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# Proceedings of the Newfoundland and Labrador Regional Peer Review of the 3Ps Atlantic Cod Stock Assessment

**Meeting dates: October 16-18, 2018**
**Location: St. John's, NL**

**Chairperson: Derek Osborne**
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**Foreword**

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may 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.

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## SUMMARY

A Regional Peer Review process was held in St. John's, Newfoundland and Labrador, from October 16th to 17th, 2018 to assess the status of the stock of Atlantic Cod in Northwest Atlantic Fisheries Organization (NAFO) Subdivision 3Ps. The assessment was requested by the Fisheries Management Branch to provide the Minister with detailed advice on the status of the stock in order to inform management decisions for the 2019 fishing season.

This Proceedings document contains abstracts from meeting presentations, and summaries of discussions. The Terms of Reference, agenda, and list of participants are detailed in the appendix.

## INTRODUCTION

The status of Northwest Atlantic Fisheries Organization (NAFO) Subdivision 3Ps Cod was last assessed in October 2017 (DFO 2017). A Regional Peer Review process was held in St. John's, Newfoundland and Labrador (NL), from October 16th to 17th, 2018 to assess the status of the stock of Atlantic Cod in NAFO Subdivision 3Ps. The assessment was requested by the Fisheries Management Branch to provide the Minister with detailed advice on the status of the stock in order to inform management decisions for the 2019 fishing season.

This Proceedings document contains abstracts from meeting presentations, and summaries of discussions. The Terms of Reference, agenda, and list of participants are detailed in the appendix.

## PRESENTATIONS

### OCEANOGRAPHIC VARIABILITIY IN 3PS – POTENTIAL INFLUENCES ON ATLANTIC COD

Presenters: E. Colbourne and G. Maillet

#### Abstract

Oceanographic conditions in Subdivision 3Ps are influenced by several factors, including local atmospheric climate conditions, advection by the Labrador Current from the east and the warmer and saltier Gulf Stream waters from the south as well as the complex bottom topography in the region. Near bottom temperatures, while showing significant variability from one year to the next, have experienced a general warming trend up to 1.5°C in some areas since 1990.

Oceanographic data from 3Ps during the spring of 2018 indicate sea surface temperatures, except for a cold anomaly in later spring and early summer, were generally near-normal or above normal. Bottom temperatures increased significantly over 2017 to about 1°C above normal in some areas, with a corresponding decrease in the amount of cold Labrador Current Shelf water overlying the bottom area. Temperature values in deeper waters of the Laurentian Channel and the southeastern St. Pierre Bank, which showed positive anomalies (up to +4°C) in 2017, decreased to more normal values in 2018. The extent of cold intermediate water (CIL) also decreased over the previous year to below normal (warmer) conditions.

Variations in the abundance of cod from the research vessel (RV) surveys in strata directly influenced by Labrador Current shelf water appear to be correlated with bottom temperature (r=0.6) indicating a potential thermal influence on cod distribution in these areas. The distribution plots show a high number of zero survey catches in <0°C water with larger catches becoming more widespread over St. Pierre Bank as the cold water mass recedes from the area.

Satellite remote sensing data indicate continued lower intensity and magnitude of the spring bloom in 3Ps and across the Grand Bank during recent years (2015-18). The timing metrics of the spring bloom which include the time of the peak magnitude and duration are returning to near normal based on the climatology in 2018.

Zooplankton biomass on the Grand Bank and Newfoundland Shelf are normally dominated by large, energy-rich calanoid copepods, which represent important prey for planktivorous fish and early life stages of demersal fish such as cod. In 2018, the biomass of both small and large size fractions of zooplankton in 3Ps and ocean monitoring sections over the Grand Bank and

northeast Shelf continue to remain near the lowest levels observed in the 19-year time series. The reduction in standing stocks of phytoplankton and zooplankton observed in recent years indicate changes in the structure of the ecosystem and lower productivity conditions that may influence higher trophic levels.

### Discussion

The discussion began with questions focused on the decline of zooplankton in NAFO Subdivision 3Ps, and factors that could be influencing this decline. It was noted that the ecosystem in 3Ps is complex, and the decline of zooplankton was most likely attributed to a combination of factors beyond temperature. This could have included changes in circulation, as well as the physiology of all the species in the ecosystem. A participant suggested that macro zooplankton could be major consumers of mesozooplankton, and this could be impacting the overall decline. It was noted, however, that both classes are currently in decline, so the reduction in biomass was being seen at both levels.

A participant also asked if the current models could predict bottom temperature. It was explained that the current projections can be used to predict a few days into the future, but long-term projections are not conducted.

