

## Western Cape Breton Snow Crab (Area 18)

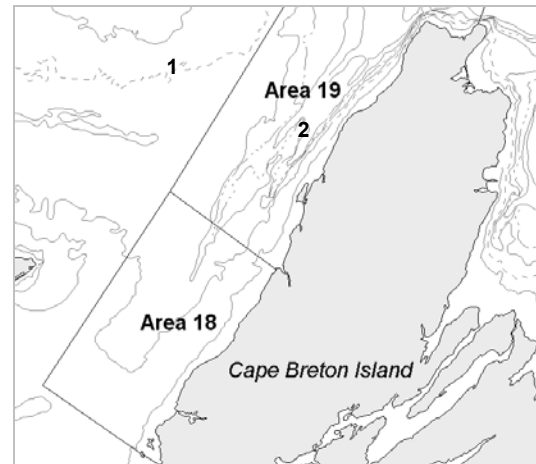
### Background

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 (<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 after their final moult, in which they acquire a wider abdomen for carrying egg. 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 as small as 40mm. 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 the late summer in Area 18. Neither soft-shelled nor white crabs are harvested.

Management of this fishery is based strictly on quotas and effort controls (number of licenses, trap limits and seasons).



1. Cape Breton Corridor
2. Cape Breton Trough

### Summary

- Crabs in management Area 18 are part of a larger biological population, including crab in adjacent Areas 19, F and Area 12. Any biological key events observed in the southern Gulf of St. Lawrence may have subsequent impacts on the biomass condition in Area 18.
- Seventy-two percent of the 2002 quota (680 t) was reached.
- Catch per unit effort (CPUE) increased from 15.3 kilograms per trap haul (kg/th) in 2001 to 18.6 kg/th in 2002, but remained low relative to the mean CPUE observed during the 1991-2000 period (39.5 kg/th).
- The mean size of commercial-sized crabs in sea samples has been decreasing since 1995.
- The 2002 survey biomass index of commercial-sized crabs (3,440 t ± 48 %) represents a 323 % increase compared to the 2001 estimate (1,065 t ± 115 %) and the highest recorded since the beginning of the survey (1992).

- Ninety-six percent of this survey biomass index is composed of new recruitment (3,285 t ± 47 %).
- Abundance of prerecruits (R-3 and R-2) remains high, which may increase the recruitment to the fishery for the next 2 or 3 years.
- Although the survey biomass index of commercial-sized crabs was estimated at its highest observed level, the exploitation strategy for next year should be set to allow an accumulation of residual biomass. It is also important to consider the factors of uncertainty (seasonal movement of crabs, possible overestimation of survey biomass index) and some negative signs of the stock condition (low CPUE, decrease in the mean size of commercial-sized crabs and high dependency on the new recruitment).

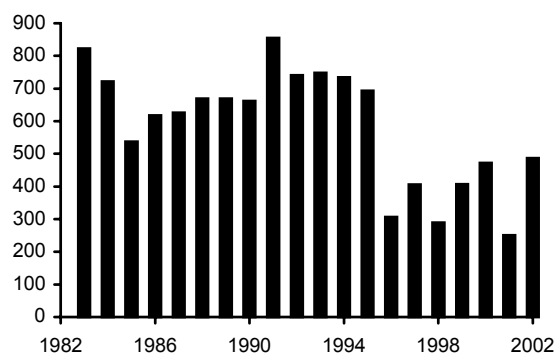
### The Fishery

In 2002, the fishery in Area 18 was opened on April 15 and closed on August 10. The fishery was inactive between June 1<sup>st</sup> and July 3<sup>rd</sup>. The 2002 quota was increased from 476 t in 2001 to 680 t, but landings only reached 72 % of the quota. The fishing effort in 2002 was estimated at 26,414 trap hauls, an increase of 60 %, compared to 2001 (16,446 trap hauls). As usual, the majority of the fishing effort and landings was located in one or two small areas at the northern boundary of the Area. The average catch rates (CPUE) in 2002 was estimated at 18.6 kg/trap haul (th), an increase of 22 % compared to 2001 (15.3 kg/th).

For the first time since 1999, the percentage of **soft-shelled crabs** decreased in Area 18. This annual

percentage was 5.0 %, compared to 8.4 % in 2000 and 8.6 % in 2001. The **mean size of commercial-sized crabs** in sea samples has been decreasing since 1995 from 118.6 to 106.7 mm of carapace width (CW).

