



ASSESSMENT OF SNOW CRAB IN THE SOUTHERN GULF OF ST. LAWRENCE (AREA 19)

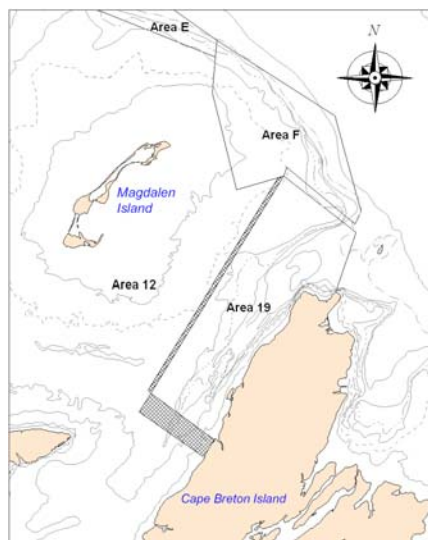


Figure 1: Snow crab management Area 19, the southeastern part of Area 12, and management buffer zones (shaded area).

Context

Snow crab, *Chionoecetes opilio*, has been commercially exploited in the southern Gulf of St. Lawrence (sGSL) since the mid 1960s. In 1978, Area 19 (Figure 1) was established for the exclusive use of Cape Breton inshore fish harvesters with vessels less than 13.7 m (45 feet) in length. The number of permanent license holders increased throughout the years from 14 in 1978 to 74 in 1995.

Landings, controlled by annual quota, ranged from 900 to 1,390 t between 1979 and 1991. The quotas from 1992 to 1994 were set at 1,686 t. In 1995, 37 temporary (one year) license holders using 25 inshore vessels fished 134 t of the total quota of 1,577 t. In 1996, the 37 temporary license holders were converted into permanent licenses and the 111 permanent license holders fished a quota of 1,343 t. The landings then gradually increased to reach 3,279 t in 2002. In 2004, despite the highest commercial biomass index observed in Area 19 from the 2003 fall trawl survey, the 2004 landings did not reach the quota (landings of 3,894 t representing 76.5% of the total quota). Since 2005, the quota in Area 19 is allocated based on the commercial biomass index estimated from the June trawl survey. Landings decreased to 1,989 t in 2006 and increased again to 3,034 t in 2007.

In support of the fishery, DFO Gulf Region Fisheries and Aquaculture Management requests from DFO Science an assessment of the resource status and the consequences of various harvest levels for the coming fishing season. This document is a scientific overview of the assessment undertaken in support of the 2008 fishery. Commercial catch rates and other fishery statistics in the 2007 fishery are reported. An assessment of the status of Area 19 snow crab up to the end of the 2007 is made from fishery independent surveys using indicators of : abundance (fishable biomass index), reproductive potential (numerical abundance of mature females), recruitment, and exploitation rates.

The status of the southern Gulf of St. Lawrence snow crab resource is presented in two science advisory reports, one specific to management Areas 12, E and F, and the other specific for management Area 19.

SUMMARY

- Crabs in management Areas 12, E, F and 19 are part of a larger biological population and the southern Gulf has to be considered as one unit for biological and assessment purposes.
- The 2007 landings in Area 19 were 3,034 t (quota of 3,074 t).
- The annual mean CPUE in 2007 was within the range observed in the previous decade.
- The 2007 fall survey biomass index of commercial-sized crabs was 5,500 t (4,300 t – 7,000 t), which represents an increase of 29% relative to 2006.
- The recruitment to the fishery was estimated at 4,000 t (3,100 t – 5,000 t), and accounted for 72% of the 2007 commercial biomass index.
- The residual biomass in 2007 was 1,500 t, has been decreasing since 2003, and represents the lowest value since 1998.
- Exploitation rate in 2007 was 67%, the highest of the time series for this fishery.
- The fishery has become largely dependent on new annual recruitment to the fishery.
- The commercial biomass index estimates based on the fall trawl survey may not reflect the fishable stock at the time of the fishery 8-10 months later. The June survey prior to the July fishery provides a more reliable biomass estimate.

