

## Snow Crab of the Estuary and Northern Gulf of St. Lawrence (Areas 13 to 17)

### Background

The commercial snow crab fishery in the Estuary and northern Gulf of St. Lawrence intensified as of the late 1970s. The northern Gulf is divided into five management areas, numbered from 13 to 17 from east to west. TAC-based management was gradually introduced in the region between 1985 and 1994. The fishery is directed exclusively at males with a carapace width (CW) of at least 95 mm.

Male snow crabs stop growing after a terminal moult. The male is referred to as an adolescent (recognized by its small claws) prior to the terminal moult and as an adult afterward (large claws). Males range in size from 40 to 165 mm CW after the terminal moult. Recruitment in snow crab varies over an intrinsic cycle of about eight years, generally characterized by five years of moderate-to-high recruitment (recruitment wave) followed by three years of low recruitment (recruitment trough). Males reach legal size at about nine years of age. The 1985-1987 year-classes, which are currently being harvested, form a recruitment trough. The biomass, and hence catches and yields, are thus lower than the values observed between 1991 and 1995, when the last recruitment wave occurred. This situation should persist until 1998-1999 in areas 17 and 16, and until 2000-2001 in areas 15, 14 and 13, when the 1988-1992 year-classes, which will form the next recruitment wave, begin to be recruited to the fishery.

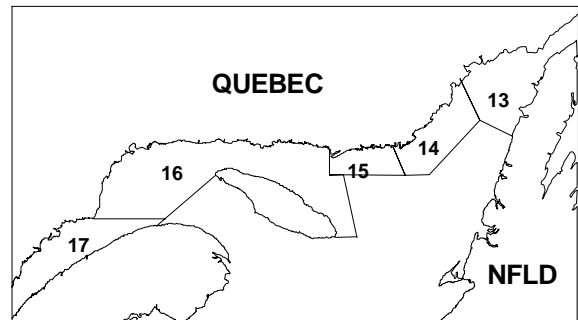


Figure 1. Snow crab management areas in the northern Gulf of St. Lawrence.

### Summary

- In Area 17, all the indicators show that the harvestable biomass is recovering and increasing due to the 1988-92 recruitment wave;
- Since the resource is dominated by recently moulted adult crabs, natural mortality from senescence will be low over the coming years. Crabs recruited in 1998 will be available to the fishery for about three years;
- Recruitment of legal-size crabs should continue at a high level through the year 2000 at least. The small size of the 1993-95 year-classes suggests that recruitment will begin declining in 2002.
- In the areas farther east (16, 15, 14 and 13), most indicators of current status are negative and show that the number and biomass of legal-size crabs has continued to decrease;
- Most indicators of future population status for Area 16 are positive, pointing to an increase in both recruitment and biomass beginning in 1999;
- However, there is a considerable abundance of sublegal-size adult males in Area 16 (particularly in the west), indicating that the 1988-90 year-classes contracted before the crabs reached legal size, owing to a high rate of early terminal moult;
- In contrast, most short-term indicators of future population status are negative in areas 15, 14 and 13, presaging low recruitment in 1999;
- Recruitment is expected to resume in 2000 and 2001 in areas 15, 14 and 13.

## The fishery

### Location and historical context

The territory is divided into five management areas (Figure 1), corresponding to three broad geographic regions: the Upper North Shore and much of the north shore of the Gaspé Peninsula (Area 17 or Estuary), the Middle North Shore (areas 16 and 15) and the Lower North Shore (areas 14 and 13). However, since the population structure of snow crab and fishing patterns in Area 15 have more in common with those of areas 14 and 13, that Area was grouped with the latter two in 1997.

Snow crab is fished with baited traps, mostly conical steel models, such as the Japanese trap with a 1.2-m-diameter base. Since 1990, the fishery in the Estuary and the Middle North Shore has begun at ice break-up (March-April) and generally closed after 10 to 14 weeks (June-July). On the Lower North Shore, the opening of the fishery is often delayed because the ice cover stays longer, and the season generally does not begin until June, ending in October or November.

The snow crab fishery in the Estuary and northern Gulf of St. Lawrence began in the late 1960s. From 1968 to 1971, vessels from Quebec and New Brunswick reported catches of about 1,000 t from around the Port Cartier sector of the Middle North Shore. Subsequently, a limited inshore fishery took place, with annual landings of roughly 200-300 t until the late 1970s. The fishery experienced a boom from 1979 to 1985, when the number of participants, fishing effort, geographic extent and landings increased substantially.

Between 1987 and 1989, landings for the entire region of the Estuary and northern Gulf of St. Lawrence plummeted from 5,255 t to 2,622 t (Figure 2). This drop was accompanied by marked decreases in

catches per unit of effort and ever-greater catches of white crab, as a direct result of a recruitment trough made up of the 1977-1979 year-classes. Beginning in 1990-91, the white crab problem gradually disappeared, catches per unit of effort rose, and landings increased to a record level of 7,245 t in 1995, thanks to the advent of the recruitment wave made up of the 1980-84 year-classes. Landings slipped somewhat in 1996 (6,716 t) and 1997 (5,599 t) as a result of the decrease in the TAC (total allowable catch) in all areas and the inability of some fishermen to reach their 1997 quotas. In 1998, landings (5,715 t as at December 1, 1998) remained at the same level as in 1997 because the TAC was frozen in most areas, except Area 13 where the TAC was decreased.

