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Assessment of the 1992 snow crab (*Chionoecetes opilio*) exploratory fishery in Bay of Islands, western coast of Newfoundland.

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ABSTRACT

An exploratory snow crab (*Chionoecetes opilio*) fishery was initiated in Bay of Islands, on the western coast of Newfoundland in 1987. Since the beginning of this exploratory fishery, it has been managed under no quota limitations. Between 1987 and 1991, landings were negligible (less than 15 t per year). In 1992, landings increased to 199 t, however, the fishery had to be closed on several occasions due to the high incidence of soft shell crab in the catches. The total fishing effort for 1992 was 8,737 trap hauls which represents a catch per unit of effort of 20.8 kg per trap haul.

For the first time in 1992, a post-season trawl survey was conducted in Bay of Islands in order to evaluate the available biomass and provide scientific advice for the establishment of a sound management plan. Twenty five (25) stations were sampled during the day time using a twenty five meter (*Nephrops)* otter trawl. During the survey, 802 crabs (424 males and 378 females) were caught. Using the trawl survey data, the initial biomass of hard shell morphometrically mature males ≥95.0 mm, for 1993, was estimated at 224.3 t. The high exploitation rate observed in the 1992 season coupled with the uncertainty of the future recruitment to the fishery suggest a cautious approach when setting a TAC level for the 1993 season.

RÉSUMÉ

Une pêcherie de développement au crabe des neiges (*Chionoecetes opilio*) a débuté en 1987 dans Bay of Islands sur la côte ouest de Terre Neuve. Depuis le début, cette pêcherie n'est soumise a aucun contingents. Entre 1987 et 1991, les débarquements ont été négligeables (moins de 15 t par année). En 1992, les débarquements ont atteint un sommet de 199 t. Par contre, la pêche a due être interrompue à deux reprises due à la présence d'un haut taux de crabes mous dans les captures. D'après les livres de bord, l'effort total de 1992 a été estimé a 8,737 casiers levés et la prise par unité d'effort saisonnière a été de 20,8 kg par casier levé.

En 1992, une croisière post saison a été effectuée dans Bay of Islands afin d'évaluer la biomasse de crabe des neiges disponible pour 1993 et ainsi définir un plan de gestion pour cette pêcherie. Vingt cinq (25) stations ont été échantillonnées à l'aide d'un chalut (*Nephrops*) de vingt cinq (25) mètres. Pendant cette croisière, 802 crabes des neiges (424 mâles et 378 femelles) ont ainsi été capturés. En utilisant les données de chalutage, la biomasse de crabe dure morphométriquement mature ≥95,0 mm pour 1993 a été évaluée a 224,3 t. Le taux d'exploitation élevé observé pendant la saison de 1992 jumelé à l'incertitude future du recrutement à la pêcherie, suggère une approche prudente en ce qui a trait au niveau du TPA pour la saison de 1993.

INTRODUCTION

An exploratory snow crab (*Chionoecetes opilio*) fishery was initiated in Bay of Islands, on the western coast of Newfoundland (Figure 1) in 1987 with the issuance of three exploratory permits with a trap limit of 100 per boat. Eight more permits were issued in 1989 with a trap limit of 30 per boat. The most common trap used is the 1.2 m (4') conical (Comeau et al. 1991), so called Japanese trap which are usually set on a string of ten. According to fishermen, the most productive grounds for snow crab in Bay of Islands are found at depths ranging from 120 to 250 metres.

Since the beginning of this exploratory fishery, it has been managed under no quota limitations. In 1987 and 1988, the fishery took place during October and November. No commercial landings were officially recorded in 1987, while the fishermen had started to sell their catches in 1988. In 1989 and 1990, the fishery was opened during the months of September and October. Low catch levels, less than a ton per year, were recorded in 1989 and 1990. In 1991, the fishery lasted only two weeks during which 6 out of 11 boats were active and 14 t of snow crab were landed.

For the 1992 fishery, the season opened on June 25, and the first landings were recorded on July 04. The fishery was closed between July 11 and August 02 due to a high incidence of soft shell crab in the catches. The fishery was reopened on August 03, but closed again from September 03 to 29 for the same reason. It reopened once more on September 30 and the season was finally closed on October 18. All eleven boats were active during the fishery resulting in total landings of 199 t. The catch per unit of effort (CPUE) for the season was 20.8 kg per trap haul.

For the first time, in 1992, a post-season trawl survey was conducted in Bay of Islands in order to evaluate the available biomass and provide scientific advice for the establishment of a sound management plan. An overview of catch, effort, biological characteristics and projected biomass for this exploratory fishery in Bay of Islands are discussed herein.

