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**Assessment of the 1996 Snow crab (*Chionoecetes opilio*) fishery off eastern
Cape Breton, Nova Scotia (Areas 20 to 24 and 4X).**

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ABSTRACT

Total 1996 landings in eastern Cape Breton were comparable to 1994 and 1995. Overall, there was a 35% increase in CPUE and a 40% reduction in total fishing effort compared to the same periods. However, in Area 22, reported total landings, fishing effort and CPUE have all decreased compared to 1995, while Areas 20 and 21 reported higher fishing effort (25 - 50%) and lower CPUE (25 - 35%) than 1995. As in 1995, the exploratory fishery for snow crab in NAFO Division 4X had low mean catch rates (1.01 kg/trap haul) relative to Areas 20-24.

A first trial of a research trawl and methods has been conducted as a potential supplementary tool to the current method of assessment of the eastern Cape Breton snow crab fishery. Twenty-three trawl stations were sampled prior to the fishery, covering mostly the inshore area of Area 23 and part of Area 24. The results matches the high catch rates and landings found for the same area.

The usefulness of carrying annually separated statistics for inshore and offshore areas, as well as for standardized and unstandardized fishing effort and CPUE, in the research document are discussed.

RÉSUMÉ

Les débarquements totaux de 1996 pour l'est du Cap-Breton étaient comparable à ceux de 1994 et 1995. En général, il y a eu une augmentation de 35% de la PUE moyenne et une baisse de 40% de l'effort de pêche comparé à ces mêmes années. Cependant, la zone 22 a démontré une baisse dans les débarquements rapportés, dans l'effort de pêche et de la PUE moyenne comparativement à 1995, tandis que les zones 20 et 21 ont rapporté un effort de pêche plus élevé (25 - 50%) et un taux de PUE moyenne plus bas (25 - 35%) que ceux de 1995. Tout comme pour 1995, la pêche exploratoire du crabe des neiges dans la Division 4X de l'OPANO a eu de faible taux de capture (1.01 kg/casier levé) relatif aux zones 20 - 24.

Un premier essai d'une croisière de chalutage a été effectué pour évaluer le potentiel de cette technique comme outil supplémentaire à la méthode d'évaluation traditionnelle de la pêche au crabe des neiges de l'est du Cap-Breton. Vingt-trois stations de chalutage ont été échantillonnées avant le début de la saison de pêche commerciale, et qui couvrait surtout la partie cotière de la zone 23 et une partie de la zone 24. Les résultats obtenues se comparent avec les hauts taux de capture et de débarquements retrouvés pour cette même région.

L'utilité de rapporter annuellement des statistiques séparées pour les parties cotières et hauturières, de même que l'effort de pêche et la PUE standardisés et non-standardisés, dans le document de recherche est discuté.

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 increased abundance and biomass, an expanded fishing area, and an increased 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 1996 snow crab fishery in Areas 20 to 24, as well as the NAFO Division 4X, is being assessed. An experimental trawl survey is also being evaluated as a potential supplementary tool to the current methods used for this assessment. The research trawl and methods are routinely used in the Gulf of St. Lawrence to study the snow crab resource.

DESCRIPTION OF THE FISHERIES

Harvesting of snow crab, *Chionoecetes opilio*, off the east coast of Cape Breton (Areas 20 to 24; Figure 1) began in the late 1970's. Landings rose rapidly in phase with effort to a peak in 1979 but landings and catch per unit 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 mt (Tremblay and Eagles, 1996). In 1994, total landings over 1993 declined by 23 % to 1551 mt, and remained stable at this level in 1995 and 1996. Catch rates in 1994, 1995 and 1996 were influenced by factors such as 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, a cap on landings (individual boat quota of 65,000 lb or 29.5 mt) was put into effect 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 mt) with 10 traps per license. The total effort for "regular" license holders was controlled by the introduction of individual boat quotas (Areas 20, 21, 23 and 24) or fleet cap (Area 22). The individual boat quotas (IBQ) were 20,000 lb (9 mt) in Area 20, 10,000 lb (4.5 mt) in Area 21, and 55,000 lb (25 mt) in Areas 23 and 24. The fleet cap in Area 22 was of 350 mt. These "quotas" and "fleet cap" were developed based on recent landings history and are in no way scientific based. An additional management change was directed at reducing the landing of soft shell 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 the "traditional" grounds off eastern Cape Breton, exploration for snow crab has been conducted further to the southwest, and further offshore (NAFO Division 4X). Four vessels fished in late 1994 and in 1995.

In 1996, the management measures (Table 1) were essentially the same as 1995. The individual boat quotas (IBQ) were 20,000 lb (9 mt) in Area 20, 10,000 lb (4.5 mt) in Area 21, 55,000 lb (25 mt) in Areas 23 and 24, and the fleet cap in Area 22 was of 350 mt. The number of temporary permits were reduced to 3 in Area 23 and to 4 in Area 24. However, in both of these Areas, 30,000 lb (13.6 mt) were allocated to Natives on a temporary, communal basis. In all Areas, an enforcement plan was created which includes 10% sea coverage paid for by the industry, as well as the introduction of a single mandatory paper log used by all fishers for both dockside monitoring and the scientific data base. Also in all Areas, a "panel" was required on all traps to prevent "ghost fishing". 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 this fishery with the funding of DFO as well as snow crab fleet in Areas 22, 23 and 24. This is expected to result in an improved ability to assess biomass. In NAFO Division 4X, the trap limit was raised from 100 to 250 traps from 100 (majority of them are the smaller 3' diameter type), and was subjected to dockside monitoring for the first time.

MATERIALS AND METHODS

Landings, catch rate and effort, and price

Raw data on landings and fishing effort were obtained from the new, single, mandatory paper log used by all fishers for both dockside monitoring and the scientific data base. Copies of the original paper logs sent in were obtained from the Statistic Division of the Maritime Region of the Department of Fisheries and Oceans and compiled by the Science Branch. Thereafter, total seasonal landings for each Area were obtained from a revised preliminary report produced by the Statistic Division in late April 1997, and may slightly differ from results presented in the Stock Status Report in January of the same year. All fishers submitted their paper logs, but not all logs were usable; some of them have one or more missing values. On average, and depending on the specific calculation being executed, more than 75% of the 1,766 paper logs received were completed properly.

Inshore and Offshore Areas - Landings are not estimated separately for inshore and offshore portions. As stated in the 1995 assessment document of Tremblay and Eagles (1996): "The apportioning of landings to inshore or offshore grounds is dependent upon good location information from fishing logs, or knowledge that an individual's fishing grounds remained constant between years". These requirements were not met in 1996.

Landings - Total landings by Area are the sum of the paper logs received for each Area. Landings by category (such as inshore / offshore) are weighed proportion of total landings based on ratios obtained from the usable paper logs. The geographic distribution of landings was presented as the sum of total landings within each 10° latitude X 10° longitude grid (10 X 7 nautical miles grid); the fishing positions were taken from the logs. It should be noted that previous research documents of Eastern Cape Breton snow crab have reported landing within 5° latitude X 10° longitude grid. This change in grid size has been introduced to make geographic representation uniform amongst all snow crab stock evaluations in the Maritime Region.

Catch rate and effort - The average catch per unit of effort (CPUE) corresponds to the ratio of total landings (y_i) and the number of trap haul (tf_i) reported in the paper logs: $CPUE = \sum(y_i) / \sum(tf_i)$. 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 X 10° longitude grid; the fishing positions were taken from the logs. The geographic distribution of average CPUE was calculated within each of the same grid. Informations from the exploratory fishery (Area 4X) was analyzed separately from the "traditional" fisheries.

Treatment of catch rate data - Catch rate and effort has been adjusted for the use of different trap types within Areas according to Tremblay *et al.* (1994). Therefore, for each Area both unstandardized catch rate (total landings divided by total trap hauls regardless of trap type) and standardized catch rate (that of the most common identifiable trap) are presented. Unstandardized and standardized estimates of total effort derive from division of the total landings by their respective CPUE estimate.

Price - The mean annual dockside price per kg for snow crab was obtained from the Economics Division of the Department of Fisheries and Oceans.

At-sea sampling

The introduction in the 1996 Management Plan of a 10% sea coverage has permitted to obtain at-sea sampling data from all Areas (Figure 3). For each trap randomly sampled, the total number of male crabs, the position and depth were recorded, and a sub-sample of 40 crabs were taken randomly for the following measurements: carapace width (CW), the height of the left claw, the condition of the carapace (on a scale of 1 to 5; Appendix 1) and the hardness of the left claw (Foyle *et al.*, 1989). Snow crab with a claw hardness less than 68 in durometer readings were considered as soft crab (Hébert *et al.*, 1992).

Mature males are recognizable by morphometry, and the most simple procedure is to plot logarithms of chela height (CH) against logarithms of carapace width (CW) (Conan and Comeau, 1986). Data from large-clawed and small claw 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 99 % of cases (for mature males: $Y > 0$) (Comeau, pers. communication, raw data collected in 1985-86 by R.W. Elner, DFO Halifax, N.S.).

Experimental trawl survey

Trawl sampling - An experimental trawl survey was conducted prior to the fishery, from June 5th to June 11, 1996. The objective of this survey is to test the efficiency and appropriateness of the research trawl and methods that are routinely used in the Gulf of St. Lawrence to study the snow crab resource (Hébert *et al.*, 1992). A Bigouden *Nephrops* trawl originally developed for Norway lobster (*Nephrops norvegicus*) fishery in France is

used (20 m opening with a 27.3 m footrope 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 to 8 minutes at a mean speed of approximately 2 knots, depending on the depth, current speed and sediment type. The horizontal opening of the trawl has been measured, every 7 seconds, with a SCANMAR net sensor. The distance of each tow was estimated from the position (Latitude / Longitude) measured at the start and the end of the 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 23 sets. The duration of each tow, as well as depth of the water column were recorded. The following measurements were taken for all snow crab caught in each tow: carapace width (CW), the height of the left 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 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, maps of isodensity contours are then generated for this 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. The size-weight relationship 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 determined for Eastern Cape Breton, this southern Gulf of St. Lawrence model will be used until a specific model is established. This model supposes that the majority of individuals molt once a year until the terminal molt. However, some individuals may not molt in a given year and are called skip molters. The proportion of skip molters is not yet predictable. Also, the model supposes that trawl efficiency is 100% for individuals larger than 30 mm CW.

Projections of biomass were estimated for the following categories: large-clawed male ≥ 95 mm CW (total harvestable crab) and small claw male ≥ 56 mm CW (future recruitment).

Morphological maturity - We used the terminology "small claw" which are sexually mature male but has not attained terminal molt and "large claw" to represent the terminal molt male crab. The distinction of 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). The 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 stage based on carapace condition, durometer reading and corresponding approximate age after terminal molt (CAFSAC, 1991 and Anonymous, 1994 modified).

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 iridescence, 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 opened in 1996. In Area 20, landings occurred between July 23 to September 12, although all fishers had stopped by August 31 but for one who fished only once after that on September 12. Area 21 had the shortest season of all CFAs, with landings occurring from July 23 to August 22. Area 22 fished from July 22 to September 2nd, voluntarily stopped until September 27 because of high incidence of soft crab, and then fished again from September 28 to October 24. The season was from July 23 to September 13 in Area 23, with the temporary license-holders starting three weeks after the other groups of this Area. The season in Area 24 began later than any other area, from August 1st to September 25. The fishing period of exploratory 4X covered by this document is from March 26 to September 6.

The average CPUE for the "traditional" fishery off eastern Cape Breton was 29.6 kg per trap haul (kg/th), while the average fishing effort was 50,300 trap hauls (Table 2 and 3). Overall, this represents an increase in CPUE of over 30% compared to the 1994 (21.2 kg/th) and 1995 (22.0 kg/th) levels, and a reduction in fishing effort of around 30% over 1994 (73,200 trap hauls) and 1995 (70,600 trap hauls). The seasonal geographic distribution is presented for landings (Figure 4), unstandardized CPUE (Figure 5) and unstandardized fishing effort (Figure 6).

Area 20:

Landings - Total landings in 1996 (43 mt) are similar to the high landings of 1995 (Table 4). For the second year in a row, the average landings / license of 8.6 mt were just below the IBQ of 9.0 mt. Over 60% of the landings occurred in the first two weeks of fishing, and most (35%) occurred during the second week (Tables 3 and 5; Figure 7).

Catch rate and effort - The average catch rate was 14.7 kg/th in 1996, which represents a decrease of over 25% in CPUE compared to 1994 (20.9 kg/th) and 1995 (19.8 kg/th). Meanwhile, total effort (2,900 trap hauls) increased by over 50% compared to the 1,400 trap hauls in 1994 (Table 4). Of the 102 paper logs received for this Area, 92 were usable for total and weekly calculation of unstandardized CPUE and effort, while 50 were used for the standardized calculation (Table 5; Figures 7 and 8). Three of the five fishers used conical traps, and the two others had square traps.

At-sea sampling - The catch composition derived from the at-sea samples showed that about 82% of the measured crabs were large-clawed males greater than 95 mm (Table 6). Over 50% of the samples had a carapace condition of 5 and 30% had a condition of 4 (Table 7). Small claw males accounted for 15% of the catches (Figure 9). The weekly soft crab percentages were generally low, and the seasonal average was around 7% (Table 6; Figure 10).

Area 21:

Landings - Total landings in Area 21 were 36% higher than those of 1995 (Table 8), with average landing / license (4.3 mt) just below the IBQ of 4.5 mt. Over 56% of the total landings occurred in the first week of the fishing season (Tables 3 and 9; Figure 11).

Catch rate and effort - The standardized CPUE (6.4 kg/th) was 35% lower and the effort (21,000 trap hauls) over 50% higher than those of 1995 (10.1 kg/th, 9,900 trap hauls), but comparable to the 1994 data (Table 8). However, the unstandardized CPUE and effort were about 15% higher compared to 1995. Of the 416 paper logs received for this Area, 215 were usable for the calculation of total and weekly unstandardized CPUE and effort, while 127 were used for the standardized calculations (Table 9; Figures 11 and 12). Of the 32 license / holders, 14 fished wooden traps, 10 used conical traps, 5 square traps, 1 pyramidal traps, 1 had a mix of wooden and square traps, and 1 fished square and conical traps.

At-sea sampling - There was a 30% reduction in soft crab compared to 1995 (Table 10), however this Area had one of the highest percentage in soft crab (27%) for eastern Cape Breton (Figure 10). Approximately 50% and 20% of the measured crabs were of carapace condition 2 and 1, respectively (Table 7). Small claw males represented 24% of the catch composition (Table 10). The CW frequency distribution and the mean carapace width (107 mm) of at-sea samples were similar to those reported in 1994 (109 mm CW) and 1995 (105 mm CW) (Figure 13).

Area 22:

Landings - Total landings in 1996 for Area 22 were 38% lower than in 1995 (Table 11), and averaged landings / license of 4.7 mt.

Catch rate and effort - The standardized CPUE (10.5 kg/th) was 20% than that of 1995 (13.2 kg/th) (Table 11 and 12). Total effort for the whole Area in 1996 (18,200 trap hauls) was 28% lower than that of 1995 (25,400 trap hauls) (Table 11 and 12). Of the 585 paper

logs received for this Area, 530 were usable for total and weekly calculation of unstandardized CPUE and effort, while 335 were used for the standardized calculations (Table 12; Figures 14, 15 and 16). There was 24 fishers using conical traps, 10 fishing square traps, 1 had pyramidal traps, 1 used a mix of conical and pyramidal trap, and 1 fished conical and square traps.

At-sea sampling - The seasonal percentage of soft shell crab was 30% in 1996, with the highest percentage occurring from the third to fifth week where it was above 40% (Table 13; Figure 10). However, this represents a 40% reduction in soft crab compared to 1994. It is due to these high incidence of soft crab that license-holders decided to voluntarily stop fishing for over 2 weeks in September of this year. Almost 50% of the crab measured were of carapace condition 1 (31%) and 2 (19%) (Table 7). Concerns should be directed to the fact that 40% of the hard-shelled large claw males were under the legal carapace size limit of 95 mm (Table 13). Small claw male represented 24% of the total catches, while the average CW of the measured individuals was slightly above 100 mm (Table 13; Figure 17).

Area 23:

Landings - Landings in 1996 (564 mt) were comparable to that of 1995 (Table 14). The average landings / license for the permanent fishers was 24.4 mt, close to the 24.9 mt IBQ. The temporary (4.5 mt / license) and native (6.6 mt / license) fishers have reached their respective IBQs (Table 3 and 15). Most of the landings occurred during the beginning of the fishery (Figure 18)

Catch rate and effort - The Area seasonal standardized catch rate was 77.7 kg/th, 32% higher than the average of 1995 (52.8 kg/th)(Table 16), while the total effort (7,200 trap hauls) decreased by 30% (10,200 trap hauls in 1995)(Table 17). Of the 306 paper logs received for this Area, 196 were usable for the unstandardized calculation of CPUE and effort, while 130 logs were used for the standardized calculations (Table 15, 16 and 17; Figure 18, 19, 20, 21 and 22). Of the 22 permanent license-holders, 19 fished square traps, 2 used rectangulars (wired), and 1 had conical traps. Conical traps were also used by two temporary and one native fishers, and squares for the other remaining fishers.

At-sea sampling - The seasonal percentage of soft crab was 9.5% of total catches, and remained stable throughout the fishing season (Table 18; Figure 10). This is much lower than the rates reported in 1994 (40-50% inshore) and 1995 (50 - 65% inshore, 20 - 45% offshore). Over 75% of the crab measured were of carapace condition 4 (67%) and 5 (9%)(Table 7). Again, concerns should be directed to the fact that 42% of the hard-shelled large claw males were under the legal carapace size limit of 95 mm (Table 18). Small claw male crab accounted for 14% of the total catches, while the average CW (98.2 mm) of measured individuals was the lowest recorded in all of eastern Cape Breton at (Table 18; Figure 23).

Area 24:

Landings - Total 1996 landings (560 mt) in Area 24 were comparable to those of 1994 and 1995 (Table 19). The permanent, temporary and native license-holders have generally all met their IBQs (Tables 3 and 20).

Catch rate and effort - Seasonal standardized CPUE in 1996 was higher than any previous year (Table 19 and 21). Total effort was 40% lower than in 1995 (Table 19 and 22). Of the 313 paper logs received for this Area, 271 were usable for the unstandardized calculation of CPUE and effort, while 255 were used for the standardized calculations (Table 20, 21 and

22; Figure 24, 25, 26, 27 and 28). All license-holders fished with square traps, except for two permanent fishers; one used conical traps and the other both conical and square traps.

At-sea sampling - The seasonal percentage of soft shell crab was 15% of the total catch (Table 23; Figure 10), which is much lower than the levels of 56% for inshore and 48 - 54% for offshore grounds reported in 1995. Most of the sampled crabs were of carapace condition 3 (47%) and 2 (30%)(Table 7). The small claw males accounted for 20% of the total catch, while the average CW was 113 mm (Figure 29).

Exploratory fishery in 4X:

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 trap types, such as 6' and 7' diameter steel conical, 4' conicals and a few pyramidal types (Tremblay and Eagles, 1996). All 44 paper logs received were used for the CPUE and effort calculations. Total landings between March 26 and September 6, 1996, were 11.7 mt (Tables 24; Figure 30), while they were 18.5 mt between June 1994 and September 1995. The monthly CPUE were consistently higher in March, April and May, while the monthly effort was at it's peak in July and August (Table 24; Figure 31). Overall, the general trend for 1996 was similar to 1995.

Price

The average price obtained by fishers of eastern Cape Breton increased by almost a dollar per kg of snow crab from 1994 (\$6.78/kg) to 1996 (\$ 7.72/kg).

