

Western Cape Breton Snow Crab (Area 19)

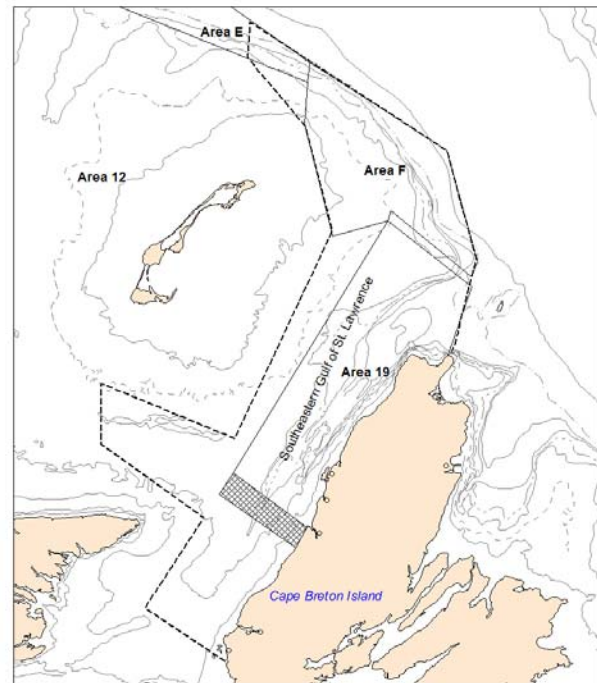
Background

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 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 wider abdomen for carrying eggs. This occurs at shell widths less than 95mm. Male snow crab stop growing when 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 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 on quotas and effort controls (number of licenses, trap limits and season).

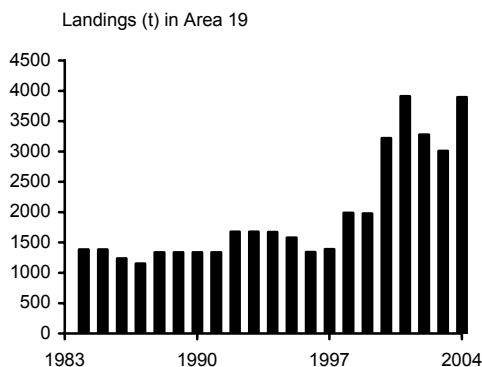


Snow crab management Area 19 and the southeastern part of Area 12 (Southeastern unit of the southern Gulf of St. Lawrence, dotted line) and the 5-mile buffer zone (shaded area).

Summary

- Crabs in management Area 19 are part of a larger biological population including crab in adjacent Areas 12 and F. Any biological key events observed in the southern Gulf of St. Lawrence may have subsequent impacts on the stock condition in Area 19.
- Despite the fact that the 2003 trawl survey projected the highest commercial biomass index ever recorded in Area 19 for the 2004 fishing season, the 2004 fishery was prematurely closed on August 24 with reported landings of 3,894 t representing only 76.5% of the total quota of 5,092 t.
- The fishery was closed due to high incidences of white crabs and low CPUEs in the last two weeks of the fishing season.

- Although a TAC of 5,092 t was set based on a target 63% exploitation rate of the 2003 biomass index, retrospectively the exploitation rate was re-estimated at 86% of the biomass index derived from the June 2004 survey.
- CPUE decreased by 33% from 103.6 kilograms per trap haul (kg/th) in 2003 to 68.9 kg/th in 2004.
- The September 2004 survey biomass index of commercial-sized crabs (4,113 t \pm 29%) has decreased by 49% compared to 2003 (8,083 t \pm 18%).
- Thirty-six percent of this survey biomass index is composed of new recruitment (1,495 t \pm 56%).
- The most plausible reason for the significant difference in commercial biomass indices between the September 2003 and June 2004 surveys may have been a migration of commercial-sized adult males from Area 19 toward the Cape Breton Corridor before the start of the fishing season.
- Prerecruits \geq 56 mm CW (R-4, R-3 and R-2) in Area 19 have been decreasing since 2001. A decrease in the commercial biomass index is now expected for the next 3 to 5 years if no immigration occurs in this area.
- For 2005, it is recommended to follow the soft-shelled male protocol to protect the future recruitment to the fishery.
- Multiple trawl surveys (regular fall and pre-fishery) would be helpful to estimate the level of commercial-sized adult males in Area 19.



