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The status of Redfish in Div. 3O

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ABSTRACT

Nominal catches have ranged between 3,000 t and 35,000 t since 1960. Up to 1986 catches averaged 13,000 t, increased to 35,000 t by 1988 and declined subsequently to 3,000 t in 1995 due to reductions in foreign allocations. Foreign fleets historically accounted for most of catch but Canada has increased its activity in since 1995. From 1996-1999 Canadian catches have alternated between levels of about 8,000 t and 2,500 t due to the lack of market for redfish near the 22cm size limit. Assessment of this stock has been primarily based on research data due to variable commercial indices and fleets prosecuting different areas of the stock. It is difficult to reconcile year to year changes in seasonal RV survey, but generally, the spring survey biomass index suggests the stock may have increased since the early 1990s, but has stabilized at around 100,000 t since 1994. The autumn RV survey, while more stable in the early 1990s, generally supports this. RV surveys do not adequately sample fish greater than 25 cm which up to 1997 have generally comprised the main portion the fishery which makes it is difficult to interpret survey estimates in relation to what is happening to the stock as a whole. The fishery since 1998 appeared to target the relatively strong 1988 year class that has grown sufficiently to exceed the small fish protocol of 22 cm. There is concern that there has been little sign in recent surveys of size groups smaller than 17 cm despite using a shrimp trawl, which is very effective at catching small fish.

RÉSUMÉ

Depuis 1960, les prises nominales ont varié de 3 000 t à 35 000 t. Jusqu'en 1986, la moyenne des prises a été de 13 000 t. Cette moyenne a augmenté à 35 000 t en 1988. En 1995, elle avait diminué à 3 000 t à cause des diminutions des allocations de pêche aux bateaux étrangers. De façon traditionnelle, la plupart des captures étaient effectuées par des flottilles étrangères. Toutefois, depuis 1995, le Canada est devenu plus actif à ce niveau. De 1996 à 1999, les prises canadiennes ont oscillé entre des niveaux d'environ 8 000 t à 2 500 t à cause du manque de demande de sébaste près de la limite de taille de 22cm. Compte tenu des indices commerciaux variables et du fait que les flottilles pêchent le stock dans diverses zones, le stock a été évalué principalement à partir de données de recherches. Il est difficile de comparer d'une année à une autre les variations des résultats des relevés saisonniers effectués par les bateaux de recherche. Toutefois, de façon générale, les indices de biomasse des relevés faits au printemps permettent de croire que le stock a peut-être augmenté depuis le début des années 1990, mais qu'il s'est stabilisé à près de 100,000 t depuis 1994. Bien qu'ils aient été plus stables au début des années 1990, les résultats des relevés effectués par les bateaux de recherche à l'automne semble indiquer, de façon générale, la même tendance. Les relevés des navires de recherche ne permettent pas de faire un échantillonnage adéquat des poissons dont la taille dépasse 25 cm. Jusqu'en 1997, ces poissons ont constitué généralement la majeure partie des captures. Il est donc difficile d'interpréter les estimations faites à partir des relevés par rapport à ce qui se passe réellement dans l'ensemble du stock. Depuis 1998, la pêche semble avoir été axée sur la classe annuelle relativement solide de 1988 qui a grossi suffisamment pour ne plus être touchée par le protocole de protection des juvéniles de moins de 22 cm. On s'inquiète du fait que les relevés récents ont permis d'échantillonner peu d'individus des groupes dont la taille est inférieure à 17 cm, et ce, en dépit du fait qu'on ait utilisé un chalut à crevettes qui est pourtant très efficace pour capturer le petit poisson.

DESCRIPTION OF MANAGEMENT REGULATIONS AND THE FISHERY

Management regulations

Redfish in Div. 3O have been subject to management regulation since 1974, but, has only applied to that portion of Div. 3O within Canada's 200 mile Exclusive Economic Zone (EEZ). About 10% of the habitable redfish area within Div. 3O lies outside Canada's 200 mile limit. A TAC of 16,000 t was first implemented in 1974. The TAC was increased in 1978 to 20,000 t and generally remained at that level through to 1987. The TAC for 1988 was reduced to 14,000 t and remained unchanged until 1994 when it was reduced to 10,000 t as a precautionary measure and maintained at that level to 1999. During 1999 a shift was implemented from the current calendar year based TAC to a fiscal year based TAC which will take effect from April 1, 2000 to March 31, 2001. To facilitate this temporal shift in TAC, the 1999 calendar year TAC was extended to March 31, 2000 and increased from 10,000 tons to 10,200 tons to accommodate the extension. In addition to catch regulation, a small fish protocol at 22 cm was implemented inside the 200 mile limit for this stock in 1995. The 1999 adjusted TAC (10,200 t) is divided into a Canadian quota (8,670 t), and a French quota (1,530 t).

Nominal Catches

Nominal catches have ranged between 3,000 t and 35,000 t since 1960 (Table 1, Fig. 1). Up to 1986 catches averaged 13,000 t, increased to 27,000 t in 1987 with a further increase to 35,000 t in 1988, exceeding TACs by 7,000 t and 21,000 respectively. Catches declined to 13,000 t in 1989, increased gradually to about 16,000 t in 1993 and decline subsequently to about 3,000 t in 1995, partly due to reductions in foreign allocations since 1993. Since 1996, catch has fluctuated between 9,000 t and 14,000 t with the exception of 5,000 t in 1997. Up to the end of the third quarter in 1999, total catch was at 9,000 t.

The increased catches in 1987 and 1988 were due primarily to increased activity outside the 200 mile limit by countries who were not contracting parties of NAFO (primarily Panama and South Korea) and had no bilateral agreements with Canada. Canadian surveillance estimates of non-reported catch, which have ranged from 200 t to 23,500 t, are included in catch statistics since 1983. A further explanation of these is given in Shelton and Atkinson (1994). There hasn't been any activity in the area outside the 200 mile EEZ by non-NAFO fleets since 1994.

Russia predominated in this fishery up until 1993 (Table 2) and generally caught its share (about 50%) of the total non-Canadian allocation, which accounted for about 2/3 of the TAC. From 1985 to 1993 Russian catches ranged from 3,800 t to 7,200 t. Russia and Cuba, impacted by the reduction and eventual elimination of foreign allocations by Canada, have not fished since 1995 and 1993 respectively. Catches by Portugal, which began fishing in the limited stock area outside the 200 mile limit in 1992, peaked at 4,800 t in 1995 and declined to 1,900 t by 1998. Spain, which had only incidental catches of redfish before 1996 has increased catch outside the 200 mile limit from 300 t in 1996 to 1,900 t in 1998.

Canada, which has had limited interest in a fishery in Div. 3O because of small sizes of redfish encountered in trawlable areas, landed less than 200 t annually from 1983-1991. In 1994, Canada took 1,600 t due to improved markets related to lobster bait, but declined to about 200 t in 1995. Since then

Canadian catches have alternated between levels of about 8,000 t and 2,500 t due to the market demand for redfish near the 22cm size limit.

