



**FPCUP ACTION 2021-2-33:
COPERNICUS FOR MARINE SPATIAL PLANNING
AND EU DIRECTIVES**

**Final Reporting Process//SGA#20/WP21
Country report for Spain**

Task 1. Review of the official implementation of EU marine Directives

Task 2. Data gaps analysis in the implementation of EU Directives

Task 3. Identification on how to use Copernicus Data in the implementation of EU

Task 4. Copernicus data to generate high spatial information for the implementation process

Task 5. Lessons learnt and recommendations

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BACKGROUND

Marine sectors face several challenges regarding management and sustainability. It is becoming evident that these challenges are even more noticeable during the implementation of specific policies and strategies, particularly those related to marine data and information availability in the context of certain European Directives.

The Copernicus program is dedicated to deliver global data in a reliable and sustainable way. Numerous nations encounter difficulties in ensuring sustainable growth in specific industries, and the Framework Partnership Agreement for Copernicus User Uptake (FPCUP) focuses on harnessing Copernicus data for different maritime sectors within the framework of some EU Directives implementation.

The FPCUP aims at a better integration of Copernicus data in the European regulatory framework by increasing the number of users and applications derived from Copernicus through different actions. This report relates to Action 2021-2-33: *Copernicus for Marine Spatial Planning and EU Directives* that pursues "to promote the use of Copernicus data in the implementation of the EU Marine Spatial Planning Directive (Directive 2014/89/EU; MSP) and EU Marine Strategy Framework Directive (Directive 2008/56/EC; MSFD), while contributing to the standardization of methodologies in the implementation process".

This objective will be achieved through 3 specific objectives:

1. To examine the implementation of EU Directives by Member States using as pilot sites Spain, Portugal, Estonia, Cyprus, and France, and to identify data gaps.
2. To analyse how Copernicus satellite data products can improve those data gaps.
3. To use Copernicus data services in the implementation of EU marine Directives.

To address these objectives within Action 2021-2-33, the following duties should be carried out:

- In **Task 1** (*Review of the official implementation of EU marine Directives*) is dedicated to carry out a review of the application of the two EU marine Directives in each country.
- **Task 2** (*Data gaps in the implementation of EU marine Directives*) is dedicated to identify data gaps and needs within the maritime sectors that are actively engaged in the implementation of the EU marine Directives mentioned earlier.
- In **Task 3** (*Identification on how to use Copernicus Data in the implementation of EU marine Directives*) the requirements of the Marine

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Directives and the data gaps detected in Task 2 will be contrasted with the benefits and opportunities offered by Copernicus data services. As a final result, a jointly standardized set of protocols leading to the implementation of improved methodologies for use in national reporting will be compiled.

- In **Task 4** (*Copernicus data to generate high spatial information for the implementation process*) Copernicus spatial data will be analysed and processed to generate spatial maps related to specific maritime activities and uses required by the national authorities and stakeholders.

TASK 1. REVIEW OF THE OFFICIAL IMPLEMENTATION OF EU MARINE DIRECTIVES

1. Introduction

At the European level, there are three main directives related to the protection and management of water and marine resources in the European Union, the Directives 2000/60/EC, 2008/56/EC, and 2014/89/EU. This Action will focus on the analysis of two of them:

1. **Marine Strategy Framework Directive (MSFD) - Directive 2008/56/EC:** This directive aims to establish a framework for the protection and management of the marine environment in the EU. The MSFD is based on the ecosystem approach and aims to achieve a good environmental status of marine waters. It requires Member States to develop marine strategies and programs of measures to prevent degradation and preserve marine ecosystems.
2. **Directive on Maritime Spatial Planning (MSP) - Directive 2014/89/EU:** This directive aims to establish a framework for maritime spatial planning in the EU. It recognizes the need for an integrated and sustainable approach to managing maritime activities. It requires Member States to develop maritime spatial plans to ensure efficient and sustainable use of maritime activities such as renewable energy, fishing, maritime transport, and tourism. It also promotes cross-border cooperation in maritime spatial planning.

In summary, these directives focus on the protection and sustainable management of water and marine resources in the EU. The Marine Strategy Framework Directive focuses on the protection of the marine environment, while the Directive on Maritime Spatial Planning deals with the planning of maritime space for efficient and sustainable use of maritime activities. Additionally, the Water Framework Directive addresses the management of inland waters but as mentioned before this Action will not deal with this Directive. Together, these directives seek to ensure the conservation of aquatic ecosystems, water quality, and sustainable use of marine resources.

This technical report presents the results of the review of the official implementation of EU marine Directives in Spain to fulfil Task 1.

2. Marine Strategy Framework Directive (Directive 2008/56/EC) in Spain

2.1. Spanish legislation (Law 41/2010)

Marine strategies envisaged in the Law 41/2010 (Law 41/2010, of 29 December 2010, on the Protection of the Marine Environment) refer to a **set of plans and actions** designed to protect and manage the country's marine resources, with the aim of guaranteeing their sustainable use and the conservation of marine biodiversity. These strategies are part of the European Union's Integrated Maritime Policy and are based on the MSFD.

In addition, these strategies also aim to promote the sustainable development of economic activities related to the sea, such as fishing, tourism or renewable energy, always guaranteeing the protection of the marine environment.

2.1.1. Objectives

The objective of this law is to establish the adoption of the measures necessary to achieve or maintain the good environmental status of the marine environment, through its planning, conservation, protection and improvement.

Specific objectives of marine strategies are:

- a) To protect and preserve the marine environment, including its biodiversity, prevent its deterioration and restore marine ecosystems in areas that have been adversely affected;
- b) To prevent and reduce discharges into the marine environment, with a view to progressively eliminating pollution of the marine environment, to ensure that there are no serious impacts on or risks to marine biodiversity, marine ecosystems, human health or the permitted uses of the sea.
- c) To ensure that activities and uses in the marine environment are compatible with the preservation of its biodiversity.

2.1.2. Application area

The Spanish marine environment is divided into the following marine regions and subdivisions:

Marine regions.

Marine strategies in Spain are divided into **five marine regions**: Gulf of Cadiz, Strait and Alborán, Western Mediterranean, Eastern Mediterranean and Macaronesia. Each region has its own management plan and is coordinated by a competent authority.

Marine subdivisions.

In order to facilitate the law application, the Spanish marine regions have been divided into **5 marine subdivisions**, taking into account the hydrological, oceanographic and bio-geographical characteristics of each area.

Marine subdivisions (MD) are established over the marine regions, which constitute the spatial scope over which each Marine Strategy will be developed, and are: north Atlantic MD, south Atlantic MD, Estrecho and Alborán MD, levantine-balearic MD and canary MD (Figure 1-1).

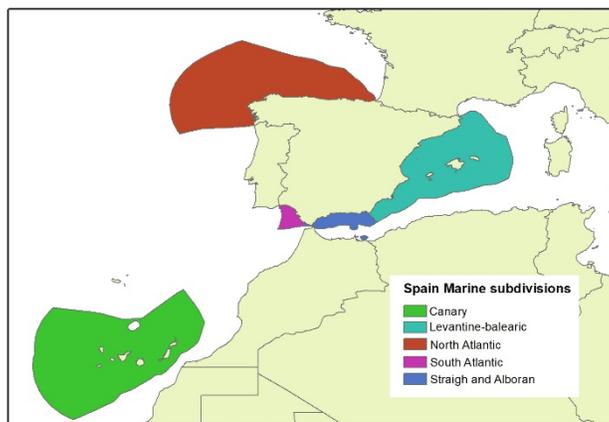


Figure 1-1. Spain Marine Subdivisions

2.1.3. Administrative coordination

In Spain, **competent authorities** of Law 41/2010 application are: Ministry for Ecological Transition and the Demographic Challenge (MITERD), Spanish Institute of Oceanography (IEO) and Public Works Study and Experimentation Centre (CEDEX). MITERD is also **coordinator** of marine strategies in Spain.

Each marine subdivision has its own **monitoring committee**, which is the main responsible for coordination with the Autonomous Regions.

2.1.4. Phases of marine strategies

For each Spanish marine subdivisions, a marine strategy will be developed and its implementation follows an iterative process which is carried out in **six-year cycles**.

The actions included in each strategy follow the next **5 phases**:

Phase 1: initial assessment of marine waters, including an analysis of the current environmental status, the main impacts and pressures, as well as an economic, social and cost analysis of the deterioration of the marine environment;

Phase 2: definition of **good environmental status** according to 11 qualitative descriptors (Figure 1-2) and the development and implementation of monitoring programmes;

Phase 3: proposal of **environmental objectives and associated indicators** for marine waters in order to guide the process towards achieving good environmental status;

Phase 4: establishment of **monitoring programmes**;

Phase 5: elaboration and implementation of **programmes of measures**.

Detail of these phases in Spain will be described in the next section.



Figure 1-2. Qualitative descriptors to determine good environmental status.

2.2. Spanish application

Since the publication of Law 41/2010, the following six-year cycles have been developed in Spain:

- First cycle (2012-2018)
- Second cycle (2018-2024)

Following, it will be analysed how the different phases have been implemented in Spain, taking into account each of the two cycles.

2.2.1. First cycle: 2012-2018

Phases 1 to 3: initial assessment, good environmental status & objectives

In 2012, after an intense compilation, consultation and documentary review, the technical work of the first three phases of the 5 Spanish marine subdivisions was completed. The **environmental objectives** of the marine strategies, together with the definition of good environmental status, were approved by Agreement of the Council of Ministers on 2 **November 2012**.

Phase 4: Monitoring programmes

Following the timetable established in the MSFD, the Member States must design Monitoring Programmes with the aim of guaranteeing a continuous assessment of the good environmental status and determining whether the good environmental status and the proposed environmental objectives are being achieved, as well as analysing the effectiveness of the Programmes of Measures.

In the period 2012-2018, 5 monitoring programmes were designed (one per marine subdivisions) for each of the marine subdivisions established. They were published in September **2014**.

Phase 5: Programmes of measures

In **2016**, the Programme of measures was approved. For their design, a critical analysis was carried out of the measures already in place, both at regional, national and international level, analysing whether these measures are sufficient to achieve good environmental status of the marine environment by 2020, as well as to achieve the environmental objectives.

As a result of all the work undertaken to inventory existing measures, a total of **320 measures or groups of measures** was compiled and characterised. Moreover, a set of 97 new measures were proposed (Figure 1-3). These measures are structured in 9 thematic areas, taking into account the descriptors of Annex II of the Marine Environment Protection Act (Act 41/2010). The bulk of the new measures were in marine litter and biodiversity, followed by Protected Marine Spaces and Horizontal Themes (generally focused on increasing knowledge, improving coordination, promoting awareness).

The first cycle (2012-2018), including their corresponding Programme of Measures, were approved by **Royal Decree 1365/2018**, of 2 November, following the stipulations of article 15 of Law 41/2010. Thus, in 2018, the first cycle of the marine strategies comes to a close.

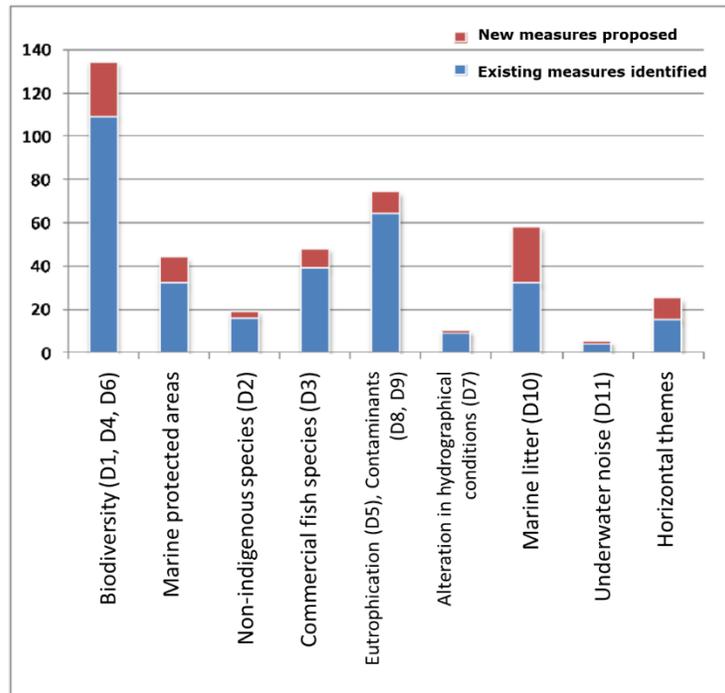


Figure 1-3. Programme of measures for the first cycle (2012-2018): Existing measures identified and new measures proposed by thematic area

2.2.2. Second cycle: 2018-2024

Phases 1 to 3: initial assessment, good environmental status & objectives

First steps of second cycle consisted of:

- Status of marine environment descriptors
- Assessing to which extent the environmental objectives of the first cycle had been achieved. Depending on their degree of compliance, as well as their suitability to this Initial Assessment, a proposal was made to maintain, modify or eliminate them
- Identification of measures that have been implemented since 2016 and level of application.

All this work led to the identification of **gaps** for each of the environmental objectives, leading to the establishment of **action priority lines**, so that in next phases proposal for new measures to address identified gaps could be done.

These first 3 phases of Marine Strategies for the 5 marine subdivisions were finally updated in 2018. The final version of the environmental objectives was approved in **June 2019**.

Phase 4: Monitoring programmes

In Spain, the monitoring programmes of the second cycle are very similar in content to those of the first cycle. The **update** took into account in particular the adaptation of monitoring to the **new criteria and methodological standards** of Decision 2017/848, the changes introduced by Directive 2017/845, as well as the lessons learned during the first cycle. This second cycle was decided to unify the programmes in a **single sheet** applied to the 5 marine subdivisions, for the sake of simplification and to maintain coherence.

MITERD presented the update of the fourth phase of the second cycle by the **end of 2020**.

Phase 5: Programmes of measures

Measures were updated by assessing which ones were maintained from the first cycle, which were modified, which initiatives that have emerged since 2016 can be counted among the existing measures, and above all, which new actions will make up the package of new measures in the second cycle.

The identification of measures was based on the analysis of the degree of coverage of the environmental objectives of the second cycle, which enabled the detection of **priority lines of action**. These priority lines constituted the guide for the definition of new measures to achieve these objectives, as well as to advance towards GES. To this end, the results of the evaluation of the 11 descriptors of the marine environment corresponding to the second cycle of marine strategies, were also taken into account.

As a result, **203 measures** were finally selected for the second cycle as follows:

- **59** first cycle measures have been maintained, most of them corresponding to "Horizontal theme" and "Marine litter (D10)";
- **81** new measures proposed in this second cycle, most of them corresponding to "Biodiversity (D1, D4, D6)", "Horizontal theme" and "Marine litter (D10)";
- **63** additional existing measures

Reporting to European Commission was done by the **end of 2022**.

3. Maritime Spatial Planning Directive (Directive 2014/89/EU) in Spain

3.1. Spanish legislation (Royal Decree 363/2017)

Law 41/2010, even before the Maritime Spatial Planning Directive had been approved, already conceived maritime spatial planning as a tool to guarantee sustainability and the achievement of good environmental status (article 4.2). It already includes in Annex V a list with the types of measures that could be included in the programmes of measures of the marine strategies, including "Marine Spatial Planning" as one of these types of measures.

Royal Decree 363/2017 (Royal Decree 363/2017 of 8 April establishing a framework for maritime spatial planning.), was conceived as a regulatory development in application of the provisions of article 4.2 of Law 41/2010. It states that "This management framework will constitute a common guideline for all marine strategies, in accordance with the provisions of article 4.2.f) of the Law for the Protection of the Marine Environment".

A summary of the Regulatory framework for the MSP in Spain is shown in Figure 1-4.

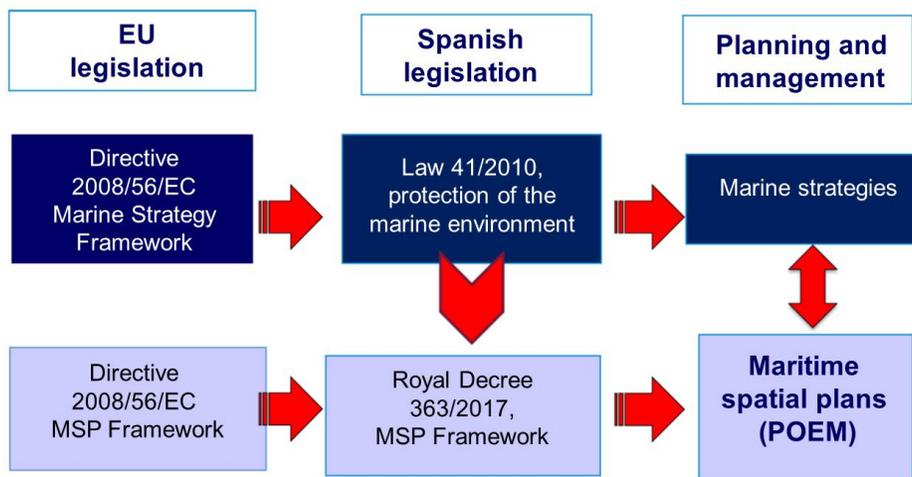


Figure 1-4. Regulatory framework for the MSP in Spain

3.1.1. Objective

Establishes a framework for maritime spatial planning, and aims to promote the sustainable growth of maritime economies, the sustainable development of marine areas and the sustainable use of marine resources.

3.1.2. Application area

This Royal Decree applies to all marine waters, including the seabed, subsoil and natural resources, in which the Kingdom of Spain exercises sovereignty, sovereign rights or jurisdiction. It also applies to the Spanish continental shelf.

It doesn't apply to the following:

- a. To activities whose sole purpose is defence or national security.
- b. Spatial and urban planning.
- c. To coastal waters, to parts thereof which are the subject of town and country planning measures, or to the waters in the service area of ports, provided that this is so established in maritime spatial plans.

3.1.3. Administrative coordination

Royal Decree 363/2017 establishes the following structure for coordination:

- **Working Group on Maritime Spatial Planning.** This group is of a technical nature, and brings together the different units of the National Government that regulate in a sectorial way all the human activities included in programmes of measures.
- **Monitoring Committees,** one for each marine subdivision and for coordination with the Autonomous Regions.
- **Ad-hoc groups,** for discussion of specific themes. For example:
 - Port activity (January and March 2021)
 - Nautical-recreational activity and benthic habitats (January 2021)
 - Underwater cultural heritage (Dec 2020)
 - Protected marine spaces (January 2021)
 - Marine renewable energies (February and March 2021)
 - Sailing, cetacean collisions (Jan 2021)

In Spain, **competent authority** of MSP and coordination is the Ministry for Ecological Transition and the Demographic Challenge (MITERD).

3.1.4. Phases of marine spatial planning

Phase 1: Initial diagnosis of the environmental characteristics present in the marine environment;

Phase 2: Establishment of **management objectives for MSP;**

Phase 3: Drawing up **Maritime spatial plans** and its improvement;

Phase 4: Implementing Maritime spatial plans and **monitoring**

Phase 5: Review (at least) every 10 years

Detail of these phases in Spain is described in the next section.