The fishery was closed due to low catch rates (CPUE) and high incidences of white crabs in catches in the last two weeks of the fishery. The incidences of white crabs were 29.4% in week 6 and 34.7% in week 7 while the average CPUE were at 36.6 kilograms per trap haul (kg/th) and 30.3 kg/th during the same period. The CPUE decreased from 103.6 kg/th in 2003 to 68.9 kg/th in 2004. The fishing effort increased from 56,517 trap hauls in 2004 compared to 29,952 trap hauls in 2003.

Quotas (t), Landings (t), Fishing Effort (number of trap hauls), and Catch Performance in Area 19

	2000	2001	2002	2003	2004
Quota	3,370	3,912	3,285	3,106	5,092
Landings	3,225	3,910	3,279	3,103	3,894
Effort	55,977	46,251	43,662	29,952	56,517
CPUE	64.1	88.5	72.3	103.6	68.9
Mean size (mm)	115.4	114.3	110.0	114.0	113.9
Soft crab (%)	5.6	6.5	3.5	3.7	7.1

The Fishery

The 2004 fishing season in Area 19 started July 8 and closed August 24 with total landings of 3,894 t. The 5,092 t quota was not caught. Although a TAC was set based on a target 63% exploitation rate of the 2003 biomass index, retrospectively the exploitation rate was re-estimated at 86% of the biomass index derived from the June 2004 survey.

The seasonal percentage of **soft-shelled crabs** in Area 19 was 7.1%. The **mean size of commercial-sized crabs** in sea samples has remained relatively the same in 2004 at 113.9 mm of carapace width (CW) compared to 114 mm CW in 2003.

Carapace condition was estimated from sea samples taken from the 2004 fishery. Conditions 3 and 4 represent 84% of the catches.

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

Condition	Description	Percentage
1-2	White crab	15.6
3	Intermediate	69.5
4	Old crab	14.3
5	Very old crab	0.5

Resource Status

A change in the survey vessels used to conduct the trawl survey in Area 19 occurred from 1990 to 1998 (Emy-Serge D), from 1999-2002 (Den C. Martin) and since 2003 (Marco-Michel). Without a comparative study to evaluate the catch efficiency between the three vessels, the commercial biomass index from the time series cannot be compared.

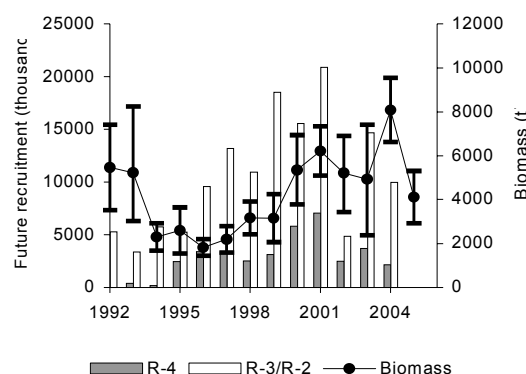
Stock status is primarily based on a post-fishing season trawl survey, which provides a remaining portion of exploitable biomass index (hard-shelled adult males of legal size) immediately after the fishery. It also provides estimates of soft-shelled adult males larger than 95mm (R-1) that will be new recruits to the fishery the following fishing season. An abundance index is 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 abundance index. The terms R-4, R-3 and R-2 represent male crabs with a carapace width range at 56-68, 69-83, and larger than 83 mm, 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 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). An abundance index of adolescent males larger than 56 mm CW, composed of prerecruits R-4, R-3 and R-2, is also estimated and used as an index of incidence of soft-

shelled crabs that may enter commercial traps the following fishing season.

The 2004 survey biomass index was estimated at 4,113 t \pm 29%. This is a decrease of 49% compared to last year. The recruitment (1,495 t \pm 56%) represents 36% of this survey biomass index. The main concentrations were located in the southern and middle parts of the area showing a similar pattern to 2003.

The abundance index of R-4, R-3 and R-2 has been decreasing since 2001, which may indicate a decrease in commercial biomass index for the next 3 to 5 years.

Survey biomass index (t) with a 95% confidence interval 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.

Sources of Uncertainty

Research is needed to resolve uncertainties regarding many aspects of the snow crab biology such as growth pattern, skip molters, and reproductive output. Also, movement of adult crab in and out of the surveyed areas, environmental factors and the catch efficiency of the trawl need further studies.