MATERIAL AND METHODS

Log book data

Catch and effort data were obtained from fishermen's logbooks by the Department of Fisheries and Oceans Electronic Data Processing and Statistics Branch. The resulting data set was comprised of entries containing the following information:

a) Canadian Fisheries Vessel number (CFV)
b) date fished
c) date landed
d) fishing position (Loran C or latitude/longitude)
e) number of traps hauled
f) catch estimate in pounds by the fisherman

From these data, catch (converted to kg) and CPUE (daily catch/ number of trap hauls per day) were calculated and summarized into weekly intervals.

Port sampling

A port sample was collected in Lark Harbour, Newfoundland during the 10th week (August 31) of the 1992 fishing season. A total of 306 male crabs

were sampled for size frequency (carapace width, C.W.), morphometric maturity (Comeau and Conan, 1992) and carapace condition. From the port sample data, the percentage of soft shell, juvenile and undersize (C.W. <95.0 mm) crabs were calculated.

Post season trawl survey

Between October 23 and 28, 1992, a post season trawl survey was conducted for the first time in Bay of Islands in order to evaluate the snow crab biomass in the area. Twenty five (25) stations chosen randomly, were sampled during the day time. The Humber Arm area (Figure 1) was avoided due to the presence of under water cables which were hazardous to the trawling operation. A twenty five (25) meter (*Nephrops)* otter trawl (Conan et al. 1993) equipped with a "SCANMAR" electronic net sensor system was used on a DFO research vessel, the "C.S.S. Opilio". The duration of the tows varied from 4 to 8 minutes at a speed of 2.0 to 3.5 knots. A standard trawl haul started when the predetermined amount of cable (usually three times the depth) was let out and the winch drums locked. The starting and end positions of each tow was determined using a global positioning system (GPS). The area swept by the trawl was calculated by multiplying the length of each tow by the width of the trawl mouth.

The crabs in each tow were sorted and measured using a modified vernier caliper (Watson and Wells, 1970). The following measurements and observations were made: carapace width (C.W.), chela height (Comeau and Conan, 1992), carapace condition (quantity of epibionts and colour of the carapace) and carapace rigidity (durometer reading, Foyle et al. 1989). In addition, the presence/absence and colour of external eggs was also noted for the females.

Size frequency distributions were produced for male and female crab caught during the survey. The mean size and the percentage of soft and hard carapace specimens according to morphometric maturity (juvenile and morphometrically mature; Comeau and Conan, 1992) were calculated for legal (≥ 95.0 mm C.W.) and sub-legal (<95.0 mm C.W.) males. For the females, the mean size and the percentage of immature were calculated.

A geostatistical technique, Kriging (Conan, 1985), was applied to the trawl survey data using the software package "MATLAB" (Marcotte, 1991). The available biomass of morphometrically mature males larger than 95.0 mm in carapace width for the 1993 fishing season was estimated. Also, projection of recruitment biomass to the 1993 season was also made based on the analysis of size frequency distribution. Densities of crab in number were converted into weight using a length-weight relationship.

RESULTS

Fishing effort and catch per unit of effort

The logbook records from all 11 fishermen were received and the total catch from the logbooks was 198,982 kg. The total fishing effort for 1992 was 8,737 trap hauls which represents a CPUE of 20.8 kg/trap haul. The weekly CPUE varied between 27.9 kg/trap haul (week 2) and 10.7 kg per trap haul (week 14). The low CPUE level observed during week 3 is attributed to high percentages of soft shelled crab in the catches which were discarded at sea. The seasonal and weekly fishing effort, catch rate and total catch are summarized in Table 1.

Biological information from port sample

A port sample was taken on August 31, during which a total of 306 male crabs were measured. The mean size of the sample was 109.0 mm (C.W.) and the percentage of soft and juvenile crabs was 64.4 % and 16.7 % respectively (Figure 2).

