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Study on catchability and size structure of snow crab (*Chionoecetes opilio*) in relation to three different trap types.

by

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ABSTRACT

Comparisons of CPUE (in number and weight), size frequency distribution as well as mean size of snow crab (Chionoecetes opilio) were made in relation to three different types of commercial crab traps (6'x 6' rectangular, 6' diameter conical and 6'x 6' pyramidal types).

The results showed that the three different types of traps have different catch characteristics in terms of both the quantity and the biologiclal characteristics of crabs caught. The size distributions were significantly different ($p<0.05$) between the three trap types, which was mainly due to the differences in the frequency distributions of sub-legal crabs. No significant differences were found in the mean size of crabs from the three types of trap, while there was a significant difference between pyramidal and rectangular, as well as conical and rectangular trap types, for sub-legal males. The CPUE of pyramidal trap was significantly higher than that of the rectangular trap, both in number and in weight. The conical type trap showed no significant difference in CPUE in number and in weight compared to pyramidal type trap.

The fishing effort conversion factor for pyramidal traps versus 6'x 6' rectangular traps was estimated at 1.57 : 1 based on CPUE in weight of legal size males. From a conservation point of view, pyramidal and conical traps are more suitable to the crab fishery because of their higher selectivity towards the larger sub-legal crabs, which are less prone to mortality after being released.

RÉSUMÉ

Les comparaisons de PUE (en nombre et en poids), distribution de fréquences de taille et de la taille moyenne du crabe des neiges (Chionoecetes opilio) ont été fait selon trois types différents de casier commercial soit de forme rectangulaire 6'x 6', conique 6' diamètre et 6'x 6' de type pyramidal.

Les résultats ont démontré que les trois différents types de casier ont des différentes caractéristiques de prise en quantité et en caractéristiques biologiques de crabe capturé. Les distributions de tailles étaient significativement différentes entre différents types de casier , qui était principalement du à la différence dans la structure de taille des crabes sous-légaux. La comparison des tailles moyennes des crabes entre différents types de casier ont révélé aucune différence significative pour les mâles de taille légale, tandis qu'une différence significative a été trouvée entre le casier de type pyramidal et rectangulaire ainsi que le casier de type conique et rectangulaire pour les mâles de taille sous-légale. Aucune différence significative dans la taille moyenne a été observée entre le casier pyramidal et conique. La PUEdes casier de type pyramidal était la plus haute en nombre et en poids montrant des valeurs significativement plus élevées comparativement au casier de type rectangulaire. Le casier de type conique a démontré aucune différence significative dans la PUE en nombre et en poids comparé au casier de type pyramidal.

Le facteur de conversion de l'effort de pêche pour le casier de type pyramidal versus le type rectangulaire 6' x 6' a été estimé à 1,57 : 1 basé sur le PUE en poids de mâles de taille légale. Au point de vue de la conservation, le casier de type pyramidal et conique sont plus appropriés pour la pêcherie de crabe du à une moyenne de taille de carapace des crabes sous-légaux plus élevée. Ces crabes pourraient avoir une meilleure chance de survie après le rejet en mer.

INTRODUCTION

The southwestern Gulf of St. Lawrence snow crab, (Chionoecetes opilio), fishery (Figure 1) was initiated in the mid-1960's and has grown steadily in importance to its present status of being the largest crab fishery in Atlantic Canada. After reaching a peak of 31500 t in 1982, the landings varied for the following years between 24000 t and 26000 t until 1986. The 1987 landings drastically dropped to 11782 t, which was the lowest level since 1978 and reached 12450 t in 1988. The 1989 landings fell to 7500 t due to the high incidence of newly molted crabs in the catches. Facing this drastic decrease in catch of snow crab, effective monitoring of the fishery and better understanding of life cycle of the species are urged in order to establish sound stock management strategies.

The catchability and selectivity of a baited snow crab trap can be affected by various factors such as mesh size, trap size and shape, shape and number of entrances, slope of entrance, duration of trap immersion, type of bait and crab density. Previous studies on the selectivity and catchability of conventional traps include: selectivity relative to mesh size: Miller, 1976; Coulombe and Beaulieu, 1985, Sinoda et al.,1987; catchability relative to trap volume and form: Lafleur et al.1983; Bailey and Dufour 1983; Dufour 1984; effective fishing surface by baited trap: Miller, 1975; Sinoda and Kobayashi,1969; Bretes et al., 1985.

The various types of traps used in the southwestern Gulf snow crab fishery by the Quebec and New Brunswick fishermen include the 5' x 5' and 6' x 6' rectangular traps, 6' x 6' and 7' x 7' pyramidal traps, 4',6',6.5' and 7'(in diameter) conical traps. The history of utilization of conventional traps can be divided into three periods: the Quebec fishermen initially used a conical trap with 4' diameter (standard Japanese trap), then switched to a 5' x 5' rectangular trap and after increased its size to 6' x 6'; the New Brunswick fishermen started the fishery with 5' x 5' rectangular traps then switched to the larger 6'x 6'. In 1981, the minimum mesh size was set at 131 mm for all trap types (Bouchard et al.,1986).

Bailey and Dufour (1983) compared the catchability between the standard conical trap and the 5'x5' rectangular trap, and found that the latter was more efficient by a factor of 1.71 to1.95 times in terms of CPUE with a 2-3 days immersion. Furthermore, Dufour (1984) demonstrated that the larger rectangular trap (6' x 6') was more efficient by estimating the conversion factors of 2.0-3.0:1.0:3.5 between the 5' x 5' rectangular, 4' diameter conical and 6' x 6' rectangular traps. A similar study has been conducted by Lafleur et al. (1983) using 5' x 5' rectangular, 4' diameter conical and a modified 5.5' experimental trap.

