



ASSESSMENT OF THE ESTUARY AND NORTHERN GULF OF ST. LAWRENCE (AREAS 13 TO 17, 12A, 12B, 12C AND 16A) SNOW CRAB STOCKS IN 2019

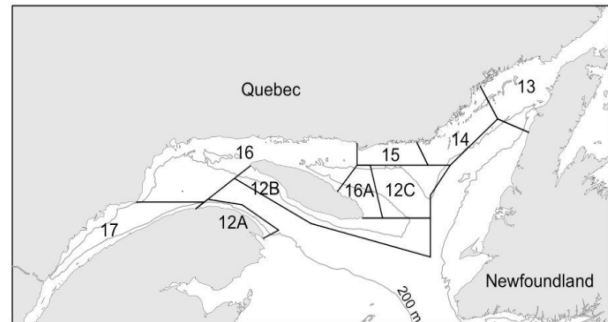
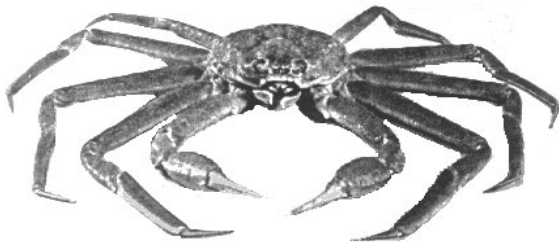


Figure 1. Snow crab management areas in the Estuary and the northern Gulf of St. Lawrence.

Context:

The snow crab fishery in the Estuary and the northern Gulf of St. Lawrence began in the late 1960s. The fishery experienced a boom from 1979 to 1985, and a management approach based on the total allowable catch (TAC) was gradually introduced between 1985 and 1995. Nine fishery management areas (13 to 17, 16A, 12A, 12B and 12C) for this species are under the responsibility of the Quebec Region in the Estuary and northern Gulf of St. Lawrence (Figure 1).

Landings have varied depending on the adjusted TACs based on recruitment waves and troughs that affect the quantity of crabs available to the fishery (Figure 2). Landings for the nine fishing areas totalled 6,386 t in 2019.

The fishery targets only males with a carapace width ≥ 95 mm. White crab (crab that has recently moulted) and adolescent males may be returned to the water during the fishing season to enhance their meat yield and give them a chance to reproduce. Furthermore, since 1985, when the proportion of white crab in catches at sea exceeds 20%, the fishery is automatically closed in the affected area. This measure aims to minimize the mortality of these very fragile crabs, which will be available to the fishery the following year.

The DFO Fisheries and Aquaculture Management Branch, Quebec Region, requested a stock status assessment and a science advisory report to set the 2020 quotas. A scientific peer review was conducted on February 11-12, 2020 to assess the new relevant and available information to respond to this request. Participants included representatives from DFO Science and Fisheries and Aquaculture Management, the fishing industry and First Nations.

SUMMARY

- For all areas combined, catches totalled 6,386 t in 2019, down 25.6% from 2018 (8,583 t). Quotas were reached in Areas 13, 16 and 16A, and were almost reached (90–95%) in Areas 14 and 15 but they were not reached in Areas 12A, 12B, 12C and 17. The industry cited socio-economic factors as the reason for the failure to reach the total allowable catch (TAC) in Areas 12A, 12B, 12C.
- Anticipated removals in 2020 are lower in all nine areas because of a cyclical and natural decrease in recruitment. The trawl survey conducted in Sainte-Marguerite Bay (Area 16) and in Areas 13 and 14 indicates that Areas 13 to 16 should see improved recruitment within a few years, if ecosystem conditions remain favourable. It should be noted that the post-season survey was not carried out by industry in Area 12A, which increased the level of uncertainty with regard to stock status there. Areas 12B and 12C are more vulnerable than other areas to the gradual warming of deep channel waters, which has been observed since 2012 and is expected to persist or worsen over the next few years. The short- and medium-term outlook for both areas is poor.
- Science made three recommendations for each area (see Outlook). The recommended reductions for the intermediate scenario range from 10% to 40% of landings in 2019, depending on the area.

Outlook

- The outlook for each area includes three possible scenarios for establishing the following season catches. These scenarios have been developed by taking into account an indicator combining the catch rate (standardized catch per unit effort, CPUE) from the commercial fishery of the previous year and the abundance of commercial-size adult males (number per unit effort, NPUE) from the post-season scientific survey, the uncertainty associated with this indicator, and related stock status indicators (crab carapace size and condition, expected recruitment, and level of spermathecal load of females, if available), with the objective of ensuring sustainable resource management. The proposed changes are related to the landings of the last fishing year. The characteristics of each scenario are described below.

Higher scenario

- Greater likelihood of increased harvesting intensity for the upcoming season compared to the previous season;
- Harvest level that may result in fishing mortality exceeding the historical average;
- Harvesting pressure that may not be sustainable in the long term; and
- Likely decrease in abundance compared to the previous year if recruitment remains relatively stable or decreases.

Intermediate scenario

- Likelihood of moderate harvesting intensity for the upcoming season, similar to the previous season;
- Harvest level assumed to maintain fishing mortality close to the historical average; and
- Could maintain the stock at a level of abundance similar to the previous year.

Lower scenario

- Greater likelihood of lower harvesting intensity for the upcoming fishing season compared to the previous one;

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- Cautious harvest level assumed to result in fishing mortality below the historical average; and
- Could lead to an increase in stock abundance compared to the previous year or maintain existing biomass over a longer period of time.

Area 17

- The TAC decreased by 15% between 2018 and 2019 to 2,230 t, and was not reached. Landings totalled 1,702 t in 2019.
- The commercial fishery CPUE declined sharply from 2018 to 2019 (-41%). It is below the historical average of the time series, at a value similar to the lowest values observed during the last 25 years.
- Landings were mostly made up of recruits, with a slight decrease between 2018 and 2019 in the proportion of recruits in favour of crabs with a more advanced carapace.
- After a sharp decline in 2018, the commercial abundance index of the post-season survey was down again in 2019, below the average. The values observed on the north and south shores in 2019 show a strong decrease since the last increases observed in 2017.
- The abundance of adolescents 78-95 mm in the post-season survey decreased between 2018 and 2019 and is below the average. However, trends differ between the two shores for adolescents ≥ 95 mm, with a value that increases slightly on the north shore but decreases slightly on the south shore. The 2019 values are, however, below the historical average for both shores and take together.
- The scientific trawl survey carried out in 2019 shows low recruitment for both shores in 2020, with a high abundance of commercial-sized adults observed since 2017. However, the survey of the north shore was incomplete (48 stations out of 68).
- Although the mean weight of the spermathecal load of primiparous females was among the highest ever recorded in the scientific trawl surveys for both shores, the abundance of reproductive females declined sharply in the 2017 and 2019 surveys on the north shore as well as in the 2019 survey on the south shore, dropping to values that were among the lowest in the series for both shores.
- The combined index for both shores decreased by 30% relative to 2018, falling to the lowest value recorded since the time series began in 2000. This sharp decline suggests that the biomass available to the fishery will be even lower in 2020 than in 2019.

Outlook

- A sharp decline in the combined index for the second consecutive year, coupled with the non-attainment of the TAC and the lower recruitment expected in the short and medium term, points to the need to significantly reduce removals in 2020.

Higher scenario: A 25% decrease applied to total landings in 2019.

Intermediate scenario: A 30% decrease applied to total landings in 2019.

Lower scenario: A more than 30% decrease in total landings in 2019.

Area 16

- The TAC decrease by 15% in 2019 to 3,101 t, and was reached.

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- The commercial CPUE has been declining since a high CPUE period was observed in 2013–2015 and it was below the historical average with the lowest value observed in 30 years.
- Landings consisted mostly of recruits, with a slightly lower proportion of intermediate-shell crabs.
- With the exception of 2015, the commercial abundance index of the post-season survey has been declining since 2013, when the highest value in the time series was observed. The 2019 value was the lowest since 2002.
- The combined index decreased by 28% compared with 2018, reaching the lowest value in the time series initiated in 1995. This value suggests that less biomass will be available to the fishery in 2020 than in 2019.
- Monitoring of the snow crab population in Sainte-Marguerite Bay suggests that recruitment, in terms of legal crab numbers will be low in 2020 and will increase starting in 2022.

Outlook

- A sharp decline in the combined index for the second consecutive year (22% in 2018 and 28% in 2019), in a context where recruitment to the fishery is expected to decline in 2020, points to the need to significantly reduce the TAC in 2020.

Higher scenario: A 25% decrease applied to total landings in 2019.

Intermediate scenario: A 30% decrease applied to total landings in 2019.

Lower scenario: A greater than 30% decrease to total landings in 2019.

Area 15

- The TAC decreased by 30% to 442.2 t and was almost reached (413.1 t or 93.4%).
- The commercial fishery CPUE declined for a fourth consecutive year and, in 2019, is among the lowest in the time series.
- The average size of crabs observed at-sea in the commercial fishery have been fairly stable over the last 13 years and are among the highest in history.
- Landings in 2019 consisted mainly of intermediate-shell crabs recruits, while recruits decreased.
- The commercial abundance index of the post-season survey has decreased between 2017 and 2019. The abundance of adolescents ≥ 78 mm has been relatively stable in the post-season survey between 2018 and 2019.
- The combined index is down 41% from the 2018 value. This was the fourth consecutive decline. This decline in the index suggests that there will be less biomass available to the fishery in 2020 than in 2019.

Outlook

- A fourth consecutive decline in the combined index in a context where recruitment to the fishery is expected to remain low in the short term suggests that the landings should be reduced in 2020. However, the size of legal males in the commercial fishery remains stable and high, suggesting that the reduction in removals may be less than that observed for the CI.

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Higher scenario: A 25% decrease applied to total landings in 2019.

Intermediate scenario: A 35% decrease applied to total landings in 2019.

Lower scenario: A greater than 35% decrease to total landings in 2019.

Area 14

- The TAC decreased by 25% in 2019 to 463 t and was almost reached (438.6 t or 94.7%).
- In 2019, the commercial fishery CPUE declined sharply for the third consecutive year and is at the lowest value since 1991.
- Landings consisted primarily of intermediate-shell crab in 2019.
- Although among the lowest values in the time series, the commercial abundance index of the post-season survey is slightly higher in 2019 compared to 2018.
- The abundance of adolescents ≥ 78 mm has remained low and fairly stable in the post-season survey and trawl survey over the past five years, which suggests that recruitment to the fishery will not increase in 2020.
- The combined index decreased by 11% from 2018 to 2019, which suggests that the biomass available to the fishery in 2020 will be lower than in 2019.

Outlook

- A decrease (-11%) in the combined index with no indication of improved recruitment in the short term suggests that the landings should be reduced in 2020.

Higher scenario: A 5% decrease applied to total landings in 2019.

Intermediate scenario: A 10% decrease applied to total landings in 2019.

Lower scenario: A greater than 10% decrease in total landings in 2019.

Area 13

- The TAC decreased by 25% to 304.5 t and was reached.
- After several years of relatively high values, the commercial fishery CPUE declined sharply from 2017 to 2019, and is among the lowest values in 2019.
- Average size of crabs caught in the commercial fishery decreased over the past three years to below the historical average in 2019.
- Landings consisted primarily of intermediate-shell crab in 2019.
- The commercial abundance index of the post-season survey on the north side of the area is similar between 2018 and 2019 and is at the level of the historical average. The 2019 value for the south side of the area is down from the previous year and is among the lowest values in the historical series.
- In the northern part of the area, the abundance of adolescents ≥ 78 mm from the post-season survey was above the historical average, while in the southern part, it was below the historical average.
- The high abundance of 40–62 mm male crabs in the 2018 trawl survey indicated possible recruitment to the fishery in the medium term.

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- In 2018, the abundance of primiparous females reached the highest value recorded in this survey since 1994. In contrast, in 2018 (trawl survey) and 2019 (post-season survey), the mean weight of the spermathecal load of primiparous females was among the lowest values seen since data collection began in 2003.
- The combined index decreased by 15% from 2018 to 2019 and is among the lowest values in the time series. The biomass available to the fishery in 2020 is expected to be lower than in 2019.

Outlook

- The decline (-15%) in the combined index in 2019, coupled with the decrease in the size of legal crabs in the commercial fishery, the low spermathecal load index of primiparous females and the expectation that recruitment will remain low in the short term, all suggest that removals should be reduced in 2020. Taking into consideration other, related indices that were negative, the 2019 value of the combined index was used as a reference for the high scenario.

Higher scenario: A 15% decrease applied to total landings in 2019.

Intermediate scenario: A 25% decrease applied to total landings in 2019.

Lower scenario: A greater than 25% decrease in total landings in 2019.

Area 16A

- The TAC decreased by 24.9% in 2019 to 310 t and was reached.
- The commercial fishery CPUE decreased for a fifth year. The 2019 CPUE is the lowest since the series began in 2004.
- As in 2018, landings consisted of a large majority of recruits in 2019.
- The commercial abundance index of the post-season survey has decreased between 2014 and 2019, with a slight decrease in 2019.
- Although the abundance level remains low, an increase was seen in the abundance of 78–95 mm adolescents in the post-season survey for the fifth consecutive year. During the same period, the abundance of adolescents > 95 mm remained stable.
- The combined index was down for the fifth consecutive year (-12% decrease from 2018 to 2019). This decline in the index suggests that there will be less biomass available to the fishery in 2020 than in 2019.

Outlook

- The decrease in the combined index since 2014 suggests a decrease in total landings in 2020. However, the recruitment is expected to remain stable in the short term.

Higher scenario: A 5% decrease applied to total landings in 2019.

Intermediate scenario: A 12% decrease applied to total landings in 2019.

Lower scenario: A greater than 12% decrease in total landings in 2019.

Area 12C

- The TAC decreased by 25.1% to 192 t, and was not reached (landings of 149.5 t). Some licences were inactive in 2019.

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- The commercial fishery CPUE is down for the third consecutive year. The CPUE in 2019 is the lowest values observed in the time series.
- Landings consisted mostly of intermediate-shell crab.
- The commercial abundance index of the post-season survey decreased significantly over the past five years.
- The abundance of adolescents ≥ 78 mm remained low and fairly stable in the post-season survey between 2014 and 2019, which does not suggest an increase in recruitment to the fishery in 2020.
- The combined index decreased for a fifth consecutive year, with a 39% decrease from 2018 to 2019. This decline in the index suggests that there will be less biomass available to the fishery in 2020 than in 2019.

Outlook

- The 39% drop in the combined index, during a period of stable and low recruitment, suggests a sharp decrease in the removals in 2020.

Higher scenario: A 30% decrease applied to total landings in 2019.

Intermediate scenario: A 40% decrease applied to total landings in 2019.

Lower scenario: A greater than 40% decrease applied to total landings in 2019.

Area 12B

- In order to address socio-economic considerations and to enable monitoring of yields in this area, the TAC was set at 125 tonnes for 2018 and 2019.
- The fishing effort was low in 2019, with landings of 30 t.
- The commercial fishery CPUE from 2016 onwards is at the lowest values observed since 1995.
- The average size of legal crab caught in the commercial fishery remained similar to that of 2017 and 2018, and is below the historical average.
- Landings consisted mostly of intermediate-shell crabs.
- The commercial abundance index of the post-season survey has been decreasing since 2013 and is close to 0.

Outlook

- The non-attainment of the TAC, low catch rates, small size and low recruitment of snow crab suggest that stock status did not improve in 2019. The short-term outlook is not favourable.
- According to all indicators available in 2019, the biomass is very low and may not be able to support a commercial fishery.

Area 12A

- In 2019, the TAC remained unchanged at 105.5 t, and was not reached (landings of 80.5 t). Some licences remained inactive.

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- The commercial fishery CPUE remained similar in 2019 to that of the two previous years, and is among the lowest values observed.
- Landings consisted primarily of intermediate-shell crab.
- The post-season survey was not conducted in 2019 and the CI was not calculated. All abundance indices from the 2018 post-season survey were declining or fairly stable and were among the lowest values observed in the historical series.
- The combined index in 2018 was the lowest value in the time series beginning in 2000.

Outlook

- Commercial fishery yields that are among the lowest in the historical series, combined with the uncertainty resulting from the absence of the post-season survey, point to the need to reduce removals in 2020.

Higher scenario: Same total landings in 2020 as in 2019.

Intermediate scenario: A 10% decrease applied to total landings in 2019.

Lower scenario: A greater than 30% decrease applied to total landings in 2019.

INTRODUCTION

Species biology

In Canada, snow crab can be found from the southern tip of Nova Scotia to halfway up the Labrador coast, as well as in the Estuary and Gulf of St. Lawrence. In the Gulf of St. Lawrence, commercial-size males live at depths ranging from 50 m to 200 m, except during their winter moulting and reproductive periods, during which they migrate to shallower waters. Snow crab stop growing after the terminal moult. Males are considered adolescents (small claws) prior to the terminal moult and adults (large claws) afterwards. Adult male carapace width (CW) ranges from 40 mm to 165 mm. If they do not undergo their terminal moult earlier, males reach legal size (95 mm CW) at about 9 years of age. The proportion of males that reach the legal size is correlated with the temperature of the environment throughout their development. Snow crab recruitment is periodic or episodic and varies considerably over an 8- to 12-year cycle. The entry of recruits into the fishery can be determined by regular monitoring of landings (carapace size and condition) and the catch rate (catch per unit effort or CPUE), and is confirmed by scientific trap and trawl surveys. Global warming, and specifically recent years' upward trend in the average temperature of the deep layer, could affect snow crab distribution and productivity by warming.

RESOURCE ASSESSMENT

Analyses of all areas are based on fishing data (Table 1) from logbooks, processing plant purchase slips and dockside weighing summaries, along with catch sampling data obtained from the At-sea Observers Program and DFO samplers. In 2019, the industry conducted a trap-based research survey in all fishing areas (except in Area 12A, where there was no survey, and Area 13, where two independent surveys (northern and southern) were conducted), and the findings were incorporated into the stock status assessments. These surveys help determine the average NPUE (numbers per unit effort) of legal-size crab by area and the NPUE of adolescent crabs with a carapace more than 78 mm wide that will reach or exceed legal size

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during the next moult. The results of the trawl research surveys conducted in 2018 and 2019 in areas 13, 16 and 17 were used to calculate an adolescent or adult crab abundance index.

