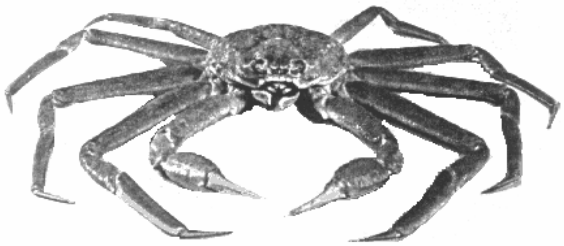
ASSESSMENT OF THE ESTUARY AND NORTHERN GULF OF ST. LAWRENCE (AREAS 13 TO 17 AND 12A, 12B AND 12C) SNOW CRAB STOCKS IN 2007



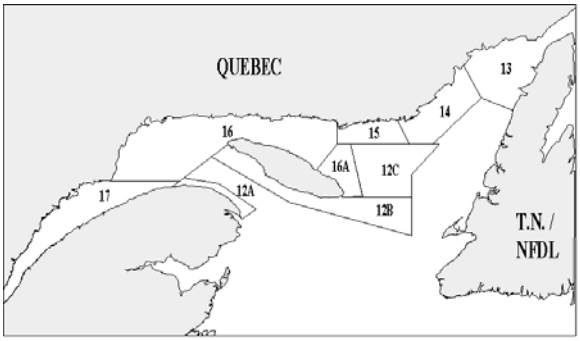


Figure 1: Snow crab management areas in the Estuary and the northern Gulf of St. Lawrence.

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 eight management areas (13 to 17 and 12A, 12B and 12C) (Figure 1). A new area (16A), which is adjacent to Area 16, was created in 2001 to help Area 13 fishermen who were experiencing hardship.

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.

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 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.

SUMMARY

- The last recruitment wave was fully exploited in certain management areas and is still ongoing in others. Landings are now characterized by the last intermediate-shell crabs from the previous wave and by a significant proportion of recruits (new crabs) whose abundance will be decreasing. Advices for 2008 vary, from increasing the TAC by 10% to significantly lowering it based on whether new crab arrivals have been sufficient or not to maintain the available commercial biomass.

- It is recommended that the moratorium be lifted in Area 13 to allow for a small scale commercial fishery. Advices for 2008 encourage the maintenance of an adequate reproductive biomass for males so as to not adversely affect the recovery of the population in a given area. Recommendations assume that the natural mortality rate will not differ in 2008 compared with previous years.

In Area 17, a 30% drop in the 2007 TAC is recommended for 2008.

In Area 16, a TAC not exceeding that of 2007 would be acceptable for 2008.

In Area 15, a TAC increase of 10% would be acceptable for 2008.

In Area 14, the same TAC level as in 2007 is recommended for 2008.

In Area 13, the moratorium should be lifted along with a TAC of 150t for 2008.

In Area 12A, a TAC reduction of around 80t is recommended for 2008.

In Area 12B, the same catch rate as in 2007 is recommended for 2008.

In Area 12C, a 10% catch increase would be acceptable for 2008.

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 immature or an adolescent (small claws) prior to the terminal moult and as an 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.

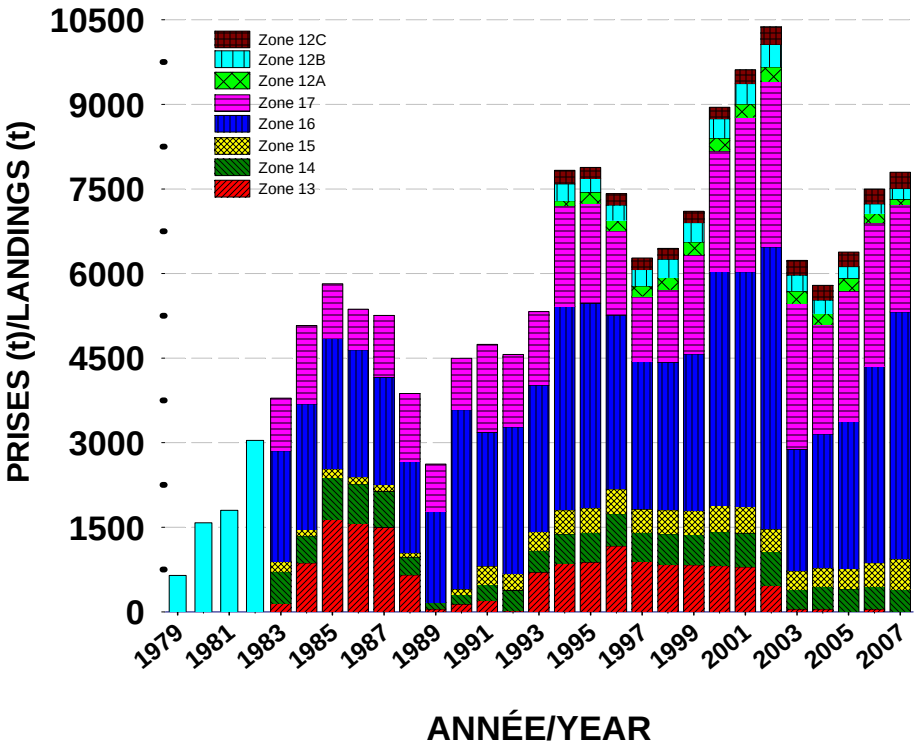


Figure 2. Snow crab landings in the Estuary and northern Gulf of St. Lawrence. From 1979 to 1982 (grey bars), landings were not differentiated per area.

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 2007, a trap-based research survey was carried out in all fishing areas and the findings were incorporated into the stock status analyses. These surveys help determine the mean CPUE (catch per unit effort) per area for commercial size crab and the NUE (number per unit effort) for crab categories of over 78mm carapace width. The results from the trawl research surveys conducted in 2006 and 2007 in Areas 13, 16 and 17 were used to calculate an abundance index for juvenile crab.

The raw CPUE for the fishery were standardized using a multiplicative model to take into account changes caused by the different fishing strategies employed and environmental and economical constraints. The proportion of new crabs or recruits, recognizable with a new carapace (carapace condition 1 or 2), was determined by samplers dockside and at sea.

Data on the size structure of crab sampled at sea, at 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.

Snow Crab in Area 17

Fishery Description

There are 22 active license holders in Area 17. The TAC dropped by 25% between 2006 and 2007 and totalled 1,906t (Figure 3A), including 229t in temporary allocations. The fishing season opened on March 29th and closed on July 15th, 2007, and the TAC was met.

Resource Status in 2007

In the commercial fishery, the standardized CPUE was maintained at high values from 2000 to 2004 and dropped by 41% between 2004 and 2007 (Figure 3B). In 2007, it is near the low values recorded during the last recruitment recession in 1997. The proportion of new crabs (condition 1 or 2) represented by adult males of 95+ mm arriving in the fishery has been increasing in the landings over the last few years (Figure 4). Oppositely, the proportion of intermediate-shell crab (condition 3), which arrived in the fishery in massive numbers during the last recruitment wave and that greatly supported the fishery in recent years, has dropped. The proportion of old crabs (conditions 4 and 5) in the landings totalled 8% in 2007. The mean of legal-size crab caught at sea, which increased between 1999 and 2004, dropped in 2005 and 2006 and then rose again to 112.3 mm in 2007 (Figure 3C).

Results from the postseason trap survey, a data series that began in 1996 on the north shore and in 1999 on the south shore, indicate a large drop in the CPUE on the north and south shores between 2005 and 2007 (56% and 57% respectively) (Figure 5).

On both shores, the highest recruit catch rates were made on a point-to-point basis between 2000 and 2003. Recruits have been less abundant in the catches since 2004 even though the gradual disappearance of intermediate-shell crabs (condition 3) could have led to increased catchability (Figure 6). The latter event has led to an increase in new crabs (conditions 1 or 2) since 2004. The proportion of old crabs has been stable on both shores since 2005. The mean number of adolescents between 78 mm and 95 mm CW (ADO^{-1}) caught in traps (NUE) has increased since 2005 on the north shore likely because of the reduction of intermediate-shell crabs. However, numbers on the south shore have remained stable since 2002 (Figure 7). The mean size of legal size crabs dropped in 2006 and then rose in 2007 on both shores.

Results from the trawl survey conducted on the north shore of the Estuary in 2005 and 2007 showed a downward trend compared to previous years and indicated low abundance for adolescents between 62 mm and 78 mm as well as for individuals between 20 and 62 mm.