Since 1985 for Quebec and 1986 for New Brunswick, fishermen changed traps from the 6' x 6' rectangular to either a pyramidal or larger conical traps because of their mobility and ease of transportation. However, no information is available on the on the catchability of these traps in order to compare historical fishing effort and CPUE data.

The purpose of this study is to evaluate the fishing efficiency of three types of snow crab traps used by fishermen in the southwestern Gulf of St. Lawrence in order to improve the fishery monitoring program.

MATERIALS AND METHODS

The historical evolution in the use of various trap types was obtained from a questionnaire given to New Brunswick fishermen.

A chartered commercial crab vessel was used to conduct experimental fishing in the Baie des Chaleurs (Figure 1) during the month of September 1988. The area is one of the major commercial fishing areas of the southwestern Gulf of St. Lawrence crab fishery. The experimental site was located on one of the main fishing grounds according to the fishing effort distribution from the logbooks (Mallet et al.1989). The depth of the experimental site was between 75 and 80 m. Three types of conventional traps(6' x 6' rectangular, 6' diameter conical with two entrances on the top and 6' x 6' pyramidal with four entrances on the top) were used(Figure 2). Six replicates of the three types of trap were set with 167 m between traps. Each trap was baited with 3 kg of fresh mackerel (Scomber scombrus). All traps were checked after 24 hrs soak time and the bait was changed each time. Captured crabs were counted, sexed and measured for carapace width to the nearest millimetre.

In some cases, number of replicates were different for each set of data(maximum difference of two traps per day for each trap type) because the data were discarded in cases where the trap door was opened during soaking time.

CPUE's (number of crab per trap haul) for legal size males and for sub-legal size males as well as for total females were calculated for each trap type because the catch weight of legal size males is the basis by which fishermen would evaluate the efficiency of the different traps. The size-weight relationship for male crabs used to obtain a CPUE in weight was calculated from data collected from an independant trawl survey conducted in the Baie des Chaleurs during the month of September, 1989. A predictive linear regression was fitted by least squares to each set of paired data for carapace width (mm) and wet body weight (g) after logarithmic transformation. The following equation was used:

Body Weight (g) = $3.35 \cdot 10^{-4}$ x [Carapace Width (mm)]$^{3.04}$

The size frequency distributions for each type of trap were standadized based on the number of traps because of unequal number of traps were used. The size compositions were compared between trap types by the Kolmogorov-Smirnov two-sample test (Dowdy and Wearden, 1983). The mean carapace widths of all samples for both sexes as well as legal (carapace width equal or larger than 95 mm) and sub-legal (carapace width smaller than 95 mm) size males were also compared between trap types by a t-test.

All data sets were analyzed by Bartlet's chi-square test for homogeneity of variance and then compared by ANOVA except for the data set which did not meet the assumption of homogeneity of variance which were compared by Kruskal-Wallis test. In the presence of significant difference among the different data sets, comparison between two data sets were done using the t-test.

RESULTS

The evolution in the percentage of trap types used by New Brunswick fishermen clearly showed a period of transition over the last 25 years (Figure 3). New Brunswick fishermen started the fishery with 5' x 5' rectangular traps, which were replaced by 6' x 6' rectangular traps by 1985. Since then, new traps (conical and pyramidal) have been replacing the rectangular trap and in 1989, about 90% of traps used by New Brunswick fishermen fall within this category (conical and pyramidal).

From the 9 days of the experimental fishing, data for 3 days were excluded because of unequal duration of soak time (greater than 24 hours) caused by weather condition. The carapace size compositions for males and females caught with different types of trap with 24 hrs soak time are shown in Figures 4 and 5 respectively. The size frequency distributions of crabs caught from the three different types of trap were compared by use of the Kolmogorov-Smirnov test (Table 1). The size frequency distribution of male crabs were significantly different between pyramidal and rectangular traps (D=0.109, p=0.0099) and also between conical and rectangular trap (D=0.148, p=0.0008), while they were similar between pyramidal and conical traps (D=0.043, p=0.3028). The size frequency distributions of female snow crab were similar for all three types of traps (Table 1).

The mean carapace width for males collected from the pyramidal traps (102.12 mm) and the conical traps (103.36 mm) were significantly larger than rectangular traps (98.83 mm) when compared by t-test (t=-5.154 with d.f.= 2279, p=0.001 and t=-6.716 with d.f.=2046, p=0.001 respectively). There was no significant difference between the mean carapace width of male crabs caught in conical traps and the pyramidal trap (t=-1.955 with d.f.=2277, p=0.0507). Comparison of the mean carapace width of commercial size crabs between different types of trap revealed no significant differences between trap types (Pyramidal vs rectangular: t=-1.206, d.f.=1248, p =0.228; conical vs rectangular: t=-0.549 with d. f.=1506, p= 0.5834; pyramidal vs conical: t=0.758 with d.f.=1356, p= 0.4487). The comparison of the mean carapace width of sub-legal size males between different trap types revealed a significant difference between pyramidal and rectangular traps (t=2.174 with d.f.=921, p=0.0299) as well as between conical and rectangular traps (t=-2.178 with d.f.=796, p=0.0297), while no significant difference was observed between pyramidal and conical traps (t=-0.165 with d.f.=769, p=0.869). For female crabs, no significative difference in mean carapace width was observed among the three trap types.

The variances of the CPUE values were homoscedastic ($p < 0.05$) for all sets for males and heteroscedastic ($p < 0.05$) for females. The data sets for females were therefore compared by Kruskal-Wallis test while those for males were compared by ANOVA (Table 2).