## FISH COMMUNITY TRENDS

Presenter: M. Koen-Alonso

### Abstract

The ecosystem structure of the NL bioregion can be described in terms of four Ecosystem Production Units (EPUs): the Labrador Shelf (2GH), the Newfoundland Shelf (2J3K), the Grand Bank (3LNO), and southern Newfoundland (3Ps).

These EPUs coarsely represent functional ecosystems, and have been used as geographic boundaries for the estimation of fisheries production potential (FPP) using ecosystem production potential models. Estimated FPP distributions, together with proxies for the current productivity state of the EPU, which in the case of 3Ps was based on the ratio of the landings before and after the 1990s regime shift, have been used to construct guidelines for total ecosystem catches, which represent an approximate upper limit for sustainable total catches for aggregates of species representing functional nodes in the ecosystem structure. These functional nodes of “guilds” closely match the fish functional groups used to describe the status and trends of the fish community, but they do not map them perfectly; these guilds represent a higher level of aggregation. In the case of 3Ps, since this ecosystem sits at the boundary between temperate and sub-arctic regions, two sets of model parameterizations were considered, one representing a temperate ecosystem and another representing a sub-arctic ecosystem.

While the results of these modelling exercises for 3Ps are only exploratory at this stage, they suggest that overall productivity in 3Ps is likely impaired to levels similar to the Grand Bank (3LNO), suggesting a consistent picture of reduced productivity across the entire NL bioregion. Catches for functional guilds in the model show different patterns. Planktivore and benthivore catches are below their guidelines, catches for piscivores have been around the limit since 2010, and suspension feeding benthos are on the rise and potentially moving into unsustainable levels from an ecosystem perspective. The implications for cod in these results are that while piscivores catches have been at the limit of ecosystem sustainability in recent years, earlier catch levels were likely above. Even though these results remain exploratory, they still suggest

that increasing catch levels for cod beyond current values could push exploitation levels beyond ecosystem-level sustainability.

Analyses of fishing effort distribution in 3Ps show clear areas of concentration, with differences in the use of space by different fisheries. While the groundfish fishery partially overlaps with Significant Benthic Areas (gorgonian coral and sea pen habitats) along the edge of the shelf, most core fishing grounds do not overlap with these areas. Still, no protection currently exists for coral and sea pen habitats in the areas where overlaps do occur.

The overall biomass of the fish community declined in the late-1980s and early-1990s. This decline also involved changes in the structure of the fish community, and a decline in fish size. Since the mid to late-1990s, the overall biomass of the fish community has not increased significantly, oscillating around an index level of 280,000 t. After 2014 total biomass showed reduced levels in comparison to precedent years, but increased in 2018. Abundance increased in the late 2000s, peaked around 2013, and declined afterwards. This increase was mainly driven by planktivores and plankpiscivores. The 2018 abundance level is comparable to the mid-1990s. Fish size (BA Ratio) declined in the late 2000s and has remained at that lower level, but planktivores and medium benthivores showed positive anomalies in 2018. The Piscivore functional group used to be highly dominated by Atlantic Cod. Since 2012, Silver Hake increased its dominance, rising to similar dominance levels as cod. While the overall picture of reduced productivity remains, results from the 2018 survey suggest that some conditions may be improving.

Regarding the order of magnitude of consumption, the fish community in 3Ps is estimated to consume food in the range of 1-2 million tonnes (t) per year. Within this envelope, Piscivores are estimated to eat in the order of 150,000-600,000 t per year. Within Piscivores, the magnitude of the consumptions by cod and Silver Hake is similar, and in the order of 50,000-250,000 t per year.

Snow Crab was a dominant prey for cod in 2013-16. Since 2017, cod diet has changed, showing an increase in the fish fraction of the diet. Although diet time series in 3Ps are far from complete, the available evidence indicates that cod has a very variable diet in this region. This suggest that food availability may be highly variable. Although stomach content weights for 3Ps cod suggest a possible change from the declining trend observed in recent years, values remain on the low side. The trend in turbot does not suggest an improvement in foraging conditions. Stomach content weights for cod and turbot suggest that 3Ps may be comparatively more food limited than other ecosystems. The observed differences in trend between these two predators could indicate patchiness/spatial variability in the prey field.

