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Gulf Region

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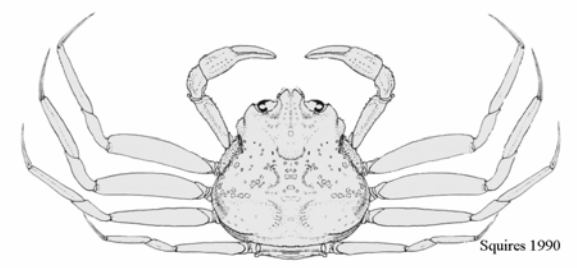
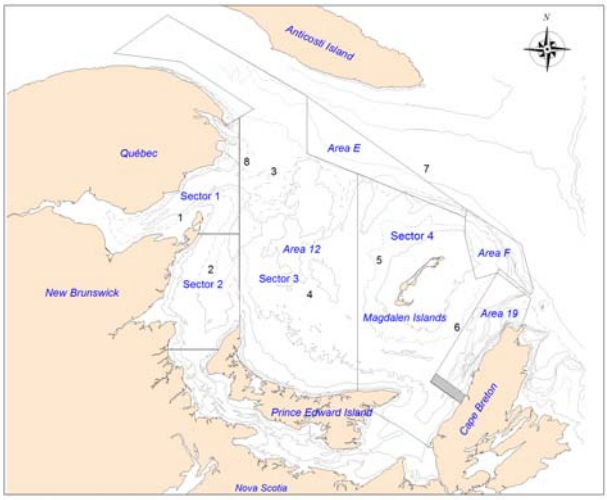


SOUTHERN GULF OF ST. LAWRENCE SNOW CRAB (AREAS 12, E AND F)



1. Baie des Chaleurs
2. Shediac Valley
4. Bradelle Bank
3. Orphan 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 2005 landings in Area 12 were 32,363 t (quota of 32,336 t).
- CPUE's increased from 54.9 kilograms per trap haul (kg/th) in 2004 to 63.7 kg/th in 2005.
- The incidence of soft-shelled crab remained low at 3.9%.
- According to the 2005 soft-shelled crab protocol, two sectors were closed during the 2005 fishing season. Part of the Chaleur Bay was closed on June 7 and another sector which included mostly the mouth of Chaleur Bay and the American Bank was closed on July 5.
- Since 2000, the Chaleur Bay has been closed on four occasions because of high incidences of soft-shelled crabs in catches.
- The 2005 survey biomass index of commercial-sized crabs was 59,606 t (53,920 t – 65,723 t), which represents a decrease of 17% compared to the 2004 estimate of 71,859 t (65,697 t – 78,438 t).
- Sixty-nine percent (69%) of the 2005 survey biomass index is composed of new recruitment estimated to be 41,384 t (37,312 t – 45,775 t).
- 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%).
- A decline in the recruitment to the fishery is expected until 2010 because of the decrease in abundance of prerecruits ≥ 56 mm CW (R-4, R-3 and R-2) observed in the 2005 trawl survey.
- Low abundances of males smaller than 56 mm CW (R-5 and younger) were observed in the 2004 and 2005 trawl surveys which may affect the level of recruitment to the fishery after 2010.
- Since 2000, this fishery is more dependent on the annual recruitment to the fishery than on the remaining commercial biomass from one year to the next. The stock is now in a declining phase of recruitment to the fishery until 2010. Continued high fishing pressure on the recruitment to the fishery would accelerate the decline of the commercial biomass index after 2006 and would require even greater conservative management measures in the coming years to address the situation.

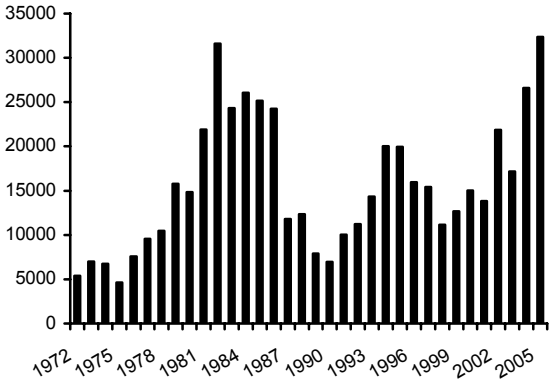
Areas E and F

- Because of the unknown amount of crab movement in and out of these small areas within a given year, the estimates of commercial biomass index in these two areas may not necessarily reflect the biomass at the beginning of the following fishing season. The populations in Areas E and F are not biologically distinct from Area 12 and Area 19. In both areas, the crab concentrations are found near the boundaries and the biomass estimates have large confidence intervals.
- In Area E, the landings were 449 t (quota of 550 t) and the CPUE was 80.6 kg/th. The 2005 survey biomass index was estimated to be 817 t (285 t – 1,863 t), a 50% increase compared to the 2004 estimate.
- In Area F, landings were 479 t (quota of 480 t). The average CPUE in 2005 (93.7 kg/th) increased compared to 2004 (74.8 kg/th). The 2005 survey biomass index of commercial-sized crabs was estimated to be 1,629 t (1,000 t – 2,512 t), a 53% increase compared to 2004.
- In both areas, a high exploitation rate could accelerate the decline in commercial biomass indices in the near future as stock dynamics seem to be influenced by recruitment from adjacent areas (Areas 12 and 19).

The Fishery

The 2005 fishing season opened on April 30 and closed on July 16 with reported landings of 32,363 t (quota of 32,336t). About 75% of the total landings were caught during the first five weeks of the fishery, which is comparable to 2004 (quota of 26,600 t), even though the quota was higher in 2005. It took 11 weeks to catch the quota in 2005, the same as the 2004 fishery.

Landings (t) in Area 12



In accordance with the 2005 soft-shelled crab protocol, the Chaleur Bay sector was closed on June 7 (incidence of soft-shelled males of 27.8% at closure time) and another sector which included mostly the mouth of Chaleur Bay and the American Bank was closed on July 5 (29.6% at closure time). The fishing effort also increased from 484,991 to 508,053 trap hauls from 2004 to 2005.

