

Northwest Atlantic Fisheries Organization



**Report of the NAFO Joint Commission-Scientific Council Working Group on
Risk-Based Management Strategies (WG-RBMS) Meeting**

08-10 August 2024
Bergen, Norway

NAFO
Halifax, Nova Scotia, Canada
2024

Report of WG-RBMS,
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|-----|--|----|
| 1. | Opening by co-Chairs, Fernando González-Costas (European Union) and Ray Walsh (Canada) | 3 |
| 2. | Appointment of Rapporteur | 3 |
| 3. | Adoption of Agenda | 3 |
| 4. | Finalization of the MSE process for 2+3KLMNO Greenland halibut..... | 3 |
| 5. | Application of the 2+3KLMNO Greenland halibut Management Strategy | 3 |
| 6. | Progress on the MSE process for 3LN redfish | 4 |
| 7. | Finalization of the Revised Precautionary Approach Framework | 4 |
| 8. | Scientific Council workload | 4 |
| 9. | Other Business..... | 5 |
| | a. Terms of Reference..... | 5 |
| 10. | Recommendations | 5 |
| 11. | Adoption of report | 6 |
| 12. | Adjournment | 6 |
| | Annex 1. List of Participants..... | 7 |
| | Annex 2. Agenda | 9 |
| | Annex 3. Changes to the NAFO CEM resulting from the revised Management Strategy for 2+3KLMNO Greenland halibut..... | 10 |
| | Annex 4. Revised NAFO Precautionary Approach Framework..... | 15 |
| | Annex 5. REVISED Terms of Reference – NAFO Joint Commission-Scientific Council Working Group on Risk-Based Management Strategies..... | 20 |

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08–10 August 2024
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1. Opening by co-Chairs, Fernando González-Costas (European Union) and Ray Walsh (Canada)

The meeting was opened by the co-Chairs Fernando González-Costas (European Union) and Ray Walsh (Canada) at 09:07 hours (UTC/GMT +2 hours) on Thursday, 08 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, Japan, Norway, Russian Federation, Ukraine, United Kingdom, and United States of America. The Chair of the Scientific Council and an accredited observer from the Deep Sea Conservation Coalition were 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 working group agreed to include an item on the Terms of Reference under agenda item 9 – Other Business. The adopted agenda is outlined in Annex 2.

4. Finalization of the MSE process for 2+3KLMNO Greenland halibut

Paul Regular (Canada) presented an update on the status of the Management Strategy Evaluation (MSE) process for Subarea 2 + Divisions 3KLMNO Greenland halibut and highlighted the Scientific Council response to Commission Request #3a (SCS Doc. 24/16 (Revised)). The Scientific Council, at its meeting in June 2024, reviewed the candidate management procedures¹ (CMP) and the revised exceptional circumstances protocol and recommended their adoption. The working group thanked the Scientific Council for their efforts and agreed to recommend the Commission adopt the candidate management procedure and exceptional circumstances protocol as outlined in SCS Doc. 24/16 (Revised). The working group also agreed that the management procedure should be implemented for an initial period of ten years with an “update” assessment every three years, and a more in-depth MSE review after six years to revise the management procedure if needed. The “update” assessment can also be done any year if the exceptional circumstances, included in the exceptional circumstances protocol, occur. It was noted that the three year “update” assessment would involve rerunning the previously agreed base case models unchanged, except for the addition of any available data in subsequent years. A full assessment would include consideration of alternative assessment assumptions and methods. The working group also encouraged the Scientific Council to continue investigating the probability-based CMP in future, as workload allows.

The working group also noted the changes that would be required within the NAFO Conservation and Enforcement Measures (CEM) as a result of the adoption of the candidate management procedures and the revised exceptional circumstances protocol, and agreed to forward the proposed changes outlined in COM-SC RBMS-WP 24-02 (Rev. 2) (Annex 3) to the Commission for adoption.

5. Application of the 2+3KLMNO Greenland halibut Management Strategy

The Scientific Council Chair, Diana González-Troncoso (European Union), presented an update on the application of the Management Strategy for Subarea 2 + Divisions 3KLMNO Greenland halibut (SCS Doc. 24/16 (Revised)). It was noted that the Scientific Council response to Commission Request #2 was deferred until the

¹ Management procedure and harvest control rule are used interchangeably in this meeting report.

Report of WG-RBMS,
08–10 August 2024

September 2024 Scientific Council meeting, pending the recommendation from WG-RBMS for the Commission to adopt the CMP and the revised exceptional circumstances protocol, which WG-RBMS agreed to recommend the Commission adopt under agenda item 4 (Recommendation 1). As a result, WG-RBMS recommends that, pending the Commission's adoption of Recommendation 1, the Scientific Council use the new management procedure to provide advice on the total allowable catch for 2025 at the 2024 Annual Meeting. The Scientific Council Chair also highlighted that exceptional circumstances will be occurring in the new management procedure due to recent gaps in the EU-Spain 3L series but that sensitivity analyses presented at this meeting indicate that the application of the new harvest control rule (HCR), without the EU-Spain 3L information, will still be appropriate.

