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Review of the western Cape Breton Island snow crab (Chionoecetes opilio) fishery
for 1990 and 1991

by

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ABSTRACT

During the 1990 and 1991 fishing seasons, the snow crab populations fished off the western coast of Cape Breton, Areas 18 and 19, were assessed using port sampling and/or sea sampling aboard commercial vessels, fishermen's logbooks and processor's sales slips. Trawl surveys outside the 1990 and 1991 fishing seasons were used for assessment.

Area 19:

Total landings of 1333 t and 1337 t were recorded for the 1990 and 1991 season respectively. The mean CPUE increased from 44.5 kg/trap haul in 1989 to 46.9 kg/trap haul in 1990 and to 79.9 kg/trap haul in 1991. The calculated effort decreased from 29978 trap hauls in 1989 to 28422 trap hauls in 1990 and again to 16733 trap hauls in 1991.

According to the trawl survey data, the biomass of large claw legal size crab increased significantly from 2971 t in 1990 to 3462 t in 1991 and is projected to increase again to 5459 t in 1992.

Area 18:

Ninety eight percent of the total allowable catch (TAC) in 1990 (674 t) was caught. The fishery took place in the spring (139 t) and the fall (523 t). The mean CPUE decreased from 58.1 kg/trap haul in 1989 to 50.5 kg/trap haul in the fall 1990. The spring CPUE increased from 26.1 kg/trap haul in 1990 to 30.7 kg/trap haul in 1991. The TAC for the spring 1991 (200 t) was caught (187 t). 535 t of the combined TAC for the fall 1991-spring 1992 (674 t) was caught in the fall 1991.

The Area 18 fishery has always been dependent on recruitment which has caused quality problems. A large increase of biomass is estimated for the 1992 season. It is therefore recommended to exploit this increase of biomass over several years in order to allow for an accumulation of large claw crab on the grounds and reduce the dependancy of this fishery on soft and small claw crab and possibly stabilizing the fishery.

RÉSUMÉ

Les populations de crabe des neiges pêchées sur la côte ouest du Cap-Breton, régions 18 et 19, ont été évaluées en se basant sur l'échantillonnage au port et/ou l'échantillonnage en mer, les carnets de bord des pêcheurs et les récipissés d'achat des usines pendant les saisons de pêche ainsi que des campagnes de chalutage hors saison.

Région 19:

Des débarquements de 1333 t et 1337 t ont été enregistrés pour la saison de pêche de 1990 et 1991 respectivement. La PUE moyenne a augmenté de 44,5 kg/casier levé en 1989 à 46,9 kg/casier levé en 1990 et a ensuite grimpé à 79,9 kg/casier levé en 1991. L'effort calculée a diminué de 29978 casiers levés en 1989 à 28422 casiers levés en 1990 et à 16733 casiers levés en 1991.

D'après la campagne de chalutage, la biomasse de crabe à grosses pinces de taille légale a augmentée considérablement de 2971 t en 1990 à 3462 t en 1991. Selon les projections, la biomasse devrait augmenter à 5459 t en 1992.

Région 18:

Quatre-vingt-dix-huit pourcent du total des prises admissibles (TPA) en 1990 (674 t) a été capturé. La pêcherie a eu lieu au printemps (139 t) et en automne (523 t). La PUE moyenne a diminué de 58,1 kg/casier levé en 1989 à 50,5 kg/casier levé en 1990. La PUE printanière a augmenté de 26,1 kg/casier en 1990 à 30,7 kg/casier en 1991. Le TPA

printanier 1991 (200 t) a été capturé (187 t). 535 t du TPA combiné pour l'automne 1991-printemps 1992 (674 t) a été capturé à l'automne 1991.

Cette pêcherie a toujours été dépendante du recrutement, ce qui cause des problèmes de qualité. Une grande augmentation de biomasse est estimée pour la pêcherie de 1992. Il est fortement recommandé d'exploiter cette augmentation de biomasse sur une base de quelques années de façon à permettre une accumulation de crabe à grosses pinces sur les fonds de pêche et de réduire la dépendance de la pêcherie sur le crabe mou et le crabe à petites pinces et possiblement stabiliser cette pêcherie.

INTRODUCTION

The snow crab grounds off Cape Breton (CB) Island were first commercially exploited in the mid 1960's by a group of fishermen based in Chéticamp, Nova Scotia. The New Brunswick and Québec offshore boats started to fish sporadically in the same area soon after. With the increasing value of snow crabs in the late 1970's and early 1980's, the fishery gradually expanded to cover all the snow crab grounds off the western coast of CB Island.

In 1978, an inshore fishing area (Area 19, Figure 1) was established on the western coast of the Island to be used exclusively by inshore vessels of under 13.7m (45ft) in length. At that time, 14 inshore boats were licensed for the area with a maximum of 40 traps per license. An additional 13 licenses were issued in 1979 and the maximum number of traps per license was reduced to 30. Another 34 licenses were issued in 1984 at which time the maximum number of traps per license was set to 20 and the quota per boat reduced from 37,195 kg (82,000 lbs) to 22,680 kg (50,000 lbs). These changes resulted in an increase of the TAC from 1004 t in 1982 to 1385 t in 1984. Since 1979, the catches in this fishery have been regulated by a TAC derived from Leslie analysis (Ricker, 1980) of fisheries data and by boat quotas (Davidson and Comeau, 1987). In 1986, the number of licenses was reduced to 59. In 1987, the quota per boat was lowered to 19,505 kg (43,000 lbs). The subsequent decrease of 14% in the TAC had been proposed by CAFSAC in order to decrease the fishing pressure and stabilize the catch rates (Davidson and Comeau, 1987). In 1988, good catch rates resulted in the implementation of an increased quota per boat to 22,680 kg (50,000 lbs) which had been in place from 1984 to 1986 for a TAC of 1338 t. The same management regime remained from 1989 to 1991. A summary of information on seasons, TAC's, catches, licenses and trap limits is presented in Table 1.

Area 18 was first exploited in 1979 by 14 inshore vessels which were given exploratory permits allowing them to fish a maximum of 30 traps per permit. These permits were upgraded to licenses the following year and 9 additional licenses were issued to explore an area further from shore. In 1981, all 23 entrants were issued licenses and allowed to fish anywhere in Area 18. Larger mobile vessels from New Brunswick and Québec fished in Area 18 from 1980 to 1982. In 1983, the mobile fleet did not participate in this fishery as their season closed before the opening date for the inshore area. In 1984, the offshore vessels were excluded from the zone and northwestern and southwestern boundaries were established (Figure 1). A boat quota of 36,288 kg (80,000 lbs) was put in place for Area 18 in 1981 and retained through 1985. The corresponding TAC of 835 t was a preliminary figure which was used for management purposes as biological estimates were not available because of the unknown level of participation in the area by the mobile vessels. Declining catch rates, high exploitation levels and low production estimates resulted in a decrease in the boat quotas to 27,216 kg (60,000) in 1986 for an overall TAC of 626 t. In 1988, four new licenses were issued for a total of 27 fishermen and the TAC was set at 674 t, which allowed boat quotas of 24,948 kg (55,000 lbs). The same management regime remained for 1989. Throughout the history of the fishery, white (soft shell) crabs have been a problem in Area 18. In 1981, an early spring season in addition to the fall season was attempted to avoid poor quality crabs. This experiment was not a success as the animals caught in the spring and early summer were soft shelled and had a low meat yield. Since

1982, the season has been set for late summer and early fall with the opening date being determined by the results of meat yield tests which are done on animals caught during pre-season sampling. In 1990, the fishery opened on April 23rd and closed on April 27th following an agreement with the groundfish fishermen. The crab fishermen were to remove their gear when the cod migrated into the zone. The fishery was re-opened on May 29th and closed on June 13th when the percentage of white crab in number from the total catch at sea reached 20%. The catch for the spring seasons reached 139 t. The fishery was again re-opened from September 3rd to November 3rd and extended to November 13th. A total catch of 523 t was recorded for the fall season. For the 1991 season, a quota of 200 t was set for the spring. A total of 187 t was landed. For the first time, a quota of 674 t was set for the combined fishery of the fall 1991 and spring 1992. Further information on catches, TAC's, seasons and licenses are presented in Table 2.

This document presents a review of biological characteristics and catch trends for Areas 18 and 19 snow crab fisheries for 1990 and 1991 and gives advice for the 1992 fishing season for both Areas.

MATERIALS AND METHODS

Port sampling and sea sampling

In Area 19, sea sampling and port sampling data were collected during weeks 1 to 4 in 1990 and during weeks 1 to 5 in 1991. In Area 18, sea samples were carried out in weeks 1 to 3 in the spring of 1990; during weeks 1 and 2 in the fall of 1990 and during weeks 2 to 6 in the spring of 1991. Port samples were collected during weeks 2 to 6 in the spring of 1991. Weekly percentages of soft shelled males were calculated from a carapace hardness gauge (durometer; Foyle *et al.*, 1989), percentage of morphometrically immature (Conan and Comeau, 1986) and undersize males were calculated from the sea sampling data. In the present document, at the request of the Steering Committee to standardize the terminology between the regions, morphometrically immature and mature crab will be called small and large clawed crab respectively. The small claw and the large claw are the crabs falling in the lower and the upper cloud, respectively, of a plot of chela height versus carapace width (Comeau *et al.*, 1991).

In 1991, the sea samples were prorated to the landings to get more precise values of the percentages of soft crab in the catches. Weekly percentages of soft shelled males and small claw males were obtained from the port samples. Weekly and overall size distributions were generated and the percentages of large claw and small claw male crabs in the sea samples and port samples were plotted according to their carapace size.

Logbook and sales slip data

Logbook and sales slip data were compiled on computer by the Statistics and EDP Systems Division of the Department of Fisheries and Oceans. The weekly and cumulative catch statistics for use in the Leslie analysis (Ricker, 1980) and the CPUE (catch in kg for a trip/number of traps hauled during the same trip) were calculated directly from the logbook data. The calculated CPUE's were summarized into weekly intervals for both areas (Tables 3a,b and 4a,b).

The sales slip data, usually more representative of the real catch (Davidson and Comeau, 1987) than logbooks, were not used in either Area because the total catches calculated from the logbooks were higher or similar to the catches reported in the sales slips.

The overall distribution of fishing effort calculated from the logbooks was plotted by sub-areas of 3 min. of latitude x 3 min. of longitude for Area 19 and by sub-areas of 2 min. of latitude x 2 min. of longitude for Area 18.

Trawl survey

In 1990, a post season trawl survey was conducted in the Southern Gulf of St. Lawrence and included 28 stations and 18 stations within Area 19 and 18, respectively (Figure 2). In 1991, the survey included 19 tows and 28 tows in Area 19 and 18, respectively (Figure 3). The dates are as follows:

	Area	Season	Trawl survey	Season	Trawl survey
1990	18	April 23-27 May 29-June 13	June 22-30	Sept. 3-Nov. 13	-
	19	-	June 22-30	July 14-Sept. 15	-
1991	18	May 16-June 30	July 13-18	Sept. 4 -	-
	19	-	-	July 15-Sept. 15	Sept. 6-14

A standard 20 m Nephrops trawl equipped with a SCANMAR electronic net sensor was used on a chartered vessel for the research surveys. Stations were sampled on a twelve hour basis during daylight. The duration of the tows varied from 4 to 8 minutes at a speed of 2.0-3.5 knots. A standard tow started when the predetermined amount of cable (usually three times the depth) was let out and the winch drums locked. The catch was sorted by sex, size, morphometric maturity, carapace condition and the presence/absence of external eggs for females.

A geostatistical technique, Kriging (Conan, 1985; Conan *et al.*, 1988) was used to estimate the biomass in this study. Total biomass for each of the fisheries was estimated by the Kriging method based on a variogram calculated from samples collected over the whole S.W.Gulf.

Size frequency distributions were produced for the males captured during the surveys. Percentages of white (recently molted) male crab were calculated for sub-legal and commercial size crab. The totals would not add up to 100% if claws are missing and size measurements unobtainable. The catch in number of large claw male crab larger than 95 mm carapace width (CW) from the 1990 and 1991 trawl survey was used to estimate the commercially exploitable biomass at the beginning of the 1991 and 1992 fishing season, respectively. Numbers of crab were converted to weight using the size-weight relationships of crabs sampled in the Cape Breton zones (according to the molt stage, morphometric maturity and the sampling season). The catch, in number of small claw crabs larger than 56 mm CW from the survey in 1990 and 1991 was used to estimate the biomass of newly molted crab larger than 70 mm CW for the 1991 and 1992 spring season. Estimates used global growth rate independantly from the morphometric maturity. The same size-weight relationship as the Southwestern Gulf fishery (zone 12) was used. The fishable area in the Cape Breton crab fishery was determined using the contours of variance from the trawl survey over the whole sampling area. The swept surface by trawl net was estimated from the data on net opening width measured by the SCANMAR electronic net sensor.

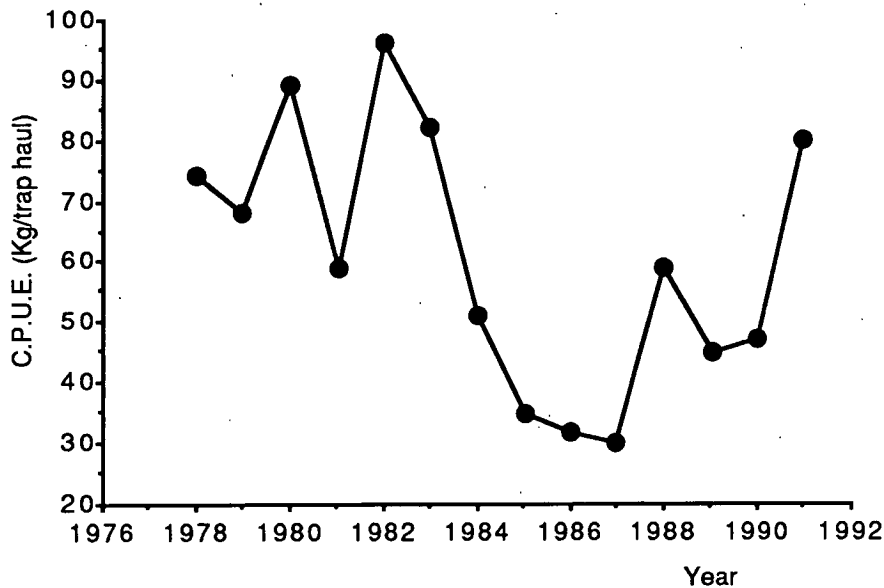
RESULTS AND DISCUSSIONS**Area 19**

The spatial distribution pattern of fishing effort showed a concentration at the southern end of the zone (Figure 4). The effort was distributed uniformly throughout the season.