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

There are many reasons to explain the significant difference in commercial biomass indices between the September 2003 survey (8,083 t \pm 18%) and the June 2004 survey (4,712 t \pm 16%): 1) overestimation of the commercial biomass index; 2) seismic activities; 3) bottom temperature; and 4) fishing activities in adjacent areas. The most plausible reason may have been a migration of commercial-sized adult males from Area 19 toward the Cape Breton Corridor before the start of the fishing season.

Since the beginning of the trawl survey in Area 19, a discrepancy was observed between the observed and expected values of the commercial-sized adult male abundance. This discrepancy has changed from the positive during 1998 to 2003 to the negative in 2004 suggesting an emigration of commercial-sized adult males outside Area 19. The increase in commercial biomass index from 1998 to 2003 was mainly due to the emigration of commercial-sized adult males from Area 12 toward Area 19 where the abundances and distributions shifted from the central part of Area 12 to the southeastern part of the southern Gulf. This distribution change had a positive impact on the commercial biomass condition in Area 19. A retraction of the geographical distribution of these males associated with a decrease in prerecruits R-4, R-3 and R-2 toward the central part of Area 12 is anticipated, which may negatively affect the commercial biomass index in Area 19 in the near future. The commercial biomass index estimated from the 2004 trawl survey (4,113 t \pm 29%) may not reflect the available commercial biomass at the beginning of the 2005 fishing season. Fishing effort in the Cape Breton Corridor and the direction and level of crab migration before the beginning of the Area

19 fishing season may impact the available commercial biomass in this area.

A loss (natural mortality and migration) of commercial-sized adult males between the time of the trawl survey and the following fishing season was estimated at 26.5% based on a non-linear least squares model (Wade et al. 2003).

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

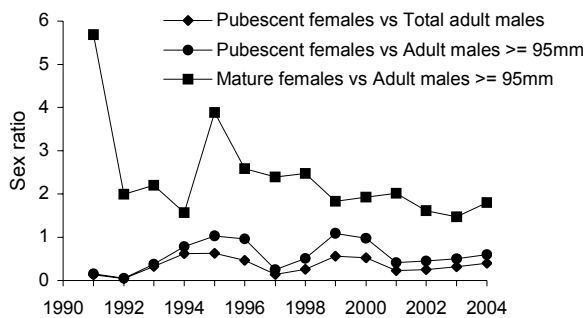
Biological characteristics such as **recruitment and growth pattern** in the southeastern Gulf seem to differ from those in the southwestern Gulf. These biological parameters need further investigations.

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 a unit of the southeastern Gulf of St. Lawrence.

In that large unit, the abundance index of the pubescent females increased from 8.3 million in 2001 to 14.5 million in 2003. In 2004, the abundance index of these females decreased to 11.1 million of individuals. The main concentrations were located in the northern and southern parts of Area 19 and in the Cape Breton Corridor. The abundance index for the **spawning stock** (mature females) has been decreasing since 2002 (86.2 million) to reach 66.8 million in 2004. The main concentrations were located mostly in the southern and middle parts of Area 19 and in the Cape Breton Corridor.

The **sex 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, 2000-2004).

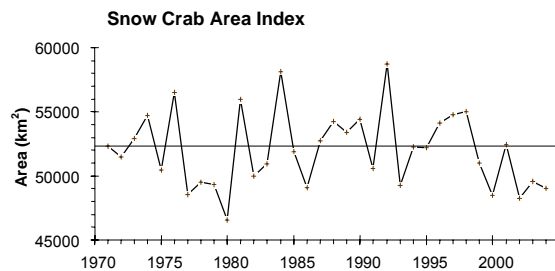
Sex ratio between different categories of females and males in the southeastern Gulf of St. Lawrence