Biological information from trawl survey

During the survey, 802 crabs (424 males and 378 females) were obtained from the 25 tows. The percentage of juvenile males was 39.9 % and the percentage of newly molted (soft) males was 48.7 %. The overall size frequency distribution (Figure 3) shows a mean size of 100.0 mm C.W. and the catch composition in percentages was as follows:

	Soft shell			Hard shell			Total		
	J	M	T	J	M	T	J	M	T
Legal size	7.9	29.9	37.8	3.0	19.8	22.8	10.9	49.7	60.6
Sub-legal size	9.7	1.2	10.9	19.3	9.2	28.5	29.0	10.4	39.4
Total	17.6	31.1	48.7	22.3	29.0	51.3	39.9	60.1	100.0

J: juvenile, M: morphometrically mature, T: total

The mean size for the female crab was 65.0 mm C.W. and the percentage of immature was 1.9 % (Figure 3). The percentage of mature females carrying eggs was 98.9 % of which 41.0 % were orange eggs and 59.0% were brown eggs.

Biomass estimation

The total area covered (88,315 m^2) by sampling resulted in density contours covering 226 km^2. The variogram plot for morphometrically

mature males ≥95.0 mm C.W., juvenile males >70.0 mm C.W. (these crabs will molt to the legal size category during the winter and enter the fishery as soft crab in 1993) and juvenile males >56.0 mm C.W. (these crabs will molt to the undersize category during the winter and will be captured as soft crab in 1993) showed a nugget range of approximately 10 km.

Using the trawl survey data, the initial biomass of hard shell morphometrically mature males ≥95.0 mm for 1993 was estimated at 224.3 t ± 139.0 t (1673 crabs/km^2). The biomass of soft shell crab ≥95.0 mm (recruitment) that will enter the fishery in 1993 was estimated at 229.7 t ± 78.0 t (1714 crabs/km^2) and the density of crab ≥56.0 mm was estimated at 1822 crabs/km^2. Density contour charts for each category of male crab are presented in Figures 4-5-6. The main concentrations of the three categories were found in the southeastern part of the bay.

DISCUSSION AND CONCLUSION

Based on the mid-value of the biomass estimates from the trawl survey, the initial biomass for 1992 was 324.2 t (125.3 t of hard morphometrically mature male crab ≥95.0 mm, found in the trawl survey + 198.9 t landed). Landings in 1992 were 198.9 t representing an exploitation rate of 61.3 %. This exploitation rate appeared to be very high compared to other snow crab fisheries in the southern Gulf of St. Lawrence (Mallet et al., 1992). Therefore, a reduction in the exploitation level for the 1993 fishing season is highly recommended.

It is premature to comment on future recruitment based on a one year size frequency data. Although some potential molters to commercial size classes are present in the fishery, which will ensure a short term (1-2 years) recruitment to the fishery, there is a lack of smaller size juvenile males which

suggest some uncertainty of future recruitment to the fishery.

The percentage of soft shell crab in the commercial catch was very high in 1992 compared to other snow crab fisheries in the Gulf of St.Lawrence. Protective measures should continue to be implemented in order to protect the recruitment to the fishery and increase the value of this fishery to the fishing industry. If this fishery is to be exploited for a long term period, with a certain stability of the catch rather than being a sporadic fishery, some cautious approaches when setting the 1993 TAC should be considered. Under similar stock conditions, in the southwestern Gulf of St. Lawrence snow crab fishery, an exploitation level of 38.0 % had been implemented in 1989. Since then, the stock appears to be recovering steadily. This 38.0 % exploitation rate would translate into a TAC level of 85 t for the 1993 Bay of Islands snow crab fishery.

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Table 1. Seasonal and weekly fishing effort, catch per unit of effort and total catch for the 1992 fishing season in Bay of Islands.

Week	Trap haul	CPUE	Total catch	$C_t/2$	K_t
01 (28-06/04-07)	60	26.8 kg	2,151.0 kg	1,076 kg	1,076 kg
02 (05-07/11-07)	690	27.9 kg	20,431.0 kg	10,216 kg	12,367 kg
03 (12-07/18-07)	180	10.2 kg	2,196.0 kg	*	*
04 (19-07/25-07)	-	-	-	-	-
05 (26-07/01-08)	-	-	-	-	-
06 (02-08/08-08)	370	26.7 kg	12,859.0 kg	6,430 kg	29,012 kg
07 (09-08/15-08)	1,450	24.0 kg	39,871.0 kg	19,936 kg	55,377 kg
08 (16-08/22-08)	1,945	27.3 kg	54,717.0 kg	27,359 kg	102,671 kg
09 (23-08/29-08)	1,204	17.6 kg	22,911.0 kg	11,456 kg	141,485 kg
10 (30-08/05-09)	1,158	15.4 kg	21,499.0 kg	10,750 kg	163,690 kg
11 (06-09/12/09)	150	14.1 kg	2,115.0 kg	1,058 kg	175,497 kg
12 (13-09/19-09)	30	18.2 kg	544.0 kg	272 kg	176,826 kg
13 (20-09/26-09)	-	-	-	-	-
14 (27-09/03-10)	390	10.7 kg	4,155.0 kg	2,078 kg	179,176 kg
15 (04-10/10-10)	480	12.9 kg	6,197.0 kg	3,099 kg	184,352 kg
16 (11-10/17-10)	630	14.8 kg	9,330.0 kg	4,665 kg	192,115 kg
Seasonal	8,737	20.8 kg	198,982.0 kg		