In 2007, the average amount of sperm stored in the female's spermatheca remained above the level required for a high success rate of fertilizing eggs.

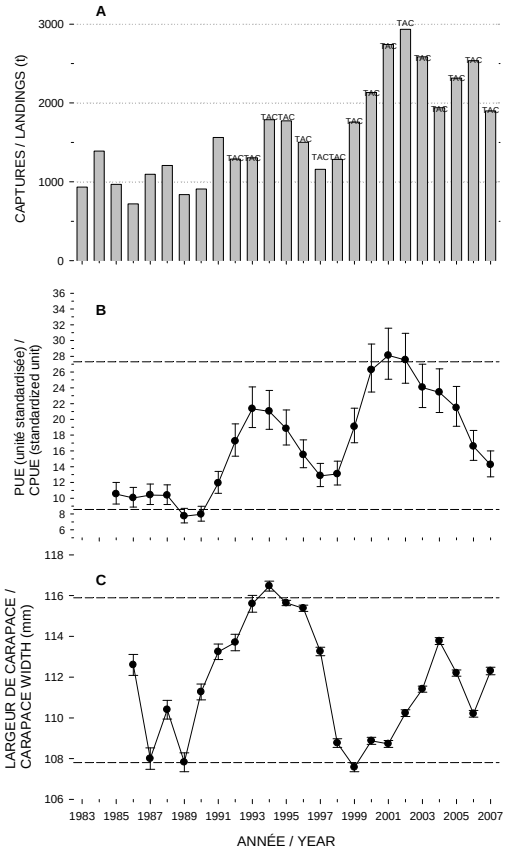
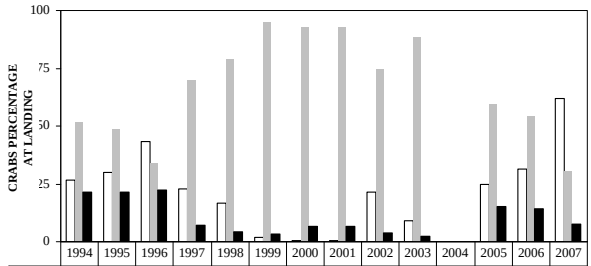


Figure 3. Main parameters estimated during the fishing season for Area 17, 1983–2007: A) landings and TAC; B) standardized CPUE ± confidence interval); and C) mean carapace width ± confidence interval for commercial crabs sampled at sea. The mean of the 3 lowest values and the mean of the 3 highest values are indicated by dotted lines in graphs B and C.



	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
□ 1 et 2	26.6	30	43.5	22.8	16.7	1.8	0.7	0.7	21.5	8.9		25	31.4	62
▒ 3	52	48.5	34	70	79.1	94.9	92.8	92.8	74.6	88.7		59.7	54.5	30.3
■ 4 et 5	21.4	21.5	22.5	7.3	4.2	3.3	6.5	6.5	3.9	2.4		15.4	14.1	7.7

Figure 4. Carapace conditions for commercial crabs landed in Area 17 between 1994 and 2007.

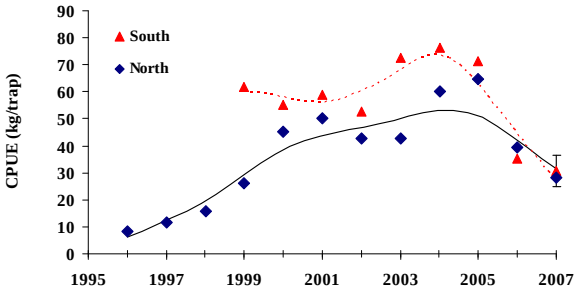


Figure 5. Catch rates (CPUEs) of adult crabs ≥ 95 mm with confidence interval and trend line (Lowess type) from the postseason survey in Area 17, 1996– 2007.

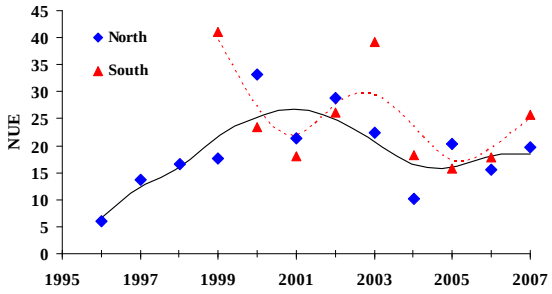


Figure 6. Catch rates (NUE) with trend lines (Lowess type) for recruits from the postseason survey conducted in Area 17, 1996–2007.

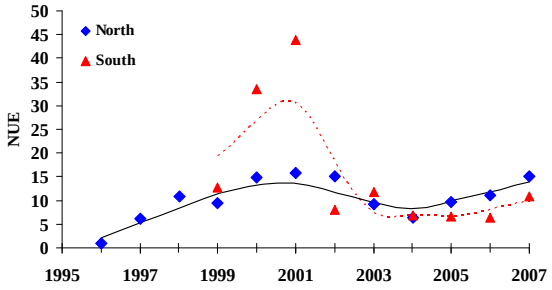


Figure 7. Catch rates (NUE) with trend lines (Lowess type) for adolescents measuring between 78 mm and 95 mm from the postseason survey conducted in Area 17, 1996–2007.

Conclusions and Advice

Landings and TAC dropped by 25% from 2006 to 2007, totalling 1,906 t.

Catch rates have dropped since 2006, both in the commercial fishery and in the postseason survey. They dropped respectively by 15% and 22% between 2006 and 2007.

The mean size increased during the 2007 commercial fishery and postseason survey, compared to 2006. It should remain high during the 2008 fishery.

The proportion of crabs with intermediate-size carapaces has dropped since 2005. The fishery is now conducted mostly on recruitment and the fishing pressure prevents the accumulation of intermediate-size crabs. In addition, some commercial-size crabs with a low meat yield were caught in certain sectors in 2007.

The trawl survey conducted in 2007 did not show any new wave of juveniles: recruitment could therefore drop or remain at the same level for several years.

In 2007, recruitment was not high enough to maintain the commercial biomass indices at the 2006 level. If fishing pressure remains at the same level, catches will mostly include recruits and performance will drop.

Recommendations

Indices suggest that biomass dropped by about 20% between 2006 and 2007. The extent of the recruitment recession and the desired maximum performance in terms of meat suggest that a more significant catch reduction is necessary. Consequently, a 30% drop in the 2007 TAC is recommended for 2008.

Snow Crab in Area 16

Fishery Description

A total of 39 fishers hold regular snow crab fishing licenses in Area 16. In 2007, the TAC was 4,006 t, a 25% increase over 2006 level (Figure 8A). A portion of this TAC was allocated for Area 16A (370 t). The fishery opened on April 5 and closed on July 12; the TAC was met.

Resource Status in 2007

In the fishery, the standardized CPUE dropped from 2000 to 2003, but increased subsequently and reached high values in 2005 and 2006. In 2007, it dropped by 30% (Figure 8B). The proportion of new crabs in the landings totalled over 65% in 2006 and 2007 and, oppositely, the proportion of intermediate-shell (condition 3) crabs dropped sharply for these same years (Figure 9). The mean CW of legal-size crab at sea, which had begun increasing in 2003 following a sharp downward period, increased by almost 4 mm between 2005 and 2007, reaching 111.7 mm (Figure 8C).

