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Proceedings of the Maritimes Regional Peer Review of the Arctic Surfclam (*Mactromeris polynyma*) Framework: 2016

June 28-29, 2016
Dartmouth, Nova Scotia

Chairperson: John Neilson
Editors: Tanya Koropatnick and Tana Worcester

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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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TABLE OF CONTENTS

SUMMARY

A regional peer review meeting was held on June 28-29, 2016, at the Bedford Institute of Oceanography in Nova Scotia to conduct a review of the Arctic Surfclam framework. The focus of the meeting was to review the science information basis to conduct a preliminary risk assessment of spatial management options for Arctic Surfclam in Atlantic Canada, including a review of available fishery, survey, biological, and ecological information. As part of this review, the relative risk and ongoing information requirements of the current management approach and alternative spatial management approaches were discussed. Participation in this meeting included Fisheries and Oceans Canada (DFO), non-DFO scientists, First Nations and Aboriginal organizations, the fishing industry, Nova Scotia Department of Fisheries and Aquaculture, and a non-governmental organization.

The Arctic Surfclam fishery in the Canadian Atlantic operates on both Banquereau and the Grand Bank, with primary focus on Banquereau in recent years. There was insufficient new information for the Grand Bank to allow a new analysis of that area, so the meeting focused on new information and analyses for Banquereau. Meeting participants agreed that available information and analyses supported the need for an updated assessment approach and corresponding science advice for Banquereau. In the absence of habitat suitability data, the use of Vessel Monitoring System (VMS) data to determine fished area was considered a reasonable proxy for habitat suitability of the Arctic Surfclam in areas that have been fished. The proposed surplus production model and spatially disaggregated analysis was considered by most participants to be informative and useful, and viewed as an improvement over the previous bank-wide stock assessment approach. However, the use of multiple assessment approaches was deemed advisable to help validate results. Participants recommended that survey data, in addition to other available information, should be used to inform an integrated stock assessment once sufficient data are available. The current frequency of stock assessments for Arctic Surfclam was considered too low. It was recommended that the assessment schedule and the format of annual updates be revisited.

This proceedings document is the record of the meeting discussions and conclusions.

Compte rendu de l'examen par les pairs de la région des Maritimes de l'évaluation du Cadre pour la mactre de Stimpson (*Mactromeris polynyma*): 2016

SOMMAIRE

Une réunion d'examen par les pairs s'est déroulée les 28 et 29 juin 2016 à l'Institut océanographique de Bedford, en Nouvelle-Écosse, dans le but d'effectuer un examen du Cadre pour la mactre de Stimpson. La réunion a consisté principalement à examiner les renseignements scientifiques de base afin d'effectuer une évaluation préliminaire des risques des options de gestion spatiale de la mactre de Stimpson au Canada atlantique, et comportait un examen des renseignements disponibles en matière de pêche, de relevé, de biologie et d'écologie. Dans le cadre de cet examen, le risque relatif et les exigences d'information continue de l'approche de gestion actuelle et des approches de gestion spatiale de rechange ont été abordés. Les participants à cette réunion comprenaient des représentants de Pêches et Océans Canada (MPO), des scientifiques ne faisant pas partie du MPO, des Premières Nations et des organisations autochtones, l'industrie de la pêche, le ministère des Pêches et de l'Aquaculture de la Nouvelle-Écosse et un organisme non gouvernemental.

La pêche à la mactre de Stimpson dans l'Atlantique du Canada se déroule sur le banc Banquereau et le Grand Banc, avec une attention particulière accordée au banc Banquereau ces dernières années. Les nouveaux renseignements concernant le Grand Banc étaient insuffisants pour permettre une nouvelle analyse de cette zone; la réunion s'est donc concentrée sur les analyses et les nouveaux renseignements relatifs au banc Banquereau. Les participants à la réunion ont convenu que les renseignements et les analyses disponibles soutenaient le besoin d'une approche d'évaluation à jour et d'avis scientifiques correspondants pour le banc Banquereau. En l'absence de données sur les habitats propices, l'utilisation des données d'un Système de surveillance des navires (SSN) pour déterminer les zones de pêche a été considérée comme un indice raisonnable relatif aux habitats propices de la mactre de Stimpson dans les zones où des activités de pêche se sont déroulées. D'après la plupart des participants, le modèle de production excédentaire proposé et d'analyse désagrégée sur le plan spatial s'est révélé instructif et utile et a été perçu comme une amélioration par rapport à la précédente approche d'évaluation d'un stock à l'échelle du banc. Toutefois, l'utilisation de plusieurs approches d'évaluation a été recommandée pour aider à valider les résultats. Les participants ont recommandé d'utiliser les données d'enquête, en plus des autres renseignements disponibles, afin d'éclairer l'évaluation intégrée d'un stock dès que suffisamment de données sont disponibles. La fréquence actuelle des évaluations des stocks pour la mactre de Stimpson a été jugée trop faible. Il a été recommandé de revoir le calendrier des évaluations ainsi que le format des mises à jour annuelles.

Le présent document est un compte rendu des discussions et des conclusions de la réunion.

INTRODUCTION

The Arctic Surfclam (*Mactromeris polynyma*) fishery on Banquereau, on the Scotian Shelf, was initiated in 1986. After some initial exploratory fishing, a quota-regulated fishery was put in place for Arctic Surfclam on the Grand Bank in 1989. The Scotian Shelf and Grand Bank offshore clam fisheries are managed under one plan, with the licence holder(s) having equal access to quotas in both areas. Science surveys of Banquereau Arctic Surfclam were conducted in 2004 and 2010. Due to the large size of the Grand Bank, a scientific survey of Grand Bank Arctic Surfclam was conducted in three parts ending in 2009 (2006, 2008 and 2009) to assess the biomass of the stock in this area. An assessment framework for Arctic Surfclam on Banquereau and Sable banks took place in 2007. A peer-reviewed stock assessment of Grand Bank Arctic Surfclam was conducted in 2010, using an assessment approach similar to that developed for Banquereau. The Banquereau Arctic Surfclam stock was last assessed in 2011. In 2014, DFO initiated independent reviews of the science and management of Canadian Arctic Surfclam. Both the science and management reviews recommended consideration of a spatial management approach for Arctic Surfclam.

