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Assessment of the 1997 snow crab (*Chionoecetes opilio*) fisheries off eastern Nova Scotia (Areas 20 to 24 (and 4X)), Canada.

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ABSTRACT

The 1997 total landings in eastern Nova Scotia were 12% higher than those of 1996. There was a 25% increase in the seasonal catch-per-unit-of-effort (CPUE) and a 10% reduction in total fishing effort compared to last year. The increase in landings was mostly the result of the 80% increase in landings observed in Area 22, raising from 189 t in 1996 to 343 t this year. In Area 21 fishers met their quota this year, representing a 7% increase in landings over 1996. Although Areas 23 and 24 respectively experienced a 12 and 20% decrease in seasonal CPUE and a 20 and 25% increase in total fishing effort, the overall picture for eastern Nova Scotia fisheries are strongly influenced by the marked increase in seasonal CPUE and decrease of effort in Areas 20, 21 and 22.

The first comprehensive trawl survey was carried out in eastern Nova Scotia in 1997. The initial data collected are good and the trawl survey method could be useful for managing eastern Nova Scotia stocks. However, fishery parameters estimated from this survey are not considered reliable now because of uncertainties, such as the relationship between carapace size and weight which are borrowed from the southern Gulf of St. Lawrence (GSL), an area with different temperature and growth characteristics. Furthermore, discriminant functions used to separate crabs into the adolescent or adult categories were calculated from data collected in the inshore fishing grounds of Areas 22 and 23, based on the discriminant function used in the southern GSL. In addition, the substrate and bottom configuration found in eastern Nova Scotia is quite different than what is found in the southern GSL where this method was developed. These uncertainties are discussed, and recommendations are made for next year's survey. In the meantime, the management of this fishery must still primarily rely on the assessment based on the fishery related data.

RÉSUMÉ

Les débarquements totaux de 1997 à l'est de la Nouvelle-Écosse (E.N.-É.) étaient de 12 % supérieurs à ceux de 1996. Il y a eu une augmentation de 25% dans les prises-par-unité-d'effort (PUE) saisonnières, et une diminution de 10% de l'effort total comparé à l'année dernière. Cette augmentation dans les débarquements a été principalement causé par l'augmentation de 80% des débarquements observés dans la zone 22, passant de 189 t en 1996 à 343 t cette année. De plus, les pêcheurs de la zone 21 ont capturés leur contingent cette année, représentant une augmentation de 7% des débarquements comparé à 1996. Malgré le fait que les zones 23 et 24 ont respectivement connu une diminution dans les PUE saisonnières de 12 et 20%, et une augmentation de 20 et 25 % dans l'effort de pêche total, la pêcherie de l'E.N.-É. a été grandement influencé par l'augmentation marquée des PUE saisonnières et la diminution de l'effort de pêche des zones 20, 21 et 22.

Le premier relevé scientifique de chalutage de grande envergure a été réalisé à l'E.N.-É. en 1997. Les données brutes qui en découlent sont bonnes, et la méthode du relevé scientifique devrait s'avérer utile pour la gestion de ce stock à l'E.N.-É.. Cependant, les différents paramètres estimés à partir de ces données brutes ne sont pas considérés fiables, du moin pour le moment, et cela à cause d'incertitudes entourant l'application de la méthode du relevé scientifique. Parmis ces incertitudes, on retrouve la relation entre la largeur de carapace et le poid qui a été directement emprunté de la méthode utilisée dans le sud du golfe du Saint-Laurent (GSL), une région aux températures et aux caractéristiques de croissance différentes. Il y a également les fonctions discriminantes qui furent utilisées pour séparer les crabes adultes des crabes adolescents, et qui ont été calculées à partir de données amassées dans la partie cotière des zones 22 et 23, mais basée sur la fonction discriminante établie pour le sud GSL. De plus, le substrat et la configuration du fond marin retrouvés à l'E.N.-É. sont très différents de ceux que l'on retrouve dans le sud GSL, là où cette méthode fut initiallement développée. Ces incertitudes sont élaborées dans la discussion, et des recommendation sont suggérées pour le relevé de chalutage de l'année prochaine. Entre-temps, la gestion de cette pêcherie doit dépendre principalement d'une évaluation des stocks qui est basée sur des données qui sont directement reliées à la pêche (livre de bord, observateur,...).

INTRODUCTION

Analysis of catch rate, spatial distribution of effort, biomass, and population structure for the period of 1978-1993 (Tremblay *et al.*, 1994) indicate that the increased landings after 1986 resulted from an increase of abundance and biomass, an expanded fishing area, and an increase of total effort (Tremblay and Eagles 1995). Although snow crab price was a factor in some years, fishing effort appears to have been driven mainly by catch rate (Tremblay and Eagles 1995). The high incidence of soft shell crab in the 1994 and 1995 catches (up to 50%) was associated with a near record high effort (Tremblay and Eagles 1996).

In the present document, the 1997 snow crab fishery in Areas 20 to 24, as well as the NAFO Division 4X, is being assessed. Also, following the *experimental* trawl survey of 1996 as a potential supplementary tool to the current methods the first annual assessment survey was completed. An accurate biomass level could not be estimated from the raw data collected by the survey because of uncertainties with the method. These uncertainties are discussed, and recommendations are made for next year's survey.

DESCRIPTION OF THE FISHERIES

Harvesting of snow crab, *Chionoecetes opilio*, off the east coast of Nova Scotia (Areas 20 to 24; Figure 1) began in the late 1970's. Landings rose rapidly with effort to a peak in 1979 but landings and catch-per-unit-of-effort (CPUE) then collapsed within four fishing seasons (Tremblay *et al.* 1994). In 1985, this fishery was believed to be near commercial extinction (Elner and Robichaud 1985). However, a pulse of pre-recruits entered the commercial catches of snow crab in all Areas in 1986 (Elner and Robichaud 1987). Total landings rose rapidly from 1989 to 1993 when peak levels were reached at 2016 t (Tremblay and Eagles 1996). In 1994, total landings declined by 23% to 1551 t, and remained stable at this level in 1995 and 1996. Catch rates in 1994, 1995 and 1996 were influenced by individual boat quotas, whether or not soft-shell crab were retained, and reduced fishing season in some Areas.

From 1982 to 1993, management of these fisheries was based strictly on effort controls (seasons, licenses and trap limits). The number of licenses remained stable except for Area 24 where 7 new licenses were added between 1989 and 1991. In 1994, individual boat quotas of 65,000 lb (29.5 t) was imposed in Area 23. This was in response to the industry's request to limit high landings. Dockside monitoring was also introduced in 1994 for all Areas.

There were substantial changes to the management of these fisheries in 1995. Nine temporary (1 year) licenses were allowed in Area 23 and ten in Area 24. Each temporary license was permitted to land 10,000 lb (4.5 t) with 10 traps per license. The total effort for "regular" license holders was controlled by the introduction of individual boat quotas (Areas 20, 21 and 24) or fleet cap (Area 22). The individual boat quotas (IBQ) were 20,000 lb (9 t) in Area 20, 10,000 lb (4.5 t) in Area 21, and 55,000 lb (25 t) in Areas 23 and 24. The fleet cap in Area 22 was of 350 t. These "quotas" and "fleet cap" were developed based on recent landings history, not science. Another management change was directed at reducing the landing of soft-shelled crab in the catch of any individual, on any given day, to 10% or less (as defined by a durometer). In addition to the fishery on "traditional" grounds off eastern Nova Scotia, exploration for snow crab has been conducted further southwest, and further offshore (NAFO Division 4X). Four vessels fished in late 1994 and in 1995.

The management measures of 1996 were essentially the same as 1995. The number of temporary permits was reduced to 3 in Area 23 and 4 in Area 24. However, in both Areas, 30,000 lb (13.6 t) were allocated to Natives on a temporary, communal basis. In all Areas, an enforcement plan was created which includes surveillance by observers of 10% of the fleet paid for by the industry, as well as the introduction of a single mandatory logbook used by all fishers for both dockside monitoring and the scientific data base. Also, a "panel" was required on all traps to prevent "ghost fishing" in all Areas. Some voluntary measures requested by fishers were also introduced in 1996, such as a shortened season (Area 21), no fishing on Sundays (Area 22), and the initiation of a tagging study by the licence holders in Areas 23 and 24. Additional scientific effort was directed at these fisheries with the funding of DFO as well as snow crab fleet in Areas 22, 23 and 24. This shoud improve biomass assessment. In NAFO Division 4X, the trap limit was raised to 250 traps from 100 (majority of them are the smaller 3' diameter type), and was subjected to dockside monitoring for the first time.

In 1997, the individual boat quota of fishers in Areas 23 and 24 was lowered from 55,000 to 52,000 lbs in order to bring the four First Nations allocations (introduced last year) to full quota status while allocating quota to more temporary permits (six in each of these two Areas) without increasing effort over that of the past two years. It is intended that these four Native licences will remain in the fishery in future years, thereby changing the total number of full-quota licences to 24 (from 22) in Area 23 and to 23 (from 21) in Area 24 (Table 1). The number of regular licences in Areas 20, 21 and 22 remained as in 1996. In Area 21, at the request of the Area 21 Association, the 1997 trap limit was reduced by licence condition to 25 (from 30). At-sea monitoring was realized by certifed observers in Areas 22, 23 and 24, and covered 5%, 20% and 10% of sea days, respectively. Other management items remained as they were in 1996. For example, seasons, 100% dockside monitoring, landing not more than 0 - 10% soft-shell crabs, mandatory logbooks. Complete information about this years' management measures are elaborated in "The 1997 snow crab (Chionoecetes opilio) integrated fishery management plan" (Anonymous 1997).

MATERIALS AND METHODS

Landings, catch rate and effort

In 1997, for a second year, data on landings and fishing effort were obtained from the new, single, mandatory logbook used by all fishers for both dockside monitoring and the scientific data base. Copies of the original completed logs and the compiled electronic data base were obtained from the Statistic Division of the Maritimes Region of the Department of Fisheries and Oceans. Thereafter, total seasonal landings for each Area were obtained from a revised preliminary report produced by the Statistic Division in late December 1997, and may slightly differ from results presented in the Stock Status Report in January 1998. All fishers submitted their logs, but not all logs were usable; some have one or more missing or erroneous values such as missing number of trap used or impossible fishing location. On average, 75% to 100% of the 1,677 logs received were adequately completed.

Inshore and Offshore Areas - Since 1995, adjustments were made to the distribution of landings between inshore and offshore grounds as location of catches was not always documented in fishing logs (Tremblay and Eagles 1996; Biron et al. 1997). However, sharing of fishing grounds in Area 22 has been guided by a "gentlemen agreement" since 1996 allocating fishers to inshore or offshore (Glace Bay Hole) regions. Therefore, based on two lists of names (1996 and 1997) and information supplied by the president of Area

22 Snow Crab Association (N. MacMullin,), landings, effort and calculated CPUE were determined for inshore and offshore grounds in that Area, and for both 1996 and 1997. Based solely on these two lists, all fishing logs of both years were used for these estimations regardless of missing or erroneous locations. Landings, effort and CPUE are not reported separately for inshore and offshore portions for any other Area.

Landings - Total landings by Area are the sum of landings from the logs received for each Area. The geographic distribution of landings was presented as the sum of total landings within each 10° latitude by 10° longitude grid (10 X 7 nautical miles grid); the fishing positions were taken from the logs.

Catch rate and effort - The average CPUE corresponds to the ratio of total landings (y_i) to the number of trap hauled (tf_i) reported in the logs: CPUE = $\Sigma(y_i) / \Sigma(tf_i)$. The total effort (total number of trap hauls: F) was then estimated from total landings (Y) divided by average CPUE: F = Y / CPUE. The geographic distribution of fishing effort was presented as the sum of number of trap hauls within each 10° latitude by 10° longitude grid; the fishing positions were taken from the logs. The geographic distribution of average CPUE was calculated within each of these grids. Information from the exploratory fishery (Area 4X) was analyzed separately from the "traditional" fisheries.

Sea sampling

For each randomly-sampled trap, the total number of male crabs, the position and depth of the trap were recorded, and a sub-sample of 40 crabs were taken randomly for the following measurements: carapace width (CW), the height of the right claw (CH), the condition of the carapace (on a scale of 1 to 5) and the hardness of the right claw (Foyle *et al.* 1989). Snow crab with a claw hardness less than 68 in durometer readings were considered as soft-shell crab (Hébert *et al.*, 1992).

Mature males are recognizable by morphometry by plotting logarithms of chela height (CH) against logarithms of carapace width (CW) (Conan and Comeau, 1986). Data from adult and adolescent crab fit into two distinct ellipses with parallel major axes (Conan and Comeau 1986). The following discriminant functions;

$$Y = 0.595765 \ln(CH) - 0.803159 \ln(CW) + 1.868191 \text{ (for Areas 20, 21 and 22)}$$
$$Y = 0.613255 \ln(CH) - 0.789885 \ln(CW) + 1.747569 \text{ (for Areas 23 and 24)}$$

will assign individuals to the correct groups in 91.4 % of cases (for mature males: $Y > 0$) (Comeau, pers. comm. DFO, Moncton, N.B.; from raw data collected in 1985-86 by R.W. Elner, DOE, Surrey, B.C.).

Annual trawl survey

Trawl sampling - Following last years' experimental trawl survey, this year saw the first large-scale annual trawl survey conducted prior to the fishery, from May 15 to June 14. A Bigouden *Nephrops* trawl originally developed for Norway lobster (*Nephrops norvegicus*) fishery in France is used (20 m opening with a 27.3 m foot rope on which is mounted a 3.2 m long, 8 mm galvanized chain; Conan *et al.*, 1994). The duration of the tows varies between 4 and 8 minutes at an average speed of 2 knots, depending on the depth, current speed and sediment type. The horizontal opening of the trawl was measured, every 7

seconds, with a SCANMAR net sensor. The distance of each tow was estimated from the position (Latitude / Longitude) recorded at the beginning and end of tow. The swept surface was then calculated based on the distance trawled and net width.

A systematic random design was used to determine the location of the 150 stations, one station within each 10° latitude by 10° longitude grid. Overall, there are 26 stations in Area 22, and 62 sets in each of Areas 23 and 24. The duration of each tow, as well as depth of the water column were recorded. The following measurements were taken for all snow crab captured in each tow: carapace width (CW), the height of the right claw and the carapace condition, for the males; and the CW, the width of the fifth abdominal segment and the color of the eggs and gonads, for the females.

Kriging - A geostatistical method, kriging was used to estimate annual and density contours of different biological categories of the snow crab biomass (Conan, 1985; Conan *et al.,* 1988). Kriging is described by Clark (1979) and its analytical basis was defined by Matheron (1970). It consists of two procedures 1) analyzing and modeling the covariance between sampling units as a function of distance between their locations, and 2) calculating optimal weights to be attributed to each sampling unit for calculating a predicted average characteristic of a given region to be assessed. Mapping of the whole area surveyed is the next step and, using point kriging and a fitted variogram, map of isodensity contours and isovariance contours is then generated for this area. We further use block kriging for estimating on average density and variance over the whole area, and thereby estimating the total number of crab present in a given area.

The abundance of snow crab estimated by kriging was converted into biomass according to the size-weight relationship and size-frequency histograms. To convert size to weight, size-weight relationships were calculated according to molt stage, the morphological maturity and sampling season. Unfortunately no biological data were available for Nova Scotia and relationships from the southern GSL were used. The size-weight relationship for adult hard-shell males in the southern GSL is expressed by the function $W = 2.665 \times 10^{-4} CW^{3.098}$ (Hébert *et al.,* 1992). Because such model has not yet been determinated for eastern Nova Scotia, this southern GSL model will be used until a more adequate model is established. Nevertheless, it should be appreciated that the temperature regimes are different for the two areas and therefore growth characteristics are also expected to differ. Also, the model supposes that trawl efficiency is 100% for individuals larger than 30 mm CW.

