



ASSESSMENT OF THE ESTUARY AND NORTHERN GULF OF ST. LAWRENCE (AREAS 13 TO 17, 12A, 12B, 12C AND 16A) SNOW CRAB STOCKS IN 2010

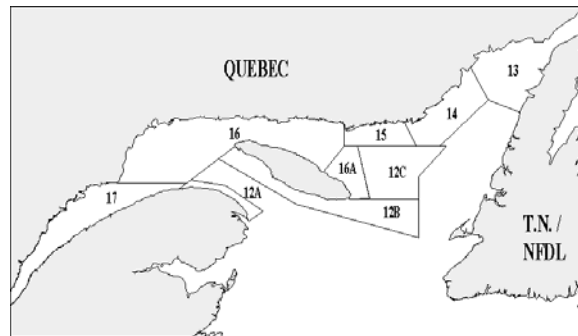
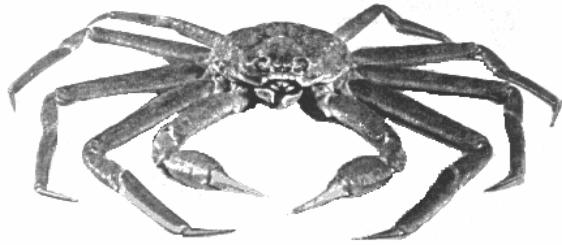


Figure 1: Snow crab management areas in the Estuary and the northern Gulf of St. Lawrence.

Context

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

Landings have varied depending on the adjusted TACs based on the recruitment waves and troughs that have affected the fishery (Figure 2), with maximum levels recorded in 1995 (7,879 t) and 2002 (10,372 t). Landings dropped considerably in 2003 owing to the lower TACs established in response to perceived signs of overfishing, particularly in Area 16. Landings totalled 8,209 t in 2010.

The fishery is directed exclusively at males with a carapace width of at least 95 mm. White crab (crab that has recently moulted) and adolescent males may be returned to water during the fishing season to enhance their meat yield and give them a chance to reproduce. Furthermore, since 1985, when the proportion of white crab in catches at sea exceeds 20%, it automatically triggers the closing of the fishery in the area concerned, in order to minimize the mortality of these very fragile crabs that will be available to the fishery the following year.

The DFO Fisheries and Aquaculture Management Branch for the Quebec Region requested a resource status assessment as well as scientific advice in order to set the 2011 quotas. A scientific peer review was held from February 7 to 9, 2011. Participants included representatives from DFO Science and Fisheries and Aquaculture Management, fishing industry, provincial governments and First Nations.

SUMMARY

- In 2010, all stocks in the Estuary and northern Gulf of St. Lawrence had a low or decreasing residual biomass. Strong reliance on recruitment in order to maintain the commercial biomass was observed in most stocks.
- In areas 17 and 12A, the TAC reduction from 2006 to 2008 helped stabilize and then generate a small commercial biomass recovery. In areas 16 and 14, lower catch rates during the commercial fishery and in the post-season survey, suggest a decrease in commercial biomass. In Area 15, the commercial biomass remained relatively high according to the 2010 fishing results, but could drop in 2011 according to the post-season survey. In areas 12C and 16A, the reduction of residual biomass, leading to increased reliance of the fishery on recruitment, indicates that yields should not be increased in order to help maintain the commercial biomass. In Area 13, the commercial fishery catch rate, which was near the 1998-2009 average, and the predominance of intermediate-shell crab in the landings, suggests that the fishing mortality rate was not too high.
- Advices encourage the maintenance of an adequate reproductive biomass for males so as to not adversely affect the recovery or maintenance of the population in a given area. Recommendations assume that the natural mortality rate will not differ in 2011 compared with previous years.

Recommendations:

- **In Area 17**, a 10% TAC increase in 2011 compared to 2010 would likely not reduce commercial biomass indices if recruitment is equal or higher in 2011 than the 2009 and 2010 values.
- **In Area 16**, a 15-25% TAC decrease in 2011 compared to 2010 could halt the decreasing commercial biomass in 2011 and reduce the fishery's reliance on recruitment.
- **In Area 15**, the status quo or a 10% TAC decrease in 2011 compared to 2010, should help maintain the commercial biomass if older crabs are targeted and the eastern part of the area is exploited.
- **In Area 14**, a 20% TAC decrease in 2011 compared to 2010, could help stabilize the commercial biomass.
- **In Area 12A**, a 20% TAC increase in 2011 compared to 2010, would not likely jeopardize the observed recovery.
- **In Area 12B**, a 10% TAC increase in 2011 compared to 2010, would not likely produce a decline in the resource.
- **In areas 12C and 16A**, maintaining the 2010 TAC in 2011 should help sustain the commercial biomass at an acceptable level.
- **In Area 13**, the available information does not provide any reason for changing the pre-established management plan for the 2011 fishing season.

INTRODUCTION

Species Biology

In Canada, snow crab can be found from the southern tip of Nova Scotia to midway up Labrador as well as in the Estuary and Gulf of St. Lawrence. In the Gulf of St. Lawrence, males of commercial size live at depths of around 60-220 m, except during their moulting and reproductive period when they migrate to shallower waters. Snow crab stop growing after their terminal moult. The male is referred to as adolescent (small claws) prior to the terminal moult and as adult (large claws) afterward. Males range in carapace width (CW) from 40 mm to 165 mm after their terminal moult. If they do not do their terminal moult before, males reach legal size (CW of 95 mm) at about nine years of age. Snow crab recruitment is periodic or episodic and varies considerably over a cycle of 8 to 12 years. The recruitment situation in the fishery can be determined through the regular monitoring of catches (size, carapace condition) and effort (catch per unit effort, CPUE), and confirmed by scientific trap and trawl surveys.

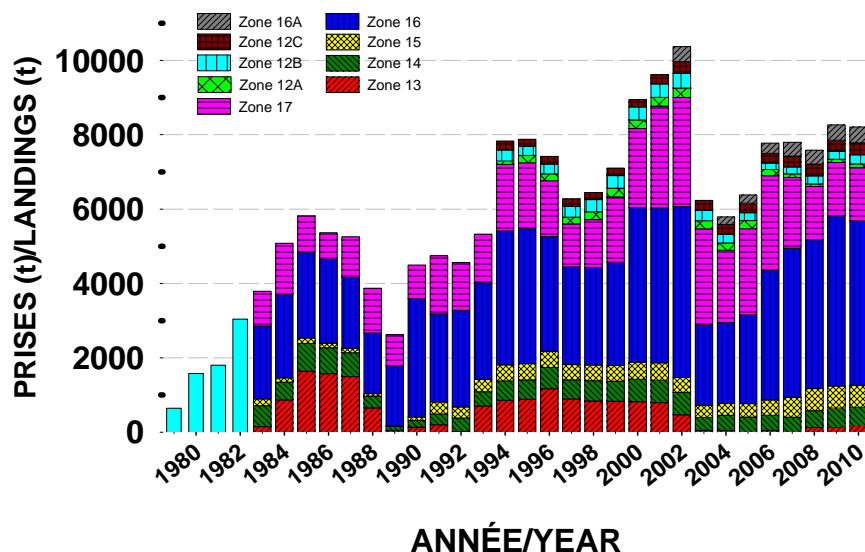


Figure 2. Snow crab landings in the Estuary and northern Gulf of St. Lawrence. From 1979 to 1982, landings were not differentiated per area.

ASSESSMENT OF THE RESOURCE

Fishing data derived from logbooks, processing plant purchase slips and dockside weighing summaries, along with catch sampling data obtained from the Observers Program and DFO samplers, are the basis for the analyses of all areas. In 2010, a trap-based research survey was carried out by Industry in all fishing areas and the findings were incorporated into the stock status analyses. These surveys help determine the mean NPUE (numbers per unit effort) per area for commercial size crab and the NPUE for adolescent crab categories of over 78mm carapace width that will reach or remain at legal size at the following moult. The results from the

trawl research surveys conducted in 2009 and 2010 in Areas 13 and 17 were used to calculate an abundance index for juvenile or adult crab.

The raw CPUE (catches per unit effort) for the fishery were standardized using an additive model to account for seasonal changes, gear type, soak time and fishing site. The proportion of new crabs or recruits, recognizable with a new carapace (carapace condition 1 and 2), was determined by dockside samplers.

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

Until now, data on female insemination levels have been collected sporadically in certain areas. An annual systematic sampling of each area is preferred in order to use this parameter for stock status assessments, because it is a measure of female mating success and relative abundance of large adult males.

Area 17

Description of the Fishery

There are 22 active license holders in Area 17. The TAC dropped by 44% between 2006 and 2008 and remained unchanged in 2009 and 2010 at 1,430 t (Figure 3), including 172 t in temporary allocations. The fishing season opened on March 30th and closed on June 21st, and the TAC was met.

Resource Status in 2010

In the commercial fishery, the standardized CPUE remained at high values from 2000 to 2004 and dropped by 48% between 2004 and 2008 (Figure 4). It increased in 2009, near the series average and remained at similar values in 2010. The proportion of recruits (new crabs, conditions 1 and 2) in the landings increased from 2005 to 2009 and dropped in 2010, whereas the proportion of intermediate-shell crab (condition 3) represented the majority (Figure 5). The latter had accumulated during the last recruitment wave and had largely supported the fishery between 1999 and 2006. The proportion of old crabs (conditions 4 and 5) in the landings has been low in the last few years. The mean of legal-size crab caught at sea, which increased between 1999 and 2004, dropped in 2005 and 2006 and then rose again in 2007 to a value that has remained relatively stable until 2010 at about 112 mm (Figure 6).

Results from the postseason trap survey, a data series that began in 1996 on the north shore and in 1999 on the south shore, indicated a drop in the NPUE of over 50% between 2005 and 2007, followed by stable and below average values up to 2010 (Figure 7). The number of crabs left by the fishery, intermediate-shell or old crabs (conditions 3, 4 and 5) dropped sharply between 2005 and 2009 and remained low in 2010. The number of recruits (conditions 1 and 2) remained near the mean between 2005 and 2008, then increased considerably in 2009 and remained high in 2010 (Figure 8), which significantly contributed to maintain the available commercial biomass during the 2010 season.

