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Southern Gulf of St. Lawrence (CFAs 12, 12E, 12F and 19) Snow Crab (*Chionoecetes opilio*) Stock Assessment in 2025

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Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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ABSTRACT

Stock status of southern Gulf of St. Lawrence (sGSL) snow crab (*Chionoecetes opilio*) in 2025 is in the healthy zone of the Precautionary Approach (PA). A commercial biomass of 46,720 tonnes (t) is projected for 2026. Fishery recruitment biomass is estimated at 25,525 t, while the residual biomass was estimated at 21,377 t. Based on the harvest decision rule, the commercial biomass estimate corresponds to a target exploitation rate of 34.82% and a catch option of 16,268 t for the 2026 fishery. For this catch option, a risk analysis indicates that there is a very low likelihood that the residual biomass would be below the limit reference point and a low likelihood (16.7%) that the 2026 commercial stock biomass will fall below the upper stock reference point of 41,400 t. Female spawning stock abundance is below average and primiparous abundance is very low. Population recruitment is below average. There is continued evidence of warming conditions in the sGSL that can impact snow crab population dynamics and distribution.

1. INTRODUCTION

The snow crab, *Chionoecetes opilio*, is a common cold-water species found in many northern regions from Greenland, northern Europe, Japan, the Bering Sea, and eastern Canada. Canadian snow crab populations are found off the coasts of Nova Scotia and Newfoundland and Labrador, as well as the northern and southern portions of the Gulf of St. Lawrence.

The southern Gulf of St. Lawrence (sGSL) snow crab population is naturally bounded by warm coastal temperatures to the south and west, and by warm deep waters of the Laurentian channel to the northeast (Figure 1), residing within an area of cold intermediate water layer (CIL). The snow crab population in the sGSL is considered as a single stock unit, with limited exchanges with northern and southern snow crab populations (Biron et al. 2008) and some free-floating larval inputs from the Quebec population to the north (Puebla et al. 2008).

1.1. BIOLOGY

The snow crab is a crustacean with a flat, almost circular body and five pairs of legs. The hard outer shell is periodically shed in a process called moulting, after which crabs have a relatively soft shell for a period of 8 to 10 months. Snow crab do not moult throughout their lifespan, but rather undergo a final, terminal moult after which they attain full sexual maturity (Conan and Comeau 1986; Comeau and Conan 1992). Sexually mature males have larger claws and span a wide range of sizes from 40 to 150 mm carapace width (CW). Sexually mature females develop a wider abdomen for carrying eggs and range in size from 40 mm to 95 mm CW. Females carry their eggs for either one to two years in the sGSL (Moriyasu and Lanteigne 1998). Eggs hatch in late spring or early summer and the newly-hatched larvae spend 12-15 weeks in the water column, then settle on the bottom. It takes at least 8-9 years (post-settlement) for males to grow to the commercial size (> 95 mm CW).

1.2. FISHERY AND MANAGEMENT

Since its beginnings in the mid-1960s, the sGSL snow crab fishery has grown to be a commercially important fishery with landings often in excess of 20,000 tonnes (t) annually (Figure 2). Management of the fishery is based on annual quotas (attributed by crab fishing area (CFA) and distributed among license holders) and effort controls (number of licenses, trap allocations, trap dimensions, and seasons). Landing of females is prohibited. The commercial stock is defined as hard-shelled mature males with a minimum size of 95 mm CW.

There are currently four CFAs in the sGSL: CFA 12, 12E, 12F and 19 (Figure 1), with CFA 12 being the largest by area, number of participants, and landings. Area bounds are not based on biological considerations, but solely for management purposes (DFO 2009). The fishing season in CFAs 12, 12E and 12F generally starts as soon as the sGSL is clear of ice in early April to early May and lasts until the end of June or when the area quota is caught. In CFA 19, the fishing season starts in July, after the lobster season, and ends in mid-September or when the quota is caught. The number of traps per license varies by harvester group and CFA.

There are two buffer zones within the sGSL where fishing is prohibited: one is along the northern edge of CFA 19 and the other is located along the south edge of CFA 19 (Figure 5). During the season, the fishery is subject to local area closures, usually in the form of 10’ x 10’ grids, to limit fishery impacts on soft-shelled and white-shelled crabs. In 2025, such closures were not implemented in favor of sharing information about soft-shells in catches with fishers, with the idea that these areas would be avoided. Local area closures are also used to minimize the risks of entanglement of critically endangered North Atlantic Right Whales (NARW) with fishing gear, which has been an ongoing concern since 2017.

1.3 ASSESSMENT CONTEXT AND OBJECTIVES

Snow crab stocks are known to go through cycles of abundance. The recent period from 2016 to 2022 was characterized by high levels of commercial recruits that were above 50,000 t annually. However, the snow crab stock is currently in a low part of its cycle, characterized by below average levels of not only commercial stock recruits, but also population and reproductive stock recruitment as well.

This research document contains advice to support two management objectives. The first is to ensure that a viable reproductive stock of commercial males remains after the fishery. The second aims to maintain a minimum quantity of commercial stock to sustain a commercial fishery. The advice is supported by survey-derived estimates of stock trends of different life stages, including the commercial biomass. We determined the 2025 stock status in relation to the Precautionary Approach (PA) framework and performed a risk analysis for specific catch options along with their likely stock status for 2026.

2. METHODS

Stock status of snow crab is mainly assessed through trends in abundance and biomass indices calculated using data from a dedicated post fishery annual trawl survey, conducted between July and September. These data provide indices of recruitment, spawning stock, and other crab categories of biological or commercial interest.

2.1. FISHERY PERFORMANCE

Data on reported landings and fishing effort (number of trap haul) were obtained from fishery logbooks and dockside monitoring data, compiled by the DFO statistics branches from the Quebec and Gulf Regions. Post-processing of these data by science staff involved verification, correction or deletion of erroneous data. This included corrections for fishing dates, fishing coordinates, landings and effort data (Harbicht et al. 2025).

2.2. SURVEY METHODS

2.2.1. Spatial Design

The sGSL snow crab trawl survey has undergone changes in sampling design, survey area and sampling protocol since its inception in 1988. Originally, the extent of the survey area was smaller and concentrated over fishing grounds. The survey area was sub-divided using a lattice of 10’ x 10’ latitude-longitude grids and a small number of randomly selected sampling locations were then selected and held as fixed stations in subsequent surveys, though stations were often discarded and relocated over subsequent years due to trawl damage. Major methodological reviews occurred in 2005 (DFO 2006) and 2011 (DFO 2012; Wade et al. 2014), which resulted in major design changes in the 2006 and 2012 surveys, respectively. In 2006, a large portion of survey stations was redistributed with the 10’ x 10’ lattice-grid design so that sampling stations would be more uniformly distributed within the survey area. In 2012, the 10’ x 10’ lattice-grid layout was discarded in favor of square grids, as defined using a Universal Transverse Mercator (UTM) (NAD 83) projection. This change was also accompanied by an expansion of the survey area boundaries to the 20 and 200 fathom isobaths. We consider that the survey area encompasses the vast majority of snow crab habitat in the sGSL.

As part of the implementation of the 2011 review, a new set of 325 sampling stations was generated for the 2012 survey and 355 new stations were generated for the 2013 survey. As was the common practice in previous surveys, it was decided that sampling locations generated for 2013 were to be retained as fixed stations in subsequent surveys.

However, not all regions within the survey area are amenable to trawling and this survey does not scan the sea bottom prior to trawling. About 20% of first tows in 2012 and 2013 failed due to damage to the trawl. The survey vessel was directed to a new, randomly-generated alternate sampling station within its assigned survey grid when significant trawl damage was incurred. The alternate location station would then be used as the reference fixed station for the following year's survey. At the time, it was felt that the fact that these alternate sampling locations were randomly generated would ensure that survey catches would remain as representative samples of their assigned grids, as was the intent of the original sampling design. However, this had the overall effect of a portion of stations being displaced to more trawlable areas within their respective sampling grids over time.

Since 2021, survey stations have been held at fixed locations from the 2020 survey, with the exception of an ongoing experiment involving a random subset of 100 of the survey sampling stations temporarily reverting to their original locations, as per the 2013 survey design (Hébert et al. 2021). This experiment is being performed in an effort to monitor and assess possible bias due to stations being relocated to more trawlable areas over time with possibly higher catches of snow crab.

2.2.2. Trawling

Sampling stations are trawled during civil twilight hours using a Bigouden *Nephrops* bottom trawl net, originally developed for Norway lobster fisheries in France. The trawl has a 20 m opening and a 28.2 m footrope (Moriyasu et al. 2008). The vessel fishes at a target speed of 2 knots for 5 minutes. A 3:1 warp-to-depth ratio is used, up to a maximum warp length of 575 fathoms. Monitoring probes were attached to the trawl at various positions. eSonar ® acoustic probes (eSonar, St. John's, NL, Canada) relayed real-time measurements of trawl depth, headline height and wing spread. Star-Oddi ® DST centi-TD et DST tilt probes (Star-Oddi, Gardabaer, Iceland) recorded water pressure and temperature, along with tilt angle measurements from a tilt probe attached to the center of the footrope.

2.2.3. Sampling Protocols

Survey catches were sorted by species or taxonomic group and measured directly aboard the vessel. For every crab, carapace width and carapace condition were recorded. Chela height (CH) was also measured for males while gonad color and egg clutch fullness were recorded for females (Hébert et al. 1997). Other species or taxonomic groups in the catch were identified, weighed and counted.

2.2.4. 2025 Survey

The *Avalon Voyager II*, a 65-foot stern-trawling (850 HP) fiberglass boat performed the survey from July 9th to September 17th, 2025. A total of 341 sampling stations (Figure 3) were successfully trawled out of a target number of 355, with a total of 411 trawling attempts. A maximum of three trawling attempts were performed at each sampling station.
Fourteen sampling stations were abandoned this year due to significant trawl damage. The 100 sampling stations which were reverted to their original random locations from 2013 are shown in Figure 4.

The average trawling speed in 2025 was 2.19 knots, compared to 2.28 knots in 2024, and 2.25 knots in 2023. Average trawl wing spread measurements were comparable to those of past years, at an average 7.7 meters.

The eSonar trawl acoustic monitoring system performed poorly in 2025, with only 68% of tows (233 of 341 tows) having sufficient wingspread observations to properly estimate the swept areas, down from 87% in 2024. The tow duration was a median of 311 seconds (s) in 2025, compared to 306 s in 2024 and 302 s in 2023. Trawl swept areas slightly increased to an average 2,707 m^2, from 2,691 m^2 in 2024.

Following a change in end-of-trawling protocol in 2021, the duration of the passive trawling phase, the period during which the trawl remains on the bottom during the winching of the trawl, has been greatly reduced, passing from an median time of ~90 s in 2019 and 2020, to 18 s in 2021, 13 s in 2022, 8 s in 2023, 7 s in 2024, and 14 s in 2025 (Surette and Chassé 2022).

2.2.5. Biological Categories

The following criteria were used to define the various snow crab categories used in this assessment. Crab maturity is assessed morphometrically using chela height and carapace width (Conan and Comeau 1986), while female maturity was based on visual inspection of the abdomen. Commercial crab are defined as mature male crab ≥ 95 mm CW. Immature males may be landed though they represent only a small percentage of overall landings. Commercial crab are divided into two groups: new recruits to the fishery (also called R-1 crab), identified as new-shelled crab (carapace conditions 1 and 2); and residual crab, which represents the portion of the commercial crab that is left over after the fishing season, identified as old-shelled crab (carapace conditions 3, 4 and 5). Skip moulting crab were identified as immatures with an old shell.

Adolescent male crab were grouped into size categories according to the time they are expected to recruit to the fishery. These categories are R-2 (83 to 98 mm CW), R-3 (69 to 83 mm CW), and R-4 (56 to 68 mm CW), which are expected to recruit to the fishery in two, three or four years' time, respectively. Female snow crab were separated into primiparous (defined as mature and new-shelled) and multiparous (mature and old-shelled) categories.

2.2.6. Catch Standardization

Survey catches were standardized by trawl swept area, calculated using wing spread measurements and vessel speed, integrated over the time interval defined by the trawl touchdown, calculated using tilt probe angle data, and the stop time, which signals the start of trawl winching. For tows with missing or insufficient wing spread data, their swept areas were calculated as the average of the nearest 10 tows with sufficient data.

2.2.7. Stock Composition

Annual size-frequency distributions were determined from standardized survey catches, separated by sexual maturity. For surveys prior to 2012, size-frequencies within each 10' x 10' grid (generally less than three stations), the survey design used at the time, were averaged prior to calculating the annual average. This step was performed to spatially disaggregate survey catches for these older surveys. Means and interquartile ranges of crab sizes were calculated for fishery recruits (legal-sized, new-shelled mature males) and mature females from their corresponding spatially disaggregated size-frequency distributions for each year.

2.2.8. Abundance and Biomass

The survey bounds are defined by a polygon with a surface area of 57,842.8 km^2. The survey area was partitioned using CFA and buffer zone spatial bounds (Figure 5). Kriging with external drift was used to estimate all abundance and biomass indices (DFO 2012). For biomass estimates, crab counts at each tow were first converted to weights using the size-weight equation $w = (2.665 \times 10^{-4})\ CW^{3.098}$, where w is the weight in grams and CW is the carapace width in mm (Hébert et al. 1992).

2.2.9. Pre-Recruit Survival Indices

To further investigate recent downward trends observed in the size-frequencies and fishery pre-recruits, we compared the abundances of different recruit and pre-recruit categories to the abundances of their corresponding successors the following year. Four recruit categories were considered: pubescent females and three fishery pre-recruit categories, i.e., R-4, R-3 and R-2. The abundance of pubescent females, identified as being immature with developing (orange colored) gonads was compared to the abundance of primiparous females from the following year. This category represents a relatively simple case for snow crab: females only remain in the pubescent stage for one year before they almost all become primiparous females the following year. Skip-molting rates among pubescents were considered negligible. For males, we considered fishery pre-recruit categories and their successors the following year. Because of skip-molting and variable maturation rates, these successors were defined as the sum of three categories: skip-moulters, new-shelled immatures and new-shelled matures from the following year.

2.3. SURVIVAL AND EXPLOITATION RATES INDICES

An index for annual exploitation rates (F_t) was defined as a proportion of fishery landings (L_t) for fishing year t over the commercial biomass B_{t-1} estimate from the previous year:

$$F_t = L_t / B_{t-1}$$

An index of the survival rate of commercial crab from post-fishery survey in year $t-1$ to the post-fishery survey in the following year, excluding fishery removals, was calculated as the ratio of the landings (L_t) plus the residual biomass (R_t) in year t after the fishery over the commercial crab estimate (B_{t-1}) from year $t-1$:

$$S_t = (L_t + R_t) / B_{t-1}$$

Annual survival rates projection are subject to estimation error, changes in survey catchability and misidentification of carapace conditions. Also note that this estimate assumes that discard mortality from the fishery is negligible.

2.4. RISK ANALYSIS AND CATCH OPTIONS

The risk analysis calculated the probabilities that the biomass estimates from the 2025 survey would fall below their target reference points, considering a range of catch options. Specifically, that the residual biomass would fall below the Limit Reference Point (LRP) of 10,000 t, and that the total commercial biomass from the post-fishery survey would be below the Upper Stock Reference (USR) of 41,400 t. Inputs to the risk analysis were the projected recruitment biomass to the fishery (R-1) for next year's survey, using a Bayesian model (Surette and Wade 2006; Wade et al. 2014). Risk probabilities were then calculated for each catch option, with an assumed natural mortality equal to the observed rate from the survey for the past 5 years.

2.5. SNOW CRAB HABITAT INDICES

Snow crab habitat was defined as the area in the sGSL with bottom temperatures less than 3 °C. Habitat indices for snow crab, which included the size of the area and their average bottom temperature, were calculated using Conductivity Temperature Depth (CTD) profile data from the sGSL September multispecies survey (Galbraith et al. 2022). This temperature time series is the longest available and most reliable for the sGSL.

Temperature distributions for each crab category was obtained by first calculating average densities by 0.1 degree temperature bins, then scaling by the September temperature distribution within the survey area for the corresponding year. Quantiles of the resulting temperature distribution were then calculated and displayed as a whisker plots by crab categories and survey years. To account for the different survey design prior to 2012, standardized catches and temperature data were averaged by 10’ x 10’ grid prior to analysis. The temperature distribution of three crab categories of interest were examined:

1. mature females, an index of reproductive stock,
2. instar VIII crab, an index of population recruitment, and
3. commercial crab.