Morphological maturity - We used the terminology "adolescent" (small claw) for sexually mature males but has not attained terminal molt and "adult" (large claw) to represent the terminal molt male crabs (Sainte-Marie *et al.,* 1995). The distinction between the two groups is based on the relationship between carapace width and chela height (Conan and Comeau, 1986).

Carapace condition - Crabs were categorized into five groups based on the carapace condition and hardness (Anonymous 1994). Crabs falling in the "New soft" category and a part of "Clean" category with durometer reading less than 68 were considered as postmolt soft-shell crab (called soft-shell crab in this document).

Classification of carapace stages based on carapace condition, durometer reading and corresponding approximate age after terminal molt (modified from CAFSAC 1991; Anonymous 1994).

Category	Stage	Durometer reading	Carapace condition	Approximate age after terminal molt
New soft	I	< 68	brightly colored, iridescent, soft, no epibionts, chelae easily bent.	0-5 months
Clean	II	variable	brightly colored, some iridescence, may have epibionts, chelae not easily bent	5 months- 1 year
Inter-mediate	III	> 68	dull brown dorsally and yellow-brown ventrally, no irridescence, shell abrasion evident, epibionts.	8 months -3 years
Old	IV	> 68	carapace very dirty but hard, decay may be present at leg joints, epibionts removable at processing plant.	2 - 5 years
Very old	V	variable	carapace very dirty and may be soft (durometer reading < 68), progression of decay may be evident, epibionts not removable at processing plant.	4-6 years

RESULTS

Fishery

Five "traditional" crab fishery areas (CFA- 20 to 24) and one exploratory fishery (NAFO Division 4X) were exploited in 1997. In Area 20, landings occured between July 23 and August 24. Area 21 had the shortest season of all Areas, with landings occuring from July 23 to August 06. Area 22 fished from July 23-24 to August 08 (inshore) or August 19 (offshore). Landings occured from July 25 to September 11 in Area 23, and from August 03 to September 29 in Area 24. The fishing period of the exploratory 4X (Area 24) covered by this document is from September 1996 to September 1997.

The average CPUE for the "traditional" fishery off eastern Nova Scotia was 37.3 kg per trap haul (kg/th), while the average fishing effort was 44,940 trap hauls (Table 2). Overall, this represents an increase in CPUE of over 25% compared to the 1996 (29.6 kg/th) levels, and a reduction in fishing effort of 10% (50,300 trap hauls). The seasonal geographic distribution is presented for landings (Fig. 2), CPUE (Fig. 3) and fishing

effort (Fig. 4), as well as the location of the logbook positions recorded by the fishers (Figure 5).

The averaged CPUEs for all Areas was the highest in the last 20 years (Table 2). The size-frequency data (Figs 6-10) suggest the presence of new recruitment in Areas 22 - 24, but not in Area 20 (not enought data to stipulate for Area 21).

Area 20;

Landings - Total landings in 1997 (45 t) are similar to the high landings of 1995 and 1996 (Table 3). The average landings/licence was 9.071 t. Hence, on average all fishers met their IBQ of 9.072 for this Area. Landings occured within 5 weeks, from July 23 to August 24 (Table 4).

Catch rate and effort - The average catch rate was 20.2 kg/th in 1997, which represents an increase of almost 40% in CPUE compared to 1996 (14.7 kg/th)(Table 3). Meanwhile, total effort (2,246 trap hauls) decreased by 23% compared to the 2,900 trap hauls in 1996.

At-sea sampling - The catch composition derived from the at-sea samples showed that 87% of the measured crabs were adult males greater than 95 mm (Table 5). Over 56 % of the samples had a carapace condition of 3, 18% had a carapace condition of 2 and 16% had a condition of 4 (Table 6). Adolescent males accounted for less than 12% of the catches. The weekly soft-shell crab percentages were between 11 and 16%, while the seasonal average was 14%. The mean carapace width was 118.2 mm (Figure 6).

Area 21;

Landings - Total landings in Area 21 were 146 t, 7% higher than those of 1996 (Table 7). On average, all fishers met their IBQ of 4,536 t. All landings occured within the first two weeks of the fishing season, from July 22 to August 06 (Table 8).

Catch rate and effort - The seasonal CPUE of 35.7 kg/trap haul is the highest value ever recorded since 1978, 3.6 times higher than last year CPUE of 9.7 kg/trap haul (Table 7). The effort (4,083 trap hauls) is amongst the lowest recorded, 2 to 3 times lower than the effort recorded for the last ten years.

At-sea sampling - The soft-shell crab percentage (27.5%) is similar to the percentage reported for 1996 (Table 9). However, the sample size (N=240) of the measured crabs is about 3 times smaller than that of last year, representing only 1 sea-trip of 6 sampled traps. Approximately 55% and 30% of the measured crabs were of carapace condition 3 and 2, respectively (Table 6). Adolescent males represented 6% of the catch composition (Table 9). The mean carapace width (112.2 mm) of at-sea samples was superior to the one reported in 1996 (107 mm) (Fig. 7).

Area 22;

Landings - Total landings in 1997 for Area 22 were 80% higher than in 1996 (Table 10), and averaged landings / license of 9.3 t. In the inshore portion, 17 fishers landed 185 t within 3 weeks in 1997 (Table 11), while 10 fishers landed 90 t in a period of 6 weeks in 1996 (Table 12). Meanwhile, 20 fishers in the offshore area landed 158 t within 4 weeks in 1997 (Table 11), while 27 fishers landed 85 t in 7 weeks in 1996 (Table 12).

Catch rate and effort - The seasonal CPUE (20.8 kg/th) was double that of 1996 (Table 10). In the inshore portion, seasonal CPUE was 30.7 kg/th in 1997 (Table 11) and 12.5

kg/th in 1996 (Table 12), while in the offshore area it was 15.1 kg/th and 8.7 kg/th in 1997 and 1996, respectively. Total effort for the whole Area in 1997 (16,472 trap hauls) was slightly lower than 1996 (16,894 trap hauls) (Table 11 and 12). The breakdown shows that the seasonal effort for the inshore grounds was 6,020 trap hauls in 1997 and 7,192 trap hauls in 1996, and of 10, 470 trap hauls for the offshore portion in 1997 and 9,846 trap hauls in 1996 (Tables 11 and 12).

At-sea sampling - The seasonal percentage of soft-shell crab was 38.5% in 1997 (Table 13). This represents a 25% increase in soft-shell crab compared to 1996. Almost 75% of the crab measured were of carapace condition 2 (38%) and 3 (36%) (Table 6). This year, less than 25% of the hard-shell adult males were under the legal carapace size limit of 95 mm (Table 13) compared to 40% in 1996. Adolescent males represented 27% of total catches. The average CW of the measured individuals was slightly under 100 mm (Fig. 8), which is similar to 1996.

Area 23;

Landings - Landings in 1997 were 592 t, which is comparable to 1995 and 1996 (Table 14). Permanent and temporary license-holders have generally all met their IBQs (Table 15).

Catch rate and effort - The Area seasonal catch rate was 57.8 kg/th, 12% lower than the average of 1996 (65.6 kg/th) (Table 15), while the total effort (10,232 trap hauls) increased by 20% (8,595 trap hauls in 1996). The seasonal catch rate of permanant fishers was 58.7 kg/th and the seasonal total effort of 9,675 trap hauls, while these were 40.8 kg/th and 457 trap hauls for the temporary fishers.

At-sea sampling - The seasonal percentage of soft-shell crab was 20% of total catches, starting at about 12 % the first week to slowly increase to 31% by the fifth week (Table 16). Over 70% of the crabs measured were of carapace condition 3 (40%) and 4 (31%) (Table 6). This year data showed that 25% of the hard-shell adult males were under the legal carapace size limit of 95 mm (Table 16), which represent a decrease of 40% in undersize adult males compared to 1996. Adolescent male crabs accounted for 22% of the total catches. The average CW (99.3 mm) of measured individuals is comparable to last year (Fig. 9).

Area 24;

Landings - Total 1997 landings (565 t) in Area 24 were comparable to those of 1995 and 1996 (Table 17). Permanent and temporary license holders have generally all met their IBQs (Table 18).

Catch rate and effort - Seasonal CPUE in 1997 was 20% lower than 1996 (Table 17). Total effort was 25% higher than in 1996. The seasonal catch rate of permanent licence holders was 46.4 kg/trap haul and the seasonal total effort of 11,589 trap hauls, while the temporary fishers had an seasonal averaged CPUE of 32.9 kg/trap haul and a seasonal total effort of 837 trap hauls (Table 18).

At-sea sampling - The seasonal percentage of soft-shell crab was 18% of the total catch (Table 19), which is comparable to 1996. Most of the sampled crabs were of carapace condition 3 (50%) and 4 (24%) (Table 6). The adolescent males accounted for 13% of the total catch. The average CW was 104 mm (Fig. 10), almost 10 mm less than in 1996.

Exploratory fishery in 4X (Area 24);

The 4 exploratory permits were allowed 250 traps each provided the majority of them are the smaller 3' diameter type. In 1995, fishers used a combination of 6' and 7' diameter steel conical, 4' conicals and a few pyramidal type traps (Tremblay and Eagles 1996). Only 1 fisher reported landings of snow crab in 1997 for a total of 1,808 kg that was fished between April and May. The averaged CPUE was 2.3 kg/trap haul and the total effort was 786 trap hauls.

Annual trawl survey

The 150 trawl stations (26 stations in Area 22, 62 stations in each of Area 23 and 24) were surveyed between May 15 and June 11, 1997 (Figure 11). During the survey, 7,810 males and 6,787 females were captured and measured. Amongst the 7,810 males, 864 individuals (11%) were mature (adult) larger than 95 mm. Male histograms (Fig. 12) indicated that there were several modes of adolescent (future recruitment). The total area covered by Kriging was approximatively 32,000 km^2 . The different variograms used in the Kriging calculations indicate that there is a covariance effect between the values sampled ranging from 10 to 90 km.

Area 22;

In Area 22, the total area covered by the survey was 4,254 km^2 and the number of crab caught was 1,549 males and 1,672 females, and 17% of the males were mature larger than 95 mm. Several modes of recruitment can be visually identified in the male histogram (Fig. 13). The inshore portion covered an area of 1,258 km^2 , while the offshore covered 3,512 km^2 (Fig. 14). The comparison of inshore and offshore histograms (Figs 15 and 16) shows that both areas have a similar structure (number of modes), but the quantity of crabs inshore was three fold that of the offshore grounds. The average carapace width of commercial crab (males greater than 95 mm) was 107.0 mm.

Area 23;

The total area covered by the survey was 14,000 km^2 . There were 3,898 males and 3,492 females collected and measured. Amongst the males caught, 7.7% were mature greater than 95 mm. At least 3 distinct pulses of future recruitment can be observed in the male histogram (Fig. 17). The average CW of commercial crab was 105.4 mm.

Area 24;

The area covered by the survey in Area 24 totalized 14,500 km^2. A total of 2,363 males and 1,623 females were caught and measured. Slightly less than 20% of the males were mature greater than 95 mm. The male histogram (Fig. 18) shows only one large pulse of adolescent males. The average CW of commercial crab was 107.1 mm.

Biomass distribution;

The contour of density maps that illustrate the distribution of the estimated biomass concentration show 3 major concentrations of adult male that are located in the "offshore" fishing grounds, with smaller patches inshore. Of the 3 major concentrations, the one located in Area 23 was mainly composed of crab of carapace condition 1 and 2, while the other two in Area 24 were mostly crabs of carapace condition 3, 4 and 5. These maps also

indicate that the concentration of adult male found inshore of Area 22 was mainly composed of crab of carapace condition 1 and 2.

CPUE vs contour of density maps;

Groups of grids were selected within and outside the predicted high densities shown on the contour of density map of adult male greater than 95 mm, and the seasonal catch rates for these "sub-areas" were calculated (Table 21) and compared. Results show that "sub-areas" selected within high density areas on the map had the highest catch rates, while the one selected in low density areas had the lowest seasonal CPUE.

DISCUSSION

The 1997 total landings in eastern Nova Scotia were 12% higher than 1996. There was a 25% increase in the seasonal CPUE and a 10% reduction in total fishing effort compared to last year. The increase in landings was mostly the result of the 80% increase in landings observed in Area 22, from 189 t in 1996 to 343 t this year. Fishers from Area 21 also reached their quota this year, representing a 7% increase in landings over those of 1996. Although Areas 23 and 24 respectively experienced a 12 and 20% decrease in seasonal CPUE and a 20 and 25% increase in total fishing effort, the overall picture for eastern Nova Scotia fisheries is strongly influenced by the marked increase in seasonal CPUE and decrease of effort in Areas 20, 21 and 22.

In Area 22, the seasonal catch rate doubled and the fishing effort decreased slightly compared to 1996. In Area 20, seasonal CPUE increased by 40% and total effort decreased by 23%. The average catch rate and effort in Area 21 were unexpectedly high. The seasonal CPUE of 35.7 kg/th is the highest value recorded since 1978, more than twice the previous high of 16.7 kg/th reported in 1992, and 3.6 times higher than last years' seasonal CPUE of 9.7 kg/th. A similar situation was reported by Biron *et al.* (1997) in Areas 23 and 24, but priliminary data analysis indicated some differences in catch rates between logbooks and at-sea sampling. Catch rates calculated from logbooks were always higher, and it was believed that the main reason was double hauling of traps which was not recorded in the logbooks, therefore overestimating catch rates. Unfortunately, the at-sea sampling coverage of Area 21 was inadequate, only 1 sea-trip representing 6 sampled traps. Also, most at-sea sampling data sheets received from Areas 22, 23 and 24 did not include the total number of crabs in the traps sampled (or were estimated total), which made it impossible to calculate sea-sampling CPUE this year. In all Areas, but particularly in Areas 23 and 24, many fishers clearly indicated in the logbook when double hauling occured.

Area-22 inshore and offshore areas - In Area-22, the 1996 and 1997 data were separated into inshore and offshore areas. In this particular Area, sharing of fishing grounds for both years was guided by "gentlemen's agreement" allocating fishers into inshore and offshore areas. However, both agreements were different; 10 fishers were allocated to the inshore area in 1996 and 17 in 1997, while the offshore portion went from 27 fishers in 1996 to 20 in 1997.

Results show that for both years landings in Area 22 were more or less equally shared between inshore and offshore grounds. Both the inshore and offshore areas have seen marked improvement compared to 1996, their average catch rates doubled while there was a 15% reduction in total fishing effort in the inshore and a 5% increase in the offshore portion. Although the average landings per fishers does not mean much for this Area (controled by a fleet cap), it does give a sense of comparison between both years. In the

inshore area, the average landings/licence was 8,990 t in 1996 and 10,870 t in 1997, while the average for the offshore was 3,161 t in 1996 and 7,912 t in 1997.