BACKGROUND

Species Biology

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. White-crab is defined by shell hardness (<78 durometer units) and includes both new-soft (condition 1) and clean hard-shelled crab (condition 2).

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.

Fishery

The minimum legal shell carapace width (CW) is 95 mm, and females are not landed. 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. White-crabs are not landed.

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 (Figure 1). In 2007, a one nautical mile buffer zone was implemented between Area 12 and Area 19 (Figure 1) for conservation measures. Management of this fishery is based on quotas and effort controls (number of licenses, trap limits and seasons). The number of boats fishing in Area 19 in 2007 was 107 while the number of licenses was 176.

The 2007 regular fishing season opened on July 10 and ended on September 7 with reported landings of 3,034 t (quota of 3,074 t) (Figure 2). This quota was set from a pre-season trawl survey conducted in June 2007 based on a target portion of 45% of the commercial biomass index estimated at 6,832 t (5,367 t – 8,668 t).

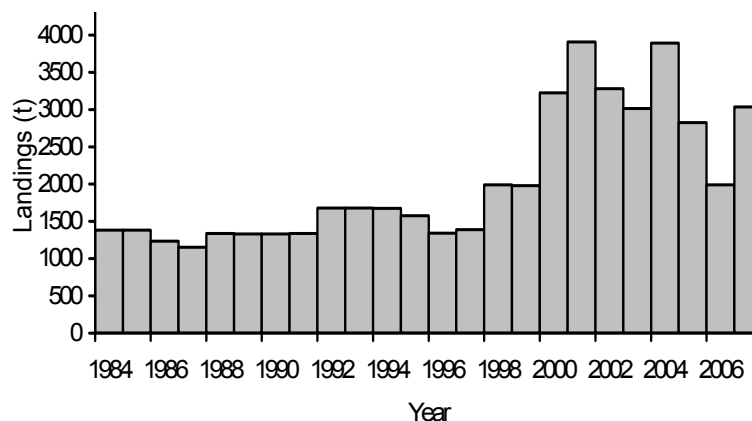


Figure 2: Landings in Area 19 snow crab fishery.

The fishery indicators were generally good during the 2007 fishing season. The annual mean catch-per-unit-of-effort (CPUE) in 2007 decreased from 2006 while the fishing effort almost doubled from 2006 (Table 1). The annual percentage of white-crabs remained at the same level as 2006 (Table 1). No sector was closed during the 2007 fishing season. The mean size of commercial adult males increased from 110.0 mm CW in 2002 to 117.3 mm CW in 2007 (Table 1).

Table 1. Quota, Landings, Fishing Effort and Catch Performance in Area 19.

	2000	2001	2002	2003	2004	2005	2006	2007
Quota (t)	3,370	3,912	3,285	3,106	5,092	2,878	2,000	3,074
Landings (t)	3,225	3,910	3,279	3,103	3,894	2,827	1,989	3,034
CPUE (kg/trap haul)	64.1	88.5	72.3	103.6	68.9	68.1	84.4	71.3
Effort (# of trap hauls)	55,977	46,251	43,662	29,952	56,517	41,512	23,566	42,553
Mean size (mm)	115.4	114.3	110.0	114.0	113.9	116.1	116.5	117.3
White-crab (%) in catches	5.6	6.5	3.5	3.7	7.1	9.8	8.3	8.3

The fishing effort during the 2007 season was concentrated mostly in the southern and central parts of Area 19 where the highest CPUE were observed.

Carapace condition (Table 2) was estimated from sea samples taken from the 2007 fishery. The percentage of commercial-sized adult males with carapace conditions 1 and 2 in the catches decreased in 2007 from 2004 to 2006. The percentage of crabs with carapace condition 3 and 4 combined represented 89.2% of the catches in 2007.