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

	2001	2002	2003	2004	2005
Quota	13,819	22,000	17,148	26,600	32,336
Landings	13,819	21,869	16,898	26,626	32,363
CPUE	42.3	40.2	50.0	54.9	63.7
Effort	326,382	544,454	337,960	484,991	508,053
Mean size (mm)	112.2	109.0	110.4	110.4	111.8
Soft crab (%) in catches	6.2	4.6	3.3	3.0	3.9

In 2005, landings for Areas E and F were 449 t and 479 t (quotas of 450 t and 480 t), respectively. The fishing season in Area E began on April 30 and ended July 16, while in Area F, it began April 28 and ended July 16. The fishing effort in Area E decreased from 6,277 trap hauls in 2004 to 5,571 trap hauls in 2005 although the quota was increased from 350 t to 450 t. In Area F, the fishing effort decreased more than 50% from 10,775 trap hauls in 2004 to 5,112 trap hauls in 2005. The quota in Area F decreased from 808 t in 2004 to 450 t in 2005.

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

	2001	2002	2003	2004	2005
Quota	163	163	350	350	450
Landings	155	165	345	349	449
CPUE	23.2	56.6	63.1	55.6	80.6
Effort	6,700	2,916	5,471	6,277	5,571
Mean size (mm)	106.1	107.2	108.8	110.8	112.7
Soft crab (%) in catches	0.7	0.3	1.2	1.5	2.9

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

	2001	2002	2003	2004	2005
Quota	377	378	808	808	480
Landings	378	378	817	806	479
CPUE	63.0	85.2	78.1	74.8	93.7
Effort	5,736	4,437	10,460	10,775	5,112
Mean size (mm)	108.7	109.3	111.0	112.1	113.6
Soft crab (%) in catches	1.3	0.5	0.4	0.6	0.8

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.

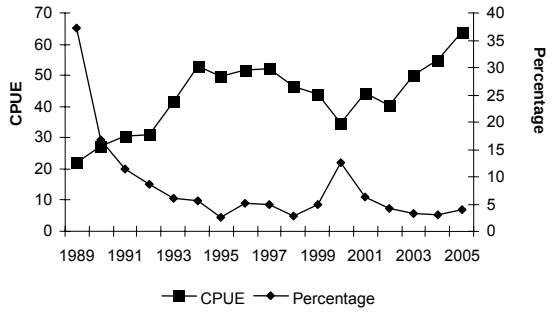
In Area 12, the mean CPUE increased from 54.9 kg/th in 2004, to 63.7 kg/th in 2005. Area E showed an increase in 2005 (80.6 kg/th) compared to 2004 (55.6 kg/th), as well as Area F where the mean CPUE rose

in 2005 (93.7 kg/th) compared to 2004 (74.8 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 at 3.9 % in 2005. The discard mortality of soft-shelled crabs increased from 237,000 crabs in 2004 to 391,559 crabs in 2005.

CPUE and percentage of soft-shelled crab in Area 12



Management measures, such as a comprehensive soft-shelled crab protocol, are implemented to protect the soft-shelled crabs (the future recruitment to the fishery).

The percentage of soft-shelled crabs in Areas E and F remained low in 2005 (2.9% and 0.8%, respectively). It is important to note that the incidence of soft-shelled crab in catches is strongly influenced by the fishing strategy used by fishermen during the season, as well as by their abundance in the area.

In Area 12, the **mean size of commercial-sized crabs** has increased from 110.4 mm of carapace width (CW) in 2004 to 111.8 mm CW in 2005. 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 2005, the mean size of commercial-sized crabs was 112.7 mm CW in Area E and 113.6 mm CW in Area F.

Carapace condition was estimated from sea samples taken during the 2005 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 for Area 12

Condition	Description	2000	2001	2002	2003	2004	2005
1 & 2	White Crab	11.5	6.0	4.7	3.7	3.4	4.4
3	Intermediate	64.4	82.7	86.4	87.6	86.7	89.6
4	Old Crab	19.3	9.5	8.2	8.1	9.2	5.5
5	Very Old Crab	4.8	1.8	0.7	0.6	0.7	0.5
Total		100	100	100	100	100	100

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

Condition	Description	2000	2001	2002	2003	2004	2005
1 & 2	White Crab	4.3	0.9	0.7	2.6	0.3	1.9
3	Intermediate	77.1	84.8	91.7	92.0	95.0	95.1
4	Old Crab	13.9	12.8	7.1	5.3	4.1	2.4
5	Very Old Crab	4.7	1.5	0.5	0.1	0.6	0.6
Total		100	100	100	100	100	100

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

Condition	Description	2000	2001	2002	2003	2004	2005
1 & 2	White Crab	6.5	1.7	14.7	0.8	1.7	3.0
3	Intermediate	84.4	87.8	79.8	92.2	87.1	89.6
4	Old Crab	8.1	10.0	5.4	6.5	10.7	7.1
5	Very Old Crab	1.0	0.5	0.1	0.5	0.5	0.3
Total		100	100	100	100	100	100

Resource Status

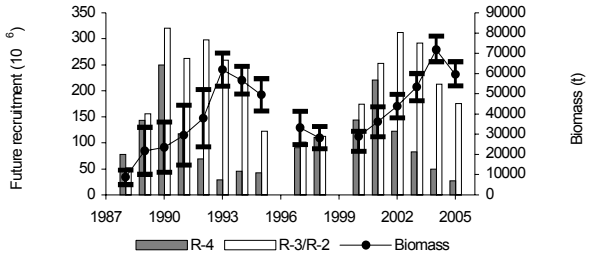
Conclusions about stock status are primarily based on a trawl survey conducted from July to September, which provides an index of the size of the exploitable biomass (hard-shelled adult males of legal size) remaining immediately after the fishery. It also provides estimates of soft-shelled adult males 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', includes primiparous and multiparous females (excluding senile females). An 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 2005 trawl survey provides a commercial biomass index at the time of the survey of 59,606 t (53,920 t – 65,723 t), which represents a decrease of 17% compared to the 2004 trawl survey estimate of 71,859 t (65,697 t – 78,438 t). The recruitment to the fishery at the time of the survey was estimated to be 41,384 t (37,312 t – 45,775 t) comprising 69% of the commercial biomass index. This recruitment to the fishery declined by 28% compared to the 2004 estimates of 57,809 t (52,629 t – 63,356 t). Comparing survey estimates in the previous year to the present year, and accounting for reported landings, the unaccounted loss of commercial-sized adult males was estimated to be 32.5% for the period 2004-2005, 20.6% for 2001-2005 and 28.4% for 1988-2005. This loss of commercial-sized males could be attributable in large part to natural mortality, non-reported landings, and emigration. There is also a proportion of hard-shelled adolescent males of commercial-size taken by the fishery, and is required to be factored into the calculation of the overall loss.

