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Northwest Atlantic Fisheries Organization

Report of the NAFO Joint Commission–Scientific Council Working Group on Ecosystem Approach Framework to Fisheries Management (WG-EAFFM) Meeting

05-07 August 2024
Bergen, Norway

NAFO
Halifax, Nova Scotia, Canada
2024

Report of the NAFO Joint Commission–Scientific Council Working Group on Ecosystem Approach Framework to Fisheries Management (WG-EAFFM) Meeting

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1. Opening by the co-Chairs, Mar Sacau Cuadrado (European Union) and Elizabethann Mencher (United States of America)

The meeting was opened by co-chairs, Mar Sacau Cuadrado (European Union) and Elizabethann Mencher (United States of America), at 09:03 hours (UTC/GMT +2 hours) on Monday, 05 August 2024. The co-Chairs welcomed participants attending in person and virtually. This included representatives from Canada, Denmark (in respect of the Faroe Islands and Greenland), European Union, Iceland, Japan, Norway, Russian Federation, Ukraine, United Kingdom, and the United States of America, the Chair of the Scientific Council, and an accredited observer from the Deep Sea Conservation Coalition was present (Annex 1).

2. Appointment of Rapporteur

The NAFO Secretariat (Dayna Bell MacCallum and Jana Aker) was appointed as rapporteur of this meeting.

3. Adoption of Agenda

The adopted agenda is outlined in Annex 2.

4. Presentation of Scientific Council responses to Commission requests for advice (COM Doc. 23-09) relevant to WG-EAFFM

The co-Chair of WG-EAFFM, Mar Sacau Cuadrado (European Union), presented a summary of the Scientific Council advice relevant to the WG-EAFFM (SCS Doc. 24/16 (Revised)). The co-Chair noted that the Scientific Council advice will be discussed in detail in subsequent agenda items and presented a summarized overview of each of the responses. The working group thanked the Scientific Council for their work and the co-Chair for the presentation.

5. VME and SAI Assessments

a. Update on the centralized data repository (COM Request 5.a)

Andrew Kenny (United Kingdom) provided an update on the Scientific Council response to Commission request 5. a. on the ArcGIS Data Repository (SCS Doc. 24/16 (Revised)). It was noted that a data subgroup has been formed and is currently working to build on the existing list of standard data layers, develop a workflow for the data management, configure and test the ArcGIS online platform, and to extend the data management strategies to include standardized analysis and reporting tools. The ArcGIS data repository is expected to be fully operational in 2026.

The working group thanked the Scientific Council for the update and recognized the importance of this work and the effort that has gone into the centralized data repository to date. The working group also reflected on the resources that have been allotted in setting up the data repository to date, and the work still required. The working group discussed the benefits of the data repository for the Scientific Council and that it will greatly assist in the work towards the VME reassessment in 2026, as well as possibly other Scientific Council work (i.e. stock assessments, etc.) in the future. There was also a discussion on the potential for future use of the data repository by other NAFO bodies, and potentially external users, however further detailed discussions on data confidentiality and privacy are required before expanding the scope of the data repository beyond use by the Scientific Council.

b. Update on reassessment of VMEs and impact of bottom fisheries on VMEs for 2026 (COM Request 5.c)

Andrew Kenny (United Kingdom) presented an update on the Scientific Council response to Commission request 5.c. on the review of VME and reassessment of bottom fisheries (SCS Doc. 24/16 (Revised)). The Scientific Council noted that they will be undertaking the review of VMEs in November 2024, which will be presented to WG-EAFFM and Commission in 2025. The work on the reassessment of bottom fisheries (assessment of SAI) will be undertaken in November 2025 and will be presented to WG-EAFFM and Commission in 2026. The working group is recommending that the Commission request the Scientific Council to provide management options as part of the reassessment of bottom fishing.

6. Ecosystem Roadmap (COM Request 4)

Mariano Koen-Alonso (Canada) presented an update on the Scientific Council response to Commission request 4 on the continued work on tiers 1 and 2 of the Ecosystem Roadmap and the work that has been completed to date (SCS Doc. 24/16 (Revised)). It was recalled that, in response to a Commission request, the results of the TCI analysis included scoping for catches in the current and following year; Scientific Council concluded that, if TAC decisions are aligned with Scientific Council advice, catches would remain below the 2TCI ecosystem reference point in 2024 and 2025. It was noted that the next scheduled update of the Ecosystem Summary Sheets (ESSs) will be in 2027 and that there are vacancies in Designated Experts for the ESSs, reflecting the ongoing challenges in the Scientific Council's workload. The working group thanked the Scientific Council for their work, noting that the discussion also included points on the integration of climate change into the roadmap and the information exchange from Scientific Council to the Commission surrounding 2TCI.

