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Proceedings Series 2011/042 / **Compte rendu 2011/042**

Newfoundland and Labrador Region / **Région de Terre-Neuve et du Labrador**

Proceedings of the Newfoundland and Labrador Regional Advisory Process for the Recovery Potential Assessment of American Plaice *(Hippoglossoides platessoides)*, Newfoundland and Labrador Designatable Unit

Compte rendu du processus de consultation scientifique régional de Terre-Neuve et du Labrador sur l'évaluation du potentiel de rétablissement de la plie *(Hippoglossoides platessoides)* de l'unité désignable de Terre-Neuve et du Labrador

January 24-26, 2011
Battery Hotel and Conference Center
100, Signal Hill Road
St. John's, NL

Du 24 au 26 janvier 2011
Hôtel Battery et Centre des congrès
100, chemin Signal Hill
St. John's, T.-N.L.

Geoff Veinott
Meeting Chairperson

Geoff Veinott
Président de la réunion

Fisheries and Oceans Canada / Pêches et Océans Canada
Science Branch / Direction des sciences
P.O. Box / C.P. 5667, 80, chemin East White Hills Road
St. John's, NL / T.-N.L., Canada
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July, 2012 / **Juillet, 2012**

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings include research recommendations, uncertainties, and the rationale for decisions made by the meeting. Proceedings also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

Avant-propos

Le présent compte rendu a pour but de documenter les principales activités et discussions qui ont eu lieu au cours de la réunion. Il contient des recommandations sur les recherches à effectuer, traite des incertitudes et expose les motifs ayant mené à la prise de décisions pendant la réunion. En outre, il fait état de données, d'analyses ou d'interprétations passées en revue et rejetées pour des raisons scientifiques, en donnant la raison du rejet. Bien que les interprétations et les opinions contenus dans le présent rapport puissent être inexacts ou propres à induire en erreur, ils sont quand même reproduits aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considéré en tant que reflet des conclusions de la réunion, à moins d'indication précise en ce sens. De plus, un examen ultérieur de la question pourrait entraîner des changements aux conclusions, notamment si l'information supplémentaire pertinente, non disponible au moment de la réunion, est fournie par la suite. Finalement, dans les rares cas où des opinions divergentes sont exprimées officiellement, celles-ci sont également consignées dans les annexes du compte rendu.

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SUMMARY

A Regional Advisory Process (RAP) for the Recovery Potential Assessment (RPA) of American Plaice was held on 24-26 January 2011 at the Battery Hotel and Conference Centre, St. John's, NL. The requirement for a RPA is triggered when COSEWIC recommends an aquatic species as Threatened or Endangered. The purpose of the RPA is to provide information that will a) support development of scenarios for evaluating costs of recovery, b) inform public consultations, c) inform the decision on whether or not to list a species on Schedule 1 of *Species at Risk Act* (SARA) and d) assist the Recovery Team in developing a Recovery Strategy and/or Action Plan for the species if the listing recommendation is accepted.

Participants included DFO staff from Science (NL and Gulf Regions), Fisheries and Aquaculture Management (NL and National Capital Region), and Policy and Economics (NL Region), Newfoundland and Labrador Department of Fisheries and Aquaculture (DFA), the Marine Institute of Memorial University, World Wildlife Fund–Canada, Fisheries, Food and Allied Workers Union (FFAW) and Ocean Choice International (OCI). The meeting rapporteur was C.M. Miri.

These proceedings contain a summary of working papers, PowerPoint presentations, and other documentation available during the meeting; as well as summaries of related discussions. Also included as Appendices are the Agenda, Terms of Reference, list of participants and research recommendations.

Additional information on this RPA is available in the CSAS Research Document series and in the Science Advisory Report (SAR).

SOMMAIRE

Un processus de consultation régionale (PCR) pour l'évaluation du potentiel de rétablissement de la plie canadienne a eu lieu du 24 au 26 janvier 2011 à l'Hôtel Battery et au Centre des congrès de St. John's (Terre-Neuve-et-Labrador). Une évaluation du potentiel de rétablissement (EPR) doit être produite lorsque le COSEPAC recommande qu'une espèce aquatique soit désignée comme étant menacée ou en voie de disparition. Le but de l'EPR est de fournir de l'information qui servira : a) à soutenir l'élaboration de scénarios permettant d'évaluer les coûts liés au rétablissement; b) à documenter les consultations publiques; c) à éclairer le processus décisionnel menant à l'inscription ou non de l'espèce à l'annexe 1 de la *Loi sur les espèces en péril* (LEP); d) à aider l'équipe de rétablissement à élaborer un programme de rétablissement ou un plan d'action pour l'espèce si celle-ci est inscrite à la liste de la Loi.

Parmi les participants, mentionnons le personnel de la Direction des sciences (région du Golfe et région de Terre-Neuve-et-Labrador), de la Gestion des pêches et de l'aquaculture (région de la capitale nationale et région de Terre-Neuve-et-Labrador), de Politiques et économie et Communications (région de Terre-Neuve-et-Labrador) de DFO, du Ministère des Pêches et de l'Aquaculture de Terre-Neuve-et-Labrador, de l'Institut maritime de l'Université Memorial, du Fonds mondial pour la nature, de l'Union des pêcheurs de Terre-Neuve et de Ocean Choice International. Le rapporteur de la réunion était C.M. Miri.

Le présent compte rendu résume les documents de travail, les présentations PowerPoint ainsi que les autres documents présentés pendant la réunion et synthétise les discussions tenues à propos de ceux-ci. L'ordre du jour, les cadres de référence, la liste des participants ainsi que les recommandations en matière de recherche figurent en annexe du compte rendu.

De plus amples renseignements sur la présente EPR se trouvent dans les séries de documents de recherche et d'avis scientifiques du SCCS.

INTRODUCTION

A Regional Advisory Process (RAP) for the Recovery Potential Assessment (RPA) of American Plaice was held on 24-26 January 2011 at the Battery Hotel and Conference Centre, St. John's, NL. The requirement for a RPA is triggered when COSEWIC recommends an aquatic species as Threatened or Endangered. The purpose of the RPA is to provide information that will a) support development of scenarios for evaluating costs of recovery, b) inform public consultations, c) inform the decision on whether or not to list a species on Schedule 1 of SARA and d) assist the Recovery Team in developing a Recovery Strategy and/or Action Plan for the species if the listing recommendation is accepted.

The process followed guidelines of the Government of Canada for producing sound and effective advice, and was conducted following specific RPA Guidelines provided by DFO's Canadian Science Advisory Secretariat (CSAS).

Participants were welcomed by the Chair and provided with background on the RPA and CSAS process. The main purposes of the RAP were to review the science to be presented during the RAP and produce a Science Advisory Report (SAR). The Chair also provided a description of the Terms of Reference (TOR; Appendix II) for participants.

