

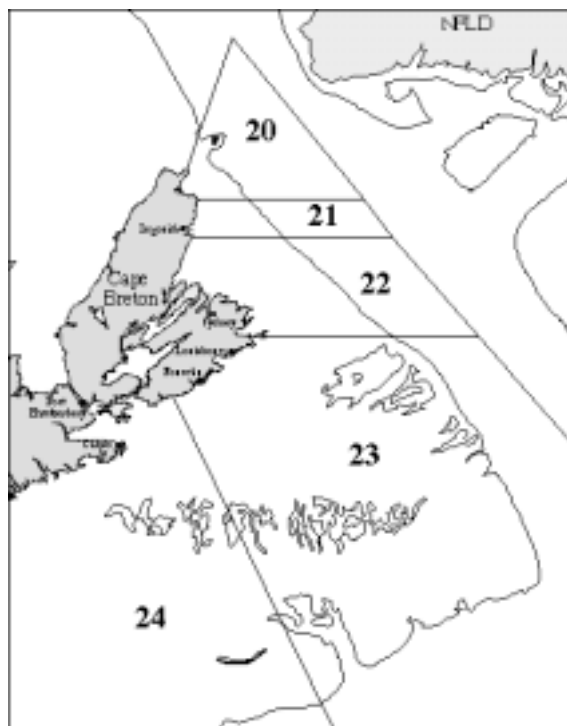
Eastern Nova Scotia Snow Crab

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, crab 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 does not continue to molt throughout their lives. Females stop growing after the molt in which they acquire a wider abdomen for carrying eggs. This occurs at shell widths less than 95 mm. Male snow crab stops growing after the molt in which they acquire large claws on the first pair of legs. This can occur at shell widths as small as 40 mm. Female crab produces 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 free floating in the water. 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 95 mm, and female crabs are not kept by industry. Fishing is by baited square or conical traps constructed of wire or tubular steel and netting. The traps are set on muddy or sand-mud bottoms at temperature ranging from -0.5 to 4.5 C and depth ranging from 50 to 280 m. Typical fishing depths off eastern Nova Scotia are 130 m to 250 m.



From 1982 to 1993, management of these fisheries was strictly based on effort controls (seasons, licenses and trap limits). In 1994-95, restrictions were placed on the landings of soft-shelled crab, and individual boat quotas (IBQ) that were tied to overall quotas were introduced in all areas except for Area 22 where they were introduced in 1998. In 1999, the small exploratory fishery in NAFO Division 4X was separated from Area 24. Compared to 1997, the number of permanent licenses remained stable, but temporary permits were introduced in Areas 23 and 24, and in Area 20 in 1999. In 1998 and 1999, the same management measures (IBQs and restriction of landings of soft-shelled crab) were maintained.

Summary

- There are only two main biological concentrations of the resource, one in the north (Areas 20-22) and the other in the south (Areas 23-24).
- For the first time, stock status is based on a trawl survey, first introduced in 1997.

- Estimates of exploitable biomass for 2000 are 1,477 t for Areas 20-22 and 29,322 t for Areas 23(A-D)-24(A-C).
- The management areas do not reflect biological distribution of resource and compromise reliability of the biomass estimates.
- There was significant loss or movement of adolescent crabs between 1998 and 1999. The cause is unknown, but could be due to increase of warmer water.
- Because of the uncertainty, caution should be used for the management of the fishery in the coming year.

The Fishery

The fishery in Areas 20 to 24 began in 1978. The fishery collapsed in the mid-1980s but from 1987 to 1993 landings increased steadily. This increase resulted from a greater abundance of crab, an expanded fishing area, and an increase in effort.

Certified observers conducted at-sea monitoring in Areas 20 and 21 for the first time in 1998, while this program had been introduced in 1997 in Areas 22, 23 and 24. The voluntary reduction in the trap limit from 30 to 25 introduced in Area 21 in 1997 was maintained in 1999. The number of allowed traps in Area 24 increased from 30 to 40 in 1999.

