Fisheries and Oceans Canada | Pêches et Océans Canada
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National Capital Region

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Science Advisory Report 2016/020

GUIDELINES FOR PROVIDING INTERIM-YEAR UPDATES AND SCIENCE ADVICE FOR MULTI-YEAR ASSESSMENTS

Figure 1. The administrative regions of Fisheries and Oceans Canada (DFO). The dashed line indicates Canada's Exclusive Economic Zone (EEZ).

Context:

Fisheries and Oceans Canada (DFO) is broadening the application of the multi-year approach to management to those fisheries for which (i) it is deemed an appropriate way to provide stability and predictability for harvesters, and (ii) it can be effectively applied to reduce the frequency of peer-reviewed stock assessments and subsequent fisheries advisory processes. The Department's early experience with this broader implementation of multi-year assessments has highlighted the need for clear guidelines on when and what kind of advice is required for the interim years between full stock assessments.

This document provides guidance and best practices for providing science advice during interim-years for multi-year assessments.

This Science Advisory Report is from the March 10-12, 2015 National Peer Review on Providing Science Advice to management in the interim years for multi-year stock assessments (Technical Expertise in Stock Assessments). Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SUMMARY

- Within Fisheries and Oceans Canada (DFO) multi-year assessments are being undertaken for many stocks and there is a need to provide advice for interim years. This document provides guidance on providing advice to clients for the interim years between multi-year full stock assessments.
- The process for providing advice during interim years should be established early in the planning of the science advisory process for a given species or stock. Details of indicators, trigger values, harvest decision rules and measures to be undertaken need to be clearly identified during the full peer-reviewed stock assessment process.
- Indicators are proxies or metrics of stock status. They must be defined during the multi-year full stock assessment process, including those required for the application of harvest decision rules.
- Trigger values are pre-defined thresholds of an indicator which if crossed would signal a change in stock status that may warrant a re-assessment ahead of schedule or changes to management measures used for a particular species or stock. They must be defined during the multi-year full stock assessment process.
- Interim-year updates are the science response advisory processes that are carried out between full stock assessments. Interim-year updates may be produced annually or at less frequent intervals within the multi-year full stock assessment cycle.
- Interim-year updates are scheduled during the full stock assessment processes, and should only be undertaken at a different schedule under exceptional circumstances.
- How the harvest decision rules are used with the indicator(s) to set harvest levels in the interim years should be clearly outlined at the full stock assessment processes.
- It should not be assumed that an interim-year update would be produced every year. The need for interim updates must be identified during the full stock assessment process.
- The development of indicators and trigger values, as well as the frequency of the interim-year updates, will be stock specific.

BACKGROUND

Fisheries and Oceans Canada (DFO) is broadening the application of the multi-year approach to fisheries management to include most fisheries in order to provide stability and predictability for harvesters, and where it can be effectively applied to reduce the frequency of full peer-reviewed stock assessments and subsequent fisheries advisory processes. The multi-year approach to management consists of two components:

- The provision of science advice through full peer-reviewed stock assessments at a prescribed interval, which may be complemented by interim-year updates.
- The development of multi-year management measures, including harvest levels based on this science advice.

While full peer-reviewed stock assessments are now mostly conducted on a multi-year cycle, monitoring continues mostly on an annual basis and Science may provide interim-year updates on the status of the stock based on pre-identified indicator(s).

Actions may be taken if the pre-identified indicator(s) fall outside predetermined thresholds during interim years. These actions, determined on a case-by-case basis, could lead to:

- A full stock assessment sooner than indicated in the multi-year implementation schedule, and/or
- An adjustment of management measures.

DFO's early experience with the broader implementation of multi-year assessments has highlighted the need for clear guidelines on the provision of advice for the interim years between full stock assessments. Guidance is required to facilitate the process of integrating the science delivery in the assessment year and in the interim years within the multi-year management approach. It is particularly important to ensure that approaches to providing advice for interim years are relevant and useable by fisheries managers in planning and engaging resource users on multi-year fishing plans. The guidance in this report is focused on the process required, as opposed to the scientific methodologies applied, and aims to strike a balance between clear guidance and considerations that could leave room for flexibility given the range of situations for different stocks and fisheries.

The guidance was developed based mainly on regional experiences in undertaking annual and multi-year stock assessments. Topics to orient the discussion and development of the guidance included:

- Characteristics of indicators that could be used to inform interim-year updates,
- Conditions that could trigger a re-assessment and provision of revised advice,
- Approaches to provide advice in interim years that would allow managers to adjust the fishing plan in an interim-year of the multi-year management cycle when required,
- Conditions for defining the frequency of interim-year updates to be provided, and
- Processes for communicating the interim-year updates and advice for interim years.

