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### **Proceedings of the Regional Advisory Meeting on the Assessment of the Estuary and Northern Gulf of St. Lawrence Snow Crab Stocks**

**February 16–18, 2022**  
**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 outlines the proceedings of the regional peer review meeting on the assessment of the Estuary and northern Gulf of St. Lawrence snow crab stocks. This meeting, which was held via Zoom platform (virtual meeting), on February 16–18, 2022, brought together more than 70 participants from science, industry and management. These proceedings detail the essential parts of the presentations and discussions held during the meeting, as well as the recommendations and conclusions made.

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## INTRODUCTION

The Quebec Region of Fisheries and Oceans Canada (DFO) is responsible for assessing several stocks of fish and invertebrate species harvested in the Estuary and Gulf of St. Lawrence. Most of these stocks are periodically assessed as part of a regional advisory process that is conducted at the Maurice Lamontagne Institute in Mont-Joli. This document consists of the proceedings of the meeting held on February 16–18, 2022 via the Zoom platform (virtual meeting), on the assessment of the Estuary and northern Gulf of St. Lawrence snow crab stocks.

The objective of the meeting was to determine whether there were any changes in the resource's status and whether management plans need to be adjusted based on the chosen conservation approach, with the ultimate goal being to provide a science advisory report on the management of Estuary and northern Gulf of St. Lawrence snow crab stocks for the 2022 fishing season.

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 peer review meeting 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 meeting (Appendices 1 and 2). The proceedings also list the recommendations made by the meeting participants.

## ASSESSMENT

The meeting was chaired by Charley Cyr and Kim Émond. Following a reminder of the science review process and objectives, and the role of the participants, the terms of reference and agenda were presented. Attendees were then asked to introduce themselves. Stock assessment biologist Cédric Juillet noted the contributions made by his collaborators and presented the agenda of the meeting. He provided a general overview of landings on the Atlantic coast and by fishing area (16, 12C, 16A, 15, 14, 13, 17, 12A, 12B). In 2021, landings totalled 4,456 t, a decrease of about 8% compared with 2020 (4,854 t).

The conservation principle that applies to these areas seeks to protect reproductive potential. Management measures include limits imposed on catches via a Total Allowable Catch (TAC), effort controls (number of traps, number of licences and fishing season), and a minimum legal carapace size set at 95 mm. In addition, an area's fishery is closed when catches in it include more than 20% white crab.

The data used in the assessment are mainly from the fishery (ZIFF and logbooks, commercial sampling at sea and dockside) and independent sources (post-season survey, trawl survey). Environmental data complete the information (temperature and thermal habitat). These data provide the key stock status indicators, including the commercial catch per unit of effort (CPUE), post-season number per unit of effort (NPUE), combined CPUE and NPUE index, carapace condition at landing, the relative abundance of adult crab left by the fishery, new adult crab (recruits) and adolescents in post-season surveys, distribution of fishing effort, long-term recruitment (trawl surveys), size frequencies and spermathecal load.

The stock assessment biologist then provided a brief overview of the various carapace conditions and crab categories mentioned during the meeting. Categories 1 and 2 are recruits, and categories 3 to 5 are crabs left by the fishery. The biologist explained the CPUE standardization method (since 2009), as well as the approach to determine the combined index

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based on the average of the two commercial biomass indices (standardized commercial CPUE and NPUE of adults  $\geq 95$  mm in the post-season survey). He said that this approach was under review.

Additional information about how the outlooks were developed using the method validated by peers the previous year was presented. These include three possible harvesting scenarios (high, intermediate, low). The scenarios were developed based on the analysis of the combined stock status indicator, the qualitative integration of related indicators of stock health and the species' population dynamics. The proposed changes pertain to the total landings from the previous fishing year.

Before going into the details of the assessment, area by area, certain environmental considerations were introduced, including seafloor temperature conditions in 2021. A warming of the Gulf of St. Lawrence deep waters has been observed since 2012. The area of the seabed covered by water with a temperature above 6°C has increased. In addition, the cold intermediate layer was much warmer in August 2021 than in August 2020, reaching the warmest values in current CTD data. A thermal habitat index, based on the snow crab's thermal preferences (large crabs: -1 to 3 °C; small crabs: 0 to 2° C), was briefly presented. In 2021, an overall trend of erosion of the favourable thermal habitat was observed for large crab in the western and central areas (12A, 12B, 12C, 16 and 17), whereas a slight increase in the availability of favourable thermal habitat was observed in areas 13 and 14. For small crabs, a downward trend in the area of favourable thermal habitat was seen in areas 16 and 17, but an increasing trend was observed in areas 16A, 14 and 13. A table showing the vulnerability and resilience of snow crab to warming during different life cycle phases was presented. Additional data on biodiversity and by-catch in the snow crab environment, from a survey on the Lower North Shore (2018) and in the lower estuary (2019), would be made available.

## **RESULTS**

For each fishing area, a review of key indicators is conducted by the biologist. He then presented an overview of the area, along with wording for three possible scenarios (high, intermediate, low) for harvesting in 2022. Participants asked questions and made comments. As part of this meeting, participants have to agree on the scenarios, but the preferred option will be discussed at the Advisory Committee meeting. It was suggested that a general key point on 2021 specific environmental conditions be incorporated in the SAR.

### **AREA 16**

#### **Review of Indicators: Area 16**

From 2020 to 2021, the total allowable catch (TAC) decreased by 16.1% to 1,951 t, and it was reached (landings of 1,962.6 t). After a sharp decline over the 2016–2019 period, catch per unit effort (CPUE) for the commercial fishery is increasing (+19.4%) in 2021 for a second consecutive year, but remains below the historical average. Dockside sampling indicated that landings in 2021 were approximately half recruits (carapace condition 1–2), representing a proportion fairly similar to the last sampling in 2019 and 2020.

