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An Assessment of Newfoundland And Labrador Snow Crab in 1997

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Abstract

Data on catch rate, size (carapace width, CW) and molt status (chela allometry) from various sources were used to infer resource status. Data from 1995 to 1997 fall bottom trawl surveys were particularly useful. These surveys showed that legal-sized males were broadly distributed throughout much of the survey area but were absent north of Div. 2J, as well as on the deep slope of the continental shelf north of 48°N and across most of the shallow southern Grand Bank. Fall bottom trawl surveys indicated a substantial commercial biomass for 1997 throughout Div. 2J3KL, comparable to that of the previous year. Continued strong recruitment is indicated for 1998 but longer-term prospects are uncertain. A trap survey in White Bay (NAFO Div. 3K) showed that males were segregated by size in inshore strata, with small males predominantly in the shallowest strata. A great increase in trap survey catch rates of small crabs in White Bay during 1994-97 suggests that there may be considerable local variation in recruitment dynamics.

Résumé

Des données sur le taux de capture, la taille (largeur de carapace, LC) et la mue (allométrie des chélipèdes) provenant de diverses sources ont été utilisées pour déduire l'état de la ressource. Les données des relevés d'automne au chalut de fond de 1995 à 1997 se sont avérées particulièrement utiles. Elles montrent que les mâles de taille légale étaient largement distribués dans la plus grande partie de la zone du relevé, mais absents au nord de la division 2J de même que de la pente profonde du plateau continental au nord de 48°N et de la plus grande partie du secteur sud peu profond du Grand Banc. Les relevés d'automne au chalut de fond montraient la présence d'une biomasse commerciale appréciable dans l'ensemble des divisions 2J3KL pour 1997, comparable à celle de l'année précédente. Le fort recrutement devrait se maintenir en 1998, mais les valeurs à plus long terme demeurent incertaines. Un relevé au casier effectué dans la baie White (div. 3K de l'OPANO) a montré que les mâles étaient regroupés par tailles dans les strates côtières, les petits se trouvant surtout dans les strates les moins profondes. Une importante augmentation du taux de capture des petits crabes au moment des relevés au casier de la baie White de 1994 à 1997 porte à croire à une variation locale considérable de la dynamique du recrutement.

Introduction

This document presents research data from various sources and fishery data toward evaluating the status of the Newfoundland and Labrador snow crab resource in 1997 and projecting fishery performance in 1998. Data sources include the fall 1995-97 bottom trawl surveys throughout NAFO Div. 2J3KLNO and spring 1996 and 1997 Div. 3Ps bottom trawl surveys. Data are also presented from 1994 to 1997 September trap surveys in White Bay (NAFO Div. 3K) and from limited bottom trawl sampling in NAFO Div. 4R during September 1997. Data from at-sea sampling by fisheries observers and from the dockside-monitoring program are also utilized.

METHODS

Bottom Trawl Surveys

Data Collected:

Data on total catch number and weight were acquired from the 1995 to 1997 fall stratified random bottom trawl surveys which extended throughout NAFO Divs. 2J3KLNO. The 1996 and 1997 surveys also extended to NAFO Divs. 2GH and inshore strata, not included in the 1995 survey. Data were also acquired from 1996 and 1997 NAFO Div. 3Ps spring surveys.

All males were measured in carapace width (CW, mm) and chela height (0.1 mm). Shell condition was assigned one of three categories; (1) New-shelled; these crabs had molted in spring have a low meat yield and are assumed to recruit to the fishery in the following year, although an unknown portion may be retained late in the current season. (2) Intermediate-shelled; these crabs last molted in the previous year and represented new recruits to the fishery of the current year. (3) Old-shelled; these crabs have been available to the fishery for at least 2 years.

Treatment of Biological Data:

A schematic model of snow crab recruitment (Dawe et al. 1997) was followed in assigning individuals to population components for subsequent analysis. Based on this model, data were grouped into classes for each of three biological variables:

i) Carapace Width (CW) - based on growth per molt data (Moriyasu et al. 1987, Taylor and Hoenig 1990, and Hoenig et al. 1994) three main size groups were established: legal-sized crabs ($\geq$95 mm CW); Sub-legal 1, those which would achieve legal size after one molt (76-94 mm CW); and Sub-legal 2, those which would achieve legal size after two molts (60-75 mm CW).

ii) Chela Allometry - males develop enlarged chelae when they undergo a final molt, that may occur at any size larger than about 40 mm CW. Therefore only males with small chelae will continue to molt and subsequently recruit to the fishery. A model which separates two 'clouds' of chela height on carapace width data ($CH = 0.0806CW^{1.1999}$) was applied to classify each individual as either large-clawed or small-clawed.

iii) Shell Hardness - males that undergo their terminal molt in the spring will remain new-shelled throughout the fishery season of that year and will not be fully hardened and retained by the fishery until the following year. It is assumed that all males with small chelae remain new-shelled between molts. In reality, however, an annually-variable proportion of small-clawed males will not molt in any given year ('skip molters') and so will develop 'older shells' between molts. For each year that a crab skips a molt, its eventual recruitment is delayed by a year.

Analysis of Data:

Spatial distribution throughout NAFO Div. 2J3KLNO was examined using the relatively extensive fall survey data for 1996 and 1997. The SPANS Spatial Analysis System (Burke 1997, Kulka 1998) was used to describe density distribution of each of three size groups of males: legal-sized (>94 mm CW), Sub-legal 1 (76-94 mm CW), Sub-legal 2 (60-75 mm CW) and all males less than 60 mm CW.

Minimum trawlable biomass estimates were generated using STRAP (Smith and Somerton 1981) separately for each of the above size groups of males, as well as for smaller males (<60 mm CW) and for each of immature and mature females. Biomass estimates for each group were generated by NAFO Division using 1995-97 fall survey data for Divs. 2J3KLNO and using 1996-97 spring survey data for Div. 3Ps. For comparison of the incomplete 1995 Div. 2J3KLNO biomass estimates with those of the following year, it was necessary to delete some survey strata from the 1996 data set. Biomass estimates for 1996 and 1997 were also generated using the SPANdex method (Kulka 1998) for Div. 2J3KLNO legal-sized males, for comparison with STRAP estimates.

To examine size composition of males, carapace widths were grouped into 3 mm intervals and adjusted up to total population abundance. Each size interval was partitioned by claw type.

RESULTS AND DISCUSSION

NAFO Div. 2J3KLNO - Fall Surveys:

Spatial Distribution

The fall distribution of the four size groups of males throughout NAFO Div. 2J3KLNO in 1996 and 1997 (Fig. 1) was similar to that previously described (Dawe et al. 1997). Males were broadly distributed throughout the Div. 2J3KLNO survey area but were notably absent from most of the deepest sets (mostly >800 m) along the Div. 3KL slope. Largest males (legal-size and Sub-legal 1 (Fig. 1a)) were also usually absent from innermost sets <300 m in Div. 2J3K and the shallow (<100 m) southern Grand Bank (Div. 3LNO), where smaller males were caught (Fig. 1b). For both years, it generally appeared that highest densities for largest males were associated with offshore areas (Fig. 1a) whereas those for smallest males (Fig. 1b) extended into inshore areas as well. The 1996 and 1997 surveys extended north into NAFO Div. 2GH, but no crabs were caught in those areas.

Despite these similarities between years, there were also differences. For all size groups, but especially the smallest (Fig.1b), the distribution of highest densities throughout Divs. 3KL were more continuous in 1996 than in 1997. Also, the highest densities appeared to have shifted northward in 1997.

Biomass

Biomass estimates are interpreted qualitatively because the catchability of the survey trawl for snow crab is unknown. Biomass estimates are presented for population components, defined by size for males (Table 1) and by maturity for females (Table 2). For all components confidence limits were especially broad for NAFO Div. 3NO, probably due to the highly aggregated distribution in those areas. Biomass estimates for Div. 3NO are not considered to be reliable. Estimates for legal-sized males are considered to represent residual (post-fishery) biomass levels, although about 7% (2,485 t) and 16% (6,459 t) of the annual catch was taken during the October-December survey period in 1996 and 1997, respectively. STRAP residual biomass estimates of legal-sized crabs were quite similar between 1996 (75,951 t) and 1997 (76,516 t). For both years SPANdex (SPANS estimates) of legal-size crab biomass (Fig. 2) agreed closely with those generated by STRAP (79,393 t for 1996 and 73,143 t for 1997). SPANS also showed that for both years, about 20% of the survey area accounted for 72-74% of the biomass.