In summary, ongoing warming trends, together with an increased dominance of warm water species and reduced fish sizes across many fish functional groups, indicate that this ecosystem is undergoing structural changes. Although there are some positive indicators for cod (e.g. improvement in biomass and a more piscivore diet), these signals are not widespread nor fully consistent across the fish community. The ecosystem still remains under reduced productivity conditions. Exploratory analyses on fisheries production potential suggest that piscivores are likely fully exploited in 3Ps. Increases in catches of these species beyond current values could push exploitation levels into unsustainable territory. Therefore, the available evidence suggests that while there are some positive signs, cod productivity in 3Ps likely remains hindered. In this context, it continues to be advisable to employ higher than usual risk-aversion in the management of this stock.

## Discussion

Participants discussed the species included in the ecosystem analysis of 3Ps. It was questioned whether shrimp and squid were included in the ecosystem analysis. Shrimp were incorporated into the model, but often appeared in such few numbers that they were hard to identify on the plots. Squid, however, were not included, as the time-series data for squid in 3Ps had many inconsistencies and were not considered reliable enough to use as a model input.

Participants questioned how the RV data was scaled. A scaling factor of the ratio of total RV biomass index in recent years to index in the years before the 1990s collapse had been used for other models but was unsuccessful for 3Ps. When applied, this scaling factor increased the biomass for certain species to unrealistic values. It was suggested that the sets which were being used from 3Ps for scaling had many large fish, and this caused the biomass to be unrealistically inflated. The method used in the analysis for 3Ps was the ratio between the median landings in 2010-17 and 1980-90. One participant commented that this method could paint an unrealistic picture of the ecosystem in 3Ps, as the composition of species could be very different in surveys than it would be for landings.

A participant inquired how the strata were allocated in the research. If there were fewer than two sets per strata in the years of interest, then it was not used in the analysis. As well, it was noted that the large fish and small fish were omitted from the analysis to avoid bias from those extremes. A participant also commented that there were no inshore strata included in the analysis. This was due to the inshore time series data covering a shorter time span, beginning in the mid-1990s. An investigation into the inshore fish community trends was identified as a topic of further interest.

There was some disagreement on the conclusions that 3Ps showed signs of higher food stress than other NL ecosystems. A participant noted that the current stomach content weights for cod were the same as the older stomach content weights for other regions, implying that the overall stomach weights were similar. A participant disagreed with this statement, by noting that the interannual variability in 3O was smaller than the variability in 3Ps, and this would indicate that the food availability was more consistent in 3O, than it was in 3Ps.

It was noted by a participant that using RV data scaled by landings may not properly represent the structure of the ecosystem. There are some species that are not well caught in RV surveys, and they would be underrepresented in the analysis. It was responded that for an individual species, this could be a problem, but on a larger ecosystem scale these small inconsistencies would not be expected to have a large impact on the level of overall production that was approximated.

# REVIEW OF 2017/18 FISHING SEASON AND 2018/19 SEASON TO DATE

Presenter: M. Abbott

## Abstract

An overview of 3Ps cod fishery was provided. The summary included the Total Allowable Catch (TAC), the fleet allocations, the individual quotas by management area, the Canadian catch, and the percentage taken by both the inshore and offshore fleets over the previous three years. The management measures including; the small fish protocol, gear requirements, monitoring requirements, season dates and area closures were summarized. The presentation outlined the changes in the number of active participants in recent years. A summary of the pilot 3Ps cod re-allocation program was provided.

## Discussion

For the most recent quota report, it was noted that the fixed gear catches (65-100') were zero. A participant commented that this value was unrealistic, as it implied that there was no bycatch for those fleets. It was proposed that these zeros in the data were because the bycatch was so low that the raw numbers could not be given for reasons of confidentiality.

A participant commented that for future assessments, it would be helpful to have information about where the current landings are with respect to total quota for the year. It was also highlighted that there was a need for information on monitoring requirements.

Information about the St. Pierre fishery was also put forward and it was noted that a large trawler was out of service in 2017, and a new vessel was brought to the fishery in that same year. Both vessels needed gear upgrades and both boats did not enter the fishery until late January/February of 2017. This was cited as one of the major reasons that so little of the French quota was taken that year.

# CATCH AND SURVEY TRENDS FOR 3PS COD

Presenters: D. Ings, B. Rogers and M. J. Morgan

## Abstract

The status of the cod stock in the NAFO Subdivision 3Ps was assessed during a Fisheries and Oceans Canada (DFO) Regional Peer Review Process meeting held October 16-17, 2018.

Total landings for the 2017-18 management year (April 1-March 31) were 5,031 t or 77% of the TAC. This marks the eighth consecutive season that the TAC has not been fully taken.

Estimates of numbers and weights at age of the commercial and Sentinel catches were updated for 2017. Consistent with the results from the research survey, strong cohorts such as those produced in 2006 and 2011 track through the time-series and most of the fish in the landings during 2017 were ages six to eight. Trends in weight at age differed among ages. There was an increasing trend observed in the youngest ages (3-4 year olds) up to 2016 although 2017 values were lower. Weights were relatively stable for ages five to seven and a decreasing trend was observed for older fish.

