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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). Since 1984 landings have steadily increased from about 8,000 t to 27,000 in 1993. Catch rates have been declining since 1990. Research surveys do not cover the entire stock area and are not representative of year to year changes in stock size. Above average recruitment to the fishery is expected in the mid to late 1990s 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 5 years. It is not possible to provide an estimate of the size of this stock, and therefore it is not possible to estimate fishing mortalities during the past nor the possible fishing mortality generated by catching the TAC of 25,000 t in 1994.

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). Depuis 1984, les débarquements ont constamment augmenté, passant d'environ 8 000 t à 27 000 t en 1993. Les taux de prises sont en baisse depuis 1990. Les relevés de recherche ne portent pas sur la totalité des zones où évolue le stock et ne reflètent pas les changements dans la taille de celui-ci d'une année à l'autre. On s'attend à ce que le recrutement à la pêche soit supérieur à la moyenne depuis le milieu jusqu'à la fin des années 1990, mais il est peu probable qu'il égale l'apport des classes d'âge du début des années 1980, qui ont alimenté la pêche ces cinq dernières années. Il n'est pas possible d'estimer la grosseur de ce stock et partant la mortalité causée jusqu'ici par la pêche ou celle qui résulterait de la capture du TPA (25 000 t) en 1994.

Introduction

Prior to 1993 redfish in Divisions 3P4RST4VWX were managed as three units, namely Div. 3P, Div. 4RST and Div. 4VWX. In 1989 the integrity of these units as closed populations for management purposes 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)). 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 the fishery

Nominal Catches

Catches have ranged from 8,100 t in 1984 to 58,000 t in 1971 (Table 1, Fig.1). From 1960-1968 landings were at a level of 20,000 t, increased to an average of 43,000 up to 1975 mainly due to increases by foreign fleets and subsequently declined to the lowest on record in 1984 at 8,100 t. Catches have steadily increased to the 1993 value of about 27,000 t.

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. In recent years, increases in total landings have been due to removals from 3Ps and 4Vn while there has been a substantial decrease in landings from 4Vs since 1991. Since the implementation of the 200-mile exclusive economic zone in 1977, catches have been primarily by Newfoundland and Maritimes fleets. Maritimes vessels generally account for the majority of landings in Subdivisions 4Vs and 4Vn while Newfoundland vessels concentrate in Subdivisions 3Ps and 3Pn (Table 2).

Monthly catches since 1981 indicate prosecution of the fishery generally occurs throughout the year in all Subdivisions (Table 3). In recent years a higher proportion of landings has been taken from Jan-Apr in 3Ps, Jun-Jul in 4Vn and Apr-Jun in 4Vs. However, these observations are based on activity under the old management units (3P, 4VWX).

The 1993 fishery was quite different than that in 1992. 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 that were almost equally split between the Maritimes and Newfoundland fleets. The implementation in 1993 of the three revised management units coupled with declines in TACs for other species had an effect on the fishing pattern.

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. There is also a tangible proportion of the 3Ps catch taken with gillnets and longlines.

Industry Experience

The two major fleets involved in the fishery south of the Cabot Strait relate there are two "runs" of fish in the area based on the percentage of large sizes (characterized as greater than 25 cm standard length) in the catch. One run of about 75% large occurs generally in fall and winter while at other times, more notably the summer, the run generally contains about 40% large. This is probably

related to the movements of fish between the Gulf of St. Lawrence and the Cabot Strait area.

Bycatch restrictions of cod and other regulations are affecting the fishing patterns. Windows were put in codends in the early 1990s to limit the catch because of high catch rates but were not adopted as much in 1993 and have not been used in 1994 to date. Thus far in 1994 catch rates have dropped off compared to what they have been in the past few years. Trawler captains believe there is not as much fish in Unit 2 or Unit 1 as experienced previously.

Available Data

Commercial catch rates

Catch and effort data from 1960 to 1989 from ICNAF/NAFO Statistical Bulletins were combined with provisional 1991-92 Atlantic region data compiled by various DFO regional statistics branches. Due to the late arrival of the 1993 Atlantic regional data because of delays in obtaining the Nfld. statistics, only information from logbooks of Nfld. based vessels for 1993 (that had been compiled in late 1993) could be added to the catch/effort database. 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 analysed 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 52% 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 (Table 5b, Fig. 2) shows a steady increase from 1960 to 1966 followed by a decrease to the lowest rate on record in 1979. The rate increased again until 1983 to about the same magnitude of the 1960 catch rate. From 1983 to 1988 catch rate declined to about the level of the 1979 rate. Large increases occurred in 1989 and again in 1990 to the highest rate observed over the time series. The catch rate declined abruptly in 1991 and continued to decline in 1992. Preliminary data for 1993 (including only Nfld. fleet) suggest the mean catch rate remained at the 1992 level, but there is much variability surrounding this estimate relative to any other year in the series. 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. However, it is also partly due a change from side trawlers to specialized stern trawlers for the FPI fleet and the utilization of the highly efficient midwater "turbo" trawl for all fleets. Midwater gears are aggregated in the current database utilized to derive a standardized catch rate series and therefore the recent increase cannot be put into historical perspective because the new gear is a confounding factor.

Research survey data

Stratified random groundfish surveys have been conducted since 1973 in Subdiv. 3Ps and consistently since 1986 in 3Pn 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. 3). These are too dynamic to reflect year to year changes in stock abundance. However, in terms of longer periods, numbers per tow were higher during the 1970s than they have been since 1980. Geographical distribution plots of catches in 3Ps since 1984 and 3Pn since 1986 (Fig. 4), indicate generally two clusters apparent throughout the time series. One cluster is in an area encompassing the northwest corner of St. Pierre Bank which extends into 3Pn. The second generally occurs along the southern slopes of St. Pierre Bank in proximity of Div. 3O.

Length frequencies and numbers at age from the Subdiv. 3Ps surveys (Fig. 5) represented as numbers per thousand reflect the relatively strong year class(es) of the early 1980s that were first captured in the 1981 survey. These year classes presently constitute the main component of the commercial fishery. The yearly length frequency distributions also indicate a pulse in the 1988 survey (perhaps the 1984-1985 year classes), and a relatively larger pulse of recruitment observed in 1991 corresponding to the 1987-1988 year classes. The 1984-1985 and 1987-1988 year classes represented about 40% of the research catch in 1993. Although it is not possible to precisely estimate the abundance of these year classes it is quite evident that the 1980s year classes comprised a much greater percentage of the research catch as it was being tracked through the years than either the 1984-85 or 1987-88 year classes represent relative to it.

Estimation of stock parameters

Production model

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

Prognosis

It is not possible to provide an estimate of the size of this stock, because of a limited database, and therefore it is not possible to estimate fishing mortalities during the past nor the possible fishing mortality generated by catching the TAC of 25,000 t in 1994. Commercial catch rates (t/hr) increased dramatically beginning in 1989 and peaked in 1990. Although part of this increase can be attributed to recruitment to the fishery of the relatively strong year classes of the early 1980s, it is also partly due to a change from side trawlers to specialised stern trawlers for one fleet sector, as well as a general switch to the highly efficient mid-water turbo trawl. The current data set does not allow separation of this gear from earlier midwater trawl gears, so this increase cannot be put in historical perspective. Catch rates declined in 1991, again in 1992, and according to the provisional data, were at the same rate in 1993, albeit with much variability. This gives cause for concern because it is generally considered that the schooling nature of redfish is such that densities generally remain the same during declines in stock size; it is the size and number of aggregations which decrease first. Thus, catch rates based on trawling time alone may not reflect the size of the resource, and declines in catch rates based on tonnes per hour may lag behind real declines in the resource. A decline in the

resource is not unexpected given the variable recruitment patterns observed for redfish. However, the apparent rapid decline in catch rates is unexpected and may reflect exploitation levels greater than previously believed, or what may be considered safe.

Anecdotal evidence from industry supports a decline in the Unit 2 resource. Trawler captains do not believe there is as many fish in the area. Whereas a few years ago windows were being cut in the nets, these were not so prevalent in 1993 and have not been used so far in 1994. There are concerns that winter movement from Unit 1 is greater than in the past, and this may also mask possible declines in Unit 2.