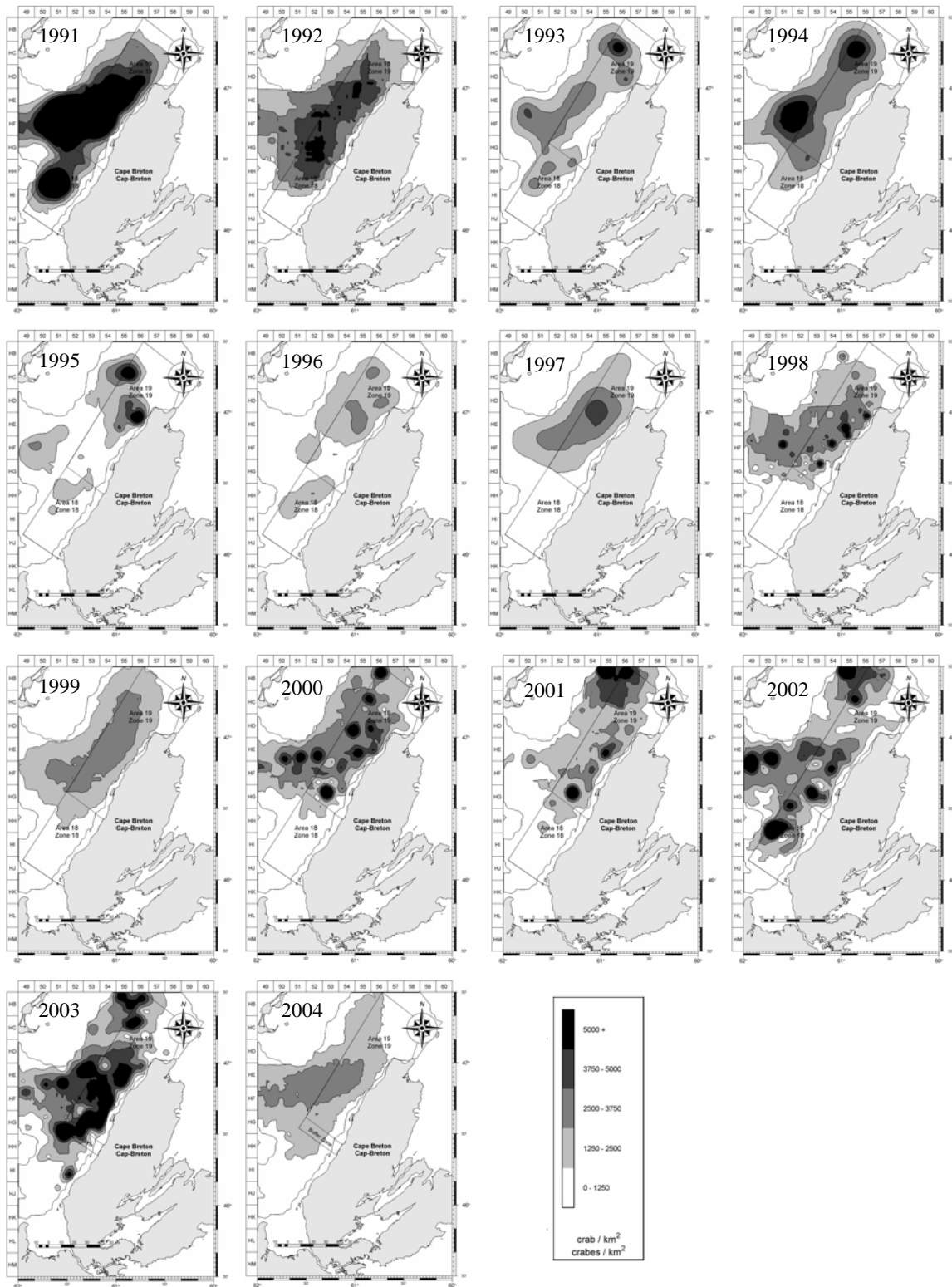
Close monitoring of the key events on population reproductive output (e.g., sex ratio, fecundity, recruitment to the early benthic stages) is necessary to detect any anomalies on the quality and quantity of the spawning stock and subsequent recruitment.