In general, the fishery has occurred primarily in the second and third quarters of the year since 1985 (Table 3a). The prominent means of capture from the mid-1970s to the early 1980s was the bottom otter trawl (Table 3b). The use of midwater trawls from 1985 to 1993 was primarily by Russia and Cuba. Canadian, Portuguese and Spanish fleets primarily use bottom trawling.

COMMERCIAL DATA

CPUE Index of Abundance

In past assessments a standardized commercial catch rate index based on data since 1959 had been developed routinely for evaluation. The analysis of catch rates by the Canadian fleet are not considered indicative of overall trends in the resource. Until recently, Canada has not accounted for a major portion of the reported catches from Division 3O and has only fished within the 200 mile EEZ. Large interannual variability in the catch rates and recent changes in the composition of the domestic fleets participating in this fishery makes it difficult to draw inferences about stock status.

The annual update to the databases did not provide any further information on catch rate of foreign countries than was available for the 1995 assessment. The data from Portugal and Spain since 1995 do not have effort available in hours fished. Previous analyses of catch rate series for foreign fleets indicate a general decline from the mid 1980s to about 1994 (Power et. al. MS 1995). It is considered that catch rates of the fleets that have fished outside is probably indicative of a decline in the proportion of the stock outside the EEZ where most of that effort had occurred.

Catch at Length

Length distributions were sampled from the following fisheries: Canadian fisheries 1998-1999 from port sampling and observer programs, Portuguese fisheries in 1998-1999 by Portuguese observers (R. Alpoiem, pers. comm.) and the Japanese fishery in 1998 by Canadian observers. These samples were combined by month and quarter weighted by appropriate landings to derive a catch-at-length by country for Division 3O. The length-weight relationships used in the compilation were:

$$\text{WT (males)} = 0.01659\ \text{Forklength}^{2.9548}$$
$$\text{WT (females)} = 0.013272\ \text{Forklength}^{3.0210}$$

The data (Fig. 2) indicate that in 1998 there was a mode at about 23 cm for both males and females in the Portuguese fishery , a peak at 25 for males and 27 for females in the Japanese fishery and a peak of 21 cm for males and 24cm for females in the Canadian fishery. The general size range was consistent between the Canadian and Portuguese fisheries for 1998 and it was evident that Japanese fishery in 1998 consisted of somewhat larger fish. The Japanese samples illustrate the differences in growth rates between males and females. This was not evident in the Portuguese samples in 1998. Sampling for 1999 suggests the Portuguese fishery was very similar to 1998 by a dominant mode at 23 cm (unsexed). Canadian catches for 1999 were dominated by modes at 23cm for males and 26cm for females. Generally, the Canadian catches were comprised of a larger range of sizes than the

Portuguese fishery. The size distribution from the 1998 and 1999 Portuguese fisheries (range 19cm-35cm, mode at 23cm) compared to 1995 and 1996 (range 21cm-42cm, various modes greater than 29cm, see Power and Atkinson (MS 1998a)) suggest that the pattern of the fleet has changed to fishing in shallower water, given the general observation that fish size increases with depth for redfish.

RESEARCH SURVEY DATA

Abundance Estimates

Stratified random groundfish surveys have been conducted in the spring and autumn in Division 3O since 1991, with coverage of depths to 730 m. In addition, a summer survey was conducted in 1993. From 1991 to spring 1995 an Engel 145 otter trawl was used (1.75 n. mi. standard tow) and from autumn 1995 onwards a Campelen 1800 shrimp trawl (0.75 n. mi. standard tow). The 1991 to spring 1995 Engel 145 data were converted into Campelen 1800 trawl equivalent data. Details of the comparative fishing trials and data modelling can be found in Power and Atkinson (MS 1998a).

The series of mean weight per standard tow for spring (Table 4) and autumn (Table 5) exhibits large fluctuations in estimates between seasons and years for some strata, not uncommon for bottom trawl surveys for redfish. This is usually accounted for by the influence of one or two large sets on the survey. It is difficult to reconcile year to year changes in the indices, but generally, the revised spring survey biomass index (Fig. 3) suggests the stock may have increased since the early 1990s, but has stabilized at around 100,000 t since 1994. The low 1997 value is considered a sampling anomaly. The autumn surveys, while more stable in the early 1990s, generally supports this pattern. It should also be noted that the estimates for 1996 and 1999 do no include important strata that were not sampled in those years. In most surveys, the densities outside the 200-mile EEZ (strata 355, 256, 721, 722 and the eastern half of strata 354) were generally lower than inside. Differences between the spring and fall surveys may be related to changes in availability within the Division at different times of the year.

Recruitment

Size distribution in terms of mean number per tow at length from the spring surveys (Fig. 4) indicates a bimodal distribution in 1991 with modes at 11 cm and 20 cm corresponding to about the 1988 and 1984 year classes respectively. The 20 cm mode progresses at about a cm per year up to 1994 (at 23 cm) and cannot be traced any further. The 11 cm mode progresses at about 2-3 cm per year until it reaches 21 cm in 1996. From 1996 to 1998 the mode remains at 21cm but is dominant. The 1999 survey shows a dominant mode at 22cm. Size distribution from the autumn surveys (Fig. 5) indicates a bimodal distribution in 1991, similar to the spring survey, with modes at 13 cm and 21 cm. The 21 cm mode only progresses to 23 cm by 1994 after which it is no longer discernible. The 13 cm mode progresses to a 17 cm mode in 1992 but only increments to 19 cm up to the 1995 survey. The mode progresses about 1 cm per year to 23 cm in the 1999 survey. There has been little sign in the surveys since 1995 of size groups smaller than 17cm.

The size distributions of the survey catches indicate only a narrow range of sizes caught each year in Division 3O. Generally fish smaller than about 10 cm and larger than about 25 cm are absent in survey catches from 1991-1998 which cover strata down to 732 m (400 fathoms). It is well documented

that the Engel survey gear (e.g. Power MS 1995) and the Campelen survey gear (e.g. Power and Atkinson, MS 1998b) can catch both smaller (than 10 cm) and larger (than 25 cm) redfish. Length sampling from the commercial fisheries in the mid-1990s reveals a higher proportion of fish greater than 25 cm compared to the survey catches. Therefore, it appears that fish sizes outside this range, especially fish greater than 25 cm, are generally unavailable to the gear in this area. The reasons for this are unknown but may be related to distribution relative to trawlable bottom.

Stratified random groundfish surveys have been conducted in the spring in Division 3O from 1973 to 1990, with coverage of depths to 367m. The surveys used a Yankee 41.5 trawl with a liner from 1973-1982 and an Engel 145 trawl with a liner from 1983-1990. Size distributions were plotted to get an indication of historical recruitment pattern and size range in depths from 93m-367m which is considered the shallower end of redfish distribution. It is clear from the varied scales on the y-axis (Fig. 6) that estimates of abundance from these surveys fluctuated greatly from year to year. In general, the upper limit of the size range was 29cm in this depth range. The 1990 survey shows a dominant mode at 24 cm. This mode could be followed back to the 1981 survey at 9cm. The next tractable pulse of recruitment occurred in the 1975 survey at 9-10cm.