After declining sharply from 2001 to 2003, the average number of adolescents of 78+ mm captured in traps remained above average starting in 2005, despite a drop in 2010 (Figure 8).

The mean size of legal size crabs in the postseason survey has changed little since 2007 and is expected to remain similar in 2011.

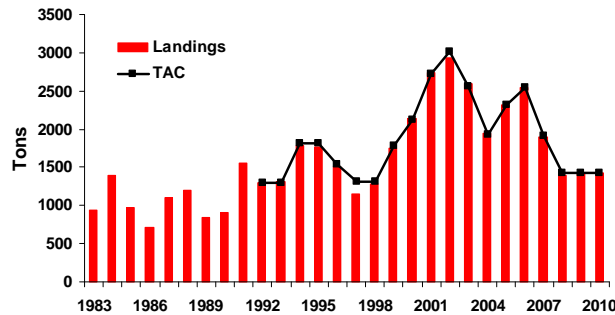


Figure 3. Landings and TAC in Area 17 between 1983 and 2010.

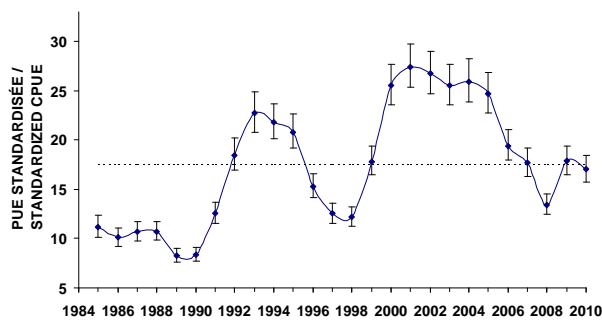


Figure 4. Standardized CPUE ± confidence interval in the commercial fishery between 1985 and 2010 in Area 17. The dotted line shows the data series mean

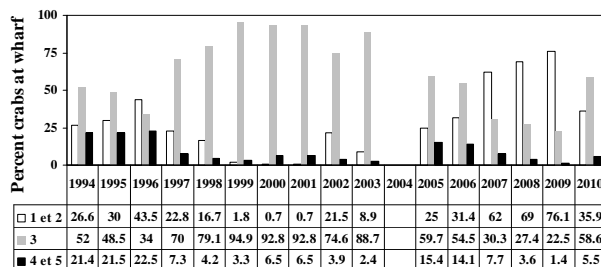


Figure 5. Carapace conditions for legal-size crabs landed in Area 17 between 1994 and 2010.

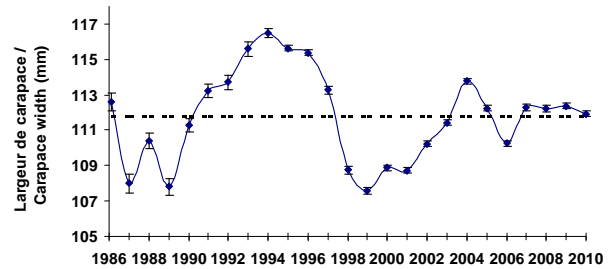


Figure 6. Mean carapace width ± confidence interval for commercial crabs sampled at sea between 1986 and 2010 in Area 17. The dotted line shows the data series mean.

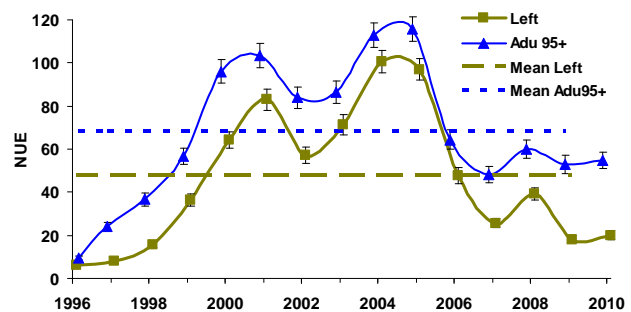


Figure 7. Catch rates (NPUE), with confidence interval and mean, of adult crab ≥ 95 mm and those left by the fishery from the postseason survey in Area 17 between 1996 and 2010.

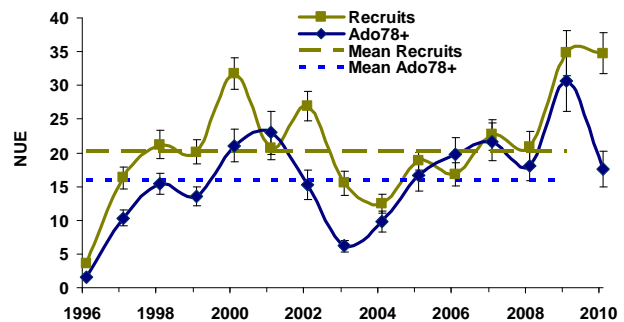


Figure 8. Catch rates (NPUE), with confidence interval and mean, of adolescent crab of 78+ mm and recruits, from the postseason survey in Area 17 between 1996 and 2010.

Results from the trawl survey conducted on the north shore of the Estuary indicated that the abundance of adolescents between 78 and 95 mm has been stable since 2005 and that adolescents between 40 and 78 mm were less abundant in 2009 than in the previous survey in 2007. There was a sharp increase of males of 40 mm and less in 2009.

In 2010, the average amount of sperm stored in the female's spermatheca remained above the level required for a high success rate of fertilizing eggs.

Conclusion and Advice:

TACs and landings have totalled 1,430 t since 2008.

The catch rate in the commercial fishery was low in 2008 and near average in 2009 and 2010. The 2010 postseason survey suggests that the 2011 fishing yields should be similar to those of 2010 and that landings should include a significant proportion of recruits.

The size of crabs caught in the 2010 commercial fishery was stable and has been slightly above average since 2007; it is expected to remain at that level in 2011 based on the postseason survey.

The postseason survey results indicated that the abundance of adolescents of 78+ mm was high in 2009 but dropped in 2010, to values slightly above the 1996-2009 average.

The 44% TAC decrease from 2006 to 2008, which was maintained until 2010, provided some stability and helped somewhat the recovery of the commercial biomass. The proportion of intermediate-shell or old crabs in the landings was higher and it was lower for recruits in 2010 compared to the two previous years, which suggests a lower fishing mortality rate.

Recommendation:

A 10% increase of the TAC in 2011 compared to 2010 is not likely to lower the commercial biomass indices if recruitment is equal or higher in 2011 than the 2009 and 2010 values.

Area 16

Description of the Fishery

In Area 16, 39 fishermen hold regular snow crab fishing licenses in group A (92.7% of the TAC) and 20 in group B (7.3% of the TAC). The TAC increased by 15% from 2008 to 2009, peaking at 4,606 t, and remained at the same level in 2010 (Figure 9). In 2010, the fishery opened on April 5th and closed on July 10th.

Resource Status in 2010

In the fishery, the standardized CPUE reached high values in 2005 and 2006 before dropping to near average in 2007. It then remained stable up to 2009 and dropped sharply below the average in 2010 (Figure 10). Recruits have made up the majority of landings since 2006 and, oppositely, the proportion of intermediate-shell (condition 3) has been relatively low over the same period (Figure 11). The mean size of legal-size crab sampled at sea, which had begun increasing in 2003 following a sharp downward period, dropped in 2009 and 2010 and remains near average at 109.7 mm (Figure 12).

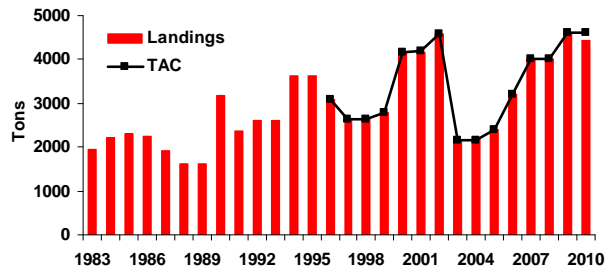


Figure 9. Landings and TAC for Area 16 between 1983 and 2010.

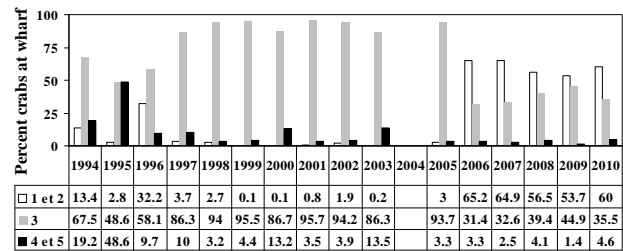


Figure 11. Carapace conditions of legal-size crab landed in Area 16 between 1994 and 2010.

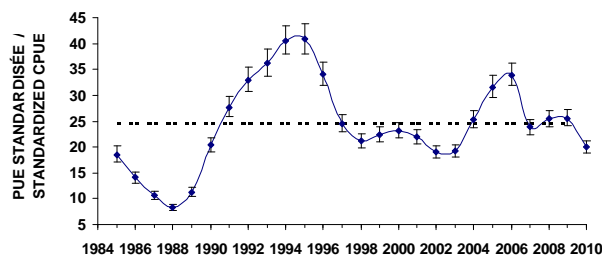


Figure 10. Standardized CPUE ± confidence interval in the commercial fishery from 1985 to 2010 in Area 16. The dotted line indicates the data series mean.

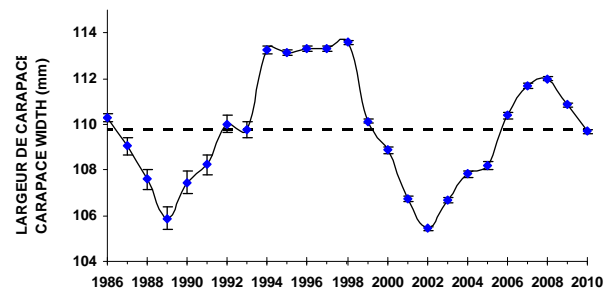


Figure 12. Mean carapace width ± confidence interval for legal-size crab sampled at sea between 1986 and 2010 in Area 16. The dotted line indicates the data series mean.

