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Proceedings of the Maritimes Regional Peer Review of the Framework Review for Stock Assessment of Offshore Whelk in 4Vs and 4W

Meeting dates: May 17-18, 2022

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Chairpersons: Leslie Nasmith and Rabindra Singh

Editor: Rabindra Singh

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Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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TABLE OF CONTENTS

SUMMARY.....	iv
INTRODUCTION	1
OBJECTIVES.....	1
DAY 1: INTRODUCTIONS AND PRESENTATION	1
BIOLOGICAL OVERVIEW	2
FISHERY OVERVIEW	2
FISHERY-DEPENDENT DATA (MONITORING DOCUMENT).....	3
FISHERY-DEPENDENT DATA (DETAILED SAMPLING)	4
RECENT GENETIC RESEARCH ON POPULATION STRUCTURE.....	4
Abstract.....	4
Discussion.....	5
INDICATORS AND REFERENCE POINTS	5
LENGTH-BASED INDICATORS	5
DAY 2: PRESENTATION CONTINUED	6
LIMIT REFERENCE POINTS	6
CONSIDERATIONS FOR A POTENTIAL COMMERCIAL FISHERY	7
Fishing Area	7
Fishing Season	7
Exploitation Rates and Biomass	8
TIMING FOR ASSESSMENTS AND FUTURE FRAMEWORKS.....	8
REFERENCES CITED.....	8
APPENDIX A: TERMS OF REFERENCE.....	9
APPENDIX B: LIST OF PARTICIPANTS.....	12
APPENDIX C: AGENDA.....	13

SUMMARY

Buccinum undatum, the waved whelk, is a ubiquitous marine gastropod within the North Atlantic. Their reproductive cycle involves internal fertilization and direct development of larvae within demersal egg capsules. This lack of planktonic larvae coupled with limited adult movement results in a limited dispersal in this species. Whelk exhibit variation in life history characteristics as well as genetic differentiation over relatively small spatial scales making their populations vulnerable to local depletion or even extirpation, and slow to recover from their removal. There is currently an exploratory whelk fishery in Northwest Atlantic Fisheries Organization (NAFO) Divisions 4W and 4Vs. There are no independent surveys and thus information on these stocks is based on data collected by fishery. This assessment framework review was undertaken to enable Fisheries and Oceans (DFO) Science to address requests from DFO Resource Management and provide advice on the stock status of whelk to guide decisions in the management of offshore 4Vs and 4W whelk including the viability of commercial fisheries, the management of food, social, and ceremonial allocations, and commercial quota allocations. This meeting was held virtually on May 17–18, 2022, using Microsoft Teams and participants included experts from DFO Science, DFO Resource Management, the Province of Nova Scotia, academics, aboriginal communities/organizations, the fishing industry and non-government organizations.

INTRODUCTION

Buccinum undatum, the waved whelk, is a ubiquitous marine gastropod within the North Atlantic. Distributed from the low water mark to depths of up to 600 m they are most abundant in the shallower portion of their range. Their reproductive cycle involves internal fertilization and direct development of larvae within demersal egg capsules. This lack of planktonic larvae coupled with limited adult movement results in a limited dispersal in this species. Whelk exhibit variation in shell morphology, size at sexual maturity, and size frequency as well as genetic differentiation over relatively small spatial scales making their populations vulnerable to local depletion or even extirpation, and slow to recover from their removal.

There is currently an exploratory whelk fishery in Northwest Atlantic Fisheries Organization (NAFO) Divisions 4W and 4Vs. There are no independent surveys and thus information on these stocks is based on data collected by the exploratory license holders (Louisbourg Seafoods Ltd. and Premium Seafoods Ltd.). This assessment framework review was undertaken to enable DFO Science to address requests from DFO Resource Management and provide advice on the stock status of whelk to guide decisions in the management of offshore 4Vs and 4W whelk including the viability of commercial fisheries, the management of food, social, and ceremonial allocations, and commercial quota allocations.

OBJECTIVES

The specific objectives to be addressed in this assessment framework review were as follows:

- Review current biological knowledge and fisheries practices for whelk.
- Analyze available fishery dependent and independent data to assess the 4Vs and 4W offshore whelk stocks.
- Develop appropriate indicators for monitoring stock status or provide contextual indicators.
- Determine if the NAFO Divisions 4Vs and 4W are appropriate spatial scales to monitor stock status and if not, determine appropriate spatial scale for fishing zones.
- Outline any potential recommendations for an annual fishing season and recommendations for time closures if appropriate.
- Determine an approach for developing limit reference points for each zone, and advice on appropriate reference points.
- Discuss the appropriate timeframe for future updates and assessments.
- Provide recommendations to improve future monitoring and research.

