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THE ROLE OF ICES ECOSYSTEM OVERVIEWS IN SUSTAINABLE MARINE MANAGEMENT

BACHELOR THESIS

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This thesis is dedicated to Detlef Schönen.

Abstract

This thesis provides an answer to the question if the International Council for the Exploration of the Sea (ICES) does fulfil its own objective of supporting Ecosystem-based management by producing Ecosystem Overviews as advice. Against the background of ongoing changes and pressures on the ecosystem, management requires a knowledge base for decision making that is tangible and immediate. The extent to which Ecosystem Overviews, as one of many ICES advice products, have been applied in practice has remained unclear in the past. In this study, a mixed methods approach was chosen, analysing the following topics through desk research: ICES objective of supporting Ecosystem-based management by producing Ecosystem overviews as advice, their understanding of the role of Ecosystem Overviews, how Ecosystem-based management is understood and implemented, and if the product is referenced to by actors in the Celtic Seas and Central Arctic Ocean ecoregions, the case study regions of this study. In addition to that, a self-prepared survey was carried out and assessed, next to an existing survey by ICES, shared during two meetings with ICES clients and observers (MIRIA and MIACO) in early 2021. As last step, an interview was held with an expert on Ecosystem Overviews, engaged in the development, and with experience, in the Celtic Seas ecoregion. From all steps, it became clear that the understanding of the role of Ecosystem Overviews often differs between ICES and external parties. For example, several external actors underlined the necessity of a precise knowledge base, enabling the opportunity for the product to be used widely. However, the majority of participants from the self-prepared survey indicated that they do not consider Ecosystem Overviews operational nor easy to use in their field of work. Limited dissemination and promotion was further underlined by survey participants and the interviewee, combined with a recommendation for broadening of the target audience. Ecosystem Overviews contain an enormous potential in informing about the ecosystem, its state and capacity. They have evolved greatly over the last decade, with many adaptations still to come. Especially in the complex quilt of shared authorities and responsibilities in marine management, Ecosystem Overviews have the potential to serve as the knowledge base that is so often requested by different actors in the field. However, changes such as adapting to current pressures on the ecosystem, using a short and precise structure, being tangible and immediate advice as well as better promoting are needed to sufficiently fulfil the ICES objective of supporting EBM in ICES ecoregions, eventually leading to Ecosystem Overviews playing a crucial role in future marine management.

Keywords: ICES, Ecosystem Overview, Ecosystem-based management, Marine Management, Usage, Evaluation, Dissemination, Feedback

Abbreviations

ACOM	Advisory Committee
EC	European Commission
EO	ICES Ecosystem Overview
EU	European Union
HELCOM	Helsinki Commission
ICES	International Council for the Exploration of the Sea
IEA	Integrated Ecosystem Assessment
LCA	Life Cycle Assessment
LMEs	Large Marine Ecosystems
MIACO	Meetings between ICES, Advisory Councils and other Observers
MIRIA	Meetings between ICES and Requesters of ICES Advice
MoU	Memorandum of Understanding
MSFD	Marine Strategy Framework Directive
NASCO	North Atlantic Salmon Conservation Organization
NEAFC	North-East Atlantic Fisheries Commission
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic/ OSPAR Convention
PAME	Arctic Council Protection of the Arctic Marine Environment Working Group
PICES	North Pacific Marine Science Organization
SCICOM	Science Committee
UK	United Kingdom
WGBESEO	ICES Working Group on Balancing Economic, Social and Ecological Objectives
WGEAWESS	ICES Working Group on Ecosystem Assessment of Western European Shelf Seas
WGICA	ICES/PICES/PAME Working Group on Integrated Ecosystem Assessment (IEA) for the Central Arctic Ocean

Glossary

Advice “ICES mission is to advance and share scientific understanding of marine ecosystems and the services they provide and to use this knowledge to generate state-of-the-art advice for meeting conservation, management, and sustainability goals. This advice supports ecosystem-based decision-making for the management of human activities in our seas and oceans, and contributes towards the effective application of an ecosystem approach. The approach seeks to maintain the health of marine ecosystems, alongside appropriate human use, for the benefit of current and future generations.” (ICES, 2019a)

Ecosystem Approach (EA): “The ecosystem approach, defined by the Convention on Biological Diversity (CBD) is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way.” (Convention on Biological Diversity COP 5, 2000, cited in Biodiversity A-Z, 2019-a)

Ecosystem-based management (EBM): “An approach to maintaining or restoring the composition, structure, function, and delivery of services of natural and modified ecosystems for the goal of achieving sustainability. It is based on an adaptive, collaboratively developed vision of desired future conditions that integrates ecological, socioeconomic, and institutional perspectives, applied within a geographic framework, and defined primarily by natural ecological boundaries.” (Millennium Ecosystem Assessment, 2005, cited in Biodiversity A-Z, 2019-b)

Ecosystem Overviews (EO) are developed for each ecoregion on a regular basis. The aim is to provide readers with a detailed “description of the ecosystems, [to] identify the main human pressures, and [to] explain how these affect key ecosystem components” (ICES, n.d.-a).

The **International Council for the Exploration of the Sea (ICES)** is an organization in which experts from different international institutes and organizations come together, forming the ICES network. This network provides scientific-based advice in which the current state of ecosystems is examined and needed conservation and management approaches are recommended to guarantee a sustainable use of seas and oceans (ICES, 2021a).

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1. BACKGROUND INFORMATION

Our oceans are full of potential, ranging from their ability to influence the weather to the provision of a nutritional basis for large parts of Earth's inhabitants (National Geographic, 2011). They are one of the most productive ecosystems in regard to providing services benefiting humans. Diverse human communities share this exceptional environment, with many of their activities directly affecting it. By applying integrated marine management, the three components of stakeholder involvement, the effective use of science, and capacity building (Winther & Dai, 2020) can tackle arising management challenges and guarantee a sustainable use of these marine ecosystem. This is exactly what the International Council for the Exploration of the Sea (ICES) has taken to heart.

1.1 ICES

ICES is an organization in which experts from different international institutes and organizations come together, forming the so-called ICES network. This network provides scientific-based advice in which the current state of marine ecosystems is examined, and conservation and management approaches are recommended to guarantee a sustainable use of seas and oceans (ICES, 2021a). ICES describes its mission as using scientific knowledge to create advice with which management and sustainability goals can be reached. The ICES mission and vision can be seen in *Figure 1*.

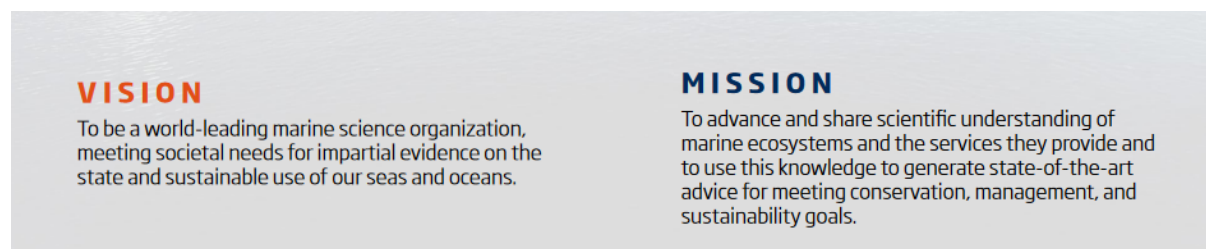


FIGURE 1. ICES VISION AND MISSION (ICES, 2021-A)

Understanding marine ecosystems and their benefits to society is ICES' core principle. Especially in light of anthropogenic climate change, the demand for sustainable, resilient marine management has increased. Applying Ecosystem-based Management (EBM), also called 'Ecosystem Approach', can guarantee a sustainable management style, especially to detect the effects of human activities onto marine ecosystems (ICES, n.d.-b). The ICES Science Plan summarizes it as follows:

Sustainability science and ecosystem-based management are predicated on an underlying understanding of the structure, function, and dynamics of marine ecosystems and their interactions with the physical and chemical environment. As

this understanding advances and evolves, so does our capacity to report and advise on the status of the marine environment and to measure, describe, and manage human interactions with the sea. (ICES, 2019-b, p.12)

With this being said, ICES does adapt its strategy to interests of one of its biggest clients, the European Commission. According to them, the Ecosystem-based approach “integrates the complexity of ecosystems as well as the interaction between humans and ecological systems with management decisions” (Altvater & Passarello, 2018, p.2). It is considered a crucial and promising element in today’s marine management even though the practical implementation is still in its early stages across the European Union (EU) (European Commission, n.d.-a).

ICES' spatial scope of influence stretches across the Northeast Atlantic Ocean, including 12 designated ecoregions. These ecoregions, seen in *Figure 2*, were introduced in 2015. From then onwards, advice was, and still is, directly linked to specific ecoregions. Working with defined geographical areas “enhances ICES ability to research ecosystem and social dynamics and translate those findings into consolidated ecosystem-based advice” (ICES, 2020-a, p.1). Since 2005, an advisory product of particular interest to this study has been developed - the ICES Ecosystem Overviews, from here on only referred to as ‘Ecosystem Overviews’.



FIGURE 2. ICES ECOREGIONS. (ICES, 2020A)

1.2 ECOSYSTEM OVERVIEWS

As part of ICES advice products, Ecosystem Overviews play a crucial role in ICES' current approach towards supporting EBM. ICES refers to its objective as "helping policy developments by providing impartial evidence" (ICES, 2020-b, p.13). Ecosystem Overviews function as a tool to accomplish this objective. In the past few years, several approaches and guidelines have been remodelled in response to changing requests of clients. This is primarily due to the demand for the use of an ecosystem approach and new policy frameworks that are developing as a result (Ramírez-Monsalve, et al., 2021). Nowadays, the product describes the ecosystem, identifies the main human pressures, clarifies how these affect key ecosystem components (Abspoel, et al., 2021), and elaborates on relevant socio-economic aspects (ICES, 2021b). The standard structure of an Ecosystem Overview can be seen in *Figure 3*.

Content list

Key messages

Ecoregion description

Management

Pressures

Ecosystem state

Climate change impact

FIGURE 3. STRUCTURE OF AN ECOSYSTEM OVERVIEW (ICES, 2021-B).

What is known so far about the role of Ecosystem Overviews?

ICES' role in ocean governance is defined by its responsibility to produce and offer advice to diverse actors with a stake in marine ecosystems. By now, Ecosystem Overviews are covered in most grant agreements and memorandums of understanding (MoUs) with ICES clients (ICES, 2021b; ICES, 2021c). The main clients are "governments of ICES member countries, European Commission (EC), Helsinki Commission (HELCOM), North Atlantic Salmon Conservation Organization (NASCO), North-East Atlantic Fisheries Commission (NEAFC), and OSPAR Commission (OSPAR)" (ICES, n.d.-c). The production of advice requires a continuous evaluation, especially to analyse a specific type of usage or a demand in products. According to Ramírez-Monsalve et al. (2021), details about potential end users of advice products and the context in which they are used is meant to be determined. In 2020, it was stated at a Meetings between ICES and Requesters of ICES Advice (MIRIA) that "at the moment the secretariat does not have a way of tracking the use of the ecosystem overviews" (ICES, 2020-c, p.12). Information on the latter is required to know what the role of Ecosystem Overviews is in practice, underlining the need for this study.

In contrast to lacking knowledge on the usage of Ecosystem Overviews, their general role as advice product has been described in detail. For example, it was stated that overviews enjoy positive feedback from ICES observers (ICES, 2021d), although many suggestions and criticisms for improvement were made as well. These were obtained through an ICES survey that was shared with participants from both the MIRIA and the Annual Meeting between ICES, Advisory Councils and other Observers (MIACO). Feedback of the former was summarized as requesting a product that is affecting advice (ICES, 2021e), the latter indicating that Ecosystem Overviews must be more operational (ICES, 2021d). The biggest point of criticism, at the same time also the biggest pitfall, is the lack of recognition as a meaningful and usable advice product (ICES, 2021d). The aim is to make them practicable for management purposes (ICES, 2020b).

Problem description

In general, it is unclear if Ecosystem Overviews as an ICES advice product do fulfil the ICES objective of supporting Ecosystem-based management. Due to lacking information on the recognition and uptake of Ecosystem Overviews within the ecoregions, one cannot yet determine their role in supporting Ecosystem-based management.

Problem statement

It is unclear to what extent the Ecosystem Overviews fulfil the objective of supporting Ecosystem-based management in the ICES ecoregions.

Research aim

This research aims at providing an assessment of the role of Ecosystem Overviews in supporting Ecosystem-based management, visualized through an analysis of their usage and users in the ICES ecoregions.

Main question

What is the role of ICES Ecosystem Overviews in fulfilling the ICES objective of supporting Ecosystem-based management in ICES ecoregions?

Sub-questions

1. Which requirements are needed to successfully fulfil the ICES objective of supporting Ecosystem-based management?
2. In what way does ICES define the role of ICES Ecosystem Overviews?
3. How is the concept of Ecosystem-based management implemented in ecoregions?
4. To what extent and by whom are ICES Ecosystem Overviews used as a tool within the ICES ecoregions?

Reader's guide

The following chapter will provide you with information on the methodology applied. The subsequent chapter contains the most important results per sub-question, with more details data to be found in the Appendix. The most relevant data is summarized at the end of each sub-chapter in regard to the main question. Following, the discussion chapter goes into more detail on the interpretation of the results, as well as criticism and recommendations on the chosen methodology. All findings are summarized and concluded in the last chapter before relevant recommendations on the product ICES Ecosystem Overviews were made in form of a graphical overview. Next to the bibliography, this report ends with an appendix that contains all data that was obtained, summarized in tables and other overviews.

2. METHODOLOGY

It is unknown to what extent Ecosystem Overviews fulfil the ICES objective of supporting EBM in the ICES ecoregions. To bring more clarity to it, the steps described in this chapter were taken during a 12-week research period. A research visualisation can be seen in *Figure 5*.

2.1 SCOPE OF STUDY AND STUDY AREA

The scope of this study was not to evaluate if the advice product is effective in its application, nor if the form of this product is usable. Rather, the scope of this study allowed to analyse the first step of potentially many to come – if Ecosystem Overviews are used at all and therefore may fulfil the ICES objective of supporting EBM.

Indications on the use of Ecosystem Overviews were needed to determine if the ICES objective is fulfilled, in other words what role they play in marine management. Against the background of limited time and resources, as only the author performed this research project, two designated ecoregions were chosen to be analysed in more detail, see *Figure 4*: The Celtic Seas and the Central Arctic Ocean. This applied to the 3rd sub-question and 4th sub-question (desk research and partly survey) only.

The Celtic Seas were chosen as their Ecosystem Overview has evolved significantly over the last 17 years. In December 2021, a new version was published that included more socio-economic aspects and impacts of climate change. This ecoregion has been well studied by the linked ICES expert group WGEAWESS, making it a very suitable case study.

For the Central Arctic Ocean, on the other hand, the first ever Ecosystem Overview was published in December 2021. Due to the expected rapid changes in the regions linked to climate change, potentially leading to an increasing demand in (fossil) resources and new shipping routes, this ecoregion is of great importance. ICES members operating in this ecoregion have been active in regard to supporting an Ecosystem approach in management, making it a suitable case study as well.



FIGURE 4. CHOSEN CASE STUDIES, NAMELY CELTIC SEAS AND CENTRAL ARCTIC OCEAN. (ADAPTED FROM ICES, 2020-A)

2.2 RESEARCH VISUALISATION

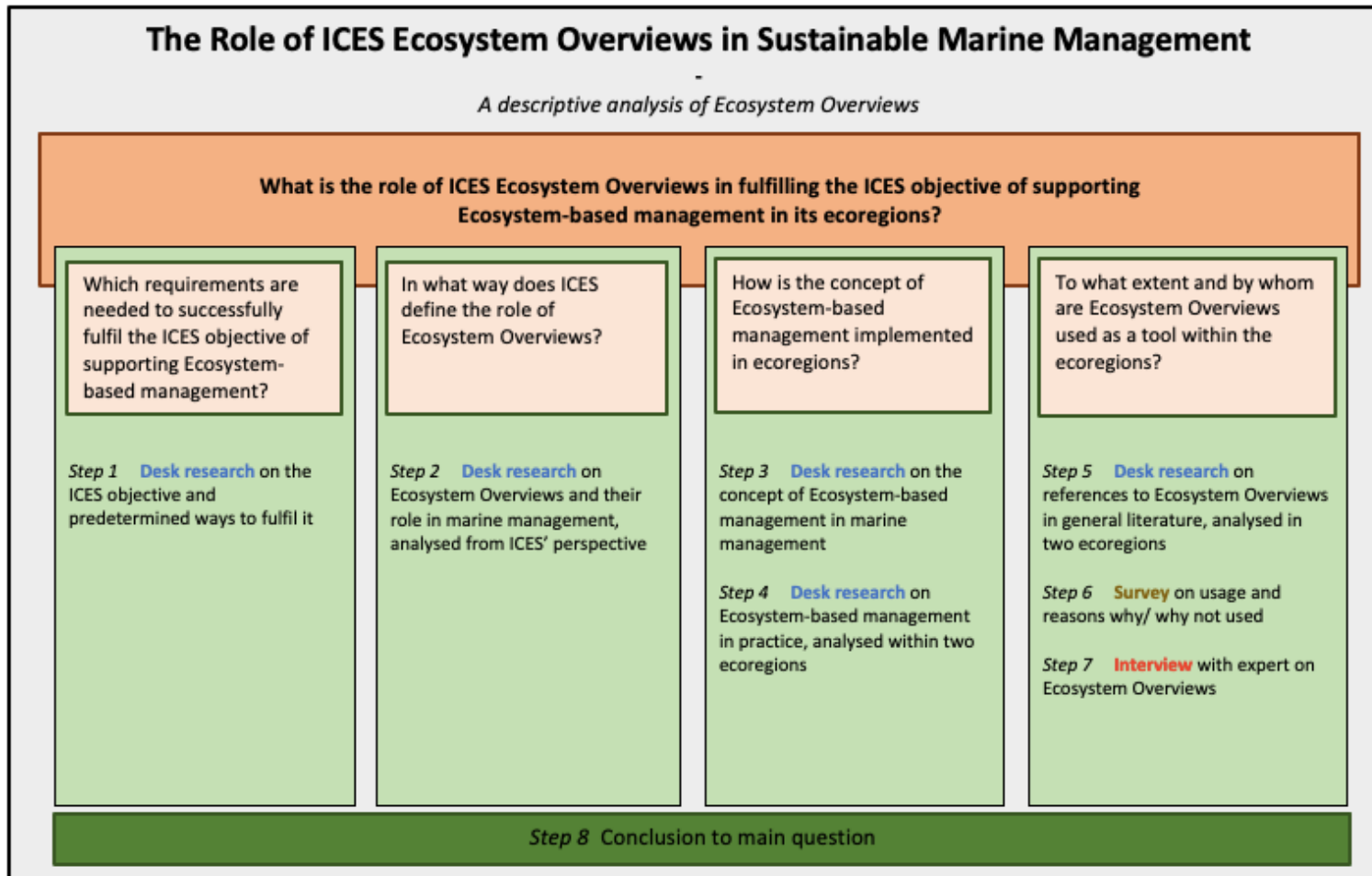


FIGURE 5. RESEARCH VISUALISATION

2.3 OPERATIONALISATION

Given the lacking information on the uptake of Ecosystem Overviews, a descriptive research design was chosen (University of Southern California, 2022). As there was not much information available in the beginning of this study, general data had to be obtained first, concerning the current status of EBM, what is known about ICES' objective and the role of Ecosystem Overviews in marine management, as well as the usage of this product in practice. By doing so, the aim was to gather and analyse data on a broad scale, analysing data through methodological triangulation (Vivek & Nanthagopan, 2021; Bhandari, 2022). This meant to apply different methods or tools to examine the same topic. The methodical concept called Life Cycle Assessment (LCA) was taken as basis for the research design of this study. Especially its four main steps, namely defining the goal and scope of a product, analysing the inventory circumstances (inputs and outputs of a product), assessing its impact (here understood as impact of a product on the environment), and interpreting the results of the latter steps contra to its objectives were taken to reinterpretation. LCA is usually applied to "evaluate the environmental burdens associated with a product, process, or activity" (Wind Energy The Facts, n.d.). In here, however, the framework was used to evaluate the role in sustainable marine management. The framework seen in *Figure 6* displays the original LCA concept (black and white boxes) that was used to connect the following sub-questions with new meaning of each of the four steps (yellow boxes).

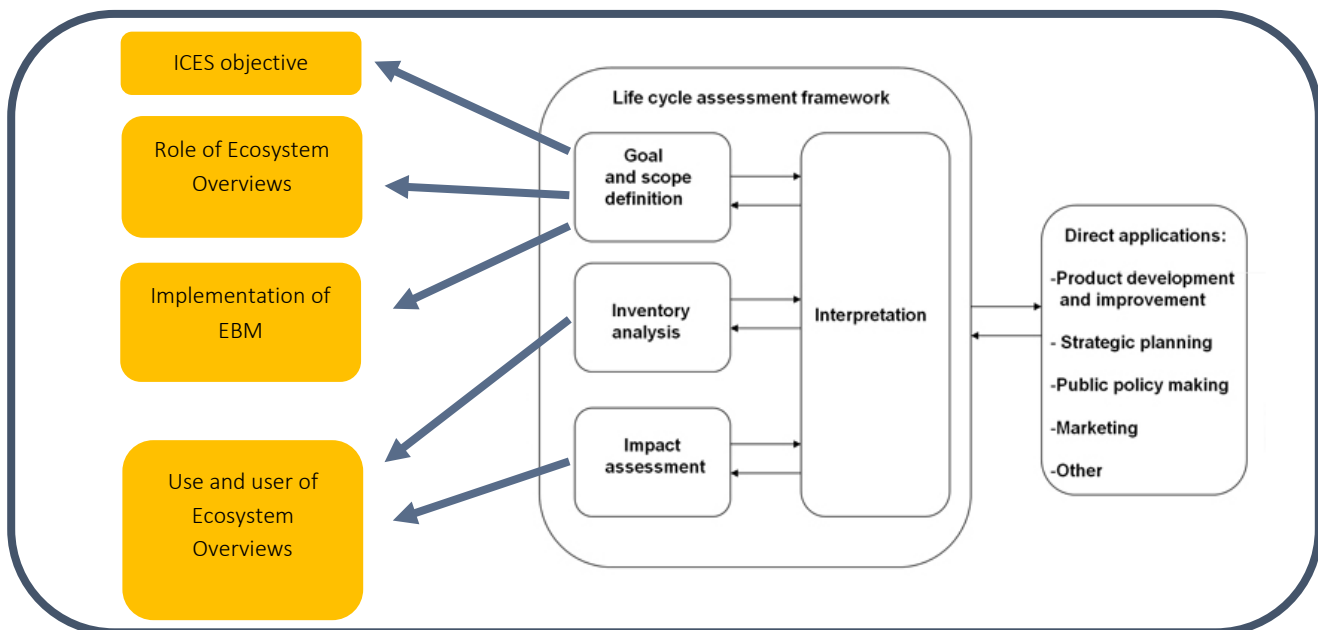


FIGURE 6 ADAPTED LIFE CYCLE ASSESSMENT FRAMEWORK (ADAPTED FROM ISO 14040, N.D., CITED IN WIND ENERGY THE FACTS, N.D.)

SUB-QUESTION 1 - WHICH REQUIREMENTS ARE NEEDED TO SUCCESSFULLY FULFIL THE ICES OBJECTIVE OF SUPPORTING ECOSYSTEM-BASED MANAGEMENT?

Step 1 - Desk research: As stated before, ICES puts the support of EBM central to their goals and strategies. Various general ICES plans were read that underline the importance and purpose of Ecosystem Overviews. All needed documents were found on the ICES [website](#), by inserting the following word(s) into the built-in search function at the top right of the page: *Ecosystem-based, Ecosystem Approach, Requirement, ICES, Management, EBM, Objective, Fulfil/ fulfilment*. Documents of high value to this study are the Strategic Plan, the Advisory Plan, the Scientific Plan, reports on 'ICES and Ecosystem-based management/Ecosystem Approach' and other official literature written by ICES. In all literature, the aim was to collect data referring to requirements/ goals/ interests/ objectives of ICES. This applied to all ecoregions as well as both case study areas.

During the analysis, the scope of relevance was linked to potential requirements that can be fulfilled by products or services. All data and sources were gathered in a Word document, applicable for further use, see *Table 1*.

TABLE 1 TEMPLATE FOR DESK RESEARCH

Name of author/ expert group/ affiliation, with year	Link to source	Quote / Paraphrase	Notes, if necessary
...	...	...	...

SUB-QUESTION 2 - IN WHAT WAY DOES ICES DEFINE THE ROLE OF ECOSYSTEM OVERVIEWS?

Step 2 - Desk research: This step functioned as a follow up to the previous one. Data was primarily collected on the purpose of ICES Ecosystem Overviews, in other words their role in marine management and their function to ICES. Similar to the previous step, general literature (the Strategic Plan, the Advisory Plan, the Scientific Plan, reports on 'ICES and Ecosystem-based management/Ecosystem Approach' and other official literature written by ICES) was read as well as specific literature on Ecosystem Overviews, published by ICES. All data was found on the ICES [website](#), by inserting the following word(s) into the built-in search function at the top right of the page: *Ecosystem Overview, EO, ICES, Marine management, Role, Function, Goal, Predetermined*.

During the analysis, the scope of relevance was linked to the role/ function of Ecosystem Overviews. How the data was gathered was the same as in the previous step, see *Table 1*.

SUB-QUESTION 3 - HOW IS THE CONCEPT OF ECOSYSTEM-BASED MANAGEMENT IMPLEMENTED IN ECOREGIONS?

This section first describes the method used to gather information on EBM in general as well as how EBM is implemented in ICES ecoregions, in this case only the chosen case study regions.

Step 3 - Desk research: Important to analyse were the predetermined ways of application/ implication of EBM in marine management. Data collected refers to a general context, meaning the spatial scope that overarches the ICES ecoregions. Of relevance to this study was any written record from the ICES website as well as peer-reviewed scientific literature, focussing on concepts, objectives, means and general experiences. The following search terms were inserted in the Google search engine: *Ecosystem-based, Ecosystem Approach, Apply/ applied, How, Management, Ecoregions, Concept, Marine management*. Against the background of this study, it was relevant to remember that Ecosystem Overviews are a tool that can be applied to support EBM, a tool itself within integrated (sustainable) marine management. There is a direct link between the usage of Ecosystem Overviews and a potentially efficient implementation of EBM, making this step crucial to this study. The data obtained was gathered in a Word document, same approach as in the previous steps, see *Table 1*.

Step 4 - Desk research: The aim of this step was to analyse how the EBM concept is applied in practice, by the means of two examples, the Celtic Seas and the Central Arctic Ocean, from here on referred to as case studies. Starting with reports from the ICES expert groups of those ecoregions, the analysis of this step included sources from governments, NGO's or other actors in these areas. The following search terms were inserted in the Google search engine: *Ecosystem-based, Ecosystem Approach, Apply/ applied, How, Management, Ecoregions, Concept, Marine management, Central Arctic Ocean, Celtic Seas, Arctic Council, France, Ireland, Isle of Man, United Kingdom*. Data was analysed by looking into potential similarities and differences to step 1. All data was be gathered in a Word document, applicable for further use, see *Table 1*.

SUB-QUESTION 4 - TO WHAT EXTENT AND BY WHOM ARE ECOSYSTEM OVERVIEWS USED AS A TOOL WITHIN THE ECOREGIONS?

