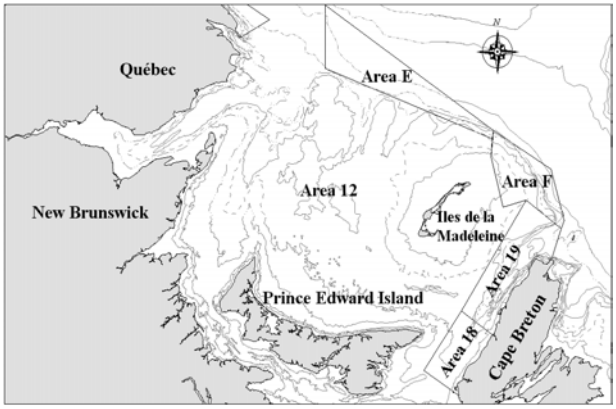
Fisheries and Oceans / Pêches et Océans
Gulf Region

DFO Science
Stock Status Report C3-01(2002)

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



Southern Gulf of St. Lawrence Snow Crab Management Zones

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 (categories 1 and 2 respectively).

Unlike lobster, snow crab do not continue to moult throughout their lives. Females stop growing after their final moult, in which they acquire a wide abdomen for carrying eggs, which occurs at shell widths less than 95mm. Males stop growing after their final moult, in which they acquire large claws on the first pair of legs, and which can occur at shell widths as small as 40 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 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 males to reach legal size.

The snow crab fishery in Area 12 has been exploited by 130 mid-shore fishermen from New Brunswick, Quebec and Nova Scotia. Area 12 and exploratory Areas (E and F) each have separate management schemes. Since 1997, the PEI coastal fishery, (Area 25/26) has been integrated into Area 12 to form one management unit. For the purpose of this assessment, Area 12 refers to the new management unit. There is no biological basis for 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 strictly on quotas and effort controls (number of licenses, trap limits and seasons). Based on management considerations and resource availability, temporary licenses were issued in 2001 for Area 12.

Summary

- In 2001, in the Area 12, landings were 13,819t and equalled the quota, 85% of the landings were caught in the first five weeks of the fishery.

- The percentage of soft-shelled crab was 6.2%, 50% less than the 2000 level.

- CPUE was 42.3 kilograms per trap hauls (kg/th), 25% higher than the 2000 level. The increased catch rate was related to the increase abundance of commercial crab.

- A firm estimate of stock biomass is not available. Based on the method used for the past decade, the commercial biomass estimate of 36,100t would be comparable to values used in previous years. This value is 25% higher than in 2001, 70% of this biomass will be new recruitment.

- All indicators in the 2002 fishery are positive:
  - Strong recruitment is expected for the next three or four years. The pre-recruits R-3 and R-2 are well above the average of the past ten years.
  - Carapace size is increasing.
  - There is no excess of mossy or old-carapace crabs.
  - The pre-recruits are widely distributed throughout the southern Gulf.

- It is not possible to accurately estimate an exploitation rate. However, a 2002 quota ranging between 25 and 60% increase over last year's quota would be unlikely to have any significant short term impact on the reproductive potential of the stock.

- An exploitation strategy reflecting a 60% increase over last year's quota could increase the incidence of soft-shelled crabs in the catches, resulting in an increased mortality of these crabs in the short term.

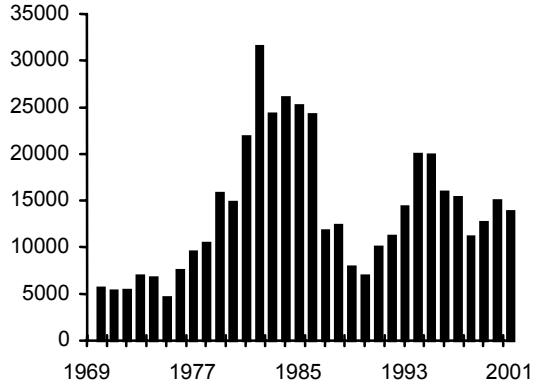
- In Area E, landings were 155t; the quota was 163t. CPUE was 23.2kg/th and has remained low since 1998. There is no biological reason to change the quota.

- In Area F, landings were 378t and equalled the quota. CPUE was 63.0kg/th, 11% higher than 2000. The current indicators are positive, a quota increase may be possible for next year.

The Fishery

In **Area 12**, for the first time since 1997, temporary licenses were attributed to non-traditional fishermen. Their landings reached 1,381t (quota of 1,385t). The traditional and the aboriginal fishermen recorded landings of 12,438t (quota of 12,434t). The fishermen holding exploratory fishing licenses for **Areas E and F** achieved landings of 155t and 378t (quota of 163t and 377t), respectively.

Landings (t) in Area 12



In Areas 12, E and F, the fishing season began on April 20th and ended July 20th. All fishermen from each area achieved their quota excluding Area E (95%).