The post-season survey commercial abundance index is up (+20.9%) in 2021 after a sharp decline over the 2016–2020 period, but remains among the lowest values observed in 20 years. The abundance of male recruits and adolescents  $> 95$  mm was stable in the post-season survey, while the abundance of adolescent and adult males measuring 78–95 mm increased between 2020 and 2021 and remained below the historical average.

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Monitoring of the Sainte Marguerite Bay snow crab population could not be conducted in 2021. The last survey in 2020 predicted that the biomass available to the fishery would increase from 2023–24. At the same time, the density of primiparous females was increasing sharply in 2020, suggesting a high abundance of spawning females in 2021–2023.

The favourable thermal habitat indices for large and small crabs showed a downward temporal trend over the 1990–2021 period. The values observed in 2021 are the lowest in each of the time series.

The combined index is up 20.0% from 2020, but remains among the lowest values in the last 20 years. This suggests that the biomass available to the fishery in 2022 should be similar to that of 2021.

Several comments were made by participants:

- It was noted that the next survey in Sainte-Marguerite Bay is expected to be conducted in spring 2022.
- It was noted that despite seasonal variations, the spermathecal load remained fairly high in connection with a favourable sex ratio possibly associated with increasing temperatures. Attrition of spermathecal content was observed in the period between the two surveys (trawl vs. post-season).
- Questions were raised about the impact of the reduction in favourable thermal habitat and the possible concentration of crabs on CPUE and NPUE values. This impact has not yet been explored; however, work is under way. It was noted that the catch was carried out quickly.
- It was agreed that significant temperature changes create uncertainty in the data.
- With respect to carapace condition, questions were asked about the value of separating conditions 1 and 2 in the data.

## **Summary and Outlook: Area 16**

Participants discussed the summary and the scenarios presented:

- The key point on the CPUE shows evidence of an increase as opposed to a slight increase in 2021. This also applies to the key points on the post-season (NPUE) and combined index.
- With respect to carapace condition, it was noted that the information comes from dockside sampling.
- It was decided to remove the key point on carapace width. The information will be in the science advisory report.
- A suggestion was made to remove the sentence indicating that no increase in males is expected in 2022.
- With respect to the wording preceding the scenarios, it was suggested that the section indicating that “no major increase in the biomass available to the fishery is expected in 2022” be replaced with “the biomass available to the fishery in 2022 should be similar to that in 2021.”
- In relation to the three scenarios, some participants deemed that the intermediate scenario could suggest an increase rather than the status quo, thereby reflecting the trend of the indices presented, while others suggested remaining more cautious since the effects of recruitment are only beginning to be felt. Given the uncertainty associated with the potential

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impact of the warming of the water, the proposed increases should remain moderate. It seems reasonable to suggest a 20% increase in the higher scenario, a 10% increase in the intermediate scenario and status quo in the lower scenario.

Finally, after extensive discussion, the assembly agreed on the following scenarios:

The combined index increased (+20.0%) between 2020 and 2021 but remains among the lowest values of the last 20 years. The biomass available to the fishery in 2022 is expected to be similar to that of 2021.

In the context of an assumed high density of reproductive females for the 2021–2023 period, these indicators suggest limiting increases in removals in 2022 to avoid obtaining a sex ratio that is overly biased towards females.

1. Higher scenario: A 20% increase applied to total landings in 2021.
2. Intermediate scenario: A 10% increase applied to total landings in 2021.
3. Lower scenario: A status quo compared to total landings in 2021.

## **AREA 12C**

### **Review of Indicators: Area 12C**

The total allowable catch (TAC) remained the same between 2020 and 2021 at 96 t, and was reached. Landings in 2021 were 91 t, up 15.2% from 2020 (79.0 t). The fishing season was closed up to 24 days early due to white crabs. The catch per unit effort (CPUE) for the commercial fishery is down in 2021 (-32.8%) compared to 2020 and the last three years' values are the lowest over the 2000–2021 period. Dockside sampling indicates that landings were about half recruits (carapace condition 1–2) in 2021, which is up from 34.5% in 2019. The mean carapace width (CW) of commercial males sampled at sea during the fishing season was at the lowest value observed for the 2001–2021 period (103.2 mm), while the CW of males sampled dockside was at the historical average (110.3 mm).

Different spatial coverage across the post-season survey created some uncertainty in the indicators for 2021. The commercial abundance index of the post-season survey declines markedly between 2020 and 2021, to the lowest values of the 2014–2021 period. All indicators for this survey of adults and legal-size adolescents declined between 2020 and 2021, with the exception of 78–95 mm adolescents. The abundance indicator for sublegal-size adolescents was at its highest value for the 2014–2021 period. An increase in the abundance of primiparous females was also observed in 2021. From 2020 to 2021, increased numbers of sublegal-size adolescents and primiparous females were consistent indicators of an upcoming pulse of recruitment.

The thermal habitat index favourable to large crabs showed a temporal decline over the period 1990–2021, and is at the lowest value of the time series in 2021.

The combined index (CI) is decreasing between 2020 and 2021, and is at the lowest value of the 2014–2021 period. This decrease suggests that the biomass available to the fishery in 2022 is expected to be less than or equal to that in 2021. In the context of a very low apparent abundance in the last post-season survey, the relative difference in the CI compared with the previous year was strongly influenced by a difference of only a few crabs per trap in comparison with the previous year.

Several comments were made by participants:



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- It was noted that this is a small area that is closely linked to adjacent areas (16A and 15). There would be movement of crab between these areas during the season. These movements could have an influence on post-season results compared with those of the fishery.
  - It was noted that a few individuals can cause the percentages to vary considerably given the small size of the area. Therefore, there is a considerable amount of inter-annual variability.
  - In this particular area, there is a significant problem with beach fleas affecting trap catchability.