Step 5 - Desk research: Ecoregions of interest were the Celtic Seas and Central Arctic Ocean ecoregions. To gather as much data as possible, literature of diverse kind was analysed looking for word frequency. Search engines of choice were Google Advanced Search, Google Scholar and websites of actors engaged in ecoregions. Here an example of a search term: <ICES “Ecosystem Overview” Celtic Seas>. This was used both in Google Advanced Search as well as on websites. As it was not yet clear who exactly uses ICES Ecosystem Overviews, there were no specific actors to start with, except of institutions like the European Union or governments of member states. Websites with lists of stakeholders in the ecoregions were used instead, see *Appendix 4*. By applying the snowball techniques, new users were detected. All sorts of statements, in which the recognition or use of ICES Ecosystem Overview are given, were targeted. This included policy documents, peer-reviewed paper, news statements on websites or similar, (annual or specific) formal reports, etc. After identifying the actors that referred to targeted key terms, the context of use was analysed as well, especially any indication of usage that resulted in a decision made, either from decision makers or other stakeholders. To workdays of research per case study region were taken to gather as much references as possible. Data collected was written down in an Excel file, see *Table 2*, with information on the professional background and context of the user, aspects on what the Ecosystem Overview was used for, and the type of reference. Excel allows for an overview in written form that can be easily adapted in the process of evaluation. Three separate sheets were created – one template, one for the Central Arctic Ocean and one for the Celtic Seas.

Figure 7 displays the coding framework, through which findings of this step were analysed. If a reference was found, one category was chosen from the following list: reference related to fisheries, to biology, to ecology, to human dimension, or to information on the Ecosystem Overview itself.

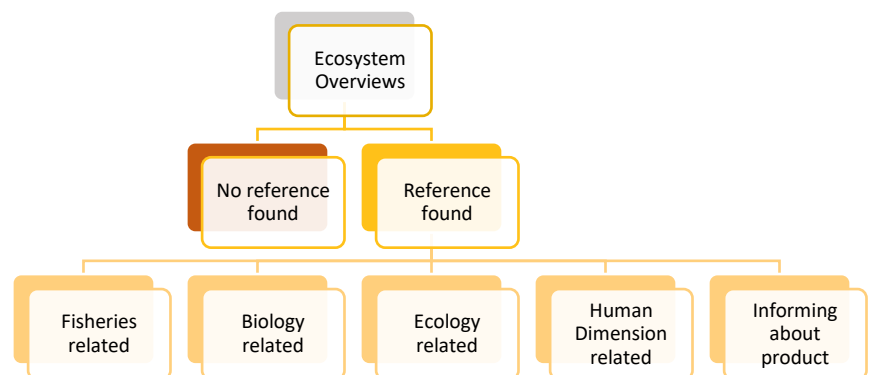


FIGURE 7 CODING FRAMEWORK DESK RESEARCH SUB-QUESTION 4

TABLE 2 TEMPLATE FOR EXCEL FILE DESK RESEARCH SUB-QUESTION 4

Name of Ecoregion						
Actor	Indication of use	Reference to term "Ecosystem Overview"	Quote/Reference	Reference itself	Classification of user	Classification of use
name of company, etc.	Yes = stated that they use EOs/ No = stated that they do not use EOs/ No indication found at all	Yes = term was specifically stated/ Not found = term was not specifically stated	Insert text from document that indicated use of Ecosystem Overviews + year in which it was stated/used	Insert link or reference (in APA style)	Insert sector-related info of user (role of actor, etc.) Example of clustering, based on official datasets for human activities (European Commission, n.d.-b): Aquaculture; Cables; Cultural Heritage; Dredging; Economic; Environment; Extraction diverse; Fisheries; Main Ports; Ocean Energy Facilities; Other; Other Forms of Area Management/Designation; Pipelines; Science; Shipping Density; Waste; Wind Farms	Insert context-related info of usage (what it is used for) Examples of clustering: Annual report; Creating advice; Decision-making only governance; Decision-making other; Documentation; Lobby strategy; Other; Report of meeting; Supporting of own argumentation; Website

Step 6 - Survey: The hereafter described qualitative approach is supplementary to the desk research done on all sub-questions. In preparation, it has proven very helpful to reach out to the Ecosystem Overview Operational Group, the ICES Science Committee (SCICOM) and the ICES Advisory Committee (ACOM) in the course of this section.

SELF-PREPARED SURVEY

All questions targeted the same aspects as in the previous steps, namely who uses ICES Ecosystem Overviews and why, or why not, there are used. The method of a survey offered more opportunities to ask for more specific information than what was shared in finalized published documents (written literature).

The survey consisted of multiple-choice questions, both single select and multi select, as well as open-ended questions, giving the participants more freedom in stating their perspective or experience. The finalized version that was shared can be found in *Appendix 11*. The questions were based on what information were missing up to this point, and therefore could not have been obtained from the desk study.

The survey itself was created in Google forms, enabling to gather all results on the Google-forms website as they are automatically submitted. Keeping in mind the short amount of time participants had due to other responsibilities in their schedule, the survey was kept short, approximately five minutes to complete. The open-ended questions were used for more informative questions and the multiple-choice option for the few required questions. Those were mainly background or basic questions such as if an ICES Ecosystem Overview was used before and if so, from what ecoregion the most. The case study ecoregions were aimed for in particular, however the option 'other' was provided. Answers from other ecoregions were later separated from the case study regions but kept for a general analysis. The survey was shared via the Twitter account of the author's university. As the scope of this project stretched across several ecoregions, posting it online was considered the fastest and most efficient way to reach as much people as possible, especially though re-'tweeting' the link to the survey. In addition to this, the IEA-groups for both ecoregions were asked to share the survey with potential users in their respective region. The results were listed in a new Excel file. It was important to not overwrite results from the previous step. In order to be able to make statements that are as accurate as possible, a minimum number of ten completed surveys was aimed for. The results of the survey were later transferred into informative graphs through application by Google Forms and Excel.

Regarding multiple-choice questions from the self-prepared survey, the number of indications was counted, only differentiating between the product about the Central Arctic Ocean, the Celtic Seas, ecoregions in general, or no usage at all. The remaining open-ended question from both surveys were coded by using thematic analysis. In here, the theme, content or structure of sentences is targeted but not specific terms. With the help of pre-defined codes in a hierarchical frame, few codes could be generated that functioned as a starting point. While analysing more data, codes were elaborated and specified. This method of inductive coding was applied because of a lack of knowledge, referring to usage of Ecosystem Overviews but also the reasons why or why not they were used. The coding framework used to analyse this set of data can be seen in *Figure 8*. This matches the thematic structure of the survey by ICES, see page 22f.

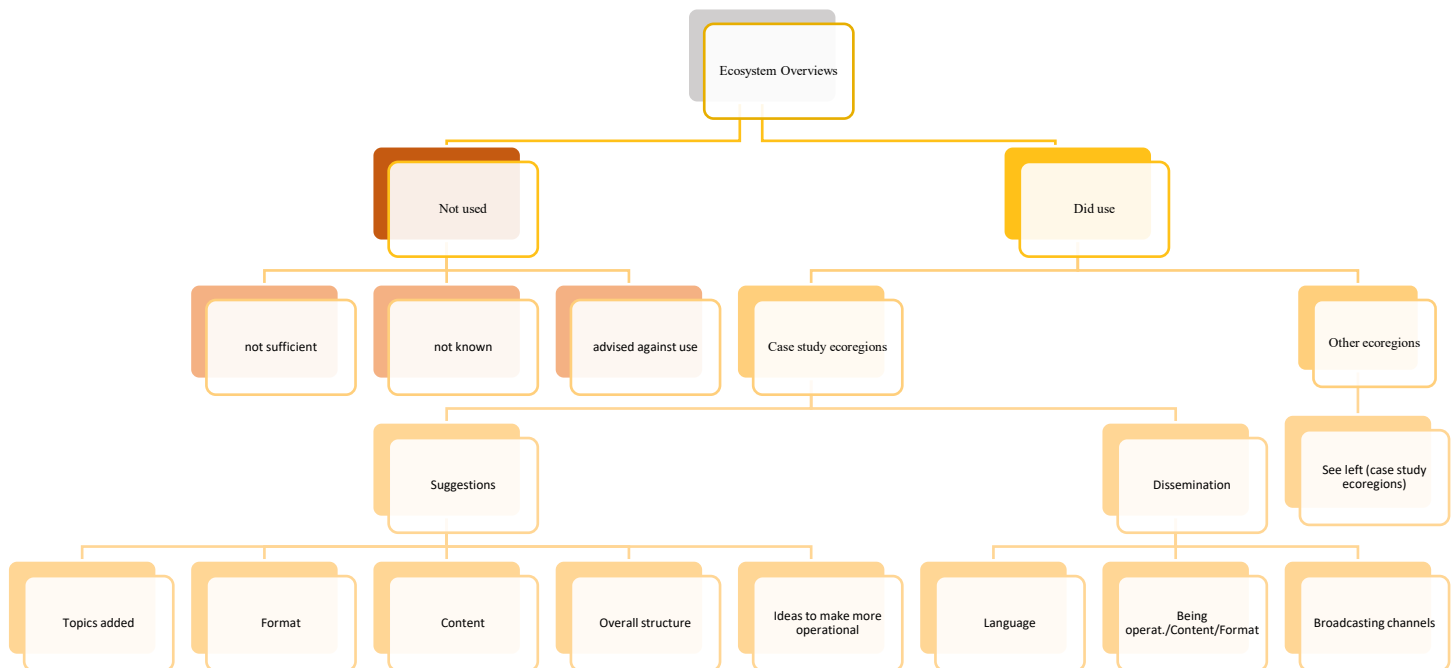


FIGURE 8 CODING FRAMEWORK SELF-PREPARED SURVEY

SURVEY BY ICES

In addition to the self-prepared survey, a survey performed by ICES itself was offered to the author in the course of this study. It was conducted in early 2021 during the MIRIA and MIACO meetings, containing a total of 23 responses by participants. With their consent, the anonymised data sets were given to the author of this study. Other than with the self-prepared study, no indication on an ecoregion was given by the participants of the MIRIA/MIACO survey, resulting in rather general feedback. The thematical structure of the survey was used to create a coding framework, enabling the categorial analysis of the data sets. The aim of this analysis was to examine if references were made to specific ecoregions, if the indications from the two groups differed or addressed similar topics, and if the feedback shared resembles suggestions from

the self-prepared survey. The coding framework support the process of comparison as all other coding frameworks are based on this thematical structure. The framework can be seen in *Figure 9*.

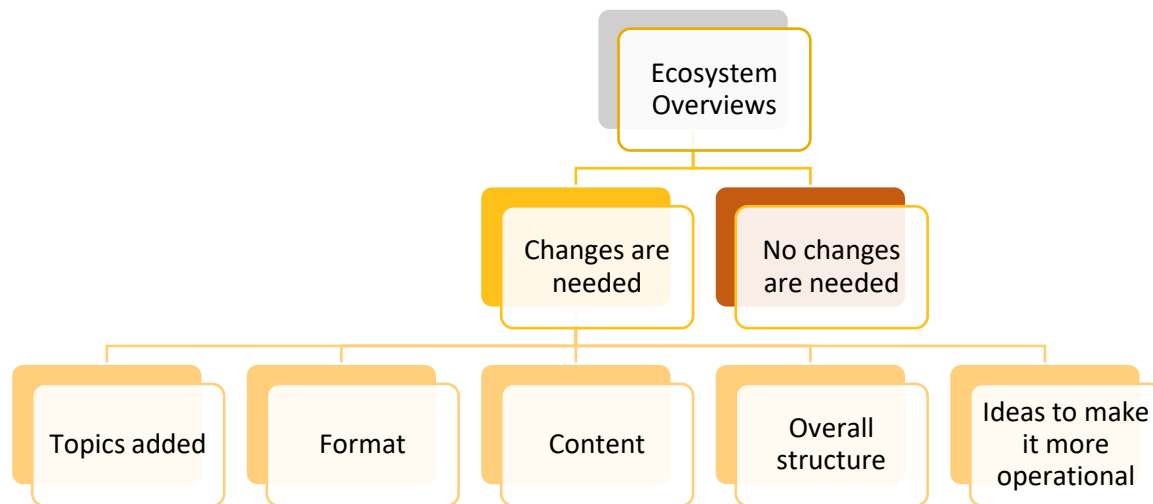


FIGURE 9 CODING FRAMEWORK SURVEY BY ICES

Step 7 - Interview: As a final step, an expert engaged with Ecosystem Overview did provide more insights in perspectives that have not been examined up to this point. Recommendations for suitable interviewees were requested from both the ICES expert groups WGEAWESS and WGICA. The interview itself was held online through Microsoft Teams, making it possible to record and transcribe the meeting. Questions of interest were primarily about the evolvement of this product, experiences, and insights from contact with externals, and feedback from the perspective on an internal expert. The core of this was to find out if the external and internal perspective on Ecosystem Overview differ from each other and where possible opportunities for improvements lie. The interview guide created in advance to the interview can be found in *Appendix 14, Table 11*. However, not all questions in this order were asked or asked in this order due to the spontaneous course of the conversation. The interview was coded by using thematic analysis alike the surveys. The coding framework of the previous step, when analysing the survey by ICES, was used here too, see *Figure 9*.

CONCLUSION

Step 8 – Conclusion: As all previous steps were written down in either Word documents or Excel files, those findings were directly compared with the main question, aiming for short and precise statements per sub-question. In this step, notes and thoughts were taken on topics that later could be added to the discussion or the conclusion chapter. This process of narrowing down all findings to the most relevant core helped connecting all sub-questions with one another, creating a concrete answer to the main question in which all aspects from all sub-questions were considered equally.

3. RESULTS

3.1 WHICH REQUIREMENTS ARE NEEDED TO SUCCESSFULLY FULFIL THE ICES OBJECTIVE OF SUPPORTING ECOSYSTEM-BASED MANAGEMENT?

ICES core interest is characterised by the provision of “impartial evidence” (ICES, 2019-b, p.5) on the condition of marine waters and their potential sustainable use. This is achieved through the creation of various state-of-the-art advice on opportunities to meet conservation, management, and sustainability goals (ICES, 2019a). ICES is committed to a better understanding of marine ecosystems to ensure benefits for humans, so-called Ecosystem Services, and to recognize the connection between marine waters and society. Ways to achieve this commitment are to broaden the incorporation of diverse scientific knowledge into advice, to “develop and coordinate integrated, quality assured, and cost-effective monitoring programmes . . . [and to e]valuate and optimize survey designs” (ICES, 2019-b, p.17). In focal point, the support of fisheries assessment, integrated ecosystem assessment and EBM is aimed for. These commitments can be seen as requirements demanding establishment and development in order to successfully support EBM. As impartial advice provider, ICES is continuously engaged in the improvement of quality and transparency of its advice products and services. ICES’ commitment was formulated in the recent Strategic Plan (2021-a, p.14): “We will regularly publish, update, and disseminate overviews on the state of fisheries, aquaculture, and ecosystems in the ICES region, drawing as appropriate on analyses of human activities, pressures, and impacts, and incorporating social, cultural, and economic information”. Because the request itself as well as the context in which the product is applied may vary drastically, each advice product is tailored to the individual situation. The advice is required to be transparent, clear, unambiguous, accessible, and understandable to all parties in the ecoregion and beyond (ICES, 2021f) . More requirements can be found in *Appendix 1* as well as more additional data, see *Appendix 2, Table 4*.

Concluding, the main objective of ICES can be described as understanding the marine ecosystem and its benefits to society, all working towards supporting the implementation and recognition of EBM. Work processes are precisely defined and coordinated, by which every product, such as the ICES Ecosystem Overviews, need to fulfil to criteria. To mention the most significant ones, they need to be peer-reviewed, regularly evaluated and published, and their development must be transparent. The following chapter will dive into the role of one specific product, namely the Ecosystem Overviews.

3.2 IN WHAT WAY DOES ICES DEFINE THE ROLE OF ECOSYSTEM OVERVIEWS?

In the current Strategic Plan, ICES refers to its objective as helping policy developments by providing impartial evidence (ICES, 2021a). Ecosystem Overviews, next to other overviews, function as a tool to accomplish this objective. They complement other advice products, “allowing users to understand the implications of sectoral decisions and impacts in an ecosystem context” (ICES, 2021-b, p.1). Overviews in general can be described as “continuously evolving advisory documents” (ICES, 2021-f, p.4), recognizing issues and regional trends of the ecosystem, fisheries, and aquaculture that are of interest to regional managers. The main purpose of Ecosystem Overviews is to highlight core aspects that could be useful in the further course of implementing EBM. In addition to that, they function as a descriptive overview; including some general information on the ecoregion, main regional pressures, state of the ecosystem components, and relevant socio-economic aspects (ICES, 2021b). Additional data can be found in *Appendix 3, Table 5*.

When defining the role of ICES Ecosystem Overviews, it became apparent that they function as a complementation to other ICES products and services. They are listed as an advice product to support actors in marine management. ICES sees the benefits of this product primarily in the context of the need for sustainable planning of resources or human impacts on ecosystems. Ecosystem Overviews evolved significantly over time which reflects the willingness to invest time and effort in it, all depending on the demand of externals and the capacity of ICES. However, there remains lacking knowledge on the consistent appreciation of this product between ICES and non-ICES stakeholders.

3.3 HOW IS THE CONCEPT OF ECOSYSTEM-BASED MANAGEMENT IMPLEMENTED IN ECOREGIONS?

Concept of EBM

The concept of EBM is alike its definition not clearly defined. Most definitions describe EBM as an integrated approach with the aim to preserve living and non-living resources in a sustainable and balanced way. The position of humans and their impacts on the ecosystem differ depending on the source; some define humans as part of the system, others depict humans outside of the ecosystem but with a direct impact on the system. To mention a few examples, WWF underlines the needed understanding of an ecosystem, including its functions and processes, in order to make informed decisions. Due to pressures and other challenges, EBM “must be adaptive and anticipate trends, new developments and the long-term implications of management decisions” (WWF Germany, 2016, p.16). The Canadian Coast Information Team (2004, p.iii) adds that EBM aims for securing a “high probability of maintaining ecological integrity”, meaning maintaining temporal and spatial characteristics of an ecosystem, which can support ecological processes and ultimately human well-being. Those ecological and social systems were taken up by the United Nations Environment Programme (2011), stating that a sufficient level of knowledge of those two systems would enable the prioritization of significant management actions and activities. Further elements of relevance to the process of EBM are “[r]ecognizing connections within and across ecosystems; utilizing an ecosystem services perspective; addressing cumulative impacts; managing for multiple objectives; and embracing change, learning, and adapting” (UNEP, 2011, p.19). Criticism on the approach by the United States was raised that summarizes the common global challenge regarding EBM, namely that the drafting of legislation remains demanding as long as there is no “agreed upon definition of EBM or a goal for management” (Fluharty, 2018, p.382). The complexity of this becomes apparent when directly compared, as to be seen in *Appendix 4, Figure 12*.

ICES, the producer of several informative products describes their role in regard to EBM as follows: EBM is a process towards reaching the ICES mission (ICES, 2020d). To provide managers with advice, ecosystems and relevant ecosystem components need to be identified. Human activities and their impacts on the ecosystem are of primary significance to which EBM can provide the supporting framework for management under changing demands in the long term. ICES provides the “evidence for ecosystem-based decision-making” (ICES, 2020-d, p.2) that strengthens the well-being of ecological and social systems, and the management of marine ecosystems in general. Even though ICES provides advice in the form of

Ecosystem Overviews, global actors see potential opportunities to better implement EBM. The following paragraph will dive into potential opportunities and suggestions.

What becomes apparent is the demand for knowledge, or better the demand for a tool to provide knowledge (Grieve & Short, n.d.; WWF Germany, 2016; UNEP, 2011). Knowledge on ecosystems in transboundary and cross-sectoral work is seen as the basis for decision making. Especially when confronted with global pressures through anthropogenic climate change and an expected shift in geopolitical scenes (Potts, Rüttinger, & Vivekananda, 2022), knowledge on environmental states and resources becomes essential. According to McLeod and Leslie (2009), EBM is a complex and challenging step to take in the opinion of most managers. Science, e.g., a scientific product consisting of knowledge on an ecosystem, could be of help. When looking at the main groups involved in marine management – decision makers, scientists, and other actors (Röckmann, Van Leeuwen, Goldsborough, Kraan, & Piet, 2014) – Ecosystem Overviews represent a significant communication tool that enables interaction between these groups. More data can be found on this section can be found in *Appendix 6, Table 6*.

In summary, it can be said that the implementation of EBM remains challenging, not only due to a lacking definition of the concept but also through the variety of interpretations, leading to different management objectives on a global scale. The description of EBM differed, among other things, in the referral to humans as an integral part of an ecosystem or as external parties. One thing that many of the sources studied had in common was the demand for a better understanding of the ecosystem(s). As ICES' products aim for precisely this, the significance of Ecosystem Overviews could be emphasised. Potential differences in-between ecoregions are further analysed in the next section.

EBM in two ecoregions

Central Arctic Ocean

Key characteristics of marine management in the Central Arctic Ocean can be seen in *Figure 10*.

Governed by eight states that share border with this unique ecosystem, namely Canada, The Kingdom of Denmark, Finland, Iceland, Norway, The Russian Federation, Sweden, and The United States

Arctic Council assessments and recommendations are the result of analysis and efforts undertaken by the Working Groups

Decisions of the Arctic Council are taken by consensus among the eight Arctic Council States, with full consultation and involvement of the Permanent Participants

Each arctic states is responsible for implementation in their jurisdictional area, however, a large area beyond national jurisdiction remains. The Arctic Council plays a "supporting and coordinating role"(Coon, Mundy, Skjoldal, & Panelists, n.d., p.27)

FIGURE 10 INFO BOX MANAGEMENT IN CENTRAL ARCTIC OCEAN (ARCTIC COUNCIL, N.D.-A; ARCTIC COUNCIL, N.D.-B; PAME, N.D.-A; COON, MUNDY, SKJOLDAL, & PANELISTS, N.D.)

The Arctic Council defines EBM as follows:

Ecosystem-based management is the comprehensive, integrated management of human activities based on best available scientific and traditional knowledge about the ecosystem and its dynamics, in order to identify and take action on influences that are critical to the health of ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity. (Arctic Council, 2013, p.5)

EBM is seen as great benefit to policy making in this region, especially because of the intended incorporation of different stressors and the adaption to changing socio-economic or ecological conditions. Against the background of e.g., climate change and its consequences, the understanding of this unique ecoregion demands a fast and dynamic handling. The status of scientific, traditional, or local knowledge of the ecosystem and human activities that operate within the ecosystem is constantly evolving. At the same time, all types of information available are needed to support the process of decision making sustainably

when “controlling and mitigating impacts of human use” (Jørgensen, et al., n.d., p.1). The Arctic Council set up nine principles to enable a common understanding of EBM, potentially representing their approach towards EBM in the Central Arctic Ocean, see *Appendix 5, Figure 13*. In addition, the joint AMAP/CAFF/PAME Ecosystem Approach Expert Group (all belonging to the Arctic Council) developed a framework for implementation (PAME, 2014; Coon, 2016), consisting of six elements:

- 1) Identify the geographic extent of the ecosystem,
- 2) Describe the biological and physical components and processes of the ecosystem,
- 3) Set ecological objectives that define sustainability of the ecosystem,
- 4) Assess the current state of the ecosystem,
- 5) Value the cultural, social and economic goods produced by the ecosystem,
- 6) Manage human activities to sustain the ecosystem.

It was stated in 2016 that these elements were “assumed to be sufficient” (Coon, 2016, p.1) for the implementation of EBM. However, in how far the implementation of EBM has evolved in the last years remains unclear.

In 2017, WWF has analysed the implementation of EBM in the Central Arctic Ocean, finding that the process is rather moderate. The following recommendations were addressed to the arctic states and the Arctic Council:

Arctic countries

- ⇒ Invest in applying the ecosystem approach as requested by Arctic ministers, and implement the practical steps developed by the AC to inform implementation of EBM;
- ⇒ Develop monitoring programs to identify and assess the combined effects of multiple stressors on an ongoing basis;
- ⇒ Establish and/or strengthen multilateral cooperation to implement ecosystem-based management in key transboundary areas such as the Bering Sea, Beaufort Sea and Baffin Bay.

Arctic Council

- ⇒ Develop an overarching EBM goal, including supporting objectives;
- ⇒ Update and adjust Observed Best Practices in Ecosystem-based Ocean Management in the Arctic to make it applicable to all environments, including marine, coastal and terrestrial. (WWF, n.d.)

Celtic Seas

Key characteristics of marine management in the Celtic Seas can be seen in *Figure 11*.

Celtic Seas ecoregion: the shelf west of Scotland and Ireland, the Irish Sea, Porcupine Bank, Celtic Sea, western part of the Channel

Countries responsible for implementation: Ireland, United Kingdom (UK), France, Isle of Man

Each county (in France and Ireland) and sub-states (UK) are implementing it (e.g. Marine Strategy Framework Directive (MSFD)) according to own planning

"There have been a number of European research projects. . . . However, while these projects have provided a platform for consideration of different perspectives in developing management plans, they have no legal standing, are time-limited, and while it may be politically expedient for national governments to engage with such groups, there is no legal requirement to follow up on any specific recommendations." (O'Higgins, O'Higgins, O'Hagan, & Ansong, 2019, p.55)

FIGURE 11 INFO BOX MANAGEMENT IN CELTIC SEAS (HEESSEN, DAAN, & ELLIS, 2015; O'HIGGINS, 2016; O'HIGGINS, O'HIGGINS, O'HAGAN, & ANSONG, 2019)

The Celtic Seas ecoregion differs significantly from the Central Arctic Ocean, mainly because it is not coordinated by one entity. Rather, all bordering nations (France, Ireland, Isle of Man, UK) do not necessarily have to collaborate as each nation is responsible for management in their area of national jurisdiction. Several supporting collaborative projects were held in the past to help guide the implementation of EBM in this ecoregion, such as

- **PISCES (2009-2012)** (European Commission, n.d.-c),
- **Celtic Seas Partnership (2013-2017)** (European MSP Platform, n.d.-a),
- **SIMCelt (2015-2017)** (European MSP Platform, n.d.-b).

These projects were relevant when collaboratively expanding the level of knowledge and expertise on EBM in the Celtic Seas. However, they were time-limited and have no legal standing. It is up to national governments to decide whether to endorse the proposed recommendations.

No clear statement could be found on the general status of implementing EBM in the Celtic Seas ecoregion, likely caused by the institutional complexity. The next section presents the implementation of EBM in each nation separately.

FRANCE

The requirements of the EU-Directive MSFD were included in so-called Marine Action Plans for each county, with Brittany bordering the Celtic Seas (MAREOS, 2020). The status of implementation of EBM in Brittany remains unclear.

IRELAND

To incorporate both EBM and Marine Spatial Planning was highlighted as “necessary” (O'Higgins, O'Higgins, O'Hagan, & Ansong, 2019, p.51), characterizing marine management in Ireland and its waters. However, it remains difficult to determine the status of implementation of EBM at this point.

ISLE OF MAN

The present status of progress/achievements includes Marine Protected Areas (as of 2015, covering more than 3% of territorial waters), “establishing significant fisheries conservation areas, bringing in further sustainable management rules” (Charter, 2015, p.13), a Marine Biosecurity Plan, as well as marine habitat mapping and marine education efforts that have been made (Department of Environment, Food and Agriculture, 2020).

UNITED KINGDOM

The main elements of EBM (sometimes referred to as ‘Ecosystem Approach’) were integrated in the UK-Marine and Coastal Access Act, introduced in 2009 (Bloomfield, Stamp, & Goudge, 2014). In 2014, the status of implementation of MSFD, which includes many elements of the concept EBM, was for most parts theoretical and still in progress (MMO, 2014). When assessing the marine spatial plans for both UK and Ireland, “Scottish and Welsh plans were considered to most comprehensively demonstrate an ecosystem-based approach” (WWF, 2017, p.5). O’Higgins, O'Higgins, O'Hagan, & Ansong add to this that the “UK has traditionally engaged more proactively with environmental legislation and implemented more stringent measures than strictly necessary” (2019, p.54) in comparison with Ireland that has behaved more “reactive, in response to infraction proceedings or the potential for these” (2019, p.54). An example of management plans by a sub-state is “the Environment Bill for Wales 2013, and the . . . published Wales Marine and Fisheries Strategic Action Plan 2013” (Bloomfield, Stamp, & Goudge, 2014, p.11). However, it cannot yet be determined if the legislative ground is going to change due to Brexit. More background information on both the Central Arctic Ocean and the Celtic Seas can be found in *Appendix 7, Table 7*.