7. Development of operational objectives for the protection of VMEs and biodiversity in the NRA (COM Request 5.b)

Andrew Kenny (United Kingdom) presented an update on the Scientific Council response to Commission request 5.b. on the development of operational objectives for the protection of VMEs and biodiversity in the NRA (SCS Doc. 24/16 (Revised)). The WG-EAFFM co-Chairs reflected on the discussions from the 2023 WG-EAFFM meeting and noted that it was agreed to complete the intersessional work to develop a draft framework document. The co-Chairs updated that some work had been done on this, but that further clarification was required before moving forward. Following discussions, the working group agreed that the general principles of the NAFO Convention should be used as the starting point for outlining the goals for which the operational objectives would be following under. The co-Chairs presented a draft discussion paper on identifying operational objectives for the protection of VMEs and biodiversity in the NRA in COM-SC EAFFM-WP 24-07 as a starting point to guide future work. The working group participants provided some feedback including the need to review the applicability of all the Convention General Principles in this exercise, the need to focus the development of the objectives and targets on what NAFO is doing in practice rather than the end goals, as well as the possibility of incorporating relevant elements of the FAO Deep Sea Guidelines. The co-Chairs thanked the working group for the detailed discussions and feedback on the way forward and agreed that they will continue work on the development of operational objectives for the protection of VMEs and biodiversity in the NRA intersessionally and circulate an updated version to WG-EAFFM participants for further discussion.

8. Other Effective Area-based Conservation Measures (OECMs)

Andrew Kenny (United Kingdom) and Brynhildur Benediktsdóttir (Executive Secretary) provided an update on the process of submitting the NAFO seamount closure areas and the sponge bottom fishing closed areas 1 to 6 to the CBD Secretariat and to the UN Environment Programme World Conservation Monitoring Centre (UNEP WCMC) for inclusion in the World Database on OECMs, as agreed at the 2023 Annual Meeting. The draft templates for the submission were provided to the working group for information and comments, and it was noted that the submission process was more complex than was previously discussed, and therefore has resulted in a delay in the submission. Contracting Parties were asked to review the draft templates and provide any comments to the Secretariat.

At the 2023 WG-EAFFM meeting, it was also agreed that WG-EAFFM continue to review the other NAFO area-based management measures in relation to the CBD OECM criteria. The working group discussed the possibility of submitting the coral bottom fishing closed areas as OECMs. It was agreed that WG-EAFFM recommend to the Commission to request the Scientific Council to develop the materials in support of the coral bottom fishing closed areas as OECMs to inform a discussion at the 2025 WG-EAFFM meeting.

9. Implementation of the 2018 Performance Review Panel Recommendations

The NAFO Secretariat highlighted COM-SC EAFFM-WP 24-01 outlining the recommendations from the 2018 performance review panel relevant to WG-EAFFM. The working group noted that the work is still ongoing in relation to Recommendation 1 and noted the discussions under agenda item 7. The working group also reflected the ongoing work of the WG-EAFFM and the Scientific Council to monitor and provide regular updates on the potential impacts of activities other than fishing in the Convention Area in relation to Recommendation 37. The working group noted that this work has now been engrained into the regular work of the Scientific Council and WG-EAFFM. As such, it was agreed to mark this recommendation as completed, noting the work will be continued. The status of the recommendation was updated in COM-SC EAFFM-WP 24-01 (Revised).

10. Scientific Council workload

The Chair of the Scientific Council, Diana González-Troncoso (European Union), presented an update of the discussions at the June Scientific Council meeting (SCS Doc. 24/16 (Revised)) around the potential ways forward that were discussed in the NAFO Informal Group to reflect on the workload of the Scientific Council on 22 April 2024 (COM-SC WP 24-01). The Scientific Council Chair reiterated that the current workload of the Scientific Council is unsustainable, and that some of the continued issues are a lack of expertise to address specific requests, an increase in the number of working groups and meetings, and a lack of support from some Contracting Parties (i.e. scientists and Chairs). The Scientific Council Chair highlighted some short-term solutions agreed to at the June Scientific Council meeting, including a revised agenda for the Divisions 3LN redfish Management Strategy Evaluation (MSE) process, and the scheduling of the assessment for Division 3M cod from annual to biannual. In addition, at its June meeting, the Scientific Council **recommended** that *the Commission should conduct a detailed workload assessment of the NAFO Scientific Council with the intention of revisiting the way scientific work is organized and seeking for possible solutions to improve efficiency and effectiveness.*

The working group thanked the Scientific Council Chair for the presentation and reflected on the importance of addressing the Scientific Council workload issues including the availability of resources and prioritization of requests, while ensuring effective engagement during the process. The working group noted that there were two fundamental issues: understanding the resource and capacity needs to adequately address the current and forecasted workload, and addressing any additional resource and capacity needs from new work requests. Regarding existing Scientific Council work requirements, the Working Group reflected on the complexity of the 5-year workplan developed by the Scientific Council and noted that it would be beneficial to simplify the workplan to align it with the specific Commission requests to ensure that the Commission is better able to see how the Scientific Council workload aligns with each request. The working group developed a draft template for this and agreed that the discussions should continue at RBMS meeting, for further consideration by the Scientific Council and the Commission at the 2024 Annual Meeting. The working group also agreed that an assessment of the current workload is required to inform the ongoing effort to address the Scientific Council workload.