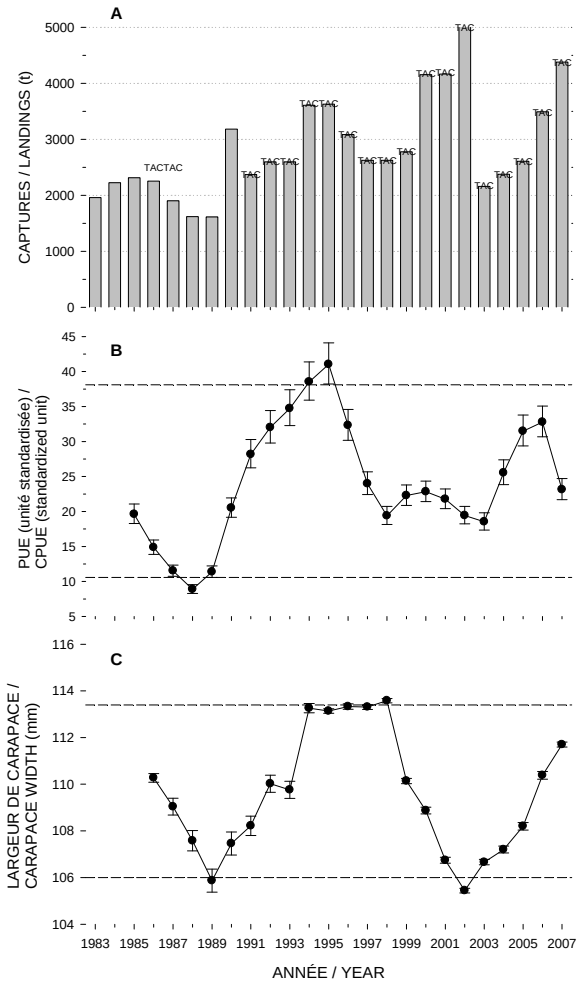
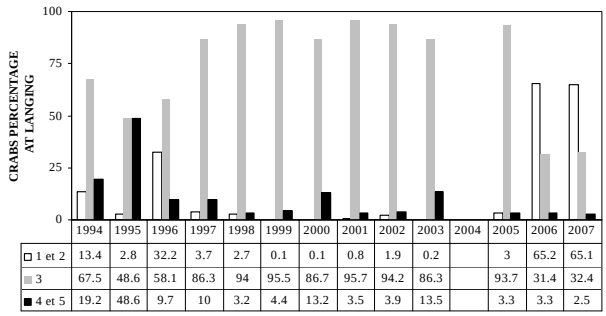


Figure 8. Main parameters estimated during the fishing season in Area 16, 1983–2007: A) landings and TAC; B) standardized CPUE ± confidence interval; and C) mean carapace width ± confidence interval of commercial crabs sampled at sea. The mean of the 3 lowest values and the mean of the 3 highest values are indicated by dotted lines in graphs B and C.



	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1 et 2	13.4	2.8	32.2	3.7	2.7	0.1	0.1	0.8	1.9	0.2		3	65.2	65.1
3	67.5	48.6	58.1	86.3	94	95.5	86.7	95.7	94.2	86.3		93.7	31.4	32.4
4 et 5	19.2	48.6	9.7	10	3.2	4.4	13.2	3.5	3.9	13.5		3.3	3.3	2.5

Figure 9. Carapace conditions for commercial crabs landed in Area 16 between 1994 and 2007.

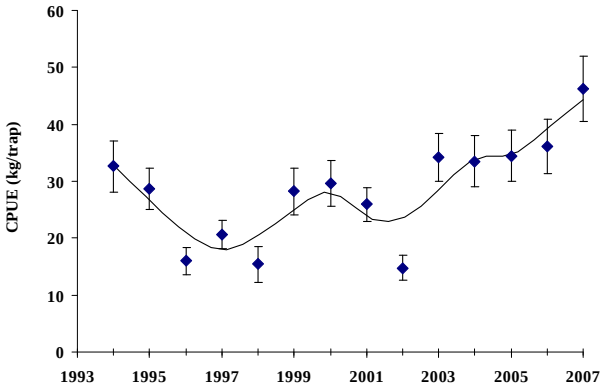


Figure 10. Catch rates (CPUEs) of adult crabs ≥ 95 with confidence interval and trend line (Lowess type) from the postseason survey in Area 16, 1994– 2007.

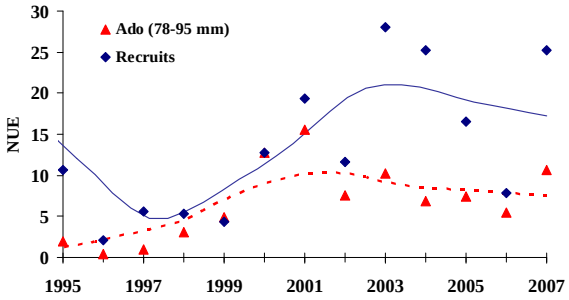


Figure 11. Catch rates (NUE) with trend line (Lowess type) for recruits and adolescents between 78 mm and 95 mm from the postseason survey conducted in Area 16, 1994–2007.

Postseason trap surveys, conducted every fall since 1994, showed that the CPUE for legal-size crabs increased significantly in 2003, and then remained between 34 and 36 kg/conical trap until

2006. In 2007, the CPUE increased by 28%, to 46 kg/trap (Figure 10). The mean size of adult crabs of 95+ mm increased between 2003 and 2006, and remained at about 110 mm from 2006 to 2007. The mean NUE for recruits and adolescents, which had been dropping since 2003, increased sharply for both categories in 2007, totalling 25.2 and 10.7 crabs/conical trap respectively (Figure 11). The proportion of new crabs (conditions 1 or 2) increased significantly between 2006 and 2007 and, oppositely, the proportion of intermediate-size crabs dropped sharply. The proportion of old crabs has been relatively low and stable since 2000 at less than 20%.

Results from the trawl survey conducted in St. Marguerite Bay in 2007, near Sept-Îles, showed a high abundance of small individuals that could represent the next recruitment wave as of 2011. The capture of males between 45 and 95 mm was low during this survey, which suggests a temporary recruitment drop until then.

The spermatheca of mature females were not as full in 2007 compared to 2006, which indicates an increasing sex ratio unbalance of females over males and a drop in terms of male availability.

Conclusions and Advice

Landings and TAC increased from 3,480 t in 2006 to 4,376 t in 2007, including 370 t in sector 16A.

Catch rates in the commercial fishery dropped between 2006 and 2007 and landings were mostly made up of new crabs, which suggest a drop in biomass and increased dependence on recruitment.

During the postseason survey, the catch rate of commercial-seize crabs, new crabs (recruits) and prerecruits (adolescents between 78 and 95 mm) increased in 2007 compared to 2006, which suggests a biomass increase.

The mean size of crabs during the 2008 fishing season should be similar to 2007.

The spermatheca of females from St. Marguerite Bay were not as full in 2007 compared to 2006, which indicates a drop in terms of male availability over females.

The trawl survey conducted in St. Marguerite Bay showed a strong occurrence of crabs of less than 45 mm CW, but suggests a drop in recruitment to the fishery over the next 2-3 years.

Recommendations

Because of the inconsistencies between the commercial fishery and the postseason survey, a TAC not exceeding that of 2007 would be acceptable for 2008.

Snow Crab in Area 15

Fishery Description

Area 15 has 8 regular fishers. In 2007, the TAC was 539 t, a 30% increase compared to 2006 (Figure 12A), including 50 t in temporary allocations. In 2007, the fishery opened on April 16 and closed on July 23 and the TAC was met.

Resource Status in 2007

The fishery's standardized CPUE, in decline from 1996 to 2002, stabilized in 2003 and has gone up by 117% since 2003, 10% between 2006 and 2007 (Figure 12B). During the dockside sampling, the proportion of intermediate-shell crabs (condition 3) was clearly lower in 2006 and 2007 compared with 2005, and for the same period, the proportion of new crabs (conditions 1 or 2) was very high (Figure 13). Only 3% were old crabs (conditions 4 or 5). Between 2005 and 2007, the mean CW of legal-size crabs sampled at sea increased from 106.1 mm to 112.1 mm (Figure 12C).

The **scientific trap survey**, which has been conducted since 1998, showed that the CPUE of commercial-size crab, which increased from 2001 to 2006, stabilized in 2007 at around 19 kg/Japanese trap (Figure 14). In 2007, the proportion of intermediate-shell crabs (condition 3) and new crabs (conditions 1 or 2) was slightly lower to the 2005 and 2006 levels, whereas the proportion of old crabs (conditions 4 and 5) increased during this period and accounted for more than 50% of the catches. The mean size of the harvested crab has been gradually increasing since 2002 and reached 109 mm in 2007. After reaching a high of 7.3 crabs per trap in 2002, the mean NUE for recruits dropped to 1.9 crabs per trap in 2007 (Figure 15). The mean NUE for adolescents between 78 mm and 95 mm only slightly changed between 2002 and 2006, and then dropped sharply to 0.6 individuals per trap in 2007 (Figure 15).

Conclusions and Advice

Following a TAC increase of 30% between 2006 and 2007, landings reached a high of 538 t.

Catch rates in the commercial fishery slightly increased from 2006 to 2007 whereas the postseason survey catch rates remained stable and high.

The mean size of crabs harvested in 2007 was relatively high and should remain this way in 2008.

Recommendations

A TAC increase of 10% would be acceptable for 2008.

