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Stock assessment and fishery trends for the Prince Edward Island snow crab  
(Chionoecetes opilio) fishery -1990.

by

Yvon Chiasson, C. Gallant , P. DeGrâce and Mikio Moriyasu

Department of Fisheries and Oceans  
Gulf Region , Science Branch  
P. O. Box 5030  
Moncton, N.B.  
E1C 9B6

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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 operated under a quota limitation for the first time in 1990. The fishing season opened on April 21st with a global quota of 500 t. The last landings were recorded on May 18th. Total landings of 546 t were recorded during that period.

Biological information was obtained from sea sampling while catch, effort and distribution of fishing effort were obtained from fishermen's logbooks. Twenty-eight stations within the P.E.I. fishery were surveyed and analysed for biomass estimation within the framework of the Southern Gulf post season trawl survey.

Logbook records for the season represented 35% of the total catch of 546 t. Abnormally high catch per unit effort (CPUE's) were discarded after investigations. The mean CPUE in 1990 (24.8 kg/trap haul) calculated from logbooks for the season was 48% lower than the 1989 season (47.6 kg/trap haul). Fishing locations were concentrated at the edge of the zones.

The trawl survey data may indicate that a good recruitment into the fishery is expected in the future. However, this recruitment should be protected by avoiding the catch of newly molted crab. It is therefore highly recommended to protect the recruitment of newly molted crab which is expected to appear in the fishery in 1991 by closing the fishery as soon as the soft shell crab enter the fishery.

## RÉSUMÉ

Une pêche exploratoire du crabe des neiges a été établie au nord de l'Île-du-Prince-Édouard (I.-P.-E.) 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 licences en 1987. Un contingent a été établi pour la première fois dans cette pêcherie en 1990. La saison de pêche a débuté le 21 avril avec un contingent global de 500 t. Les derniers débarquements ont été enregistrés le 18 mai. Des débarquements de 546 t ont été enregistrés durant cette période.

Les caractéristiques biologiques pertinentes ont été obtenues lors de l'échantillonnage en mer pendant la saison de pêche. La prise, l'effort et la distribution d'effort ont été obtenus des carnets de bord des pêcheurs. Vingt-huit stations à l'intérieur de la zone de l'I.-P.-E. ont été échantillonnées et analysées pour l'estimation de la biomasse lors de la croisière d'après-saison du Sud du Golfe.

Les prises rapportées des carnets de bord représentaient 35% de la capture totale de 546 t. Des P.U.E. anormalement hautes ont été éliminés après investigations. La prise par unité d'effort moyenne (P.U.E.) en 1990 (24,8 kg/casier) calculée à partir des carnets de bord était 48% inférieure à 1989 (47 kg/casier levé). Cette pêcherie a été toujours concentrée à la frontière des zones de pêche.

Les données de chalutage suggèrent un bon recrutement dans la pêcherie dans le futur. Cependant, ce recrutement devrait être protégé en évitant la capture du crabe récemment mué. Il est alors fortement recommandé de protéger le recrutement de crabe récemment mué qui entrera dans la pêcherie de 1991 en fermant la pêcherie aussitôt que le crabe mou entre dans les casiers.

## 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 (Fig.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. The fishermen are allowed to fish 30 traps.

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

In 1988, the snow crab fishery management plan proposed a 10 week season with no fall fishery. The 1988 spring fishery opened April 28th and ended July 5th which coincided with the midshore southwestern Gulf crab fishing season. The DFO News Release (NR-HQ-88-022E) indicated that a fall season could be reconsidered "if there was evidence during the spring fishery that harvests and catch rates had changed for the better". Following the closure of the 1988 fishery on July 5, 1988, an ad hoc CAFSAC meeting for the P.E.I. fishery was called (Moriyasu et al., 1988) and CAFSAC provided advice concerning a fall fishery. CAFSAC concluded that the P.E.I. crab resource was significantly reduced and the level of exploitation remained very high. CAFSAC also cautioned that catches during the period from the fall 1988 to the summer of 1989 would depend largely on the recruitment (molting) during the summer of 1988. Consequently, CAFSAC advised that a fishery in the fall 1988 would result in an exploitation rate likely well above the target level and reduce the spawning potential in the zone.

Despite CAFSAC's advice against a fall fishery for 1988, an opening was supported by the Province of P.E.I., processors from Eastern P.E.I. and 13 of the 30 fishermen; a 4 week fall fishery was officially announced by the Fishery's Parliamentary Secretary on October 1st. The first landings were recorded on October 3rd and the last landings on October 31st (Moriyasu et al., 1989).

In 1989, the crab fishing season was the same as the southwestern Gulf with an opening date on April 9th and a closure on May 29th because of high percentage of newly molted crab in the catches (DeGrâce et al., 1990).

In 1990, the fishery opened on April 21st with a global quota of 500 t. However, unlike the mid-shore fleet, no boat quota were established. The last landings were recorded on May 18th for a total of 546 t of crab landed for the season.

## **MATERIAL AND METHODS**

### **SEA SAMPLING**

Location of capture, size in mm (carapace width and chela height), sex and shell condition (soft, medium and old) was noted for all crabs sampled during the 1990 fishing season. Chela height was measured for males to determine morphometric maturity using the method described by Conan and Comeau (1986). A sea sample was obtained during week 4 and another during week 6 (starting on April 21th). The percentage of undersized males, immature males, soft shelled crab and mean size were calculated for the males.

### **LOGBOOK DATA**

Catch/effort data for the P.E.I. fishery was obtained from fishermen's logbooks by the Department of Fisheries and Oceans Electronic Data Processing and Statistics Branch and contained 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 logbook information from four fishermen were eliminated due to questionable reported information. The geographical fishing positions were plotted to identify the major fishing effort concentrations.