### **Summary and Outlook: Area 12C**

Participants discussed the summary and outlook:

- In the key point on landings, it was agreed that landings consisted of approximately 50% crabs with a carapace condition of 1–2, which is up from 34.5% in 2019.
- It was decided to retain the key point on the average carapace width of commercial males sampled at sea since this is the lowest value observed from 2001–2021 period.
- Some participants wanted to draw attention to the importance of the presence of the beach flea. It was decided to include this only in the advisory report.
- The key point on crab categories from the post-season is being revised to include that between 2020 and 2021, the increases in sublegal-size adolescents and primiparous females are consistent indicators of an upcoming pulse of recruitment. This item will be revisited for the adjacent areas (16A and 15).
- It was noted that it would be useful to address areas 12C, 16A and 15 collectively.
- With respect to the key point indicating that the abundance index of the post-season survey declined significantly between 2020 and 2021 and represented the lowest value of the 2014–2021 period, it is important to first point out that the limited spatial coverage north of the area creates uncertainty in the indicators for this survey in 2021.
- With respect to the key point on the combined index, it was decided to remove the percentage decline between 2020 and 2021 to place more emphasis on the comparison with the 2014–2021 period.
- With respect to the wording preceding the scenarios, it was decided that the sentence indicating that post-season survey abundance indicators do not confirm an increase in biomass available to the fishery in 2022 would be removed.
- With respect to the scenarios, decreases ranging from 20% (higher scenario) to 30% (intermediate scenario) and more than 30% (lower scenario) were proposed considering, among other things, that the combined index is at the lowest value observed in eight years, which cannot be explained solely by the presence of beach fleas. It is acknowledged that this indicator may be partly biased in the post-season (partial coverage in 2021). While some would prefer to see more emphasis placed on CPUE, the post-season should not be discounted.
- It was agreed that the biomass available to the fishery in 2022 should be less than or equal to that in 2021.

The assembly agreed on the following scenarios:

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The combined index (CI) is at the lowest value observed in eight years, with fishing yields that were, over the last three years, the lowest seen in the last two decades and a commercial abundance indicator that is the lowest on record. The biomass available to the fishery in 2022 is expected to be less than or equal to that available in 2021.

Given the increasing densities of primiparous females, these indicators suggest that great caution is needed when setting the total allowable landings in 2022 to prevent an excessively biased sex ratio towards females during the recruitment of primiparous females.

Scientific consensus has also been reached on proposed adjustments to harvests, which—although they may be smaller than those based solely on the value of the relative change in the CI compared with the previous year—can result in a comparable or lower level of harvesting intensity in the upcoming fishing season compared with the previous season.

1. Higher scenario: A 20% decrease applied to total landings in 2021.
2. Intermediate scenario: A 30% decrease applied to total landings in 2021.
3. Lower scenario: A more than 30% decrease applied to total landings in 2021.

## **AREA 16A**

### **Review of Indicators: Area 16A**

The total allowable catch (TAC) decreased by 10% between 2020 and 2021 to 245.0 t, and was reached. Landings in 2021 were 244.2 t, down 5.0% from 2020 (257.0 t). The commercial fishery CPUE increase between 2020 and 2021 (+14.3%) but the 2021 value remains among the lowest observed over the 2000–2021 period. No indicators based on sea sampling data are available for the 2020 and 2021 fishing seasons.

Dockside sampling indicates that landings in 2021 consisted of a majority of recruits (over half), similar to 2019 and 2020.

Different spatial coverage across the post-season survey created some uncertainty in the indicators for 2021. The commercial abundance index from the post-season survey was declining over the period 2014–2021. The high abundance of sublegal-size adolescents in 2020 and 2021 and of primiparous females since 2019 have been consistent indicators of an upcoming pulse of recruitment.

The favourable thermal habitat index for small crabs showed a downward temporal trend over the 1990–2021 period.

The combined index was declining over the 2014–2020 period, but only decreases by 4.2% between 2020 and 2021. This decrease suggests that the biomass available to the fishery in 2022 is expected to be less than or equal to that available in 2021.

Several comments were made by participants:

- With respect to carapace width, it was noted that the 2020 sample cannot be compared with that of 2021 given its small size. The same applies for the carapace condition factor.
- With respect to the post-season, there were some questions about data from stations located in deeper areas, as it appears that these stations are no longer sampled. This may be a data entry error. The deeper stations should be retained, even if crab are not present, to ensure that uniform spatial coverage is achieved for the whole set and thus reduce the uncertainty in the data.

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- It was suggested to add primiparous and multiparous females in the graphs to calculate the number of females in experimental traps. There is also a great deal of variability in the sampling, particularly regarding the depth of traps, which varies greatly. The sampling plan should be reviewed.

### **Summary and Outlook: Area 16A**

Comments were raised regarding the key points in the Area 16A summary and outlook:

- It was suggested that a key point be added regarding the partial coverage of the post-season survey which creates uncertainty.
- The key point on abundance indices from the post-season survey by crab category was reviewed, indicating that between 2020 and 2021, the increases in abundance of sublegal-size adolescents and primiparous females are consistent indicators of an upcoming pulse of recruitment.
- With respect to the bullet point on the combined index, it was agreed that the decline is insignificant. This index only decreases by 4.2% between 2020 and 2021.
- In terms of scenarios, a decrease of 5% was proposed for the higher scenario, based on the combined index. Industry members felt that this new pulse of recruitment could result in a 5% increase in the higher scenario and a 5% decrease in the intermediate one. The lower scenario would indicate a decrease of more than 5%. In the long term, it will be important to consider the high abundance of primiparous females that must be protected for reproduction as well as the potential impacts of the warming of the water in the coming years. Therefore, with respect to the higher scenario, maintaining the status quo appears to be the more precautionary approach.
- Industry participants noted that the precautionary approach that has already been adopted is far too cautious. Questions were raised about the viability of this fishery once this approach is legally established.
- A clarification was made by specifying that the precautionary approach is a legal framework whereas what was being discussed was precautionary principles.