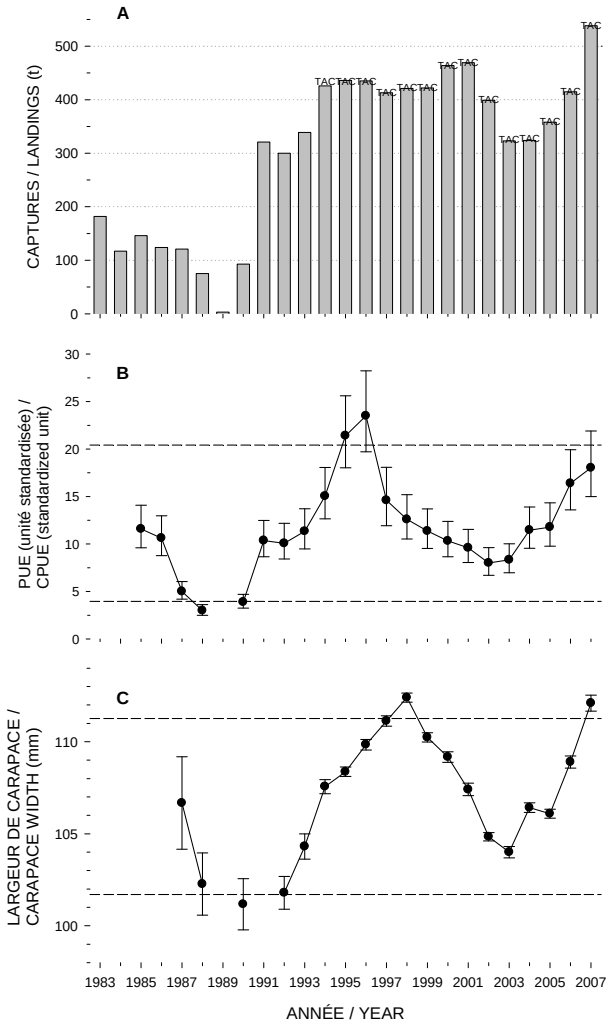
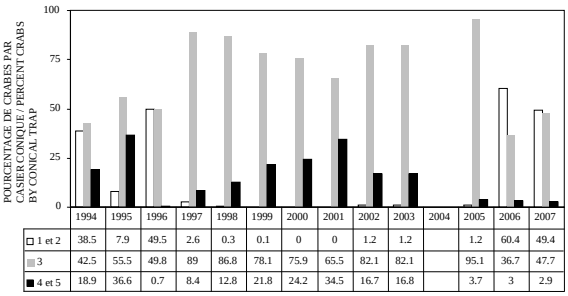


Figure 12. Main parameters estimated during the fishing season in Area 15, 1983–2007: A) landings and TAC; B) standardized CPUE ± confidence interval; and C) mean carapace width ± confidence interval of commercial crabs sampled at sea. The mean of the 3 lowest values and the mean of the 3 highest values are indicated by dotted lines in graphs B and C.



	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1 et 2	38.5	7.9	49.5	2.6	0.3	0.1	0	0	1.2	1.2		1.2	60.4	49.4
3	42.5	55.5	49.8	89	86.8	78.1	75.9	65.5	82.1	82.1		95.1	36.7	47.7
4 et 5	18.9	36.6	0.7	8.4	12.8	21.8	24.2	34.5	16.7	16.8		3.7	3	2.9

Figure 13. Carapace conditions for commercial crabs landed in Area 15 between 1994 and 2007.

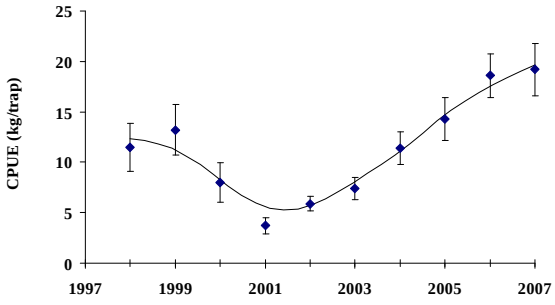


Figure 14. Catch rates (CPUEs) of adult crabs ≥ 95 with confidence interval and trend line (Lowess type) from the postseason survey in Area 15, 1998– 2007.

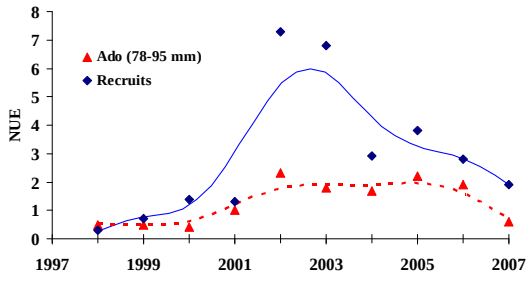


Figure 15. Catch rates (NUE) with trend line (Lowess type) for recruits and adolescents between 78 mm and 95 mm from the postseason survey conducted in Area 15, 1998–2007.

Snow Crab in Area 14

Fishery Description

Area 14 has 21 regular fishers. The 2006 quota of 403 t was renewed in 2007 and did not include any temporary allocations (Figure 16A). In 2007, the fishing season opened on May 7 and closed on August 12. The TAC was met.

The standardized CPUE for the commercial fishery, which had risen sharply in 2003, plummeted by 38% in 2004. It varied only slightly up to 2007 and was a little below the mean for the 1985-2006 period (Figure 16B). According to dockside sampling, the proportion of intermediate-shell crabs (condition 3) in 2006 and 2007 was the lowest since 1995, whereas, oppositely, for the same two years, the proportion of new crabs (conditions 1 or 2) was the highest since 1997 (Figure 17). Only a few old crabs (conditions 4 and 5) were landed. The mean size of legal-size crabs caught at sea rose from 104.9 mm in 2005, to 108.5 mm in 2006 and then dropped to 107.5 mm in 2007 (Figure 16C).

The **scientific trap survey** conducted since 1996 indicated, following a CPUE drop for commercial-size crab of 46% between 2004 and 2005, a certain CPUE stability between 2005 and 2007 (Figure 18). There was a sharp drop in the proportion of intermediate-shell crab (condition 3) (from 70 to 36%) combined with a sharp increase of old crabs (conditions 4 or 5) (17 to 46%) in the catches between 2004 and 2005, whereas new crabs (conditions 1 or 2) accounted for about 15% of the catches during this period. The proportions have only changed slightly since 2005, when old crabs accounted for most of the catches, or nearly 50%. The mean size of legal-size crabs increased from 105.1 mm in 2006 to 106.1 mm in 2007. The mean NUE for recruits and adolescents between 78 mm and 95 mm dropped from 2003 to 2006 and then increased slightly in 2007 (Figure 19).

Conclusions and Advice

Landings and TAC have been stable since 2004 at 405 t.

Catch rates, both for the commercial fishery and the postseason survey, have been stable since 2005.

The mean size of harvested crabs during the commercial fishery dropped slightly from 2006 to 2007, and it rose a little in the postseason survey.

Recommendations

The same TAC level as in 2007 should be maintained for 2008. However, an increase of up to 10% would not have any negative short-term impact on the stock.

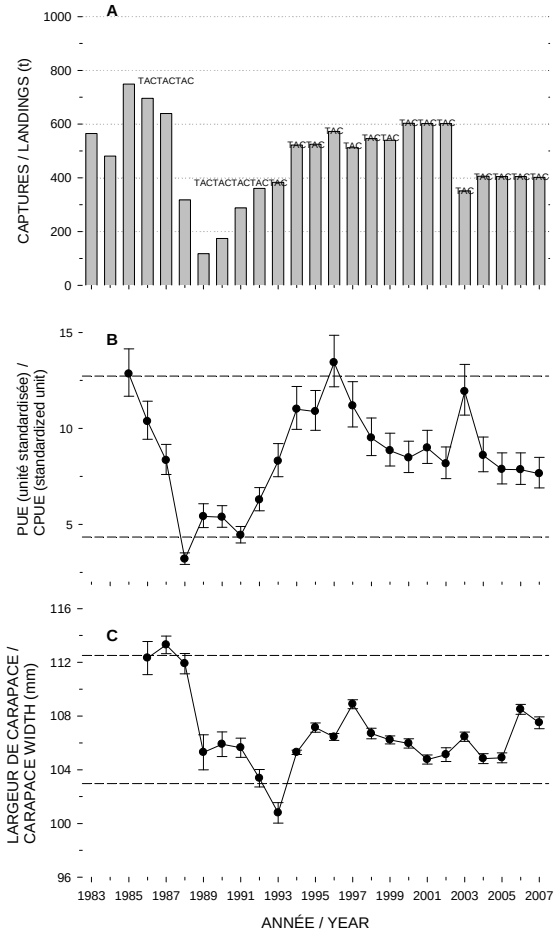
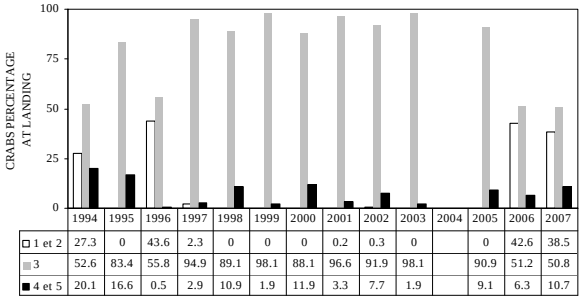


Figure 16. Main parameters estimated during the fishing season in Area 14, 1983–2007: A) landings and TAC; B) standardized CPUE ± confidence interval; and C) mean carapace width ± confidence interval of commercial crabs sampled at sea. The mean of the 3 lowest values and the mean of the 3 highest values are indicated by dotted lines in graphs B and C.



