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An Assessment of the Status of the Redfish in NAFO Division 3O

by

D. Power

Science Branch, Department of Fisheries and Oceans
P. O. Box 5667, St. John's, NL, Canada A1C 5X1

Abstract

There are two species of redfish, the deep sea redfish (*Sebastes mentella)* and the Acadian redfish (*Sebastes fasciatus*) that have been commercially fished and reported collectively in fishery statistics in Div. 3O. Nominal catches have ranged between 3 000 tons and 35 000 tons since 1960 (Table 1, Fig. 1). Up to 1986 catches averaged 13 000 tons, increased to 27 000 tons in 1987 with a further increase to 35 000 tons in 1988, exceeding TACs by 7 000 tons and 21,000 tons respectively. Catches declined to 13 000 tons in 1989, increased gradually to about 16 000 tons in 1993 and declined further to about 3,000 tons in 1995, partly due to reductions in foreign allocations within the Canadian fishery zone since 1993. Catches increased to 14,000 tons by 1998, declined to 10 000 tons by 2000 then doubled to 20 000 tons in 2001. From 2002-2003 catches averaged 17 200 tons then declined dramatically to about 3,800 tons in 2004. 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 the indices, but generally, the Canadian spring survey biomass index suggests the stock may have increased since the early 1990s, fluctuated over 100,000 tons from 1994 to 1999 and declined to 2002. The index shows an increase in 2003 and a larger increase in 2004 that was influenced by one large set in a stratum that represented 40% of the biomass index. The Canadian autumn surveys, while more stable in the early 1990s, generally supports the pattern of the spring survey index to 2002 but suggests stability to 2004. RV surveys do not adequately sample fish greater than 25 cm which up to 1997 have generally comprised the main portion of 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.

Introduction

There are two species of Sebastes that have been commercially fished in Div. 3O, the deep sea redfish (*Sebastes mentella)* and the Acadian redfish (*Sebastes fasciatus*). The external characteristics are very similar, making them difficult to distinguish, and as a consequence they are reported collectively as “redfish” in the commercial fishery statistics. Redfish in Div. 3O have been subject to management regulation since 1974 within Canada’s 200 mile exclusive fishery zone. Beginning in 2005 the NAFO Regulatory Area (NRA) was also brought under TAC regulation. About 8% of the habitable redfish area within Div. 3O lies within the NRA.

Nominal Catches and TACs

Nominal catches have ranged between 3 000 tons and 35 000 tons since 1960 (Table 1, Fig. 1). Up to 1986 catches averaged 13 000 tons, increased to 27 000 tons in 1987 with a further increase to 35 000 tons in 1988, exceeding TACs by 7 000 tons and 21 000 tons, respectively. Catches declined to 13 000 tons in 1989, increased

gradually to about 16 000 tons in 1993 and declined further to about 3 000 tons in 1995, partly due to reductions in foreign allocations within the Canadian fishery zone since 1993. Catches increased to 14 000 tons by 1998, declined to 10 000 tons by 2000 then doubled to 20 000 tons in 2001. From 2002-2003 catches averaged 17 200 tons then declined dramatically to about 3 800 tons in 2004.

The large catches in 1987 and 1988 were due mainly to increased activity in the NRA by South Korea and non-Contracting parties (NCPs), primarily by Panama. There hasn't been any activity in the NRA by NCPs since 1994. Estimates of under-reported catch have ranged from 200 tons to 23 500 tons. There have also been estimates of over-reported catch in the recent period since 2000. Over this time period, over-reported catch has ranged ranged from 1 800 tons (2001) to 4 300 tons (2003).

A TAC of 16 000 tons was first implemented by Canada within its 200-mile limit in 1974. The TAC was increased in 1978 to 20 000 tons and generally remained at that level through to 1987. The TAC for 1988 was reduced to 14 000 tons and remained unchanged until 1994 when it was reduced to 10 000 tons as a precautionary measure and maintained at that level to 2003. During 1999 a shift was implemented from a calendar year based TAC to a fiscal year based TAC currently in effect from April 1, 2000 to March 31, 2001 at 10 000 tons. 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 September 2004, the NAFO Fisheries Commission adopted TAC regulation for redfish in 3O, implementing a level of 20 000 tons for 2005-2007. This TAC applies to the entire division.

Description of the Fishery

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 Canadian TAC. From 1987 to 1993 Russian catches ranged from 3 800 tons to 7 200 tons. Russia and Cuba, impacted by the reduction and eventual elimination of foreign allocations by Canada, ceased directed fishing in 1994. Russia resumed directed fishing in 2000 rapidly increasing their catch from 2 200 tons to about 11 000 tons from 2001-2003 before a large reduction in catch to only 240 in 2004. Portugal began fishing in 1992 averaged about 1 800 tons between 1992 to 1998. Their reported catches escalated to 5 500 tons in 1999 and have averaged about 4 500 tons to 2004. Spain, who had taken less than 50 tons before 1995, increased catches from 1 200 tons in 1997 to a peak of 4 500 tons in 1999 with a subsequent decline to 300 tons in 2004. Although most fleets in the NRA have reduced their catch from 2003 to 2004, the reduction was primarily accounted for in the reduced activity of the Russian fleet.

Canada has had limited interest in a fishery in Div. 3O because of small sizes of redfish encountered in areas suitable for trawling. Canadian landings were less than 200 tons annually from 1983-1991. In 1994, Canada took 1 600 tons due to improved markets related to lobster bait, but declined to about 200 tons in 1995. Between 1996 and 1999 Canadian catches have alternated between levels of about 8 000 tons and 2 500 tons based on market acceptance for redfish near the 22 cm size limit regulated within Canada. From 2000-2004 Canada has averaged about 3 200 tons.

In general, the fishery has occurred primarily from May to October since 1990 (Table 3a). The prominent means of capture since 1990 is the bottom otter trawl which generally accounts for greater than 90% of the catch (Table 3b). The catch by midwater trawls is predominantly by Russia. Canadian, Portuguese and Spanish fleets utilize bottom trawling.

Commercial Fishery Data

Catch and Effort

Catch and effort data for 1959 to 1999 were extracted from ICNAF/NAFO Statistical Bulletins and were combined with provisional 2000-2003 NAFO data and 2004 Canadian logbook data compiled by various Department of Fisheries and Ocean regional statistics branches. Initially selected from this database were observations where redfish comprised more than 50% of the total catch and were therefore considered to be redfish directed.

These data were analysed with a multiplicative model (Gavaris 1980) to derive a standardized catch rate index for hours fished. The effects included in the model were a combination country-gear-tonnage class category type

(CGT), month, and a category type representing the amount of by-catch associated with each observation. For this effect five groups were arbitrarily established: (>50% <=60%), (>60% <=70%), (>70% <=80%), (>80% <=90%) and (>90%) where each group corresponds to the percentage of redfish relative to the total catch associated with each observation. Due to missing effort data for hours fished for some of the principal fleets in the fishery since 1992, only days fished data were extracted. In the usual manner, catch less than 10 tons and effort less than 5 days were eliminated prior to analysis in addition to any categories with less than five samples except in the year category type. For all analyses an unweighted regression was run because of unknown percentages of prorating prior to 1984.

In the 2003 assessment of this stock it was noted that the analysis of catch rates separately by fleet category suggested different trends over the time period from the mid-1970s to the mid-1990s (Power, MS 2003). The Canadian fleet generally shows an increase over the period while the fleets fishing inside and outside show a decrease. The trends are generally in agreement since 1993. This suggests these fleets should be analysed separately for a historic perspective. In consideration that the Canadian fleet fishes totally with its exclusive fishery zone, whereas other contracting parties fish in the NRA, it was decided to standardize these fleets separately. In the past, Canada had bi-lateral fisheries agreements with Russia, Japan and Cuba which enabled their fleets to fish with Canada's exclusive fishery zone. As these arrangements ceased in 1993 the data for these fleets prior to 1994 were not used in the standardization of CPUE.

For the NRA FLEETS "days fished" standardization, the regression was significant (P <0.05), explaining 59% of the variation in catch rate (Table 4). There was a significant year effect but the regression coefficients and their standard errors indicate no year was significantly different from the reference year (1987). The catch rate index (Table 4, Fig. 2 right panel) shows much within year variability prior to 1992. The series generally suggests an increase from 1987 to 1991 followed by a decrease to the lowest level in 1996. Catch rate then doubled from 1996 to 1999 then continued to increase more slowly to 2001 where it was at the same level as in 1987. The index decreased by 6% between 2001 and 2003.

For the CANADIAN FLEETS "days fished" standardization, the regression was significant (P <0.05), explaining 62% of the variation in catch rate (Table 5). ANOVA results indicate no significant month effect (P >0.18). There was a significant year effect but the regression coefficients and their standard errors indicate that only 1994 was marginally different from the reference year (1960) and this is so because the mean value for this year is three times higher than any one year in the series. The catch rate index (Table 6, Fig. 2 left panel) shows much within year variability. There are also only short periods of sustained directed effort prior to 1996. During a period of sustained activity from 1976-1981 catch rates were stable and comparable to catch rates at the beginning of the series. The next onset of a sustained directed fishery began in 1996 which shows a general increase to 2004. The index in recent years is at the same level it was in the late 1970s as well as the early 1960s.

Canada has not accounted for a major portion of the reported catches from Div. 3O and has only fished within the 200-mile Canadian fishing zone. Market conditions have determined the Canadian activity in Div. 3O. There are fleets within the industry that search for larger fish rather than simply maximizing catch rate. The trend in the Canadian catch rate series is similar to the trend for fleets that have only fished in the NRA for the period since 1996, both indicating an increase. In summary, these catch rates indices may simply be reflecting fishing success of fleets within there area of operation rather than stock trends. The interpretation of commercial catch rates as an indicator of stock abundance remains difficult for a species like redfish that tend to form patchy aggregations at times very dense. In Div. 3O there is a limited amount of fishable area in deeper waters along the steep slope of the southwest Grand Bank where larger fish tend to be located.