3. RESULTS

3.1. FISHERY PERFORMANCE

Catch per unit effort (CPUE) was calculated directly from landings and effort data for each CFA, compiled from crab harvesters’ logbook data. These CPUE values were not standardized. In CFA 12, the average CPUEs decreased by 12.6% from 60.3 kilograms per trap haul (kg/th) in 2024 to 52.7 kg/th in 2025, which is close to the average of values from 2018 to 2025. The CPUE for CFA 12E decreased substantially by more than half from 78.2 kg/th in 2024 to 36.2 kg/th in 2025. The CPUE for CFA 12F decreased by 12.2% to 79.0 kg/th. In CFA 19, the CPUE decreased by 16.8% from 136.5 kg/th in 2024 to 113.5 kg/th. CPUEs by CFAs are shown in Figure 6. Despite the lower CPUEs in CFA 12, fishers caught their quotas in a shorter time than usual, with 80% of the quota being caught in three weeks, rather than the five weeks required in 2024 (Harbicht et al. In press[1]).

3.2. STOCK COMPOSITION

3.2.1. Size Distributions

Size-frequency distributions for immature, new-shelled matures and old-shelled matures are shown for male crab in Figure 7 and female crab in Figure 8. The abundance of immature males across all sizes has significantly decreased from record-high levels in 2019 to 2021, down to moderate levels in 2025. New-shelled mature males have also visibly declined in 2025, relative to the period from 2019 to 2023. In contrast, the level of old-shelled mature males, in particular at sub-legal sizes, have remained fairly constant in recent years.

Size frequency distributions among female snow crab (Figure 8) show that immature females and new-shelled mature females have declined to low levels in 2025. Old-shelled mature females have declined to moderate levels in 2025. The size distribution of old-shelled females shows that it is composed of roughly equal parts instar IX (mode at about 48 mm CW) and X (mode at about 58 mm CW) in 2025.

[1] Harbicht, A., Surette, T., and Landry, J.-F. In press. Review of the 2025 snow crab (*Chionoecetes opilio*) fishery in the southern Gulf of Saint Lawrence (CFAs 12, 12E, 12F and 19). Can. Data Rep. Fish. Aquat. Sci.

Annual variation in mean crab sizes was examined for legal-sized new-shelled mature males (i.e., fishery recruits). Mean size among these recruits have varied from a low of 107.6 mm CW in 1999 to high of 115.1 mm in 2008. The mean size then decreased to 109 mm in 2011-2012, increased to 113.0 mm in 2015, then decreased to 108.8 mm in 2018 and has remained relatively constant and stands at 108.7 mm in 2025 (Figure 9), which is slightly below the series average.

Mean sizes among mature females have varied from 56.8 mm CW in 1999, to a high of 60.7 mm in 2005. Since 2005, mean size has gradually decreased to 56.7 mm in 2019, to 55.5 mm in 2022 and 2023, to 55.1 mm CW in 2024, the lowest in the series, but has increased to 56.3 mm CW in 2025 (Figure 9). The 5-6 mm CW decrease in mature females size (Figure 9) from 2005 to 2025 translates to a potential 20-28% decrease in individual fecundity.

3.2.2. Population Recruitment

The population recruitment index is defined as the abundance of small male crabs (34-44 mm CW), which roughly corresponds to instar VIII. Population recruitment has seen precipitous declines from a record high of 329 million crab in 2021, down to 66 million crab in 2024, but increased slightly to 77 million in 2025 (Figure 10), which is below the series average of 121.6 million crab. Male instar VIII is expected to reach commercial size in 5-6 years, though some portion may mature at sizes smaller than the commercial size.

3.2.3. Spawning Stock

Total mature male abundance from the survey had a period of high abundance from 1999 to 2004 with a high of 401 million animals in 1999, then declined to 160 million in 2009 (Figure 11). Abundance then increased to 299 million in 2012, decreasing to lower levels of about 235 million from 2013 to 2015. Since 2016, total abundance of mature males increased to highs of 425 million in 2022 but has decreased to 268 million in 2025, which is slightly below the series average of 300 million crab.

From 2018 to 2022, the quantity of legal-sized mature males was between 144 and 154 million crab and decreased to 85 million crab in 2025, which is below the time-series average of 118 million. The abundance of sub-legal sized mature crab, passing from 173 million in 2018 to 271 million in 2021 and 2022, then decreased to 182 million in 2025, which is very near the time-series average of 184 million.

Mature female abundance from the survey was over 600 million crab from 1999 to 2002, then declined to 237 million in 2006 (Figure 11). Since then, female abundance gradually increased to a high of 777 million in 2020, but has declined to 348 million in 2025, which is below the time-series average of 496 million.

Primiparous abundance from the survey was high from 1997 to 2001, with a sudden drop from 233 million in 2001 to 51 million in 2002, which gradually increased to 152 million in 2010, followed by a decrease to 79 million in 2011, which grew to 201 million in 2018 and 197 million in 2019, but has decreased down to a low value of 40 million crab in 2025, which is below the series average of 124 million, and the 2nd lowest in the time-series. Primiparous females generally represent an average of 25% of the spawning stock. In 2025, primiparous females only made up 10% of the spawning stock.

3.2.4. Fishery Recruitment

Fishery recruit estimates from the 2025 survey showed that R-4 abundances decreased by 12.3% to 107.7 million, which is slightly below the time-series average of 127.4 million (Table 1). R-3 abundances increased by 46.4% to 105.1 million, which is also slightly below the time-series average of 117.7 million. R-2 abundances increased by 17.9% to 64.6 million, which remains below the series average of 103.3 million. R-1 abundances further decreased by 24.0% to 45.4 million, which is below the time-series average of 79.5 million and the 3rd lowest value overall.

In terms of biomass, fishery recruitment (R-1) was considered to be at high levels from 2018 to 2022, with a low of 58,438 t in 2020 and a high of 68,348 t in 2022 (Table 2). From 2023 onward, there has been a steady decrease down to 25,525 t (21,611 t to 29,940 t) in 2025, the 3rd lowest value overall. After two years of high levels in 2023 and 2024, the proportion of skip-moulters among R-2 crab have decreased to 27% in 2025, which is slightly below the series average is 31% (Figure 12).

One-year predictions from the Bayesian recruitment model had over-estimated recruitment by 21.3% in 2020 and 15.6% in 2021, but predictions in subsequent years were similar to the survey estimates. Fishery recruitment is predicted to increase to 32,670 t (23,220 t to 44,760 t) in 2026, from 25,525 t in 2025 which would represent a 28.0% increase, but still lies below the series average of 46,538 t (Figure 13).

3.2.5. Commercial Biomass

Commercial biomass for 2025 is estimated at 46,720 t, with a 95% confidence interval of (40,530 – 53,582 t) (Table 2, Figure 14). This represents a 9.8% decline from 2024, a 31.0% decline from 2023 and a 45.4% decline from 2022. Recruitment represents 55% of the commercial biomass in 2025. The spherical variogram model used for interpolating the commercial biomass had a nugget value of 0, a sill at 1.4×10^6 and a range of 11.2 km.

Residual biomass (i.e., commercial crab with carapace conditions 3, 4 and 5) was estimated at 21,377 t (17,585 to 25,742 t), representing an increase of 25.1% from 2024 (Table 2, Figure 14). Residual biomass was dominated by carapace condition 3, representing 71% of survey catches, with 27% made up of carapace condition 4 crab and 2% carapace condition 5 crab (Table 1). The large proportion of carapace condition 3 in the residual biomass suggests that the post-fishery population is young and does not show signs of an ageing population, presumably because of high mortality due to fishing pressure.

A breakdown of the 2025 commercial biomass by CFA and buffer zone is shown in Table 3. The commercial biomass for CFA 12 was 37,865 t (32,593 – 43,742 t) representing 81.7% of the total estimated biomass located within the four fishing areas. In CFA 12E, the commercial biomass was estimated at 698 t (181 – 1,885 t), representing 1.5% of the biomass located within the four CFAs. In CFA 12F, the commercial biomass was estimated at 3,083 t (2,290 – 4,063 t), representing 6.7% of the total estimated biomass located within the four fishing areas. The commercial biomass for CFA 19 was estimated at 4,678 t (3,655 – 5,900 t), representing 10.1% of the total estimated biomass located within the four CFAs. An estimated 468 t of commercial crab lie within the unassigned zone above CFA 12E/12F and the two buffer zones (Table 3, Figure 5).

3.3. SPATIAL DISTRIBUTION OF COMMERCIAL CRAB

The spatial distribution of commercial crab in 2025 reflects the general decline in abundance in recent years. Crab concentrations remain centered around the Magdalen islands, notably to the northeast and southwest, as well as the Shediac Valley and Baie des Chaleurs (Figure 15).

The spatial distribution of the residual portion of commercial crab is shown in Figure 16. Residual stock concentrations are higher than 2024, but on a scale comparable to 2023, with local pockets in 12F and north of PEI. Concentration of residuals generally mirror that of the commercial biomass from the previous year (Figure 15).

Fishery pre-recruits in 2025 show a shift in spatial distribution from the southeastern toward the more central north-western portion of the sGSL (Figure 17). The main concentration is located immediately east of the Shediac Valley and is composed of mainly R-4 and R-3 crab. Lesser concentrations are present in CFAs 19 and 12F.

3.4. PRE-RECRUIT SURVIVAL INDICES

Figure 18 shows the relationship between the abundances of four recruit categories and their respective successors the following year. Differences between recruits and successors are driven mainly by annual variations in natural mortality, but can also be influenced by survey catchability, new/old-shell condition identification and size-selectivity differences due to growth.

Interannual comparison of primiparous and pubescent females shows that in general, the abundance of pubescent females is a strong predictor of primiparous females the following year, with most years showing that primiparous abundance is nearly equal to pubescent females from the year before.

However, there are important departures from this pattern. Primiparous abundance significantly exceeded pubescent abundance in 2015 (+47%), 2018 (+31%) and 2019 (+68%). While the source of the 2015 deviation is not known, 2018 was likely driven by shell condition identification issues, and 2019 was associated with a survey catchability due to a vessel change. Recent years all show record-low deviations of -57% (2022), -46% (2023), -57% (2024) and -37% (2025). This strongly suggests high levels of mortality for these years and explains much of the disappearance of the record-level population recruitment of 2020 and 2021 in subsequent years.

When we compare the relationship between the abundance of R-4 and its successors, we see some of the same patterns observed among pubescent and primiparous. Years 2018 and 2019 still significantly exceed R-4 abundance from the previous year (+41%), as well as 1999 and 2010. The latter was also associated with shell condition identification issues. The years 2022 to 2024 had similarly lower deviations of -26%, -14% and -28%, which also suggest significant increases in natural mortality for these years. The rate for 2025 was slightly positive at 14%, indicating a reduced mortality.

The relationship between the abundance of R-3 and its successors does not show the same negative deviation for 2022 to 2025, suggesting that natural mortality for this group has not greatly increased in recent years. There are still more cases where the abundance of successors of R-3 exceed that of their progenitors, indicating that there may have been survey catchability increases or shell condition identification issues for 1999, 2014 and 2015, in addition to the known issues for 2018 and 2019.

The relationship between the abundance of R-2 and its successors was somewhat more consistent than for smaller-sized crab. A particularity of this group was that the successors exceeded their R-2 progenitors by +41%, largely due to the fact that large crab in the R-1 category are generated by smaller R-1s from the previous year, not only R-2s. As was the case for R-3s, recent years were not associated with seemingly higher levels of mortality.

3.5. COMMERCIAL EXPLOITATION AND SURVIVAL RATES

Exploitation rates have varied between 21.0% and 44.7% from 1998 to 2025, with an average of 35.5% over the same period. The exploitation rate for the 2025 fishery was estimated at 35.7%, based on the 2024 survey commercial biomass estimate (Table 2).

Commercial survival rates have ranged from 50.6% in 2000 to 80.7% in 2010, with an average of 67.0%. The survival rate for 2025 was 77.0%, the fourth highest in the series (Table 2).

3.6. ENVIRONMENTAL CONDITIONS

3.6.1. Water Temperatures

Environmental factors, such as water temperature, can affect the timing and frequency of moulting and reproduction, as well as the movement of snow crab. Bottom temperatures over most of the sGSL are typically below 3 °C, a temperature range suitable for snow crab habitat. Bottom temperatures in deeper waters of CFAs 12E and 12F are higher (1 to 7 °C) than in snow crab grounds in CFA 12, while bottom temperatures in CFA 19 are usually 1 to 2 °C warmer than on the traditional crab grounds in CFA 12 (Chassé and Pettipas 2010).

Bottom temperatures in September 2025 were compared to the average temperatures over the period from 1991 to 2020 using data from surveys (Figure 19). Overall, near-bottom temperatures across most of the sGSL in 2025 remained above the long-term average, but anomalies were weaker and less spatially extensive than those observed in 2024. Positive anomalies generally ranged from +0.5 to +2.0 °C across much of the offshore sGSL, while near-normal to slightly cooler-than-average conditions persisted along portions of the southern and southwestern Gulf.

In CFA 12, bottom temperatures in September 2025 were above normal across large offshore areas between the Acadian Peninsula and the Magdalen Islands, including the Bradelle Bank, while Orphan and American Banks exhibited normal temperatures. Bottom temperatures in CFAs 12E, 12F and 19 also remained mostly above normal, particularly along the eastern and northeastern margins of the sGSL.

Temperatures in the deep waters of the Laurentian Channel remained elevated in 2025 and continued to be warmer than the long-term average, consistent with the persistence of warm deep-water in the deep channels of the GSL.

Figure 20 shows the average temperature stratification in September within the snow crab survey area by year. It shows that the depth range at which the deeper waters fall below the 3 °C threshold has been decreasing over the period as these waters warm, reaching record lows in 2021 and 2022, at around 115 m. This depth threshold increased slightly in 2023 and has remained stable at just over 125 m.

3.6.2. Habitat Indices

The surface area of the sGSL with bottom temperatures below 3 °C in September, an index of snow crab habitat, has been increasing from a low of 44, 881 km^2 in 2019 to 49, 959 km^2 in 2025, slightly above the long-term average of 48, 640 km^2 (Figure 21). This increase is mostly due to the cooler waters over Orphan and American Banks during the summer of 2025 compared to 2024. The temperature within the habitat area, at an average 1.31 °C, is still well above the long-term average (1991-2020) and is similar to the temperature observed in 2023 and 2024 and a 0.8 °C increase from the last significant minimum observed in 2014 (0.5 °C). The 2025 average temperature within the snow crab habitat ranks among the highest of the time series (Figure 21). The highest value (1.57 °C) was observed in 2021.

The water volume of the CIL, defined as waters < 1 °C, has been increasing for the last three years from a low of 482 km^3 in 2022 to 1,502 km^3 in 2025, but remains below the series average of 2,348 km^3 (Figure 21). The lowest CIL volumes were observed in 1980 and 2022.

3.6.3. Temperatures Occupied by Snow Crab

Figure 22 shows the September temperature distribution occupied by mature females, male instar VIII and commercial snow crab from 1997 to 2025 in the sGSL. September temperatures occupied by mature females have oscillated over the time series, with warm temperature periods in 2000, 2006, 2010, and 2012. The most recent warming trend began in 2014 with a low median temperature of 0.20 °C which rose to the highest value in the series at 1.21 °C in 2021 and has since decreased slightly to 1.09 °C in 2025 (Figure 22). The median temperature for instar VIII crab in 2025 was tied to the record high value in 2021 at 1.77 °C. Commercial crab occupation temperatures in September were relatively warm in 2000 and 2009-2014, and has since warmed from a median 0.17 °C in 2014 to a series high of 1.24 °C in 2021. Occupation temperatures in 2025 remained high at 1.12 °C. The occupation temperatures from 2020 to 2025 were the highest of the series.

4. PRECAUTIONARY APPROACH

4.1. REFERENCE POINTS

Reference points conforming to the PA (DFO 2009) were developed for sGSL snow crab in 2010 (DFO 2010). These reference points, in conjunction with appropriate stock parameters, are used to classify stock status as being in the critical, cautious or healthy zones, with each zone being assigned its particular management/harvest decision rules.

The sGSL snow crab stock has three defined reference points (Figure 23). A LRP = 10,000 t, was defined according to the lowest survey residual biomass observed from 1997 to 2008. An USR point = 41,400 t, was defined as 40% of the maximum commercial biomass (i.e., recruitment plus residuals) from the 1997 to 2008 surveys.

