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Ecosystems and Oceans Science
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Quebec Region

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Science Advisory Report 2020/010

ASSESSMENT OF NORTHERN SHRIMP STOCKS IN THE ESTUARY AND GULF OF ST. LAWRENCE IN 2019

Image: Northern shrimp (Pandalus borealis). Credit: Fisheries Oceans Canada.

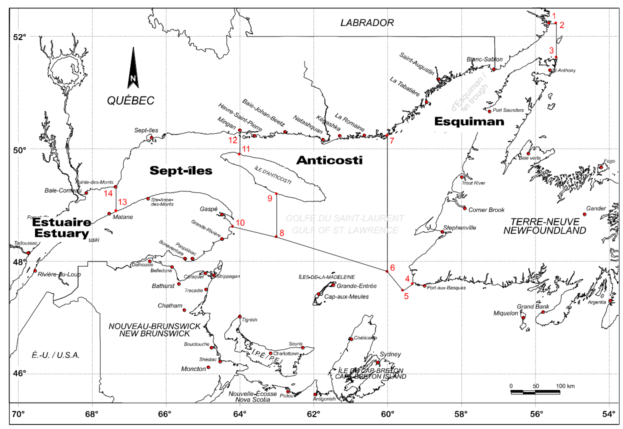

Figure 1. Shrimp fishing areas in the Estuary and Gulf of St. Lawrence.

Context

The northern shrimp (Pandalus borealis) fishery began in the Gulf of St. Lawrence in 1965. The exploitation is conducted by trawlers in four shrimp fishing areas (SFA): Estuary (SFA 12), Sept-Iles (SFA 10), Anticosti (SFA 9) and Esquiman (SFA 8) (Figure 1).

Shrimp fishing is regulated by a number of management measures, including the setting of total allowable catches (TAC) in each area. TAC-based management limits fishing to protect the reproductive potential of the population. The essential elements for the establishment of a precautionary approach were adopted in 2012. Reference points were determined and harvest guidelines were established based on the main indicator and its position in relation to the stock status classification zones (healthy, cautious and critical). These guidelines are consistent with a precautionary approach. Once the harvest is projected, decision rules are applied to determine the TAC.

This Science Advisory Report is from the January 22-23, 2020 meeting on Assessment of northern shrimp stocks in the Estuary and Gulf of St. Lawrence. Participants in the science review included representatives from DFO Science, DFO Fisheries Management, the fishing industry, provincial governments, university researchers, and Aboriginal organizations. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada (DFO) Science Advisory Schedule](#) as they become available.

SUMMARY

- In 2019, preliminary landings for all shrimp fishing areas were 16,161 t from a TAC of 17,335 t.
- Northern shrimp is widely distributed in the northern Gulf of St. Lawrence, but since 2008 the research survey has shown a decline in the species' area of concentration. This

decrease is also seen in the commercial fishery, as some fishing grounds are no longer occupied due to low shrimp abundance.

- The catch per unit of effort (CPUE) of the commercial fishery decreased between 2014 and 2017. Since then, the CPUE has stabilized in Sept-Iles, Anticosti and Esquiman and has increased in Estuary. The CPUEs of recent years are comparable to those of the early 2000s.
- In 2019, the biomasses estimated from the survey were similar to or slightly higher than the 2018 estimates for Sept-Iles, Anticosti and Esquiman. The biomasses estimated since 2017 in these fishing areas were low and comparable to the biomasses of the early 1990s. In Estuary, the interannual variations in estimated biomass were large; the values for 2017 and 2018 were among the lowest in the series (1990-2019) while the value for 2019 was among the highest.
- Warming of deep waters and predation by redfish appear to be important factors in the decline of northern shrimp. These conditions are not expected to improve in the short term.
- The low male abundance observed in recent years and the downward trend in females' size indicate low productivity of these stocks.
- The exploitation rate index for Sept-Iles and Esquiman decreased in 2019 and was similar to the series average, while that of Anticosti increased in 2018 and 2019 to above the average. In Estuary, this index is quite variable and in 2019 it reached the lowest value of the series.
- In 2019, the main stock status indicator increased slightly in Sept-Iles, Anticosti and Esquiman, but increased markedly in Estuary. The indicator for the four stocks had fallen sharply in previous years. In 2019, the Estuary, Anticosti and Esquiman stocks were in the healthy zone while the Sept-Iles stock was still in the cautious zone.
- Following the harvest guidelines established as part of the precautionary approach, the projected harvests for 2020 are 1,524 t for Estuary, 5,123 t for Sept-Iles, 6,311 t for Anticosti and 6,142 t for Esquiman. Fisheries Management will set the TACs based on this information.

INTRODUCTION

The biology of northern shrimp has several particularities, which in turn influence the exploitation strategy, fishery management and resource conservation. Shrimp play a key role in the ecosystem, acting as an intermediary in the transfer of energy from the lower trophic levels (e.g., zooplankton) to the higher ones (predators such as fish, marine mammals and seabirds). Ecological relationships (e.g., predator-prey and competition) must be maintained among the species affected directly or indirectly by the fishery within the bounds of natural fluctuations in these relationships.

Species Biology

Northern shrimp change sex over the course of their life cycle, achieving male sexual maturity at about two and a half years old, then becoming female between four and five years old. The females, which carry their eggs beneath the abdomen, are thus among the largest specimens in commercial catches; the males are smaller because they are younger. Mating takes place in the fall and the females carry their eggs for eight months, from September until April. The larvae are pelagic when they hatch in the spring and metamorphose and settle to the bottom at the end of the summer. Northern shrimp migrations are associated with breeding (the egg-bearing females migrate to shallower water in winter) and feeding (at night, they leave the ocean floor to feed on small planktonic organisms).

Species Distribution

Northern shrimp are present in the Northwest Atlantic, from Baffin Bay to the Gulf of Maine in the south. The species is generally associated with the deep water mass and found mainly at depths where sediments are fine and consolidated and where the temperature varies from 1 to 6 °C.

DFO research survey data indicate that the northern shrimp is widespread in the Estuary and in the northern Gulf of St. Lawrence (Figure 2). It is distributed over more than 90,000 km^2 at depths from 150 to 350 m, with more than 80% of the biomass concentrated in channels between 192 and 329 m, at bottom temperatures ranging from 3.7 to 5.8 °C. While there is some stability in the area of occupancy, since 2008 there has been a decrease in shrimp concentration areas, where over 95% of the biomass is distributed, which have decreased from more than 50,000 km^2 to less than 35,000 km^2.

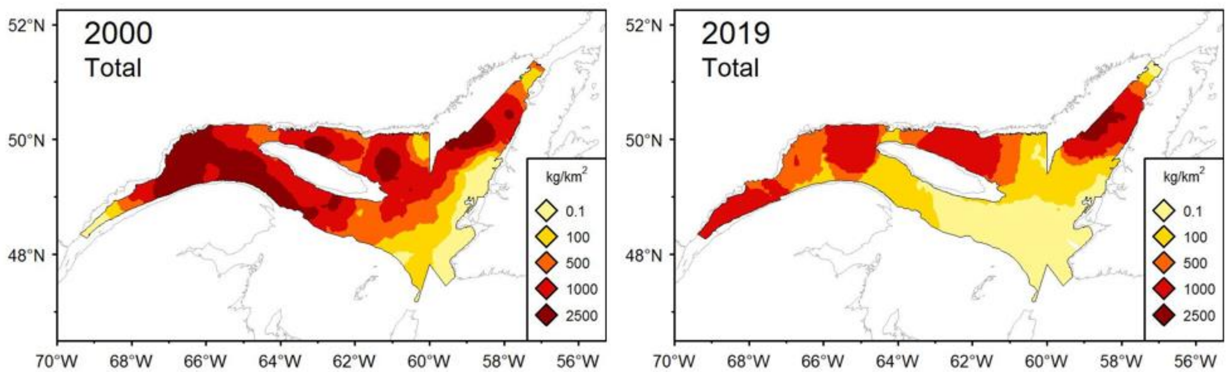

Figure 2. Northern shrimp catch rates (kg/km²) distribution in the DFO survey in 2000 and 2019.