Table 1. Summary by Area of the number of licences and dates of commercial fishery in 2019.

| Areas | 13 | 14 | 15 | 16 | 16A | 17 | 12A | 12B | 12C |
|--------------------|-----------------|-----------------|----------------|---------|----------------|----------|----------|----------|--------------------|
| Number of licences | 43 | 19 | 30 | 51 | 36 | 39 | 9 | 6 | 37 |
| Opening dates | May 9 or 16 | May 6 or 14 | April 14 or 24 | April 9 | April 14 or 21 | March 27 | March 30 | March 30 | April 23 and May 3 |
| Closure dates | August 14 or 21 | August 11 or 19 | July 20 or 30 | July 15 | July 20 or 27 | June 22 | June 7 | June 21 | August 8 |

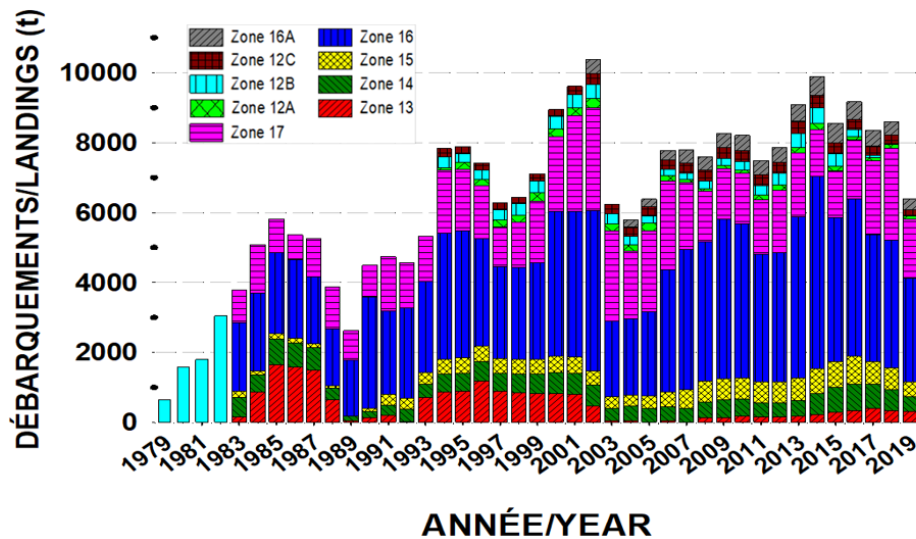


Figure 2. Snow crab landings in the Estuary and northern Gulf of St. Lawrence from 1979 to 2019. From 1979 to 1982, landings were not attributed to their area of origin.

The fishery's raw catches per unit effort (CPUE) were standardized using a linear statistical model to account for seasonal changes, gear type, soak time and fishing site. The proportion of recruits (or new crab), which can be identified by its new carapace (carapace conditions 1 and 2), intermediate-shell crab (carapace condition 3) and old-shell crab (carapace conditions 4 and 5) was determined by dockside samplers.

Since 2013, a combined index (CI) was introduced to obtain a better estimate of the short-term commercial biomass trend and help increase the consistency of the inter-annual recommendations for a given stock. This index is based on two biomass indices: the standardized commercial CPUE and the post-season NPUE for adult males ≥ 95 mm (the average NPUE from the north and south surveys in Area 13). The combined index is calculated by standardizing each of the two indices according to their respective average and standard deviation over the 2000-2012 reference period, and averaging them for the current year.

Data on the size structure of crab sampled at sea, dockside and during trap surveys were also used.

To date, data on female insemination levels, based on the average weight of spermatheca, have been collected sporadically in certain areas. Annual systematic sampling of each area is recommended so this parameter can be used for stock status assessments because it is a

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measure of primiparous female mating success and the relative abundance of large adult males.

Snow crab thermal habitat

Two new indicators of favourable thermal habitat for snow crab are now available, one for adults and the other for juveniles. These indicators represent the area of seabed where water temperatures are between -1°C and 3°C (adults) or between 0°C and 2°C (juveniles). During the 1985 to 2019 period, a declining trend in the area of favourable thermal habitat for adult snow crab was observed in 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 (Figure 3, A and B). For juveniles, a downward trend in the area of favourable thermal habitat was seen in Areas 12A, 16 and 17, but an increasing trend was observed in Areas 12B, 13 to 15 and 16A (Figure 4, A and B).

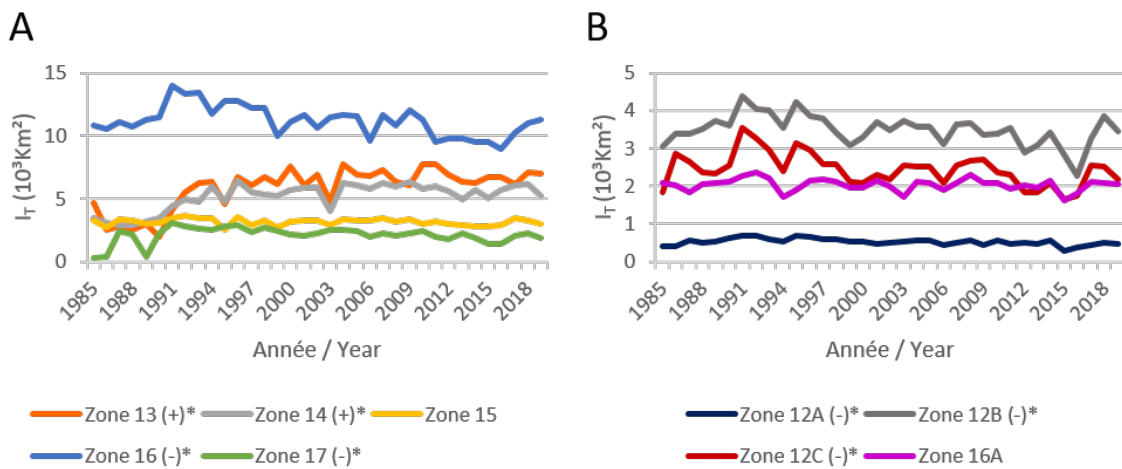


Figure 3, A and B. Indicator, I_T , of favourable thermal habitat for adult snow crab: area of seabed where water temperatures are between -1°C and 3°C . The positive or negative sign associated with each area indicates a potential linear temporal trend, either increasing or decreasing (the asterisk indicates that the statistical model with a linear temporal trend was chosen over a null model, following model selection).

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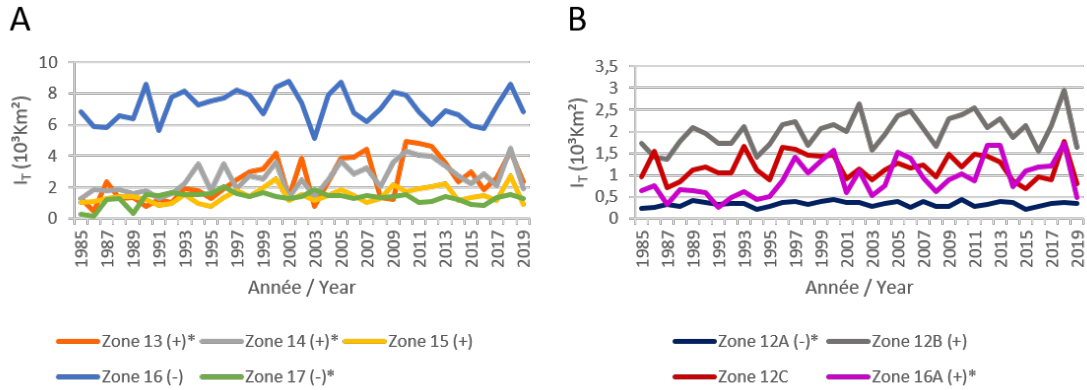


Figure 4, A and B. Indicator, I_T , of favourable thermal habitat for juvenile snow crab: area of seabed where water temperatures are between 0°C and 2°C. The positive or negative sign associated with each area indicates a potential linear temporal trend, either increasing or decreasing (the asterisk indicates that the statistical model with a linear temporal trend was chosen over a null model, following model selection).

Area 17

Description of the fishery

In Area 13, the TAC decreased by 15% between 2018 and 2019 to 2,230 t (Figure 5), and was not reached (landings totalled 1,702 t or 76.3% of the TAC).

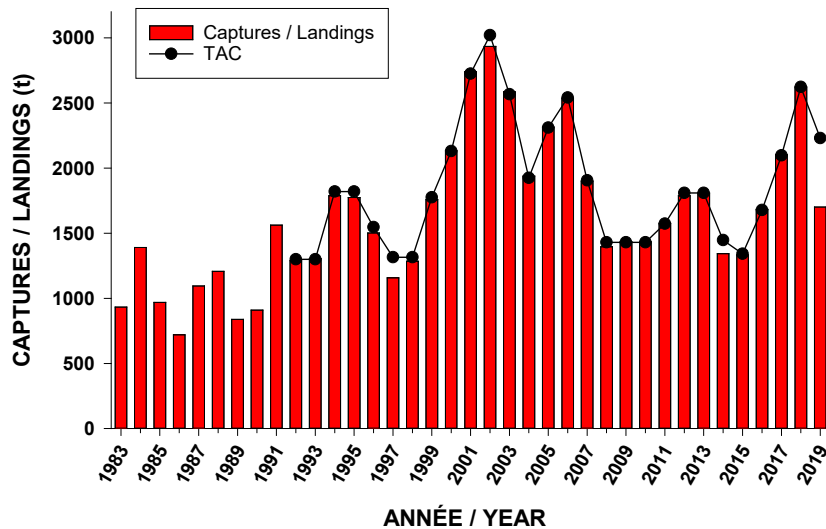


Figure 5. Annual landings and TACs in Area 17.

Resource status in 2019

Commercial fishery. The standardized CPUE declined sharply in 2019 to a level below the historical average of the time series. The 2019 CPUE is one of the lowest values recorded in the past 25 years (Figure 6). For the second consecutive year, landings consisted primarily of recruits with carapace condition 1 or 2, which have been increasing since 2014, followed by intermediate-shell crabs. The average size of legal-sized crabs caught at sea decreased slightly

between 2018 and 2019. This indicator has remained below the historical average since 2014 (Figure 7).

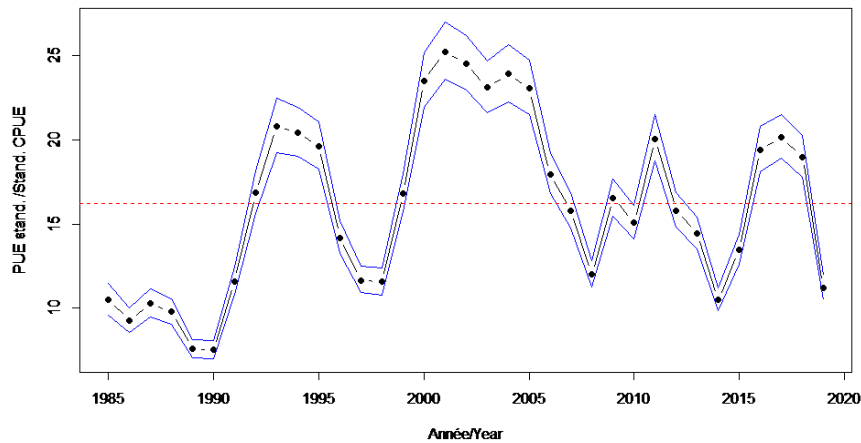


Figure 6. Standardized annual CPUE (\pm 95% confidence interval) in the commercial fishery in Area 17. The red dashed line shows the data series average (excluding 2019).

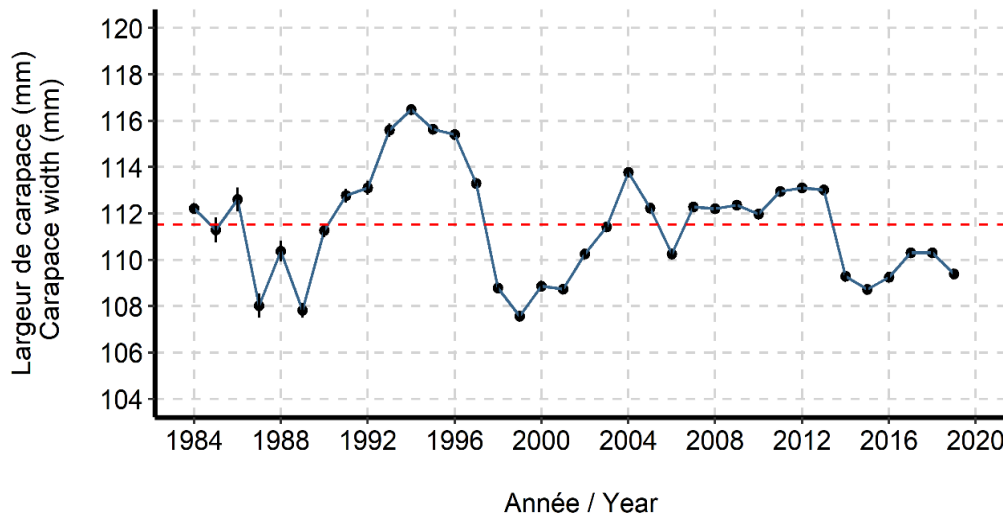


Figure 7. Average carapace width (\pm 95% confidence interval) of legal-size male crabs in the commercial fishery in Area 17. The dashed line shows the data series average (excluding 2019).

Fishery-independent surveys. The research trap survey indicates that the NPUE of ≥ 95 mm adults declined for the second consecutive year, falling below the historical average to the lowest value recorded between 2000 and 2019 (Figure 8), despite a slight increase for the north shore. The trends for adolescents ≥ 95 mm differ between the two shores, with a slight increase on the north shore (to a level close to the historical average) and a slight decrease on the south shore (to a level just below the historical average). The NPUE of adolescents ≥ 78 mm declined between 2018 and 2019, falling below the historical average (Figure 9), while the NPUE of recruits (Figure 10) increased between 2018 and 2019 to a level slightly above the historical average. The scientific trawl survey in 2019 points to low recruitment for both shores in 2020, with a high abundance of commercial-sized adults observed since 2017. The density of commercial-sized adults reached the highest value observed on the north shore since 1995,

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and the second highest value observed on the south shore since the first survey of the area was conducted in 2007. However, the survey of the north shore was incomplete (48 stations out of 68). Although the mean weight of the spermathecal load of primiparous females reached one of the highest values recorded in the scientific trawl surveys for both shores, the abundance of reproductive females declined sharply in the 2017 and 2019 surveys on the north shore and in the 2019 survey on the south shore, dropping to values among the lowest in the series for both shores.

The combined index (CI) of commercial CPUE and of NPUE of adults ≥ 95 mm in the post-season survey decreased by 30% between 2018 and 2019, at the lowest level of the historical series. This suggests that there will be less biomass available in the 2020 fishing season than there was in 2019 (Figure 11).

A downward trend in snow crab favourable thermal habitat in Area 17 (Figure 3A and Figure 4A) has been observed in recent years, which could have a negative impact on the future stock productivity.

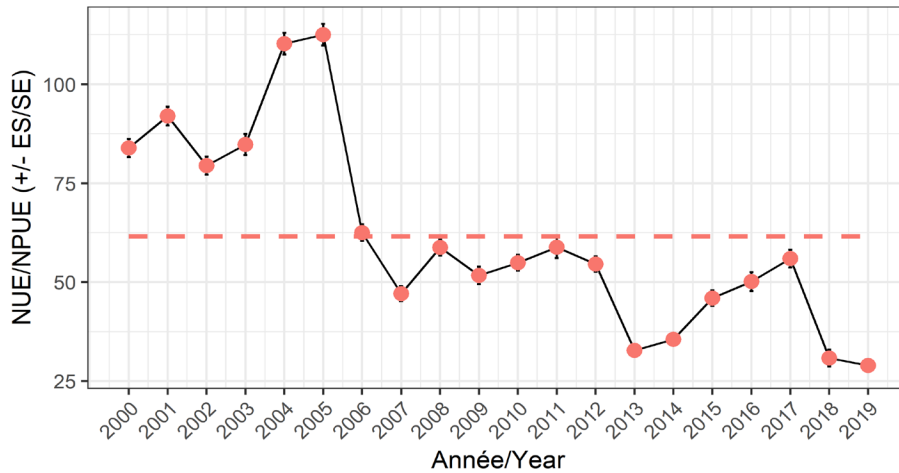


Figure 8. Annual catch rates (NPUE) (\pm standard error) of adult crabs ≥ 95 mm from the post-season survey in Area 17. The dashed line shows the data time series average.

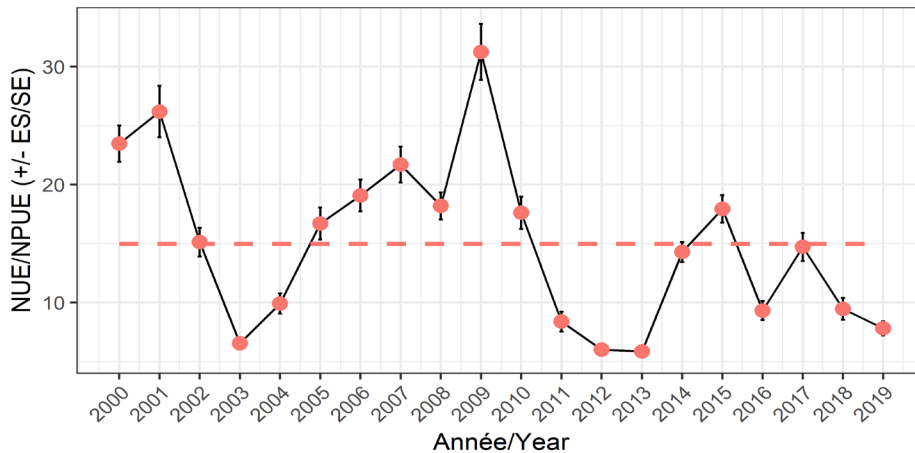


Figure 9. Annual catch rates (NPUE) (\pm standard error) of adolescents ≥ 78 mm from the post-season survey in Area 17. The dashed line shows the data time series average.

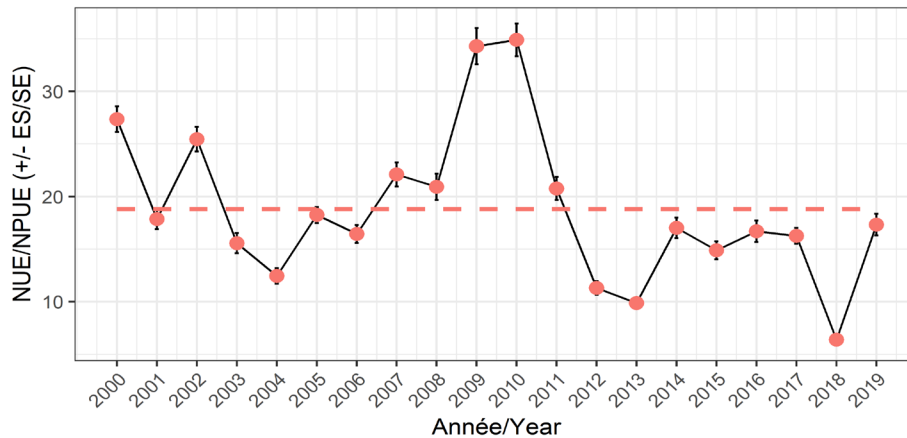


Figure 10. Annual catch rates (NPUE) (\pm standard error) of recruits from the post-season survey in Area 17. The dashed line shows the data time series average.