The commercial biomass estimate for the 2026 sGSL fishery is 46,720 t (Tables 2 and 3), which is within the healthy zone of the PA framework (Figures 23 and 24). The residual biomass after the 2025 fishery was at 21,377 t (Table 2), which was well above its limit reference point of 10,000 t.

4.2. RISK ANALYSIS

Inputs to the risk analysis were the commercial biomass from the 2025 survey (46,720 t), the projected fishery recruitment from the Bayesian model (32,670 t), and the 5-year average annual survival rate of 65.2%. A provisional catch option of 16,268 t, corresponding to an exploitation rate of 34.82%, as per the harvest decision rule, was used for the 2026 fishery (Figure 25).

The risk analysis indicates that the 16,268 t catch option would result in a low probability (16.7%) that the commercial biomass would fall below the USR in 2026, largely due to the low level of the predicted fishery recruitment of 32,670 t. In contrast, the residual biomass has a very low probability of 1.7% that it would be below LRP after the 2026 fishery.

This is the second year in row, since the PA reference points for this stock were updated in 2012, that there is a low likelihood that the stock will be in the cautious zone (Table 4). Previously, only the commercial biomass estimates in 2009 and 2010 would have placed the stock in the cautious zone, but these predated the implementation of the PA (Figure 24). Under the assumptions of the analysis, the 2026 commercial biomass is projected to remain almost identical to the one in 2025 (a 0.6% increase).

5. DISCUSSION

5.1. FISHERY CATCH PER UNIT EFFORT

Fishery quotas in CFA 12 were caught in a relatively short time in 2025: 80% of the quota was caught three weeks into the fishery, compared to five weeks in 2024. This suggests that the biomass available to the fishery was higher than expected. This perception is supported by the very low over-winter mortality (23%) that was estimated for the commercial biomass in 2025, in contrast to the more typical mortality (38%) that was estimated for 2024. Consequently, this lower mortality resulted in more commercial crab than expected being available for the fishery in 2025.

This low mortality also implied that the residual biomass would consequently be higher in the 2025 post-fishery survey. This was in fact the case, with the residual biomass increasing from 17,091 t to 21,377 t, despite the significant drop in fishery recruitment. Despite the low mortality, logbook CPUEs in 2025 nonetheless showed a moderate decrease relative to 2024, but remained relatively high, resulting in a shorten fishing season. In many ways, 2025 is comparable to fishing years 2010 and 2011, which also saw very low quotas and short fishing seasons, which were also associated with low mortality rates in 2010 (2011 mortality was not estimated due to data quality issues).

5.2. STOCK STATUS INDICATOR UNCERTAINTIES

The sGSL snow crab survey was developed to provide quality abundance and biomass indices: it uses a bottom trawl with high catchability for commercial crab, contains a large number stations, and a survey area that covers most of the crabs' habitat.

Changes in sampling design and fishing protocols have led to improvements in the survey over the years. However, these changes may imply that there have been unaccounted changes in the scale of indices. In particular, survey catchability has changed through time due to changes in survey design, expansion of the survey area, relocation of survey stations and variations in the timing of the survey. In addition, trawl catchability is known to vary with bottom type, sea conditions, current, vessel types, and trawl geometry.

6. CONCLUSION

The sGSL snow crab stock is currently at a low point in its population cycle. Commercial, population recruitment and reproductive stocks are currently below average. Primiparous abundance is at its second lowest value in the series. Record levels of small recruits in 2019 and 2020 have only led to average yields in 2025, likely the result of high natural mortality rates from 2022 to 2024. The commercial stock biomass from the post-fishery survey is estimated at 46,720 t, composed of 55% new recruitment and 45% of residual biomass. The large quantity of residuals in 2025 was due to low overwinter mortality.

Commercial biomass indicators placed the stock in the healthy zone of the PA in 2025. Based on the harvest decision rule, this commercial stock biomass estimate corresponds to an exploitation rate of 34.82%, and a catch option of 16,268 t for the 2026 sGSL snow crab fishery. Under this catch option, a risk analysis indicates there is a low likelihood that the stock will be in the cautious zone of the PA in 2026.

Warming temperatures in the sGSL remain a cause of concern, although the extent of the snow crab habitat and volume of the CIL have seen increases in the last few years.

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The snow crab team would like to bid a fond farewell to Ghislain Bourgeois, our fishmaster since 1990 and our survey captain from 2013-2024 who, despite his illness, took the time to show the ropes to the new captain at the beginning of the survey this year. Ghislain passed away less than a month later on August 10th, 2025 at age 75. We are grateful for your presence and service and you will be sorely missed.

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9. TABLES

Table 1. Annual abundance (in millions) of crab categories based on southern Gulf of St. Lawrence trawl survey data. Table entries shaded in red indicate below average values in the series, blue entries indicate above values and white entries indicate near average values. Yellow shaded years indicate survey vessel changes.

Year	Pre-recruits			Recruits	Residuals		
	R-4	R-3	R-2	R-1	CC3	CC4	CC5
1997	114.0	98.2	59.7	59.3	28.3	17.7	5.2
1998	135.3	91.3	60.3	50.9	24.9	16.0	8.6
1999	195.6	151.1	112.9	48.1	32.7	16.8	7.8
2000	237.5	159.1	88.4	68.4	10.3	7.4	2.5
2001	310.8	227.3	136.3	76.4	28.1	5.4	1.6
2002	164.3	242.2	202.2	112.3	21.7	4.3	0.9
2003	133.2	202.3	178.5	100.3	38.0	11.7	1.8
2004	85.8	122.9	144.1	143.3	28.2	9.9	1.2
2005	62.2	79.8	117.2	99.1	30.0	10.5	0.6
2006	54.1	49.6	65.7	84.2	29.2	5.8	1.0
2007	56.5	47.6	55.4	62.8	31.5	14.0	1.0
2008	80.6	54.6	45.8	49.1	23.0	11.4	3.0
2009	88.5	69.3	43.8	31.7	12.5	5.3	1.3
2010	140.8	110.3	72.5	32.8	20.6	4.2	1.6
2011	91.4	99.2	88.2	53.0	44.3	9.8	1.8
2012	95.7	86.4	80.5	86.6	37.9	5.7	1.2
2013	103.1	85.1	79.4	63.7	30.1	18.3	0.7
2014	105.1	93.6	117.2	73.3	29.6	13.1	0.6
2015	107.1	124.7	127.5	56.2	27.2	17.3	0.5
2016	113.1	124.8	101.6	125.9	30.6	14.7	0.1
2017	113.0	119.6	103.3	90.0	21.6	6.1	0.4
2018	135.6	116.5	108.3	115.6	34.6	4.5	0.8
2019	190.7	186.0	185.7	105.1	28.8	9.3	0.8
2020	180.9	170.3	174.3	103.5	29.8	7.2	0.6
2021	135.9	154.4	154.0	112.0	29.7	6.4	1.5
2022	94.7	93.1	102.3	119.6	27.6	6.2	0.7
2023	139.6	78.0	72.7	78.4	36.1	10.1	0.6
2024	122.8	71.8	54.8	59.7	24.5	8.2	1.7
2025	107.7	105.1	64.6	45.4	28.5	10.7	1.0
Average	127.4	117.7	103.3	79.5	28.3	9.9	1.8

Table 2. Annual recruitment, residual and total commercial biomass (in tonnes) of southern Gulf of St. Lawrence snow crab, based on trawl survey data. Parentheses show 95% confidence intervals. Also shown are annual landings, annual and five year average survival rates of commercial crab and exploitation rate (ER).

Year	Recruitment (t)		Residual (t)	Commercial (t)	Landings (t)	Survival (%)		ER (%)
	Observed (t)	Predicted (t)				Annual	5-year	
1997	37,910 (30,911-46,018)	-	27,688 (21,982-34,422)	64,518 (54,105-76,345)	17,249			
1998	30,603 (22,695-40,384)	-	28,295 (21,497-36,566)	57,813 (45,856-71,931)	13,575	64.9		21.0
1999	26,015 (20,709-32,265)	-	31,177 (25,044-38,356)	56,757 (47,641-67,102)	15,110	80.1		26.1
2000	40,734 (33,592-48,942)	-	9,979 (6,987-13,827)	50,621 (41,843-60,692)	18,712	50.6		33.0
2001	42,358 (33,800-52,422)	-	17,612 (13,853-22,077)	60,328 (49,851-72,351)	18,262	70.9		36.1
2002	66,076 (55,416-78,180)	-	13,060 (10,793-15,662)	79,228 (67,983-91,791)	25,691	64.2	66.1	42.6
2003	58,270 (50,270-67,175)	-	26,993 (22,124-32,613)	84,448 (73,486-96,574)	21,163	60.8	65.3	26.7
2004	83,764 (74,392-93,981)	-	21,259 (17,343-25,794)	103,146 (92,426-114,758)	31,675	62.7	61.8	37.5
2005	59,939 (53,551-66,870)	60,500 (38,800-86,000)	23,496 (18,902-28,868)	82,565 (73,514-92,415)	36,118	57.8	63.3	35.0
2006	54,541 (48,235-61,438)	49,700 (33,200-73,000)	19,621 (16,697-22,907)	73,645 (65,681-82,302)	29,121	59.0	60.9	35.3
2007	40,048 (35,286-45,269)	35,200 (21,300-55,000)	26,829 (23,232-30,821)	66,371 (59,971-73,264)	26,867	72.9	62.6	36.5
2008	32,241 (27,929-37,027)	29,000 (18,500-42,000)	20,981 (17,989-24,327)	52,921 (47,167-59,178)	24,458	68.5	64.2	36.9
2009	20,618 (17,747-23,818)	27,700 (17,800-38,000)	10,454 (8,687-12,474)	31,015 (27,519-34,829)	23,642	64.4	64.5	44.7
2010	20,477 (17,815-23,423)	25,900 (17,100-37,000)	15,490 (13,022-18,289)	35,929 (32,049-40,147)	9,549	80.7	69.1	30.8
2011	29,643 (25,676-34,045)	33,700 (22,900-47,000)	33,679 (28,430-39,613)	62,841 (55,985-70,299)	10,708	-	71.6	29.8
2012	49,010 (40,382-58,931)	40,700 (31,300-52,400)	25,615 (21,607-30,147)	74,778 (64,881-85,748)	21,956	75.7	72.3	34.9
2013	39,988 (31,504-50,055)	40,380 (31,670-50,380)	27,092 (22,041-32,952)	66,709 (54,294-81,108)	26,049	71.1	73.0	34.8
2014	44,285 (37,440-52,014)	37,893 (28,568-49,114)	23,863 (20,356-27,799)	67,990 (59,802-76,978)	24,479	72.5	75.0	36.7
2015	34,982 (29,145-41,643)	42,300 (32,760-51,840)	24,106 (20,290-28,429)	58,927 (51,368-67,278)	25,911	73.6	73.2	38.1
2016	74,124 (64,811-84,392)	50,000 (36,400-66,900)	24,309 (20,876-28,143)	98,394 (87,150-110,677)	21,725	78.1	74.2	36.9
2017	51,127 (43,976-59,103)	46,200 (31,400-64,230)	14,650 (12,134-17,534)	65,738 (57,221-75,157)	43,656	59.3	70.9	44.4
2018	59,609 (51,755-68,310)	47,700 (33,800-64,880)	21,432 (17,271-26,291)	80,746 (70,984-91,467)	24,260	69.5	70.6	36.9
2019	58,995 (50,215-68,863)	49,820 (33,790-70,970)	20,291 (16,940-24,109)	79,066 (69,072-90,091)	31,707	64.4	69.0	39.3
2020	58,438 (49,759-68,189)	74,280 (49,300-107,400)	19,107 (16,235-22,239)	77,748 (67,706-88,852)	28,156	59.8	66.2	35.6
2021	62,473 (53,650-71,590)	72,230 (48,200-104,100)	19,144 (15,997-22,726)	80,950 (70,543-92,451)	24,479	56.1	61.8	31.5
2022	68,348 (58,894-78,880)	65,100 (44,410-92,220)	17,388 (14,040-21,292)	85,532 (74,658-97,535)	31,661	60.6	62.1	39.1
2023	44,512 (37,846-52,010)	49,100 (34,050-68,450)	24,393 (20,500-28,807)	67,731 (59,204-77,135)	35,404	69.9	62.4	41.4
2024	34,946 (30,191-40,235)	37,040 (25,870-51,370)	17,091 (14,373-20,172)	51,786 (45,558-58,621)	25,616	62.6	62.1	37.4
2025	25,525 (21,611-29,940)	29,570 (20,590-41,170)	21,377 (17,585-25,742)	46,720 (40,530-53,582)	18,530	77.0	65.2	35.7
2026	-	32,670 (23,220-44,760)	-	-	-	-	-	-

Table 3. Commercial biomass by crab fishing area (CFA) and buffer zones based for the last four years. Parentheses show 95% confidence intervals. Labels are from Figure 5.

CFA	Area (km^2)	Biomass (t)				
		2022	2023	2024	2025	
Southern Gulf	57,842.8	85,532	67,731	51,786	**46,720**	(40,530-53,582)
CFA 12	48,074.0	75,742	58,412	42,090	**37,865**	(32,593-43,742)
CFA 12E	2,436.9	685	509	717	**698**	(181-1,885)
CFA 12F	2,426.8	4,320	4,675	3,395	**3,083**	(2,290-4,063)
CFA 19	3,813.0	4,094	3,702	5,271	**4,678**	(3,655-5,900)
Sum of CFA[1]	56,750.7	84,841	67,298	51,473	**46,324**	-
Unassigned zone above 12E/F **(A)**	667.9	43	45	33	**45**	(0-301)
Buffer zone 19/12F **(B)**	134.2	137	149	159	**222**	(115-387)
Buffer zone 12/19 **(C)**	289.5	552	311	194	**201**	(38-634)
Sum of total areas and zones	57,842.7	85,573	67,803	51,859	**46,792**	-

[1] Small difference in the sum of all individual area estimates compared to the southern Gulf estimates is due to rounding of intermediate calculations.

Table 4. Risk analysis for different catch options for the 2026 southern Gulf of St. Lawrence snow crab fishery showing the probability that the residual commercial biomass (B_{res}) would be below limit reference point (LPR), the probability that the total commercial biomass (B) would be below the upper stock reference (USR), and the expected biomass for the 2026 survey. In bold is the catch option corresponding to an exploitation rate of 34.82%, the rate as per the harvest decision rule.