Commercial fishery sampling

Sampling of the redfish fisheries was conducted by Canada, Portugal (Vargas *et al*., MS 2005), and Russia (Vaskov *et. al*., MS 2005) from the 2004 trawl fishery (Fig. 3). The Portuguese fleet fished between 140-966 m while the Russian fleet fished from 300-600 m. Logbook information from the Canadian fleets indicated most of the catch was taken at depths <300 m. The following are the sampling details for the Canadian fleets:

Can(N)	Month	No. Samples	n	Depth Range
	Apr	6	1473	320-549m
	Sep	5	1503	475-607m
	Oct	3	772	360-516m
	Nov	1	415	357-357m

The compilation of annual catch at length derived as number per thousand suggested fish between 21-29 cm generally dominated the catches. Lengths between 21-26 cm (range 7-42 cm) dominated the Portuguese catch. The dominant size range in the Russian catch was 22-29 cm (range 17-42 cm), which was sampled for total length.

A compilation of catch at length from various fleets from 1995 to 2004 suggests that the size composition has changed over the time period with fleets catching a larger portion of fish >25 cm prior to 1998 (Fig. 3).

Research Survey Data

Abundance Indices

Stratified random groundfish surveys have been conducted in the spring and autumn in Div. 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 7) and autumn (Table 8) 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 spring survey biomass index (Fig. 4) suggests the stock may have increased since the early 1990s, fluctuated over 100 000 tons from 1994 to 1999 and declined to 2002. The index shows an increase in 2003 and a larger increase in 2004 that was influenced by one large set in a stratum that represented 40% of the biomass index. The low 1997 value is considered a sampling anomaly. The autumn surveys, while more stable in the early 1990s, generally supports the pattern of the spring survey index to 2002. However, the autumn index suggests stability to 2004. It should also be noted that the 1996 autumn estimate does not include important strata that were not sampled due to problems on the survey.

In most surveys, stratum by stratum density estimates in the NAFO Regulatory Area (denoted in Tables 7 and 8 as strata 354, 355, 356, 721, 722) were generally lower than inside, although there is a portion of these strata that actually occurs inside. Estimates of percentages of survey biomass have ranged from 3% to 53% with an average of the values being 16.5% for the spring surveys. For the autumn surveys estimates range from 7% to 37% with an average of the values being 20%.

Recruitment

Size distribution in terms of mean number per tow at length from the spring surveys (Fig. 5) 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 21 cm but is dominant. It appears to have increased to 22 cm in 1999 and 23 cm in the 2000 survey. This mode remains dominant and at 22 cm or 23 cm from 2001-2004. There were pulses of recruitment detected in the 1999 and 2003 surveys that have since diminished. Another discernable pulse was detected in the 2004 survey.

Size distribution from the autumn surveys (Fig. 6) 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 increases about 1 cm per year to 23 cm by 1999 and remains at that length until the 2000 survey. In the 2001-2004 surveys the dominant mode remains between 21 cm to 23 cm. The pulses of recruitment detected in the spring of 1999 were also detected in the autumn survey, but both were diminished by 2002. There were two pulses less than 13cm detected in the 2004 survey but are small relative to the predominant peak at 23 cm.

The size distributions of the survey catches indicate only a narrow range of sizes caught each year in Div. 3O. Generally fish smaller than about 10 cm and larger than about 25 cm are absent in survey catches from 1991-2000 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 (see Fig. 3). 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 Div. 3O from 1973 to 1990, with coverage of depths to 367 m. 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 93-367 m, which is considered the shallower end of redfish distribution. It is clear from the varied scales on the y-axis (Fig. 7) that estimates of abundance from these surveys fluctuated greatly from year to year. In general, the upper limit of the size range was 29 cm 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 9 cm. The next tractable pulse of recruitment occurred in the 1975 survey at 9-10 cm. These correspond to large year classes in other redfish stocks that have occurred in the early 1970s and early 1980s and demonstrate the boom-or-bust nature of redfish recruitment.

Estimation of Stock Parameters

A Non-equilibrium stock production model incorporating covariates (ASPIC)

In the 2003 assessment of Div. 3O redfish, catch and a CPUE series based on days fished from an all fleet standardization were utilized in a non-equilibrium logistic production model (Prager, 1994 and 1995). Indices used as covariates were the 1991-2002 Canadian spring and autumn survey indices and the Russian Spring/Summer survey index. Model diagnostics suggested the results are not consistent with a long lived species like redfish and therefore not acceptable as indicative of the stock dynamics. A number of the covariate indices (Canadian Spring and Autumn indices) exhibited a negative correlation within that model. Although there were different CPUE standardizations conducted for this assessment, follow up ASPIC runs were not considered because there is relatively no contrast in the Canadian CPUE series and a standardized CPUE for fleets restricted to fishing in the NRA was considered inadequate as it covers an area that represents only about 10% of the management area.

Catch/Biomass ratio

A fishing mortality proxy was derived by simple catch to survey biomass ratios. In deriving a fishing mortality proxy, and because most of the catch is taken in the last three quarters of the year, the catch in year “n” was divided by the average of the Canadian Spring (year = n) and Autumn (year = n-1) survey biomass estimates to better represent the relative biomass at the time of the year before the catch was taken. Survey catchability (q) for redfish is not known but assumed less than one. All fish sizes were included in the survey biomass estimate. The results (Fig. 8) suggest that relative fishing mortality decreased rapidly from a relatively high level in 1992 to the lowest in the series in 1995, increased sequentially to the highest estimate in the series in 2002. This relatively high value was maintained in 2003 but declined substantially in 2004.

Size at Maturity

Recent size at maturity data for redfish (Power and Atkinson, MS 1998a) suggests L_{50} is about 28 cm for females and 21 cm for males. These results were obtained from samples that contained a mixture of redfish species from the area.

State of the Stock

It is still not possible to determine current fishing mortality rate or absolute size of the stock. It is difficult to accept that the CPUE series are representative of the trends in the stock. Accepting that the surveys may indicate general trends over the time period, the Canadian spring and autumn survey estimates have remained stable since 2001. Therefore the increase in catches from 2001-2003 which averaged about 18 000 tons, suggests that fishing mortality increased during this time period. On the same basis, the reduction in catch to about 4 000 tons in 2004 suggests a reduction in fishing mortality. What is of particular concern is the poor recruitment since the relatively strong 1988 year-class. Given that the bulk of the catches in recent years are comprised of fish less than 25 cm, these fisheries are targeting predominantly immature fish.

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

Year	Canada	Others	Total [a]	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	7,133	7,340	20,000
1984	167	9,861	16,978	20,000
1985	104	8,106	12,860	20,000
1986	141	10,314	11,055	20,000
1987	183	12,837	27,170	20,000
1988	181	11,111	34,792	14,000
1989	27	11,029	13,256	14,000
1990	155	8,887	14,242	14,000
1991	28	7,533	8,461	14,000
1992	1,219	12,149	15,268	14,000
1993	698	12,522	15,720	14,000
1994	1,624	3,004	5,428	10,000
1995	177	2,637	3,214	10,000
1996	7,255	2,390	9,845	10,000
1997	2,554	2,558	5,112	10,000
1998	8,972	4,380	14,052	10,000
1999	2,344	10,249	12,593	10,200
2000	2,206	10,584	10,003	10,000
2001	4,893	17,203	20,307	10,000
2002	3,000	16,452	17,234	10,000
2003	3,125	18,466	17,246 [b]	10,000
2004	2,612	3,837	3,753	10,000
2005				20,000 [c]

[a] Totals since 1983 may include adjustments for estimated catches from various sources

[b] Midpoint of estimates ranging between 16100-18400

[c] Prior to 2005 TACs were set by Canada within it's fisheries jurisdiction

Table 2. Reported and estimated catches (t) of redfish in Div. 3O by country and year since 1992.

Country	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Canada (M)	27	21	779	4	2124	693	2851	317	1326	336	12	32	275
Canada (N)	1192	677	845	173	5131	1861	6121	2027	880	4557	2988	3093	2337
France (SPM)	-	-	-	-	-	134	266	-	-	-	-	-	-
Japan	125	159	-	264	417	285	355	-	-	-	-	-	2
Portugal	1468	4794	2918	1935	1635	894	1875	5469	4555	3537	4610	6382	3259
Spain	-	-	26	22	338	1245	1884	4549	3747	2314	659	1289	327
Russia	5845	6887	60	416	-	-	-	231	2233	11343	11182	10794	243
Cuba	2776	665	-	-	-	-	-	-	-	-	-	-	-
Ukraine	-	-	-	-	-	-	-	-	-	-	-	1	3
Estonia	-	-	-	-	-	-	-	-	49	9	-	-	3
Lithuania	-	-	-	-	-	-	-	-	-	-	1	-	-
Korea(S)	1935	17	-	-	-	-	-	-	-	-	-	-	-
OTHER [a]	1900	2500	800	400	200	-	700	-	2787	1789	2218	4345	2696
Total	15268	15720	5428	3214	9845	5112	14052	12593	10003	20307	17234	17246	3753
TAC [a]	14000	14000	10000	10000	10000	10000	10000	10200	10000	10000	10000	10000	10000

[a] Estimates of catch from other sources (shaded cells are estimates of amounts over-reported)
[b] Prior to 2005 TACs were set by Canada within it's fisheries jurisdiction

Table 3a. Nominal reported catches (t) of redfish in Div. 3O by month and year since 1992.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Unk	Total
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	60	93	742	1609	236	83	-	68	1000	540	19	178		4628
1995	7	125	145	2	45	28	56	765	645	879	107	10		2814
1996	0	0	89	119	166	46	773	882	1685	2864	1539	1482		9645
1997	4	0	10	34	86	417	1298	909	622	1274	409	49		5112
1998	40	193	216	279	1329	2723	1924	953	1280	1964	2275	176		13352
1999	100	139	262	463	527	942	1644	2513	2298	2056	1434	215		12593
2000	80	92	943	739	1077	1844	1088	1254	1545	2068	1814	246		12790
2001	31	193	1228	1909	1958	2750	1257	1421	2020	4048	3472	2287		22574
2002	1850	1269	2356	1904	1490	1423	300	2085	2000	2309	1402	1064		19452
2003	453	1212	910	1392	2361	3232	2826	961	2294	2212	2484	1149		21486

Table 3b. Nominal reported catches (t) of redfish in Div. 3O by gear since 1992.