Detailed survey data from the 3Ps portion of the stock area indicate biomass has fluctuated greatly, and it is not possible to determine trends in the stock from these data. It has been assumed in the past that length frequency distributions from these surveys are applicable to the entire stock area. From this it has been determined that subsequent to the good year classes of the early 1980s there was also above average recruitment in the mid- and late-1980s, and their presence resulted in an optimistic forecast for the future of this resource. Close examination of the data however, reveals that the year classes of the early 1980s made up a relatively greater proportion of the population than do those of the mid-1980s. It may be inferred from this that their contribution to the fishery in the future will be less than that of the early 1980s year classes. If this is true, then rather than a future reversal of the apparent catch rate decline, it may only be temporarily halted.

Recent unpublished information examined by the Fisheries Oceanography Committee of DFO suggest that catches in Subdiv. 3Pn during November and December are most likely from Unit 1 and the committee concluded that management units should be changed to reflect this. The situation was unclear for catches in October, but it may be that a substantial portion of these catches in 1993 was also of Unit 1 fish.

Current fishing mortality on this resource cannot be estimated. However, with declining catch rates, maintenance of the same fishing effort on this stock will result in an increase in fishing mortality. In addition, leaving the TAC for Unit 2 redfish at 25,000 t while changing management units would itself result in an increase in fishing mortality of about 45% on Unit 2 fish, assuming the 25,000 t would be caught. During the period 1981-1992, the average catch from this Unit excluding 3Pn in November and December was about 14,000 t.

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Table 1. Summary of nominal catches (t) of redfish in NAFO Divisions and Subdivisions comprising the "Laurentian Channel" management unit.

Year	3Pn (Jun-Dec)	3Ps	4Vn (Jun-Dec)	4Vs	4Wfgj	4Wfgj (assigned) ^a	Total	4W (unknown)
1960	14	9211	5277	8122	-	663	23287	0
1961	1058	8340	4157	4170	-	604	18685 ^b	8
1962	2127	11306	2710	4372	-	780	21347 ^c	3870
1963	2154	11150	2166	6270	-	550	22290	12005
1964	4445	9119	1849	7629	80	70	23192	3005
1965	5570	9931	2097	3319	733	184	21850 ^d	1326
1966	2444	16543	6022	3067	242	74	28392	8720
1967	3531	28465	7976	1989	78	131	42170	55
1968	1974	11764 ^e	4097	2222	16	96	20169	210
1969	1412	29460	4726	10241	0	437	46276	1387
1970	2169	33581	2849	6694	2101	2013	49407	8744
1971	373	26534	4762	23698	1334	1499	58200	11921
1972	358	25398	2272	14580	1346	976	44930	8609
1973	2133	14714	2709	11213	495	563	31827	5484
1974	2759	17894	4898	8112	357	18	34038	4018
1975	4722	20345	6548	6791	37	28	38471	3944
1976	1409	13235	3832	4718	317	198	23709	315
1977	1713	14678	4763	7123	245	228	28750	
1978	1975	12203	3661	7856	593	260	26548	
1979	1975	6459	4500	4979	666	192	18771	
1980	1845	5192	3713	5431	817	131	17129	
1981	3283	4685	6134	6789	430	430	21751	
1982	3757	2090	6350	4585	128	115	17025	
1983	2607	2996	3559	3758	489	64	13473	
1984	1460	2005	2129	2367	140	40	8141	
1985	1587	1854	3143	4502	194	214	11494	
1986	958	3651	3347	2736	15	58	10765	
1987	1348	2169	6423	3651	195	170	13956	
1988	484	2386	4856	2725	156	121	10728	
1989	1953	2874	5236	4990	81	252	15386	
1990	189	5438	2471	6325	73	296	14792	
1991 ^g	1050	4390	8746	8538	98	816	23540	
1992 ^g	793	6618	7318	1732	473	356	17290	
1993 ^g	10780	6963	8092	1155	108	-	27098	

^aPortions of Catches identified only as "4W" were assigned to 4W_{FBI} 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)

^bIncludes 356 t from Div. 3P that could not be disaggregated by subdivision.

^cIncludes 52 t from Div. 4V that could not be disaggregated by subdivision.

^dIncludes 11 t from Div. 3P and 5 t from Div. 4V that could not be disaggregated by subdivision.

^eIncludes 522 t from Div. "3P" by Japan (generally the fleet fished in 3Ps).

^fIncludes 500 t that could not be disaggregated by subdivision.

^gProvisional.

Table 2a. Nominal catches (t) of redfish in Subdivision 3Pn (Jun-Dec) by fleet/country since 1981. (1991-93 are provisional.)

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Canada (M)	103	311	502	65	325	143	577	39	825	0	346	266	4770
Canada (N)	3180	3446	2105	1395	1262	815	770	445	1128	189	704	522	5521
Canada (Q)	-	-	-	-	-	-	1	-	-	-	-	5	489
Total	3283	3757	2607	1460	1587	958	1348	484	1953	189	1050	793	10789

Table 2b. Nominal catches (t) of redfish in Subdivision 3Ps by fleet/country since 1981. (1991-93 are provisional.)

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Canada (M)	391	515	670	396	313	606	421	836	1038	1252	377	2648	3163
Canada (N)	4123	1553	2316	1608	1529	2915	1645	1441	1823	4186	4013	3970	3800
Canada (Q)	-	-	-	-	-	88	-	-	-	-	-	-	-
France (M)	124	5	-	-	-	-	67	95	-	-	-	-	-
France (SPM)	47	17	-	-	-	42	36	14	13	-	-	-	-
France	-	-	10	1	12	-	-	-	-	-	-	-	-
Total	4685	2090	2996	2005	1854	3651	2169	2386	2874	5438	4390	6618	6063

Table 2c. Nominal catches (t) of redfish in Subdivision 4Vn (Jun-Dec) by fleet/country since 1981. (1991-93 are provisional.)

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Canada (M)	3332	2356	2710	1133	1368	1237	2544	2327	3245	1874	7453	6149	7048
Canada (N)	2802	3993	849	153	1677	1790	3682	2345	1909	579	1076	947	593
Canada (Q)	-	-	-	-	38	63	-	-	1	-	217	222	451
France (SPM)	-	1	-	-	-	-	-	-	-	-	-	-	-
Japan	-	-	-	843	60	257	197	184	81	18	-	-	-
Total	6134	6350	3559	2129	3143	3347	6423	4856	5236	2471	8746	7318	8092

Table 2d. Nominal catches (t) of redfish in Subdivision 4Vs by fleet/country since 1981. (1991-93 are provisional.)

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Canada (M)	6119	4109	3208	1735	2924	1081	2279	2111	3452	3997	5864	1621	1087
Canada (N)	641	476	539	148	724	465	428	335	1139	1852	1911	111	68
Canada (Q)	-	-	-	-	-	-	-	-	-	-	263	-	-
USSR	29	-	1	-	-	-	-	-	-	-	-	-	-
Portugal	-	-	10	-	-	-	-	-	-	-	-	-	-
Japan	-	-	-	484	854	1190	944	279	399	475	500	-	-
Total	6789	4585	3758	2367	4502	2736	3651	2725	4990	6324	8538	1732	1155

Table 3a. Nominal catches (t) of redfish in Subdivision 3Pn portion of the "Laurentian Channel" management unit by month since 1981. (1991-93 are provisional.)

