FISHERIES SCIENCE ADVICE REPORT GUIDANCE

One document should be completed for each assessed stock. Do not aggregate stocks or summarize fisheries on multiple stocks. In all cases, use N/A if information for the data field is not available. If no suitable option exists, then insert something suitable.

Probabilities. Stock status and fishing mortality should be expressed in a probabilistic manner with respect to reference points and targets and/or other quantitative management (fishery) objectives (i.e. biomass, timeframe, risk tolerance). Where probabilities cannot be explicitly estimated, qualitative likelihood approaches may be required.

Where probabilities are used in qualifying a statement regarding the status of the stock in relation to limit, target, or other threshold reference levels, the following probability categories and associated verbal descriptions from DFO’s PA Policy (2009) are to be used (Table 1). Probability categories and associated descriptions should relate to the probability of being “at or above” (or “at or below”), targets, upper stock references, limit reference points, and removal references.

Table 1. Reproduced from DFO 2009

|  |  |
| --- | --- |
| **Probability** | **Description** |
| Less than 5% | Very low |
| 5% - 25% | Low |
| 25% - 50% | Moderate |
| ~50% | Neutral |
| 50%-75% | Moderately High |
| 75%-95% | High |
| >95% | Very High |

Context. Include only information about the request for advice, the date of the peer review meeting, and information on participants. The following paragraph is mandatory for the Context section. The meeting date and title must be exactly as they appear on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule. Be sure to use the default text in the French template for the translation as well as the meeting information on the French version of the schedule.

This Science Advisory Report is from the [meeting date and title (e.g., January 25, 2011 Assessment of Quebec inshore waters softshell clam)]. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada (DFO) Science Advisory Schedule](http://www.isdm-gdsi.gc.ca/csas-sccs/applications/events-evenements/index-eng.asp) as they become available.

*Example 1:*

|  |
| --- |
| *The Fisheries Management Branch of Fisheries and Oceans (DFO) has requested harvest levels for the sGSL Atlantic Cod stock. A regional peer review meeting was held February 20-21, 2019 to address the request for science advice. Participants included DFO Science and DFO Fisheries Management personnel from Gulf, Quebec, and the Newfoundland and Labrador regions, the fishing industry, the province of Nova Scotia and an Indigenous community.* |

*Example 2:*

|  |
| --- |
| *The Fisheries Management Branch of Fisheries and Oceans Canada (DFO) has requested that the 4X5Y Atlantic Cod stock be assessed relative to reference points that are consistent with the DFO Precautionary Approach, provide harvest advice, and inform the rebuilding plan for this stock. This Fisheries Science Advisory Report is from the December 4, 2018, Stock Assessment of Atlantic Cod in NAFO Division 4X5Y. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.* |

*Example 3:*

*The previous advice (DFO 2019a) for BC Pacific Cod recommended assessment updates be pro­vided in years immediately following the biennial groundfsh synoptic bottom trawl survey (i.e., when the most recent survey index point is available). However, given the low 2018 index of abundance in Area 3CD, coupled with the lack of updated survey information in 2020, the Pacifc Fisheries Management Branch of Fisheries and Oceans Canada (DFO) has requested that DFO Pacifc Science Branch assess the status of both BC Pacifc Cod stocks in 2020 and recommend harvest advice for 2021, to inform the development of the 2020/2021 Integrated Fisheries Man­agement Plan.*

*This Fisheries Science Advice Report results from the Science Response Process of October 2020 on the Stock Assessment Update of British Columbia Pacifc Cod for Areas 3CD, and 5ABCD in 2020.*

|  |
| --- |
| *Example 4: The Fisheries Management Branch of Fisheries and Oceans Canada (DFO) requested that the Walleye Pollock stock be assessed relative to reference points that are consistent with the DFO Precautionary Approach (DFO 2009), and that probabilistic decision tables be produced that forecast the effect of a range of fixed annual harvest levels on stock status.*  *This Science Advisory Report is from the November 14-15, 2017 regional peer review on Walleye Pollock (Theragra chalcogramma) stock assessment for British Columbia in 2017. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.* |

Fish Stock Name. ‘Advice Year’ Name of the assessed stock (formal taxonomic treatments) and ‘Advice Year’; hyperlink to species overview document