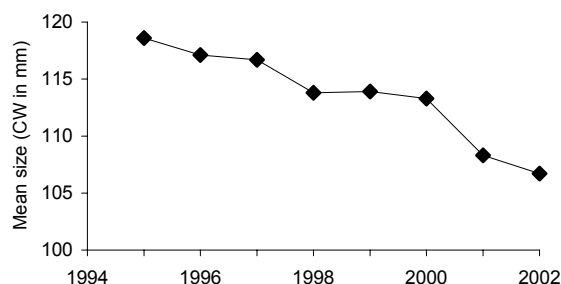
Landings (t) in Area 18



Quotas (t) and Landings (t) and Catch Performance in Area 18

	1997	1998	1999	2000	2001	2002
Quota	580	411	408	476	476	680
Landings	406	289	407	472	251	487
CPUE	18.1	18.0	34.5	32.1	15.3	18.6
Soft crab (%)	13.1	17.1	3.2	8.4	8.6	5.0

Mean size of commercial-sized crabs in Area 18



**Carapace condition** was estimated from sea samples taken during the 2002 fishery. Carapace conditions 3 and 4 represented 85 % of the catches.

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

Condition	Description	Percentage
1-2	White crab	14.3
3	Intermediate	64.8
4	Old crab	20.2
5	Very old crab	0.7

### **Resource Status**

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 index (R-2 and R-3) and females (pubescent and mature) as future and current spawning abundance index. 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 index of the potential presence of soft-shelled crabs that may enter commercial traps the following fishing season.

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 their second brood or older. The term mature females, also refers to the spawning stock, includes

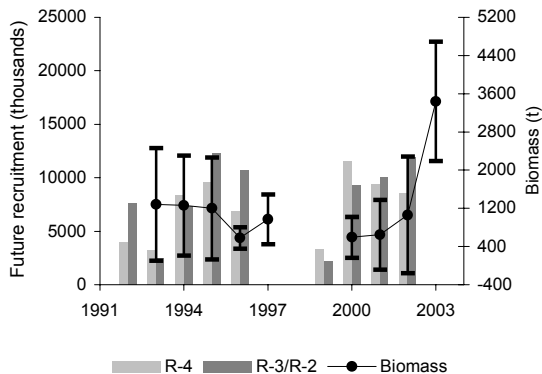
primiparous and multiparous females (excluding senile females).

The survey has been conducted each year since 1990, except for 1997 and 1998. As the concentration of biomass straddles the boundaries of Areas 12, 18 and 19, seasonal movements of crab among these areas will affect the biomass level in any given area.

Up to 2001, the survey biomass index of commercial-sized crabs (survey biomass index) had often been interpreted as an absolute estimate of biomass. These estimates were based on two assumptions. First, except for very old crab, there was no loss (mortality) between the time of the survey and the beginning of the fishing season 9 months later. Secondly, the trawl caught 100 % of crabs larger than 40 mm CW. New information has raised the need for further investigations on these assumptions. As a result, the survey estimates should be considered as relative indices of abundance.

**The 2002 survey biomass index** is 3,440 t ( $\pm 48$  %), which represents an increase of 323 % from the 2001 estimate (1,065 t  $\pm 115$  %). The recruitment to the fishery index is 3,285 t ( $\pm 47$  %) constituting 96 % of the survey biomass index. This survey biomass index is concentrated in the mid-western border between Areas 12 and 18 with another patch of lesser abundance in the northwestern corner of Area 18.

Survey biomass index (t) and abundance indices of future recruitment in Area 18



**Size frequency distributions** of male crabs caught in the trawl survey have been available since 1991. Continuous growth of small crabs found in the 1999 trawl survey towards larger size categories was observed through the years and became the main component of the biomass index for the 2003 fishing season.

The abundance of R-3 for 2002 (7.1 million) has remained at a high level since 2000. The abundance of R-2 has been continuously increasing since 2000 from 3.9 to 4.9 million in 2002. However, this abundance of prerecruits may not necessarily contribute to the future biomass as it is uncertain whether this potential recruitment to the fishery will stay within the area after molting to adult phase. The increase of the survey biomass index suggests that the recruitment of previous years has stayed within the Area, contrary to what happened during 1995-1996 when a high abundance of prerecruits did not contribute to the subsequent increase in biomass indices. The mechanism of retention and the seasonal movement after the survey of the commercial biomass is unknown in this Area.

