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The Status of Redfish in Unit 2 (Laurentian Channel Management Unit)

by

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Abstract

Prior to 1993 redfish in Subarea 4 and Div. 3P were managed as three units (Div. 3P, 4RST and 4VWX). The subsequent implementation of three new units in 1993 resulted in a change in fishing pattern in the Laurentian Channel unit (Unit 2). Fishing pattern will be affected again in 1995 in response to seasonal closures to minimize overlap with Unit 1 redfish. Since 1984 landings have steadily increased from about 8,000 t to 24,000 in 1994. The 1995 TAC of 14,000 t represented an 11,000 t reduction from the 25,000 t TAC set in 1994. The reduction was implemented as a conservation measure. Catch rates have declined steadily since 1990. Summer research surveys indicate stability in biomass between 1994 and 1995 although the proportion of older commercial sized fish (>25 cm) declined from 1994 to 1995. The next anticipated pulse of recruitment (1988 year class) will probably not fully recruit to the fishery before 1997 or 1998 but it is unlikely that the contribution will be as abundant as the early 1980s year classes that have supported the fishery for the past 6 years. It is not possible to provide an estimate of the absolute size of this stock, therefore, it is not possible to estimate fishing mortalities for the past. The ratio of catch to estimated exploitable biomass indexes derived from the 1995 summer suggests that a catch of 14,000 t (TAC in 1995) would generate an exploitation rate of between 13% and 24%, however, as the survey estimates are only minimal estimates, actual exploitation rate is likely to be within a lower range.

Résumé

Avant 1993, les stocks de sébaste de la sous-zone 4 et de la division 3P étaient gérés en trois unités distinctes (divisions 3P, 4RST et 4VWX). Le découpage en trois nouvelles unités adopté en 1993 s'est traduit par une modification des habitudes de pêche dans le chenal Laurentien (unité 2). En 1995, les habitudes de pêche seront à nouveau modifiées, par suite des fermetures saisonnières instaurées pour réduire le chevauchement avec le sébaste de l'unité 1. Depuis 1984, les débarquements ont constamment augmenté, passant d'environ 8 000 t à 24 000 t en 1994. Le TAC de 1995, soit 14 000 t, représentait une réduction de 11 000 t par rapport à celui de 1994 (25 000 t), cette réduction ayant été adoptée à des fins de conservation. Les taux de prises sont en baisse constante depuis 1990. Les relevés de recherche d'été dénotent une stabilité de la biomasse entre 1994 et 1995, quoique la proportion des plus gros poissons de taille commerciale (>25 cm) ait diminué de 1994 à 1995. La prochaine poussée de recrutement attendue (classe d'âge de 1988) ne sera sans doute pas entièrement recrutée à la pêche avant 1997 ou 1998, et il peu probable que sa contribution soit aussi importante que celle des classes d'âge du début des années 1980, qui ont alimenté la pêche pendant les six dernières années. Il n'est pas possible d'estimer l'effectif absolu du stock et, partant, la mortalité par pêche des années passées. D'après le rapport entre les prises et les indices de biomasse exploitable estimés d'après le relevé de l'été 1995, des prises de 14 000 t (TAC de 1995) correspondraient à un taux d'exploitation se situant entre 13 et 24 %; toutefois, comme les estimations du relevé ne sont que des estimations minimales, le taux d'exploitation réel sera vraisemblablement d'un ordre de grandeur inférieur.

Introduction

Prior to 1993 redfish in Divisions 3P4RST4VWX were managed as three units: Div. 3P, Div. 4RST and Div. 4VWX. In 1989 the integrity of these units as separate management areas was questioned and an examination of applicable data and pertinent published studies ensued. This resulted in the proposal of new management units believed to have a firmer biological basis than the former units (see CAFSAC (1991); Atkinson and Power (1990, 1991)). Allocations and conservation measures under these new management units were first implemented in 1993. This paper presents information relevant to the provision of advice for the Laurentian Channel unit (Unit 2) which comprises Subdiv. 3Ps4Vs4Wfgj and Subdiv. 3Pn4Vn (Jun-Dec).

Description of management regulations and the fishery

Management regulations

As an interim measure in 1991, the former CAFSAC suggested the TAC total of the three former management areas be divided among the new management units based on the average percent caught in each of the new units during 1981-1990. This suggested a TAC of 25,000 t for Unit 2 in 1992. The new management units were not implemented until 1993 and a TAC of 28,000 t was set for Unit 2. The 1995 TAC of 14,000 t represented an 11,000 t reduction from the TAC set in 1994. The reduction was implemented as a conservation measure. In addition, there were seasonal/area closures implemented in 1995 to minimize the possible overlaps with Unit 1 fish given a lack of understanding of redfish migration patterns.

Nominal Catches

Annual catches have ranged between 8,100 t in 1984 to 58,000 t in 1971 (Table 1, Fig.1). From 1960-1968 landings were about 20,000 t, increased to an average of 43,000 up to 1975 mainly due to increases by foreign fleets, then subsequently declined to the lowest on record in 1984 at 8,100 t. Catches then steadily increased to 27,000 t in 1993 approximating the TAC. In 1994 catch of 24,000 t was again near the TAC. Up to the end of the third quarter of 1995 approximately 10,000 t of a 14,000 t TAC had been taken. The larger catches in the 1990s relative to the mid to late 1980s is a mainly due to renewed interest in redfish because of depletions of other groundfish resources.

Prior to 1980 most of the catch was taken in 3Ps and 4Vs. Since then a larger proportion of the catch has been taken from 4Vn. Since 1991, increases in total landings have been due to removals from 3Ps and 4Vn while there was a substantial decrease in landings from 4Vs for 1992-1993 (Table 2). Since the implementation of the 200-mile Exclusive Economic Zone in 1977, catches have been primarily by Canadian fleets. Maritime vessels generally account for the majority of landings in Subdivisions 4Vs and 4Vn while Newfoundland vessels concentrate in Subdivisions 3Ps and 3Pn.

Monthly catches since 1981 indicate prosecution of the fishery occurs throughout the year in all Subdivisions (Table 3). From 1991-1993, a higher proportion of landings were taken during the fall/winter fishery in 3Pn/3Ps respectively, while the greatest activity in 4Vn/4Vs occurred around the summer season. Otter trawling is the predominant method of fishing, primarily with bottom trawls (Table 4). Since 1986 there has been an increase in the proportion of catch taken with midwater trawls.

The implementation of this new management unit in 1993 caused a change in fishing pattern from that generally in place under the old 3P, 4RST and 4VWX units. There was a 10,000 t increase from the 1992 catch of about 17,000 t and this was almost totally accounted for by landings from 3Pn during October to December. Based on information presented to the Fisheries Oceanography Committee of DFO, Science in March, 1994 these catches in November and December were probably of Unit 1 redfish which moved into the area earlier in 1993 (Morin et al, 1994). The pattern changed again in 1994 when only about 1,200 t were taken in subdivisions 3Pn4Vn during this period.

Available Data

Commercial catch rates

Catch and effort data from 1960 to 1992 from ICNAF/NAFO Statistical Bulletins were combined with provisional 1993-94 Atlantic region data compiled by various DFO regional statistics branches and Maritime Region data from 1970-1992. Initially selected from this database were observations where redfish comprised more than 50% of the total catch and were therefore considered to represent redfish directed fishing.

These data were analyzed with a multiplicative model (Gavaris 1980) to derive a standardized catch rate series. Effects included in the model were a combination country-gear-tonnage class category type (CGT), NAFO division, month, and a category type representing the amount of bycatch associated with each observation. For this effect five groups were arbitrarily established : ($>50 \leq 60$), ($>60 \leq 70$), ($>70 \leq 80$), ($>80 \leq 90$) and (>90) where each group corresponds to the percentage of redfish relative to the total catch associated with each observation. In the usual practise, catch or effort data of less than 10 units were eliminated prior to analysis as were data where there was less than five samples from any one category type except year.

The model explained 51% of the variability in the catch rates (Table 5a). All category types are highly significant. Estimated coefficients from the regression show catch rates are generally higher during the first half of the year. The standardized catch rate series based on hours fished (Table 5b, Fig. 2a) shows a steady increase from 1960 to 1966 followed by a decrease to a relatively low rate in 1979. The rate increased again until 1983 to about the same magnitude of the 1960 catch rate. From 1983 to 1986 catch rate declined slightly to about the level of the 1979-1980 rates and remained stable to 1988. Large increases occurred in 1989 and again in 1990 to the highest rate observed over the time series. Over the next four years catch

rate declined sharply to the lowest rate on record in 1994.

Previous catch rate standardizations only included data for tonnage classes 4-7 vessels (Power 1994). As there were sufficient data available for tonnage classes 1-3 vessels from 1991 to 1994, they are included in the current analysis. A comparison of catch rate standardizations with (Fig. 2a) and without (Fig. 2b) tonnage class 1-3 data reveals the same dramatic decline from 1991 to 1994 suggesting these vessels had a similar experience as the larger vessels in the fishery over the comparable period.

The catch rates seem to track reasonably well with the movement of what were perceived to be strong year classes (1956-58 and early 1970s) through the fishery. Successive large increases in 1989 and 1990 can be partly attributed to the recruitment to the fishery of the relatively strong year classes of the early 1980s. It was also believed that technological changes in the fishery, specifically the introduction of the midwater "turbo" trawl for all large vessel fleets, accounted for some of this increase because this highly efficient gear was aggregated with other midwater gears in previous standardizations. However, standardized catch rates for bottom gears alone (Fig. 2c) also show the large increases in 1989 and 1990 followed by similar declines to the lowest rate on record in 1994. This suggests that other factors need to be investigated to account for the dramatic changes which have occurred since 1989 relative to the prior period in the data series.

Catch at length

Length distributions sampled during the 1994 fishery from port sampling and observer data were weighted by the monthly landings by division to derive a combined length distribution for Unit 2. The data (Fig. 3.) suggest a bi-modal distribution with a predominant mode at 30 cm and another at 23 cm. Additional information from the sampling data indicate fishing occurred generally in the 250 m - 400 m depth range for both midwater and bottom trawling.

Research survey data

3Ps Winter-Spring surveys

Stratified-random groundfish surveys have been conducted since 1973 in Subdiv. 3Ps generally in the February to April period. These surveys usually cover the extent of the area of Subdiv. 3Ps to a maximum of 730m.

The historical series of mean numbers and weights per standard tow for 3Ps show some rather dramatic fluctuations between some years (Tables 6-9, Fig. 4). The changes in relative abundance throughout the series are too dynamic to reflect year to year changes in stock abundance. These surveys only cover part of the management unit and consequently may not be reflective of changes in stock size throughout the entire unit, but may reflect fish movements into and out of the survey area. Therefore, the 3Ps winter/spring survey series has

limited value in determining current stock status in Unit 2. The stratification scheme from which the stratified-random design of the surveys is based was revised for certain strata boundaries along the southern slope edge of St. Pierre Bank for the 1994 survey. Although the total areal change was small, the data for 1994-1995 (Tables 7 and 9) are presented separately to avoid any confusion. Geographical distribution plots (Fig. 5) of catches in 3Ps since 1984 and 3Pn since 1986 (considered to be part of management Unit 1 at this time of year), indicate generally two clusters of relatively higher density apparent throughout the time series. One cluster is in area encompassing the northwest corner of St. Pierre Bank which extends into 3Pn. The second cluster generally occurs along the southern slopes of St. Pierre Bank in proximity of Div. 3O.

Size composition and numbers at age from the Subdiv. 3Ps surveys (Fig. 6) are dominated by the relatively strong year-class(es) of the early 1980s that were first caught in the 1981 survey. These year classes presently constitute the main component of the commercial fishery. There was also a much smaller pulse of recruitment detected first during the 1988 survey (perhaps the 1984 or 1985 year-class), and a larger pulse observed in the 1991 survey corresponding to the 1987 or 1988 year-class. The early 1980s year-class(es) comprised a much greater proportion of the research catch than those of either 1984-85 or 1987-88 suggesting that it is much stronger.

Unit 2 Summer surveys

Stratified-random research surveys were conducted in subdivisions 3Ps, 3Pn, 4Vs and 4Vn during the summers of 1994 and 1995 utilizing a Campelen 1800 shrimp trawl. Although there are only two years of data, results from these surveys are considered a better indicator of relative stock size (compared to the winter-spring survey series) because they cover most of the area comprising Unit 2 and are conducted at a time when it is believed that there is no mixing of Unit 1 and Unit 2 fish. The biomass index derived from the surveys (Table 10) suggest that stock size remained stable between 1994 and 1995.

Size composition (Fig. 7) from the surveys show similar distributions from 1994 to 1995 within each subdivision. For the 1995 survey, the distribution is bi-modal with modes at about 19-21 cm and 31-32 cm. It is also clear that there are differences in distributions between subdivisions, the most striking being the absence of a pronounced mode around 19-21 cm in subdivision 4Vn. Accounting for growth, a similar pattern was observed in 1994. In subdivision 3Ps there was a tri-modal distribution in 1994 and a bi-modal distribution in 1995. A similar pattern was observed in the winter-spring surveys in subdivision 3Ps from 1994 to 1995 although a different net was used. In both surveys it was the central mode that disappeared in 1995. These observations suggest that a finer spatial analysis of the data is warranted.

Total abundance estimated the summer surveys (Fig. 8) suggest that the proportion of older commercial sized fish declined from 1994 to 1995. There is still a substantial proportion of the research catch comprised of the early to mid 1980s year-classes, which have been fished for about 6 years now, again suggesting that the 1988 year class is weaker than that of the

early 1980s. Geographical distribution plots of the 1994 (Fig. 9) and 1995 (Fig. 10) surveys show the reduction in the density in subdivision 4Vn and the larger 1995 catches taken in the vicinity of the "Stone Fence" area of Banquereau Bank that was poorly sampled in 1994.

Estimation of stock parameters

Production model

A General production model was not attempted because of the difficulties apparent in the catch rate analysis.

Industry Perspectives

One major industry stakeholder indicated that the 1995 fishing patterns in Unit 2 changed because of seasonal closures in April-May and November-December. They report that fishing has been good in subdivisions 3Ps and 4Vs and south Banquereau so far in 1995 (up to end of September), and catch rates and fish sizes were comparable to 1994. Nonetheless, they have not seen anything to help them decide whether the resource is up or down. Trawler captains have seen more "small" redbfish (less than 23 cm (9 inches)) near the corner of Banquereau Bank than had been seen during the previous five years.

Another major industry representative reported good and consistent trips from July-September with fish sizes being comparable to those in 1994. They found it difficult to relate their 1995 experiences to previous years as the areas fished in 1995 have not been fished consistently for the past 15 years.

One fleet reported about the same catch rate as in 1994 even though more bottom trawling was conducted than midwater trawling compared to previous years. Therefore, they could not interpret what this may mean in terms of any possible change in the resource.

Prognosis

Fishing patterns changed in response to the implementation of this new management unit in 1993, and will certainly continue to change in 1995 due to seasonal closures related to spawning and migrations.