6. Progress on the MSE process for 3LN redfish

The Scientific Council Chair, Diana González-Troncoso (European Union), presented an update on the progress of the Divisions 3LN redfish MSE process, noting that due to the workload and capacity constraints, there has been no progress since January 2024. The Scientific Council updated the workplan at its June meeting (SCS Doc. 24/16 (Revised)). Canada reflected on its commitment to support this work and noted that there is currently an internal review taking place to determine if more resources can be allocated to the redfish MSE process and requested additional time to review the workplan before recommending its adoption to the Commission. The working group noted the difficulty in developing the CMP for redfish and that it is novel work, and workplan timelines should take that into account. It was agreed that the discussion of the workplan would continue at the 2024 Annual Meeting, noting revisions may occur at that time depending on the internal review of available resources being completed by Canada.

7. Finalization of the Revised Precautionary Approach Framework

The Chair of the Scientific Council Precautionary Approach Working Group (PA-WG), Fernando González-Costas (European Union), presented the basic structure of the revised PAF, the objectives and performance statistics, the results of the generic and specific testing, as well as the conclusions from the Scientific Council July Intersessional meeting (SCS Doc. 24/17). The working group thanked the Scientific Council and technical teams for the tremendous efforts that have gone into the PAF revision process. The PA-WG Chair also highlighted some elements of the framework that needed to be discussed and clarified.

The working group compiled the elements of the Revised NAFO Precautionary Approach Framework in COM-SC RBMS-WP 24-03 (Rev. 2) (Annex 4) and agreed to recommend it to the Commission for adoption. The recommended approach includes the use of the middle width leaf tested by SC and the development of a new risk-based table to guide the provision of SC advice (Appendix 1 and Table 2 of Annex 4). The working group highlighted the importance of implementing the revised PAF gradually, noting that things such as substantial TAC changes, or the need to establish reference points, may create difficulties in applying the PAF. The working group supported the Scientific Council to use expert judgement in the provision of advice in applying the PAF where reference points are not available. The working group also noted that the Scientific Council should work towards the development of reference points where they are not available, recognizing the other priorities and workload of the Scientific Council.

8. 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 co-Chair of WG-EAFFM, Elizabethann Mencher (United States of America), reported on the related discussions that took place at the August WG-EAFFM meeting, and highlighted the recommendation being put forward to the Commission from that working group. The WG-RBMS supported the discussions and recommendations being put forward by the WG-EAFFM on this topic.

Reflecting on the Scientific Council workload required to undertake MSE processes, the WG-RBMS noted that, under its Standard 3.0, the Marine Stewardship Council (MSC) will require the implementation of management strategies that have been tested using MSEs in order for fisheries to be eligible to receive certification for stocks managed by regional fisheries management organizations (RFMOs). The working group reflected that MSEs may not be the best tools for certain stocks, and that there is a significant workload associated with the development and completion of MSE processes. Given limited scientific resources, the completion of these MSEs for healthy stocks, unintentionally diverts scientific resources from other stocks that may be in greater need of attention. Finally, it also noted that the Revised NAFO Precautionary Approach Framework may fulfil the MSE requirement, as it was subject to thorough simulation testing. The working group recommended that the Commission send correspondence to the MSC, and other certifying bodies as appropriate, noting these concerns and challenges of requiring a MSE for RFMO managed fisheries to receive certification.

9. Other Business

a. Terms of Reference

At the July 2023 meeting, the working group discussed its Terms of Reference, and noted that a further review could be considered taking into account any proposed revisions to the Terms of Reference of the WG-EAFFM. The co-Chair of WG-EAFFM, Elizabethann Mencher (United States of America), highlighted the proposed changes to the WG-EAFFM Terms of Reference that were agreed to at their August 2024 meeting. WG-RBMS agreed to update its Terms of Reference to align with the changes from WG-EAFFM, and agreed to forward the revised Terms of Reference, outlined in COM-SC RBMS-WP 24-01 (Revised) (Annex 5), to the Commission for adoption.

10. Recommendations

The WG-RBMS agreed to forward the following conclusions and recommendations to the Commission.

