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Proceedings of a Maritimes Science Advisory Process to Assess the Arctic Surfclam (*Mactromeris polynyma*) Stock on Banquereau

Compte rendu de la réunion tenue dans le cadre du Processus consultatif scientifique de la Région des Maritimes pour évaluer le stock de mactre de Stimpson (*Mactromeris polynyma*) du Banquereau

October 19-20, 2011 | **Les 19 et 20 octobre 2011**

Tana Worcester
Meeting Chair

Tana Worcester
Présidente de la réunion

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June 2012 | **Juin 2012**

Canada

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 contenues dans le présent rapport puissent être inexactes ou propres à induire en erreur, elles sont quand même reproduites aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considérée 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 Maritimes Region Science Advisory Process to assess Arctic surfclam on Banquereau was held on October 19-20, 2011, at the Bedford Institute of Oceanography in Dartmouth, Nova Scotia. Participants included DFO Science and Resource Management, Nova Scotia and Newfoundland provincial fisheries management, as well as Industry representatives. The results of this meeting will be used to support management decisions related to the fishery in 2012 and beyond.

SOMMAIRE

Un processus d'avis scientifique régional des Maritimes pour l'évaluation des mactres de Stimpson du Banquereau a été tenu les 19 et 20 octobre 2011 à l'Institut océanographique de Bedford, à Dartmouth, en Nouvelle-Écosse. Les participants comprenaient des représentants du Secteur des sciences et de la Gestion des ressources du MPO, de la gestion des pêches provinciales de Nouvelle-Écosse et de Terre-Neuve-et-Labrador, et de l'industrie. Les résultats de cette réunion serviront à appuyer les décisions de gestion concernant la pêche en 2012 et au-delà.

INTRODUCTION

The Chair of the meeting, T. Worcester, welcomed participants (Appendix 1) and thanked them for coming to this DFO Science Advisory Process to assess Arctic surfclam and the surfclam fishery on Banquereau, which was held 19-20 October, 2011.

The Chair noted that this was a science peer-review and advisory meeting, which meant that the primary goals of the meeting were to review the information presented by the surfclam assessment team (i.e., to ensure that it was accurate and complete) and then to review the science advice to Fisheries and Aquaculture Management (FAM) based on this information.

She also noted that DFO Science advisory meetings operate by consensus. For the purpose of this meeting, consensus means an absence of opposition to the meeting conclusions and advice that are based on scientific data and information and not on external considerations such as the potential impacts of future decisions. There are no observers within an advisory meeting, so all participants were welcomed and encouraged to participate in the discussion, ask questions, and contribute their knowledge to the process. However, participants were asked to remain respectful, open minded, and constructive in their comments.

The Terms of Reference of the meeting (Appendix 2) were reviewed, including the objectives of the meeting:

- Applying the 2007 assessment framework for offshore clams, identify a range of fishing mortality and TAC options for the harvesting strategy in relation to $F_{current}$ and $F_{0.33M}$ for Arctic surfclams on Banqeureau.
- Examine the annual area swept for trends in the footprint of the fishery.

To assist in this review, H. Bourdages (DFO Science, Quebec Region) had offered to act as an impartial reviewer. In addition, the Chair encouraged other participants to provide a critical review of the information presented based on their knowledge and expertise about surfclam and the clam fishery.

To guide discussions, a working paper had been prepared, which would be produced as a research document upon acceptance. A Science Advisory Report (SAR) would also to be produced as a result of this meeting. This Proceedings report is the record of the discussion of the meeting.

The Agenda (Appendix 3) was reviewed, and no further additions or corrections were made.

ASSESSMENT

Working Paper: Roddick, D., J. Brading, L. Carrigan, T. Davingnon-Burton, S. Graham, and C. McEwen. 2011. Assessment of the Arctic Surfclam (*Mactromeris polynyma*) Stock on Banquereau in 2010. CSA Working Paper 2011/034.

Presenter: D. Roddick
Rapporteurs: T. Worcester

History of the Fishery

Presentation Highlights

The surfclam fishery on Banquereau is a fairly recent fishery. The fishery operates both on the Grand Bank and Banquereau, with Banquereau being the main focus in the late 1990s and most recently. Landings value has increased, but some of this is due to an evolution of the methodology used to calculate landed value. The current TAC is 24,000 t.

Discussion

A change in methodology for calculating landed value was explained in the text, but it would be more useful it is were standardized in the graph or indicated as a change in the series. However, it appears this has been an evolution in the approach and not a change over a single year. It was suggested that a note be included in the figure caption or reference to value be taken out of the working paper entirely.

Recommendation

Given the changes in methodology that complicated interpretation, it was recommended that the description of the changes in fishery value over time be taken out (both Figure and Text).

Commercial Data

Presentation Highlights

A description of the spatial distribution of fishing activity was provided. The fishery started out on the eastern portion of Banquereau, then moved toward the centre, but moved back again. There is still fishing in the central portion, but a large portion is coming out of the east. Changes in commercial CPUE are considered to be reflective of where the fishing occurs, among other factors. Also, catches are fed into a hopper system that continuously feeds the factory, and the processed weight taken at the end of the processing line, so it is hard to match a unit of catch to the effort that produced it. To improve the measure of commercial CPUE, the assessment team looked at breaks in trip that gave enough time for the processing line to be cleared. They then tried to match catch and effort to a smaller level than trip.