MEETING PROCEEDINGS

The meeting proceeded with presentations as per the Agenda but with one topic reordered; followed by associated discussions. This document has followed the order of the meeting.

REVIEW OF CURRENT AND RECENT STATUS

Presenter: Dr. Joanne Morgan, DFO Science Branch, NL Region

Abstract

The Newfoundland and Labrador DU is composed of three populations: SA2+Div. 3K, Div. 3LNO, and Subdiv. 3Ps. The Div. 3LNO population is by far the largest in this DU. The three stocks are managed separately, and there is very little connection between SA2+3K and 3Ps stocks. The last assessment for 3LNO American Plaice was conducted in June 2010.

Stock status was updated based on the number of mature adults from DFO RV survey data for SA2+Div.3K (data available for Div. 2J3K only) and Subdiv. 3Ps, and based on Virtual Population Analysis (VPA ADAPT) for Div. 3LNO. In Div. 2J3K, the number of adults declined steeply from the mid-1980s to 1995. The decline continued to about 2003. There has been some increase in the number of adults since 2005, but the average of the last 3 years remains at only 16% of the 1980-85 average. In Div. 3LNO, the number of adults declined steeply from the mid-1980s to 1995. There has been some increase since then, and the average number of adults in 2007-09 is 30% of the 1983-85 average. In Subdiv. 3Ps, the number of adults declined steeply; starting in the mid to late 1980s and reaching a minimum in 2002. The number of adults has increased since then, but the number in 2010 is estimated to be only 25% of the 1980-85 average.

The range of American Plaice was examined using the Design-Weighted Area Occupied (DWAO) from surveys in each area. In each of the 3 populations, this species occupied most of the area surveyed. The smallest proportion was 56% in Subdiv. 3Ps in 1994. More than 80% of the survey area is occupied in most years in all areas, and in many years more than 90% of the area was occupied. A significant change in the proportion of area occupied over the 1994-96 period may be due to the change in DFO RV gear (Engel to Campelen). The Campelen shrimp trawl is better able to catch small fish in both the Fall and Spring Surveys. There is no indication of a trend to decreased area occupied in recent years.

Bycatch of American Plaice SA2+3K stock, which has been under moratorium for directed fishing since 1994, is mainly taken in the Greenland Halibut fishery (Div. 2J3K). Bycatch has averaged about 35 tons since 1994, however in 2008 and 2009 bycatch was less than 10 tons. Bycatch of American Plaice Div. 3LNO stock, also under moratorium for directed fishing since 1994, mainly occurs in the Yellowtail Flounder, skate, and Greenland Halibut fisheries. Bycatch has averaged about 3600 t since 1994, however in 2000-04 averaged more than 6000 t. The Subdiv. 3Ps American Plaice stock has been under moratorium for directed fishing since September 1993, with bycatch mainly occurring in the Atlantic Cod fishery. The average bycatch has been approximately 575 t since moratorium. However, in 2001-03 bycatch averaged more than 1000 t.

American Plaice in all three populations are maturing at a younger age and smaller size. In SA2+Div.3K (Div. 2J3K data only), the age at 50% maturity (A50) declined from just under 11 years to around 7 years for females, and from around 7 to just under 4 for males. Length at 50% maturity (L50) has also declined. In Div. 3LNO, male A50 was around 6 at the beginning of the time series, and for recent cohorts has been about 4.5 years; while for females A50 has declined from about 11 to about 8 years. L50 has also declined in this population. In Subdiv. 3Ps, male A50 has declined from about 7 to less than 4.5 years; while female A50 has declined from about 11 to just under 9 years. As in the other two populations, L50 has also declined.

Fecundity data are available for only Div. 3LNO and Subdiv. 3Ps. Median relative fecundity (number of eggs per gram of whole body weight) was lower in Div. 3LNO and Subdiv. 3Ps for the earlier samples, but there was no significant difference in relative fecundity over time for either area.

Recruitment was estimated from survey data using relative cohort strength models for SA2+Div.3K (data for Div. 2J3K only) and Subdiv. 3Ps, and from VPA for Div. 3LNO. In Div. 2J3K, recruitment declined from the mid-1980s to the late 1990s. There has been an increase in recruitment since then. In Div. 3LNO, there was a long decline in recruitment from the 1970s to the mid-1990s. There has been some increase in recruitment since then, but it remains very low compared to the 1980s. In Subdiv. 3Ps, recruitment declined from 1980 until 1995. It increased fairly steadily since then, to reach levels similar to the beginning of the time series.

Total mortality (Z) was estimated from survey data for each area as Log (number at age 5-7 in year 1 divided by number at age 6-8 in year 2). In Div. 2J3K, the average Z was 0.45. Z has been above average for most years since 1989. This high level of mortality occurred despite very low commercial catches. The average Z in Div. 3LNO was 0.41. Z was above average in most years from the late 1980s to the mid-1990s, but has been greatly reduced since then. In Subdiv. 3Ps, the average Z was 0.43. Total mortality was quite variable, but was generally higher in the first half of the time series.

<u>Discussion</u>

A question arose as to the reliability of the commercial Div. 3LNO American Plaice bycatch estimates, and it was explained that they originate from the Northwest Atlantic Fisheries Organization's (NAFO) Scientific Council, whose sources are confidential beyond NAFO SC members. It was also noted that the recent decline in Canadian Yellowtail Flounder fishing in

Div. 3LNO caused the apparent decline in American Plaice bycatch, and the non-Canadian Greenland Halibut and skate fisheries have also declined.

COSEWIC's criteria for the listing of American Plaice as "threatened" was briefly discussed, and that the source of the threat (bycatch) has not ceased. It was also noted that B_{lim} (biomass below which serious harm occurs) is presently available for the 3LNO stock, and will be developed later for the SA2+3K and 3Ps stocks.

DFO's new policy document on the Precautionary Approach (PA) states that B_{lim} (a limit) should be avoided; while the target of B_{MSY} (biomass of Maximum Sustainable Yield) or above should be achieved. B_{lim} is a Recovery Target, and not a Target for the final population size. In terms of the PA, the B_{lim} is a milestone that is estimated and established by science. DFO then needs to assess where we are in relation to B_{lim}; irrespective of other management targets. This is a first step in the RPA process.

COSEWIC's assessment document on American Plaice cited three threats to the NL population: (1) Although directed fishing is under moratorium, poorly regulated bycatches are negatively influencing Plaice recovery; (2) fishing gears are size-selecting larger individuals; thereby negatively affecting the population's reproductive potential; and (3) natural mortality has increased, which reduces the population's ability to withstand fishing. At least two of these threats are amenable to fisheries management. It was agreed that these two threats should be addressed in the SAR's Threats and Mitigation section.

