Northwest Atlantic Fisheries Organization

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(Adopted)

36TH ANNUAL MEETING - SEPTEMBER 2014

Recommendations from the WG-RBMS to forward to FC and SC

The FC-SC Joint WG on Risk-based Management Strategies (WG-RBMS) met on 5-7 February 2014 in Halifax, Nova Scotia and agreed on the following recommendations (FCSC Doc 14/02):

1. In order for the WG to start the process of revising the PA framework the WG **recommends** SC provide feedback on the following*:*
   - Discuss the relevance and implications of:
   - having F_{lim} at F_{msy}
   - F_{msy} as a target

     These analyses should include situations where quantitative analysis of uncertainty are limited and situations where uncertainty has been well incorporated into evaluation of Harvest Control Rules.

   - Consider the utility of buffers (particularly B_{buf}) in the framework and in management plans and provide advice on whether the use of buffers is considered appropriate for stocks which have B_{lim}.

     Note: the WG **recommends** that B_{isr} is not considered part of the PA (but may be used as an interim milestone to aid decision making).

   - The working group noted that SC, in its 2013 June report, concluded that reference points can theoretically be constructed for all stocks, and that this work is given high priority. The WG recommends SC provide a status report and possible timelines for this work for consideration of Fisheries Commission in September 2014.
   - In its assessments and advisory sheets, the working group **recommends** Scientific Council provide a table or list of reference points available for each stock that includes information on their derivation, and if reference points are missing, explain why.
2. The WG **recommends** FC adopt amendments to the interim management plan for Div. 3NO Cod (Annex 1).
3. The WG **recommends** FC adopt amendments to the General Framework on Risk Based Management Strategies (Annex 2).
4. The WG **recommends** SC discuss selection of operating models and evaluate the Div. 3LN Redfish management strategy relative to the performance statistics prior to the 2014 Annual Meeting (Annex 3).
5. The WG **recommends** SC comment on likely by-catch levels associated with the implementation of the proposed HCR for 3LN Redfish (Annex 3)
6. The WG **recommends** SC to discuss selection of operating models and evaluate the Div. 3M Cod management strategy prior to the 2015 Annual Meeting (Annex 4)

Annex 1. Updated 3NO Cod Conservation Plan and Management Strategy

Interim 3NO Cod Conservation Plan and Rebuilding Strategy

1. **Objective(s):**

   (a) **Long-term Objective**: The long-term objective of this Conservation Plan and Rebuilding Strategy is to achieve and to maintain the 3NO Cod Spawning Stock Biomass (SSB) in the 'safe zone', as defined by the NAFO Precautionary Approach framework, and at or near B_{msy}.

   (b) **Interim Milestone**: As an interim milestone, increase the 3NO Cod Spawning Stock Biomass (SSB) to a level above the Limit Reference Point (B_{lim}). It may reasonably be expected that B_{lim} will not be reached until after 2015.

2. **Reference Points:**

   (a) Limit reference point for spawning stock biomass (B_{lim}) – 60,000t[1]

   (b) An intermediate stock reference point or security margin B_{isr}[2] – [120,000t]

   (c) Limit reference point for fishing mortality ($F_{lim} = F_{msy}$) – 0.30

   (d) ~~B_{msy} – [248,000t]~~ Interim B_{target} – 185 000 t and interim F_{target} of $F_{0.1}$ – 0.19[3]

3. **Re-opening to Directed Fishing:**

   (a) A re-opening of a directed fishery should only occur when the estimated SSB, in the year projected for opening the fishery, has a very low[4] probability of actually being below $B_{lim.}$

   (b) An annual TAC should be established at a level which is projected to result in:

      (i) continued growth in SSB

      (ii) low[5] probability of SSB declining below Blim throughout the subsequent 3-year period, and

      (iii) fishing mortality < F0.1

4. **Harvest Control Rules:**

Noting the desire for relative TAC stability, the projections referred to in items (a) through (d) below should consider the effect of maintaining the proposed annual TAC over 3 years. Further, in its application of the Harvest Control Rules, Fisheries Commission may, based on Scientific Council analysis, consider scenarios which either mitigate decline in SSB or limit increases in TACs as a means to balance stability and growth objectives.