On questions of the future workload, the Working Group discussed a few approaches. While unable to agree upon a specific tool or approach, the Working Group underscored the need for the Commission and the Scientific Council to address these concerns. It was discussed that Contracting Parties' obligation to provide adequate scientific support to the Organization can be impacted due to unforeseen changes in policies or budgets.

The Working Group concluded that additional analysis on the Scientific Council's processes and NAFO's priority development would assist in these efforts, and therefore, building upon the Scientific Council's recommendation, recommends that the Commission and/or the Scientific Council perform an assessment or assessments that can help inform future discussions.

11. Bycatch

a. BDS Action Plan

The co-Chairs reflected on the Commission tasking from the 2023 Annual Meeting for the working groups (including WG-EAFFM) to review the Action Plan in the Management and Minimization of Bycatch and Discards (COM Doc. 17-26) to ensure that the work continues, where required. The working group discussed the current status of the tasks under the action plan and noted that Task 4 of the action plan, relating to the development of potential management options for the Commission to consider, had not been completed. The working group reflected that the analyses that had been completed by the NAFO Secretariat in the past had been very useful, but the information needed to be updated and compiled in a comprehensive manner to allow for the proper review of the work. As such, WG-EAFFM agreed to request the Commission to task the NAFO Secretariat, in collaboration with the Scientific Council as appropriate, to compile a summary of the previous analyses completed under the action plan, as well as the relevant data sources associated with that work. The compilation will be shared with the WG-EAFFM, WG-RBMS, and STACTIC in 2025 for consideration. This will help the WG-EAFFM and/or the appropriate NAFO body to identify data gaps and available data sources that could help fill those gaps, and will inform scoping discussions for the rest of the work in the action plan.

b. Greenland shark bycatch

The co-Chairs reflected on the Commission tasking from the 2023 Annual Meeting for WG-EAFFM to consider other appropriate management options for the bycatch of Greenland sharks in the NAFO Regulatory Area, to inform the Commission's consideration of additional conservation measures. The working group reflected on the significant progress made to date in NAFO on the conservation of Greenland sharks, including but not limited to, the strengthening of management measures, improving data collection through the NAFO Observer Program, and developing guidance for identification as well as safe handling and release. It was noted that the management measures adopted in 2018 and 2022 reflect compromises across Contracting Parties, and that Contracting Parties need time to implement both the relatively new management measures, and consider how they will apply the new data collection elements. The working group noted the Commission, STACTIC and the Scientific Council have each been instrumental to this progress, in addition to the independent research and other efforts by Contracting Parties to complement this work. It was noted that NAFO at-sea observers have been completing the updated reporting template (Annex II.M Part 5 of the NAFO CEM) since 2020, and data are received by the Secretariat; however, no NAFO body is currently reviewing or otherwise using this data. To facilitate continued considerations of potential additional measures for the conservation for Greenland shark, WG-EAFFM agreed to recommend to the Commission that the Secretariat summarize and analyze the available observer data related to Greenland shark with a view to identify trends, and any potential data gaps. The WG-EAFFM will then review the summary and analysis at the 2025 meeting and as appropriate, and if necessary, consider any data gaps and/or issues, and discuss potential ways to address them. Additionally, the WG-EAFFM, at its 2025 meeting, will consider recommending that the Commission request to Contracting Parties to provide updates on their efforts to implement the relevant provisions of the NAFO CEM, including any independent relevant research or data, to WG-EAFFM for its 2026 meeting. At its 2026 meeting, WG-EAFFM will review the available information related to Greenland sharks, including any provided by Contracting Parties, to identify any additional scientific and/or technical gaps/issues. At its 2027 meeting, WG-EAFFM will, if necessary, consider appropriate management options for the bycatch of Greenland sharks in the NRA. For any proposals, Contracting Parties will need time to consider them. Proposals should be transparent, introduced and reviewed timely and be consensus based.

c. Directed Fisheries

The United States of America presented a discussion paper on NAFO Directed Fishing Policy outlined in COM-SC EAFFM-WP 24-06, which reflected the difficulties that some Contracting Parties vessels are facing in the changing landscape of NAFO fisheries while effectively balancing NAFO's current approach to directed fishing. The United States reflected on recent changes to the NAFO CEM that have been adopted to address specific fishery challenges with directed fishing, and noted the opinion that broader, policy level discussions are required to address these challenges. The working group reflected on the discussion paper and did not find a clear consensus on the best body to undertake these discussions and address these issues (i.e. STACTIC, WG-EAFFM, WG-RBMS).

12. Review of the Terms of Reference for WG-EAFFM

The co-Chairs reflected on the revisions made to the Terms of Reference at the 2023 WG-EAFFM meeting in COM-SC EAFFM-WP 23-14 (Rev. 3) and noted that they had consulted with the co-Chairs of WG-RBMS on the draft, as agreed at the 2023 meeting and presented further revisions in COM-SC EAFFM-WP 24-08. The working group revised the draft changes, made additional suggestions, and agreed to recommend that the Commission and the Scientific Council review and approve the revised Terms of Reference as outlined in COM-SC EAFFM-WP 24-08 (Rev. 2) (Annex 3).