Year	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1981	160	969	540	498	753	272	91	3283
1982	153	502	288	923	652	959	280	3757
1983	217	294	622	791	144	356	183	2607
1984	87	305	258	173	435	130	72	1460
1985	131	272	527	206	135	122	194	1587
1986	69	169	94	84	188	282	72	958
1987	77	97	242	74	13	45	800	1348
1988	120	39	123	74	40	69	19	484
1989	7	44	153	878	611	131	129	1953
1990	4	36	64	55	8	4	18	189
1991	10	9	44	42	250	310	335	1050
1992	29	7	11	23	430	82	210	793
1993	376	347	128	777	3373	3237	2542	10780

Table 3b. Nominal catches (t) of redfish in Subdivision 3Ps by month since 1981. (1991-93 are provisional.)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1981	21	537	763	157	217	897	465	937	134	150	224	183	4685
1982	4	5	27	127	154	133	220	580	193	398	205	44	2090
1983	8	11	25	28	82	61	133	462	667	957	168	394	2996
1984	9	126	179	39	114	470	804	141	40	37	22	24	2005
1985	32	27	102	50	126	127	361	413	367	150	63	36	1854
1986	13	37	685	281	499	433	754	213	343	111	186	96	3651
1987	41	94	110	139	172	268	439	244	189	92	74	307	2169
1988	73	557	208	129	135	180	128	179	200	97	126	374	2386
1989	263	174	353	356	116	402	185	376	522	60	37	30	2874
1990	140	2161	1104	370	59	277	298	435	357	159	50	28	5438
1991	210	1234	378	678	79	80	365	361	393	450	51	111	4390
1992	91	427	3835	936	120	106	101	263	255	124	49	106	6618*
1993	111	1349	1167	1012	559	129	85	183	213	726	939	491	6963

*Includes 205 t that could not be disaggregated by month.

Table 3c. Nominal catches (t) of redfish in Subdivision 4Vn portion of the "Laurentian Channel" management unit by month since 1981. (1991-93 are provisional.)

Year	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1981	807	1900	1636	568	165	836	222	6134
1982	737	608	1579	1420	917	685	404	6350
1983	688	412	768	792	137	577	185	3559
1984	393	375	295	164	440	63	399	2129
1985	705	517	1123	244	114	197	243	3143
1986	480	1502	474	428	155	162	146	3347
1987	2041	1611	941	603	132	327	768	6423
1988	1339	1285	799	656	284	325	168	4856
1989	1700	857	881	602	250	42	904	5236
1990	696	822	353	176	56	33	335	2471
1991	4181	627	620	555	182	737	844	8746
1992	1142	1725	824	498	394	656	2080	7318
1993	3714	2363	1418	352	188	53	4	8092

Table 3d. Nominal catches (t) of redfish in Subdivision 4Vs by month since 1981. (1991-93 are provisional.)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1981	28	21	171	93	1034	1795	1378	1064	539	467	105	94	6789
1982	11	30	68	136	224	309	1450	738	402	912	191	114	4585
1983	9	86	176	31	131	300	564	561	446	1255	17	182	3758
1984	10	105	595	86	138	91	418	290	91	353	48	142	2367
1985	98	510	242	207	187	469	940	615	126	410	341	357	4502
1986	34	62	209	206	233	357	409	256	356	236	319	59	2736
1987	35	27	187	477	330	806	529	616	304	115	150	75	3651
1988	9	34	94	77	580	331	425	138	617	257	103	60	2725
1989	30	31	170	35	800	2651	388	376	248	191	68	2	4990
1990	40	71	120	454	1714	2040	81	778	177	182	514	154	6325
1991	89	52	67	1306	5854	243	76	19	260	20	36	16	8538 ^a
1992	27	27	109	70	53	506	269	34	3	28	376	230	1732
1993	1	4	209	313	182	274	55	7	0	21	26	63	1155

^aIncludes 500 t by Japan that could not be disaggregated by month.

Table 3e. Nominal catches (t) of redfish in Division 4Wfgj by month since 1981. (1991-93 are provisional.)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1981	2	0	2	30	45	174	160	0	12	2	2	1	430
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	4	4	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

Table 4a. Nominal catches (t) of redfish in Division 3P by gear since 1981. (1991-93 are provisional.)

Year	3Pn				3Ps			
	Bottom trawl	Midwater trawl	Other	Total	Bottom trawl	Midwater trawl	Other	Total
1981	3279	-	4	3283	3990	65	630	4685
1982	3755	-	2	3757	1777	-	313	2090
1983	2591	-	16	2607	2630	-	377	2996
1984	1445	-	15	1460	1130	-	275	2005
1985	1584	-	3	1587	1533	-	321	1854
1986	953	5	-	958	2920	152	579	3651
1987	1057	285	6	1348	1311	35	823	2169
1988	413	62	9	484	1389	467	530	2386
1989	1440	499	14	1953	1527	747	600	2874
1990	147	40	2	189	933	3162	1343	5438
1991	402	570	78	1050	1641	1599	1150	4390
1992	191	565	37	793	1097	4456	858	6618*
1993	4783	5965	32	10780	2227	4301	435	6963

*Includes 207 t that could not be disaggregated by gear.

Table 4b. Nominal catches (t) of redfish in Division 4V by gear since 1981. (1991-93 are provisional.)

Year	4Vn				4Vs			
	Bottom trawl	Midwater trawl	Other	Total	Bottom trawl	Midwater trawl	Other	Total
1981	6134	-	-	6134	6789	-	-	6789
1982	6345	-	5	6350	4585	-	-	4585
1983	3557	-	2	3559	3743	1	14	3758
1984	1811	315	3	2129	2267	100	-	2367
1985	3131	-	12	3143	4502	-	-	4502
1986	3153	182	12	3347	2731	5	-	2736
1987	5338	1049	36	6423	3615	35	1	3651
1988	4506	314	36	4856	2720	5	-	2725
1989	2853	2350	33	5236	2911	2075	4	4990
1990	1923	444	104	2471	3530	2789	6	6325
1991	5060	3619	167	8746	2309	6223	6	8538
1992	4070	3054	194	7318	1112	616	4	1732
1993	3716	4363	13	8092	749	395	11	1155

Table 5a. ANOVA results and regression coefficients from a multiplicative model utilized to derive a standardized catch rate series for redfish in Unit 2 (Laurentian Channel). Effort is measured in hours fished. (1991-93 provisional)

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.722
 MULTIPLE R SQUARED..... 0.522

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	5.357E2	5.357E2	
REGRESSION	85	6.165E2	7.252E0	37.905
Country Gear TC (1)	33	2.414E2	7.316E0	38.236
Month (2)	11	1.977E1	1.798E0	9.395
Division (3)	4	1.142E1	2.855E0	14.920
Bycatch PCT (4)	4	6.047E1	1.512E1	79.019
Year (5)	33	1.651E2	5.003E0	26.151
RESIDUALS	2951	5.646E2	1.913E ⁻¹	
TOTAL	3037	1.717E3		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.	CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
CGT	3114	INTERCEPT	-0.639	0.099	3037	(1)	11126	17	0.715	0.106	19
Month	7						11127	18	0.742	0.200	5
Division	37						14124	19	0.548	0.184	6
Bycatch PCT	95						14125	20	0.564	0.137	11
Year	60						14126	21	0.506	0.090	27
(1)	2114	1	0.087	0.032	311		14127	22	0.901	0.060	65
	2124	2	-0.055	0.059	65		16127	23	0.376	0.107	19
	2125	3	0.365	0.049	107		20114	24	-0.616	0.072	44
	2154	4	0.305	0.062	61		20127	25	1.456	0.080	34
	2155	5	0.673	0.069	46		20157	26	1.513	0.136	11
	3124	6	0.095	0.041	153		27114	27	0.348	0.043	167
	3125	7	0.233	0.031	359		27124	28	0.470	0.050	109
	3126	8	0.253	0.137	12		27125	29	0.579	0.038	311
	3144	9	0.417	0.086	29		27154	30	0.724	0.113	17
	3154	10	0.426	0.068	49		27155	31	0.783	0.069	54
	3155	11	0.675	0.053	90		27157	32	0.828	0.173	7
	3156	12	1.111	0.118	17		28154	33	0.722	0.110	18
	9114	13	-0.131	0.062	58	(2)	1	34	0.194	0.065	54
	9125	14	0.265	0.075	38		2	35	0.209	0.055	84
	11115	15	0.339	0.145	10		3	36	0.141	0.045	136
	11116	16	0.605	0.142	10		4	37	0.028	0.045	134

Table 5a. (continued)