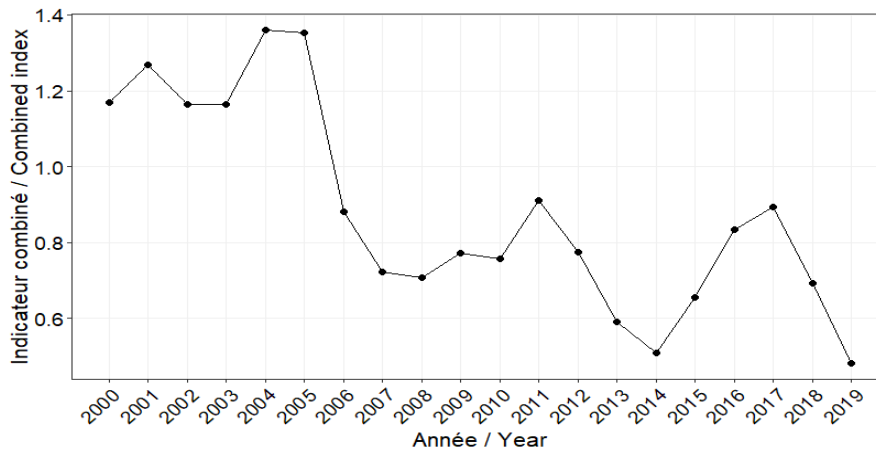


Figure 11. Combined index derived from the standardized annual CPUE and annual NPUE for Area 17.

Outlook and conclusions

A sharp decline in the combined index for the second consecutive year, coupled with the non-attainment of the TAC and the lower recruitment expected in the short and medium term, points to the need to significantly reduce the TAC in 2020.

Higher scenario: A 25% decrease applied to total landings in 2019.

Intermediate scenario: A 30% decrease applied to total landings in 2019.

Lower scenario: A greater than 30% decrease applied to total landings in 2019.

Area 16

Description of the fishery

In Area 16, the TAC decrease by 15% from 2018 to 2019 at 3,101 t (Figure 12) and was reached.

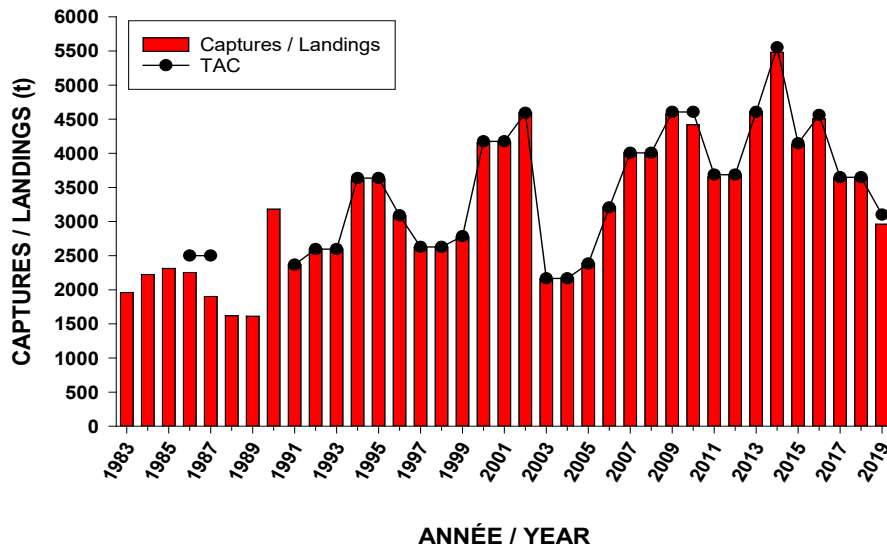


Figure 12. Annual landings and TACs in Area 16.

Resource status in 2019

Commercial fishery. After peaking from 2013 to 2015, the standardized CPUE is decreasing and is at its lowest observed value since 1990 (Figure 13). Landings consisted of a majority of recruits (carapace conditions 1 and 2) with a slightly lower proportion of intermediate shell crab (carapace condition 3). The average size of legal-size crabs caught at sea decreased slightly between 2018 and 2019 and is at the historical average level (Figure 14).

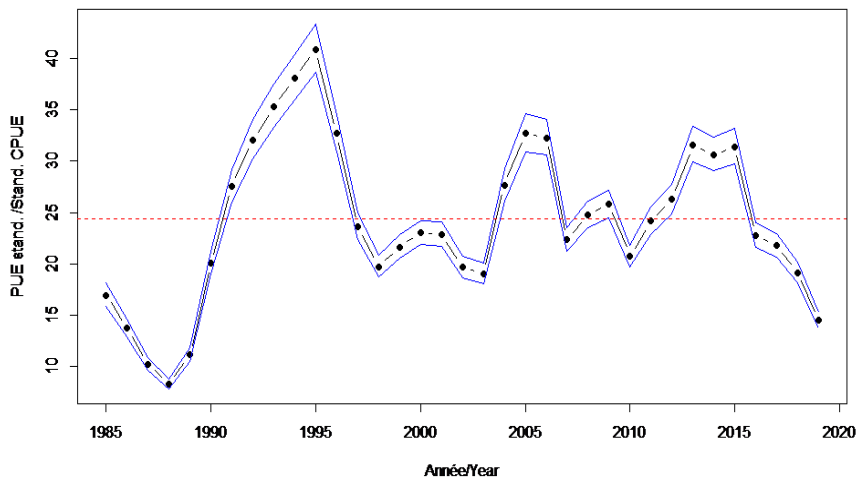


Figure 13. Standardized annual CPUE (\pm 95% confidence interval) in the commercial fishery in Area 16. The red dashed line shows the data series average (excluding 2019).

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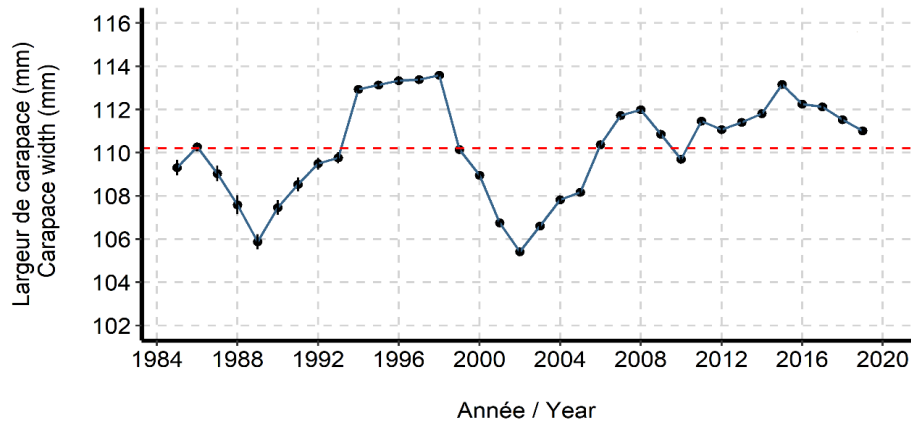


Figure 14. Average carapace width (\pm 95% confidence interval) of legal-size male crabs in the commercial fishery in Area 16. The dashed line shows the data series average (excluding 2019).

Fishery-independent surveys. The trap-based research survey, conducted every fall since 1994, shows a further decrease in NPUE of adults ≥ 95 mm between 2018 and 2019, and is still below average, at the lowest value observed since 2002 (Figure 15). The NPUE of adolescents ≥ 78 mm has been relatively stable since 2016 and is slightly below the historical average (Figure 16). The NPUE of recruits, which reached its highest historical value in 2015, decreased again between 2018 and 2019, and is now at the historical average (Figure 17). Based on the results of the trawl survey conducted in Sainte-Marguerite Bay, low recruitment of legal-sized crabs is anticipated for 2020. From 2022 onward, recruitment is expected to increase for this population. The abundance of primiparous females has increased for the third consecutive year. Despite the decrease recorded between 2018 and 2019, the spermathecal load indicator remains high, with a record level reached in 2019.

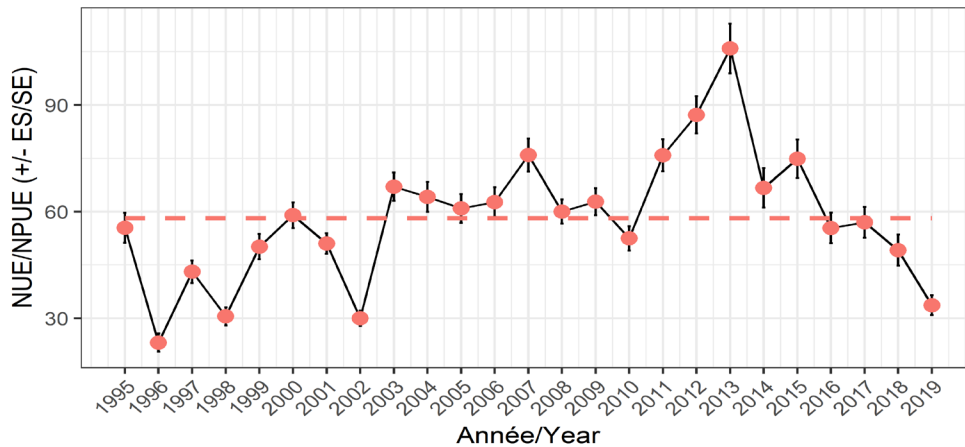


Figure 15. Annual catch rates (NPUE) (\pm standard error) of adult crabs ≥ 95 mm from the post-season survey in Area 16. The dashed line shows the data time series average.

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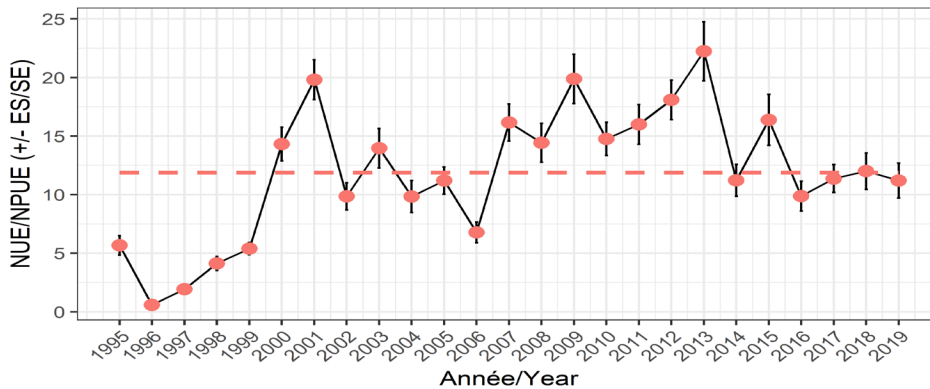


Figure 16. Annual catch rates (NPUE) (\pm standard error) of adolescents ≥ 78 mm from the post-season survey in Area 16. The dashed line shows the data time series average.

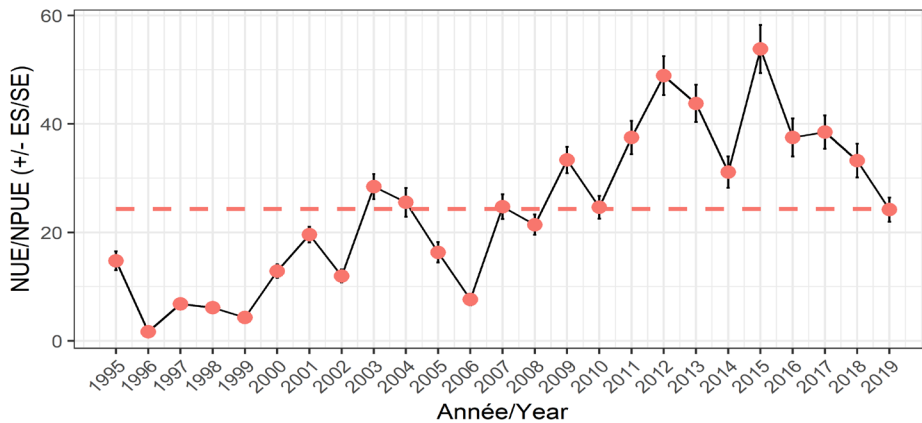


Figure 17. Annual catch rates (NPUE) (\pm standard error) of recruits from the post-season survey in Area 16. The dashed line shows the data time series average.

The combined index of commercial CPUE and NPUE of adults ≥ 95 mm from the post-season survey decreased by 28% compared with 2018, which suggests that less biomass will be available to the fishery in 2020 than in 2019.

A downward trend in the area of favourable thermal habitat for snow crab in Area 16 (Figure 3A and Figure 4A) has been observed since 1990. The marked decrease in the availability of favourable thermal habitat, during the period from 2011 to 2016, could have a negative impact on the future productivity of the stock.

Quebec Region

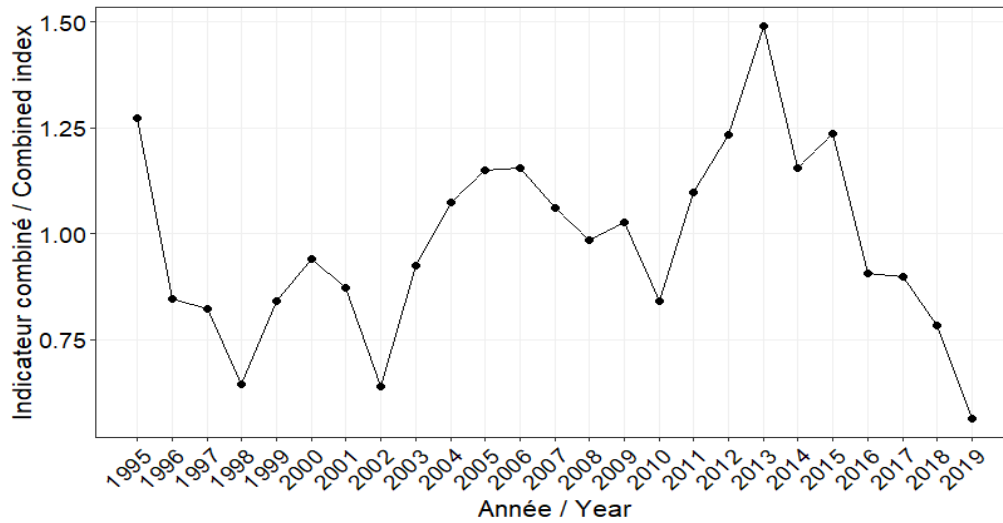


Figure 18. Combined index derived from the standardized annual CPUE and annual NPUE for Area 16.

Outlook and conclusions

A sharp decline in the combined index for the second consecutive year (22% in 2018 and 28% in 2019), in a context where recruitment to the fishery is expected to decline in 2020, points to the need to significantly reduce the TAC in 2020.

Higher scenario: A 25% decrease applied to total landings in 2019.

Intermediate scenario: A 30% decrease applied to total landings in 2019.

Lower scenario: A greater than 30% decrease in total landings in 2019.

Area 15

Description of the fishery

The TAC decreased by 30% between 2018 and 2019 to 442.2 t (Figure 19), and was almost reached (landings totalled 413.1 t or 93.4% of the TAC).

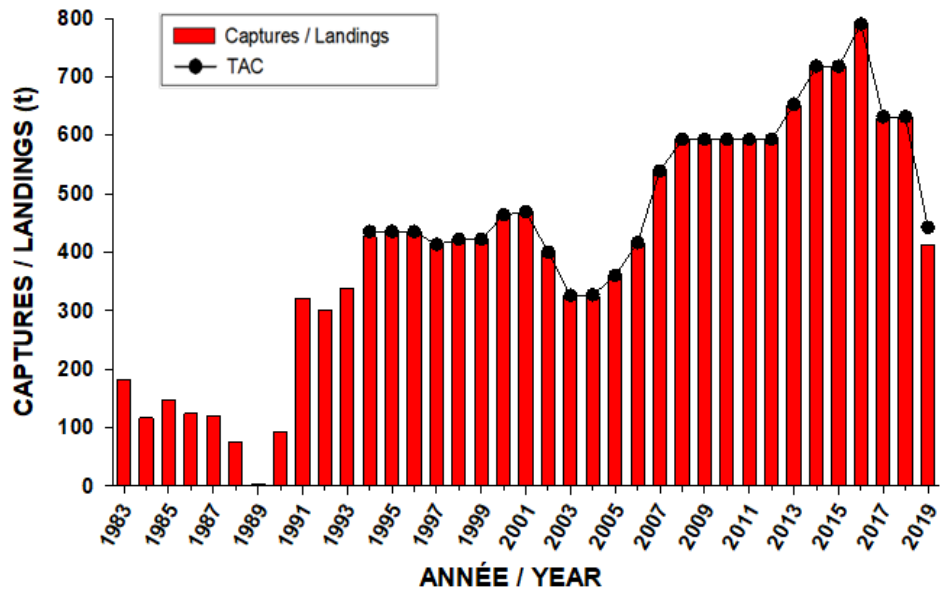


Figure 19. Annual landings and TACs in Area 15.

Resource status in 2019

Commercial fishery. The standardized CPUE decreased sharply between 2018 and 2019 and is now below the historical average at one of the lowest values observed during the 1985-2019 period (Figure 20). Landings are slightly dominated, proportionally, by intermediate-shell crabs. After an increase between 2016 and 2018, the proportion of recruits (carapace conditions 1 and 2) decreased. The average size of crabs caught in the commercial fishery, over the historical average, has been stable over the past 12 years (Figure 21).

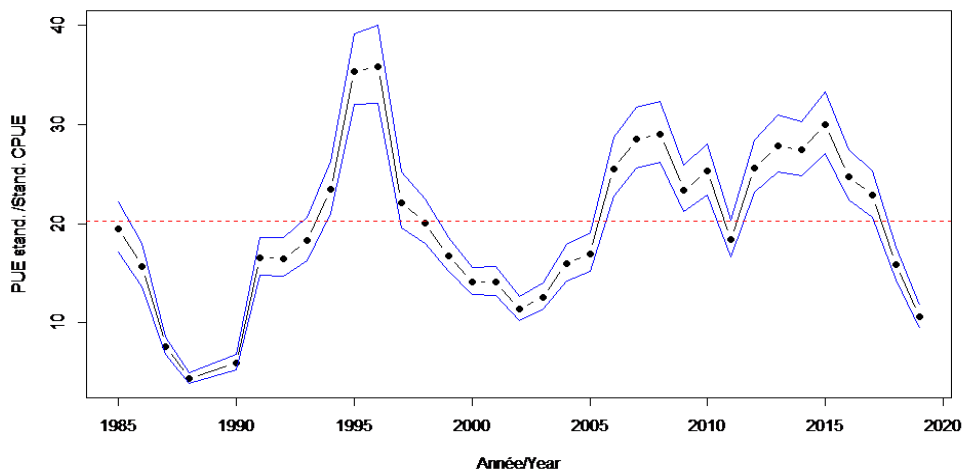


Figure 20. Standardized annual CPUE (± 95% confidence interval) in the commercial fishery in Area 15. The red dashed line shows the data series average (excluding 2019).