The meeting was held virtually on May 17–18, 2022, using MS Teams and participants included experts from DFO Science, DFO Resource Management, the Province of Nova Scotia, academics, aboriginal communities/organizations, the fishing industry and non-government organizations. See Appendix A for the Terms of Reference, Appendix B for full list of participants and Appendix C for the agenda for the two-day meeting.

DAY 1: INTRODUCTIONS AND PRESENTATION

Rapporteurs: Jarrad Sitland and Dheeraj Busawon

The meeting started with the Co-Chair (L. Nasmith) introducing herself and Co-Chair R. Singh and welcoming everyone. The participants were then asked to introduced themselves. L.

Nasmith then briefly described the Canadian Science Advisory Secretariat (CSAS) peer review process and the use of the Scientific Advice for Government Effectiveness (SAGE) Principles and Guidelines. Since the meeting was using Microsoft Teams (MS Teams) as the platform, tips on the effective use of MS Teams were provided. The Terms of Reference with the specific meeting objectives and the Agenda for the two days were reviewed.

BIOLOGICAL OVERVIEW

M. Barrett presented a biological overview of the Waved Whelk. This was followed by questions and comments from participants.

It was noted that on the topic of the reproductive cycle, that during embryo and larval development there is a high level of cannibalism. Even though the female lays thousands of eggs, only a couple hundred juveniles will emerge. At that early stage the mortality is, therefore, already high because cannibalism starts within the egg capsules. Parasitism also seems to be widely distributed and it is unknown how this impacts reproduction. Some organs in females are not well-developed when parasites are present.

It is presently unknown how parasites impact reproduction and the only way to know whether an animal is parasitized is to remove the whelk from its shell. There is need for a study that could examine the impact of parasites on reproduction; however, how this is done is still something that will have to be determined. Louisburg Seafoods Ltd. has recorded evidence of parasitism during sampling for tracking prevalence.

In some parts of the Quebec Region, another parasite (a polychaete) that causes holes in the shell has been observed. The shell becomes very fragile to the point you can crack it with your hands. This has led to some thought being given to increase the minimum landing size (MLS) in Quebec to allow for increased number of mature whelk in the population. There is presently no evidence of a polychaete infestation on Banquereau whelks.

FISHERY OVERVIEW

Following the presentation on the fishery overview a question was raised about the licence conditions that allow for the landing of both whelk and Moonsnail and whether the same traps were being used to catch the Stimpson's Whelk and Moonsnail. It was explained that the licence conditions do allow fishers to land both of these species and that the landings data are reflective of just Waved Whelk. It is not believed that Moonsnail are caught but Stimpson's Whelk are caught and landed because it is difficult to differentiate Waved Whelk from Stimpson's Whelk at sea. Differentiation is only done at the processing plants, which is a bit of an issue and should be looked at later on because it is unknown what proportion of the catch contains Stimpson's Whelk. Industry believes that Stimpson's Whelk is less than 2% of total catch.

In the Quebec Region, it is believed that there are other species of whelks that are too small to be captured, but there are some present in the landings. These other species are typically in deep water while the fishery is prosecuted in shallow waters from 10–30 m. The licence conditions in Quebec Region allow them to land all species of whelk.

A participant wanted to know how the total allowable catch was determined and the original values settled upon. It was explained that with any exploratory fishery request, the industry usually comes to DFO with the request for a TAC. The TAC has been adjusted over time and in 2018 and 2019 changes were made after a request from one licence holder for 700 t for 4Vs. DFO Science did not see an issue with approving the request at that time. There was no formal scientific process to review the appropriateness of the request. In 4W, the decision was made because there was no significant catches of whelk for some time. Only in recent years has the

TAC been realized. Science at the time advised that the TAC seemed high, and there has not been changes to TAC in recent years as management await the development of indicators.