3.2. Spanish application

3.2.1. Phase 1. Initial diagnosis

The initial assessment should contain the following information for each marine subdivision:

- oceanographic, climatic, physical and chemical features of the marine environment that will underpin the plans (bathymetry, temperature, salinity, dissolved oxygen, nutrients, depth of photic layer, currents, sediments, etc.)
- Spatial distribution of habitats and species, including areas of known importance for supporting certain species or biological communities.
- Spatial information on human activities
- Marine protected areas

In order to carry out this diagnosis, information generated in the **second cycle (2018-2024) of Spain's marine strategies** was used, specifically in the updating of the initial assessment of the state of the marine environment, its pressures and impacts, and of the economic and social analysis. This source was completed by an **inventory of the distribution of existing and to future activities and uses**.

This initial diagnosis was presented by March 2019 in five separate documents, one for each of the five marine subdivisions, including:

1. Main features and characteristics;
2. Maritime sectors in the DM: current situation and spatial distribution;
3. Current limitations of certain uses and activities derived from sectoral regulations or management plans for protected marine spaces;
4. Spatial distribution of future uses and activities;
5. Land-sea interactions;
6. Interactions between uses and activities in the marine subdivision

The set of cartographic information included in the diagnosis of each of the five marine subdivisions is called informative cartography. This cartography can be consulted in the geographic viewer of the platform www.infomar.miteco.es, in the Maritime Spatial Planning section.

3.2.2. Phase 2. Objectives

The following objectives should be identified:

- a) A general management objective
- b) Horizontal management objectives, which link all sectors.
- c) Objectives of management of uses of general interest
- d) Sector management objectives, substantiated by the needs that each maritime sector may pose in the use of maritime space, with the ultimate goal that management plans contribute to the achievement of said objectives.

According to these guidelines, the following set of objectives were established:

- **1 general management objective:** promote the sustainable activity and growth of the maritime sectors in a manner compatible with respect for the values of marine spaces and with the sustainable use of resources;
- **12 horizontal management objectives;**
- 18 objectives of management of uses of **general interest** regarding these main themes:
 - Protection of the marine environment, including marine protected areas, coastal environment, and mitigation of and adaptation to the effects of climate change (8)
 - Freshwater supply and water supply security, including desalination (1)
 - Drainage, purification and water quality, including bathing water (3)
 - National Defence (2)
 - Surveillance and monitoring (2)
 - Scientific research, innovation and development (1)
 - Underwater cultural heritage (1)
- **Sector management objectives**, around 1-3 objectives per sector, regarding the ones in Table 3-2.

3.2.3. Phase 3. Maritime spatial plans

Based on the information gathered in the initial diagnosis, one maritime spatial plan will be drawn up for **each of the five Spanish marine subdivisions**. Maritime spatial plans will include the suitability of marine spaces for carrying out relevant activities and uses, taking into account the potential of each area, as well as its carrying capacity and maintaining good environmental status.

Maritime spatial plans will establish the **existing and future spatial and temporal distribution of a set of uses and activities**, that have been

TASK 1

previously included in the initial diagnosis. These have been grouped into the structure of two groups: general interest uses (Table 1-1) and maritime sector uses (Table 1-2), as explained in the tables below.

Table 1-1. Activities uses and interests considered to be of general interest, in the context of the Maritime spatial plans, whose objectives are a priority because they emanate from public policies aimed at the protection of the common heritage, safety and health.

ACTIVITIES, USES AND INTERESTS CONSIDERED TO BE OF GENERAL INTEREST IN THE CONTEXT OF THE Maritime spatial plans
Marine environment, including marine protected areas, coastal environment, and mitigation and adaptation to the effects of climate change
Ensuring freshwater supply and water supply, including desalination
Drainage, purification and water quality, including bathing water
National Defence
Maritime surveillance, control and security
Scientific research, development and innovation
Protection of Underwater Cultural Heritage

Table 1-2. Maritime economic sectors targeted for the establishment of MSP objectives.

ACTIVITIES USES AND INTERESTS OF THE MARITIME ECONOMIC SECTORS
Aquaculture
Extractive fishing
Energy sector - hydrocarbons
Energy sector - renewable energies
Electricity transport and telecommunications sector
Navigation
Port activity
Tourism and recreational activities

Royal Decree 150/2023, of 28 February, was published approving the maritime spatial plans of the five Spanish marine subdivisions. This document was scheduled for publication in March 2021.

The plans are structured in these five blocks:

- I. Context and scope of application
- II. Guiding principles and management objectives
- III. Diagnosis: maritime sectors, current situation and forecasts for future or potential development
- IV. Maritime spatial planning
- V. Implementation, evaluation and monitoring of the plans

TASK 1

Blocks I, II, IV y V are common part of Maritime spatial plans for the five marine subdivisions. Block III, there is a specific one for each of the five marine subdivisions. Plans also include the cartographic representation of the scope of application and zoning of the plans.

Regarding Maritime spatial planning of Spanish waters, the following management scheme has been established:

- The areas where the different uses of general interest are carried out have been identified, and these areas and their corresponding perimeters have been defined. Some of these zones have been defined as priority use zones (ZUPs).
- Identify certain sectoral activities whose future development is foreseeable, and where it is also necessary to identify the most suitable space for their development. For this purpose, High Potential Areas (ZAPs) (for different uses and activities) have been established.

Priority use zones (ZUP)

A set of priority use zones (ZUP) have been identified for activities of general interest and which require specific occupation. The six categories of ZUP are:

- ZUP for biodiversity protection
- ZUP for the extraction of aggregates for coastal protection
- ZUP for Cultural Heritage Protection
- ZUP for research, development and innovation (R&D&I)
- ZUP for national defence
- ZUP for navigational safety
- ZUP for Offshore Wind Energy

High potential areas (ZAP)

Once the uses and activities of general interest have been guaranteed, Maritime spatial plans pay special attention to certain sectoral activities and to activities whose future development is foreseeable and which, due to their characteristics, must be located in a specific area or groups of areas. To this end, six additional categories ZAP have been established, together with provisions, management criteria and measures. These ZAP are:

- ZAPs for biodiversity conservation
- ZAP for research, development and innovation (R&D&I)
- ZAP for port activity
- ZAP for the development of offshore wind energy
- ZAP for marine aquaculture

3.2.4. Phase 4. Implementing Maritime spatial plans and monitoring

Once the Maritime spatial plans have been approved, each Department concerned, within the framework of its competences, shall draw up an **annual report** on the implementation of these plans. This report will be sent to the competent authority. The Working Group on Maritime Spatial Planning Marinas will ensure the coordinated implementation and management of Maritime spatial plans and their updates.

Finally, Maritime spatial plans have a monitoring programme. This programme has been designed to detect the evolution of the different human uses and activities in the marine environment, the effectiveness and possible shortcomings of the plan, and thus facilitate adaptive management and guide the steps towards the updating of the plans that will take place in 2027.

During the design of the plans, a series of measures have been detected that need to be addressed during the period of validity of the plans in order to improve the management of uses and activities. Some measures have been proposed by different agents and administrations during the coordination and participation process. Others are the result of needs detected, such as better collection of basic information, management on a more detailed scale, or improved governance.

The programmes of measures of the Marine Strategies are currently being updated within their second cycle (2018-2024). The proposed **programmes of measures** should be ready by 31 December 2021. The work on the elaboration of the Maritime spatial plans is being carried out in coordination with this update, and it is foreseeable that some of the measures included in the Maritime spatial plans will be part of these programmes of measures of the Marine Strategies. For the moment a set of 26 measures have been proposed.

A **monitoring programme** for the plan has been drawn up, which will be fed with information from different sources and planning tools, information with which a set of indicators specific to the plan will be constructed. Spain's marine strategies have a set of monitoring programmes designed, which have recently been updated within the second cycle (year 2019). These monitoring programmes will provide the necessary information for updating the diagnosis that will be necessary in the revision of the management plans, together with the update of the assessment of the state of the marine environment, which will be carried out within the 3rd cycle of marine strategies (2024-2030).

3.2.5. Phase 5. Review

Maritime spatial plans will be reviewed and updated no later than December 31, 2027.

TASK 2. DATA GAPS ANALYSIS IN THE IMPLEMENTATION OF EU MARINE DIRECTIVES

This chapter was partially published as “*Unlocking multi-use synergies: Spanish industry perspectives on offshore wind and aquaculture integration*” published by Carlos V.C. Weiss, Barbara Ondiviela, Elvira Ramos, Lucía Meneses, Raúl Guanche, José Juanes in *Journal of Marine Policy* (2025), 180: 106786. <https://doi.org/10.1016/j.marpol.2025.106786>

1. Introduction

Data gaps have been analysed through a consultation with practitioners, stakeholders and relevant administrations in the context of the Marine Strategy Framework Directive or the Marine Spatial Planning Directive.

This technical report presents the results of the survey conducted among Spanish stakeholders to fulfil Task 2. Additionally, it provides initial insights for Task 3, examining how the identified data gaps among Spanish stakeholders could potentially be addressed using Copernicus data. Moreover, it also provides preliminary results for Task 4, exploring services of higher interest required by the different marine sectors. The **objectives of the survey** are:

- To identify the current needs and gaps of Spanish stakeholders to better understand their current usage of Copernicus data, across different marine sectors, in the implementation of both EU Marine Directives (Task 2 and Task 3).
- To identify the Copernicus services of higher interest for the marine sectors involved in the implementation process (Task 4).

2. Methodology

The survey was compiled from contributions, by the different action partners, and a final English version with 34 questions was agreed upon (Annex I). It should be noted that this action is being coordinated with other actions, part of Working Group Oceans, namely, Action 2021-2-42 (Copernicus uptake for the maritime sector) and Action 2021-2-47 (Coastal coordination of user needs and methodologies), and, therefore, the survey included questions that contributed to all three actions, to improve efficiency and avoid stakeholder fatigue. The final survey was then translated to the different languages of the participating

TASK 2

countries for dissemination. Survey questions were organised in the following sections:

- GENERAL INFORMATION (Q.1)
- MARINE SECTORS (Q2-Q13)
- MARINE SECTOR & MSP GAPS (Q14-Q16)
- EU MARINE DIRECTIVES (Q17-Q23)
- MARINE STRATEGY FRAMEWORK DIRECTIVE GAPS (Q24-Q27)
- COPERNICUS (Q28- Q34)

The identification of stakeholders and dissemination of the survey was done independently by each partner leveraging contacts, partners, previous email campaigns, social media outreach, as well as personalised invitations to encourage participation. The objective was to gather diverse perspectives, maximise participation and enrich the outcome of the project. For the Spanish survey, a list of relevant stakeholders was identified by IHCantabria and completed by INTA (involved in Action 42). The total number of stakeholders listed, including the 3 FPCUP actions, was 350. The Spanish survey was disseminated online through the IHCantabria web page. Potential stakeholders were individually addressed, but also a broad distribution of the survey link was done through relevant mailing lists and social media.

3. Results for survey conducted in Spain

3.1. General overview of stakeholder’s profile for the maritime sector in Spain

The survey for Spain received a total number of 57 responses. A list with the stakeholder’s participant in the survey is presented in Annex II: Stakeholders for Spain survey.

In general terms, most of entities stated to be included within North-east Atlantic Ocean marine region (52), and the Mediterranean Sea marine region (27), some have activity in both of them (22).

The profile of the stakeholders that responded to the survey is shown in Figure 2.1. Regarding their **entity type**, they are mostly from research institutions (33), followed by public administration (26) and academia (16). There were also contributions from, private sector (3), non-governmental organisations (1) and association (1). Regarding their **area of activity** (coastal, marine, inland), most of the entity’s activities are located in both coastal (44) and marine (46) areas. Only 12 are located inland. This indicates a participation that is primarily research-oriented and focused on marine and coastal realms. It should be mentioned that the majority of stakeholders interested in the marine activities also expressed interest in coastal activities.

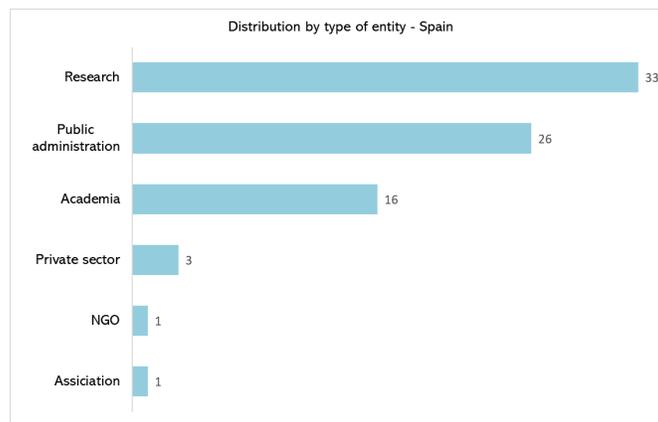


Figure 2-1. Stakeholder’s profile by type of entity for Spain.

The overall **stakeholder's profile regarding their relation with marine sectors and with EU marine Directive's implementation in Spain** was evaluated with a multiple answer question, so that respondents could select more than one option of their involvement (Figure 2-2). Regarding **marine sectors**, the analysis revealed that Species conservation and protected areas sector received the highest number of responses (32), followed by Coastal protection sector (23) and Fisheries sector (18).

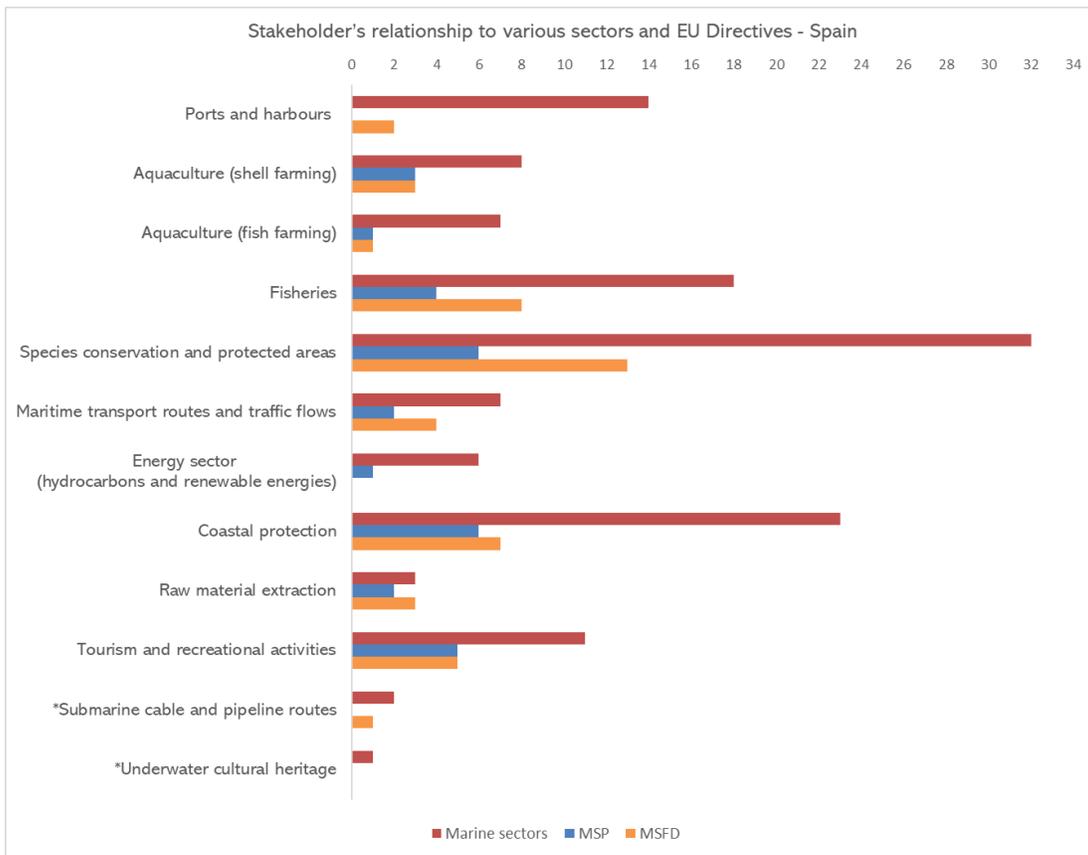


Figure 2-2. Stakeholder's profile regarding their relation with marine sectors and with EU marine Directive's implementation in Spain

Regarding the stakeholder's profile involved in the **implementation of the EU marine Directives in Spain (MSP and MSFD)**, the analysis revealed that a total of 18 stakeholders, from the survey participants, have participated in the implementation of one of these Directives in Spain, 10 in MSP and 16 in MSFD. Highlight that, among them, 7 entities have participated in the implementation of both Directives (Universidad de Málaga, Principado de Asturias, Universidad de La Laguna, Gobierno de Cantabria, Consejería de Medio Ambiente de Ceuta, Fundación Biodiversidad and Ministerio para la Transición Ecológica y el Reto Demográfico).

Regarding their marine sector of involvement, most of them refer to the sectors Species conservation and protected areas, Coastal protection, Fisheries and Tourism and recreational activities. The profile of the stakeholders that have participated in the implementation of these Directives is mainly from research and public administration, as was to be expected, since they are the main entities in charge of implementing them in Spain.

3.2. Stakeholder's areas of interest for the maritime sector in Spain

The overall **stakeholder's areas of interest for the maritime sector in Spain** were evaluated with a multiple answer question, so that respondents could rate different areas by order of interest (Figure 2-3). The results indicate that the areas of higher interest for the maritime sector in Spain are the effects of climate change, identification of pressures and environmental monitoring. A shared lower interest emerged for the "infrastructure monitoring" services across most marine sectors.

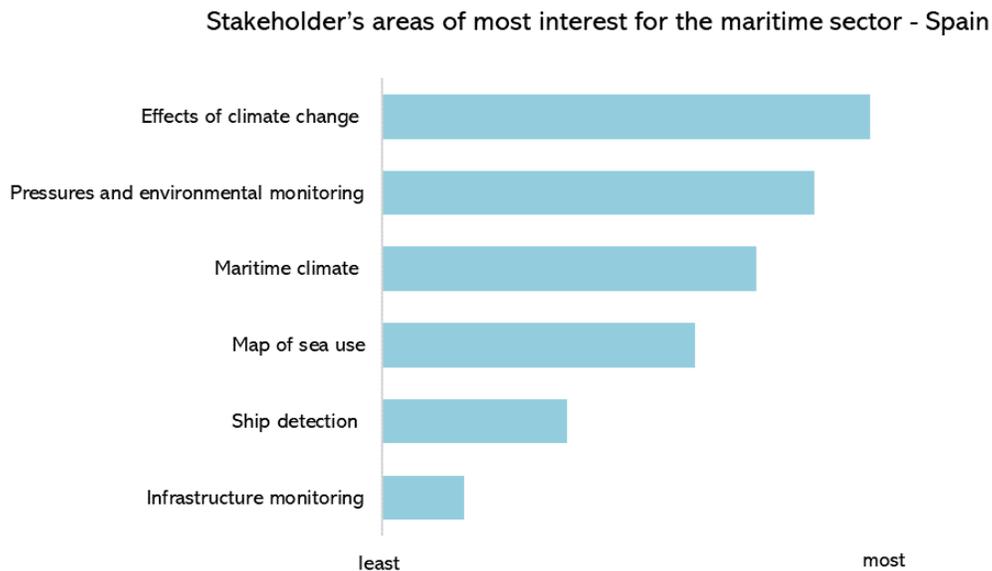


Figure 2-3. Stakeholder's areas of most interest for the maritime sector in Spain (least=minimum interest; most=higher interest)

Figure 2.4 shows a detailed analysis of stakeholder's areas of most interest for each of the marine sectors listed in Figure 2-3.