Table 2. Composition (%) of the catch of commercial-sized adult crabs by carapace condition for Area 19.

Condition	1 & 2	3	4	5
Description	White-crab	Intermediate	Old	Very Old
2000	16.5	26.9	55.8	0.8
2001	8.3	31.3	60.1	0.3
2002	8.7	70.2	20.6	0.5
2003	4.9	80.4	14.5	0.2
2004	15.7	69.5	14.3	0.5
2005	15.2	73.9	10.6	0.3
2006	11.1	83.8	4.9	0.2
2007	10.1	75.1	14.1	0.7

ASSESSMENT

Snow crab in management Areas 12, E, F and 19 is part of a larger biological population and the southern Gulf has to be considered as one unit for biological and assessment purposes. Reference points have yet to be defined for this resource.

Stock Trends and Current Status

Conclusions about stock status are primarily based on annual trawl surveys conducted during July to October, which provide an index of commercially exploitable biomass (hard-shelled adult males of legal size remaining immediately after the fishery and 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 future male recruitment to the fishery (prerecruits defined as R-4, R-3 and R-2). The prerecruits 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, respectively. A portion of these crabs could be available to the fishery in 4, 3 and 2 years, respectively.

Indices of future and current spawning stock abundance are estimated using female abundance estimates (pubescent and mature). 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.

The 2007 fall trawl survey indicates a commercial biomass index at the time of the survey of 5,500 t with 95% confidence limits (95% CL) of 4,300 t – 7,000 t, which represents an increase of 29% compared to the 2006 survey estimate (Figure 3).

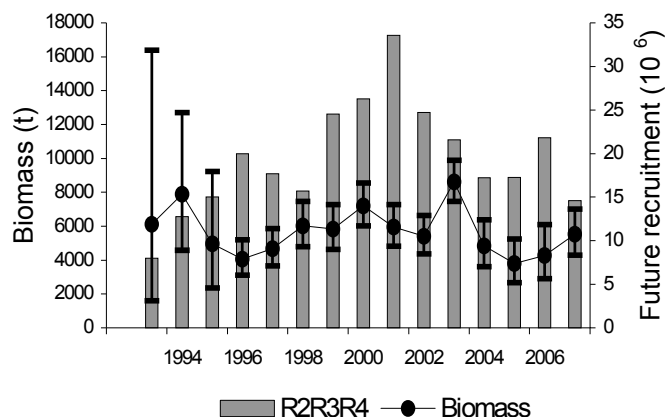


Figure 3: Survey biomass index with 95% confidence intervals and abundance of future recruitment in Area 19.

The recruitment to the fishery at the time of the 2007 fall survey, estimated at 4,000 t (3,100 t – 5,000 t), represents 72% of the commercial biomass index. The residual biomass index in 2007 was estimated at 1,500 t (1,000 t – 2,200 t), has been decreasing since 2003, and represents the lowest value since 1998 (Figure 4).

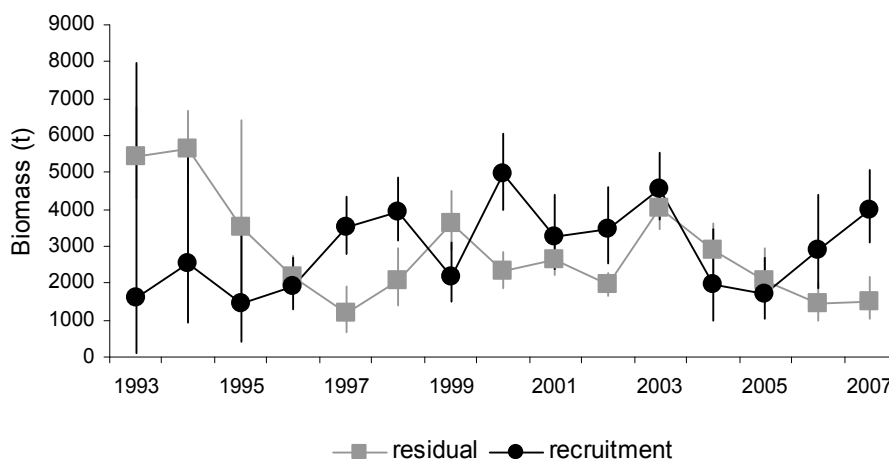


Figure 4: Survey recruitment to the fishery and residual biomass indices (with 95% confidence intervals) in Area 19.