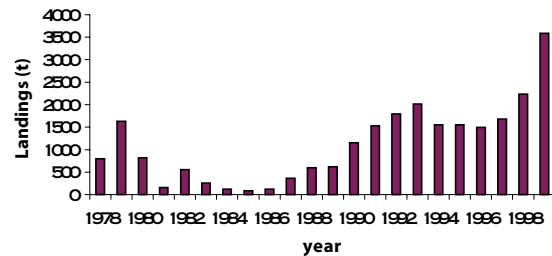
Individual boat quotas (IBQ) for permanent fishermen (introduced in 1994-95) were set as follows:

Area	IBQ (kg)
20	11,340
21	9,072
22(north)	13,154
22(south)	15,422
23	37,500
24	35,870

The 1999 total **landings** in eastern Nova Scotia (ENS) were 60% higher than those of 1998. There was a 15% increase in the seasonal catch-per-unit-of-effort (CPUE)

and a 40% increase in total fishing effort compared to 1998. The increase in landings was the result of an increase in individual boat quotas of regular licenses in all areas (25% in Area 20, 33% in Area 21, 32% in Area 22 northern, 26% in Area 22 outer, 50% in Area 23, and 44% in Area 24). There was an introduction of new allocations (for a total of 39.9t) for temporary fishers in Area 20, and increase in allocations for temporary fishermen in Areas 23 (from 250 t to 400 t) and 24 (from 250 t to 575 t).

Landings (metric tonnes)



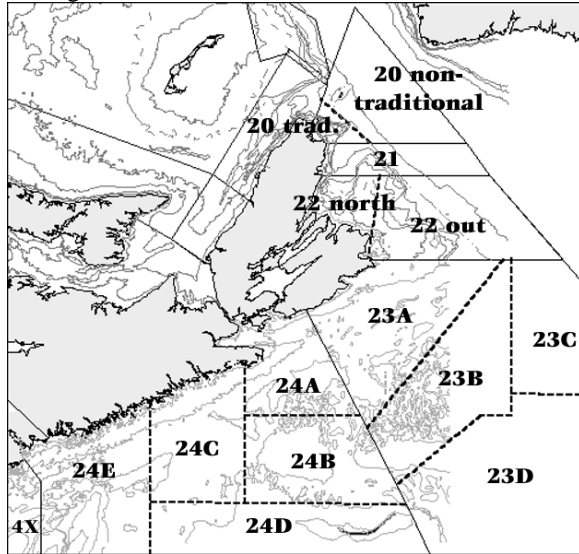
Landings (metric tonnes)

Area	Average	Average	1996	1997	1998	1999 ¹
	90-94	95-99				
20	17	55	43	45	45	97
21	159	178	136	146	216	291
22	238	346	188	343	396	519
23	555	768	565	592	813	1,296
24	662	762	560	565	745	1,390
Total	1,631	2,109	1,493	1,691	2,215	3,593

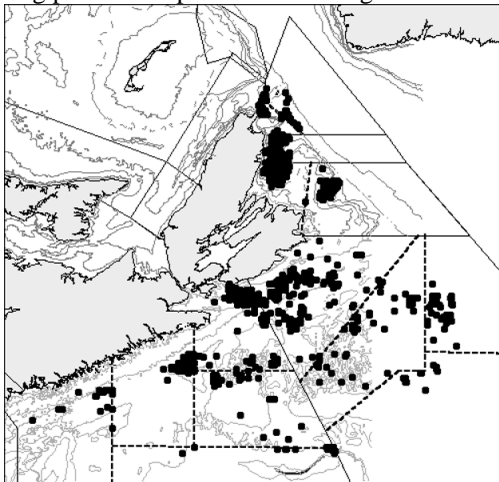
¹Preliminary data, unadjusted

There was a significant increase in TAC in all areas compared to 1998, and therefore DFO Fisheries Management drew sub-areas within traditional and non-traditional grounds to regulate the fishing effort in 1999.

Management areas and sub-areas in 1999.

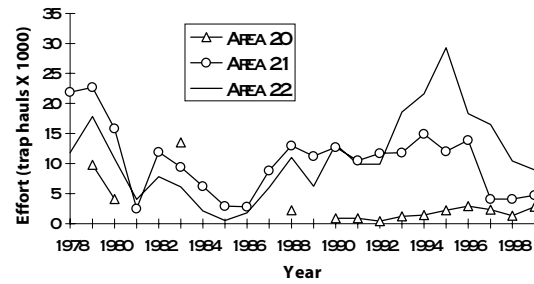


Fishing positions reported in 1999 logbooks.