Experimental trawl survey

Trawl stations for the experimental survey were randomly selected, and happened to cover mostly the inshore portion of Area 23, with a small section of the offshore area (Figures 32 and 33). A brief summary of the geostatistical assessment for the surveyed area is presented in Table 26. It shows that 6 weeks before opening this fishery, the total population estimated for large claw male ≥ 95 mm (MMGT95) was 4.76 million, which represented a concentration of 730 crab / km² or again, a biomass of 3,000 mt \pm 2,200 mt. Another example is the small claw male ≥ 56 mm CW (MIMMGT56) which had a total population of 46.58 million at a density of 7,150 crab / km² (Table 25). Isodensity contour maps of the two previous categories show that both groups are concentrated inshore, at the Areas 23 and 24 frontier (Figure 34 and 35). The CW frequency distribution shows a strong pulse of pre-recruits which should be entering this fishery in the next few years (Figure 36). This histogram also illustrate the important portion of large claw males smaller than 95 mm CW.

DISCUSSION

The 1996 total landings in eastern Cape Breton were comparable to 1994 and 1995, but there was a 35% increase in CPUE and a 40% reduction in fishing effort compared to the same periods. This summation belies major differences among Areas. Comparisons in landings, CPUE and effort with previous years and between Areas are complex because of the introduction of IBQs, changes in the practice of handling soft shell crab, differences in season length (i.e. Area 21 with voluntary short season), and differences in type of traps used. Also, prices obtained by fishers this year should not particularly be a factor in

explaining any of the reduction in effort since they are comparable to the high unofficial figures of 1995 at \$7.70 / kg (average of all Areas).

Overall in Areas 20 and 21, reported total landings were comparable (Area 20) or higher (Area 21) to those of 1995, while their respective seasonal CPUE has decreased by 25 - 35 % and the fishing effort increased by 25 - 50 %. In Areas 23 and 24, similar landings to those of 1995 have been reported, while the respective catch rates were higher than any previous year and the fishing effort were among the lowest. Total landings, CPUE and fishing effort have all decreased in Area 22. However, part of the reduced fishing activity can be explained by a voluntary decision to close the "offshore" fishery for over 3-4 weeks due to a high incidence of soft shell crab (over 40%). In Area 22, a high incidence of soft crab, a 10% limit on soft shell crab landed, and the closure itself would have negatively impacted the landings and fishing effort this year. It should be underlined that Area 22 is the only remaining fishery to still be managed by a competitive fishery system. It has been proved difficult to control fishing effort under such condition because this management régime has a tendency to "promote" over-exploitation of the resource. It is recommended that the fleet cap of 350 mt allowed in Area 22 (which is not based on any scientific considerations, and has been reached only in 1979 and 1993) should be replaced by a quota system.

Priliminary data analysis indicates some differences in catch rates between logbooks and at-sea sampling. Logbook catch rates were always higher, and it is believed that the main reason was double hauling of traps which was not recorded in the logbooks. It is not known to what extent double hauling was an issue in previous years, but it would have inflated logbook catch rates in 1996. Double hauling is not an illegal practice and should be clearly recorded on logbook so that more accurate catch rate estimation can be done.

Population structure - The catch composition established by the sea-sampling shows that Areas 21, 22 and 24 are mainly composed of a young (recently recruited) population (carapace conditions 1, 2 and 3) with signs of more new recruits entering the fishery. By opposition, Areas 20 and 23 were mostly composed (75 - 80%) by individuals of carapace conditions 4 and 5. The sea-sampling also indicates a marked reduction in soft shell crab percentage in the catches in all Areas. In Areas 22 and 23, it should be pointed out that over 40% of the hard-shelled large clawed males are under the legal carapace size limit of 95 mm. The discriminant function determining the terminal molt and non-terminal molt groups based on claw - carapace width relationship for the eastern Cape Breton fishery has to be re-evaluated to make sure that this high percentage of the presence of small-sized terminal molt crabs is not artefact.

Inshore and offshore areas - Up until 1995, statistics were usually developed for inshore and offshore fishing grounds for Areas 22, 23 and 24 (Tremblay and Eagles, 1996). In Area 22, data from the crab hole (offshore area) and the contiguous inshore portion of Areas 20 - 22 (inshore area) were treated separately because of its distance from one to another (Tremblay and Eagles, 1996). In Areas 23 and 24, offshore grounds (beyond 20 miles to as far as 80 miles from shore) were also analysed separately because they were fished intensively only since the late 1980's (Tremblay and Eagles, 1996). However, this fishery is currently changing and some of the effort is now being distributed outside and beyond these traditional inshore / offshore boundaries. In Area 22, the change in grid size (introduced in order to make geographic representation uniform amongst all snow crab stock evaluations in the Maritime Region) renders the imaginary inshore / offshore line less distinctable. It also increase the inshore portions of Areas 23 and 24 by 140 square nautical miles (each). Furthermore, there is no biological and/or scientific justifications whatsoever to support these inshore / offshore boundaries. Some sub-areas of the Eastern Cape Breton

snow crab fishery should be redefined or eliminated altogether to reflect the evolving reality of this fishery.

Standardized / unstandardized results - Introduced by Tremblay *et al.* (1994), the objective of standardization of catch rates and effort was to generate values that would be adjusted for the use of different trap types within Areas. From 1978 to 1993, wooden traps were most common in the inshore contiguous grounds of Areas 20 - 22, while steel rectangular traps have dominated the offshore grounds of Area 22, and all of Areas 23 and 24. However, in this document, at least half of the fishers in Areas 20, 21 and 22 used conical traps. Without comparative indices among trap types being developed because location data are inadequate (Tremblay *et al.*, 1994), it simply becomes another set of number being carried from year to year. Standardized results can not be compared from one year to another, nor from Area to Area, or even within any given Area. Some attempt of general standardization is necessary to properly assess historical fishing effort in the eastern Cape Breton fishery.

Outlook for Areas 20 - 24 and 4X

This assessment is purely based on landings, catch rates and effort used as an index of abundance and against longterm time series that were under different management conditions most years. It is very difficult to "predict" or "recommend" futur consideration because of the lack of an extensive fishery-independent survey to give us reliable biomass estimates, and there are uncertainties as to when pre-recruit crab will become available to these fisheries. It is true that Areas 23 and 24 have been showing signs of increasing commercial biomass, but soft shell crab percentage have decreased considerably compared to 1994 and 1995, which could indicate a slowing down of this recruitment. Areas 20 and 21 show signs of decreasing commercial biomass with signs of an ageing population (Area 20) or with signs of a young population (Area 21). As for Area 22, there are strong indications towards incoming recruitment, but the landings are well below the fleet cap allowed. It should be noted that the fleet cap in Area 22 was unrealistic from the start since 350 mt was reached in only 2 years since 1978 (1979 and 1993). Furthermore, unless there has been a fundamental shift in the productive capacity of eastern Cape Breton snow crab grounds, the high levels of landings are unlikely to continue (Tremblay and Eagles, 1996). In spite of the low catch rates in exploratory 4X area, these areas may support a small number of licenses with high trap limits during periods of good recruitment and high price (Tremblay and Eagles, 1996). Therefore, it is recommended that total effort and landings do not increase, at least until a better method to assess this resource can be found.

Experimental trawl survey

This first trial of the research trawl and methods as a potential supplementary tool to the current method of assessment of the eastern Cape Breton snow crab fishery is very promising. Although only 23 trawl stations out of the originally planned 46 stations were carried out (stormy weather unabled the research boat to operate for the entire allocated sea-days), the results obtained are in accordance with the data of this assessment. The bulk of the biomass found in the surveyed area, and which was concentrated inshore near the Areas 23 and 24 frontier, matches the high catch rate and landings found for the same area. It has also picked up the same large proportion of large claw males < 95 mm CW that was indicated by the sea-sampling for the same area. Furthermore, it actually showed a pulse of incoming recruits (small claw ≥ 56 mm CW).

One of the major advantages of research trawl surveys is that it allows us to estimate the population size and biomass directly, rather than indirectly by using indexes of

abundance. It also can evaluate the population size of future recruits, therefore giving time to fishers to plan for most incoming circumstances. It is strongly believed that trawl surveys would be a perfect supplementary tool to current methods of assessment, if given enough time to adapt it to the eastern Cape Breton fishing ground particularities.

Soft shell crab exploitation - Because the scientific trawl survey occurs before the commercial fishery (while the biomass estimated will apply to the coming year fishery rather than the current year fishery), a part of the estimated biomass will already have been exploited (mortality, removal) during the current year as terminal molted soft shell crab ≥ 95 mm. Although some of these values to be subtracted are easily known like the landings, the soft shell crab exploitation may affect the accuracy of such biomass estimation. It will be necessary to establish a rate of mortality associated with the release of soft shell crab, as well as a rate of removal of these crabs during the commercial fishery (directly affecting the recruitment biomass). It would also be a good husbandry practice for all fishers of Eastern Cape Breton to reduce landing of soft shell crab to a minimum and to avoid altogether any known "patches" of high soft shell crab concentration to reduce mortality associated with the release of such crab.

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Table 1. Summary of the Management Plan measures for 1996.

CFA	Season	Regular licences	Traps allowed	Quota per regular licences (lbs)	Temporary permits	Traps allowed	Quota per temporary permits (lbs)	Allocation set aside for Scientific Program	Native Allocation (lbs)
20	July 22- Sept. 15	5	30	20,000	n/a	n/a	n/a	participation as needed	n/a
21	July 22- Aug. 22 ¹	32	30	10,000	n/a	n/a	n/a	participation as needed	n/a
22	<u>Inshore group:</u> ² July 22- Sept. 1 st	37	30	competitive	n/a	n/a	n/a	participation as needed;	n/a
	<u>Offshore group:</u> ² July 27- Sept. 8								
23	July 22- Sept 15	22	30	55,000	3	10	10,000	35,000	30,000 ⁵
24	July 22- Sept. 30	21	30	55,000	4	10	10,000	30,000	30,000 ⁶
4X	year round	4 ³	250 ⁴	competitive	n/a	n/a	n/a	n/a	n/a

¹ This is a voluntary shortened season, and fishers in CFA 21 have retained the right to revert back to their regular season in the future.

² Both groups have agreed not to fish on Sundays.

³ These are exploratory fishing licences in the 4X portion of CFA 24.

⁴ Provided the majority of them are the smaller 3' diameter type.

⁵ Landed by two fishers.

⁶ Landed by three fishers

Table 2. Landings of Snow crab for Eastern Cape Breton (CFA's 20 to 24), 1978 - 1995.

Year	Active licences	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
Average (all)			907	20.4	39.4
Average (91-95)			1,690	26.9	64.1

Table 3. Summary of the 1996 weekly landings (kg) of Snow Crab in Eastern Cape Breton (Total, CFA's 20 to 24) compiled from usable logbooks.

week	zone										
	20 ¹	21 ²	22 ³	23				24			
				all	perm ⁴	temp ⁵	native ⁶	all	perm ⁷	temp ⁸	native ⁹
21/07	12,068	76,064	31,937	126,396	126,042		354				
28/07	15,111	41,613	72,482	190,056	185,049		5,007	85,260	84,200		1,060
04/08	6,707	11,026	34,577	105,771	101,834		3,937	159,767	154,294	1,110	4,362
11/08	5,398	5,345	14,213	86,832	80,160	3,662	3,011	129,513	123,870	1,740	3,904
18/08	2,009	1,425	5,562	23,317	16,048	6,396	874	87,069	81,287	4,279	1,503
25/08	2,184		3,060	7,788	5,702	1,923	163	56,984	48,764	6,757	1,463
01/09			420	563		563		18,086	14,340	3,064	683
08/09	181			2,727	1,918	809		21,762	19,553	1,537	672
15/09								1,509	1,509		
22/09			4,975					5,447	5,447		
29/09			3,089								
06/10			4,656								
13/10			182								
20/10			755								
un-known	- 516	45	12,858	20,486	20,393	215	-124	- 5,816	- 5,777	- 1	- 40
total	43,142	135,518	188,766	563,936	537,146	13,568	13,222	559,581	527,487	18,486	13,607

¹ Landings from July 23 to September 12
³ Landings from July 22 to September 2^{sd},
and then from Sept 28 to October 24.
⁵ Landings from August 15 to September 9.
⁷ Landings from August 1st to September 25.
⁹ Landings from August 3rd to September 11.

² Landings from July 23 to August 22.
⁴ Landings from July 23 to September 13.
⁶ Landings from July 27 to August 27.
⁸ Landings from August 6 to September 11.

Table 4. Landings, catch rate and effort statistics for snow crab Area 20, 1978 - 1996.

Year	Active boats	Logbooks received	Landing statistics (mt)	Mean CPUE (kg/trap haul)		Total Effort (1000's of trap hauls)	
				standard.	unstandard.	standard.	unstandard.
1978	-	0	61	-	-	-	-
1979	8	3	80	9.5	8.2	8.4	9.8
1980	8	3	34	11.4	8.3	3.0	4.1
1981	6	0	2	-	-	-	-
1982	-	0	2	-	-	-	-
1983	12	2	23	1.7	1.7	13.5	13.5
1984	2	0	10	-	-	-	-
1985	1	0	1	-	-	-	-
1986	2	1	0	1.9	1.9	-	-
1987	3	0	1	-	-	-	-
1988	4	2	17	7.0	7.9	2.4	2.2
1989	5	0	8	-	-	-	-
1990	4	2	5	5.4	5.3	0.9	0.9
1991	4	3	14	27.2	16.3	0.5	0.9
1992	3	3	18	78.3	40.6	0.2	0.4
1993	4	4	20	17.3	17.3	1.2	1.2
1994	5	4	29	20.9	20.2	1.4	1.4
1995	5	1	44	19.8	19.8	2.2	2.2
1996	5	5	43	14.7	14.7	2.9	2.9
average			22	19.4	15.0	3.3	3.6

Table 5. Weekly landings, catch rate and effort statistics for snow crab Area 20, 1996.

week	landing (kg)	CPUE (kg/trap haul)		Effort (total number of trap hauls)	
		unstandardized	standardized	unstandardized	standardized
July 21	12,068	18.59	12.29	649	982
July 28	15,111	18.09	18.75	835	806
Aug. 4	6,707	11.33	13.27	592	505
Aug. 11	5,398	12.60	13.21	428	409
Aug. 18	2,009	11.61	10.98	173	183
Aug. 25	2,184	12.20	11.1	179	197
Sept. 1					
Sept. 8	181	12.1		15	
total ¹	43,142	14.67	14.68	2940	2939

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

Table 6. Catch composition from at-sea samples for snow crab Area 20.

a) Catch composition in percentage.

Week	Size	Soft shell crab			Hard shell crab			Total
		small claw	large claw	total	small claw	large claw	total	
July 28	< 95 mm	0.00	0.00	0.00	0.00	1.20	1.20	1.20
	> 95 mm	1.80	1.80	3.59	10.78	84.43	95.21	98.80
	total	1.80	1.80	3.59	10.78	84.43	96.41	100.00
Aug. 4	< 95 mm	1.80	0.00	1.80	0.00	4.19	4.19	5.99
	> 95 mm	4.79	4.19	8.98	10.78	74.24	85.03	94.01
	total	6.59	4.19	10.78	10.78	74.24	85.03	100.00
Season	< 95 mm	0.90	0.00	0.90	0.00	2.69	2.69	3.59
	> 95 mm	3.29	2.99	6.29	10.78	79.34	90.12	96.41
	total	4.19	2.99	7.19	10.78	82.04	92.81	100.00

b) Catch composition in number.

Week	Size	Soft shell crab			Hard shell crab			Total
		small claw	large claw	total	small claw	large claw	total	
July 28	< 95 mm	0	0	0	0	2	2	2
	> 95 mm	3	3	6	18	141	159	165
	total	3	3	6	18	143	161	167
Aug. 4	< 95 mm	3	0	3	0	7	7	10
	> 95 mm	8	7	15	18	124	142	157
	total	11	7	18	18	131	149	167
Season	< 95 mm	3	0	3	0	9	9	12
	> 95 mm	11	10	21	36	265	301	322
	total	14	10	24	36	274	310	334

Table 7. Carapace condition of mature male snow crab > 95 mm in Areas 20 to 24.

a) Catch composition in percentage

carapace condition	Areas				
	20	21	22	23	24
1	1.64	19.13	30.65	5.78	1.29
2	13.82	48.44	19.21	4.40	30.10
3	2.30	10.19	16.73	13.48	46.47
4	29.93	18.50	30.04	67.40	21.08
5	52.30	3.74	3.38	8.94	1.06
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	5	92	753	42	17
2	42	233	472	32	397
3	7	49	411	98	613
4	91	89	738	490	278
5	159	18	83	65	14
total	304	481	2457	727	1319

Table 8. Landings, catch rate and effort statistics for snow crab Area 21, 1978 - 1996.

Year	Active boats	Logbooks received	Landing statistics (mt)	Mean CPUE (kg/trap haul)		Total Effort (1000's of trap hauls)	
				standard.	unstandard.	standard.	unstandard.
1978	16	16	247	10.9	11.3	22.7	21.9
1979	27	27	243	10.6	10.7	22.9	22.7
1980	31	25	153	10.0	9.7	15.3	15.8
1981	22	1	34	13.6	13.6	2.5	2.5
1982	20	18	94	8.3	7.9	11.3	11.9
1983	27	25	48	5.5	5.1	8.7	9.4
1984	19	13	18	2.8	2.9	6.4	6.2
1985	10	7	10	3.5	3.5	2.9	2.9
1986	12	8	7	2.3	2.5	3.0	2.8
1987	21	15	56	8.1	6.4	6.9	8.8
1988	24	19	125	10.0	9.6	12.5	13.0
1989	30	27	154	25.8	13.7	6.0	11.2
1990	31	27	167	12.6	13.1	13.3	12.7
1991	29	27	157	18.7	14.9	8.4	10.5
1992	31	28	196	25.4	16.7	7.7	11.7
1993	30	28	168	16.7	14.2	10.1	11.8
1994	31	29	107	6.7	7.2	16.0	14.9
1995	32	7	100	10.1	8.3	9.9	12.0
1996	32	32	136	6.4	9.7	21.0	13.9
average			117	11.0	9.5	10.9	11.4

Table 9. Weekly landings, catch rate and effort statistics for snow crab Area 21, 1996.

week	landing (kg)	CPUE (kg/trap haul)		Effort (total number of trap hauls)	
		unstandardized	standardized	unstandardized	standardized
July 21	76,064	17.12	10.39	4443	7321
July 28	41,613	9.37	7.45	4441	5586
Aug. 4	11,026	5.52	5.46	1997	2019
Aug. 11	5,345	4.43	4.14	1206	1291
Aug.18	1,425	4.32	4.32	330	330
total ¹	135,518	9.72	6.44	13,942	21,043

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

Table 10. Catch composition from at-sea samples for snow crab Area 21.

a) Catch composition in percentage.

Week	Size	Soft shell crab			Hard shell crab			Total
		small claw	large claw	total	small claw	large claw	total	
July 21	< 95 mm	4.60	0.84	5.44	2.93	7.53	10.46	15.90
	> 95 mm	10.46	18.83	29.29	5.86	48.95	54.81	84.10
	total	15.06	19.67	34.73	8.79	56.49	65.27	100.00
July 28	< 95 mm	3.13	1.88	5.00	3.75	5.63	9.38	14.38
	> 95 mm	6.25	11.25	17.50	9.38	58.75	68.13	85.63
	total	9.38	13.13	22.50	13.13	64.38	77.50	100.00
Aug. 4	< 95 mm							
	> 95 mm							
	total							
Aug. 11	< 95 mm	6.43	0.71	7.14	2.14	11.07	13.21	20.36
	> 95 mm	10.71	4.29	15.00	4.64	60.00	64.64	79.64
	total	17.14	5.00	22.14	6.79	71.07	77.86	100.00
Season	< 95 mm	5.01	1.03	6.04	2.80	8.54	11.34	17.38
	> 95 mm	9.57	11.05	20.62	6.19	55.82	62.00	82.62
	total	14.58	12.08	26.66	8.98	64.36	73.34	100.00

b) Catch composition in number.

