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Proceedings of a Maritimes Science Advisory Process to Assess the Ocean Quahog (*Arctica islandica*) Stock in Southwest New Brunswick

Compte rendu d'un processus d'avis scientifique de la Région des Maritimes pour l'évaluation des stocks de quahog nordique (*Arctica islandica*) dans le sud-ouest du Nouveau-Brunswick

October 21, 2011

Le 21 octobre 2011

Tana Worcester
Meeting Chair

Tana Worcester
Présidente de la réunion

Bedford Institute of Oceanography
1 Challenger Drive, P.O. Box 1006
Dartmouth, Nova Scotia
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July 2012

Juillet 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 Ocean Quahog in southwest New Brunswick was held on 21 October 2011, at the Bedford Institute of Oceanography in Dartmouth, Nova Scotia. Participants included DFO Science and Resource Management, provincial fisheries management, as well as Industry representatives.

SOMMAIRE

Un processus d'avis scientifique de la Région des Maritimes pour l'évaluation des stocks de quahog nordique dans le sud-ouest du Nouveau-Brunswick a eu lieu le 21 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 et de l'industrie.

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 ocean quahog in southwest New Brunswick, which was held 21 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 clam 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.

The Terms of Reference of the meeting were presented (Appendix 2).

To assist in the scientific review process, H. Bourdages (DFO Science, Quebec Region) and Angelica Silva (DFO Science, Maritimes Region) had offered to act as impartial reviewers. In addition, the Chair encouraged other participants to provide a critical review of the information presented based on their knowledge and expertise on ocean quahog and the quahog 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 be produced as a result of this meeting. This Proceedings report is the record of the discussion of the meeting.

The Agenda (Appendix 2) was reviewed, and no further additions or corrections were made.

ASSESSMENT

Working Paper: Roddick, D. 2011. Assessment of the Ocean Quahog (*Arctica islandica*) Stock in Southwest New Brunswick. CSA Working Paper 2011/035.

Presenter: D. Roddick
Rapporteur: T. Worcester

Fishery

Presentation Highlights

An exploratory fishery for ocean quahog in southwest New Brunswick (SWNB) was initiated in 1997, with 12 exploratory licenses issued from 1997-2002. The licenses were not renewed in 2003 after a regional review. In 2004, a non Developing Species Advisory Board (DSAB) process to continue the development of ocean quahog fishery was approved. A joint project agreement was signed in 2006 between DFO and the Southwest New Brunswick Quahog Group Inc. (i.e., former exploratory licenses holders) to conduct survey work in 2006 and 2007.

Discussion

It should be noted that it was the DSAB that requested and received approval for the fisheries in LFAs 38 and 36 to be treated as separate areas with 6 licenses each, not the area office.

There were questions about whether the DSAB still exists. It was thought that the regional DSAB had met three years ago but was never heard from again. There are not many

developing fisheries left, and this program has gone through flux over time. The ocean quahog fishery in SWNB may be one of the few developing fisheries left.

It was unclear from the working paper what had happened in the fishery since 2006. It was clarified that there had been some fishing from January to March 2007. Everything was closed due to elevated levels of PSP found in bivalves in the Bay of Fundy. In 2009, interest was expressed in fishing again. Science advice on this fishery had been requested but not received.

Recommendations

The species name for Ocean Quahog should be provided in the first sentence of the working paper to distinguish it from *Venus mercenaria*. Also, *Venus mercenaria* (bay quahog) is spelled wrong. Although it is a quotation, it should still be corrected.

Some more details of the fishing activity in Mace's Bay in 2007 (i.e., one license with a catch of 12 t) should be added, as well as mention of the interest in fishing in 2009.

Within the description of the Joint Project Agreement (JPA), mention that the results of this survey work are analyzed within the current assessment.

Survey Methods

Presentation Highlights

The Mace's Bay survey was conducted in 2006, and the Grand Manan survey was conducted in 2007 with several delays. The survey areas were based on locations where fishing had occurred and where ocean quahogs had been caught in other surveys. Boxes were drawn around areas that were thought to be fishable.

The Mace's Bay survey was a random statistical design, with kriging. The survey was conducted in Feb 2006 using the Miss October, with a dry dredge and three minute tows. Depths ranged from 17 to 42 m.

The Grand Manan survey was a random statistical design, without kriging. It was conducted in Feb 2007 using the Beverly Ann II, with a dry dredge and 5 minute tows. Depths were more variable than in Mace's Bay, ranging from 6 to 110 m.

