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A review of catch, fishing effort and biological
trends for the 1987 southwestern Gulf of
St Lawrence snow crab, Chionoecetes opilio fishery

by

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ABSTRACT

The southwestern Gulf of St Lawrence snow crab fishery began in 1966 and has grown steadily in importance to its present status as the largest crab fishery in Atlantic Canada. The fishery is currently composed of 130 vessels. In 1987, the landings dropped to 11782 t which represents a 51% decrease of landed weight compared to 1986.

The fishing season in 1987 was delayed three weeks due to the ice condition and opened on April 25th. A considerable trap loss was reported due to the drifting ice in the first week of the season.

Catch and effort data were obtained from fishermen's logbooks and processors' sales slips and summarized into weekly intervals for use in a Leslie analysis. Sea sampling aboard both Quebec and New Brunswick vessels was conducted to determine seasonal size distribution, shell condition and morphometric maturity in the commercial catch. The weekly distribution of fishing effort for the New Brunswick/Cape Breton Island fleet indicates frequent temporal shifts. Fishing effort was concentrated in the gully/slope regions bordering the Bradelle Bank (eastern and western Bradelle) and the Orphan Bank. The Quebec fleet tended to exploit the Baie des Chaleurs, the eastern and northern Miscou Bank regions and the Orphan Bank. The mean percentage of morphometrically immature males in the catch decreased from 17.9% in 1986 to 7.75% in 1987. A high percentage of ovigerous females (90%) was observed. The seasonal mean size for overall Gulf samples was 108.0 mm carapace width in 1986 and 110.4 mm in 1987. The decrease in the mean size as the season progressed may be due to the selective removal of the large size classes from the fishery. The overall mean CPUE declined 53.0% between 1986 and 1987 (55.7 kg/trap haul and 26.2 per trap haul respectively), to the lowest level since 1978. The estimated initial biomass for 1987 (21962 t) was down 53% from 1986 (46691 t).

RESUME

La pêche au crabe des neiges a débuté en 1966 dans le sud-ouest du Golfe Saint-Laurent. Cette pêcherie de crabe est progressivement devenue la plus importante aux provinces de l'Atlantique. Par contre, en 1987 les débarquements ont chuté à 11782 t, ce qui représente une diminution de 51% par rapport à 1986. La saison de pêche en 1987 a été retardée de trois semaines due aux conditions des glaces dans le golfe et a débuté le 25 avril. Durant la première semaine de pêche un nombre considérable de casiers a été perdu (2466) par les pêcheurs du N.-B.). En 1987, deux permis ont été émis à la flotte du Nouveau-Brunswick. Le nombre total de navires exploitant le stock du sud-ouest du golfe se situe maintenant à 130.

Les prises et l'effort de pêche ont été obtenus à partir des journaux de bord des pêcheurs. Ces informations ont été compilées pour chaque semaine de pêche et analysées par la méthode de Leslie. Afin de déterminer les distributions de tailles, la condition des carapaces et la maturité morphométrique, des échantillons en mer ont été prélevés à bord des bateaux de la flotte du Québec et du N.-B. Les distributions d'efforts par semaines ont démontré que la flotte du N.-B. se déplace au fur et à mesure que la saison progresse. L'effort de pêche est concentré sur les pentes et les goulets autour du banc Bradelle et Orphelin. La flotte du Québec exploite principalement la Baie des Chaleurs, l'est et le nord du banc Miscou et le banc de l'Orphelin. Le pourcentage de crabe morphométriquement immature dans les prises est passé de 17.9% en 1986 à 7.75% en 1987. La taille moyenne a diminué de 110.4 mm en 1986 à 108.0 mm en 1987 pour les échantillons du golfe. La diminution de la taille moyenne à mesure que la saison progresse est attribuable au fait que les mâles de grande taille sont enlevés de la pêcherie les premiers. Quatre-vingt-dix (90) pourcent des femelles observées lors de l'échantillonnage en mer portaient des oeufs. La moyenne des prises par unité d'effort a diminué de 53% comparativement à 1986 (55.7 kg/casier en 1986 et 26.1 kg/casiers en 1987). La biomasse initiale de 1987 a été évaluée à 21962t.

INTRODUCTION

The southwestern Gulf of St Lawrence snow crab, Chionoecetes opilio, fishery was initiated in the mid-1960's and has grown steadily in importance to its present status as the largest crab fishery in Atlantic Canada (Table 1). The history of the fishery can be partitioned into exploratory, industry development and growth phases as documented by Elner and Bailey (1986). The fishery began in 1966, with catches expanding rapidly to 7580 t in 1969 and then fluctuating within the range of 4632 t to 7568 t until 1977 when they increased to 9500 t. Landings increased later to about 15000 t in 1979 and 1980. Since 1978, the upward trend of snow crab landings reflects an intensification of the fishing effort and an apparent increase in the performance of the fishing gear. After reaching a peak of 31500 t in 1982, the landings remained at a level of 24000 - 26000 t until 1986. In 1987, the landings drastically dropped to 11782 t, which is the lowest level since 1978 (Table 1). The catch per unit of effort was 55.7 kg per trap haul in 1986 and dropped to 26.2 kg per trap haul in 1987 (Table 8).

In 1987, changes in the fishing season, fishing gear and number of licences compared to the previous seasons have been recorded. The 1987 southwestern Gulf snow crab fishing season in was delayed for three weeks compared to the 1986 season due to the bad ice condition and opened on April 25th. During the first week of the season, a considerable trap loss was reported (2466 traps by the New Brunswick fleet; DFO Protection Branch) due to the drifting ice.

Different trap types (shape and number of entrances) were introduced by the Quebec fleet in 1986 (Coulombe, 1987) and widely adopted by the New Brunswick fleet in 1987. These new trap types increased the mobility of the fleet. Several trap types such as large conical and large pyramidal traps with two or four entrances, have been recorded.

In 1987 two licences were reissued to the New Brunswick fleet. The fishery is currently composed of 130 vessels (81 from N.B., 47 from Quebec and 2 from western Cape Breton Island).

Assessments of the southwest Gulf snow crab populations have been limited. Bailey (1978) proposed catch-effort and yield models for providing insight into Gulf snow crab biomass and production levels. The use of Leslie analysis (Ricker, 1975) has become generally accepted for snow crab assessments and has been used to estimate exploitation levels for the southwest Gulf's snow crab populations (Bailey, 1978; Cormier, 1984; Davidson et al., 1986, 1987).

Tentative explanations such as overfishing, change in the molting pattern, considerable trap loss (ghost fishing), slow start up of the fishing season and low water temperature have been given to explain the decrease in the 1987 catch.

An overview of catch, effort and biological trends is presented in this paper in order to investigate this drastic catch decrease in the southwestern Gulf snow crab fishery in 1987.

MATERIALS AND METHODS

Sea sampling on board commercial vessel

An extensive sea sampling program has been in place since 1986 using DFO sampling personnel from the Quebec region, and contracted observers in the Gulf region. Location of capture, sex, size (carapace width, CW-mm), shell condition (either hard or soft), and claw height were recorded for all crabs sampled.

The sampling positions were plotted for Quebec and New Brunswick vessels (Fig. 1). Weekly percentages of ovigerous females, immature males, undersize males, and soft shelled crabs were calculated for the Quebec fleet, the New Brunswick fleet and for both fleets combined (Tables 2-6, Figs 2-4).

Monthly and seasonal size distributions and statistics were generated for the Quebec fleet, the New Brunswick fleet and both fleets combined (Figs 7-9).

Trawl survey

A trawl survey using a 20 meter Nephrops trawl was conducted in western Bradelles Bank between July 30th and August 31st, 1987. Eighty-nine (89) tows were drawn and 3114 male snow crabs have been sampled for molt stage determination (Moriyasu and Mallet, 1986) and measured for morphometric maturity (Conan and Comeau, 1986). During the survey, 15 lost traps were recovered, the location, type of trap and the total number of crabs in each trap were noted. A sub-sample of thirty crabs in each trap were sampled for size distribution, morphometric maturity, and molt stage determination.

Log book and sales slip records

Catch and effort data were obtained from fishermen's logbooks and processor's sales slips as collated by Gulf and Quebec Regions DFO Electronics Data Processing and Statistic Branches.

Catch per unit effort (CPUE, daily catch in kg/daily number of trap hauls) was calculated from logbook data.

Experience has shown that the total catch calculated from fishermen's logbooks tends to underestimate the total landings - estimated from the sales slip records, therefore, sales slip data was used in the calculation of catch statistics. Five Quebec vessels still used standard conical traps (1.22 m in diameter). In order to standardize to rectangular traps (1.8 x 1.8 m) CPUE's, 2 standard conical traps hauls were considered to be equivalent to 1 rectangular trap haul.

CPUE and catch/statistics were summarized into weekly periods for both the New Brunswick/Cape Breton Island vessels (hereafter referred to as NB/CB and the Quebec vessels (Table 7). In addition, those two data sets were combined to calculate overall weekly CPUE, catch, and cumulative catch statistics (Table 7) which were used in the Leslie analysis.

To determine the weekly and seasonal distribution of fishing effort, the fishing positions (given as Loran C or latitude/longitude coordinates) were plotted for the NB/CB vessels (Figs 10 and 11). For the Quebec fleet, the data tape came too late to match the exact fishing positions from the log's to the fishing data on tape. However, they were plotted by 10' x 10' squares and locations of sea samples collected by Quebec observers are presented in figures 1 and 13.

RESULTS

Fishing effort distribution

The overall distribution of fishing effort of the NB/CB fleet (Fig. 10) shows that the fishing effort is concentrated in the gully/slope regions bordering the Bradelle Bank (eastern and western Bradelle) and Orphan Bank. The fishing effort in 1987 increased in the second trough between Miscou Bank and southwestern Bradelle compared to 1986 (Fig. 14).

The weekly distribution of fishing effort for the NB/CB fleet indicates temporal relocation of fishing effort as the season progresses (Fig. 10). During the 1st week of the season the bulk of the fleet's fishing effort is concentrated in the second trough and in the southwestern Bradelle Bank region. In May, a major portion of the effort shifts to the eastern and western Bradelle Bank region. In June, a part of the effort shifts to the southeastern Bradelle Bank region. During the two final weeks of the season the effort shifts back westward to be concentrated along the slope of the southwestern Bradelle Bank and the second trough (Fig. 10).

The Quebec fleet mostly exploits the Baie des Chaleurs region, the eastern and northern Miscou Bank region (second trough), the eastern and southeastern Bradelle bank region and the Orphan Bank (Fig. 13).

Size distribution

The size distribution for New Brunswick samples in May is symmetrical with a mean size of 111.1 mm CW and a mode at 110-112 mm CW (Fig. 7). In June, the size distribution is skewed to the left, the mean size has decreased to 110.4 mm CW and the mode has shifted to the right at 115-117 mm CW (Fig. 7). In July, the size distribution is symmetrical, the mean size has decreased to 109.9 mm CW and the mode has shifted to the left at 108-110 mm CW (Fig. 7). The seasonal size distribution (Fig. 8) is symmetrical with a mean of 110.5 mm CW and a mode at 117-119 mm CW.

The size distribution for Quebec sea samples in May is skewed to the left with a mean of 112.5 mm CW and modes at 108-110 mm CW and 116-121 mm CW (Fig. 7). In June, the size distribution is symmetrical and the mean size has decreased to 108.4 mm CW with a mode at 117-119 mm CW (Fig. 7). In July, the size distribution is symmetrical, the mean size has decreased to 106.5 mm CW and modes at 107-109 mm CW and 113-115 mm CW (Fig. 7). The seasonal size distribution is slightly skewed to the left with a mean of 110.2 mm CW and a mode at 117-119 mm CW (Fig. 8).

The size distribution for the Gulf samples (NB/CB and Quebec combined) in May (Fig. 9) is symmetrical with a mean of 111.9 mm CW and a mode at 109-111 mm CW. In June, the size distribution is skewed to the left with a mean of 109.4 mm CW and a mode at 116-118 mm CW (Fig. 9). In July, the size distribution is skewed to the left with a mean of 109.2 mm CW and a mode at 113-115 mm CW (Fig. 9). The seasonal size distribution for all Gulf samples (Fig. 9) is skewed to the left with a mean of 110.4 mm CW and a mode at 115-118 mm CW.

The percentage of undersize males in Quebec, New Brunswick and total Gulf sea samples generally fluctuated below 20% (the majority of weekly percentage were below 15% for the NB/CB fleet) for the entire sampling season (Table 3, Figs. 2-4). The single exception to the above was in week 9 when the percentage of undersize males reached 27% in the Quebec samples (Table 3, Fig. 2). The mean percentages of undersize males were slightly higher in the Quebec samples (16.1% versus 6.7% for New Brunswick samples). The mean percentage of undersize male for the total Gulf samples was 11.6% (Table 3).

Mean size (sea samples)

	MAY	JUNE	JULY	SEASONAL
NB/CB	111.1mm	110.4mm	109.9mm	110.5mm
Quebec	112.5mm	108.4mm	106.5mm	110.2mm
Combined	111.9mm	109.4mm	109.2mm	110.4mm

Soft/white crab

The percentage of soft/white crabs in Quebec samples remained below 20% for the entire sampling season (Table 4, Fig. 2). The incidence of soft/white crab in New Brunswick samples increased rapidly in weeks 6 and 7 (Table 4, Fig. 3). The mean seasonal percentages of soft/white crab present in sea samples were 14.9% for New Brunswick samples, 8.05% for Quebec samples, and 10.8% for the total Gulf samples (Table 4).

Maturity

The percentage of morphometrically immature males (MI-males) in the Quebec samples is five times higher than the New Brunswick samples (Table 5, Figs 2-4). The seasonal mean percentage of MI-males in Quebec samples is 13.8% compared to 2.4% for the New Brunswick (Table 5). The mean percentage of MI-males in the total Gulf samples was 7.7% (Table 5). The percentage of MI-males peaked in week 6 for Quebec and total Gulf samples and in week 4 for New Brunswick samples (Table 5).

The percentage of legal size (95 mm CW) MI-males in the New Brunswick samples remained below 5% for the entire sampling season (Table 6). The incidence of legal size MI-males in Quebec samples increased rapidly in weeks 6 and 7 (Table 6). The maximum percentage of legal size MI-males was found to occur in week 4 for New Brunswick, and in week 6 for Quebec and the total Gulf sample (4.91%, 14.15% and 9.07% respectively, Table 6). The seasonal mean percentage of legal size MI-males in New Brunswick, Quebec and total Gulf samples were 2.01%, 8.05% and 4.85% respectively (Table 6).

Catch and effort

Catch and effort in the first week of the season (Table 7) was low (ice condition) and was not interpreted to be indicative of fishery trends for the overall fleet, thus, it was excluded from the Leslie analysis. Using the remaining data (weeks 2-11, Table 7), Leslie analysis gave the following results (Fig. 12):

$$\begin{aligned} \text{CPUE}_t &= 37.26 - 0.00169 K_t \\ r &= -0.91 \\ B_0 &= 21962 \text{ t} \text{ (} 17836 \text{ t} - 30764 \text{ t, } p \text{ } 0.05) \end{aligned}$$

Given a total catch of 11782 t (Table 7) the above initial biomass B_0 estimate yields an exploitation level (E.L.) estimate of 53.6% (33.9% - 61.7%, P 0.05).

Trawl survey

The size distribution of crabs from the trawl survey ranged from 18 mm CW to 138 mm CW (Fig. 16), the mean size is at 81.3 mm CW and modes at 27-29 mm CW, 45-57 mm CW, 81-83 mm CW and 97-99 mm CW (Fig. 16). The percentage of crabs in each 3 mm class ranges from .03% (137-139 mm CW) to 4.88% (95-97 mm CW) low percentages are noted for classes 55 to 67 mm CW. The percentage of MI-males is 52.5% and the percentage of white/soft crabs was 61.9%.

