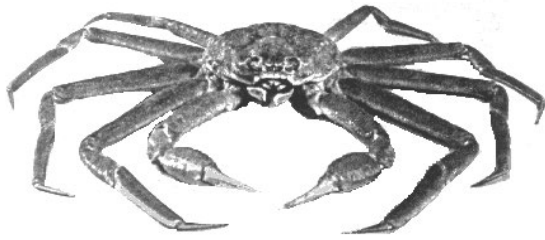




## ASSESSMENT OF THE ESTUARY AND NORTHERN GULF OF ST. LAWRENCE (AREAS 13-17, 12A, 12C AND 16A) SNOW CRAB STOCKS IN 2023



*Chionoecetes opilio* (Fabricius, 1788)

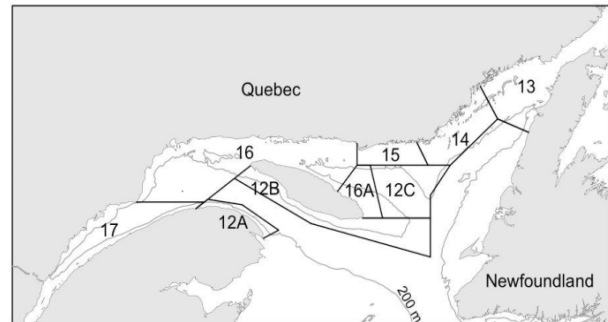


Figure 1. Snow crab management areas in the Estuary and the northern Gulf of St. Lawrence.

### 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 (Figure 1).

Annual landings have varied depending on the adjusted TACs based on recruitment waves and troughs that affect the quantity of crabs available to the fishery. In 2022, a moratorium was imposed on snow crab fishing in Area 12B. Landings for the eight fishing areas totalled 5,241 t in 2023.

The fishery targets only males with a carapace width  $\geq 95$  mm. White crabs (crabs that have 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 2024 quotas. A scientific peer review was conducted on February 14-16, 2024 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, First Nations and Newfoundland and Labrador province.

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## SUMMARY

### Area 17

- The total allowable catch (TAC) in 2023, which was increased to 1,394.0 t from 2022, was reached. Landings in 2023 totalled 1,396.0 t (+15.2%).
- The standardized commercial catch per unit effort (CPUE) rose significantly between 2022 and 2023 (+37.7%) and is close to the historical average [2000; 2022].
- The average size of legal-size crabs sampled at sea was down slightly between 2022 and 2023, and is below the historical average [2000; 2022].
- Half of landings in 2023 consisted of intermediate-shell crabs, and the other half, of recruits.
- The abundance index for commercial-size adults obtained from the post-season survey increased between 2022 and 2023 and is above the historical average. This increase can be observed throughout the fishing area, with the abundance of crabs left by the fishery also above the historical average [2000; 2022]. In contrast, the abundance of recruits to the fishery declined between 2022 and 2023. The abundance of legal- and sublegal-size subadults declined, reaching the lowest values of the time series.
- The results of the scientific trawl survey carried out in 2023 in the Estuary showed high densities of mature females (primiparous and multiparous), which should continue over the next two years. These increased densities can be observed on both sides of the Estuary. The survey results confirm the arrival of a new pulse of recruitment to the fishery, which, in the short term, seems to be stronger along the north shore than the south. High densities of subadult males (40–78 mm) suggest good years of recruitment to the fishery over the medium term, throughout the entire fishing area.
- The mean weight of the spermathecal load of primiparous females has been declining since 2019, with one of the lowest values in the time series being reached.
- The combined index, derived from the commercial CPUE and the number per unit effort (NPUE) obtained from the post-season survey, rose by 32.1% between 2022 and 2023, suggesting that the biomass available to the fishery in 2024 will be greater than in 2023.

### Outlook

- The combined index increased between 2022 and 2023 (+32.1%), which suggests that the biomass available to the fishery in 2024 should be greater than in 2023.
- The recruitment of mature females, which is expected to continue over the short term at similar levels, and the low spermathecal load in 2023 suggest that the increase in removals in 2024 should be limited to avoid obtaining a sex ratio that is overly biased towards females.

*Higher scenario:* A 30% increase relative to total landings in 2023.

*Intermediate scenario:* A 20% increase relative to total landings in 2023.

*Lower scenario:* A 10% increase relative to total landings in 2023.

### Area 16

- The total allowable catch (TAC) in 2023, which was increased to 2,585.0 t from 2022, was reached. Landings in 2023 totalled 2,552.0 t (+13.3%).

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- The standardized commercial catch per unit effort (CPUE) increased in 2023 (+14.2%) for the fourth consecutive year, and is above the historical average [1996; 2022]. Estimated effort for the last three years has been constant and low, and below the historical average [1996;2022].
- The average size of legal-size crabs sampled at sea is decreasing and is currently below the historical average [1996; 2022].
- Two-thirds of the landings in 2023 were recruits, a higher proportion than in previous years [2019; 2022].
- Following two consecutive increases, the abundance index for commercial-size adults obtained from the post-season survey was down slightly in 2023, remaining below the historical average [1996; 2022]. The increase in the index of recruit abundance does not compensate for the reduced abundance of crabs left by the fishery. Dramatic increases continue to occur in the abundance of sublegal-size adults. The average size of adult male crabs declined between 2022 and 2023, remaining below the historical average [1996; 2022].
- The abundance of mature females was high in the western part of the area in the 2023 post-season survey. These females consisted primarily of multiparous individuals.
- The monitoring of the snow crab population in Sainte-Marguerite Bay in 2023 showed that the recruitment of mature females is declining. The abundance of sublegal- size adult males is still high due to the prevalence of early terminal moulting. However, given the high abundance of adolescent males (78–95 mm), recruitment of legal-size males is expected to increase from 2024 onwards.
- The combined index, derived from the commercial CPUE and the number per unit effort (NPUE) obtained from the post-season survey, rose slightly (+5.1%) between 2022 and 2023, suggesting that the biomass available to the fishery in 2024 should be comparable to or higher than in 2023.

**Outlook**

- The combined index, rose slightly (+5.1%) between 2022 and 2023, suggesting that the biomass available to the fishery in 2024 should be comparable to or higher than in 2023.
- Crab abundance, which is cyclical in nature, appears to be on the upswing as the pulse of primiparous females has come to an end and male recruitment to the fishery is rising.

*Higher scenario:* A 25% increase relative to total landings in 2023.

*Intermediate scenario:* A 15% increase relative to total landings in 2023.

*Lower scenario:* A 5% increase relative to total landings in 2023.

**Area 15**

- The total allowable catch (TAC) in 2023, which was increased to 322.0 t from 2022, was reached. Landings in 2023 totalled 323.0 t (+36.3%).
- The standardized commercial catch per unit effort (CPUE)—after hitting the lowest values of the time series in the years between 2019 and 2022—increased dramatically between 2022 and 2023 (+92.9%), and is now above the historical average [2000; 2022].

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- The average size of legal-size crabs sampled at sea increased between 2022 and 2023, but remains below the historical average [2000; 2022].
- The majority of landings in 2023 consisted of recruits. This percentage has been increasing since 2019, while the percentage of intermediate-shell crabs declined from 47.2% in 2019 to 26.8% in 2023.
- According to the 2023 post-season survey, the abundance index for commercial-size adults is stable and above the historical average [2014; 2022], despite the decline in the abundance of crabs left by the fishery. This is because the decline is offset by increased recruitment. The abundance indices for legal- and sublegal-size subadults increased between 2022 and 2023 to levels above their respective historical averages [2014; 2022]. The average size of adult males has been increasing since 2020, but the 2023 value is still below the historical average [2000; 2022].
- Although the abundance of primiparous females has declined, the mean spermathecal load has increased to among the highest values of the time series [2008; 2023].
- All the survey indicators point to increasing levels of recruitment to the commercial fishery, and this trend is expected to continue in the short and medium term.
- The combined index, derived from the commercial CPUE and the number per unit effort (NPUE) obtained from the post-season survey, rose by 31.8% between 2022 and 2023, suggesting that the biomass available to the fishery in 2024 will be greater than in 2023.

**Outlook**

- The combined index, which was at the lowest values between 2019 and 2021, increased between 2022 and 2023 (+31.8%), which suggests that the biomass available to the fishery in 2024 should be higher than in 2023.
- Crab abundance, which is cyclical in nature, appears to be on the upswing as the pulse of primiparous females has come to an end and male recruitment to the fishery is increasing.

*Higher scenario:* A 40% increase relative to total landings in 2023.

*Intermediate scenario:* A 30% increase relative to total landings in 2023.

*Lower scenario:* A 20% increase relative to total landings in 2023.

**Area 14**

- The total allowable catch (TAC) increased between 2022 and 2023 to 388.0 t, and it was reached with landings of 377.0 t (+21.3%).
- Following an increase between 2020 and 2022, the standardized commercial catch per unit effort (CPUE) remained stable in 2023 (+0.9%) and is still below the historical average [2000;2022].
- The average size of legal-sized crabs sampled at sea increased slightly between 2022 and 2023, but is below the historical average [2000;2022].
- Landings in 2023 consisted primarily of intermediate-shell crabs and recruits, in proportions similar to the previous two years.
- According to the 2023 post-season survey, the abundance index for legal-size adults, which consisted mainly of crabs left by the fishery, was down slightly. Recruit abundance

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decreased for the third consecutive year, while the abundance of subadults has remained very low for the last three years. Since 2016, the average size of adult male crabs has been in decline, reaching a historical low in the last two years.

- The combined index, derived from the commercial CPUE and the number per unit effort (NPUE) from the post-season survey, is stable (-3.5%) between 2022 and 2023, which indicates that the biomass available to the fishery in 2024 should be similar to that in 2023.

**Outlook**

- The combined index is stable (-3.5%) between 2022 and 2023, which indicates that the biomass available to the fishery in 2024 should be similar to that in 2023.

*Higher scenario:* A 10% increase relative to total landings in 2023.

*Intermediate scenario:* Status quo relative to total landings in 2023.

*Lower scenario:* A 10% decrease relative to total landings in 2023.

**Area 13**

- The total allowable catch (TAC) increased between 2022 and 2023 to 206.8 t, and it was reached, with landings of 200.0 t (+6.4%).
- The standardized commercial catch per unit effort (CPUE), which had declined between 2015 and 2021, increased for the second consecutive year (+19.0%), but is still below the historical average [2000; 2022]. This increase was more pronounced in the southern part of the area.
- In 2023, the dockside sampling of legal-size crabs indicated that the average size, down since 2017, was below the historical average [2000; 2022] and at the 2002 pre-moratorium levels.
- Landing in 2023 consisted mainly of recruits (83.3%).
- The abundance index for commercial-size crabs caught in the post-season survey in 2023 was up from 2022. In the northern part of the area, these crabs consisted mainly of recruits. The average size of adult males increased between 2022 and 2023 throughout the area. The abundance of sublegal-size adult males on the northern side of the fishing area remained high in 2023 despite a decline from 2022 to 2023.
- The combined index, derived from the commercial CPUE and the number per unit effort (NPUE) from the post-season survey, is increasing between 2022 and 2023 (+21.1%), suggesting that the biomass available to the fishery in 2024 will be greater than in 2023.

**Outlook**

- The combined index is increasing between 2022 and 2023 (+21.1%), which suggests that the biomass available to the fishery in 2024 should be higher than in 2023.
- According to data from the post-season survey in the northern side of the fishing area, the pulse of primiparous females appears to be over. The abundance of subadults was down throughout the area, which suggests that recruitment to the fishery could decline in the medium term.

*Higher scenario:* A 20% increase relative to total landings in 2023.

*Intermediate scenario:* A 10% increase relative to total landings in 2023.

*Lower scenario:* Status quo relative to total landings in 2023.

### Area 16A

- The total allowable catch (TAC) increased between 2022 and 2023 to 294.0 t, and it was reached, with landings of 290.0 t (+18.7%).
- After dropping to very low values between 2017 and 2022, the standardized commercial catch per unit effort (CPUE) increased sharply between 2022 and 2023 (+69.2%), and is now at the historical average [2002; 2022].
- The average size of legal-size crabs sampled at sea decreased between 2022 and 2023, and is below the historical average [2000; 2022].
- Landings in 2023 consisted mainly of recruits, which have made up an increasing proportion of landings since 2020.
- The 2023 post-season survey suggests that the abundance of commercial-size adults (consisting mainly of recruits) and legal-size subadults is very much on the rise. The abundance of crabs left by the fishery remains very low. The average size of adult male and adolescent crabs increased between 2022 and 2023 but remains below their respective historical averages [2002; 2022].
- The results of the post-season survey indicate a high density of multiparous females. All the survey indicators point to increasing levels of recruitment to the commercial fishery, and this trend is expected to continue in the short and medium term.
- The combined index, derived from the commercial CPUE and the number per unit effort (NPUE) obtained in the post-season survey, rose steeply between 2022 and 2023 (+95.0%), after declining to its lowest value in 2021. This increase suggests that the biomass available to the fishery in 2024 should be greater than in 2023.

### Outlook

- The combined index, after declining during the 2014-2021 period, has increased over the last two years, suggesting that the biomass available to the fishery will increase in 2024.
- Crab abundance, which is cyclical in nature, appears to be on the upswing as the pulse of primiparous females has come to an end and male recruitment to the fishery is increasing.

*Higher scenario:* A 40% increase relative to total landings in 2023.

*Intermediate scenario:* A 30% increase relative to total landings in 2023.

*Lower scenario:* A 20% increase relative to total landings in 2023.

### Area 12C

- The total allowable catch (TAC) in 2023 was reduced to 67.0 t from 2022, and was reached with landings totalled 64.0 t (-3.0%). Landings in 2023 are the lowest since the creation of the area.
- The commercial catch per unit effort (CPUE), which was at its lowest levels between 2019 and 2022, has since skyrocketed (+195.3% between 2022 and 2023) to slightly above the historical average [2001; 2022]. The estimated effort in 2023 was the lowest it has been since 2001.

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- The average size of legal-sized crabs sampled at sea increased for the second consecutive year, but remains below the historical average [2001;2022].
- According to dockside sampling, the proportion of recruits was up for the second consecutive year, and recruits made up the majority of landings in 2023.
- The results of the 2023 post-season survey suggest that the abundance of legal-size crabs, consisting mainly of recruits, is on the rise. However, it is still below the average for the time series [2014; 2022]. The abundance of crabs left by the fishery declined between 2022 and 2023 and remains very low. The average size of adult crabs has risen slightly, but is still below the historical average [2001; 2022].
- The abundance of subadults (78–95 mm) has risen steadily since 2019, reaching the highest value of the time series [2014; 2023] in 2023. Furthermore, in the last two years, the abundance of adults smaller than 95 mm reached the highest levels recorded since 2014.
- The combined index, derived from the commercial CPUE and the number per unit effort (NPUE) obtained from the post-season survey, rose steeply (+160.4%) between 2022 and 2023. This suggests that the biomass available to the fishery in 2024 should be greater than in 2023.

**Outlook**

- The combined index rose sharply between 2022 and 2023 (+160.4%), suggesting that the biomass available to the fishery in 2024 should be higher than in 2023.
- The cyclical pattern of crab abundance appears to be in an upward phase as the pulse of primiparous females has come to an end and male recruitment to the fishery is increasing. On the other hand, the size of adult crabs has remained low in the last three years despite an increase in average size in 2023.

*Higher scenario:* A 160% increase relative to total landings in 2023.

*Intermediate scenario:* A 120% increase relative to total landings in 2023.

*Lower scenario:* A 80% increase relative to total landings in 2023.

**Area 12A**

- At 45.0 t, the total allowable catch (TAC) in 2023 remained similar to that in 2022. The TAC was not reached due to socio-economic reasons. Landings in 2023 totalled 39.0 t (-9.3%).
- As part of the development of a precautionary approach for Area 12A, limit thresholds were formulated for two standardized commercial biomass indicators: standardized commercial catch per unit effort (CPUE) and standardized CPUE for legal-size males based on the post-season survey (CPUE95). Combining the status of the two indicators using a scoring grid makes it possible to establish a limit reference point (LRP) and situate the stock in relation to the LRP.
- The standardized CPUE, which reached one of the lowest values of the time series in 2022, increased in 2023. The probability of the moving average for the previous two years being below the limit threshold established for this indicator is 76%.
- Landings in 2023 consisted primarily of intermediate-shell crabs (78.8%).
- The post-season survey was conducted later than usual in 2023. The CPUE95, which peaked in 2011, declined to its lowest value between 2011 and 2021. Although the CPUE95

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increased between 2022 and 2023, the probability of the moving average for the previous two years being below the limit threshold established for this indicator is 100%.