A question arose regarding the degree of Fisheries Observer coverage in fisheries where Plaice is a substantial bycatch. In Div. 3LNO, the Canadian fishery that takes the most Plaice is the Yellowtail fishery, which has 25% coverage in "sea days" (NAFO sets observer coverage levels outside of Canada's EEZ; was originally 100% coverage; then 50% coverage until recent years); the 2+3K Greenland Halibut fishery has very low coverage (5% or less); the 3Ps offshore Witch Flounder fishery in recent years has 50% coverage. A participant felt that for <65 ft. vessels, dockside monitors capture 100% of the landings in NL. Yet another view was that this is actually not the case as not all NL landings are dockside monitored, because they can be landed in other ways (e.g., Authorizations) that are not monitored. However, the point was made that there is confidence in the Canadian catch data for American Plaice.

REVIEW OF HABITAT USE

Presenter: Dr. Joanne Morgan, DFO Science Branch, NL Region

<u>Abstract</u>

American Plaice in the Newfoundland and Labrador DU are widely distributed (often occupy more than 80% of the area). They have a broad temperature distribution/tolerance, and are distributed over a broad range of depths. They are found on all substrate types in the area. They are opportunistic feeders; with prey type depending on their size and what is available. They spawn over a broad area. They have no residence as defined in SARA. Juveniles are somewhat more restricted in their substrate and depth distribution than adults, but still occur widely. Given the extent of distribution of American Plaice in the Newfoundland DU, it is likely that, while habitat preference appears to exist for this species, the range of habitats that can be occupied covers the entire area. The main threats to habitat are bottom trawling, and oil and gas development. However, given the wide distribution of American Plaice, it is unlikely that threats will alter habitat enough to limit recovery. There are no known spatial configuration constraints. How the biological function(s) that specific habitat(s) provide to the species varies with the state

or amount of the habitat is not known. However, American Plaice are widely distributed, and habitat availability is not likely to be a limiting factor in their recovery.

Discussion

It was noted that "climate change" was not addressed in this RPA.

In the Gulf of St. Lawrence, American Plaice seek the coldest water during Summer. However, NL waters are always cold therefore seeking out colder temperatures is not a factor for Plaice in this region.

A question arose regarding whether bottom trawling has any effect on the habitat of this species, and the author noted that there has been no indication of it; given that Plaice often live in locations of disturbance (e.g., ice scours; wave action; non-protected locations).

There was a discussion regarding Critical Habitat (CH). It was suggested that ToR #15 may not apply to marine species with wide distributions (geographically). However, as per COSEWIC criteria, all assessed species must have "CH" addressed. Allocations to particular areas will eventually be made by managers, and proportions per location necessary for the recovery of each species will be decided upon. It was also pointed out that habitat for marine species at the scale of a fish cannot be surveyed; given the scale (50,000 times larger) at which DFO Research Vessel (RV) surveys are conducted, making the determination of CH for species such as American Plaice very difficult. The meeting decided that wording in the SAR should state that there has been no evidence to suggest any CH for Plaice; as this species is widely distributed.

REVIEW OF THREATS AND MITIGATION

Author: FAM, DFO NL Region
Presenter: Joanne Morgan, DFO Science, NL Region

Abstract

The primary factor thought to be responsible for the decline of American Plaice stocks is overfishing, although there is some suggestion that increased natural mortality may also have played a role; particularly in Div. 2J3K and Div. 3LNO. Inability to enforce bycatch limits of Newfoundland Plaice stocks, including foreign fisheries on the Grand Banks, is regarded as the greatest impediment to recovery of these stocks. There are several measures that could mitigate this bycatch. These include:

- Application of a Bycatch Protocol; in addition to measures included in CHPs (e.g., gear type; mesh size; % or weight of allowable incidental catches per trip in certain areas or during certain times of year).
- Adoption of more stringent requirements, when necessary, for the management, control and monitoring of bycatch in other directed fisheries.
- Increase Observer coverage in directed groundfish fisheries when (and where) the bycatch is likely to be high.
- Conduct a review, in conjunction with industry, of additional measures such as seasonal closures or gear restrictions to address by-catch issues.
- Mandatory hail out.
- Completion of log books.
- Expansion of the requirement for Vessel Monitoring Systems (VMS).
- Compliance monitoring activities (e.g., Conservation & Protection Patrols, Dockside Inspections, At-Sea Inspections, and Aerial Surveillance).

Survivorship can be increased by decreasing bycatch. The amount of increase will depend on the amount of reduction in fishing mortality.

Discussion

It was suggested by an industry representative that bycatch of American Plaice offshore in Div. 3LNO should be controlled (focus to reduce catch below 3, 500 tons – or desired level – outside the EEZ) to help reduce the decline. NAFO Fisheries Commission sets the management measures for Div. 3LNO outside Canada's EEZ, and DFO FAM follows those measures.

A question arose concerning whether oil and gas exploration/production was addressed as a "threat" for Plaice in this RPA. The author replied that the only threat with known magnitude is fishing, and that Plaice mortality due to oil and gas activities was not investigated for this RPA.

REVIEW OF PRODUCTION MODELS

Presenter: Dr. Jason Bailey, DFO Science Branch, NL Region

Abstract

Population dynamics of American Plaice biomass were modeled using a Bayesian state-space implementation of the Schaefer Surplus-Production (BSP) model for stocks in NAFO Div. 3LNO, Subdiv. 3Ps, and Div. 2J3K using DFO RV survey and commercial catch data from 1960-2009. Several models were tested and included versions using the entire time series in the estimation of population parameters, as well as models dividing the series into 2-3 periods; in order to explore the possibility that productivity has changed in the populations. Upon examination of these models, evidence did not warrant the acceptance of a more complex model in favour of a simpler one using only one time period. Therefore, models using the entire time series (1960-2009) were accepted and used here. Models were fitted to the data and forecasted 48 years (3 generations) using several scenarios of fishing mortality based on *F* for Div. 3LNO, Subdiv. 3Ps, and Div. 2J3K.

The stock in Div. 3LNO is relatively the largest in biomass and area covered. Regarding estimated carrying capacity (K), Div. 3LNO is approximately five times larger than the next largest stock (Div. 2J3K), and about seven to eight times that of Subdiv. 3Ps. An accepted age-based Virtual Population Analysis (VPA) was used for comparison of historical biomass trends for Div. 3LNO. The median biomass estimated using the BSP model followed the trends seen in the VPA.

Parameters for K, r (intrinsic rate of population growth), BMSY (Biomass at maximum sustainable yield), and MSY (maximum sustainable yield) were estimated for each stock using the BSP model. Posterior distributions of these parameters were consistent with what would be expected based on prior knowledge. Previous research suggested that catch was not the driving force behind a significant decline in the Div. 2J3K stock, and that perhaps other sources of mortality (*i.e.,* M or natural mortality) played a large role in this decline. This is reflected in the very low productivity parameter estimate for this stock (r=0.05).