Because of the limited database, it is not possible to provide an estimate of the absolute size of this stock. Therefore it is not possible to estimate actual fishing mortalities for the past. However, application of selectivity curves for 90 mm and 130 mm mesh codends (Lisovsky et al, 1995) to the catch-at-length from the 1995 summer survey (which covers the main stock area) enables estimation of an exploitable biomass index. A ratio of catch to this exploitable biomass, suggests that a catching 14,000 metric tons in 1995 would generate an exploitation rate of between 13% and 24%. It must be cautioned however, that the survey results are only minimal estimates of biomass so the actual exploitation rate is likely to be lower than estimated above.

Overall, this stock is probably lower than it has been in recent years. Catch rates have declined steadily since 1990. Current catches are composed primarily of the early 1980s year-class(es) which have been fished for about six years now. Based on these observations, the fishery will not improve in the immediate future because the abundance of fish sizes currently harvested (mainly >25 cm (10 inches)) will continue to decline until another pulse of recruitment reaches this size.

The next anticipated pulse of recruitment (1988 year-class) will probably not enter the fishery before 1997 or 1998. However, their contribution is likely to be less than that of the year-class(es) of the early 1980s.

REFERENCES

- CAFSAC. (1991). Advice on the management of groundfish stocks. CAFSAC Adv. Doc. 91/13 (Revised):29 p.
- Atkinson, D.B., and D. Power. (MS 1990). Some analyses of data for redfish off the south coast of Newfoundland (NAFO Div. 3P/4V). CAFSAC Res Doc. 90/57.
- Atkinson, D.B., and D. Power. (MS 1991). The Redfish Stock Issue in 3P, 4RST and 4VWX. CAFSAC Res Doc. 91/38.
- Gavaris, S. 1980. Use of a multiplicative model to estimate catch rate and effort from commercial data. Can. J. Fish. Aquat. Sci. 37:2272-2275.
- Lisovsky, S.F., V.A. Tretyak, I.M. Kiseleva and S.M. Kotlyarov. 1995. On minimum mesh-size during deepwater redfish fishery with mid-water trawl in NAFO divisions 3NO. NAFO SCR Doc. 95/25. Serial No. N2533. 9 p.
- Morin, B., D. Power and P. Gagnon. (MS 1994). Distribution of redfish (*Sebastes* spp.) in the Gulf of St. Lawrence and in Laurentian Channel based on RV surveys and commercial fishery catch rates. DFO Atl. Fish. Res. Doc. 94/91. 52p.
- Power, D. (MS 1994). The status of Redfish in Unit 2 (Laurentian Channel Management Unit). DFO Atl. Fish. Res. Doc. 94/23. 28p.

Table 1: Summary of Nominal Catches (t) of redfish in Unit 2.

Year	3Pn (Jun-Dec)	3Ps	4Vn (Jun-Dec)	4Vs	4Wfgj	4Wfgj (assigned)	Total	3P4V Unknown	4W (unknown)	3Pn/4Vn Nov.-Dec.	TAC
1960	14	9,211	5,277	8,122	-	663	23,287		-	72	
1961	1,058	8,340	4,157	4,170	-	604	18,329	356	8	148	
1962	2,127	11,306	2,710	4,372	-	780	21,295	52	3,870	989	
1963	2,154	11,150	2,166	6,270	-	550	22,290		12,005	591	
1964	4,445	9,119	1,849	7,629	80	70	23,192		3,005	2,937	
1965	5,570	9,931	2,097	3,319	733	184	21,834	11	1,326	2,712	
1966	2,444	16,543	6,022	3,067	242	74	28,392		8,720	5,128	
1967	3,531	28,465	7,976	1,989	78	131	42,170		55	3,641	
1968	1,974	11,764	4,097	2,222	16	96	20,169	522	210	2,608	
1969	1,412	29,460	4,726	10,241	-	437	46,276		1,387	1,657	
1970	2,169	33,581	2,849	6,694	2,101	2,013	49,407		8,744	1,170	
1971	373	26,534	4,762	23,698	1,334	1,499	58,200		11,921	1,070	
1972	511	25,398	2,390	14,580	1,346	976	45,201		8,609	192	
1973	2,133	14,714	2,709	11,213	495	563	31,827		5,484	1,526	
1974	2,759	17,894	4,898	8,112	357	18	34,038		4,018	2,899	
1975	4,722	20,345	6,548	6,791	37	28	38,471		3,944	896	
1976	1,409	13,235	3,832	4,718	317	198	23,709		315	126	
1977	1,713	14,678	4,763	7,123	245	228	28,750			307	
1978	1,975	12,203	3,661	7,856	593	260	26,548			1,016	
1979	1,975	6,459	4,500	4,979	666	192	18,771			1,642	
1980	1,845	5,192	3,713	5,431	817	131	17,129			1,140	
1981	3,283	4,685	6,134	6,789	430	430	21,751			1,421	
1982	3,757	2,090	6,350	4,585	128	115	17,025			2,328	
1983	2,607	2,996	3,559	3,758	489	64	13,473			1,301	
1984	1,460	2,005	2,129	2,367	140	40	8,141			664	
1985	1,587	1,854	3,143	4,502	194	214	11,494			756	
1986	958	3,651	3,347	2,736	15	58	10,765			662	
1987	1,348	2,169	6,423	3,651	195	170	13,956			1,940	
1988	484	2,386	4,856	2,725	156	121	10,728			581	
1989	1,953	2,874	5,236	4,990	81	252	15,386			1,206	
1990	189	5,438	2,471	6,325	73	296	14,792			390	
1991	1,050	4,390	8,746	8,537	100	382	23,205			2,226	
1992a	766	6,629	7,348	1,727	473	224	17,167			3,029	28,000
1993a	10,780	6,963	8,092	1,155	108	-	27,098			5,836	25,000
1994a	3,887	7,887	6,335	5,590	267	-	23,966			1,311	14,000
1995b							7,271				

Note: Portions of Catches identified only as "4W" were assigned to 4Wfgj based on:

- (1) Information of other catches that could be split between the "Laurentian Channel" and "Scotia Shelf" units
- (2) USSR and "others" fishing since 1977 (see Power MS 1992)

a Provisional.

b to July 26, 1995 (Canadian Atlantic Quota Reports)

Table 2a: Nominal catches of redfish by country from Subdiv. 3Pn (June-Dec.) (1992 to 1994 are provisional).

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Canada (M)	311	502	65	325	143	577	39	825	0	346	213	4,770	1,209
Canada (N)	3,446	2,105	1,395	1,262	815	770	445	1,128	189	704	548	5,521	2,673
Canada (Q)	-	-	-	-	-	1	-	-	-	-	5	489	5
Total	3,757	2,607	1,460	1,587	958	1,348	484	1,953	189	1,050	766	10,780	3,887

Table 2b: Nominal catches of redfish by country from Subdiv. 3Ps (1992 to 1994 are provisional).

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Canada (M)	515	670	396	313	606	421	836	1,038	1,252	377	2,648	3,163	3,957
Canada (N)	1,553	2,316	1,608	1,529	2,915	1,645	1,441	1,823	4,186	4,013	3,981	3,800	3,930
Canada (Q)	-	-	-	-	88	-	-	-	-	-	-	-	-
France (M)	5	-	-	-	-	67	95	-	-	-	-	-	-
France (SPM)	17	-	-	-	42	36	14	13	-	-	-	-	-
France	-	10	1	12	-	-	-	-	-	-	-	-	-
Total	2,090	2,996	2,005	1,854	3,651	2,169	2,386	2,874	5,438	4,390	6,629	6,963	7,887

Table 2c: Nominal catches of redfish by country from Subdiv. 4Vn (June-Dec.) (1992 to 1994 are provisional).

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Canada (M)	2,356	2,710	1,133	1,368	1,237	2,544	2,327	3,245	1,874	7,453	5,871	7,048	3,865
Canada (N)	3,993	849	153	1,677	1,790	3,682	2,345	1,909	579	1,076	1,255	593	1,970
Canada (Q)	-	-	-	38	63	-	-	1	-	217	222	451	500
France (SPM)	1	-	-	-	-	-	-	-	-	-	-	-	-
Japan	-	-	843	60	257	197	184	81	18	-	-	-	-
Total	6,350	3,559	2,129	3,143	3,347	6,423	4,856	5,236	2,471	8,746	7,348	8,092	6,335

Table 2d: Nominal catches of redfish by country from Subdiv. 4V (1992 to 1994 are provisional).

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Canada (M)	4,109	3,208	1,735	2,924	1,081	2,279	2,111	3,452	3,997	5,864	1,621	1,087	4,897
Canada (N)	476	539	148	724	465	428	335	1,139	1,852	1,911	106	68	693
Canada (Q)	-	-	-	-	-	-	-	-	-	263	-	-	-
USSR	-	1	-	-	-	-	-	-	-	-	-	-	-
Portugal	-	10	-	-	-	-	-	-	-	-	-	-	-
Japan	-	-	484	854	1,190	944	279	399	475	499	-	-	-
Total	4,585	3,758	2,367	4,502	2,736	3,651	2,725	4,990	6,324	8,537	1,727	1,155	5,590

Table 3a: Nominal catches of redfish in Subdiv. 3Pn by month (1992 to 1994 are provisional).

Year	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1982	153	502	288	923	652	959	280	3,757
1983	217	294	622	791	144	356	183	2,607
1984	87	305	258	173	435	130	72	1,460
1985	131	272	527	206	135	122	194	1,587
1986	69	169	94	84	188	282	72	958
1987	77	97	242	74	13	45	800	1,348
1988	120	39	123	74	40	69	19	484
1989	7	44	153	878	611	131	129	1,953
1990	4	36	64	55	8	4	18	189
1991	10	9	44	42	250	310	335	1,000
1992	19	6	11	21	394	79	236	766
1993	376	347	128	777	3,373	3,237	2,542	10,780
1994	16	212	5	1,375	1,050	882	347	3,887

Table 3b: Nominal catches of redfish in Subdiv. 3Ps by month (1992 to 1994 are provisional).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1982	4	5	27	127	154	133	220	580	193	398	205	44	2,090
1983	8	11	25	28	82	61	133	462	667	957	168	394	2,996
1984	9	126	179	39	114	470	804	141	40	37	22	24	2,005
1985	32	27	102	50	126	127	361	413	367	150	63	36	1,854
1986	13	37	685	281	499	433	754	213	343	111	186	96	3,651
1987	41	94	110	139	172	268	439	244	189	92	74	307	2,169
1988	73	557	208	129	135	180	128	179	200	97	126	374	2,386
1989	263	174	353	356	116	402	185	376	522	60	37	30	2,874
1990	140	2,161	1,104	370	59	277	298	435	357	159	50	28	5,438
1991	210	1,234	378	678	79	80	365	361	393	450	51	111	4,390
1992	92	763	3,716	911	113	110	106	272	261	122	87	76	6,629
1993	111	1,349	1,167	1,012	559	129	85	183	213	726	939	491	6,964
1994	1,528	255	81	382	2,222	756	537	184	399	787	606	151	7,888

Table 3c: Nominal catches of redfish in Subdiv. 4Vn by month (1992 to 1994 are provisional).

Year	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1982	737	608	1,579	1,420	917	685	404	6,350
1983	688	412	768	792	137	577	185	3,559
1984	393	375	295	164	440	63	399	2,129
1985	705	517	1,123	244	114	197	243	3,143
1986	480	1,502	474	428	155	162	146	3,347
1987	2,041	1,611	941	603	132	327	768	6,423
1988	1,339	1,285	799	656	284	325	168	4,856
1989	1,700	857	881	602	250	42	904	5,236
1990	696	822	353	176	56	33	335	2,471
1991	4,181	627	620	555	182	737	844	7,746
1992	1,658	1,126	909	498	453	769	1,945	7,358
1993	3,714	2,363	1,418	352	188	53	4	8,092
1994	2,765	2,460	574	454	70	12	0	6,335

Table 3d: Nominal catches of redfish in Subdiv. 4Vs by month (1992 to 1994 are provisional).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1982	11	30	68	136	224	309	1,450	738	402	912	191	114	4,585
1983	9	86	176	31	131	300	564	561	446	1,255	17	182	3,758
1984	10	105	595	86	138	91	418	290	91	353	48	142	2,367
1985	98	510	242	207	187	469	940	615	126	410	341	357	4,502
1986	34	62	209	206	233	357	409	256	356	236	319	59	2,736
1987	35	27	187	477	330	806	529	616	304	115	150	75	3,651
1988	9	34	94	77	580	331	425	138	617	257	103	60	2,725
1989	30	31	170	35	800	2,651	388	376	248	191	68	2	4,990
1990	40	71	120	454	1,714	2,040	81	778	177	182	514	154	6,325
1991	89	52	67	1,315	5,845	243	387	19	260	20	224	16	8,537
1992	33	28	105	68	73	666	92	26	4	28	410	194	1,727
1993	1	4	209	313	182	274	55	7	0	21	26	63	1,155
1994	325	962	526	293	934	1,412	508	12	4	113	410	91	5,590

Table 3e: Nominal catches of redfish in 4Wfgj by month (1992 to 1994 are provisional).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1982	0	0	2	5	66	3	7	25	1	0	18	1	128
1983	0	0	2	26	4	26	20	169	106	116	16	4	489
1984	0	1	0	42	2	8	30	11	43	3	0	0	140
1985	6	1	2	3	0	0	139	10	1	12	2	18	194
1986	0	0	1	1	4	0	2	0	0	0	7	0	15
1987	0	1	16	17	5	60	55	1	1	32	7	0	195
1988	0	0	1	0	4	5	24	34	67	5	16	0	156
1989	1	6	5	0	11	10	16	9	11	3	9	0	81
1990	6	8	20	3	10	0	2	3	0	0	21	0	73
1991	0	11	3	5	14	0	37	13	2	5	2	6	98
1992	13	12	3	9	6	71	30	4	1	12	152	160	473
1993	0	0	22	2	16	5	20	17	1	25	0	0	108
1994	0	2	28	44	59	112	3	15	0	2	0	2	267

Table 4a: Nominal catches (t) of redfish in Division 3P by gear (1992 to 1994 are provisional).

Year	3Pn			Total	3Ps			Total
	Bottom trawl	Midwater trawl	Other		Bottom trawl	Midwater trawl	Other	
1982	3,755	-	2	3,757	1,777	-	313	2,090
1983	2,591	-	16	2,607	2,630	-	377	3,007
1984	1,445	-	15	1,460	1,130	-	275	1,405
1985	1,584	-	3	1,587	1,533	-	321	1,854
1986	953	5	-	958	2,920	152	579	3,651
1987	1,057	285	6	1,348	1,311	35	823	2,169
1988	413	62	9	484	1,389	467	530	2,386
1989	1,440	499	14	1,953	1,527	747	600	2,874
1990	147	40	2	189	933	3,162	1,343	5,438
1991	402	570	78	1,050	1,641	1,599	1,150	4,390
1992	196	537	33	766	1,137	4,639	853	6,629
1993	4,783	5,965	32	10,780	2,227	4,301	435	6,963
1994	2,736	1,121	30	3,887	3,017	4,789	81	7,887

Table 4b: Nominal catches (t) of redfish in Division 4V by gear (1992 to 1994 are provisional).

