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Canadian Atlantic Fisheries  
Scientific Advisory Committee

CAFSAC Research Document 88/ 56

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Comité scientifique consultatif  
des pêches canadiennes dans  
l'Atlantique

CSCPCA Document de Recherche 88/ 56

**Prince Edward Island Snow Crab, Chionoecetes opilio  
fishery stock assessment - 1988 spring season**

by

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### ABSTRACT

An experimental snow crab fishery was established off northern Prince Edward Island (PEI) with the issuance of 16 exploratory permits in 1985 and 14 new permits in 1986. The 16 original permits were reissued as licenses in 1987. The fishery has been under no quota limitations.

During the 1988 spring season, pertinent biological characteristics were obtained through a sea sampling program. Catch, effort and distribution of fishing effort were obtained from fishermen's logbooks and processor's sales slips.

The distribution of fishing effort in 1988 reveals the presence of one fishing ground situated in the middle of Area 26. The fishing ground is delimited by the 30 fathoms contour and the zone boundaries.

Mean size of male crabs caught decreased from 111.8 mm carapace width (CW) in 1986 to 101.7 mm CW in 1987 and to 97.9 mm CW in 1988. The percentage of morphometrically immature males increased from 17.1% in 1986 to 50.9% in 1987 and slightly decreased to 45.1 % in 1988. The percentage of newly molted crabs showed a continuous increase from 17.3% in 1986 to 54.9% in 1987 and to 62.0% in 1988 for the spring season which indicates that this fishery depends more and more on the annual recruitment of commercial size crabs.

The mean CPUE for the spring season decreased from 47.9 Kg/trap haul in 1985 to 32.7 Kg/trap haul in 1986 and to 15.1 Kg/trap haul in 1987. It then increased to 26.5 Kg/trap haul in 1988. The catch increased from 288 t in the spring of 1987 to 437 t in 1988 and the total effort decreased 14% from 19,069 trap hauls in the spring of 1987 to 16,478 trap hauls in 1988.

The combined fall 1987 and spring 1988 data were not amenable to Leslie analysis. A Leslie analysis on the first 6 weeks in 1988 resulted in an estimated initial biomass ( $B_0$ ) of 580 t and an exploitation rate of 75.3%. The total catch for that period was 457 t.

The evidence indicates that in the spring of 1988, the abundance of commercial crab was higher than in the spring of 1987. However, the estimates indicate that the exploitation rate for the spring fishery in 1988 exceeded the 50-60% target level and a fall fishery in 1988 would result in a higher level of exploitation.

### RESUME

Une pêche expérimentale du crabe des neiges a été établie au nord de l'Ile-du-Prince-Edouard (I.-P.-E.) avec l'émission de 16 permits exploratoires en 1985 et 14 nouveaux permits en 1986. Les 16 permits originaux ont été ré-émis comme licences en 1987. Aucun contingent n'a été établi pour cette pêcherie.

Durant la saison de pêche du printemps 1988, des caractéristiques biologiques ont été obtenues grâce à un programme d'échantillonnage intensif. La prise, l'effort et la distribution d'effort de pêche ont été obtenus à partir des carnets de bord des pêcheurs.

La distribution d'effort de pêche en 1988 indique la présence d'une concentration de pêche située au centre de la zone 26. Cette concentration de pêche est délimitée par l'isobathe de 30 brasses et la limite de la zone de pêche de l'I.-P.-E.

La taille moyenne des crabes mâles dans la prise a diminué de 111,8 mm de largeur de carapace (LC) en 1986 à 101,7 mm LC en 1987 et à 97,9 mm LC en 1988. Le pourcentage de mâles morphométriquement immatures a augmenté de 17,1% en 1986 à 50,9% en 1987 et diminué à 45,1% en 1988. Le pourcentage de crabes récemment mués a augmenté continuellement de 17,3% en 1986 à 54,9% en 1987 et à 62,0% en 1988 pour les saisons de printemps; ce qui indique que la pêcherie dépend de plus en plus sur le recrutement annuel de crabe atteignant la taille commerciale.

La prise par unité d'effort (PUE) pour la saison de printemps a diminué de 47,9 Kg/casier levé à 32,7 Kg/casier levé en 1986 et à 15,1 Kg/casier levé en 1987. En 1988, la PUE a ensuite augmenté à 26,5 Kg/casier levé. La prise a augmenté de 288 t au printemps de 1987 à 437 t en 1988 et l'effort total a diminué de 14% (19 069 casiers levés en 1987 et 16 476 casiers levés en 1988).

Il n'a pas été possible d'utiliser l'analyse de Leslie en combinant les données de l'automne 1987 avec celles du printemps 1988. Une biomasse initiale ( $B_0$ ) de 580 t a été estimée en utilisant l'analyse de Leslie sur les 6 premières semaines de 1988; ce qui donne un taux d'exploitation de 75,3%. La prise totale pour cette période était de 457 t.

Les évidences indiquent qu'au printemps 1988, l'abondance de crabe commercial était plus élevée qu'au printemps 1987. Toutefois, les estimés indiquent que le taux d'exploitation pour la pêcherie de printemps 1988 a excédé le taux cible de 50-60% et qu'une saison d'automne 1988 resulterait en un taux d'exploitation plus élevé.

## INTRODUCTION

An experimental snow crab fishery was initiated off the coast of Prince Edward Island (PEI) in 1985 and is composed of management Areas 25 and 26 (Fig. 1). The number of experimental permits were increased from 14 in 1985 to 30 in 1986 (Comeau and Davidson, 1987). The initial 14 experimental permits were issued as licenses for the 1987 snow crab fishing season. The fishermen are allowed to fish 30 traps, which are mainly 6' x 6' standard square traps.

The PEI snow crab fishery was under no quota limitations and was officially opened April 1st and closed November 30th from 1985 to 1987 fishing season. In 1988, the fall fishing season was closed and the duration of a fishing season was determined by coinciding with that observed by midshore southwest Gulf fishery, which was between April 28th and July 5th.

Fishing effort increased in 1986 compared to 1985 (38,003 trap hauls vs 15,190 trap hauls respectively) resulting in a 54.6% increase in total catch (1,239 t in 1986 vs 801.7 t in 1985). In 1987, total catch drastically dropped to 457 t (26,395 trap hauls). In 1988, the total catch in the spring season was 437 t (14,904 trap hauls) and the mean CPUE is almost doubled compared to 1987 level.

	Spring total trap haul (#weeks)	Spring CPUE (Kg/trap haul)	Spring Total Catch (t)	Fall Total Catch (t)
1985	14,044 (13)	47.9	672.6	129.1
1986	30,827 (13)	32.7	1007.7	231.3
1987	19,066 (11)	15.1	287.9	168.7
1988	16,478 (10)	26.5	436.7	-

The DFO News Release (NR-HQ-88-022E) mentioned that if there is evidence in the spring fishery that harvests and catch rates have changed for the better, this decision (reduction of the fishing effort by closing the fall fishery) can be reconsidered. Consequently, a detailed analysis of the 1988 spring fishery is required to examine the stock condition of the 1988 PEI snow crab fishery and to provide biological advice whether the fall fishery can be opened.

## MATERIALS AND METHODS

### SEA SAMPLING

A sea sampling program for the 1988 fishing season was carried out by two contracted observers. Location of capture, size in mm (carapace width and chela height), sex and shell condition (soft, new, medium and old) was noted for all crabs sampled. Chela height was measured for males to determine morphometric maturity using the method described by Conan and Comeau (1986).

Sea samples were obtained from Areas 25 and 26 (Fig. 1) during weeks 2, 3, 4, 6, 7 and 8 (starting on May 10th). Weekly percentages of undersized males, immature males, soft shelled crabs and mean carapace size were calculated and plotted. Monthly and seasonal size distributions and statistics were generated for the males.

### LOGBOOK DATA

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

- a) Canadian Fisheries vessel number (CFV)
- b) date fished
- c) date landed
- d) fishing position (Loran C or latitude/longitude)
- e) number of traps hauled
- f) catch estimated in pound by the fishermen

From these data, catch (converted to kg) and CPUE (daily catch/number of trap hauls per day) were calculated and summarized into weekly intervals. The weekly data summaries were used in Leslie Analysis (Ricker, 1975). The geographical fishing positions were plotted to identify the major fishing effort concentrations (Fig. 3). Only logbook received by the DFO/EDPS Branch by July 25th 1988 has been analyzed.