Discussion

A question arose regarding which data the Div. 3LNO Bayesian Surplus Production Model (SPM) was fitted to. A new plot was requested, using all five indices for the Div. 3LNO model scaled by their means; in order to examine the input data to this Bayesian SPM.

A concern was, given the relatively high "r" (0.2) plus the low fishery removals (since the mid-1990s) during this timeframe, whether the Bayesian Surplus Production Model for Div. 3LNO used "process errors" to keep the Plaice (virtual) population down to fit the input indices. Did the early data, especially the stable population during the 1970s and 1980s under relatively high fishing mortality, cause an erroneously high "r"? It was suggested that, to investigate this, indices for the last 10 years (2000-2009) be removed from the Bayesian SPM, and subsequent projections for that period then be compared to what actually happened in this timeframe. This was done, and the model then predicted a significantly large increase in the Div. 3LNO Plaice stock, which did not actually occur. However, what was actually observed in the Plaice population fell between the model's 95% credible intervals, and the indices removed (2000-2009) represented a period of low productivity. This issue was explored further by dividing up the 1960-2009 input data of the first model into 3 periods: 1960-1988; 1989-1996 (period of high natural mortality); and 1997-2009. To remove the influence of the second time period in the Div. 3LNO model, "r" was estimated for the 1st and 3rd time periods (combined = r_1) and separately for the 2nd (middle = r_2) period before projections. "r" was also estimated for each of the three time periods (r_1; r_2; r_3) before projections. After examining results of these explorations, the author decided to choose the first (single period) model for Div. 3LNO Plaice. The deviance information criteria was lowest for the first SPM when compared to all of the other models, and population projections for Div. 3LNO Plaice will come from VPA.

A question arose regarding the "process errors" of the Div. 3LNO SPM: Did they indicate a trend, or were they just random? Was process error large? It was noted that Bayesian modeling entails process errors that clean-up stuff which the model does not use; so what biologically has been cleaned up by this SPM? It could possibly be changes in natural mortality. A comment was that DFO has a low level of statistical expertise in this area: Science is trying to determine what is a "good model fit" and what is a "bad model fit".

It was recommended that a "prior" for "r" should be developed from life history parameters (new paper on how to do this now in press).

REVIEW OF POPULATION PROJECTIONS FOR NAFO DIV. 3LNO, SUBDIV. 3Ps, AND SUBAREA 2+DIV. 3K
Presenter: Dr. Jason Bailey, DFO Science Branch, NL Region

Abstract

Projections for each of the three stocks were made for 48 years. At F=0, all stocks showed increasing biomass, with Div. 3LNO and Subdiv. 3Ps increasing to carrying capacity over this time period. However, the Div. 2J3K stock increased at an extremely slow rate, and did not near the estimate of carrying capacity; even after 48 years with no fishery removals. The BSP projections for Div. 2J3K showed widening 95% credible intervals, which encompass an enormous range of possibilities after only 5-10 years of projection. Beyond this timeframe, estimates should be interpreted with extreme caution. At $F_{allowable\ harm,}$ the median biomass for Subdiv. 3Ps and Div. 2J3K decreased by the acceptable percentage (30% decline after 3 generations); above which the stock is designated as "threatened" by COSEWIC. However, the lower 95% credible interval (*i.e.,* worst case scenario with 95% certainty) decreased by nearly 100% over this time period. At $F_{current}$, stocks in Subdiv. 3Ps and Div. 2J3K showed patterns similar to those seen for projections at F=0: a result which was not surprising, given that $F_{current}$ is nearly at F=0 for both stocks (F=0.025 for Subdiv. 3Ps; F= 0.0006 for Div. 2J3K).

Discussion

A question regarding whether a multivariate distribution was used in Bayesian SPMs for developing projections for SA 2+3K (Div. 2J3K) and separately for Subdiv. 3Ps stocks. It was noted that “r” and “K” are usually highly correlated in SPMs, and that running them in WinBUGS takes this correlation into account. The model had been run in WinBUGS, and the author made the projections programme (R code) available to participants for review.

Agreement was reached that, beyond a timeframe of 10 years, populations projections should be interpreted with extreme caution. A comment was also made that the requirement for 48-year projections in this RPA process is completely unrealistic and inherently dangerous as input to managers' decisions concerning listing any marine fish species.

A participant clarified a species listing issue: the fishery on each Plaice stock will not be managed by setting F; but rather by setting a Total Allowable Catch (TAC) or allowing a bycatch. From a species at risk perspective, one must bear in mind that the risk of population extinction is not addressed by this model. The economists and sociologists will be using these population projection results as input to whether or not to list this species under Canada's SARA, and may say that Plaice cannot go extinct under a range of fishing mortality rates. However, Science knows that there is definitely a risk of extinction for Plaice at this level of fishing mortality, and this knowledge should be included in the SAR.

STOCHASTIC PROJECTION OF VPA RESULTS, AMERICAN PLAICE IN NAFO DIVS. 3LNO
Presenter: Brian Healey, DFO Science Branch, NL Region

Abstract

The 2010 VPA assessment of American Plaice in NAFO Divs. 3LNO was projected forward 48 years, presumed to be 3 generations. Estimated survivors in 2010 were randomly varied, as were: future recruitment, weights at age, proportion mature at age, selectivity at age and natural mortality. Random recruitment was resampled from historic (i.e. VPA) recruitment within three spawner biomass intervals. To resample other projection parameters, a 'backward expanding window' approach was employed. (Complete technical specifications are provided in Morgan et al., 2011). Decline rates of biomass, numbers mature and spawning biomass were computed over each possible 48 year period. The projections were conducted at fixed fishing mortality rates of F=0, current fishing mortality levels (FCurr), and 50% of FCurr. If fishing mortality is eliminated, the population rapidly increases above Blim, and remains well above the reference point for the entire projection period. If fishing mortality remains constant at FCurr, however, the population declines after a modest short-term increase, with a high probability of remaining below Blim for the projection period. If fishing mortality is reduced to half of FCurr, the projections indicated a period of stability, followed by substantial increases. The probability that SSB was below Blim was low. To assist in determining what the allowable harm level might be, subsequent projections with alternate fishing mortalities were also considered. Although the definition of maximum allowable harm is not specific, consideration was given to the levels of decline which may lead to this population no longer being designated as threatened. Concerns were raised on the length of the projection period, and also with large increases in SSB for ages 15+ in the projection results. Results of the age-based projection of VPA estimates and that from a surplus production model were compared with results indicating general similarity.

Discussion

This VPA model for Plaice in Div. 3LNO was presented to and accepted by NAFO Scientific Council at its June 2010 Meeting; including the projections for various fisheries management options.