	Otter Trawls				
Year	Bottom	Midwater	Gillnets	Misc	Total
1992	10046	3292	1	29	13368
1993	11997	1214	-	9	13220
1994	3085	1498	26	19	4628
1995	2221	525	26	42	2814
1996	9303	335	7	-	9645
1997	5091	10	2	9	5112
1998	13352				13352
1999	11623	970			12593
2000	12750	39		1	12790
2001	21945	629			22574
2002	16586	2866			19452
2003	19226	2260			21486

Table 4. ANOVA results and regression coefficients from a multiplicative model utilized to derive a standardized catch rate series for Redfish in Div. 3O. Effort is DAYS FISHED. Analysis is for FLEETS IN THE NRA (2003 based on preliminary data).

REGRESSION OF MULTIPLICATIVE MODEL
MULTIPLE R..... 0.767
MULTIPLE R SQUARED..... 0.589

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARE	F-VALUE
INTERCEPT	1	1.39E3	1.39E3	
REGRESSION	39	3.62E1	9.28E-1	5.983
Cntry|Gear|TC	8	6.60E0	8.25E-1	5.316
Month	11	3.30E0	3.00E-1	1.930
Bycatch	4	3.43E0	8.58E-1	5.529
Year	16	5.85E0	3.65E-1	2.355
RESIDUALS	163	2.53E1	1.55E-1	
TOTAL	203	1.45E3		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VAR #	REG. COEF	STD. ERR	NO. OBS
Cntry|Gear|TC	17126	INT	2.740	0.324	203
Month	6				
Bycatch	95				
Year	87				
1	19105	1	0.576	0.172	9
	19125	2	0.835	0.176	7
	25126	3	-0.007	0.308	8
	25127	4	0.333	0.228	16
	34126	5	0.269	0.105	34
	34127	6	0.319	0.141	14
	34156	7	0.267	0.165	10
	34157	8	0.353	0.165	8
2	1	9	-0.334	0.171	9
	2	10	-0.224	0.157	10
	3	11	-0.209	0.133	18
	4	12	-0.033	0.133	15
	5	13	0.151	0.124	19
	7	14	0.164	0.136	15
	8	15	0.127	0.127	20
	9	16	0.003	0.125	21
	10	17	0.099	0.128	19
	11	18	-0.072	0.129	19
	12	19	-0.131	0.137	15
3	55	20	-0.613	0.144	17
	65	21	-0.352	0.120	19
	75	22	-0.349	0.111	21
	85	23	-0.133	0.084	43
4	88	24	-0.149	0.304	4
	89	25	0.130	0.249	6
	90	26	0.305	0.301	4
	91	27	0.388	0.447	1
	92	28	-0.249	0.282	10
	93	29	-0.054	0.336	10
	94	30	-0.401	0.340	9
4	95	31	-0.666	0.347	8
	96	32	-0.722	0.369	4
	97	33	-0.499	0.353	7
	98	34	-0.140	0.336	13
	99	35	-0.101	0.340	9
	100	36	-0.022	0.333	19
	101	37	-0.008	0.326	24
	102	38	-0.149	0.330	31
	103	39	-0.072	0.326	39

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
1987	2.7401	0.1049	15.885	5.028	87	5
1988	2.5906	0.1057	13.674	4.343	88	6
1989	2.8702	0.0962	18.172	5.521	89	5
1990	3.0449	0.0958	21.644	6.562	90	4
1991	3.1284	0.2578	21.687	10.366	91	4
1992	2.4913	0.0406	12.794	2.559	92	7
1993	2.6866	0.0232	15.689	2.382	93	6
1994	2.3394	0.0261	11.071	1.784	94	8
1995	2.0736	0.0300	8.471	1.462	95	11
1996	2.0177	0.0467	7.943	1.702	96	12
1997	2.2414	0.0443	9.946	2.078	97	10
1998	2.5996	0.0256	14.365	2.290	98	7
1999	2.6391	0.0284	14.922	2.506	99	7
2000	2.7176	0.0254	16.166	2.566	100	6
2001	2.7318	0.0200	16.441	2.318	101	6
2002	2.5914	0.0232	14.265	2.167	102	7
2003	2.6679	0.0218	15.410	2.271	103	7

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.221

Table 5. ANOVA results and regression coefficients from a multiplicative model utilized to derive a standardized catch rate series for Redfish in Div. 3O. Effort is DAYS FISHED. Analysis is for CANADIAN fleets (2003-4 based on preliminary data).

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.786

MULTIPLE R SQUARED..... 0.618

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARE	F-VALUE
INTERCEPT	1	1.23E3	1.23E3	
REGRESSION	55	5.00E1	9.09E-1	4.976
Cntry|Gear|TC	8	7.38E0	9.22E-1	5.049
Month	9	2.32E0	2.58E-1	1.411
Bycatch	4	6.57E0	1.64E0	8.993
Year	34	2.17E1	6.39E-1	3.499
RESIDUALS	169	3.09E1	1.83E-1	
TOTAL	225	1.31E3		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VAR #	REG. COEF	STD. ERR	NO. OBS
Cntry|Gear|TC	3125	INT	2.804	0.492	225
Month	9				
Bycatch	95				
Year	60				
1	2114	1	-0.287	0.225	13
	2125	2	0.182	0.185	14
	3114	3	-0.005	0.130	51
	3121	4	-0.225	0.176	14
	3123	5	-0.462	0.141	42
	3124	6	0.110	0.141	42
	3154	7	0.048	0.265	5
	3155	8	0.146	0.227	10
2	3	9	-0.494	0.259	6
	4	10	-0.454	0.189	9
	5	11	-0.172	0.136	20
	6	12	-0.225	0.119	26
	7	13	-0.191	0.117	32
	8	14	-0.270	0.111	30
	10	15	-0.116	0.107	36
	11	16	-0.033	0.132	18
	12	17	-0.033	0.158	11
3	55	18	-0.787	0.217	10
	65	19	-0.429	0.189	8
	75	20	-0.698	0.146	14
	85	21	-0.365	0.102	31
4	61	22	0.046	0.479	6
	62	23	-0.015	0.492	5
	63	24	-0.299	0.497	6
	64	25	-0.029	0.605	2
	67	26	0.052	0.502	5
	70	27	-0.363	0.583	2
	71	28	0.228	0.625	1
	72	29	-0.400	0.511	5
	74	30	-0.804	0.676	1

CATEGORY	CODE	#	COEF	ERR	OBS
4	75	31	-0.429	0.656	1
	76	32	-0.124	0.505	10
	77	33	-0.208	0.492	12
	78	34	-0.054	0.490	9
	79	35	0.062	0.498	11
	80	36	-0.163	0.506	6
	81	37	0.228	0.512	7
	82	38	0.141	0.575	2
	84	39	0.471	0.649	1
	86	40	0.042	0.668	1
	87	41	0.292	0.656	1
	88	42	0.076	0.656	1
	92	43	-0.596	0.596	2
	93	44	-0.252	0.602	2
	94	45	1.274	0.618	2
	95	46	-0.077	0.606	2
	96	47	-0.690	0.517	12
	97	48	-0.878	0.516	12
	98	49	0.077	0.520	19
	99	50	-0.201	0.521	14
	100	51	-0.646	0.546	5
	101	52	0.039	0.523	16
	102	53	0.137	0.524	16
	103	54	0.272	0.527	15
	104	55	0.272	0.530	12

Table 6. Standardized catch rate index for Redfish in Div. 3O from a multiplicative model utilizing DAYS FISHED as a measure of effort. Index is for CANADIAN fleets (2003-4 based on preliminary data).

PREDICTED CATCH RATE

	LN TRANSFORM		RETRANSFORMED			
YEAR	MEAN	S.E.	MEAN	S.E.	CATCH	EFFORT
1960	2.8038	0.2417	16.024	7.444	60	4
1961	2.8501	0.0764	18.238	4.962	61	3
1962	2.7889	0.0633	17.270	4.288	62	4
1963	2.5050	0.0541	13.061	3.005	63	5
1964	2.7745	0.1666	16.161	6.347	64	4
1967	2.8554	0.0531	18.552	4.232	67	4
1970	2.4405	0.1133	11.886	3.901	70	6
1971	3.0319	0.2402	20.144	9.333	71	4
1972	2.4040	0.0745	11.686	3.139	72	6
1974	1.9999	0.2542	7.127	3.385	74	10
1975	2.3750	0.2150	10.577	4.665	75	7
1976	2.6797	0.0309	15.737	2.753	76	5
1977	2.5962	0.0329	14.462	2.608	77	5
1978	2.7501	0.0439	16.775	3.486	78	5
1979	2.8654	0.0290	18.967	3.216	79	4
1980	2.6410	0.0424	15.053	3.074	80	5
1981	3.0316	0.0387	22.288	4.352	81	4
1982	2.9445	0.1036	19.771	6.220	82	4
1984	3.2747	0.2120	26.048	11.416	84	3
1986	2.8455	0.1964	17.091	7.237	86	5
1987	3.0955	0.2150	21.741	9.589	87	4
1988	2.8797	0.2150	17.521	7.728	88	5
1992	2.2079	0.1276	9.352	3.245	92	10
1993	2.5516	0.1307	13.168	4.621	93	7
1994	4.0775	0.1411	60.244	21.914	94	2
1995	2.7273	0.1244	15.746	5.400	95	6
1996	2.1134	0.0274	8.948	1.475	96	11
1997	1.9261	0.0285	7.416	1.247	97	13
1998	2.8808	0.0271	19.279	3.160	98	5
1999	2.6024	0.0371	14.521	2.781	99	7
2000	2.1582	0.0531	9.238	2.107	100	11
2001	2.8425	0.0320	18.510	3.297	101	5
2002	2.9404	0.0340	20.391	3.741	102	5
2003	3.0757	0.0340	23.347	4.278	103	4
2004	3.0760	0.0383	23.304	4.528	104	4

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.288

Table 7. Mean number (upper panel) and weight (kg., lower panel) per standard tow from Canadian SPRING surveys in Div. 3O covering strata to 732 m (400 ftm.). Dashes (---) represent unsampled strata. Number of successful sets in brackets. Data from 1991-1995 are Campelen trawl equivalent units (see text). Data from 1996 to present are actual Campelen data. G=GadusAtlantica, W=Wilfred Templeman, A=Alfred Needler.