## RESULTS AND DISCUSSION

### LOGBOOK DATA

As of July 25th 1988, we received logbooks from 22 of the 30 fishermen, 3 of them sent only 1 to 5 logbooks. From the remaining 19 fishermen, 4 of them did not send any logbooks after May 30th. Logbook records for the last two fishing weeks (June 26th to July 5th) were not available for analysis (as of July 25th). Logbook records usable for CPUE calculations for the 1988 spring fishery accounted for 64% (279.4 t) of the total catch. Another 12% (54.5 t) of the catch reported by logbooks were not usable for CPUE calculation due to unreported number of trap haul.

### CATCH PER UNIT OF EFFORT

The CPUE fluctuated from 24.4 kg per trap haul to 54.1 kg per trap haul between the 1st and 8th week (from May 1st to June 25th, Table 1). Due to a small fishing effort in Area 25, the data was not separated into two zones for the 1988 analysis. A relatively high CPUE (54.1 kg per trap haul) was observed during the 1st week. During that week, a high fishing performance (up to 155 kg per trap haul) has been reported by one fisherman who fished in one grid in Area 26 (Fig. 2). It was not possible to verify whether these records are erroneous. Logbook data from this fisherman showed often doubtful effort value. Therefore, the logbook data from this fisherman were eliminated for CPUE calculation. The CPUE for the first week was estimated at 43.6 kg per trap haul. The mean CPUE then gradually decreased to 22.1 kg per trap haul in the 4th week. It then increased to 25.9 kg per trap haul and dropped again to 20.4 kg per trap haul. A slight increase was observed in the 7th and 8th week (24.5 kg per trap haul and 29.3 kg per trap haul respectively). The mean CPUE for the 8 fishing weeks was 26.5 kg per trap haul. The mean CPUE increased by 75% compared to the 1987 spring fishing season (from 15.1 kg per trap haul in 1987 to 26.5 kg per trap haul in 1988).

### FISHING EFFORT AND CPUE DISTRIBUTION

The distribution of fishing effort (Fig. 3) shows one main fishing ground concentrated in the middle of Area 26 and is delimited by the 30 fathom contour. Only four of 583 records were reported in Area 25. However, more fishermen have fished in this zone according to the sea sampler's information. This fishing concentration pattern is almost identical each year.

High CPUE's (higher than 50 kg per trap haul) were recorded in the grids near the PEI fishery border line in Area 26 (Fig. 2). In Area 25, logbook records showed fishing activity only in the first three fishing weeks with relatively low CPUE's (11 kg to 29 kg per trap haul).

The mean CPUE observed from the PEI fleet in Area 26 (29.28 kg per trap haul) and CPUE from the NB fleet outside but near the PEI fishery border (22.37 kg per trap haul) were compared and a significant difference in CPUE's was found ( $P \leq 0.05$ ).

#### BIOMASS ESTIMATES

In order to estimate the initial biomass ( $B_0$ ), two types of data set of catch and effort information were used: (1) Fall 87 data combined with spring 88 data and (2) spring 88 data.

#### Combined Fall 87 and Spring 88 Catch and Effort Data

Comeau and Davidson (1987) indicated that the annual recruitment to the fishery corresponds most likely to the increased incidence of white crabs in the catch. That incidence of white crabs forced a mid-season closure for the PEI fishery each year (Davidson *et al.*, 1986; Comeau and Davidson, 1987), which resulted in a spring fishery and a fall fishery. Comeau *et al.* (1988) estimated the  $B_0$  by adding the parameters of the fall fishery for a given year to the parameters of the spring fishery of the following year. The  $B_0$  and exploitation rate (E.R.) estimated by this method for 1987 season were 689 mt (558 - 980 t) and 75.4% respectively. This approach was also used this year by combining the data from October 4th 1987 to June 25th 1988 (Table 2). The Leslie Analysis was not amenable with those raw data ( $r = -0.08$ ).

According to the sea sampling data in the 1988 spring season, more than 50% of the catch consisted of newly molted crabs and during the first two weeks in the 1987 fall season, fishermen searched for good fishing grounds by avoiding to catch white crabs. Although the Leslie Analysis was attempted on the data by eliminating the CPUE's for the first two weeks of the 1987 fall season and the last two weeks of the 1988 spring season, the result was not significant ( $r = -0.49$ ).

#### Spring 88 Catch and Effort Data

By using catch and effort data of the spring from the 1st to 6th week (Table 2), the results of the Leslie Analysis (Fig. 4) and their corresponding estimate of  $B_0$  and E.R. assuming a total catch ( $T_c$ ) of 436,676 kg are as follows:

$$\begin{aligned} \text{CPUE} &= 39.41 - 0.068 K_t \\ r &= -0.89 \\ B_0 &= 580 \text{ (398 t - 1614 t)} \\ \text{E.R.} &= T_c/B_0 = 75.5\% \end{aligned}$$

#### SIZE FREQUENCY DISTRIBUTIONS AND BIOLOGICAL INFORMATION

The overall size frequency distribution for the 1988 spring season (Fig. 5) shows an average size of 97.9 mm C.W.. A continuous decrease in the mean size in the spring season was observed since 1986 (111.8 mm in 1986, 101.7 mm in 1987). The mode observed at 114-116 mm C.W. for the 1986 season is observed neither in the 1987 nor 1988 season, probably these size classes have been swept out. Consequently, the size distribution is skewed to the

right in the 1987 season compared to that in the 1986 season, and in 1988 the sizes are relatively symmetrically distributed showing a mode at 96-98 mm C.W.. This phenomenon may be a sign of a heavily exploited stock (Fig. 5).

For the spring season, the percentage of morphometrically immature crab (Table 3) increased from 17.1% in 1986 to 50.9% in 1987 and slightly decreased to 45.1% in 1988. For the fall season, the percentage of immature crab increased from 17.6% in 1986 to 57.3% in 1987, which may be a positive sign for future recruitment into the fishery. According to Moriyasu et al. (1987), the growth rate at molt for terminal molt is smaller than for normal molt. By using the minimum growth rate which is for terminal molt ( $L_{t+1} = 10.6522 + 1.0443 L_t$ , Moriyasu et al., 1987), the crabs larger than 81 mm C.W. (43.0% of the undersized crabs sampled) can grow to commercial size after the ecdysis.

The percentage of crabs with soft carapace (molted just before or during the fishing season; Table 3) continuously increased from 6.9% in 1986, 11.1% in 1987 to 25.0% in 1988 for the spring season and from 0% in 1986 to 16.0% in 1987 for the fall season. The increase in CPUE during the last two fishing weeks can be explained by the recruitment of newly molted crabs in the fishery (the percentages of white crabs in the catch are 62.0% in the 7th week and 51.1% in the 8th week).

The same phenomenon was observed for the percentage of newly molted crabs (molted during the previous year) showing a continuous increase from 17.3% in 1986, 54.9% in 1987 to 62.0% in 1988 for the spring season and from 34.1% in 1986 to 81.2% in 1987 for the fall season.

A high percentage of newly molted crabs in the catch in the 1987 and 1988 seasons and the incidence of large number of morphometrically immature in the catch may indicate a positive sign for strong recruitment into the fishery in the coming seasons. The PEI snow crab fishery depends more and more on the yearly recruitment to the fishery i.e. newly molted crabs (molted a year before or during the same year). A considerable decrease in large morphometrically mature males with old carapace may indicate a decrease in the reproductive potential of the stock. Moriyasu and Conan (1988) observed that neither newly molted immature nor newly molted mature males can successfully mate with females. Furthermore, a decrease in the mean carapace size for three consecutive years may indicate a highly exploited stock condition.

Although, 64% of total logbook records submitted to the DFO were usable for CPUE calculation, reliability of the effort data is uncertain. A better participation of fishermen in providing an accurate information on fishing effort, catch and positions will be recommended. An increase in effort of Protection Branch observers to verify the number of traps used and of sea samplers to obtain detailed biological information will also be recommended.

Concerning the eastern end of Area 25 which seems to have a similar bottom type to the Cape Breton fishery where the fishing season is opened in the fall, we have no basis to assess the feasibility of the opening of the fall fishery because of very low fishing activity based on logbook data.