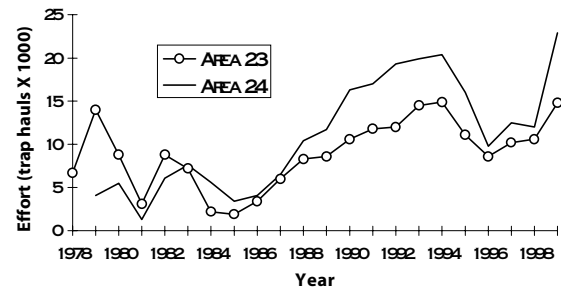


Overall, for the eastern Nova Scotia fishery there was a 40% increase in **fishing effort** compared to 1998. While the reported fishing effort was higher in Area 20 (92%), Area 21 (12%), Area 23 (41%) and Area 24 (91%), it was 15% lower in Area 22.

Fishing effort for Areas 20, 21 and 22.



Fishing effort for Areas 23 and 24.



At-sea sampling of the commercial catch to evaluate the percentage of soft-shelled crab prior to sorting was conducted throughout the fishing season through a certified observer program in all areas in 1999. Samples of male crab were categorised by shell characteristics (size, hardness) and claw height. The seasonal average percentage of soft-shelled crab has been decreasing in the last two years. In 1999, it was 6% in Area 20, 11 % in Area 21, 16% in Area 22, 6% in Area 23 and 9% in Area 24.

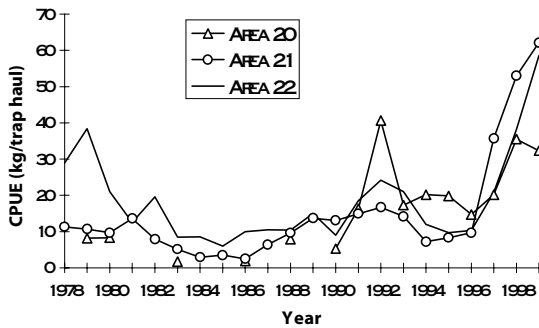
Resource Status

Catch rate (CPUE: kg/trap haul) and effort (total number of trap haul) were derived from fishing logs. In 1999, increases in CPUE compared to 1998 were observed in Areas 21 (18%), 22 (53%) and 23 (13%), while there were slight decreases in Area 20 (-8%) and in Area 24. In 1998, and again in 1999, some snow crab buyers dealt with the

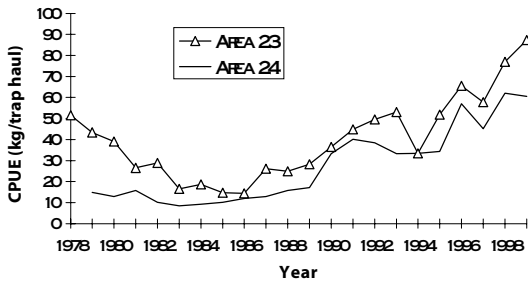
increase in snow crab allocations by asking fishers to restrict their landings, or again by offering a lower price per pound above a certain quantity of landings. Catch rates were also affected by the move towards more efficient fishing gear, such as high-cone traps. It was not necessary to adjust catch rates for soak time.

The trends in the CPUE do not suggest that the stock is declining.

CPUE for Areas 20, 21 and 22.



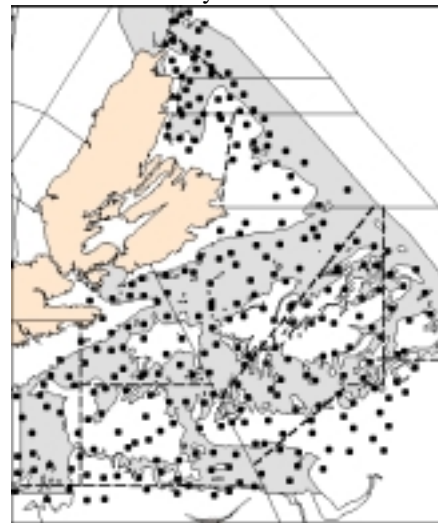
CPUE for Areas 23 and 24.