Stratum	Depth Range (M)	Area sq mi	% Area within NRA	May3-11 1991-Q2 W105	May2-13 1992-Q2 W119-20	May5-18 1993-Q2 W136-7	May14-22 1994-Q2 W153	May13-27 1995-Q2 W168-69	May22-30 1996-Q2 W188	May-Jun 1997-Q2 W204	May-Jun 1998-Q2 W221-2	May-Jun 1999-Q2 W238	May-Jun 2000-Q2 W315-16	May-Jun 2001-Q2 W365,367	May 2002-Q2 W419,421	May 2003-Q2 W479-480	May 2004-Q2 W546-547
329	093-183	1721	0.00	13.3 (9)	0.0 (8)	0.0 (6)	169.6 (5)	19.6 (5)	0.0 (6)	33.5 (6)	0.0 (7)	0.3 (6)	0.0 (5)	0.0 (5)	0.0 (5)	80.0 (5)	0.0 (5)
332	093-183	1047	0.00	35.5 (6)	1.4 (5)	0.0 (4)	0.0 (4)	1177.8 (4)	181.8 (4)	7.3 (3)	348.0 (4)	899.0 (4)	43.5 (4)	44.0 (3)	23.7 (3)	79.7 (3)	94.8 (3)
337	093-183	948	0.00	607.2 (5)	6.5 (4)	3.0 (2)	0.0 (3)	3462.8 (4)	5.0 (3)	2.0 (3)	703.5 (4)	339.0 (3)	207.5 (4)	48.7 (3)	2.7 (3)	429.7 (3)	1048.8 (3)
339	093-183	585	0.00	0.0 (3)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.5 (2)	0.0 (2)	0.0 (2)
354	093-183	474	0.52	0.0 (3)	0.0 (2)	2537.0 (2)	0.0 (2)	0.0 (3)	2.5 (2)	0.0 (2)	422.9 (2)	1006.5 (2)	4.5 (2)	81.1 (2)	0.0 (2)	3.0 (2)	1.0 (2)
333	185-274	151(147)	0.00	1089.0 (2)	3240.0 (2)	8184.5 (2)	50275.0 (2)	979.5 (2)	870.1 (2)	231.9 (2)	4321.3 (2)	5502.4 (2)	1355.9 (2)	1525.5 (2)	941.5 (2)	534.3 (2)	2759.2 (2)
336	185-274	121	0.00	187.5 (2)	688.5 (2)	4496.5 (2)	9955.5 (2)	83150.0 (2)	1360.6 (2)	139.1 (2)	34839.0 (2)	1682.7 (2)	1714.3 (2)	1742.0 (2)	1048.0 (2)	1456.5 (2)	12646.5 (2)
355	185-274	103	0.72	119.5 (2)	111.0 (2)	7307.0 (2)	5829.0 (2)	1928.0 (2)	36488.9 (2)	306.2 (2)	5152.0 (2)	2191.6 (2)	4161.1 (2)	407.5 (2)	515.2 (2)	1191.0 (2)	1321.6 (2)
334	275-366	92(96)	0.00	733.0 (2)	223.0 (2)	837.0 (2)	1179.0 (2)	159.0 (2)	1206.8 (2)	286.2 (2)	733.5 (2)	2515.2 (2)	3960.3 (2)	730.9 (2)	916.5 (2)	3154.1 (2)	1387.1 (2)
335	275-366	58	0.00	39.7 (3)	265.3 (3)	582.5 (2)	6992.0 (2)	2267.0 (2)	15196.4 (2)	531.6 (2)	5796.0 (2)	8671.3 (2)	957.6 (2)	4730.6 (2)	4291.9 (2)	1155.1 (2)	1037.1 (2)
356	275-366	61	0.77	444.0 (2)	805.5 (2)	2552.5 (2)	883.0 (2)	3980.0 (2)	4347.0 (2)	133.6 (2)	3990.2 (2)	9384.4 (2)	24603.5 (2)	503.2 (2)	2020.9 (2)	521.3 (2)	658.0 (2)
717	367-549	93(166)	0.00	1461.5 (2)	324.0 (2)	279.0 (2)	1269.0 (2)	312.5 (2)	597.0 (2)	3398.6 (2)	483.6 (2)	3239.6 (2)	740.9 (2)	139.5 (2)	242.0 (2)	584.0 (2)	1349.7 (2)
719	367-549	76	0.00	277.0 (2)	88.5 (2)	497.5 (2)	1985.0 (2)	331.0 (2)	440.5 (2)	374.3 (2)	1098.0 (2)	1487.6 (2)	1685.1 (2)	1755.4 (2)	208.8 (2)	602.5 (2)	326.5 (2)
721	367-549	76	0.76	176.0 (2)	4369.0 (2)	449.0 (2)	108.0 (2)	7596.5 (2)	575.5 (2)	262.6 (2)	543.0 (2)	3263.2 (2)	687.8 (2)	541.1 (2)	94.7 (2)	304.4 (2)	116.5 (2)
718	550-731	111(134)	0.00	56.5 (2)	17.5 (2)	174.0 (2)	349.0 (2)	15.5 (2)	47.8 (2)	60.8 (2)	79.3 (3)	35.4 (3)	369.0 (3)	22.5 (2)	79.0 (2)	0.0 (2)	30.2 (2)
720	550-731	105	0.00	35.5 (2)	113.0 (2)	24.0 (2)	34.5 (2)	40.0 (2)	284.6 (2)	63.2 (2)	35.6 (2)	221.3 (2)	53.6 (2)	52.1 (2)	93.1 (2)	31.5 (2)	42.0 (2)
722	550-731	93	0.76	186.5 (2)	79.0 (2)	76.0 (2)	327.5 (2)	17.0 (2)	80.0 (2)	91.8 (2)	334.0 (2)	47.5 (2)	640.2 (2)	447.9 (2)	86.7 (2)	71.9 (2)	69.5 (2)
	Total:	6011	8.25														
Upper (95% CI)				465.3	495.8	1955.9	3238.5	4318.0	8884.4	1255.6	10277.2	1348.6	895.5	288.5	234.6	490.9	1861.6
Weighted mean (by area)				190.987	180.3	698.4	1748.5	2662.6	953.2	141.7	1250.0	869.5	571.3	204.7	149.3	263.6	610.9
Lower (95% CI)				-83.3	-135.1	-559.1	258.6	1007.2	-6978.1	-972.1	-7777.3	390.4	247.1	121.0	64.1	36.3	-639.8
SURVEY ABUNDANCE(x10^6)				155.4	146.7	568.3	1445.8	2201.7	788.2	117.2	1033.6	719.0	472.4	169.3	123.5	218.0	505.1
ABUNDANCE within NRA				7.3	42.0	181.1	69.1	106.1	405.0	7.0	100.2	143.6	213.3	18.8	19.9	18.7	19.4
% within NRA				4.7	28.6	31.9	4.8	4.8	51.4	6.0	9.7	20.0	45.2	11.1	16.1	8.6	3.8
				Campelen Trawl Equivalent 1991-1995					Campelen Trawl 1996-Present								
329	093-183	1721	0.00	0.3 (9)	0.0 (8)	0.0 (6)	11.2 (5)	0.5 (5)	0.0 (6)	1.0 (6)	0.0 (7)	0.0 (6)	0.0 (5)	0.0 (5)	0.0 (5)	3.0 (5)	0.0 (5)
332	093-183	1047	0.00	0.7 (6)	0.2 (5)	0.0 (4)	0.0 (4)	148.5 (4)	11.9 (4)	0.3 (3)	49.1 (4)	238.5 (4)	1.7 (4)	2.3 (3)	3.1 (3)	10.3 (3)	5.5 (3)
337	093-183	948	0.00	16.0 (5)	1.5 (4)	0.9 (2)	0.0 (3)	335.0 (4)	0.1 (3)	0.1 (3)	75.9 (4)	29.5 (3)	14.5 (4)	4.7 (3)	0.0 (3)	58.3 (3)	152.1 (3)
339	093-183	585	0.00	0.0 (3)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)
354	093-183	474	0.52	0.0 (3)	0.0 (2)	284.6 (2)	0.0 (2)	0.0 (3)	0.0 (2)	0.0 (2)	109.4 (2)	28.7 (2)	0.1 (2)	8.4 (2)	0.0 (2)	0.7 (2)	0.2 (2)
333	185-274	151(147)	0.00	120.8 (2)	404.0 (2)	1339.7 (2)	5428.5 (2)	113.5 (2)	120.4 (2)	20.2 (2)	696.3 (2)	797.6 (2)	236.2 (2)	225.7 (2)	154.9 (2)	71.3 (2)	426.0 (2)
336	185-274	121	0.00	11.6 (2)	81.2 (2)	630.9 (2)	1032.9 (2)	8543.1 (2)	161.8 (2)	7.7 (2)	5068.7 (2)	198.9 (2)	226.1 (2)	222.9 (2)	133.7 (2)	202.3 (2)	2033.3 (2)
355	185-274	103	0.72	2.7 (2)	2.8 (2)	972.9 (2)	608.3 (2)	178.4 (2)	4916.3 (2)	7.5 (2)	741.6 (2)	314.7 (2)	502.8 (2)	44.2 (2)	78.3 (2)	154.9 (2)	232.5 (2)
334	275-366	92(96)	0.00	103.3 (2)	36.5 (2)	202.9 (2)	171.1 (2)	29.4 (2)	220.0 (2)	33.9 (2)	140.3 (2)	478.9 (2)	733.0 (2)	146.4 (2)	142.3 (2)	447.8 (2)	284.9 (2)
335	275-366	58	0.00	4.3 (3)	54.3 (3)	118.3 (2)	1210.4 (2)	263.7 (2)	2445.8 (2)	58.7 (2)	1053.9 (2)	1460.3 (2)	138.7 (2)	741.6 (2)	740.4 (2)	164.1 (2)	192.7 (2)
356	275-366	61	0.77	26.6 (2)	113.0 (2)	462.4 (2)	135.8 (2)	468.0 (2)	515.8 (2)	7.5 (2)	651.6 (2)	1600.5 (2)	4317.8 (2)	73.3 (2)	302.7 (2)	66.3 (2)	133.5 (2)
717	367-549	93(166)	0.00	452.4 (2)	74.3 (2)	83.2 (2)	395.3 (2)	91.4 (2)	191.2 (2)	534.7 (2)	143.1 (2)	670.0 (2)	310.6 (2)	30.2 (2)	45.3 (2)	135.8 (2)	452.0 (2)
719	367-549	76	0.00	33.7 (2)	12.3 (2)	150.0 (2)	669.7 (2)	71.8 (2)	79.5 (2)	59.6 (2)	291.6 (2)	289.0 (2)	326.3 (2)	366.5 (2)	52.4 (2)	113.0 (2)	99.1 (2)
721	367-549	76	0.76	24.7 (2)	183.6 (2)	110.5 (2)	22.0 (2)	1220.5 (2)	68.2 (2)	20.9 (2)	153.0 (2)	651.6 (2)	129.6 (2)	90.7 (2)	17.2 (2)	43.0 (2)	30.0 (2)
718	550-731	111(134)	0.00	42.2 (2)	7.5 (2)	87.7 (2)	156.0 (2)	7.3 (2)	27.2 (2)	15.0 (2)	35.5 (3)	16.7 (3)	174.5 (3)	7.4 (2)	18.1 (2)	0.0 (2)	9.3 (2)
720	550-731	105	0.00	11.7 (2)	57.7 (2)	9.7 (2)	15.9 (2)	14.6 (2)	129.1 (2)	21.0 (2)	14.5 (2)	103.6 (2)	17.7 (2)	18.2 (2)	30.9 (2)	5.8 (2)	15.0 (2)
722	550-731	93	0.76	118.4 (2)	12.6 (2)	33.2 (2)	126.1 (2)	6.3 (2)	25.4 (2)	12.2 (2)	137.0 (2)	19.7 (2)	261.0 (2)	114.2 (2)	26.6 (2)	16.3 (2)	23.2 (2)
	Total:	6011	8.25														
Upper (95% CI)				100.7	104.2	277.6	848.6	451.0	1081.0	189.5	1504.1	268.3	145.8	45.7	37.4	75.9	298.4
Weighted mean (by area)				18.8	19.6	103.1	208.3	283.8	124.2	19.0	192.7	148.2	101.0	31.7	24.3	35.8	103.0
Lower (95% CI)				-63.2	-65.0	-71.5	-431.9	116.6	-832.6	-151.5	-1118.8	28.1	56.2	17.6	11.3	-4.2	-92.4
SURVEY BIOMASS(tons)				15278	15961	83874	172264	234648	102695	15699	159313	122550	83508	26183	20126	29642	85170
BIOMASS within NRA				1553	2347	23733	8478	14641	54177	410	18024	19914	36624	3048	3151	2529	3702
% within NRA				10.2	14.7	28.3	4.9	6.2	52.8	2.6	11.3	16.2	43.9	11.6	15.7	8.5	4.3