Key terms used in this document include

- **Advice for interim years**: is a broad-term that encompasses any science advice that is provided for years in-between full stock assessments. It can refer to science advice provided at full peer-reviewed stock assessment processes that cover a number of future interim years, or it can refer to an interim-year update. **Interim-year update**: is a specific product stemming from the Science Response advisory process that is carried out between full stock assessments. The content of an interim-year update report should include an update on indicator(s), assessments of indicators against trigger values, and the calculation of harvest decisions rules (or others) that were agreed upon at the full assessment. Interim-year updates may be produced annually or at less frequent intervals within the multi-year assessment cycle. The timing and number of interim-year updates are scheduled during the full stock assessment processes, but they could be requested due to exceptional circumstances.
- **Indicators**: proxies or metrics of stock status.
- **Trigger values**: pre-defined thresholds of an indicator which if crossed would signal a change in stock status that may warrant a full stock assessment ahead of schedule and possible revision of advice.

ASSESSMENT

Overview of current multi-year assessments and the type of advice being provided

An inventory of the current state of assessments within the multi-year approach was compiled based on input from science experts in all DFO regions (via a questionnaire distributed in January 2015). Nationally, information was available for 126 fishery assessment groups (species/stocks), although not every questionnaire was responded to for each of 126 species/stocks. From the responses 78% of the fisheries were output controlled (via Total Allowable Catch, TAC, or similar measures) compared to 22% which were input controlled (effort controlled) fisheries. In terms of the frequency of assessment, about 15% occurred every second year, 57% of assessments occurred at 3-5 year intervals, and 28% at intervals greater than five years.

Identified gaps in current practices for providing advice for interim years

A large number of the stocks assessed by DFO, for which responses were provided, may require advice for interim years. The majority (99 of the 113 responses, or 88%) of species/stocks assessed on a multi-year schedule do not have indicators identified for use in interim-year updates.

The major challenges to advancing the multi-year assessment and interim-year update process are:

- Few stock assessments have defined indicators and trigger values for determining if a full re-assessment is warranted earlier than the pre-agreed multi-year full peer-reviewed stock assessment cycle, and
- Few stocks have defined harvest decision rules to adjust annual management measures relative to changes in indicators of stock status in the interim years.

Other national and international jurisdictions have moved, or are in the process of moving, to multi-year assessments and most have developed formal or informal means of monitoring stocks in interim years. A review of current practices related to multi-year assessment and advice in other jurisdictions showed a variety of approaches, however few stocks have pre-defined trigger values for assessments or management action in interim years.

Guidance for providing advice for interim years

The provision of science advice in support of the multi-year approach to fisheries management requires the identification and tracking of stock status in the interim years for the purpose of:

- Determining whether there has been a change in stock status which would signal a full stock re-assessment and a revision of the science advice prior to the scheduled assessment cycle may be warranted, or
- Providing information to adjust the annual fishing plan in the interim years based on the state of an indicator of stock status linked to a defined harvest decision rule.

As a first priority, indicators which can be monitored and used for tracking the status of the resource in the interim years must be identified. Once the indicator(s) are defined, threshold levels (trigger values) that would signal that a full stock re-assessment and possibly that revised advice may be warranted, should be specified.

Considerations for defining indicators to be used in interim-year updates

The most useful indicators are those which are proportional to stock size and can be associated directly with, or used as proxies for, the stock status zones of the Precautionary Approach. Further considerations for characteristics of indicators to be used in interim-year updates are:

- The indicators must be based on data or model outputs available in the interim years for which an update is expected,
- Indicators must be based on data that would be collected and processed with sufficient time to provide an interim-year update and, if warranted, a re-assessment before the next fishing period,
- The indicators should be characterized by sufficiently small inter-annual variation to allow the detection of variation of stock status. Options for handling inter-annual variation may include using smoothed values over a stock-appropriate number of years or the consideration of multiple indices, and
- The indicators must be able to be evaluated against the trigger values in the interim years.

The indicators to be used in the interim-year updates would be proposed, peer-reviewed and described in the advice during the full stock assessment process. When multiple indicators are used the approach for applying them must be clearly defined at the full stock assessment process.