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
(2)	5	38	0.111	0.043	153
	6	39	0.101	0.031	386
	8	40	-0.059	0.030	418
	9	41	-0.056	0.031	369
	10	42	-0.086	0.032	336
	11	43	-0.119	0.034	291
	12	44	0.015	0.036	245
(3)	36	45	0.049	0.028	412
	44	46	-0.031	0.023	750
	45	47	0.118	0.023	763
(4)	71	48	-0.149	0.052	103
	55	49	-0.599	0.045	118
	65	50	-0.431	0.039	160
(5)	75	51	-0.309	0.029	297
	85	52	-0.213	0.024	503
	61	53	-0.020	0.128	27
	62	54	0.208	0.124	31
	63	55	0.169	0.119	39
	64	56	0.214	0.121	36
	65	57	0.465	0.119	40
	66	58	0.529	0.110	66
	67	59	0.527	0.110	81
	68	60	0.393	0.110	66
	69	61	0.382	0.108	89
	70	62	0.289	0.105	115
	71	63	0.191	0.104	139
	72	64	0.092	0.105	133
	73	65	0.073	0.105	127
	74	66	-0.134	0.104	148
	75	67	-0.112	0.104	147
	76	68	-0.275	0.107	101
	77	69	-0.190	0.104	134
	78	70	-0.150	0.103	151
	79	71	-0.313	0.105	143
	80	72	-0.208	0.106	120
	81	73	-0.252	0.107	106
	82	74	-0.035	0.108	99
	83	75	0.036	0.110	82
	84	76	-0.112	0.116	53
	85	77	-0.177	0.107	110
	86	78	-0.210	0.108	110
	87	79	-0.202	0.108	103
	88	80	-0.194	0.108	102
	89	81	0.247	0.111	86
	90	82	0.623	0.115	63
	91	83	0.448	0.114	86
	92	84	0.335	0.115	74
	93	85	0.341	0.178	9

Table 5b. Standardized catch rate series for Unit 2 (Laurentian Channel) redfish from a multiplicative model utilizing hours fished as a measure of effort.

STANDARDS USED VARIABLE NUMBERS: 3114 7 37 95

PREDICTED CATCH RATE

YEAR	LN TRANSFORM		RETRANSFORMED		CATCH	EFFORT
	MEAN	S.E.	MEAN	S.E.		
1960	-0.6395	0.0098	0.578	0.057	23287	40309
1961	-0.6597	0.0079	0.567	0.050	18685	32974
1962	-0.4317	0.0068	0.712	0.059	21347	29974
1963	-0.4705	0.0056	0.686	0.051	22290	32516
1964	-0.4258	0.0060	0.717	0.055	23192	32359
1965	-0.1746	0.0056	0.922	0.069	21850	23709
1966	-0.1100	0.0036	0.984	0.059	28392	28854
1967	-0.1123	0.0035	0.982	0.058	42170	42949
1968	-0.2462	0.0037	0.859	0.052	20169	23487
1969	-0.2579	0.0031	0.849	0.047	46276	54512
1970	-0.3501	0.0026	0.774	0.039	49407	63800
1971	-0.4489	0.0024	0.702	0.035	58200	82956
1972	-0.5470	0.0024	0.636	0.031	44939	70642
1973	-0.5664	0.0024	0.624	0.030	31827	51018
1974	-0.7736	0.0023	0.507	0.024	34039	67123
1975	-0.7518	0.0022	0.518	0.024	38471	74226
1976	-0.9146	0.0028	0.440	0.023	23709	53847
1977	-0.8294	0.0023	0.480	0.023	28750	59949
1978	-0.7899	0.0022	0.499	0.023	26548	53212
1979	-0.9522	0.0024	0.424	0.021	18771	44255
1980	-0.8472	0.0025	0.471	0.024	17129	36362
1981	-0.8919	0.0028	0.450	0.024	21751	48293
1982	-0.6745	0.0030	0.560	0.030	17025	30417
1983	-0.6037	0.0034	0.601	0.035	13473	22429
1984	-0.7516	0.0047	0.518	0.035	8141	15723
1985	-0.8163	0.0028	0.486	0.025	11494	23660
1986	-0.8494	0.0028	0.470	0.025	10765	22905
1987	-0.8415	0.0030	0.474	0.026	13956	29464
1988	-0.8333	0.0030	0.478	0.026	10728	22466
1989	-0.3924	0.0036	0.742	0.045	15386	20738
1990	-0.0165	0.0045	1.080	0.072	14792	13696
1991	-0.1912	0.0043	0.907	0.059	23540	25954
1992	-0.3043	0.0045	0.810	0.054	17290	21348
1993	-0.2980	0.0230	0.808	0.122	27098	33557

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.063

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)
Stratified Analysis:													
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
Multiplicative Analysis:													
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)
Stratified Analysis:													
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
Multiplicative Analysis:													
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 7. Mean number of redfish caught per standard tow in Division 3Ps from the 1994 Canadian research survey utilizing a revised stratification scheme. (Numbers in brackets are number of successful sets.)

Stratum	Depth range (m)	Area (sq.n.mi.)	1994 WT 150-151 Apr 5-27
306	185-274	419	132.50(4)
307	93-183	395	25.00(4)
309	185-274	296	333.67(3)
310	185-274	170	492.00(3)
311	93-183	317	5.00(4)
313	185-274	165	155.50(2)
316	185-274	189	22.50(2)
317	93-183	193	0.00(2)
318	185-274	129	0.00(2)
319	93-183	984	0.00(9)
705	275-366	195	87.67(3)
706	275-366	476	79.25(4)
707	275-366	74	2615.50(2)
708	367-549	126	5878.50(2)
709	550-731	158	59.30(2)
710	732-914	176	0.00(2)
711	367-549	961	52.50(6)
712	367-549	973	134.86(7)
713	367-549	950	148.00(7)
714	367-549	1195	121.75(8)
715	275-366	132	328.25(4)
716	275-366	539	79.40(5)
<u>Stratified Analysis:</u>			
Upper			500.0
Mean			198.8
Lower			-102.4
Total (x10 ⁻⁶)			137.5

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)
Stratified Analysis:														
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
Multiplicative Analysis:														
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 Feb 2-20	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 (kg) of redfish caught per standard tow in Division 3Ps from the 1994 Canadian research survey utilizing a revised stratification scheme. (Numbers in brackets indicate number of sets.)

Stratum	Depth range (m)	Area (sq.n.mi.)	1994 WT 150-151 Apr 5-27
306	185-274	419	11.53(4)
307	93-183	395	1.86(4)
309	185-274	296	56.53(3)
310	185-274	170	38.57(3)
311	93-183	317	0.45(4)
313	185-274	165	11.23(2)
316	185-274	189	1.75(2)
317	93-183	193	0.00(2)
318	185-274	129	0.00(2)
319	93-183	984	0.00(9)
705	275-366	195	16.30(3)
706	275-366	476	21.48(4)
707	275-366	74	777.36(2)
708	367-549	126	1036.12(2)
709	550-731	158	38.92(2)
710	732-914	176	0.00(2)
711	367-549	961	18.62(6)
712	367-549	973	58.72(7)
713	367-549	950	64.32(7)
714	367-549	1195	52.43(8)
715	275-366	132	74.05(4)
716	275-366	539	10.19(5)
<u>Stratified Analysis:</u>			
Upper			83.9
Mean			49.2
Lower			14.4
Biomass (t)			33994