### POST SEASON TRAWL SURVEY

A post season trawl survey was conducted in the southern Gulf of St. Lawrence between June 18th and August 31st, 1990 and included 28 stations within the P.E.I. fishery (zones 25 and 26 sampled between June 22th and August 31st, 1990 (Fig.2) ).

A standard 20m Nephrops trawl equipped with a SCANMAR electronic net sensor was used on a chartered vessel for the research survey. 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 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, morphometric maturity, molt stages and the presence/absence of the external eggs for females.

A geostatistical technique, Kriging ( Conan, 1985; Conan et al., 1988) was used to estimate the biomass for the P.E.I. fishery based on a variogram calculated from samples collected over the southwestern Gulf.

A size frequency distribution was produced for the males captured during the survey. The catch in number of morphometrically mature male crab larger than 95 mm carapace width (C.W.) from the 1990 trawl survey was used for estimating the commercially exploitable biomass at the beginning of the 1991 fishing season. Numbers of crab were converted to weight by using the size-weight relationships according to the molt stage, morphometric maturity and the sampling season. The catch in number of immature crab larger than 56 mm C.W. from the 1990 trawl survey was used for estimating the biomass of newly molted crab larger than 70 mm for the 1991 spring season using the global growth rate independently from the morphometric maturity. The fishable area in the P.E.I. crab fishery was estimated from the historical fishing effort distribution. The swept surface by the trawl net was estimated from the data on net opening width measured by the SCANMAR electronic net sensor and the distance towed.

## **RESULTS AND DISCUSSION**

### LOGBOOK DATA

The logbook records from 16 of the 30 fishermen who returned log information in the fishery accounted for 190 t or 35% of the total catch (546 t).

### FISHING EFFORT AND CATCH PER UNIT OF EFFORT

The seasonal total fishing effort , catch rates and total catch are summarized as follows:

Year	Trap hauls (#weeks)		CPUE		Total catch	
	S	F	S	F	S	F
1985	11756 (13)	3404 (7)	57.2	37.9	672.6	129.1
1986	30824 (13)	7182 (9)	32.7	32.2	1007.7	231.3
1987	19069 (11)	5919 (6)	15.1	28.5	287.9	168.7
1988	16478 (10)	4813 (4)	26.5	47.6	436.7	229.1
1989	15726 (06)	-	47.5	-	747	-
1990	22016 (04)	-	24.8	-	546	-

S: spring season, F: fall season

# Weeks : duration of the fishing season in weeks

The calculated total fishing effort increased from 15726 trap hauls in 1989 to 22016 trap hauls in 1990. The duration of the season decreased from 1986 to 1988, both in the spring and the fall, and decreased again in 1989 and 1990. The CPUE calculated for the 1990 season (24.8 kg/trap haul) decreased by 48% compared to 1989 (47.6 kg/trap haul).

The distribution of fishing effort (Fig.3) showed two concentrations : one in the central zone 26; and one at the northeastern corner of the zone 25.

#### BIOLOGICAL INFORMATION FROM THE TRAWL SURVEY

The catch from the trawl survey comprised 78.9% of recently molted male crab compared to 96.7% for the 1989 survey. The percentage of morphometrically immature crab increased from 85.5% for the 1989 survey to 89.7% for the 1990 survey. The composition of the catch from the 1990 survey was as follows:

	Recently molted			Hard shell			Total		
	I	M	T	I	M	T	I	M	T
Legal size	7.4	7.0	14.4	1.7	0.5	2.2	9.1	7.5	16.6
Sub-legal size	63.1	1.4	64.5	17.6	1.3	18.9	80.7	2.7	83.4
Total	70.5	8.4	78.9	19.3	1.8	21.1	79.7	10.3	100.0

(I=immature, M=mature, T=immature+mature)

The comparisons over a period of three years are as follows:

Year of the survey	1988	1989	1990
Mean size	64.9	78.7	75.0
% immature males	90.6	85.5	89.7
% recently molted males	83.0	96.7	78.9

The increase in the mean size from 1988 to 1989 is probably due to a shift towards larger sizes of immature crab (56-58 mm) in 1989. The shift towards smaller mean size in 1990 can probably be attributed to a pulse of recruitment of smaller size (35-37 mm) immature crab in 1990 (Figure 4).

#### BIOLOGICAL INFORMATION FROM SEA SAMPLING

The biological information (in percentages from the total) for the two samples collected during the fishing season is as follows (n=349):

	White crab			Hard shell			Total		
	I	M	T	I	M	T	I	M	T
Legal size	39.0	0.9	39.9	20.6	21.2	41.8	59.6	22.1	81.7
Sub-legal size	14.9	0.5	15.4	1.5	1.4	2.9	16.4	1.9	18.3
Total	53.9	1.4	55.3	22.1	22.6	44.7	76.0	24.0	100.0

(I=immature, M=mature, T=immature+mature)

It is interesting to note that a proportion of morphometrically immature crab (22%) present in the catch for the first year were hard shell. We suspect that this group of crab was in pre-molt. The same phenomenon was observed in the midshore fishery for 1990 and in Bonne Bay, Newfoundland (M. Comeau, personal communication). The overall size frequency distribution for 1990 (Fig. 5) showed an average size of 101.2 mm C.W.. The seasonal percentage of morphometrically immature males in the samples fluctuated from 17.1% in 1986, 50.9% in 1987, 45.1% in 1988 (Moriyasu *et al.*, 1988), 12.0% in 1989 (DeGrâce *et al.*, 1990) and to 76% in 1990.