Discussion

Although improvements have been made to CPUE, it is still not considered an appropriate index of biomass.

Boat locations are provided every six hours, but the location of the boat does not match exactly with the location of the catch. Aggregating by one minute squares does seem to capture the spatial pattern of fishing reasonably well.

Figure 10 has been revised.

Recommendations

Be clear about the location of the “high density” area, including an indication of location on Figure 8.

Figure 9 should be fixed (line error) and may include some data from 2011 in the final draft.

Survey Design / Survey Gear

Presentation Highlights

The assessment team looked at the standard error of the catch with number of tows, they then picked 260 stations knowing that there would be problems with some. The intent was to ensure at least 200 stations were towed. A new ramp system for the dredge was used to improve safety. Everything was weighed when it came up in the tow, including rocks. A 5 bushel sample from each tow was sorted for catch composition and a 20 bushel sample for large bivalves, including Arctic surfclams. Length frequencies were measured for all clam species. Surfclam samples were taken for aging and other measurements. Samples of other species were not retained because of limited freezer capacity. A SeaScan system was used to determine the suitability of bottom type before dredging. Some tows were done in the rocky areas to check that the bottom was being accurately characterized. Dredge sensor data recorded tow details to help determine accurate tow duration.

Discussion

There was some confusion as to what the different colors on Figure 5 meant. The green line is the 40 meter contour, the red line is the survey line, and the black line is the 100 m contour line. Green dots are regular survey stations, and red dots are repeats of the 2004 survey stations. Some dots are outside the survey line -- wanted to see whether it was possible to fish there but did not use them for the analysis.

Questions were asked about the data that was used to pick survey stations. It was clarified that the survey stations are selected randomly, with the depth contour defining the outer boundary of the survey area. In the past, areas shallower than 40 m were excluded from the survey, but they were included in the survey this year.

The benthos can take up to 10 years to recover. If surveying occurs in an area where fishing has occurred, there would be few surfclams there. Would this influence the biomass estimate? If you have enough stations, this should not influence the results. You want to know where the clams are as well as where they are not.

In the working paper, differences in vessel and gear were mentioned. The dredge was also different, but the width and depth of the blade was the same. Pictures of the dredge were shown later in the day.

There was some discussion about the tow length and whether tow saturation had occurred. Some concern was expressed about throwing out good tows because they had reached saturation, thus potentially biasing the results towards poorer tows. Most tows were 3 minutes. The capacity of the new dredge was different than the previous survey dredge, so if the tow came up full, would tow again for 2 minutes. Tows were only 2 minutes in the high density area in an attempt to avoid tow saturation. Tow saturation only occurred occasionally (approximately 3-4 times) with a 3 minute tow. When two tows were conducted due to saturation of the first tow, both tow results were considered and the one with the greatest catch was used.

There were also some concerns expressed about whether a lower capacity dredge would be less efficient as it got close to being full (but not entirely full, so not requiring a repeat at 2 minutes). This was considered a possibility, but the new dredge also retains less shell hash and sand and, therefore, was less likely to get full as quickly as the old dredge. Catches were recorded by weight and not volume, so it was not possible to look at tow by tow volumes during the meeting.

It was unclear how tow distance had been determined as the graph was in seconds. It was clarified that the tow was timed and then matched to the vessel movement. Tow distance was reduced for those periods where the tow angle indicated the dredge was not fishing.

The rationale for the change from a side to a stern trawler was also clarified. The boat used in the last survey was sold, and the dredge was beat up. The new boat is a stern trawler. Some side dragging was attempted, but it was not considered to be safe. A stern trawler with a ramp system takes less time to dump and set the dredge, and is safer handling on the deck. However, if that design was found to be the reason for the dredge inefficiency, would want to use an approach that increased efficiency. The rationale for the change can be provided in the research document.

There was some discussion on whether there was any use in comparing the surveys in 2010 and 2004 given the large differences between them (vessel, gear, etc.). It was felt that it would be like comparing apples and oranges.

Recommendation

The word “trash” in the text should be changed to “shells” (and other non-living material?).

Selectivity

Presentation Highlights

The selectivity of the dredge was investigated, and a selectivity curve was developed. This indicates that the 2010 dredge retained smaller clams than the 2004 dredge. This should, in theory, increase the catch weight.

Size at 50% retention of the 2010 survey dredge was 62.2 mm and the commercial dredge was 85.6 mm, so an adjustment was required. The selectivity curve was shifted so that the mid-points of the two curves were the same.

Comparison of 2004 and 2010 Surveys

Presentation Highlights

Some (36) of the same tows that were done in 2004 were towed again in 2010, in areas that had not been fished by the clam fishery. Admittedly, these were likely low biomass areas, which is why they were not fished. Analysis indicated that they were significantly different. The tows in 2010 caught less than the same tows in 2004 by 63%. A second approach was to calculate the overall biomass for areas that had not been fished between the surveys. The 2010 biomass estimate was less than the 2004 biomass estimate for these areas. However, they were not statistically different, as the confidence intervals are large.