Comparing both the status of implementation in the Central Arctic Ocean and Celtic Seas, it can be said that both ecoregions have a strong base in knowledge, recommendations, and opportunities, not least due to cooperative projects and councils. The Central Arctic Ocean region provides collaboration through the Arctic Council where decisions need to be made in consensus between the member states, although each state is self-responsible for implementation on a national level. The concept of EBM was prioritised over the last decade, however, the status of implementation in this Large Marine Ecosystem (LME) remains to be unclear. The management of all waters differs significantly from the Celtic Seas as the largest part of the Central Arctic Ocean covers an area beyond national jurisdiction. For the Celtic Seas ecoregion, national or regional authorities are responsible for the implementation of EBM in their respective region. This results in a rather complex quilt of jurisdictional setting. The incorporation of EBM or goals of the MSFD were recognised in most regional management plans, with pre-Brexit UK being the most advanced in comparison to France, Ireland and the Isle of Man. To support the alignment and evaluation of EBM in the Celtic Seas, few cross-border short term projects were introduced in the past decade. However, even though all nations and actors seem to value the recognition of an Ecosystem Approach, the current status of implementation remains unclear in most regions. To better implement EBM, many actors demanded a product that could function as a base for knowledge.

3.4 TO WHAT EXTENT AND BY WHOM ARE ECOSYSTEM OVERVIEWS USED AS A TOOL WITHIN THE ECOREGIONS?

The following sub-chapter is divided into results from the desk research, the surveys, and the interview.

Desk research

During a desk research, organisations, universities, and other actors of diverse disciplines were analysed, primarily by searching for word frequency on their websites, using either the term ‘ICES Ecosystem Overview Central Arctic Ocean’ or ‘ICES Ecosystem Overview Celtic Seas’.

For the Central Arctic Ocean, the analysis showed no cases of usage or application stated in written records. 96 different websites or documents by actors were listed in the Excel file, see *Appendix 8, Table 8 and Appendix 9, Table 9*. The in December 2021 for the first-time published Ecosystem Overview was only referred to by actors such as e.g., the Protection of the Arctic Marine Environment Working Group (PAME) that were involved in the development of it. Those rather introduced the idea and purpose of such a product or mentioned its release date. For example, PAME stated that “the ‘Ecosystem Overview’ is being reviewed by the ICES advisory board and is expected as a final product in late 2021” (PAME, n.d.-b, p.17). The North Pacific Marine Science Organization (PICES) added information to this, published in a report by WGICA (2021, p.2), saying

[a]n Ecosystem Overview is an ICES advisory report supporting Ecosystem Based Management. The report is short and concise (maximum of 14–16 pages) highlighting the main characteristics and challenges the region faces. The first draft of the Ecosystem Overview for the Central Arctic Ocean was completed in November 2020. ICES conducted a light review of this draft in February 2021.

The lack of practical use of this product has been matched by the lack of announcement or promotion of other groups not involved in its production.

Regarding the Celtic Seas Ecosystem Overview, significantly more references could be found in the course of this desk study, namely 36 different references, see *Appendix 8, Table 8 and Appendix 10, Table 10*. This specific Ecosystem Overview is one of the oldest produced by ICES, therefore references from the last 15 years were found. Most references related primarily to fisheries or the health of fish stocks. The OSPAR Assessment Portal, e.g., stated that “according to ICES, some bycatch in Celtic Seas fisheries may have reduced in recent years due to less fishing activity and the use of acoustic alarms attached to fishing gear

as a mitigation technique” (OSPAR Assessment Portal, n.d.), referencing the Ecosystem Overview for the Celtic Seas from 2019. The PEW Charitable Trusts referred to the Ecosystem Overview from 2014, using it in the context of spawning migratory fish species (Mulvaney, 2015). Many other actors used graphs or tables from the advice product, such as the Marine Institute in Ireland (2011) and SEAFISH (n.d.). Similar to the Central Arctic Ocean results, the Celtic Seas’ Ecosystem Overview was also promoted by e.g. Pelagic AC, stating “ICES also produced an ecosystem overview for several ecoregions, e.g. the Celtic Sea and North Sea” (2016, p.10) or the National Marine Fisheries Research Institute in Poland, stating “The Fisheries Overview series expanded to include the Celtic Seas, as did the Ecosystem Overview series. . . .” (2019).

Generally speaking, there were no statements about the conscious rejection of Ecosystem Overviews or the mention that they were specifically not used. If there was no indication on the use, this was solely due to the lack of hits for a search term, either on Google Advanced Search or the respective website of actors. Ecosystem Overviews (based on the example of the Celtic Seas) were mostly used in the context of fisheries or concerning the ecological components, e.g., fish stocks. If used, they were mostly referred to in order to support an own argumentation or statement. No references were found supporting an argumentation on human dimension aspects. As case study, the findings display the number of users as well as the extent to which the product is used in two ecoregions.

In summary, one can say that no references to the applied product in a different context than informing could be found for the Central Arctic Ocean Ecosystem Overview. Striking was that no indication was found on informing about the new product by other actors not engaged in the process of making. Regarding the Celtic Seas Ecosystem Overview, most users applied the product in the context of fisheries or in relation to ecology. No reference of a stakeholder engaged in human dimensions could be found.

Self-prepared survey

The extent to which Ecosystem Overviews are used in practice is analysed in the following chapter, based on two surveys conducted within users and potential users of this advice product. In order to compare similarities or differences to the previous desk research section, the self-produced survey aimed for participants who either used the Central Arctic Ocean Ecosystem Overview or the Celtic Seas one. Because the survey provided by ICES as well as a few completions of the self-prepared survey did provide insights on a general level, they are analysed separately.

Case study regions

The survey conducted by the author displays 13 completions by participants, from which four indicated the usage of the Celtic Seas Ecosystem Overview, none regarding the Central Arctic Ocean Ecosystem Overview, three indicating they have not used Ecosystem Overviews before. The predominant discipline of participant's employment were the sectors of 'Environment' and 'Fisheries', in which most of them represent the role of science and research, followed by significantly less indications for advice and policy.

Two of the three participants who indicated that they did not use Ecosystem Overviews stated that they are engaged in ICES' work through being an expert, one indicated that no engagement had taken place. Regarding the reasoning why no Ecosystem Overviews was used before, it was stated that they do not provide sufficient information for their respective field or work. One participant stated that he/she never heard of it at all.

For the four participants who used the Celtic Seas Ecosystem Overview, all indications of the context in which it was used were distributed in equal numbers. Similar to the context of usage, the aspects of the products of greatest value to the participants were equally spread as well, with Climate Change Impacts and State of the Ecosystem having the agreement of all four participants. Suggestions were made on making the product more integrative and interactive, as well adding quantifiable components to support tactical decision making (for more details, see *Appendix 12*). The respective participants learned about Ecosystem Overviews through their engagement in ICES working groups or their own work environment. Valuable suggestions on potential ways to disseminate the product highlighted the 'word-to-mouth' aspect, meaning informing others through communication and therefore promoting the product. Another possibility was listed, namely the direct linkage to national researchers completing assessments like the Natural Capital Ecosystem Assessment. Through this, the advice product could be promoted on a larger

scale. Even though all four indicated that they used the product before, only two consider Ecosystem Overviews (operational) advice that can be used in their work, one disagreeing to the statement, and one other not being sure about it.

No indications were made regarding the Central Arctic Ocean Ecosystem Overviews, either on the usage of the product nor that it was not used for this ecoregion.

General ecoregions

Six participants provided insights based on the usage of Ecosystem Overviews of the Greater North Sea (4x), the Bay of Biscay (2x), and the Baltic Sea (3x). It was possible to indicate more than one other ecoregion. Similar to the case study regions, the six participants predominantly belong to the environment and fisheries sector, with two more indication referring to the energy and tourism/ recreation sector. All six participants described their role within their discipline as 'science and research'. Alike to the case study regions, the Ecosystem Overviews from other ecoregions were used more often in 2021 and 2022, however, showing that an Overview was used on average 2-5 times, rather than once. The context in which they were used as well as the aspects of greatest value were likewise pronounced as in the other group, both showing a similar distribution. Like with the former group, about 66% of users from non-case study Ecosystem Overviews know of no other (identical) product. Significantly more participants from other ecoregions than the case study do not consider Ecosystem Overviews 'advice' that can be used operationally in their work. To broaden the extent and the number of users, the following suggestions were made (for more details, see *Appendix 12*): include trends; focus on ongoing changes and actions to take; include trade-offs on fishing opportunities; translate the product in different languages.

In conclusion, the self-prepared survey revealed more insights than the previous step. All data gathered represent experiences with the Celtic Seas Ecosystem Overview, other ecoregions, or no product at all. No surveys were completed for the Central Arctic Ocean ecoregion. Most users belonged to the environmental or fisheries sector, within here working as scientist or researcher, using the product for consultation or informing purposes. No significant difference to the previous step could be found regarding the case study regions. Striking was that even though ten out of the 13 completions indicated that they used Ecosystem Overviews, only three said that they consider them advice that is operational/ useful in their work. This does hugely differ from ICES' objective on how Ecosystem Overviews are seen and taken up by practitioners.

Survey by ICES

From here on, all data is analysed under the assumption that Ecosystem Overviews have been used at some point in the past. The experiences of participants from the MIRIA and MIACO meeting cannot be traced back in more detail as questions on the usage or context in which it was used were not part of the performed survey. This survey was set up asking for the following feedback regarding Ecosystem Overviews: Topics to be added, Format/ Content of display material, Overall structure, and Ideas to make it more operational. Participants had the choice between indicating 'no changes are needed' or 'changes are needed', the latter requiring elaboration. There was no significant divergence found between the two study groups of the MIRIA and the MIACO participants. *Table 3* displays the aggregated data from both groups, divided into 'no changes are needed' and 'changes are needed'. The suggestions made are of particular value as it is assumed that the extent to which Ecosystem Overviews are used can be increased by adapting to the feedback that is given. The indication 'changes are needed' was interpreted as that the extent of usage could be increased.

TABLE 3 SUMMARY RESULTS SURVEY BY ICES, SHOWING THE NUMBER OF INDICATIONS

Category	No changes are needed	Changes are needed
Topics to be added	12	11
Format/ Content of display materials (1)	18	5
Overall structure	17	6
Format/ Content of display materials (2)	19	4
Ideas to make it more operational	12	11

Summarizing, it can be said that topics to be added included suggestions on more ongoing changes and pressures, e.g., climate change, the status of the latest science on a topic/region, and the effects of a policy

response on an ecosystem. Content wise, the demand for an inclusion on the Good Environmental Status (in the context of MSFD) was raised as well. Some participants indicated that the format and overall structure could be advanced through making graphs more readable, displaying precise data, and a generally clear and appealing layout. Ideas on how to make Ecosystem Overviews more operational included statements on making it more quantitative, more tactical (useful for tactical decision making), as well as making the data on which the advice is based available to the reader. For more details, see *Appendix 13*.

Concluding, the survey by ICES, performed during the MIRIA and MIACO meetings in early 2021, it was not specifically asking for feedback per ecoregion but rather on a general level. Most participants indicated that no changes to the format, content, overall structure, etc. are needed. However, suggestions on improvements included making it more precise and adapted to current pressures, more readable, tangible, quantitative, and directly linked and shared through national researchers.

Interview

The interview was held with Prof. Dave Reid, Principal Investigator in the Fisheries Ecosystems Advisory Services team at the Marine Institute (Ireland). He is an expert on Ecosystem Overviews who has contributed a significant part to the development and elaboration, especially in the Celtic Seas region. This interview aimed for a rather general perspective regarding the study area, even though most experiences were obtained within the Celtic Seas ecoregion.

From what was being said, the preliminary impression that the number of users and the extent to which the product is used could be increased was supported. Reid underlined the necessity of such a product, especially its active uptake in the context of informing oneself and informed decision making. However, Ecosystem Overviews are not yet expected to be taken up by managers and decision makers on a large scale. According to Reid, they are required to include more interdisciplinary aspects when making them operational. Through expanding the thematical and disciplinary scope of an Ecosystem Overview, it is likely that they are considered to a greater extent in decision making. This could prevent the recognition of aspects in isolation, therefore not assessing the bigger picture within an ecosystem. Not only is the interdisciplinary inclusion of different aspects seen as valuable but also the incorporation of a broader audience. Reid underlined the necessity of making the product likable to read by the general public. They are not only part of the ecosystem that the Ecosystem Overviews focusses on but also have a say in management through voting. Informing oneself about the ecosystem one is living in, eventually even impacting, does account for all roles in society. Overviews have the potential to be actively used by the wide public as they are freely available on the internet. As for the free access, the understanding of the context is equally important. For this, the most important key points could be summarized in the beginning of each document, e.g., going into detail on certain pressures on the ecosystem and why the wide public should be aware of it. A short and precise format that at the same time is easily understandable and traceable may increase the willingness to use this product. When negotiating or comparing interests, elements of an ecosystem tend to be measured according to a common value, in most cases money. Reid provided the hypothetical example of “How many cods is a dolphin worth?”. Comparing aspects of an ecosystem requires far more than this economical price tag. It is rather difficult as every stakeholder involved is likely to value aspects differently, all depending on individual preferences and interests. Developing an Ecosystem Overview that analyses and describes all aspects of an ecosystem in an equal manner becomes a complex task. It's a tightrope act to give equal room to diverse human activities,

different interests in the ecosystem, all brought to an audience that includes society in general. Concreteness and tangibility become fundamental. The necessary steps he considers important are best expressed by looking at his three wishes regarding Ecosystem Overviews. The first one would be that whenever an Ecosystem Overview is released, decision makers and others want to have it on their desk, meaning that they consider the product essential to their work, knowing about the release date and awaiting it with anticipation. The second wish addresses the appreciation for the work that goes into developing such a product. In more detail it was requested that organisations (outside and inside ICES) and employers show gratitude to the people who work on them, which of course requires that they know about Ecosystem Overviews. This topic merges seamlessly with the third wish expressed, namely that the work on this product becomes remunerated. To the question of whether Reid would welcome the linking of different advice products, he answered positively. As much of the data and topics addressed (for example between Ecosystem Overviews and Fisheries Overviews) partly overlap, it could work very well, as long as the focus of the Ecosystem Overviews as a general analysis is not lost. The interview ends with the proposal to create an additional product that combines information from different overviews but broken down to the most important: the “Things to think about-overview”.

In summary, the interview provided similar answers and suggestions as the participants of the surveys. The number of users as well as the extent to which they are used seem to be rather limited, requiring some general evolvments e.g., in its precise structure, the inclusion of different disciplines and interests, or the adapted dissemination, engaging with a broader audience than managers and decision makers. More details can be found in *Appendix 15*.

4. DISCUSSION

The previously presented results aimed at answering the question of what role Ecosystem Overviews have in fulfilling the ICES objective of supporting Ecosystem-based management in the ICES ecoregions. The following discussion is separated into one section that focusses on the methodology applied, followed by a section that discusses the results obtained.

METHODOLOGICAL APPROACH

The main element of the desk research on the usage of Ecosystem Overviews was to examine written records, looking into the amount or way of referencing to it. Two aspects need to be kept in mind when interpreting the results. Firstly, the selected case study ecoregions are of almost opposite nature. The Celtic Seas product is one of the oldest, regularly updated since 2005, whereas the Central Arctic Ocean product was first released in December 2021. The resulting number of references found or, in case of the Central Arctic Ocean not found, may therefore just represent the awareness of the product. It can be assumed that the longer a product has been published, the more it will have been presented or discussed in various meetings, workshops, or conversations in and outside of ICES. Secondly, one can expect a certain level of inaccuracy or probability of error when it comes to interpreting references in written records. It may be possible that not all sources for (background) knowledge were referenced to in official statements. It may be the case that Ecosystem Overviews were used as informative tool in preparation to meetings in which decisions were made, however when publishing a report on this very decision it was then not referred to the process of informing oneself in preparation. During the set amount of time to gather references, the numbers of references found per ecoregion cannot be directly compared to each other as there were 96 sources found for the Central Arctic Ocean, mostly with no indication to use, in comparison to 36 sources for the Celtic Seas where many references and quotes were noted. This does not mean that more sources could not be found in future studies. In addition to that, the question arises if the classification into the categories 'fisheries', 'ecological', 'biological', 'human dimension', and 'informing about the product' may have led to a false distinction between interests in the fisheries sector vs. social aspects. It can rather be expected that within the fishing industry, social and economic interests are both considered. As ICES mostly concerns data and advice on the context of fisheries, 'fisheries' were added as category, even though this does not give detailed information on the closer allocation into the wider spectrum of social, economic, ecological, and institutional interests.

Following the desk study, a self-prepared survey was conducted and assessed next to another retrieved survey by ICES. The results of the latter were offered to the author in the course of this study. The datasets by ICES were anonymized and handed over in consent with all survey participants. As the set-up of this study differed from the self-prepared one, it had to be assumed that if a participant provided feedback on Ecosystem Overviews (in general) that he/ she also used them in practice. Participants were not asked if they have experience with the product through actively using them or just by skimming them before filling in the survey. Due to the lack of commonality of the study parameters, the feedback of both surveys was not directly compared with each other. The suggestions and experiences were rather gathered and summarized in the form of recommendations. These other sets of data have caused yet another challenge, namely the broadening of the study area from only two ecoregions to a general scope. Because of this generalisation, the datasets were analysed without the variable of 'case study-ecoregion', as well as the six completions for non-case study ecoregions from the self-prepared survey. For future research, it is recommended to either invest more time in a specific ecoregion, actively pushing for more completions by participants, or focusing on a general scope, including all ecoregions. The latter could either be managed as to analyse all ecoregions or excluding the factor of 'ecoregion-dependant'. Similar accounts for the interview. Due to a lack of responses for interviews with (external) users of Ecosystem Overviews, it was chosen to do one qualitative interview with an expert on the product instead. This enables the study to include qualitative input from both external and internal sources. More insights from users of the product could be obtained in future research.

In general reference to the entire study, it must always be kept in mind that English was not the mother tongue of the author and therefore possible errors in the understanding of data or in the wording of results can occur.

EVALUATION OF RESULTS

From the conducted desk research on ICES objective of supporting EBM by producing Ecosystem Overviews as advice, and the role of Ecosystem Overviews, both stated by ICES, the question remains if the way ICES describes its product matches the understanding and perception of externals. From findings, it can be concluded that the perceptions on the role and the recognition of this product differ significantly between ICES and actors in the field of marine management. Limited dissemination and promotion is an important element, perhaps even the element that could drastically increase the uptake of Ecosystem Overviews by

the wider public. Throughout this research, the classification of when exactly ICES would sufficiently fulfil its objective remained challenging because this was dependent on several factors, some of which lie not within the direct responsibility of ICES. Examples are: Is the fulfilment of the ICES objective purely given when the product is produced? Or rather according to the level of application in practice? And if so, where does ICES responsibility end when it comes to clients/ actors reading the product? Is there a shared responsibility that asks for an adaption from both ICES and its clients/ actors in practice?

In the context of analysing the status of implementation of EBM in marine management, the Celtic Seas ecoregion was divided into national or regional authorities. For the UK, almost all findings have to be questioned because of Brexit in 2020, which may have led to a change in the management plans found. The UK is now “outside of the EU and it is unclear as to how the UK intends to manage its marine environment” (McQuatters-Gollop, n.d.) in the future. EU legislation is no longer legitimate in this region, which leaves open the question to what extent the UK wants to implement the goals of the EU MSFD, in which EBM plays a key role, in its own plans. Regardless of Brexit the findings of this sub-question do display the complexity of marine management, with EBM being one concept that not only is defined in various ways but also implemented on an individual level. As every nation follows their own plans and objectives, the shared interest in a knowledge product stands out against the general complex and sometimes contradictory quilt of marine management legislation. Ecosystem Overviews, when developed and shared to their full capacity, may hold the potential of being applied on a larger scale – laying the foundation for a common approach that is of interest to all participants, beyond jurisdictional boundaries. From comparing statements by ICES with external ones, it became apparent that most external actors in the field do not currently recognize Ecosystem Overviews as a tool of great value, other than what could be assumed from ICES’ perspective. Due to the lacking recognition that may result in a low level of usage, the role of Ecosystem Overviews in the context of supporting the implementation of EBM is rather limited.

Adding to what was discussed in the previous section on the desk research within the case study regions, the results display examples of how Ecosystem Overviews could be used and referenced to. However, the amount of data is not sufficient enough to make valuable statements on its use and value to users. Information on internal use (therefore not necessarily quoted in written records) or the context in which it is used was not obtained in this step, but aimed for during the surveys and interview.

Both the surveys and the interview did provide this research with many tangible suggestions and feedback on Ecosystem Overviews. They were seen as recommendations to increase the number of users as well as the extent of usage. This presupposes that Ecosystem Overviews are not used on a large scale which in turn is not in line with ICES' goals. Resulting from all analyses on the type of users and the extent to which Ecosystem Overviews are used, the high amount of recommendations and suggestions made can be interpreted as a high level of interest in the product. This interest is, however, not necessarily bound to the high amount of usage in practice but rather displays the demand for an evolving product. Suggestions made underline the desire to have a product that fits into the demand in today's and future marine management. The desired role of Ecosystem Overviews can be described as important and significant for various actors in the field, however, the current status is, as was requested by participants, expandable. Especially against the background of ongoing pressures on the state of the ecosystem, survey participants and the interviewee underlined similar concerns as were made by various actors in the context of implementing EBM, namely the adaptation of data sets, tools and legislation to those pressures.

5. CONCLUSION

This study analysed the role of Ecosystem Overviews in fulfilling the ICES objective of supporting EBM in the ICES ecoregions.

As to the main objective of ICES, one can best describe it supporting the understanding of the marine ecosystem and its benefits to society through the provision of advice. In regard to global marine management goals, EBM plays a crucial role and is therefore targeted in ICES' work and products, all linked to criteria and guidelines. When defining the role of Ecosystem Overviews, it became apparent that they function as a complementation to other ICES products and services. However, there is lacking knowledge on the consistent appreciation of this product between ICES and non-ICES stakeholders. During the assessment of definitions for EBM, it was striking how much variety there is in interpretation and phrasing from different actors around the world. Regarding the status of implementation of EBM in the ICES ecoregions Celtic Seas and Central Arctic Ocean, the two regions differed significantly in their statutory composition and collaborative management. The status of implementation of EBM for both ecoregions remains unclear. However, to better implement EBM, many actors require a product that could function as a base for knowledge. This very base of knowledge could be provided by Ecosystem Overviews. The desk study on the usage of Ecosystem Overviews revealed that no references were made to the Central Arctic Ocean Ecosystem Overview yet, bearing in mind that it was only released five months prior to this research. Differing to the former ecoregion, the desk study regarding the Celtic Seas revealed much more usage and uptake of the product over the last 15 years. Most users applied the Ecosystem Overview in the context of fisheries or ecology, such as health of fish stocks or impact by fishing activities. The surveys revealed more insights in the uptake of Ecosystem Overviews and the reasons why. Again, most users belonged to the environmental or fisheries sector, working as scientist and/or researcher. No surveys were completed for the Central Arctic Ocean region. Participants who used the Celtic Seas Ecosystem Overview indicated that they mostly worked with the product for consultation or informing purposes. The few participants who did not use the product did so because of insufficient information for their demand, or because they have never heard of the product in the first place. The statements of the group with experiences of other ecoregions largely overlapped with the data provided by participants who used the Celtic Seas Ecosystem Overviews. Striking was that even though ten out of the 13 completions indicated that they used Ecosystem Overviews, only three said that they consider them advice that is operational and useful in their work. This hugely differs from ICES' objective on how Ecosystem Overviews are seen and taken up by practitioners.

Both the self-prepared as well as the obtained survey by ICES revealed a large quantity of feedback and suggestions on Ecosystem Overviews, implying that if adopted, the number of users and the extent to which the product is used could increase. The survey by ICES, shared during the MIRIA and MIACO meetings in early 2021, did ask for general feedback unspecific to ecoregions. The majority of indications revealed that no changes to the format, content, or overall structure are needed. However, suggestions on improvements included making it more precise and adapted to current pressures, more readable, tangible, quantitative, as well as directly linked and shared through national researchers. The interview held with Prof. Dave Reid, an expert on Ecosystem Overview who has been actively engaged in the development and evolvement specifically in the Celtic Seas, did generally provide similar answers and suggestions as the participants of the surveys. The number of users as well as the extent to which Ecosystem Overviews are used seems to be rather limited, requiring some general evolvements e.g., in its precise structure, the inclusion of different disciplines and interests, or the adapted dissemination, engaging with a broader audience than only managers and decision makers.

Dealing with pressures and challenges caused by anthropogenic climate change, marine management must act in a sustainable way – which requires a knowledge base in the first place. In the broad field of marine affairs, a product such as Ecosystem Overviews would be highly demanded as a base for knowledge, providing managers and the general public with knowledge on the ecosystem they are living in. Combining all findings, it becomes apparent that ICES has invested in the evolvement of Ecosystem Overviews and has set up a coherent plan to produce and invest in it as an advice product. However, the product itself is not seen in an identical manner by most of its users, making the Ecosystem Overviews mostly not yet sufficient enough for use in practice. The divergence in considering the product ‘advice’ that is useful and operational as well as the discrepancies that have arisen between the current thematical status of Ecosystem Overviews and the demand expressed by practitioners underlined the necessity for adaptation. To support the further implementation of EBM, the product should be tailored to the needs of actors, but at the same time point out possible threats that need to be taken into account by managers and the public. The role of Ecosystem Overviews in sustainable marine management remains rather limited at the moment. Therefore, Ecosystem Overviews do not yet fulfil the ICES objective of supporting Ecosystem-based management in the ICES ecoregions.

6. RECOMMENDATIONS

The following recommendations aim to fulfil the ICES objective of supporting EBM in ICES ecoregions through the production of Ecosystem Overviews, having a long-lasting impact on sustainable marine management.

FORMAT AND STRUCTURE OF ECOSYSTEM OVERVIEWS

- ⇒ Adapt to current challenges and pressures
- ⇒ Keep it 'short and precise'
- ⇒ Advice must be of tangible and immediate nature
- ⇒ Keep the layout readable and the content understandable
- ⇒ "Things to think about" – product that contains information from both Ecosystem Overviews, Fisheries Overviews and more

DISSEMINATION OF THE PRODUCT

- ⇒ Direct link with national researchers
- ⇒ Promote the usage in practice, e.g., in education
- ⇒ Promote the product within ICES

ITS ROLE IN MARINE MANAGEMENT

- ⇒ Underline its necessity to immediately bring forward the implementation of EBM
- ⇒ Promote Ecosystem Overview as a communication tool

FURTHER RESEARCH

- ⇒ Can one make assumptions on the efficiency of Ecosystem Overviews based on their usage?
- ⇒ Ways to share a knowledge base – online or as paper print? Short or extensive?

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Appendix

APPENDIX 1 – SUB-QUESTION 1 REQUIREMENTS FOR ICES PRODUCTS

In their Advisory Plan (2019-a), ICES lists further requirements in more detail, all needed to offer the best products and fulfil its role as an advice provider.

- Credibility – This can be achieved through consensual scientific advice which is also peer-reviewed. As a result, there is a double safeguard for the working method and product creation.
- Relevancy – ICES strives for an ecosystem advice framework that respects and considers international objectives summarized by several directives or resolutions, such as the Marine Strategy Framework Directive or the UN Convention of Biological Diversity.
- Legitimacy – As advice products are used and requested by decision makers, expectations and interests of requesters of advice are required to be reflected.
- Assuring quality – The end-to-end quality assurance framework can secure a sound data management, data integration, and translation into advice.
- Incorporation innovation – In cooperation with scientists, advisors and advice requesters, ICES will take up new and a broader range of scientific knowledge with the interest of developing the capacity of providing ecosystem-based advice.
- Highlighting benefits – In order to provide credible, timely and relevant advice, data needed is “based on the best available science and is characterized by quality assurance, developed in a transparent process, in an unbiased, independent manner”(ICES, 2019a)

- Sharing evidence – When advice is delivered, ICES highlights the necessity to show and explain the methods used to obtain data next to general principles.
- Evolving evidence – In dialogue with requesters of advice, management objectives, future scenarios and potential trade-offs are determined as well as mechanisms that could alert stakeholder in case of changes in marine ecosystems and human activities.
- Identifying needs – To be aware of potential improvements, gaps, and emerging issues is key, describing the responsibility ICES has towards the scientific community and the requesters of advice.

