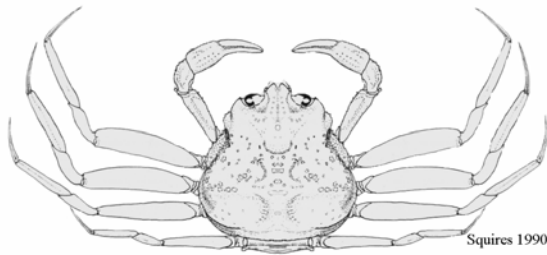


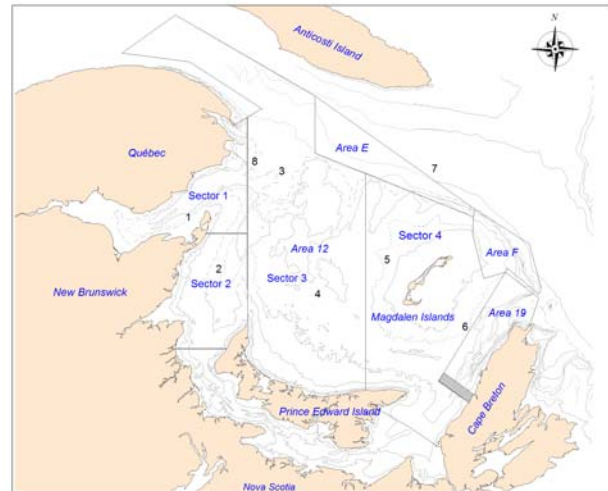


Gulf Region

Canadian Science Advisory Secretariat Science Advisory Report 2005/022



Southern Gulf of St. Lawrence Snow Crab (Areas 12, E and F)



- 1. Baie des Chaleurs 2. Shediac Valley 3. Orphan Bank 4. Bradelle Bank 5. Magdalen Channel 6. Cape Breton Corridor 7. Laurential Channel 8. American Bank

Background

Snow crab (Chionoecetes opilio) is a crustacean like lobster and shrimp, with a flat, almost circular, body and five pairs of spider-like legs. The hard outer shell is periodically shed in a process called moulting. After moulting, crabs have a soft shell for a period of 8 to 10 months. Soft-shelled crab is defined by shell hardness (<68 durometer units). The term "white crab" describes both new-soft and clean hard-shelled crab (conditions 1 and 2, respectively).

Unlike lobsters, snow crabs do not continue to moult throughout their lives. Females stop growing when they acquire a wide abdomen for carrying eggs, which occurs at shell widths less than 95mm. Males stop growing when they acquire large claws on the first pair of legs, which can occur at shell widths between 40 and 150 mm. Females produce eggs that are carried beneath the abdomen for approximately 2 years. The eggs hatch in late spring or early summer and the newly-hatched crab larvae spend 12-15 weeks floating freely in the water column. At the end of this period, they settle on the bottom. It takes at least 8-9 years for males to reach legal size.

Until 1997, the snow crab fishery in Area 12 has been exploited by 130 mid-shore fishermen from New Brunswick, Quebec and Nova Scotia. Since 1997, the PEI coastal fishery, (Areas 25/26) has been integrated into Area 12 to form one management unit. In 2002, the status of Areas E and F was changed from exploratory to distinct permanent fishing area and, in 2003, Area 18 was integrated to Area 12. For the purpose of this assessment, Area 12 refers to the new management unit. Areas 12, E and F, each has separate management scheme. There is no biological basis for delimitating these management areas.

The minimum legal shell width is 95 mm, and females are not kept by industry. Baited traps, constructed of wire or tubular steel, are used to catch crab, mainly on mud or sand-mud bottoms at temperatures ranging from -0.5 to 4.5°C and depths ranging from 50 to 280m. The fishery takes place in spring and early summer in Areas 12, E and F. Neither soft-shelled nor white crabs are harvested.

Management of these fisheries is based on quotas and effort controls (number of licenses, trap limits and seasons).

## Summary

- Crabs in management Areas 12, E and F are part of a larger biological population, including crabs in Area 19. Any key biological event observed in the southern Gulf of St. Lawrence may have a subsequent impact on the commercial biomass in any given area.

### Area 12

- The 2004 landings in Area 12 were 26,626 t (quota of 26,600 t).
- The fishery indicators were generally good in 2004. CPUE increased from 50.0 kilograms per trap haul (kg/th) in 2003 to 54.9 kg/th in 2004 while the incidence of soft-shelled crab remained low (3.0%).
- The 2004 survey biomass index of commercial-sized crabs was 71,859 t ( $\pm 9\%$ ), 35% higher than the 2003 estimate (53,250 t  $\pm 13\%$ ).
- Eighty percent (80%) of this 2004 survey biomass index is composed of new recruitment (57,809 t  $\pm 9\%$ ).
- The retention rate of the stock has been decreasing since 1999 (less than 40%) indicating a high fishing pressure on the recruitment to the fishery compared to the 1991-1998 period (over 40%).
- The decline in the abundance of prerecruits (R-4, R-3 and R-2) observed in the 2004 trawl survey may be a sign of recruitment decline into the fishery starting in 2006.
- The stock has now reached the peak of recruitment into the commercial biomass and a decline in recruitment is expected after 2005. A high exploitation could accelerate the decline of the commercial biomass index after 2005.
- Using a similar approach as in 2003 (40% of the commercial biomass index observed at the time of the survey), the 2005 quota would be 28,743 t. By using the same exploitation level as 2004 (50% of the commercial biomass index), the 2005 quota would be 35,930 t. A conservative approach is suggested in order to attenuate the rapid decline in

the commercial biomass index after 2005.