Week	Size	Soft shell crab			Hard shell crab			Total
		small claw	large claw	total	small claw	large claw	total	
July 21	< 95 mm	11	2	13	7	18	25	38
	> 95 mm	25	45	70	14	117	131	201
	total	36	47	83	21	135	156	239
July 28	< 95 mm	5	3	8	6	9	15	23
	> 95 mm	10	18	28	15	94	109	137
	total	15	21	36	21	103	124	160
Aug. 4	< 95 mm							
	> 95 mm							
	total							
Aug. 11	< 95 mm	18	2	20	6	31	37	57
	> 95 mm	30	12	42	13	168	181	223
	total	48	14	62	19	199	218	280
Season	< 95 mm	34	7	41	19	58	77	118
	> 95 mm	65	75	140	42	379	421	561
	total	99	82	181	61	437	498	679

Table 11. Landings, catch rate and effort statistics for snow crab Area 22, 1978 - 1996.

Year	Active boats	Logbooks received	Landing statistics (mt)	Mean CPUE (kg/trap haul)		Total Effort (1000's of trap hauls)	
				standard.	unstandard.	standard.	unstandard.
1978	15	14	341	42.6	28.9	8.0	11.8
1979	35	35	684	48.2	38.4	14.2	17.8
1980	26	24	227	24.2	21.0	9.4	10.8
1981	11	3	50	21.7	12.5	2.3	4.0
1982	21	14	153	24.7	19.6	6.2	7.8
1983	26	21	52	9.8	8.5	5.3	6.1
1984	7	7	18	10.0	8.6	1.8	2.1
1985	8	7	3	6.0	6.0	0.5	0.5
1986	5	3	18	10.0	10.0	1.8	1.8
1987	16	14	63	11.5	10.5	5.5	6.0
1988	29	22	114	11.9	10.4	9.6	11.0
1989	26	20	93	17.9	15.0	5.2	6.2
1990	26	21	119	10.6	9.0	11.2	13.2
1991	24	23	183	22.1	18.5	8.3	9.9
1992	27	15	240	25.0	24.2	9.6	9.9
1993	40	27	390	20.0	21.0	19.5	18.6
1994	38	28	259	12.5	12.0	19.6	21.6
1995	37	11	284	13.2	9.7	25.4	29.3
1996	37	37	189	10.5	10.3	18.0	18.3
average			183	18.4	15.5	9.6	10.9

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

a) Total

week	landing (kg)	CPUE (kg/trap haul)		Effort (total number of trap hauls)	
		unstandardized	standardized	unstandardized	standardized
July 21	31,937	20.57	19.75	1,553	1,617
July 28	72,482	11.67	11.80	6,211	6,141
Aug. 4	34,577	7.37	7.66	4,692	4,513
Aug. 11	14,213	7.74	7.71	1,836	1,843
Aug. 18	5,562	6.50	7.13	856	780
Aug. 25	3,060	5.47	5.20	559	589
Sept. 1	420	9.59		44	
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Sept. 22	4,975	20.24	22.38	246	222
Sept. 29	3,089	12.75	11.84	242	261
Oct. 6	4,656	6.41	6.40	726	727
Oct. 13	182	7.91	7.91	23	23
Oct. 20	755	6.68	7.91	113	96
total ¹	188,766	10.32	10.49	18,291	17,995

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

a) Catch composition in percentage.

Week	Size	Soft shell crab			Hard shell crab			Total
		small claw	large claw	total	small claw	large claw	total	
July 21	< 95 mm	1.81	0.72	2.54	6.88	11.96	18.84	21.38
	> 95 mm	3.26	8.33	11.59	20.65	46.38	67.03	78.62
	total	5.07	9.06	14.13	27.54	58.33	85.87	100.00
July 28	< 95 mm	5.32	2.03	7.35	15.32	22.83	38.15	45.50
	> 95 mm	3.36	6.80	10.16	11.57	32.76	44.33	54.50
	total	8.68	8.84	17.51	26.90	55.59	82.49	100.00
Aug. 4	< 95 mm	5.85	3.11	8.96	6.33	14.10	20.43	29.39
	> 95 mm	7.29	27.48	34.77	5.26	30.59	35.84	70.61
	total	13.14	30.59	43.73	11.59	44.68	56.27	100.00
Aug. 11	< 95 mm	2.66	6.89	9.55	1.56	20.66	21.75	31.30
	> 95 mm	3.60	29.89	33.49	1.1	33.65	35.21	68.70
	total	6.26	36.78	43.04	2.66	54.30	56.96	100.00
Aug. 18	< 95 mm	5.98	2.39	8.37	3.37	13.04	16.41	24.78
	> 95 mm	8.37	25.43	33.80	3.80	37.61	41.41	75.22
	total	14.35	27.83	42.17	7.17	50.65	57.83	100.00
Aug. 25	< 95 mm	0.00	0.00	0.00	0.00	5.88	5.88	5.88
	> 95 mm	0.00	23.53	23.53	5.88	64.71	70.59	94.12
	total	0.00	23.53	23.53	5.88	70.59	76.47	100.00
-----	-----	-----	-----	-----	-----	-----	-----	-----
Oct. 20	< 95 mm	0.31	1.56	1.88	1.56	74.06	75.63	77.50
	> 95 mm	0.00	0.00	0.00	0.63	21.88	22.50	22.50
	total	0.31	1.56	1.88	2.19	95.94	98.13	100.00
Season	< 95 mm	4.55	2.92	7.46	7.25	21.76	29.01	36.47
	> 95 mm	4.97	17.93	22.90	6.93	33.70	40.63	63.53
	total	9.51	20.85	30.36	14.18	55.46	69.64	100.00

b) Catch composition in number.

Week	Size	Soft shell crab			Hard shell crab			Total
		small claw	large claw	total	small claw	large claw	total	
July 21	< 95 mm	5	2	7	19	33	52	59
	> 95 mm	9	23	32	57	128	185	217
	total	14	25	39	76	161	237	276
July 28	< 95 mm	68	26	94	196	292	488	582
	> 95 mm	43	87	130	148	419	567	697
	total	111	113	224	344	711	1055	1279
Aug. 4	< 95 mm	49	26	75	53	118	171	246
	> 95 mm	61	230	291	44	256	300	591
	total	110	256	366	97	374	471	837
Aug. 11	< 95 mm	17	44	61	7	132	139	200
	> 95 mm	23	191	214	10	215	225	439
	total	40	235	275	17	347	364	639
Aug. 18	< 95 mm	55	22	77	31	120	151	228
	> 95 mm	77	234	311	35	346	381	692
	total	132	256	388	66	466	532	920
Aug. 25	< 95 mm	0	0	0	0	1	1	1
	> 95 mm	0	4	4	1	11	12	16
	total	0	4	4	1	12	13	17
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Oct. 20	< 95 mm	1	5	6	5	237	242	248
	> 95 mm	0	0	0	2	70	72	72
	total	1	5	6	7	307	314	320
Season	< 95 mm	195	125	320	311	933	1244	1564
	> 95 mm	213	769	982	297	1445	1742	2724
	total	408	894	1302	608	2378	2986	4288

Table 14. Landings, catch rate and effort statistics for snow crab in Area 23, 1978 - 1996.

Year	Active boats	Logbooks received	Landing statistics (mt)	Mean CPUE (kg/trap haul)		Total Effort (1000's of trap hauls)	
				standard.	unstandard.	standard.	unstandard.
1978	-	15	347	62.3	51.5	5.6	6.7
1979	-	22	608	44.7	43.4	13.6	14.0
1980	-	21	343	42.4	39.0	8.1	8.8
1981	-	10	82	28.3	26.5	2.9	3.1
1982	-	21	253	32.9	28.8	7.7	8.8
1983	-	26	119	18.6	16.5	6.4	7.2
1984	-	7	41	17.1	18.6	2.4	2.2
1985	5	5	28	11.2	14.7	2.5	1.9
1986	6	6	49	11.4	14.4	4.3	3.4
1987	14	11	157	26.2	26.2	6.0	6.0
1988	21	18	207	23.3	24.9	8.9	8.3
1989	25	23	243	28.6	28.3	8.5	8.6
1990	27	24	386	37.1	36.4	10.4	10.6
1991	23	22	528	45.5	44.8	11.6	11.8
1992	22	18	595	51.7	49.6	11.5	12.0
1993	26	16	770	56.2	53.1	13.7	14.5
1994	22	22	497	34.7	33.4	14.3	14.9
1995	31	7	576	52.8	51.8	10.9	11.1
1996	27	27	564	77.7	65.6	7.3	8.6
average			337	37.0	35.1	8.3	8.6

Table 15. Weekly landings statistics for snow crab Area 23, 1996.

week	landings (kg)			
	all fishers	permanant	temporary	native
July 21	126,396	126,042		354
July 28	190,056	185,049		5,007
Aug. 4	105,771	101,834		3,937
Aug. 11	86,832	80,160	3,662	3,011
Aug. 18	23,317	16,048	6,396	874
Aug. 25	7,788	5,702	1,923	163
Sept. 1	563		563	
Sept. 8	2,727	1,918	809	
total ¹	563,936	537,146	13,568	13,222

¹ Total seasonal landings.**Table 16.** Weekly catch rate statistics for snow crab Area 23, 1996.

week	CPUE (kg/trap haul)							
	unstandardized				standardized			
	all	perm.	temp.	native	all	perm.	temp.	native
July 21	67.51	67.51			76.88	76.88		
July 28	81.97	85.04		58.44	91.03	92.01		53.53
Aug. 4	66.15	67.62		50.92	73.18	73.18		50.92
Aug. 11	58.54	60.49	55.91	42.4	69.21	66.7	40.18	42.4
Aug. 18	51.38	41.39	58.64		70.48	52.08	46.61	
Aug. 25	30.50	27.60	33.40		18.14	18.14	33.40	
Sept. 1	28.12		28.12				28.12	
Sept. 8	61.18	51.34	80.88		51.34	51.34	80.88	
total ¹	65.61	68.62	52.13	52.55	77.65	77.32	41.99	52.43

¹ Total seasonal landings.**Table 17.** Weekly effort statistics for snow crab Area 23, 1996.

week	Effort (total number of traps hauls)							
	unstandardized				standardized			
	all	perm.	temp.	native	all	perm.	temp.	native
July 21	1872	1867			1644	1640		
July 28	2319	2176		86	2088	2011		94
Aug. 4	1599	1506		77	1445	1392		77
Aug. 11	1483	1325	66	71	1255	1202	91	71
Aug. 18	453	388	109		331	308	137	
Aug. 25	255	207	58		429	314	58	
Sept. 1	20		20				20	
Sept. 8	45	37	10		53	37	10	
total ¹	8595	7828	260	251	7263	6947	323	252

¹ Total seasonal landings.

Table 18. Catch composition from at-sea samples for snow crab Area 23.

a) Catch composition in percentage.

Week	Size	Soft shell crab			Hard shell crab			Total
		small claw	large claw	total	small claw	large claw	total	
July 21	< 95 mm	1.39	6.13	7.52	1.39	29.25	30.64	38.16
	> 95 mm	0.28	2.23	2.51	2.23	57.10	59.33	61.84
	total	1.67	8.36	10.03	3.62	86.35	89.97	100.00
July 28	< 95 mm	7.50	1.00	8.50	12.00	1.50	13.50	22.00
	> 95 mm	1.00	0.50	1.50	35.00	41.50	76.50	78.00
	total	8.50	1.50	10.00	47.00	43.00	90.00	100.00
Aug. 4	< 95 mm	2.70	2.54	5.25	4.45	39.59	44.04	49.28
	> 95 mm	0.16	2.23	2.38	1.27	47.06	48.33	50.72
	total	2.86	4.77	7.63	5.72	86.65	92.37	100.00
Aug. 11	< 95 mm	1.43	2.50	3.93	3.57	47.14	50.71	54.64
	> 95 mm	0.71	8.21	8.93	1.07	35.36	36.43	45.36
	total	2.14	10.71	12.86	4.64	82.50	87.14	100.00
Season	< 95 mm	2.79	3.20	5.99	4.56	33.31	37.87	43.87
	> 95 mm	0.41	3.13	3.54	6.06	46.53	52.59	56.13
	total	3.20	6.34	9.54	10.63	79.84	90.46	100.00

b) Catch composition in number.

Week	Size	Soft shell crab			Hard shell crab			Total
		small claw	large claw	total	small claw	large claw	total	
July 21	< 95 mm	5	22	27	5	105	110	137
	> 95 mm	1	8	9	8	205	213	222
	total	6	30	36	13	310	323	359
July 28	< 95 mm	15	2	17	24	3	27	44
	> 95 mm	2	1	3	70	83	153	156
	total	17	3	20	94	86	180	200
Aug. 4	< 95 mm	17	16	33	28	249	277	310
	> 95 mm	1	14	15	8	296	304	319
	total	18	30	48	36	545	581	629
Aug. 11	< 95 mm	4	7	11	10	132	142	153
	> 95 mm	2	23	25	3	99	102	127
	total	6	30	36	13	231	244	280
Season	< 95 mm	41	47	88	67	489	556	644
	> 95 mm	6	46	52	89	683	772	824
	total	47	93	140	156	1172	1328	1468

Table 19. Landings, catch rate and effort statistics for snow crab Area 24, 1978 - 1996.

Year	Active boats	Logbooks received	Landing statistics (mt)	Mean CPUE (kg/trap haul)		Total Effort (1000's of trap hauls)	
				standard.	unstandard.	standard.	unstandard.
1978	-	-	-	-	-	-	-
1979	4	4	61	14.8	14.8	4.1	4.1
1980	10	10	70	12.8	12.8	5.5	5.5
1981	5	5	21	15.8	15.8	1.3	1.3
1982	7	7	62	10.1	10.1	6.1	6.1
1983	13	11	64	8.6	8.4	7.5	7.6
1984	13	12	52	9.2	9.2	5.6	5.6
1985	6	5	35	10.2	10.2	3.4	3.4
1986	7	5	49	11.9	11.9	4.1	4.1
1987	11	9	84	12.9	12.9	6.5	6.5
1988	13	13	163	15.5	15.7	10.5	10.4
1989	18	17	201	17.2	17.2	11.7	11.7
1990	19	18	543	33.3	33.3	16.3	16.3
1991	21	16	682	39.7	40.1	17.2	17.0
1992	22	14	743	38.5	38.5	19.3	19.3
1993	21	17	662	33.3	33.3	19.9	19.9
1994	21	21	682	34.1	33.4	20.0	20.4
1995 ¹	31	8	550	35.7	34.4	15.4	16.0
1996	27	27	560	57.5	57.1	9.7	9.8
average			294	22.8	22.7	9.2	10.3

Table 20. Weekly landings statistics for snow crab Area 24, 1996.

week	landings (kg)			
	all fishers	permanant	temporary	native
July 28	85,260	84,200		1,060
Aug. 4	159,767	154,294	1,110	4,362
Aug. 11	129,513	123,870	1,740	3,904
Aug. 18	87,069	81,287	4,279	1,503
Aug. 25	56,984	48,764	6,757	1,463
Sept. 1	18,086	14,340	3,064	683
Sept. 8	21,762	19,553	1,537	672
Sept. 15	1,509	1,509		
Sept. 22	5,447	5,447		
total ¹	559,580	527,487	18,486	13,607

¹ Total seasonal landings**Table 21.** Weekly catch rate statistics for snow crab Area 24, 1996.

week	CPUE (kg/trap haul)							
	unstandardized				standardized			
	all	perm.	temp.	native	all	perm.	temp.	native
July 28	83.86	86.55		52.98	85.51	88.61		52.98
Aug. 4	65.83	66.60	111.04	55.33	65.54	66.31	111.04	55.33
Aug. 11	54.78	57.82	45.65	44.30	54.38	57.52	45.65	44.30
Aug. 18	54.20	56.05	53.49	37.57	54.68	56.79	53.49	37.57
Aug. 25	48.74	48.85	54.40	36.57	48.64	48.71	54.40	36.57
Sept. 1	46.89	47.77	63.66	34.13	47.47	48.63	63.66	34.13
Sept. 8	42.98	44.15		33.61	43.31	44.70		33.61
Sept 15	22.59	22.59			30.72	30.72		
Sept 22	41.68	41.68			49.13	49.13		
total ¹	57.14	59.10	55.47	44.49	57.50	59.72	55.47	44.49

¹ Total seasonal landings**Table 22.** Weekly effort statistics for snow crab Area 24, 1996.

week	Effort (total number of traps hauls)							
	unstandardized				standardized			
	all	perm.	temp.	native	all	perm.	temp.	native
July 28	1017	973		20	997	950		20
Aug. 4	2427	2317	10	79	2438	2327	10	79
Aug. 11	2364	2142	38	88	2382	2153	38	88
Aug. 18	1606	1450	80	40	1592	1432	80	40
Aug. 25	1169	998	124	40	1172	1001	124	40
Sept. 1	386	300	48	20	381	295	48	20
Sept. 8	506	443		20	503	438		20
Sept 15	67	67			49	49		
Sept 22	131	131			111	111		
total ¹	9793	8925	333	306	9732	8832	333	306

¹ Total seasonal landings

Table 23. Catch composition from at-sea samples for snow crab Area 24.

a) Catch composition in percentage.

Week	Size	Soft shell crab			Hard shell crab			Total
		small claw	large claw	total	small claw	large claw	total	
July 28	< 95 mm	1.00	0.00	1.00	5.50	2.50	8.00	9.00
	> 95 mm	2.00	3.50	5.50	24.00	61.50	85.50	91.00
	total	3.00	3.50	6.50	29.50	64.00	93.50	100.00
Aug. 4	< 95 mm	2.14	2.14	4.29	2.14	10.71	12.86	17.14
	> 95 mm	3.57	14.64	18.21	2.86	61.79	64.64	82.86
	total	5.71	16.79	22.50	5.00	72.50	77.50	100.00
Aug. 11	< 95 mm	4.03	1.11	5.15	2.23	12.80	15.02	20.17
	> 95 mm	2.09	7.37	9.46	3.76	66.62	70.38	79.83
	total	6.12	8.48	14.60	5.98	79.42	85.40	100.00
Aug. 18	< 95 mm	3.61	0.83	4.44	3.61	9.03	12.64	17.08
	> 95 mm	4.72	5.56	10.28	15.97	56.67	72.64	82.92
	total	8.33	6.39	14.72	19.58	65.69	85.28	100.00
Season	< 95 mm	3.28	1.04	4.33	3.07	10.01	13.08	17.40
	> 95 mm	3.28	7.35	10.63	10.32	61.65	71.96	82.60
	total	6.57	8.39	14.96	13.39	71.65	85.04	100.00

b) Catch composition in number.

Week	Size	Soft shell crab			Hard shell crab			Total
		small claw	large claw	total	small claw	large claw	total	
July 28	< 95 mm	2	0	2	11	5	16	18
	> 95 mm	4	7	11	48	123	171	182
	total	6	7	13	59	128	187	200
Aug. 4	< 95 mm	6	6	12	6	30	36	48
	> 95 mm	10	41	51	8	173	181	232
	total	16	47	63	14	203	217	280
Aug. 11	< 95 mm	29	8	37	16	92	108	145
	> 95 mm	15	53	68	27	479	506	574
	total	44	61	105	43	571	614	719
Aug. 18	< 95 mm	26	6	32	26	65	91	123
	> 95 mm	34	40	74	115	408	523	597
	total	60	46	106	141	473	614	720
Season	< 95 mm	63	20	83	59	192	251	334
	> 95 mm	63	141	204	198	1183	1381	1585
	total	126	161	287	257	1375	1632	1919

Table 24. Monthly landings, catch rate and effort statistics for snow crab exploratory Area 4X, 1996.

month	landings (kg)	CPUE (kg/trap haul)	effort (total number of trap hauls)
March	1,535	1.52	1,010
April	4,040	1.68	2,405
May	1,710	1.86	919
June	249	0.44	566
July	1,767	0.64	2,761
August	1,484	0.53	2,800
September	57	0.23	248
total ¹	11,804	1.01	11,687

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

Table 25. 1996 Experimental trawl survey geostatistic assessment summary.