Although the decrease in total fishing effort (trap hauls) of 14% compared to the 1987 season might compensate certain CPUE increase in the 1988 spring season, it seems that the biomass of snow crab in the Prince Edward Island fishery increased for the current season based on total catch and CPUE's. However, the estimated exploitation rate for 1987 and 1988 (75.4% and 75.5% respectively) largely exceeded the target 40-50% level. A disappearance of old large males from the fishery and a continuous decrease in the mean carapace size for three consecutive seasons also indicates a depressed stock condition. A closure of the 1988 fall fishery would allow newly molted male crabs to participate at least once in reproduction before being captured, and allow fishermen to gain maximum benefit (high meat yield) from the pulse of recruitment of molters to the 1989 spring fishery.

#### ACKNOWLEDGEMENTS

The authors wish to thank Dr. G. Hare and M. Comeau (DFO/Science, Gulf Region) for critical review of the manuscript, P. Mallet and P. Degrâce (DFO/Science, Gulf Region) for their assistance with data analysis and D. Aubé (DFO/Science, Gulf Region) for preparation of the manuscript.



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Table 1. Weekly catch per unit effort (CPUE: catch in kg/number of trap haul) for the Prince Edward Island snow crab fishery in the 1985, 1986, 1987 and 1988 fishing seasons.

	1985 <sup>1</sup>	1986 <sup>2</sup>		1987 <sup>3</sup>	1988 <sup>4</sup>
WEEK	Combined	Zone 1 <sup>5</sup>	Zone 2 <sup>5</sup>	Combined	Combined
1	21.9	15.0	-	12.1	54.1
2	48.6	33.0	-	18.6	33.7
3	52.6	32.3	11.5	19.4	27.0
4	42.9	40.7	16.8	13.3	24.4
5	51.7	47.9	12.6	15.9	26.7
6	56.3	32.9	6.8	18.8	25.2
7	64.4	38.1	6.1	16.8	32.7
8	60.0	30.6	16.2	13.2	36.5
9	41.0	40.0	27.7	7.6	
10	45.1	40.7	38.8	9.0	
11	31.4	26.8	41.4	8.6	
12	36.7	13.5	36.6	-	
13	31.2	17.7	41.4	-	

1 - week 1 corresponds to April 14th to April 20th.

2 - the season officially opened April 1st and closed November 30th. The fishermen fished from April 13th (week 1) to November 8th).

3 - the season was officially opened April 1st and closed November 30th. The fishermen fished from May 14th (week 1) to November 14th.

4 - week 1 corresponds to May 1st to May 7th.

5 - see CAFSAC Research Document 87/51 for definition of zones 1 and 2.

Table 2. Weekly effort and catch data for the fall 1987 and spring 1988 Prince Edward Island snow crab, Chionoecetes opilio, fishery (Areas 25 and 26).

Week		Total Catch* <sup>1</sup> Ct (Kg)	Ct/2 (Kg)	# Trap hauls	CPUE* <sup>2</sup> (Kg/trap haul)		
		1	May 10-16	1805	902	180	8.5
		2	May 17-23	32117	16059	1245	17.2
		3	May 24-30	46705	23353	1245	18.9
	S	4	May 31-June 6	30777	15389	1380	13.1
1	P	5	June 7-13	29950	14975	1165	15.9
9	R	6	June 14-20	34960	17480	910	18.9
8	I	7	June 21-27	40464	20232	1095	15.9
7	N	8	June 28-July 4	31990	15995	650	12.9
	G	9	July 5-11	21622	10811	534	7.2
		10	July 12-18	10668	5334	285	8.7
		11	July 19-25	<u>6886</u>	<u>3443</u>	<u>199</u>	<u>8.6</u>
TOTAL		287944		8888	15.1		
		22	Oct 4-10	9442	4721	129	17.6
1	F	23	Oct 11-17	40682	20341	834	22.8
9	A	24	Oct 18-24	52713	26356	615	38.6
8	L	25	Oct 25-31	27360	13680	390	26.8
7	L	26	Nov 1-7	16573	8287	140	34.4
		27	Nov 8-14	<u>21924</u>	<u>10962</u>	<u>148</u>	<u>27.1</u>
TOTAL		168694		2256	28.5		
		1	May 1-7	22272	11136	321	54.1 (43.6)
		2	May 8-14	82570	41285	2141	33.7 (31.9)
	S	3	May 15-21	79215	39607	2193	27.0 (25.7)
1	P	4	May 22-28	59147	29574	1898	24.4 (22.1)
9	R	5	May 29-June 4	30898	15449	876	26.7 (25.9)
8	I	6	June 5-11	37335	18668	960	25.2 (20.4)
8	N	7	June 12-18	45687	22844	750	32.7 (24.5)
	G	8	June 19-25	47572	23786	335	36.5 (29.3)
		9	June 26-July 2	23368	13184	-	-
		10	July 3-5	<u>8612</u>	<u>4306</u>	<u>-</u>	<u>-</u>
TOTAL		436676		9474	29.3 (26.5)* <sup>3</sup>		

\*<sup>1</sup> Calculated using catch and effort data from logbooks

\*<sup>2</sup> Total weekly catch reported for each week as compiled by DFO/EDPS Branch

\*<sup>3</sup> Suspected erroneous data from one fisherman eliminated

Table 3. Weekly biological characteristics of snow crab present in the sea samples during the Prince Edward Island snow crab fishery in 1986, 1987 and 1988 fishing seasons.

WEEK	Mean size (mm)				% Imm.				% 95 mm ≥ C.W.				% white (% Newly molted *1 excluding white)			
	86	87	88		86	87	88		86	87	88		86	87	88	
1	--	--	--		--	--	--		--	--	--		--	--	--	
2	107.5	--	102.5		--	--	34		--	--	17		--	--	2	(98)
3	--	--	96.3		8	--	56		16	--	39		--	--	17	(65)
4	105.6	95.7			16	33	43		14	22	46		--	10	26	(51)
5	112.3	101.4	--		10	58	--		16	36	--		3	13	--	
6	100.7	95.2			--	56	48		--	37	49		--	19	13	(70)
7	97.2	99.5			15	38	53		6	53	34		13	2	62	(29)
8	--	--	100.1		--	--	40		--	--	27		--	--	51	(38)
9	114.0	100.5			7	47			9	38			0	3		
10	102.9				11	54			6	27			79	12		
11	--	--			7	--			3	--			76	--		
													(17.3)*2	(54.9)*2		