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



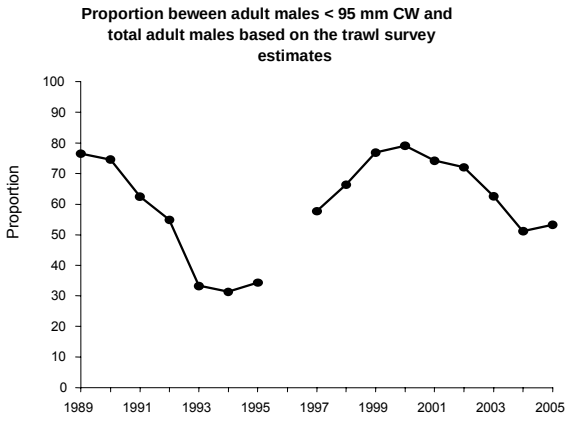
* An increase in the sampling area since 1998 resulted in an underestimation of the commercial biomass index prior to this date.

A decline in the recruitment to the fishery is expected until 2010, because of the declining trend in abundances of adolescent males (sizes R-4, R-3, and R-2) observed in the trawl surveys since 2001. In addition, low abundances of males smaller than 56 mm CW (R-5 and younger) were observed in the 2004 and 2005 trawl surveys which may affect the level of recruitment to the fishery after 2010. Additionally, the estimated abundance and distribution of prerecruits ≥ 56 mm CW observed during the 2005 trawl survey suggest that there could be high incidences of soft-shelled males in 2006 catches in some areas (e.g. Chaleur Bay).

Size frequency distributions of male crabs caught in the trawl survey have been available since 1988. The cohort of small crabs (10 to 56 mm CW) composed of many instars observed in 1998-99 can be followed molting to larger sizes in subsequent annual surveys, and became the main component of the survey biomass index during the 2000-2005 fishing seasons. However, since 2001, a low abundance of adolescent crabs smaller than 56 mm CW has been observed, which may result in the decline of the recruitment to the commercial biomass after 2010.

The **abundance of under-sized adult males (< 95 mm CW)** increased from 106 million individuals 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 individuals in 1999 but has gradually decreased since then to reach 112 million in 2005.



Areas E and F:

The commercial biomass indices projected forward for the next fishing season from the preceding fall survey have wide confidence intervals. Moreover, there is an unknown amount of crab movement in and out of these areas within a given year. These factors mean that the annual survey biomass index may not reflect the available commercial biomass 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. This makes stock estimates for these small areas difficult and uncertain.

In Area E, the commercial biomass index from the 2005 trawl survey was estimated to be 817 t (285 t -1,863 t), which represents an increase of 50% compared to the 2004 estimate of 544 t (113 t – 1,646 t). The recruitment to the fishery index estimated to be 634 t (249 t – 1,341 t) represents 78% of the 2005 survey biomass index. It is difficult to predict the commercial biomass index in this very small fishing area as it is not independent of the stock condition in adjacent Area 12. This is well supported by lack of consistent passage of cohorts of immature and adolescent crabs through the size frequency distributions of survey abundance within Area E from one year to the next. Moreover, the estimated abundance of prerecruits ≥ 56 mm CW in the southern Gulf have been decreasing and become proportionately more concentrated in the central part of Area 12. This retraction of the Area 12 stock may negatively affect the recruitment to the fishery and commercial biomass indices after 2006. The biomass indices in Area E should be interpreted with caution, as the crab concentrations are located at the boundaries of the area sampled and biomass estimate indices have high confidence intervals.

In Area F, the commercial biomass index from the 2005 trawl survey was estimated to be 1,629 t (1,000 t – 2,512 t) which represents a 53% increase compared to the 2004 estimate of 1,063 t (297 t – 2,756 t). The recruitment to the fishery index of 1,194 t (692 t – 1,925 t) represents 73% of the 2005 commercial biomass index. Low abundances of adolescent crabs observed from the survey may indicate that the recruitment to the fishery will decrease for the coming years. In addition, the prerecruits ≥ 56 mm CW in the southern Gulf have been decreasing and have become proportionately more concentrated in the center of Area 12, which may also affect the emigration of crabs into Area F. The biomass indices in Area F should be interpreted with caution, because the crab concentrations are located at the boundaries of the area sampled and biomass estimate indices have high confidence intervals.

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

Survey Year	12	E	F
1988	**8676** 5041-12311	-	-
1989	**21748** 10134-33362	-	-
1990	**23444** 11042-35846	-	-
1991	**29443** 14729-44157	-	-
1992	**37771** 23596-51946	-	-
1993	**61936** 53760-70112	-	-
1994	**56682** 49934-63430	-	-
1995	**49517** 41594-57440	-	-
1996	**43570** 20121-67019		
1997	**33085** 24847-41323	**1456** 635-2277	**513** 178-848
1998	**28193** 22645-33741	**219** 0-492	**903** 9-1797
1999	**-**	**-**	**-**
2000*	**28874** 22577-35171	**155** 0-777	**1508** 648-2368
2001*	**36057** 28701-43413	**327** 43-1202	**2430** 1329-4093
2002*	**43843** 38317-49958	**723** 281-1540	**2693** 1533-4399
2003**	**53251** 46848-60279	**447** 77-1476	**1973** 939-3674
2004**	**71859** 65697-78438	**544** 113-1646	**1063** 297-2756
2005**	**59606** 53920-65723	**817** 285-1863	**1629** 1000-2512

Biomass (projected) at the time of the survey of adult males with a CW ≥ 95 mm without considering the loss (mortality and migration).

* Biomass estimates with ''Den C. Martin'' (not adjusted to ''Emy-Serge'').