Quota (t), Landings (t) and Catch Performance in Area 12

	1996	1997	1998	1999	2000	2001
Quota	16,100	15,400	11,125	12,686	15,500	13,819
Landings	15,978	15,413	11,136	12,682	15,046	13,819
CPUE	50.1	50.8	45.8	43.9	34.5	44.3
Mean size (mm)	113.1	114.5	114.4	112.7	109.1	112.2
Soft crab (%) in catches	4.2	5.0	2.8	4.9	12.5	6.2

Quota (t), Landings (t) and Catch Performance in Area E

	1996	1997	1998	1999	2000	2001
Quota	163	163	163	163	163	163
Landings	163	163	161	159	150	155
CPUE	60.3	34.7	28.6	29.4	22.9	23.2
Mean size (mm)	115.1	114.1	111.5	109.6	105.8	106.1
Soft crab (%) in catches	4.6	4.3	2.9	8.0	8.3	0.7

Quota (t), Landings (t) and Catch Performance in Area F

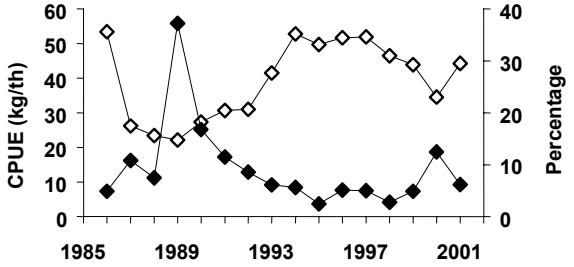
	1996	1997	1998	1999	2000	2001
Quota	238	288	288	288	288	377
Landings	238	287	290	290	291	378
CPUE	42.4	44.9	48.1	57.2	56.7	63.0
Mean size (mm)	114.7	113.9	110.6	108.5	107.9	108.7
Soft crab (%) in catches	5.3	1.5	1.1	1.1	2.4	1.3

Catch rates (CPUE) are calculated from logbooks and must be viewed with caution because (1) fishers are provided with maps showing crab concentrations before the opening of the fishery, (2) CPUE is affected by socio-economic factors, and (3) the soft-shelled crab protocol may have an impact on the fishing performance due to the movement of fishing effort from areas of high concentrations of soft-shelled crab. On the other hand, the percentage of soft-shelled crab and the mean size of commercial adult crabs are calculated using the data gathered from the at-sea observer program. Mean CPUE increased in 2001 compared with 2000 from 34.5 to 42.3 kg/th and from 56.7 to 63.0 kg/th for Area 12 and F, respectively. Mean CPUE for Area E is practically at the same level in 2001 (23.2 kg/th) compared to the previous year.

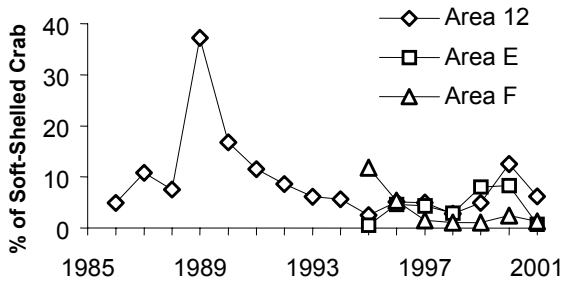
In Area 12, the **percentage of soft-shelled crab** decreased in 2001 (6.2%) compared to the previous year (12.5%). The same trend was seen in Area E (8.3 to 0.7%) and in Area F (2.4 to 1.3%). The decrease of the soft-shelled crab, in Area 12, is mainly related to the fishing strategy used by the fishermen during the season 2001. By

comparing the landings from the first 6 weeks of the last 2 fishing seasons, the fishermen had reached 90% of their landings in 2001 which represents a 23% increase over 2000 (67%). It is the first increase in the mean size of commercial crab since 1997.

CPUE (kg/th) and Soft-Shelled Percentage Crab in Area 12



Percentage of Soft-Shelled Crab in Areas 12, E and F



Carapace condition was estimated from sea samples taken from the 2001 fishery. Crabs with carapace categories 3 and 4 comprised the bulk of the fishery in all areas.

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

Category	Description	12	E	F
1-2	White crab	6.0	0.9	1.7
3	Intermediate	43.8	55.4	69.4
4	Old crab	48.4	42.2	28.5
5	Very old crab	1.8	1.5	0.5

Resource Status

Stock status is primarily based on a **trawl survey**, which provides estimates of the commercial biomass (hard-shelled adult males of legal size) immediately following the fishery. It also provides estimates of soft-shelled adult males larger than 95 mm (R-1) that will become recruitment to the fishery in the following year. Abundance is also estimated for pre-recruits (R-2 and R-3) and females (preprimiparous, primiparous and multiparous). The R-2 represents crabs with a CW larger than 83 mm, which a portion could be available to the fishery in 2 years. The R-3 represents crabs of CW between 69-83 mm, which a portion could be available to the fishery in 3 years. The term preprimiparous defines females with a narrow abdomen and orange gonads that will moult to maturity the following year as primiparous females (first brood). The term multiparous defines females, which are in their second brood or older.