The overall quota, total catch, fishing effort and catch rate from 1986 to 1991 are summarized as follows:

Year	Overall quota	total catch	fishing effort (trap hauls)	catch rate
1986	1338	1235	38594	32.0
1987	1150	1151	37987	30.3
1988	1338	1337	22794	58.7
1989	1338	1334	29978	44.5
1990	1338	1333	28422	46.9
1991	1338	1337	16733	79.9

The 1991 seasonal CPUE (79.9 kg/trap haul) represents an increase of 70 % over 1990. The total effort calculated for the 1990 season (28422 trap hauls) decreased by 5% over 1989 (29978 trap hauls) and then decreased by 41% in 1991 (16733 trap hauls).



Biological information from sea samples

a) 1990

The composition in percentage of the sea sample males (N=779) obtained during the second part of the season for which shell hardness was recorded was as follows (S=small claw, L=large claw, T=total):

	Soft crab			Hard crab			Total		
	S	L	T	S	L	T	S	L	T
Non legal	2.6	1.2	3.9	7.1	3.5	10.6	9.7	4.7	15.0
Legal	8.2	6.7	15.5	28.9	36.7	65.6	37.1	43.4	85.0
Total	10.8	7.9	19.4	36.0	40.2	76.2	46.8	48.1	100.0

The percentage of males in all sea samples (N=1601) was as follows (S=small claw, L=large claw, T=total):

	S	L	T
Non legal	6.3	10.1	16.4
Legal	20.0	63.5	83.5
Total	26.3	73.6	100.0

The mean size was 109.7 mm CW (Figure 5) and the mean percentage of undersized male crabs was 16.4% for the fishing season. The percentage of berried females in the sea samples was 98.4% (N=435) for the fishing season. The mean percentage of small claw males for the season was 26.3%.

b) 1991

The percentage of males in the sea samples (N=1958) was as follows (S=small claw, L=large claw, T=total):

	Soft crab			Hard crab			Total		
	S	L	T	S	L	T	S	L	T
Non legal	0.4	0.4	0.9	1.0	4.3	5.4	1.4	4.7	6.3
Legal	2.5	1.3	4.2	4.9	84.6	89.5	7.4	85.9	93.7
Total	3.0	1.8	5.1	5.9	89.0	94.9	8.9	90.8	100.0

The seasonal mean size was 115.6 mm CW (Figure 6) and the mean percentage of undersized males was 6.3 %. The mean percentage of small claw males for the season was 8.9%.

Biological information from port samples

a) 1990

The mean size was 113.4 mm CW for the fishing season. The percentage of soft crab was negligible. The percentage of small claw crab was 5.5% (Figure 5) for the season.

b) 1991

The mean size was 118.3 mm CW for the fishing season. The percentage of soft crab was negligible. The percentage of small claw crab was 6% (Figure 6) for the season.

Biological information from the trawl survey

a) 1990

The catch from the trawl survey data comprised 48.6 % of recently molted crab of which 39.9% had small claws. 54.2 % of the total catch had small claws. The mean carapace size of males from the survey was 79.7 mm (Figure 7) and the composition of the catch was as follows (S=small claw, L=large claw, T=total):

	White crab			Hard crab			Total		
	S	L	T	S	L	T	S	L	T
Non legal	35.1	2.6	38.1	11.8	14.0	25.9	46.9	16.6	64.0
Legal	4.8	5.5	10.5	2.5	22.6	25.3	7.3	28.1	36.0
Total	39.9	8.1	48.6	14.3	36.6	51.2	54.2	44.7	100.0

b) 1991

The catch from the trawl survey data comprised 30.2% of recently molted crab of which 22.4% had small claws. 46.4% of the total catch had small claws. The mean carapace size of males from the survey was 89.8 mm CW (Figure 7) and the composition of the catch was as follows (S=small claw, L=large claw, T=total):

	White crab			Hard crab			Total		
	S	L	T	S	L	T	S	L	T
Non legal	20.0	0.6	20.6	20.1	9.8	29.9	40.1	10.4	50.5
Legal	2.4	7.2	9.6	3.9	36.0	39.9	6.3	43.2	49.5
Total	22.4	7.8	30.2	24.0	45.8	69.8	46.4	53.6	100.0

Biomass estimation

The total fishable surface estimated for Area 19, based on the contours of variance was 3419 km². The variogram plots for the large claw male crabs larger than 95 mm CW and small claw male crabs larger than 70 mm CW showed a range of approximately 10.0 km and 19.3 km respectively for 1990; 9.7 km and 10.0 km respectively for 1991 beyond which no more spatial covariance effects were detected (Figure 8 and 9). Mapping of density contours of male crab in the 1990 trawl survey showed that the concentrations of large claw hard shell crab in this zone are not common with adjacent zones. However, in the 1991 survey, the concentrations were continuous with zone 12 (Figure 10 and 11). Using kriging techniques, the concentrations of male crab, according to their biological category, are as follows:

Category	Crabs/km ²	
	1990	1991
Large claw ≥95 mm CW	1753.3	2400.1
small claw ≥56 mm CW	4747.0	5043.4

a) 1990

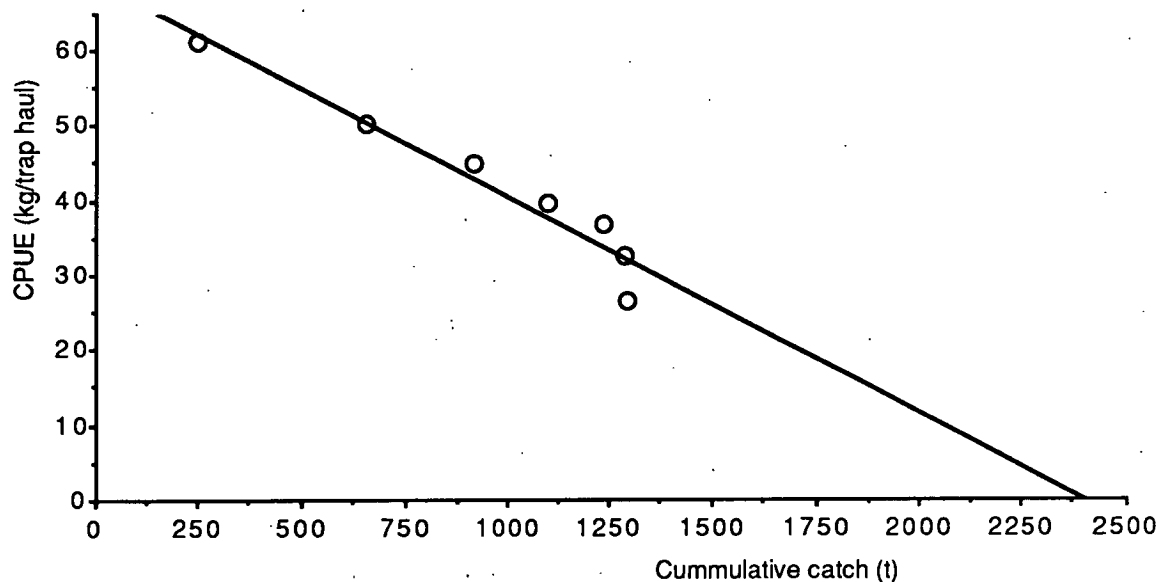
If there had been no fishery after the survey, the biomass of large claw hard crab ≥95 mm CW for 1991 would have been 3627t (±1483t). By subtracting the catch of large claw crab from the 1990 season (1260 t), the biomass of large claw hard shell crab in the spring of 1991 would be 2367 t.

The estimation of the initial biomass (B_0) and the exploitation level (E.L.) for 1990 (Table 3a), using the Leslie analysis on logbook data, showed an increase in biomass and a decrease in exploitation rate (Total catch/ B_0) compared to 1988 and 1989 (Table 5), was as follows:

$$\begin{aligned} \text{CPUE} &= 69.4 - 0.029Kt \\ r &= -0.94 \\ B_0 &= 2394 \text{ t} (2075 \text{ t} - 2980 \text{ t}, p < 0.05) \\ \text{E.L.} &= Tc/B_0 = 56\% \end{aligned}$$

The biomass of legal size large claw hard shell crab (before the start of the fishery) was estimated at 2971 t \pm 1432 t giving an estimated exploitation level of 42% (1260/2971) for the 1990 fishing season.

The biomass of white crab that would be available to the fishery (≥ 70 mm CW) in the spring of 1991 according to the trawl survey was estimated at 6372t (73t of the catch in 1990 subtracted from 6445t \pm 3532 estimated from small claw crab ≥ 56 mm CW in the 1990 survey).

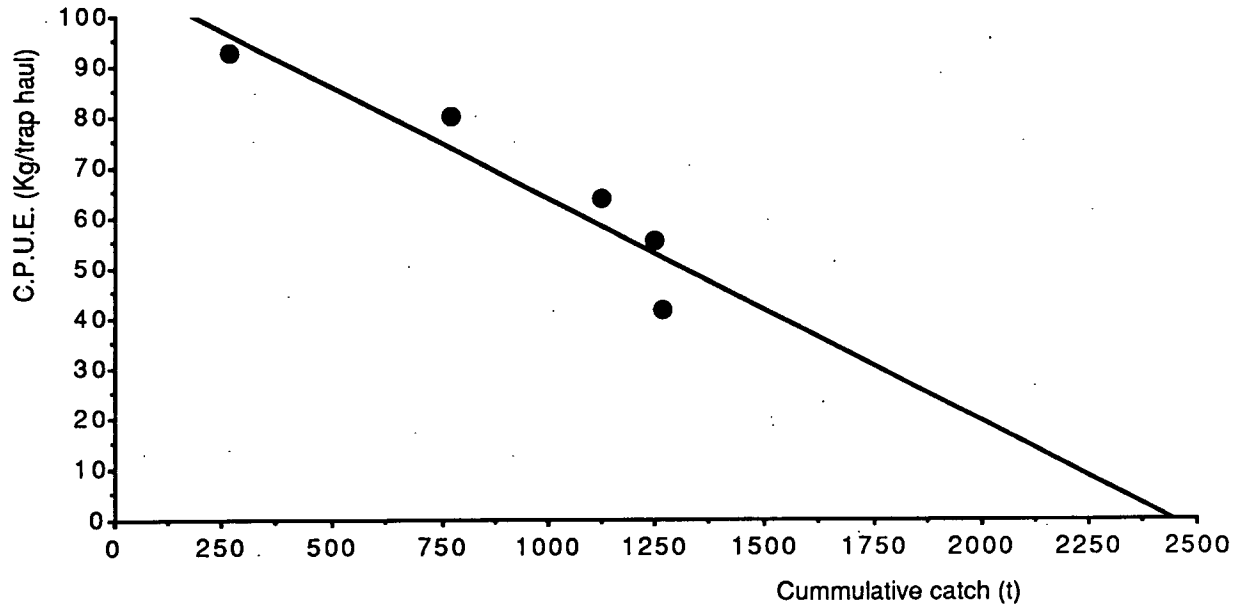


b) 1991

The biomass of large claw hard crab ≥ 95 mm CW available to the fishery in 1992 is estimated at 5459 t (± 1942 t).

The estimation of the initial biomass (B_0) and the exploitation level (E.L.) for 1991 (Table 3b), using the Leslie analysis on the logbook data, showed an increase of biomass and an exploitation rate similar to 1990 (Table 5), and were as follows:

$$\begin{aligned} \text{CPUE} &= 108.149 - 0.044Kt \\ r &= -0.877 \\ B_0 &= 2458 \text{ t} (1792 \text{ t} - 5775 \text{ t}, p < 0.05) \\ \text{E.L.} &= Tc/B_0 = 54.4\% \end{aligned}$$



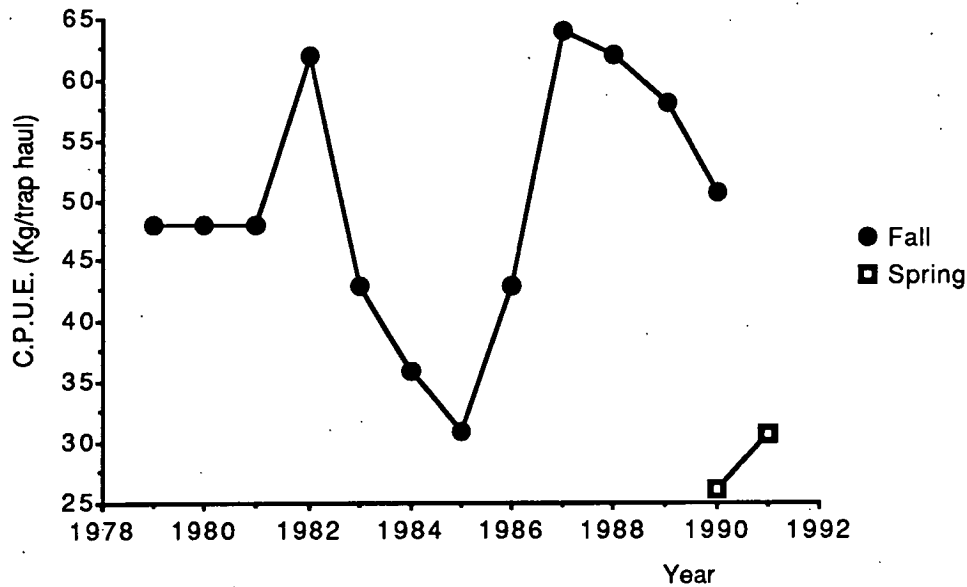
The biomass of legal size large claw hard shell crab (before the start of the fishery) was estimated at $3462 \text{ t} \pm 1087 \text{ t}$ giving an estimated exploitation level of 27% ($1257/4719$) for the 1990 fishing season.