An Arctic Surfclam Framework Data Review meeting was held on June 28-29, 2016, at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia. After welcoming participants (Appendix 1) and doing a round of introductions, the meeting chairperson, Dr. John Neilson, provided a brief introduction to the meeting. It was noted that this was a science peer-review meeting, which means that it would be focussed on the review of science information rather than on the management implications of that information. While everyone was invited to participate fully in the discussion and contribute knowledge to the process, the intent was to deliver a scientifically defensible product. Following the Chairman's introduction, the Coordinator for the Maritimes Region Centre for Science Advice, Tana Worcester, provided a brief overview of the Canadian Science Advisory Secretariat (CSAS) science advisory process. It was then explained that Fisheries and Oceans Canada (DFO) is obliged to protect confidential information provided to the government by a third party, including financial, commercial, scientific or technical information (as per the Access to Information Act), and has implemented the "Rule of Five" to restrict disclosure of commercial catch/effort information, including fishing locations, that can be attributed to fewer than five participants. Given that there is a single participant in the surfclam fishery, fulfilling the Rule of Five is particularly challenging. However, to enable a reasonable Peer Review of the assessment methods proposed, an agreement with industry was reached so that important but sensitive information could be presented during the meeting. To help fulfill obligations to protect this information, an Arctic Surfclam Peer Review Committee Agreement was circulated to participants for consideration prior to the meeting. The Agreement was reviewed with participants, including limitations on the use and disclosure of certain third party information. Each participant provided verbal consent with the agreement.

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

- compile and review the science information basis to conduct a preliminary risk assessment of spatial management options for Arctic Surfclam in Atlantic Canada;
- conduct a qualitative risk assessment to assess the relative risk and ongoing information requirements of the current management approach and alternative spatial management approaches; and
- determine whether any of the information presented would trigger a new science assessment for Banquereau or Grand Bank surfclam, and if so, what approach would be used to conduct the assessment.

The agenda (Appendix 3) was reviewed and no additions were suggested. To guide discussion, three working papers were provided to meeting participants on June 23, 2016, ahead of the meeting.

This Proceedings document constitutes the record of the meeting discussion, including consensus statements and research recommendations that were agreed upon during the course of the meeting. A Science Advisory Report was not produced.

PRESENTATIONS AND DISCUSSIONS

DATA REVIEW AND ASSESSMENT FRAMEWORK OF THE ARCTIC SURFCLAM (MACTROMERIS POLYNYMA) ON BANQUEREAU AND GRAND BANK

Working Paper: Hubley, B., and S. Heaslip. 2016. Data Review and Assessment Framework of the Arctic Surfclam (*Mactromeris polynyma*) on Banquereau and Grand Bank. CSAM Working Paper 2016/13.

Presenters: B. Hubley and S. Heaslip
Rapporteur: T. Koropatnick

Presentation

A review of survey and fishery information, life-history characteristics, habitat suitability, and impacts of dredging for Arctic Surfclam (*Mactromeris polynyma*) in Atlantic Canada was provided. The last Arctic Surfclam survey was in 2010 and since 2007, fishing activity has occurred almost entirely on Banquereau with very little effort directed towards Grand Bank. Thus, the majority of the analysis presented was based on fishery data from Banquereau. There are issues with using catch per unit effort (CPUE) data, such as increasing efficiency in the fishery, spatial variability, and a short time lag in the reporting of catch. The time lag and spatial variability was partially mitigated through censoring and spatial aggregation of the data. Vessel Monitoring System (VMS) data provided more accurate and more frequent positional information for the spatial analysis and allowed us to determine the specific areas of exploitation. An animation of VMS data illustrated the movement of fishing vessels from 2004 to 2015 showing frequent movement to different areas within the defined fishing areas with vessels often returning to the same general area over time.

Density estimates from the survey in 2010 were similar to density estimates from the 2010 CPUE when overlapping locations were compared. When these density estimates were expanded to the fished area, which was determined from the VMS footprint, the resulting biomass estimates were also similar between the survey (209,261 t) and CPUE (217,604 t) for 2010. Biomass estimates from the last assessment were corrected for dredge efficiency, which was estimated to be 0.45 with considerable uncertainty. A Bayesian surplus production model was fit to the available data in order to incorporate and quantify the uncertainties in dredge efficiency and the resulting biomass estimates, and to provide estimates of process and observation error. The ability to propagate credible errors is particularly useful in the context of risk assessment. To facilitate the discussion of a spatial management approach, five example areas were constructed considering the following criteria: easily navigable (made of straight lines), encompasses large scale contiguous clam beds, be roughly equal in total biomass, and include both high and low density areas. The production model was then fit to the CPUE indices for each area with some parameters (i.e., dredge efficiency) estimated across areas. The results of the model show a trend in declining catch rates across areas for the last few years. Maximum sustainable yield (MSY) reference points were calculated from the surplus production model with an F_{MSY} estimate near 0.1; however, phase plots indicate that catch rates tend to decline when F is greater than 0.5.

The relative risks of high F (MSY) versus low F (MCY) management strategies, and whether these management strategies are applied to biomass estimates based on only the fished areas versus the total bank area, were assessed. This analysis suggested that fishing strategies based on estimated biomass of the whole bank are more risky than estimated biomass for just the fished areas because less information is available for the areas that have not previously supported fisheries. In addition, exploitation rates near the estimates of F_{MSY} are more risky than alternative F reference levels that are lower than F_{MSY}.

Discussion: Background, Life History, and Ecosystem Considerations

It was observed that it would have been useful to review annual maps of catch and effort on Banquereau more slowly (i.e., rather than as a fast-paced animation) to better examine changes in catch and effort distribution over time. It was explained that the animation was provided as a compromise to protect third party information, while also illustrating the cyclical ebb and flow of fishing pressure within the different fishing areas on the Bank.

There were remarks on the frequency by which the fishery returned to certain areas. Specifically, for higher effort areas, the data indicate certain grid cells received continual effort over multiple years. It was observed that data resolution (i.e., binning into 1 km^2 cells) may be part of the issue. The same general area may be revisited without repeatedly fishing the exact same place, but the data is not available at a fine enough resolution to reveal such details. It was further observed that the rationale for applying a surplus production model to estimate the biological rate of population increase is that the model could be used to identify an appropriate return time for specific areas of the Bank.

There was some general discussion on the question of scale with respect to the usefulness of the available data in detecting individual clam beds. For example, a survey tow is short (approximately 3 minutes), and thus can provide more accurate clam density data than data from a commercial tow (approximately 15 min duration), which may cross multiple patches of varying densities. It was observed that patches of clams can be found at various resolutions (including patches smaller than a 1 km^2 grid cell). The approach proposed in Hubley and Heaslip (WP 2016/13) uses VMS data to characterize more coarse scale patches.

There was a question about the level of confidence with the age data. It was confirmed that the bomb radio carbon method has been used to verify lifespan as determined by the annual ring method, so the life history information on growth and longevity can be considered accurate (D. Roddick).