In 1999, for the first time, the evaluation of stock status is also based on an annual **trawl survey** introduced in eastern Nova Scotia in 1997. The trawl survey in eastern Nova Scotia occurs 1-2 months before the fishery except in Area 24 in 1998. By contrast, in the southern Gulf, the survey occurs immediately after the fishery, which means the terminology for eastern Nova Scotia is different from that used in Areas 12, 18 and 19. In this report; **total biomass** means all adult males greater than 95 mm at the time of the survey; **exploitable biomass** means

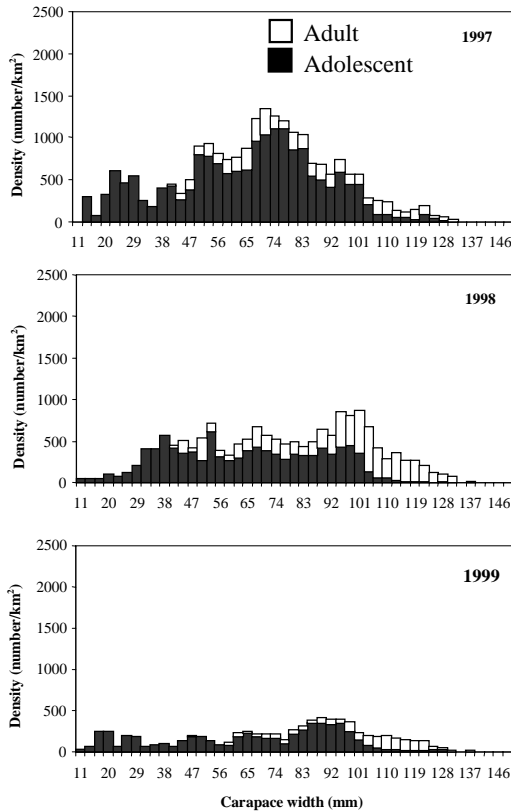
adult males greater than 95 mm and of carapace condition 3, 4 and 5 at the time of the survey; **recruitment to the fishery** means adult males greater than 95 mm with a soft-shell and of carapace condition 1 and 2 at the time of the survey (these will not enter the fishery following the current survey, but the following year); and **pre-recruits** means adolescent males greater than 56 mm at the time of the survey.

Distribution of the survey stations in 1999.

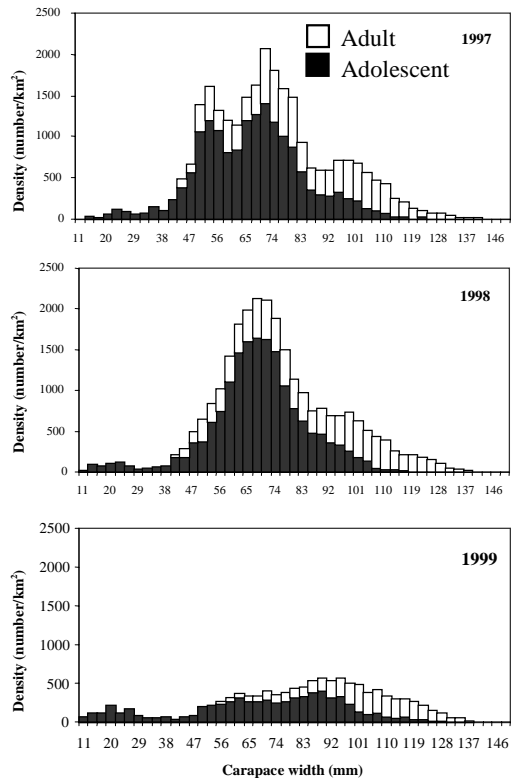


Biomass of adult commercial-size crab was estimated within the area indicated in grey.

Survey size frequency of male crab in Areas 20-22 from 1997 to 1999.



Survey size frequency of male crab in Areas 23-24 from 1997 to 1999.



Although surveys were completed 1997-1999, estimates of exploitable biomass are presented for only 2000. The 1999 survey indicated that there was 2,384 t of total biomass in the north, Area 20-22; and 31,810 t of total biomass in the south; Areas 23(A-D)-24(A-C). The fishery occurred after the survey and harvested 907 t in Areas 20-22 and 2,488 t in Area 23(A-D)-24(A-C). Thus assuming no other losses, the exploitable biomass available for the 2000 fishery will be 1,477 t in Areas 20-22 and 29,322 t in Areas 23(A-D) – 24 (A-C).

Exploitable biomass (t) available for 2000 fishery and proportion by fishing grounds.

Areas	Exploitable biomass (t)	Traditional grounds (%)	Non-traditional grounds (%)
20	-	8.6	-
21	-	43.8	-
22	-	47.6	-
Total	1,477	100.0	-
23	-	38.9	21.6*
24	-	38.4	1.0**
Total	29,322	77.3	22.7

*23CD; ** 24C

The biomass values may be over-estimated and must be interpreted with caution. In addition to the uncertainties mentioned below, they do not account for mortality of old carapace crabs.