1. **In relation to the MSE process for 2+3KLMNO Greenland halibut (agenda item 4), WG-RBMS recommends the adoption of the candidate management procedure and exceptional circumstances protocol as outlined in SCS Doc. 24/16 (Revised), and the changes to the NAFO CEM outlined in COM-SC RBMS-WP 24-02 (Rev. 2) (Annex 3).**
2. **In relation to the application of the 2+3KLMNO Greenland halibut Management Strategy (agenda item 5),**
 - a. **WG-RBMS recommends that the Scientific Council use the new management procedure to provide advice on the total allowable catch for 2025 at the 2024 Annual Meeting.**
 - b. **WG-RBMS acknowledges that exceptional circumstances will be occurring due to recent gaps in the EU-Spain 3L series. However, sensitivity analyses presented at this meeting by the Scientific Council indicate that the application of the new HCR will still be appropriate.**
3. **WG-RBMS recommends that the Commission adopt the Revised Precautionary Framework (COM-SC RBMS-WP 24-03 (Rev. 2)) (Annex 4). Further, WG-RBMS recommends a periodic full review of the Framework on a timeline to be determined at a later date by the Commission following the advice of WG-RBMS.**
4. **WG-RBMS recommends that the Scientific Council gives priority to the development of reference points, to facilitate implementation of the PAF, for stocks that currently do not have them.**

Report of WG-RBMS,
08-10 August 2024

5. **In relation to the Scientific Council workload (agenda item 8), WG-RBMS recommends that the Commission send correspondence to the Marine Stewardship Council (MSC), and other certifying bodies as appropriate, highlighting the adoption of the Revised Precautionary Approach Framework and noting the concerns and challenges of requiring a Management Strategy Evaluation (MSE) for RFMO managed fisheries to receive certification.**
6. **In relation to the review of the Terms of Reference (agenda item 9.a), WG-RBMS recommends that the Commission and the Scientific Council endorse the revised Terms of Reference, outlined in COM-SC RBMS-WP 24-01 (Revised) (Annex 5).**

11. Adoption of report

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

12. Adjournment

The meeting adjourned early at 11:45 hours (UTC/GMT +2 hours) on Saturday, 10 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 González-Costas, Fernando (European Union) Walsh, Ray (Canada) |
| SC CHAIR | In-person González-Troncoso, Diana (European Union) |
| CANADA | In-person Burns, Adam Byrne, Vanessa Fagan, Robert Johnson, Kate Koen-Alonso, Mariano Rayner, Gemma Regular, Paul Simpson, Mark Virtual Burrige, Angela Gullage, Nicholas Krohn, Martha Kumar, Rajeev Lebeau, Amy Perreault, Andrea Rowsell, Nicole Varkey, Divya |
| DENMARK (IN RESPECT OF FAROE ISLANDS AND GREENLAND) | In-person Svarrer Wang, Ulla |
| EUROPEAN UNION | In-person Belmonte, Luis Virtual Blazkiewicz, Bernard Cortina, Angela Garrido, Irene Granell, Ignacio Lopes, Luis Mancebo, Carmen Margarita Merino Buisac, Adolfo Tuvi, Aare |
| JAPAN | Virtual Butterworth, Doug Takehara, Toya Taki, Kenji |
| NORWAY | In-person Bakke, Gunnstein Sandberg, Per Virtual Hvingel, Carsten |

Report of WG-RBMS,
08-10 August 2024

| | |
|---------------------------------|---|
| RUSSIAN FEDERATION | Virtual Fomin, Konstantin |
| UKRAINE | Virtual Didenko, Oleksandr Honcharuk, Ihor Paramonov, Valerii |
| UNITED KINGDOM | Virtual Fischer, Simon |
| UNITED STATES OF AMERICA | In-person Emmert, Samantha Jaburek, Shannah Kelly, Moira Mencher, Elizabethann Warner-Kramer, Deirdre Virtual Sosebee, Kathy |
| ACCREDITED OBSERVERS | Deep Sea Conservation Coalition (DSCC) Diz, Daniela (in-person) |
| NAFO SECRETARIAT | In-person Benediktsdóttir, Brynhildur Aker, Jana Bell MacCallum, Dayna Virtual LeFort, Lisa |

Annex 2. Agenda

1. Opening by co-Chairs, Fernando González-Costas (European Union) and Ray Walsh (Canada)
2. Appointment of Rapporteur
3. Adoption of Agenda
4. Finalization of the MSE process for 2+3KLMNO Greenland halibut
5. Application of the 2+3KLMNO Greenland halibut Management Strategy
6. Progress on the MSE process for 3LN redfish
7. Finalization of the revised Precautionary Approach Framework
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 - a. Terms of Reference
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Report of WG-RBMS,
08-10 August 2024

**Annex 3. Changes to the NAFO CEM resulting from the revised Management Strategy for 2+3KLMNO
Greenland halibut
(COM-SC RBMS-WP 24-02 (Rev. 2))**

The following edits to Article 10, Annex I.F and Annex I.G of the NAFO CEM reflect the proposed adoption of a revised management procedure and exceptional circumstances protocol recommended by the WG-RBMS.