Year	4Vn			Total	4Vs			Total
	Bottom trawl	Midwater trawl	Other		Bottom trawl	Midwater trawl	Other	
1982	6,345	-	5	6,350	4,585	-	-	4,585
1983	3,557	-	2	3,559	3,743	1	14	3,758
1984	1,811	315	3	2,129	2,267	100	-	2,367
1985	3,131	-	12	3,143	4,502	-	-	4,502
1986	3,153	182	12	3,347	2,731	5	-	2,736
1987	5,338	1,049	36	6,423	3,615	35	1	3,651
1988	4,506	314	36	4,856	2,720	5	-	2,725
1989	2,853	2,350	33	5,236	2,911	2,075	4	4,990
1990	1,923	444	104	2,471	3,530	2,789	6	6,325
1991	5,060	3,619	167	8,846	2,308	6,223	6	8,537
1992	4,128	3,030	190	7,348	1,112	612	3	1,727
1993	3,716	4,363	13	8,092	749	395	11	1,155
1994	3,178	3,060	97	6,335	4,391	1,170	29	5,590

TABLE 5a. REGRESSION OF MULTIPLICATIVE MODEL FOR CATCH AND EFFORT DATA FOR UNIT 2 REDFISH

MULTIPLE R..... 0.717
 MULTIPLE R SQUARED..... 0.514

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	5.517E2	5.517E2	
REGRESSION	94	6.931E2	7.373E0	36.027
CNTRY-GEAR-TC	41	2.790E2	6.805E0	33.250
MONTH	11	2.944E1	2.677E0	13.078
SUBDIVISION	4	1.434E1	3.584E0	17.512
% REDFISH	4	7.024E1	1.756E1	85.803
YEAR	34	2.002E2	5.889E0	28.774
RESIDUALS	3207	6.564E2	2.047E-1	
TOTAL	3302	1.901E3		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	3114	INTERCEPT	-0.633	0.102	3302
2	7				
3	37				
4	95				
5	60				
1	2114	1	0.087	0.033	311
	2124	2	-0.054	0.061	65
	2125	3	0.367	0.050	107
	2154	4	0.292	0.064	61
	2155	5	0.664	0.071	46
	3121	6	0.044	0.142	12
	3123	7	0.297	0.113	19
	3124	8	0.109	0.043	154
	3125	9	0.201	0.031	388
	3126	10	0.258	0.146	11
	3144	11	0.400	0.089	29
	3151	12	0.276	0.154	10
	3153	13	0.494	0.150	10
	3154	14	0.502	0.068	53
	3155	15	0.534	0.050	118
	3156	16	0.990	0.120	17
	9114	17	-0.131	0.064	58
	9125	18	0.257	0.078	38
	11115	19	0.339	0.150	10
	11116	20	0.610	0.147	10
	11126	21	0.717	0.109	19
	11127	22	0.751	0.207	5
	14124	23	0.501	0.166	8
	14125	24	0.597	0.142	11
	14126	25	0.531	0.093	27
	14127	26	0.908	0.062	65
	16127	27	0.379	0.111	18

TABLE 5a. REGRESSION COEFFICIENTS (continued)

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
	20114	28	-0.618	0.074	44
	20127	29	1.455	0.083	34
	20157	30	1.495	0.141	11
	27114	31	0.389	0.045	168
	27122	32	-0.071	0.133	13
	27123	33	-0.014	0.100	25
	27124	34	0.516	0.051	112
	27125	35	0.690	0.038	356
	27154	36	0.774	0.103	22
	27155	37	0.800	0.058	95
	27156	38	1.036	0.190	6
	27157	39	1.042	0.157	9
	28124	40	0.377	0.206	5
	28154	41	0.715	0.101	23
2	1	42	0.198	0.064	60
	2	43	0.317	0.054	95
	3	44	0.122	0.045	149
	4	45	0.064	0.045	144
	5	46	0.091	0.043	166
	6	47	0.105	0.031	426
	8	48	-0.060	0.030	433
	9	49	-0.050	0.032	387
	10	50	-0.096	0.032	375
	11	51	-0.158	0.033	322
	12	52	0.025	0.035	277
3	36	53	0.056	0.027	483
	44	54	-0.029	0.024	820
	45	55	0.117	0.023	799
	71	56	-0.208	0.051	111
4	55	57	-0.638	0.046	119
	65	58	-0.455	0.040	161
	75	59	-0.328	0.030	295
	85	60	-0.218	0.024	525
5	61	61	-0.017	0.132	27
	62	62	0.209	0.128	31
	63	63	0.167	0.123	39
	64	64	0.212	0.125	36
	65	65	0.466	0.123	40
	66	66	0.533	0.114	66
	67	67	0.525	0.114	81
	68	68	0.397	0.114	66
	69	69	0.386	0.112	89
	70	70	0.295	0.109	115
	71	71	0.192	0.108	139
	72	72	0.099	0.108	133
	73	73	0.086	0.108	127
	74	74	-0.123	0.107	148
	75	75	-0.105	0.107	147
	76	76	-0.276	0.110	101
	77	77	-0.190	0.108	134
	78	78	-0.150	0.107	151
	79	79	-0.334	0.109	143
	80	80	-0.232	0.110	120
	81	81	-0.280	0.111	106
	82	82	-0.061	0.112	99

TABLE 5a. REGRESSION COEFFICIENTS (continued)

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
	83	83	-0.009	0.114	82
	84	84	-0.156	0.120	53
	85	85	-0.207	0.111	111
	86	86	-0.234	0.111	112
	87	87	-0.227	0.112	103
	88	88	-0.226	0.112	102
	89	89	0.218	0.115	86
	90	90	0.615	0.118	65
	91	91	0.434	0.115	102
	92	92	0.307	0.115	98
	93	93	0.061	0.114	130
	94	94	-0.499	0.114	99

Table 5b. Standardized catch rates for Unit 2 Redfish.

YEAR	LN TRANSFORM		RETRANSFORMED		CATCH	EFFORT
	MEAN	S.E.	MEAN	S.E.		
1960	-0.6329	0.0104	0.585	0.060	23287	39790
1961	-0.6498	0.0084	0.576	0.053	18685	32437
1962	-0.4236	0.0072	0.723	0.061	21347	29541
1963	-0.4663	0.0060	0.693	0.053	22290	32171
1964	-0.4209	0.0064	0.725	0.058	23192	31992
1965	-0.1664	0.0059	0.935	0.072	21850	23364
1966	-0.0998	0.0038	1.001	0.062	28392	28374
1967	-0.1076	0.0037	0.993	0.060	42170	42472
1968	-0.2360	0.0039	0.873	0.054	20169	23097
1969	-0.2468	0.0032	0.864	0.049	46276	53554
1970	-0.3378	0.0027	0.789	0.041	49407	62606
1971	-0.4407	0.0025	0.712	0.036	58200	81732
1972	-0.5334	0.0025	0.649	0.033	45201	69643
1973	-0.5470	0.0025	0.640	0.032	31827	49710
1974	-0.7555	0.0024	0.520	0.025	34038	65482
1975	-0.7377	0.0023	0.529	0.025	38471	72707
1976	-0.9090	0.0030	0.446	0.024	23709	53198
1977	-0.8224	0.0025	0.486	0.024	28750	59141
1978	-0.7832	0.0023	0.506	0.024	26548	52509
1979	-0.9668	0.0025	0.421	0.021	18771	44611
1980	-0.8649	0.0027	0.466	0.024	17129	36770
1981	-0.9124	0.0029	0.444	0.024	21751	48970
1982	-0.6934	0.0031	0.553	0.031	17025	30792
1983	-0.6416	0.0036	0.582	0.035	13473	23144
1984	-0.7885	0.0050	0.502	0.035	8141	16209
1985	-0.8395	0.0029	0.478	0.026	11494	24056
1986	-0.8668	0.0029	0.465	0.025	10765	23156
1987	-0.8596	0.0031	0.468	0.026	13956	29808
1988	-0.8585	0.0032	0.469	0.026	10728	22888
1989	-0.4152	0.0038	0.730	0.045	15386	21077
1990	-0.0183	0.0047	1.085	0.074	14792	13631
1991	-0.1993	0.0039	0.906	0.057	23205	25617
1992	-0.3258	0.0041	0.798	0.051	17167	21509
1993	-0.5714	0.0037	0.624	0.038	27098	43396
1994	-1.1316	0.0036	0.357	0.021	23966	67203

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.061

Table 6. Mean number of redfish caught per standard tow in Division 3Ps during Canadian research surveys 1973-1993 (Numbers in brackets are number of successful sets, * indicates those strata estimated with a multiplicative model utilizing data to 1991.)

Stratum	Depth range (m)	Area (sq.n.mi.)	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
			ATC 207 Mar 12-25	ATC 221 Apr 19-30	ATC 234 Jun 2-13	ATC 247-248 May 11-Jun 6	ATC 261 Apr 14-26	ATC 275 Apr 4-14	ATC 287 Feb 16-Mar 5	ATC 302 Mar 19-Apr 2	ATC 316 Mar 7-26	ATC 330 May 28-Jun 9	AN 9 Apr 22-May 8
306	185-274	419	844.56 *	573.67(6)	3198.00(6)	2284.67(6)	2159.20(6)	2177.33(6)	408.40(5)	1051.50(2)	1830.67(3)	934.67(3)	421.50(4)
307	93-183	395	288.80(5)	200.71(7)	4067.03(4)	1861.25(4)	1252.50(4)	234.25(4)	20.50(4)	83.50(2)	924.67(3)	150.00(4)	121.25(4)
309	185-274	296	3647.00(3)	1386.75(4)	8421.66(6)	5836.57(7)	1955.48(6)	1019.33(6)	2540.33(6)	24599.00(2)	7772.50(2)	522.00(2)	981.33(3)
310	185-274	170	95.00(1)	175.00(3)	2981.52(6)	5497.80(5)	110.50(6)	622.33(6)	316.00(6)	240.00(2)	252.50(2)	5677.00(3)	547.00(3)
311	93-183	317	3.78(9)	495.00(8)	7.00(4)	805.67(6)	1022.00(4)	0.00(4)	19.50(4)	0.00(2)	6.50(2)	7.67(3)	0.00(3)
313	185-274	165	1.50(2)	133.00(5)	1010.33(3)	990.50(6)	78.90(10)	130.00(2)	80.00(5)	95.50(2)	187.00(2)	4397.00(2)	829.33(3)
316	185-274	189	228.33(3)	150.00(6)	1471.00(1)	1368.25(4)	86.42(6)	119.00(6)	110.67(3)	384.00(2)	175.00(2)	457.00(1)	653.75(4)
317	93-183	193	1.57(7)	217.62(8)	558.00(4)	466.50(4)	691.37(4)	3.25(4)	16.33(3)	3.50(2)	1.00(2)	112.00(3)	7980.66(3)
318	185-274	123	999.00(1)	169.50(2)	2034.29(4)	2087.00(7)	228.00(6)	480.50(2)	292.50(2)	1403.50(2)	807.29 *	6077.00(2)	1688.33(3)
319	93-183	984	174.20(5)	411.00(2)	432.43(4)	92.25(4)	83.17(6)	1241.00(4)	156.00(2)	3.00(4)	8455.00(2)	260.57(7)	27.29(7)
705	275-366	195	476.50(2)	56.75(4)	154.94(2)	256.20(5)	79.50(4)	251.67(3)	73.50(4)	161.00(2)	162.00(2)	644.00(2)	5.67(3)
706	275-366	476	640.00(2)	226.57(7)	165.00(1)	73.75(4)	112.28(4)	71.00(2)	312.00(3)	97.00(2)	86.00(2)	118.00(4)	77.80(5)
707	275-366	93	568.73 *	590.00(2)	785.25(4)	1893.67(6)	210.01(4)	649.50(2)	740.50(2)	211.00(2)	554.88 *	221.53 *	306.33(3)
708	367-549	117	444.99 *	574.52 *	185.00(3)	520.33(3)	364.21(4)	473.00(1)	592.50(2)	89.00(2)	434.29 *	173.32 *	722.00(2)
709	550-731	96	7.07 *	9.27 *	14.03 *	102.50(2)	8.80 *	7.26 *	4.83 *	1.39 *	6.89 *	2.46 *	0.50(2)
710	550-731	36	6.73 *	8.83 *	13.37 *	10.34 *	8.38 *	6.91 *	4.59 *	1.30 *	6.56 *	2.32 *	3.75(3)
711	367-549	961	202.08 *	260.97 *	388.34 *	169.50(2)	248.46 *	207.22 *	142.21 *	25.50(2)	32.50(2)	11.50(2)	68.13(8)
712	367-549	973	182.57 *	235.78 *	350.89 *	151.50(2)	224.48 *	187.24 *	104.00(2)	71.00(2)	150.50(2)	23.00(3)	67.86(7)
713	367-549	950	132.38 *	171.01 *	39.43(3)	87.50(2)	162.81 *	135.76 *	93.11 *	15.00(2)	65.33(6)	11.50(2)	23.71(7)
714	367-549	1195	228.90 *	295.59 *	439.79 *	248.50(2)	281.43 *	127.00(2)	145.00(1)	64.00(2)	50.50(8)	39.67(6)	62.30(10)
715	275-366	132	588.00(1)	62.75(4)	318.00(2)	811.40(5)	124.00(4)	343.75(4)	717.00(3)	2417.50(2)	1015.50(2)	20.00(2)	71.33(3)
716	275-366	539	412.00(1)	108.00(3)	1367.39 *	252.00(3)	127.50(6)	473.50(4)	173.00(4)	43.00(2)	207.75(4)	122.00(2)	54.50(4)
<u>Stratified Analysis:</u>													
Upper			1113.7	1499.3	2576.9	1009.5	746.4	1157.1	415.8	9026.0	14082.20	698.3	843.1
Mean			563.1	357.4	1561.4	750.2	585.0	566.7	313.0	978.9	1459.9	432.1	339.7
Lower			12.5	-784.6	545.9	490.8	423.7	-23.6	210.2	-7068.2	-11162.5	165.9	-163.8
<u>Multiplicative Analysis:</u>													
Mean			385.3	303.9	987.3	747.2	417.0	432.6	244.8	964.6	1407.0	420.8	339.7
Total (x 10 ⁶)			260.7	205.6	668.0	505.6	282.2	292.7	165.7	652.7	952.0	284.7	229.8

Table 6. (Cont'd.)