CPUE: catch per unit of effort, C_t: weekly catch, K_t: cumulative catch

** These figures were not used in the calculation due to the low fishing effort at this time and the high incidence of soft shell crab in the catch which were discarded at sea. The fishery was closed during that week due to the high incidence of soft shell crab.*

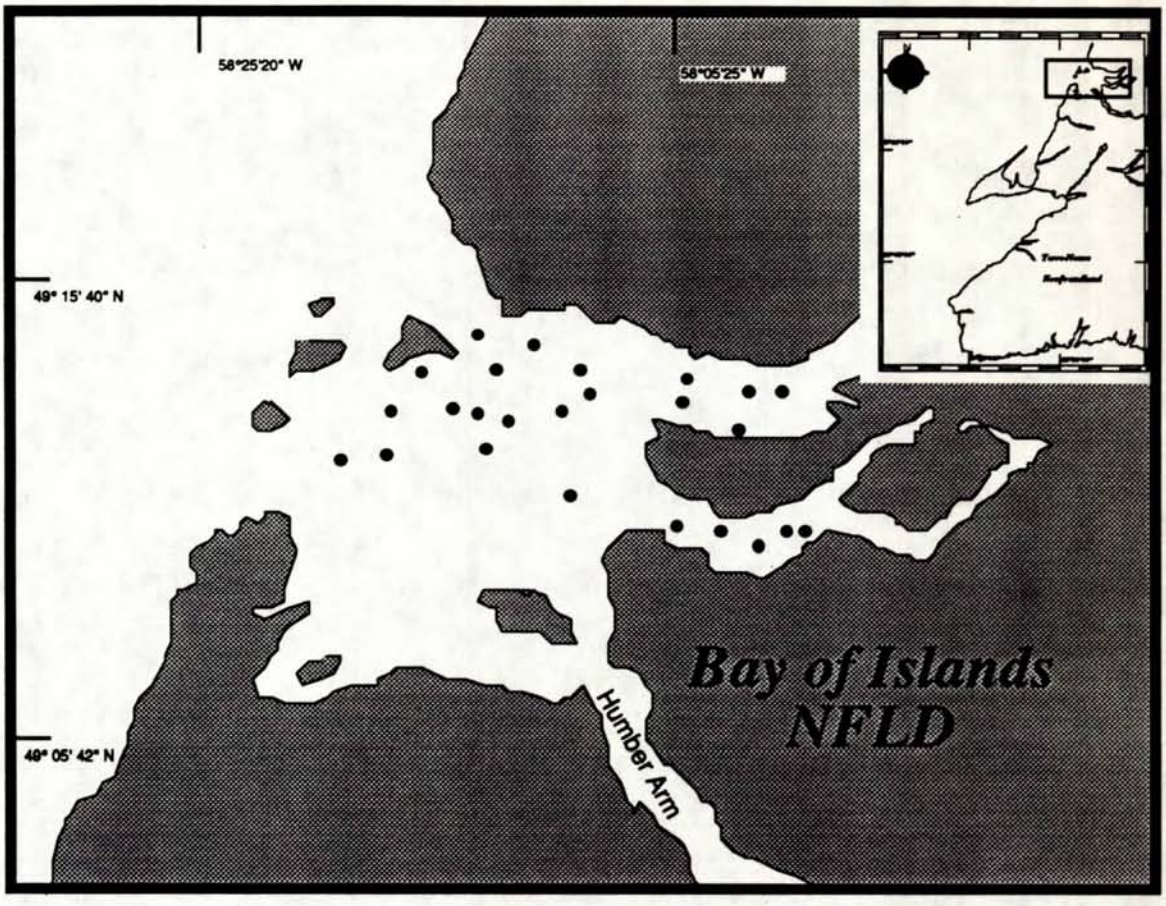

Figure 1. Trawling locations in Bay of Islands, Newfoundland.

