



EcoScope

Ecocentric management for sustainable fisheries  
and healthy marine ecosystems

## Project Deliverable Report

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## 1 Executive Summary

EcoScope aims to develop a series of e-tools that can be easily used by stakeholders as a decision support system to implement an ecosystem-based fisheries management (EBFM). A survey was conducted as a first step to gauge the specific requirements of key stakeholders for the EcoScope tools. The aim of the survey was to understand the main needs, challenges and barriers of stakeholders that will be using the EcoScope tools and/or their outputs in order to better plan the development of these tools. The survey was sent to 33 stakeholders from 21 different organisations representing key European stakeholders in fisheries management, of which 18 individuals provided responses. The responses indicated that the main challenges stakeholders face in relation to implementing EBFM are knowledge and data gaps, followed by general policy/management issues and stakeholder communication problems, as well as fundamental questions on the EBFM concept. The top EBFM related priorities for the respondents were effects of climate change, bycatch, protected areas/ fisheries restricted areas and biodiversity indicators. Climate change was also seen as one of the main future challenges in implementing EBFM. Assessing the impacts of specific management scenarios was a central need of the respondents and the survey identified a list of concrete questions/ scenarios for which respondents need answers. This list will inform the scenario testing modules of the EcoScope tools. Although the stakeholders were overall positive about the potential of using ecosystem models for management and to help meet EU policy requirements, they were concerned about data gaps and model limitations and thus about the reliability and realism of the model's forecasts. The EcoScope project is overall well placed to address many of the key concerns and needs that were reported in this survey. However, it is essential to create trust in the models that will be developed as part of EcoScope for forecast and scenario testing, including communicating limitations and uncertainties. The insights obtained from this survey are highly valuable for the development of the EcoScope e-tools and the project will continue to engage with stakeholders to ensure the final tools are fit for purpose and that they address key stakeholder needs.

## 2 Introduction

EcoScope aims to develop an efficient and holistic approach to ecosystem-based fisheries management (EBFM) that can be easily used by policy makers and advisory bodies. This will be achieved through an interoperable platform, a robust decision-making toolbox and ecosystem models. The **EcoScope Platform** will organize and homogenise climatic, oceanographic, biogeochemical, biological and fisheries datasets for European Seas to a common standard and format that will be available through interactive mapping layers. The **EcoScope Toolbox**, a sustainability scoring system based on assessments of all ecosystem components, ecosystem- and economic models, will operate as a decision-support tool for examining fisheries management and marine policy scenarios and spatial planning simulations. **Ecosystem models** will be created for eight case study areas (North Sea, Baltic Sea, Bay of Biscay, Balearic Sea, Adriatic Sea, Aegean Sea, Baltic Sea, Black Sea and Levantine Sea) and will form the basis for testing and evaluating various management and policy scenarios. They will allow users to explore the impact of very concrete management options, such as for example the effects of adding a new Seasonally Closed Area in the Adriatic Sea on fish stocks, the wider marine ecosystem and fisher's profitability. Moreover, a new edition of the **Maritime Spatial Planning (MSP) Challenge Simulation Platform**<sup>1</sup> will be created to cover the eastern Mediterranean Sea, which will include a fisheries module to visualise the effects of different fisheries management scenarios. The fisheries edition will then be applied to existing MSP Challenge simulation platform editions, covering five out of the eight case studies (Baltic Sea, North Sea, Adriatic Sea, Aegean and Levantine Seas) by the end of the project. In order to make these tools and their outputs fit for purpose, EcoScope strives to co-develop them with end-users and stakeholders by involving them in the design and development of the tools (scoring system, models and platforms).

EcoScope's stakeholder are persons or institutions with an interest or stake in the project's outputs. This may be end-users (i.e. a person or group using the EcoScope tools or their outputs), or persons or groups who are affected by decisions, which were informed by the EcoScope tools. The target stakeholders of interest for EcoScope can be classified into: (1) policy/ regulatory (e.g. European Commission officials, Regional Fisheries Management Organisations, government bodies; and fisheries/ ecosystem managers); (2) advisory/ scientific (e.g. fisheries advisory bodies, scientific associations; and ocean data aggregators); and (3) others, including the fishing sector, environmental NGOs, representatives of other related enterprises and the civil society.

As a first step to involve stakeholders and end-users in the design of the tools, a survey was conducted to gauge their specific requirements for the EcoScope tools (EcoScope Task 8.3.1).

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<sup>1</sup> MSP Challenge simulation platform: <https://www.mspchallenge.info/>

The aim of the survey was to understand the main needs, challenges and barriers of stakeholders that will be using the EcoScope tools and/or their outputs in order to better plan the development of these tools. The questionnaire covered ecosystem-based fisheries management, ecosystem modelling and policy needs. It was sent to a selected group of key stakeholders that were also invited to the first EcoScope workshop (Foresight workshop 1: Policy Maker and Stakeholder requirements workshop; Task 8.2.2). This deliverable analyses and synthesises the responses of the stakeholders to this survey, highlighting key needs and concerns that emerged from their responses, and highlighting issues that need to be considered in the development of the EcoScope tools.

### 3 Methods

The survey consisted of 17 questions, which were predominantly qualitative in nature. They were divided into the following sections: (1) context, (2) ecosystem-based fisheries management (EBFM) needs, (3) ecosystem modelling, (4) ecosystem modelling and EU policy, (5) ecosystem modelling needs, and (6) other comments (see Annex 1 for a copy of the full questionnaire). The survey was conducted online via Google Forms<sup>2</sup> and sent to 33 individuals from 21 different organisations. The organisations to which the survey was sent included 10 units from the European Commission relevant for fisheries management, 2 Regional Fisheries Management Organisations, 8 fisheries advisory bodies, 4 NGOs and 2 fisheries representatives. The individuals and organisations to which the survey was sent represented the same subset of stakeholders that were invited to the first EcoScope workshop. Stakeholders were selected based on their relevance for EBFM at European level, and the total number was restricted to ca. 30 individuals to facilitate interaction during the workshop. The questionnaire was sent to all stakeholders ahead of the workshop, and the survey results were also used as input into the workshop. All data were collected anonymously and stored in compliance with the General Data Protection Directive (95/46/EC). If any response included the participants organisation's name, the response was anonymised by removing the name. All open-ended responses were grouped by topics for analysis in order to find trends and common themes in the responses.

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<sup>2</sup> Google Forms: <https://www.google.com/forms/about/#overview>



## 4 Responses

### 4.1 Section 1: Respondents

Out of the 33 stakeholders to whom the survey was sent, 18 individuals responded to the questionnaire. A compilation of all answers (anonymised, in the event that a respondent included the organisation name) can be found in Annex 2. The respondents were approximately evenly distributed between policy/ regulatory (7 individuals; 38.9%), advisory/ scientific (6 individuals; 33.3%) and other stakeholders (5 individuals; 27.8%) (Fig. 1A). Approximately half of the respondents (10 individuals; 55.6%) reported that they occasionally implement/ regulate/ advise on ecosystem-based fisheries management (EBFM), while the remaining respondents were evenly divided between working ‘never/ almost never’ (4 individuals; 22.2%) and ‘regularly/ very often’ on EBFM (4 individuals; 22.2%; Fig. 1B). Nearly half of the respondents (8 individuals; 44.4%) rated their capacity to implement/ regulate/ advise on EBFM as medium, while the remaining respondents were evenly divided between rating themselves as having a high level of expertise in EBFM and reporting to have a low level of EBFM expertise (5 individuals each, 27.8%; Fig. 1C). The Marine Strategy Framework Directive<sup>3</sup>, the Common Fisheries Policy<sup>4</sup>, the EU Green Deal<sup>5</sup> and the Biodiversity Strategy 2030<sup>6</sup> were the most relevant directives/ strategies informing the work of the respondents, followed by the Blue Economy Strategy<sup>7</sup>, the Habitats and Birds Directive<sup>8</sup> and the Marine Spatial Planning Directive<sup>9</sup> (Fig. 1D).

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<sup>3</sup> Marine Strategy Framework Directive (Directive 2008/56/EC):

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0056>

<sup>4</sup> Common Fisheries Policy (Regulation (EU) No 1380/2013):

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32013R1380>

<sup>5</sup> EU Green Deal (COM/2019/640):

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN>

<sup>6</sup> Biodiversity Strategy 2030 (COM/2020/380):

[https://ec.europa.eu/info/sites/default/files/communication-annex-eu-biodiversity-strategy-2030\\_en.pdf](https://ec.europa.eu/info/sites/default/files/communication-annex-eu-biodiversity-strategy-2030_en.pdf)

<sup>7</sup> Sustainable Blue Economy Strategy (COM/2021/240):

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2021:240:FIN>

<sup>8</sup> Habitats Directive on the conservation of natural habitats and of wild fauna and flora (Directive 92/43/EEC):

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31992L0043>

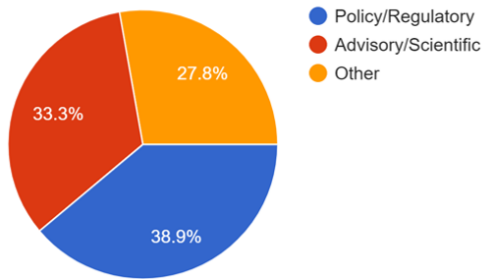
Birds Directive on the conservation of wild birds (Directive 2009/147/EC):

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32009L0147>

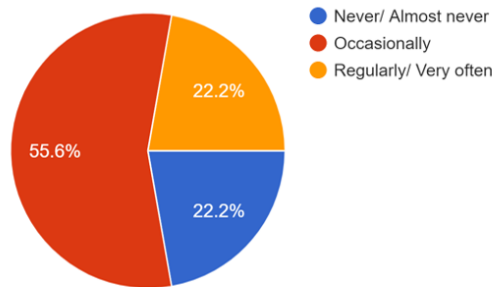
<sup>9</sup> Marine Spatial Planning Directive (Directive 2014/89/EU):

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0089>

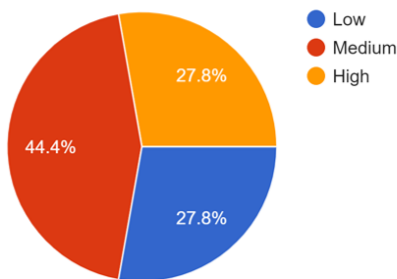
A: Which category does the organisation you work for belong to?