2019 *4X5Y Atlantic Cod (Gadus morhua), Maritimes Region; 4X5Y Atlantic Cod Stock Overview*

Science Advice. Include a summary of the science advice incorporating status, trends, forward-looking advice, including the expected outcome of harvest scenarios evaluated (and note any scenarios that met measurable objectives for the stock, if applicable). (include those that met measurable objectives for the stock if applicable), and trends in other biological, fishery, or environmental and climate change factors affecting the stock that may be taken into a account in decision-making. As per (SAR 2016/020), statement of the type “Science recommends a reduction in TAC or effort” or other prescriptive statements that could be interpreted as fishery management decisions or related to policy are not to be used.”

Status. Mandatory bullet(s) that state the prescribed major fish stock’s status relative to its PA reference points (LRP, USR, TRP and RR). With likelihood if available. Phrasing should be consistent with the wording below.

* *The 2018 spawning stock biomass is above the USR with an X probability, placing the stock in the Healthy Zone of its PA Framework.*
* *The 2018 spawning stock biomass is above the LRP (with an X probability), but below the USR (with an X probability), placing the stock in the Cautious Zone of its PA Framework.*
* *The 2018 spawning stock biomass is below the LRP with an X probability, placing the stock in the Critical Zone of its PA Framework.*
* *The 2018 stock status is uncertain as (we were unable to conduct the survey this year, this is a data poor stock; reference points are under development).*
* *The 2020 fishing mortality was below (or above) the RR with a 75% probability.*

Other Management Objectives (if applicable). State the probability of achieving the objective for the stock and timeframe for evaluation. If no measurable objective has been defined, state the goal or report unknown. If the stock is subject to a rebuilding plan, what are the objectives for rebuilding.

* Summary Bullets: Style – List Bullet

*Example 1: (Full quantitative assessment indicating status in relations to limits; short term projections; tactical and strategic ecosystem considerations)*

*Status*

* *The 2018 spawning stock biomass is below the LRP with an 85% probability, placing the stock in the Critical Zone of its PA Framework.*

*Science Advice*

* *In the absence of fishery removals, it is likely (> 80%) that the stock will remain in the Critical Zone by 2027.*
* *In the harvest scenarios tested, the probability that SSB will increase by 2024 ranges from 44% at a catch of 0, to 42% at a catch 1,250 t under the current conditions (high natural mortality, declines in weight-at-age, and low recruitment).*
* *Natural mortality for older fish (ages 7-11+) has increased since 2010 to reach a maximum of 65% in 2018 before declining to 59% in 2020 and 2021.*

*Ecosystem Considereations*

* *Given the ongoing trend towards warmer environmental conditions and zooplankton dynamics, it is not expected that recruitment will improve. Recruitment has remained stable at low values since 1993. This low recruitment corresponds with long-term environmental changes including temperature increases and changes in zooplankton abundance and phenology. Based on dynamics in predator abundance, natural mortality is expected to remain high.*

*Example 2: (Full quantitative assessment indicating status relative to reference points; short term projections; no tactical or strategic considerations)*

*Status*

* *The 2021 spawning stock biomass is above the USR with an 90% probability, placing the stock in the Healthy Zone of its PA Framework.*

*Science Advice*

* *The three constant catch scenarios tested resulted in the probability of annual biomass being above the LRP with a > 75% likelihood (by when): 0 catch (87%), 500 t (84%), and 100 t (78%).*
* *The available evidence indicates that incoming recruitment < 30 cm is not as strong as the recruitment noted in 2009 and 2010.*

*Example 3: (Full quantitative assessment indicating status relative to reference points; HDR; short term projections; tactical ecosystem considerations)*

*Status*

* *The 2020 spawning stock biomass is below the LRP with a 52% probability, placing the stock in the Critical Zone of its PA Framework.*
* *The 2020 fishing mortality is below the 10 year average.*

*Science Advice*

* *The Harvest Decision Rule for this stock indicates removals for 2021 of 12,999t.*
* *The harvest scenarios tested (0-15,360 mt) resulted in a <98% probability that biomass will remain below the LRP.*
* *The probability the stock will increase from 2021 to 2022 across all harvest scenarios tested ranged from 52-59%.*
* *The 2020 Natural Mortality rate (0.51) is above the 10-year average (0.02)*
* *The pre-recruit index suggests that recruitment from 2018-2020 will be weaker than in the past ten years.*

