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Assessment of Prince Edward Island (zone 25 and 26) snow crab (Chionoecetes opilio) stock for 1992.

by

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ABSTRACT

An exploratory snow crab fishery was established off northern Prince Edward Island (P.E.I.) with the issuance of 16 exploratory permits in 1985 and 14 additional permits in 1986. The 16 original permits were reissued as licenses in 1987. The fishery is operatating under an overall quota limitation since 1990 and is taking place in the spring. Quotas of 500 t, 600 t and 800 t were attained in 1990, 1991 and 1992 respectively.

Biological information was obtained from sea and port sampling and a trawl survey, while catch, effort and distribution of fishing effort were obtained from fishermen's logbooks and processor's sales slips. Thirty one stations within the P.E.I. fishery were surveyed and analyzed for biomass estimations.

Complete logbook records used for the CPUE calculations represented only 5% of the total catch of 783 t. The mean CPUE in 1992 (44.4 kg/trap haul) calculated from logbooks for the season was higher than the 1991 season (33.4 kg/trap haul). Fishing concentrations were located at the edge of the zones.

Even thought a relatively low exploitation rate (29.4% based on the biomass from the trawl survey data) was applied to this fishery in 1992 (783 t/ 2665 t), projections for 1993 are showing a 17% decrease in the biomass of large claw legal size crab. A decrease in the prerecruits is also foreseen in that zone for future years. It is therefore recommended that the exploitation do not exceed last season's level of 29.4%.

RÉSUMÉ

Une pêche exploratoire du crabe des neiges a été établie au nord de l'Ile-du-Prince-Édouard (I.-P.-É.) avec l'émission de 16 permis exploratoires en 1985 et 14 nouveaux permis en 1986. Les 16 permis originaux ont été émis à nouveau comme licenses en 1987. Cette pêcherie opère au pringemps d'après un contingent global depuis 1990. Les contingents de 500 t, 600 t et 800 t ont été atteints respectivement pour 1990,1991 et 1992.

Les caractéristiques biologiques pertinentes ont été obtenues lors de l'échantillonage en mer et au port pendant la saison de pêche et à partir d'une campagne de chalutage après la saison de pêche. La prise, l'effort et la distribution de l'effort de pêche ont été obtenus des carnets de bord des pêcheurs et des bordereaux d'achat. Trente et une stations à l'intérieur de la zone de l'I.-P.-É. ont été échantillonnées et analysées pour l'estimation de la biomasse.

Les informations rapportées des carnets de bord utilisées pour le calcul des P.U.E. représentaient seulement 5% de la capture totale de 783 t. La P.U.E. moyenne en 1992 (44,4 kg/casier levé) calculée à partir des carnets de bord était supérieure à celle de 1991 (33,4 kg/casier levé). Cette pêcherie a toujours été concentrée à la frontière des zones de pêche.

Même si qu'un niveau d'exploitation relativement bas (29,4 % selon les données de chalutage) a été appliqué à cette pêcherie en 1992 (783 t/2665 t), les projections pour 1993 démontrent une diminution de 17% de la biomasse de crabes à grosse pince de taille légale. De plus, une diminution dans l'abondance des prérecrus est prévue dans cette zone dans les années futures. Ceci suggère fortement de ne pas augmenter le taux d'exploitation de l'an passé à 29,4%.

INTRODUCTION

An exploratory snow crab fishery was initiated off the coast of Prince Edward Island (P.E.I.) in 1985 and is composed of management zones 25 and 26 (Figure 1). The number of exploratory permits was increased from 16 in 1985 to 30 in 1986 (Davidson et al. 1986; Comeau and Davidson, 1987). The initial 16 exploratory permits were issued as licenses for the 1987 snow crab fishing season. Each fishermen is allowed to set 30 traps.

From 1985 to 1987, the P.E.I. snow crab fishery had no quota limitation and the fishing season was from April 1st to November 30th.

In l988, the fishery management plan proposed a 10 week spring fishing season from April 28th to July 5th which coincided with the midshore (southwestern Gulf) crab fishing season. Contrary to CAFSAC advice not to open a fall fishery for 1988, an opening was supported by the Province of P.E.I., processors from eastern P.E.I. and 13 fishermen out of 30. A 4 week fall fishery took place with the first landings recorded on October 3rd and the last landings on October 31st (Moriyasu et al. 1989).

In 1989, the fishing season for the P.E.I. fishery was the same as that of the southwestern Gulf. It opened on April 9th and closed on May 29th due to a high percentage of newly molted crab in the catches (DeGrâce et al. 1990). No fall fishery was permitted.

In 1990, the fishery opened on April 21st with a global quota of 500 t. The last landings were recorded on May 18th for a total landing of 546 t for the season.

In 1991, the season opened on May 4th with a global quota of 600 t. The closure of the season occurred May 27th as the quota was reached (615 t).

In 1992, the quota was set at 800 t. Landings of 783 t were recorded for the season which opened on May 14 th and closed on June 11th.

MATERIAL AND METHODS

SEA AND PORT SAMPLING

Sea samples (prorated to the landings) were obtained from May 25th to June 5th using the sampling procedures described by Hébert et al. 1992. Location of capture, measurement of the carapace width (CW) and chela height (CH) in mm, sex and shell hardness using a carapace hardness gauge (durometer, Foyle et al. 1989) were obtained for a sub-sample of crabs while the remaining of the catch was counted. The total catch of that vessel was also noted for each sampling trip during the 1992 fishing season. The mean size (CW) and the percentage of undersized, percentage of morphometrically immature or juvenile (Conan and Comeau, 1986; Comeau and Conan, 1992) and soft shelled crab were calculated for the males sampled at sea. In the present document, a standardized terminology adopted by the Steering Committee will be used for the morphometrically immature (juvenile) and mature crab which will be called small and large claw crab respectively. The small claw and the large claw are represented by the lower and the upper cloud, respectively, of a plot of chela height versus carapace width (Conan and Comeau, 1986; Comeau and Conan, 1992). A soft crab is a crab with a durometer reading of less than 68 and a white crab is a crab that molted the same year. Overall size distributions of both sea and port samples were generated and plotted according to their morphometric maturity.

LOGBOOK DATA

Catch and effort data for the P.E.I. fishery was obtained from fishermen's logbooks by the Department of Fisheries and Oceans Electronic Program Coordination and Economics Branch which gathers 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 estimated in pounds by the fishermen.

The seasonal CPUE (total catch / number of trap hauls) was calculated from the logbook data. The geographical fishing positions were plotted to identify the distribution and concentration of fishing efforts.

POST SEASON TRAWL SURVEY

A post season trawl survey was conducted in the southern Gulf of St. Lawrence between July 13th and October 21st, 1992 which included sampling 31 stations within the P.E.I. crab fishing zones 25 and 26 (Figure. 2).