Environmental and Ecosystem Conditions

Temperature is a dominant ecological factor that influences the biology of ectothermic or cold-blooded organisms, such as the northern shrimp. These organisms have an optimal temperature window in which they function better. Moderate differences in the optimal temperature can affect productivity and reduce resistance to environmental challenges such as hypoxia and ocean acidification. The northern shrimp is a coldwater species. The Gulf of St. Lawrence is near the southern limit of the northern shrimp's distribution, and the species is present there in temperatures nearing the upper level of its thermal preference. In addition, larvae that emerge in the surface layer are exposed to a much wider range of temperatures, from about 0 °C to above 10 °C, which can affect their survival. The northern shrimp is therefore vulnerable to surface and deep-water warming.

Deep-water temperatures in the Gulf have been rising in the last few years. These waters, which come from outside the Gulf, are a mix of the cold Labrador current and the warm Gulf Stream waters. The ratio of these two water masses is currently richer in warm Gulf Stream water. Waters entering through the bottom of the Cabot Strait move upstream, mixing little with shallower waters. The seabed area covered by temperatures above 6 °C has increased in the Estuary and the northern Gulf of St. Lawrence, to the detriment of the bottom habitat immersed in waters within the temperature range of 5 to 6 °C (Figure 3). In 2019, male and female shrimp were found in bottom temperatures that were 1 °C warmer compared to the 1990 to 2017 average.

The reproductive cycle of shrimp is affected by environmental conditions. Bottom water temperatures influence the development time of the eggs the females carry under their abdomen. Furthermore, the hatching of the eggs in spring must be synchronized with the timing of the spring phytoplankton bloom to ensure better larval survival. The reproductive cycle of shrimp in the Sept-Iles fishing area was studied from samples taken in the fishery (Figure 4). Shrimp phenology seems to have become adapted to the increase in deep-water temperatures and the earlier start of the spring phytoplankton bloom in recent years so that larval release remains synchronized with the bloom.

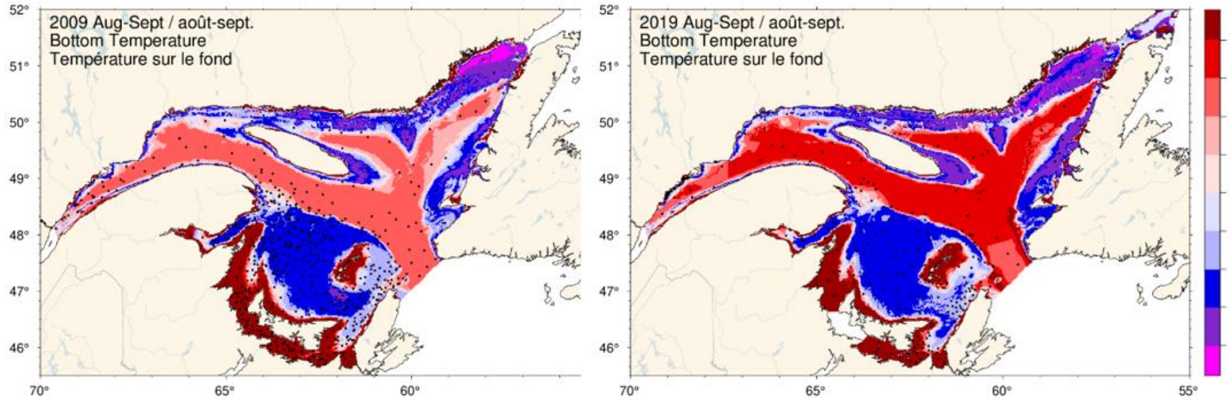

Figure 3. Maps of bottom temperature observed in August-September in 2009 and 2019.

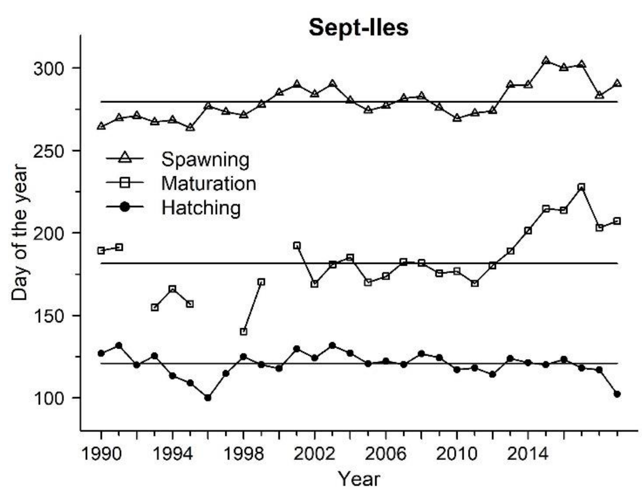

Figure 4. Day of the year where 50% of female shrimp were maturing (maturation), where 50% had spawn there eggs (spawning) and where 50% of females had released larvae (hatching) from samples collected in the area of Sept-Iles from 1990 to 2019. Solid horizontal lines represent the averages for the 1990-2019 series.

The Estuary and Gulf of St. Lawrence ecosystem, dominated by groundfish until the late 1980s, has transitioned to an ecosystem dominated by forage species from the 1990s to 2010. Shrimp abundance increased after the abundance of large-sized groundfish species decreased. Since 2013, the situation has been reversing: the abundance and biomass of invertebrates sampled in the DFO survey in August is decreasing, while those of groundfish, mainly redfish (mainly

Deepwater redfish, *Sebastes mentella*), are increasing (Figure 4). Three strong cohorts (2011, 2012 and 2013) of Deepwater redfish have contributed to this increase since 2013 in the Estuary and northern Gulf. The 2011 cohort, which is the most abundant, now has a modal length of 23 cm, and these redfish are distributed throughout the northern Gulf channels. The redfish diet varies according to the size of the fish. The diet of small redfish is based on zooplankton, with redfish consuming progressively more shrimp and fish as their length increases. Northern shrimp is a significant prey species for redfish of 25 cm and over. Estimated predation by redfish on northern shrimp has increased substantially in the past three years and the situation is not expected to improve in the near future. However, the impact of this phenomenon may be lessened if the spatial overlap between northern shrimp and redfish diminishes owing to the expected migration of adults *S. mentella* individuals to depths of over 300 m.

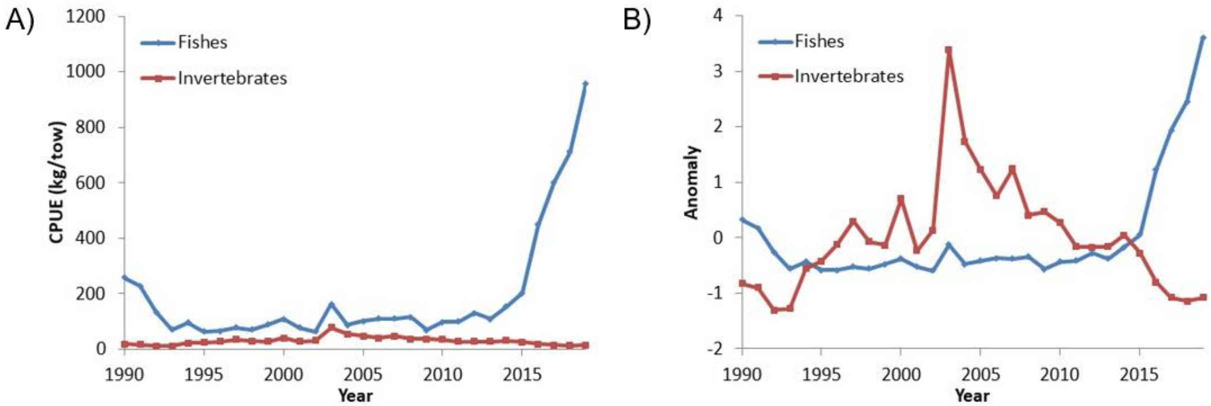

Figure 5. Biomass indices (kg per trawling tow) estimated during the DFO survey in the northern Gulf of St. Lawrence for invertebrates and fish (A) and expressed as anomalies (deviations from the mean) (B).

