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

Meeting date(s): Oct 17-18, 2017
Location: St. John's, NL

Chairperson: Derek Osborne
Rapporteur : Tom Fowler

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Canada

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 meeting of the Newfoundland and Labrador (NL) Regional Peer Review Process was held October 17-18, 2017, in St. John's, NL, to assess the stock status of Atlantic Cod (*Gadus morhua*) in Northwest Atlantic Fisheries Organization (NAFO) Subdivision 3Ps. This Proceedings Report includes an abstract and summary of discussion for each presentation, and a list of research recommendations. The meeting's terms of reference, agenda, and list of attendees are appended.

Participants at the meeting included staff from Fisheries and Oceans Canada (DFO) Science and Fisheries Management Branches, and representatives from the Newfoundland and Labrador Department of Fisheries and Aquaculture, Memorial University, l'Institut français de recherche pour l'exploitation de la mer (IFREMER: France), and the fishing industry.

In addition to these Proceedings, publications to be produced from the meeting include a Science Advisory Report and a comprehensive Research Document, all to be available online on the DFO Canadian Science Advisory Secretariat's Website.

INTRODUCTION

The status of Atlantic Cod in Northwest Atlantic Fisheries Organization (NAFO) Subdivision 3Ps was last assessed in October 2016 (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 was requested by Fisheries Management to provide the Minister with detailed advice on the status of the stock in order to inform management decisions for the 2018 fishing season.

PRESENTATIONS – 3Ps COD

OCEANOGRAPHIC CONDITIONS IN NAFO DIVISION 3Ps DURING SPRING 2017 - POTENTIAL INFLUENCES ON ATLANTIC COD

Presenter: E. Colbourne

Abstract

Oceanographic data from NAFO Subdivision 3Ps during the spring of 2017 are examined and compared to previous years and the long-term (1981-2010) average. In the 3Ps region sea surface temperatures decreased over the previous year reaching about 1.5°C below normal in June. In 2017, bottom temperatures decreased significantly compared to 2016 to about normal in most areas of the banks. Bottom temperatures in deeper water of the Laurentian Channel show positive (up to +4°C) anomalies with temperature values up to 9°C in some areas. Deeper slope waters on southeastern St. Pierre Bank were also exceptionally warm during the past 4 years with values reaching 8°-12°C.

The extent of < 0°C water covering the bottom of St. Pierre and Green Banks in the 3Ps region decreased to near-zero in 2010-13 but has been increasing since then reaching the highest value since 2008 in 2017. In addition, the area of the water column with temperatures < 0°C (CIL) increased over the 2016 value to above normal (cooler) 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 indicates a reduction in both magnitude and amplitude of the spring bloom in 3Ps and across the Grand Banks during 2015-17. The peak timing of the spring bloom has occurred later by up to two weeks from 2014-17 while the duration has been on the decline in some areas of the Grand Banks.

The trend in zooplankton biomass has been in decline in 3Ps since 2013, showing a substantial reduction (~50 %) from peak levels in 2010. The preliminary biomass data from spring 2017 show a slight recovery over the 2014-16 values but it remains at a low level. Along the standard Atlantic Zone Monitoring Program (AZMP) sections, biomass of marine copepods also show a decline since 2008 while macro-zooplankton show a downward trend beginning in 2013. The large reduction in zooplankton biomass in recent years may influence transfer of energy to higher trophic levels in the ecosystem.

Discussion

Participants inquired about the dynamics of the spring phytoplankton bloom, including possible transport away from cod feeding grounds, fall blooms, and other timing events. They were advised that some of the data required to answer these kinds of questions exist, but is still being analyzed.

Interactions between 3Ps cod and neighboring stocks and areas were discussed in light of the unfavourable oceanographic conditions in 3Ps, the relatively low abundance of cod in colder water, and the extent to which cod might move to find preferable conditions. It was suggested the cold water on either side of 3Ps may actually hem them in. Information from past studies and future recruitment work may help understand this better.