Postseason trap surveys, conducted every fall since 1994, showed that the NPUE for legal-size crabs increased significantly in 2003, and has then remained relatively high up to 2009 and then dropped in 2010 to a level slightly below the average (Figure 13). The number of intermediate-shell or old crabs (conditions 3, 4 and 5), left by the fishery, declined between 2007 and 2009 and remained low in 2010 (Figure 13), while the number of recruits (conditions 1 or 2) has been relatively high since 2007, despite a drop in 2010 (Figure 14). The available biomass at the beginning of the 2011 season should therefore be lower than that of 2010, and would consist of a high proportion of recruits. The average size of adult males of 95+ mm increased considerably from 2003 to 2006 and did not change much thereafter. It was 111 mm in the 2010 survey. The mean NPUE for adolescents of 78+ mm has been significantly above average since 2007 (Figure 14), which suggests a good medium-term recruitment.

Results from the trawl survey conducted annually in St. Marguerite Bay, near Sept-Îles, showed a recruitment wave of low abundance that could nevertheless help maintain the commercial biomass.

The spermatheca of females from St. Marguerite Bay were not as full in 2010 compared to 2008 and 2009, suggesting a lower relative availability of larger males.

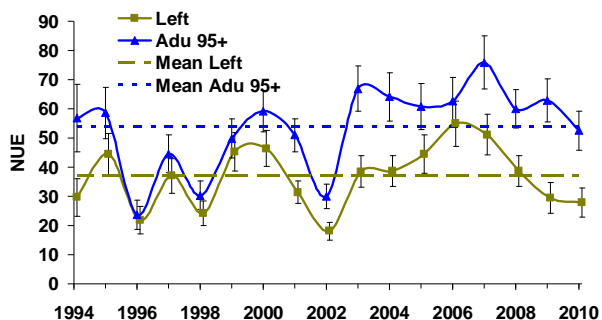


Figure 13. Catch rates (NPUE), with confidence interval and mean, for adult crab ≥ 95 mm and those left by the fishery, from the postseason survey in Area 16 between 1994 and 2010.

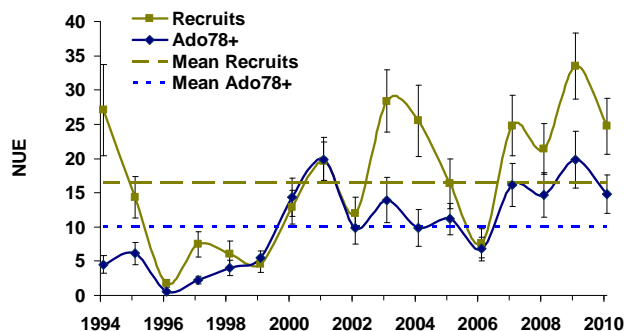


Figure 14. Catch rates (NPUE), with confidence interval and mean, for adolescent crab of 78+ mm and recruits, from the postseason survey in Area 16 between 1994 and 2010.

Conclusion and Advice:

The TAC peaked at 4,606 t in 2009 and 2010. Catches totalled 4,420 t in 2010.

The catch rate in the commercial fishery dropped in 2010 and is below the 1994-2009 average. The landings were mostly composed of recruits.

The 2010 postseason survey suggests that harvesting yields in 2011 could drop and landings will be mostly composed of recruits.

The size of crabs caught in the 2010 commercial fishery dropped and is near the average; it could increase slightly in 2011 based on the postseason survey.

The postseason survey results indicated that the abundance of adolescents of 78+ mm dropped, but remained above the average. Results from the trawl survey conducted in the western part of the area showed the arrival of a new recruitment wave to the fishery. This new recruitment wave is clearly less abundant than the previous wave.

The lower catch rates from the commercial fishery and from the postseason survey, and the predominance of recruits in the landings, suggest an overly high fishing mortality rate and a decrease in the commercial biomass.

Recommendation:

A 15-25% TAC decrease in 2011 compared to 2010 could halt the decreasing commercial biomass in 2011 and reduce the fishery's reliance on recruitment.

Area 15

Description of the Fishery

Area 15 has 8 regular fishermen. Since 2008, the TAC has peaked at 539 t (Figure 15), including 55 t in temporary allocations. In 2010, the fishery opened on April 5th and closed on July 12th. The TAC has always been met.

Resource Status in 2010

The standardized CPUE from the commercial fishery, in decline from 1996 to 2002, increased gradually beginning in 2003, and has been clearly above the average since 2006 (Figure 16). In 2010, the proportion of recruits (conditions 1 and 2) landed increased, and oppositely, the proportion of intermediate-shell crab (condition 3) decreased, but still represented the majority of crabs landed (Figure 17). The proportion of old crabs (conditions 4 and 5) increased in 2010. Harvesting effort was concentrated in the western part of the area. Between 2005 and 2007, the mean CW of legal-size crabs sampled at sea increased from 106.1 mm to 112.1 mm, and then remained relatively stable until 2010, measuring 111.5 mm (Figure 18).

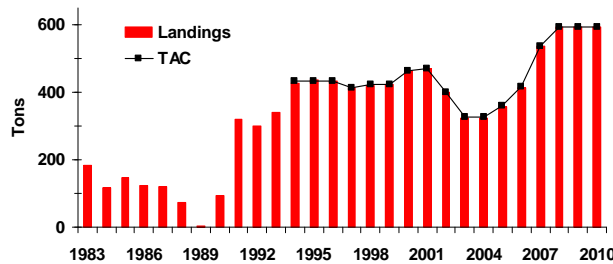


Figure 15. Landings and TAC for Area 15 between 1983 and 2010.

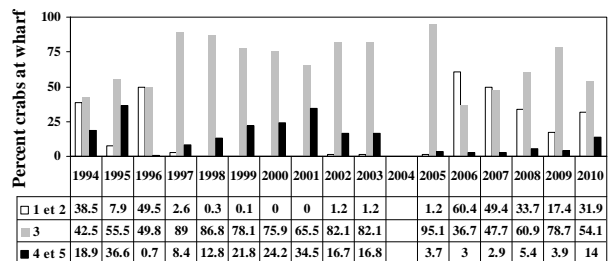


Figure 17. Carapace conditions of commercial crab landed in Area 15 between 1994 and 2010.

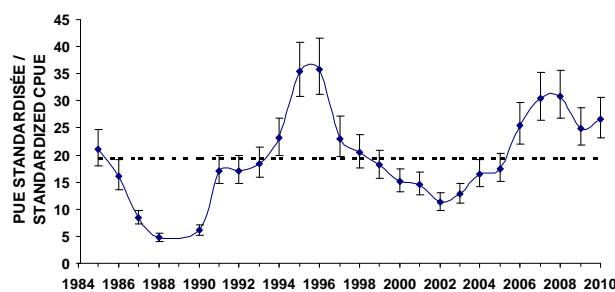


Figure 16. Standardized CPUE \pm confidence interval in the commercial fishery from 1985 to 2010 in Area 15. The dotted line indicates the data series mean.

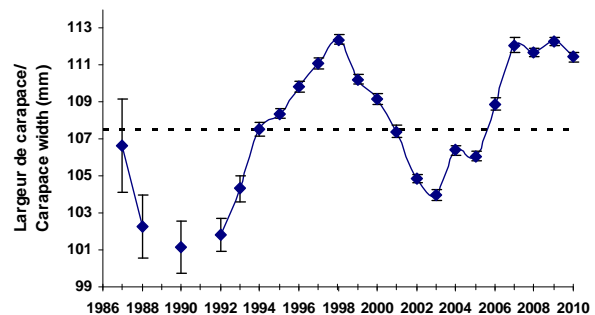


Figure 18. Mean carapace width \pm confidence interval for legal-size crab sampled at sea between 1987 and 2010 in Area 15. The dotted line indicates the data series mean.

The scientific trap survey, which has been conducted since 1998, showed that the NPUE of legal-size crab was at high values from 2005 to 2009, and then dropped under the average in 2010 (Figure 19). The abundance of intermediate-shell or old crabs (conditions 3, 4 or 5), or left by the fishery, is strongly correlated with that of all legal-size crab and was also, in 2010, well below average (Figure 19). Oppositely, the NPUE of recruits (conditions 1 and 2), which has

increased since 2009, was clearly above the average in 2010 (Figure 20) and their proportion in the postseason survey catches increased significantly, but did not represent the majority. Thus, the postseason survey results suggest that the available biomass at the beginning of the 2011 season could be lower than in 2010 and catches would consist of a large proportion of intermediate-shell or old crabs. The mean size of crabs of 95+ mm increased between 2002 and 2007 and has remained relatively stable until 2010 at 109.7 mm, suggesting that it should remain high in the 2011 commercial catches. The mean NPUE of adolescents of 78+ mm, which was relatively high from 2002 to 2006, declined significantly in 2007 and remained low until 2010 (Figure 20).

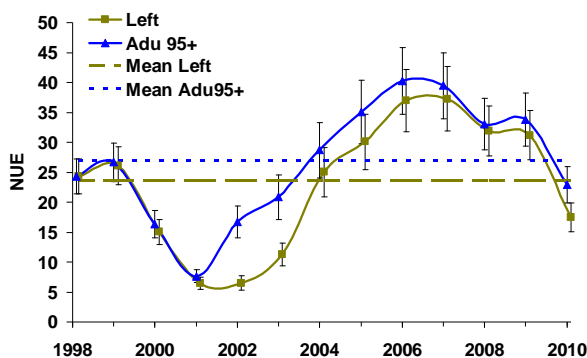


Figure 19. Catch rates (NPUE), with confidence interval and mean, for adult crab ≥ 95 mm and those left by the fishery, from the postseason survey in Area 15 between 1998 and 2010

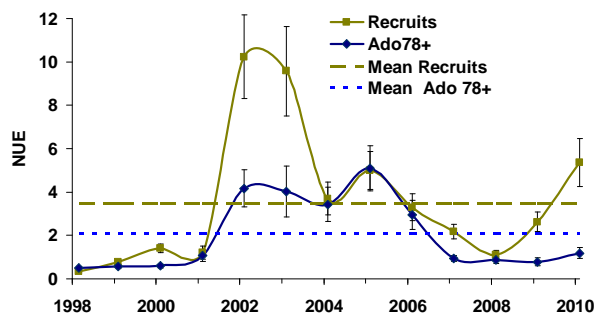


Figure 20. Catch rates (NPUE), with confidence interval and mean, for adolescent crab of 78+ mm and recruits, from the postseason survey in Area 15 between 1998 and 2010.