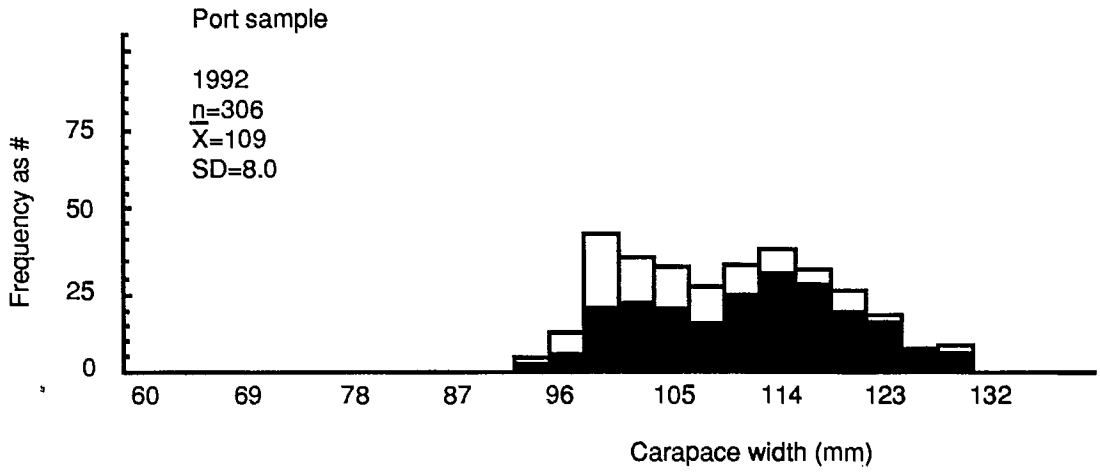

Figure 2. Size distribution of male snow crab from port sample taken during the 1992 fishery.