Catch option (t)	Probability		Predicted survey biomass for 2026 (t)
	B_{res} < LRP	B < USR	
10,000	0.0%	1.0%	53,351 (42,996-65,935)
11,000	0.0%	1.9%	52,351 (41,996-64,935)
12,000	0.0%	3.2%	51,351 (40,996-63,935)
13,000	0.0%	5.1%	50,351 (39,996-62,935)
14,000	0.0%	7.7%	49,351 (38,996-61,935)
15,000	0.3%	11.2%	48,351 (37,996-60,935)
16,000	1.2%	15.4%	47,351 (36,996-59,935)
16,268	**1.7%**	**16.7%**	**47,013 (36,657-59,636)**
17,000	4.1%	20.5%	46,351 (35,996-58,935)
18,000	11.1%	26.4%	45,351 (34,996-57,935)
19,000	23.3%	32.8%	44,351 (33,996-56,935)
20,000	39.9%	39.6%	43,351 (32,996-55,935)
21,000	58.2%	46.6%	42,351 (31,996-54,935)
22,000	74.3%	53.5%	41,351 (30,996-53,935)
23,000	86.1%	60.2%	40,351 (29,996-52,935)
24,000	93.4%	66.4%	39,351 (28,996-51,935)
25,000	97.2%	72.1%	38,351 (27,996-50,935)
26,000	99.0%	77.2%	37,351 (26,996-49,935)
27,000	99.6%	81.6%	36,351 (25,996-48,935)
28,000	99.9%	85.3%	35,351 (24,996-47,935)
29,000	100.0%	88.5%	34,351 (23,996-46,935)
30,000	100.0%	91.0%	33,351 (22,996-45,935)
35,000	100.0%	97.8%	28,351 (17,996-40,935)

10. FIGURES

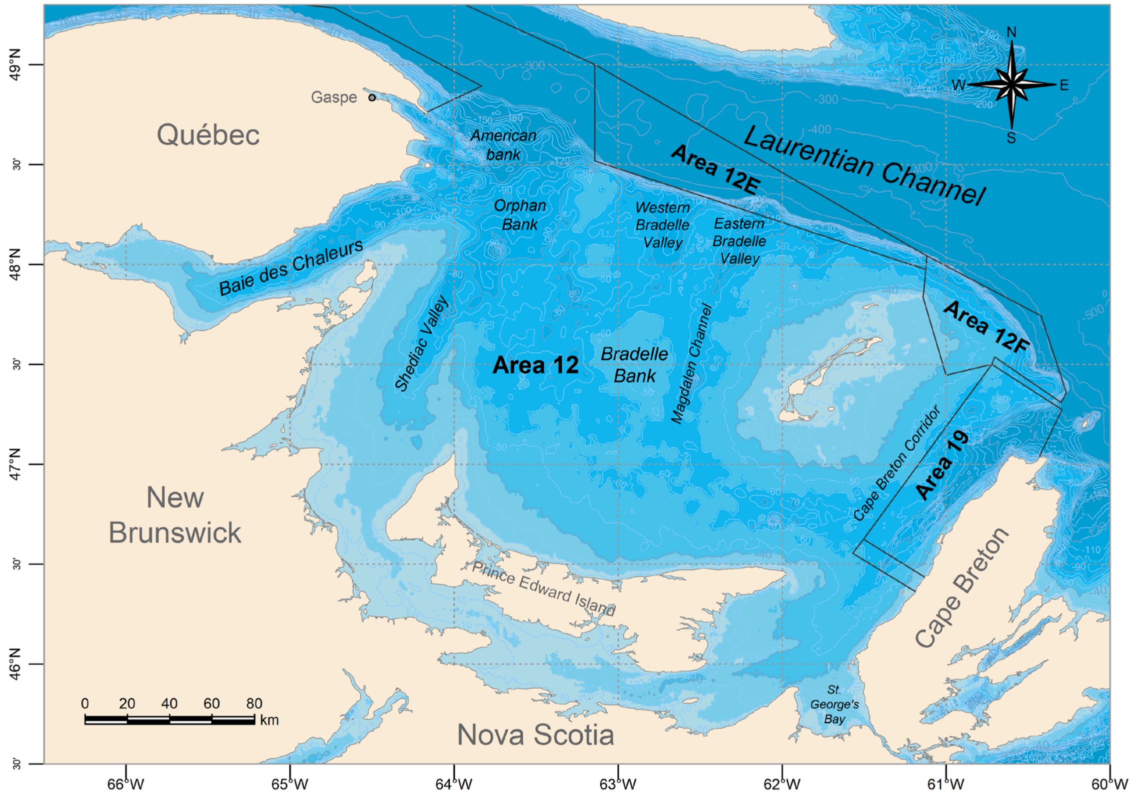

Figure 1. Map of the southern Gulf of St. Lawrence showing snow crab fishery areas (CFAs 12 12E, 12F and 19) and common names for fishing grounds.

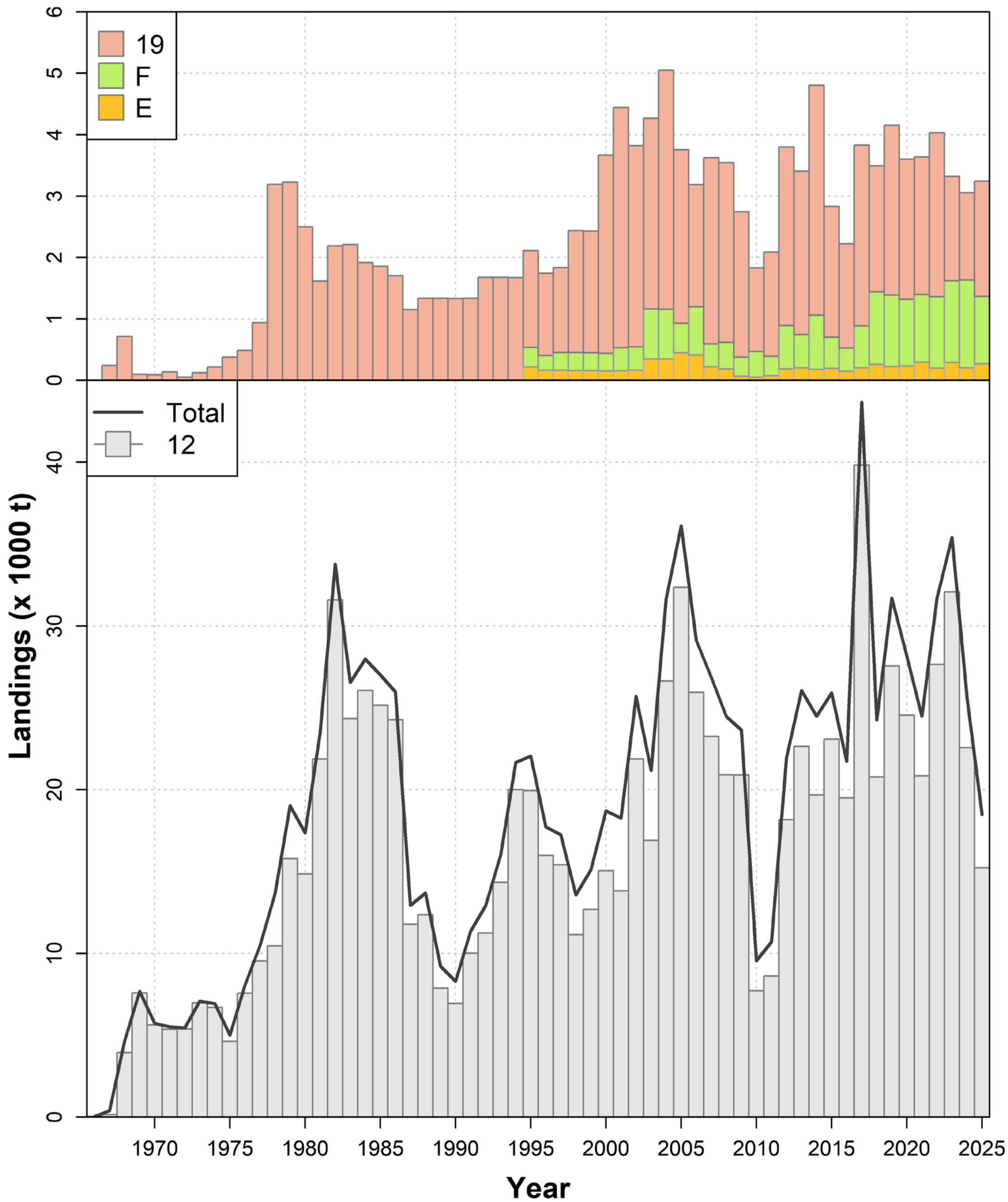

Figure 2. Annual landings (in tonnes) of southern Gulf of St. Lawrence in snow crab fishing areas 12E, 12F, 19 (top panel) and 12 (bottom panel). Solid black line (bottom panel) indicates total landings for the southern Gulf of St. Lawrence (CFAs 12, 12E, 12F and 19).

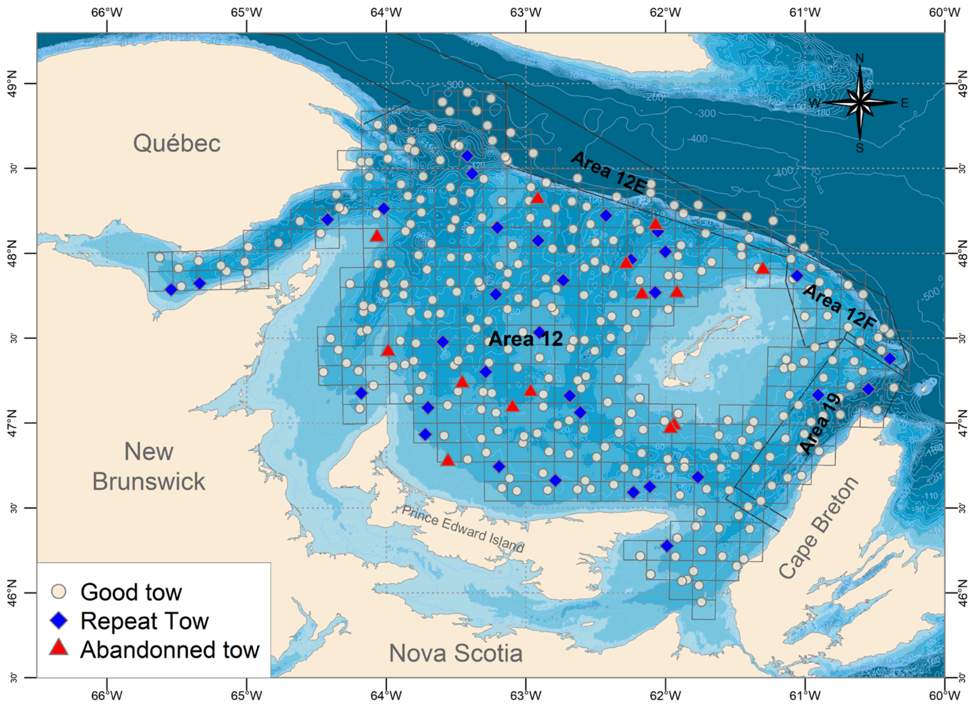

Figure 3. Locations of the 2025 snow crab trawl survey stations. Grey circles points are tows successfully trawled on the first try, blue diamonds show tows repeated and successfully trawl at the same station, and red triangles are abandoned tows. Survey sampling grids are shown in grey.

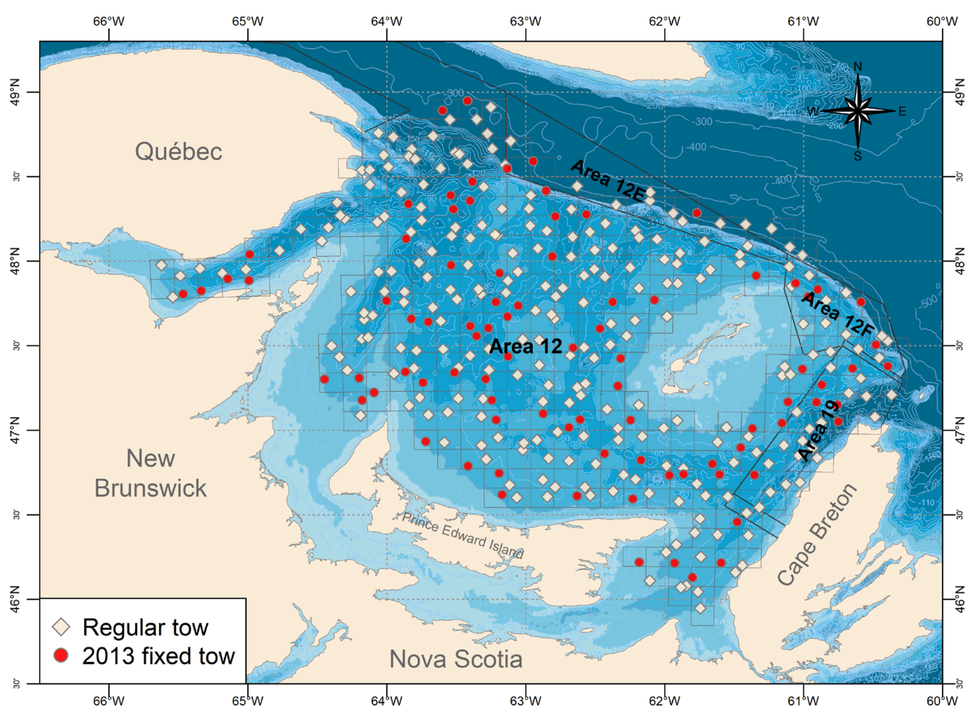

Figure 4. Map showing the 100 stations which were moved to their original 2013 positions (red circles) during the 2025 survey, along with the 255 remaining stations (grey diamonds). Survey sampling grids are shown in grey.

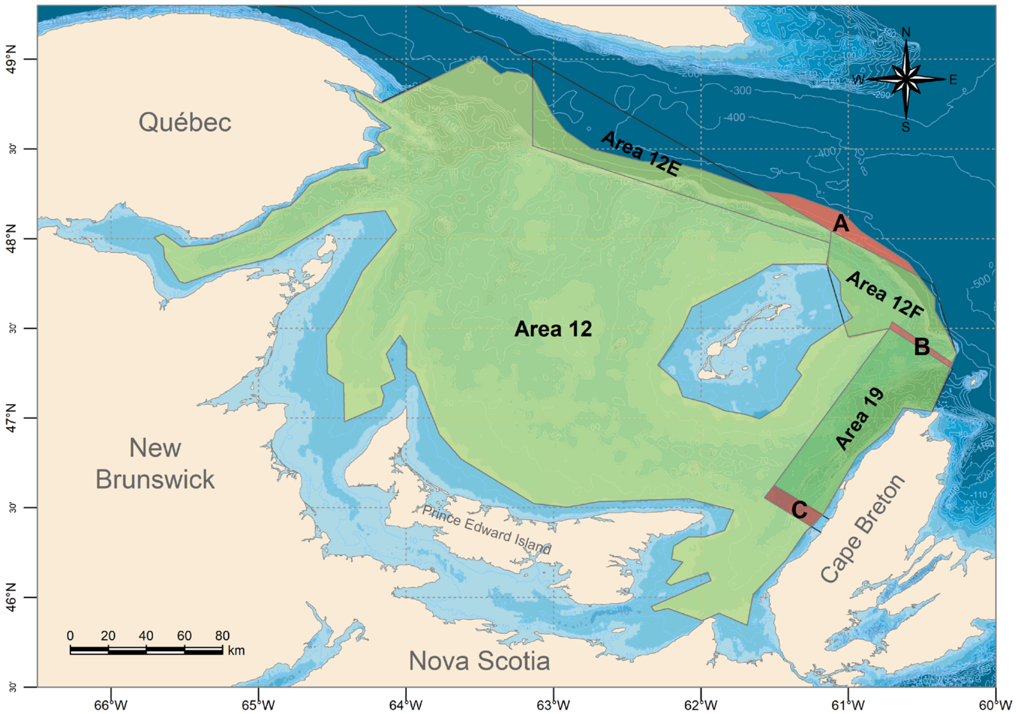

Figure 5. Polygons used for estimating survey stock indices. The unassigned zone north of crab fishing areas 12E and 12F (label A) and buffer zones (labels B and C) are also shown.

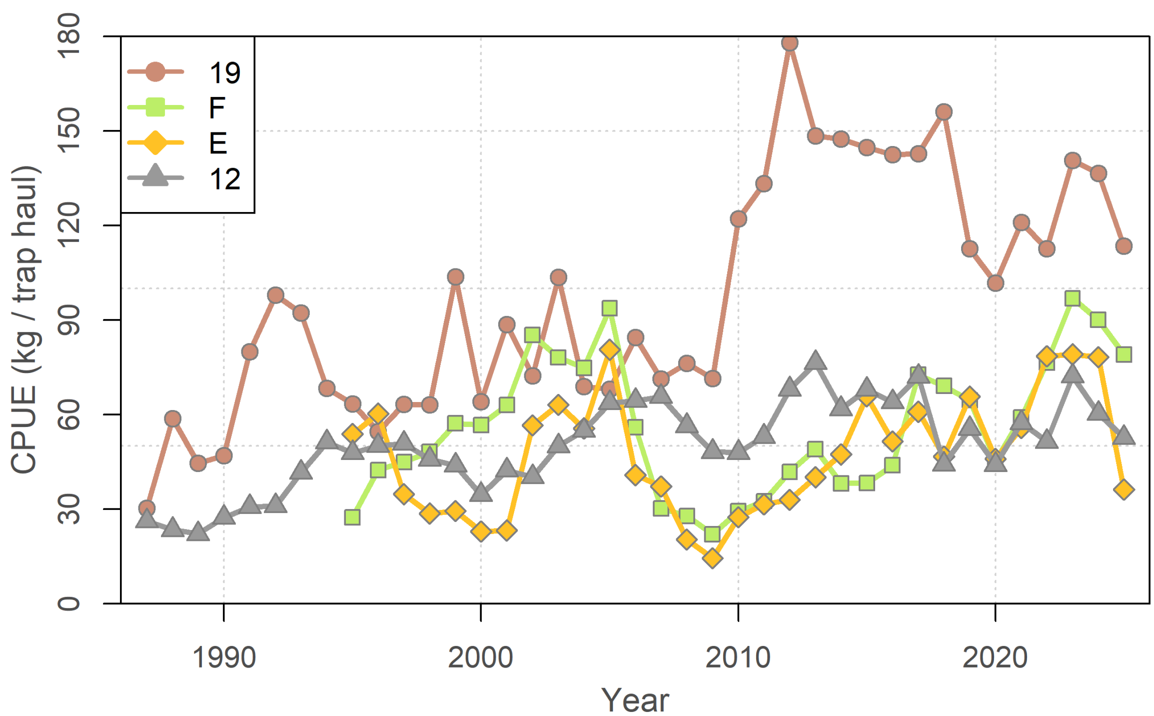

Figure 6. Seasonal average catch-per-unit-of-effort (CPUE; kg / trap haul) by crab fishing area in the southern Gulf of St. Lawrence, based on fishery logbook data.