The biomass of white crab available to the fishery ($\geq 70 \text{ mm CW}$) in the spring of 1992, according to the trawl survey, is estimated at $3746 \text{ t} \pm 1702$ (estimated from the small claw crab $\geq 56 \text{ mm CW}$ in the 1991 survey).

Area 18

a) 1990

The fishing effort was concentrated at the northern end of the zone (Figure 12). The spring weekly CPUE fluctuated throughout the season with the highest value (29.8 kg/trap haul) in week 2 (Table 6) and lowest value (22.1 kg/trap haul) during week 1. The weekly fall CPUE fluctuated throughout the season with the highest value (63.5 kg/trap haul) in week 7 (Table 6) and lowest value (41.3 kg/trap haul) during week 4. The spring and fall CPUE were 26.1 kg/trap haul and 50.5 kg/trap haul respectively, the fall value being closer to the historical values:



The lower mean CPUE for the spring of 1990 was predictable (Chiasson and Hébert, 1990) because a proportion of the 1989 recruitment to the fishery was caught in the fall of 1989.

The total effort calculated for the spring and fall seasons were 5334 trap hauls and 10357 trap hauls respectively, i.e. an increase of 37% over 1989.

The overall quota, total catch, fishing effort and catch rate from 1986 to 1991 are summarized as follows:

Year	Overall quota	total catch	fishing effort	catch rate
1986	626	618	14372	43.0
1987	626	626	9766	64.1
1988	674	669	10790	62.0
1989	674	666	11463	58.1
1990	674	662	15691	50.5 Fall; 26.1 Spring
1991	200 Spring	187 Spring	6091 Spring	? 30.7 Spring

Biological information from sea sampling

a) 1990

Spring fishery:

The percentage of soft crabs increased from 4.8% at the beginning of the fishery (April 24) to 88.5% at the closure of the fishery (June 11). The proportion of small claw males in the sea samples increased from 5.9% to 85.9% at the closure of the fishery for an overall seasonal percentage of 19.8% (Figure 13).

The size composition of the samples (N=2861) was as follows (S=small claw, L=large claw, T=total):

a- Legal size

Date	Soft crab			Hard crab			Total			N *
	S	L	T	S	L	T	S	L	T	
26-04	4.8	0.0	4.8	4.7	90.5	95.2	9.5	90.5	100.0	105
02-06	4.0	0.6	4.6	16.8	72.3	89.1	20.8	72.9	93.7	173
02-06	6.5	0.7	7.2	10.9	76.8	87.7	17.4	77.5	94.9	138
05-06	3.3	0.6	3.9	5.5	86.1	91.7	8.8	86.7	95.6	180
05-06	8.0	0.5	8.5	25.5	58.5	84.0	33.5	59.0	92.5	200
06-06	2.5	1.5	3.9	16.7	77.4	94.1	19.2	78.9	98.0	204
06-06	15.9	0.8	16.7	21.0	52.7	73.7	36.9	53.5	90.4	239
07-06	15.7	1.8	17.5	10.4	52.3	62.7	26.1	54.1	80.2	172
07-06	16.6	1.0	17.6	34.4	30.0	64.4	51.0	31.0	82.0	300
08-06	11.6	0.7	12.3	33.7	36.8	70.5	45.3	37.5	82.8	294
08-06	30.0	3.3	33.3	23.4	38.3	61.7	53.4	41.6	95.0	60
09-06	18.5	1.4	19.9	10.6	53.2	63.9	29.1	54.6	83.8	216
09-06	12.9	0.0	12.9	35.0	40.0	75.0	47.9	40.0	87.9	240
11-06	84.4	3.8	88.2	1.5	10.0	11.5	85.9	13.8	99.7	340

b- Non legal size

Date	Soft crab			Hard crab			Total		
	S	L	T	S	L	T	S	L	T
26-04	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02-06	2.3	0.6	2.9	1.7	1.7	3.4	4.0	2.3	6.3
02-06	0.0	0.7	0.7	4.4	0.0	4.4	4.4	0.7	5.1
05-06	0.0	0.0	0.0	4.4	0.0	4.4	4.4	0.0	4.4
05-06	2.0	0.5	2.5	4.0	1.0	5.0	6.0	1.5	7.5
06-06	0.0	0.0	0.0	1.0	1.0	2.0	1.0	1.0	2.0
06-06	5.0	1.2	6.2	2.1	1.2	3.3	7.1	2.4	9.5
07-06	6.4	3.5	9.9	4.7	5.2	9.9	11.1	8.7	19.8
07-06	10.0	0.0	10.0	7.7	0.3	8.0	17.7	0.3	18.0
08-06	5.1	0.7	5.8	10.9	0.7	11.6	16.0	1.4	17.4
08-06	3.3	0.0	3.3	0.0	1.7	1.7	3.3	1.7	5.0
09-06	4.2	2.3	6.5	3.2	6.5	9.7	7.4	8.8	16.2
09-06	4.6	0.8	5.4	4.2	2.5	6.7	8.8	3.3	12.1
11-06	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.3	0.3

* N= Total sample size (Legal and non legal)

Fall fishery:

The percentage of soft crabs was 24.8% for the fishing season. The percentage of small claw males in the sea samples was 16.6% with a mean size of 115.6 mm CW (Figure 13) for the fishing season. 9.4% of all samples were sub-legal.

The size composition of the samples (N=1442) was as follows (S=small claw, L=large claw, T=total):

	Soft crab			Hard crab			Total		
	S	L	T	S	L	T	S	L	T
Non legal	4.1	1.1	7.6	0.6	1.1	1.7	4.6	4.6	9.4
legal	8.9	8.3	17.2	3.0	69.6	72.6	12.0	77.9	90.6
Total	13.0	9.2	24.8	3.6	70.7	74.3	16.6	82.5	100.0

b) 1991

Spring fishery

The seasonal percentage of soft crabs was 18.0%. The seasonal proportion of small claw males in the sea samples was 10.1% with a mean size of 113.4 mm CW (Figure 14). 8.7% of all samples was sub-legal.

The composition of the samples (N=3986) by size from the total samples was as follows (S=small claw, L=large claw, T=total):

	Soft crab			Hard crab			Total		
	S	L	T	S	L	T	S	L	T
Non legal	0.6	1.4	2.2	1.5	5.0	6.5	2.1	6.4	8.7
legal	2.7	10.6	15.7	5.2	70.5	75.6	7.9	81.1	91.3
Total	3.4	12.0	18.0	6.7	75.4	82.1	10.1	87.4	100.0

Biological information from port samples

a) 1990

The mean size was 117.6 mm CW (N=243) for the fishing season. The percentage of small claw crab was 16.9% (Figure 13) for the fishing season.

b) 1991

The mean size was 116.6 mm CW (N=2370) for the fishing season. The percentage of small claw crab was 6.2% (Figure 14) for the fishing season.

Results from sampling of previous years have shown a higher proportion of small claw crab in the catch of Area 18 compared to Area 19, except for 1990 and 1991 where it was lower than previous years for Area 18. The percentages of small claw crab were as follows (N=total number of snow crab sampled):

Year (source)	Area 18		Area 19	
	Sea samples % (N)	Port samples % (N)	Sea samples % (N)	Port samples % (N)
1986 (1)	39.9 (706)		24.4 (982)	22.1 (2892)
1987 (2)	51.4 (511)	34.3 (1140)	14.6 (1366)	18.6 (4417)
1988 (3)	60.1 (3305)		13.0 (1770)	-
1989 (4)	63.3 (731)		11.6 (1201)	5.3 (1151)
1990	19.8 (2861)S 16.6 (1442)F	16.9 (243)	26.3 (1601)	5.5 (1610)
1991	10.1 (1263)S	6.2(2370)	8.9 (1960)	6.0 (1399)

(1) Davidson and Comeau (1987)

(2) Chiasson *et al.* (1988)

(3) Chiasson *et al.* (1989)

(4) Chiasson and Hébert (1990)

S=spring fishery; F=fall fishery

Biological information from the trawl survey

a) 1990

The catch from the trawl survey data was composed of 87.1% of white crab of which 51.3% had small claws. 58.9 % of the total catch had small claws. The mean carapace size of males from the survey was 96.0 mm (Figure 15) and the catch composition was as follows (S=small claw, L=large claw, T=total):

	White crab			Hard crab			Total		
	S	L	T	S	L	T	S	L	T
Non legal	40.5	1.7	42.4	3.8	5.1	8.9	44.5	6.7	51.5
Legal	10.8	32.5	44.7	3.6	0.2	3.8	14.4	32.8	48.5
Total	51.3	34.2	87.1	7.4	5.3	12.7	58.9	39.5	100.0

b) 1991

The catch from the trawl survey data was composed of 82.2 % white crab of which 34.8% had small claws. 45.2 % of the total catch had small claws. The mean carapace size of males from the survey was 102.4 mm CW (Figure 15) and the catch composition was as follows (S=small claw, L=large claw, T=total):

	White crab			Hard crab			Total		
	S	L	T	S	L	T	S	L	T
Non legal	16.2	0.2	16.4	8.0	4.9	12.9	24.2	5.1	29.3
Legal	18.6	47.2	65.8	2.4	2.5	4.9	21.0	49.7	70.7
Total	34.8	47.4	82.2	10.4	7.4	17.8	45.2	54.8	100.0

Biomass estimation

The total fishable surface estimated for Area 18, based on the contours of variance was 1815 km². The variogram plots for large claw males larger than 95 mm CW and small claw males larger than 70 mm CW showed a range of approximately 10.0 km and 19.3 km respectively for 1990; 9.7 km and 10.0 km respectively for 1991 beyond which no more spatial covariance effects were detected (Figure 8 and 9). Mapping of density contours of male crab in the 1990 and 1991 trawl survey suggests a continuity of the P.E.I. fishing grounds with Cape Breton Zone 18 fishing grounds. An overlapping concentration of large claw hard shell crab was found between the two zones. By using the kriging techniques, the concentrations of male crab (Figure 10 and 11) for different biological categories gave the following results:

Category	Crabs/km ²	
	1990	1991
Large claw ≥95 mm CW	1764.9	2751.2
Small claw ≥56 mm CW	4876.0	5938.5

a) 1990

The biomass for 1991 would have been 1932t (±835t) if there had been no fishery after the survey. In order to calculate the biomass of large claw hard shell crab in the spring of 1991, the catch of large claw crab from the fall 1990 season should be subtracted from the biomass calculated before the start of the fishery. However, only one port sample was obtained (N=243) and the percentage of small claw crab in that sample was 16.9%. Based on this sample, the catch of large claw crab for Area 18 for 1990 would be calculated at 435 t. The available biomass of large claw hard shell legal size crab for the spring of 1991 would therefore be 1497 t.

Based on the same calculations, the biomass of white crab (≥70 mm CW) for the spring 1991 would be calculated at 3636t (3724 t ± 2216 t - 88 t caught in 1990).

The biomass of legal size large claw hard shell crab estimated from the trawl survey (before the fall fishery) was 727 t ± 763t giving an estimated exploitation level of 59.8% (435/727) for the 1990 fall fishing season.

The fall 1989 and spring 1990 data were not amenable to Leslie analysis (Table 4a) due to fluctuating catch rates which do not fit the model.

b) 1991

The biomass of hard shell large claw crab at the beginning of the 1991 fall season was estimated at 1322 t (1497 t (from trawl survey in 1990)-175 t(catch of large claw crab in spring 1991)).

According to the 1991 trawl survey data, the available biomass of large claw hard shell crab in the fall 1991 was calculated at 681.4 t (±600.4 t).

The biomass for the fall 1992 would have been 3284.7 t (±1037.9 t) if there had been no fishery after the survey.

Conclusions

The following conclusions are based on the mid-value of the biomass estimates from the survey and do not take into consideration the possible high mortality rate (induced by the discard

of white crab at sea during the 1990 fishery), especially for the Area 18. It is also assumed that there is no movement in and out of the two areas between the survey of one year and the fishery of the following year.

Area 19

a) 1990 - advice for 1991

Based on Leslie analysis and trawl survey analysis, the exploitation rate for the 1990 season was calculated at 56% and 42% respectively. The CPUE level increased slightly for the 1990 season. Based on the 1990 trawl survey results, if an exploitation rate of 50 to 60% is targeted for 1991, the overall quota should be set at between 1184 t and 1420 t (quota for 1990 was set at 1338 t).

b) 1991 - advice for 1992

Based on the Leslie analysis and the trawl survey analysis, the exploitation rate for the 1991 season was calculated at 54.4% and 36% respectively. The CPUE level increased by 70% from 1990 to 1991. Based on the 1991 trawl survey results, the biomass of large claw hard shell crab available to the 1992 fishery is calculated at 5459 ± 1942 t; an increase of 58% over 1991.

By targeting an exploitation rate between 50 and 60%, the catch level for the 1992 season should be set at between 2730 t and 3275 t. The catch level corresponding to 60% of the lower limit of the biomass estimate and 50% of the biomass estimate would be 2110 t and 2730 t respectively.