\*1 : Newly molted crabs : molted during 1987

\*2 : Mean percentage for the season

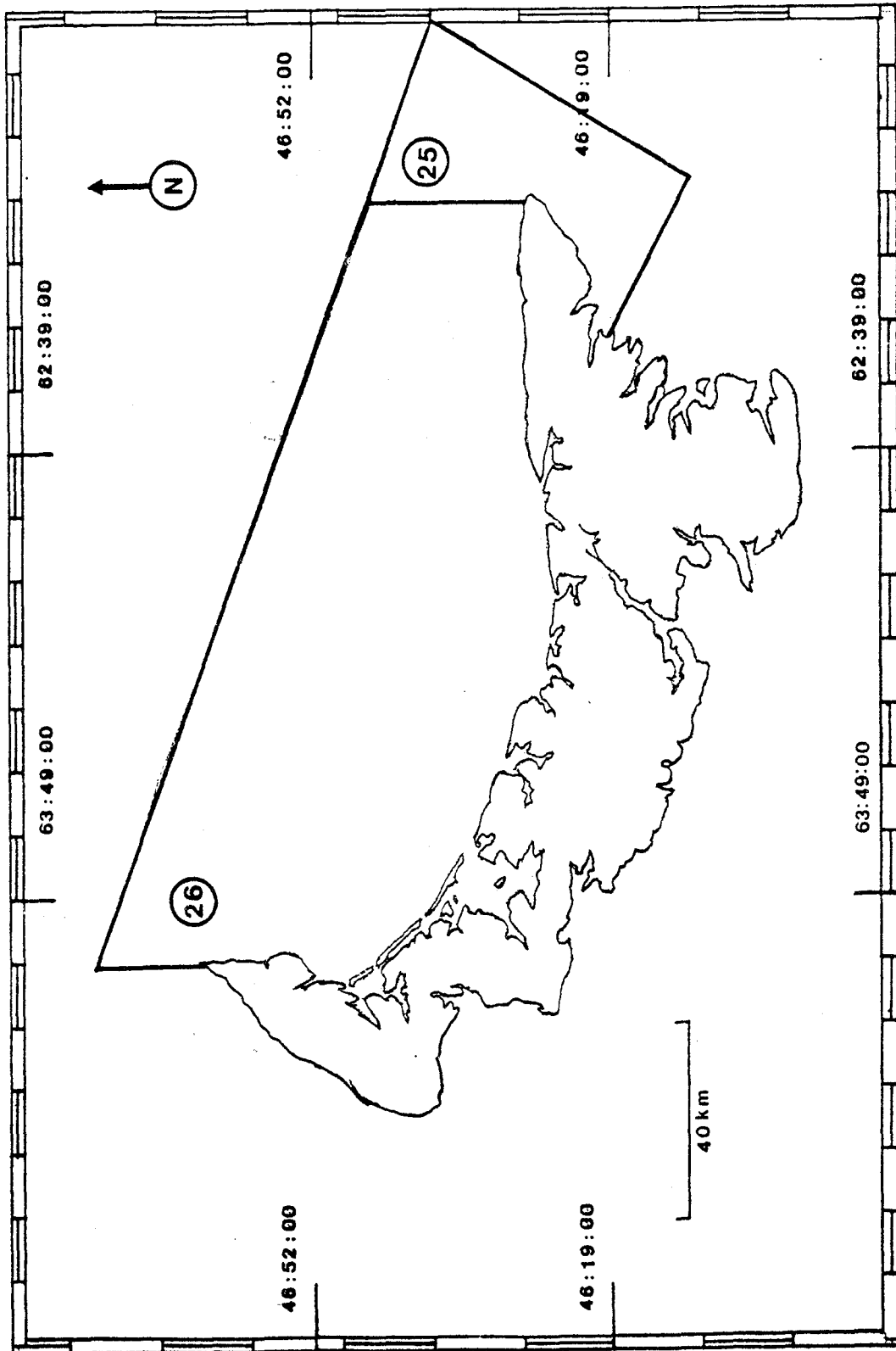


Figure 1: Prince Edward Island fishing areas 25 and 26.

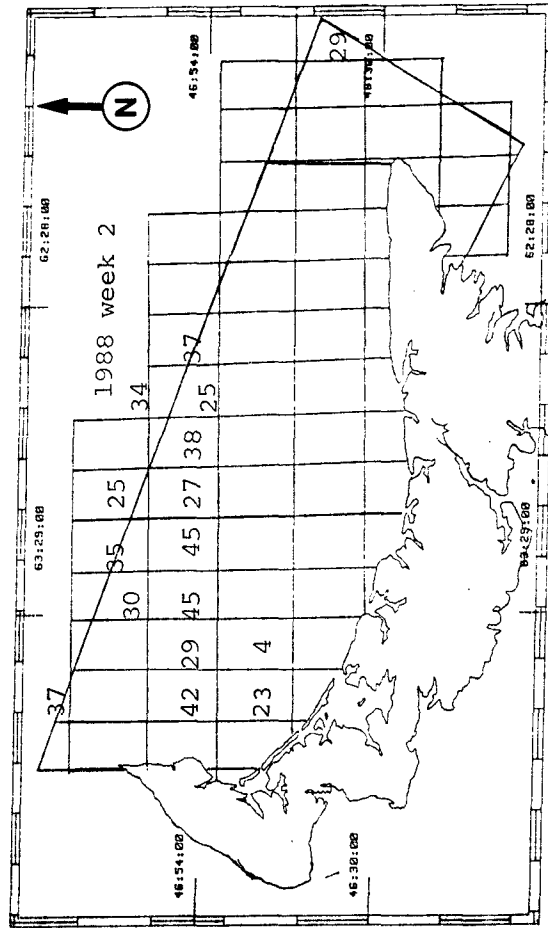
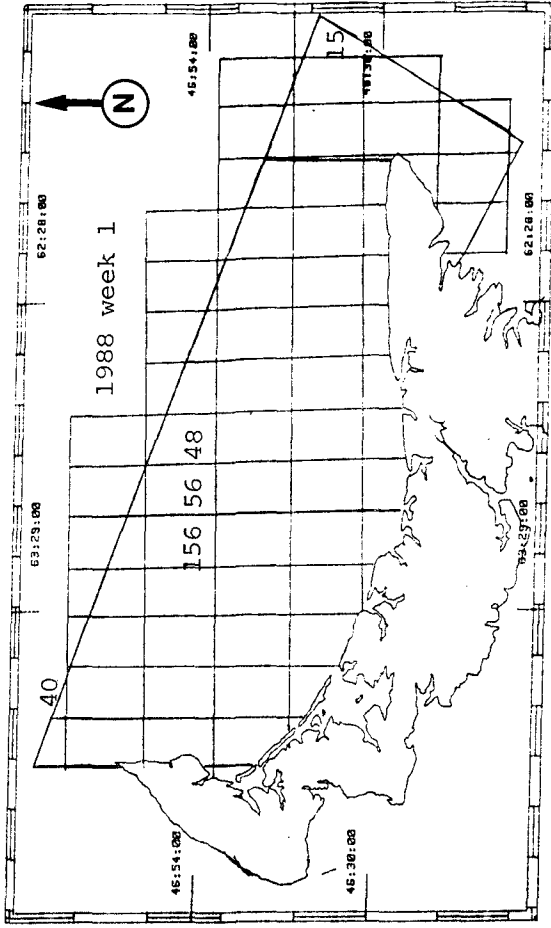
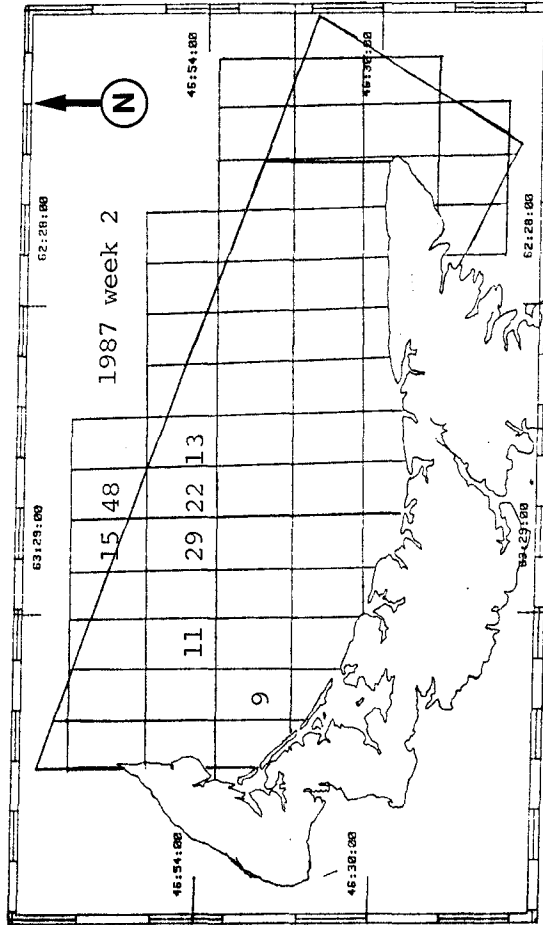
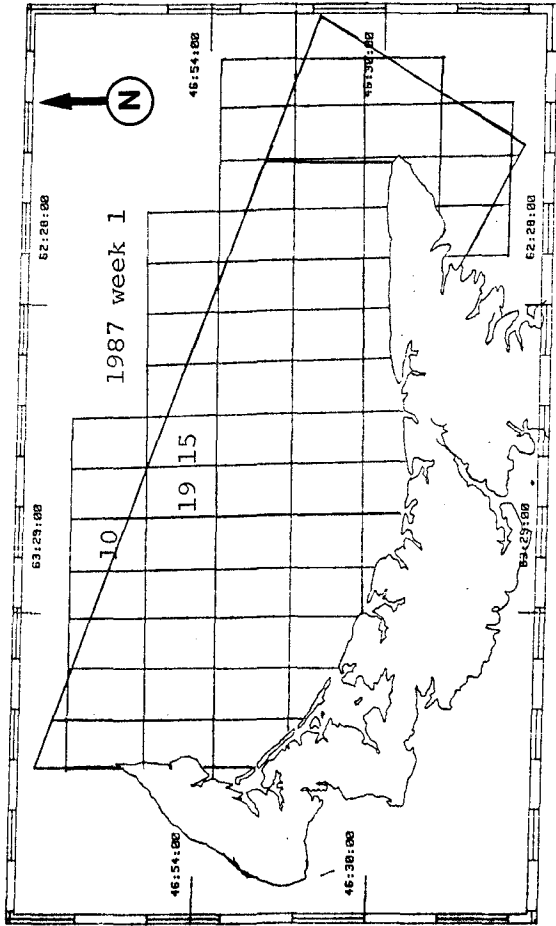