Ghost fishing

The mean number of crabs per lost trap, found during the trawl survey, was 44.3 which corresponds to around 25.5 kg/trap. According to the DFO protection branch, 2466 traps were lost by the New Brunswick fishermen during the 1987 season. The estimate catch lost by traps lost is 62.9 t at one point in time.

DISCUSSION

The size distribution pattern and the decrease in the seasonal mean size in 1987 exhibit little difference from those presented by Davidson *et al.*, (1987) for 1986. In May, the mean size for the New Brunswick fleet was 110.4 mm CW in 1986 and 111.1 in 1987 (modes were at 111-113 mm CW in 1986 and 110-112 mm CW respectively). In June, the mean size was 108.2 mm CW in 1986 and 110.4 in 1987 (modes were at 108-110 mm CW and 115-117 mm CW respectively). In July, the mean size was 109.9 mm CW in 1987. The seasonal mean size was 109.1 mm CW in 1986 and 110.5 mm CW in 1987.

In May, the mean size for the Quebec fleet was 107.6 mm CW in 1986 and 112.5 mm CW in 1987 (modes were at 104-106 mm CW and 108-110 mm CW respectively). In June, the mean size was 104.6 mm CW and 108.1 mm CW in 1987 (modes were at 98-100 and 117-119 mm CW respectively). In July, the mean size was 106.5 mm CW in 1987. The seasonal mean size was 106.8 mm CW in 1986 and 112.5 mm CW in 1987.

The seasonal mean size for the overall Gulf samples was 108.0 mm CW in 1986 and 110.4 mm CW in 1987.

Mean size (sea samples)

Year	May		June		July		Seasonal	
	Quebec	N.B.	Quebec	N.B.	Quebec	N.B.	Quebec	N.B.
1985	110.1 mm		105.9 mm		---		109.2 mm	
1986	107.6	110.4	104.6	108.2	---	---	106.8	109.1
1987	112.5	111.1	108.1	110.4	106.5	109.9	110.2	110.5

The decrease in the mean size as the season progresses may be explained by the selective removal of the large size classes from the fishery. The low catch rate during the 1987 season lead the crab boats to frequent shifts of fishing grounds in order to find crab patches scattered over the southwestern Gulf which resulted in an increase in the seasonal mean size. This phenomenon is well demonstrated by the weekly shifts of the fishing effort observed during the 1987 season.

The percentage of morphometrically immature males in New Brunswick sea samples decreased from 14.8% in 1986 to 2.7% in 1987. For the Quebec samples, the percentage decreased from 22.9% in 1986 to 13.8% in 1987 and for both fleets combined, the percentage decreased from 17.9% in 1986 to 7.7% in 1987. The decrease in the percentage in MI-male crab in the catch can indicate a decrease in the recruitment.

The percentage of soft/white crabs in New Brunswick sea samples increased from 5.8% in 1986 to 14.9% in 1987. For the Quebec samples, the percentage increased from 4.0% in 1986 to 8.05% in 1987 and for both fleets combined, the percentage increased from 4.9% in 1986 to 10.8% in 1987. The increase in the percentage of soft/white crabs in the catch in 1987, can be attributed to the fact that the season ended late in July when newly molted crabs are more catchable.

The percentage of undersize male crabs in New Brunswick sea samples increased slightly from 5.8% in 1986 to 6.7% in 1987. For the Quebec samples, the percentage increased from 7.3% to 16.1% in 1987 and for both fleets combined, the percentage increased from 6.5% to 11.6% in 1987.

The total catch, mean CPUE, and biomass estimates in 1987 have drastically decreased compared to the previous years (Davidson et al., 1987). The total catch exhibited a 3.5% decline between 1985 and 1986 (25158 t versus 24267 t) and a 51.5% decline from 1986 to 1987 (24267 t to 11782 t). The total effort in 1987 decreased 4.7% compared to 1986 (from 415670 trap hauls in 1986 to 396180 trap hauls in 1987).

The overall mean CPUE declined 53.0% between 1986 and 1987 (55.7 kg/trap haul and 26.2 kg per trap haul respectively). The mean CPUE for the NB/CB fleet has historically been higher than the Quebec fleet (except for 1986). In 1986, the mean CPUE for the NB/CB and Quebec fleets were 42.2 kg/trap haul and 65.5 kg/trap haul respectively (Davidson et al., 1987). In 1987, the difference in the mean CPUE between the two fleets was negligible (26.3 kg/trap haul for the NB/CB and 26.1 kg/trap haul for the Quebec fleet). In 1986, a part of the Quebec fleet introduced large conical trap (1.8 m in diameter), which have been identified in logbook records as traditional conical trap and therefore they have been treated as being half as efficient as the rectangular trap. This underestimation of fishing effort for the Quebec fleet could be a cause of the reversed trend CPUE's in 1986.

In 1987, the majority of the New Brunswick fleet also adopted large conical traps and those used by the Quebec fleet were identified and separated from standard conical trap. Therefore, the estimation of the CPUE for both the NB/CB fleet and Quebec fleet in 1987 is correct, unless the efficiency of the large conical trap is different from that of the rectangular traps. Preliminary studies done after the 1987 fishing season revealed that there was no significant difference among these two trap types. The mean number of crabs caught per day during 12 days was 13.1 for the conical traps and 14.8 for the rectangular traps.

A slight increase in the mean CPUE level between the seventh and ninth fishing weeks, coupled with an increase in the percentage of white/soft crabs and a decrease in the percentage of immature crabs, may indicate a recruitment of newly molted crabs to the fishery. The authors contend that these CPUE's resulted in a decrease slope in the Leslie regression thereby increasing (overestimating) the B_0 estimate which in turn decreased (underestimate) the exploitation level.

The decrease in the mean CPUE, total catch and B_0 level in 1987, may be attributed to many factors:

Overfishing: For three consecutive seasons (1985-1987), frequent shifts of the fishing effort by the NB/CB fleet have been observed. Especially, the mobility of the vessels has increased by the introduction of large conical traps. This type of trap can be stacked, up to 150 at a time on a standard crab boat (20 meters). Despite such an increase in mobility, the CPUE's showed a relatively steady decrease as the season progressed which may indicate that all of the fishable surface in this fishery has been exploited.

Although, the total number of trap hauls has remained at the same level since 1985, the total fishing effort might have increased with the introduction of new type of trap (conical, pyramidal) allowing a greater mobility of the fleet (Coulombe, 1987) and recent technological advances in electronic navigation devices increasing efficiency of fishing operation.

In addition, the Danish seiners catch a considerable quantity of snow crabs as a by-catch and discard at sea, which may cause a high mortality of released crabs. No estimated annual by-catch of crab by bottom trawlers in the southwestern Gulf fishery is available.

Despite the above, the percentage of ovigerous females in the fishery seems to be high (approximately 90% for the 1986/87 fishing seasons). However, no data is available on the viability of those eggs.

Change in the molting patterns due to a late ice departure: In 1986, the fishing grounds were free of ice three weeks earlier than in 1987. According to the appearance of white crabs in the commercial catch in 1987 and 1986, it is not evident that the molting pattern has changed due to the ice coverage in 1987.

Considerable trap loss: The total catch or retention of crabs by the lost traps (2466 traps) of the NB fleet was estimated to be 62.9 t in 1987. No information on the number of traps lost by the Quebec fleet was available at the time of the analyses. Assuming that the same proportion of trap has been lost by the Quebec fleet, the total estimated catch by ghost fishing could be at 100 t level. There is no information whether the crabs once captured are retained in the trap until they die or they are temporary retained inside and escape from the trap afterwards. Breen (1987) reported that up to 7% of the total catch of the dungeness crabs, Cancer magister, is lost by ghost fishing every year. In any case, this phenomenon is not negligible and a special consideration should be put on the installation of self trap opening system such as "timed-failure device" (Blott, 1978) and biodegradable netting which prevents ghost fishing.

Recruitment failure: Theoretically, the difference between the estimated B_0 for 1987 and the estimated biomass at the end of the 1986 season indicates the recruitment to the fishery. However, the estimated B_0 for the 1987 season was 21962 t (17836 - 30764 t) which corresponds to the same level as the estimated biomass at the end of 1986 which was 22428 t (16027 - 32704 t), (Davidson et al., 1987). The similarity between these two biomass estimates indicates that the recruitment to the fishery for the 1987 season was low and could not support the same catch level as the previous seasons. A preliminary analysis of the post season trawl survey at the Bradelle Bank (Conan et al., unpublished data) supports these results.

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Table 1 - Estimated snow crab landings and landed values for Atlantic Canada, 1966-1987.

Year	SW Gulf of St. Lawrence (N.B., Quebec)	Cape Breton Island (Nova Scotia)	Atlantic Canada total (t)	Landed values (\$000)	Average price to fishermen (/kg)
1966(1)	30	---	30	2.4	8
1967(1)	158	241	496	84	17
1968(1)	3939	713	5029	1005	20
1969(1)	7580	98	8223	1664	20
1970(1)	5634	90	7534	1582	21
1971(1)	5374	136	6992	1246	18
1972(1)	5392	51	6718	1948	29
1973(1)	6969	122	9549	3724	39
1974(1)	6704	217	10046	3817	38
1975(1)	4632	379	6849	2397	35
1976(1)	7568	489	10500	4619	44
1977(1)	9537	936	14099	7331	52
1978(1)	10462	3189	21936	12503	57
1979(1)	15793	3225	30681	20556	67
1980(1)	14854	2500	28539	16838	59
1981(1)	21877	1615	37453	21723	58
1982(1)	31585	2190	47004	3243	92
1983(1)	24342	2209	37255	53274	143
1984(1)	26062	1916			
1985(1)	25158	1856	30565	32292	106
1986(1)	24263	1703(3)	29479	39540	134
1987	11782	1139(2)			

(1) Davidson et al., 1987

(2) Quota Report

(3) Davidson et Comeau, 1986

TABLE 2 - Number of berried and non-berried females without eggs snow crab, *Chionoecetes opilio*, present in sea samples taken during the 1987 southwestern Gulf of St Lawrence offshore fishing season.

WEEK	N.B. samples # of females	N.B. samples # of females non-berried	P.Q. samples # of females	P.Q. Samples # of females non-berried	Total Gulf # of females	Total Gulf # of females non berried
1 Apr.26-May 2	-	-	2	0 (0.0%)	2	0 (0.0%)
2 May 3- 9	5	0 (0.0%)	-	-	5	0 (0.0%)
3 May 10-16	2	0 (0.0%)	-	-	2	0 (0.0%)
4 May 17-23	29	0 (0.0%)	-	-	29	0 (0.0%)
5 May 24-30	24	0 (0.0%)	283	25 (8.8%)	307	25 (8.1%)
6 May 31-June 6	46	0 (0.0%)	37	18 (48.6%)	83	18 (21.7%)
7 June 7-13	140	5 (3.6%)	204	32 (15.7%)	344	37 (10.8%)
8 June 14-20	69	0 (0.0%)	-	-	69	0 (0.0%)
9 June 21-27	82	14 (17.1%)	23	1 (4.3%)	105	15 (14.3%)
10 June 28-July 4	80	4 (5.0%)	-	-	80	4 (5.0%)
11 July 5-11	40	0 (0.0%)	15	1 (6.7%)	55	1 (1.8%)
Mean=	51.7	2.3	94.0	15.2	67.6	6.3

Table 3 - Percentage of undersize male snow crabs (% unders), Chionoecetes opilio, present in sea samples taken during the 1987 southwestern Gulf of St. Lawrence offshore fishing season.

WEEK	N.B. samples %Unders.(N)*	P.Q. samples %Unders.(N)*	Total Gulf %Unders.(N)*
1 Apr.26-May 2	-	0.2% (411)	0.2% (411)
2 May 3- 9	3.1% (295)	-	3.1% (295)
3 May 10-16	3.4% (58)	-	3.4% (58)
4 May 17-23	4.9% (570)	-	4.9% (570)
5 May 24-30	7.8% (294)	14.7% (1242)	13.4% (1536)
6 May 31-June 6	4.9% (508)	22.0% (749)	15.1% (1257)
7 June 7-13	6.1% (699)	12.8% (156)	7.4% (855)
8 June 14-20	3.5% (509)	-	3.5% (509)
9 June 21-27	14.6% (397)	27.0% (341)	20.3% (738)
10 June 28-July 4	12.4% (531)	-	12.4% (531)
11 July 05-11	0% (169)	19.8% (182)	10.3% (351)
Mean = 6.75% (4030) 16.13% (3081) 11.60% (7111)			

* Number sampled

Table 4 - Percentage of soft/white snow crabs (% soft), Chionoecetes opilio, present in sea samples taken during the 1987 southwestern Gulf of St. Lawrence offshore fishing season.

WEEK	N.B. samples % Soft (N)*	P.Q. samples % Soft (N)*	Total Gulf % Soft (N)*
1 April 26-May 2	-	0.0% (411)	0.0%(295)
2 May 3- 9	4.7% (295)	-	4.7%(295)
3 May 10-16	6.9% (58)	-	6.9%(58)
4 May 17-23	9.3% (570)	-	9.3%(570)
5 May 24-30	0.7% (294)	4.6% (1242)	3.8%(1536)
6 May 31-June 6	21.1% (508)	10.7% (749)	14.9%(1257)
7 June 7-13	25.5% (699)	19.2% (156)	24.3%(855)
8 June 14-20	13.7% (509)	-	13.7%(509)
9 June 21-27	7.5% (397)	18.8% (341)	12.7%(738)
10 June 28-July 4	17.1% (531)	-	17.1%(531)
11 July 5-11	29.6% (169)	9.3% (182)	22.3%(351)
Mean = 14.9% (4030) 8.05%(3081) 10.8%(7111)			

* Number sampled

Table 5 - Percentage of morphometrically immature male snow crabs (% imm.), Chionoecetes opilio, present in sea samples taken during the 1987 southwestern Gulf of St. Lawrence offshore fishing season.

WEEK	N.B. samples % Imm. (N)*	P.Q. samples % Imm. (N)*	Total Gulf % Imm. (N)*
1 April 26-May 2	-	0.49%(411)	0.49%(411)
2 May 3- 9	4.07%(295)	-	4.07%(295)
3 May 10-16	5.17%(58)	-	5.17%(58)
4 May 17-23	5.38%(570)	-	5.38%(570)
5 May 24-30	3.40%(294)	11.89%(1242)	10.19%(1536)
6 May 31-June 6	2.00%(508)	23.19%(749)	14.39%(1257)
7 June 7-13	2.35%(699)	18.06%(156)	5.27%(855)
8 June 14-20	1.18%(509)	-	1.18%(509)
9 June 21-27	1.51%(397)	16.17%(341)	8.29%(738)
10 June 28-July 4	2.08%(531)	-	2.08%(531)
11 July 5-11	1.81%(169)	10.43%(182)	11.46%(351)
Mean =	2.70%(4030)	13.79%(3081)	7.75%(7111)

* Number sampled

Table 6 - Percentage of morphometrically immature male snow crabs (≥ 95 mm CW), Chionoecetes opilio, present in sea samples taken during the 1987 southwestern Gulf of St. Lawrence offshore fishing season.