- On the basis of the two commercial biomass indicators combined, the Area 12A snow crab stock has been in the critical zone since 2015, according to the precautionary approach being developed.

**Outlook**

- Considering that the precautionary approach is under development and that the Area 12A stock remains in the critical zone despite an improvement in the primary commercial biomass indicators between 2022 and 2023, removals in 2024 should be as low as possible and should not exceed the 2023 landing values or thereabouts in order to promote rebuilding of the snow crab stock.

## **INTRODUCTION**

### **Species biology**

In Canada, snow crab can be found from the southern tip of Nova Scotia to the Labrador, 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 subadults (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 arrival of recruitment 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 post-season trap survey and scientific trawl surveys. Legal-size adult crabs that have moulted recently—recruits—can be identified from their bright orange shell and iridescence (carapace condition 1 and 2). As crabs age after the terminal moult, their carapace gradually turns brown and loses its iridescence, and their claws become worn (carapace condition 3 to 5). Global warming coupled with the upward trend in the average temperature of the deep layer could affect snow crab distribution and productivity by warming and thinning the cold intermediate layer that is their habitat.

## **ASSESSMENT**

Analyses of all areas are based on fishing data from logbooks, processing plant purchase slips and dockside weighing summaries, along with catch sampling data obtained from the At-sea Observers Program and DFO dockside samplers. In 2023, the industry conducted after the fishing season a trap-based research survey in all fishing areas assessed (Areas 14 to 17, 12A, 12C and 16A), as well as in Area 13, where two independent surveys, northern and southern, were conducted), and the findings were incorporated into the stock status assessments. These trap surveys are notably used to determine the average number per unit of effort (NPUE) for each fishing area for all legal-size adult crabs as well as the NPUE based on their seniority in the commercial population (one NPUE for crabs left by the fishery, which represent the residual commercial component, and one NPUE for new recruits) and the NPUE for adolescent crabs with a carapace width of 78 mm or more that will reach or exceed legal size during the next



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moult. Experimental traps (smaller mesh sizes) can be used to better document the proportion of younger crabs and females in the survey. The scientific trawl surveys normally conducted every two years by DFO in the northern Gulf and Estuary areas did not take place in 2020 because of the prevailing COVID-19 pandemic and in 2021 due to the unavailability of DFO research vessel. In 2023, the scientific trawl survey was carried out on the north and south shores of the St. Lawrence Estuary (Area 17). Thus the results of research trawl surveys in the St. Lawrence Estuary and in Sainte Marguerite Bay in Area 16 were used to better assess the relative abundance of adolescent and adult crabs, males and females, as well as the position of the population in the recruitment cycle.

The numbers of fishing licenses and dates that fishing was allowed in 2023 are indicated in Table 1. Total landings in 2023 reached 5,241.0 t, representing a 15.1% increase over 2022, with Areas 16 and 17 having particularly significant increases (Figure 2).

Table 1. Summary by Area of the number of licences and dates of commercial fishery in 2023.

Areas	13	14	15	16	16A	17	12A	12B	12C
<b>Number of licences</b>	40	19	30	51	34	33	9	Moratorium	36
<b>Opening dates</b>	May 26	April 24 or May 1	April 1 or 8	April 1	April 3 or 10	March 27	March 31	-	April 1 or 8
<b>Closure dates</b>	August 18	July 30 or August 6	July 7 or 14	July 7	July 9 or 16	June 5	June 9	-	July 7 or 14

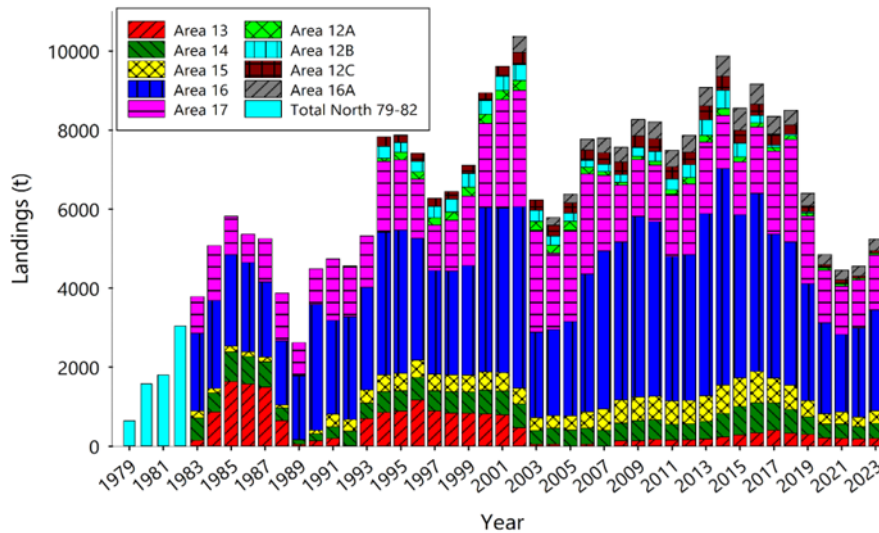


Figure 2. Snow crab landings in the Estuary and northern Gulf of St. Lawrence from 1979 to 2023. From 1979 to 1982, landings were not attributed to their area of origin.

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

Since 2013, a combined index was used 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

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standardized commercial CPUE and the post-season NPUE for adult males  $\geq 95$  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, when available, were also used.

Data on female insemination levels, based on the average weight of spermatheca, have been collected sporadically in certain areas. The relationship between the density of females and the mean weight of the spermathecal load has already undergone careful analyses for Baie Sainte-Marguerite and is undergoing larger-scale analysis in the Estuary and northern Gulf. Large-scale preliminary results indicate a strong negative relationship between the density of primiparous females observed during the trawl surveys and the mean weight of the spermathecal load, once the size of females is accounted for. Systematic annual sampling of spermathecal loads in each area (during post-season trap or trawl surveys) is recommended to use this parameter for assessing stock status along with a sex ratio favouring the reproductive potential of populations for different abundance levels for females in the short, medium and long term.

## **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 a combined index, the uncertainty associated with this indicator, and related stock status indicators (crab carapace size and condition, expected recruitment, and levels 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**

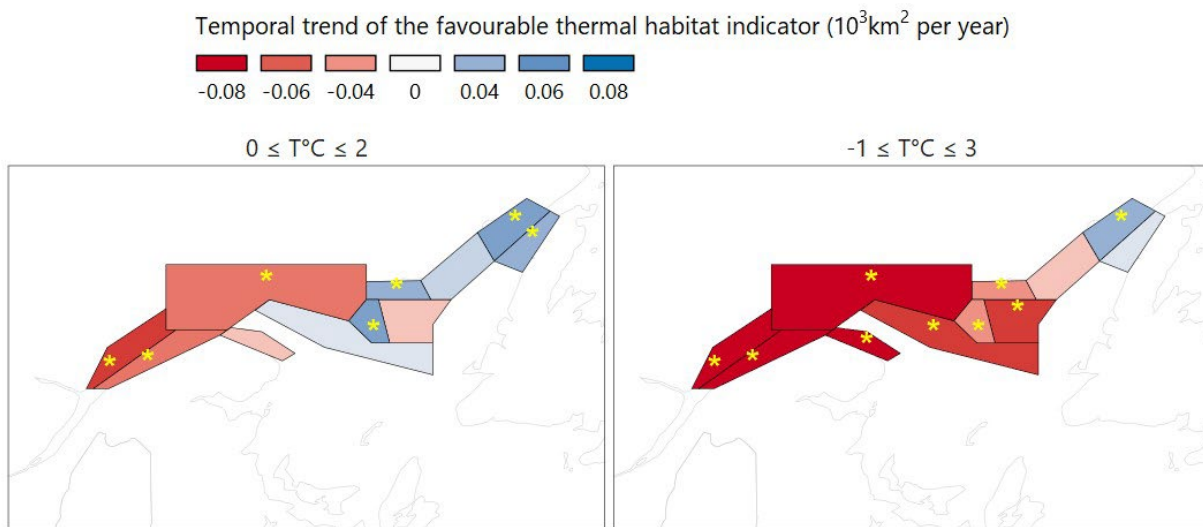
- Greater likelihood of lower harvesting intensity for the upcoming fishing season compared to the previous one;
- Cautious harvest level assumed to result in fishing mortality below the historical average; and

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- Could lead to an increase in stock abundance compared to the previous year or maintain existing biomass over a longer period of time.

**Snow crab thermal habitat**

Two indicators of favourable thermal habitat for snow crab have been developed, one for adults and the other for juveniles (<12 mm). 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 1990 to 2023 period, a declining trend in the area of favourable thermal habitat for adult snow crab was observed in Areas 12A, 12B, 12C, 15, 16A, 16 and 17, whereas a slight increase in the availability of favourable thermal habitat was observed in Areas 13 (Figure 3B). For juveniles, 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 13, 15 and 16A (Figure 3A).



*Figure 3. Temporal trends of the favourable thermal habitat indices for and juvenile snow crabs (<12 mm) (A) and adult snow crabs (B) over the 1990–2023 period. Note that, for the portion of Area 13 along the north shore and Area 14, the trends shown are based on the 1994–2022 period due to an absence of temperature data for this area in some years. 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 2023, the total allowable catch (TAC) in Area 17 was 1,394.0 t, an increase of 15.9% over 2022. In 2023, landings increased by 15.2% to 1,396.0 t, representing 100.1% of the TAC (Figure 4).

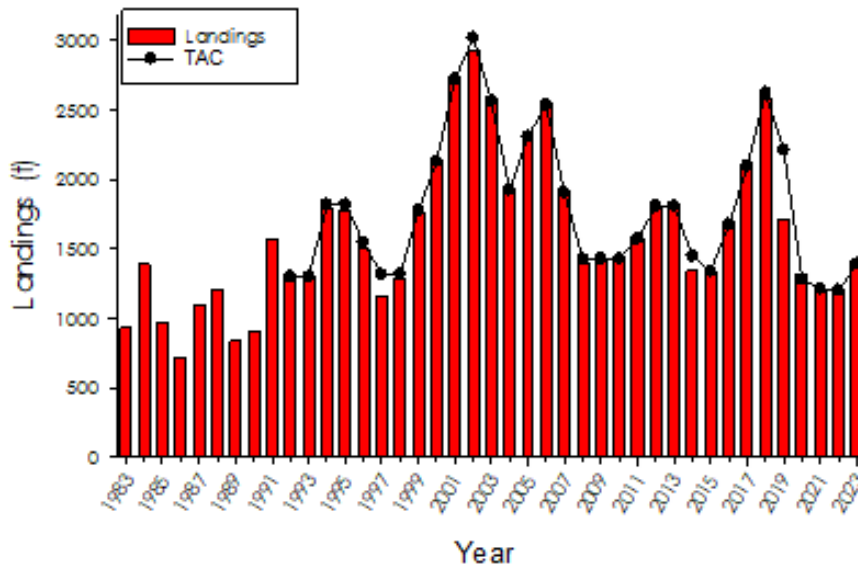


Figure 4. Annual landings and TACs in Area 17.

**Resource status in 2023**

**Commercial fishery.** The standardized catch per unit effort (CPUE) increased significantly between 2022 and 2023 (+37.7%), reaching the historical average for the time series [2000; 2022] (Figure 5).

The average carapace width of legal-size crabs sampled at sea decreased slightly (-1.15 mm) between 2022 and 2023, and is below the historical average [2000; 2022] (Figure 6). Landings in 2023 consisted of 50.6% intermediate-shell crabs and 48.4% recruits.

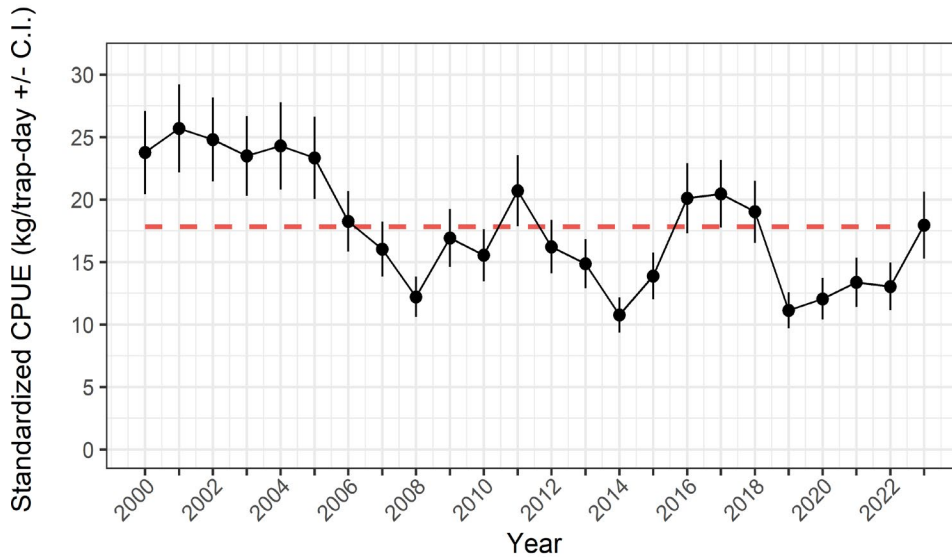


Figure 5. Standardized annual CPUE (± 95% confidence interval) in the commercial fishery in Area 17. The dashed line shows the historical data series average (excluding the last year) which is 17.8 kg/trap per day.

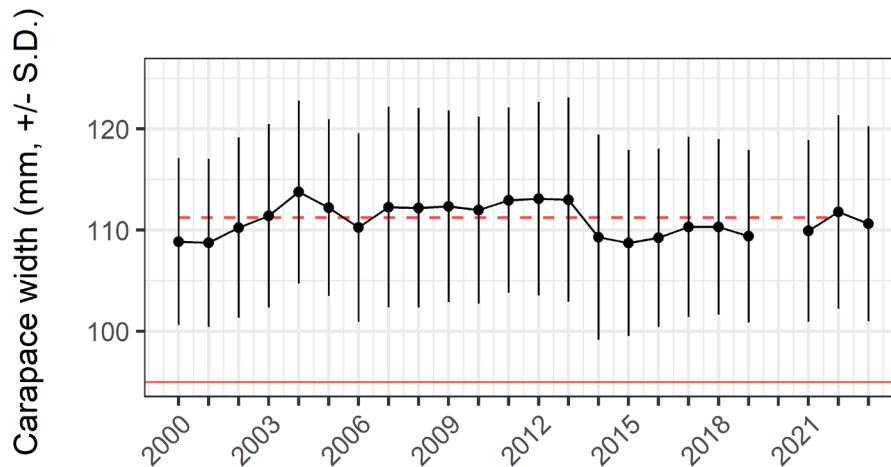


Figure 6. Average carapace width ( $\pm$  standard deviation) of legal-size male crabs measured at sea in the commercial fishery in Area 17. The solid line shows the legal size at 95 mm and the dashed line shows the historical data series average (excluding the last year) which is 110.6 mm.

**Fishery-independent surveys.** According to the post-season survey, the abundance index for legal-size adult crabs increased between 2022 and 2023 (+27.1%), and is above the historical average [2000; 2022]. This increase can be observed along both the north and south shores of the fishing area (Figure 7). The abundance of crabs left by the fishery continued to rise significantly in 2023 (+66.0%), and is above the historical average [2000; 2022]. In contrast, the abundance of recruits to the fishery declined by 28.4% between 2022 and 2023, and is below the historical average. The number of legal-size subadults per trap has continued to decline since 2020 (-52.3% between 2022 and 2023), reaching one of the lowest values in the time series [2000; 2023]. The abundance index for sublegal-size subadults also remains at the lowest value of the monitoring period [2000; 2023].