*Ecosystem Considerations*

* *Cod productivity has been linked to Capelin levels. Given the forecasted levels of Capelin for the next two years, the prospects for cod stock growth appear limited.*

*Example 4: (Partial quantitative assessment; no reference points; no tactical or strategic ecosystem considerations)*

*Status*

* *The status of this stock is uncertain, as this is a data poor stock.*

*Science Advice*

* *The catch per unit effort (CPUE) for 2018 to 2020 are above the time series median.*
* *The exploitation rate is below the 3% recommended rate.* 
  + *The 2018-2020 landed surfclam size averages are above the time series median*
* *Area 3A meets the criteria for a 6% quota increase: 80% of quota reached, CPUE and mean size are above the time series median, and exploitation is below 3%.*
* *Fishing effort should be distributed within and among beds to limit the possibility of local overfishing.*

*Example 5 (full quantitative assessment including status relative to reference points, decision tables, Healthy Zone):*

*Status*

* *There was an estimated probability of 1 that B2022 is above the LRP and the USR, placing the stock in the Healthy Zone if it’s PA framework.*
* *The 2021 exploitation rate was below that the RR with a 95% probability for the commercial fishery.*

*Science Advice*

* *Advice to managers was presented in the form of decision tables using ten-year projections across a range of constant catches up to 3000 tonnes/year.*
* *The stock was projected to remain above the LRP and USR with a probability of 99% over the next 10 years at current levels of catch (1000-1250 t/y). Catches greater than 1500 t were predicted to exceed the RR (uMSY) in 10 years with probability greater than 50%.*
* *The median (with 5th and 95th percentiles) female spawning biomass at the beginning of 2022 (B2022) was estimated to be 0.69 (0.44, 1.08) of the equilibrium unfished female spawning biomass (B0). and 2.39 (1.54, 3.73) times the equilibrium spawning biomass at maximum sustainable yield, BMSY.*

*Example 6 (MSE, no ecological consideration)*

*Status*

* *The 2018 three-year moving average of the acoustic index is below the LRP, placing the SWNS/BoF stock is in the Critical zone of its PA Framework. Since 2018, the stock has been below the Limit Reference Point (LRP).*

*Science Advice*

* *Although there is uncertainty with annual estimates of spawning stock biomass (SSB), there is a decreasing trend in the acoustic index since 1999 to present that is evident for the two remaining major spawning grounds*
* *Of the 11 candidate MPs evaluated, 8 MPs had a probability of the Spawning Stock Biomass (SSB) being above the LRP with at least 75% probability in each year (from years 10–15) of the projection period for each Operating Model (OM) in the reference set of OMs.*

*Or*

* *Based on the agreed upon harvest decisions rule, the value of the 2020 DFO Summer RV Survey corresponds to a catch limit of 3,407 t for WC Pollock for FY 2021–2022, which is a decrease of 20% from 2020–2021.*
* *No exceptional circumstances were triggered during the first two projection years of the MSE framework*

*Example 7: (Qualitative Evaluation or Low information evaluation; index-based assessment)*

*Status*

* *Stock status is uncertain due to (e.g. a lack of reliable survey and catch data).*

*Science Advice*

* *Stock and fishery indices (XYZ) have remained stable in recent years, however environmental conditions are trending XYZ and a continued positive trend is expected.*
* *It is uncertain how the stock may respond to harvest in the future (due to XYZ).*

BASIS FOR ASSESSMENT

**Year Framework (or Assessment Approach) was Approved.** Year & Reference *i.e. Vitti et al. 2016*

**Previous Assessment Date(s)**

1. Last Full Assessment.Year and reference; i.e., *2019*
2. Last <interim year> Update.Year and reference; i.e., *2019*

Assessment Approach. (select as many as apply)

