

Western Cape Breton Snow Crab

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 molting. After molting, 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 lobsters, snow crabs do not continue to molt throughout their lives. Females stop growing after the molt, in which they acquire a wider abdomen for carrying eggs, which occurs at shell widths less than 95 mm. Male snow crab stop growing after the molt, in which they acquire large claws on the first pair of legs, and which can occur at shell widths as small as 40 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 snow crab fishery in western Cape Breton began in the late-1970s. Currently, there are two fishing Areas: 18 and 19. These management areas are part of a larger biological unit namely Area 12, 18, 19, E and F.



Snow crab management areas in Western Cape Breton.

The minimum legal shell width is 95 mm, 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 280 m. The fishery takes place in late summer in Areas 18 and 19. 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). In 2000, landings in Area 18 were 472 t (quota of 476 t) and landings in Area 19 were 3,225 t (quota of 3,370 t). From the 3,370 t quota, an allocation of 668 t was allowed to temporary fishermen.

Summary

- Crab in management Areas 18 and 19 are part of a larger biological population, including crab in adjacent parts of Area 12.
- The 2000 biomass estimate from the 1999 trawl survey is not considered to be reliable.
- The biomass estimates in 2001 may not be comparable with the estimates prior to 1999. Further research is needed to properly assess the gear efficiency between the two vessels.

Area 18

- The average CPUE in 2000 was similar to 1999.
- The 2000 quota of 476 t was caught.
- The average percentage of soft-shelled crab (8 %) was higher than 1999 (3 %).
- The projected exploitable biomass for 2001 is 510 t (without considering the possible trawl efficiency difference) and the recruitment is uncertain because of movement of crab.
- Fishing at levels comparable to previous years should not result in a stock decline overall.

Area 19

- The 2000 quota of 3,370 t was essentially caught.
- The average catch per trap among permanent fishermen has decreased comparatively to 1999.

- The average percentage of soft-shelled crab was low.
- The projected exploitable biomass (without considering the possible trawl efficiency difference) for 2001 (6,200 t) is mainly composed of new recruitment (4,300 t).

The Fishery

Areas 18 and 19, Western Cape Breton -

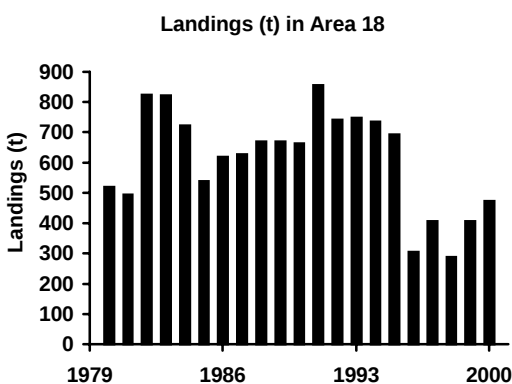
The fishing grounds along the west coast of Cape Breton were initially fished by a group of fishermen based in Cheticamp. Subsequently, fishermen from Quebec and New Brunswick sporadically fished in the area. With the increase in the commercial value of snow crab in the late 1970s, the fishery gradually expanded to cover all fishing grounds along the west coast of Cape Breton.

Area 18 was fished for the first time in 1979 by 14 inshore vessels with exploratory licenses and a trap limit of 30 traps per license. In 1984, Area 18 was reserved exclusively for inshore fishermen. The overall quota, which had initially been set at 835 t in 1981, was reduced to 626 t in 1986 and then increased to 674 t in 1988, where it remained until 1990. In the spring of 1991, a quota of 200 t was set to promote a spring fishery in the area. Later that year, a quota of 674 t was set for the 1991 fall fishery and 1992 spring fishery. The quota was raised to 749 t for 1992-93, and remained at that level for 1993-94 and 1994-95. Since 1992-93, 30 fishermen have participated in this fishery. In 1995, the quota was 705 t of which 109 t were allocated to 30 temporary license holders. In 1996, no temporary licenses were issued and a quota of 340 t was allocated to 30 fishermen. In 1997, the quota was set at 580 t. Landings were 406 t, which correspond to 70 percent of the total quota. In 1998, landings were 289 t, which

correspond to 70 percent of the total quota of 411 t. In 1999, the quota was reached for the first time since 1995 (408 t). In 2000, landings were at 472 t (quota at 476 t).

