Original

REPORT ON THE STATUS OF SNOW CRAB STOCKS IN THE SOUTHERN GULF OF ST. LAWRENCE (FISHING AREAS 12, 18, 19 AND 25/26)

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INTRODUCTION

This report provides an assessment of snow crab stocks in the southern Gulf of St.Lawrence (fishing areas 12, 18, 19 and 25/26). The data used to prepare this assessment, together with the technical details of the analyses used, will be published as a research document.

OVERVIEW OF SNOW CRAB STOCKS IN THE SOUTHERN GULF OF ST.LAWRENCE

History of the fishery — Table 1

The snow crab (*Chionoecetes opilio*) fishery in the southern Gulf of St.Lawrence (areas12, 18, 19 and 25/26) began in the mid-1960s. It has always been managed on the basis of fishing areas, with a specific management regime for each area. In 1994, landings for the southern Gulf of St.Lawrence totalled 23,324 t (quota of 23,435 t), accounting for 99.6% of the quota. Historical data on landings and quotas are presented in Table 1.

Area 12 — Figure 1

The largest snow crab fishery is in Area 12, which is located in the midshore sector. It is fished by 130 fishermen from New Brunswick, Quebec and Nova Scotia (Figure 1), with a trap limit of 150 per licence. The fishery expanded rapidly, and landings peaked in 1982 at 31,500 t. Landings then fluctuated around 25,000 t until 1986, falling to 11,700 t in 1987. Even lower catches were recorded in 1989 (7,800 t) (as a result of the early closure of the fishery due to a high incidence of soft-shelled crabs in the catches) and in 1990 (6,950 t). In 1994, landings increased to 19,995 t (quota of 20,000 t). Monitoring of the 1994 fishery revealed that the percentage of discards of the smallest crabs of legal size (< 102 mm) was 2.5%. However, no discarding of old-shelled crabs was detected. Surveys conducted in the last three years reveal that the age of the exploited part of the population is continually increasing. On the basis of the analysis of trawl survey results, the proportion of commercial-sized crabs having moss on the carapace rose from 3.1 % in 1992 to 14.9% in 1993 and to 16.2% in 1994.

Areas 18 and 19, Cape Breton Island — Figure 1

The fishing grounds along the west coast of Cape Breton Island were initially fished by a group of fishermen based in Chéticamp. Subsequently, fishermen from Quebec and New Brunswick sporadically fished in the area. With the increase in the commercial value of snow crabs in the late 1970s, the fishery gradually expanded to cover all fishing grounds along the west coast of Cape Breton Island. In 1978, Area 19 was established (Figure 1) as an inshore area reserved exclusively for inshore fishermen using vessels under 13.7 m (45 feet) in length. Landings, regulated by quotas, fluctuated between 900 t and 1,390 t from 1979 to 1991. In 1994, 74 fishermen

participated in this fishery, with a trap limit of 20 per licence. Since 1992, quotas have been set at 1,686 t and have been reached.

Area 18 was fished for the first time in 1979 by 14 inshore vessels with exploratory licences and a trap limit of 30 traps per licence. The following year, the licences were converted into permanent fishing licences and nine supplementary licences were issued to explore fishing grounds further offshore. Midshore vessels fished these same grounds until 1982. In 1984, Area 18 was reserved exclusively for inshore fishermen (Figure 1). The overall quota, which had initially been set at 835 t in 1981, was reduced to 626 t in 1986 and then increased to 674 t in 1988, where it remained for the 1990 season. In the spring of 1991, a quota of 200 t was set to promote a spring fishery in the area. Later that year, a quota of 674 t was set for the 1991 fall fishery and 1992 spring fishery. The quota was raised to 749 t for 1992-93, and remained at that level for 1993-94 and 1994-95. Since 1992-93, 30 fishermen have participated in this fishery.

Area 25/26 of Prince Edward Island **Figure 1**

The Prince Edward Island snow crab fishery, which comprises areas 25 and 26, began as an exploratory fishery in 1985 (Figure 1). In 1986, the number of licences issued was increased to 30. Since 1989, this fishery has been open only in the spring. In 1990, the two areas in question were reserved exclusively for fishermen from Prince Edward Island. Each of the 30 fishermen can use 50 traps. The largest total catch recorded to date was 1,239 t in 1986. Since 1990, this fishery has been subject to a quota, which was increased from 500 t to 1,000 t in 1994. The quotas have been reached every year except 1994, when the fishery was closed early due to a high incidence of soft-shelled crabs in the catches.

Biological unit and stock assessment in the southern Gulf of St. Lawrence

The status of snow crab stocks has traditionally been assessed on the basis of management areas. Chiasson et al. (1991) demonstrated that snow crab concentrations straddle management areas and crab concentrations are fished by fishermen from different management areas.

A detailed analysis of biomass fluctuations and the interpretation of size frequency distribution histograms derived from trawl surveys indicate that the status of snow crab stocks cannot be assessed on the basis of the current management areas, with the exception of Area 12, which is large enough and contains high concentrations of crab. It is clear that the current management areas do not correspond to biological units or independent entities. For the above reasons and in order to facilitate the interpretation of crab abundance data, an overall assessment is presented for the entire southern Gulf of St. Lawrence. The overall assessment was conducted on the basis of fisheries and trawl sampling survey data from 1990 to 1994. It should be noted that prior to 1992, trawl sampling in certain areas was carried out between the spring and fall fishery, which may introduce biases in the projections for the following year. Details for each area are also presented on the basis of the spatial distribution of crabs from trawl sampling surveys and the analysis of fishing activities. This approach provides a general overview of the changes in the

entire southern Gulf of St. Lawrence in order to more accurately interpret fluctuations in snow crab abundance in the various management areas.

STATUS OF SNOW CRAB STOCKS IN THE SOUTHERN GULF OF ST. LAWRENCE

Effort and catch per unit of effort — Figure 2

For all areas, fishermen's logbook catch/effort data were used to describe the general distribution of fishing effort per section 10 minutes of latitude by 10 minutes of longitude. In the 1994 season, fishing effort was concentrated on snow crab concentrations that straddle adjacent management areas, which confirms that the management units do not correspond to biological units (Figure 2).