It was observed that vulnerability to climate change and the role of surfclam in the ecosystem should be given further consideration. It was also observed that certain bycatch species (e.g., Ocean Quahog) are exceptionally long lived, so impacts to these species should also be further explored.

There was some discussion on the need for a habitat suitability assessment, including considerations of depth, temperature, and sediment properties. The current analysis uses fishing data as a proxy for habitat suitability. Some participants noted again their concern with using fishing data as a proxy for habitat suitability for the entire Bank, as large portions of the Bank have never been fished. The license holder noted that multibeam sonar data has been collected for Banquereau and analyzed to identify suitable clam habitat. Going forward, these data could be made available to DFO for incorporation into the assessment.

Discussion: New Analyses

The Chair reminded participants that the modeling methods and analyses presented in the working paper are intended to be illustrative of an approach that could be used in a future stock assessment, and to help identify issues that require further attention.

While meeting participants acknowledged that there are inherent risks with relying upon CPUE, there was general agreement that the analysis was appropriate, given available data. The importance of fishery-independent survey data was also stressed. However, in the interim years between surveys, analyses that rely on catch and effort data, like the one proposed here, could be used to monitor the fishery and support management decision-making. Catch and effort data will also continue to be an important part of the assessment until a sufficiently long time series of surveys is available, and will be useful even if surveys are conducted more frequently.

There was some discussion on the approach to calculating fishable biomass. While total biomass is critical for stock recruitment relationships, here the focus was on what is considered fishable, thus low density areas were excluded. It was noted that when the fleet moves on from a fishing area, roughly 25% of the biomass may remain. Thus, by relying on catch rate to calculate total biomass, the estimate may be off by approximately 25%. It was noted that there is no stock-recruitment relationship in the surplus production model, and q addresses the fishing efficiency component to some extent. The proposed approach was intended to estimate total biomass in the fishable areas, which builds upon previous efforts that extrapolated biomass estimates across the entire Bank.

The rationale for the spatial assessment was questioned. Spatial assessments may be conducted in cases where there are concerns for the loss of reproductive units, which is not the case here. They may also be conducted to promote stability in the fishery, but it is not clear that can be achieved through this approach. It was suggested that conducting the assessment in five separate areas could compound the uncertainty in the parameter estimates. In response, it was explained that modelling of five areas allowed for better modelled parameter estimates.

The five management areas were delineated by grouping contiguous clam beds, with the expectation that the grouped clam beds experience similar conditions. The observed trends, especially in Area 5, suggest the groupings made sense. When the model was run on the entire bank, it was found that Area 5 strongly influenced the outputs and made the model unstable. In terms of management implications the breakdown of the Bank into separate areas would allow for a better distribution of effort across the Bank and the flexibility to set different quotas in different areas.

It was observed by several participants that identifying multiple assessment areas had value; for example, the trends observed in Area 5 would not have been clear if the analysis was applied to the entire Bank.

Limitations of the surplus production model were discussed. For example, it was observed that production models do not allow for variable recruitment. In response to this observation, it was noted that available data does not indicate large variability in recruitment.

It was further observed that model estimates could be verified through surveys and specialized field studies. While it was acknowledged that there is a need for new survey data, the approach of Hubley and Heaslip (WP 2016/13) was useful in that it helps to smooth available data, provides reference points and estimates of uncertainty that can help inform the risk assessment.

It was observed that the model would require updating on a regular basis if quotas are to be based on it. CPUE data are available quarterly, and an assessment could be done yearly.

However, given that changes in abundance were detectable within a 5-10 year time frame, it is not clear that a yearly assessment is warranted.

It was observed that the CPUE data showed evidence for biomass decline in all of the example management areas. The evidence of depletion in Area 5 is of particular note. Area 5 has been fished intensely over multiple years. It was also observed that the biomass estimates from the CPUE data appear to be about 40% below average, whereas estimates from the surplus production model are 20% below average. This discrepancy may have to do with the estimation for commercial dredge efficiency (q) used in the model, as well as the difference between using the estimated biomass and the raw data.

In considering the outputs from the surplus production model, it was observed that the target for F was set at about 2.5% (for the whole Bank), but at least three of the example management areas were fished above that target.

There was some discussion about the MSY-based reference points calculated from the estimates of *r* (rate at which population grows when very small) and K (carrying capacity of the stock) from the surplus production model. Specifically, it was observed that B_{MSY} was below the current biomass in all management areas, 0.5F should be the maximum level, and 0.33M would be a good precautionary reference level if applied specifically to fished areas.

There was a question about how biomass estimates from the 2004 survey might compare to CPUE-based biomass from the same year. While this comparison was not presented, one can postulate that the biomass estimates from the survey would have been significantly (>50%) higher. Many of the 2004 survey stations were located in areas that had not been fished. The gear used in 2004 was also found to catch more than the gear in the 2010 survey – this was likely due to differences in the gear.

It was observed that most of the declines in biomass have occurred in the last 4 years (i.e., since the last assessment) and the modeling outputs are consistent with what industry has observed to be happening with the fishery. While the annual updates did note a decline, and this trend has been discussed at Advisory Committee meetings, the levels have remained well above the threshold for action. It was suggested that thresholds and indicators in the management plan should be reviewed as they may not be adequate.

There was some discussion regarding the use of VMS for identifying fishable clam habitat as grid cells containing >30 VMS data points since 2004 (approximately 1600 km^2 fished area). It was suggested that a sensitivity analysis be conducted to see how different VMS data thresholds affect the delineation of fishable clam habitat. An analysis showing the effects of a range of thresholds on the estimation of fished area was subsequently completed and presented on the second day of the meeting. This analysis will be included in the Research Document developed from Hubley and Heaslip (WP 2016/13). Meeting participants agreed that thresholds between >20 and >40 VMS data points should be used to identify the fished area. The licence holder confirmed that what was identified as fishable clam habitat in the working paper (i.e., using the >30 VMS data point threshold) showed good overlap with their own internal habitat suitability mapping efforts.

Suggestions for improvements to the VMS analysis included the possible application of a speed filter to remove data from vessels traveling at transiting speeds, and the consideration for other vessel positional information such as data collected from automatic identification system (AIS), which reports at a higher frequency, and so could increase resolution of fishing locations.

Concerns with the use of CPUE data to estimate biomass included the risk of underrepresenting low biomass areas and areas that have been fished out. Industry also acknowledged that habitat mapping efforts and gear modifications have resulted in improvements in fishing efficiency, so the concerns expressed in Hubley and Heaslip (WP 2016/13) with respect to the potential for bias in the CPUE-derived biomass estimates were valid.