The percentage of white crab for the spring fishing season showed a continuous increase from 17.3% in 1986, 54.9% in 1987, 62.0% in 1988 (Moriyasu *et al.*, 1988) to 97% in 1989 and a decrease to 55.3% in 1990.

#### BIOMASS ESTIMATION

Total fishable surface estimated for the P.E.I. fishery, based on the commercial fishing effort distribution, was 2442.51 km<sup>2</sup> (Moriyasu *et al.*, 1989).

The variogram plots for the morphometrically mature male crabs larger than 95 mm C.W. and the immature male crabs larger than 70 mm C.W. showed a range of approximately 10.0 km and 19.3 km respectively beyond which no more spatial covariance effects were detected (Fig. 6).

By using the Kriging techniques, the biomass estimation for males at the beginning of the spring of 1991 based on the 1990 trawl survey for different biological categories gave the following results:

Category	Surface (km <sup>2</sup> )	Crabs/km <sup>2</sup>	Biomass(t)	±2SD
Mature hard ≥95 mm	2442.51	1291.9	1325	950
Mature hard ≥98 mm	2442.51	1146.9	1292	1031
Mature hard ≥101 mm	2442.51	991.7	1222	1061
newly molted ≥70 mm	2442.51	8591.1	7706	2890

The biomass of mature crab ≥95 mm estimated for 1991 (1325 t ± 950 t) is 2% higher than the estimate for 1990 (1298 t ± 1274 t)\* .

\* The biomass for 1990 reported in DeGrâce *et al.*, 1990 should be 1298±1274 t instead of 1319±1295 due to standardization of the calculations of the average weight.

### P.E.I. ZONES AND ADJACENT FISHERIES

Analysis and mapping of the trawl survey results with the Kriging method showed that the P.E.I. fishing grounds are continuous with the Southern Gulf and Cape Breton zone 18 fishing grounds (Fig. 7 et 8). Two high density zones were observed in 1990: One between the P.E.I. zone 25 and Cape Breton zone 18 and the other one between the P.E.I. zone 25, 26 and the midshore zone.

### **RECOMMENDATION**

Comeau and Davidson (1987), Comeau *et al.*, (1988), Moriyasu *et al.* (1988), and Moriyasu *et al.* (1989) all reported a low level of fishable biomass of snow crab in the P.E.I. zone for 1986, 1987 and 1988 respectively. From 1987 to 1989, exploitation rates (over 75%) have always been higher than the CAFSAC reference level of 50-60 % except for the 1988 fall season (52%; DeGrâce *et al.*, 1990).

The high percentages of morphometrically juvenile males found during the trawl survey in 1988 (90.6%; Moriyasu *et al.*, 1988) 1989 (85.5%; DeGrâce *et al.*, 1990) and 1990 (89.7%) may be a positive indication of good recruitment into the fishery in the coming seasons.

Effective management of the annual renewal of the stock (recruitment of newly molted crabs) is of utmost importance to this fishery. It is therefore recommended to decrease the fishing effort in this fishery in order to protect the recruitment of newly molted crab which is expected to appear in the fishery in 1991 by closing the fishery as soon as the newly molted crab enter the fishery. This would also allow the participation of the newly molted mature crab in the reproduction cycle during early spring of the following year.

### **ACKNOWLEDGEMENTS**

The authors wish to thank Donald Maynard and Pierre Mallet (DFO/Science, Gulf Region) for critical review of the manuscript.

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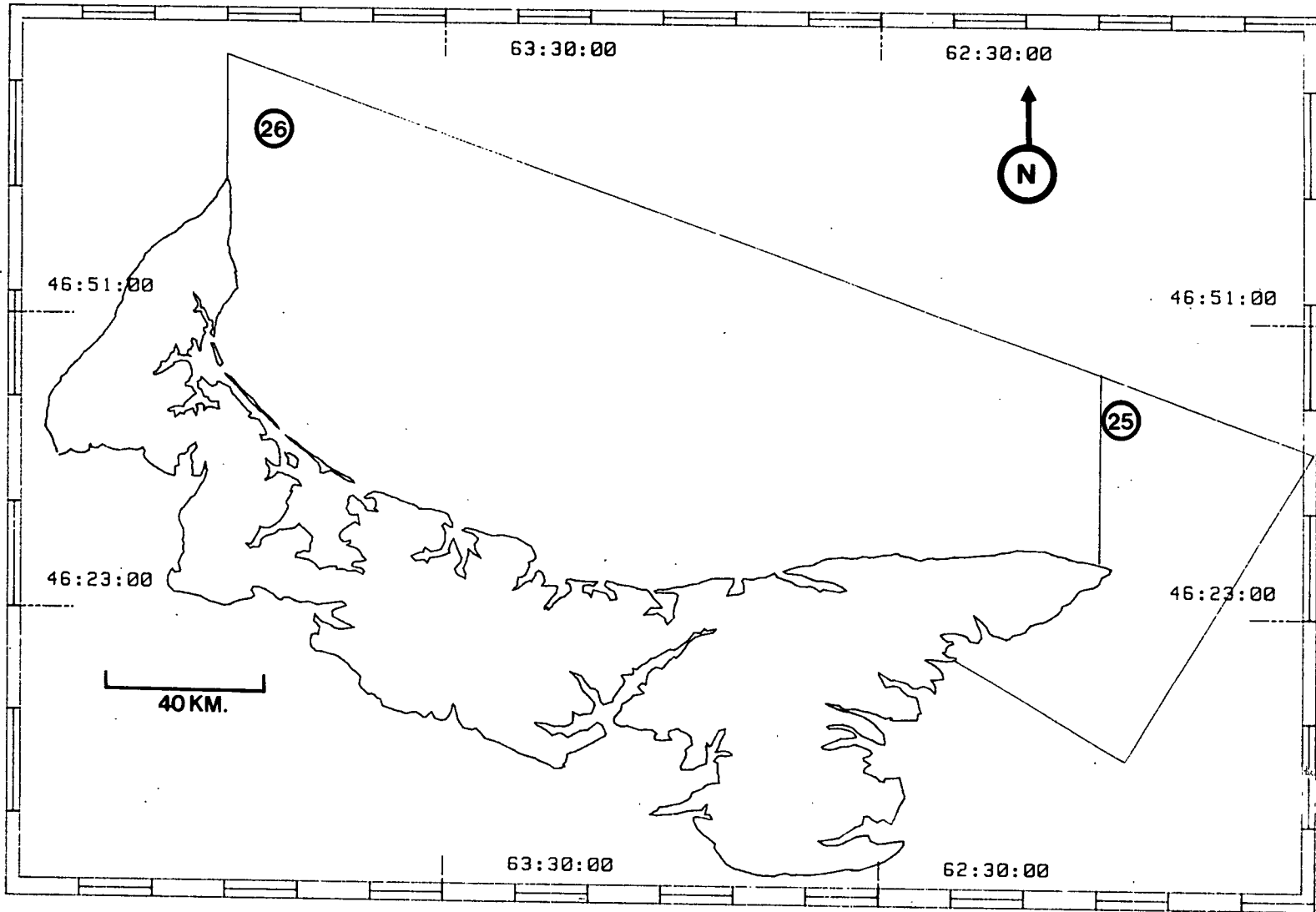