Industry Perspectives

The increased activity in 1996 for some Canadian enterprises was motivated by a need to find fish of marketable size in light of the moratorium in UNIT 1 and a reduction of the UNIT 2 TAC. The experience of this fishery was different from other Canadian fisheries but there was reasonable success in finding good concentrations of acceptable size fish, primarily from October to December. The knowledge from the Russian fishing experience in the area available to some Canadian enterprises suggests that water temperature influences fishing success.

Catches and catch rates were considered relatively high in 1996, low in 1997 and high again in 1998. Fluctuations in catch were largely market driven and there were problems with small fish in 1997. The general intent of some fleets is to concentrate their fishing where they are confident of finding fish of sizes appropriate for market and sometimes take smaller fish to finish up a trip. In the 1998 fishery, there were reports of much fish in the landings close to the 22 cm small fish protocol. The reduced Canadian catch in 1999 is again primarily a result of market conditions for smaller sized fish (22cm to 25cm) predominantly harvested from this area. Some industry participants have expressed concern that the small fish protocol (at 22cm) is too small and should be raised. This is related to possible connections of redfish in this area as recruitment to fisheries in adjacent UNIT 2.

The targeting of fish sizes greater than 30 cm results in substantial reduction of catch rates. Although this fishery is still considered to be in the learning stage, the acceptability of fish near the small fish protocol will likely result in a targeting of effort for these sizes as catch rates are more cost effective.

SOURCES OF UNCERTAINTY

It is still not possible to describe overall trends in total stock size, or estimate the current size of the fishable portion of the population, nor is it possible to determine current fishing mortality rate. Current data suggests that redfish in this area are predominantly *Sebastes fasciatus*. However, this

needs further study. In addition, the affiliation of redfish in Div. 3O to those in adjacent areas remains unclear.

PROGNOSIS

Although variable, recent surveys suggest that catches of about 10,000 t are not likely to generate fishing mortality in excess of $F_{0.1}$.

Before 1998, the surveys were considered to have been monitoring pre-recruits to the fishery and tracked a relatively strong year class which in recent years has caused problems for industry in complying with the small fish protocol. This year class has now reached a size where it contributed to the 1998 and 1999 commercial catches. The Canadian fishery will target this year class in the future. There is concern, however, about the poor sign of subsequent recruitment (less than 17 cm). It is also important to consider that length at which 50% of males are mature is about 21cm, whereas 50% of females do not reach maturity until about 28cm.

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Table 1. Nominal catches (t) and TACs of redfish in Div. 3O.

Year	Canada	Others	Total	TAC
1960	100	4,900	5,000	
1961	1,000	10,000	11,000	
1962	1,046	6,511	7,557	
1963	2,155	7,025	9,180	
1964	1,320	14,724	16,044	
1965	203	19,588	19,791	
1966	107	15,198	15,305	
1967	645	18,392	19,037	
1968	52	6,393	6,445	
1969	186	15,692	15,878	
1970	288	12,904	13,192	
1971	165	19,627	19,792	
1972	508	15,609	16,117	
1973	133	8,664	8,797	
1974	91	13,033	13,124	16,000
1975	103	15,007	15,110	16,000
1976	3,664	11,684	15,348	16,000
1977	2,972	7,878	10,850	16,000
1978	1,841	5,019	6,860	16,000
1979	6,404	11,333	17,737	20,000
1980	1,541	15,765	17,306	21,900
1981	2,577	10,027	12,604	20,000
1982	491	10,869	11,360	20,000
1983	7	7,333	7,340	20,000
1984	167	16,811	16,978	20,000
1985	104	12,756	12,860	20,000
1986	141	10,914	11,055	20,000
1987	183	26,987	27,170	20,000
1988	181	34,611	34,792	14,000
1989	27	13,229	13,256	14,000
1990	155	14,087	14,242	14,000
1991	28	8,433	8,461	14,000
1992	1,219	14,049	15,268	14,000
1993	698	15,022	15,720	14,000
1994 [a]	1,624	3,804	5,428	10,000
1995 [a]	177	3,037	3,214	10,000
1996 [a]	7,255	2,590	9,845	10,000
1997 [a]	2,588	2,559	5,147	10,000
1998 [a]	8,931	5,121	14,052	10,000
1999 [b]	2,244	6,656	8,900	10,000

[a] Provisional

[b] Provisional to Nov. 5, 1999 (based on Canadian Atlantic Quota Reports and NAFO data)

Table 2. Nominal catches (t) of redfish in Div. 3O by country and year since 1986 (1994-1999 are provisional, 1999 to Nov. 5).

Country	1986	1987	1988	1989	1990	1991	1992	1993	1994a	1995a	1996a	1997a	1998a	1999a
Canada (M)	5	24	5	18	27	4	27	21	779	4	2124	693	2850	316
Canada (N)	136	159	176	9	128	24	1192	677	845	173	5131	1895	6081	1928
France (SPM)	-	-	-	-	-	-	-	-	-	-	-	134	266	200
Japan	1162	1074	1606	1724	1406	226	125	159	-	264	417	285	355	
Portugal	-	-	22	12	83	3	1468	4794	2918	1935	1635	894	1875	
Spain	45	26	4	-	4	-	-	-	26	22	338	1245	1925	
Russia	6099	7152	4921	4517	3811	4427	5845	6887	60	416	-	-	-	
Cuba	3006	2859	2753	2138	2750	2748	2776	665	-	-	-	-	-	
USA	2	-	-	-	-	-	-	-	-	-	-	-	-	
Korea(S)	-	1726	1805	2638	833	129	1935	17	-	-	-	-	-	
EU	-	-	-	-	-	-	-	-	-	-	-	-	-	6656
OTHER [b]	600	14150	23500	2200	5200	900	1900	2500	800	400	200	-	700	NA
Total	11055	27170	34792	13256	14242	8461	15268	15720	5428	3214	9845	5146	14052	9100
TAC	20000	20000	14000	14000	14000	14000	14000	14000	10000	10000	10000	10000	10000	10000

[a] Provisional

[b] Estimates of non-reported catch (by Canadian Surveillance)

Table 3a. Nominal catches (t) of redfish in Div. 3O by month and year since 1986 (not including surveillance estimates).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1986	707	-	427	593	69	710	3491	3712	58	1	319	368	10455
1987	102	40	1052	37	1010	757	2001	4142	429	344	1326	1780	13020
1988	15	1	493	684	915	1	1755	3922	1286	1057	915	248	11292
1989	228	585	224	6	674	1411	1143	3311	2737	666	51	20	11056
1990	108	23	257	26	1220	2474	1534	1571	1002	686	28	113	9042
1991	17	47	96	1	713	2054	2346	1118	830	338	-	1	7561
1992	0	57	14	10	635	3262	2520	1808	896	1261	797	2108	13368
1993	226	14	754	817	2089	1601	1887	2068	1809	829	630	496	13220
1994 [a]	60	93	742	1609	236	83	-	68	1000	540	19	178	4628
1995 [a]	7	125	145	2	45	28	56	765	645	879	107	10	2814
1996 [a]	-	-	88	119	166	46	704	783	1582	2814	1524	1481	9307
1997 [a]	4	-	-	43	87	416	1299	943	622	963	435	49	4861
1998 [a]	-	174	22	74	890	2485	1685	239	598	1374	1251	142	8934

[a] Provisional (1998 for Canada)

Table 3b. Nominal catches (t) of redfish in Div. 3O by gear since 1986 (not including surveillance estimates).