The CPUE's in number for legal size crabs were different among the three different trap types (Table 2). The difference was significative between pyramidal and rectangular traps (t=2.658 with d.f.=66, p=0.0098) being 1.55 times higher than that of the rectangular trap. No significant difference was observed between pyramidal and conical traps (t=1.741 with d.f.=68, p=0.0862) and between conical and rectangular traps (t=1.026 with d.f.=66, p=0.3086).

The CPUE's in weight were also calculated and compared by ANOVA for different types of trap (Table 2). CPUE in weight was significantly different between pyramidal and rectangular types (t=2.589 with d.f.=66, p=0.0118), while no significant difference was observed between pyramidal and conical (t=1.537 with d.f.=68, p=0.129), and between conical and rectangular (t=1.078 with d.f.=66, p=0.2848).

The CPUE's in number for sub-legal size crabs were not significantly different among the three different types of traps when compared by ANOVA (Table 2). For female crabs, there was no significant difference in CPUE's in number among the three different groups when analysed by the Kruskal-Wallis test (H=4.107, p=0.1283, Table 3).

DISCUSSION

The present study showed that three types of trap have different catch characteristics both in terms of quality and quantity of crabs caught. The size distributions were significantly different for some paired comparisons between different trap types , which was mainly due to the difference in size distribution of sub-legal crabs. The comparison of the mean carapace width from different types of trap revealed no significant difference between trap types for legal size males, while a significant difference between pyramidal and rectangular as well as conical and rectangular trap types for sub-legal males. In terms of CPUE, pyramidal traps were the most efficient in terms of number as well as in weight showing significantly higher values compared to the rectangular type. Conical traps showed no significant difference in terms of CPUE in number and in weight as well as in mean sizes compared to pyramidal type trap. Although conical traps showed no significant difference compared to rectangular types in terms of CPUE, the mean size of sub-legal males is significantly larger than that of rectangular type. The fishing effort conversion factor for pyramidal versus 6'x 6' rectangular type was estimated at 1.57 : 1 based on CPUE in weight of legal size males.

Results of comparisons of different catch characteristics (CPUE in number and in weight, size structure and mean size) between different trap types are as follows:

(1) CPUE comparison

Comparison	CPUE in number Male≥95 mm	 Male<95 mm	 Female	CPUE in weight Male≥95 mm
Pyramidal vs Rect.	*	-	-	*
Conical vs Rect.	-	-	-	-
Pyramidal vs Con.	-	-	-	-

* significantly different (p<0.05)

\- Not significantly different (p<0.05)

(2) Size comparison

Comparison	Size structure Male	Size structure Female	Mean carapace width Male	Mean carapace width Male≥95 mm	Mean carapace width Male <95 mm
Pyramidal vs Rect.	*	-	*	-	*
Conical vs Rect.	*	-	*	-	*
Pyramidal vs Con.	-	-	-	-	-

* Significantly different ($p<0.05$)
\- Not significantly different ($p<0.05$)

Since 1986, fishermen have been diversifying the type of traps used in the fishery (e.g. within conical type there are 6',6.5' and 7' diameter sizes with one, two and four entrances; also within pyramidal type there are 6'x 6' and 7'x 7' sizes with one, two and four entrances) in order to find the most efficient trap type in terms of catch and handling ease. However, during the 1989 season, it appears that the 6' diameter conical trap with two entrances became dominant with about 40% of total traps used by New Brunswick fishermen because of its advantage in trapping efficiency and ease of handling.

According to the fishermen, the top entrance of the conical traps seem to reduce their catchability of newly molted soft shell crabs. For the southwestern Gulf of St.Lawrence snow crab fishery, the newly molted crabs represent the yearly renewal part of the stock, which becomes increasingly important due to the existence of a terminal molt in males (Conan and Comeau ,1986) and the steady decrease in biomass level of the standing stock (Mallet et al., 1988, l989). However, during this experiment, we observed that almost all crabs that molted in the spring have a relatively hard carapace condition (molt stage C_3 or later) by the fall. Additional observations during the early summer will be required in order to evaluate the catchability of soft shell crabs. The catchability of morphometrically mature (terminal) and immature (non terminal) males should also be investigated for the different types of trap which would be useful for designing a trap selectively catching terminal males in order to protect annual recruitment of the stock and to achieve maximal yield per recruit.

This study demonstrated only a few aspects of the quantitative differences of the three types of traps used in this study but cannot reveal their real catch characteristics. Both quantitative and qualitative evaluations of the traps are required for better understanding its impact on the stocks. A quantitative evaluation is useful for a standardization of the fishing effort and for selecting the most efficient fishing gear for the fishermen. The latter type of evaluation is important in terms of stock conservation (e.g. minimum size regulations, reduce catching of certain type of crabs such as female, small size crabs,non terminal males and newly molted crabs). Direct observations on the behaviour of different biological stages of crabs, vis-a-vis different types of trap, might explain the difference in catch characteristics. The present study showed that although the CPUE's in number and in weight of legal size crabs were non-significantly different between conical and rectangular types, the former trap is more suitable from the conservation point of view because of its selectivity towards larger sub-legal crabs which might have a higher chance of survival after being released at sea

The present analysis has used paired comparisons. Further statistical work using multivariate analysis and multiple range comparisons in ANOVA and non parametric analogs will be required for providing definite results with adequate levels of significance.