Figure 1. Prince Edward Island fishing Area 25 and 26.

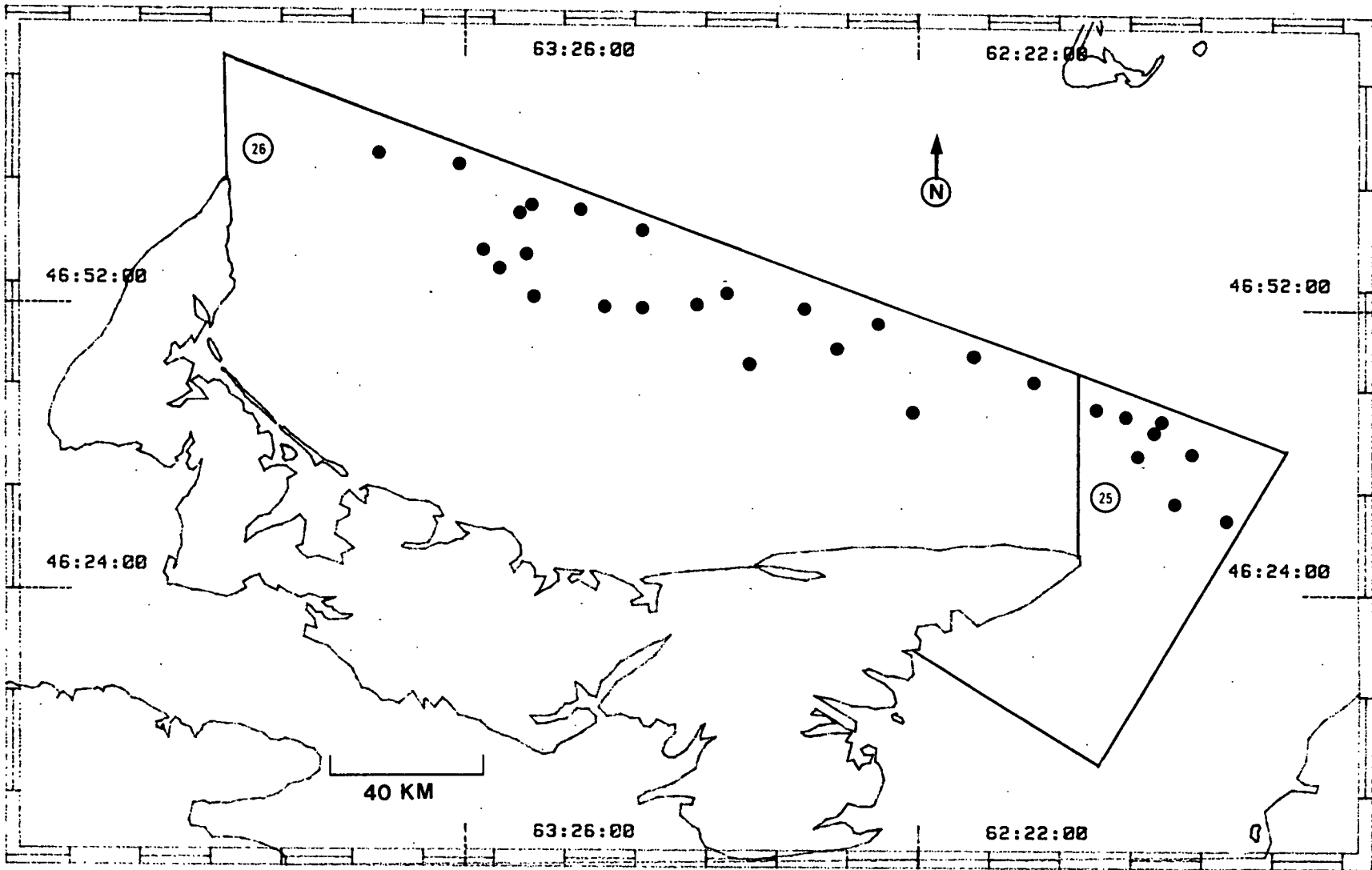


Figure 2. Geographic locations of the post season trawl survey in the P.E.I zone in 1990. Each dot represents one five minute tow.