Nonetheless, the low abundance of adolescent crabs and recruits observed may represent an underestimation and should be viewed with caution. The catchability of adolescent crabs and recruits could be affected by competition with larger adult males ( $\geq 95$  mm), which are more abundant in the traps. Lastly, as observed in other areas farther east, the number of sublegal-size adults is growing, which has resulted in a decline in the average size of adults obtained in the 2023 post-season survey after a period of stability [2016; 2022].

Since 2020, the abundance of primiparous females has increased in the experimental traps used in the post-season survey. The mean spermathecal load of primiparous females has been declining since 2019, and is among the lowest values in the time series [2006; 2023].

The results of the scientific trawl survey carried out in 2023 in the Estuary showed high densities of both primiparous and multiparous females, which are expected to remain at high levels for the next two years. These increased densities can be observed along both shores of the Estuary. The survey results confirm the arrival of a new pulse of recruitment to the fishery, which, in the short term, seems to be greater along the north shore than the south shore. In the medium term, high densities of adolescent male crabs (40–78 mm) suggest good years of recruitment to the fishery for the entire area.

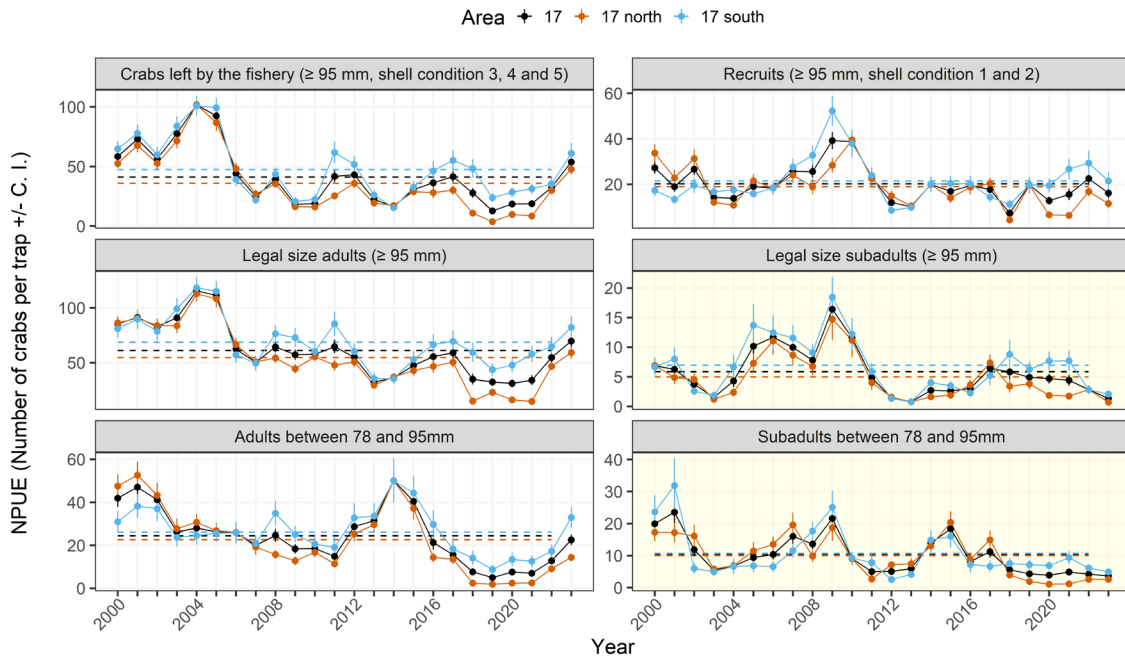


Figure 7. Annual catch rate (NPUE) ( $\pm$  95% confidence interval) of different categories of adult (white background) and subadult (yellow background) crabs from the post-season survey for the overall Area 17 (black), and in Area 17 North (in orange) and Area 17 South (in blue). The dashed line shows the historical data time series average (excluding the last year).

**The combined index**, derived from the commercial CPUE and the post-season NPUE for adult males  $\geq$  95 mm, increased by 32.1% between 2022 and 2023 (Figure 8). Indicators suggest that the biomass available to the fishery in 2024 will be greater than in 2023.

**The thermal habitat indices** favourable to juvenile (Figure 3A) and adult (Figure 3B) snow crabs in Area 17 show a decline in extent over the 1990-2023 period, which could have a negative impact on the future productivity of the stock.

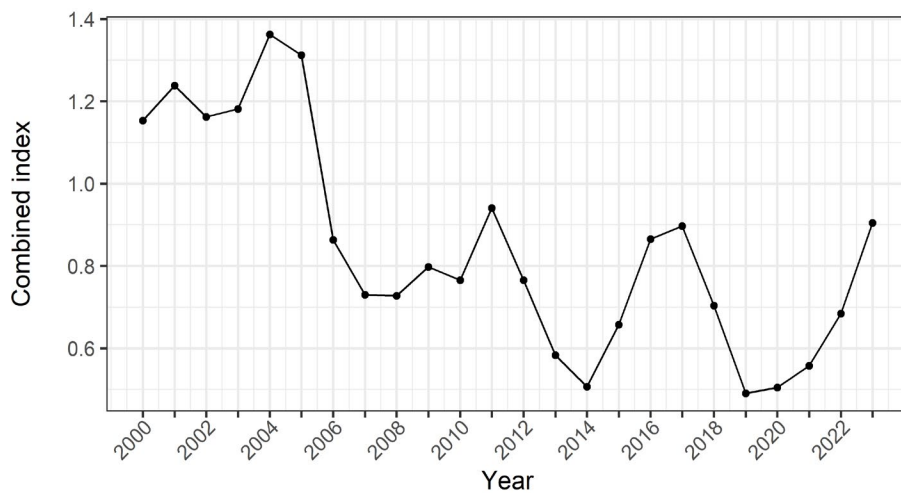


Figure 8. Combined index, derived from the annual standardized commercial CPUE and the annual NPUE from the post-season survey for legal-size adult males in Area 17.

**Outlook**

The combined index increased by 32.1% between 2022 and 2023, suggesting that the biomass available to the fishery in 2024 will be greater than that in 2023.

Recruitment of mature females, which is expected to continue at similar levels in the short term, and the low mean value for the spermathecal load obtained in 2023 suggest that a more modest increase in removals in 2024 should be adopted in order to avoid obtaining a sex ratio that is overly biased towards females.

*Higher scenario:* A 30% increase applied to total landings in 2023.

*Intermediate scenario:* A 20% increase applied to total landings in 2023.

*Lower scenario:* A 10% increase applied to total landings in 2023.

**Area 16**

**Description of the fishery**

The total allowable catch (TAC) in 2023, which was increased to 2,585.0 t from 2022 (+15.6%), was reached. Landings in 2023 totalled 2,552.0 t (+13.3%) or 98.7% of the TAC (Figure 9).

**Resource status in 2023**

**Commercial fishery.** For a fourth consecutive year, the standardized catch per unit effort (CPUE) increased in 2023 (+14.2%), and is above the historical average [1996;2022] (Figure 10). The estimated fishing effort in the last three years has been relatively constant but low, remaining below the historical average [1996; 2022]. The average carapace width of legal-size crabs sampled at sea has declined slightly since 2021 (-1.3 mm between 2022 and 2023), and is below the historical average [1996; 2022] (Figure 11). Recruits made up two-thirds (66.2%) of landings, a higher proportion than in previous years [2019; 2022].

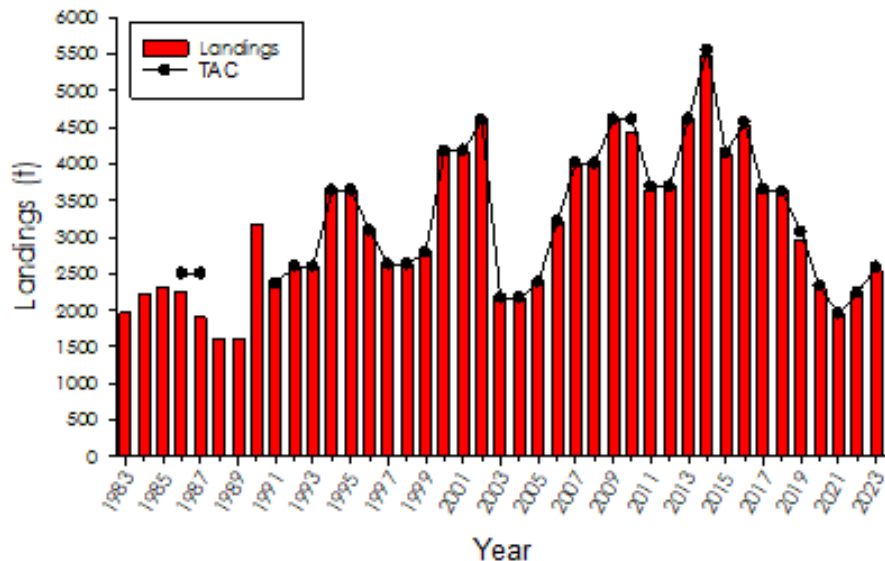


Figure 9. Annual landings and TACs in Area 16.

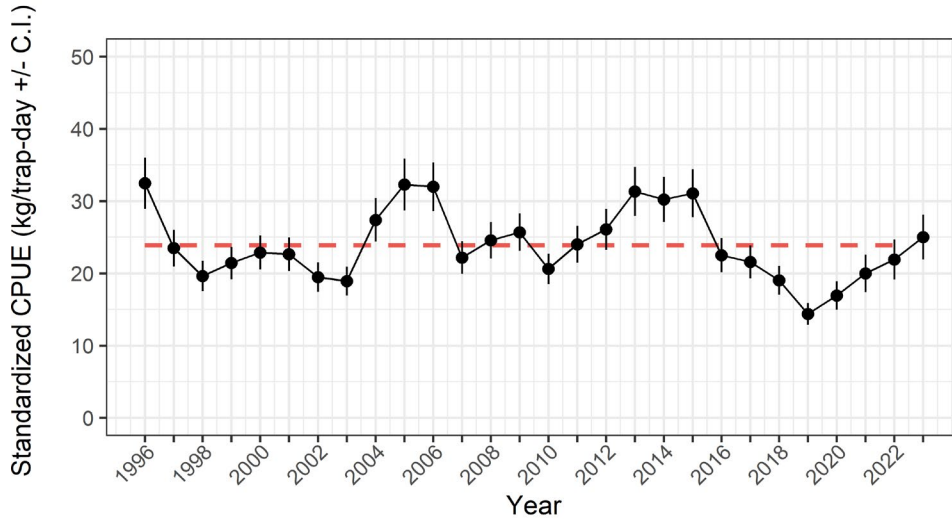


Figure 10. Standardized annual CPUE ( $\pm$  95% confidence interval) in the commercial fishery in Area 16. The dashed line shows the historical data series average (excluding the last year) which is 23.9 kg/trap per day.

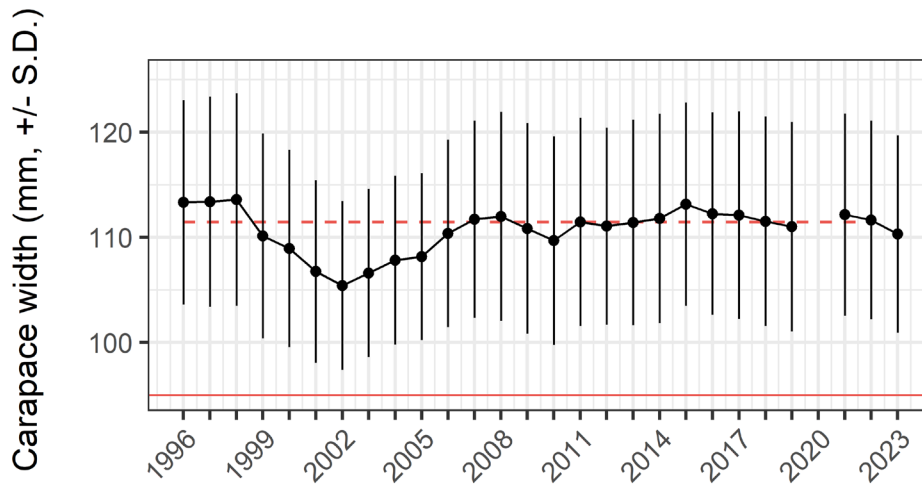


Figure 11. Average carapace width ( $\pm$  standard deviation) of legal-size male crabs measured at sea in the commercial fishery in Area 16. The solid line shows the legal size at 95 mm and the dashed line shows the historical data series average (excluding the last year) which is 111.5 mm.

**Fishery-independent surveys.** Following two consecutive increases, the abundance index for legal-size adults obtained in the post-season survey was down slightly in 2023 (-5.7%) and remains below the historical average [1996; 2022] (Figure 12) despite a 19.5% increase in recruit abundance [1996; 2022]. The decline in the abundance index for legal-size adults can be explained by the similar trend in the abundance index for crabs left by the fishery in 2023 (-43.1%). For the third consecutive year, numbers of sublegal-size adults have increased dramatically, reaching the highest value in the time series [1996; 2023] and indicating that a large proportion of male crabs have undergone early terminal moulting. The abundance index for sublegal-size subadults has been increasing since 2020, but remains below the historical average [1996; 2022], while the abundance index for legal-size subadults declined between 2022 and 2023. In the 2023 post-season survey, the abundance of mature females, mainly



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### Quebec Region

consisting of multiparous individuals, was high in the western part of the area. The average size of adult crabs caught in the post-season survey has shown a downward trend since 2014, reaching the lowest value of the time series in 2023, likely due to the high frequency of early terminal moulting.

The 2023 survey in Sainte-Marguerite Bay was carried out in July, two months later than usual. Recruitment of mature females is declining, and the average carapace width continues to decrease. Following a significant decline between 2020 and 2022, the mean weight of the spermathecal load of primiparous females rose slightly between 2022 and 2023. The abundance of sublegal-size adult males is still high due to a very high frequency of early terminal moulting. However, the abundance of subadults (78–95 mm) is also high, indicating that the recruitment of legal-size males can be expected to increase from 2024 onwards. Since 2019, the high frequency of early terminal moulting has created uncertainty regarding the strength of the pulse of recruitment to the fishery.

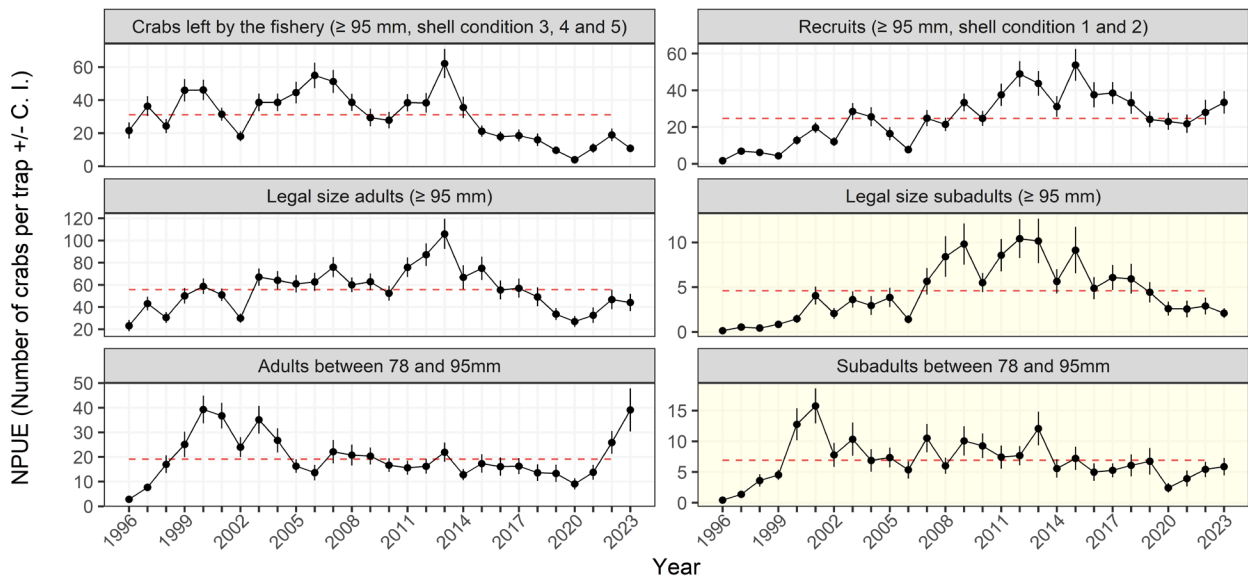


Figure 12. Annual catch rate (NPUE) ( $\pm$  95% confidence interval) of different categories of adult (white background) and subadult (yellow background) crabs from the post-season survey in Area 16. The dashed line shows the historical data time series average (excluding the last year).