- Since the beginning of the trawl survey in 1988, a systematic loss has been observed between the observed biomass index at year (y) and the sum of the remaining biomass index and the landings from the following year (y + 1).
- It is essential to continue an annual trawl survey and a soft-shelled crab protocol to monitor the status of the southern Gulf snow crab stock.

### Areas E and F

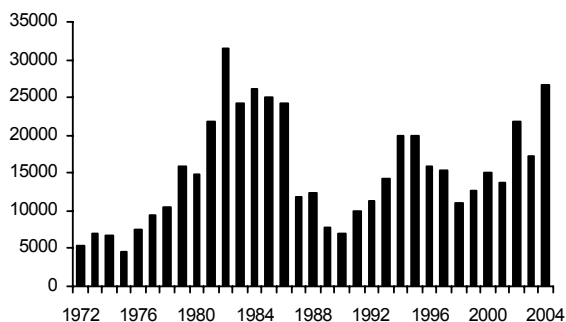
- In Area E, the landings were 349 t (quota of 350 t) and the CPUE was 55.6 kg/th. The 2004 survey biomass index was estimated at 544 t ( $\pm 151\%$ ), a slight increase compared to the 2003 estimate.
- A high exploitation rate could accelerate the decline in commercial biomass index in the near future. In addition, the commercial biomass seems to be significantly influenced by recruitment from Area 12.
- In Area F, landings were 806 t (quota of 808 t). The average CPUE in 2004 (74.8 kg/th) decreased compared to 2003 (78.1 kg/th) but still remained relatively high. The survey biomass index of commercial-sized crabs was estimated at 1,063 t ( $\pm 121\%$ ), a decrease of 46% compared to 2003.
- The absence of prerecruits in this area may contribute to an accelerated decline in the commercial biomass index for the next 3-5 years. A high exploitation rate would accelerate the decline in commercial biomass index in the near future.

## The Fishery

In **Area 12**, the 2004 landings were 26,626 t (quota of 26,600 t). The fishing season began on May 1 and ended July 17. The first landings were reported on May 1. About 75% of the quota was landed during the first five weeks of the fishery compared to 95% for the same period during the 2003 fishing season. Also, in 2004, 11 weeks

were needed to reach the quota compared to 7 weeks for 2003. The fishing effort increased from 338,000 trap hauls in 2003 compared to 485,000 trap hauls in 2004.

Landings (t) in Area 12



In 2004, about 90% of the fishing effort and landings occurred during the first 3-4 weeks of the fishery in Baie des Chaleurs and Shediac Valley (sectors 1 and 2) compared to 7-8 weeks in sectors 3 and 4. Local depletion of large adult males before the mating season could impact the success of multiparous mating that occurs in late May-early June. The importance of the reproductive potential of the stock from Baie des Chaleurs and Shediac Valley is unknown but given the fact that most of the adult males  $\geq 95$  mm CW have been fished in a period of 3-4 weeks since 2000, it would be prudent to leave enough commercial-sized males prior to the multiparous mating in order to permit these males to participate in mating. At the beginning of the 2004 fishing season, the fishery in Baie des Chaleurs and Shediac Valley was delayed for the first two weeks for conservative measures.

In 2004, landings for Areas E and F were 349 t and 806 t (quotas of 350 t and 808 t), respectively. The fishing season in Area E began on April 30 and ended July 17, while in Area F it began April 24 to end July 17. The fishing effort in Area E increased from 5,471 trap hauls in 2003 compared to 6,277 trap hauls in 2004 while in Area F, the fishing effort slightly increased from 10,460 trap hauls in 2003 to 10,775 trap hauls in 2004.

Quota (t), Landings (t), Fishing Effort (# of trap hauls) and Catch Performance in Area 12

	2000	2001	2002	2003	2004
Quota	15,500	13,819	22,000	17,148	26,600
Landings	15,046	13,819	21,869	16,898	26,626
CPUE	34.5	42.3	40.2	50.0	54.9
Effort	436,782	326,382	544,454	337,960	484,991
Mean size (mm)	109.1	112.2	109.0	110.4	110.4
Soft crab (%) in catches	12.5	6.2	4.6	3.3	3.0

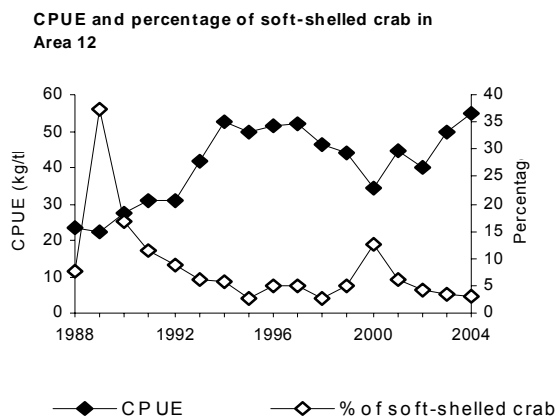
Quota (t), Landings (t), Fishing Effort (# of trap hauls) and Catch Performance in Area E

	2000	2001	2002	2003	2004
Quota	163	163	163	350	350
Landings	150	155	165	345	349
CPUE	22.9	23.2	56.6	63.1	55.6
Effort	6,528	6,700	2,916	5,471	6,277
Mean size (mm)	105.8	106.1	107.2	108.8	110.8
Soft crab (%) in catches	8.3	0.7	0.3	1.2	1.5

Quota (t), Landings (t), Fishing Effort (# of trap hauls) and Catch Performance in Area F