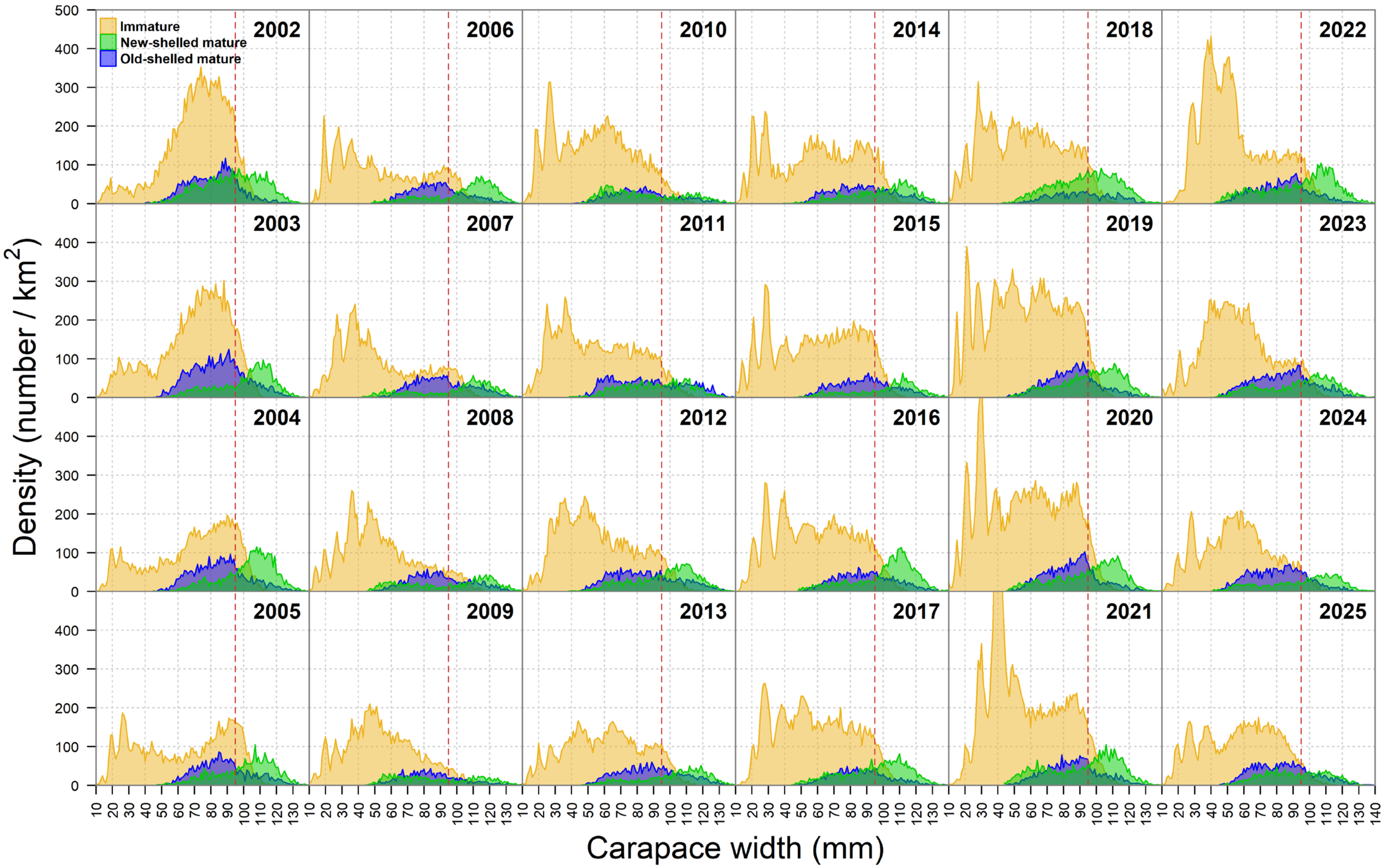

Figure 7. Annual size-frequency distributions of immature and adolescent (yellow), new-shelled mature (green) and old-shelled mature (blue) male snow crab from the trawl surveys. The red dotted line shows the minimum legal size of 95 mm carapace width. Note that abundances for small crab for 2020 and 2021 exceed the scale of the plot.

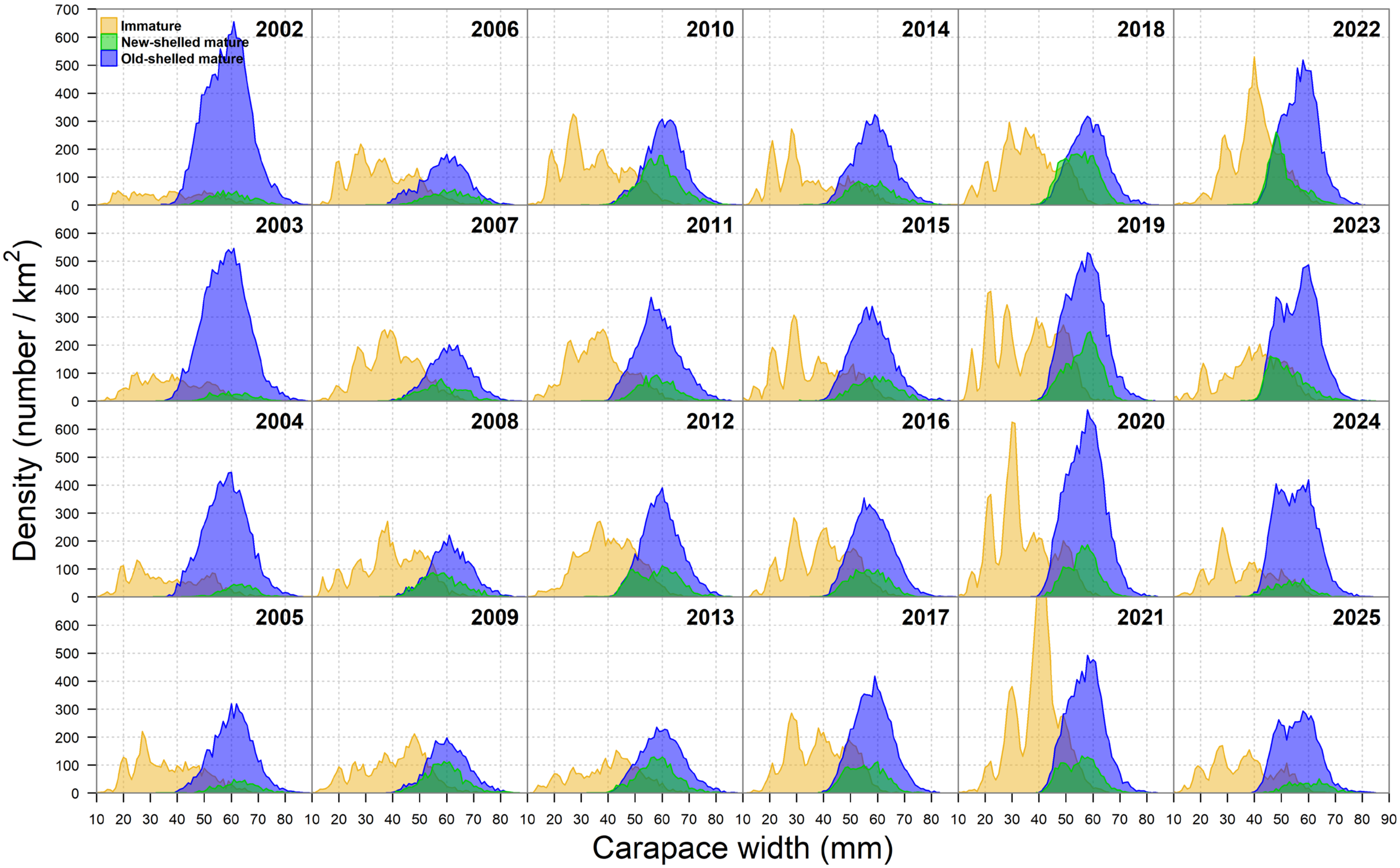

Figure 8. Annual size-frequency distributions of immature and pubescent (yellow), new-shelled matures (green) and old-shelled mature (blue) female snow crab from the trawl surveys. Note that abundances for small crab for 2021 exceed the scale of the plot.

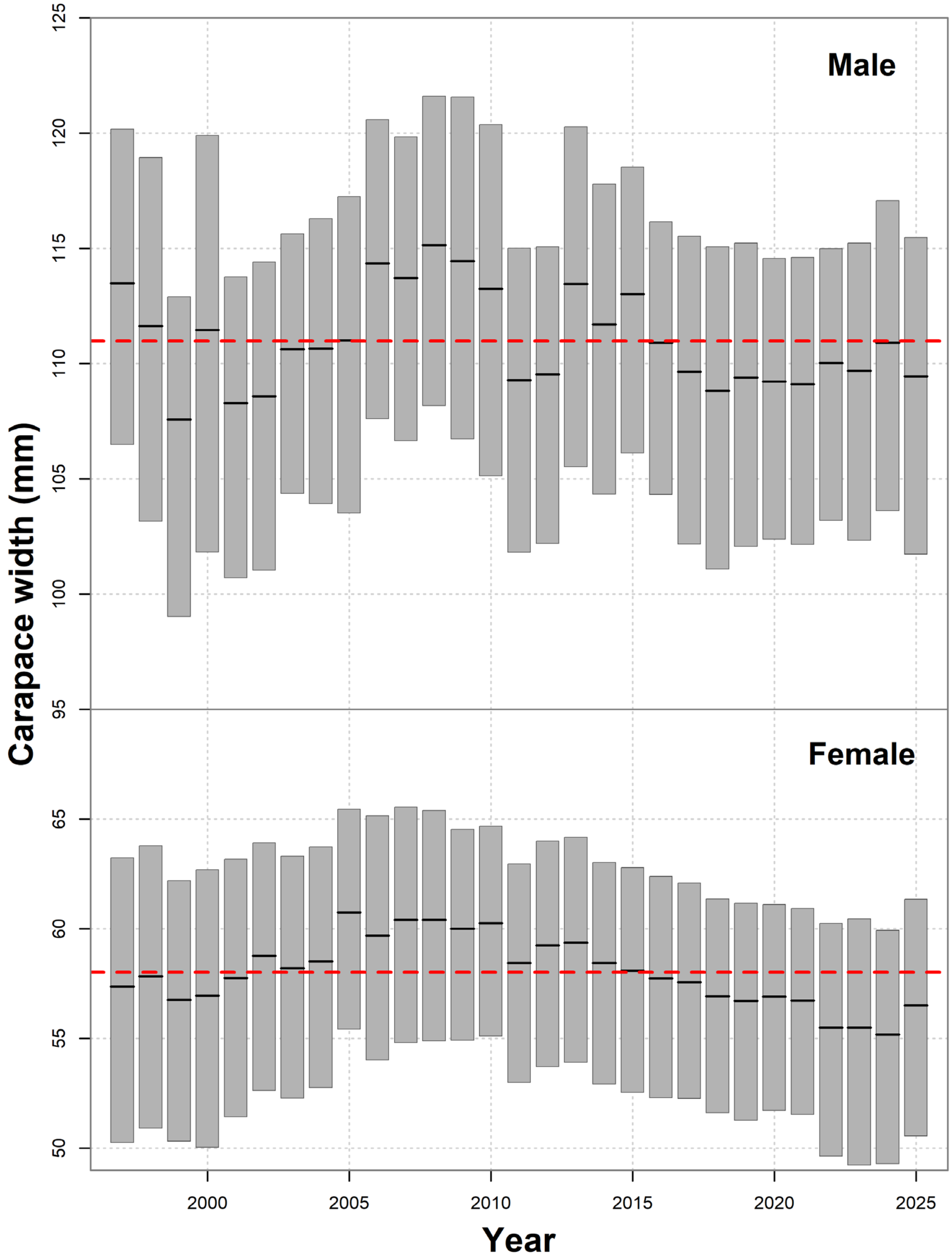

Figure 9. Size variation of mature legal-sized male (top panel) and mature female (bottom panel) snow crab observed in trawl survey data. Middle line shows the mean carapace width and grey bars show interquartile size range. The timeseries mean is shown as red dashed lines for reference.

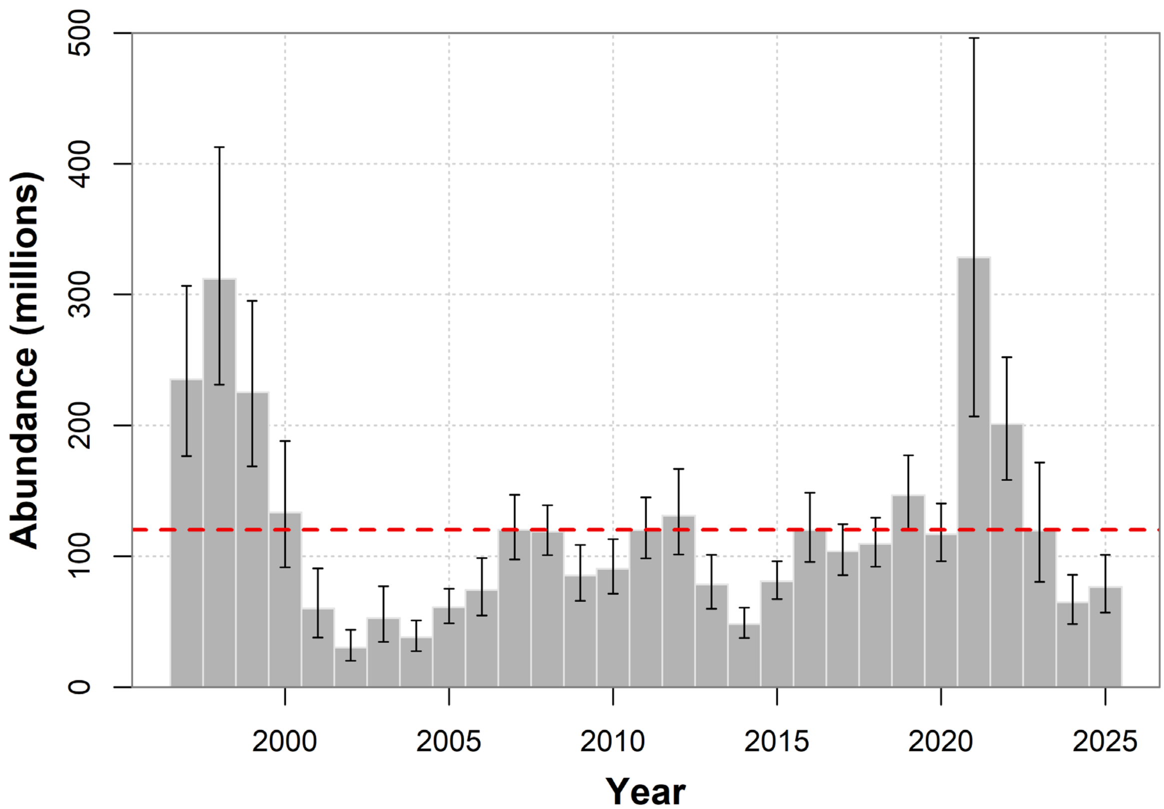

Figure 10. Annual abundance (in millions; means with 95% confidence intervals) of small male crabs of 34 to 44 mm carapace width (Instar VIII), based on the trawl survey data. The red dashed line shows the average for the series.

