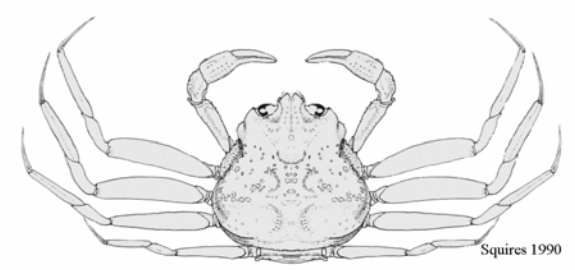


Western Cape Breton Snow Crab (Area 19)

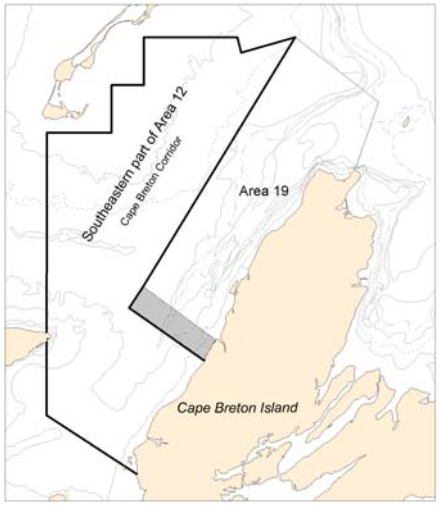
Background

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 time. Soft-shelled crab is defined by shell hardness (<78 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 after their final moult, in which they acquire a wider abdomen for carrying eggs. This occurs at shell widths less than 95mm. Male snow crab stop growing after their final moult, in which they acquire large claws on the first pair of legs. This can occur at shell widths between 40 and 150 mm. Female crab produce eggs that are carried beneath the abdomen for approximately 2 years. The eggs hatch in late spring or early summer and the tiny 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 snow crab males to reach legal size.

The minimum legal shell width is 95mm, and female crabs 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 late summer in Area 19. Neither soft-shelled nor white crabs are harvested.

In 2003, Area 18 was integrated to Area 12 and a 5 nautical miles no fish buffer zone was implemented between Area 18 and Area 19. Management of this fishery is based strictly on quotas and effort controls (number of licenses, trap limits and season).



Snow crab management Area 19 and the southeastern part of Area 12 (Southeastern unit of the southern Gulf of St. Lawrence) and the 5-mile buffer zone (shaded area).

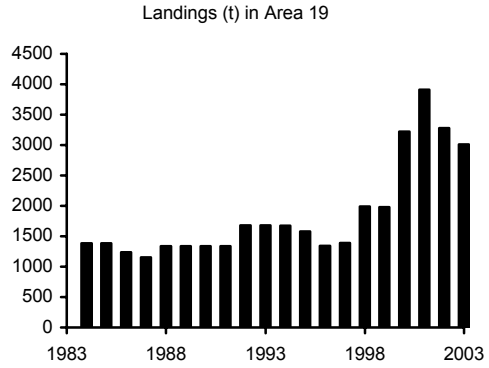
Summary

- Crabs in management Area 19 are part of a larger biological population including crab in adjacent Areas 12 and Area F. Any biological key events observed in the southern Gulf of St. Lawrence may have subsequent impacts on the stock condition in Area 19.
- In 2003, landings were 3,103 t and equaled the quota.
- CPUE increased from 72.3 kilograms per trap haul (kg/th) in 2002 to 103.6 kg/th in 2003.
- The mean size of commercial-sized crabs in sea samples has increased from 110 mm of carapace width (CW) in 2002 to 114 mm CW in 2003.
- The 2003 survey biomass index of commercial-sized crabs (8,080 t ± 18 %) has increased by 64 % compared to 2002 to reach the highest level recorded since conducting the trawl survey in 1991.
- This survey biomass index is composed of new recruitment (50 %) estimated at 4,070 t ± 24 %.

- Since the beginning of the trawl survey in 1991, a discrepancy 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). Even if attempts were made to quantify this loss or gain, it was not incorporated in the commercial biomass estimates.
- The prerecruits R-3 and R-2 have been decreasing which may indicate a decrease in commercial biomass index in the near future if no immigration of adult males ≥ 95 mm CW occurs.
- Any increase from the 2003 exploitation level (63 %) is not recommended in 2004.
- It is essential to continue an annual trawl survey and soft-shelled crab protocol to optimize the exploitation of this fishery.