WEEK	N.B. samples Imm. ≥ 95 mm (N)*	P.Q. samples Imm. ≥ 95 mm (N)*	Total Gulf Imm. ≥ 95 mm (N)*
1 April 26-May 2	-	-	0.24%(411)
2 May 3- 9	2.71%(295)	0.24%(411)	2.71%(295)
3 May 10-16	3.45%(58)	-	3.45%(58)
4 May 17-23	4.91%(570)	-	4.91%(570)
5 May 24-30	1.70%(294)	6.36%(1242)	5.47%(1536)
6 May 31-June 6	1.77%(508)	14.15%(749)	9.07%(1257)
7 June 7-13	1.72%(699)	12.82%(156)	3.74%(855)
8 June 14-20	1.18%(509)	-	1.18%(509)
9 June 21-27	1.01%(397)	8.50%(341)	4.47%(738)
10 June 28-July 4	0.75%(531)	-	0.75%(531)
11 July 5-11	1.78%(169)	7.14%(182)	6.27%(351)
Mean =	2.01%(4030)	8.05%(3081)	4.85%(7111)

* Number sampled

TABLE 7 - Weekly effort and catch data for the 1987 southwestern Gulf of St. Lawrence snow crab, Chionoecetes opilio, fishery.

WEEK	CPUE ¹ N.B.	CPUE ¹ P.Q.	CPUE ¹ Overall	Trap hauls N.B.	Trap hauls P.Q.	Trap hauls Overall	Catch N.B. (t)	Catch P.Q. (t)	Catch, C _t Overall (t)	C _t /2 (t)	Cumulative Catch K _t (t)
1 Apr.26-May 2	24.7	27.0	25.7	13374	12899	26273	356.97	311.88	688.85	334.43	334.43
2 May 3- 9	35.6	40.0	37.5	23741	20832	44573	912.76	634.96	1547.72	773.86	1442.71
3 May 10-16	33.4	29.3	31.5	16729	12823	29552	635.92	360.83	996.75	498.38	2714.95
4 May 17-23	33.5	28.4	31.4	30820	19502	50322	1129.75	544.18	1673.93	836.97	4050.29
5 May 24-30	25.6	26.1	25.8	29459	22250	51709	831.23	547.81	1379.04	689.52	5576.77
6 May 31-June 6	19.7	20.8	20.2	23690	18272	41962	528.57	384.61	913.18	456.59	6722.88
7 June 7-13	17.0	24.5	20.5	19589	16170	35759	385.17	419.55	804.75	402.36	7581.83
8 June 14-20	23.2	23.8	23.5	19966	15594	35560	526.21	357.54	883.75	441.88	8426.07
9 June 21-27	24.9	20.0	23.0	23367	14394	37761	648.26	282.96	931.22	465.61	9333.55
10 June 28-July 4	23.7	16.8	21.1	18980	11535	30515	484.03	183.17	667.20	333.60	10132.76
11 July 5-11	17.8	13.8	16.6	8654	3540	12194	171.68	46.28	217.96	108.98	10575.34
Mean=26.2	26.1	26.2	Total=228369	167811	396180	6610.55	4073.77	10684.32			

¹ CPUE - kg/trap haul

TABLE 8 - Annual catch, effort and quotas for the southwestern Gulf of St. Lawrence snow crab, Chionoecetes opilio, fishery from 1968 to 1987.

Year	C.P.U.E. (kg/trap haul)		Total catch (t)	# of trap haul	Quota (t)
1968(1)	30.32		3939	129914	-
1969(1)	38.28		7580	198015	-
1970(1)	52.22		5634	107890	-
1971(1)	47.51		5374	113113	-
1972(1)	42.18		5392	127833	-
1973(1)	19.74		6969	353040	-
1974(1)	25.80		6704	259845	-
1975(1)	31.88		4632	145295	-
1976(1)	23.01		7568	328900	-
1977(1)	29.38		9537	324608	-
1978(1)	N.B. 27.9	Quebec 18.0	10462	438697	-
1979(1)	35.7	23.8	15794	506853	-
1980(1)	50.6	34.9	14854	328178	-
1981(1)	61.8	34.7	21877	396759	-
1982(1)	66.8	41.2	31585	499709	-
1983(1)	65.5	42.7	24342	362772	-
1984(1)	66.7	43.9	26062		26000
1985(1)	58.8 57.3-	53.1 combined	25158	439096	28000
1986(1)	48.2 55.7-	65.5 combined	24267	415670	-
1987(2)	26.3 26.2-	26.1 combined	11782	396180	-

(1) Davidson et al., 1987, CAFSAC Res. Doc. 87/52.

(2) Present paper

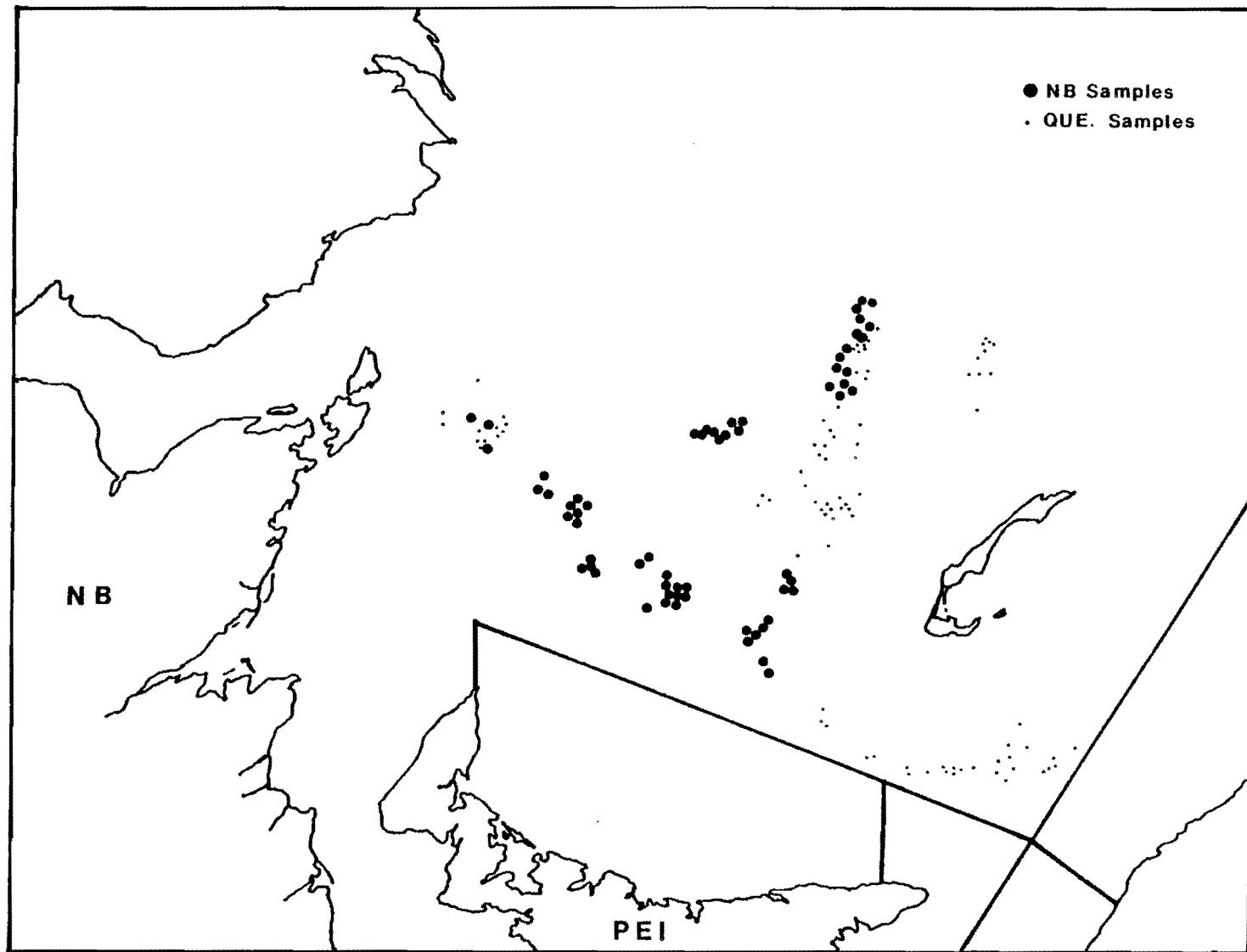


Figure 1: Geographic distribution of sea samples taken aboard New Brunswick and Quebec vessels during the 1987, SW Gulf of St. Lawrence snow crab, Chionoecetes opilio, fishery.

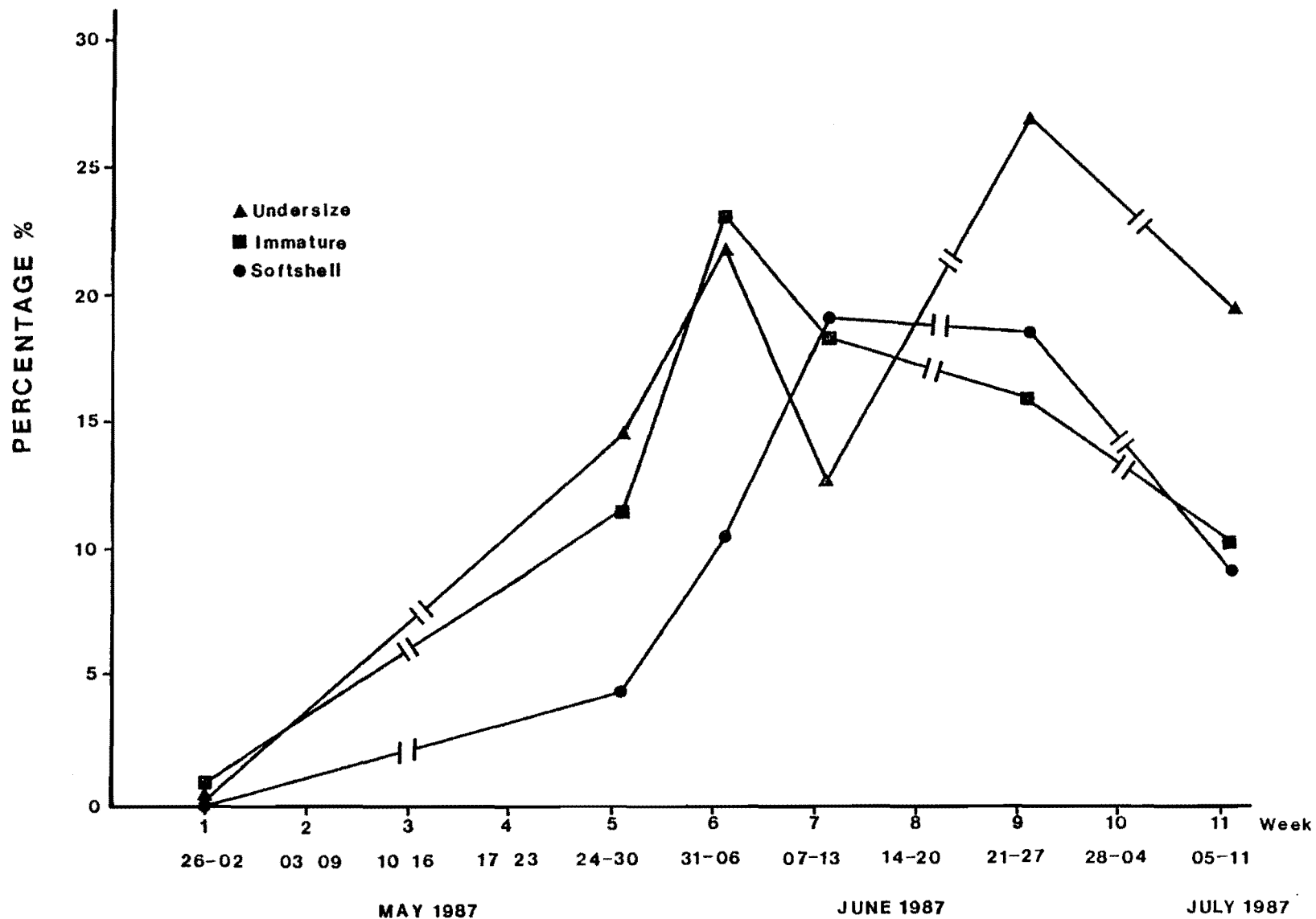


Figure 2: Weekly percentages of undersize, soft/white, and morphometrically immature male snow crabs, Chionoecetes opilio, present in sea samples taken aboard Quebec vessels during the 1987 SW Gulf of St Lawrence fishery.

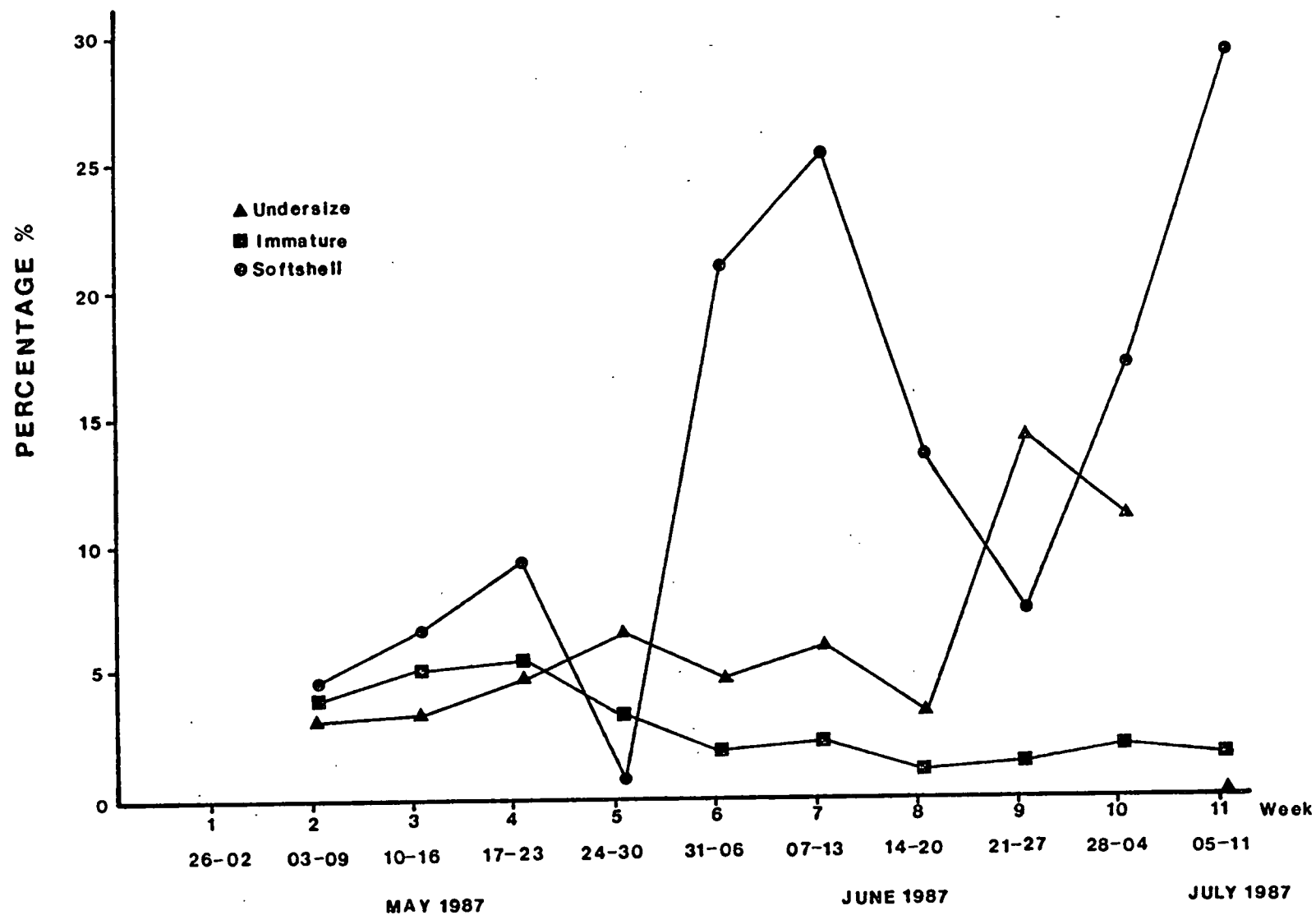


Figure 3: Weekly percentages of undersize, soft/white, and morphometrically immature male snow crabs, Chionoecetes opilio, present in sea samples taken aboard New Brunswick vessels during the 1987 SW Gulf of St Lawrence fishery.