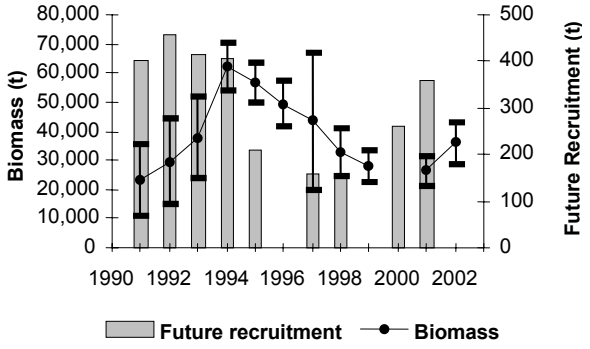
In Area 12, the trawl survey was conducted every year since 1989, except for 1996. The survey in Areas E and F has been conducted since 1997. Up to now, the commercial biomass index has been interpreted as an absolute estimate of biomass. However, these estimates were based on two important assumptions. 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 catchability of the trawl for commercial adult crabs was equal to 100%. Until these factors are assessed, the survey estimate should be considered as a relative index of abundance.

<u>Area 12</u>:

The survey is unable to provide a firm estimate of stock biomass. Nevertheless, based on the method used for the past

decade, the commercial biomass estimate of 36,100t would be comparable to values used in previous years. This value is 25% higher than in 2001, of which 70% is new recruitment. However, about 1% is very old crab that will mate and die and not be available for the 2002 fishing season. The main concentrations of commercial adult crabs are located at Bradelle Bank and the southeastern part of Magdalen Islands near Areas 19 and F. The adolescent males ≥56 mm (R-4, R-3 and R-2) are widely distributed throughout the southern Gulf.

Commercial Biomass Index (t) and Abundance Index of Future Recruitment (Adolescent Crabs ≥56 mm) in Area 12



Areas E and F:

Because of the unknown amount of crab movement in and out of these areas within a given year, the commercial biomass index for these two areas may not be reliable. In both areas, the crab concentrations are near the boundaries.

In Area E, commercial biomass (comparable to the previous years) is 330t (±670t), of which 30% is new recruitment. Concentrations of commercial adult crabs are located in the southwestern part of the zone adjacent to Area 12.

In Area F, commercial biomass (comparable to previous years) is 2,430t (±1,424t), of which 80% is new recruitment. Concentrations of commercial adult crabs are located in the southeastern part of the zone adjacent to Areas 12 and 19.

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

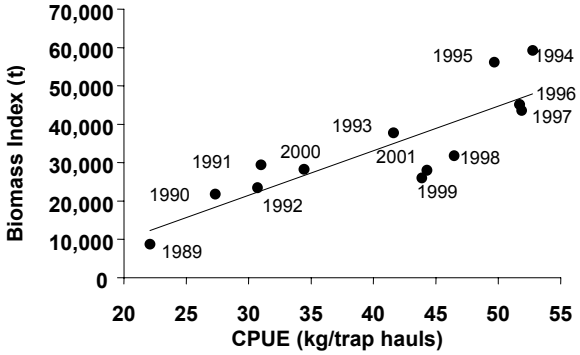
Survey Year	12	E	F
1988	8,700 (± 42 %)	-	-
1989	21,700 (± 53 %)	-	-
1990	23,400 (± 53 %)	-	-
1991	29,400 (± 50 %)	-	-
1992	37,800 (± 38 %)	-	-
1993	62,000 (± 13 %)	-	-
1994	56,700 (± 12 %)	-	-
1995	49,500 (± 16 %)	-	-
1996[1]	43,600 (± 54 %)	-	-
1997	33,000 (± 25 %)	1,460 (56%)	510 (65%)
1998	28,200 (± 20 %)	220 (±125%)	900 (±99%)
1999[2]	-	-	-
2000	26,500 (± 19 %)	160 (± 401 %)	1,510 (± 57 %)
2001	36,100 (± 20 %)	330 (± 205 %)	2,430 (± 59 %)

[1] no survey in Area 12 in 1996.
[2] not reliable due to the incapacity to estimate the swept surface.

Sources of Uncertainty

Research is needed to resolve uncertainties in the population model due to the unknown catchability of commercial-sized crab to the trawl, movement of adult crab in and out of the surveyed area, unknown natural mortality of commercial crabs, errors in the classification of carapace condition and statistical errors in the forecast. The survey is unable to provide a firm estimate of stock biomass. Despite uncertainties in the trawl survey, the commercial biomass index is highly correlated with the catch rate.