Figure 2. Weekly distributions of catch per unit effort for the Prince Edward Island snow crab fishery based on the logbook data for 1987 and 1988 ( first 8 weeks )

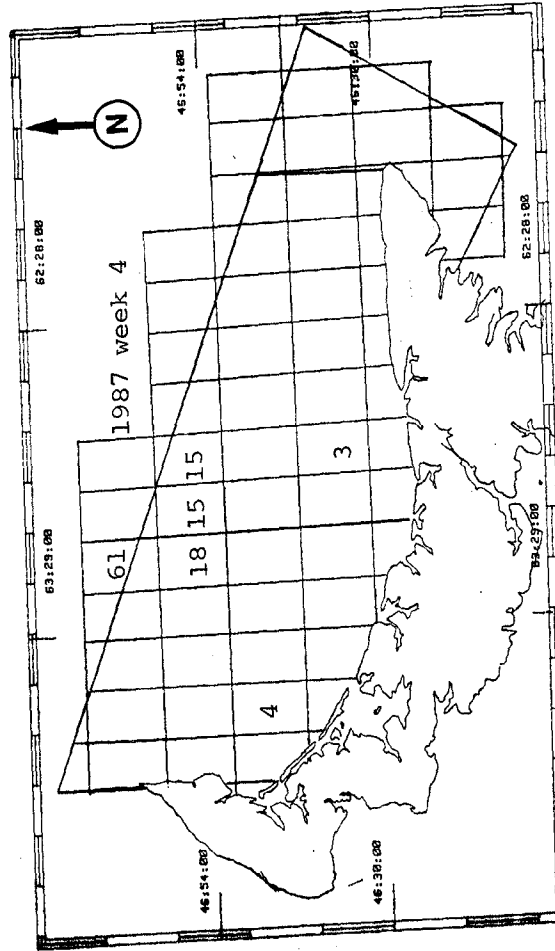
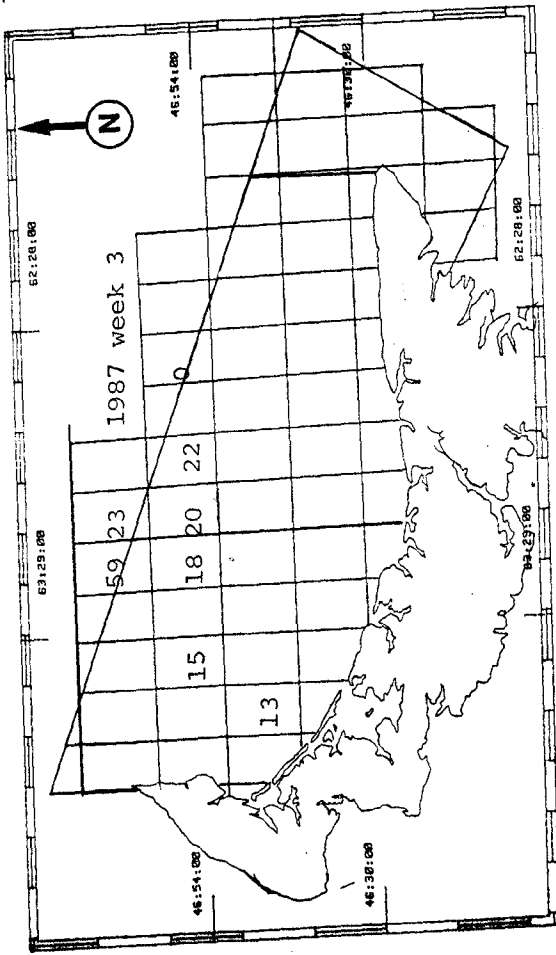
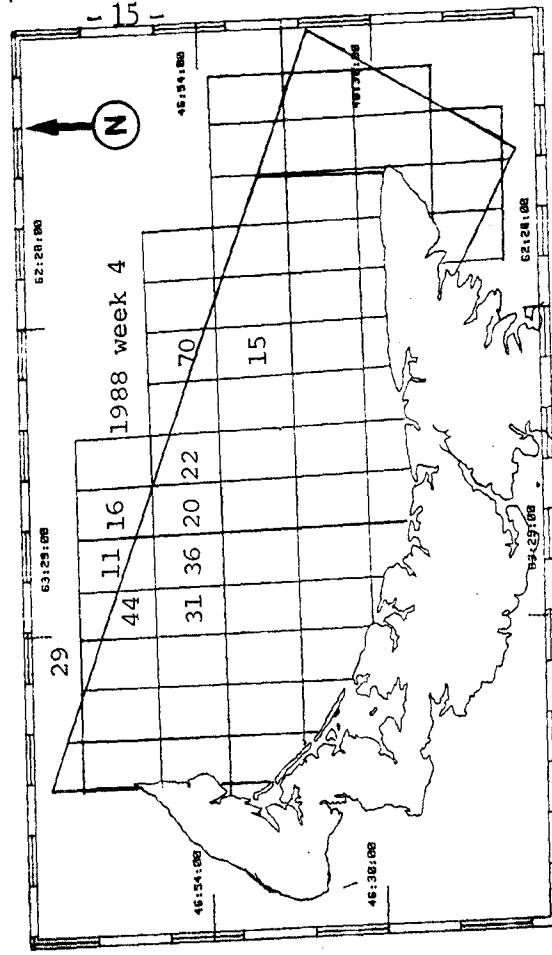
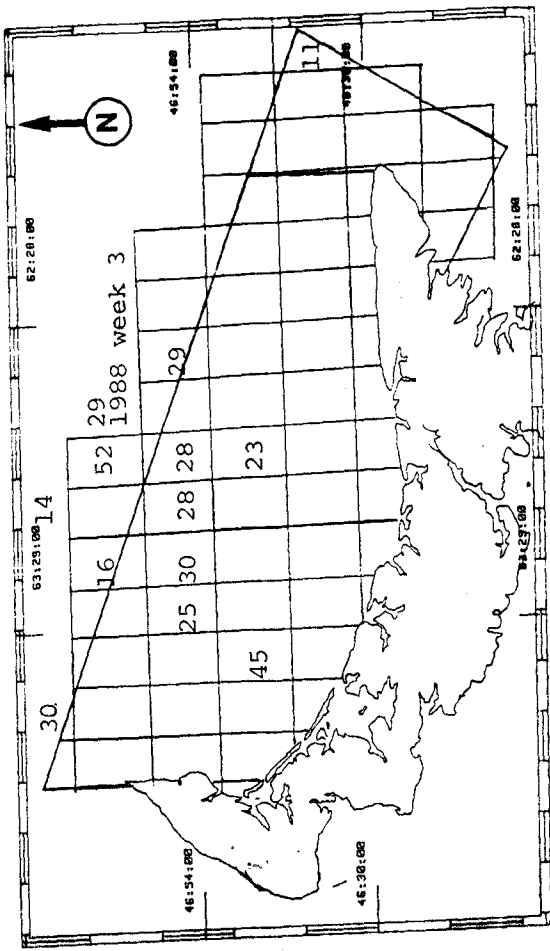