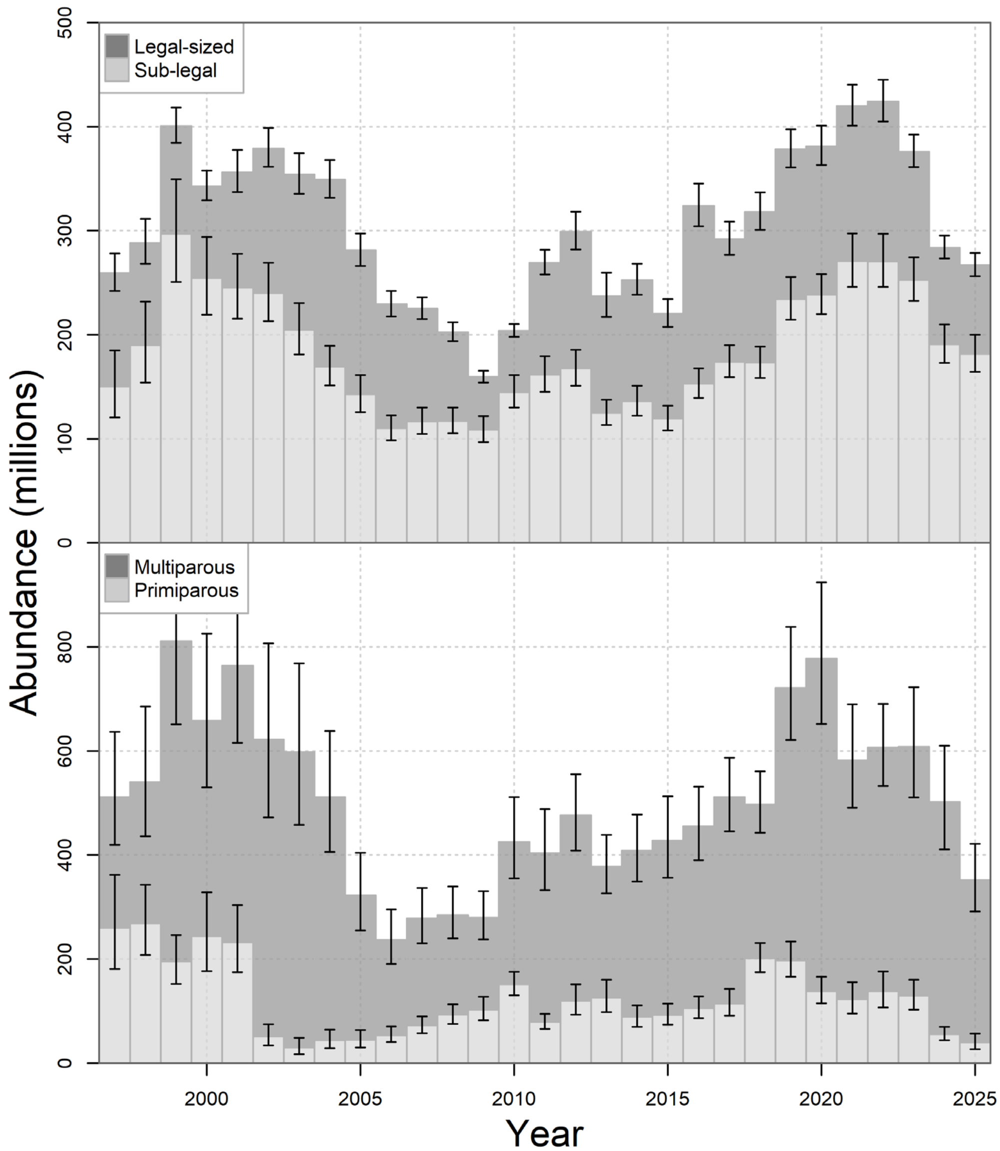

Figure 11. Survey abundance of legal and sub-legal male (top panel) and primiparous and multiparous female snow crab (bottom panel) in the southern Gulf of St. Lawrence. Error bars indicate 95% confidence intervals.

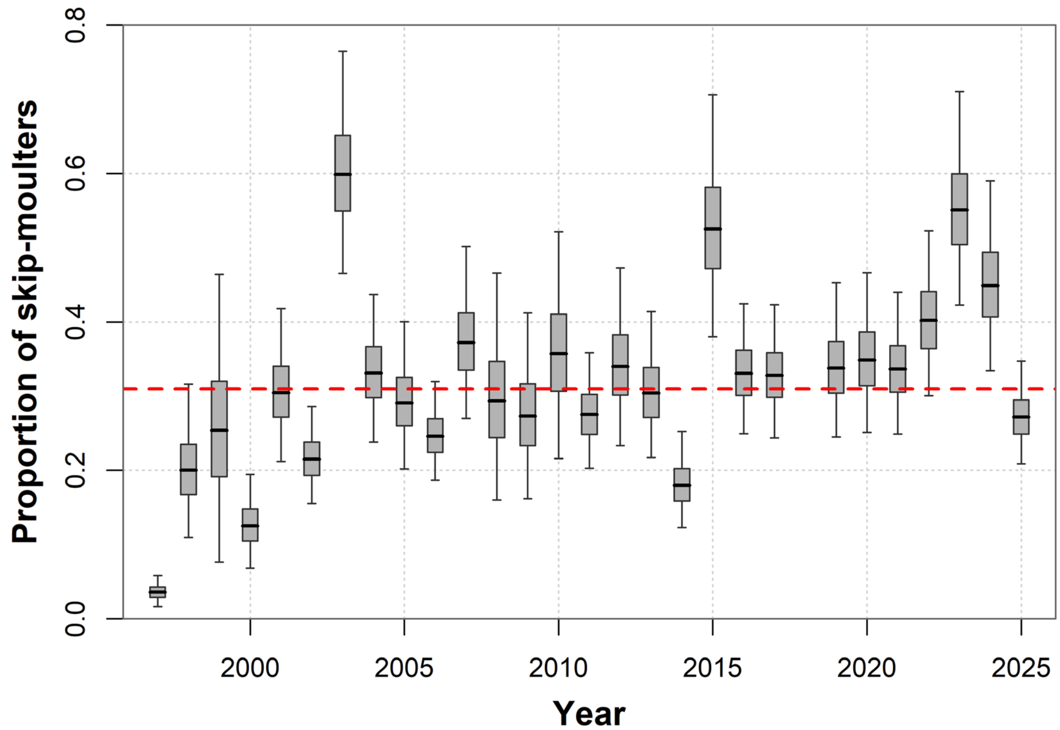

Figure 12. Proportions of R-2 skip moulter crab by survey year. The proportion for 2018 was not included as skip-moulter identification was deemed unreliable. The red dashed line shows the average value of 0.31.

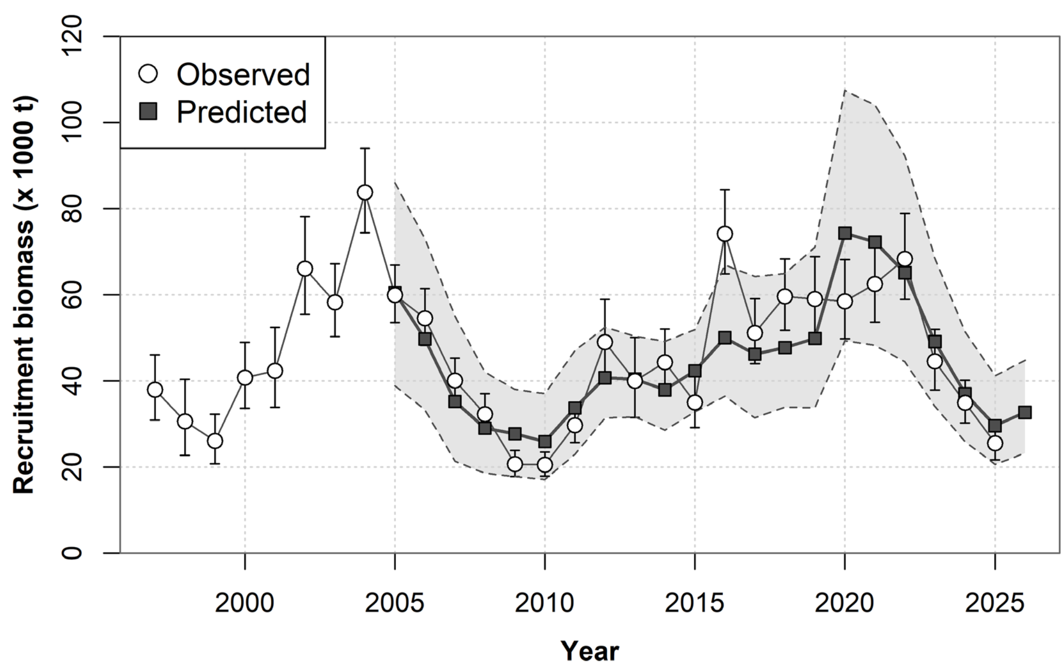

Figure 13. Observed (open circles and 95% confidence interval error bars) and predicted (black squares and shaded 95% confidence intervals) fishery recruitment biomasses of R-1 snow crab in the year of the survey.

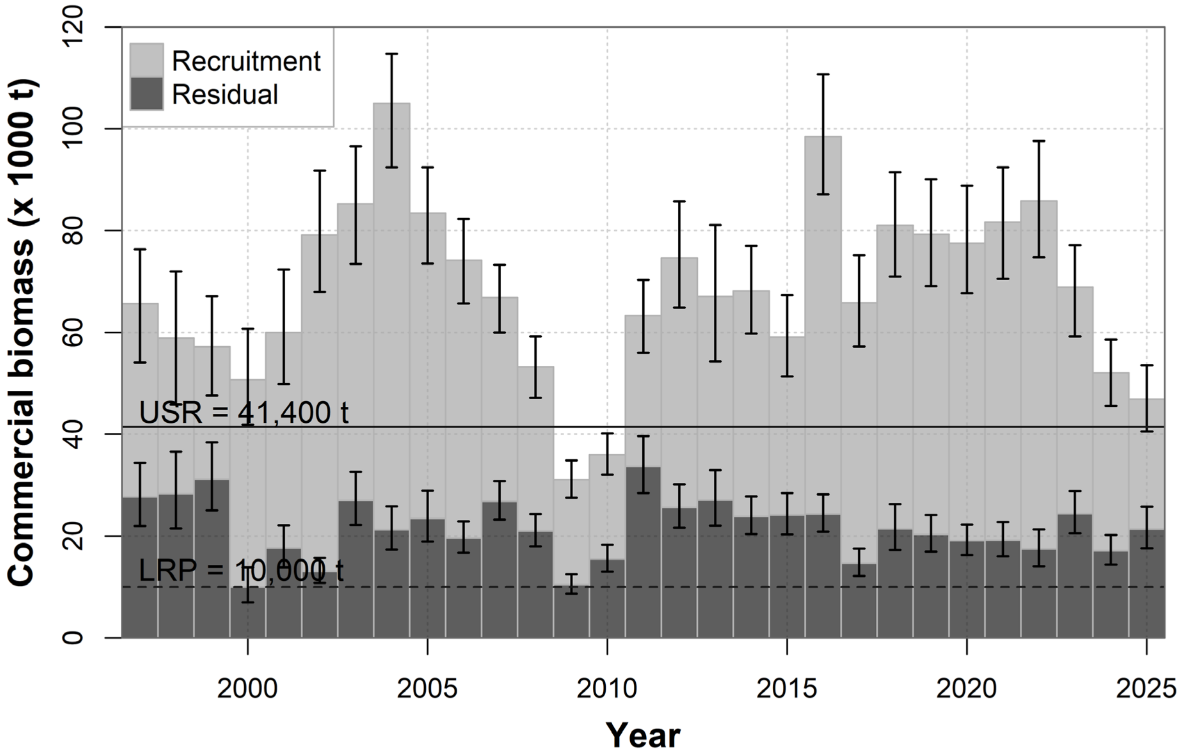

Figure 14. Stacked bar plot of commercial recruitment (light grey bars) and residual (dark grey bars) biomass, as estimated from trawl survey data. Error bars show 95% confidence intervals. Also shown are the corresponding limit reference point (LRP) for the residual biomass (dashed line) and upper stock reference (USR) (solid line).

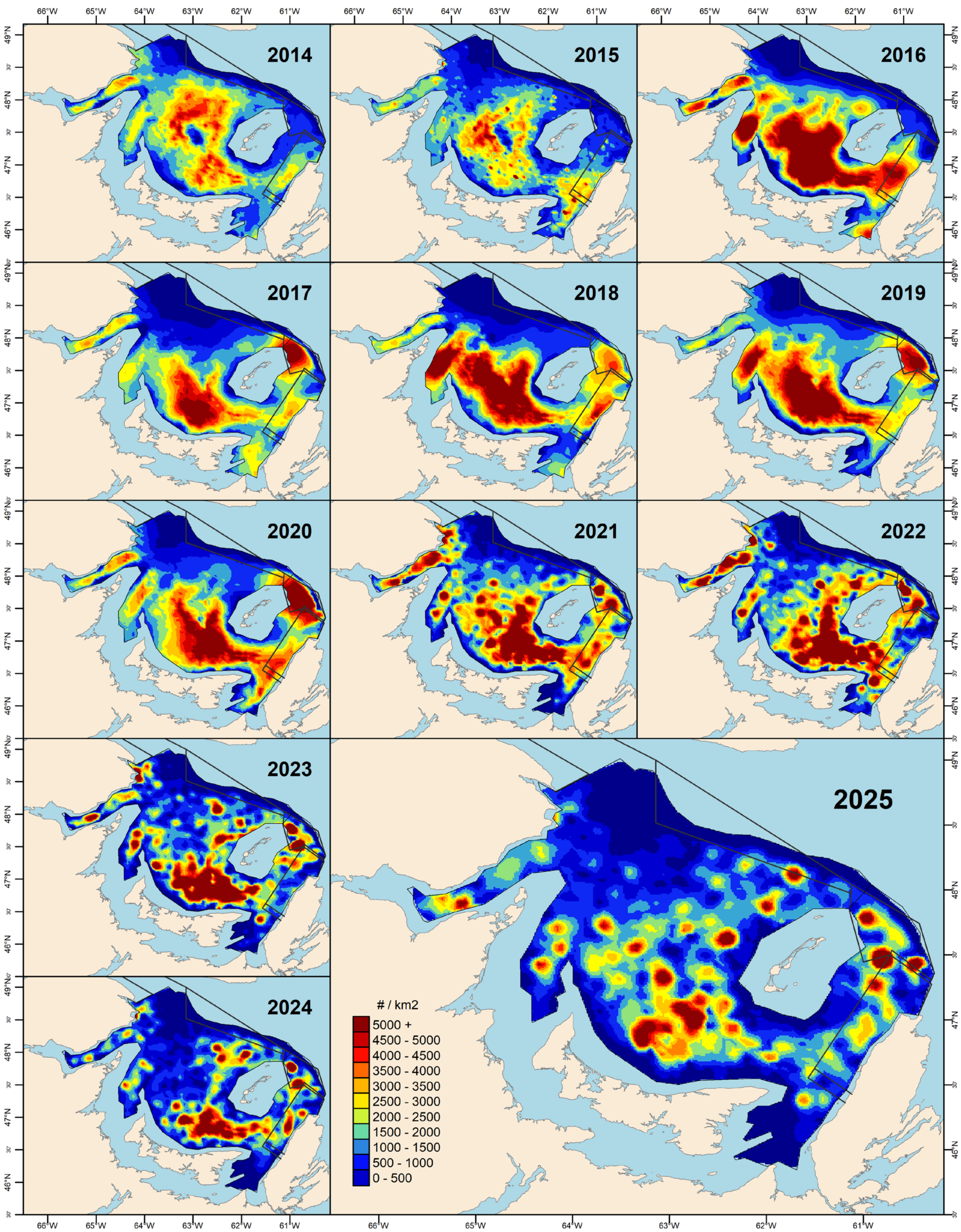

Figure 15. Density (number per km^2) contours of commercial crab in the southern Gulf of St. Lawrence from 2014 to 2025, based on the snow crab trawl survey, interpolated using kriging.