	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1 et 2	27.3	0	43.6	2.3	0	0	0	0.2	0.3	0		0	42.6	38.5
3	52.6	83.4	55.8	94.9	89.1	98.1	88.1	96.6	91.9	98.1		90.9	51.2	50.8
4 et 5	20.1	16.6	0.5	2.9	10.9	1.9	11.9	3.3	7.7	1.9		9.1	6.3	10.7

Figure 17. Carapace conditions for commercial crabs landed in Area 14 between 1994 and 2007.

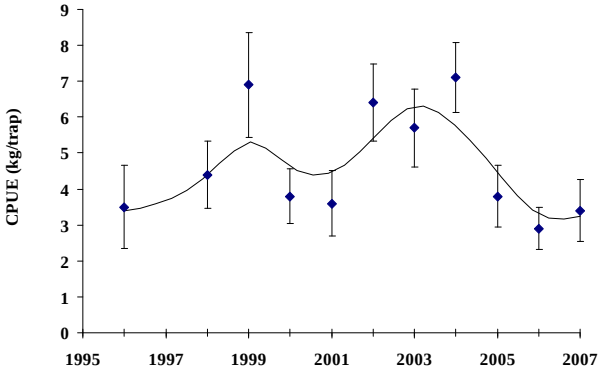


Figure 18. Catch rates (CPUEs) of adult crabs ≥ 95 with confidence interval and trend line (Lowess type) from the postseason survey in Area 14, 1996– 2007.

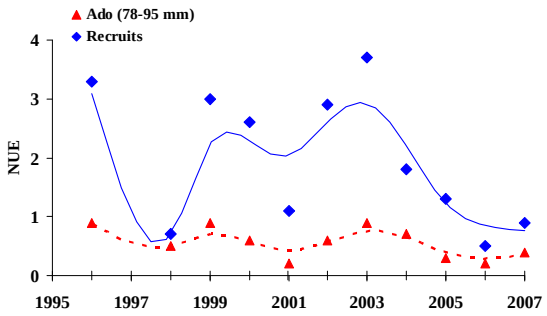


Figure 19. Catch rates (NUE) with trend line (Lowess type) for recruits and adolescents between 78 mm and 95 mm from the postseason survey conducted in Area 14, 1996–2007.

Snow Crab in Area 13

Fishery Description

Forty-three fishers from Quebec and six fishers from Newfoundland shared the regular quota allocated for this area until 2002. Since 2003, the area has been under moratorium. An index fishery of 50 t was nevertheless authorized in 2003, 2004 and 2006.

In 2006, during **the last index fishery**, the standardized CPUE were higher than in 2003 and 2004, which suggested a biomass improvement. However, the 2006 fishery was conducted over a very small portion of the area. Therefore, results could not be compared with the period when the commercial fishery was fully active.

The abundance indices (NUE) obtained from **the scientific trap survey** were standardized to compare the results from 1999 to 2007. The mean standardized NUE for legal-size crabs from **the scientific trap survey** has been low and stable since 2001 on the northern side (3 crabs/Japanese conical trap in 2007) whereas on the southern side, this number increased from 3 crabs/trap in 2004 to 10 crabs/trap in 2005 and 19 crabs/trap in 2006. This value dropped in 2007 but remained high at 17 crabs/trap (Figure 20). In 2007, on the northern side, the proportion of intermediate-shell crab (condition 3) in the traps was 63%, and 24% were old crabs (conditions 4 and 5). On the southern side, only new crabs (conditions 1 or 2) were reported in 2005 while in 2006 and 2007, 53% of the catches were intermediate-shell crab, and new crabs accounted for 41 and 42% of the catches respectively for these two years. The mean and median sizes of adult legal-size crab increased from 2002 to 2004 in both sectors, and remained stable on the northern side until 2007, whereas on the southern side they dropped in 2005 but remained stable until 2007. The median size of legal-size adults in 2007 was 101 mm on the northern side and 104 mm on the southern side (Figure 21). The mean NUE for recruits has been stable since 2005 in both sectors, and in 2007 numbered 0.6 crab per trap on the northern side and 9.2 crabs per trap on the southern side. The mean NUE for adolescent crabs between 78 mm and 95 mm was weak and stable in both sectors from 2003 to 2007.

Primiparous female insemination levels showed a noticeable drop between 2003 and 2005, and increased in 2006, only to drop again to a low value in 2007 to a level that would prevent reproductive success.

The last **trawl survey** covering the northern part of Area 13 and the eastern part of Area 14 in 2006 showed that the abundance of adult legal-size crab (7.7 crab/10,000 m^2) increased compared to 2004 (3.6 crabs/10,000 m^2). The abundance of adolescents between 78 mm and 95 mm was slightly higher in 2006 (7.4 crabs/10,000 m^2) than in 2004 (6.1 crabs/10,000 m^2). Conversely, adolescents between 62 mm and 78 mm experienced a drop in abundance of around 50% between these two years. Males less than 62 mm increased considerably between 2004 and 2006, and particularly those less than 40 mm, which increased from 191 crabs/10,000 m^2 in 2004 to an all-time high of 800 crabs/10,000 m^2 in 2006. These strong cohorts (crabs less than 40 mm) will not be apparent in the fishery until 2010 if the natural mortality and premature terminal moult level isn't too high and if growth is regular. The abundance of primiparous females also increased considerably between 2004 and 2006. Females less than 40 mm were also very abundant during the 2006 trawl survey, which provides hope for a strong productivity over the next 3 or 4 years if reproductive success is good.

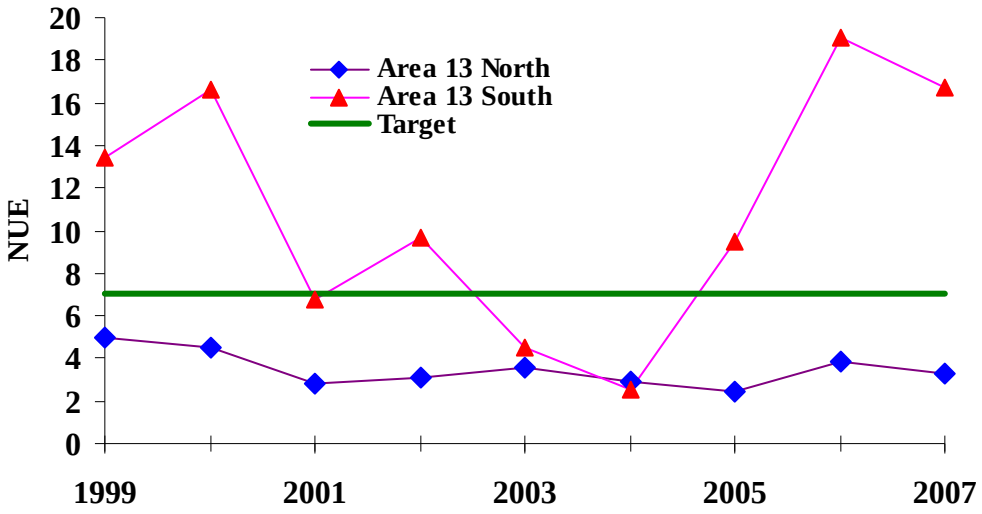


Figure 20. Catch rates (NUE) for crabs of 95+ mm, with trend line (Lowess type), from the postseason surveys conducted in Area 13, 1999–2007.