A standard 20m Nephrops trawl equipped with SCANMAR™ electronic net sensors was used on a chartered vessel for the research survey. Stations were sampled during daylight. The tow duration varied from 4 to 8 minutes at a speed of 1.5-2.5 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 catch was sorted out by sex, size, percentage of small and large claw males, molt stages and the presence/absence of the external eggs for females.

Biomass estimates for the P.E.I. fishing zones were calculated using the kriging, a geostatistical technique (Conan, 1985; Conan et al. 1988). The estimates were based on a variogram calculated from samples collected throughout the southern Gulf of St. Lawrence.

A size frequency distribution for males captured during the 1988 to 1992 surveys was standardized to the same area swept. The 1992 trawl survey catch in number of large claw male crab with a CW larger than 95 mm was used to estimate the commercially exploitable (hard carapace) biomass at the beginning of the 1993 fishing season. A hard carapace crab is a crab that molted at least one year prior to the fishing season (which gives a durometer reading greater of equal to 68). The catch in number of small claw crab larger than 56 mm (CW) from the 1992 trawl survey was used for estimating the biomass of newly molted crab larger than 70 mm (CW) for the 1993 spring season using the global growth rate independently from the morphometric maturity status after the molt. Numbers of crab were converted to weight by using the size-weight relationships according to the molt stage, their morphometric maturity status and the sampling season.

The fishable area in the P.E.I. crab fishery was estimated according to the historical fishing effort distribution. The surface swept by the trawl net was estimated from the data on net opening width measured by the SCANMAR™ electronic net sensors and the distance towed.

RESULTS AND DISCUSSION

LOGBOOK DATA

Logbook records (completed logs) received from fishermen accounted only for 39.4 t or 5% of the total catch.

FISHING EFFORT AND CATCH PER UNIT OF EFFORT

The seasonal total fishing effort , catch rates and landings since the start of the fishery are summarized as follows:

Year	Trap hauls (#weeks)		CPUE		Total catch		Source
	S	F	S	F	S	F	
1985	11756 (13)	3404 (7)	57.2	37.9	672.6	129.1	Moriyasu et al. 1988
1986	30824 (13)	7182 (9)	32.7	32.2	1007.7	231.3	Moriyasu et al. 1988
1987	19069 (11)	5919 (6)	15.1	28.5	287.9	168.7	Moriyasu et al. 1988
1988	16478 (10)	4813 (4)	26.5	47.6	436.7	229.1	Moriyasu et al. 1989
1989	15726 (06)	-	47.5	-	747	-	DeGrâce et al. 1990
1990	22016 (04)	-	24.8	-	546	-	Chiasson et al. 1991
1991	18413 (04)	-	33.4	-	615	-	Chiasson et al. 1992
1992	17635 (04)	-	44.4	-	783	-	

S: spring season, F: fall season
Weeks : duration of the fishing season in weeks

The calculated total fishing effort decreased from 18413 trap hauls in 1991 to 17635 trap hauls in 1992. The duration of the season decreased from 1986 to 1988, both in the spring and the fall, and decreased again in 1989 and 1990 and remained stable until 1992. The CPUE calculated for the 1992 season (44.4 kg/trap haul) increased by 33% from the 1991 estimate of 33.4 kg/trap haul.

The distribution of fishing effort (Figure 3) showed two main concentrations: one concentration in the center of zone 26 and another one at the intersection of zone 25 and 26.

BIOLOGICAL INFORMATION FROM THE TRAWL SURVEY

The catch from the trawl survey was comprised of 81.3% of white crab compared to 70.2% in 1991, 78.9% in 1990 and 96.7% in 1989. The percentage of small claw crab increased from 85.5% in 1989 to 89.7% in 1990, then decreased to 81.7% in 1991 and 68.2% in 1992. The size frequency distributions do not seem to be comparable over the whole time series (Figure 4). In 1990, larger modes were observed at around 38 and 92 mm (CW). The sudden appearance of modes in 1990 could be explained in part by the fact that only 16 and 11 tows were drawn in 1988 and 1989 respectively compared to 29, 22 and 31 tows in 1990, 1991 and 1992 respectively. Although the distributions were standardized to the same swept surface, the surveys in 1988 and 1989 could have missed certain size range due to the patchiness of crab concentrations. Other unknown factors such as migration and/or high natural

mortality of certain size groups of crab between the surveys could have affected the shape of the distributions.

The mean size of males from the survey is calculated at 75.6 mm (CW), and the composition of the catch (%) was as follows(Figure 4):

	White crab			Hard shell			Total		
	S	L	T	S	L	T	S	L	T
Legal size	6.8	20.7	28.0	3.6	1.3	4.9	10.4	22.0	32.9
Sub-legal size	50.9	1.2	53.3	7.0	5.8	13.5	57.9	7.0	67.1
Total	57.6	21.9	81.3	10.6	7.2	18.5	68.2	29.1	100.0

(S=small claw, L=large claw, T=total)
The numbers do not add up to its totals when the maturity can not be determined due to missing claws.

The historical average size (mm CW), and percentage of small claws and white crab over the last five years are as follows:

Year of the survey	1988	1989	1990	1991	1992
Mean size	64.9	78.7	75.0	81.5	75.6
% small claw males	90.6	85.5	89.7	81.7	68.2
% white crab	83.0	96.7	78.9	70.2	81.3

BIOLOGICAL INFORMATION FROM SEA SAMPLING AND PORT SAMPLING

The biological information (in percentages from the total) for the six samples collected at sea during the fishing season is as follows (n=1461):

	Soft shell			Hard shell			Total		
	S	L	T	S	L	T	S	L	T
Legal size	3.2	6.1	9.3	3.3	85.0	88.4	6.5	91.1	97.9
Sub-legal size	0.3	0.5	0.8	0.1	1.2	1.4	0.4	1.7	2.1
Total	3.5	6.6	10.1	3.4	86.2	89.8	6.9	92.8	100.0

(S=small claw, L=large claw, T=total)
The numbers do not add up to its totals when the maturity can not be determined due to missing claws.

In 1992, the overall size frequency distribution of males measured from the sea samples (Figure 5) showed an average size of 111.7 mm (CW) compared to 104.3 mm (CW) in 1991.

The percentage of small claw males in the sea samples from 1986 to 1992 are as follows:

1986	1987	1988	1989	1990	1991	1992
17.1	50.9	45.1	12.0	76.0	64.0	6.9

The percentage of soft shell crabs collected during the spring fishing season showed an increasing trend from 17.3% in 1986, 54.9% in 1987, 62.0% in 1988 (Moriyasu et al. 1988) to 97% in 1989, and reversing to 55.3% in 1990, 36.4% in 1991 and 10.1% in 1992.

The overall size frequency distribution of the port samples (Figure 5) showed an average size of 111.6 mm (CW) and the seasonal percentage of small claw males in the samples was 4% (N=312).