Article 10 – Greenland Halibut

Rebuilding Program

1. The current Management Strategy (MS) for Greenland halibut stock in Subarea 2 + Divisions 3KLMNO adopted by NAFO in ~~2024~~2017 shall be in force from ~~2025~~2018 to ~~2034~~2023 inclusive, or until such a time that the Commission adopts a revision.
2. The total allowable catch (TAC) shall be adjusted annually according to the harvest control rule (HCR) specified in Annex I.F.

The text for Annex I.F below will replace the entirety of the current text of Annex I.F.

Annex I.F Greenland Halibut Management Procedure

The MP combines a “target based” and “slope based” rule, which was tuned to reach B_{msy} by 2044 under OM1 using the SCAA framework. The full set of control parameters are shown in Table 1.

Target based (t)

The target rule is:

$$TAC_{y+1}^{target} = TAC_y (1 + \gamma(J_y - 1)) \quad (1)$$

where TAC_y is the TAC recommended for year y , γ is the “response strength” tuning parameter, J_y is a composite measure of the immediate past level in the mean weight per tow from surveys (I_y^i) that are available to use for calculations for year y ; five survey series are used, with $i = 1, 2, 3, 4,$ and 5 corresponding respectively to Canada Autumn 2J3K, Canada Autumn 3LNO, EU-Spain 3L, EU-Spain 3NO and EU 3M 0-1400m:

$$J_y = \frac{\sum_{i=1}^5 \frac{1}{(\sigma^i)^2} \frac{J_{current,y}^i}{J_{target}^i}}{\sum_{i=1}^5 \frac{1}{(\sigma^i)^2}} \quad (2)$$

with $(\sigma^i)^2$ being the estimated variance for index i (estimated in the SCAA model fitting procedure),

$$J_{current,y}^i = \frac{1}{q} \sum_{y'=y-q}^{y-1} I_{y'}^i \quad (3)$$

$$J_{target}^i = \alpha \frac{1}{5} \sum_{y'=2011}^{2015} I_{y'}^i \quad (\text{where } \alpha \text{ is a control/tuning parameter for the MP}) \quad (4)$$

and q indicating the period of years used to determine current status. Note the assumption that when a TAC is set in year y for year $y + 1$, indices will not at that time yet be available for the current year y . Missing survey values are treated as missing in the calculation using the rule, as was done in the MSE. In such cases, q in equation (3) is reduced accordingly.

Slope based (s)

The slope rule is:

$$TAC_{y+1}^{slope} = TAC_y [1 + \lambda_{up/down} (s_y - X)] \quad (5)$$

where $\lambda_{up/down}$ and X are tuning parameters, s_y^i is a measure of the immediate past trend in the survey-based mean weight per tow indices, computed by linearly regressing $\ln I_{y'}^i$, vs year y' for $y' = y - 5$ to $y' = y - 1$, for each of the five surveys considered, with:

$$s_y = \frac{\sum_{i=1}^5 \frac{1}{(\sigma^i)^2} s_y^i}{\sum_{i=1}^5 \frac{1}{(\sigma^i)^2}} \quad (6)$$

with the standard error of the residuals of the observed compared to model-predicted logarithm of survey index i (σ^i) as estimated in the SCAA base case operating model. Missing survey values are treated as missing in the calculation using the rule, as was done in the MSE. In such cases, the slope for each index, s_y^i , in equation (6) is calculated from the available values within the last five years.

Combination Target and Slope based (s+t)

For the target and slope-based combination:

- 1) TAC_{y+1}^{target} is computed from equation (1),
- 2) TAC_{y+1}^{slope} is computed from equation (5), and
- 3) $TAC_{y+1} = \mu(TAC_{y+1}^{target} + TAC_{y+1}^{slope})/2$, where μ is a tuning parameter.

Finally, constraints on the maximum allowable annual change in TAC are applied, viz.:

$$\text{if } TAC_{y+1} > TAC_y(1 + \Delta_{up}) \quad \text{then } TAC_{y+1} = TAC_y(1 + \Delta_{up}) \quad (7)$$

and

$$\text{if } TAC_{y+1} < TAC_y(1 - \Delta_{down}) \quad \text{then } TAC_{y+1} = TAC_y(1 - \Delta_{down}) \quad (8)$$

During the MSE process, this inter-annual constraint was set at 10%, for both TAC increases and decreases.