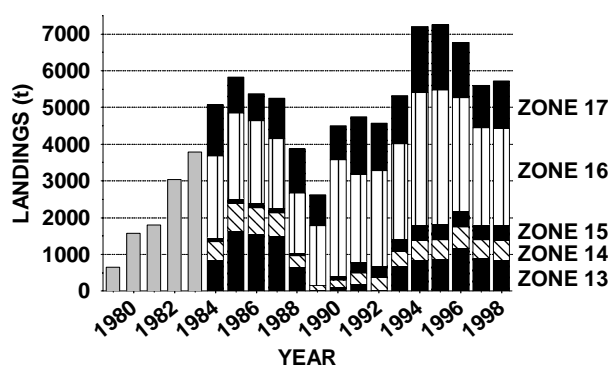


Figure 2. Snow crab landings in the northern Gulf of St. Lawrence

### Fishery management

Although the fishery was originally managed by controlling fishing effort, a TAC was gradually introduced in the different fishing areas between 1985 and 1994. The number of traps authorized per licence is limited to 150 Japanese traps; however, fishermen may substitute one regular trap (maximum volume 2.1 m<sup>3</sup>) for two Japanese traps (maximum volume 0.44 m<sup>3</sup>).

As elsewhere in Canada, the minimum legal size is set at 95 mm, and the landing of females is prohibited. Since 1985, once the limit of 20% of white crab in catches at sea has been exceeded, the fishery is automatically closed in the area concerned to minimize the mortality of these very fragile crabs which will be available to the fishery the following year. In addition, white crabs may be returned to the water during the fishing season to enhance their value and give them a chance to reproduce.

### *State of the resource*

The status of snow crab populations in areas 17 and 16 is established yearly on the basis of statistical analyses, fishery sampling and research surveys conducted using a beam trawl and traps. In 1998, fishers from areas 15 and 14 conducted a research survey with traps, and the results were incorporated into the stock assessment analyses. The stock status of snow crab in Area 13 was determined solely from fishing data.

### *Snow crab in Area 17*

There are 22 holders of active licences in Area 17. The first TAC was set at 1,300 t in 1992 (Table 1). In 1998, the fishery began on March 25, one week earlier than in 1997, and ended on June 19. The 1998 TAC of 1,315 t (the same level as in 1997) did not include any special allocations. As of December 1, 1998, catches stood at 1,285 t (preliminary data), or 30 t short of the TAC.

### *State of the resource in 1998*

In 1998, yields rose slightly, from 8.2 (1997) to 8.6 kg/Japanese trap, reversing the downward trend that had been ongoing since 1994. This points to moderate growth or to stabilization of the harvestable biomass, particularly on the south shore (Table 1). However, fishing effort rose slightly in 1998 (+6%), and concentrated on the south shore

as in 1997. Accordingly, catches from the north shore, in steady decline since 1995, accounted for only 36% of total landings in Area 17 in 1998, compared with an average of 66% between 1993 and 1995.

**White crab** was abundant toward the end of the fishing season, in June 1998, leading to closure of the Area about one week earlier than in 1997. Intermediate-shell crabs (condition 3) dominated catches at sea and dockside, and old crabs (conditions 4 and 5), which had been declining in proportion since 1996, made up only 12% of the individuals caught in 1998. Adolescent males from 78 to 95 mm CW, that is, pre-recruits which will reach legal size in a year, are currently increasing in number and accounted for 5% of catches at sea, which is close to the record high of 7% observed in 1991.

**The average CW of legal-size crabs** caught at sea, in decline since 1994, slipped 4% from 1997, to 108.8 mm. The average size of landed crabs, which has also been falling, dropped by a substantial 8%, from 117.8 mm in 1996 to 108.6 mm in 1998. New crabs (conditions 1 and 2) sampled at sea were smaller in average size than the oldest crabs (conditions 4 and 5), at 97 mm versus 101 mm. This situation indicates that recruitment of legal-size crabs is attributable mainly to the year-classes making up the 1988-92 recruitment wave.

**The annual post-season trawl survey** conducted on the north shore in Area 17 between late July and early August revealed a sharp increase in abundance (+88%) and biomass (+83%) of legal-size snow crab in 1998, compared to 1997. This increase was caused by the arrival of the 1988-89 year-classes. Total mortality (comprising both natural and fishing mortality) was estimated at 33% on the north shore in 1998.

Table 1. Catch and effort data for Area 17.

| Year                      | 1983 to 1989 <sup>4</sup> | 1990  | 1991  | 1992  | 1993  | 1994  | 1995               | 1996               | 1997               | 1998  |
|---------------------------|---------------------------|-------|-------|-------|-------|-------|--------------------|--------------------|--------------------|-------|
| TAC                       | -                         | -     | -     | 1 300 | 1 300 | 1 820 | 1 820 <sup>5</sup> | 1 547 <sup>5</sup> | 1 315 <sup>5</sup> | 1 315 |
| Catch <sup>1</sup>        | 1 022                     | 910   | 1 562 | 1 289 | 1 305 | 1 788 | 1 774              | 1 502              | 1 156              | 1 285 |
| Effort <sup>2</sup>       | 121.8                     | 137.9 | 173.6 | 107.4 | 90.6  | 124.2 | 155.6              | 153.3              | 141.0              | 149.4 |
| CPUE <sup>3</sup> : Total | 8.5                       | 6.6   | 9.0   | 12.0  | 14.4  | 14.4  | 11.4               | 9.8                | 8.2                | 8.6   |
| North shore               | 8.4                       | 7.7   | 10.0  | 12.4  | 15.2  | 15.7  | 11.7               | 10.3               | 7.7                | 7.4   |
| South shore               | 7.4                       | 5.3   | 7.8   | 11.5  | 13.2  | 11.4  | 9.7                | 9.3                | 8.5                | 9.2   |

- 1 Landings in metric tons, as at December 1, 1998 (preliminary)
- 2 Standardized effort in thousands of Japanese trap hauls
- 3 Catch per unit effort in kilograms per Japanese trap
- 4 Average for the period
- 5 Including special allocations

The abundance of new crabs  $R(0)$ , on the rise since 1996, more than doubled between 1997 and 1998, totalling 64% of all individuals on fishing grounds. In contrast, the percentage of old crabs, which has been falling since 1996, is now only 10%. The average CW of legal-size crabs declined slightly from 1997 (about 103 mm versus 104 mm), but the decrease was smaller than that observed between 1995 and 1997.