The author mentioned that this VPA model is age-based (unlike SPMs) using ages 5-15 and a "+ group", began with the year 1960 so 2008 was the first 48-year window available, and was run for 10,000 iterations. A definition of "F_{max_harm}" was also requested; in order for the author to accurately compute it then present results for review during this meeting.

Random variation was in the model's starting values; so each projection used the variances (not covariances)of the estimated population size in 2010; the VPA did not use "bootstrapping".

Although possibly unnecessary for the RPA process, a suggestion was made to look at the uncertainty in the "unconverged" portion of the VPA model as a refinement to this analysis, and may be most useful for "F_{max_harm}".

It was noted that an earlier framework meeting on Atlantic Cod addressing how to generate its population projections lead to this accepted method (including using a "backward window") then being employed on the American Plaice stock in Div. 3LNO.

As a cautionary note to everyone interpreting these VPA results, the author pointed out that there is a large increase in the number of fish in the plus group as the projections cover more year. The number of recruits to the "plus" group begins overtaking and rapidly increasing over the number of older fish that are dying due to natural mortality.

A question arose regarding how these "plus" group projections compare to the historic percentages of the "plus" group in the 1960s and 1970s. An initial response is that at the beginning of the time series, it was just under 30%; then declined to approximately 20% in the early 1970s; and fell to its lowest at 4% during the period of really high M and high F (1989-1996). Essentially, the earliest "plus" group never reached 40% in the time series; but it was 30%. It was also pointed out that Plaice at the beginning of the time series were maturing at age-11; but as the VPA model moved forward, this species were maturing at progressively younger ages. The selectivities were resampled by using a "backwards window". The fishing mortality on the "plus" age was also assumed to be the same as that estimated for the last true age; just like in the VPA.

A question arose concerning whether a decrease in the age of maturity would lead to a decrease in longevity for Plaice in the "plus" group. Potentially it could, but natural mortality is assumed to be 0.2 in the model; except for the 1989-1996 timeframe.

The choice of the "plus" group as >15 years was clarified. This decision originated back in 1999 when VPA was brought back into use by DFO – NL Science for population projections, and the "plus" group was >Age-17 at that time. This original "plus" group was too small in numbers caught-at-age (probably also too small in survey indices); so this group then had to be collapsed to >Age-15. It was also noted that "plus" group Plaice are still being caught in DFO RV surveys.

It was reiterated that long-term projections for a population are ill-advised (and projecting over 48 years is totally unrealistic; and not encouraged for input to managers' decisions), and that such a timeframe is far too long to adhere to even the smallest degree of certainty. Uncertainty increases progressively with projections moving into 48 years. Beyond 5-8 years projections, the population results are mostly driven by the recruitment assumption used in the model.

Clarification was given on B_{lim} for Plaice in Div. 3LNO. It is 50,000 tons, and is set by NAFO. B_{lim} is the Spawning Stock Biomass (SSB) below which serious harm to the population occurs.

A question arose regarding whether the mandate of this meeting included discussing and deciding on the long-term timeframe for population projections required by the RPA process. A participant explained that a DFO meeting held a number of years ago at in Ottawa addressed this timeframe issue in detail, and emphasized the fact that "process errors" dominate long-term projections; thereby distorting results.

Plaice bycatch limits in the Yellowtail Flounder fishery have just been increased to 15%. Projections in the 2009 Plaice assessment were promising; but , not as optimistic in the 2010 assessment in terms of the stock's proximity to B_{lim}. This is due to a whole series of issues (e.g., additional input data; changes in some input data; some errors in some data); not just any one issue. However, the recent increase in Plaice bycatch limits has not affected the Div. 3LNO stock, because catches in the Yellowtail fishery have recently been low. In comparison, most total catches for Div. 3LNO in 2006-08 were by foreign vessels (e.g., = 7 times the Canadian catch in 2007; = 2 times the Canadian catch in 2008), but Canada then took 1,077 tons of a total of approximately 3,000 t caught in 2009 (2010 total catches are not yet available). It was noted that if the new Yellowtail TAC of 17,500 t is taken, then the outlook for Div. 3LNO Plaice will be more pessimistic. It was also noted that TAC for the Greenland Halibut fishery has also been increased slightly for 2011 (highest it has been since 2006). Plaice is also a bycatch in this fishery.

With respect to stock-recruit models, it was clarified that the same method employed here for Div. 3LNO Plaice was previously used at NAFO for similar types of projections with other species; but no single stock-recruit model has yet to be accepted.

An important cautionary note for managers and decision-makers was given, concerning all of the projection models presented during this RPA meeting. Do not simply use the median generated by each model while ignoring all other results; such action would be scientifically/biologically unacceptable. Instead, use the whole distribution of projections from each model, which is very wide.

REVIEW OF COMBINED DESIGNATABLE UNIT (DU) PROJECTIONS

Presenter: Dr. Joanne Morgan, DFO Science Branch, NL Region

Abstract

The results of the projections for each of the populations were combined to examine trends for the entire DU. An examination of the biomass from surveys showed that in the 1980's (before the major decline in the late 1980s that occurred in all of these stocks) the biomass in Div. 3LNO was 5 times that in Div. 2J3K and 9 times that in Subdiv. 3Ps. The ratios of biomass from the surplus production modelling for Div. 2J3K and Subdiv. 3Ps and VPA for Div. 3LNO were similar. To produce the result for the DU combined the results for each population were combined in a weighted average where the weightings were based on the relative population sizes in the 1980's (weightings: Div. 3LNO 1, SA 2+Div. 3K 0.2, Subdiv. 3Ps 0.11).

For the DU as a whole, results of projections of population biomass over 48 years at current fishing mortality range from an increase of more than 7 times to a decrease in biomass to reach

less than 50% of the biomass in 2009. Most of the range encompassed by the 95% of the results is above the level of biomass at the beginning of the projection period. It should be noted that current F varies greatly across the different populations with Fcurrent=0.0005 in SA 2+Div. 3K, 0.172 in Div. 3LNO and 0.025 in Subdiv. 3Ps. There is no B_{lim} for the DU as a whole.

For the DU as a whole there is a substantial increase in biomass over 48 years with an F=0.

Since current F was so small for SA 2+Div. 3K, no projection at half of current F was conducted for that stock. This meant that results were not combined for the DU as a whole.

The determination of allowable harm was conducted for each population separately and not combined for the DU as the level of F that can be sustained will be very different for the different populations.

Discussion

Although all analyses for this Plaice RPA were conducted separately for the three stocks, the author combined projections into one "Designatable Unit" (DU) for the Newfoundland and Labrador waters. However, future Plaice assessments will not be presented as one DU, because these three stocks will continue to be managed as separate entities (especially Div. 3LNO which is managed by NAFO Fisheries Commission).