Standardized catch rate indices for data from vessels <35 feet which fish in the inshore, i.e., unit areas 3Psa, 3Psb, and 3Psc was presented along with separate, new indices for vessels >35 ft. The percentage of the total cod catch for the <35 ft sector represented in the logbooks has decreased over time, from about 70% in 1997 to about 20% in recent years. This is considerably less than for logbooks from vessels >35 feet where approximately 65% of the landings are covered. Catch rates in gillnets from both logbooks series were consistent in showing initial declines; then, catch rates were stable to 2017. Catch rates from line trawls were variable over time for vessels <35 ft, with the 2017 value only slightly higher than the previous year, which was the lowest in the time series. However, these data were derived from only 37 logbooks. Catch rates from otter trawlers (>35 ft) showed a general decline over the time-series, except during 2006 when effort was concentrated in the area that typically has the highest catch rates.

A catch rate index for gillnets based on at sea observer sampling was also presented. Results were consistent with those from the two logbook time-series showing stable catch rates following initial declines. Note that only a low percentage (<2%) of the landings is represented by observer sampling in most years.

Research vessel surveys are conducted annually during spring and provide fishery independent data on the status of the resource. Survey abundance estimates were generally higher over 2009 to 2015 than during the previous decade, but the 2016 to 2018 values were below the time-series average. The biomass estimate has been variable over much of the post-moratorium period, but shows a general decline over 1998 to 2018, except for the high value in 2013. The 2018 biomass value was below the time-series average.

Sampling of research vessel catches indicated improvements in some biological parameters during 2018. Length at age was the lowest in the time series during the period 2013 to 2017, but it increased to average values in 2018. Mean weight at age increased from the mid-1990s to mid-2000s, but during 2007 to 2017 were generally lower than the mid-2000s. There was a downward trend in weight at age for ages six to eight from 2007 to 2017, with the trend starting later for age fours. Similar to length at age, weight at age also increased to average values during 2018. Measures of cod condition were among the lowest in the time-series over 2014 to 2017, but they were higher in 2018. Also, age at 50% maturity generally varied between six to seven years during the early part of the time series but declined sharply during the early to mid-1980s and has varied at a lower level (~5 years) since that time.

## Discussion

The discussions began with comments on catch weights at age, and whether some of the variability in the weights across years could be coming from gear type. It was acknowledged that the gear type could be influencing the interpretations of catch weights across years, and investigating this impact was a topic of further interest.

For the logbook data, a participant commented that the low response rates could be because there were fewer harvesters in the region, so the number of vessels in the database would be smaller overall. However, the number of vessels had been accounted for in the analysis, and the response rates were still very low. For the logbooks, it was also noted that there were no follow up calls when they were not submitted, this likely contributed to the low return rate.

A model was presented for gillnets based on observer data, however the models from otter trawler and line trawl data were not presented, as there was insufficient data from otter trawlers and the line trawl data had an unresolved reporting issue to allow adequate model fitting. Some participants expressed frustration with this issue. It was commented that harvesters were paying for something that was not of value to them or to science.

There was some discussion about the importance of the age 9 fish in 2018 regarding the biological data. It was noted that the sample size of these age 9 fish was similar to the typical sample size for fish of that age in previous years. The overall length at age of these fish was discussed, and it was concluded that there was some clustering in the 2018 sample, but this was not a major concern. It was also noted that when the age 9 fish were removed from averaging, the trends remained the same, showing increases toward mean values.

There was also a discussion on the factors that could be causing the decrease in age at 50% maturity. Cod in 3Ps historically reached 50% maturity at age seven, but the age at maturity had decreased to age five. No single factor could currently be attributed to this decrease in age at maturity, but a combination of many factors could be the cause, including warmer waters, and possibly a genetic component caused by fishing.

A participant made the link between the improvements in the liver index and gutted condition and the improvement in the diet of cod discussed earlier. However, there was a comment on the fact that the 2018 survey was done one month later than normal, and that could be the reason for the perceived condition improvement. It was noted in response that this could perhaps be

the case, but that comparing the data one month later was much more reliable than comparing the conditions from the winter and spring, referring to the shift in survey timing in 1993. There was a request by the group to see the results for the condition indices with the 2018 age nine cohort removed, and these results were subsequently presented. There was very little difference in condition when removing these fish and it was noted that since there were very few fish of that age, removing them from the analysis had little impact.