1. Pick one: Data-poor, index-based, stock assessment model, model ensemble, MSE(full or MSE-lite), other (specify)
2. Pick one or as many as apply: Index-based (fishery-dependent indices only), Index-based (including fishery-dependent and fishery-independent indices), Delay difference, Biomass dynamics, Virtual population analysis, Statistical catch-at-length, Statistical catch-at-age, State-Space, Sequential Population Analysis, Surplus Production, Potential Biological Removal, Other (please explain)

**Assessment Type.** **(select one)**

Full Assessment: Full peer-reviewed stock assessment

Interim-Year Update: Science advice that is provided for years in-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 ([DFO, 2016](https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/365593.pdf?_gl=1*1ravech*_ga*MTQ3MTgzODM1Ni4xNTUyMzIwMDQz*_ga_7CCSB32R7T*MTY3Mzg5MTc2Ny41LjAuMTY3Mzg5MTc2Ny4wLjAuMA)).

Harvest Decision Rule (HDR) Update: The stock has a Harvest Decision Rule that is currently being updated

Stock Structure Assumption. Briefly summarize the current assumptions regarding the stock structure and distribution of the stock being reported. Where the assessed stock distribution differs from the stock defined for management (i.e. there are mismatches between the biological unit and the assessment unit and/or the management unit), an explanation must be provided of how the assessed stock relates to the managed stock. Where there are LRPs for multiple sub-units, indicate, by name, the sub-units that have LRPs and those that do not (where possible).

*Examples:*

* *One LRP has been developed for the aggregate stock (meaning the sub-units do not have their own LRPs).*
* *LRPs have been developed for all of the sub-units of this stock.*
* *LRPs have been developed for some, but not for all of the sub-units of this stock.*
* *There are no LRPs developed for the sub-units of this stock.*

Reference Points. Include the description of reference point, current value (numbers or formulas), and reference.

* 1. Limit Reference Point (LRP) – *x tonnes (2019 estimate), 30% of the geometric mean of female spawning stock biomass (SSB) over the productive period (2005-2009 for [stock area]), a proxy for BMSY, Turnbull et al. 2018.*
  2. Upper Stock Reference (USR) *- x tonnes; 80% BMSY, Turnbull et al. 2020*
  3. Removal Reference (RR) – *(include example)* (if there are different removal references for Healthy, Cautious and Critical, list them all).
  4. Target (TRP) – (if developed; e.g. BMSY)

Harvest Decision Rule. Include text and/or figure to describe the management procedure (s) for the fishery if applicable.

Data. Short summary of main data inputs. Longer summary in Research Document/ or if unchanging Species Overview Document

* *DFO Summer RV Survey Catch at Age (1983- 2019)*
* *Commercial Catch at Age (1983-2018)*
* *Survey Weight at Age (1983- 2019)*
* *Commercial Weight at Age (1983-2018).*

Historical and Recent Stock Trajectory: The recent fish stock trends should be reported in terms of stock size and fishing intensity (or proxies for these), respectively. Observed trends should be reported using descriptors such as increasing, decreasing, stable, or fluctuating without trend. Where it is considered relevant, mention could be made of whether the indicator is moving towards or away from a limit, target, or long term average. Note if fishing mortality includes total catch (including bycatch) or only commercial catches. If the mortality rate is not for all the fisheries on this stock, please indicate so. Include:

* **Abundance** - a value(s) has been calculated for the abundance for the target species in the stock of focus.
* **Biomass** - a value(s) has been calculated for the biomass for the target species in the stock of focus.
* **Density** - a value(s) has been calculated for the density for the target species in the stock of focus.
* **No** – Values have **NOT** been calculated for the abundance, density or biomass for the target species in the stock of focus.
* Provide the **exploitation rate(s)**, exploitation rate index or relative F (i.e., survey biomass/landings) calculated for fisheries on this stock. If the exploitation rate is not for all the fisheries on this stock, please indicate so. Provide links to any online documents that reference these values.
* **Recruitment –** a values (s) has been calculated for recruitment for the target species in the stock of focus
* **Natural Mortality –** a value(s) has been calculated for natural mortality (M) for the target species in the stock of focus.

*The stock’s index of abundance has increased from 2013 and was the highest in the time series in 2018.*

Panel of images. (confidence intervals should be presented graphically with shading that includes fading edges at more extreme probabilities in order to better characterize improbably but high consequence events). Figures in greyscale. Font on axes (x). Use standardized graphs.