TASK 2

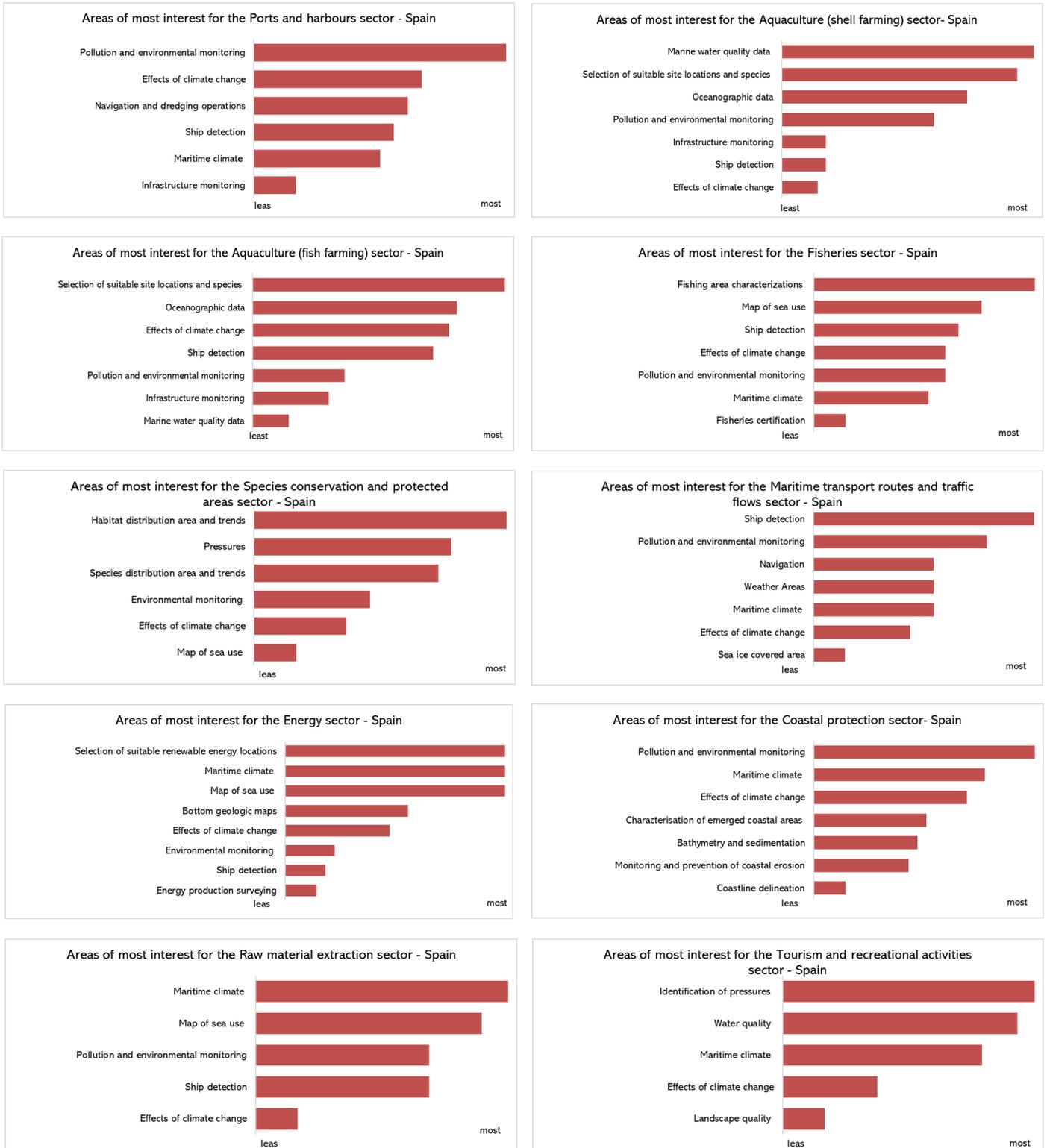


Figure 2-4. Detail of stakeholder's areas of most interest for the maritime sector in Spain (least=minimum interest; most=higher interest)

3.3. Data gaps and needs in the implementation process of EU marine Directives in Spain

The survey allows us to identify the current needs and gaps of Spanish stakeholders by considering two different elements: how intermediate users are currently using the available data and the usage needs and requirements identified by the participants. On one hand, it focuses on those stakeholders engaged in the implementation of both EU marine Directives, and on the other hand, it encompasses stakeholders involved in each specific marine sector.

3.3.1. Stakeholders involved in EU Marine Spatial Planning Directive implementation

3.3.1.1. *Problems encountered when working with the data available*

Regarding general data usage, most of Spanish stakeholders involved in Marine Spatial Planning Directive implementation (10), when asked about the most common problems encountered when working with data (Figure 2-5), mentioned the challenges associated with Heterogeneous sources (60%), Incomplete Temporal and spatial distribution (50%), Heterogeneous data collection methodologies (50%) and Inaccessible data or unavailability of data (50%).

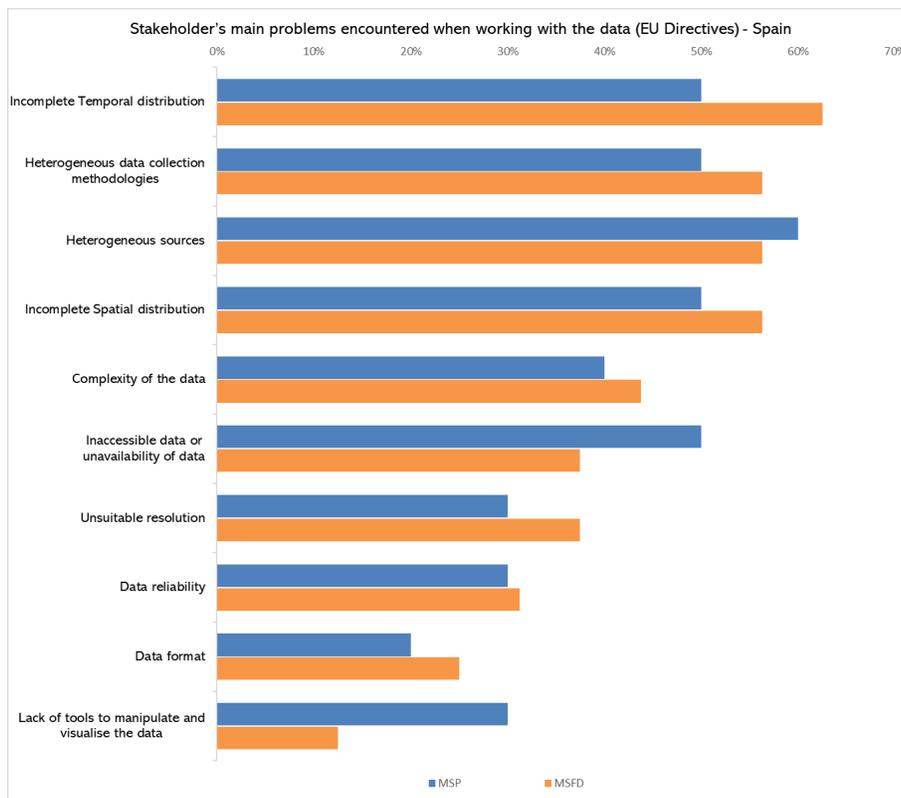


Figure 2-5. Stakeholder's main problems encountered when working with the data available in the implementation process of EU marine Directives in Spain

3.3.1.2. Needs regarding temporal extent and spatial resolution of the data

Most of Spanish stakeholders involved in Marine Spatial Planning Directive implementation (10), when asked about their needs **regarding temporal extent of the data** (Figure 2-6a), expressed a clear higher need for long-term historical data series (years) and for long-term projections (month) (80%) in the implementation process. This indicates a clear demand for historical context.

Most of Spanish stakeholders involved in Marine Spatial Planning Directive implementation (10), when asked about their needs regarding **spatial resolution of data** (Figure 2-6b), expressed, by far, the need for medium (5-30 m) resolutions (70%) in the implementation process. Around 40% of them mentioned the need for Low ($\geq 250\text{m}-1\text{ Km}$) and High (1-5 m) spatial resolutions. The analysis suggests a clear need for medium resolution data.

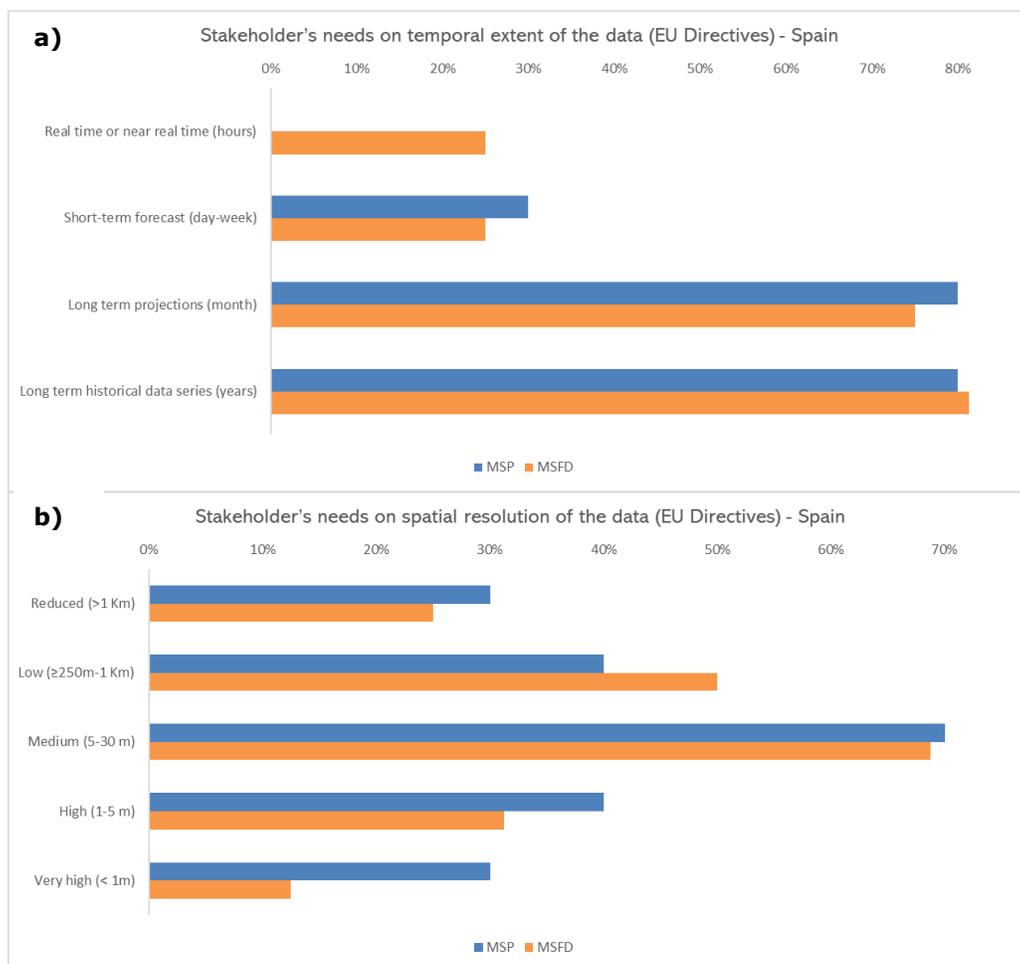


Figure 2-6. Stakeholder's needs on temporal extent (a) and spatial resolution (b) of the data in the implementation process of EU marine Directives in Spain

3.3.2. Stakeholders involved in EU Marine Strategy Framework Directive implementation

3.3.2.1. *Knowledge gaps encountered when working with the descriptors*

Spanish stakeholders involved in Marine Strategy Framework Directive implementation (16), when asked about the most common problems encountered when implementing COMMISSION DECISION (EU) 2017/84, mentioned that, by far, the greatest challenges encountered were those associated with Spatial and Temporal distribution (18%) and, Abundance (16%). Lower challenges were associated with Pressures and impacts (14%) and Spatial cover/extent (11%). These answers highlight the need for improved data coverage and species density measure.

3.3.2.2. *Problems encountered when working with the data available*

Regarding general data usage, most of Spanish stakeholders involved in Marine Strategy Framework Directive implementation (16), when asked about the most common problems encountered when working with data (Figure 2-5), mentioned the challenges associated with Incomplete Temporal (63%) and Spatial (56%) distribution as well as, Heterogeneous sources and data collection methodologies (56%). Around 40% of them mentioned the challenges associated with Complexity and Unsuitable resolution in the implementation process. These answers highlight the need for improved data heterogeneity and coverage.

3.3.2.3. *Needs regarding temporal extent and spatial resolution of the data*

Most of Spanish stakeholders involved in Marine Strategy Framework Directive implementation (16), when asked about their needs regarding **temporal extent of the data** (Figure 2-6a), expressed a clear higher need for long-term historical data series (years) (81%) and for long-term projections (month) (75%) in the implementation process. On the other hand, 25% of stakeholders stated that Real time or near real time (hours) and short-term forecast (day-week) extent were less needed. This indicates a clear demand for historical context.

Most of Spanish stakeholders involved in Marine Strategy Framework Directive implementation (16), when asked about their needs regarding **spatial resolution of data** (Figure 2-6b), expressed, by far, the need for medium (5-30 m) resolutions (69%) in the implementation process. However, they also stated to have high need for Low ($\geq 250\text{m}-1\text{ Km}$) (50%) and High (1-5 m) (31%) spatial resolutions. The analysis suggests a need for medium-to-low resolution data.

3.3.3. Marine sectors affected by EU Marine Directives implementation

3.3.3.1. *Problems encountered when working with the data available*

Regarding general data usage, when analysed marine sectors in Spain (Figure 2-7), most stakeholders, when asked about the most common problems encountered when working with data, mentioned the challenges associated with Inaccessible data or unavailability of data (15%), Incomplete Spatial (13%) and Temporal (12%) distribution. Least problematic seemed to be the reliability and data format (7%) and, the Lack of tools to manipulate and visualise the data (6%). These answers highlight the need for improved data accessibility, availability and coverage. Figure 2-7 shows a detailed analysis of the stakeholder's main problems encountered when working with the data available for each of the marine sectors listed in Figure 2-2.

In "**Ports and harbours**" sector, stakeholders stated that the most common challenges encountered when working with data are related with Inaccessible data or unavailability of data (14%), Incomplete spatial (14%) and temporal (12%) distribution of the datasets, Unsuitable resolution (12%) and, Heterogeneous sources (12%).

In "**Aquaculture**" sector, stakeholders stated that the most common challenges encountered when working with data are related with Inaccessible data or unavailability of data (9%), Heterogeneous data collection methodologies (7%), and Incomplete Spatial distribution (6%). None of the stakeholders encountered problems with Data format.

In "**Fisheries**" sector, stakeholders stated that the most common challenges encountered when working with data are related with Incomplete Temporal (18%) and Spatial (14%) distribution, Complexity of the data (14%) and Heterogeneous sources (14%).

In "**Species conservation and protected areas**" sector, stakeholders stated that the most common challenges encountered when working with data are related with Incomplete Temporal (30%) distribution, Inaccessible data or unavailability of data (28%) and Unsuitable resolution (25%). They also encountered difficulties with Complexity of the data (23%) and Incomplete Spatial distribution (23%).

In "**Energy sector**", stakeholders stated that the main challenge encountered when working with data is related with Inaccessible data or unavailability of data (11%). They also encountered difficulties with the Complexity of the data (5%), Heterogeneous data collection methodologies (5%) and Incomplete Spatial (5%) and Temporal (4%) distribution.

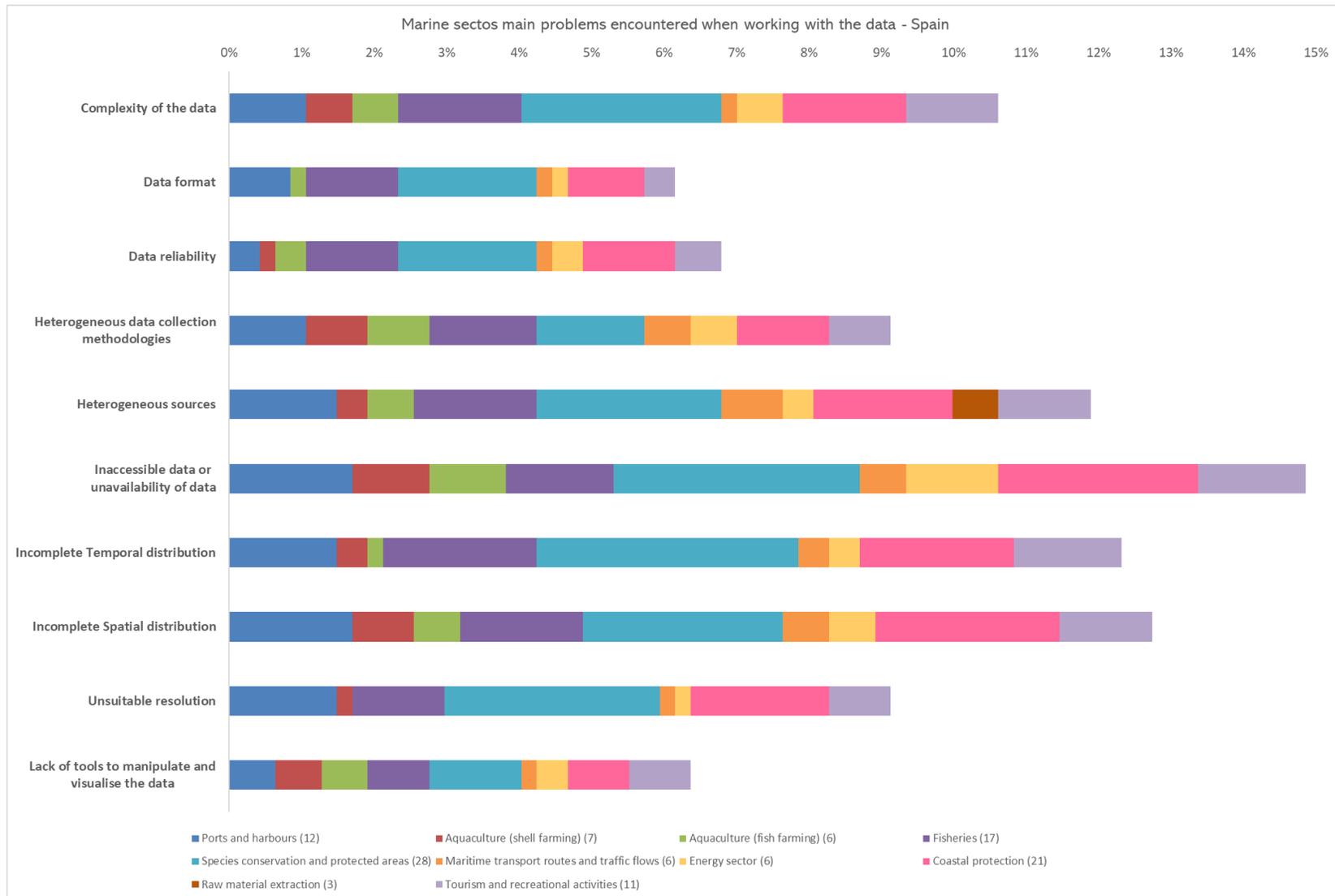


Figure 2-7. Marine sectors main problems encountered when working with the data available in Spain

In “**Coastal protection**” sector, stakeholders stated that the most common challenges encountered when working with data are related with Inaccessible data or unavailability of data (23%) and, Incomplete Spatial (21%) and temporal distribution (18%).