Conclusion and Advice:

The TAC and landings have peaked at 593 t since 2008.

The catch rate in the commercial fishery varied little between 2009 and 2010 and remained high compared with the 1998-2009 series average. Landings consisted in large part of intermediate-shell crab, despite a larger proportion of recruits than in 2009. The harvesting effort in the easternmost part of the area remained low.

The 2010 postseason survey suggests that the 2011 fishing yields will be lower than in 2010 and that the landings will be composed mainly of intermediate-shell crabs, despite an increase in the proportion of recruits.

The mean size of crabs caught in the 2010 commercial fishery decreased slightly, but remains high compared to the average and should remain high in 2011 based on the postseason survey.

In the postseason survey, the abundance index for adolescents of 78+ mm has remained below average since 2007.

The commercial biomass was still relatively high according to the 2010 fishery results, but it could decrease in 2011 based on the postseason survey. In fact, commercial yields are not likely to be as high in 2011 than in 2009 and 2010 due to the increased reliance of fishing success on recruitment, due to the gradual decrease of the residual biomass.

Recommendation:

The status quo or a 10% TAC decrease in 2011 compared to 2010, should help maintain the commercial biomass if older crabs are targeted and the eastern part of the area is exploited.

Area 14

Description of the Fishery

Area 14 has 21 regular fishermen. The TAC increased by 15% to 509 t from 2008 to 2009 and remained at this level in 2010 (Figure 21). In 2010, the fishing season opened on April 18th and closed on July 24th. The TAC was met.

Resource Status in 2010

The standardized CPUE from the commercial fishery was low but relatively stable from 1999 to 2009, except in 2003 (Figure 22) when the TAC had been significantly reduced. However, in 2010, the CPUE dropped sharply. Intermediate-shell crabs (condition 3) have dominated the landings since 2008 even though the proportions of recruits (conditions 1 and 2) and old crabs (conditions 4 and 5) increased during this period (Figure 23). The mean size of legal-size crabs caught at sea has dropped since 2008 and was near the average in 2010, at 106.8 mm (Figure 24).

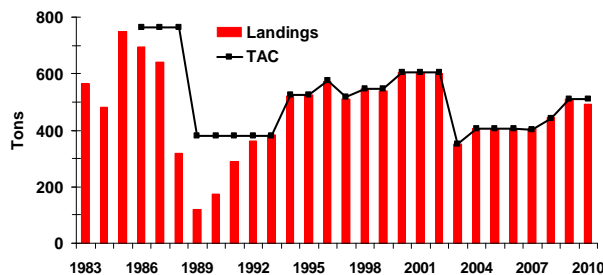


Figure 21. Landings and TAC for Area 14 between 1983 and 2010.

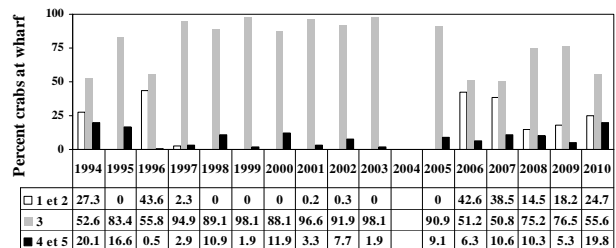


Figure 23. Carapace conditions of commercial crab landed in Area 14 between 1994 and 2010.

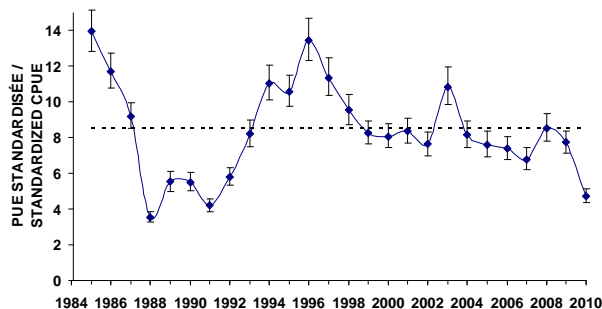


Figure 22. Standardized CPUE ± confidence interval in the commercial fishery from 1985 to 2010 in Area 14. The dotted line indicates the data series mean.

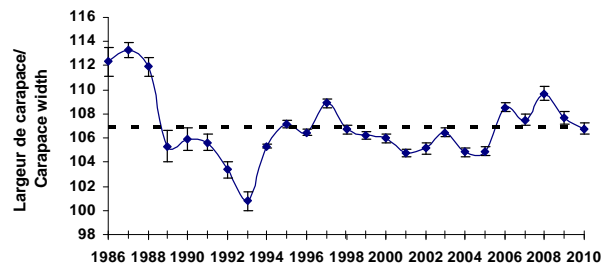


Figure 24. Mean carapace width ± confidence interval for legal-size crab sampled at sea between 1986 and 2010 in Area 14. The dotted line indicates the data series mean.

The **scientific trap survey** conducted since 1996 indicates that the NPUE has decreased since 2008 and has been clearly below average since 2009 (Figure 25). The abundance of intermediate-shell or old crabs (conditions 3, 4 or 5) is strongly correlated with that of all commercial crab and, in 2010, the NPUE represented the lowest value of the series (Figure 25). Recruits (conditions 1 and 2) were below the average between 2005 and 2009, and then increased sharply in 2010 (Figure 26) and they represented a high majority of legal-size crabs in the postseason survey catches. Thus, the postseason survey results suggest that the biomass available at the beginning of the 2011 season will be lower than in recent years and will include a high proportion of recruits. The mean size of legal-size crabs has changed little since 2005 and stood at 105.3 mm in 2010. The mean NPUE of adolescents of 78+ mm was above the average in 2008 and 2009, and then dropped below the average in 2010 (Figure 26).

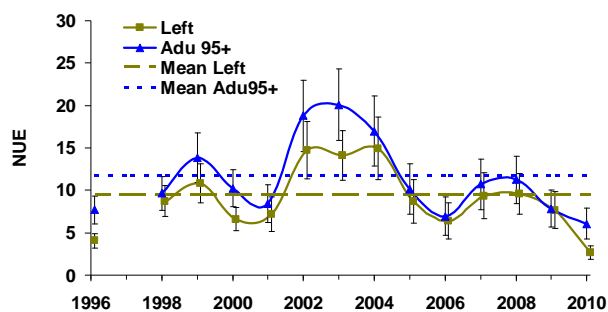


Figure 25. Catch rates (NPUE), with confidence interval and mean, for adult crab ≥ 95 mm and those left by the fishery, from the postseason survey in Area 14 between 1996 and 2010.

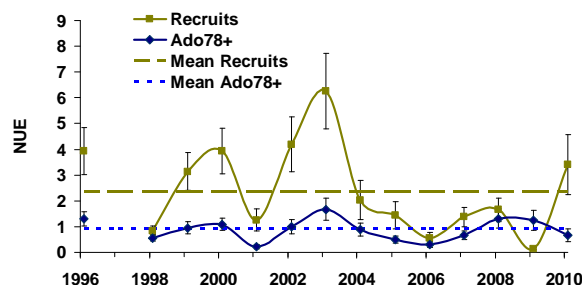


Figure 26. Catch rates (NPUE), with confidence interval and mean, for adolescent crab of 78+ mm and recruits, from the postseason survey in Area 14 between 1996 and 2010.

Conclusion and Advice:

The TAC and landings were 509 t in 2009 and 2010.

The catch rates in the commercial fishery dropped sharply in 2010 and landings included a majority of intermediate-shell crabs.

The 2010 postseason survey suggests that the 2011 fishing yields will remain low and landings will be composed mainly of recruits.

The mean size of crabs caught in the 2010 commercial fishery was equal to the average and according to the postseason survey, it may decrease slightly in 2011.

The postseason survey indicates that the abundance of adolescents in 2010 was slightly below the average, after being relatively high in 2008 and 2009.

In 2010, residual biomass and recruitment to the fishery was not high enough to maintain the commercial catch rate at the prevailing levels since 1999.

Recommendation:

A 20% TAC decrease in 2011 compared to 2010, could help stabilize the commercial biomass.

Area 13

Description of the Fishery

Area 13 has forty-three fishermen from Quebec and six from Newfoundland. This area was under moratorium from 2003 to 2007 as a result of a significant drop in biomass. An index fishery with an annual TAC of 50 t was nevertheless authorized in 2003, 2004 and 2006. The area was reopened to the commercial fishery in 2008 with a TAC of 150 t in 2008 and 2009 (Figure 27). TACs were then set at 188 t for 2010 and 2011. Landings totalled 175 t in 2010. The 2010 fishing season opened on April 29th and closed on July 19th.

Resource Status in 2010

The standardized CPUE from the commercial fishery dropped slightly from 2009 to 2010, to a value similar to the 1988-2009 average (Figure 28). The harvested area since 2008 has been relatively small compared to the total extent of areas traditionally harvested. Since 2008, the majority of individuals landed were intermediate-shell or old crabs (condition 3-5) (Figure 29). The average size of crabs caught at sea in 2010 (104 mm) was similar to the average of the historical series (Figure 30), but remains low compared to other areas of the northern Gulf of St. Lawrence.