Discussion

It was noted that even two tows off the side of the boat can catch different amounts. So, the tows would have to be very close to the previous locations for the results to be meaningful. Also, there were not a large number of tows available for the comparison. However, it was felt that the comparison did provide some real information. It indicates that the 2010 dredge was not catching the same (i.e. was less efficient) as the 2004 dredge. However, it may not be useful to apply the 63% value to do a numerical comparison.

The majority of the best catches were 50-70 m, which was similar to 2004.

No comparisons were made with previous surveys other than the 2004 survey.

There were no other known activities that would have disturbed the site, or at least that would have been expected to change the density of surfclams at the survey locations between 2004 and 2010.

Dredge Efficiency

Presentation Highlights

The assessment team tried to determine what proportion of the clams on the sea floor were caught by the dredge (i.e. dredge efficiency) using a depletion experiment and two models developed by the US National Marine Fisheries Service. They also looked at the length frequencies of the clams. In terms of length frequencies, almost all sizes were fully selected by the survey gear. However, it was determined that the dredge was only 45% efficient. This was a surprise, since the US commercial gear is considered to be 80-90% effective. Their survey dredge is only 15% efficient, but it is a much different system. In the presentation, the 95% confidence limits were provided: 21-86%.

Catch versus effective area swept was evaluated. One would expect to see a positive relationship, but, in this case, there was a negative slope. One possible explanation for this negative relationship between catch and effective area swept would be that the clams were deeper than the dredge depth, and that the subsequent passes of the dredge in the depletion study were able to catch the deeper clams (i.e. sediment was liquefied in the first pass allowing for additional catch in the second pass. Patchiness could also be having an effect. The depth of the blade on the dredge was constant throughout the survey -- set as deep as possible with the current dredge.

Discussion

Forty-five percent is not very efficient and indicates that survey biomass would have to be corrected to provide any meaningful estimate of fishable or total biomass.

Additional details were provided on the depletion models used. The first model makes a fine grid and records when the track passes through a grid cell. The model looks at the catch rate and adjusts for the number of passes. If it was 100% efficient, would expect no clams on the next pass. The second model uses a grid of points at 20 cm intervals, which is a much finer grid. Both models came up with identical efficiency and initial density estimates. The parameter k differed slightly between models.

The dredge efficiency in 2004 is not known. A depletion experiment was attempted at that time, but it did not work. This would have had impacted the biomass estimate in 2004.

It was noted that Figure 14 was the track of the boat and not the track of the dredge. It would be better to have the track of the dredge, but this has not been possible to date. One approach would be to multibeam the area during and after the depletion experiment, with the expectation that the tow tracks would be visible on the multibeam image. However, it would be difficult to secure a multibeam system during a depletion study.

It was noted that the location of a 5 foot dredge at depth, with a lot of wire, would be hard to accurately determine. The model should be taking this error into account; however, a multibeam image of the tow tracks would further reduce the error.

The maximum number of times the tracks overlapped was 6 or 7. The majority of the tracks overlapped 0-1 time. However, the CPUE did decrease over time, which is how you determine when the experiment stops.

The area of the experiment was 1/10 of a mile, which is a very small area.

The US has done a large number of these depletion studies, perhaps 20-30 experiments over time. They are starting to look at differences in efficiencies with depth, as well as other possible variables. The US survey dredge efficiency is so low (15%) that they would have to spend 3 days doing a depletion experiment using the survey dredge, so they use a commercial dredge for the depletion experiments.

Do not tend to break many clams with this dredge. A dry dredge tends to break more clams.

Surfclams are not known to go bury down deep. They bury only to the extent of their siphon. Deeper clams may be bigger. The length frequencies of the surfclams from the beginning and the end of experiment look quite similar. Large clams indicated at the end of the graph are likely a measurement error.

Ideally, the survey would use a dredge that was 100% efficient so that no corrections were necessary. However, it may be hard to design something more efficient without knowing why the current dredge is not very efficient. It does not really matter how efficient the dredge is if we know more accurately what the efficiency actually is (i.e. smaller confidence interval). Additional depletion experiments would be expected to improve efficiency estimates.

The efficiency of the groundfish trawl depends on the species and the area of fishing. For many species, trawl efficiency is not known. For many groundfish, the assessments look at trends in the biomass instead trying to determine the total or fishable biomass.

The colored lines in Figure 14 are just to make the tracks distinguishable. A note should be added to the caption.

Recommendations

Include the decline in catch rate for the number of depletion experiment tows in the research document, as well as the confidence intervals.

Some consideration should be given to doing an experiment to look at dredge depth. Would like to see more dredge efficiency experiments.

Need a statement somewhere about the inability to compare biomass between 2004 and 2010. Trend should not be inferred.

Biomass Estimates

Presentation Highlights

The estimated 2010 survey biomass was estimated using two methods: a simple statistical model and an areal expansion using inverse distance weighting with the ACON Data Visualization software package. Results from the statistical model gave a biomass estimate of 798, 085 t with confidence interval of ±17,891 t. The Areal Expansion Method gave a biomass estimate of 744,864 t without a confidence estimate. Adjusting the biomass from the statistical model for the selectivity of the dredge gives a biomass of 518,223 t ± 13,854 t, which only accounts for error in the biomass and not any error in the selectivity curve (will be dropped in the research document). The final efficiency corrected biomass was 1,150,585 t.