The **combined index**, derived from the commercial CPUE and the post-season NPUE for adult males  $\geq$  95 mm, rose slightly (+5.1%) between 2022 and 2023, suggesting that the biomass available to the fishery in 2024 should be comparable to or higher than in 2023 (Figure 13).

**The thermal habitat indices** favourable to juvenile (Figure 3A) and adult (Figure 3B) snow crab in Area 16 show a decline in extent over the 1990-2023 period, which could have a negative impact on the future stock productivity.

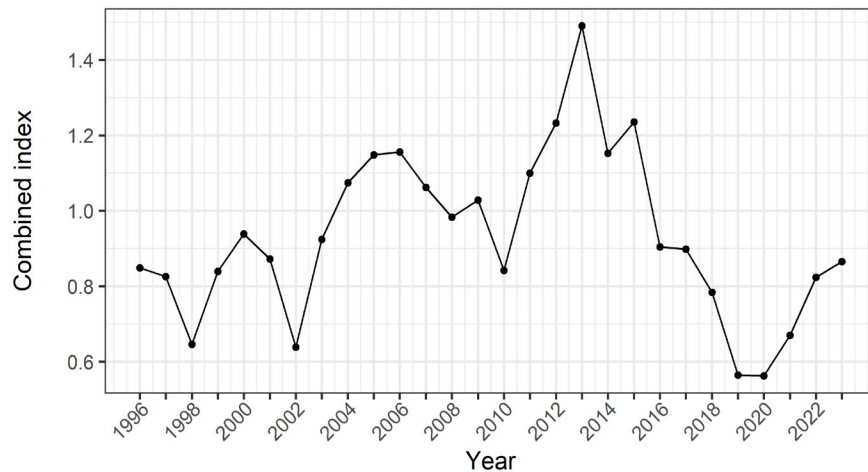


Figure 13. Combined index, derived from the annual standardized commercial CPUE and the annual NPUE from the post-season survey for legal-size adult males in Area 16.

### Outlook

The combined index rose slightly (+5.1%) between 2022 and 2023, suggesting that the biomass available to the fishery in 2024 should be comparable to or higher than in 2023.

Crab abundance, which is cyclical in nature, appears to be on the upswing as the pulse of primiparous females has come to an end and the recruitment of male crabs to the fishery is increasing.

*Higher scenario:* A 25% increase relative to total landings in 2023.

*Intermediate scenario:* A 15% increase relative to total landings in 2023.

*Lower scenario:* A 5% increase relative to total landings in 2023.

## Area 15

### Description of the fishery

In 2023, the total allowable catch (TAC) of 322.0 t, which represents an increase of 32.4% relative to 2022, was reached with landings of 323.0 t (+36.3%), i.e. 100.3% of the TAC (Figure 14).

### Resource status in 2023

**Commercial fishery.** The standardized commercial catch per unit effort (CPUE), after dropping to the lowest values of the time series in the years from 2019 to 2022, increased dramatically between 2022 and 2023 (+ 92.9%), and is now above the historical average [2000; 2022] (Figure 15). The average carapace width of legal-size crabs sampled at sea rose slightly (+1.0 mm) between 2022 and 2023, but is still below the historical average [2000; 2022]. Landings in 2023 consisted primarily of recruits (71.5%). This percentage has been on the rise since 2019, whereas the percentage of intermediate-shell crabs has fallen from 47.2% in 2019 to 26.8% in 2023.

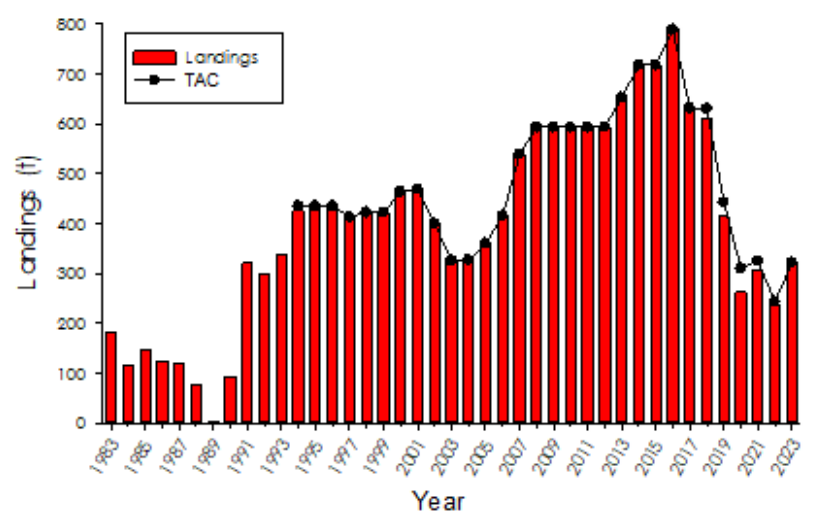


Figure 14. Annual landings and TACs in Area 15.

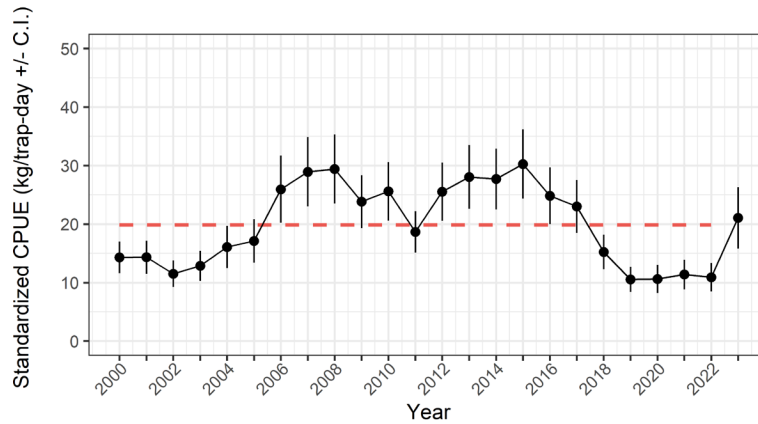


Figure 15. Standardized annual CPUE ( $\pm$  95% confidence interval) in the commercial fishery in Area 15. The dashed line shows the historical data series average (excluding the last year) which is 19.9 kg/trap per day.

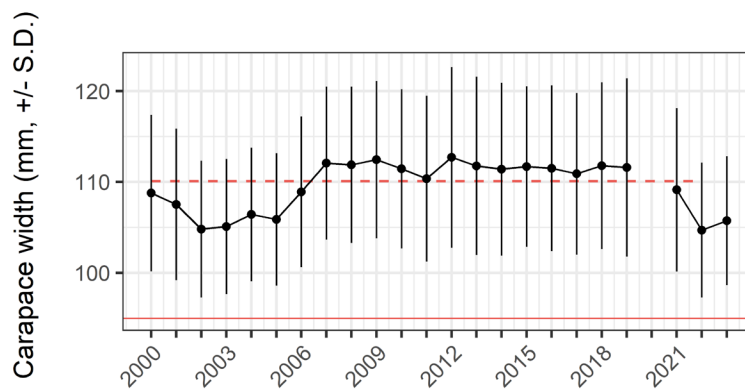


Figure 16. Average carapace width ( $\pm$  standard deviation) of legal-size male crabs measured at sea in the commercial fishery in Area 15. The solid line shows the legal size at 95 mm and the dashed line shows the historical data series average (excluding the last year) which is 110.1 mm.

**Fishery-independent survey.** According to the 2023 post-season survey, the abundance index for commercial-size adults ( $\geq 95$  mm) is stable and remains above the historical average [2014; 2022] despite a slight decline in the abundance of crabs left by the fishery. This is because the decline is offset by an increase in recruits to the fishery (Figure 17). The abundance indices for legal-size ( $\geq 95$  mm) and sublegal-size (78–95 mm) subadults increased between 2022 and 2023 to values above their respective historical averages [2014; 2022], suggesting that, over the short term (2 to 4 years), recruitment to the commercial fishery should continue increasing. The average carapace width of subadults remains stable and below the historical average [2000; 2022]. Since 2020, the average carapace width of adult males has been on the rise (+1.6 mm between 2022 and 2023), but is still below the historical average [2000; 2022].

Although the abundance of primiparous females has declined, their spermathecal load increased sharply for the second consecutive year, reaching some of the highest values of the time series [2008; 2023].

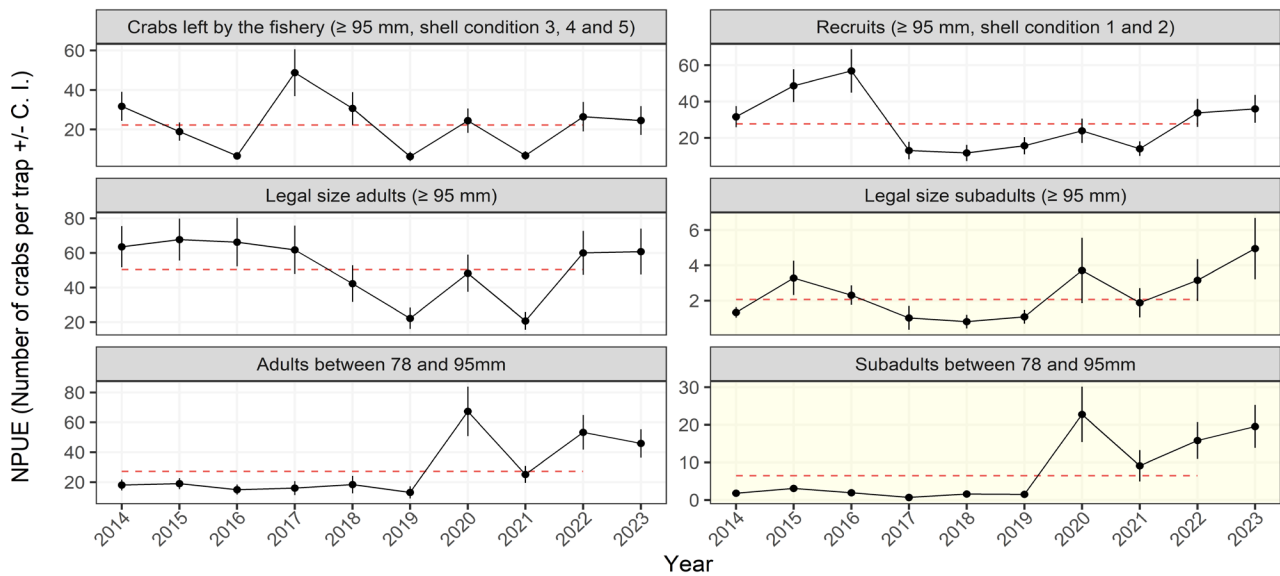


Figure 17. Annual catch rate (NPUE) ( $\pm$  95% confidence interval) of different categories of adult (white background) and subadult (yellow background) crabs from the post-season survey in Area 15 (with large traps). The dashed line shows the historical data time series average (excluding the last year).

The **combined index**, derived from the commercial CPUE and the post-season NPUE for adult males  $\geq 95$  mm, has continued to increase for the second consecutive year (+31.8% between 2022 and 2023), suggesting that more biomass should be available to the fishery in 2024 than in 2023 (Figure 18).

All the survey indicators point to increasing levels of recruitment to the commercial fishery, and this trend is expected to continue in the short and medium term.

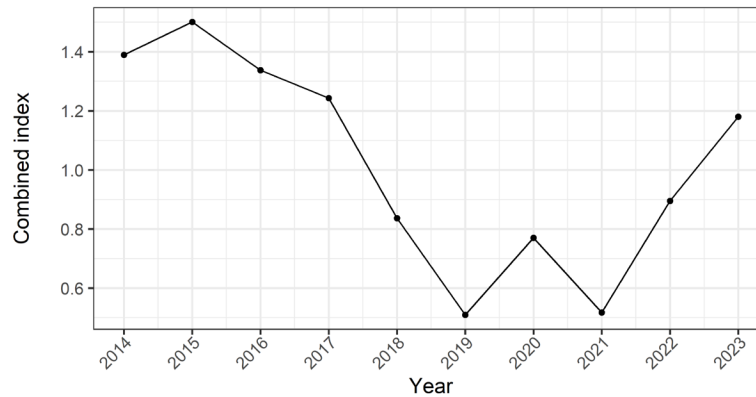


Figure 18. Combined index, derived from the annual standardized commercial CPUE and the annual NPUE from the post-season survey for legal-size adult males in Area 15.

Although highly variable, **the favourable thermal habitat indicator** for juvenile snow crabs (Figure 3A) in Area 15 increased, while the one for adults (Figure 3B) has declined steadily since 1990, which could have a negative impact on the stock's future productivity.

### Outlook

The combined index, which reached one of the lowest values in the time series between 2019 and 2021, rose between 2022 and 2023 (+31.8%), indicating that the biomass available to the fishery in 2024 should be greater than in 2023.

The cyclical pattern of crab abundance appears to be in an upward phase, as the pulse of primiparous females has come to an end and male recruitment to the fishery is increasing.

*Higher scenario:* A 40% increase relative to total landings in 2023.

*Intermediate scenario:* A 30% increase relative to total landings in 2023.

*Lower scenario:* A 20% increase relative to total landings in 2023.

## Area 14

### Description of the fishery

In 2023, the total allowable catch (TAC) was raised to 388.0 t, representing a 25.2% increase from 2022, and was reached with landings of 377.0 t (+21.3%), representing 97.2% of the TAC (Figure 19).

### Resource status in 2023

**Commercial fishery.** The standardized commercial catch per unit effort<sup>1</sup> (CPUE), after increasing between 2020 and 2022, remained stable in 2023 (+0.9%) and below the historical average [2000; 2022] (Figure 20). The average carapace width of legal-size crabs sampled at sea rose slightly (+1.2 mm) between 2022 and 2023, but remains below the historical average [2000; 2022] (Figure 21). Landings in 2023 consisted primarily of intermediate-shell crabs (47.5%) and recruits (50.4%), which occurred in proportions similar to those in the previous two years.

<sup>1</sup> The standardized CPUE in Area 14 is calculated solely from fishing trips involving the use of Japanese traps, which are smaller than the standard conical traps. See the "Sources of Uncertainty" section.

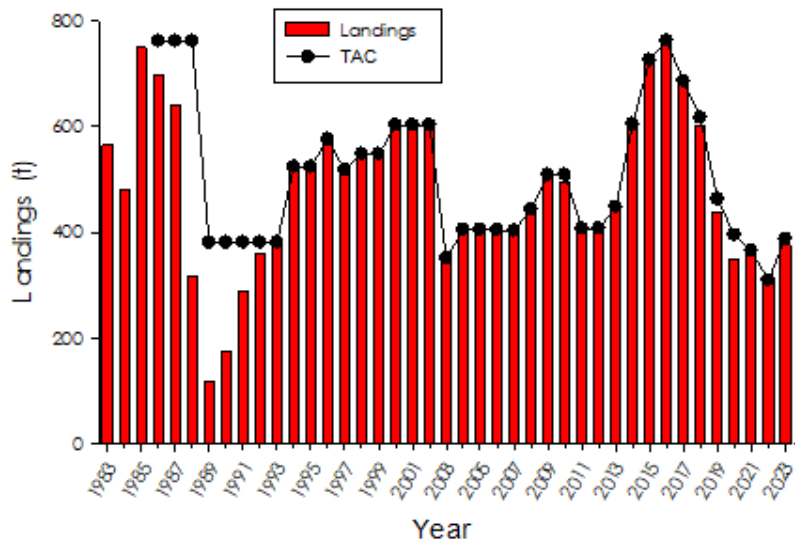


Figure 19. Annual landings and TACs in Area 14.