Area 18

a) 1990 - advice for 1991

Based on the trawl survey results, if an exploitation rate of 50 to 60% is targeted for 1991, the overall quota should be set at between 749 t and 898 t respectively (the quota set for 1990 was 674 t). However, due to a decrease in the CPUE for 1990, the uncertainty of biomass estimates calculated between two fishing seasons in 1990 as well as high incidence of white crab in the catch from past seasons, no increase in the quota for 1991 can be recommended. Also, this fishery would benefit from harvesting only large claw hard shell crab during the spring season which would be of better quality (Chiasson and Hébert, 1990). The fishery should be closed when white crab appear in the catches and remain closed until the spring of the following year. This would reduce mortality of white crab due to discard at sea. An annual trawl survey done after the fishery could give more precise biomass estimates and would be a better tool in order to make projections for the following year.

b) 1991 - advice for 1992

The biomass estimate for spring 1992 would be 3284.7 t (± 1037.9 t) if there had been no fishery after the survey. By assuming a catch of 674 t for fall 1991-spring 1992, the biomass after the spring 1992 fishery would be 2611 t. This value is probably overestimated because this biomass is a projection from the 1991 survey taking into account the increase in weight. A catch in fall 1991 doesn't allow this increase in weight and probably represented a larger catch if projected to the spring 1992.

Using an exploitation rate of 50% for the 1992 season and subtracting the fall 1991-spring 1992 catches results in a TAC of 1100 t. The past history of this fishery has shown that this catch level is not sustainable. This sudden large increase in the biomass is probably due to a recruitment pulse in the fishery in 1991; the catch rate over the previous three years being on

the decrease. It is therefore recommended to exploit this increase of biomass over several years (the lifespan of terminal molt crab is thought to be around four years; unpublished data). This could allow an accumulation of large claw crab on the grounds, a reduced dependency on soft and small claw crab and the possible stabilization of the fishery.

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Table 1. Number of participants, trap limits, seasons, TAC regulations and total catch for the Area 19, western Cape Breton Island snow crab, Chionoecetes opilio, fishery: 1978-1991.

Year	# of Licensed boats	# of traps per boat *	Season	TAC (kg/license) (t)	catch (t)
(1) 1978	14	40	May 13 - Sept. 30	-	1941
(1) 1979	27	30	June 16 - Sept. 16	1406 (52164)	1390
(1) 1980	27	30	June 15 - Sept. 15	1225 (45360)	1158
(1) 1981	27	30	July 15 - Sept. 15	1004 (37195)	913
(1) 1982	27	30	July 15 - Sept. 15	1004 (37195)	953
(1) 1983	27	30	July 15 - Sept. 15	1004 (37195)	906
(1) 1984	61	20	July 15 - Sept. 15	1385 (22680)	1315
(1) 1985	61	20	July 15 - Sept. 15	1385 (22680)	1234
(1) 1986	59	20	July 15 - Sept. 15	1338 (22680)	1235
(1) 1987	59	20	July 15 - Sept. 15	1150 (19505)	1151
(1) 1988	59	20	July 15 - Sept. 15	1338 (22680) **	1337
(1) 1989	59	20	July 15 - Sept. 16	1338 (22680)	1334
1990	59	20	July 14 - Sept. 15	1338 (22680)	1333
1991	59	20	July 15 - Sept. 15	1338 (22680)	1337

* Standard box trap 1.5m x 1.5m x 0.6m or 1.8m x 1.8m x 0.6m

** Originally set at 1150 t, the TAC has increased to 1338 t during the season.

Table 2. Number of participants, trap limits, seasons, TAC regulations and total catch for the Area 18, western Cape Breton Island snow crab, Chionoecetes opilio, fishery: 1979-1991.

Year	# of Licensed boats	# of traps per boat *1	Season	TAC (kg/license) (t)	catch (t)
(1) 1979	14	30	July 1 - Sept. 30	-	213
(1) 1980	23	30 *2	July 15 - Sept. 15	-	519
(1) 1981	23	30	April 15 - June 15 Sept. 1 - Nov. 30	835 (36288)	494
(1) 1982	23	30	Aug. 20 - Nov. 30	835 (36288)	824
(1) 1983	23	30	Aug. 15 - Nov. 3	835 (36288)	822
(1) 1984	23	30	Aug. 25 - Nov. 10	835 (36288)	722
(1) 1985	23	30	Aug. 3 - Oct. 31	835 (36288)	537
(1) 1986	23	30	Aug. 4-8 ; 28 - Oct. 28	626 (27216)	618
(1) 1987	23	30	Aug. 16 - Oct. 10	626 (27216)	626
(1) 1988	27	30	Aug. 26 - Oct. 26	674 (24948)	669
(1) 1989	27	30	Sept. 4 - Nov. 4	674 (24948)	666
1990	27	30	April 23 - April 27 May 29 - June 13 Sept.3 - Nov. 13	674 (24948)	139 S 523 F
1991	27	30	May 16 - June 30 Sept 9 -	200 (xxxxx) 674 (24948) *3	187 S ?

(1) Chiasson and Hébert, 1990

*1 Standard box traps - 1.5m x 1.5m x 0.6m or 1.8m x 1.8m x 0.6m

*2 9 or 10 new exploratory permit holders were allowed 20 traps.

*3 Combination fall 1991 and spring 1992

Table 3a. The 1990 western Cape Breton Island, Area 19 snow crab, Chionoecetes opilio, fishery CPUE and cumulative catch (K) statistics used in Leslie analysis.

Week	CPUE (kg/trap haul)	# Trap hauls*	Weekly logbook catch. C_{t1} (kg)	$C_{t1}/2$ (kg)	K_t (t)	% of total (C_{t1}/C_{total})
1- July (08-14)	33.35	231	7737.70	3868.85	3.87	0.60
2- July (15-21)	61.26	7520	473590.10	236795.05	244.53	36.49
3- July (22-28)	50.26	6842	354703.90	177351.95	658.68	27.33
4- July (29-04)	44.86	3399	159420.50	79710.25	915.74	12.28
5- Aug. (05-11)	39.57	4638	201288.10	100644.05	1096.10	15.51
6- Aug. (12-18)	36.59	2021	78617.40	39308.70	1236.05	6.06
7- Aug. (19-25)	32.48	470	15559.40	7779.70	1283.14	1.20
8- Aug. (26-01)	26.63	216	6875.20	3437.60	1294.35	0.53
9- Sept. (02-08)	11.74	8	93.90	46.95	1297.84	0.01
10-Sept. (09-15)	8.64	8	77.10	38.55	1297.92	0.01
Total	mean=46.90	25353	1297963.30			

* Reported in the logs

Table 3b. The 1991 western Cape Breton Island, Area 19 snow crab, Chionoecetes opilio, fishery CPUE and cumulative catch (K) statistics used in Leslie analysis.

Week	CPUE (kg/trap haul)	# Trap hauls*	Weekly logbook catch. C_{t1} (kg)	$C_{t1}/2$ (kg)	K_t (t)	% of total (C_{t1}/C_{total})
1- July (14-20)	92.6	5686	527665.7	263832.7	263.8	41.6
2- July (21-27)	79.9	6172	492928.3	246464.1	774.1	38.9
3- July (28-03)	63.8	3307	211841.2	105920.6	1126.5	16.7
4- Aug. (04-10)	55.2	586	32342.1	16171.0	1248.6	2.6
5- Aug. (11-17)	41.5	70	2903.0	1451.5	1266.2	0.2
6- Aug. (18-24)	11.4	2	22.7	11.3	1267.7	0.002
7- Aug. (25-31)	9.1	2	18.1	9.0	1267.7	0.001
Total	mean=79.9	15825	1267721.1			

* Reported in the logs

Table 4a. The 1989 fall and 1990 spring western Cape Breton Island, Area 18 snow crab, Chionoecetes opilio, fishery CPUE and cumulative catch (K) statistics used in Leslie analysis.

Week	CPUE (kg/trap haul)	# Trap hauls*	Weekly logbook catch, C_{t1} (kg)	$C_{t1/2}$ (kg)	K_t (t)	% of total (C_{t1}/C_{total})
1- Sept. (3-9)	68.5	1671	138547	69273	69.3	25.0
2- Sept. (10-16)	45.1	1934	111409	55704	194.3	20.1
3- Sept. (17-23)	53.7	2094	135291	67646	317.6	24.4
4- Sept. (24-30)	47.7	506	24155	12077	397.3	4.4
5- Oct. (1-7)	51.0	689	43650	21825	431.2	7.9
6- Oct. (8-14)	69.4	763	61420	30710	483.8	11.1
7- Oct. (15-21)	64.6	484	37307	18654	533.1	6.7
8- Oct. (22-28)	51.9	56	2909	1454	553.2	0.5
9- Oct. (29-Nov.4)	22.3	15	334	167	554.9	0.1
Total	mean=56.2	8212	555021			

Week	CPUE (kg/trap haul)	# Trap hauls*	Weekly logbook catch, C_{t1} (kg)	$C_{t1/2}$ (kg)	K_t (t)	% of total (C_{t1}/C_{total})
1-April (22-28)	22.11	560	12379.80	6189.90	6.19	8.90
2-June (27-02)	29.84	961	29272.60	14636.30	27.02	21.03
3-June (03-09)	25.10	2461	63477.90	31738.95	73.39	45.61
4-June (10-16)	26.88	1162	34042.30	17021.15	122.15	24.46
Total spring	mean=26.1	5144	139172.60			

* Reported in the logs

Table 4b. The 1990 fall and 1991 spring western Cape Breton Island, Area 18 snow crab, Chionoecetes opilio, fishery CPUE and cumulative catch (K) statistics used in Leslie analysis.

Week	CPUE (kg/trap haul)	# Trap hauls*	Weekly logbook catch, C_{t1} (kg)	$C_{t1}/2$ (kg)	K_t (t)	% of total (C_{t1}/C_{total})
1-Sept. (02-08)	46.18	1534	70843.5	35421.75	35.42	15.11
2-Sept. (09-15)	54.20	1827	107028.7	53514.35	124.36	22.83
3-Sept. (16-22)	51.03	1435	80620.3	40310.15	218.18	17.20
4-Sept. (23-29)	41.33	1622	68748.6	34374.30	292.87	14.66
5-Sept. (30-06)	55.50	436	26356.6	13178.30	340.42	5.62
6-Oct. (07-13)	52.50	891	48826.0	24413.00	378.01	10.41
7-Oct. (14-20)	63.51	485	32591.0	16295.50	418.72	6.95
8-Oct. (21-27)	58.73	514	30189.0	15094.50	450.11	6.44
9-Oct. (28-03)	57.08	24	1369.9	684.95	465.89	0.29
10-Nov. (04-13)	41.41	55	2277.5	1138.75	467.71	0.49
Total fall	mean=50.5	8823	468851.10			

Week	CPUE (kg/trap haul)	# Trap hauls*	Weekly logbook catch, C_{t1} (kg)	$C_{t1}/2$ (kg)	K_t (t)	% of total (C_{t1}/C_{total})
1-May (16-25)	27.25	310	8448.2	4224.1	473.08	4.7
2-May (26-01)	27.19	1260	34269.6	17134.5	494.43	18.9
3-June (02-08)	36.61	2485	90982.9	45491.4	557.06	50.2
4-June (09-15)	23.63	812	19235.6	9617.8	612.17	10.6
5-June (16-22)	27.88	902	25555.9	12778.0	634.57	14.1
6-June (23-29)	25.05	115	2880.4	1440.2	648.78	1.6
Total spring	mean=30.7	5884	181372.0			

* Reported in the logs

Table 5. Trends in exploitation level, initial (B_0) and final (B_f) biomass estimates, initial ($CPUE_0$), final ($CPUE_f$) and mean ($CPUE$) catch per unit effort for the Area 19 snow crab, Chionoecetes opilio, fishery: 1978-1991.

Year	Exploitation level (%)	B_0 (t)	B_f (t)	Estimated production *	Trap hauls **	$CPUE_0$ (kg/trap haul)	$CPUE_f$ (kg/trap haul)	$CPUE$ (max.-min.) (kg/trap haul)
(1) 1978	64	3016	1075	-	26301	86.4	55.0	73.8 (86.4-51.8)
(1) 1979	62	2239	848	1164	20436	69.3	45.2	68.0 (75.1-45.2)
(1) 1980	60	1838	733	990	12953	112.0	52.6	89.4 (112.0-52.6)
(1) 1981	47	1690	894	957	15396	-	-	59.3
(1) 1982	44.7	2282	1329	1388	9927	114.0	45.0	96.0 (114.0-45.0)
(1) 1983	54.7	1654	748	325	11076	98.5	36.3	81.8 (98.5-32.8)
(1) 1984	67.2	2240	925	1492	26040	93.2	51.5	50.5 (93.2-33.9)
(1) 1985	34.8	3291	2057	2366	35460	47.1	26.3	34.8 (47.1-26.3)
(1) 1986	52.7	2343	1108	286	38594	49.8	22.1	32.0 (49.8-22.1)
(1) 1987	52.5	2126	1010	1018	37987	51.6	29.8	30.3 (134.8-1.7)
(1) 1988	80.4	1662	325	652	22794	101.4	13.3	58.7 (202.5-4.0)
(1) 1989	71.5	1865	531	1540	29978	63.7	22.7	44.5 (142-0)
1990	55.6 L 42.0 K	2394 L 2971 K	1061 L 1638 K	1863 L 1910 K	28422	61.3	11.7	46.9 (184-0)
1991	54.4 L 53.1 K	2458 L 2367 K	1397 L 1110 K	820 L 457 K	16733	92.6	9.1	79.9 (256.6-2.8)
1992		5459 K						

(1) Chiasson and Hébert, 1990

* $B_0^t - B_f^{t-1}$ where t=year

** Total catch/mean CPUE

L From Leslie analysis; K from kriging

Table 6. Trends in exploitation level, initial (B_0) and final (B_f) biomass estimates, and initial ($CPUE_0$), final ($CPUE_f$) and mean ($CPUE$) catch per unit effort for the Area 18 snow crab, Chionoecetes opilio, fishery: 1979-1991.