13. Other Business

The Executive Secretary provided an update on the "Applying the Ecosystem Approach to Fisheries Management in ABNJ" symposium scheduled to take place from 11-13 March 2025 at the FAO Headquarters in Rome, Italy. More info about the symposium can be found at https://eafm-symposium.nafo.int/.

It was noted that the Ecosystem Roadmap will be discussed at the symposium, but there has not been a specific document developed in NAFO outlining the details of the Roadmap. The working group discussed the importance of having a comprehensive document to refer to when discussing the Roadmap and agreed to recommend the Commission to request the Scientific Council, over the next 1-3 years, to develop a reference document detailing the Ecosystem Roadmap. In the meantime, a draft summary description of the Roadmap is provided in Annex 4.

14. Recommendations

The WG-EAFFM agreed to forward the following recommendations to the Scientific Council and the Commission for consideration and adoption at the 2024 Annual Meeting of NAFO:

1. **In relation to agenda item 5.b on the update on reassessment of VMEs and impact of bottom fisheries on VMEs for 2026, the WG-EAFFM requests the Commission to recommend the Scientific Council to include potential management options in the reassessment of bottom fisheries, with the goal of supporting meaningful and effective discussions between scientists and managers at WG-EAFFM.**

2. **In relation to agenda item 8 on Other Effective Area-based Conservation Measures (OECMs), the WG-EAFFM recommends that the Commission request the Scientific Council to develop materials to inform a discussion on the potential of submitting NAFO coral bottom fishing closed areas as OECMs at the 2025 WG-EAFFM meeting.**

3. **In relation to agenda item 10 on the Scientific Council workload, the WG-EAFFM recommends the Commission and/or the Scientific Council consider undertaking internal, or support external, assessments to inform the ongoing effort to address the Scientific Council workload. Such assessments could include how to optimize:**

    a) **the organization / structure and function of the Scientific Council, its standing committees and working groups,**

    b) **further development and implementation of the Scientific Council's workplan,**

c) **the process to prioritize across requests to Scientific Council, and**

d) **the process to consider the work of the Scientific Council in the NAFO budget.**

4. **In relation to agenda item 11.a on the Action Plan in the Management and Minimization of Bycatch and Discards, the WG-EAFFM recommends the Commission requests the NAFO Secretariat, in collaboration with the Scientific Council as appropriate, compile a summary of the previous analyses completed under the action plan, as well as the relevant data sources associated with that work. The compilation will be shared with the WG-EAFFM, WG-RBMS, and STACTIC in 2025 for consideration.**

5. **In relation to agenda item 11.b on Greenland shark bycatch, the WG-EAFFM recommends that the Commission requests that the Secretariat provide a summary and analysis of the observer data related to Greenland shark to WG-EAFFM at its 2025 meeting, with a view to identify trends, and any potential gaps, in that information.**

6. **In relation to agenda item 12 on the review of the Terms of Reference, the WG-EAFFM recommends that the Commission and the Scientific Council review and approve the revised Terms of Reference, outlined in COM-SC EAFFM-WP 24-08 (Rev. 2) (Annex 3).**

7. **In relation to the ecosystem roadmap, WG-EAFFM recommends the Commission to request the Scientific Council to develop a reference document detailing the ecosystem roadmap, for completion in the next 1-3 years.**

15. Adoption of the Report

The report was adopted via correspondence following the end of the meeting.

16. Adjournment

The meeting was adjourned at 15:20 hours (UTC/GMT +2) on Wednesday, 07 August 2024.

The co-Chairs thanked meeting participants for their cooperation and input. The participants likewise expressed their thanks and appreciation to the co-Chairs for their leadership. The working group also expressed their gratitude to Norway for hosting the meeting, and the NAFO Secretariat for their support.

Annex 1. List of Participants

CO-CHAIRS	**In-person** Sacau Cuadrado, Mar (European Union) Mencher, Elizabethann (United States of America)
SC CHAIR	**In-person** González-Troncoso, Diana (European Union)
CANADA	**In-person** Byrne, Vanessa Fagan, Robert Johnson, Kate Koen Alonso, Mariano Rayner, Gemma Simpson, Mark **Virtual** Burridge, Angela Fuller, Susanna Krohn, Martha
DENMARK (IN RESPECT OF FAROE ISLANDS AND GREENLAND)	**Virtual** Svarrer Wang, Ulla
EUROPEAN UNION	**In-person** Belmonte González, Luis **Virtual** Abalo-Morla, Sara Blazkiewicz, Bernard Cortina, Angela Durán Muñoz, Pablo Dybiec, Leszek Garrido, Irene Granell, Ignacio Lopes, Luis Mancebo, C. Margarita Merino Buisac, Adolfo Palas Otero, Santiago Szumlicz-Dobiesz, Justyna Teixeira, Isabel Tuvi, Aare
ICELAND	**In-person** Bragason, Agnar Bragi
JAPAN	**Virtual** Iwano, Taisuke Takehara, Toya Taki, Kenji
NORWAY	**In-person** Bakke, Gunnstein Øvregård Østebø, Kjetil