Quebec Region

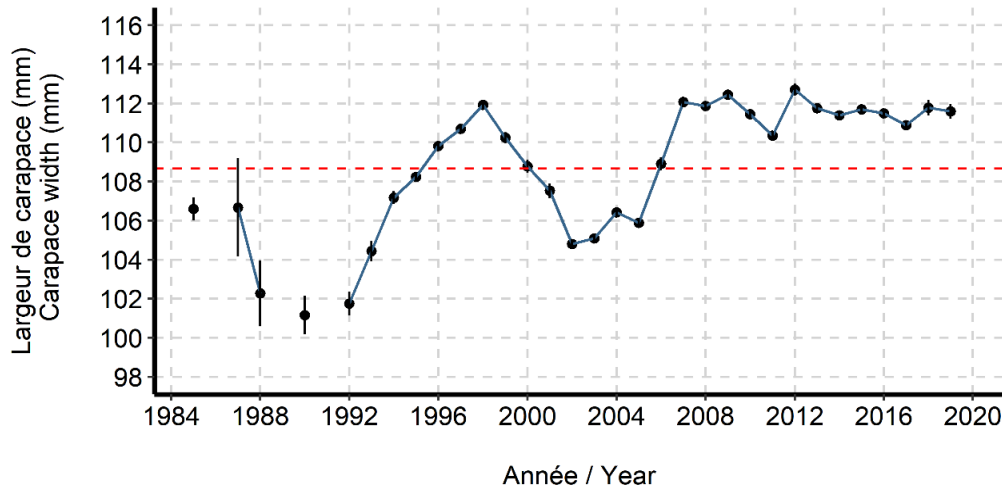


Figure 21. Average carapace width (\pm 95% confidence interval) of legal-size male crabs in the commercial fishery in Area 15. The dashed line shows the data series average (excluding 2019).

Fishery-independent survey. The protocol for trap-based research survey was changed in 2014 to allow the use of a new larger, standard conical trap of 6.5 ft diameter. Both types of traps, former and new, were being used from 2014 to 2016. Since 2017, only the larger trap is used. Since catchability with this new trap needs to be further assessed in comparison with the former traps, only the data including this new trap are presented. The trap-based research survey shows a further well below-average decrease in the NPUE of adults \geq 95 mm in 2019 (Figure 22). The NPUE of adolescents \geq 78 mm is fairly stable between 2018 and 2019, but remains lower than the 2014-2016 values (Figure 23). The NPUE of recruits in 2019 is relatively stable compared to 2017 and 2018 and is below the historical average (Figure 24).

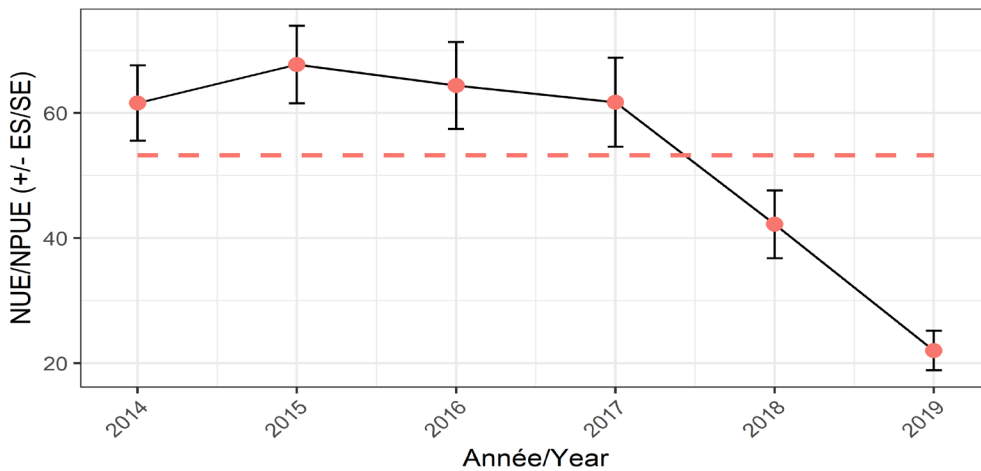


Figure 22. Annual catch rates (NPUE) (\pm standard error) of adult crabs \geq 95 mm from the post-season survey in Area 15. The dashed line shows the data series average.

Quebec Region

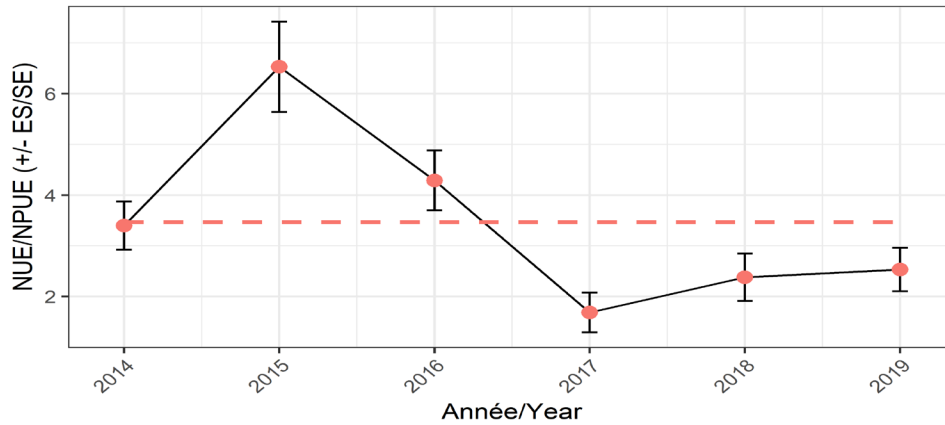


Figure 23. Annual catch rates (NPUE) (\pm standard error) of adolescents ≥ 78 mm from the post-season survey in Area 15. The dashed line shows the data series average.

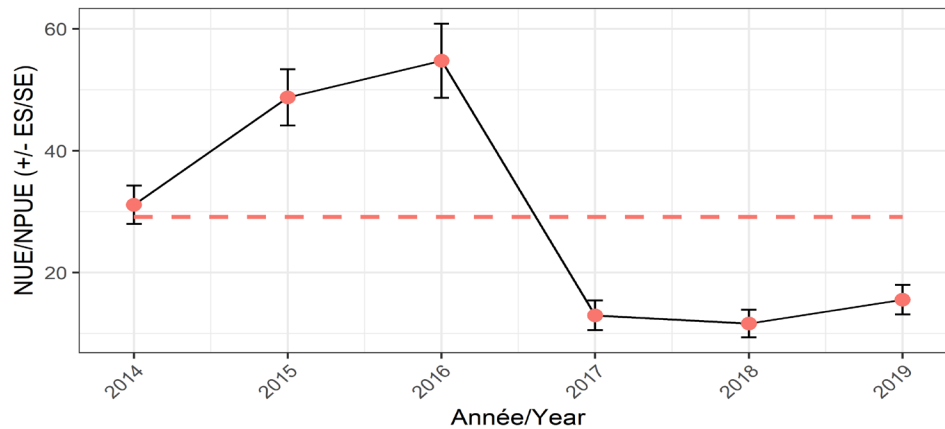


Figure 24. Annual catch rates (NPUE) (\pm standard error) of recruits from the post-season survey in Area 15. The dashed line shows the data series average.

The combined index of the commercial CPUE and NPUE of adults ≥ 95 mm from the post-season survey decreased by 41%. This is the fourth consecutive decrease. This decline in the indicator suggests that the biomass available to the fishery will be lower in 2020 than in 2019 (Figure 25).

Quebec Region

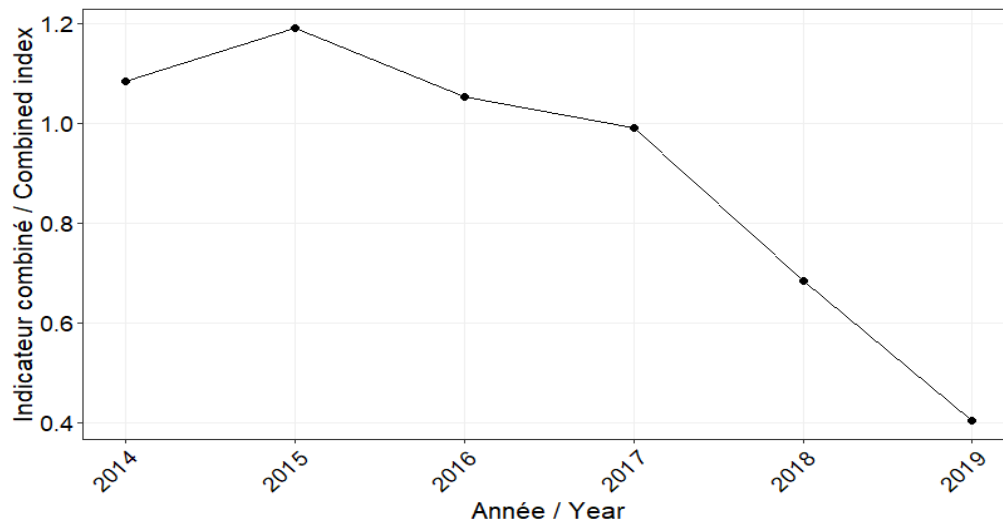


Figure 25. Combined index derived from the standardized annual CPUE and annual NPUE for Area 15.

Outlook and conclusions

A fourth decline in the combined index, in a context where recruitment to the fishery is expected to remain low in the short term, suggests that the landings should be reduced in 2020. However, the size of legal males in the commercial fishery remains stable and high, suggesting that the reduction in removals may be less than that observed for the combined index.

Higher scenario: A 25% decrease applied to total landings in 2019.

Intermediate scenario: A 35% decrease applied to total landings in 2019.

Lower scenario: A greater than 35% decrease to total landings in 2019.

Area 14

Description of the fishery

The TAC decreased by 25% from 2018 to 2019 to 463 t (Figure 26), and the TAC was almost reached with 438.6 t (94.7%) landed.

Resource status in 2018

Commercial fishery. After reaching its highest value in 2016 over the 1985-2019 period, the standardized CPUE decreased sharply to the lowest values observed since 1991 (Figure 27). Recruits (carapace conditions 1 and 2), whose proportion increased slightly in landings from 2008 to 2013, remain a minority in landings. Intermediate-shell crabs strongly dominate landings, followed by old-shell crab (carapace conditions 4 and 5), in proportion similar to 2018. The average size of legal-size crab caught at sea has increased since 2013 and is well above the historical average despite a decrease between 2018 and 2019 (Figure 28).

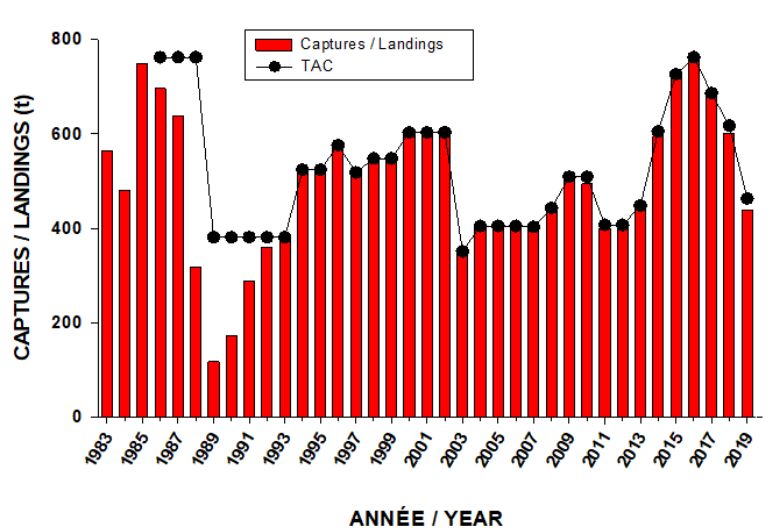


Figure 26. Annual landings and TACs in Area 14.

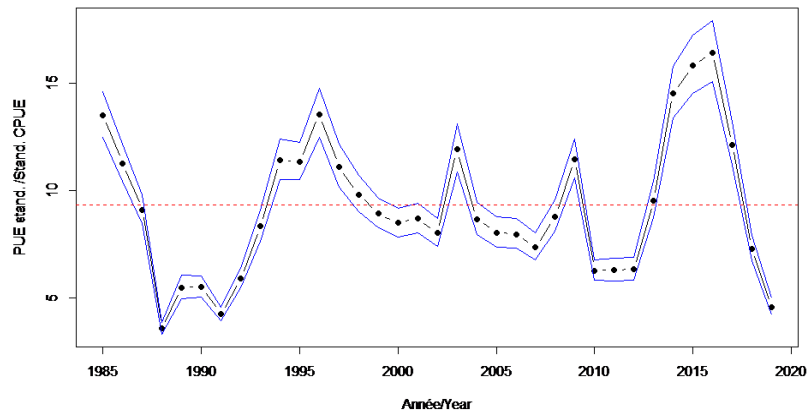


Figure 27. Standardized annual CPUE (\pm 95% confidence interval) in the commercial fishery in Area 14. The red dashed line shows the data series average (excluding 2019).

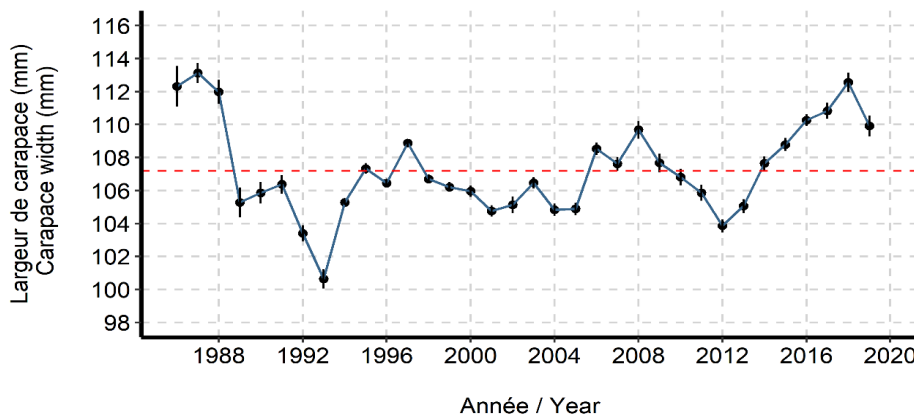


Figure 28. Average carapace width (\pm 95% confidence interval) of legal-size male crabs in the commercial fishery in Area 14. The dashed line shows the data series average (excluding 2019).

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Fishery-independent survey. The trap-based research survey, conducted since 1996, shows that the NPUE of adults ≥ 95 mm (Figure 29) and of recruits (Figure 31) decreased sharply from 2014 to 2018 and were below their historical average in 2018 and 2019, despite a slight increase between 2018 and 2019. The NPUE of adolescents ≥ 78 mm remains relatively stable, but below the historical average since 2015 (Figure 30). This indicator, along with observations from the 2018 trawl survey, suggests that recruitment to the fishery will not increase in 2020.

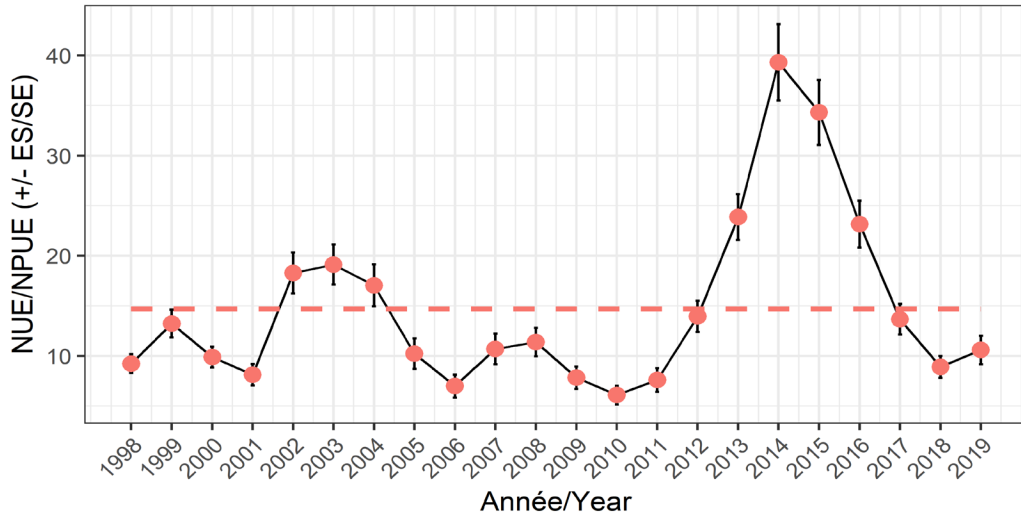


Figure 29. Annual catch rates (NPUE) (\pm standard error) of adult crabs ≥ 95 mm from the post-season survey in Area 14. The dashed line shows the data series average.

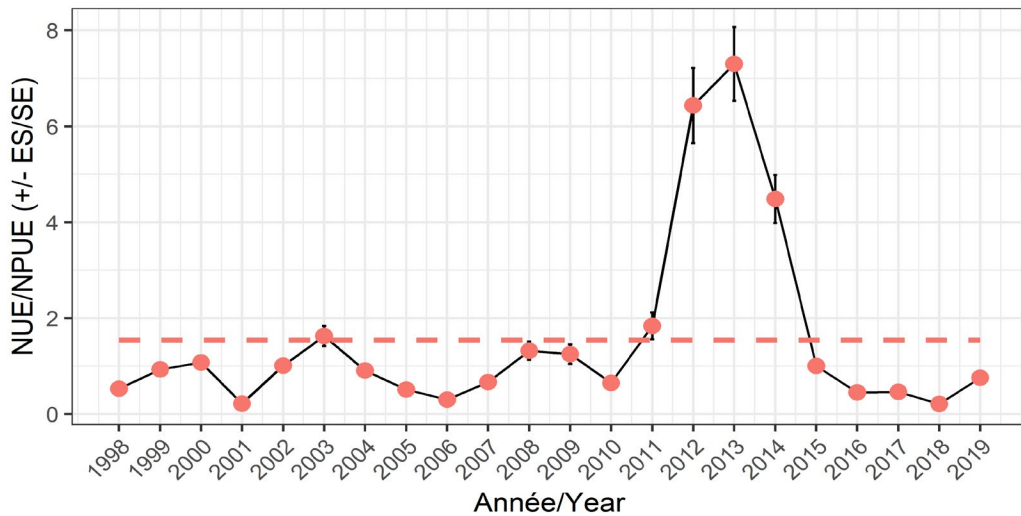


Figure 30. Annual catch rates (NPUE) (\pm standard error) of adolescents ≥ 78 mm from the post-season survey in Area 14. The dashed line shows the data series average.

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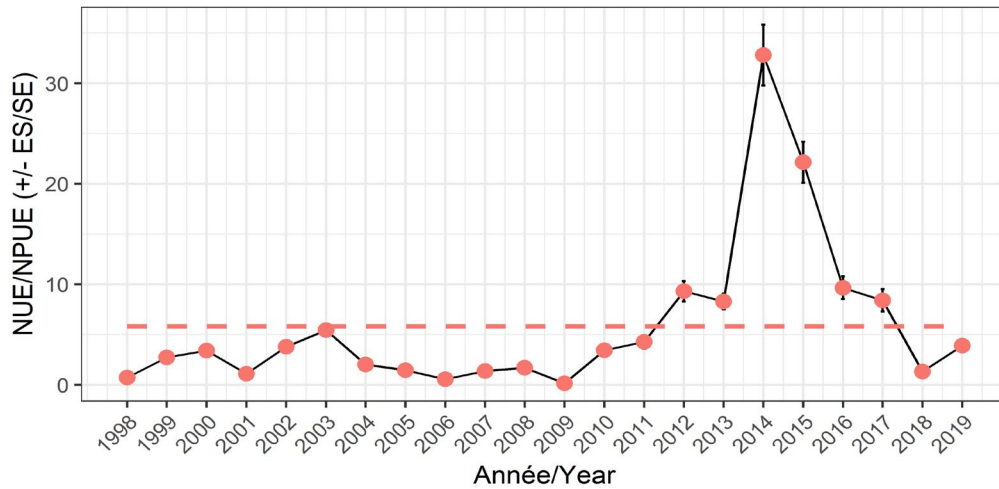


Figure 31. Annual catch rates (NPUE) (\pm standard error) of recruits from the post-season survey in Area 14. The dashed line shows the data series average.