Year	Exploitation level (%)	B_0 (t)	B_f (t)	Estimated production *	Trap hauls **	$CPUE_0$ (kg/trap haul)	$CPUE_f$ (kg/trap haul)	$CPUE$ (max.-min.) (kg/trap haul)
(1) 1979	49.7	428	216	-	4449	37.3	30.7	47.9 (61.0-37.3)
(1) 1980	-	-	-	-	10745	61.2	47.7	48.3 (61.2-39.4)
(1) 1981	-	-	-	-	10207	-	-	48.4
(1) 1982	-	-	-	-	13290	98.0	23.0	62.0 (122.0-23.0)
(1) 1983	45.8	1577	854	-	18940	41.4	34.0	43.4 (49.9-33.8)
(1) 1984	40.1	1147	687	293	20168	41.9	27.2	35.8 (41.9-27.2)
(1) 1985	71.3	753	216	66	17102	49.1	24.1	31.4 (49.1-17.2)
(1) 1986	59.7	1153	465	937	14372	61.8	55.3	43.0 (61.8-26.6)
(1) 1987	47.4	1315	691	850	9766	64.5	26.4	64.1 (140.2-11.0)
(1) 1988	-	-	-	-	10790	64.2	69.2	62.0 (190.0-2.7)
(1) 1989	-	-	-	-	11463	70.1	22.3	56.2 (136.7-3.0)
1990 S K					5334	22.1	26.9	26.1 (69.9-1.4)
1990 F K	59.8	727	292	-	10357	46.2	41.4	50.5 (116.4-6.4)
1991 S k		1497	1322					
1991 F k		3284						

(1) Chiasson and Hébert, 1990

* $B_0^t - B_f^{t-1}$ where t=year

** Total catch/mean CPUE

S=spring; F=fall

K=from kriging

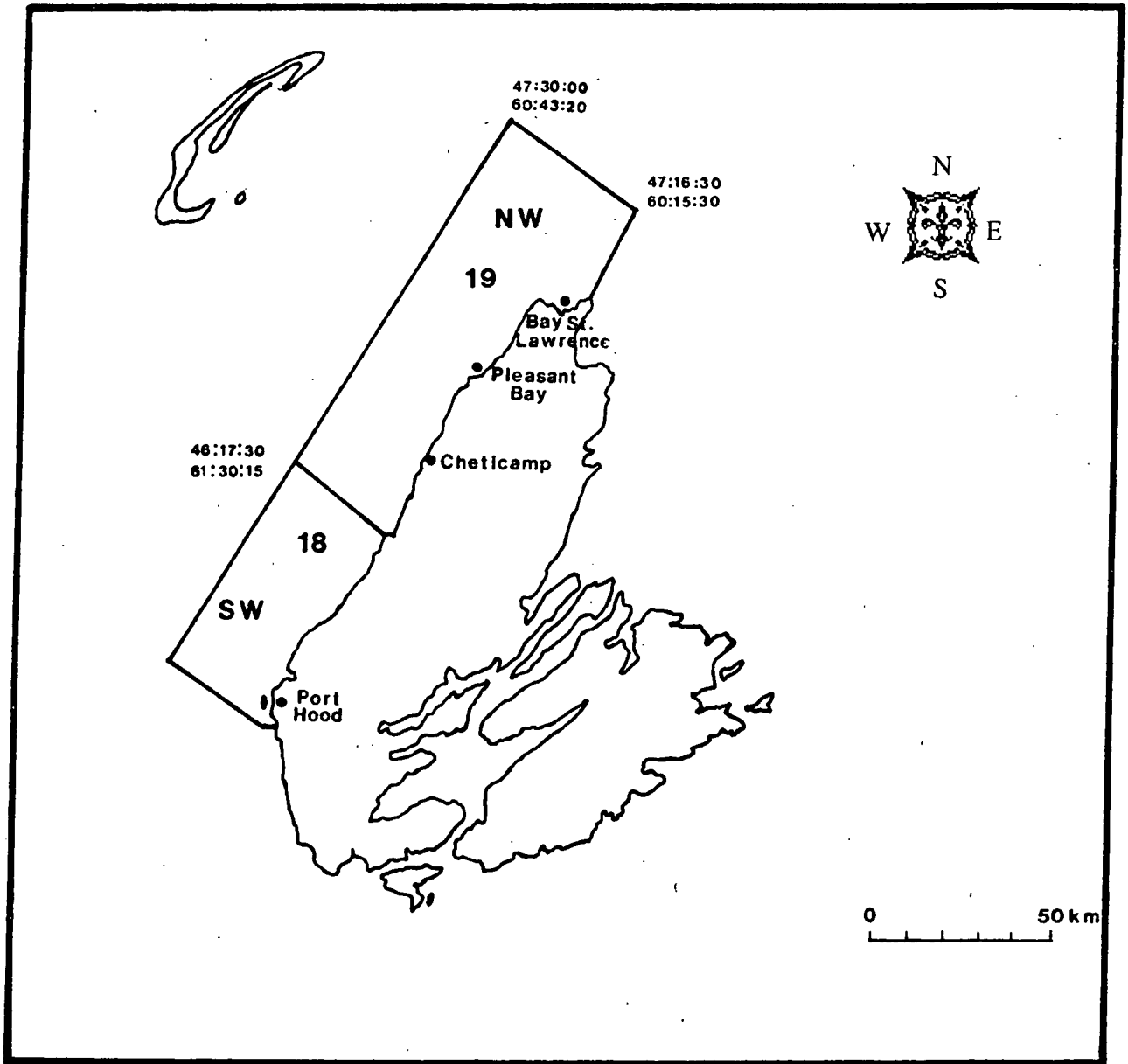


Figure 1. Western Cape Breton Island snow crab management areas.

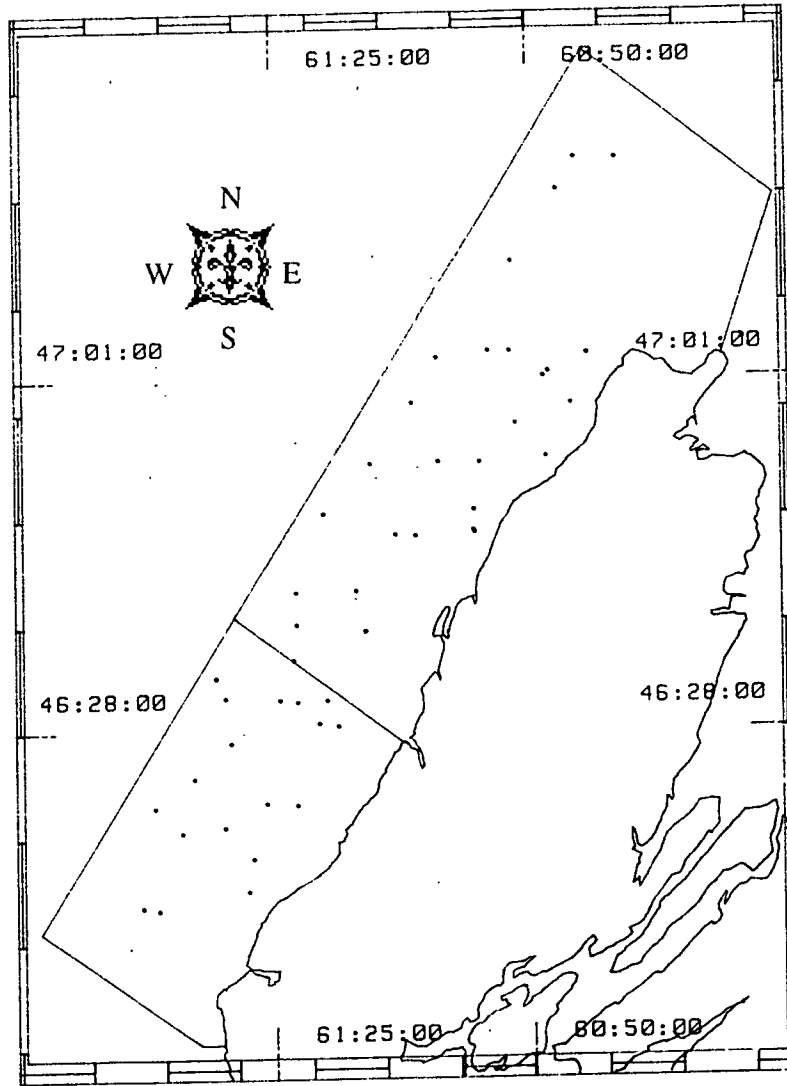


Figure 2. Geographical locations of the trawl survey in the Western Cape Breton Island Areas 18 and 19 in 1990.

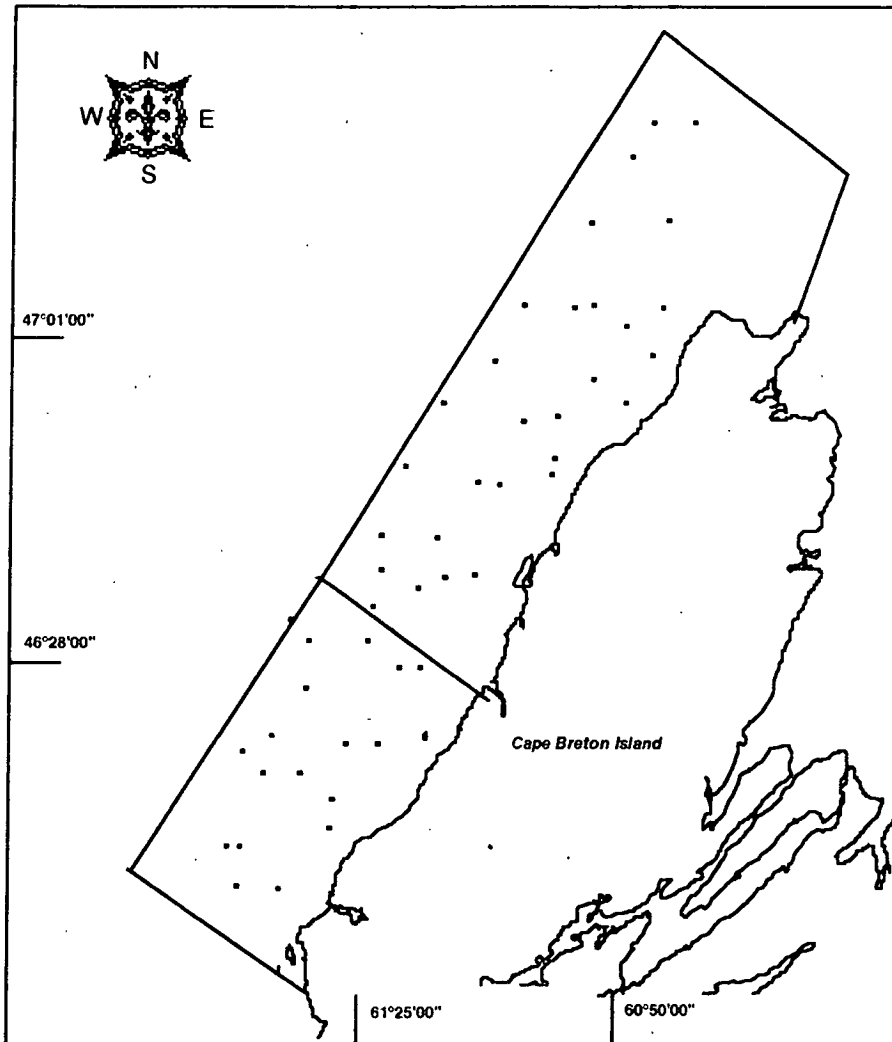


Figure 3. Geographical locations of the trawl survey in the Western Cape Breton Island Areas 18 and 19 in 1991.

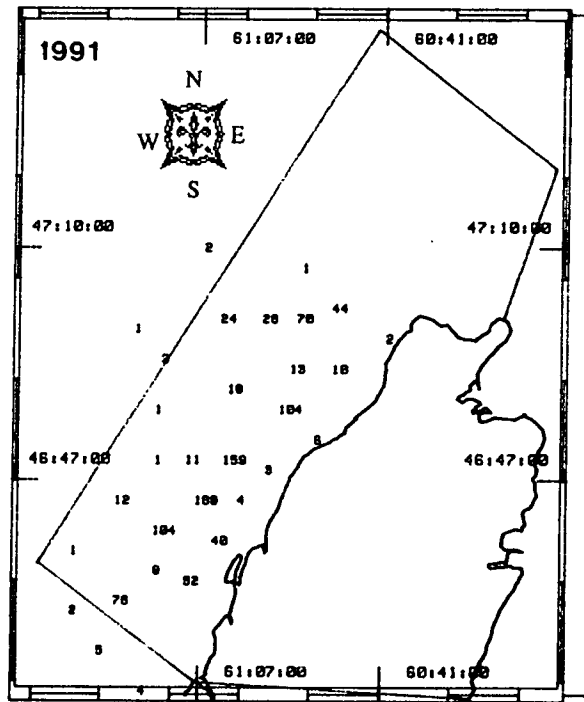
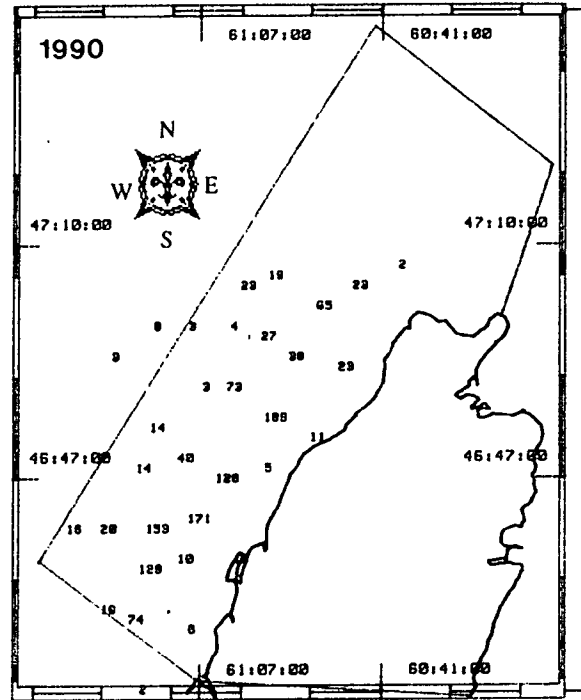


Figure 4. Distribution of fishing effort for the Area 19 Cape Breton Island snow crab, *Chionoecetes opilio*, fishery for 1990 and 1991.