Table 1. Control parameter values for the CMP. The parameters μ , α , and X were adjusted to achieve a median biomass equal to B_{msy} for the exploitable component of the resource biomass in 2044 for the Base Case SCAA Operating Model.

| | |
|---------------------|---------|
| μ | 0.963 |
| γ | 0.15 |
| q | 3 |
| α | 0.972 |
| λ_{up} | 1 |
| λ_{down} | 2 |
| X | -0.0056 |
| $\Delta\phi_{up}$ | 0.1 |
| $\Delta\phi_{down}$ | 0.1 |

Annex I.G Exceptional Circumstances Protocol

The following criteria constitute Exceptional Circumstances:

1. Missing survey data:
 - ~~More than two values missing, in a five-year period, from a survey used in the MP~~~~More than one value missing, in a five-year period, from a survey with relatively high weighting in the HCR (Canadian Fall 2J3K, Canadian Fall 3LNO, and EU 3M surveys);~~
 - ~~Missing more than two of the five survey indices from the terminal year. More than two values missing, in a five-year period, from a survey with relatively low weighting in the HCR (Canadian Spring 3LNO and EU Spain 3NO surveys);~~
2. The composite survey index used in the ~~MP~~~~HCR~~, in a given year, is above or below the 90 percent probability envelopes projected by the base case operating models from SSM and SCAA under the MS; ~~and~~
3. TACs established that are not generated from the MP.

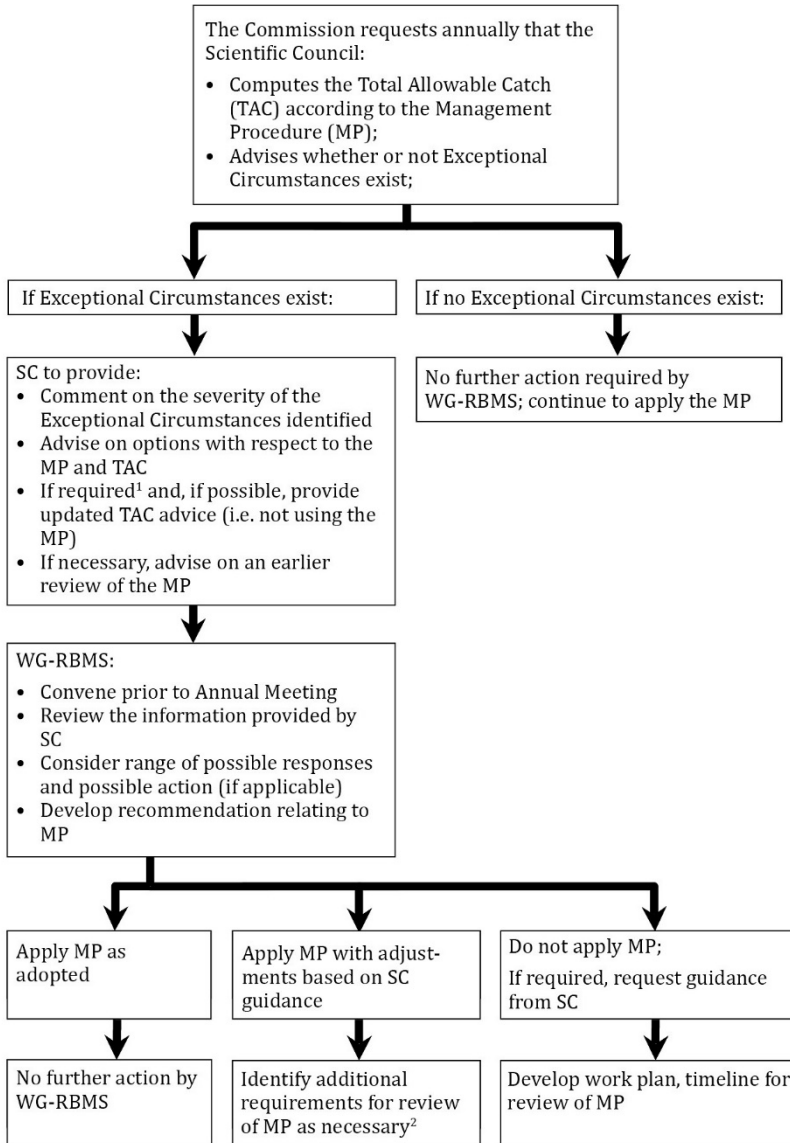
The following elements will require application of expert judgment to determine whether Exceptional Circumstances are occurring:

1. the five survey indices relative to the 80, 90, and 95 percent probability envelopes projected by the base case operating models (SSM and SCAA) for each survey;
2. survey data at age four (age before recruitment to the fishery) compared to its series mean to monitor the status of recruitment; ~~and~~
3. discrepancies between catches and the TAC calculated using the MP.¹

Figure 1 illustrates the actions to be taken in Exceptional circumstances.

¹ Noting that 10% exceedance of TAC was tested during MSE.