White bars: number of hard crab
Black bars: number of soft crab

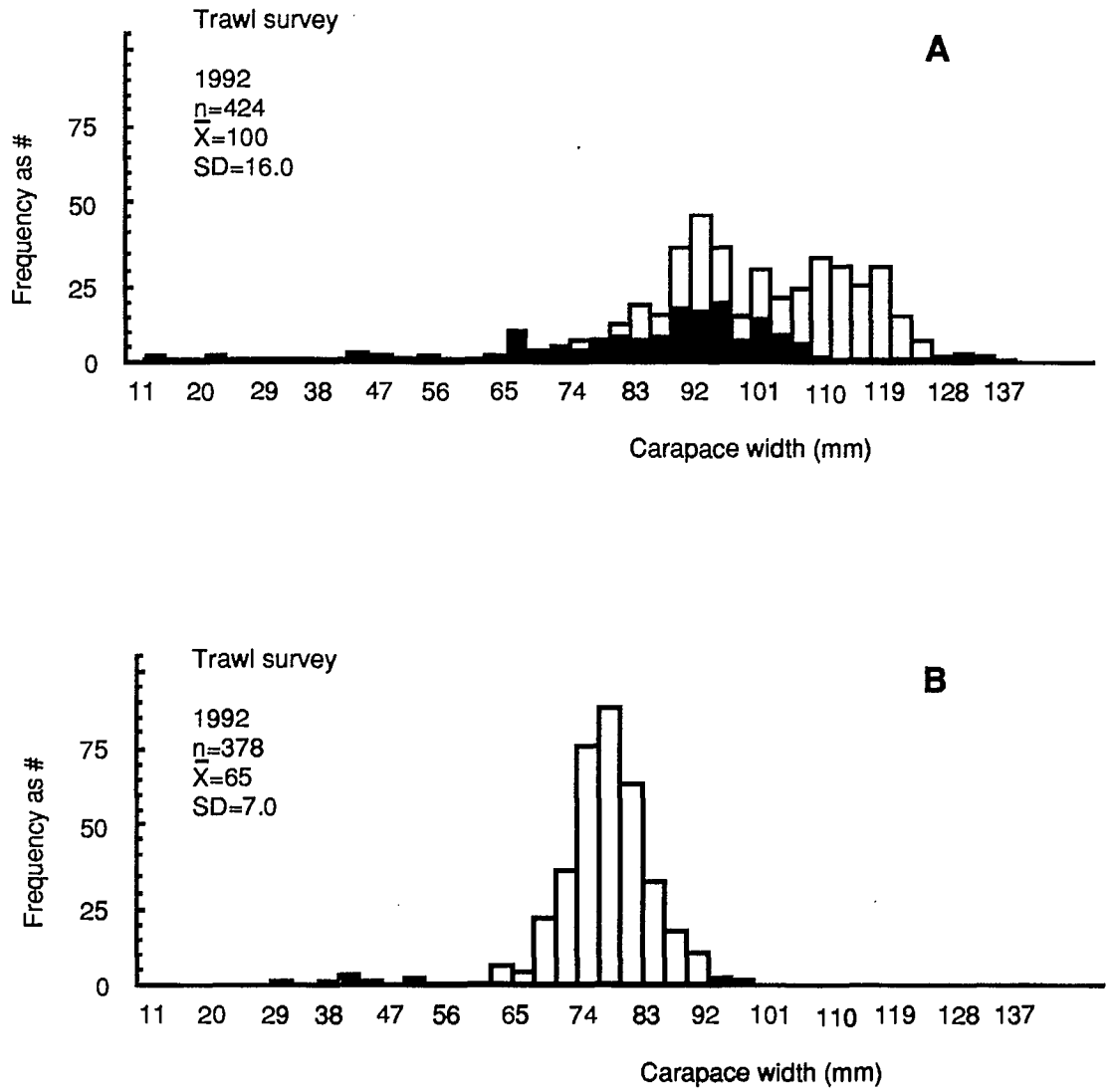

Figure 3. A) Size distribution of male snow crab from the trawl survey conducted after the 1992 fishing season in Bay of Islands.

White bars: number of mature crab
Black bars: number of juvenile crab

B) Size distribution of female snow crab from the 1992 trawl survey in Bay of Islands.

White bars: number of mature female
Black bars: number of immature female

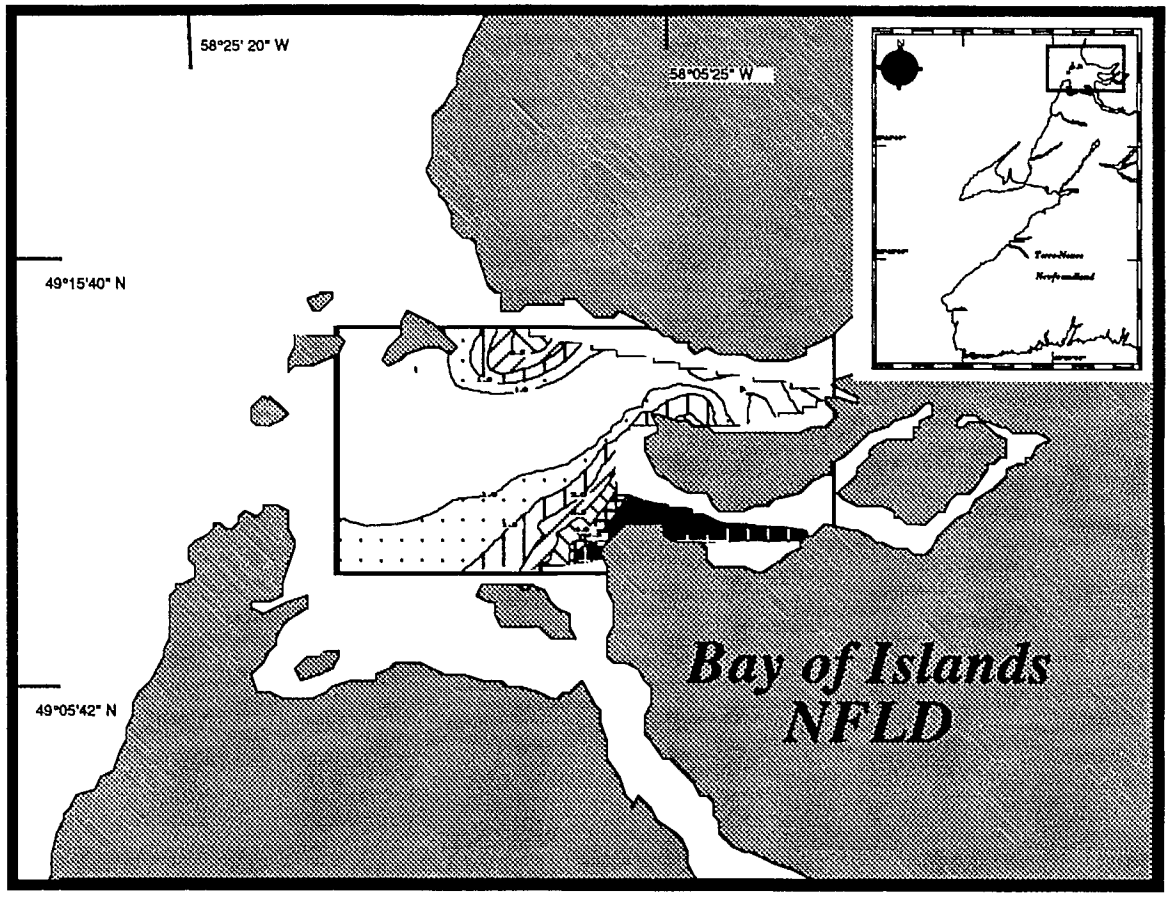

Figure 4. Density contours of morphometrically mature male crab ≥ 95 mm calculated from the trawl survey data.