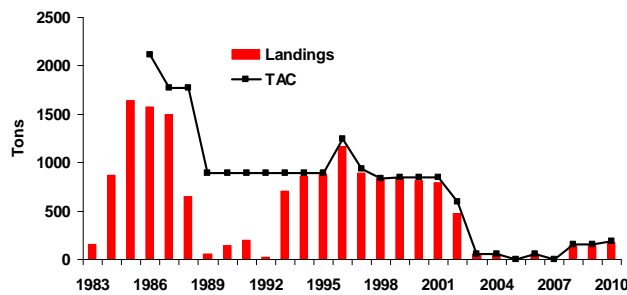


Figure 27. Landings and TAC for Area 13 between 1983 and 2010.

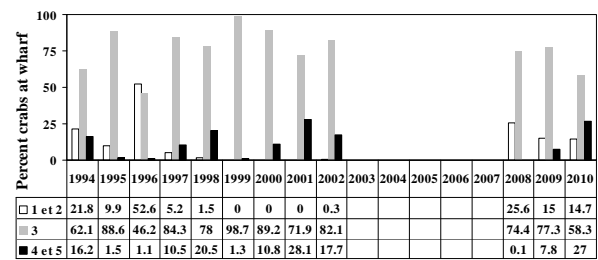


Figure 29. Carapace conditions of commercial crab landed in Area 13 between 1994 and 2010.

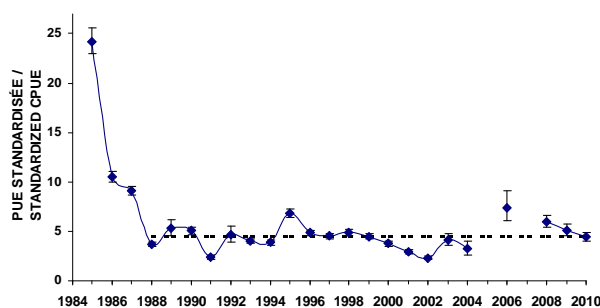


Figure 28. Standardized CPUE \pm confidence interval in the commercial fishery between 1985 and 2010 in Area 13. The dotted line shows the 1988-2009 data series mean.

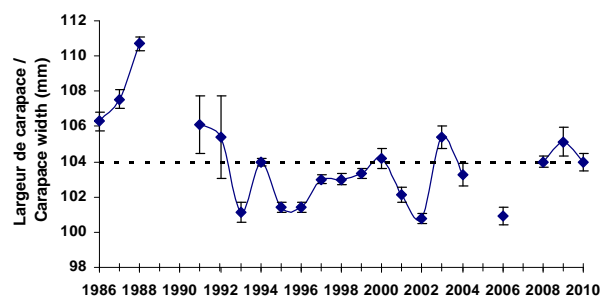


Figure 30. Mean carapace width \pm confidence interval for legal-size crab sampled at sea between 1986 and 2010 in Area 13. The dotted line indicates the data series mean.

The abundance indices (NPUE) obtained from the **scientific trap survey** were standardized to compare the results from beginning of the series in 1999. The mean standardized NPUE for legal-size crabs from the scientific trap survey was low and stable from 2001 to 2007 on the northern side, and then increased in 2008 and 2009, reaching values clearly above the historic series average, before dropping below the average in 2010 (Figure 31). On the south side, the survey indicated that the mean NPUE was low from 2001-2005, and then high from 2006-2010 (Figure 32). In the north and south surveys, intermediate-shell or old crabs (condition 3, 4 and 5) were the most abundant in the catches, even though the number of recruits has been increasing on the north side since 2007 (Figure 33). On the south side, recruits were abundant from 2004 to 2007, then declined to low values since 2008 (Figure 34). Thus, the postseason survey results suggest that available biomass at the beginning of the 2011 season could decrease on the north side and vary little on the south side, compared to 2010, and in each case, it will be made up of a high proportion of intermediate-shell or old crabs. In the postseason surveys, the mean size of crabs has varied little since 2004 on each side of the area, despite a small drop in 2010, suggesting that the size of crabs will decrease slightly in the 2011 commercial catches. The mean NPUE for adolescent crabs of 78+ mm was high in 2008 and 2009, but dropped sharply in 2010 on the north side, whereas on the south side, it was low in 2008 and 2009 and increased slightly in 2010 and is close to the average (Figures 33 and 34). It is noteworthy that there were no adolescent crabs of 95+ mm observed on the north side in the postseason surveys.

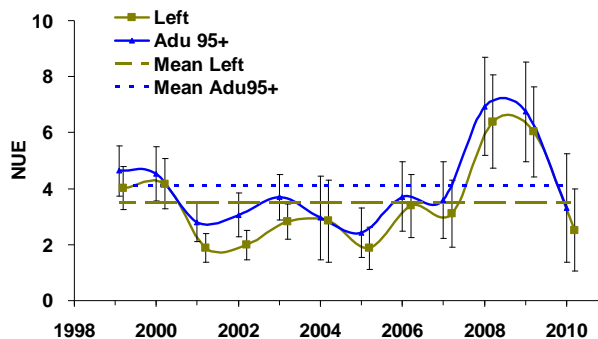


Figure 31. Catch rates (NPUE) for adult crab ≥ 95 mm and those left by the fishery with confidence interval and mean, from the postseason survey in Area 13 North, between 1999 and 2010.

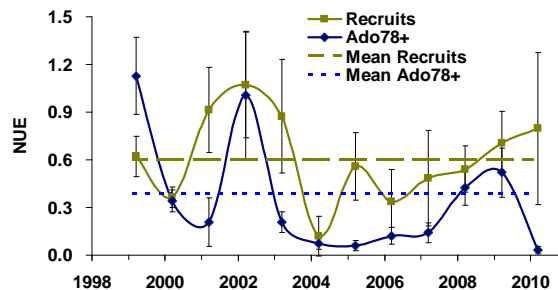


Figure 33. Catch rates (NPUE), with confidence interval and mean, for adolescent crab of 78+ mm and recruits, from the postseason survey in Area 13 North between 1999 and 2010.

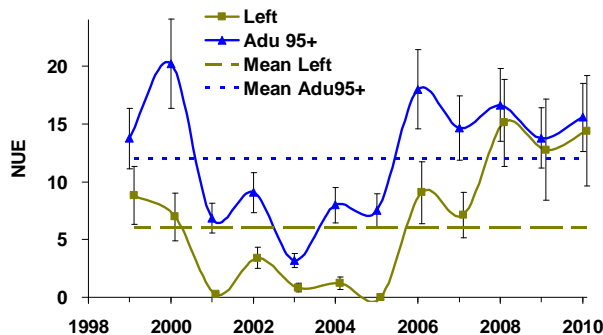


Figure 32. Catch rates (NPUE), with confidence interval and mean, for adult crab ≥ 95 mm and those left by the fishery, from the postseason survey in Area 13 South between 1999 and 2010.

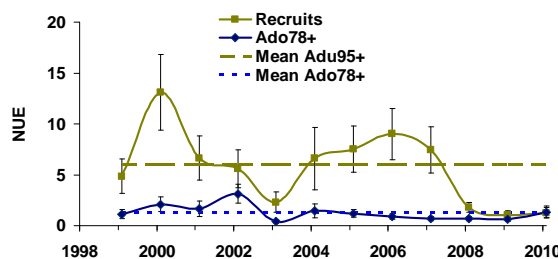


Figure 34. Catch rates (NPUE), with confidence interval and mean, for adolescent crab of 78+ mm and recruits, from the postseason survey in Area 13 South between 1999 and 2010.

Primiparous female insemination levels suggest an average to low mating success since 2008.

The last **trawl survey** covering the northern part of Area 13 occurred in 2010 and showed a high abundance of adult crab of less than 95 mm with a certain reproductive potential despite their small size. The abundance of adolescent crab between 78 and 95 mm (4.1 crabs/10,000 m²) was weak. The abundance of adolescents between 62 mm and 78 mm has increased since 2008 and reached 44 crabs/10,000 m² in 2010. The abundance of adolescents between 40 and 62 mm had increased considerably between 2004 and 2008, but then decreased in 2010. Crabs of less than 40 mm significantly decreased, from a reported maximum of 800 crabs/10,000 m² in 2006, to 207.5 crabs/10,000 m² in 2008 and 47 crabs/10,000 m² in 2010.

Conclusion and Advice:

The fishery was reopened in 2008, following a five year moratorium. The TAC was set at 150 t for 2008 and 2009. The TAC was increased to 188 t for 2010 and 2011.

The catch rate in the 2010 commercial fishery was equal to the 1988-2002 average, before the moratorium. Since 2008, landings have been mostly made up of intermediate-shell crab.

The 2010 postseason survey suggests that fishing yields in 2011 will be lower in the northern part, but will be stable in the south compared to 2010. The survey suggests that landings will be composed mostly of intermediate-shell crabs.

The mean size of crabs caught in the 2010 commercial fishery was equal to the average and based on the postseason surveys, it could decrease slightly in 2011. The trawl survey results on the north side in 2010 confirmed the presence of a high abundance of adults of less than 95 mm, or excluded from the commercial fishery, but with a certain reproductive potential.

The postseason survey and the trawl survey indicate that the abundance of adolescents of 78+ mm was low in 2010. However, the trawl survey showed a strong density of adolescents between 62-78 mm that could reach legal size in two years.

The catch rate in the commercial fishery and the predominance of intermediate-shell crab in the landings suggests that the fishing mortality rate has not been overly high since 2008. In addition, since 2008, the annual harvested area is small compared to the total extent of areas traditionally harvested in Area 13.

Recommendation:

The available information does not provide any reason for changing the pre-established management plan for the 2011 fishing season.

Area 12A

Description of the Fishery

Area 12A has 10 regular licenses. The TAC dropped from 229 t in 2006 to 80 t in 2008 as a result of an overall decrease of commercial biomass abundance indices, and then increased by

10% to 88 t in 2009 and another 10%, to 97 t, in 2010 (Figure 35). In 2010, the fishery opened on March 20th and closed on May 28th and the TAC was met.