In “**Raw material extraction**” sector, all stakeholders stated that the main challenge encountered when working with data is related with Heterogeneous sources.

In “**Tourism and recreational activities**” sector, stakeholders stated that the most common challenges encountered when working with data are related with Inaccessible data or unavailability of data (12%) and, Incomplete Temporal (12%) and Spatial distribution (11%). They also encountered difficulties with Complexity of the data and Heterogeneous sources (11%).

3.3.3.2. Needs regarding temporal extent and spatial resolution of the data

In terms of the **temporal extent of data**, when analysed marine sectors in Spain (Figure 2-8a), 82% of stakeholders expressed a clear higher need for long-term historical data series (years). Around 56% also expressed need for long-term projections (month). This indicates a higher demand for historical context.

When analysed sectors separated, all of them shared higher need for the long-term historical data series (years) extent. Some sectors stated that Real time or near real time (hours) extent was also a high priority in the development of their activities (Port and harbours, Fisheries, Energy sector). Short term forecast (day-week) extent was important for stakeholders from Aquaculture sector.

In terms of the **spatial resolution of data**, when analysed marine sectors in Spain (Figure 2-8b), 60% of stakeholders expressed a clear higher need for medium (5-30 m) resolutions. Around 40% also expressed need for Low ($\geq 250\text{m}-1\text{ Km}$) spatial resolutions. A clear less need seemed to be Very high ($< 1\text{m}$) spatial resolutions (18%).

When analysed sectors separated, almost all of them shared the higher need for medium (5-30 m) resolutions, except for the Raw material extraction sector, where their priority seemed to be Reduced ($>1\text{ Km}$) resolutions. Some sectors stated High (1-5 m) resolution also as an important priority in the development of their activities (Port and harbours, Species conservation and protected areas.)

Overall, the analysis suggests a clear need for intermediate spatial resolution data among marine sectors in Spain.

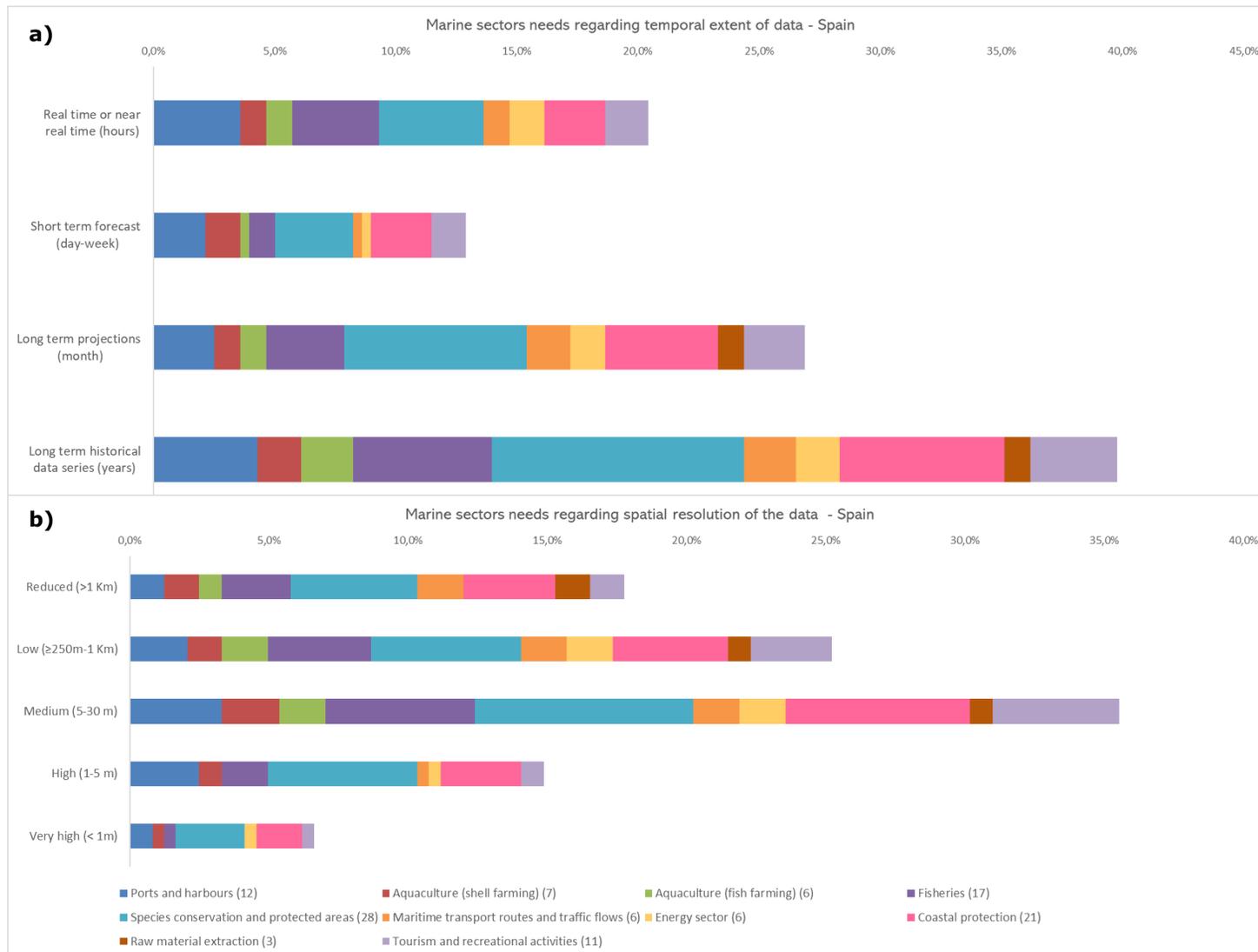


Figure 2-8. Marine sectors needs on temporal extent (a) and spatial resolution (b) of the data in Spain

3.4. Copernicus usage in the implementation process of EU marine Directives in Spain

The following analysis focuses on the segment of the survey aimed to understand awareness and data usage related with Copernicus products among the marine sectors and stakeholders engaged in the implementation of the two EU marine Directives in Spain.

Within the questions collected in the general information section, stakeholders were asked what **type of Copernicus user** they considered themselves to be. For Spanish stakeholders the majority of them stated to be "End users". Only 4 affirmed to be service providers. These entities are mainly related to the research activity and to the following sectors: Tourism and recreational activities (2), Ports and harbours (1), Fisheries (1) and Coastal protection (1).

3.4.1. Stakeholder's awareness with the Copernicus program

Regarding **stakeholder's awareness of the Copernicus program** (Figure 2-9), the majority of Spanish stakeholder's were aware of the Copernicus program, with approximately 82% of stakeholders having heard of the program. When analysed marine sectors separately, Species conservation and protected areas, Coastal protection and Energy sector are the sectors with the highest rates of stakeholders being unaware of the programme. When analysed EU marine Directives, results arise that those Spanish stakeholders involved in MSP Directive implementation are a bit less aware of the Copernicus programme than the ones involved in MSFD implementation.

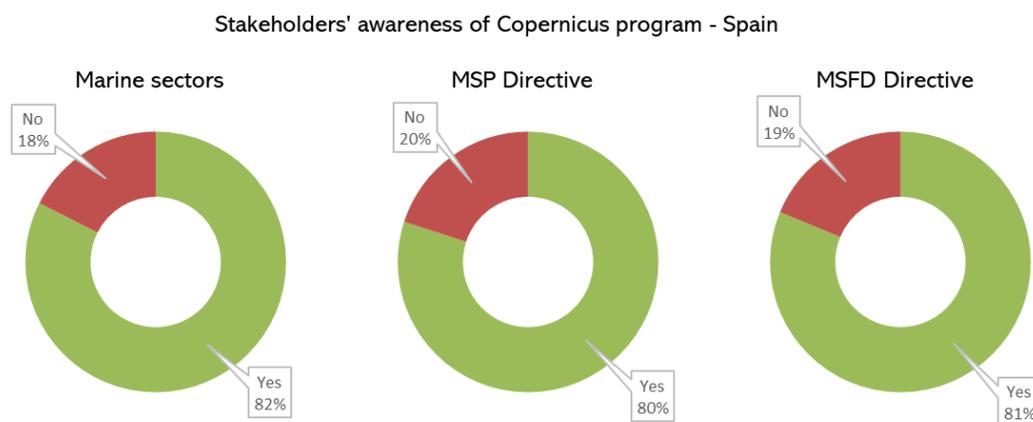


Figure 2-9. Stakeholders' awareness of the Copernicus program in Spain across marine sectors and EU marine Directives in Spain

3.4.2. Copernicus data usage

For the stakeholders that mentioned being aware of the program it was further questioned their **usage of Copernicus Data** (Figure 2-10). The results indicate a slightly higher rate of the ones not using Copernicus data (53%). When analysed marine sectors, more than 60% of the stakeholder's don't use Copernicus Data (Ports and harbours, Aquaculture, Maritime transport routes and traffic flows and, Energy sector).

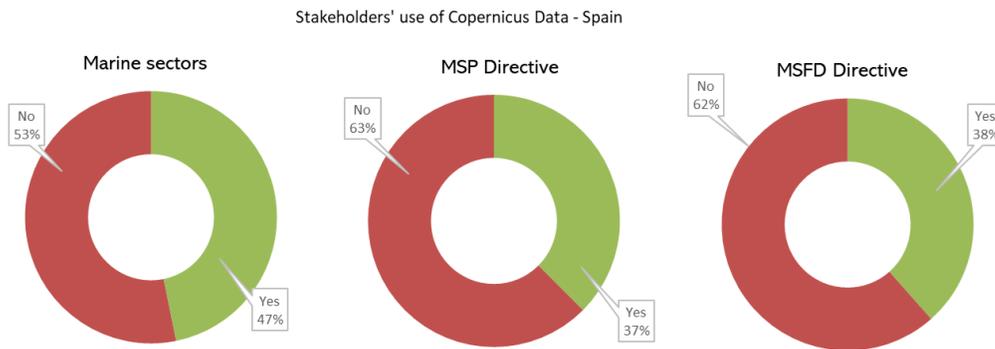


Figure 2-10. Stakeholders' Copernicus Data usage across marine sectors and EU marine Directives in Spain

For the stakeholders that declared using Copernicus data, the **periodicity of usage and type of data used** were further inquired (Figure 2-11). The analysis indicates a different frequency of utilisation of Copernicus data among Spanish stakeholders. The majority of stakeholders (54%) reported using Copernicus data on a monthly basis, and 41% use it only on an annual basis. Satellite-derived products and Model-derived products support most stakeholders' activities with 82% and 73%, respectively, of stakeholders relying on them.

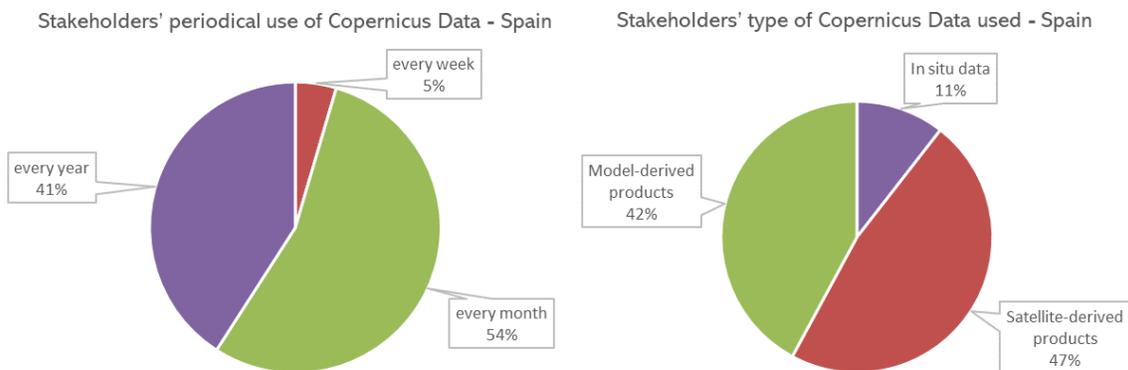


Figure 2-11. Stakeholders' that declared using Copernicus data in Spain: periodicity of usage and type of data used.

For the stakeholders that declared using Copernicus data, one open-ended question (Q.30ii) was asked to get further information to know what was **stakeholders' purpose for using Copernicus data**. In summary, Spanish stakeholders stated to use Copernicus data for the study of coastal processes and dynamics, the use of in-situ data and models, the mapping of habitats and species, and the development of distribution and response models. They also pointed for addressing coastal risk, monitoring anthropogenic activities, and supporting decision-making through data analysis and reporting. Detailed summary to the question Q30 is reported in the Annex III. For the stakeholders that **declared not using Copernicus** (Figure 2-11), 80% of them stated that the main reason for it was the lack of knowledge or skills to use the data, while 32% declared not having enough human resources or time to do it.

3.4.3. Data analysis and visualisation tools

Regarding needs related with tools for **data transformations** for the implementation process in Spain of the two Directives, stakeholders were asked about most-used data tools for Copernicus data analysis and visualisation (Figure 2-12). When analysed **marine sectors** in Spain, stakeholders expressed that Mapping software is the most used tool for visualising and analysing Copernicus data in a spatial context, followed by Programming languages. When analysed marine sectors separately, the majority of them follow the general trend, but some of them show a different preference of use regarding tools for data transformations. In Ports and harbours sector, Programming languages are the most used. For Maritime transport routes and traffic flows sector, Visualisation software acquires greater importance than in the rest of the sectors.

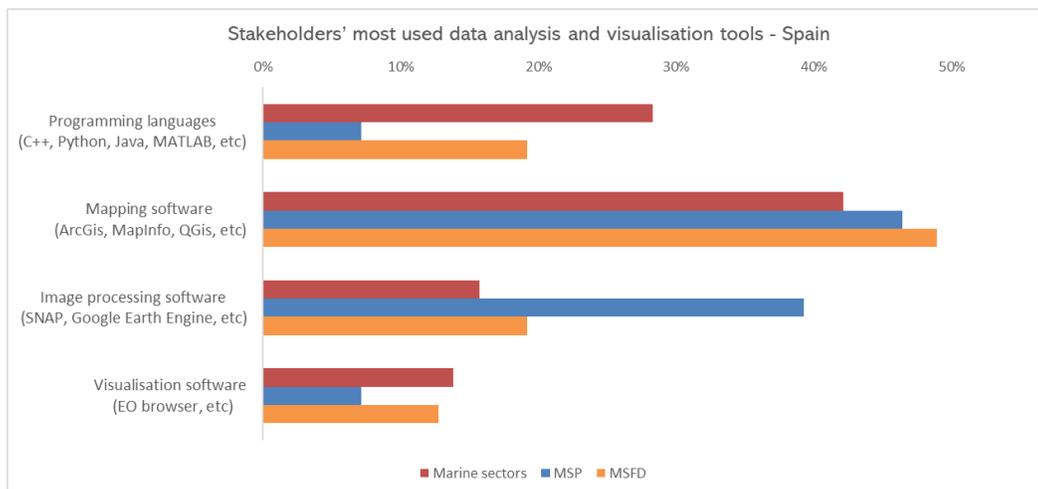


Figure 2-12. Stakeholders' most used data analysis and visualisation tools at all marine sectors in Spain

TASK 2

Concerning tools utilisation within Spanish **stakeholders involved in EU marine Directives implementation**, when comparing these results with the ones stated for all marine sectors, Mapping software is still the most used, especially among stakeholder's participant in MSFD Directive implementation. Unlike for the general analysis, both Directives stated a more frequent use of Image processing software. Visualisation software is least used in MSP Directive.

3.4.4. Open ended questions

Three open-ended questions were asked at the end of the survey to get further information on: how users think that Copernicus data can be improved (Q30.vi), stakeholders' needs besides Copernicus data (Q32) and other relevant space solutions for the maritime domain (Q33). Detailed summary of the answers to these questions is provided in Annex III.

TASK 3. IDENTIFICATION ON HOW TO USE COPERNICUS DATA IN THE IMPLEMENTATION OF EU MARINE DIRECTIVES

1. Introduction

The Copernicus program, established by the European Union, offers a comprehensive and continuous supply of marine data. This data comes from a variety of sources, primarily Earth observation satellites, and is used to monitor and analyse various marine parameters and phenomena in the maritime sector. The Copernicus program includes several services that contribute to the better implementation of the EU Marine Directives.

In this task, the main objective is to develop a jointly standardized set of protocols. These protocols aim to facilitate the development of enhanced methodologies for use in national reporting. To achieve this goal, the requirements outlined in the EU Marine Directives and the data gaps identified in Task 2 have been compared with the advantages and opportunities provided by Copernicus data services.

2. Gap Filling Based on Copernicus Data

The following aspects are the most important points, in relation to advantages and opportunities provided by Copernicus data services, to fill the gaps stated in the survey by stakeholders involved in the implementation of EU marine Directives in Spain.

- **Data availability:** The Copernicus program operates a fleet of Sentinel satellites that provide Earth observation data. These satellites cover a wide range of parameters, including land, ocean, atmosphere, and climate variables. Each of these satellites is equipped with sensors designed to capture specific types of data. The Sentinel satellites are strategically positioned in various orbits to provide frequent and consistent observations of the Earth's surface.
- **Temporal coverage:** The Sentinel satellites offer a variety of temporal resolutions, from high-frequency observations (e.g., daily) to long-term records spanning several years. This diversity in temporal coverage allows users to access data that aligns with their specific needs, whether they require near-real-time monitoring or historical data for trend analysis.
- **Temporal distribution and forecasting:** Some Copernicus services use data assimilation techniques to combine observed data with models to fill

temporal gaps and provide forecasts. This approach ensures that users have access to up-to-date and continuous marine information. Moreover, Copernicus is a long-term program with plans for future missions and data continuity. This commitment ensures that users can rely on a consistent temporal distribution of environmental data for years to come.