   (a) When SSB is below B_{lim}:

      (i) no directed fishing, and

      (ii) by-catch should be restricted to unavoidable by-catch in fisheries directing for other species

Before SSB increases above B_{lim}, additional or alternative harvest control rules should be developed, following the Precautionary Approach, to ensure the long-term objective is met, such as:

   (b) When SSB is between B_{lim} and B_{isr}:

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[1] The Fisheries Commission shall request the Scientific Council to review in detail the limit reference point when the Spawning Stock Biomass has reached 30,000t.

[2] A 'buffer zone' (B_{buf}) is not required under the NAFO PA given the availability of risk analysis related to current and projected biomass values; however, SC has advised that an additional zone(s) between B_{lim} and B_{msy} could be considered. An intermediate stock reference point (B_{isr}) is proposed to delineate this zone. The proposed value is set at a level equivalent to twice B_{lim} Should the SC review of the limit reference point (B_{lim}) result in a change to that value then the intermediate stock reference point (B_{isr}) should also be re-evaluated.

[3] B_{target} is a proxy of B_{msy}. The level of F has very low probability of being higher than F_{lim}. The B_{target} is the equilibrium SSB that results from F_{target}. These are interim targets until more stock recruitment and productivity regime information is available to better estimate MSY-based reference points.

[4] 'very low' means 10% or less

[5] 'low' means 20% or less

(i) TACs should be set at a level(s) to allow for continued growth in SSB consistent with established rebuilding objective(s)
(ii) TACs should result in a low probability of SSB declining below Blim throughout the subsequent 3-year period, and
(iii) Biomass projections should apply a low risk tolerance

(c) When SSB is above B_{isr}:

(i) TACs should be set at a level(s) to allow for growth in SSB consistent with the long term objective, and
(ii) Biomass projections should apply a risk neutral approach (i.e. mean probabilities)

(d) When SSB is above ~~B_{msy}~~ B_{target}:

- TACs should be set at a level of F that has a low probability of exceeding $F_{msy,}$ and
- Biomass projections should apply a risk neutral approach (i.e. mean probabilities)

5. **Ecosystem Considerations:**

Considering the importance of capelin as a food source, consistent with the ecosystem approach, the moratorium on 3NO capelin will continue until at least 31 December 2015.

6. **By-catch Provisions**

The by-catch provisions in the CEM for 3NO cod should be reviewed periodically, to coincide with scheduled assessments of the stock by Scientific Council, and adjusted to reflect the overall trend in spawning stock biomass.

Annex 2. Revised General Framework on Risk-based Management Strategies

1. **Introduction:**

The purpose of this document is to provide guidance on the development and implementation of risk management strategies based on the application of the Precautionary Approach framework.
While not intended to be a template, the following are recommended elements for the development and implementation of risk based management strategies

2. **Biological Synopsis / Fishery Overview:**

A brief overview outlining the main biological characteristics of the stock with emphasis on the aspects which impact rebuilding of the stock, as appropriate, including:

- A species' **life history characteristics** (e.g. growth rates, fecundity, longevity, age-at-maturity, size-at-maturity) - critical elements to consider in determining a stock's response to both fishing pressures and rebuilding measures
- **Multispecies interactions** – these can have a strong influence on stock recovery potential and ability of all stocks to reach MSY
- **Environmental conditions** (e.g. temperature, salinity) - will impact the rebuilding dynamics of a stock by affecting life history characteristics, such as fecundity, growth and general productivity. Environmental conditions will also influence predator and prey abundance, which in turn impacts a stocks' overall health and recruitment.