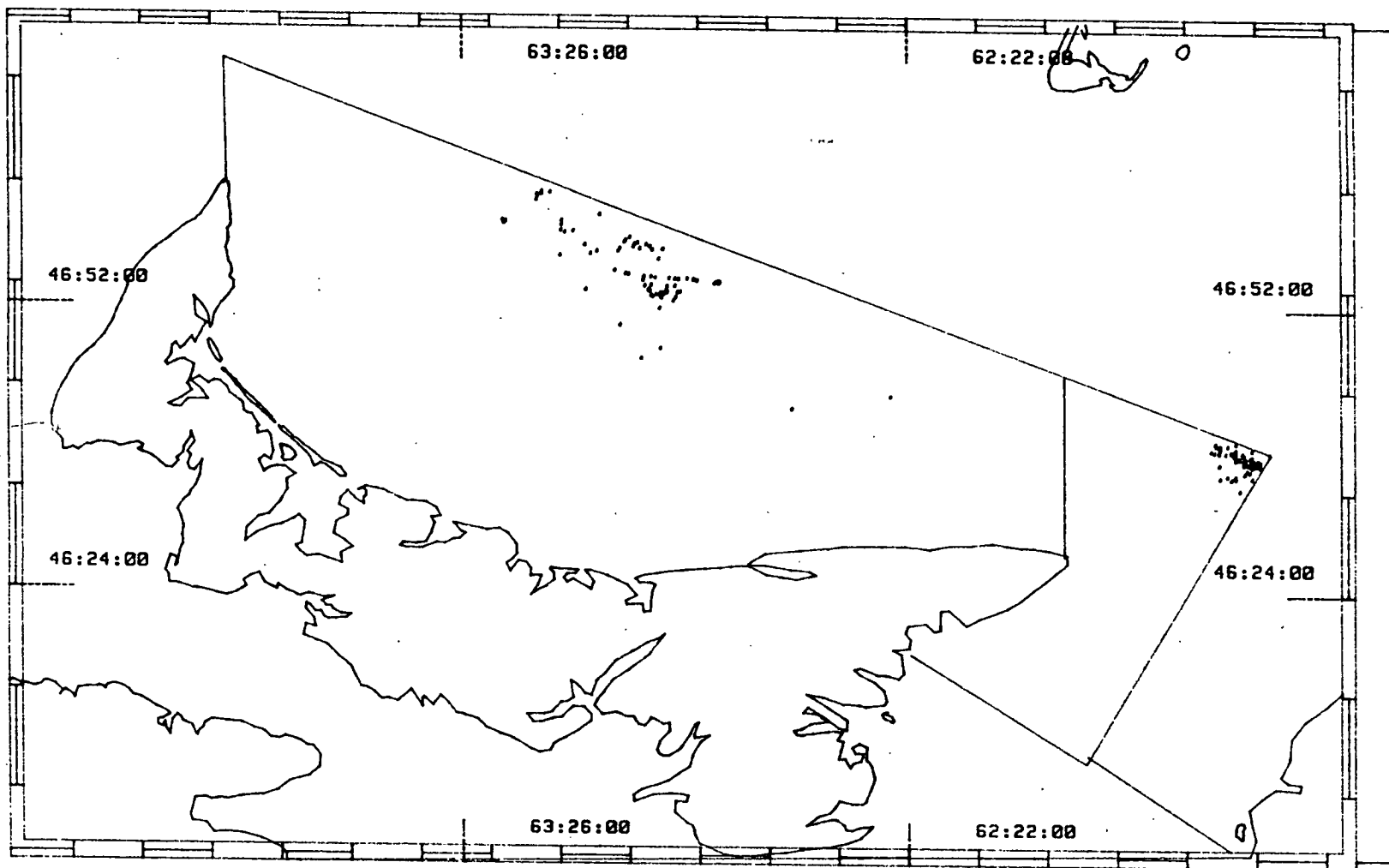


Figure 3. Overall distribution of fishing effort for the P.E.I. snow crab fishery for the 1990 season based on the logbook data. Each dot represents the location of at least one set of traps.