- **Long-term data archives:** Copernicus maintains extensive data archives that house historical records of Earth observation data since the 1980s. These archives are valuable for tracking marine changes over time, conducting research, and assessing long-term trends.
- **Data availability and accessibility:** Copernicus is committed to providing open and free access to its data. This accessibility promotes the widespread use of marine data and encourages innovation in various sectors, including agriculture, urban planning, and disaster management.
- **Tailored data products:** Copernicus offers data products that are pre-processed, analysed, and tailored to specific applications. These products often have well-defined temporal characteristics and are designed to simplify the use of marine data.
- **Data reliability:** Data quality is a priority for Copernicus. Rigorous quality control procedures are applied to ensure the accuracy and reliability of the data provided.
- **Homogeneous data collection:** Copernicus employs a set of standardized procedures and protocols for data collection. This ensures that data is collected consistently across different sensors and satellites, leading to a homogeneous dataset. Moreover, to maintain data homogeneity, Copernicus satellites and sensors undergo rigorous calibration and validation processes. This is essential for ensuring the accuracy and reliability of the data.
- **Homogeneous data source:** Copernicus combines data from various sources, including the Sentinel satellites, other Earth observation missions, ground-based measurements, and climate models. Data fusion techniques help create a comprehensive and coherent temporal distribution of marine information, enabling users to access integrated data from different sources.
- **Data format:** Copernicus data is encoded and formatted following international standards. This ensures that data can be easily accessed, shared, and used by a wide range of users and applications.

These structural advantages of Copernicus services directly match the gaps expressed by Spanish stakeholders, as illustrated in the national round-table event presented below.

3. Spanish Case Study: Copernicus Event on Marine Applications

3.1. Context and Relevance to MSP and MSFD

In October 2024, IHCantabria and INTA, in collaboration with Action 2021-2-42 and Action 2021-2-47, organised a national Copernicus Spanish event, titled “Copernicus in marine applications: Opportunities and training”. The event, held online, included an awareness and networking session with stakeholders from fisheries, aquaculture, ports and infrastructure sectors, followed by a five-hour training for technical staff on accessing and using Copernicus products, especially the Copernicus Marine Environment Monitoring Service (CMEMS).

This event was highly relevant for Action 33 as it provided a national platform to directly identify sectoral information needs and to evaluate the capacity of Copernicus data to support the implementation of the Marine Strategy Framework Directive (MSFD, 2008/56/EC) and the Maritime Spatial Planning Directive (MSP, 2014/89/EU).

The round-table session, “Copernicus Marine Services: Needs and Opportunities”, gathered national institutions representing fisheries, aquaculture, marine conservation, ports, and infrastructure, alongside CMEMS representatives. Its results directly link to the identification of data gaps (Task 2) and how Copernicus services can fill them (Task 3). The discussion was moderated by Bárbara Ondiviela (IHCantabria) and gathered national stakeholders from key marine-related institutions:

- Puertos del Estado (Begoña Pérez)
- Ministerio de Agricultura, Pesca y Alimentación – MAPA: Fisheries, Aquaculture and Marine Reserves (Juan Carlos Jorquera and Raquel López)
- Instituto Español de Oceanografía (IEO) (José Manuel González)
- INTA (Eduardo de Miguel)
- Mercator Ocean International / CMEMS (Valentina Giunta)

3.2. Methodology of the Round Table

The discussion was structured in four thematic blocks, based on the stakeholder survey previously conducted in Spain:

- **Water Quality** – linked to MSFD descriptors on eutrophication (D5), contaminants (D8), and biodiversity (D1).
- **Habitat Characterisation** – relevant to MSFD (D1 biodiversity, D6 seafloor integrity) and MSP initial diagnosis.
- **Climate Change Impacts** – transversal to MSFD (pressures and impacts) and MSP (long-term planning scenarios).
- **Optimal Site Selection** – core to MSP planning (zoning for aquaculture, MPAs, and renewable energy).

Representatives from Puertos del Estado, MAPA (Fisheries, Aquaculture, Marine Reserves), IEO, and INTA were asked targeted questions about data gaps, temporal needs, and spatial resolutions. The CMEMS representative then responded with examples of available datasets and services. In addition, the session included a live Q&A segment with online participants, where cross-cutting issues such as data accessibility and training needs were raised.

3.3. Key Findings from Stakeholders

The round-table discussions confirmed that Spanish stakeholders face recurrent challenges in accessing and applying marine data to support both the MSFD and MSP implementation processes. These needs are directly connected to MSFD descriptors (D1, D5, D6, D8) and to MSP planning requirements, particularly in site selection and long-term scenario analysis. Needs were grouped into four thematic blocks: water quality, habitat characterisation, climate change impacts, and optimal site selection.

Water Quality (MSFD D5, D8)

Stakeholders from Puertos del Estado and MAPA highlighted the need for real-time and high-resolution data on pollutants, harmful algal blooms, fish diseases, and eutrophication. Concerns were raised about gaps in nearshore monitoring, stressing the importance of Copernicus products for early detection and preventive management.

Habitat Characterization (MSFD D1, D6 / MSP diagnosis phase)

MAPA (Marine Reserves) and IEO underlined gaps in species distribution and habitat mapping. The absence of detailed environmental descriptors was identified as a major limitation for fisheries management and MSP zoning. CMEMS data were considered relevant but require downscaling and local calibration.

Climate Change Impacts (cross-cutting to MSFD/MSP)

Puertos del Estado and IEO representatives stressed the importance of climate projection data (sea level rise, extreme events, temperature trends). Such information is critical for the resilience of port infrastructure and for adaptive management of fisheries and ecosystems.

Optimal Site Selection (MSP planning phase)

MAPA representatives identified the need for bathymetric data, climatic variables, historical series, and forecast scenarios to select suitable locations for aquaculture installations and marine protected areas. Both short-term operational data and long-term projections were highlighted as essential for MSP processes.

Table 3-1 provides a structured synthesis of the institutional contributions, user needs, and their direct relevance to the EU Directives.

Table 3-1. Institutional contributions and user needs identified in Spain, with their relevance to EU Directives (MSP/MSFD).

Thematic Area	Institutional Contribution	User Needs Identified	Relevance to EU Directives (MSP/MSFD)
Water Quality	Puertos del Estado, MAPA (Aquaculture)	Real-time and high-resolution data on pollutants, algal blooms, fish diseases, eutrophication; improved nearshore monitoring.	MSFD (D5 Eutrophication, D8 Contaminants, D1 Biodiversity) – monitoring of water quality and ecosystem health.
Habitat Characterisation	IEO, MAPA (Marine Reserves)	Gaps in species distribution, habitat mapping, lack of detailed environmental descriptors.	MSFD (D1 Biodiversity, D6 Seafloor integrity); MSP initial diagnosis phase (assessment of habitats and resources).
Climate Change Impacts	Puertos del Estado, IEO	Short-, medium-, and long-term projections for ports, fisheries, and ecosystems; need for sea level rise, extreme events, and temperature trends.	Cross-cutting: MSFD (pressures & impacts); MSP (long-term planning scenarios, adaptive management).
Optimal Site Selection	MAPA (Aquaculture & Marine Reserves)	Bathymetry, climatic variables, historical time series, and forecast scenarios; short-term operational	MSP (zoning and allocation of uses: aquaculture, MPAs, offshore renewables).

		data and long-term projections.	
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Whereas Table 9-1 presents a detailed account of institutional contributions and their alignment with EU Directives, Figure 3-1 provides a complementary graphical synthesis, highlighting the four priority thematic areas and illustrating the role of Copernicus data in addressing the identified information needs.

Copernicus Contributions to MSP & MSFD Data Gaps

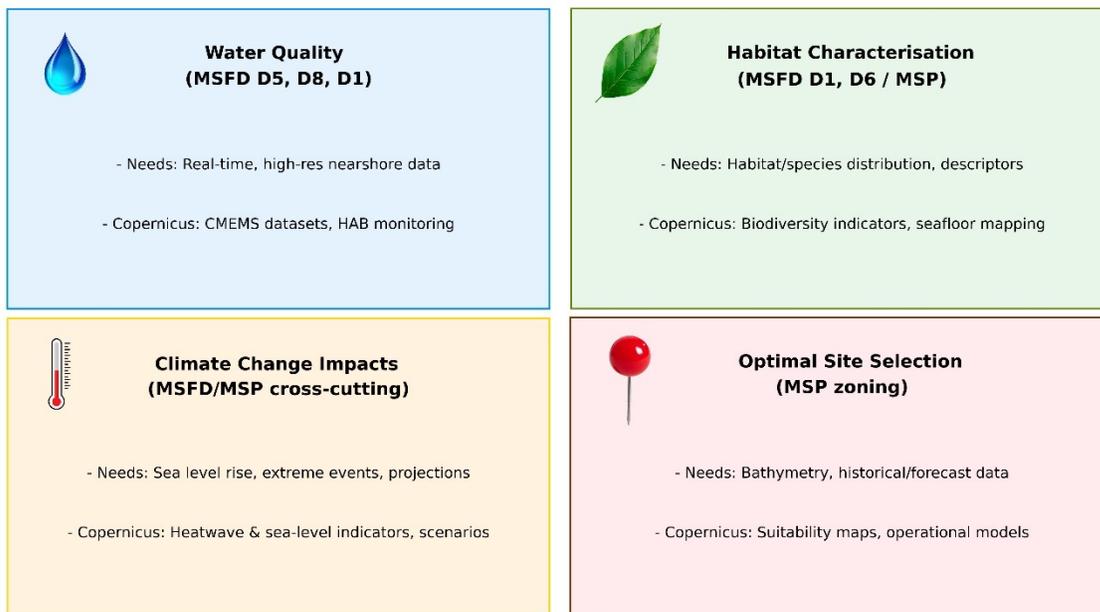


Figure 3-1. Graphical synthesis of stakeholder needs and Copernicus contributions to MSP & MSFD data gaps (Spanish round-table, October 2024).

3.4. Copernicus Contributions to Gap Filling

Building upon the structural advantages outlined in Section 3.2, the CMEMS representative presented concrete products already addressing stakeholder needs.

- Water quality monitoring through real-time and historical datasets.
- Forecasting models for aquaculture and fisheries management.
- Indicators of marine heatwaves and sea-level trends, directly relevant to climate adaptation strategies under MSFD and MSP.

Stakeholders recognised the growing accessibility of Copernicus services but emphasised the need for:

- Downscaling to local/regional contexts to ensure applicability in national MSP and MSFD processes.
- Capacity building and training for practitioners, to fully integrate Copernicus data into reporting and planning.
- Exploration of Digital Twin Ocean (DTO) initiatives as a next step to enhance integration of Copernicus data with stakeholder-driven scenarios.

3.5. Cross-Cutting Issues and Lessons Learned

- Data accessibility and usability remain key challenges, especially for non-specialist end users.
- There is a strong demand for training and capacity building, as many stakeholders expressed limited technical capacity to exploit Copernicus datasets.
- The round-table demonstrated the added value of structured engagement with national stakeholders, which ensures that Copernicus services are aligned with the concrete requirements of EU Directives.

The Spanish event served as a model for integrating stakeholder-driven discussions into the operationalization of Copernicus data for MSP and MSFD implementation.

TASK 4. COPERNICUS DATA TO GENERATE HIGH SPATIAL INFORMATION FOR THE IMPLEMENTATION PROCESS

This chapter is an edited version of the article "*Ocean multi-use for the transition to sustainable energy and aquaculture developments in the Mediterranean Sea*" published by Bárbara Ondiviela, Raúl Guanche, Elvira Ramos, Lucia Meneses, Carlos V.C. Weiss, Jonne Kotta and José A. Juanes in *Journal of Environmental Management* (2025), 392:126678. doi.org/10.1016/j.jenvman.2025.126678

1. Introduction

The two maritime sectors selected for the implementation process have been aquaculture and renewable energy, as these are the sectors with the main potential for development in the European maritime waters. Additionally, the results of the Task 2 survey showed that the areas of most interest for the renewable energy and aquaculture sectors were the selection of suitable locations (Figure 4-1). Thus, the implementation process has focused on identifying new locations for the development of these two activities within the exclusive economic zone. **The implementation is common to France and Spain and has been developed in the Gulf of Lion.**

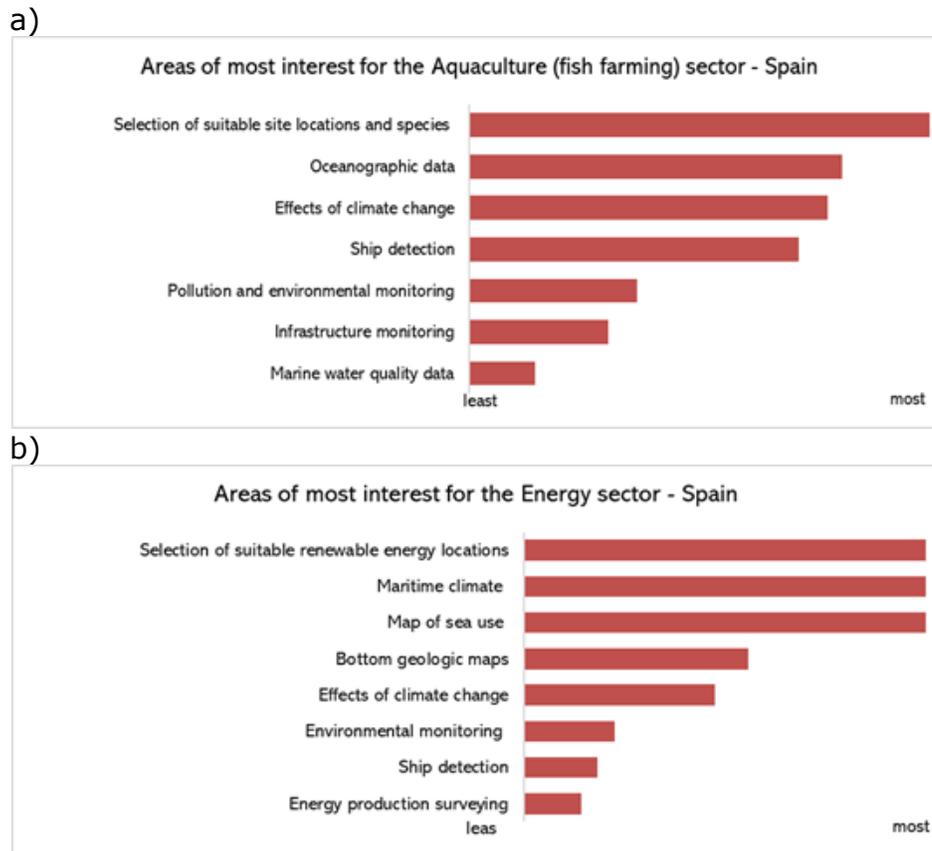


Figure 4-1. Stakeholder's areas of most interest for two maritime sectors in Spain: Aquaculture and Energy sector (least=minimum interest; most=higher interest).

2. Methodology

2.1. Study area

The Mediterranean is a semi-enclosed sea connected to the Atlantic Ocean by the Strait of Gibraltar. It encompasses three continents (Africa, Asia and Europe) and is bordered by 22 countries. It has a surface area of about 2.51 million km² and a total coastline of 46,000 km.

The Study area was the Gulf of Lion, a large, semi-circular bay in the western area of the Mediterranean Sea, located along the southern coast of France and northern coast of Spain. It extends from the French-Spanish border to Toulon, bordering the Ligurian Sea to the east and the Balearic Sea to the southwest. The gulf is known for its broad continental shelf, diverse coastline, and the influence of the Rhône River (Figure 4-2).



Figure 4-2. Stakeholder's areas of most interest for two maritime sectors in Spain: Aquaculture and Energy sector (least=minimum interest; most=higher interest).

2.2. Assessment of marine renewable energy potential

A Suitability Index (hereafter *SI*), based on the approach developed and applied across various temporal and spatial scales by Weiss et al. (2018a, b, 2020, 2023), was used to assess the potential for wind and wave developments. A threshold of $SI \geq 0.5$ was applied to identify areas suitable for wind and wave energy developments, considering the limit defined by Weiss et al. (2018c) between low and moderate suitability. The *SI* is calculated by integrating four suitability factors through the critical value method: wind and wave energy production (I_{we} , I_{wve}), structural integrity (I_{wss} , I_{wvss}), operation and maintenance (I_{os}) and energy transmission (I_{et}). Each suitability factor is independently evaluated (0-1), according to international standards, reference wind turbines and generic wave devices (Table 4-1). The resulting value, expressed as the probability (in percentage) of encountering optimal conditions, reflects how closely the environment aligns with the required conditions for each suitability factor.

For *wind power production* suitability (I_{we}), wind speed (W_s), available wind potential (W_p) and significant wave height (H_s) were considered. W_s and W_p were measured at 150m hub-height, and the maximum H_s is the limit at which the turbines can interrupt power production for safety reasons. The wind production was evaluated as a function of the percentage of time in which the

W_s and W_p remain within the production thresholds. The W_s was distributed according to the power curve of the IEA- 15MW turbine referenced by DTU (Figure 4-3a, Gaertner *et al.*, 2020).

$$I_{we} = (3W_s + 2W_p + 1H_s)/6 \quad (1)$$

For the *wave energy production suitability* (I_{wve}), the available energy flux (E_f), wave peak period (T_p) and H_s were considered. The production index for wave energy was calculated by integrating each element through the weighted mean, with more height assigned to the availability of the resource against the site severity.

$$I_{wve} = (3H_s + 2E_f + T_p)/6 \quad (2)$$

The *structural suitability* was characterized based on the severity of the met-ocean conditions (*i.e.* 50-year return period for W_s -50yr, H_s -50yr, T_p -50yr) and the bathymetry (Bat). The structural suitability index (I_{wss}) for wind energy was defined based on the weights reflected in the following equation:

$$I_{wss} = (W_{50yr} + H_{s,50yr} + 4Bat)/6 \quad (3)$$

For wave energy exploitation (I_{wvss}), the integration of the index was done according to the following equation:

$$I_{wvss} = (T_{p,50yr} + H_{s,50yr} + 4Bat)/6 \quad (4)$$

The extreme conditions (*i.e.*, W_s -50yr, H_s -50yr, T_p -50yr) and the Bat were parameterised according to specific distribution functions (Figure 4-3b, 4-3e).