A brief overview of the fisheries in which the stock is captured, including both targeted catch and by-catch, including:

- Impacts of rebuilding on other fisheries - rebuilding efforts for a depleted stock harvested in a mixed-stock or multispecies fishery may have impact on / be impacted by fishing opportunities on targeted stocks/species whose populations are healthy

3. **Objective(s):**

Objectives (fishery and conservation related) should be clearly stated and direct the development of specific measures. Milestones may also be established as interim steps to achieving objectives.
Objectives and milestones may take into account the following components:

- A target, which is preferably quantifiable (e.g. specified biomass goal)
- A desired time to reach the target (e.g. specified # of years/ generations)
- An acceptable probability level for reaching the target within the specified timeframe

The long-term objective of a Risk-based Management Strategy is to achieve and to maintain the Stock Biomass and the Fishing Mortality in the 'safe zone', as defined by the NAFO Precautionary Approach framework and to ensure that fisheries resources are maintained at or restored to levels capable of producing maximum sustainable yields, according to the Convention objectives (resolution NAFO/GC Doc. 08/3).

4. **Reference Points:**

The level of information available to perform a quantitative assessment and to define biological reference points may vary considerably between stocks. There are currently stocks with an adopted quantitative assessment and with limit and/or potential target reference points defined but there are stocks with inadequate information to perform a quantitative assessment and for which the definition of reference points is difficult or not possible.
Where limit reference points can be defined, they should be calculated by the Scientific Council (SC).

SC should also provide advice and analysis in support of the development of other reference points (e.g. targets).

5. **Guidance on Management Strategies and Harvest Control Rules[1]**

a. Stocks below limit reference point

- no directed fishing, and
- by-catch should be restricted to unavoidable by-catch in fisheries directing for other species

b. Re-opening to direct Fishing:

A decision to reopen the fishery should only be considered when Biomass is above B_{lim}.
When a stock has recovered beyond B_{lim}, initial TAC levels should be set at conservative levels to allow for continued recovery and growth.
Decisions to reopen a fishery should take into account any available risk analysis.
Where quantitative risk analysis is available, reopening the fishery should only be considered when there is a very low[2] probability of Biomass actually being below B_{lim}.
In the absence of a quantitative risk analysis, a decision to reopen a fishery would only occur when FC has a high degree of confidence, taking into account any available advice/analysis from SC, that biomass is above B_{lim} or its proxy. Any subsequent increases in TAC should be gradual in order to allow for monitoring of the stock response to the fishery.

c. Open fisheries:

The NAFO Precautionary Approach framework should be applied and Harvest Control Rules (HCR) should be developed in order to specify actions to be taken.
Fisheries specific harvest control rules should be designed with the objective of keeping the fishery in the safe zone.
There should be a low probability that fishing mortality will exceed F_{lim}.
Scenarios may be considered which mitigate decline in biomass and/or limit increases in TACs as a means to balance fishery socio-economics and long-term conservation objectives.

d. Closing of Directed Fishing:

~~[~~As noted in NAFO's PA Framework, a ~~fishery~~ stock will be closed when it is below B_{lim}. Fisheries Managers will consider the probability and establish risk tolerance taking into consideration short term projections and stock fluctuations.~~]~~

e. Additional management measures

When practical, considerations may be given to specific management measures to reduce fishing mortality associated with bycatch including discards, and/or improve selectivity.

6. **Ecosystem Considerations:**

Risk-based management strategies should be consistent with the ecosystem approach and take into consideration the associated species.

7. **By-catch provisions:**

For closed fishery, by-catch provisions in the CEMs should be reviewed periodically, to coincide with scheduled assessments of the stock by Scientific Council, and adjusted to reflect the overall trend in spawning stock biomass.

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[1] Noting the merits of quantifiable and testable harvest control rules, these aspects should be considered, on a stock by stock basis, in the development of risk-based management strategies.

[2] The actual level of risk should be specified by managers.

8. **Monitoring and Review:**

Reviews should be completed on a regular basis at intervals such that failures of the plan (e.g. prolonged declining or stagnant stock growth) can be detected, and changes made as required.