The difference in estimated residual biomass between 1996 and 1997, by NAFO Division, for all population components (Table 3) reflects the northward shift in distribution described earlier. Estimated biomass for all components increased by 44-153% in Div. 2J

whereas it decreased by 20-65% in Div. 3L. This shift was especially pronounced in the smallest males (<60 mm CW) indicating that it is not an artefact related to fishing patterns.

Estimated exploitation rates also reflect a shift of biomass northward. Between 1996 and 1997 exploitation rates declined in Div. 2J, but increased in Div. 3LNO (Table 4). Exploitation apparently has not been excessive as suggested by rates of 0.31 (1996) and 0.34 (1997) for Div. 2J3KLNO overall.

Biological Characteristics

Size composition of males throughout Div. 2J3KLNO in 1997 was generally similar to that of the previous year (Fig. 3), with a major mode for large males near legal size (93-95 mm CW), and with the major mode for small males at 18-20 mm CW. A 'trough' at about 40-70 mm CW in 1996 did not advance to larger sizes as expected, perhaps reflecting low catchability of this size group. Such low catchability could be related to size and distribution, especially with respect to substrate type, for this component. For example, catchability of this size group may be low on rough shallow-water inshore strata, where the trawl may not maintain constant contact with the bottom.

Comparison of size composition among years suggests that biomass of small crabs has declined continuously during 1995-97. Meanwhile, the mode for largest small-clawed (prerecruit) males has progressed from about 66-68 mm CW in 1995 to about 78-80 mm in 1996 and about 93-95 mm in 1997 (Fig. 3). These large prerecruits would be expected to achieve legal size in 1998, as new-shelled crabs, and to be fully available to the fishery in 1999. The biomass of small-clawed males increased between 1996 and 1997 fall surveys for legal-sized males (Table 5), whereas it decreased for 76-94 mm CW sub-legal males. This reflects the progression of the modal group of immediate prerecruits to legal size. While the percentage small-clawed increased regularly for both legal-sized and sub-legal 1 males since 1995, the percentage new-shelled declined for both those components between 1996 and 1997. This may, at least in part, reflect an increase in the incidence of 'skip-molting'.

Projection of Biomass and Recruitment

Projection of biomass based on the 1996 and 1997 fall survey data (Table 6) suggests that the 1998 initial biomass will be as large or slightly larger than that of 1997. The biomass of 'residual' large-clawed crabs is expected to increase slightly and projected recruitment to legal size is expected to remain strong. The projected slight increase in biomass is primarily due to anticipated growth of legal-sized small-clawed crabs. However all crabs that molt in spring 1998 will remain new-shelled and will not be fully available to the fishery until the following year. Although the exploitation rate on legal-sized crabs (including those with new shells) was only about 34% in 1997 (Table 4),

it was about 65% on those crabs with older shells which were large-clawed in the fall of 1996 and fully available to the 1997 fishery (Table 5). This indicates that the large catches in recent years have been highly dependent upon sustained strong recruitment.

Although recruitment prospects appear promising for 1998, they are uncertain in the longer term. This uncertainty is primarily due to a possible decline in biomass of immediate prerecruits (76-94 mm CW) after the current 93-95 mm CW modal group of small-clawed crabs (Fig. 3) achieves legal size. The likelihood of low catchability of small prerecruits (<76 mm CW) by the survey trawl, together with unknown annual variability in proportions which 'skip-molt', further contribute to this uncertainty. Furthermore, recruitment to the fishery (as relatively old-shelled crabs) may be affected by unknown levels of direct and indirect fishing mortality on legal-sized new-shelled crabs.

NAFO Div. 3Ps - Spring Surveys

Biomass estimates for NAFO Div. 3Ps from spring pre-fishery surveys in 1995 and 1996 are highly unreliable, as indicated by broad confidence intervals (Table 7). Such poor estimates are probably due to a high degree of aggregation of biomass, as described for Divs. 3NO from the fall surveys. The estimated initial biomass of legal-sized (including new-shelled) crabs for 1997 was lower than both the 1996 biomass estimate (5,397 t, Table 7) and the 1997 catch (4,753 t) by a factor of 4.

Because of inadequate sampling by the spring surveys, it is not possible to infer recruitment trends from size composition. However spring size frequencies (Fig. 4) show that a 'trough' at about 40-70 mm CW remained stationary between 1996 and 1997, as noted from the fall Div. 2J3KLNO surveys. This supports the suggestion of low catchability of this size group by the survey trawl.

NAFO Div. 4R

During September 1997, 11 incidental Campelen trawl sets were executed in NAFO Div. 4R (Fig. 5), during a survey for scallops, to gather some limited data on distribution and size composition of snow crabs. Very small crabs (<40 mm CW) predominated at bottom depths of 105-167 m (Fig. 6), whereas considerably larger crabs (>76 mm CW) were most prevalent at greater depths. When all 11 sets were pooled a 'trough' was again apparent at about 44-76 mm CW.

Sampling in Inshore NAFO Div. 3K

A trapping survey has been carried out in the White Bay area during September of 1994-97. In two of the three depth strata (excluding >400 m depth), catch rates of small crabs (about 40-70 mm CW) from small-meshed traps have increased greatly during 1995-97 (Fig. 7). This increase was most prevalent in the shallowest stratum

(201-300 m). Limited sampling of inshore 3K strata using the Campelen trawl during the 1997 fall survey (Fig. 8) showed a predominance of such small crabs in all strata including the deepest. This supports the view that the consistent 'trough' seen in size compositions of trawled samples, at about 40-70 mm CW, reflects inadequate sampling. Sampling of this size group may be inadequate due to an aggregated distribution (e.g. in inshore areas) and quite possibly low catchability of the trawl on hard, shallow-water substrates.

Effects of Fishing Practices

A two-tiered pricing system was in effect during 1996 and 1997, with a higher price paid for largest crabs (>101 mm CW) than for smaller legal-sized crabs (96-101 mm CW). It was felt that this pricing system promoted the practice of 'high-grading', whereby smaller, lower-priced crabs are discarded at sea. Comparison of the size structure of landed crab (sampled by dockside grading) with that from a variety of research-based sources (Table 8) shows that in both 1996 and 1997 the proportion of large crabs was higher in commercial (landed) samples than in research (at-sea) samples, excepting Div. 4R in 1996. This indicates that the practice of 'high-grading' was widespread in both years. The level of indirect fishing mortality imposed by this practice on small legal-sized crabs is unknown.

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Table 1. Minimum trawlable biomass estimates for males from the 1996 and 1997 **(in bold)** fall bottom trawl surveys by NAFO Division and population component.

NAFO Div.	Biomass (t)	95% confidence limits Lower	Upper	Mean kg/set
Legal-size males (>95 mm CW)				
2J	7,291	4,685	9,897	2.03
	11,741	**5,455**	**18,026**	**3.17**
3K	22,971	18,562	27,380	4.23
	27,736	**19,087**	**28,385**	**4.37**
3L	36,015	23,398	43,632	5.31
	29,002	**19,592**	**38,411**	**4.27**
3N	8,312	2,152	14,471	3.25
	6,120	**-16,647**	**28,887**	**2.39**
3O	1,362	-5,633	8,357	0.78
	1,917	**-157**	**3,992**	**1.10**
TOTAL	75,951			
	76,516			
Sublegal 1 (76-94 mm CW)				
2J	1,145	543	1,746	0.32
	1,753	**1,181**	**2,325**	**0.47**
3K	7,696	6,023	9,368	1.42
	7,021	**5,731**	**8,311**	**1.29**
3L	18,763	11,273	26,252	2.76
	11,906	**6,882**	**16,929**	**1.75**
3N	3,534	-506	7,574	1.38
	1,948	**-10,041**	**13,937**	**0.76**
30	376	122	630	0.22
	447	**20**	**874**	**0.26**
TOTAL	31,514			
	23,075			
Sublegal 2 (60-75 mm CW)				
2J	234	123	344	0.06
	338	**116**	**561**	**0.09**
3K	2,588	1,824	3,352	0.48
	1,826	**1,306**	**2,346**	**0.34**
3L	4,295	860	7,729	0.63
	1,815	**1,145**	**2,484**	**0.27**
3N	514	-102	1,130	0.20
	236	**93**	**379**	**0.09**
3O	94	50	137	0.05
	120	**-78**	**319**	**0.07**
TOTAL	7,725			
	4,355			

Table 1. Continued ...