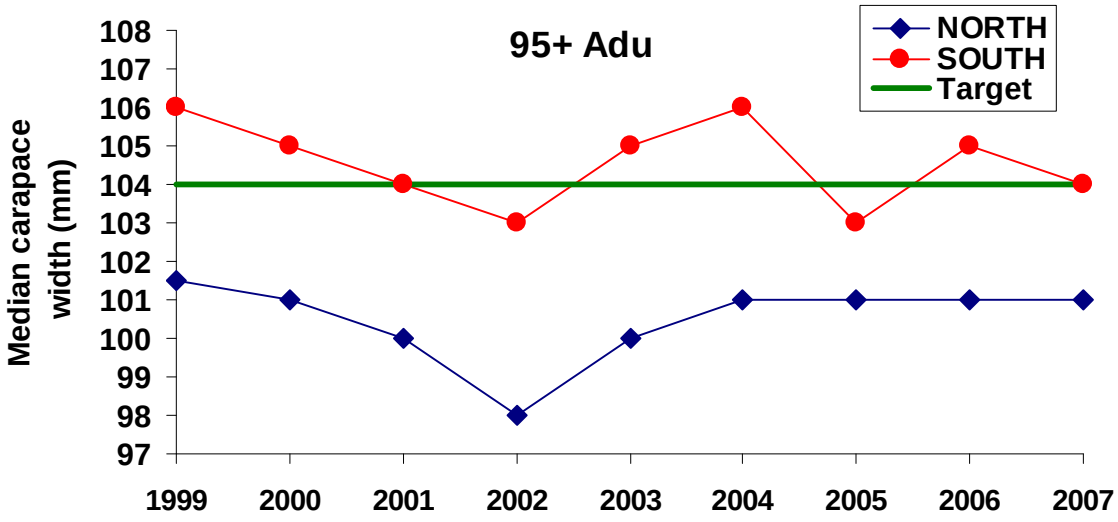


Figure 21. Median carapace width of crabs of 95+ mm from postseason surveys conducted in Area 13, 1999-2007.

Conclusions and Advice

Snow crab harvesting was under moratorium in Area 13 in 2003. The decision was made as a result of the drop in CPUE and the mean size of crab, combined with the deterioration of the size structure (knife effect at the 95 mm threshold) from 2000 to 2002, and the failure to reach the TAC in 2002 even though there was a sharp drop of the authorized catch level.

Certain criteria for reopening the fishery were set based on the historical performance of Area 13 and the recent performance of neighbouring Area 14. These criteria were: reaching an NUE of 7 legal-size crabs per Japanese trap with a median size of 104 mm. Both criteria had to be met on the northern side (Mecatina trough) as well as on the southern side (Esquiman Channel) of Area 13.

The status of the population continued to be monitored during the moratorium by way of two annual trap surveys (one for each side of the area), scientific surveys of usually 50 t, and one biennial trawl survey. Size structure improved overall in 2007 and the 2006 trawl survey showed that a strong recruitment wave (crab of less than 40 mm) occurred on the northern side. The population status on the northern side improved slightly but did not reach standards for reopening. On the southern side, there was a clear recovery of the population and the criteria for reopening were reached.

Some new information showed that temperature was a significant factor for determining the size at terminal moult for female and male crabs. The colder the temperature, the more likely the crab will do its terminal moult at a small size: consequently, this reaction will reduce the NUE and the median size of legal-size crabs, other things being equal. Some data indicated that the northern side of Area 13 was clearly colder than the southern side and that this disparity has been more evident in recent years. The entire northeastern Gulf of St. Lawrence has gotten colder since the 1990s. Snow crab in Area13 is likely less productive commercially than it once was, particularly on the northern side. This recent data discredits the criteria for reopening and provides an explanation for the greater recovery on the southern side than on the northern side of Area 13 since the introduction of the moratorium.

In light of this new information, the moratorium should be lifted in Area 13. A catch level of 150 t for two years appears reasonable since the harvesting of around 50 t within the framework of the scientific surveys did not prevent the stock condition indices from improving.

Harvesting in Area 13 will be monitored using a precautionary approach which will be implemented over the next two years. However, the basic elements will include a step-by-step approach for changes to catch levels, regular monitoring and an annual assessment of the population's response, and determining the limit points based on abundance and median size of legal males as well as female reproductive success.

Snow Crab in Area 12A

Fishery Description

Area 12A has 9 regular fishers and a community license. The TAC was 171.8 t in 2007, 57 t less than in 2006 (Figure 22A). In 2007, the fishery opened on March 16 and closed on June 22. The TAC wasn't met, mostly due to a weaker availability of the resource. Landings totalled 99 t.

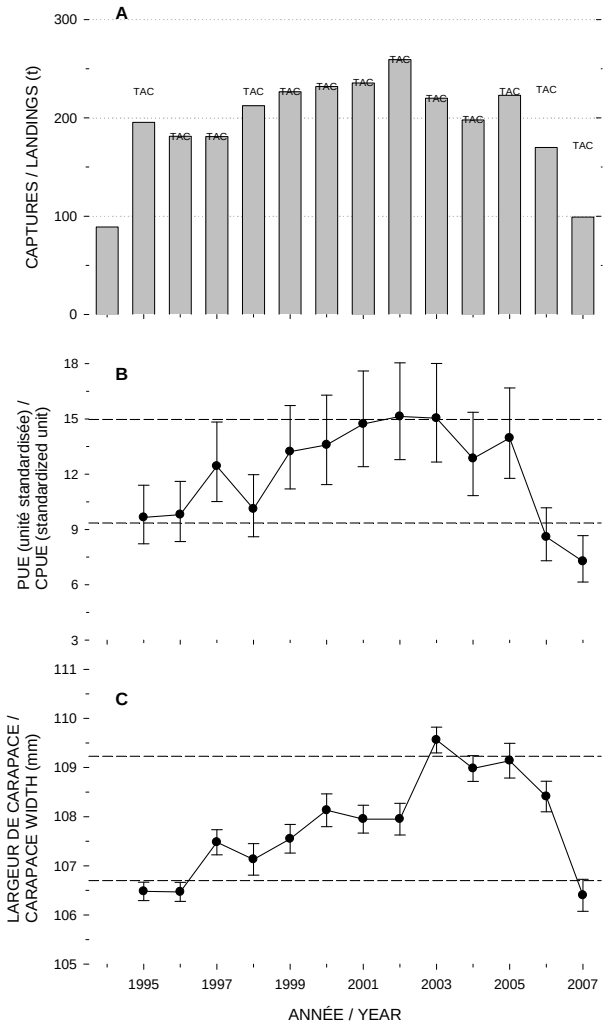
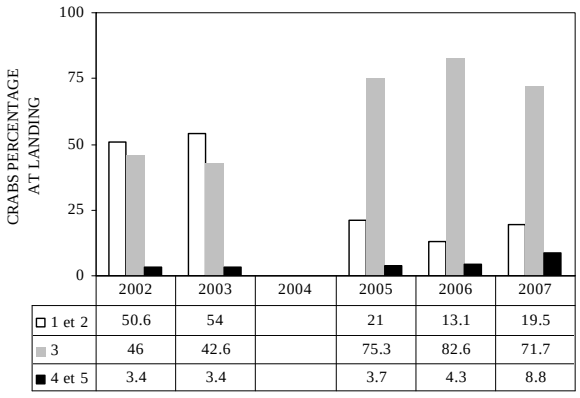


Figure 22. Main parameters estimated during the fishing season in Area 12A, 1995–2007: A) landings and TAC; B) standardized CPUE ± confidence interval; and C) mean carapace width ± confidence interval of commercial crabs sampled at sea. The mean of the 3 lowest values and the mean of the 3 highest values are indicated by dotted lines in graphs B and C.



	2002	2003	2004	2005	2006	2007
1 et 2	50.6	54		21	13.1	19.5
3	46	42.6		75.3	82.6	71.7
4 et 5	3.4	3.4		3.7	4.3	8.8

Figure 23. Carapace conditions for commercial crabs landed in Area 12A between 2002 and 2007.

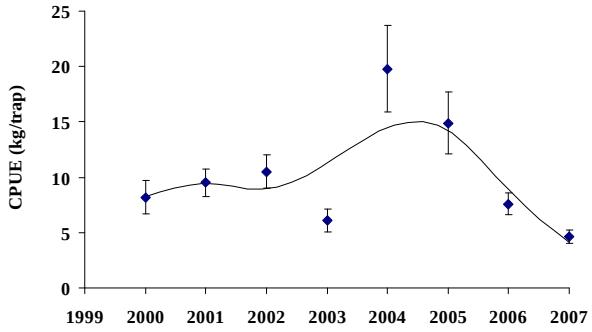


Figure 24. Catch rates (CPUEs) of adult crabs ≥ 95 with confidence interval and trend line (Lowess type) from the postseason survey in Area 12A, 2000– 2007.

