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

by

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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, but rose again in 2005 to about 11 000 t and is about the same in 2006. 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 increased to 85 000 t in 2004 although 40% of the biomass index was attributed to one large set. The Canadian autumn surveys, while more stable in the early 1990s, generally supports the pattern of the spring survey index to 2002 but shows a more gradual increase from 2004 to 53 000 t in 2006. Canadian 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. In 2005 and 2006 catches were higher at about 11 000 and 13 000 tons respectively.

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 from 300 tons (2006) 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 240t in 2004 and 170 t in 2005. In 2006, catches rose again to 2 000 t. Portugal began fishing in 1992 and averaged about 1 800 tons between 1992 and 1998. Their reported catches escalated to 5 500 tons in 1999 and have averaged about 4 500 tons to 2006. 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. Spanish catches then increased again in 2005 to 1 700 t and nearly doubled to 3 200 t in 2006. Although most fleets in the NRA reduced their catch from 2003 to 2004, the total reduction in catch 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 2000-2006 Canada has averaged about 3 600 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 1960 to 1999 were extracted from ICNAF/NAFO Statistical Bulletins and were combined with 2000-2005 STATLANT 21B data and 2006 Canadian logbook data compiled by regional statistical branches of the Canadian Department of Fisheries and Oceans. 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.

Catch rate analyses were conducted for two groups. One analysis was conducted for the Canadian fleet, which fishes within it's exclusive fishery zone, and a separate analysis was conducted for fleets that fish in the NRA because of different trends over time between these two groups (Power, MS 2005). 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 fleets in the NRA .

For the NRA FLEETS "days fished" standardization, the regression was significant (P <0.05), explaining 62% of the variation in catch rate (Table 4). The standardized catch rate (Table 4, Fig. 2 right panel) shows much within year variability and fluctuation prior to 1992 but averaged about 17 tons per day over this period. The index declined to its lowest level in the series at 8 tons per day in 1996 then increased to 15 tons per day in 1998 then remained stable to 2003. Catch rate was lower in 2004 and 2005, averaging about 13 tons per day.

For the CANADIAN FLEET "days fished" standardization, the regression was significant (P <0.05), explaining 60% 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 5, Fig. 2 left panel) shows much within year variability. There are also only short periods of sustained directed effort prior to 1996. Catch rates have been stable over the period from 2001-2005 at about 22 tons per day which has been at the 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 stability in the past five years. 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, Spain (González et al., MS 2007), Portugal (Vargas *et al*., MS 2007), and Russia (Vaskov *et. al*., MS 2007) from the 2006 trawl fishery (Fig. 3). The Portuguese fleet fished between 121 and 750 m while the Russian fleet fished from 120-600 m. Logbook information from the Canadian fleets indicated most of the catch was taken at depths >300 m. Sampling details for the Canadian fleets are given in Table 7. Annual catch at length suggested fish between 21-29 cm generally dominated the catches. Lengths between 20-24 cm (range 11- 39 cm) dominated the Portuguese catch. The Spanish catch was dominated by 20-31 cm fish (range 17-38 cm) while the dominant size range in the Russian catch was 21-31 cm (range 15-44 cm), which was sampled for total length.

A compilation of catch at length from various fleets from 1995 to 2004 suggested that the size composition has changed over the time period with fleets catching a larger portion of fish >25 cm prior to 1998 (Power, MS 2005). These size compositions were converted to catch at length for 2001 to 2006 and compared to Canadian RV survey numbers at length in Figure 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). In 2006, due to vessel problems, the spring survey had only one tow in redfish depths.

Biomass indices for spring (Table 8) and autumn (Table 9) 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, fluctuating over 100 000 t between 1994 to 1999 (average over 160 kg per tow) and declined to 2002 (21 000 t, 24 kg per tow). The index showed an increase in 2003 and a larger increase in 2004 to 103 kg per tow that was influenced by one large set in a stratum that represented 40% of the biomass index of 85 000 t. In 2005, the index declines to 60 000 t and 73 kg per tow. 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 and then a more gradual increase to 2006 at 53 000 t (66 kg per tow). 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. As well, indices of biomass and abundance could not be produced for 3O redfish for spring 2006 since the survey had only one set in redfish depths due to mechanical problems with the research vessel.