APPENDIX 2 – SUB-QUESTION 1 ADDITIONAL DATA

TABLE 4 ADDITIONAL INFORMATION SUB-QUESTION 1

Name of author/ expert group/ affiliation, with year	Link to source	Quote / Paraphrase	Notes, if necessary
ICES, 2021a	See bibliography	In the current Strategic Plan, ICES refers to its objective as helping policy developments by providing impartial evidence. Ecosystem Overviews, next to other overviews, function as a tool to accomplish this objective. Provide “impartial evidence on the state and sustainable use of our seas and oceans” “Generate state-of-the-art advice for meeting conservation, management, and sustainability goals.” ICES objective: “Commitment to better understanding marine ecosystems and securing the benefits that people derive from them” Implementing Strategic Plan will ‘improve food security and otherwise benefitting people’s lives and livelihoods’ => objective? “Advance understanding of marine ecosystems, their uses, and their connections with society”	

		“We will facilitate the incorporation of a wider range of scientific knowledge into advice to inform decision-makers and society about the state of our seas and oceans, the consequences of human use, and options for conservation and management.” “We will continue <u>to develop and coordinate integrated, quality assured, and cost-effective monitoring programmes</u> and to explore the oceans to improve our understanding of the distribution and function of marine life and habitats. We will <u>evaluate and optimize survey design</u> and advance and implement <u>innovative technologies to collect, process, and analyse data</u>. This will be accomplished with a <u>focus on supporting fisheries assessment, integrated ecosystem assessment and ecosystem-based management</u>.” “Improve the quality and transparency of our advice and the processes through which it is developed” “We will regularly publish, update, and disseminate overviews on the state of fisheries, aquaculture, and ecosystems in the ICES region, drawing as appropriate on analyses of human activities, pressures, and impacts, and incorporating social, cultural, and economic information”	
ICES, n.d. (ICES advice and science in areas beyond national jurisdiction)	https://www.ices.dk/news-and-events/Documents/Press%20Room/Ar eas%20Beyond%20National%20Jurisdiction.pdf	“Our goal is to provide the best available science for decision-makers to make informed choices on the sustainable use of the marine environment and ecosystems.” Advice on fishing opportunities ICES advisory process requires these analyses (harvesting of 10–15 fish stocks in the Northeast Atlantic based on analyses by the Working Group on the Biology and Assessment of Deep-sea Fisheries Resources; advice on a further 10 stocks from analyses by other working groups) to be peer reviewed and quality assured before being drafted into catch advice Advice of ecosystem protection Both the MPA (Marine Protected Areas) and EBSA (Ecological and Biologically Significant Marine Areas) proposals were fully peer reviewed by ICES using our network of experts on the various aspects of biodiversity that were proposed for protection	

		ICES PRODUCTS AND SERVICES • Advice on fishing opportunities for app. 250 stocks • Advice in response to special requests • Ecosystem and fisheries overviews • International peer review • Data used in science and advisory products • Science highlights within areas of societal importance • Identification of research needs • Training • Publications	
ICES, 2019b	See bibliography	“Our science will advance and shape understanding of marine ecosystems, improve assessments of the effects of human activities, improve observations of the seas and oceans, and provide evidence and solutions to support conservation and management.”	ICES has marine science objectives , see scientific priorities
ICES, 2019a	See bibliography	Delivering evidence-based advice to meet conservation, management, and sustainability goals + Advice to support ecosystem-based decision-making for our seas and oceans “This advice supports ecosystem-based decision-making for the management of human activities in our seas and oceans, and contributes towards the effective application of an ecosystem approach. The approach seeks to maintain the health of marine ecosystems, alongside appropriate human use, for the benefit of current and future generations”	

		“The interconnected challenges encountered by managers of natural resources, species and habitat biodiversity targets while adapting to climate change are central to ICES” “Ecosystem Overviews - Increasing our capacity to provide integrated ecosystem advice. The Ecosystem Overviews are central to ICES approach to support evidence-based ecosystem-based management” “Requests for advice will be answered following ICES framework and guidelines for providing fisheries advice and the developing framework for ecosystem advice. Key phrases illustrating the ecosystem approach • Management of human activities • Consideration of collective pressures • Achievement of good environmental status • Sustainable use • Optimization of benefits among diverse societal goals • Regionalization • Trade-offs • Stewardship for future generations” “Evidence is required to explore the consequences of likely trade-offs between and within sectors as well as between sectors and conservation and protection obligations. This is to support sustainable development aimed at both human and ecosystem wellbeing and stewardship of marine ecosystems” Overviews “providing supporting context and allowing users to understand the implications of sectoral decisions in an ecosystem context”	
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		Information on different overviews: Fisheries are put into the context of other anthropogenic activities that impact marine biodiversity and the influence of climate change. They provide a concise and informative introduction to ecoregions and human activities considered in other ICES advice. Ecosystem Overviews identify the main human pressures and environmental characteristics and provide a description of the state of the ecoregions. Fisheries Overviews summarize fishing activities in the ecoregions, describing the countries and fleets, the distribution and intensity of fishing activities, catches and bycatches. They also cover management of the fisheries, the status of fished stocks, wider fisheries impacts and advice on the trade-offs linked to mixed fisheries scenarios. Aquaculture Overviews will describe the distribution, ecosystem interactions, benefits, impacts and potential of aquaculture production at a regional scale. We will continue to provide the evidence base for policy-developers and managers of marine activities in response to their needs for recurrent advice and special one-off requests. To embed the provision of evidence in the context of ecosystem-based management, the advice will be framed within Fisheries, Aquaculture, and Ecosystem overviews. ICES Viewpoints will also provide valuable contributions to global discourse around the state of the marine ecosystem, the management of human impacts, and the provision of goods and services Credibility: “The dual tools of consensual deliberation of science and independent peer review of those deliberations are the key mechanisms to deliver our vision.” Relevancy: “The management objectives determined by society are already incorporated into the fisheries advice framework. We will work with partners to create a similar ecosystem advice framework which reflects international objectives, such as those of the UN Convention of Biological Diversity (CBD) and regional objectives such as the Baltic Sea Action Plan, North-East Atlantic Environment Strategy, and the Marine Strategy Framework Directive. We will also use FAO guidance on the ecosystem-based fisheries management to link and where possible reconcile resource management and biodiversity conservation objectives.” Legitimacy: “Continuing adaption and improvement of our processes to reflect the expectations of the requesters of advice”	
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		Assuring quality: “The existing quality control and assurance processes are enhanced to form an end-to-end quality assurance framework that will encompass best practice in data management, data integration, and translation into advice.” Incorporation innovation: “ICES advice is based on the best available knowledge, while also meeting our stringent requirements for transparency, traceability, documentation, peer-review, robustness, and being relevant to the needs of requesters and stakeholders. We will work with scientists, advisors, requesters of advice, and stakeholders and be guided by their feedback as we assimilate new and a wider range of relevant scientific knowledge, especially on natural resource management, biodiversity and climate change. The principal use of assimilated knowledge will be to advance our capacity to provide ecosystem-based advice.” Highlighting benefits: “ICES has recognised the need to have credible, timely and relevant advice. The advice is based on the best available science and is characterized by quality assurance, developed in a transparent process, in an unbiased, independent manner” Sharing evidence: “The methods used to create the advice must be transparent and explained with the advice. The flow from the underlying science research to the published advice will be explicitly described, together with the principles by which we deliver the advice and evidence.” Evolving evidence: “We will actively engage with requesters to understand and meet their oncoming needs. Efforts with requesters will intensify to identify and clarify management objectives, future scenarios and potential trade-offs. Mechanisms will be developed to alert managers and stakeholders to changes in the marine ecosystem and human activities.” Identifying needs: “To enhance the provision of advice, we need to ensure that the scientific community and advice requesters are aware of potential improvements, gaps, and emerging issues that should be addressed.”	
Lassen, H.; Kelly, C.; and	https://www. researchgate	Background to introduction of scientific priorities:	

Sissenwine, M., 2014 (ICES advisory framework 1977–2012: from Fmax to precautionary approach and beyond)	.net/publications/27538394 8 ICES advisory framework 1977-2012 From Fmax to precautionary approach and beyond	“The establishment of the ICES Advisory Committee on Fishery Management (ACFM) in 1977 required that ICES develop a formal basis for its advisory work, and a set of scientific principles and objectives was subsequently formulated (ICES, 1977)” Change from advisory committee on ecosystems to ACOM: “The ecosystem approach has gained importance over the past 20 years. In 2001, ICES established another advisory committee, the Advisory Committee on Ecosystems (ACE), to deal with these issues. However, this structure was cumbersome; a more holistic approach was needed than what could be achieved by separate advisory committees. Consequently, a single Advisory Committee (ACOM) was established in 2008 merging the then three advisory committees (ACFM, ACE, and the Advisory Committee on the Marine Environment) into a single unit” “The advisory structure within ICES developed after 1977 with the addition of the Advisory Committee for Marine Pollution (ACMP), later renamed the Advisory Committee on the Marine Environment (ACME), and the Advisory Committee for Ecosystems (ACE). These committees were merged in 2009 to form the Advisory Committee (ACOM). These institutional changes reflected the need to provide integrated ecosystem advice in addition to the fishery advice” Early stages of formal basis of advice: “ICES has provided advice in the context of international conventions and international law. The objectives in these agreements are often formulated in terms of rational yield and resource conservation. For example, the preamble of the North East Atlantic Fisheries Convention (1959) states the purpose of the Convention as “desiring to ensure the conservation of the fish stocks and the rational exploitation of the fisheries of the Northeast Atlantic Ocean and adjacent waters ...”. Similar formulations are used in other legal documents concerning the conservation and management of fishery resources.” Fisheries advice in 2012: “The ICES approach to fishery advice integrates a PA, maximum sustainable yield, and an ecosystem approach in a single advisory framework. In accord with the aggregate of international	
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		guidelines, the aim is to inform policies for high long-term yields while maintaining productive fish stocks within healthy marine ecosystems” Ecosystem-based concept in fisheries advice: “The advisory objectives were influenced by the need for “ecosystem-based advice”, e.g. the UN Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem (UN, 2001) that called for “ecosystem-based fisheries management” and noted that including ecosystem considerations in fishery management would enhance management performance, and advocated “developing and implementing management strategies that incorporate ecosystem considerations and which will ensure sustainable yields while conserving stocks and maintaining the integrity of ecosystems and habitats on which they depend.” This expanded the considerations required for fishery management advice to include the state of the ecosystem in which the fish resources live and how fisheries impact this system. However, for most fisheries, the management measures remained as an annual TAC supplemented with technical measures and bycatch restrictions for the protection of vulnerable habitats and species.” “ICES has constantly been analysing how best to include ecosystem considerations in fishery advice. The changes in its advisory committee structure that took place in 2001 and 2009 were introduced with the prime objective to promote ecosystem-based advice. ICES (2012) points out that its MSY concept is not in any way separated from the ecosystem or PAs, but rather that these approaches are nested within each other”	
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		Table 2. Themes and objectives for the ICES advisory strategy. <table><tr><th>Themes</th><th>Objectives</th></tr><tr><td>Data</td><td>Access to more and better data to fulfil advisory needs</td></tr><tr><td>Human resources</td><td>A scientific community with enhanced capability to contribute to advice</td></tr><tr><td>Integration</td><td>Integrated advice based on advances in scientific knowledge and ecosystem considerations</td></tr><tr><td>User needs</td><td>Responsiveness to the evolving needs of advice users</td></tr><tr><td>Credibility</td><td>Advice that has earned and enjoys a high degree of credibility</td></tr><tr><td>Planning</td><td>Expectations for advice harmonized with human and fiscal resource constraints</td></tr></table>	Themes	Objectives	Data	Access to more and better data to fulfil advisory needs	Human resources	A scientific community with enhanced capability to contribute to advice	Integration	Integrated advice based on advances in scientific knowledge and ecosystem considerations	User needs	Responsiveness to the evolving needs of advice users	Credibility	Advice that has earned and enjoys a high degree of credibility	Planning	Expectations for advice harmonized with human and fiscal resource constraints	
Themes	Objectives																
Data	Access to more and better data to fulfil advisory needs																
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User needs	Responsiveness to the evolving needs of advice users																
Credibility	Advice that has earned and enjoys a high degree of credibility																
Planning	Expectations for advice harmonized with human and fiscal resource constraints																
ICES, 2021f	See bibliography	Background to advisory process: “ICES advisory process is open and transparent and generates independent, credible, and peer-reviewed advice based on the work of ICES scientific community. All experts are called on to declare any conflicts of interest. The diversity of scientific topics addressed allows ICES to provide advice on issues ranging from the effects of contaminants on individual animals to the status of fish stocks and the effects of multiple human pressures and climate at the scale of ICES ecoregions.”															

		Framework of ICES advisory process  <pre> graph LR A[Request formulation] --> B[Peer review] B --> C[Knowledge synthesis] C --> D[Advice production] </pre> Request formulation Iterative dialogue with requesters and scientists to build request and confirm roles Peer review Independent review of methods ensuring use best available science and ICES frameworks Knowledge synthesis Quality assured data and knowledge building via expert groups using ICES data policy Advice production Draft answer to request, publish with international consensus, and explain evidence and rationale “Advisory products frequently provide recommendations and suggestions on how the science and data flows can be further utilized, developed, and improved. This feedback stimulates work within ICES scientific community and, at a national level, helps coordinate and improve the monitoring of marine ecosystems and how we use their services.” “All advice is published on ICES website.” “The majority of requests are in support of the development or implementation of policies and legislation to meet conservation, management, and sustainability goals and objectives. A list of current policies and legislation considered by ICES for the management of human activities in the marine ecosystem is presented in Annex 1” Annex 1:	
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		Annually, ICES considers the policy and legislation under which it provides advice. The current legislation that impacts the advice is: • The United Nations Convention on the Law of the Sea (UNCLOS; UN, 1982), which includes a call for a maximum sustainable yield (MSY) approach to managing fisheries; • The United Nations Conference on Environment and Development (UNCED; UN, 1992a), including Chapter 17 of Agenda 21, which highlights a precautionary approach; • The United Nations Straddling Fish Stocks Agreement of 1995 (UN Fish Stocks Agreement [UNFSA]; UN, 1995) and the FAO Code of Conduct for Responsible Fisheries (Food and Agriculture Organization of the United Nations [FAO]; FAO, 1995), both of which call for a precautionary approach; • The Convention on Biological Diversity (CBD; UN, 1992b), which calls for conservation of biological diversity through an ecosystem approach and includes biodiversity goals and targets; • The Johannesburg Declaration of the World Summit on Sustainable Development (WSSD; UN, 2002), which calls for an ecosystem approach and rebuilding fisheries to maximum sustainable yield; • The International Union for Conservation of Nature (IUCN), which influences, encourages, and assists societies in conserving the integrity and diversity of nature and ensures that any use of natural resources is equitable and ecologically sustainable. In addition, ICES advice responds to the policy and legal needs of ICES Member Countries as well as to multinational and intergovernmental organizations that use the advice. Some applicable policy and legal instruments include: • The OSPAR Atlantic Strategy; • The HELCOM Baltic Sea Action Plan;	
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		• The Common Fisheries Policy of the European Union (CFP; EU, 2013); • The Marine Strategy Framework Directive (MSFD; EU, 2008); • The Norwegian Marine Living Resources Act (Anon., 2008); • The Russian Federal Law on Fisheries and conservation of aquatic biological resources (Anon., 2004); • The Icelandic Fisheries Management Act (Anon., 1990); • The Norwegian Act on the Management of Marine Resources (Anon., 2017); • The UK Fisheries Act (Anon., 2020). ICES objective position in giving out advice: “However, requests may relate to issues governed by normative, ambiguous, or even incompatible policy or legislative goals and objectives. In responding to these more complex requests, it is not ICES role to reconcile objectives; rather the organization strives to provide evidence-based advice that takes account of the ambiguity and complexity in societal objectives, illustrating the consequences of policy choices. This requires an iterative approach with a high degree of transparency and consultation with advice requesters.” “Consistent with its Strategic Plan and the ecosystem approach, ICES strives to maximize the utility of the data, science, and advice supplied by ICES Member Countries.” => never ending evaluation “Transparency of the advisory process and the delivery and publication of clear and unambiguous advice is fundamental for an effective ecosystem approach. The nature of advice requests is broad and each individual advisory product is tailored so that it is accessible and understandable to all interested and informed non-experts.” Extra products: overviews and viewpoints “ICES provides a range of advice products relating to marine ecosystems, from advice on fishing opportunities to advice on ecosystem and environmental issues. Based on needs identified by ICES	
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		scientific community and requesters of advice, ICES produces and regularly updates Ecosystem and Fisheries Overviews; Aquaculture Overviews are also in production. Overviews are geographically based and developed at the level of ICES ecoregions. In addition, ICES produces Viewpoints on emerging topics related to the state and sustainable use of marine ecosystems. Overviews and Viewpoints are formally approved for publication by ICES Advisory Committee (ACOM) as ICES advice."	
ICES, 2020 (A new framework for ICES advice)	https://www.ices.dk/news-and-events/news-archive/news/Pages/AdvisoryPrinciples.aspx	"Ballesteros- The advisory process facilitates exploring the space for decision-making (principle 3), mobilizing new knowledge and knowledge sources (principles 4 and 5) and enabling advisory tools that comprehensible embed the ecosystem approach without risking the integrity of the advice"	
ICES, 2019 (Advice basis)	https://www.ices.dk/sites/pub/Publications/Advice/2019/2019/Introduction to	"ICES mission is to advance and share scientific understanding of marine ecosystems and the services they provide, and to use this knowledge to generate state-of-the-art advice that meets conservation, management, and sustainability goals. This advice supports ecosystem-based decision-making for the management of human activities in the ICES area, and contributes to the effective application of an ecosystem approach. The approach seeks to maintain the health of marine ecosystems, alongside human use, for the benefit of current and future generations."	

	advice 2019.pdf		
ICES, 2020 (ICES Annual Report 2019)	https://issuu.com/icesdk/docs/annual-report-2019-english	“Ecosystem Science: Advance and shape understanding of the structure, function, and dynamics of marine ecosystems — to develop and vitalize marine science and underpin its applications.” “By estimating the vulnerability of marine ecosystems to pressures and impacts and assessing human impacts on ecosystem goods and services, we can develop approaches to mitigate undesirable impacts”	
ICES, 2020d	See bibliography	“ICES mission <i>“to advance and share scientific understanding of marine ecosystems and the services they provide and to use this knowledge to generate state-of-the-art advice for meeting conservation, management, and sustainability goals.”</i> EBM is a process towards this goal, and the organization is incrementally using its network of researchers, data centre, and advisory role to provide the scientific basis for operational management. As the process is incremental, it allows ICES to respond appropriately to the changing demands of a developing policy landscape and dynamic ecosystem.”	

APPENDIX 3 – SUB-QUESTION 2 ADDITIONAL DATA

TABLE 5 ADDITIONAL INFORMATION SUB-QUESTION 2

Name of author/ expert group/ affiliation, with year	Link to source	Quote / Paraphrase	Notes, if necessary
ICES, 2021b	See bibliography	“Ecosystem overviews are key products in ICES approach to supporting ecosystem-based management (EBM). The overviews complement other types of advice, providing supporting context and allowing users to understand the implications of sectoral decisions and impacts in an ecosystem context”	
ICES, n.d. (ICES advice and science in areas beyond national jurisdiction)	https://www.ices.dk/news-and-events/Documents/Press%20Room/Articles%20Beyond%20National%20Jurisdiction	“In addition to these specific areas of advice, we are also developing a series of ecosystem overviews for each ICES ecoregion. Each overview provides a description of the state of ecosystem, the main human pressures and activities, as well as an overview of the likely effects of climate change. These overviews also provide an easy way to access relevant parts of ICES databases.”	

	al%20Juristic tion.pdf		
ICES, 2021f	See bibliography	“Overviews are continuously evolving advisory documents, addressing issues relevant to regional managers and incorporating new knowledge on regional trends in the ecosystem, fisheries, and aquaculture.”	
ICES, 2020 (ICES Annual Report 2019)	https://issuu.com/icesdk/docs/annual-report-2019-english	“Our Ecosystem Overviews identify the main environmental influences and human pressures in ICES ecoregions, and explain how these affect ecosystem components including marine mammals, seabirds, threatened species, and non-indigenous species. The overviews are a valuable resource for managers, stakeholders, scientists, and others interested in Northeast Atlantic ecosystems.” In 2019, our Ecosystem Overview portfolio strengthened with the addition of the Oceanic Northeast Atlantic and Azores ecoregions. We now produce nine ecosystem overviews, covering the vast majority of ICES ecoregions: Oceanic Northeast Atlantic, Azores, Baltic Sea, Barents Sea, Bay of Biscay and the Iberian Coast, Celtic Seas, Greater North Sea, Icelandic Waters, and Norwegian Sea. We are working towards full coverage of subarctic waters with an overview for the Central Arctic Ocean and Greenland Sea. Together with the Arctic Council’s Protection of the Arctic Marine Environment Working Group (PAME) and the North Pacific Marine Science Organization (PICES), our Working Group on Integrated Ecosystem Assessment for the Central Arctic Ocean gives ICES a central role in this remote and changing ecosystem. These outputs will uphold the commitments that we made at Our Ocean 2019 conference to provide ecosystem overviews for areas beyond national jurisdiction (ABNJ), and specifically for the Oceanic Northeast Atlantic and the Central Arctic Ocean. All eight Arctic Council countries are members of ICES, and through our cooperation with PICES this collaboration in the Arctic extends even further. Cooperating with PICES, PAME, and NOAA, we co-sponsored a 2019 conference Implementation of the Ecosystem Approach to Management in the Arctic: Integrating information at different scales in the framework of EA implementation.	

		"ICES, like many fisheries science and management organizations around the world, has turned to Integrated Ecosystem Assessments (IEAs) as a key tool for conducting Ecosystem-Based Management. Under the aegis of our Integrated Ecosystem Assessment Steering Group, multiple expert groups are studying IEAs, with ten regional seas groups working to implement IEAs in their seas. Ecosystem Overviews are being revised to improve the range of data (including social and economic) they supply for IEA inputs. And ICES expert groups are now publishing some of the cutting edge literature on IEAs." Patricia Clay, Co-chair of Working Group on Maritime Systems (WGMARS)"	
ICES, 2013	https://www.ices.dk/news-and-events/news-archive/news/Pages/asdf.aspx	"According to discussions at WKECOVER, ecosystem overviews have four key purposes: - to describe the location, scale, management, and assessment boundaries of eco-regions; - to alert ICES expert groups to situations within the environment and ecosystems that are expected to significantly influence their advice; - to describe the distribution of human activity and resultant pressure on the environment and ecosystem; - to describe the state of the ecosystem and to comment on pressures accounting for changes in state."	

APPENDIX 4 – SUB-QUESTION 3 – DEFINITIONS OF EBM

DEFINITIONS OF EBM	
“The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. Thus, the application of the ecosystem approach will help to reach a balance of the three objectives of the Convention: conservation, sustainable use, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.” <i>CBD</i>	The ecosystem approach is defined as “the comprehensive integrated management of human activities based on the best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of marine ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity”. <i>OSPAR Commission</i>
“In ecosystem-based management, the associated human population and economic/social systems are seen as integral parts of the ecosystem. Most importantly, ecosystem-based management is concerned with the processes of change within living systems and sustaining the goods and services that healthy ecosystems produce. Ecosystem-based management is therefore designed and executed as an adaptive, learning-based process that applies the principles of the scientific method to the processes of management.” <i>UNEP</i>	“Ecosystem-based management is a long-term, integrated approach that recognizes humans are part of and have significant influences on their environments. It is a shift away from conventional management paradigms that are often jurisdictional, short term and consider humans to be independent of nature. An ecosystem-based management plan includes adaptive management strategies and trade-offs, whether between ecosystem services, management strategies or other components of the plan, that are made as explicitly as possible.” <i>Seaweb</i>
An approach that, “requires that development activities be coordinated in a way that minimizes their impact on the environment and integrates thinking across environmental, socio-economic, political and sectoral realms.” <i>PAME</i>	“EBM looks at all the links among living and nonliving resources, rather than considering single issues in isolation... Instead of developing a management plan for one issue... EBM focuses on the multiple activities occurring within specific areas that are defined by ecosystem rather than political boundaries.” <i>U.S. Commission on Ocean Policy</i>

FIGURE 12 DEFINITIONS OF EBM (ARCTIC COUNCIL, 2013)

APPENDIX 5 – SUB-QUESTION 3 PRINCIPLES FOR IMPLEMENTATION OF EBM BY ARCTIC COUNCIL

3. PRINCIPLES²

In order to proceed with a common understanding of the core elements of EBM, an analysis was conducted of all relevant EBM-related principles that were identified by Expert Group members and Observers. Sources included:

- Convention on Biological Diversity, Principles of the Ecosystem Approach;
- United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea, agreed consensual elements from its 7th meeting;
- Best Practices in Ecosystem-based Oceans Management in the Arctic (BePOMAr);
- World Wildlife Fund Principles for Ecosystem-based Management; and,
- Ecological Society of America (ESA)³.

Based on this assessment, a series of principles were identified that could represent common elements of a potential approach by the Arctic Council. These principles include:

1. EBM supports ecosystem resilience in order to maintain ecological functions and services.
2. EBM recognizes that humans and their activities are an integral part of the ecosystem as a whole, and that sustainable use and values are central to establishing management objectives.
3. EBM is place-based, with geographic areas defined by ecological criteria, and may require efforts at a range of spatial and temporal scales (short-, medium- and long-term).

4. EBM balances and integrates the conservation and sustainable use ecosystems and their components.

5. EBM aims to understand and address the cumulative impacts of multiple human activities (rather than individual sectors, species or ecosystem components).

6. EBM seeks to incorporate and reflect, to the extent it is relevant, expert knowledge including scientific, traditional and local knowledge.

7. EBM is inclusive and encourage participation at all stages by various levels of government, indigenous peoples, stakeholders (including the private sector) and other Arctic residents.

8. Transboundary perspectives and partnerships can contribute significantly to the success of EBM efforts.

9. Recognizing that ecosystems and human activities are dynamic, that the Arctic is undergoing rapid changes, and that our understanding of these systems is constantly evolving, successful EBM efforts are flexible and adaptive.

The analysis outlining the linkages and commonalities amongst the principles reviewed, as well as additional context on the rationale for their inclusion, is outlined in Table 1. A comprehensive listing of the principles reviewed is included in Annex 3.