RUSSIAN FEDERATION	**Virtual** Fomin, Konstantin
UKRAINE	**Virtual** Honcharuk, Ihor Paramonov, Valerii
UNITED KINGDOM	**In-person** Gawlyk, Joe Gibbins, Imogen Kenny, Andrew
UNITED STATES OF AMERICA	**In-person** Emmert, Samantha Jaburek, Shannah Warner-Kramer, Deirdre **Virtual** Sosebee, Katherine
ACCREDITED OBSERVERS	**In-person** Diz, Daniela (Deep Sea Conservation Coalition)
NAFO SECRETARIAT	**In-person** Benediktsdóttir, Brynhildur Aker, Jana Bell MacCallum, Dayna **Virtual** LeFort, Lisa

Annex 2. Agenda

1. Opening by the co-Chairs, Mar Sacau Cuadrado (European Union) and Elizabethann Mencher (United States of America)
2. Appointment of Rapporteur
3. Adoption of Agenda
4. Presentation of Scientific Council responses to Commission requests for advice (COM Doc. 23-09) relevant to WG-EAFFM
5. VME and SAI Assessments
    a. Update on the centralized data repository (COM Request 5.a)
    b. Update on reassessment of VMEs and impact of bottom fisheries on VMEs for 2026 (COM Request 5.c)
6. Ecosystem Roadmap (COM Request 4)
7. Development of operational objectives for the protection of VMEs and biodiversity in the NRA (COM Request 5.b)
8. Other Effective Area-based Conservation Measures (OECMs)
9. Implementation of the 2018 Performance Review Panel Recommendations
10. Scientific Council workload
11. Bycatch
    a. BDS Action Plan
    b. Greenland shark bycatch
    c. Directed Fisheries
12. Review of the Terms of Reference for WG-EAFFM
13. Other Business
14. Recommendations
15. Adoption of the Report
16. Adjournment

Annex 3. REVISED Terms of Reference – Joint Commission-Scientific Council Working Group on Ecosystem Approach Framework to Fisheries Management (WG-EAFFM)
(COM-SC EAFFM-WP 24-08 (Rev.2))

Structure:

The Working Group on Ecosystem Approach Framework to Fisheries Management reports to both the Commission (COM) and Scientific Council (SC); considers the advice of Scientific Council; and provides recommendations to the Commission.

The Working Group shall be comprised of fishery managers, scientists, and advisors from Contracting Parties, supported by observers and invited experts. The Co-chairs will consist of a fishery manager from the Commission and a scientist from the Scientific Council.

Plenary discussions will be conducted in an informal, open manner, unless the Contracting Parties, decide to conduct sessions in a delegation format. Recommendations to the Commission will be developed and agreed upon through formal sessions of official delegations. When the Working Group breaks from plenary session and reverts to participation by delegation, individual scientists remain as part of their delegations and Scientific Council as a whole would be represented by the Scientific Council Chair or a designated alternate.

Accredited observers may attend meetings of the Working Group. Participation will be subject to the *NAFO Rules of Procedure*.

If a Contracting Party so requests, particular agenda items of the meeting, or parts thereof, shall be restricted to delegates representing Contracting Parties and Scientific Council.

Objective:

The main objective of the Working Group is to make recommendations to the Commission and provide feedback to Scientific Council on the development and effective implementation of ecosystems approaches to fisheries management.

Specific Duties:

In responding to requests for advice and recommendations from the Commission, considering the associated advice of Scientific Council, the Working Group shall:

- Further develop and provide recommendations on the application of the Ecosystem Approach to Fisheries (EAF) Roadmap.
- Consider ecosystem status, functioning and dynamics of NAFO marine ecosystems, including species interactions, and their productivity,
- Consider impacts of non-fisheries activities.
- Consider the impacts of climate change as an element of work on the EAF roadmap.
- Make recommendations on mitigation strategies and measures to avoid significant adverse impacts of fishing activities on vulnerable marine ecosystems, including the evaluation of associated risks.
- Review area closures periodically and other measures as outlined in the NAFO Conservation and Enforcement Measures (CEMs).
- Provide recommendations in relation to requests to conduct exploratory bottom fishing and evaluate authorized exploratory fishing activities.

- Provide recommendations for updating the CEMs in relation to EAF including the text in Chapter II (Bottom Fisheries in the NAFO Regulatory Area) and any associated Annexes (e.g. the Exploratory Protocol for New Fishing Areas - Annex I.E), as necessary.

- Provide recommendations and information, and support the Secretariat, on coordination with other regional or global organizations on activities related to the implementation of the ecosystem approach to fisheries management.

Meetings:

The Working Group will typically meet annually unless otherwise agreed by the Scientific Council and the Commission.

Whenever possible, the regular meeting of the Working Group should occur after the June Scientific Council meeting and prior to the NAFO annual meeting.

Reporting out

The Working Group will issue a written report to the Commission and the Scientific Council, prior to the NAFO annual meeting.