Report of WG-RBMS,
08-10 August 2024



¹ For example, where the SC determines that, in the light of identified exceptional circumstances, the application of the TAC generated by the MP may not be appropriate.

² This review may include updated assessment, sensitivity analysis, etc.

Figure 1. Decision tree illustrating actions to be taken in the event of Exceptional Circumstances.

Annex 4. Revised NAFO Precautionary Approach Framework (COM-SC RBMS-WP 24-03 (Rev. 2))

The Revised NAFO Precautionary Approach Framework is set out below. When implementing this Framework, the Commission should consider a gradual approach, for example if substantial TAC changes are indicated by the Revised Framework or if the required reference points have not yet been established. Further, the Commission and the Scientific Council, through WG-RBMS, should also consider potential refinements of the Framework that may become apparent over time, for example upon application across the NAFO stocks.

NAFO should apply this Precautionary Approach Framework in its fisheries management decision making. This framework defines three Zones (Healthy, Cautious, and Critical) to characterize the status of the stock. These zones are defined by two biomass reference points (B_{lim} and $B_{trigger}$). Within this framework, the limit fishing mortality is defined as $F_{lim}=F_{msy}$, and F_{target} as a fraction of F_{msy} (Fig. 1).

Reference Points could be set as a function of the type of stock being managed. As a first step in the initial implementation of the PAF, the reference points or their best proxies, in the context of Figure 1 are set as follows:

$$F_{target}=0.85 \cdot F_{msy}$$

$$B_{lim} = 0.30 \cdot B_{msy}$$

$$B_{trigger} = 0.75 \cdot B_{msy}$$

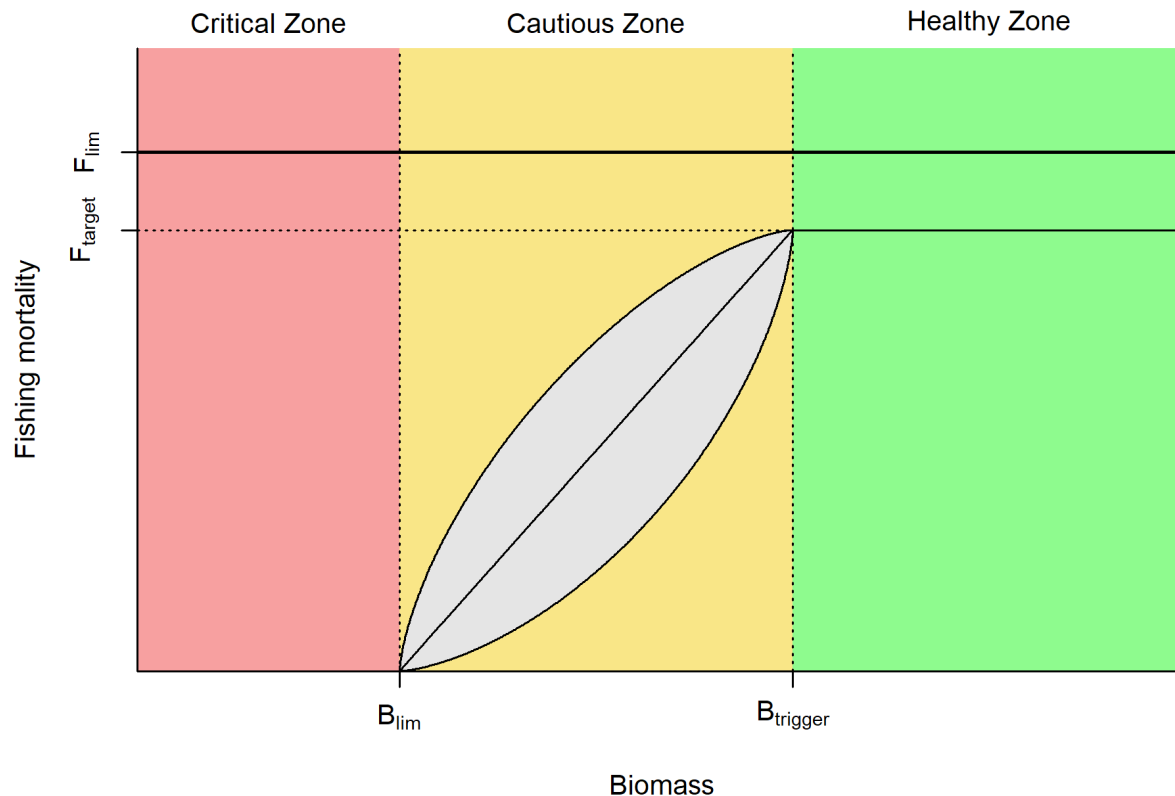


Figure 1. Schematic representation of the NAFO Precautionary Approach, including the leaf space to define fishing levels within the Cautious Zone.