Population structure - Except for Area 21, the sampling coverage and accumulation of raw data is similar (Area 20) or more extensive (Areas 22, 23 and 24) than last year. However, in Area 21 the data collected represents only 1 sea-trip of 6 sampled traps, and therefore should not be generalized to the whole Area. The catch composition established by the sea-sampling shows that the highest rate of adolescent males was found in Area 22 (27%), while the lowest was found in Areas 20 (12%) and 24 (13%). It is also in Area 22 that the highest seasonal percentage of soft-shell crab was estimated (38.5%), while the lowest percentages were again found in Areas 20 (14%) and 24 (18%). In Area 22, although the seasonal average of soft-shell crab was higher this year than in 1996 (30%), the overall situation has improved compare to last year. In 1997, the weekly percentage of soft-shell crab for this Area remained close to or under 40%, starting at 41% the first week, it decreased to 39% the second week and remained under 40% throughout the remaining of the fishery. In 1996 however, the percentage was 14% the first week, rose rapidly to 44% on the third week, and remained above 40% for the next 2 weeks, until this fishery was voluntarily closed by fishers due to a high incidence of soft-shell crab. As the fishery resumed later that year, the percentage of soft-shell crab was below 10%.

The majority of crab measured during the sea-sampling was of carapace condition 2 and 3 in Areas 20 (75%), 21 (86%) and 22 (74%), and of carapace conditions 3 and 4 in Areas 23 (71%) and 24 (74%). The high levels of adult males under the commercial carapace limit of 95 mm observed last year (over 40%) in Areas 22 and 23 has dropped to approximately 25% in both Areas. This important decrease may result from the improved sea-sampling coverage, and/or the appearance of a pulse of recruitment into these fisheries, and/or simply because of the change from the southern GSL discriminant function to the one derived from Elner's work in 1985-86 (discussed further in the trawl survey section). The average carapace width remained comparable (or improved slightly) to those reported in 1996 for Areas 22 and 23, while these averages decreased by 4 and 10 mm in Areas 20 and 24, respectively. The average carapace width of commercial size crab in Area 22, 23 and 24 calculated from the trawl survey data are similar (107.0 mm, 105.4 and 107.1, respectively).

The histograms of size frequency distribution, especially those generated from the research trawl survey, indicate that overall Area 22 is composed by at least 5 different modes of immature and adolescent males. This number falls to 3 modes in Area 23 and 1 large undefined pulse in Area 24. The comparison of Area 22 inshore and offshore data shows that both grounds have the same population structure (number and similar modes), and that the major differences consisted in the high quantity of future recruitment and larger carapace size of mature crabs that are found inshore.

The high percentage of soft-shell crab, the high density of adolescent, the small average carapace size, the high number of future recruitment modes, combined to the fact that high recruitment predicted in the past does not materialize and the observations drawn from the research survey, all seem to indicate that the inshore grounds of Area 22 might be a nursery area. Although there are indications that such a nursery may also be present elsewhere in Areas 23 and 24 (i.e.: patches of high concentration of adolescent), in Area-22 this area coincides with the best fishing grounds available in the whole Area. Because of its small fishing Area and the high number of fishers, it is presently impossible to suggest a redistribution of effort within the inshore portion to protect this highly productive ground. It is however recommended that a large scale tagging study be initiated in all Areas to study the movement between the densities of crab, as well as to increase the number of trawl stations to cover Areas 20 and 21.

4X exploratory fishery (Area-24)- The results from the exploratory fishery in 4X are sketchy for 1997. It seems that from the four fishers present in this fishery, 2 fishers have directed their effort in catching Jonah (*Cancer borealis)* and Northen Stone (*Lithodes maja)* crab, 1 has not been active this year. Only fishery data from one fisher are presented in this document. Therefore, no detailed analysis and/or discussion of the 4X fishery can be presented.

Annual trawl survey

Introduced last year (Biron *et al.,* 1997), one of the advantages of research trawl surveys is that it allows the estimation of the population size and biomass directly, rather than indirectly by using indexes of abundance. It also evaluates the population size of future recruits, therefore giving a better management of the ressources. This year, the first of such annual survey carried out in eastern Nova Scotia was done, and the first biomass estimations and/or abundance in numbers were produced. However, after presenting these priliminary results to the Scientific Committee of the Regional Assessment Process (RAP), it was felt that it was premature to present these results because of uncertainties concerning the direct application of the southern GSL krigging method to eastern Nova Scotia. It was suggested that these points be addressed before attempting to analyse data and produce any biomass estimate.

It still remains that the objectives for this year have been fully achieved. Since there are still many questions regarding the accuracy and/or importance that one should accord to these biomass numbers for now, more emphasis should be put on the ratios, the densities, and how the method itself performed and reacted to the particularities of eastern Nova Scotia.

The "uncertainties" or "unknown factors" influencing the accuracy of the biomass estimates are: 1) A size-weight relationship specific to eastern Nova Scotia has not yet been determined, and the southern GSL model is used until a specific model is established; 2) The discriminant functions used to assign individuals to the correct adult (large claw) or adolescent (small claw) groups in 99% of cases is based on a small sample of raw data collected by R.W. Elner (pers. comm.)in 1985-86 and calculated by M. Comeau (pers. comm.) in 1990. One of the models was developed for the contiguous area in CFA 20-21, and the other for the traditional fishing grounds of Areas 23 and 24. A single model developed on samples collected throughout the surveyed area would certainly give a more representative and accurate distribution for adult and adolescent groups. Therefore, we question whether or not the discriminant functions established from the sampling in the traditional fishing area in 1985-86 truly represent the 32,000 km^2 surveyed this year. Furthermore, the measurements of the carapace width and chela height by R.W. Elner (pers. comm.) were taken to the nearest millimeter, which produce discriminant functions that are less accurate than if the measurements had included decimals; 3) Another concern is the different type of bottom found in eastern Nova Scotia. In the southern GSL, where the research trawl survey method was developed to evaluate the snow crab population, the bottom is more or less uniform with most of its surface ranging in depth of <30 meters to 100 meters. In eastern Nova Scotia, this type of bottom (or at least comparable) comprise grossly 50% of the surveyed area, and is mainly present as a relatively narrow strip along the shore and many large fishing banks, such as Missaine, Banquereau, Sable Island, Middle, Canso and French Banks. The other 50% of surface surveyed was comprised of large areas of rough bottom forming gullies, passages and holes in and around fishing banks and the narrow strip along the shore. The depth of this mountainous terrain ranges

between 100 meters to over 200 meters. Further observations indicated that the 3 major concentrations of male crabs adult greater than 95 mm found in the offshore portion of the surveyed area in CFA 23 and 24 are mostly located within these rough grounds; an area surrounded by Canso, French and Middle Banks; a second area which is surrounded by Middle, Sable Island and the western tip of Banquereau Banks, at the end of the Gully; and the last one was reported within the area between Missaine and Banquereau Banks, near Artimon Bank. At present, it is not known to what extent the type of bottom encountered in eastern Nova Scotia will affect the results of the trawl survey, but its implication and consequences are too important to be left unanswered. Our belief, based on the very limited experience of the southern GLS, which does not have this type of bottom but does have a few relatively deep holes, is that when a "big hole" is encountered the concentration of crab usually tends to be higher at the bottom and less on steep slopes. However, no experiments have been realized to verify such observations. However, if the crab distribution in these mountainous areas in eastern Nova Scotia is not homogeneous between the bottom (valleys), the slopes and the peak of each "mountain", it could easily result in an over-estimation of the biomass.

There are several positive features of this survey. First, we have shown that the survey method can work for eastern Nova Scotia. Second, the research survey produced an excellent set of data, the first snapshot of a potential time series. The total number of 150 trawl stations were surveyed between May 15 and June 11 during which 7,810 males and 6,787 females were captured and measured. Overall, the area surveyed covers 32,000 km^2. The contour of density maps generated as a result of the trawl survey and the fisher's logbook data corroborate. CPUE of fishers within the predicted high density areas were the highest, while those fishing outside such concentration where the method forecasted the lowest densities of crab had the lowest catch rates. Furthermore, a study of groundfish trawl survey data (Tremblay 1997) confirm the presence of high concentration of snow crab "offshore" such as the patches found offshore of Area 23 and at the limit of the surveyed area in Area-24, near Sable Island for the period of 1990 - 94. This study also pointed out that, from data obtained during a special groundfish survey directed at seal worm in May 1994, a strong concentration of pre-recruits (50 mm to 65 mm) and a smaller one of adolescent (70 mm to 90 mm) were observed near Sable Island, exactly were forecasted by this research trawl method. If the high density of adolescent males found there in 1994 is extrapolated for today, it should be present as a group of mature males of carapace condition 3 and 4, which is what this method reported. The existence of such a high density patch of crab near Sable Island has also been confirmed by fishers of Area 24, and their description of the carapace conditions of crabs fished there also support these findings. There are also histograms of the population structure that are generated from the survey data and that are important tools in assessing the overall picture, future recruitment included.

Overall, and because of uncertainties previously mentioned, this first year research trawl survey can not accurately estimate the biomass levels. However, the data acquired is good and with enough time, as this method would further be adapted to the particularities of eastern Nova Scotia, true estimates should be produced and the present data reevaluated. This first survey also allowed us to evaluate the whole process and to pin-point its actual weaknesses. As it is now, the bulk of the biomass that has been identified is located in the offshore portion of Areas 23 and 24, near or at the edge of the surveyed surface, giving the impression that there is "a lot more" beyond the limits of the 32,000 km^2 surveyed. However, the observation that these high concentration patches seem located within the areas of rough bottom combined to the actual natural barriers such as Sable Island and the abrupt end of the Scotian Shelf itself, indicate otherwise. Therefore, increasing the number of trawl stations to cover areas outside the present surveyed grounds would easily clarify the general picture. The sampling necessary to establish specific models for the size-weight

relationship and the discriminant function should be a priority of the Science group for next year. Sampling for these two models can readily be combined to the sampling of the research trawl survey. Also, preliminary work aimed at understanding the effects the two different bottom types on the biomass estimation method should be initiated.

OUTLOOK FOR AREAS 20-24 AND 4X

As mentioned for the trawl survey method was introduced last year, the minimum time series acceptable by the Science group to produce "predictions" with confidence was and remains 3 years. This should give time to adapt this method to the particularities of eastern Nova Scotia, and to build a time series data base to understand the population dynamics. In the meantime, the management of this fishery must still primarily rely on the assessment from the fishery related data and any other unrelated studies such as the one produced by Tremblay (1997). It is therefore difficult to "predict" or "recommend" future considerations because of this lack of extensive fishery-independent survey, and there are still uncertainties as to when pre-recruits crabs will become available to these fisheries.

Analysis of the logbook data collected in Areas 23 and 24 indicate a reduction in catch rates and an increase in total fishing efforts. Although some of this could be explained by the observed better reporting of double hauling occurrences by the fishers of these Areas, there was nonetheless a real decrease in CPUE and increase in the fishing effort to capture the overall quotas allowed this year, and which were the same as those of 1996. However, the histograms of size frequency reveal that future recruitment is present on these fishing grounds. In Areas 20, 21 and 22 the overall state of these fisheries have improved considerably since last year. There was a marked increase in the catch rate levels and an important decrease in the seasonal fishing effort in Areas 20 and 21. In Area 22, although the improvement is also considerable when compared to the disastrous results of last years season, the recommendation is that this Area should still be considered as precarious. As it stands now, there is no known reasons that would not justify a conservative and well supervised increase in landings in all Areas, but for the inshore portion of Areas 22 were ways to control the fishing pressure should be considered first.

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Table 1. Summary of the Management Plan measures for 1997.

Area	Season	Regular licences	Traps allowed	Quota per regular licences (lbs)	Temporary permits	Traps allowed	Quota per temporary permits (lbs)
20	July 22- Sept. 15	5	30	20,000	none	none	none
21	July 22- Aug. 22	32	25	10,000	none	none	none
22	Inshore group:[1]	17	30				
	July 22- Sept. 1st			competitive	none	none	none
	Offshore group:[1]	20	30				
	July 22- Sept. 8						
23	July 22- Sept 15	24	30	52,000	6	10	10,000
24	July 22- Sept. 30	23	30	52,000	6	10	10,000
4X	year round	4[2]	250[3]	competitive	none	none	none

[1] Both groups have agreed not to fish on Sundays.
[2] These are exploratory fishing licences in the 4X portion of CFA 24.
[3] Provided the majority of them are the smaller 3' diameter type.

Table 2. Landings of snow crab (*Chionoecetes opilio)* for eastern Nova Scotia (Areas 20 to 24), 1978 - 1997.

Year	Active licences/permits	Logbooks received	Landing Statistics (mt)	Total mean CPUE (kg/trap haul)	Total Effort (1000's of trap hauls)
1978	42	42	801	28.4	28.2
1979	98	89	1,634	28.7	56.9
1980	99	81	819	19.8	41.4
1981	55	19	156	21.8	7.2
1982	67	56	554	16.7	33.2
1983	97	80	259	9.6	27.0
1984	51	38	124	8.6	14.4
1985	29	24	89	8.7	10.2
1986	29	23	120	10.2	11.8
1987	61	49	361	12.6	28.7
1988	88	74	596	14.6	40.8
1989	100	85	616	18.7	32.9
1990	102	87	1,152	25.4	45.4
1991	101	91	1,533	30.9	49.6
1992	104	77	1,797	32.5	55.3
1993	113	85	2,016	28.1	71.7
1994	117	83	1,551	21.2	73.2
1995	134	41	1,554	22.0	70.6
1996	124	124	1,491	29.6	50.3
1997	133	132	1,677	37.3	44.9
Average (all)			945	21.3	39.7
Average (95-97)			1,574	29.6	55.3

Table 3. Landings, catch rate and effort statistics for snow crab Area 20, 1978 - 1997.

Year	Active boats	Logbooks received	Landing statistics (mt)	Mean CPUE (kg/trap haul)	Total Effort (1000's of trap hauls)
1978	-	0	61	-	-
1979	8	3	80	8.2	9.8
1980	8	3	34	8.3	4.1
1981	6	0	2	-	-
1982	-	0	2	-	-
1983	12	2	23	1.7	13.5
1984	2	0	10	-	-
1985	1	0	1	-	-
1986	2	1	0	1.9	-
1987	3	0	1	-	-
1988	4	2	17	7.9	2.2
1989	5	0	8	-	-
1990	4	2	5	5.3	0.9
1991	4	3	14	16.3	0.9
1992	3	3	18	40.6	0.4
1993	4	4	20	17.3	1.2
1994	5	4	29	20.2	1.4
1995	5	1	44	19.8	2.2
1996	5	5	43	14.7	2.9
1997	5	5	45	20.2	2.3
average (all)			23	14.0	3.5
average (95-97)			44	18.2	2.5

Table 4. Weekly landings, catch rate and effort statistics for snow crab Area 20, 1997.

week	landings (kg)	CPUE (kg/trap haul)	Effort (total number of trap hauls)
July 20	13,071	26.5	493
July 27	12,804	20.1	636
Aug. 3	11,084	17.6	629
Aug. 10	6,221	19.0	330
Aug. 17	1,553	12.3	126
total[1]	45,360	20.2	2,246

[1] Total seasonal landings and seasonal CPUE were used to obtain these results.

Table 5. Catch composition from at-sea samples for snow crab Area 20 in 1997.

a) Catch composition in percentage.

Week	Coverage		Size	Soft shell crab			Hard shell crab			Total
	trip	trap		small claw	large claw	total	small claw	large claw	total	
July 20	1	6	< 95 mm	0.42	0	**0.42**	1.67	2.08	**3.75**	**4.17**
(week 1)			> 95 mm	3.75	7.50	**11.25**	4.58	80.00	**84.58**	**95.83**
			total	4.17	7.50	**11.67**	6.25	82.08	**88.33**	**100.00**
Aug. 3	1	5	< 95 mm	0.50	2.50	**3.00**	1.00	4.00	**5.00**	**8.00**
(week 3)			> 95 mm	4.50	8.50	**13.00**	6.50	72.50	**79.00**	**92.00**
			total	5.00	11.00	**16.00**	7.50	76.50	**84.00**	**100.00**
Season	2	11	< 95 mm	0.45	1.14	**1.59**	1.36	2.95	**4.31**	**5.91**
			> 95 mm	4.09	7.95	**12.04**	5.45	76.59	**82.04**	**94.09**
			total	4.55	9.09	**13.64**	6.82	79.55	**86.37**	**100.00**

b) Catch composition in number.