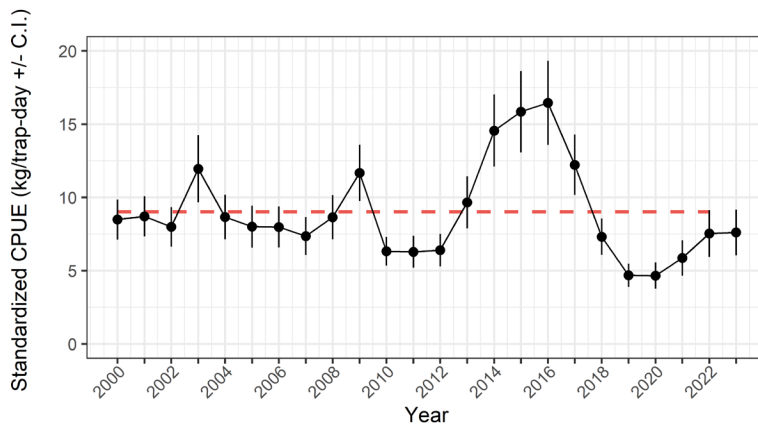


Figure 20. Standardized annual CPUE ( $\pm$  95% confidence interval) in the commercial fishery in Area 14. The dashed line shows the historical data series average (excluding the last year) which is 9.0 kg/trap per day.

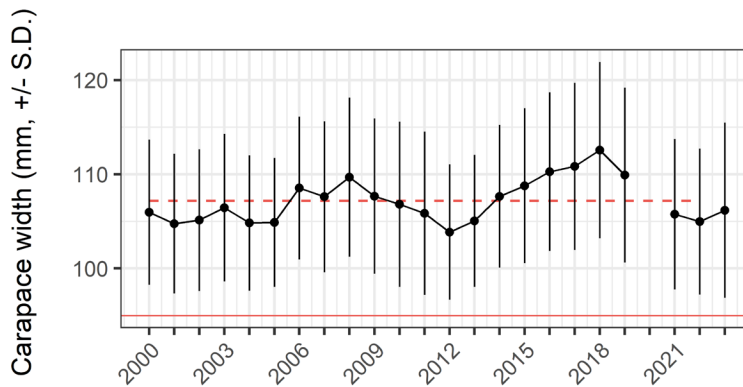


Figure 21. Average carapace width ( $\pm$  standard deviation) of legal-size male crabs measured at sea in the commercial fishery in Area 14. The solid line shows the legal size at 95 mm and the dashed line shows the historical data series average (excluding the last year) which is 107.2 mm.

**Fishery-independent survey.** According to the 2023 post-season survey, the abundance index for legal-size adults, which consisted mainly of crabs left by the fishery, was down slightly (-8.8%; Figure 22). The abundance index for recruits declined (-59.3%) for the third consecutive year, while the index for sublegal-size adults (78–95 mm) rose slightly, reaching its highest value since 2019. The number of legal-size subadults ( $\geq 95$  mm) per trap has been very low for the past three years. The abundance index for subadults (78–95 mm) was also stable in 2023 (-6.2%) and remains above the four-year average [2019; 2022] (Figure 22). Since 2016, the average carapace width of adult male crabs has steadily declined, reaching a historical low in the last two years. However, this trend appears to have stabilized in 2023 (+0.52 mm).

The scientific trawl survey carried out in 2022 on the Lower North Shore, in the eastern portion of Area 14 and the north side of Area 13 showed a high density of spawning females (primiparous and multiparous) and of sublegal-size males (DFO 2023). The mean weight of the spermathecal load of primiparous females increased for a second consecutive year. According to the 2023 post-season survey, the abundance of primiparous females declined for a second consecutive year. This downwards trend seems to indicate that the cyclical abundance of primiparous females is approaching its low point.

The **combined index**, derived from the commercial CPUE and the post-season NPUE for adult males  $\geq 95$  mm, is stable (-3.5%) between 2022 and 2023 (Figure 23), which indicates that the biomass available to the fishery in 2024 should be similar to that in 2023.

**The favourable thermal habitat indicator** (i.e. area of favourable thermal habitat) for juvenile snow crabs (Figure 3A) has been trending upwards over the past few decades, while the indicator for adults (Figure 3B) shows a downward trend.

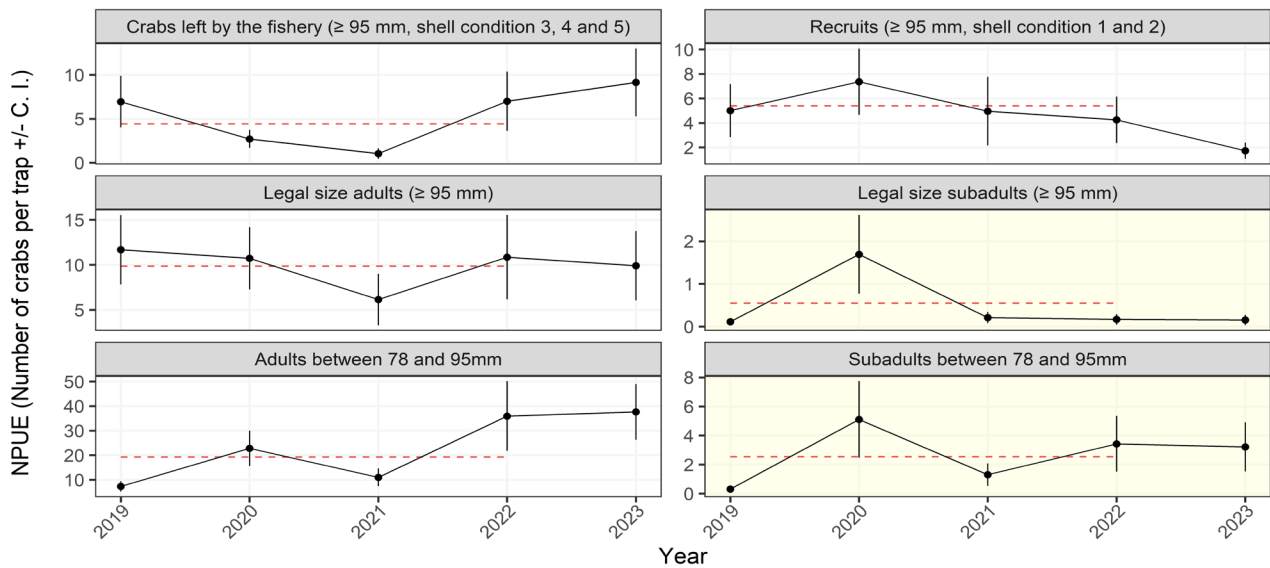


Figure 22. Annual catch rate (NPUE) ( $\pm$  95% confidence interval) of different categories of adult (white background) and subadult (yellow background) crabs from the post-season survey in Area 14. The dashed line shows the historical data time series average (excluding the last year).

Quebec Region

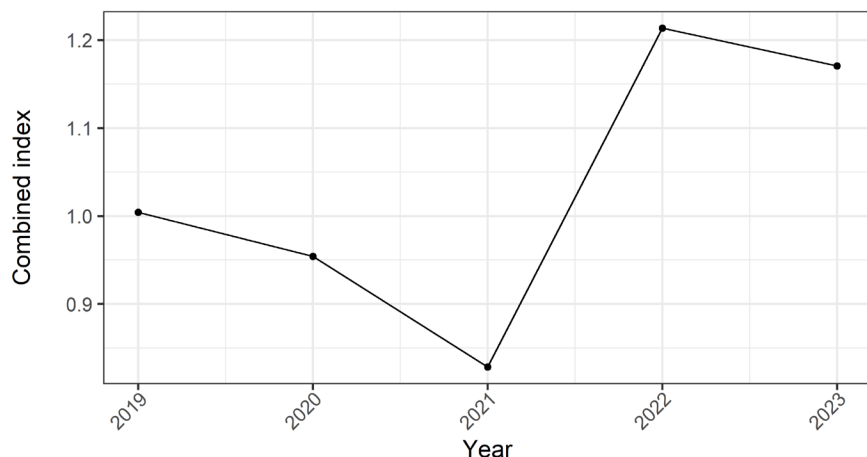


Figure 23. Combined index, derived from the annual standardized commercial CPUE and the annual NPUE from the post-season survey for legal-size adult males in Area 14.

Outlook

The combined index is stable (-3.5%) between 2022 and 2023, which indicates that the biomass available to the fishery in 2024 should be similar to that in 2023.

*Higher scenario:* A 10% increase relative to total landings in 2023.

*Intermediate scenario:* Status quo relative to total landings in 2023..

*Lower scenario:* A 10% decrease relative to total landings in 2023.

Area 13

Description of the fishery

Between 2022 and 2023, the total allowable catch (TAC) increased by 4.3% to 206.8 t, and was reached. Landings in 2023 totalled 200.0 t (+6.4%) or 96.7% of the TAC (Figure 24).

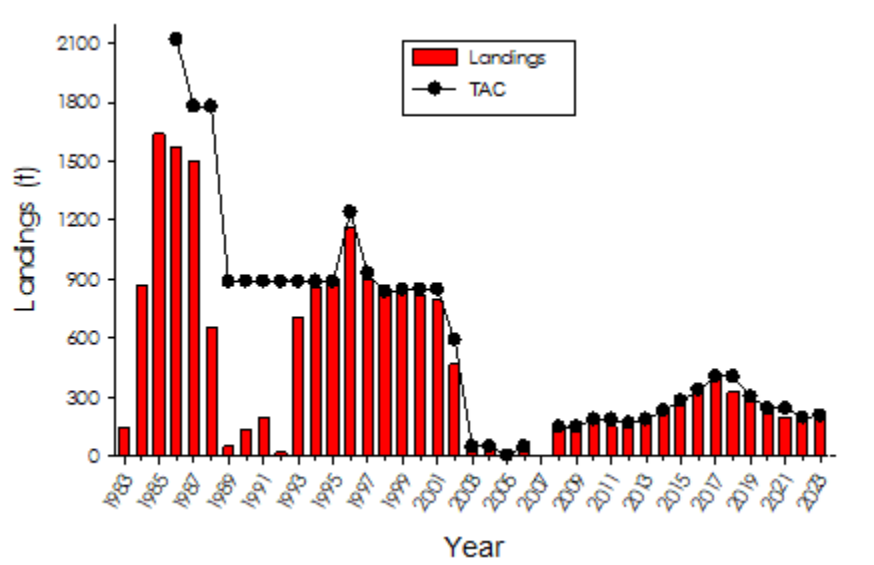


Figure 24. Annual landings and TACs in Area 13.



**Resource status in 2023**

**Commercial fishery.** The standardized commercial catch per unit effort<sup>2</sup> (CPUE), which declined between 2015 and 2021, increased for the second consecutive year (+19.0%), but is still below the historical average [2000; 2022] (Figure 25). This increase was more pronounced in the southern part of the area. The average carapace width of legal-size crabs sampled at sea has been declining since 2016 (-0.3 mm between 2022 and 2023; Figure 26), and is now among the lowest values in the time series [2000; 2023], and is similar to the 2002 pre-moratorium levels. Landings in 2023 consisted primarily of recruits (83.3%).

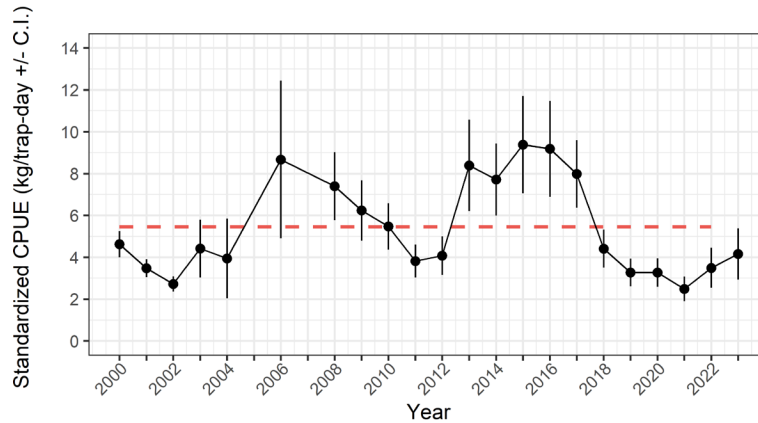


Figure 25. Standardized annual CPUE ( $\pm$  95% confidence interval) in the commercial fishery in Area 13. The dashed line shows the historical data series average (excluding the last year) which is 5.5 kg/trap per day.

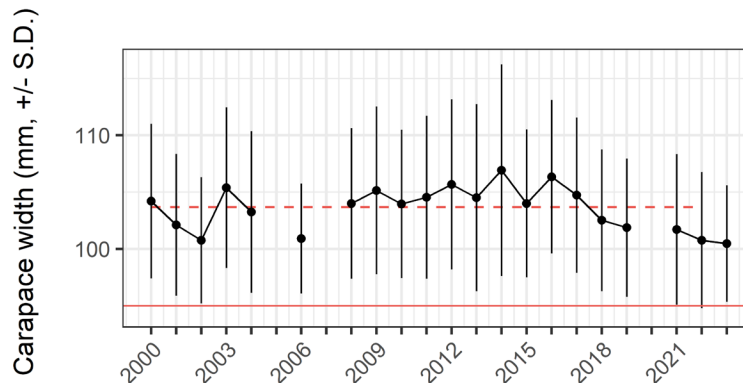


Figure 26. Average carapace width ( $\pm$  standard deviation) of legal-size male crabs measured at sea in the commercial fishery in Area 13. The solid line shows the legal size at 95 mm and the dashed line shows the historical data series average (excluding the last year) which is 103.7 mm.

**Fishery-independent surveys.** Based on the data obtained from the post-season survey, the abundance index for commercial-size crabs, which consisted mainly of recruits on the north shore, continues to rise (+11.6% between 2022 and 2023; Figure 27). The abundance index for sublegal-size adult males (78–95 mm) in the northern part of the fishing area remained high in 2023 despite a decline relative to 2022. The abundance index for legal-size ( $\geq$  95 mm)

<sup>2</sup> The standardized CPUE in Area 13 is calculated solely from fishing trips involving the use of Japanese traps, which are smaller than the standard conical traps. See the “Sources of Uncertainty” section.

subadults remained low but stable, while the abundance of sublegal-size subadults (78–95 mm) declined, particularly along the north shore (Figure 27). The average carapace width of subadults increased for the second year in a row, but remains below the historical average [2000; 2022]. The average carapace width of adult males rose by 3.5 mm between 2022 and 2023 throughout the area.

The scientific trawl survey carried out in 2022 on the Lower North Shore, in the eastern portion of Area 14 and the north side of Area 13 showed a high density of spawning females (primiparous and multiparous) and of sublegal-size males (DFO 2023).