The assembly agreed on the following scenarios:

The combined index was declining over the 2014–2020 period, but only decreases by 4.2% between 2020 and 2021. The biomass available to the fishery in 2022 should be less than or equal to that available in 2021.

Given the high abundance of primiparous females, these indicators suggest a decrease in harvesting in 2022 in order to prevent an excessively biased sex ratio towards females during the recruitment of primiparous females.

1. Higher scenario: A status quo compared to total landings in 2021.
2. Intermediate scenario: A 5% decrease applied to total landings in 2021.
3. Lower scenario: A more than 5% decrease applied to total landings in 2021.

### **AREA 15**

#### **Review of Indicators: Area 15**

The total allowable catch (TAC) increased by 4.8% between 2020 and 2021 to 325.5 t, and was nearly reached. Landings in 2021 were 306.0 t, up by 16.3% from 2020 (263.0 t). The catch per

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unit effort (CPUE) for the commercial fishery is stable since 2019 (+1.5% between 2020 and 2021), and the last three years' values are the lowest over the 2000–2021 period. In the absence of adequate at-sea sampling program coverage for monitoring the mean carapace width (CW) of commercial males in 2021, dockside data indicate a sharp decline from 2020 to 2021 in the mean CW, which was among the lowest values for the 2000–2021 period. Dockside data indicate that the majority of landings (53.3%) in 2021 consisted of recruits (crabs of carapace condition 1–2). This proportion increased between 2020 and 2021, while the percentage of intermediate-shell crabs declined from 45.2% to 37.9%.

The peaks in abundance observed in 2020 in the post-season survey (particularly with respect to adult males 78–95 mm), alongside the return of indicators for 2021 to values near those seen in 2019, increase the uncertainty when comparing 2020 and 2021 values. Between 2020 and 2021, the commercial abundance index of the post-season survey declined significantly to the lowest value of the 2014–2021 period. All other post-season survey abundance indices for adolescent and adult males declined between 2020 and 2021, and only the abundance indicator for sublegal-size adolescents was above its historical average. According to the post-season survey, the abundance of primiparous and multiparous females is high in 2021, while the weight of the spermathecal load is decreasing. In 2020 and 2021, high abundances of sublegal-size adolescents and primiparous females were consistent indicators of the upcoming arrival of a pulse of recruitment.

The combined index increased by 35.4% between 2020 and 2021, and is at the same level as the 2019 value. The 2019 to 2021 values are the lowest values observed over the 2014–2021 period. The available indicators suggest that the biomass available to the fishery in 2022 is expected to be less than or equal to that of 2021.

Several comments were made by participants:

- Some clarifications were made to explain the failure to reach the TAC, i.e., socio-economic factors (plant closure).
- There is a significant decrease in the size at landing in 2021, which may have an impact on landed quantities. It was noted that this decrease in size seems to reflect the new pulse of recruitment.
- In terms of the post-season, the 2021 value has decreased significantly from 2020, but remains similar to other values in the series. Concern was expressed regarding the 2020 data. It is also possible that we missed some catches in 2021. The aggregation of females can affect the catches. There were also questions about why the abundance of adult males declined significantly between 2020 and 2021, which could indicate a detection problem. It was pointed out that while beach fleas were present in 2021 in the post-season, they were not present in 2020.

## **Summary and Outlook: Area 15**

Participants made several comments on the summary and outlook for Area 15:

- It was decided to remove the key point on carapace width.
- It was agreed that the abundance of primiparous and multiparous females in the post-season survey is high in 2021, while the spermathecal load weight is decreasing.
- The key point on crab categories from the post-season survey is being revised to include that between 2020 and 2021, the increases in abundance of sublegal-size adolescents and primiparous females are consistent indicators of an upcoming pulse of recruitment.

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- It was also noted that the peaks in abundance observed in the 2020 post-season survey (especially for adult males 78–95 mm), with a return in 2021 to values close to those in 2019, increase the uncertainty when comparing 2020 and 2021 values.
  - Some participants noted that the situation in area 15 appears to be less of a concern, despite it being very similar to area 12C.
  - Industry participants once again noted that the precautionary principle is being applied by emphasizing the importance of avoiding an overly female-biased sex ratio during this period of high reproductive female abundance in the outlook.
  - Based on the combined index, a 30% decrease was suggested in the intermediate scenario. According to some participants, too much emphasis is placed on the post-season survey data, which remain highly uncertain. It was therefore suggested that the delta (35.42%) be moderated by proposing a 20% decrease in the intermediate scenario. A decrease of 10% was suggested for the higher scenario and more than 20% for the lower scenario.

The assembly agreed on the following scenarios:

The combined index (CI) is among the lowest values observed in eight years (-35.4% between 2020 and 2021), with fishing yields that were, over the last three years, the lowest observed in the last two decades and a commercial abundance indicator that returned to the lowest observed value (2019). This last point is a source of uncertainty associated with using the CI to develop scenarios. The biomass available to the fishery in 2022 is expected to be less than or equal to that of 2021.

Given the increase in densities of primiparous females since 2019, these indicators suggest that greater caution should be exercised in establishing total allowable landings in 2022 to avoid obtaining a sex ratio that is overly biased towards females during this period of high abundance of reproductive females.

1. Higher scenario: A 10% decrease applied to total landings in 2021.
2. Intermediate scenario: A 20% decrease applied to total landings in 2021.
3. Lower scenario: A more than 20% decrease applied to total landings in 2021.