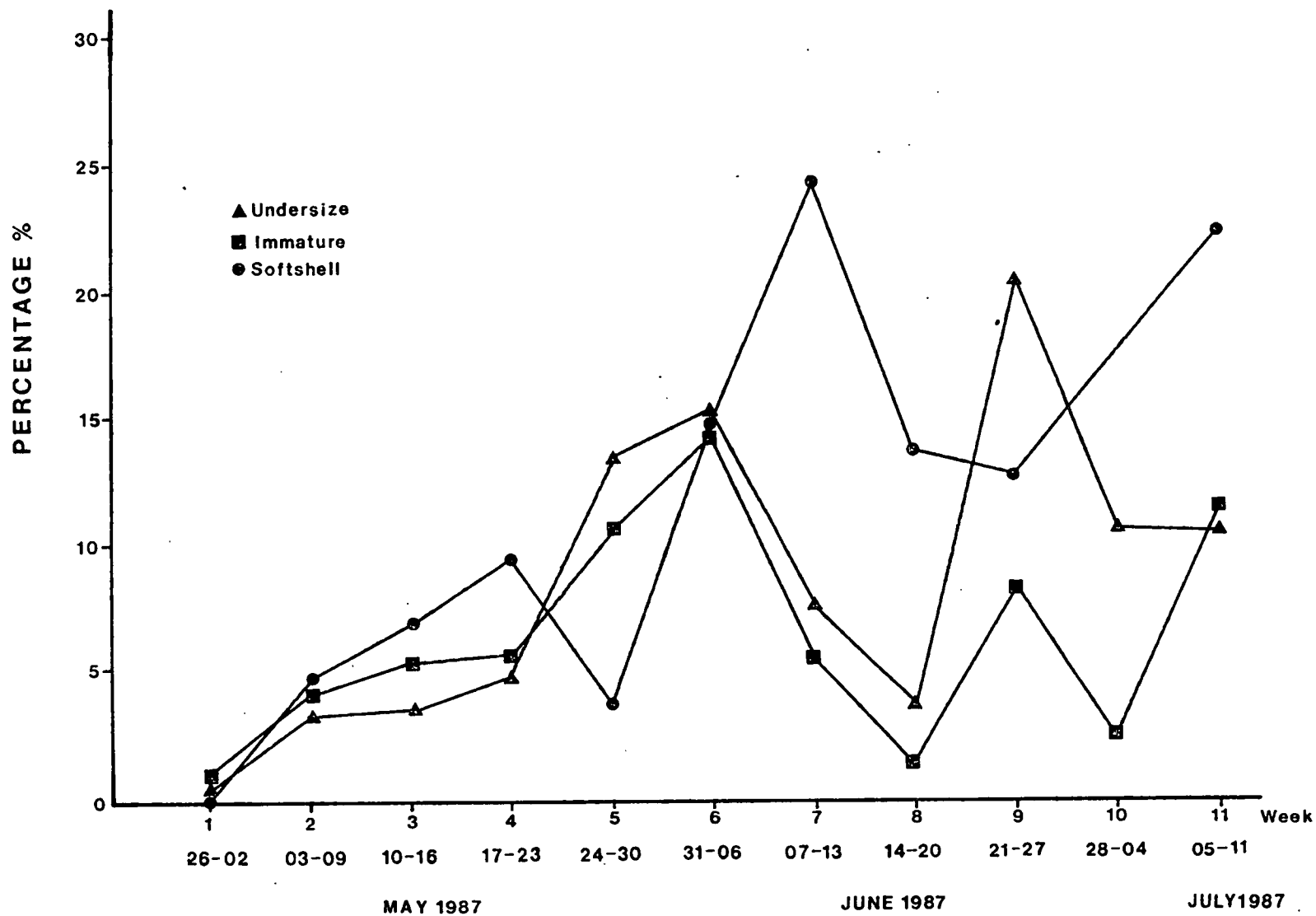


Figure 4: Weekly percentages of undersize, soft/white, and morphometrically immature male snow crabs, Chionoecetes opilio, present in all sea samples taken during the 1987, SW Gulf of St Lawrence fishery.

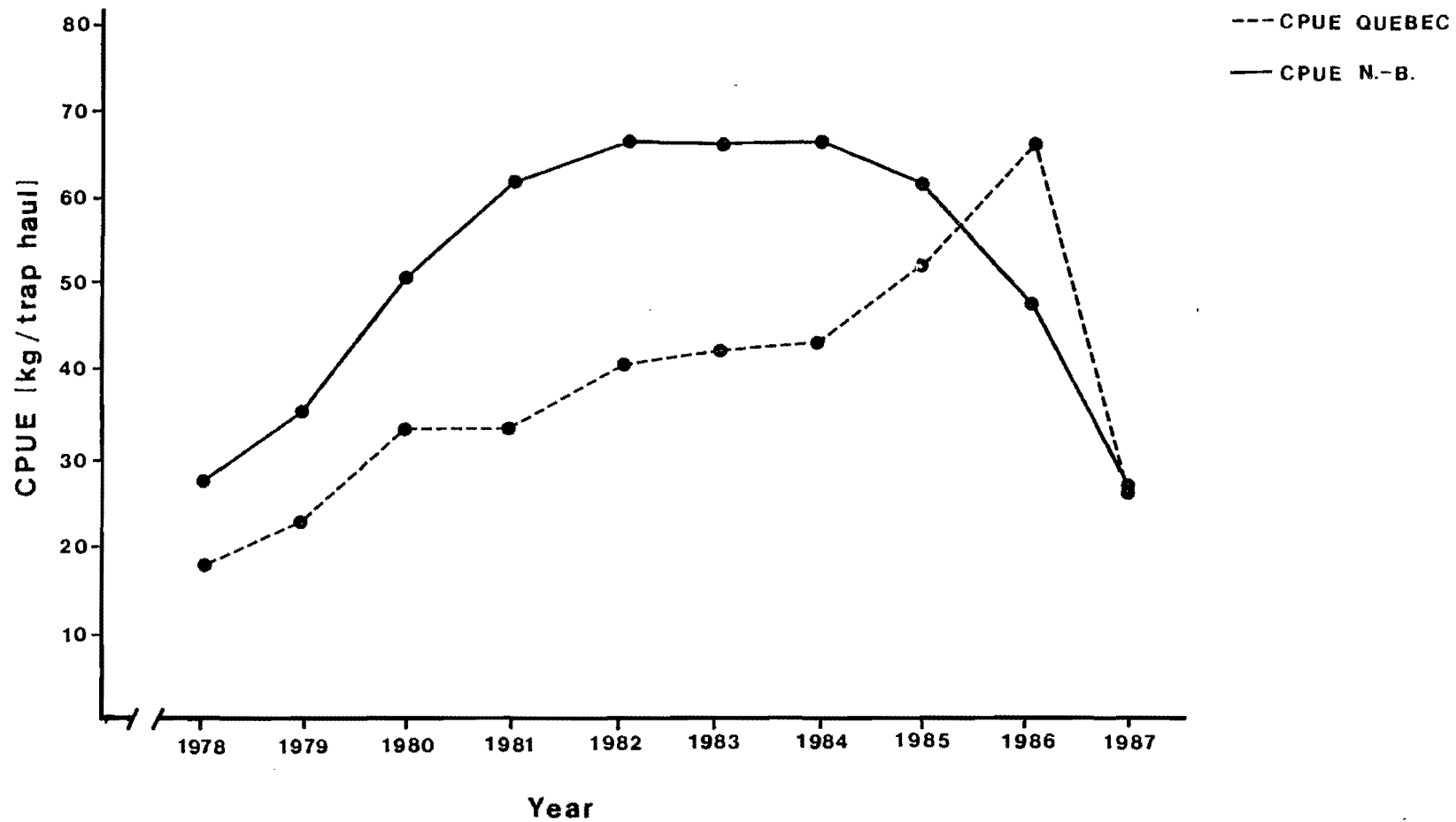


Figure 5: Trends in mean CPUE (kg/trap haul) for the snow crab, Chionoecetes opilio, fishery in the Gulf of St. Lawrence from 1978-1987.

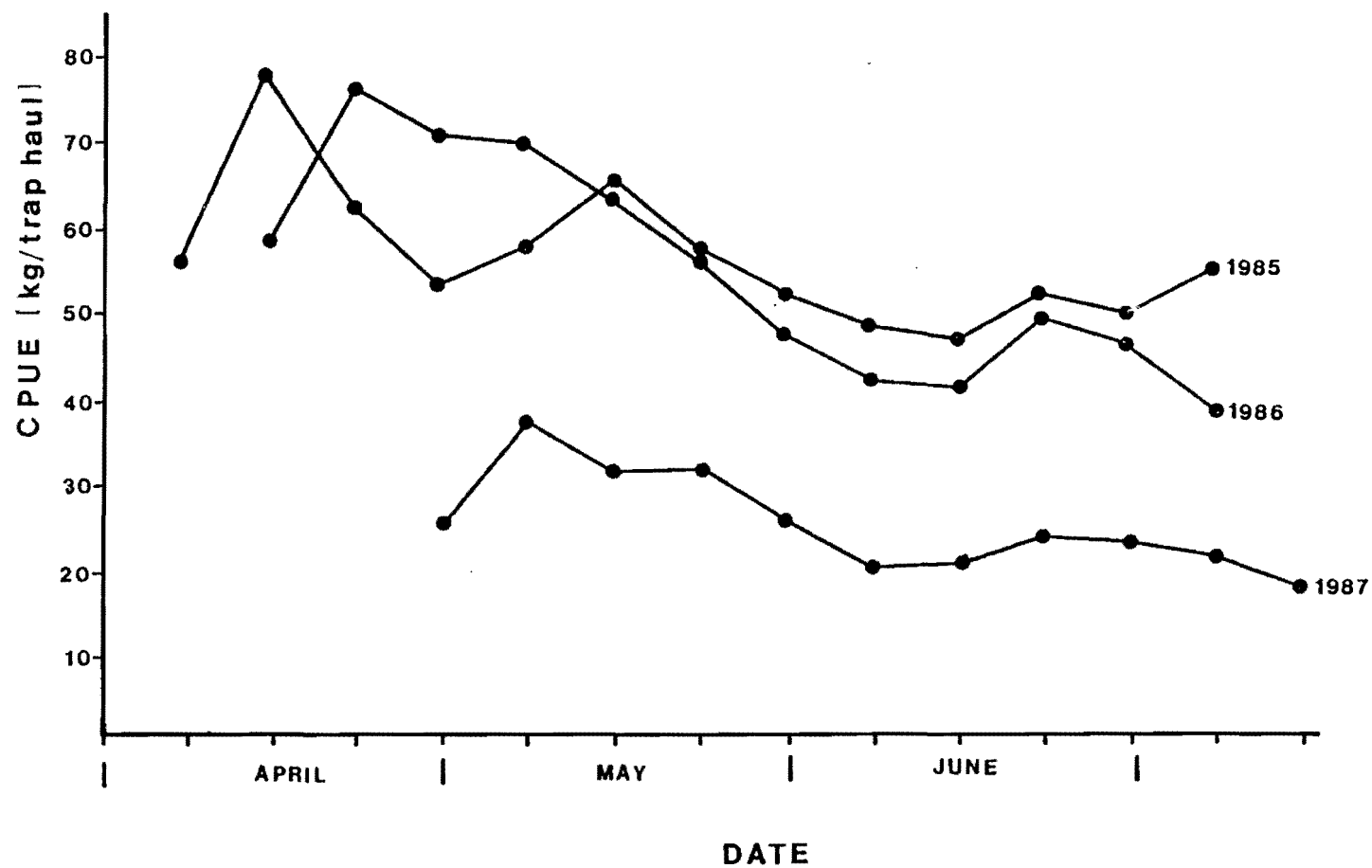


Figure 6: Weekly mean CPUE (kg/trap haul) for the snow crab, Chionoecetes opilio, fishery in the Gulf of St. Lawrence for 1985, 1986 and 1987.

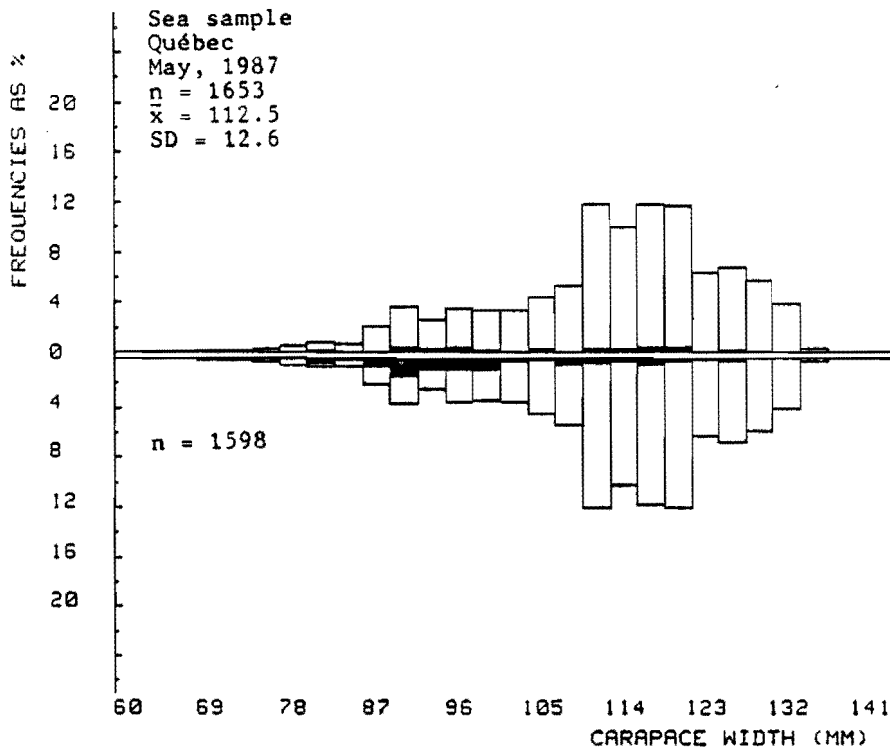
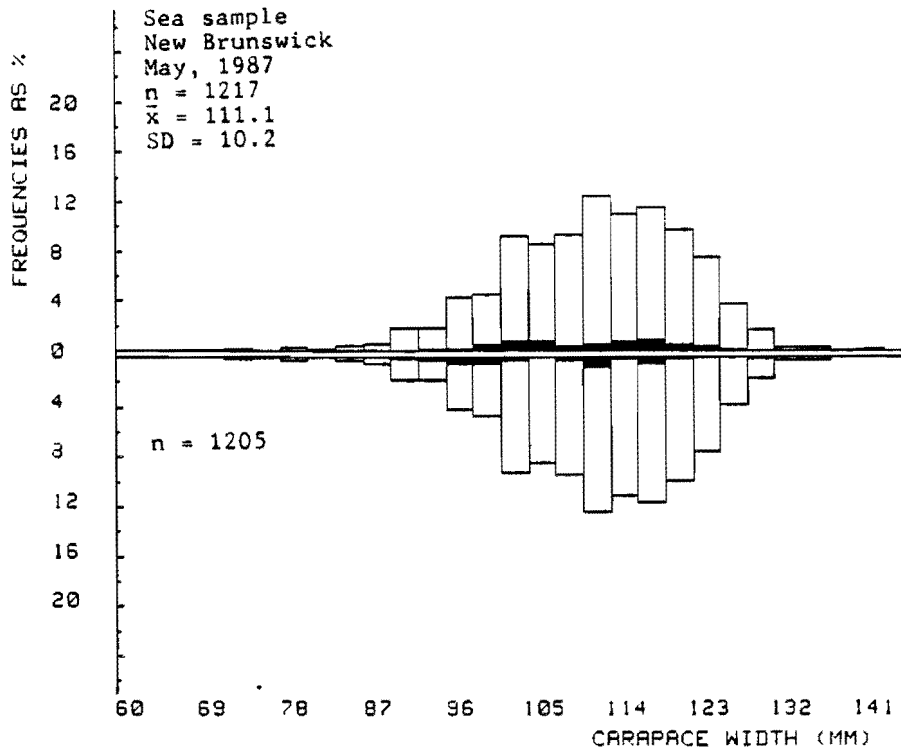


Figure 7: Monthly size distributions for sea samples of male snow crabs, Chionoecetes opilio, caught by Quebec and New Brunswick vessels during the 1987, SW Gulf of St Lawrence fishery.