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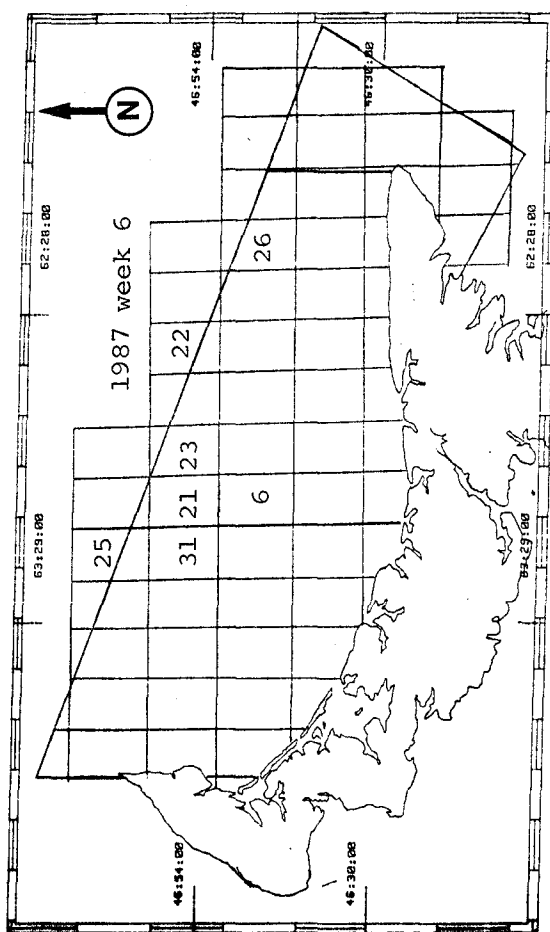
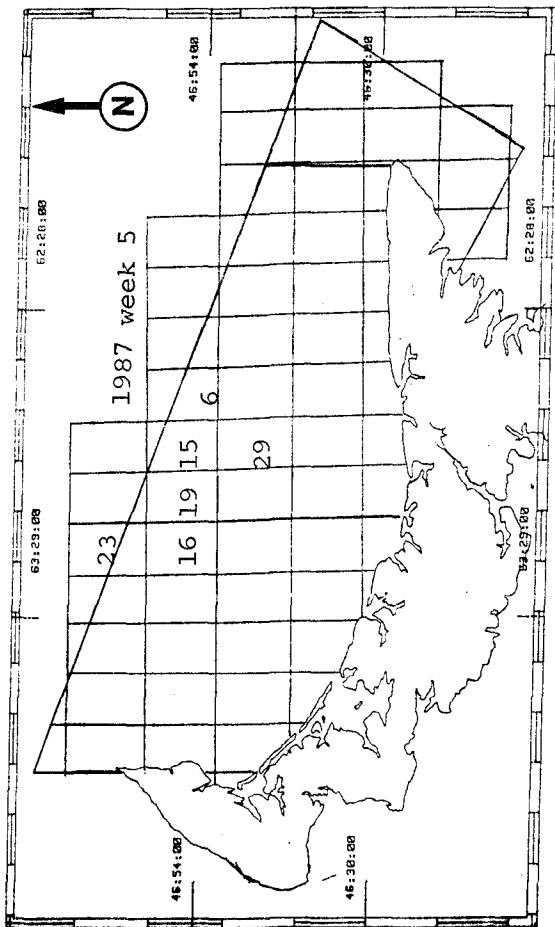
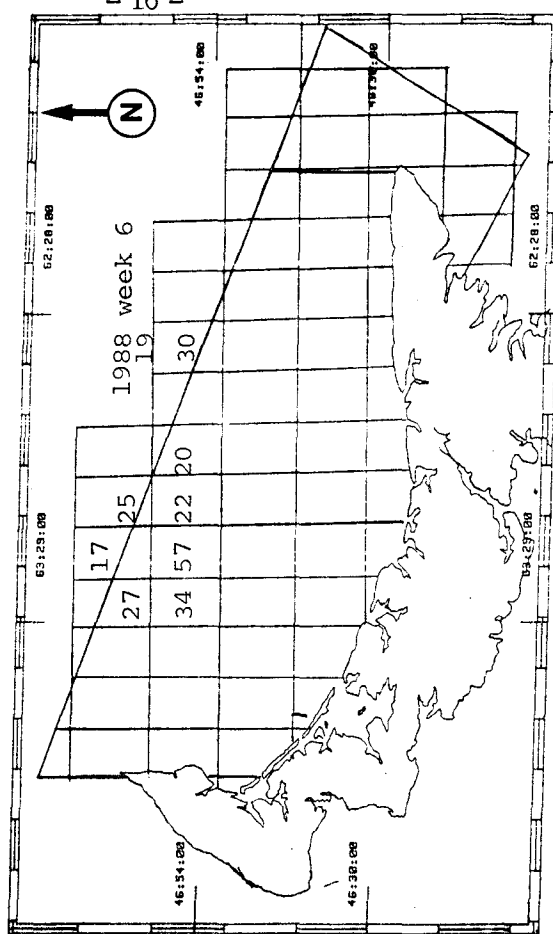
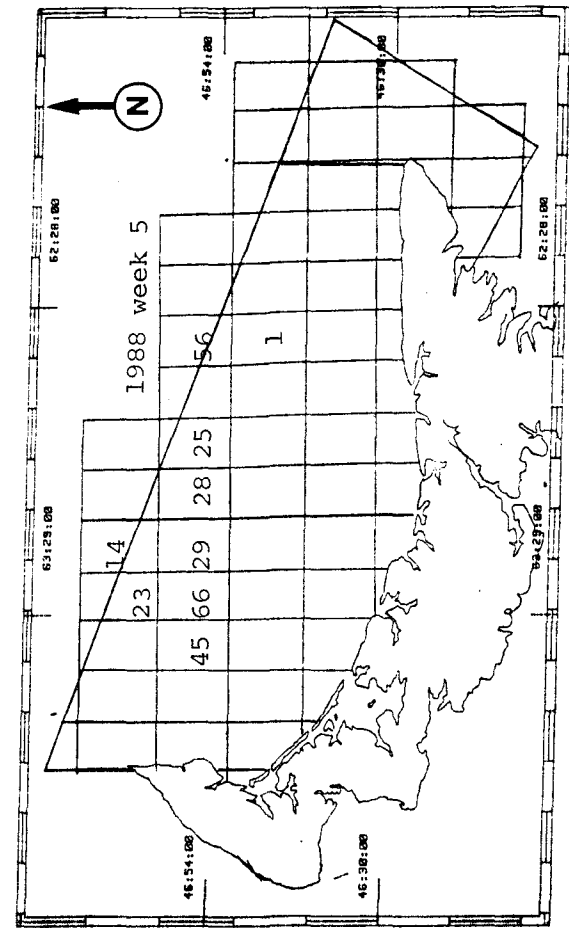


Figure 2 cont.