Operational suitability (I_{os}) was assessed based on the availability of annual 8-hour weather windows for W_s and H_s (*i.e.*, Win) and the distance to ports (D). The study area was considered fully accessible if it has 1095 windows of access. For wind energy, the W_s corresponds to a height of 150 m. For wave energy, the W_s corresponds to a height of 10 m.

$$I_{os} = (2D + 3Win)/5 \quad (5)$$

Energy transmission (I_{et}) for wind and wave suitability was assessed by calculating the Euclidean distance to the nearest urban areas (*i.e.*, consumer centres). Euclidean distance was parameterized assuming a radius of 80 km of distance (Figure 4-3f).

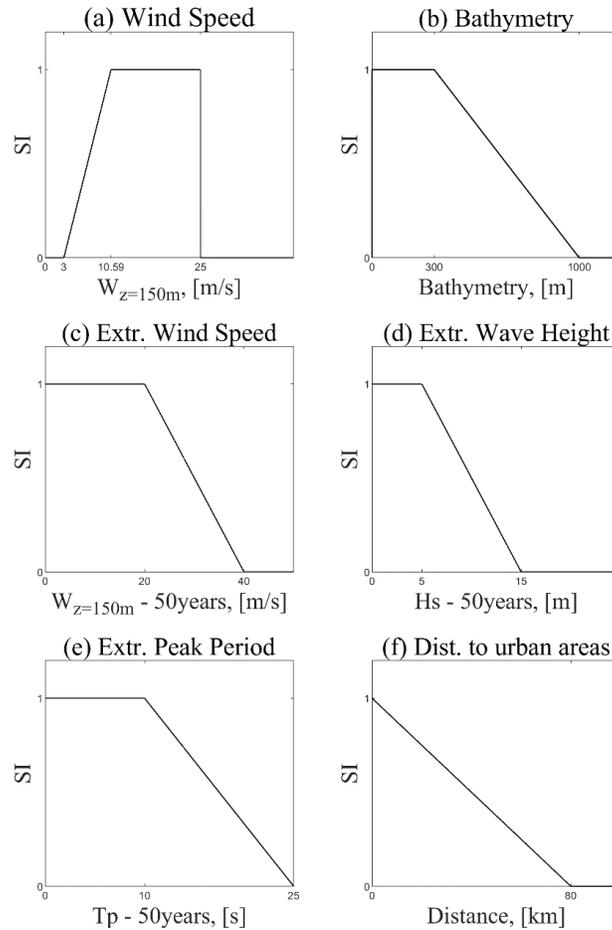


Figure 4-3. Distribution functions used to parametrise the indicators used to assess the opportunities for marine renewable energy: (a) wind speed; (b) bathymetry; (c) 50-year return period for wind speed – 150m (W_{s-50yr}); (d) 50-year return period for significant wave height (H_{s-50yr}); (e) 50-year return period for peak period (T_{p-50yr}); (f) distance to urban areas.

Table 4-1. Variables and thresholds for a) wind and b) wave marine renewable energies.

Marine renewable energies	Thresholds
<i>a) Wind Energy potential</i>	
<i>Wind production suitability</i>	
Mean wind speed (hub-height- 150m) (W_s ,m/s)	$3 < W < 25$
Available wind potential (W_p ,Kw/m ²)	> 400
Significant wave height (H_s ,m)	$H_s < 5$
<i>Structural suitability</i>	
Wind speed 50-yr (W_{s-50yr} ,m/s)	< 40
Significant wave height 50-yr (H_{s-50yr} ,m)	< 15
Bathymetry (m)	< 300
<i>Operational suitability</i>	
Distance from ports (km)	< 60
Mean wind speed (hub-height- 150m) (W_s ,m/s)	< 15
Significant wave height (H_s ,m)	< 2
<i>Energy transport</i>	
Distance from consumer centers (km)	< 80
<i>b) Wave Energy potential</i>	
<i>Wave production suitability</i>	
Wave energy flux (Ef)	> 15
Significant wave height (H_s ,m)	$1 < H_s < 6$
Peak Period (T_p , s)	$5 < H_s < 14$
<i>Structural suitability</i>	
Peak Period (T_p , s)	< 25
Significant wave height 50-yr (H_{s-50yr} ,m)	< 15
Bathymetry (m)	< 300
<i>Operational suitability</i>	
Distance from ports (Km)	< 60
Mean wind speed (10m high) (W_s ,m/s)	< 15
Significant wave height (H_s ,m)	< 2
<i>Energy transmission</i>	
Distance from consumer centers (km)	< 80

2.3. Assessment of aquaculture potential

The potential of the Mediterranean Sea for offshore aquaculture was addressed through the methodological approach developed by Weiss *et al.* (2018b). The *SI* was calculated for aquaculture from three suitability factors: biological, operational and structural requirements. *SI* calculations were performed similarly to the marine renewable potential assessment. The *SI* was assessed for 22 species, including fish, cephalopods, bivalves and macroalgae, although only species with $SI \geq 0.5$ were included in the results. The selection of these species considered factors such as their history as farmed species, biomass, economic value, and future market potential (Table 4-2). The selection was made in collaboration with the Spanish aquaculture sector and included species currently

in production (i.e., blackspot seabream, meagre, gilthead seabream, European seabass), and new species with future market potential in which the sector is now interested (i.e., wreckfish, common dentex, flathead grey mullet, red porgy, or greater aberjack).

Biological suitability assessed how closely the environmental conditions resemble the requirements of the species (e.g. temperature, salinity, Chlorophyll a), defined through their optimum growth requirements. The environmental conditions were compared with the species' requirements and the probability of meeting optimal conditions was calculated concomitantly for the variables influencing their growth (Table 4-2), based on the entire historical time series of available data (Table 4-3).

Structural suitability, similar to the approach used for renewable energies, assessed the severity of met-ocean conditions and their influence on the long-term integrity of aquaculture structures. This assessment considered factors such as bathymetry, seabed slope, extreme waves, and currents, as well as survival conditions, to parameterize the study area (*cf. Weiss et al., 2018b*).

Operational suitability, similar to the approach used for renewable energies, evaluated the possibility of carrying out the O&M (operations and maintenance) activities (feeding, fishing, cleaning, maintenance, etc.) and was determined by met-ocean conditions and by the distance to ports (*cf. Weiss et al., 2018b*).

To complement the *SI*, the probability of *species survival against extreme events* caused by marine cold or heatwaves was analysed. An extreme event is a period of unusual conditions that could result in mortality or stress for the species. In this study, an extreme event was defined as a period of more than seven consecutive days during which sea surface temperatures are either above or below the optimal growth range for the species (Table 4-2). The probability was calculated using the entire historical dataset, and species survival was considered at risk if the likelihood of extreme events exceeded 50%. Thus, regardless of the *SI* values, study areas where species survival was at risk were classified as unsuitable for aquaculture.

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Table 4-2. Variables and thresholds to define the optimum growth conditions for the 22 species of interest: fish, cephalopods, bivalves and macroalgae.

Common name	Scientific name	Temperature (°C)	Salinity (UPS)	PAR (Einstein/m ² day)	Chlorophyll a (mg/m ³)	Current velocity (m/s)
<i>Fish in production</i>						
Blackspot seabream	<i>Pagellus bogaraveo</i>	12-21	34.5-37.8			
Meagre	<i>Argyrosomus regius</i>	14-28	29.5-39.1			
Gilthead seabream	<i>Sparus aurata</i>	14-28	30.0-40.0			
European seabass	<i>Dicentrarchus labrax</i>	4.1-30	5.0-50.0			
Rainbow trout	<i>Oncorhynchus mykiss</i>	6-18	10.0-38.0			
<i>Fish with future market potential</i>						
Atlantic Bluefin tuna	<i>Thunnus thynnus</i>	15-30	30.0-38.0			
Wreckfish	<i>Polyprion americanus</i>	12-20	32.4-37.8			
Common dentex	<i>Dentex dentex</i>	15-28	35.4-38.8			
Dusky grouper	<i>Epinephelus marginatus</i>	14-23	33.2-37.2			
Flathead grey mullet	<i>Mujil cephalus</i>	15-30	30.0-38.0			
Common dolphinfish	<i>Coryphaena hippurus</i>	20-30	16.0-36.4			
Red porgy	<i>Pagrus pagrus</i>	15-26	31.6-38.0			
Greater amberjack	<i>Seriola dumerilii</i>	14-28	30.0-38.0			
<i>Cephalopods</i>						
Octopus vulgaris	<i>Octopus vulgaris</i>	10-20	27.0-35.5			
Sepia officinalis	<i>Sepia officinalis</i>	20-30	25.0-38.0			
<i>Bivalves</i>						
Mediterranean mussel	<i>Mytilus galloprovincialis</i>	10-25	20.0-38.0		>1	<0.35
King scallop	<i>Pecten maximus</i>	8-17	28.0-35.0		>1	<0.35
Queen scallop	<i>Aequipecten opercularis</i>	8-16	> 26.0		>1	<0.35
Variiegated scallop	<i>Mimachlamys varia</i>	8-18	25.0-35.0		>1	<0.35
<i>Macroalgae</i>						
Laver	<i>Porphyra sp</i>	10-15°C	30.0-40.0	6.05-43.2		
Velvet horn	<i>Codium tomentosum</i>	10-16°C	30.0-40.0	6.05-17.3		
Irish moss	<i>Chondrus crispus</i>	10-15°C	28.0-40.0	5.62-34.6		

2.4. Data sources and analysis

The spatial resolution of the grid cell for the Mediterranean Sea was 0.2° (20 km), from 0 to 2000 m depth. Long-term data series with spatial resolutions between 0.04° (≈4 km) and 0.3° (≈30 km) and temporal resolutions of hours and days were used (Table 4-3). To account for the different resolutions of data sources for each variable, the closest point to each grid cell was used. Regarding temporal resolution, the use of hourly or daily data from different sources was determined by the specific requirements of each parameter included in the *SI* formula. If a variable was available hourly but needed daily, the daily average was calculated to enable its integration with other daily data. Finally, the temporal period was adjusted to each *SI*, based on the overlapping temporal coverage of all relevant variables. Thus, to ensure consistency and coherence in the final *SI* calculations, a common time frame was selected, even at the expense of excluding longer time series from individual variables. This temporal

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window varies between groups (fish and cephalopods, bivalves, and macroalgae) because each needs different variables for their *SI*.

SI analysis were conducted at each cell of the grid (3,632 cells) using MATLAB R2023b. The spatial data was analyzed using a Geographic Information System (ArcGIS Desktop 10.8 by ESRI), employing the Pan-European projection system ETRS89 Lambert Azimuthal Equal-Area (LAEA).

Table 4-3. Data sources, spatial resolution, temporal resolution and time period available for met-ocean and physiographic variables.

Variable	Source	Period	Temporal resolution	Spatial resolution
Sea temperature (°C)	Copernicus https://data.marine.copernicus.eu/product/SST_MED_SST_L4_REP_OBSERVATIONS_010_021/description	1982-2024	Daily mean	0.05° × 0.05°
Salinity (UPS)	Copernicus https://data.marine.copernicus.eu/product/MEDSEA_MULTIYEAR_PHY_006_004/description	1987-2024	Daily mean	0.042° × 0.042°
Chlorophyll <i>a</i> (mg/m ³)	Copernicus https://data.marine.copernicus.eu/product/MEDSEA_MULTIYEAR_BGC_006_008/description	1999-2024	Daily mean	0.042° × 0.042°
Wind (m/s)	IHData https://ihdataprot-a.ihcantabria.com/	1985-2022	1 h	0.312°
Wave (m)	IHData https://ihdataprot-a.ihcantabria.com/	1985-2015	1 h	0.125°
Currents (m/s)	IHData https://ihdataprot-a.ihcantabria.com/	1985-2015	1 h	0.114°
Bathymetry	EMODnet, DTM https://www.emodnet-bathymetry.eu/data-products	2020		1/16x1/16arcmin
PAR (Einstein/m ² day)	Aqua/MODIS https://oceancolor.gsfc.nasa.gov/l3/	2002-2022	Daily	4km
Ports	World Port Index-NGA https://arc-gis-hub-home-arcgishub.hub.arcgis.com/datasets/EDT::world-port-index/about	2019		Polygon
Consumer centers	Eurostat; World Bank Open Data; United Nations Data Portal; https://data.un.org https://ec.europa.eu/eurostat/ https://data.worldbank.org	2023		Points

3. Results

For the analysis of the results, the study area was extended slightly beyond the strict boundaries of the Gulf of Lion in order to achieve a more comprehensive assessment of the potential of the region.

The French coast between Saintes-Maries-de-la-Mer and Marseille has the highest wind *SI* (>0.6), with maximum values closed to the shoreline (Figure 4-4a). From this area to approximately the Spanish border, a tongue of high *SI* values, close to 0.6, extends along the coast, even though the highest wind resource is located offshore.

The highest *SI* values ($SI > 0.5$) for wave energy are again observed along the French coast, between Saintes-Maries-de-la-Mer and Marseille, extending further east to Toulon, and, in addition, along the Spanish coast between Lloret de Mar and Cadaqués (Figure 4-4b). In the latter case, the maximum values are not located directly at the shoreline but approximately 20–30 km offshore. In this case, the limitations in *SI* values are determined by the wave resource and the conditions for O&M activities. The maps for each of the suitability factors considered in the Suitability Index (*SI*) for wind and waves (*i.e.* energy production, structure, operation and energy transmission) are available in the Marine Spatial Planning Viewer (<https://msp.ihcantabria.com/#/tool>).

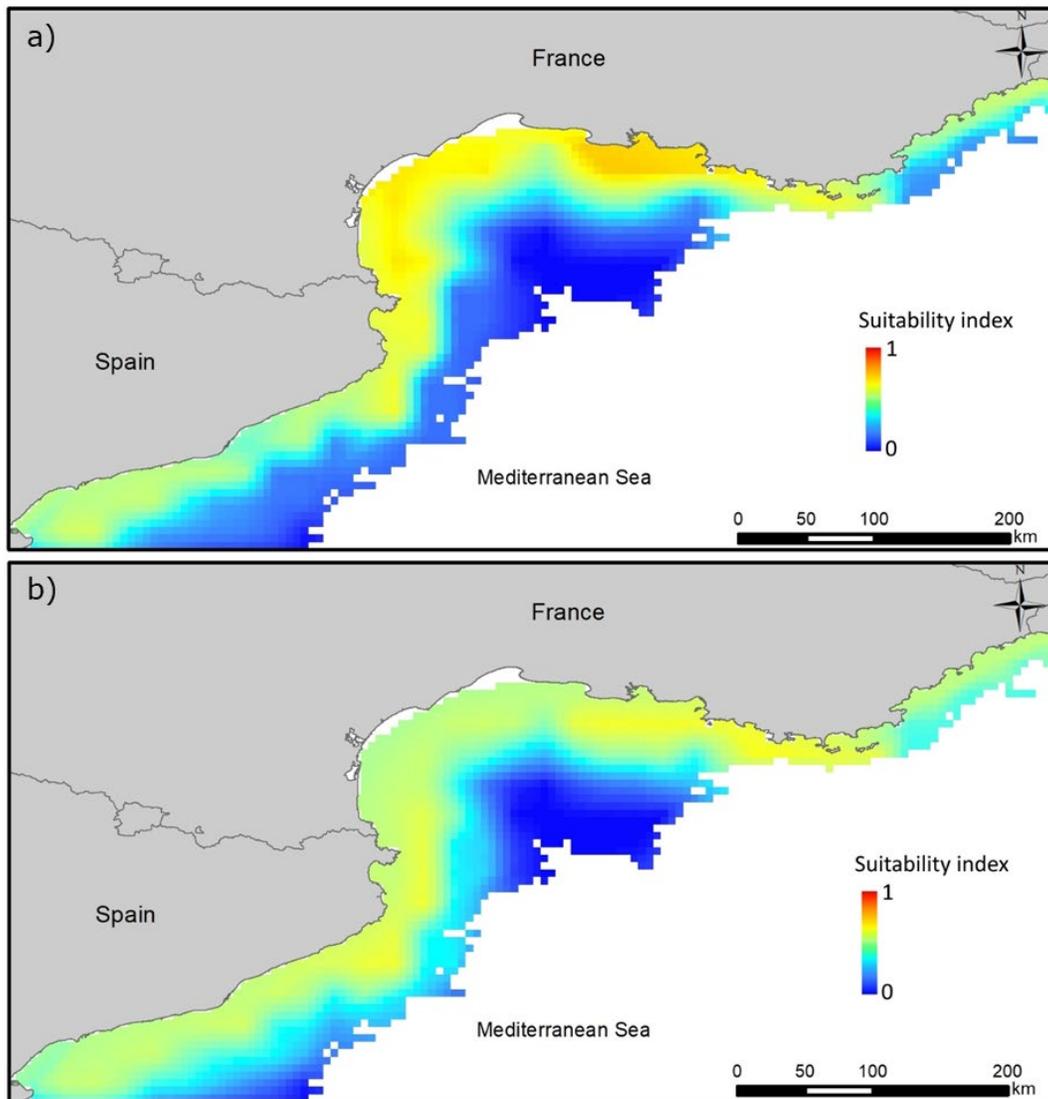


Figure 4-4. Suitable areas for marine renewable energies in the Mediterranean Sea: a) Suitability index, SI (0-1) for wind energy. b) Suitability index, SI (0-1) for wave energy.

Out of the twenty-two finfish species originally considered, nine have suitable areas for aquaculture in the Gulf of Lyon ($SI > 0.5$) (Figure 4-5). Looking for synergies between different aquaculture productions, we find that a small coastal area in front of Saintes-Maries-de-la-Mer (5 km from the shoreline) is suitable ($SI > 0.6$) for farming at least four species (gilthead seabream, European seabass, meagre, greater amberjack).

European seabass is the species with the highest SI values (Figure 4-5b), with the coast in front of Montpellier and the area between Narbonne and Perpignan

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($SI \sim 0.9$) representing the most suitable locations for its cultivation. However, the entire Gulf of Lion coast, between 10 and 20 km offshore depending on the location, also shows high suitability ($SI > 0.7$) for its cultivation. Similar spatial distribution patterns and SI values are observed for gilthead seabream (Figure 4-5a) and meagre (Figure 4-5d), although with lower suitability values, particularly between Sète and Narbonne. The remaining species show suitability values below 0.6. Common dentex (Figure 4-5i) shows $SI > 0.5$ intermittently along the nearshore areas of the Gulf of Lion. Greater amberjack (Figure 4-5f) only shows SI values close to 0.5 in a narrow coastal strip between Sète and Martigues, and between Perpignan and Narbonne. Red porgy (Figure 4-5c) and Atlantic bluefin tuna (Figure 4-5e) share suitable areas due to similar biological requirements. A small portion of the coast in front of Narbonne and Saintes-Maries-de-la-Mer has suitable areas ($SI \geq 0.5$) for these species. The last group of species sharing suitable areas are wreckfish (Figure 4-5g) and blackspot seabream (Figure 4-5h). For these species, the same area as for the previous ones showed suitable areas ($SI \geq 0.5$), but with a more limited extent.