## Sources of Uncertainty

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

The natural mortality for commercial-sized crabs was estimated from 26 to 40 % between the time of the survey and the following fishing season. However, at the present time, the natural mortality is not included in the biomass estimates. Therefore, the trawl survey estimates should be considered as relative indices of abundance.

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. This needs further study.

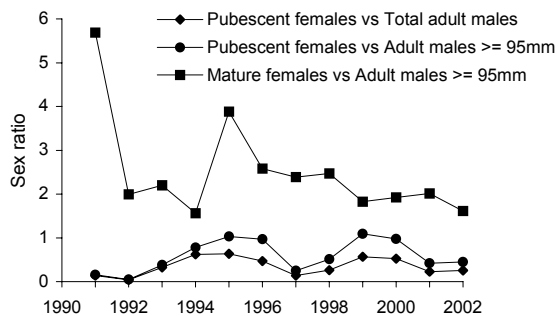
**The reproductive potential of the stock** for Areas 18 and 19 is evaluated as part of a larger biological unit that also includes Area F and part of Area 12. This entire area is considered as

the unit of the southeastern Gulf of St. Lawrence.

In that large unit, the abundance index of the pubescent females increased from 10 to 12 million between 2001 and 2002. The main concentrations were located in Area 18, the northern part of Area 19 and in the Cape Breton Corridor. The abundance index for the **spawning stock** (mature females) also increased from 40 million in 2001 to 43 million in 2002. The main concentration was located in the Cape Breton Trough (Area 19).

The **sex ratio**, within the southeastern Gulf, between pubescent females and all adult males or adult males  $\geq 95$  mm CW has always been close to or less than 1 female to 1 male (1F:1M) since 1991. For mature females, the ratio was under 3F:1M except for 1991 and 1995.

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

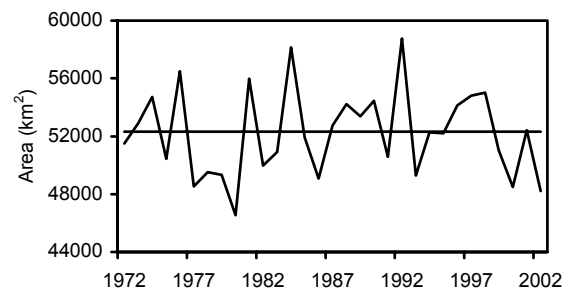


Close monitoring of the biological key events on population reproductive output (e.g., sex ratio, fecundity, spermathecal load, recruitment to the early benthic stages) is necessary to detect any anomalies on the quality and quantity of the spawning stock and subsequent recruitment.