Stratum	Depth range (m)	Area (sq.n.mi.)	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1993
			AN 26 Apr 9-18	WT 26 Mar 7-26	WT 45 Mar 5-24	WT 55-56 Feb 12-Mar 23	WT 68 Jan 26-Feb 15	WT 81 Jan 31-Feb 17	WT 91 Jan 31-Feb 20	WT 103 Feb 2-20	WT 118 Feb 6-24	WT 133 Feb 6-23	WT 135 Apr 2-20
306	185-274	419	15.50(2)	313.00(2)	623.67(3)	231.25(4)	493.50(4)	137.33(3)	819.33(3)	870.75(4)	65.50(2)	367.50(4)	357.75(4)
307	93-183	395	127.00(2)	53.33(3)	17.00(3)	36.33(3)	44.50(4)	14.33(3)	37.67(3)	6.00(3)	1.50(2)	6.50(4)	7.67(3)
309	185-274	296	50.50(2)	453.00(3)	618.50(2)	1142.50(2)	535.00(3)	398.50(2)	363.00(2)	1898.67(3)	32.50(2)	46.00(3)	2929.00(2)
310	185-274	170	70.50(2)	1225.33(3)	303.00(2)	33.50(2)	801.33(3)	326.00(2)	85.50(2)	8716.00(2)	3.50(2)	79.00(2)	910.50(2)
311	93-183	317	41.00(2)	11.00(4)	0.00(3)	0.00(3)	1.50(4)	2.67(3)	0.00(3)	0.00(3)	1.00(2)	3.67(3)	0.00(2)
313	185-274	165	35.00(2)	1033.50(2)	988.00(2)	150.50(2)	181.00(2)	507.50(2)	61.50(2)	4682.50(2)	757.00(2)	35.00(2)	452.00(2)
316	185-274	189	127.00(2)	140.00(3)	57.50(2)	313.67(3)	210.00(3)	76.40(3)	151.00(2)	731.50(2)	661.00(2)	0.01(1)	196.67(3)
317	93-183	193	882.50(2)	0.00(2)	0.00(2)	0.00(3)	2.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)
318	185-274	123	138.00(2)	216.16 *	958.00(2)	5547.50(2)	58.50(2)	658.50(2)	410.35 *	564.00(2)	216.80(2)	52.50(2)	962.50(2)
319	93-183	984	11.67(6)	0.00(2)	15.88(8)	9.11(9)	99.38(8)	11.50(8)	37.65 *	7.33(9)	2.60(10)	0.89(9)	3.83(6)
705	275-366	195	28.50(2)	78.00(2)	424.00(2)	247.50(2)	121.00(2)	30.00(2)	22.00(2)	54.00(2)	178.00(2)	20.00(2)	235.00(2)
706	275-366	476	75.00(2)	465.25(4)	308.25(4)	181.92(5)	429.75(4)	91.00(4)	38.50(4)	201.00(4)	69.20(5)	17.67(3)	44.20(5)
707	275-366	93	226.00(2)	148.46 *	265.50(2)	200.50(2)	634.00(2)	302.13(2)	281.98 *	1389.50(2)	2203.50(2)	1306.50(2)	1148.25(2)
708	367-549	117	113.00(2)	116.11 *	278.75(2)	354.50(2)	432.50(2)	549.00(2)	220.65 *	435.50(2)	881.50(2)	2179.00(2)	7044.00(2)
709	550-731	96	4.50(2)	1.48 *	0.00(1)	14.29(1)	6.83 *	12.50(2)	3.26 *	18.00(2)	1.71 *	33.04(2)	4.44(2)
710	550-731	36	1.00(2)	8.00(2)	78.00(2)	2.51 *	114.50(2)	3.74 *	3.09 *	11.00(2)	34.00(1)	18.44(2)	0.00(2)
711	367-549	961	20.40(5)	121.75(8)	280.78(9)	154.00(7)	181.43(7)	315.43(7)	312.67(3)	265.88(8)	189.20(10)	240.60(5)	41.80(5)
712	367-549	973	31.85 *	44.33(6)	120.78(9)	117.00(4)	115.71(7)	347.50(8)	180.80(5)	71.75(8)	123.10(10)	50.00(7)	58.29(7)
713	367-549	950	22.98 *	55.50(8)	66.80(5)	197.00(4)	954.43(7)	212.88(8)	113.43(7)	279.19(8)	72.10(10)	76.13(8)	96.50(6)
714	367-549	1195	40.03 *	69.00(1)	89.40(5)	66.25(4)	488.33(9)	394.90(10)	301.29(7)	236.36(11)	285.14(7)	170.33(11)	127.22(9)
715	275-366	132	43.50(2)	2448.00(1)	569.00(2)	463.00(2)	307.50(2)	1542.00(2)	1476.50(2)	9797.50(2)	624.50(2)	1976.00(2)	1219.50(4)
716	275-366	539	18.67(3)	84.60(5)	207.00(4)	226.00(3)	240.80(5)	123.25(4)	45.80(5)	25.40(5)	175.67(3)	16.75(4)	42.25(4)
<u>Stratified Analysis:</u>													
Upper			238.3	225.8	282.5	1299.6	531.3	358.6	374.8	1658.2	217.5	282.00	698.32
Mean			74.0	164.0	206.8	240.6	334.4	240.1	225.4	650.9	178.0	160.46	325.18
Lower			-90.2	102.3	131.0	-818.5	137.6	121.7	76.0	-356.5	138.6	38.92	-47.96
<u>Multiplicative Analysis:</u>													
Mean			59.6	183.1	204.5	237.2	331.1	239.2	204.7	650.9	175.6	157.1	325.2
Total (x 10 ⁶)			40.3	123.9	138.4	160.5	224.0	161.8	138.5	440.4	118.8	106.3	220.0

Table 8. Mean weight (kg) of redfish caught per standard tow in Division 3Ps during Canadian research surveys, 1973-1993. (Numbers in brackets indicate number of sets; * indicates strata estimated using a multiplicative model utilizing data to 1991.)

Stratum	Depth range (m)	Area (sq.n.mi.)	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
			ATC 207 Mar 12-25	ATC 221 Apr 19-30	ATC 234 Jun 2-13	ATC 247-248 May 11-Jun 6	ATC 261 Apr 14-26	ATC 275 Apr 4-14	ATC 287 Feb 16-Mar 5	ATC 302 Mar 19-Apr 2	ATC 316 Mar 7-26	ATC 33 May 28-Jun 9	AN 9 Apr 22-May 8	AN 26 Apr 9-18
306	185-274	419	83.09 *	56.09(6)	175.99(6)	188.85(6)	137.59(6)	298.47(6)	48.90(5)	165.71(2)	44.93(3)	54.93(3)	81.13(4)	3.51(2)
307	93-183	395	12.25(5)	8.55(7)	34.34(4)	58.91(4)	47.29(4)	17.69(4)	3.06(4)	12.38(2)	21.17(3)	4.05(4)	49.00(4)	69.25(2)
309	185-274	296	541.59(3)	135.85(4)	666.33(6)	939.79(7)	224.35(6)	108.48(6)	337.55(6)	3908.91(2)	264.50(2)	42.50(2)	101.92(3)	12.25(2)
310	185-274	170	2.27(1)	34.62(3)	256.09(6)	416.67(5)	29.22(6)	96.61(6)	59.35(6)	35.64(2)	17.50(2)	529.11(3)	34.67(3)	4.75(2)
311	93-183	317	0.30(9)	30.53(8)	0.11(4)	17.69(6)	61.12(4)	0.00(4)	3.69(4)	0.00(2)	1.50(2)	0.17(3)	0.00(3)	4.00(2)
313	185-274	165	0.90(2)	16.51(5)	153.62(3)	168.74(6)	12.60(10)	24.94(2)	11.25(5)	15.55(2)	29.00(2)	158.50(2)	44.33(3)	3.50(2)
316	185-274	189	25.71(3)	20.26(6)	48.99(1)	290.30(4)	13.61(6)	14.17(6)	10.89(3)	51.30(2)	21.00(2)	36.50(1)	55.88(4)	9.75(2)
317	93-183	193	0.52(7)	16.22(8)	49.05(4)	8.16(4)	41.94(4)	0.21(4)	1.74(3)	3.40(2)	0.25(2)	1.07(3)	110.70(3)	31.25(2)
318	185-274	123	97.07(1)	23.13(2)	373.83(4)	324.71(7)	32.51(6)	56.70(2)	22.46(2)	94.89(2)	48.53 *	148.50(2)	88.50(3)	21.25(2)
319	93-183	984	12.91(5)	64.41(2)	70.35(4)	8.96(4)	5.62(6)	86.64(4)	6.58(2)	0.79(4)	46.00(2)	3.86(7)	4.79(7)	2.90(6)
705	275-366	195	241.31(2)	19.28(4)	90.15(2)	123.38(5)	22.34(4)	115.21(3)	44.03(4)	62.65(2)	49.50(2)	317.00(2)	4.33(3)	13.50(2)
706	275-366	476	91.18(2)	53.27(7)	37.19(1)	33.90(4)	31.91(4)	28.12(2)	60.18(3)	26.33(2)	17.00(2)	42.25(4)	11.50(5)	8.50(2)
707	275-366	93	136.99 *	93.89(2)	237.12(4)	469.55(6)	58.59(4)	100.24(2)	126.60(2)	38.82(2)	77.86 *	37.05 *	80.83(3)	96.75(2)
708	367-549	117	157.57 *	189.83 *	82.25(3)	210.02(3)	124.44(4)	192.00(1)	201.03(2)	15.43(2)	89.61 *	42.68 *	358.75(2)	40.50(2)
709	550-731	96	4.52 *	5.54 *	7.42 *	96.39(2)	4.40 *	5.41 *	3.24 *	1.31 *	2.36 *	0.87 *	0.10(2)	1.75(2)
710	550-731	36	7.67 *	9.34 *	12.40 *	12.67 *	7.48 *	9.12 *	5.58 *	2.45 *	4.16 *	1.73 *	2.27(3)	0.50(2)
711	367-549	961	90.88 *	109.52 *	143.78 *	128.37(2)	88.78 *	107.05 *	67.50 *	15.66(2)	13.50(2)	5.40(2)	28.21(8)	16.10(5)
712	367-549	973	112.77 *	135.88 *	178.34 *	121.11(2)	110.17 *	132.82 *	83.91(2)	40.18(2)	112.00(2)	15.00(3)	49.50(7)	30.09 *
713	367-549	950	87.61 *	105.59 *	30.50(3)	68.04(2)	85.59 *	103.21 *	65.07 *	10.44(2)	41.33(6)	8.25(2)	16.86(7)	23.29 *
714	367-549	1195	144.85 *	174.50 *	228.98 *	206.62(2)	141.52 *	89.36(2)	110.67(1)	41.09(2)	32.69(8)	30.08(6)	49.85(10)	38.75 *
715	275-366	132	201.40(1)	26.99(4)	99.79(2)	339.65(5)	39.12(4)	70.31(4)	383.81(3)	472.84(2)	183.84(2)	11.40(2)	12.50(3)	22.00(2)
716	275-366	539	258.55(1)	25.93(3)	101.59 *	106.90(3)	32.66(6)	155.13(4)	73.26(4)	22.02(2)	22.25(4)	25.25(2)	15.50(4)	10.07(3)
<u>Stratified Analysis:</u>														
Upper			168.2	218.7	198.1	182.2	65.0	145.4	87.0	1285.3	185.7	72.6	54.1	75.3
Mean			85.2	45.7	125.2	151.8	52.4	89.2	67.6	166.7	48.8	39.6	40.1	15.8
Lower			2.2	-127.3	52.4	121.4	39.8	33.0	48.3	-951.9	-88.1	6.7	26.0	-43.8
<u>Multiplicative Analysis:</u>														
Mean			107.8	86.9	137.3	151.3	77.1	97.4	72.1	164.3	49.0	39.0	40.1	21.1
Biomass (t)			72952	58800	92910	102343	52193	65903	48801	111141	33130	26401	27099	14304

Table 8. (Cont'd.)

Stratum	Depth range (m)	Area (sq.n.mi.)	1985	1986	1987	1988	1989	1990	1991	1992	1993	1993
			WT 26 Mar 7-26	WT 45 Mar 5-24	WT 55-56 Feb 12-Mar 23	WT 68 Jan 26-Feb 15	WT 81 Jan 31-Feb 17	WT 91 Jan 31-Feb 20	WT 103 Feb2-20	WT 118 Feb 6-24	WT 133 Feb 6-23	WT 135 Apr 2-20
306	185-274	419	37.00(2)	39.67(3)	24.63(4)	190.77(4)	10.33(3)	212.48(3)	32.64(4)	1.70(2)	17.53(4)	107.15(4)
307	93-183	395	3.70(3)	2.00(3)	5.67(3)	3.95(4)	3.00(3)	25.63(3)	0.44(3)	0.04(2)	0.69(4)	0.64(3)
309	185-274	296	85.33(3)	69.25(2)	127.00(2)	86.17(3)	69.00(2)	44.80(2)	235.25(3)	2.15(2)	2.77(3)	191.30(2)
310	185-274	170	95.83(3)	43.00(2)	4.00(2)	46.17(3)	16.25(2)	2.75(2)	132.77(2)	0.85(2)	3.10(2)	50.08(2)
311	93-183	317	1.97(4)	0.00(3)	0.00(3)	0.05(4)	0.13(3)	0.00(3)	0.00(3)	0.02(2)	0.17(3)	0.00(2)
313	185-274	165	89.50(2)	93.75(2)	20.25(2)	31.00(2)	25.00(2)	1.92(2)	42.26(2)	21.14(2)	1.47(2)	25.43(2)
316	185-274	189	12.83(3)	10.50(2)	40.50(3)	24.33(3)	4.87(3)	2.65(2)	7.97(2)	25.23(2)	0.01(1)	11.27(3)
317	93-183	193	0.00(2)	0.00(2)	0.00(3)	0.20(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)
318	185-274	123	27.04 *	149.75(2)	671.00(2)	13.00(2)	105.75(2)	48.70 *	14.23(2)	7.36(2)	7.05(2)	169.25(2)
319	93-183	984	0.00(2)	1.45(8)	1.19(9)	13.82(8)	1.00(8)	4.44 *	0.28(9)	0.05(10)	0.03(9)	0.22(6)
705	275-366	195	29.50(2)	90.50(2)	102.25(2)	65.00(2)	11.00(2)	5.50(2)	4.58(2)	34.33(2)	6.78(2)	91.30(2)
706	275-366	476	60.13(4)	45.88(4)	35.10(5)	114.35(4)	23.88(4)	10.78(4)	24.70(4)	10.84(5)	7.57(3)	7.70(5)
707	275-366	93	43.51 *	61.50(2)	69.50(2)	153.25(2)	108.28(2)	78.12 *	93.25(2)	321.02(2)	185.63(2)	271.79(2)
708	367-549	117	50.11 *	73.25(2)	101.75(2)	156.00(2)	228.00(2)	89.91 *	70.72(2)	338.30(2)	322.58(2)	1666.10(2)
709	550-731	96	1.11 *	0.00(1)	5.70(1)	5.43 *	6.25(2)	2.37 *	4.65(2)	0.79 *	19.71(2)	2.21(2)
710	550-731	36	5.25(2)	53.50(2)	3.74 *	68.63(2)	4.55 *	4.18 *	4.70(2)	16.70(1)	10.93(2)	0.00(2)
711	367-549	961	31.27(8)	119.11(9)	52.71(7)	84.71(7)	149.36(7)	165.15(3)	73.04(8)	75.35(10)	115.53(5)	16.94(5)
712	367-549	973	27.97(6)	70.78(9)	77.63(4)	68.00(7)	163.06(8)	83.46(5)	29.91(8)	64.88(10)	20.28(7)	25.86(7)
713	367-549	950	41.19(8)	45.10(5)	110.13(4)	651.84(7)	119.06(8)	57.26(7)	127.50(8)	38.22(10)	36.74(8)	42.03(6)
714	367-549	1195	31.00(1)	58.60(5)	48.38(4)	312.92(9)	204.10(10)	160.49(7)	104.55(11)	138.29(7)	78.12(11)	57.58(9)
715	275-366	132	1137.00(1)	97.25(2)	127.50(2)	133.00(2)	735.43(2)	353.00(2)	4253.50(2)	105.01(2)	935.83(2)	184.81(4)
716	275-366	539	27.50(5)	71.63(4)	147.50(3)	100.06(5)	52.88(4)	17.10(5)	8.30(5)	17.37(3)	3.53(4)	14.48(4)
<u>Stratified Analysis:</u>												
Upper			38.7	72.1	116.6	301.0	245.8	133.4	915.7	65.40	256.4	223.8
Mean			30.6	54.5	65.9	163.1	98.4	87.5	117.4	50.9	51.8	62.3
Lower			22.5	36.8	15.2	25.1	-49.0	41.6	-681.0	36.46	-152.9	-99.1
<u>Multiplicative Analysis:</u>												
Mean			46.9	53.9	65.0	161.4	98.0	76.6	117.4	50.3	50.7	62.3
Biomass (t)			31721	36472	44002	109193	66325	51820	79423	34006	34290	42180

Table 9: Mean weight of redfish caught per standard 30 min. tow during surveys to Subdiv. 3Ps utilizing a revised stratification scheme (number of sets indicated in ()).