BIOMASS ESTIMATION

The total fishable surface estimated for the P.E.I. fishery based on the commercial fishing effort distribution is 2442.51 km^2 (Moriyasu et al. 1989).

The variogram plots for the large claw male crabs larger than 95 mm (CW) and the small claw male crabs larger than 56 mm (CW) showed a range of approximately 24.7 and 38.2 km respectively beyond which no more spatial covariance effects are detected (Figure 6).

By using Kriging techniques, the biomass estimates for males (Figures 7 and 8) at the beginning of the spring of 1993 based on the 1992 trawl survey for different biological categories gave the following results:

Category	Surface (km2)	Crabs/km2	Biomass(t)	±2SD
Large claw hard ≥95 mm	2442.51	1524	2208.6	1787
white crab ≥70 mm	2442.51	3865	2543.4	2235

The estimated biomass of large claw crab ≥95 mm (CW) increased by 2% from 1990 (1319.9 t ± 1295.5 t) to 1991 (1325 t ± 950 t), by 101% from 1991 to 1992 (2665 t ± 1661 t) and than decreased by 17% from 1992 to 1993 (2208.6 ± 1787 t).

The estimated biomass of white crab ≥70 mm (CW) increased by 31% from 1990 (5880.8 t ± 4140 t) to 1991 (7704 t ± 2890 t) and decreased by 5% from 1991 to 1992 (7283 t ± 3620 t). The projections for 1993 shows a decrease of 65% (2543.4 ± 2235 t) in the estimated biomass. The increase in the estimated biomass from 1991 to 1992 is assumed to be the result of a larger recruitment to the fishery in 1991 compared to 1990 (Chiasson et al., 1992).

RECOMMENDATION

Since this fishery depended highly on the annual recruitment to the fishery in the past (Moriyasu et al. 1988, Chiasson et al. 1991), it is recommended that this fishery be exploited

in a way to allow an accumulation of large claw crab on the grounds to reduce the present dependency on soft and small claw crab. These measures may help stabilize the fishery.

Even thought a relatively low exploitation rate of 29.4% (based on the trawl survey data) was applied to this fishery in 1992 (783 t/ 2665 t), the projected biomass estimates of large claw legal size crab decreased by 17%. In addition, a decrease in the recruitment to the fishery is foreseen in that zone for future years. Due to the large confidence intervals on the biomass estimations for this zone and based on the observations previously mentionned, it is strongly suggested not to exceed the last season's exploitation level at 29.4% for the 1993 fishing season.

If the same exploitation level is to be applied to the 1993 fishery, an overall catch level of 649 t should be allocated to this fishery.

REFERENCES

Chiasson, Y., P. DeGrâce, C. Gallant, and M. Moriyasu. 1992. The Prince Edward Island snow crab (Chionoecetes opilio) stock assessment for 1991. CAFSAC Res. Doc. 92/12:16 pp.

Chiasson, Y., C. Gallant, P. DeGrâce, and M. Moriyasu. 1991. Stock assessment and fishery trends for the Prince Edward Island snow crab (Chionoecetes opilio) fishery - 1990. CAFSAC Res. Doc. 91/24:15 pp.

Comeau, M., and G. Y. Conan. 1992. Morphometry and gonad maturity of male snow crab, *Chionoecetes opilio*. Can. J. Fish. Aquat. Sci. 49: 2460-2468.

Comeau, M., and K.G. Davidson. 1987. Prince Edward Island snow crab fishery stock assessment for 1986. CAFSAC Res. Doc. 87/51:16 pp.

Conan, G.Y. 1985. Assessment of shellfish stocks by geostatistical techniques. ICES Shellfish Committee C.M. 1985/ K:30.

Conan, G.Y., and M. Comeau. 1986. Functional maturity and terminal molt of male snow crab, (Chionoecetes opilio). Can. J. Fish. Aquat. Sci. 43:1710-1719.

Conan, G.Y., M. Moriyasu, E. Wade, and M. Comeau. 1988. Assessment and spatial distribution surveys of snow crab stocks by geostatistics. ICES Shellfish Committee C.M.1988/ K:10

Davidson, K.G., M. Comeau, P. Mallet, and M. Moriyasu. 1986. Fishery trends and stock assessments for four snow crab Chionoecetes opilio, fisheries in the Gulf of St. Lawrence, 1985. CAFSAC Res. Doc. 86/51:50 pp.

DeGrâce, P., Y. Chiasson, and M. Moriyasu. 1990. Prince Edward Island snow crab, Chionoecetes opilio, fishery stock assessment - 1989. CAFSAC Res. Doc. 90/26:18 pp.

Foyle, T. P., G. V. Hurley, and D. M. Taylor. 1989. Field testing shell hardness guages for the snow crab fishery. Can. Ind. Rep. Fish. Aquat. Sci. 193: 38 p.

Hébert, M., C. Gallant, Y. Chiasson, P. Mallet, P. DeGrace, et M. Moriyasu. 1992. Le suivi du pourcentage de crabes mous dans les prises commerciales de crabe des neiges (Chionoecetes opilio) dans le sud-ouest du golfe du Saint-Laurent (Zone 12) en 1990 et 1991. Rapp. tech. can. sci. halieut. aquat. 1886:18p.

Moriyasu, M., Y. Chiasson, and C. Bourgeois Godbout. 1988. Prince Edward Island snow crab, Chionoecetes opilio fishery stock assessment- 1988 spring season. CAFSAC Res. Doc. 88/56:20pp.

Moriyasu, M., Y. Chiasson, E. Wade, P. DeGrâce, and G. Y. Conan. 1989. Prince Edward Island snow crab, Chionoecetes opilio, fishery stock assessment - 1988 fall season. CAFSAC Res. Doc. 89/27:20 pp.