The combined index of commercial CPUE and NPUE of adults ≥ 95 mm from the post-season survey decreased by 11% from 2018 to 2019. This is the fifth consecutive decline, suggesting that the biomass available to the fishery will be lower in 2020 than in 2019 (Figure 32).

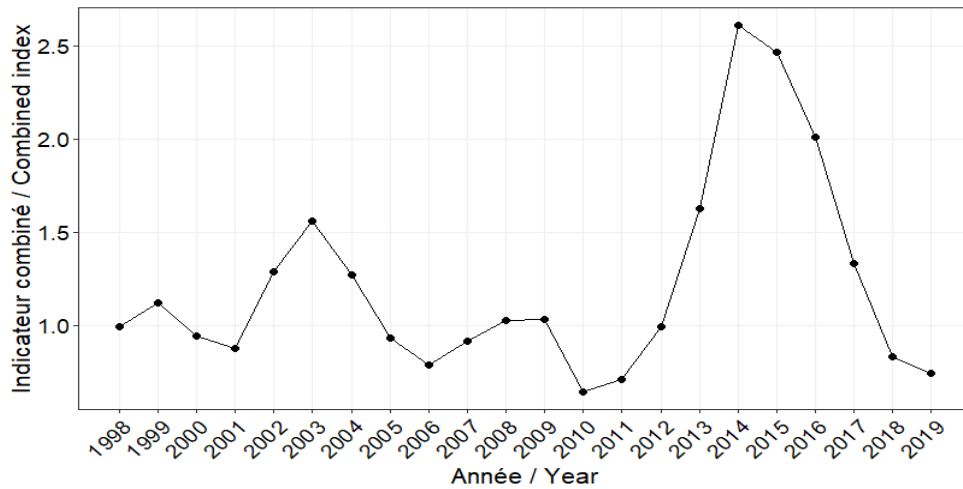


Figure 32. Combined index derived from the standardized annual CPUE and annual NPUE for Area 14.

Outlook and conclusions

A decrease (11%) in the combined index with no indication of improved recruitment in the short term suggests that the TAC should be reduced in 2020.

Higher scenario: A 5% decrease applied to total landings in 2019.

Intermediate scenario: A 10% decrease applied to total landings in 2019.

Lower scenario: A greater than 10% decrease to total landings in 2019.

Area 13

Description of the fishery

The area was placed under a moratorium from 2003 to 2007 as a result of a marked decline in the biomass of legal-size crab. However, an index fishery with an annual TAC of 50 t was approved in 2003, 2004 and 2006. When the area was reopened in 2008, it was decided that precautionary, meaning low, TACs would be in effect at first and would gradually increase only if the stock indices remained positive despite harvesting. In 2019, the TAC decreased to 304.5 t and was reached (Figure 33).

Ressource status in 2019

Commercial fishery. The standardized CPUE decreased sharply from 2017 to 2019 and was below the historical average, at the lowest value observed since 2002 (Figure 34). The proportion of recruits (carapace conditions 1 and 2), decreased in 2019, while landings consisted primarily of intermediate-shell crab. From 2009 to 2014, the fishing effort was significantly higher in the southern part than the northern part, almost equally between both parts in 2015 and 2016, and finally higher in the northern part since 2017. The average size of legal-size crab caught at sea decreased from 2016 to 2019 with a value that is now below average for a second year (Figure 35). This average size is low compared with other areas in the Gulf of St. Lawrence.

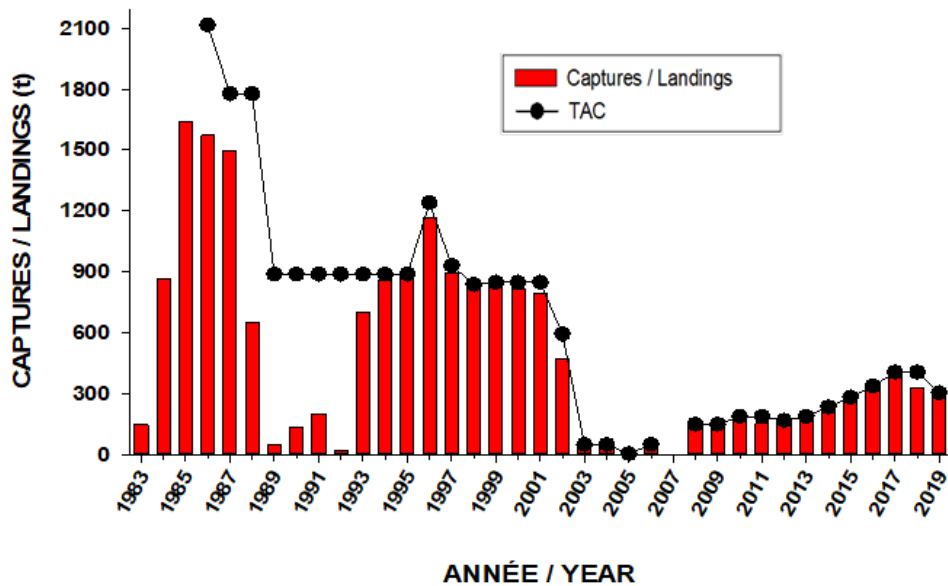


Figure 33. Annual landings and TACs in Area 13.

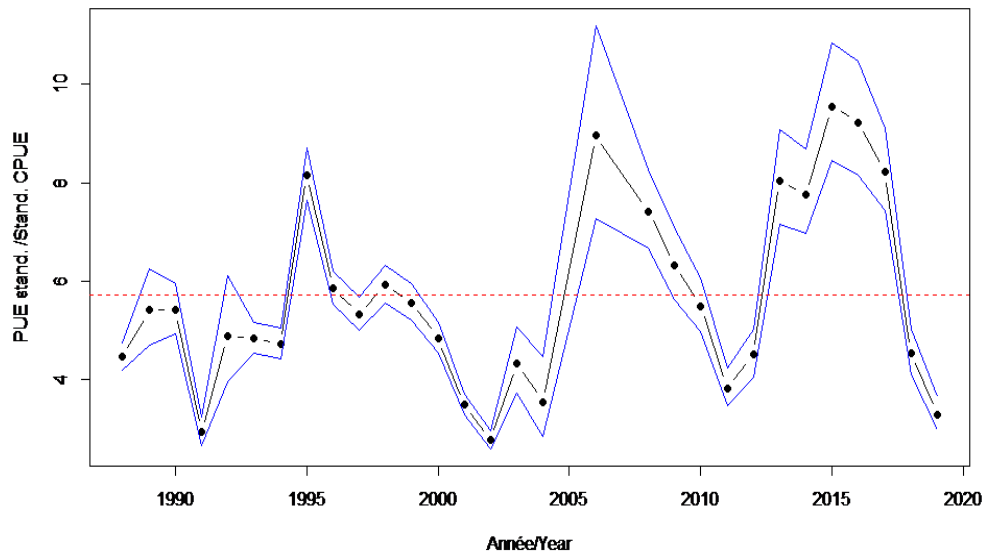


Figure 34. Standardized annual CPUE (\pm 95% confidence interval) in the commercial fishery in Area 13. The red dashed line shows the data series average (excluding 2019).

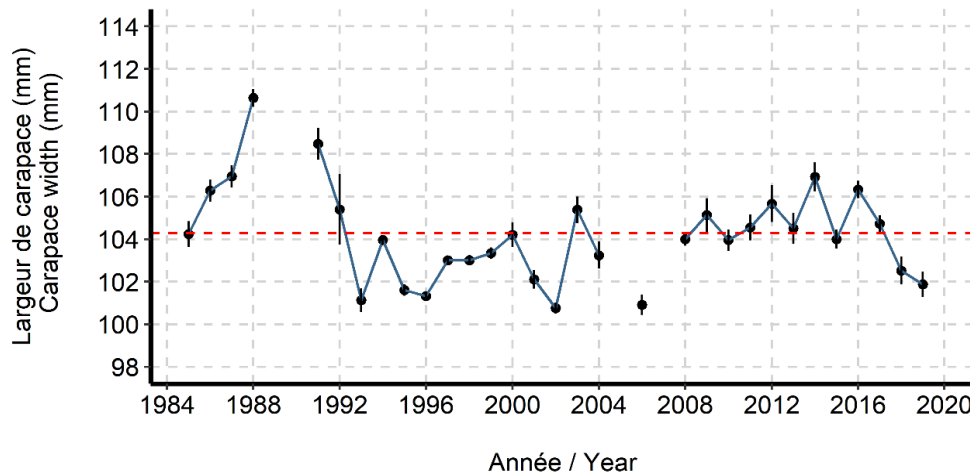


Figure 35. Average carapace width (\pm 95% confidence interval) of legal-size male crabs in the commercial fishery in Area 13. The dashed line shows the data series average (excluding 2019).

Fishery-independent surveys. The trap-based research surveys show relative stability of the NPUE of adults ≥ 95 mm in the northern part between 2018 and 2019 to a value at the historical average level (Figure 36), and a decrease in the southern part since 2017 to a value that remains well below the historical average and among the lowest values observed since 2003 (Figure 37). In 2019, the NPUE of adolescents ≥ 78 mm (Figure 38) and recruits (Figure 39) increased to their respective average level in the northern part. Both indices decreased on the southern part and have been below their respective historical average since 2011 for adolescents ≥ 78 mm (Figure 40), and since 2008 for recruits (Figure 41),

A high abundance of 40–62 mm adolescent males in the 2018 trawl survey indicates possible recruitment to the fishery in the medium term. In 2018 the abundance of primiparous females reached the highest level observed in the survey since 1994. In contrast, the mean weight of the

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spermathecal load of primiparous females in 2018 (trawl survey) and 2019 (post-season survey) was among the lowest values seen since data collection began in 2003.

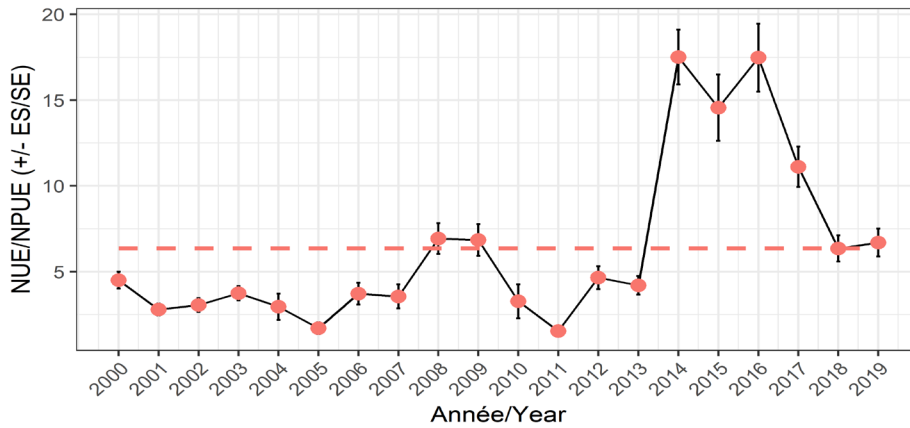


Figure 36. Annual catch rates (NPUE) (\pm standard error) of adult crab ≥ 95 mm from the post-season survey in northern Area 13. The dashed line shows the data series average.

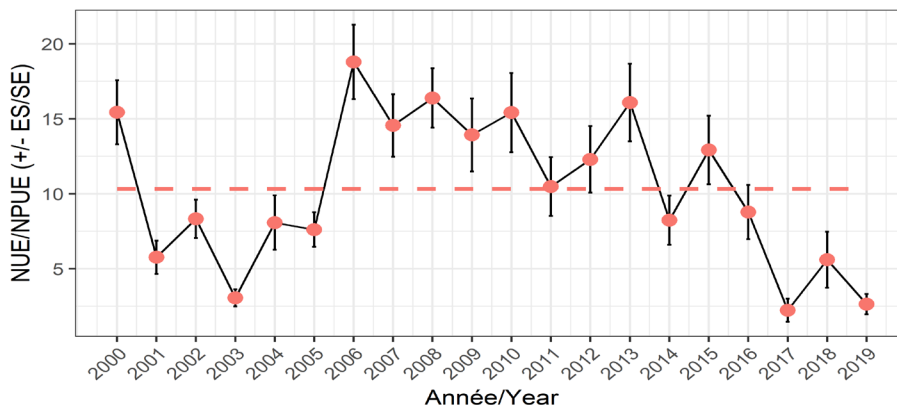


Figure 37. Annual catch rates (NPUE) (\pm standard error) of adult crab ≥ 95 mm from the post-season survey in southern Area 13. The dashed line shows the data series average.

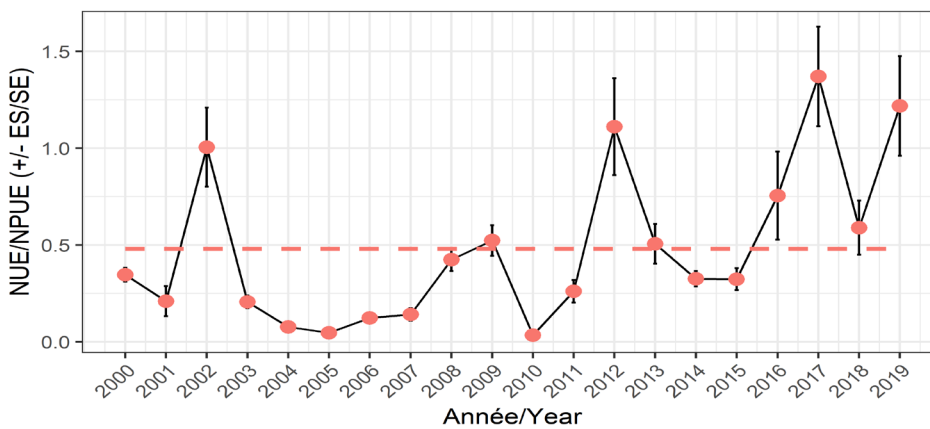


Figure 38. Annual catch rates (NPUE) (\pm standard error) of adolescents ≥ 78 mm from the post-season survey in northern Area 13. The dashed line shows the data series average.

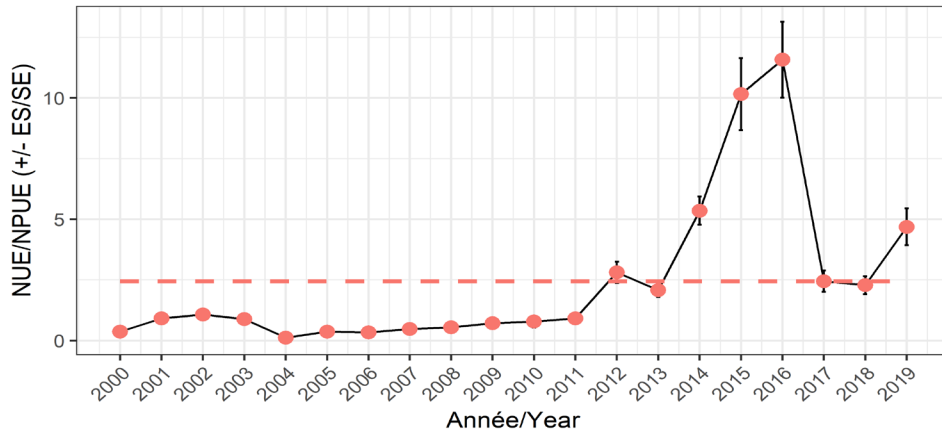


Figure 39. Annual catch rates (NPUE) (\pm standard error) of recruits from the post-season survey in northern Area 13. The dashed line shows the data series average.

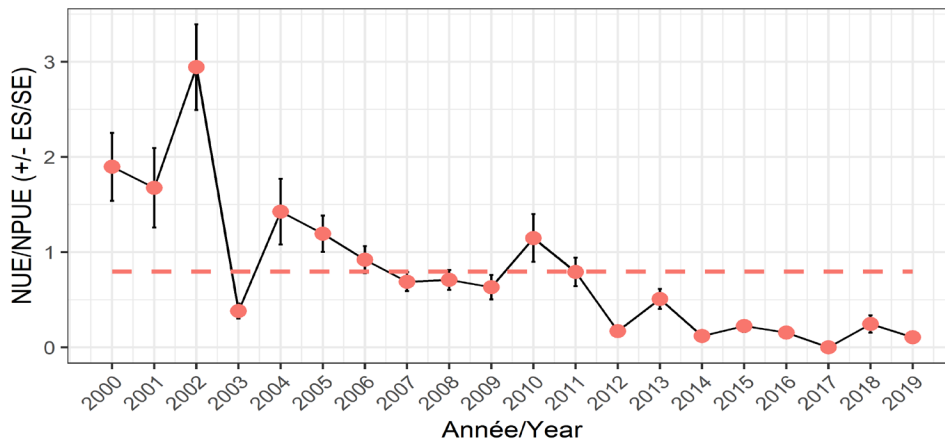


Figure 40. Annual catch rates (NPUE) (\pm standard error) of adolescents ≥ 78 mm from the post-season survey in southern Area 13. The dashed line shows the data series average.

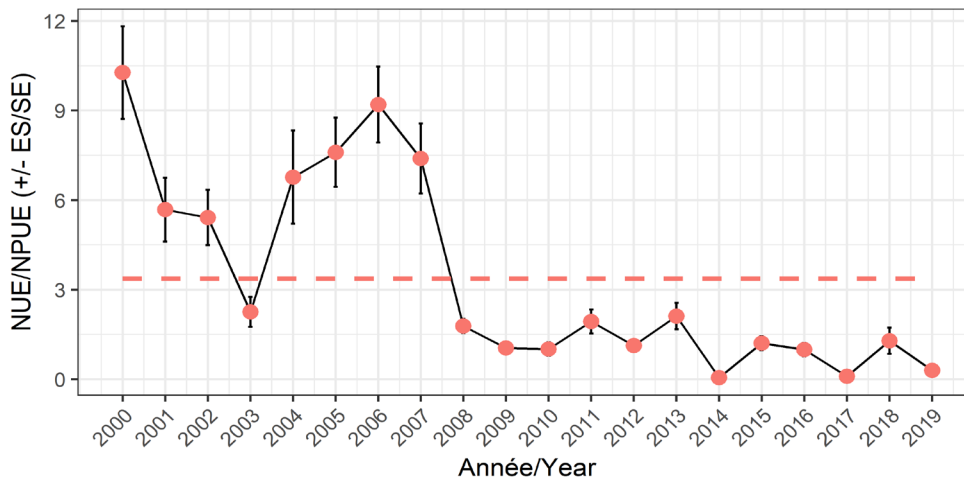


Figure 41. Annual catch rates (NPUE) (\pm standard error) of recruits from the post-season survey in southern Area 13. The dashed line shows the data series average.