Under the current stock condition (i.e. scarcity of hard shell mature crabs and early appearance of white crabs in the commercial catch), it is preferable to harvest a certain level of hard shell crabs (as soon as the ice condition allows) before the appearance of white crabs in the catch, in order to reduce the high mortality of the annual recruitment (white crab and small immature crab) and thereby rebuilding the stock. A trap selective towards larger size crabs such as conical and pyramidal types is appropriate for this purpose. According to our observations with an underwater video camera (unpublished data), it seems that crabs caught with square traps can easily escape from it compared to pyramidal or conical type. This strongly suggests the necessity of a self opening trap mechanism such as biodegradable netting or auto-release panel when being lost at sea in order to avoid ghost fishing.

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REFERENCES

Bailey R. and R. Dufour, 1983. Comparaison des rendements de crabe des neiges obtenus par deux types de casiers differents. CSCPCA Doc. rech. 83/19: 9p.

Bouchard R., J.C.F. Brethes, G. Desrosiers and R.F.J. Bailey, 1986. Changes in size distribution of snow crabs (Chionoecetes opilio) in the southwestern Gulf of St.Lawrence. J. Northwest. Atl. Fish. Sci.7:67-75

Bretes J.-C., R. Bouchard and G. Desrosiers, 1985. Determination of the area prospected by a baited trap from a tagging and recapture experiment with snow crab (Chionoecetes opilio). J.Northwest Atl. Fish. Sci. 6:37-42.

Conan G.Y. and M. Comeau, 1986. Functional maturity and terminal molt of male snow crab Chionoecetes opilio. Can. J. Fish. Aquat. Sci. 43:1710 -1719.

Coulombe F. and J.L. Beaulieu, 1985. Les effets d'une augmentation de la dimension des mailles sur la selectivite et les captures du casier regulier a crabe des neiges, Chionoecetes opilio. CAFSAC Res. Doc. 85/15, 24p.

Dowdy S. and S. Wearden, 1983. Statistics for research. John Wiley and Sons. Inc.,New York,537pp.

Dufour R., 1984. Rendements comparatifs et selectivite de trois types de casiers à crabes des neiges. CSCPCA Doc. rech. 84/01, 25p.

Lafleur P.E., M. Monette and M.Gaudet, 1983. Evaluation du rendement et de la selectivite de trois types de casiers a crabes. D.R.S.T. Cahier d'information 102, 32p.

Mallet P., Y.Chiasson and M.Moriyasu, 1988. A review of catch, fishing effort and biological trends for the 1987 southwestern Gulf of St Lawrence snow crab Chionoecetes opilio fishery. CAFSAC Res. Doc. 88/32,39p.

Mallet P., E.Wade, Y.Chiasson, P.DeGrace, G.Y.Conan and M.Moriyasu, 1989. La peche du crabe des neiges (Chionoecetes oplio) dans le sud-ouest du golfe Saint-Laurent en 1988: L'analyse des prises, de l'effort de peche et l'estimatio de la biomasse. CAFSAC Res. Doc. 89/25,59p.

Miller R.J.,1975. Density of commercial spider crab, Chionoecetes opilio, and calibration of effective area fished per trap using bottom photography. J.Fish.Res. Board Can., 32(6): 761-768.

Miller R.J., 1976. Trap mesh selection and catches of the spider crab, Chionoecetes opilio. Fish. Mar. Serv. Res. Dev., Tech. Rep. 598, 15p.

Sinoda M. and T. Kobayashi, 1969. Studies on the fishery of Zuwai crab in the Japan Sea - VI. Efficiency of the Toyamakago (a kind of crab trap) in capturing the Beni-Zuwai crab. Bull. ap. Soc. Sci. Fish. 35(10): 948-956.

Sinoda M., T. Ikuta, and A. Yamazaki, 1987. On changing the size selectivity of fishing gear for Chionoecetes opilio in the Japan Sea. Nippon Suisan Gakkaishi, 53(7):1173-1179.

Table 1. Results of the Kolmogorov-Smirnov test for comparison of size frequency distributions between different types of traps for males (1) and females (2).

(1) Males

Pyramidal vs Rectangular		Conical vs Rectangular		Pyramidal vs Conical	
DF	2	DF	2	DF	2
Pyramidal	1023	Conical	1256	Pyramidal	1256
Rectangular	1025	Rectangular	1025	Conical	1023
Maximum difference	.148	Maximum difference	.109	Maximum difference	.043
K-S Chi Square	44.692	K-S Chi Square	26.631	K-S Chi Square	4.247
Z	3.343 p=.0008	Z	2.580 p=.0099	Z	1.000 p=.3028

(2) Females

Pyramidal vs Rectangular		Conical vs Rectangular		Pyramidal vs Conical	
DF	2	DF	2	DF	2
Pyramidal	295	Conical	230	Pyramidal	295
Rectangular	376	Rectangular	376	Conical	230
Maximum difference	.066	Maximum difference	.113	Maximum difference	.062
K-S Chi Square	2.922	K-S Chi Square	7.291	K-S Chi Square	1.957
Z	.855 p=.3927	Z	1.350 p=.1770	Z	.700 p=.4842

Table 2. Statistics and results of ANOVA test for comparison of CPUE's in number of both legal and sub-legal size males and CPUE's in weight of legal size males among three different types of traps.

(1) CPUE's in number of male crabs larger than 95 mm carapace width.

Source:	Df:	Sum Squares:	Mean Square:	F-test
Between groups	2	2637.559	1318.78	3.899
Within groups	100	33825.594	338.26	p=.0234
Total	102	36463.153		

Group:	Count:	Mean:	Std. Dev.:	Std. Err.:
Pyramidal	35	34.343	21.147	3.575
Conical	35	26.308	17.275	2.92
Rectangular	33	22.216	16.273	2.833

(2) CPUE's in weight of male crabs larger than 95 mm carapace width.