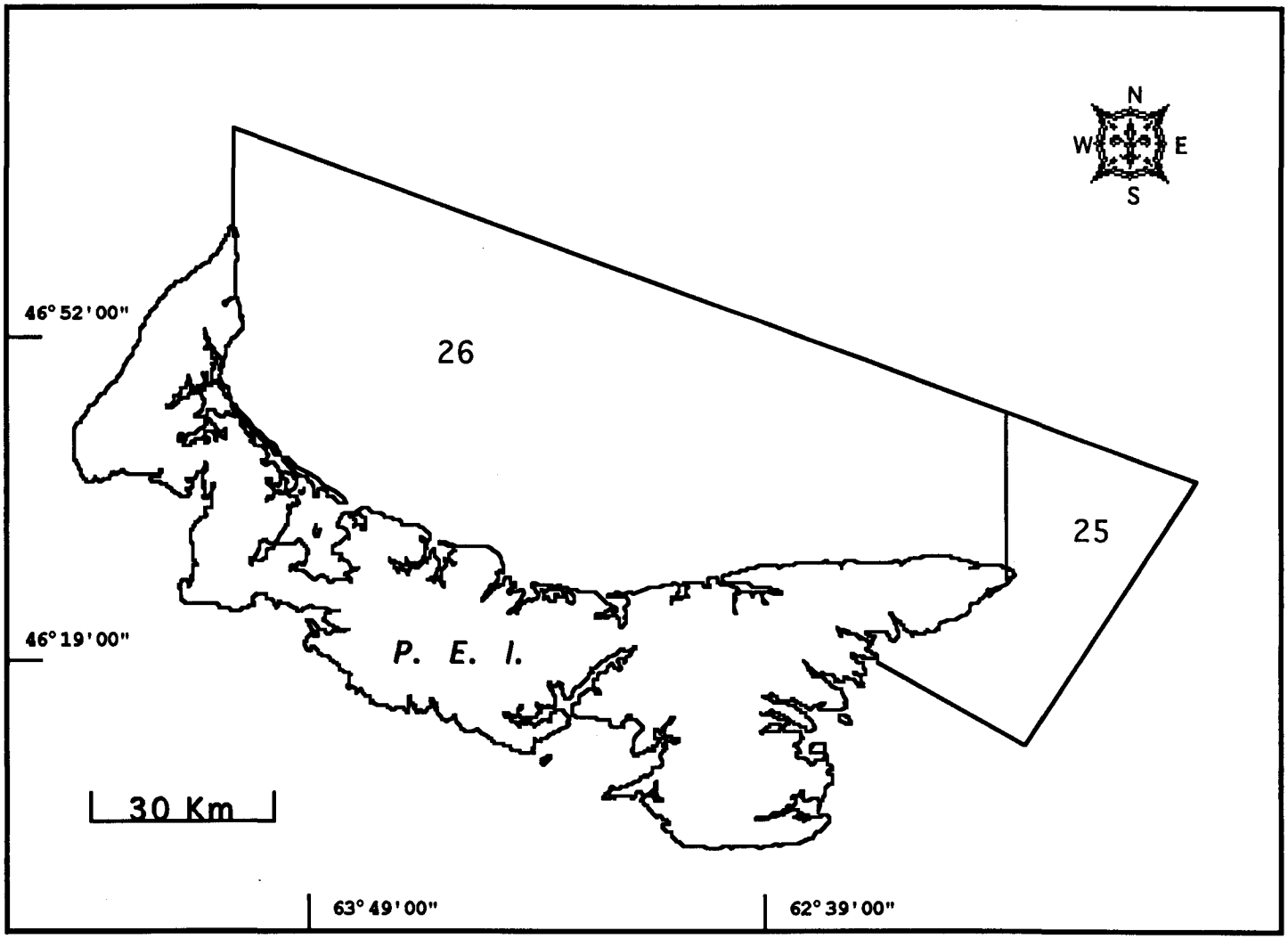

Figure 1. Prince Edward Island fishing zones 25 and 26.

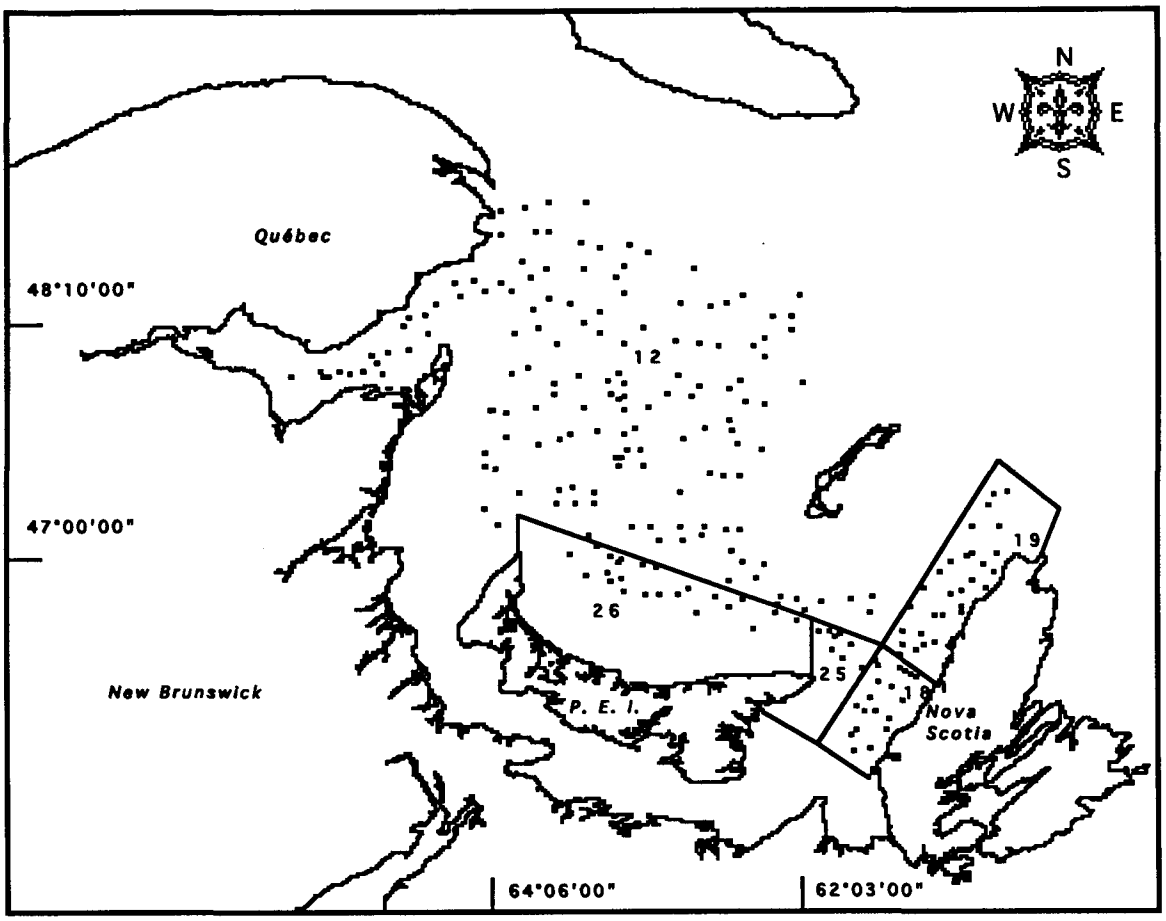

Figure 2. Geographic locations of the post season trawl survey stations in the southern Gulf of St.Lawrence in 1992. Each dot represents one 4 to 8 minute tow.