NAFO Div.	Biomass (t)	95% confidence limits		Mean kg/set
		Lower	Upper	
Small males (<60 mm CW)				
2J	98	62	134	0.03
	248	**160**	**335**	**0.07**
3K	1,415	1,008	1,823	0.26
	862	**634**	**1,090**	**0.16**
3L	1,621	1,165	2,077	0.24
	885	**545**	**1,225**	**0.13**
3N	163	-656	982	0.06
	93	**13**	**174**	**0.04**
3O	22	-54	99	0.01
	57	**20**	**94**	**0.03**
TOTAL	3,319			
	2,145			
All males				
2J	8,767	5,789	11,745	2.44
	14,080	**7,362**	**20,797**	**3.80**
3K	34,670	28,858	40,482	6.38
	33,445	**28,081**	**38,810**	**6.15**
3L	60,694	47,986	73,402	8.94
	43,616	**29,066**	**58,165**	**6.43**
3N	12,523	2,261	22,785	4.89
	8,397	**-26,024**	**42,818**	**3.28**
3O	1,854	-5,315	9,024	1.06
	2,542	**-0.54**	**5,084**	**1.47**
TOTAL	118,508			
	102,080			

Table 2. Minimum trawlable biomass estimates for females by maturity category and NAFO Division from 1996 and 1997 (**in bold**) fall bottom trawl surveys.

NAFO Div.	Biomass (t)	95% confidence limits		Mean kg/set
		Lower	Upper	
Immature females				
2J	70	41	99	0.02
	124	**82**	**166**	**0.03**
3K	931	482	1,381	0.17
	385	**290**	**479**	**0.07**
3L	713	551	875	0.11
	465	**-532**	**1,463**	**0.07**
3N	112	-584	809	0.44
	24	**12**	**36**	**0.01**
3O	22	-26	69	0.01
	23	**0.91**	**46**	**0.01**
TOTAL	1,848			
	1,021			
Mature females				
2J	92	39	145	0.03
	149	**-458**	**756**	**0.04**
3K	1,311	380	2,242	0.24
	633	**337**	**928**	**0.12**
3L	2,500	417	4,582	0.37
	879	**656**	**1,102**	**0.13**
3N	375	147	603	0.15
	44	**4**	**84**	**0.02**
3O	68	-635	772	0.04
	100	**-51**	**251**	**0.06**
TOTAL	4,346			
	1,805			
All females				
2J	161	99	224	0.04
	273	**-373**	**918**	**0.07**
3K	2,243	1,278	3,207	0.41
	1,017	**651**	**1,383**	**0.19**
3L	3,212	1,115	5,310	0.47
	1,344	**1,046**	**1,642**	**0.20**
3N	487	220	754	0.19
	68	**29**	**107**	**0.03**
3O	90	29	107	0.03
	123	**-27**	**274**	**0.07**
TOTAL	6,193			
	2,825			

Table 3. Percent change in fall residual biomass estimates from 1996 and 1997 Campelen surveys and STRAP analysis.

Div.	Males				Total males	Females		Total females
	Legal size >94 mm	Sublegal 1 76-94 mm	Sublegal 2 60-75 mm	Smallest <60 mm		Mature	Immature	
2J	61	53	44	153	61	62	77	70
3K	3	-9	-29	-39	-4	-52	-59	-55
3L	-20	-37	-58	-45	-28	-65	-35	-58
3N	-26	-45	-54	-43	-33	-88	-79	-86
3O	41	19	-60	159	37	47	5	37

Table 4. Estimation of initial biomass and exploitation rate by NAFO Division from annual catch and fall Div. 2J3KLNO survey data.

NAFO Div.	Year	Catch (t)	Residual fall biomass (t)	Initial* biomass (t)	Exploitation rate
2J	1996	3,090	7,291	10,381	0.30
	1997	3,166	11,741	14,907	0.21
3K	1996	14,185	22,971	37,156	0.38
	1997	14,830	27,736	42,566	0.35
3LNO	1996	16,847	45,689	62,536	0.27
	1997	22,185	37,039	59,224	0.38
TOTAL	**1996**	**34,122**	**75,951**	**110,073**	**0.31**
2J3KLNO	**1997**	**40,181**	**76.516**	**116,697**	**0.34**

* Initial biomass estimates are slightly inflated due to late season (October-November) catches of 2,485 t in 1996 and 6,459 t in 1997, which are also partly represented in the survey-based residual fall biomass estimates.

Table 5. Comparison of biomass and percentage (in parentheses) of small-clawed and new-shelled crabs within the legal size and sub-legal 1 size groups from fall 2J3KLNO surveys during 1995-97.

Year	New-shelled		Small-clawed	
	Legal-size (>94 mm CW)	Sub-legal 1 (76-94 mm CW)	Legal-size (>94 mm CW)	Sub-legal 1 (76-94 mm CW)
1995*	-	-	3.1 (6)	10.3 (41)
1996	42.1 (56)	19.5 (62)	6.3 (8)	16.8 (54)
1997	38.3 (50)	12.2 (53)	10.7 (14)	12.9 (56)

* 1995 biomasses represent underestimates because the survey was incomplete.

Table 6. Projection of initial biomass of legal-size crabs (all shell categories) from 1996 and 1997 fall Div. 2J3KLNO surveys.

Year projected	Standing stock		Recruitment (t)[3]	Projected biomass (t)
	Large-clawed (t)[1]	Small-clawed (t)[2]		
1997	61,688	12,162	26,876	100,726
1998	66,845	20,036	24,470	111,351

[1] Large-clawed legal-sized crabs do not subsequently molt and so would be intermediate-shelled or old-shelled and fully available to the fishery in the subsequent (projected) year.

[2] Small-clawed legal-sized crabs molt and grow (by about 19 mm CW) but remain new-shelled and generally unavailable to the fishery in the subsequent year.

[3] Small-clawed prerecruit crabs of 76-94 mm CW molt, grow (by about 19 mm CW) and 'recruit' to legal size in the subsequent year but would remain new-shelled and generally unavailable to the fishery of that year.

Table 7. Minimum trawlable biomass estimates by population component from the 1996 and 1997 **(in bold)** spring bottom trawl surveys in NAFO Div. 3Ps.

Population component	Biomass (t)	95% Confidence limits		Mean kg/set
		Lower	Upper	
Legal-sized males (>94 mm CW)	5,397 **1,246**	1,839 **637**	8,955 **1,854**	2.33 **0.45**
Sublegal 1 males (76-94 mm CW)	1,419 **321**	89 **170**	2,748 **473**	0.61 **0.12**
Sublegal 2 males (60-75 mm CW)	162 **64**	48 **24**	275 **103**	0.07 **0.02**
Small males (<60 mm CW)	179 **50**	89 **11**	269 **90**	0.08 **0.02**
Total males	7,157 **1,681**	2,364 **927**	11,949 **2,434**	3.10 **0.61**
Mature females	986 **536**	-404 **-1,510**	2,376 **2,581**	0.42 **0.20**
Immature females	170 **38**	74 **24**	266 **53**	0.07 **0.01**
Total females	1,156 **574**	-210 **-1,470**	2,522 **3,619**	0.50 **0.21**

Table 8. Percentage of large (>101 mm CW) crab by weight within catches of legal-sized (>95 mm CW) crab from various sources, 1994-97. Values in parentheses are based on data excluding new-shelled crabs.