Added tows could influence statistical analysis because it can bias the results, i.e., adding them in good areas when you suspect they are good may bias the results up.

Discussion

A question was asked about the knife depth setting on the dredge. It was clarified that knife depth depends on the area. Hydraulic dredges offshore NS can be set them as deep as 8 inches. Inshore surfclam dredges are set at 4 inches. Quahog dredges are set shallower since they don't have a siphon. However, quahogs can burrow down deeper without oxygen and go into an anaerobic state. It is not clear why they do this. When they are feeding, they have to be located right at the surface. Quahogs are not expected to "dive" as a result of the dredge vibration.

It was clarified that 70 stations were selected for Mace's Bay but only 40 were completed.

A question was asked about the speed of surveying. It was clarified that the survey speed was half a knot (quite slow) since it is very muddy. It was joked that you could fish with an excavator.

Note that the protocol wasn't followed for repeating the tows if they came up full, as they were often filled almost immediately with the same catch regardless of tow duration.

There was some discussion on the significance of shell colour. Shell color was not investigated, though this had been considered. It wasn't felt that shell colour was an important factor in fisheries value.

A question was asked about the stratified subsample for aging. Three quahogs per 5 mm grouping were collected for morphometrics. There were some problems with how this was conducted. In particular, the length frequencies that were collected do not suggest a random stratified age sample. The samples that came back were length stratified. When they were aged, they were not length stratified. Sixty-one samples were measured, but, even with this number, none were really small.

Recommendations

Include maps of what the stations were based on (i.e., from consultations).

Include the number of stations for each area in Table 2.

Explain how tow distance was calculated.

Change measures to metric.

Drop the mention of shell color from the document.

Describe the quality control protocols that were used for aging, e.g., comparisons between the two agers had a CV less than 5%, but there wasn't a reference set or cross-lab comparison.

<u>Survey Results</u>

Presentation Highlights

The Macy's Bay survey showed some good catches in the centre of the survey area. Some similarities were observed in relation to depth.

The survey in Grand Manan had some gear conflicts. There were good catches closer to shore and to the east.

At North Head, there was a narrow band of quahogs along the shore.

The Swallowtail area also had a narrow band that could be compared to the multibeam. Unfortunately, the multibeam didn't cover the whole area of interest.

Discussion

A question was asked about the minimum separation distance between survey stations (0.5 km). This was done to help space the stations out. They are still intended to be random.

A question was asked about the use of zero catch in the variogram. It was clarified that the analysis was run with and without the zero catches. The variogram shouldn't include the zero catches, but the zeros are used in the kriging.

It was noted that it is possible to get an estimate of variance from other software packages. However, there seems to be some scientific debate argument about the use of these packages.

It was asked whether dead quahogs were observed in the survey around Grand Manan. The bycatch results would have to be consulted, but it was felt that dead ones weren't seen as much as expected. There have been areas in the offshore where large areas of dead shells have been observed, and it is assumed that they accumulate as a result of currents.

Recommendations

Include the number of stations for each location in a separate table. Add reference to the table in section 3.1.

Include the contour plot in the research document.

Be clear about the survey areas. Perhaps label them A, B, and C.

Aging

Presentation Highlights

Pictures of the aging process were shown and this process was described. It takes a lot of work to age quahogs. The ages are fairly clear in young shells, but it is harder to read the older ones. The population in Mace's Bay was much younger than expected – it is the youngest population seen in the area. The growth curve wasn't as complete as hoped, as some ages were missing from the samples, and it is not considered to be very accurate given the small sample size. The oldest quahog sampled was 32 years. The oldest quahog ever aged was 410, and there was one off Sable that was 200 years old. In St. Mary's Bay, many were in the 60-80 mm range. The difference may be related to the habitat type (sand versus mud).

Discussion

Clarification was sought on the aging process for quahogs, particularly whether quahogs continue to create rings as they got older. It was clarified that even very old quahogs continue to add growth rings, though they may be harder to distinguish. They do grow more quickly when they're young.

Concerns about the aging data used were reiterated, including the small sample size, lack of old and young quahogs, and that there were no Grand Manan samples aged; however, it was felt that bias should be slight given the small sample size at the older ages.

Recommendation

Present the raw data for the length frequencies. Compare the length frequencies of Mace's Bay with another place (i.e., St. Mary's Bay).