	2000	2001	2002	2003	2004
Quota	288	377	378	808	808
Landings	291	378	378	817	806
CPUE	56.7	63.0	85.2	78.1	74.8
Effort	5,136	5,736	4,437	10,460	10,775
Mean size (mm)	107.9	108.7	109.3	111.0	112.1
Soft crab (%) in catches	2.4	1.3	0.5	0.4	0.6

**Catch rates (CPUE)** are calculated from logbooks and must be viewed with caution because (1) CPUE is affected by many factors (socio-economic, soak time, trap type and size, type of bait, mesh size, weather, and the abundance of hard-shelled adult males), (2) the soft-shelled crab protocol may have an impact on the fishing performance. In Area 12, the mean CPUE increased from 50.0 kilograms per trap haul (kg/th) in 2003 to 54.9 kg/th in 2004. Area E showed a decrease in 2004 (55.6 kg/th) compared to 2003 (63.1 kg/th) while in Area F, the mean CPUE decreased in 2004 (74.8 kg/th) compared to 2003 (78.1 kg/th).



The **percentage of soft-shelled crabs** and the **mean size of commercial-sized crabs** are calculated using data gathered from the at-sea observer program. In Area 12, the percentage of soft-shelled crab has been decreasing since 2001 and remained low (3.0 %).

The discard mortality of soft-shelled crabs increased from 172,000 crabs in 2003 to 237,000 crabs in 2004. The percentage of soft-shelled crabs in Areas E and F remained low in 2004 (1.5% and 0.6%, respectively). It is important to note that the incidence of soft-shelled crab is strongly influenced by the fishing strategy used by fishermen during the season.

In Area 12, the **mean size of commercial-sized crabs** has remained unchanged at 110.4 mm of carapace width (CW) from 2003 to 2004. In Areas E and F, the mean size of commercial-sized crabs had been decreasing from 1998 to 2000 but has increased since 2001. In 2004, the mean size of commercial-sized crabs was 110.8 mm CW in Area E and 112.1 mm CW in Area F.

**Carapace condition** was estimated from sea samples taken during the 2004 fishery. Crabs with carapace condition 3 comprised the bulk of the landings in all areas.

Composition (%) of the Catch of Commercial-Sized Adult Crabs by Carapace Condition

Condition	Description	12	E	F
1-2	White crab	3.4	0.3	1.7
3	Intermediate	86.7	95.0	87.1
4	Old crab	9.2	4.1	10.7
5	Very old crab	0.7	0.6	0.4

## Resource Status

A change in the survey vessels used to conduct the trawl survey in Areas 12, E and F occurred from 1990 to 1998 (Emy-Serge D.), from 1999 to 2002 (Den C. Martin) and since 2003 (Marco-Michel). An increase in the sampling area since 1998 resulted in an underestimation of the commercial biomass index prior to this date. Therefore, estimated exploitation rates prior to 1998 should be re-adjusted to lower values so as to compare the levels of exploitation for the time series.

Stock status is primarily based on a post-fishing season trawl survey, which provides an index of the remaining portion of the exploitable biomass (hard-shelled adult males of legal size) immediately after the fishery. It also provides estimates of soft-shelled adult males larger than 95 mm CW (R-1) that will be new recruits to the fishery the following fishing season. Abundance indices are estimated for males as future recruitment to the fishery (R-4, R-3 and R-2) and females (pubescent and mature) as future and current spawning stock abundance. The terms R-4, R-3 and R-2 represent male crabs with a carapace width range of 56-68, 69-83, and larger than 83 mm CW, respectively. A portion of these crabs could be available to the fishery in 4, 3 and 2 years, respectively. The term pubescent refers to females with a narrow abdomen and orange gonads that will molt to maturity and mate the following year and become primiparous females (first brood). The term multiparous refers to females which are carrying a brood for the second time or more. The term mature female, also known as spawning stock, includes primiparous and multiparous females (excluding senile females). Abundance

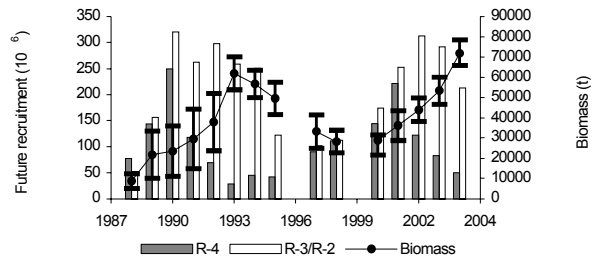
index of total adolescent males larger than 56 mm CW (R-4, R-3 and R-2 combined) is also estimated and used as an index of the incidence of soft-shelled crabs that may enter commercial traps the following fishing season.

Area 12:

The **2004 survey biomass index** in Area 12 was estimated at 71,859 t ( $\pm 9\%$ ), which is 35% higher than the 2003 estimate (53,250 t  $\pm 13\%$ ). The 2004 survey biomass index is composed of 80% of new recruitment R-1 (57,809 t  $\pm 9\%$ ). The main concentrations of the commercial biomass were located in the middle and southern parts of Area 12, including Bradelle bank and the northern and southern parts of Magdalen Channel.

The abundance of **prerecruits** R-4 has increased since 1995 to reach 221 million crabs in 2001. Since 2001, the abundance of R-4 decreased to reach 50 million individuals in 2004. The abundance of R-3 had increased from 39 million crabs in 1995 to 163 million crabs in 2002 and decreased since then to reach 79 million crabs in 2004. The abundance of R-2 increased from 46 million in 1998 to 149 million in 2002 but decreased in 2003 and 2004 to 144 and 134 million crabs, respectively. The abundance and distribution of prerecruits R-4, R-3 and R-2 may result in high incidences of soft-shelled crabs in the catches depending on the proportion of hard-shelled and soft-shelled crabs on the fishing ground and the timing of the fishery. Management measures, such as a comprehensive soft-shelled crab protocol, are necessary to protect the soft-shelled crabs (the future recruitment to the fishery). The main concentrations of these prerecruits in 2004 were located on Bradelle and Orphan banks, in Shediac Valley and in the southern part of Area 12.