** Biomass estimates with ''Marco Michel'' (not adjusted to ''Den C. Martin'').

Reproduction:

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

Since 1988, two periods (1989-1992 and 1999-2002) of high **mature females** abundance were observed in the trawl surveys.

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) ≥ 95 mm CW varied from 36-6F:1M for the first period (1989-1992) but was around 7-4F:1M for the second period (1999-2002). For 2005, the global ratio was 1F:1M. The global ratio between the pubescent females and the total adult males (commercial-sized and under-sized) was 1F:5M for 2005.

An inadequate proportion of large hard-shelled adult males relative to mature females before the mating season could impact the success of multiparous mating that occurs in late May- early June, although monitoring has not found evidence of fertilization problems in this stock. In 2005, in Chaleur Bay and Shediac Valley; (sectors 1 and 2, respectively), about 75% of the fishing effort and landings occurred during the first 4 weeks of the fishery. In these two sectors, a significant decrease in catch rates was observed for this period, leading to an accelerated depletion of large-sized adult males. Based on the soft-shelled crab protocol, the Chaleur Bay has been closed on four occasions since 2000 due to the high incidences of soft-shelled crabs in catches. In addition, the survey biomass index of commercial-sized adult males remaining after the fishery has been low in sectors 1 and 2 since 2000 suggesting that most of the adult males ≥ 95 mm CW have been fished by the end of the fishing season. The importance of the reproductive potential of the stock in Chaleur Bay and Shediac Valley is unknown. However, given the fact that most of the adult males ≥ 95 mm CW have been fished within 4 weeks of the beginning of the fishery since 2000, a slower decline in commercial-sized adult males prior to the multiparous mating in order to maximize the reproductive output of the stock could produce biological benefits.

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

the long term and justifies monitoring fertilization rates and the productivity of both multiparous and primiparous females. If there were evidence of incomplete fertilization, then a slower decrease and lesser depletion of the adult males would be necessary.

Sources of Uncertainty

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 means that the commercial biomass index estimates prior to that date may be for only a portion of the population surveyed since then. Therefore, estimated exploitation rates prior to 1998 should have been at lower values than the ones calculated for the time series.

Since the beginning of the trawl survey in 1988, a systematic loss has been observed between the observed commercial biomass index at year (y), and the sum of the biomass index estimated to have survived the fishery (remaining biomass) and the landings from the following year (y + 1). This loss of commercial-sized males could be attributable in large part to natural mortality, non-reported landings and emigration. This loss is variable from year to year for commercial-sized adult males and both its causes and variability add uncertainty to the assessment of stock status and implications for management.

The proportion of adult males < 95 mm CW observed in the trawl surveys since 2000 could be the result of high exploitation rates triggering adolescent males to reach the terminal molt below the commercial size. If there is evidence of increasing maturation of males < 95mm CW when abundance of large males is low, then there would be a greater risk that the contribution of the adult males < 95 mm CW to the reproduction may lead to a shift in size structure of the population in the long term.

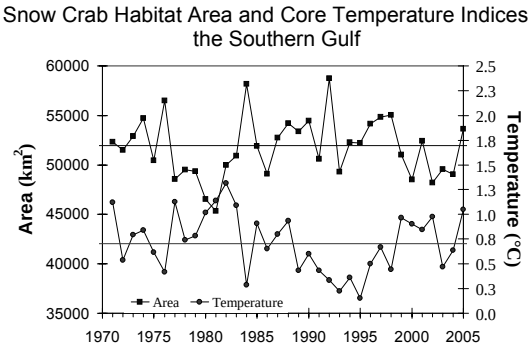
The relationship between the dynamics of crabs in Areas E and F is a major source of uncertainty in managing fisheries in those areas. During the current increasing phase of commercial biomass indices observed in Area 12, the geographical distribution of adult males ≥ 95 mm CW has been shifting from the northern to the southern part of the area, which may reduce the overflow of these crabs into Areas E and F. Also, the relative abundance of prerecruits ≥ 56 mm CW in the southern Gulf have been decreasing and becoming increasingly concentrated in the central part of Area 12. This may affect negatively the recruitment to the fishery and commercial biomass indices in Areas E and F in the near future, adding uncertainty to the consequences of any management approaches apply to these areas.