Quotas (t) and landings (t) in Area 18.

	Average 1990-94	1995	1996	1997	1998	1999	2000
Quota	759	705	340	580	411	408	476
Landings	748	693	306	406	289	407	472
CPUE	51.7	33.5	21.2	18.1	18.0	34.5	32.1
Soft crab (%)	10.4	8.2	20.5	13.1	17.1	3.2	8.4

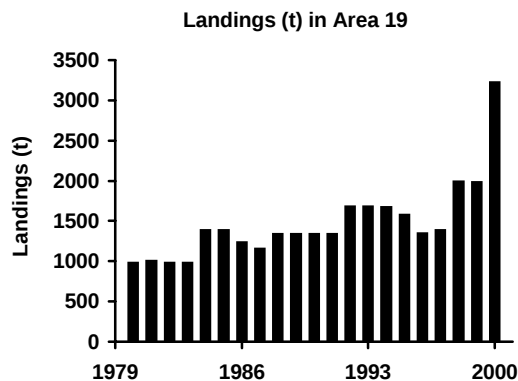


In 1978, **Area 19** was established as an inshore area reserved exclusively for inshore fishermen using vessels under 13.7 m (45 feet) in length. Landings, regulated by quotas, fluctuated between 900 t and 1,390 t from 1979 to 1991. During 1992-94, quotas were set at 1,686 t. In 1995, there were 74 permanent and 37 temporary license holders in the fishery with a global quota of 1,575 t. In 1996, the quota was 1,343 t for the 111 permanent license holders. In 1997 and 1998, the quotas were 1,386 t (landings of 1,386 t) and 1,991 t (landings of 1,988 t), respectively. The 1999 quota (1,986 t) was reached (landings of 1979). In 2000, the quota (3,370 t) was shared with temporary fishermen who had an allocation of 668 t. The 2000 landings were 3,225 t, which represent 96 % of the total quota (3,370 t).

Quotas (t) and landings (t) in Area 19.

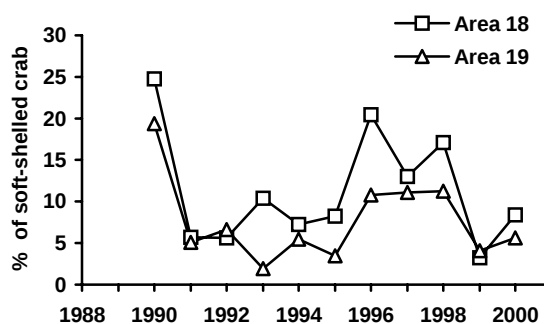
	Average 1990-94	1995	1996	1997	1998*	1999*	2000*
Quota	1,546	1,575	1,343	1,386	1,991	1,986	3,370
Landings	1,540	1,575	1,343	1,386	1,988	1,979	3,225
CPUE	77.0	63.4	54.6	63.2	71.6	103.8	73.0
Soft crab (%)	7.7	3.5	10.8	10.7	11.2	4.1	5.6

* In 1998, mean CPUE was calculated using week 2 to 4. In 1999 and 2000, the mean CPUE were calculated using the first four weeks.



The percentage of **soft-shelled crab** in Areas 18 and 19 were 8.4 % and 5.6 %, respectively. The higher percentage of soft-shelled crab in Area 18 could mean that there would be local recruitment to the fishery next year.