Survey biomass index (t) with a 95% confidence interval and abundance indices of future recruitment in Area 12

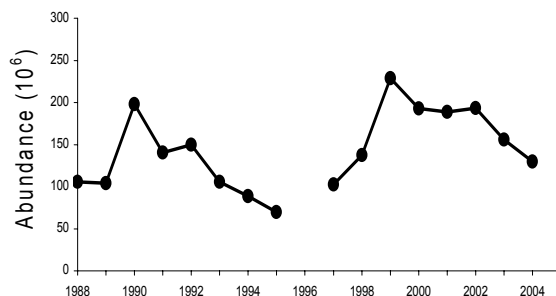


\* An increase in the sampling area since 1998 resulted in an underestimation of the commercial biomass index prior to this date.

**Size frequency distributions** of male crabs caught in the trawl survey have been available since 1988. The annual growth of small crabs (10 to 56 mm CW) observed in 1998-99 can be seen in subsequent annual surveys. This 1998-99 size cohort has grown to larger size categories and became the main component of the survey biomass index for the 2000 fishing season and is still contributing for the 2005 fishing season. However, a major concern is the scarcity of adolescent crabs smaller than 56 mm CW observed since 2001 which may result in a decline of the recruitment to the commercial biomass after 2005.

The **abundance of under-sized adult males (< 95 mm CW)** increased from 106 million in 1988 to 198 million in 1990 and has gradually decreased to reach 70 million of individuals in 1995. The abundance of adult males < 95 mm CW increased afterward to reach 228 million in 1999 but gradually decreased since then to reach 130 million in 2004.

Adult males < 95 mm CW



Areas E and F:

Because of the unknown amount of crab movement in and out of these areas within a given year, the projected survey biomass indices have wide confidence intervals and may not reflect the available commercial biomass index at the beginning of the fishery. In both areas, the crab concentrations are near the boundaries and may be affected by the overflow or reduction of the concentrations from adjacent areas.

In Area E, the **2004 survey biomass index was estimated at 544 t ( $\pm 151\%$ )**, a slight increase compared to 2003 (450 t  $\pm 170\%$ ). The main concentrations were located in the southwestern part of the area. During the current increasing phase of commercial biomass observed in Area 12, the geographical distribution of adult males  $\geq 95$  mm CW has been shifting from the northern to the southern part of the area, which may reduce the overflow of these crabs into Area E. Also, the relative abundance and geographic distribution of prerecruits  $\geq 56$  mm CW in the southern Gulf have been decreasing and retracting toward the central part of Area 12, which may affect negatively the recruitment to the fishery and commercial biomass indices in the near future.

In Area F, the **2004 survey biomass index of 1,063 t ( $\pm 121\%$ )** represents a decrease of 46% compared to the 2003 estimate (1,970 t  $\pm 70\%$ ). The main concentrations observed in the trawl survey are located in the northern and southeastern part of the zone adjacent to Areas 12 and 19. The scarcity of adolescent males  $\geq 56$  mm CW may indicate that the recruitment to the fishery will decrease for the next 3-5 years. In addition, the prerecruits  $\geq 56$  mm CW in the southern Gulf have been decreasing and retracting to the center of Area 12, which may affect the availability of crabs in Area F.

**Survey Biomass Index (t) Including Very Old Crabs in the Southern Gulf of St. Lawrence (with 95 % Confidence Intervals)**

Survey Year	12	E	F
1989	21,700 ( $\pm 53\%$ )	-	-
1990	23,400 ( $\pm 53\%$ )	-	-
1991	29,400 ( $\pm 50\%$ )	-	-
1992	37,800 ( $\pm 38\%$ )	-	-
1993	62,000 ( $\pm 13\%$ )	-	-
1994	56,700 ( $\pm 12\%$ )	-	-
1995	49,500 ( $\pm 16\%$ )	-	-
1996 <sup>1</sup>	-	-	-
1997	33,000 ( $\pm 25\%$ )	1,460 (56%)	510 (65%)
1998	28,200 ( $\pm 20\%$ )	220 ( $\pm 125\%$ )	900 ( $\pm 99\%$ )
1999 <sup>2</sup>	-	-	-
2000	28,900 ( $\pm 19\%$ )	160 ( $\pm 401\%$ )	1,510 ( $\pm 57\%$ )
2001	36,100 ( $\pm 20\%$ )	330 ( $\pm 205\%$ )	2,430 ( $\pm 59\%$ )
2002	43,840 ( $\pm 13\%$ )	720 ( $\pm 91\%$ )	2,690 ( $\pm 55\%$ )
2003	53,250 ( $\pm 13\%$ )	450 ( $\pm 170\%$ )	1,970 ( $\pm 70\%$ )
2004	71,900 ( $\pm 9\%$ )	540 ( $\pm 151\%$ )	1,060 ( $\pm 121\%$ )

<sup>1</sup> no survey in Area 12 in 1996.

<sup>2</sup> not reliable due to the incapacity to estimate the swept surface.

Reproduction:

The abundance, mean size and fecundity of the spawning stock and female-male ratio were studied to provide indications on **the reproductive potential of the stock** in the southern Gulf of St. Lawrence.