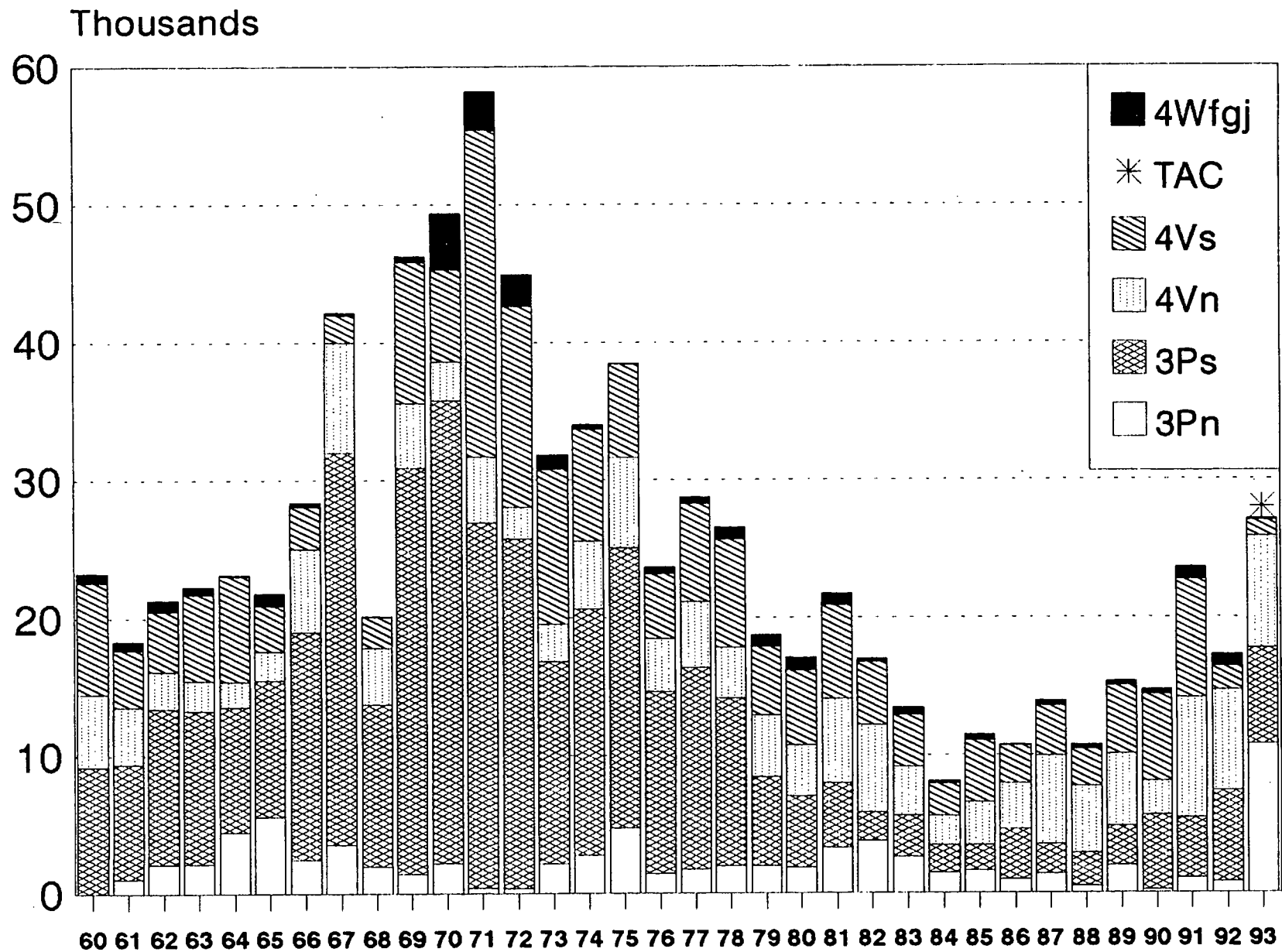


Fig. 1. Nominal catches of redfish from the "Laurentian Channel" management unit for the period 1960-1993(3Pn and 4Vn from Jun-Dec).

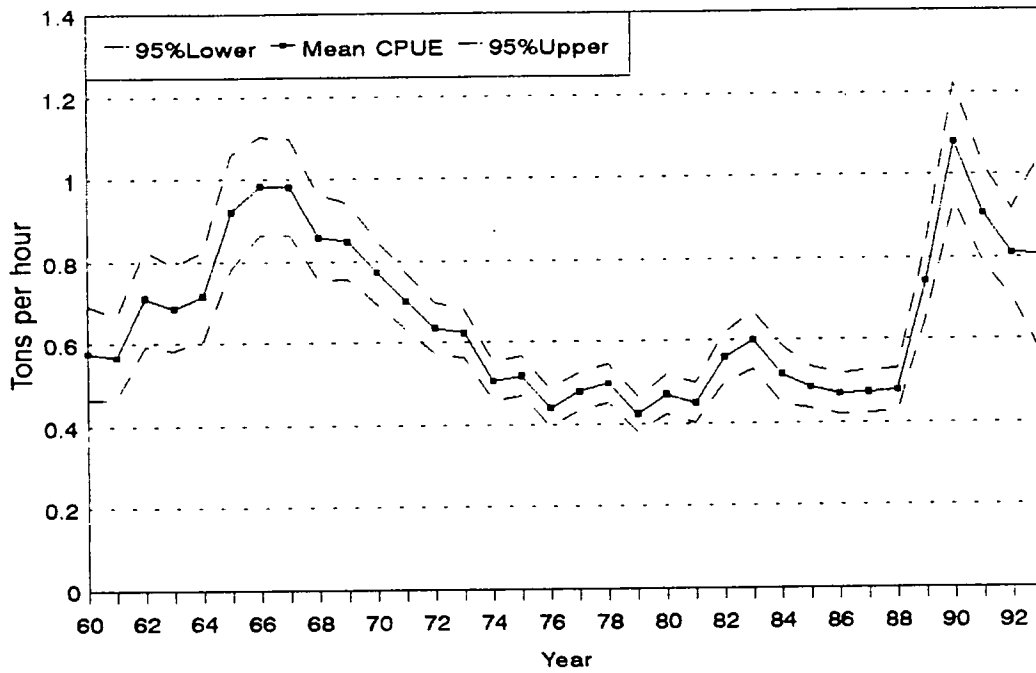


Fig. 2. Standardized CPUE for redfish in Unit 2 from 1960-93. (1993 only contain provisional Nfld. data)

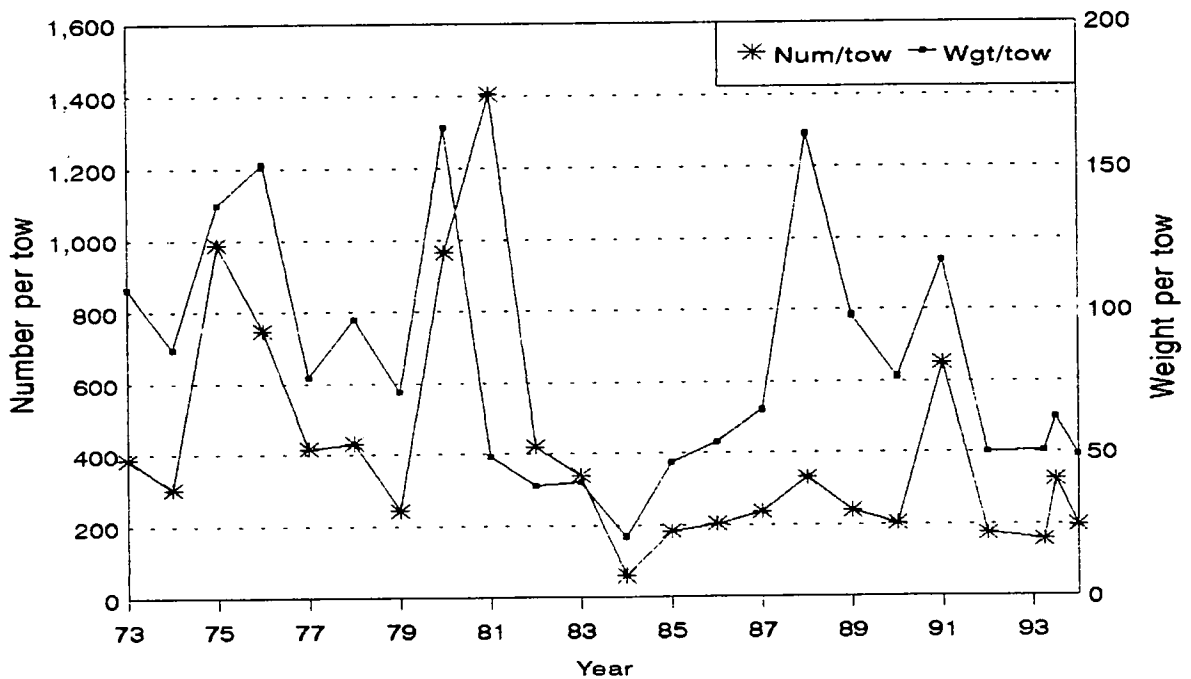


Fig. 3. RV mean numbers and weights per standard tow for redfish in Subdiv 3Ps. from 1973 to 1994