Concerning the issue of having considered Plaice as one DU, it was clarified that the two Div. 3LNO models (VPA; Bayesian SPM) themselves cannot be combined for 1 DU; instead, results of both models based on relative population sizes (common currency was biomass) were combined. There was also no B_{lim} for Subarea 2+3K, nor for Subdiv. 3Ps. Furthermore, the "allowable harm" F could not be calculated for one DU, due to sustainable F being very different for the three stocks, and the right combination of Fs for projection modeling cannot be found.

A question arose regarding how COSEWIC decided on one DU for American Plaice. It was not done through population modeling. COSEWIC combined Div. 2J3K and Subdiv. 3Ps using a Generalized Linear Model (GLM) with DFO RV survey data and a VPA on Div. 3LNO (all weighted by area) to produce one DU. It was pointed out that weighting by population size was superior to weighting by area, because density of fish is not the same in all areas: for example, a small amount of fish in a large area would receive more weight than a large amount of fish in a small area. COSEWIC prefers to use only DFO survey data (or other data) for determining decline rates rather than models. However, the value of combining results into one DU is to help the Minister of the Department decide whether to list American Plaice under SARA.

An important cautionary note for managers and decision-makers was reiterated. It was advised that managers not only look at the median line on a projection graph but consider the entire level of spread of the population projections as they indicate the risk profile under projection assumptions. The meeting decided to remove the median line from any projection figure.

A question arose regarding what happens if one of the separate Plaice stocks goes extinct. COSEWIC assumes that the other two stocks will repopulate the extinct area. Extinction probably does not apply to the Div. 3LNO stock at this time. Although extinction was not in the RPA TOR, it was discussed further because these Plaice models do not go to "zero"; thereby giving a false impression that fish stocks cannot go to zero.

DISCUSSION AND REVIEW OF TOR PROTOCOL POINTS (SAR DRAFTING)

Document Title: Recovery potential assessment of American Plaice (*Hippoglossoides platessoides*) in Newfoundland and Labrador Draft SAR presented by Dr. Joanne Morgan

Discussion

The participants decided to focus the SAR on the separate models for each of the three Plaice stocks; although the combined results for one DU will be presented.

A question arose concerning a population decline of less than 30% being a "target". It was clarified that this is the COSEWIC-threshold to declare a species as "threatened", and that if a decline by less than 30% occurs over 3 generations, then the species is no longer threatened. In DFO's new Sustainable Fisheries Framework policy, "target" is where Science wants the stock to be (in a healthy zone; B_{MSY}), and "limit" is what fisheries managers should avoid (B_{lim}; the boundary between the cautious and the critical zones). B_{lim} should never become a "recovery target" for any species. It was noted that "recovery targets" for a species are determined by FAM. It should be noted in the SAR that a goal of 30% decline is not satisfactory; instead, DFO should be trying to reduce or reverse a stock decline. A further decline in a population (even under 30%) is not a recovery; nor is it an improvement.

The clarity of COSEWIC's criteria for "delisting" a species was debated. There was no agreement on this issue and further clarification is required. Concern was also raised that if the 3-generation "window" was moved backwards into historical data, then at least a 30% population decline would readily appear; whereas if this "window" is used, for example, in 20 years time (2030), then a 30% decline would probably not be seen because of a low population level over 3 generations in the latter timeframe.

The format of population projection figures for the SAR was discussed. It was recommended that managers should only use the first 5 years of projections with some degree of certainty, and not base their decisions on any projections after that period.

From a scientific perspective, it was pointed out that a probabilistic statement cannot be made about the population (relative to B_{lim}) 48 years into the future. It must be noted in the SAR that distributions of the model projection runs are not symmetrical; with different implications for each projection run. The take away should be that for the Div. 3LNO stock with respect to the B_{lim} reference level, Fcurrent is too high.

"Critical habitat" (CH) was discussed further, and it was agreed that there is currently no evidence for Plaice CH and that it cannot be defined for the NL DU; although if Plaice becomes listed by COSEWIC, then there will be a requirement to define CH for this species.

A question arose regarding threats to Plaice from oil and gas exploration through seismic testing and sea floor drilling. It was mentioned that seismic activity probably has no effect on Plaice adults, while larvae may be affected; but there have been no direct studies of seismic effects on American Plaice. Effects of drilling the sea floor can spread beyond just the localized drill action; especially if leaks occur.

Climate change effects on Plaice in the NL DU were discussed. It was not known whether NL marine waters are predicted to increase in temperature due to "climate change", or to decrease. It was noted that model projections are somewhat robust to environmental changes that have occurred in the past; but would not be to new types of changes in the future. It was decided that terminology in the SAR will be “large-scale environmental change” (geographically and in magnitude); rather than simply “climate change”. Although habitat is probably not a limiting factor on Plaice stocks, the quality of Plaice habitat was not known; in addition to how it would be affected by environmental changes.

Including a summary bullet in the SAR on uncertainties in the commercial catch data was discussed. The uncertainty in catch data is unknown, for example, there is always uncertainty with DFO’s Zonal Interchange Format (ZIF) Canadian landings data; NAFO’s Scientific Council were not able to reach a conclusion in one particular year. It was pointed out that catch is an important component to modeling fish populations, and that catches should not be thrown out when no concrete reason(s) can be found to indicate a problem with these data. The meeting decided not to include a summary bullet in the SAR on catch data uncertainty.

APPENDIX I – Meeting Agenda

DFO Regional Advisory Process
Recovery Potential Assessment of American Plaice,
Newfoundland and Labrador Designatable Unit (DU)

Riverhead Room, Battery Hotel, 100 Signal Hill Road, St. John's, NL
January 24-26, 2011

Chairperson: Dr. Geoff Veinott, Salmonids Section, DFO, NL Region

Time (Jan 24, 20111)	Agenda Item	Presenter
0845-0900 h	Participant arrival and room setup	
0900-0930 h	Introductions and opening remarks	**Geoff Veinott**
0930-1030 h	Current and recent status, including trends in biological parameters and distribution	**Joanne Morgan**
1030-1050 h	**Break**	
1050-1200 h	Discussion Current and recent status	**All Participants**
1200-1300 h	**Lunch**	
1300-1315 h	Habitat Use	**Joanne Morgan**
1315-1345 h	Discussion Habitat Use	**All Participants**
1345-1415 h	Threats and Mitigation	**Joanne Morgan**
1415-1445 h	Discussion Threats and Mitigation	**All Participants**
1445-1500 h	**Break**	
1500-1600 h	Production Model	**Jason Bailey**
1600-1700 h	Discussion Production Model	**All Participants**
Jan 25 2011	**DAY 2**	
0845-0900 h	Participant arrival and room setup	
0900-0915 h	Introductions and opening remarks	**Geoff Veinott**
0915-1030 h	Population Projections Div. 3LNO	**Brian Healey**
1030-1050 h	**Break**	
1050-1200 h	Discussion Population Projections Div. 3LNO	**All Participants**