These changes in environmental and ecosystem conditions observed in the Estuary and Gulf of St. Lawrence have an impact on northern shrimp population dynamic through their effects on such factors as abundance, spatial distribution, growth, reproduction and trophic relationships. Warming water and increased predation by redfish appear to be important factors in the northern shrimp’s decline. These conditions are not expected to improve in the short term.

Description of the fishery

The fishery has been managed by TAC since 1982, and the traditional fishers have had individual quotas since the mid-1990s. The number of active licences for northern shrimp fishing in the Estuary and Gulf was 109 in 2019. Operators are from five provinces and seven First Nations communities. The fishery management measures include the imposition of a minimum mesh size (40 mm) and, since 1993, the compulsory use of the Nordmore grate, which significantly reduces groundfish bycatches. A protocol to limit small fish bycatch is in place. Shrimpers must also keep a log book, have their catches weighed at dockside, and agree to have an observer on board at the Department's request (5% coverage). Use of the Vessel Monitoring System (VMS) has been mandatory since 2012. The season begins on April 1 and ends on December 31.

Northern shrimp landings in the Estuary and Gulf of St. Lawrence have gradually increased since the fishery began. Landings have increased from about 1,000 t in the early 1970s to more than 35,000 t in 2004 and 2007–2010 (Figure 5). Landings decreased thereafter to 16,161 t in 2019. The preliminary statistics for 2019 indicate landings of 199 t in the Estuary, 3,884 t in

Sept-Iles, 6,241 t in Anticosti, and 5,837 t in Esquiman (Figure 6). In 2018, the TAC decreased by 74% in the Estuary, by 60% in Sept-Iles and by 15% in Anticosti and Esquiman. In 2019, TACs remained the same as in 2018 for the four fishing areas. As of December 9, 2019, the TAC has been reached at 83% in Estuary, at over 90% in Sept-Iles and Anticosti and at almost 100% in Esquiman.

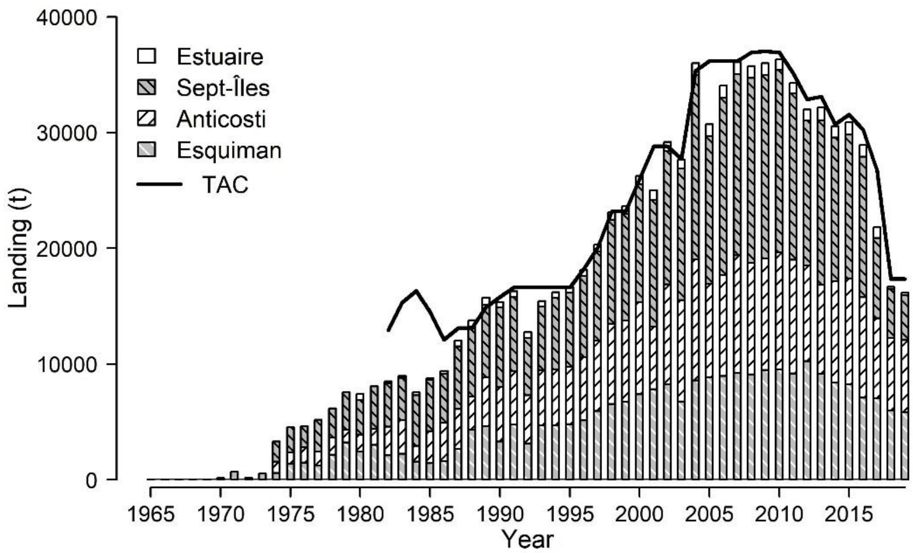

Figure 6. Landing and total allowable catches (TAC) by fishing area and by year. The 2019 data are preliminary.

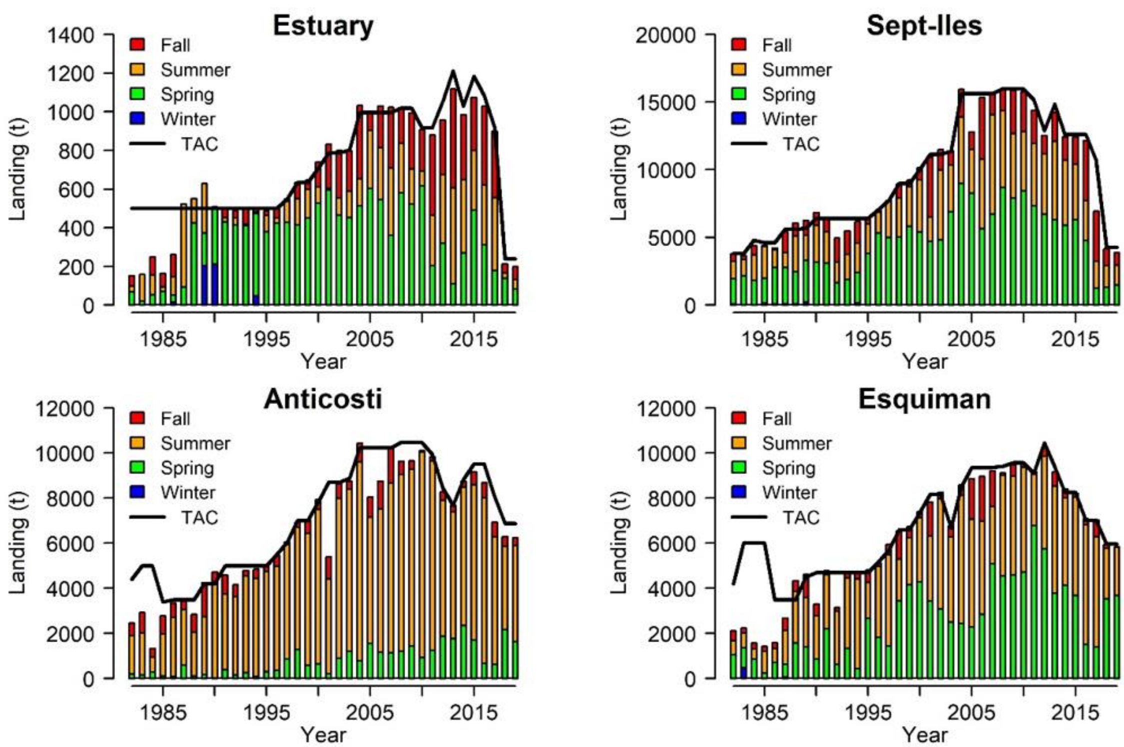

Figure 7. Seasonal landing and total allowable catches (TAC) by fishing area and by year. The 2019 data are preliminary.

ASSESSMENT

Programs were implemented in the 1980s and 1990s to monitor the fishery and the status of northern shrimp populations in the Estuary and Gulf of St. Lawrence on an annual basis. Commercial fishery statistics (shrimper catch and effort) are used to estimate the fishing effort and calculate catch rates. The commercial catch samples allow the estimation of the number of shrimp harvested by size classes and by sexual maturity stage. A research survey is conducted every year in the Estuary and Gulf of St. Lawrence in August from a DFO vessel. Biomass indices are calculated using a geostatistical method. Survey catch samples provide abundance estimates of shrimp by size classes and by stage of sexual maturity.

The sectors that sustain fishing in the four areas correspond to the spots where high concentrations of shrimp are generally observed during the research survey (Figure 7). In recent years, certain traditional fishing grounds have been abandoned because of the low abundance of shrimp, for example, the area east of the Manicouagan Peninsula in the Estuary, the northeastern tip of the Gaspé Peninsula, the southeast of Anticosti Island, and the southwest of the Esquiman Channel.

Fishing effort decreased from 114,000 hours in 2017 to 79,000 and 71,000 in 2018 and 2019, the two lowest annual fishing efforts observed since 1982 (Figure 8). Use of the Vessel Monitoring System (VMS) since 2012 has made it possible to specify fishing grounds (Figure 7). Fishing effort increased in 2016 and 2017 and is comparable to the historical average (Figure 8). Since 2012, the total annual fishing effort has been about 86,000 hours and corresponds annually to a maximum footprint on the seabed of about 7,000 km^2, assuming no overlapping of tows. This effort is concentrated in an area of 13,000 km^2 where fishing intensity is variable year after year. The fishing area where activity is most intense corresponds to an area of 2,200 km^2, where 27% of all fishing effort is deployed. The fishing footprint overlaps 15% of the shrimp's distribution range.