In regards to the qualitative assessment of risks of high versus low F management strategies applied to biomass estimates for the fished area versus total bank area, the assignment of medium risk to a high F strategy for the fished area was challenged. High F in the fished area was considered similar to low F in the total area, so the risk should be similarly high. In response, it was argued that the risk was considered higher for the total area because the total biomass estimate for the bank was more uncertain.

There was considerable discussion both here and throughout the 2-day meeting regarding the need for research survey information, and the frequency by which the survey should be conducted. There was general consensus that once every ten years was considered too infrequent, and a yearly survey would be excessive; every 4-5 years was suggested to be appropriate. It was generally agreed that survey data is needed to update estimates of total fishable biomass, especially in the known high density areas. Survey data could also be used to monitor fished areas to ensure recovery. The survey should be conducted by either DFO or in partnership with industry.

The usefulness of a full Bank survey was questioned, given only a portion is commercially fished. It was proposed that a stratified survey design be developed that takes into account habitat suitability. This type of research survey has been implemented for scallop in Scallop Fishing Area (SFA) 29 (Sameoto et al., 2012).

There was an additional suggestion that surveys might also be conducted to identify and map new clam beds on the bank. If new areas were identified, the fishable area could be expanded and new quota set based on the biomass estimates for the new area. It was observed that the surveys would need to be conducted at sufficiently high densities to be able to distinguish patch size, which could be very costly.

REVIEW OF ROTATIONAL MANAGEMENT OF FISHERIES AND ITS APPLICATION TO CANADIAN EAST COAST ARCTIC SURFCLAM

Working Paper: O'Boyle, R., D. Roddick, and M. Sinclair. 2016. A Review of Rotational Management of Fisheries and its Application to Canadian East Coast Arctic Surfclam. CSAM Working Paper 2016/11.

Presenter: D. Roddick
Rapporteur: T. Koropatnick

Presentation

In order to inform decisions on the application of rotational management to the Canadian East Coast Artic Surfclam fishery, this paper first provides an overview of the theory of rotational management. It then reviews case studies of its application to benthic sessile invertebrates and examines the yield and biomass per recruit benefits using a rotational yield per recruit model. The case studies were used to develop a list of species biology and fishery characteristics that contribute to rotational fishing being preferred to a non-rotational strategy which were examined in relation to the Arctic Surfclam fishery.

The rotational Yield per Recruit model of Hart (2003) was adapted for Arctic Surfclam and showed that the discounted yield per recruit reached a maximum under a 14 year rotation period, but was only 2.85% higher than a non-rotation strategy. Similarly, total and exploitable biomass were maximal at a 7 year rotational period by 0.51% and 0.70%, respectively. Yield and biomass per recruit increases appear to be limited for this fishery, perhaps due to the fishery already targeting the age/size classes for optimal yield per recruit. At the same time fishing the open areas at a high F increases the risks to the stock. The working paper concludes with observations on the strengths and weaknesses of the application of rotational management to Arctic Surfclam in Atlantic Canada.

Discussion

The Working Paper was considered a good review of spatial management applications in other areas.

Concerns were expressed with respect to the yield per recruit model. Specifically, the model assumes nothing is changing and everything is in equilibrium, but the fisheries science literature suggests nothing is in equilibrium. In order to keep the fishery economically viable, open areas would have to be fished at very high F levels. Before such an approach could be considered, there is a need to have a much better understanding of both stock dynamics and available biomass. It was acknowledged that under a rotational plan open areas would be fished at high intensity, and if biomass were overestimated recruitment overfishing could be a problem. There are increased risks to fishing at a high F in the open areas, and little benefit to be gained from rotational fishing for the Arctic Surfclam fishery.

There was some discussion about monitoring needs under a rotational fishery approach. It was acknowledged that there would be a need to survey during closed periods to watch for indications of recovery, and areas would need to remain closed until the biomass returns. For a viable fishery, there would be a need to divide the fishing grounds into multiple areas so that there are enough areas to fish while the closed areas recover. In many cases, there is also a reproductive reserve area set aside to address concerns with recruitment overfishing. For this approach, there is also a need to understand source and sink, because one cannot assume consistent production across all areas. A genomics study could be helpful for this.

There was an additional comment about the need to consider the potential for incidental mortality and injury, as raised by one of the case studies. Incidental mortality was included in the model (15%).

There was some discussion about the application of various rotational management approaches for Surfclam. For example, it was suggested that the fishable area be divided up and a Total Allowable Catch (TAC) be assigned to each area. Once an area has been fished up to the TAC, the area would be set aside to allow the area to recover for a period of time (a range of 10 to 16 years was discussed). As part of this discussion, John Hoenig proposed an ‘informal rotation’ approach. A brief presentation was provided to further explain this approach, as follows.

A SIMPLE, COST-EFFECTIVE MANAGEMENT STRATEGY FOR SURFCLAMS USING INDUSTRY SURVEYS UNDER AN INFORMAL AREA ROTATION FISHERY

Presenter: J. Hoenig
Rapporteur: T. Koropatnick

Presentation

Consider setting catch quotas for the patchily distributed surfclam fishery on Banquereau and other areas in Atlantic Canada. Much of the banks have densities too low to be harvested economically. Fishers focus on areas of high density and tend to deplete these areas before searching for new patches, thus depleting areas serially. One *could* achieve sustainability by determining the fishing mortality rate that matches the time to depletion of all areas with the time to recovery, and then convert that estimate of fishing mortality into a catch quota. This requires determining fishing and natural mortality, catchability coefficient, absolute biomass, and gear selectivity. Alternatively or additionally, one could divide the region where surfclams are found into smaller regions and try to assess and manage each of the smaller regions, possibly including area rotation.

A simpler, more direct approach is to estimate the fishable stock, *s*, in the entire region, where fishable stock is defined as the amount that could profitably be harvested from all the high-density areas combined. This can be modeled as $s = A\ d$ p where *A* is the area with commercially viable concentrations of clams, *d* is the average catch rate of commercial gear in high density areas, and *p* is the percentage of a high density area that is harvested before the patch is abandoned. (There is some literature that indicates d is around 0.1 kg/m^2 and *p* is around 0.75.) The time in years required to fish down all high density areas is *s/C* (*C* is the annual catch) and, for sustainability, *s/C* must be greater than or equal to the recovery time, *R*. Thus, total allowable catch must be $\leq s/R$. The parameter p can be estimated by mapping dredge tracks in an area after it is abandoned; *R* is determined based on growth rates and based on empirical observations on how long areas remain fallow before fishers return.

The scheme described above can be thought of as “informal” area rotation because, like formal area rotation, it relies on the serial depletion of areas. However, under the informal scheme, fishers are free to choose the areas they wish to deplete instead of being required to fish in specified areas at specified times. The theoretical benefits of informal area rotation are similar to those obtained from formal rotation.