FIGURE 13 PRINCIPLES FOR IMPLEMENTATION OF EBM IN CENTRAL ARCTIC OCEAN (ARCTIC COUNCIL, 2013)

APPENDIX 6 – SUB-QUESTION 3 ADDITIONAL DATA CONCEPT OF EBM

TABLE 6 ADDITIONAL INFORMATION SUB-QUESTION 3 CONCEPT OF EBM

Name of author/ expert group/ affiliation, with year	Link to source	Quote / Paraphrase	Notes, if necessary
ICES			
ICES, 2020 (A new framework for ICES advice)	https://www.ices.dk/news-and-events/news-archive/news/Pages/AdvisoryPrinciples.aspx	“For the past four years, our Advisory Committee (ACOM), who are responsible for all ICES advice, has been developing a more appropriate framework that incorporates the ecosystem approach in all sectors.” “ The Pew Trusts comments that, “Establishing the ecosystem approach as the central tenet that governs ICES scientific advice processes is exactly what is needed to provide the right information to member countries and intergovernmental organizations, to enable them to manage human activities sustainably.”” “Kåre Nørdlie Nielsen: The new guide to ICES advisory framework not only provides an account of these processes, but also identifies the principles that underpins them. By putting principles on the table, ICES will stimulate reflection, and thereby help providers, requesters and other users of	

		ICES advice to navigate in the complex, uncertain and value-laden context of marine resources and ecosystems” “... states Mark Dickey-Collas, Chair of ICES Advisory Committee, as they allow us to move from a fisheries focused framework into a broader advice framework, one that encourages ecosystem-based management across all sectors.”	
ICES, 2004 (ICES Advice)	https://www.ices.dk/sites/pub/Publications/Advice/2004/oct/ICES%20Advice.pdf	“Marine management should take an integrative view and include ecosystem considerations, i.e. use an Ecosystem Approach. ICES is implementing an Ecosystem Approach in its advisory work. This is in response to several political declarations calling for such an approach, e.g. Reykjavik 2001, Bergen 2002, and the World Summit on Sustainable Development, Johannesburg, 2003. Ecosystem considerations have been included in ICES advice in the past both as a response to requests for advice regarding ecosystems and more specifically in relation to fisheries” “Management advice under an Ecosystem Approach is a multi-step procedure which includes identification of ecosystems, identification of the relevant ecosystem components, and linking human activities to impact on the ecosystems.”	
ICES, 2020d	See bibliography	“ICES mission <i>“to advance and share scientific understanding of marine ecosystems and the services they provide and to use this knowledge to generate state-of-the-art advice for meeting conservation, management, and sustainability goals.”</i> EBM is a process towards this goal, and the organization is incrementally using its network of researchers, data centre, and advisory role to provide the scientific basis for operational management. As the process is incremental, it allows ICES to respond appropriately to the changing demands of a developing policy landscape and dynamic ecosystem.” “ICES sees Ecosystem-based Management (EBM) as the primary way of managing human activities affecting marine ecosystems. Ecosystem-based Fisheries Management (EBFM) addresses the fishing sector. These approaches to management of marine activities have been described by a number of organizations (FAO, CBD, Arctic Council, NOAA, CFP, MSFD) and applied in relevant legislation. Certain key phrases illustrate the central tenet of these ecosystem	

		approaches: management of human activities, consideration of collective pressures, achievement of good environmental status, sustainable use, optimization of benefits among diverse societal goals, regionalization, trade-offs, and stewardship for future generations. ICES role is to provide the evidence for ecosystem-based decision making for the management of fisheries and other sectors in the ICES area”	
ICES, n.d.-b	See bibliography	“The aim of EBM is long-term sustainable use of marine resources with a resilient ecosystem. The health and productivity of the ecosystem should be maintained while allowing appropriate human uses for the benefit of current and future generations. EBM serves multiple objectives, involves strong stakeholder participation, and focuses on human behaviour as the central management dimension. ICES follows the principles laid down by the UN Convention of Biological Diversity (CBD) and UN Food and Agriculture Organisation (FAO), and this is further explained in our advisory plan. Our role is to provide the management of fisheries and other sectors with the evidence for ecosystem-based decision-making. This is to support sustainable development aimed at both human and ecosystem well-being and the stewardship of marine ecosystems.”	
Other external sources (non-ICES)			
Grieve & Short, n.d.	See bibliography	WWF states: “EBM aims to achieve ‘sustainability’ in exploiting natural resources. Two main themes run through the concept: the effect of the environment on the resource, and conversely, the effect of resource exploitation on the environment. EBM is a highly integrated approach that encompasses all the complexities of ecosystem dynamics, the social and economic needs of human communities, and the maintenance of diverse, functioning and healthy ecosystems”	

		THE PRINCIPLES OF EBM Ecosystem-based management has objectives and targets that: • Focus on maintaining the natural structure and function of ecosystems and their productivity • Incorporate human use and values of ecosystems in managing the resource • Recognize that ecosystems are dynamic and constantly changing • Are based on a shared vision of all stakeholders • Are based on scientific knowledge, adapted by continual learning and monitoring. Example of implementation in marine capture fisheries: “taking careful account of the condition of ecosystems that may affect fish stocks and their productivity. It also requires taking equally careful account of the ways fishing activities may affect marine ecosystems”	
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		WWF has identified 12 operational components that form the basis for implementing EBM in a typical fishery: SIX ELEMENTS FOR SUCCESSFUL EBM IN FISHERIES: 1 Operate within a policy framework designed to incorporate EBM principles 2 Recognise economic, social and cultural interests 3 Recognise the risk of the impacts of resource exploitation on ecological values 4 Incorporate adequate information on exploited species 5 Ensure the fishery management system is adequate for EBM to be effective 6 Consider externalities that may affect the resource TWELVE OPERATIONAL COMPONENTS, OR STEPS, FOR IMPLEMENTING EBM IN FISHERIES 1 Identify the stakeholder community 2 Prepare a map of the ecoregions and habitats 3 Identify partners and their specific interests 4 Establish the ecosystem values 5 Determine the major factors that could affect the ecosystem values 6 Conduct an ecological risk assessment 7 Establish objectives and targets for specific elements of ecosystems 8 Establish strategies within the fishery for achieving targets 9 Design an effective information system, including monitoring 10 Establish research and information needs and priorities 11 Design performance assessment and review processes 12 Prepare an education and training package for outreach to fishers and other stakeholders
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WWF Germany, 2016	See bibliography	“Making informed decisions Management must be built on a good understanding of the functions and processes which characterize a specific ecosystem. EBM must be adaptive and anticipate trends, new developments and the long-term implications of management decisions. Adaptive planning starts from existing knowledge. It does not have to wait until all questions are answered because in reality this will never be the case. EBM also requires regular updates.” “The definition provided by the Convention on Biological Diversity is very helpful: “The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way.” “Within the framework of EU marine policy, the EU Marine Strategy Framework Directive defines a Good Environmental Status which provides measurable indicators for EBM”	=> EOs could be of help here ; <i>WWF offers information of what EBM means for one's sector (like fisheries , shipping , mineral extraction, planning , energy, economy, etc.)</i>
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Halpern, B.S.; Lester, S.E.; McLeod, K.L., 2010 (Placing marine protected areas onto the ecosystem- based management seascape)	https://www.pnas.org/doi/full/10.1073/pnas.0908503107	“In response to the increasing diversity and intensity of ocean uses and associated impacts, and the recognition that we need to more carefully and explicitly include human dimensions in our efforts to understand and manage the oceans, there has been a recent push toward ecosystem-based management (EBM). Emerging from this development are numerous variations on the EBM theme, including area-based management, ecosystem-based fisheries management (EBFM), marine spatial planning, and ocean zoning, among others.”	
Coast Information Team, 2004	See bibliography	“The CIT defines EBM as: ...an adaptive approach to managing human activities that seeks to ensure the coexistence of healthy, fully functioning ecosystems and human communities. The intent is to maintain those spatial and temporal characteristics of ecosystems such that component species and ecological processes can be sustained and human well-being supported and improved.” In practice: “The CIT approach to EBM seeks to secure a high probability of maintaining ecological integrity overall at the subregional scale and in landscapes and watersheds with high conservation values, while providing for human well-being by allowing focus on economic development in landscapes and watersheds with greater economic values. Application of management targets ranging from precautionary to high risk at lower planning scales, within the overarching objective to maintain ecological integrity by managing to low risk at the subregional level, provides for operational	Very interesti ng handbo ok with many more insights into manage

		flexibility and exploration of alternative management practices in different landscapes, watersheds and sites. The underlying assumption is that it is not necessary to sustain all species and processes everywhere all the time to maintain ecological integrity.” “The CIT approach to EBM also seeks to create enabling institutional arrangements, land use zoning and management direction through which local and regional human well-being can be sustained and improved. Recognition of First Nations Rights and Title, coupled with collaborative planning, provides a means for First Nations, governments, and stakeholders to share information and develop mutually acceptable land and resource stewardship plans.”	ment etc.
Fluharty, 2018	See bibliography	“The term ecosystem approach to management (EAM) was selected by NOAA as a preferable term to ecosystem management (EM) because it reflects the notion that the principle (sic) activity is the management of human interactions with the ecosystem rather than the complex ecosystem itself. The term EAM is also preferable over EM because the latter implies that it is possible to control and manage an entire ecosystem’. Despite the quasi-official definition of EAM most of the discourse and practice in the United States uses the term ecosystem-based management (EBM) to describe the suite of approaches.” “To the extent that the United States can claim to have an ecosystem approach to management, it is the product of weaving together these multiple strands of implementation. An examination of how each of these strands and their ensemble are able to incorporate or adapt to new uses like marine renewable energy reveals interesting insights into how a true ecosystem approach to management might function and demonstrates inherent weaknesses of this multi-strand approach.” Criticism: “... Congress has been willing, on a regular basis, to endorse EBM but not to mandate that such an approach be applied in management. One can argue that this approach is prudent in that the critical wording of a statute for EBM might be difficult to craft as long as there is no agreed upon definition of EBM or a goal for management”	Info’s on single sector approac h at the example of fisheries manage ment + IEA + MSP +MPA

		“Similarly, if one asks agency personnel to evaluate whether they use EBM best practices and principles in their program implementation the results appear to be mixed but lean in favor of management programs being more ecosystem-based than not” “US Ocean Action Plan (2004) in response to the USCOP (US Commission on Ocean Policy) report [...] to advise him on policies related to the oceans. While this all seems to indicate decisive action, the overall effect is aptly summarized as, ‘[A]lthough the Action Plan took steps towards fulfilling the USCOP’s recommendations (...) it made only very limited references to ecosystem issues and did not require any concrete or specific steps toward EBM.’” “Nevertheless, the appetite in Congress for comprehensive, EBM oriented legislation appears to be very small and no strong groundswell of popular support for legislative action is expected under the prevailing political climate”	
UNEP, 2011	See bibliography	“Management of (<i>natural</i>) systems is often under the control of different agencies or sectors, which may not communicate fully with one another. This disconnect can significantly undermine progress toward conservation goals. EBM practitioners should assess ecological linkages from the start, build sectoral integration and communication, and continue to learn and update knowledge through scientific advice and monitoring.” “EBM does not require managing all aspects of a system at once. Instead, an EBM initiative founded on good knowledge and understanding of ecological and social systems can allow for thoughtful prioritization of the most important management actions and activities.” “There are several core elements that must be put into practice at some point in an EBM process: 1. Recognizing connections within and across ecosystems 2. Utilizing an ecosystem services perspective 3. Addressing cumulative impacts	Underlines importance of EOs

		4. Managing for multiple objectives 5. Embracing change, learning, and adapting”	
Carr, S., 2015 (Retrospective : Experts see progress on EBM but warn of risk of “all planning but little action”)	https://octogroup.org/news/retrospective-experts-see-progress-on-ebm-warn-risk-all-planning-little-action/?highlight=EBM		Interview that could give insight in potential direction of own study
Carr, S., 2015 (Is your work EBM? Reflections	https://octogroup.org/news/your-work-ebm-reflections-ebm-tools-		Shared experiences by users of tool, potential

from the EBM Tools Network)	network/?highlight=EBM		lly similar tool to Ecosyste m Overvie ws (?)
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APPENDIX 7 – SUB-QUESTION 3 EBM IN TWO ECOREGIONS

TABLE 7 ADDITIONAL INFORMATION SUB-QUESTION 3 EBM IN TWO ECOREGIONS

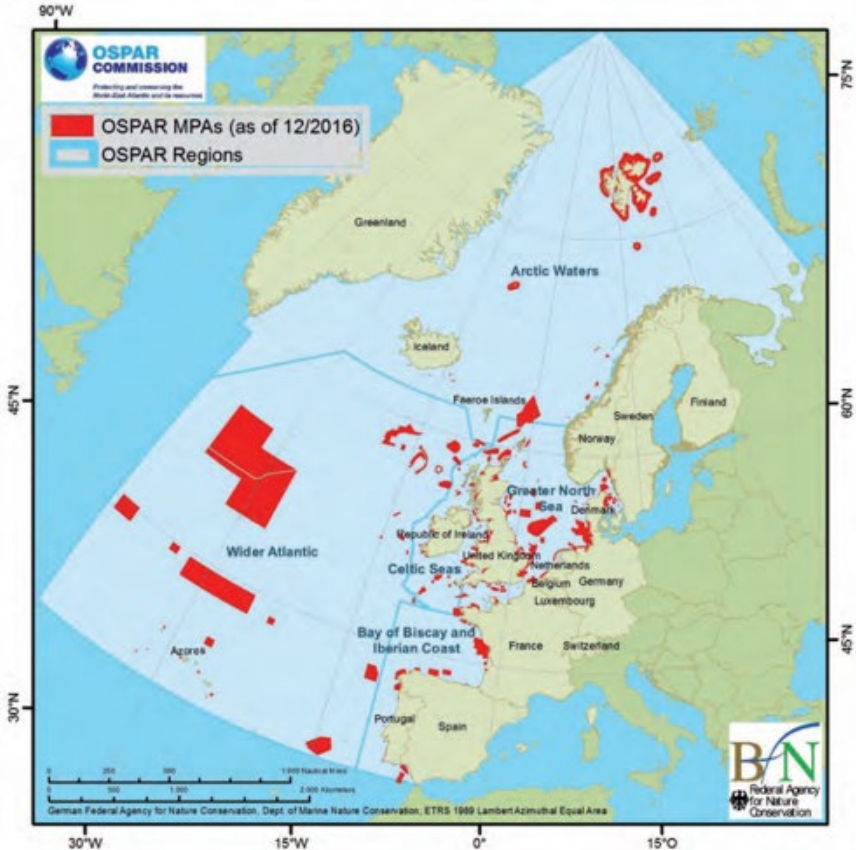
Name of author/ expert group/ affiliation, with year	Link to source	Quote / Paraphrase	Notes, if necessary
Central Arctic Ocean			
Siron, R.; Sherman, K.; Skjoldal, H. R.; & Hiltz, E., 2008 (Ecosystem- Based Management in the Arctic Ocean: A Multi-Level	https://www.jstor.org/stable/40513359		describes early beginning of EBM recognition in this ecoregion + short background about basic governance info

Spatial Approach)			
Arctic Council, 2013	See bibliography	“Arctic ecosystems are inherently diverse, variable, and dynamic. Ecosystem components are constantly changing, making it sometimes difficult to assess between large natural fluctuations and changes due to human activities. This underscores the importance of understanding the full breadth and nature of Arctic ecosystems at a variety of scales as part of efforts to ensure their long-term sustainability.” Climate change: “Arctic ecosystems are vulnerable to a number of existing and potential pressures. For example, the Arctic climate is warming rapidly, and impacts on the region are already being documented as a result of climate change” Other stressors: “Other key stressors include pollution (transported primarily from sources outside the Arctic), as well as increased economic activities such as shipping, oil and gas development, commercial fishing and tourism.” Benefit of EBM “At a general level, EBM facilitates efficient and science-based decisions by providing a way of assessing and managing the effects of multiple stressors affecting the same ecosystem. Locally, through the design of inclusive processes that reflect a broad range of scientific as well as traditional and local knowledge, EBM can ensure that policy outcomes achieve not only ecological, but also social and economic goals, and help Arctic peoples adapt to changing ecological and socio-economic conditions.”	EOs can help support those principles!! <i>More detail about each principle in document</i>

		“Finally, because ecosystems and human activities are dynamic, our understanding of these systems and activities is constantly evolving. The flexible and adaptive nature of EBM is, therefore, well-suited to address the rapid changes occurring in the Arctic” 3. PRINCIPLES² In order to proceed with a common understanding of the core elements of EBM, an analysis was conducted of all relevant EBM-related principles that were identified by Expert Group members and Observers. Sources included: • Convention on Biological Diversity, Principles of the Ecosystem Approach; • United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea, agreed consensual elements from its 7th meeting; • Best Practices in Ecosystem-based Oceans Management in the Arctic (BePOMAr); • World Wildlife Fund Principles for Ecosystem-based Management; and, • Ecological Society of America (ESA)³. Based on this assessment, a series of principles were identified that could represent common elements of a potential approach by the Arctic Council. These principles include: 1. EBM supports ecosystem resilience in order to maintain ecological functions and services. 2. EBM recognizes that humans and their activities are an integral part of the ecosystem as a whole, and that sustainable use and values are central to establishing management objectives. 3. EBM is place-based, with geographic areas defined by ecological criteria, and may require efforts at a range of spatial and temporal scales (short-, medium- and long-term). 4. EBM balances and integrates the conservation and sustainable use ecosystems and their components. 5. EBM aims to understand and address the cumulative impacts of multiple human activities (rather than individual sectors, species or ecosystem components). 6. EBM seeks to incorporate and reflect, to the extent it is relevant, expert knowledge including scientific, traditional and local knowledge. 7. EBM is inclusive and encourage participation at all stages by various levels of government, indigenous peoples, stakeholders (including the private sector) and other Arctic residents. 8. Transboundary perspectives and partnerships can contribute significantly to the success of EBM efforts. 9. Recognizing that ecosystems and human activities are dynamic, that the Arctic is undergoing rapid changes, and that our understanding of these systems is constantly evolving, successful EBM efforts are flexible and adaptive. The analysis outlining the linkages and commonalities amongst the principles reviewed, as well as additional context on the rationale for their inclusion, is outlined in Table 1. A comprehensive listing of the principles reviewed is included in Annex 3.	
Jørgensen, L., Mundy, P., Hoel, A.,	See bibliography	“Implementing the ecosystem approach to management (EA) in the Arctic during a time of profound climate change creates a heavy demand for all types of information that can guide the managers responsible for controlling and mitigating impacts of human use”	

Skjoldal, H., Hallfredsson, E., Ottersen, G., & Arneberg, P., n.d.		Find info on talk/ presentation of Strategic Initiative Arctic (SI Arctic) and ICES on description of area of High Arctic (northern part of the Barents Sea Large Marine Ecosystem (LME) and the southern part of the Central Arctic Ocean LME). The topics stated are: - 1) describe the LME-subarea under consideration, - 2) describe the ecological conditions, and existing and anticipated future human activities, - 3) consider potential ecological objectives and the data collection needed to monitor that they are met, - 4) introduce comparable efforts of the ICES working group on integrated assessment of the Barents Sea (WGIBAR) which is exploring means of separating human footprints from natural fluctuations through the approach of Integrated Assessment (IA) and - 5) examine the ability to provide ecosystem-based advice from the scientific results of the monitoring that is relevant to implementing the ecosystem approach to management in the Arctic	
PAME, CAFF, AMAP, n.d. (THE ECOSYSTEM APPROACH TO MANAGEMENT OF ARCTIC ECOSYSTEMS :STATUS OF	https://www.pame.is/images/03_projects/EA/EA_Conference/Agenda/EA_Conference_Program_25_August.pdf	Session 1: the vision and role of the arctic council - Development and Implementation of the Ecosystem Approach to Management in the Arctic Council by Hein Rune Skjoldal, Phil Mundy, Alf Håkon Hoel and Joel Clement “The Arctic Council (AC) adopted in 2013 the following definition of EA or EBM: <i>Ecosystem-based management is the comprehensive, integrated management of human activities based on best available scientific and traditional knowledge about the ecosystem and its dynamics, in order to identify and take action on influences that are critical to the health of ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity. ”</i> Session 3: making EA operational - Ecosystem Approach to Management and Integrated Ecosystem Assessment (Jason Link) “To do effective ecosystem approaches to management requires a solid science basis, yet negative perceptions and certainly objections remain as rationales for not enacting an ecosystem approach.”	

IMPLEMENTATION INTERNATIONAL SCIENCE AND POLICY CONFERENCE)		Session 6: status of implementing the EA to management in the arctic - Panel Presentation on next steps in Implementing the Ecosystem Approach in the Arctic “The questions then follow the steps leading to EA implementation that have been addressed by the Joint AMAP/CAFF/PAME EA-Expert Group in a framework for implementation . The framework consists of six elements that are not necessarily sequential: - 1) Identify the geographic extent of the ecosystem; - 2) Describe the biological and physical components and processes of the ecosystem, - 3) Set ecological objectives that define sustainability of the ecosystem, - 4) Assess the current state of the ecosystem, - 5) Value the cultural, social and economic goods produced by the ecosystem, - 6) Manage human activities to sustain the ecosystem. The six elements are assumed to be sufficient to characterize implementation of EA for the purposes of this evaluation. ”	
Arctic Council, 2017 (New Observer: ICES)	https://www.arctic-council.org/news/new-observer-ices/	“ICES is committed to building a foundation of science around one key challenge: integrated ecosystem understanding of marine ecosystems. Current work developing an Integrated Ecosystem Assessment (IEA), including an ecosystem overview for the Central Arctic Ocean, is bringing together experts from ICES, the Arctic Council (PAME), and PICES. This work contributes directly to Goal 1 of the Arctic Council’s Arctic Marine Strategic Plan 2015-2025 to <i>improve knowledge of the Arctic marine environment and continue to monitor and assess current and future impacts on Arctic marine ecosystems.</i>”	
OSPAR Commission, n.d. (The	https://www.ospar.org/about/international-		Background information

Arctic Council)	cooperation/the-arctic-council		
Wright, G., Schmidt, S., Rochette, J., Shackeroff, J., Unger, S., Waweru, Y., Müller, A., 2017 (Partnering for a Sustainable Ocean: The Role of Regional Ocean Governance in	https://www.prog-ocean.org/wp-content/uploads/2017/03/PROG_Partnership-for-a-Sustainable-Ocean_Report.pdf	 Figure 9: The OSPAR MPA network Source: OSPAR Secretariat	

Implementing SDG14)			
European Commission, n.d. (Arctic Ocean)	https://ec.europa.eu/oceans-and-fisheries/ocean/sea-basins/arctic-ocean_en		Background information
European Commission, 2021 (JOINT COMMUNICATION TO THE EUROPEAN PARLIAMENT, THE COUNCIL,	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52021JC0027&from=EN	“OBJECTIVES - Building on its policy as set out in previous Joint Communications on Arctic matters⁸ 9, and based on the 2016 Global Strategy for the European Union’s Foreign and Security Policy and the political priorities of the Commission, the EU will strengthen its Arctic engagement through: • contributing to maintaining peaceful and constructive dialogue and cooperation in a changing geopolitical landscape, to keep the Arctic safe and stable, by raising Arctic matters in its external contacts, intensifying regional cooperation and developing strategic foresight on emerging security challenges; • addressing the ecological, social, economic and political challenges arising as a consequence of climate change and taking strong action to tackle climate change and environmental degradation, making the Arctic more resilient, through environmental legislation, concerted action on black carbon and permafrost thaw, and by pushing for oil, coal and gas to stay in the ground, including in Arctic regions;	

THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS - A stronger EU engagement for a peaceful, sustainable and prosperous Arctic)		• supporting the inclusive and sustainable development of the Arctic regions to the benefit of its inhabitants and future generations, focusing on the needs of Indigenous Peoples, women and the young, and investing in future-orientated jobs and the blue economy.”	
Coon, Mundy, Skjoldal, &	See bibliography	“It should be noted that the responsibility for IEA implementation lies with the Arctic states within the areas of national jurisdiction, with the Arctic Council as a forum playing supporting and coordinating roles.”	

Panelists, n.d.			
DiMento, J.F.C.; Taylor, E.M.; Talavera, S.L., 2016 (Advancing Ecosystem- Based Marine Management in the Arctic: Recommend ations to the Arctic Council Task Force on Arctic Marine Cooperation)	https://www.law.uci.edu/centers/cleanr/AdvancingEBM_Arctic_Report_CLEA_NR.pdf		Current Status of Ecosystem- Based Manageme nt in the Arctic

WWF, n.d.	See bibliography	"Findings - Arctic states have been slow to implement Ecosystem-Based Management as developed and approved by the Arctic Council." "Recommendations" ARCTIC COUNTRIES - Invest in applying the ecosystem approach as requested by Arctic ministers, and implement the practical steps developed by the AC to inform implementation of EBM; - Develop monitoring programs to identify and assess the combined effects of multiple stressors on an ongoing basis; - Establish and/or strengthen multilateral cooperation to implement ecosystem-based management in key transboundary areas such as the Bering Sea, Beaufort Sea and Baffin Bay. ARCTIC COUNCIL - Develop an overarching EBM goal, including supporting objectives; - Update and adjust Observed Best Practices in Ecosystem-based Ocean Management in the Arctic to make it applicable to all environments, including marine, coastal and terrestrial."	More scores and criteria on their website, or in report: http://wwf-ap.org/apps/site/templates/downloads/wwf-arctic-council-conservation-scorecard-WEB.pdf
Celtic Seas			
International Hydrographic Organization, 1953 (Limits of Oceans and Seas)	https://epic.awi.de/id/epri-nt/29772/1/1HO1953a.pdf		Territorial descriptions of regions that belong to the Celtic Seas ('Celtic Seas' not mentioned as such)

Mark D. Spalding, Helen E. Fox, Gerald R. Allen, Nick Davidson, Zach A. Ferdaña, Max Finlayson, Benjamin S. Halpern, Miguel A. Jorge, Al Lombana, Sara A. Lourie, Kirsten D. Martin, Edmund McManus, Jennifer Molnar, Cheri A. Recchia, James Robertson, 2007 (Marine Ecoregions of the World: A Bioregionalization of	https://academic.oup.com/bioscience/article/57/7/573/238419	Celtic Seas belonging to Temperate Northern Atlantic Introduction of MEOW (Marine Ecoregions of the World)	
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Coastal and Shelf Areas)			
European MSP Platform, n.d. (Marine management and decision-making across borders)	https://maritime-spatial-planning.ec.europa.eu/practices/marine-e-management-and-decision-making-across-borders		Celtic Seas Partnership review, with info on workshops and organizations involved
Celtic Seas Partnership, n.d. (Ecosystem Approach)	https://www.celticseaspartnership.com/about-		Celtic Seas Partnership description of Ecosystem Approach

	us/ecosyste m-approach/		
European Commission, n.d. (Celtic Seas Partnership (CSP) – stakeholder driven integrated management of the Celtic Seas Marine Region.)	https://webgate.ec.europa.eu/life/publicWebsite/index.cfm?fuseaction=search.hdspPage&proj_id=4218	Coordinator: WWF Participants: SeaWeb, France, NERC (British Oceanographic Data Centre), United Kingdom, University of Liverpool, United Kingdom, Dublin Regional Authority, Republic of Ireland	
Roxburgh, T.; Dodds, L., n.d. (Towards sustainability	https://assets.wwf.org.uk/downloads/t	PISCES (Partnerships Involving Stakeholders in the Celtic Sea Ecosystem) has brought together stakeholders from the Celtic Sea to develop this practical guide on implementing the ecosystem approach in the context of the European Union (EU) Marine Strategy Framework Directive (MSFD)	=> PISCES project stated many times how very much needed EA

in the Celtic Sea - A guide to implementing the ecosystem approach through the Marine Strategy Framework Directive)	he_pisces_guide.pdf	“However, the growing demand for finite marine space and resources is causing increasing conflict between stakeholders, and threatening the health of marine environment on which so many depend” “To help guide implementation, the CBD (Convention on Biological Diversity) adopted a set of 12 principles known as the Malawi principles (https://www.cbd.int/decision/cop/?id=7148) , designed to be adaptable in different contexts. Early on in the project, PISCES stakeholders developed their own interpretation; comprising 11 principles for the Celtic Sea (see Box 4)”	is and how MSFD should be implemented using EA. But no info on status of EBM/EA at this point (2012)
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Box 4: PISCES stakeholder interpretation of ecosystem approach principles

The 11 PISCES principles are shown below. Symbols corresponding to principle numbers 1 to 11 are used to highlight linkages between the contents of this guide and each of the principles.