## **AREA 14**

### **Review of Indicators: Area 14**

The total allowable catch (TAC) decreased by 7.6% between 2020 and 2021 to 365.0 t, and was reached. Landings in 2021 were 362.5 t, up by 4.2% from 2020 (348.0 t). The catch per unit effort (CPUE) for the commercial fishery is increasing in 2021 (+30.1% between 2020 and 2021), and the last three years' values are the lowest over the 2000–2021 period. In the absence of adequate at-sea sampling program coverage for monitoring the mean carapace width (CW) of commercial males in 2021, dockside data indicate a decline in the mean CW since the last sampling in 2019. The mean CW in 2021 was close to the historical average. Dockside data indicate that the majority of landings (55.6%) in 2021 consisted of recruits (crabs of carapace condition 1–2). This proportion saw a significant increase between 2019 and 2021, while the percentage of crabs with shell condition 3 and 4–5 dropped from 59.9% to 39.2% and 28.3% to 5.2%, respectively.

All of the post-season survey abundance indices for adolescent and adult males decreased between 2020 and 2021, with a 2021 value that was among the lowest observed in the 2000–2021 period. Uncertainty remains about the validity of the indicators for 2021 compared

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with the last trawl survey in 2018, which signalled the arrival of a new pulse of recruitment. According to the post-season survey, the abundance of primiparous and multiparous females is high in 2021, while the weight of the spermathecal load remains relatively low.

The thermal habitat indices favourable to large and small crabs showed an increasing temporal trend over the period 1990–2021.

The combined index decreased by 34.9% between 2020 and 2021, and is at the lowest value over the 2000–2021 period. Indicators suggest that the biomass available to the fishery in 2022 is expected to be less than or equal to that available in 2021.

Several comments were made by participants:

- It was noted that at-sea observer coverage was limited and conducted at the end of the fishing season.
- It was noted that there are also beach fleas present in this area. A problem with “bait” at the bottom was also raised.
- Fishers observed a large number of small crabs in 2021.

### **Summary and Outlook: Area 14**

- It was decided to remove the key point on carapace width.
- Some participants argued that beach fleas impacted the abundance indices from the post-season survey.
- In addition, data from the 2018 trawl survey that indicated an upcoming pulse of recruitment do not support the data from the 2021 post-season survey. Industry members also reported observing recruitment in the fishery. Therefore, in the key point on the post-season, uncertainty was raised with respect to the 2021 post-season survey indicators.
- It was agreed that the abundance of primiparous and multiparous females in the post-season survey is high in 2021, while the weight of the spermathecal load remains relatively low.
- Despite the uncertainty regarding the post-season survey results, there was agreement that the indicators seem to suggest that the biomass available to the fishery in 2022 should be less than or equal to that in 2021.
- Industry participants deemed the outlook to be very precautionary.
- Participants suggested a 10% decrease in the higher scenario, 20% in the intermediate scenario and more than 20% in the lower scenario. A consensus was reached fairly quickly.

Thus, the assembly agreed on the following scenarios:

The combined index is at the lowest value observed over the 2000–2021 period (-34.9% between 2020 and 2021), with fishing yields that were, for the last three years, the lowest observed in the last two decades and a commercial abundance indicator that is the lowest on record. Although some uncertainty remains on the representativeness of the 2021 post-season survey in terms of the status of the resource, the biomass available to the fishery in 2022 should still be less than or equal to that available in 2021.

Given the increase in densities of primiparous females since 2019, these indicators suggest that greater caution should be exercised in establishing total allowable landings in 2022 to avoid obtaining a sex ratio that is overly biased towards females during this period of high abundance of reproductive females.

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1. Higher scenario: A 10% decrease applied to total landings in 2021.
  2. Intermediate scenario: A 20% decrease applied to total landings in 2021.
  3. Lower scenario: A more than 20% decrease applied to total landings in 2021.

## **AREA 13**

### **Review of Indicators: Area 13**

The total allowable catch (TAC) remained unchanged between 2020 and 2021 to 244.0 t, and was not reached. Landings in 2021 were 199.0 t, down 7.2% from 2020 (214.0 t). The fishing season was closed 11 days early due to white crabs. The commercial fishery CPUE decrease between 2020 and 2021 (-26.5%) and is the lowest value observed over the 2000–2021 period. Dockside sampling indicates that landings consisted of a majority (59.7%) of recruits (carapace condition 1–2) in 2021, which is up from 2019 (+24.4%). The mean carapace width of commercial males sampled at sea and dockside has decreased since the last sampling in 2019 and is among the lowest values for the 2000–2021 period.

The commercial abundance index of the post-season survey increased between 2020 and 2021 and is now above the historical average. This increase is primarily due to the increased abundance of crabs left by the fishery (carapace condition 3–5) on the north side and, to a lesser extent, the increased abundance of recruits on the south side. Data on spermathecal load weight in the 2019–2021 post-season surveys and densities of primiparous females in the trawl survey in 2018 suggest that the abundance of reproductive females will remain high following a peak in 2018–2019.

The thermal habitat indices favourable to large and small crabs showed an increasing temporal trend over the period 1990–2021.

After a sharp increase in 2020, the combined index remains stable between 2020 and 2021. Indicators suggest that the biomass available to the fishery in 2022 should be similar to that available in 2021.

Several comments were made by participants:

- It was noted that work on size at maturity is under way to provide a more accurate picture.
- There was discussion on the strong possibility of an early molt occurring, prior to reaching the commercial size of 95 mm.
- The northern and southern parts of area 13 show a starkly contrasting picture. Some participants suspected that this was due to the impact of the cold waters in the Mecatina Trough, in contrast with the warmer waters of the Esquiman Channel.
- The importance of repeating a trawl survey was emphasized. Additionally, the post-season survey should cover transects to the east of the area to achieve a more accurate representation.
- Questions were raised about what happens to the white crab observed in the fishery during the post-season. It was noted that all crabs that enter the traps are typically measurable, including those in categories 1 and 2. These crabs should be available to the fishery the following year (stage 2), but perhaps more so in 2023 (stage 3). A trawl survey could lead to a readjustment in 2023.
- It was speculated that this area is a nursery for the Gulf.