A contour map of surfclam selectivity adjusted, efficiency corrected biomass estimated from the 2010 Banquereau offshore clam survey was presented.

Discussion

It was asked whether the same approach was used for calculating the biomass in 2007. The approach recommended in the 2007 framework was used.

Initially, it was suggested that the range of possible biomasses based on the 95% confidence interval should be provided. Upon further discussion, however, it was agreed that this would be an inappropriate use of the confidence interval. The 95% confidence interval provides an indication of the level of uncertainty with the best fit estimate, and does not suggest that a “preferred” biomass level could be selected from within the range.

The biomass contours indicate a density gradient from the area high in Arctic surfclams to the area where Atlantic surfclams dominate when, in fact, the catch composition indicates a sharp divide between these territories. The average may be appropriate, but this map should not be used to identify specific areas of high density that are dependent on a single tow.

It was asked whether the density maps from 2010 and 2004 had been compared to determine any shifts in distribution. There was felt to be a fairly good match between the 2010 and 2004

maps. Observed density levels appeared to have dropped overall, but the areas of high density in 2004 were similar to the high density areas in 2010.

Recommendation

The asymmetrical nature of the likelihood profile (Figure 16) should be carefully described both within the research document and within the Science Advisory Report. The 95% confidence lines on the profile should be labeled.

Aging

Presentation Highlights

Testing of readers showed good agreement within a reader and between readers. In general, a CV of 5 or less is considered good. Here, there is a CV of close to 1, which is very good.

More samples were required in the larger sizes to accurately represent the larger range in ages of these larger clams; however, not very many large clams were sampled. A spike (recruitment pulse) can be seen at 20 years, along with some other pulses. Aging results enable investigation of the survey population size frequencies and population age frequencies.

Discussion

It was asked whether there had been any changes in aging protocols since the framework. There had been none that would affect the use of the data.

It was also asked where the target 5% CV came from. It was noted that there was no set rule, but 5% is a standard that is commonly used in the literature.

The discussion from an aging workshop in the US, that indicated it was difficult to age clams, was mentioned. It was clarified that the difficulty is in the aging process, not in the reading of the samples. Old clams get harder to age since their age “rings” get closer together.

In other areas, some bivalves can produce two rings per year. However, this has not been observed on Banquereau.

It was noted that there has been no cross-lab comparisons (testing of age reading between labs) or verification of ages using the bomb radiocarbon method. However, the assessment team has been searching for old shells in good shape to do this analysis.

Figure 6 is just one example of a reader test against the reference collection. It was considered typical. Not all tests were shown.

A question was asked about fecundity measurements. It was noted that for bivalves in general, fecundity increases with size, but older bivalves may produce eggs that are not as viable.

Recommendation

Include a bit more text describing the recruitment pulses, i.e., whether the new data is consistent with what was discussed during the framework.

Length Frequencies

Presentation Highlights

Length frequencies of Arctic surfclams caught during the 2010 survey were presented.

Discussion

It was asked whether the commercial length frequencies had been compared with those sampled in the observer program. This had not been done recently, but it was noted that there was expected to be more variability in the commercial catch.

Recommendation

It would be useful to compare the length frequencies from the 2010 assessment with the 2004 assessment.

Mortality

Presentation Highlights

Several different methods for calculating total mortality (Z) were used. The "Z=3/Tmax" approach gave a total mortality of 0.06, which was considered to be low. The Beverton and Holt method gave a total mortality of 0.082; the catch curve method gave a total mortality of 0.079; and the Chapman and Robson method gave a total mortality of 0.076. The strengths and weakness of each approach were described. All methods assumed that there were no trends/changes in natural mortality over time. In this case, the analysis covers a 55 year period and there is reasonable confidence that there has not been a trend over that time scale. Fishing mortality was assumed to be small and, since it is based on clams over 25 years old, they have all been exposed to the same cumulative fishing mortality regardless of age.

Discussion

The total mortality was assumed to be 0.08 in 2004 (i.e. for the 2007 assessment). This is the same value that was used in the 2007 framework assessment, though it was not clear how carefully this had been reviewed during the framework.

Is it uncertain whether the mortality is higher in low density areas.

Recommendation

The Chapman and Robson calculation need a better description.

It was agreed that there was no compelling evidence to suggest a change in the assumed natural mortality (M) of 0.08. For example, the following text could be included, "For consistency and compatibility with previous assessments, it was felt that there was no reason to change the M from 0.08." Three methods gave values close to this; the fourth method was simplistic (using only the lifespan of surfclams) and did not make use of available data.

Recruitment

Presentation Highlights

The assessment team looked at population recruitment patterns by applying the estimated constant mortality rate to the estimated age structure for 2010.

There appears to be a recent recruitment pulse as indicated by a mode of clams less than 55 mm. Some recruitment is evident in areas where fishing is occurring, as well as in areas that have not been fished. Recruitment appears to be widespread over the bank, but the pulse of small clams will not enter the fishery for another 10 years.

Discussion

There was some discussion of possible density dependent effects. There is anecdotal evidence from fishermen that areas of high density have large numbers of small clams that are growing slower than expected. Some studies are being done to investigate growth in those higher density areas, and, at first glance, it looks like it is true that there is a slower growth rate in these areas.