B: To what extent do you implement/ regulate/ advise on EBFM?



C: How would you rate your capacity/ expertise to implement/ regulate/ advise on EBFM?



D: Which of the following inform your work? Please check only the most relevant (up to 5)

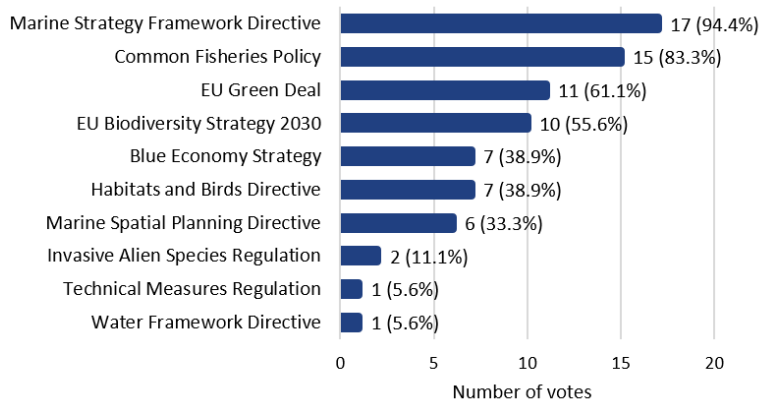


Figure 1: Responses to context questions: A) Which category does the organization you work for belong to? B) to what extent do you implement/ regulate/ advise on EBFM? C) How would you rate your capacity/ expertise to implement/ regulate/ advise on EBFM? D) Which of the following directives/ strategies inform your work?

## 4.2 Section 2: Ecosystem-based fisheries management (EBFM) needs

The respondents were asked to list the three **most significant challenges/ barriers** they face when implementing/ regulating/ advising on EBFM (Annex 2, question 5). The main issues that were mentioned were knowledge and data gaps, reliability of results and/ or models, a lack of clarity on the EBFM concept, issues with policy and regulatory frameworks and stakeholder communication issues. The topic that was most frequently mentioned was **knowledge and data gaps** (11 out of 48 responses). Here the respondents indicated that a lack of data/ information is one of the main impediments in implementing/ regulating/ advising on EBFM (Fig. 2). Related to this topic, reliability of results and model limitations were also perceived to be a problem, including

the limited reliability of models and results, and model uncertainty (4 out of 48 responses). One respondent also indicated that enhanced data sharing would be beneficial and would avoid duplicated data collection.

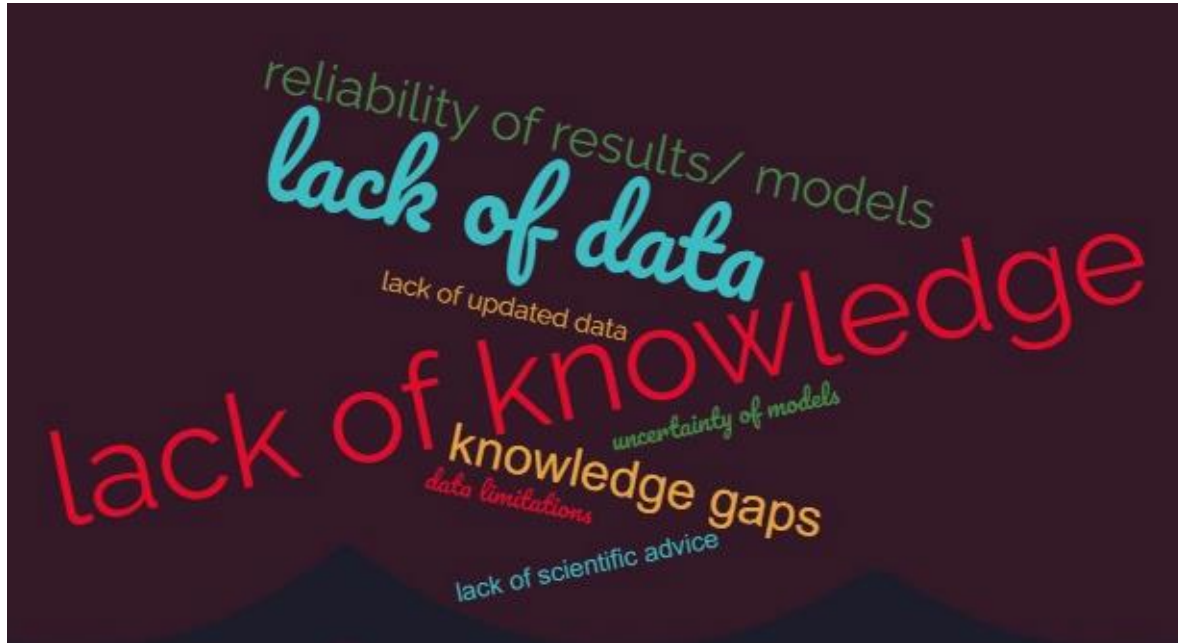


Figure 2: Word cloud showing the most frequently mentioned concern theme (knowledge gaps) in the respondent's answers when asked about the main challenges/ barriers they face when implementing EBFM.

A **lack of clarity of the EBFM concept** was also perceived to be a barrier (4 out of 48 responses), including no common understanding of what the concept means, no guidelines on what EBFM could look like, no agreed definition and therefore different interpretations, perceptions and expectations among the various stakeholders. **Policy and regulatory framework issues** were also mentioned as a problem (7 out of 48 responses), including poor policy frameworks for EBFM, insufficient inclusion of ecosystem aspects by decision makers in requests to scientists, insufficient enforcement of regulations, and the complexity of different regulatory mechanism in different countries. The last overarching topic that was mentioned as a barrier in implementing EBFM, was **stakeholder communication issues** (6 out of 47 responses), including insufficient communication and coordination, different mindsets and lack of a common vision.

Next, the stakeholders were asked about the three **main future challenges** they foresee when implementing/ regulating/ advising on EBFM (Annex 2, question 6). The most frequently mentioned theme was related to **stakeholder communication and engagement** (10 out of 52 responses). This theme included viewing other stakeholders responsible for insufficient

achievements in EBFM, and a call for more participatory approaches, given that the regulatory system of the ocean is fragmented, where different bodies regulate different sectors. **Data availability and data processing** (9 out of 52 responses) issues was the second most frequently mentioned theme, including lack of data, insufficient sharing of data, and the computational power needs to run and access long data time series. **Climate change** and accounting for its effects on the marine environment was another key challenge (5 out of 52 responses), as well as **policy and enforcement issues** (5 out of 52 responses). The latter included specific articles of the Common Fisheries Policy (article 11 and 17) that were seen to hinder the implementation of EBFM, a need for stronger enforcement and the need for regulations with stronger wording on EBFM. Other challenges that were mentioned, were to **generate sound and timely scientific advice**, given the complexity of marine ecosystems (3 out of 52 responses); the problem of **increasing competition for space** in the marine environment, leading to cumulative pressures (3 out of 52 responses); and **socio-economic constrains** (3 out of 52 responses), such as phasing out bottom trawling given the resistance of the industry, and the challenge of correctly including socioeconomic aspects in EBFM. Finally, **a lack of minimum standards and measurable goals** when implementing EBFM measures was also seen to be a barrier (2 out of 52 responses).

The last question within the ‘EBFM needs’ section of the survey (Annex 2, question 7) asked the stakeholders to list the three **most significant questions they would need answers** to in order to better implement/ regulate/ advise on EBFM. The respondents’ answers can be grouped into three response themes (see Table 1 for example responses). The first theme was centred around **specific questions on EBFM**, including “**what if**” **scenarios** and their impacts, **interactions between species, economic activities and regulations**, and **fundamental questions on EBFM**, such as the relationship between EBFM and MSY. The second theme was related to the **complexity of ecological systems**, the related **data needs and/or knowledge gaps**, and **how to quantify uncertainty**. Stakeholders voiced concern whether it is possible to describe such complex systems and whether we have the necessary tools to develop scientific advice related to EBFM. They also questioned whether we can quantify uncertainty properly and how to deal with uncertainty in a whole ecosystem scenario. The final theme was centred around **stakeholder-, cross-sectoral-, and regulatory issues** including how to develop synergies and collaborations between sectors to improve dialogue and outcomes, whether there is a need to improve the regulatory framework, and how to clearly communicate all EBFM aims and benefits to stakeholders to ensure that they are willing to implement EBFM.

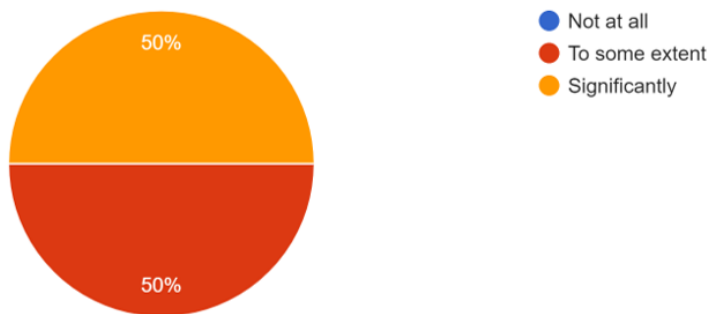
**Table 1: Example responses to the question: ‘In order to better implement/ regulate/ advise on EBFM what are the main questions you need answers to’.**

Grouping themes and subtopics	Responses
<b>Theme 1: Specific questions on EBFM</b>  - What if scenarios and their impacts - Interactions between species, economic activities and regulations - Fundamental questions on EBFM	What if scenarios, based on models integrating fisheries/environmental impact of fisheries/climate/fishing sector's response to regulations/recovery rate of habitats and ecosystem services
	What are the impacts on the wider ecosystem (impacts on other species, the integrity of ecosystems, ecosystem functioning etc.) of a certain management scenario
	The relationships between cause effect of various impacts (fishery pressure, pollution, climate change)
	Impacts of various fishing activities on the wider ecosystem
	What is the effect on medium and long-term profitability of fisheries depending on the chosen management scenarios
	Multispecies interactions
	How different factors and stressors interact and their relative importance
	How does EBM in fisheries interact with other sea uses?
	How to take into account the needs of marine predators in setting TACs/quotas for forage fish
	How to account for the likely effects of climate change on predator (marine megafauna) and prey distributions
	What is EBFM?
	What is MSY in the frame of EBFM?
	How to link EBFM with single stock assessment/ advice/ management?
<b>Theme 2: Complexity of ecological systems</b>	How do you describe properly the complexity of such ecosystems when in many cases just one species life traits are controversial?