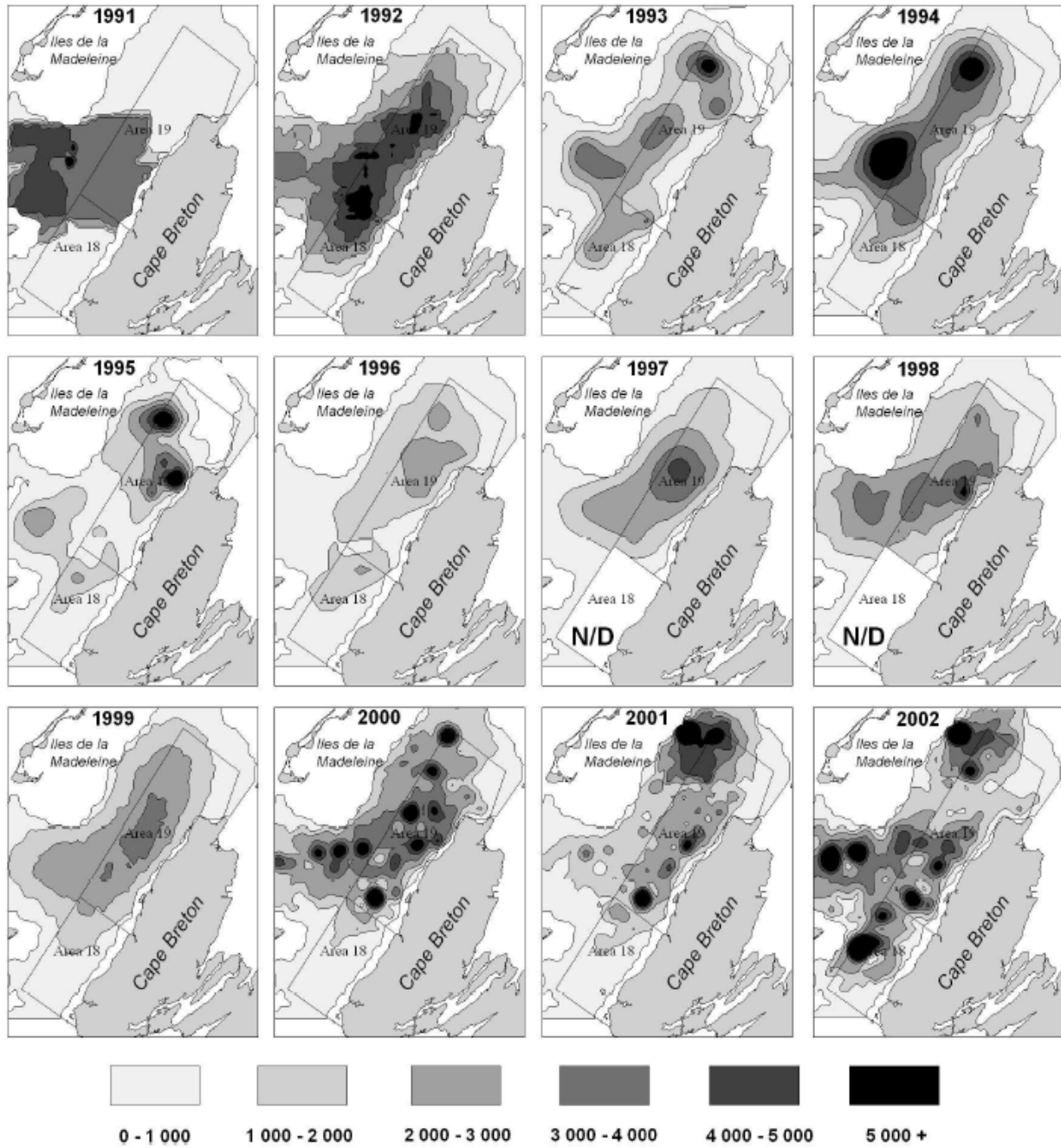
## Ecosystem Considerations

Environmental factors, such as the water temperature, can affect the molting and reproductive dynamics as well as the movement of crab. Bottom temperatures over most of the southern Gulf of St. Lawrence are  $<3^{\circ}\text{C}$ , which is considered ideal thermal habitats for snow crab. Bottom temperatures in Areas 18 and 19 are typically  $1^{\circ}\text{--}2^{\circ}\text{C}$  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 2002 was covered by water of temperatures  $<1.5^{\circ}\text{C}$  whereas in Areas 18-19 it was  $<3^{\circ}\text{C}$ . Near-bottom temperatures at most depths in Areas 18-19 during 2002 were generally observed to be warmer than the long-term (1971-2000) average. This is consistent with the decrease in the Gulf wide snow crab habitat index (area of the bottom covered by water temperatures between  $-1$  and  $3^{\circ}\text{C}$ ) and the increase in the average temperature within this area. In spite of the increase, the temperature conditions are still considered favorable for snow crab.