The recent recruitment pulse appears to have been widespread, but it is highest in one particular area. It is not clear what the characteristics are of this area that would make it better for recruitment. It is possible that low densities of filter feeders may make it easier for surfclam larvae to settle. Alternatively, areas with higher sediment turn-over, either naturally or through fishing activity, may make conditions better for surfclam settlement.

This evidence of a recent pulse of clams less than 55 mm is in a size range with low selectivity (i.e., are not retained well by the survey dredge). Seeing this many small clams, given the low selectivity, indicates that it may be a big pulse. Length frequencies are being collected from the commercial fishery, so it would be possible to track this suspected recruitment pulse over time. It is not clear whether there would be another survey within the next 10 years.

This potential recruitment pulse (< 55mm) has not yet been observed in the commercial fishery.

Recommendation

Take reference to Grand Bank out.

Size and Age at Sexual Maturity

Presentation Highlights

Age at 50% maturity is estimated to be 8.3 years. If this is compared to the selectivity curve of the commercial gear, it is clear that the age of 50% maturity is below the selectivity of the fishery. Also, there does not appear to be growth over-fishing as the commercial gear is selecting right around the maximum biomass per recruit.

Discussion

A question was asked about the ratio of males to females. This is presented in Table 10, though this table only includes the small (thus younger) clams used to estimate age at 50% maturity

and does not include older/larger clams. For ocean quahogs, there is evidence of difference in growth rate between males and females.

It was unclear why the surfclams on Banquereau appeared to be maturing later than on Grand Bank. Attempts were made to explain the species' strategy; however, it was not the difference you might expect.

A question was asked about Figure 25, and whether the one outlaying point had a large influence on the result. It could, but the data is real.

Recommendation

It was recommended that, at some future point, the aging samples should be combined to determine an overall age and size at maturity and investigate any potential changes over time.

Yield

Recommendation

Add "fishable" to biomass on page 20 (last sentence).

Other Species

Presentation Highlights

The surfclam survey catches other clam species. A map was presented showing the spatial distribution of other species.

Discussion

There had been a previous discussion, there had been some talk about looking at the proportion of Atlantic and Arctic surfclams on the eastern shoal as an indication of climate change. In the shallow area, get almost all Atlantic surfclam. It is not clear whether there range is expanding down into the deeper waters as the 2004 survey did not select stations from this shallow area (above 40 m). It was felt that there would not need to be a dramatic change in temperature at that depth to impact clams.

There is competition between Arctic and Atlantic surfclams that leads to this distinct divide between them. There is not much overlap between the two species. This would be apparent in the commercial catch.

It would be possible to investigate changes in water temperature over time in this area. However, climate change could also increase storminess, which may also have an impact. Unfortunately, there are not any links between survey catch and temperature.

Has there been any indication of "jelly clams" lately? None.

Recommendations

Include any relevant links to temperature maps if they exist and note that the 2010 survey could be considered a baseline for climate change investigations into the future.

Bycatch

Presentation Highlights

Bycatch data from the International Observer program data was presented. Observers are not out often on the boats. Observers are told to get the best estimate they can of the catch composition, but there are no rules on how to do that. They can either take a sample or do a visual estimate. Most of the data indicates big items, so most observers are likely providing a visual estimate. Small worms and other small animals that you might expect from sampling have not been recorded. Northern propellerclam are the highest non-surfclam species. The next most common bycatch is sand dollars. It is unlikely that the fishery is having an impact on sand dollars, but this is not known for sure. Another species of potential concern is Skate if they get listed by COSEWIC. In the future, it might be necessary to separate out the skate species.

Crew on fishing vessels also do some identification of bycatch. These results indicate 49% surfclam, 16% propellerclam, etc.

Finally, there is the survey bycatch. However, the survey covers areas that are not fished, so only areas with high catch rates of surfclam were included as areas of potential fishing. Only living material was presented. Some differences were observed between the survey bycatch and the commercial sampling. Sand dollars are still high, and there are many other similarities. Both sea cucumbers and sea mice are non-bivalve species above 1% of the catch. The occasional skate was caught, including one winter skate. Less than half of the catch is surfclam if you include non-living material.

Discussion

The table in the document shows winter skate as a separate category. However, this does not mean all winter skate are captured in this section. It appears as though winter skate was only identified to species by an observer in 1995. Be very careful interpreting skate identification, as skate less than 35 cm are hard to distinguish.

It was not clear why rock and shell were included in the bycatch analysis. It is recorded, but nothing is done with it for now. Perhaps it may be useful in the future.

A question was asked about the crew sampling program. It has improved since 2007, but it could use some more improvement.

The fishing crew and observer program results are difficult to compare as there have been changes over time. The bycatch is also expected to vary depending on where the fishing occurs.

Whether bycatch is presented as tons versus kg should be checked.

Studies of bycatch mortality in this fishery have not been conducted. There is hand picking and automatic separation of bycatch at different points.

Clarification was sought on how areas of probable fishing activity were selected for the bycatch analysis. It was done somewhat arbitrarily, with densities of surfclams above 100 g/m2 considered more likely to be targeted by the fishery. A sensitivity analysis could be done on this.

