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Proceedings of the Regional Advisory Meeting on the Assessment of the Sea Cucumber Fishery in Quebec's Inshore Waters

June 1-2, 2021
Virtual meeting

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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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SUMMARY

This document contains the proceedings of the regional advisory meeting on the assessment of the Sea cucumber fishery in the Quebec's inshore waters. The meeting, which was held virtually via Zoom on June 1-2, 2021, brought together roughly 40 participants from science, management, the fishing industry and First Nations. These proceedings describe the highlights of the meeting presentations and discussions and outline the recommendations and conclusions resulting from the review.

INTRODUCTION

The Quebec Region of Fisheries and Oceans Canada (DFO) is responsible for assessing the stocks of several exploited fish and invertebrate species in the Estuary and Gulf of St. Lawrence. Most of these stocks are assessed periodically within a regional advisory process, which is conducted at the Maurice Lamontagne Institute in Mont-Joli. This document consists of the proceedings of the meeting held on June 1-2, 2021 via the Zoom platform (virtual meeting), on the assessment of the Sea cucumber fishery in inshore waters of Québec.

The objective of the meeting was to determine whether there were any changes in the resource's status and whether adjustments were required to the management plans based on the chosen conservation approach, the ultimate goal being to provide a scientific advice on the management for the 2021–2023 fishing seasons.

These proceedings report on the main points discussed in the presentations and deliberations stemming from the activities of the regional stock assessment committee. The regional review is a process open to all participants who are able to provide a critical outlook on the status of the assessed resources. Accordingly, participants from outside DFO are invited to take part in the committee's activities within the defined framework for this review (Appendices 1 and 2). The proceedings also list the recommendations made by the meeting participants.

EVALUATION

The chair of the meeting, Charley Cyr, welcomed participants, briefly went over the peer review process and objectives, and outlined the agenda. After introductions were made, the stock assessment biologist, Hacène Tamdrari, began his presentation by highlighting collaborators' contributions, outlining the terms of reference for the peer review and summarizing the last science advisory report, published in 2017. He then described a few aspects of the species' biology (distribution, habitat, stages of development) and discussed the context of the fishery, management measures and data sources (commercial fishery statistics, 2018 scientific survey, research projects and 2016-2020 post-season surveys). In Quebec, the sea cucumber dredge fishery began in 2008 and is still in the exploratory stage in management units 3, B and C and in the experimental stage in areas along the Lower North Shore. During the 2017-2020 period, average annual landings totalled 1 087.7 tonnes (t), 57.4% of which came from the Gaspé Peninsula's north shore and 42.6%, from the North Shore. In general, fishing effort seems to be well distributed in the various management units.

- It was noted that samplers measure sea cucumbers right after they are caught, when they are contracted. Questions were raised on the reliability of this measurement as an accurate size indicator. Further details on this subject were to be provided during Catherine Couillard's presentation.

FISHERY INDICATORS: UNIT 3

The assessment biologist outlined the results of the exploratory fishery in Unit 3. The authorized fishing effort increased from 100 to 120 fishing days in 2018. Average annual landings from 2017 to 2020 were 463 t, which is comparable to those during the 2014-2016 period (467 t). However, the fishing effort increased by 8.2% on average in 2017-2020 relative to 2014-2016, from 85 fishing days (2014-2016) to 94 fishing days (2017-2020). The mean CPUE in 2017-2020 (233 kg/hm) was comparable to that in 2009-2016 (240.4 kg/hm).

- It was suggested that the authorized fishing effort be shown in the same figure as the actual fishing effort.

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- According to industry representatives, the fact that the total number of fishing days authorized were not all used is attributable to the poor weather during the period when harvesters were available for this fishery.
 - The boundary between the centre and east in the figure could be more accurate so that it does not go through a sub-unit.
 - Less fishing effort seems to have occurred in the eastern portion of the unit, where some harvesting sites were fairly far away from fishing ports.
 - In the case of sea cucumbers, the notion of beds appears to be somewhat questionable and highly relative given the species' movement capacity. It was suggested that concentration (aggregation) be used instead. Questions were raised about the extent of the species' movements, which could be substantial according to some experiments reported in the literature. There were still many unanswered questions, and caution needs to be exercised before making any generalizations.
 - There were also questions about how the CPUE is calculated. It is the sum of all catches divided by the total effort in a given year in the entire unit. When standardizing the CPUE, it might be useful to be able to take account of the effect of cucumber movements.