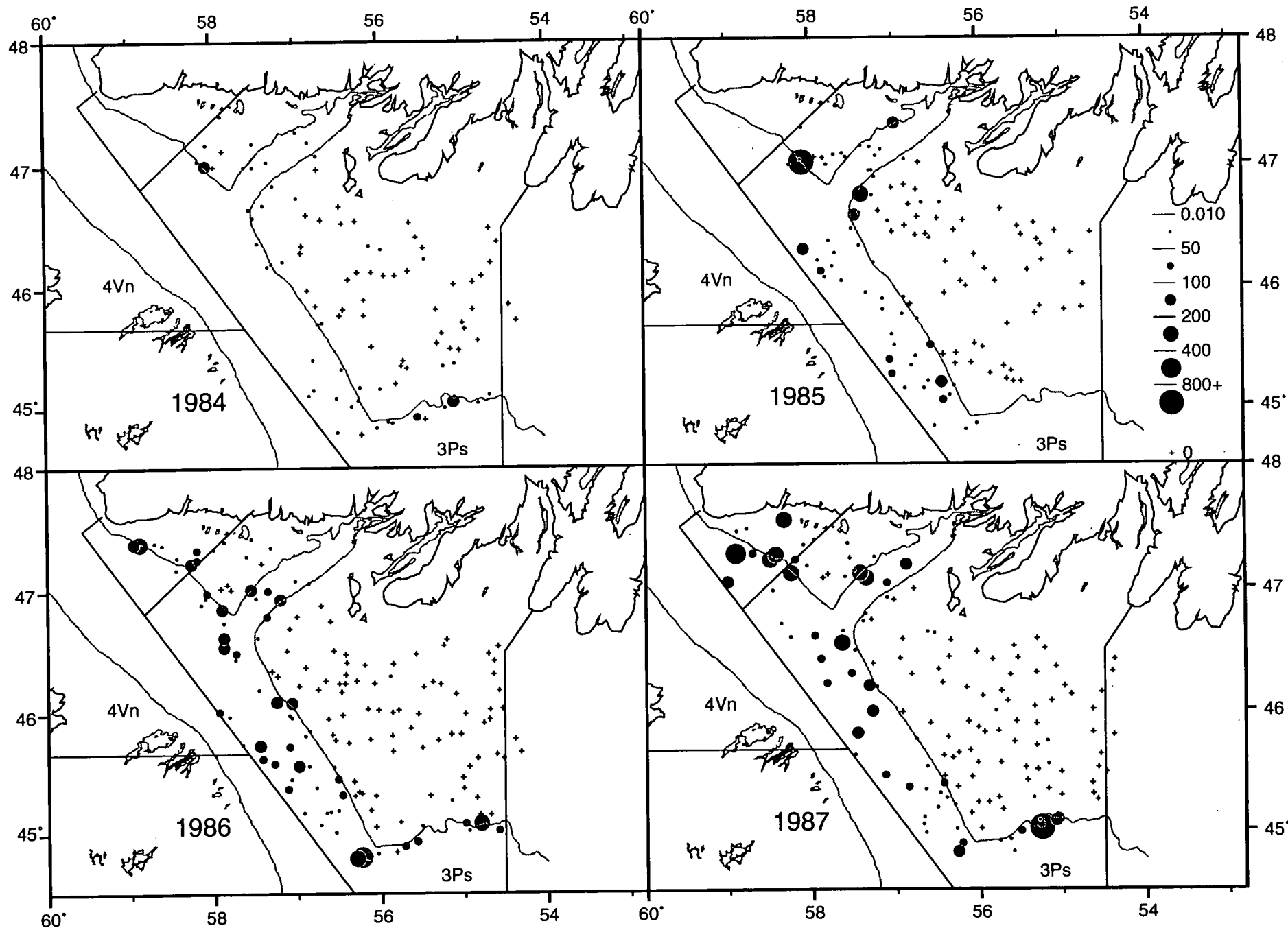


Fig. 4. Distribution of Redfish catches (Kg./standard tow) from 1984-1994 Canadian surveys to Div. 3P showing 250m depth contour.

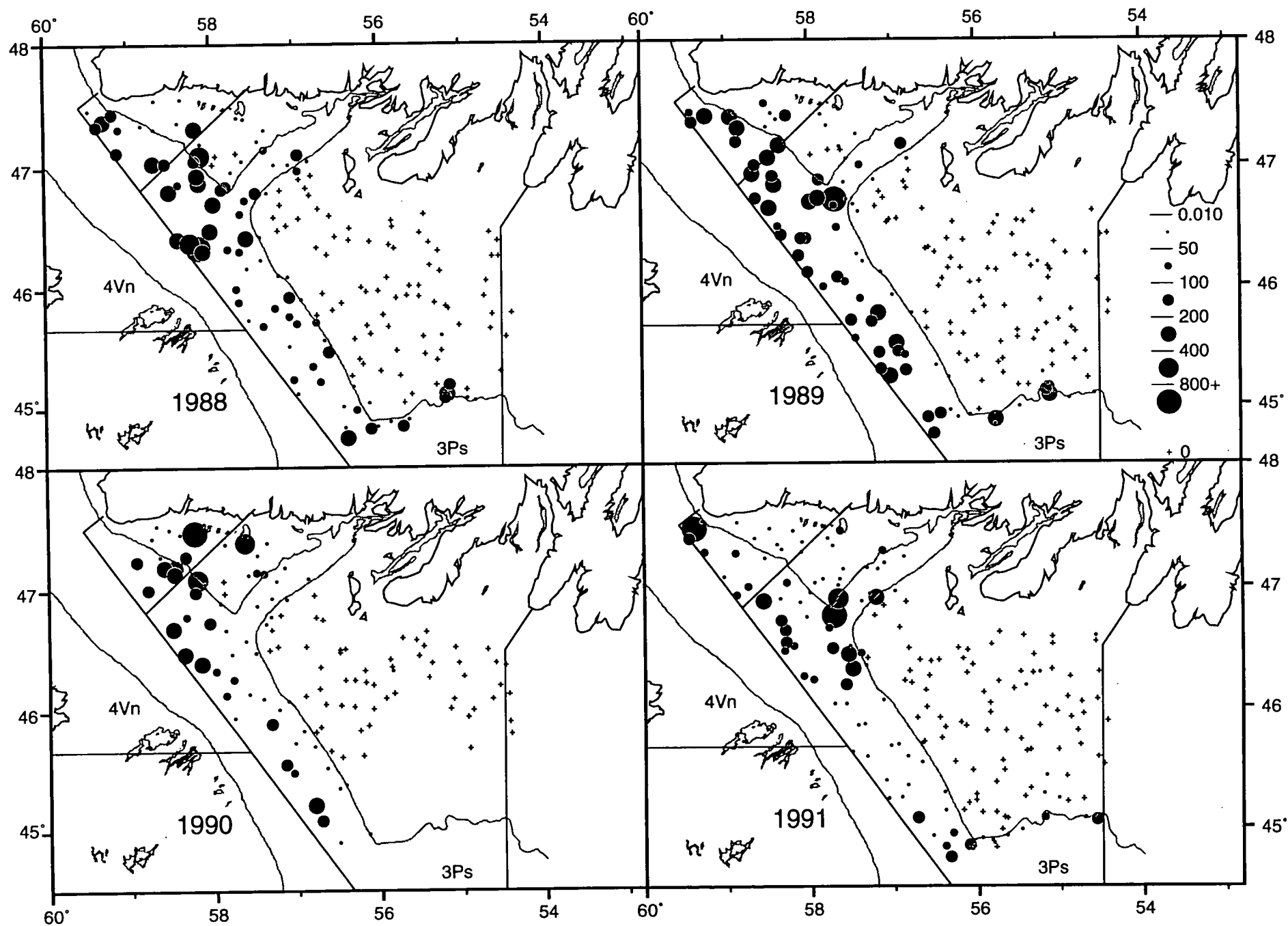


Fig. 4. (continued)

