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The Northwest Atlantic Fisheries Organization (NAFO) Roadmap for an Ecosystem Approach to Fisheries: A summary of its implementation and level of development as of December 2025

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Abstract

The NAFO Roadmap for an Ecosystem Approach to Fisheries (EAF) is the framework NAFO is following to deliver on the NAFO Convention commitment to implement an ecosystem approach for the management of fisheries resources. The Roadmap is intended to be adaptive rather than prescriptive, as its details can evolve as the different elements are developed, implemented, and tested through practice. This implies that while the framework itself remains stable, the specific details of the Roadmap implementation can change over time. It follows that documenting the Roadmap implementation requires tracking of which components of the Roadmap are implemented at a given point in time, and how they are implemented, both in terms of the scientific tools used, as well as the expected role these can play in supporting an ecosystem-informed decision-making process. This study summarizes the current implementation of the NAFO Roadmap in NAFO as of December 2025.

Introduction

One important aspect of the modernization of the Northwest Atlantic Fisheries Organization (NAFO), introduced by the fourth set of amendments to the NAFO Convention, was the incorporation of an ecosystem approach to fisheries management (NAFO, 2017). To expedite the implementation of the objective and principles in the amended Convention, NAFO adopted these through a Commission (COM) resolution years ahead of the amended Convention entering into force (NAFO, 2008a, b). This fostered the early development of the tools and concepts needed for the implementation of an Ecosystem Approach to Fisheries (EAF) in NAFO. The result of those efforts is the framework known as the NAFO Roadmap for EAF (Koen-Alonso et al., 2019). This framework (Fig. 1) represents both the structure needed for developing and implementing an EAF in NAFO, and the necessary recursive process (management cycle) to put it into practice. Its core premises are: a) the approach has to be objective-driven, b) it must 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.

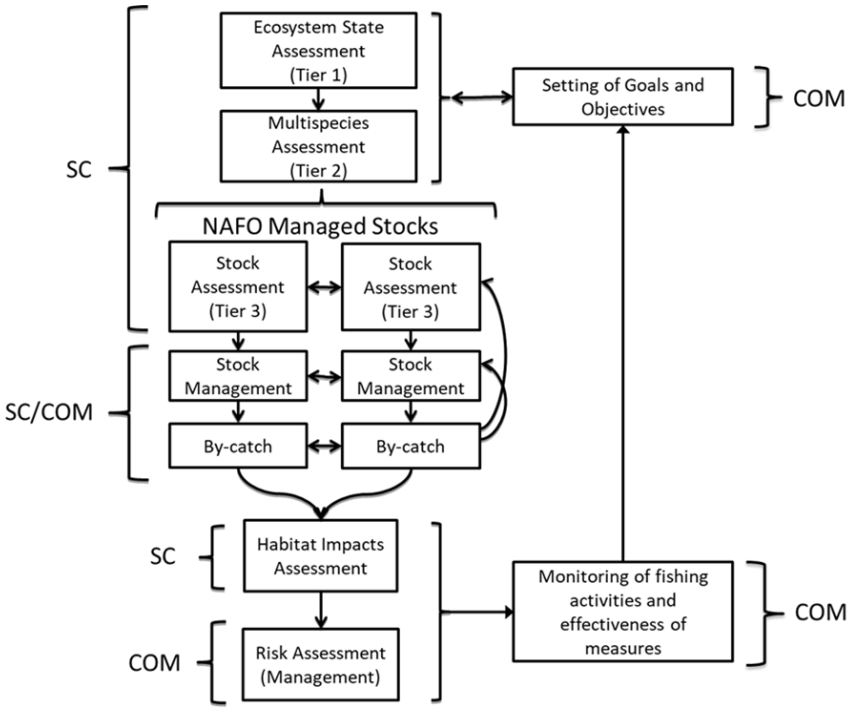

Figure 1. Current template of the NAFO Roadmap for EAF. SC: Scientific Council, COM: Commission. The labelled vertical brackets indicate the leading NAFO body for each Roadmap component. Arrows represent the flow of information and interactions between different components, and schematically correspond to the representation of the Roadmap as an integrated and recursive management cycle.