The Fishery

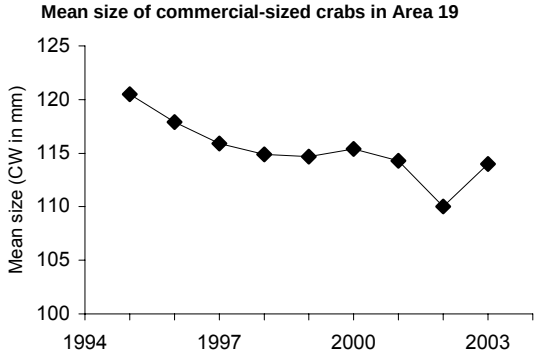
The 2003 fishing season in Area 19 started July 7 and closed September 6 with a total quota of 3,106 t. The traditional and temporary license holders caught their quota (total landings of 3,103 t) by the ninth fishing week. Seventy-three temporary license holders started fishing on July 21st (first landings occurred on July 22nd) with individual quotas of 8.2 t (18,062 lbs). The average catch rates (CPUE) of traditional fishermen increased from 72.3 kg/th in 2002 to 103.6 kg/th in 2003.



Quotas (t), Landings (t) and Catch Performance in Area 19

	1998	1999	2000	2001	2002	2003
Quota	1,991	1,986	3,370	3,912	3,285	3,106
Landings	1,988	1,979	3,225	3,910	3,279	3,103
CPUE	63.7	103.7	64.1	88.5	72.3	103.6
Soft crab (%)	11.2	4.1	5.6	6.5	3.5	3.7

The percentage of **soft-shelled crabs** in Area 19 was 3.7 %, the same level as the previous year. The **mean size of commercial-sized crabs** in sea samples has increased for the first time since 2000 to reach 114 mm of carapace width (CW) in 2003.



Carapace condition was estimated from sea samples taken from the 2003 fishery. The conditions 3 and 4 represent 95 % of the catches.

Percentage of the Catch of Commercial-Sized Adult Crabs by Carapace Condition

Condition	Description	Percentage
1-2	White crab	4.9
3	Intermediate	80.4
4	Old crab	14.5
5	Very old crab	0.2

Resource Status

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

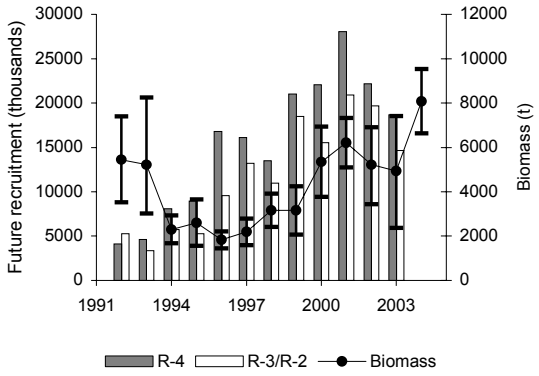
the following fishing season. Abundance indices are also estimated for males as future recruitment to the fishery (R-4, R-3 and R-2) and females (pubescent and mature) as future and current spawning stock abundance. The terms R-4, R-3 and R-2 represent adolescent male crabs with a carapace width range 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 to become primiparous females (first brood). The term multiparous refers to females which are carrying their second brood or older. The term mature females, also refers to the 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 index of the potential problem of soft-shelled crabs that may enter commercial traps the following fishing season.

The survey has been conducted each year since 1990. As the concentration of biomass straddles the boundaries of Areas 12 and 19, seasonal movements of crab between these areas will affect the biomass level in any given area.

The 2003 survey biomass index was estimated at 8,080 t (± 18 %), which is the highest value ever recorded since the beginning of the trawl survey. This represents an increase of 64% over last year. The recruitment (4,070 t ± 24 %) represents 50 % of this survey biomass index. The main concentrations were located in the southern and middle part of the Area showing a similar pattern as 2002.

In 2003, the abundance estimates of R-3 and R-2 decreased to 3.2 million and 11.4 million of individuals respectively, which may indicate a decrease in commercial biomass index in the near future. Contrary to what was observed in Area 12, the abundances of prerecruits R-3 at year (y) were much lower than the abundance of R-2 at year (y + 1) indicating a continuous immigration of these crabs into Area 19, which positively affects the recruitment to the fishery in this area each year. A directional movement of commercial-sized crabs was demonstrated by comparing the results between the September 2001 and June 2002 surveys in Area 19, which suggests an incoming biomass to Area 19 after the survey in September and prior to the 2002 fishing season.