Annex 4. A draft summary description of the NAFO Roadmap for an Ecosystem Approach to Fisheries

As stated in its convention, NAFO's objective is to *ensure the long term conservation and sustainable use of the fishery resources in the Convention Area and, in so doing, to safeguard the marine ecosystems in which these resources are found*. The convention **recognizes** *the economic and social benefits deriving from the sustainable use of fishery resources*, **promotes** *the long term conservation and sustainable use of the fishery resources based on the best available scientific advice and the precautionary approach*, and **commits** to *apply an ecosystem approach to fisheries management in the Northwest Atlantic that includes safeguarding the marine environment, conserving its marine biodiversity, minimizing the risk of long term or irreversible adverse effects of fishing activities, and taking account of the relationship between all components of the ecosystem*.

Implementing an ecosystem approach along the lines established in the NAFO Convention requires the development of scientific tools and assessment methods that can inform the relevant components, their interactions, and trade-offs, as well as the production and integration of related scientific advice into the regular management processes, and activities of NAFO bodies.

To this end NAFO constructed a framework for the development and implementation of an ecosystem approach for its operations. This framework, commonly referred to as the NAFO Roadmap for an Ecosystem Approach to Fisheries (EAF), highlights the scientific information and advice required to deliver an EAF. It aligns the information and advice with the structure and operations of the organization, and identifies the lead NAFO bodies associated with the production, delivery and implementation of its elements (Fig.1, Table 1). It amalgamates new and existing elements within the NAFO management cycle, and its design is purposely modular so that new and/or improved components can be incorporated into management practices as soon as their status is deemed ready for application. The Roadmap represents both, the structure needed for developing and implementing an EAF in NAFO, and the recursive process (management cycle) required to put it into practice (Koen-Alonso et al., 2019).

The Roadmap is intended to be adaptable by providing a basic structure and general principles on which to build an EAF for NAFO, and whose details can evolve as the different elements are developed, implemented, and tested through practice. Its core premises are: a) the approach has to be objective-driven, b) it should consider long-term ecosystem sustainability, c) it must be place-based, and d) the consequences of trade-offs in managing human activities have to be explicitly defined.

The ecological underpinning for the Roadmap structure is the nested hierarchical organization of natural ecosystems that integrates biological, chemical, and physical processes operating at different temporal and spatial scales, where higher level structures function as constraints for the levels within. In this context implementing EAF requires consideration of geographical units that are consistent with the spatial and temporal scales of the interacting stocks to be managed in a coordinated way, while considering what factors regulate and constrain ecosystem productivity at those scales. In practical terms, this requires taking into account two complementary and interrelated considerations: a) the effects of the ecosystem and fishing on the target stocks (impacts of the system on the stocks), and b) the effects of fishing on ecosystem components beyond the target stocks (impacts of fishing on habitats and other species).

The Roadmap addresses the effects of the ecosystem and fishing on the target stocks by informing sustainable harvest rates through a three-tiered hierarchical approach which evaluates sustainability at the ecosystem, multispecies, and stock levels (Fig. 1, Table 1). Tier 1 includes the identification of the ecosystem units, the assessment of ecosystem state, and the evaluation of productivity at the ecosystem unit scale. This tier of the Roadmap allows general considerations of large scale climate and ecological forcing, and the basic constraint imposed by primary production on fisheries productivity. Tier 2 considers multispecies interactions (e.g. predation, competition) and the impacts of environmental drivers on the managed stocks to evaluate the capacity of the system of interacting stocks to respond to anthropogenic and ecological perturbations. Tier 2 allows evaluation of trade-offs among fisheries, and identifies harvest rates which are consistent with multispecies sustainability. Tier 3 recognizes existing single-species stock assessments and allows consideration of traditional fishery management measures within sustainable ecosystem production limits. When taken together, the tiers of the Roadmap take into account ecosystem sustainability considerations at three nested levels of ecological organization, and informs stock management decisions which are framed by

the NAFO Precautionary Approach Framework (PAF), and/or stock-specific Management Strategy Evaluation (MSE) frameworks.

Complementary to this 3-tiered approach, the Roadmap addresses the effects of fishing on the ecosystem by focusing on both by-catch, and impacts on benthic habitats. While some fisheries can be more impactful than others, the full extent of fishing impacts on the ecosystem is cumulative in nature, and hence, their evaluation requires integration across all fisheries operating within an ecosystem production unit.

By-catch is one of the first ecosystem impacts of fishing for which management measures have been traditionally developed. Incidental catches of species of conservation concern (e.g. marine mammals, seabirds, turtles, sharks), as well as the catch of undersized commercial species and/or under moratoria, are issues of concern in most fisheries around the world. Mechanisms to address concerns of this nature were part of NAFO regulatory framework before the Roadmap, and its integration within the Roadmap aims at improving the evaluation of by-catch and assessing its effects at the ecosystem level.