ECOSYSTEM SUMMARY: TRENDS IN THE FISH COMMUNITY IN NAFO SUBDIVISION 3Ps

Mariano Koen-Alonso, Nadine Wells, Denise Holloway, Jennifer Mercer, Margaret Warren and Corinna Favaro

Presenter: M. Koen-Alonso

Abstract

The marine community in southern Newfoundland, NAFO Subdivision 3Ps, is considered a functional ecosystem unit, albeit one highly influenced by neighbouring ecosystems. The overall biomass of this fish community declined in the late-1980s and early-1990s. This decline also involved changes in community structure, and a decline in fish size. Since the mid to late-1990s, the overall biomass of the fish community has not increased significantly, but abundance has. The abundance increase was mainly driven by planktivore fishes. However, both biomass and abundance after 2014 have shown reduced levels in comparison to immediately preceeding years. Notwithstanding the relative stability of the overall biomass level, the relative composition by fish functional groups has changed during this period. Fish size (RV Biomass/Abundance ratio) also showed a further decline in the mid-2000s, and still remains at that lower level.

Among fish functional groups, Small Benthivores, Shellfish, Piscivores, and Planktivores have shown declines in biomass within the last five years. The Piscivores functional group used to be highly dominated by Atlantic Cod, but since 2012, Silver Hake has increased its dominance within this functional group, rising to similar dominance levels as cod. Silver Hake was the dominant piscivore species in 2017.

There is a clear spatial structure in the distribution of the different fish functional groups. For example, PlankPiscivores, and Small Benthivores core areas appear to be more consistently associated to the deep water channels, where seapen significant benthic areas are also located. Medium Benthivores appear more associated with the shallower waters on top of the banks. The core areas occupied by the most fish functional groups remained generally stable before and after the ecosystem decline in the 1990s. However, Planktivores, and to a lesser extent Small Benthivores, showed shifts in core area distribution. Before the decline Planktivores core area was along the outer edge of the banks; after the decline, it shifted towards the top of the banks and appears more fragmented. This shift suggests a reduced spatial overlap between forage fishes and large groundfishes (piscivores and large benthivores). Small Benthivores, in addition to the deep-water areas along the Laurentian Channel, appear to have expanded its core area along the Halibut Channel.

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 per year. Within this envelope, Piscivores are estimated to eat in the order of 200-400 thousand tonnes per year.

Breaking with the pattern observed since 2013, Snow Crab saw an important reduction in its contribution to the spring diet of cod in 2017, with sandlance becoming the dominant prey item. Redfish is another prey item that was important in the past, and has started to appear again in the diet in 2016-17. Although time series of cod diet data in 3Ps are far from complete, the available evidence indicates that cod has a very variable diet in this region. This suggests that food availability may be highly variable, and potentially limiting. The potential consequences of the diet change observed in 2017 would depend on how stable the current diet composition will be in the years to come.

In the 2013-17 period, other predators like Yellowtail Flounder and American Plaice also had sandlance as a dominant prey; capelin was also an important prey in some predators. Unlike cod, Thorny Skate maintained Snow Crab as the major component of its diet in 2017. Silver Hake diet in 2017 continued to be dominated by pelagic prey types including krill, lantern fishes and other fishes. Even though only a couple of years of diet data are available, the evidence suggests that, in comparison to cod, Silver Hake diet seems more associated to water column resources. This observation suggests a low likelihood for direct competition for food.

Average weight of cod stomachs indicate that meal sizes were smaller in the 1990s, suggesting that availability of food may have been a factor in the decline. Current cod meal sizes are around the lower end of the range observed in the mid to late-1980s. Recent cod productivity seems more likely related to food quality than availability, but availability of high quality food may also be playing a role. Historical data indicates that meal sizes in 3Ps have been consistently lower than in the Grand Bank, but average stomach content weights in 2016-17 have been similar in both ecosystems. This suggests that the prey field conditions experienced in 3Ps since 2014 could be starting to occur in the Grand Bank.