Fishermen's logs were also used to obtain data on catch per unit of effort. However, these data cannot be used as abundance indices at this time because fishing activities are highly affected by socioeconomic factors (the number of weeks of work required to qualify for unemployment insurance, discarding of certain classes of crab, trips limits imposed by the industry, and the optimization of fishermen's income relative to vessel-related expenses required to reach their quotas) and by the fact that fishermen are provided with density contours produced during the fall survey before the opening of the subsequent fishing season.

Research survey — Figure 3

A bottom trawl survey was conducted for the first time in 1988 in areas 12 and 25/26. Beginning in 1990, the survey was conducted in the entire southern Gulf area. Sampling is carried out after the spring fishery in areas 12 and 25/26. Prior to 1992, sampling was carried out between the spring and fall fisheries in areas 18 and 19. Sampling in areas 18 and 19 after the fall fishery was not started until 1992. Catch data were standardized for a sampled area of 0.8 km^2. Kriging, a geostatistical technique, was used to estimate snow crab biomass and to produce density contour maps for the different classes of crab.

Spatial distribution — Figures 4 and 5

Isodensity maps, produced using kriging applied to the trawl survey data, clearly illustrate the increase in snow crab abundance between 1989 and 1993 (Figure 4). However, the area of high commercial concentrations declined slightly in 1994 compared to 1993. In addition, the area of concentration of small-claw crabs of carapace width greater than 56 mm has declined continuously since 1990 (Figure 5). We also observed that a part of the commercial crab concentration is found near the boundary of the sampled area since 1993, i.e., northwest of the Magdalen Islands in 1993 and east of Miscou Island in 1994.

Size frequency histograms **Figure 6**

Size frequency histograms from the trawl survey for individual coastal zones (18, 19 and 25/26) are not representative of the whole population, in part because snow crab concentrations straddle the boundaries of the management zones. For this reason only the size frequencies for the southern Gulf as a whole are presented (Figure 6). For the time being, the use of histograms is limited to following modes.

Size frequency distributions for 1994 are similar to those of 1993, except that in 1994 there is the appearance of small crabs of 15 - 28 mm. Following the three modes seen in 1988 (27 mm, 38 mm and 52 mm) indicates that the first of these cohorts of crab began to enter the fishery in 1991, resulting in an increase in biomass to the current level. However, the position of the modes remained relatively unchanged from 1993 to 1994. The appearance of crabs of 15-28 mm in 1994 will comprise the new recruitment in the future.

PROSPECTS

Recruitment estimates

Based on the results of post-season research surveys, forecasts were made regarding the classes of crabs that will be present after the molt in the following spring. This approach provides a snapshot of the situation at the start of the fishing season. For projection purposes, a growth model must be applied to the various size classes of crab as estimated at the time of the survey to simulate the situation after molting the following spring. The projections apply to male crabs only, since the females are not commercially fished. The model takes account of the fact that male crabs have a terminal molt in which they acquire large claws and stop growing.

The various groups of pre-recruit and recruiting crabs are described below based on their carapace width, claw size and shell hardness.

R – 3:" *recruits – 3 years*"

At the time of the survey: Crabs between 61 and 76 mm CW with small claws and a soft shell.

In the spring (projection): Most of these crabs will have molted but will not have gone through their terminal molt. They will fall in the 76 to 95 mm CW size range; they will have small claws and a soft shell. Some of these crabs have gone through their terminal molt and become "dwarf" crabs.

In the summer, during the fishing season: These crabs are not available to the fishery, as they are too small.

R – 2: "*recruits – 2 years*"

At the time of the survey: Crabs between 76 and 95 mm CW with small claws and a soft shell.

In the spring (projection): Most of these crabs will have gone through their terminal molt and reached the minimum legal size. They will have acquired large claws, but their shell will be soft (group R-1). Some of these crabs will have gone through a molt that is not the terminal molt, so they will still have small claws and a soft shell. Small-clawed crabs of carapace width greater than 95 mm are called group R'-2 to distinguish them from those of R-2 (CW 76 - 95 mm); they have further growth potential and they make up part of potential recruitment to the fishery in two years.

In the summer, during the fishing season: These crabs are not available to the fishery, as they have a soft shell.

R – 1: "*recruits – 1 year*"

At the time of the survey: Crabs of legal size with a soft shell and large claws. These crabs have just gone through their terminal molt.

In the spring (projection): The shell of these crabs will have hardened, but their size will remain unchanged. These crabs will be added to the accumulated biomass of crabs over 95 mm CW, with a hard shell and large claws.

In the summer, during the fishing season: These crabs contribute to the commercial biomass and will be fully available to the fishery.

R: "*recruits*"

At the time of the survey: Crabs of legal size, with large claws and a hard shell, which have not been harvested during the fishing season just ended because the exploitation rate is not 100%. It is difficult to separate crabs that have recruited to the fishery in the current year from those which recruited in earlier years (unless shell appearance is noted and classified) and whose biomass is accumulating.

In the spring (projection): These crabs will be part of the accumulated biomass consisting of crabs over 95 mm CW, with a hard shell and large claws.

The model used contains certain sources of inaccuracy. First, it does not take natural mortality into account. Second, the model assumes that all crabs molt once a year, every year, until terminal molt and that growth is constant at 25%. In fact, some crabs may not molt in a given

year; they are said to "skip" molt. However, the proportion of animals in a given size class that does not molt is unknown. Third, the model assumes that trawl efficiency is 100% for snow crabs larger than 30 mm CW.

Estimate of abundance of classes R – 2 and R – 1

Year of survey	1990	1991	1992	1993	1994
R – 2 [SC 76 mm < CW < 95 mm] nbr x 10^3 (±%)	111,111 (±18.3%)	132,435 (±14.0%)	97,256 (±27.5%)	80,187 (±26.5%)	70,851 (±15.7%)
R'-2 [SC 95mm < CW] nbr x 10^3	25,482 (n/a)	37,214 (n/a)	20,674 (n/a)	40,087 (n/a)	39,064 (n/a)
Total (R-2 + R'-2) [SC 76mm < CW] nbr x 10^3 (±%)	136,593 (19,8%)	169,649 (16%)	117,930 (26,6%)	120,274 (21,0%)	109,915 (16,5%)
R – 1 [LC 95 mm < CW] nbr x 10^3 (±%)	30,415 (±20%)	37,483 (±21%)	48,185 (±19.6%)	62,529 (±24.8%)	56,759 (±28.4%)

SC: small claw; LC:large claw; CW: carapace width

Numbers of crabs in the R-2 group reached a maximum in 1991 and have decreased steadily since then; in 1994, abundance of this group was about 53% of the maximum value observed and was some 12% lower than in the 1993 survey. Abundance of the R'-2 group has varied since 1990, remaining relatively high in 1993 and 1994. Total abundance of these two groups, that is the potential recruitment (R-2 + R'-2) declined significantly between 1991 and 1992 but has remained more or less constant at 110 - 120 x 10^6 animals from 1992 to 1994.