Since 1988, two periods (1989-1992 and 1999-2002) of high **spawning stock** abundance were observed in the trawl surveys. The results showed that the abundance of spawning stock during the

second period decreased by 35% compared to the abundance of the first period.

Regarding **female abundances**, high concentrations of pubescent females were observed in the northeastern and southeastern parts of Area 12, mostly on American bank and in the Cape Breton Corridor. Observed concentrations of primiparous females have reduced since 2001. The annual mean size of primiparous females has been increasing since 1997 to reach 62.8 mm CW in 2004. The main concentrations of multiparous females were located mostly on Bradelle bank, in Shediac Valley, Baie des Chaleurs, and in the Magdalen Channel. Their annual mean size has been increasing since 2000 to reach 57.9 mm CW in 2004.

### Sources of Uncertainty

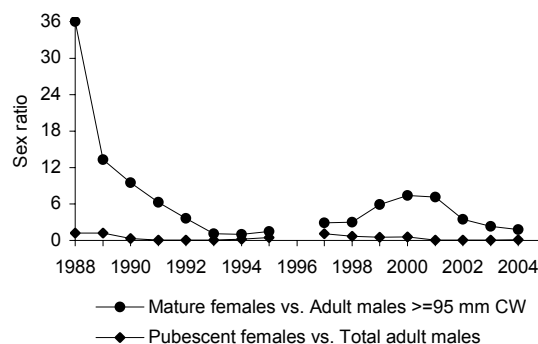
Since the beginning of the trawl survey in 1988, a systematic loss (migration and natural mortality) has been observed between the observed commercial biomass index at year ( $y$ ), and the sum of the remaining biomass index and the landings from the following year ( $y + 1$ ). By taking into account the loss of adult males  $\geq 95$  mm CW of 20.8% between the time of the survey and the following fishing season, the available commercial biomass index for the 2005 fishery was estimated at 56,912 t  $\pm$  9%.

The commercial biomass estimates prior to 1998 are considered underestimated compared to recent estimates. Consequently, the exploitation rates since 1999 are considered to be much higher compared to the period from 1990 to 1998.

A **female-male ratio** can be estimated by comparing the abundance of female to male categories. For Area 12, the global ratio between the mature females (F) and the adult males (M)  $\geq 95$  mm CW varied from 36-6.3F:1M for the first period (1989-1992) but was around 7.4-3F:1M for the second period (1999-2002). For 2004, the global ratio was 1.8F:1M. The global ratio

between the pubescent females and the total adult males (commercial-sized and under-sized) was 0.1F:1M for 2004.

Female-male ratio in the southern Gulf of St. Lawrence



The female-male ratio was also estimated per sector (sectors 1 to 4). The ratios for the multiparous mating in sectors 1 and 2 were at much higher levels than those observed in sectors 3 and 4, which may be an indicator of local overexploitation in these sectors. Although the 2004 trawl survey indicated an increase in the commercial biomass index to 71,859 t, there are lower abundances of commercial-sized adult males in sectors 1 and 2.

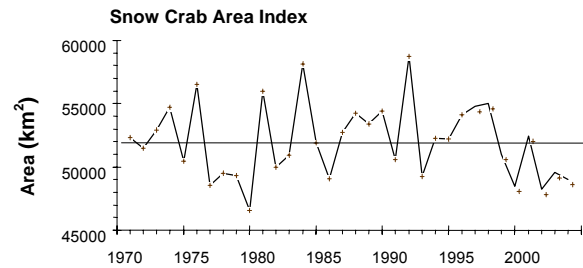
The optimal sex ratio to sustain the future recruitment to the population is unknown but the depletion of large adult males before the mating season could negatively affect the reproductive output of the stock in the long term.

The high abundances of adult males  $< 95$  mm CW observed in the trawl surveys since 2000 may have been the result of high exploitation rates triggering adolescent males to reach the terminal molt below the commercial size. Heavy harvest of larger-sized adult males of the population may lead the adolescent males to molt to adult phase below the commercial size since they do not have to compete with larger-sized adult males in reproductive activities. The contribution of the adult males  $< 95$  mm CW in the reproduction may lead to a shift in size structure of the population in the long term.