Stratum	Depth range (m)	Area (sq.n.mi.)	1994		1995	
			WT 150-151 Apr 5-27		WT 166-167 Apr 3-29	
306	185-274	419	11.53	(4)	0.49	(3)
307	93-183	395	1.86	(4)	0.45	(4)
309	185-274	296	56.53	(3)	4.68	(3)
310	185-274	170	38.57	(3)	2.30	(2)
311	93-183	317	0.45	(4)	0.06	(3)
313	185-274	165	11.23	(2)	5.05	(2)
316	185-274	189	1.75	(2)	1.17	(2)
317	93-183	193	0.00	(2)	0.00	(2)
318	185-274	129	0.00	(2)	622.97	(2)
319	93-183	984	0.00	(9)	2.00	(8)
705	275-366	195	16.30	(3)	3,356.81	(2)
706	275-366	476	21.48	(4)	30.44	(4)
707	275-366	74	777.36	(2)	151.23	(2)
708	367-549	126	1,036.12	(2)	351.07	(2)
709	550-731	158	38.92	(2)	3.34	(2)
710	732-914	176	0.00	(2)	-	
711	367-549	961	18.62	(6)	84.86	(5)
712	367-549	973	58.72	(7)	71.04	(7)
713	367-549	950	64.32	(7)	89.79	(8)
714	367-549	1,195	52.43	(8)	98.01	(10)
715	275-366	132	74.05	(4)	403.97	(2)
716	275-366	539	10.19	(5)	9.24	(5)

Weight per Tow:

Upper	83.90	1,174.20
Mean	49.20	141.70
Lower	14.40	-890.90
Total Biomass (t)	33,994	86,210

Table 10. Mean weight (kg) of redfish caught per standard 15 minute tow in Unit2 during summer research surveys for 1994-1995. (Numbers in brackets are successful sets, "." indicates strata not sampled)

STRATUM	Depth Range (m)	Area sq. n. ml.	1994	1995
3Pn				
303	185-274	554	63.34	43.47
304	093-183	151	463.55	234.44
305	185-274	733	45.61	75.95
Upper			694.89	171.34
Mean			96.33	60.08
Lower			-502.23	-11.18
Biomass (metric tons)			17546	14588
3Ps				
306	185-274	363	45.37	14.50
309	185-274	296	146.39	191.89
310	105-274	170	136.20	12.70
313	185-274	165	18.01	124.95
316	185-274	189	136.11	162.04
318	185-274	129	270.81	303.17
705	275-366	195	229.86	45.25
706	275-366	476	296.88	88.19
707	275-366	74	1008.71	356.33
708	367-549	126	550.65	233.98
709	550-731	147	0.19	6.80
710	732-914	158	0.00	1.13
711	367-549	593	173.65	130.73
712	367-549	731	99.97	56.58
713	367-549	051	38.15	161.09
714	367-549	1047	78.86	92.97
715	275-366	128	127.28	63.03
716	275-366	539	79.08	67.41
Upper			173.06	140.77
Mean			129.70	104.29
Lower			86.34	67.61
Biomass (metric tons)			104733	84217
4Vn				
415	367-532	2915	113.49	65.36
416	275-366	671	264.84	103.88
417	185-274	387	300.25	56.16
Upper			225.44	85.64
Mean			157.24	70.98
Lower			89.04	56.32
Biomass (metric tons)			79133	35722
4Vs				
397	307-549	540	77.42	104.93
398	367-549	833	169.34	137.89
399	367-549	465	66.27	227.87
400	367-549	270	56.27	105.13
448	275-366	313	102.51	606.82
451	275-366	147	212.80	109.00
452	275-366	345	1.08	1.98
458	367-549	148	-	467.18
Upper			145.83	403.22
Mean			100.45	190.02
Lower			55.07	-23.18
Biomass (metric tons)			37065	73679
TOTAL BIOMASS			238477	208166

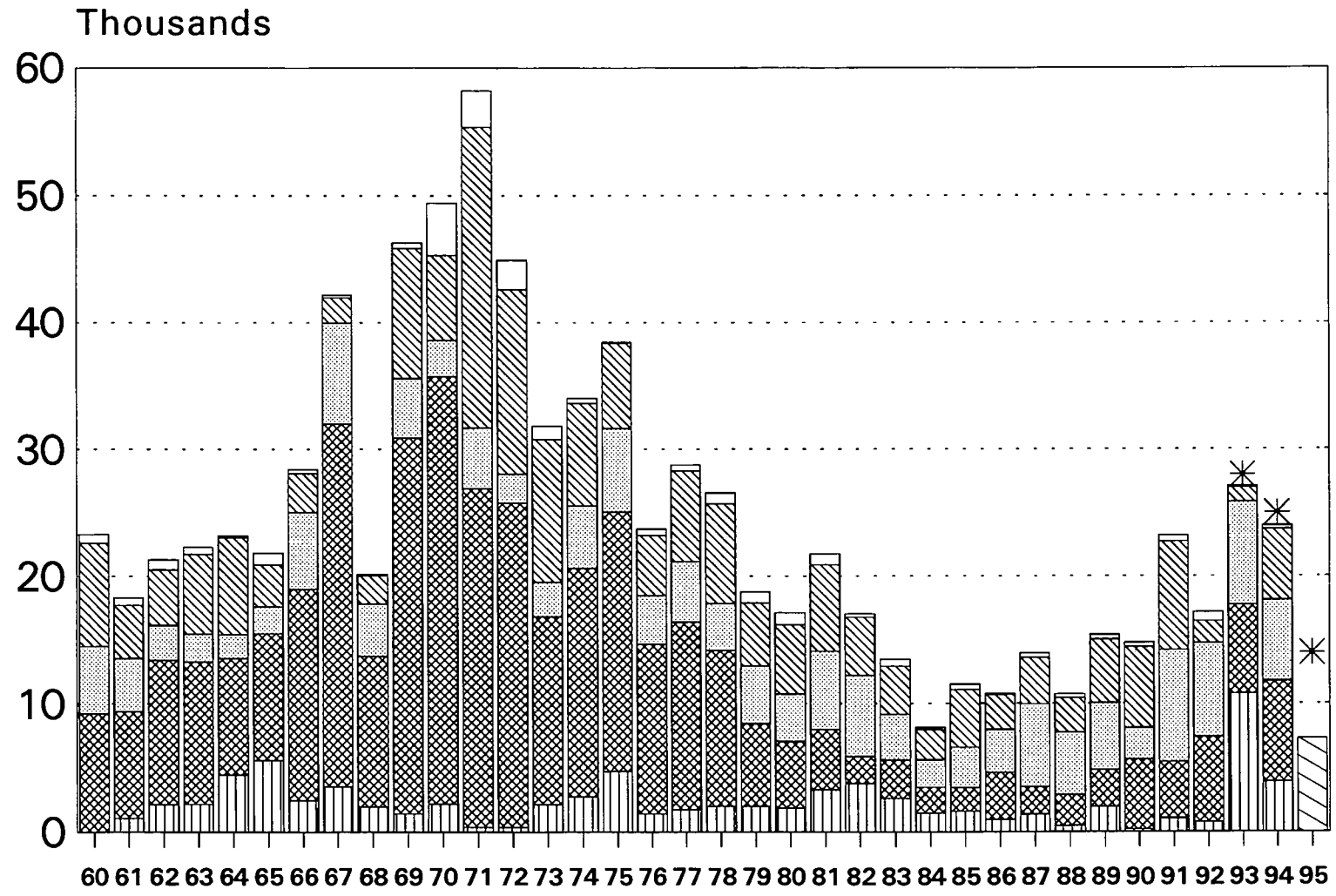
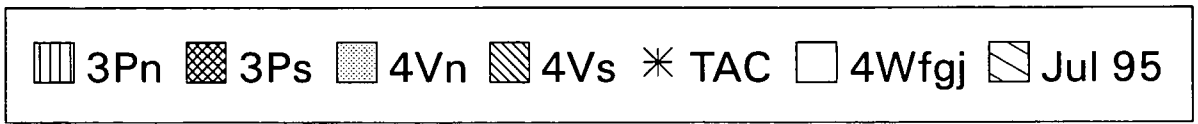


Fig. 1. Nominal catches of redfish from the "Laurentian Channel" management unit for 1960-1995 (1995 provisional to July 26).

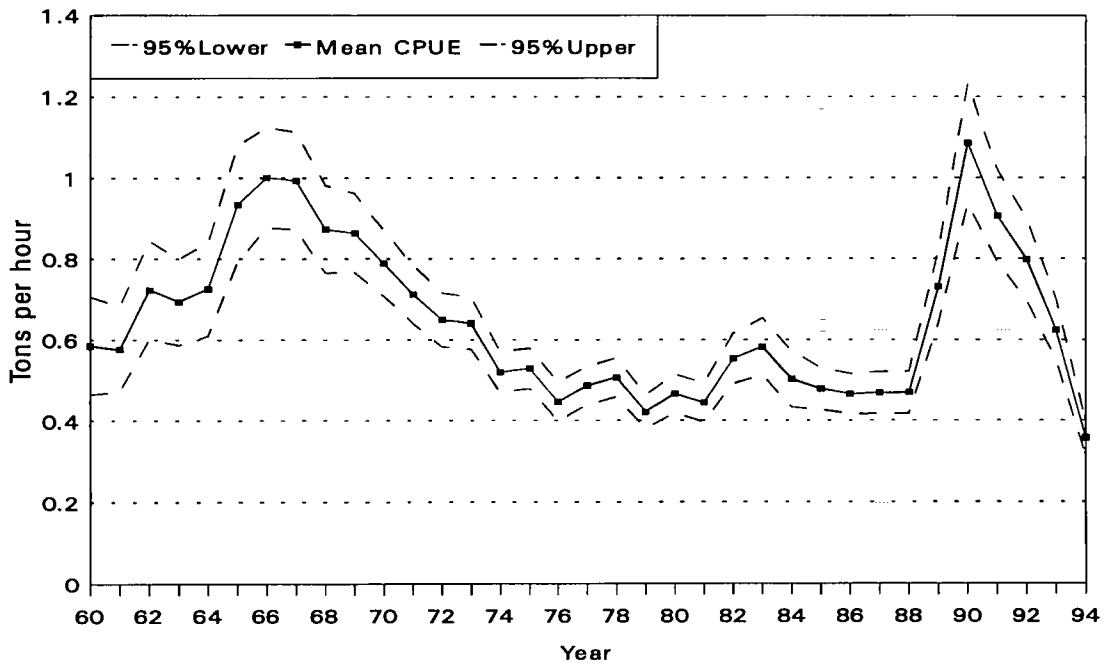


Fig. 2a. Standardized CPUE for redfish in Unit 2 from 1960-94 utilizing all gears and tonnage classes.

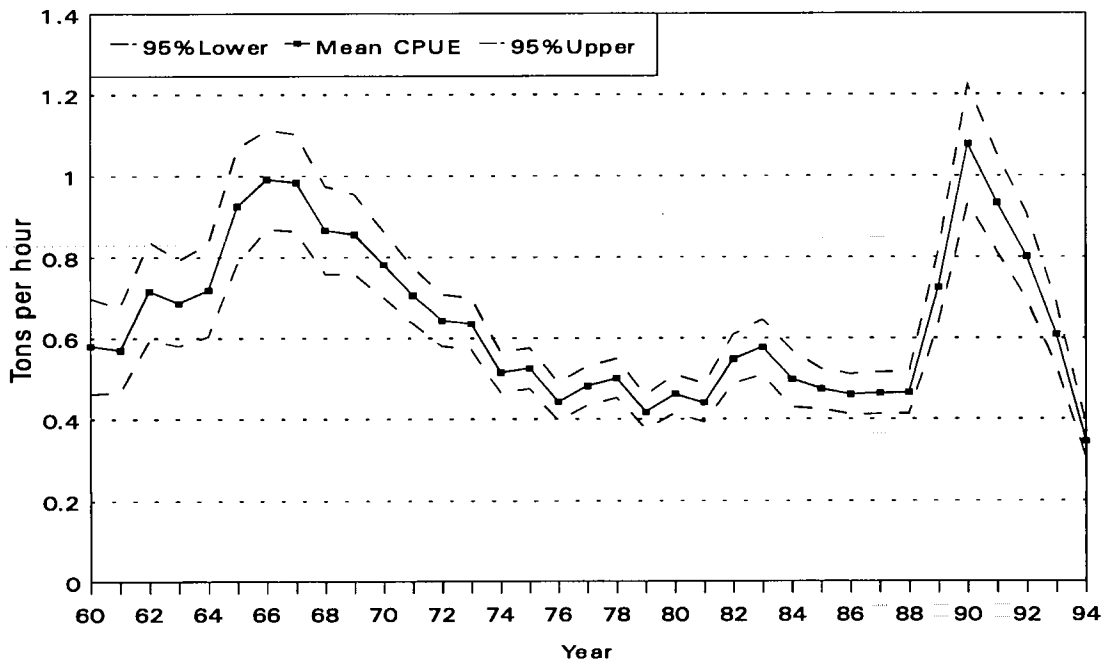


Fig. 2b. Standardized CPUE for redfish in Unit 2 from 1960-94 utilizing all gears and tonnage classes 4-7.