Thus, the uncorrected (for efficiency and for selectivity) survey biomass of the fishable stock is determined using the same gear used by the commercial fishers. The goal is to map the concentrations that are profitable to fish so the sampling does not have to follow a randomized design if an appropriate statistical method such as kriging is used to produce the maps. This lends itself nicely to a partnership between DFO and the industry since commercial boats are the ideal survey platform. Given an estimate of the fishable stock, the allowable catch is determined by dividing the fishable stock by the time required for an area to recover, currently believed to be around 16 years.

The computation can be done statically. That is, given one survey, the allowable catch can be set for the next 16 years. However, it is better to use a dynamic approach to assessment where the survey is repeated every year or after several years to check that the rate of harvest is sustainable and close to the maximum.

There are two key assumptions behind this approach. The first is that the behavior observed in the past whereby fishers deplete a region before moving on to the next patch continues. This behavior arises when searching for the next patch is expensive so that once a patch is identified it is worthwhile to fish it down. If maps become readily available there might be less incentive to fish down the patch as much. This will undermine the basis for informal area rotation. The second key assumption is that by fishing down some patches the reproductive capacity of the stock is not diminished. The assumption is that the substantial biomass in the low density areas and in the patches that have not yet been fished will provide adequate spawning potential to maintain recruitment. Both assumptions can be verified by ongoing monitoring (not necessarily every year). Indications that fishers are abandoning patches before they are substantially depleted or that settlement is not taking place in depleted patches would presage trouble.

The above scheme can form the basis for the assessment and management of the Arctic Surfclam resource. Alternatively, it can provide a check on the reasonableness of any other procedure adopted to assess and manage the resource.

Discussion

It was observed that this approach produced results that were similar to the modelling approach proposed in Hubley and Heaslip (WP 2016/13) (e.g., exploitation rate of 0.05). The difference is that fewer assumptions are required. It was observed that biomass estimates are inherently uncertain so assumptions are still being made. Other uncertainties in this approach include assumptions about fishing behavior. For example, the fishery may not fully deplete a patch before moving on, and may not leave a fished patch fallow to allow for an appropriate recovery time. The VMS data from Hubley and Heaslip (WP 2016/13) showed that the fleet was not fishing patches down and moving on, but moving between patches and returning to the same areas over time.

It was argued that one advantage of this approach is that it can be updated easily. For example, economic factors can influence the definition of commercial viability such that ‘fishable’ clam patches may change over time. If this occurs, the survey data can be re-evaluated to calculate TAC for these newly defined fishable patches.

It was observed that there is value in conducting simple analyses like this one as a check on results from more detailed models.

AN ANALYSIS OF THE SPATIAL EXTENT OF THE ARCTIC SURFCLAM FISHERY ON BANQUEREAU BANK

Working Paper: Mugridge, A. 2016. An Analysis of the Spatial Extent of the Arctic Surfclam Fishery on Banquereau Bank. CSAM Working Paper 2016/12.

Presenter: A. Mugridge
Rapporteur: T. Koropatnick

Presentation

To facilitate discussions regarding potential spatial management systems for the Arctic Surfclam fishery on Banquereau and Grand Bank, the actual spatial extent (i.e., footprint) of the fishery must be determined. For Banquereau, two methods were used to estimate the fishery footprint. The first method involved a theoretical calculation of maximum fishery footprint using the current TAC and annual fishery-reported CPUE. A variety of CPUEs were considered (minimum, maximum, and 5, 10, 15, and 20 year means), as were assumptions about recovery time and tow overlap. This method produced a range for the estimated fishery footprint, expressed as a percentage of the overall Bank area, of 15-35%.

The second method involved analysis of a previously-presented figure from Roddick et al., (2012), that detailed commercial catch on Banquereau during the period of 1986-2010. The catch data, displayed as color-scaled one-minute squares and overlaid upon a nautical chart of Banquereau, was manipulated by use of photo-editing software to remove data points with low catches (two thresholds were used: >100 tonnes and >250 tonnes) thought to represent insignificant commercial fishing effort. The remaining data was thought to most likely represent the commercial catch data and, therefore, the fishery footprint. This area, when calculated, produced a range for the estimated fishery footprint, expressed as a percentage of the overall bank area, of 16-36%.

It was concluded that the fishery occupies only a portion of Banquereau, estimated to be on the low end of the range of 15-36% of the entire bank. Many areas of the remaining 'unfished' portions of the bank contain high densities of Arctic Surfclam and other clam species (Northern Propellor Clam, Greenland Cockle, Ocean Quahog, Atlantic Surfclam) based on information from scientific surveys in 2004 and 2010. The importance of these unfished portions of Banquereau is to be determined but may play a key role in spatial planning for the fishery.

Discussion

There was general agreement that the analysis and results were consistent with, and made good use of, published and publically available information (noting that use of more recent information would have yielded a different result). The analysis did a good job of illustrating the patchiness of the resource. It was cautioned that the inverse distance weighting approach used to map surfclam densities from the 2010 and 2004 surveys can lead to misleading interpretations of local biomass [note: inverse distance weighting was not used for the biomass estimates, only to plot the distribution for the maps].

With respect to the aggregation of commercial fisheries data from 1986-2010 to determine the spatial extent of the fishery footprint, it was observed that the >100 tonne catch threshold translated into an estimate of the commercial fishing footprint that was approximately 36% of the bank. It was also observed that in aggregating so many years together, the information on temporal changes in distribution was lost.

There was some discussion on the potential for fishable densities of surfclam outside of the commercial fishing footprint. While there have been exploratory efforts to fish outside of the known high density areas, it was suggested that any successful efforts would have been captured in the footprint generated from commercial fisheries data. It was reported that the fleet had tried fishing in the low effort areas but had not found commercial concentrations. The fished areas identified using VMS data also correlated very well with the license holders habitat suitability maps generated from multibeam and backscatter information (i.e., non-fisheries data).

QUALITATIVE RISK ASSESSMENT

Presenter: T. Worcester and K. Smedbol
Rapporteur: T. Worcester

A qualitative assessment of risks and benefits of the current surfclam management approach and two alternative approaches was presented for discussion, and revised with input from meeting participants (see Table 1). While it was noted that there are various aspects of this fishery that can be assessed for risk, this assessment focused on ecological risk to the stock and the risk to fisheries sustainability.

The focus of this exercise was not to decide upon a management system, but to look at available information for current and alternative approaches to inform further discussion. It is important to note that the two alternative approaches examined here are examples intended to illustrate benefits and risks associated with a suite of CPUE approaches.