If the growth model described above was a perfect representation of crab growth, total abundance of the two groups (R-2 + R'-2) would be an accurate predictor of recruitment two years after the survey. However, several biological factors whose importance is currently unknown complicate recruitment predictions based on the total abundance of these two groups. For example, the fact that abundance of the R'-2 group increased at the same time that abundance of the R-2 group was declining indicates that small-clawed crabs are tending to continue to molt after reaching commercial size since 1993, rather than going through terminal molt.

The decline in abundance of crabs in group R-2 indicates that recruitment to the fishery will decline in the future. However, the contribution to recruiting biomass of a given number of R'-2 crabs will be greater than the same number of R-2 crabs since individual weight of the former is greater. As a result the decline in recruitment which would be expected based on the decline in R-2 abundance may be lessened over several years by recruitment to the fishery (molt to maturity) of the R'-2 crabs. The extent of the anticipated decline in recruitment will depend on the timing and extent of terminal molting by the R'-2 crabs.

It is difficult to forecast the level of recruitment more than one year in advance. The factors that determine molt to maturity and skip molt are poorly understood. A detailed study will be necessary to improve the capacity to forecast beyond one year.

Commercial biomass

Projections of commercial biomass that will be available to the fishery at the beginning of each season, i.e., snow crabs larger than 95 mm CW with large claws and a hard shell, are provided in the following table. For inshore areas, these figures are considered relatively accurate at the time of the survey, but the projections for the following spring may be affected by several factors, including the fact that the crab concentrations straddle fishing areas. The figures in parentheses indicate the value that must be added to and subtracted from the estimate to obtain the upper and lower limits of the 95% confidence interval.

Commercial biomass estimates

Area	Southern Gulf	Area 12	Area 25/26	Area 19	Area 18
1989		8,676 (±3,635)	472 (±570)		
1990		21,748 (±11,614)	1,298 (±1,274)		
1991		23,444 (±12,402)	1,325 (±950)		
1992		29,443 (±14,714)	2,665 (±1,661)	5,459 (±1,942)	
1993	46,483 (±19,338)	37,771 (±14,175)	2,208 (±1,787)	5,226 (±2,205)	1,278 (±1,171)
1994	68,832 (±10,710)	61,936 (±8,176)	623 (±455)*	2,300 (±621)	1,256 (±1,043)
1995	66,145 (±9,092)	58,682 (±6,748)	2,175 (±840)	2,598 (±1,045)	1,195 (±1,060)

*Caution must be exercised in the use and interpretation of the values for Area 25/26 in 1994 because the survey was not completed in this area in 1993.

The table demonstrates that the commercial biomass (≥95 mm CW with large claws and hard shell) in the southern Gulf and inshore areas for 1995 will be similar to 1994 levels.

Forecast of the incidence of soft-shelled crabs

An estimate of the number of soft-shelled crabs larger than 70 mm CW that will be present in the fishing grounds at the beginning of the fishing season is provided in order to give fishermen an indication of the amount of soft-shelled crabs they will encounter during the fishing season. Given that the number of soft-shelled crabs has been declining since 1991 and that the commercial biomass is relatively high, there should not be a high incidence of soft-shelled crabs in the 1995 season. Since the number of crabs in size classes R−3, R−2 and R−1 may give only an indication of recruitment trends in the future, these figures should not be used for a detailed forecast of recruitment.

Number of soft-shelled crabs larger than 70 mm CW (x 10^3)

Area	Southern Gulf	Area 12	Area 25/26	Area 19	Area 18
1989		119,040			
1990		287,000			
1991		368,020	20,980		
1992		225,780	17,540	17,240	
1993	218,280	199,100	9,440	6,120	3,610
1994	156,200	148,310	150*	4,860	1,060
1995	169,580	147,630	3,410	5,290	3,430

* Caution must be exercised in the use and interpretation of the values for area 25/26 since the survey was not completed in this area in 1993.

CONCLUSION

Retrospective

Since 1989, the management of snow crab stocks in the southern Gulf of St. Lawrence has been based on the protection of soft-shelled crabs and, since 1990, on annual quotas set on the basis of biomass. These management measures coincided with a pulse of recruitment, which resulted in an increase in CPUE in this fishery.

The performance of the fishery in Area 12 in 1994 and the results of the post-season trawl survey are consistent with the forecasts made on the basis of the 1993 trawl survey. It had been projected that commercial biomass would increase considerably in 1994 and that this increase would result in high CPUEs in 1994. It had also been projected that recruitment into the fishery in 1995 would be good. The 1994 survey indicates a slight reduction in biomass available to the fishery and good recruitment in 1995.

These forecasts are not, however, 100% accurate as indicated in the following table, which compares the results of the two different methods of estimating recruitment. Method 1 gives estimates based on the abundance of the R – 1 class in the survey of a given year expressed in recruitment for the following year (for example, the estimate of crabs in class R – 1 for 1994 gives the recruitment for 1995). Method 2 provides estimates based on a projection of the total commercial biomass for a given year calculated on the basis of the survey of the previous year less the harvestable biomass remaining after the fishery of the previous year (for example, the total commercial biomass for 1995 based on the 1994 survey minus the biomass remaining after the fishery for 1994 gives the recruitment for 1995).

Comparison of recruitment estimates in Area 12

	1990	1991	1992	1993	1994	1995
Method 1 (t)	19,741	15,082	13,659	22,491	34,052	27,606
Method 2 (t)	20,854	8,646	16,018	19,563	38,501	16,741
Ratio	1.06	0.57	1.17	0.87	1.13	0.61

As we can see, the calculations do not reveal any systematic upward or downward deviations. Generally speaking, the two recruitment estimates coincide relatively well, on the order of 20%, although for 1991 and 1995, the discrepancies are more pronounced. As a result, caution is required in the use and interpretation of these biomass forecasts.