Ongoing warming trends, together with the increasing dominance of warm water species, and the reduced fish sizes across fish functional groups suggest that this ecosystem is undergoing structural changes, and likely experiencing reduced productivity. This could be, at least in part, associated to availability of high quality food items (not just in terms of overall biomass levels, but also accessibility). The available evidence suggests that cod productivity in 3Ps appears to be hindered. In this context, it would be strongly advisable to use higher than usual risk-aversion in the management of this stock.

Discussion

Participants questioned the use of stomach samples, the accuracy of the consumption estimates, and the reasoning behind the categories and functional groups used to describe the fish community of 3Ps.

Participants discussed whether indications of reduced productivity, e.g., food stress, within an ecosystem could have utility in generating advice on stock status, i.e., reduce fishing mortality.

There was interest in investigating how diet changes with life stage, e.g., changes in fish diet with age or length. It was suggested that stomach contents be used to explore diet as a function of size. Participants also suggested incorporating natural mortality into these analyses, and investigating the relationships between cod and its prey species together with its competitor species.

Participants discussed the potential for developing an ecosystem model incorporating natural mortality. It was asked if the meeting could group species as prey for cod versus competitors for cod for future assessment presentations.

Participants inquired about the link between primary production and zooplankton, asking whether energy transmission modelling was currently being explored. The response was that such models exist but we have yet to succeed in pulling the findings into a coherent package. There was a suggestion that an existing energetics model used for 2J3KLNO cod could be adjusted to be applicable to 3Ps, but 3Ps is characterized by numerous boundaries, and the modeling exercise would have to address import and export impacts on primary production.

Participants referenced the core area maps that showed the top 20% biomass percentiles of all fish functional groups, and asked about the timing of the apparent planktivore shift in distribution. There was discussion on whether piscivores had left the area or could merely be showing reduced abundance rather than out-migration. The limitations in comparing data series among differing gear types was also noted.

The prevalence of Silver Hake was discussed, with participants asking if hake competed with cod. They were advised that the two have different diets and temperature regimes, so displacement due to competition was unlikely at larger sizes. It was theorized that hake prevalence was due to the presence of their preferred (warm) water mass and that, if cod is eating less, it would be due to unavailability of prey items. It was noted that there was little data available to investigate potential interactions between cod and Silver Hake during the early life stages.

In addition to prey availability, participants asked whether changes in prey quality might be a factor. They asked if sand lance is considered a higher quality/more energy intensive, prey species compared to juvenile crabs. It was agreed that lance is better energetically than small crabs, but the new diet needs to persist for a few years before this might become evident.

REVIEW OF 2016/17 FISHING SEASON AND 2017/18 SEASON TO DATE

Presenter: D. Coffin

Abstract

An overview of 3Ps cod fishery was provided. The summary included the 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

Harvesters asked for clarity regarding hailing requirements, quota “bump ups” (re-allocations) for those who have caught their IQs or fleet quotas, restrictions on number of baited hooks, and enforcement of small fish protocol. Harvesters were advised appropriately, or referred to the next advisory committee meeting.

CATCH AND SURVEY TRENDS FOR 3Ps COD

Presenter: D. Ings

Abstract

The status of the cod stock in the NAFO Subdivision 3Ps was assessed during a Regional Peer Review Process meeting held October 17-18, 2017.

Total landings for the 2016-17 management year (April 1-March 31) were 6,282 t or just 48% of the Total Allowable Catch (TAC). This marks the seventh 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 2014 to 2016. 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 2016 were ages five to seven. Trends in weight at age differed among ages, with increasing trends observed in the youngest (3-4 year olds), relatively stable weights for ages five to seven and a decreasing trend 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 were presented along with separate, new indices for vessels > 35 feet. 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 15% in recent years. This is considerably less than for logbooks from vessels > 35 ft 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 2016. Catch rates from line trawls were variable over time for vessels < 35 ft, with the 2016 value the lowest in the time series. However, these data were derived from only 13 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 (< 1%) of the landings is represented by observer sampling in most years.