Resource Status in 2010

In the commercial fishery, the standardized CPUE was relatively high between 1999 and 2005, and then dropped sharply between 2005 and 2006. In 2007 and 2008, the CPUE remained well below the historic series average and then increased sharply in 2009, and in 2010, it decreased slightly to around the average (Figure 36). It is important to note that after re-examining the harvesting effort, the CPUE for some years were corrected which led to significant increases in 2000 and 2009. A majority of intermediate-shell crabs (condition 3) was landed every year since 2005, and the proportion of new crabs (conditions 1 and 2) has decreased since 2008 (Figure 37). The mean size of legal-size crabs sampled at sea was high in 2010, at 109.5 mm, despite a slight drop compared to 2009 (Figure 38).

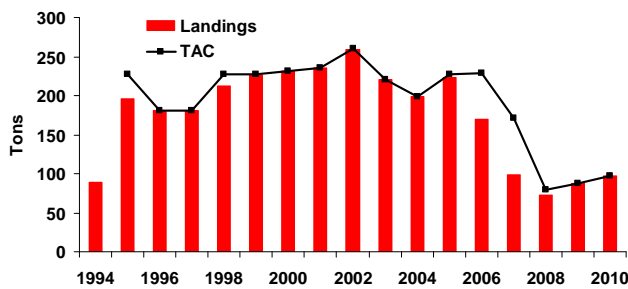


Figure 35. Landings and TAC for Area 12A between 1994 and 2010.

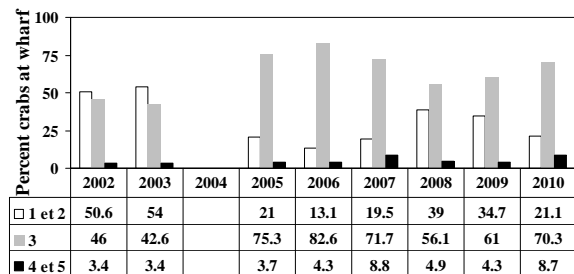


Figure 37. Carapace conditions of commercial crab landed in Area 12A between 2002 and 2010.

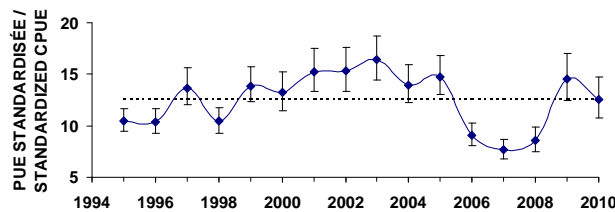


Figure 36. Standardized CPUE ± confidence interval in the commercial fishery between 1995 and 2010 in Area 12A. The dotted line shows the data series mean.

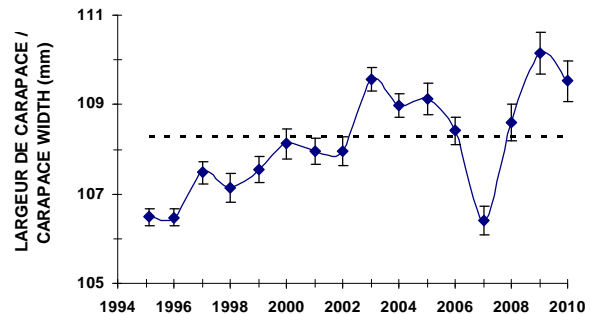


Figure 38. Mean carapace width ± confidence interval for legal-size crab sampled at sea between 1995 and 2010 in Area 12A. The dotted line indicates the data series mean.

The **scientific trap survey**, which has been conducted since 2000, indicated that the mean NPUE was below the average from 2006 to 2009, and then increased above the average in 2010, as was the number of intermediate-shell or old crabs (conditions 3-5), with which it is strongly correlated (Figure 39). Recruits also increased in 2010 after low abundance years in 2008 and 2009 (Figure 40). Postseason survey results suggest that the available biomass at the beginning of the 2011 season will be higher than in 2010 and will be composed mainly of intermediate-shell crab. The mean size of legal-size adult males remained stable between 2009 and 2010, at 105.8 mm. The mean NPUE for adolescents of 78+ mm has been near or above the historical average since 2006 (Figure 40).

It is important to note that crab abundance in Area 12A is partly due to the overlapping adjacent Area 17 to the west, and Area 12 to the east, which have also experienced a significant drop in commercial biomass after 2005, followed recently by a slight recovery.

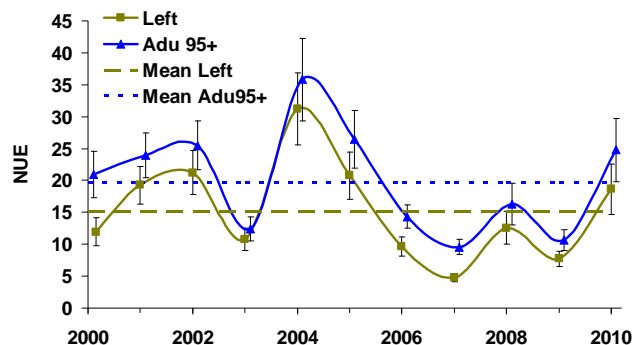


Figure 39. Catch rates (NPUE), with confidence interval and mean, for adult crab ≥ 95 mm and those left by the fishery, from the postseason survey in Area 12A between 2000 and 2010.

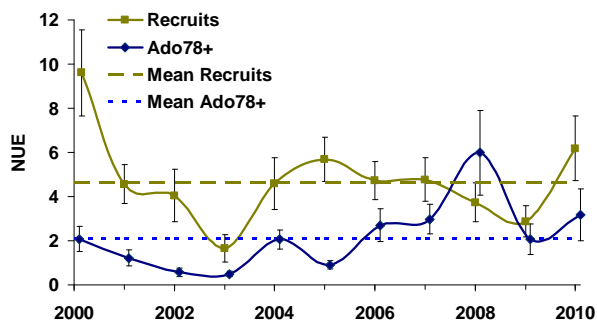


Figure 40. Catch rates (NPUE), with confidence interval and mean, for adolescent crab of 78+ mm and recruits, from the postseason survey in Area 12A between 2000 and 2010.

Conclusion and Advice:

The TAC increased by 10% to 97 t from 2009 to 2010, and it was met.

The catch rate in the 2010 commercial fishery remained near the 2000-2009 average. Landings were primarily made up of intermediate-shell crab.

The 2010 postseason survey suggests that the fishing yields in 2011 will be higher than in 2010 and that landings will be made up primarily of intermediate-shell crab.

Despite a small drop compared to 2009, the mean size of crab caught in the 2010 commercial fishery remained high and should remain that way in 2011 according to the postseason survey.

Results from the postseason survey indicate an abundance of adolescent crabs of 78+ mm which has been equal or above the average since 2006.

After re-examining the harvesting effort, the commercial fishery catch rates for some years were adjusted which led to significant increases in 2000 and 2009. The 65% TAC decrease from 2006-2008 helped the commercial biomass to recover somewhat.

Recommendation:

A 20% TAC increase in 2011 compared to 2010, would not likely jeopardize the observed recovery in this area.

Area 12B

Description of the Fishery

In 2010, Area 12B had 8 commercial fishing licenses. The TAC was 246 t in 2009 and 2010 (Figure 41) and it was met in 2010. In 2010, the fishery opened on March 25th and closed on June 24th.

Resource Status in 2010

The standardized CPUE for the commercial fishery was below the average between 2002 and 2009, but increased sharply in 2010 to its highest value since 2000 (Figure 42). Compared to previous years, there was a shift in fishing effort from east to west in 2010. A majority of intermediate-shell crab (condition 3) has been landed every year since 2005, even though the proportion of recruits (conditions 1 and 2) was higher between 2008 and 2010 than during the 2005-2007 period (Figure 43). The mean size of legal-size crab measured at sea (Figure 44) was low and stable in 2008 and 2009, and then increased to 107.9 mm in 2010.

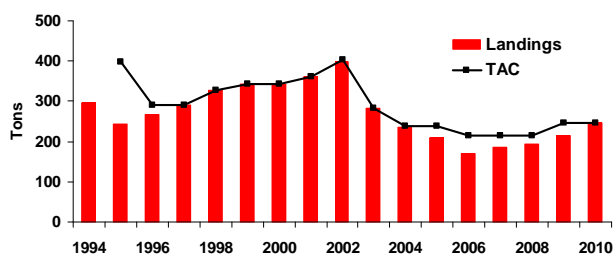


Figure 41. Landings and TAC for Area 12B between 1994 and 2010.

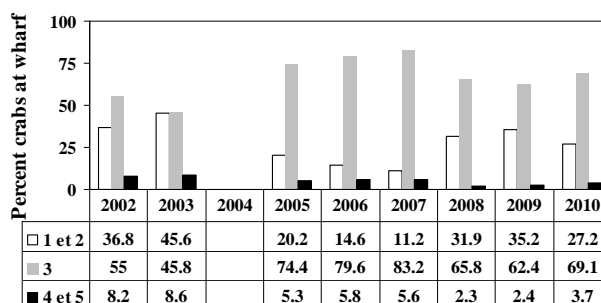


Figure 43. Carapace conditions of commercial crab landed in Area 12B between 2002 and 2010.

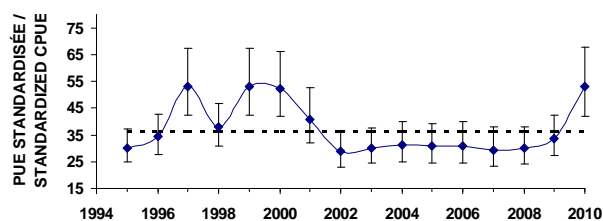


Figure 42. Standardized CPUE \pm confidence interval in the commercial fishery between 1995 and 2010 in Area 12B. The dotted line shows the data series mean.