The final agreed PISCES principles are:

- 1 Stakeholder role:** stakeholders should adopt an active and committed role to achieve the common goal of the ecosystem approach; stakeholders should be involved in all aspects of management leading to a shared understanding of objectives.
- 2 Balance:** there should be a suitable balance between conservation and the sustainable use of resources in the interests of the health of the whole ecosystem.
- 3 Evidence:** an evidence-based system should be used to integrate social, environmental and economic interests.
- 4 Adaptive:** management should use an iterative and flexible approach.
- 5 Timescales:** management should be set for the long-term with short- and medium-term objectives and milestones and should enable involvement of future stakeholders.
- 6 Economic sensitivity:** involvement in implementing the ecosystem approach should not create an economic disadvantage but should promote responsible and sustainable behaviour.
- 7 Subsidiarity:** management should be undertaken by the smallest, lowest, or least-centralised competent authority.
- 8 Connecting international through to local:** local and sectoral strategies, plans and policies should be harmonised and priorities established to reflect national and international goals and objectives for conservation and sustainable use.
- 9 Review and monitoring:** an effective and targeted performance monitoring and review regime should be used to inform management.
- 10 Adjacent impacts:** consideration should be given to how events or actions in the Celtic Sea can influence or be influenced by events or actions on the land, in the air or in different parts of the ocean.
- 11 Involve and inform:** management should involve and inform all relevant sectors of society and scientific disciplines.

The PISCES principles reflect many of the same elements as the Malawi principles but with a more explicit emphasis on stakeholder involvement (Principle 1) and the need to connect strategies and management across multiple scales (Principle 8).

Heessen, Daan and Ellis, 2015	See bibliography	Celtic Seas ecoregion (CSER): the shelf wet of Scotland and Ireland, the Irish Sea, Porcupine Bank, Celtic Sea, western part of the Channel. Wide range of habitats: from oceanic banks to semi-enclosed sea-lochs and bays	If more info on fisheries and the geographic description to it in this sector is needed, this book could help
ICES, n.d. (Ecosystem Overviews – Celtic Seas ecoregion description)	https://www.ices.dk/advice/ESD/Pages/Celtic-Seas_description.aspx	“Four key areas constitute this ecoregion: • The west of Scotland region consists of shallow shelf regions of the Shetland Shelf, Malin Shelf, Hebridean islands, and the coastal area between the Scottish mainland and the islands (including the Minch), and the adjacent deep-sea region of the Faroe-Shetland Channel. • The Celtic Sea continental shelf (< 200 m), with southern and western boundaries delimited by sharp changes in bathymetry at the shelf edge. • The continental shelf ecoregion to the west of Ireland, which is limited westward by the Rockall Trough, with the Goban Spur and Porcupine Bank forming long extensions of the coastal continental shelf. • The relatively shallow, semi-enclosed Irish Sea. A higher density of large cities in this region leads to a concentration of human pressures.”	

Irish Sea Maritime Forum, n.d. (About)	http://www.irishseamaritimeforum.org/about/	“To this end, the objectives of the Irish Sea Maritime Forum are: - To provide a broad-based forum for all Irish Sea users and provide an opportunity for voices to be heard, - To facilitate knowledge exchange and capacity building across all administrative areas and sectors about marine planning, - To facilitate sharing of data and information, - To encourage and maintain political support for transnational partnership working in support of marine planning, with the aim of promoting sustainable development in the Irish Sea region, and - To facilitate a more coordinated, efficient planning process for transnational issues/projects and good working relationships among Irish Sea partners.”	
Marine Institute Ireland, n.d. (Marine Spatial Planning)	https://www.marine.ie/Home/site-area/areas-activity/marine-environment/marine-spatial-planning-0		Background information

Department of Housing, Local Government and Heritage, 2021 (National Marine Planning Framework)	https://www.gov.ie/en/publication/60e57-national-marine-planning-framework/#		Background information For more reports: https://www.gov.ie/en/publication/a4a9a-national-marine-planning-framework/#journey-to-the-nmpf
Marine Institute EMFF 2014-2020, n.d. (Blue Growth and Marine Spatial Planning)	https://emff.marin.ie/blue-growth		Background information

Ireland's Marine Atlas, n.d. (Ireland's Marine Atlas)	http://atlas.marine.ie/#?c=85.0207:-19.3359:2		Background information
North Western Waters Advisory Council, 2021 (Application of the Ecosystem-based Approach to Fisheries management in the North Western Waters – A review of	https://www.nwwac.org/fileupload/Meetings%20Documents/WKIrish%20webinar%20report.pdf		Background information

ICES WKIRISH processes, outcomes and possible next steps)			
Thomas, H.; Bhola, N., (Delivering ecosystem-based marine spatial planning in practice - Assessing the integration of an ecosystem-based approach into UK and Ireland	https://www.wwf.org.uk/sites/default/files/2017-12/Final%20Report_WWF_Ecosystem%20approach%20in%20MSP%20%28002%29.pdf	1.3 Methodology The following plans were included in this study: • 'East Plan' – 2014 East England inshore and offshore marine plans; • 'South Plan' – South England inshore and offshore marine plans (public consultation version, November 2016); • 'Welsh Plan' – Welsh National Marine Plan (Draft for 2017 consultation provided by Welsh Government, June 2017); • 'Irish Plan' – Integrated Marine Plan for Ireland ("Harnessing our Ocean Wealth", 2012); • 'Scottish Plan' – Scottish National Marine Plan (2015); • 'Shetlands Plan' – Shetland Islands Marine Spatial Plan (4th edition, 2015); • 'Sound of Mull Plan' – Sound of Mull Marine Spatial Plan (2010) This study involved five stages: A. A review of literature describing the principles of ecosystem-based MSP; B. An assessment of UK and Ireland Marine Spatial Plans against the WWF Ecosystem Approach checklist and the Baltic SCOPE EBM Toolkit checklist; C. A summary of the ecosystem approach within each MSP plan; D. A comparative analysis of the performance of all plans against each checklist question; E. An appraisal of the checklist approach.	

Marine Spatial Plans)			
O'Higgins, 2016	See bibliography	"Firmly grounded in the MSFD policy process, stakeholders within the PISCES project (http://www.projectpisc.es.eu/) and the subsequent Celtic Seas Partnership have agreed eleven principles for the management of the marine environment (based on the principles of the Convention of Biodiversity) and have particularly stressed the importance of the EA within the Marine Strategy Framework Directive and the important role of stakeholders in management of the marine environment under the MSFD and implementation of the EA (PISCES 2012). The PISCES declaration, with its foundation in CBD therefore reflects the spirit of the EA and the language of the MSFD in its recognition of the importance of balancing conservation and sustainable development." "Nevertheless, the Celtic Seas Partnership has demonstrated both the necessity and the desire for stakeholder involvement and understanding of the MSFD process. Thus, one key challenge for data discovery and delivery in the context of the Celtic Seas is providing relevant data and information to the particular audience of diverse stakeholders, the type of data relevant depends both on the stakeholder and their level of knowledge" institutional complexity: "For example, within the Celtic Seas area, there are four independent states Ireland, France, the United Kingdom and the Isle of Man (which is not a member of the EU). Within the United Kingdom, government is further subdivided with three devolved authorities, Scotland, Northern Ireland and Wales, with one centralised government in Westminster. Further subdivisions also occur within each nation, for example the counties of Ireland each have their own county council. To further complicate matters within each nation, different institutional structures mean different government departments have different responsibilities and data are reported in different formats	Knowledge/ Data => Ecosystem Overviews

		and locations all having emerged from the gradual process of policy development over several decades.” “For example, in the UK, The Department for the Environment Food and Rural Affairs (Defra) is responsible for delivering the MSFD, but data relevant to the assessment of environmental status come from diverse sources, including (among many others) the Centre for Environment Fisheries and Aquaculture Science (CEFAS) (for England and Wales) as well as from Marine Scotland for fisheries, the Environment Agency (for England and Wales) and the Scottish Environmental Protection Agency (SEPA). In some of these cases the data are in turn gathered by local authorities before being centralised. The full depth of institutional complexity is beyond the scope of this report, the Celtic Seas Partnership has applied tools to investigate the complexity of governance and policy Implementation within the Celtic Seas Region (Potts et al., 2013) and Bainbridge et al (2012) give a detailed treatment for the UK and Scotland.” “..., the Celtic Seas have no specifically dedicated management bodies (though all nations of the region are signed up to OSPAR) helping to coordinate management efforts in the wider North East Atlantic.”	
Perry, S., 2017 (Reflections from PISCES: Partnerships Involving Stakeholders in the Celtic	https://www.researchgate.net/publication/318744981_Reflections_from_PISCES_Partnerships_Involving_Stakeholders_in_the_Celtic	“This article reviews the practical experiences of operationalizing the Ecosystem Approach in the Celtic Seas, based on the lessons learned from the implementation of the EU Life funded project led by WWF-UK: Partnerships Involving Stakeholders in the Celtic Sea EcoSystem (PISCES). PISCES demonstrates the steps needed to apply the Ecosystem Approach (EA) into practice within the context of the EU’s Marine Strategy Framework Directive through active multi-sector stakeholder participation. PISCES aimed to improve policy and governance through developing guidance for effective engagement and delivery of the EA , developed by key marine stakeholders and in close collaboration with governments in the Celtic Sea. The objectives of the project were to increase knowledge and understanding, improve cooperation among stakeholders and identify mechanisms for implementing the EA. The key results from PISCES	

Sea Ecosystem (2009-2012))	Stakeholders in the Celtic Sea Ecosystem 2009-2012	were an increase in understanding of the EA among Celtic Sea stakeholders, a guide for implementing the EA through the EU Marine Strategy Framework Directive and the identification of processes and techniques for multi-sector, regional engagement.”	
O’Higgins, L.A., Ansong, J., Le Lievre, C., MacMahon, E., O’Hagan, A.M., 2017 (Overview Assessment: Summary Information on Marine Aspects of the Celtic Seas)	https://www.marei.ie/wp-content/uploads/2022/02/Initial-Assessment-Developing-Overview.pdf	Context of ODEMM, PISCES and Celtic seas partnership: “The Celtic Seas represents a subregion of the larger North East Atlantic region and spans the sovereign and/or jurisdictional waters of Ireland, France and the United Kingdom. Within UK waters, further delimitation occurs within and between the devolved administrations of Scotland, Northern Ireland, England and Wales, the Crown dependencies of Jersey, Guernsey and the Isle of Man and neighbouring MS. To date, these waters have been the subject of numerous EU-funded studies examining the requirements of transboundary working primarily in relation to the MSFD e.g. ODEMM1 , PISCES2 and the Celtic Seas Partnership” SIMCelt objectives and indicators (of relevance to ICES and EOs): “1. Objective: Inform awareness and understanding of the range of factors potentially impacting on the marine area within the Celtic Seas, their likely cumulative impact and projected future trends. Indicator: Provide a description of existing conditions and activities, trends and impacts.” “4. Objective: Examine the potential impact and interaction of maritime sectoral activities, specifically where they span marine area borders. Indicator: Collate sectoral information relating to future trends and priorities.” Status of national MSP as of January 2017:	Further info per state in document!! On how MSP is regulated More info and extensive details on various human activities in Celtic seas!!

Table 2. Status of development of national maritime spatial plans in EU and non-EU nations within the Celtic Seas region.

Country	Status of National MSP as of January 2017
Scotland	• March 2015; National Marine Plan published covering area between Mean High Water Springs to 200 nautical miles. • May 2015; Scottish Marine Regions Order enacted to define 12 marine regions. • Marine Planning Partnerships set up to add local information to the National Marine Plan.
Northern Ireland	• Borders with Ireland, Isle of Man and UK (Scotland and England) at 12nm limit. • Cross-border loughs with IE (Carlingford Lough and Lough Foyle); looked after by the Loughs Agency – some outstanding issues relating to marine borders between NI and IE. • Consultation on draft NI National Marine Plan expected in June 2016. Adoption expected by end of 2017. • Department of Agriculture, Environment and Rural Affairs (DAERA) loses its current function for terrestrial planning but retain responsibility for marine planning, licensing and fisheries after the NI Elections in 2017.
France	• No single planning authority covers all four sea basins in which FR has an interest (Eastern Channel; North Atlantic & Western Channel; Southern Atlantic; Mediterranean) – instead, 4 Planning Authorities but no single one in the lead; new process to understand • Marine Plans are under preparation (deadline 2017): supported by Sea • Basin Strategy documents and being prepared by 4 pairs of Préfets (covering administrative and navigational functions)
Ireland	• Competent authority for MSP is the newly formed Department of Housing, Planning, Community and Local Government • Irish Marine Institute to assist with MSP development but won't adopt or implement it. Most likely format is for a single national plan with regional sub-plans
Wales	• Pre-consultation draft of National Marine Plan to be ready later in 2016. Pressure on limited human resources.

Country	Status of National MSP as of January 2017
England	• Eastern Regions inshore and offshore Marine Plans completed; Southern Region inshore and offshore Marine Plans in preparation (draft reports). Remaining 7 Marine Areas to be prepared <i>en bloc</i> by 2021.
Isle of Man	• UK Crown Dependency but not member of EU • Activity toward MSP but no plan as yet

Annex 2. Marine Governance Institutions and Stakeholder Forums in the Celtic Seas

Institution/Forum	Countries	Remit	Website
British - Irish Council (BIC)	UK, Ireland, Isle of Man, Guernsey & Jersey	Statutory institution for co-operation on matters of mutual interest within the competence of the relevant administrations	Click here
Loughs Agency	Northern Ireland (UK) & Ireland	Statutory regulator and enforcement Agency that ensures effective conservation, management and development of the fisheries and marine resources of the Foyle and Carlingford Areas (border bays)	Click here
OSPAR	UK, EU, France & Ireland	Statutory mechanism for collaboration by which Governments cooperate to protect the marine environment of the North-East Atlantic	Click here
North Western Waters Advisory Council	Ireland, UK and France	Legitimate EU fisheries stakeholder body which produces regular advice on its own initiative or at request of the EC and the concerned MS on all relevant matters related to fisheries management in the EC offshore waters within the EEZ of Ireland, part of the United Kingdom and France	Click here
ICES (International Council for the Exploration of the Sea)	Ireland, UK and France	Multidisciplinary scientific forum for the exchange of information and ideas on all aspects of marine sciences. ICES also provides advice on the marine ecosystem to governments and international regulatory bodies that manage the North Atlantic Ocean	Click here
Irish Sea Maritime Forum	UK incl. Isle of Man, and Ireland	A broad based forum for all Irish Sea users and stakeholders	Click here
Cross Channel Forum	England and France	The Cross-Channel Forum, was set up as part of the CAMIS and PEGASEAS projects, which enabled French and British 'sea and coastal' stakeholders to share views and exchange ideas about the future of the Channel area.	Click here
Solway Firth Partnership	Scotland & England	An independent charity that works to support a sustainable and vibrant local economy through respecting, protecting and celebrating the distinctive character, heritage and natural features of the Solway Firth	Click here
Severn Estuary Partnership	Wales & England	An independent estuary-wide partnership that works with both local and national stakeholders in promoting a sustainable approach to the planning, management, and development of the estuary	Click here
North West Coastal Forum	North-West England & North Wales	An independent multi-sector partnership of coastal stakeholders working to promote and deliver integrated coastal zone management along the North West's coast of England and Wales.	Click here

Marine Management Organisation, 2014	See bibliography	Table 2: Elements of ecosystem approach from each case study drawn out and incorporated into the ten principles. <table><tr><th>Initiative</th><th>Elements of ecosystem approach taken forward</th></tr><tr><td>ESSIM: Canadian government initiative for ecosystem-based management in the Eastern Scotian Shelf in Canadian Waters</td><td> • Collaborative, multi-stakeholder approach to plan development and implementation • Objective-based approach with system of indicators and evaluation </td></tr><tr><td>US National Ocean Council: Marine Planning Handbook</td><td> • Goals and objectives • Plan implementation, monitoring, evaluation and adaptation </td></tr><tr><td>Norwegian EBM</td><td> • High-level goals, detailed aims and regulations – established Ecological Quality Objectives⁷ • Considered environmental, social and economic factors • Utilised Cost-Effectiveness Analysis </td></tr><tr><td>The PISCES Project: stakeholder-developed guide to implementing ecosystem approach in the Celtic Sea</td><td> • Initial assessment of ecosystem condition • Monitoring programmes for ongoing assessment • Programme of management measures • Large focus on stakeholder involvement </td></tr><tr><td>Australian Government Guidelines for Applying Ecosystem Approach in the Oceans</td><td> • Define the ecosystem in which the plan is operating • Assessment of activity/ecosystem interactions and knock-on effects • Consideration of social, economic and cultural factors </td></tr><tr><td>The DPSIR Framework: 'Driver-Pressure-State-Impact-Response' management framework</td><td> • Theoretical framework for the assessment of human pressures on the environment </td></tr><tr><td>UK MSFD Implementation</td><td> • Modelling of environmental state under 'BAU' scenario • Development of supporting economic analysis tools • Development of evidence base </td></tr><tr><td>The ODEMM Project</td><td> • Numerous outputs regarding current knowledge base, existing governance structures, operational objectives, management options and their evaluation, risk analysis, CBA implementation plan and dissemination. </td></tr><tr><td>BALANCE Project: Towards Marine Spatial Planning in the Baltic Sea</td><td> • Importance of Geographical Information Systems (GIS) and spatial information • Identification and mapping of marine landscapes and habitats • Cyclic structure of marine spatial planning </td></tr></table>	Initiative	Elements of ecosystem approach taken forward	ESSIM: Canadian government initiative for ecosystem-based management in the Eastern Scotian Shelf in Canadian Waters	• Collaborative, multi-stakeholder approach to plan development and implementation • Objective-based approach with system of indicators and evaluation	US National Ocean Council: Marine Planning Handbook	• Goals and objectives • Plan implementation, monitoring, evaluation and adaptation	Norwegian EBM	• High-level goals, detailed aims and regulations – established Ecological Quality Objectives⁷ • Considered environmental, social and economic factors • Utilised Cost-Effectiveness Analysis	The PISCES Project: stakeholder-developed guide to implementing ecosystem approach in the Celtic Sea	• Initial assessment of ecosystem condition • Monitoring programmes for ongoing assessment • Programme of management measures • Large focus on stakeholder involvement	Australian Government Guidelines for Applying Ecosystem Approach in the Oceans	• Define the ecosystem in which the plan is operating • Assessment of activity/ecosystem interactions and knock-on effects • Consideration of social, economic and cultural factors	The DPSIR Framework: 'Driver-Pressure-State-Impact-Response' management framework	• Theoretical framework for the assessment of human pressures on the environment	UK MSFD Implementation	• Modelling of environmental state under 'BAU' scenario • Development of supporting economic analysis tools • Development of evidence base	The ODEMM Project	• Numerous outputs regarding current knowledge base, existing governance structures, operational objectives, management options and their evaluation, risk analysis, CBA implementation plan and dissemination.	BALANCE Project: Towards Marine Spatial Planning in the Baltic Sea	• Importance of Geographical Information Systems (GIS) and spatial information • Identification and mapping of marine landscapes and habitats • Cyclic structure of marine spatial planning	
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		UK MSFD Implementation (2008 onwards) Currently in development and remains largely theoretical • Comprehensive ecosystem approach • Development of future scenarios and evidence base to inform the Initial Assessment • Strong buy-in by UK government agencies and devolved administrations • Work in progress • Untested in practice • Needs to ensure consideration of social and economic factors • Data limitations MSFD taken forward within the UK by a collaboration of UK devolved administrations and the relevant government agencies. Represents the best model for application of MSFD and assessment of the broad-scale impacts of policy measures. Easily applicable to other broad-scale, marine planning assessments.	
Bloomfield, Stamp, Goudge, 2014	See bibliography	Governance in UK: “The concept of an ecosystem approach (EA) derives from the 1992 Convention on Biological Diversity and the subsequent declaration of the 2002 World Summit on Sustainable Development. The EA concept has been adopted as a central tenet of the FAO Code of Conduct for Responsible Fisheries and a number of European policies, including the Integrated Maritime Policy, the Marine Strategy Framework Directive, the reformed Common Fisheries Policy and the Blue Growth strategy. At the UK level, the EA has been incorporated into the Marine and Coastal Access Act 2009, and in Wales, underlies the Environment Bill for Wales 2013, and the recently published Wales Marine and Fisheries Strategic Action Plan 2013.” For Wales specifically: “The merits and practicalities of implementing an EAFM in Wales, and to marine management more generally, are currently being explored by the fishing industry, nongovernmental organisations, and statutory bodies through the Welsh Fishermen’s Federation “Striking the Balance” report, the PISCES project work in the Celtic Sea and the Living Wales	More details on context, EBM definition and approach overview in document (pages 25-28)

	Programme's (LWP) "Using the Ecosystem Approach – A Framework for Natural Resources Wales" respectively" Table 1 Key policy drivers for an Ecosystem Approach to Fisheries Management (EAFM) and management of the wider marine environment in Wales. <table><tr><td>International</td><td>Convention on Biological Diversity 1992 FAO Code of Conduct for Responsible Fisheries 1995 World Summit on Sustainable Development 2002</td></tr><tr><td>European</td><td>Integrated Maritime Policy (IMP) 2007 Marine Strategy Framework Directive (MSFD) 2008 Blue Growth Strategy* 2012 Common Fisheries Policy (CFP) 2013</td></tr><tr><td>UK</td><td>Marine and Coastal Access Act 2009</td></tr><tr><td>Wales</td><td>Environment Bill for Wales 2013 Wales Marine and Fisheries Strategic Action Plan 2013</td></tr></table> ¹Url1 JNCC; Url2 EC IMP	International	Convention on Biological Diversity 1992 FAO Code of Conduct for Responsible Fisheries 1995 World Summit on Sustainable Development 2002	European	Integrated Maritime Policy (IMP) 2007 Marine Strategy Framework Directive (MSFD) 2008 Blue Growth Strategy* 2012 Common Fisheries Policy (CFP) 2013	UK	Marine and Coastal Access Act 2009	Wales	Environment Bill for Wales 2013 Wales Marine and Fisheries Strategic Action Plan 2013	
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		Box 1.2 The 12 Malawi principles of an Ecosystem Approach (Url3 CBD 1992) 1. The objectives of management of land, water and living resources are a matter of societal choices. 2. Management should be decentralised to the lowest appropriate level. 3. Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems. 4. Recognising potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should: (a) reduce those market distortions that adversely affect biological diversity; (b) align incentives to promote biodiversity conservation and sustainable use; (c) internalise costs and benefits in the given ecosystem to the extent feasible. 5. Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of The Ecosystem Approach. 6. Ecosystems must be managed within the limits of their functioning. 7. The Ecosystem Approach should be undertaken at the appropriate spatial and temporal scales. 8. Recognising the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term. 9. Management must recognise that change is inevitable. 10. The Ecosystem Approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity. 11. The Ecosystem Approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices. 12. The Ecosystem Approach should involve all relevant sectors of society and scientific disciplines. ⇒ 11. is important for ICES and Ecosystem Overviews	
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		Box 1.3 Example definitions of an ecosystem approach to fisheries (management), and of an ecosystem approach, based on a selection of the key references reviewed (see Section 2 for further details). Ecosystem-Based Management of Fisheries (EBMF) <i>"makes ecological sustainability the primary goal of management, as well as recognising the critical interdependence between human well-being and ecological health"</i> (Ward et al. 2002). The goal of an Ecosystem Approach to Fisheries (EAF) is to <i>"balance diverse societal objectives, by taking into account the knowledge and uncertainties about biotic, abiotic, and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries."</i> (FAO 2003; Garcia & Cochrane 2005). The Ecosystem Approach to Fisheries (EAF) is to <i>"plan, develop and manage fisheries in a manner that addresses the multiple needs and desires of societies, without jeopardizing the options for future generations to benefit from the full range of goods and services provided by marine ecosystems."</i> (FAO 2005). Ecosystem Based Management (EBM) <i>"...differs from conventional resource management in that it defines management strategies for entire systems, not simply individual components of the ecosystem. As a consequence, EBM takes into account interactions among ecosystem components and management sectors, as well as cumulative impacts of a wide spectrum of ocean-use sectors. Importantly, EBM considers humans as an integral part of the ecosystem, since humans derive a portfolio of services from the ecosystem and also act as a driver influencing ecosystem processes"</i> (Levin et al. 2009). An Ecosystem Approach (EA) is <i>"based on the application of appropriate scientific methodologies focused on levels of biological organization, which encompass the essential structure, processes, functions and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of many ecosystems"</i> (Woolmer 2012). An Ecosystem Approach (EA) is <i>"a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way"</i>. (From the Convention on Biological Diversity (CBD), cited in PISCES 2012; Spode et al. 2013). An Ecosystem Approach (EA) is <i>"the comprehensive integrated management of human activities based on best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of the marine ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity"</i>. (From International Council for the Exploration of the Sea (ICES), cited in PISCES 2012; Url4 OSPAR).	
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	Table 2.1 Summary of the ecosystem approach implementation steps in Striking the Balance (Woolmer 2012); Towards sustainability in the Celtic Sea (PISCES 2012); and Using the Ecosystem Approach: A Framework for Natural Resources Wales (Spode et al. 2013). <table> <tr> <th>Striking the Balance: An Ecosystem-Approach for MCZ management in Wales (Woolmer 2012).</th> <th>Towards Sustainability in the Celtic Seas: A Guide to implementing the ecosystem approach through the Marine Strategy Framework Directive (MSFD) (PISCES 2012).</th> <th>Using the Ecosystem Approach: A Framework for Natural Resources Wales (Spode et al. 2013).</th> </tr> <tr> <td>1. High level objectives, in line with relevant (inter) national policy drivers are to be developed, to guide the co-management group.</td> <td>1. Carry out initial assessment of marine waters, determine Good Environmental Status (GES) and define environmental targets and indicators upon which they define GES. To be done at Member State level.</td> <td>1. Establish Project Team and/or identify key stakeholders. The consortium should include relevant stakeholders, encompass multiple disciplines, and be headed by an appropriate team leader.</td> </tr> <tr> <td>2. Ecosystem based assessment. An assessment of the ecosystem must be conducted and should include a description of the ecological, social and economic drivers, and their associated risks.</td> <td>2. Develop and implement monitoring and evaluation programme for continued assessment of GES. To be done at Member State level and should consider transboundary impacts.</td> <td>2. Understand the activity. The scale and focus of the current activities within the ecosystem should be defined.</td> </tr> <tr> <td>3. Establish objectives. Based on results from Step 2, site specific management objectives should be developed and agreed by the co-management group.</td> <td>3. Develop programme of measures to reach or maintain GES.</td> <td>3. 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4. Develop and implement MCZ management. Locally applicable management measures should be developed by the co-management group to achieve agreed site specific objectives.	4. Implement programme of measures; the programme of measures should be implemented by competent authorities.	4. Understand the ecosystem services relevant to the activity and place. The current, and potential future, ecosystem services should be defined in terms of their condition, beneficiaries, vulnerability to environmental and/or management change, enhanceability and interdependence.																		
5. Collaborative monitoring and feedback to be conducted and outcomes should be fed back into an adaptive management policy, and inform successive management objectives and measures.	5. Evaluation and adaptation. A review and adaptation process is to be conducted on a 6 year cycle, to assess the maintenance or achievement of GES and adapt/enhance process in future iterations within the MSFD.	5. Visioning and objective setting based on the above. Stakeholders should define a collective vision for the ecosystem, with the information/data gathered from Steps 2 to 4, and develop objectives which deliver this shared vision.																		