The assessment biologist presented the size data obtained at sea and dockside. He suggested that only the sea sampling results (2018 and 2019) should be considered. Measurements taken at sea were likely to be more reliable than those taken dockside due to water loss, which can occur quickly. The mean length of individuals measured at sea increased in 2018 (127 mm) relative to 2016 (108 mm). Since then, it has remained stable but is still below the values recorded from 2009 to 2015 (average of 137 mm). Bycatches consisted mainly of a large number of sea urchin as well as starfish, *Hyas* spp., and rock crab.

- It was pointed out that the fishery takes place at depths of 28-29 fathoms and up to 60 fathoms.
- According to some participants, the smallest sea cucumbers (<114 mm on the measuring table) are thrown back into the water. At-sea discards are likely able to survive based on the literature and harvesters' observations. Observers must record the quantity of the non-retained catch.
- To better characterize bycatch, it was proposed that the bycatch from all fishing activities during the season should be reported. It was also suggested that not only the quantity but also the biomass of bycatch be presented, since these two metrics provide complementary information. This comment also applied to units B and C.
- Participants wondered about the impact of the recent modifications to fishing gear on bycatch. According to industry representatives, less bycatch was observed in 2019 and 2020. The increase in recent years shown on the graph may be associated with the greater presence of at-sea observers in these years.
- A number of factors could account for the high percentage of sea urchins in bycatch, including the species' wide distribution and the selectivity of the fishing gear. The fact that discarded sea urchin likely have good survival rates after release was also mentioned.

FISHERY INDICATORS: UNITS B AND C

In 2015, units B and C were divided into sub-units to improve the distribution of fishing effort. At the same time, the authorized range of depths that can be fished was modified from 22-40 m to

32-42 m, reducing the harvesting area and exploitable biomass, with TAC values lowered accordingly.

In Unit B, the TAC was reduced from 350 t in 2016 to 325 t in 2017. Annual landings in 2017-2020 averaged 300.1 t. Fishing effort has been increasing since 2016. The CPUE declined from 2017 to 2018 but has been rising since then, reaching 581 kg/hm in 2020, which is slightly under the 2017 value (641 kg/hm). The mean length of individuals measured at sea from 2017 to 2019 was relatively stable (135 mm) and similar to that in 2016 (134 mm).

- In 2020, according to calculations of fishing effort, the number of fishing days fell but the number of hours metre (hm) per day increased. According to an industry representative, fishing duration in 2020 would likely be the same as in previous years but dredge width was probably less. The source of the confusion may be how the beginning and end of a fishing day is defined and recorded (whether or not transport time is taken into account). This comment also applied to Unit C.
- The uncertainty associated with the CPUE seemed to be due to changes over the years in such things as fishing gear, masters, and management measures.
- It might be useful to include the age structures for previous years in order to assess the impact of the 2016 management measure that changed the authorized range of depths from 22-40 m to 32-42 m.
- Furthermore, in 2016, the fishery began later, and the weather had an impact on fishing yields. Therefore, questions were raised over which year should be considered the reference year. The year 2016 appeared to be highly uncertain given all the changes that occurred around that time.
- Participants wondered about why so many sub-legal-sized individuals were present at dockside (or at the plant). Water loss and the fact that cucumbers were stressed before they were measured were mentioned as possible reasons.
- In terms of bycatch, it would be useful to specify lobster numbers given the species' commercial importance. Participants wondered if the presence of lobsters in bycatch could be due to an increase in, or shifting of, the stock.
- It was noted that bycatch can vary enormously from tow to tow and therefore this information must be interpreted with caution.