A reviewer wanted to know whether there is a high rate of mortality of the smaller undersized whelks after the process to sort them out at sea and whether they represent a large proportion of what is caught in the traps. In response, it was explained that the prevalence of small whelk caught in the traps is unknown and studies suggest 98% survivability. So presently, we do not have a measure of recruits. On the logbook there is a bycatch field where this information could be captured, but it is not commonly reported. One of the licence conditions allows for 5% retention of small whelks but the data suggests they are capturing much more than that¹. Industry submits science plans and there have been suggestions to look at the retention of smaller individuals.

On the topic of the fishing timelines for 4W, the joint survey efforts between Premium Seafoods and Louisbourg Seafoods was actually in 2017 and not 2018. This will be adjusted in the Working Paper.

FISHERY-DEPENDENT DATA (MONITORING DOCUMENT)

After the presentation on this section, a participant wanted to know if the fishery-dependent data were independently verified. It was explained that all of the landings are verified by dockside monitoring and that since the fishery began, 3–4 trips have been verified by an at-sea observer.

In response to a question from a participant, it was pointed out that the bait used was typically haddock and it was the same in all the fishing areas. While industry has experimented with multiple types of bait including herring and mackerel, they have found only marginal differences based on type of bait used.

A reviewer suggested filtering the data further for catch-per-unit-effort (CPUE) analyses (e.g., main months or where there is consistency in effort (for specific areas). The Science Lead mentioned filtering the data was attempted but it did not result in significant improvement. It is possible to maybe use the Snow Crab survey as it is standardized and biomass could be calculated at an area level. In the Quebec Region, despite the license conditions saying 72 hrs limit for soak time, traps can be left for more than 96 hours. These are filtered out when calculating the CPUE. The Quebec Region also uses a model to standardize data by month and year.

There was a suggestion to modify the logbook to get more effort information (i.e., time set and time hauled). As the fishery moves to potentially becoming commercial, there will be opportunities to make appropriate changes to these documents and processes.

Following a question on the consistency of the number of traps per string over time, it was explained that the number of traps on a string depends on the vessel. For 4Vs, the number of traps is 40 or 50 traps per string depending on the vessel, for 4W it is fewer. The number of traps set and hauled is recorded on the logbook and used in the CPUE analyses.

A participant wondered if Waved Whelk abundance on Georges Bank is a function of concentrated sampling there, or whether there is a high population on the bank. There used to be an exploratory fishery on Georges Bank but it was interfering with other fisheries and this

¹ At the subsequent Assessment Meeting held on June 14, 2022, it was learned that the samples from which the 5% retention of undersized whelk were obtained are from unsorted (ungraded) at sea catch and not the landed catch which is graded.

prompted a change in license condition following a review of the 2011 Whelk survey results and the analysis of potential for gear conflicts. As a result access to 5Z (Georges Bank) was excluded in the licences from around 2012–2013.

FISHERY-DEPENDENT DATA (DETAILED SAMPLING)

Following the presentation, a reviewer wondered if it was possible to get gonado-somatic index (GSI) from the commercial samples. The Science Lead mentioned that it was not possible because currently gonad weight is not recorded and this was one of the recommendations in the working paper to look at monthly samples to help understand reproduction through a GSI. Industry also mentioned that they had looked at GSI prior but it was very time consuming to separate the gonad from the digestive complex. In the Quebec Region various methods were used to try to determine maturity stage but this was very time consuming and a quick visual method described in Couillard and Brulotte (2020) is being used presently.

It was pointed out that presently there is no record of the amount of the landed catch that is below the minimum landing size (MLS). Also, there currently is no record of small whelks discarded at sea. It is known that there are quite a few landed whelks that are under the MLS. For 4Vs, there is a different MLS. In the Quebec Region, there are five different species but all are recorded as the same species. The MLS is described for only one species and while other species can be landed, it is not known if they are within the appropriate size.

A discussion followed on the usability of the fishery independent survey (i.e., the DFO Research Vessel [RV] ecosystem survey and the snow crab survey). With the RV survey there is always a question about mesh size and what is ultimately retained. The snow crab survey has a smaller mesh size and will retain more whelks. It is also conducted in areas where the offshore whelk fishery occurs. It was explained that there was potential to modify the species identification in the snow crab survey to make them useful.

In the Quebec Region, other surveys done in the Gulf of St. Lawrence are not useful as mesh size and area surveyed differ. However, for whelks surveys scallop nets are used for sampling and may be appropriate for the Maritimes Region. It was mentioned that there is a planned meeting in the fall/winter where the proposal of a formal survey will be discussed.