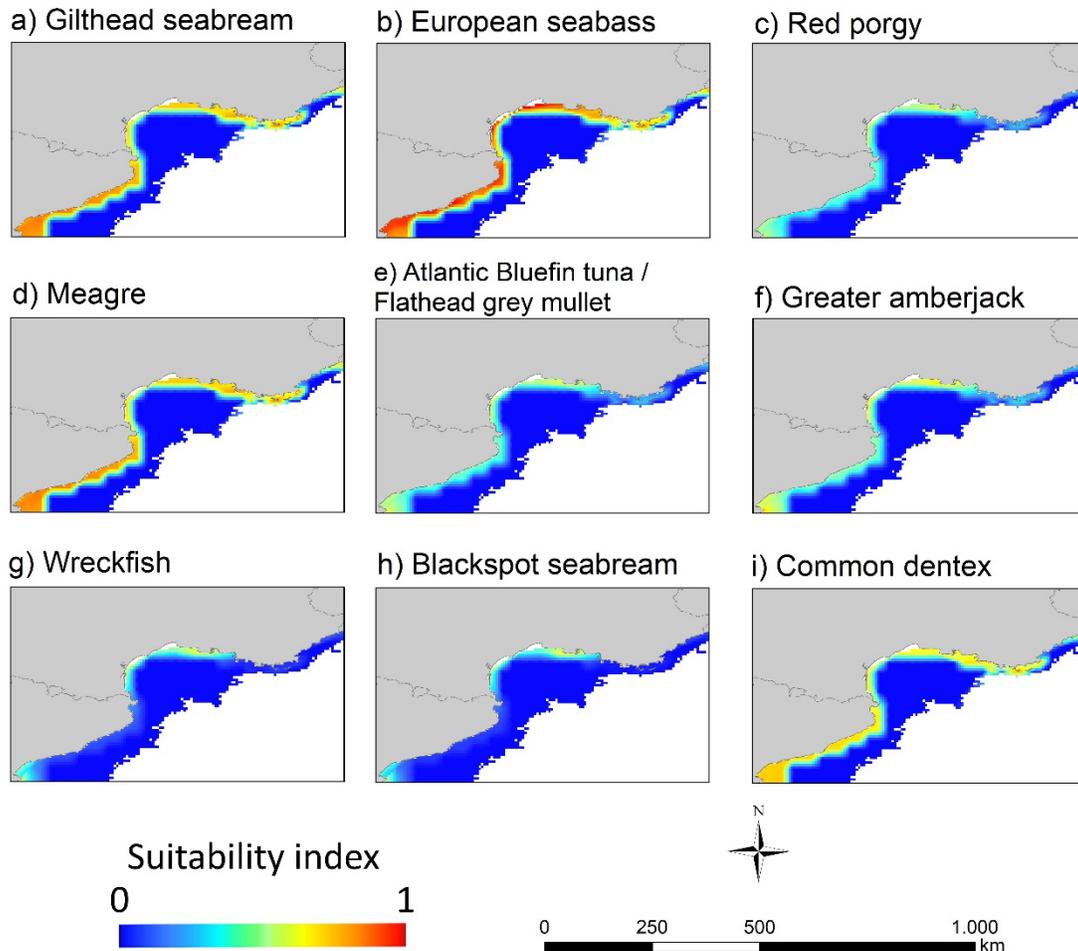


Figure 4-5. Suitability index, SI (0-1) for aquaculture of: a) Gilthead seabream; b) European seabass; c) Red porgy; d) Meagre; e) Atlantic Bluefin tuna and flathead grey mullet; f) Greater amberjack; g) Wreckfish; h) Blackspot seabream; i) Common dentex.

4. Conclusions

Throughout this implementation in **the Gulf of Lion** it has been shown that the shoreline in this area has potential for aquaculture and renewable energies. The coast in front of Port-Saint-Louis-du-Rhone has the highest wind resource. The wave energy potential is lower, but with some suitable areas between Mataró and Perpignan and between Saintes-Maries-de-la-Mer and Toulon. Aquaculture suitability is also high in some areas, particularly, similar to wave energy, between Saintes-Maries-de-la-Mer and Toulon, and along the coast near Perpignan and Roses.

TASK 5. LESSONS LEARNT AND RECOMMENDATIONS

1. Introduction

The purpose of Task 5 is to synthesise the knowledge acquired throughout the implementation of previous tasks in order to derive lessons learnt and formulate recommendations for future applications. This task builds on the identification of challenges (Task 1), the analysis of data gaps and stakeholder needs (Task 2), the assessment of how Copernicus data can contribute to filling those gaps (Task 3), and the evaluation of Copernicus data for implementation processes (Task 4). The outcome of Task 5 aims to provide authorities, public administrations, private actors, and other stakeholders with practical insights and strategic recommendations that can improve the uptake of Copernicus services in Spain, strengthen the implementation of EU Marine Directives, and foster a more effective integration of Earth observation data into marine governance and spatial planning frameworks.

2. Lessons learnt in the Implementation of EU marine Directives in Spain

Under Task 5 a set of lessons learnt, results of the exchange experience and recommendations for understanding, addressing and improving future applications have been performed to transfer to the authorities, interested parties and private sector the knowledge acquired about the use of Copernicus in the implementation of Marine Directives.

2.1. Challenges in the official implementation of EU Directives in Spain-Task 1

One of the main challenges that Spain has faced in the application of marine strategies and marine spatial planning is related to the **limited data availability**. Accurate and up-to-date data is crucial for effective implementation of the two directives. Limited data availability can make it difficult to develop well-informed MSP plans and monitor their effectiveness.

The following challenges have been highlighted in the review performed:

Heterogenous data: it is essential to have data on the marine ecosystem, including information on habitats, biodiversity, and ecological connectivity. However, obtaining comprehensive and up-to-date ecological data was challenging due to factors such as limited monitoring efforts, heterogeneous data

collection methodologies, dispersion of information for most species and habitats.

Unavailability of data: this refers to the challenge of not being able to access or obtain the necessary information. This can occur due to a variety of reasons, including data being restricted, proprietary, incomplete, or simply not collected or available in the first place.

Data integration and interoperability: marine strategies and MSP requires the integration of data from various sources, such as environmental monitoring programs, socioeconomic studies, and resource assessments. However, data integration can be hindered by differences in data formats, inconsistent data collection methods, and limited data sharing between organizations and sectors. These barriers can make it challenging to obtain a comprehensive and coherent picture of the marine environment.

Spatial and temporal resolution: Data availability also encompasses spatial and temporal resolution. In some cases, the available data may not provide sufficient spatial detail to support fine-scale decisions. For example, certain marine activities or ecological features may require data at a smaller spatial scale than what is currently available. Additionally, temporal data—information on changes occurring over time—can be limited, making it challenging to assess long-term trends or anticipate future changes in the marine environment.

2.2. Data Gaps in the implementation of EU Directives in Spain-Task 2

The survey performed reveals a pattern where the majority of respondents are primarily research-oriented and public administration and focused on marine and coastal realms. Additionally, the high number of responses related to coastal and marine activities suggests a specific focus on these areas.

Overall, the analysis demonstrates a higher representation of “species conservation”, “fisheries” and “coastal protection” sectors among the surveyed participants. These prone to assume a significant role of these stakeholders in the execution of the two European Directives.

When looking at the survey results considering the distribution by type of entity, it shows a very low contribution and engagement by private entities (5 for all 10 sectors).

Upon analysing stakeholder’s areas of most interest for the maritime sector in Spain, it becomes evident that “effects of climate change” consistently stood out

as highly rated and crucial services. “Pressures and environmental monitoring” also received significant interest across the 10 marine sectors analysed.

Stakeholder’s analysis of the main problems encountered when working with the data available highlight the need for improved data accessibility, availability, and coverage. The responses related to the characteristics of satellite data, such as temporal extent of the data, highlighted the clear higher demand for historical context. Regarding spatial resolution, the analysis suggests a clear need for intermediate spatial resolution data (5-30m) among marine sectors in Spain. Notably, the very high resolutions (< 1m) were amongst the least selected.

Concerning questions on the usage of Copernicus, there is a high level of awareness regarding the Copernicus program, however barely half of stakeholders use Copernicus services. The majority of those not using these services cited a lack of knowledge or skills as the primary reason.

Stakeholders from the research, public administration, and academia have the highest rates of unawareness regarding the Copernicus program. In the case of public administration stakeholders, a significant portion of them (the mayoralty) indicated that, despite been aware of Copernicus program, they do not currently use Copernicus data. Stakeholders from the Energy sector have the highest rates of unawareness regarding the Copernicus program.

The kind of products used is well balanced between satellite data and models, with in situ data having a minor role. Considering that satellite data are also key inputs for models, it is clear the importance of satellite data.

Spanish stakeholders exhibit diverse patterns in their utilization of Copernicus data, with some favouring monthly access while others opt for annual usage. Weekly access is lowly represented.

The answers to the open-ended questions further underline the importance and need for improvement and lay out some priorities regarding specific data requirements in the maritime domain. It confirms that stakeholders seek space solutions that address their unique needs with a preference of usage in those user-friendly interfaces. Moreover, users proposed several new products they would like to see in the Copernicus program.

[2.3. Identification on how to use Copernicus marine data in EU Directives in Spain-Task 3](#)

When comparing data gaps in the implementation of EU marine Directives with the Copernicus data it become clear that the different services offered by the Copernicus programme can help to fill the gaps.

The Copernicus program provides stakeholders with easy access to marine data, fostering better decision-making by addressing data gaps and enabling continuous monitoring. Copernicus facilitates spatial analysis, mapping, and visualization, assisting in the evaluation of marine conditions and impact assessments. It contributes to long-term monitoring, risk assessment, and cross-border cooperation while supporting public awareness and engagement. This comprehensive Earth observation system enhances scientific research and empowers stakeholders to make informed decisions, promoting the sustainable use of maritime resources and the achievement of environmental objectives laid out in both directives.

The Copernicus Spanish event held with stakeholders and interested parties confirmed the relevance of Copernicus Marine Services for national stakeholders in Spain and helped refine the understanding of priority data needs for coastal and marine planning. The round-table format proved effective in fostering direct exchange, and the diversity of actors ensured a comprehensive view of sectoral requirements. Continued engagement and feedback loops will be essential to improve the usability and impact of Copernicus services. The feedback will also support the future development of tailored products, improved resolution, and the effective implementation of tools like the DTO within Spain's marine governance frameworks.

2.4. Copernicus data for the implementation process -Task 4

The implementation under Task 4 operationalises Copernicus data as decision-support for identifying new suitable locations for offshore aquaculture and marine renewable energies in the Gulf of Lion, a cross-border area shared by France and Spain. In line with the sectoral prioritisation emerging from Task 2 (where stakeholders highlighted site selection as a top need for Energy and Aquaculture), the analysis applies a Suitability Index (SI) framework to integrate met-ocean, physiographic and operational constraints derived from Copernicus (CMEMS) and complementary sources. The objective is not to establish prescriptive zoning, limits or thresholds, but to provide administrations and interested parties with transparent, reproducible and up-to-date evidence to inform planning choices under MSP and MSFD.

Accordingly, Copernicus products (long historical series, harmonised spatial coverage and consistent quality control) underpin the computation of the SI for wind and wave energy (production, structural integrity, operations & maintenance, and energy transmission) and for aquaculture (biological, structural and operational suitability across selected species). These datasets enable like-for-like comparisons across the EEZ, support scenario testing and allow alignment with precautionary and preventive principles in marine spatial

planning—namely, reducing pressures on fragile ecosystem components and avoiding cumulative overloading.

The resulting suitability maps should therefore be interpreted as evidence layers that:

(i) reveal opportunity areas consistent with environmental and operational requirements;

(ii) help prioritise further site-specific studies (e.g., local calibration, in situ validation, environmental assessment); and

(iii) facilitate cross-border coherence by applying a common, Copernicus-based methodology on both sides of the Gulf of Lion. In practice, this strengthens the integration of Earth observation into MSP workflows and supports MSFD objectives by steering development towards locations with higher environmental compatibility and lower operational risk, without predetermining where activities may or may not occur.

2.5. Transnational meeting -Task 5

As part of Task 5, the Spanish team actively participated in the Final Transnational Meeting of the FPCUP actions dedicated to maritime sectors, organised online on 29 September 2025, from 10:00 to 13:30 (CET), with the support of PT Space and moderated by AIR Centre and PMBA. The event brought together coordinators of the three related actions (A47, A33 and A42) to present their main results, alongside a session on CMEMS future opportunities.

The meeting was structured in two main parts. Part 1 consisted of an overview of each action: A47 (Coastal Users, ISPRA), A33 (EU Directives, IHCantabria), and A42 (Maritime Sectors: Ports, Aquaculture and Fisheries, PT Space), followed by a presentation on the forthcoming opportunities of CMEMS. This session allowed participants to share key findings, compare approaches, and situate Action 33 within the broader European context.

Part 2 focused on use-case presentations that illustrated concrete applications of Copernicus data. These included: the IH-MSP platform (Spain), optimisation of aquaculture sites for seaweed and shellfish in European seas (France), maritime use-cases in Cyprus, and Next Ocean services for sustainable fishing and aquaculture (Portugal). These examples highlighted the versatility of Copernicus in supporting MSP, aquaculture, fisheries, and environmental protection.

The event concluded with a final round table, moderated by PT Space, which brought together experts, service providers and end-users to discuss the main current limitations in the uptake of Copernicus data for maritime applications,

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as well as ways forward to improve usability and integration. The discussion emphasised the importance of addressing gaps in spatial resolution, enhancing user training, and reinforcing cooperation between institutions and service providers.

Through its contribution to this meeting, Action 33 benefited from the exchange of experiences at transnational level, reinforcing the alignment of Spanish needs and lessons learnt with those of other Member States, and supporting the formulation of common recommendations for the improved integration of Copernicus data into the implementation of EU Marine Directives.

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Annex I: Survey questions

Survey on the use of Copernicus data for the Marine sector

The marine sector faces several challenges regarding management and sustainability. It is becoming evident that the challenges linked to marine data and information availability will become even more important during the implementation of certain policies and strategies. Users from different marine sectors can use Copernicus data to extract information to determine the environmental status of coastal waters, to support sustainable development or growth in certain maritime areas and activities.

Under this context, the Framework Partnership Agreement on Copernicus User Uptake (FPCUP) aims at a better integration of Copernicus data in the European regulatory framework by increasing the number of users and applications derived from Copernicus through 3 different actions:

- Action A2021-2-33 pursues "to promote the use of Copernicus data in the implementation of the EU Marine Spatial Planning Directive (Directive 2014/89/EU; MSP) and EU Marine Strategy Framework Directive (Directive 2008/56/EC; MSFD),
- Action A2021-2-42 pursues "to promote the use of Copernicus data across the maritime sector, focusing on Ports and Harbours, Aquaculture and Fisheries",
- Action A2021-2-47 pursues "to define the roadmap to guide the future evolution of Copernicus products to fulfil the needs of users in coastal areas".

The aim of this survey is to identify the current needs and gaps of the stakeholders to better understand the current usage of Copernicus data across different sectors:

- implementation of the two Directives (Action 33),
- marine sector, focusing on Ports and Harbours, Aquaculture and Fisheries (Action 42),
- national coastal users (Action 47).

By participating in this survey, you will have the opportunity to join future Copernicus training events that will be organised in the scope of the FPCUP project.

For this survey, please consider the following definitions and policies:

"[Copernicus](#) program" is the Earth Observation program of the European Union.

"Copernicus satellite data" are the data from Sentinel satellite missions (Sentinel 1, 2, 3, 5P and 6), as well as data from satellite missions of other space agencies and commercial providers, called Contributing Missions.

"Copernicus service products" are the products provided by the 6 Copernicus Services (Land, Marine, Atmosphere, Climate Change, Emergency, Security), that use satellite and in situ data as inputs.

"[EU Marine Strategy Framework Directive](#) (Directive 2008/56/EC)". This Directive establishes a framework within which Member States shall take the necessary measures to achieve or maintain good environmental status in the marine environment.

"[Commission Decision \(EU\) 2017/848](#)" laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment.

"[EU Marine Spatial Planning Directive](#) (Directive 2014/89/EU)". This Directive establishes a framework for maritime spatial planning aimed at promoting the sustainable growth of maritime economies, the sustainable development of marine areas and the sustainable use of marine resources.

"[Water Framework Directive](#) (Directive 2000/60/EC)". This Directive requires EU Member States to achieve good status in all bodies of surface water and groundwater by 2027.

"[Habitats Directive](#) (Directive 92/43/EEC)". This Directive ensures the conservation of a wide range of rare, threatened or endemic animal and plant species.