## SENTINEL PROGRAM

Presenter: L. Mello

### Abstract

Catch rates and biological information for Atlantic Cod from the Sentinel Survey Program in the NAFO Subdivision 3Ps are updated for 2017, and preliminary results presented for 2018. Temporal trends in gillnet (small 3¼ inch mesh, large 5½ inch mesh) and linetrawl unstandardized catch rates were similar for all gears, with the highest values at the beginning of each time-series, sharp declines after 1997, and oscillations around or below the series' mean catch rate thereafter. Mean catch rate for small mesh gillnets was consistently higher than that of large mesh gillnets for the entire time-series: peaking at 142 fish/net in 1996, and then averaging 11-36 fish/net; except for its lowest value of 6 fish/net in 2011. Large mesh gillnets yielded the lowest mean catch rate of all gears: declining from 49 fish/net in 1997 to less than 9 fish/net since 2000. Mean catch rate for linetrawl peaked at 223 fish/1,000 hooks in 1996 and fluctuated around 100 fish/1,000 hooks until 2010 (except in 2006); prior to reaching its lowest value of 62 fish/1,000 hooks in 2014-2015. Sentinel catch rates for large mesh gillnet and linetrawl at fixed and experimental locations were standardized using Generalized Linear Models. Age-disaggregated standardized catch rates for recent year-classes were generally weaker than those in the past. Age-aggregated catch rates were higher at the beginning of each time-series for both gears, declined over the mid-to-late 1990s, then remained at their lowest levels; decreasing below the series' mean of 6.4 fish/net (large mesh gillnets) in 1999, and 86 fish/1,000 hooks in 2009 (linetrawl). Gillnet and linetrawl catch rates for 2017 were 2.5 fish/net and 47.5 fish/1,000 hooks (fixed sites), and 2.3 fish/net and 53.7 fish/net (experimental sites) , respectively.

Length frequencies of Atlantic Cod measured in Sentinel Surveys indicated that the small mesh gillnet was the least selective gear (retaining small and large fish from multiple length-classes), whereas large mesh gillnet and linetrawl captured larger fish in specific size ranges and few overlapping length-classes. Fish lengths from small mesh gillnet showed several modes ranging between 37-43 cm and 53-60 cm throughout the time-series, while those of fish from large mesh gillnet and linetrawl ranged between 60-68 cm and 42-61 cm, respectively. Indices describing the physiological condition of Atlantic Cod varied at both seasonal and annual scales: the liver (hepatosomatic index) and gutted body condition (Fulton's K condition factor) declined over winter and early spring (while the gonadosomatic index increased), then improved over summer after spawning. These trends varied annually over the time-series, but generally declined in 2004-17.

### Discussion

There was an initial discussion as to why the catch rates for the program declined sharply in 1997. No specific reason was concluded, but a few theories were discussed. One of the reasons proposed was the end of the moratorium. It was suggested that many harvesters left the program to re-join the competitive fishery. Another reason put forward was that the fish were not there to begin with, suggesting that the rates were especially high in the first year. It was

commented that perhaps the stock size was overestimated, and removals were too high in the earlier years, but it was unclear how this could affect commercial catch rates. The final reason that was proposed was that the timing of the sentinel program perhaps did not coincide with when the fish are in the region. This change in timing could be for a variety of reasons (e.g. temperature changes), and these causes were not discussed in detail.

## TAGGING UPDATE

Presenter: G. Robertson

### Abstract

The geographical coverage of tagging since 2007 has been limited to areas of Fortune Bay and Placentia Bay, which causes some uncertainty as to how results from these inshore areas relate to the full stock. Although exploitation rates based on tagging of cod in these inshore areas may not be applicable to other areas, or to the full stock area, these inshore regions account for a significant portion (~50%) of the overall annual landings from the stock.

The general pattern of cod tag returns remains unchanged with most of the fish tagged in 3Ps being harvested in 3Ps. Recent tagging suggests exploitation of 3Ps cod in neighbouring stock areas (Divs. 3KL) is minimal and not a major issue for management.

### Discussion

One participant inquired whether there was an estimate of the ratio of fish tagged in 3Ps to those that were not. It was thought that if the harvesters knew what the tagging density should be relative to the population at large, then they could get an idea of whether the fish they were catching were from the region or not, based on the proportion of those caught that had tags. This ratio was unknown but mentioned as a further topic of interest.