Positive field: Total number of observations(%),
percentage of soft crab in black.
Negative field: Percentage of mature in white,
percentage of immature in black.

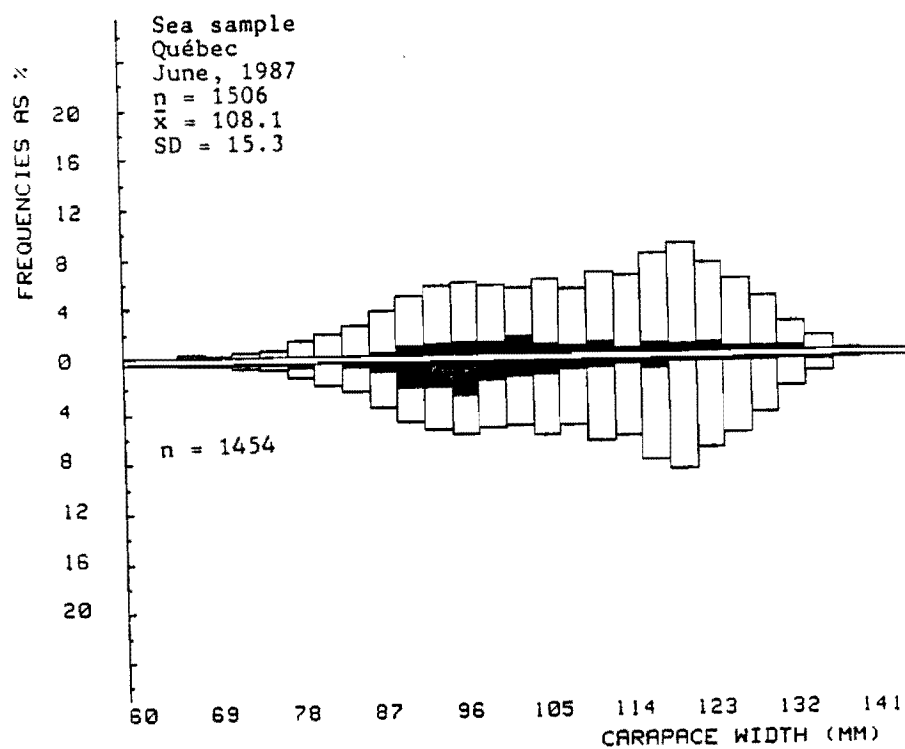
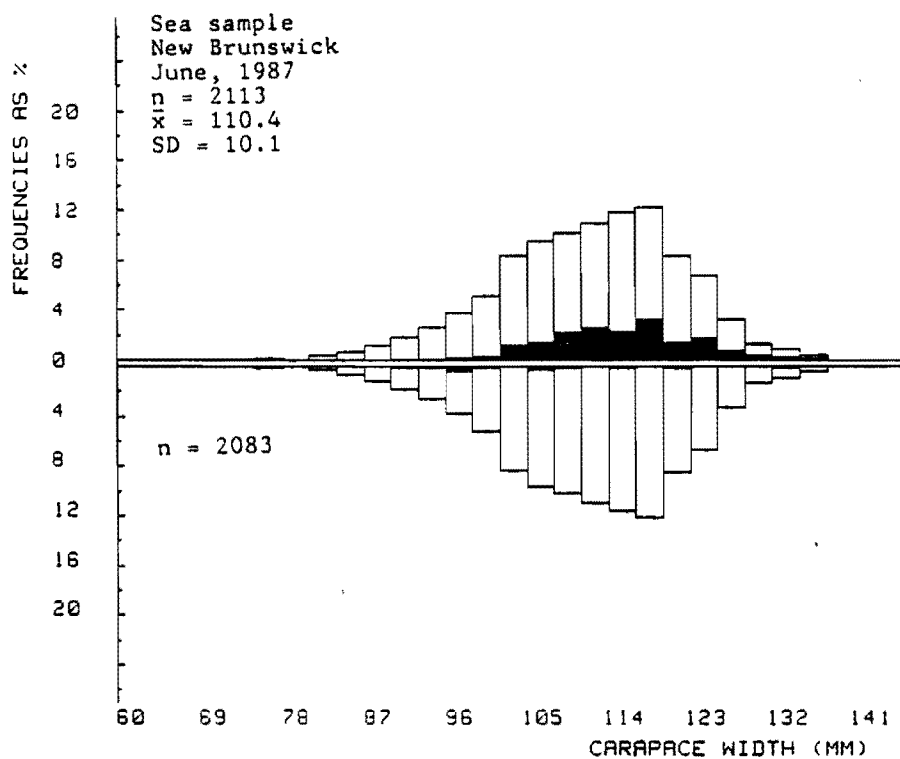


Fig.7 Cont.

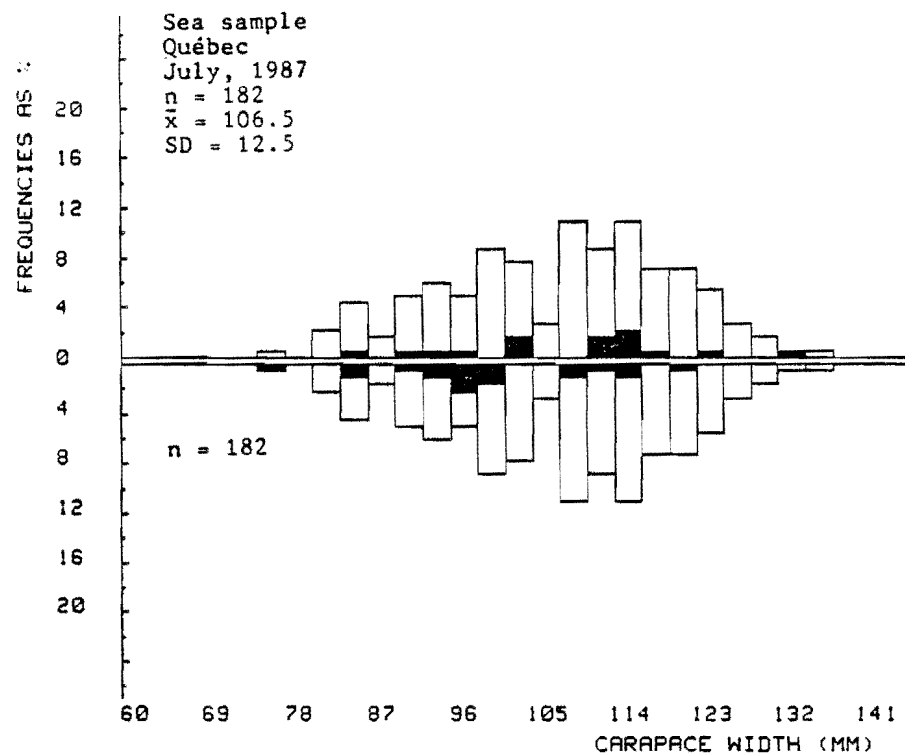
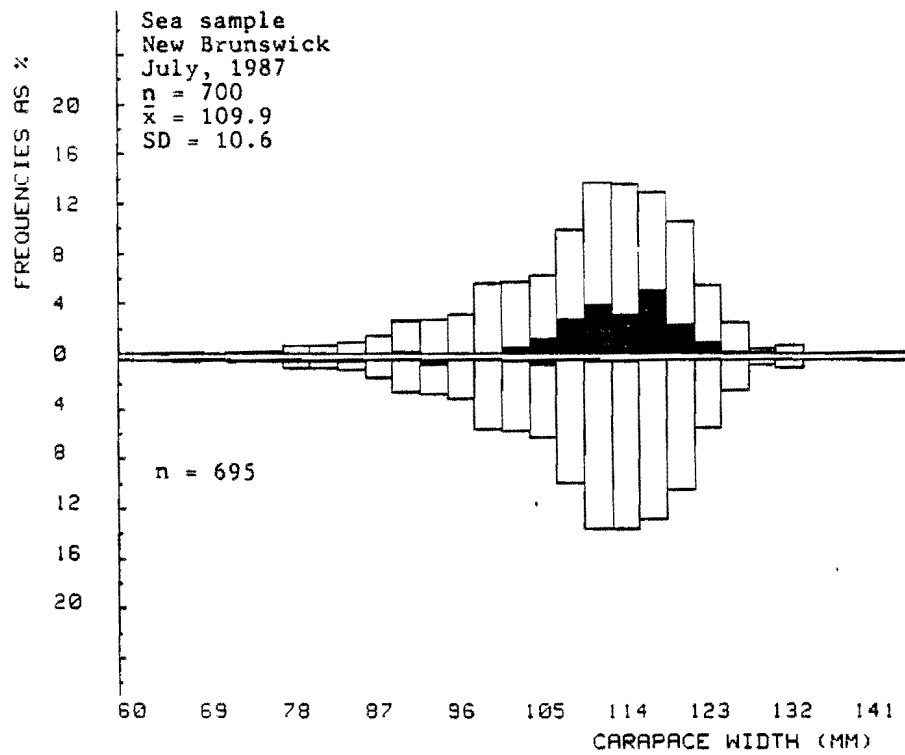


Fig. 7 Cont.

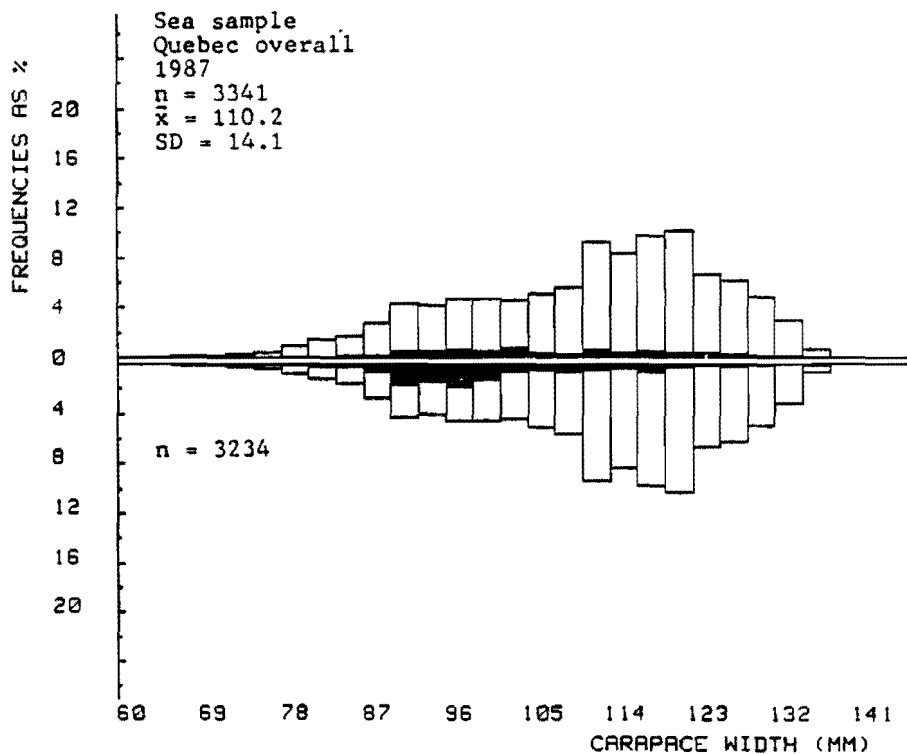
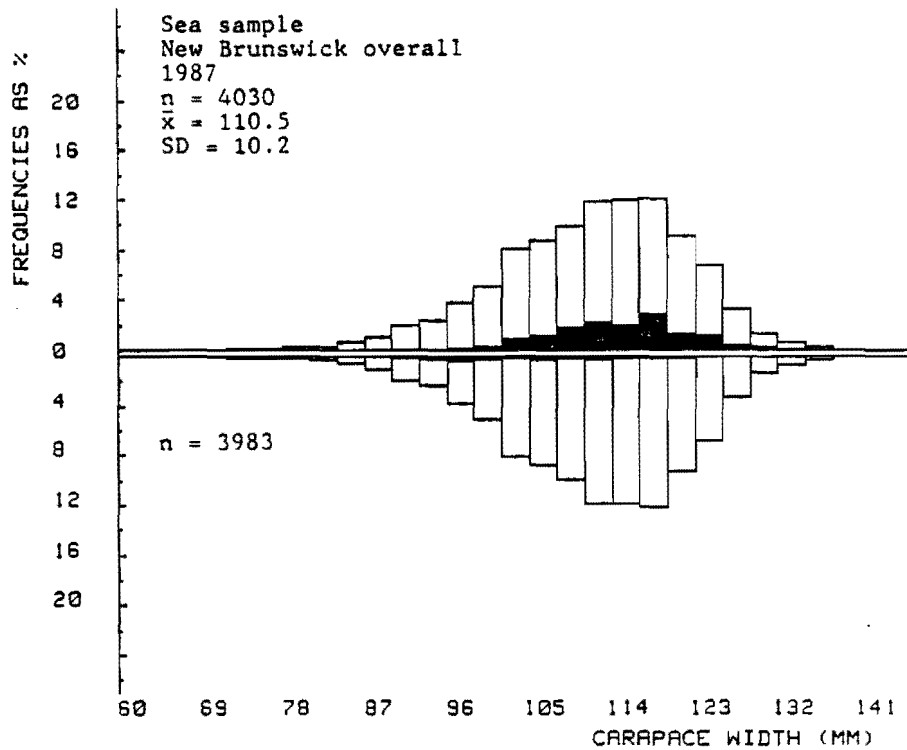


Figure 8: Seasonal size distributions for sea samples of male snow crabs, Chionoecetes opilio, caught by Quebec and New Brunswick vessels during the 1987, SW Gulf of St Lawrence fishery.