<b>- How to quantify uncertainty</b> <b>- Data needs and knowledge gaps</b>	Do we have the necessary tools to develop scientific advice related to EBFM?
	Is it realistic to add management objectives related to EBFM?
	Uncertainty is fundamentally in fisheries management. Forecast (or applying MSE approach) on monospecific stock is already quite challenging. How deal with an ecosystem scenario?
	Can we quantify uncertainty properly?
	Can we forecast for environmental regimes outside historical range (e.g. warming seas)?
	Is the capacity for collecting sufficient reliable data, processing data and producing advice possible? If so, at which level?
	How you can collect data to describe properly such huge system and which would be the costs
	What are the main research gaps?
	Scientific data on pelagic systems, including food web dynamics and carrying capacity are needed.
	What is the spatial extension of each ecosystem? What "ecosystems" have to be managed? What do we want to protect and where?
<b>Theme 3: Stakeholder-, cross-sectoral-, and regulatory issues</b>	Can we implement EBFM without new/changes org structures?
	How do we develop synergies and collaboration between sectors to improve outcomes? Dialogue needs to be improved to understand how the different sectors can help each other
	How can the regulatory framework be improved to consider the different sectors and implement better spatial planning
	Are stakeholders willing to implement the EBFM?
	Can all the aims and benefits be clearly communicated with all stakeholders?
	How to manage conflicts?

### 4.3 Section 3: Ecosystem modelling

Survey participants were familiarised with the potential of using ecosystem models as a decision support tool through a short section (Annex 1, section “Ecosystem modelling”) illustrating the type of questions that ecosystem models can help answer, as well as through a short (5min) video<sup>10</sup> from the Israeli part of the Mediterranean. This video was chosen to illustrate how the EcoScope models will work and what type of questions they will be able to answer. Subsequently, the stakeholders were asked whether they think robust ecosystem modelling could help address the most significant questions they identified in the previous section. The respondent’s views were equally divided between that ecosystem modelling could help address these questions to ‘some extent’ and ‘significantly’. No participant indicated that ecosystem models could not help at all (Fig. 3).



*Figure 3: Survey responses to the question ‘to what extent do you think robust ecosystem modelling could address the most significant questions you identified in the previous question (Q7)?’*

Next, respondents were asked whether they foresee any **specific limitation or barrier in using the results of ecosystem models** to advice on or implement EBFM (Annex 2, question 9). The three main issues that were mentioned were **model accuracy** (5 out of 17 responses), **insufficient data** (5 out of 17 responses) and having enough **trust in the model outputs** (4 out of 17 responses). Respondents were concerned with the reliability and realism of the models and their forecasts, including the accuracy of the models due to limited understanding of some ecological processes and data scarcity. Insufficient data, data limitations and the quality on input data was a key concern expressed by a respondent as ‘models can only be as good as the

<sup>10</sup> Video: <https://www.youtube.com/watch?v=xCI3XTdH7HA>

underlying data'. Thus, trust in the models was seen as a key barrier and it was suggested to better understand and communicate the limitations and uncertainties of the models.

Respondents were then asked to provide examples of **specific situations in which they would use the results generated by ecosystem modelling** in the context of EBFM (Annex 2, question 10). The main topics that were mentioned included: marine spatial planning; identifying and implementing marine protected areas; setting spatial or temporal fishing restrictions; setting TAC quotas; assessing changes in selective properties of fishing gears and/or assessing the impact of a total ban of fishing methods; evaluating the impacts of climate change; and assessing ecosystem health. Other specific situations that were mentioned were to **assess specific management options, provide scientific advice** and for **advocacy**, for instance in the context of NGOs.

In the last question of this section respondents were asked **in which format would the results of the EcoScope tools be most useful** for them (Annex 2, question 11). The preferred formats included **visual spatial** formats, **interactive** maps and **infographics**. Furthermore, the respondents wanted an online **user-friendly, easy to use** and **easy to understand** tool with many **customisable** functionalities, including spatial representations, 'Gamifying' models were also suggested as a means to make the tools easier to use.

#### 4.4 Section 4: Ecosystem modelling and EU policy

The stakeholders were asked whether they think **ecosystem modelling can help meet existing EU policy requirement** (Annex 2, question 12). All respondents answered this question positively. The most frequently mentioned directives/ strategies that ecosystem modelling could support were the Marine Strategy Framework Directive (9 out of 18 responses), the Common Fisheries Policy (7 out of 18 responses) and the EU Biodiversity to 2030 (5 out of 18 responses). For the **Marine Strategy Framework Directive**, stakeholders stated that ecosystem modelling could help meet the requirements of descriptor 1 (biodiversity is maintained), descriptor 3 (the population of commercial fish species is healthy), descriptor 4 (elements of food webs ensure long-term abundance and reproduction), descriptor 6 (the sea floor integrity ensures functioning of the ecosystem) (see Fig. 4), as well as in assessing progress towards Good Environmental Status and the threshold between good and moderate environmental status. For the **Common Fisheries Policy**, stakeholders noted that ecosystem modelling could help with the requirements of conducting an ecosystem-based approach to fisheries management (Article 2.3), fishing at Maximum Sustainable Yield (Article 2.2) and establishing fish stock recovery areas (Article 8). For the **EU Biodiversity Strategy 2030**, the protected areas targets (30% protection and 10% strict protection) were highlighted. Other directives and strategies that were mentioned were the **Birds and Habitats Directive** (2 out of 18 responses), specifically the objectives related to environmental and species protection, the **Marine Spatial Planning Directive** (1 out of 18



responses) and the **Blue Economy Strategy** (1 out of 18 responses). In addition, it was noted that ecosystem modelling could help implement the following regulations: **Technical Measures Regulation**<sup>11</sup> (1 out of 18 responses) by helping to evaluate different gear solutions and management options; the **Mediterranean Regulation**<sup>12</sup> (1 out of 18 responses) concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea and associated derogations for fishing over protected (seagrass) habitats<sup>13</sup>; and the **Multiannual Management Plans** for fisheries<sup>14</sup> (1 out of 18 responses). For the latter it was specifically referred to the objectives of using an ecosystem-based approach to fisheries management (Article 3.3 in each plan) and the Articles on Technical measures, which empower the Commission to adopt technical measures to improve the selectivity of fishing gears, limit/prohibit certain fishing activity to protect spawning fish and fish below a minimum size (Reg. 2016/1139, articles 7.1, 8.1; Reg. 2018/973 article 9.1; Reg. 2019/472, article 9.1; and Reg. 2019/1022, article 13.1).

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<sup>11</sup> Technical measures regulation (Regulation (EU) 2019/1241):

<https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32019R1241&from=EN#d1e1358-105-1>

<sup>12</sup> Mediterranean regulation (Council Regulation (EC) No 1967/2006):

<https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A32006R1967>

<sup>13</sup> Derogation of Council Regulation (EC) No 1967/2006 as regards the prohibition to fish above protected habitats:

<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R0141&from=EN>

<sup>14</sup> Multiannual management plans for fisheries:

- Multiannual plan for the stocks of cod, herring and sprat in the Baltic Sea (Regulation (EU) 2016/1139): <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32016R1139>
- Multiannual plan for demersal stocks in the North Sea (Regulation (EU) 2018/973): <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32018R0973>
- Multiannual plan for stocks fished in the Western Waters (Regulation (EU) 2019/472): <https://eur-lex.europa.eu/eli/reg/2019/472/oj>
- Multiannual plan for the fisheries exploiting demersal stocks in the western Mediterranean Sea (Regulation (EU) 2019/1022): <https://eur-lex.europa.eu/eli/reg/2019/1022/oj>



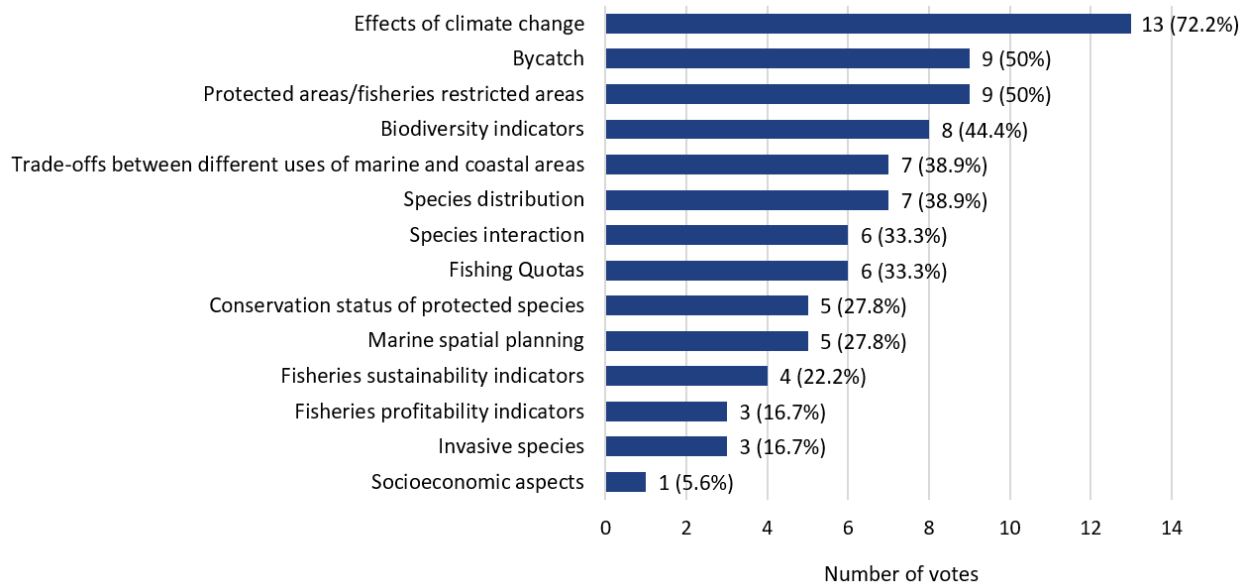
Figure 4: Good Environmental Status (GES) descriptors of the Marine Strategy Framework Directive. Respondents indicated that ecosystem modelling could help achieve GES requirements for descriptors 1, 3, 4 and 6. Image source: [https://www.msfd.eu/rages/D6\\_4.pdf](https://www.msfd.eu/rages/D6_4.pdf)

The stakeholders were then asked if they think **ecosystem modelling can help meet any planned policy requirements**, such as upcoming action plans, new directives, etc (Annex 2, question 13). All respondents unanimously agreed that ecosystem modelling could help meet upcoming commitments. The most frequently cited specific commitments where the upcoming **Nature Restoration Law** (5 out of 16 responses) and **Action Plan for Fisheries and the Marine Environment** (3 out of 16 responses), both of which are commitments under the Biodiversity Strategy 2030 (COM/2020/380). Other upcoming commitments that were mentioned as being able to benefit from ecosystem modelling outputs were the **revision of the Marine Strategy Framework Directive** and its associated Good Environmental Status (by 15 July 2023; 1 out of 16 responses), as well as **future reports on the functioning of the Common Fisheries Policy** (1 out of 16 responses) and on the **Technical Measures Regulation** (1 out of 16 responses).