1200-1300 h	**Lunch**	
1300-1345 h	Population Projections Div. SA2 plus Div. 3K SubDiv. 3Ps	**Jason Bailey**
1345-1445 h	Discussion Population Projections Div. SA2 plus Div. 3K SubDiv. 3Ps	**All Participants**
1445-1515 h	Combined DU projections	**Joanne Morgan**
1515-1530 h	**Break**	
1530-1630 h	Discussion Combined DU projections	**All Participants**
Jan 26 2011	**Day 3**	
0845-0900 h	Participant arrival and room setup	
0900-0915 h	Introductions and opening remarks	**Geoff Veinott**
0915-1630 h	Production of Science Advisory Report	**All Participants**

APPENDIX II – Terms of Reference

Recovery Potential Assessment for American Plaice (Newfoundland and Labrador Designatable Units)

Regional Advisory Process

January 24-26, 2011
St. John's, Newfoundland

Chairperson: Geoff Veinott

Context:

When the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designates aquatic species as threatened or endangered, Fisheries and Oceans Canada (DFO), as the responsible jurisdiction under the Species at Risk Act (SARA), is required to undertake a number of actions. Many of these actions require scientific information on the current status of the species, population or designatable unit (DU), threats to its survival and recovery, and the feasibility of its recovery. Formulation of this scientific advice has typically been developed through a Recovery Potential Assessment (RPA) that is conducted shortly after the COSEWIC assessment. This timing allows for the consideration of peer-reviewed scientific analyses into SARA processes including recovery planning.

The Committee on the Status of Endangered Wildlife in Canada has designated the American Plaice DU, Newfoundland and Labrador (April 2009) as Threatened. This species is not currently listed under the Species at Risk Act (SARA).

In support of listing recommendations for American Plaice by the Minister, DFO Science has been asked to undertake an RPA, based on the National Frameworks (DFO 2007a and b). The advice in the RPA may be used to inform both scientific and socio-economic elements of the listing decision, as well as development of a recovery strategy and action plan, and to support decision-making with regards to the issuance of permits, agreements and related conditions, as per section 73, 74, 75, 77 and 78 of SARA. The advice generated via this process will also update and/or consolidate any existing advice regarding the American Plaice DU that has been assessed as Threatened by COSEWIC: Newfoundland and Labrador.

Objectives

- To assess the recovery potential of American Plaice DU: Newfoundland and Labrador.

Assess current/recent species/American Plaice status

1. Evaluate present American Plaice status for abundance (i.e., numbers and biomass focusing on matures) and range and number of populations for the DU.

2. Evaluate recent species trajectory for abundance (i.e., numbers and biomass focusing on matures) and range and number of populations for the DU.

3. Estimate, to the extent that information allows, the current or recent life-history parameters for American Plaice (total mortality, natural mortality, fecundity, maturity, recruitment, etc.) or reasonable surrogates; and associated uncertainties for all parameters.

4. Estimate expected population and distribution targets for recovery, according to DFO guidelines (DFO 2005) and based on the limit reference points, where available, developed under the Precautionary Approach Framework.

5. Project expected American Plaice population trajectories over 48 years, which represents at least three generations for all populations, and trajectories over time to the recovery target (if possible to achieve), given current American Plaice population dynamics parameters and associated uncertainties using DFO guidelines on long-term projections (Shelton *et al.* 2007). See Annex 1 for details.

6. Evaluate **residence requirements** for the species, if any.

Assess the Habitat Use of American Plaice

7. Provide functional descriptions (as defined in DFO 2007b) of the properties of the aquatic habitat that American Plaice needs for successful completion of all life-history stages.

8. Provide information on the spatial extent of the areas in American Plaice's range that are likely to have these habitat properties.

9. Identify the activities most likely to threaten the habitat properties that give the sites their value, and provide information on the extent and consequences of these activities.

10. Quantify how the biological function(s) that specific habitat feature(s) provide to the species varies with the state or amount of the habitat, including carrying capacity limits, if any.

11. Quantify the presence and extent of spatial configuration constraints, if any, such as connectivity, barriers to access, etc.

12. Provide advice on how much habitat of various qualities / properties exists at present.

13. Provide advice on the degree to which supply of suitable habitat meets the demands of the species both at present, and when the species reaches biologically based recovery targets for abundance and range and number of populations.

14. Provide advice on feasibility of restoring habitat to higher values, if supply may not meet demand by the time recovery targets would be reached, in the context of all available options for achieving recovery targets for population size and range.

15. Provide advice on risks associated with habitat "allocation" decisions, if any options would be available at the time when specific areas are designated as Critical Habitat.

16. Provide advice on the extent to which various threats can alter the quality and/or quantity of habitat that is available.

Scope for Management to Facilitate Recovery of American Plaice

17. Assess the probability that the recovery targets (see Annex 1) can be achieved under current rates of American Plaice population dynamics parameters, and how that probability would vary with different mortality (especially lower) parameters.

18. Quantify to the extent possible the magnitude of each major potential source of mortality identified in the pre-COSEWIC assessment, the COSEWIC Status Report, information from DFO sectors, and other sources.

19. Quantify to the extent possible the likelihood that the current quantity and quality of habitat is sufficient to allow population increase, and would be sufficient to support a population that has reached its recovery targets.

20. Assess to the extent possible the magnitude by which current threats to habitats have reduced habitat quantity and quality.

Scenarios for Mitigation and Alternative to Activities

21. Using input from all DFO sectors and other sources as appropriate, develop an inventory of all feasible measures to minimize/mitigate the impacts of activities that are threats to the species and its habitat (Steps 18 and 20).

22. Using input from all DFO sectors and other sources as appropriate, develop an inventory of all reasonable alternatives to the activities that are threats to the species and its habitat (Steps 18 and 20).

23. Using input from all DFO sectors and other sources as appropriate, develop an inventory of activities that could increase the survivorship parameters (Steps 3 and 17).

24. Estimate, to the extent possible, the reduction in mortality rate expected by each of the mitigation measures in step 21 or alternatives in step 22 and the increase in survivorship associated with each measure in step 23.

25. Project expected population trajectory (and uncertainties) over 48 years, which represents at least three generations for all stocks, and to the time of reaching recovery targets when recovery is feasible; given mortality rates associated with specific scenarios identified for exploration (see Annex 1). Include scenarios which provide as high a probability of survivorship and recovery as possible for biologically realistic parameter values.

26. Recommend parameter values for starting mortality rates, and where necessary, specialized features of population models that would be required to allow exploration of additional scenarios as part of the assessment of economic, social, and cultural impacts of listing the species.