## ***Ecosystem Considerations***

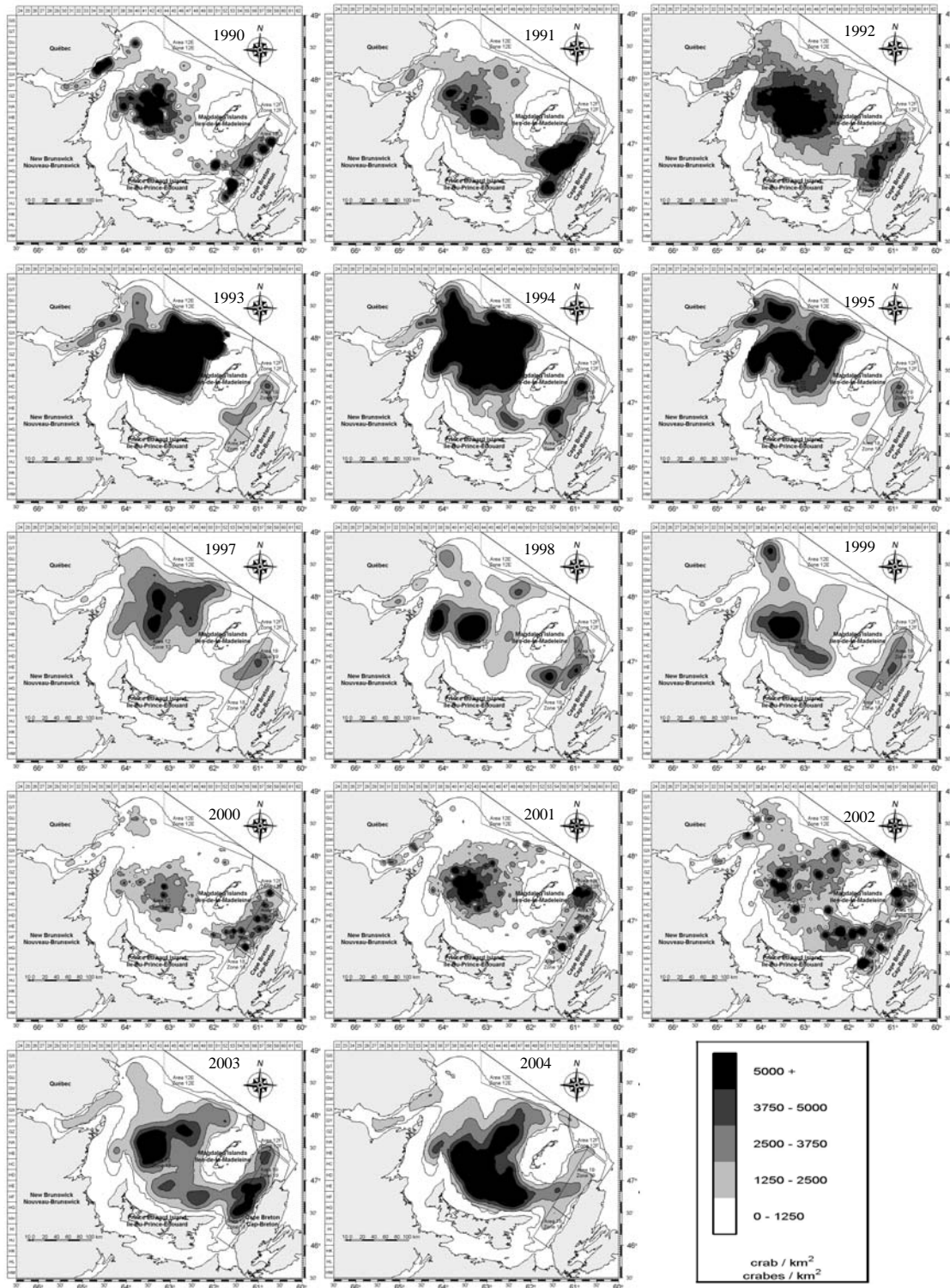
Environmental factors, such as water temperature, can affect the growth and reproductive dynamics as well as the movement of crab. Chassé et al. (2005) reported that the bottom temperatures over a stripe extending from Baie des Chaleurs to Western Cape Breton on the Magdalen Shallows, were below (colder) the long-term (1971-2000) average while the shallower parts along the coasts and deeper parts along the Laurentian Channel exhibit warmer than normal conditions. The habitat index decreased compared to 2003 and is also below the long-term average.

The abundances of predatory groundfish remain low which is considered favorable for the snow crab population.