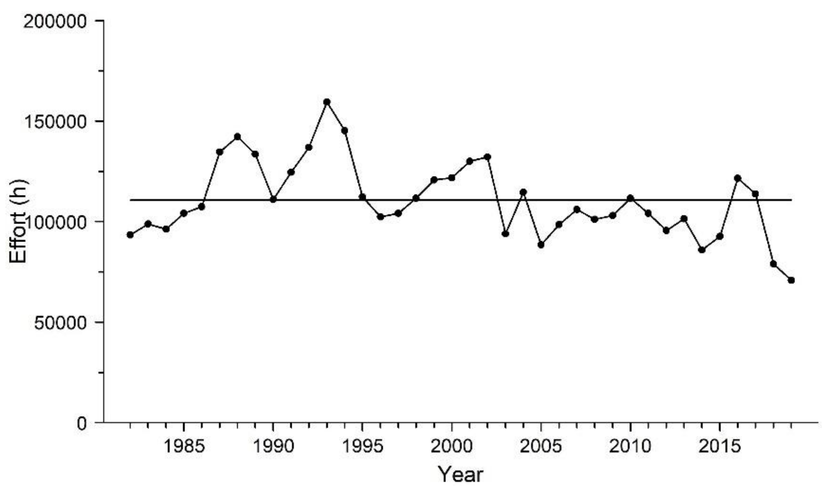

Figure 8. Total number of fishing hours per year for all management areas in the Estuary and the Gulf of St. Lawrence. The horizontal line represents the mean of the series.

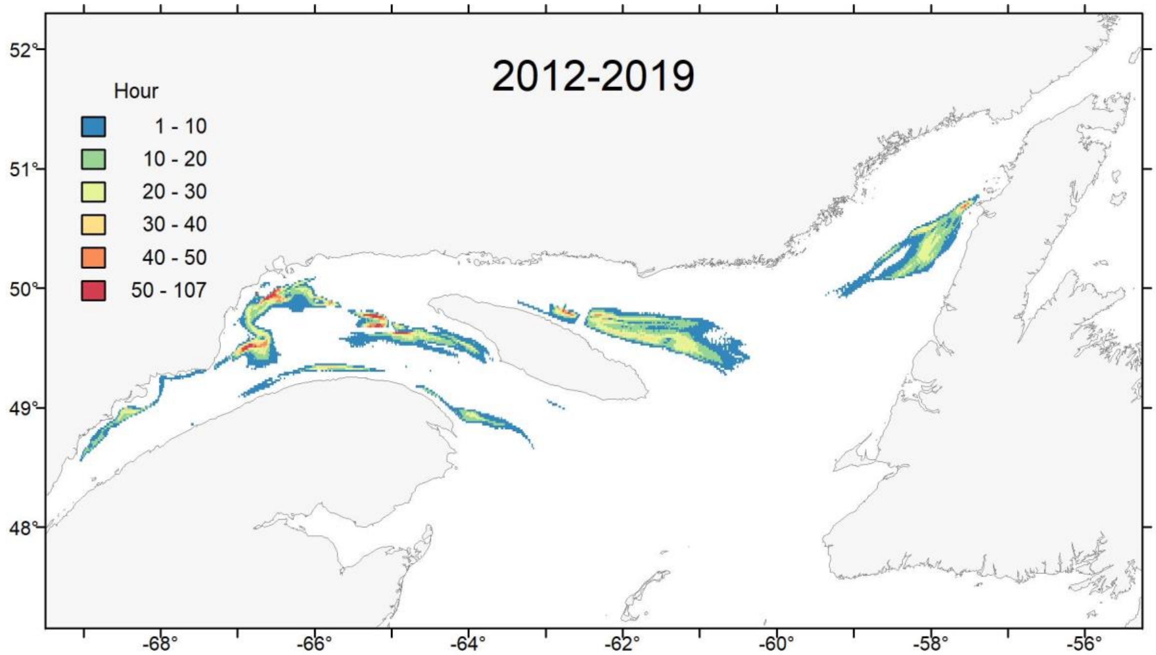

Figure 9. Distribution of the mean annual fishing effort from 2012 to 2019 according to data from the vessel monitoring system (VMS)

Annual catches per unit effort (CPUEs) are standardized to take into account changes in fishery capacity and in seasonal fishing patterns. CPUE values have varied widely over time and have followed similar trends since 1982 in all four fishing areas. CPUEs were low from 1982 to 1994, and then increased from 1995 to peak around 2005, and then remained high for a few years (Figure 10). From 2014-2015 to 2017-2018, CPUE values declined sharply in the Sept-Iles, Anticosti and Esquiman areas but have stabilized since then. CPUEs in the Estuary dropped markedly between 2006 and 2010, remained fairly stable between 2011 and 2018 and then increased fairly substantially in 2019. In recent years, CPUEs in the four areas are comparable to those observed in the early 2000s.

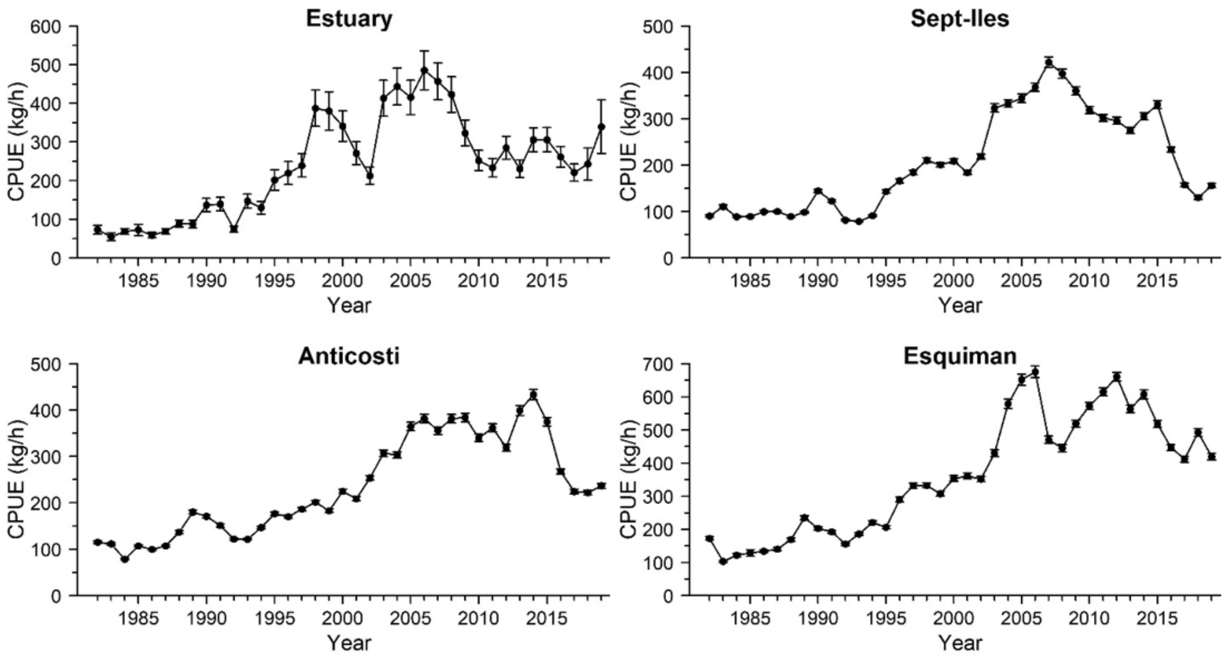

Figure 10. Standardized catch per unit effort (CPUE) from the fishery (confidence interval at 95%).

Indices of total biomass (Figure 11) and male and female biomass for Sept-Iles, Anticosti and Esquiman showed upward trends in the1990s, but downward trends since 2003. Biomass estimates for 2019 were comparable to, or slightly greater than, those for 2018. Biomass values observed since 2017 are comparable to the low values of the early 1990s. Significant interannual variations were found in the biomass estimates for the Estuary: values in 2017 and 2018 were among the lowest in the time series, while the 2019 value was among the highest.