	Otter Trawls				
Year	Bottom	Midwater	Gillnets	Misc	Total
1986	5231	5224	-	-	10455
1987	8601	4419	-	-	13020
1988	6692	4596	-	4	11292
1989	7026	4030	-	-	11056
1990	5501	3537	-	4	9042
1991	4625	2936	-	-	7561
1992	10046	3292	1	29	13368
1993	11997	1214	-	9	13220
1994 [a]	3085	1498	26	19	4628
1995 [a]	2221	525	26	42	2814
1996 [a]	8966	334	7	-	9307
1997 [a]	4841	10	2	-	4853
1998 [a]	8932	-	-	2	8934

[a] Provisional (1998 for Canada only)

Table 4. Mean weight (kg) of redfish caught per standard tow in Division 3O during spring and summer Canadian research surveys from 1991 - 1999. ("---" indicates strata not sampled). Estimates from 1991-1995 are Campelen trawl equivalent units based on a Comparative fishing trials with an Engels 145 bottom trawl. Estimates from 1996-1999 are the actual Campelen trawl data.

STRATUM	Depth (m)	Area* sq. n. mi	1991 Spring	1992 Spring	1993 Spring	1993 Summer	1994 Spring	1995 Spring	1996 Spring	1997 Spring	1998 Spring	1999 Spring
329	093-183	1721	0.27 (9)	0 (8)	0 (6)	---	11.2 (5)	0.49 (5)	0.00 (6)	1.01 (6)	0.00 (7)	0.00 (6)
332	093-183	1047	0.71 (6)	0.19 (5)	0 (4)	---	0 (4)	148.49 (4)	11.90 (4)	0.28 (3)	49.05 (4)	238.46 (4)
337	093-183	948	15.97 (5)	1.52 (4)	0.92 (2)	---	0 (3)	334.99 (4)	0.05 (3)	0.09 (3)	75.90 (4)	29.45 (3)
339	093-183	585	0 (3)	0 (2)	0 (2)	---	0 (2)	0 (2)	0.00 (2)	0.00 (2)	0.00 (2)	0.00 (2)
354	093-183	474	0 (3)	0 (2)	284.6 (2)	489.09 (3)	0 (2)	0 (3)	0.01 (2)	0.00 (2)	109.43 (2)	28.65 (2)
333	185-274	151(147)	120.82 (2)	404.03 (2)	1339.7 (2)	---	5428.5 (2)	113.46 (2)	120.42 (2)	20.23 (2)	696.32 (2)	797.63 (2)
336	185-274	121	11.57 (2)	81.2 (2)	630.9 (2)	431.18 (2)	1032.9 (2)	8543.1 (2)	161.82 (2)	7.73 (2)	5068.70 (2)	198.93 (2)
355	185-274	103	2.65 (2)	2.79 (2)	972.94 (2)	162.87 (3)	608.28 (2)	178.36 (2)	4916.31 (2)	7.49 (2)	741.55 (2)	314.70 (2)
334	275-366	92(96)	103.33 (2)	36.48 (2)	202.9 (2)	--- (3)	171.11 (2)	29.37 (2)	219.97 (2)	33.87 (2)	140.25 (2)	478.93 (2)
335	275-366	58	4.27 (3)	54.34 (3)	118.28 (2)	9874.39	1210.4 (2)	263.69 (2)	2445.79 (2)	58.72 (2)	1053.90 (2)	1460.30 (2)
356	275-366	61	26.61 (2)	112.96 (2)	462.44 (2)	5750.33 (4)	135.84 (2)	467.99 (2)	515.78 (2)	7.50 (2)	651.61 (2)	1600.52 (2)
717	367-549	93(166)	452.43 (2)	74.25 (2)	83.19 (2)	---	395.28 (2)	91.4 (2)	191.18 (2)	534.69 (2)	143.11 (2)	670.04 (2)
719	367-549	76	33.66 (2)	12.33 (2)	149.95 (2)	4258.21 (2)	669.65 (2)	71.78 (2)	79.53 (2)	59.59 (2)	291.57 (2)	289.02 (2)
721	367-549	76	24.71 (2)	183.57 (2)	110.51 (2)	2485.73 (4)	21.98 (2)	1220.5 (2)	68.23 (2)	20.90 (2)	152.95 (2)	651.62 (2)
718	550-731	111(134)	42.2 (2)	7.53 (2)	87.7 (2)	---	155.99 (2)	7.25 (2)	27.15 (2)	14.98 (2)	35.49 (3)	16.72 (3)
720	550-731	105	11.67 (2)	57.7 (2)	9.65 (2)	50.69 (3)	15.92 (2)	14.61 (2)	129.06 (2)	21.01 (2)	14.52 (2)	103.58 (2)
722	550-731	93	118.39 (2)	12.62 (2)	33.24 (2)	75.32 (3)	126.1 (2)	6.28 (2)	25.38 (2)	12.16 (2)	136.98 (2)	19.73 (2)
Upper			100.67	104.24	277.61	2689.90	848.59	450.96	1209.99	189.48	1504.14	268.28
Mean			18.77	19.62	103.08	1498.82	208.31	283.78	135.27	18.99	192.68	148.20
Lower			-63.16	-65.00	-71.45	307.74	-431.93	116.57	-939.44	-151.50	-1118.80	28.13
TOTAL BIOMASS (metric tons)			15278	15961	83874	240612	172264	234648	111854	15721	159313	122550

*NOTE: In brackets are revised areas based on a redrawn stratification scheme implemented in 1994.

Unconverted Estimates of the Engels Trawl (1.75 n. mi. tow)						
Upper	120.04	79.25	243.40	1008.21	779.24	284.29
Mean	18.20	15.22	93.50	597.47	164.87	186.74
Lower	-83.63	-48.81	-56.38	126.72	-449.50	89.19
TOTAL BIOMASS (metric tons)	8082	6759	41518	52338	74391	84261

Table 5. Mean weight (kg) of redfish caught per standard tow in Division 3O during autumn Canadian research surveys from 1991 - 1999. ("---" indicates strata not sampled). Estimates from 1991-1994 are Campelen trawl equivalent units based on a Comparative fishing trials with an Engels 145 bottom trawl. Estimates from 1995-1999 are the actual Campelen trawl data.