The 1994 report on the status of snow crab stocks in the southern Gulf of St. Lawrence mentioned that long-term forecasts suggested a significant decline in recruitment into the fishery in 1996. This forecast was based on the low numbers of crabs in class R – 3 (from 61 mm to 76 mm CW) in 1993, as indicated by the size frequency distribution histograms. In order for the forecast to be realised, there would have to have been a marked decline in the total of crabs in groups R-2 and R'-2 in the 1994 survey. As noted above, the total abundance of crabs in these groups has remained more or less the same from 1992 to 1994.

The current state of our knowledge does not allow us to make accurate forecasts more than one year in advance.

Prospects

The size frequency distributions of male snow crab caught during post-season trawl surveys from 1988 to 1993 show the progression of the modes of crabs that appeared in 1988. However, a comparison of the histograms of 1993 and 1994 show that the relative abundance of the different classes has changed little for crabs over 65 mm CW. The appearance of small males in the 15-28 mm CW size range was observed in the southern Gulf in the 1994 survey, and will comprise the recruitment into the fishery in the future. This is the first time such a large number of small crabs has been observed since the 1988 and 1989 surveys. It is still too early to say whether their effect on recruitment in the southern Gulf will be comparable to the 1988-89 recruitment. It is clear that progression of small crabs (< 55 mm CW) of 1988 towards the commercial size was slower than predicted by the growth model described above (which assumes that there is a 25% increase per molt, that there is one molt a year and that crabs molt to the large-claw form when they reach the commercial size). As a result, it is difficult to predict precisely when the weak abundance of crabs sized 40-76 mm observed in the 1993 and 1994 surveys will affect the fishery.

The commercial biomass of snow crab in the southern Gulf is relatively high. However, the life expectancy of terminal molt crab rarely exceeds 5 years, the appearance of the carapace deteriorates with time and, on average, the crab become dirty in less than 3 years. An increase in natural mortality

among old crabs is possible in the future. In addition, there is evidence that the catchability of crabs declines as the carapace ages, which could further reduce catches of old crabs. Given the continual decline in recruitment (R – 2) and in small-claw crabs (56 mm ≤ CW) since 1991 combined with aging of the population, it is highly likely that the abundance of the resource will decline in the future.

Based on total abundance of the two groups making up potential recruitment (R-2 + R'-2), recruitment to the fishery for the years 1994 - 1996 should be approximately constant, assuming no dramatic changes in the rate of molt to maturity in these groups (it will be recalled that available biological information does not allow predicting recruitment accurately more than a year in advance). Taken with the observed aging of the harvestable part of the population in 1994 and assuming fishery removals in 1995 of the same order as in 1994, this conclusion would suggest a slight decrease in harvestable biomass in 1996. The decline in abundance of the R-2 group since 1991 suggests that recruitment should decline after 1996. This decline would be expected to continue as the weak cohorts observed in size frequencies in the 1993 and 1994 surveys recruit to the fishery. Presence of small crabs 15 - 28 mm in the 1994 survey suggests that recruitment may improve after the period (5 - 6 years) of anticipated lower recruitment.

The short and long-term forecasts may be biased by such factors as sampling errors in the survey and analysis problems (crab concentrations are sometimes situated at the boundaries of the area sampled as noted in the 1993 and 1994 surveys, and there is the possibility of dispersion of the crabs between the time the survey is conducted and the start of the following fishing season). In addition, biological factors, such as changes in natural mortality, could have a significant impact. Long-term forecasts are also affected by our lack of knowledge of the growth pattern of the species.

Exploitation strategies

In the 1994 stock status report, two exploitation strategies were described: (1) maximize catches in the short term or (2) spread catches over a period of years to offset the anticipated decline in recruitment. The two strategies presented last year are still applicable today:

> Maximize catches over the short term. This approach would make it possible to take advantage, in the short term, of the abundant snow crab stocks that are currently available and that will decline in quantity and quality in the future. The higher the quota and the lower the recruitment into the fishery, the faster the available biomass will decline.
>
> Spread catches over a period of years. By opting for smaller catches in 1995, it should be possible to maintain a population of commercial-sized males with a range of appearances and survival potentials, to serve as a buffer for the anticipated period of low recruitment into the fishery that could occur after 1996. However, the appearance of the snow crabs caught would deteriorate as the carapace ages.

If the second strategy is adopted, it is critical that the industry not target only the best crabs in the upcoming fishing seasons. If all old crabs are discarded, an increase in mortality and a reduction in their catchability could be expected.

Four possible TAC scenarios for the southern Gulf are presented below, based on the following criteria: (1) the same quota as in 1994; (2) the same exploitation rate as in 1994; (3) the same biomass remaining on the fishing grounds as after the 1994 fishery and the same biomass remaining on the fishing grounds as after the 1993 fishery.

TAC scenarios (t) in southern Gulf of St. Lawrence

Criteria	1995 TAC	1995 exploitation rate	Biomass of hard shelled crabs over 95 mm CW remaining after the 1995 fishery
1995 TAC similar to 1994 TAC	23,324 t	35.3%	42,821 t
1995 exploitation rate similar to 1994 rate	22,423 t	33.9%	43,721 t
Biomass remaining after the 1995 season similar to that at the end of the (a) 1993 season and (b) 1994 season	(a) 37,212 t (b) 20,637 t	(a) 56.3% (b) 31.2%	(a) 28,993 t (b) 45,508 t

Although the crab population is aging, it is important not to forget that when the small crabs (15 - 28 mm CW) observed in 1994 reach 70 mm and over, there is a possibility of increased incidence of soft-shelled crabs in the fishery if the commercial biomass is too low. This would lead to early closure of the fishery to protect future recruitment into the fishery. As a result, the industry must optimize catches in the short term and/or spread catches over a period of years in such a way as to maximize their income, taking into account the quantity and quality of available crab.

The analyses of biomass forecasts for inshore areas show that caution must be exercised in interpreting annual variations in biomass in areas 18, 19 and 25/26. These variations are highly affected by the fact that the current management areas do not correspond to biological units since crab concentrations straddle the boundaries between the areas.

Reference

Chiasson, Y., M. Hébert, and M. Moriyasu. 1991. A review of the southern Gulf of St. Lawrence snow crab (Chionoecetes opilio) management zone boundaries. CAFSAC Res. Doc. 91/75, 14 p.

Table 1. Snow crab landings and TAC data for the Southern Gulf of Saint-Lawrence from 1968 to 1994.