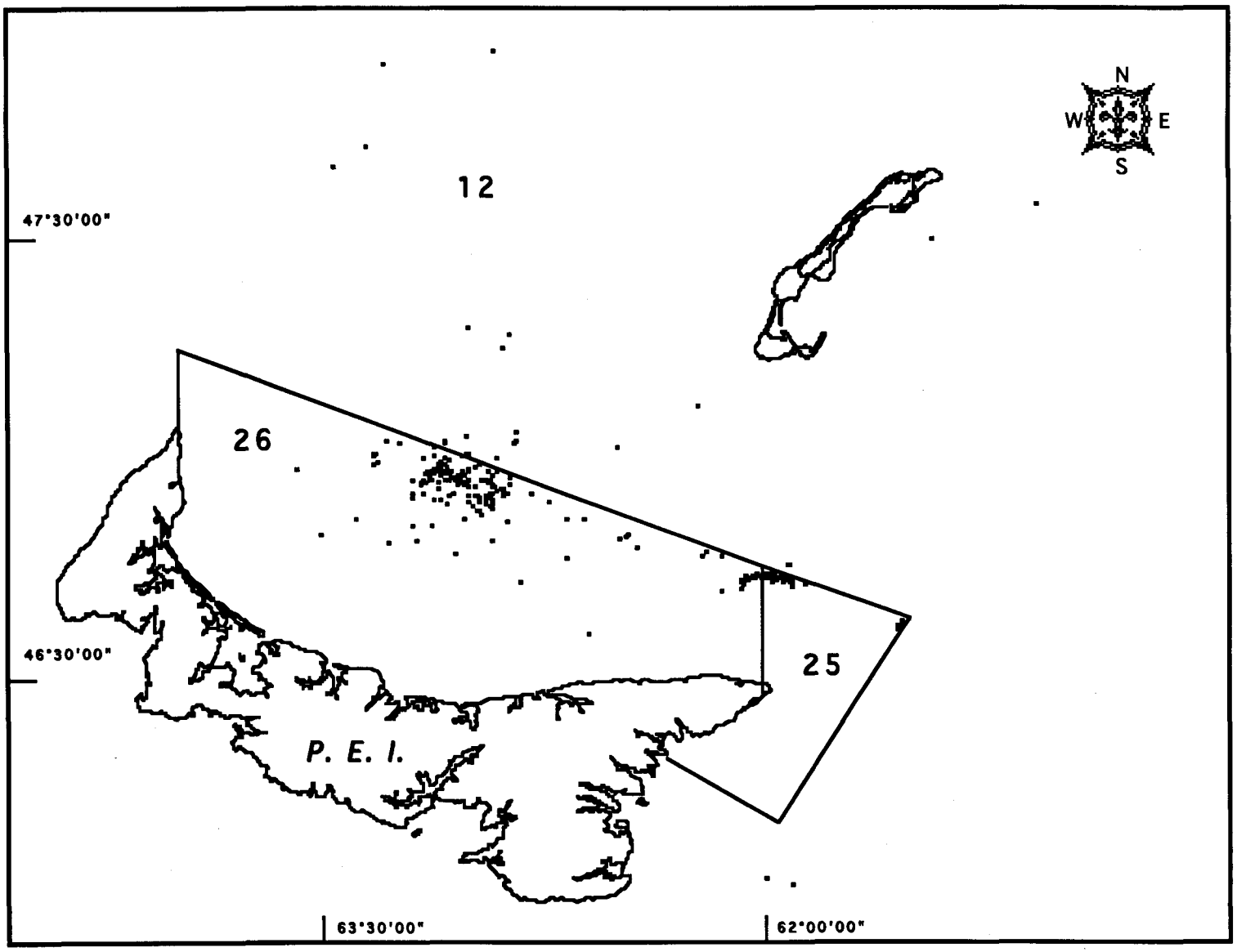

Figure 3. Overall distribution of fishing effort based on the logbook data for the 1992 P. E. I. snow crab fishery. Each dot represents the location of at least one trap haul.

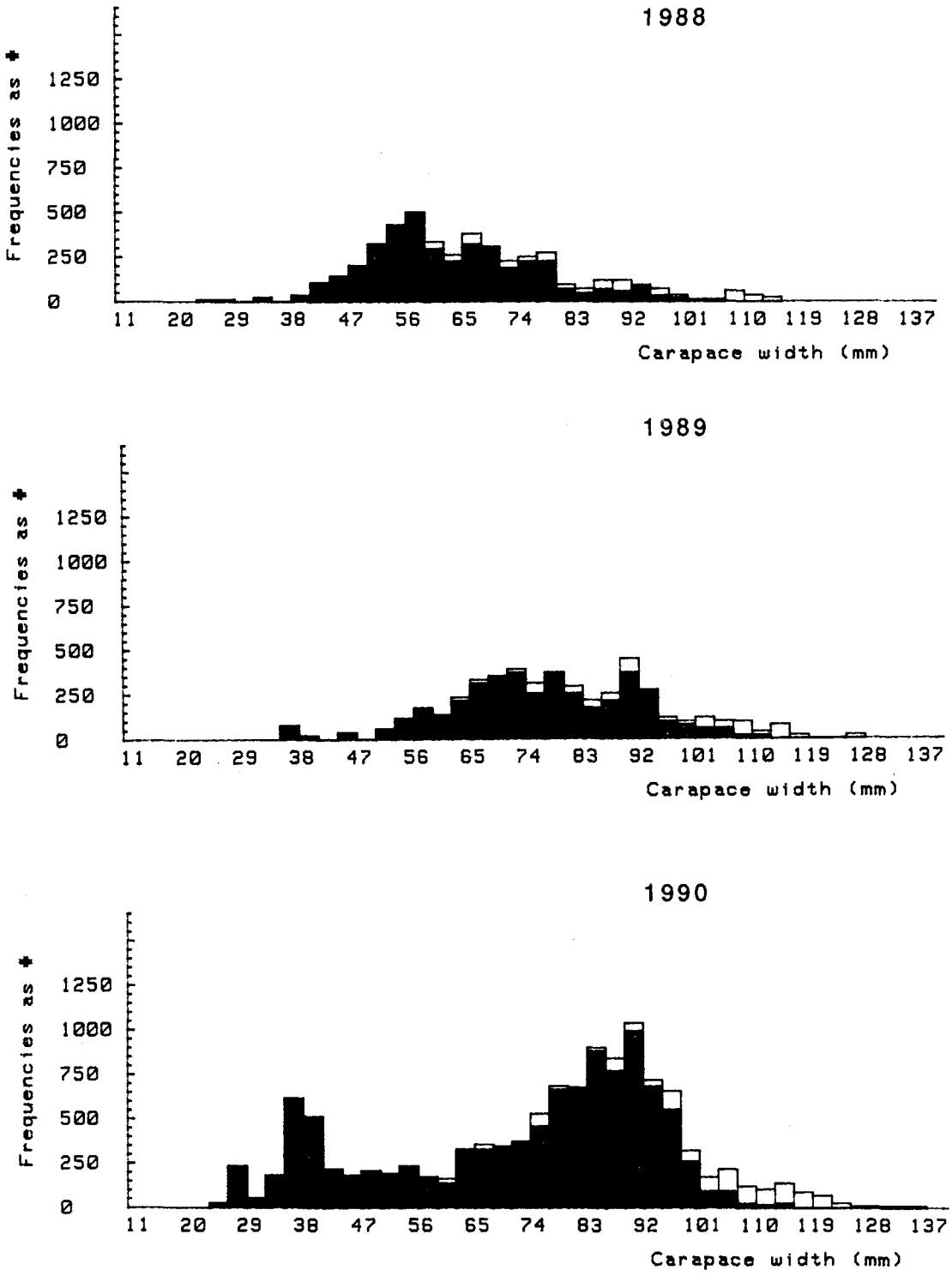

Figure 4. Overall size distributions of male crab, Chionoecetes opilio, present in the Prince Edward Island zones 25 and 26 trawl survey from 1988 to 1992.