## SPATIOTEMPORAL VARIATION IN JUVENILE MORTALITY RATES OF ATLANTIC COD OFF NEWFOUNDLAND AND LABRADOR

Presenter: F. Zhang

### Abstract

Understanding the mechanisms causing strong temporal variation and large-scale spatial synchronization of fish recruitment has been a long-standing challenge in fisheries science. Previous studies mostly focused on ecological processes during early-life history stages, especially larvae and early-juvenile stages. Whereas, for species with a prolonged juvenile stage, e.g., Atlantic Cod, juvenile mortality after the first year of life may also affect the strength of subsequent recruitment. Using data from 23 surveys off Newfoundland and Labrador, we studied the spatiotemporal variation of juvenile mortality and cohort strength of Atlantic cod in NAFO divisions 2J3KL (Northern cod), 3NO (Southern Grand Bank cod), 3Ps (Southern Newfoundland cod), 4RS (Northern Gulf of St. Lawrence cod) and 3M (Flemish Cap cod). For the four surveys on Southern Newfoundland cod, results indicated that 1) variations of juvenile mortality and cohort strength were not significantly correlated among surveys; 2) the offshore survey in eastern 3Ps suggested increased juvenile mortality since 2010, coinciding with decreased cohort strength; and 3) variation of cohort strength in eastern 3Ps was positively correlated with that in the Southern Grand Bank (3NO). Our study suggested potential importance of juvenile mortality in affecting spatiotemporal recruitment dynamics of Atlantic Cod, and more future studies are needed to understand mechanisms affecting cod juvenile mortality.

## Discussion

One participant wanted to see the results of the analysis with the survey in 3Ps as one index, and not divided into two, as this could be a good baseline with which to compare the other models. It was clarified that the goal of this analysis was the finer spatial dynamics, so splitting the surveys was the point of interest. In addition, if there were differences, then the model should have picked them up with the current methods.

There was a discussion on the effects that catchability, timing of survey and year-class could be having on the correlations. The catchability and timing of survey were both accounted for in the model; however, no assumptions had been made concerning the year-class strength. It was noted that this was an exploratory investigation to try to get a better idea of the stock structure overall, and that the year-class correlations could be incorporated into future models.

Topics of further research were proposed:

- Multivariate analysis to investigate the correlation matrices
- Investigations into large correlations on the western side of Newfoundland
- Investigations into the inshore index

# FFAW QUESTIONNAIRE UPDATE

Presenter: E. Carruthers

## Abstract

Not provided.

## Discussion

The major discussion for this topic centered on the low response rates for the phone survey. Potential solutions to help increase the responses were proposed, including repeated calling, follow up phone calls, or email reminders. It was noted that changing the way the respondents were approached would change the overall methodology of the survey.

There were a few comments on the stomach contents of the fish. One participant noted that the abundance of capelin in the stomachs should not be viewed as an abundance of capelin in the region. That is, fishing was most likely located in a capelin heavy region, but that region could be the only region that had capelin. A similar comment was noted for baitfish, which were reported at a low level of abundance by fishers but often reported in the stomachs of fish.

# SURVEY BASED ANALYSIS (SURBA) FOR 3PS COD

Presenter: D. Ings

## Abstract

Consistent with recent assessments, a cohort model (SURBA) based on the spring DFO survey was used to infer overall stock trends. The 2018 spawning stock biomass (SSB) is estimated to be in the Cautious Zone (49% above $B_{lim}$) as defined by the DFO Precautionary Approach (PA) Framework. The probability that the stock is in the critical zone is 0.04. SSB has increased since 2015. In 2018, 71% of the SSB is comprised of ages 6 and 7. Recruitment has generally been at or above the time-series average since 2005, with a particularly strong cohort produced in 2011. Estimated total mortality remains high. Over 2015-17, total mortality averaged 0.61 (54%

survival per year); however, the relative contributions of natural and fishing mortality to total mortality are unknown.

Projection of the stock to 2021 was conducted assuming mortality rates will be within +/- 20% of current values (2015 to 2017 average). All projections show SSB in 2021 to be lower than SSB in 2018. Where total mortality is assumed to remain at or above current levels, projections indicate that SSB in 2020 and 2021 to be at or below $B_{lim}$.

### Discussion

One major point of conversation for this presentation revolved around the general increase in mortality rates for cod in 3Ps, as the mortality rates in the past few years have been high. It was commented that the mortality rates were perhaps lower in the past because there were more young fish in the population and the mortality rate is higher for older fish.

A participant commented on the proportion of the SSB that was composed of younger fish. This proportion had decreased since the last assessment, but still represented more than half the estimated SSB. This was discussed as a potential point of concern, as the mortality rates for these fish was expected to increase considerably over the next couple of years.