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 2001-2005. There were pulses of recruitment detected in the 1999 and 2003 surveys that have since diminished. Discernable pulses were also detected in the 2004 and 2005 surveys.

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 2001-2006 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 13 cm detected in the 2004 survey but are small relative to the predominant peak at 23 cm. A recruitment pulse around 12 cm seen in the 2005 survey progressed to the 2006 survey as a small mode at 16 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 Power, MS 2005). 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.

Estimation of Stock Parameters

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. 7) suggest that relative fishing mortality increased from 1998 to the highest estimate in the series in 2002. This relatively high value was maintained in 2003 but declined substantially in 2004. In 2005, relative fishing mortality increased once more and was around the series average. The 2006 estimate of fishing mortality was calculated using only the autumn survey biomass.

Size at Maturity

Size at maturity data for redfish (Power and Atkinson, MS 1998a) suggested that 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. Information presented in 2005 (Vaskov, MS 2005) estimated size at maturity for *S. fasciatus* with the species identified by meristic characters. The data suggest for *S. fasciatus* L_{50} for males is 21 cm and for females is 20 cm. STACFIS noted these results were unusual in that typically L_{50} values are larger for females than males. As well, the L_{50} for female *S. fasciatus* and *S. mentella* were higher in the neighboring stock area of 3M at 26.5 and 30.1 cm respectively (Saborido-Rey, 1994). L_{50} for female S. fasciatus in 3O was calculated at 25 cm and male L_{50} at 24 cm in 2006 (Vaskov, MS 2007).

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 remained stable from 2001 to 2003. Therefore, the increase in catches seen in 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 suggested a reduction in fishing mortality. In the last 2 years, relative fishing mortality increased to about the series average. 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. Estimated 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	5,499	5,806	10,702	20,000 [c]
2006	3,580	9,310	12,610	20,000

[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. Nominal 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	2005	2006
Canada (M)	27	21	779	4	2124	693	2851	317	1326	336	12	32	275	137	-
Canada (N)	1192	677	845	173	5131	1861	6121	2027	880	4557	2988	3093	2337	5364	3580
France (SPM)	-	-	-	-	-	134	266	-	-	-	-	-	-	-	-
Japan	125	159	-	264	417	285	355	-	-	-	-	-	2	1	-
Portugal	1468	4794	2918	1935	1635	894	1875	5469	4555	3537	4610	6382	3259	4553	5183
Spain	-	-	26	22	338	1245	1884	4549	3747	2314	659	1289	327	1683	3150
Russia	5845	6887	60	416	-	-	-	231	2233	11343	11182	10794	243	170	977
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	603	280
Total	15268	15720	5428	3214	9845	5112	14052	12593	10003	20307	17234	17246	3753	11305	12610
TAC [a]	14000	14000	10000	10000	10000	10000	10000	10200	10000	10000	10000	10000	10000	20000 [b]	20000

[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
1982	-	1	1121	1258	545	652	4555	2245	661	233	89	-		11360
1983	254	355	2904	1227	71	156	576	938	319	1	73	266		7140
1984	219	155	2	32	85	257	446	3210	2799	1882	435	506		10028
1985	1522	-	453	239	118	252	227	1711	1486	350	35	1817		8210
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	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
2004	323	343	597	794	318	180	336	400	651	1393	859	270		6464
2005	100	12	241	169	436	371	2114	2115	1100	1288	1933	2029		11908

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

	Otter Trawls				
Year	Bottom	Midwater	Gillnets	Misc	Total
1982	9394	1966	-	-	11360
1983	5217	1923	-	-	7140
1984	7451	2577	-	-	10028
1985	4431	3778	-	1	8210
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	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
2004	6308	156			6464
2005	11908				11908

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 (2005 based on preliminary data).