Survey biomass index (t) and abundance indices of future recruitment in Area 19



Size frequency distributions of male crabs caught in the trawl survey have been available since 1991. In this area, the size distribution pattern seemed to be different compared to Area 12. The appearance of the recruitment to the population has been observed without interruption throughout the years. However, the abundance indices of R-4, R-3 and R-2 in 2003 decreased, which may indicate a decrease in recruitment to the fishery in the near future. On the other hand, these size categories were observed in the adjacent Area 12. The migration of these crabs towards Area 19 might affect the level of biomass index in Area 19 in the future.

Sources of Uncertainty

Since the beginning of the trawl survey in 1991, a discrepancy was 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).

Even if preliminary attempts were made to quantify this discrepancy, more study is needed to estimate the loss or gain of commercial-sized crabs between the time of the survey and the fishing season in order to adequately incorporate this in the stock assessment.

Also, a change of survey vessel for the 2003 trawl survey showed that the swept area, the opening of the trawl and the speed of the boat were significantly different compared to the previous vessel. Without a comparative study to evaluate the catch efficiency between the two vessels the biomass and abundance estimates have to be interpreted with caution. Therefore, these estimates are still based on the assumption that the trawl catch efficiency is 100 % for crabs larger than 40 mm CW. Further investigations are needed to verify this assumption. Despite these uncertainties, the survey biomass indices are closely correlated with the catch rates.

In December 2003, a seismic testing was conducted by Corridor Resources Inc. in Area 19 and adjacent waters. This seismic study was done after the annual snow crab trawl survey conducted in Area 19 in October 2003. According to Hébert et al. (2002), the crab concentration into the Cape Breton Gully occurs between the fall and the following fishing season in July based on the results of double trawl surveys. There is no knowledge yet on the possible effect of this seismic testing activity on commercially exploitable crabs. If there is any effect on crab behavior, especially immigration to the Cape Breton Gully, the level of exploitable biomass may have been influenced by the seismic activities. An additional trawl survey prior to the next fishing season would be useful to measure any unusual changes in the abundance of commercial-sized crabs.

The relationship between the spawning stock and stock recruitment needs further monitoring and investigations. Computer simulations of current and post-larvae distribution should be continued to determine the relationship between the spawning stock and the future recruitment to stock units in the periphery and outside the southern Gulf of St. Lawrence.

Biological Considerations

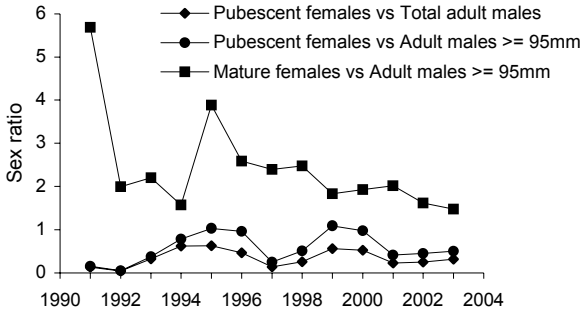
Biological characteristics such as **recruitment and growth pattern** in the southeastern Gulf seem to differ from those in the southwestern Gulf. These biological parameters need further investigations.

The **reproductive potential of the stock** for Area 19 is evaluated as part of larger biological unit that also includes Area F and part of Area 12. This entire area is considered as the unit of the southeastern Gulf of St. Lawrence.

In that large unit, the abundance index of the pubescent females increased from 12 million crabs in 2002 to 14 million in 2003. The main concentrations were located in the northern part of Area 19 and in the Cape Breton Corridor. In 2003, the abundance index for the **spawning stock** was estimated at 42 million of mature females compared to 43 million in 2002. The main concentrations were located mostly in the southern and middle part of Area 19.

The **female-male ratio**, within the southeastern Gulf, between pubescent females and all adult males or adult males ≥ 95 mm CW has always been close to or less than 1 female vs. 1 male (1F:1M) since 1991. For the spawning females, the ratio was skewed towards female dominance (6F vs. 1M in 1991 and 4F vs. 1M in 1995). Except for these two years, the ratio varied between 3F:1M (1997-1999) and 2-1.5F:1M (1992-1994, 2000-2003).

Female-male ratio between different categories of females and males in the southeastern Gulf of St. Lawrence

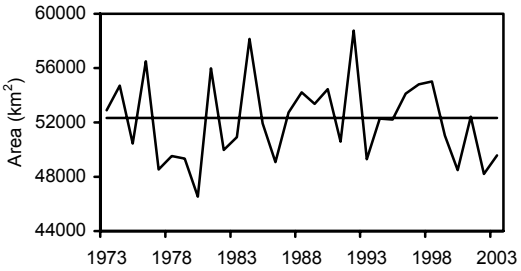


Close monitoring of the key events on population reproductive output (e.g., female-male ratio, fecundity, spermathecal load, recruitment to the early benthic stages) is necessary to detect any anomalies on the quality and quantity of the spawning stock and subsequent recruitment.