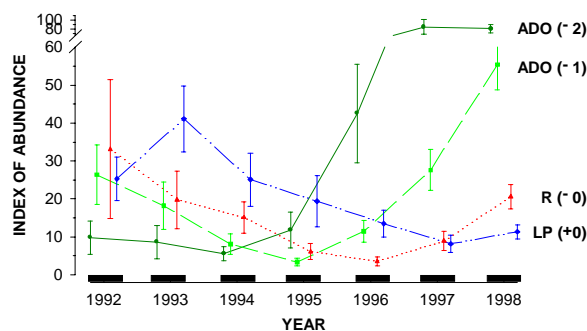


Figure 3. Abundance of male snow crab caught in trawl surveys in the Estuary between 1992 and 1998.  $LP(+0)$ : males left by the fishery during the survey year;  $R(0)$ : males recruited to the fishery;  $ADO(1)$ : adolescent males of 78–95 mm CW;  $ADO(2)$ : adolescent males of 62–78 mm CW.

The recovery will continue over the next three years, because the abundance of the 1989 to 1991 year-classes is presently greater than that of the 1988 year-class, which was fully recruited to the fishery in 1998 (Figure 3). Adolescents of 78–95 mm CW ( $ADO(1)$ ), which will reach legal size in 1999, doubled in number in 1998 versus 1997, whereas the abundance of adolescents of 62–78 mm CW ( $ADO(2)$ ), although high and exceeding that of older groups, has stabilized. The 1993–95 year-classes are weak and will form the next recruitment trough. Recruitment of adult females, which mature faster than males, declined for the first time since 1993 and will continue to decrease over the coming years, until the advent of the new recruitment wave.

The post-season trap survey showed trends consistent with those observed in the fishery and trawl surveys. The average yield of legal-size crabs, up significantly since 1996, increased by 35% in weight and 40% in number, between 1997 and 1998 (Figure 4). In 1998, the yield reached the highest level since the start of the survey in 1996, that is, 14.2 kg/trap (29 crabs/trap). New crabs made up 62% of catches and old crabs about 8%. The average CW of legal-size crabs

stood at 105.4 mm, down somewhat from 1997 (107.4 mm), following a steeper decrease of about 4% between 1996 and 1997. The number of adolescents of 78–95 mm CW increased by 77% between 1997 (5.7 crabs per trap) and 1998 (10.1 crabs per trap).

three years. The average CW of legal-size crabs, in sharp decline for two years, will stabilize or begin to increase as of 1999.

On the north shore, recruitment of legal-size crabs should continue in full force into the year 2000 at least. White crab may become abundant in catches in 1999 if fishing pressure is strong. In view of the weak 1993-95 year-classes, recruitment is likely to decline as of 2002. Recruitment of adult females will drop sharply beginning in 1999, and the reproductive status of females will improve since adult males will be proportionately more numerous.

Although the fishing data suggest that the population trends for crab are the same on both shores, some doubt persists regarding the population status of the south shore crabs, given that their abundance is not quantified by trawl or trap surveys. The positive trends observed on the north shore may not provide an accurate picture of the situation in Area 17 as a whole.

Given the uncertainty over the crab population on the south shore and given the higher fishing effort on that shore versus the north shore since 1997, three scenarios are proposed:

1. *Prudent scenario.* Assuming that the spatial distribution of fishing effort reverts to the way it was prior to 1997, with 66% of landings coming from the north shore, a 15% increase in catches in Area 17 would keep total mortality on the north shore at a level below or equal to that of 1998, that is, about 35% or less of legal-size crab.
2. *Moderate-risk scenario.* Assuming that the increase in abundance of legal-size crab will be the same on both shores and that the spatial distribution of effort will be the same as in 1998 (i.e., 60% of landings from the south shore), a 35% increase in catches (consistent with the higher CPUEs noted in the post-season

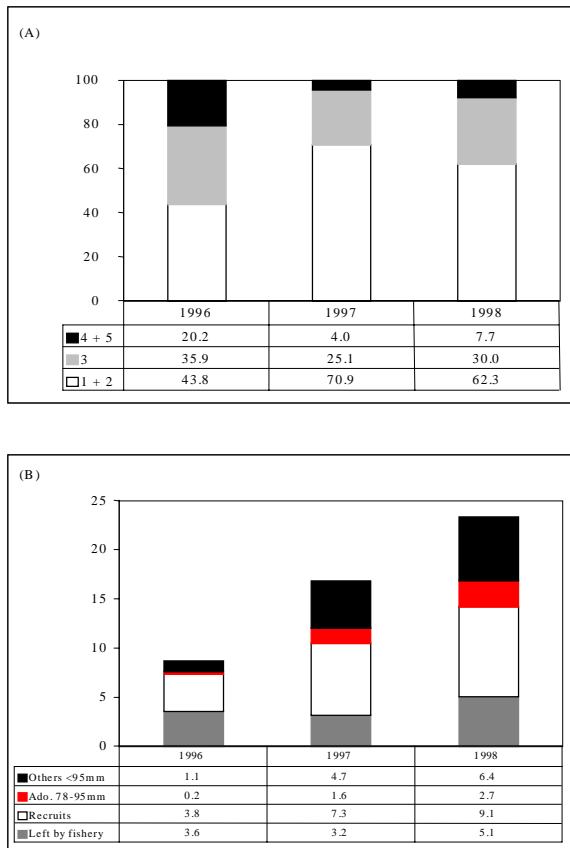


Figure 4. Results of the post-season trap survey conducted on the north shore in Area 17, from 1996 to 1998. (A) Shell condition (%) of legal-size males. (B) Yield (kg/trap) of the different groups of males.