RECENT GENETIC RESEARCH ON POPULATION STRUCTURE

The next presentation was by C. D'Aloia on the results of a recent genetic study by William Sturch and Cassidy D'Aloia on the Waved Whelks in Atlantic Canada. Below is an abstract of the presentation.

Abstract

For benthic marine species, the mode and length of larval development are generally expected to be strong drivers of connectivity. Direct-developing species lack a pelagic larval phase and are thus predicted to have limited dispersal capacities and strong genetic structure over small spatial scales. But recent work on direct developers suggests that realized connectivity patterns can be more complex. Here, we characterized spatial genetic structure within the western North Atlantic lineage of the waved whelk (*Buccinum undatum*), a direct-developing marine gastropod that is the target of an emerging fishery. We genotyped 198 individuals from 9 sampling sites throughout Atlantic Canada using 1,052 SNPs obtained from ddRAD sequencing. *B. undatum* exhibits strong hierarchical genetic structuring throughout this region. At broad spatial scales, genetic patterns align with expectations for a dispersal-limited direct developer: pairwise genetic structure estimates are high and there are two major genetic clusters that divide southwestern sites from northeastern sites. However, at smaller spatial scales, more complex patterns

emerge, including the strong genetic divergence of an intertidal population on the southwest tip of Nova Scotia. Notably, pairs of sites on deeper offshore habitat exhibit panmixia, despite being separated by up to 100 km. Collectively, these results illustrate that the species' strong broad-scale genetic structure is concordant with expectations for a direct developer, but, counter to expectations, populations are genetically homogeneous in several offshore regions. As a commercial fishery for *B. undatum* develops in more regions of Atlantic Canada, further exploration of potential depth-variable connectivity is warranted.

Discussion

There is an apparent close link between the Magdalen Islands and Newfoundland populations shown in the study. Some participants wondered if there was a missing dispersal mechanism to explain this closeness. These species used to be considered sedentary, but now they have the ability to disperse. Some species of gastropods do have the ability to float at the surface of the water when conditions are not optimal at the sediment.

It was suggested that analysis should be carried out on samples from 4W as these would help better define the western and eastern separation on the Scotian Shelf. Samples could be requested from DFO RV surveys or from one of the licence holders. It was noted that the Newfoundland site was an approximation and that the exact location should be confirmed.

INDICATORS AND REFERENCE POINTS

There was general discussion of methods used including the method developed by one of the reviewers (M. Boudreau), a data limited decision tree that was very useful in selecting methods. A number of methods were mentioned that could be investigated (e.g., $B_{recovery}$, JABBA, etc.)

On the SPICT model, participants wondered why there was such a huge variability. A potential cause was identified as the model requiring contrast in the data which is not the case currently. Another suggestion was that the movement of fishermen from one bed to another could be influencing variability. A reviewer mentioned that the biomass calculation method could be used as a proxy for fishing mortality. Participants wondered if the apparent downward trend in CPUE persisted in 2021 and it was indicated that CPUE in Middle Bank increased in 2021. A participant noted that catchability can fluctuate as new areas are fished and this can add variability in the models or data.

LENGTH-BASED INDICATORS

After the presentation on length-based indicators, a questions was asked about the possibility of devaluing the bigger individuals because most of them are castrated and do not contribute to the reproduction. It was indicated that it is a simple model based only on the given inputs it is difficult to quantify the impact of parasitism. The end result is an SPR value that can be used as an indicator and these models would have a flat top but the default with a domed shape might be more appropriate. The science lead indicated that it is not so much a shape issue but a result of parasitism (e.g., dome shaped for parasitized individuals but not for normal one).

A reviewer mentioned that length-based approaches are quite new and have not been thoroughly tested and more case studies are needed. It was suggested to explore LIME (simulation) and compare that to actual length frequencies. For data limited stocks, there may be the need for more than one indicator (cumulative indicators may be more appropriate) and that these length-based methods should be kept in mind as more data are added.

The science lead inquired if there were any comments regarding the use of maximum as B_0 proxy and there was a discussion on whether the geometric mean or the maximum should be

used. It was pointed out that the two approaches of using the maximum or the average are both acceptable; however, it is more appropriate to use the maximum at the beginning of time series and average when CPUE has stabilized. Industry did not have an alternative to the maximum but was not convinced it represents the unfished stock biomass.