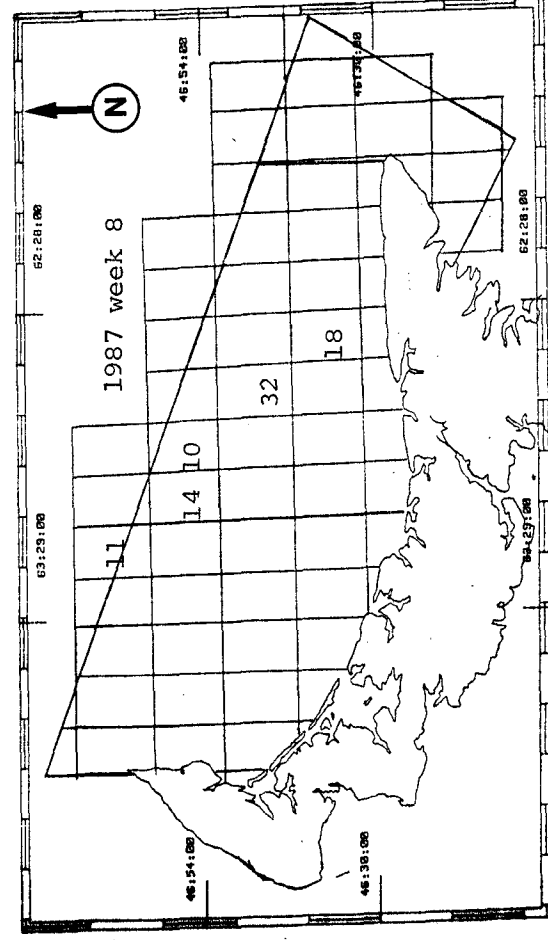
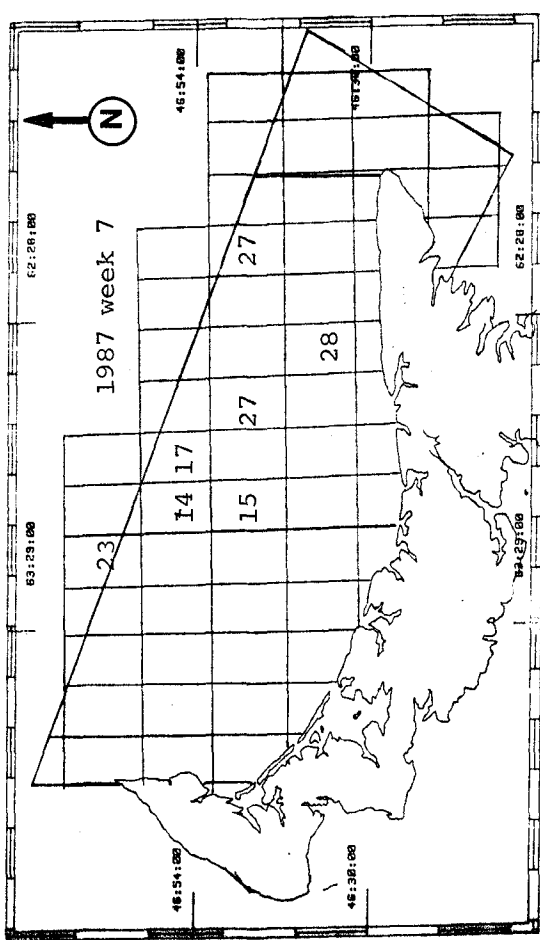
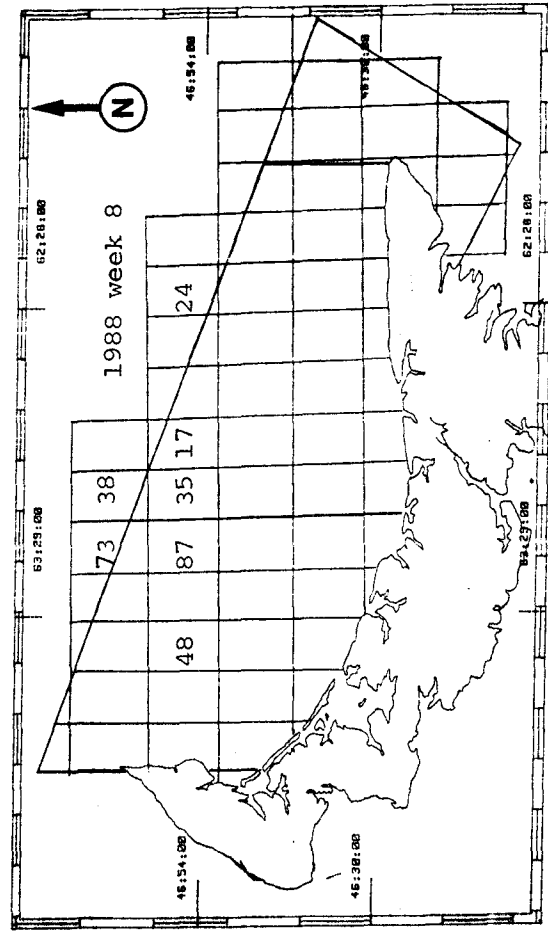
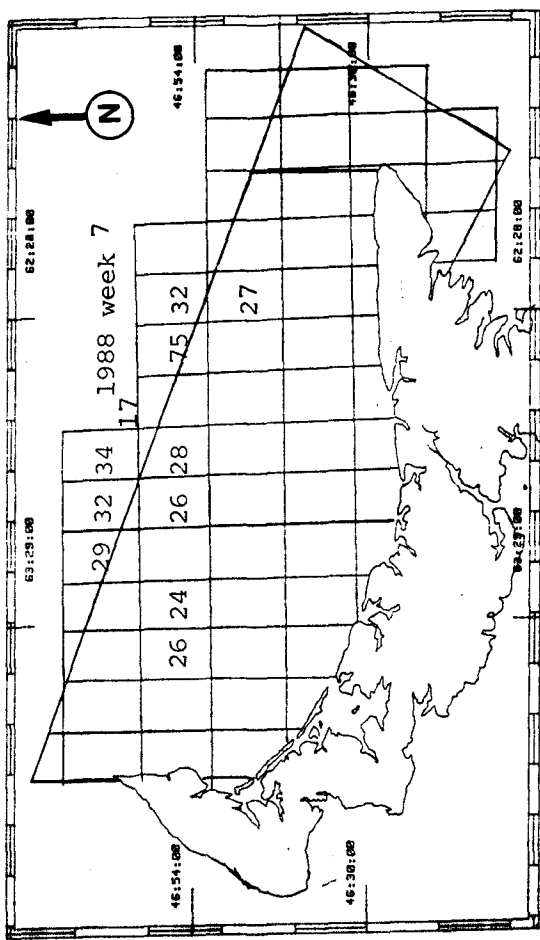


Figure 2 cont.

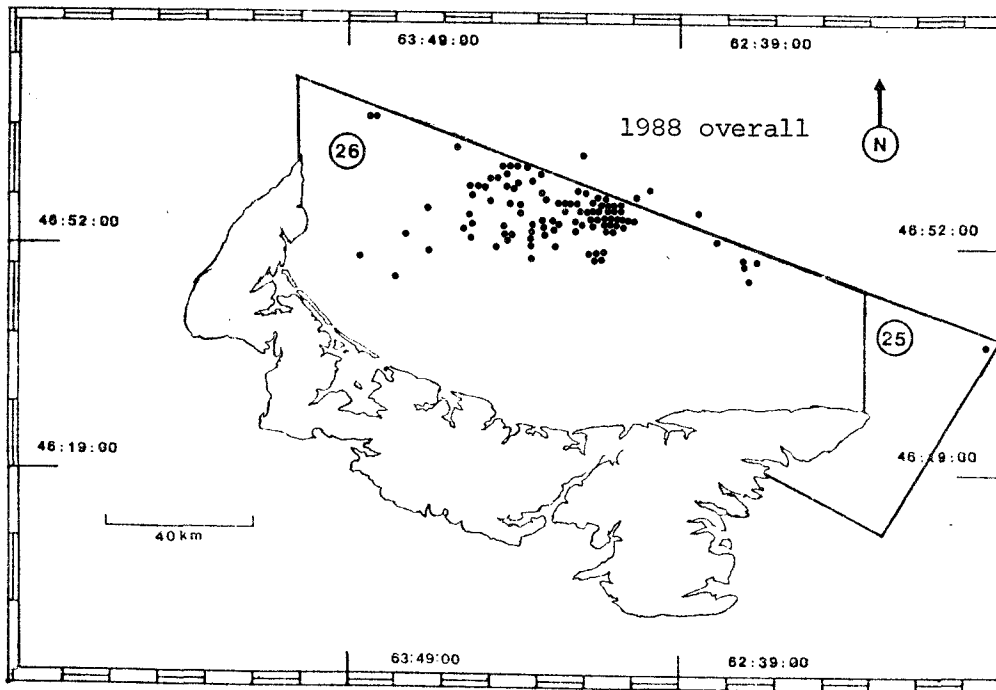
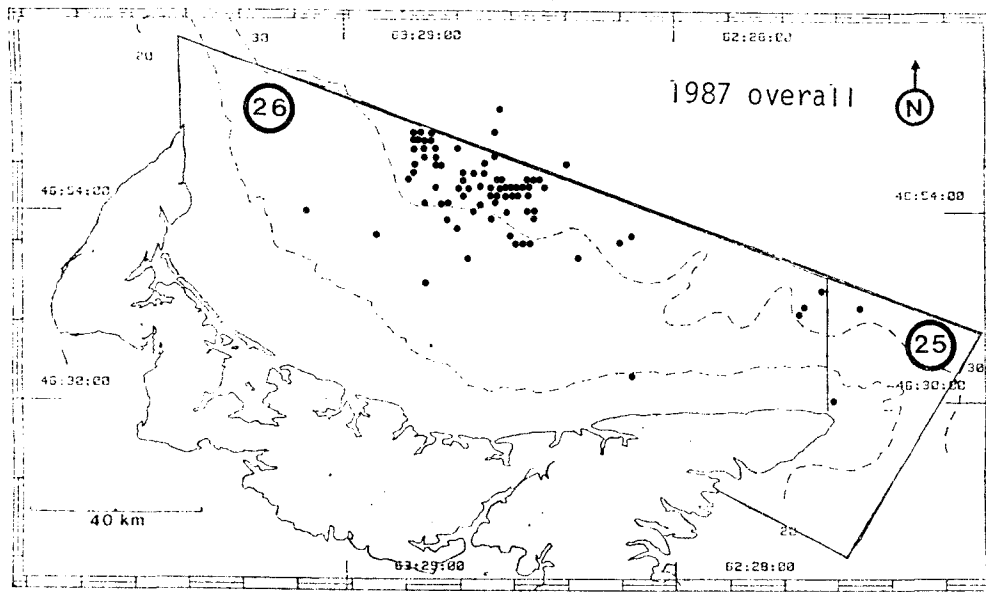


Figure 3. Overall distributions of fishing effort for the Prince Edward Island snow crab fishery based on the logbook data for 1987 and 1988.