Soft-shelled crab percentage in Areas 18 and 19



Carapace condition was estimated from sea samples taken from the 2000 fishery. Crab with carapace categories 3 and 4 comprised the bulk of the fishery in all areas. In Area 19, a large portion of commercial-sized adult males of categories 1 and 2 (16.6 %)

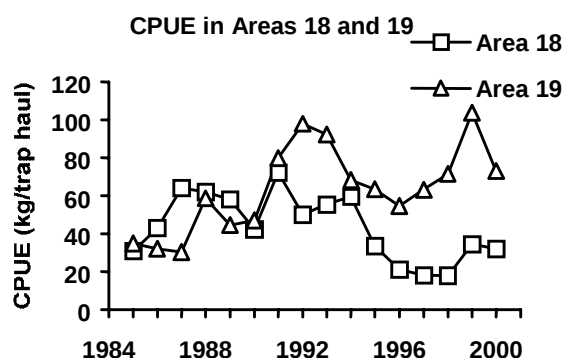
were caught during the fishery. These crabs could contribute to the fishery next year if no migration of crabs between Areas 18, 19 and 12 occurred.

Percentage of the catch of commercial-sized adult crab by carapace condition.

Category	Description	18	19
1-2	White crab	8.0	16.6
3	Intermediate	22.4	26.9
4	Old crab	60.1	55.8
5	Very old crab	9.5	0.8

Resource Status

Logbook data were used to describe the general distribution of fishing effort per section (5 minutes of longitude by 5 minutes of latitude). In Area 18, the average CPUE decreased from 34.5 kg/trap haul in 1999 to 32.1 kg/trap haul in 2000. In 2000, the average CPUE in Area 19 decreased to the level of 1998.



The evaluation of stock status is based on a trawl survey, which provides estimates of exploitable biomass (hard-shelled adult males of legal size) immediately following the fishery, plus estimates of soft-shelled adult males larger than 95 mm that will be new recruits in the following year. The method assumes that there is no natural mortality and no movement between the time of the survey and the beginning of the fishery nine months later, except for very

old crab. Abundance is also estimated for smaller size crab or pre-recruits.

In Areas 18 and 19, the survey was conducted each year since 1990, except for 1997 and 1998 in Area 18. From 1990 to 1998, the “Emy Serge”, (65 feet, side-trawl, wooden boat with 375 HP), was used to conduct the trawl surveys. In 1999, the “Emy Serge” was sold and the “Den C. Martin”, (65 feet, stern trawl, steel boat with 402 HP), was chosen to continue the surveys. Without a comparative study between the two survey vessels, which was not possible at this time, the biomass estimate results from the time series cannot be compared.

The stock assessment in Areas 18 and 19 was based on a 2000 trawl survey. As the concentration of biomass straddles the boundaries of Areas 12, 18 and 19, seasonal movements of crab among these areas would affect the biomass level in any given area.

Exploitable biomass estimates (t) in western Cape Breton (Areas 18 and 19) (with 95 % confidence intervals)

Year	18	19
1991	-	5,500 (± 36 %)
1992	1,280 (± 92 %)	5,200 (± 42 %)
1993	1,260 (± 83 %)	2,300 (± 27 %)
1994	1,200 (± 89 %)	2,600 (± 40 %)
1995	580 (± 39 %)	1,800 (± 21 %)
1996	970 (± 54 %)	2,200 (± 27 %)
1997 ¹	-	3,200 (± 24 %)
1998 ¹	-	3,200 (± 35 %)
1999 ²	-	-
2000 ³	510 (± 111 %)	6,200 (± 18 %)

¹ No survey.

² Not available at the moment due to ongoing study regarding the vessel change.

³ Biomass estimates from the “Den C. Martin” without adjustment of gear efficiency change.