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.784

MULTIPLE R SQUARED..... 0.615

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARE	F-VALUE
INTERCEPT	1	1.49E3	1.49E3	
REGRESSION	40	3.85E1	9.64E-1	7.136
Cntry|Gear|TC	7	5.65E0	8.07E-1	5.979
Month	11	1.95E0	1.77E-1	1.310
Bycatch	4	4.49E0	1.12E0	8.307
Year	18	6.44E0	3.58E-1	2.648
RESIDUALS	179	2.42E1	1.35E-1	
TOTAL	220	1.56E3		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VAR #	REG. COEF	STD. ERR	NO. OBS
Cntry|Gear|TC	17126	INT	3.106	0.308	220
Month	6				
Bycatch	95				
Year	87				
(1)	19125	1	0.602	0.104	19
	25126	2	0.215	0.289	7
	25127	3	0.332	0.212	16
	34126	4	0.259	0.096	34
	34127	5	0.302	0.130	14
	34156	6	0.240	0.151	10
	34157	7	0.368	0.153	8
(2)	1	8	-0.304	0.153	10
	2	9	-0.191	0.141	11
	3	10	-0.080	0.121	19
	4	11	-0.022	0.123	15
	5	12	0.130	0.115	19
	7	13	0.103	0.123	16
	8	14	0.106	0.113	22
	9	15	0.047	0.113	22
	10	16	0.020	0.112	23
	11	17	-0.008	0.114	22
	12	18	-0.064	0.121	17
(3)	55	19	-0.620	0.127	18
	65	20	-0.432	0.106	21
	75	21	-0.342	0.097	24
	85	22	-0.090	0.073	52
(4)	88	23	-0.538	0.290	4
	89	24	-0.374	0.248	6
	90	25	-0.136	0.289	4
	91	26	-0.329	0.434	1
	92	27	-0.645	0.270	10
	93	28	-0.430	0.320	10
	94	29	-0.801	0.324	9
	95	30	-1.068	0.330	8
	96	31	-1.092	0.350	4
	97	32	-0.832	0.333	7
	98	33	-0.465	0.318	13
	99	34	-0.480	0.324	9
	100	35	-0.406	0.312	19
	101	36	-0.383	0.310	24
	102	37	-0.524	0.314	31
	103	38	-0.427	0.310	39
	104	39	-0.724	0.336	7
	105	40	-0.553	0.318	11

LEGEND FOR ANOVA RESULTS:

CGT CODES: All Vessels are Stern Trawlers

17126 =	EU/Prt	Otter Trawl	TC 6
19125 =	EU/Spn	"	TC 5
25126 =	KOR	"	TC 6
25127 =	"	"	TC 7
34126 =	RUS	"	TC 6
34127 =	"	"	TC 7
34156 =	"	Midwater Trawl	TC 6
34157 =	"	"	TC 7

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
1987	3.1061	0.0947	22.792	6.869	87	4
1988	2.5678	0.0901	13.335	3.926	88	7
1989	2.7325	0.0830	15.779	4.464	89	6
1990	2.9697	0.0808	20.024	5.595	90	4
1991	2.7770	0.2265	15.348	6.927	91	6
1992	2.4607	0.0340	12.324	2.261	92	7
1993	2.6761	0.0196	15.396	2.153	93	6
1994	2.3048	0.0221	10.607	1.573	94	9
1995	2.0384	0.0255	8.113	1.290	95	12
1996	2.0146	0.0400	7.865	1.562	96	12
1997	2.2739	0.0363	10.212	1.934	97	9
1998	2.6406	0.0206	14.852	2.128	98	7
1999	2.6266	0.0237	14.622	2.244	99	7
2000	2.6997	0.0173	15.782	2.071	100	6
2001	2.7236	0.0162	16.173	2.056	101	6
2002	2.5817	0.0183	14.018	1.894	102	7
2003	2.6791	0.0175	15.459	2.041	103	7
2004	2.3819	0.0309	11.407	1.996	104	9
2005	2.5530	0.0222	13.596	2.019	105	8

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.199

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 (2006 based on preliminary data).