Source:	Df:	Sum Squares:	Mean Square:	F-test
Between groups	2	889218431.955	444609215.978	3.468
Within groups	100	1.282E10	128199133.322	p=.035
Total	102	1.371E10		

Group:	Count:	Mean:	Std. Dev.:	Std. Err.:
Pyramidal	35	19746.679	12683.839	2143.960
Conical	35	15352.526	11193.270	1892.008
Rectangular	33	12591.520	9826.884	1710.641

(3) CPUE's in number of male crabs smaller than 95 mm carapace width.

Source:	Df:	Sum Squares:	Mean Square:	F-test
Between groups	2	447.061	223.531	1.702
Within groups	100	13132.520	131.325	p=.1875
Total	102	13579.582		

Group:	Count:	Mean:	Std. Dev.:	Std. Err.:
Pyramidal	35	14.715	11.973	2.024
Conical	35	12.321	11.170	1.888
Rectangular	33	17.450	11.203	1.950

Table 3. Statistics and results of Kruskal-Wallis test for comparison of CPUE's in number of female crabs among three different types of traps.

DF	2	
# groups	3	
# cases	901	
H	4.107	$p=.1283$
H corrected for ties	4.117	$p=.1277$
# tied groups	36	

Group:	#Cases:	Σ Ranks:	Mean Rank:
Pyramidal	295	129347.5	438.466
Conical	230	99669.0	433.343
Rectangular	376	177334.5	471.634

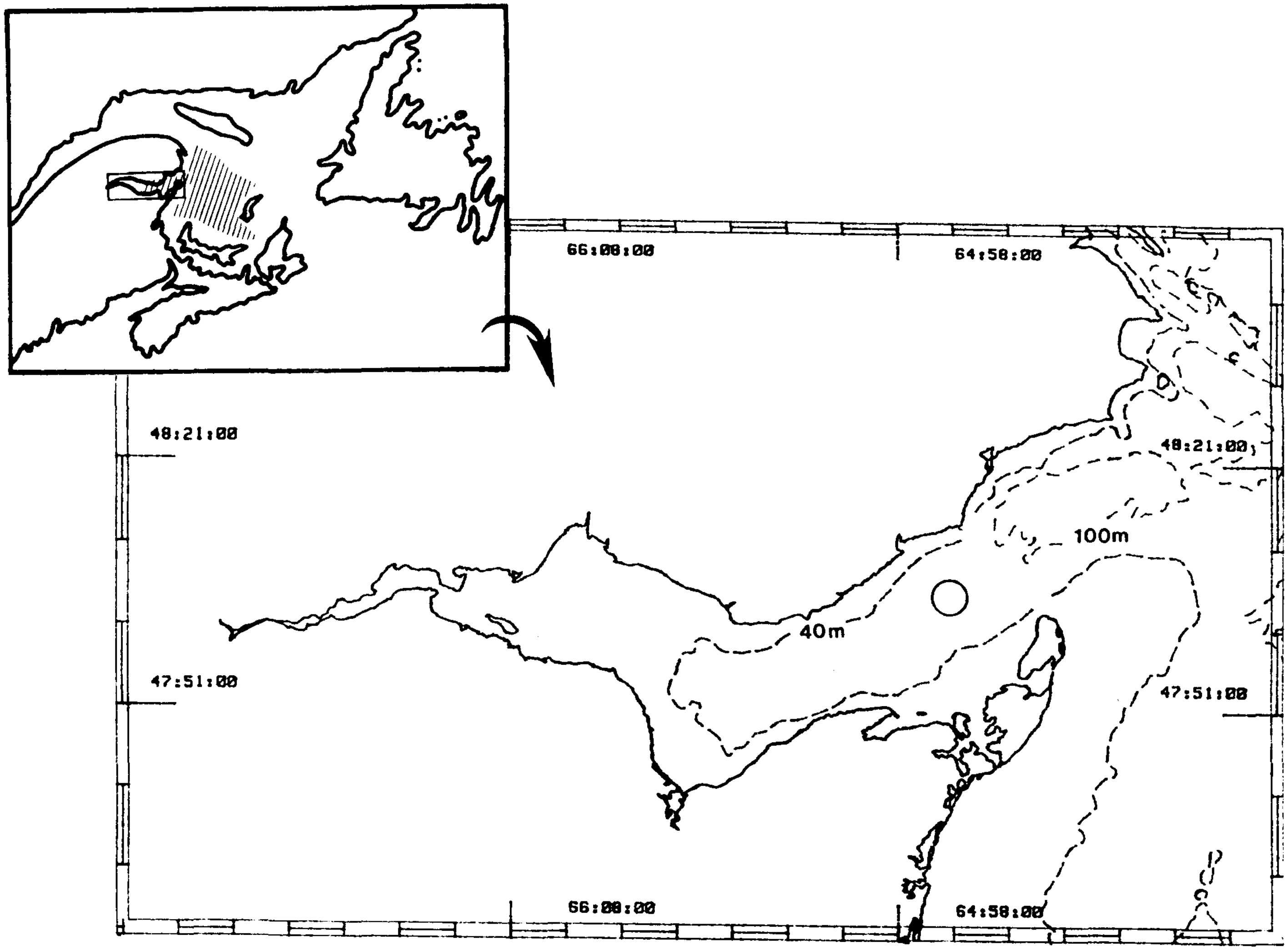

Figure 1. Geographic location of the southwestern Gulf of St. Lawrence snow crab (<u>Chionoecetes</u> <u>opilio</u>) fishery and sampling site.