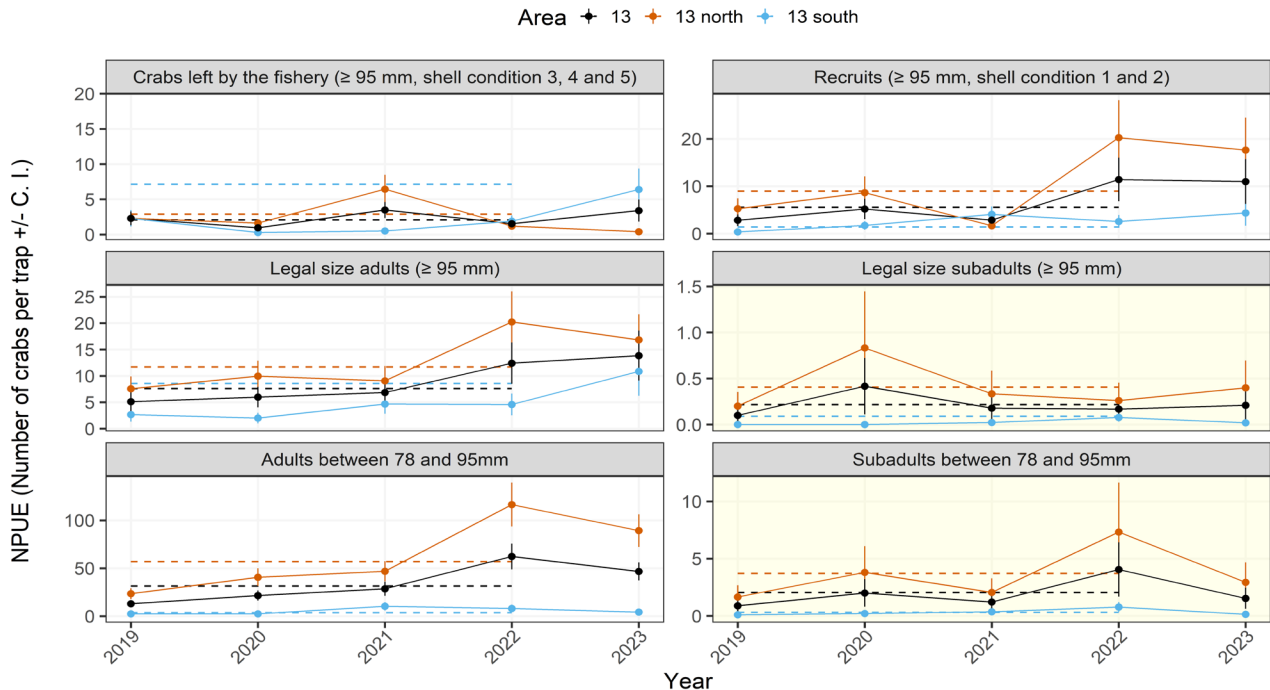


Figure 27. Annual catch rate (NPUE) ( $\pm$  95% confidence interval) of different categories of adult (white background) and subadult (yellow background) crabs from the post-season survey in Area 13 (black), and restricted to sub-area 13 north (orange) and sub-area 13 south (blue). The dashed line shows the historical data time series average (excluding the last year).

The **combined index**, derived from the commercial CPUE and the post-season NPUE for adult males  $\geq$  95 mm, is increasing between 2022 and 2023 (+21.1%, Figure 28), which suggests that the biomass available to the fishery in 2024 should be higher than in 2023.

The **thermal habitat indices** favourable to juvenile (Figure 3A) and adult (Figure 3B) snow crabs increase between 1990 and 2022.

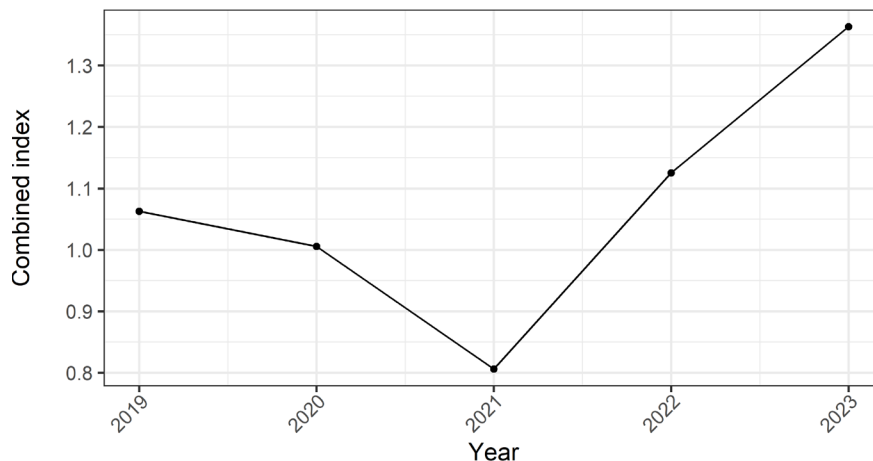


Figure 28. Combined index, derived from the annual standardized commercial CPUE and the annual NPUE from the post-season survey for legal-size adult males in Area 13.

### Outlook

The combined index is increasing between 2022 and 2023 (+21.1%), which suggests that the biomass available to the fishery in 2024 should be higher than in 2023.

According to the data from the post-season survey in the northern part of the fishing area, the pulse of primiparous females appears to have run its course. The abundance of subadults declined throughout the area, which suggests that recruitment to the fishery could decrease in the medium term.

*Higher scenario:* A 20% increase relative to total landings in 2023.

*Intermediate scenario:* A 10% increase relative to total landings in 2023.

*Lower scenario:* Status quo relative to total landings in 2023.

## Area 16A

### Description of the fishery

The total allowable catch (TAC) increased between 2022 and 2023 to 294.0 t, and it was reached, with landings of 290.0 t (+18.7%) or 98.6% of the TAC (Figure 29).

### Resource status in 2023

**Commercial fishery.** After reaching very low values between 2017 and 2022, the standardized commercial catch per unit effort<sup>3</sup> (CPUE) increased sharply between 2022 and 2023 (+69.2%), and is now at the historical average [2002; 2022] (Figure 30). The average carapace width of legal-size crabs sampled at sea declined by 3.0 mm between 2022 and 2023 (Figure 31). Landings in 2023 consisted mainly of recruits (72.7%), and this proportion has increased by 17% since 2020.

<sup>3</sup> The standardized CPUE in Area 16A is calculated solely from fishing trips involving the use of Japanese traps, which are smaller than the standard conical traps. See the “Sources of Uncertainty” section.

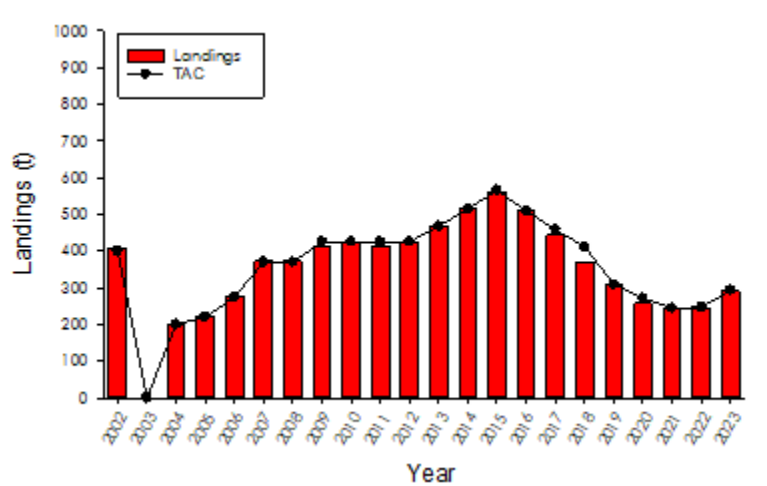


Figure 29. Annual landings and TACs in Area 16A.

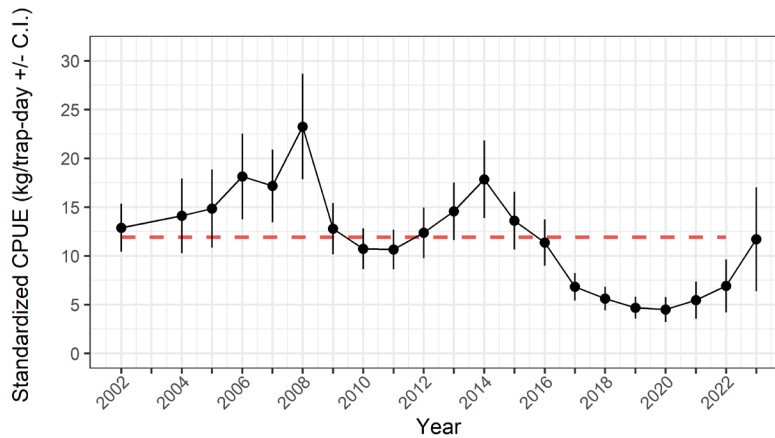


Figure 30. Standardized annual CPUE ( $\pm$  95% confidence interval) in the commercial fishery in Area 16A. The dashed line shows the historical data series average (excluding the last year) which is 11.9 kg/trap per day.

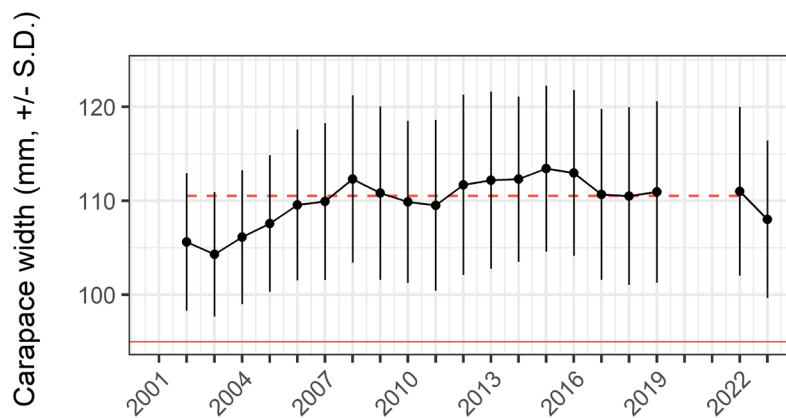


Figure 31. Average carapace width ( $\pm$  standard deviation) of legal-size male crabs measured at sea in the commercial fishery in Area 16A. The solid line shows the legal size at 95 mm and the dashed line shows the historical data series average (excluding the last year) which is 110.5 mm.

**Fishery-independent survey.** Area 16A encompasses two sectors (north and south) separated by the Anticosti Channel. In 2021, only traps on the south side of the Anticosti Channel were deployed in the post-season survey, which created uncertainty in the indicators for 2021 and trends between 2021 and 2022. The spatial coverage in the 2022 and 2023 post-season surveys was very similar. The 2023 post-season survey suggests that the abundance of both legal-size adult crabs, which consisted mainly of recruits, and of legal-size subadults increased dramatically (+118.2% and +119.5%, respectively; Figure 32). The abundance of crabs left by the fishery remains very low. The abundance of sublegal-size adults (78–95 mm) increased for the second year in a row (+20.0%), while that of sublegal-size subadults (78–95 mm) fell (-19.3%), although it remains above the historical average [2014; 2022] (Figure 32). The average carapace width of adult and adolescent male crabs increased between 2022 and 2023, although these values remain below their respective historical averages [2002;2022].

The results of the post-season survey point to a high density of multiparous females, while the density of primiparous females declined for a second consecutive year. All the survey indicators suggest increasing levels of recruitment to the commercial fishery, and this trend is expected to continue in the short and medium term.

**The combined index**, derived from the commercial CPUE and the post-season NPUE for adult males  $\geq 95$  mm, increased dramatically between 2022 and 2023 (+95.0%), after declining to its lowest value in 2021 (Figure 33). This increase suggests that the biomass available to the fishery in 2024 will be greater than in 2023.

The **thermal habitat indices** favourable to juvenile crabs showed an upward temporal trend during the 1990-2023 period (Figure 3A), while that for adult crabs declined during the same period (Figure 3B).

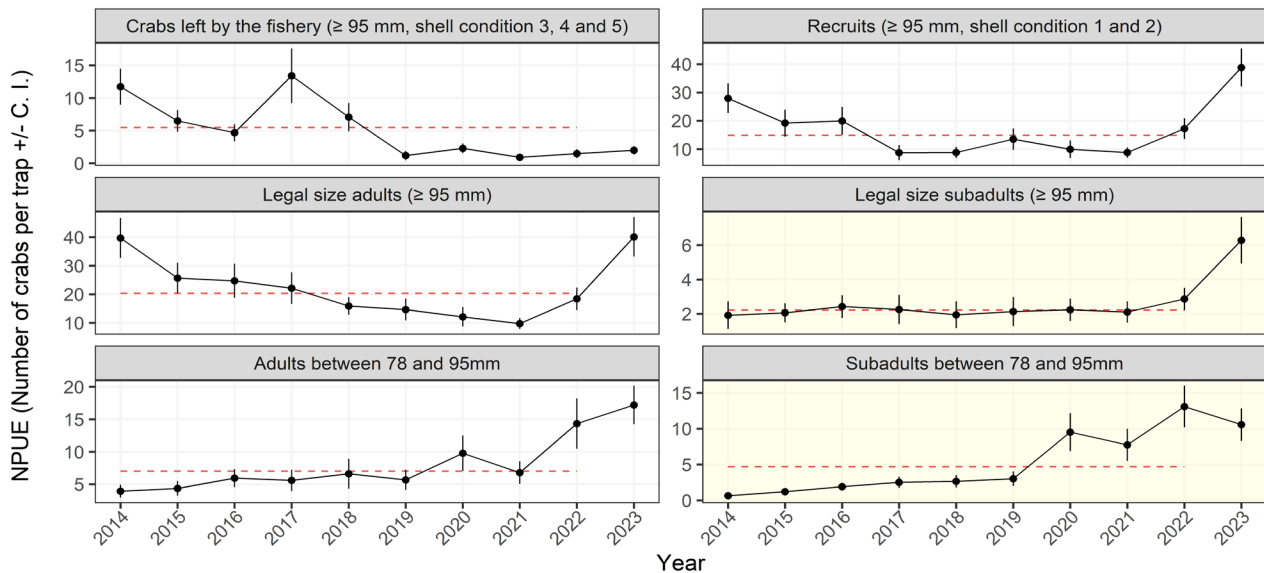


Figure 32. Annual catch rate (NPUE) ( $\pm$  95% confidence interval) of different categories of adult (white background) and adolescent (yellow background) crabs from the post-season survey in Area 16A (with large traps). The dashed line shows the historical data time series average (excluding the last year).

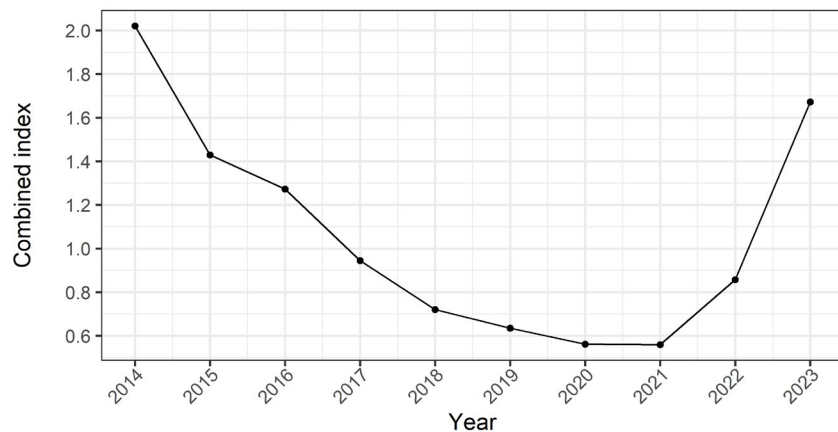


Figure 33. Combined index, derived from the annual standardized commercial CPUE and the annual NPUE from the post-season survey for legal-size adult males in Area 16A.

### Outlook

The combined index, after declining during the 2014-2021 period, has increased over the last two years, suggesting that the biomass available to the fishery will increase in 2024.

Crab abundance, which is cyclical, appears to be on the upswing as the pulse of primiparous females has come to an end and male recruitment to the fishery is increasing.

*Higher scenario:* A 40% increase relative to total landings in 2023.

*Intermediate scenario:* A 30% increase relative to total landings in 2023.

*Lower scenario:* A 20% increase relative to total landings in 2023.

## Area 12C

### Description of the fishery

The total allowable catch (TAC), which was reduced to 67.0 t in 2023 (a 6.3% decrease relative to 2022), was reached with landings of 64.0 t (-3.0%), representing 95.5% of the TAC (Figure 34). Landings in 2023 were the lowest since Area 12C was established.

### Resource status in 2023

**Commercial fishery.** Area 12C encompasses two sectors (north and south) separated by the Anticosti Channel. Since 2018, the commercial fishery is primarily concentrated in the northern part of the area, which adjoins Areas 14 and 15. The standardized commercial catch per unit effort (CPUE) fell to an all-time low between 2019 and 2022, but bounced back subsequently (195.3% increase between 2022 and 2023), to a value just above the average for the time series [2001; 2022] (Figure 35). The estimated effort in 2023 was the lowest on record since 2001, and the fishery was closed in less than five weeks. The average carapace width of legal-size crabs sampled at sea increased for the second consecutive year (+2.1 mm between 2022 and 2023), but remains below the historical average [2001; 2022] (Figure 36). Landings in 2023 consisted mostly of recruits (82.7%), and this proportion has increased by 33% since 2021.