RV 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 2017 than during the previous decade, but the 2016 and 2017 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 2017, with the exception of the high value in 2013. The 2017 biomass value was below the time-series average.

Sampling of research vessel catches indicated negative trends or reductions in many biological parameters. During the last five years, length at age was the lowest in the time series. 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 since 2007, with the trend starting later for age fours. Measures of cod condition were among the lowest in the time-series during the last four years. 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

In terms of Catch Trends, participants asked whether we can compare observer and log book data from different fleet sectors (i.e.: < 35’ and > 35'), given that the trends look similar. They were advised that observer data will tend to overlap for > 35’ fleet and is relatively easy to compare, as the percent coverage for that fleet is typically much higher. However, it is less easy for the inshore fleet, which has low observer coverage.

Harvesters were asked to comment on the low return rate for logbooks from the < 35’ fleet, which limits the usefulness of the data, given that returning logbooks is a condition of licence. It was noted that there are some issues internal to DFO that may contribute to the low return rate, specifically, Science Branch does not follow up with licence holders who do not return logbooks. This differs for logbooks from the > 35’ fleet as they are administered by Policy and Economics Branch and follow up is conducted when logbooks are not returned.

In terms of survey trends, participants expressed concern that growth estimates based on survey data rely on a much shorter time period compared with the commercial data. They highlighted the lack of samples from the offshore line trawl surveys, general decrease in sampling activity, and issues regarding representativeness/oversampling from single sources. This could potentially influence the estimated age structure, but wether age distributions were skewed could not be determined.

Participants asked what has been done to determine stock weights because commercial catch at age estimates were not available for 2014/15 in time for the 2016 assessment meeting. They were advised that weights were assumed from earlier years, using a three-year average. There is further uncertainty given that we only collect lengths, not weights in th Sentinel Survey. There is concern that the survey weights appear to be in decline, but the trends are different for the commercial, which are applied to the model results.

Participants asked about the fish weights, and what we can conclude about condition. They were advised that there does appear to be a long-term negative trend in condition, but additional analysis is needed to ensure the latest decline is not just an artifact of the way we are treating the data. It was noted that harvesters generally had a more current basis of observation from summer 2017 fisheries compared to the April 2017 RV survey.

Participants asked if the traditional timing of the RV survey might be a factor in the condition differences, given the shifts in reproductive timing. They were advised that the survey collects data on total weight and gutted weight and that seasonal variation in condition is accounted for, especially when looking at older data. It is important to note that, in addition to condition, length at age is also declining which is independent of the survey timing.

Participants inquired about the apparent spatial variation in size at age, and whether we might be mistaking changes in the spatial distribution for actual changes in size or weight at age across the population. It was agreed that we should take a close look at this question. DFO Science has completed spatial analysis and there are differences in the maturation schedule across the area, as well as differences in relative year class strength.

SENTINEL PROGRAM

Presenter: M. Simpson

Abstract

The most recent data and related analyses from the Sentinel program in NAFO Subdivision 3Ps are presented. Catch rates are updated for 2016 and preliminary results are given for 2017. Temporal trends in gillnet (3¼ in. and 5½ in. mesh sizes) and linetrawl unstandardized catch rates were similar for all gears with the highest values observed at the beginning of the time-series and then declined sharply after 1997 and oscillated around or below the series mean catch rate thereafter. 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 the lowest time-series value of 62 fish/1,000 hooks in 2014-15. Mean catch rate for small mesh gillnets was consistently higher when compared to catch rate for large mesh gillnets throughout the time-series, peaking at 142 fish/net in 1996 and then averaging 11-36 fish/net thereafter, except in 2011 when the lowest time-series value of 6 fish/net was observed. 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 from 2000 onwards.