On-going changes in stock status, resulting in implementation of associated harvest decision rules should be continuously examined; trends observed in long-term monitoring are an essential element for consideration in reviewing rebuilding plan performance.

Additional management action may be considered if the stock does not show signs that rebuilding is occurring.

Annex 3. Development of a Risk-Based Management Strategy for 3LN Redfish

(FC-SC RBMS WP 14/4 Rev 3)

Preamble

NAFO identified the development of a risk-based management strategy for 3LN redfish as a priority in 2012, and reaffirmed that priority in 2013.

1. Context

This is a recently re-opened fishery and the response of the stock to fishing at higher levels is uncertain at this stage.

In addition, a high percentage of the fish are juveniles. **Implementation of the proposed HCR should allow for an increase in the spawning stock biomass but it is not possible to test this element at this time.**

The proposed management strategy is intended to initially focus on the short to medium term. A review/ evaluation would be recommended at the end of the 7 year period (outlined below).

2. Objectives and Performance Statistics:

a) Objective(s): Maintain the stock at or above B_{msy}, achieve a TAC of 20 000t within 7 years, and maintain a TAC at or above[1] 20,000t for subsequent years.

- Rationale for 20 000t is that it represents the approximate average catch for the period 1965-1985 - a prolonged period of relative stability in the TAC/ resource.
- The current average fish size in the stock and fishery is low and a slow increase in the TAC should promote survival and growth. This should result in an increased SSB.

b) Performance Statistics:

i. Low (30%) probability of exceeding F_{msy} in any year
ii. Very low (10%) probability of declining below B_{lim} in the next 7 years
iii. Less than 50% probability of declining below 80% B_{msy} in the next 7 years

3. Harvest Control Rule:

Increase the TAC in constant increments starting in 2015 – i.e. $TAC_{y+1} = TAC_y$ + 1,900t to a maximum of 20 000t. This would provide the following annual TACs:

2015: 8 900
2016: 10 800
2017: 12 700
2018: 14 600
2019: 16 500
2020: 18 400
2021: 20 000

[1] Evaluating at 5 000t increments, *i.e.* 25 000, 30 000, etc.

4. Proposed Next Steps:

- The working group request Scientific Council to evaluate this management strategy relative to the performance statistics prior to the 2014 NAFO Annual Meeting.
- **SC is requested to comment on likely by-catch levels associated with the implementation of the proposed HCR for 3LN redfish.**

Annex 4. Development of a Risk-Based Management Strategy for 3M Cod

(FC-SC RBMS WP 14/2 Rev2)

Background

The cod stock in Division 3M (Flemish cap) experienced very low biomass levels in the 1990s and was under moratorium to direct fishing between 1999 and 2009. The stock rebuilt and the direct fishery reopened in 2010. The spawning stock biomass increased substantially since mid-2000s and is now well above the limit reference point and among the highest levels observed since the 1970s. The rebuilding of this cod stock was a success for NAFO. NAFO identified the development of a risk-based management strategy for 3M cod as a priority in 2012, and reaffirmed that priority in 2013. The development of such a management plan should be based on scientific advice.

This paper presents the outline of a future 3M Cod Risk-based Management Strategy, indicating reference points with associated risks, options of candidate Harvest Control Rules (HCR) and performance statistics and targets to evaluate these HCR. Two candidate HCRs are proposed: 1) a model based HCR, with different options of target fishing mortality (F_{target}) and 2) a model free HCR based on survey trends. The model based HCR would require a stock assessment each year, to estimate the necessary stock parameters, while the model free HCR would only be based on surveys and assessments would not be necessary.

These different HCR will give managers a wide range of options to choose from, based on the different risk and performances. The Scientific Council should review this plan, propose alternative HCRs and performance statistics and perform a Management Strategy Evaluation (MSE).

1. Objective

The objective of this Conservation Plan is to maintain the 3M cod Spawning Stock Biomass in the safe zone as defined by the NAFO precautionary approach framework and to assure the optimum utilization, rational management and conservation of the 3M cod stock.