Table 8. Mean number (upper panel) and weight (kg., lower panel) per standard tow from Canadian AUTUMN surveys in Div. 3O covering strata to 732 m (400 ftm.). Dashes represent unsampled strata. Number of successful sets in brackets. Data from 1991-1995 are Campelen trawl equivalent units (see text). Data from 1996 to present are actual Campelen data. G=GadusAtlantica, W=Wilfred Templeman, A=Alfred Needler.

Stratum	Depth Range (M)	Area sq mi	% Area within NRA	Oct27-Nov10 1991-Q4 W113-4	Oct26-Nov5 1992-Q4 W128-9	Nov1-12 1993-Q4 W144-5	Oct29-Dec13 1994-Q4 W160-61	Sep28-Oct26 1995-Q4 W176-77	Nov25-Dec13 1996-Q4 W200 A253, T42	Oct-Dec 1997-Q4 W212-13	Sep-Oct 1998-Q4 W229-230	Sep-Oct 1999-Q4 W246-247	Sep-Oct 2000-Q4 W319-320 T338	Sep-Oct 2001-Q4 W372 T357	Sep-Oct 2002-Q4 W427 T411	Sep-Oct 2003-Q4 W485-6 T469	Nov 2004-Q4 W557
329	093-183	1721	0.00	1.1 (7)	0.0 (3)	0.0 (5)	0.0 (6)	47.8 (5)	0.2 (5)	421.4 (5)	0.8 (5)	0.0 (5)	0.0 (5)	746.8 (5)	405.8 (5)	0.4 (5)	0.0 (5)
332	093-183	1047	0.00	0.0 (4)	88.3 (3)	49.7 (3)	118.0 (3)	403.0 (3)	11.5 (2)	89.0 (3)	45.3 (3)	32.0 (3)	65.5 (3)	8.7 (3)	12.8 (3)	37.4 (3)	29.7 (3)
337	093-183	948	0.00	175.5 (4)	667.5 (2)	35.3 (3)	41.5 (2)	515.0 (2)	0.0 (2)	149.3 (3)	273.8 (3)	28.7 (3)	50.6 (3)	37.3 (3)	61.9 (3)	55.3 (3)	54.9 (3)
339	093-183	585	0.00	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (3)	0.0 (2)	0.0 (2)		1.0 (2)	1.0 (2)	0.5 (2)	0.0 (2)	0.6 (2)
354	093-183	474	0.52	0.0 (2)	628.0 (2)	0.0 (2)	0.0 (2)	8100.0 (3)	427.3 (2)	6357.5 (2)	226.5 (2)	695.5 (2)	0.0 (2)	272.5 (2)	150.9 (2)	0.0 (2)	171.6 (2)
333	185-274	151(147)	0.00	314.5 (2)	1365.0 (2)	479.0 (2)	2073.0 (2)	923.5 (2)	---	217.0 (2)	155.2 (2)	230.5 (2)	488.8 (2)	320.7 (2)	31.6 (2)	96.5 (2)	77.5 (2)
336	185-274	121	0.00	364.5 (2)	2760.0 (2)	3298.5 (2)	3807.0 (2)	450.0 (2)	161.5 (2)	918.0 (2)	691.7 (2)	3481.0 (2)	802.0 (2)	131.0 (2)	87.5 (2)	85.5 (2)	273.5 (2)
355	185-274	103	0.72	9957.0 (2)	6381.0 (2)	1317.5 (2)	2310.5 (2)	2317.3 (2)	391.4 (2)	215.0 (2)	124.5 (2)	2333.5 (2)	1020.5 (2)	879.1 (2)	614.5 (2)	61.5 (2)	527.0 (2)
334	275-366	92(96)	0.00	8774.0 (2)	3290.0 (2)	2603.7 (3)	975.0 (2)	3474.0 (2)	---	1670.0 (2)	1110.5 (2)	178.1 (2)	378.7 (2)	1441.2 (2)	106.2 (2)	872.5 (2)	256.3 (2)
335	275-366	58	0.00	3853.0 (2)	5346.0 (2)	2541.5 (2)	5648.0 (2)	1667.0 (2)	2895.5 (2)	8352.5 (2)	2459.5 (2)	2748.0 (2)	2403.4 (2)	740.5 (2)	781.7 (2)	1051.0 (2)	2291.6 (2)
356	275-366	61	0.77	678.5 (2)	3828.0 (2)	568.5 (2)	2671.0 (2)	3637.1 (2)	868.4 (2)	735.5 (2)	5602.0 (2)	3452.9 (2)	5888.0 (2)	2481.2 (2)	692.0 (2)	828.0 (2)	603.4 (2)
717	367-549	93(166)	0.00	---	---	6079.5 (2)	1172.5 (2)	2247.5 (2)	---	13031.5 (2)	8428.5 (2)	603.2 (2)	5420.1 (2)	1401.5 (2)	488.9 (2)	675.7 (2)	2530.3 (2)
719	367-549	76	0.00	813.5 (2)	---	4854.0 (2)	2715.5 (2)	2892.6 (2)	5015.5 (2)	5311.5 (2)	1953.0 (2)	3604.0 (2)	8204.0 (3)	2407.5 (2)	6420.9 (2)	1265.0 (2)	1844.2 (2)
721	367-549	76	0.76	315.5 (2)	---	543.5 (2)	82.5 (2)	9946.8 (2)	575.5 (2)	3882.0 (2)	1872.5 (2)	905.6 (2)	1502.7 (2)	1970.5 (2)	4210.8 (2)	3567.9 (2)	927.6 (2)
718	550-731	111(134)	0.00	---	---	520.0 (2)	1051.5 (2)	863.8 (2)	---	95.0 (2)	12.5 (2)	169.5 (2)	102.0 (2)	289.5 (2)	545.3 (2)	16.0 (2)	120.5 (2)
720	550-731	105	0.00	---	---	147.0 (2)	306.0 (2)	43.2 (2)	1560.6 (2)	---	471.0 (2)	103.5 (2)	160.0 (2)	88.4 (2)	12.7 (2)	236.4 (2)	478.9 (2)
722	550-731	93	0.76	11.5 (2)	---	371.5 (2)	56.5 (2)	365.5 (2)	324.0 (2)	13.8 (2)	278.0 (2)	15.0 (2)	156.4 (2)	282.3 (2)	336.4 (2)	112.4 (2)	106.9 (2)
764	732-914	105	1.00	---	---	---	---	---	---	---	5.0 (2)	---	4.5 (2)	0.0 (2)	0.5 (2)	---	---
768	732-914	99	0.00	---	---	---	---	---	---	---	0.5 (2)	---	0.0 (2)	0.0 (2)	0.0 (2)	---	---
772	732-914	135	0.00	---	---	---	---	---	---	---	0.0 (2)	---	6.3 (2)	---	0.6 (2)	1.3 (2)	---
	Total:	6350	9.46														
Upper (95% CI)				3059.2	1217.7	587.0	672.0	9437.2	445.6	7592.4	3138.3	686.7	515.7	1000.7	618.7	457.2	915.3
Weighted mean (by area)				436.0	572.0	371.5	388.6	1233.7	203.8	1304.5	455.7	359.5	411.0	416.0	317.1	135.9	193.8
Lower (95% CI)				-2187.1	-73.7	156.0	105.2	-6969.8	-25.1	-4983.5	-2226.9	32.3	306.3	-168.7	15.5	-185.4	-527.7
SURVEY ABUNDANCE(x10^6)				336.3	421.8	302.3	321.3	1020.1	153.3	1059.8	398.0	268.3	359.0	355.6	300.9	114.9	160.2
ABUNDANCE within NRA				108.4	111.0	25.1	42.0	404.2	31.8	253.2	62.9	77.0	62.0	52.7	52.7	35.5	23.5
% within NRA				32.2	26.3	8.3	13.1	39.6	20.8	23.9	15.8	28.7	17.3	14.8	17.5	30.9	14.7
				Campelen Trawl Equivalent 1991-1994				Campelen Trawl 1995-Present									
329	093-183	1721	0.00	0.0 (7)	0.0 (3)	0.0 (5)	0.00 (6)	1.0 (5)	0.0 (5)	22.6 (5)	0.0 (5)	0.0 (5)	0.0 (5)	42.1 (5)	32.2 (5)	0.0 (5)	0.0 (5)
332	093-183	1047	0.00	0.0 (4)	13.3 (3)	2.7 (3)	15.59 (3)	31.5 (3)	0.2 (2)	7.7 (3)	2.7 (3)	0.8 (3)	0.8 (3)	0.1 (3)	1.7 (3)	2.9 (3)	0.1 (3)
337	093-183	948	0.00	30.8 (4)	64.7 (2)	7.0 (3)	5.04 (2)	55.5 (2)	0.0 (2)	17.9 (3)	34.6 (3)	1.9 (3)	12.7 (3)	2.9 (3)	3.9 (3)	3.8 (3)	0.3 (3)
339	093-183	585	0.00	0.0 (2)	0.0 (2)	0.0 (2)	0.00 (2)	0.0 (2)	0.0 (3)	0.0 (2)	0.0 (2)		0.2 (2)	0.2 (2)	0.1 (2)	0.0 (2)	0.0 (2)
354	093-183	474	0.52	0.0 (2)	171.5 (2)	0.0 (2)	0.00 (2)	785.3 (3)	15.6 (2)	915.0 (2)	31.5 (2)	69.0 (2)	0.0 (2)	35.2 (2)	10.9 (2)	0.0 (2)	7.2 (2)
333	185-274	151(147)	0.00	27.1 (2)	168.0 (2)	46.5 (2)	257.7 (2)	107.0 (2)	---	26.5 (2)	20.0 (2)	18.0 (2)	24.4 (2)	31.0 (2)	3.9 (2)	11.3 (2)	3.0 (2)
336	185-274	121	0.00	18.5 (2)	374.3 (2)	378.8 (2)	357.8 (2)	49.7 (2)	9.1 (2)	117.4 (2)	103.8 (2)	548.7 (2)	98.9 (2)	13.5 (2)	9.0 (2)	10.0 (2)	31.9 (2)
355	185-274	103	0.72	352.2 (2)	450.7 (2)	77.9 (2)	264.2 (2)	237.0 (2)	37.9 (2)	25.9 (2)	11.9 (2)	387.8 (2)	127.8 (2)	119.0 (2)	64.2 (2)	6.3 (2)	67.2 (2)
334	275-366	92(96)	0.00	1317.9 (2)	480.7 (2)	380.5 (3)	171.1 (2)	506.8 (2)	---	289.5 (2)	188.3 (2)	22.6 (2)	54.6 (2)	188.8 (2)	13.7 (2)	146.6 (2)	54.9 (2)
335	275-366	58	0.00	512.6 (2)	850.9 (2)	351.8 (2)	877.1 (2)	187.7 (2)	332.2 (2)	1114.4 (2)	362.1 (2)	443.2 (2)	355.4 (2)	89.0 (2)	82.5 (2)	136.1 (2)	334.0 (2)
356	275-366	61	0.77	59.4 (2)	684.6 (2)	60.1 (2)	303.8 (2)	387.6 (2)	145.5 (2)	106.1 (2)	914.5 (2)	592.9 (2)	801.6 (2)	370.6 (2)	96.4 (2)	91.3 (2)	82.3 (2)
717	367-549	93(166)	0.00	---	---	1391.3 (2)	340.4 (2)	588.8 (2)	---	2281.8 (2)	1834.0 (2)	135.7 (2)	1143.7 (2)	229.2 (2)	75.9 (2)	115.4 (2)	540.9 (2)
719	367-549	76	0.00	268.9 (2)	---	930.5 (2)	536.2 (2)	414.0 (2)	656.4 (2)	880.2 (2)	321.3 (2)	691.0 (2)	1313.7 (3)	373.6 (2)	889.9 (2)	194.9 (2)	385.7 (2)
721	367-549	76	0.76	53.7 (2)	---	100.4 (2)	16.57 (2)	1686.7 (2)	87.3 (2)	732.5 (2)	410.5 (2)	177.5 (2)	230.2 (2)	319.2 (2)	762.0 (2)	718.8 (2)	184.1 (2)
718	550-731	111(134)	0.00	---	---	169.3 (2)	442.1 (2)	409.4 (2)	---	37.1 (2)	4.4 (2)	48.0 (2)	24.8 (2)	79.5 (2)	118.0 (2)	3.9 (2)	34.8 (2)
720	550-731	105	0.00	---	---	50.0 (2)	118.7 (2)	16.5 (2)	572.6 (2)	---	162.6 (2)	21.3 (2)	52.3 (2)	16.1 (2)	2.9 (2)	49.3 (2)	134.1 (2)
722	550-731	93	0.76	7.7 (2)	---	164.0 (2)	22.71 (2)	125.8 (2)	103.9 (2)	4.0 (2)	108.6 (2)	5.3 (2)	34.9 (2)	125.2 (2)	68.1 (2)	33.8 (2)	46.7 (2)
764	732-914	105	1.00	---	---	---	---	---	---	---	1.6	---	2.6 (2)	0.0 (2)	0.4 (2)	---	---
768	732-914	99	0.00	---	---	---	---	---	---	---	0.3	---	0.0 (2)	0.0 (2)	0.0 (2)	---	---
772	732-914	135	0.00	---	---	---	---	---	---	---	0.0	---	2.2 (2)	---	0.1 (2)	0.2 (2)	---
	Total:	6350	9.46														
Upper (95% CI)				306.5	147.4	105.2	109.0	972.0	86.2	1182.1	664.3	106.8	83.3	75.6	68.1	86.6	179.4
Weighted mean (by area)				44.9	76.3	63.6	64.5	151.9	30.5	190.3	86.6	56.4	68.7	43.6	38.9	22.0	33.4
Lower (95% CI)				-216.7	5.2	22.1	20.0	-668.2	-25.1	-801.5	-491.0	6.0	54.0	11.6	9.7	-42.6	-112.6
BIOMASS(tons)				34618	56247	51782	53324	125578	22974	154622	75676	42100	60004	37286	33976	18604	27631
BIOMASS within NRA				4473	14818	3584	5008	46022	3565	37798	11459	11585	8700	8567	8396	6720	3385
% within NRA				12.9	26.3	6.9	9.4	36.6	15.5	24.4	15.1	27.5	14.5	23.0	24.7	36.1	12.3