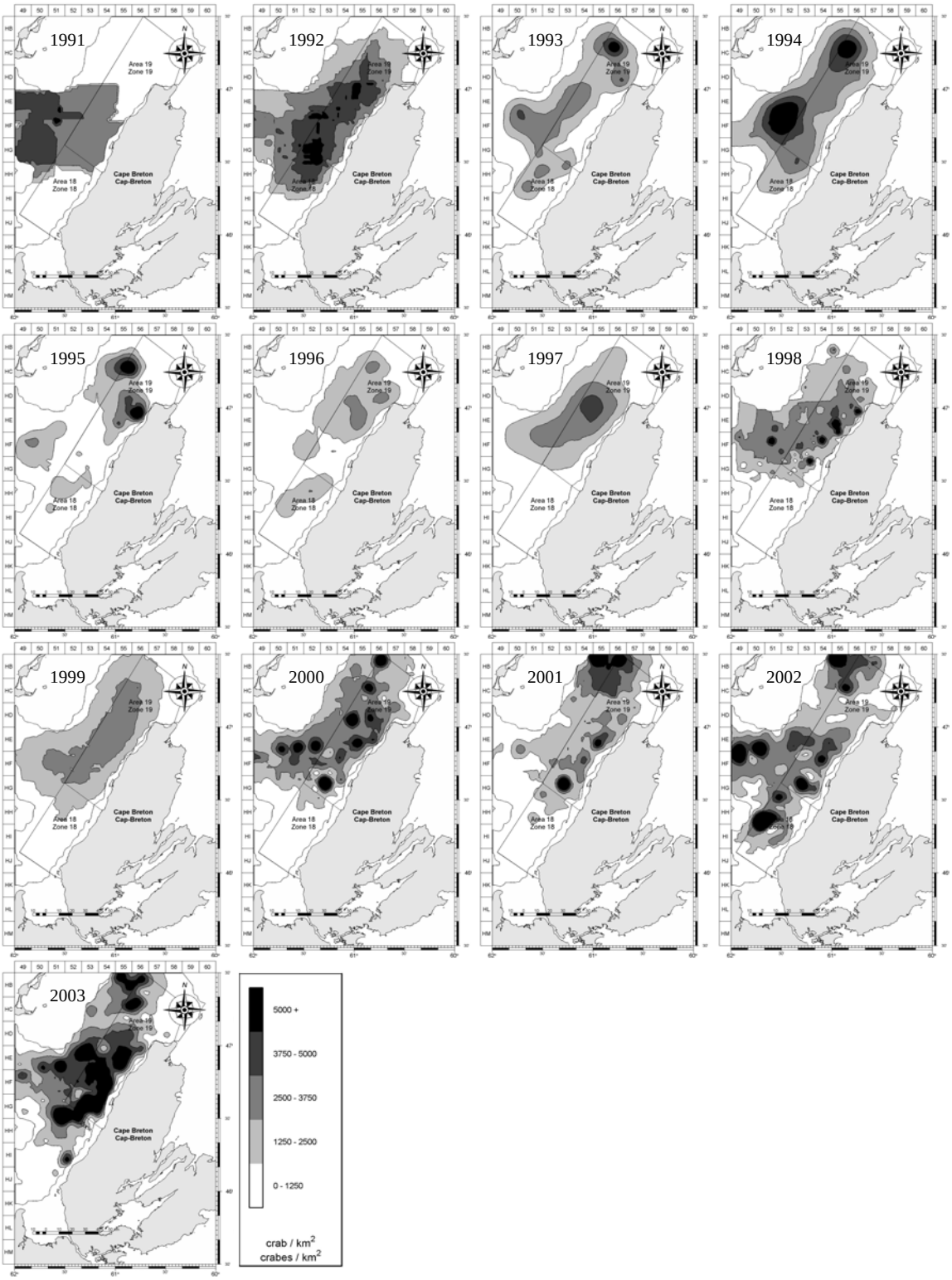
Ecosystem Considerations

Environmental factors, such as water temperature, can affect the molting and reproductive dynamics as well as the movement of crab. Chassé et al. (2004) reported that the bottom temperatures over most of the southern Gulf of St. Lawrence are less than 3 °C, which is considered ideal thermal habitats for snow crab. Chassé et al. (2004) reported that the bottom temperatures in Area 19 are typically 1°-2 °C warmer than the traditional crab grounds in Area 12. For example, approximately 80% of the trawled area during the snow crab survey in Area 12 in 2003 was covered by water of temperatures of < 1.0 °C whereas in Area 19, it was < 2.5 °C. Near-bottom temperatures at most depths in Area 19 during 2003 were generally observed to be colder than the long-term (1971-2000) average and decreased relative to 2002. This is consistent with the increase in the Gulf wide snow crab habitat index (area of the bottom covered by water temperatures between –1 and 3 °C) and the decrease in the average temperature within this area. With this decrease, the temperature conditions are considered more favorable for snow crab than in 2002, although the habitat index is still below normal.