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The combined index of commercial CPUE and NPUE of adults ≥ 95 mm from the post-season surveys decreased by 15% from 2018 to 2019. This result suggests a decrease in the available biomass in 2020 compared with 2019 (Figure 42).

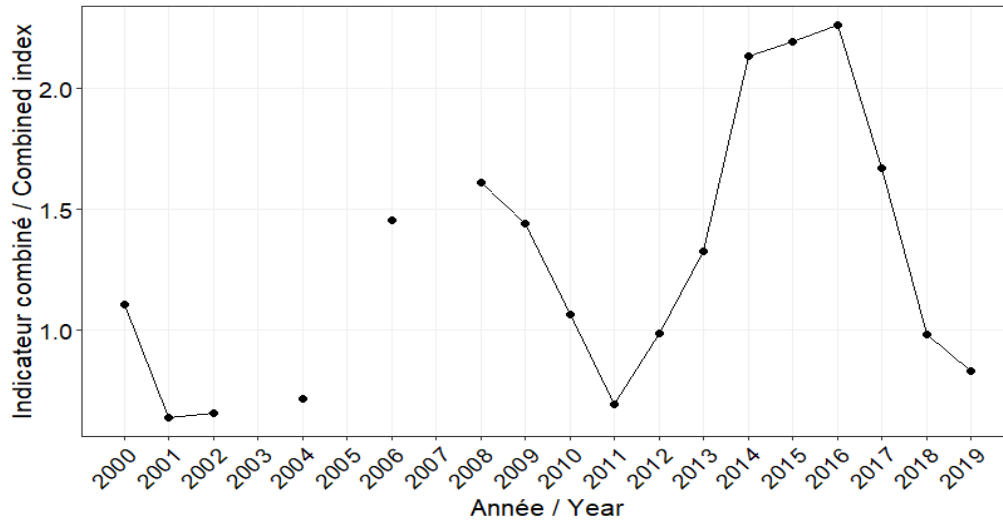


Figure 42. Combined index derived from the standardized annual CPUE and annual NPUE for Area 13.

Outlook and conclusions

The decline (15%) in the combined index in 2019, coupled with the decrease in the size of legal crabs in the commercial fishery, the low spermatheca fullness index of primiparous females and the expectation that recruitment will remain low in the short term, points to the need to reduce removals in 2020. Taking into consideration other, related indices that are negative, the decline in the combined index between 2018 and 2019, expressed as a percentage, was used as a reference for the high scenario.

Higher scenario: A 15% decrease applied to total landings in 2019.

Intermediate scenario: A 25% decrease applied to total landings in 2019.

Lower scenario: A greater than 25% decrease to total landings in 2019.

Area 16A

Description of the fishery

The Area 16A includes two parts (north and south) separated by the Anticosti Channel. The TAC peaked at 566 t in 2015, then it was subsequently decreased to reach 310 t in 2019 after a decrease of 24.9% between 2018 and 2019 and was reached (Figure 43).

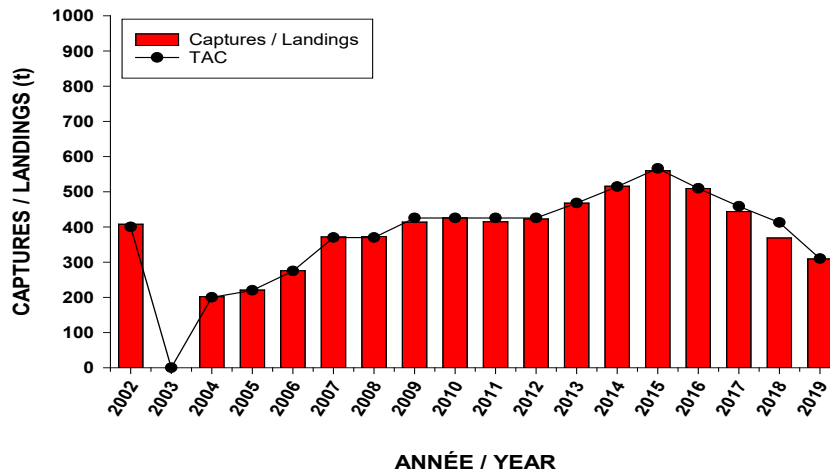


Figure 43. Annual landings and TACs in Area 16A.

Resource status in 2019

Commercial fishery. The standardized CPUE increased from 2011 to 2014 and then decreased since 2015 to reach in 2019, the lowest value since the beginning of this series (Figure 44). As in 2018, landings are dominated by recruits (carapace conditions 1 and 2) who outnumber intermediate-shell crab while the proportion of old-shelled crab (carapace conditions 4 and 5) has declined. The average size of legal-size crab caught at sea has been decreasing since 2016 and was at the historical average starting in 2017, with a very slight increase between 2018 and 2019 (Figure 45).

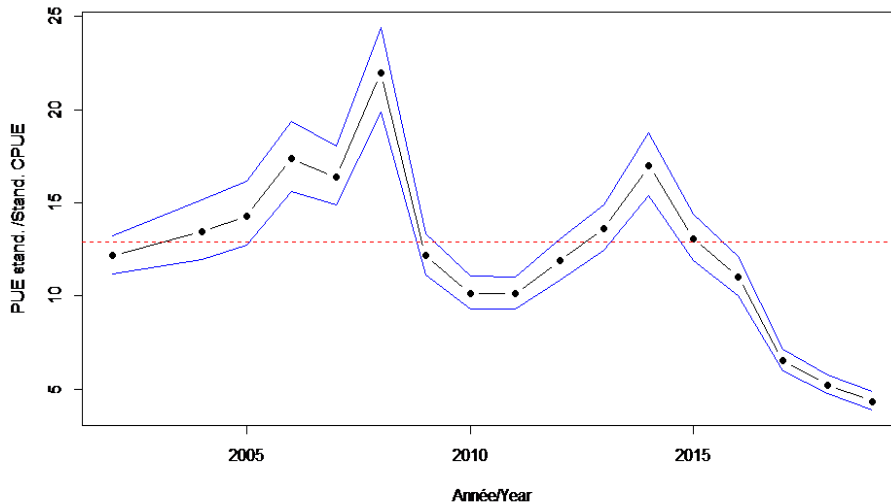


Figure 44. Standardized annual CPUE (± 95% confidence interval) in the commercial fishery in Area 16A. The red dashed line shows the data series average (excluding 2019).

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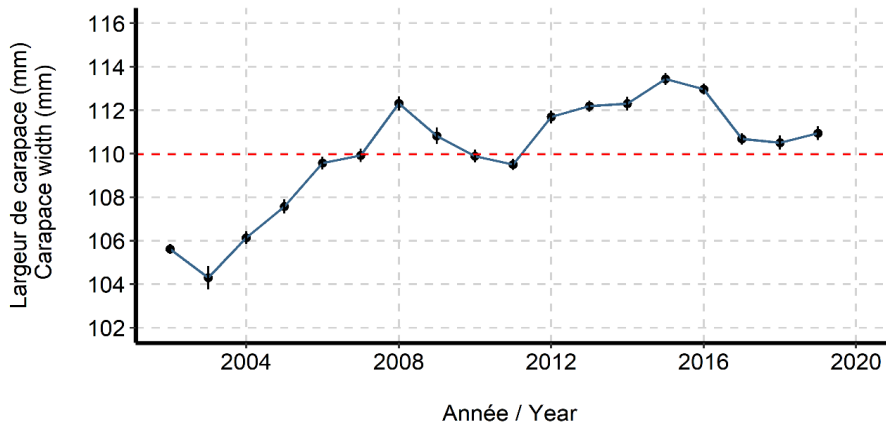


Figure 45. Average carapace width (\pm 95% confidence interval) of legal-size male crabs in the commercial fishery in Area 16A. The dashed line shows the data series average (excluding 2019).

Fishery-independent survey. The protocol for trap-based research survey was changed in 2014 to allow the use of a new larger, standard conical trap of 6.5 ft diameter. Both types of traps, former and new, were being used from 2014 to 2016. Since 2017, only the larger trap is used. Since catchability with this new trap needs to be further assessed in comparison with the former traps, only the data including this new trap are presented. The trap-based research survey shows that the NPUE of adults \geq 95 mm has decreased since the introduction of the new protocol with a yield that has decreased by more than half since 2014 (Figure 46). While the NPUE of adolescents \geq 78 mm has been gradually increasing since 2014 and has been above the average since 2016 (Figure 47), the NPUE of recruits, which was declining between 2014 and 2018, increased between 2018 and 2019 to approach the 2014-2018 average (Figure 48).

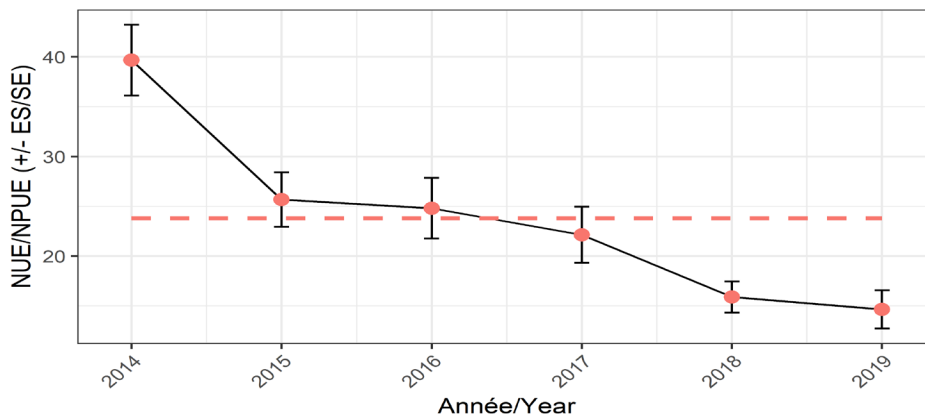


Figure 46. Annual catch rates (NPUE) (\pm standard error) of adult crabs \geq 95 mm from the post-season survey in Area 16A. The dashed line shows the data series average.

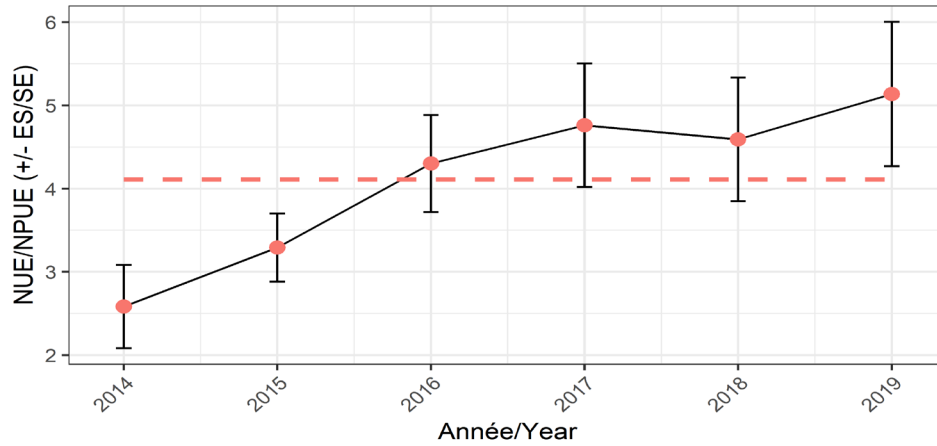


Figure 47. Annual catch rates (NPUE) (\pm standard error) of adolescents ≥ 78 mm from the post-season survey in Area 16A. The dashed line shows the data series average.

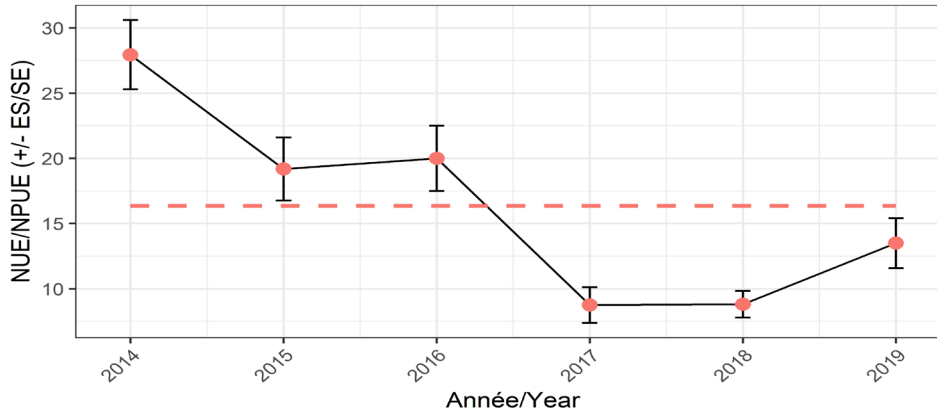


Figure 48. Annual catch rates (NPUE) (\pm standard error) of recruits from the post-season survey in Area 16A. The dashed line shows the data series average.

The combined index of commercial CPUE and NPUE of adults ≥ 95 mm from the post-season survey has been decreasing for a 5th consecutive year (-12% from 2018 to 2019). This decline suggests that the commercial biomass available to the fishery will be lower in 2020 than in 2019.

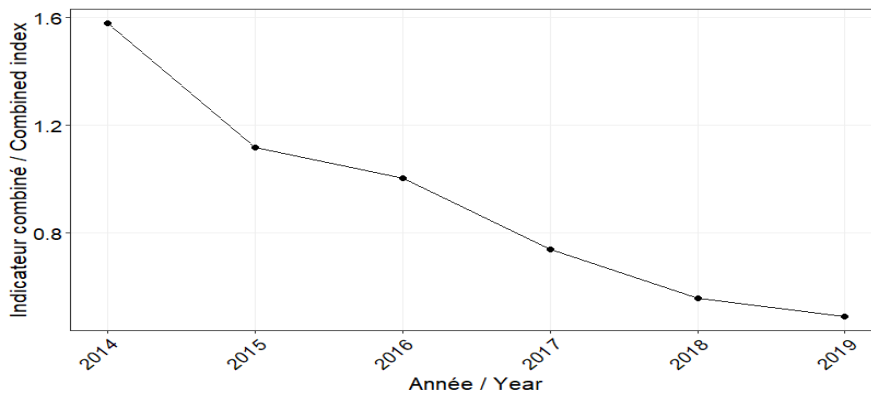


Figure 49. Combined index derived from the standardized annual CPUE and annual NPUE for Area 16A.

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Outlook and conclusions

The decrease in the combined index since 2014 suggests a decrease in landings in 2020. However, recruitment is expected to remain stable in the short term.

Higher scenario: A 5% decrease applied to total landings in 2019.

Intermediate scenario: A 12% decrease applied to total landings in 2019.

Lower scenario: A greater than 12% decrease applied to total landings in 2019.

Area 12C

Description of the fishery

Area 12C includes two parts (north and south) separated by the deep Anticosti Channel. The TAC peaked at 352 t in 2013 and 2014, and decreased in subsequent years. The TAC was further reduced by 25.1% in 2019 to 192 t and was not reached (landings of 149.5 t) (Figure 50).

Resource status in 2019

Commercial fishery. In 2019, the standardized CPUE decreased, reaching the lowest value observed since the beginning of the time series, well below the historical average (Figure 51). The fishing effort was concentrated mainly in the northern part of the area. The proportion of recruits (carapace conditions 1 and 2) that had increased between 2017 and 2018 decreased again from 2018 to 2019. The proportion of intermediate-shell crab increased slightly between 2018 and 2019 in landings, while the proportion of old-shelled crab (carapace conditions 4 and 5) remains stable between 2018 and 2019. The average size of legal-size crab caught at sea decreased between 2018 and 2019 and is at the historical average with relative stability observed since 2010 (Figure 52).

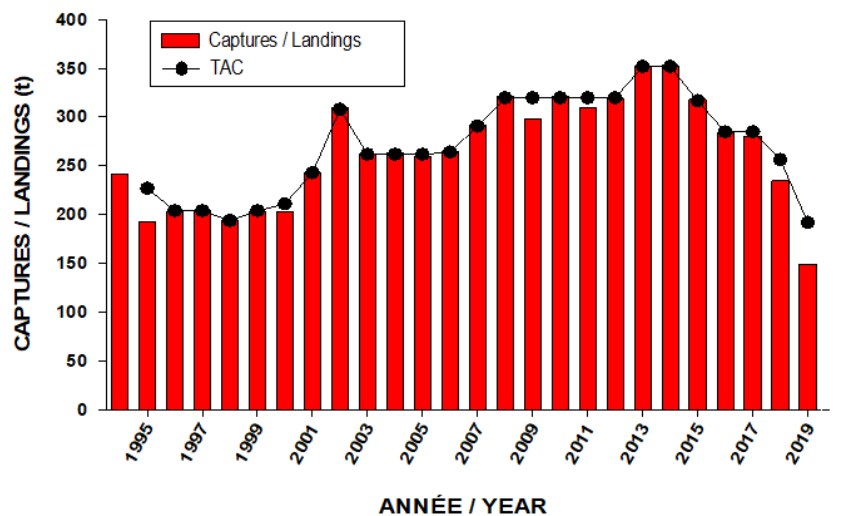


Figure 50. Annual landings and TACs in Area 12C.

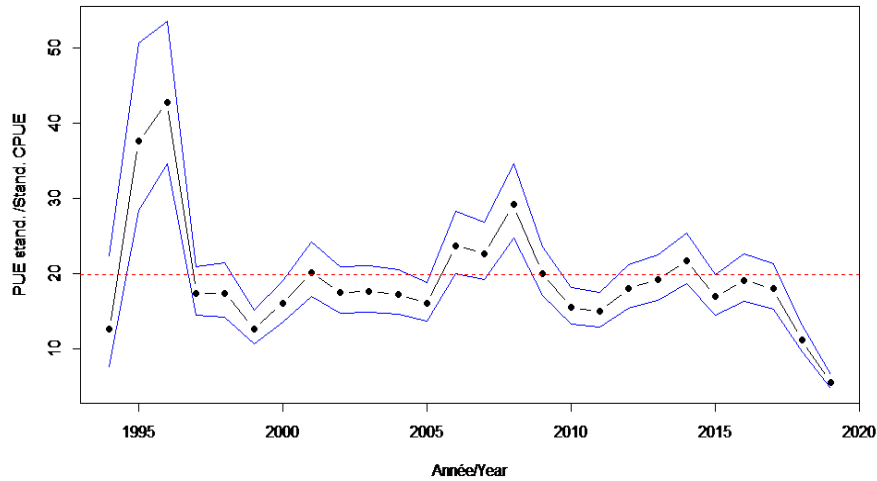


Figure 51. Standardized annual CPUE (\pm 95% confidence interval) in the commercial fishery in Area 12C. The red dashed line shows the data series average (excluding 2019).