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.777

MULTIPLE R SQUARED..... 0.603

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARE	F-VALUE
INTERCEPT	1	1.40E3	1.40E3	
REGRESSION	57	5.43E1	9.52E-1	5.115
Cntry|Gear|TC	8	7.79E0	9.74E-1	5.233
Month	9	3.08E0	3.42E-1	1.839
Bycatch	4	5.77E0	1.44E0	7.748
Year	36	2.40E1	6.67E-1	3.580
RESIDUALS	192	3.57E1	1.86E-1	
TOTAL	250	1.49E3		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VAR #	REG. COEF	STD. ERR	NO. OBS
Cntry|Gear|TC	3125	INT	2.609	0.493	250
Month	9				
Bycatch	95				
Year	60				
(1)	2114	1	-0.146	0.223	13
	2125	2	0.315	0.182	14
	3114	3	0.114	0.127	51
	3121	4	-0.211	0.154	18
	3123	5	-0.462	0.125	49
	3124	6	0.056	0.125	51
	3154	7	0.054	0.262	5
	3155	8	0.177	0.226	10
(2)	3	9	-0.534	0.256	6
	4	10	-0.489	0.159	13
	5	11	-0.183	0.134	21
	6	12	-0.282	0.115	28
	7	13	-0.166	0.111	35
	8	14	-0.237	0.106	34
	10	15	-0.117	0.102	40
	11	16	-0.070	0.124	21
	12	17	-0.053	0.158	11
(3)	55	18	-0.747	0.219	10
	65	19	-0.373	0.190	8
	75	20	-0.641	0.145	14
	85	21	-0.312	0.098	33
(4)	61	22	0.102	0.482	6
	62	23	0.024	0.496	5
	63	24	-0.259	0.501	6
	64	25	0.024	0.609	2
	67	26	0.126	0.505	5
	70	27	-0.276	0.586	2
	71	28	0.256	0.628	1
	72	29	-0.382	0.515	5
	74	30	-0.807	0.682	1
	75	31	-0.343	0.661	1
	76	32	-0.007	0.507	10
	77	33	-0.146	0.495	12
	78	34	-0.184	0.493	10
	79	35	0.184	0.500	11
	80	36	-0.081	0.510	6
	81	37	0.347	0.514	7
	82	38	0.246	0.578	2
	84	39	0.603	0.653	1
	86	40	0.211	0.669	1
	87	41	0.378	0.661	1
	88	42	0.162	0.661	1
	92	43	-0.466	0.600	2
	93	44	-0.087	0.606	2
	94	45	1.475	0.616	2
	95	46	0.122	0.605	2
	96	47	-0.479	0.516	12
	97	48	-0.699	0.516	12
	98	49	0.300	0.517	19
	99	50	-0.023	0.520	14
	100	51	-0.404	0.544	5
	101	52	0.255	0.520	16
	102	53	0.348	0.520	16
	103	54	0.483	0.524	15
	104	55	0.478	0.529	11
	105	56	0.498	0.520	14
	106	57	0.449	0.527	11

LEGEND FOR ANOVA RESULTS:

CGT CODES:

2114 = Can(M) (Side) Otter Trawl TC 4
2125 = " (Stern) Otter Trawl TC 5
3114 = Can(N) (Side) Otter Trawl TC 4
3121 = " (Stern) " TC 1
3123 = " " " TC 3
3124 = " " " TC 4
3154 = " " Midwater Trawl TC 4
3155 = " " " TC 5

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 (2006 based on preliminary data).