Table 1. Relative risks and benefits of the current management approach versus two example alternative approaches.

Approach	Requirements		Assumptions	Sources of Uncertainty	Risks		Benefits	Time and Cost to Implement for DFO Science	Mitigating Factors	Conclusions
	Monitoring	Assessment			Risk to the Stock	Risk to Fishery Sustainability				
Current Approach - Survey-based fishable biomass estimate - Constant TAC (whole Bank) - Interim monitoring using 3 indicators	Full bank biomass survey conducted every 10 years (or when indicator thresholds are exceeded) In interim years, 3 indicators are evaluated: - Fishery footprint - CPUE - Catch size and comp	Full assessment every 10 years (or when thresholds exceeded) Annual review of interim indicators	Fishing could be distributed across the bank but likely to focus on higher density areas (assumption of 75g/m) Whole biomass is available to fishing Fishing will occur at a sufficiently low F to have minimal impact on biomass	Biomass estimate - Survey dredge efficiency - Lack of consistency in survey vessel and gear Estimates of M, F, etc. CPUE issues e.g. hyperstability but also others Determination of what is considered fishable biomass	Reliance on initial biomass estimate and setting appropriate reference points / thresholds. Likelihood of higher than anticipated F on localised (high density) fishing locations (simultaneous locations.) Limited tracking of stock status in interim years. - (harder to respond effectively when declines observed)	Risk of running out of concentrations worth fishing - hard to match biomass level with fishable biomass level	flexibility in fishing location low data requirements low cost to DFO Science established method	In use now High cost in survey year / low cost in interim years.	Could add components of habitat suitability mapping to improve survey estimates (e.g., SFA 29).	Medium to Low risk as currently implemented, but some evidence of stock decline in recent years.

Approach	Requirements		Assumptions	Sources of Uncertainty	Risks		Benefits	Time and Cost to Implement for DFO Science	Mitigating Factors	Conclusions
	Monitoring	**Assessment**			**Risk to the Stock**	**Risk to Fishery Sustainability**				
Example meant to illustrate a suite of CPUE approaches. <u>Area-based approach using CPUE index</u> - CPUE-based fishable biomass estimate (by area) [option of using the SPM]. - Annual TAC (by area)	CPUE index Secondary indicators: - catch size and comp - etc. Periodic biomass or habitat suitability surveys	Assessment every X years - VMS / AIS/ habitat suitability to set areas - Biomass estimate by area - Setting an appropriate exploitation rate - Reference points by area Annual Update - Status relative to reference points	CPUE is indicative of biomass trends. Average recruitment. Similar biological characteristics between bed.s	Determination of Areas – how these are set (thresholds used, e.g. VMS pings). CPUE index: - potential for hyperstability - issues with standardization (especially if multiple vessels) - commercial dredge efficiency Survey estimates: - - survey dredge efficiency	Potential for all productive areas to be fished at the same time. Potential for recruitment overfishing (role of unfished areas as reproductive reserves?.)		Uses available information Ability to assess status annually. Ability to set reference points and evaluate status against these. Could be adapted to higher resolution as it becomes available. Characterizes/quantifies uncertainty.	Soon Higher than above (increased frequency of assessment). Commitment to conduct annual updates.	Incorporation of rotational / reproductive reserves could reduce risk to these areas.	Risk may be lower than current approach as it allows for more robust annual monitoring of the status of discrete areas.

Approach	Requirements		Assumptions	Sources of Uncertainty	Risks		Benefits	Time and Cost to Implement for DFO Science	Mitigating Factors	Conclusions
	Monitoring	**Assessment**			**Risk to the Stock**	**Risk to Fishery Sustainability**				
Example informal rotational approach, where rotation refers to voluntary rotation by the fishery once a bed is depleted. <u>Informal rotational approach</u> - Set an annual TAC based on the fishable stock and time to recovery. - Conduct targeted surveys to monitor bed recovery.	Mapping of high density beds Monitoring of previously fished beds (for adaptive management).	Initial Assessment: - Estimation of the fishable stock (s) x 0.75 - Estimation of time to recover fishable beds (R) - Setting of TAC< s/R Re-assessment if new high density beds are located or if revised information on recovery time becomes available.	Gear used to survey beds could be similar to fishing gear (though expected differences were noted). Beds are fished down (75%) before moving on.	Initial fishable stock size. Estimate of recovery time (to be refined through subsequent monitoring).	Reliance on predictable behaviour (self-regulation and monitoring) – risk that irregular fishing practices lead to unintended consequences. No annual assessment of stock status relative to reference points (<u>BUT</u> MSY in the sense that if you take more, you'll run out of product). Risk of not accounting for recruitment relationship – risk depends on ability to follow-up to monitor recruitment.	Requires corporate memory in the fishing industry. - without this memory, there is a risk that knowledge of past fishing behaviour will nott be used to inform an effective rotation strategy.	Simple Easy to implement Adaptive Precautionary Low risk of running out of product (key goal is fishery sustainability). Uncertainty characterized through biomass survey uncertainty. Incentive to locate new fishable beds.	Soon Low cost – though would need to do work to get a better estimate of recovery time. Need for targeted surveys to assess recovery. Research Recommendation: Recovery Time - first look at existing information on return rates from the fishery	Incorporation of rotational / reproductive reserves could reduce risk to these areas.	Risk may be lower over the time period selected as it purposefully allocates quota to ensure fishery sustainability, based on anticipated rate of recovery

CONCLUSIONS

RESEARCH RECOMMENDATIONS

Rapporteur: T. Worcester

Throughout the meeting, suggestions for additional research were noted. These suggestions were further developed with meeting participants into the following list of recommendations (list order is not intended to imply order of priority):

- Continue to evaluate the lessons learned from the fishery to date including further analysis of depletion rates, return rates, and recovery times at local levels.
- Continue work to improve the inputs for the stock assessment model described in Hubley and Heaslip (WP 2016/13), including:
  - Standardize and correct for potential bias in the CPUE data.
  - Developing a habitat suitability index based on environmental variables to replace the VMS proxy.
- Develop improved estimates of commercial dredge efficiency that can be used to inform the prior on q. Improvements could include, but are not limited to, accounting for changes in the dredge and other factors in a catch rate standardization approach.
- Commence work on design of fishery independent surveys for both Banquereau and Grand Bank clam populations. Consider incorporation of habitat suitability into the design (e.g., as was done for the scallop survey in SFA 29).
- Further investigate Arctic Surfclam reproductive areas, including the role that biomass outside of fishing areas and the remaining biomass within depleted areas contributes with respect to recruitment. To inform the work of establishing protected reproductive areas, improved knowledge of larval recruitment dynamics and interconnectivity among Arctic Surfclam patches within Banquereau is required. Biophysical simulations and genomic analyses could be used to investigate these processes and population characteristics.
- Develop an improved estimate of biomass for Grand Bank. Exploration of the application of methods used for Banquereau is recommended as a first step; however, analyses of fishery related data are limited since the fishery has concentrated on Banquereau to date.
- Further evaluate potential assessment/management areas on Banquereau, including the criteria that could be used to delineate the boundaries of these areas.
- Explore the variation in the conversion factors used for meat weight to whole weight for Arctic Surfclam (e.g., differences among locations and time of year), given that the biomass estimates are based on whole weight and the TAC is in whole weight. Information for specific products and species could be collected directly from the fishing vessels under processing conditions.
- Investigate differences in biological characteristics between beds. If significant differences exist, there is a potential for the management strategy to be tailored to each location.