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- Various factors, such as an early closure of the fishery caused by the presence of white crabs and limited economic interest in crab (versus other species), may have affected the fishery results.

### **Summary and Outlook: Area 13**

Participants discussed the summary and proposed scenarios:

- In the key point on the failure to reach the TAC, it was decided to include information on the early closure of the fishery.
- With respect to carapace width, it was decided not to refer to the years prior to the moratorium in the summary, but in the science advisory report only.
- The key point on the trawl survey was retained in the science advisory report only.
- After some discussion, it was agreed that biomass available to the fishery in 2022 would likely be similar to that in 2021.
- The status quo was suggested as a first step for the intermediate scenario. Given the uncertainty associated with the socio-economic context and the early closure of the fishery, the industry participants felt that the intermediate scenario should favour the status quo for the TAC (and not for landings) or an increase in relation to landings. To account for this uncertainty, participants proposed a 20% increase in landings in the higher scenario, which corresponds to the status quo in terms of the TAC. A decrease in landings was suggested in the lower scenario. It was noted that it had been decided to establish scenarios based on landings.

The assembly agreed on the following scenarios:

The combined index remains stable in 2021 after a strong increase in 2020. The biomass available to the fishery in 2022 should be similar to that available in 2021.

1. Higher scenario: A 20% increase applied to total landings in 2021.
2. Intermediate scenario: A status quo compared to total landings in 2021.
3. Lower scenario: A decrease applied to total landings in 2021.

## **AREA 17**

### **Review of Indicators: Area 17**

Between 2020 and 2021, the total allowable catch (TAC) decreased by 5.0% to 1,213.2 t and was reached. Landings in 2021 totalled 1,217.0 t, down 8.1% from 2020 (1,324.0 t). For a second consecutive year, the commercial catch per unit effort (CPUE) rose in 2021 (+11.2% from 2020 to 2021) but remained among the lowest values of the 2000–2021 period. Dockside sampling indicated that landings in 2021 were approximately half recruits (crabs of carapace condition 1–2), representing a proportion fairly similar to the last sampling in 2019.

The commercial abundance indicator of the post-season survey remained steady (+5.8% from 2020 to 2021) throughout the 2018–2021 period, with the lowest values seen since 2000. However, for a second year in a row, this indicator rose steadily in the southern portion of the area to near the historical average for this subregion. All the post-season survey abundance indicators for adolescent and adult males showed values similar to those observed in 2020. Adolescent abundance levels in the southern part of the area were at the historical average. The decrease in the mean weight of the spermathecal load of primiparous females and data



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from the post-season survey since 2020 suggest an increase in the number of primiparous females.

The favourable thermal habitat indices for both large and small snow crabs showed a downward temporal trend over the 1990–2021 period. The values observed in 2021 are the lowest in each of the time series.

The combined index increased by 9.1% between 2020 and 2021. Values from 2019 to 2021 were among the lowest observed throughout the 2000–2021 period. Indicators suggest that the biomass available to the fishery in 2022 should be similar to that available in 2021.

Several comments were made by participants:

- In relation to the mean weight of the spermathecal load of primiparous females, it would be useful to develop an index of the minimum threshold. Work is planned on this topic.
- Based on the temperature recorded during the post-season survey, there was little variation between 2016 and 2021 at 96 fathoms, although the temperature remains above the favourable thermal habitat index for crabs. Work on this topic is under way.
- It was noted that the resource was highly concentrated in 2021, which would explain why the fishery was conducted more quickly.
- Also mentioned was the potential impact of the shrimp fishery, which could possibly affect crab on the north side and explain some of the differences between the north and the south. Participants were reminded that measures are in place to minimize this impact.
- As pointed out for other areas, it was suggested that the post-season protocol be reviewed to get a better picture of the area.

### **Summary and Outlook: Area 17**

Participants discussed the summary and proposed scenarios:

- In the key point on the decrease in the mean weight of the spermathecal load of primiparous females, “and post-season survey data since 2020” was added as it also suggests an increase in the number of primiparous females.
- After discussion, it was agreed that the indicators suggest that the biomass available to the fishery in 2022 should be similar to that available in 2021. Despite the increase in the combined index, it is noted that the recruitment pulse has not yet begun.
- Participants quickly agreed on the scenarios (i.e., a 10% increase in the higher scenario, status quo in the intermediate scenario and a decrease in the lower scenario).

The assembly agreed on the following scenarios:

The combined index increased by 9.1% between 2020 and 2021. Values from 2019 to 2021 were among the lowest observed throughout the 2000–2021 period. The biomass available to the fishery in 2022 is expected to be similar to that of 2021.

Given the increase in densities of primiparous females since 2020, these indicators suggest that greater caution should be exercised in establishing total allowable landings in 2022 to avoid obtaining a sex ratio that is overly biased towards females during this period of high reproductive female abundance.

1. Higher Scenario: A 10% increase applied to total landings in 2021.
2. Intermediate scenario: A status quo compared to total landings in 2021.

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3. Lower scenario: A decrease applied to total landings in 2021.

## **AREA 12A**

### **Review of Indicators: Area 12A**

The total allowable catch (TAC) decreased by 12.7% between 2020 and 2021 to 69.0 t, and it was not reached (mainly for socio-economic considerations). Landings in 2021 were 54.0 t, which corresponds to a decrease of 21.7% compared to 2020 (69.0 t). The catch per unit effort (CPUE) of the commercial fishery is decreasing in 2021 (-37.6% between 2020 and 2021), reaching the lowest value over the 2001–2021 period. At-sea sampling was limited in 2021, but the mean carapace width of commercial males sampled during the fishing season has been declining and was at the lowest value of the 2001–2021 period. Dockside data indicate that two-thirds of the landings were intermediate-shell crabs (category 3). Other than adolescent crabs with a carapace width of 78–95 mm, the numbers of which increased between 2020 and 2021 to exceed the historical average, all abundance indices from the 2021 post-season survey were among the lowest values observed across their historical series. Increased abundances of primiparous females and small males were observed in 2020 and 2021.