#### 4.5 Section 5: Ecosystem modelling needs

In this section, stakeholders were asked to **select from a list the five most relevant topics** for them (Annex 2, question 14). The pre-set topics reflected areas that can potentially be addressed with the EcoScope tools and included: fishing quotas; protected areas/fisheries restricted areas; bycatch; invasive species; marine spatial planning; effects of climate change; species distribution; conservation status of protected species; fisheries sustainability indicators; biodiversity indicators; fisheries' profitability indicators; species interactions, and trade-offs between different uses of marine and coastal areas. In addition, respondents were given the option to add additional topics

to the list. **Effects of climate change** was the most frequently voted topic (72% of the votes, Fig. 5). The second most frequently voted topics were **bycatch** and **protected areas/fisheries restricted areas**, (50% of the votes each). **Biodiversity indicators** was the fourth most voted topic (44 %), and **trade-offs between different uses of marine and coastal areas** and **species distribution** were the fifth most voted topics (33.3% of votes each, Fig. 5). In addition, one respondent added the topic of 'socioeconomic aspects' which was not originally on the list.



*Figure 5: The most relevant topics to the respondents in number and percentage. The respondents were asked to select the top 5 and they were also given the option to add additional topics. 'Socioeconomic aspects' was added by one of the respondents.*

Next, the stakeholders were asked to provide up to five **specific questions and issues (i.e. scenarios) related to the topics** they selected in the previous question that they would like ecosystem models to help them answer (Annex 2, question 15). The topics that were most frequently selected to provide specific questions on where: climate change (10 out of 55 responses); fishing quotas (8 out of 55 responses); bycatch (7 out of 55 responses); protected areas/ fisheries restricted areas (6 out of 55 responses); trade-offs between different uses of marine and coastal areas, particularly on reducing bottom trawling (6 out of 55 responses); and biodiversity indicators (3 out of 55 responses). A summary of the main questions provided by the stakeholders is given in Table 2.

<b>Table 2: Summary of specific questions/ issues related to the topics listed in Figure 5 that stakeholder would like answers to</b>	
<b>Topic</b>	<b>Question/ issue</b>
<b>Effects of climate change</b>	What are the impacts on fish stocks (e.g. distribution and productivity)?
	What are the impacts on species distribution?
	How does it change the distribution of forage fish and what are the impacts on marine sensitive species (specifically seabirds during the breeding season)?
	Will it lead to regime shift?
<b>Fishing quotas</b>	Which fishing quotas are really sustainable (e.g. considering impacts of climate change, interspecies interactions and ecosystem resilience to stressors)?
	Are current quotas (also FMSY; BMSY) sustainable in an ecosystem context - also in light of future climate change?
	What is the fishing mortality that allows a harvested species to develop its role in the ecosystem (e.g. predator prey-interactions, etc.)?
	What is the exploitation rate that ensures that all species in a mixed fishery are maintained at "healthy" levels?
	How would x percent reduction in quota of y species change its biomass in z years? Would it cause changes in abundance of other species?
<b>Protected areas/ fisheries restricted areas</b>	Which areas should be protected across a certain region to harness maximum positive effects
	What are the most valuable ecosystems to designate protected areas and strictly protected areas and how do they overlap with areas important for fishing (and other uses)?
	How would the closure of x Bay to y fishery effect the species diversity/abundance in z years?

<b>Biodiversity indicators</b>	What is the threshold of good environmental status for marine biodiversity?
	What would be the effect of reductions on 'charismatic species' (relevant to MSFD D1)?
	What are the best ecosystem based indicators for biodiversity, in relation to the biodiversity strategy targets?
<b>Trade-offs between different uses of marine and coastal areas</b>	What is the effect of reducing trawling (or other fishing techniques) in all marine protected areas and in X% of marine area on 1. economic performance of fisheries and 2. on restoring biodiversity?
	Impacts of closure of x% bottom trawling
	Computing trade-offs of the impact of preserving seabed habitats or areas of higher sensitive species occurrence (through 'strictly protected' MPAs) vs. impact on economic activities, fishing in particular.
<b>Bycatch</b>	Population impacts of specific bycatch levels on marine sensitive species (e.g. harbour porpoise in the Baltic and common dolphin in the Bay of Biscay)
	What is the "allowed" bycatch of a protected / sensitive species (and the species that these species depends on) that will allow recovery or sustaining healthy levels?
	What is the by-catch impact of fisheries on the status of protected species now and in the next few years and how can different management scenarios change this?
	Which is the impact of the bycatch species on the ecosystem?
	What are the best gear modification options to minimize capture of juveniles/vulnerable species?
<b>Fisheries profitability indicators</b>	What is the effect on medium and long-term profitability of fisheries given various management scenarios
<b>Invasive species</b>	What would be the overall economic and ecological impact of restricting commercial fishery for an already settled invasive species?

#### 4.6 Section 6: Other comments

In the final section of the survey, the stakeholders were asked to provide any other comments they may have (Annex 2, questions 16 and 17). Twelve responses were recorded in this section. One respondent noted that **ecosystem models could be really useful in management. However, available data is still limited** and therefore using these kinds of models in management could be very risky. Existing **large knowledge gaps** was highlighted by another respondent, including on issues such as pelagic ecosystems, primary productivity, the base of the food chain and food web dynamics, especially with forage fish and the cumulative impact of different industrial sectors. The same respondent also noted that **cumulative effects** are still unclear and that **baselines are still uncertain** in some places (e.g. in the North Sea), since there are little to no pristine reference areas to compare with. Moreover, one respondent reiterated that it is important that all stakeholders **understand the basic and key limitations of the models** if they are to be successfully used to improve and change management. The stakeholder further explained that fishers will not adopt model results if they do not **trust them**.

One respondent also recommended exploring other ecosystem models, apart from the Ecopath with Ecosim (EwE) models that the EcoScope project aims to use. Another respondent encouraged including data on illegal, unreported and unregulated fishing (IUU) whenever available. Furthermore, a stakeholder highlighted the need to **consider how to use and implement new data sets in models as they become available**. Finally, a respondent noted that it would be helpful to know what real-time services, general data requirements and data formats the fishing/management sector would find valuable.

## 5 Discussion

The aim of this survey was to identify the main needs, challenges and barriers of key fisheries stakeholders related to EBFM to better plan the development of the EcoScope tools. Stakeholder reported a range of challenges and barriers, ranging from data gaps, a lack of clarity on the EBFM concept, to poor policy frameworks and stakeholder communication problems. Some respondents questioned whether we have the necessary data and tools to provide sound advice related to EBFM. They also reported a lack of clarity on the EBFM concept, lacking minimum standards and measurable goals, and having difficulties in reaching a common vision on what the concept means with different stakeholders. The main needs included obtaining answers to specific scenario questions, understanding how different factors interact, clarifying fundamental questions on EBFM (e.g. how does MSY fit into the EBFM concept?), as well as developing synergies and collaborations between sectors and stakeholders to improve EBFM outcomes.

While these challenges are wide-ranging, and EcoScope will not be able to address many of them, there is one need that EcoScope will be able to address in particular, namely testing “what

if" scenarios. This is one the main aims of the EcoScope tools. Moreover, the ecosystem models that will be part of the EcoScope toolbox may also help addressing some of the problems related to data gaps. This is because models are built in order to be help answer what is hard or impossible to measure, and where the most important data gaps are, as they are able to project into the future and tell us about the past. The MSP Challenge Simulation Platform tool that will be part of the EcoScope outputs may further help with the challenge of stakeholder communication. This Platform can be used to bring various stakeholder groups together to get a common understanding of challenges, trade-offs and management options within a marine geographical area. This could improve communication between stakeholders, potentially identify common visions and measurable goals for EBFM, motivating compliance across sectors which is crucial to address sustainability issues related to the marine environment.

In order to inform the development of the EcoScope e-tools, several questions in the survey were aimed at understanding stakeholder needs related to scenario testing. This included understanding key topics, specific questions and policy commitments relevant for the stakeholders that could be addressed with ecosystem modelling. The most important topics were: effects of climate change, bycatch, protected areas/ fisheries restricted areas and biodiversity indicators. Climate change was also mentioned as one of the main future challenges in implementing EBFM. A list of specific questions to which respondents need answer was also provided during the survey. This list of questions concerns predominantly the topics of: climate change effects; fishing quotas in relation to EBFM; bycatch; protected areas/ fisheries restricted areas; reducing bottom trawling; and biodiversity indicators.

The respondents also reported on key policy commitments for which ecosystem modelling can help provide answers, namely: (i) achieving Good Environmental Status under the Marine Strategy Framework Directive, particularly for descriptors D1 (biodiversity is maintained), D3 (the population of commercial fish species is healthy), D4 (elements of food webs ensure long-term abundance and reproduction) and D6 (the sea floor integrity ensures functioning of the ecosystem); (ii) implementing EBFM, MSY and establishing fish stock recovery areas under the Common Fisheries Policy; (iii) implementing the protected areas target of 30% protection and 10% strict protection under the Biodiversity Strategy 2030; and (iv) the upcoming Nature Restoration Law and Action Plan for Fisheries and the Marine Environment.

The above-mentioned priority policy commitments, topics and questions will guide the development of the models and EcoScope's scenario testing tools, so that end users can obtain answers to the most pertinent questions they have. Limitations of the scenario testing module, however, include that end-users will only be able to test management options for the case study areas of the project (North Sea, Baltic Sea, Bay of Biscay, Balearic Sea, Adriatic Sea, Aegean Sea, Baltic Sea, Black Sea and Levantine Sea). Continued engagement with key stakeholders of

the case study areas will therefore be crucial to maximise the usefulness of the EcoScope scenario testing modules.