In Unit C, the TAC of 382 t in 2016 was reduced to 352 t in 2017 and to 271.8 t in 2020. Annual landings decreased from 421.6 t in 2017 to 259.3 t in 2020. The average fishing effort in 2017-2020 was 17.6% greater than in 2015-2016. The mean CPUE decreased between 2017 and 2020, and, at 183 kg/hm, was 9.2% less than in 2015-2016 (201 kg/hm). The mean length of individuals measured at sea in 2017-2019 was stable (131 mm) and similar to that in 2015-2016 (137 mm).

- As was the case in Unit B, various factors (a change in the vessel, gear or master; management measures; weather) are thought to have potentially affected yields. They were included in the assessment as sources of uncertainty.
- In units B and C, 2017 was said to have been an excellent year.
- Participants were reminded that, in 2020, the TAC had been substantially reduced, which could explain the drop in effort in 2020.
- Some industry representatives found that the CPUE values presented were not representative of reality. It was recognized that the authorized range of depths only covers a

very small area of the seabed. Participants were reminded that the uncertainties raised would help clarify the results. Additional information would be provided in the upcoming presentations.

- It was also suggested that the data provided by the at-sea observers be examined (with the beginning and end of the tow and the tow duration). This information could possibly provide a more accurate estimate of the CPUE than the logbook data. However, participants were reminded that at-sea observer coverage remained low. The post-season data could also be examined (particularly 2018 and 2019). These avenues, among others, should be explored.

DIVE FISHERY: UNITS AA, A AND B

Hacène Tamdrari briefly outlined the results of the small-scale dive fishery carried out on a trial basis in units AA, A and B in 2017 and 2018, to depths of around 18 m.

- It was noted that there were no harvests in 2019 or 2020. This fishery requires a great deal of energy for little yield and is also high risk.
- In addition, the dive fishery is conducted in nursery areas and the sizes caught do not correspond to market requirements.

2018 RESEARCH SURVEY: UNITS A, B AND C

The assessment biologist presented the sampling plan and the results of the scientific survey conducted in 2018 in units A, B and C. According to the survey results, in the Gaspé Peninsula region, sea cucumbers were more abundant at depths of less than 20 m, where they were also smaller in size. The survey also showed that average weight and density decreased from west to east. At the depths fished in units B and C (32-42 m), the average density was 184 individuals/1 000 m² and 63 individuals/1 000 m² respectively, and the average weight, 780 g and 667 g.

- Participants wondered about the calculation of average density.
- It was suggested that weighting based on the area of the depth stratum, which may vary, be implemented.
- A more thorough examination of the impact of establishing fishery closure areas could be carried out.
- Before proceeding further, it would be useful to examine the observed disparity in density in greater detail. Further analyses were needed to avoid introducing bias linked to the spatial component and the depth effect.
- For average weight per individual and per unit, comparing the sub-units based on similar depths would seem appropriate, taking the depth effect (increase in weight with depth) into account.

EXPERIMENTAL FISHERY ON THE LOWER NORTH SHORE (2017-2020)

A total of four surveys were conducted along the Lower North Shore, from Kégaska to Blanc-Sablon, during the 2017-2020 period (two in 2017 and one each in 2018 and 2020). The analysis of the survey data suggests that sea cucumbers are small and occur in low densities in this region.

- On the figure showing densities, it was suggested that a symbol be added to represent the value of 0, meaning that zero density was observed in that location.

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- According to the results of the experimental fishery, it appears that this region would have difficulty supporting a commercial fishery.
 - Participants thought it was inappropriate to compare the size data from this survey with those from the 2010 survey in the Mingan region, since the environmental conditions in the regions are very different.
 - The effect of depth on mean length could be examined.

IMPACT OF THE SEA CUCUMBER DRAG FISHERY ON BENTHIC COMMUNITIES AND COMPARISON OF TWO DREDGE TYPES

Rénauld Belley presented the results of a study on the impact of the sea cucumber drag fishery on benthic communities according to fishing area status (fishing area, protected area or fishery closure area) and the comparison of two types of dredges (a conventional versus a wheeled model). This project, a collaborative effort between DFO and the Mi'gmaq Maliseet Aboriginal Fisheries Management Association (MMAFMA), was carried out in units B and C in 2018. According to the results, the fishing areas were different from the protected areas, but were similar to the fishery closure areas based on the data obtained from photos, but different based on the video data. The results show that the megafauna (> 5 cm) had become re-established in the fishery closure areas, but the macrofauna (1-5 cm) had not yet returned. Furthermore, sea cucumber abundance was lower in the fished areas, particularly in Unit C. The conventional dredge caught more sea cucumbers, but also more bycatch (abundance data). It was pointed out that these results could be partly attributable to harvester experience and the vessel used, as well as the difference in the weight of the fishing gear. No differences were observed in the biomass data. The conventional dredge could be more damaging to benthic communities due to its greater weight and its greater bycatch.