Year	Source	NAFO Division						
		2J	3K	3L	3N	3O	3P	4R
1994	White Bay		61.9 (60.5)					
	Observer (at sea)	92.7	88.6	69.1				70.5
1995	Fall survey	79.2 (97.9)	80.1 (89.1)	65.8 (72.8)	63.5 (59.8)	74.2 (81.3)		
	White Bay		69.6 (64.3)					
	Observer (at sea)	85.2	87.8	70.2				74.6
1996	Spring survey						69.6 (69.9)	
	Fall survey	86.1 (90.1)	76.3 (80.1)	70.9 (72.7)	70.6 (71.2)	84.6 (85.3)		
	White Bay		80 (72.9)					
	Observer (at sea)	78.3	82.8	67.8				90.3
	Dockside grading	**87.1**	**95.3**	**93.9***			**87.7**	**90.3**
1997	Spring survey						75.5 (76.2)	
	Fall survey	87.4 (92.0)	78.6 (85.3)	71.8 (68.7)	67.5 (70.6)	86.1 (88.6)		
	White Bay/ Notre Dame Bay		71.9 (69.6)					
	Dockside grading	**97.9**	**92.6**	**87.7***			**93.5**	**84.4**

* actually represents 3LNO

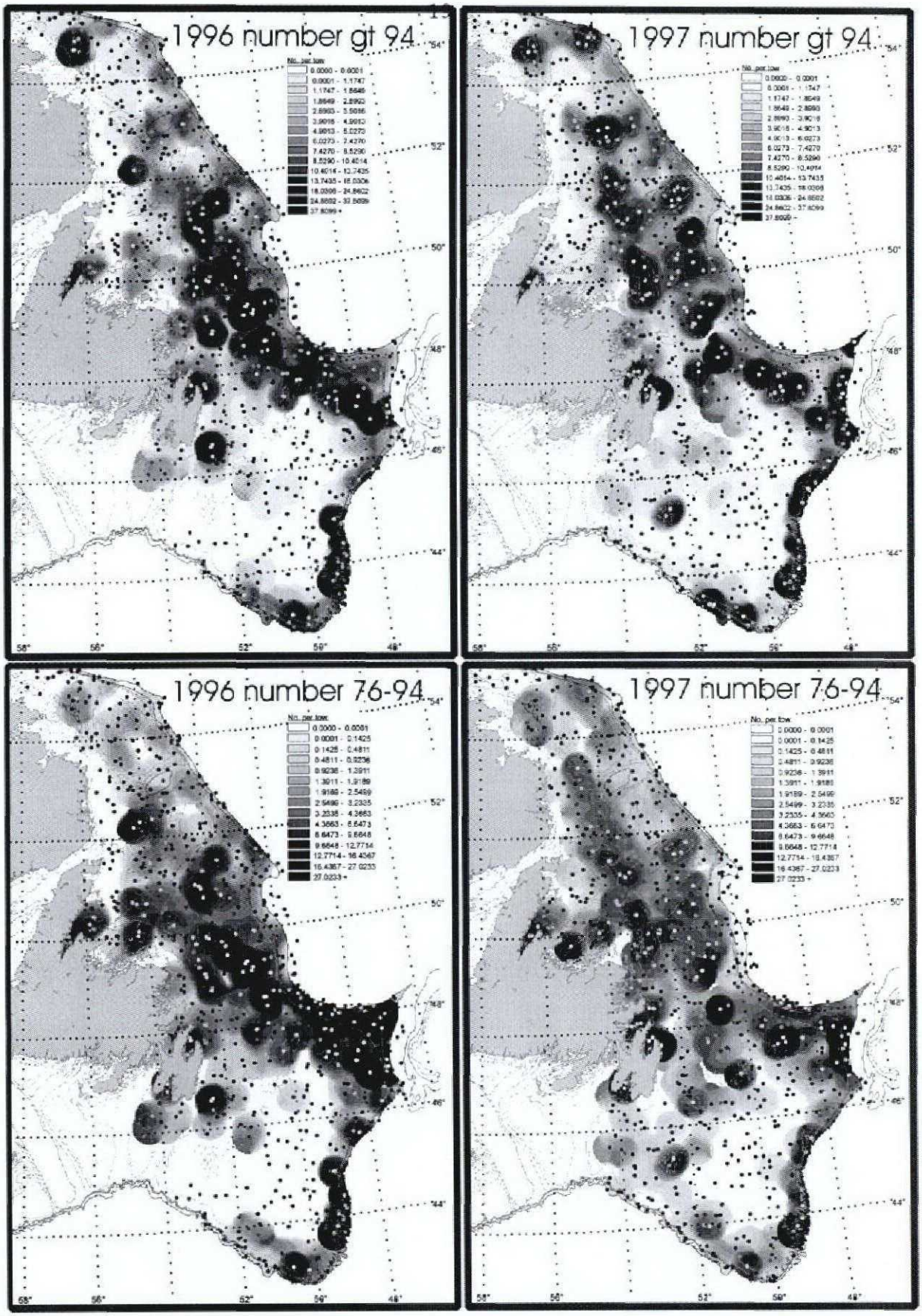

Figure 1a. Distribution of legal sized males (upper panels) and sublegal 1 males, 76-94 mm cw (lower panels) from fall 2J3KLNO Campelen surveys in 1996 (left) and 1997 (right).

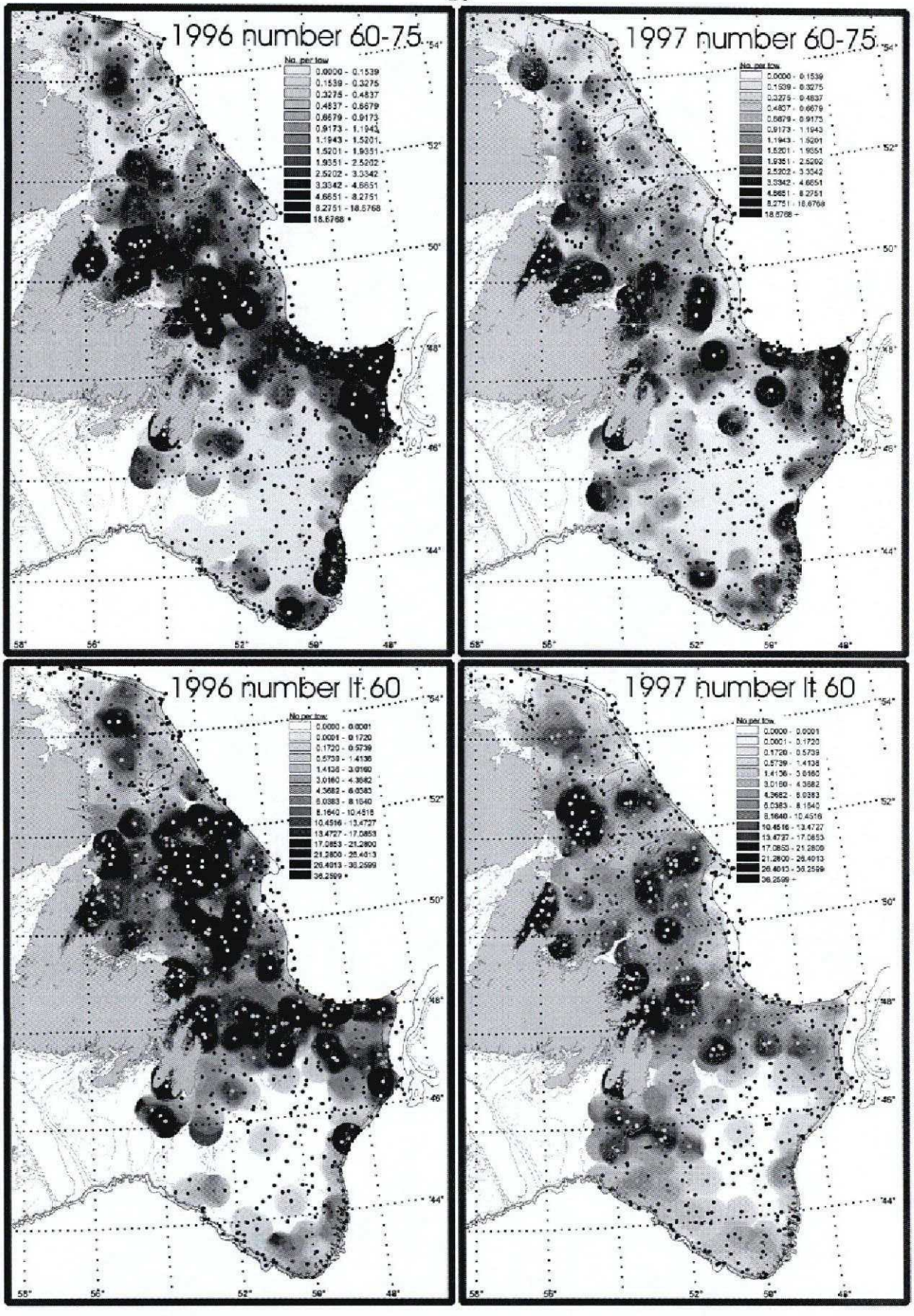

Figure 1b. Distribution of sublegal 2 males, 60-75 mm cw (upper panels) and males less than 60 mm cw (lower panels) from fall 2J3KLNO Campelen surveys in 1996 (left) and 1997 (right).