**Outlook for Area 17 in 1999**

All the indicators are positive and point to renewal of the harvestable biomass, which is increasing due to the 1988-92 recruitment wave. Since the resource is dominated by recently moulted adult crabs, natural mortality from senescence will be low over the coming years. Crabs recruited in 1998 will be available to the fishery for about

trap survey) would maintain total mortality for all of Area 17 at a level about half that recorded on the north shore in 1998. *However, if effort were focussed primarily on the north shore, total mortality might be high there and the likelihood of encountering white crab in 1999 would be high.*

3. *Risky scenario.* Assuming that the increase in abundance of legal-size crab will be the same on both shores and that the spatial distribution of effort will be the same as in 1998 (i.e., 60% of landings from the south shore), an 80% increase in catches (consistent with the greater number of crabs observed in the post-season trawl survey) would maintain total mortality for all of Area 17 at a level below or equal to that recorded on the north shore in 1998. *However, if effort were concentrated mainly on the north shore, total mortality might be very high there, and the likelihood of encountering white crab in 1999 would be very high.*

### ***Snow crab in Area 16***

Thirty-six fishers hold a regular snow crab fishing licence for Area 16. In 1998, the TAC remained at the same level as in 1997 (2,627 t) and included a temporary allocation of 151 t for non-crabbers (Table 2). The fishery began a week earlier (April 4) than in 1997 and ended on August 1. The TAC was attained.

### ***State of the resource in 1998***

The overall CPUE dropped 20%, from 13.4 kg/Japanese trap in 1997 to 10.7 kg/Japanese trap in 1998 (Table 2). The decrease in yields was greater in the western part (-21%) versus the eastern part (-12%) of the territory. As in 1997, the eastern part of Area 16 was fished more heavily. Catches at sea were generally dominated by intermediate shell specimens. New crabs (conditions 1 and 2) were more abundant in the west (10%) than the east (7%); however, they made up only 8% of catches, a lower percentage than in 1996-97. In contrast, old crabs (conditions 4 and 5), although less abundant than in 1997, still

Table 2. Catch and effort data for Area 16.

| Year                | 1983 to 1989 <sup>4</sup> | 1990  | 1991  | 1992  | 1993  | 1994  | 1995               | 1996               | 1997               | 1998               |
|---------------------|---------------------------|-------|-------|-------|-------|-------|--------------------|--------------------|--------------------|--------------------|
| TAC                 | 2 500 <sup>5</sup>        | -     | 2 368 | 2 596 | 2 596 | 3 636 | 3 636 <sup>7</sup> | 3 090 <sup>7</sup> | 2 627 <sup>7</sup> | 2 627 <sup>7</sup> |
| Catch <sup>1</sup>  | 1984                      | 3 181 | 2 371 | 2 597 | 2 595 | 3 608 | 3 629              | 3 085              | 2 623              | 2 625              |
| Effort <sup>2</sup> | 257.7                     | 250.5 | 137.8 | 137.4 | 127.2 | 178.6 | 177.9              | 153.5              | 195.7              | 245.3              |
| CPUE <sup>3</sup>   |                           |       |       |       |       |       |                    |                    |                    |                    |
| <b>Total</b>        | 7.7                       | 12.7  | 17.2  | 18.9  | 20.4  | 20.2  | 20.4               | 20.1               | 13.4               | 10.7               |
| <b>West</b>         | 6.0                       | 8.9   | 14.1  | 17.4  | 18.4  | 21.5  | 19.8               | 21.0               | 13.1               | 10.4               |
| <b>Centre</b>       | 7.7                       | 12.4  | 18.2  | 22.0  | 23.3  | 19.7  | 21.7               | 18.5               | 12.2               | 9.8                |
| <b>East</b>         | 10.1 <sup>6</sup>         | 15.2  | 18.7  | 17.4  | 19.9  | 18.5  | 19.9               | 21.2               | 16.2               | 14.3               |

1 Landings in metric tons as at December 1, 1998

2 Standardized effort in thousands of Japanese trap hauls

3 Catch per unit effort in kilograms per Japanese trap

4 Average for the period

5 From 1986 to 1987

6 The CPUEs for Area 16 East and Area 15 were combined prior to 1990

7 Including special allocations

accounted for a considerable proportion of the crabs (29%) taken in traps. Old crabs were proportionately more numerous in the west (26 %) versus the east (20%) of Area 16.

In 1998, the average CW of legal-size crabs landed in Area 16 as a whole decreased for the first time since 1990 and now stands at 114.9 mm. The average CW of legal-size crabs captured at sea has held steady at about 113 mm since 1994. Between 1997 and 1998, crabs sampled at sea in the eastern region increased in average size, while those in the west exhibited a decline in size. The eastern crabs of legal size were 6% larger (114.8 mm) than their western counterparts (106.6 mm). Throughout Area 16, new crabs were smaller than old ones, as was the case in Area 17. Adolescents of 78–95 mm CW, due to attain legal size upon their next moult, were not well represented in traps (3%) and displayed a moderate downturn compared to 1997. They were more numerous in the west (4%) than in the east (1%).

**The results of the trawl survey** conducted in 1998 in St. Marguerite Bay, near Sept Iles (in the west of Area 16) showed trends similar to those observed in the fishery. The abundance of legal-size crabs, most of which had an intermediate shell condition in 1998, was up from 1996-97; their average size also increased (107 mm in 1998), after a two-year decline. The survey revealed a substantial increase in the number of adolescents of 78–95 mm CW, and an expansion of the contingent of smaller adolescents (62 to 78 mm), compared with 1997 values. However, the number of sublegal-size adults has shot up since 1996 (300% or over), indicating that a large proportion of males from the 1988-92 year-classes has undergone early terminal moult, before reaching legal size. The 1993-95 year-classes, due to reach legal size in 2002-2004, are smaller than older year-classes.