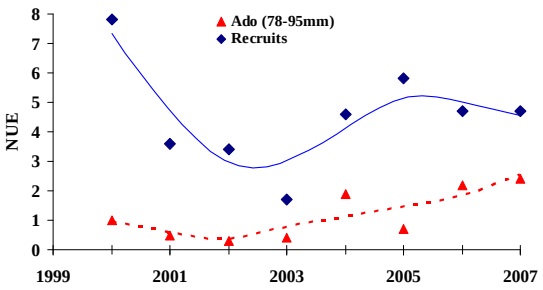


Figure 25. Catch rates (NUE) with trend line (Lowess type) for recruits and adolescents between 78 mm and 95 mm from the postseason survey conducted in Area 12A, 2000–2007.

In the commercial fishery, the standardized CPUE, which had been stable between 2004 and 2005, dropped by 50% in 2006, then increased in 2007 while remaining at a very low level (Figure 22B). A majority of intermediate-shell crabs (condition 3) were landed in 2007 (Figure 23).

The mean size (Figure 22C) of legal-size crabs sampled at sea decreased between 2006 (108.4 mm) and 2007 (106.4 mm).

The **scientific trap survey,** which has been conducted since 2000, indicated that the mean CPUE reached a high of 19.8 kg/conical trap in 2004 and gradually decreased to 4.6 kg/conical trap in 2007. The proportion of intermediate-shell crab (condition 3) has been dropping since 2004 and, oppositely, the proportion of new crabs (conditions 1 or 2) has been increasing during this period; the latter accounted for 53% of the catches in 2007. The mean size of legal-size adult male crabs dropped from 109.2 mm in 2005 to 105.1 mm in 2006, and to 103 mm in 2007. The mean NUE for recruits and adolescents between 78 mm and 95 mm CW, whose catchability could have increased due to fewer intermediate-shell crabs, has been stable since 2004 (Figure 25).

It is important to note that a study revealed that crab abundance in Area 12A is partly due to the overlapping adjacent Area 17 in the west, and Area 12 in the east. Thus, the abundance indices of these two last areas are decreasing.

Conclusions and Advice

From 2006 to 2007, the TAC dropped by 25% to 172 t. In 2007, landings only totalled 99 t.

Catch rates and mean size from the commercial fishery and postseason survey dropped to very low values between 2006 and 2007.

The mean size should be lower in 2008 than in 2007.

The TAC will have to be lowered to avoid another drop in terms of biomass available to the fishery.

Recommendations

A TAC reduction of about 80 t is recommended for 2008.

Snow Crab in Area 12B

Fishery Description

In 2006, Area 12B had 6 commercial fishing licenses and 2 community licenses. The 214 t TAC introduced in 2006 was renewed for 2007 (Figure 26A). In 2007, the fishery opened on March 16 and closed on June 22. The TAC was not met in 2007 and catches totalled 187 t.

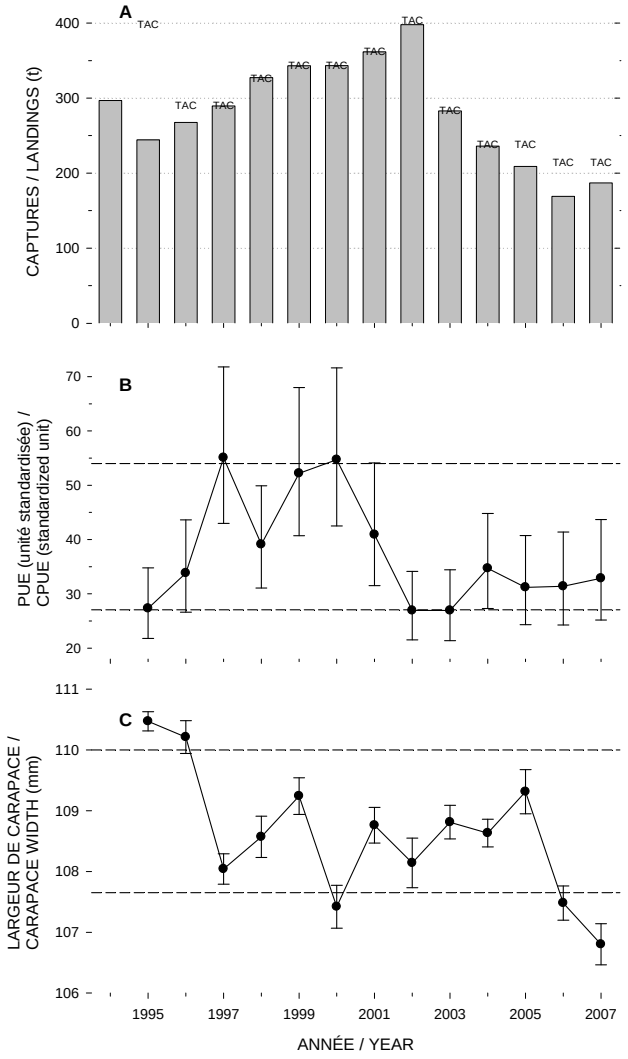
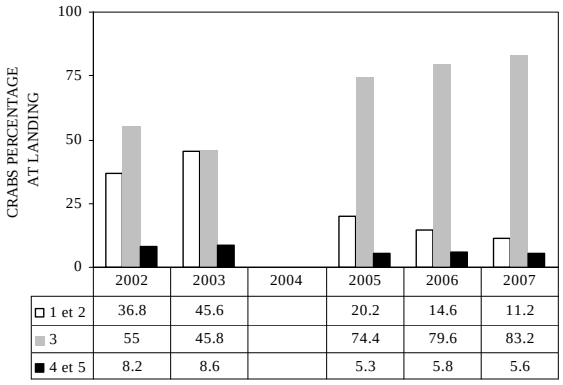


Figure 26. Main parameters estimated during the fishing season in Area 12B, 1994–2007: A) landings and TAC; B) standardized CPUE ± confidence interval; and C) mean carapace width ± confidence interval of commercial crabs sampled at sea. The mean of the 3 lowest values and the mean of the 3 highest values are indicated by dotted lines in graphs B and C.



	2002	2003	2004	2005	2006	2007
1 et 2	36.8	45.6		20.2	14.6	11.2
3	55	45.8		74.4	79.6	83.2
4 et 5	8.2	8.6		5.3	5.8	5.6

Figure 27. Carapace conditions for commercial crabs landed in Area 12B between 2002 and 2007.

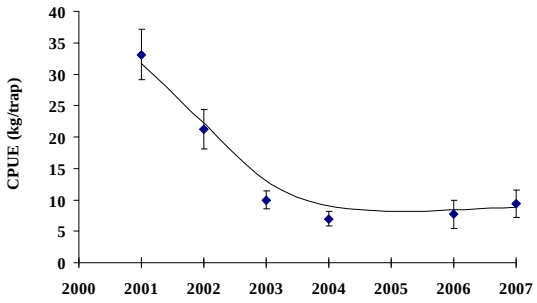


Figure 28. Catch rates (CPUEs) of adult crabs ≥ 95 with confidence interval and trend line (Lowess type) from the postseason survey in Area 12B, 2001– 2007 (except 2005).

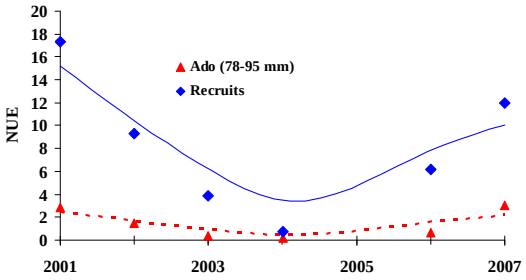


Figure 29. Catch rates (NUE) with trend line (Lowess type) for recruits and adolescents between 78 mm and 95 mm from the postseason survey conducted in Area 12B, 2001–2007 (except 2005).

The standardized CPUE for the commercial fishery has been weak but stable since 2004 (Figure 26B). The stability of this biomass index could be attributed to reduced landings since

2002. A majority of intermediate-shell crab (condition 3) was landed in 2007 (Figure 27). The mean size of legal-size crab measured at sea (Figure 26C) dropped for a second consecutive year, from 109.3 mm in 2005 to 106.8 mm in 2007.