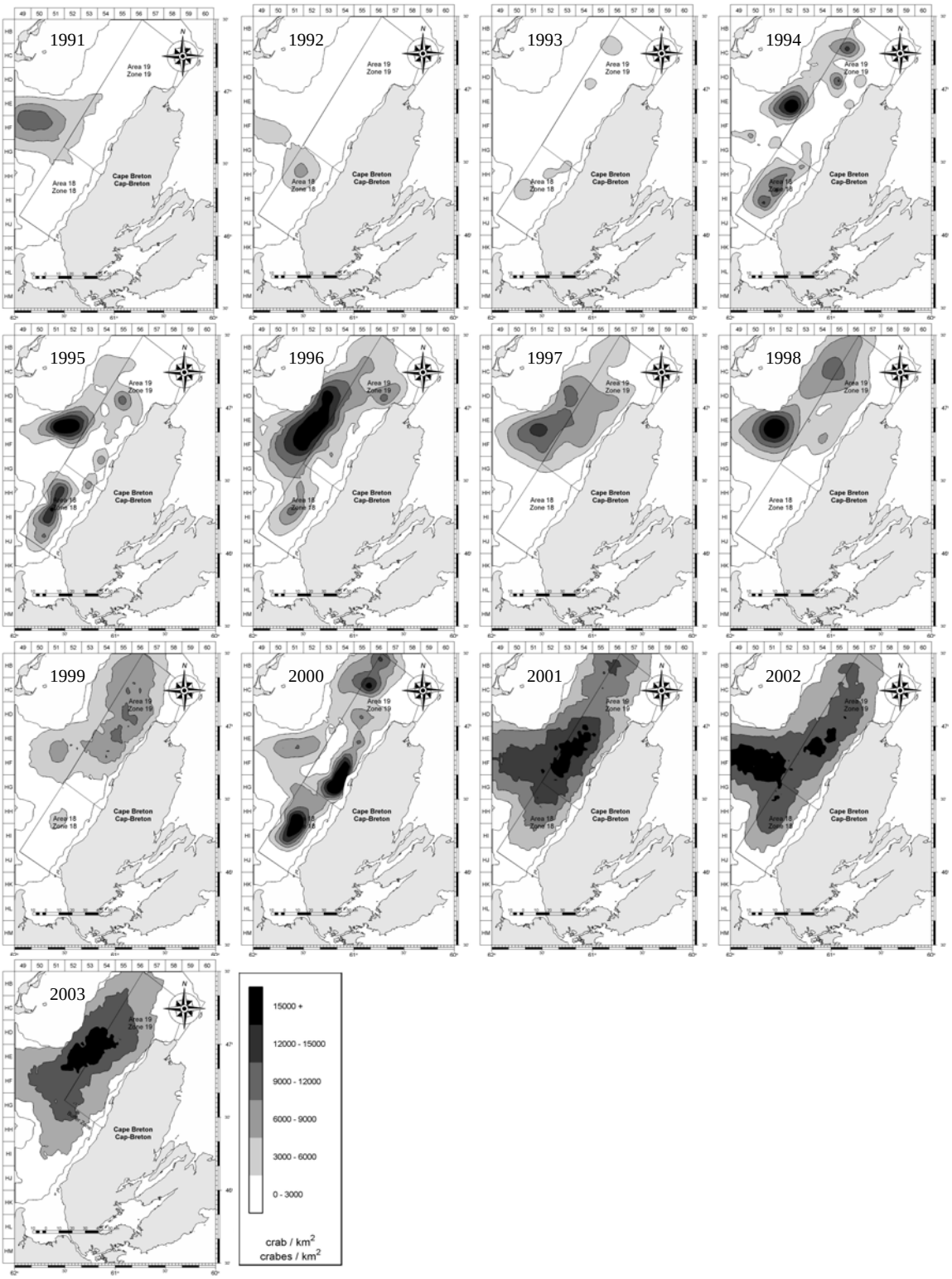
Snow crab habitat index