Generic objectives for identifying indicators and trigger values should be included within the terms of reference of full peer-reviewed stock assessment processes. The generic objectives for the indicator(s), trigger values, and frequency of interim-year updates could read as follows:

- Identify indicators which would be used to characterize stock status in the intervening years of the #-year stock-assessment and management cycle,
- Identify changes in the indicators (trigger values) which would suggest that a full stock re-assessment may be warranted earlier than the scheduled #-year stock assessment cycle, and
- Propose the frequency and timing of interim-year updates to be provided between full peer-reviewed stock assessments as well as the information to be included within the updates.

Consideration for setting trigger values that would prompt a re-assessment earlier than the pre-agreed full stock assessment cycle

The choice of the trigger values should be guided by the status of the stock in the context of the precautionary approach framework and risks to productivity of the resource. For example:

- If a stock is in the critical zone and the interim-year update shows indicators with a significant directional change in stock trajectory from expected positive to observed negative, this represents a high risk to sustainability,
- Stock status under status quo fishing that unexpectedly declines from cautious to critical zones represents a high risk to sustainability,
- For stocks in the cautious zone, unexpected declines in status may represent a high risk if the changes present a long-term conservation concern for the sustainability of the stock,
- If stock status under status quo fishing unexpectedly declines from healthy to cautious, this represents a moderate risk, and
- For a stock that remains in the healthy zone, unexpected changes in direction are unlikely to pose a risk to sustainability.

The trigger values for an indicator would be developed by considering a number of factors including:

- The precision of the anticipated value and of the measured value of the indicators in the interim years,
- The recent status of the resource,
- The current management plan, and
- The direction of change of the indicator.

When selecting the values for the trigger, consideration should be given to the precision of the projected model value (if applicable) and precision of the measured indicator. The anticipated trend of the indicator can also be considered; for example if a stock is recovering and a continued positive trend is expected. If the range of trigger values are too narrow this may result in signaling a full stock re-assessment more often than is required. On the other hand, if the range of trigger values are too wide, the trigger values may not be responsive to true changes in the stock and fail to signal a full stock re-assessment when one may be warranted.

The selected trigger values will be case-specific and would be defined at the full stock assessment process, including pre-agreed responses when trigger values are crossed. Trigger values could be defined and tested using historical data to quantify how often full stock re-assessment recommendations would have been signaled in the past under different ranges of trigger values.

Uncertainty may need to be accounted for in a number of ways. For example, an assessment may produce Bayesian posterior distributions of estimated biomass and catchability coefficients, and survey indices will likely have observation error associated with them. Furthermore, in some cases there may need to be an agreed-upon level of confidence that a trigger value's threshold has been exceeded given the new data. Evidence of an unexpected change in a stock is stronger if multiple indicators simultaneously provide a conclusion that a stock is outside the expected bounds. For full stock assessments which have identified multiple indicators, options for weighting the individual indicators and the conclusion leading to a re-assessment must be examined and agreed upon at the full stock assessment process.

The following are examples of trigger values corresponding to a range of assessment methodologies:

- For analytical assessments, if the indicator was the population abundance then the bounds of the projected abundance from the last assessment may be appropriate trigger values. These bounds will be case-specific. If a smoothed index is used to reduce year effects for the monitored indicator, then depending on the inter-annual variation in the smoothed index, the 25^{th} – 75^{th} percentile range for the projected abundance could be reasonable bounds for the trigger value range. For assessments based on abundance index trends, if the main smoothed index has changed by more than X standard deviations (SD) from the expected value, given the sensitivity of the survey index, then this may warrant a re-assessment and revised advice. Or if two or more of the main smoothed indices have increased or decreased more than X SD from the expected values, given the sensitivity of the survey index, then this should warrant a re-assessment and revised advice.
- For assessments based on catch as a proxy for abundance, catch is the indicator used to establish the threshold values for the trigger. If expected catch was not obtained, for reasons related to harvesters' ability to find fish, then this may warrant a re-assessment and revised advice.

Guidance on updating indicators used in Harvest Decision Rules or fishing plans

For some species/stocks, harvest decision rules have been developed that allow management measures to respond in interim years to changes in the stock status indicators. Examples of such harvest decision rules include a scallop fishery in Quebec (DFO 2013), the snow crab fishery of the southern Gulf of St. Lawrence (DFO 2014a), the western component of Pollock in NAFO Div. (4Xopqrs5) (DFO 2015), and Sablefish in Pacific region (DFO 2014b).

As in these examples, how the harvest decision rules are used with the indicator to set harvest levels in the interim years should be clearly outlined at the full peer-reviewed stock assessments process.