Categories	Densities per km ²	Confidence interval (%)	Area (km ²)	Total population	Confidence interval in number	Average weighth of crab (g)	Total weight (mt)	Weigth confidence interval
MIMMGT56	7,151	70.7	6514	46,580,311	32,932,280			
MMGT95	730	73.1	6514	4,755,220	3,476,066	639.39	3,041	2,223

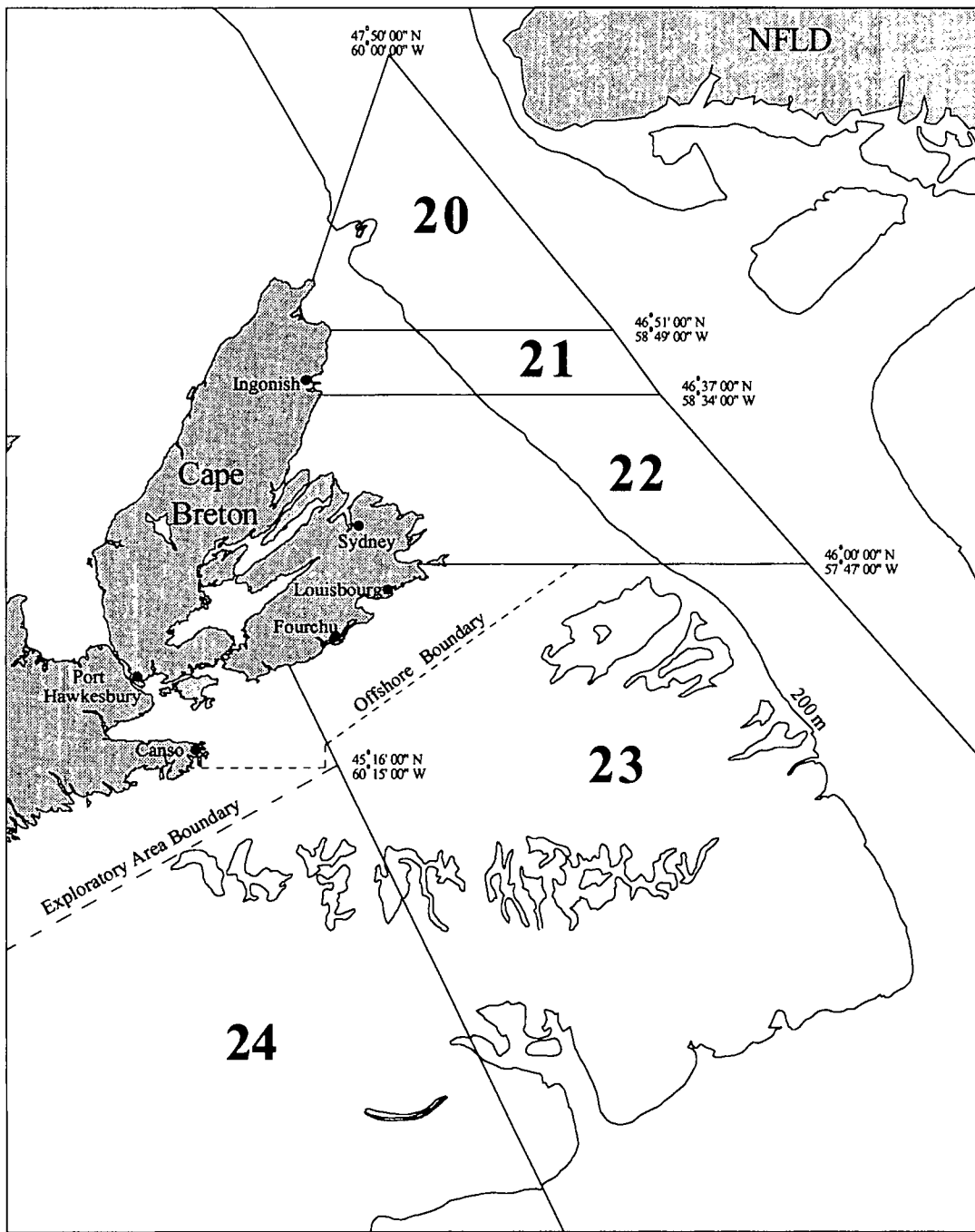


Figure 1. Snow crab Areas off eastern Cape Breton, Nova Scotia.

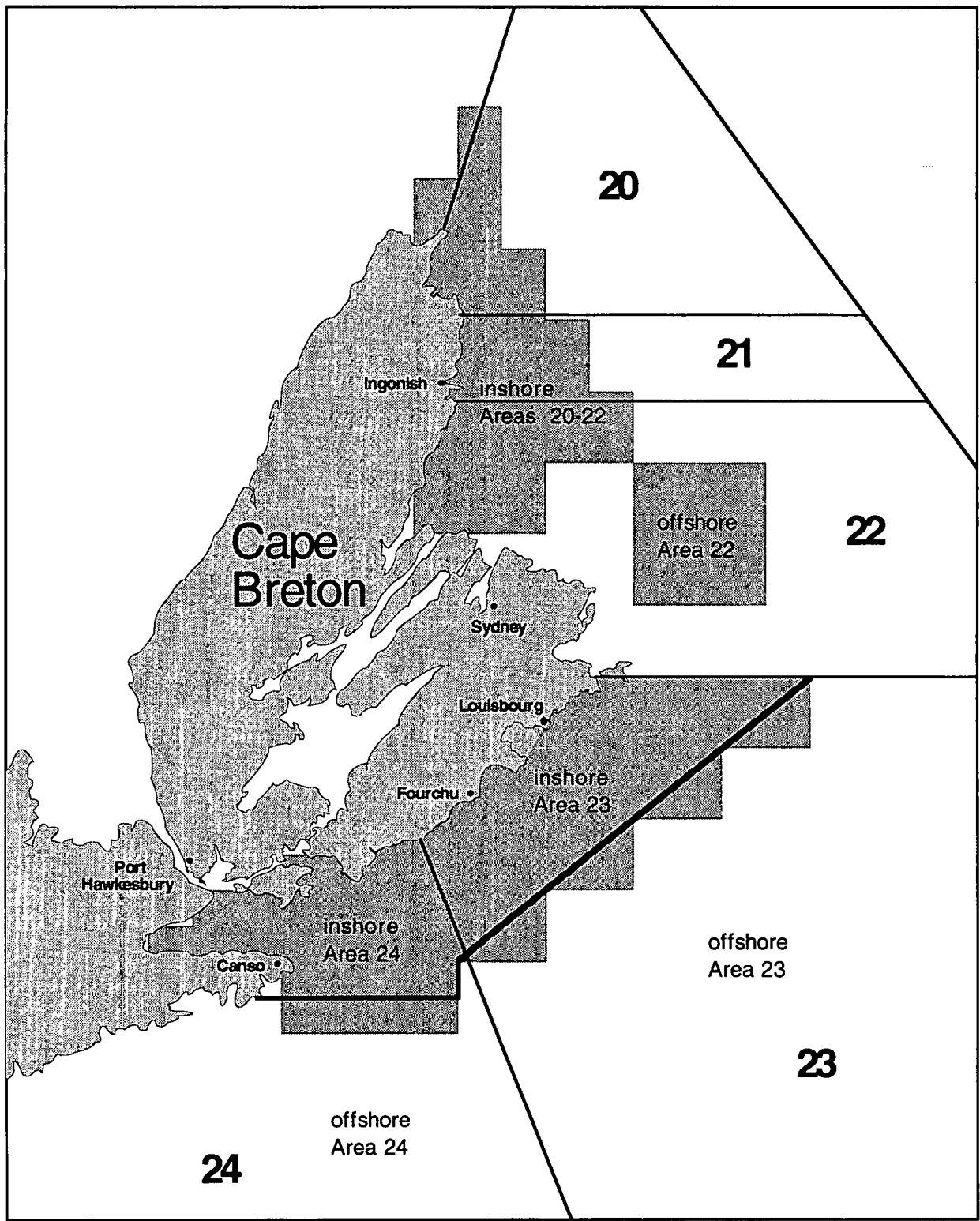


Figure 2. Eastern Cape Breton fishing Areas showing inshore and offshore grounds used for assessment purposes. Shaded areas show where most fishing occurs in Areas 20-22 and the inshore grounds of Areas 23 and 24. Fishing location in offshore grounds of Areas 23 and 24 is more variable.

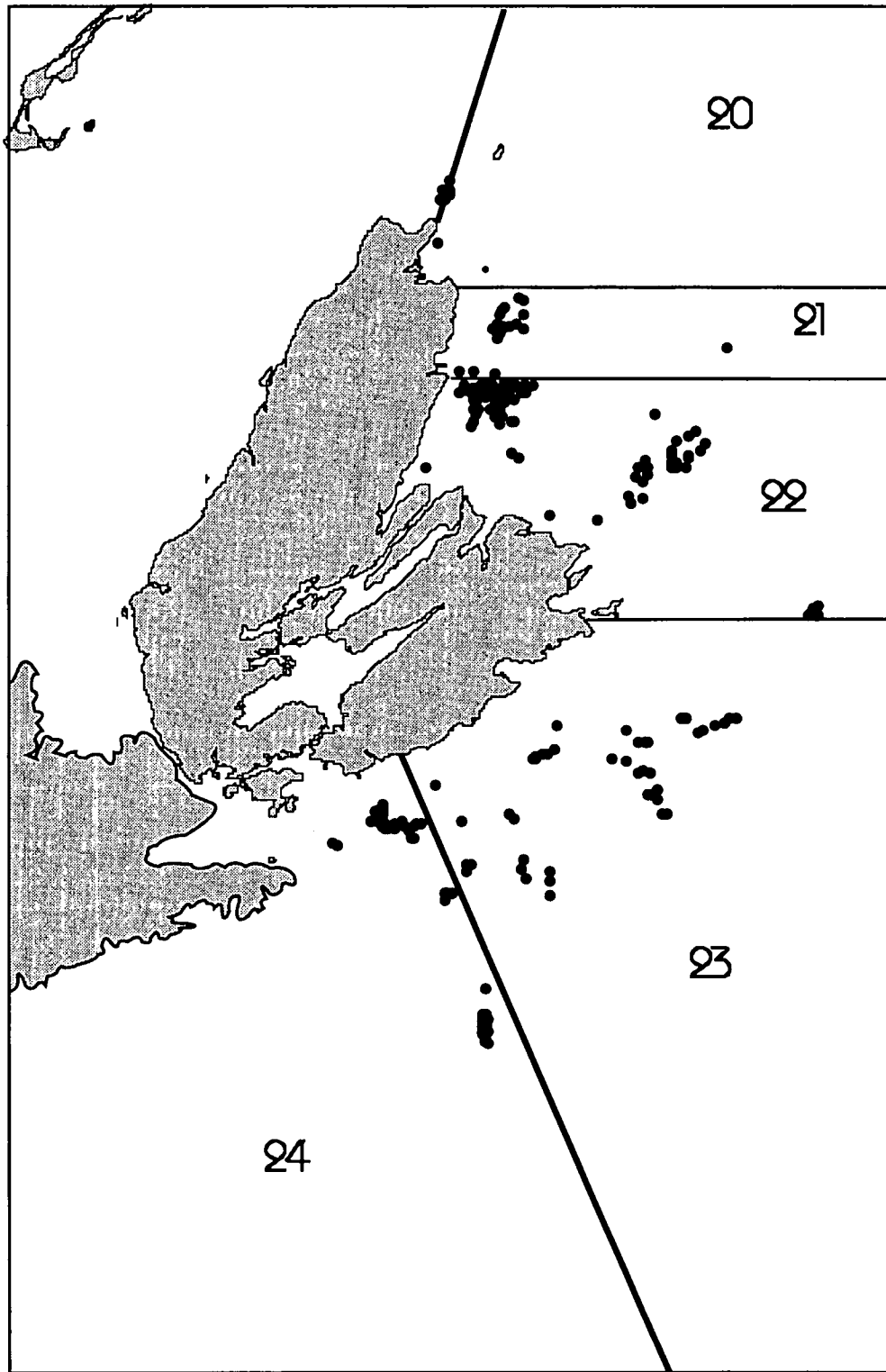


Figure 3. Sea-sampling locations from Eastern Cape Breton (Areas 20 to 24) snow crab fisheries in 1996.

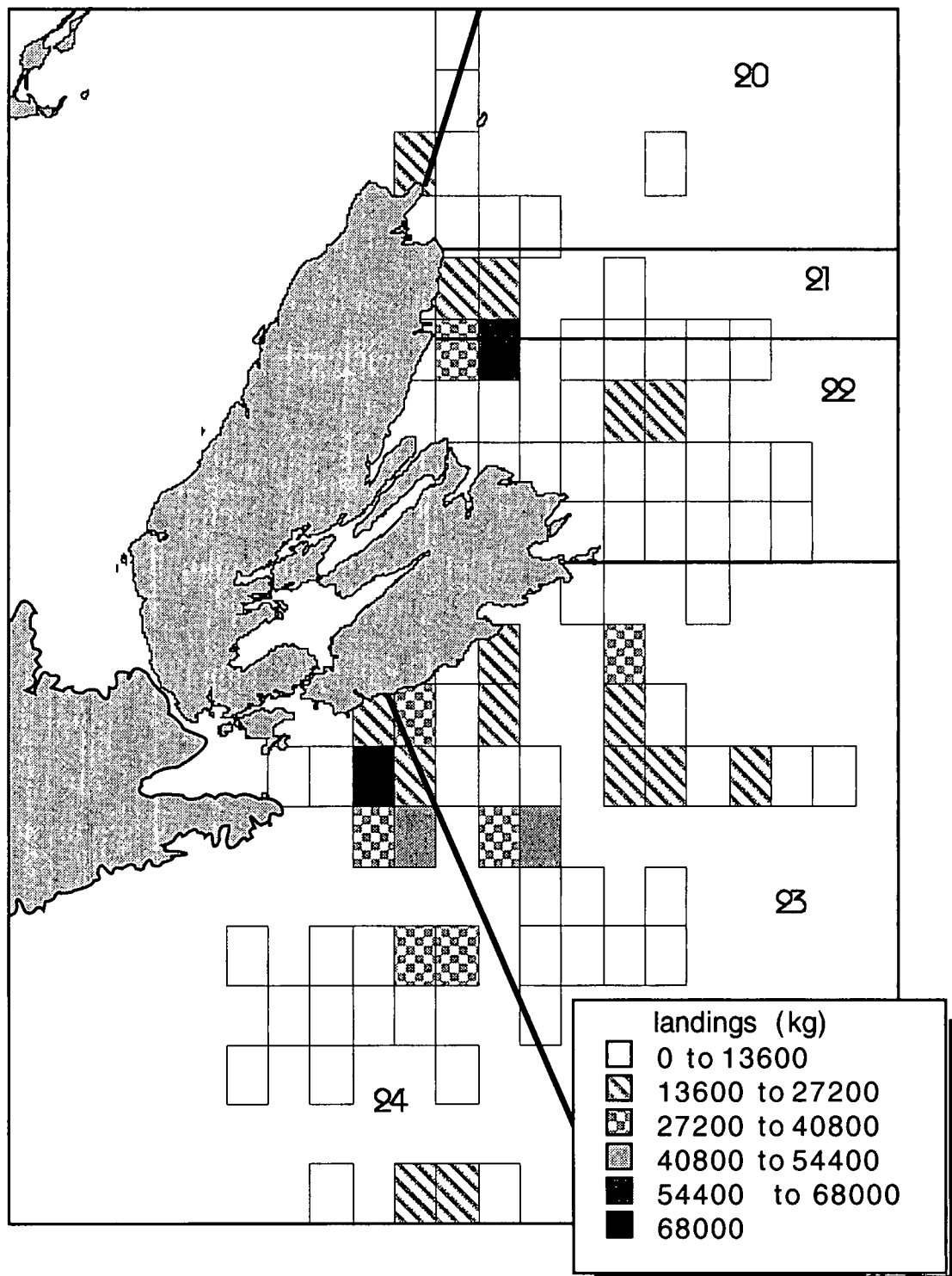


Figure 4. Seasonal distribution of the landings (kg) in Eastern Cape Breton in 1996.

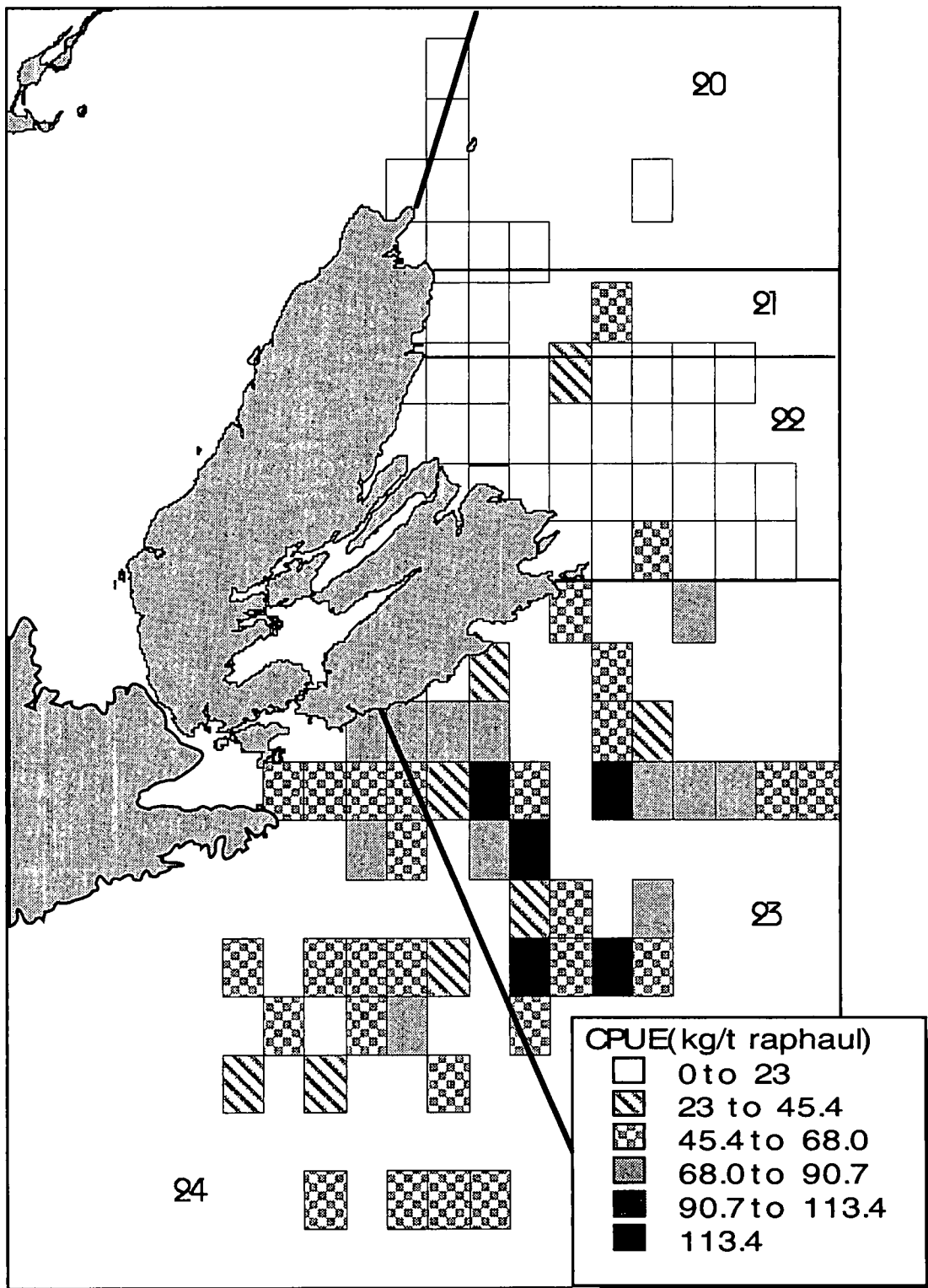


Figure 5. Seasonal distribution of the CPUE (kg/trap haul) in Eastern Cape Breton in 1996