3O Autumn

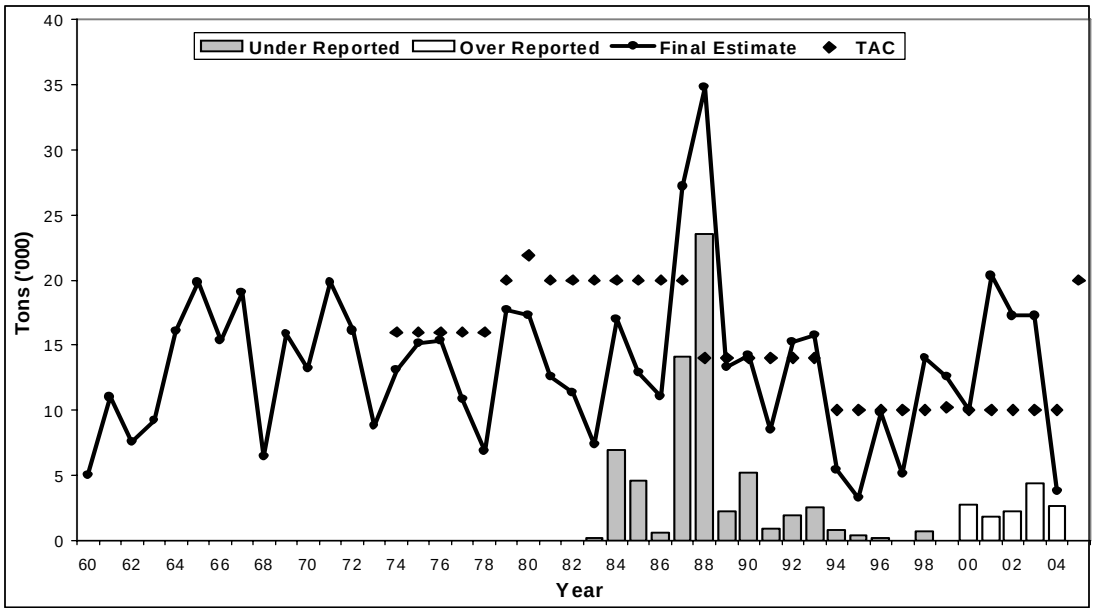

Fig. 1: Nominal catches and TACs of redfish in Div. 3O. TAC to 2004 was only for Canadian fishery zone.

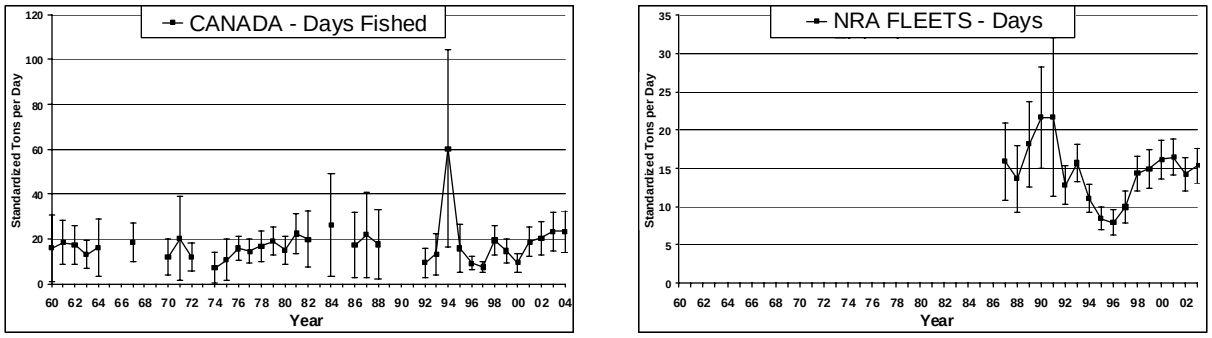

Fig. 2. Standardized Mean CPUE ± 2 standard errors for Redfish in Div. 3O from 1960-2002 utilizing effort in DAYS fished.