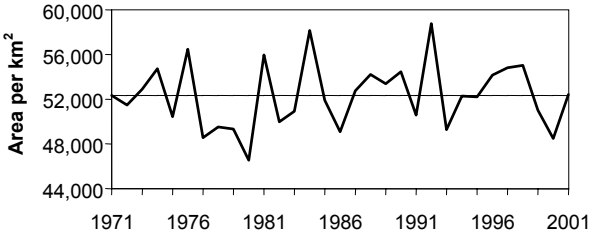
Biomass Index Versus Catch Rates in Area 12



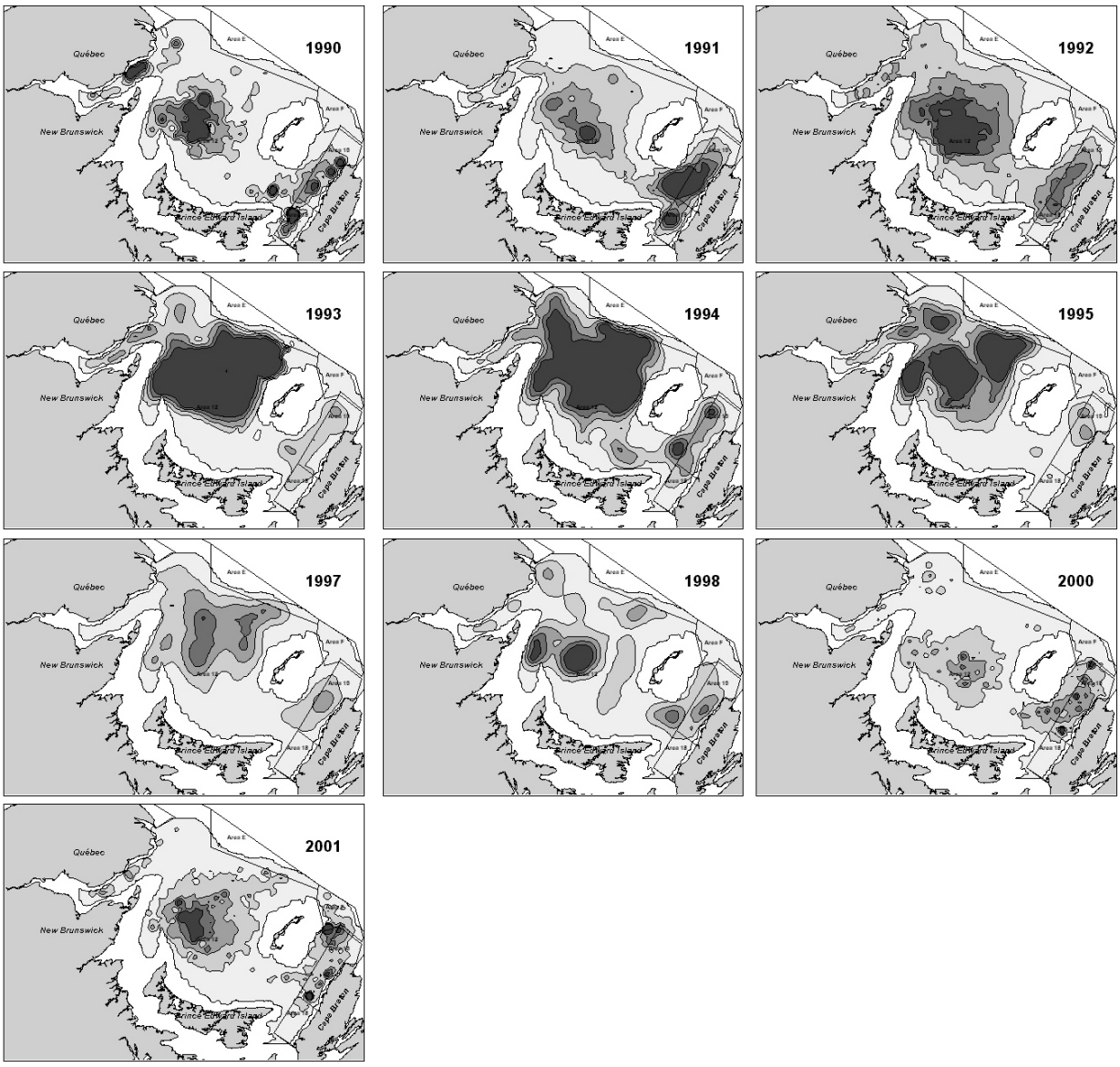
Ecosystem Considerations

Environmental factors such as the water temperature can affect the moulting and reproductive dynamic as well as the movement of crab. Bottom temperatures in the southern Gulf of St. Lawrence and in the northern Scotian Shelf have been in general less than 3°C, which are ideal conditions for snow crab. Bottom temperatures in deeper waters of Area E are higher (1 to 5°C) than traditional crab grounds (-1 to 0°C) in Area 12 (50 to 100m). This range of temperature is at the upper physiological tolerance threshold for snow crab based on aquarium observations. Bottom temperatures within the snow crab areas of the southern Gulf were generally colder than average in 2001, there was an increase in the snow crab habitat index during the September groundfish survey. This was largely due to a significant increase in area covered by temperatures of 0-1°C and more crabs were caught in the annual snow crab survey at these temperatures. In spite of the generally colder conditions, there was a decrease in the area of the bottom covered by temperatures less than 0°C compared to 2000. Lower water temperatures in 2001 are possibly due to cold water advected into the Gulf of St. Lawrence from Labrador Shelf through the Strait of Belle Isle. The present temperature conditions are considered favourable for snow crab.