	12		18		19		25+26		Total
Year	Catch (t)	TAC (t)	Catch (t)	TAC (t)	Catch (t)	TAC (t)	Catch (t)	TAC (t)	Catch (t)
1968	3,939								3,939
1969	2,580								2,580
1970	5,634								5,634
1971	5,374								5,374
1972	5,392								5,392
1973	6,969								6,969
1974	6,704								6,704
1975	4,632								4,632
1976	7,568								7,568
1977	9,537								9,537
1978	10,462				1,941				12,403
1979	15,794		213		1,390	1,406			17,397
1980	14,854		519		1,158	1,225			16,531
1981	21,877		494	835	913	1,004			23,284
1982	31,585		824	835	953	1,004			33,362
1983	24,342		822	835	906	1,004			26,070
1984	26,062		722	835	1,315	1,385			28,099
1985	25,158		537	835	1,234	1,385	802		27,731
1986	24,267		618	626	1,235	1,338	1,239		27,359
1987	11,782		626	626	1,151	1,150	457		14,016
1988	12,355		669	674	1,337	1,338	666		15,027
1989	7,882		666	674	1,334	1,338	747		10,629
1990	6,950	7,000	662	674	1,333	1,338	546	500	9,491
1991	10,019	10,000	722	874	1,337	1,338	615	600	12,693
1992	11,235	11,200	715	749	1,678	1,686	783	800	14,411
1993	14,336	14,500	748	749	1,678	1,686	800	800	17,562
1994	19,995	20,000	734	749	1,672	1,686	923	1000	23,324

* The spring season in 1990 was interrupted by a conflict between groundfish and snow crab fishers, and later by the high occurence of soft-shelled crab in the commercial traps. The remainder of the spring quota was therefore taken during the autumn fishery. In 1991, a quota of 200 tonnes was allocated for the spring season; a quota of 674 tonnes was allocated for the autumn 1991 and spring 1992. Therefore, the table above indicates the spring and autumn seasons of 1991 and the spring season in 1992. Similarly, the 1992 to 1994 TAC's correspond to the autumn of that year and the spring of the following year.

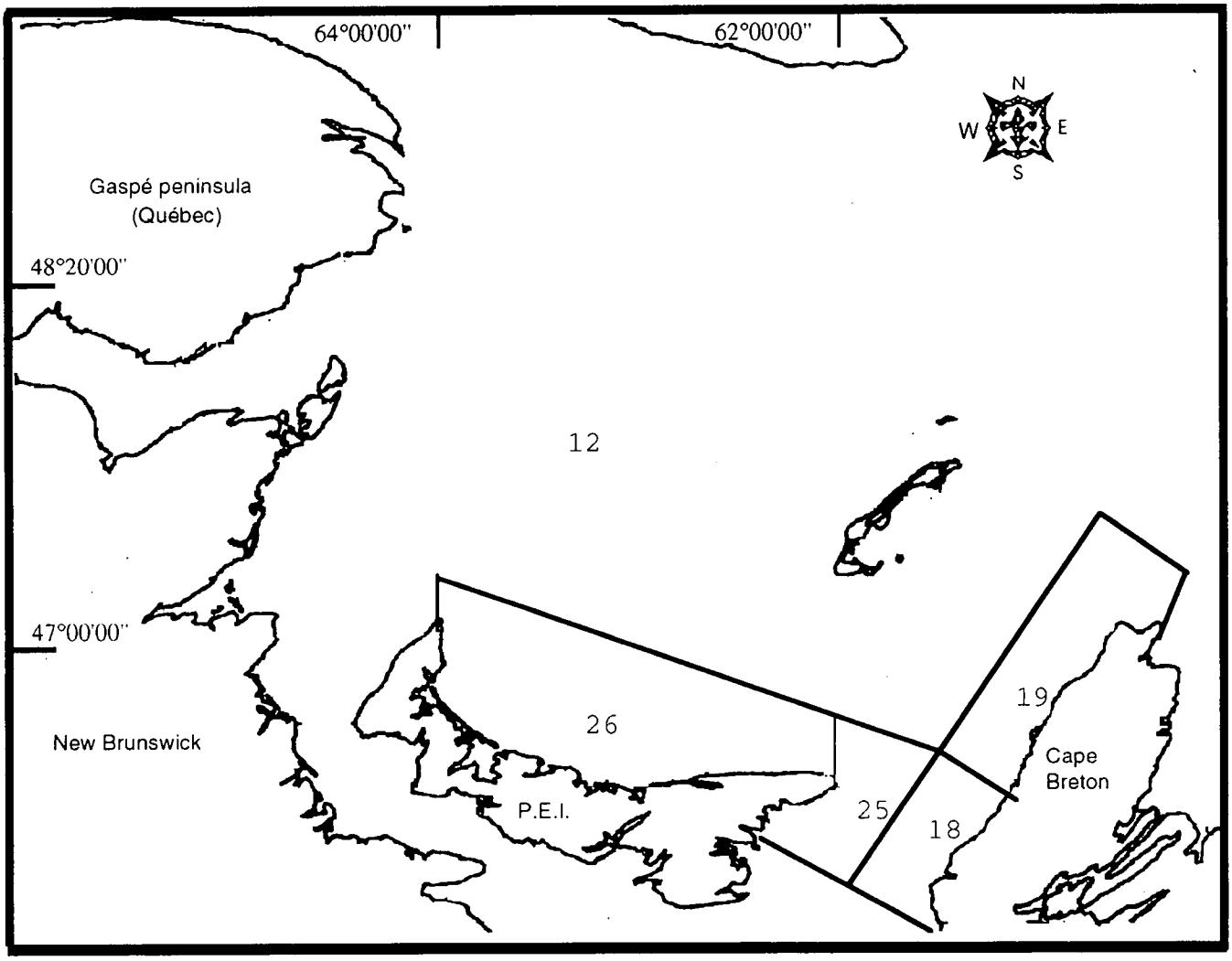

Figure 1. Southern Gulf of St. Lawrence snow crab, Chionoecetes opilio, management zones.