Sentinel catch rates were standardized using Generalized Linear Models (GLM) in order to remove the effects of site selection and season and are presented for large mesh size gillnets and linetrawl control locations. Age aggregated catch rates from sentinel surveys were higher in the early part of the time series (both gears), declined over the mid to late-1990s and have remained lower since then. Gillnet and linetrawl standardized catch rates dropped below the series mean of 6.4 fish/net and 86 fish/1000 hooks in 1999 and 2009 respectively and have remained at this level. Estimates for 2016 reached 1.5 fish/net for gillnets and 57.5 fish/1000 hooks for linetrawl. In the age disaggregated standardized catch rate series, cohorts produced in recent years have been in general weaker than stronger cohorts in the past, although the standardized proportions at age of sentinel catch rates for gillnets suggest that the strength of the 2008 cohort has improved vis-a-vis previous recent cohorts.

The length frequency of cod measured in sentinel surveys shows that the small mesh gillnet is the least selective gear as it retains small and large fish from multiple cohorts, whereas large mesh gillnet and linetrawl tend to capture larger fish from specific size ranges and few overlapping cohorts. Fish captured by small mesh gillnet displayed several modal lengths between 35 and 62 cm throughout the time-series. Modal length of fish retained by large mesh gillnets and linetrawl ranged between 62-68 cm and 54-62 cm, respectively. Indices describing the physiological state of cod varied at both seasonal and annual scales. Liver and gutted body condition declined over the winter and early spring, contrasting with the gonadosomatic condition, and increasing again over the summer once spawning occurs. Annually, trends in condition have varied over the time series, but in general, have declined from 2004-16. Both length and weight at age (6 and older) have declined since the early part of the time series.

Discussion

Participants asked if the sentinel survey is capable of providing information on the performance of the stock as a whole. It was noted that the surveys were introduced at a time when there were gaps in the data, e.g., information originating shoreward of the survey was collected in a manner typical of inshore fishing operations, and cannot be said to be representative of the entire area. However, there is sufficient similarity with commercial catches in certain areas which makes the biological data gathered valuable. It was asked whether these similarities

include length and weight at age. Framework discussions will need to look at a more integrated treatment of the data sets, including what the limitations are.

TAGGING UPDATE

John Brattey and Paul Regular

Presenter: P. Regular

Abstract

Cod tagging in NAFO Subdivision 3Ps was continued through to 2016. During 2008-11 tagging coverage was restricted to Placentia Bay (3Psc); however, coverage was expanded to include Fortune Bay (3Psb) in 2012-16 and Hermitage Bay (3Psa) in 2013. Total numbers of tagged cod released have exceeded 900 since 2009, but dropped to 502 in 2016 when only Fortune Bay was covered. Annual exploitation rates (= % harvested) were estimated for the inshore region (3Psa, 3Psb, 3Psc) and for various size groups of cod, based on recaptures of cod released within the preceding two years. Cod released within six weeks of the fishery opening or during the current fishing season were not used to estimate harvest rates. The numbers of tags returned were adjusted by annual estimates of tag reporting rate based on a high-reward tagging study. The single tag reporting rate for the inshore of 3Ps during 2016 was 0.67 and averaged 0.77 during 1997-2016. The numbers of tagged cod available for capture at the time of the fishery each year was estimated after accounting for initial tagging mortality, tag loss, assumed natural mortality (M = 0.2), and recaptures in preceding years adjusted by the tag reporting rate. The estimates are influenced by the sizes of cod tagged due to selectivity of commercial fishing gear and larger cod (> 60 cm) tend to be more readily selected by gillnets than smaller ones; estimates for 2016 were similar to those for 2015 and ranged from 12% to 19% depending on cod size groups. The harvest rates for 2016 based on cod > 60 cm at tagging were 20% and 27% in 3Psb and 3Psc, respectively. Only 48% (approx.) of the TAC was taken in 2016; if the full TAC was taken harvest rates would have approximately doubled given that most of the unharvested TAC was available to the inshore sector. Tagging in Placentia Bay (3Psc) indicates limited movement to 3KL. Tagging in the western portion of the inshore (3Psa) indicated considerable movement between 3Pn and the extreme west of 3Psa, whereas cod tagged further east in Hermitage Bay tended to move eastward into Fortune Bay. Recent tagging suggests exploitation of 3Ps cod in neighbouring stock areas (3KL/3Pn) is not a major issue for management. Overall the tagging indicates extensive movement between coastal areas among 3Ps cod tagged inshore, but more limited offshore movement.