The favourable thermal habitat index for large crabs showed a downward temporal trend over the 1990–2021 period.

Between 2020 and 2021, the combined index (CI) declined by 40.8% to reach the lowest value of the 2001–2021 period. In the context of a very low apparent abundance in the last post-season survey, the relative difference in the CI compared with the previous year was strongly influenced by a difference of only a few crabs per trap in comparison with the previous year. Indicators suggest that the biomass available to the fishery in 2022 is expected to remain very low.

Several comments were made by participants:

- It was noted that three licences remain inactive, which is approximately 15% of the 22% of the TAC not reached.
- It was understood that this issue is being looked at by Management so as not to penalize active fishers.
- The temperature recorded during the post-season survey between 2017 and 2021 (at 190 m) remains above the favourable thermal habitat index for crabs.

### **Summary and Outlook: Area 12A**

Participants discussed the summary and proposed scenarios:

- In the key point on the TAC, it was agreed that the TAC was not reached primarily for socio-economic reasons.
- It was agreed that the current situation with low biomass values suggests that the biomass available to the fishery in 2022 should remain very low.
- A 35% decrease in the intermediate scenario was proposed as a first step. Some participants felt that the non-attainment of the TAC for socio-economic reasons should be considered. It was agreed that a  $\pm 10\%$  difference at these low biomass levels would not have much impact. It was finally decided that the higher scenario should be reduced by 20%, the intermediate scenario by 30% and the lower scenario by more than 30%.

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- A paragraph was added to the wording to justify this deviation from the usual approach based on the combined index delta.

The assembly agreed on the following scenarios:

The combined index is at the lowest value on record for the 2001–2021 period (-40.8% from 2020 to 2021), with fishing yields and a post-season commercial abundance indicator that are at the lowest values observed in the last two decades. The biomass available to the fishery in 2022 is predicted to remain very low.

Given the increasing densities of primiparous females, these indicators suggest that great caution is needed when setting the total allowable landings in 2022 to prevent an excessively biased sex ratio towards females during the recruitment of primiparous females.

Scientific consensus has also been reached on proposed adjustments to harvests, which—although they may be smaller than those based solely on the value of the relative change in the CI compared with the previous year—can result in a comparable or lower level of harvesting intensity in the upcoming fishing season compared with the previous season.

1. Higher scenario: A 20% decrease applied to total landings in 2021.
2. Intermediate scenario: A 30% decrease applied to total landings in 2021.
3. Lower scenario: A more than 30% decrease applied to total landings in 2021.

## **AREA 12B**

### **Review of Indicators: Area 12B**

A 20.0 t index fishery was introduced in 2020 but could not be conducted due to the COVID-19 pandemic. In 2021, it was renewed, and the allocation was achieved with landings of 19.0 t. The catch per unit effort (CPUE) of the index fishery was 14.0 kg/trap-day, while the average for the commercial fishery in the 2001–2019 period was 25.7 kg/trap-day. However, the uncertainty associated with the results from 2021 is very high. At-sea sampling was limited in 2021, but catches consisted mainly of recruits (carapace condition 1–2) during the index fishery (87.8%). Meanwhile, dockside data indicated that the majority (72.8%) of landings from the index fishery were intermediate-shell crabs (condition 3).

No post-season surveys were conducted in 2020 and 2021.

The favourable thermal habitat index for large crabs showed a downward temporal trend over the 1990–2021 period. The 2021 value was one of the lowest on record.

Several comments were made by participants:

- In relation to 2021 catches, industry members said that no clear request had been made by Science. It would be advisable to develop a specific protocol going forward. The Advisory Committee will discuss this matter.
- It was added that this falls within the framework of a recovery plan. Follow-up measures must be developed and additional resources are required to gain a better understanding of what is happening in this area. Participants stressed the importance of maintaining an index fishery and post-season survey.

### **Summary and Outlook: Area 12B**

Participants made several comments on the summary:

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- The first key points related to the index fishery, allocation and landings were summarized in one point.
  - In the key point on the CPUE, it was suggested that the 2021 index fishery be compared with the average of the commercial fishery over the 2001–2019 period. It was noted that uncertainty associated with the 2021 CPUE is very high.
  - The at-sea and dockside sampling key points were merged.
  - One key point states that no post-season surveys were conducted in 2020 and 2021.
  - A key point on the thermal habitat trend was added.
  - The assembly agreed that with the information available, it is impossible to determine the status of the resource.

The assembly agreed on the following scenarios:

Based on the information available, the status of the resource in Area 12B cannot be assessed.

### **RESEARCH IDENTIFICATION AND PRIORITIZATION**

With respect to research priorities, brief reference was made to the following issues:

- Development of a precautionary approach (important for eco-certification) and the ecosystem approach;
- Collection and analysis of demographic (e.g., crab size, tagging and telemetry) and environmental (biodiversity, oceanography) data to inform these approaches.

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## APPENDIX 1 – TERMS OF REFERENCE

### Assessment of the Estuary and northern Gulf of St. Lawrence Snow Crab stocks Regional Peer Review – Quebec Region

February 16–18, 2022

Virtual meeting

Chairpersons: Charley Cyr and Kim Émond

#### Context

The snow crab fishery in the Estuary and the northern Gulf of St. Lawrence began in the late 1960s. Landings have varied depending on the adjusted Total Allowable Catches (TACs) based on the recruitment waves and troughs. In 2020, landings have totalled 4,852 t, down by 24% from 2019.

The Estuary and northern Gulf of St. Lawrence are divided into nine management areas (13 to 17, 16A, 12A, 12B and 12C). The effort is controlled by a fishing season as well as a limited number of licences and traps and catches are limited by quotas. A limitation of fishing for male crabs with a legal size of 95 mm is also in place.