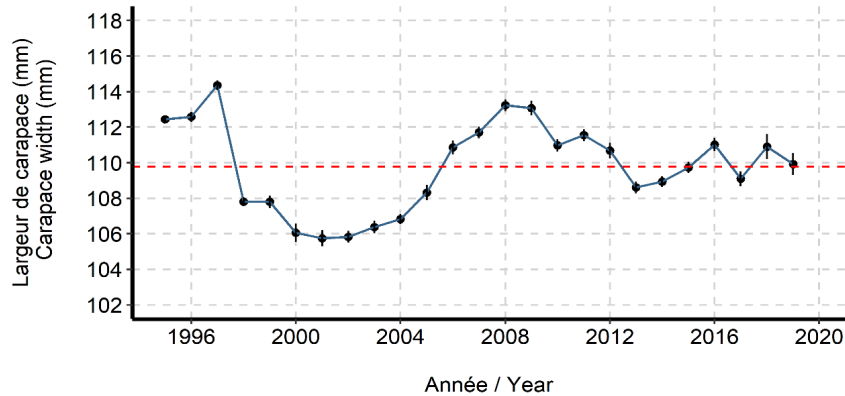


Figure 52. Average carapace width (\pm 95% confidence interval) of legal-size male crabs in the commercial fishery in Area 12C. The dashed line shows the data series average (excluding 2019).

Fishery-independent survey. The protocol for trap-based research survey was changed in 2014 to allow the use of a new larger, standard conical trap of 6.5 ft diameter. Both types of traps, former and new, were being used from 2014 to 2016. Since 2017, only the larger trap is used. Since catchability with this new trap needs to be further assessed in comparison with the former traps, only the data including this new trap are presented. The trap-based research survey shows that the NPUE of adults \geq 95 mm significantly decreased since 2014 (Figure 53). The NPUE of adolescents \geq 78 mm (Figure 54) remained low and rather stable below the average under the new protocol, which does not suggest an increase in recruitment to the fishery in 2020. The NPUE of recruits increased slightly from 2018 to 2019, and is below the average under the new protocol (Figure 55).

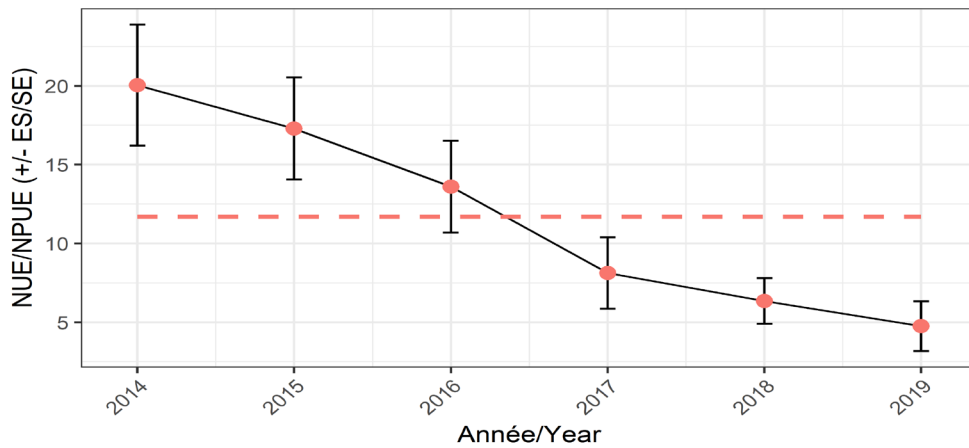


Figure 53. Annual catch rates (NPUE) (\pm standard error) of adult crabs ≥ 95 mm from the post-season survey in Area 12C. The dashed line shows the data series average.

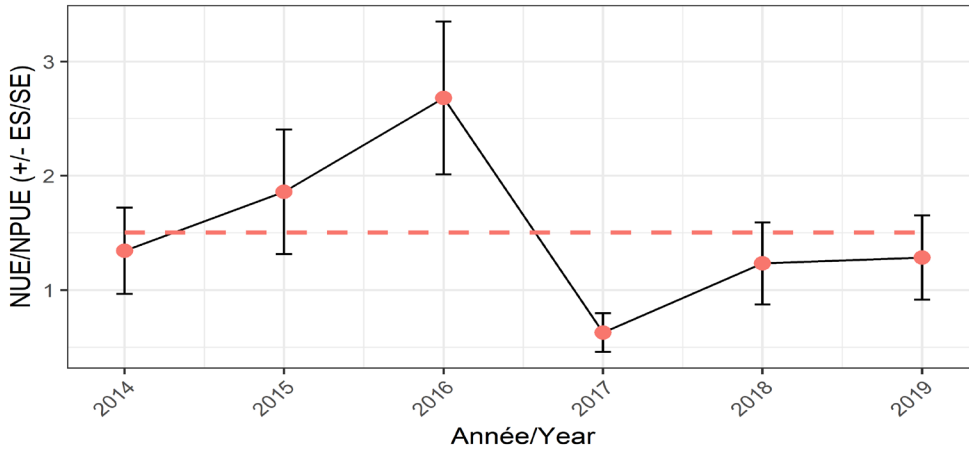


Figure 54. Annual catch rates (NPUE) (\pm standard error) of adolescents ≥ 78 mm from the post-season survey in Area 12C. The dashed line shows the data series average.

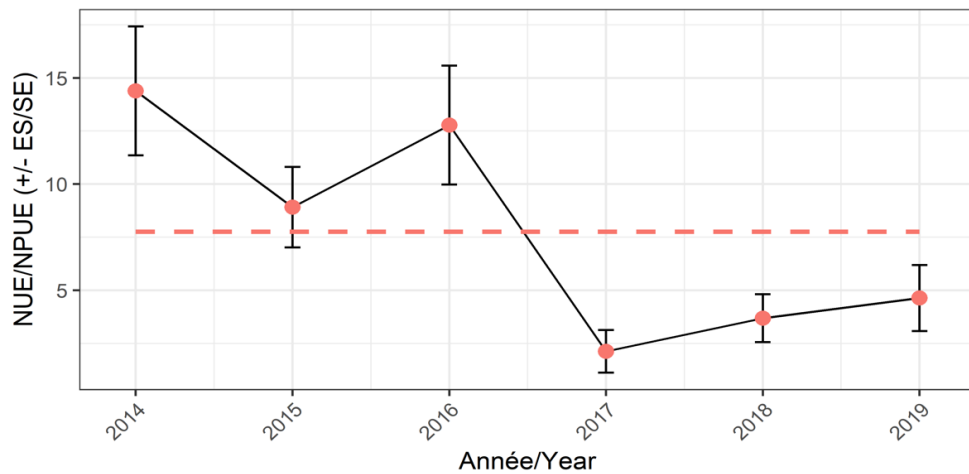


Figure 55. Annual catch rates (NPUE) (\pm standard error) of recruits from the post-season survey in Area 12C. The dashed line shows the data series average.

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The combined index of commercial CPUE and NPUE of adult ≥ 95 mm from the post-season survey has been decreasing for a fifth consecutive year with a 39% decrease from 2018 to 2019. This decrease suggests that the biomass available to the fishery will be lower in 2020 than 2019 (Figure 56).

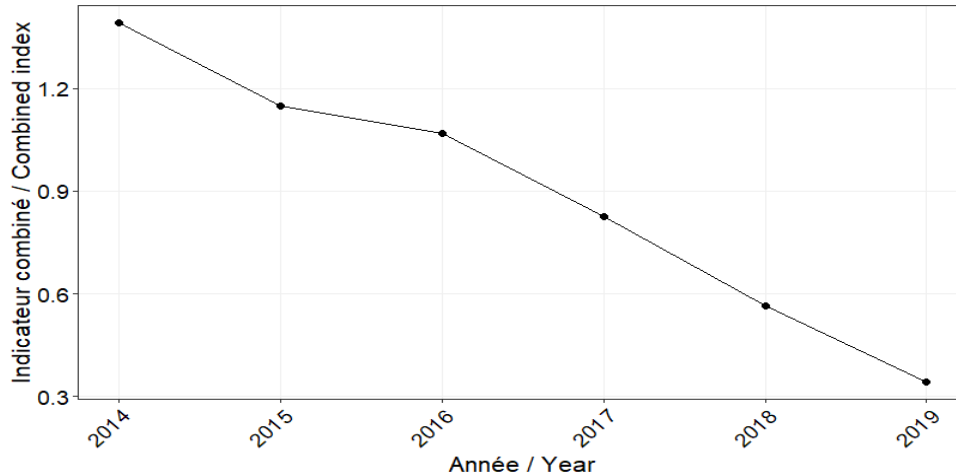


Figure 56. Combined index derived from the standardized annual CPUE and annual NPUE for Area 12C.

Outlook and conclusions

The 39% drop in the combined index, during a period of stable and low recruitment, suggests a sharp decrease in the removals in 2020.

Higher scenario: A 30% decrease applied to total landings in 2019.

Intermediate scenario: A 40% decrease applied to total landings in 2019.

Lower scenario: A more than 40% decrease applied to total landings in 2019.

Area 12B

Description of the fishery

From 2010 to 2014, the TAC was gradually increased from 246 tonnes to 468 tonnes, a record high level. Despite a considerable decrease in the TAC, it has not been met since 2015. The TAC set for 2018 was intended to enable monitoring of snow crab yields for this stock; the stock is considered to be in poor condition but its exact status is unknown because the trap survey was not conducted in 2017 or 2018. The TAC was kept at the same level (125 tonnes) from 2018 to 2019. In 2019, the TAC was not met, with landings totalling only 30 tonnes (Figure 57). The area has been deserted by some fishers for various reasons and fishing effort has been low, which could partly explain why the TAC was not reached.

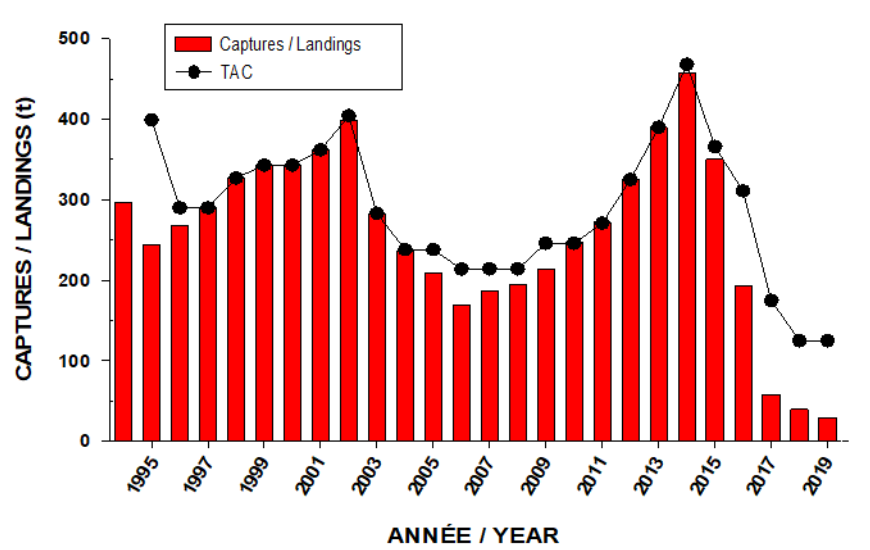


Figure 57. Annual landings and TACs in Area 12B.

Resource status in 2019

Commercial fishery. The standardized CPUE decreased sharply between 2013 and 2017, and has remained stable since then, with the last three years representing the lowest values in the 1995-2018 series (Figure 58). Landings consisted primarily of intermediate-shell crabs. The proportion of recruits (carapace conditions 1 and 2) increased slightly while old-shelled crab (carapace conditions 4 and 5) decreased between 2018 and 2019. After a decrease between 2013 and 2018, the average size of crabs caught in the commercial fishery increased very slightly between 2018 and 2019, but remains relatively stable over the 2017-2019 period, and below the historical average (Figure 59).

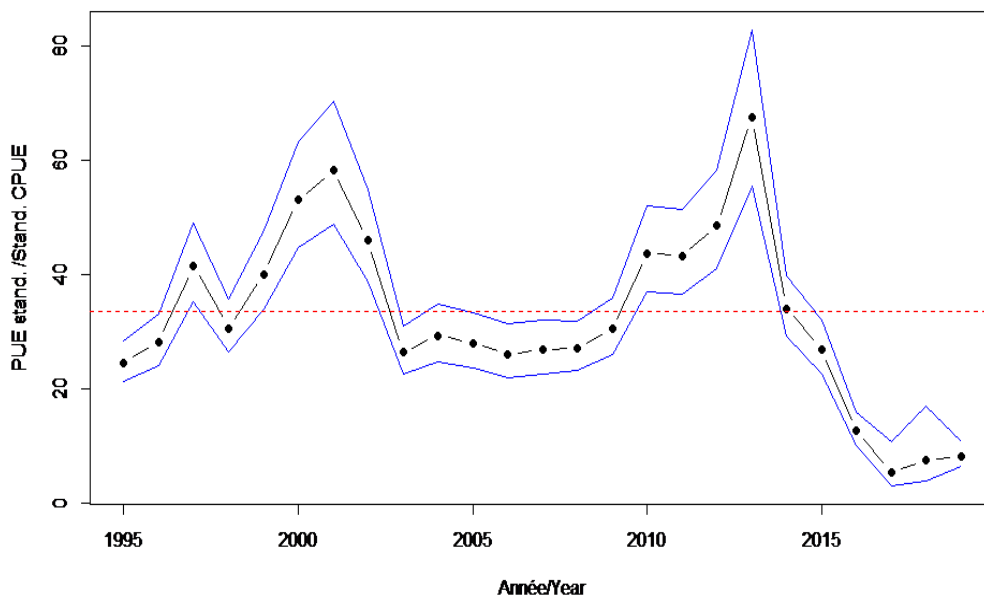


Figure 58. Standardized annual CPUE (± 95% confidence interval) in the commercial fishery in Area 12B. The red dashed line shows the data series average (excluding 2019).

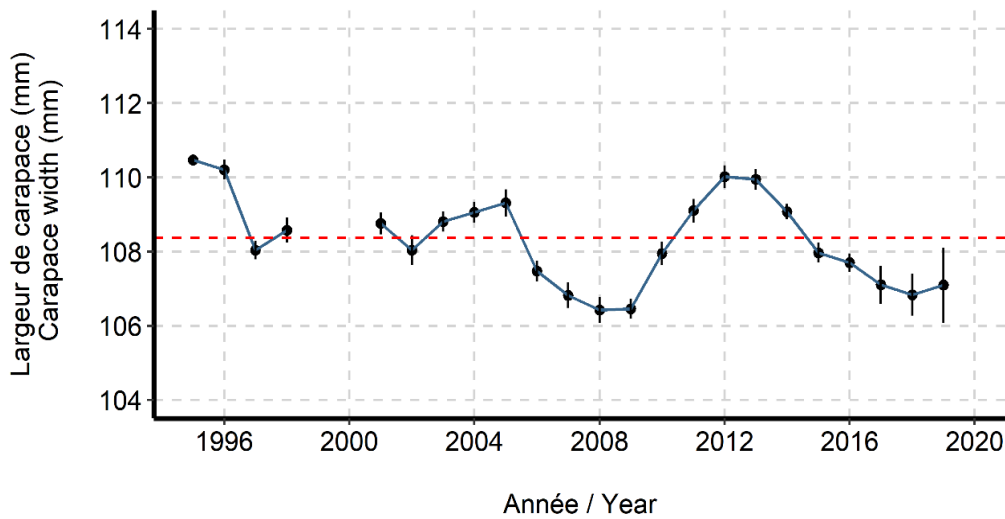


Figure 59. Average carapace width (\pm 95% confidence interval) of legal-size male crabs in the commercial fishery in Area 12B. The dashed line shows the data series average (excluding 2019).

Fishery-independent survey. The trap-based research survey conducted since 2001 shows that the NPUE of adults ≥ 95 mm (Figure 60), adolescents ≥ 78 mm (Figure 61), and recruits (Figure 62) has decreased sharply since 2013 and are closed to 0 in 2019. These results suggested a low biomass available to the fishery in the short and medium term. The survey was not conducted in 2017 and 2018.

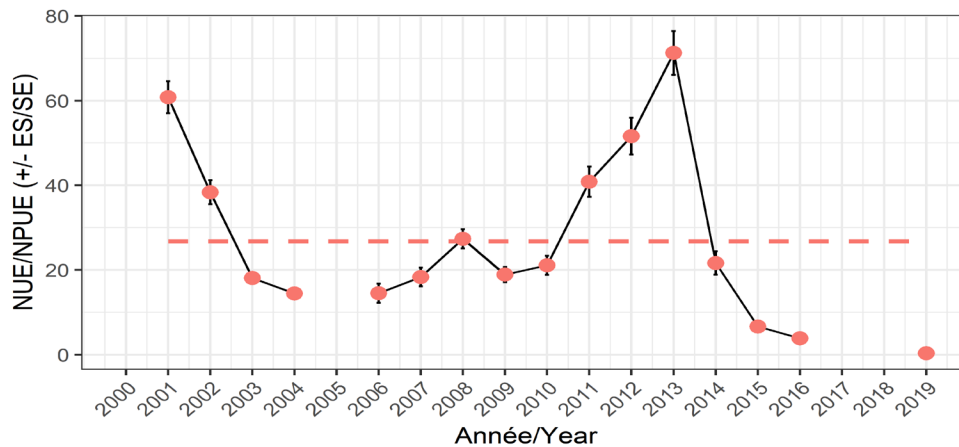


Figure 60. Annual catch rates (NPUE) (\pm standard error) of adult crabs ≥ 95 mm from the post-season survey in Area 12B. The dashed line shows the data series average.

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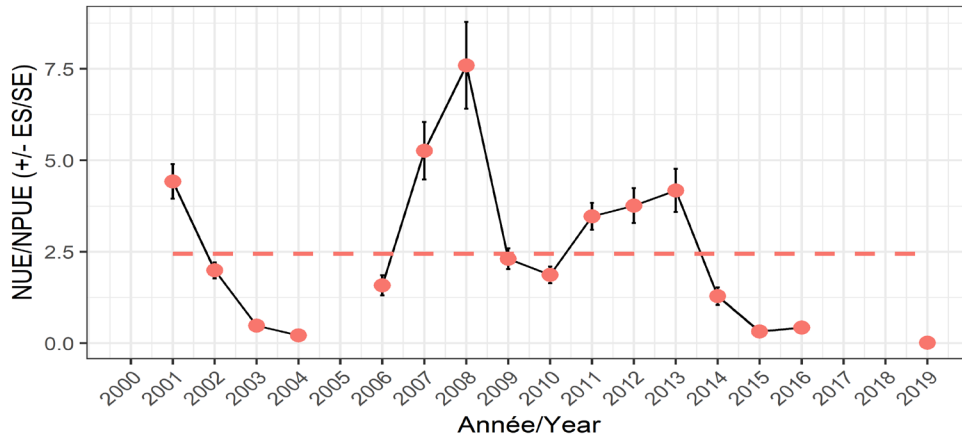


Figure 61. Annual catch rates (NPUE) (\pm standard error) of adolescents ≥ 78 mm from the post-season survey in Area 12B. The dashed line shows the data series average.