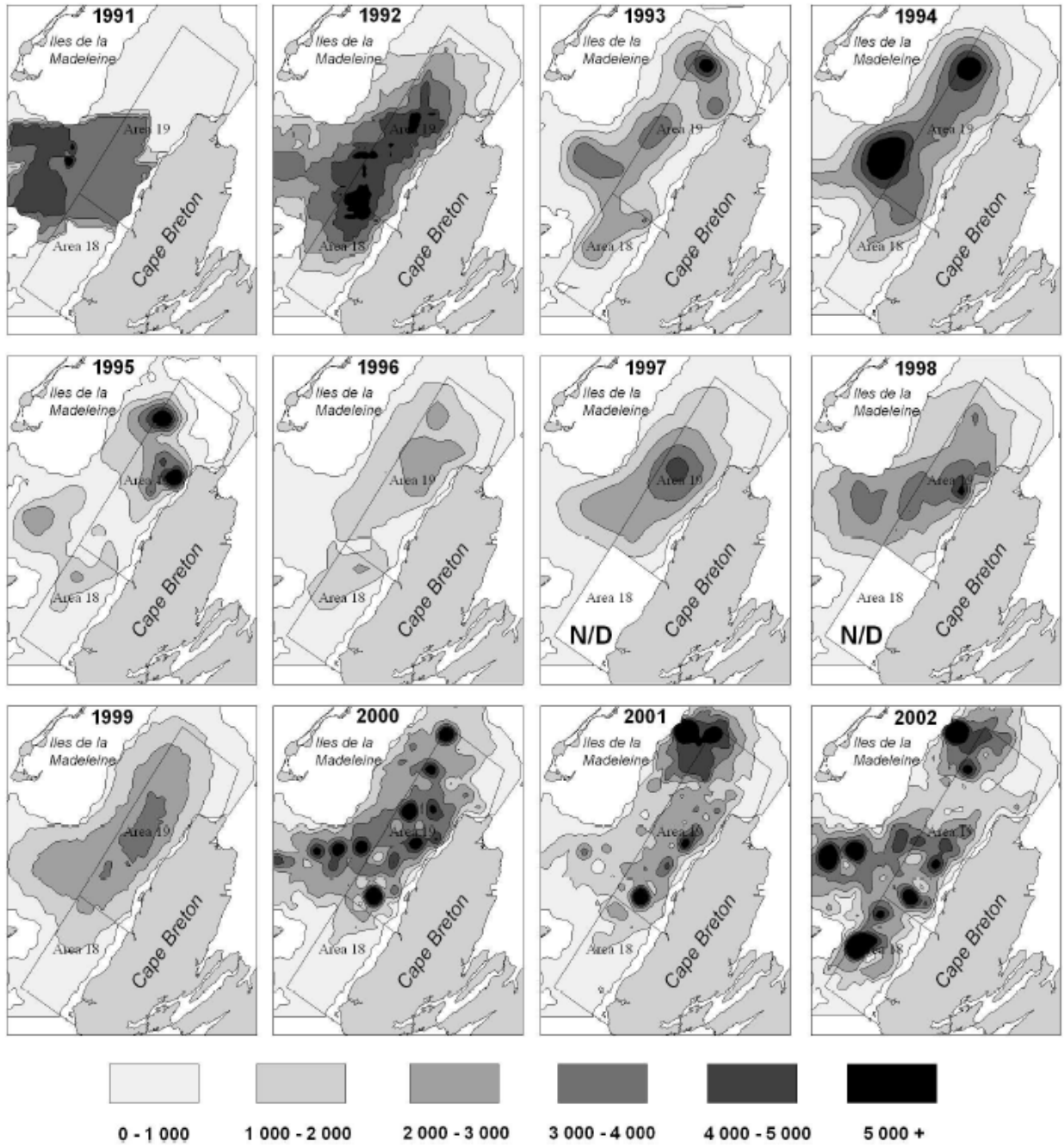
Snow crab habitat index



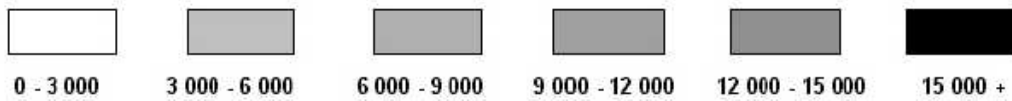