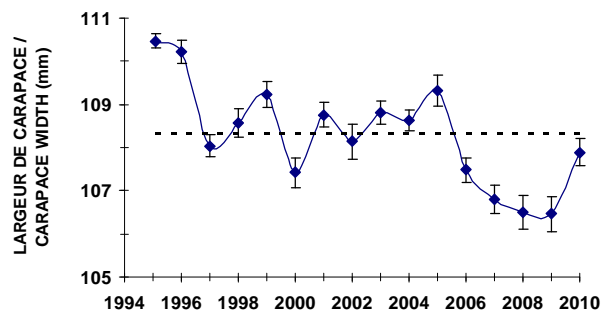


Figure 44. Mean carapace width \pm confidence interval for legal-size crab sampled at sea between 1995 and 2010 in Area 12B. The dotted line indicates the data series mean.

The scientific trap survey conducted since 2001 (except in 2005) showed a sharp drop of the mean NPUE of legal-size crab from 2001 to 2003, which remained below the series average until 2010 (Figure 45). The mean number of intermediate-shell or old crabs (conditions 3-5) caught has also been below average since 2003, whereas the number of recruits (conditions 1 and 2) has increased since 2004 and was clearly above average in 2009 and 2010 (Figure 46).

The available biomass at the beginning of the 2011 season should therefore vary little compared to that of 2010, and will likely consist of a proportion intermediate-shell and recruits resembling that of 2010. The mean size of legal-size adult crab, which dropped from 2006 to 2008, increased in 2009 and 2010, to 107.3 mm. The mean NPUE for adolescents of 78+ mm, which was high in 2008, dropped in 2009 and remained stable in 2010, at a value slightly below the series average (Figure 46).

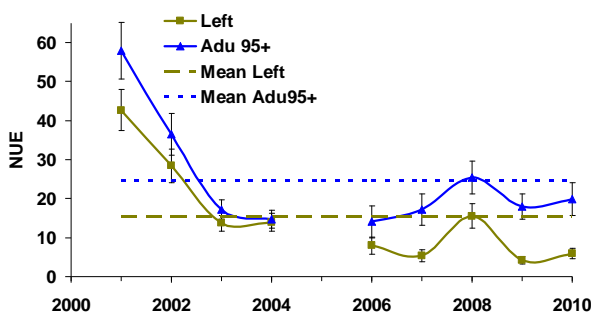


Figure 45. Catch rates (NPUE), with confidence interval and mean, for adult crab ≥ 95 mm and those left by the fishery, from the postseason survey in Area 12B between 2001 and 2010 (except for 2005).

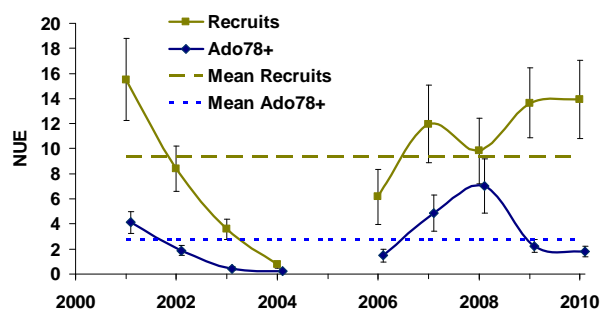


Figure 46. Catch rates (NPUE), with confidence interval and mean, for adolescent crab of 78+ mm and recruits, from the postseason survey in Area 12B between 2001 and 2010 (except for 2005).

Conclusion and Advice:

The TAC was 246 t in 2009 and 2010 and was met in 2010.

The catch rate in the commercial fishery increased sharply in 2010. Landings were primarily made up of intermediate-shell crabs.

The 2010 postseason survey suggests that the available biomass in the area in 2011 will be comparable to that of 2010 slightly below the average.

The mean size of crab caught in the commercial fishery increased in 2010, but remains below the average. The postseason survey suggests that size could increase in 2011.

In the 2009 and 2010 postseason surveys, the abundance of adolescent crabs of 78+ mm was slightly below the average.

The catch rates in the 2009 and 2010 postseason surveys suggest that the commercial biomass remains more or less the same. Oppositely, the 2010 commercial fishery catch rates suggest it has increased.

Recommendation:

A 10% TAC increase in 2011 compared to 2010, would not likely produce a decline in the resource.

Area 12C

Description of the Fishery

Area 12C features two banks (north and south sectors) separated by the deep channel of the Jacques-Cartier Strait. It has five regular fishermen. The TAC has been set at a maximum of 320 t since 2008 (Figure 47) and it was met in 2010. Temporary allocations totalling 100 t were granted in 2010. The fishery opened on April 11th and closed on July 18th.

Resource Status in 2010

The standardized CPUE for the commercial fishery plummeted between 1996 and 1997 and has remained at relatively low values until 2010 (except for 2008) (Figure 48). In 2009 and 2010, the major proportion landed were intermediate-shell crabs (condition 3), despite an increase of recruits (conditions 1 and 2) in 2010 (Figure 49). The mean size of legal-size crab measured at sea increased considerably between 2002 and 2008 and then decreased in 2009 and 2010 to a value still above the average (111 mm) (Figure 50). Since 2006, the fishing effort has been more concentrated in the northern part of the area than in preceding years.

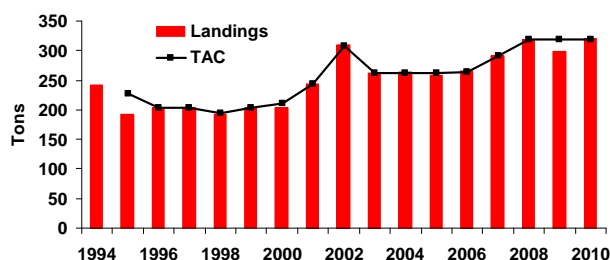


Figure 47. Landings and TAC for Area 12C between 1994 and 2010.

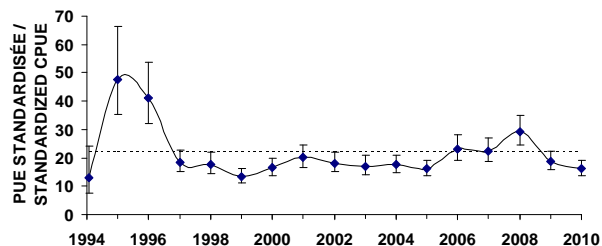


Figure 48. Standardized CPUE ± confidence interval in the commercial fishery between 1994 and 2010 in Area 12C. The dotted line shows the data series mean.

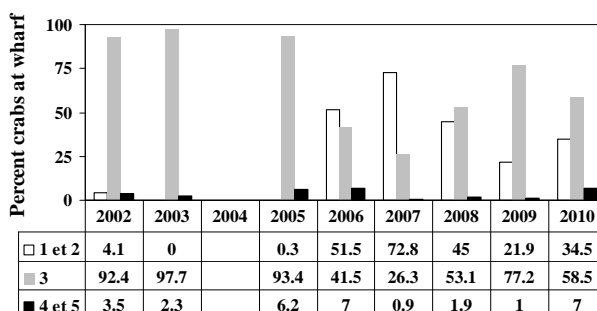


Figure 49. Carapace conditions of commercial crab landed in Area 12C between 2002 and 2010.

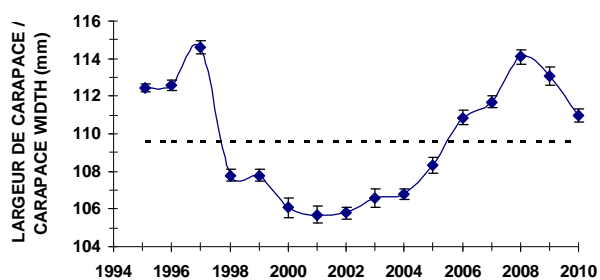


Figure 50. Mean carapace width ± confidence interval for legal-size crab sampled at sea between 1995 and 2010 in Area 12C. The dotted line indicates the data series mean.

The scientific trap survey conducted since 2000 showed that the mean NPUE has been stable and near the average since 2007, but the number of intermediate-shell or old crabs (conditions 3-5) in the catches has nevertheless reached the lowest value of the series in 2010 (Figure 51), whereas the number of recruits (conditions 1 and 2) increased in 2009 and 2010, reaching the highest value of the series (Figure 52). The postseason survey results suggest that

the available biomass at the beginning of the 2011 season should be comparable to that of 2010 and that it will consist of a more significant proportion of recruits. The mean size of legal-size adult crabs has remained high despite a slight drop to 109.3 mm in 2010. The mean NPUE for adolescents of 78+ mm has increased since 2007 and was well above the series average in 2010 (Figure 52).

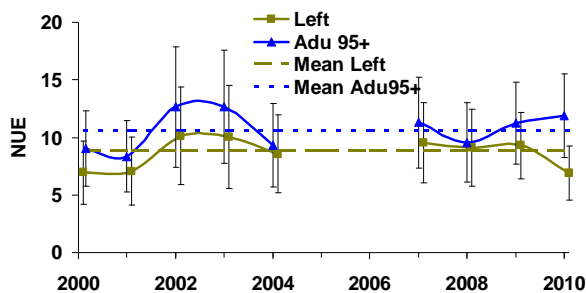


Figure 51. Catch rates (NPUE), with confidence interval and mean, for adult crab ≥ 95 mm and those left by the fishery, from the postseason survey in Area 12C between 2000 and 2010 (except for 2005 and 2006).

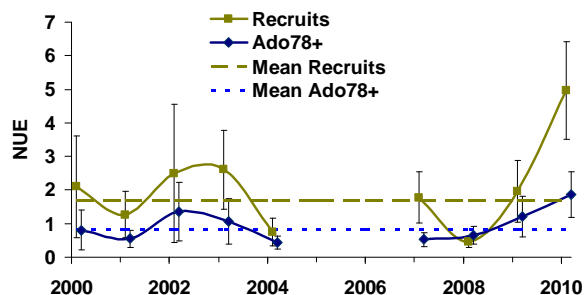


Figure 52. Catch rates (NPUE), with confidence interval and mean, for adolescent crab of 78+ mm and recruits, from the postseason survey in Area 12C between 2000 and 2010 (except for 2005 and 2006).