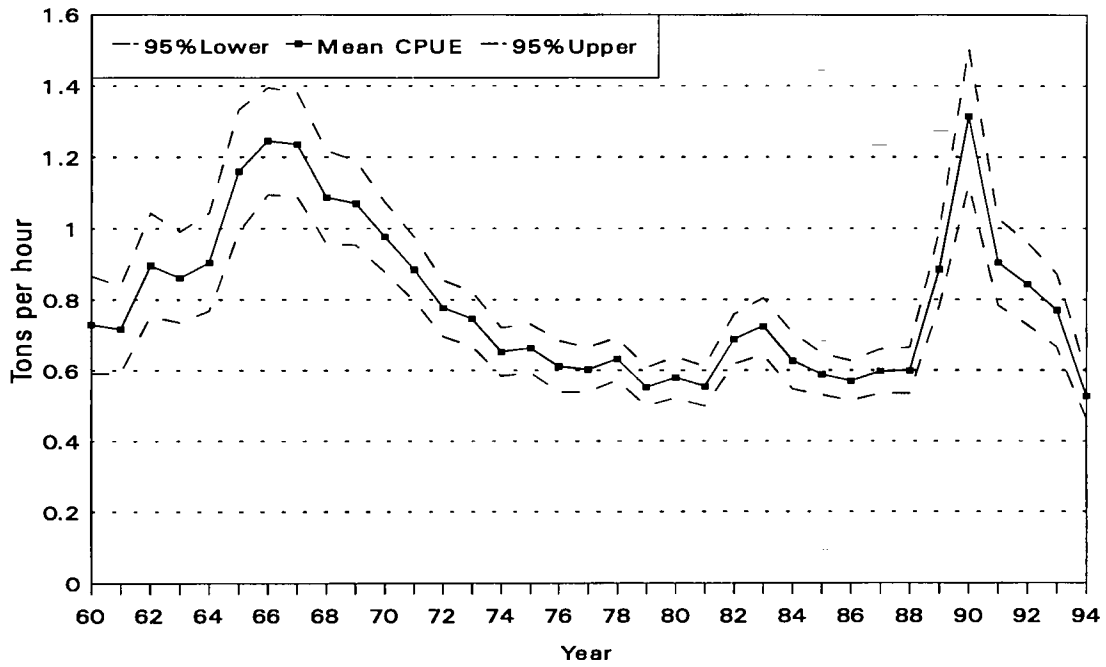


Fig. 2c. Standardized CPUE for redfish in Unit 2 from 1960-94 utilizing bottom trawls only and all tonnage classes.

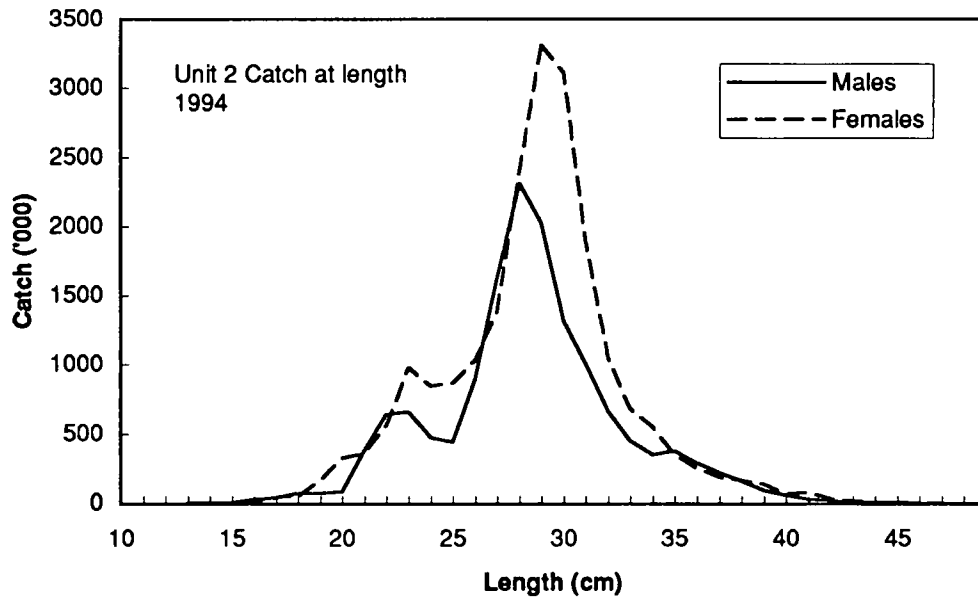


Fig. 3. Commercial catch at length for Unit2 redfish derived from port and observer samples weighted by monthly landings.

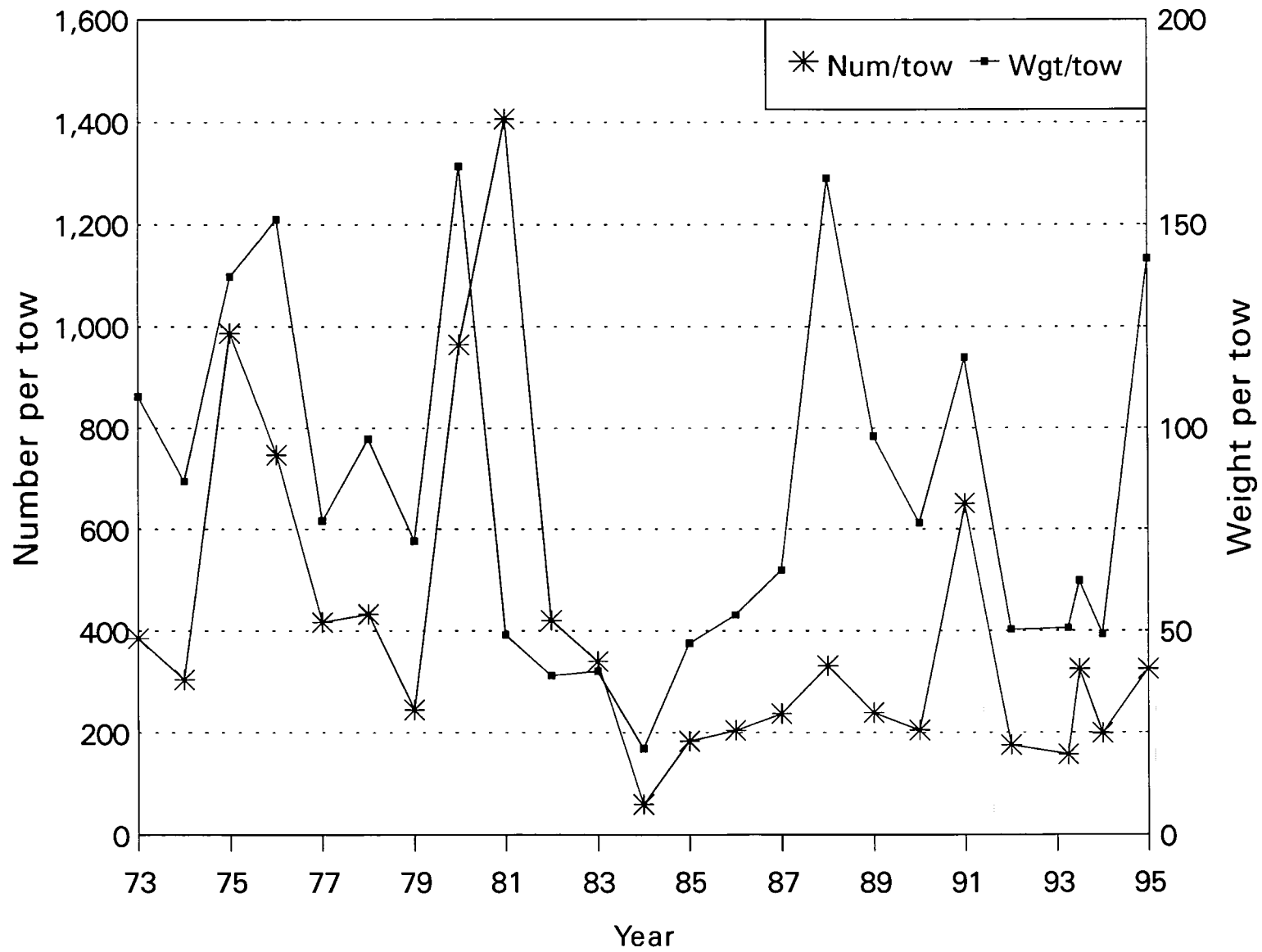


Fig. 4. RV mean numbers and weights per standard 30 minute tow for redfish in Subdiv 3Ps. from 1973 to 1995.

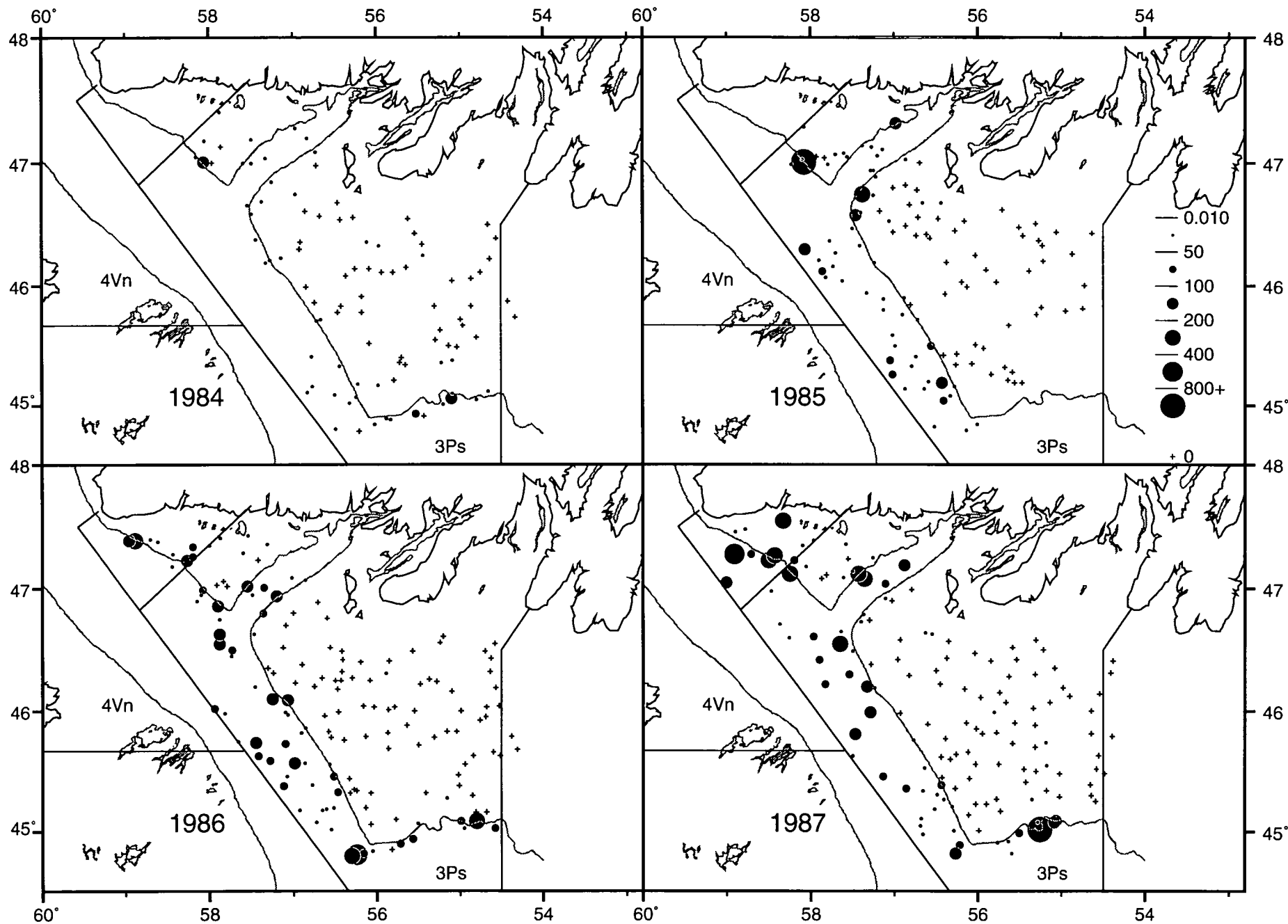


Fig. 5 Distribution of Redfish catches (Kg./standard tow) from 1984-1995 Canadian surveys to Div. 3P showing 250m depth contour.

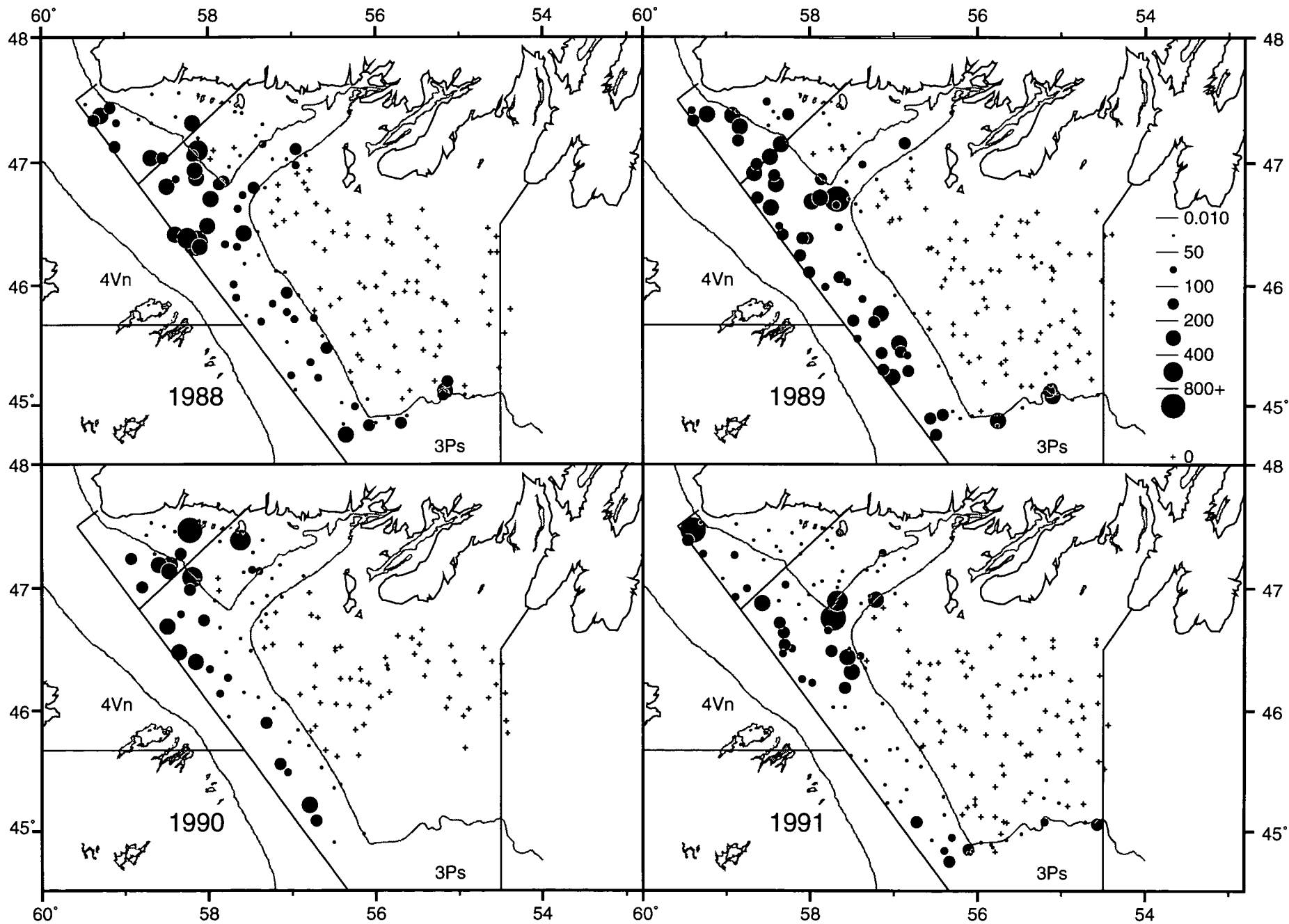


Fig. 5 (continued)