Some participants wanted to know how the uncertainty in the projections was estimated, and if this uncertainty was carried forward for each subsequent year. This was investigated, and it was eventually explained that the projection quantities were functions of the parameters, and the uncertainty in the parameters was carried forward into the projections.

## PROJECTIONS AND FINAL DISCUSSION

The group agreed on fitting projections for three years, up to 2021.

A major point of discussion centered on the increase in the retrospective pattern in mortality between this year's model and the model run that drops the last year of data. The fluctuations in total mortality from one run to the next were seen by some participants as a cause of concern. As an explanation for these fluctuations, a participant noted that the current presentations seemed to agree with what was being seen in the fishery where some age classes appeared stronger than in the research vessel survey. It was suggested that the previous assessment did not characterize the population as well as the current assessment due to low catches of older fish in the 2017 survey. The participant suggested that the retrospective pattern in mortality seen in the current assessment was the model adjusting itself from last year to account for older fish in the population. Another participant also noted that the total mortality estimated for this year was still within the estimated error intervals for last year. If this year's total mortality did not fall into this range, then this would be a cause for concern, but this was not the case.

There was a lot of discussion surrounding the issue of which plots and tables to include in the research document. One participant was uncomfortable with including the table of probabilities of being below the limit reference points, and only wanted the plot of the three-year projections included. However, other participants wanted to include the table, as it was argued that including it would paint a more representative picture of the overall health of the stock. A suggestion was to exclude the table of probabilities, but include the confidence bounds on the projection plot. Meeting participants decided to include the table of probabilities, and the Z-multiplier plot and with the three-year projections.

There was a proposal to include a bullet with biological data that would include the change in maturity at age. One participant thought it important to add information about the change in age at 50% maturity, as this had previously been used in other fisheries as an indicator of an

overexploited stock. It was noted, however, that there had not been a change in age at 50% maturity since the 1990s, so including the bullet point could be misleading. It was eventually agreed not to include this bullet point.

## RESEARCH RECOMMENDATIONS

1. Investigate recent tagging results from 3Ps in relation to those from neighbouring areas (3L, 4Vn, 3Pn, 4RS).
2. If possible, include inshore index data in the analysis of juvenile mortality rates.
3. Examine the extent, causes and consequences of skipped spawning in 3Ps cod.

## REFERENCES CITED

DFO. 2017. Stock Assessment of NAFO Subdivision 3Ps Cod. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2017/051.

# APPENDIX I: TERMS OF REFERENCE

**Assessment of Northwest Atlantic Fisheries Organization (NAFO) Subdivision 3Ps Atlantic Cod**

**Regional Peer Review – Newfoundland and Labrador Region**

**October 16-18, 2018**
**St. John's, NL**

Chairperson: Derek Osborne

**Context**

The status of Northwest Atlantic Fisheries Organization (NAFO) Subdivision 3Ps Cod was last assessed in October 2017 (DFO 2017). The main objectives were to evaluate the status of the stock and to provide scientific advice concerning conservation outcomes related to various fishery management options.

The current assessment is requested by Fisheries Management Branch to provide the Minister with detailed advice on the status of the stock in order to inform management decisions for the 2019 fishing season.

**Objective**

- Provide an ecosystem overview (e.g., environment, predators, prey) for the stock area.
- Assess and report on the current status of the 3Ps cod stock. In particular, assess current spawning biomass relative to baseline conservation thresholds ($B_{lim}$), total (age 3+) biomass, total mortality, and biological characteristics (including age composition, size at age, age at maturity, and distribution). Describe these variables in relation to historic observations.
- Further to the previous assessment, analyze recent year class strength relative to previous observations, as it relates to long-term growth and sustainability of the stock.
- To the extent possible, provide information on the strengths of year-classes expected to enter the exploitable populations in the next 1-3 years.
- Provide annual projections to 2021 based on the assessment of trends in the abundance index, biomass index and other stock indicators, including associated risk analyses. Specifically, these analyses will include an assessment of the trends in the stock and in the risks relative to $B_{lim}$.
- Highlight major sources of uncertainty in the assessment, and where appropriate, consider alternative analytical formulations of the assessment.
- Report on results of tagging and the distribution of this stock in other areas (e.g., 3L/3Pn).

**Expected Publications**

- Science Advisory Report
- Proceedings
- Research Document

**Expected Participation**

- Fisheries and Oceans Canada (DFO) (Science and Fisheries Management Branches)
- French Research Institute for Exploitation of the Sea (IFREMER)
- Provincial Department of Fisheries and Land Resources
- Fishing Industry
- Academia
- Indigenous groups

- Non-government organizations

**References**

DFO. 2017. Stock Assessment of NAFO Subdivision 3Ps Cod. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2017/051.