The size frequency distributions show a substantial decrease in adolescent males from 1997 to 1999 in both northern and southern areas.

Density contours of adult male ≥ 95 mm CW in 1999.



Sources of Uncertainty

Two major problems with the survey were identified which would affect the biomass estimates. The number of stations and the area covered by the survey have increased from 1997 to 1999. In addition, the spatial model has assumed that the densities could be extrapolated over a larger area than would be reasonable considering the abrupt changes in the bottom topography. Both of these problems have probably resulted in overestimates of biomass in all years, although we consider that the current biomass estimates are the most accurate available values.

There also appeared to be some inconsistency in the size frequency distributions that cannot be explained totally by survey methods. For example, a large aggregation of crab was found at the outer edge of Area 22 in 1998 but not in 1999. The 1999 fishery did find part of the concentration, indicating that in slope areas there may be significant movement of the resource. In addition to movement outside the survey area, other possible reasons for the inconsistency of size frequency

distributions would be a change in the time of the survey or a large die-off, perhaps caused by the large change in bottom water temperature between the two years.

The assumption that snow crab bearing barnacles on the carapace are “old” or “older” crab may not be true. Although it is known that areas that have not been previously exploited would have an accumulation of older crab over years, in the case of eastern Nova Scotia, warmer temperatures in the southern part probably favour the rapid growth of barnacles. An unknown portion of the crabs in eastern Nova Scotia that we considered old, because of the epibiont growth, should actually be classified with carapace condition 3. Presently, epibiont growth on the carapace, if clearly visible, will automatically result in a classification of carapace condition 4. This needs an in-depth investigation to establish a proper key for the relative carapace age determination for the eastern Nova Scotian fishery.

The range of distribution for females, juveniles, adolescents and the undersized adult males is different from that of adult ≥ 95 mm. Further studies are required to improve our knowledge on the distribution of all size-classes of male and female snow crab.

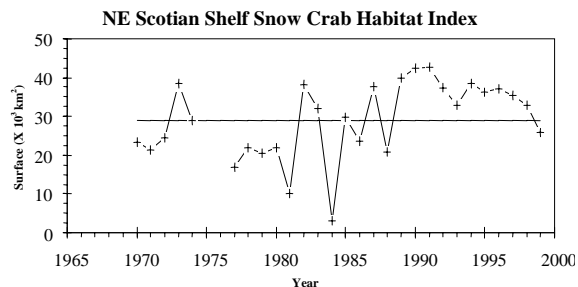
Changes in the survey size frequency distributions in 1998-1999 cannot be solely explained by the survey methods. Possible causes are mortality, seasonal movement, changes in environmental condition such as water temperature. In the outside portion of Area 22 the timing of survey could be important to our interpretation of the abundance changes between years. Tagging is a useful tool to understand the movement among areas.

A trawl survey is scheduled to occur just prior to the opening of the 2000 fishery and it will be very valuable for clarifying the state of the resource.

Ecosystem Considerations

Snow crab on the Scotia Shelf are near the southern limit of their distribution, and are found mainly where summer bottom temperatures are less than 3°C. These conditions are limited to the eastern Scotia Shelf and cold water pockets off southwestern Nova Scotia. Adult snow crab have been reported in warmer bottom temperature, but it is believed that molting crabs, being at a fragile stage, might be more affected by warmer temperatures.

A cooling trend in the bottom temperature that started in early 1990 correlates with the 'sudden' increase in the snow crab population observed during the same time in eastern Nova Scotia. The cold water would have opened new habitat previously unacceptable to snow crab. This cooling trend seems to have stopped, and the cold bottom temperature has remained more or less stable in its distribution since 1997-98. Bottom temperature is an environmental limiting factor, and if the warming trend continues, a loss of snow crab habitat is to be expected. In the southwestern part of Area 24, temperatures are warm (5-7°C) and extremely low numbers of crab were found in 1999.



Outlook

Estimates of exploitable biomass for 2000 are 1,477 t for Areas 20-22 and 29,322 t for Areas 23(A-D)-24(A-C). In addition, there was significant loss or movement of adolescent crabs between 1998 to 1999. The cause is unknown, but could be due to increase of warmer water. Because of the uncertainty, caution should be used for the management of the fishery in the coming year.

Trawl survey including a tagging study for all areas must continue, and a detailed accounting of losses will be required to improve our understanding of the resource.

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Reference

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