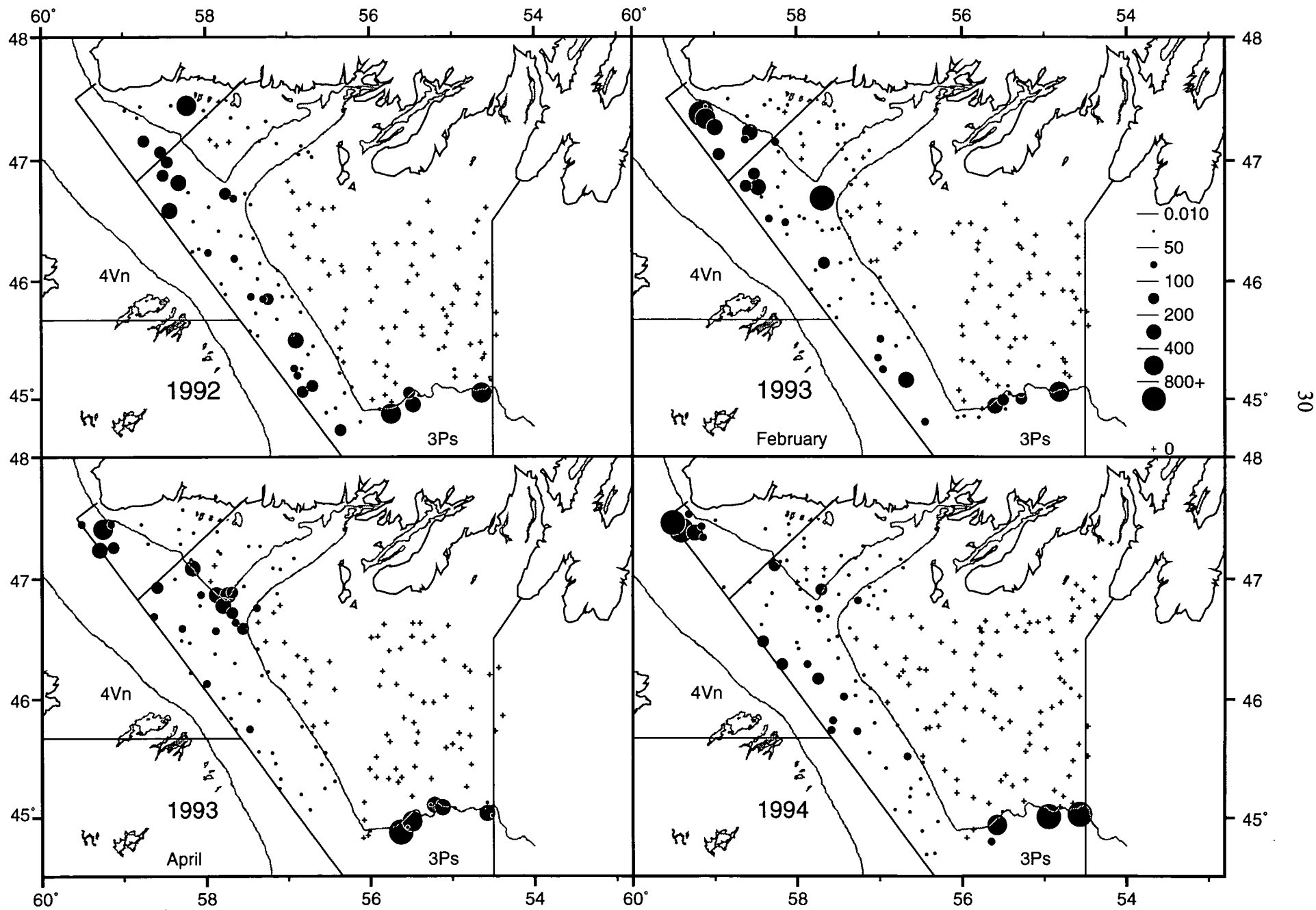


Fig. 5 (continued)

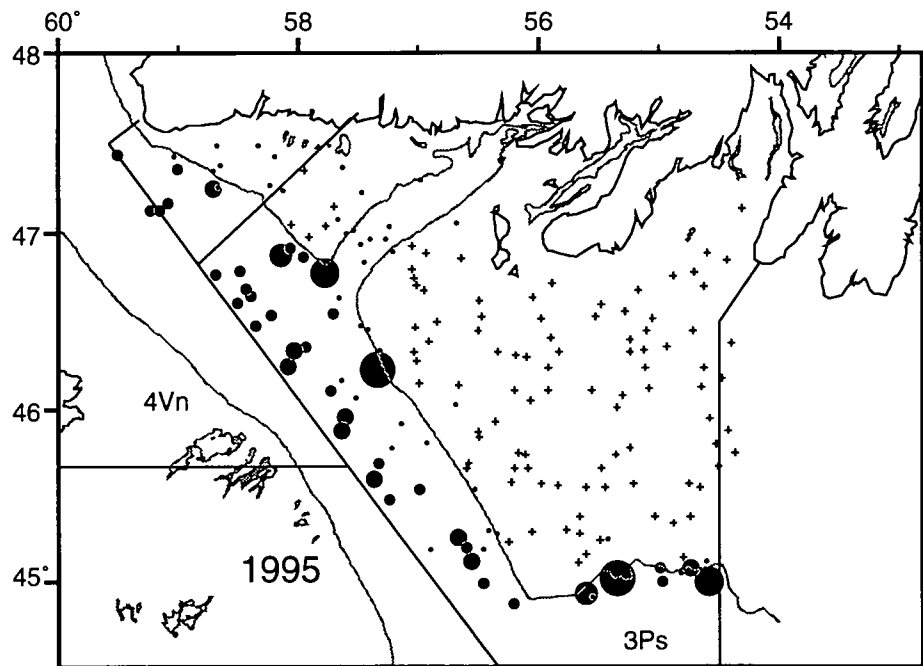


Fig. 5 (continued)

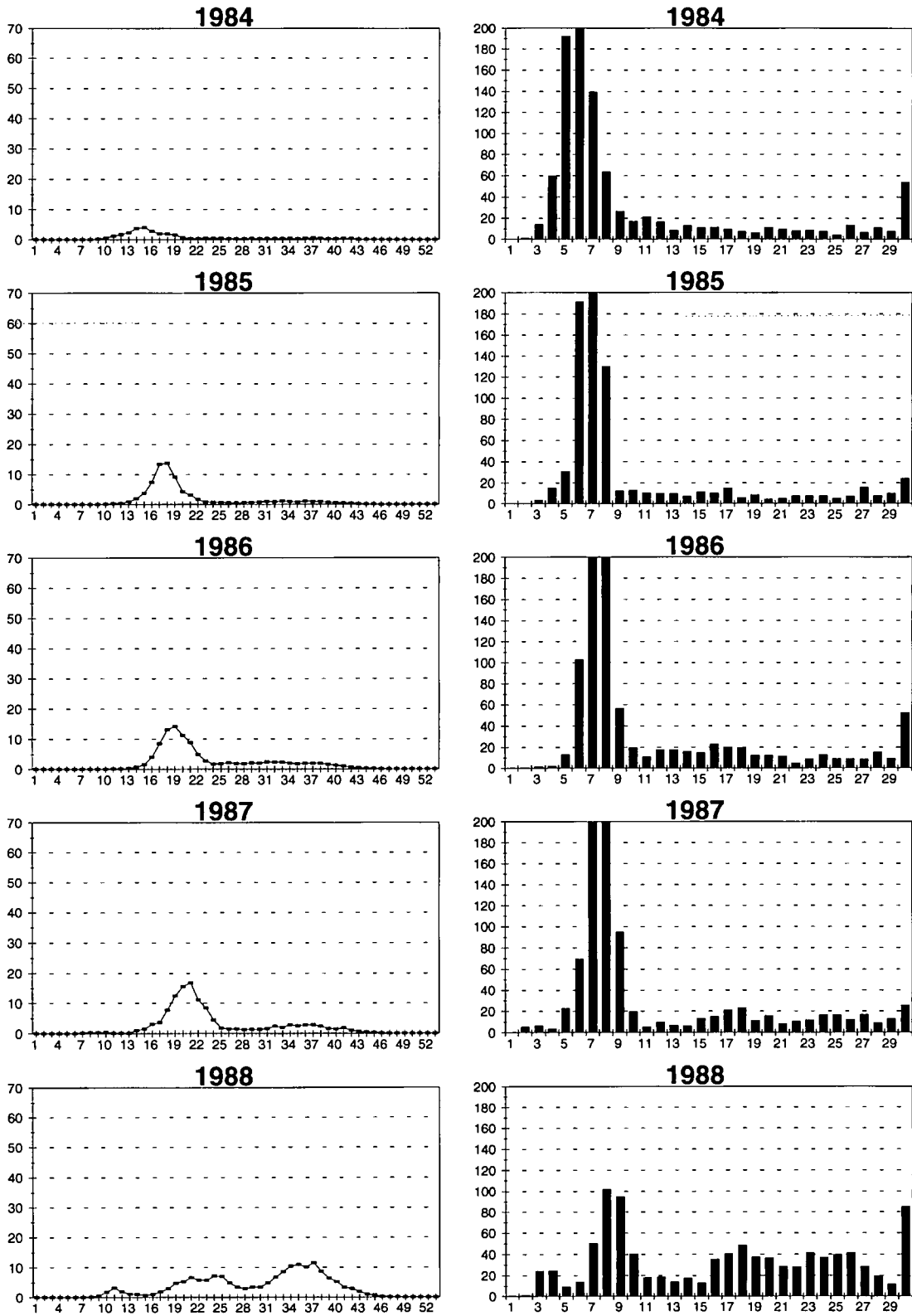


Fig. 6. Length frequencies and corresponding age distribution from stratified-random research surveys to Div. 3Ps from 1984-1995. Plotted above are mean number per standard tow (left) and corresponding number per thousand age distribution (right). X-axis is forklength in centimetres for left plot, and age in years for right plot.

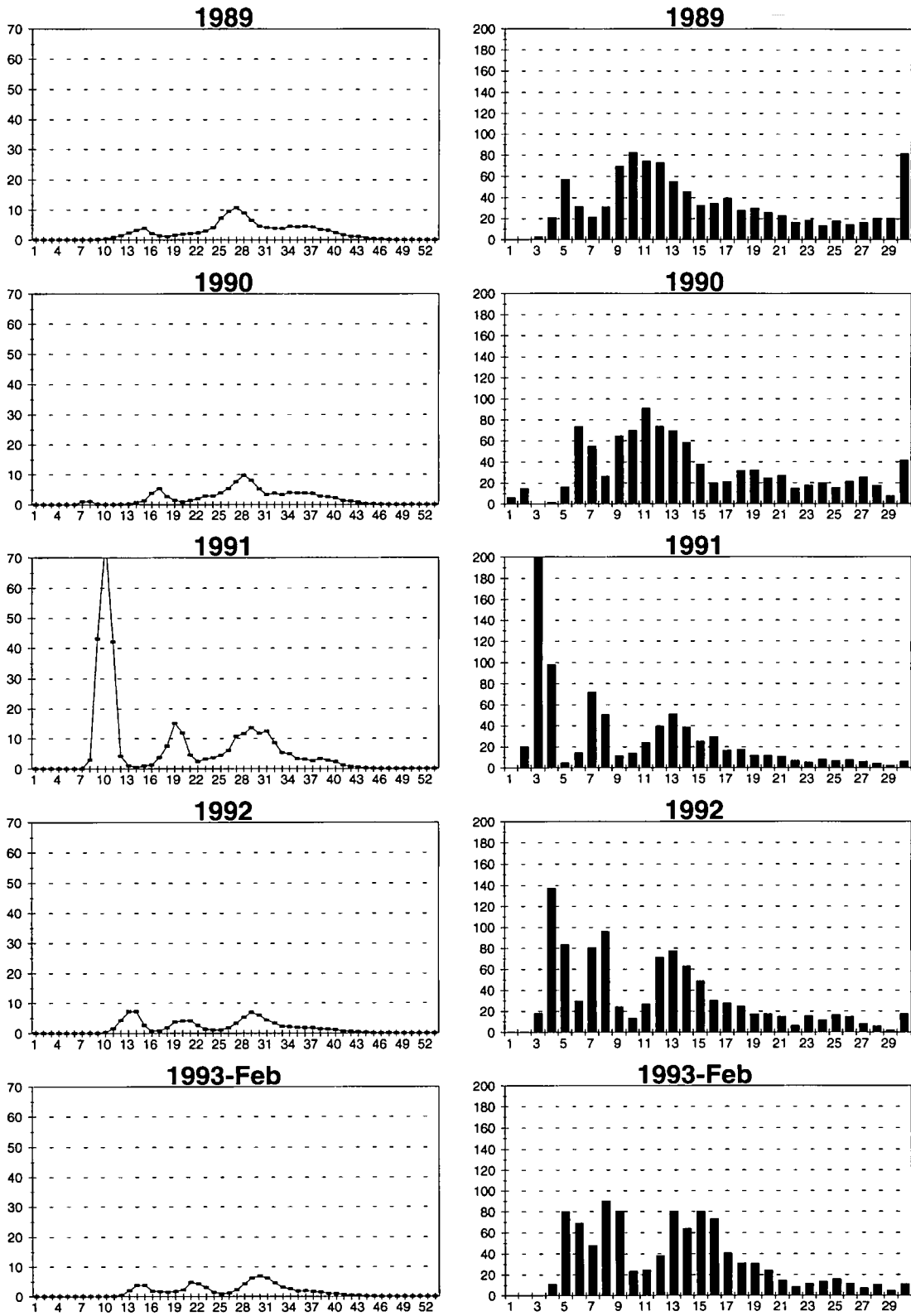


Fig. 6. (continued)