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

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

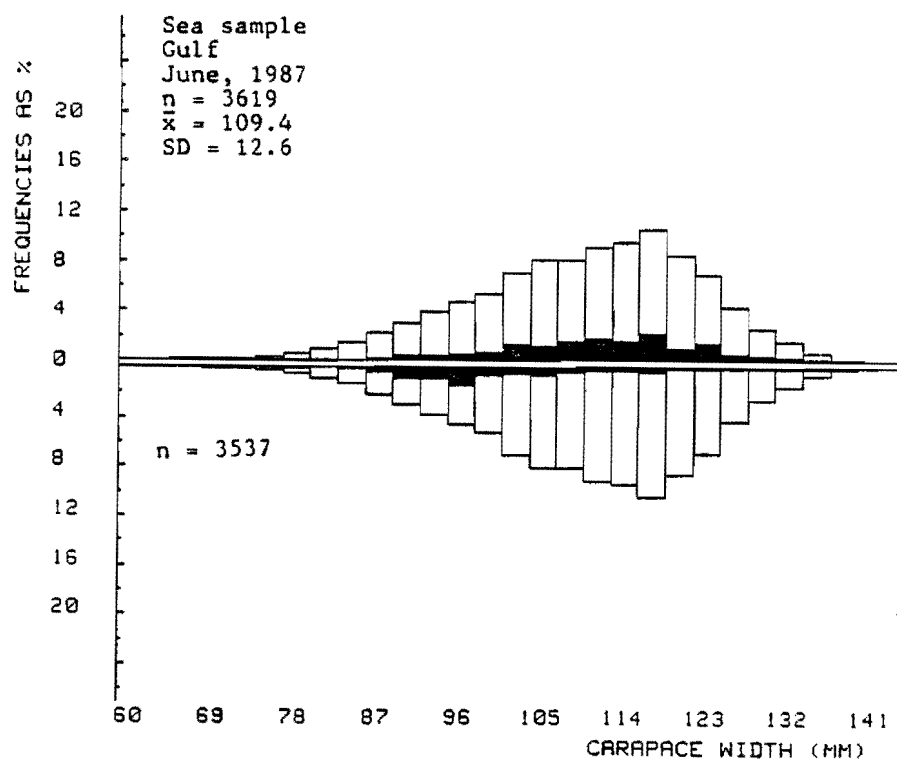
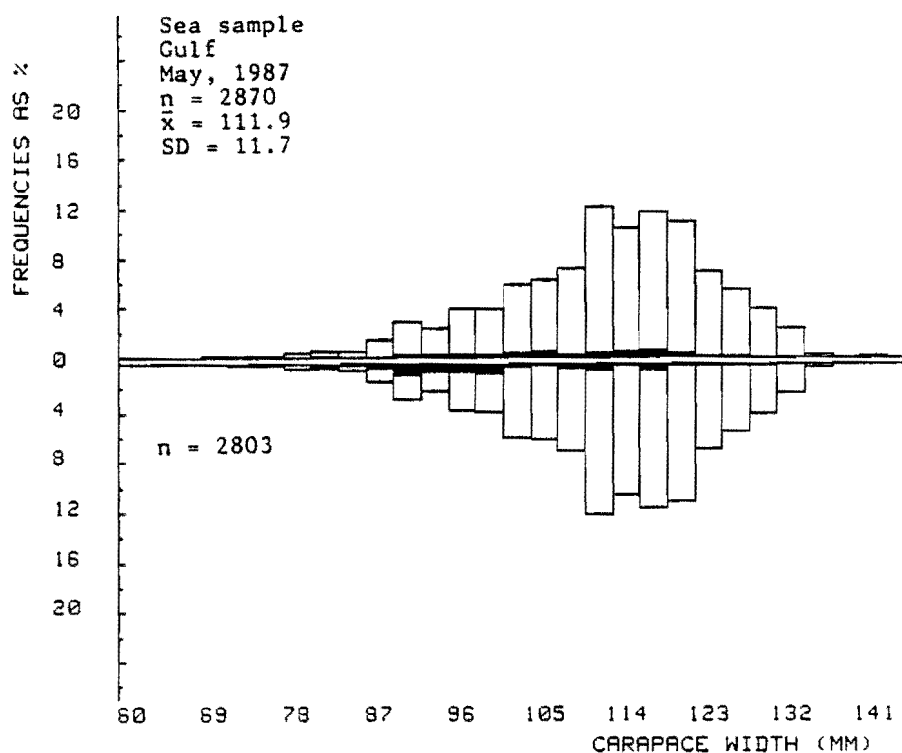


Figure 9: Monthly and overall size distribution for male snow crabs, Chionoecetes opilio, present in sea samples measured during the 1987, SW Gulf of St Lawrence fishery.

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

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

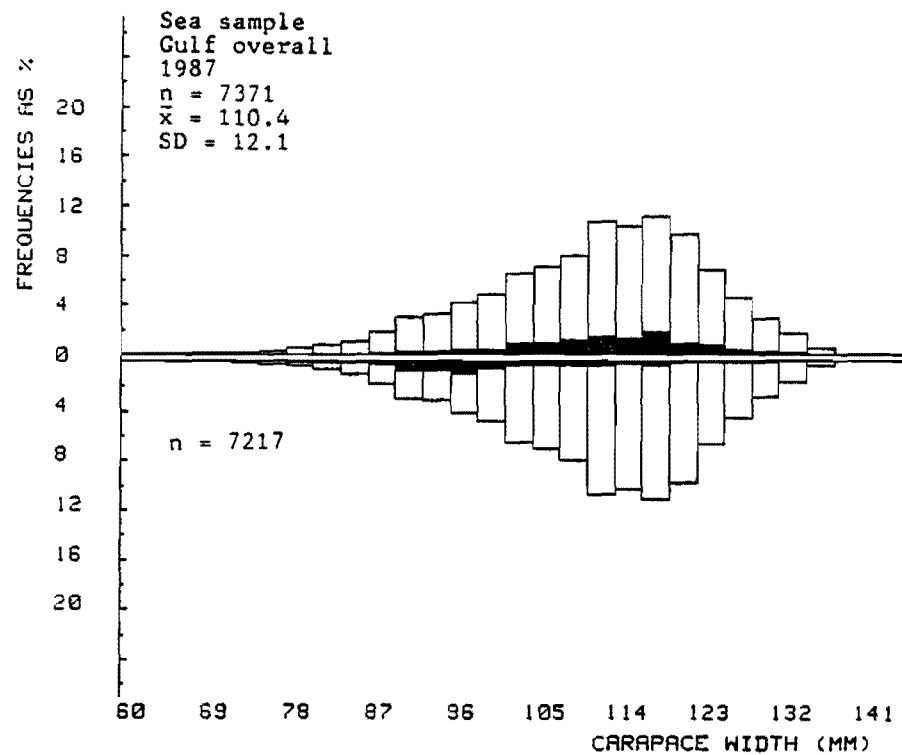
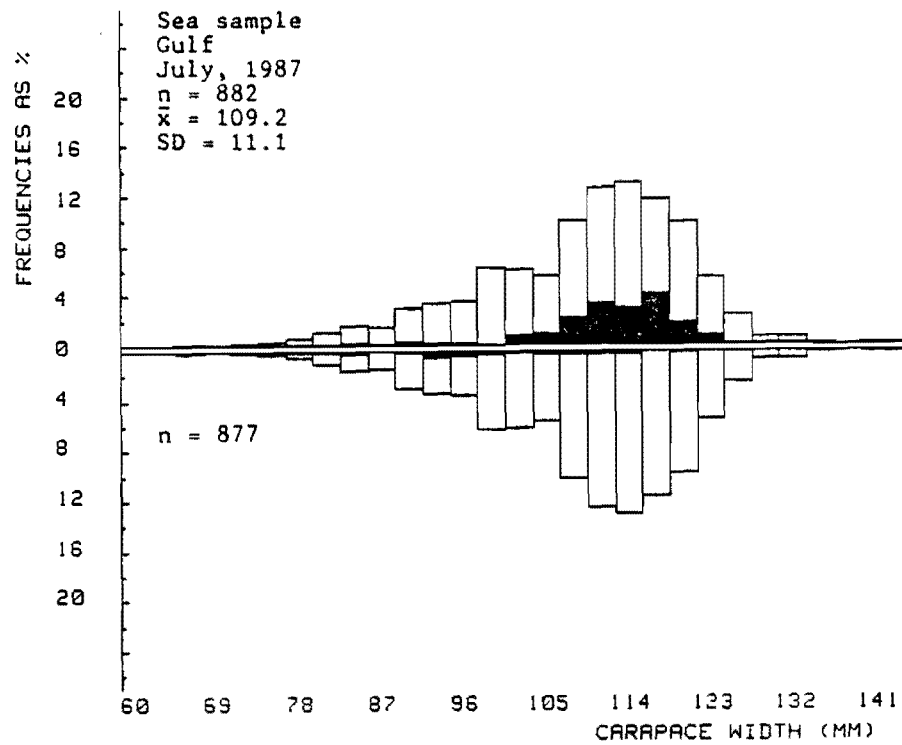


Fig.9 Cont.

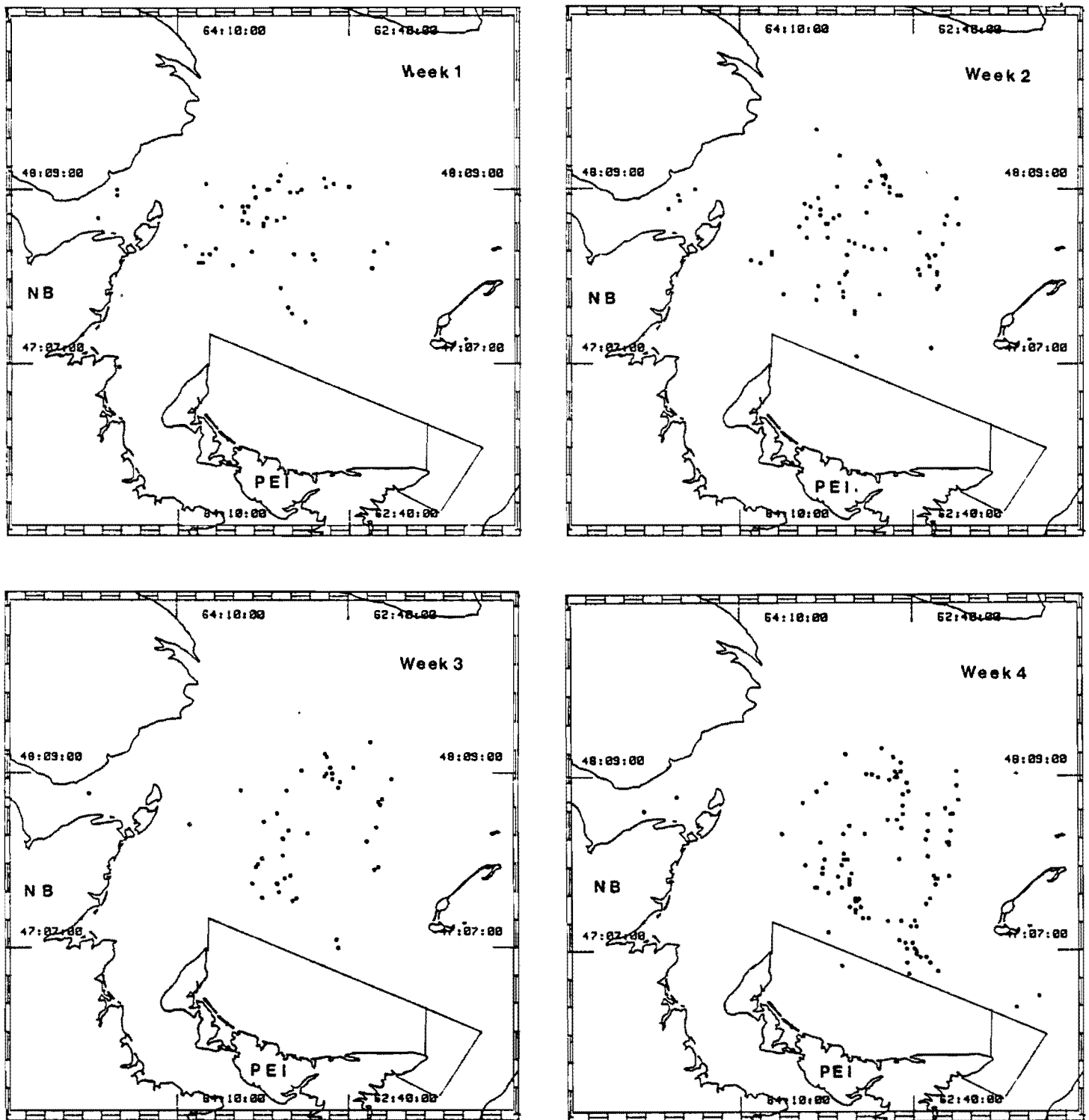


Figure 10: Weekly distributions of fishing effort for New Brunswick/Cape Breton Island snow crab, Chionoecetes opilio, fishing vessels participating in the 1987, SW Gulf of St Lawrence fishery.

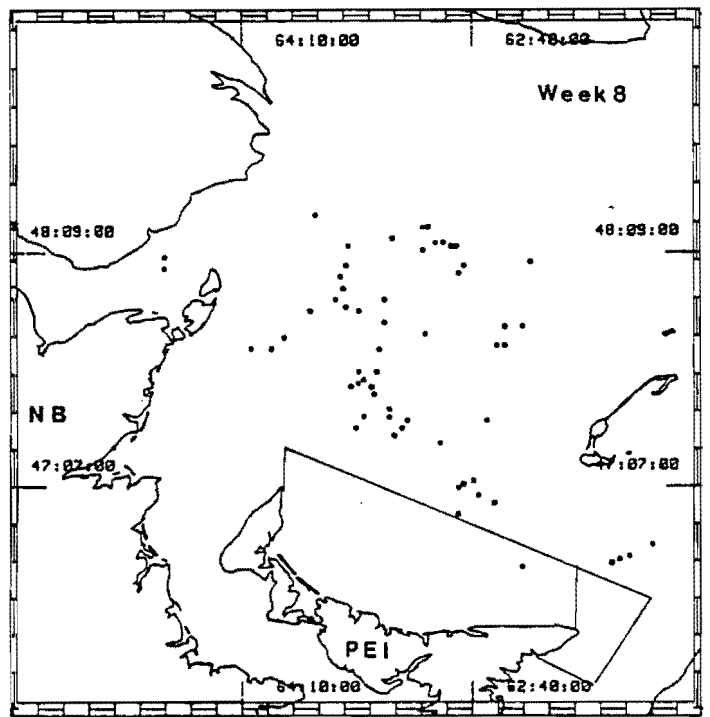
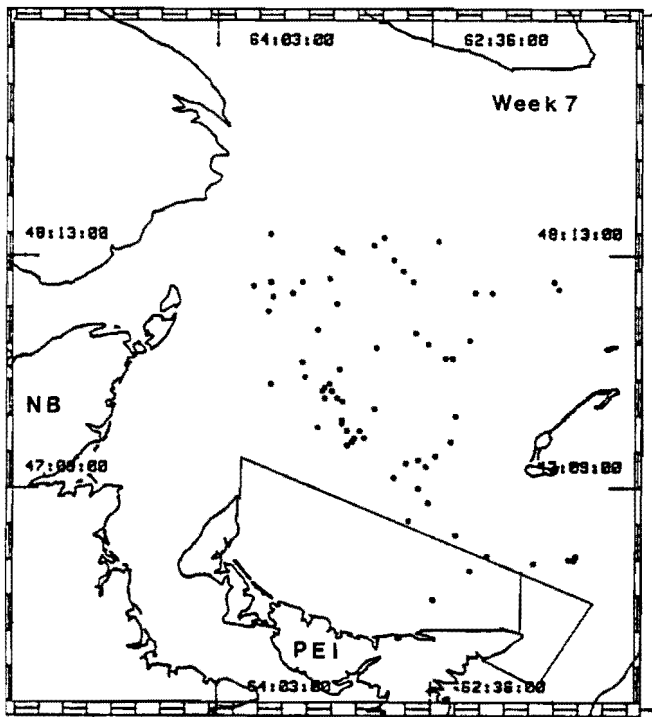
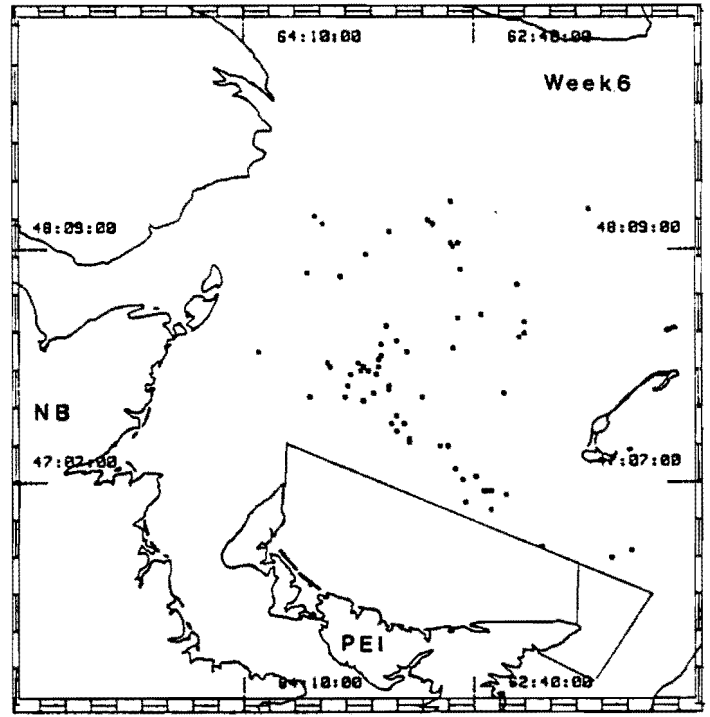
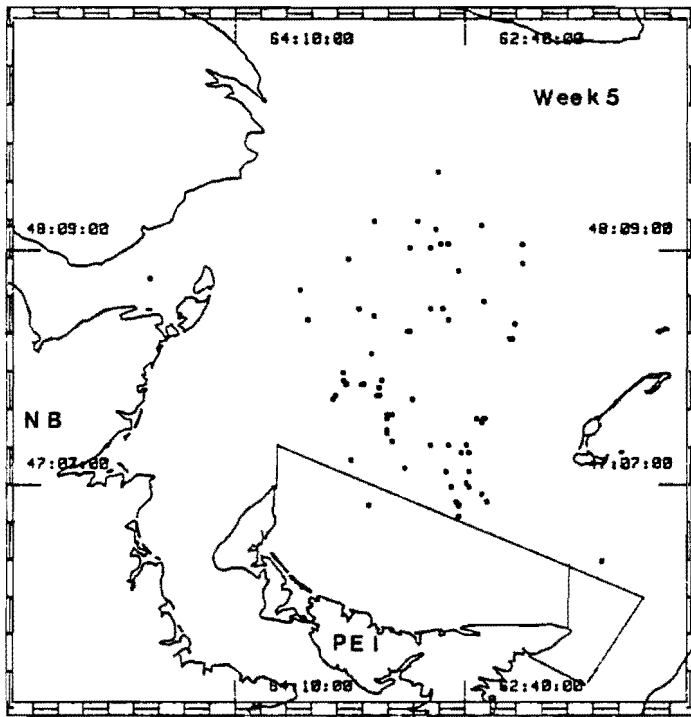