STRATUM	Depth (m)	Area* sq. n. mi	1991 Autumn	1992 Autumn	1993 Autumn	1994 Autumn	1995 Autumn	1996 Autumn	1997 Autumn	1998 Autumn	1999 Autumn
329	093-183	1721	0.02 (7)	0.00 (3)	0.00 (5)	0.00 (6)	0.98 (5)	0.00 (5)	22.59 (5)	0.01 (5)	0.00 (5)
332	093-183	1047	0.00 (4)	13.29 (3)	2.69 (3)	15.59 (3)	31.46 (3)	0.17 (2)	7.73 (3)	2.67 (3)	0.76 (3)
337	093-183	948	30.80 (4)	64.65 (2)	7.00 (3)	5.04 (2)	55.45 (2)	0.00 (2)	17.93 (3)	34.58 (3)	1.90 (3)
339	093-183	585	0.00 (2)	0.00 (2)	0.00 (2)	0.00 (2)	0.00 (2)	0.00 (3)	0.00 (2)	0.00 (2)	---
354	093-183	474	0.00 (2)	171.47 (2)	0.00 (2)	0.00 (2)	785.26 (3)	15.58 (2)	915.00 (2)	31.50 (2)	---
333	185-274	151(147)	27.06 (2)	167.95 (2)	46.53 (2)	257.68 (2)	107.01 (2)	--- (2)	26.45 (2)	20.01 (2)	17.98 (2)
336	185-274	121	18.46 (2)	374.31 (2)	378.73 (2)	357.75 (2)	49.73 (2)	9.05 (2)	117.42 (2)	103.82 (2)	548.70 (2)
355	185-274	103	352.16 (2)	450.70 (2)	77.86 (2)	264.21 (2)	237.04 (2)	37.85 (2)	25.85 (2)	11.85 (2)	387.84 (2)
334	275-366	92(96)	1317.90 (2)	480.72 (2)	380.53 (3)	171.11 (2)	506.80 (2)	--- (2)	289.50 (2)	188.27 (2)	22.58 (2)
335	275-366	58	512.56 (2)	850.90 (2)	351.81 (2)	877.11 (2)	187.70 (2)	332.17 (2)	1114.40 (2)	362.06 (2)	443.19 (2)
356	275-366	61	59.40 (2)	684.61 (2)	60.08 (2)	303.84 (2)	387.60 (2)	145.49 (2)	106.10 (2)	914.53 (2)	667.05 (2)
717	367-549	93(166)	---	---	1391.30 (2)	340.35 (2)	588.78 (2)	--- (2)	2281.80 (2)	1834.04 (2)	---
719	367-549	76	268.90 (2)	---	930.48 (2)	536.15 (2)	413.97 (2)	656.38 (2)	880.23 (2)	321.31 (2)	691.01 (2)
721	367-549	76	53.71 (2)	---	100.37 (2)	16.57 (2)	1666.67 (2)	87.32 (2)	732.51 (2)	410.54 (2)	172.43 (2)
718	550-731	111(134)	---	---	169.30 (2)	442.14 (2)	409.37 (2)	--- (2)	37.13 (2)	4.38 (2)	48.03 (2)
720	550-731	105	---	---	50.02 (2)	118.70 (2)	16.48 (2)	572.55 (2)	---	162.58 (2)	21.33 (2)
722	550-731	93	7.67 (2)	---	164.02 (2)	22.71 (2)	125.80 (2)	103.91 (2)	3.96 (2)	108.63 (2)	---
Upper			306.48	147.37	105.23	108.99	971.94	86.17	1182.13	701.71	128.26
Mean			44.89	76.27	63.64	64.49	151.87	30.54	190.31	91.49	54.22
Lower			-216.70	5.17	22.05	19.99	-668.20	-25.08	-801.49	-518.73	-19.82
TOTAL BIOMASS (metric tons)			34618	56247	51782	53324	125579	22974	154622	75649	35002

*NOTE: In brackets are revised areas based on a redrawn stratification scheme implemented in 1994.

Unconverted Estimates of the Engels Trawl (1.75 n. mi. tow)				
Upper	274.18	163.42	127.90	119.76
Mean	37.19	65.24	64.02	62.91
Lower	199.80	-32.93	0.13	6.06
TOTAL BIOMASS (metric tons)	15649	26256	28423	28387

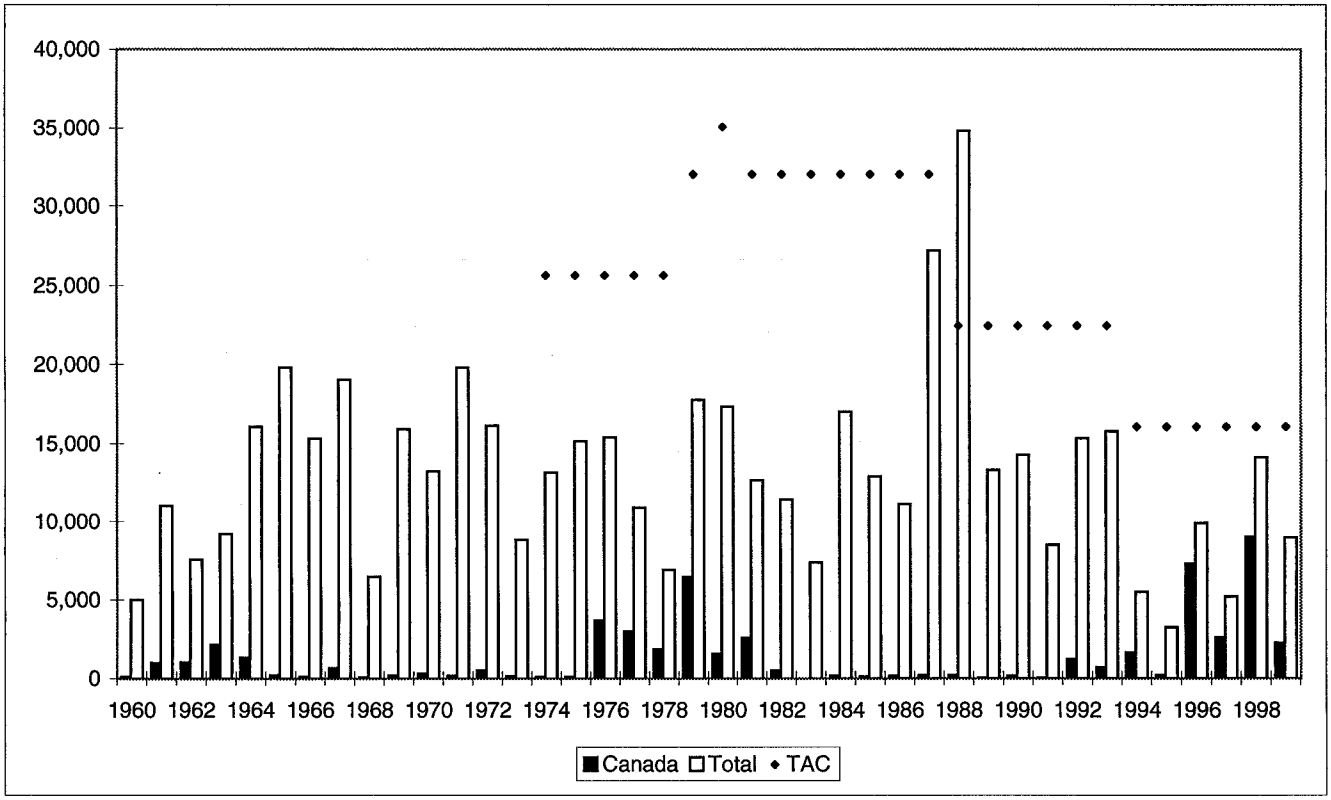

Fig. 1. Nominal catches and TACs for Division 3O redfish.