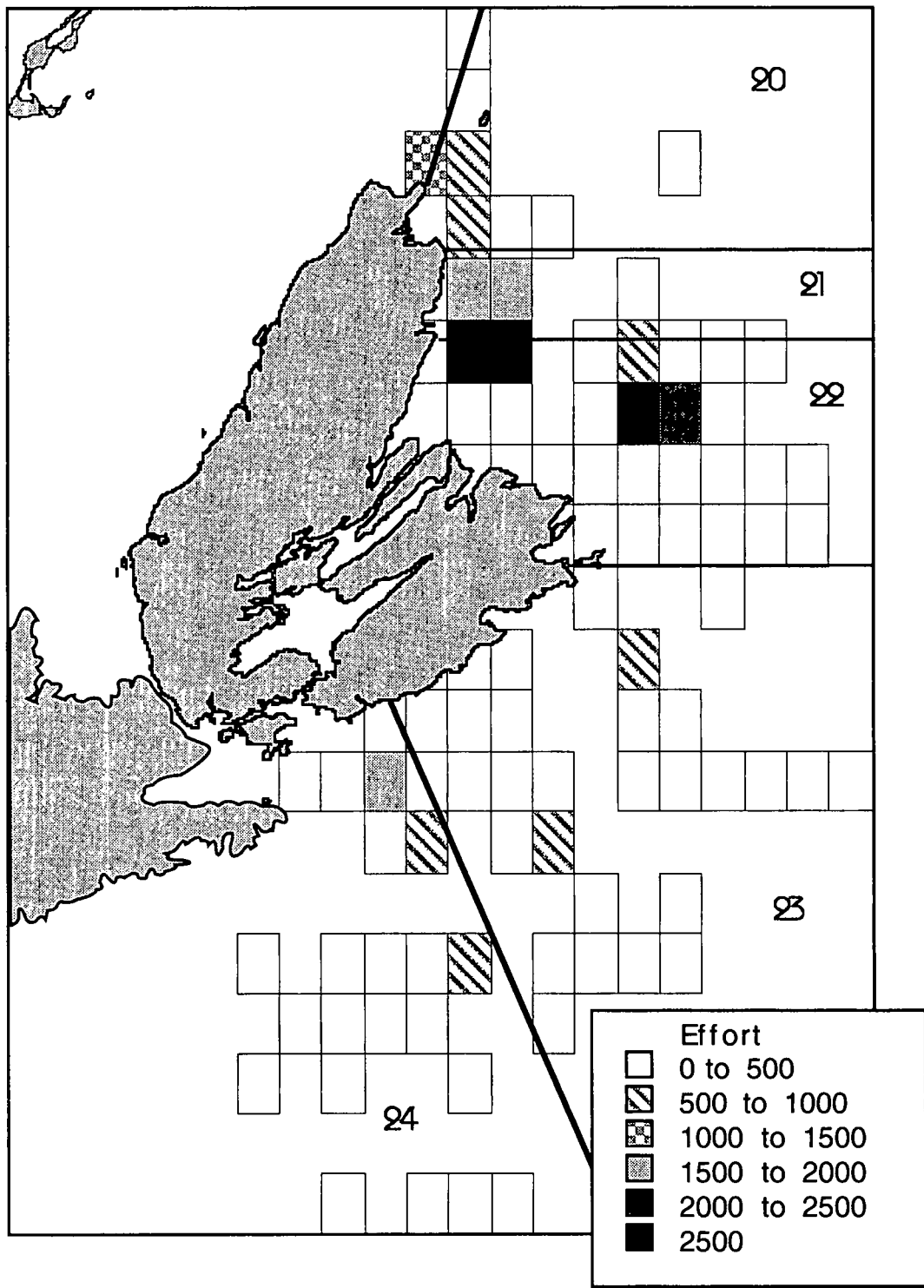


Figure 6. Seasonal distribution of the effort (# of trap hauls) in Eastern Cape Breton in 1996

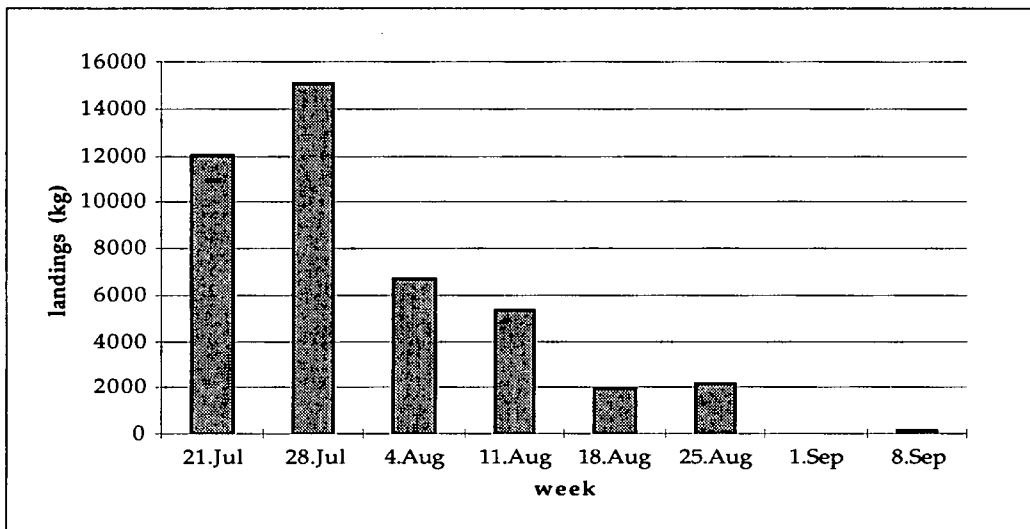


Figure 7. Reported weekly landings of snow crab in Area 20 in 1996.

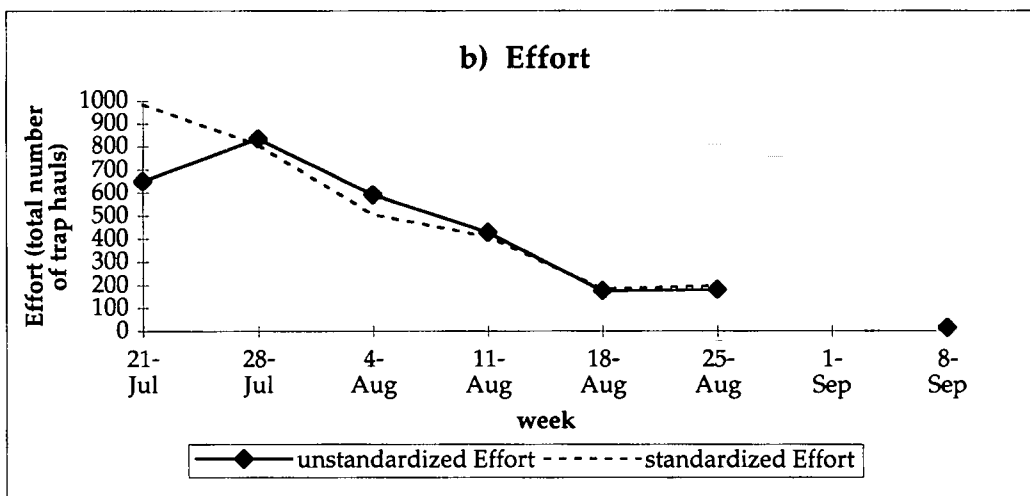
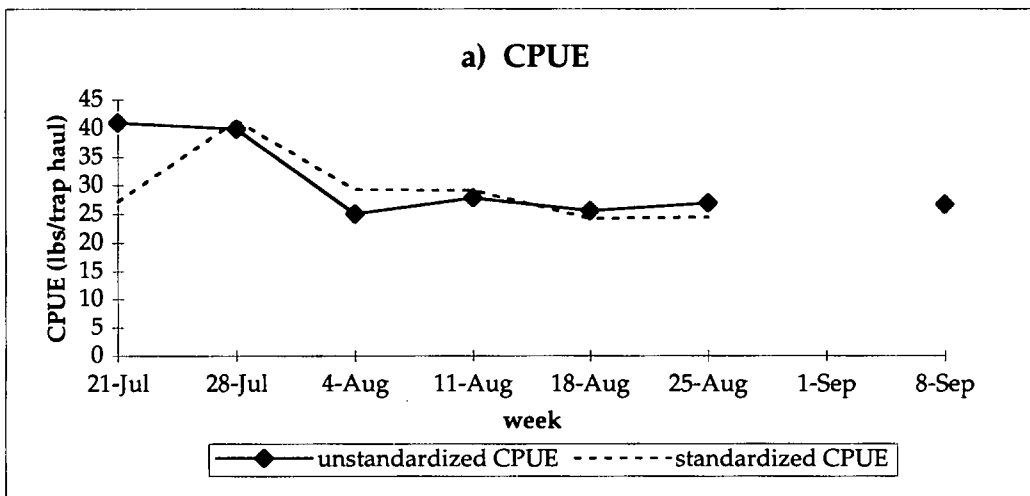


Figure 8. Reported weekly catch rate and effort in Area 20 in 1996.

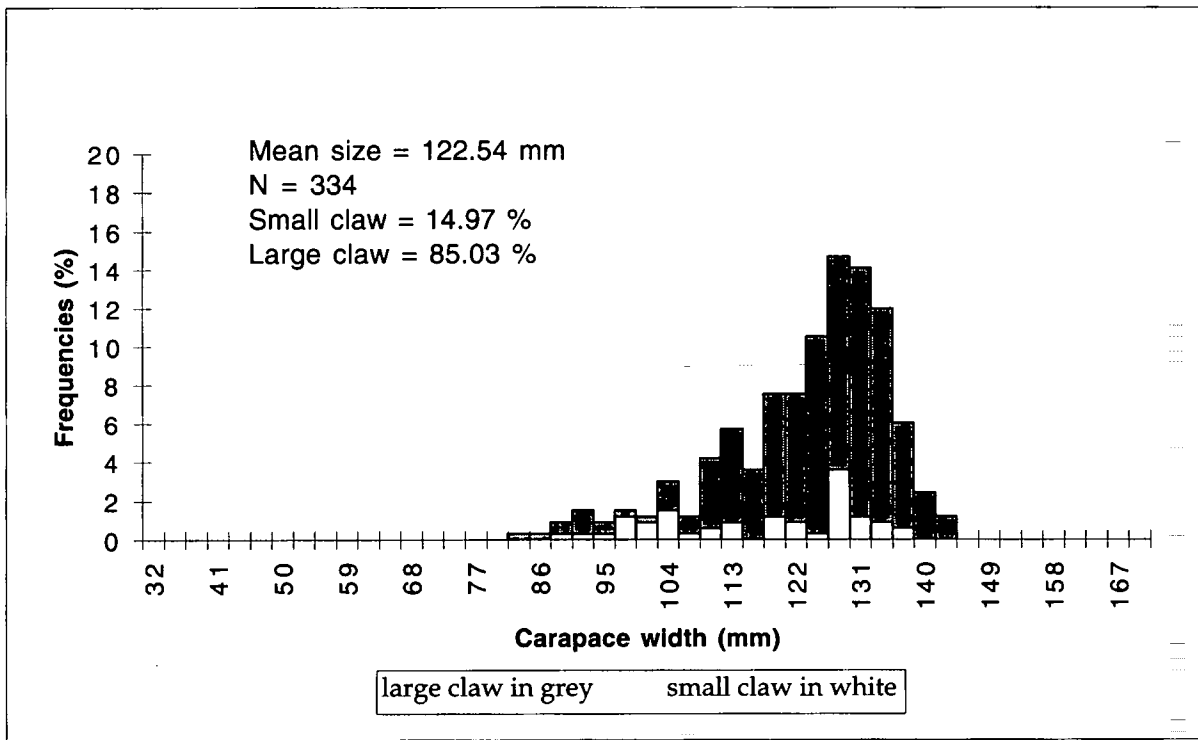


Figure 9. Histogram of frequency size distribution in Area 20.

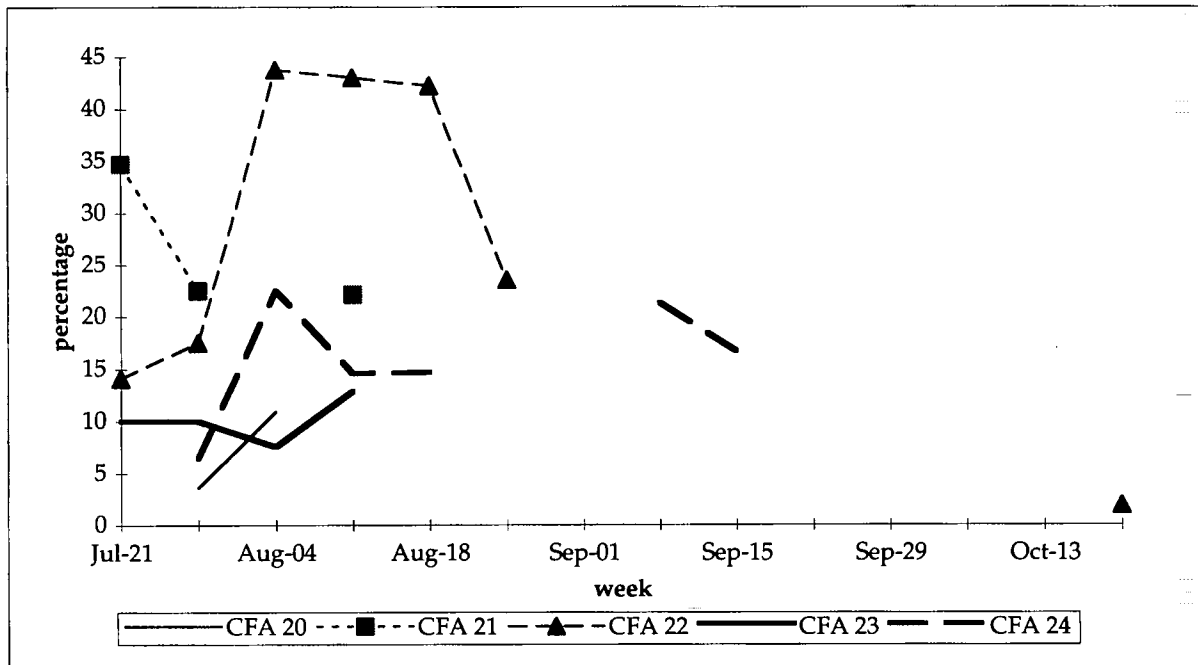


Figure 10. Weekly white crab percentage in Areas 20 - 24 in 1996.

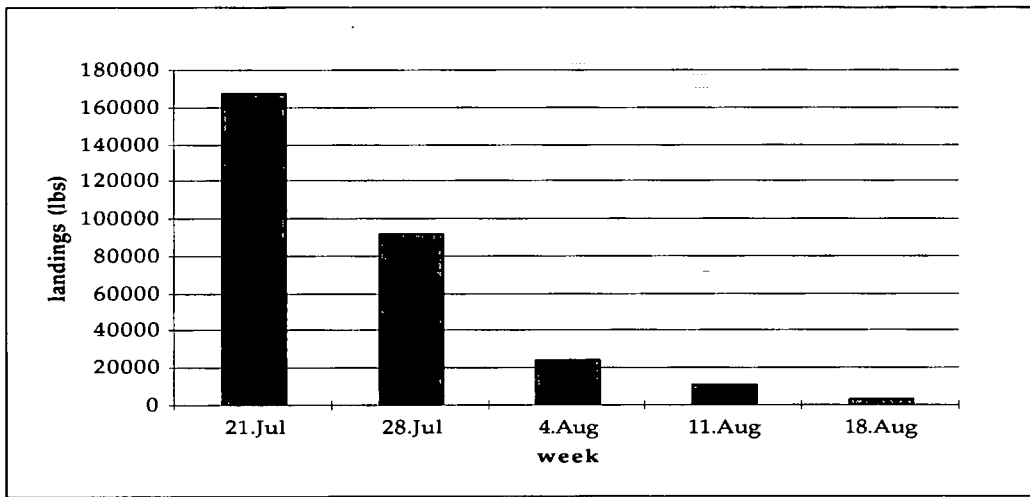


Figure 11. Reported weekly landings of snow crab in Area 21 in 1996.

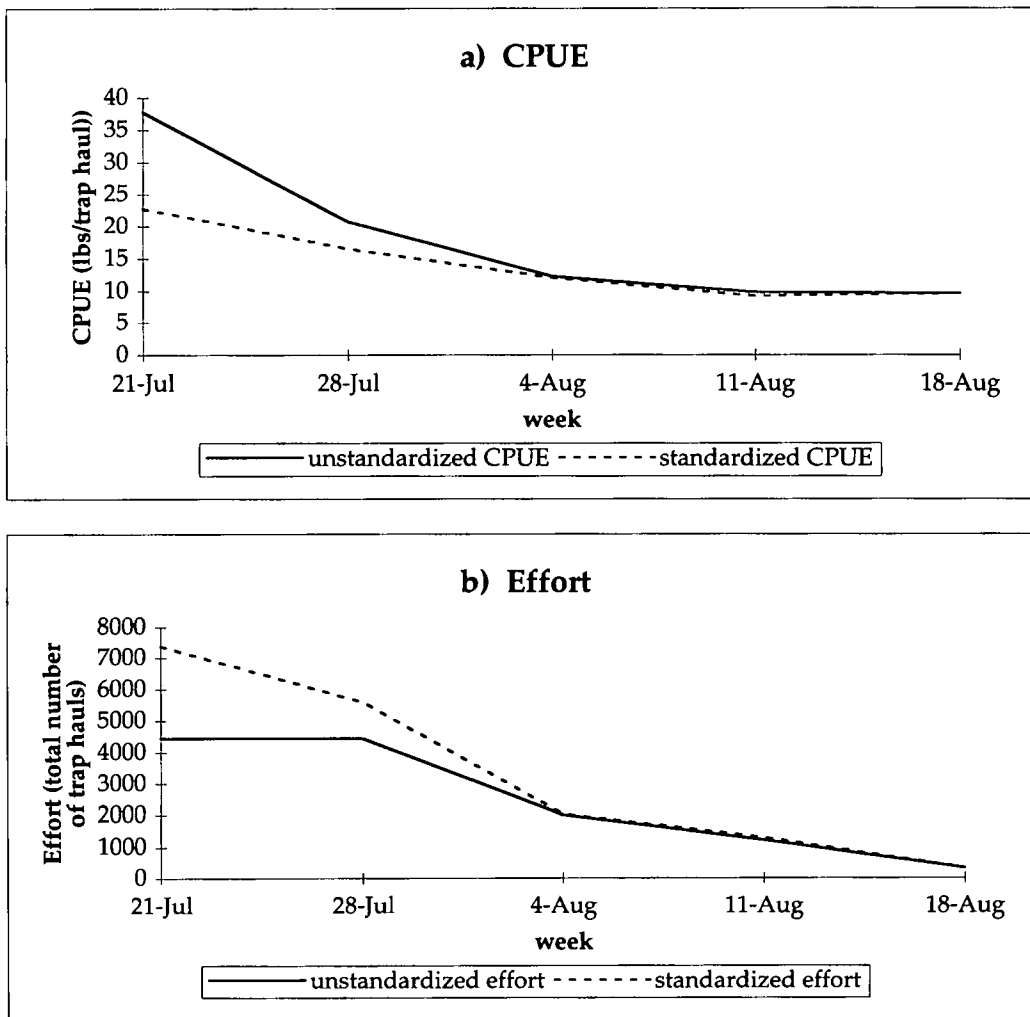


Figure 12. Reported weekly catch rate and effort in Area 21 in 1996.