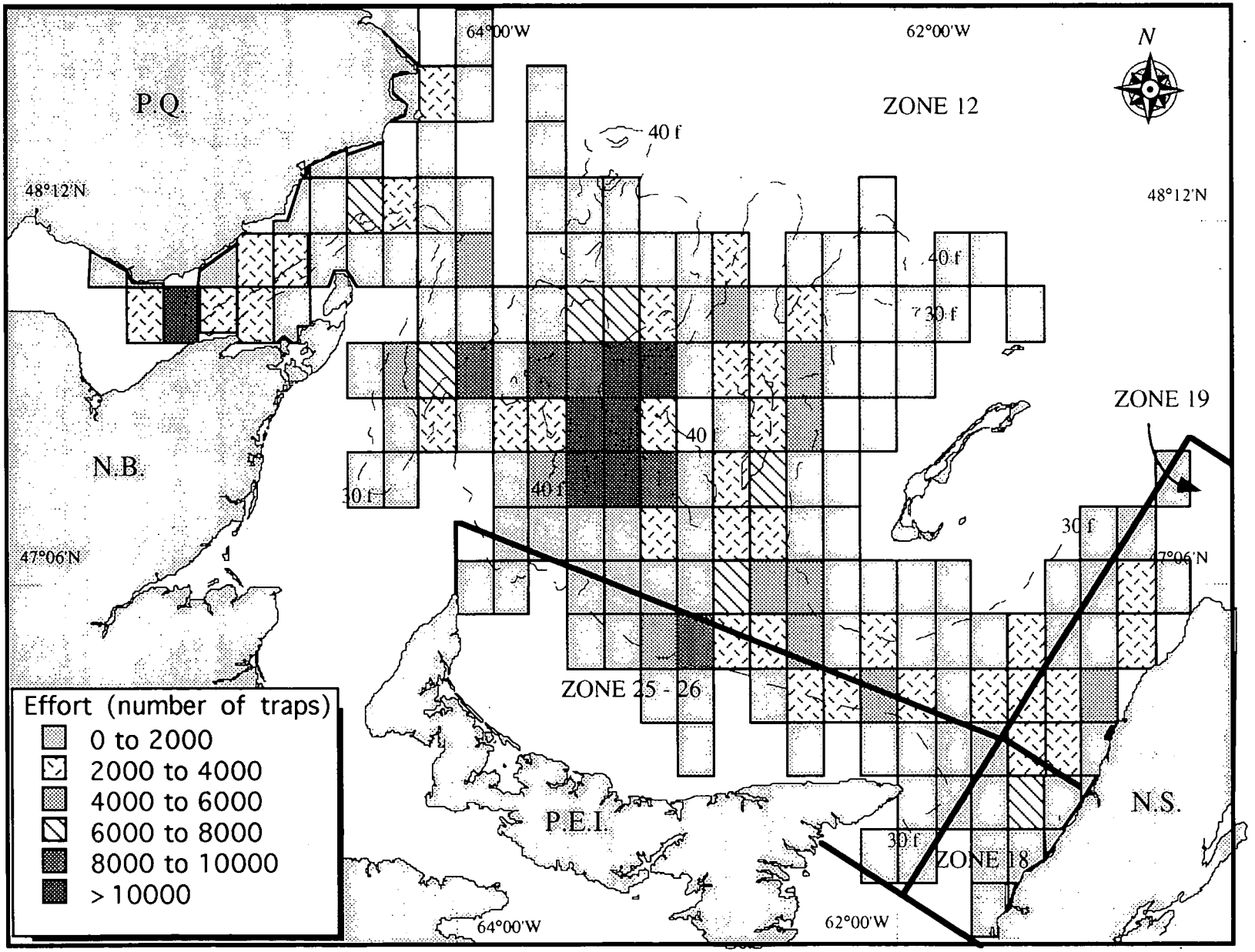

Figure 2. Geographic distibution of fishing effort for the Southern Gulf of St. Lawrence snow crab fisheries in 1994.