Ecosystem Considerations

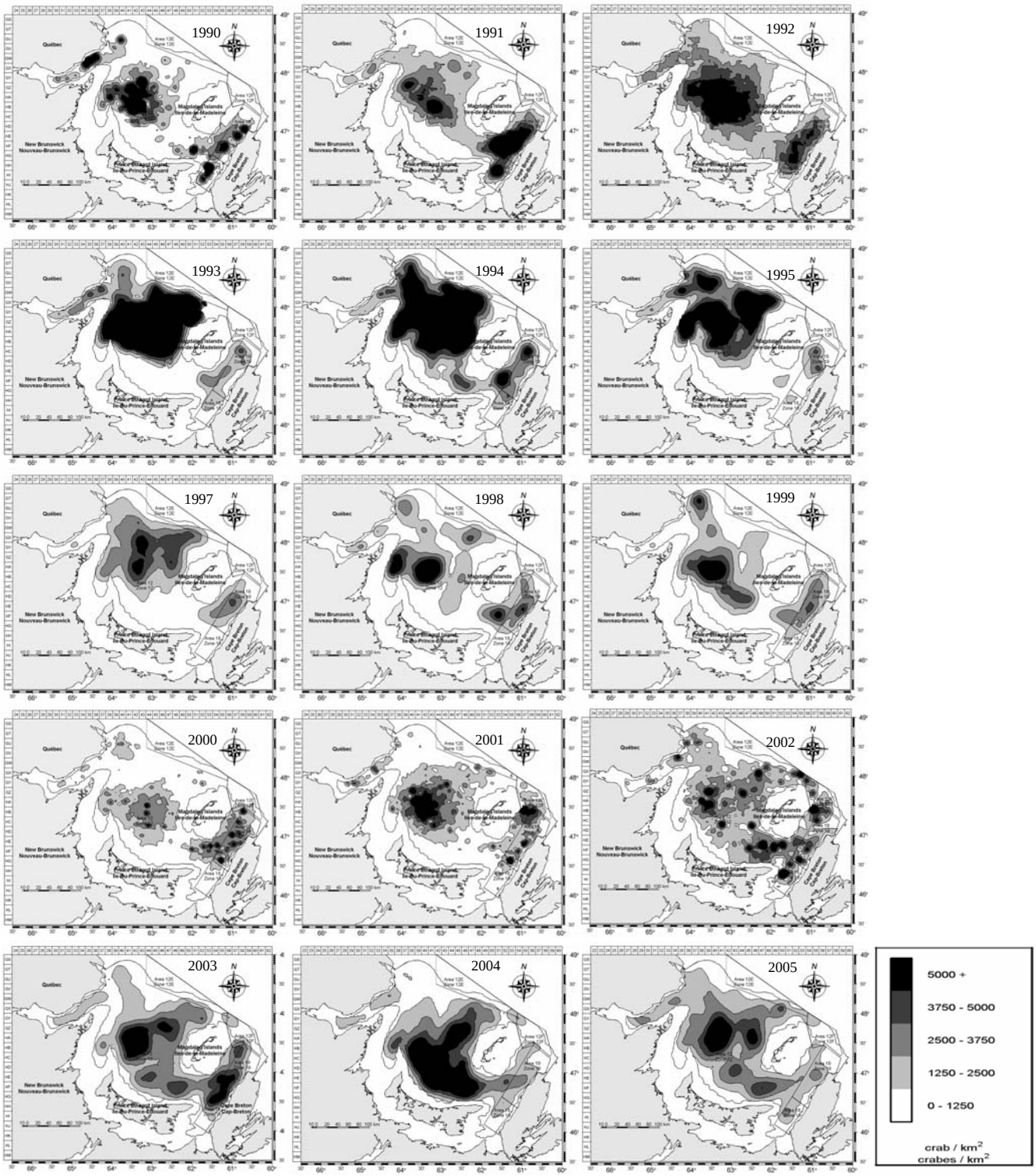
Environmental factors, such as water temperature, can affect the molting and reproductive dynamic as well as the movement of snow crab. Chassé et al. (2006) reported that the bottom temperatures over most of the southern Gulf of St. Lawrence are typically less than 3 °C, which is considered suitable thermal habitats for snow crab.

The cooler coastal water is consistent with a significant increase in the Gulf-wide snow crab habitat index (area of the bottom covered by water temperatures between –1 and 3 °C). The habitat index is now above the long-term average. However, the mean temperature within the habitat area in 2005 also significantly increased compared to 2004; this is an unusual situation as the two time series are usually negatively correlated. The mean temperature is above the long term mean, reaching a value similar to the ones observed during the 1999-2002 warm period and is the highest of the last 23 years. With this increase, the temperature conditions are not considered to be as favorable for snow crab as the mean core-index temperature is higher than

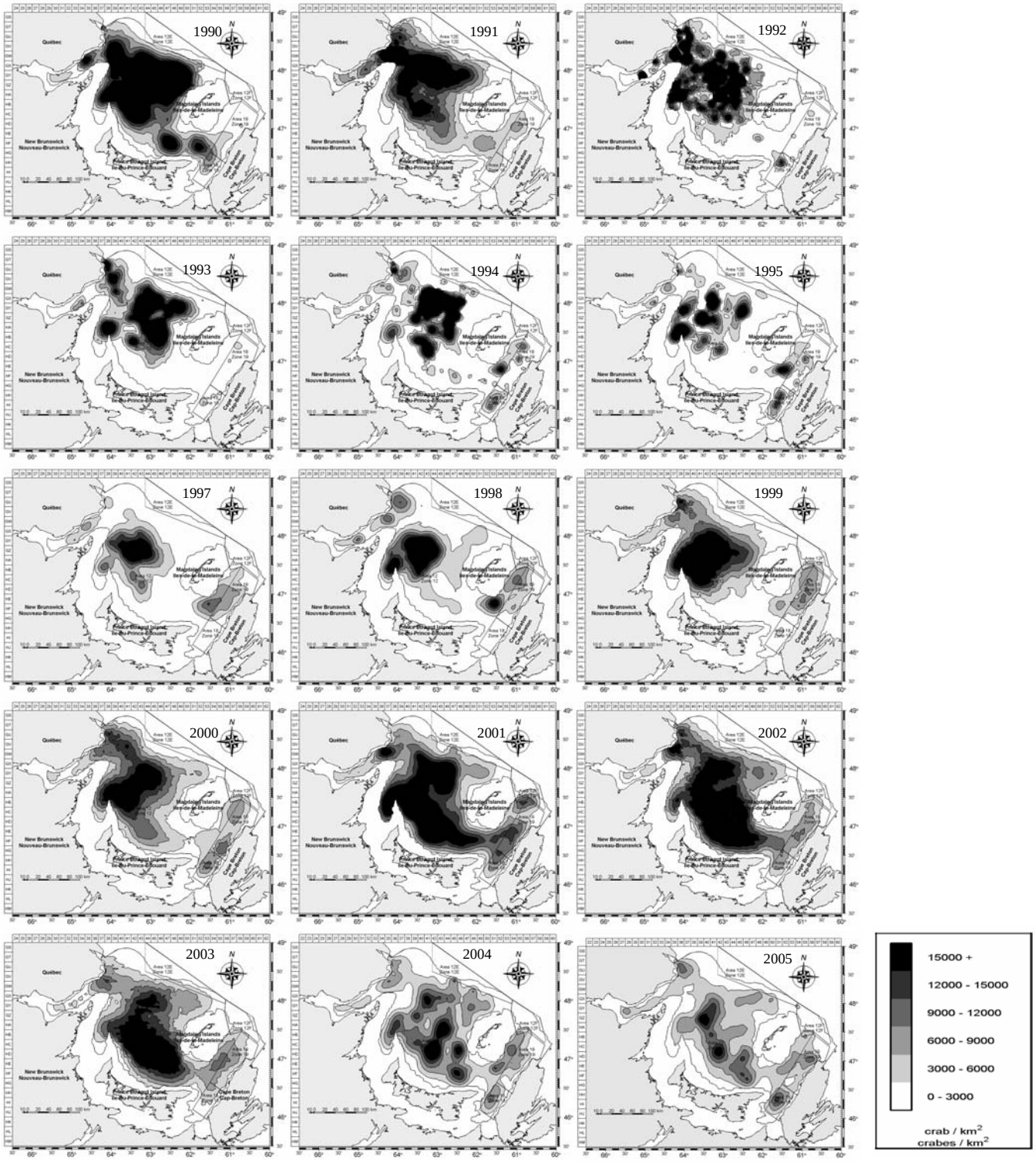
normal, although the habitat index itself is above normal.