Discussion

Participants discussed the effect that spatial distribution (of release of tagged fish) has on recapture results and subsequent estimation of mortality. When asked about the usability of the data, participants were advised that the work has recently been focused on tightly restrained geographic areas and may not reveal much about the current overall stock status. However most of the catch comes from the inshore, which is where the tagging is conducted recently.

SURVEY BASED ANALYSIS 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 2017 spawning stock biomass (SSB) is estimated to be in the Cautious Zone (54% above B_{lim}) as defined by the DFO Precautionary Approach (PA) Framework. The probability that the stock is in the critical zone is 0.03. SSB decreased from 2012, but showed an increase in 2017. However, SSB is concentrated (75% of SSB) in ages 5 and 6, with few older (ages 7+) fish in the population. Recruitment has generally been at or above the time-series average since 2005, with particularly strong cohorts produced in 2006 and 2011. Estimated total mortality for fish in the age range of 5-10 years decreased slightly in 2016, but remains high. Over 2014-16, total mortality averaged 0.70 (50% survival per year); however, the relative contributions of natural and fishing mortality to total mortality are unknown.

Projection of the stock to 2020 was conducted assuming mortality rates will be within +/- 20% of current values (2014 to 2016 average). Projected SSB shows a continuous decline to 2020 in most cases, with the decrease ranging from 23 to 58% (2017 to 2020). The risk of being below B_{lim} by 2019 ranges from 0.09 and 0.73, and by 2020 from 0.25 to 0.94.

Discussion

There was discussion on the adequacy of SURBA as a modelling tool for 3Ps Cod. It was noted that the data correlates well for younger and older year classes, but there is little or no correlation between cohorts in year classes 4, 5, and 6. This needs to be investigated, especially considering the length of the data series and the resulting expectation of meaningful results.

Short-term projections were discussed, together with model assumptions (e.g., separating mortality by age and year to indicate how mortality is impacting each year class). A key finding is that SSB has shown recent upturn driven by the strong 2011-year class, however 75% are ages 5-6 so it is a very young SSB, with most fish only now entering into the period of peak mortality. Recently there has been strong recruitment but offset by high mortality. It also means little mature biomass at the older ages. Ultimately, Science was able to determine the probably of biomass being below B_{lim} at approximately 3%, which is relatively low.

There was discussion on the use of retrospective analysis to get a sense of how stable the model is and wether short term predications should be estimated. In the current assessment, there is much less of a retrospective pattern between the model runs, which was a major concern for 2015-16.

There was an agreement that future research should address applying weights from catches versus weights from surveys to the model results. While it appears the current process/model is satisfactory for the current assessment, a model that can estimate both fishing and natural mortality would be a marked improvement. Agreeing on new methods for analyzing the input data and developing new models are two key areas for discussion at the Framework meeting.

Participants asked about the objective for the fishery. The rebuilding strategy focuses on getting the stock into the healthy zone (preliminary target reference point is 2 x B_{lim}) but does not provide a specific time line. While not a Science issue, it was recommended that Fisheries Management include a specific timeline in the next rebuilding plan/harvest plan.

There were suggestions for analyses to be conducted when developing a new model with the ability to estimate fishing mortality. The average age of the SSB over time should be investigated to determine which age classes and possibly whether a plus group should be used in the model. Also, it was noted there is a need to better understand the potential value of spawning biomass at different ages, given that larger fish may produce proportionally more eggs than smaller individuals. We also need to understand the contributors to the high mortality (e.g., fishery, parasites, food stress) as well as alternate theories for low year class strength in some years

There was a discussion that the Harvest Control Rules will not be calculated as this was abandoned in 2016 and removed from the Terms of Reference for the 2017 assessment.