Since there are only three years (points) of data this indicator will need to be reviewed every 5 years. Having a fishery indicator for each area is most important, but ideally it would be great to have some sort of reference point to measure against.

A discussion around setting the Limit Reference Point (LRP) for the fishing areas followed. Participants wondered if there was an expectation that area boundaries will change. While it was believed that that the boundaries would not change there might be the new fishing areas. It was emphasized that shifting fishing areas boundaries should be avoided since reference points will be specific for an area. It was pointed out at other stocks use an absolute value of the biomass and use geometrical means to set the reference point based on proxy of B_{MSY} using proportions. In the case of this whelk fishery, since there are more data for Area 1, B_0 proxy could be determined using the three maximum years and set at B_{MSY} to represent stability in the catch.

This being a good time to break the meeting was adjourned to Day 2.

DAY 2: PRESENTATION CONTINUED

Rapporteurs: Jarrad Sitland and Dheeraj Busawon

Day 2 started with a review of the items discussed in previous day after which the Science Lead (M. Barrett) reviewed the possible candidate LRPs.

LIMIT REFERENCE POINTS

M. Barrett proposed that after the meeting an area will be defined for the Middle Bank area (southern middle bank) and an LRP for just that area will be identified. This would exclude any CPUE outside of that area.

A reviewer concluded that primary indicators should be B_0 based on CPUE with the LRP calculated based on the geometric mean. Furthermore, the ICES length-based approach should be used as a secondary indicator and other analyses should be kept in mind until more data are available. After discussion, the reviewer agreed to using the maximum as it would be more precautionary.

The second reviewer noted that the issue seems to be limited data but that a good framework has been laid and agreed that B_0 seems to be appropriate at this point. The maximum CPUE seems to be more precautionary. The geometric mean may reflect more realistic CPUE but only limited data are available. Support was also expressed for monitoring length frequency as a secondary indicator.

Industry also agreed that the maximum CPUE seems more intuitive and had no concerns with using the 2017 data point. Resource Management (RM) was also in agreement with using B_0 along with the length-based approach as a secondary indicator.

There was some questions surrounding length-based approach and the effect of parasitism on older individuals. This approach is being proposed since it will provide information to protect immature whelks and allow for tracking large, optimal yield whelks. It was also pointed out that if length-based approach was going to be used, better length frequency sampling would be required (e.g., sample from the catch not only the landings).

Discussion then followed about which areas should be included in the CPUE (e.g., 4W LRP or Middle Bank LRP). RM agreed that LRP should focus on areas where there are consistent fishing and that the LRP should be specific to the fishing area.

Other secondary indicators that could be considered include the condition factor; however, there are no known condition factor for whelks. Industry warned that whelk exhibit a wide range of phenotypical variations (e.g. thickness of the shell) so a condition factor might be more complex than anticipated.

The appropriateness of 20% B_0 vs 30% B_0 then followed and it was agreed that 30% was the more precautionary approach. No one felt strongly about using 20% instead of the 30%. The 30% was supported since it is more cautious approach in light of the data-limited nature of the fishery.

CONSIDERATIONS FOR A POTENTIAL COMMERCIAL FISHERY

Fishing Area

There was a general discussion about the management area with exploratory fishery in place for some time and now there is consideration of a commercial fishery. It was hoped that the areas could be refined based on data collected through exploratory fishery (i.e., enough is known of these areas to say these are likely the areas of focus for the fishery). Industry mentioned that the different areas are synonymous with whelk beds and Areas 2, 3 & 4 were a result of more vessels being available and there is no commitment that these are the only areas that may be the focus of the fishery.

In the Newfoundland and Labrador Region, there are 3 defined whelk beds in one NAFO division and they are restricted to these 3 beds. CPUE has consistently decreased in these areas after peaking. In the Quebec Region, there are 14 fishing zones (9 North Shore, 1 Magdalen, 4 in Gaspé-Lower St. Lawrence) and the stocks are managed by fishing zones. The problem is that there are too many licenses and not all are used in any given year; however, having multiple fishing zones encourages harvesters to go to different areas and this helps guard against effort being too concentrated in one area. The whelk population would not support a fishery if all the fishermen decided to fish whelks. It is a similar situation in the Newfoundland and Labrador Region and it was noted that management have to be careful with the TAC and the number of licenses.