		<table><tr><th>Striking the Balance: An Ecosystem-Approach for MCZ management in Wales (Woolmer 2012).</th><th>Towards Sustainability in the Celtic Seas: A Guide to implementing the ecosystem approach through the Marine Strategy Framework Directive (MSFD) (PISCES 2012).</th><th>Using the Ecosystem Approach: A Framework for Natural Resources Wales (Spode et al. 2013).</th></tr><tr><td></td><td></td><td> 6. Review activity and generate options. Stakeholders should develop a "long" list of feasible management options which addresses conflicts between the collective shared vision (Step 5) and current activities. 7. Select preferred option(s). Stakeholders should select the preferred option(s) considering effectiveness, impacts on associated ecosystems, opportunities for restoration and/or enhancement. 8. Embed ecosystem approach objectives into the design and development of the preferred option, reflecting objectives in the design and/or timings of proposed activity. 9. Detailed appraisal. Prior to implementation, the design of the new activity should be tested against the overall collective vision. 10. Implementation of the selected management activity. 11. Monitor activity against ecosystem objectives and outcomes, the monitoring protocol should be proportionate. 12. Learning and adaptation. Feedback lessons learned to inform current or future activity within the ecosystem. </td></tr></table>	Striking the Balance: An Ecosystem-Approach for MCZ management in Wales (Woolmer 2012).	Towards Sustainability in the Celtic Seas: A Guide to implementing the ecosystem approach through the Marine Strategy Framework Directive (MSFD) (PISCES 2012).	Using the Ecosystem Approach: A Framework for Natural Resources Wales (Spode et al. 2013).			6. Review activity and generate options. Stakeholders should develop a "long" list of feasible management options which addresses conflicts between the collective shared vision (Step 5) and current activities. 7. Select preferred option(s). Stakeholders should select the preferred option(s) considering effectiveness, impacts on associated ecosystems, opportunities for restoration and/or enhancement. 8. Embed ecosystem approach objectives into the design and development of the preferred option, reflecting objectives in the design and/or timings of proposed activity. 9. Detailed appraisal. Prior to implementation, the design of the new activity should be tested against the overall collective vision. 10. Implementation of the selected management activity. 11. Monitor activity against ecosystem objectives and outcomes, the monitoring protocol should be proportionate. 12. Learning and adaptation. Feedback lessons learned to inform current or future activity within the ecosystem.	
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“6 key implementation phases:

- Phase 1: Understanding the context - “Where are we now?”
- Phase 2: Objective setting - “Where do we want to be?”
- Phase 3: Explore management options - “How can we get there?”
- Phase 4: Implement preferred management - “Do it!”
- Phase 5: Monitor - “Are things changing?”
- Phase 6: Evaluate and adapt - “How are we doing (against objectives)?”

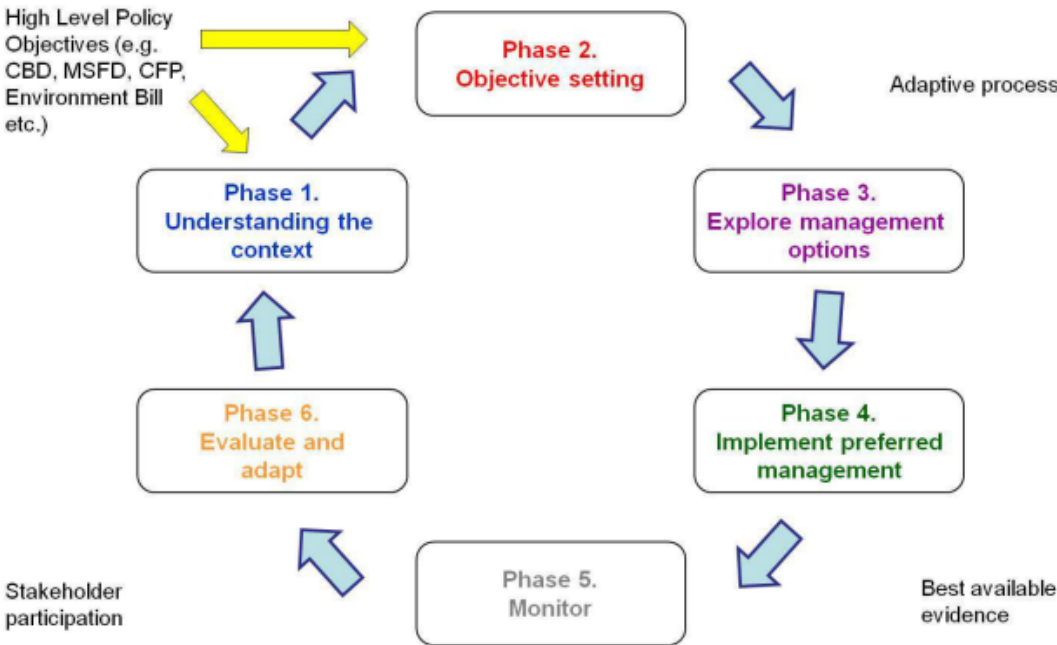
Table 2.2 Summary of ecosystem approach implementation guidance; colours demonstrate the commonalities among approaches (blue (P1), understanding the context; red (P2), objective setting; purple (P3), exploring management options; green (P4), implement management plan; grey (P5), monitor; and orange (P6), evaluate and adapt).

Policy Proposals and Operational Guidance for EBM of Marine Capture Fisheries		Putting into practice the ecosystem approach to fisheries		Ecosystem Approach to Fisheries (EAF): a review of implementation guidelines		Integrated ecosystem assessments: developing the scientific basis for EBM of the ocean		An evaluation of progress in implementing EBM of fisheries in 33 countries.	
Ward et al. 2002		FAO 2005 (also FAO 2003; FAO 2009)		García & Cochrane 2005		Levin et al. 2009		Pitcher et al. 2009	
1	Identify stakeholder community (P1).	1	High level policy goals (social, economic, environmental) (P1).	1	Scoping: Mapping resources, issues, stakeholders, competing uses, and existing rights (P1).	1	Scoping: Identify goals of EBM and threats to achieving goals (P1).	1	Identify stakeholder community (P1).
2	Prepare a map of eco regions and habitats (P1).	2	Identify broad objectives relevant to fishery (or area) in question (P2).	2	Collection of background information and analyses: Ex-ante assessments, strategic analysis, synergies, conflicts (P1).	2	Indicator development: Develop ecosystem indicators and targets (P2).	2	Prepare a map of eco regions and habitats (P1).
3	Identify partners and their interests/responsibilities (P1).	3	Break these objectives down into smaller priority issues and sub-issues that can be addressed by management measures (P2).	3	Setting operational objectives: With indicators and reference points (P2).	3	Risk analysis (P1).	3	Identify partners and their interests/ responsibilities (P1).
4	Establish ecosystem values (P1).	4	Set operational objectives (P2).	4	Formulation of decision rules (P3).	4	Ecosystem assessment: Assessment of ecosystem status relative to EBM goals (P1).	4	Establish ecosystem values (P1).
5	Determine major factors influencing ecosystem values (P1).	5	Develop indicators and reference points (P2).	5	Implementation and enforcement (P4).	5	Management strategy evaluation (P3).	5	Determine major factors influencing ecosystem values (P1).
6	Conduct Ecological Risk assessment (P1).	6	Develop decision rules on how the management measures are to be applied (P3).	6	Monitoring (P5).	6	Implementation of management action (P4).	6	Conduct ecological risk assessment (P1).
7	Establish objectives and targets (P2).	7	Monitor (P5) and evaluate performance (P6).	7	Ex-post assessment and review (P6).	7	Monitoring of ecosystem indicators & manage effectiveness (P5).	7	Establish objectives and targets (P2).
8	Establish strategies for achieving targets (P3).					8	Adapt management if necessary (P6).	8	Establish strategies for achieving targets (P3).
9	Design information system, including monitoring (P5).							9	Design information system, including monitoring (P5).
10	Establish research and information needs and priorities (P6).							10	Establish research and information needs and priorities (P6).
11	Design performance assessment and review process (P6).							11	Design performance assessment and review processes (P6).
12	Prepare education and training package for fishers (P6).							12	Prepare education and training package for fishers (P6).

Table 2.2 cont. Summary of ecosystem approach implementation guidance; colours demonstrate the commonalities among approaches (blue (P1), understanding the context; red (P2), objective setting; purple (P3), exploring management options; green (P4), implement management plan; grey (P5), monitor; and orange (P6), evaluate and adapt).

The many faces of Ecosystem – Based Management: Making the process work today in real places		Structuring decision-making for ecosystem-based management	PISCES: Celtic Seas Project	Welsh Fisherman's Association: Striking the Balance	Natural Resources Wales: Ecosystem Approach Framework
Tallis et al. 2010		Espinosa-Romero et al. 2011	PISCES 2012	Woolmer 2012	Spode et al. 2013
1	Scoping: Identify goals and threats (P1).	1 Definition of objectives, threats to ecosystems and ecosystem management drivers (P1).	1 Carry out initial assessment of marine waters, determine Good Environmental Status (GES) (P1) and define environmental targets and indicators (P2).	1 High-level objective setting (P1).	1 Establish the project team and/or key stakeholders (P1).
2	Indicators: Choose measures or proxies for goals (P2).	2 Development of indicators for ecosystem state (P2)	2 Develop (P3) and implement monitoring and evaluation programme (P3).	2 Ecosystem-based assessment (P1).	2 Understand the activity (P1).
3	Thresholds: Set target levels or trends (P2).	3 Establishment of thresholds for each indicator (P2).	3 Develop programmes of measure (P3)s.	3 Establish objectives (P2).	3 Understand the place, ecosystems and people: Key drivers, issues and opportunities (P1).
4	Risk Assessment: Link between indicators and threats (P1).	4 Risk analyses to evaluate how indicators respond to human and environmental disturbances and the probability that indicators will reach an undesirable state (P1).	4 Implement programme of measures (and monitoring) (P5).	4 Develop and implement (P4) MCZ management.	4 Understand the ecosystem services relevant to the activity and place (P1).
5	Management Strategy Evaluation: Assess options and choose approach (P3).	5 Evaluation of management strategies to predict the effects on the indicators (P3).	5 Evaluation and adaptation (P6).	5 Collaborative monitoring (P5) and feedback (P6).	5 Visioning and objective setting based on the above (P2).
6	Monitor: Track indicators (P5).	6 Monitoring management strategy outcomes (P5).			6 Review activity and generate options (P3).
7	Evaluation: Assess change (P6).				7 Select preferred option(s) (P3).
					8 Detailed appraisal (P3).
					9 Embed ecosystem approach objectives into the design and development of the preferred option (P3).
					10 Implementation (P4).
					11 Monitor activity against ecosystem objectives and outcomes (P5).
					12 Learning and adaptation (P6).

(More details in document, page 32ff)

		 High Level Policy Objectives (e.g. CBD, MSFD, CFP, Environment Bill etc.) Phase 2. Objective setting Adaptive process Phase 3. Explore management options Phase 4. Implement preferred management Phase 5. Monitor Best available evidence Phase 6. Evaluate and adapt Stakeholder participation Phase 1. Understanding the context Figure 3.1 Key phases in the implementation process for an ecosystem approach to fisheries management (EAFM); summarised following literature review.	
MAREOS, 2020	See bibliography	“In order to achieve the objectives set for 2020, France has decided to implement the requirements of the MSFD through Marine Action Plans (MAP). Each MAP corresponds to a metropolitan marine sub- region and is in made up of the 5 steps of the MSFD implementation. The content of the MAPs is defined by the coordinating authorities (Prefectures) of the four metropolitan marine sub-regions, in consultation with the stakeholders concerned who are	

		members of each Maritime Councils (representatives of socio-economic sectors, scientific experts, researchers, NGOs, elected officials,)." "The governance of the MSFD is based on competent administrative authorities at the national level - the Ministry in charge of the Environment (Directorate of Water and Biodiversity) and at the level of each marine sub-region (Prefectures coordinating seafronts)."	
Region Bretagne, 2021 (Regional research and innovation strategy - Smart Specialisation Strategy (S3))	https://msca-bienvenue.bzh/app/uploads/2021/02/S3_Smart_Specialisation_Strategy_RB_2021-2027-1.pdf		Background information
Belloni B, Astruch P, Le Diréach L, Changeux T, Boudouresque CF, 2020	https://horizon.documentation.ird.fr/exl-doc/pleins_textes/2021-	"However, ecosystem-based management, and therefore ecosystem-based indices, represents the future. It will take time for stakeholders and the general public to understand that the complexity of the functioning of ecosystems can lead to responses which, at times, are counter-intuitive, but much more realistic and effective." (Boudouresque et al., 2020) "Ecosystem-based management of marine ecosystems considers impacts caused by complex interactions between environmental and human pressures (i.e., oceanographic, climatic, socio-economic) and marine ecosystems. Understanding ecosystem responses to multiple human threats is a major challenge for the implementation of sustainable natural resource management. Risk	

(GECOMARS: International workshop on eco- system-based management)	09/010082507.pdf	assessment is a preventive approach allowing the management of human pressures upstream of the damage they could cause. Even more effective ecosystem-based management methods should anticipate the impacts and only a risk assessment approach can make this possible to achieve.” (Ruitton et al., 2020)	
Robinson, L.A., Culhane, F.E., Baulcomb, C., Bloomfield, H., Boehnke-Henrichs, A., Breen, P., Goodsir, F., Hussain, S.S., Knights, A.M., Piet, G.J.,	https://www.odemm.com/sites/default/files/ODEM%20Report_0.pdf		Background information

Raakjaer, J., van Tatenhove, J. and Frid, C.L.J., 2014 (Towards delivering ecosystem- based marine management : The ODEMM Approach)			
European Commission, n.d. (Environmen t – Our Oceans, Seas and Coasts)	https://ec.europa.eu/environment/marine/index_en.htm		Background information

United Nations Environment Programme-European Commission, 2018 (United Nations Environment Programme-European Commission 2018 - Roadmap on Healthy, Productive and Resilient Oceans)	https://ec.europa.eu/environment/marine/international-cooperation/pdf/2018_UNEP_EU_roadmap.pdf		Background information
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APPENDIX 8 – SUB-QUESTION 4 DESK RESEARCH RESULTS

TABLE 8 NUMBER OF REFERENCES FOUND PER DISCIPLINE (CLASSIFICATION OF USER), PER CASE STUDY REGION

<u>Colour coding:</u> Celtic Seas: a total of 36 sources Central Arctic Ocean: a total of 96 sources		
Classification of User	Yes = 1	Not found = 2
Cultural Heritage	0 // 0	0 // 1
Economic	1 // 0	0 // 1
Environment	3 // 4	2 // 6
Extraction diverse	0 // 0	0 // 1
Fisheries	4 // 0	0 // 1
Other	4 // 0	0 // 11
Other Forms of Area Management/ Designation	4 // 1	6 // 19
Science	7 // 1	3 // 48
Shipping Density	1 // 0	0 // 2
Wind Farms	0 // 0	1 // 0

Analysis of Indication of Use per Reference to term 'Ecosystem Overview' and	Indication of Use From which 16 stated that they use(d) Ecosystem Overviews	Classification of Source From which all but one sources were classified as 'website', 1x 'other'
Analysis of Classification of Source	From which none stated that they use(d) Ecosystem Overviews	From which all sources were classified as 'website'

Desk Research on the use and users of Ecosystem Overviews within the Central Arctic Ocean and Celtic Seas

[click here for results of the desk research](#)

APPENDIX 9 – SUB-QUESTION 4 DESK RESEARCH COLOUR-CODED CENTRAL ARCTIC OCEAN

Excel File analysis:

Colour coding

X = fisheries related

X = biological/ ecological (also fish stocks)

X = social interests

X = informing about (existence of) EO

TABLE 9 EXTRACTED RESULTS FROM SUB-QUESTION 4 DESK RESEARCH, COLOUR-CODED, CENTRAL ARCTIC OCEAN

Arctic Council	“ICES is committed to building a foundation of science around one key challenge: integrated ecosystem understanding of marine ecosystems. Current work developing an Integrated Ecosystem Assessment (IEA), including an ecosystem overview for the Central Arctic Ocean , is bringing together experts from ICES, the Arctic Council (PAME), and PICES. This work contributes directly to Goal 1 of the Arctic Council’s Arctic Marine Strategic Plan 2015-2025 to improve knowledge of the Arctic marine environment and continue to monitor and assess current and future impacts on Arctic marine ecosystems.”	https://www.arctic-council.org/news/new-observer-ices/
Arctic Council - PAME	"PAME thanks Debbi Pedreschi [...] for her presentation and appreciates insight into ICES operations, priorities [...], and advice products such as Ecosystem Overviews . [...] PAME notes that the “Ecosystem Overview” is being reviewed by the ICES advisory board and is expected as a final product in late 2021 ."	https://www.pame.is/library/pame-reports-new/pame-working-group-meeting-reports/814-pame-

		ii-2021-working-group-meeting-report/file
Arctic Council - PAME	"The working group on the Integrated Assessment of the Central Arctic Ocean (WGICA) aims to provide a holistic analysis of the present and future status of the ecosystem and human activities therein. A lack of consistent spatially and temporally dataset from the Central Arctic Ocean (CAO) limit trends and warning signal analyses. But the group aims toward an Ecosystem Overview (EO) that relate the main regional pressures with the human activities and the ecosystem components that are most impacted by these pressures."	https://pame.is/document-library/pame-reports-new/pame-ministerial-deliverables/2021-12th-arctic-council-ministerial-meeting-reykjavik-iceland/798-ecosystem-approach-to-management-2019-2021-progress-report/file
Arctic Council - PAME	"PAME welcomed the information on the work of the joint ICES/PICES/PAME Working Group for Integrated Ecosystem Assessment of the Central Arctic Ocean (WGICA) and noted that the management advisory product "Ecosystem Overview" will be passed to the ICES advisory drafting group and is expected to be finished in 2021 . The next step is to produce a report with more emphasis on impacts of human activities on the Central Arctic	https://www.pame.is/document-library/pame-reports-new/pame-working-group-meeting-reports/800-pame-i

	Ocean (CAO) ecosystem. The outline for this report has been circulated within PAME for scientific input, comment, and orientation, and feedback is due no later than 1 March 2021. The final report is expected in late 2021. PAME welcomed efforts to strengthen the communication between the EA Expert Group co-chairs and the relevant Arctic Council WG members to secure coordination of work plans and efforts towards Ecosystem Approach to management; to inform about progress and status of respective work; and to seek inputs, as relevant."	2021-meeting-report/file
Arctic Council - PAME	"The WGICA, established in 2016, was tasked to report on the current knowledge about all ecosystem components and the physical environment of the CAO ecosystem, to develop advice on IEA and to develop an Ecosystem Overview for the CAO. The two latter tasks distinguish the WGICA from the other groups. To accomplish its tasks, it is vital that the WGICA utilizes the knowledge already collected about fishes in the CAO, to the extent possible, including knowledge that has been summarized and reviewed by FiSCAO, the PSCG and AMAP, CAFF and PAME working groups." + short introduction and info on EO in general + CAO EO "This will be an addition to the series of Ecosystem Overviews prepared by ICES."	https://www.pame.int/images/05_Protected_Area/2020/PAME-II/EA/EA-EG_Pre-Meeting_agenda_8_3_WGICA_report_2020.pdf
PISCES	"An Ecosystem Overview (EO) is also required to finish in 2021 and will be submitted to ICES. An Ecosystem Overview is an ICES advisory report supporting Ecosystem Based Management. The report is short and concise (maximum of 14–16 pages) highlighting the main characteristics and challenges	https://meetings.pices.int/publications/Annual-

	the region faces. The first draft of the Ecosystem Overview for the Central Arctic Ocean was completed in November 2020. ICES conducted a light review of this draft in February 2021. An additional pressure assessment for a future sea-ice free summer situation (ballpark 2050) was conducted online in March/April 2021. Results are being processed. The Ecosystem Overview will be finalized this year."	Reports/2021/2021-WG-39.pdf
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APPENDIX 10 – SUB-QUESTION 4 DESK RESEARCH RESULTS COLOUR-CODED CELTIC SEAS

Excel File analysis:

Colour coding

X = fisheries related

X = biological/ ecological (also fish stocks)

X = social interests

X = informing about (existence of) EO

TABLE 10 EXTRACTED RESULTS FROM SUB-QUESTION 4 DESK RESEARCH, COLOUR-CODED, CELTIC SEAS

European Fishmeal and Fish oil producers	"ICES has released a new Ecosystem Overview for the East Greenland Sea ecoregion ... In addition, annual fisheries graphs have been updated for ... Celtic Seas, ... ecoregions. These overviews provide a description of the ecosystems, identify the main human pressures, and explain how these affect key ecosystem components. ..."" + links to all Ecosystem Overviews"	https://effop.org/news-events/ices-ecosystem-overviews/
European Parliament, presentation by ICES ACOM Vice-chair	"Recurrent yearly advice... Ecosystem Overviews..."	https://www.europarl.europa.eu/cmsdata/187520/ICES%20-%20Colm%20LORDAN-original.pdf
ICES Facebook	"The experts have been updating the Celtic Sea Ecosystem Overview, integrating Integrated Trend Analyses, examining issues around spatial scales and marine spatial planning, and forging links with	https://www.facebook.com/photo/?fbid=322

	ICES groups on social indicators (WGSOCIAL), economics (WGECON), and economic, social & ecological objectives (WGBESEO)."	1577401220322&set=a.216906871687405
Flanders Marine Institute (VLIZ)	displays an old version of a Celtic Seas Ecosystem Overview	https://www.vliz.be/imisdocs/publications/ocrd/131573.pdf
IFREMER	shared an WGEAWESS report	https://archimer.ifremer.fr/doc/00587/69896/67802.pdf
United Nations	"In 2018, an Ecosystem Overview was produced for the Baltic Sea ecoregion, adding to the six previously published overviews (Barents Sea, Bay of Biscay and the Iberian Coast, Celtic Seas, Greater North Sea, Icelandic Waters, Norwegian Sea)"	https://www.un.org/depts/los/general_assembly/contributions_2019/ICES.pdf
Casal, G.; Cordeiro, C.; McCarthy, T.	"SST trends are already influencing the onset of spawning, migration, and distribution of blue whiting, northeast Atlantic mackerel, and western horse mackerel as well as the recruitment of some gadoids in the Irish Sea, Celtic Sea, and west of Scotland [86]."	https://www.mdpi.com/2072-4292/14/7/1749/pdf
National Marine Fisheries Research Institute, Poland	"The Fisheries Overview series expanded to include the Celtic Seas, as did the Ecosystem Overview series[...]"	https://mir.gdynia.pl/raport-roczny-ices/?lang=en

"Nolan, C. , Kelly, E. , Dransfeld, L. , Connolly, P. , van Hoof, L. , Hegland, T. , Aanesen, M., Armstrong, C. & Raakjaer, J." / MEFPO	<i>used tables for the Irish Sea and Celtic Sea</i>	https://www.liverpool.ac.uk/media/livacuk/mefepo/documents/wp1/NWW_WP1_Technical_Report_V2.1.pdf https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.962.1076&rep=rep1&type=pdf
Marine Institute, Ireland	<i>used tables for the Irish Sea and Celtic Sea</i>	http://oar.marine.ie/bitstream/10793/669/1/The%20Stock%20Book%202011.pdf
OSPAR Assessment Portal	"Some improvements in addressing bycatch have occurred: for example, according to ICES, some bycatch in Celtic Seas fisheries may have reduced in recent years due to less fishing activity and the use of acoustic alarms attached to fishing gear as a mitigation technique (ICES, 2019j)."	https://oap.ospar.org/en/versions/1896-en-1-0-0-fisheries/

Cordula Scherer, Richard J. Gowen and Paul Tett	"Existing relevant population data (JNCC, 2015) suggest that birds are breeding successfully, implying good feeding. However, according to ICES Ecosystem Overviews (published in March 2016) trends in the abundance of many breeding seabirds are on a broad downwards trend in the Celtic Seas region since the early 2000s, while species that breed elsewhere have been reported to feed in the area (ICES Ecosystem overview, 2016)."	https://www.frontiersin.org/articles/10.3389/fmars.2016.00236/full#h12
Idac EU	<i>shared ICES MIACO report</i>	https://www.idac.eu/images/MIACO_2021_Report.pdf
SAI Global, CSHMAC Celtic Sea Herring Fishery, facilitated by Celtic Sea Herring Management Advisory Committee (CSHMAC)	""Regarding the ecosystems needs, Herring is not considering a key LTL species in the ecosystem, therefore with the stock fluctuating around the reference points and the low level of interactions that the fishery has with ETPs the assessment team can support that the fishery can support marine mammals and seabird as necessary. Last report form ICES Celtic ecoregion has not shown any significant impacts on that issue""	MSC026 CSHMAC Celtic Sea herring PCR _SAIG Feb 2018.pdf
SAI Global, Ireland Celtic Sea haddock and whiting trawl	List of "Threatened and declining habitats in the Celtic Seas according to OSPAR (includes OSPAR Regions III and V) (Source: ICES, 2016c)"; Figure of "Surface and subsurface abrasion pressure expressed as the swept-area ratio from VMS data from 2013 in the ICES Celtic Seas ecoregion (Source:	http://irishwhitefishfi.p.ie/wp-content/uploads/2019/06/Form-12h-MSC-

and seine fishery, facilitated by Bord lascaigh Mhara (BIM)	ICES, 2015b cited in ICES 2016c"); [...] Fishing is mainly concentrated along the shelf edge, i.e. around the southern shelf regions and on fishing grounds in the Irish Sea and to the west of Scotland (ICES, 2016c); [...] The proportion of swept seafloor was gradually reduced from 2009 until 2013 by ca 2.5% in total (ICES, 2016c)	Pre-Assessment-Reporting-Template-v2.1-Issue-4-October-2017_Ireland-Celtic-Sea-haddock-and-whiting_v3-.pdf
Natural Resources Wales	"A recent summary for the ICES Celtic Seas ecoregion states that overall fishing mortality for shellfish (Nephrops norvegicus), benthic, demersal, and pelagic stocks subject to TAC has reduced since the late 1990s, and mean mortality is now closer to the level that produces maximum sustainable yield (MSY), with 30 of 45 stocks now fished at or below MSY (ICES, 2019). The Celtic Seas ICES ecoregion covers the north western shelf seas of the EU, ranging from north of Shetland to Brittany in the south."	https://cdn.cyfoethnaturiol.cymru/media/693277/sonarr2020-ecosystem-marine.pdf
Marine Conservation Society	used as reference in reference list, but no quote found	https://www.mcsuk.org/goodfishguide/ratting/wild-capture/99/
Wildlife and Countryside LINK	" Commercial fisheries are the main cause of physical disruption to the seabed with over 45% and 73% of the Celtic Seas(11) and Greater North Sea(12) ecoregions respectively still being physically damaged by bottom towed fishing gear"	https://www.wcl.org.uk/assets/uploads/images/Link_OR_briefing_sustainable_fisheries_1.pdf

Pew Charitable Trusts	"The numerous migratory fish species that spawn here include mackerel and horse mackerel; in the waters above the continental shelf, the main pelagic fish species are herring, pilchard and sprat. Although more than 100 species live on or near the water's floor, 99 per cent of groundfish biomass in the sea is composed of 25 species(68)"	https://www.pewtrusts.org/-/media/assets/2015/03/turningthetide_report_web.pdf
SIMAtlantic project	"In the Celtic Seas ecoregion, phytoplankton abundance and the abundance of diatom and dinoflagellate species in shelf and oceanic waters west of the European shelf show long-term declines since 1958, while diatom and dinoflagellate species abundances increased in coastal waters of the Malin shelf and southwest of Ireland between 1990 and 2010 (ICES, 2016, Celtic Sea ecosystem overview)"	https://www.simatlantic.eu/wp-content/uploads/2020/08/D1.1-Description-of-MSP-relevant-information-for-Atlantic-countries.pdf
NEF Consulting	"[Regarding habitat and fish production, it is not immediately clear what the overall impact may be. While the government has published material stating that it believes that wind farming will not affect fish stocks as a whole,(13)] in the wider context of the Celtic Seas many species of sea life appear to be declining,(14) [potentially due to fishing practices and other factors]."	https://www.nefconsulting.com/wp-content/uploads/2017/09/Socio-economic-benefits-assessment-of-the-Celtic-Seas-Partnership-co-existence-guidelines_NEFC_logo.pdf

SEAFISH	Figure from Overview: "Figure 2 Time series of ratio of estimated ratio of fishing mortality to fishing mortality at Maximum Sustainable Yield F/F_{MSY} for North Sea (above) and Celtic Sea (below). $F/F_{MSY} = 1.0$ (dotted line) would indicate fishing at Maximum Sustainable Yield which is in line with the CFP objective (from ICES 2016; Ecosystem Overviews)"	Seafish Industry Guidance Note FS 96 09 16
Pelagic AC	"ICES also produced an ecosystem overview for several ecoregions, e.g. the Celtic Sea and North Sea. Others are under development. The aim is to provide a concise, up-to-date, evidence-based overview of each of the ICES ecoregions including the main human activities and their effects."	https://pelagic-ac.org/media/pdf/Minutes%20WG%20I%2012072016.pdf

APPENDIX 11 – SUB-QUESTION 4 SELF-PREPARED SURVEY

Questionnaire on the usage of ICES Ecosystem Overviews in the Central Arctic Ocean and Celtic Seas

Hello, my name is Lea Schönen and this survey is part of my bachelor thesis at Van Hall Larenstein, University of Applied Sciences. The aim is to investigate to what extent ICES (www.ices.dk) can fulfil its own Ecosystem-based Management goals by offering the Ecosystem Overviews. In other words: what is the role of ICES Ecosystem Overviews in marine management?