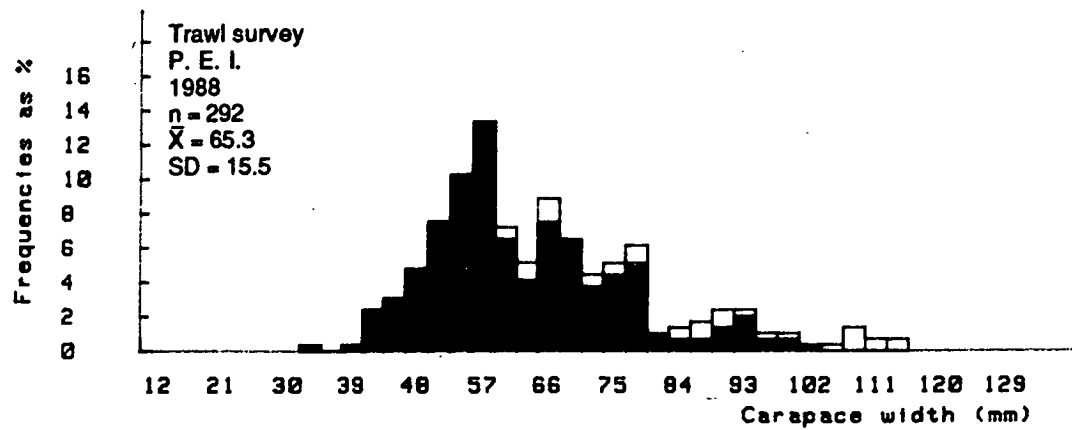
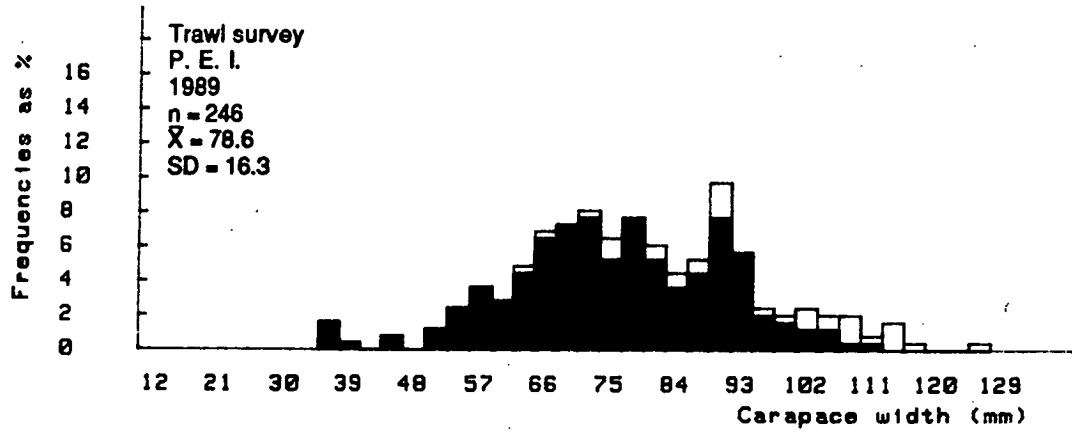
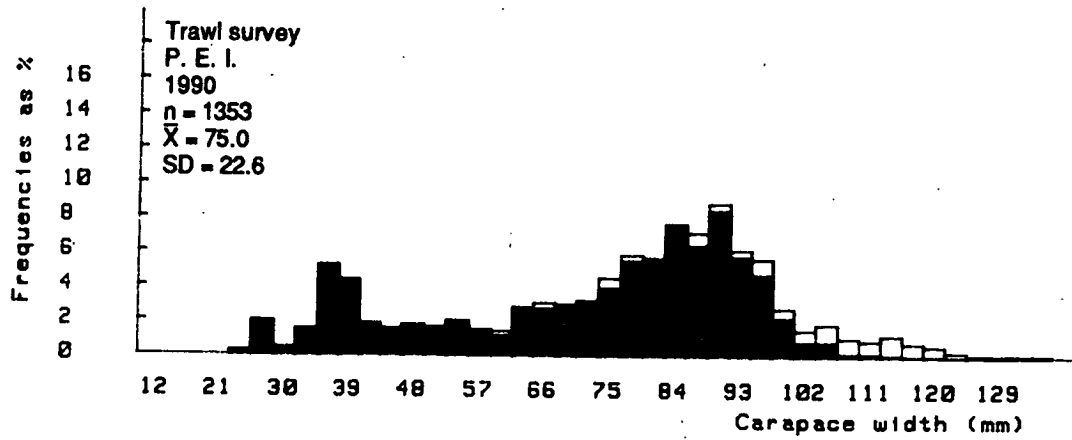


Figure 4. Overall size distribution of male snow crab, *Chionoecetes opilio*, collected during the trawl survey from 1988 to 1990 in the P.E.I. snow crab fishery.

Percentage of morphometrically immature in black, percentage of mature in white.

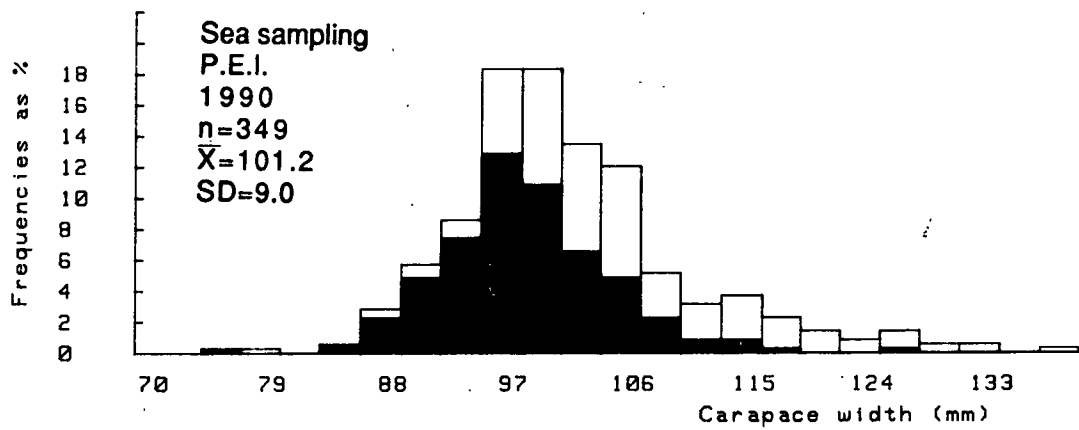


Figure 5. Overall size distribution of male snow crab, *Chionoecetes opilio*, present in the sea samples collected in the P.E.I. snow crab fishery in 1990.

Percentage of recently molted crab in black, percentage of total in white.