- The wheeled dredge made sorting easier due to the smaller number of bycatch species caught. One harvester mentioned a strong preference for the wheeled model.
- A comparison of the two dredges in a commercial fishery context would be useful, in terms of bycatch and towing speed (2 knots versus 3 knots).
- The comment was made that the least harmful dredge was the one that was best adapted to its environment. Should we try to standardize the gear, or to adapt the gear to its environment?
- Rotating the fishery closure areas could be envisaged.
- Participants wondered whether it was possible to make a recommendation based on the study, which had not been done yet.

RESEARCH PROJECT: VARIATION IN SIZE, CONDITION AND REPRODUCTIVE STATUS OF SEA CUCUMBERS ALONG THE GASPÉ PENINSULA

The study by Catherine Couillard aimed to examine factors causing variations in the size, condition and reproductive status of sea cucumbers along the Gaspé coast. According to the results, contracted length is the most variable dimension. Wet weight, volume, and the size index were less variable, but were still strongly influenced by capture and post-capture conditions. Eviscerated and processed weights were the best indicators of sea cucumbers' actual size. The main source of variation in individual processed weight was depth (sea cucumbers caught at depths of 26-47 m were 1.5 times heavier than those caught at 9-16 m). The season and the reproductive cycle were found to have very little effect on yield. According to observations, spawning likely occurs from late May to early June at depths of less than 20 m,

and there is a bathymetric gradient in maturation. This work confirms that the measurement of individual length and weight in sea cucumbers is strongly influenced by capture and handling conditions.

- Questions were raised about the implementation of the recommendations made, particularly the use of eviscerated and processed weight as the best indicator for size.
- It was suggested that a calibrated gauge for contracted length and width be used at sea for borderline cases (around 114 mm) so that individuals smaller than the legal size could be thrown back. This option could be tested with harvesters.
- It was noted that, at the processing plant, roughly 48 hours are allotted for the cucumber to elongate again before it is cut up, to improve the quality of the processed product.
- By controlling the depth and the timing of the fishing season, certain factors can be influenced (size, avoidance of spawning), which is beneficial for the industry and the conservation of the resource.
- Participants wondered whether the current size indicator would be able to detect a gradual decrease in the size of captured sea cucumbers.
- Questions were raised about the validity of the information on the spawning season (late May-early June) for all sea cucumber habitats, particularly the area where the drag fishery takes place, since the study on reproduction focused exclusively on individuals caught at depths of less than 20 m. Additional verification appeared to be necessary.
- A study on size at maturity in different fishing areas could allow the threshold between mature and immature individuals to be identified. A gonadosomatic index and visual criteria developed from the dissection of juveniles and adults could provide useful information on this.
- According to meeting participants, a size index based on contracted length and width, which could potentially be measured immediately after capture, would be preferable.
- It was agreed that further examination and experimentation were required to be able to advise Fisheries Management on the best way to proceed in implementing a method for determining the actual size of sea cucumbers.

POST-SEASON SURVEYS

Marie-Hélène Rondeau presented a study based on post-season surveys in units B and C. The main purpose of the study was to assess the impact of the drag fishery on the sea cucumber and on benthic communities. The results for 2016-2019 demonstrated that dragging has a significant effect on the characteristics of benthic assemblages (abundance, biomass, diversity index, equitability index and sea cucumber length), but no effect on species richness. In addition, the analyses showed that fishing intensity also has a substantial effect on benthic assemblages. Abundance and biomass were lowest in the sites where drag fishing took place. Therefore, dragging seems to have a short-term impact on the species by reducing its abundance and biomass. The results of the 2020 post-season survey (different vessel and fishing gear than in previous surveys) indicate that fishing intensity has a significant effect on biomass. Total biomass was significantly greater in protected areas and in areas that were dragged 4-7 years previously than in sites currently undergoing dragging. Individual length varied considerably depending on fishing intensity. Sea cucumbers were significantly shorter in areas dragged 4-7 years previously, but longer in protected areas. The 2020 results revealed significant differences in assemblages of organisms as a function of fishing intensity.