Fishing Season

Historically the season has been opened after receiving fishing and science plans as required under exploratory licences. Industry indicated their preference for an earlier season (with a June opening) due to current infrastructure, processing of other catch and weather. It was mentioned that in Quebec Region, the fishery is open for 6 months and this may be too long. A suggestion was made to analyze the CPUE in, and outside, of the breeding season to determine change in catchability based on spawning season. It was noted that current season seems to work from a biological perspective but that does not mean that an earlier season would not work.

In the Maritimes Region, fishing usually occurs outside of the spawning season. Research indicate that females do not feed during this time which might be a potential justification for an earlier season but not enough is known as yet. Industry would like to understand what would happen if the fishery occurs only during May-June. It was also mentioned that GSI (discussed earlier) could be examined throughout an earlier season. It was also noted that egg masses come up in the trap occasionally and this could be used to back calculate when spawning is occurring. Enough data do not presently exist to evaluate this proposal.

It was also indicated that whelk fishery could interfere with the clam fishery but that there is presently a protocol in place to avoid conflict. This protocol has worked very well the previous year; however, this working relationship may be dependent on number of licences distributed when the whelk fishery becomes commercial.

Exploitation Rates and Biomass

Currently, there are no good estimates for stock biomass but Industry did make a recommendation. From a management perspective, the lack of biomass estimates poses an issue. The Science Lead offered to calculate 80% B_{MSY} for the Upper Reference Point (URP) if that would help. While there are some data from the fishery, part of the current monitoring would be to adjust the TAC to determine how the stock reacts. It was suggested that the snow crab survey could be used to get a biomass estimate in the future.

Participants also discussed the potential of drawing on other fisheries (Quebec, Newfoundland, or Europe) for guidance. The Quebec Region has a similar problem of no biomass estimate and because whelk are very long lived, by the time a change in CPUE is detected the stock would be too low. Whelk stock assessment/update schedules should be set with this in mind. Also, an increase in TAC will only be able to be judged in a couple years' time when the stock is reassessed, so it is difficult to tell in the interim whether the measures are appropriate.

TIMING FOR ASSESSMENTS AND FUTURE FRAMEWORKS

It was proposed that an update will occur every 2 years. Reporting information on small whelk discarded at-sea is important. Having a record of that as a number of whelk, and also a weight is important. The fishery depth ranges from 38 m in 4Vs to 51 m in 4W. In other fisheries, such as for sea cucumbers, industry has used camera surveys to estimate biomass.

The use of camera surveys was mentioned as a potential for whelk surveys versus using diving. Cameras would be viable only for looking at 1 m² so this may require the need to increase number of drops. A research need is to determine the reproductive time frame while the GSI could be used to provide an idea of the reproductive season.

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APPENDIX A: TERMS OF REFERENCE

Framework Review for Stock Assessment of Offshore Whelk in 4Vs and 4W

Regional Peer Review - Maritimes Region

Dates: May 17–18, 2022

Location: Virtual

Co-chairs: Leslie Nasmith and Rabindra Singh

Context

Buccinum undatum, the waved whelk, is a ubiquitous marine gastropod within the North Atlantic. They are distributed from the low water mark to depths of up to 600 m but are most abundant in the shallower portion of that range (Hansson 1998; Weetman et al. 2006; Włodarska-Kowalczyk 2007; Heude-Berthelin et al. 2011). Their reproductive cycle involves internal fertilization and direct development of larvae within demersal egg capsules. This lack of planktonic larvae coupled with limited adult movement (Pálsson et al. 2014, Lapointe and Sainte-Marie 1992; Hancock, 1963; Himmelman and Hamel 1993) results in a limited dispersal in this species. A growing body of research has shown whelk to exhibit variation in shell morphology, size at sexual maturity, and size frequency as well as genetic differentiation over relatively small spatial scales (Weetman et al. 2006; Shelmerdine et al. 2007; Pálsson et al. 2014; McIntyre et al. 2015; Valentinsson et al.). This makes whelk populations vulnerable to local depletion or even extirpation (Gendron 1991; de Jonge et al. 1993), and slow to recover from their removal.