Ecosystem Considerations

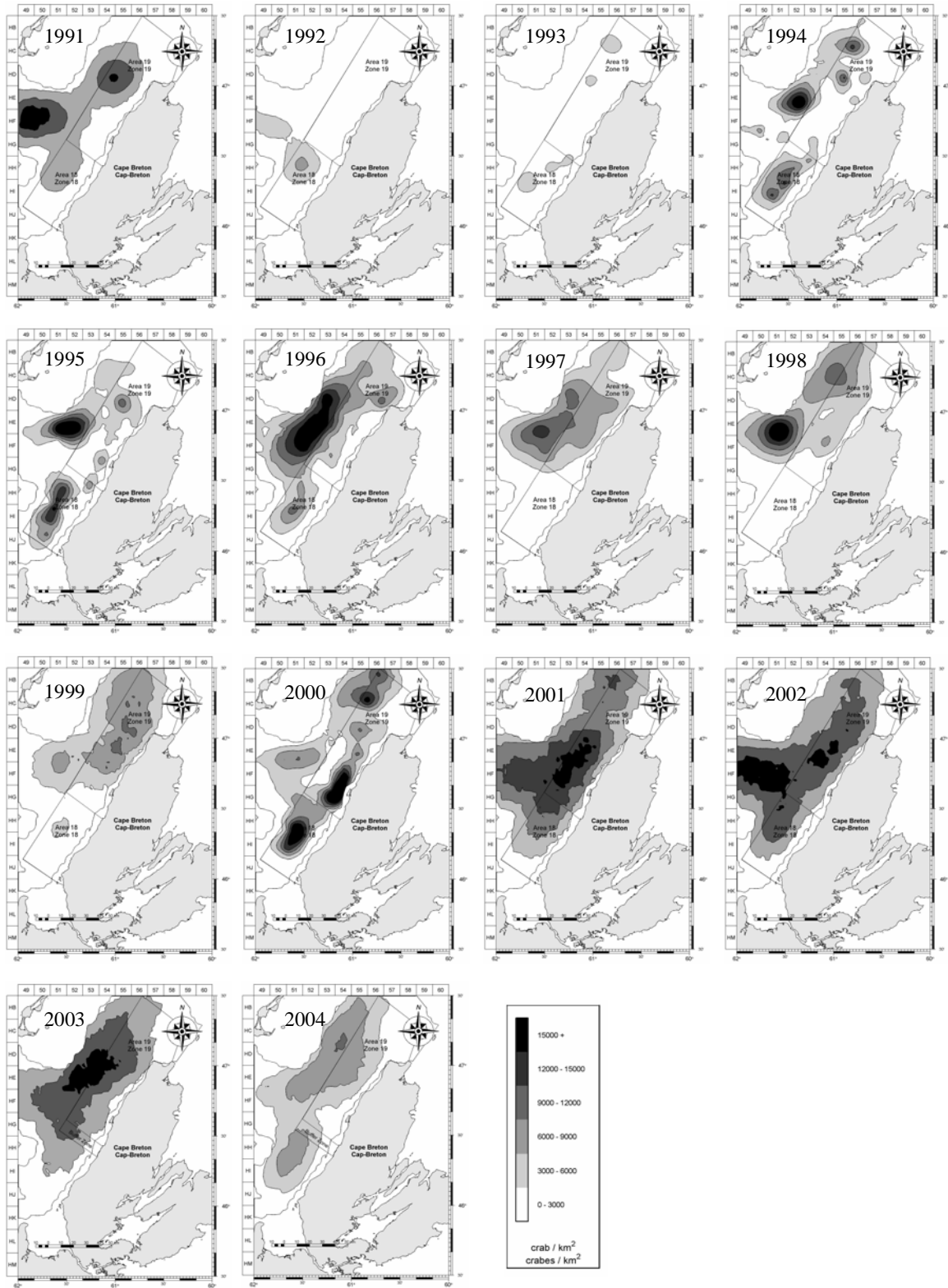
Environmental factors, such as water temperature, can affect the growth and reproductive dynamics as well as the movement of crab. Chassé et al. (2005) reported that the bottom temperatures over a stripe extending from Baie des Chaleurs to Western Cape Breton on the Magdalen Shallows, were below (colder) 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 (-1 °C to 3 °C) decreased compared to 2003 and is below the long-term average.