As in Area 17, recruitment of adult females dropped in 1998 compared to levels in 1995-97. The insemination rate, in decline since 1991, rose, given the growing abundance of males; however, the percentage of fertilized eggs remained below 100% for many adult females.

**Indices from the post-season trap survey**, conducted every fall since 1994 in Area 16, agree with the findings of fishery and trawl surveys and likewise show a west–east gradient in stock status (Figure 5). Overall, the yield of legal-size crabs decreased by 26% in weight and by 19% in number in 1998 versus 1997, but this decline is largely attributable to the eastern region (-61% in weight and -58% in number). By contrast, although the CPUE measured in weight remained at about the 1997 level, the number of crabs caught per trap rose by 11% in the west in 1998. In 1998, the proportion of new crabs in catches in the west was greater than in 1997, and three times higher (31%) than in the east (9%). Conversely, the proportion of old crabs, down sharply from 1997, was three times higher in the east (40%) than in the west (12%). In 1998, legal-size crabs were moderately smaller in the west (109 mm) than in the east (110 mm), and the average size exhibited a more pronounced decline in the west versus the east, in comparison with the 1997 value.

In 1998, the trap survey (like the trawl survey) showed very strong growth (230%) in the number of sublegal-size adult males caught in the west (9 to 30 crabs per trap) and a slight drop in the east (4 to 3 crabs per trap) in relation to 1997. These results indicate that a large proportion of crabs from the 1988-92 recruitment wave will not reach legal size. The number of adolescents of 78–95 mm CW nonetheless increased between 1997 and 1998, from 1 to 3 crabs per trap, owing to a substantial increase in the west (from 1 to 6 crabs per trap),

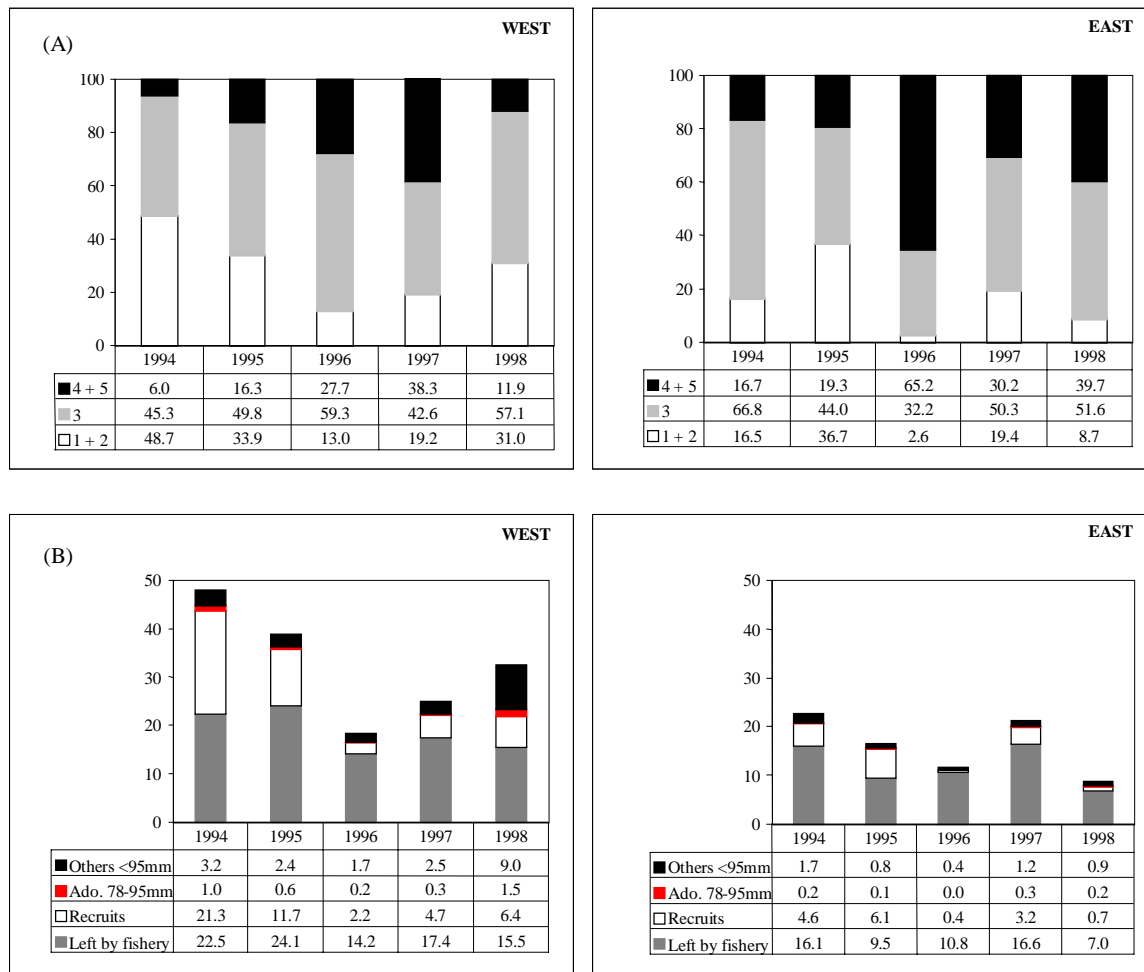


Figure 5. Results of the post-season trap survey in Area 16 from 1994 to 1998. (A) Shell condition (%) of legal-size males. (B) Yields (kg/trap) of the different groups of males. Only the western sector (Pointe des Monts to Rivière au Tonnerre) and the eastern sector (Mingan to Natashquan) in Area 16 are shown.

whereas in the east there was a slight decline (from 1 to 0.8 crab per trap).

**Outlook for 1999**

Snow crabs in Area 16 do not exhibit homogeneous behaviour.