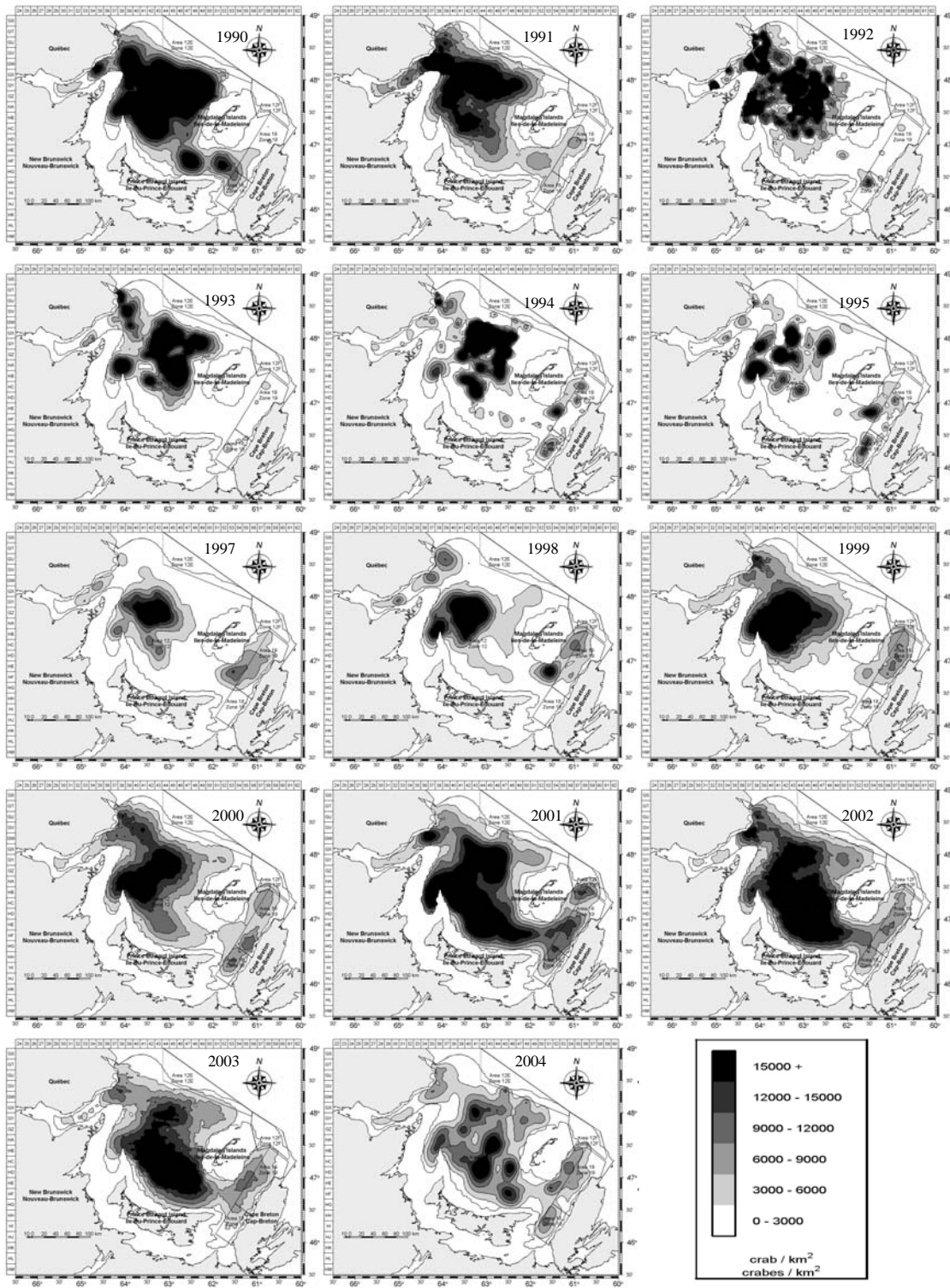




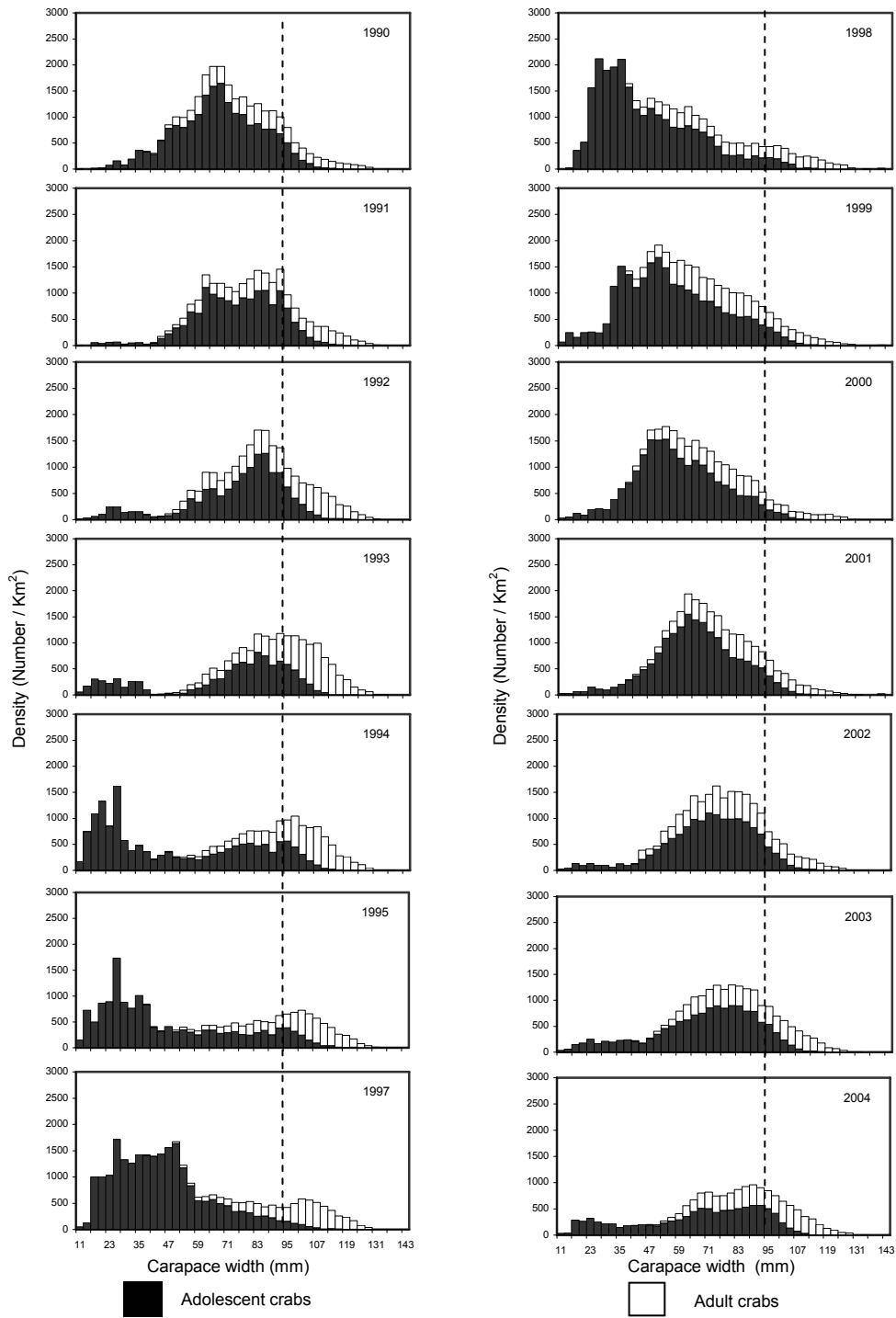
Density (crabs per km<sup>2</sup>) Contours of Adult Male Crab ≥95 mm CW based on the Trawl Survey between 1990 and 2004 in the Southern Gulf of St. Lawrence



Density (crabs per km<sup>2</sup>) Contours of Adolescent Male Crab ≥56 mm CW based on the Trawl Survey between 1990 and 2004 in the Southern Gulf of St. Lawrence



Size Frequency Distributions (number per km<sup>2</sup>) of Male Crab Sampled during the Trawl Survey in Area 12 after the Fishing Season



## **Outlook**

The stock status for Area 12 is generally positive in the short term. The mean annual CPUE, low incidence of soft-shelled males and the mean size of commercial-sized adult crabs in commercial catches indicate that the fishery performance was good in 2004. The 2004 survey commercial biomass index was estimated at 71,859 t. This index is composed of new recruitment (80%) and residual biomass of the 2004 fishery (20%) while the biomass of very old crabs is very low. The Area 12 snow crab population has now entered a phase of declining recruitment. The abundance of prerecruits has been declining since 2001 for R-4 and since 2002 for R-3 and R-2. Crabs smaller than 56 mm CW (R-5 and earlier prerecruits) were in very low abundance in the 2004 trawl survey.