The Roadmap is intended to be adaptive rather than prescriptive, as its details can evolve as the different elements are developed, implemented, and tested through practice. It serves as guidance for EAF implementation, and it is designed to support managers, stakeholders, and policymakers in integrating ecological considerations into fisheries management decisions in a practical and adaptive manner.

The implementation of the Roadmap in NAFO represents an evolution from traditional single-species management practices to an EAF. This process integrates existing elements of the traditional single-species management system with new ones, to build a management approach that aims for a more comprehensive delivery of the NAFO objective and principles.

This implies that while the framework itself remains stable, the specific details of the Roadmap implementation can change over time. It follows that documenting the Roadmap implementation requires tracking of which components of the Roadmap are implemented at a given point in time, and how they are implemented, both in terms of the scientific tools used, as well as the expected role these can play in supporting an ecosystem-informed decision-making process.

The goal of this document is to fill this gap by summarizing the current implementation of the NAFO Roadmap in NAFO as of December 2025.

Methods

A review of the many scientific tools and communication devices used by NAFO SC to inform COM decisions was conducted by examining SC, COM, joint COM-SC, and SC Working Groups Reports from the last 5 years (2020-2025), as well as information collected through participation in NAFO meetings in relation to work in development. The NAFO Convention and NAFO Enforcement and Conservation Measures were also examined.

All these documents are available in the NAFO website (www.nafo.int). The pertinent elements relevant to the Roadmap implementation were identified. A brief description of the key elements, as well as the expected role in supporting ecosystem-informed decision-making processes and practices were summarized in tabular form.

Results

While some components of the Roadmap are still in development, the currently implemented elements already illustrate the ongoing transformation of NAFO's management system into one firmly anchored on the principles of the Precautionary and Ecosystem Approaches, and where pre-existing and new elements contribute to inform and support ecosystem-informed decision-making processes and practices (Table 1).

Table 1. Summary description of key elements of the Roadmap currently implemented or under development, including their role in decision-making. NCEM indicates the NAFO Enforcement and Conservation Measures.

Component	Current Implementation	Decision-making context
Goal setting	**Current implementation** • General objectives based on the NAFO Convention. • Specific operational objectives for stocks (embedded in the Precautionary Approach (PA) framework and NCEM) • Specific operational objectives for managing by-catch in specific fisheries and/or for specific species of concern (NCEM). **Elements currently in development** • Definition of operational objectives for some Roadmap components (i.e. Tier-1 and SAI-VME) had been discussed, but their development has been put on pause for the moment.	• General objectives provide an agreed framing for the overall outcomes that management decisions are intended to achieve. • Specific operational objectives provide a more detailed scope/target for informing concrete management decisions in alignment with the general objectives.
Ecosystem State Assessment (Tier-1)	**Current implementation** • Identification of Ecosystem Production Units (EPUs) as the spatial scale for EAF strategic planning and management. • Ecosystem Summary Sheets (ESSs) developed for the Grand Bank (3LNO) and Flemish Cap (3M) EPUs: o ESSs provide a synoptic view on the state of NAFO ecosystems and their management regime. o ESSs constitute a tool for strategic assessment, advice and planning. o ESSs are on a 5 year update schedule, with annual interim monitoring of ecosystem conditions	• ESSs provide support for strategic planning discussions, and to identify issues/elements that may require additional focused management attention. • The analyses of cumulative catches in relation to the 2TCI Ecosystem Reference Point inform on the ecosystem-level sustainability of the aggregated harvest level at the EPU scale. The associate scoping exercise supports stock-level TAC decisions by providing information on the risk of ecosystem overfishing linked to the aggregated harvest