Commission

Management decisions by the Commission within these zones will be informed as follows:

Healthy Zone:

In establishing an F for a stock in the Healthy Zone, the Commission should be informed by a range of options at, above, and below F_{target} , and associated risks, provided by the Scientific Council (Table 2) aimed at keeping the stock in the healthy zone.

Cautious Zone:

F should be generally managed within the boundaries of the leaf space defined by the structure of the PAF (Figure 1, Appendix 1).

Generally, the Commission should adopt an F that achieves the following policy objectives depending on stock trajectory and relative position in the cautious zone (Table 1).

Table 1.

| Focus of management action within Cautious Zone | | Stock status in the Cautious Zone | |
|---|------------------|--|------------------------|
| | | Low level | High level |
| Stock trajectory in the Cautious Zone | Decreasing Trend | Reduce risk of further stock decline | Mitigate stock decline |
| | Increasing Trend | Promote stock growth with high certainty | Promote stock growth |

These focal elements for management actions are intended to articulate an increasing risk avoidance in management actions as the stock gets closer to B_{lim} . Overall, the intent is to avoid falling below B_{lim} .

Critical Zone:

F should be set as low as possible. In establishing F , the Commission should be informed by the range of options and associated risks provided by the Scientific Council (Table 2). The primary focus of management should be to rebuild the stock out of the Critical Zone.

Scientific Council

The role of Scientific Council is to inform Commission's decision of where F should be set by characterizing the consequences of alternative management actions. These consequences would be typically described in terms of the status of the stock and F levels as:

- Probability of $B > B_{\text{trigger}}$ within e.g. 1,2,3 years (depending on the stock)
- Probability of $B < B_{\text{lim}}$ within e.g. 1,2,3 years (depending on the stock)
- Probability of $B_{\text{future}} > B_{\text{current}}$ ($B_{\text{future}} = 1,2,3$ years depending on stock) including indication of magnitude of this growth.
- Probability of $F > F_{\text{lim}}$
- Probability of $F > F_{\text{target}}$

To inform the Commission's decision, SC would also provide:

- Current stock status and confidence intervals
- Recent trajectory of the stock

Whenever deemed necessary by the Scientific Council, interpretations of the consequences of fishing options and/or any additional considerations and advice that may be relevant for the management decision should also be provided. SC should not be prescriptive among the options in its advice.

SC should provide the Commission with a risk-based table that would indicate the risks/probabilities associated with the items indicated above, based on available information. The F levels to consider would depend on the Zone where the stock status falls, and generally would follow the template table indicated below.

Report of WG-RBMS,
08-10 August 2024

Table 2.

| | Yield | | | P(F>F _{lim}) | | | P(B<B _{lim}) | | | | P(F>F _{target}) | | | P(B<B _{trigger}) | | | | P(B _{t+3} > B _t) | (B _{future} - B _{current})/B _{current} |
|---|---------------------|-----------------------|-----------------------|------------------------|-----|-----|------------------------|-----|-----|-----|---------------------------|-----|-----|----------------------------|-----|-----|-----|---------------------------------------|---|
| F in y+1 and following years | Yield y (50%) | Yield y+1 (50%) | Yield y+2 (50%) | y | y+1 | y+2 | y | y+1 | y+2 | y+3 | y | y+1 | y+2 | y | y+1 | y+2 | y+3 | | |
| Critical Zone | | | | | | | | | | | | | | | | | | | |
| F=0 | t | t | t | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % |
| F=X% current* | t | t | t | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % |
| F current | t | t | t | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % |
| Cautious Zone | | | | | | | | | | | | | | | | | | | |
| F lower edge leaf | t | t | t | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % |
| F midrib leaf | t | t | t | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % |
| F upper edge leaf | t | t | t | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % |
| Healthy Zone | | | | | | | | | | | | | | | | | | | |
| F=0.75F _{msy} | t | t | t | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % |
| F _{target} =0.85F _{msy} | t | t | t | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % |
| F _{lim} =F _{msy} | t | t | t | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % |

*X% may vary stock by stock. In the future, this framework may be modified to include F bycatch.



Appendix 1. Implementation of the leaf HCR

The Leaf HCR represents a space within the Cautious Zone of the NAFO Precautionary Approach Framework (PAF) that bounds the F levels to be considered by Scientific Council in its advice to the Commission.