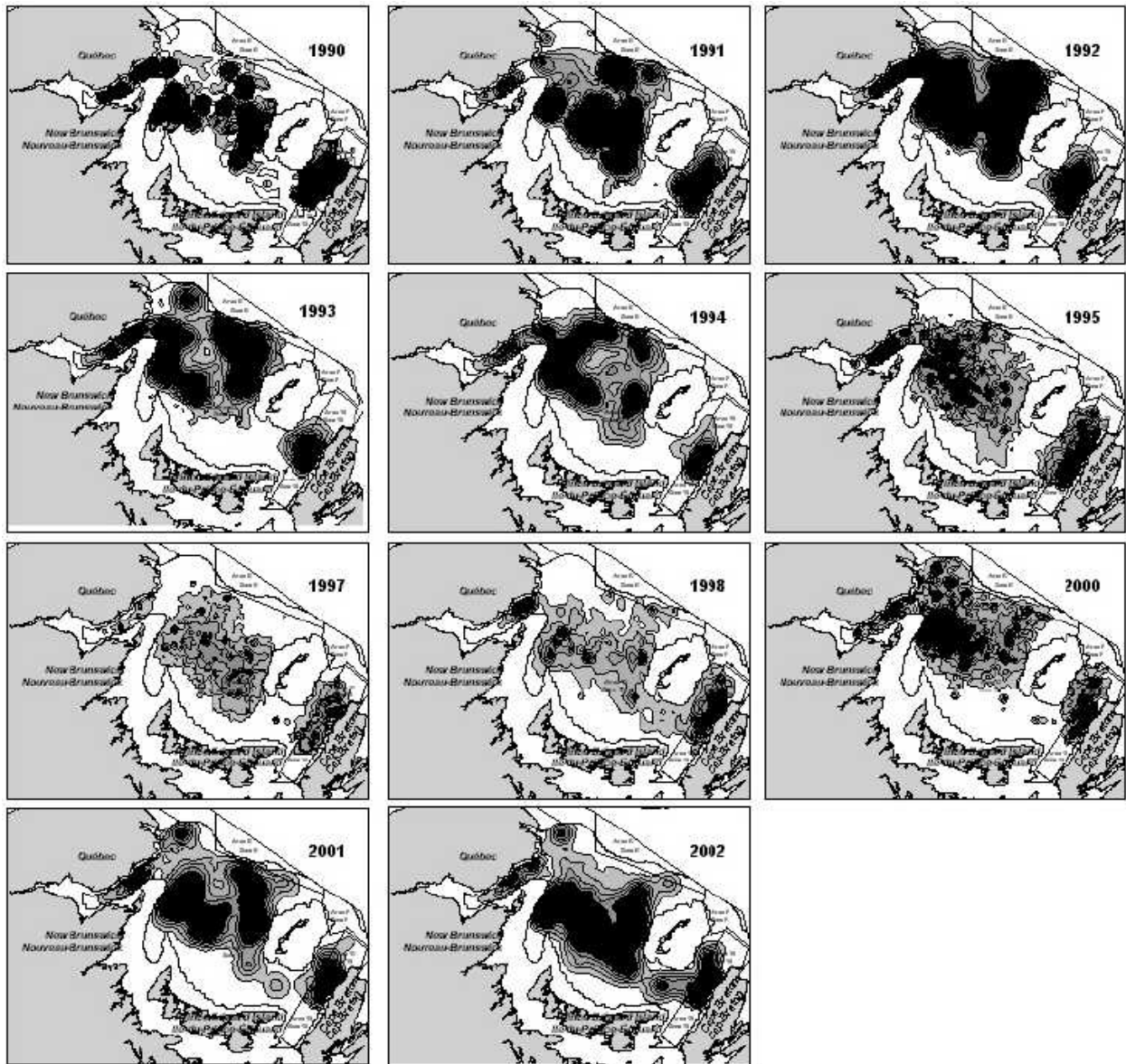
Density (crab/km<sup>2</sup>) Contours of Adult Male Crab ≥95mm CW