Do you have an estimate of the total amount of sand dollar caught? It would be a pretty rough estimate. Sand dollars are a low concern given their coverage across the whole shelf. Even skate are not necessarily a concern unless listed by COSEWIC.

Is there any catch of surfclam in other fisheries? No.

Recommendation

Show the same types of bycatch (i.e., with or without non-living material) in all tables.

Ecosystems and Habitat

Presentation Highlights

Area impacted by fishing activity within the 100 m contour were mapped and presented. The total area dredged per year does not account for overlapping tows. In general, the fishery impacts less than one percent per year. In 2000, 2.3% of the total area was impacted.

Discussion

Clarification was sought on how area of impact was calculated. Time on bottom and speed was used to calculate distance.

The 30 m contour could be excluded from the calculation of the total area (thus the proportion of the area impacted), since fishing does not occur in this area.

It was considered unlikely that ¼ of the total area has been dredged.

It was unclear how this analysis accounted for areas that may have recovered over time. A report in 2008 did an analysis of recovery. The recovery of fast growing species was found to be less than 3 years. Large bivalves took longer to recover. Ten years later, side scan sonar was still able to detect impacts to the sediment structure. However, the area studied was deeper than the areas that are typically fished. With ongoing fishing effort, surfclam populations are not expected to recover to virgin biomass.

Recommendation

Only include the last two years worth of footprint in the SAR, as this was the way it was presented in the 2007 assessment. In the research paper, maps of the last two years, ten years, and the full time series should be included.

Exclude the estimate of “total area”, as it may not be meaningful given that we know there are tow overlaps.

Find out how the publication of the study results are coming along (ask Kent Gilkinson) and exert pressure, if possible, to get this completed.

Discussion / Conclusions

Presentation Highlights

Efficiency corrected fishable biomass was estimated to be 1,150,585 t. At a harvest strategy of $F_{0.33M}$ where 0.33M is 0.026, the TAC would be 30,375 t. At a harvest strategy of $F_{0.33M}$ only looking at areas with a density of surfclams greater than 75g/m2 (as was done in the Grand Bank assessment), the TAC would be 27,592 t. Using a harvest strategy of $F_{current}$ where F=0.017 as the average of the last 5 years, the TAC would be 19,731 t, and using a harvest strategy of F_{TAC} where the current F=0.021, the TAC would be 24,000 t.

The size at 50% selectivity of the current commercial dredge is near the maximum cohort biomass and is larger than the size at 50% maturity.

The only potential concern with bycatch is skate if listed by COSEWIC, and sand dollars based on Marine Stewardship Council (MSC) criteria. The MSC criteria are not necessarily a concern for DFO.

A strong year class appears to have recently entered the fishery, and CPUE is the highest since at least 1992. There is evidence of a strong recruitment pulse that would enter the fishery in 10 years.

This fishery uses bottom contacting gear, and disturbance to substrate may last up to a decade.

Discussion

Is $F_{current}$ relevant given the increase in TAC in the last few years? Recent $F_{current}$ is closer to F_{TAC}.

Why is CPUE being used as an indication of abundance? In the last few years, it has jumped dramatically. It may reflect recruitment entering the fishery. However, there still have been changes in the fishery that confound this. For example, industry has done some multibeam mapping of the area, and there are likely efficiency gains associated with this. In the 2007 framework, CPUE could not be modeled as an index of biomass, despite quite a bit of work on this. It is a non-standardized CPUE, and one would expect differences between vessels. One vessel is close to being active since the beginning of the time series. It was asked whether the decision to reject the CPUE as an abundance index was a general conclusion about CPUE or specific to the surfclam fishery. It was clarified that this decision was specific to the surfclam fishery.

There was some discussion of whether a comparison should be made with the 2004 survey or whether this was just an opportunity to best describe the current state of the resource. It was suggested that the later approach was preferable. The 2006 data point was more precise but it could have been wildly inaccurate. A range of other indicators suggest that it is a healthy fishery. Natural mortality may be a bigger factor than fishing mortality.

There was further discussion on the usefulness of a time series for this species. Again, it was reiterated that the goal should be to focus on using the best absolute estimate at a given point in time, and it was felt that a good understanding of dredge efficiency is critical in getting the best point estimate. Other requirements should also be captured.

In the 2007 framework, modeling indicated that the biomass estimates were poor and were lower than expected from the survey data.

It was asked why the target F was applied only to areas greater than 75g/m^2 on the Grand Bank and whether there was a scientific basis for doing so. It was clarified that this came out following the Grand Bank Assessment, and that it was only presented here for information. For the Grand Bank, no target F was set. No target F was set for Banquereau either. Science is providing the biomass, and it is up to management to determine risk.

It was suggested that the lengths may have to be binned into groupings greater than 5 mm bins in 2004.

It was noted that there is an indication of a recruitment pulse that could enter the fishery in 10 years time. This could be monitored in the commercial sampling. It was unclear whether size composition had changed since 2004, and it was suggested that this could be check and added to the Research Document.

Recommendations

The conclusion of the RAP was that trying to compare the two time periods is not useful given the differences in survey gear, design and execution.