The Leaf HCR space is defined by a generalized formulation for the edges of the leaf, where the upper or lower edges of the leaf HCR can be obtained by defining $F_t = f(B_t)$ as:

$$F_t = \frac{a^*(B_t - B_{lim})}{(B_x^* - B_{lim}) + (B_t - B_{lim})} \quad \text{Eq. 1}$$

where B_x^* is defined for the upper (B_x^{up}) and lower leaf (B_x^{low}) functions as:

$$B_x^* = B_{lim} + \left[\frac{(B_{50}^* - B_{lim})(B_{trigger} - B_{lim})}{(B_{trigger} - B_{lim}) - 2(B_{50}^* - B_{lim})} \right] \quad \text{Eq. 2}$$

where B_{50}^* , defined for the upper (B_{50}^{upper}) and lower (B_{50}^{lower}) leaf edge functions, controls the width of the leaf. In order to maintain a symmetric leaf shape B_{50}^* needs to be set in a “complementary” way in the upper and lower edge functions.

To facilitate the setup of the leaf width, B_{50}^* has been implemented as determined by X_{50}^* , i.e. $B_{50}^* = X_{50}^*(B_{trigger} - B_{lim}) + B_{lim}$, where X_{50}^* represents the fraction within the $B_{lim} - B_{trigger}$ range where the B_{50}^* is located. For the upper leaf edge function, X_{50}^{upper} must fall between 0 and 0.5, while for the lower leaf edge function X_{50}^{lower} must fall between 0.5 and 1. As mentioned above, to maintain the symmetry of the NAFO Leaf HCR the two X_{50}^* must be “complementary” in the sense that $X_{50}^{lower} = 1 - X_{50}^{upper}$.

Using B_x^* from Eq. 2, a^* can then be calculated for both the upper (a^{up}) and lower (a^{low}) leaf edge functions as:

$$a^* = \frac{F_{target} [(B_x^* - B_{lim}) + (B_{trigger} - B_{lim})]}{(B_{trigger} - B_{lim})} \quad \text{Eq. 3}$$

The Revised NAFO PAF has adopted a middle width leaf for its initial implementation, corresponding to:

$$X_{50}^{lower} = 0.75$$

$$X_{50}^{upper} = 0.25$$

**Annex 5. REVISED Terms of Reference – NAFO Joint Commission-Scientific Council
Working Group on Risk-Based Management Strategies
(COM-SC RBMS-WP 24-01 (Revised))**

Structure:

The Working Group shall be comprised of fishery managers, ~~and~~ and advisors from Contracting Parties supported by ~~experts and advisors observers and invited experts.~~

~~Plenary discussions will be conducted in The work form may be an informal, open manner, forum/dialogue unless the Contracting Parties decide to conduct sessions in a delegation format, at the discretion of the chairs of the working group and with the consent of Contracting Parties.~~ Recommendations to ~~Fisheries~~ Commission will ~~shall~~ be developed and agreed upon through formal sessions of official delegations.

The Co-Chairs will consist of ~~shall be selected from participating fishery managers and scientists with both a fishery manager from the Commission and a scientist from the Scientific Council~~ represented in the two positions.

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. ~~A total of up to two persons per non-governmental organizations that have been given the right to participate as observers shall be permitted.~~

The Working Group on Risk-Based Management Strategies reports to both the ~~Fisheries~~ Commission and Scientific Council; considers the advice of Scientific Council; and provides recommendations to ~~Fisheries~~ Commission.

Objective:

The main objectives of the Working Group are to make recommendations to the ~~Fisheries~~ Commission and feedback to Scientific Council on the development and effective implementation of management strategies, based on the application principles of the precautionary approach to fisheries management, including conservation plans and rebuilding strategies, and to facilitate dialogue between Scientific Council and the Commission.

Specific Duties:

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

- Review, update and further develop a general framework including management objectives and performance statistics for the elaboration of management strategies, conservation plans and rebuilding strategies for all NAFO managed stocks.
- Evaluate, and as appropriate update and develop new ones where none exist, all management strategies, conservation plans and rebuilding strategies implemented in NAFO with respect to the Precautionary Approach framework, management objectives and performance statistics.
- Develop alternative strategies for stocks that may not be suited to formulaic rules and/or for stocks where reference points do not exist or cannot be developed.
- Consider all matters related to use of the NAFO Precautionary Approach framework.
- Consider risk management approaches in the review, update and future development of Conservation Plans and Rebuilding Strategies.

Meetings:

~~The Working Group will typically meet annually unless otherwise agreed by the Scientific Council and the Commission. Meetings may be held at the request of the Fisheries Commission or the Scientific Council, in consultation with Contracting Parties and the NAFO Secretariat.~~ Timing should be decided on a case-by-case basis.

The working group shall communicate regularly through teleconferences and electronically, as required.

Reporting

The Working Group will issue a written report of its sessions to the Fisheries Commission and the Scientific Council and present its recommendations to the Commission and Scientific Council at the NAFO annual meeting.

An oral update can be provided to both SC and FC during the annual meeting.