Size and Age at Sexual Maturity

Presentation Highlights

The assessment team looked at the hinge sections of quahogs to determine age of sexual maturity. Hinges were etched and stained, and the shell was looked at rather than a peel. This technique worked well for young quahogs. Maturity at size is fairly well defined, with 50% maturity at 38 mm. At 50 mm, quahogs are almost all mature. Maturity at age is less well defined, and the estimate of 6 years isn't trusted. Quahogs have been sampled that were still immature at 20 years old.

A selectivity study was not attempted, as it would have been almost impossible to do within this mud environment. However, bar spacing was compared to shell width. From this study, the dredge seems to be catching quahogs just as they are spawning. The size it seems to catch is 39 mm which just slightly larger than the size of 37.5 which is stated 50% maturity.

Discussion

There was some discussion about how to get small clams for sampling and the expense of doing so. For example, fishermen could acquire them if there was money and the expertise to process them.

It was noted that Table 7 presented the mean length of the sample, not of the population. There was no discussion in the working paper of male/female differences.

Recommendations

Include the six maturity stages of quahogs and a reference (Ropes 1968) in the Research Document.

Do not draw any conclusions about the age at maturity. Show the graph and indicate that there was not a good fit (don't show the line). This analysis would be improved if a greater number of small animals were included in the sample. A grab sample may be required to get the smaller animals.

Add a qualifier to Table 7 that it is for the sample and not reflective of the population – limited by the size range selected.

Biomass Estimates

Presentation Highlights

Table 1. Biomass estimates for areas surveyed.

	Area km^2	Biomass (t)	CI
GM-1	7.36	5.1	±14.6
GM-2	80.07	1,483.8	±309.4
GM-3	2.95	0	0
GM-7	3.98	992.1	±162.8
GM-8	4.94	217.9	±67.7
Maces Bay	160.55	38,808.8	±1,437.1
Total	259.85	41,507.7	1,991.6

Discussion

It was clarified that all sizes of quahogs caught by the dredge were included in the biomass estimates.

It was suggested that it might be useful to include additional information on how the data was kriged. It was also suggested that it would be useful to include the density (Mean density per tow or kg per meter squared) of quahogs in addition to total biomass.

Another question was asked about the kriging approach and the neighborhood research grid (what surrounding points were used to krig at a single point). It was suggested that the kriging result should be provided, and the same color should be used to present the results from the ACON and kriging approaches for comparison purposes. It was clarified that two different software packages were used, so getting the same colors might be challenging, but it would be possible to take data from one package and put it into the other.

It was asked why the ACON contouring appeared to show less biomass than the statistical analysis. It was clarified that the ACON contouring approach didn't include the full area, only the outer bounds of stations actually sampled.

Recommendations

Add the statement, "Additional tows were not included in the statistical estimate of biomass but were included in the spatial analysis."

Add some text on the benefits of each method used for biomass estimates.

Replace the variogram in the paper with the one that was presented at the assessment. The spherical variogram was discussed, but the linear variogram was a better fit and was the one that was used.

Note that the survey biomass is fishable biomass.

Say "biomass" instead of "volume." Change "occupied" to "towed."

In Table 2, add unit of area.

Include the density of quahogs in kg per meter squared, in addition to total biomass.

Mortality

Presentation Highlights

Total mortality (Z) was estimated using a variety of methods. Z was estimated to be 0.21 using the Tmax approach, which would be influenced by the limited aging of the oldest animals. The catch curve approach gave a Z of 0.33-0.34. The Chapman Robson estimate with different fully recruited ages gave a Z of 0.26.

It was also noted that the age sample was small, and that the age distribution was small and questionable. The growth curve is questionable for the same reason. The Beverton Holt and 3/Tmax approaches would be the least influenced by this issue. 3/Tmax appears to be the most reasonable, so a Z of 0.12 was suggested as the most reasonable. There is still some uncertainty, but this estimate is better than using one for St. Mary's Bay

Discussion

It was noted that the mortality of offshore quahog populations appeared to be lower, since they seem to live for a much longer time.

It was asked whether there was an assumption of constant recruitment in the catch curve method. The answer was that yes, the method requires this assumption.

The potential overlap with the scallop fishery was discussed. It was noted that there hasn't been an investigation of the survival of quahogs through the scallop dredge. However, scallop surveys don't get a lot of quahogs. A scallop drag doesn't dig in, it just scrapes the top. They go through the grate (3-3.5 inch rings). The contribution of scallop fishery mortality to the population is not known.