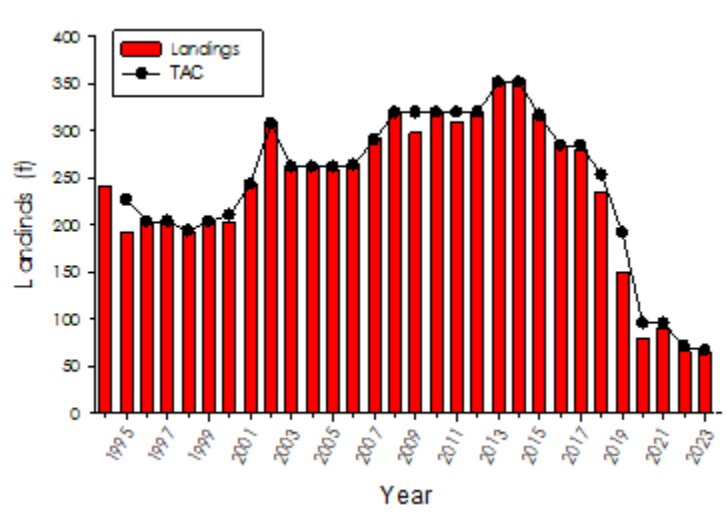


Figure 34. Annual landings and TACs in Area 12C.

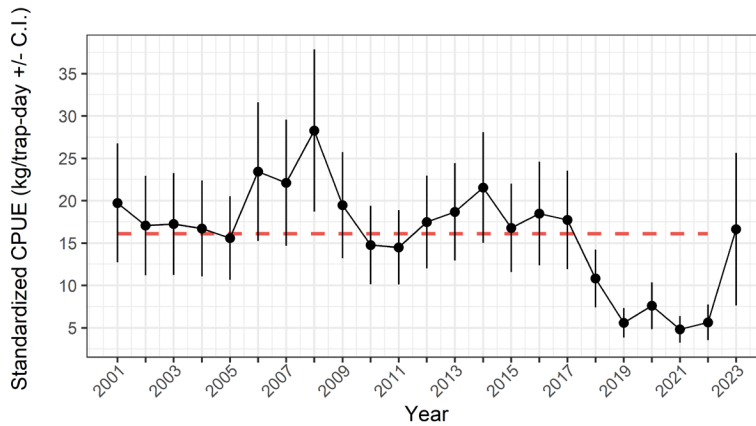


Figure 35. Standardized annual CPUE ( $\pm$  95% confidence interval) in the commercial fishery in Area 12C. The dashed line shows the historical data series average (excluding the last year) which is 16.1 kg/trap per day.

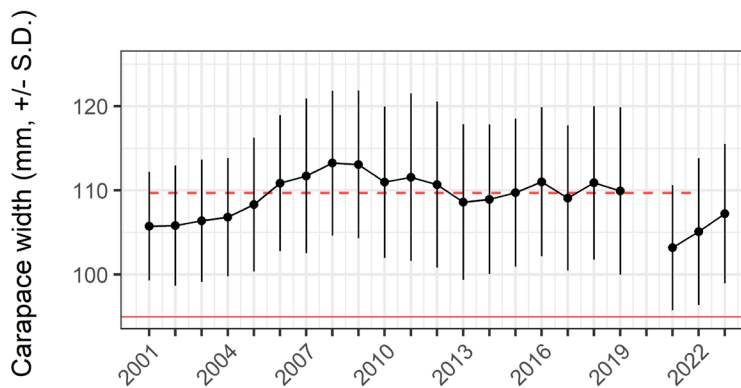


Figure 36. Average carapace width ( $\pm$  standard deviation) of legal-size male crabs measured at sea in the commercial fishery in Area 12C. The solid line shows the legal size at 95 mm and the dashed line shows the historical data series average (excluding the last year) which is 109.7 mm.

**Fishery-independent survey.** In the 2021 post-season survey, traps were only deployed on the northern side of the Anticosti Channel, which created significant uncertainty concerning the observed status of the resource and trends in the indicators for the past two years. However, in 2022 and 2023, traps were once again deployed in both the northern and southern parts of the fishing area. The 2023 post-season survey suggests that the abundance of legal-size crabs has increased sharply (+114.25%), although it remains slightly below the average for the time series [2014; 2022] (Figure 37). Recruit abundance, which was slightly above the historical average [2014; 2022] for the first time since 2016, accounted for most of this increase. The abundance index for crabs left by the fishery declined from 2022 to 2023 and remains very low. The number of legal-size adolescent crabs per trap was stable from 2022 to 2023, remaining above the historical average [2014; 2022]. The abundance index for sublegal-size adults is experiencing an upwards trend, reaching the highest value of the time series [2014; 2023] in 2023, indicating that the proportion of crabs undergoing early terminal moult is high in this area. The abundance index for sublegal-size adolescent crabs (78–95 mm) increased for the second consecutive year. Although the average size of adult crabs is rising (+2.5 mm), it is still below the historical average [2001; 2022].

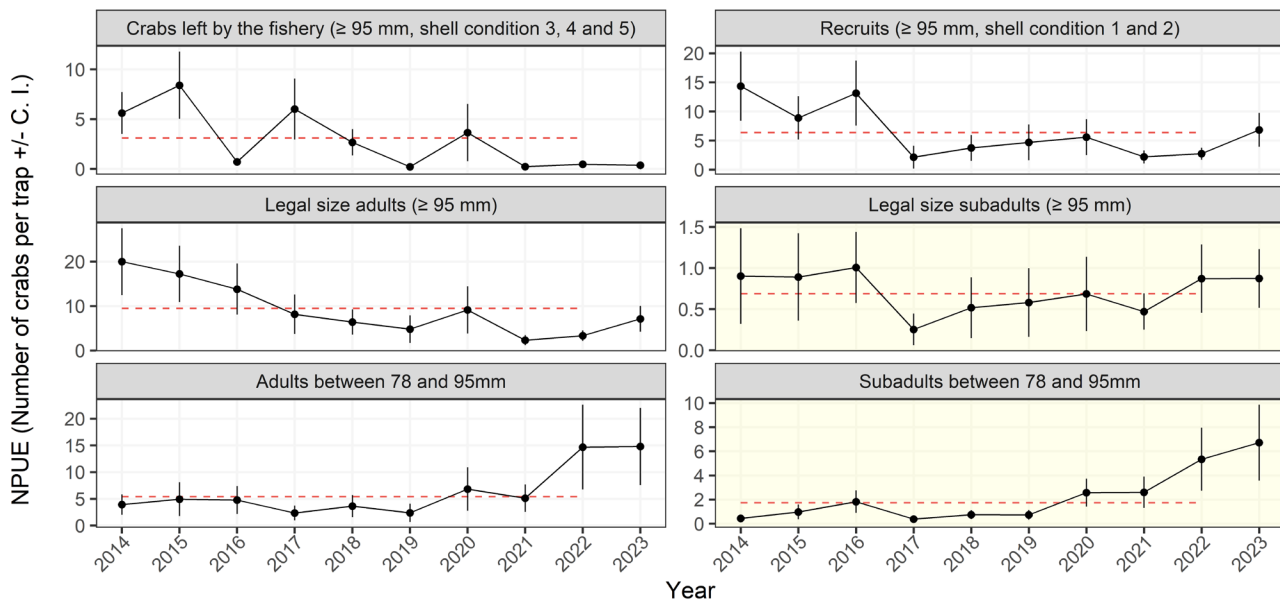


Figure 37. Annual catch rate (NPUE) ( $\pm$  95% confidence interval) of different categories of adult (white background) and adolescent (yellow background) crabs from the post-season survey in Area 12C. The dashed line shows the historical data time series average (excluding the last year).

**The combined index**, derived from the commercial CPUE and the post-season NPUE for adult males  $\geq 95$  mm, increased sharply (+160.4%) between 2022 and 2023, suggesting that the biomass available to the fishery in 2024 should be greater than in 2023 (Figure 38).



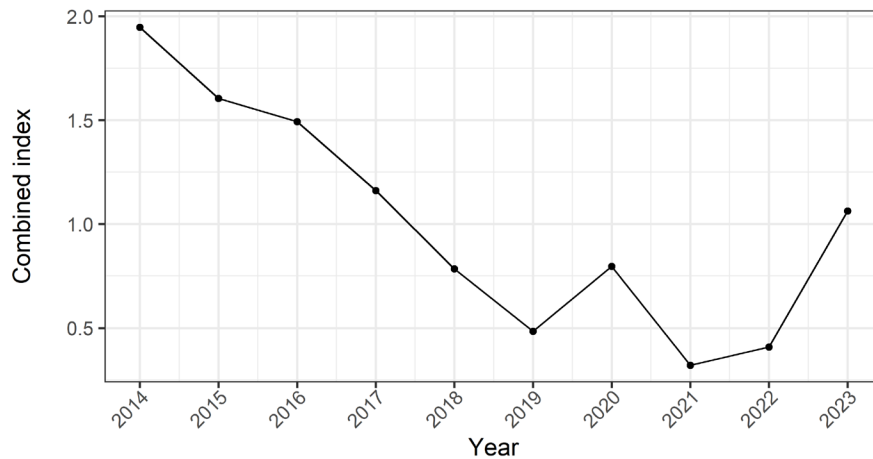


Figure 38. Combined index, derived from the annual standardized commercial CPUE and the annual NPUE from the post-season survey for legal-size adult males in Area 12C.

The favourable thermal habitat index for juvenile crabs remains stable (Figure 3A), while that for adult crabs has shown a downward trend over the last few decades (Figure 3B). This habitat loss could have a negative impact on the future stock productivity.

### Outlook

The combined index increased sharply between 2022 and 2023 (+160.4%), and the biomass available to the fishery in 2024 is expected to be greater than in 2023.

Crab abundance, which is cyclical in nature, appears to be on the upswing as the pulse of primiparous females has come to an end and male recruitment to the fishery is increasing. On the other hand, the average adult crab size has been low in the last three years despite an increase in 2023.

*Higher scenario:* A 160% increase relative to total landings in 2023.

*Intermediate scenario:* A 120% increase relative to total landings in 2023.

*Lower scenario:* A 80% increase relative to total landings in 2023.

### Area 12A

As part of the development of a precautionary approach (PA) for snow crab in Area 12A, the method for standardizing the commercial catch per unit effort (CPUE) and the CPUE of legal-size males derived from the post-season survey (CPUE95) was reviewed and amended in the winter of 2023 (Loboda *et al.* 2024, in prep.<sup>4</sup>). Limit thresholds were developed for these two standardized commercial biomass indicators in order to adopt a multi-indicator approach to implementing the PA for the stock in Area 12A. Combining the status of both indicators using a scoring grid allows the stock status to be assessed based on a limit reference point (LRP). For each of the two indicators, the two-year moving average is also calculated and used to determine whether the value for the most recent year is below the threshold in the case of an upward trend.

<sup>4</sup> Loboda, S., et al. 2024. Révision des indices de biomasse et d'abondance et proposition de points de références pour le crabe des neiges (*Chionoecetes opilio*) de la zone 12A. In preparation.

**Description of the fishery**

At 45.0 t, the total allowable catch (TAC) in 2023 remained similar to that in 2022. The TAC was not reached due to socio-economic reasons. Landings declined by 9.3% in 2023 and totalled 39.0 t, representing 86.7% of the TAC (Figure 39).

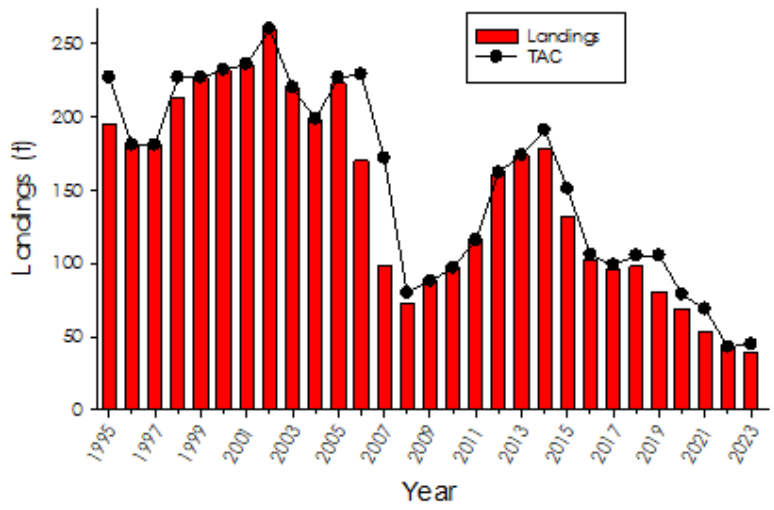


Figure 39. Annual landings and TACs in Area 12A.

**Resource status in 2023**

**Commercial fishery.** The standardized CPUE, which reached one of the lowest values of the time series in 2022, increased in 2023 (Figure 40). The probability of the moving average of the CPUE values for the last two years being below the threshold is 76%.

The average carapace width of legal-size crabs sampled at sea, which had declined between 2021 and 2022, remained stable but very low in 2023 (-0.3 mm) (Figure 41). Landings in 2023 consisted primarily (78.8%) of intermediate-shell crabs.

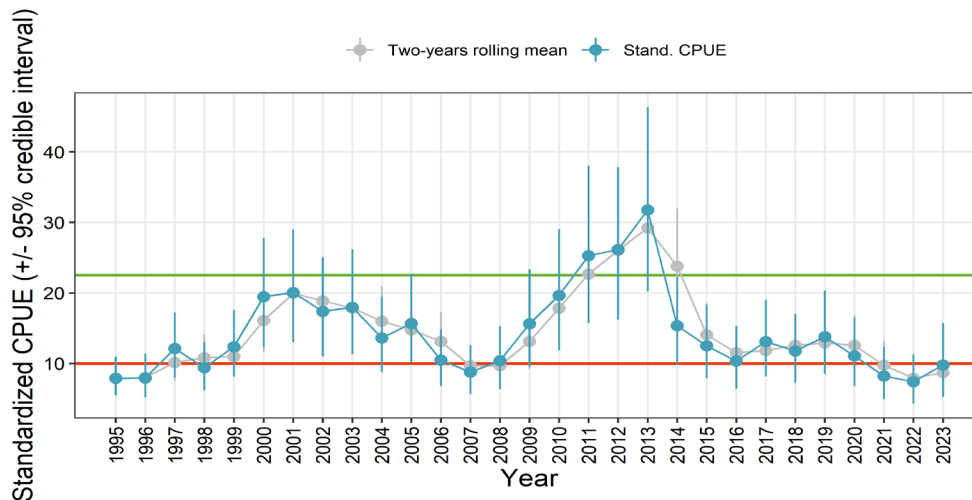


Figure 40. Standardized annual CPUE (in blue, +/- 95% credible interval) and the two-year moving average (in grey, +/- 95% credible interval) in the commercial fishery in Area 12A between 1995 and 2023. The red line shows the limit threshold established for this commercial biomass indicator, and the green line, the upper threshold proposed in developing the precautionary approach.

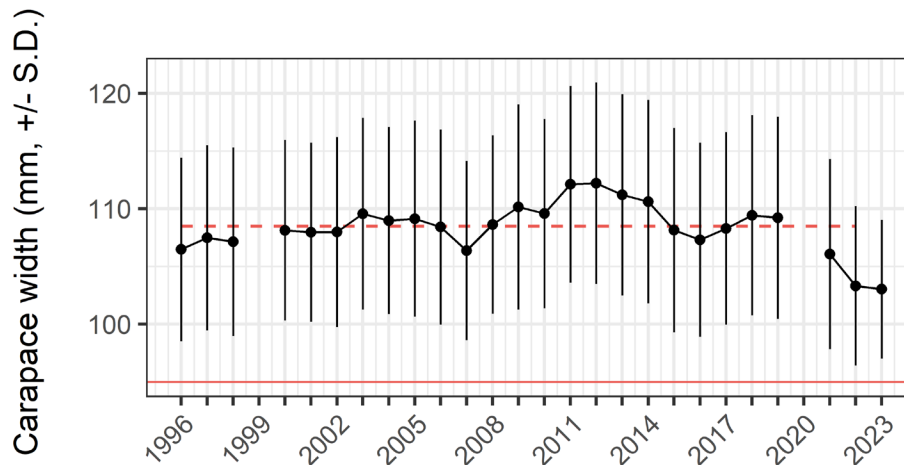


Figure 41. Average carapace width ( $\pm$  standard deviation) of legal-size male crabs measured at sea in the commercial fishery in Area 12A. The solid line shows the legal size at 95 mm and the dashed line shows the historical data series average (excluding the last year) which is 108.5 mm.