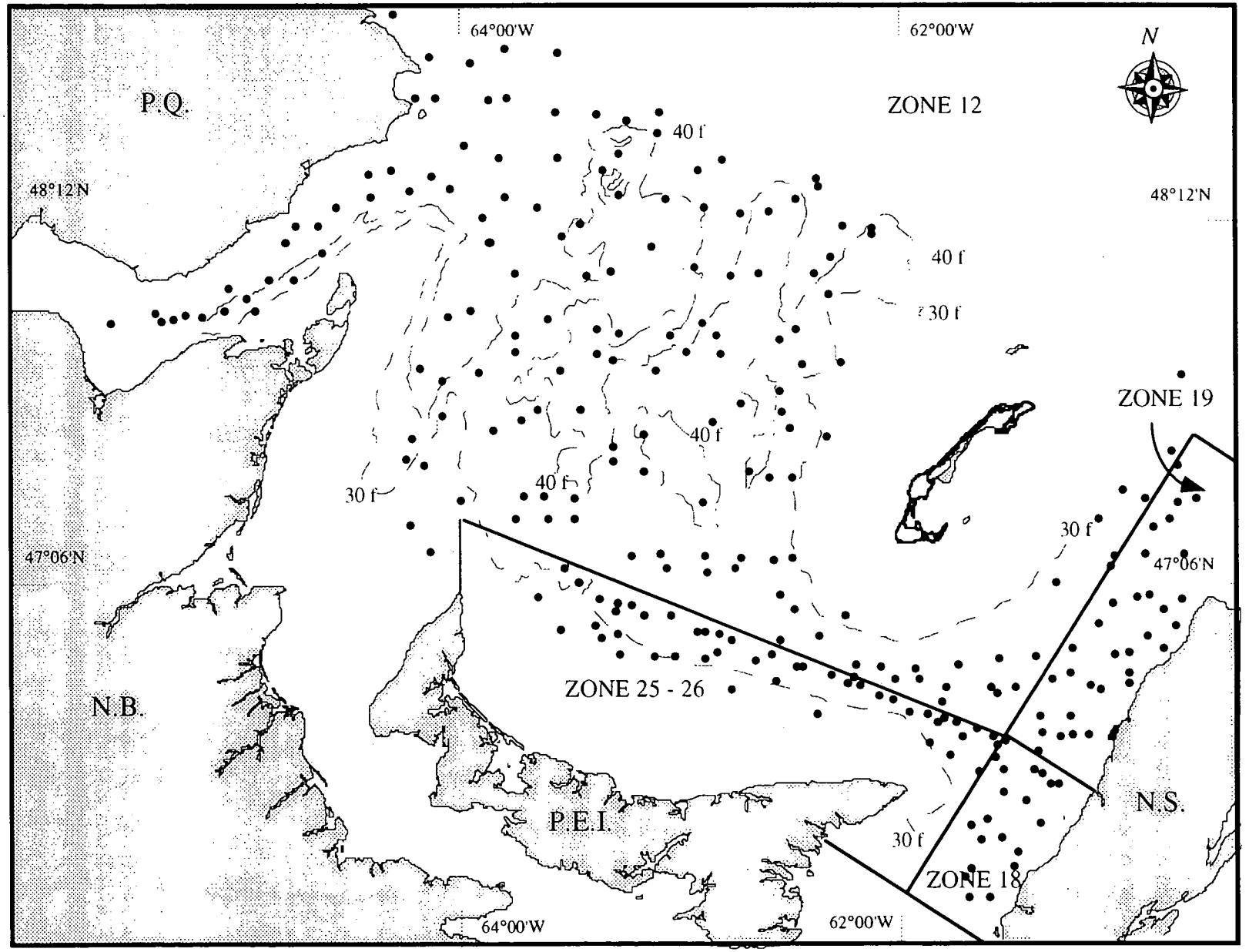

Figure 3. Geographic locations of the post season trawl survey stations in the Southern Gulf of St. Lawrence in 1994. Each dot represents one 4 to 8 minute tow.

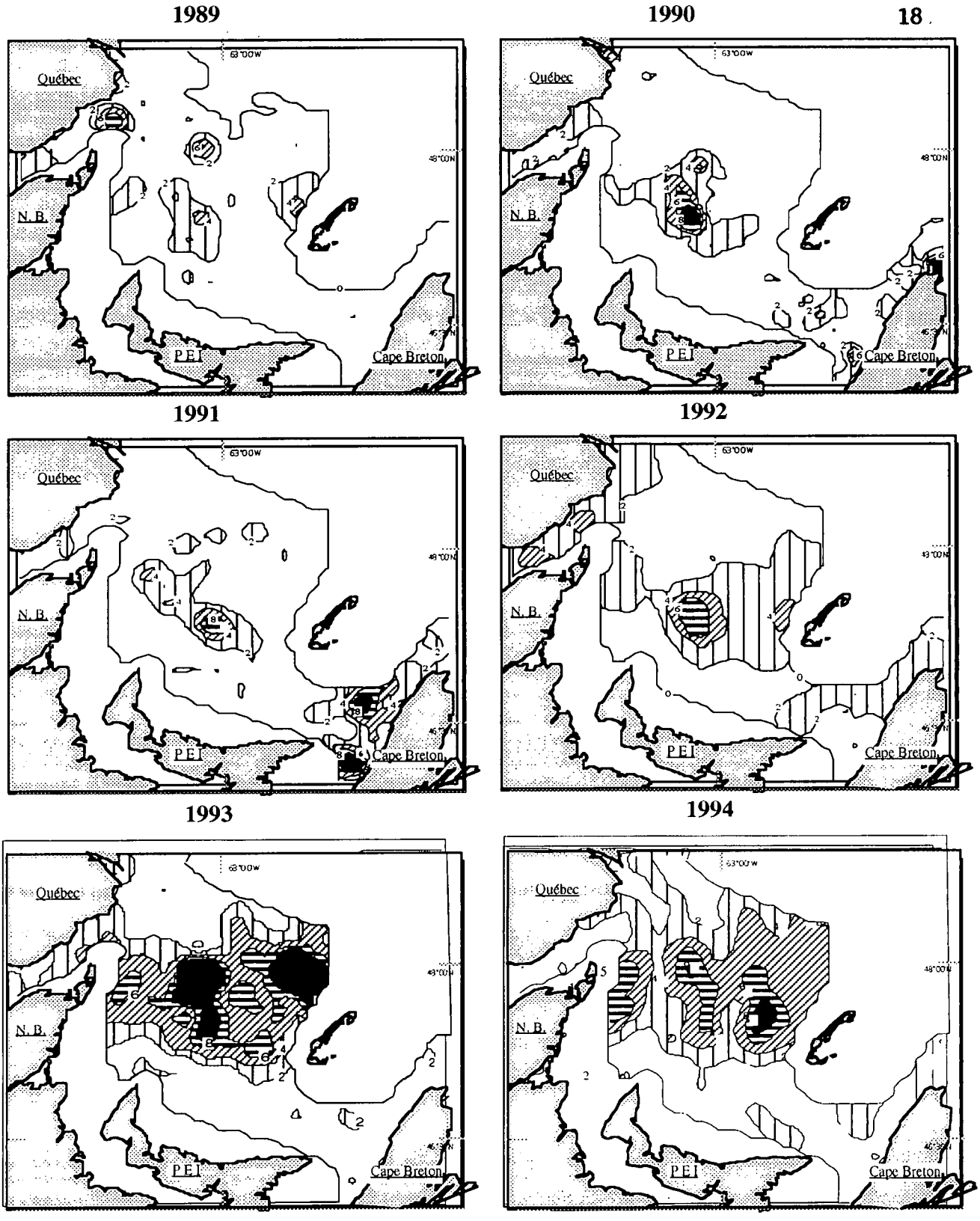

Figure 4. Density contours of large claw crab larger than or equal to 95 mm calculated by Kriging from 1989 to 1994.