The resource is assessed each year to determine whether changes that have occurred in the stock status necessitate adjustments to the conservation approach and management plan.

#### Objectives

Provide scientific advice to determine TACs for the snow crab stocks in the Estuary and northern Gulf of St. Lawrence: management units 13 to 17, 16A, 12A, 12B and 12C for the 2022 fishing season. The advice shall include:

- Description of the biology of the snow crab in the Estuary and northern Gulf of St. Lawrence;
- Description of the fishery including landings, fishing effort, carapace condition and changes in size structure over time;
- Analysis of catches per unit effort from the fishery;
- Analysis of data from post-season trap surveys conducted annually in collaboration with fishers. Indicators: number per unit of effort (NPUE) of legal-size and sub-legal-size crabs, changes in size structure over time and spermatheca load when available;
- Analysis of data from trawl survey(s) conducted annually in certain sectors or areas. Indicators: changes in size structure over time and maturity of both males and females;
- Identification and prioritization of research projects to be considered for the future;
- Perspectives and/or recommendations on management measures in effect for the 2022 fishing season, among others, harvest levels and their possible effects on the abundance and maintenance of the reproductive potential, based on a combined index (CPUE and NPUE) and related indicators for short- and medium-term forecasts in compliance with the precautionary principle.

#### Expected Publications

- Science Advisory Report
- Proceedings

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## **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

Name	Affiliation	Feb. 16	Feb. 17	Feb. 18
Beaulieu, Jérôme	DFO – Fisheries management	X	X	X
Belley, Rénaud	DFO – Science	X	X	X
Bennett, Lottie	DFO – Science	X	X	X
Bermingham, Tom	DFO – Science	X	X	X
Blais, Yan	Fisher area 16	X	-	-
Bois, Samantha	ACPG	-	-	X
Bouchard, Donald	Essipit First Nation	X	-	X
Boucher, Jean-René	Fisher area 16	X	-	X
Boucher, Larry	Fisher area 16	X	-	-
Bourassa, Luc	Consultant	X	X	X
Bourdages, Hugo	DFO – Science	X	X	X
Bourdages, Yan	Fisher area 12B	-	X	X
Briand, Yann	Fisher area 16	X	-	-
Buffitt, Shawn	APBCN	-	X	-
Burnsed, Christina	Gesgapegiag First Nation	-	-	X
Chabot, Denis	DFO – Science	X	X	X
Chamberland, Jean-Martin	DFO – Science	-	-	X
Couillard, Catherine	DFO – Science	X	X	X
Cyr, Charley	DFO – Science	X	X	X
Desgagnés, Mathieu	DFO – Science	X	X	X
Desjardins, Christine	DFO – Science	X	X	-
Dobbin, Robert	Fisher area 13	-	X	X
Doucet, Marc	Fisher area 17	X	-	X
Dubé, Sonia	DFO – Science	X	X	X
Dupuis, Mario	RPPNG	-	-	X
Émond, Kim	DFO – Science	X	X	X
Galbraith, Peter	DFO – Science	X	X	X
Gauthier, Pierre	DFO – Science	X	X	X
Gauthier, Sylvain	Fisher area 16	X	-	-
Gianasi, Bruno	DFO – Science	X	X	-
Gionet, Paolo	Fisher area 16	X	-	-
Girard, Mathieu	Fisher area 12B	X	-	X
Goldsmith, Jessica	DFO – Science	X	X	X
Hawkins, Laurie	DFO – Fisheries management	-	X	-
Henry, Martin	DFO – Fisheries management	-	-	X
Joncas, Jean-Richard	Fisher LNS	-	X	X
Juillet, Cédric	DFO – Science	X	X	X
Labrie, Luc	Fisher area 17	-	-	X
Lacasse, Olivia	DFO – Science	X	X	X
Lavallée, Dean	Fisher LNS	X	X	X
Leclerc, Caroline	MPO – Gestion des pêches	-	-	X
Léonard, Pierre	Essipit First Nation	X	-	X
Lévesque, Isabelle	DFO – Science	X	X	X
Loboda, Sarah	DFO – Science	-	X	-
Monger, Marc	Fisher LNS	X	X	X
Munro, Daniel	DFO – Science	X	X	X
Myles, Geneviève	ACPG	-	-	X
Nadeau, Paul	APBCN	X	X	X
Narancic, Biljana	DFO – Science	X	X	-
Nozère, Claude	DFO – Science	X	-	-
Pinette, Majoric	Pessamit First Nation	X	-	X

<b>Name</b>	<b>Affiliation</b>	<b>Feb. 16</b>	<b>Feb. 17</b>	<b>Feb. 18</b>
Poirier, Serge	Fisher area 16	x	-	-
Poissant, David	AGHAMM	x	-	x
Ramson, Glen	Pêcheur BCN	x	x	x
Rock, Anne	Pessamit First Nation	x	-	x
Rowsell, Austin	Fisher LNS	x	x	x
Roy, Marie-Josée	DFO – Fisheries management	-	-	x
Roy, Virginie	DFO – Science	x	-	-
Sainte-Marie, Bernard	DFO – Science	x	x	-
Sandt-Duguay, Emmanuel	AGHAMM	-	-	x
Sean, Anne-Sara	DFO – Science	x	-	x
Small, Daniel	DFO – Science	x	x	x
Spingle, Jason	FFAW	-	-	x
St-Onge, Benoît	Pêcherie Uapan	x	-	-
Stubbert, Curtis	Fisher LNS	x	x	x
Tamdrari, Hacène	DFO – Science	x	x	x
Tremblay, Yan	Pêcherie Uapan	x	-	-
Vallée, Simon	Fisher area 17	x	-	x
Vigneault, Guy	Fisher area 16	x	-	-