: Southwestern Gulf of St. Lawrence snow crab fishery

: Sampling site

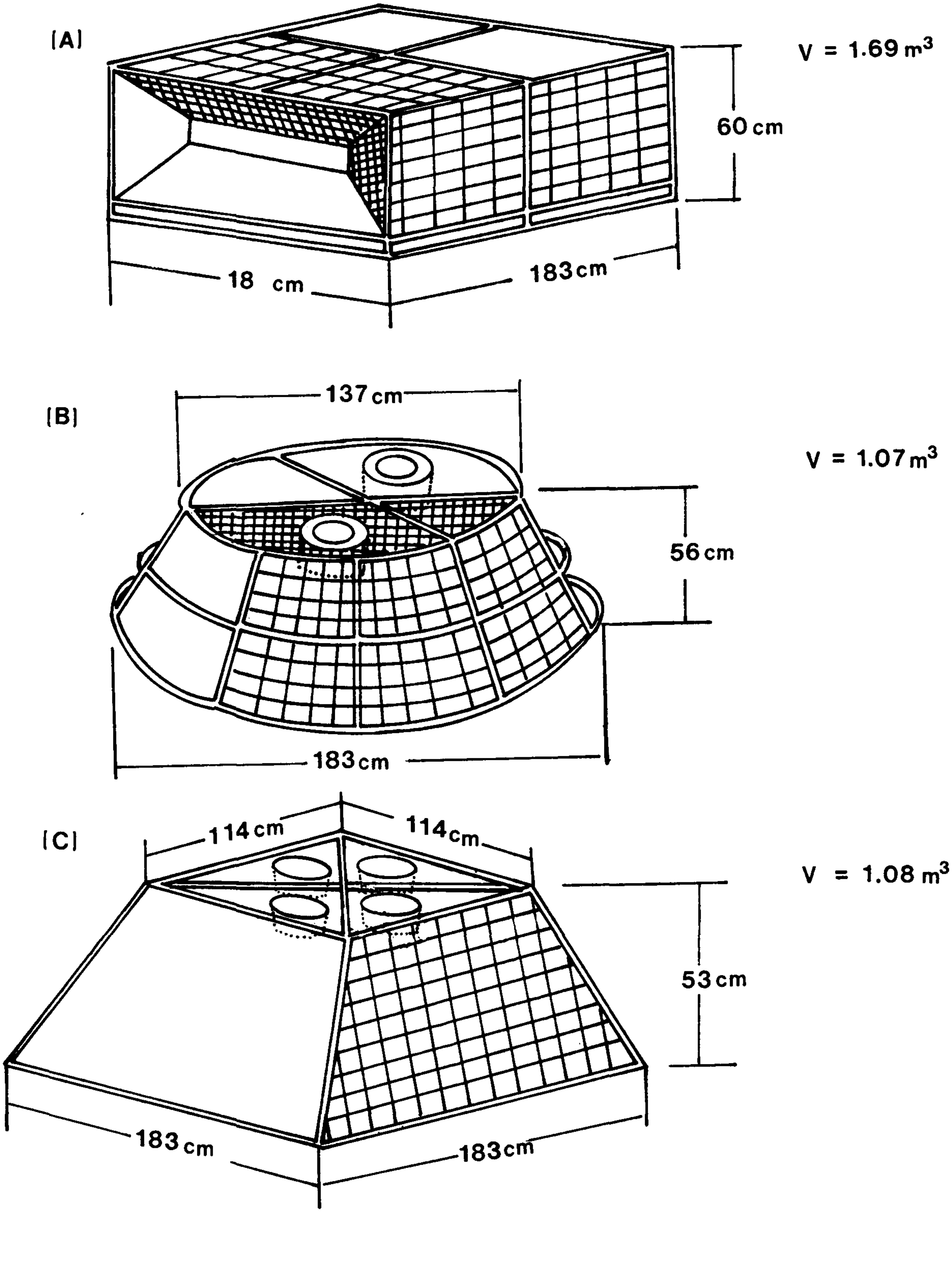

Figure 2. Measurements and characteristics of three different types of conventional snow crab (<u>Chionoecetes</u> <u>opilio</u>) trap used for the experiment.

(A) 6'x 6' rectangular trap, (B) 6' diameter conical trap, (C) 6'x 6' pyramidal trap.