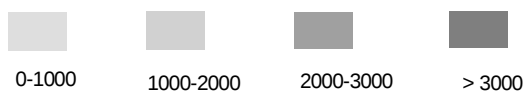
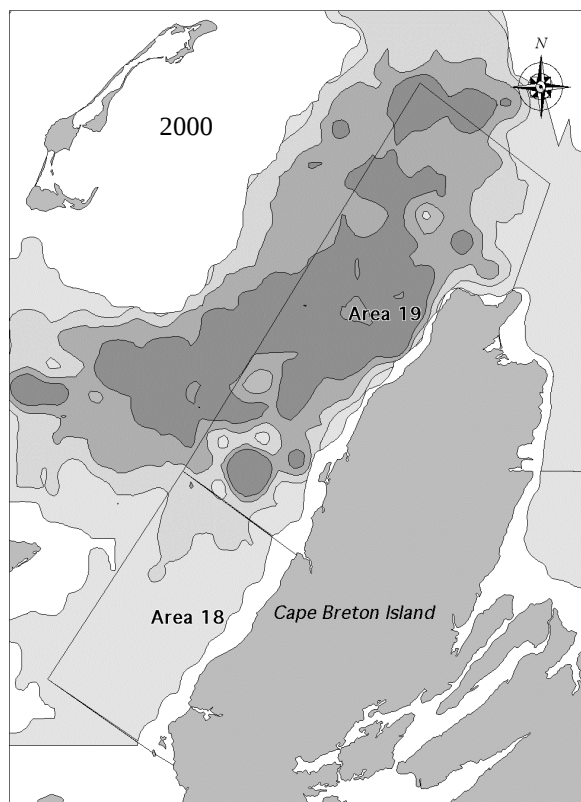
Area 18:

The survey in 2000 shows an exploitable biomass of 510 t and assuming no large movement, this crab will be available for the 2001 fishery.

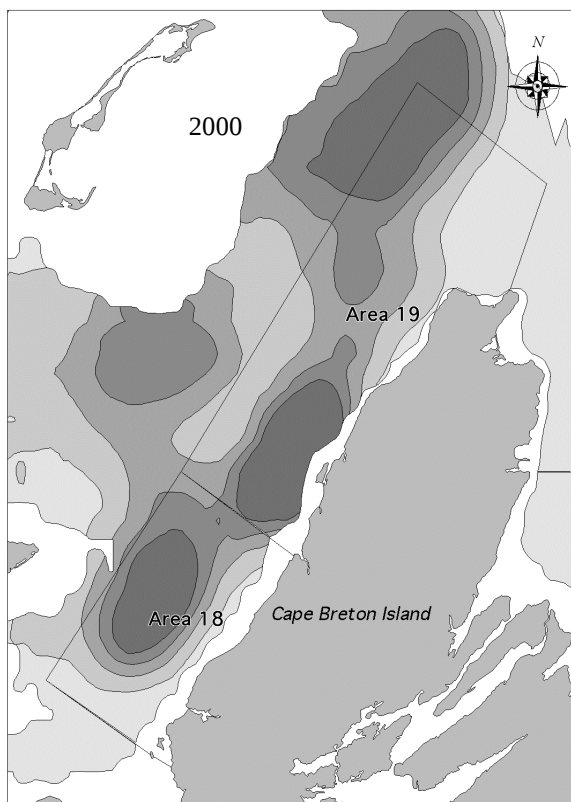
Area 19:

The survey indicates an exploitable biomass of 6,200 t that would be available for the 2001 fishing season. About 70 % of this biomass is new recruitment.