It was felt that there might be too much detail on the Tmax method. However, there has been a number of questions about this method in the past, so it was included here. The Tmax method wasn't used for surf clam because there was a lot more information available.

It was clarified that the Expert Opinion on quahog could be referenced in the Research Document. A reference to the Framework and the clarification SSR could also be provided.

Recommendations

Add a bit more detail on the calculation of Tmax.

Get rid of the reference to Banquereau and rework the paragraph.

Harvest

Presentation Highlights

Table 2. Estimated biomass and harvest levels for areas surveyed.

	Biomass (t)	$B*F_{0.33M}$
Grand Manan	2,700	107
Maces Bay	38,800	1,537
Total	41,500	1,644

The fishery gets the best price for small quahogs as a replacement for bay quahogs, especially when that fishery in the US is closed due to PSP. More meat is obtained from the larger quahogs but there isn't as good a price for these.

Ecosystems and Habitat

Presentation Highlights

The amount and number of species in the bycatch is low. This is due mainly to the necessity of washing mud out of the dredge.

Discussion

Compared to the groundfish fishery, which might catch other commercial species, there is very limited bycatch in the quahog fishery. However, DFO is not just interested in fish bycatch but is also interested in habitat impacts and impacts to SARA species.

It was clarified that the bycatch was weighed and counted, but small measurements couldn't be made with the scale that was used. Most of the ones that were retained were soft bodied organisms.

A box core or grab sample would be useful if you wanted to know what was down there. One bucket full of mud was examined, but there wasn't much in it.

The Grand Manan survey, with the liner, caught less bycatch. However, that survey also didn't obtain many quahogs.

Table 8 includes both Mace's Bay and Grand Manan bycatch.

Only approximately 400 individuals of bycatch for 100,000 quahogs.

Recommendations

Should include the amount of quahogs caught in the bycatch table (for comparison).

Separate the bycatch table into Mace's Bay and Grand Manan.

Conclusions

Presentation Highlights

It appears that the quahog stock in SWNB can biologically sustain a low level of harvest. Populations appear younger with a higher mortality rate than other populations. Ecosystem impacts of dry dredges in soft substrates are not known but are likely to persist for a long time. The current market is for small quahogs, which are close to the minimum spawning size, and there are some risks associated with this. Other management measures could be used to address this concern, e.g., closed areas or a spawning reserve. A harvest level of F0.33M is considered to be conservative, so harvesting at this rate should allow escapement of a sufficient number of spawners. Quahogs are pulse spawners. Additional aging work would provide a better understanding of the population age structure (and associated life-history parameters).

Discussion

It was asked whether the notion of a sustainable fishery depends on the minimum fishable size. It was clarified that there is certainly greater risk as you approach fishing at the minimum spawning size, but that a conservative harvest level should allow sufficient spawners survive through to spawning.

There was some discussion of a spawning reserve, particularly the possible dependence on circulation. There are lots of eddies and gyres in this area; research done for scallops could be used as an example. Quahogs are broadcast spawners and trickle spawners. Their larvae spend some time in the water column and drift in the currents. They don't have the byssus threads that scallops have, but they search for appropriate substrate using their foot. Planktonic larvae have some ability to move within the water column in calm water, and they tend to be retained in large gyres like scallops. Work done in the US indicates that they are sporatic spawners, possible timing with large plankton blooms. Mud bottom suggests that there is some retention, unless there is a storm. There are not strong current patterns. Larvae spend about 50 days in the water column. Find some quahogs in spawning condition throughout the year (quahogs in general – not specifically for Mace's Bay).

It was asked how much difference there is between the Maine dry dredge and the SWNB dredge. The assessment team didn't know much about the Maine dry dredge; however, it was considered different enough that it wasn't considered useful to use the dredge efficiency from the US studies as a surrogate.

There was further discussion on the use of a natural mortality estimate of 0.12. It was suggested that using the estimate from St. Mary's Bay, as a location in close proximity to SWNB might be possible; however, it was noted that quahogs in St. Mary's Bay are much larger and the size distribution is much different. Minimum age was 25 years. The selectivity of the gear was also a lot higher in St. Mary's Bay (22-90 mm). Maine used a natural mortality of 0.02 for their offshore population. Different levels of M could be displayed in the table, but this might just cause confusion. Some comparison of growth rate between Mace's Bay and St. Mary's Bay was attempted during the meeting. It was suggested that it may be useful to plot the St. Mary's Bay and Mace's Bay age/length keys together for comparison.