Conclusion and Advice:

The 320 t TAC was met in 2010 and was at its highest since 2008.

The commercial fishery catch rate decreased slightly between 2009 and 2010. Fishing effort was concentrated mainly in the north, near Area 15. Landings were made up primarily of intermediate-shell crab, despite a higher proportion of recruits than in 2009.

The 2010 postseason survey suggests that the 2011 fishing yields will be comparable to those of 2010 and that landings will be mainly composed of a significant proportion of recruits.

The size of crab caught in the 2010 commercial fishery decreased for a second consecutive year, but was still above the average. According to the postseason survey, it could drop slightly in 2011.

The 2010 postseason survey results indicate an increase in the abundance of adolescents since 2007.

The decrease in the numbers left by the fishery, which leads to higher reliance of the fishery on recruitment, indicates that catches should not be increased in order to help maintain the commercial biomass.

Recommendation:

Maintaining the 2010 TAC in 2011 should help sustain the commercial biomass at an acceptable level.

Area 16A

Description of the Fishery

Area 16A has only a brief fishing history. Since 2002, it has been accessible to the 43 Quebec fishermen holding a snow crab fishing licence in Area 13. The TAC has peaked at 426 t since 2009 (Figure 53) and the TAC was met in 2010. The fishery opened on April 5th and closed on July 12th.

Resource Status in 2010

The standardized CPUE for the commercial fishery was relatively stable from 2002 to 2007, and increased in 2008, before dropping below the series average value in 2009 and 2010 (Figure 54). The proportion of intermediate-shell crab (condition 3) in the landings has been high since 2008, even though recruits (conditions 1 and 2) and old crabs (conditions 4 and 5) increased in 2010 (Figure 55). The mean size of legal-size crab measured at sea has dropped since 2008, but has remained clearly above the series average (109.9 mm) (Figure 56). In 2010, increased fishing effort in the southern part of the area contributed to a better distribution of the fishing effort between the northern and southern parts of the area.

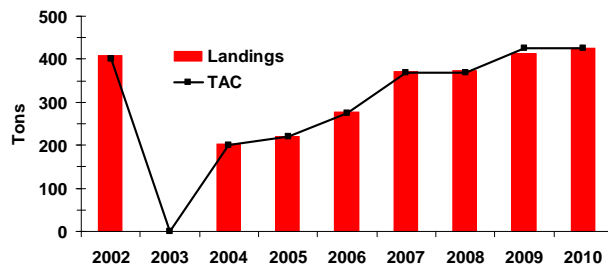


Figure 53. Landings and TAC for Area 16A between 2002 and 2010.

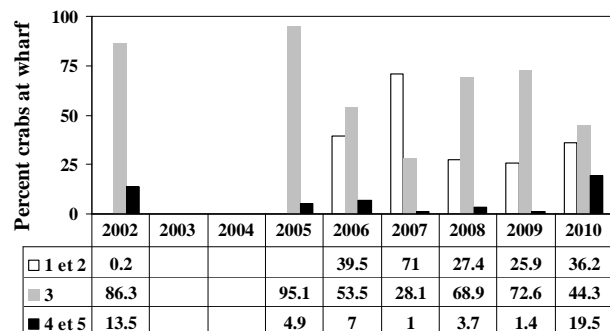


Figure 55. Carapace conditions of commercial crab landed in Area 16A between 2002 and 2010.

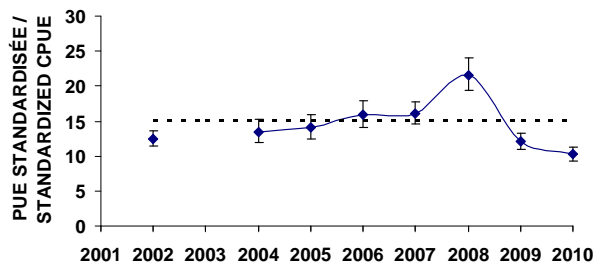


Figure 54. Standardized CPUE ± confidence interval in the commercial fishery between 2002 and 2010 in Area 16A. The dotted line shows the data series mean.

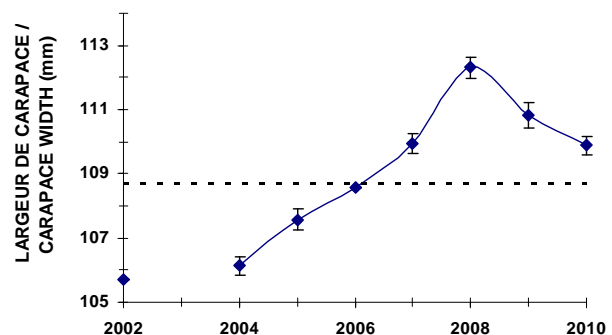


Figure 56. Mean carapace width ± confidence interval for legal-size crab sampled at sea between 2002 and 2010 in Area 16A. The dotted line indicates the data series mean.

The scientific trap surveys, conducted since 2002, showed little variation in the mean NPUE of legal-size crab since the beginning of the series, except for 2005, when it had increased significantly. In 2010, the mean NPUE increased slightly and was near the series average whereas the number of intermediate-shell or old crabs (conditions 3-5) was clearly below the average, with which it is usually strongly correlated (Figure 57). The latter are still more abundant than recruits, which had been consistently decreasing between 2002 and 2008, but have increased since 2009 (Figure 58). The postseason trap survey suggests that the available biomass at the beginning of the 2011 season could increase slightly compared to 2010, and landings will mostly consist of recruits. The mean size of legal-size adult crab of 95+ mm increased between 2003 and 2006 to more than 110 mm, and remained stable up to 2008, before dropping slightly up to 2010 at 107.9 mm. The mean number of adolescents per trap, which had been gradually decreasing from 2003 to 2007, has increased markedly since 2008 (Figure 58).

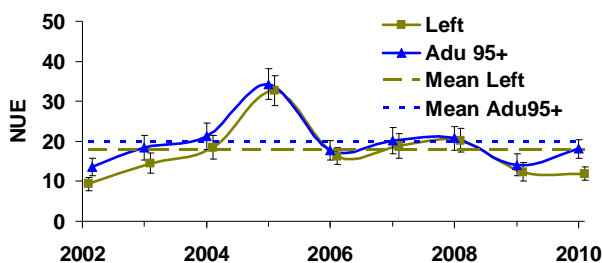


Figure 57. Catch rates (NPUE), with confidence interval and mean, for adult crab ≥ 95 mm and those left by the fishery, from the postseason survey in Area 16A between 2002 and 2010.

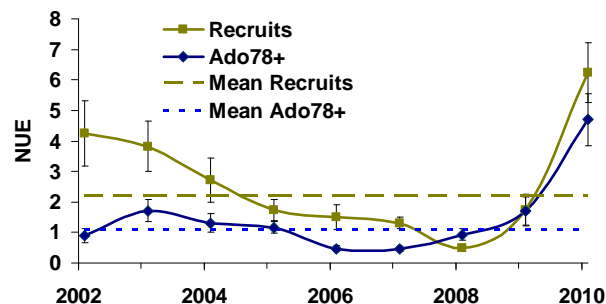


Figure 58. Catch rates (NPUE), with confidence interval and mean, for adolescent crab of 78+ mm and recruits, from the postseason survey in Area 16A between 2002 and 2010.

Conclusion and Advice:

The TAC was set at 426 t in 2009 and 2010. It was met in 2010.

The catch rate in the commercial fishery dropped slightly in 2010. From 2008 to 2010, fishing effort has increased in the southern part of the area. Landings were primarily made up of intermediate-shell or old crabs.

The 2010 postseason survey suggests that the 2011 fishing yields could increase slightly and that recruits will make up a larger proportion of the landings.

The size of crab caught in the 2010 commercial fishery decreased for a second consecutive year, but was still above the average. According to the postseason survey, it could drop slightly in 2011.

The 2010 postseason survey results indicate an increase in the abundance of adolescents of 78+ mm since 2007.

The low abundance of crabs left by the fishery, which leads to higher reliance of the fishery on recruitment, indicates that catches should not be increased in order to help maintain the commercial biomass.

Recommendation:

Maintaining the 2010 TAC in 2011 should help sustain the commercial biomass at an acceptable level.

Sources of Uncertainty

The quality of science advice depends mainly on the accuracy of the parameters obtained through sampling and the subsequent analyses. Information obtained from logbooks and purchase slips during the fishing season affects the accuracy of the parameters that are derived from these documents. For instance, abundance indices and fishing effort calculations obtained from logbooks may include errors that will affect the science advice provided. The selectivity and catchability of traps can vary depending on the type of trap used, its volume and mesh size that covers the trap, the amount and quality of bait used and soak time, which can vary with the fishing strategies employed and the prevailing environmental conditions. The catchability of adolescent crabs and recruits could also be affected by the occurrence rate of intermediate-size crabs (condition 3) on the seafloor. The selective sorting of catches can also affect the quality of the data obtained.

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

SOURCES OF INFORMATION

This Science Advisory Report is from the Fisheries and Oceans Canada, Canadian Science Advisory Secretariat, regional advisory meeting of February 7-9, 2011 on Assessment of the Estuary and Northern Gulf of St. Lawrence Snow Crab Stocks. Additional publications from this process will be posted as they become available on the DFO Science Advisory Schedule at <http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm>

Dufour, R. and J.-P. Dallaire 2003. Status of snow crab populations in the St. Lawrence Estuary and the Northern Gulf of St. Lawrence from 1999 to 2001. DFO Can. Sci. Advis. Sec., Res. Doc. 2003/048.

DFO. 2010. Assessment of the Estuary and Northern Gulf of St. Lawrence (Areas 13 to 17, 12A, 12B, 12C and 16A) Snow crab stocks in 2009. DFO Can. Sci. Advis. Sec., Sci. Advis. Rep. 2010/029.

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