Density	Count	Area	Mean kg per tow	Biomass kg	Biomass t	Stdev	% of Biomass	Cum% of Biomass	% of Area	Max kg per tow
1	214	126,737	0	0	0	0.01	0.00%	100.00%	100.00%	0.09
2	32	30,736	0.06	74,126	74	0.13	0.09%	100.00%	73.99%	0.41
3	42	31,272	0.2	251,395	251	0.37	0.32%	99.91%	67.68%	1.55
4	34	25,584	0.42	431,905	432	0.63	0.54%	99.59%	61.26%	2.2
5	34	26,571	0.72	768,973	769	0.98	0.97%	99.05%	56.01%	4.03
6	49	26,018	1.32	1,380,443	1,380	1.59	1.74%	98.08%	50.56%	6.29
7	40	24,270	2.3	2,243,718	2,244	2.22	2.83%	96.34%	45.22%	8.16
8	43	22,651	3.07	2,795,093	2,795	4.04	3.52%	93.51%	40.24%	16.64
9	38	23,915	3.51	3,374,023	3,374	3.61	4.25%	89.99%	35.59%	17.15
10	36	24,259	4.3	4,192,875	4,193	4.52	5.28%	85.74%	30.68%	22.36
11	39	28,143	4.41	4,988,610	4,989	3.77	6.28%	80.46%	25.70%	14.91
12	31	24,979	7.34	7,369,562	7,370	5.19	9.28%	**74.17%**	**19.92%**	19.33
13	34	25,312	9.22	9,380,542	9,381	10.56	11.82%	64.89%	14.80%	55.18
14	36	26,138	15.45	16,231,977	16,232	11.35	20.45%	53.07%	9.60%	43.78
15	32	20,639	31.22	25,899,544	25,900	38.04	32.63%	32.63%	4.24%	176.19
Sum	**734**	**487,224**	**6**	**79,382,786**	***79,383***	**5.80**				

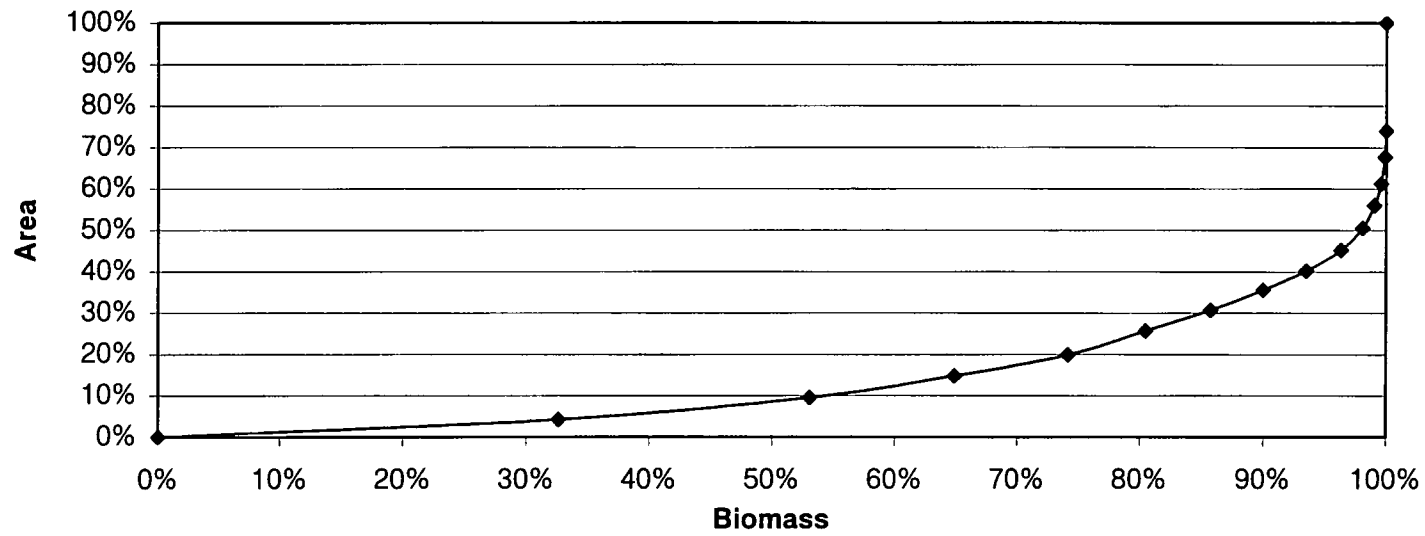

Figure 2a. SPANdex biomass estimate of legal-sized crabs (including new-shelled) from the 1996 fall Div 2J3KLNO bottom trawl survey

Density	Count	Area	Mean kg per tow	Biomass kg	Biomass t	Stdev	% of Biomass	Cum% of Biomass	% of Area	Max kg per tow
1	219	94,672	0	0	0	0	0.00%	100.00%	100.00%	0
2	39	31,941	0.04	51,355	51	0.13	0.07%	100.00%	81.25%	0.57
3	37	34,625	0.18	250,514	251	0.23	0.34%	99.93%	74.93%	0.77
4	32	31,543	0.34	431,075	431	0.54	0.59%	99.59%	68.07%	2.54
5	38	32,083	0.56	722,160	722	0.61	0.99%	99.00%	61.83%	2.37
6	46	30,188	1.06	1,286,207	1,286	1.23	1.76%	98.01%	55.48%	6.52
7	44	28,482	1.59	1,820,280	1,820	2.08	2.49%	96.25%	49.50%	6.73
8	43	29,435	1.6	1,893,017	1,893	1.67	2.59%	93.76%	43.86%	4.99
9	43	27,592	3.03	3,360,442	3,360	2.89	4.59%	91.18%	38.03%	10.41
10	39	29,249	3.89	4,573,316	4,573	3.96	6.25%	86.58%	32.57%	15.08
11	39	29,565	5.07	6,024,991	6,025	4.12	8.24%	80.33%	26.77%	15
12	34	30,759	7.34	9,074,837	9,075	7.3	12.41%	72.09%	20.92%	31.3
13	42	27,593	9.26	10,270,237	10,270	6.68	14.04%	59.68%	14.83%	28.59
14	39	24,835	9.84	9,822,676	9,823	9.66	13.43%	45.64%	9.37%	37.46
15	50	22,468	26.09	23,561,833	23,562	31.87	32.21%	32.21%	4.45%	214.26
Sum	**784**	**505,030**	**5**	**73,142,940**	***73,143***	**4.86**				