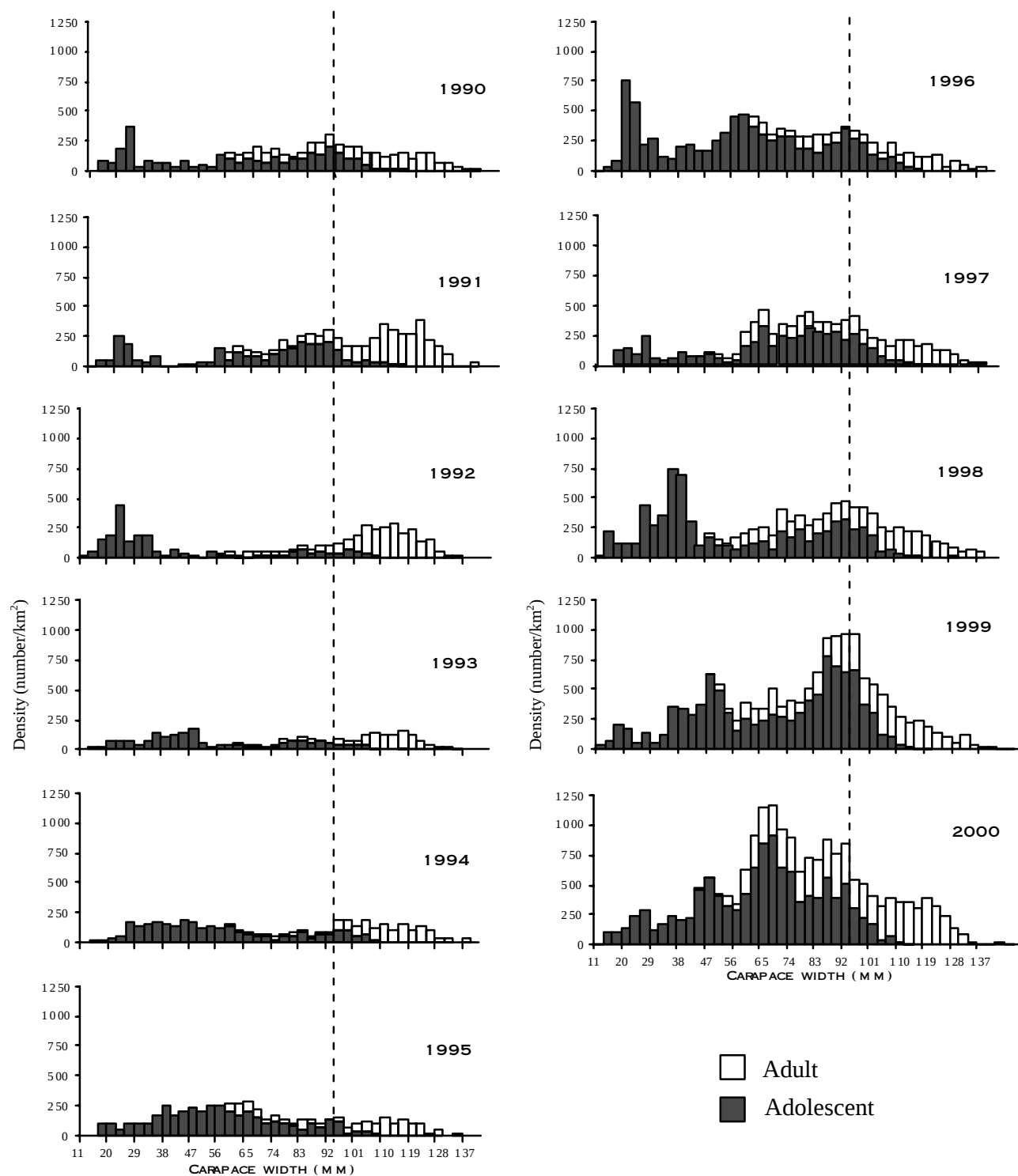
Density (crab / km²) contours of adult male crab ≥ 95 mm CW.



Density (crab / km²) contours of adolescent male crab ≥ 56 mm CW.



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



We cannot estimate the **exploitation rate** in Areas 18 and 19 because of concerns about the reliability of the 1999 trawl survey biomass estimates. It should be noted that the movement of crab into and out of these areas also influence the exploitation rates in Areas 12, 18 and 19.

Exploitation rates (%) in Areas 18 and 19

Year	Area 18	Area 19
1993	58	32
1994	58	73
1995	58	61
1996	53	74
1997	42	63
1998	-	63
1999	-	63
2000	-	-

Sources of Uncertainty

The effect of **changing the survey vessel** since 1999 on catch efficiency cannot be completely resolved until further study. However, the comparison of the values for the net width and tow distance, between the two vessels, revealed that these values were significantly different suggesting that the trawl net behaved differently with the new survey vessel. Consequently, the resulting biomass estimates with the new vessel may not be comparable to the estimates from the former vessel. Until the catch efficiency of both vessels is properly assessed, the new biomass estimates have to be interpreted with caution.