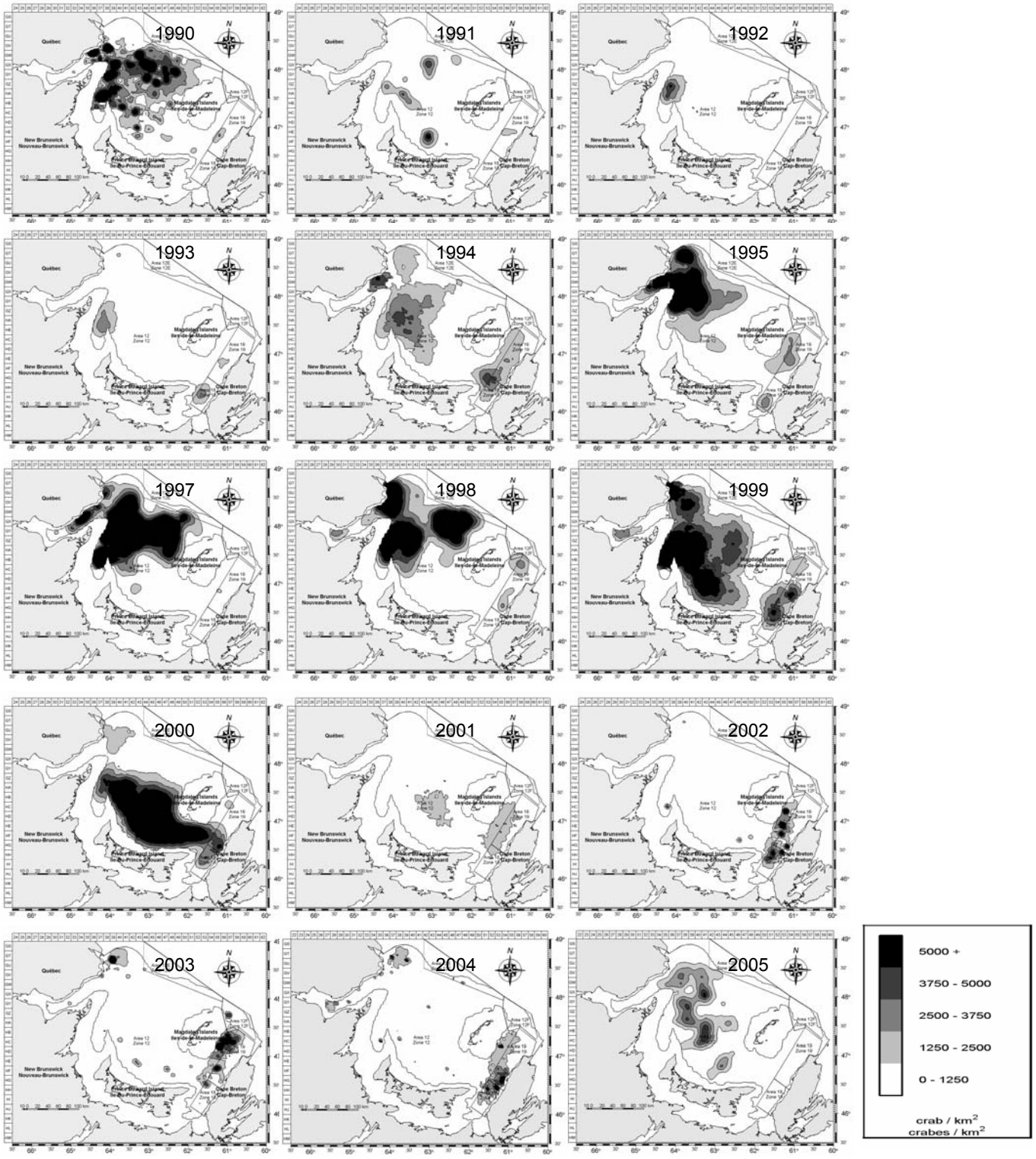
Density (crabs per km^2) Contours of Adult Male Crab ≥95 mm CW based on the Trawl Survey between 1990 and 2005 in the Southern Gulf of St. Lawrence