PREDICTED CATCH RATE

	LN TRANSFORM		RETRANSFORMED			
YEAR	MEAN	S.E.	MEAN	S.E.	CATCH	EFFORT
1960	2.6092	0.2430	13.205	6.148	60	5
1961	2.7111	0.0757	15.905	4.305	61	4
1962	2.6331	0.0628	14.808	3.662	62	4
1963	2.3500	0.0534	11.209	2.562	63	6
1964	2.6330	0.1672	14.049	5.526	64	5
1967	2.7354	0.0529	16.483	3.752	67	4
1970	2.3335	0.1141	10.695	3.520	70	7
1971	2.8655	0.2426	17.066	7.939	71	4
1972	2.2270	0.0728	9.816	2.608	72	7
1974	1.8018	0.2571	5.848	2.791	74	13
1975	2.2662	0.2177	9.491	4.208	75	8
1976	2.6024	0.0306	14.594	2.540	76	5
1977	2.4635	0.0320	12.693	2.257	77	6
1978	2.4252	0.0376	12.181	2.346	78	6
1979	2.7936	0.0286	17.686	2.978	79	4
1980	2.5284	0.0421	13.475	2.743	80	6
1981	2.9565	0.0386	20.710	4.040	81	4
1982	2.8556	0.1044	18.114	5.719	82	5
1984	3.2123	0.2151	24.477	10.793	84	3
1986	2.8205	0.1986	16.680	7.095	86	5
1987	2.9868	0.2177	19.510	8.649	87	4
1988	2.7710	0.2177	15.723	6.970	88	6
1992	2.1435	0.1293	8.777	3.064	92	10
1993	2.5221	0.1327	12.794	4.521	93	7
1994	4.0839	0.1399	60.777	22.011	94	2
1995	2.7316	0.1233	15.851	5.412	95	6
1996	2.1300	0.0259	9.121	1.461	96	11
1997	1.9106	0.0275	7.318	1.207	97	13
1998	2.9089	0.0236	19.898	3.049	98	5
1999	2.5859	0.0352	14.322	2.669	99	7
2000	2.2047	0.0508	9.706	2.167	100	10
2001	2.8642	0.0283	18.983	3.181	101	5
2002	2.9569	0.0291	20.820	3.533	102	5
2003	3.0922	0.0297	23.828	4.089	103	4
2004	3.0876	0.0370	23.630	4.518	104	4
2005	3.1068	0.0258	24.225	3.875	105	4
2006	3.0580	0.0336	22.980	4.190	106	5

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.279

Table 7. Commercial sampling of redfish catches from CAN (N) in 2005 and 2006.

SUMMARY OF CAN (N) SAMPLING 2005

	commercial sampling				Landings			
month	Samples	n	depth min	depth max	Samples	n	depth min	depth max
APR	6	1837	186	412				
MAY	5	1513	184	270				
JUNE	10	2588	238	576				
JULY	15	3664	302	531				
AUG	12	2871	335	604	12	3374	485	567
SEPT	11	2540	431	532	2	644	448	457
OCT	13	3489	317	509	2	626	420	549
NOV	10	3050	360	490				
DEC	1	98	339	339				

SUMMARY OF CAN (N) SAMPLING 2006

	commercial sampling				Landings			
month	Samples	n	depth min	depth max	Samples	n	depth min	depth max
JAN	7	3184	301	392				
MAR	3	849	235	402				
APR	13	3241	315	585	5	1615	357	494
MAY					1	313	512	512
AUG	3	284	333	430	6	943	466	561
SEPT	3	769	402	494	3	991	388	549
OCT	2	516	523	556				
NOV	4	1478	283	311	1	312	457	457

Table 8. 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	May 2005-Q2 W618-621	May 2006-Q2 W693,A729
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)	0.2 (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)	69.3 (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)	18.5 (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)	0.5 (2)	0.4 (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)	433.3 (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)	5329.0 (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)	4701.9 (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)	643.6 (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)	2364.5 (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)	2563.6 (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)	3515.6 (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)	1211.4 (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)	1346.0 (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)	566.2 (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)	55.1 (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)	23.1 (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)	60.9 (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	1909.1	
Weighted mean (by area)				190.99	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	443.6	
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	-1021.9	
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	366.8	
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	49.1	
% 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	13.4	
				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)	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)	3.6 (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)	2.4 (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)	0.2 (2)	0.0 ---
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)	43.2 (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)	705.6 (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)	698.5 (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)	80.3 (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)	418.2 (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)	496.1 (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)	713.4 (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)	352.7 (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)	312.1 (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)	154.0 (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)	33.3 (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)	6.9 (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)	25.4 (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	282.2	
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	72.7	
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	-136.7	
SURVEY BIOMASS(tons)				15278	15961	83874	172264	234648	102695	15699	159313	122550	83508	26183	20126	29642	85170	60138	
BIOMASS within NRA				1553	2347	23733	8478	14641	54177	410	18024	19914	36624	3048	3151	2529	3702	8369	
% 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	13.9	