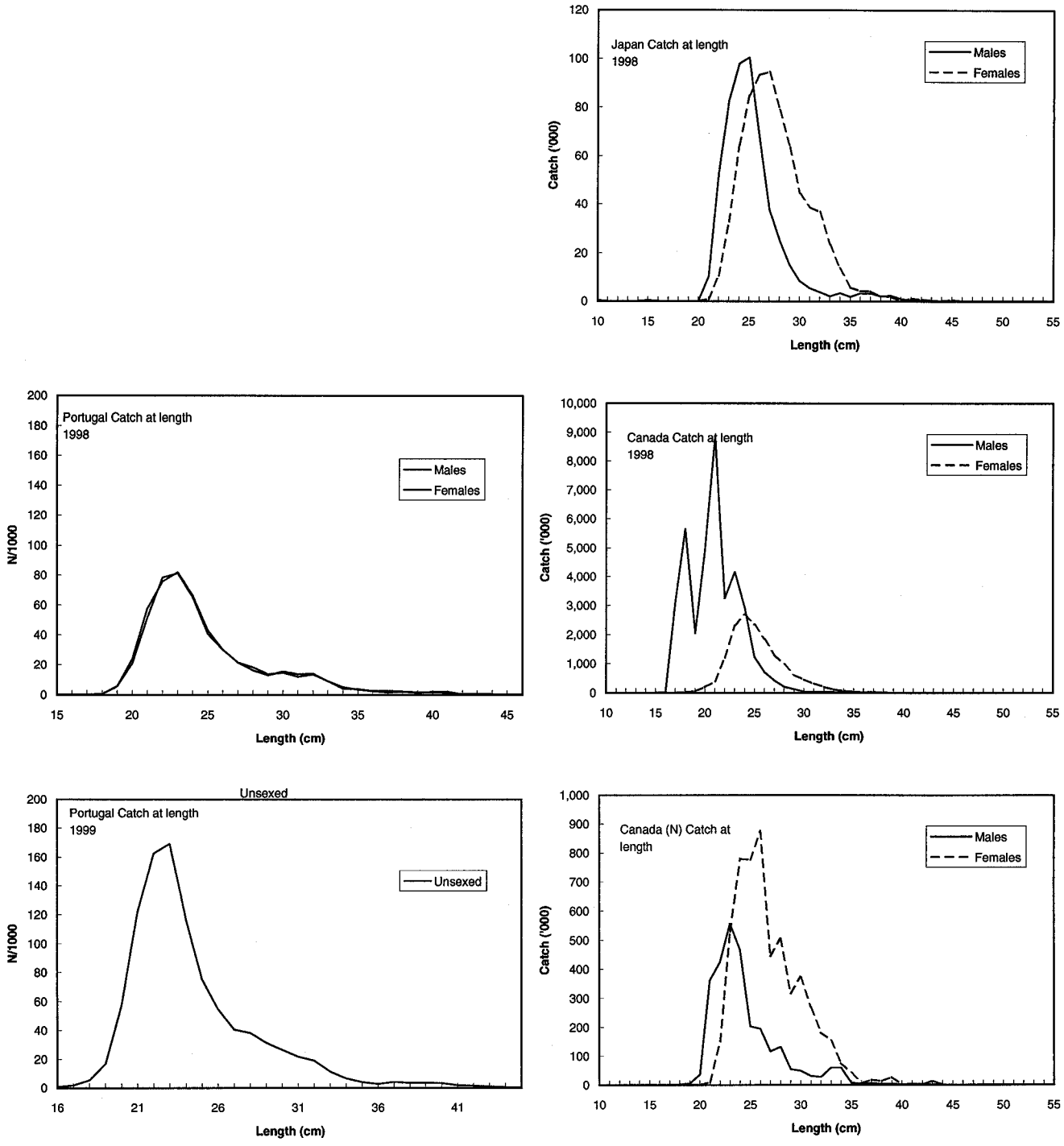

Fig. 2. Commercial catch-at-length of Div 3O redfish estimated by available port samples adjusted to landings by fleet, gear and month.