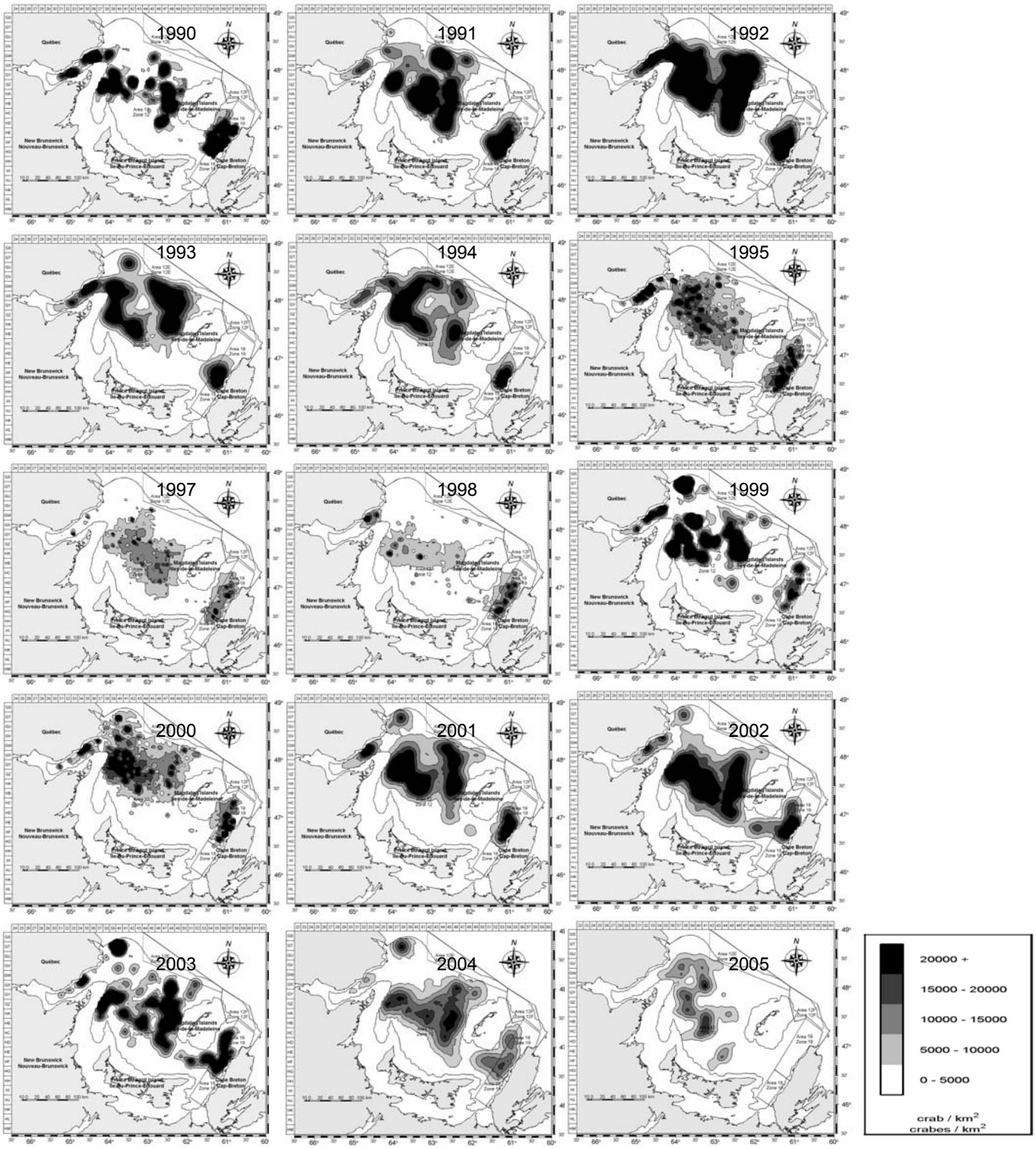
Density (crabs per km^2) Contours of Adolescent Male Crab ≥56 mm CW based on the Trawl Survey between 1990 and 2005 in the Southern Gulf of St. Lawrence



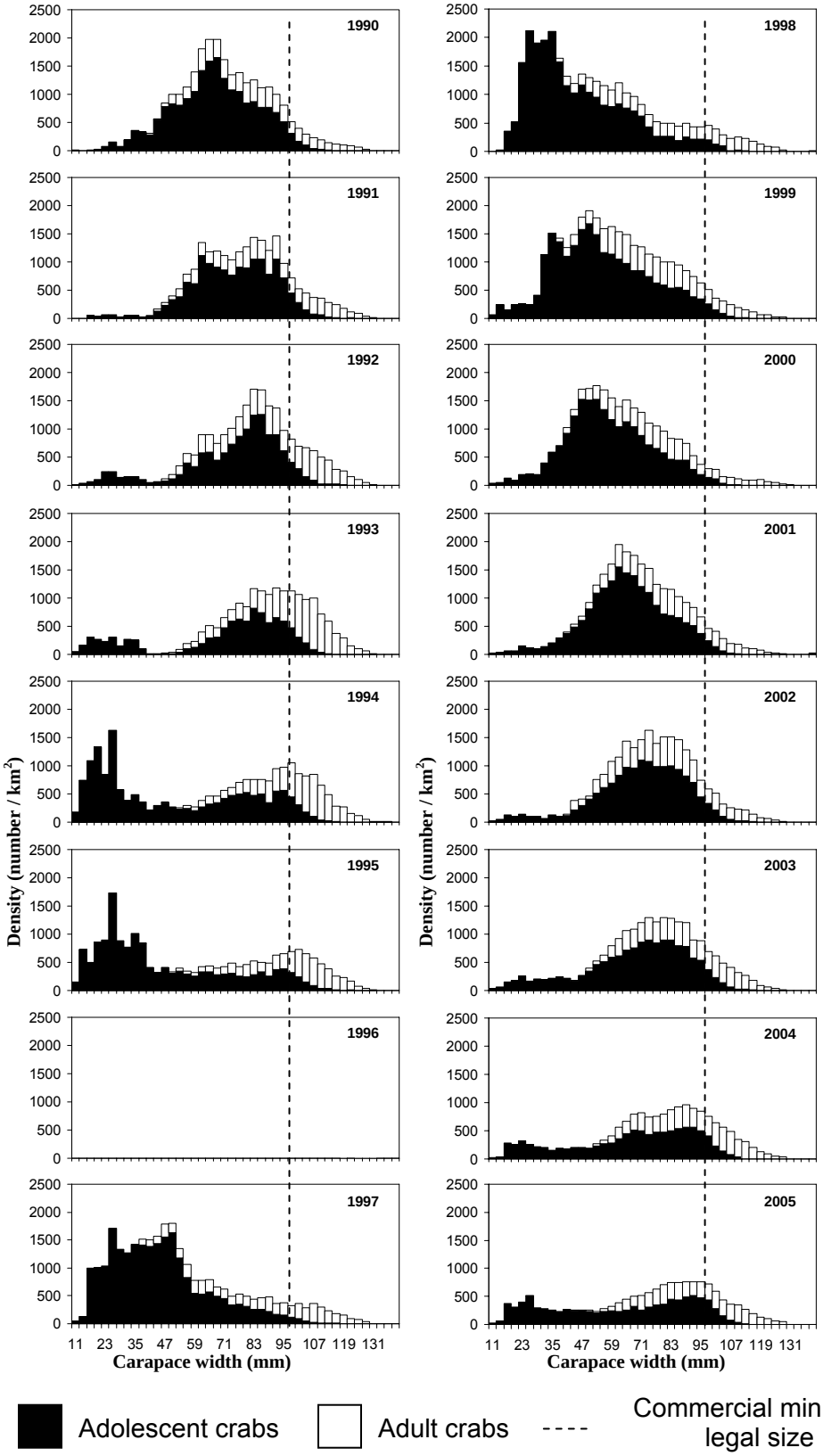
Density (crabs per km^2) Contours of Pubescent Females based on the Trawl Survey between 1990 and 2005 in the Southern Gulf of St. Lawrence