It was agreed that care should be taken in statements about CPUE (to avoid suggesting it as an index of abundance).

Talk about biomass first. Talk about confidence intervals around this. Do not compare with 2004 or use CPUE. Then continue with indicators of healthy stock, including the fact that CPUE is increasing and that there is a broad length frequency distribution with indications of recruitment. Indicate that age of maturity is below the selectivity curve and current fishing mortality is below the F level recommended in the last assessment. $F_{current}$ is less than $F_{0.33M}$.

REVIEW OF SCIENCE ADVISORY REPORT

Fix Figure 1. Remove Gully and Coral box boundaries and insert an inset map.

<u>Biology</u>

Remove reference to the Alaskan population.

Move sentence on Z to the stock status section. Add more information [see new paragraph in draft SAR]:

> Using three different methods…

There was some discussion on the need to reevaluate natural mortality if fishing mortality remains high. The current estimate is based on animals that grew up before fishing started and were exposed to the same amount of fishing mortality, so the slope would be the same just dropped down. It only includes clams over 25 years.

Recommendation

Include an explanation of how fishing mortality is not seen to have influenced estimate of total mortality – further justification for using 0.08.

Explain why a Z of 0.06 was not used in the assessment, i.e., indicate “cons” with this approach such as it is not based on available again information, etc.

Add age and size of maturity. And age at 50% selectivity.

Fishery

There was some discussion of whether to mention that the survey was a collaborative survey between DFO and industry. While this collaboration is fully supported and appreciated, DFO spends too much time explaining why results are not biased just because there is industry involvement. In 1994, when the industry survey was first started, it was a good thing to highlight the partnership and funding contribution. It is not as critical anymore. It was not felt to be necessary to highlight in the SAR.

It was asked whether it was worth mentioning that there has been a fluctuating number of vessels over time. This helps explain why CPUE is hard to interpret. There have not been 4 vessels for 22 years. If it is useful for interpretation of the science, then it should be included. The paragraph from the context could be used.

Recommendations

The agreement of the RAP was that the quality of a survey, whether it is a DFO survey or an industry-DFO survey, and its acceptance through the peer review process makes it appropriate to consider it a valid survey for consideration within the assessment. The surfclam survey is considered an appropriate survey for use within the assessment.

Modify the paragraph on the number of vessels. There were three vessels for a long time and two in the past 5 years.

Stock Assessment

Rearrange the paragraph on CPUE. Talk about the different confounding factors that make it a bad index of abundance, including changes in the fisheries.

The figure on catch and effort included in the last assessment appears to have been lost. This was presented. This new figure shows effort dropping and catch going up. There was some discussion on whether to include this figure or the one in the draft SAR.

There was some discussion on whether to show a figure of the length frequencies and recruitment pulses, specifically, which of the figures would be the most useful more management. There is a need to discuss the current recruitment pulse in the SAR.

There was also some discussion on how to describe the uncertainty around the biomass estimate. It was suggested that the confidence intervals should be included around the dredge efficiency. The biomass before correction should be included, with correction for fishable biomass, and then the dredge efficiency.

Is the biomass corrected in Figure 5? Yes

Recommendations

Include catch, effort and CPUE graph in the SAR with some supporting text.

Include the bottom of Figure 22 with the 50% selectivity line. Add text about the current and the future recruitment pulse. Note that the fishery is not dependent on incoming recruitment, and there is a broad range of ages in the population. Need to consult others to help describe exactly what the graph means.

Delete the biomass from Figure 5.

Habitat

A figure showing the sum of the three time periods was missing form the working paper. It was suggested that only the last two years of footprint should be included in the SAR, as the figure proposed was considered to be misleading in terms of fishing intensity. The two year time frame seems to focus on biological recovery rather than on habitat recovery. However, it is not clear what the habitat recovery is – a study in much deeper water indicates at least 10 years.

Check scale on Figure 6. Label may be wrong.

Recommendation

Within the Research Document, include maps of habitat footprint for 26 years, 10 years and 2 years. Include map of 2 years in the SAR.

Bycatch

It was asked why commercial catch results were presented rather than IOP results. Various explanations were provided, particularly because this was felt to better reflect the fishery and it was representative of the other results.

Recommendation

Use common names.

Add more description of what is caught (or not caught) and the sources of bycatch.

Sources of Uncertainty

It was asked whether something was needed here on recruitment and growth, as was included in the previous SAR. However, it was felt that there is less uncertainty about this now than in the past.

Conclusions

The sentence indicating that life-history characteristics have implications for management is not needed.

There was some discomfort expanding the uncertainties in the biomass to the estimate of yield, and it was felt that the column with the confidence interval range was not required. This was felt to be an inappropriate use of uncertainty. The large confidence intervals indicate that confidence in the value presented is low, so it should be used with caution. Confidence intervals should not be used to set a range from which a desirable TAC should be selected at random.

It was questioned whether $F_{current}$ should be included in the table. $F_{current}$ is an average of the past five years, and the past 5 years are not representative of the future. It was unclear what the intent or value in including this might be. $F_{current}$ is usually used to talk about whether the fishery is above or below the target.

It was suggested that a statement on the fishable biomass estimate of uncertainty, as well as what this means for management, should be included in the first paragraph.