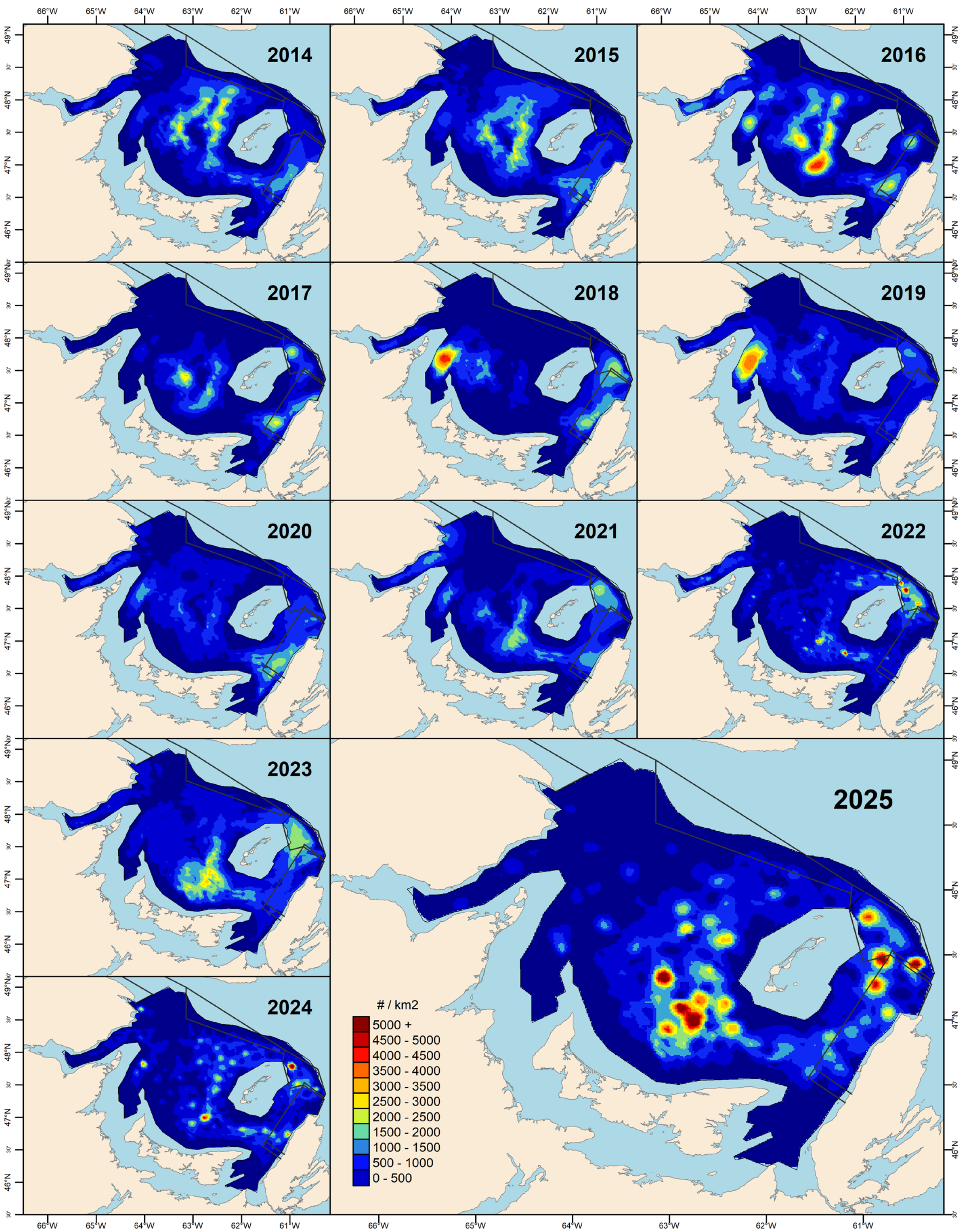

Figure 16. Spatial distribution of the residual component of commercial snow crab (carapace conditions 3,4, and 5) from 2014-2025 based on southern Gulf of St. Lawrence trawl survey data, interpolated using kriging.

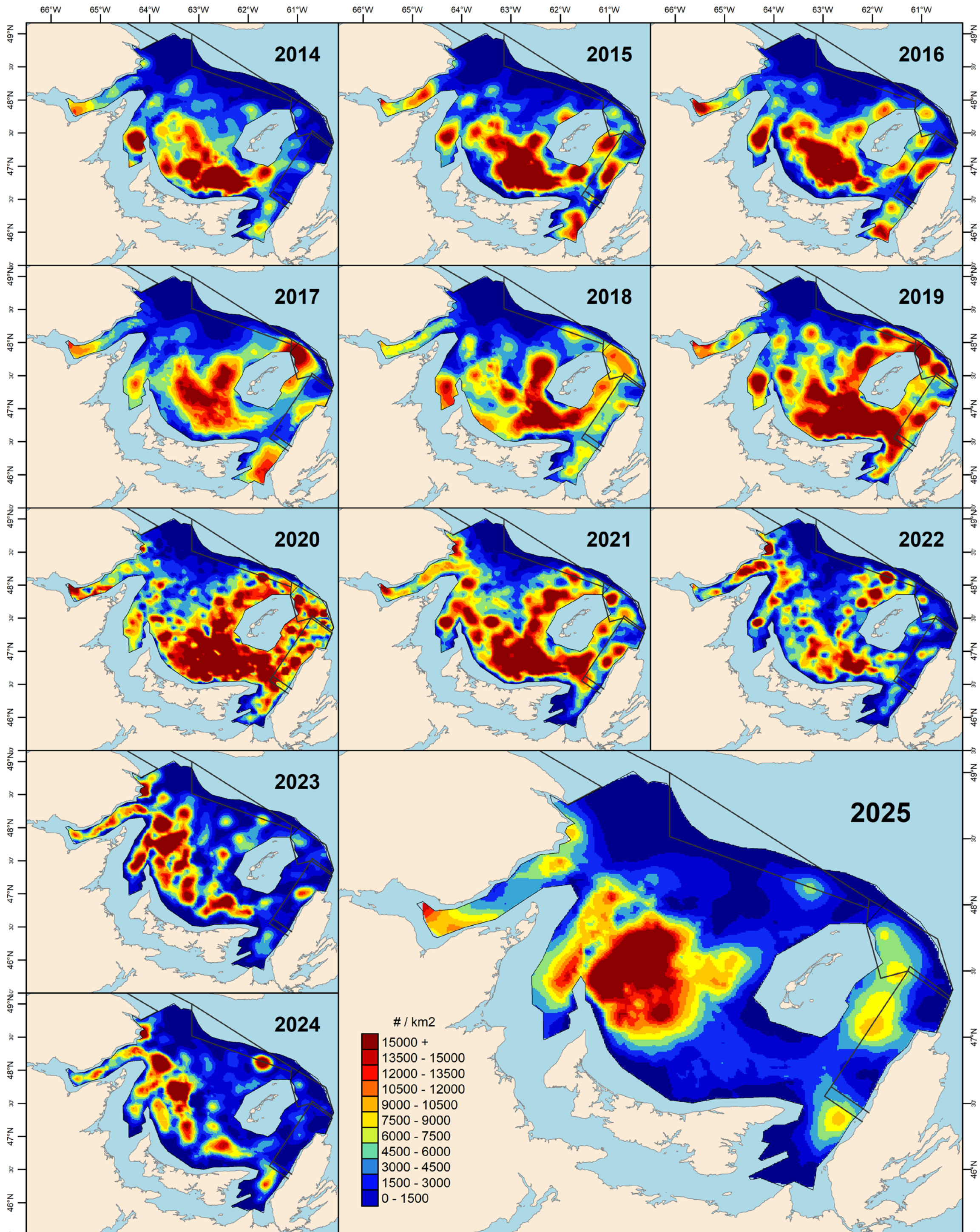

Figure 17. Adolescent male snow crab spatial distribution from 2014 to 2025 based on southern Gulf of St. Lawrence trawl survey data, interpolated using kriging. Adolescents are future recruits to the fishery (i.e., R-4, R-3 and R-2s).

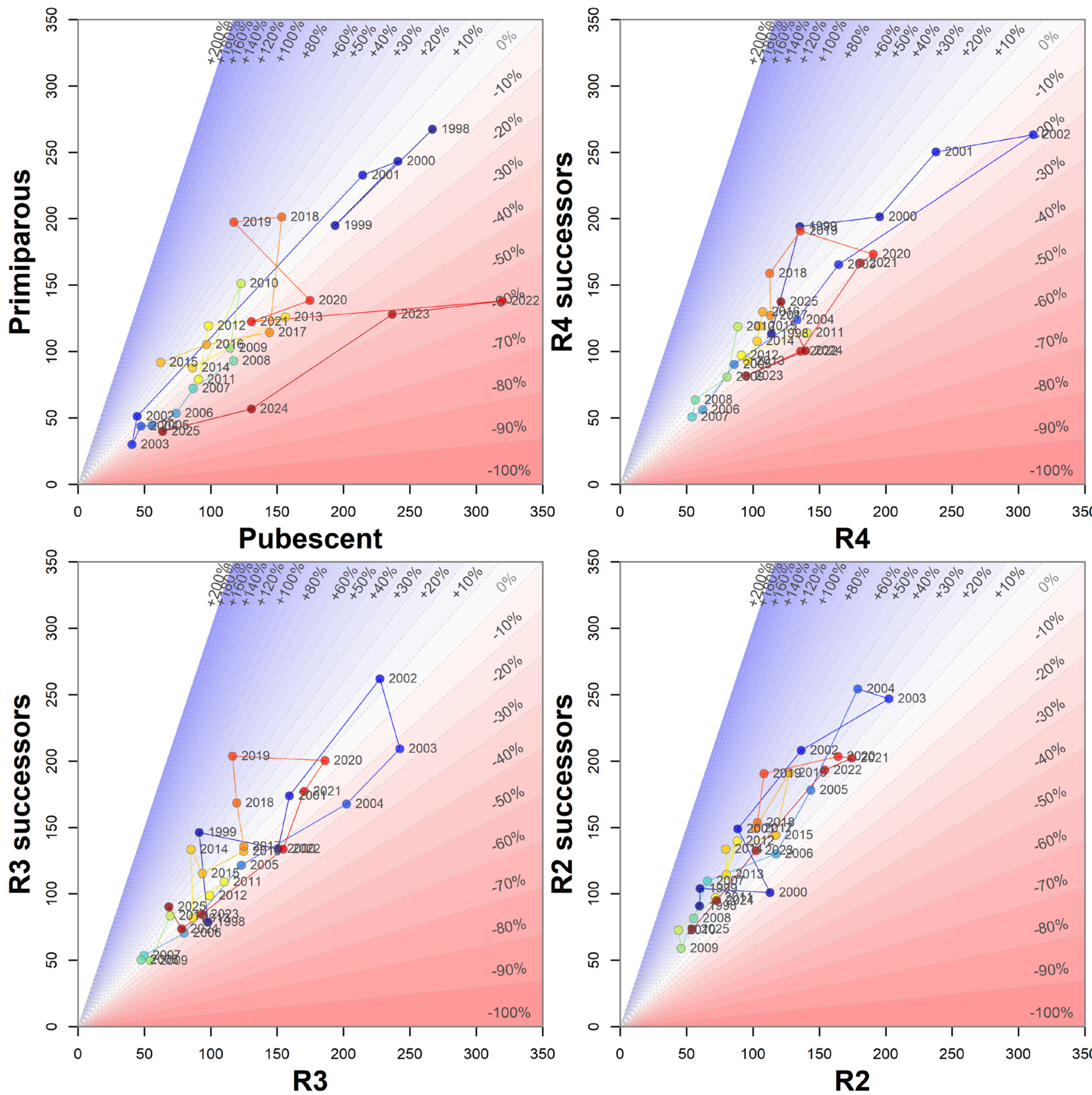

Figure 18. Scatterplot of the abundance of successors versus the abundance of their corresponding recruit/pre-recruit categories from the preceding year. Points are colored and labelled according to the survey year of successor category. The background shows the relative difference between the two, with blue indicating that successors exceed their recruits, white indicating that they are comparable, and red indicating that they are less than their recruits.

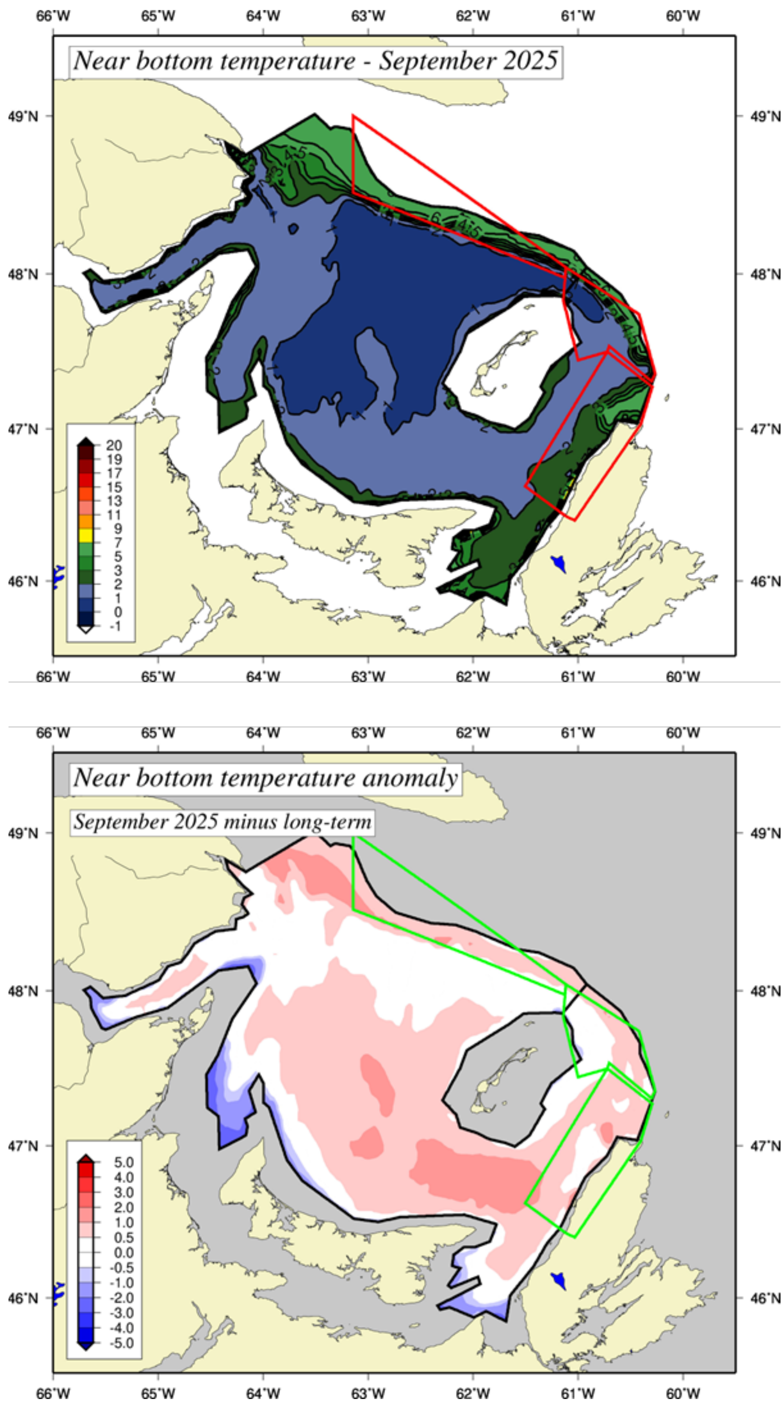

Figure 19. Map of bottom temperatures (top panel) and anomalies (bottom panel) for September 2025. Anomalies were calculated as the difference between September 2025 local bottom temperatures and their long-term means from the period from 1991 to 2020. Blue areas represent colder-than-normal temperatures while red regions represent warmer-than-normal conditions. White areas in bottom panel represent near average conditions.

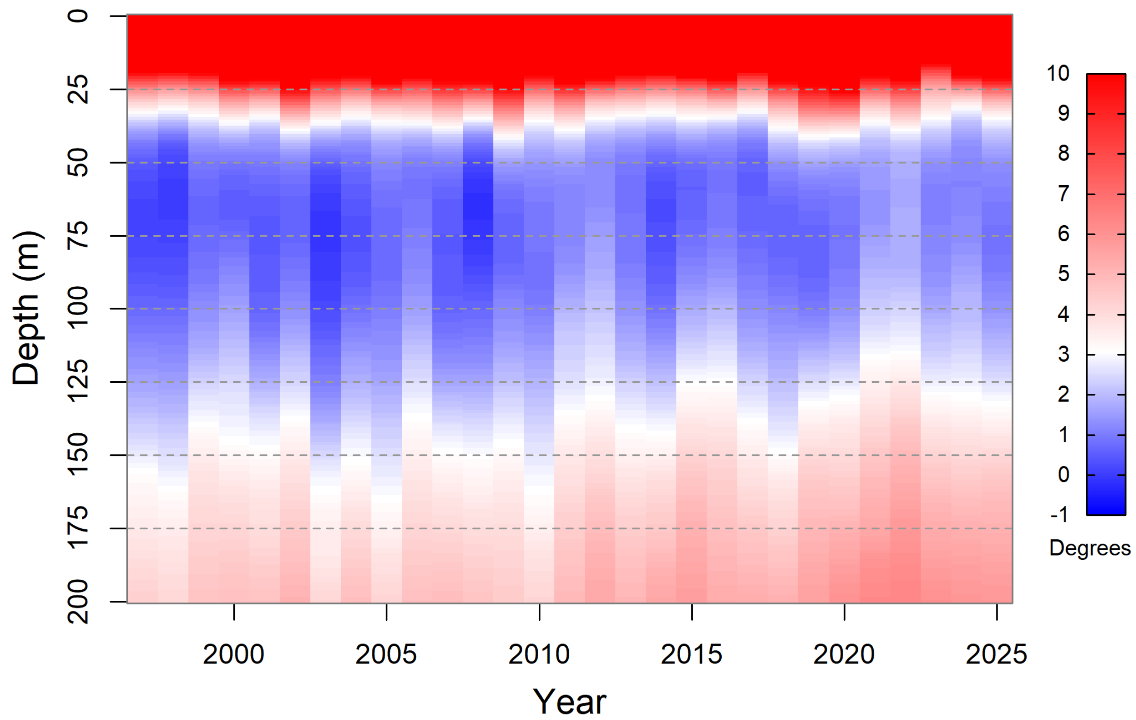

Figure 20. Average temperature stratification in September within the snow crab survey area by year. Blue areas are colder than 3 °C (the Cold Intermediary Layer), white areas are approximately 3 °C, and red areas are warmer than 3 °C. The top red layer corresponds to warm surface waters, while the bottom red layer corresponds to the deep, warm water mass of the Laurentian Channel.