An index of the exploitation rate is obtained by dividing the commercial catches in number by the abundance estimated from the research survey. This method cannot be used to estimate the absolute exploitation rate or to relate the index to target exploitation rates. However, the method does make it possible to track relative changes over the years. The exploitation rate index, like the survey abundance index, for the Estuary is highly variable, dropping in 2019 to the lowest value in the series (1990-2019) (Figure 12). In 2019, the exploitation rate indices for Sept-Iles and Esquiman declined to values comparable to the series average, while the index for Anticosti has been increasing in the past two years and has reached values that are among the highest in the series.

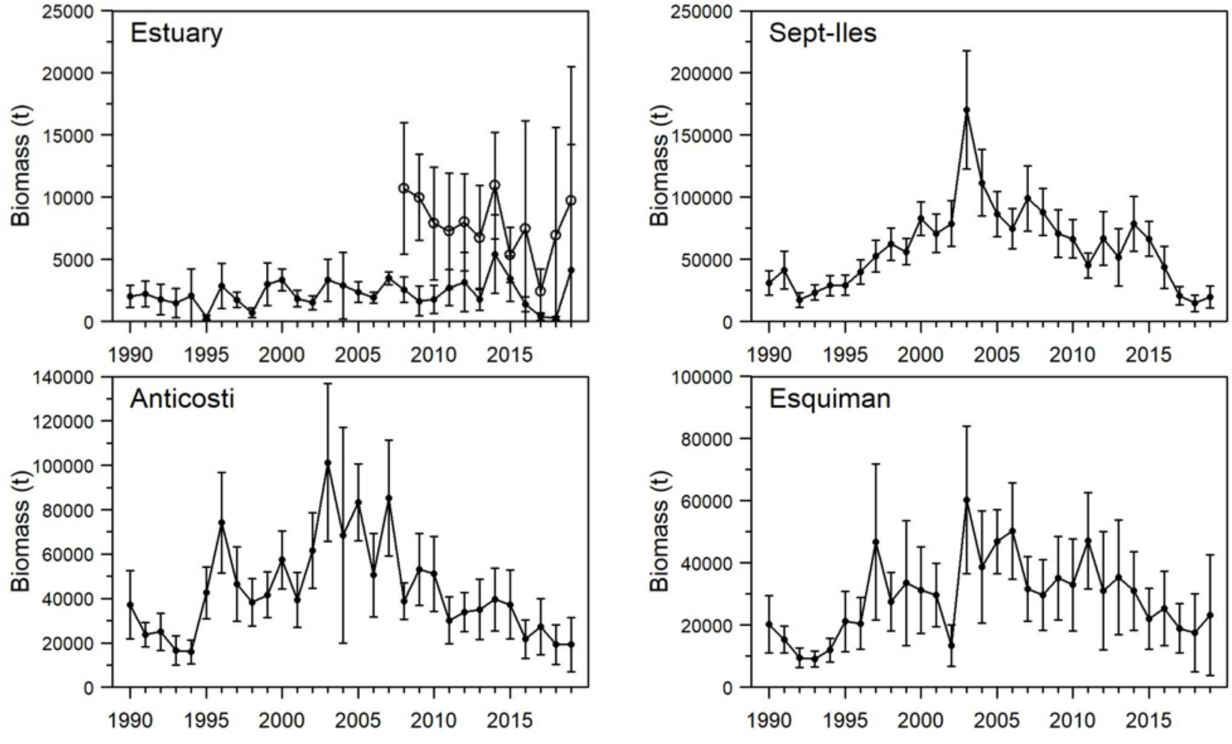

Figure 11. Biomass index from the research survey (confidence interval 95%). For Estuary, the open circles represent results obtained by integrating strata from the shallow portion that were added in 2008.

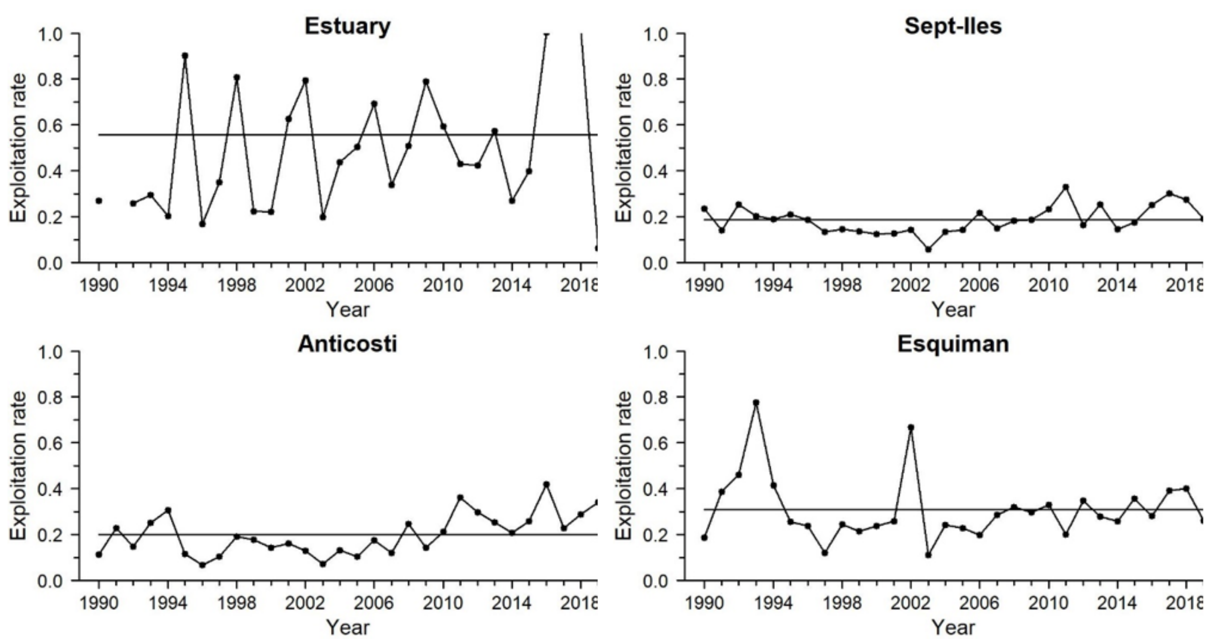

Figure 12. Index of the exploitation rate by fishing area and by year. The horizontal line represents the 1990-2019 mean.

Main Stock Status Indicator

The quantity of (primiparous) females recruited in a given year depends on the number of males that changed sex in the preceding winter. The abundance of reproductive females which will hatch the larvae in spring can be predicted from the reproductive stock estimated in summer and made up of primiparous females that have just changed sex and of multiparous females that survived larvae hatching.

The main indicator of stock status is calculated from the male and female indices obtained from the summer fishery (number per unit effort for June, July and August) and the research survey (abundance in August). In order to combine them, each index is first standardized in relation to a reference period. The main indicator of stock status represents the mean of the four indices. For the Estuary, survey indices are based on the original sampling area (shallower strata excluded).

Standardized abundance indices for males and females from the commercial fishery and from research surveys indicate similar trends for the Sept-Iles, Anticosti and Esquiman stocks since the 1980s (Figure 13). Values for these indices were low in the 1980s and early 1990s, but trended upward from the mid-1990s until 2003. Commercial fishery indices remained fairly stable and still high until 2012-2015 and then declined; in 2018-2019, they were either stable or showed a slight rising trend. The indices for the Estuary stock demonstrated much greater interannual variability. Commercial fishery indices began to increase in 2018 and research survey indices, in 2019.

The main stock status indicator for the four stocks increased in 2019, contrasting with the declines recorded in the last few years (Figure 14). The Estuary, Anticosti and Esquiman stocks are all in the healthy zone. The return of the Estuary stock to the healthy zone follows a brief time in the cautious zone in 2017. This is the third consecutive year that the Sept-Iles stock has been in the cautious zone, although the indicator showed some improvement in 2019

Outlook

The demographic structures by area obtained in 2019 from the DFO survey show that in Estuary, the small males are of very low abundance while the larger males, like the females, are above average abundance (Figure 15). In Sept-Iles and Anticosti, males and females have abundances below the average, while in Esquiman, their abundance compares to the series average (1990-2018).

The low male abundance observed in recent years and the downward trend in females' size (Figure 16) indicate low productivity of these stocks.