The concentrations of the fall 2007 trawl survey commercial biomass were located in the middle and the southern part of the area (Figure 5).

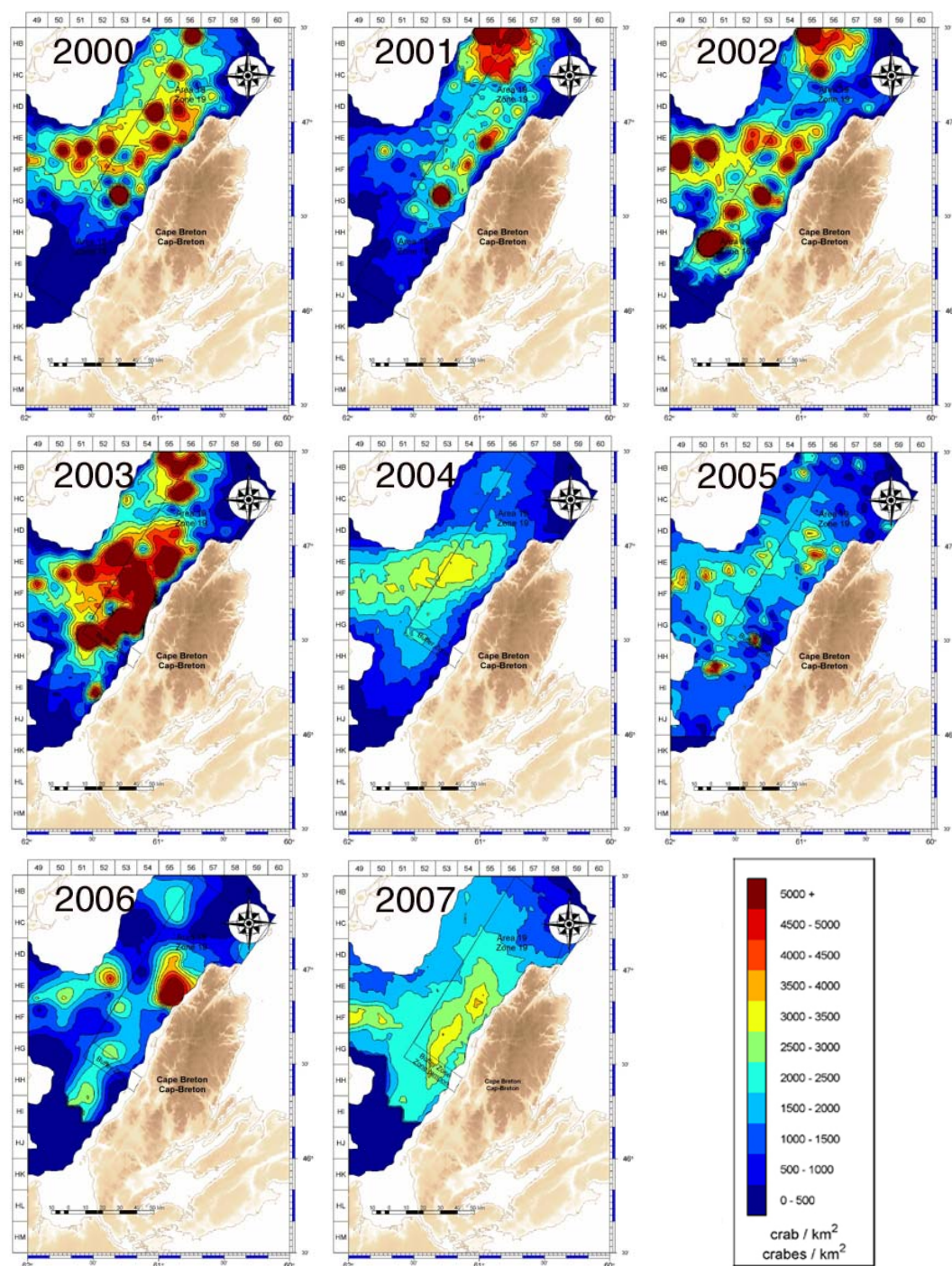


Figure 5: Density (number per km^2) contours of adult male crab ≥ 95 mm CW in Area 19 based on the trawl survey from 2000 to 2007.

The exploitation rate, calculated as the catch (t) divided by the sum of the catch and the residual biomass from the fall trawl survey of the same year, was 67% in 2007. Exploitation rates varied between 22% and 62% from 1993 to 2006 (Figure 6).

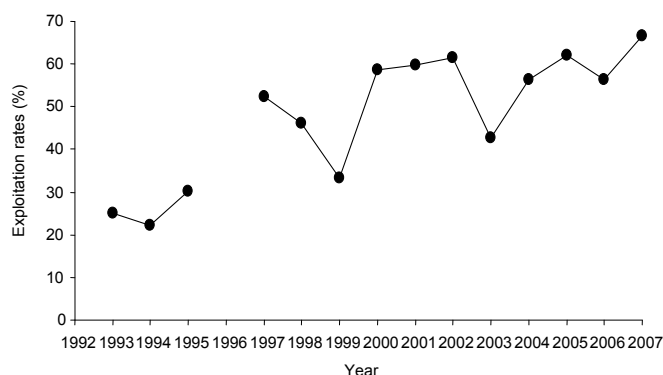


Figure 6: Exploitation rates in Area 19.

The prerecruits ≥ 56 mm CW (R-4, R-3 and R-2) from the 2007 fall survey decreased in Area 19 compared to the 2006 fall estimates (Figures 3, 7 and 8).

The commercial biomass index estimates based on the fall trawl survey may not reflect the fishable stock at the time of the fishery 8-10 months later. Movement of commercial-sized adult males occurs between Areas 12 and F to Area 19 such that in some years the biomass supporting the fishery in the year after the survey was much larger than estimated by the survey, and in other years, it was smaller.

Given the size frequency distribution observed in survey catches for Area 12, a decline in commercial biomass index is expected in Area 12 until 2011. There is a net migration from Area 12 to 19 when densities are higher in Area 12, or from Area 19 to 12, when densities are higher in Area 19.