Considerations for determining the frequency of interim-year updates

It should not be assumed that Science would provide interim-year updates every year for all species/stocks. This includes species/stocks which do not have a defined stock assessment cycle, as annual updates for these stocks would represent an additional science delivery to current activities.

Updates in interim years would be provided for species/stocks that meet the following conditions:

- A schedule for interim-year updates has been agreed upon at the full stock assessment process.
- Indicators, and associated trigger values, have been identified that can be used to establish if a full stock re-assessment may be warranted and/or revised advice may be required.
- Additional interim-year updates may be warranted if indicators or other information suggest a conservation concern.

The schedule of interim-year updates must be agreed upon during each full stock assessment process. These could be based on species characteristics and population dynamics, the defined fishing plans, the associated potential management actions for the fishery during the interim years, and resources available to conduct the interim-year updates and subsequent possible full stock re-assessment (including the CSAS review meeting). For some stocks on a multi-year assessment cycle there may simply not be the time available to conduct an interim-year update and a full re-assessment before the advice is needed.

More frequent updates may be expected for fisheries where the risks to sustainability are high (for example, species/stocks whose status is in or approaching the critical zone and subjected to directed fishing) or where there are annual management information needs (for example, fisheries with an agreed upon harvest decision rule requiring annual updates).

Less frequent updates may be undertaken in cases where the risks to sustainability are low (for example, species/stocks for which the harvests represent a small proportion of the total annual losses or for species/stocks whose spawning stock biomass is comprised of a large number of year classes and not subject to large annual variations from recruitment) or no changes to management measures are likely in the interim period.

Communication of advice including interim year updates

DFO Ecosystems and Oceans Science Branch uses the Canadian Science Advisory Secretariat (CSAS) peer-review process and advisory reports to communicate advice to client sectors. The interim-year updates are considered to be advice to clients and the communication of the results

of these updates is an important science delivery. CSAS has developed a policy for the peer-review and communication of the results of interim-year updates using the Science Response process. The Science Response process differs from the full peer-review process in the scope of the review provided and the requirements for documentation of the review process.

Not articulated in the CSAS policy for interim-year updates is the language to use for communicating the results of the analysis of the indicators and their associated trigger values, including recommended actions arising from the indicator analysis. Generic language for communicating the results is recommended. Examples of such generic language based on possible conclusions of the indicator analyses regarding a stock re-assessment are:

- "Analysis of the indicator(s) for the recent year shows the indicator(s)'s trigger values have not been reached. A stock re-assessment is not warranted and the previous advice for the fishery remains appropriate."
- "Analysis of the indicator(s) for the recent year shows the indicator(s)'s trigger value(s) have been crossed and a stock re-assessment is warranted. This re-assessment may result in revised catch advice for the fishery."

Examples of generic language for conclusions of the indicator analyses to revise the management measures, when there is an agreed upon harvest decision rule, are:

- "Analysis of the indicators for the recent year shows the indicator's trigger values have not been reached and a stock re-assessment is not warranted. Based on the agreed upon harvest decision rule, the value of the status indicator for the current year corresponds to an exploitation rate of XX% and a total allowable catch of XXX t (a total effort of XXX days/traps…) for the upcoming fishing year."
- "Analysis of the indicators for the recent year shows the indicators' trigger values have been reached (or alternative wording) and a stock re-assessment is warranted. This re-assessment may result in revised catch advice for the fishery. Current advice based on the agreed upon harvest decision rule and the value of the status indicator for the current year corresponds to an exploitation rate of XX% and a total allowable catch of XXX t (a total effort of XXX days/traps…) for the upcoming fishing year."

Statements of the type "Science recommends a re-assessment" or "Science recommends a reduction in TAC or effort" or other prescriptive statements that could be interpreted as fisheries management decisions or related to policy are not to be used.

CONCLUSIONS AND ADVICE

The decision to trigger a full stock assessment earlier than planned within the multi-year assessment schedule and provide revised advice is an internal DFO process. The two sectors in this process are Ecosystem and Oceans Science (EOS) and Ecosystem and Fisheries Management (EFM).

- Within Fisheries and Oceans Canada (DFO) multi-year assessments are being undertaken for many stocks and there is a need to provide advice in interim-years. This document provides guidance on providing advice to clients for the interim years between multi-year full stock assessments.
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SOURCES OF INFORMATION

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DFO. 2013. Stock assessment on scallop of the inshore waters of Quebec in 2012. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/027.

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