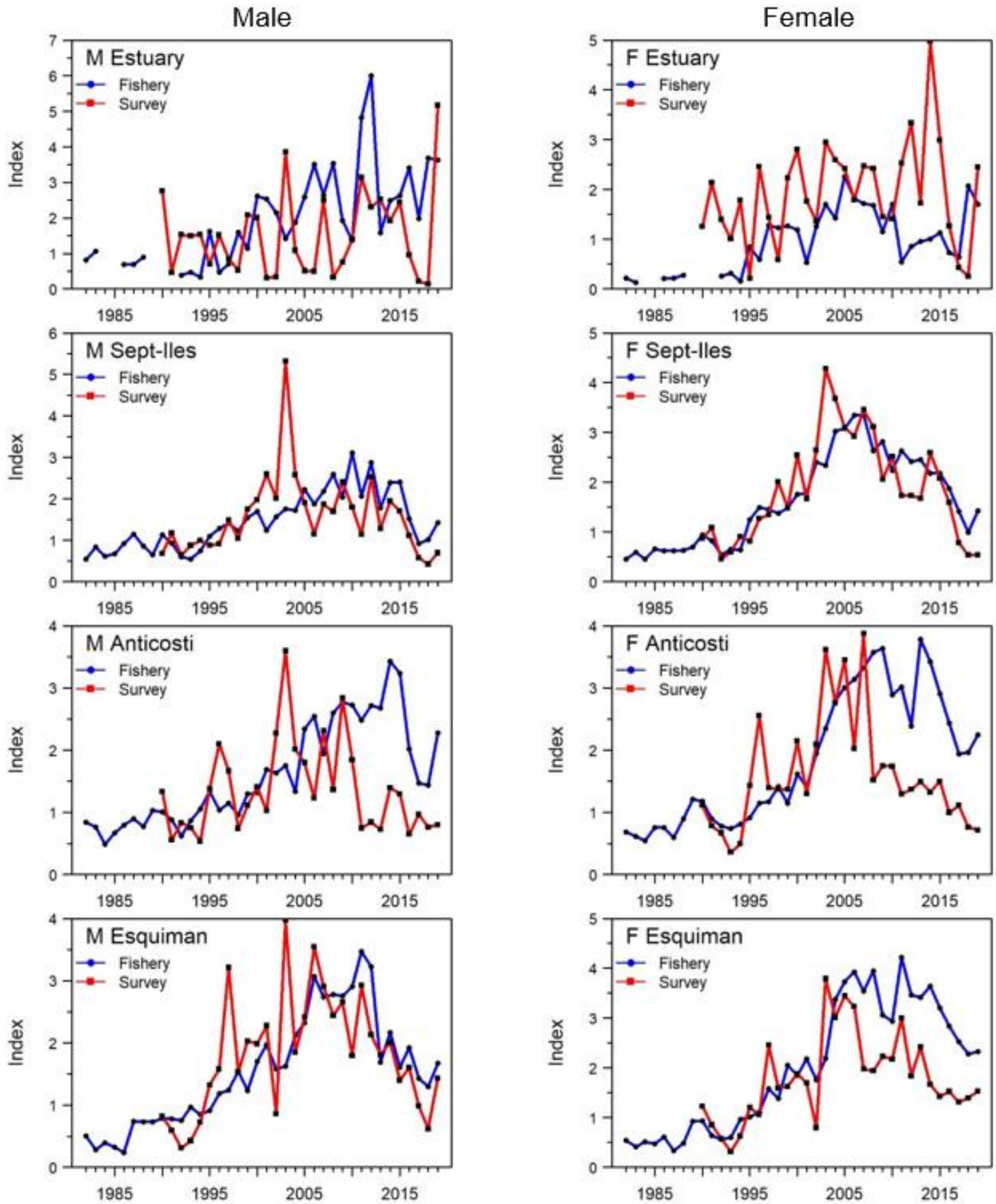

Figure 13. Standardized indices from the main indicator of stock status, which is the abundance of male and female shrimp from the DFO survey and the catch per unit effort of male and female shrimp in the summer commercial fishery.

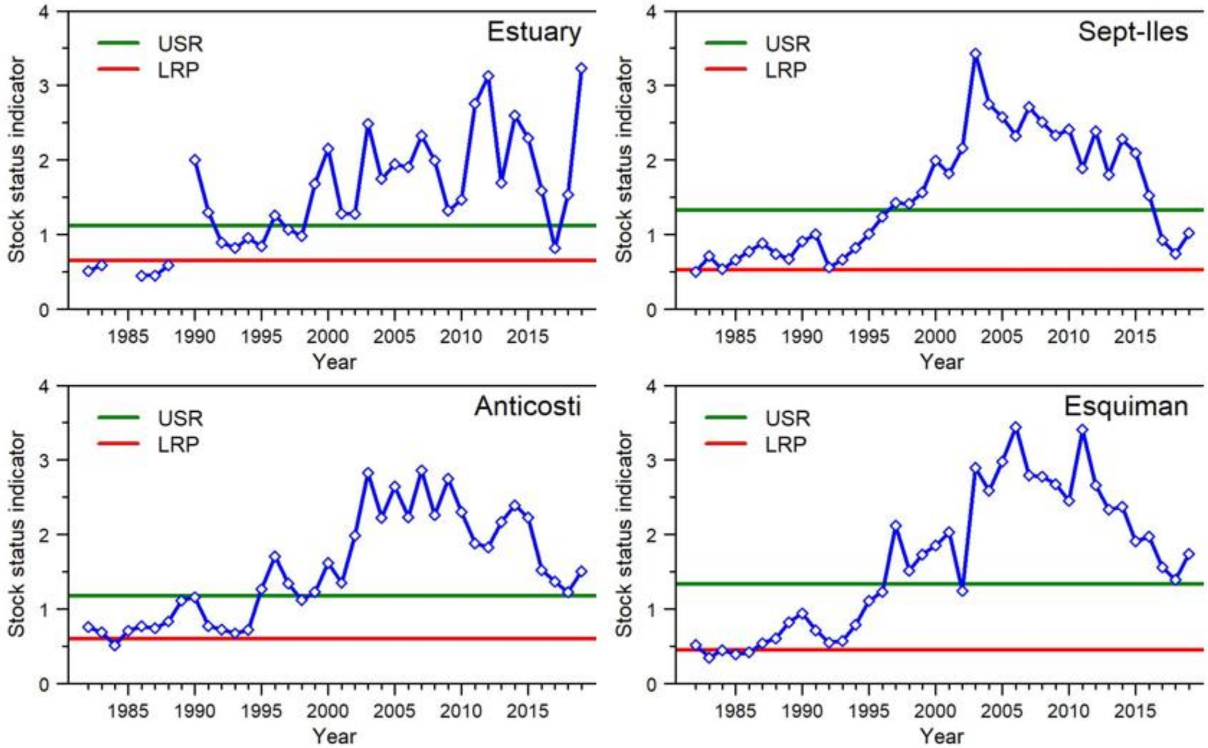

Figure 14. Main stock status indicator by year and limit (LRP) and upper (USR) stock reference points for each fishing area.

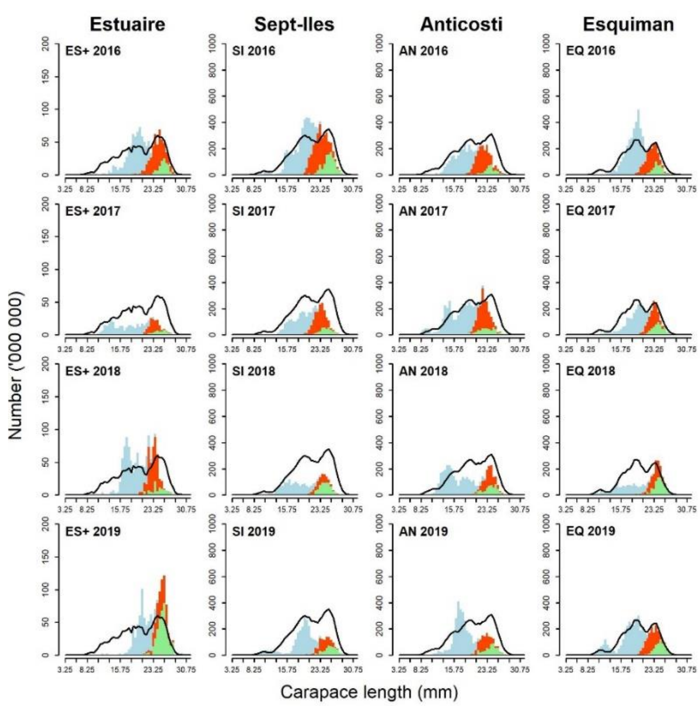

Figure 15. Shrimp abundance from the research survey (in number) by length class and by fishing area from 2014 to 2017. The histograms represent males (in blue), primiparous females (in red) and multiparous females (in green) and the solid line represents the mean of the years 1990-2015 (2008-2015 for the Estuary area).