Week	Coverage		Size	Soft shell crab			Hard shell crab			Total
	trip	trap		small claw	large claw	total	small claw	large claw	total	
July 20	1	6	< 95 mm	1	0	**1**	4	5	**9**	**10**
(week 1)			> 95 mm	9	18	**27**	11	192	**203**	**230**
			total	10	18	**28**	15	197	**212**	**240**
Aug. 3	1	5	< 95 mm	1	5	**6**	2	8	**10**	**16**
(week 3)			> 95 mm	9	17	**26**	13	145	**158**	**184**
			total	10	22	**32**	15	153	**168**	**200**
Season	2	11	< 95 mm	2	5	**7**	6	13	**19**	**26**
			> 95 mm	18	35	**53**	24	337	**361**	**414**
			total	20	40	**60**	30	350	**380**	**440**

Table 6. Carapace condition of mature male snow crab > 95 mm in Areas 20 to 24 in 1997.

a) Catch composition in percentage

carapace condition	Areas				
	20	21	22	23	24
1	7.95	0	8.87	12.93	0.16
2	18.41	31.38	38.07	11.48	18.70
3	56.82	54.81	35.85	40.20	49.87
4	16.59	13.39	15.99	30.52	24.42
5	0.23	0.42	1.22	4.87	6.85
total	100.00	100.00	100.00	100.00	100.00

b) Catch composition in number

carapace condition	Areas				
	20	21	22	23	24
1	35	0	328	1097	11
2	81	75	1407	974	1256
3	250	131	1325	3409	3350
4	73	32	591	2588	1640
5	1	1	45	413	460
total	440	239	3696	8481	6717

Table 7. Landings, catch rate and effort statistics for snow crab Area 21, 1978 - 1997.

Year	Active licences	Logbooks received	Landing statistics	Mean CPUE (kg/trap haul)	Total Effort (1000's of trap hauls)
1978	16	16	247	11.3	21.9
1979	27	27	243	10.7	22.7
1980	31	25	153	9.7	15.8
1981	22	1	34	13.6	2.5
1982	20	18	94	7.9	11.9
1983	27	25	48	5.1	9.4
1984	19	13	18	2.9	6.2
1985	10	7	10	3.5	2.9
1986	12	8	7	2.5	2.8
1987	21	15	56	6.4	8.8
1988	24	19	125	9.6	13.0
1989	30	27	154	13.7	11.2
1990	31	27	167	13.1	12.7
1991	29	27	157	14.9	10.5
1992	31	28	196	16.7	11.7
1993	30	28	168	14.2	11.8
1994	31	29	107	7.2	14.9
1995	32	7	100	8.3	12.0
1996	32	32	136	9.7	13.9
1997	32	32	146	35.7	4.1
average (all)			118	10.8	11.0
average (95-97)			127	17.9	10.0

Table 8. Weekly landings, catch rate and effort statistics for snow crab Area 21, 1997.

week	landings (kg)	CPUE (kg/trap haul)	Effort (total number of trap hauls)
July 20	114,242	42.0	2,720
July 27	31,331	22.0	1,424
total[1]	145,573	35.7	4,083

[1] Total seasonal landings and seasonal CPUE were used to obtain these results.

Table 9. Catch composition from at-sea samples for snow crab Area 21 in 1997.

a) Catch composition in percentage.

Week	Coverage		Size	Soft shell crab			Hard shell crab			Total
	trip	trap		small claw	large claw	total	small claw	large claw	total	
July 20	1	6	< 95 mm	0	0.83	**0.83**	0.42	2.08	**2.50**	**3.33**
			> 95 mm	4.17	22.50	**26.67**	0.83	69.17	**70.00**	**96.67**
			total	4.17	23.33	**27.50**	1.25	71.25	**72.50**	**100.00**

b) Catch composition in number.

Week	Coverage		Size	Soft shell crab			Hard shell crab			Total
	trip	trap		small claw	large claw	total	small claw	large claw	total	
July 20	1	6	< 95 mm	0	2	**2**	1	5	**6**	**8**
			> 95 mm	10	54	**64**	2	166	**168**	**232**
			total	10	56	**66**	3	171	**174**	**240**

Table 10. Landings, catch rate and effort statistics for snow crab Area 22, 1978 - 1997.

Year	Active licences	Logbooks received	Landing statistics (mt)	Mean CPUE (kg/trap haul)	Total Effort (1000's of trap hauls)
1978	15	14	341	28.9	11.8
1979	35	35	684	38.4	17.8
1980	26	24	227	21.0	10.8
1981	11	3	50	12.5	4.0
1982	21	14	153	19.6	7.8
1983	26	21	52	8.5	6.1
1984	7	7	18	8.6	2.1
1985	8	7	3	6.0	0.5
1986	5	3	18	10.0	1.8
1987	16	14	63	10.5	6.0
1988	29	22	114	10.4	11.0
1989	26	20	93	15.0	6.2
1990	26	21	119	9.0	13.2
1991	24	23	183	18.5	9.9
1992	27	15	240	24.2	9.9
1993	40	27	390	21.0	18.6
1994	38	28	259	12.0	21.6
1995	37	11	284	9.7	29.3
1996	37	37	189	10.3	18.3
1997	37	37	343	20.8	16.5
average (all)			191	15.8	11.2
average (95-97)			272	13.6	21.4

Table 11. Weekly landings, catch rate and effort statistics for snow crab Area 22 in 1997.

a) Weekly landings statistics

week	landings (kg)		
	All	inshore	offshore
July 20	114,454	78,162	36,292
July 27	132,721	83,300	49,421
Aug. 3	64,551	23,334	41,217
Aug. 10	30,325		30,325
total[1]	343,039	184,796	158,243

b) Weekly catch rate statistics

week	CPUE (kg/trap haul)		
	All	inshore	offshore
July 20	30.2	38.4	20.7
July 27	23.4	27.6	18.6
Aug. 3	16.4	24.1	13.9
Aug. 10	10.0		10.0
total[1]	20.8	30.7	15.1

c) Weekly effort statistics

week	Effort (total number of traps hauls)		
	all	inshore	offshore
July 20	3,791	2,035	1,756
July 27[1]	5,668	3,018	2,650
Aug. 3	3,940	967	2,973
Aug. 10	3,026		3,026
total[1]	16,472	6,020	10,470

[1] Total seasonal landings.

Table 12. Weekly landings, catch rate and effort statistics for snow crab Area 22 in 1996.

a) Weekly landings statistics

week	landings (kg)		
	All	inshore	offshore
July 21	33,231	31,937	-
July 28	71,187	26,984	45,498
Aug. 04	34,577	13,073	21,503
Aug. 11	14,213	11,827	2,386
Aug. 18	5,562	4,063	1,498
Aug. 25	3,480	2,015	1,464
Sept. 29	8,064	-	8,064
Oct. 06	4,937	-	4,937
total[1]	175,250	89900	85,350

b) Weekly catch rate statistics

week	landings (kg)		
	All	inshore	offshore
July 21	20.6	20.7	-
July 28	11.5	14.6	10.2
Aug. 04	7.6	9.8	6.6
Aug. 11	7.7	8.0	6.6
Aug. 18	6.5	6.7	6.1
Aug. 25	5.9	5.9	5.9
Sept. 29	15.7	-	15.7
Oct. 06	6.5	-	6.5
total[1]	10.4	12.5	8.7

c) Weekly effort statistics

week	landings (kg)		
	all	inshore	offshore
July 21	1,613	1,543	-
July 28	6,190	1,848	4,461
Aug. 04	4,550	1,328	3,258
Aug. 11	1,836	1,476	360
Aug. 18	853	608	245
Aug. 25	590	342	248
Sept. 29	514	-	514
Oct. 06	760	-	760
total[1]	16,894	7,192	9,846

[1] Total seasonal landings.

Table 13. Catch composition from at-sea samples for snow crab Area 22 in 1997.

a) Catch composition in percentage.

Week	Coverage		Size	Soft shell crab			Hard shell crab			Total
	trip	trap		small claw	large claw	total	small claw	large claw	total	
July 20	4	18	< 95 mm	5.10	4.52	**9.62**	1.60	22.01	**23.61**	**33.24**
(week 1)			> 95 mm	10.64	21.14	**31.78**	2.62	32.36	**34.98**	**66.76**
			total	15.74	25.66	**41.40**	4.23	54.37	**58.60**	**100.00**
July 27	10	72	< 95 mm	7.71	2.96	**10.67**	5.13	18.62	**23.75**	**34.41**
(week 2)			> 95 mm	9.14	18.90	**28.04**	7.53	30.02	**37.55**	**65.59**
			total	16.84	21.86	**38.71**	12.66	48.64	**61.30**	**100.00**
Aug. 3	1	5	< 95 mm	5.00	3.33	**8.33**	2.78	19.44	**22.22**	**30.56**
(week 3)			> 95 mm	2.22	14.44	**16.66**	1.67	51.11	**52.78**	**69.44**
			total	7.22	17.78	**24.99**	4.44	70.56	**75.00**	**100.00**
Season	15	95	< 95 mm	7.10	3.27	**10.37**	4.37	19.28	**23.65**	**34.01**
			> 95 mm	9.08	19.09	**28.17**	6.35	31.47	**37.82**	**65.99**
			total	16.18	22.36	**38.54**	10.71	50.75	**61.46**	**100.00**

b) Catch composition in number.

Week	Coverage		Size	Soft shell crab			Hard shell crab			Total
	trip	trap		small claw	large claw	total	small claw	large claw	total	
July 20	4	18	< 95 mm	35	31	**66**	11	151	**162**	**228**
(week 1)			> 95 mm	73	145	**218**	18	222	**240**	**458**
			total	108	176	**284**	29	373	**402**	**686**
July 27	10	72	< 95 mm	221	85	**306**	147	534	**681**	**987**
(week 2)			> 95 mm	262	542	**804**	216	861	**1077**	**1881**
			total	483	627	**1110**	363	1395	**1758**	**2868**
Aug. 3	1	5	< 95 mm	9	6	**15**	5	35	**40**	**55**
(week 3)			> 95 mm	4	26	**30**	3	92	**95**	**125**
			total	13	32	**45**	8	127	**135**	**180**
Season	15	95	< 95 mm	265	122	**387**	163	720	**883**	**1270**
			> 95 mm	339	713	**1052**	237	1175	**1412**	**2464**
			total	604	835	**1439**	400	1895	**2295**	**3734**

Table 14. Landings, catch rate and effort statistics for snow crab in Area 23, 1978 - 1997.

Year	Active licences/permits	Logbooks received	Landing statistics (mt)	Mean CPUE (kg/trap haul)	Total Effort (1000's of trap hauls)
1978	-	15	347	51.5	6.7
1979	-	22	608	43.4	14.0
1980	-	21	343	39.0	8.8
1981	-	10	82	26.5	3.1
1982	-	21	253	28.8	8.8
1983	-	26	119	16.5	7.2
1984	-	7	41	18.6	2.2
1985	5	5	28	14.7	1.9
1986	6	6	49	14.4	3.4
1987	14	11	157	26.2	6.0
1988	21	18	207	24.9	8.3
1989	25	23	243	28.3	8.6
1990	27	24	386	36.4	10.6
1991	23	22	528	44.8	11.8
1992	22	18	595	49.6	12.0
1993	26	16	770	53.1	14.5
1994	22	22	497	33.4	14.9
1995	31	7	576	51.8	11.1
1996	27	27	564	65.6	8.6
1997	30	30	592	57.8	10.2
average (all)			349	36.3	8.6
average (95-97)			577	58.4	10.0

Table 15. Weekly landings, catch rate and effort statistics for snow crab Area 23 in 1997.

a) Weekly landings statistics

week	landings (kg)		
	all	permanent	temporary
July 27[1]	146,358	142,318	4,040
Aug. 3	153,023	146,281	6,742
Aug. 10	128,616	122,983	5,633
Aug. 17	81,517	79,809	1,708
Aug. 24	58,791	56,655	2,042
Aug. 31	19,088	17,807	2,505
Sept. 7	3,583	2,359	
total[2]	591,533	568,212	18,630

b) Weekly catch rate statistics

week	CPUE (kg/trap haul)		
	all	permanent	temporary
July 27[1]	69.6	71.0	40.4
Aug. 3	65.8	67.2	45.2
Aug. 10	54.4	55.3	40.2
Aug. 17	50.0	51.0	26.7
Aug. 24	45.9	45.8	46.4
Aug. 31	44.8	45.0	41.8
Sept. 7	34.8	32.3	
total[2]	57.8	58.7	40.8

c) Weekly effort statistics

week	Effort (total number of traps hauls)		
	all	permanent	temporary
July 27[1]	2,104	2,004	100
Aug. 3	2,325	2,176	149
Aug. 10	2,364	2,224	140
Aug. 17	1,629	1,565	64
Aug. 24	1,281	1,237	44
Aug. 31	426	396	60
Sept. 7	103	73	
total[2]	10,232	9,675	457

[1] Including landings from July 25+26 [2] Total seasonal landings.

Table 16. Catch composition from at-sea samples for snow crab Area 23 in 1997.

a) Catch composition in percentage.

Week	Coverage		Size	Soft shell crab			Hard shell crab			Total
	trip	trap		small claw	large claw	total	small claw	large claw	total	
Aug. 3	3	17	< 95 mm	1.91	3.24	**5.15**	2.50	15.17	**17.67**	**22.83**
(week 2)			> 95 mm	1.18	5.60	**6.78**	2.65	67.75	**70.40**	**77.17**
			total	3.09	8.84	**11.93**	5.15	82.92	**88.07**	**100.00**
Aug. 10	5	32	< 95 mm	3.05	3.60	**6.65**	0.86	35.21	**36.07**	**42.72**
(week 3)			> 95 mm	1.02	6.73	**7.75**	0.70	48.83	**49.53**	**57.28**
			total	4.07	10.33	**14.40**	1.56	84.04	**85.60**	**100.00**
Aug. 17	8	68	< 95 mm	4.54	3.39	**7.93**	2.64	30.26	**32.90**	**40.83**
(week 4)			> 95 mm	4.47	6.74	**11.21**	5.99	41.98	**47.97**	**59.17**
			total	9.01	10.12	**19.13**	8.63	72.24	**80.87**	**100.00**
Aug. 24	7	47	< 95 mm	3.85	2.25	**6.10**	2.25	22.94	**25.19**	**31.28**
(week 5)			> 95 mm	3.58	8.34	**11.92**	10.75	46.04	**56.79**	**68.72**
			total	7.43	10.59	**18.02**	12.99	68.98	**81.97**	**100.00**
Aug. 31	8	49	< 95 mm	16.14	3.12	**19.26**	9.35	15.07	**24.42**	**43.67**
(week 6)			> 95 mm	5.46	6.03	**11.49**	14.30	30.54	**44.84**	**56.33**
			total	21.60	9.14	**30.74**	23.65	45.61	**69.26**	**100.00**
Season	31	213	< 95 mm	6.63	3.09	**9.72**	3.82	24.67	**28.49**	**38.22**
			> 95 mm	3.72	6.83	**10.55**	7.90	43.33	**51.23**	**61.78**
			total	10.35	9.93	**20.28**	11.72	68.00	**79.72**	**100.00**

b) Catch composition in number.