In terms of projections, the high Z and other uncertainties limit the ability to develop longer-term projections. The group decided to generate a series of 3-year projections for Z for 80%, 90%, 110%, and 120% covering the rest of 2018 plus 2019 and 2020.

Science presented findings from a retrospective analysis using stock weights set at a three-year average, with Z at status quo and plus/minus 10% and 20% status quo. This resulted in a probability of being below LRP of < 20% in all scenarios between 2018 and 2020. The projected relative SSB for 2018 ranged from 1.2 to 1.6. Participants asked whether this is too close to B_{lim}/should other scenarios/projections be considered to help keep SSB at current levels or higher. It was suggested to calculate the Z required to move the stock to the healthy zone, even if it is unattainable, and the only way to influence it is catch reduction - likely on the order of 10-12% - to maximize recruitment to counter the future high mortality. Participants concluded that there was no utility in doing this – it would be an academic exercise and other parameters in addition to Z also affect results.

3Ps FISH HARVESTER TELEPHONE SURVEY: 2016 3PS COD FISHERY

Presenter: E. Carruthers

Abstract

Canadian fixed-gear fish harvesters' perspectives on the 2016 fishery were compiled based on the results of the telephone survey conducted by the Fish, Food and Allied Workers Union (FFAW). Results are based on the responses of 56 active harvesters. Harvesters from the eastern region (St. Bride's to Point May) reported catch rates were better in 2017 than in 2016. A similar shift was not reported by those fishing between Fortune and Burgeo Bank.

Surveyed harvesters reported low levels of capelin and squid in 3Ps during the 2016 season, with sand lance and crab being most commonly reported in cod stomachs in 2016. However, reports from the 2017 fishing season indicate capelin, herring and squid increased in abundance, particularly in the bays. Additionally, harvesters reported a shift in the distribution of cod, with higher catch rates further inshore then has been the case in recent years.

Discussion

Harvesters provided highlights related to catch rates of cod, redfish, hake, pollock, as well as baitfish, sharks, and other species groups, with reference to the Halibut Channel, St. Pierre Bank, and other traditional fishing grounds. Commentary on the size, condition of cod, and prevalence of parasites in cod, was also provided. It was confirmed that condition is one of the questions in the Telephone Survey.

RESEARCH RECOMMENDATIONS

Following discussion on water temperature effects and tendency of cod to avoid sub-zero water, it was noted that cod are not found in the warmer waters of 3Ps. It was suggested that research be undertaken to understand cod preferences across the full temperature range.

In discussing the movement of cod into and out of neighboring stocks and areas, there were questions about cod movements away from 3Ps in search of preferable conditions elsewhere. It was suggested that this be investigated as part of the recruitment studies.

In terms of core diets, cod consumption of snow crab shifts to sand lance at around 15 cm, then on to larger fish, cannibalism, etc., as size increases. There is a need to understand the role of cod in the ecosystem, e.g., by understanding at what size / age it shifts from a planktivorous to a piscivorous diet. It was recommended to investigate stomach contents as a function of size.

There is a need to advise on technical aspects to improve the usefulness of the cod tagging data. In particular, we need to better understand whether mortality levels estimated via tag and recapture can be applied to the stock as a whole or whether it is more suitable for more tightly restrained geographic areas. Tagging data may be useful to provide what portion of Total Mortality is Fishing Mortality.

In order to better understand spatial variation in size at age, to distinguish between changes in the spatial distribution versus changes in size or weight at age, there is a need to build on previous work on spatial analysis, which highlighted differences in the maturation schedule across the area, and differences in relative year class strength.

There is a need to better understand the key contributors to mortality (e.g. fishery, parasites, food stress, Migration).

REFERENCES

DFO. 2017. Stock Assessment of NAFO Subdivision 3Ps Cod. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2017/002.