Numbers of small claw in black, numbers of large claw in white.

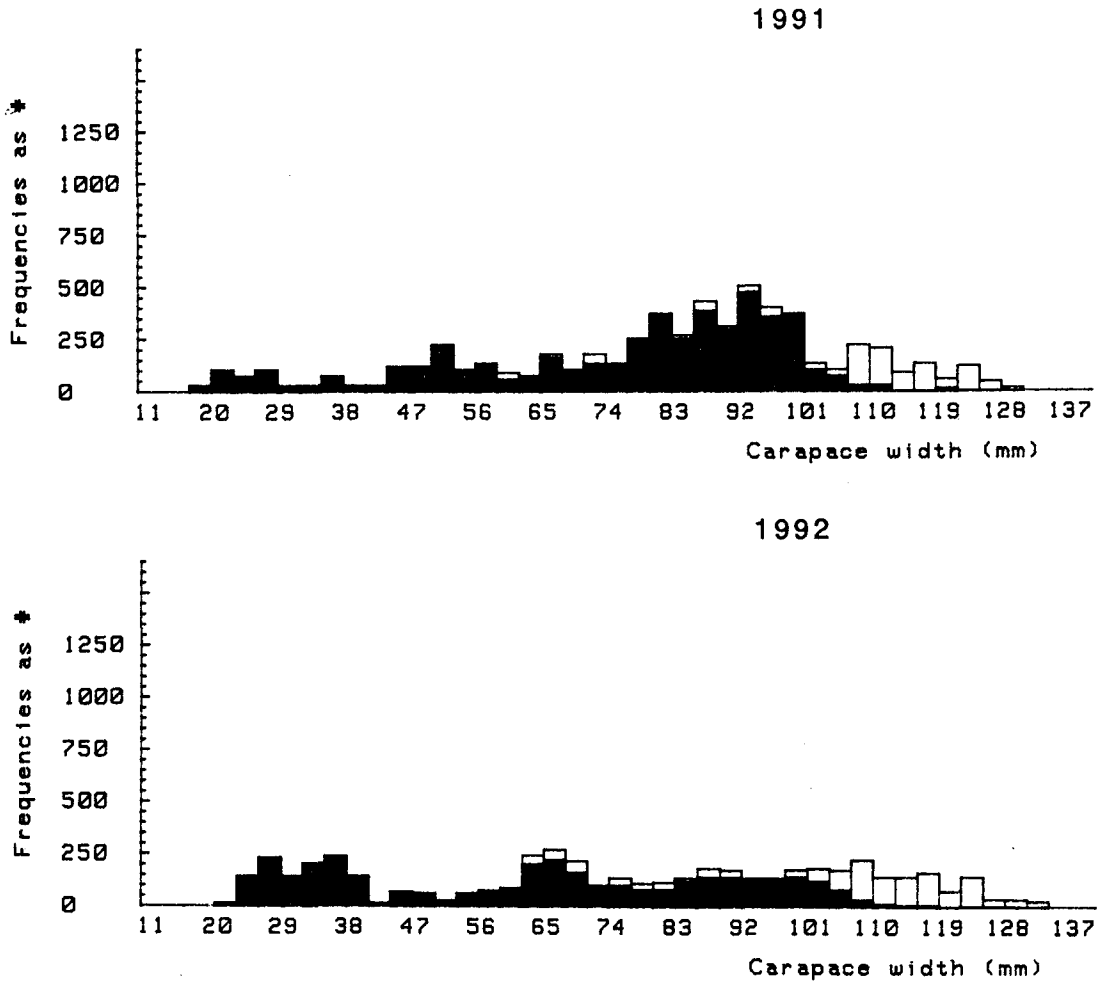

Figure 4. Cont

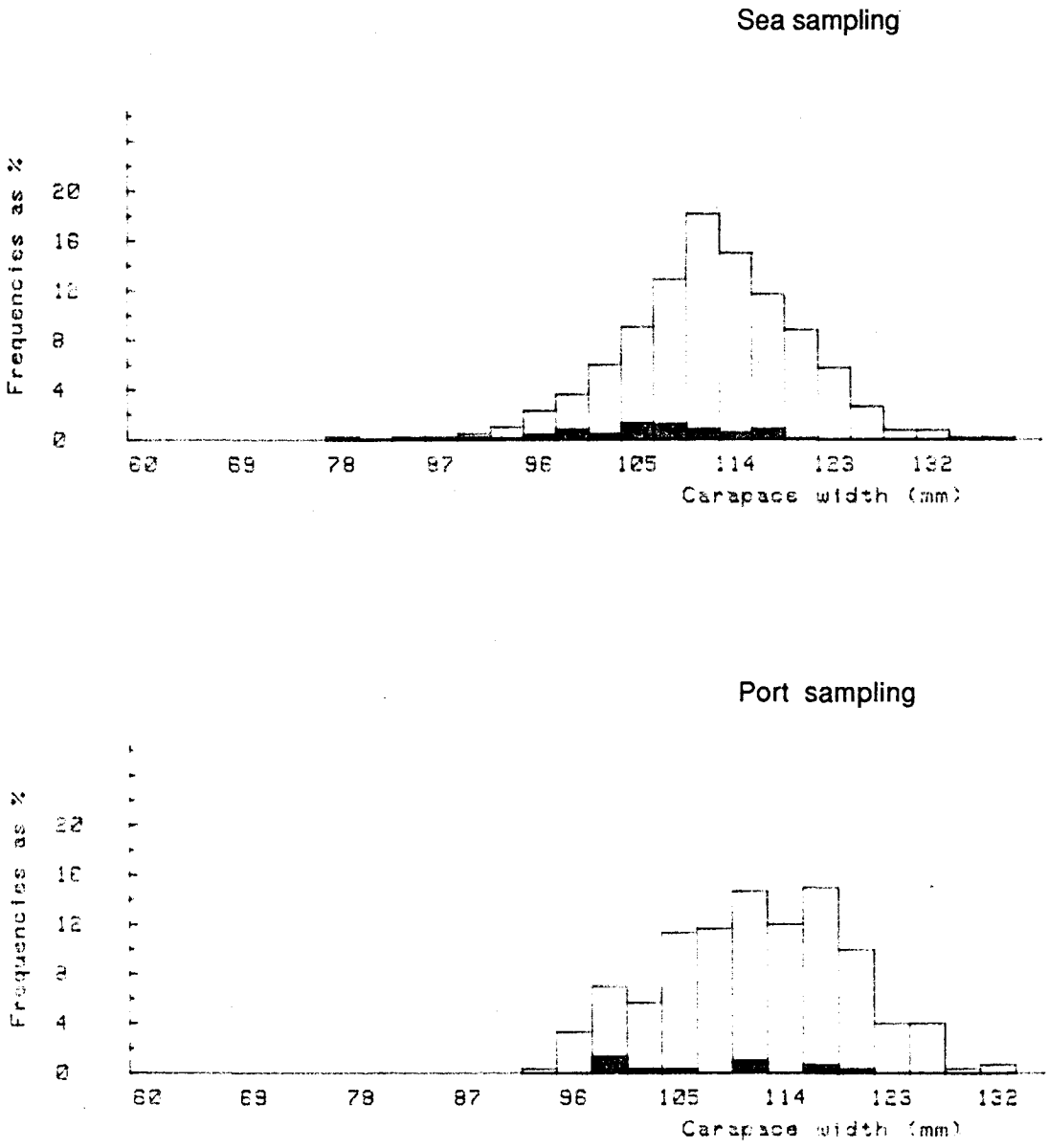

Figure 5. Overall size distributions of male crab, Chionoecetes opilio, present in sea and port samples taken during the 1992, P.E.I. snow crab fishery.