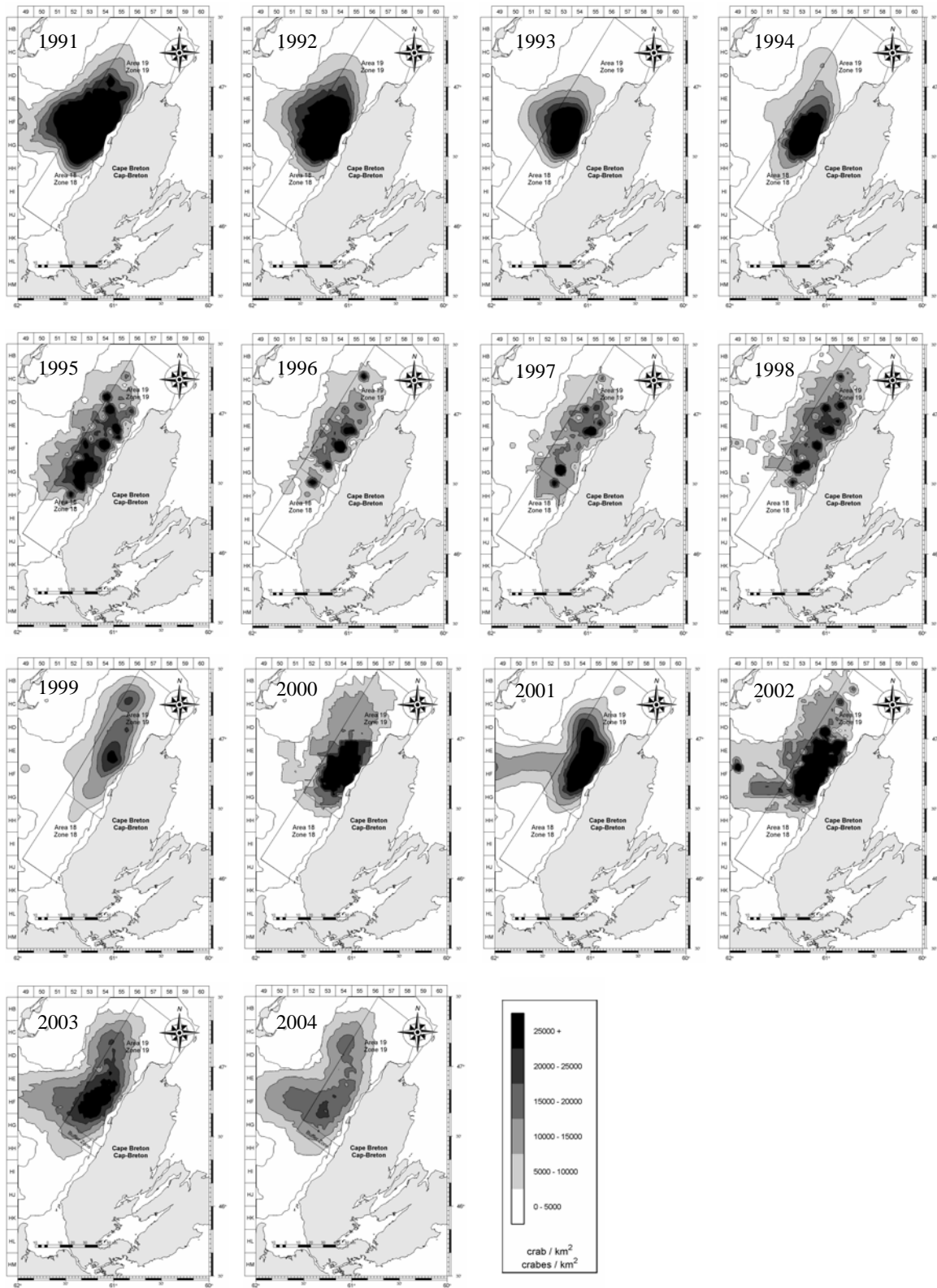
Density (crab/km²) Contours of Adult Male Crab ≥ 95 mm CW