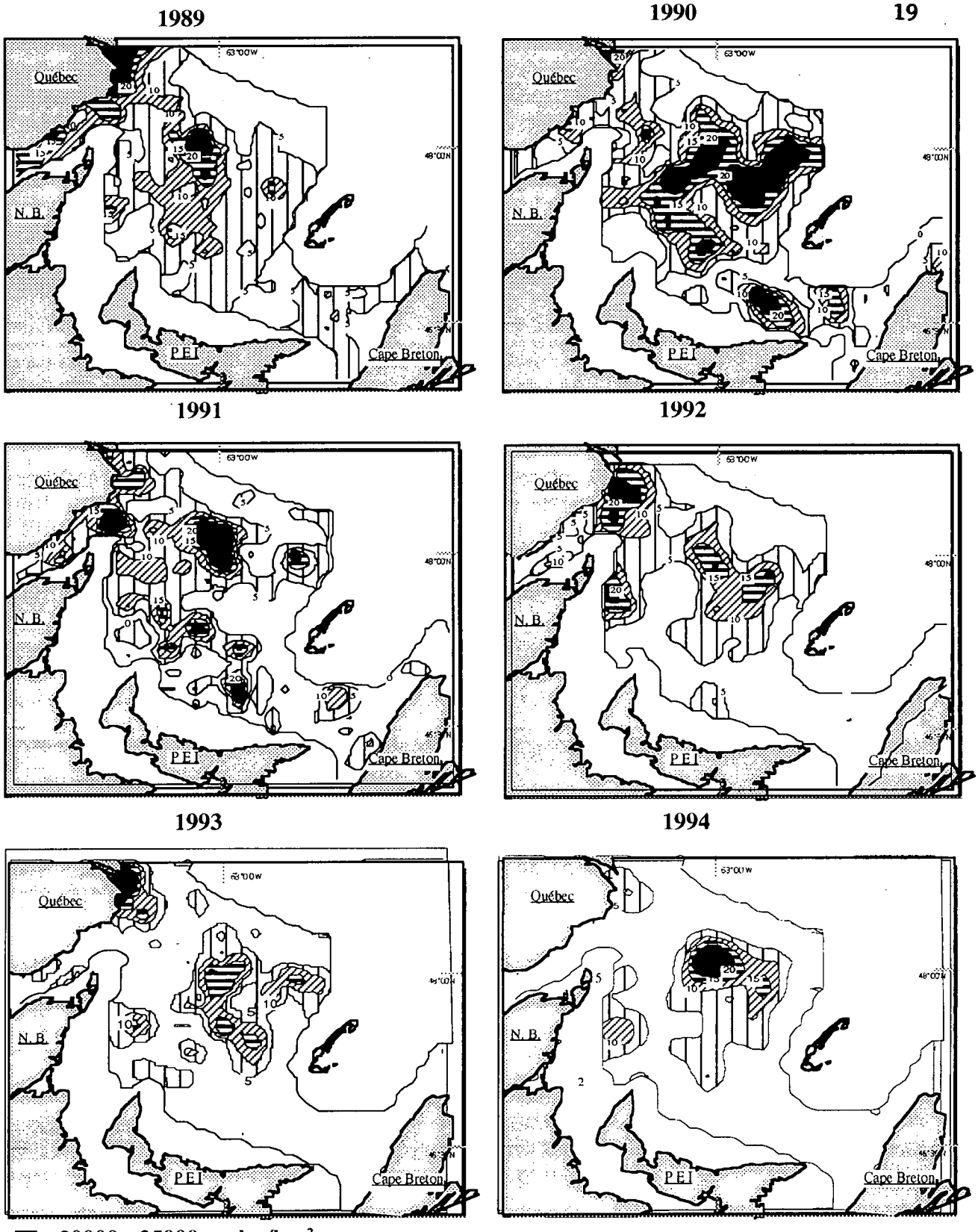

Figure 5. Density contours of small claw crab larger than or equal to 56 mm calculated by Kriging from 1989 to 1994.

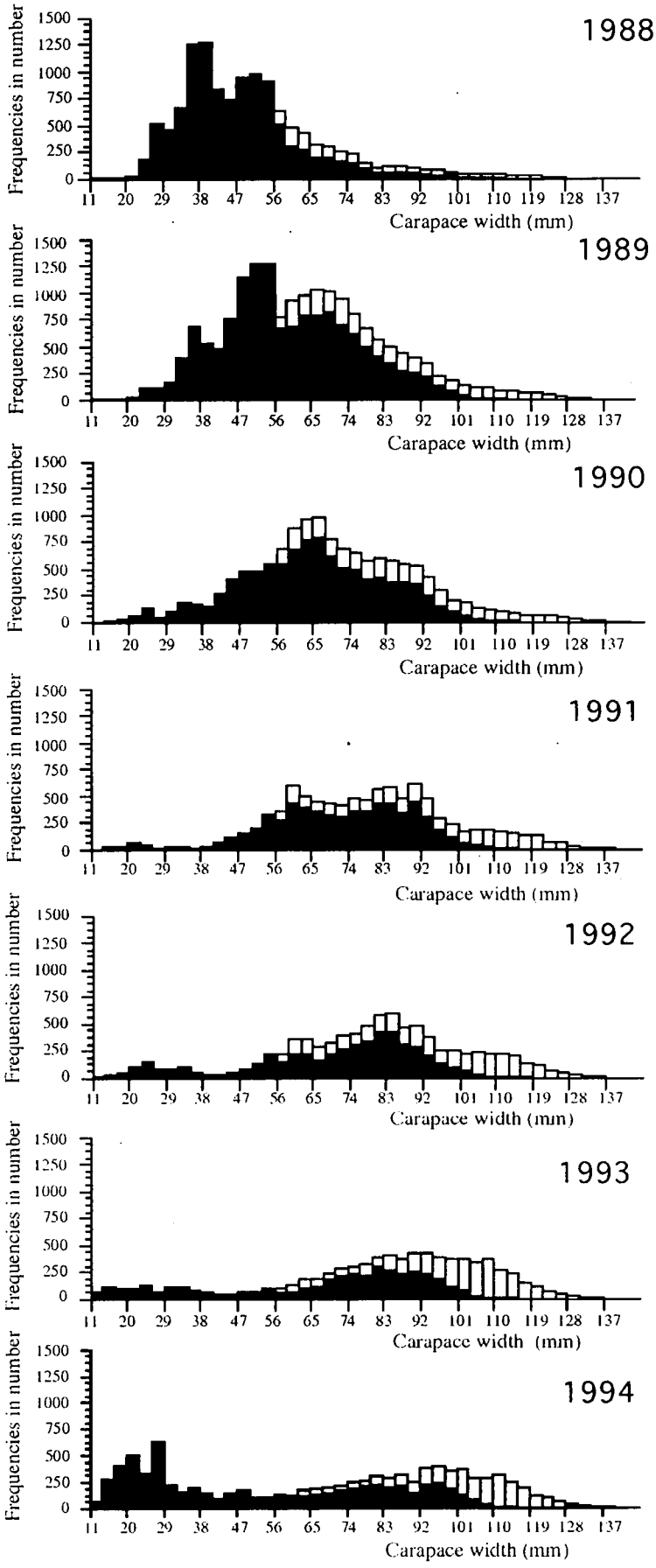

Figure 6. Size frequency distribution for male crabs taken during the research surveys in the southern Gulf of St. Lawrence, 1988 to 1994