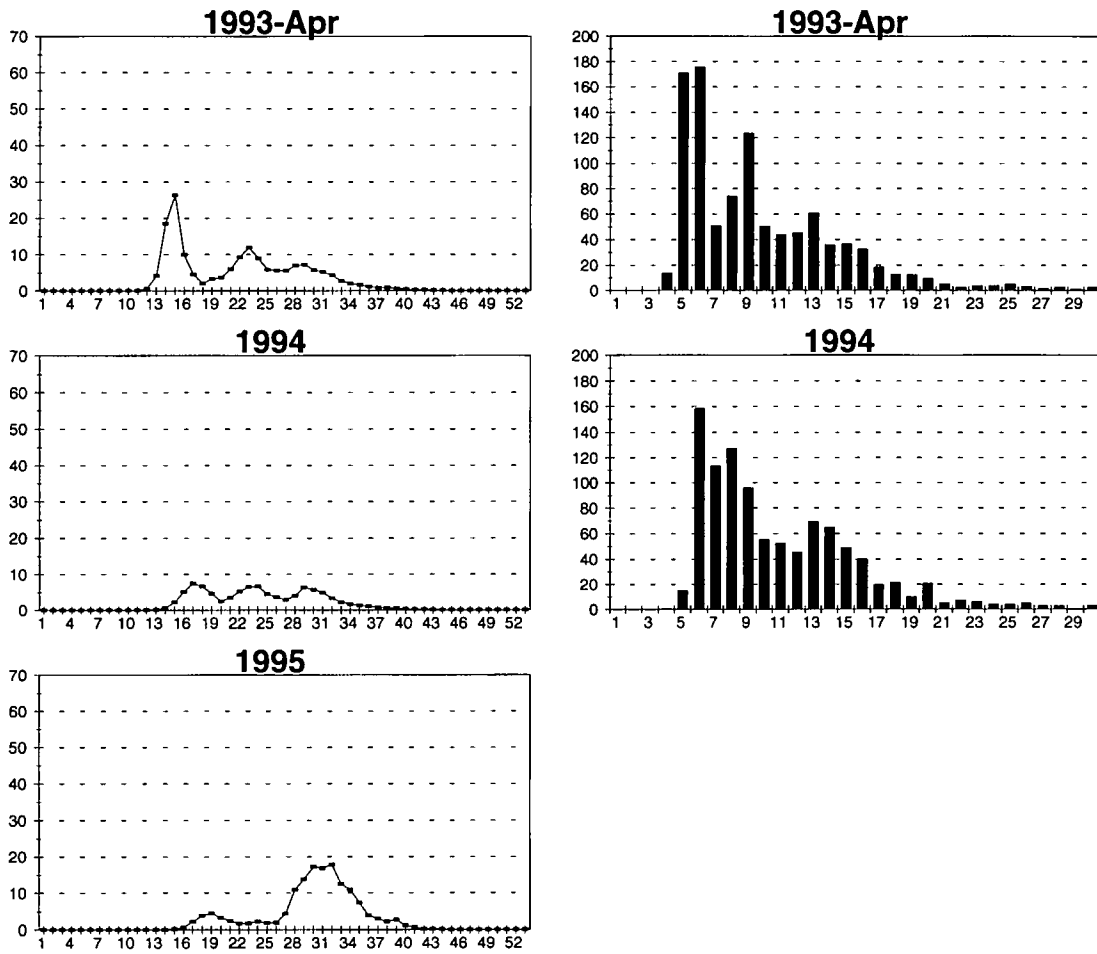


Fig. 6. (continued)

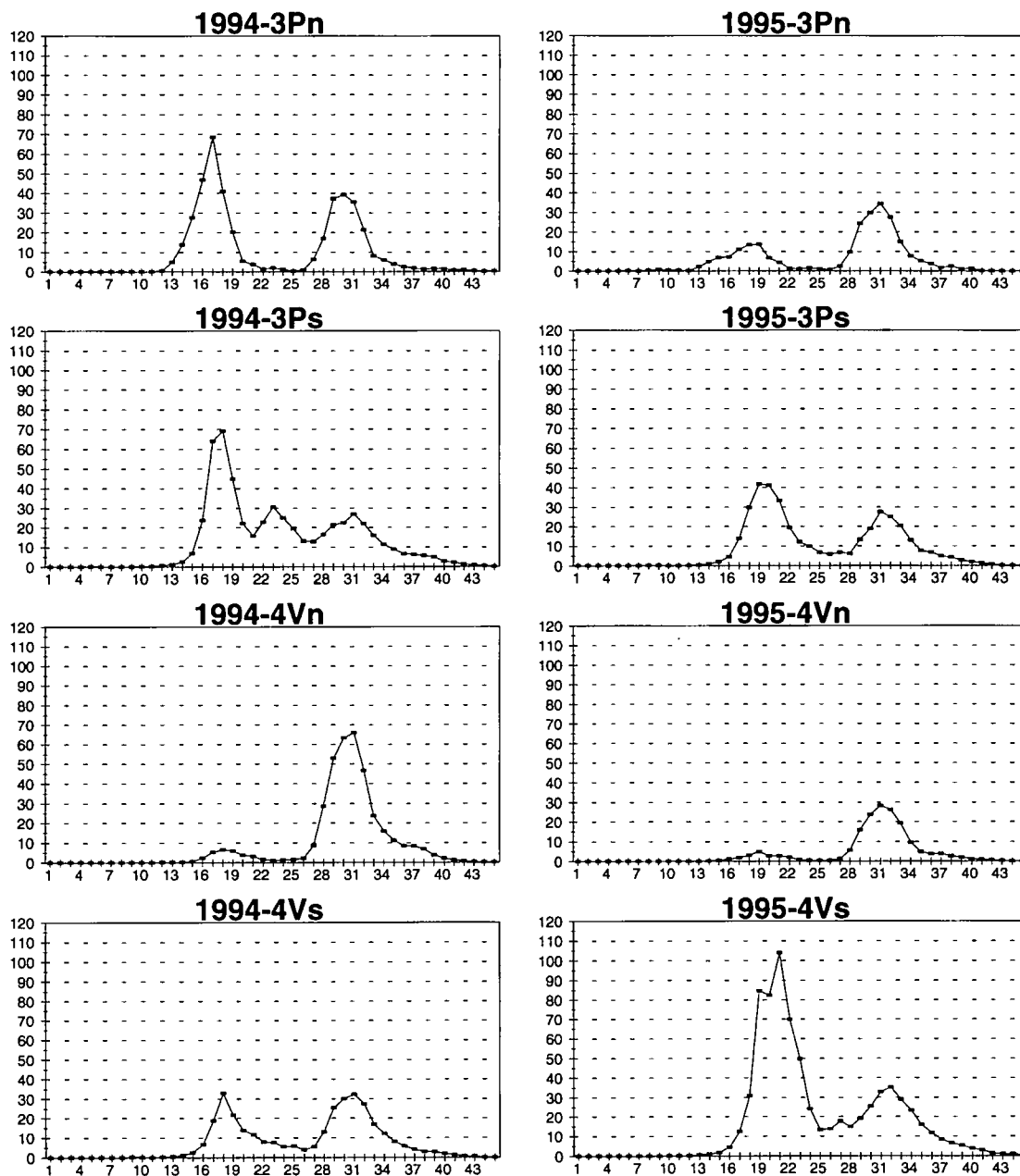


Fig. 7. Length frequencies from stratified-random research surveys to UNIT2 for 1994-1995. Plotted are mean number per standard 15 minute tow. X-axis is centimetres. The 1994 survey was conducted by the MV Gadus Atlantica and the 1995 survey by the CSS Teleost both using a Campelen 1800 shrimp trawl.

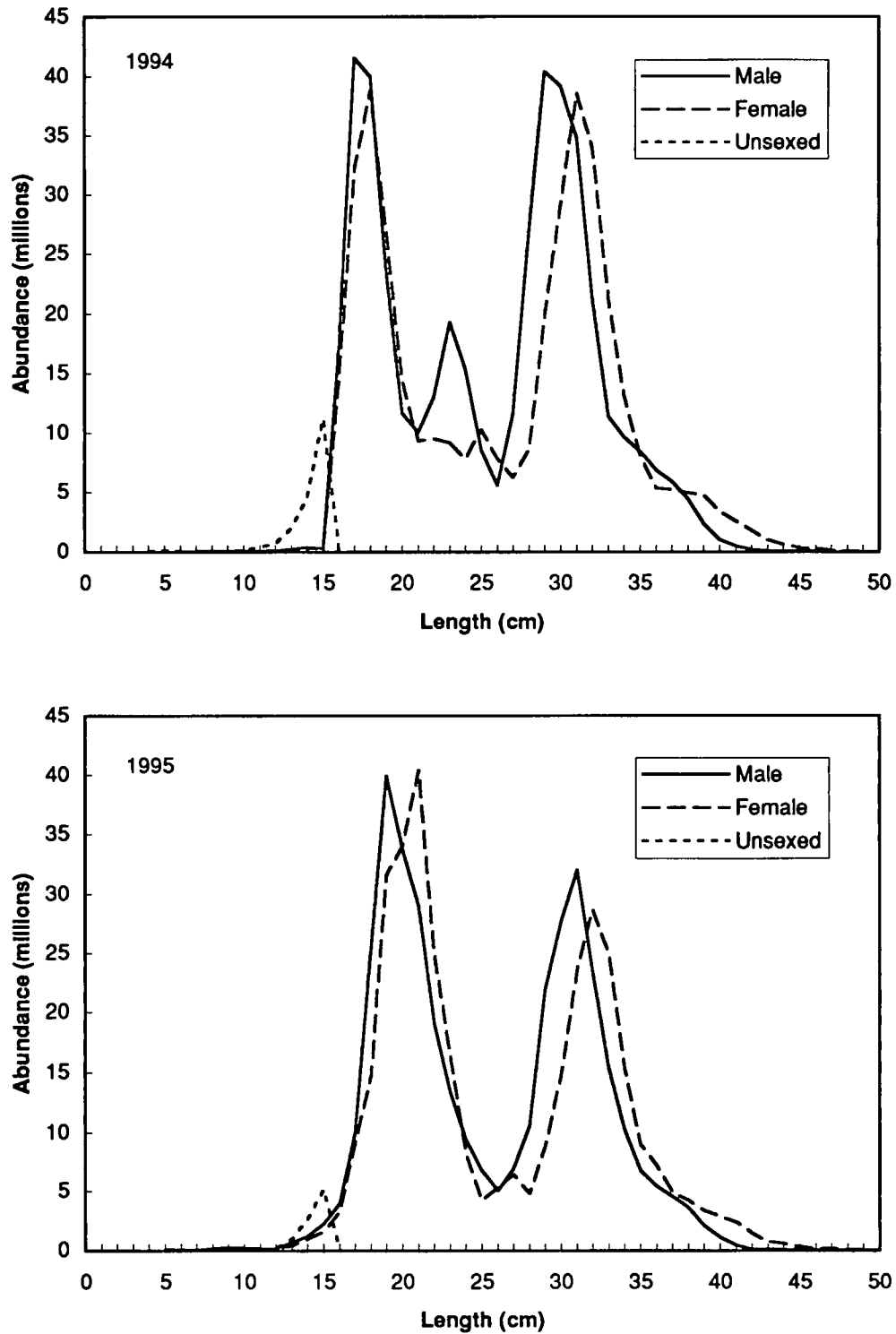


Fig. 8. Total abundance estimated from summer RV trawl surveys to Unit2 in 1994 and 1995. The 1994 survey was conducted by the MV Gadus Atlantica and the 1995 survey by the CSS Teleost utilizing a Campelen 1800 shrimp trawl.

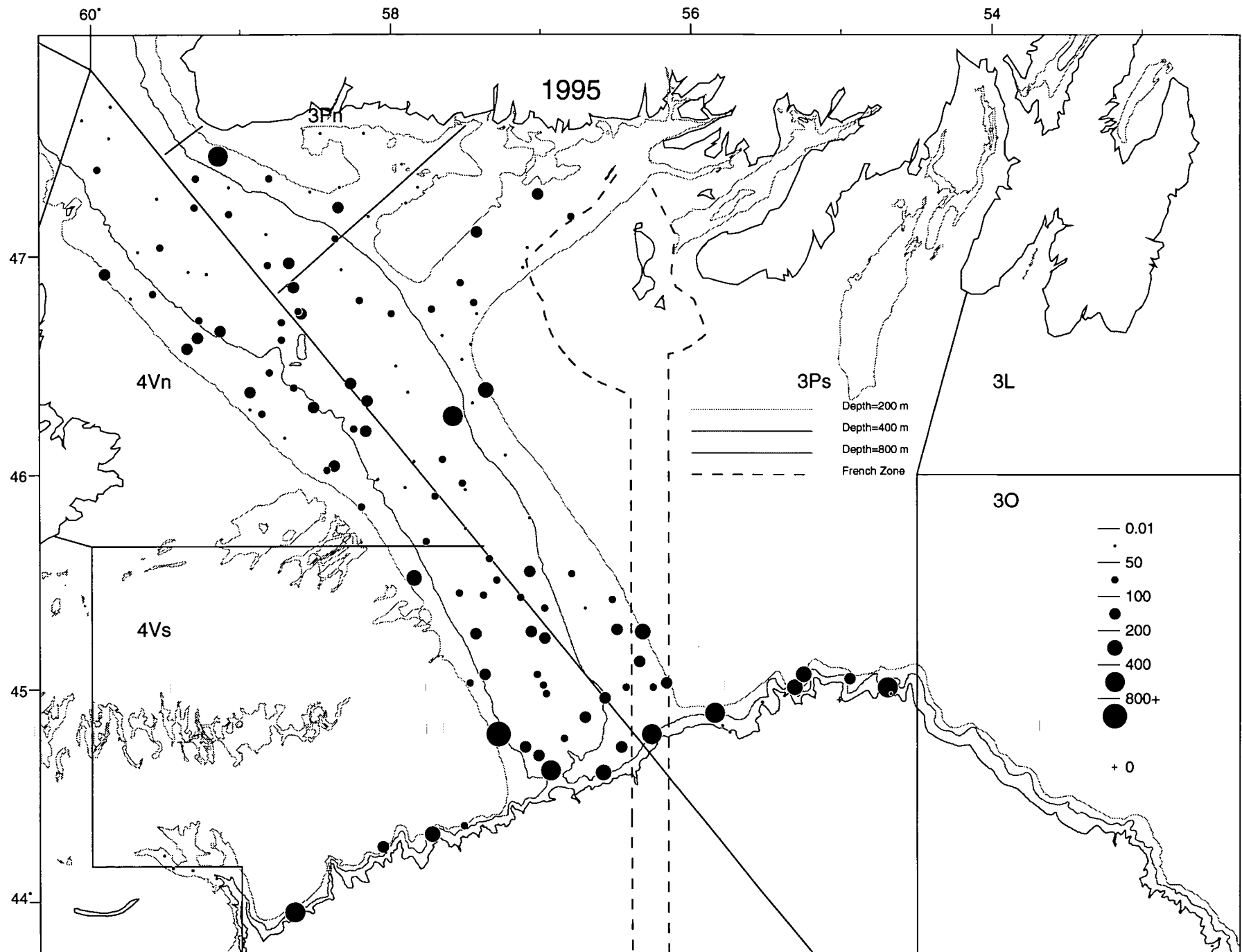


Fig. 10. Distribution of Redfish catches (Kg. per standard 0.75 nautical mile tow) from 1995 summer survey of Unit2 by the CSS Teleost using a Campelen 1800 shrimp trawl.