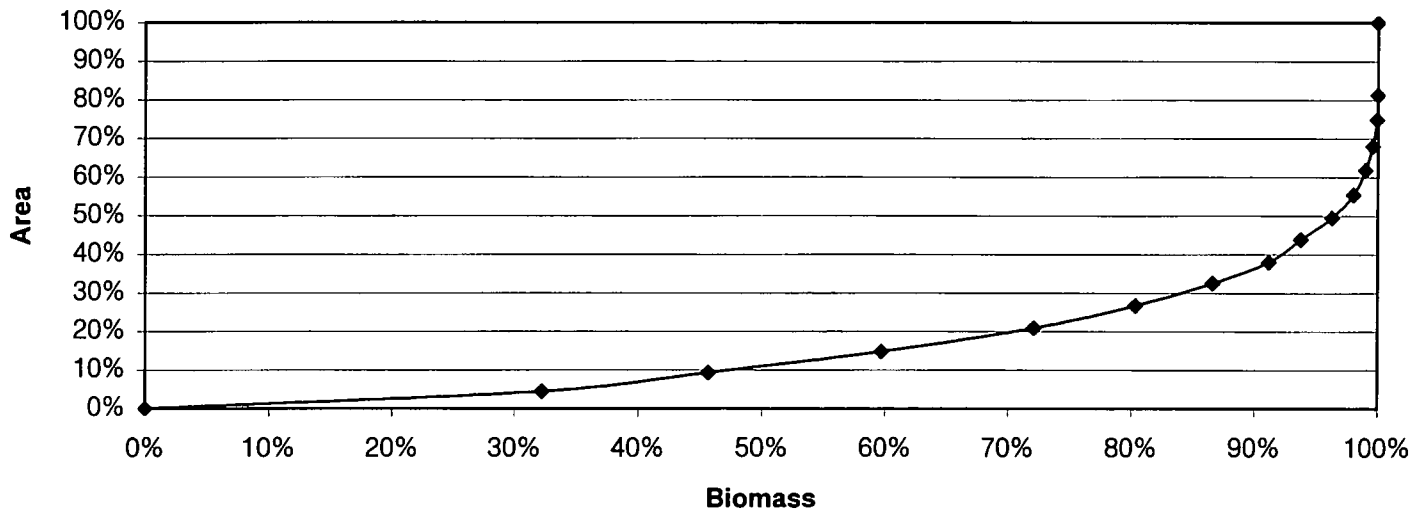

Figure 2b. SPANdex biomass estimates of legal-sized crabs (including new-shelled) from the 1997 fall Div. 2J3KLNO bottom trawl survey.

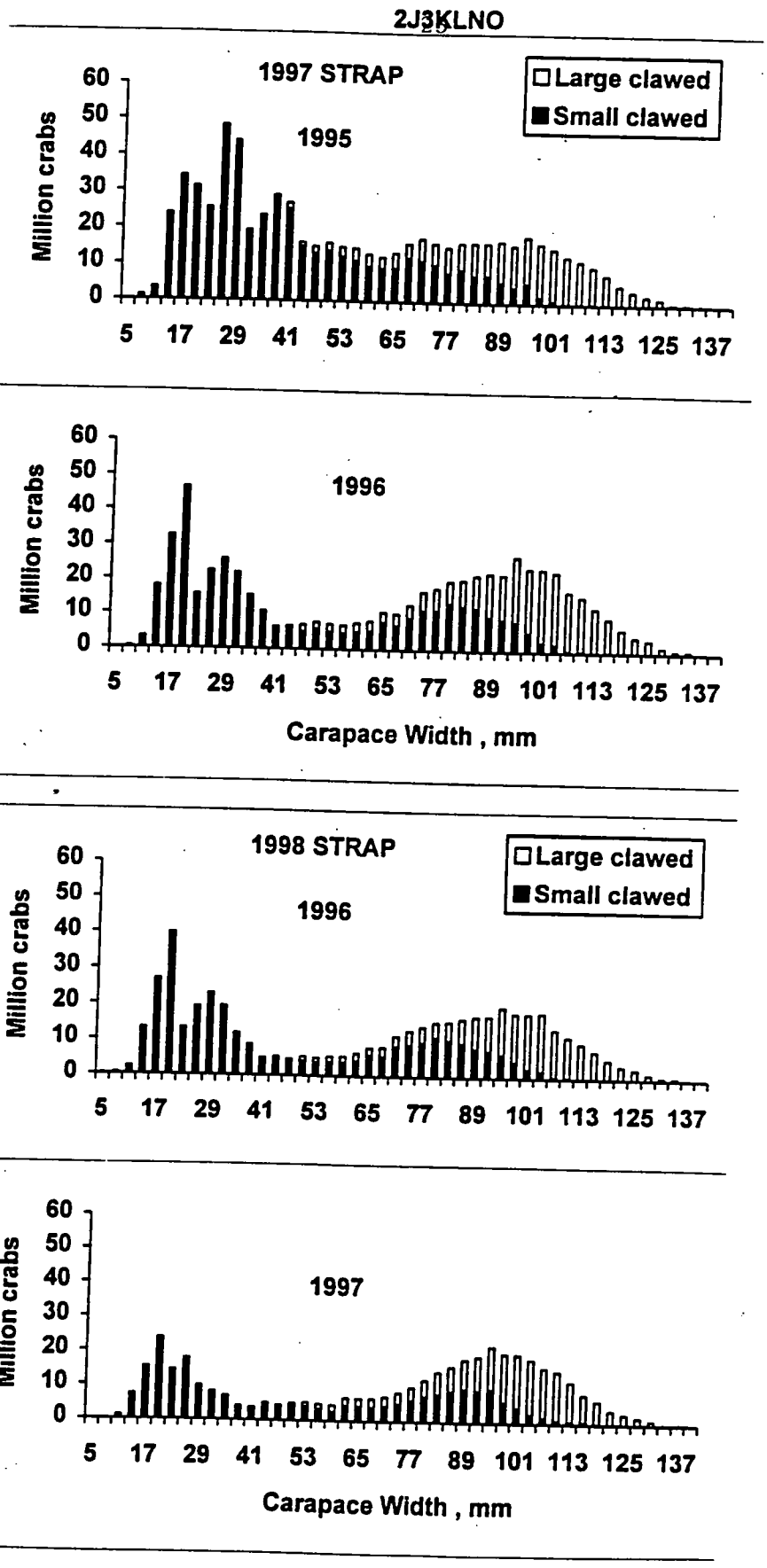

Figure 3 . Carapace width distribution from 2J3KLNO fall surveys for 1995 vs 1996 (above) and 1996 vs 1997 (below) , by claw type .

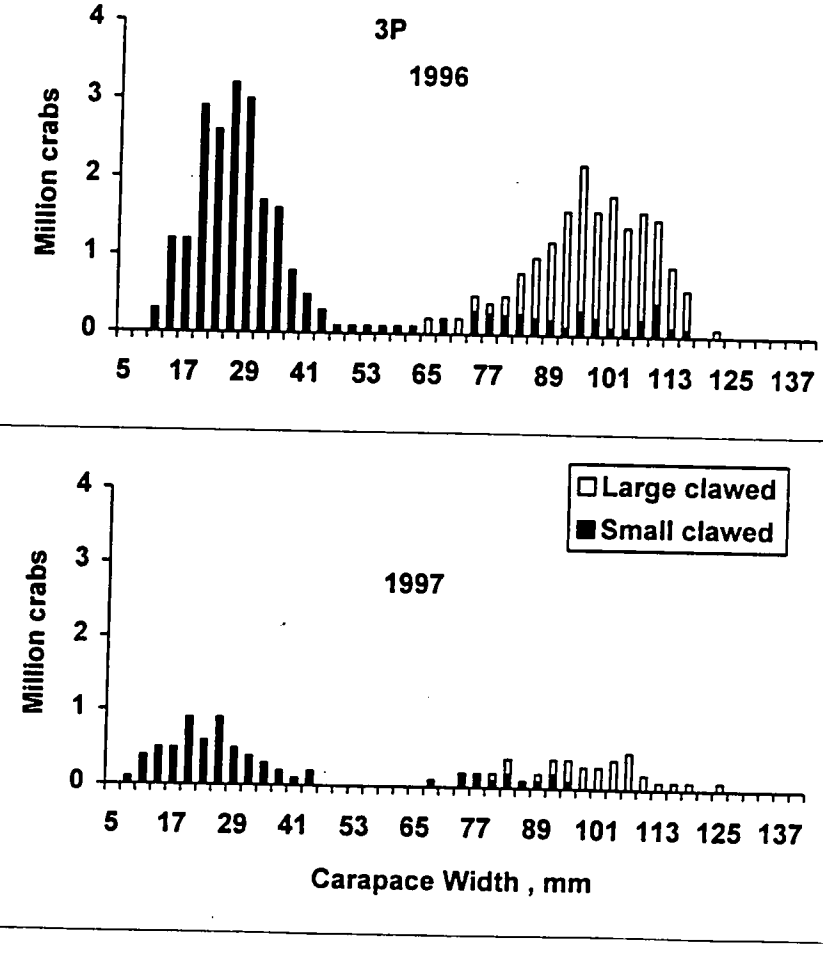

Figure 4. Carapace width distribution, from 3P spring surveys for 1996 vs 1997, by claw type.