*Western part of Area 16*

Recruitment of legal-size crabs is under way; it should intensify in 1999 and continue at a substantial pace into the year 2000 or beyond. The proportion of old crabs is small; hence, natural mortality

(senescence) will be low over the coming years. White crab might be abundant in catches in 1999 if fishing pressure is heavy. The average CW of legal-size adults, in sharp decline for two years, will stabilize or start to increase as of 1999. Judging from the weakness of the 1993-95 year-classes, recruitment should begin to decline in 2002. Recruitment of adult females will drop sharply starting in 1999, and the reproductive status of females should improve.



*Eastern part of Area 16*

The resource still contains a high proportion of old crabs, and during fall 1998 and winter 1999, natural mortality (senescence) will reduce part of the harvestable biomass composed chiefly of large adult males. The average CW of legal-size adult crabs will decline in 1999. Recruitment of legal-size specimens was very low in 1998 and should remain depressed in 1999; consequently, the harvestable biomass will contract in 1999.

*Area 16 as a whole*

Most current indicators are negative and show that legal-size crabs have continued to decline in number and biomass. However, the large proportion of old males observed in the post-season trap survey in 1996-97, and the fact that some fishing grounds were not exploited, suggest that the exploitation rate is low. There are many sublegal-size adult males, particularly in the west, which means that the 1988-92 year-classes

contracted before the crabs reached legal size, owing to a high rate of early terminal moult.

Most indicators of future population status are positive and suggest that recruitment will increase greatly in 1999 and that biomass will start expanding in 1999 or 2000. *For Area 16 as a whole, it is recommended that catches be maintained at the same level as in 1998. However, the majority of catches should be made outside the eastern part of Area 16, because the biomass is still contracting there and recovery has not yet started.*

***Snow crab in Areas 15, 14 and 13***

Areas 15, 14 and 13 have 8, 21 and 49 regular fishermen respectively. The fishery opened much earlier in 1998, in all areas, that is, on April 6 (versus May 4 in 1997) in Area 15, May 25 (June 15 in 1997) in Area 14 and June 1 (versus July 12 in 1997) in

*Table 3. Catch and effort data for Areas 15, 14 and 13.*

| Year                 |            | 1983 to 1989 <sup>4</sup> | 1990       | 1991  | 1992 | 1993  | 1994  | 1995               | 1996              | 1997               | 1998             |
|----------------------|------------|---------------------------|------------|-------|------|-------|-------|--------------------|-------------------|--------------------|------------------|
| TAC:                 | Area 15    | --                        | --         | --    | --   | --    | 435   | 435                | 435               | 413                | 422 <sup>7</sup> |
|                      | Area 14    | 667 <sup>5</sup>          | 381        | 381   | 381  | 381   | 524   | 524 <sup>6,7</sup> | 576 <sup>7</sup>  | 518,4 <sup>7</sup> | 548 <sup>7</sup> |
|                      | Area 13    | 1 642                     | 889        | 889   | 889  | 889   | 889   | 889                | 1241 <sup>7</sup> | 931 <sup>7</sup>   | 838              |
| Catches <sup>1</sup> | Area 15    | 109.7                     | 93         | 321   | 300  | 339   | 426   | 436                | 435               | 413                | 421              |
|                      | Area 14    | 509.4                     | 174<br>138 | 288   | 361  | 383   | 522   | 525                | 573               | 512                | 546              |
|                      | Area 13    | 918.4                     |            | 201   | 19   | 703   | 859   | 883                | 1121              | 795                | 838              |
| Effort <sup>2</sup>  | Area 15    | --                        | 15.2       | 22.9  | 22.1 | 22.3  | 21.2  | 17.1               | 16.0              | 21.5               | 22.6             |
|                      | Area 13+14 | 165.6                     | 76.1       | 116.4 | 53.5 | 193.9 | 212.5 | 154.7              | 281.1             | 242.0              | 184.5            |
| CPUE <sup>3</sup>    | Area 15    | --                        | 6.1        | 14.0  | 13.6 | 15.2  | 20.1  | 25.5               | 27.1              | 19.2               | 18.6             |
|                      | Area 14    | 5.2                       | 4.3        | 4.8   | 7.3  | 9.7   | 11.2  | 11.6               | 12.5              | 10.7               | 11.2             |
|                      | Area 13    | 5.7                       | 3.9        | 3.1   | 5.3  | 4.2   | 4.5   | 8.0                | 5.1               | 4.3                | 6.5              |

1 Landings in metric tons as at December 1, 1998 (preliminary)

2 Standardized effort in thousands of Japanese trap hauls

3 Catch per unit effort in kilograms per Japanese trap

4 The CPUEs for Area 14 and 13 were combined prior to 1987

5 Average for the period

6 Not in effect in Areas 14 and 13 until 1986

7 Including special allocations

Area 13. In 1998, the TAC was raised by 5 t and 29.6 t in areas 15 and 14 respectively so that a trap survey could be conducted at the end of the fishing season (Table 3). Temporary allocations of 24 t were allotted to non-crabbers in each of these areas. The TAC was reduced by 10% in Area 13 in 1998, and no temporary allocations were granted. Judging from the balance of quotas remaining in early December 1998, cumulative catches were nearing the TAC in all areas.

#### *State of the resource in 1998*

In Area 15, the CPUE declined slightly, from 19.2 kg/Japanese trap in 1997 to 18.6 kg/Japanese trap in 1998, continuing the trend which began in 1996 (Table 3). Conversely, the CPUE rose in Areas 14 and 13, after two to three years of decline: it moved from 10.7 to 11.2 kg/Japanese trap in Area 14 and from 4.3 to 6.5 kg/Japanese trap in Area 13. However, the trap soak time increased substantially in areas 14 and 13, and more than 50% of traps were fished for three or more days in 1998, compared with about 35% of traps in 1997. The longer soak times resulted in higher trap yields. Intermediate-shell specimens (condition 3) dominated catches at sea, while new crabs (conditions 1 and 2), which had shown a sharp downturn in areas 15, 14 and 13 since 1996, were barely represented in catches in 1998. The proportion of old crabs (conditions 4 and 5) in catches at sea was relatively low, about 12%, which worked out to a decline in Area 15, an increase in Area 14 and no change in Area 13, compared to 1997.