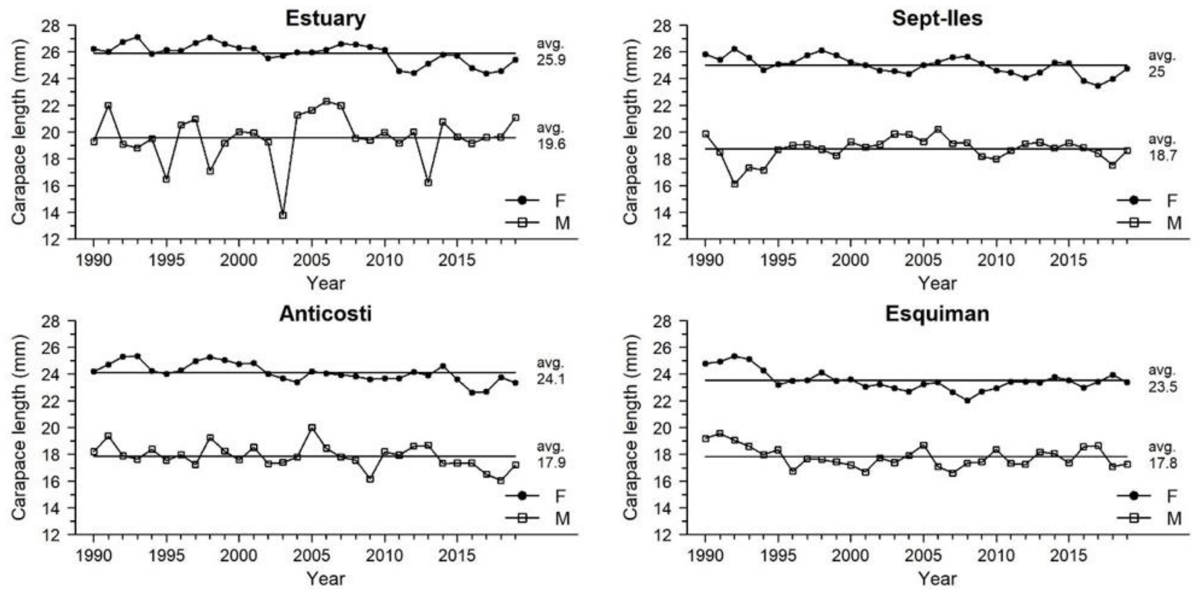

Figure 16. Mean carapace length of male and female shrimp by fishing area in the DFO survey.

Sources of Uncertainty

When the precautionary approach (PA) was developed in the late 2000s, the commercial catch rate and the research survey abundance index were consistent. From roughly 1993 to 2005, stocks were increasing, and the same rising trend was seen in commercial catch rates and research survey indices. However, from about 2005 onward, the research survey index began to decline, while the commercial catch rate remained stable at relatively high levels for roughly 10 more years. In fact, CPUEs from the commercial fishery were demonstrating hyperstability, a phenomenon that occurs when CPUE values decline more slowly than the population's abundance. The discrepancy is due to the fact that these two indices do not represent the same portion of the population. The research survey covers the species' entire range in the Estuary and northern Gulf of St. Lawrence, while the commercial fishery targets the highest concentrations of shrimp at the channels' head. Since 2015, commercial fishery indices have been declining and, in general, the gap between these and the research survey abundance index has narrowed, depending on the fishing area. This suggests that the declines in shrimp abundance and the decrease in the size of concentration areas are now substantial enough that higher catch rates can no longer be maintained in the commercial fishery.

The average size of male and female shrimp has been declining in all four stocks since the early 1990s. This trend can be observed in both the commercial fishery data and the DFO research survey data. For populations of similar abundance, a decrease in average size will have a negative impact on the stock's reproductive potential since fewer eggs will be produced per female. With the stock indices used to produce the stock status indicator and to project harvests calculated by number, we are now in a situation where the reproductive potential of the population is possibly lower now than it was in the early 1990s, for populations of comparable abundance.

The PA is based on an equal mixture of fishery dependent indices (commercial fishery catch rates) and fishery independent indices (research survey catch rates), both expressed in number of shrimp. Given the divergence between these two types of indices and the decrease in average shrimp size, it is pertinent to ask whether the main indicator still accurately reflects the stock status.

CONCLUSIONS AND ADVICE

Changes in environmental and ecosystem conditions observed in the Gulf of St. Lawrence have an impact on the northern shrimp population dynamic through their effects on such factors as abundance, spatial distribution, growth, reproduction and trophic relationships. Warming of deep waters and predation by redfish appear to be important factors in the decline of northern shrimp. These conditions are not expected to improve in the short term. The low male abundance observed in recent years and the downward trend in females' size indicate low productivity of these stocks.

The main stock status indicator for the four stocks increased in 2019, contrasting with declines in the previous years. The Estuary, Anticosti and Esquiman stocks are in the healthy zone, while the Sept-Iles stock is in the cautious zone.

Harvest guidelines were established according to the main indicator and its position relative to the stock status classification zones (healthy, cautious and critical) in compliance with the precautionary approach. According to the guidelines, the projected harvests for 2020 are 1,524 t for Estuary, 5,123 t for Sept-Iles, 6,311 t for Anticosti, and 6,142 t for Esquiman (Figure 15).

Fisheries Management will set the 2020 TACs based on these harvests by following the decision rules of the precautionary approach currently in effect.

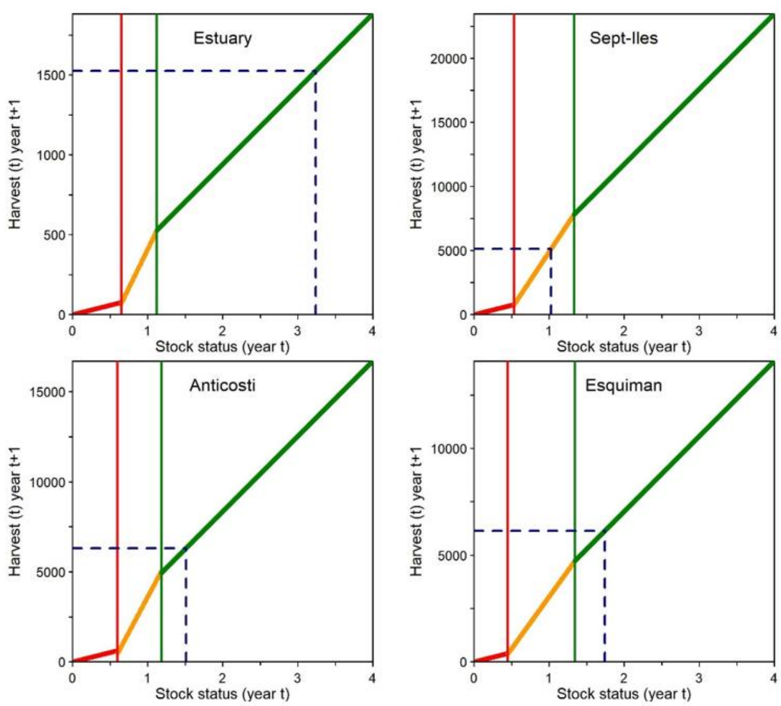

Figure 17. Harvest guidelines by fishing area. The projected harvest for 2020 is shown in view of the main stock indicator in 2019 and is indicated by the dotted lines.