## APPENDIX II: AGENDA

Memorial Room - Northwest Atlantic Fisheries Centre
80 East White Hills Road, St. John's

### Tuesday, October 16

| Time | Topic | Presenter |
|---|---|---|
| 09:00 | Opening remarks and overview of Regional Peer Review Process | *D. Osborne* |
| - | Environmental and oceanographic update | *E. Colbourne & G. Maillet* |
| - | Fish community trends | *M. Koen-Alonso* |
| - | Review of 2017/18 fishing season and 2018/19 season to date | *M. Abbott* |
| - | Catch<br>• Total landings<br>• Catch at age | *D. Ings & B. Rogers* |
| - | Logbook data, catch rate index | *D. Ings* |
| - | Observer data | *D. Ings* |
| - | Survey<br>• Distribution<br>• Biomass/Abundance updates<br>• Age composition, size at age (length, weight and condition), age at maturity | *D. Ings* |
| - | Sentinel program | *L. Mello* |
| - | Tagging update | *G. Robertson* |
| - | Spatiotemporal variation in juvenile mortality rates of Atlantic Cod off Newfoundland and Labrador | *F. Zhang* |
| - | FFAW questionnaire update | *E. Carruthers* |

| Time | Topic | Presenter |
|---|---|---|
| - | Population dynamics: SURBA – survey-based analysis | *D. Ings* |

## Wednesday, October 17

| Time | Topic | Presenter |
|---|---|---|
| 09:00 | Continue with cod assessment (if additional time is required) | *D. Ings* |
| - | Drafting of SAR/Summary Bullets | *All* |

## Thursday, October 18

| Time | Topic | Presenter |
|---|---|---|
| 09:00 | Drafting of SAR/Summary Bullets (continued) | *All* |
| - | Upgrade of working paper to research document | *All* |
| - | Closing remarks and *ADJOURN* | *D. Osborne* |

**Notes:**

- Health breaks will occur at 10:30 a.m. and 2:30 p.m. Coffee and tea can be purchased from the cafeteria.
- Lunch (not provided) will normally occur 12:00-1:00 p.m.
- Agenda remains fluid – breaks to be determined as meeting progresses.

## APPPENDIX III: LIST OF PARTICIPANTS

| Name | Affiliation |
|---|---|
| Erika Parrill | DFO – Centre for Science Advice |
| Jonathan Babyn | DFO – Science |
| Joanne Morgan | DFO – Science |
| Alfred Fitzpatrick | Harvester |
| Brian J Careen | Harvester |
| Dan Baker | Harvester |
| Erin Carruthers | Food, Fish, and Allied Workers (FFAW) |
| Bob Rogers | DFO – Science |
| Heather Penney | DFO – Science |
| Karen Dwyer | DFO – Science |
| Laura Wheeland | DFO – Science |
| Greg Robertson | DFO – Science |
| Andrea Perreault | Rapporteur |
| Derek Osborne | DFO – Science |
| Danny Ings | DFO – Science |
| Joel Vigneau | IFREMER |
| Juliette Champagnat | IFREMER |
| Chelsey Karbowski | Oceans North |
| Andrew Cuff | DFO – Science |
| Fan Zhang | MUN – Marine Institute |
| Geoff Evans | DFO Emeritas |
| Kris Vascotto | Groundfish Enterprise Allocation Council (GEAC) |
| Gary Maillett | DFO – Science |
| Eugene Colbourne | DFO – Science |
| Rick Rideout | DFO – Science |
| Mariano Koen-Alonso | DFO – Science |
| Keith Lewis | DFO – Science |
| Irene Andrushchenko | St. Andrews Biological Station (SABS) |
| Brian Healey | DFO – Science |
| Joanna Mills Flemming | Dalhousie University |
| Connie Korchoski | DFO – Centre for Science Advice |
| Frederic Cyr | DFO – Science |
| Paul Regular | DFO – Science |
| Luiz Mello | DFO – Science |
| Peter Upward | DFO – Science |
| Noel Cadigan | MUN – Marine Institute |
| Jin Gao | MUN – Marine Institute |
| Shelley Dwyer | DFO – Resource Management |
| Chelsie Tricco | DFO – Resource Management |
| Melissa Abbott | DFO – Resource Management |
| Sherrylynn Rowe | MUN – Marine Institute |

| Name | Affiliation |
|---|---|
| Jennifer Duff | DFO – Communications |
| Ben Davis | DFO – Science |
| Sebastian Donnett | DFO – Science |
| Tom Dooley | Government of NL – Fisheries and Land Resources |