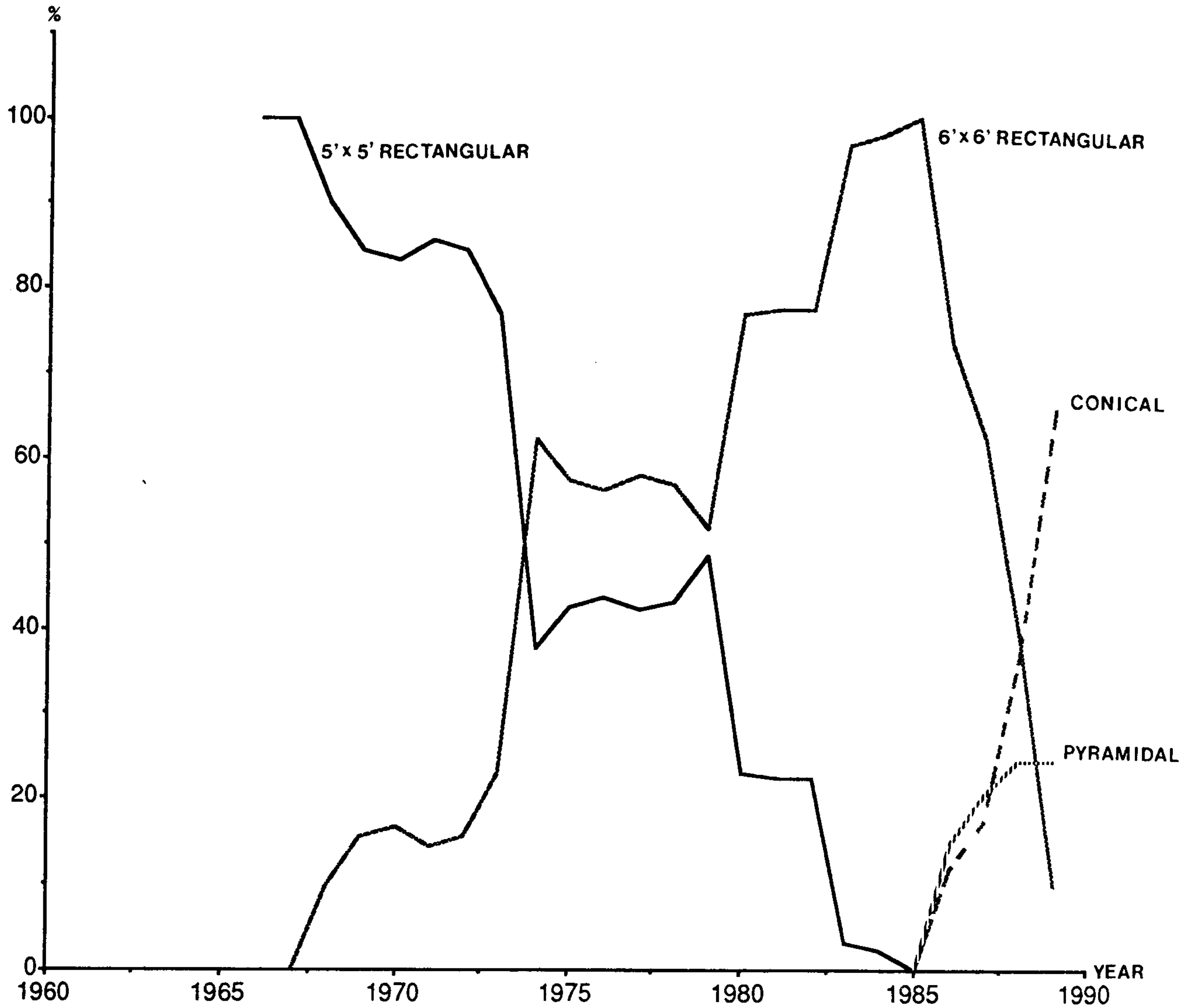

Figure 3. Historical trend in percentage of different trap types used by New Brunswick fishermen in the southwestern Gulf of St. Lawrence snow crab (<u>Chionoecetes opilio</u>) fishery.