The average CW of legal-size crabs sampled at sea and those landed in Area 15 has increased steadily since 1992 and reached 112 and 115 mm in 1998 respectively. In Area 13, average CW stabilized at about 103 mm (at sea and dockside) in 1998. Sampling at sea and dockside in Area 14 in

1998 revealed a marked decrease in the average CW of legal-size crabs, which went from 105 mm (1997) to 102 mm at sea and from 110 mm (1997) to 106 mm at dockside. In 1998, new crabs were larger than old crabs in areas 14 and 13. In Area 15, there was no size difference between new crabs and old crabs. The proportion of adolescents of 78–95 mm CW (which will reach legal size upon their next moult) was low, about 2%, which is equal or close to the record low, in all three areas.

**A trap survey was conducted for the first time in 1998 in Area 15 and for the second time since 1996 in Area 14** (Figure 6). In Area 15, the CPUE computed from the survey was 11.5 kg/Japanese trap, which is lower than the CPUE for the fishery in 1998 (18.6 kg/Japanese trap). The proportion of new crabs was only 1.5%, whereas old crabs made up 35% of catches. The average CW of legal-size crabs was approximately 104 mm, which is well below the value observed in the fishery in 1998 (111 mm).

In Area 14, the CPUE computed from the 1998 trap survey was low (4.4 kg/Japanese trap) but slightly higher than that of 1996 (3.5 kg/Japanese trap). New crabs accounted for 8% of the total, which is much lower than in 1996, while old crabs accounted for 26% of catches, up substantially from the 1996 level of 0.2%. The average CW of legal-size crabs in Area 14 was lower in the 1998 survey than in the 1996 one.

In trap catches, the abundance of adolescents of 78–95 mm CW was very low in areas 15 and 14. However, a few small-mesh traps were used in Area 14 in 1998, and these showed that the 1991 and 1992 year-classes were quite strong. The results of trawl surveys conducted in areas 14 and 13 in 1994–95 also showed that the 1991–92 year-classes were strong.

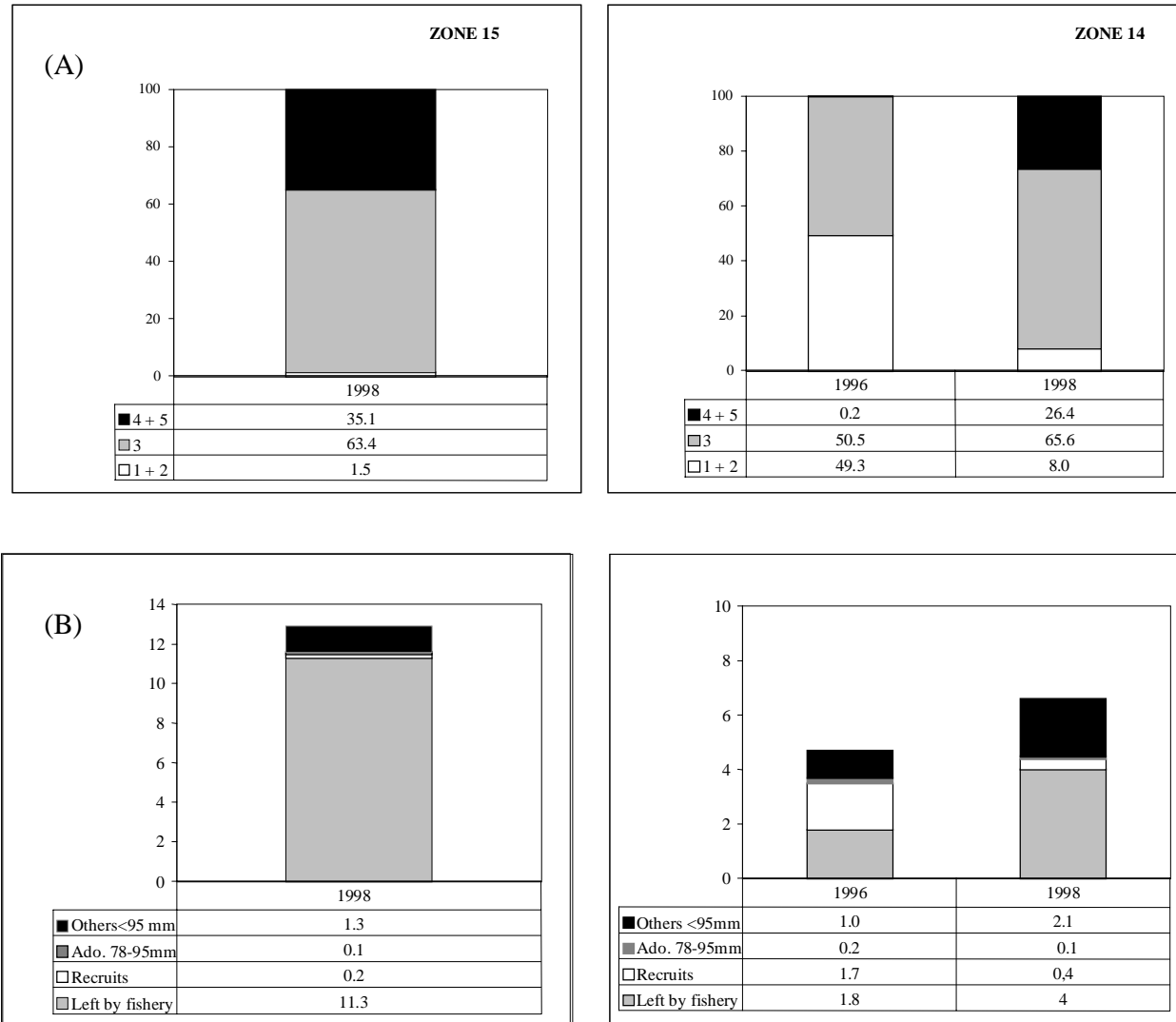


Figure 6. Results of trap surveys conducted in areas 15 and 14 in 1998 and 1996. (A) Shell condition (%) of legal-size crabs and (B) Yields (kg/trap) of the different groups of males.