Week	Coverage		Size	Soft shell crab			Hard shell crab			Total
	trip	trap		small claw	large claw	total	small claw	large claw	total	
Aug. 3	3	17	< 95 mm	13	22	**35**	17	103	**120**	**155**
(week 2)			> 95 mm	8	38	**46**	18	460	**478**	**524**
			total	21	60	**81**	35	563	**598**	**679**
Aug. 10	5	32	< 95 mm	39	46	**85**	11	450	**461**	**546**
(week 3)			> 95 mm	13	86	**99**	9	624	**633**	**732**
			total	52	132	**184**	20	1074	**1094**	**1278**
Aug. 17	8	68	< 95 mm	122	91	**213**	71	813	**884**	**1097**
(week 4)			> 95 mm	120	181	**301**	161	1128	**1289**	**1590**
			total	242	272	**514**	232	1941	**2173**	**2687**
Aug. 24	7	47	< 95 mm	72	42	**114**	42	429	**471**	**585**
(week 5)			> 95 mm	67	156	**223**	201	861	**1062**	**1285**
			total	139	198	**337**	243	1290	**1533**	**1870**
Aug. 31	8	49	< 95 mm	316	61	**377**	183	295	**478**	**855**
(week 6)			> 95 mm	107	118	**225**	280	598	**878**	**1103**
			total	423	179	**602**	463	893	**1356**	**1958**
Season	31	213	< 95 mm	562	262	**824**	324	2090	**2414**	**3238**
			> 95 mm	315	579	**894**	669	3671	**4340**	**5234**
			total	877	841	**1718**	993	5761	**6754**	**8472**

Table 17. Landings, catch rate and effort statistics for snow crab Area 24, 1978 - 1997.

Year	Active licences/permits	Logbooks received	Landing statistics	Mean CPUE (kg/trap haul)	Total Effort (1000's of trap hauls)
1978	-	-	-	-	-
1979	4	4	61	14.8	4.1
1980	10	10	70	12.8	5.5
1981	5	5	21	15.8	1.3
1982	7	7	62	10.1	6.1
1983	13	11	64	8.4	7.6
1984	13	12	52	9.2	5.6
1985	6	5	35	10.2	3.4
1986	7	5	49	11.9	4.1
1987	11	9	84	12.9	6.5
1988	13	13	163	15.7	10.4
1989	18	17	201	17.2	11.7
1990	19	18	543	33.3	16.3
1991	21	16	682	40.1	17.0
1992	22	14	743	38.5	19.3
1993	21	17	662	33.3	19.9
1994	21	21	682	33.4	20.4
1995	31	8	550	34.4	16.0
1996	27	27	560	57.1	9.8
1997	29	29	565	45.2	12.5
average (all)			308	23.9	10.4
average (95-97)			558	45.6	12.8

Table 18. Weekly landings, catch rate and effort statistics for snow crab Area 24 in 1997.

a) Weekly landings statistics

week	landings (kg)		
	all	permanent	temporary
Aug. 3	169,954	160,603	9,351
Aug. 10	127,249	120,551	6,698
Aug. 17	84,575	81,621	2,954
Aug. 24	74,038	72,000	2,038
Aug. 31	55,026	53,052	1,974
Sept. 7	51,382	46,853	4,529
total[1]	565,286	537,742	27,544

b) Weekly catch rate statistics

week	CPUE (kg/trap haul)		
	all	permanent	temporary
Aug. 3	59.5	60.9	42.3
Aug. 10	48.4	49.3	35.8
Aug. 17	43.3	44.2	26.9
Aug. 24	39.7	41.2	17.6
Aug. 31	36.0	36.3	24.7
Sept. 7	32.2	32.1	33.7
total[1]	45.2	46.4	32.9

c) Weekly effort statistics

week	Effort (total number of traps hauls)		
	all	permanent	temporary
Aug. 3	2,856	2,635	221
Aug. 10	2,631	2,444	187
Aug. 17	1,955	1,845	110
Aug. 24	1,863	1,747	116
Aug. 31	1,530	1,460	80
Sept. 7	1,595	1,461	134
total[1]	12,498	11,589	837

[1] Total seasonal landings

Table 19. Catch composition from at-sea samples for snow crab Area 24 in 1997.

a) Catch composition in percentage.

Week	Coverage		Size	Soft shell crab			Hard shell crab			Total
	trip	trap		small claw	large claw	total	small claw	large claw	total	
Aug. 3	3	22	< 95 mm	7.74	2.96	**10.70**	1.71	14.22	**15.93**	**26.62**
(week 1)			> 95 mm	2.62	8.42	**11.04**	1.82	60.52	**62.34**	**73.38**
			total	10.35	11.38	**21.73**	3.53	74.74	**78.27**	**100.00**
Aug. 10	7	52	< 95 mm	9.83	2.17	**12.00**	1.45	22.70	**24.15**	**36.14**
(week 2)			> 95 mm	2.99	7.66	**10.65**	1.54	51.66	**53.20**	**63.86**
			total	12.82	9.83	**22.65**	2.99	74.36	**77.35**	**100.00**
Aug. 17	6	42	< 95 mm	5.97	1.85	**7.82**	1.13	13.97	**15.10**	**22.93**
(week 3)			> 95 mm	2.93	13.49	**16.42**	1.25	59.40	**60.65**	**77.07**
			total	8.90	15.34	**24.24**	2.39	73.37	**75.76**	**100.00**
Aug. 24	4	32	< 95 mm	4.70	0.47	**5.17**	2.19	16.37	**18.56**	**23.73**
(week 4)			> 95 mm	1.80	1.88	**3.68**	2.11	70.48	**72.59**	**76.27**
			total	6.50	2.35	**8.85**	4.31	86.84	**91.15**	**100.00**
Aug. 31	3	20	< 95 mm	1.25	0.75	**2.00**	1.25	19.65	**20.90**	**22.90**
(week 5)			> 95 mm	1.38	2.13	**3.51**	2.00	71.59	**73.59**	**77.10**
			total	2.63	2.88	**5.51**	3.25	91.24	**94.49**	**100.00**
Sept. 7	2	12	< 95 mm	2.71	0.83	**3.54**	4.38	13.75	**18.13**	**21.67**
(week 6)			> 95 mm	3.33	6.67	**10.00**	9.58	58.75	**68.33**	**78.33**
			total	6.04	7.50	**13.54**	13.96	72.50	**86.46**	**100.00**
Season	25	180	< 95 mm	6.33	1.64	**7.97**	1.71	17.56	**19.27**	**27.25**
			> 95 mm	2.56	7.40	**9.96**	2.20	60.58	**62.78**	**72.75**
			total	8.89	9.05	**17.94**	3.91	78.15	**82.06**	**100.00**

b) Catch composition in number.

Week	Coverage		Size	Soft shell crab			Hard shell crab			Total
	trip	trap		small claw	large claw	total	small claw	large claw	total	
Aug. 3	3	22	< 95 mm	68	26	**94**	15	125	**140**	**234**
(week 1)			> 95 mm	23	74	**97**	16	532	**548**	**645**
			total	91	100	**191**	31	657	**688**	**879**
Aug. 10	7	52	< 95 mm	204	45	**249**	30	471	**501**	**750**
(week 2)			> 95 mm	62	159	**221**	32	1072	**1104**	**1325**
			total	266	204	**470**	62	1543	**1604**	**2075**
Aug. 17	6	42	< 95 mm	100	31	**131**	19	234	**253**	**384**
(week 3)			> 95 mm	49	226	**275**	21	995	**1016**	**1291**
			total	149	257	**406**	40	1229	**1269**	**1675**
Aug. 24	4	32	< 95 mm	60	6	**66**	28	209	**237**	**303**
(week 4)			> 95 mm	23	24	**47**	27	900	**927**	**974**
			total	83	30	**113**	55	1109	**1164**	**1277**
Aug. 31	3	20	< 95 mm	10	6	**16**	10	157	**167**	**183**
(week 5)			> 95 mm	11	17	**28**	16	572	**588**	**616**
			total	21	23	**44**	26	729	**755**	**799**
Sept. 7	2	12	< 95 mm	13	4	**17**	21	66	**87**	**104**
(week 6)			> 95 mm	16	32	**48**	46	282	**328**	**376**
			total	29	36	**65**	67	348	**415**	**480**
Season	25	180	< 95 mm	455	118	**573**	123	1262	**1385**	**1958**
			> 95 mm	184	532	**716**	158	4353	**4511**	**5227**
			total	639	650	**1289**	281	5615	**5896**	**7185**

Table 20. Logbook CPUE vs contour of density map of Adult.

sub-area	seasonal CPUE	density predicted
1	39.0	intermediate
2	19.8	low
3	53.9	high
4	53.7	high
5	62.7	high
6	42.5	intermediate
7	35.4	intermediate
8	13.6	low

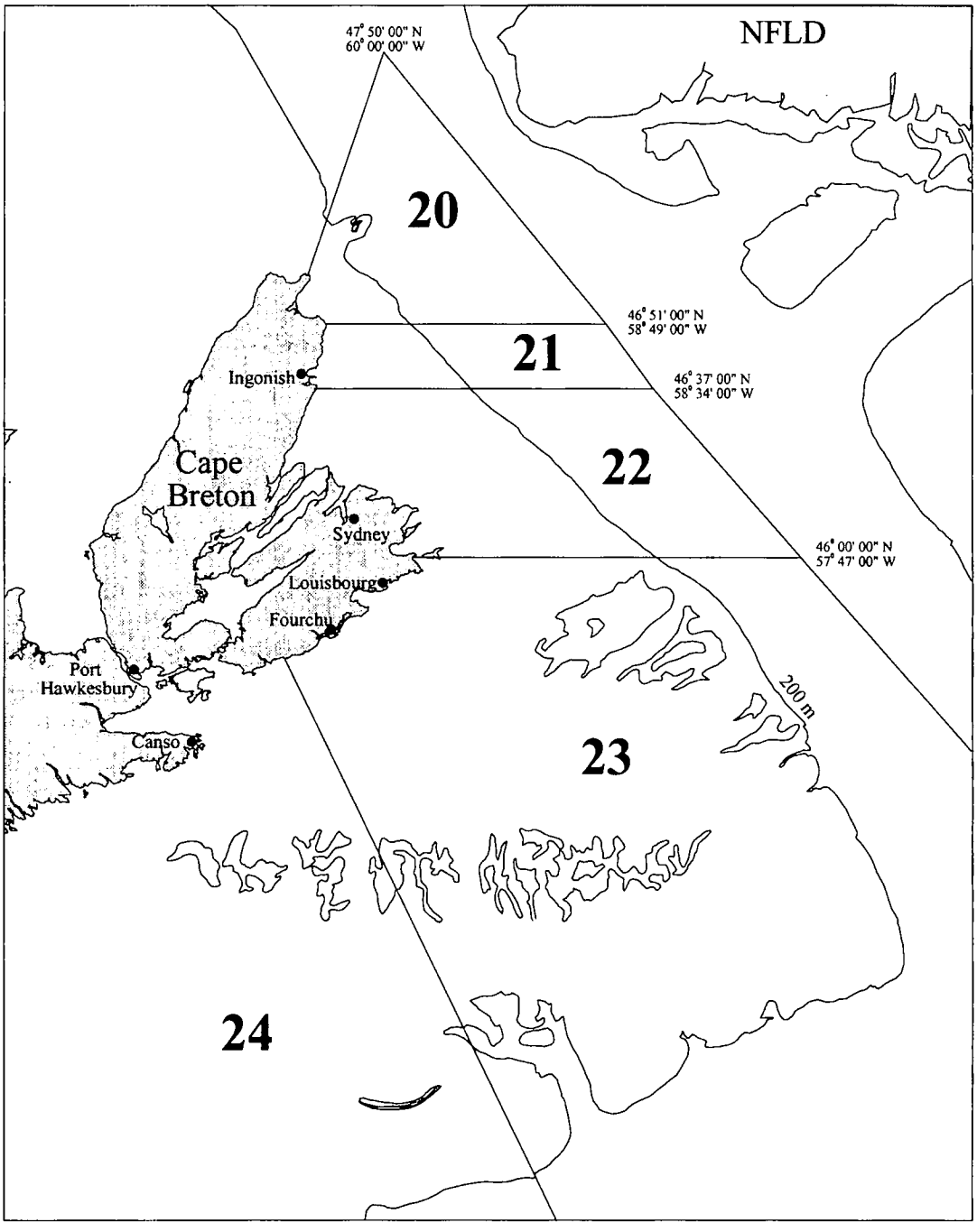

Figure 1. Snow crab Areas off eastern Nova Scotia.

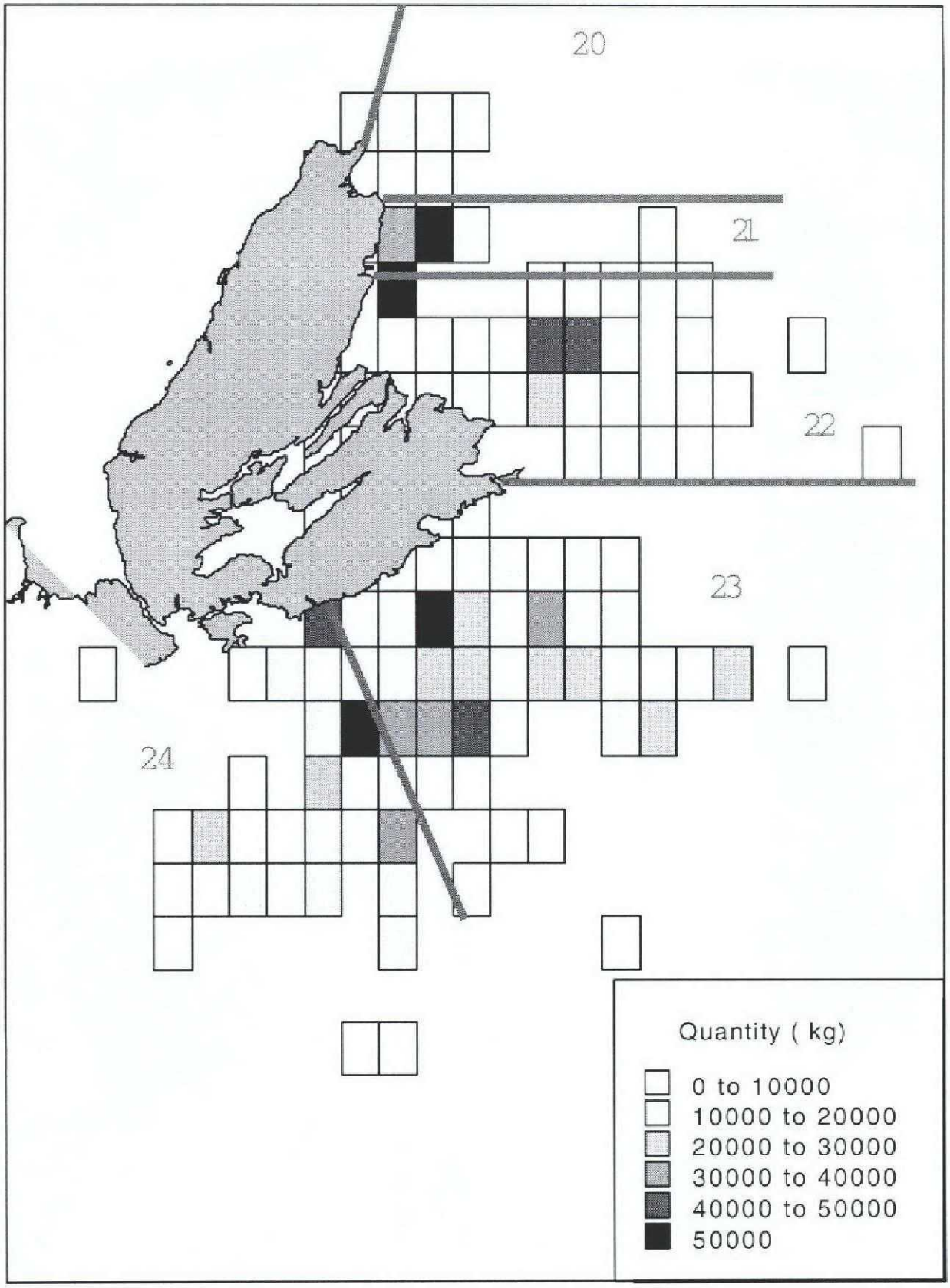

Figure 2. Seasonal distribution of snow crab landings (kg) in eastern Nova Scotia in 1997.