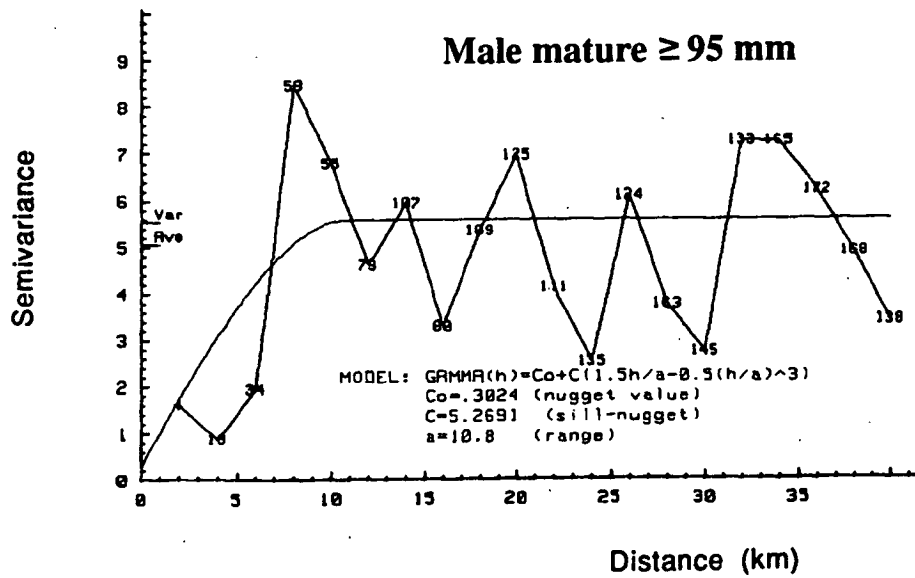
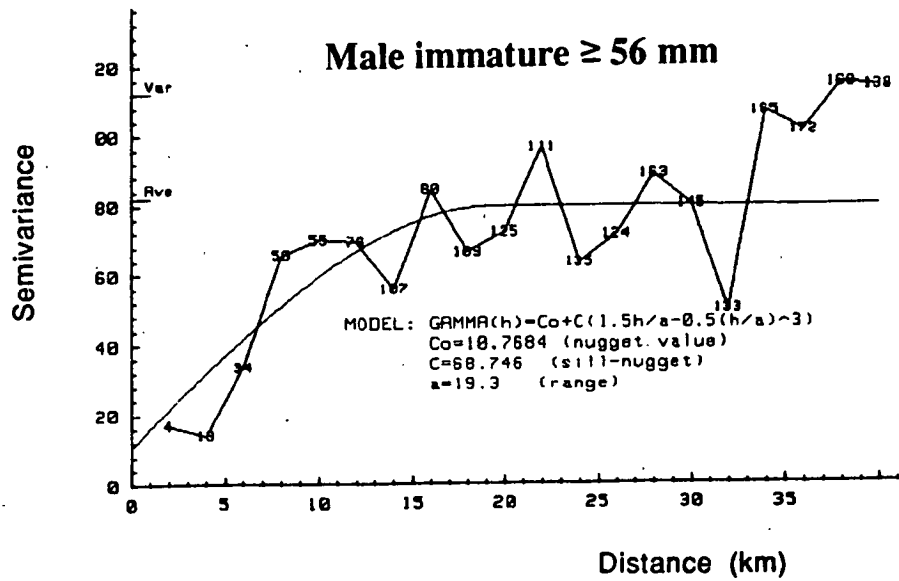


Figure 6. Variogram for morphometrically mature males  $\geq 95$  mm C.W. and immature male  $\geq 56$  mm C.W. used in the kriging calculations for the 1990 trawl survey.