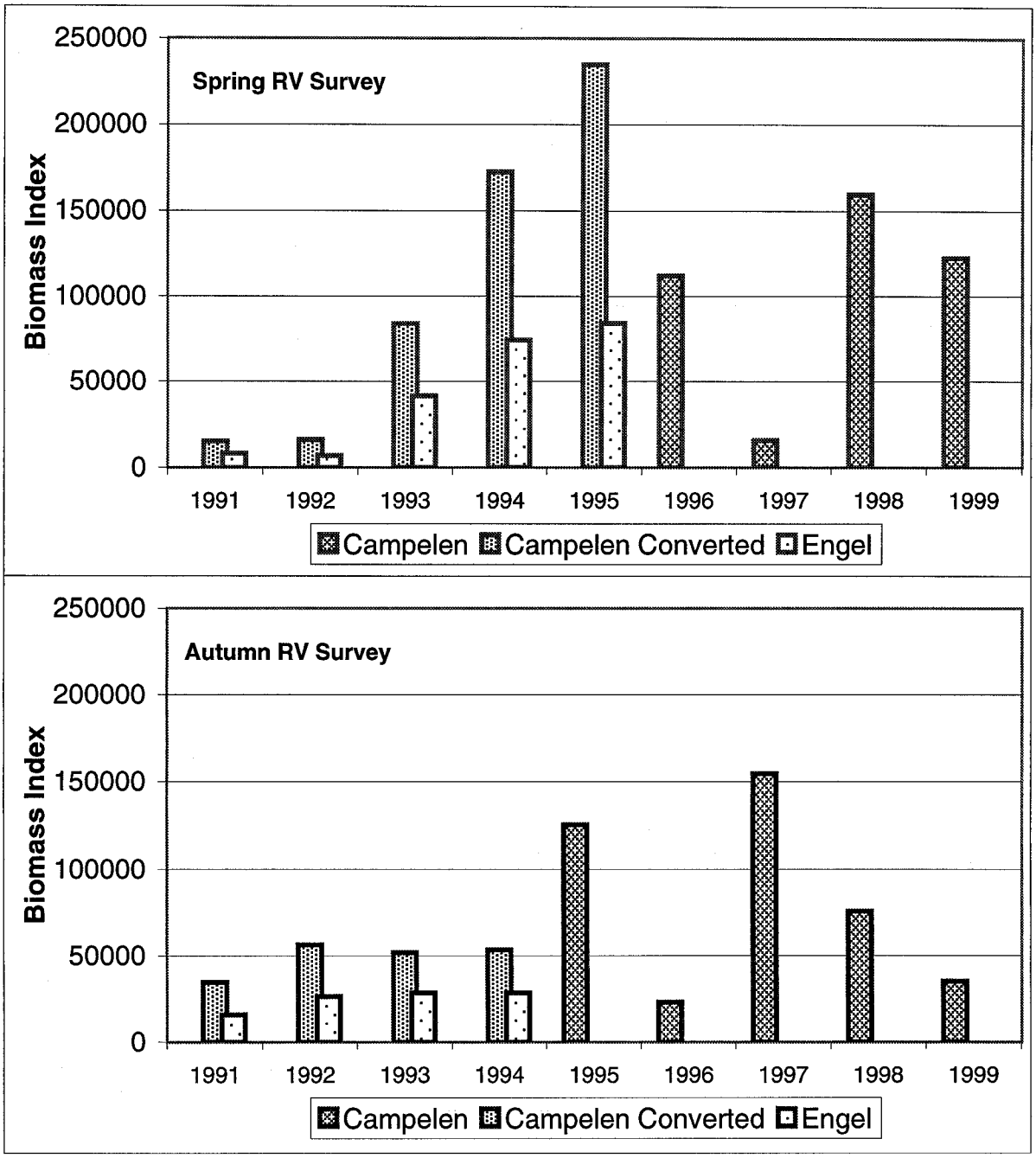

Fig. 3. Indices of survey biomass for redfish in Div. 3O for spring and autumn surveys from 1991-1999. Surveys prior to autumn 1995 utilized an Engel trawl. Estimates were converted into Campelen equivalents based on comparative fishing trials.

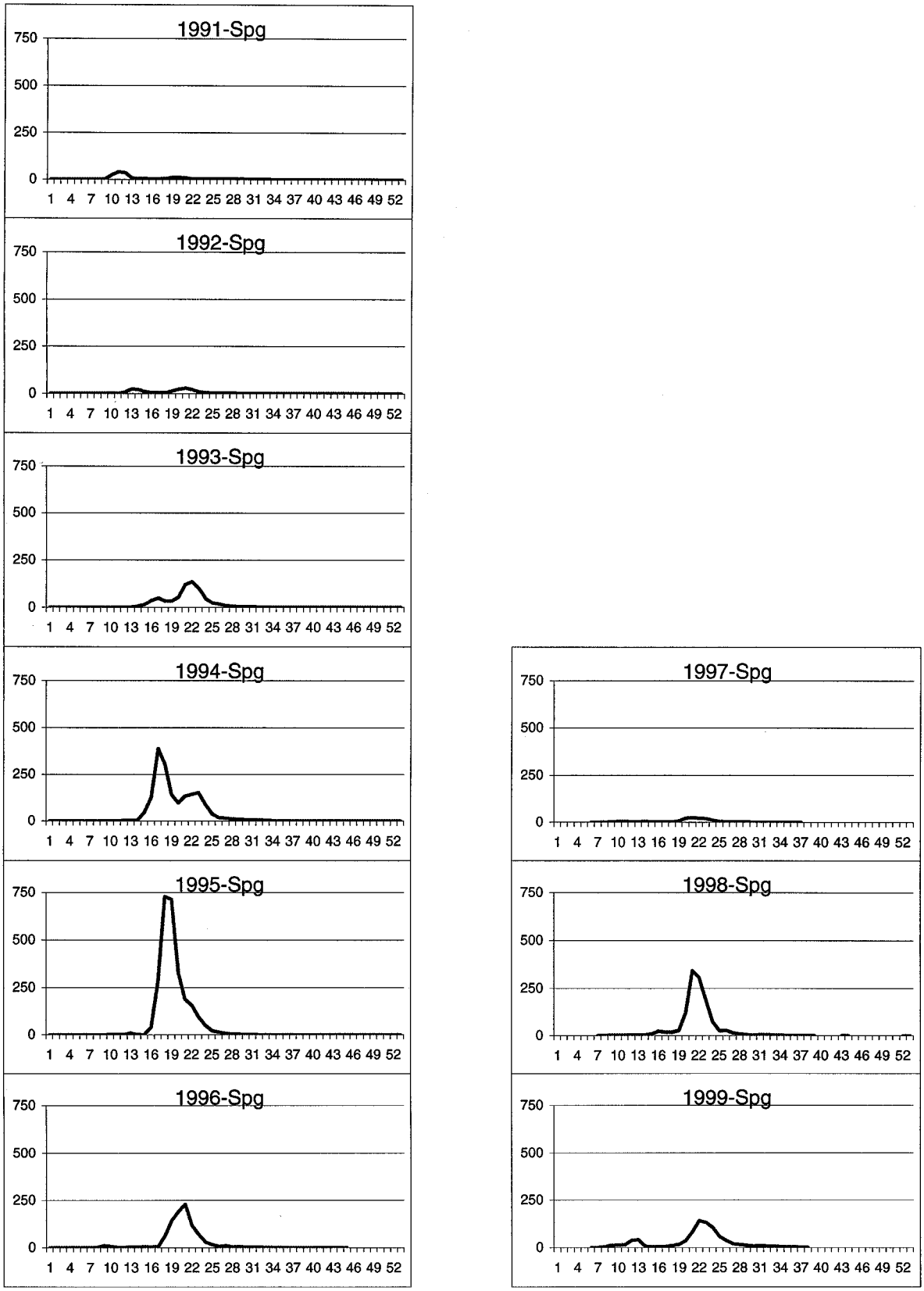

Fig. 4. Length distributions from RV surveys to Div. 3O in SPRING from 1991-1999. Plotted are mean per standard tow. The 1991-1995 data are convertions into Campelen equivalents based on a comparative fishing experiments.