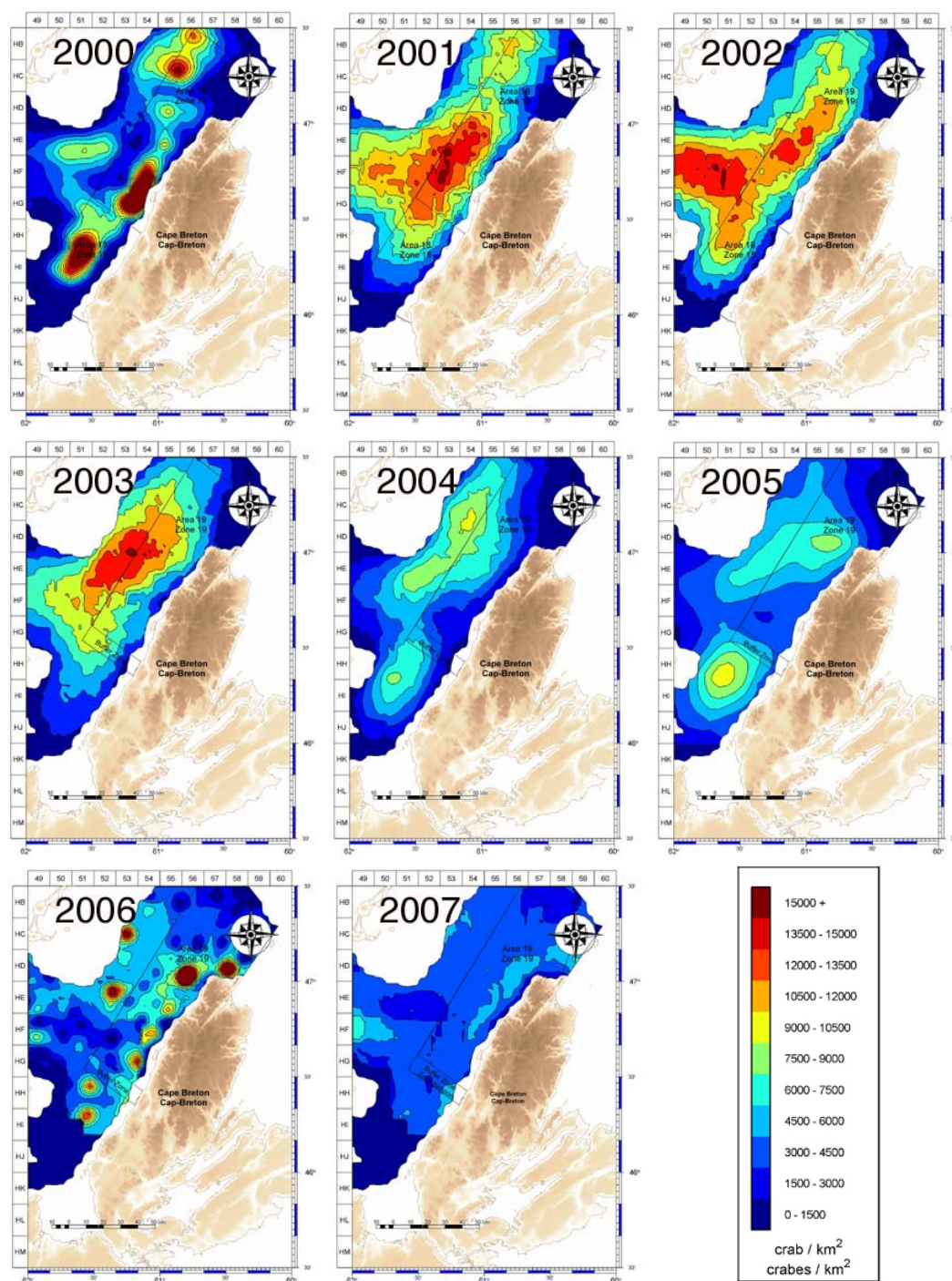


Figure 7: Density (number per km^2) contours of adolescent male crab $\geq 56\text{mm CW}$ in Area 19 based on the fall trawl survey from 2000 to 2007.