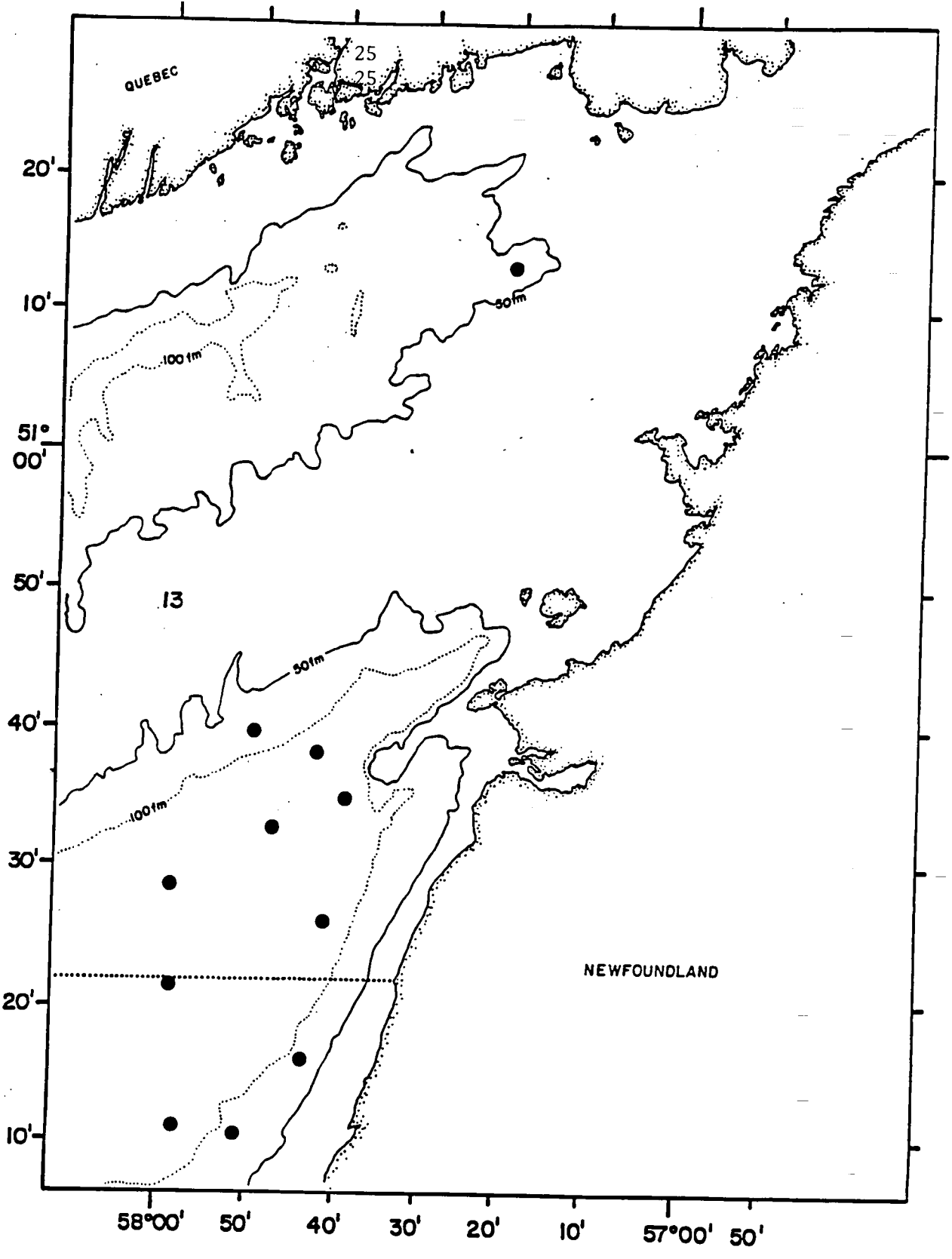

Figure 5. Location of incidental Campelen sets in Div. 4R, September 1997.

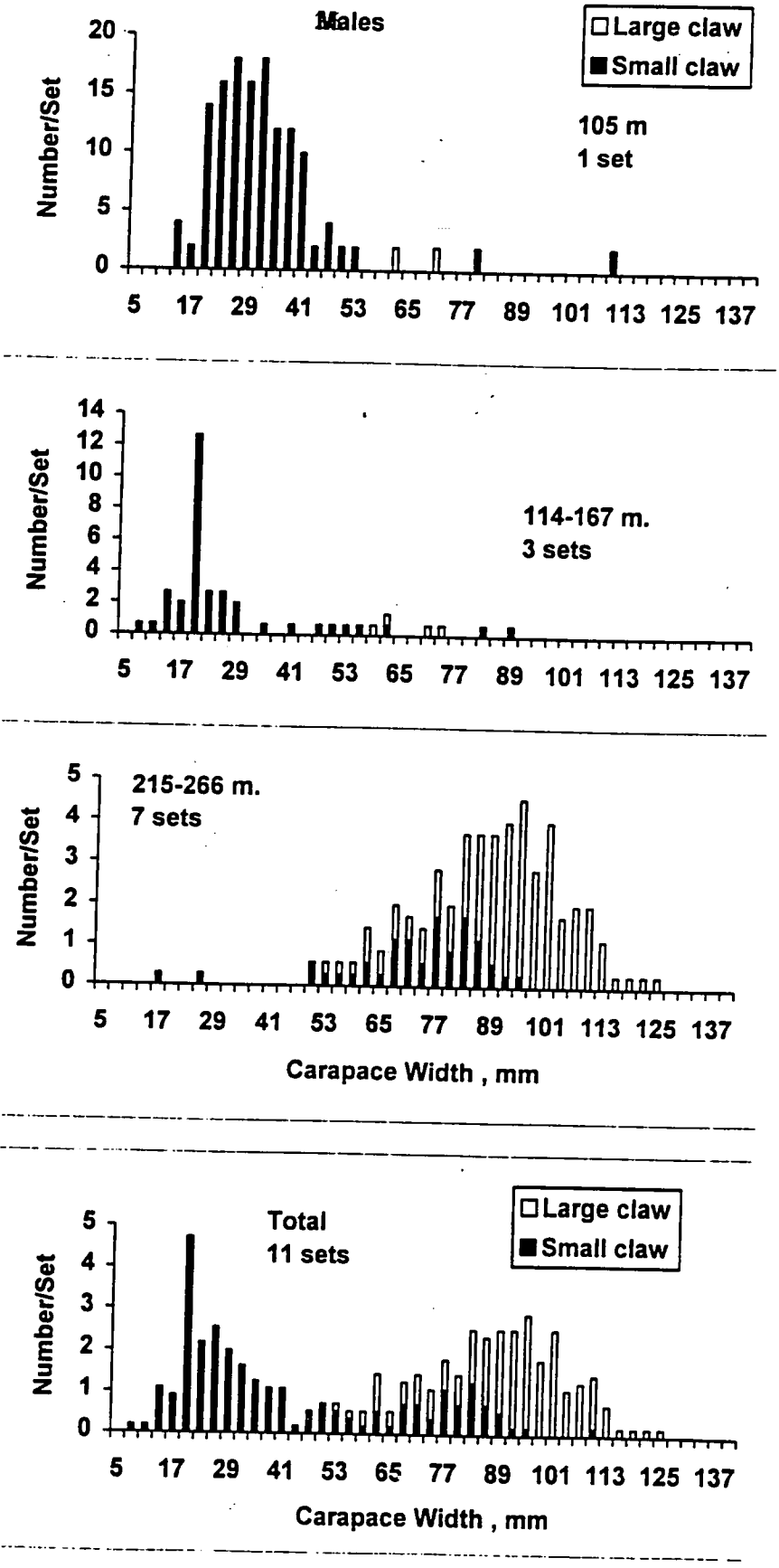

Figure 6. Male carapace width distribution by depth and claw type from 11 Campelen tons in Div. 4R, September 1997.