Recommendations

Add text such as, “At an estimated biomass of X, a harvest level of 0.33M (X t) is considered to be biologically sustainable in Mace’s Bay given the current fishing gear.” Add a similar sentence for Grand Manan.

Present commercial gear selectivity as close to the size of 50% maturity (39.41 mm). It would be good to have animals spawn at least once before they are caught. However, target F is conservative enough that enough animals should get through the fishery and spawn.

Add density comparison between Mace’s Bay and Grand Manan.

Sources of Uncertainty: Start and end point of tows are known but, with tow saturation, tow length is not known.

Research Recommendations

Additional aging would improve catch curve and better estimate of natural mortality.

An estimate of dredge efficiency and tow distance would improve biomass estimate.

Don’t throw out shells from the 2006 and 2007 survey.

Survey the area that wasn’t surveyed in 2006/2007 (South of Grand Manan and up from Passamaquody Bay).

No studies have been conducted specifically on the habitat impacts of dry dredges in the Maritimes Region; however, studies of other gear indicate that there is potential for longer terms impacts in muddy environments. Current bycatch analysis of survey samples does not permit an accurate determination of the benthic species potentially impacted. Box cores or other methods may be required to better understand the benthic communities and potential impacts in this area.

CONCLUSIONS

The meeting concluded that the working paper should be produced as a Research Document with the above noted revisions, and the Science Advisory Report would be produced after the revisions suggested at the meeting were made (and after an editorial meeting).

ACKNOWLEDGMENTS

The clam assessment team was thanked for their hard work, the reviewers for their helpful comments and suggestions, and the rest of the participants for participating in the meeting.

APPENDIX 1. List of Participants.

Maritimes Science Advisory Process on
Assessment of Ocean Quahog in southwest New Brunswick

Hayes Boardroom, BIO, Dartmouth, NS
21 October 2011

ATTENDEES

Participant	**Affiliation**
Bourdages, Hugo	DFO Science, Quebec Region
Belding, Maurice	Fisherman
Butler, Maureen	DFO Maritimes / FAM
Carrigan, Lori Leigh	Ecosystems and Oceans Science
Cronk, Ron	NB Dept. of Fisheries
Graham, Sara	DFO Martimies / PED
Roddick, Dale	DFO Maritimes / PED
Silva, Angelica	DFO Maritimes / PED
Small, David	Fisherman
Worcester, Tana	DFO Maritimes / CSA

APPENDIX 2. Terms of Reference.

Terms of Reference

Assessment of Southwest New Brunswick Ocean Quahog
Maritimes Regional Science Advisory Process

21 October 2011
Dartmouth, Nova Scotia

Chairperson: Tana Worcester

Context

DFO Science advice was last provided on inshore Ocean Quahog in 2005 (DFO 2005). At this time, Resource Management wanted to know what harvest approach would be most appropriate to apply to specific areas in order to ensure long-term sustainable quahog fisheries under the auspices of a precautionary approach. Given the low growth and recruitment rates of Ocean Quahogs, it was recommended that the Scotian Shelf quahog fisheries have some level of monitoring with a catch level set by F=0.33M As the fishery progressed, it was suggested that estimates of virgin biomass and natural mortality would be refined, as would understanding of growth rates and age structure. Surveys were conducted for SW New Brunswick in 2006 and 2007 under a 2006-2008 joint project agreement with industry. It is expected that this assessment will provide information on the status of the resource in the surveyed areas and enable continued development and management of this exploratory fishery.

Objectives

- What is the biomass of the Ocean Quahog resource in the specific areas surveyed?
- What was the bycatch of non-quahog species in the survey/fishery?
- What is the recommedned harvest level (Total Allowable Catch) for the surveyed areas based on previous DFO Science advice on Ocean Quahogs?
- Is there additional information that would suggest a different harvest level than previously recommended for Ocean Quahogs on the Scotian Shelf?

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. 2005. Expert Opinion on the Rationale for Harvest Advice on Ocean Quahogs (*Arctica islandica*). DFO Maritimes Region Expert Opinion 2005/04.

APPENDIX 3. Agenda.

Maritimes Regional Science Advisory Process on
Assessment of Southwest New Brunswick Ocean Quahog

Date: 21 October 2011

Chair: Tana Worcester

Hayes Boardroom
Bedford Institute of Oceanography
Dartmouth, Nova Scotia

DRAFT AGENDA

21 October 2010 – Friday

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	Review of Science Advisory Report
17:00	Adjournment