The respondents also provided feedback on the preferred format output for the results of the EcoScope tools. The preferred formats included visual spatial formats, interactive maps, infographics, and user-friendly tools. This aligns well with the tools EcoScope is planning to develop. For instance, the EcoScope Platform will be in a visual-spatial format, consisting of interactive maps with customisable functionalities. It is also likely that infographics will be used as one of the means for presenting scenario results.

Although the stakeholders were overall positive about the use of ecosystem models as a tool for managers in meeting EU policy requirements, a number of key concerns emerged. First, there was a general concern about the reliability and realism of the model's forecasts, given the large knowledge gaps that exist. Insufficient data, data limitations and the quality of input data were key concerns, expressed by a respondent as "models can only be as good as the underlying data". Next, many stakeholders voiced concerns about model limitations, given the complexity of ecological systems and questioned if these systems can be adequately described by models. The respondents also questioned whether models can properly quantify/deal with uncertainty in a whole ecosystem scenario. Trust in the models was therefore seen as a key barrier. A better understanding of the limitations of the EcoScope tool box and good communication of the limitations and uncertainties of the models was therefore stressed. Going forward, it is essential that the EcoScope project builds an understanding of models among stakeholders in a manner that allows them to understand the assumptions, the limitations but also the probabilities with which they predict. This includes clearly communicating limitations and uncertainties, and may involve reflecting the confidence level of scenario outputs. The method used in the IPCC summary for Policy Makers<sup>15</sup>, which includes labelling results with "*high confidence*", "*medium confidence*", and "*low confidence*" could be a good way to do that.

In conclusion, this survey highlighted some key concerns, needs and challenges of stakeholders working with EBFM. Some of the concerns and needs mentioned are highly relevant for EcoScope and the insights obtained from this survey will assist in the further development of the EcoScope e-tools. Continued engagement with stakeholders while developing the scenarios of each case study area will be crucial to maximise the usefulness of the EcoScope tools.

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<sup>15</sup> IPCC report for policy makers: <https://www.ipcc.ch/sr15/chapter/spm/>





## Annex 1: Questionnaire

### Information

This survey is part of the H2020 project [EcoScope](#), which aims to promote effective and efficient, ecosystem-based fisheries management. EcoScope will develop e-tools that can be used to explore the implementation of an ecosystem-based fisheries management and evaluate the impact of potential management options. The tools will be based on a wide array of fisheries-related datasets, ecosystem modelling and interdisciplinary indicators.

The survey below aims to understand the needs of stakeholders that will be using these tools and/or their outputs. Your input is, therefore, very valuable, as it will help us understand how to best develop the tools to address your needs. The results of this survey will be used as input to the First Stakeholder Workshop and published as a public report on the EcoScope website. They may also be published as research and to inform policy.

The questionnaire consists of 17 questions and it will take approximately 15-20 min to complete. All answers will be pooled and your identity will not be identifiable to any person using the raw dataset or reading the published report. If you have any questions, please contact us at the European Marine Board Secretariat ([info@marineboard.eu](mailto:info@marineboard.eu)).

*This project has received funding from the European Commission's Horizon 2020 Research and Innovation programme under grant agreement No 101000302. This survey reflects only the author's view and the European Union cannot be held responsible for any use that may be made of the information contained therein.*

### Context

1. Which category does the organisation you work for belong to? 1= Policy/Regulatory; 2= Advisory/Scientific; 3= Other

2. Which of the following (if any) inform your work? Please check the top five 1 = Common Fisheries Policy; 2 = Marine Strategy Framework Directive; 3 = Habitats and Birds Directive; 4 = Marine Spatial Planning Directive; 5 = EU Biodiversity Strategy 2030; 6 = EU Green Deal; 7 = Water Framework Directive; 8 = Invasive Alien Species Regulation; 9 = Blue Economy Strategy; 10 = Other

2b. If 2=10, Please specify \_\_\_\_\_

3. To what extent do you implement / regulate/ advise on ecosystem-based fisheries management? (Scale: Never/ Almost never, Occasionally, Regularly/ Very often)

4. How would you rate your capacity / expertise to implement / regulate/ advise on ecosystem-based fisheries management? (Scale: Low, Medium, High)

### **Ecosystem-based fisheries management needs**

5. What are the main challenges / barriers you face when implementing / regulating / advising on ecosystem-based fisheries management? Please list the three most significant challenges / barriers.

a. \_\_\_\_\_

b. \_\_\_\_\_

c. \_\_\_\_\_

6. What do you foresee will be the main future challenges when implementing / regulating / advising on ecosystem-based fisheries management? Please list the three most significant potential future challenges or risks.

a. \_\_\_\_\_

b. \_\_\_\_\_

c. \_\_\_\_\_

7. In order to better implement / regulate / advise on ecosystem-based fisheries management, what are the main questions you need answers to? Please list the three most significant questions.

a. \_\_\_\_\_

b. \_\_\_\_\_

c. \_\_\_\_\_

### **Ecosystem Modelling**

Ecosystem models can be used to test a wide range of management scenarios over time and space, and observe the influence of these decisions on the ecosystem and the Blue Economy. For instance, one could use the models to address questions such as:

- What would be the impact of a new Fisheries Restricted Area on the fisher's catch and the marine ecosystem over the next 5 years?
- How do different Total Allowable Catches influence the targeted stock population, the wider marine ecosystem and the fisher's profitability?
- Which of four potential marine areas would benefit most from strict protection, and what would be the long-term impact on the marine ecosystem and the fisher's catch?
- What would be the influence of invasive species on the marine ecosystem, the influence of aquaculture and different placing of cages, etc.?

This 5 min [video](#)<sup>16</sup> illustrates how ecosystem models can be used as a decision support system in the Israeli Mediterranean.

8. To what extent do you think robust ecosystem modelling could help to address the most significant questions you identified in the previous question (Q7)? (Scale: Not at all, a little, significantly)

9. Do you foresee any specific limitations or barriers in using the results of ecosystem models to advise / implement on ecosystem-based fisheries management? Please specify \_\_\_\_\_

10. In which specific situations would you use the results generated by ecosystem modelling in the context of ecosystem-based fisheries management? Please provide examples \_\_\_\_\_

11. In what form would the model results be most useful to you and why? \_\_\_\_\_

### **Ecosystem modelling and EU policy**

12. Do you think ecosystems modelling can help meet existing EU policy requirements? Please mention specific directives and requirements within the directives \_\_\_\_\_

13. Do you think ecosystems modelling can help meet planned policy requirements (e.g. upcoming action plans, new directives, etc.)? Please specify \_\_\_\_\_

\_\_\_\_\_

<sup>16</sup> Video link: <https://www.youtube.com/watch?v=xCI3XTdH7HA>

### Ecosystem modelling needs

14. Which of the following topics are most relevant for you? Please check the top 5

1 = fishing quotas; 2 = protected areas/ fisheries restricted areas; 3 = bycatch; 4 = invasive species; 5 = marine spatial planning; 6 = effects of climate change; 7 = species distribution; 8 = conservation status of protected species; 9 = fisheries sustainability indicators; 10 = biodiversity indicators; 11 = fisheries' profitability indicators; 12 = species interaction; 13 = trade-offs between different uses of marine and coastal areas; 14 = others

14b. If 14= 14, Please specify \_\_\_\_\_

15. From the topics you selected as most relevant for you (Q14), what specific questions and issues (scenarios) would you like ecosystem models to help you with? For instance: if bycatch is a main topic of interest, a specific question could be: what is the effect of x level of bycatch on a protected species and the wider ecosystem over the next 5 years. Or if fishing quota is a main topic of interest, a specific question could be: given projected climate change will current quotas allow sustaining commercial fish populations in the future? Please list up to 5 questions you would most like ecosystem models to address.

a. \_\_\_\_\_

b. \_\_\_\_\_

c. \_\_\_\_\_

d. \_\_\_\_\_

e. \_\_\_\_\_

### Other comments

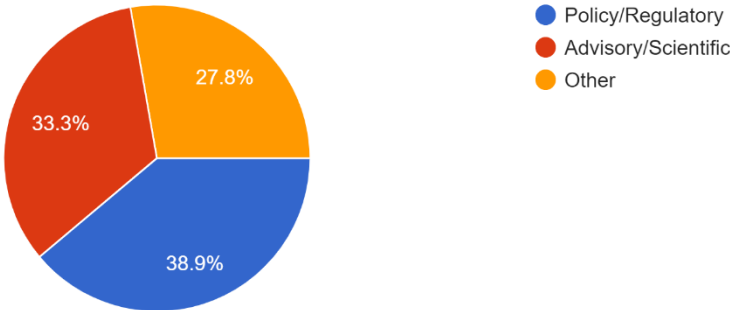
16. Please provide any other comments you may have related to ecosystem-based fisheries management needs that could be met with additional data or models. \_\_\_\_\_

17. Is there anything else you would like to mention? \_\_\_\_\_

## Annex 2: Survey responses

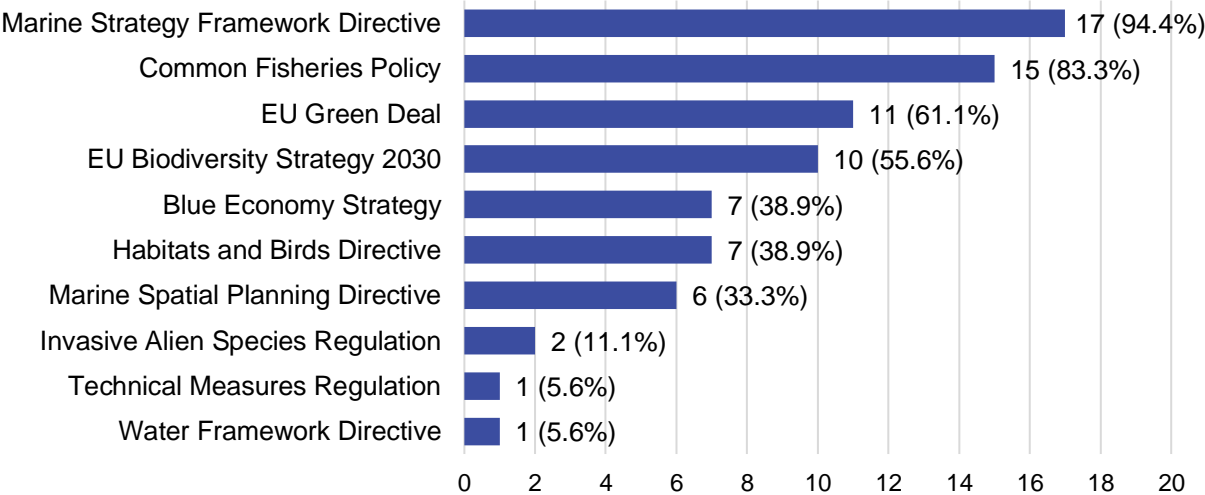
### 1. Which category does the organisation you work for belong to?