Density (crabs per km^2) Contours of Mature Females based on the Trawl Survey between 1990 and 2005 in the Southern Gulf of St. Lawrence



Size Frequency Distributions (number per km^2) of Male Crab Sampled during the trawl survey in Area 12 after the Fishing Season



Outlook

For Area 12, 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 2005. The 2005 survey commercial biomass index was estimated at 59,606 t. This index is composed of new recruitment (69%) and biomass of adult males ≥ 95mm CW remaining after the 2005 fishery (31%). The biomass of very old crabs is very low. The Area 12 snow crab population is now in 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. Low abundances of crabs smaller than 56 mm CW (R-5 and earlier prerecruits) were observed in the 2004 and 2005 trawl surveys, and suggests that recruitment may not increase quickly in the next decade.

The fishery indicators in Area E were generally positive in 2005. The CPUE increased compared to 2004. The mean size of commercial-sized adult crabs in commercial catches increased while the percentage of soft-shelled crabs was low during the 2005 fishing season. The commercial biomass and recruitment indices estimated from the trawl survey increased in 2005. This fishery and stock dynamics are not independent of the stock condition in Area 12.

The fishery indicators for Area F were generally positive in 2005. The mean annual CPUE was high and the percentage of soft-shelled crab was low in 2005. The mean size of commercial-sized adult crabs in the commercial catches increased compared to 2004. The commercial biomass index increased in 2005 compared to 2004 estimates, however, the declining abundance of prerecruits to support this zone may contribute to an accelerated decline of commercial biomass in the near future. This fishery and stock dynamics are not independent of Areas 12 and 19 biomass conditions.

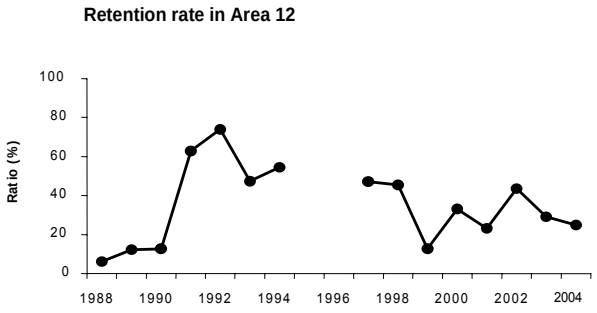
Biological Considerations

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 in the quality and quantity of the spawning stock and subsequent recruitment.

Management Considerations

The stock is now in a declining phase in recruitment to the fishery until 2010. A high exploitation rate would accelerate the decline of the commercial biomass after 2006. Moreover, it would result in little accumulation of larger-sized adult males of carapace conditions 3 and 4, the most fertile males to mate with mature females. Since 2000, the percentage of adult males ≥ 95 mm CW with a carapace condition 3 in catches from the sea samples increased from 64% in 2000 to 90% in 2005 while the percentage of these crabs with carapace conditions 4 and 5 decreased from 24% to 6% during the same period. Even with an increasing phase of recruitment to the fishery from 2000 to 2005, the 40-50% exploitation rate used in managing Area 12 since 2000 did not result in an increased percentage of adult crabs with carapace conditions 4 and 5 in the catches. Since 2000, this fishery has become largely dependent on the annual recruitment to the fishery rather than on the remaining biomass from one year to the next. This is also evident by observing the low remaining biomass of commercial-sized males from 2000 to 2005 compared to the previous increasing phase of recruitment to the fishery during the 1990 to 1995 period. The retention rate (ratio of residual commercial biomass index at year y + 1 / commercial biomass index at year y) of commercial-sized adult males between 1988 and 1990 was very low (less than 15%), which is an

indicator of high fishing pressure on the stock during the late 1980's. From 1991 to 1998, the retention rates of commercial adult males were over 40% using an exploitation strategy that was conservative.



Since 1999, the retention rates of commercial biomass were below 30% using a target exploitation rate of approximately 50%. This lowered proportion of remaining population in recent years is a direct result of the recent increased fishing pressure on the stock.

It is also noted that since 2001 there has been an increasing discrepancy between the estimates of the size of the adult commercial population in one year and the estimates of the abundance of those crab in the following year, when recorded landings have been accounted for. If this unaccounted loss from the population is an estimation error or due to unreported catches, it will be reduced in future by additional science and enforcement efforts, respectively. If it is due to density dependent factors such as emigration or natural mortality, then it might decline as recruitment falls, as was observed in the previous pulse of recruitment in the early 1990s. Any of these factors would reduce the rate of decline in the adult population, but not reverse it.

Using a conservative approach as during the 1990-1995 period (35% of the commercial biomass index observed at the time of the survey), the 2006 quota would be 20,862 t. Using a similar approach as in 2003 (40% of the commercial index), the 2006 quota would be 23,842 t. By using the same exploitation rate as in 2005 (45% of the commercial biomass index), the 2006 quota would be 26,823 t; finally, using an exploitation rate of 50% of the commercial biomass index, the 2006 quota would be 29,803 t.

At this time there is no evidence of fertilization problems in this population. However, the abundance of adolescent males (R-4, R-3, and R-2) is expected to decline annually until 2010, and with the high total loss rates that have been observed from 2000-2005, there is little accumulation of hard-shelled commercial-sized adult males remaining after the fishery. Continued high total loss rates from all sources will restrict the options available to management in the coming years, should monitoring find evidence of incomplete fertilization of females when they begin to increase in abundance at the end of this decade. Management must take account of aggregate effects of all sources of loss including reported and unreported harvest, emigration, natural mortality and other causes in managing this population during the period of declining recruitment.

There would be biological benefits to the future reproductive potential of the stock, and the future yields, if the fishery were allowed to return hard-shelled commercial-sized adolescent males to the sea, when these are taken in traps.

Particularly high proportions of soft-shelled crabs have occurred in commercial catches in the Chaleur Bay and Shediac Valley areas, leading to closures in several recent years. Management is encouraged to explore approaches which would allow an orderly fishery but reduce the incidence of this problem in future.

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. The fishery in this area depends 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 stock dynamics 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.

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