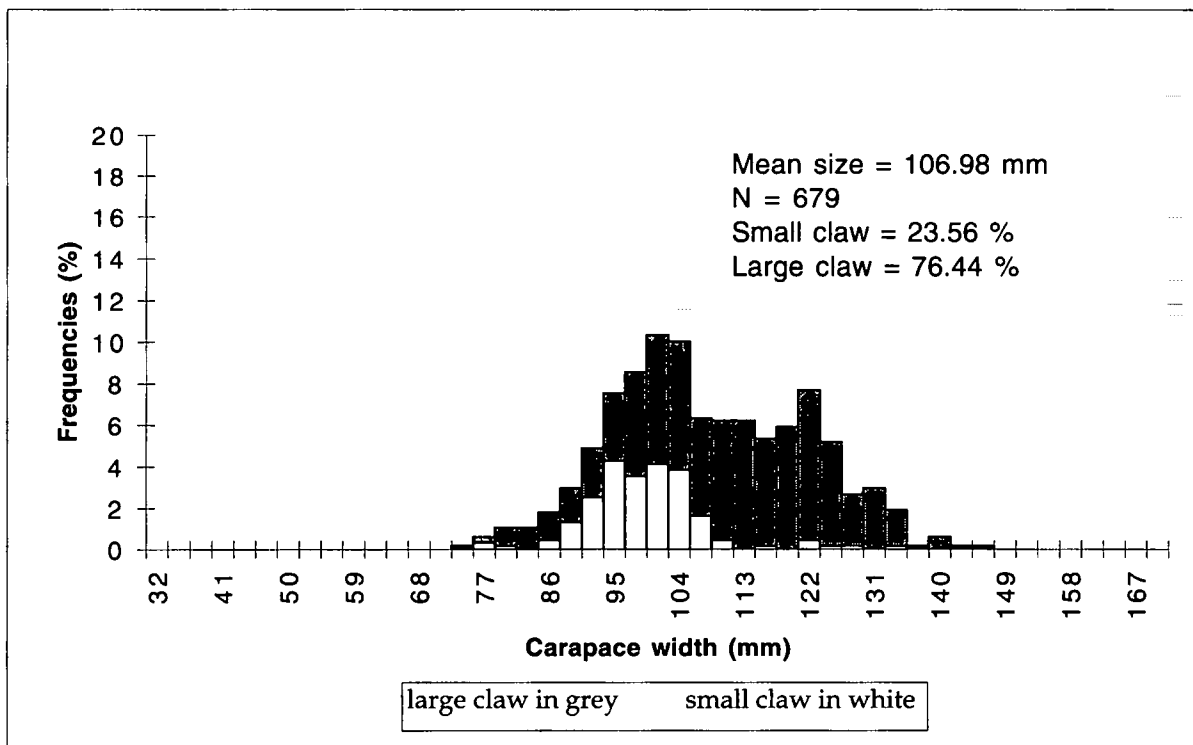


Figure 13. Histogram of frequency size distribution in Area 21.

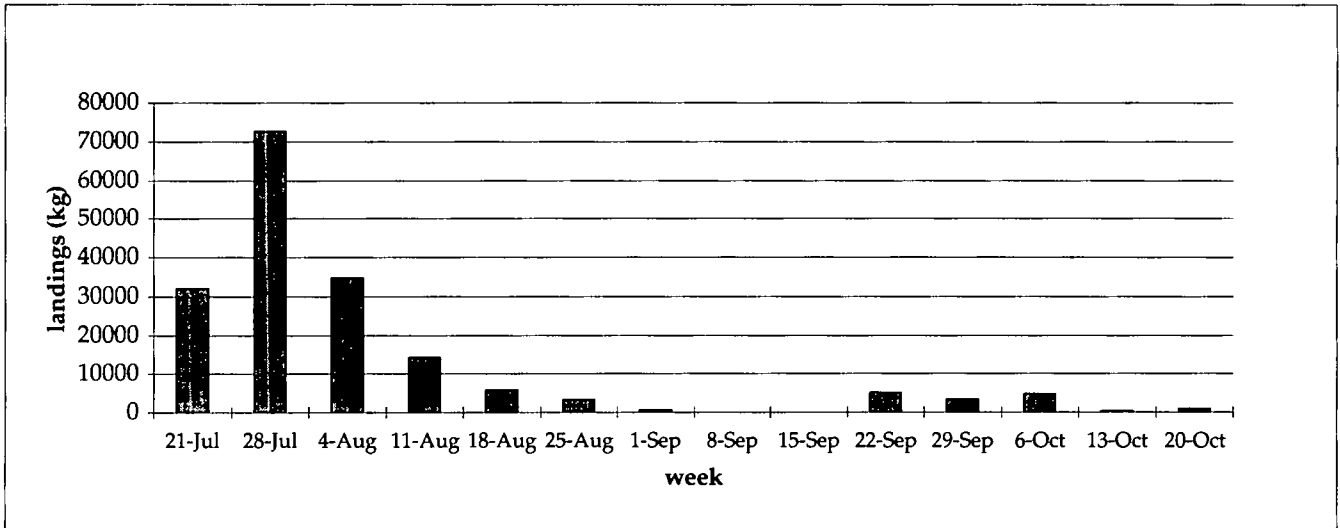


Figure 14. Reported weekly landings of snow crab in Area 22 in 1996.

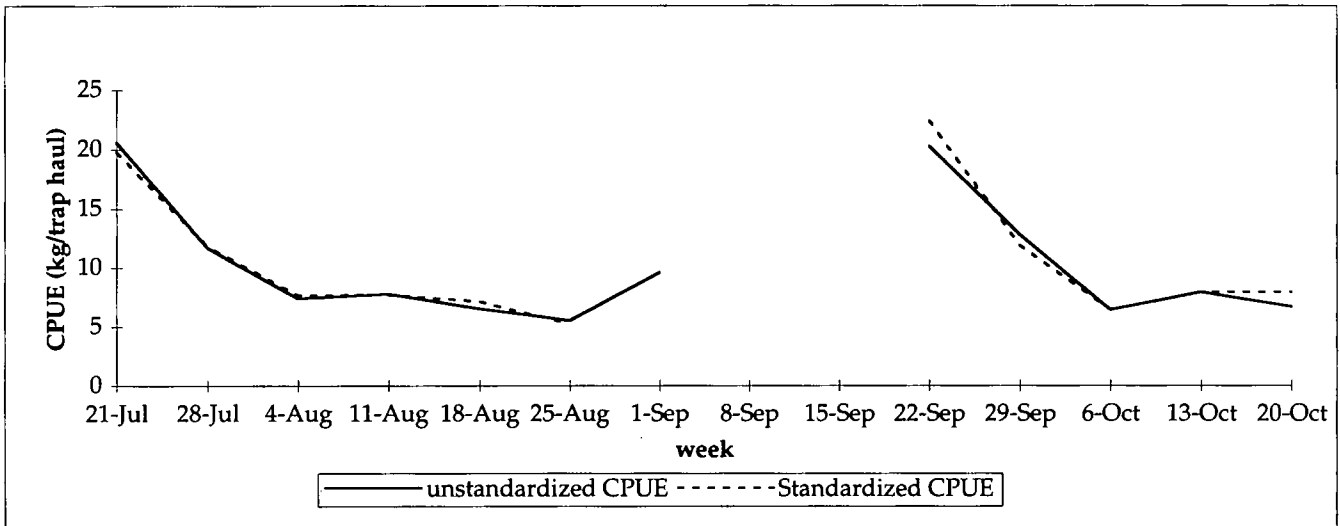


Figure 15. Reported weekly catch rate in Area 22 in 1996.

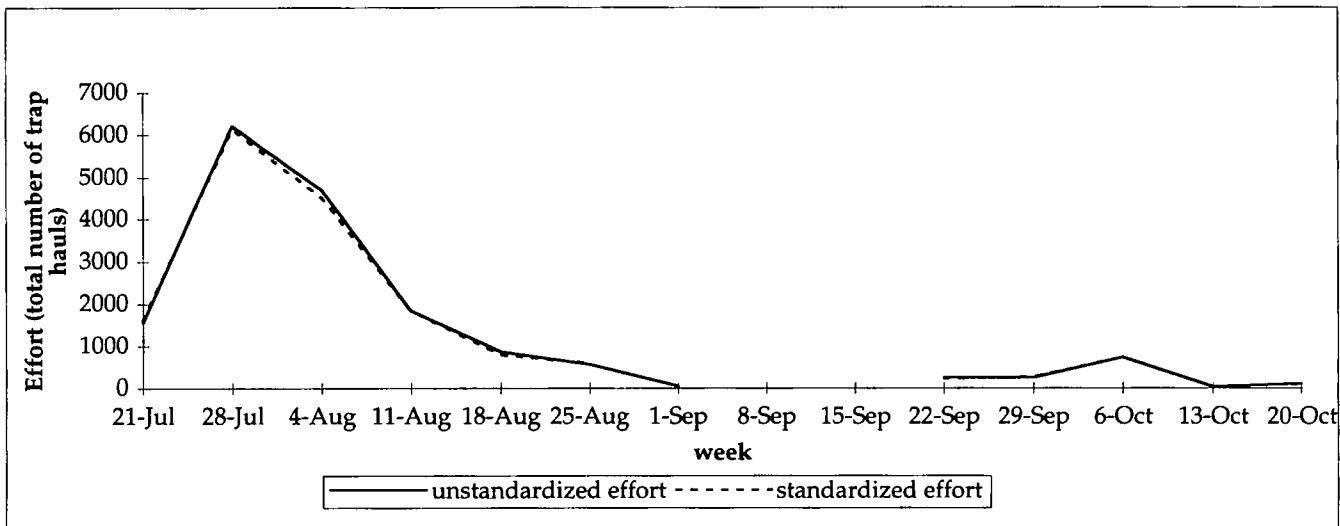


Figure 16. Reported weekly effort in Area 22 in 1996.

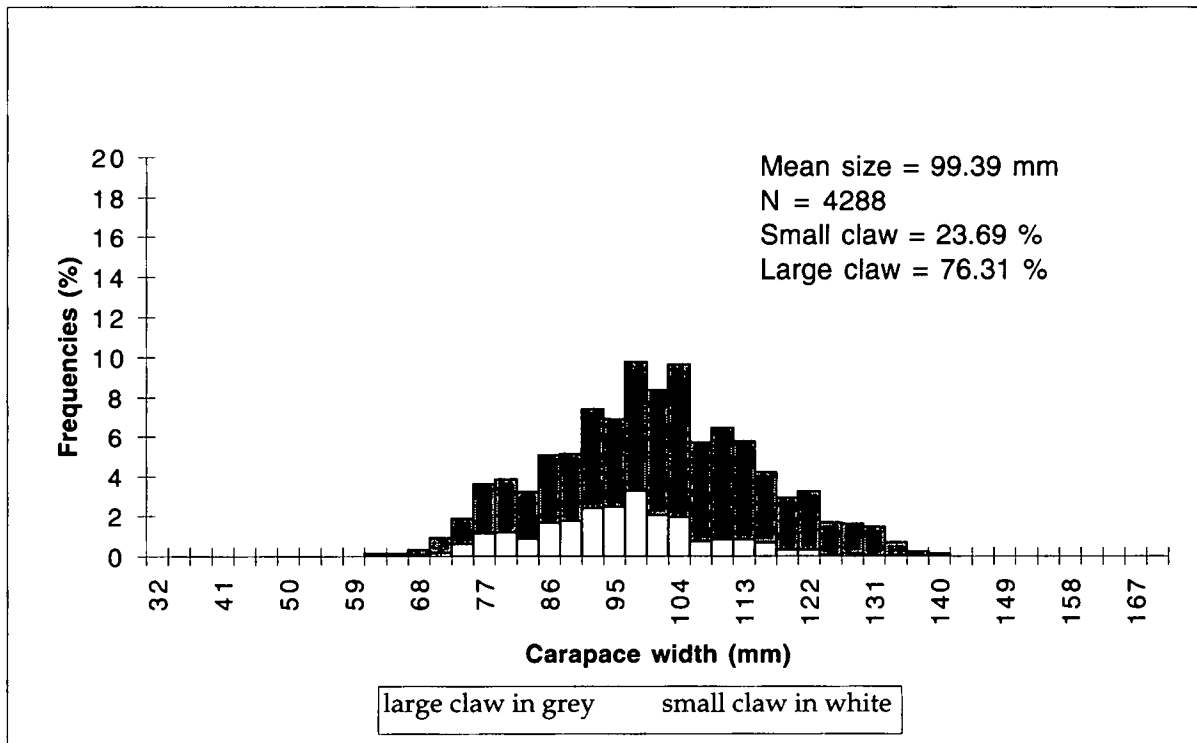


Figure 17. Histogram of frequency size distribution in Area 22.

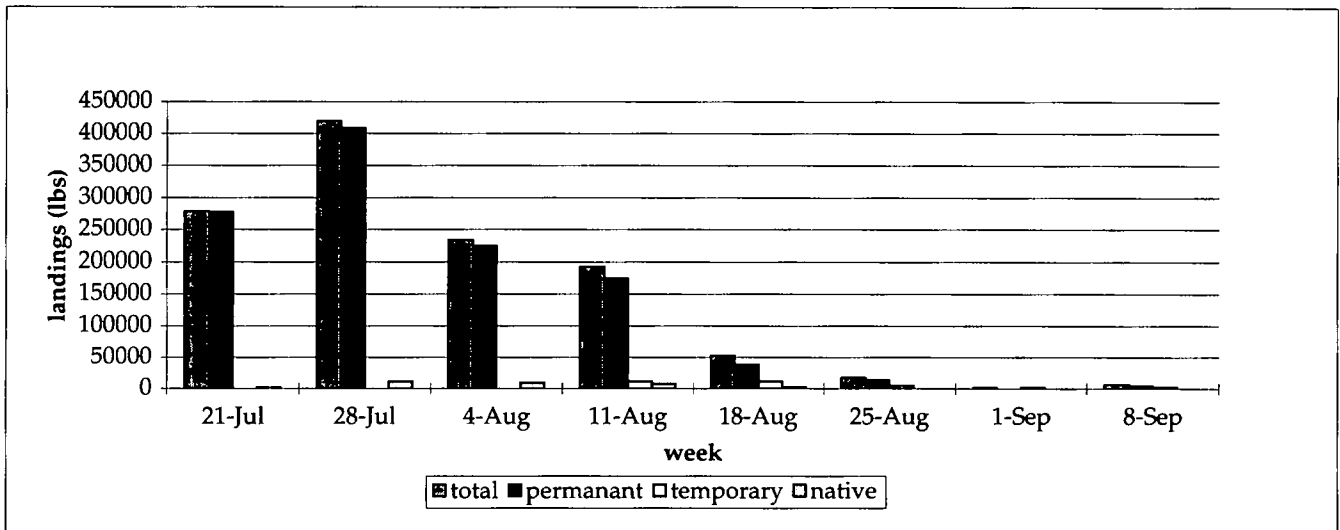


Figure 18. Reported weekly landings of snow crab in Area 23 in 1996.

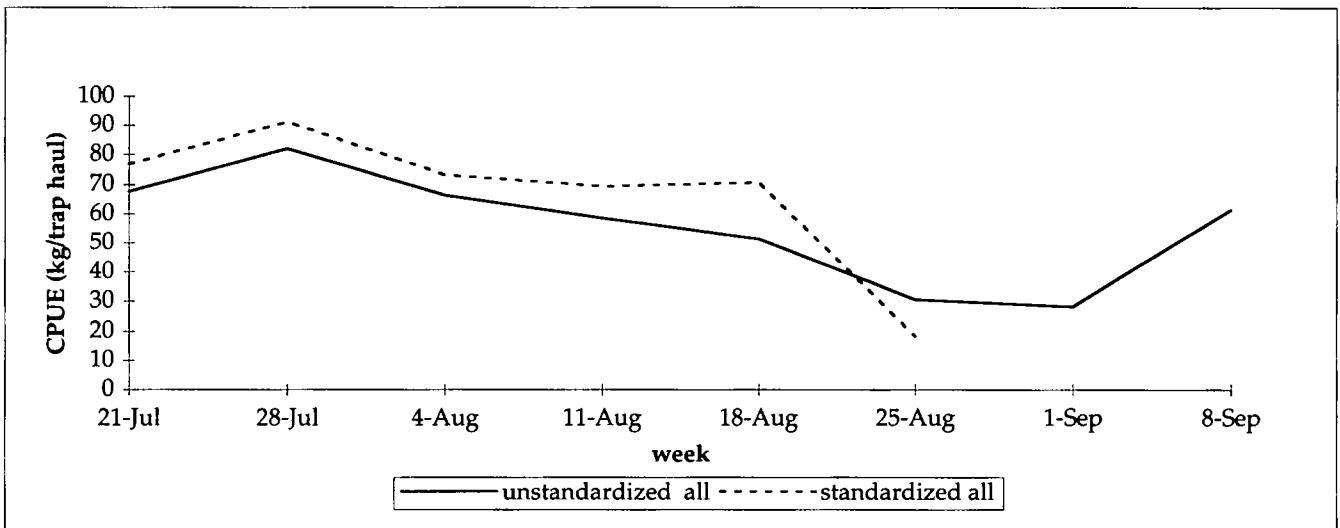


Figure 19. Reported weekly catch rate in Area 23 in 1996.

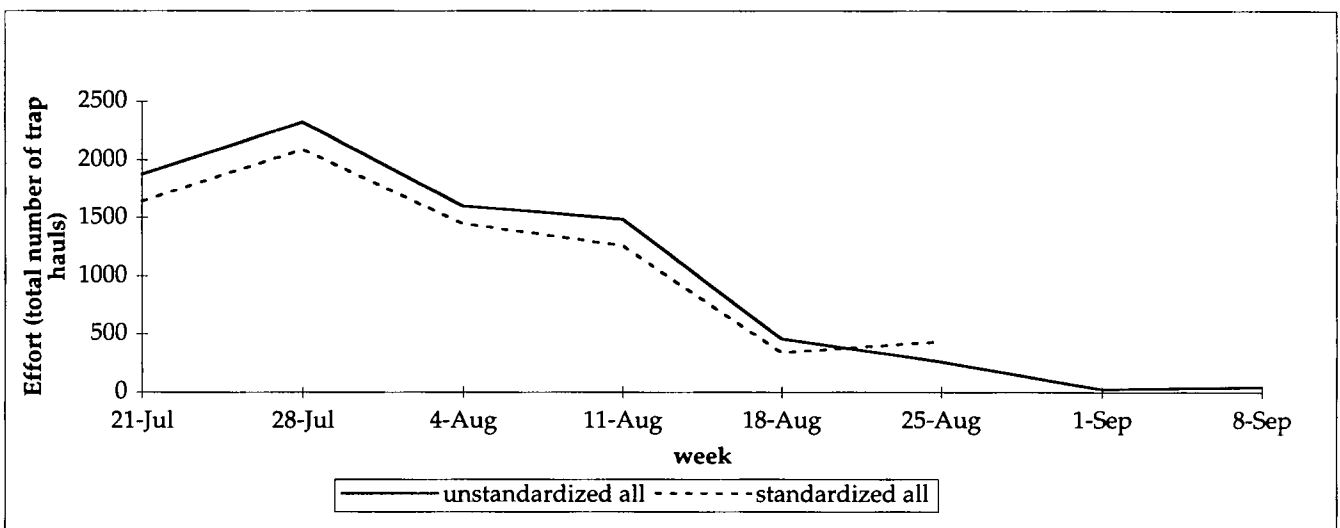


Figure 20. Reported weekly effort in Area 23 in 1996.