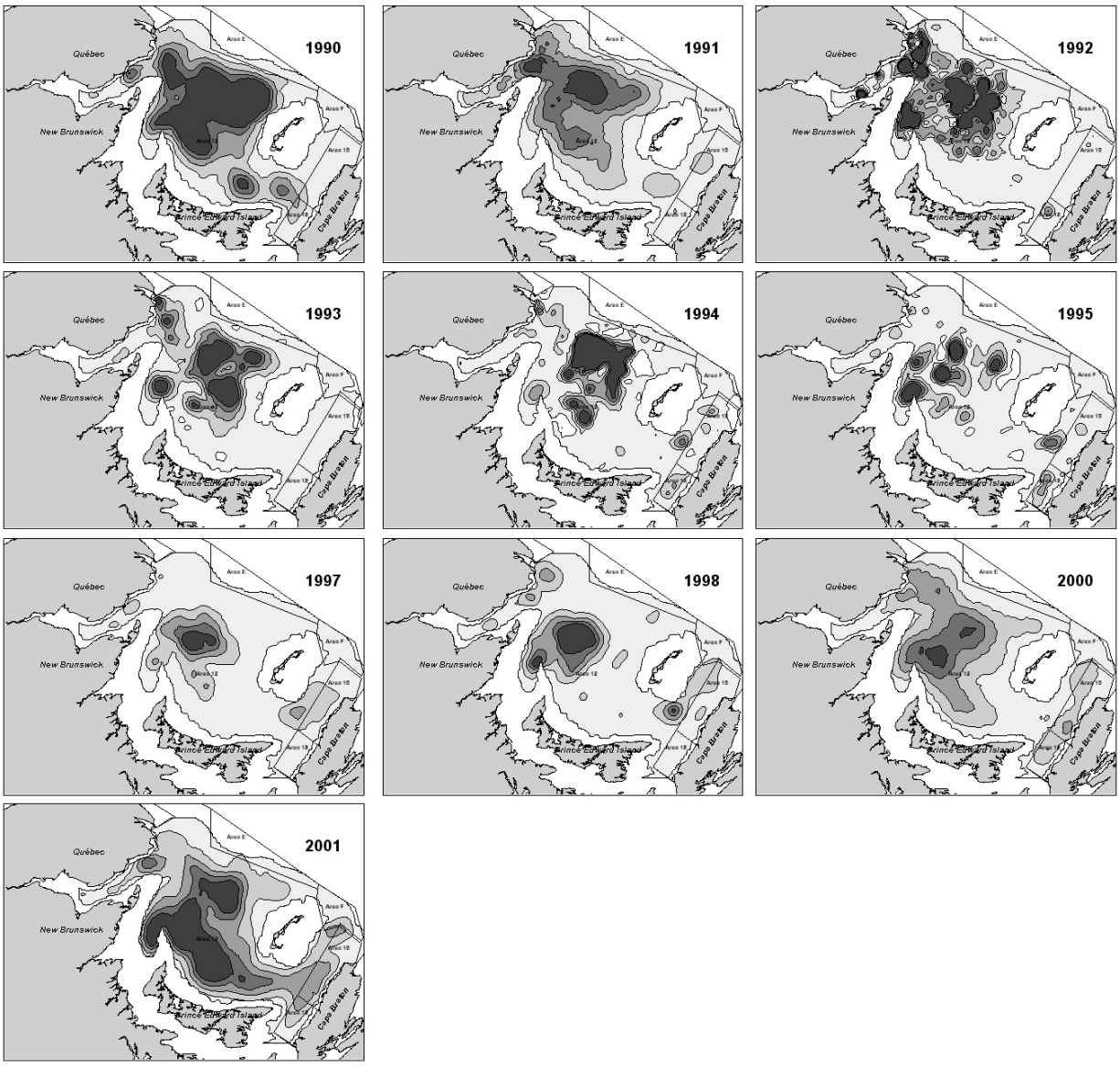
Snow Crab Habitat Index



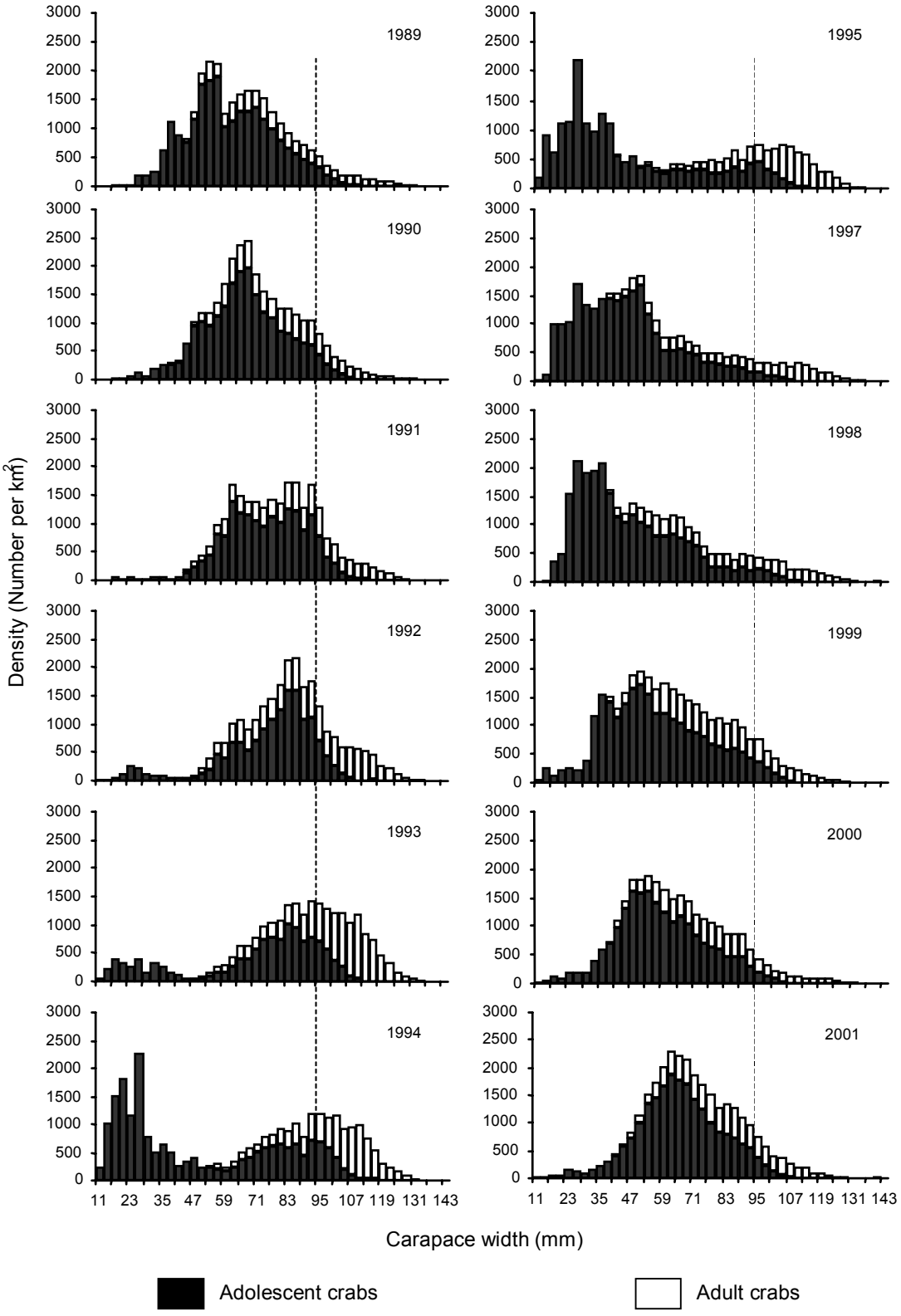
Density (crabs per km^2) Contours of Adult Male Crabs ≥95 CW Based on the Trawl Survey Between 1990 and 2001 in the Southern Gulf of St. Lawrence