Component	Current Implementation	Decision-making context
	in the intervening years. The work towards the next full update is conducted in the intervening years. • Twice the Total Catch Index (2TCI) adopted by NAFO as Ecosystem Reference Point to inform on the Risk of Ecosystem Overfishing. o Total Catch Index (TCI) is an indicator of the current fisheries productivity by functional guilds (aggregate of species) at the EPU level. o Cumulative catches above 2TCI are linked to consistent declines of the corresponding functional guilds, indicating a high risk of ecosystem overfishing. o Information on cumulative catches, including scoping for current and incoming year, in relation to TCI and the adopted 2TCI Ecosystem Reference Point are produced annually. o This information is summarized in the "Ecosystem Sustainability of Catches Report" and also included in the Stock Summary Sheets (SSSs) and ESSs as appropriate. **Elements currently in development** • Framework for regular review and update of the inputs and process involved in the estimation to the Total Catch Index (TCI). • Exploration of ways of incorporating environmental drivers and climate change impacts on ecosystem productivity, and its integration in the ecosystem advice.	levels being considered within an EPU.
Multispecies Assessment (Tier-2)	**Current implementation** • Information of diets and species interactions regularly reviewed, considered in ESSs, and included in SSSs when appropriate. • Information on species interactions and ecosystem changes has informed the parameterization of some stock-assessment models, and/or interpretation of some assessment results.	• The elements of this Tier currently implemented contribute to inform management decisions through ESSs and stock-level advice. • Once fully developed, analyses from this Tier will support management decisions by informing on the potential trade-offs associated with fisheries on stocks linked through ecological interactions

Component	Current Implementation	Decision-making context
	• General guidelines on the role and approach to the implementation of Tier-2 models have been developed. **Elements currently in development** • Multispecies model for key species (cod, redfish, shrimp) in the Flemish Cap (3M) EPU. • Multispecies models for key species in the Newfoundland Shelf (2J3K) and Grand Bank (3LNO) EPUs. • Exploration of ways of incorporating environmental drivers and climate change impacts on stock dynamics, and its integration in the ecosystem advice.	(e.g. predation, competition) within an ecosystem. • Analyses from this Tier will also support management decisions by informing on the potential impacts of environmental drivers on the dynamics of fish stocks and communities. These analyses would likely span the boundaries between Tier 2 and 3.

Stock Assessment (Tier-3)	**Current implementation**
	
	• Single species stock-assessments for NAFO managed stocks. This includes:
	  ○ Analyses of biological parameters.
	  ○ Analyses of stock dynamics and the impacts of fishing at the stock level through:
	  ○ Survey-based analyses
	  ○ Stock-assessment models
	  ○ Incorporation of relevant environmental and ecological impacts on the stock assessment whenever possible.
	  ○ Provision of scientific advice on stock status and trends under different harvest scenarios following the revised Precautionary Approach Framework (Stock Management).
	• Stock-assessment results are summarized in Stock Summary Sheets (SSSs).
	  ○ SSSs also integrate information on TCI-related advice (Tier 1) for the functional guild and EPU corresponding to the assessed stock.
	  ○ For multiyear assessments, an interim monitoring of the stock is conducted annually during the intervening years between full assessments.
		• The single species stock-assessments support stock-level TAC decisions by providing information on stock status and trends under different harvest scenarios.
		
		• Once fully developed, analyses from this Tier will also support management decisions by informing on the potential impacts of environmental drivers on stock dynamics. These analyses would likely span the boundaries between Tier 2 and 3.