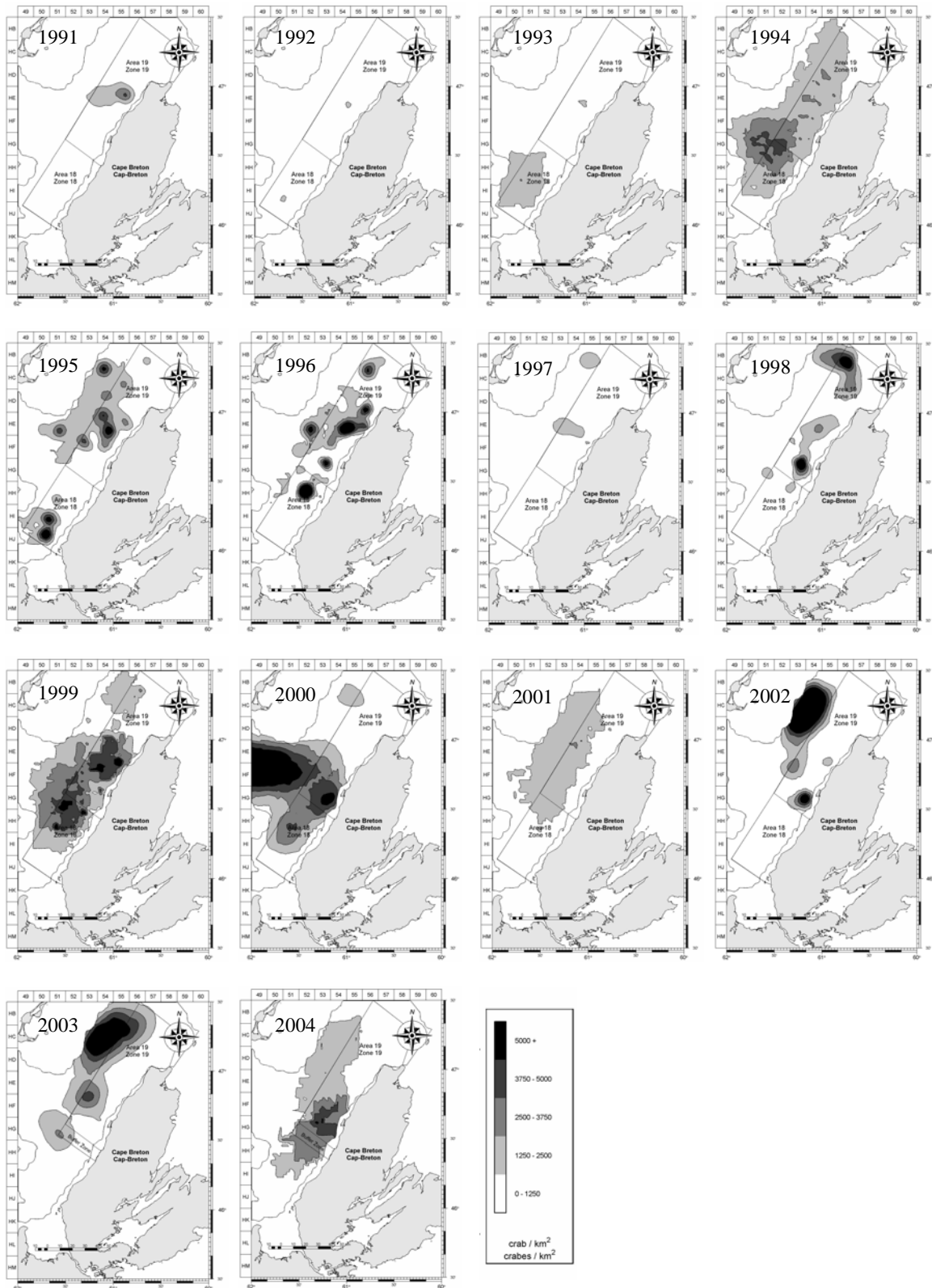
Density (crab/km²) Contours of Adolescent Male Crab ≥ 56 mm CW