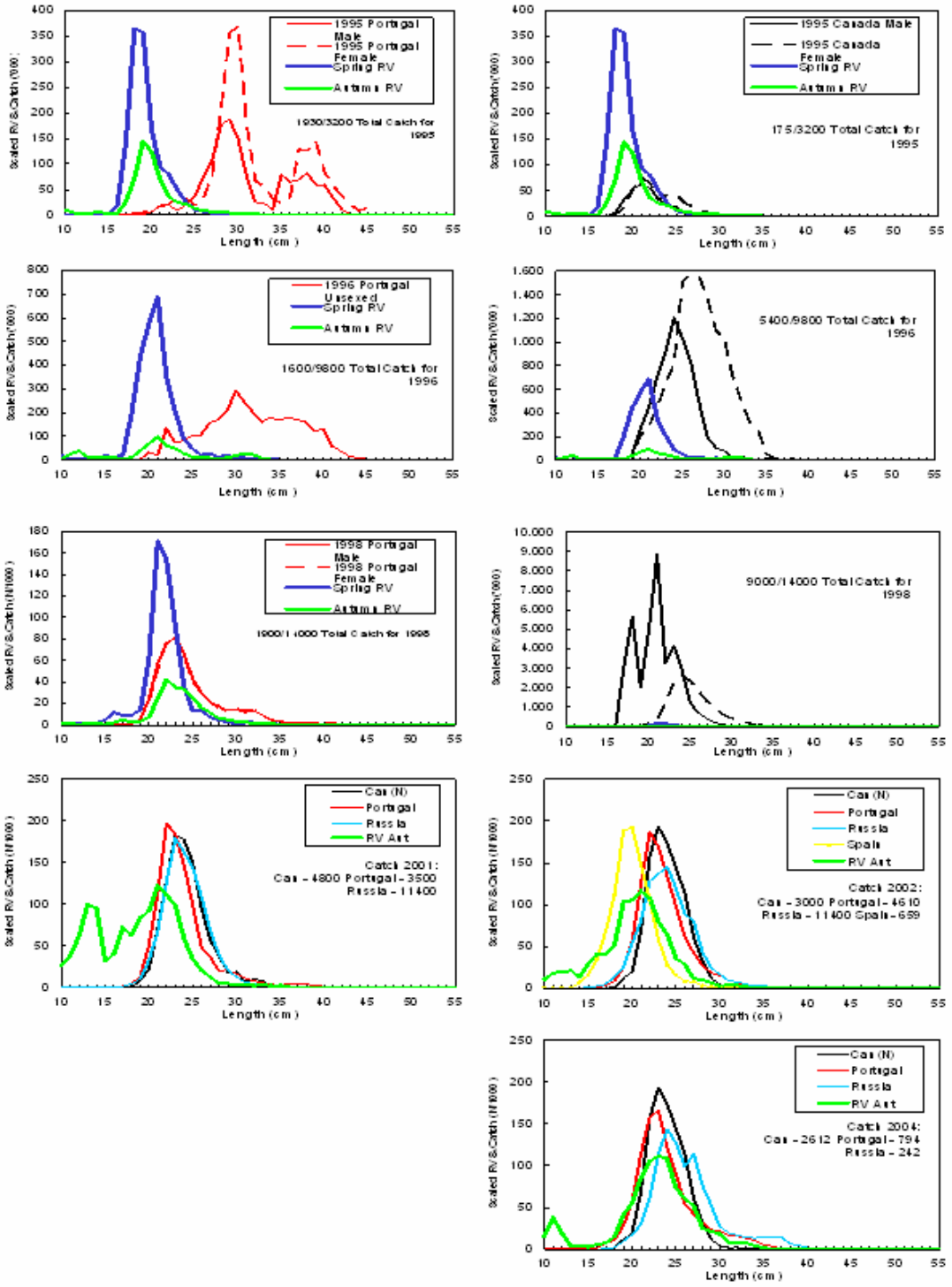

Fig. 3. Commercial catch-at-length for Div. 3O compared with RV catch-at-length.

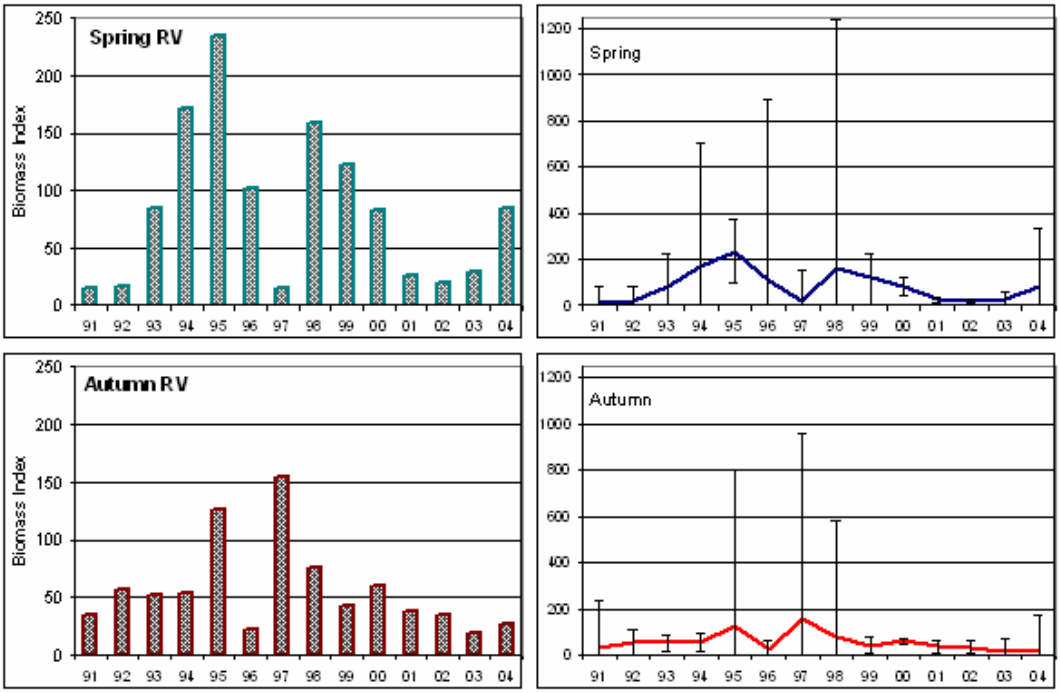

Fig. 4. Survey biomass index for redfish in Div. 3O for spring and autumn surveys from 1991-2004 (upper panel) with 95% CI (lower panels). Surveys prior to autumn 1995 utilized an Engel trawl. Estimates were converted into Campelen equivalents based on comparative fishing trials.

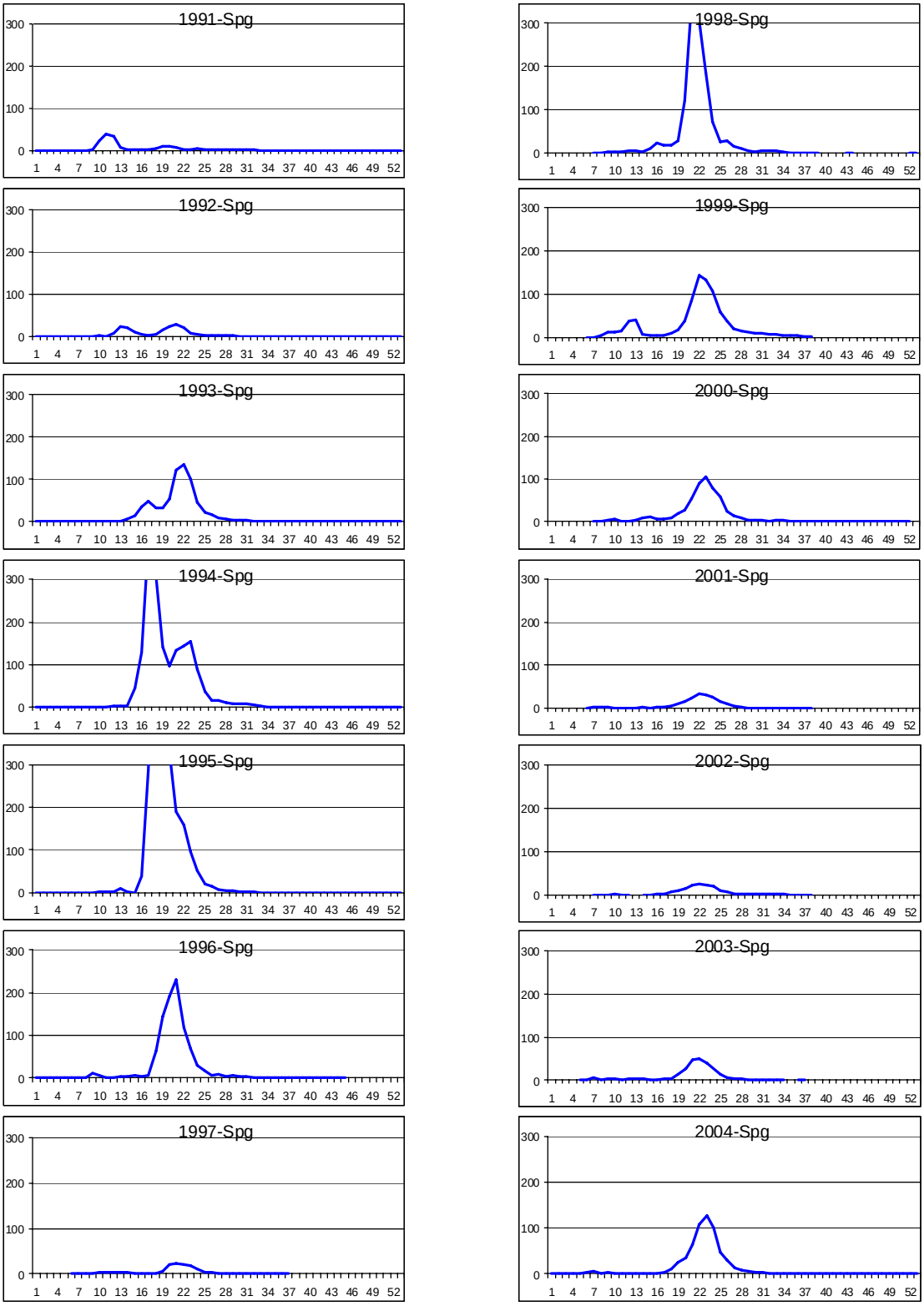

Fig. 5. Length distributions from RV surveys to Div. 3O in SPRING from 1991-2004. Plotted are mean per standard tow. The 1991-1995 data are convertions into Campelen equivalents based on comparative fishing experiments.