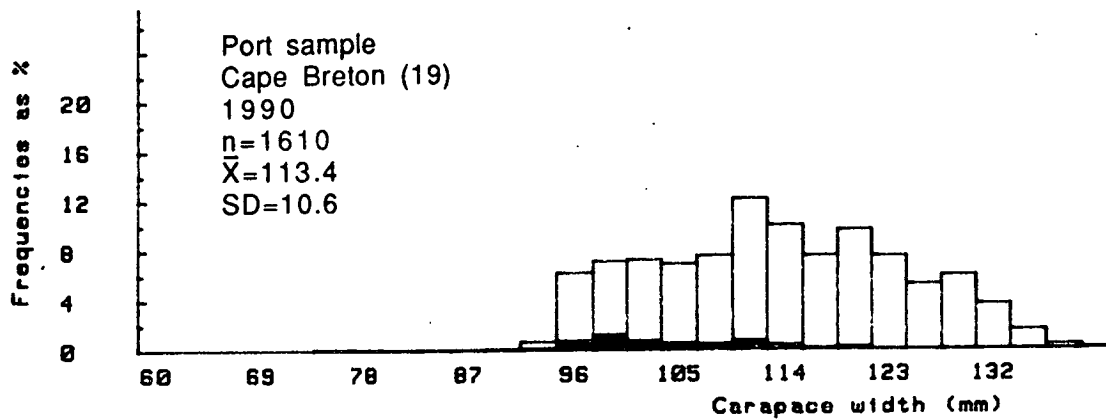
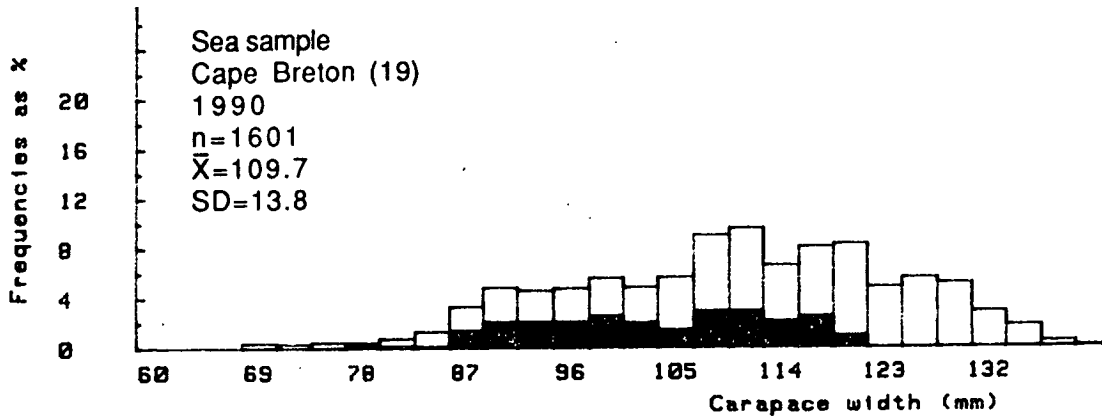


Figure 5. Overall size distributions of male crab, *Chionoecetes opilio*, present in sea and port samples taken during the 1990, Area 19 Cape Breton Island snow crab fishery.

Percentage of small claw in black, percentage of total in white.

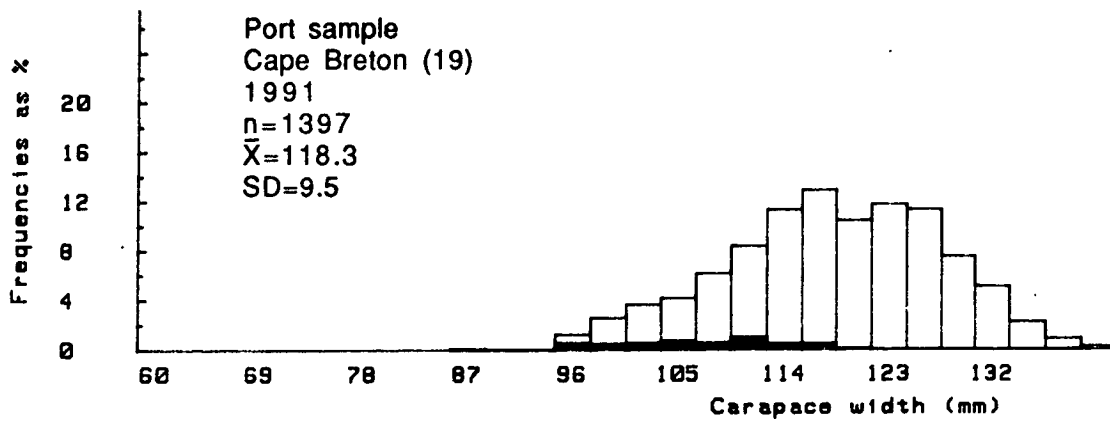
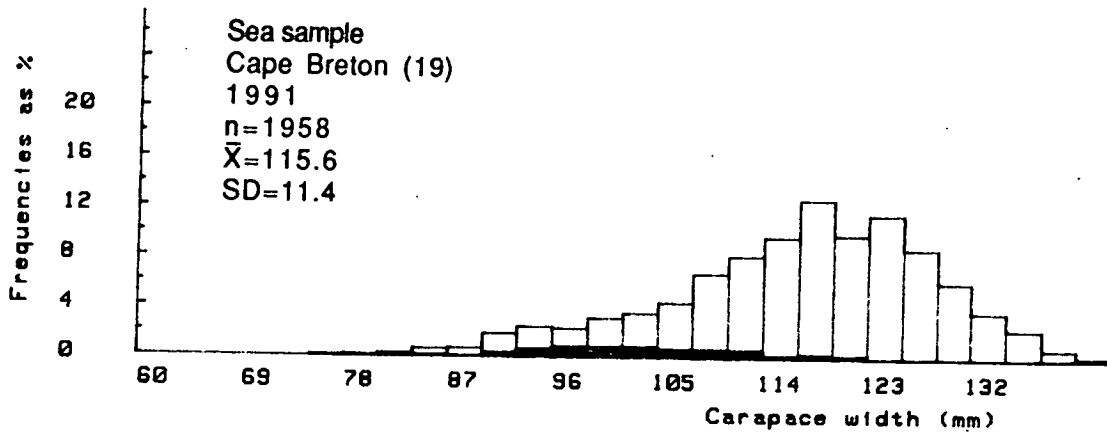


Figure 6. Overall size distributions of male crab, *Chionoecetes opilio*, present in sea and port samples taken during the 1991, Area 19 Cape Breton Island snow crab fishery.

Percentage of small claw in black, percentage of total in white.

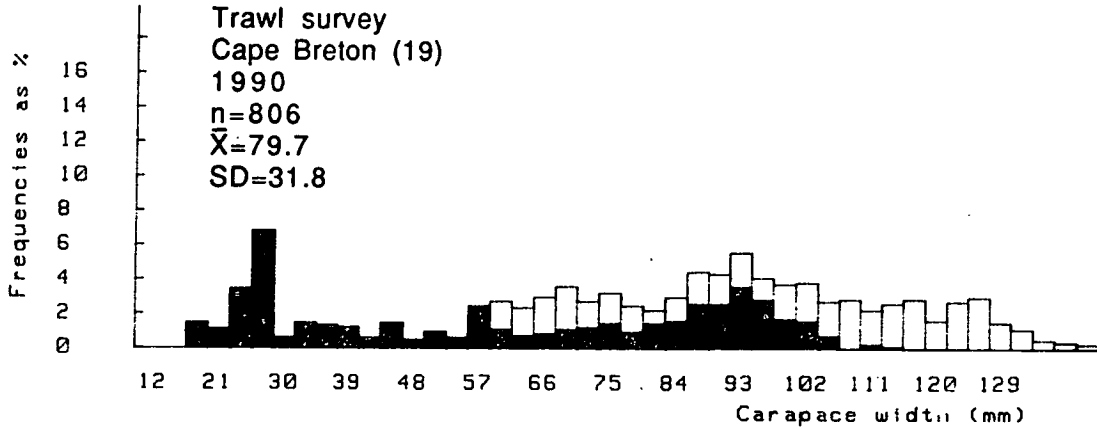
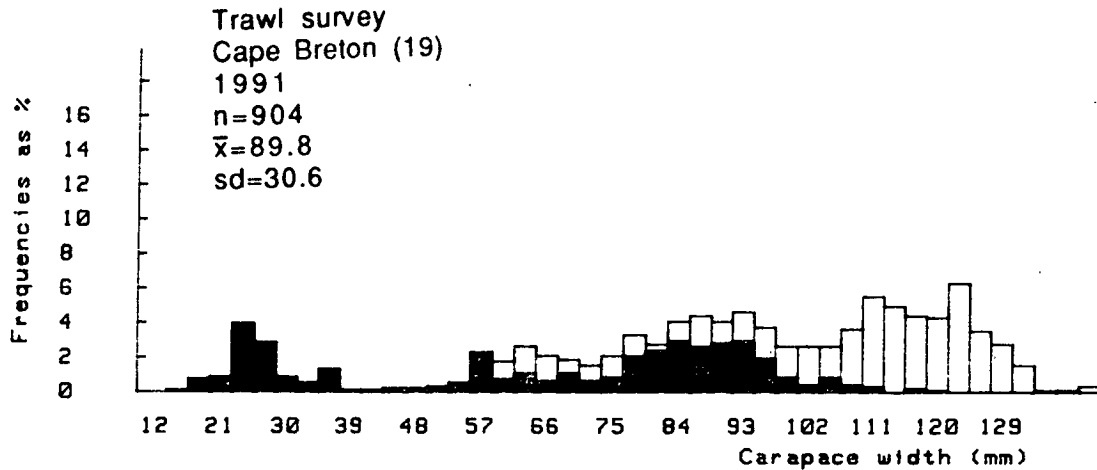


Figure 7. Overall size distributions of male crab, *Chionoecetes opilio*, collected during the 1990 and 1991 trawl surveys in the Area 19 Cape Breton Island snow crab fishery.

Percentage of small claw in black, percentage of total in white.

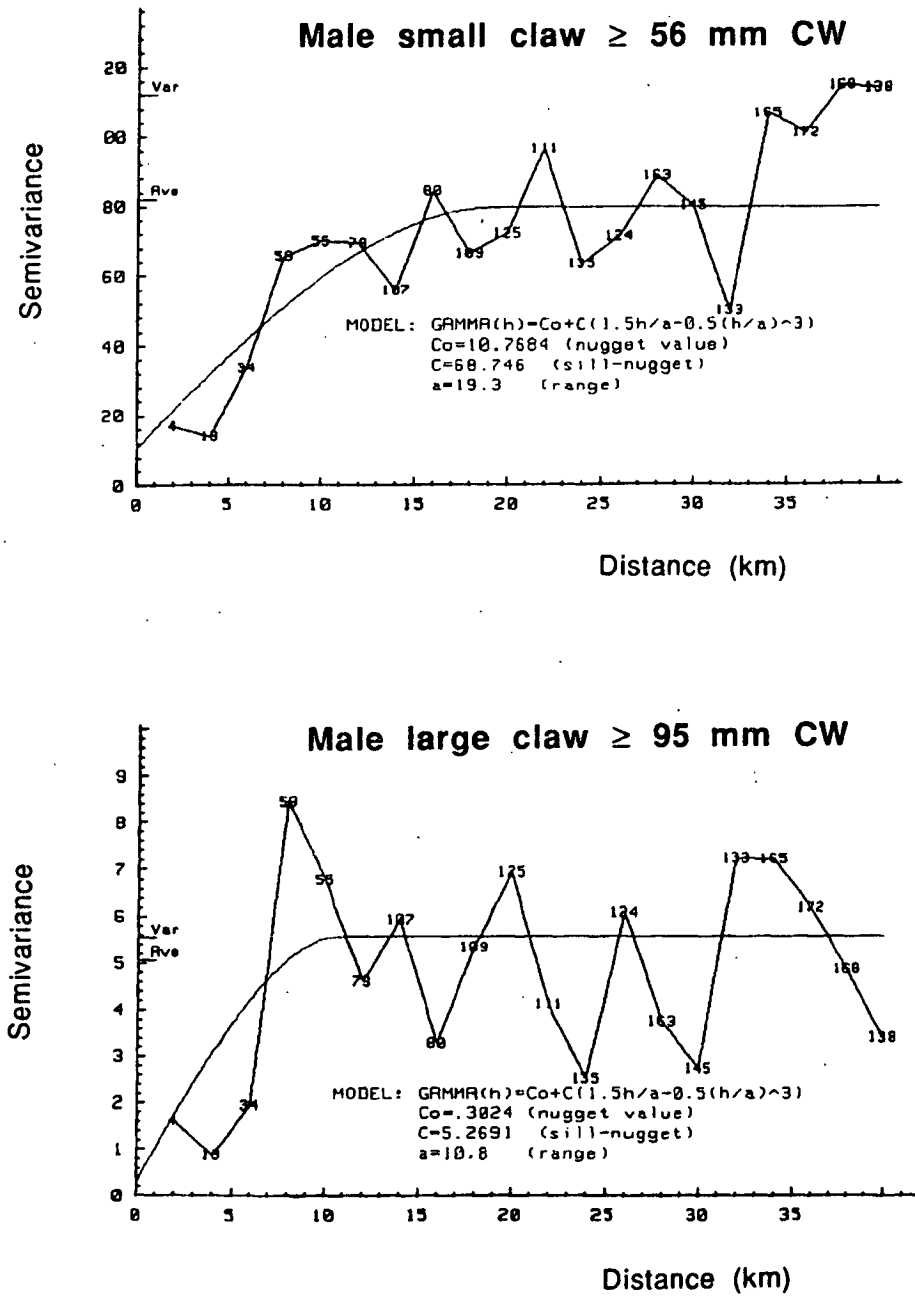


Figure 8. Variogram for large claw males ≥ 95 mm CW and small claw male ≥ 56 mm CW used in the kriging calculations for the 1990 trawl survey.