2. Reference Points:

(a) A limit reference point for spawning stock biomass (B_{lim}) – 14 000 tons[1]

(b) A target reference point for fishing mortality (F_{target})

F_{target} is to be defined by Managers. Several options regarding risks of being above F_{MSY} are indicated in one of the HCRs.

Reference points should be calculated and updated by the Scientific Council (SC).

3. Harvest Control Rule:

(a) When SSB is above B_{lim}, the future total allowable catch (TAC) shall be adjusted each year according to the following harvest control rule (HCR):

- OPTION 1 (Model based HCR): TAC = Biomass X F_{target} X Probability of SSB above B_{lim}

F_{target}: Four different levels of F will be considered as F_{target}, corresponding to probabilities of 20%, 30%, 40% and 50% of exceeding F_{MSY}.

If F_{MSY} is not available, an appropriate proxi (e.g. Fmax, current proxi) should be used.

- OPTION 2 (Model free HCR): $TAC_{y+1}=TAC_y$ x (1 + λ x slope)

Biomass projections should apply a risk neutral approach (*i.e.* mean probabilities).

(b) When SSB is below B_{lim}, no directed fishing and by-catch should be restricted to unavoidable by-catch in fisheries directing for other species

For this purpose, fisheries managers will consider the probability and establish risk tolerance, noting that the probability of biomass to be above B_{lim} is an integral part of the HCR proposed in option 1.

(c) Noting the desire for relative TAC stability, TAC should be constraint to a fixed percentage of annual change (+- [XX]%)..

[1] STACFIS 2008

Level of constraint is to be defined by Managers. Different scenarii will be tested: 10%, 15% and 20%.
The management objectives, performance statistics (PS) and performance target (PT) are indicated in Annex 1.

4. By-catch Provisions

The by-catch provisions in the CEM for 3M cod are defined in Article 6.3.

5. Reviews

Reviews should be completed on a regular basis at intervals such that failures of the plan (e.g. prolonged declining stock) can be detected, and changes made as required.

6. Final provisions

The current Risk-based Management Strategy (RBMS) for Cod stock in Subarea 3M shall be applied in consistency with the Precautionary Approach Framework and the General Framework on Risk-based Management Strategies.
It shall be in force initially until 2019.

Annex 1*: *Parameters for the evaluation of the management strategy

The priority regarding management objectives is (ranked from higher to lower priority): 1) low risk of breaching B_{lim}, 2) low risk of overfishing and 3) low risk of steep biomass decline, 4) maximise average catch and 5) limited annual catch variation.

The HCRs, PS and PT are not fully mathematically specified and are left open for the Scientific Council to propose adequate formulation. The length of the evaluation period is to be defined by the Scientific Council.

Management Objectives	Performance Statistics (PS)	Performance Targets (PT)
Low risk of steep decline	SSB_{10}/SSB_0, where SSB_{10} = spawning stock biomass in year 10 and SSB_0 = spawning stock biomass in year 0, where year 0 is the current year SSB_5/ SSB_0 SSB_{lowest} / SSB_0, where SSB_{lowest} = lowest spawning stock biomass level during projected evaluation period	The probability of the decline of 25% or more of spawning stock biomass from year 0 to year 5 is kept at 10% or lower.
Very low risk of breaching B_{lim}	SSB / B_{lim}	The probability of a spawning stock biomass under B_{lim} at 10% or lower
Limited annual catch variation	Number of times the constraint (at the lower and at the higher boundaries) has been applied on average during the period.	This will be achieved through the constraint on the TAC variation.
Maximum average catch over the period	Yearly TAC for the period Average TAC over the period	The average TAC over the period should be maximized
Low risk of overfishing	F/F_{MSY} F_{max} is used as a proxy for F_{msy}.	For the model free HCR only: The probability of F exceeding Fmsy during the evaluation period should be kept at 30% or lower.