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

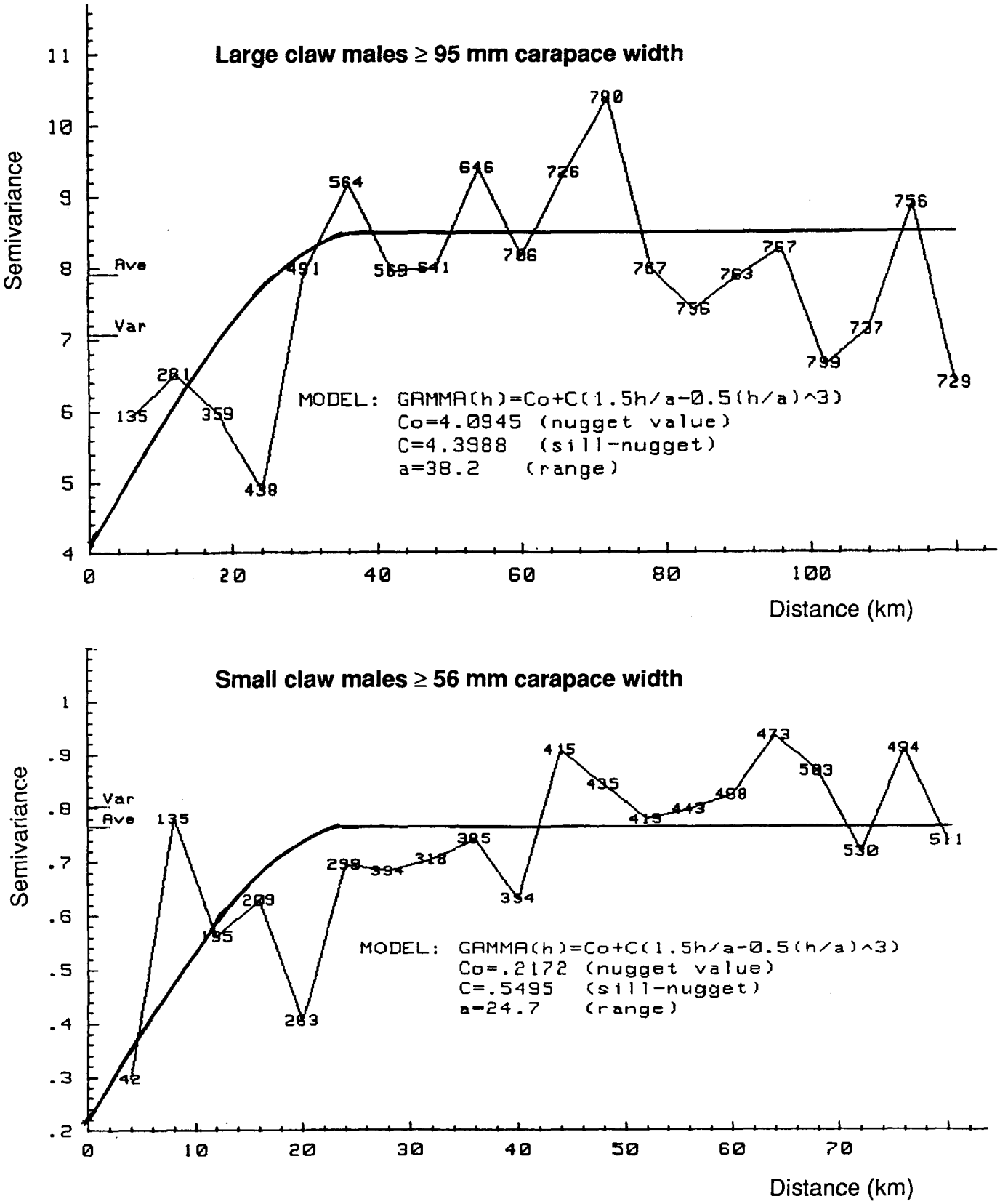

Figure 6. Variograms for the large claw males ≥ 95 mm (CW) and for small claw males ≥ 56 mm (CW) used in the kriging calculations for the 1992 survey.