ACKNOWLEDGMENTS

The clam assessment team was thanked for their hard work, the reviewer for his helpful comments and suggestions, and the rest of the participants for participating in the meeting. Best wishes to Dale!

APPENDIX 1. List of Participants.

Maritimes Science Advisory Process on
Assessment of Arctic Surfclam on Banquereau

Needler Boardroom
19-20 October 2011

ATTENDEES

Participant	Affiliation
Boudreau, Nathan	Premium Seafoods Ltd.
Bourdages, Hugo	DFO Quebec / MLI
Carrigan, Lori Leigh	Ecosystems and Oceans Science
Boyd, Catherine	Clearwater Seafood
Davignon-Burton, Tania	DFO Maritimes / PED
Graham, Sara	DFO Maritimes / PED
Greening, Linde	Nova, Scotia Fisheries & Aquaculture
Hurley, Peter	DFO Maritimes / PED
LeBlanc, Jules	Ocean Pride Fisheries
LeBlanc, Milton	Ocean Pride Fisheries
Leslie, Stefan	DFO Maritimes / FAM
Lee, Ken	Sachun Seafood
MacDonald, Carl	DFO Maritimes / FAM
Mugridge, Adam	Louisbourg Seafood's Ltd.
Mosher, Jim	Clearwater Seafoods
Paul, Tim	Maliseet Nation Conservation Council (MNCC)
Pond, Nancy	NL Dept. of Fisheries & Aquaculture
Penney, Christine	Clearwater Seafoods
Roddick, Dale	DFO Maritimes / PED
Samson, Edgar	Premium Seafoods Ltd.
Samson, Rèal	Premium Seafoods Ltd.
Sarty, Matt	Clearwater Seafoods
Sciocchetti, Robert	D'Eon Fisheries Ltd.
Sullivan, Loyola	Ocean Choice International Inc.
Worcester, Tana	DFO Maritimes, CSA

APPENDIX 2. Terms of Reference.

Terms of Reference

Assessment of Arctic Surfclam on Banquereau

Maritimes Regional Science Advisory Process

19-20 October 2011
Dartmouth, Nova Scotia

Chairperson: Tana Worcester

Context

There has been an Arctic surfclam fishery on Banquereau since 1986. At that time, the Total Allowable Catch (TAC) was set at 30,000 t. Three factory freezer-processors fished year round, with catches up to 25,000 t. A 1996-1997 Industry-DFO survey of Banquereau resulted in a reduction of the TAC for Banquereau from 30,000 t to 24,000 t in 2005.

An assessment framework for the offshore banks (Banquereau and Sable banks) conducted in 2007 recommended that the fishing mortality, F, should be a function of the natural mortality, M (DFO). With the uncertainties from a relatively new fishery and lack of a survey time series, a conservative level of F=0.33M was recommended as appropriate. The 2007 assessment of Banquereau surfclam determined that a TAC of 24,000 t corresponded to a fishing mortality of 0.0164.

A survey of Banquereau was conducted in 2010. This assessment will apply the 2007 framework using the more recent survey information. Advice will be used to determine a harvesting strategy within the context of an Integrated Fisheries Management Plan.

Objectives

- Applying the 2007 assessment framework for offshore clams, identify a range of fishing mortality and TAC options for the harvesting strategy in relation to $F_{current}$ and $F_{0.33M}$ for Arctic surfclams on Banquereau.
- Examine the annual area swept for trends in the footprint of the fishery.

Expected Publications

- CSAS Science Advisory Report
- CSAS Research Document
- CSAS Proceedings

Participation

- Scientific experts from within DFO
- Industry knowledgeable in clam fisheries
- Fisheries managers

References

DFO. 2007. Proceedings of the Maritime Provinces Regional Advisory Process on Assessment and Management Strategy Framework for Banquereau Arctic Surfclam and Ocean Quahogs on Sable Bank and in St. Mary's Bay. 17-18 January 2007; 4-5 April 2007. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2007/008. http://www2.mar.dfo-mpo.gc.ca/science/rap/internet/Pro2007_008.pdf (Accessed June 7, 2012).

DFO, 2007. Assessment of the Ocean Quahog (*Arctica islandica*) Stocks on Sable Bank and St. Mary's Bay, and the Arctic Surfclam (*Mactromeris polynyma*) Stock on Banquereau. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2007/034. http://www2.mar.dfo-mpo.gc.ca/science/rap/internet/SSR_2007_034_E.pdf (Accessed June 7, 2012).

APPENDIX 3. Agenda.

Maritimes Regional Science Advisory Process on Assessment of Arctic Surfclam on Banquereau

Date: 19-20 October 2011

Chair: Tana Worcester

Hayes Boardroom
Bedford Institute of Oceanography
Dartmouth, Nova Scotia

DRAFT AGENDA

19 October 2010 – Wednesday

09:00 – 09:15 Welcome and Introduction (Chair)

09:15 – 12:00 Presentation of Assessment Working Paper

12:00 – 13:00 Lunch

13:00 – 17:00 Discussion

17:00 Adjournment

20 October 2010 – Thursday

09:00 – 09:15 Review of Previous Day (Chair)

09:15 – 12:00 Review of Science Advisory Report

12:00 – 13:00 Lunch

13:00 – end As required