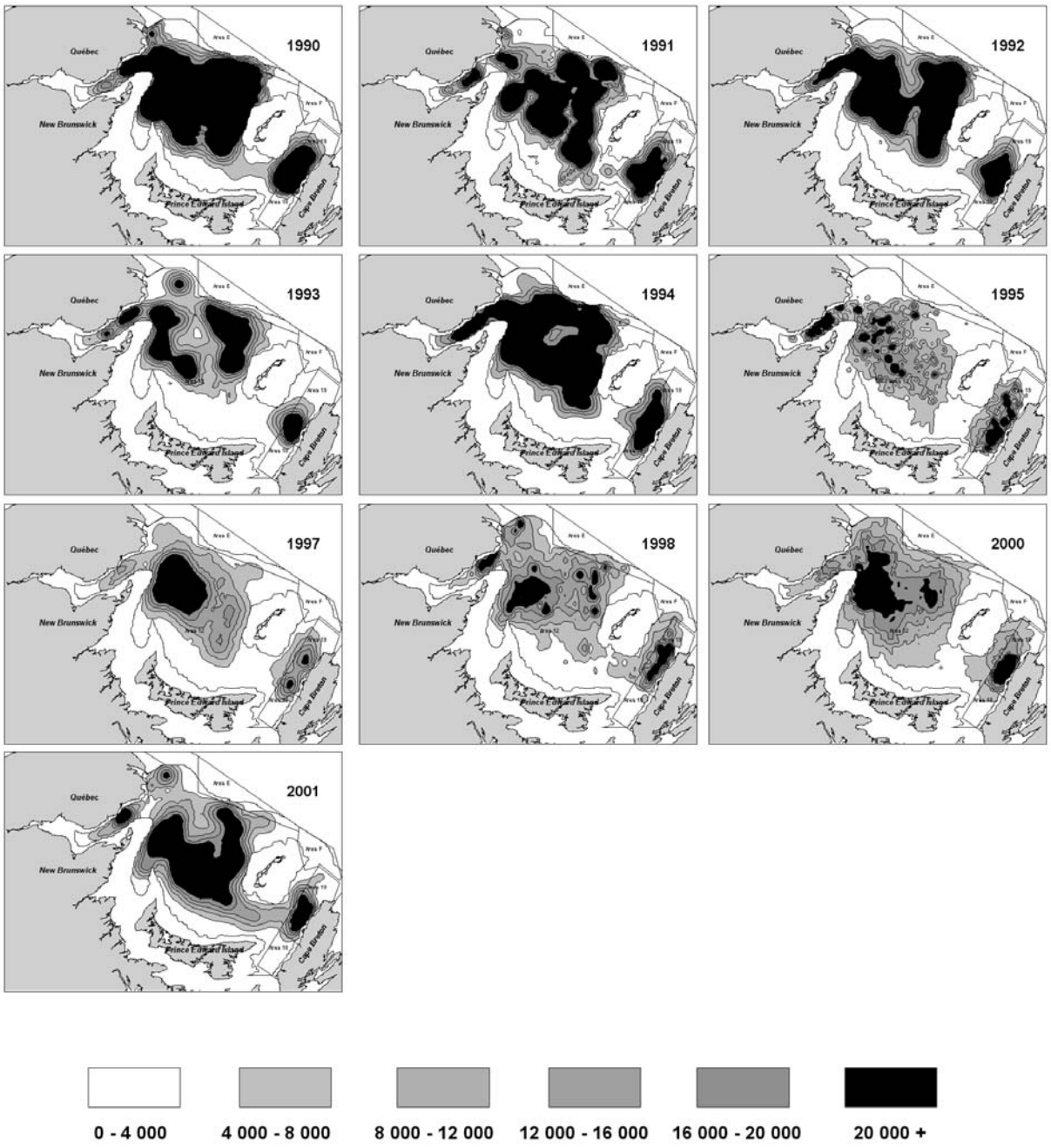
Density (crabs per km^2) Contours of Adolescent Male Crab ≥56mm CW Based on the Trawl Survey Between 1990 and 2001 in the Southern Gulf of St. Lawrence



Size Frequency Distributions (number per km^2) of Male Crab Sampled During the Trawl Survey in Area 12 after the Fishing Season



Density (crabs per km^2) Contours of Mature Females Based on the Trawl Survey Between 1990 and 2001 in the Southern Gulf of St. Lawrence



Outlook

The stock status in **Area 12** is positive for the near future. The commercial biomass index from the 2001 trawl survey (36,100t) increased by 25% from 2000, of which 70% is composed of new recruitment while the biomass of very old crabs is very low. Three strong size-classes of pre-recruits were observed in the 2001 trawl survey, which would increase the level of recruitment to the fishery for the next 3 to 4 years. Other indicators, such as the annual CPUE and mean size of commercial-sized adult crabs in commercial catches have been increasing in 2001.

It is not possible to accurately estimate an exploitation rate. However, a 2002 quota showing an increase between 25 and 60% over last year's quota would be unlikely to have any significant short term impact on the reproductive potential of the stock. The impacts on the reproductive potential of the stock in the long-term are unknown. The stock is in a phase of increasing recruitment into the fishery that should last until 2005-2006. A long term harvest strategy is not in place at the present time. A new exploitation strategy needs to be considered for avoiding wastage of older crabs.