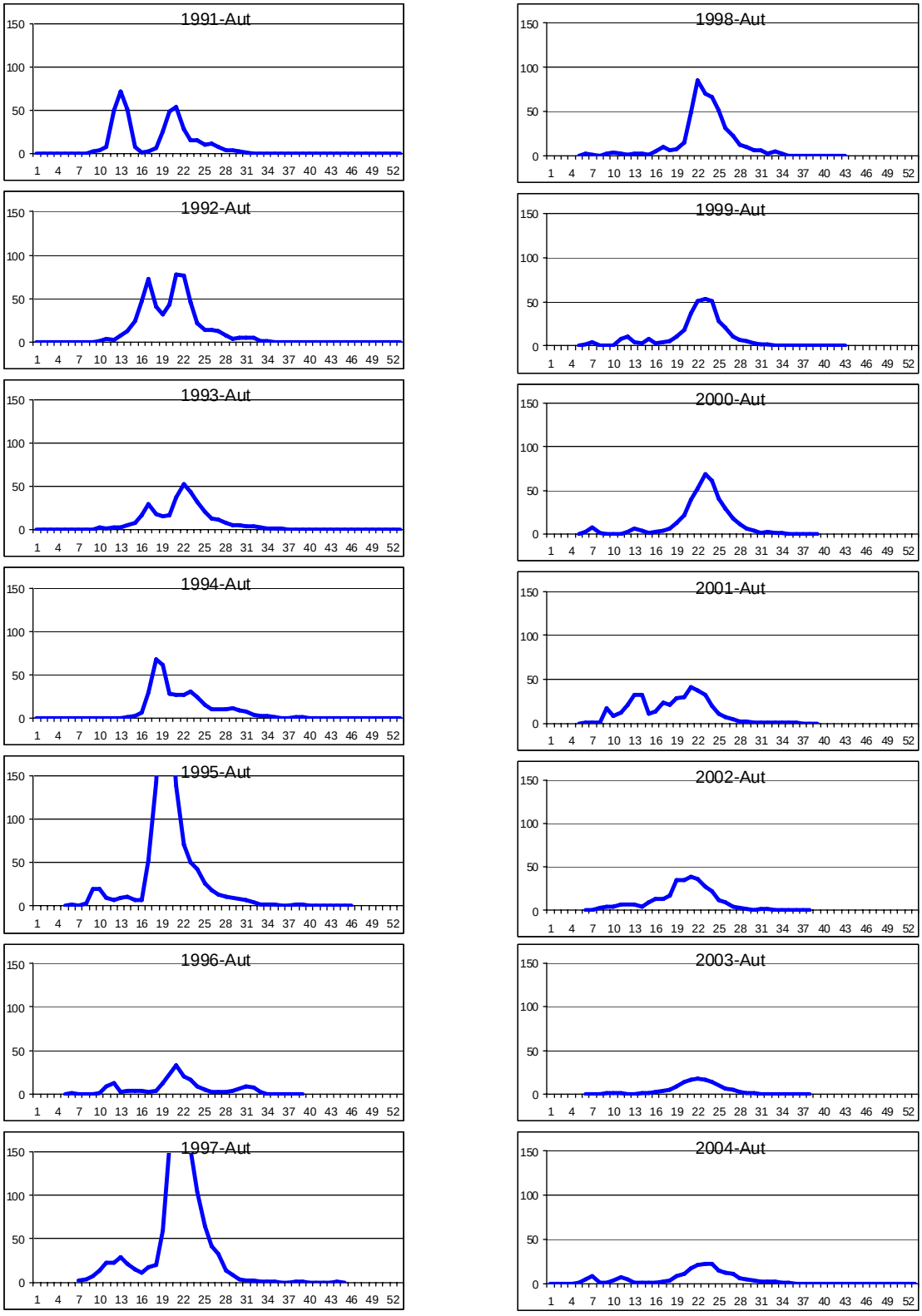

Fig. 6. Length distributions from RV surveys to Div. 3O in AUTUMN from 1991-2004. Plotted are mean per standard tow. The 1991-1994 data are convertions into Campelen equivalents based on comparative fishing experiments.

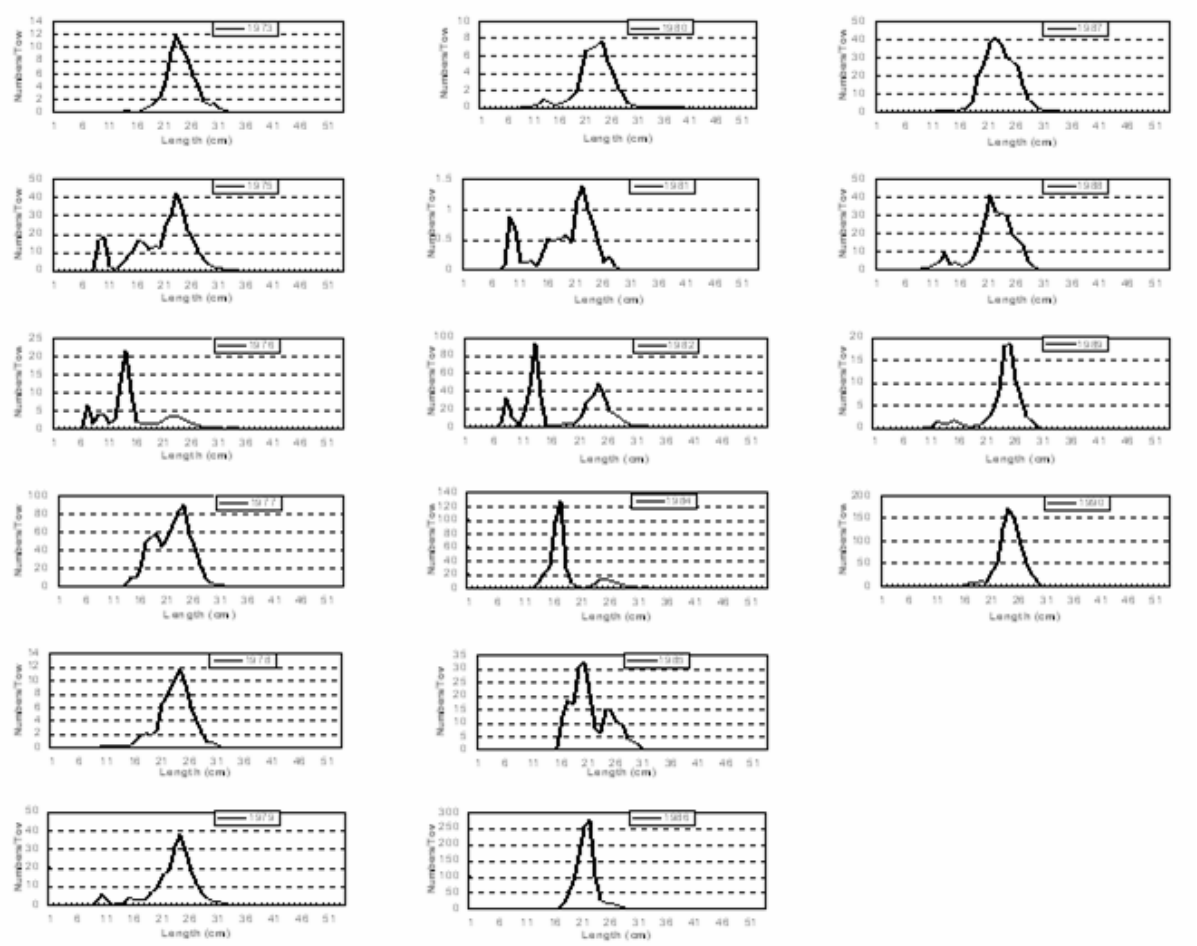

Fig. 7. Length distributions from RV surveys to Div. 3O in spring from 1973-1990. Plotted are mean per standard tow. The surveys covered depths to 200 fathoms.

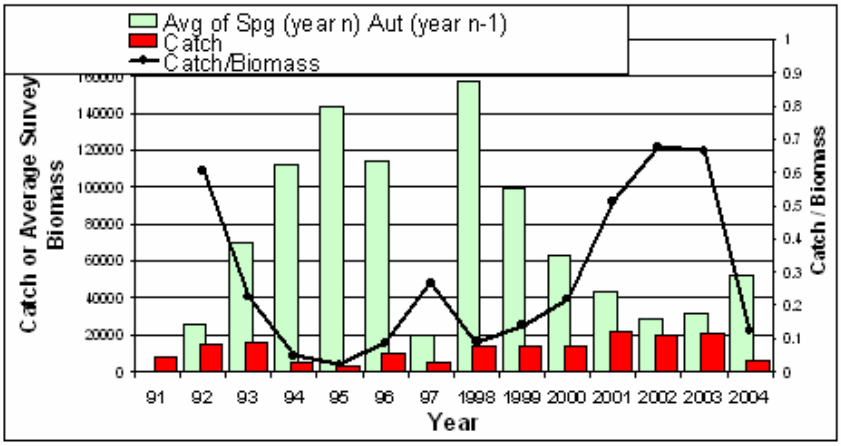

Fig. 8. Catch/Biomass ratios for Div. 3O. Plotted are average survey biomass between spring (n) and autumn (n-1) for year (n) in which catch was taken.