Scale:

- 0-1000 crabs/km^2
- 1000-1500 crabs/km^2
- 1500-2000 crabs/km^2
- 2000-2500 crabs/km^2
- 2500-3000 crabs/km^2
- 3000-3500 crabs/km^2
- 3500-4000 crabs/km^2

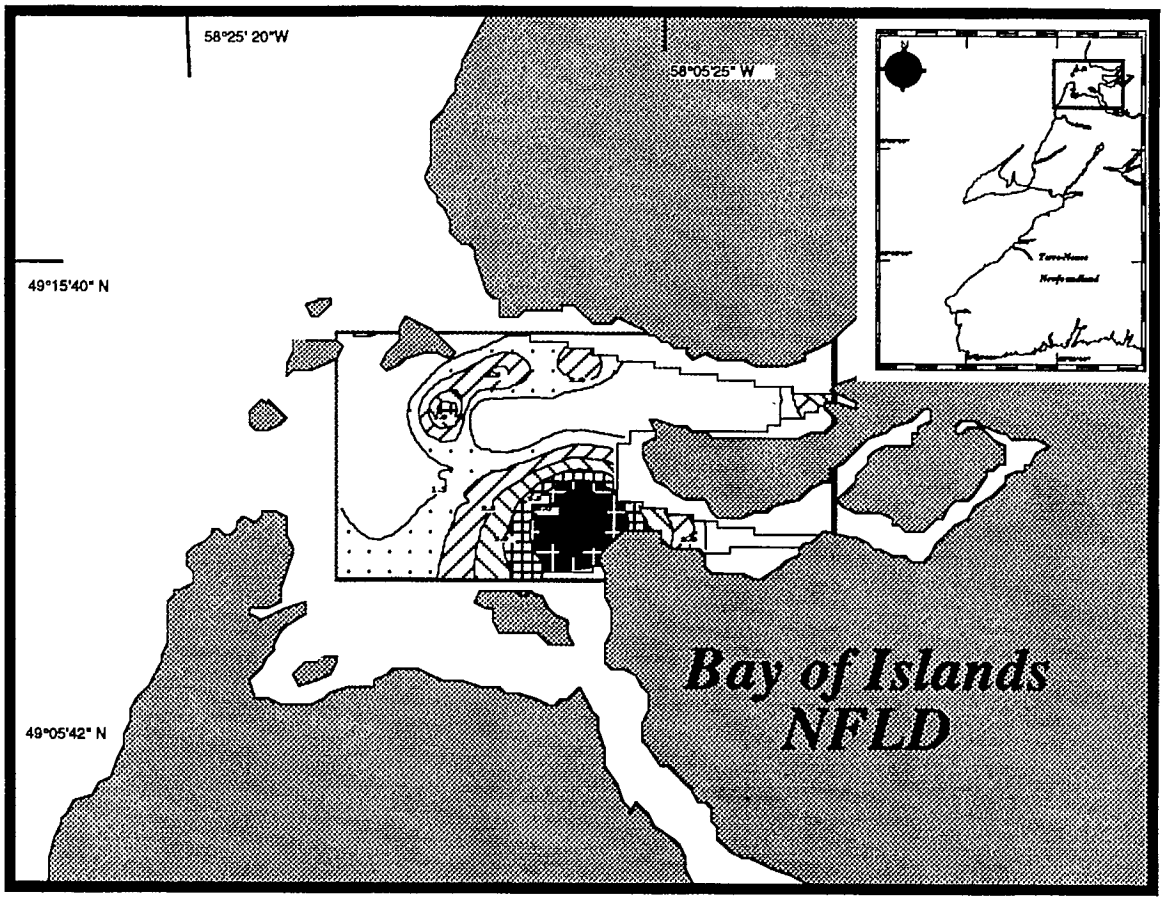

Figure 5. Density contours of juvenile male crab ≥70 mm (commercial size soft shell crab in the 1993 season) calculated from the trawl survey data.