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

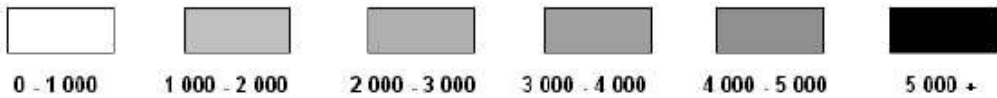
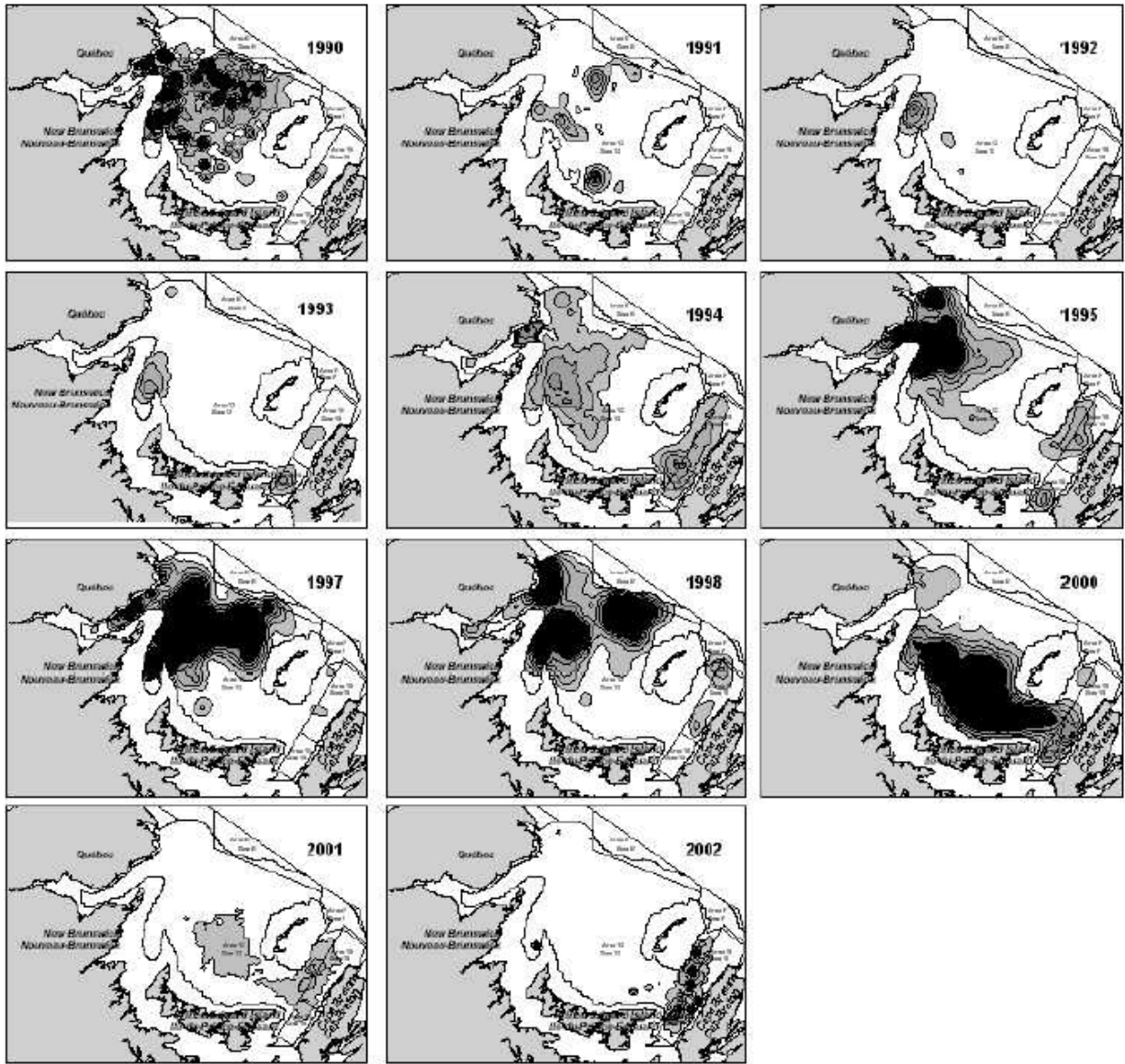