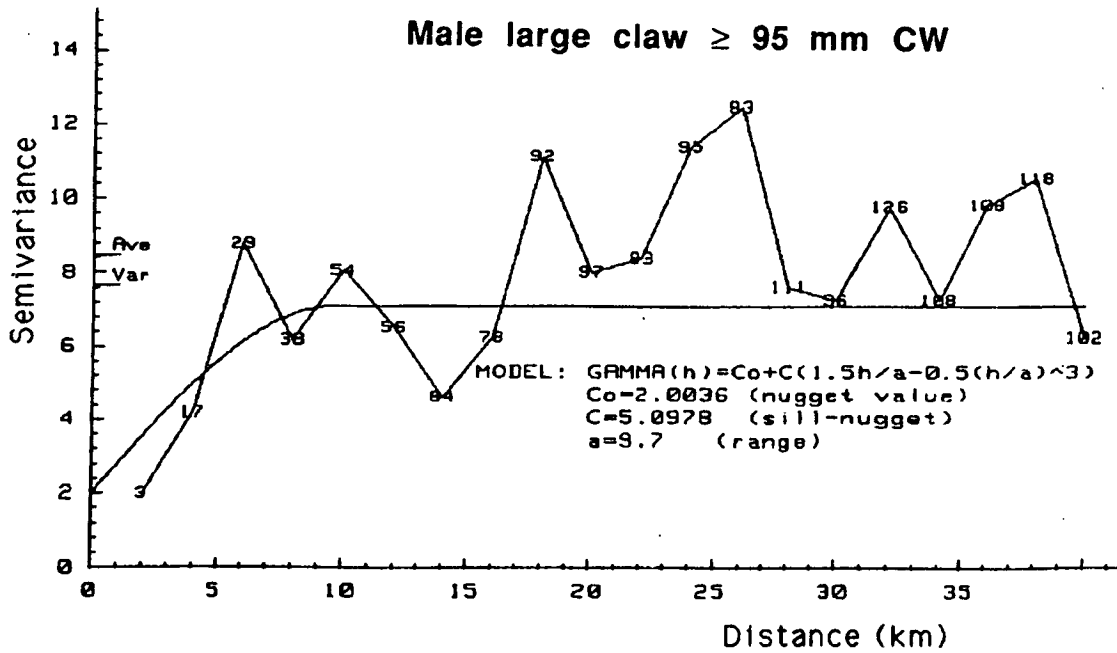
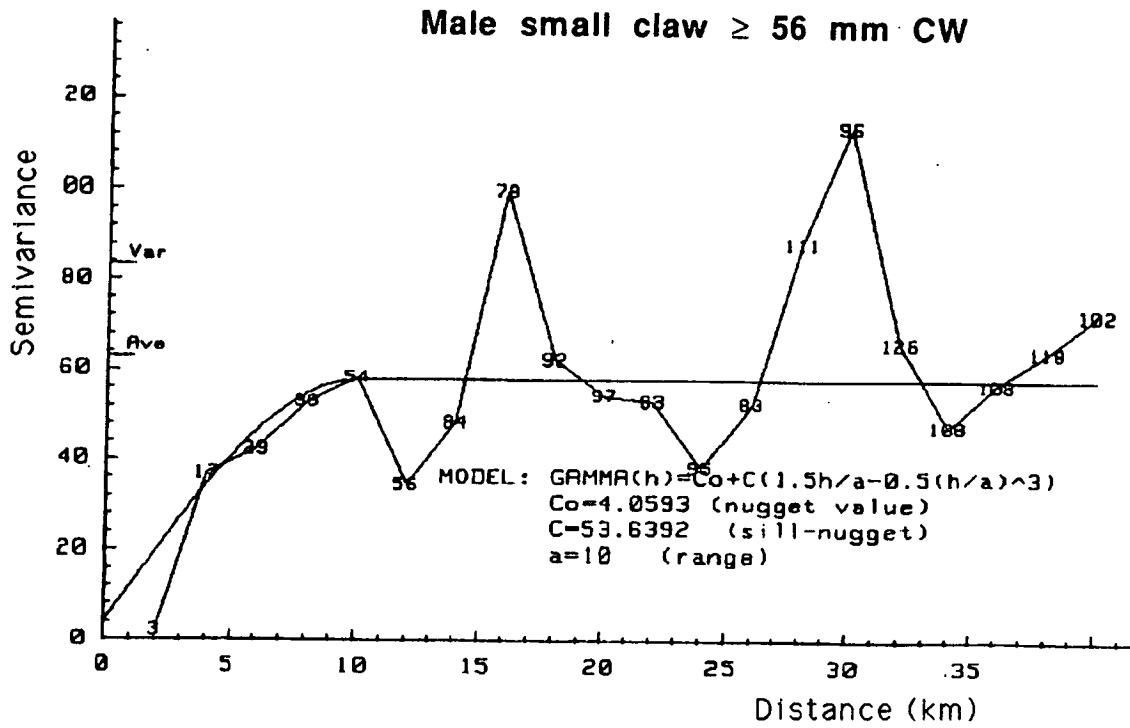


Figure 9. Variogram for large claw males ≥ 95 mm C W and small claw males ≥ 56 mm C W used in the kriging calculations for the 1991 trawl survey.

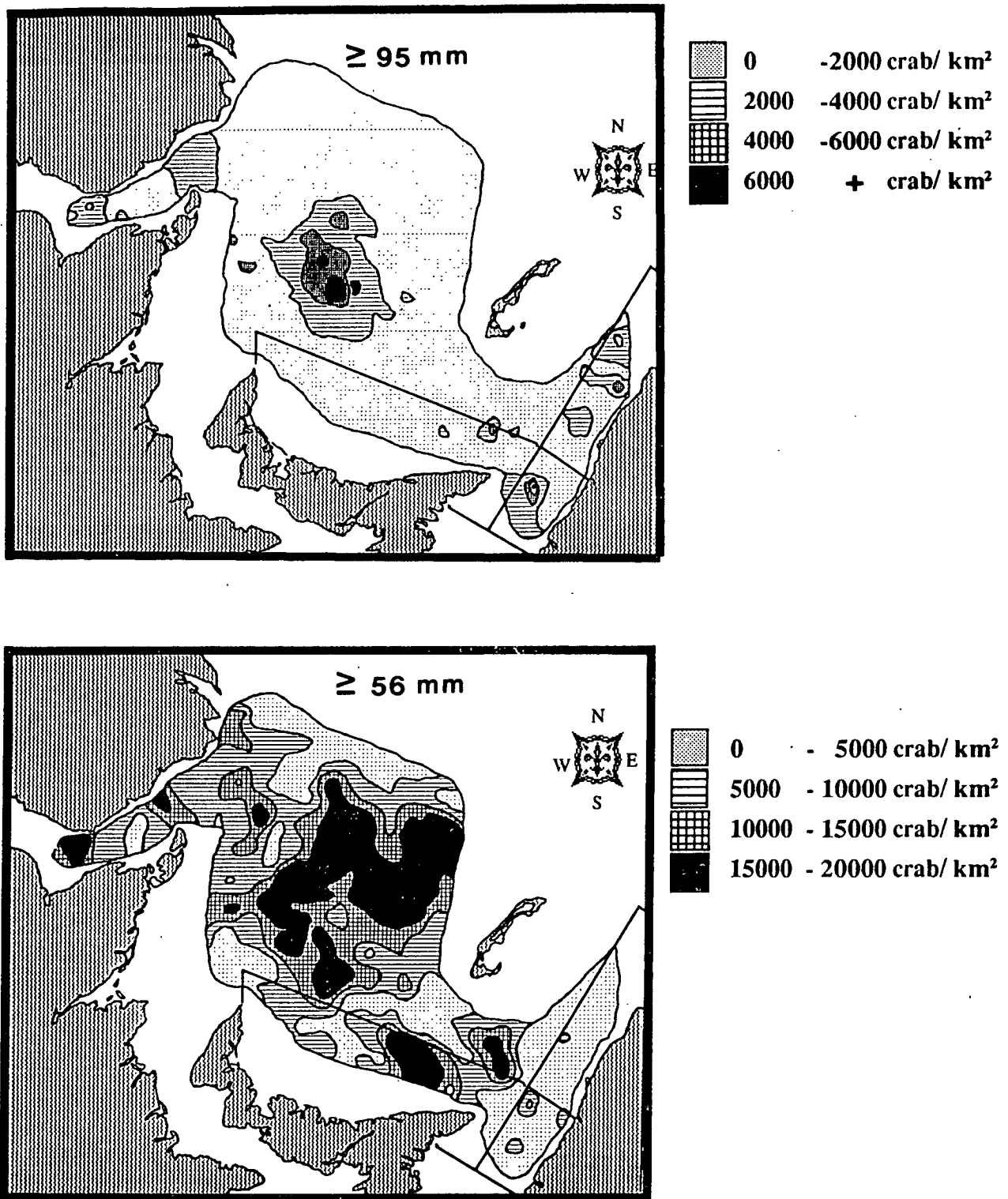


Figure 10. Density contours of large claw male ≥ 95 mm CW and small claw male ≥ 56 mm CW calculated from the trawl survey data in 1990.

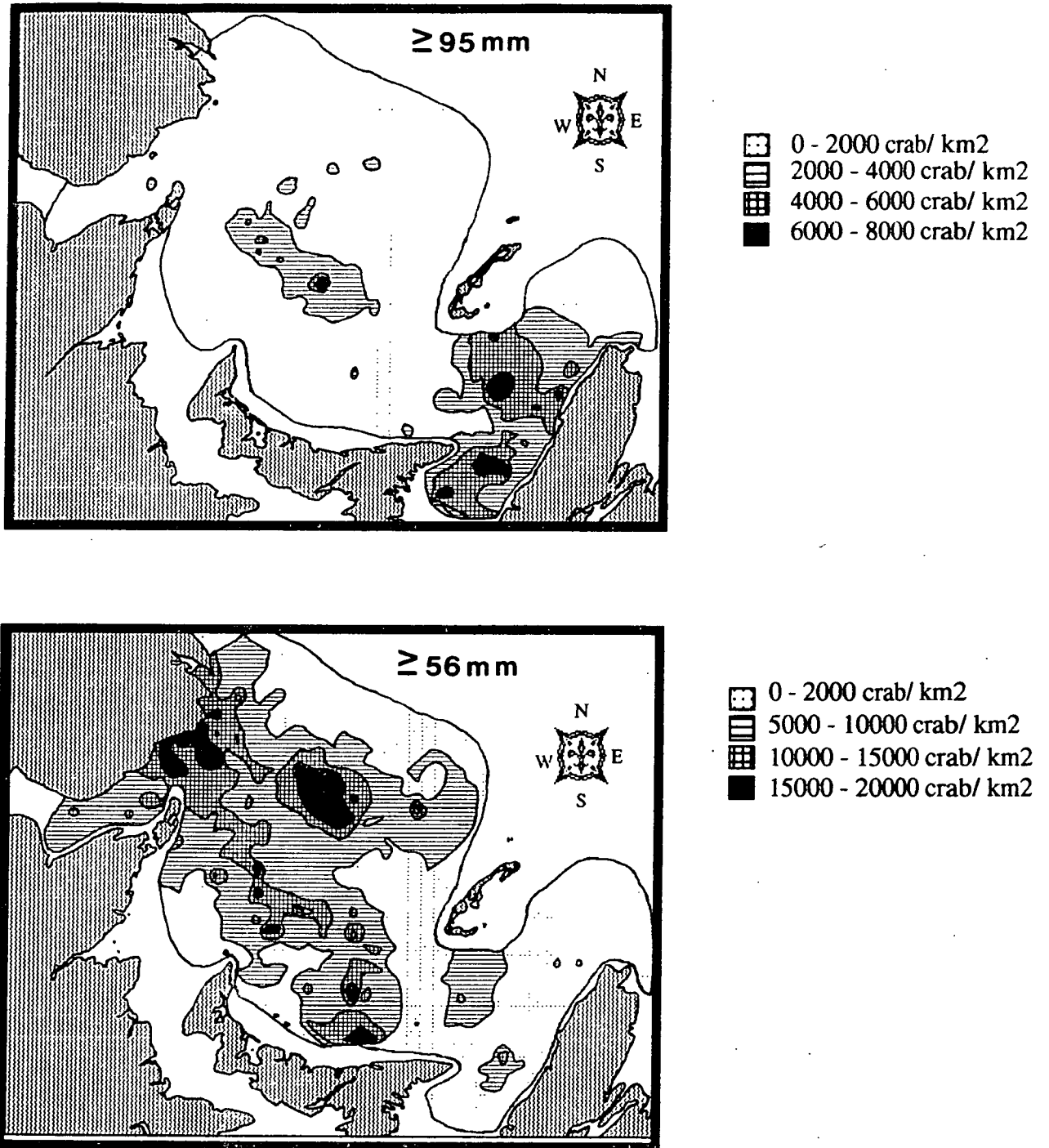


Figure 11. Density contours of large claw male ≥ 95 mm C W and small claw male ≥ 56 mm C W calculated from the trawl survey data in 1991.