18 responses



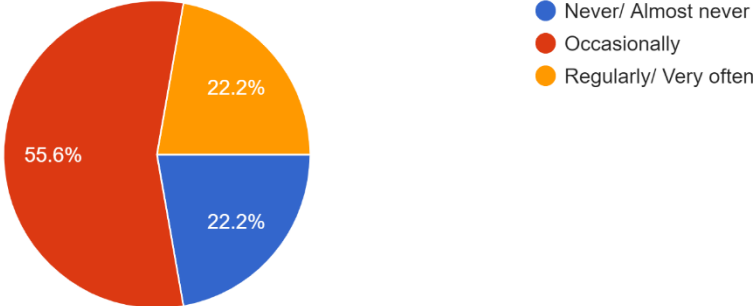
### 2. Which of the following (if any) inform your work? Please check only the most relevant (up to 5)

18 responses



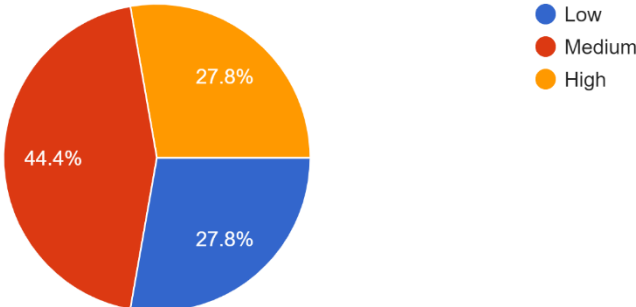
**3. To what extent do you implement / regulate/ advise on ecosystem-based fisheries management?**

18 responses



**4. How would you rate your capacity / expertise to implement / regulate/ advise on ecosystem-based fisheries management?**

18 responses



**5. What are the main challenges / barriers you face when implementing / regulating / advising on ecosystem-based fisheries management? Please list the three most significant challenges / barriers.**

Answers (a):

- Lack of understanding of the concept
- Understanding the likely effects of climate change on predator (marine megafauna) and prey distributions
- Finding relevant information
- Sufficient scientific knowledge
- The reliability of results
- Data limitations
- Technical issues
- Lack of participation of member states in relevant organisations
- It's different for every subject; there is no guidelines on how an EBFM could look like
- Data needs
- Lack of information
- There is no agreed definition of ecosystem-based fisheries management, stakeholders have different interpretations/perceptions/expectations.
- The fisheries sector operates in complete independence from operational and ocean observing sectors, synergies and collaboration should be built
- In my experience one of the most gap in running and applying ecosystem-based fisheries management lies in the huge amount of data need which in most of the cases not available and/or not standardized
- Precautionary approach is not sufficiently applied (especially, when scientific data are limited)
- Scientific knowledge gaps, poor policy frameworks for ecosystem-based management
- No common understanding of what EBFM
- Lack of scientific advice

Answers (b):

- Lack of suitable science
- Taking into account areas closed for fishing when determining TAC/quotas for non-mobile forage fish (e.g. sandeel)
- Comprehensive policy knowledge
- Appropriate regulatory environment
- The availability of scientific updated data
- High, often unaccounted, uncertainty of ecosystem models
- Mindsets
- Lack of insight into the state of the art of EBFM and knowledge gaps
- Capacity of researchers to collect/work with data
- Lack of common vision
- There is no good understanding of the functioning of marine ecosystems among stakeholders (in particular fisheries sector).
- There could be duplication in collecting information and better coordination with other marine stakeholders will be beneficial



- Ecosystem aspects are not sufficiently and strategically included by decision makers in requests to scientists
- Lack of ecological knowledge
- Complex issue

Answers (c):

- Lack of organisational structures to facilitate EB(F)M
- Lack of data on occurrence and level of bycatch of vulnerable species
- Article 11 CFP
- Enforcement of regulation (not only fisheries related)
- The relationships between cause effect of various impacts (fishery pressure, pollution, climate change)
- Difficulties to extrapolate (forecast) beyond the observed range of environmental conditions
- Communication
- Lack of data by poor sharing between data owners and other stakeholders like e.g. research institutions, needed for identifying research gaps.
- Different regulatory mechanisms in different countries
- Time consuming
- There is no good understanding of the requirements of EU legislation and policy on protection of marine ecosystems (nature directives, MSFD) and its relationship with the CFP
- Operational oceanography has the potential to benefit ecosystem-based management, currently there is limited dialogue between these sectors
- It is not always clear to what extent ecosystem-based considerations are already included in management decisions and where they are missing
- Lack of reliable models
- Decision makers do not seem really interested on it

**6. What do you foresee will be the main future challenges when implementing / regulating / advising on ecosystem-based fisheries management?** Please list the three most significant potential future challenges or risks.

Answers (a):

- Climate change
- The relationships between cause effect of various impacts (fishery pressure, pollution, climate change)
- Computational power and access to it
- The quality of the EBFM as we have no minimum standards
- Accounting for the effects of climate change on fish species and marine megafauna

- "Deliberate" misunderstanding of core principles; twisting towards ecosystem manipulation not managing human activities
- Implementing measures can be difficult because we don't always have clear and measurable goals
- Lack of participation of member states in relevant organisations
- Climate change
- Ensuring a just transition to sustainable fisheries by phasing out damaging practices such as bottom trawling due to resistance of industry or insufficient compensation of transformation
- Improve the scientific advice
- Political inertia
- To generate sound and timely scientific advice given the complexity of marine ecosystems
- Climate change
- Data collection
- Climate change
- Ensure robustness of advice
- Socio economic constrains

Answers (b):

- CFP articles 11 and 17
- The difficulties in the correct inclusion of socioeconomic aspects in the ecosystem-based fishery management
- Development of precise models and interactions between them
- Accounting for the needs of marine predators in setting TACs/quotas for forage fish
- No real political will to change current management frameworks
- Getting all stakeholders on boards, especially fisheries.
- Insight in the state of the art of EBFM and knowledge gaps
- Fragmentation in the regulatory system in the ocean, with different bodies regulating different sectors independently (e.g. fisheries management, ocean mining, ocean renewable energy generation)
- Ensuring a balanced approach to fisheries and other marine activities, looking at cumulative impacts
- Convince decision makers about the need to implement the EBFM
- Unwillingness to move away from the single stock management
- Continues inadequate reporting and monitoring of EU fisheries
- Increasing competition for space in the marine environment
- Data time series length
- Biodiversity crisis
- Achieve participatory approaches

- Political pressures

Answer (c):

- Member States willingness to offset citizens' interest vs. economic interests
- The availability of scientific updated data
- Dealing with failures
- Lack of data on occurrence and level of bycatch of vulnerable species
- Continued management in silos and thus unclear mandate on who should act/lead
- Proper control and enforcement
- Lack of data by poor sharing between data owners and other stakeholders like e.g. research institutions, needed for identifying research gaps
- Big data handling and analysis and the fast development of new technologies coming online before the sector is ready
- Communication about sustainable and damaging fisheries to wider public and change of consumer preferences (avoiding marine food coming from unsustainable practices)
- Adopt regulations with stronger wording on EBFM
- There will be winners and losers
- Data availability to underpin scientific models
- Lack of holistic EBM (too "fisheries" only)
- Computation power needs
- Competition for space
- Enforcement
- Illegal, unreported and unregulated fishing practices

**7. In order to better implement / regulate / advise on ecosystem-based fisheries management, what are the main questions you need answers to?** Please list the three most significant questions.

Answers (a):

- What if scenarios, based on models integrating fisheries/environmental impact of fisheries/climate/fishing sector response to regulations/recovery rate of habitats and ecosystem services
- The relationships between cause effect of various impacts (fishery pressure, pollution, climate change)
- Multispecies interactions
- How to take into account the needs of marine predators in setting TACs/quotas for forage fish
- Who takes the lead? Can we implement EBFM without new/changes org structures?
- Scientific data on pelagic systems, including food web dynamics and carrying capacity
- What are the main research gaps

- How do we develop synergies and collaboration between sectors to improve outcomes? Dialogue needs to be improved to understand how the different sectors can help each other
- Research of economic impacts and benefits of phasing out certain damaging fisheries
- Do we have the necessary tools to develop the scientific advice related to the EBFM?
- What is EBFM?
- How different factors and stressors interact and their relative importance
- What "ecosystems" have to be managed?
- How you can describe properly the complexity of such ecosystem when in many cases just one species life traits are controversial
- What do we want to protect?
- Can we quantify uncertainty properly?
- Is the political willingness sufficient and stable?

Answers (b):

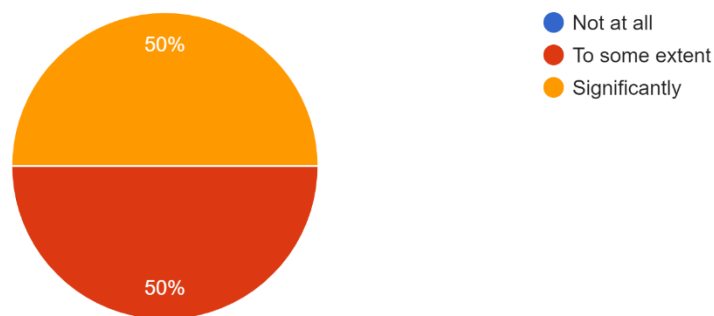
- The difficulties in the correct inclusion of socioeconomic aspects in the ecosystem-based fishery management
- Environmental factors vs. fishing impacts
- How to account for the likely effects of climate change on predator (marine megafauna) and prey distributions
- Is funding really the issue?
- Impacts of various fishing activities on the wider ecosystem
- What are the needs of fisheries managers regarding simulation tools
- How can the sector take advantage of new technologies (eDNA, imaging, etc) to inform decision makers
- Research on restoration of marine ecosystems
- Is it realistic to add management objectives related to the EBFM?
- What is MSY in the frame of EBFM?
- What is the effect on medium and long-term profitability of fisheries depending on the chosen management scenarios
- What is the spatial extension of each ecosystem?
- How you can collect data to describe properly such huge system and which would be the cost
- and where?
- Can we forecast for environmental regimes outside historical range (e.g. warming seas)?
- Is the capacity for collecting sufficient reliable data, processing data and producing advice possible? If so, at which level?