* 1. Catch vs Total Allowable Catch (DFO must account for the total catch and/or associated uncertainty on the prescribed major fish stock, consistent with the PA Policy as well as the Policy on Managing Bycatch and the Fishery Monitoring Policy.)
  2. Stock indicator, e.g. Spawning Stock Biomass (SSB) or proxy, in relation to the Limit Reference Point (LRP) – e.g. B/BLRP or other reference points as needed.
  3. Fishing Mortality (F) or proxy in relation to the Removal Reference (RR) – F/Flimit . On the opposite side include Natural Mortality (M) if available
  4. Recruitment or other indicator – estimated recruitment deviations as a function of year…..or if not available, possibly size distribution, age composition for the 4th image, or other indicator that contributes to evaluating fishery objectives and science advice.

Graphical user interface, diagram

Description automatically generated

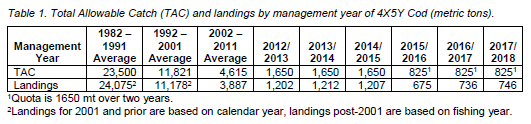
Figure 1.

**(Optional)**

Add an additional optional panel of 4 indicators, if relevant to developing advice.

History of Landings/Harvest/Effort, TAC & Catch Advice: Table of landings/harvest or effort if applicable, total allowable catch (TAC) and (optional) catch advice, over the recent historical period. Identify whether landings are based on fishing year or calendar year and the units of landings, TAC and catch advice.

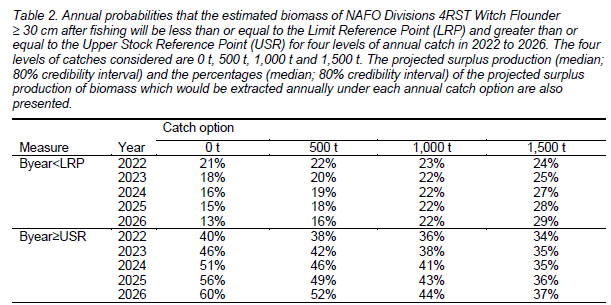
*Example:*



Projections or Simulations: This section is used to report the available information on likely future trends in biomass. Indicate the projected outcome under the current, or range of, catch levels (provide the short or long-term projections if available, or a qualitative statement based on past experience/expert judgement, etc.).

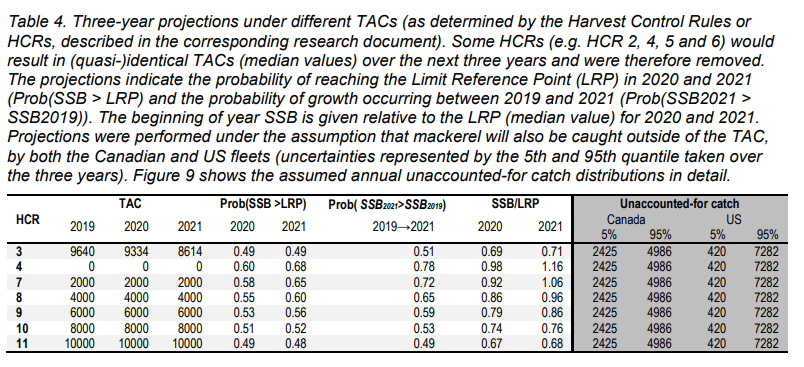
Include: years of projection, the probability of tested and current catch causing biomass to remain below, or to decline below the reference points (probability of being below the LRP and below the USR) and probability of increasing above the Removal Reference. Include probability of stock growth next year if the stock is in the Critical Zone. Include ‘risk tables’ if possible.