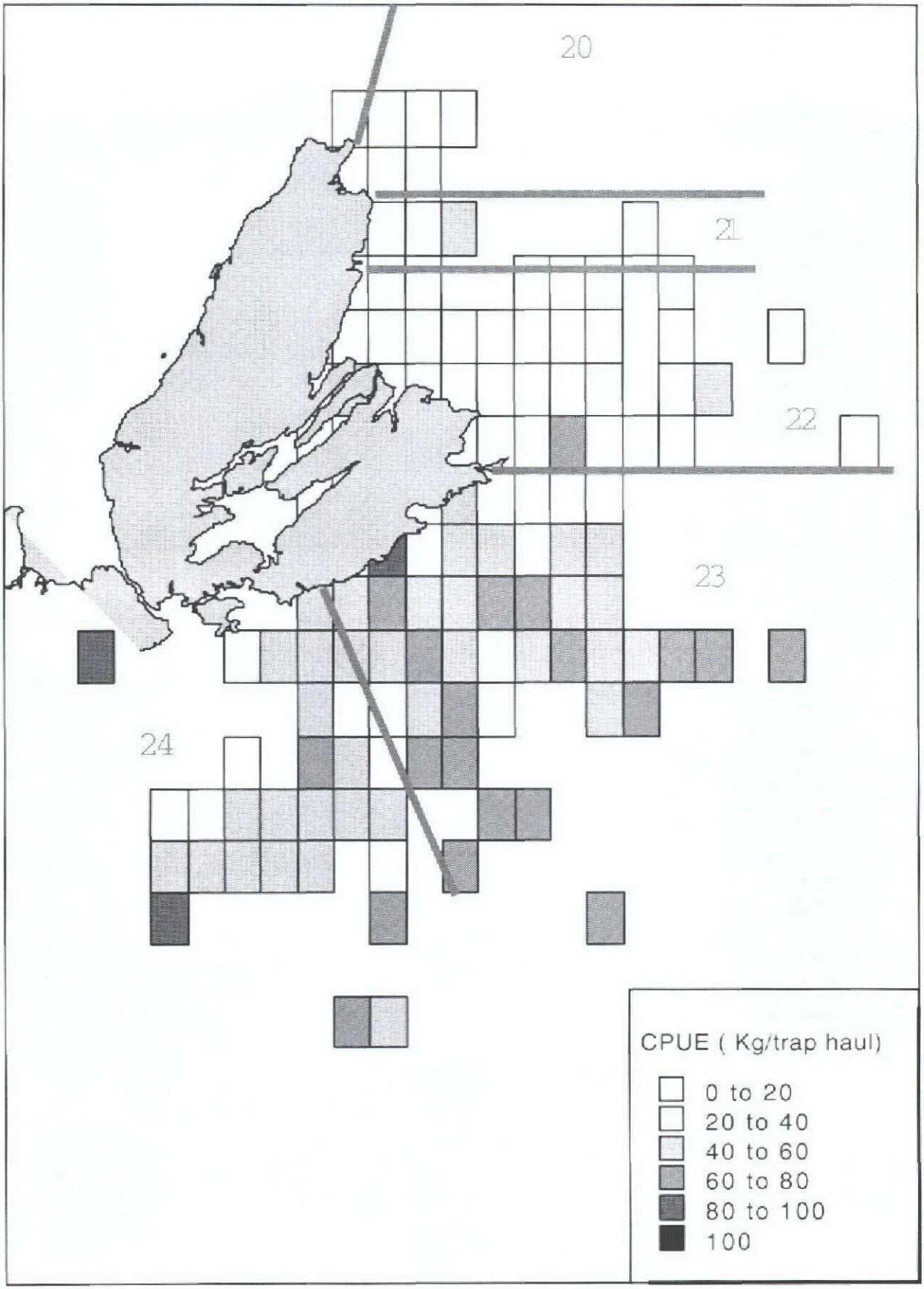

Figure 3. Seasonal distribution of the CPUE (kg / trap haul) in eastern Nova Scotia in 1997.

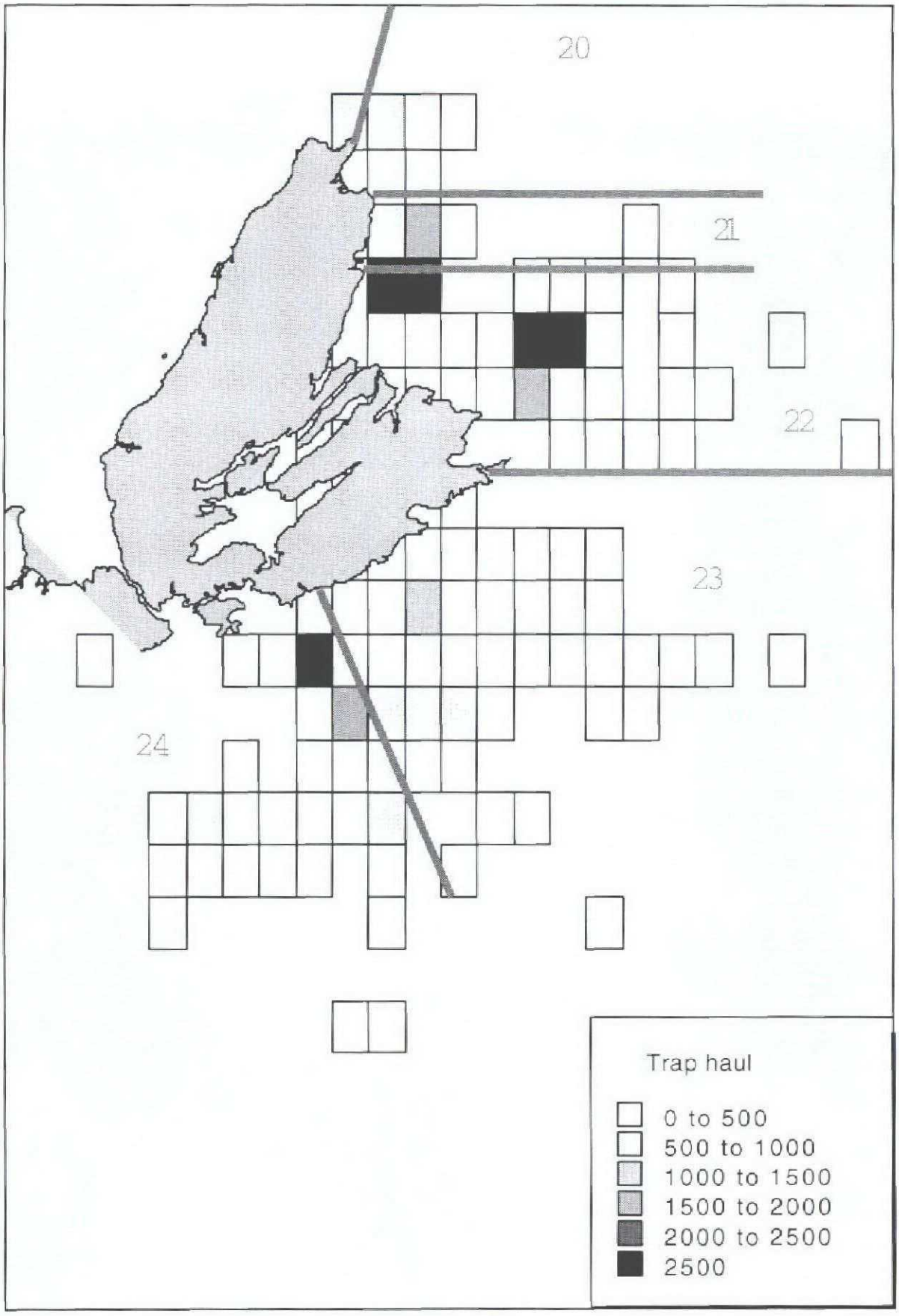

Figure 4. Seasonal distribution of the effort (# of trap hauls) in eastern Nova Scotia in 1997.

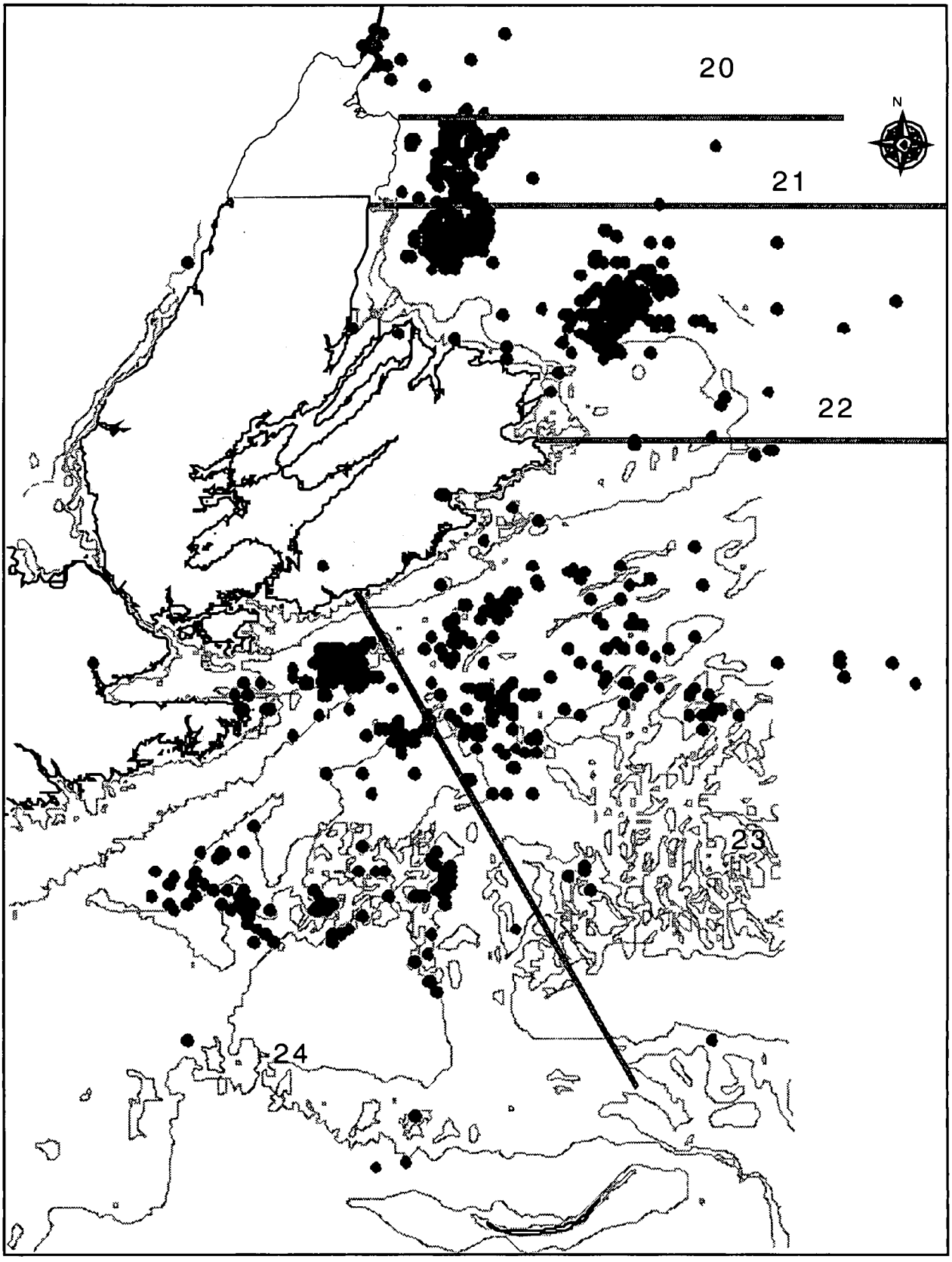

Figure 5. Reported logbook positions in 1997

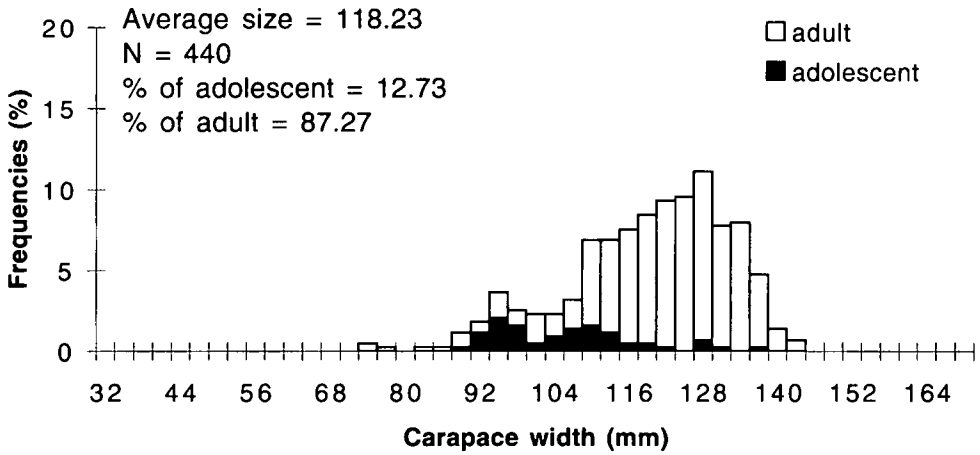

Figure 6. Histogram of size frequency distribution in Area 20.

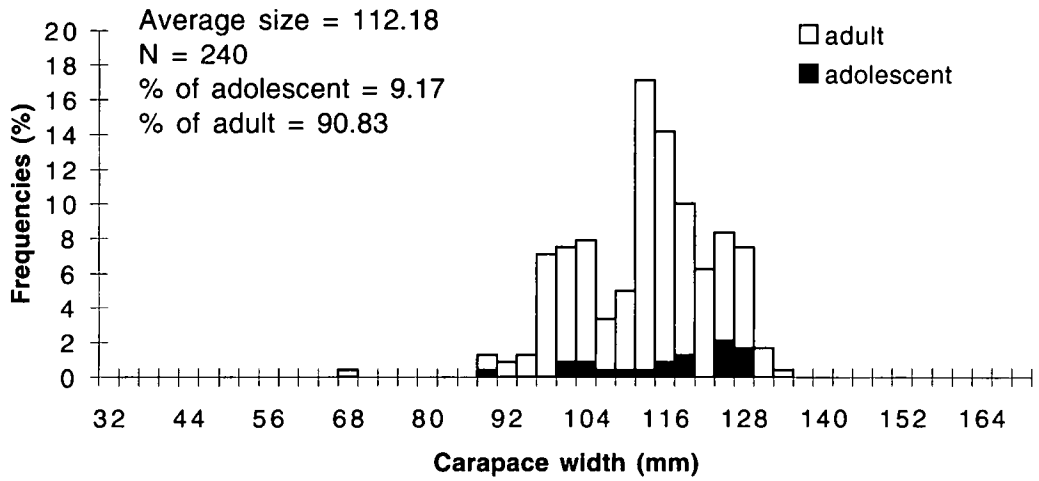

Figure 7. Histogram of size frequency distribution in Area 21.