CONSENSUS STATEMENTS

Rapporteur: T. Worcester

In lieu of a Science Advisory Report, the following statements were developed with input from meeting participants to capture points of consensus agreed to in the meeting. Note that these consensus statements focus on Banquereau since information was insufficient for Grand Bank to warrant a new analysis of that area.

- The declining catch rates of Arctic Surfclam reported in Hubley and Heaslip (WP 2016/13), as well as new information (i.e., logbook data) gathered since 2011 and updated analysis of the 2010 survey data, support the need for an updated assessment approach and corresponding science advice for Banquereau. The catch rate declines could be steeper than indicated by the current analysis of CPUE because of the potential for catch rates to remain high as population biomass declines and the increasing efficiency of the fishery, which could result in an underestimate of the decline.
- The surplus production modeling approach presented in Hubley and Heaslip (WP 2016/13) was considered by most participants to be informative concerning stock status, despite potentially problematic CPUE data. Trends in CPUE, including recent declines, were consistent with industry experience. The spatially-disaggregated analysis was considered to be useful for illustrating the spatial variance in population dynamics on Banquereau (as illustrated by the 5 example areas identified in Hubley and Heaslip (WP 2016/13).
- The surplus production modeling approach described in Hubley and Heaslip (WP 2016/13) was considered to be generally appropriate for use as an interim approach. The potential for this approach to assess trends at smaller spatial scales and for smoothing CPUE variance spatially, were viewed as an improvement over the previous bank-wide stock assessment approach. However, further evaluation is recommended. [Note: Some participants were not convinced that this approach was an improvement over the previous survey-based approach without further evaluation, including assessment of performance.]
- Data from the VMS were necessary for the analysis as a proxy for habitat suitability of the Arctic Surfclam in fished areas, which was not available at the time of meeting. Based on analyses of the VMS data, it seems possible to identify discrete areas of fishing activity. Two independent analyses presented in Hubley and Heaslip (WP 2016/13) and Mugridge (WP 2016/12) identified broadly similar areas of fishing on Banquereau, which were consistent with industry experience.
- It was recommended that the objectives, timing, and design/methodology of the surveys on both Banquereau and Grand Bank be re-evaluated and that these fishery-independent surveys, in addition to other available information, are used to inform an integrated stock assessment once sufficient data are available. The benefits of these surveys include: provision of independent biomass estimates for the whole bank (with particular attention to areas characterized by high abundance), verification of stock status, and provision of information on recovery times. A standardized survey approach (e.g., consistent gear) is strongly recommended to enable comparison of survey results across years and continuity of analysis.
- When possible, the use of multiple assessment methods is desirable to validate the results used for management advice.
- The current frequency of stock assessments for Arctic Surfclam was considered too low. It is recommended that the assessment schedule for Arctic Surfclam be formalized, and the format of annual updates be revisited.

- Review of the literature on rotational harvest schemes indicates that, due to the complex metapopulation structure of sedentary invertebrate species, recruitment overfishing has occurred in some documented cases of other species.
- The potential yield and biomass per recruit benefits derived from a rotational management approach appear to be slight when the fishery is already harvesting clams with the optimal size structure (O'Boyle et al. WP 2016/11).
- Review of the literature suggests that establishing reproductive areas that are protected from fishing activity might help to mitigate the risk of recruitment overfishing.
- There could be benefit in setting a Fishing Mortality rate based on what can be harvested sustainably over time by the fishery (e.g., the approach referred to in this meeting as the informal rotational approach), to reduce the need to close the fishery because of depletion of beds and then waiting for recovery.

DOCUMENTS

It was decided that Hubley and Heaslip (WP 2016/13) should be published as a Research Document. The authors of O'Boyle et al. (WP 2016/11) also intended to publish, and subsequent to the meeting, requested that this paper also be produced as a Research Document. As the approach proposed in Mugridge (WP 2016/12) was similar to analyses presented in Hubley and Heaslip (WP 2016/13), it was decided that Mugridge (WP 2016/12) would not be published as a Research Document.

This Proceedings Document constitutes the record of meeting discussions, recommendations, and conclusions. No Science Advisory Report will be produced.

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Roddick, D., J. Brading, L. Carrigan, T. Davignon-Burton, S. Graham, and C. McEwen. 2012. Assessment of the Arctic Surfclam (*Mactromeris polynyma*) Stock on Banquereau in 2010. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/050. Iii + 59 p.