Answer (c):

- Cross sectoral impacts and approaches to management. How to deal with this and get everyone on board?
- Standardisation, e.g. definition of fleets and métiers, fishing effort...
- How can the regulatory framework be improved to consider the different sectors and implement better spatial planning?
- Opinions of wider public on the issue
- Are the fishers and decision makers willing to implement the EBFM?
- How to reconcile economic, social and environmental concerns
- What are the impacts on the wider ecosystem (impacts on other species, the integrity of ecosystems, ecosystem functioning etc.) of a certain management scenario
- How does EBM in fisheries interact with other sea uses?
- Uncertainty is fundamentally in fisheries management. Forecast (or applying MSE approach) on monospecific stock is already quite challenging. How deal with an ecosystem scenario?
- How to manage conflicts
- How to link EBFM with single stock assessment/advice/management?
- Can all the aims and benefits be clearly communicated with all stakeholders?

**8. To what extent do you think robust ecosystem modelling could help to address the most significant questions you identified in the previous question (Q7)?**

18 responses



**9. Do you foresee any specific limitations or barriers in using the results of ecosystem models to advise / implement on ecosystem-based fisheries management?**

- Sensitivity of the model to the quality of input data and data scarcity for some parts of the model (e.g. on seabed habitats mapping and catches and fishing patterns of smaller fishing vessels not fitted with VMS or more generally fishing data in the Med).

- The relationships between cause effect of various impacts (fishery pressure, pollution, climate change)
- We have to better understand and communicate the limitations and uncertainty of ecosystems models
- Limited understanding of some ecological processes and therefore the accuracy of the models.
- It will risk to be yet another model that may or may not be used in real life advice for management. Unless there is a solid a continuous campaign to "sell in" the concepts and clearly noting the needs of changes and costs (not just funding but costs for economic activities) it will not work. The political will to push for lower quotas or a changed fishery must be there and the trust in the science delivered must be in place for that to happen. A model changes nothing by itself.
- Modelling can make a prediction of effects but is not fail proof. Barriers may be the error margins or trust of stakeholders in these modelling tools.
- The reliability and realism of modelling results seems the most important uncertainty. Data scarcity can be limiting the applicability and reliability of models. A low geographical resolution can be limiting as well - many management measures have a local aspect that is often not addressed by ecosystem models.
- Models are as good as the data that it uses. Better communication with the ocean observing community will help provide the data needed to validate model outputs. It is important that dialogue and links between modelers and the observational communities are built so there is mutual understanding of requirements. Links with operational oceanography will also be of value for fast response activities, projections and handcart of the environment.
- Insufficient data on ecosystems (habitats and species), insufficient real-world fishing activity data
- Yes, if implementing the EBFM has a (short-term) negative socio-economic impact
- Unreliable forecasts
- The model can only be as good as the underlying data and there is overall a lack of a proper monitoring and reporting of EU fisheries. Non-the-less, being aware of this limitation results of such ecosystem models can provide important indication of benefits and draw-backs of management decisions and could provide a scientific base for discussion and decision making.
- Models might help but they are difficult to understand and use.
- In my experience these models give some results only in very controlled areas and/or close systems. Actually, they were rarely applied in managing fisheries
- Lack of data for small scale fisheries
- Uncertainty/data limitations
- Uneven/limited management capacity. Lack of political commitment.

**10. In which specific situations would you use the results generated by ecosystem modelling in the context of ecosystem-based fisheries management? Please provide examples**

- Computing trade-offs on the impact of preserving seabed habitats or areas of higher sensitive species occurrence (through 'strictly protected' MPAs) vs. impact on economic activities, fishing in particular.
- As scientific basis to provide advice
- For example, to explore the medium/long term impacts associated with climate change
- Advocacy related to the establishment of MPAs and the elaboration of management measures.
- Modelling must be able to respond to the needs, a more complete picture of what happens if x or y fish stock is fished. A model must be able to deliver e.g. on the idea of GES for groups of species and their habitats. We must get away from single species MSY advice that will never deliver GES and if model such as the intended can deliver solid options, it has a chance to be relevant.
- In marine spatial planning, implementing protected areas, fishery measures such as seasonal restrictions and quotas and species protection plan and measures
- Defining research gaps and data needs
- Create scenarios and predictions considering different pressures and factors. It would also be good to have model inter comparisons, there are other ecosystem models such as Atlantis or Sepodym that could be used.
- As a support tool for policy implementation after testing in real situations
- Setting of fishing effort restrictions and/or catch limits, spatial or temporal fishing restrictions
- TACs and quotas setting
- When it comes to questions about closures or spatial and temporal measures of fisheries to protect sensitive species or important habitats. In terms of finding viable alternative management approaches that will yield a healthier ecosystem (e.g. switch of gears/fishing methods)
- Determination of spatial areas that would be allocated to fisheries
- When it is possible to have a clear idea of the interactions between biotic and abiotic ecosystem components and good estimation of abundance of all biological functional units. Basically, in some small lakes, rivers, close basin etc.
- To identify new protected and strictly protected areas as requested by biodiversity strategy 2030 and assess their benefits
- Set quotas/fishing opportunities; MPAs
- So many. To foresee the impact of area closures, shifts in seasonal closures, catch limitations, changes in minimum conservation reference sizes for different species, changes in TACs, changes in selective properties of fishing gears and/or total ban of a

fishing method. Also, to see the interactions between industrial/small scale/recreational fisheries; not only in ecological but also in socio-economically.

### **11. In what form would the model results be most useful to you and why?**

- I work in the unit implementing the MSFD.
- As scientific basis to provide advice
- For me, in particular, any format is ok
- In a visual spatial format.
- Embedded in scientific advice on setting TACs. Not as a nice-to-have on the side but fully embedded and used to first set aside what the ecosystem itself needs and then see if there is any fish left over to fish for. Basically, guide management options to be able to reach and maintain GES.
- The model results would prove useful to back up certain advice towards policy within large scale transitions in the North Sea as an ecosystem and help to bring different stakeholders as well as countries to a co management style
- Easy to use and easily accessible. No need for detailed results, general conclusions are what we need.
- For us it would be beneficial to build links with the fisheries community to understand needs in terms of data and ocean observations as well as operational services
- As online user-friendly tool with many customisable functionalities, including spatial representation
- Results provide few management options
- Infographics
- To be honest: a good idea would be to "gamify" models so that they can be easily used
- If it was "robust" enough would be very useful in improving knowledge of the stock dynamic
- Interactive maps
- Csv files should do; R-scripts also
- In easiest possible way to be understood and communicated to all stake holders. As in the video shown above. Interactive applications can be a good tool. Very often policy makers do not have a strong background in ecology and modelling, and education level of fishers are below average in most places.

### **12. Do you think ecosystems modelling can help meet existing EU policy requirements? Please mention specific directives and requirements within the directives**

- MSFD - good environmental status for: biodiversity (descriptor 1), commercially exploited fish stocks (D3), food webs (D4), seabed integrity (D6). Probably others but too tired to think.
- Yes, Biodiversity Strategy 2030 and Common Fisheries Policy (CFP)



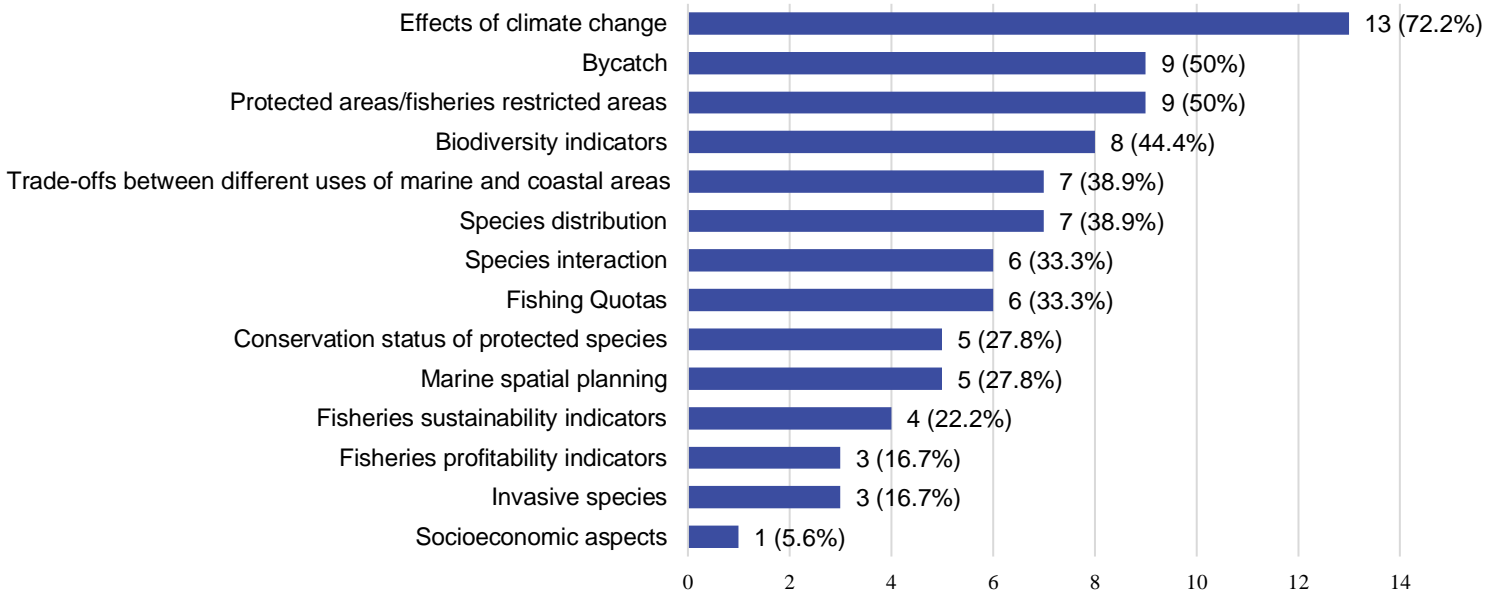
- Common Agriculture Policy (CAP), Marine Strategy Framework Directive (MSFD) and the new ambitions such as Zero Pollution (ZP), Farm to Fork (F2F) and Biodiversity Strategies are going to strongly rely in modelling capabilities in the next future
- Yes, as more and more issues are cross-cutting
- Yes, protected area targets under the EU Biodiversity Strategy
- Yes. E.g. MSFD for sure but also CFP as a part of reaching Good Environmental Status (GES)
- Yes, partly. Modelling is limited and so data collection and monitoring is also needed alongside modelling to provide sufficient information for EU policy requirements.
- Yes. Related to Common Fisheries Policy, MSFD, Blue Economy Strategy...
- I think ecosystem modelling can assist
- It could help in achieving the targets (such as protected area targets) of the Biodiversity Strategy 2030 and requirements of Birds, Habitats and Marine Strategy Framework Directives.
- REGULATION (EU) No 1380/2013, article 2.3, article 8 REGULATION (EU) 2016/1139, articles 3.3., 7.1, 8.1 REGULATION (EU) 2018/973, articles 3.3 and 9.1 REGULATION (EU) 2019/472, articles 3.3 and 9.1 REGULATION (EU) 2019/1022, articles 3.3 and 13.1
- CFP (MSY), MSFD (threshold between good and moderate environmental status)
- Yes, ecosystem modelling can help to inform decisions to implement and ecosystem-based approach to fisheries management (CFP, Art 2.3). Further, ecosystem modelling overall can help to implement the technical measures regulation overall and more specifically to evaluate different technical solutions and management options. With this it can also help to implement obligations in terms of environmental and species protection laid out in the Birds and Habitats Directive and to achieve and assess the process towards Good Environmental Status (MSFD).
- Ecosystems modelling could help in the context of the Maritime Spatial Planning Directive.
- Yes. Common Fisheries Policy (Regulation (EU) No 1380/2013) and Maritime Strategy Framework Directive (Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) for example in Descriptors 1, 3 and 4
- Biodiversity strategy 2030 and 30% and 10% protected areas, Mediterranean Regulation and derogations for fishing over protected habitats
- MSFD (D1, D3, D4); CFP
- Can definitely help significantly on all topics you listed in question 14.