**Fishery-independent survey.** In 2023, owing to the presence of North Atlantic Right Whales, certain fishing grids were closed and the post-season survey was conducted nearly two months later than usual. According to the results of the 2023 research trap survey, the abundance of commercial crabs increased slightly between 2022 and 2023, following a steady decline since 2011. This increase can be observed among both recruits and crabs left by the fishery (Figure 42). The abundance of legal-size subadults declined between 2022 and 2023, while that of sublegal-size subadults (78–95 mm) was stable and close to the historical average (Figure 42).

The CPUE95, after peaking in 2011, declined between 2011 and 2021 to its lowest values (Figure 43). Although the value of the CPUE95 increased between 2022 and 2023, there is a 100% probability that the moving average for the past two years is below the limit threshold .

A scoring grid was developed to determine the stock status in relation to the reference points of the precautionary approach being developed (Loboda *et al.* 2024, in prep.<sup>4</sup>). A final score equal to or less than 1 indicates that the stock is in the critical zone, whereas a score of between 2 and 4 places the stock in the cautious zone, and a score equal to or greater than 5 indicates that the stock is in the healthy zone. The results obtained for the Area 12A (1) snow crab stock indicates that the stock has been in the critical zone since 2015 despite an increase in the commercial biomass indicators between 2022 and 2023 (Figure 44).

## Assessment of the Estuary and Northern Gulf of St. Lawrence Snow Crab Stocks in 2023

### Quebec Region

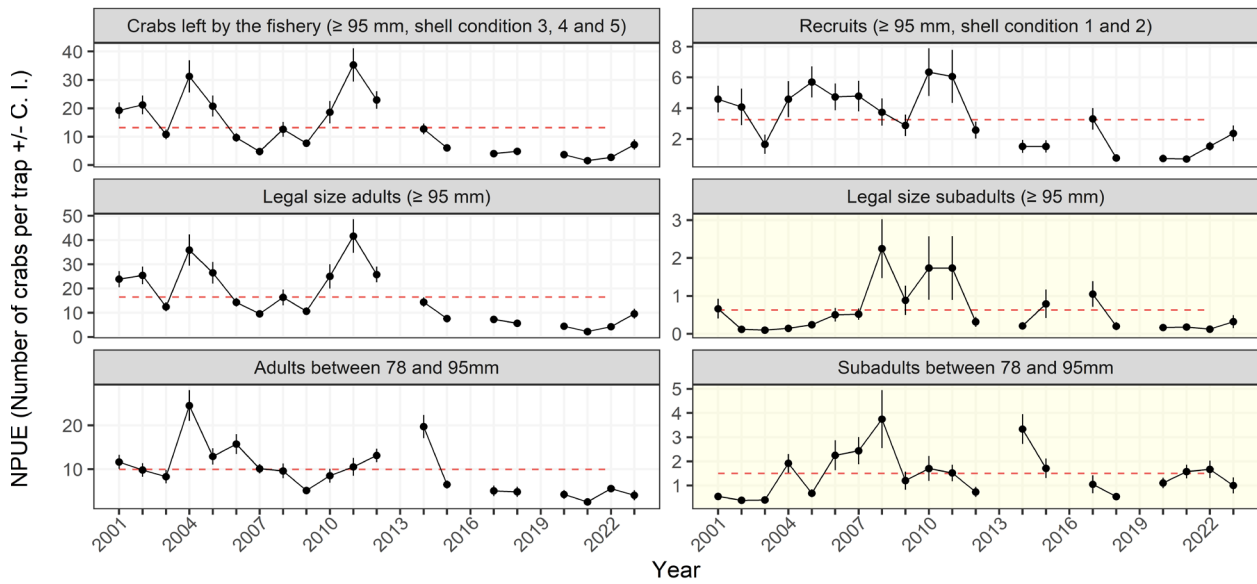


Figure 42. Annual catch rate (NPUE) ( $\pm$  95% confidence interval) of different categories of adult (white background) and adolescent (yellow background) crabs from the post-season survey in Area 12A. The dashed line shows the historical data time series average (excluding the last year).

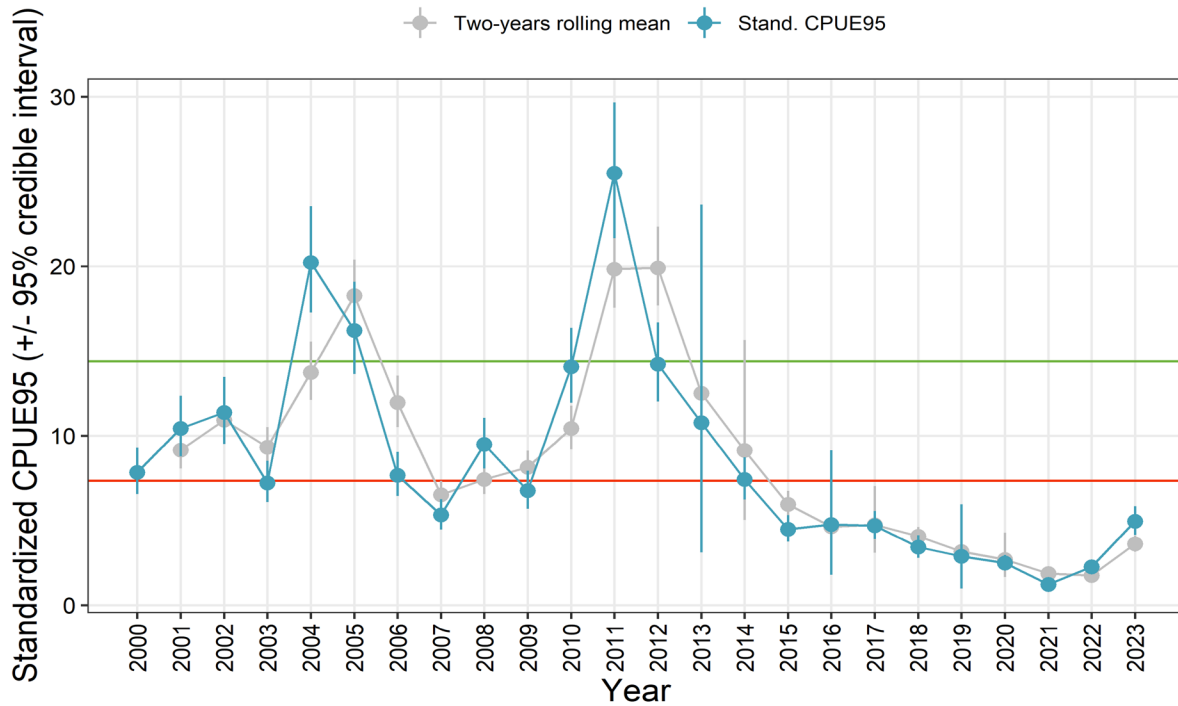


Figure 43. Standardized annual CPUE95 (in blue,  $\pm$  95% credible interval) and the two-year moving average (in grey,  $\pm$  95% credible interval) from the post-season survey in Area 12A between 2000 and 2023. The red line shows the limit threshold established for this commercial biomass indicator, and the green line, the upper threshold proposed in developing the precautionary approach.

## Assessment of the Estuary and Northern Gulf of St. Lawrence Snow Crab Stocks in 2023

### Quebec Region

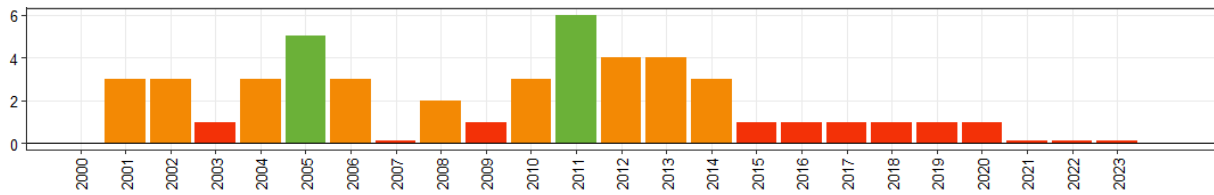


Figure 44. Final score based on the scoring grid developed for snow crab in Area 12A under a multi-indicator-based precautionary approach (Loboda *et al.* 2024 in prep.<sup>4</sup>).

The thermal habitat index favourable to adult snow crab in Area 12A shows an eroding trend over the past several decades (Figure 3B), which could have a negative impact on the future productivity of the stock.

### Outlook

Combining the status of the commercial biomass indicators puts Area 12A in the critical zone beginning in 2015, according to the precautionary approach being developed.

Considering that the precautionary approach is under development and that the Area 12A stock is in the critical zone despite an improvement in the primary commercial biomass indicators between 2022 and 2023, removals in 2024 should be as low as possible and should not exceed 2023 landings or thereabouts in order to promote the rebuilding of the snow crab stock.

### 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. 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).

The abundance and condition indices as well as 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.

The standardization approach used for the commercial CPUE index was initially developed in 2003 (Bourdages and Dufour 2003) and a few adjustments were made in 2006 (DFO 2007). Since then, the CPUE standardization method (with the exception of Area 12A; Loboda *et al.* 2024, in prep.<sup>4</sup>) has not been modified despite changes observed in the fishing season (start and length of season) and in the type of traps used by most fishers or by a large proportion of new fishers in certain fishing areas over the past two decades. For example, for areas 14, 13 and 16A, only fishing trips involving the use of Japanese traps, which are smaller than the

standard conical ones, are considered in the calculation of standardized CPUE indices, despite the increased use of conical traps over time. In addition, for areas where the two types of trap are taken into account in the calculation, the standardized CPUE value, an estimate derived through statistical modelling, appears not to be supported by the raw data. In order to process the different biases observed in the analysis methods, a review of the standardized CPUE is imperative and is currently under way.

Reviewing and modifying the protocol for standardizing the abundance indicators derived from the post-season survey is also a priority, particularly in order to integrate the data from different types of traps, which is not currently being done. Crabbers also repeatedly mentioned the possibility of trap saturation in the post-season survey during periods of high recruitment to the fishery, as is currently the case in some areas. A standardization approach that takes into account the potential maximum saturation could be considered.

## **OTHER CONSIDERATIONS**

During summer, the 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, a warming of the surface layer and the deep water layer has been observed in the Gulf of St. Lawrence with record temperatures recorded during 2021 (Galbraith et al. 2022). 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 and abundance (Émond et al. 2020). A favourable thermal habitat indices (see Tamdrari et al. 2012 for the method) was calculated for each fishing area based on the surface area where the bottom temperature is favourable to adult (-1°C to 3°C) and juvenile (0 à 2°C) snow crab ) (Dionne et al. 2003, Sainte-Marie et al. 2005, Ouellet et Sainte-Marie 2018). 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.

In recent years, the increasing presence of lobsters (*Homarus americanus*) in snow crab traps has been observed, pointing to a potential increase in interspecific interactions between the two species in the Estuary and northern Gulf of St. Lawrence or, at the least, to a greater overlap between their respective ranges. This raises questions regarding potential lobster predation on snow crab and/or the impact of interspecific competition for space and food resources. More research is needed to better document the interactions between the two species.

**LIST OF MEETING PARTICIPANTS**

Name	Affiliation	Feb. 14	Feb. 15	Feb. 16
Beaudin-Gauthier, Jérôme	Fisher Area 16	X	-	-
Belley, Rénaud	DFO – Science	X	X	X
Bernier, Denis	DFO – Science	X	-	X
Bernier, Julie	DFO – Fisheries management	X	X	X
Bois, Samantha	Association des capitaines propriétaires de la Gaspésie	X	X	X
Boudreau, Sophie	DFO – Science	-	-	X
Bouchard, Donald	Première nation Essipit	-	-	X
Boucher, Jean-René	Area 16	X	-	X
Boucher, Larry	Fisher Area 16	X	-	-
Boula, Dominique	DFO – Fisheries management	X	X	X
Bourassa, Luc	Consultant	X	X	X
Bourdages, Hugo	DFO – Science	X	X	-
Bruneau, Benoit	DFO – Science	X	X	X
Buffitt, Shawn	Lower North Shore Fishermen's Association	-	X	X
Carruthers, Erin	Fish, Food and Allied Workers	-	X	X
Cervello, Gauthier	DFO – Science	X	X	X
Condo, Jaime	Gesgapegiag Mi'gmaq First Nation	-	-	X
Croussette, Yolaine	DFO – Fisheries management	X	X	X
Cyr, Charley	DFO – Science	X	X	X
De Carufel, Valérie	DFO – Science	X	-	-
Dennis, Bill	Province of Newfoundland and Labrador	X	X	X
Desgagnés, Mathieu	DFO – Science	X	X	X
Desjardins, Christine	DFO – Science	X	-	X
Doucet, Marc	Fisher Area 17	X	X	X
Dubé, Sonia	DFO – Science	X	X	X
Duplisea, Daniel	DFO – Science	X	-	-
Émond, Kim	DFO – Science	X	X	X
Fequet, Ross	Fisher Lower North Shore	X	-	X
Gagné, Camille	Fisher Area 12A	X	X	X
Galbraith, Peter	DFO – Science	X	-	-
Gianasi, Bruno	DFO – Science	X	X	X
Gosselin, Claude	Fisher Area 17	X	-	X
Guay, Cynthia	DFO – Fisheries management	X	X	X
Henri, Louis	Fisher Area 12A	-	-	X
Hobbs, Jeffrey	Fisher Lower North Shore	X	-	-
Huard, Pierre-André	Fisher Area 17	-	-	X
Joncas, Jean-Richard	Fisher Lower North Shore	X	X	-
Landry, Samuel	Fisher Area 17	-	-	X
Langelier, Serge	Agence Mamu Innu Kaikusseth	X	X	X
Lavallée, Michael	Fisher Lower North Shore	X	X	-
Lees, Kirsty	DFO – Science	X	X	X
Lévesque, Isabelle	DFO – Science	X	X	X
Loboda, Sarah	DFO – Science	X	X	X
Monger, Julie	Lower North Shore Fishermen's Association	X	X	-
Monger, Marc	Fisher Lower North Shore	X	X	X
Munro, Daniel	DFO – Science	X	X	X

**Assessment of the Estuary and Northern Gulf of  
St. Lawrence Snow Crab Stocks in 2023**

**Quebec Region**

Name	Affiliation	Feb. 14	Feb. 15	Feb. 16
Nadeau, Paul	Lower North Shore Fishermen's Association	x	x	x
Olmstead, Melissa	DFO – Science	x	x	x
Pinette, Majoric	Première nation Pessamit	x	-	x
Poirier, Serge	Fisher Area 16	x	-	-
Rail, André	Fisher Area 16	x	-	-
Ransom, Glen	Fisher Lower North Shore	x	x	-
Roy, Virginie	DFO – Science	x	x	x
Sainte-Marie, Bernard	DFO – Science	x	x	x
Sandt-Duguay, Emmanuel	Association de gestion halieutique autochtone Mi'gmaq et Wolastoqey	x	x	x
Sean-Fortin, David	DFO – Science	x	-	-
Senay, Caroline	DFO – Science	-	x	-
Sigouin, Evelyne	Association de gestion halieutique autochtone Mi'gmaq et Wolastoqey	x	x	x
Sioui, Benoit	Agence Mamu Innu Kaikusseth	x	-	-
Smtih, Andrew	DFO – Science	x	x	x
Stubbert, Curtis	Fisher Lower North Shore	x	x	x
Tamdrari, Hacène	DFO – Science	-	-	x
Vallée, Simon	Fisher Area 17	x	-	x
Vigneault, Guy	Pêcherie Shipek	x	-	-

## SOURCES OF INFORMATION

This Science Advisory Report is from the regional peer review meeting of February 14-16, 2024 on the Assessment of the Estuary and Northern Gulf of St. Lawrence Snow Crab Stocks (Areas 12A, 12C, 13, 14, 15, 16, 16A and 17). Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada \(DFO\) Science Advisory Schedule](#) as they become available.

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