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APPENDICES

APPENDIX 1. LIST OF PARTICIPANTS

Day 1	Day 2	Name/Nom	Affiliation
x	x	Baird, Jim	Cooke Clam Group
x	x	Bennett, Lottie	DFO Maritimes / Centre for Science Advice
	x	Bernard, Allison	KMK Negotiation Office
x	x	Bertram, Doug	Full Bay Scallop Association
	x	Boyd, Catherine	Clearwater Seafoods
x	x	Coffen-Smout, Scott	DFO Maritimes / Oceans and Coastal Management Division
x	x	Cook, Adam[1]	DFO Maritimes / Population Ecology Division (BIO)
x	x	Cox, Michael	KMK Negotiation Office
x	x	Francis, Cory	Confederacy of Mainland Mi'kmaq
x		Fuller, Susanna	Ecology Action Centre
x	x	Heaslip, Susan	DFO Maritimes / Population Ecology Division (BIO)
x	x	Hoenig, John[2]	Virginia Institute of Marine Science
x	x	Hubley, Brad	DFO Maritimes / Population Ecology Division (BIO)
x		Hunka, Roger	Maritime Aboriginal Peoples Council
x	x	Keith, David[2]	DFO Maritimes / Population Ecology Division (BIO)
x	x	Koropatnick, Tanya	DFO Maritimes / Centre for Science Advice
x	x	Krohn, Martha	DFO National Capital Region / Fish Population Science
x	x	Kulka, Dave	Ocean Choice International Inc.
x	x	Large, Cory	DFO Maritimes / Policy and Economics
x	x	Lowe, Jonathan	NS Dept. Fisheries & Aquaculture
x	x	MacDonald, Carl	DFO Maritimes / Resource Management
x	x	Mosher, Jim	Clearwater Seafoods
x	x	Mugridge, Adam	Louisbourg Seafoods Ltd.
x	x	Neilson, John[3]	DFO Science Emeritus
x	x	Nicholas, Hubert	Membertou First Nation / Fisheries
x	x	Penney, Christine	Clearwater Seafoods
x	x	Perrier, Erika	Atlantic Policy Congress of First Nations Chiefs Secretariat
x	x	Roddick, Dale	DFO Maritimes Scientist Emeritus
x	x	Samson, Réal	Premium Seafoods Inc.
x	x	Sarty, Matt	Clearwater Seafoods
x	x	Skanes, Katherine[2]	DFO Science Newfoundland
x	x	Smedbol, Kent	DFO Maritimes / Population Ecology Division (BIO)
x	x	Stanley, Ryan	DFO Maritimes / Population Ecology Division (BIO)
x	x	Waters, Christa	DFO Maritimes / Resource Management
x	x	Worcester, Tana	DFO Maritimes / Centre for Science Advice

[1] Reviewer for O'Boyle et al. WP 2016/11; Mugridge WP 2016/12
[2] Reviewer for all working papers
[3] Meeting chairperson

APPENDIX 2. TERMS OF REFERENCE

Arctic Surfclam Framework: Data Review

Regional Peer Review – Maritimes Region

June 28-29, 2016
Dartmouth, NS

Chairperson: John Neilson

Context

The Arctic Surfclam (*Mactromeris polynyma*) fishery on Banquereau was initiated in 1986. After some initial exploratory fishing, a quota regulated fishery was put in place for Arctic Surfclam on the Grand Bank in 1989. The Scotian Shelf and Grand Bank offshore clam fisheries are managed under one plan, with the licence holder(s) having equal access to quotas in both areas.

Science surveys of Banquereau Arctic Surfclams were conducted in 2004 and 2010. Due to the large size of the Grand Bank, a scientific survey of Grand Bank Arctic Surfclam was conducted in three parts ending in 2009 (2006, 2008 and 2009) to assess the biomass of the stock in this area. An assessment framework for Arctic Surfclam on Banquereau and Sable banks was reviewed in 2007. A peer reviewed stock assessment of Grand Bank Arctic Surfclam was conducted in 2010, using an assessment approach similar to that developed for Banquereau. The Banquereau Arctic Surfclam stock was last assessed in 2011.

In 2014, DFO initiated independent reviews of the science and management of Canadian Arctic Surfclam. Both the science and management reviews recommended consideration of a spatial management approach for Arctic Surfclam.

Objectives

The objectives of this meeting are to:

1. Compile and review the science information basis to conduct a preliminary risk assessment of spatial management options for Arctic Surfclam in Atlantic Canada. In this context, a number of different types of information will be reviewed, including:

- Information on life-history characteristics of Arctic Surfclam (or related species), focusing on any new information since 2007.
- Previous survey information, including sources of uncertainty.
- Available fishery information, including catch composition, catch rates, distribution and effort.
- Any new information on impacts of clam dredging on Arctic Surfclam and associated species since 2007.
- Information that could be used to assess changes in Arctic Surfclam habitat suitability since 2007.
- Other information that could be used to inform a spatial management approach for Arctic Surfclam on Banquereau and Grand Bank.
- In addition, summaries will be provided of the:
  - Management approach to this fishery that has been in place since 2007.
  - Indicators and reference points that have been used to assess the status of the Arctic Surfclam stocks.

2. Conduct a qualitative risk assessment to assess the relative risk and ongoing information requirements of the current management approach and alternative spatial management approaches.
3. Determine whether any of the information presented would trigger a new science assessment for Banquereau or Grand Bank Surfclam, and if so, what approach would be used to conduct the assessment.

Expected Publications

- Science Advisory Report
- Proceedings
- Research Document(s)

Participation

- DFO Science, Ecosystem Management, Fisheries Management, and Policy and Economics
- Aboriginal Communities/Organizations
- Fishing Industry
- Provincial representatives
- Academics
- Non-governmental organizations
- Other invited experts

References

DFO. 1999. Offshore Surf Clam Integrated Fishery Management Plan, Maritimes and Newfoundland Regions 1998-2002. 24pp.

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APPENDIX 3. AGENDA.

Arctic Surfclam Framework: Data Review

Regional Peer Review – Maritimes Region

28-29 June 2016

George Needler Boardroom
Bedford Institute of Oceanography
Dartmouth, Nova Scotia

Chairperson: John Neilson

DRAFT AGENDA

DAY 1 (Tuesday, June 28, 2016)

Time	Topic	Leads
09:00 – 09:15	Welcome and Introductions	J. Nielson
09:15 – 09:45	Background, life history, ecosystem considerations, dredging impacts and by-catch	B. Hubley
09:45 – 10:30	Data review: survey and fishery data	B. Hubley
10:30 – 10:45	***Break*** *(Coffee/tea provided)*	
10:45 – 12:00	New Analyses: VMS, Biomass Estimates, Spatial Production Model	B. Hubley
12:00 – 13:00	***Lunch*** *(Not provided – cafeteria is on-site)*	
13:00 – 14:00	Discussion	B. Hubley
14:00 – 14:30	Review of Rotational Management of Fisheries and its Application to Canadian East Coast Arctic Surf Clam	D. Roddick
14:30 – 15:00	An Analysis of the Spatial Extent of the Arctic Surf Clam Fishery on Banquereau Bank	A. Mugridge
15:00 – 15:15	***Break*** *(Hospitality not provided)*	
15:15 – 17:00	Discussion	

DAY 2 (Wednesday, June 29, 2016)

Time	Topic	Leads
09:00 – 09:30	Review of previous day	J. Neilson
09:30 – 10:30	Qualitative risk assessment	T. Worcester K. Smedbol
10:30 – 10:45	***Break*** *(Coffee/tea provided)*	
10:45 – 12:00	Discussion: Is there a need for a new science assessment? If so, what approach should be used?	J. Neilson
12:00 – 13:00	***Lunch*** *(Not provided – cafeteria is on-site)*	
13:00 – 15:00	Development of consensus statements	J. Neilson
15:00 – 15:15	***Break*** *(Hospitality not provided)*	
15:15 – 17:00	Wrap-up	