*Example 1: Projections for 2022 to 2026 indicate that the biomass is expected to increase up to a total annual catch of 1,000 t. The probability of the biomass being below the LRP in 2026 is 13% in a no catch scenario, 16% under a catch of 500 t and 22% under a catch of 1,000 t. The probability that the stock biomass will be in the healthy zone in 2026 is 60% under a no catch scenario, 52% under a catch of 500 t and 44% under a catch of 1,000 t.*



*Example 2:*

*Projections were made over a three-year period to estimate the impact of different Harvest Control Rules (HCRs) on the SSB. Because the stock is currently considered to be within the Critical Zone, HCRs usually result in the application of a constant floor TAC over the next three years, with the exception of HCR 3, which allows the TAC to change up to 25% from one year to the next, depending on the relative change in the egg survey index. With increasing TACs from 0 to 10,000 t, the probability of exceeding the LRP by 2021 decreased from 68% to 48%, and the probability of stock growth from 2019 to 2021 decreased from 78% to 49%. Note that under the current quota (10,000 t), the stock is more likely to decline than grow (49%). The projections accounted for the uncertainty surrounding unaccounted-for catch from both Canada and the US (Table 4).*



Harvest Decision Rule Update: Any figures or text necessary to incorporate related to updating a Management Procedure, that haven’t already been included.

*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.”*

Evaluation of Exceptional Circumstances/Assessment Triggers: Evaluation of any exceptional circumstances to push for a re-evaluation of a management procedures in an MSE context, or triggers that would prompt an assessment earlier than the pre-agreed assessment cycle (as per SAR 2016/020).

*“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.”*

Ecological and Climate Change Considerations: Describe the environmental and climate change considerations affecting the fish stock. Focus on tactical 1-3 year advice and any long-term strategic considerations for the stock if available. Focus on more recent changes and how they represents a change from the overall ecosystem context. i.e. this is driving changes in mortality. Use plain language, and talk about the consequences/ impacts on the stock. Incorporate implications of trends in ecological and/or climate change drivers on the future state of the stock to help with development of tactical and strategic goals.

Include the method the environmental or climate change variable was included:

**Parameterization** – Environmental variables are included as parameters within the stock assessment model

Example 1 - if environmental variables were considered: *The 2014 stock assessment model also incorporated the annual timing of sea ice retreat as an* ***parameter*** *to project the current year’s biomass, and thus informed the TAC recommendation that is consistent with this stock’s Harvest Strategy.*

**Implied** – For example, the model incorporates time varying M, without clear knowledge of the specific environmental factors affecting the observed changes in M.

**Linked** – The effects of the environment on the stock were evaluated outside of the stock assessment model. This independent information was used to condition the assessment results and provide an assessment of the environmental drivers that are affecting the stock status.

*Example 2 -*

*Recruitment in Pelagic fish such as Herring often exhibit sporadic recruitment peaks, making long term projections highly uncertain. However, recruitment is currently low in both spring and fall spawners. Spring spawning Herring recruitment can be predicted by a model using three zooplankton abundances/phenology variables, explicitly* ***linking*** *ecosystem changes to Herring population dynamics. Given the ongoing trend towards warmer conditions and changes in the zooplankton community in the sGSL (Blais et al. 2021; Galbraith et al. 2021), spring spawning Herring recruitment is not expected to increase in future years.*

*Further analysis of predator abundance, spatial distribution, size distribution, diet and functional response of predators to prey will be necessary to quantify the effects of the different predators on spring and fall spawning Herring natural mortality.*

*Example 3-*

*Sea Scallop condition has varied by up to 4.3 grams, or 29%, between two consecutive years. Condition in the current year on Georges Bank can be predicted using the additive effect of the monthly median sea surface temperature (SST) on the bank from January to March of the previous and current year (Liu et al. 2020). Using the SST model, condition was predicted to be 16.9 g/dm3 in May of 2022, which is above the long term median (1986-2019) and is a decline from 2021 (20.1 g/dm3). The biomass projection for 2022 uses the 2022 SST model prediction of condition. Since biomass is dependent on both abundance and condition, if condition in 2022 differs from the SST model prediction, the biomass projection (and consequent decision table probabilities) would be affected.*

*Natural mortality can be estimated annually for Sea Scallop using clappers, which are empty paired scallop shells that are assumed to have recently died of natural causes. Every clapper observed on the survey is counted and assigned to a 5 mm shell height bin. Records are summarized by survey tow and are used to develop a clapper index. The index is used within the Bayesian state-space modified delay difference assessment model to estimate natural mortality (Hubley et al. 2014). In 2021, the natural mortality was estimated to be 0.14, which was an increase from 2020 (0.09) and is above the long term median (0.1). The biomass projection for 2022 assumes the 2021 natural mortality estimate. If natural mortality changes in 2022, the biomass projection (and consequent decision table probabilities) would be affected.*