In **Area E**, the expanding biomass from Area 12 will results to an increase of abundance in the near future. The CPUE was low while the mean size of commercial-sized adult crabs in commercial catches slightly increased during the 2001 fishing season. This fishery depends totally on the stock biomass in Area 12.

There is no biological reason to change the quota of 163t. There is an increase of the commercial biomass index within the Area, combined with the increase of pre-recruits coming from Area 12.

The current indicators in **Area F** are positive in the short term. The CPUE was high and the percentage of soft-shelled crab was low in 2001. The mean size of commercial-sized adult crabs in commercial catches increased, compared to 2000. This area is influenced by the stock conditions in Areas 12 and 19.

An increase of quota in Area F may be possible for the next season. The area seems to be very influenced by the recruitment pattern in the adjacent Areas (Areas 12 and 19).

Management Considerations

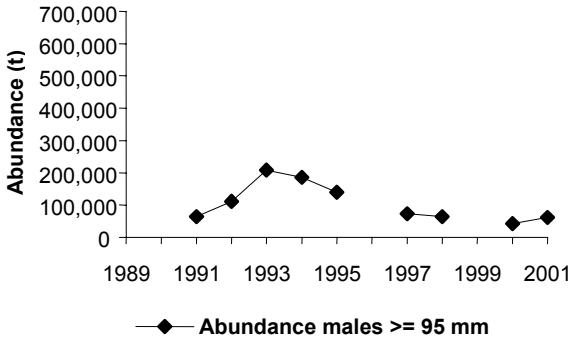
An exploitation strategy reflecting a 60% increase over last year's quota could increase the incidence of soft-shelled crabs in the catches, resulting in an increased mortality of these crabs in the short term. In order to protect future recruitment and the reproductive potential of the stock, it will be essential to maintain the application of the soft-shelled crab protocol. It is also important to understand that the survey biomass is not absolute. In the past, the loss (mortality) between the survey and the beginning of the fishing season in the following year was not taken into account.

Biological Considerations

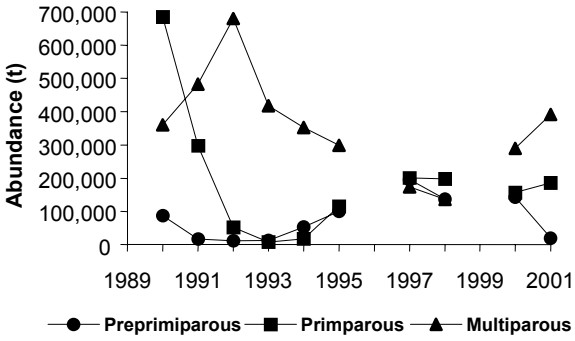
The abundance of preprimiparous, primiparous and multiparous females has been estimated through the years using data gathered during the trawl survey. By comparing the abundance of mature males and females, a sex ratio can be established which allows assessment of the reproductive potential of the stock. There is no target sex ratio but it is noted that the abundance of mature females will decline and it would be precautionary to preserve a wide range of adult males in the reproductive stock. Close monitoring of the parental stock is necessary

during periods when an increase in the abundance of preprimiparous females is observed.

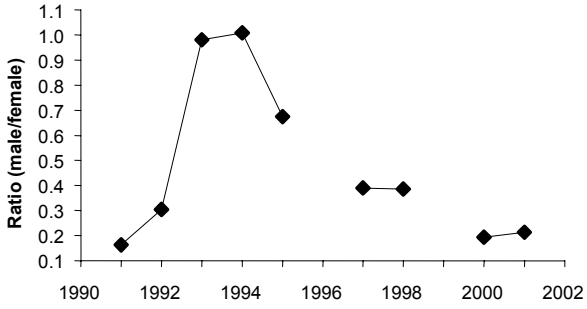
Male Abundance in Area 12



Female Abundance in Area 12



Adult Males vs Mature Females



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References

Drinkwater, K.F., R. G. Pettipas, and W.M. Petrie. 2002. Temperature Conditions on the Scotian Shelf and in the southern Gulf of St. Lawrence during 2001 Relevant to Snow crab. DFO Can. Sci. Adv. Sec. Res. Doc. 2002/043.

Hébert, M., E. Wade, T. Surette and M. Moriyasu. 2002. The 2001 assessment of Snow crab (Chionoecetes opilio) stock in the southern Gulf of St. Lawrence (Areas 12, E and F) / Évaluation de stock du crabe des neiges (Chionoecetes opilio) dans le sud du golfe du St.-Laurent (zones 12, E et F) en 2001. DFO Can. Sci. Adv. Sec. Res. Doc. 2002/013.

Swain, D.P., 1993. Age and density-dependent bathymetric pattern of Atlantic cod (*Gadus morhua*) in the southern Gulf of St. Lawrence. Can. J. Fish. Aquat. Sci., 50(6):1255-1264.

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