Abundance and biomass were significantly lower in currently dragged areas than in those dragged 4 to 7 years previously and protected areas.

- Roller dredges were suspected to be ineffective at a two-knot towing speed. Comparative tests could be conducted in 2021.
- In addition, a comparison of the data with the data on bycatch collected by at-sea observers (2018-2019) would be useful.
- It was suggested that the Simpson index be used to complement the Shannon index. The Simpson index is less sensitive to sampling effort than the Shannon index.
- Refining the analyses based on the level of effort at harvested sites would be extremely complex.
- Participants wondered about the possibility of calculating an exploitation rate index for the entire unit.
- Continuing this survey was considered critical for the development of this fishery. Interesting parallels could be drawn with Régnal Belley's presentation on the impact of the sea cucumber drag fishery on benthic communities and the comparison of the two types of dredges, particularly regarding bycatch.
- It was suggested that the term resting area (or fallow area) be used instead of fishery closure area.
- The increased lobster abundance in bycatches in recent years seems consistent with the increase observed in the lobster stock. Furthermore, there is a very good chance that the timing of the post-season surveys coincides with the fall migration of lobster.

CONCLUSION

SUMMARY AND RECOMMENDATIONS

The key points of the assessment were presented by the assessment biologist, and some changes were proposed by participants. Only comments on the content (and not the form) were reported.

- In the first key point, the units targeted in the exploratory fishery should be specified: units 3, B and C.
- The key point on effort is to be reworded to state that, overall, effort seemed to be well distributed in all the management units.
- Regarding the Gaspé Peninsula, when referring to dive harvesting, it should be specified that this activity was not continued due to profitability problems and technical issues with dive harvesting.
- Fisheries Management added clarifications on the TAC in Unit B. The wording will be modified to state that the TAC was reduced rather than lowered.
- For Unit B, it is difficult to talk about a reference value (particularly in 2016 when there was only one active licence holder). The key point is to be reworded to state that the CPUE declined from 2017 to 2020.
- In the key point on the mean length in Unit B, it was decided that the comparison with 2014 should be removed.

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- As was the case for Unit B, the wording for Unit C should be modified to say that the TAC was reduced rather than lowered.
 - For the key point on the CPUE in Unit C, the wording should be simplified by simply stating that the mean CPUE decreased between 2017 and 2020, to be followed by a comparison with the mean for 2015-2016.
 - For the key point on mean lengths in Unit C, the comparison with 2013-2015 should be replaced by a comparison with the 2015-2016 mean.
 - Regarding the Lower North Shore surveys, only one key point should be retained in the summary, stating that the analysis of the survey data suggests that sea cucumbers are small and their abundance is low in the region.
 - The participants decided that the key points on the fishery independent surveys (2018 research survey and 2016-2019 post-season surveys) should be combined so that certain information is not repeated and to synthesize all the information presented.
 - The key points on the fishery independent surveys should be restructured to emphasize the important points. Further explanations are to be provided in the text of the science advisory report.
 - Regarding the research on the size index, we should simply state that recent research confirms that, in sea cucumbers, length and weight are strongly influenced by capture and handling conditions.
 - Questions were raised on how recommendations should be formulated, given the very incomplete knowledge and the significant uncertainty involved. It was agreed that the decline in CPUE values in recent years in units B and C is worrisome (particularly in Unit C). On the other hand, specifying an order of magnitude (%) for a possible decrease in landings is problematic. Indices other than the CPUE (e.g., densities) could perhaps be used to adjust the TACs, although uncertainty is also observed here.
 - Some meeting participants thought that, for the 2021-2023 seasons, the status quo would be more appropriate, although special attention must be paid in the interim years.
 - Several participants thought that no action should be taken in the interim years and that it would be more useful to focus our energies on the fishery independent surveys, particularly the post-season survey.
 - Participants were reminded that other conservation measures could also protect the resource: an authorized range of depths for the fishery, a minimum size and protected areas.