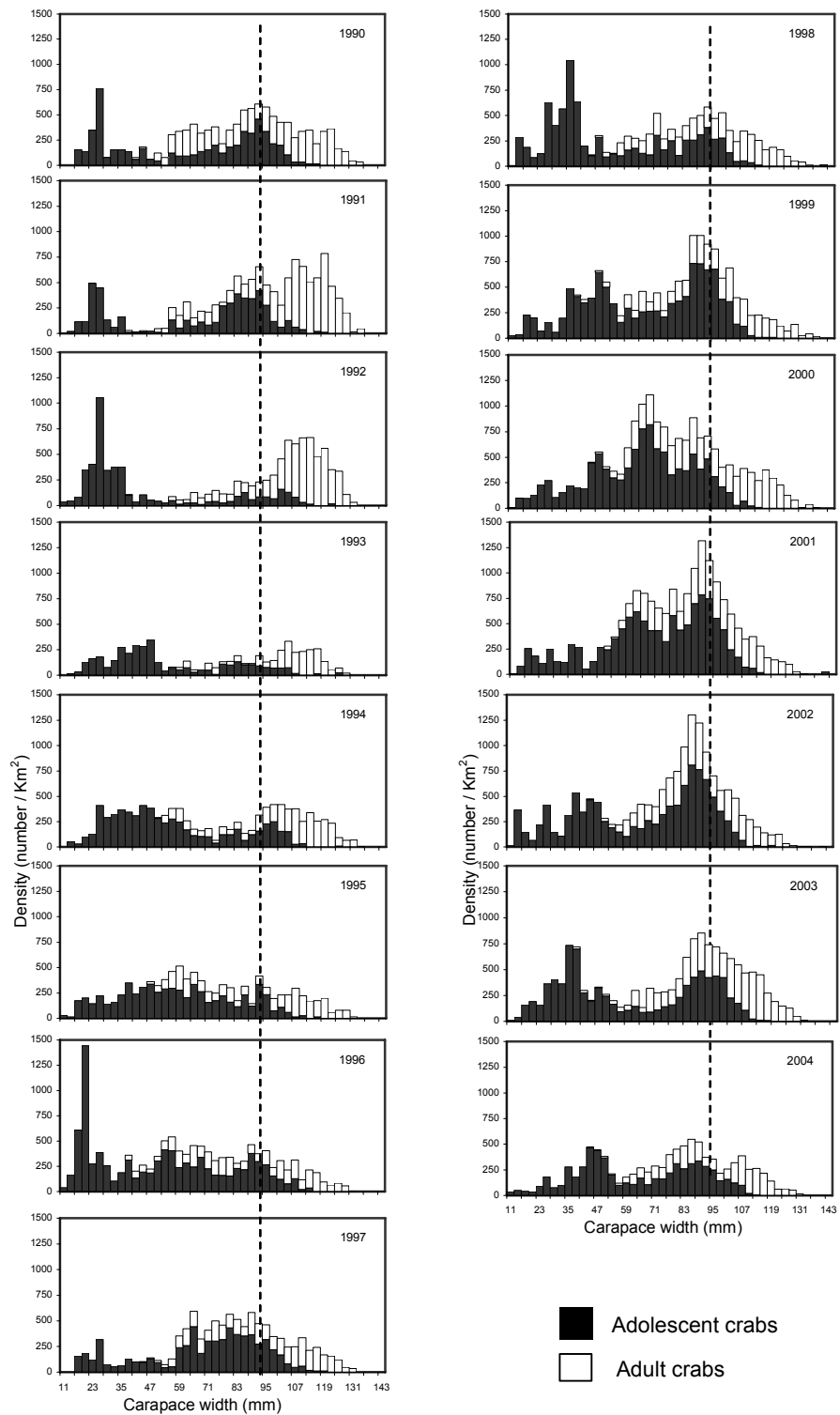
Density (crab/km²) Contours of Mature Females



Density (crab/km²) Contours of Pubescent Females



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



Outlook

A decline in the recruitment to the fishery is expected after 2005, because of the decrease in abundances of R-4, R-3 and R-2 since 2001. In addition, the scarcity of crab < 56 mm CW observed in the 2004 trawl survey may indicate the existence of a recruitment trough, which may reduce the recruitment to the fishery for the next 3 to 5 years. The distribution and abundance of prerecruits > 56 mm CW observed during the 2004 trawl survey could be an indicator of high incidences of soft-shelled crabs in catches if the fishing effort is too high.

A decrease in the commercial biomass index is now expected for the next 3 to 5 years. This decrease in the commercial biomass index in Area 19 could be accentuated by the migration of commercial-sized adult males toward the center of Area 12 where the commercial biomass index in Area 12 will decrease after 2005.

Management Considerations

The commercial biomass index for the next 3 to 5 years is expected to decline and the rate of this decline could depend on the level of movement and rate of exploitation in Area 19 and adjacent areas.

The commercial biomass index estimated from the 2004 September trawl survey may not reflect the availability of commercial biomass at the beginning of the 2005 fishing season depending on the amount of fishing effort put outside Area 19. One of the solutions will be to conduct a June trawl survey just before the opening of Area 19 fishery to estimate the level of commercial biomass prior to the fishery and therefore, readjust the fishing strategy accordingly.

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

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

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