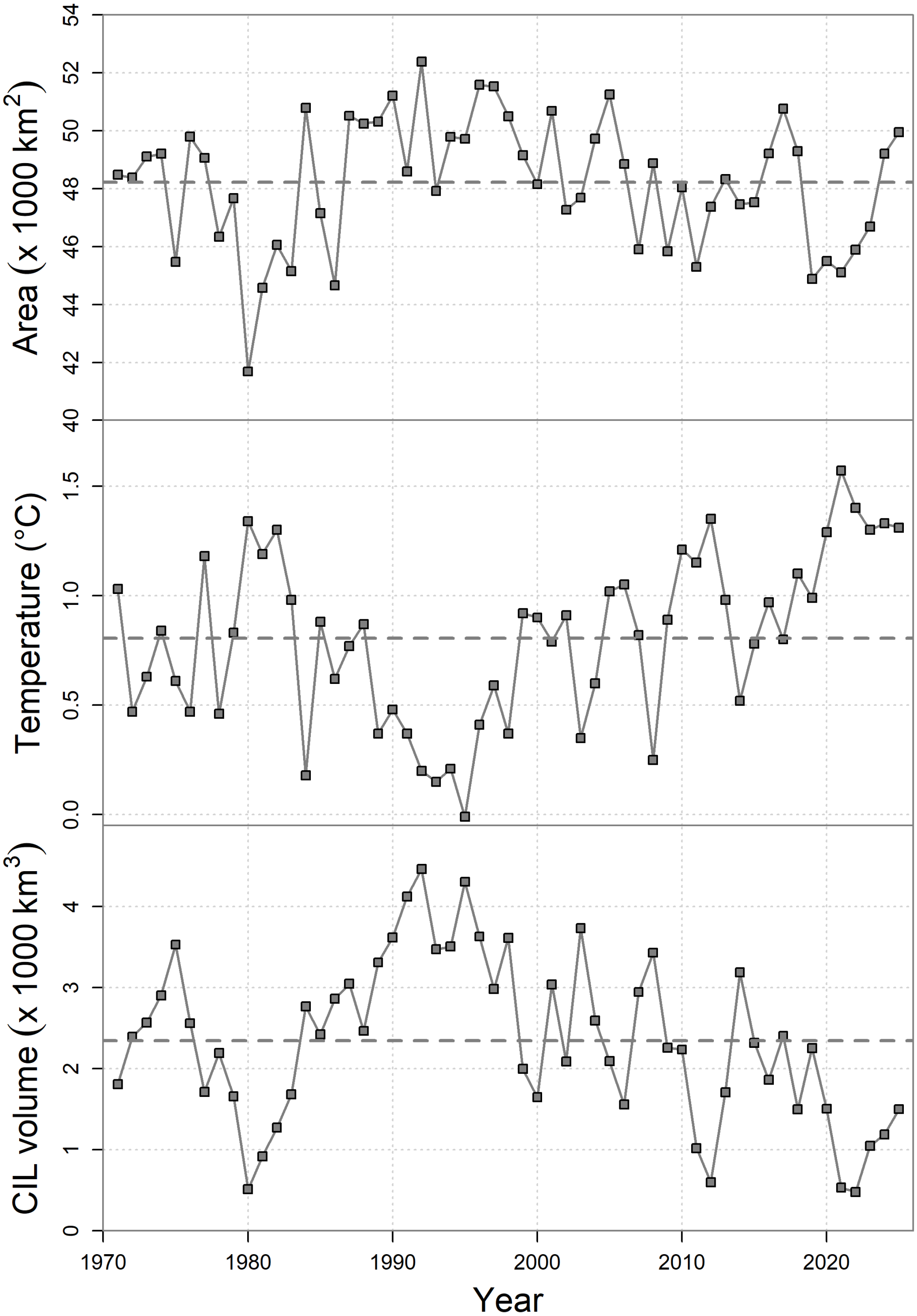

Figure 21. Surface area of the southern Gulf of St. Lawrence with bottom temperatures below 3 °C, an index of snow crab habitat (top panel), mean bottom temperature (middle panel) and cold intermediate layer (CIL) volume (bottom panel) within the area.

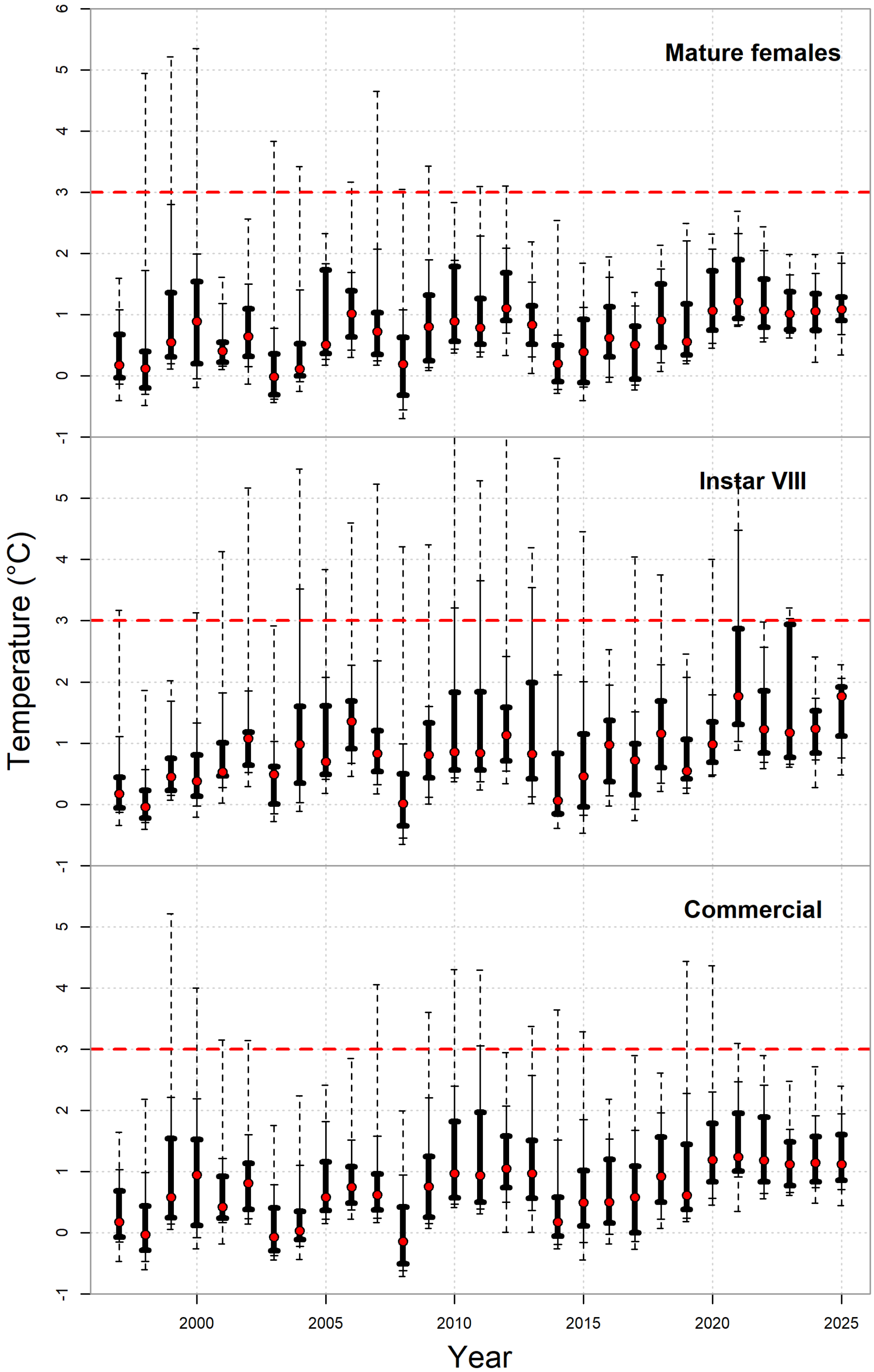

Figure 22. Annual temperature distribution in September for mature female (top panel), instar VIII (middle panel) and commercial (bottom panel) snow crab from the trawl survey. Red dots show the median, the thick black bars show the interquartile range, the thin solid black lines show the range between the 10% and 90% percentiles and the dashed lines show the 2.5% and 97.5% percentiles.

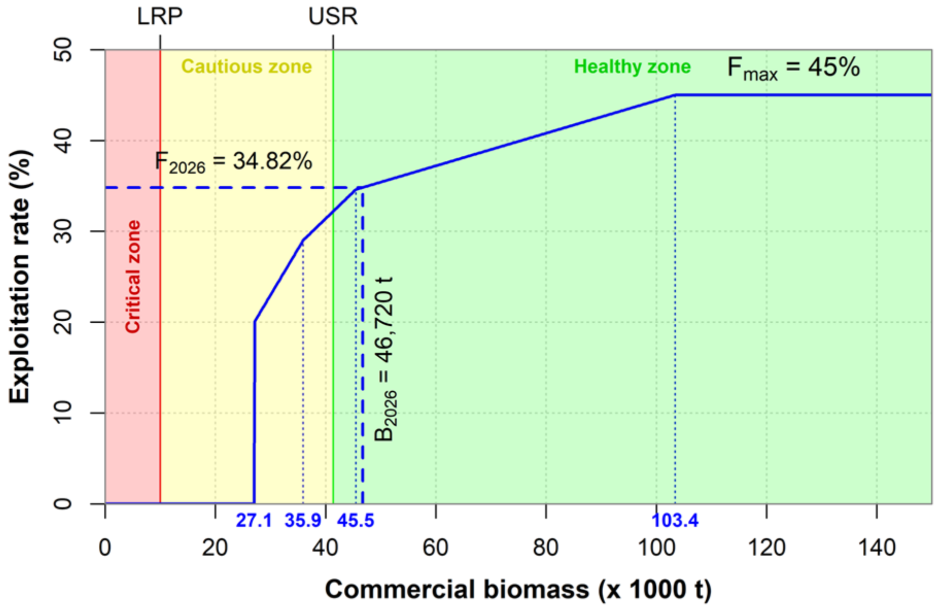

Figure 23. Harvest decision rule used for the southern Gulf St. Lawrence snow crab fishery (DFO 2014), which maps survey total commercial biomass to a target exploitation rate (solid blue line). The red line shows the limit reference point (LRP) for the residual biomass and the green line shows the upper stock reference (USR) point for the total commercial biomass. F_{max} represents the maximum allowed exploitation rate. The blue dashed line shows the projected commercial biomass for 2026 and its corresponding target exploitation rate. Dotted blue lines indicate inflection points in the harvest decision rule.

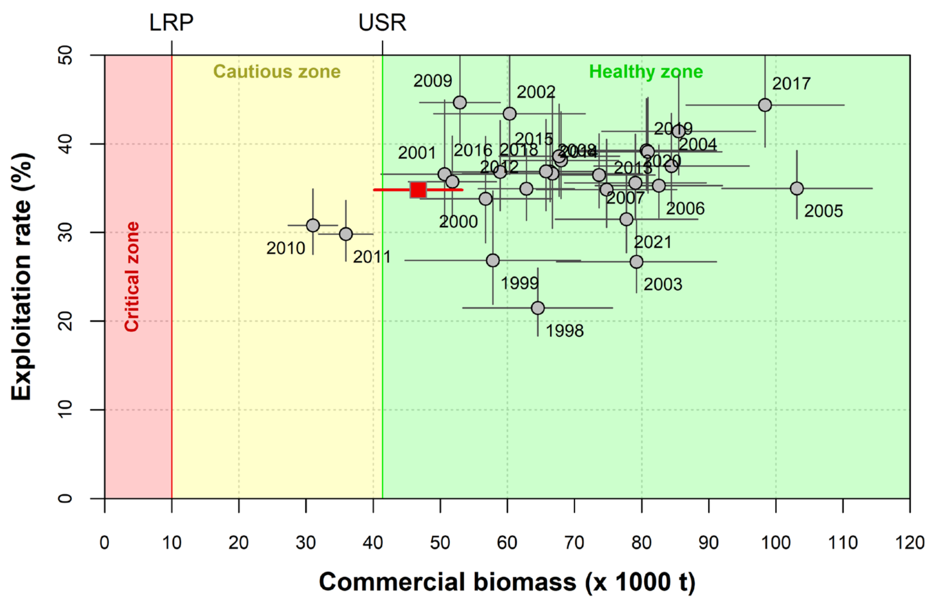

Figure 24. Exploitation rate versus the commercial biomass, with 95% confidence intervals. Year labels represent the fishery year. Coloured lines represent reference points: LRP (red line) is the limit reference point for residual commercial biomass and USR (green line) is the upper stock reference point for commercial biomass. The red square corresponds to the commercial biomass estimate with the target exploitation rate of 34.82% for the 2026 fishery.

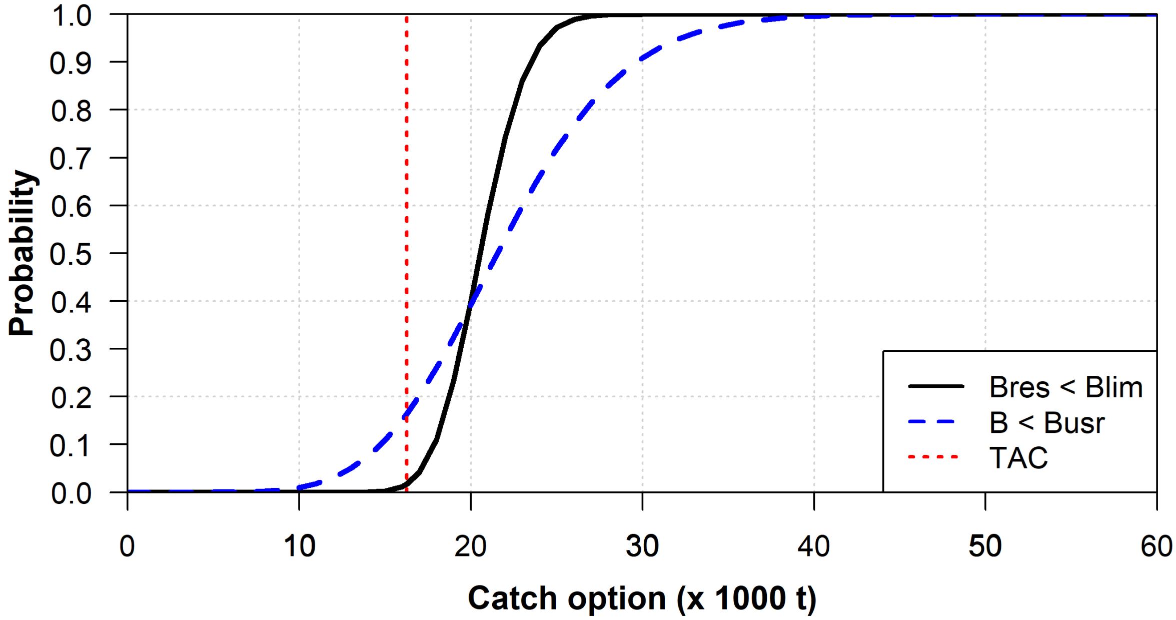

Figure 25. Risk analyses showing the probability that the residual commercial biomass falls below limit reference point (black solid line) or that the total commercial biomass falls below the upper stock reference (blue dashed line) point after the 2026 fishing season. The catch option for the 2026 fishery, 16,268 t, corresponding to the target exploitation rate of 34.82%, is shown by the dashed red line.