Outlook for 1999

Area 15

Most indicators of current stock status are negative and show that the abundance and biomass of legal-size crabs have continued to decline. Nonetheless, the CPUE remains high compared to that for the areas farther east. Since most indicators of future population status are also negative in the short term, recruitment to the population is likely to be poor in 1999 and the biomass

will continue to decline. Based on the high percentage of old crabs observed in the post-season trap survey, the exploitation rate appears not to be very high in this area. In view of the fairly high CPUE and the seemingly low exploitation rate, it is recommended that catches be maintained at the same level as in 1998.

Area 14

The CPUE derived from the commercial fishery edged up, hinting at a slight increase

in biomass. However, the fishery began three weeks earlier than in 1997 and the trap soak time was longer, a situation which could explain the higher CPUE in 1998. Although the CPUE based on the post-season trap survey is up moderately from 1996, it remains low, and the marked decrease in pre-recruit abundance and in the percentage of new crabs indicates that recruitment has declined sharply. New crabs caught at sea are larger than old crabs, indicating that the population at the end of a recruitment wave.

Recruitment in 1999 will probably be very low and the biomass will decline during fall 1998 and winter 1999, owing to natural mortality (senescence) among the smallest adult males of legal size. Based on the post-season trap survey conducted by fishers in 1998, the 1991 and 1992 year-classes are strong, a situation foreseen by the trawl surveys of 1994-95. In light of this data, recruitment can be expected to recover in 2000 and 2001.

According to the 1994-1995 trawl surveys as well, the abundance of adult females has peaked, whereas the abundance of adult males is probably in decline. This situation raises concern about reproductive potential. Since the proportion of old crabs in the post-season survey and in the fishery was lower in Area 14 than in areas 15 and 16, the exploitation rate was probably higher in Area 14. *Given the low recruitment and the concerns about the spawning stock's status, it is recommended that catches be reduced in 1999. However, in view of the short duration and incomplete nature of the data series from the post-season trap surveys, we cannot determine the level of reduction that would be appropriate.*

#### Area 13

The CPUE for the commercial fishery rose, suggesting that the biomass has increased on the fishing grounds. Nonetheless, the fishery

began six weeks earlier than in 1997, and trap soak time was much greater than usual, a situation which could explain the higher CPUE in 1998. The steep drop in abundance of pre-recruits and in the percentage of new crabs point to a marked decrease in recruitment. The fact that new crabs caught at sea are larger than old crabs indicates that the population is at the end of a recruitment wave.

All indicators of future population status are negative in the short term and point to very low recruitment in 1999, along with a decrease in biomass during fall 1998 and winter 1999 due to natural mortality (senescence) among the smallest legal-size adult males. The trawl surveys of 1994 and 1995 showed that the 1991 and 1992 year-classes were strong, a situation that could lead to improved recruitment in 2000 and 2001. Those surveys also suggest that the abundance of adult females has peaked, while the abundance of adult males is likely in decline. This raises concerns about reproductive potential. The percentage of old crabs taken in the fishery is lower than in all other areas, indicating that the exploitation rate is higher than elsewhere. A trap survey would be a more effective way to assess the abundance of old crabs. *All this information combined indicates that there should be a substantial reduction in catches in 1999. However, in the absence of data for the entire population (like that provided by a trap survey), we cannot specify the level of reduction that would be appropriate.*

#### **Environmental context**

Colder water temperatures and the increase in seabed expanse bathed by cold waters have probably helped to extend the range of snow crab and increase the species' abundance since the end of the last decade. Owing to the colder temperatures, however,

the crabs may undergo terminal moult at smaller sizes, causing a decrease in recruitment of legal-size specimens. Natural predators of snow crab, for example cod, are not very abundant, a situation which has reduced natural mortality.

### ***Conservation measures***

1. With recruitment of legal-size crabs increasing over the coming years as the 1988-92 recruitment wave arrives, catches can be expected to contain a larger proportion of adolescent males of legal size. These adolescents should not be landed, since after moulting they attain a much greater size and weight and may help to accelerate and boost recovery of the biomass recovery after a recruitment trough. Harvesting males only after their final moult increases their chances of participating in breeding and may help to maximize yield per recruit.
2. Clearly, if a substantial harvestable biomass is to be preserved or even reconstituted as rapidly as possible, white crab must continue to be protected. This measure has the added benefit of preserving most adolescent males, as they generally moult in the spring.
3. Harvesting of old-shell males may likewise help to dampen the impact of the recruitment trough, while maximizing yield per recruit. Old-shell males will in fact die off naturally within a short time if not caught, whereas clean-shell males may remain available to the fishery for another two or three years, although their appearance and condition will deteriorate. This recommendation will be less important in the following years, because of a marked rejuvenation of the population segment composed of legal-size individuals.
4. Since it is known that older crabs make an important contribution to reproduction and that the abundance patterns of female and male adults are not synchronized, fishery stakeholders should be aware that if TACs are raised in conjunction with the advent of the 1988-92 recruitment wave, they will have to be reduced subsequently to preserve a minimum spawning biomass.

***For more information:***

Dufour, R. and J.-P. Dallaire 1999. Le crabe des neiges de l'estuaire et du nord du Golfe du Saint-Laurent: État des populations de 1995 à 1998. MPO Pêches de l'Atlantique, Document de recherche no 99/19 (in prep.).

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