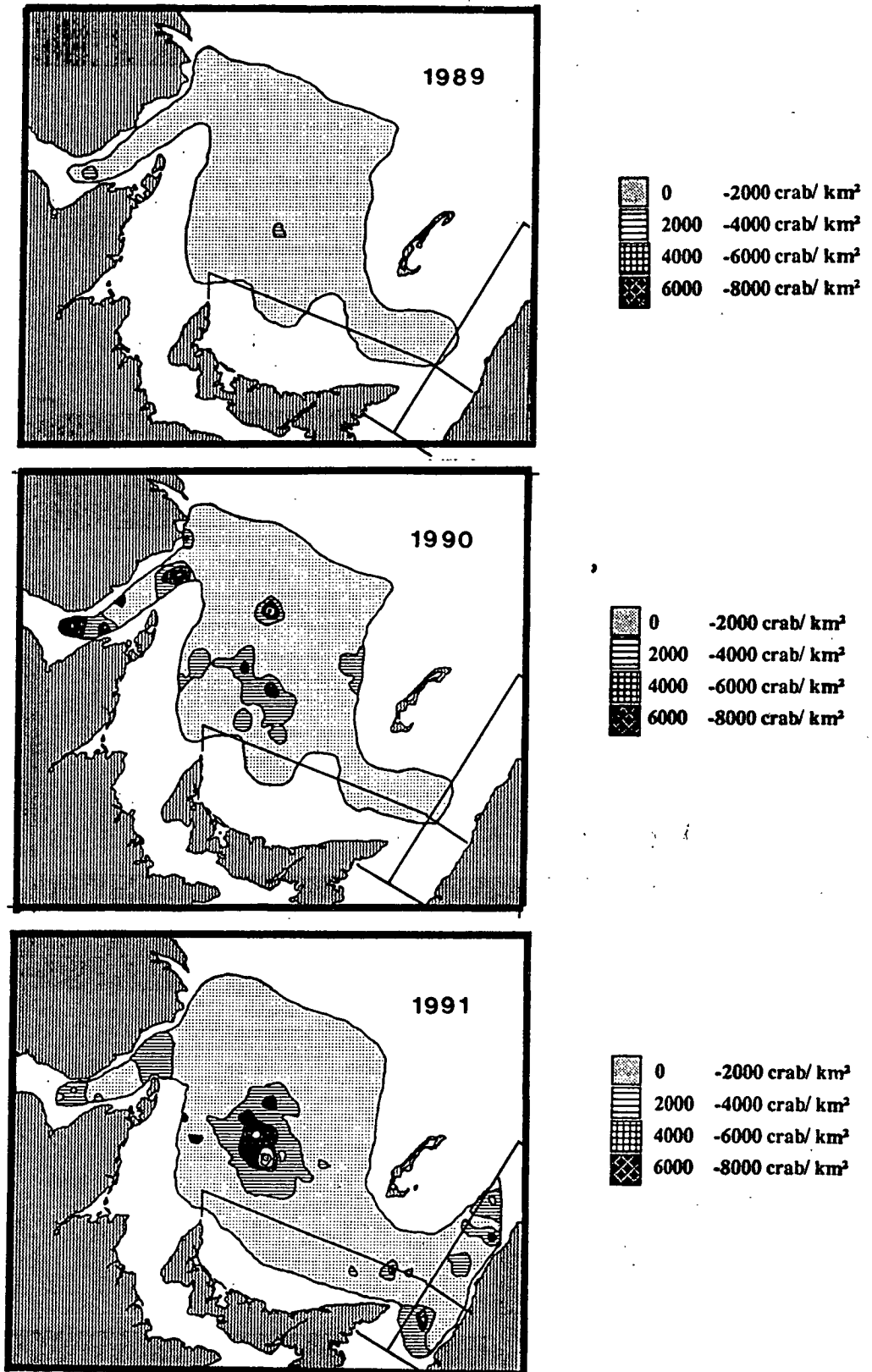


Figure 7. Density contours of mature male  $\geq 95$  mm for 1989, 1990 and 1991 based on trawl survey data from 1988, 1989 and 1990 respectively.

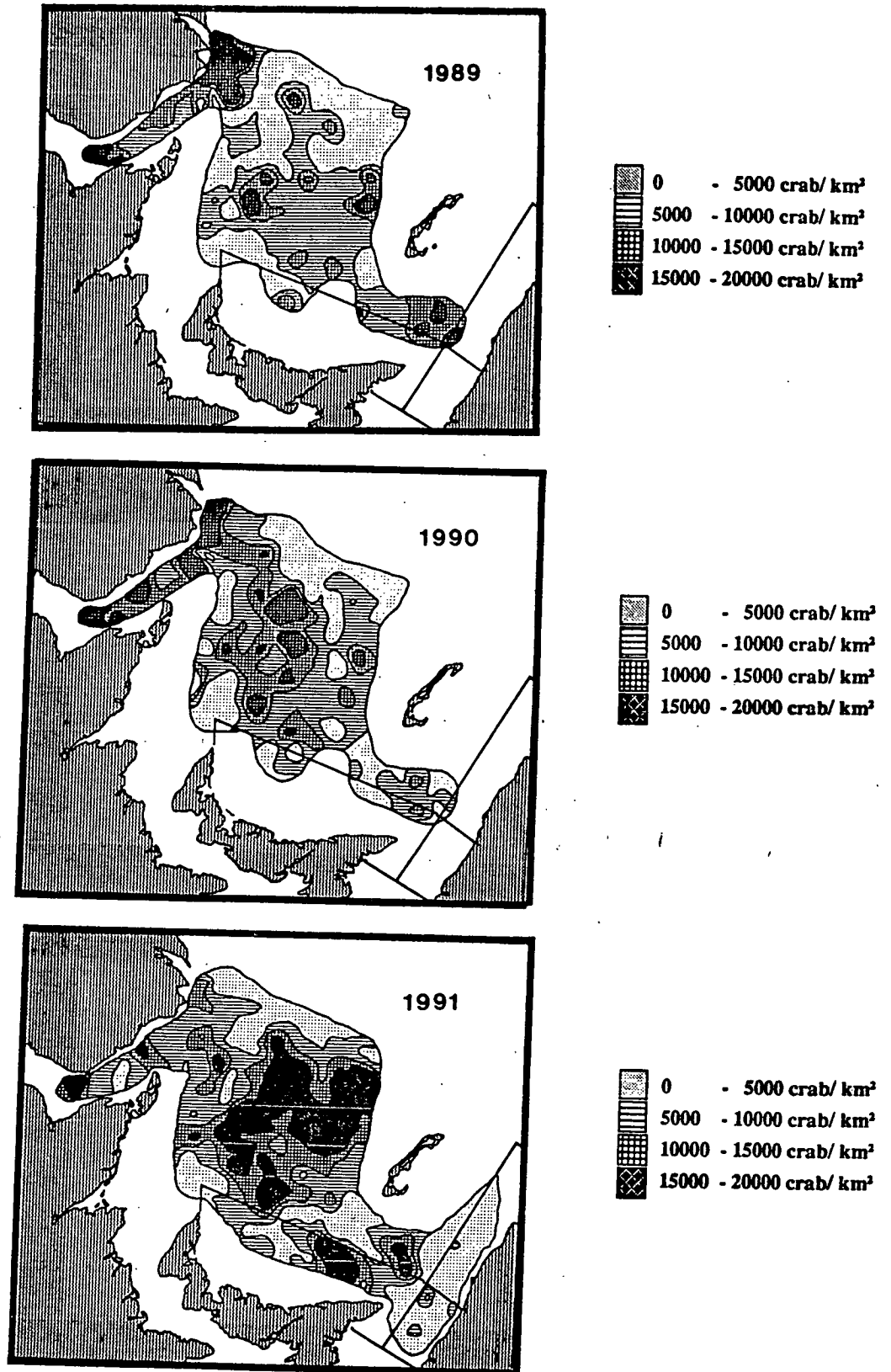


Figure 8. Density contours of immature male  $\geq 70$  mm for 1989, 1990 and 1991 based on trawl survey data from 1988, 1989 and 1990 respectively.