Component	Current Implementation	Decision-making context
	Elements currently in development • Benchmark processes to review and improve the methods and models used in the stock-assessments. • Exploration of ways of incorporating environmental drivers and climate change impacts on stock dynamics, and its integration in the stock advice.	
Stock Management	**Current implementation** • A revised Precautionary Approach (PA) framework has been recently adopted (2024) and its implementation is ongoing. Key features of the revised PA includes: o Three zones to define stock status (Critical, Cautious, and Healthy). o Defines the fishing mortality that produces the Maximum Sustainable Yield (MSY) (Fmsy) as the limit fishing mortality (Flim). o Defines the target fishing mortality (Ftarget) as a fraction of Fmsy. o Defines an envelope of F values within the Cautious zone as a function of stock level (PA leaf) that provides a range of management options within this Zone. o The performance of the revised PA framework to achieve its outcomes (e.g. rebuild stocks to the Healthy Zone), using the PA leaf and Ftarget to define a generic Harvest Control Rule, has been simulation-tested (i.e. a generic analog to Management Strategy Evaluation). o The revised PA also includes additional guidance for managers on how to consider stock trends when the stock is in the Cautious zone. o The revised PA framework remains a single-species framework (i.e. no explicit ecosystem considerations), but the stock advice is complemented by the information on scoped cumulative catches in relation to the 2TCI Ecosystem Reference Point (Tier 1).	• The revised PA and MSEs support stock-level TAC decisions by providing decision-making frameworks designed and tested to meet stock-level objectives. • The interim conservation plans and rebuilding strategies for some stocks under fishing moratoria are intended to promote the recovery of these stocks.

Component	Current Implementation	Decision-making context

	• Reference Points under the revised PA have been defined for some stocks.
	• Some stocks are (SA2+Divs. 3KLMNO Greenland halibut) or have been (3LN Redfish) managed using Management Strategy Evaluation (MSE) and their associated Management Procedures (MPs).
	  ○ MSEs are periodically reviewed.
	  ○ MSEs include annual reviews of special circumstances that may impact the MSE reliability. Protocols are in place to address these cases.
	• Interim conservation plans and rebuilding strategies for some stocks under fishing moratoria (3LNO American plaice, and 3NO Cod) are in place (NCEM).
	• Definition of general operational conditions for NAFO-managed fisheries (e.g. gear, season and areas of operations) are in place (NCEM).
	Elements currently in development
	• Definition of Reference Points (RPs) under the revised PA.
	  ○ RPs are updated/defined as stocks undergo full assessments under the revised PA.
	• Evaluation of the operational/practical details of the revised PA as its implementation progresses.
	• Revised MSE framework for 3LN Redfish.	

By-catch	**Current implementation**
	• Provisions for definition and accounting of by-catch of several commercial species in NAFO-managed fisheries (NCEM). These include:
	  ○ Definition of minimum fish sizes.
	  ○ Amounts of by-catch permitted and accounting rules for by-catch.
	  ○ Recording and reporting of by-catch.
	  ○ Move-on rules when by-catch limits are exceeded.
		• Management provisions on by-catch for specific stocks and taxa are aimed to minimize impacts of fishing operations on non-target species and/or sizes.
		• Stock-assessments for stocks under moratoria support management decisions on by-catch management measures as they inform on the impact of by-catch on the rebuilding of these stocks.
		• Ecosystem-level summaries of incidental catches support decisions/approaches to by-

Component	Current Implementation	Decision-making context

	• Provisions for the conservation and management of sharks (NCEM). These include:
	  ○ Recording and reporting of by-catch
	  ○ Prohibition of shark finning.
	  ○ Prohibition of direct fishing on Greenland sharks.
	• Provisions for the by-catch of Vulnerable Marine Ecosystem (VME) indicator taxa (NCEM). These include:
	  ○ Recording and reporting of by-catch
	  ○ Move-on rules when by-catch of VME indicator taxa exceeds pre-defined thresholds.
	• ESSs include a synoptic analysis of incidentals catches in NAFO-managed fisheries. These include:
	  ○ By-catch trends within an EPU
	  ○ Overview of by-catch of depleted and/or protected species in NAFO-managed fisheries.
	• Stock-assessments of stock under moratoria provide a mechanism to evaluate the impact of by-catch on the recovery of these stocks.
	Elements currently in development
	• Improvements on the analyses of incidental catch in NAFO fisheries at the ecosystem level (part of ESSs, Tier 1).
	• Review of classifications of special species (e.g. slow growing and/or with conservation concerns) to inform analyses of incidental catches at the ecosystem level (part of ESSs, Tier 1).
		catch management by informing managers on the trends and likely risks to non-target, depleted, and/or protected species linked to NAFO-managed fisheries.