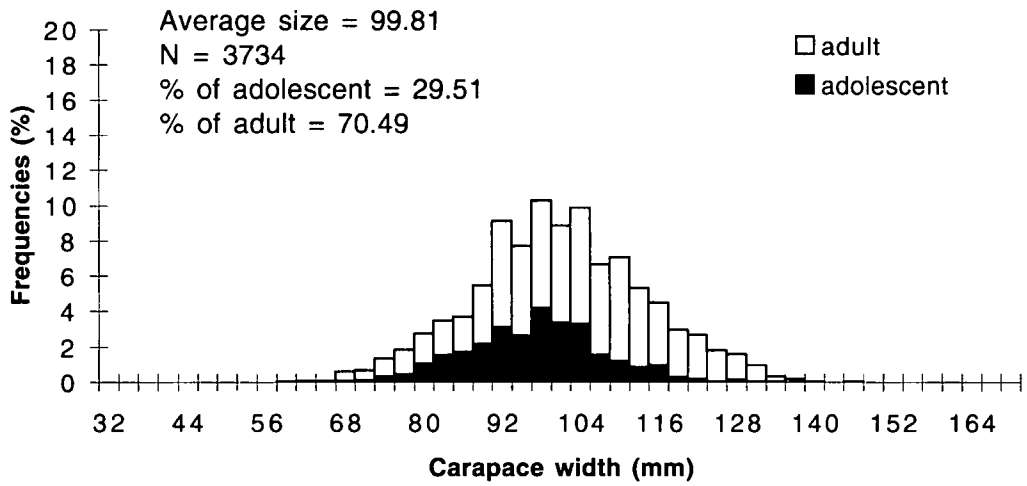

Figure 8. Histogram of size frequency distribution in Area 22.

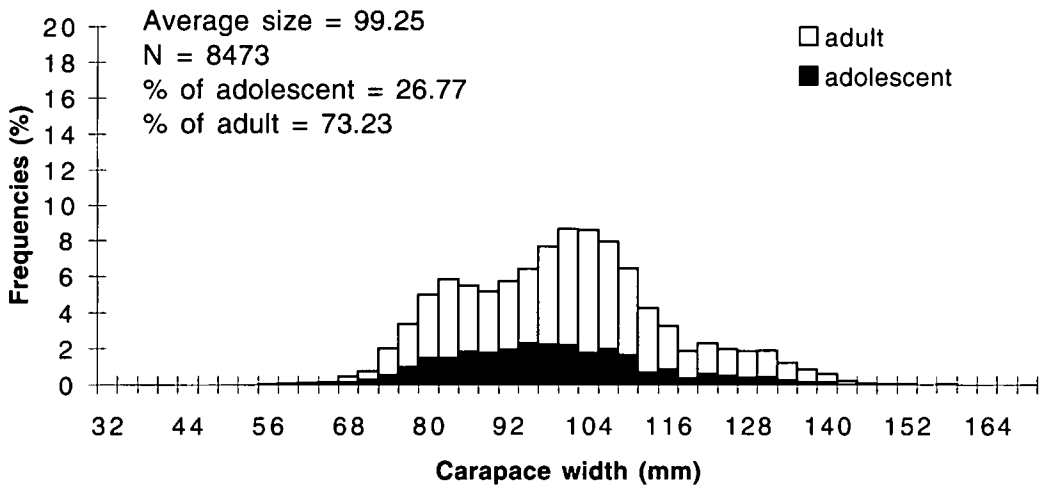

Figure 9. Histogram of size frequency distribution in Area 23.

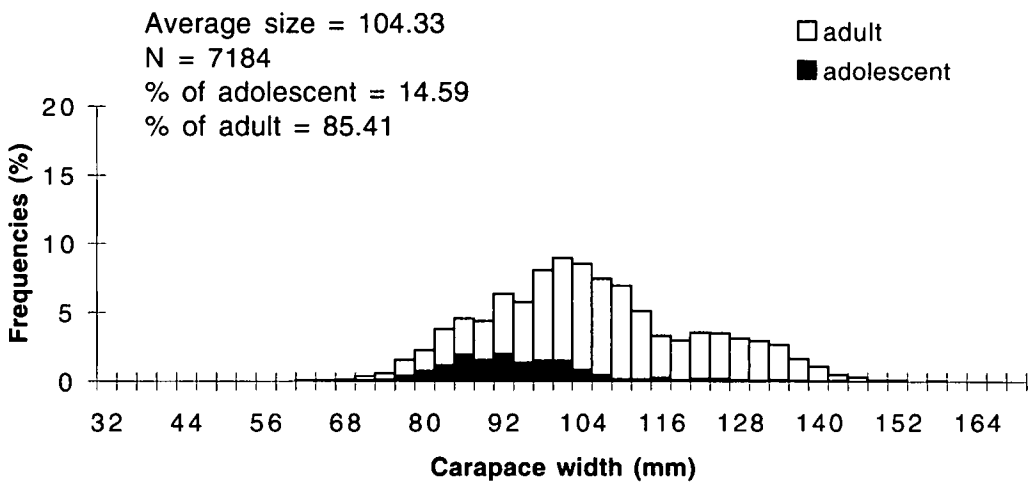

Figure 10. Histogram of size frequency distribution in Area 24.

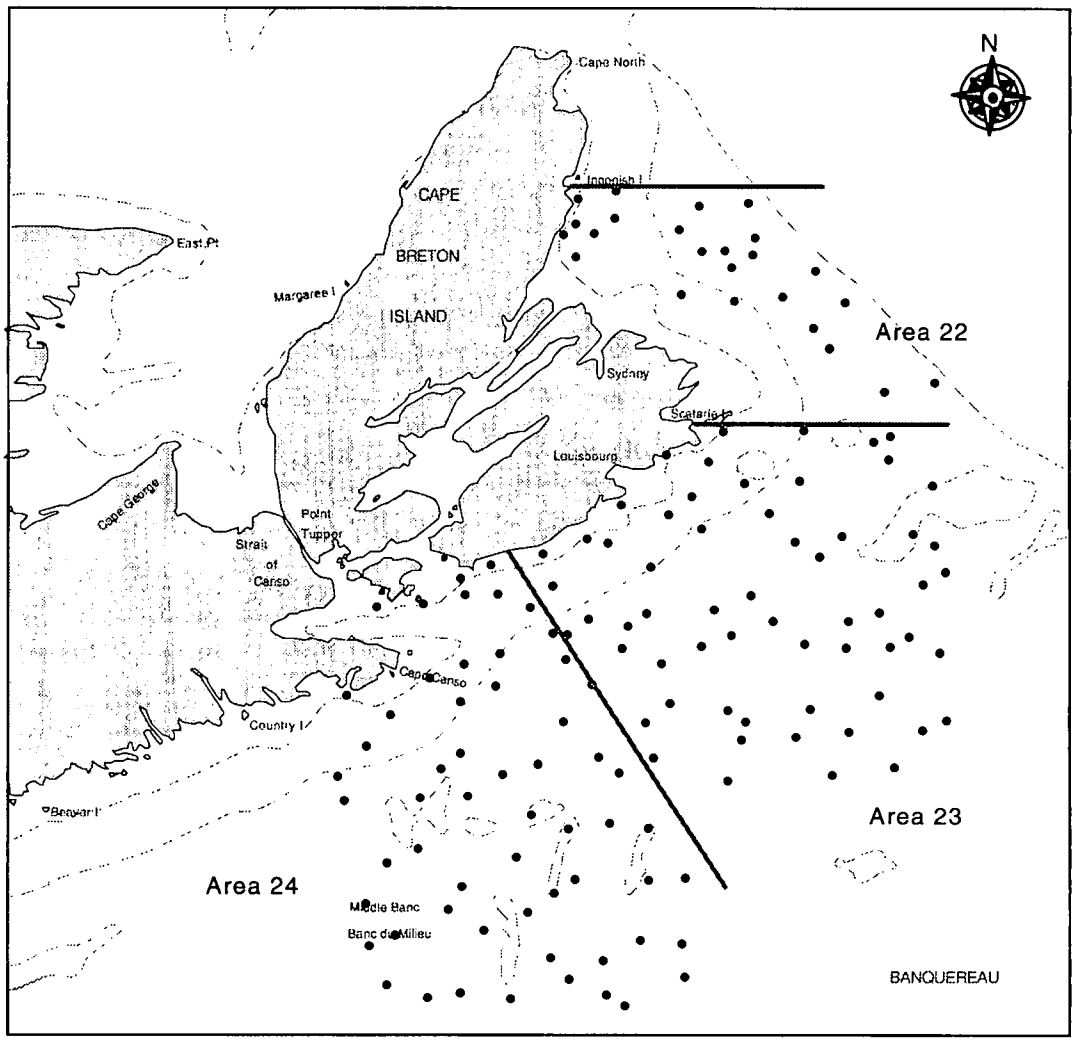

Figure 11. Location of trawl survey stations (N=150) in 1997.

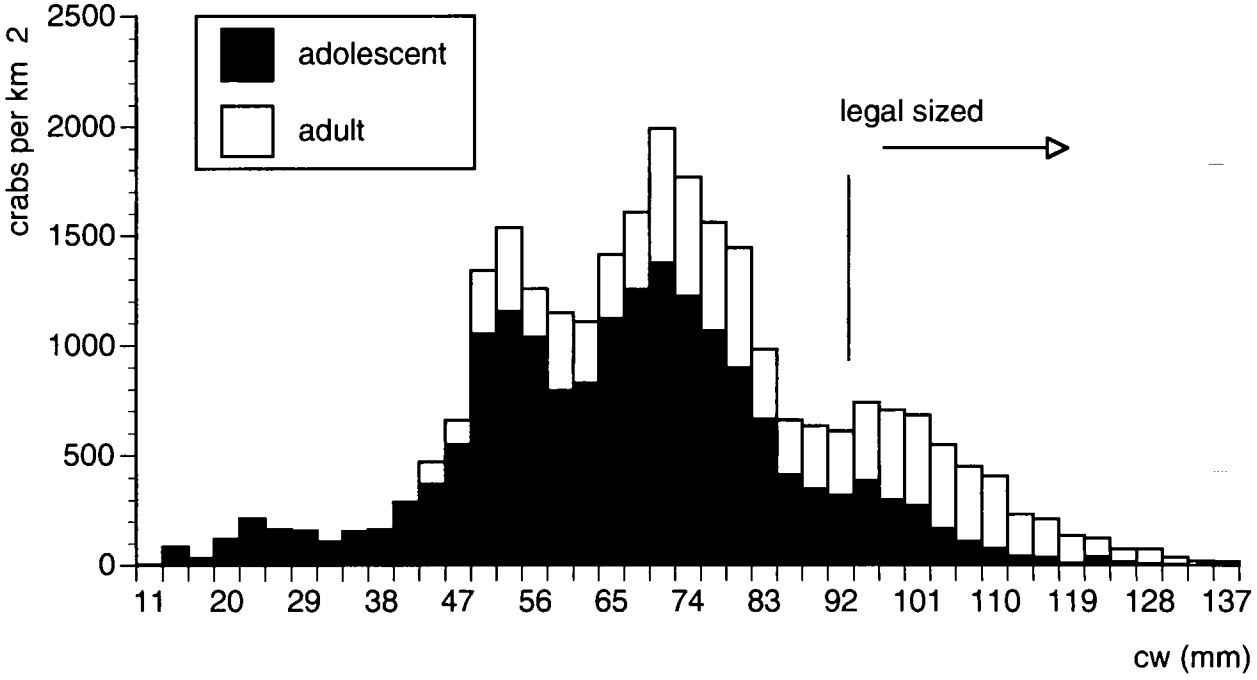

Figure 12. Histogram of size frequency distribution for the total area surveyed in eastern Cape Breton (Areas 22, 23 and 24) in 1997

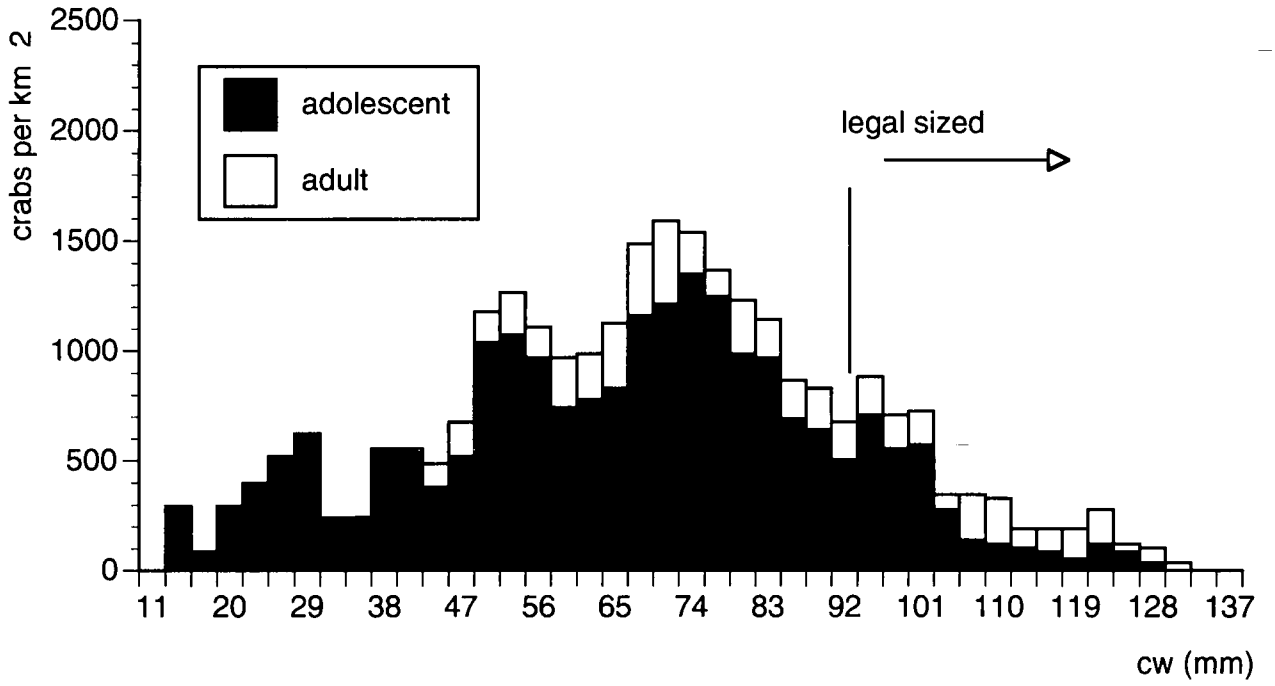

Figure 13. Histogram of size frequency distribution for the area surveyed in Area 22 in 1997