Likewise, impacts on benthic habitats can only be fully addressed in terms of the integrated losses resulting from fishing practices. Each fishery may have quantitatively and qualitatively different impacts owing to the target species, gear, and modes of operation, but the overall impact on benthic habitats is defined by the cumulative effects of all fisheries operating in a particular region. These impacts would have different long-term consequences depending on the vulnerability of the habitat being perturbed, as well as the role of those habitats for overall ecosystem functioning. Currently, the habitat impacts component of the Roadmap is focused on the evaluation of Significance Adverse Impacts (SAIs) on Vulnerable Marine Ecosystem (VME) habitats (FAO, 2009), which constitutes the key evidence for management measures aimed at protecting these habitats. As the Roadmap evolves, and our understanding on the role of different habitat structures on ecosystem functioning grows, habitat impact considerations could be expanded to other habitats types as necessary.

The practical implementation of the Roadmap requires a diversity of monitoring activities ranging from those linked to collection and analysis of scientific data, to those supporting regulatory compliance and enforcement. These monitoring activities are central to NAFO operations, and rely on coordinated efforts by Contracting Parties (CPs), and the support of the NAFO Secretariat. The full scope of these activities may exceed the Roadmap *per se*, but they are integral for understanding the Roadmap as a recursive process (management cycle) (Fig. 1, Table 1).

The setting of goals and objectives, paired with the actual action of making fisheries management decisions, constitutes both, the starting and ending point of the Roadmap as a recursive process representing the NAFO management cycle. It is the step where the information generated is incorporated and influences the outcomes of the decision-making process, as well as the generating point of feedback that will help refining and improving both, the objectives themselves, and the scientific and management work required to deliver on them.

At present, the Roadmap does not explicitly incorporate socio-economic and cultural elements into the EAF process.

In summary, the Roadmap requires for each geographically defined ecosystem unit, the development of a series of interconnected assessments aimed at different spatial scales and levels of ecological organization, which can be schematically described as ecosystem state, multispecies, stock, and habitat impacts assessments (Fig. 1, Table 1). These assessments require the implementation of analyses aimed at defining ecosystem-level fisheries productivity, exploring ecological trade-offs among exploited species, establishing the status of each exploited stock, and evaluating the cumulative impacts of fishing on benthic habitats. The results from these assessments, and their integration into the scientific advice and management discussion, provides the basis for ecosystem-informed fisheries management decisions in NAFO.