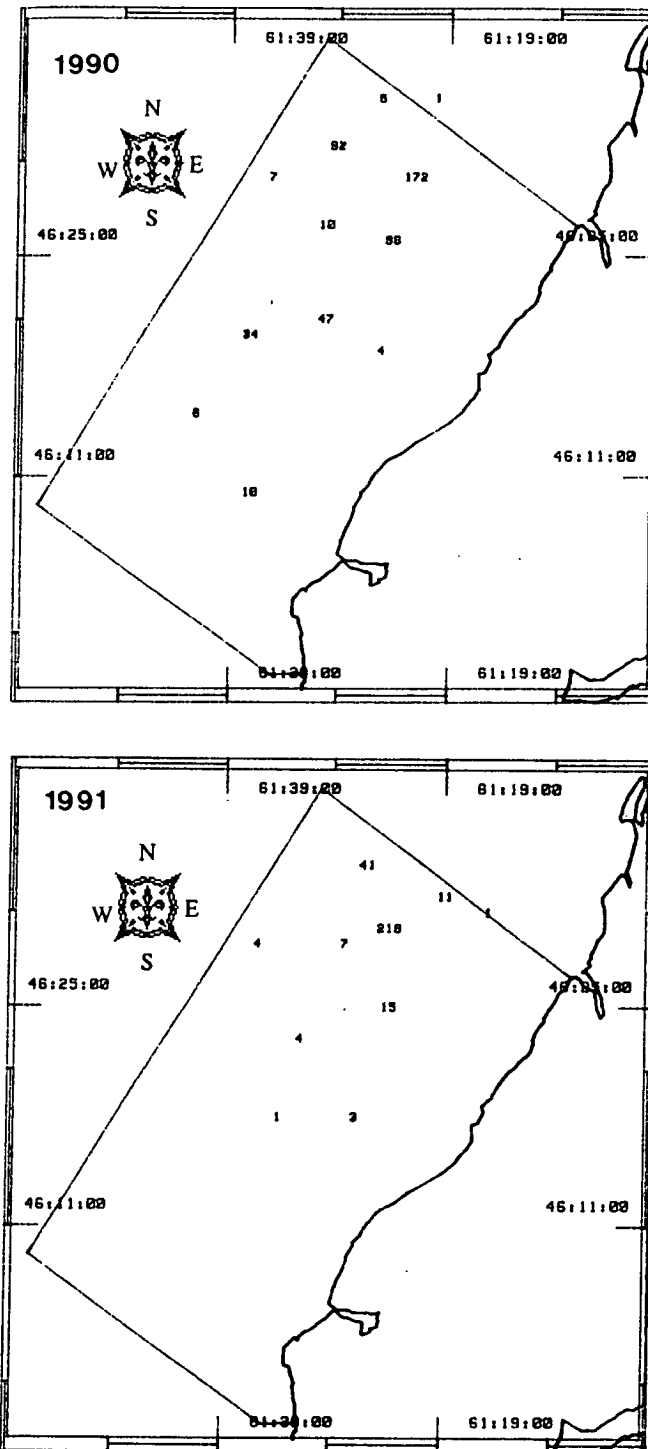


Figure 12. Distribution of fishing effort for the Area 18 Cape Breton Island snow crab, Chionoecetes opilio, fishery for 1990 and 1991.

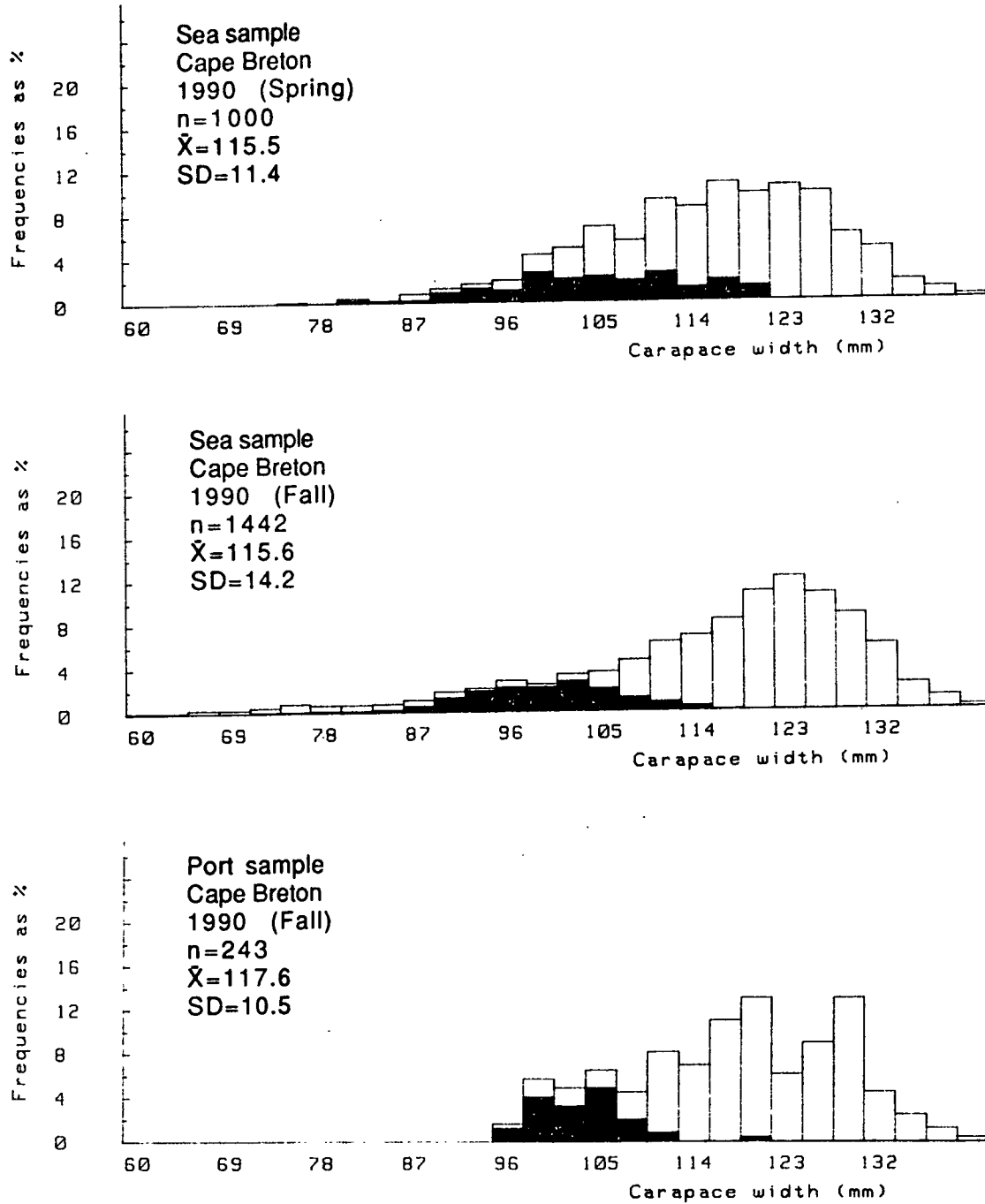


Figure 13. Overall size distributions of male crab, *Chionoecetes opilio*, present in sea and port samples taken during the 1990, Area 18 Cape Breton Island snow crab fishery.

Percentage of small claw in black, percentage of total in white.

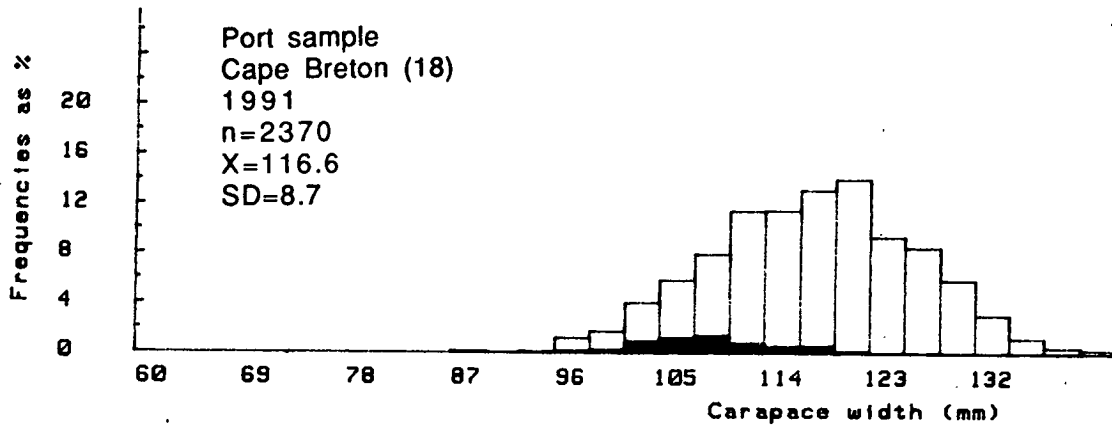
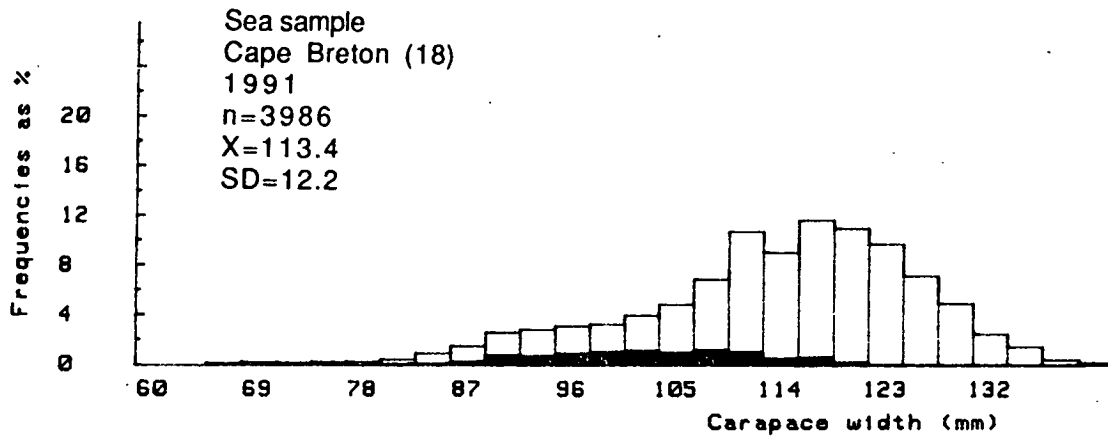


Figure 14. Overall size distributions of male crab, *Chionoecetes opilio*, present in sea and port samples taken during the 1991, Area 18 Cape Breton Island snow crab fishery.

Percentage of small claw in black, percentage of total in white.

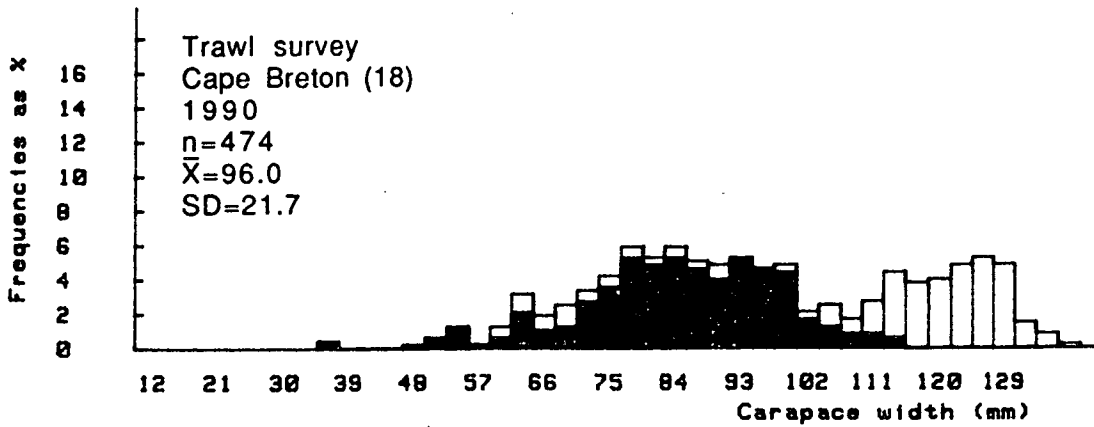
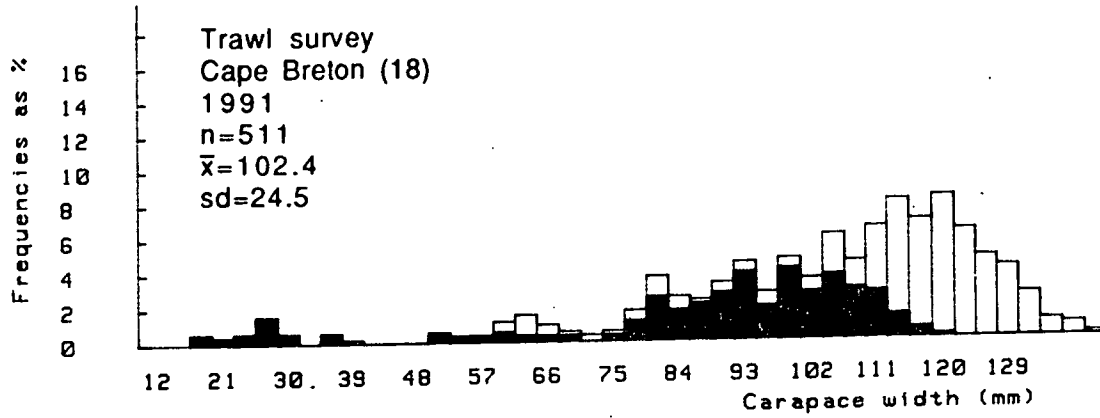


Figure 15. Overall size distributions of male crab, *Chionoecetes opilio*, collected during the 1990 and 1991 trawl surveys in the Area 18 Cape Breton Island snow crab fishery.

Percentage of small claw in black, percentage of total in white.