OTHER CONSIDERATIONS

Bycatches of small fish in the shrimp fishery between 2000 and 2019 were examined using at-sea observer data. Fish bycatches in the shrimp fishery were predominantly in the range of 1 kg or less per species per sampled tow. Since 2013, these bycatches have been well above average, trending upward and reaching a historical peak of over 1,500 t in 2016 before beginning to decline again. From 2000 to 2015, bycatches ranged between 1% and 2% of the northern shrimp catch by weight; since 2016, they have been over 4% (Figure 18). This increase is mainly due to a strong increase in catches of small redfish and a decrease in northern shrimp catches. In 2019, the main species in bycatches were, in order of importance, Greenland halibut, redfish, capelin, witch flounder, herring, white barracudina, and American plaice. The total estimated bycatch by species nonetheless represents less than 1% of their respective estimated biomass based on the DFO survey results, except for Greenland halibut in 2019 (1.2%) and American plaice since 2016 (>1%).

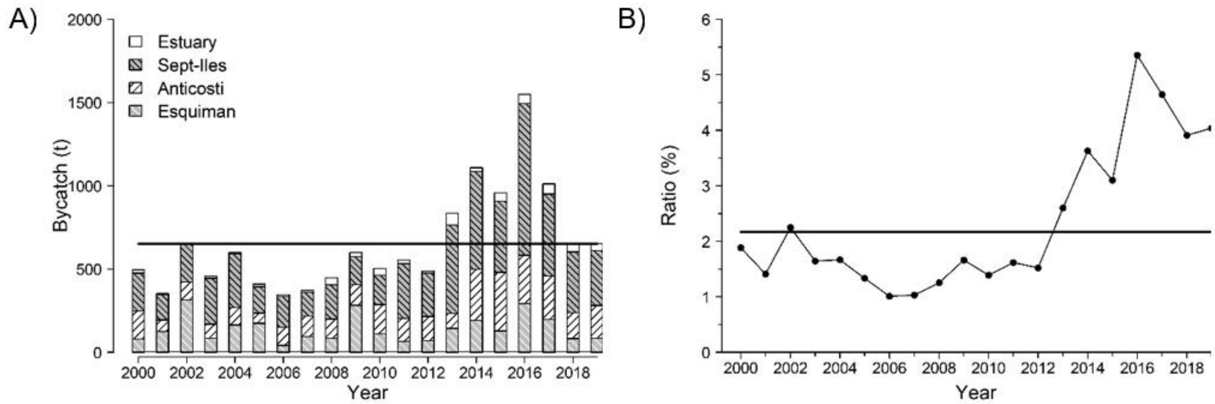

Figure 18. A) Bycatches for all species for each year and shrimp fishing area during fishing activities directed at northern shrimp and in the presence of an at-sea observer. B) Ratio (%) of bycatches to total northern shrimp catches. Solid lines indicate the average for the years 2000 to 2017.

Catches of other shrimp species during commercial fishing activities are very low compared to northern shrimp catches. Two shrimp species are common in catches: pink glass shrimp (*Pasiphaea multidentata*) and striped shrimp (*Pandalus montagui*). From 2000 to 2019, the share of *P. multidentata and P. montagui* in the total shrimp catch is estimated at 0.8% and 0.2%, respectively, according to the samples collected during landings.

The trawls used in the shrimp fishery come into contact with the seafloor. The erect and rather rigid biogenic structures of the benthic ecosystem, essentially corals and sponges, are generally considered to be most affected by the disturbances that fishing activities cause. Information on coral and sponge bycatches in shrimp fishing gear suggests that a relatively small proportion of trawling tows catch these organisms. Bycatches of sea pens (soft corals) and sponges are observed in 2.3% and 0.3% of shrimp tows respectively. To conserve corals and sponges in the Estuary and Gulf of St. Lawrence, fishery management measures were put in place in 11 areas totalling 8,571 km^2 on December 15, 2017. The use of bottom-contact gear, such as the bottom trawls used by shrimpers, is prohibited in these areas.

Assessment Schedule

The Estuary and Gulf of St. Lawrence northern shrimp stocks are assessed every two years. The precautionary approach adopted for this fishery requires an annual update of the main stock status indicator. This main indicator of stock status is calculated from the commercial fishery indices in the summer and the DFO research survey. This update was therefore prepared in early winter of the intermediary year to provide Fisheries Management with information about the projected harvests for the upcoming season, for the four shrimp fishing areas, according to the guidelines of the precautionary approach. Thus, Fisheries Management can adjust the TAC annually according to the decision rules of the precautionary approach.

LIST OF MEETING PARTICIPANTS

Name	Affiliation	Jan. 22	Jan. 23
Alberio, Marco	UQAR	-	x
Cormier Baldwin, Johanne (tel)	MAAP - NB	x	x
Barria, Aura	UQAR	-	x
Beauchamp, Brittany	DFO – Science	x	x
Beaulieu, Jérome	MPO – Gestion des pêches	x	x
Bermingham, Tom	DFO – Science	x	x
Boissonneault, Maude	UQAR	x	x
Boudreau, Mathieu	DFO – Science	x	x
Bourdages, Hugo	DFO – Science	x	x
Bourdages, Yan	ACPG	x	-
Bowlby, Heather	DFO – Science	x	x
Brassard, Claude	DFO – Science	x	x
Brown-Vuillemin, Sarah	UQAR	x	x
Brulotte, Sylvie	DFO – Science	x	-
Bruneau, Benoît	DFO – Science	x	-
Calosi, Piero	UQAR	-	x
Cassista-Daros, Manon	DFO – Science	x	x
Castonguay, Martin	DFO – Science	x	x
Chabot, Denis	DFO – Science	x	-
Chamberland, Jean-Martin	DFO – Science	x	-
Couillard, Catherine	DFO – Science	x	x
Côté, Mario	ACPG	x	x
Dennis, Bill	FLR – NF	x	x
Desgagnés, Mathieu	DFO – Science	x	x
Dewland, Jennifer	PEI Fishermen's Association	x	x
Dubé, Sonia	DFO – Science	x	x
Duplisea, Daniel	DFO – Science	x	x
Dupuis, Vincent	ACPG	x	x
Élément, Patrice	ACPG	x	x
Faille, Geneviève	DFO – Science	x	-
Ferguson, Annie (tel)	MAAP - NB	x	x
Galbraith, Peter	DFO – Science	x	-
Gauthier, Johanne	DFO – Science	x	x
Gionet, Norbert	ACAG – FRAPP	x	x
Guscelli, Ella	UQAR	x	x
Isabel, Laurie	DFO – Science	x	x
Lacroix-Lepage, Claudie	DFO – Science	x	x
Lanteigne, Jean	FRAPP	x	x
Légère, Michel	ACAG – FRAPP	x	x
Lemire, Maryse	DFO – Fisheries management	x	x
Marquis, Marie-Claude	DFO – Science	x	x
Méthot, Chantal	DFO – Science	x	x
Noisette, Fanny	UQAR - ISMER	x	x
Nozères, Claude	DFO – Science	x	x
Ouellette-Plante, Jordan	DFO – Science	x	x
Parent, Geneviève	DFO – Science	-	x
Pellerin, Mathieu	DFO – Fisheries management	x	x
Pomerleau, Corinne	DFO – Science	x	x
Plourde, Stéphane	DFO – Science	x	x
Robichaud, Roger	DAAF – NB	x	x
Roussel, Eda	ACAG – FRAPP	x	x

Name	Affiliation	Jan. 22	Jan. 23
Roux, Marie-Julie	DFO – Science	x	x
Scallon-Chouinard, Pierre-Marc	DFO – Science	x	x
Sainte-Marie, Bernard	DFO – Science	x	x
Sandt-Duguay, Emmanuel	AGHAMM – GMRC	x	x
Senay, Caroline	DFO – Science	x	x
Soubirou, Marina	UQAR	x	-
Small, Daniel	UQAR	-	x
Spingle, Jason	FFAW – NL	x	x

SOURCES OF INFORMATION

This Science Advisory Report is from the January 22-23, 2020 meeting on Assessment of northern shrimp stocks in the Estuary and Gulf of St. Lawrence. 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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