Allowable Harm Assessment

27. Evaluate maximum human-induced mortality which the species can sustain and not jeopardize survival or recovery of the species.

Expected Publications

- CSAS Science Advisory Report
- CSAS Proceedings of meeting
- CSAS Research Document(s)

Participation

DFO Science, Ecosystems and Fisheries Management, Oceans, Habitat and Species at Risk, Policy and Economics, Aboriginal Communities, Provinces, Industry, Non-governmental organizations and Other Stakeholders will be invited to participate in this meeting.

References:

COSEWIC. 2009. COSEWIC assessment and status report on the American Plaice *Hippoglossoides platessoides*, Maritime population, Newfoundland and Labrador population and Arctic population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 74 pp.

DFO. 2005. A framework for developing science advice on recovery targets for aquatic species in the context of the Species at Risk Act. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2005/054.

DFO. 2011. A Complement to the 2005 Framework for Developing Science Advice on Recovery Targets in the Context of the *Species At Risk Act*. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/061.

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Shelton, P.A., B. Best, A. Cass, C. Cyr, D. Duplisea, J. Gibson, M. Hammill, S. Khwaja, M. Koops, K. Martin, B. O'Boyle, J. Rice, A. Sinclair, K. Smedbol, D. Swain, L. Velez-Espino, and C. Wood. 2007. Assessing recovery potential: long-term projections and their implications for socio-economic analysis. DFO Can. Sci. Advis. Sec. Res. Doc. 2007/045.

Annex 1. Elements of Discussion for Projection Scenarios

The following elements will be considered to draft recovery target scenarios in order that enough details are provided so that it removes uncertainty on what has to be done.

1. Projection horizon
   - Given that the COSEWIC/IUCN decline "A" criterion make reference to 10 years or 3 generations whichever is longer, projections should expand over at least 3 American Plaice generations.1 Generation time is defined as the average age of parents in a population, the length of this time period for all stocks is 16 years. American Plaice generation time is meant to be estimated in such a way that it reflects pre-fished states by adding the 'typical' age at first maturity (age at 50% maturity) observed as long ago as we have data for (for each stock of American Plaice) and then adding to that age the value of (1/M), where M is the instantaneous rate of natural mortality (M=0.2).

2. Possible population targets to measure progress against it and likelihood of success using projections according to the scenarios regarding fishing mortality (see #4 below)

   SARA Targets:

   To satisfy COSEWIC's assessment criteria to declare that a species is not threatened (or of it becomes special concern), i.e. that it does not require a SARA recovery strategy. This can be done using Criterion "A" rate of decline in total number of mature individuals thresholds (see Table 1 below). By default, this is normally what should be done at a minimum.

   Management Targets:

   Use the limit reference point from the PA framework as a target for rebuilding, where available. This corresponds to $B_{lim.}$

3. Possible Scenarios for Fishing Mortality (natural and human induced):

   The fishing mortality scenarios will be different depending on the DUs. It should also be noted that Economics will need to provide input as they will need to determine specific activities on specific fleets for each DU. Economics would determine the most cost-effective way to find reductions in mortality. Therefore, there needs to be a back and forth between biologists and economics. It was determined that Science could start modelling scenarios for option a, b, and c below, but will also model "d", a pre-specified reduction from current level of fishing mortality from all sources, that will be determined at the DU level by managers in each region:

   a. Natural mortality only (100% reduction in human induced mortality)

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1 The A1 and A2 subcriteria apply to decline within last 3 generations. It may be that for a given stock/DU, the population has been stable for 2 generations already, and stability for another generation would be sufficient for the stock/DU to surpass the threatened category threshold as it pertains to decline in number of mature individuals. Nevertheless, it is suggested that projections for all stocks and DU cover at least the next 3 generations.

b. Natural mortality and recent level of human induced mortality (0% reduction in human induced mortality) through fishing operations (bycatch from other directed fishing, discards, directed). Need to define “recent”: e.g. last 3 years (depends on stock and availability of data)
c. Natural mortality and only fishing mortality from by-catch and discards. This implies no directed fishing and would be useful to model for stocks under moratorium or for stocks where there is a possibility of a closure on directed fishing (depends on stock and data availability)
d. Pre-specified reduction from current level of fishing mortality from all sources (e.g. 50% reduction in human induced mortality). Science will, by default, model projection scenarios based on 100% reduction rate in human induced mortality (no fishing). This will be covered under “a.” above, but for each DUs, Management will also need to determine other reduction rate(s)that are in line what they think is achievable from a management perspective. This(ese) reduction rate(s) will need to be identified in advance of the RPA meeting so that Science is able to run this through the projection trajectory model for each DU.

4. Displaying results

a. Projections, if possible, should be made based on number of mature individuals as well as biomass of spawners, over appropriate time periods as specified above.

and

b. Results should be displayed in terms of probability of achieving the set targets and describing uncertainties.

Table 1: COSEWIC Quantitative Criterion A

Indicator	Endangered	Threatened
A. Decline in Total Number of Mature Individuals		
A1. An observed, estimated, inferred or suspected reduction in total number of mature individuals over the last 10 years or 3 generations, whichever is the longer, where the causes of the reduction are: clearly reversible **and** understood **and** ceased, based on (and specifying) any of the following: (a) direct observation (b) an index of abundance appropriate to the taxon (c) a decline in index of area of occupancy, extent of occurrence and/or quality of habitat (d) actual or potential levels of exploitation (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.	Reduction of ≥ 70%	Reduction of ≥ 50%
A2. An observed, estimated, inferred or suspected reduction in total number of mature individuals over the last 10 years or 3 generations, whichever is the longer, where the reduction or its causes may not have ceased **or** may not be understood **or** may not be reversible, based on (and specifying) any of (a) to (e) under A1.	Reduction of ≥ 50%	Reduction of ≥ 30%
A3. A reduction in total number of mature individuals, projected or suspected to be met within the next 10 years or 3 generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.	Reduction of ≥ 50%	Reduction of ≥ 30%
A4. An observed, estimated, inferred, projected or suspected reduction in total number of mature individuals over any 10 year or 3 generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased **or** may not be understood **or** may not be reversible, based on (and specifying) any of (a) to (e) under A1.	Reduction of ≥ 50%	Reduction of ≥ 30%

APPENDIX III – List of Participants

Name	Affiliation	e-mail
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APPENDIX IV – Research Recommendations

1. Concerning possible threats to Plaice from oil and gas exploration/production, it was recommended that research be conducted separately on the effects of seismic activity, sea floor drilling, and crude oil leaks on two components of the NL American Plaice population: larvae, and adults (including female spawners).
2. Regarding Bayesian Surplus Production modeling, it was recommended that a “prior” for “r” be developed from life history parameters