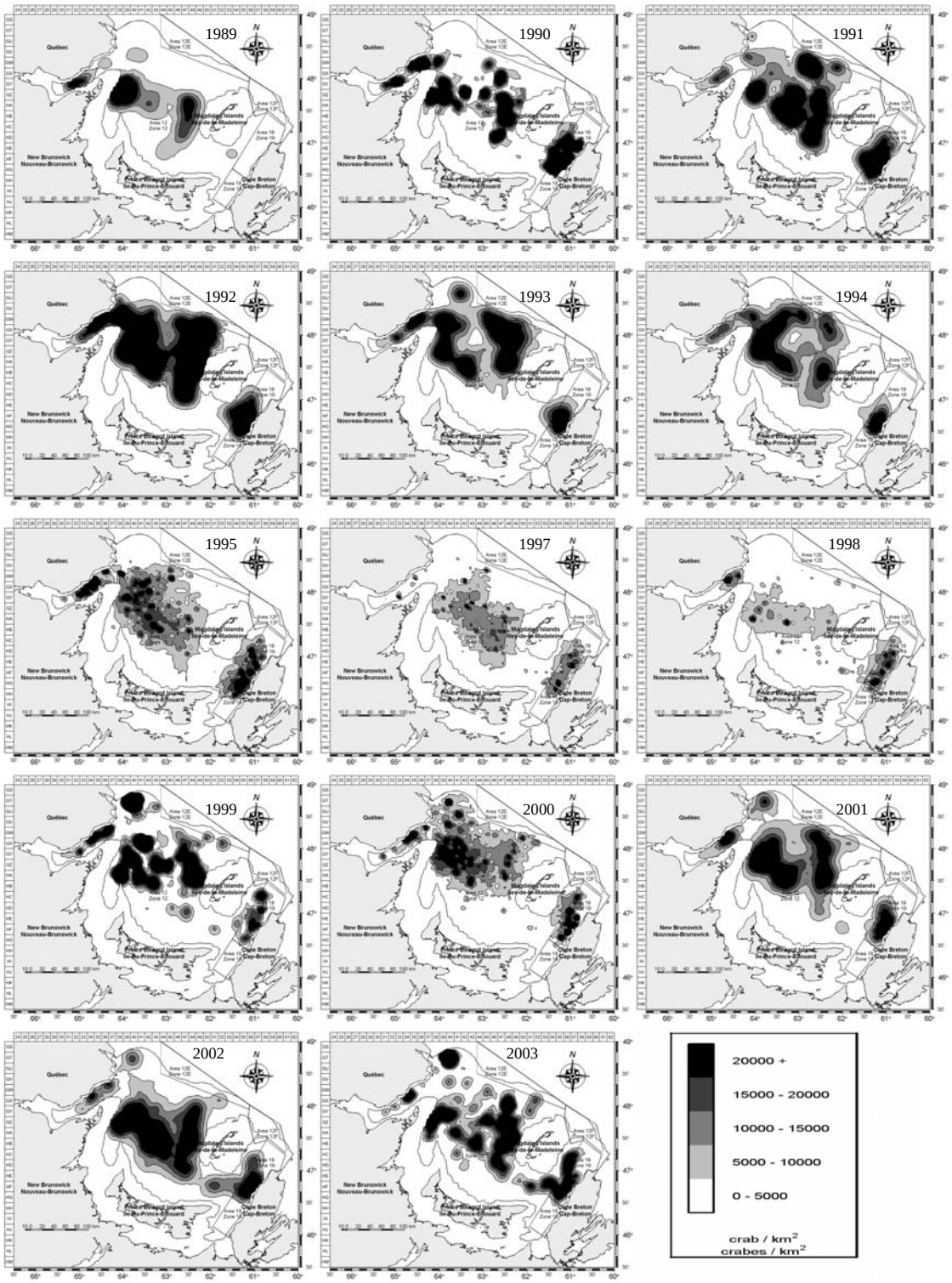
Density (crab/km^2) Contours of Adult Male Crab ≥95 mm CW