There is currently an exploratory whelk fishery in Northwest Atlantic Fisheries Organization (NAFO) Divisions 4W and 4Vs. There are no independent surveys and thus information on these stocks is based on data collected by the exploratory license holders (Louisbourg Seafoods Ltd. and Premium Seafoods Ltd.). This assessment framework review will enable DFO Science to address requests from DFO Resource Management and provide advice on the stock status of whelk to guide decisions in the management of offshore 4Vs and 4W whelk including the viability of commercial fisheries, the management of food, social, and ceremonial allocations, and commercial quota allocations.

Objectives

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- Analyze available fishery dependent and independent data to assess the 4Vs and 4W offshore whelk stocks.
- Develop appropriate indicators for monitoring stock status or provide contextual indicators.
- Determine if the NAFO Divisions 4Vs and 4W are appropriate spatial scales to monitor stock status and if not, determine appropriate spatial scale for fishing zones.
- Outline any potential recommendations for an annual fishing season and recommendations for time closures if appropriate.
- Determine an approach for developing limit reference points for each zone, and advice on appropriate reference points.
- Discuss the appropriate timeframe for future updates and assessments.

-
- Provide recommendations to improve future monitoring and research.

Expected Publications

- Research Document
- Proceedings

Expected Participation

- DFO Science
- DFO Resource Management
- Provinces of Nova Scotia and New Brunswick
- Academics
- Aboriginal communities/organizations
- Fishing industry
- Non-government organizations

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APPENDIX B: LIST OF PARTICIPANTS

Participants at the Maritimes Regional Peer-Review virtual meeting May 17-18, 2022, on the Framework Review for Stock Assessment of Offshore Whelk in 4Vs and 4W.

Name	Affiliation
D'Aloia, Cassidy	University of Toronto
Barrett, Melanie (Lead)	DFO Maritimes Science
Barrett, Tim	DFO Maritimes Science
Boudreau, Mathieu (Reviewer)	DFO Quebec Science
Boyd, Catherine	Clearwater
Busawon, Dheeraj	DFO Maritimes Science
Chlebak, Ryan	DFO National Headquarters Science
Element, Geraint (Reviewer)	DFO Maritimes Science
Finley, Monica	DFO Resource Management
Gianasi, Bruno	DFO Quebec Science
Langille, Janet	DFO Eastern Nova Scotia Area Office
Lundy, Mark	Industry consultant-Ocean Pride
Cooper-MacDonald, Kathryn	DFO Resource Management
MacLean, Allan	Louisbourg Seafoods
Mugridge, Adam	NS Fisheries and Aquaculture
Nasmith, Leslie (Co-chair)	DFO Maritimes Science
Penny, Lorne	DFO Eastern Nova Scotia Area Office
Sampson, Michelle	Premium Seafoods
Zabihi-Seissan, Sanaollah	DFO Newfoundland & Labrador Science
Simmons, Kurt	Louisbourg Seafoods
Singh, Rabindra (Co-chair)	DFO Maritimes Science
Sitland, Jarrad	DFO Resource Management
Townsend, Kathryn	Maritime Aboriginal Peoples Council

APPENDIX C: AGENDA

**FRAMEWORK REVIEW FOR STOCK ASSESSMENT OF
OFFSHORE WHELK IN 4VS AND 4W**

17-18 May, 2022

Virtual Meeting (MS Teams)

Day 1: Tuesday, May 17, 2022

Time	Topic	Leads
9:00 – 9:15	Introductions and CSAS Procedure	Co-Chairs: L. Nasmith and R. Singh
9:15 – 9:30	Agenda and Terms of Reference	Co-Chairs
9:30 – 10:30	Overview of Biology and Fishery	M. Barrett
10:30 – 10:45	Break	
10:45 – 12:00	Fishery Independent and Dependent Data	M. Barrett
12:00 – 1:00	Lunch	
1:00 – 1:30	Genetics Work	W. Sturch/C.D'Aloia
1:30 – 4:00	Review Indicators	M. Barrett

Day 2: Wednesday, May 18, 2022

Time	Topic	Leads
9:00 – 9:10	Brief review of day 1, agenda for day 2	Co-Chairs: L. Nasmith and R. Singh
9:00 – 10:00	Reference Points	M. Barrett
10:00 – 10:30	Recommendations for Future Monitoring	M. Barrett
10:30 – 10:45	Break	
10:45 – 12:00	Discussion on aspects of a commercial fishery	M. Barrett/K. Cooper MacDonald