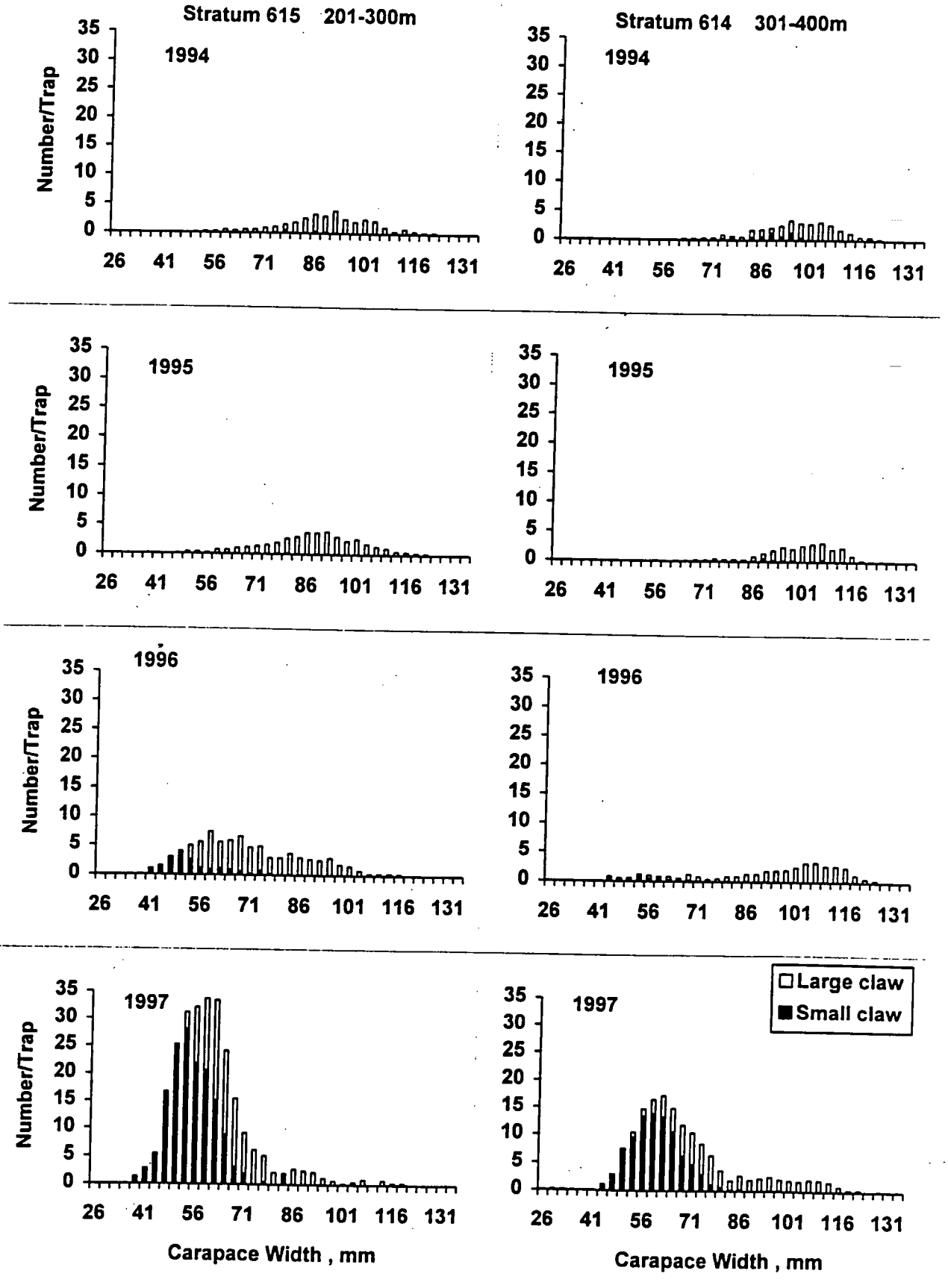

Figure 7. Yearly trends in male carapace width distribution strata, from research sampling using small-meshed traps, September 1994-97.

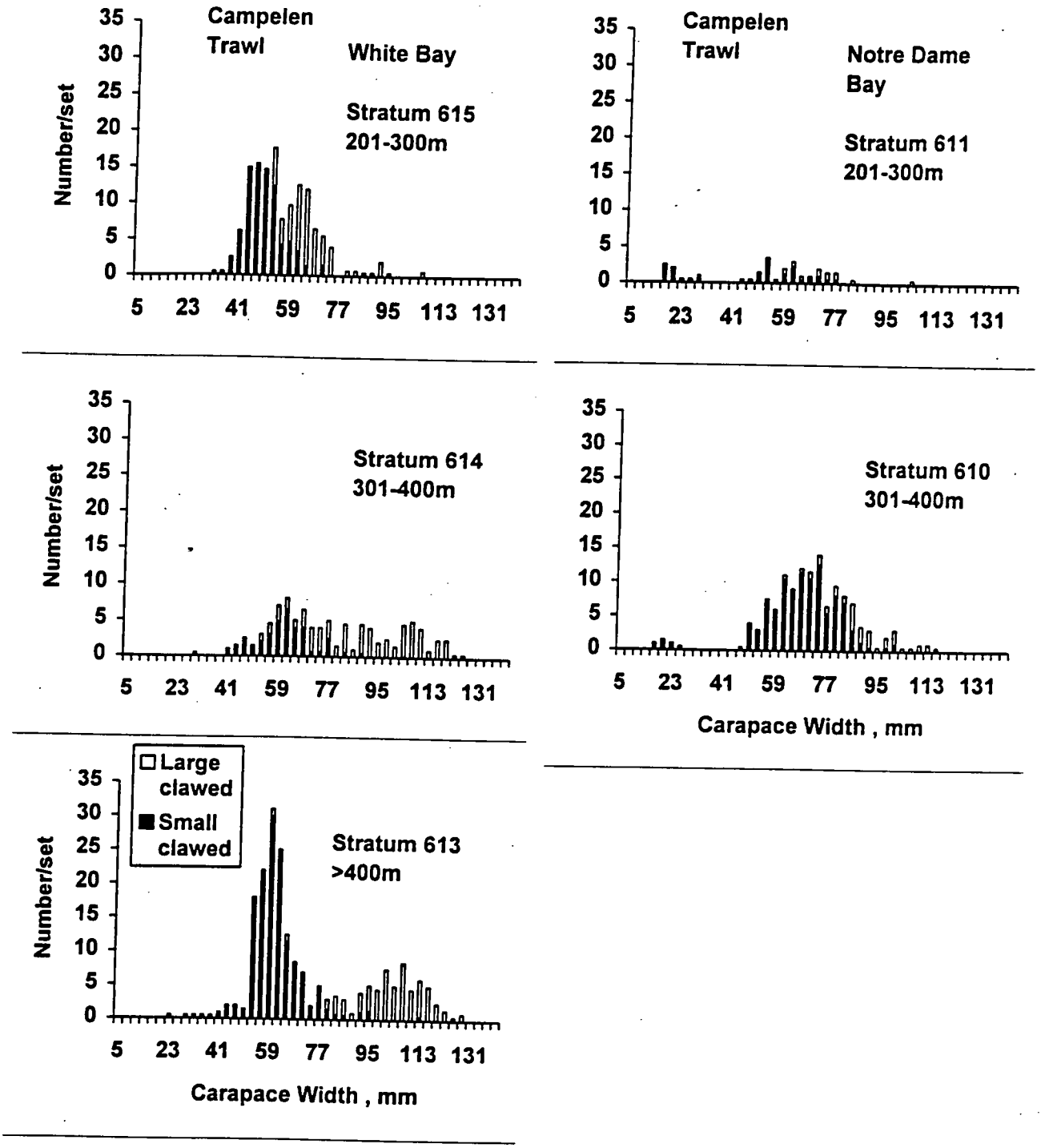

Figure 8 . Male size distribution for selected (comparitive) sets of the Campelen trawl by depth stratum and claw type for White Bay and Notre Dame Bay , fall 1997.