Density (crab/km<sup>2</sup>) Contours of Mature Females

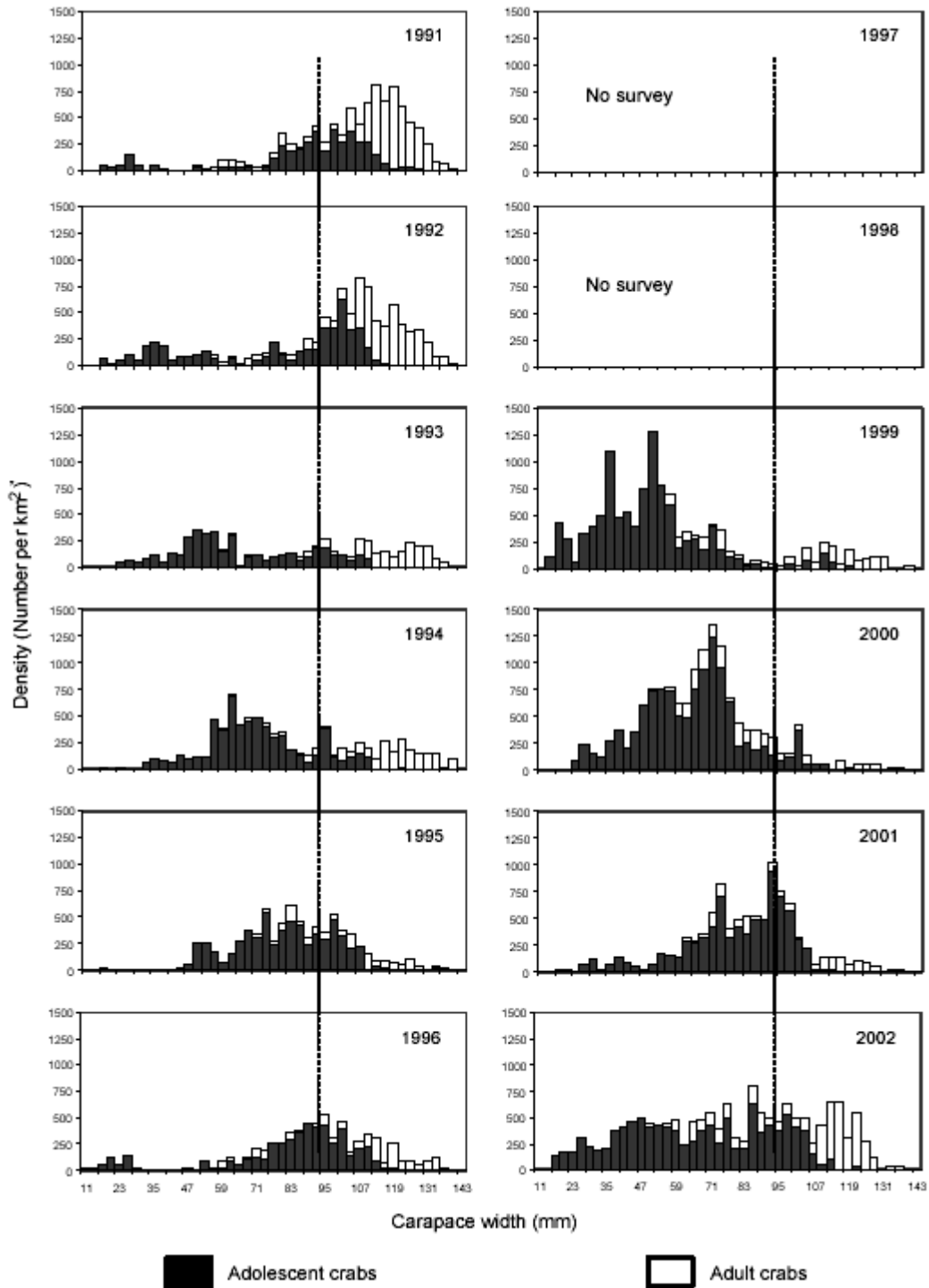




Density (crab/km<sup>2</sup>) Contours of Pubescent Females



**Size Frequency Distributions of Male Crab  
Sampled During the Trawl Survey in Area 18**



## Outlook

The 2002 survey biomass index (3,440 t  $\pm$  48 %) has tripled compared to the 2001 estimate (1,065 t  $\pm$  115 %). This biomass index is composed of 96 % of new recruits (3,285 t  $\pm$  47 %). On a negative note, CPUE in 2002 (18.6 kg/th) remained low relative to the mean CPUE observed during the 1991-2000 period (39.5 kg/th) and the mean size of commercial-sized crabs has been decreasing since 1995. However, the abundance of future recruitment increased. Therefore, there is a possibility for the biomass index to increase over the next couple of years depending on the seasonal movement of crab and the level of exploitation.

On a cautionary note, a high abundance of adolescent males larger than 56 mm CW may result in a high incidence of soft-shelled/white crab depending on the exploitation level.

## Management Considerations

Although the survey biomass index of commercial-sized crabs was estimated at its highest observed level, the exploitation strategy for next year should be set to allow an accumulation of residual biomass. It is also important to consider the factors of uncertainty (seasonal movement of crabs, possible overestimation of survey biomass index) and some negative signs of the stock condition (low CPUE, decrease in the mean size of commercial-sized crabs and high dependency on the new recruitment).

Management measures are necessary to protect the soft-shelled crabs (the future recruitment to the fishery).

## For more Information

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