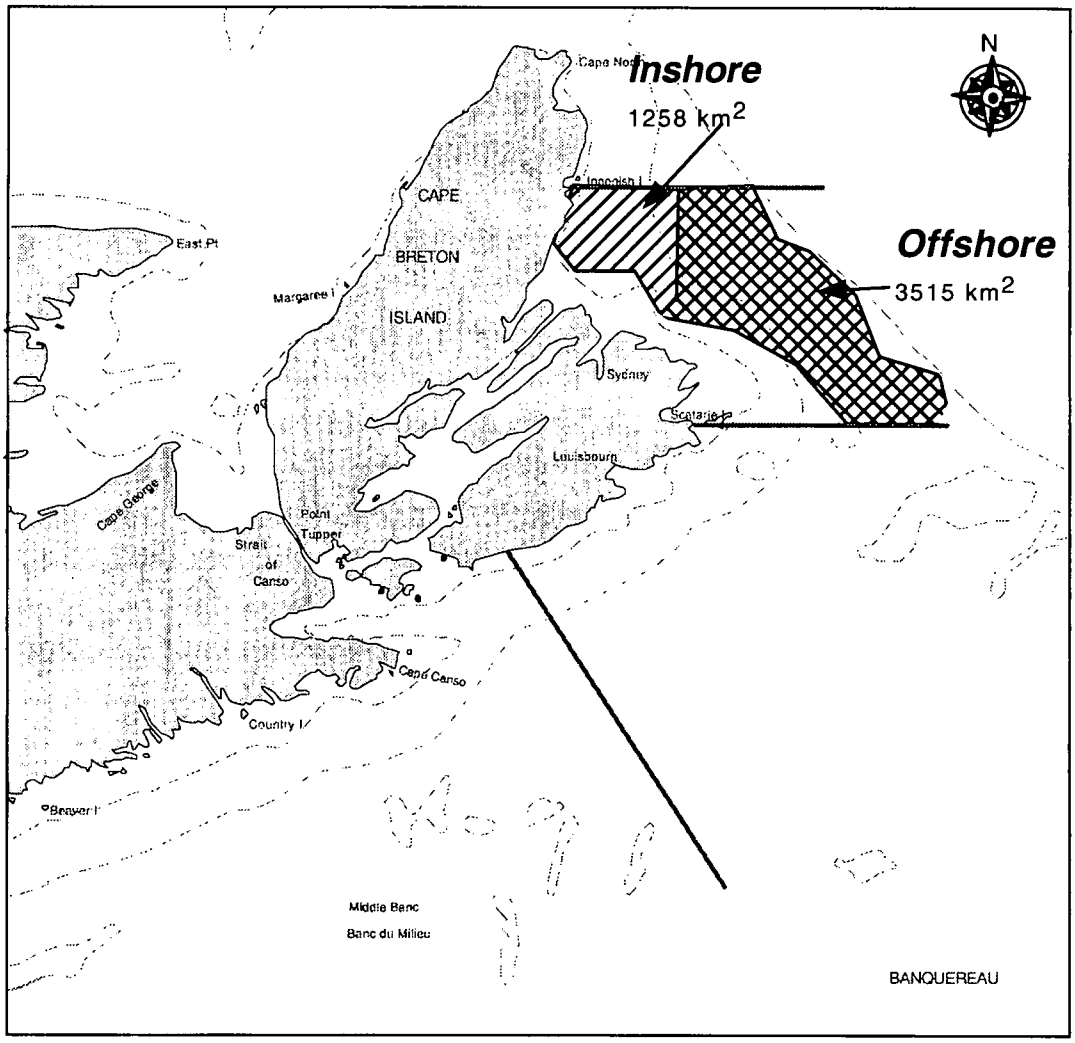

Figure 14. Inshore and offshore areas used for the estimation of biomass in CFA-22 in 1997.

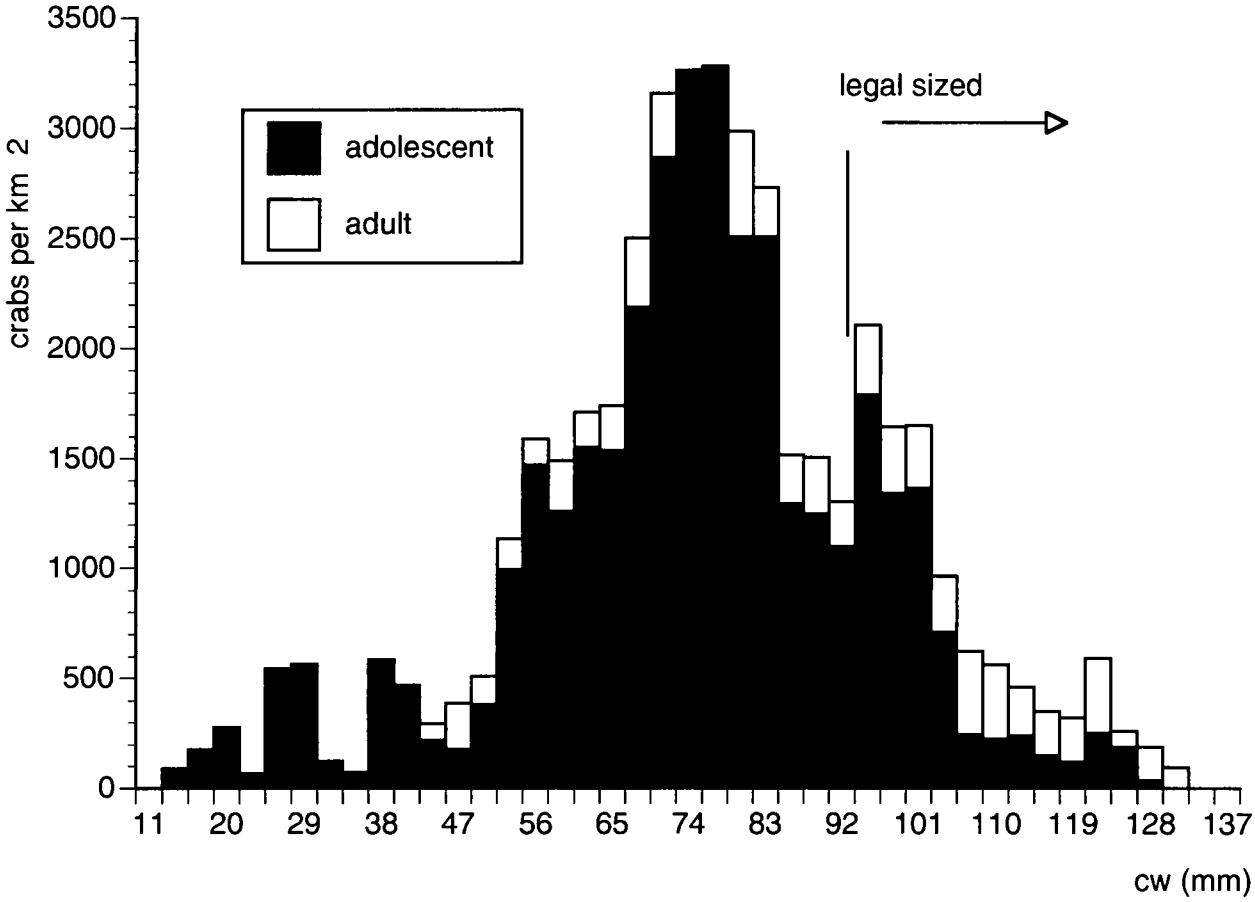

Figure 15. Histogram of size frequency distribution for the **inshore** area surveyed in Area 22 in 1997.

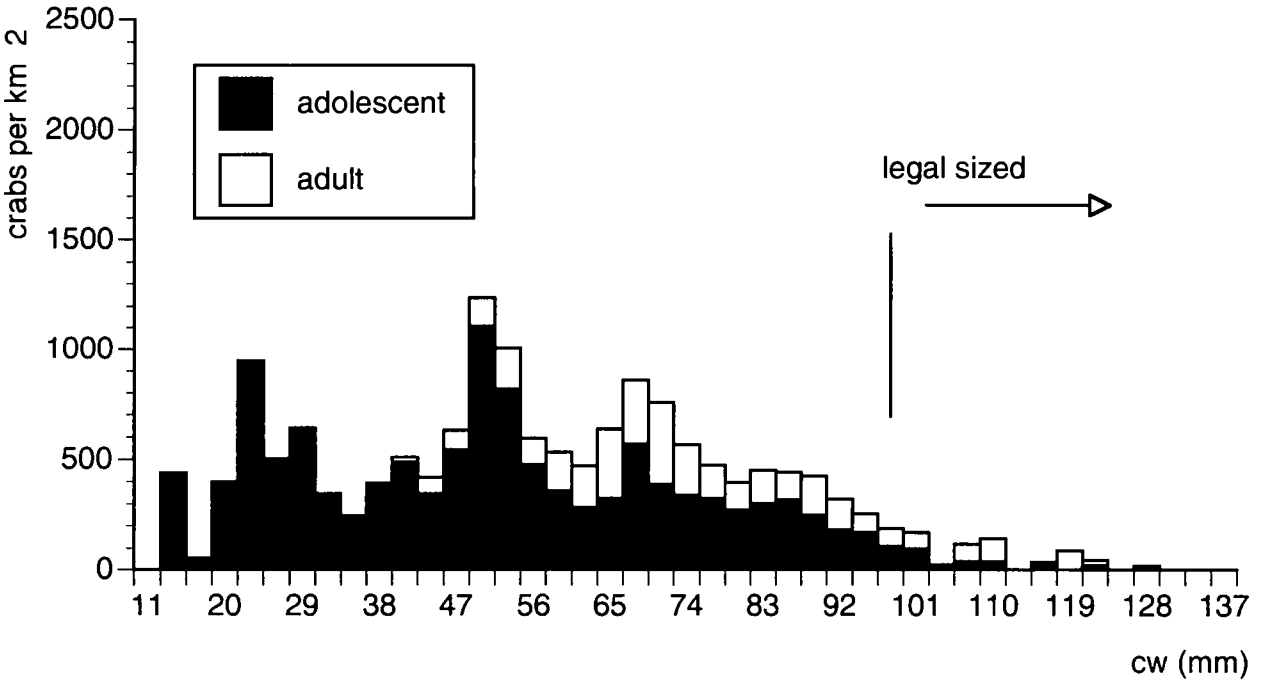

Figure 16. Histogram of size frequency distribution for the **offshore** area surveyed in Area 22 in 1997.

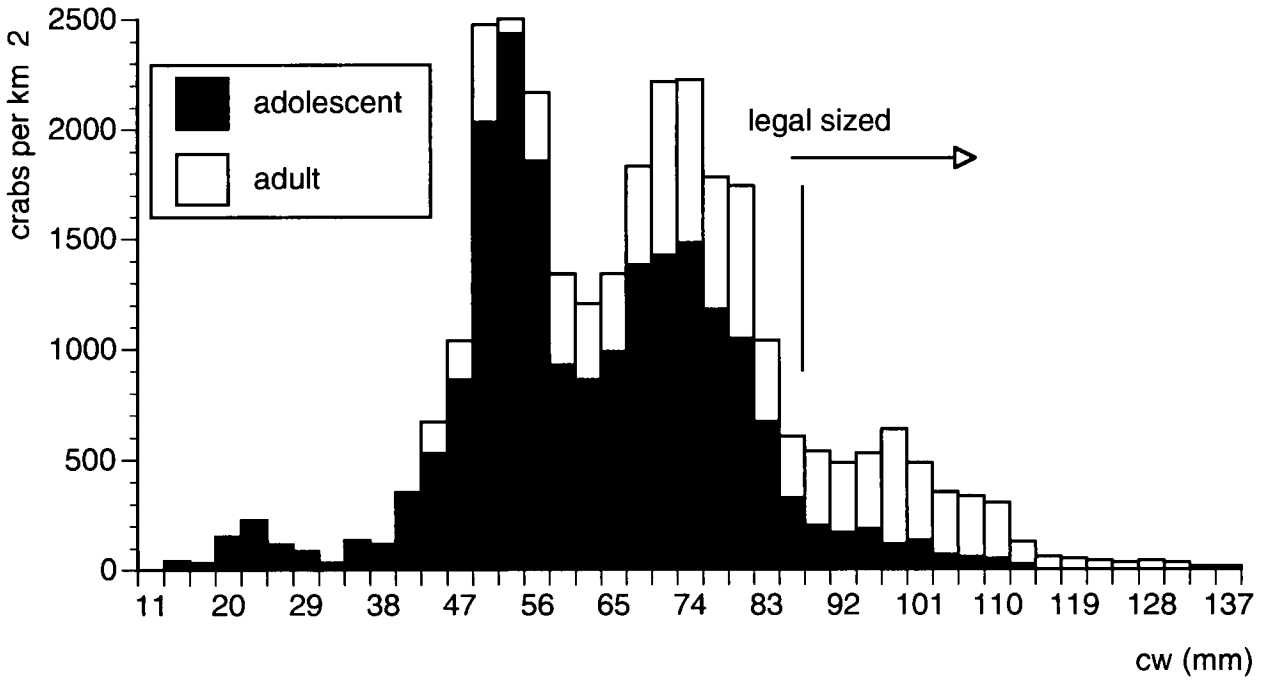

Figure 17. Histogram of size frequency distribution for the area surveyed in Area 23 in 1997.

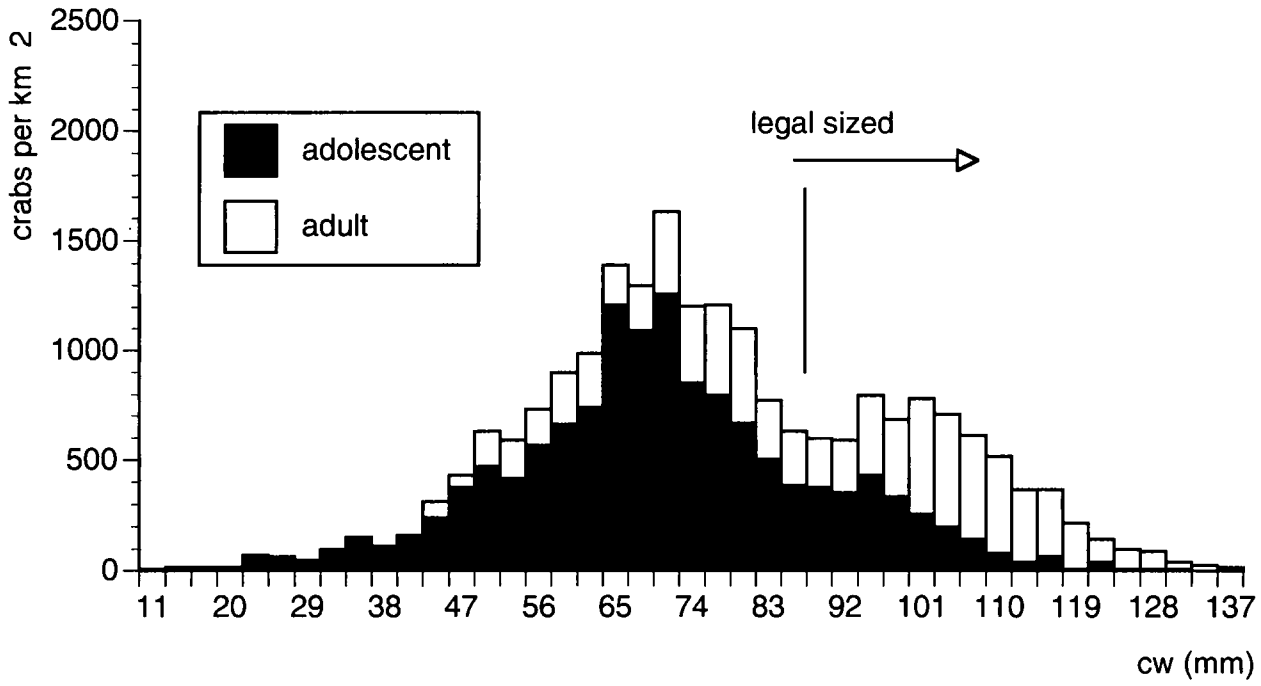

Figure 18. Histogram of size frequency distribution for the area surveyed in Area 24 in 1997.