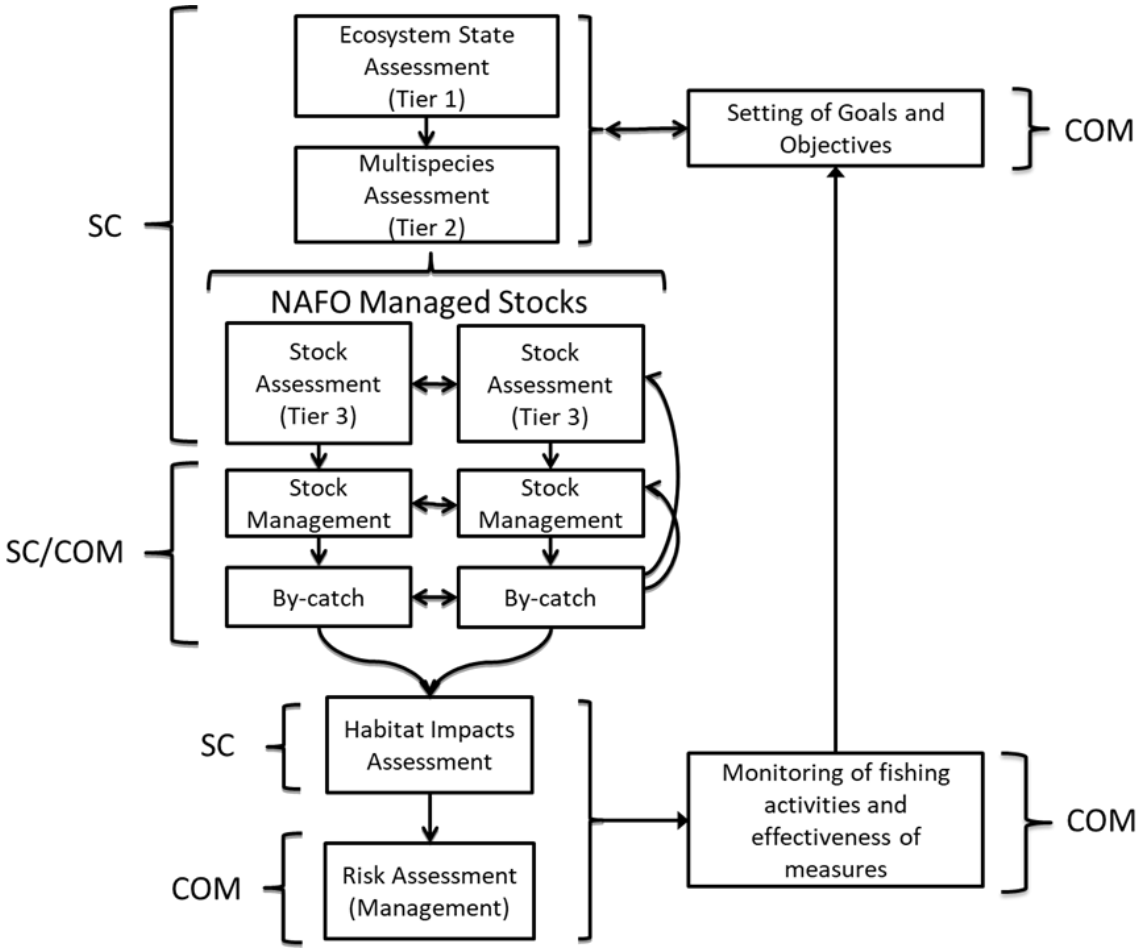

Figure 1. Current template of the NAFO Roadmap for EAF. SC: Scientific Council, COM: Commission. The labelled vertical brackets indicate the leading NAFO body for each Roadmap component.

Table 1. Brief description of the Roadmap components

Component	Examples of tasks/activities associated with the component	Lead NAFO body, and main supporting bodies
Goal setting	• Definition of operational objectives for NAFO fisheries (ecosystem and other levels). • Management decisions consistent with the objectives.	**Lead:** COM **Supporting:** SC, joint COM-SC WGs (WGEAFFM and WGRBMS), and COM STACTIC
Ecosystem State Assessment (Tier-1)	• Definition of spatial management units. • Evaluation of productivity state of the ecosystem and its variability, including impacts from large scale environmental forcing (e.g. cycles and climate change) at the ecosystem level. • Provision of advice on sustainability of total catches at the ecosystem level (risk of ecosystem overfishing).	**Lead:** SC **Supporting:** SC WGESA, SC STACFEN, joint COM-SC WGEAFFM, and COM
Multispecies Assessment (Tier-2)	• Description of species interactions and trends, including quantification of diets and predation. • Understanding the role of environmental drivers on ecosystem structure and dynamics. • Understanding the response of food webs to anthropogenic impacts. • Definition of multispecies reference points. • Provision of advice on catch portfolios based on multispecies considerations.	**Lead:** SC **Supporting:** SC WGESA, SC STACFEN, SC STACFIS, joint COM-SC WGEAFFM, and COM
Stock Assessment (Tier-3)	• Stock identification and delineation. • Assessment of the status of the stock. • Consideration of processes/environmental drivers affecting recruitment, growth, maturation and spatial distribution. • Consideration of sources of mortality at the stock level. • Provision of advice on stock-specific catch levels.	**Lead:** SC **Supporting:** SC STACFIS, SC STACFEN, SC WGESA, joint COM-SC WGs (WGEAFFM and WGRBMS), and COM
Stock Management	• Definition of a Precautionary Approach Framework, and related stock-level reference points. • Development and implementation of harvest control rules, stock-specific Management Strategy Evaluation frameworks, and rebuilding plans.	**Lead:** SC and COM **Supporting:** SC STACFIS, SC STACFEN, WGESA, and joint COM-SC WGRBMS
By-catch	• Evaluation of by-catch of commercial and non-commercial species (including VME-defining species). • Reporting of by-catch for use in all assessments (ecosystem, multispecies, stock, and habitat impacts).	**Lead:** SC and COM **Supporting:** COM WGBDS, joint COM-SC WGs (CSAG, WGEAFFM and WGRBMS), COM STACTIC, and NAFO Secretariat,

	• Development and implementation of measures to control by-catch levels.	
Habitat Impacts Assessment	• Identification of benthic areas/habitats of special concern (e.g. VMEs). • Characterization of the habitat, its functionality, and its capacity to tolerate perturbations. • Analysis of fishing impacts on benthic ecosystems. • Provision of advice on Significant Adverse Impacts (SAI) on habitats (e.g. VMEs) by fishing activities.	Lead: SC Supporting: SC WGESA, SC STACFEN, SC STACFIS, joint COM-SC WGEAFFM, and COM
Risk Assessment	• Consideration of the risk of significant adverse impacts on habitats (e.g. VMEs), in the context of current activities and objectives. • Consideration of the risk of fisheries having significant adverse impacts on ecosystem structure and function, in the context of current activities and objectives. • Development and implementation of management actions in response to the outcomes of habitat risk assessments.	Lead: COM Supporting: SC, and joint COM-SC WGEAFFM
Monitoring	• Collection, analysis, and interpretation of data pertaining to ecosystem status and human activities relevant to the NAFO convention objectives. • Use of available data to track the effectiveness of management measures.	Lead: COM Supporting: SC, NAFO Secretariat, COM STACTIC, and joint COM-SC WGs (CSAG, WGEAFFM and WGRBMS)

References

FAO 2009. International guidelines for the management of deep-sea fisheries in the high seas, Food and Agriculture Organization (FAO) of the United Nations (UN), Rome.

Koen-Alonso, M., Pepin, P., Fogarty, M. J., Kenny, A., and Kenchington, E. 2019. The Northwest Atlantic Fisheries Organization Roadmap for the development and implementation of an Ecosystem Approach to Fisheries: structure, state of development, and challenges. Marine Policy, 100: 342-352.