**13. Do you think ecosystems modelling can help meet planned policy requirements (e.g. upcoming action plans, new directives, etc.)?**

- Yes

- Yes: nature restoration law, action plan for fisheries and the marine environment, revision of the Marine Strategy Framework Directive (MSFD) (by 15 July 2023) report on the functioning of the Common Fisheries Policy (CFP), plus future report on the technical measures regulation.
- I am convinced and, actually, doing so in my daily work
- Yes, the upcoming restoration legislation.
- Yes. Again, reaching Good Environmental Status (GES) and the objectives of also restoring ecosystems under the Biodiversity strategy.
- Yes, it can support this
- It could help the implementation of the Action plan on conserving fisheries resources and protecting marine ecosystems under Biodiversity Strategy and of the upcoming Nature Restoration Law.
- Yes, this should be the next cornerstone for the fisheries management
- Yes, MSFD, Water Framework Directive (WFD)
- Yes, as they can inform management decisions that will aid in implementing named policy requirements and well as might provide a tool to assess and monitor the progress made towards meeting goals and targets.
- Yes. If they will be statistically robust enough and if they will take in account social aspects
- Action Plan to conserve fisheries resources and the marine ecosystem, Nature restoration law for the marine environment
- Hopefully
- Yes, it can

**14. Which of the following topics are most relevant for you? Please check the top 5**



**15. From the topics you selected as most relevant for you (Q14), what specific questions and issues (scenarios) would you like ecosystem models to help you with? For instance: if bycatch is a main topic of interest, a specific question could be: what is the effect of x level of bycatch on a protected species and the wider ecosystem over the next 5 years. Or if fishing quota is a main topic of interest, a specific question could be: given projected climate change will current quotas allow sustaining commercial fish populations in the future? Please list up to 5 questions you would most like ecosystem models to address.**

Answers (a):

- Effects of climate change: What are the impacts on stock status?
- Climate change and fisheries interactions
- Managing forage fish better than just a fish meal source
- Which areas should be protected across the North Sea region to harness maximum positive effects?
- Concrete questions are less relevant to us. We rather will use conclusions (or lack of it) of models and modelling platforms to advice on research agenda's and research gaps.
- For our organisation, it would be important to know how we could assist, we have expertise in operational services and modelling, which can be of value to this sector.

- What is the effect of reducing trawling (or other fishing techniques) in all marine protected areas and in X% of marine area on 1. economic performance of fisheries and 2. on restoring biodiversity?
- What is the fishing mortality that allows a harvested species to develop its role in the ecosystem?
- Which TCS and quotas are really sustainable?
- How quotas will need to be set considering impacts of climate change on fish stocks, inter-species interactions and ecosystems as well as to ensure the ecosystem resilience to climate change
- Marine/Maritime Spatial planning
- One of the main components in a fishery ecosystem should be the "fishery" itself (social and economic level) all questions should be related how to deal properly with these aspects avoiding collapsing
- Level of bycatch for Harbour Porpoise in the Baltic
- Are current quotas (also FMSY; BMSY) sustainable in an ecosystem context - also in light of future climate change?
- How would x percent reduction in quota of y species change its biomass in y years time? would it cause changes in abundance of other species?

Answers (b):

- Biodiversity indicators: Which are the best ecosystem based indicators for biodiversity, in relation to the biodiversity strategy targets?
- Impact of in-land measures with marine ecosystems (up to fisheries)
- Population impacts of specific bycatch levels on marine sensitive species.
- Addressing how the way we fish, as in what gears, has impacts. Trawls simply are too effective in a way and have too many side effects
- How can we go through a sustainable food transition while maintaining a healthy ecosystem?
- What are available reduction scenarios for different fishing methods to achieve restoration of certain habitats or species?
- What is the exploitation rate that ensures that all species in a mixed fisheries are maintained at "healthy" levels?
- How climate change affects fish stocks?
- What is the impact of fisheries on the protection status of protected species now and in the next few years and how can different management scenarios change this.
- Cumulative pressures on the marine environment
- In which way species interactions has been evaluated and which is the uncertainty
- Level of bycatch for common dolphin in the Bay of Biscay
- What would be the effect of reductions in 'charismatic species' (relevant to MSFD D1)?

- How would the closure of x Bay to y fishery effect the species diversity/abundance in z years time?

Answers (c):

- Species interaction: What are the consequences of a focused protection on a few species without the complete understanding of their interaction?
- Impact on marine sensitive species (specifically seabirds during the breeding season) of changing forage fish distributions due to climate change.
- Climate change impacts, safeguards for stocks biomass to be sustained at levels taking increasing temperatures in mind but also in relation to leaving biomass in the sea as an effective CCS
- How can we not only protect but also restore ecosystems in the upcoming years?
- What are the most valuable ecosystems to designate protected areas and strictly protected areas and how do they overlap with areas important for fishing (and other uses)?
- What is the "allowed" bycatch of a protected / sensitive species (and the species that these species depends on) to recover or maintain them at healthy levels?
- How climate change affects other species distribution?
- Which fisheries are most sustainable in terms of wider ecosystem impacts
- Creation and management of Marine Protected Areas
- Which are the effect of the climate change on the system. Are we observing a regime shift?
- Proposal for 10% strict protected areas
- What are the best gear modification options to minimize capture of juveniles/vulnerable species?

Answers (d):

- Trade-offs between different uses of marine and coastal areas?
- How can we use a cross-sectoral approach in management and marine spatial planning?
- Foodweb TAC/effort restriction. Is it feasible to develop a multi-species TAC model that considers "all" the species interactions (e.g. predator-prey)?
- What is the threshold of good environmental status for marine biodiversity?
- What are the impacts of different fishing gears on: climate, ecosystems, species but also in terms importance for economics and fishing communities.
- Impact of Climate Change on the marine environment.
- Which is the impact of the bycatch species on the ecosystem?
- Impacts of closure of x% bottom trawling

- What would be the overall economic and ecological impact of restricting commercial fishery for an already settled invasive species?

Answers (e):

- Socioeconomic aspects: What is the impact of an ecosystem approach taking into account the consequences of the socioeconomic aspects?
- How to add the effects of the climate change in the stocks distribution and productivity
- Land sea Interactions
- Do you know which is the real distribution of a species? Are different geographical areas connected? Based on which kind of data?
- What would be the impact of allowing import/facilitating export of a certain species on fisher's profitability?

**16. Please provide any other comments you may have related to ecosystem-based fisheries management needs that could be met with additional data or models.**

- Pelagic ecosystems still have large knowledge gaps, as well as primary productivity and the base of the food chain. There are also still large knowledge gaps in food web dynamics, especially within forage fish and the influence of pressure factors from different sectors. Cumulative effects are still unclear. Furthermore, in the heavily used North Sea, baselines are still uncertain, since we have little/no areas that are pristine to compare against (reference areas).
- What real-time services would be of value for this sector, data requirements and data formats
- I have no other comments
- Ecosystem model could be really useful in management. However, data available are still limited that using these kinds of models in management could be high risky
- Level of IUU (if known) can be taken into account when using official data. If possible, it can be added in to the models.

**17. Is there anything else you would like to mention?**

- Leaping forward to create models of complex ecosystem interactions to improve and change management without making sure everyone understands - the basics and the key underlining limitations and ecosystem boundaries - will fail. If the fishermen do not like what they see and hear it will not work. There must at least be a majority of fishermen on "your side".
- Our organisation will not be an active user of modelling and data platforms. But it will be important for us when we want to capture research needs. It will support the formulation

of research needs and gaps. We do want to capture research needs, research gaps, data needs etc. so we can advise the EC on research financing.

- How to use and implement new data sets that are becoming available to validate and use in models
- No
- High budget should be allocated to these topic
- Seems that the project is very EwE-centered. Maybe it would be worth to explore other ecosystem models too
- Thank you for working on such an important topic and inviting us