Scale:

- 0-1500 crabs/km^2
- 1500-2000 crabs/km^2
- 2000-2500 crabs/km^2
- 2500-3000 crabs/km^2
- 3000-3500 crabs/km^2
- 3500-4000 crabs/km^2
- 4000-4500 crabs/km^2

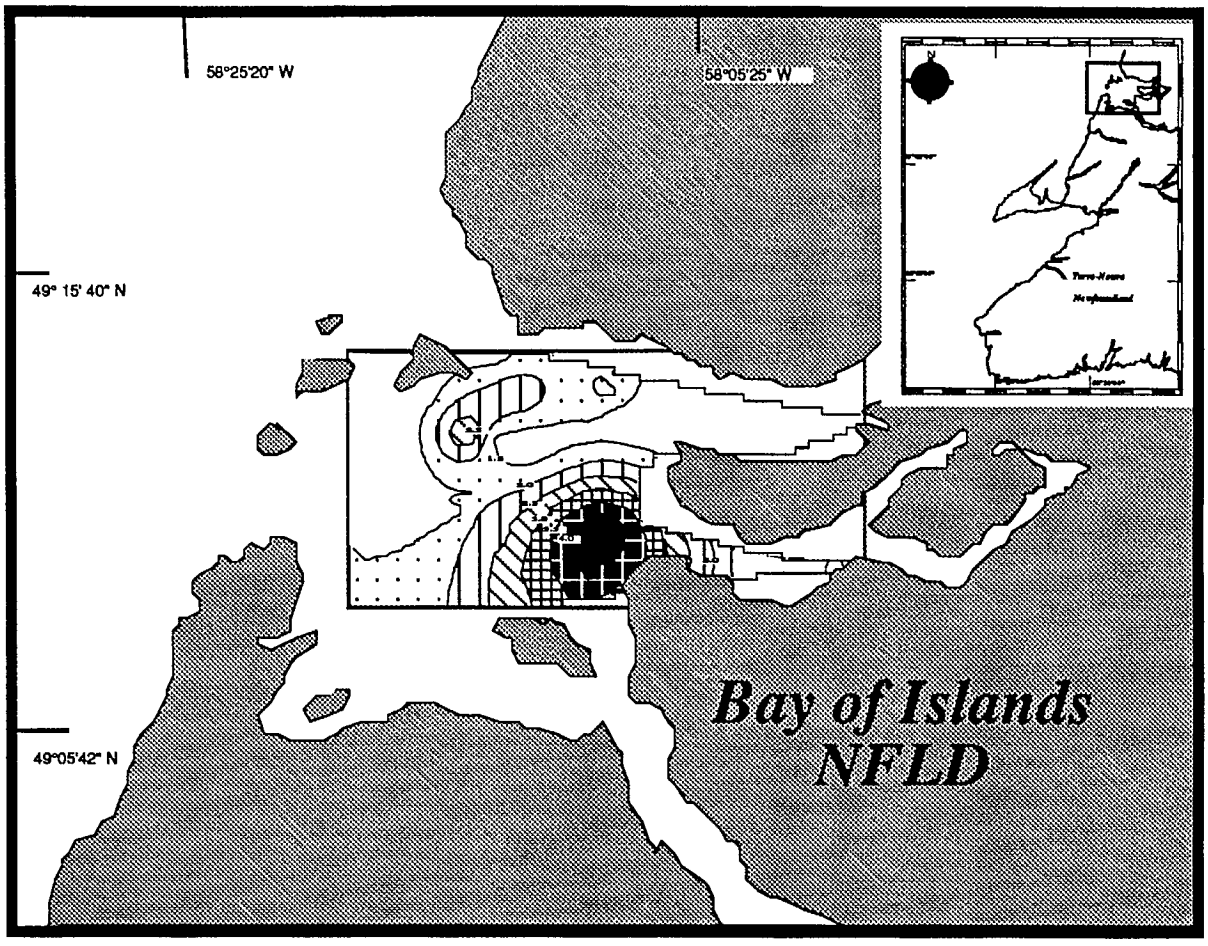

Figure 6. Density contours of juvenile crab ≥56 mm (undersize soft shell crab in the 1993 season) calculated from the trawl survey data.

Scale:

- 0-1500 crabs/km^2
- 1500-2000 crabs/km^2
- 2000-2500 crabs/km^2
- 2500-3000 crabs/km^2
- 3000-3500 crabs/km^2
- 3500-4000 crabs/km^2
- 4000-4500 crabs/km^2