Survey

(in bold below was for internal reading)

1. General information
 - a. Entity
 - b. Department
 - c. Contact name:
 - d. Email:
 - e. Job position:
 - f. City:
 - g. Country:
 - h. Type of Entity
 - i. Academia
 - ii. Research
 - iii. Public administration
 - iv. Another public entity
 - v. Private sector
 - vi. Non-Governmental Organization (NGO)
 - vii. Other (please specify)
 - i. What is your area of activity? (**Multiple choices allowed**)
 - i. Inland
 - ii. Coastal
 - iii. Marine
 - j. In terms of Copernicus Data, do you consider yourself a:
 - i. End-user
 - ii. Service provider
2. Which of these marine sectors are you related with? (**Multiple choices allowed**)
 - a. Ports and harbours
 - b. Aquaculture (shell farming)
 - c. Aquaculture (fish farming)
 - d. Fisheries
 - e. Species conservation and protected areas
 - f. Maritime transport routes and traffic flows
 - g. Energy sector (hydrocarbons and renewable energies)
 - h. Coastal protection
 - i. Raw material extraction
 - j. Tourism and recreational activities
 - k. Other
3. (**If chosen "Ports and harbours" in Q2**) For the "Ports and harbours" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest) (**bold means it is a common option between marine sectors**)
 - a. **Maritime climate (e.g., for Operational and maintenance activities)**
 - b. **Ship detection (e.g., monitoring vessel activity)**
 - c. **Pollution and environmental monitoring (e.g., oil spills, water quality, air quality)**
 - d. **Effects of climate change (e.g., sea-level rise, extreme events)**
 - e. Infrastructure monitoring (e.g., containers, piers)
 - f. Navigation and dredging operations (e.g., bathymetric mapping, sediment dynamics)
 - g. Others (specify)
4. (**If chosen "Aquaculture (shell farming)" in Q2**) For the "Aquaculture" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)
 - a. **Oceanographic data: waves, tides (e.g., for Operational and maintenance activities)**
 - b. **Ship detection (e.g., monitoring illegal activity)**

- c. **Pollution and environmental monitoring (e.g., oil spills, microbiological contamination, chemical contamination, biotoxins)**
 - d. **Effects of climate change (e.g., extreme events, marine heatwaves)**
 - e. **Marine water quality data (e.g., anoxic events, acidification, chlorophyll concentration, jellyfish presence)**
 - f. Infrastructure monitoring (e.g., cages)
 - g. Selection of suitable site locations and species (e.g., temperature, salinity, etc)
 - h. Others (specify)
5. **(If chosen "Aquaculture (fish farming)" in Q2)** For the "Aquaculture" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)
- a. **Oceanographic data: waves, tides (e.g., for Operational and maintenance activities)**
 - b. **Marine water quality data: anoxic events, acidification, chlorophyll concentration, jellyfish presence**
 - c. **Ship detection (e.g., monitoring illegal activity)**
 - d. **Pollution and environmental monitoring (e.g., oil spills, microbiological contamination, chemical contamination, biotoxins)**
 - e. **Effects of climate change (e.g., extreme events, marine heatwaves)**
 - f. Infrastructure monitoring (e.g., cages)
 - g. Selection of suitable site locations and species (e.g., water temperature, salinity, etc)
 - h. Others (specify)
6. **(If chosen "Fisheries" in Q2)** For the "Fisheries" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)
- a. **Maritime climate (e.g., for Operational and maintenance activities)**
 - b. **Ship detection (e.g., monitoring illegal activity)**
 - c. **Pollution and environmental monitoring (e.g., oil spills, water quality)**
 - d. **Effects of climate change (e.g., extreme events, marine heatwaves)**
 - e. Fishing area characterizations (e.g., areas of higher productivity)
 - f. Fisheries certification
 - g. Map of sea use (e.g., presence of conflicting human activities)
 - h. Others (specify)
7. **(If chosen "Species conservation and protected areas" in Q2)** For the "Species conservation and protected areas" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)
- a. **Pressures (e.g., pollution, spills, maritime activities...etc.)**
 - b. **Environmental monitoring (e.g., water quality, ecological status)**
 - c. **Effects of climate change (e.g., sea-level rise, extreme events)**
 - d. Habitat distribution area and trends
 - e. Species distribution area and trends
 - f. Map of sea use (e.g., presence of conflicting human activities)
 - g. Others (specify)
8. **(If chosen "Maritime transport routes and traffic flows" in Q2)** For the "Maritime transport routes and traffic flows" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)
- a. **Maritime climate (e.g., for Operational and maintenance activities)**
 - b. **Ship detection (e.g., monitoring vessel activity and flows)**
 - c. **Pollution and environmental monitoring (e.g., oil spills, water quality)**
 - d. **Effects of climate change (e.g., new routes, extreme events)**
 - e. Weather services
 - f. Navigation (e.g., Bathymetry, Sediment dynamics monitoring, etc.)
 - g. Others (specify)

9. **(If chosen "Energy sector" in Q2)** For the "Energy sector" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)
- a. **Maritime climate (e.g., for Operational and maintenance activities)**
 - b. **Ship detection (e.g., monitoring vessel activity)**
 - c. **Environmental monitoring (e.g., oil spills, water quality)**
 - d. **Effects of climate change (e.g., sea-level rise, extreme events)**
 - e. Selection of suitable renewable energy locations (wind, waves, currents)
 - f. Bottom geologic maps
 - g. Energy production surveying
 - h. Map of sea use (e.g., presence of conflicting human activities)
 - i. Others (specify)
10. **(If chosen "Coastal protection" in Q2)** For the "Coastal protection" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)
- a. **Maritime climate (e.g., winds, waves and current forecasts)**
 - b. **Pollution and environmental monitoring (e.g., eutrophication, water quality)**
 - c. **Effects of climate change (e.g., sea-level rise, extreme events)**
 - d. Monitoring and prevention of coastal erosion
 - e. Bathymetry and sedimentation
 - f. Coastline detection
 - g. Characterisation of emerged coastal areas (e.g., sediment dimension, inland extension of the beach, presence of dunes)
 - h. Others (specify)
11. **(If chosen "Raw material extraction" in Q2)** For the "Raw material extraction" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)
- a. **Maritime climate (e.g., for Operational and maintenance activities)**
 - b. **Ship detection (e.g., monitoring vessel activity)**
 - c. **Pollution and environmental monitoring (e.g., oil spills, water quality)**
 - d. **Effects of climate change (e.g., sea-level rise, extreme events)**
 - e. Map of sea use (e.g., presence of conflicting human activities)
 - f. Others (specify)
12. **(If chosen "Tourism and recreational activities" in Q2)** For the "Tourism and recreational activities" sector, which services are of higher interest to you? (Rank by order of interest, with 1 being the highest interest)
- a. **Maritime climate (e.g., for weather)**
 - b. **Effects of climate change (e.g., sea-level rise, extreme events)**
 - c. Water quality (e.g., preserving human health in bathing waters)
 - d. Identification of pressures (e.g., land use, presence of urban wastewaters or industrial waters discharges)
 - e. Landscape quality (e.g., absence of infrastructures, presence of nature-based solutions)
 - f. Others (specify)
13. **(If chosen "Other" in Q2)** For "Other" sectors, select one of the lists below and describe which services are of higher interest to you.
- a. Military
 - b. Exploration, exploitation, and extraction
 - c. Scientific research
 - d. Underwater cultural heritage
 - e. Submarine cable and pipeline routes

Concerning the sectors mentioned above, we will analyse the challenges you have encountered when searching/working for data related with them.

14. Within the framework of your current activities, what problems do you encounter when working with the data available to you? **(Multiple choices allowed)**
- a. Complexity of the data

- b. Data format
 - c. Data reliability
 - d. Heterogeneous data collection methodologies
 - e. Heterogeneous sources
 - f. Inaccessible data or unavailability of data
 - g. Incomplete Temporal distribution
 - h. Incomplete Spatial distribution
 - i. Unsuitable resolution
 - j. Lack of tools to manipulate the data.
 - k. Other, please specify.
15. Within the framework of your current activities, what temporal extent of the data would you need? **(Multiple choices allowed)**
- a. Real time or near real time (h)
 - b. Short term forecast (day-week)
 - c. Long term projections (month)
 - d. Long term historical data series (years)
16. Within the framework of your current activities, what spatial resolution of the data would you need? **(Multiple choices allowed)**
- a. Reduced (>1Km)
 - b. Low (>= 250 m-1Km)
 - c. Medium (5-30 m)
 - d. High (1-5 m)
 - e. Very high (< 1 m)
17. Have you participated in the implementation of these Directives in your Country? **(Multiple choices allowed)**
- a. EU Marine Strategy Framework Directive (Directive 2008/56/EC; MSFD)
 - b. EU Marine Spatial Planning Directive (Directive 2014/89/EU; MSP)
18. **(If yes in Q17.b)**
- a. In what period? **(Multiple choices allowed)**
 - i. 2012-2018
 - ii. 2018-2024
 - b. In what phase of MSP? **(Multiple choices allowed)**
 - i. Establishment of management objectives
 - ii. Diagnosis of the current situation
 - iii. Land-sea interactions
 - iv. Maritime spatial plans
19. In what period? **(Multiple choices allowed)**
- a. 2012-2018
 - b. 2018-2024
20. In what phase of MSFD? **(Multiple choices allowed)**
- a. initial assessment
 - b. determination of good environmental status
 - c. establishment of environmental targets and associated indicators
 - d. monitoring programme
 - e. programme of measures
21. What Marine Region do you belong to?
- a. Baltic Sea
 - b. North-east Atlantic Ocean
 - c. Mediterranean Sea
 - d. Black Sea
22. What subdivisions (if exist) of the Marine region do you belong to? **(Each country please specify yours)**

- a. North-Atlantic
- b. Sud-Atlantic
- c. ...
- d. ...
- e. ...

23. Following the classification in COMMISSION DECISION (EU) 2017/848, which of the following descriptors and Criteria elements are you related with? (**Multiple choices allowed**)

1. Biodiversity
 - Species groups (specify which):
 - birds,
 - mammals,
 - reptiles,
 - fish
 - cephalopods
 - Pelagic habitats (specify which)
 - Benthic habitats (specify which)
 - Ecosystems, including food webs (specify which)
2. non-indigenous species
3. Commercial fish species
4. Food webs
 - Ecosystems, including food webs (specify which)
5. Eutrophication
6. Sea floor
 - Benthic habitats (specify which)
7. Hydrographical conditions
8. Contaminants and effects
9. Contaminants in seafood
10. Marine litter
11. Introduction of energy (including underwater noise)

Concerning the descriptors/criteria mentioned above, we will analyse the challenges you have encountered when searching/working for data related with them.

24. What are the main knowledge gaps descriptors you encountered when working with the descriptor/criteria specified above? (**Multiple choices allowed**)

- a. Abundance
- b. Biomass
- c. Concentration
- d. Duration
- e. Genetics
- f. Pressures and impacts
- g. Spatial cover/ extent
- h. Spatial distribution
- i. Temporal distribution
- j. Other, please specify.

25. Within the framework of your current activities, what problems do you encounter when working with the data available to you? (**Multiple choices allowed**)

- a. Complexity of the data
- b. Data format
- c. Data reliability
- d. Heterogeneous data collection methodologies
- e. Heterogeneous sources
- f. Inaccessible data or unavailability of data
- g. Incomplete Temporal distribution
- h. Incomplete Spatial distribution
- i. Unsuitable resolution

- j. Lack of tools to manipulate the data.
 - k. Other, please specify.
26. Within the framework of your current activities, what temporal extent of the data would you need?
(Multiple choices allowed)
- a. Real time or near real time (h)
 - b. Short term forecast (day-week)
 - c. Long term projections (month)
 - d. Long term historical data series (years)
27. Within the framework of your current activities, what spatial resolution of the data would you need?
(Multiple choices allowed)
- a. Reduced (>1 Km)
 - b. Low (>= 250 m - 1 Km)
 - c. Medium (5-30 m)
 - d. High (1-5 m)
 - e. Very high (< 1 m)
28. Have you ever heard before about the Copernicus program?
- a. Yes
 - b. No
29. **(If yes in Q28)** Are you familiar with the different definitions of “Copernicus Satellite Data” and “Copernicus Service Products”.
- a. Yes
 - b. No
- 30. (If yes in Q28 go to a; If no in Q28 go to b)** Do you use data from Copernicus?
- a. If Yes
 - i. How often?
 - 1. every week
 - 2. every month
 - 3. every year
 - ii. For what purpose (i.e., use case)? (Please specify)
 - iii. What kind of Copernicus data do you use?
 - 1. In situ data
 - 2. Satellite-derived products
 - 3. Modelled-derived products.
 - iv. Do you consider yourself as a basic, intermediate, or advanced Copernicus data user?
 - 1. Basic
 - 2. Intermediate
 - 3. Advance
 - v. What is your level of satisfaction with Copernicus? (Set from 1(low) to 5 (very high))
 - 1. 1
 - 2. 2
 - 3. 3
 - 4. 4
 - 5. 5
 - vi. How can Copernicus data be improved (e.g., new products, different spatial/temporal resolutions, improved access)? (Please specify)
 - b. If No, why?
 - i. I do not have enough knowledge or skills to use them.
 - ii. I do not have enough staff or time to do it.
 - iii. Not relevant for me
 - iv. Other

31. Within the framework of your current activities, do you use most: (**multiple choices allowed**)
- a. Programming languages (C++, Python, Java, MATLAB, etc)
 - b. Mapping software (ArcGIS, MapInfo, Qis, etc)
 - c. Image processing software (SNAP, Google Earth Engine, etc)
 - d. Visualisation software (EO browser, etc)
 - e. I do not use any.
32. Besides Copernicus data, what kind of data or services would you need? (Please specify)
33. From your entity's perspective, which space solutions (e.g., products, providers) are relevant to the maritime domain, that you are familiar with/have you heard of? (Please specify)
34. Would you be interested to attend a workshop presenting the different tools and services offered by Copernicus?
- a. Yes
 - b. No

Annex II: Stakeholders for Spain survey

ACCISA
AEE
Asociación Vertidos Cero
Autoridad Portuaria de Vigo
AZTI (4 replies)
CIMA (Gobierno de Cantabria)
Ciudad de Ceuta/Consejería de Medio Ambiente
Federación de Cofradías de Pescadores de Cantabria
Fundación Biodiversidad
Gobierno de Cantabria
Gobierno de Navarra
IHCantabria
IHCantabria
Instituto Andaluz de Investigación y Formación Agraria y Pesquera
Instituto Español de Oceanografía - Centro Oceanográfico de Baleares (2 replies)
Instituto Español de Oceanografía - Centro Oceanográfico de Canarias (3 replies)
Instituto Español de Oceanografía - Centro Oceanográfico de Vigo
Ministerio de Agricultura, Pesca y Alimentación
Ministerio para la Transición Ecológica y el Reto Demográfico (5 replies)
NATURGY RENOVBLES
PLOCAN
Principado de Asturias (2 replies)
Red Eléctrica España
RESERVA MUNDIAL DE LA BIOSFERA LA PALMA (2 replies)
SALVAMENTO MARÍTIMO/SASEMAR
Universidad de Barcelona
Universidad de Cádiz (4 replies)
Universidad de Cantabria
Universidad de La Laguna
Universidad de Las Palmas de Gran Canaria
Universidad de Málaga (6 replies)
Universidad de Oviedo (3 replies)
Universidad de Sevilla (2 replies)
Universidad de Vigo

Annex III: Open-ended questions summary replies

Purposes for using Copernicus data (Q.30ii)

- Study and analysis of coastal processes, dynamics, and coastal risk assessment.
- Studying physical processes, historical series, and time series of environmental variables.
- Species distribution mapping and modelling.
- Use of environmental variables and oceanographic variables for species distribution modelling.
- Coastal management, marine protected areas, and fisheries research.
- Monitoring and identifying anthropogenic activities and sudden changes in the territory.
- Updating time series and spatio-temporal analysis of ocean variables.
- Early warning system for sudden changes and mass macroalgal blooms.
- Supporting and complementing other observations or model results.
- Production of suitability maps, conflict maps, and species distribution mapping.
- Management of marine protected areas and marine species.
- Spatio-temporal analysis of ocean variables.
- Supporting and complementing other observations and model results.

Suggestions for Copernicus improvement (Q.30vi)

- Better access to data: There is a focus on improving the accessibility and ease of extracting data, as well as the accessibility of downloading large amounts of data. This includes improving the cataloguing and ease of access to historical data.
- Improved resolution: There is a desire for better spatial and spectral resolution in various aspects, including coastal processes, global products, estuarine areas, and areas of particular oceanographic interest. This applies to both images and numerical models.
- Information and documentation: There is a need for more information on the available data, including how it has been obtained, the units used, and the purpose of the data.
- Enhancing spatial and temporal resolutions: There is a call for improvements in both spatial and temporal resolutions for better data analysis and understanding of coastal processes and climate change impacts.
- Integration and collaboration: There is a mention of linking different platforms and databases, such as Copernicus and EmodNet, to enhance the availability and usability of data.
- User-friendly interfaces: There is a need for the development of more user-friendly interfaces to facilitate data access and utilization.

In summary, Spanish stakeholders' suggestions focus on improving access to various types of data and increasing the resolution of the available data. There is a strong emphasis in the development of user-friendly interfaces, making it easier to extract and download data, as well as providing more information about the data, such as its source and units of measurement. Specific suggestions include improving the accessibility and

downloading of data, increasing the spatial and spectral resolution of images, and enhancing the availability and quality of historical data. Suggestions also include the integration and collaboration between different data platforms, such as Copernicus and EmodNet, to enhance the availability and usability of data.

Data needs besides Copernicus data (Q.32)

- Open-access databases: need of availability and access to marine-related data being developed by MITERD, as well as the importance of data in situ, such as EMODNET.
- Data needs for specific purposes: need for data on aquaculture facilities, bathymetry, stock status of commercial and recreational species, catch reporting, bathymetry, orthophotographs, LIDAR mapping, distribution and conservation of marine habitats and species, beach monitoring, and port water quality data, detailed coastal mapping, updated wind data, accurate fishing activity data, species distribution data, statistical and economic data, climate services, and maritime traffic data.
- Data management and tools: need for tools to manage Copernicus data, a file manager for bulk downloading, and an improved interface for easier downloading.
- Real-time data and monitoring: need for real-time data to monitor factors like maritime traffic, recreational activities, and compliance with management regulations. It also emphasizes the importance of monitoring beach evolution and port water quality.
- Data validation and verification: In-situ species distribution data is mentioned as a requirement for validation. It also states the importance of using quality in-situ data for calibration in Copernicus products.
- Technologies and methodologies: References are made to multispectral or hyperspectral drones, satellite imagery, altimetry data, and ECDIS (Electronic Chart Display and Information System).

In summary, Spanish stakeholders highlighted the need for various aspects of data management and tools in the context of marine-related information. This includes the development of open-access databases, the importance of data standardization and sharing, specific data needs such as stock status and bathymetry, real-time data for monitoring, data validation, and verification requirements, and specific data requirements for climate services, maritime traffic, and coastal mapping. Additionally, the need for tools to manage and facilitate data access is mentioned.

Space solutions relevant to the maritime domain (Q.33)

- Data processing tools and technologies: Several references are made to tools and technologies such as ESRI, Google Earth, QGIS, Matlab, ArcGIS, and numerical software for current analysis. These tools facilitate data processing and analysis for various purposes.
- Satellite imagery and remote sensing: use of very high-resolution visible images, SWOT data, and multispectral or hyperspectral data for coastal mapping and studying marine biodiversity distribution.

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- Monitoring and tracking marine species and habitats: The INTEMARES project involves working with scientific partners to develop and test technologies for monitoring and tracking marine species and habitats. This emphasizes the importance of investing in research and development in the marine field.
- Real-time data and visualization: There is a mention of the need for tools that process data and facilitate real-time visualization of pollutants, spills, plastics, air and water quality. High-resolution visible images and satellite imagery are also highlighted.
- Data integration and unified databases: The need for unified databases with access to integrated MPA (Marine Protected Area) delimitation and marine environmental information is expressed. The INFOMAR tool, collaboration between MITECO and CEDEX, is mentioned as a useful tool for integrating marine environment information from different sources.
- Climate change and adaptation: Climate importance of climate projections and climate change services for coastal adaptation measures. They also emphasize the need for case studies and services to understand coastal dynamics and variability.
- Mapping and cartography: References are made to marine cartography, eco-cartography, cartography viewers, Iberpix, and Google Earth. Up-to-date and accurate mapping is seen as crucial for planning and protection purposes.
- Data sources and platforms: Various data sources and platforms are mentioned, including CMEMS (Copernicus Marine Environment Monitoring Service), Sentinel, Argo, GLORYS, MarineTraffic, Global Fishing Watch, Sentinel-hub.com, and AIS (Automatic Identification System) data. These sources provide important data for marine studies and monitoring.

In summary, Spanish stakeholders highlighted the importance of data visualization and processing tools, satellite imagery, monitoring and tracking technologies, data integration and access, climate change services, and the use of software and platforms in the marine environment. These technologies and tools are crucial for studying marine ecosystems, monitoring environmental parameters, managing marine resources, and adapting to climate change impacts.