Fig.10 Cont.

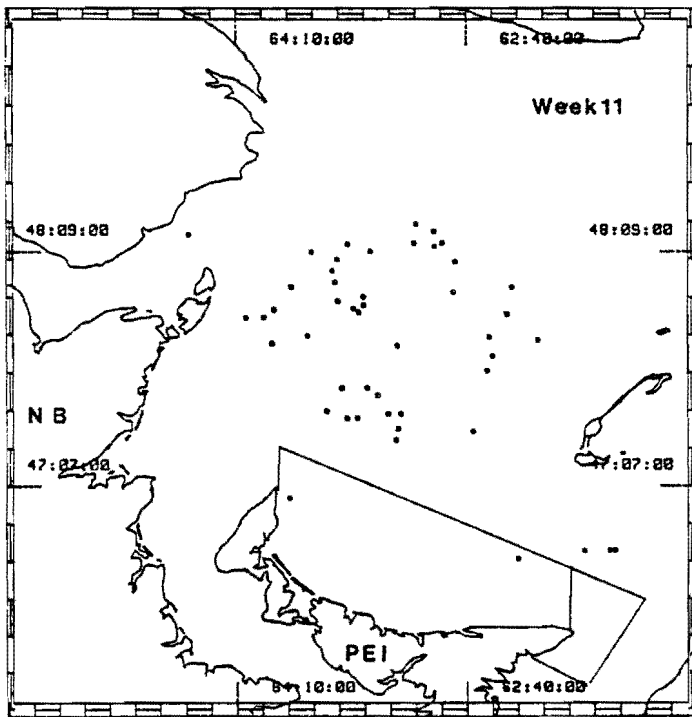
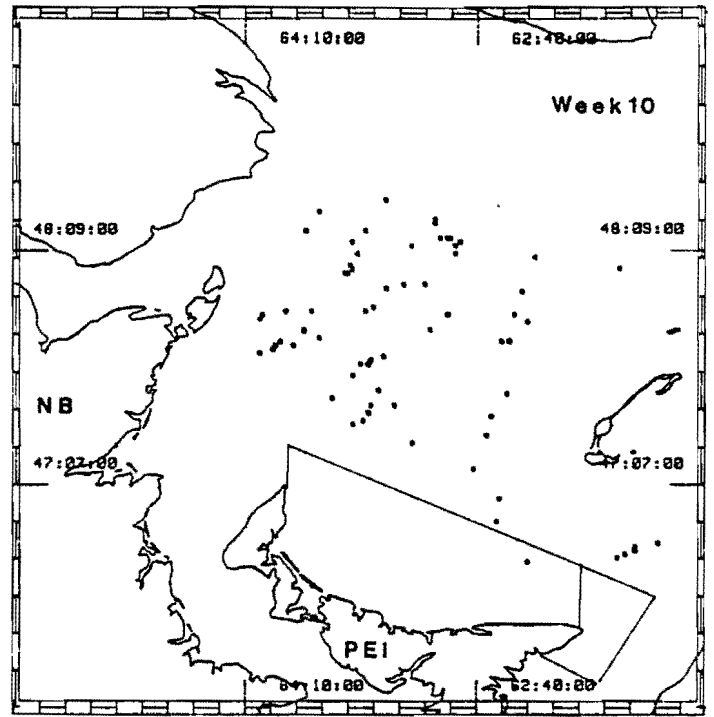
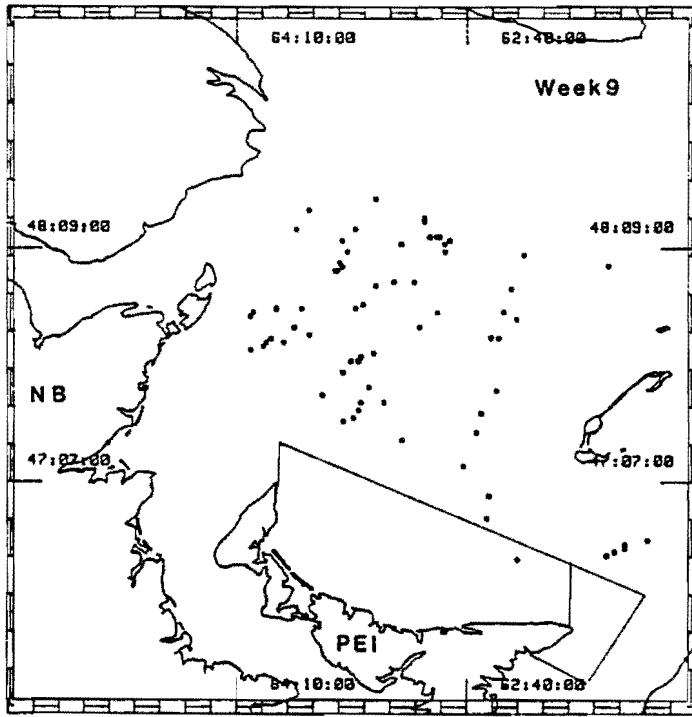


Fig. 10 Cont.

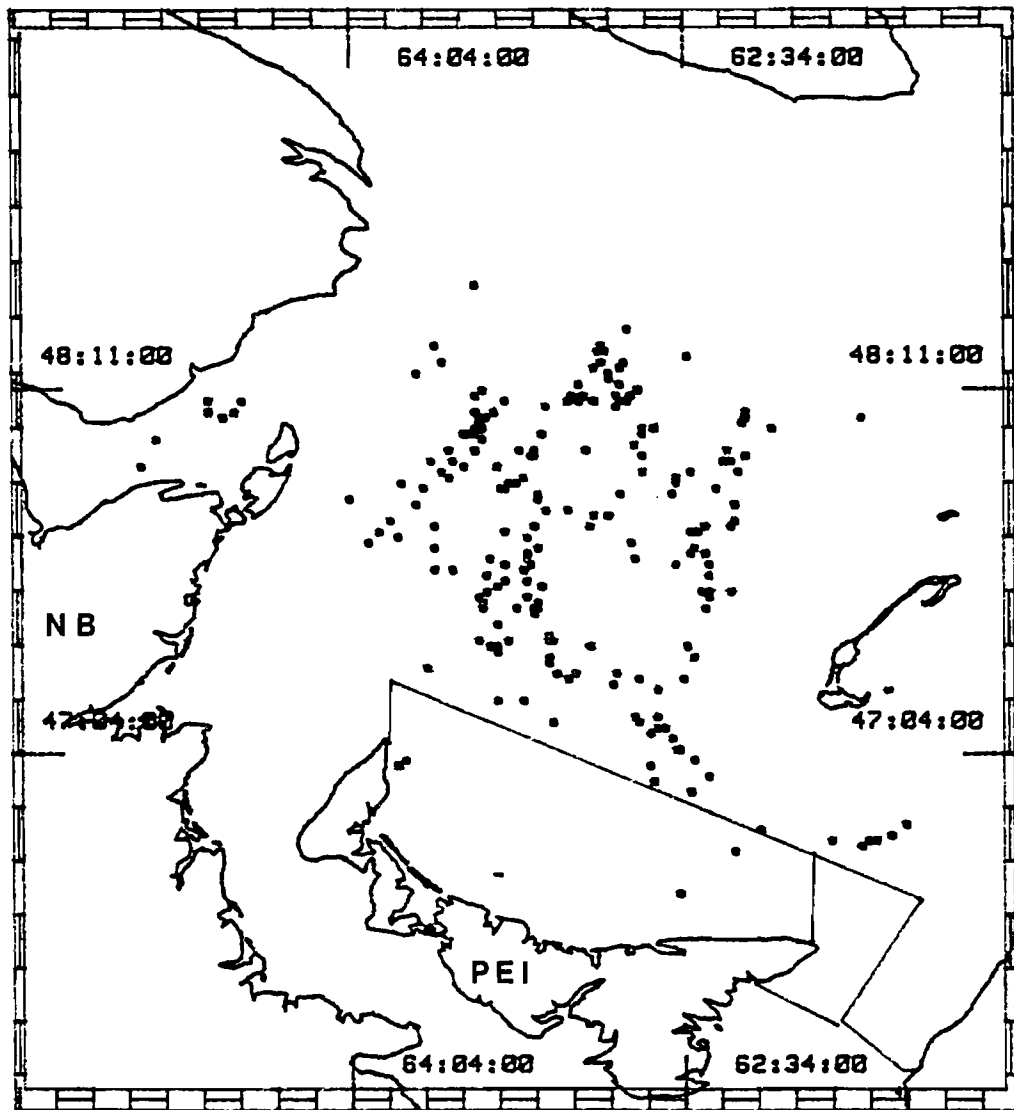


Figure 11: Overall distribution of fishing effort for New Brunswick/Cape Breton Island snow crab, Chionoecetes opilio, fishing vessels participating in the 1987, SW Gulf of St Lawrence fishery.

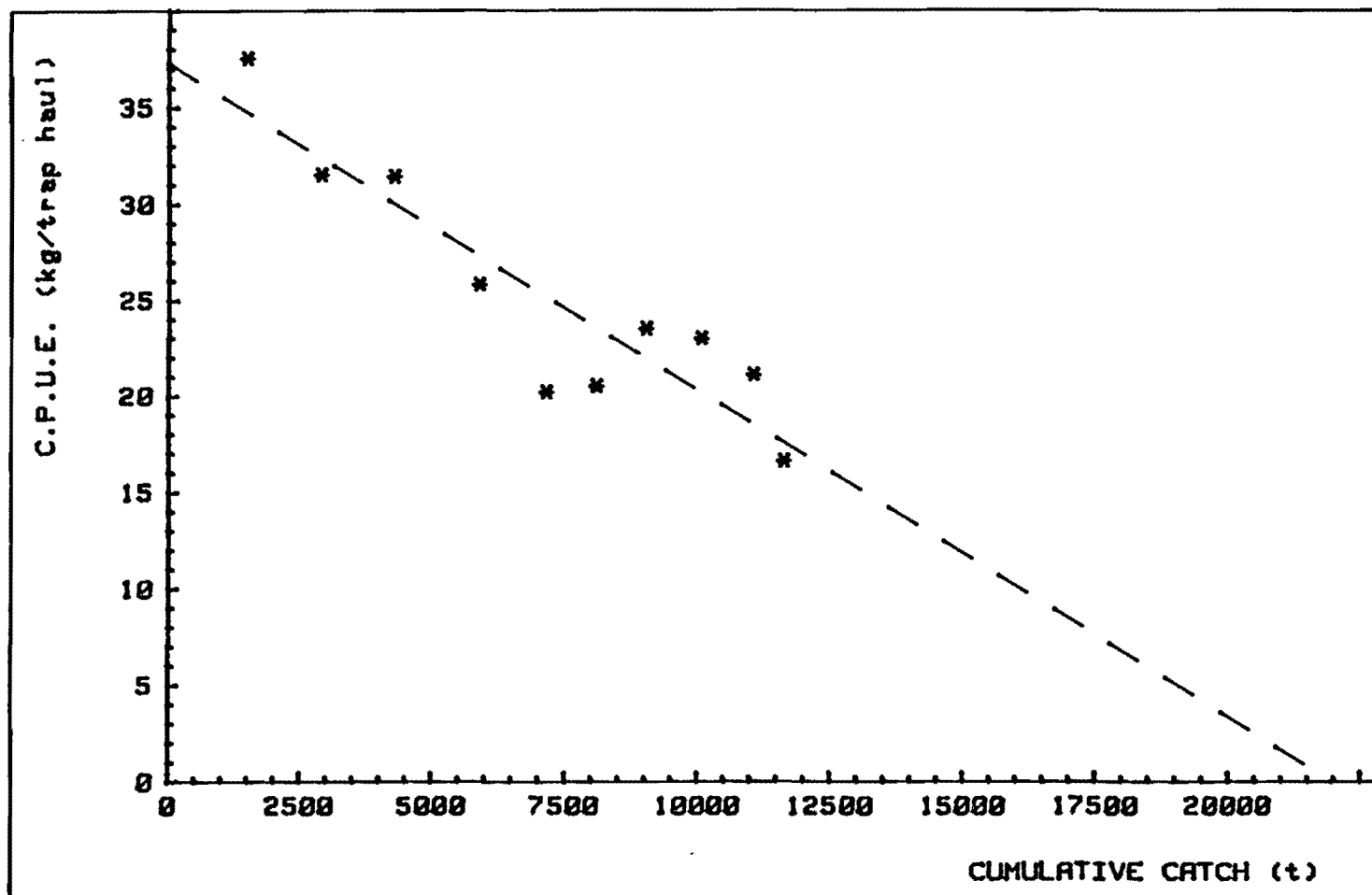


Figure 12: Leslie analysis results for catch (t) and effort CPUE data collected from fishermen's logbooks and processors sales slips for the 1987, SW Gulf of St. Lawrence snow crab, Chionoecetes opilio, midshore fishery.