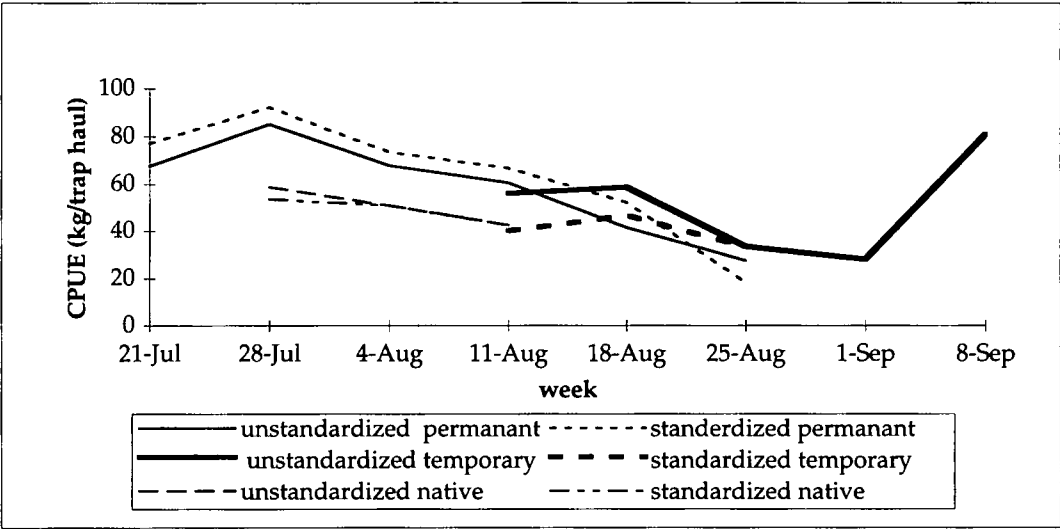


Figure 21. Reported weekly catch rate by fisher's status in Area 23 in 1996.

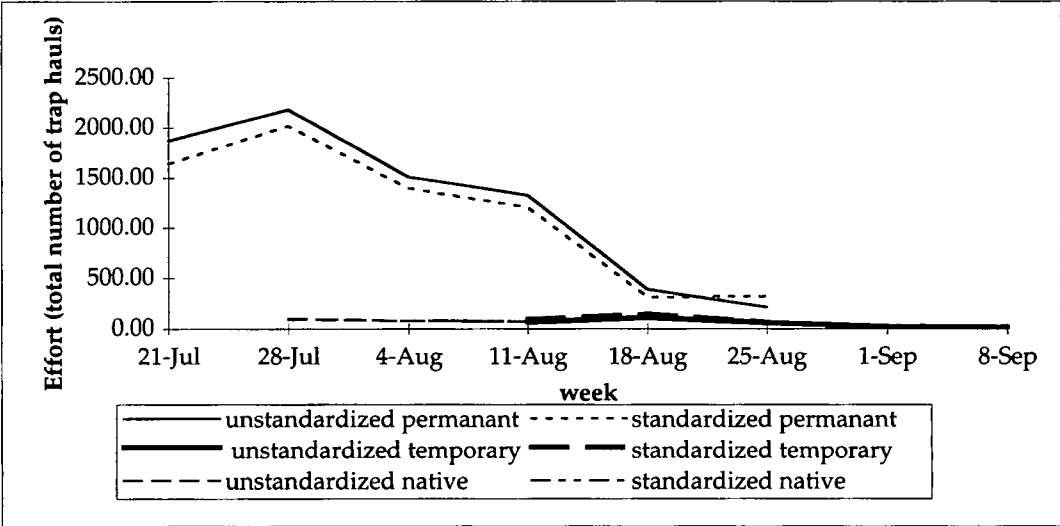


Figure 22. Reported weekly effort by fisher's status in Area 23 in 1996.

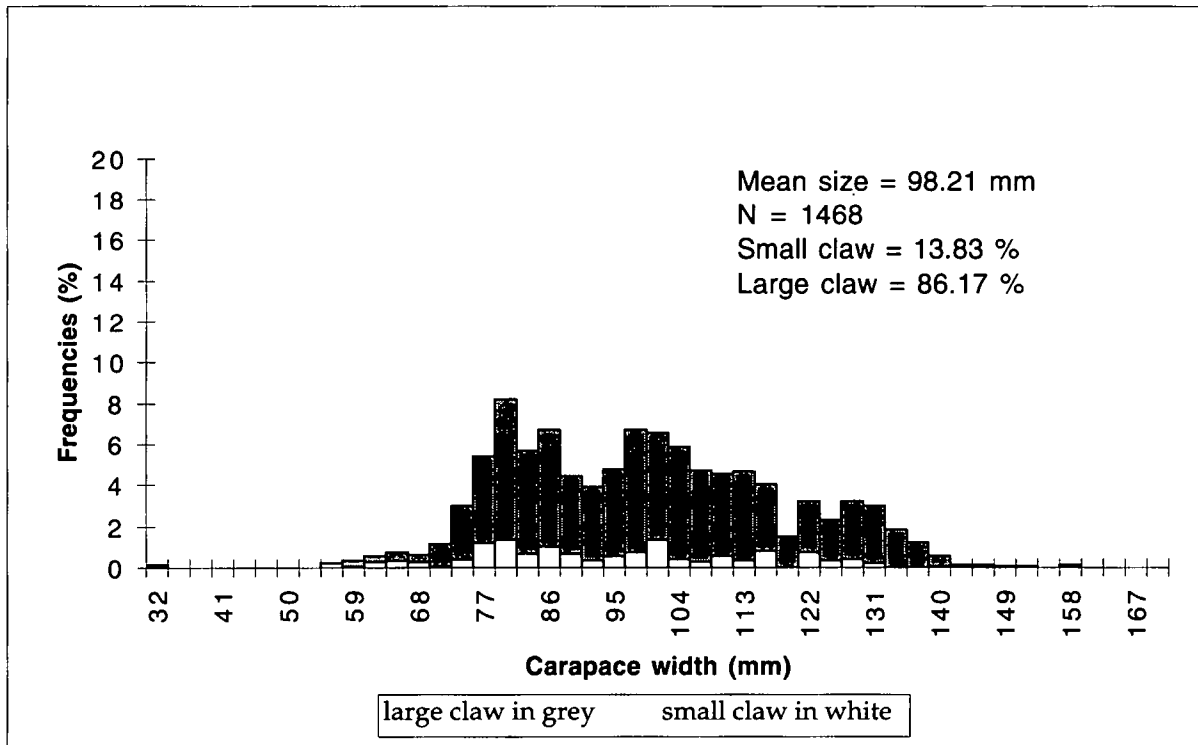


Figure 23. Histogram of frequency distribution in Area 23.

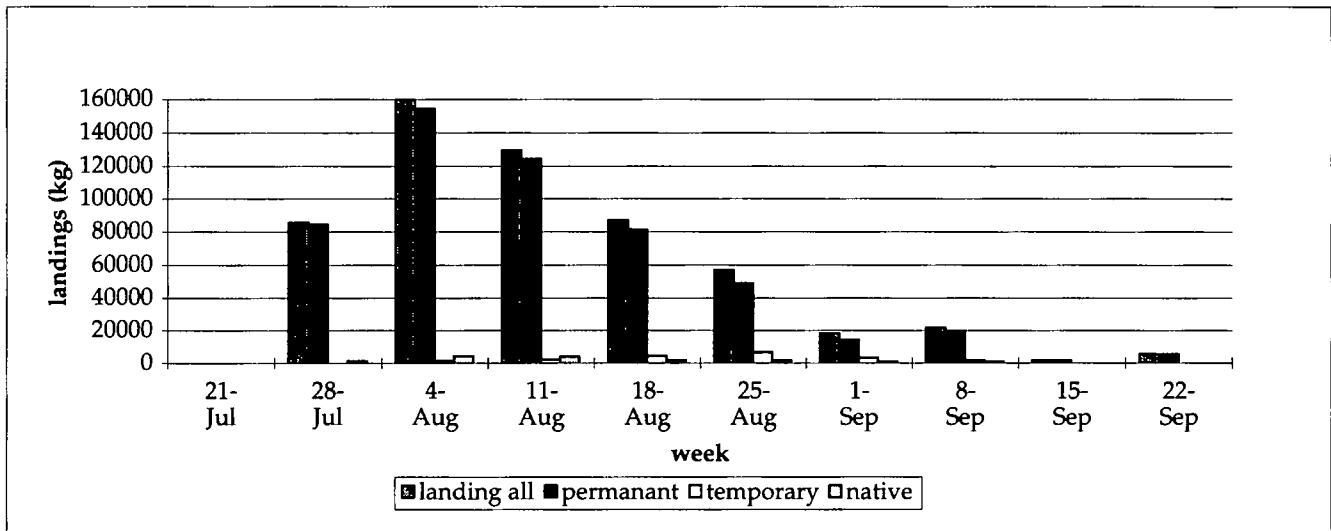


Figure 24. Reported weekly landings of snow crab in Area 24 in 1996.

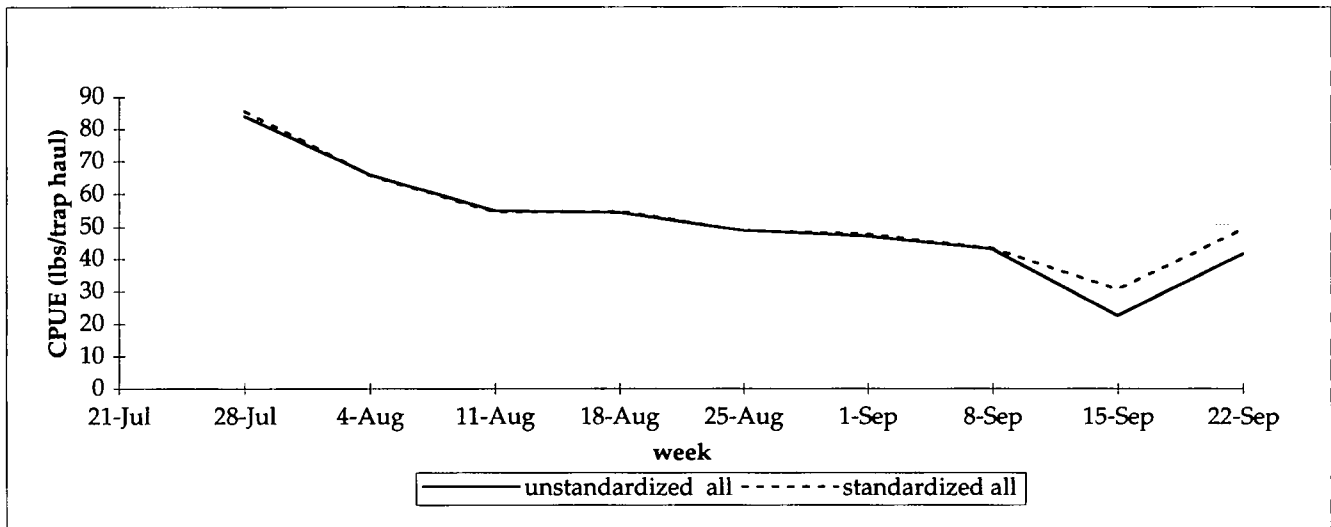


Figure 25. Weekly catch rate in Area 24 in 1996.

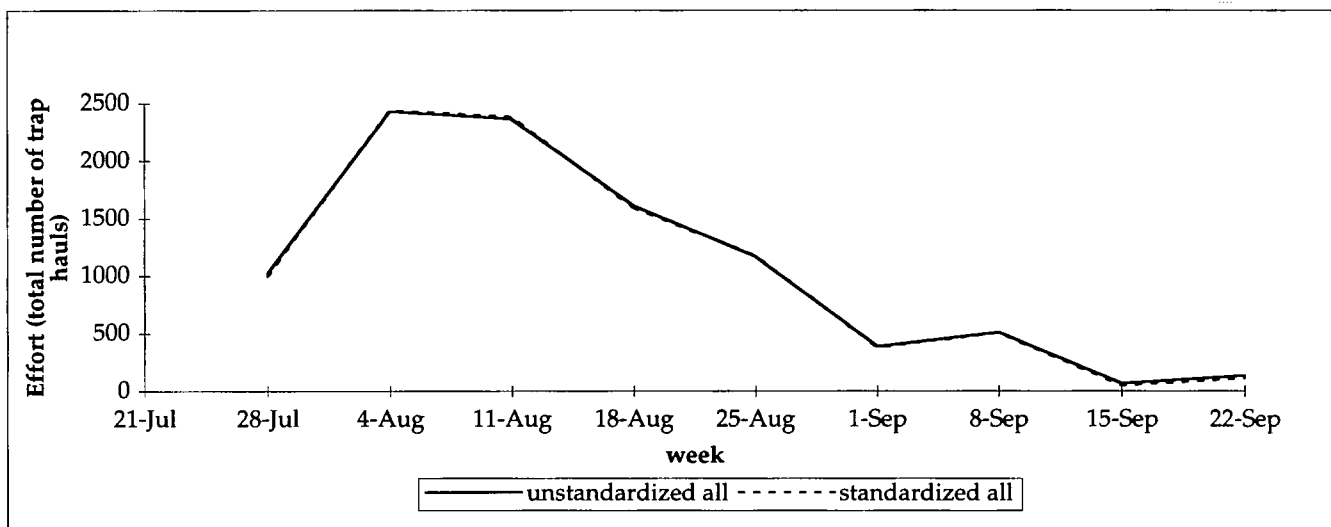


Figure 26. Weekly effort in Area 24 in 1996.

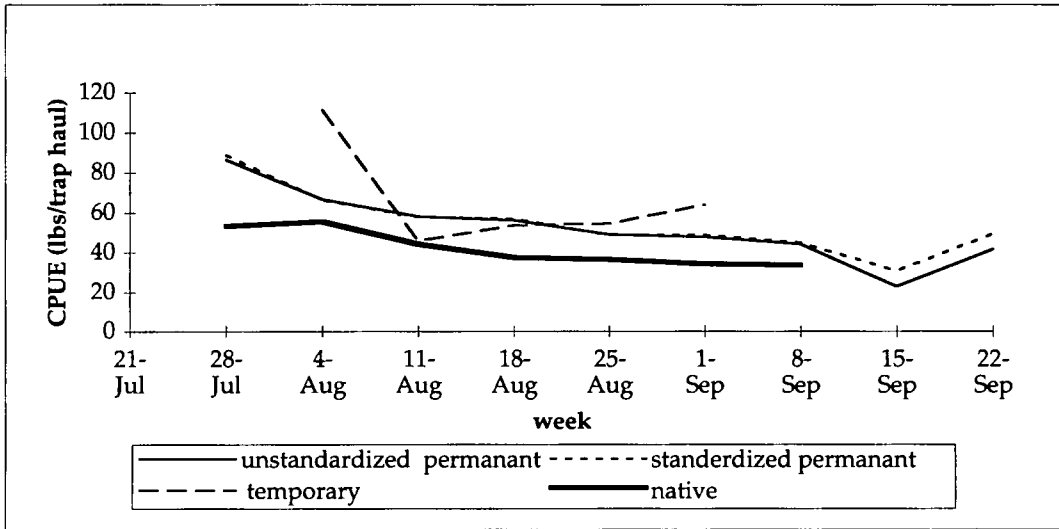


Figure 27. Weekly catch rate by fisher's status in Area 24 in 1996.

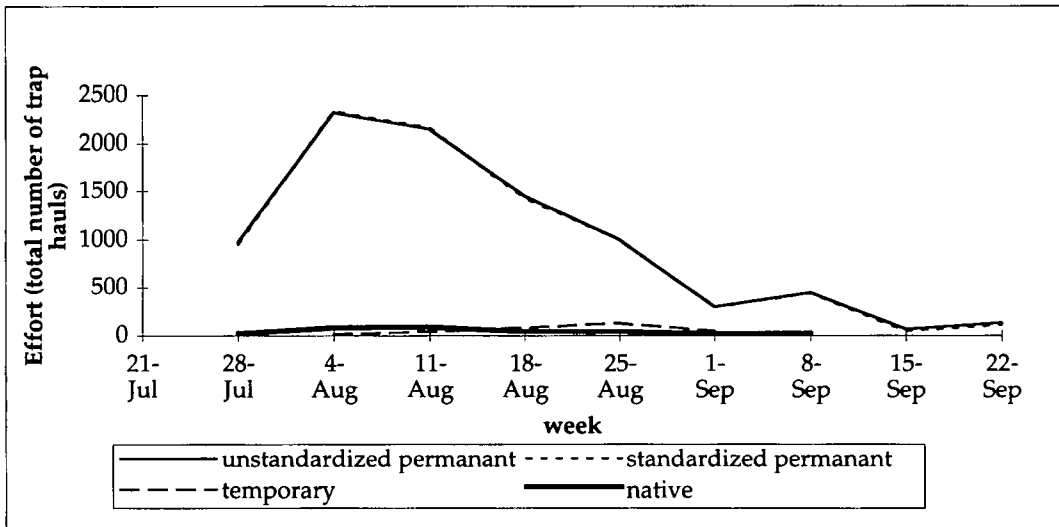


Figure 28. Weekly effort by fisher's status in Area 24 in 1996.

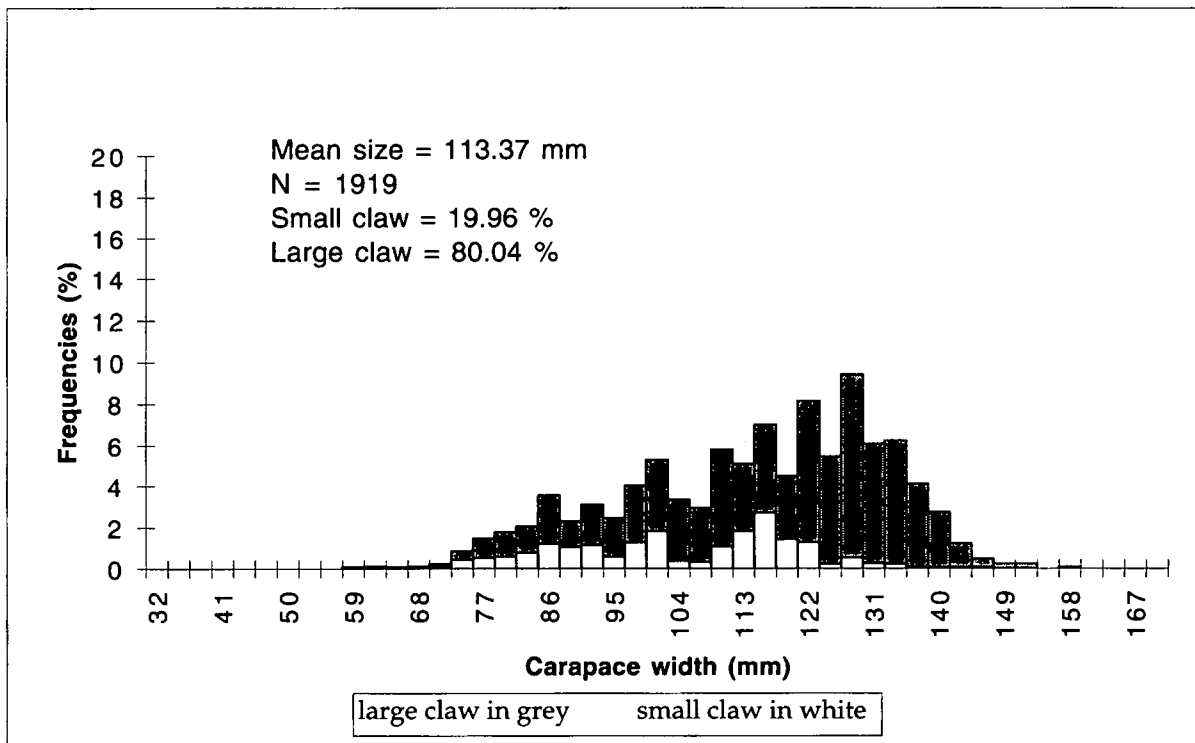


Figure 29. Histogram of frequency size distribution in Area 24.