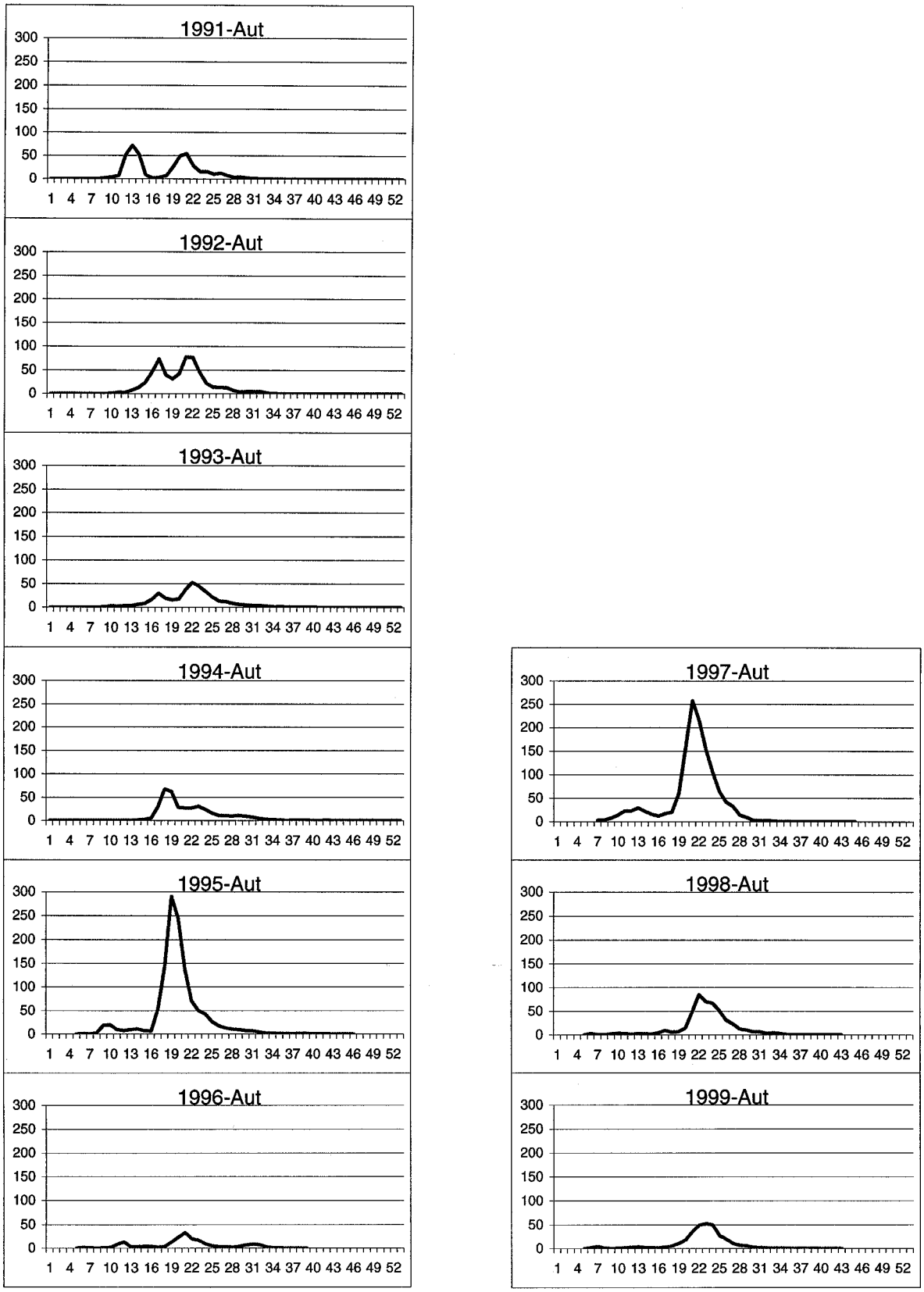

Fig. 5. Length distributions from RV surveys to Div. 3O in AUTUMN from 1991-1999. Plotted are mean per standard tow. The 1991-1994 data are convertions into Campelen equivalents based on a comparative fishing experiments.

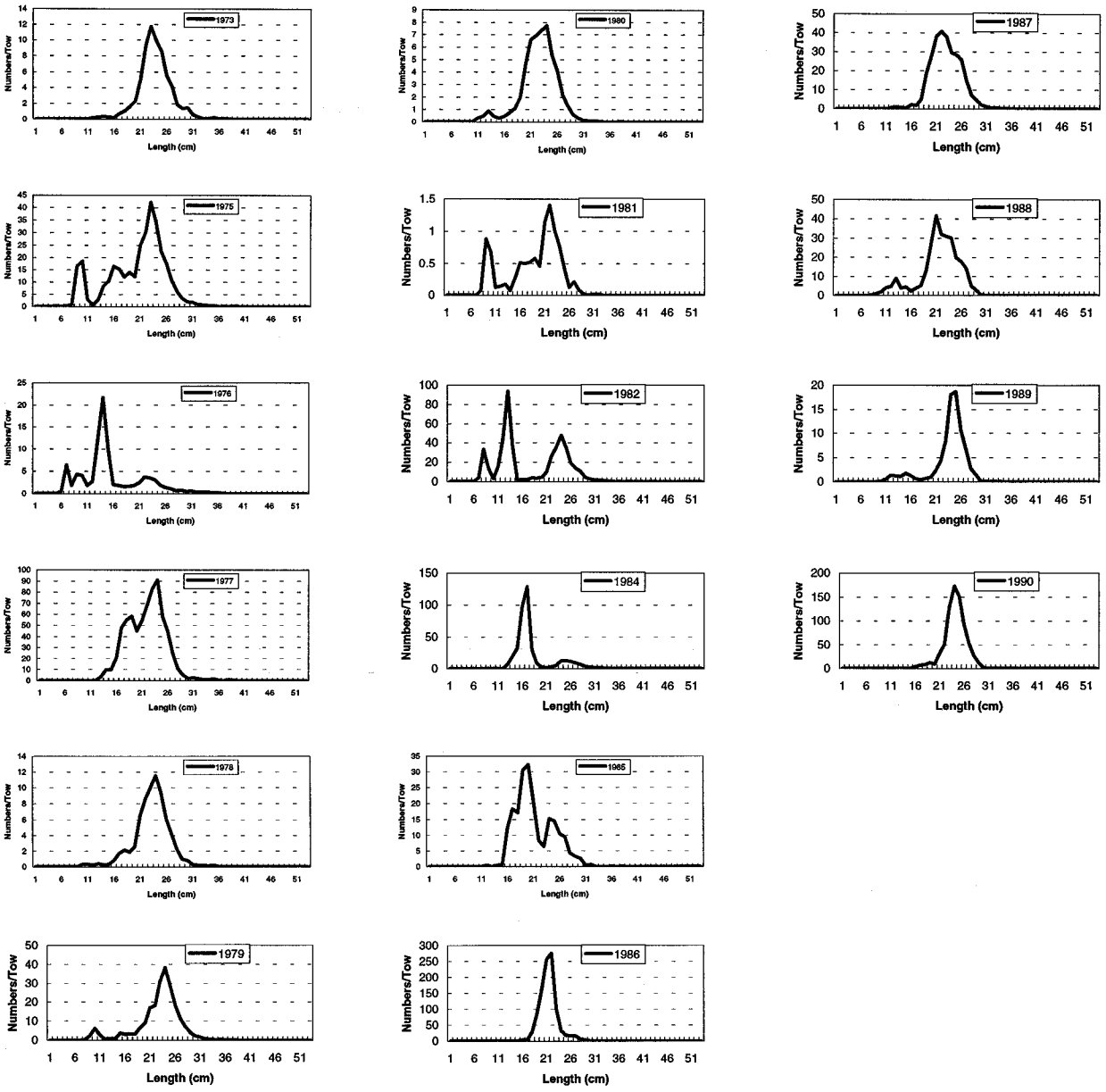

Fig. 6. Length distributions from RV surveys to Div. 3O in spring from 1973-1990. Plotted are mean per standard tow. The surveys covered depths to 200 fathoms.