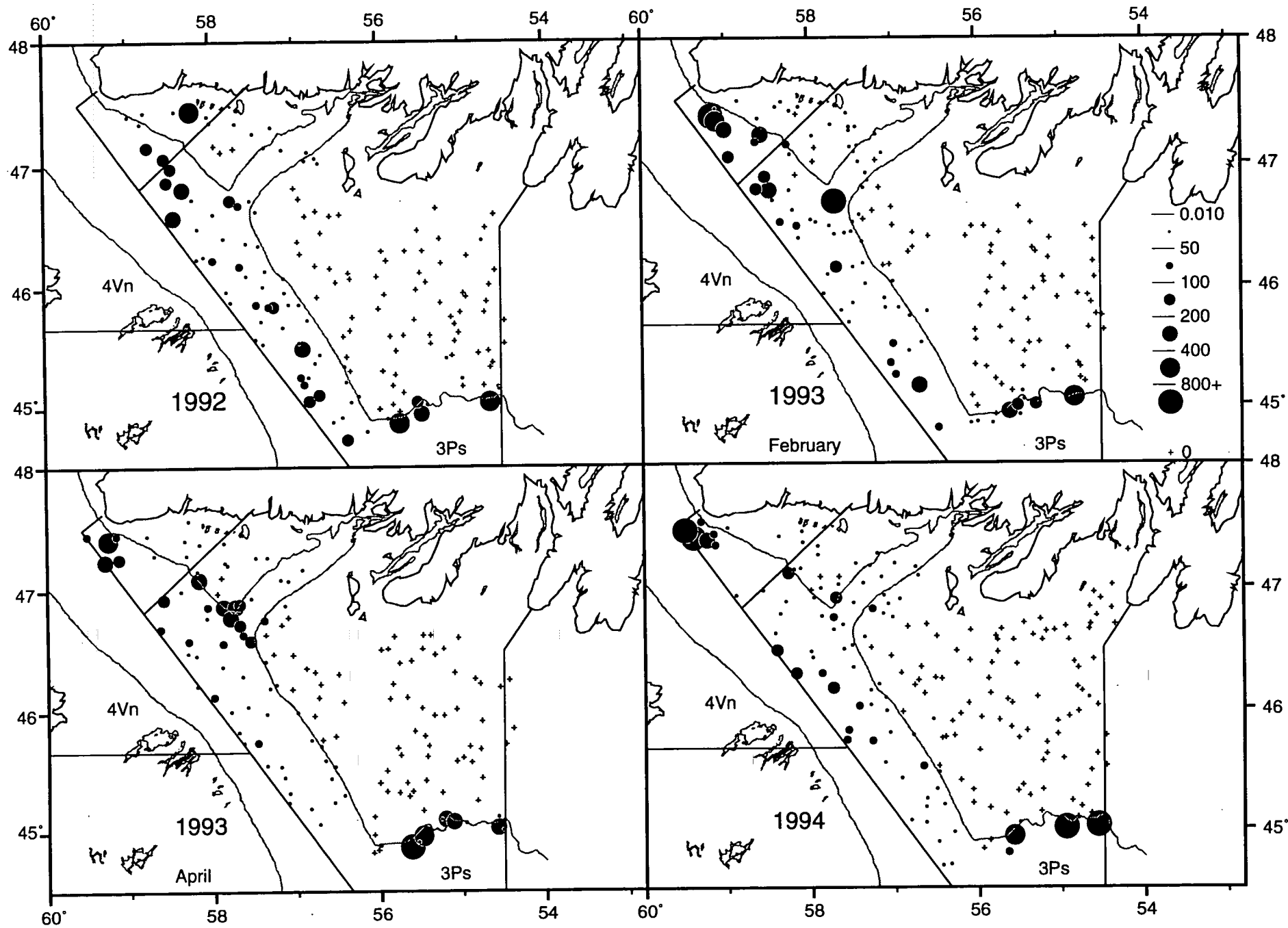


Fig. 4. (continued)

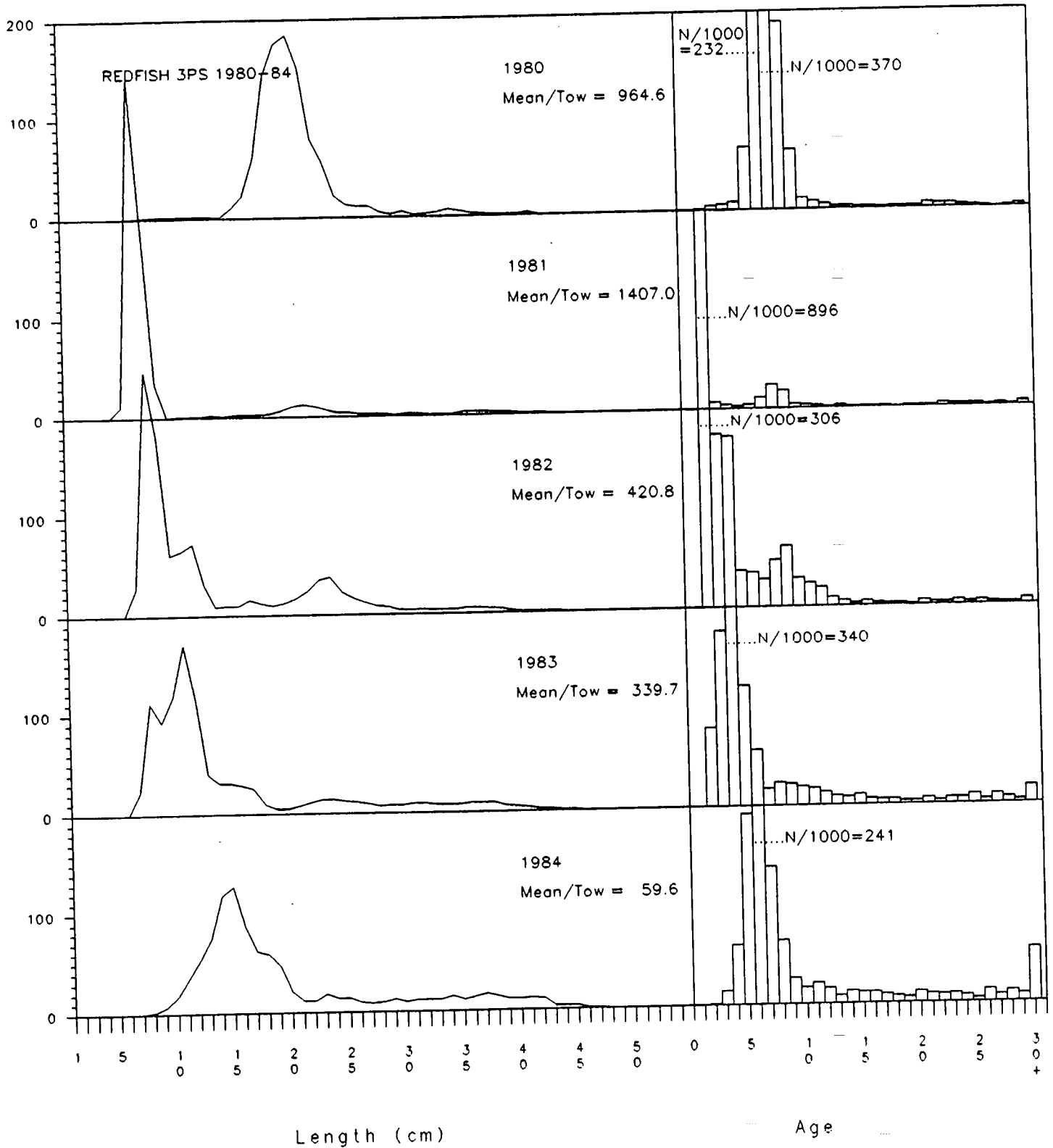


Figure 5 : Redfish length frequencies and corresponding age distribution from stratified random research surveys in Div. 3Ps for the 1980-1993 period.