The misclassification of carapace condition during the trawl survey is another source of uncertainty. Exploitable biomass is composed of the recruitment to the fishery (categories 1 and 2) and remaining biomass (categories 3 and 4).

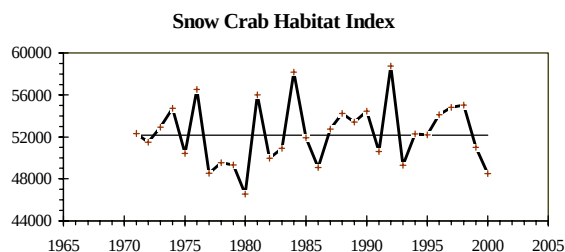
Seasonal movement between areas may occur from the time of the trawl survey and

the beginning of the subsequent fishing season (especially adult crabs of commercial size that have recently molted). Movement of crabs between Areas 12, 18 and 19 is assumed, but not explicitly taken into account in the assessment.

The natural mortality of adult crabs was assumed to be negligible in this assessment. We know that old carapace crabs (category 5) are certainly dying, but the magnitude by shell condition is unknown. In addition, discarding soft-shelled crabs at sea during fishing activities could increase the mortality of these crabs. Minimizing the catch of soft-shelled crab during fishing is important in order to protect the reproductive potential of the stock and to achieve maximum yield per recruit.

Ecosystem Considerations

Snow crab prefers cold water **temperatures**. Bottom water temperatures in the southern Gulf have generally been colder than the long-term average since the late 1980s. During 1995 and 1996, subzero bottom water temperature were seen to be at the greatest extent since these measurements began in 1971. Southern Gulf waters at 50 to 150 meters have been predominantly below normal in temperature since mid to late 1980s. The area of ocean bottom with water temperatures between -1 and 3°C is an index of snow crab habitat, and was high since late 1980s to 1998. Since 1999, the index declined below the long-term mean.



Outlook

In Area 18, the projected biomass of 510 t for 2001 is uncertain because of unknown amount of movement of crabs in and out of the area. It would be appropriate to close the fishery as soon as the catches of soft-shelled crab exceed 20 % in order to protect the future recruitment to the fishery.

In Area 19, the outlook is positive. There is a large concentration of new recruitment inside the area and the projected fishable biomass is the highest on record. The high density of commercial crab and pre-recruits in Area 12, adjacent to Area 19 could also contribute to possible increase of the exploitable biomass and recruitment to the fishery in Area 19. The opportunity for increasing catches in 2001 will depend on the amount of migration of mature crab in 2001, which cannot be predicted at this time.

As with Area 18, the migration of crabs among Areas 12, 18 and 19 make it impossible to project the actual fishable biomass with certainty.

Management Considerations

The management areas are not based on the biologically differentiated stocks. Movement of crabs between the time of the survey and the fishery could modify the exploitable biomass in these small areas. Fishing activities should be limited in areas of high concentration of soft-shelled crab in order to minimise the mortality of the future recruitment.

For Area 18, it is difficult to suggest a sound long-term fishing strategy because the main fishing activities in this area occur in about a quarter of the area available and a seasonal movement of crabs towards deeper waters is suspected.

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References

DeGrâce, P., M. Hébert, E. Wade and M. Moriyasu. 2001. Assessment of the 2000 Snow crab (*Chionoecetes opilio*) fisheries off western Cape Breton (Areas 18 and 19). DFO Canadian Science Advisory Secretariat, Res. Doc. 2001/016.

This report is available from the:

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ISSN: 1480-4913

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Correct citation for this publication

DFO, 2001. Western Cape Breton Snow Crab. DFO Science Stock Status Report C3-64 (2001).