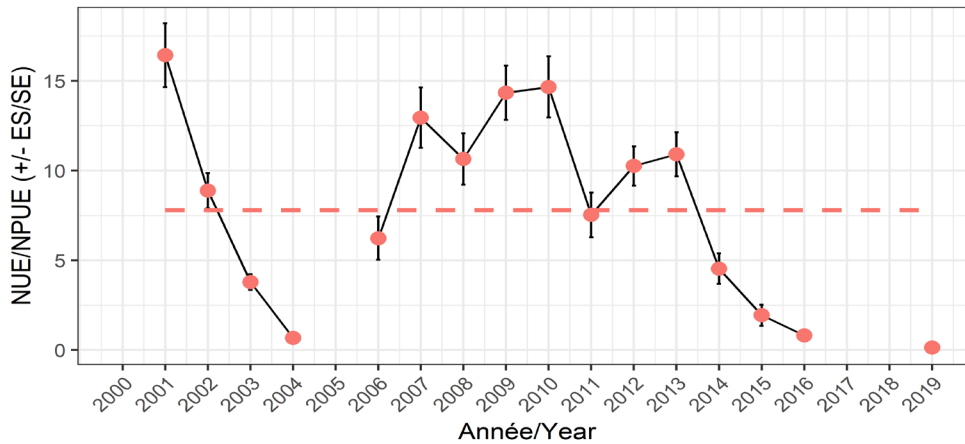


Figure 62. Annual catch rates (NPUE) (\pm standard error) of recruits from the post-season survey in Area 12B. The dashed line shows the data series average.

The combined index could be calculated for 2019, but the lack of surveys in 2017 and 2018 prevents the calculation of the relative decline from the previous year (Figure 63). However, the value calculated for 2019 is the lowest value observed over the 2001-2019 time series, with a cumulative decrease of 51% since the last survey in 2016.

Quebec Region

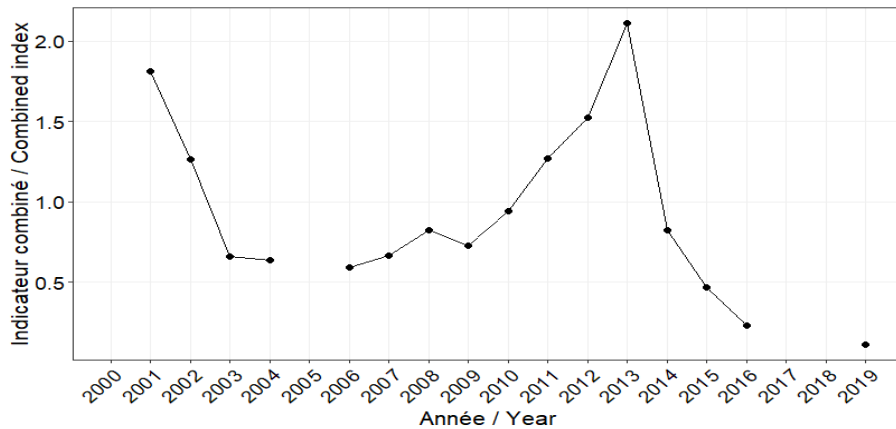


Figure 63. Combined index derived from the standardized annual CPUE and annual NPUE for Area 12B

Outlook and conclusions

The non-attainment of the TAC, low catch rates, small size and low recruitment of snow crab suggest that stock status did not improve in 2019. The short-term outlook is not favourable.

According to all indicators available in 2019, the biomass is very low and may not be able to support a commercial fishery.

Area 12A

Description of the fishery

The TAC remained unchanged between 2018 and 2019, at 105.5 t (Figure 64) and was reached (landings of 80.5 t).

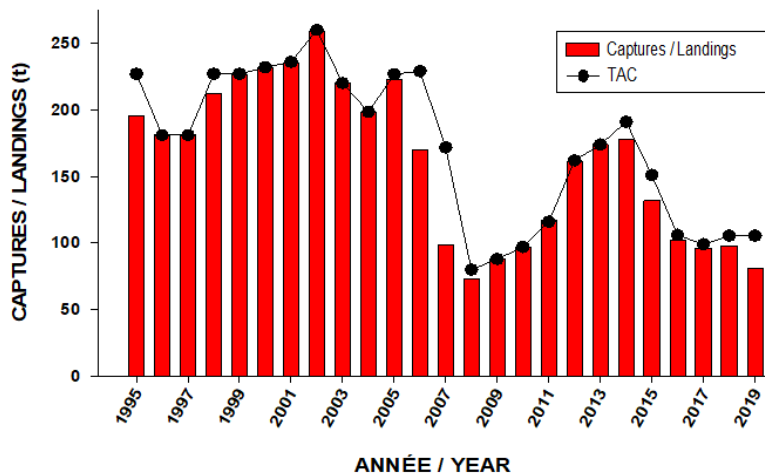


Figure 64. Annual landings and TACs in Area 12A.

Resource status in 2019

Commercial fishery. The standardized CPUE went from the highest value of the series in 2013 to stable values between 2017 and 2019, but among the lowest observed in 1994 (Figure 65). A decrease in the proportion of recruits (carapace conditions 1 and 2) in the landings was observed, which remains clearly dominated by intermediate-shell crabs. The average size of

crabs caught in the commercial fishery remains stable between 2018 and 2019, and is now slightly above the historical average after a decrease from 2012 to 2016 (Figure 66).

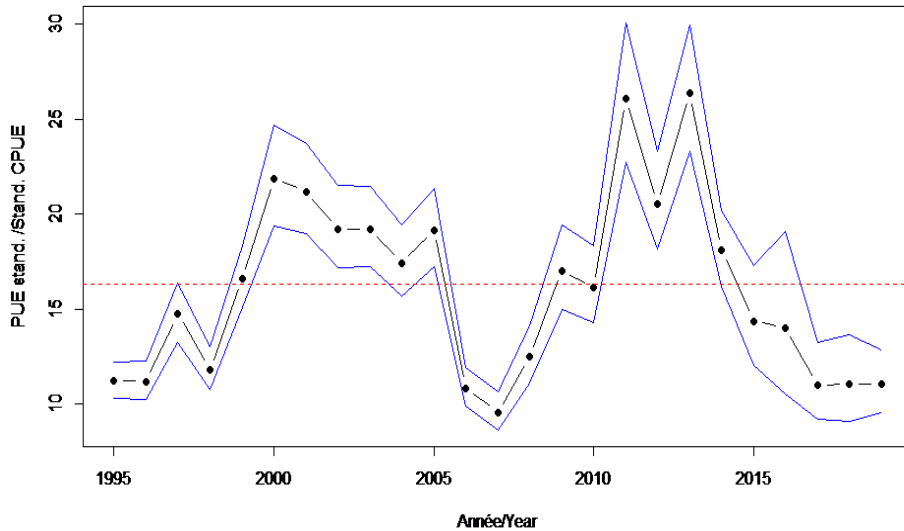


Figure 65. Standardized annual CPUE (\pm 95% confidence interval) in the commercial fishery in Area 12A. The red dashed line shows the data series average (excluding 2019).

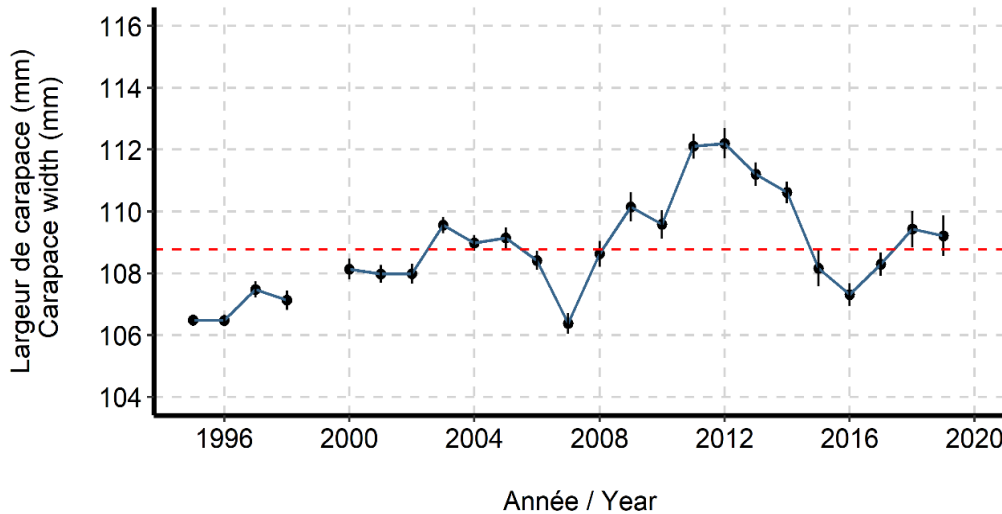


Figure 66. Average carapace width (\pm 95% confidence interval) of legal-size male crabs in the commercial fishery in Area 12A. The dashed line shows the data series average (excluding 2019).

Fishery-independent survey. The trap-based research survey, which started in 2000, was not conducted in 2013, 2016 and 2019. The last survey indicated that the NPUE of adults \geq 95 mm decreased between 2011 and 2018 from the highest value over the period to the lowest value of the series (Figure 67). The NPUE of adolescents \geq 78 mm (Figure 68) and recruits (Figure 69) decreased between 2017 and 2018, reaching the respective lowest values for these two time series.

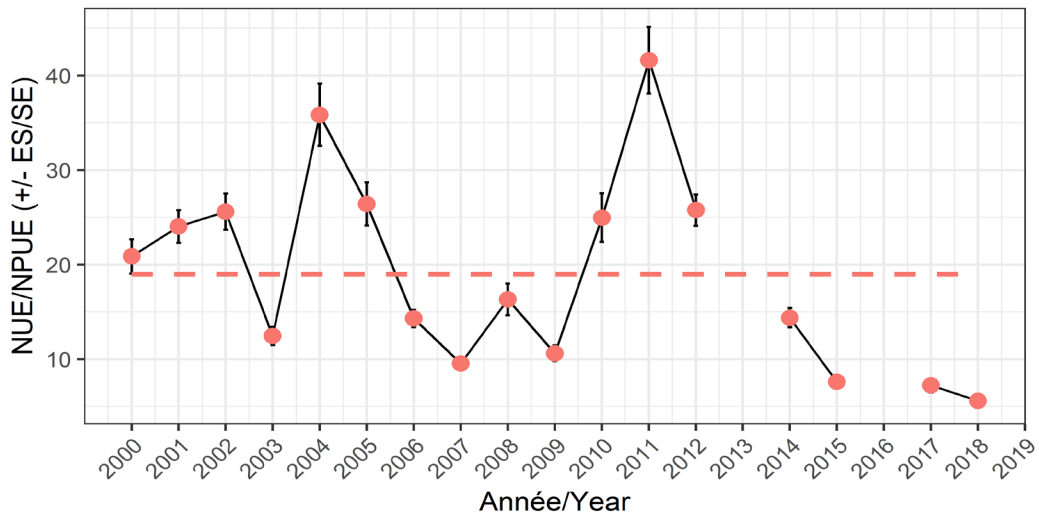


Figure 67. Annual catch rates (NPUE) (\pm standard error) of adult crabs ≥ 95 mm from the post-season survey in Area 12A. The dashed line shows the data series average.

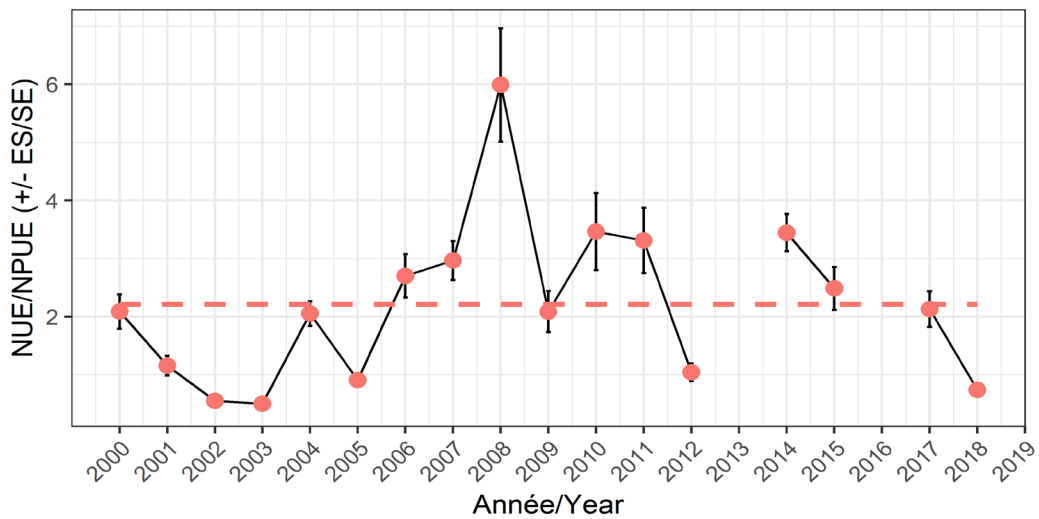


Figure 68. Annual catch rates (NPUE) (\pm standard error) of adolescents ≥ 78 mm from the post-season survey in Area 12A. The dashed line shows the data series average.

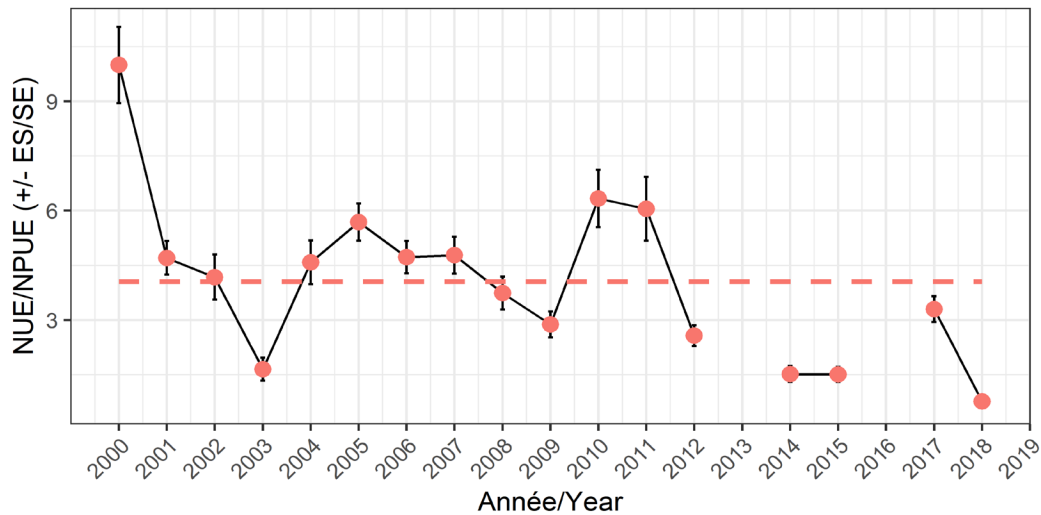


Figure 69. Annual catch rates (NPUE) (\pm standard error) of recruits from the post-season survey in Area 12A. The dashed line shows the data series average.

The combined index of commercial CPUE and NPUE of adults ≥ 95 mm from the post-season survey had decreased by 7% from 2017 to 2018. The absence of post-season survey prevents the calculation of an indicator for 2019.

A downward trend in preferred snow crab thermal habitat in Area 12A (Figure 3A and Figure 4A) was observed in recent years, which could have a negative impact on future stock productivity.

Outlook and conclusions

Commercial fishery yields that are among the lowest in the historical series, combined with the uncertainty resulting from the absence of the post-season survey, point to the need to reduce removals in 2020.

Higher scenario: Same total landings in 2020 as in 2019.

Intermediate scenario: A 10% decrease applied to total landings in 2019.

Lower scenario: A greater than 30% decrease applied to total landings in 2019.

Sources of Uncertainty

The quality of science advice depends mainly on the accuracy of the parameters obtained through sampling and the subsequent analyses. Information obtained from logbooks and purchase slips during the fishing season affects the accuracy of the parameters derived from these documents. For instance, abundance indices and fishing effort calculations obtained from logbooks may include errors that will affect the scientific advice provided. The selectivity and catchability of traps can vary depending on the type of trap used, its volume and mesh size, the amount and quality of bait used and soak time, which can vary with the fishing strategies employed and environmental conditions. The catchability of adolescent crab and recruits could also be affected by the abundance of intermediate-shell adult crab (condition 3) on the seafloor. The selective sorting of catches can also affect the quality of the data obtained. Finally, the availability/abundance of natural prey, such as capelin, can also influence the attractiveness of baited traps and therefore the catchability with underestimated biomass indices (CPUE and NPUE).

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The abundance and condition indices and the crab size distribution obtained from the trawl and trap surveys are affected by the type of gear used and by uncertainties related to catchability variations in the different crab groups targeted. Some types of fishing gear are better suited to given seafloor areas than other types, and this factor influences the spatial coverage ultimately sampled. The biological characteristics specific to snow crab can also create sources of uncertainty that impinge on the scientific advice. For instance, the terminal moulting phase, which occurs at various sizes, affects crab condition and catchability. Natural mortality can also vary with the life cycle stage and condition of the crab.

OTHER CONSIDERATIONS

Snow crab distribution is linked to the thickness (and temperature) of the cold intermediate layer which serves as its habitat during the benthic phase. In recent years, an increase in the temperature of the deep water layer and the surface layer has been observed in the Gulf of St. Lawrence. These warmer conditions, both above and beneath the cold intermediate layer, may lead to a reduction in the area of thermal habitat for snow crab and affect its distribution. A thermal habitat index (Tamdrari et al. 2012) was calculated for each fishing area based on the surface area where the bottom temperature is favourable to snow crab (-1°C to 3°C, see Ouellet and Sainte-Marie (2018) for larvae stages). The length of the early pelagic larval development stages and larval survival are related to surface water temperatures (mainly in spring and summer) just as egg incubation time and crab growth are related to water temperature on the seabed areas where they develop. It therefore seems that the distribution and productivity of snow crab stocks could be affected by the temperature in the different water layers. The effect of warming waters on crab stock productivity and distribution is a real issue. The impacts could be quite different depending on the region or area concerned and the number of years with significant warming.

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| Birmingham, Tom | DFO - Science | x | - |
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| Boucher, Jean-René | RPPNG-OPCN area 16 | x | - |
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| Turcotte, Christian | DFO - Science | x | - |
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| Vigneault, Guy | Fisher Area 16 | x | - |

SOURCES OF INFORMATION

This Science Advisory Report is from the February 11-12, 2020 meeting on the Assessment of the Estuary and Northern Gulf of St. Lawrence Snow Crab Stocks. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada \(DFO\) Science Advisory Schedule](#) as they become available.

- DFO. 2019. [Assessment of the Estuary and Northern Gulf of St. Lawrence \(Areas 13 to 17, 12A, 12B, 12C and 16A\) Snow Crab Stocks in 2018](#). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2019/047.
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THIS REPORT IS AVAILABLE FROM THE:

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ISSN 1919-5087

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Correct Citation for this Publication:

DFO. 2020. Assessment of the Estuary and Northern Gulf of St. Lawrence (Areas 13 to 17, 12A, 12B, 12C and 16A) Snow Crab Stocks in 2019. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2020/050.

Aussi disponible en français :

MPO. 2020. Évaluation des stocks de crabe des neiges de l'estuaire et du nord du golfe du Saint-Laurent (Zones 13 à 17, 12A, 12B, 12C et 16A) en 2019. Secr. can. de consult. sci. du MPO, Avis sci. 2020/050.