The fishery indicators in Area E were generally positive in 2004. The CPUE decreased compared to 2003 but remained relatively high. The mean size of commercial-sized adult crabs in commercial catches increased while the percentage of soft-shelled crabs was low during the 2004 fishing season. The commercial biomass and recruitment indices estimated from the trawl survey increased slightly in 2004. During the current increasing phase of commercial biomass observed in Area 12, the geographical distribution of adult males  $\geq 95$  mm CW has been shifting from the northern to the southern part of the area, which may reduce the overflow of these crabs into Area E. Also, the relative abundance of prerecruits  $\geq 56$  mm CW in the southern Gulf have been decreasing and retracting in the central part of Area 12, which may affect negatively the recruitment to the fishery and commercial biomass indices in the near future. This fishery depends totally on stock condition in Area 12.

The fishery indicators for Area F were generally positive in 2004. The mean annual CPUE was still high and the

percentage of soft-shelled crab was low in 2004. The mean size of commercial-sized adult crabs in the commercial catches increased compared to 2003. However, the commercial biomass index is decreasing and the absence of prerecruits to support this zone may contribute to an accelerated decline of commercial biomass in the near future. This fishery is highly dependent on Areas 12 and 19 biomass conditions.

## **Biological Considerations**

Close monitoring of the key events on population reproductive output (e.g., fecundity, recruitment to the early benthic stages) is necessary to detect any anomalies on the quality and quantity of the spawning stock and subsequent recruitment.

## **Management Considerations**

A long term harvesting strategy should be developed. The stock has now reached the peak of recruitment into the commercial biomass and a decline in recruitment is expected afterward. A high exploitation level could accelerate the decline of the commercial biomass after 2005. Moreover, it would dampen the accumulation of larger-sized adult males of carapace conditions 3 and 4. Since 2000, the percentage of adult males  $\geq 95$  mm CW with a carapace condition 3 in catches from the sea samples increased from 64.4% in 2000 to 86.7% in 2004 while the percentage of these crabs with carapace conditions 4 and 5 decreased from 24.1% to 9.9% during the same period. Even with an increasing phase of recruitment to the fishery from 2000 to 2004, the 50% target exploitation level used in Area 12 since 2000 (except in 2003 when it was 40%) did not result in an increased percentage of adult crabs with carapace conditions 4 and 5 in the catches.

Retention rate in Area 12



Since 2000, this fishery is strongly dependent on the recruitment level each year (a recruitment fishery). This is well supported by the low residual biomass of commercial-sized males from 2000 to 2004 compared to the previous increasing phase of recruitment to the fishery during the 1990 to 1995 period. The retention rate (ratio of commercial biomass index at year  $y + 1$  / residual commercial biomass index at year  $y$ ) of commercial-sized adult males indicate a very low accumulation of commercial biomass (less than 15%) from 1988 to 1990 when the fishery reached their lowest landings due to a high fishing pressure on the stock. From 1991 to 1998, the retention rates of commercial adult males were over 40% using a target exploitation rate that varied between 32 and 40% of the commercial biomass estimates at that time. Since 1999, the retention rates of commercial biomass were lower than 40% using a target exploitation rate of 50% (except in 2003 where exploitation was targeted at 40%). This would indicate a high fishing pressure on the recruitment to the fishery in recent years. The 32 and 40% exploitation rates used from 1991 to 1998 may not reflect the reality since the commercial biomass estimates for that period are considered underestimated.

Using a similar approach as in 2003 (40% of the commercial index observed at the time of the survey), the 2005 quota would be 28,743 t. By using the same exploitation

level as 2004 (50% of the commercial biomass index), the 2005 quota would be 35,930 t. The 35,930 t quota would dampen the accumulation in incidence of carapace conditions 4 and 5 as observed from 2000 to 2004 in commercial catches. A conservative approach is suggested in order to attenuate a rapid decline of the commercial biomass index after 2005.

In Area E, considering the uncertainties concerning the future recruitment to the fishery, a high exploitation level would accelerate the decline in commercial biomass index in the near future. We consider this area totally dependent on the overflow of harvestable crabs coming from the main fishing ground (Area 12).

In Area F, a high exploitation level could accelerate the decline in commercial biomass index in the near future. It will be difficult to maintain a fixed exploitation level and stabilize the fishery in the long term for this area, as it seems to be influenced by recruitment from the adjacent areas (Areas 12 and 19).

### **Basic Requirements**

To protect the future recruitment to the fishery and the reproductive potential of the stock, management measures, such as a comprehensive soft-shelled protocol, are necessary.

Continuing the trawl survey is essential to provide annual abundance and commercial biomass indices, detect any anomalies in reproductive potential of the stock and estimate the annual loss of commercial-sized crabs between the survey and the following fishing season due to natural mortality, emigration and immigration. The trawl survey is considered as the best tool in assessing the snow crab stock in the southern Gulf of St. Lawrence.

**For more Information**

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