APPENDIX I: TERMS OF REFERENCE

ASSESSMENT OF NORTHWEST ATLANTIC FISHERIES ORGANIZATION (NAFO) SUBDIVISION 3Ps ATLANTIC COD

Regional Peer Review – Newfoundland and Labrador Region

October 17-20, 2017
St. John's, NL

Chairperson: Derek Osborne

Context

The status of Northwest Atlantic Fisheries Organization (NAFO) Subdivision 3Ps Cod was last assessed in October 2016 (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 2018 fishing season.

Objectives

- 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, exploitation rate, natural mortality, 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 2020 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
- Aboriginal organizations
- Non-government organizations

References

DFO. 2017. Stock Assessment of NAFO Subdivision 3Ps Cod. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2017/002.

APPENDIX II: AGENDA[1]

Regional Peer Review Process for Subdivision 3Ps Cod

Memorial Meeting Room,

NAFC, St. John's

October 17-19, 2017

Tuesday, October 17 (0900-1700)

Activity	Presenter
Opening/Chair remarks	D. Osborne
Environmental /Oceanographic Update	E. Colbourne
Fish community trends for 3Ps	M. Koen-Alonso
Review of 2016/17 fishing season and 2017/18 season to date	D. Coffin
Catch	D. Ings
Total landings	L. Wheeland
Catch at age	D. Ings
Logbook data, catch rate index	D. Ings
Observer data	D. Ings
Survey	D. Ings
Biomass/Abundance updates	D. Ings
SSB	D. Ings
Age composition, size at age (length, weight and condition), age at maturity	D. Ings
Distribution	D. Ings
Sentinel Program	M. Simpson
Tagging Update	P. Regular
Population Dynamics: SURBA – Survey-based analysis	D. Ings

Wednesday, October 18 (0900-1700)

Activity	Presenter
Continue with Cod assessment (if additional time is required)	D. Ings
FFAW Questionnaire update	E. Carruthers
Drafting of Cod SAR/Summary Bullets	ALL

Thursday, October 19 (0900-1700)

Activity	Presenter
Drafting of SAR/Summary Bullets	ALL

[1] Please note that this agenda is fluid and changes may be made during the meeting to the timing of specific items on the agenda to allow for necessary discussion of each topic.

APPENDIX III: LIST OF PARTICIPANTS

Name	Affiliation
Derek Osborne	Meeting Chair
Jim Meade	DFO Centre for Science Advice
Sherrylynn Rowe	Marine Institute - Centre for Fisheries Ecosystems Research
Dave Coffin	DFO-FAM
Brian Healey	DFO Science
Dawn Maddock Parsons	DFO Science
Danny Ings	DFO Science
Gary Maillet	DFO Science
Karen Dwyer	DFO Science
Dennis Slade	Icewater Seafoods
Basil Daley	Icewater Seafoods
Joanne Morgan	DFO Science
Don Power	DFO Science
Joel Vigneau	IFREMER Science
Eugene Colbourne	DFO Science
Rick Rideout	DFO Science
Mariano Koen-Alonso	DFO Science
Shelley Dwyer	NL Department of Fisheries and Aquaculture
Erin Carruthers	FFAW
Roland Hedderson	FFAW
Brian J. Careen	Harvester
Kris Vascotto	GEAC
Mark Simpson	DFO Science
Alfred Fitzpatrick	Harvester
Jeff Roberts	Harvester
Laura Wheeland	DFO Science
Trevor Fradsham	DFO Science
Divya Varkey	DFO Science
Tom Fowler	Rapporteur
Nadine Wells	DFO Science
Geoff Evans	DFO Science
Frederic Cyr	DFO Science
Darrell Mullowney	DFO Science
Eugene Lee	DFO Science
Paul Regular	DFO Science
Noel Cadigan	Marine Institute - Centre for Fisheries Ecosystems Research
Nicolas LeCorre	Marine Institute - Centre for Fisheries Ecosystems Research