*Example 4-*

*Northern Shrimp biomass in SFA 6 is currently similar to the 1980-90 period (substantially down from its peak in the mid-2000s), but this is occurring in a context of a much reduced fish biomass relative to the 1980-90 period. The shrimp model and consumption analyses indicated that predation is a major driver of the stock. The shrimp predation mortality rate in NAFO Divs. 2J3KL (SFA 7, 6, and southern part of SFA 5) has increased over the last two years, to its highest levels on record.*

*Chlorophyll concentration and zooplankton biomass were below normal in the mid-2010s, increasing to values above the long-term (1999-2015) average after 2017. Additionally there have been changes in zooplankton community structure (less large energy-rich, and more small copepods) as well as changes in seasonality (weaker spring and stronger fall zooplankton signals) which may change the quality and timing of food availability for shrimp.*

*Bottom and surface temperatures are important drivers for the development of shrimp eggs and larvae, respectively. These variables have shown similar trends over the last 40 years, with a cold phase in the mid-1980s and 1990s, and a warm period in the late-1990s and early-2010s, but their trends have diverged since 2015. While warmer bottom temperatures led to above average bottom thermal habitat (2-4°C) in 2018 and 2019, colder surface waters since 2015 could have a negative impact on shrimp larval growth and survival.*

*Predation and fishing remain negatively correlated with subsequent shrimp per-capita net production in NAFO Divs. 2J3KL (SFA 7, 6, and southern part of SFA 5). The build-up of shrimp until the mid-2000s occurred during a period of favorable environmental conditions and reduced predation. Shrimp per-capita net production has declined since the mid-2000s, and is expected to remain around current low values for the next 2-3 years.*

*Under current ecosystem conditions (i.e. low shrimp biomass, high predation pressure), fishing at the current exploitation rate is unlikely to be a dominant driver for shrimp in NAFO Divs. 2J3KL (SFA 7, 6, and southern part of SFA 5), but it could now be more influential on stock declines than it may have been in the past.*

*Example 5:*

*The Newfoundland and Labrador climate experiences important fluctuations at decadal time scales, with potential impacts on ecosystem productivity. The Capelin collapse in 1990-91 and the recent declines (2015-17) were associated with cold periods, while the modest increases between the mid-2000s to mid-2010s were observed in generally warm periods. A modest increase in Capelin was observed (2013-15) in the warmer-than-average 2000s. This increase, however, was short-lived and followed by a colder period and return to low levels of Capelin. Since 2018, a warming trend has been observed……..(so….)*

*Higher nitrate inventories since approximately 2015 have resulted in improved primary (chlorophyll) and secondary (zooplankton biomass) production indices over the past four to five years. Ongoing changes in zooplankton seasonality and community structure (fewer large, energy-rich calanoids and more small copepods) may impact Capelin recovery. Increased summer and fall zooplankton biomass since 2016 may have contributed to the recent improvement of the fall adult Capelin condition index. However, Capelin larval productivity has remained low since 2014 despite an increase in abundance of a preferred prey (Pseudocalanus) over the same period.*

**Not Used**- There was no consideration of the environmental considerations affecting stock status.

Example 4 - If environmental variables were unknown: *The environmental conditions affecting the stock are currently* ***unknown****. Recent work has identified new information on the relationships between the biology of the fish (growth rates and age at maturation) and the environmental conditions (habitat and temperature). It is DFO’s intent to use this new information in the 2020 Framework Assessment to better inform DFO Science advice and the development of harvest strategies.*

Sources of Uncertainty: necessary explanations to avoid misinterpretation of information presented in the sections above. Key uncertainties and assumptions in stock status indicators, LRPs and stock status should be documented and communicated.

**Indigenous Perspectives**

**(Optional Sections) –** to turn on or off if you have this information

**Bycatch**

**Procedure for Interim Year Updates – if process if being set for the first time otherwise it will go in the Stock Overview Document**

PA Reference

DFO. 2016. Guidelines for providing interim-year updates and science advice for multi-year assessments. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2016/020