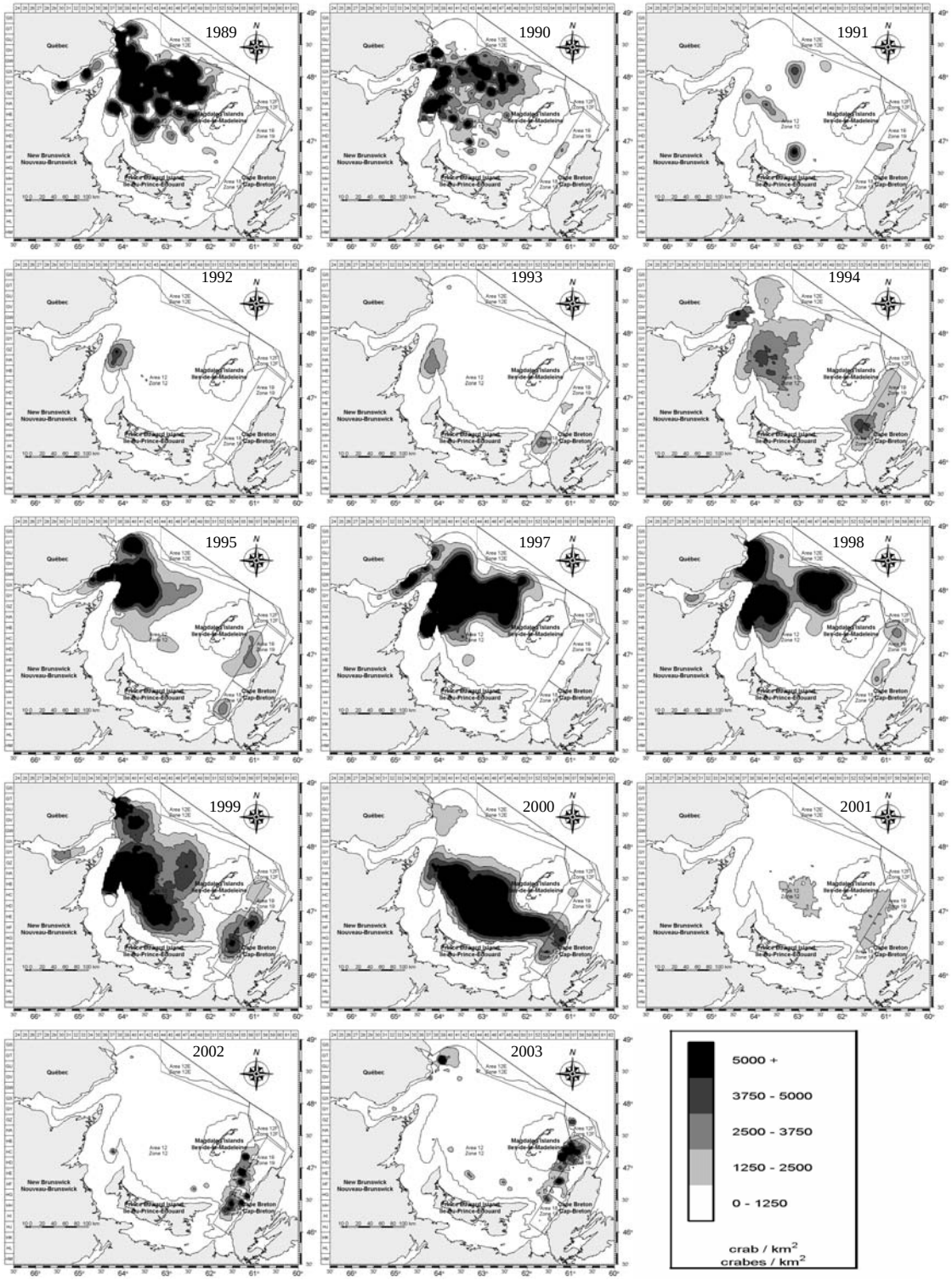
Density (crab/km^2) Contours of Adolescent Male Crab ≥56 mm CW