Lastly, the following **recommendations** were made for the 2021 to 2023 fishing seasons:

In **Unit 3**, an annual fishing effort near that expended from 2017 to 2020 could help maintain the fishery's performance over the next three years. In addition, establishing one or more refuge areas is suggested.

In **units B and C**, given the additional conservation measures implemented (protected areas and authorized range of depths for the fishery), maintaining landings near the average level for 2017-2020 should not have a major impact on sea cucumber abundance in any of these units in the next three years.

RESEARCH IDENTIFICATION AND PRIORITIZATION

The following research areas should be prioritized:

- Collecting fishery independent data (e.g., post-season surveys)
- Implementing new size measurement methods and developing other more reliable biometric indices that could be used in establishing conservation measures
- Monitoring spawning (date, sex determination, size at maturity, etc.) in the North Shore and Gaspé Peninsula regions
- Examining the growth curve
- Monitoring the medium- and long-term impact of the drag fishery on benthic communities and habitat
- Estimating the exploitation rate
- Characterizing preferred sea cucumber habitat (temperature, salinity, depth, substrate, etc.) and comparing reproductive potential and condition in various habitats
- Studying the spatial and temporal dynamics of the sea cucumber (telemetry project).

Other areas to be examined were raised by participants:

- Collate observers' data on weight and numbers. Collate data on discards.
- Calculate CPUEs using observers' data
- Standardize CPUEs using logbook data
- Develop an index of dispersion for fishing effort
- Examine Vessel Monitoring System (VMS) data to estimate the exploitation rate
- Expand the coverage of the survey in the Minganie region to obtain an ecosystem survey (scallop – sea cucumber)
- Think about establishing and enforcing a density threshold
- Standardize how fishing effort is recorded.

Industry representatives requested that the assessment of sea cucumber take place outside the fishing season.

APPENDIX 1 – TERMS OF REFERENCE

Assessment of the Sea Cucumber Fishery in the Quebec's Inshore Waters Regional Advisory Meeting: Quebec Region

June 1-2, 2021
Virtual meeting

Chairperson: Charley Cyr

Context

The sea cucumber (*Cucumaria frondosa*) fishery is a recent activity in Quebec's inshore waters. It began in 2008 on the Gaspé Peninsula's north shore and in 2009 it extended to the Middle North Shore near Havre-Saint-Pierre. This fishery, still exploratory, is carried out either by diving, using an LGS-type dredge or by a dredge specifically designed for sea cucumbers.

The last assessment of this fishery goes back to 2017. DFO Fisheries and Aquaculture management has requested an assessment of the sea cucumber fishery for 2021 to 2023 fishing seasons. The objective of the review is to determine whether changes that have occurred in the stock status require adjustments to management plans based on the conservation approach used.

Objectives

Provide science advice on management measures for the sea cucumber fishery in the Quebec's inshore waters, management units A, B, C, 3 and Lower North Shore. This advice shall include:

- Description of the biology of the sea cucumber and its distribution in Quebec's coastal waters.
- Description of the fishery including landings, fishing effort and management measures specific to the fishing areas.
- Analysis of catches per unit effort from the fishery.
- Analysis of data from the commercial sampling program and the at-sea observer program.
- Analysis of data from the scientific survey conducted in 2018 in management units A, B, C.
- Analysis of data from the experimental fishery in the Lower North Shore (2017, 2018, 2020).
- Identification and prioritization of research projects to be considered for the future.
- Perspectives for the 2021-2023 fishing seasons based on indicators derived from fishing and research activities.

Expected Publications

- Science Advisory Report
- Proceedings

Expected Participation

- Fisheries and Oceans Canada (DFO) (Science, and Ecosystems and Fisheries Management sectors)
- Fishing industry

-
- Provincial representatives
 - Aboriginal communities/organizations

APPENDIX 2 – LIST OF PARTICIPANTS

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