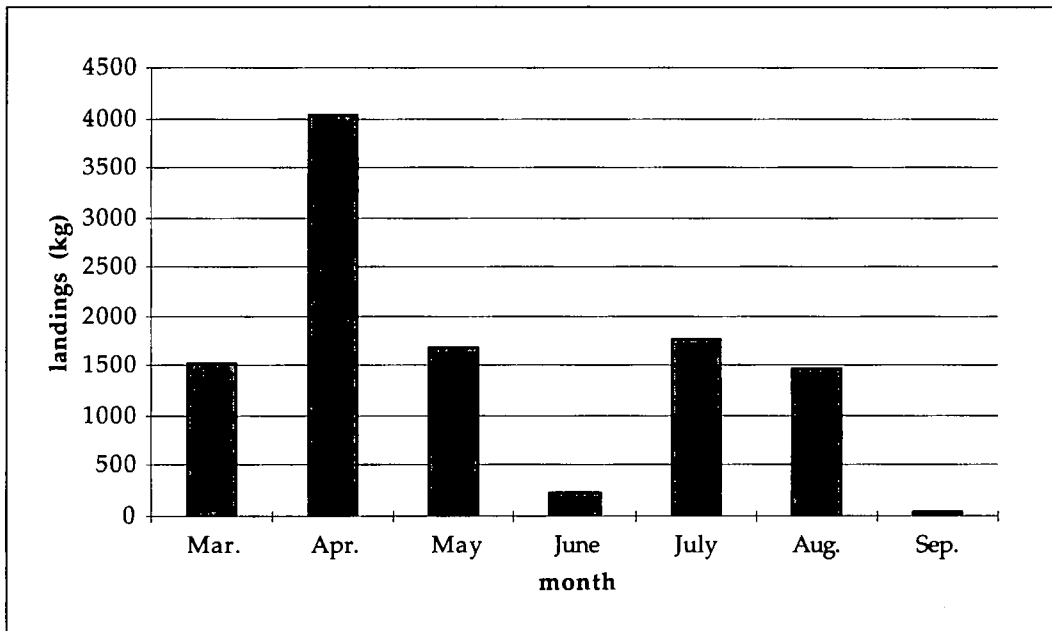


Figure 30. Reported monthly landings of snow crab in exploratory Area 4X in 1996.

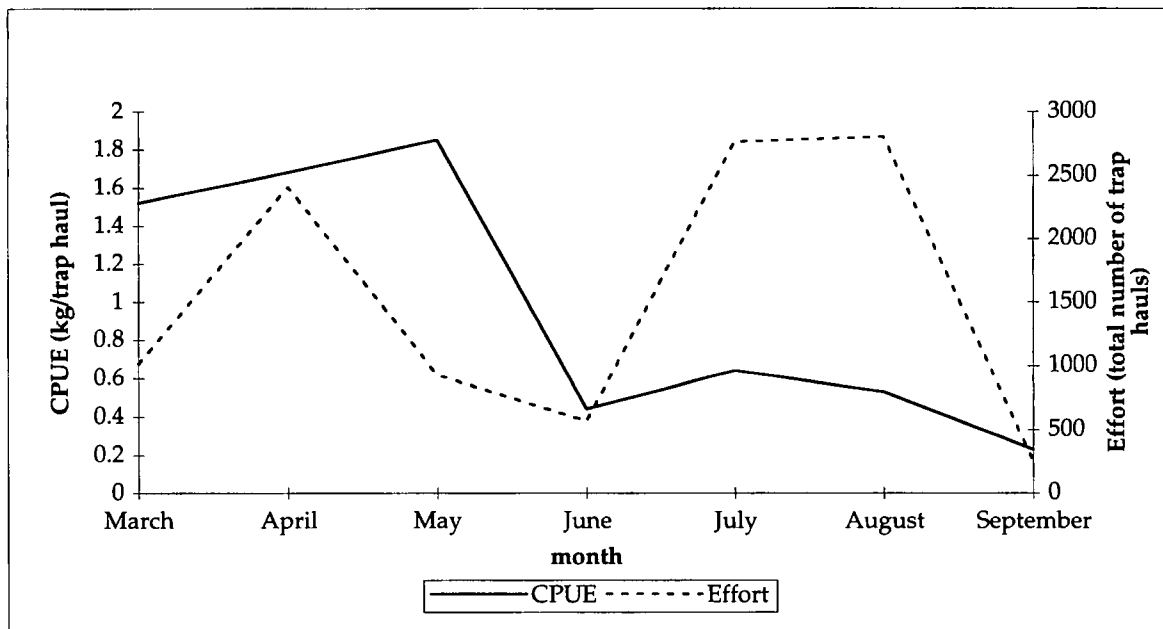


Figure 31. Monthly catch rate and effort in exploratory Area 4X in 1996.



Figure 32. Locations of trawl stations for the 1996 trawl survey.

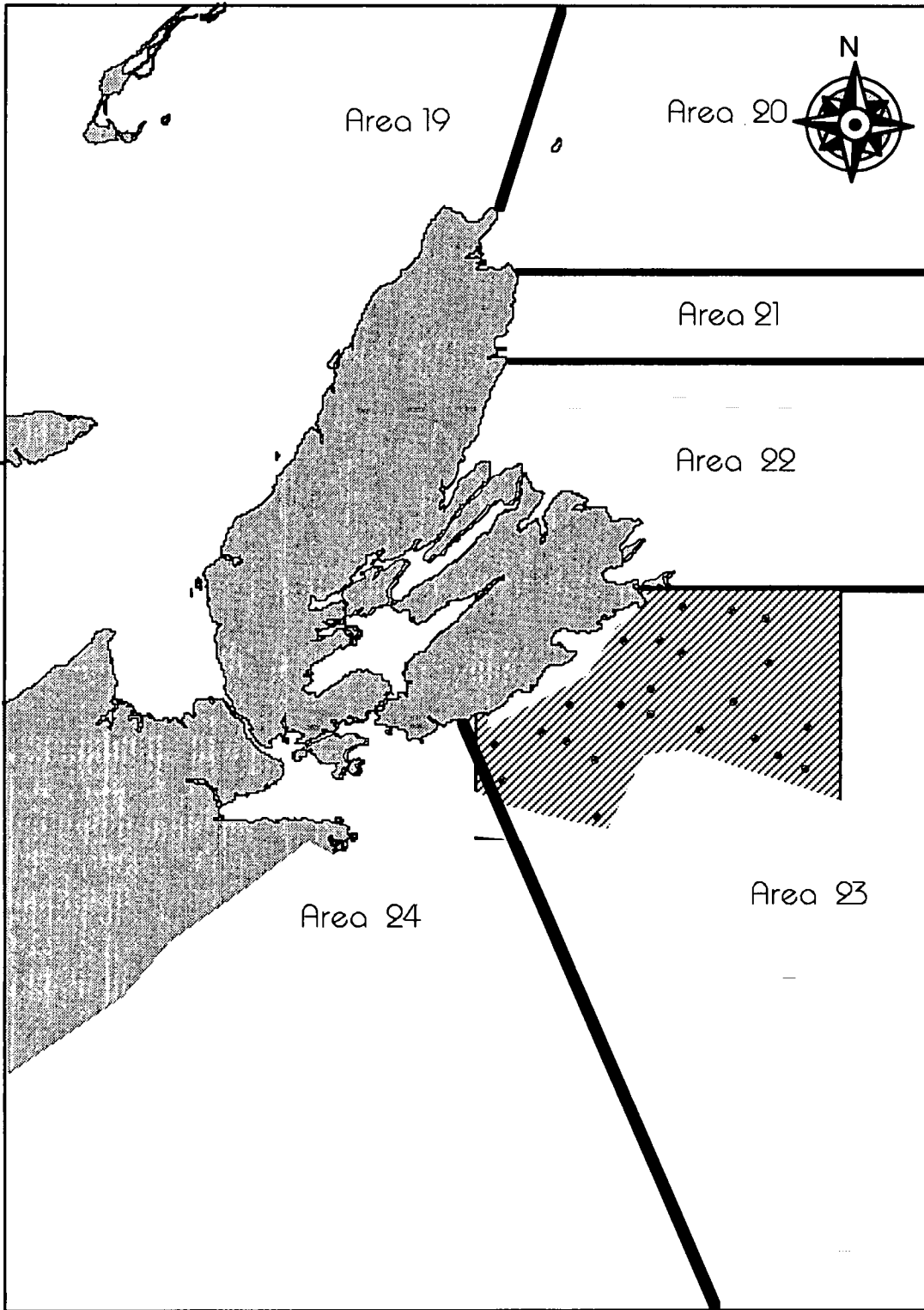


Figure 33. Location of the surveyed area

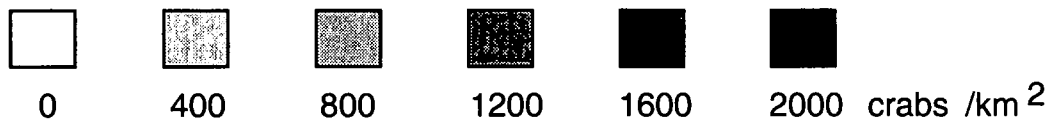
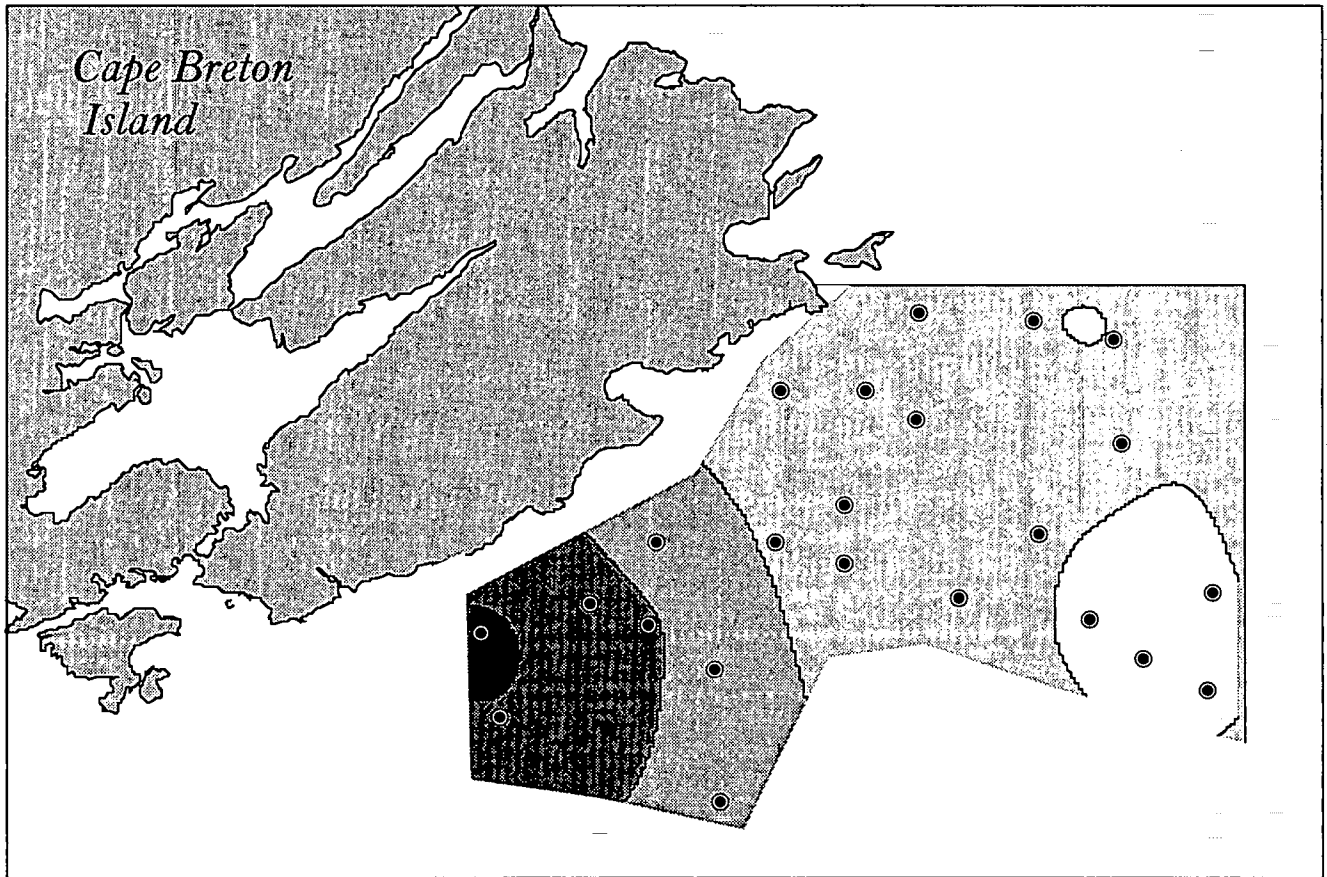


Figure 34 . Mapping of Male Mature Snow Crab densities greater than 95 mm, according to the 1996 trawl survey,

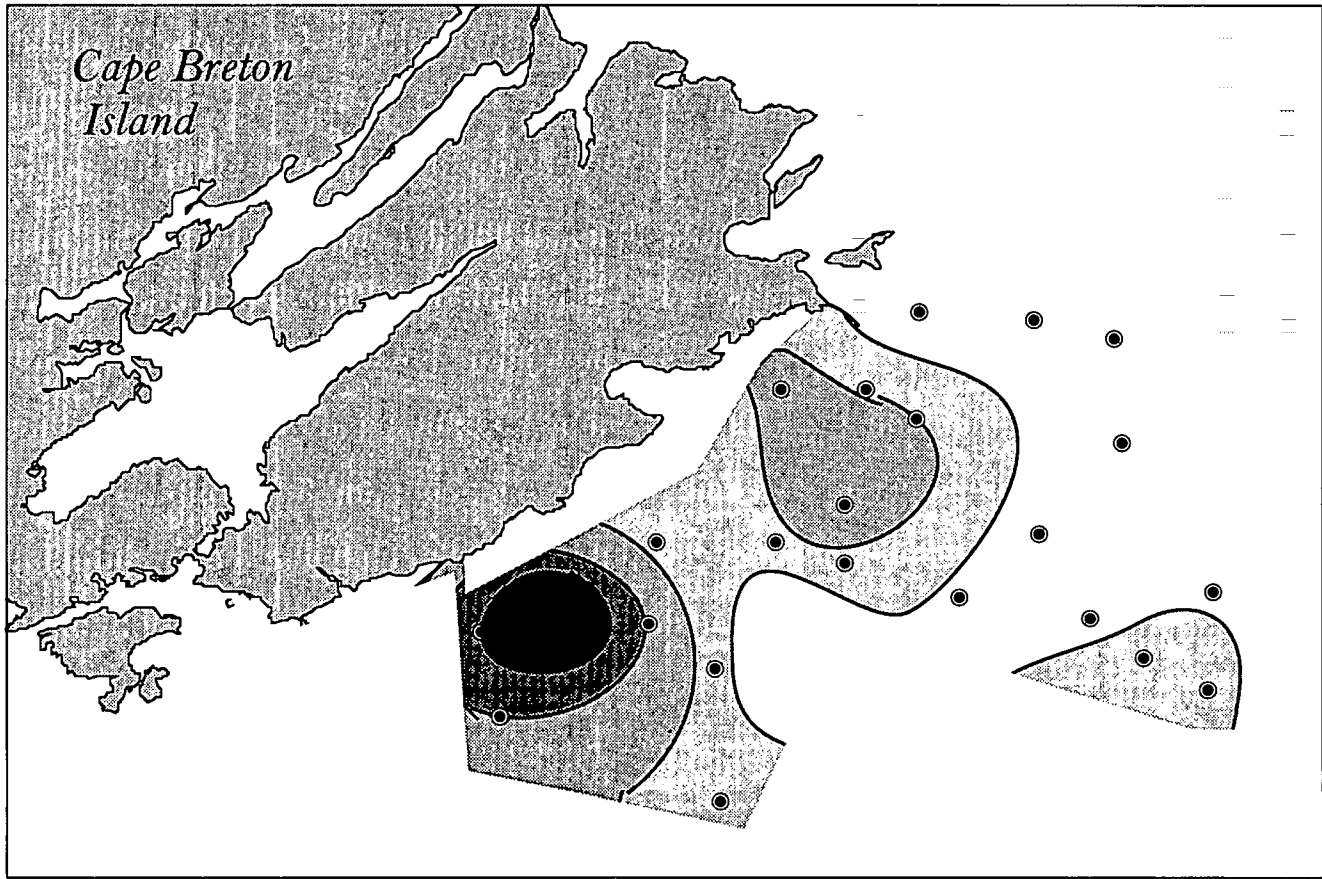


Figure 35. Mapping of Male Immature Snow Crab densities greater than 56 mm, according to the 1996 trawl survey,

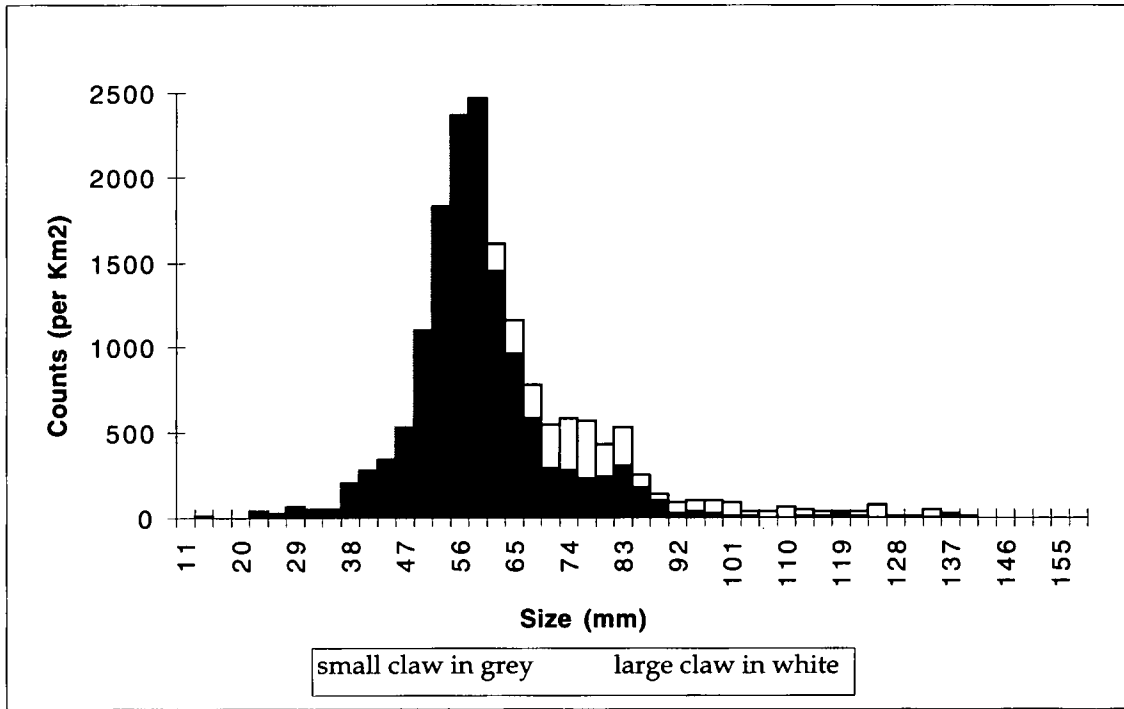


Figure 36. Histogram of frequency size distribution from the experimental trawl survey.