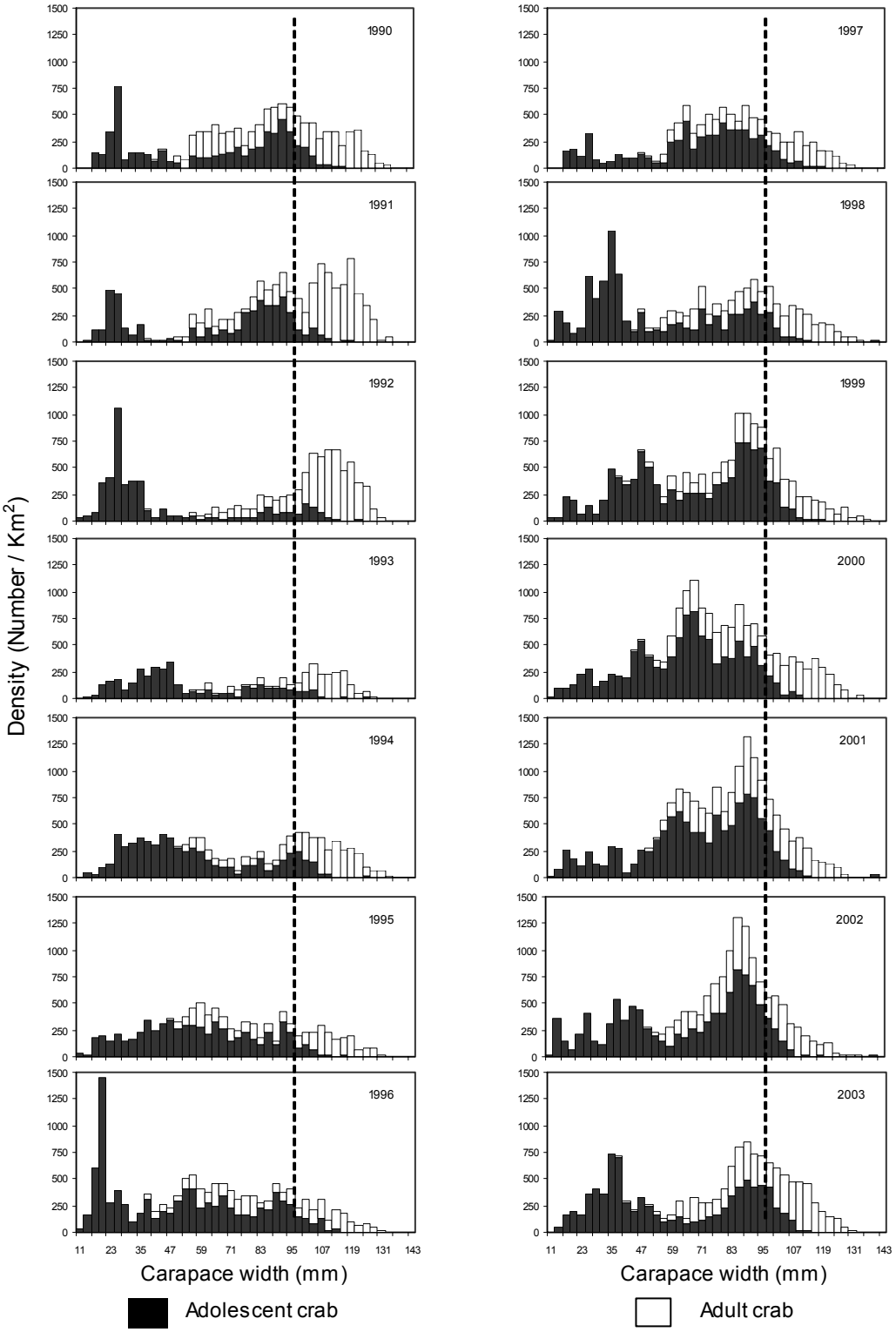
Density (crab/km^2) Contours of Mature Females



Density (crab/km^2) Contours of Pubescent Females



Size Frequency Distributions of Male Crab Sampled during the Trawl Survey in Area 19



Outlook

The 2003 survey biomass index of commercial-sized crabs (8,080 t ± 18 %) has increased by 64 % compared to 2002 (4,930 t ± 30 %). The recruitment to the fishery index (4,070 t ± 24 %) represents 50 % of the biomass index.

On the positive side, the annual CPUE (103.6 kg/th) increased by 43.5% compared to the 2002 season (72.3 kg/th) and the mean size of commercial-sized crabs in catches increased to 114 mm CW in 2003. The fishing effort decreased by 46%, while the commercial biomass and the recruitment to the fishery indices significantly increased in 2003. The female-male ratio is at a level that seems more beneficial compared to the southwestern Gulf of St. Lawrence.

On the negative side, the prerecruits R-3 and R-2 have been decreasing which may indicate a decrease in commercial biomass index in the near future if no immigration of adult males ≥ 95 mm CW occurs. The pubescent females increased in 2003. As such, any increase from the exploitation level adopted for the 2003 season may not be beneficial to the long-term reproduction of the stock.

Management Considerations

Using the historical exploitation level of 63 % seems to be beneficial in terms of female-male ratio and reproductive output and would also promote an accumulation of residual biomass for the subsequent fishing seasons. Any increase in exploitation compared to the current level may not improve the population potential in the future.

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

The continuation of 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 instantaneous mortality (natural mortality, emigration and immigration). The trawl survey is considered the major tool in assessing the snow crab stock in the southern Gulf of St. Lawrence.

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