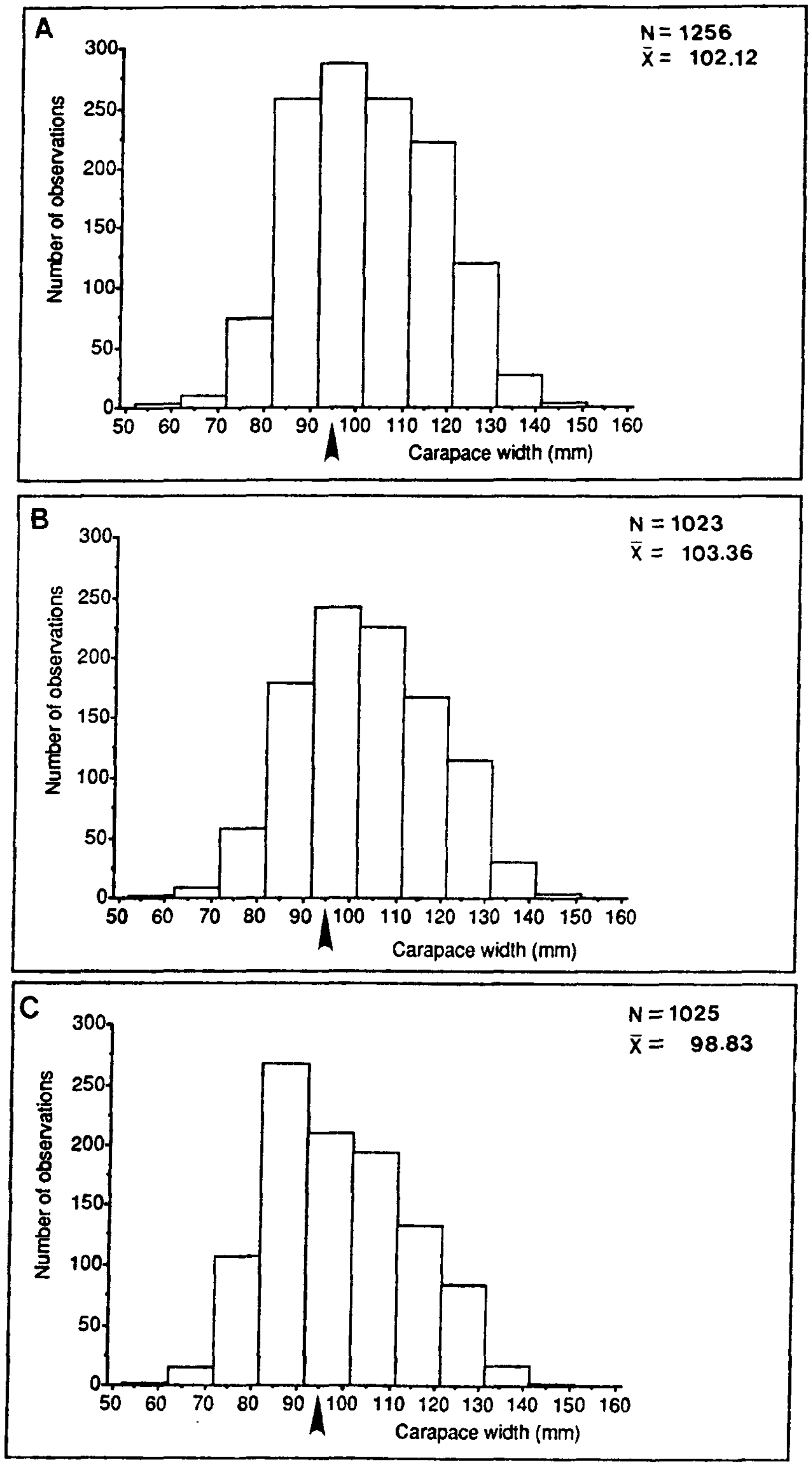

Figure 4. Size frequency distributions of male snow crab, Chionoecetes opilio, caught by three different types of traps.

(A) 6' x 6' pyramidal trap, (B) 6' diameter conical trap, (C) 6' x 6' rectangular trap.
Arrows show the minimum legal size (95 mm C. W.).

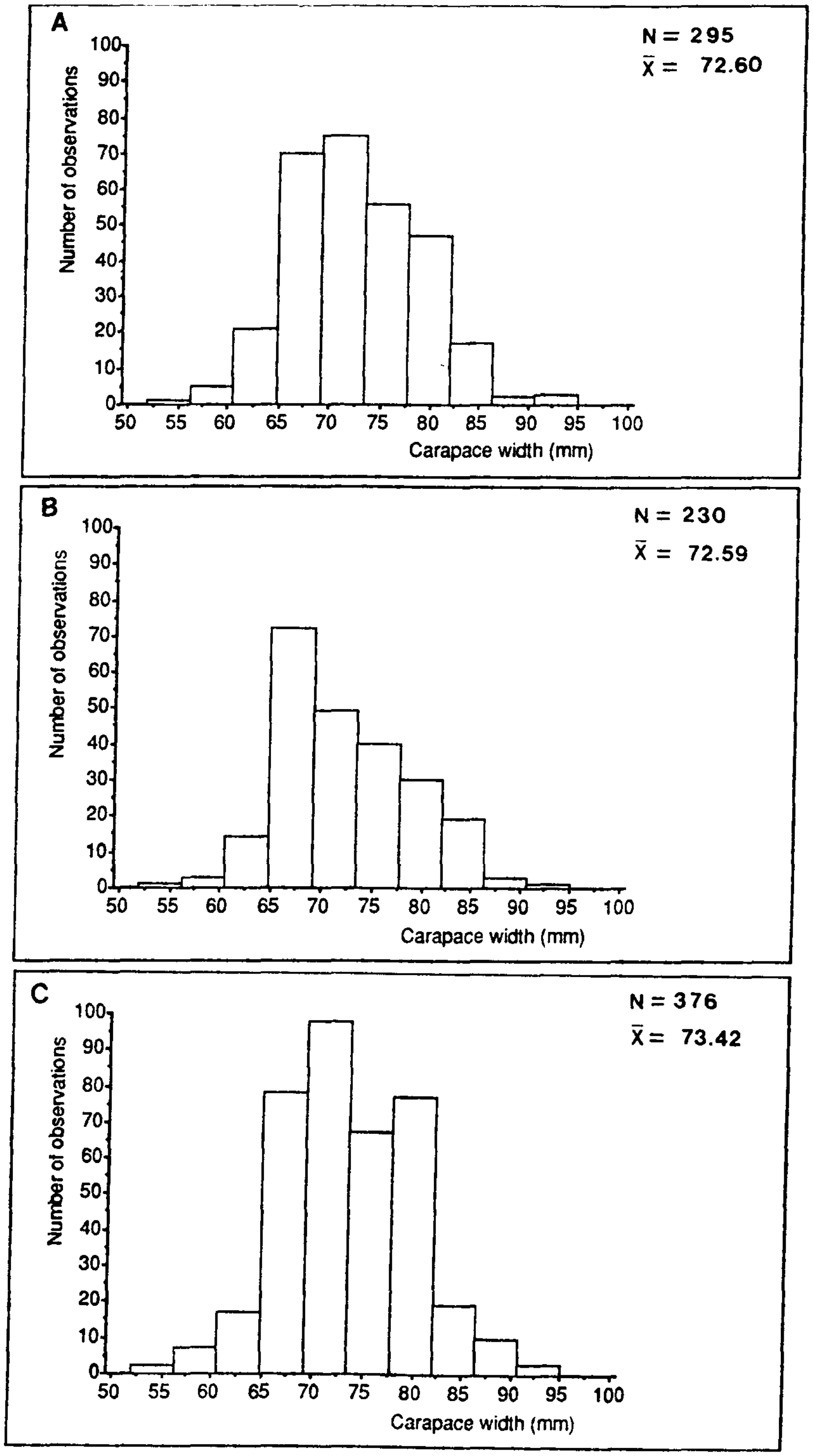

Figure 5. Size frequency distributions of female snow crab, Chionoecetes opilio, caught by three different types of traps.

(A) 6' x 6' pyramidal trap, (B) 6' diameter conical trap, (C) 6' x 6' rectangular trap.
Arrows show the minimum legal size (95 mm C. W.).