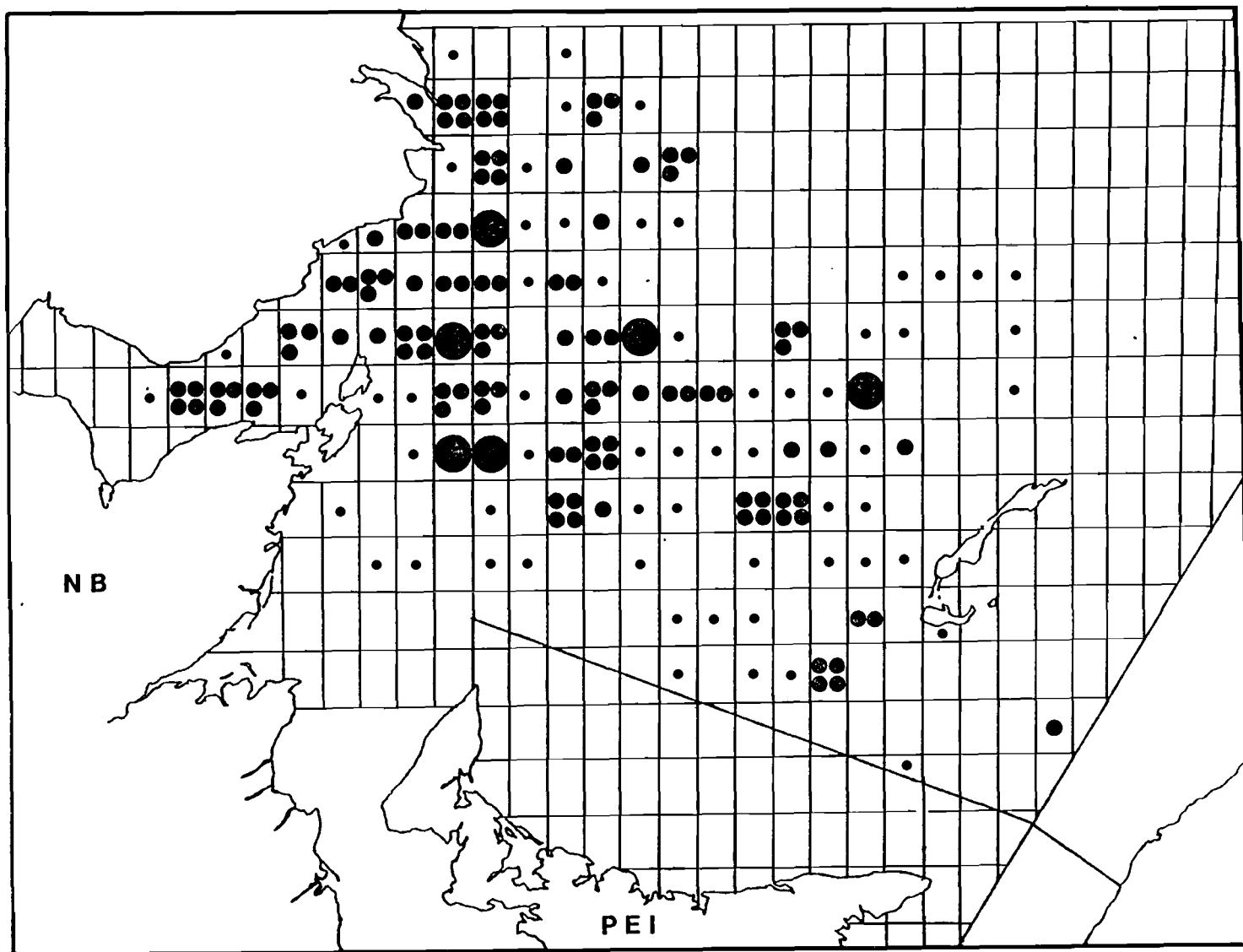


Figure 13: Distribution of fishing effort for the southwestern Gulf of St. Lawrence snow crab, Chionoecetes opilio, fishery in 1987 - The Quebec fleet.

• <1000 traps hauled
● >5000 traps hauled

● =1000 traps hauled

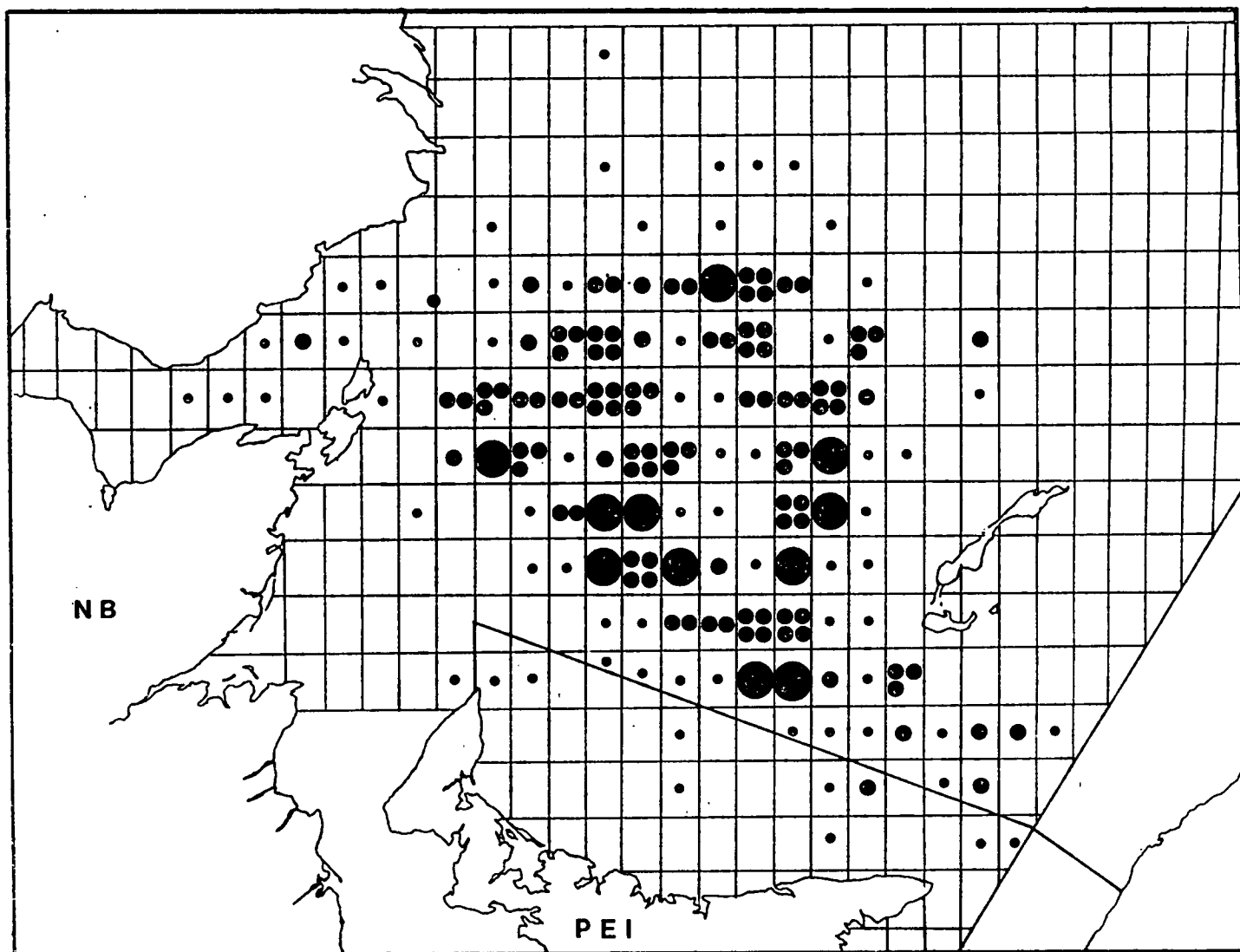


Figure 14: Distribution of fishing effort for the southwestern Gulf of St Lawrence snow crab, Chionoecetes opilio, fishery in 1987 - The New Brunswick fleet.

• <1000 traps hauled
 ● >5000 traps hauled

●=1000 traps hauled

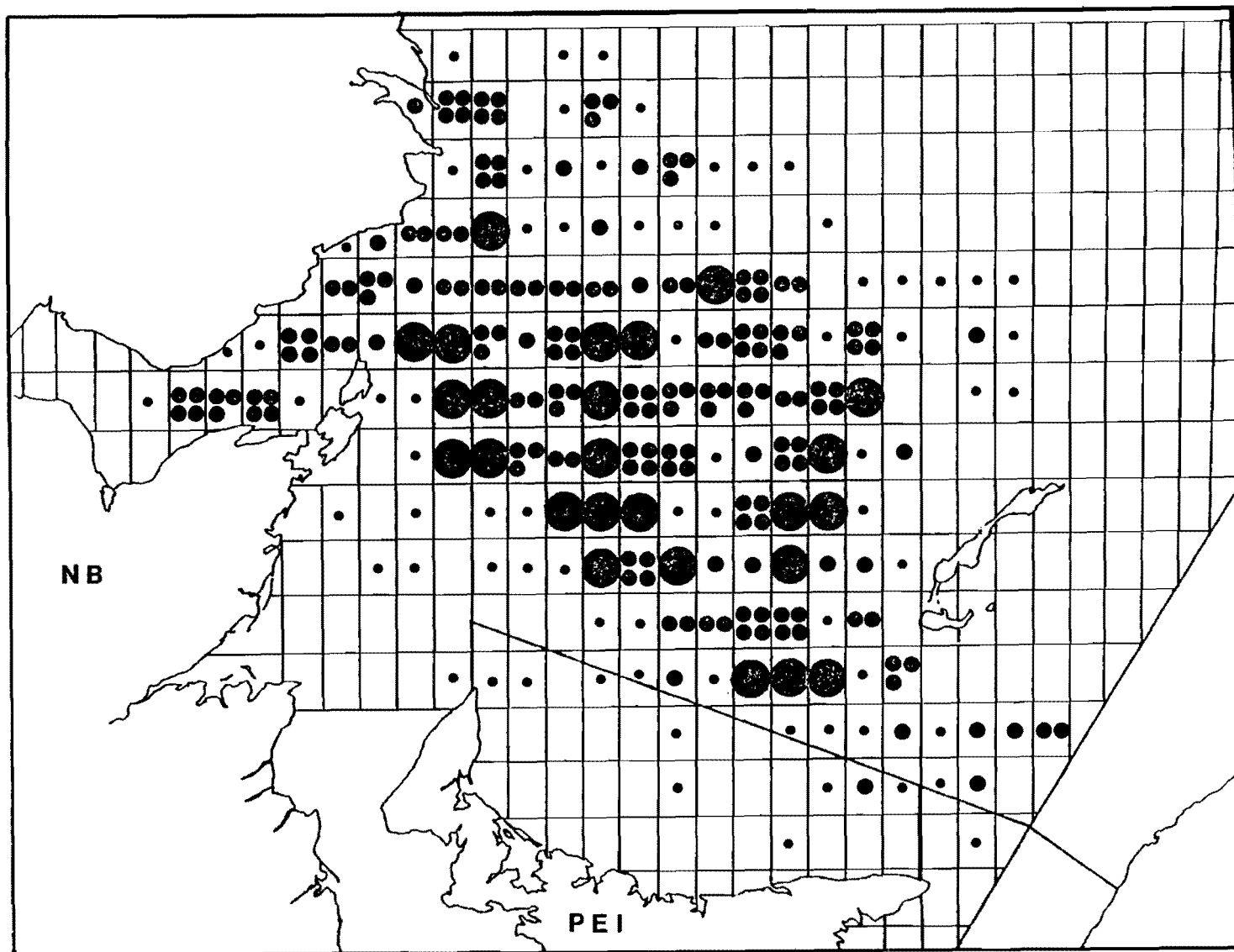


Figure 15: Distribution of fishing effort for the southwestern Gulf of St Lawrence snow crab, *Chionoecetes opilio*, fishery in 1987 - The New Brunswick and Quebec combined.

• <1000 traps hauled
 ● >5000 traps hauled

● =1000 traps hauled

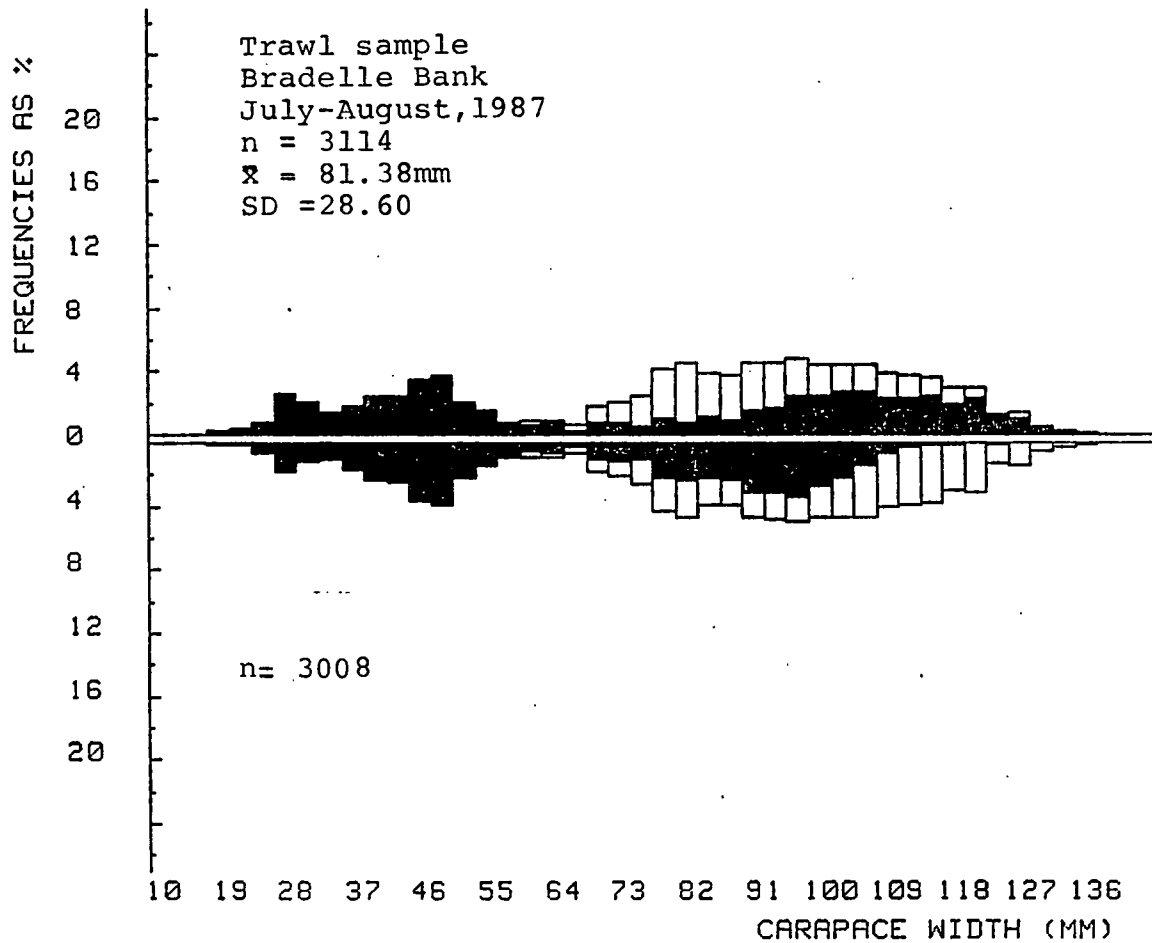


Figure 16: Overall size frequency distribution of male snow crab, Chionoecetes opilio, collected during post season trawl survey in the Bradelle Bank region

upper graph : total sample (open bar), soft shell crab (shaded bar)
lower graph : mature crab (open bar), immature crab (shaded bar)