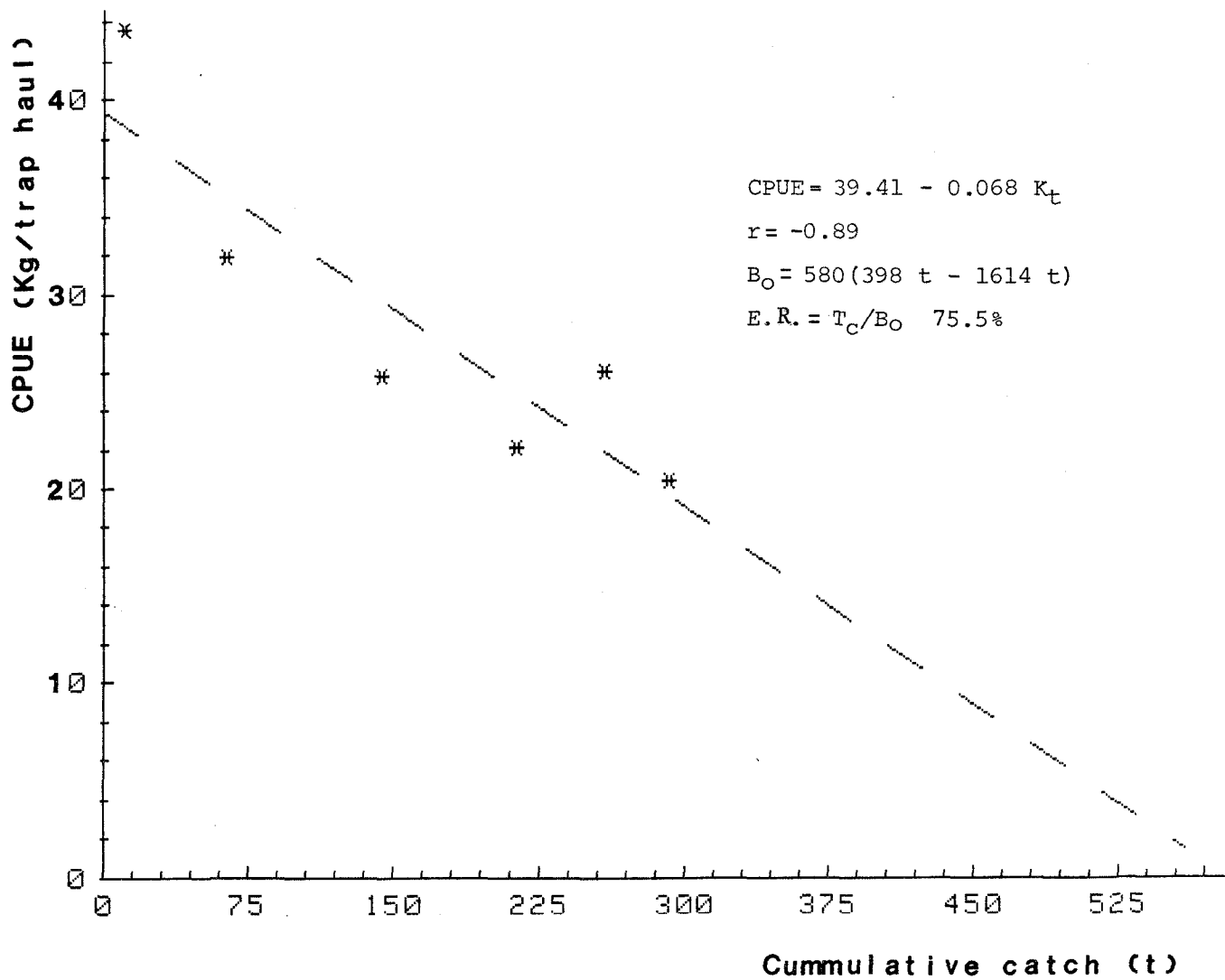


Figure 4 - Cumulative catch (t) versus mean weekly catch per unit effort (C.P.U.E. kg/trap haul) for the 1<sup>st</sup> to the 6<sup>th</sup> week (from May 1<sup>st</sup> to June 11<sup>th</sup>, 1988) in Prince Edward Island Areas 25 and 26.

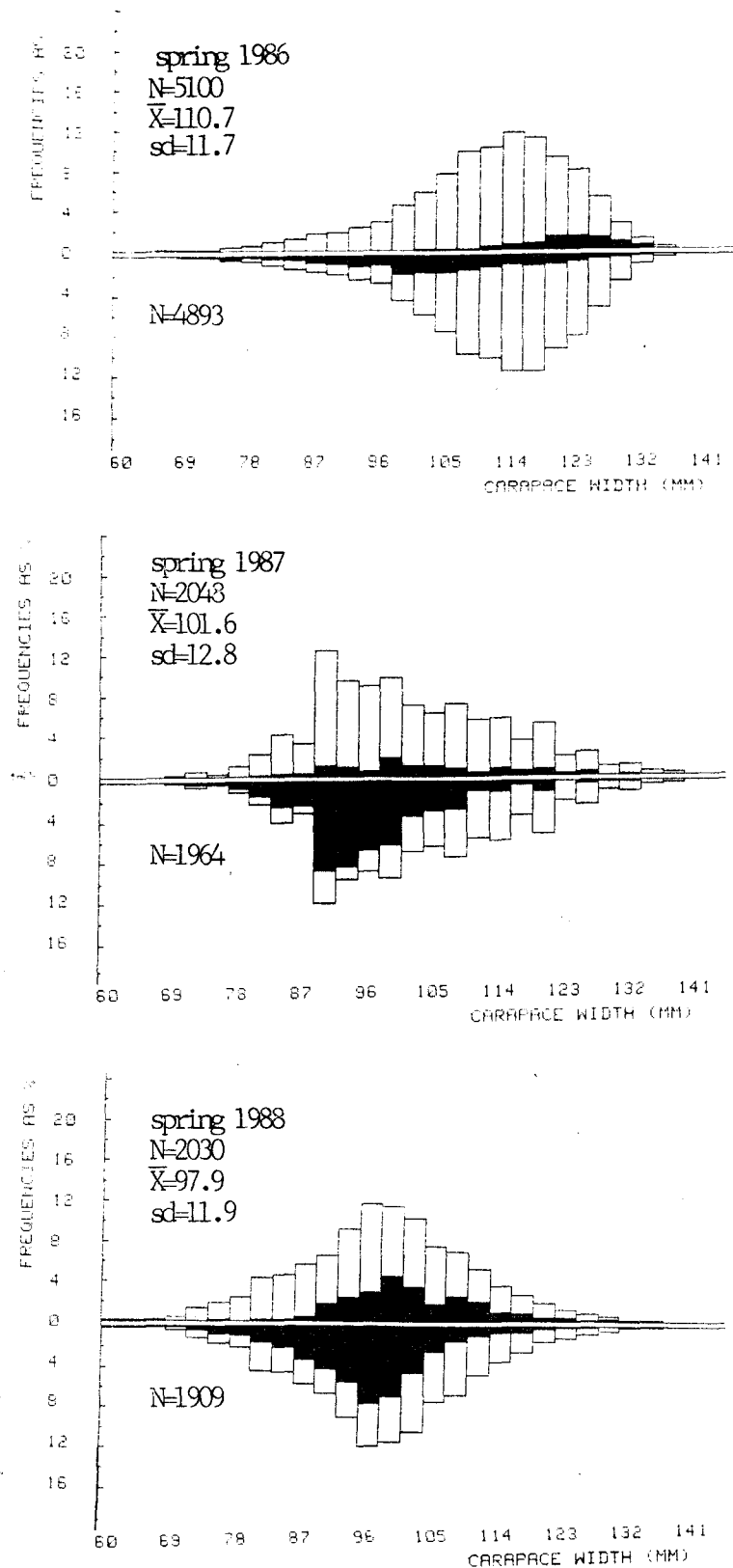


Figure 5 - Overall size distributions of male snow crab, *Chionoecetes opilio*, present in sea samples taken during the spring 1986, 1987, and 1988 Prince Edward Island snow crab fishery.

Positive field: Total number of observation (%), percentage of soft crab in black.

Negative field: Percentage of mature in white, percentage of immature in black.