Habitat Impacts Assessment	**Current implementation**
	• VME indicator taxa and VME indicator elements defined (NCEM).
	• Regular assessment of the impacts of bottom fishing activities on VMEs (NCEM). This assessment includes:
	  ○ Review of VME information and updating VME delineation.
	  ○ Review and update of the features and footprint of NAFO-managed
		• The delineation of VMEs and the assessment of SAI on VMEs provides direct support for management decisions on the minimization of fishing impacts and conservation of VMEs by informing on the level of risk of SAI associated with bottom fishing activities.
		• The provision of management options (such as bottom

Component	Current Implementation	Decision-making context
	fisheries, including assessments of the intensity of fishing in any given area for specific periods of time. ○ Evaluation of Significant Adverse Impacts (SAIs) on VMEs by fishing activities based on FAO guidelines . • The assessment of SAI on VMEs is updated every 5 years. The work towards the next update is conducted in the intervening years. • Provision of management options for minimizing the risk of SAI on VMEs. ○ These options are not part of the regular SAI on VME analysis. They are produced by SC upon request from COM during the period leading to the assessment update. **Elements currently in development** • Improvements in the analytical methods (such as the assessment of functions, and the ecological connectivity between VMEs) underpinning the assessment of SAI on VMEs to better address the criteria in the FAO guidelines . • Exploration of ways of incorporating the potential impacts of climate change on VMEs as part of the assessment SAI on VMEs.	fishery closures) to minimize the risk of SAI on VMEs facilitates management decisions by providing alternative scenarios for decisions.
Risk Assessment	**Current implementation** • NAFO footprint (NCEM) ○ Defines the boundaries for existing bottom fishing areas. ○ Bottom fishing outside the footprint is considered exploratory fishing. • Exploratory Fishing Protocol (NCEM). It defines the conditions under which bottom fishing outside the footprint needs to be conducted. This protocol includes: ○ Pre-approval of fishing plan. ○ Enhanced data collection. ○ Evaluation of risks to VMEs. • Seamounts and VME closures to bottom fishing activities for the protection of	• Management measures for minimizing impacts of bottom fishing activities on VMEs aim at striking a balance between VME conservation and impacts on fishing activities. • The evaluation of these trade-offs evolve as the understanding on VMEs and the data available increases over time.

Component	Current Implementation	Decision-making context
	VMEs (NCEM). Some characteristics of these closures are: ○ They are reviewed every 5 years based on the most recent information on VMEs and the assessment of SAI on VMEs. ○ VME closures do not necessarily encompass all VME areas. The portion of VME closed to bottom fishing is defined through an evaluation of the trade-offs between VME protection and likely impacts on fishing activities. The management options provided by SC serve as starting point for this evaluation (Habitat Impacts Assessment). • NAFO Seamounts closures are recognized as Other Effective Area-based Conservation Measures (OECMs) under the Convention of Biological Diversity. **Elements currently in development** • Preparation of the submission of NAFO coral closures to the CBD for recognition as OECMs.	
Monitoring	**Current implementation** • There are a range of monitoring activities pertaining to ecosystem status and human activities relevant to the NAFO Convention objective that inform NAFO operations. These include: ○ Scientific surveys and other scientific research activities conducted by CPs. ○ Reporting on fishing activities (e.g. haul by haul data (logbooks), daily catch reports, catch statistics, Vessel Monitoring System information). ○ Surveillance of fishing activities (e.g. at sea patrols, port and landings controls, observers in fishing vessels). • The scope of application of current monitoring activities in NAFO exceeds the Roadmap as a management framework; but they are integral to its implementation	• Monitoring activities are central to NAFO operations. They provide the basic data and evidence to inform analyses in support of the full spectrum of management decisions.

Component	Current Implementation	Decision-making context
	as a recursive process (i.e. management cycle). **Elements currently in development** • Improvements in monitoring activities and capabilities are explored on a regular basis.	

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