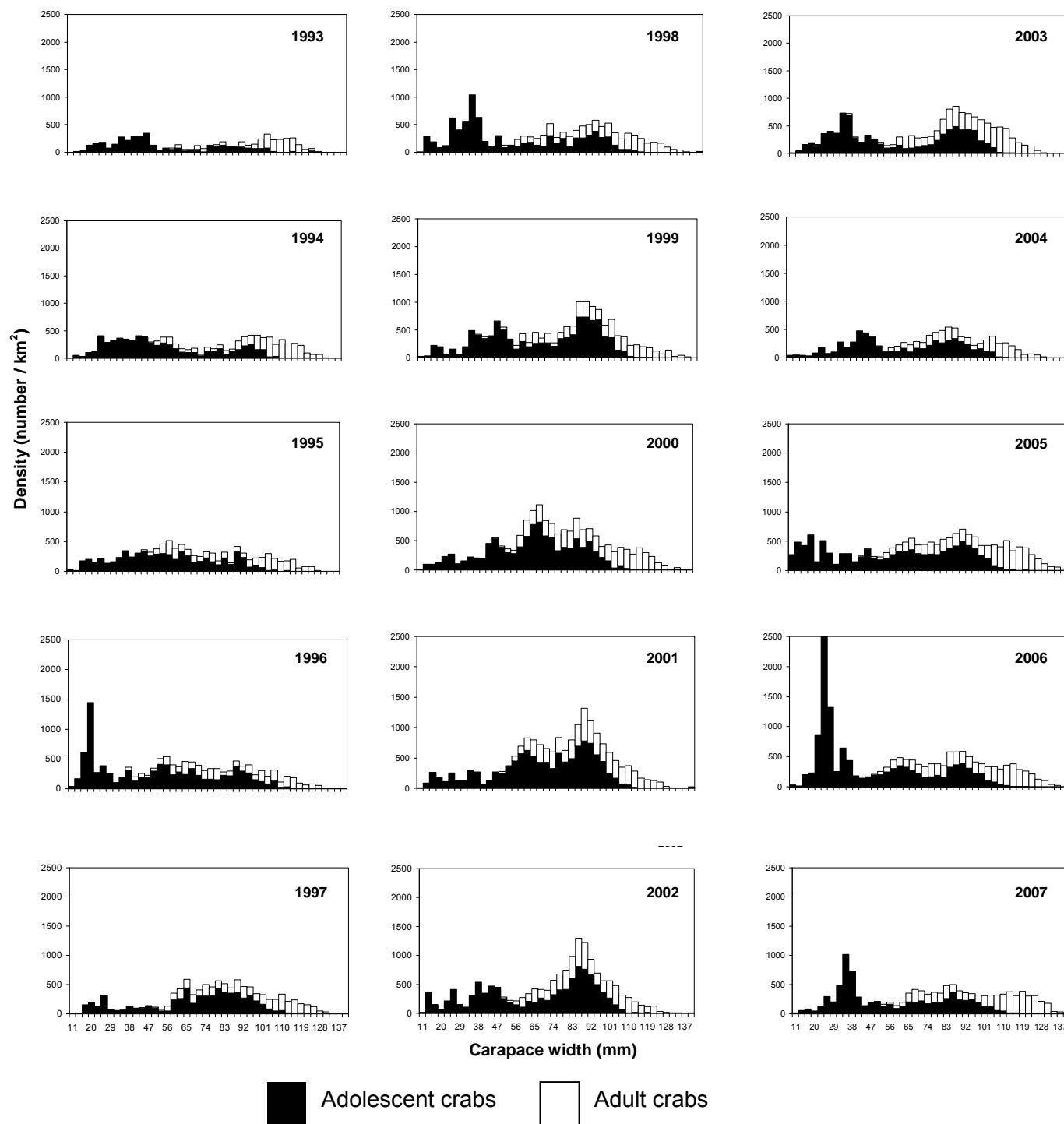


Figure 8: Size frequency distributions of male crab sampled during the trawl survey in Area 19, after the fishing season.

Sources of Uncertainty

The trawl survey data were processed using the procedure defined in the framework meeting (DFO 2006). A review of the standardization for the tow length, trawl opening width and area of polygon for the time series 1988 to 2006 was presented and accepted at the meeting. But other factors such as the vessel itself cannot be addressed without a comparative survey. It was assumed that the trawl survey biomass estimates are absolute measures of abundance. If they are less than 100% of the biomass, then the exploitation rates estimated for this fishery represent maximum values.

Other uncertainties such as growth, natural mortality, handling mortality of white crab and movement make it difficult to predict the commercial biomass index more than one year in advance.

In the absence of a defined stock-recruitment relationship in this population, there are uncertainties about the future recruitment to the population related to the reduced abundance of mature females in the southern Gulf.

The movement of crabs within the southern Gulf among the management areas is a major source of uncertainty in the provision of advice for area specific management.