The scientific trap survey conducted since 2001 (except in 2005) showed a drop of the CPUE of legal-size crab from 2001 to 2004 and then stabilized up to 2007 (Figure 28). In 2007, catches were clearly higher around the center of the area. The proportion of intermediate-shell crab (condition 3) has been dropping since 2004 and accounted for only 17% of the 2007 harvest. Oppositely, new crabs (conditions 1 or 2) increased sharply and accounted for 73% of the 2007 harvest. Old crabs (conditions 4 or 5) accounted for 10% of the harvest. The mean size of legal-size adult crab dropped in 2007 compared to 2006 and totalled 106 mm. The mean NUE for recruits and adolescents between 78 mm and 95 mm, whose catchability could have increased due to fewer adult intermediate-shell crabs, has increased considerably in 2007 compared to 2006 (Figure 29).

Conclusions and Advice

Landings and TAC totalled 214 t in 2007.

Catch rates from the commercial fishery and postseason survey have been stable since 2004. The mean size during the commercial fishery has increased for a second consecutive year.

The mean size should drop in 2008.

Recommendations

The same TAC level as in 2007 should be maintained for 2008.

Snow Crab in Area 12C

Fishery Description

Area 12C has five regular fishers and features two banks (north and south sectors) separated by a deep channel of the Jacques-Cartier Strait. The TAC (Figure 30A) was set at 291 t in 2007, a 10% increase from 2006. Temporary allocations totalling 91 t were granted in 2007. The fishery opened on April 30 and closed on August 7. In 2006 and 2007, the fishing effort was more concentrated in the northern part of the area compared to previous years. The TAC was met.

The standardized CPUE for the commercial fishery plummeted between 1996 and 1997 and, even though it fluctuated from 1997 to 2002, it has remained low. It has been stable since 2002 (Figure 30B). Intermediate-shell crab (condition 3), which represented 93% of the 2005 landings, dropped up to 2007 and accounted for only 26% of the landings. Oppositely, new crabs (conditions 1 or 2) increased from 0 to 73% during the same period (Figure 31). The mean size of legal-size crab measured at sea has been increasing since 2002 and reached 111.7 mm in 2007 (Figure 30C).

The scientific trap survey conducted since 2000 shows a drop in the mean CPUE in 2007 compared to the last survey conducted in 2005 (Figure 32). The mean size of legal-size adult crab was high in 2007 and totalled 110.6 mm. Results from the 2007 survey suggested that the abundance of recruits and adolescents between 78 and 95 mm was low.

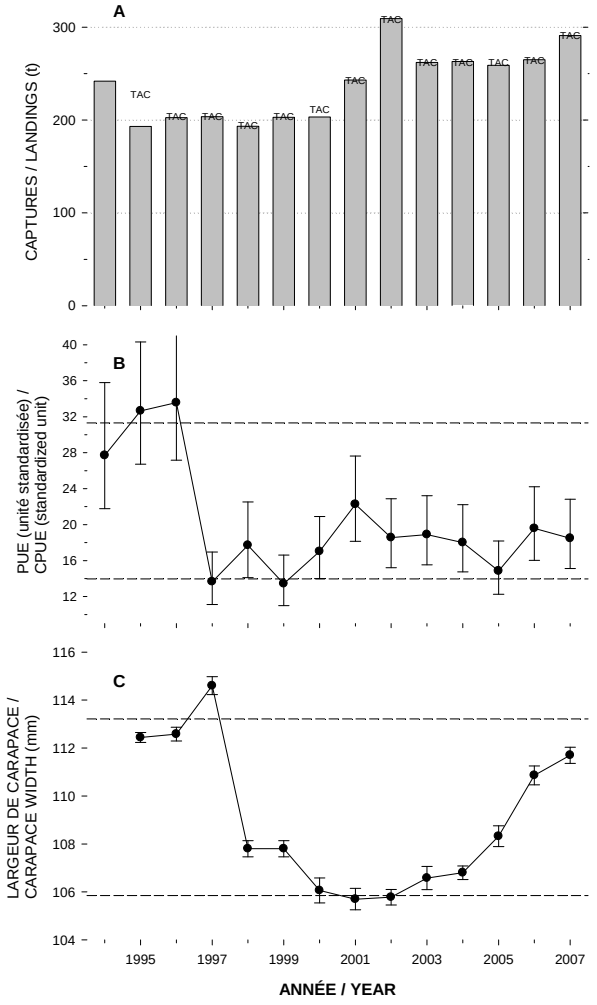
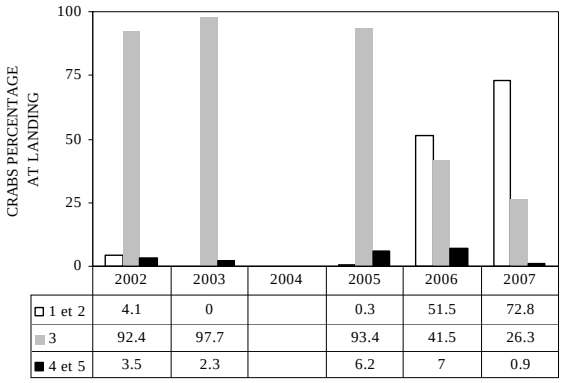


Figure 30. Main parameters estimated during the fishing season in Area 12C, 1994–2007: A) landings and TAC; B) standardized CPUE ± confidence interval; and C) mean carapace width ± confidence interval of commercial crabs sampled at sea. The mean of the 3 lowest values and the mean of the 3 highest values are indicated by dotted lines in graphs B and C.



	2002	2003	2004	2005	2006	2007
1 et 2	4.1	0		0.3	51.5	72.8
3	92.4	97.7		93.4	41.5	26.3
4 et 5	3.5	2.3		6.2	7	0.9

Figure 31. Carapace conditions for commercial crabs landed in Area 12C between 2002 and 2007.

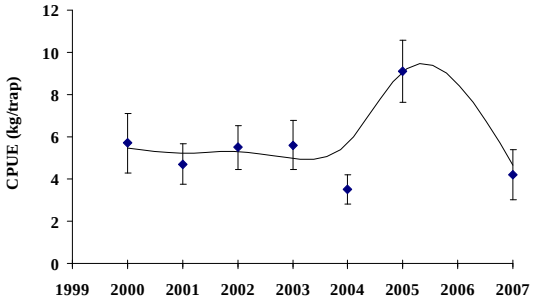


Figure 32. Catch rates (CPUEs) of adult crabs ≥ 95 with confidence interval and trend line (Lowess type) from the postseason survey in Area 12C, 2000– 2007.

Conclusions and Advice

Landings and TAC increased by 10% to 291 t from 2006 to 2007.

Catch rates from the commercial fishery have been low but stable since 2002. During the 2007 postseason survey, the catch rate for commercial-size crab was lower than in 2005.

The mean size of crab increased slightly during the commercial fishery between 2006 and 2007.

Recommendations

A TAC increase of 10% would be acceptable for 2008.

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 and trap volume and mesh size, 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

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, 2007. Assessment of the Estuary and Northern Gulf of St. Lawrence (Areas 13 to 17 and 12A, 12B and 12C) Snow Crab Stocks in 2006. DFO Can. Sci. Advis. Sec., Sci. Advis. Rep. 2007/017.

FOR MORE INFORMATION

Contact: Jean Lambert
Maurice Lamontagne Institute
850, route de la Mer
P.O. Box 1000
Mont-Joli (Quebec)
G5H 3Z4

Tel: (418) 775-0717
Fax: (418) 775-0740
E-mail: Lambertj@dfo-mpo.gc.ca

This report is available from the:

Centre for Science Advice (CSA)
Quebec Region
Fisheries and Oceans Canada
Maurice Lamontagne Institute
850 route de la Mer
Mont-Joli (Quebec)
G5H 3Z4

Telephone: (418) 775-0825
Fax: (418) 775-0679
E-mail: Bras@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

ISSN 1480-4913 (printed)

La version française est disponible à l'adresse ci-dessus.

CORRECT CITATION FOR THIS PUBLICATION:

DFO. 2008. Assessment of the Estuary and Northern Gulf of St. Lawrence (Areas 13 to 17 and 12A, 12B and 12C) Snow Crab Stocks in 2007. DFO Can. Sci. Advis. Sec., Sci. Advis. Rep. 2008/043.