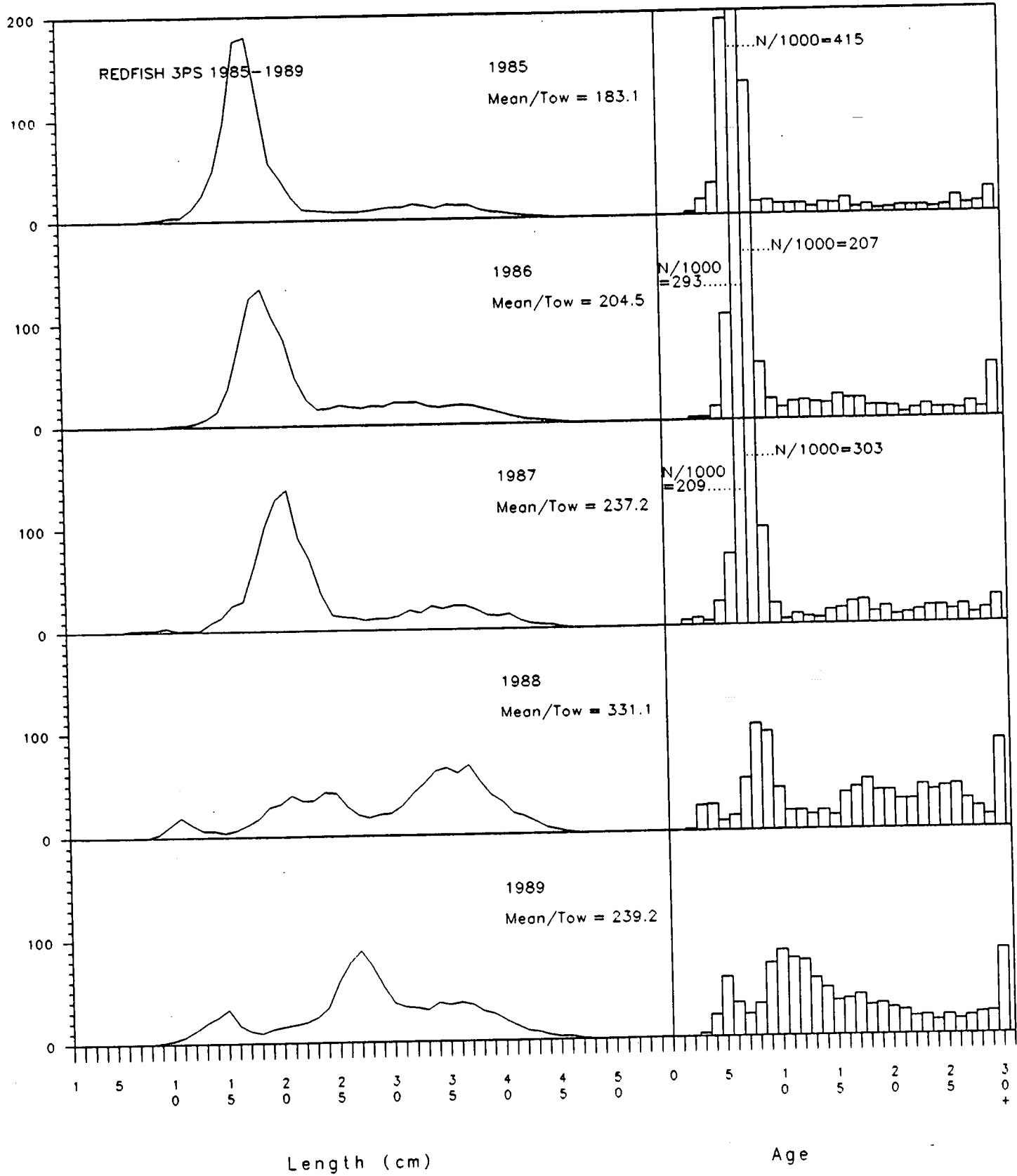


Figure 5 : (continued, 1985-1989)

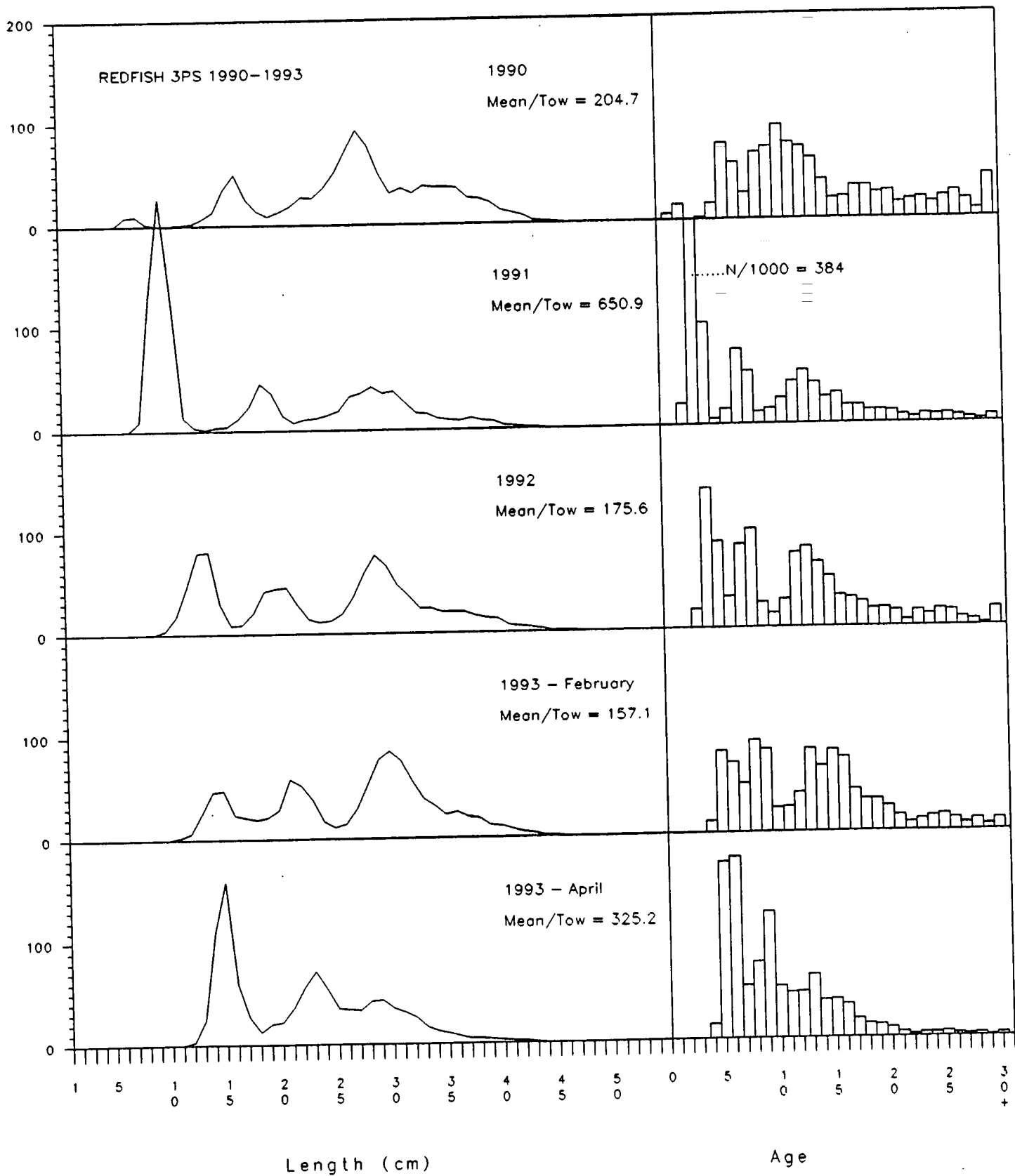


Figure 5 : (continued, 1990-1993)