The Ecosystem Overviews are a freely accessible advice product (<https://www.ices.dk/advice/ESD/Pages/Ecosystem-overviews.aspx>) which are updated at regular intervals. In this survey, I am asking a broad range of potential users in which ways the product is being used. I would love to hear your thoughts and experience on ICES Ecosystem Overviews - if you are aware of this advice product, if you actively use this, how, why or why not.

All answers will be evaluated anonymously, looking at the indication of use per ecoregion and per marine sector. The project focuses on two ICES ecoregions in more detail: the Central Arctic Ocean and the Celtic Seas. Therefore, only experiences with Ecosystem Overviews from these two ecoregions are sought. The data gathered will provide me with information on the uptake of this advice product in practice. This investigation is being carried out under the name of my university, Van Hall Larenstein, University of Applied Sciences.

Thank you for your time!

Lea Schönen

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Van Hall Larenstein, University of Applied Sciences

<https://www.vhluas.com>

*Required

Personal information - This part of the survey serves solely to classify the statements in, e.g. marine sectors or 'ecoregions'. Any statements involving your field of work or other personal information will be treated confidentially.

1. The discipline of your employment * Tick all that apply.

- Aquaculture
- Cultural Heritage
- Economic
- Energy
- Environment
- Fisheries
- Shipping
- Tourism / Recreation
- Waste water
- Other

2. Your role within your above-mentioned field of work * Tick all that apply.

- Advice
- Business and Industry
- Management
- Policy

The role of ICES Ecosystem Overviews in marine management

- Science and Research
- Other

3. The country you are engaged in with regard to marine affairs

4. Do you formally engage with the work of ICES? If so, in what capacity? Tick all that apply.

- ACOM member
- Advice requester
- Chair of expert group
- Expert (e.g. engaged in working group and/or workshop and/or other activity)
- Observer
- Participant
- SCICOM member
- Other
- No engagement

ICES Ecosystem Overview - Usage - In order to later divide into statements on use or no use, you first need to indicate your level of experience with this advice product.

5. Have you ever used ICES Ecosystem Overviews in any context? * Mark only one oval.

- Yes, I have *Skip to question 7*

- No, I have not *Skip to question 24*
- Not sure *Skip to question 7*

6. If you indicated 'Not sure', please specify.

ICES Ecosystem Overviews - Did use - This section looks at the use of ICES Ecosystem Overviews in your field of work, whether they are actively used, why, as well as particular aspects of relevance.

7. ICES Ecosystem Overviews: Which ecoregion is the most relevant to you/ your work/ have you used the most? * Mark only one oval.

- Central Arctic Ocean
- Celtic Seas
- Other

8. If you indicated 'Other', please specify.

9. When did you last use this product? * Mark only one oval.

- 2022
- 2021
- 2020
- earlier than 2020

10. How often did you use it in the year you stated? * Mark only one oval.

- Once

- 2-5 times
- More than 5 times

11. In what context did/ do you use the ICES Ecosystem Overview? * Tick all that apply.

- As a summary/consultation document in meetings/projects
- To inform decision-making (as advice)
- To inform yourself
- Other

12. If you indicated 'Other', please specify.

13. Can you provide more details of the context?

14. Which aspects/ elements do you think were of particular value? * Tick all that apply.

- Ecoregion description
- Key signals
- Pressures
- Climate change impacts
- State of the ecosystem
- Other

15. If you indicated 'Other', please specify.

16. Have you ever contributed to the development or content of the ICES Ecosystem Overviews at any level (e.g. scientists, reviewer, etc.)? * Mark only one oval.

- Yes
- No

17. Do you have any suggestions for how it could be made more useful and/ or operational?

18. Do you know of/ use any other similar products? Mark only one oval.

- Yes
- No

19. If you indicated 'Yes', please specify.

ICES Ecosystem Overviews – Other - This final section briefly examines general background questions related to ICES Ecosystem Overviews.

20. In what context did you first learn about ICES Ecosystem Overviews? * Tick all that apply.

- ICES website
- ICES Twitter
- Non-ICES websites
- Through engagement in ICES Working Group
- Your own work environment (internal sharing)

- Other

21. If you indicated 'Other', please specify.

22. What possibilities do you see to disseminate Ecosystem Overviews so that they can be used by more actors?

23. Do you personally consider the ICES Ecosystem Overview advice you can use in your work (i.e. are they operational)? * Mark only one oval.

- Yes
- No
- I don't know

ICES Ecosystem Overviews - Not used - This section looks into possible reasons why ICES Ecosystem Overviews were not used before. Only to be filled in by participants to whom this applies.

24. You indicated that you did not use ICES Ecosystem Overviews before. Please specify, why not. * Mark only one oval.

- Never heard of it
- Does not provide sufficient information to my field of work
- I was advised not to use it
- Other

25. If you indicated 'Other', please specify.

Comments and/ or Contact details - Thank you very much for your time and effort. In case of remarks or questions, you may reach out to me, Lea Schönen, responsible for evaluating the results of this survey.

If you are willing to be contacted by me in case of any follow-up questions about your statements or possible research projects in the future, please leave your contact details below.

Lea Schönen

lea.schonen@hvhl.nl

Van Hall Larenstein, University of Applied Sciences

26. If you like, you can leave a comment or your contact details.

APPENDIX 12 – SUB-QUESTION 4 SELF-PREPARED SURVEY RESULTS

Self-prepared survey results

[click here for self-prepared survey results](#)

APPENDIX 13 – SUB-QUESTION 4 SURVEY BY ICES RESULTS

Survey by ICES, MIRIA meeting 2021

[click here for MIRIA survey](#)

Survey by ICES, MIACO meeting 2021

[click here for MIACO survey](#)

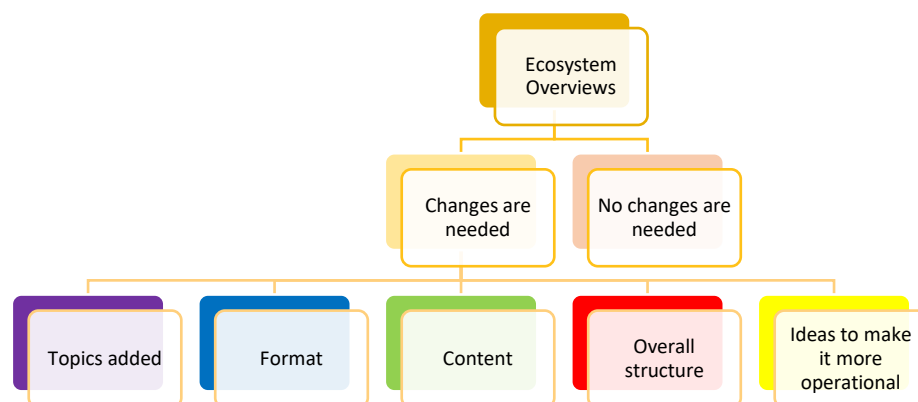
APPENDIX 14 – SUB-QUESTION 4 INTERVIEW GUIDE

TABLE 11 INTERVIEW GUIDE

EBM	- Regarding the willingness to implement EBM, what has changed the most over the last years/decade within ICES? - Do you think that ICES' objective aligns with external demand? - What could support the implementation of EBM? - o Are Ecosystem Overviews an option at all? If yes, how good?
Role of Ecosystem Overviews	- Please define the role of Ecosystem Overviews (in supporting EBM)? - Greatest strengths? - Greatest weaknesses? - Where do you want to see Ecosystem Overviews in the future? (Regarding uptake, overall structure, content/ format)
Uptake by users	- What are your experiences with the uptake of Ecosystem Overviews by externals? - What could ICES do to support the uptake of Ecosystem Overviews? - Possibility to combine/ merge with others? Also, externally? - How would you define ICES' responsibility to make them as appealing and useful as possible? - What is the responsibility of potential users/actors? - Do you know of further context of use by users?

How to go further	- If you would have three wishes that immediately become true, what would you wish for regarding Ecosystem Overviews? - In what way can Ecosystem Overviews can adapt to e.g., increasing pressures trough human activities on sea or other ongoing challenges?
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APPENDIX 15 – SUB-QUESTION 4 INTERVIEW TRANSCRIPT WITH COLOUR-CODING



- Introduction on what thesis is about “What is the role of ICES Ecosystem Overviews in fulfilling the ICES objective of supporting Ecosystem-based management in its ecoregions?”;
- Short introduction on engagement of Dave Reid in development of Ecosystem Overview during the last 20 years, highlighted the role of Ecosystem descriptions

FIGURE 14 CODING FRAMEWORK FOR INTERVIEW, COLOURS ADDED TO TRANSCRIPT

Lea Schönen: You have a lot of experience within ICES and I think also in contact with externals. So, my question regarding Ecosystem-based management is: Where do you see the biggest differences in understanding of this concept between ICES and its stakeholders/ users/ clients?

Dave Reid: Well, the biggest issue is that nobody has actually asked for an ecosystem overview. So, it's a classic thing, like in business you develop a new product and you have to persuade people to buy it in the supermarket. That was one of the major difficulties and that caused a lot of arguments backwards and forwards. Should we be waiting to be asked or should we produce these things up front? So, I think the primary purpose of these [Ecosystem Overviews], both that figure and the general text, was to encourage people to want to be given this so that when they looked at the advice for the fisheries, particularly in the Celtic Seas, they would also then look at the ecosystem advice for the Celtic Sea, understanding the context in which this was happening. The example I know best is the Irish Sea where we did a lot of work. What happened in the Irish Sea was that the fish stocks declined steadily for years, and they introduced a whole load of management measures, reduced effort, tried to reduce fishing mortality, decommissioned boats, all sort of systems. By the end of it, some of the fleets were down by 90% and the fish had not recovered. We were asked by the North Western Waters Advisory Council to investigate this and find out why, and the answer was that productivity in the Irish Sea had declined. System productivity had declined in response to the Atlantic meridional overturning circulation. What

used to be called the AMO is now called the AMOC. It drives the temperatures in the Irish Sea and that led to an increase in the temperature which reduced the productivity of the system, which meant we were unlikely to recover even if you put in these management measures. Part of the idea of the existing overviews is to say, you know, here's what the ecosystem looks like. Here's where the dangers lie. The risks lie. And when you're making your fisheries management decisions, you should also have this in your head. Now, I don't think we've got there yet. People like the Commission probably do read these and you're probably interested in them. Whether the actual managers read them, I am unsure to be honest.

Lea Schönen: Is this also its greatest weakness - that it was not requested in the first place? It is mentioned in agreements, but it still doesn't really have an equal status to special requests. How could this be improved?

Dave Reid: So, the problem with the ecosystem overviews is that nobody actually asked for them, and yet they're really interesting. And if you were interested in that ecosystem, in utilising it and wherever we're exploiting it, you'd really want to know about it. It's sort of like a strategic evaluation before you start building oil rigs or wind farms, it tells you what's important, what you need to think about. And it also tells you about what human activities are producing the greatest risks right now. It's how to get that message across to people. For my mind, the ecosystem overviews are a step in that process. What we did in the Irish Sea was actually got really, really detailed and specific. What we've essentially said was if you do not consider what the ecosystem is doing in the context of fisheries, you will make mistakes. We gave them a way of including that information, which is very numerical. The whole assessment is very numerical and the existing ecosystem model views are not so numerical. They have numbers and graphs in them, but it doesn't actually tell you what that means to you. So probably the way to improve it is to actually have a summary box, you know half a page max which says, Watch this, this is important, something for the lay user or for the manager or the politician, something that says 'Here, you need to think about this when you make your decisions'. That should be really hard hitting. It's like communicating uncertainty - so we don't know that if you continue fishing at this rate in this way that you'll do this amount of ecosystem damage. But we can and suggest you that's likely to happen.

So, another example which you may not have come across is the concept Ecosystem overfishing. It is the idea that you need a certain amount of productivity in the system. To support the amount of fish that you remove from it. It's a very holistic indicator because it doesn't look at any individual species. It looks at the whole system productivity. Essentially what it does is it looks at the phytoplankton production, the net primary production in the system. And it says, is that enough to support what you remove? Is it more than you need? Or is it less? And if it's less then you're running into danger, you're basically taking more than the system can sustain, fairly simple sustainability argument. And equally you can see things like 'Is it at risk because of certain things you could do?' I'm doing this with my PhD student at the moment and what we found for instance, is that the Celtic Sea is actually a very good place in terms of ecosystem overfishing, so we're not fishing in excess of what the system

can support. But that depends on the trophic transfer efficiency [elaboration on trophic levels, trophic pyramid]. The transfer efficiency between each trophic level is classically presented as 10%, so that you only 10% of the energy from trophic level 1 will become biomass in trophic level 2. What we have in the Celtic Sea is 16 to 17%. Which is good but it also means that the system is more vulnerable. So, if your system was doing the classic 10% and you weren't overfishing it, then it would be sort of OK. Because we've got a trophic transfer efficiency of 16%, then that lack of overfishing, depends on that uncommonly high level of trophic transfer efficiency. So if something changes like the temperature, then that one could be quite vulnerable. That's just an example, and we're not there yet. We've only been working on it six months. But it's that sort of thing that you could then convey to managers: You're getting this set of results. It's sort of OK at the moment, but the future might be more risky. And that's how I would see this going. I think it's very difficult for a layperson to absorb all the stuff that's in an ecosystem overview, certainly not at one reading. I've been a civil servant for almost 40 years now and what you do as a civil servant, you never read the whole report. You read the front page and the back page because that's where all the important stuff is done. And then after that if you got really excited by something you then go and look at the specific thing, that's true of managers and politicians as well, I think. So, something to make them more impactful is to do something like that.

Lea Schönen: When ICES Ecosystem Overviews could have such an important role in giving out advice to managers/decision makers/anyone who could then implement EBM, where does ICES responsibility lie to make this product as sufficient as possible? How can ICES achieve this?

Dave Reid: So, the classic way to do it, you know, we've been doing it. Recently Debbi Pedreschi has been doing huge amounts of work to make it scientifically correct. And hoping that if somebody was interested, they'd read it. How'd you make somebody read something and how do you help them take it into consideration when they are making management decisions?

So, right now we've got a very big push for offshore wind farms. So that means we're going to fill up areas of the ecosystem with wind farms. Which may not be a bad thing for the ecosystem, but it be certainly likely to be an issue for sea fisheries. And at the same time, we're also trying to set up marine protected areas. And you know both marine protected areas and offshore wind are both things which have an ecosystem context. We're setting up the wind farms that we stop climate change from getting any worse, and we're setting up MPAs to protect environments. And I think the problem is that in a lot of cases the objectives are fairly broad. The objective for wind farms is, well, more energy. So obviously having more wind farms means we get more green energy. And then MPAs: a MPA is a tool to achieve an objective. It's not an objective. You know if you talk to NGOs, MPAs are a good thing. And if you make an MPA, it's good, regardless, it just can't be bad, so it has to be good, so it's a good thing to do. With MPAs, we often set up these things with an objective of setting up MPAs.

So, you know about the 30 by 30 - 30% of the ocean area should be protected by MPAs by 2030. It also depends on what you mean by an MPA, of course. So, to the NGOs a MPA is something that's closed to any other activities, so it's a completely protected area. And if you look at what some of the NGO's will say, there's only about 1% of the area protected by real/true MPAs, and by that they mean no fishing. For instance, in most MPAs, not to fish in the mid water is an example. Or fish with pots, creels. And that's where this lack of an objective comes in. it's just 'let's have an MPA' and so we're just starting to work on this now. There's something with a wonderful acronym of OECS [Other effective area-based conservation measures]. If you set up a wind farm and automatically stop fishing in that area, wind farms have an exclusion zone around them, so the fishing boats don't collide with them, etc. So that becomes de facto a MPA. But under the legal definition of MPA, they don't count as MPAs. A MPA can't have industrial activity. It's all about objectives. It's all about understanding what you can do. I think, in a way, the ecosystem overviews don't particularly help with that, because they're too much a sort of guide. They say 'here's what it's like'. But they're not saying if you do this, this will happen, and I think that's probably where we need to go and say, you know, if you want to make this decision, that's fine. You're the politician, but if you do this, be aware of the risks that you're taking. We need to be able to give this qualitative advice of 'by doing this, you're taking a risk with this, but we can't give you the exact number, but we can see that the trend and/or the system is in the wrong direction, or that something is particularly endangered'. And that's probably what we should do to give these [Ecosystem Overviews] more punch.

Lea Schönen: Do you think that every IEA group has to go for this approach on their own? Or should this be like a common unified approach?

Dave Reid: Well, pretty obviously it should be unified. The IEA groups are made up of working research scientists and we mostly want to do science of one sort or another. And we don't want to be in the same position as the fish stock assessment working groups where they meet every year, they turn the machine and then they say 'here's the result'. We want to do ecosystem science, not necessarily produce the perfect advice. Opinions therefore differ across the IEA groups about what their job is. And so each individual IEA working group will have its own way of doing things. [Elaboration on "waterfall plots"/traffic light plot, and Integrated Trend Analysis]. It's just an example of where people differ in their approach, we're all trying to produce a uniform product, but from different methodologies. It doesn't make it easy.

Lea Schönen: No, especially because Ecosystem Overviews don't have the status of being priority 1. In most cases, I think that there are a lot of other (yearly) tasks an IEA group has to come back to. I still struggle to understand this, therefore the question. Thank you for your answer.

Dave Reid: It's a tough job, actually, because this is not really about ecosystem overviews. It's about how you provide advice to decision makers. You've mentioned this before, with all the fairly vague statements about the approach to do everything according to EBM or let the ecosystem be an important consideration in everything we do. We don't actually do that. What we tend to do is we do things in isolation. So, we want

MPAs, we want to protect dolphins, we want to have good livelihoods for a fisherman, we want fish to come onshore as a food security or as a commercial thing. So, you've got all these different interests. Say, we have an objective like protecting dolphins, and **we tend not to view that in in the context of all the other things that are going on in the ocean.** To take it to an absurd reduction: How many tonnes of cod is a dolphin worth?

Lea Schönen: Isn't this then always measured on an economical-value scale?

Dave Reid: Yeah, that's what they try and do, but it's actually not an economic question. It's a social question. There's a lot of work on valuing ecosystem goods and services. I think one of the examples I found was that the ecosystem goods and services of Galway Bay, which is just down the road from my house was something like \$1 billion or something. It was what that ecosystem did for us. Existing goods and services include provisioning which is getting fishing. It includes some regulating services so you know it cleans the beaches and it recycles stuff, and it includes cultural services. The classic way to value the cultural value of the seaside, for instance, is to look at the value of houses as they get closer to the sea. Walking to the seaside, who doesn't love that? So that gives it a value, goods and accumulated value of the of Galway Bay was based on all of those given a financial value. But to me that then begs the question: If I gave you a billion euros to allow me to destroy it, would you say yes? And of course, you wouldn't. That's why I find economic valuation is probably the only currency that we can use to bring all that together. Valuing it in terms of money is fine, but everybody will have an individual approach to that, so if you care about dolphins, that's the most important thing you know. Very few people care about nematodes [Roundworms]. Just despite the fact that nematodes have some of the largest biomass in the system. It could be something else. It doesn't matter it, it's just that there's a very big social dimension to that valuation.

We often talk about biodiversity, but when I'm teaching my students, will joke, saying biodiversity is about animals beginning with P, say polar bears, puffins, pandas, penguins. That's what people often think of as biodiversity. But you know the biodiversity of these nematodes, or of krill or fish or anything, there's far more going on than just that. As an ecosystem scientist, it's the whole ecosystem biodiversity that you're interested in, but to most of the people who are thinking about it but are not educated in it, they think more in terms of iconic species. You know, like, like dolphins and whales and so. I'm not criticising that, it's actually an example of a communication barrier. When we talk about biodiversity, we talk about the Shannon-Wiener diversity index and species richness and all that. But that's not easily communicable. The whole thing you're trying to investigate is about **communication of science.**

Lea Schönen: Yes! I'm not sure yet in how far I can do this later in my career, but this is certainly something I would like to focus on in the coming years. When looking into Ecosystem Overviews and the feedback that was given in surveys, I actually see a lot of communication challenges,

similar to what you mentioned as well. The feedback varies but a few examples are: shorter format, make it more precise, add more context on e.g., fish stocks.

Dave Reid: People look for different things in these products. I think the problem probably lies in the fact that we as human beings are not very good at looking at things in a holistic way. We look at particular things that concern us as of that minute. In a sort of classical economics, it depends about how far off that risk is, for instance. So, you get the classic discounting theory, so it's quite difficult. For people to grasp the climate change question, not because they are climate change deniers, but it's not going to happen tomorrow or next week or next year, it's going to happen by the end of the century. **It's not difficult for people to get the idea, but it's very difficult for them to grasp it in terms of the individual facts and science of the thing.** The world is warming up. That's not good. People get that. But the actual details of it, they don't get it because they can't... There's an English expression: you can't see the wood for the trees. So, you see all these individual things, but you want a big picture, but you actually can't operate on big pictures. You can only operate on, say, is my house going to be underwater in 10 years' time? And that becomes the big issue. Coming back to **Ecosystem Overviews, they were meant to be clear advice on the ecosystem from which you're removing these fish. But the people that are making the decisions and fisheries management are wrestling with very immediate problems. The number of fishing boats they have, the guys who work on them, the money they make from it, the food that comes in, and who votes for them of course. They may know that the ecosystem is important in there. But they have no way of taking that into consideration.** I think the way to get around that is to translate these things into something that is **immediate and tangible, and actually shows a benefit as well.** What we did in the Irish Sea was we proposed a different way of approaching fishing mortality, you actually reduced the fishing mortality in the system, which was in an unproductive status, but you could actually increase it above maximum sustainable yield in a situation where the system was more productive. If you then evaluated what would have happened if we'd done that for the last 20 years, you would end up with a higher biomass of the fish species, a better yield for the fishermen and no damage or less damage to the ecosystem. It probably needs to actually be reduced to that sort of factoid style answer description. That's why I suggest something up front in these ecosystem overviews: like **'You need to be really worried about this, because if you don't this is going to get bad'**. But you know, we're very shy of giving that sort of advice.

Lea Schönen: Do you have other ideas, or did you hear about other suggestions, on how ecosystem overviews could work as efficient as possible in giving that ecosystem descriptive look towards the future?

Dave Reid: Well, I don't think there's much we can do to the ecosystem overviews. Probably, and this is a bit heretical, is that you know the managers and/or the politicians are not going to pay any great attention to the ICES ecosystem overviews. It's not going to be: 'Has the 2022 ecosystem overview come out yet? I want to have it on my desk when it comes out.'. What's much more **important is if people in society start to look at these things.** You actually have to make it accessible to the voters, who then say 'According to the ICES ecosystem overview, this

choice you're making is a bad one'. If you think about the role of the Marine Stewardship Council. People have got to the point where if the Marine Stewardship Council says it's OK to eat this fish, then people think it's OK to eat that fish. They talk about the ecosystem components and the overexploitation components. That's the pressure from below that causes that. They didn't really invent that. People started to talk about eating sustainably fished fish. The answer to your question is you need to convert the general population who then will tell the politicians what to do.

Lea Schönen: If you would have 3 wishes, that would turn out to be true immediately, what would you wish for in the context of ecosystem overviews?

Dave Reid: My first wish would be that when an ecosystem overview came out, the decision makers wanted it on their desk. For me, I don't actually care how that happens. Whether it's bottom-up pressure or whether the government decides to pass a law that says all the fisheries ministers have to read and answer questions on the ecosystem overview. That would be my primary one. Because I think if you achieve that, then you've started to make penetration into the thing.

I think my second wish would be that the organisations who actually do the work on producing the ecosystem overview, my institute for instance, actually both valued that work and used it. Debbie will tell you this but even within the ICES community, she's encountered lots of people who've never even heard the ecosystem overview, let alone write them, and that's among marine scientists. So, on my desk right now, I have a book which I consult regularly which is the stock book for Ireland. It tells you all the fishing stocks, what their status is, what the fishing is like. So when I need something I pick it up and read it. I would really love to see the ecosystem overviews to be sitting in the same sort of place for everybody, so you just had it on your desk. You know on that bar at the top of your browser with your favourites [books], one of them should be the ICES ecosystem overviews.

The third wish is actually development of employment/payment. Our institute actually paid and employed people to do this as their job rather than doing it out of the love of it. Debbi is not paid to do ecosystem overviews but she spent much of her time. That would be my third wish, that the structure of the marine science community actually supported this in a coherent way.

Lea Schönen: This then would go hand in hand with your second wish, right? That people who worked on it are appreciated and mentioned?

Dave Reid: You know the primary motivator for your staff. It's for somebody to say thank you occasionally.

Lea Schönen: Yes, I recently read about the high five culture, saying thank you or similar.

Dave Reid: It is actually the strongest motivator for employees. For a long time, I thought that was sort of true, at our level in society, but it's actually true for anybody. It's just somebody to say 'God, that was really good. Well done!'. It really motivates strongly. To get the approval of your community is just the greatest. What we really crave for is to be appreciated, for the ecosystem overviews to be appreciated by people.

Lea Schönen: I did a survey and, next to it, was allowed to use the survey on ecosystem overviews by ICES that they did within the MIRIA and MIACO meetings, I think it was early 2021. What I got out of it was actually a lot of feedback along the lines of 'I am a user and I actually like this product. I really do. I want to use it. I am using it but there are still a few more things to change'. I was amazed by how many great ideas people had. The content of course is very dependent on 'are you related to fisheries? Are you interested in fish stocks or are you interested in any other pressure in a specific region?'. Other suggestions were made related to format, like 'a written document is fine, but what about if we could see a video of an ICES representative talking about it, just the most important points?'. Or other said: use this actively in education and/or research. Perhaps as homework task in class or something similar.

Dave Reid: One of the things I've thought for a while is that you should have the **'Are you interested? Click here for more.'**-button.

Lea Schönen: Yes, but at the same time ICES ecosystem overviews are only published on the ICES website. So, you would either google and be forwarded or go directly to their website. There's not really a sort of Social Media Research collaboration network where you could find the 'Click here- button'. Or where people could post 'Hey, have you heard about Ecosystem Overviews?'. If I'm not mistaken.

Dave Reid: I was thinking of mentioning social media to you. Those **five punchy points could be out there on Facebook or Twitter or whatever.** But you know the key thing here is it's relatively easy to get people switched on to these things. The five punchy points or three, we shouldn't feel compelled to produce five. It could be 3 or 10. Those can be posted on Twitter, Facebook and Snapchat. With that thing 'Do you want to learn more? Go and read the existing overview and it'll tell you more'. I speak in ignorance, but that's probably the way to perhaps get this filtered out.

Lea Schönen: May I ask, because it was one feedback I came across, what is your opinion on merging different overviews together? For example, taking the most important parts of the ecosystem overviews and combining them with the fisheries overviews?

Dave Reid: Yes, I think that would be a good idea. The thing is that because the ecosystem overviews contain information about fishing, which is derived from the same material that the fisheries overviews are derived from. I think we considered it quite a while back. They should sort of be the same. I think **combining them, but doing so in something small and punchy,** would be good. So, you can still have the fisheries overviews

and the ecosystem overviews, but that you then have the “Things to think about – overview”: These stocks are in trouble, these ecosystem components are at risk when you make your decision. Think about this. Read more [here](#) and [here](#).

- *Ending of interview*