The relative abundances of prerecruits ≥ 56 mm CW in the southern Gulf have been decreasing and are retracting to the central part of Area 12. This may reduce the availability of the resource to the Area 19 fishery in the near future.

CONCLUSIONS AND ADVICE

For Area 19, the mean annual CPUE, low incidence of white crabs and the mean size of commercial-sized adult crabs in commercial catches indicate that the fishery performance was good in 2007. The exploitation rate in 2007 was 67%. The residual biomass after the fishery has been decreasing since 2003.

The commercial biomass index and the abundance of prerecruits ≥ 56 mm CW (R-4, R-3 and R-2) in Area 12 are decreasing. Due to migration of commercial-sized adult males between Areas 12 and 19, this may result in reduced availability of the resource in Area 19.

The commercial biomass index estimated from the 2007 September trawl survey may not reflect the availability of commercial biomass at the beginning of the 2008 fishing season depending on the fishery and stock dynamics outside Area 19. It would be beneficial to continue the June trawl survey just before the opening of Area 19 fishery to estimate the commercial biomass prior to the fishery and re-adjust the fishing strategy according to the biomass and proportion of carapace stages observed in that particular survey.

Substantial biological benefits are expected by the current white crab protocol. This program can be considered when developing management plans, reference points and harvesting strategies.

Limits and target reference points and comprehensive harvest control rules need to be developed and used in the assessment and management for the biological unit in the southern Gulf of St. Lawrence.

Ecosystem Considerations

Environmental factors, such as water temperature, can affect the moulting and reproductive dynamic as well as the movement of snow crab. Chassé and Pettipas (2008) 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. Bottom temperatures in Area 19 are typically 1°-2 °C warmer than the traditional crab grounds in Area 12.

Near-bottom temperatures in Area 19, during 2007, were observed to be warmer than the long-term average (1971-2000). The coastal area was slightly cooler than in 2006 in the southern part and cooler in the northeastern part. The Gulf wide snow crab habitat index (area of the bottom covered by water temperatures between -1 and 3°C) is still below the long-term average (Figure 9). However, the mean temperature within the habitat area in 2007 also decreased compared to 2006, an unusual situation as the two time series are usually negatively correlated. The mean temperature is above the long term mean, reaching a value slightly below the ones observed during the 1999-2002 warm period and is closer to the average than in 2006 when the highest value of the previous 23 years was observed. The temperature conditions are not considered to be as favorable for snow crab since the mean temperature index is higher than normal, especially since the habitat index itself is below the normal. However, the influence of habitat area and mean temperature on snow crab abundance and distribution is unknown.

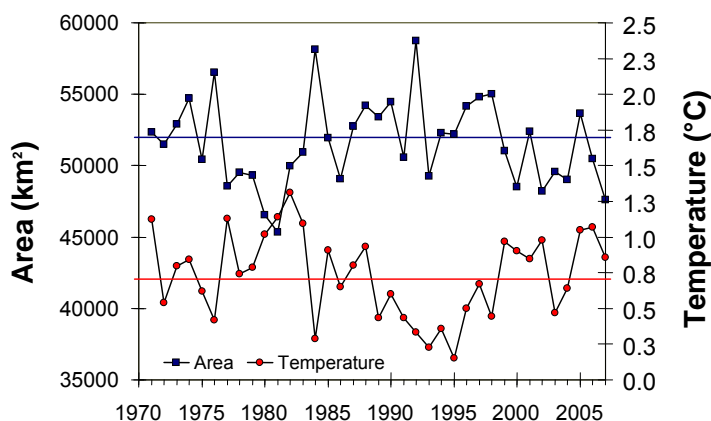


Figure 9: Snow crab habitat area and mean temperature indices in the Southern Gulf of St. Lawrence.

SOURCES OF INFORMATION

Chassé, J. and R.G. Pettipas, 2008. Temperature Conditions in the Southern Gulf of St. Lawrence during 2007 Relevant to Snow Crab. DFO Can. Sci. Advis. Sec. Res. Doc. (in prep.).

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