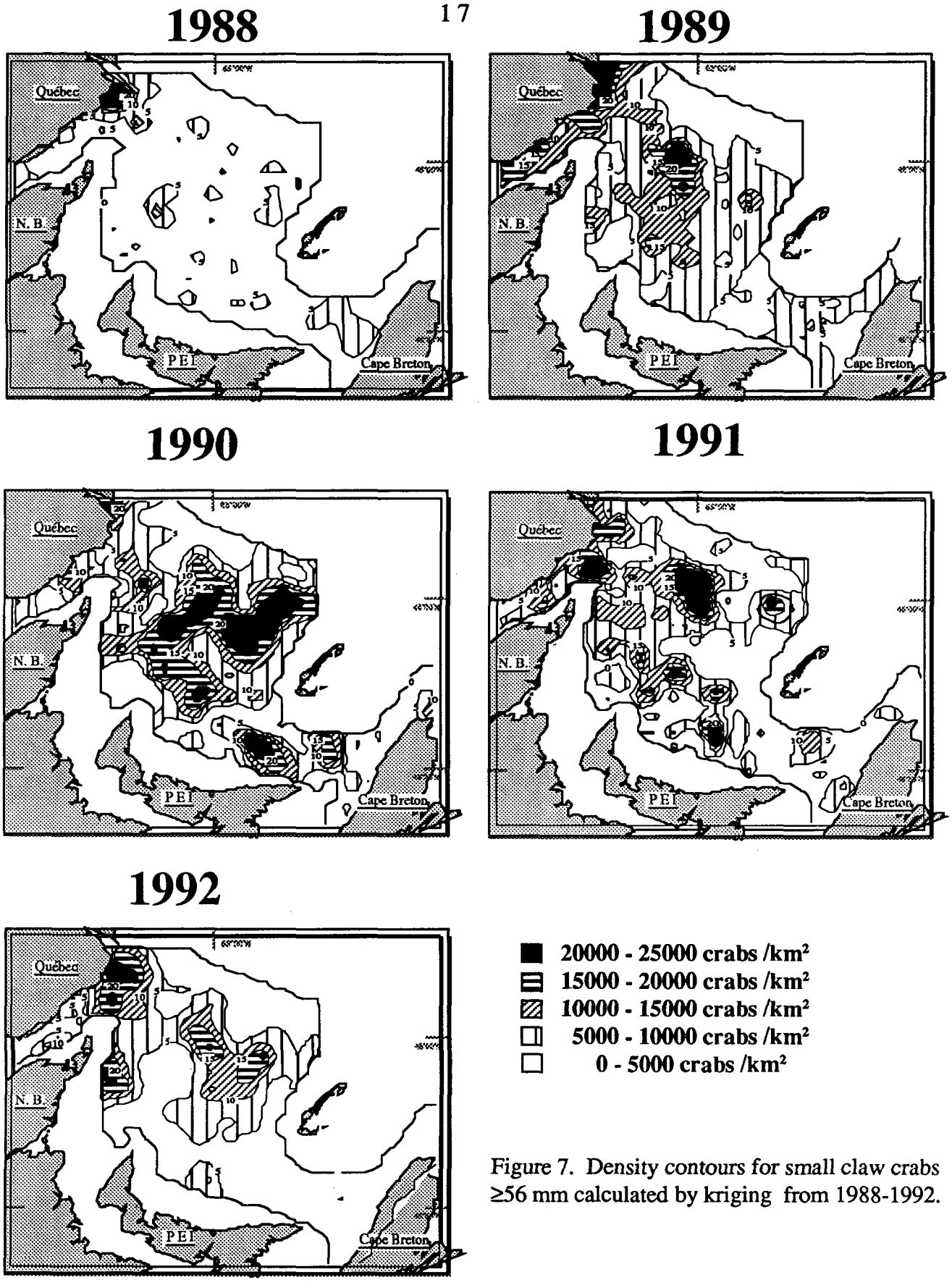

Figure 7. Density contours for small claw crabs ≥56 mm calculated by kriging from 1988-1992.

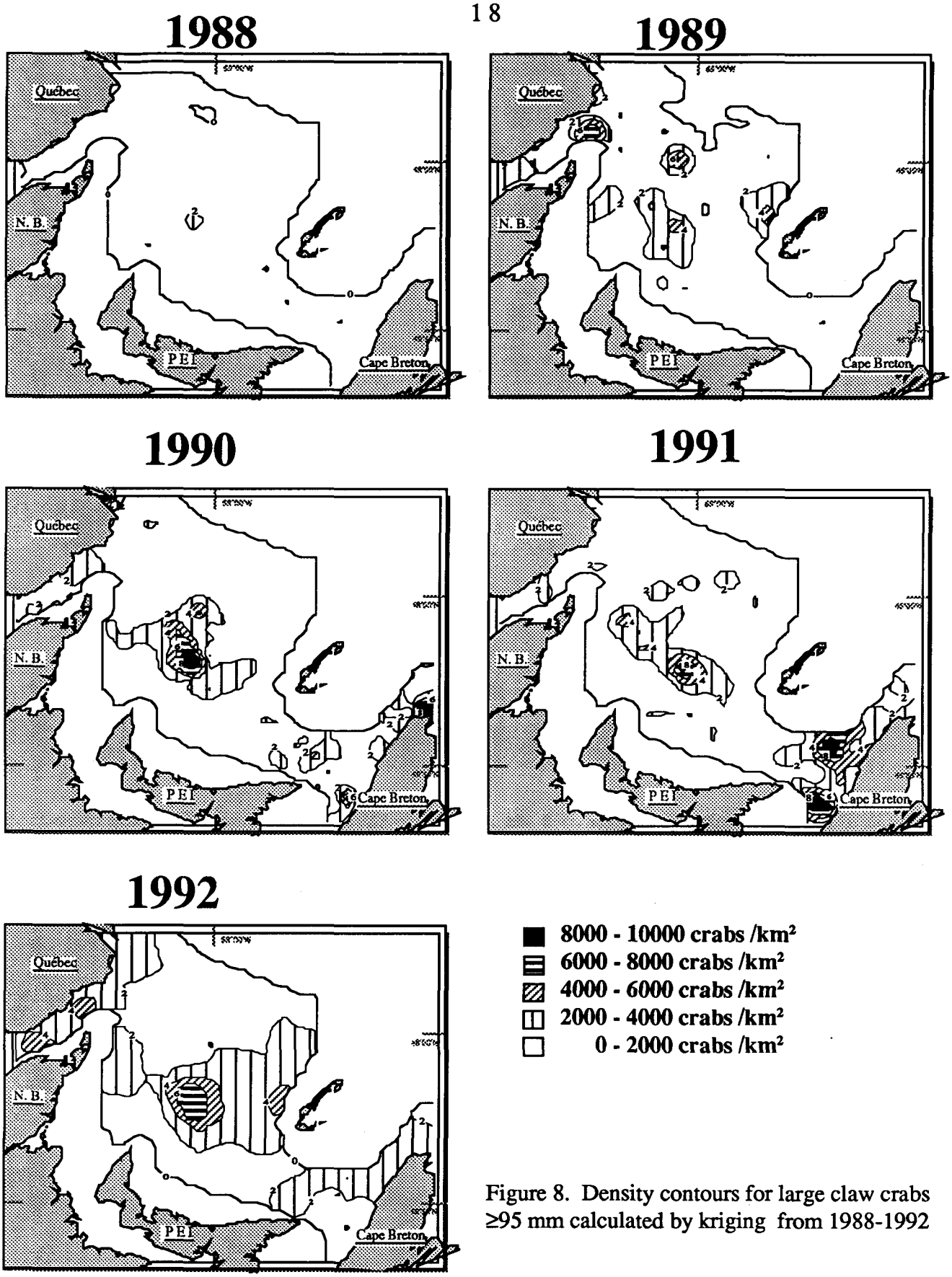

Figure 8. Density contours for large claw crabs ≥95 mm calculated by kriging from 1988-1992