Table 9. 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	1995-Q4 W176-77	Sep28-Oct26 1996-Q4 W200 A253, T42	Nov25-Dec13 1997-Q4 W212-13	Oct-Dec 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	Oct 2005-Q4 W627-628 T608	Oct 2006-Q4 W704
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)	14.2 (5)	74.2 (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)	41.2 (3)	0.3 (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)	90.3 (3)	38.3 (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)	3.0 (2)	0.0 (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)	69.5 (2)	6.0 (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)	674.0 (2)	103.8 (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)	255.0 (2)	744.0 (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)	643.4 (2)	963.8 (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)	816.5 (2)	569.8 (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)	626.7 (2)	898.0 (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)	2484.4 (2)	5727.5 (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)	1382.2 (2)	1756.3 (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)	3854.5 (2)	14161.4 (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)	648.0 (2)	410.2 (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)	45.2 (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)	4489.7 (2)	1761.3 (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)	35.1 (2)	9.0 (2)
764	732-914	105	1	---	---	---	---	---	---	---	5.0 (2)	---	4.5 (2)	0.0 (2)	0.5 (2)	---	---	0.0 (2)	---
768.00	732-914	99	0	---	---	---	---	---	---	---	0.5 (2)	---	0.0 (2)	0.0 (2)	0.0 (2)	---	---	0.0 (2)	---
772.00	732-914	135	0	---	---	---	---	---	---	---	0.0 (2)	---	6.3 (2)	---	0.6 (2)	1.3 (2)	---	0.0 (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	394.0	2367.8
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	268.1	410.5
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	142.3	-1546.7
SURVEY ABUNDANCE(x10^6)				336.26	421.83	302.30	321.33	1020.14	153.3	1059.79	398.04	268.34	359.002	355.64	276.967	114.92	160.247	234.227	331.9
DANCE 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	30.5	50.4
% within NRA				32.2	26.3	8.3	13.1	39.6	20.8	23.9	15.8	28.7	17.3	14.8	19.0	30.9	14.7	13.0	15.2
				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)	0.2 (5)	4.5 (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)	0.7 (3)	0.0 (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)	1.7 (3)	1.1 (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)	0.1 (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)	3.6 (2)	0.6 (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)	53.4 (2)	8.0 (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)	25.0 (2)	51.0 (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)	59.3 (2)	117.1 (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)	162.7 (2)	105.4 (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)	92.2 (2)	126.4 (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)	437.8 (2)	1176.1 (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)	253.7 (2)	355.2 (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)	627.9 (2)	2137.5 (2)
721	367-549	76	0.76	53.7 (2)	---	100.4 (2)	16.57 (2)	1666.7 (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)	119.8 (2)	73.8 (2)
718	550-731	111(134)	0	---	---	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)	12.0 (2)	---
720.00	550-731	105	0	---	---	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)	1013.5 (2)	403.9 (2)
722.00	550-731	93	0.76344086	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)	11.2 (2)	3.5 (2)
764.00	732-914	105	1	---	---	---	---	---	---	---	1.6	---	2.6 (2)	0.0 (2)	0.4 (2)	---	---	0.0 (2)	(2)
768.00	732-914	99.00	0.00	---	---	---	---	---	---	---	0	---	0 (2)	0 (2)	0 (2)	---	---	0 (2)	(2)
772.00	732-914	135.00	0.00	---	---	---	---	---	---	---	0	---	2 (2)	---	0 (2)	0 (2)	---	0 (2)	(2)
	Total:	6,350.00	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	65.5	356.1
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	43.6	65.9
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	21.8	-224.3
SURVEY BIOMASS(tons)				34618	56247	51782	53324	125578	22974	154622	75676	42100	60004	37286	33976	18604	27631	38125	53291
BIOMASS within NRA				4473	14818	3584	5008	46022	3565	37798	11459	11585	8700	8567	8396	6720	3385	4619	9439
% 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	12.1	17.7

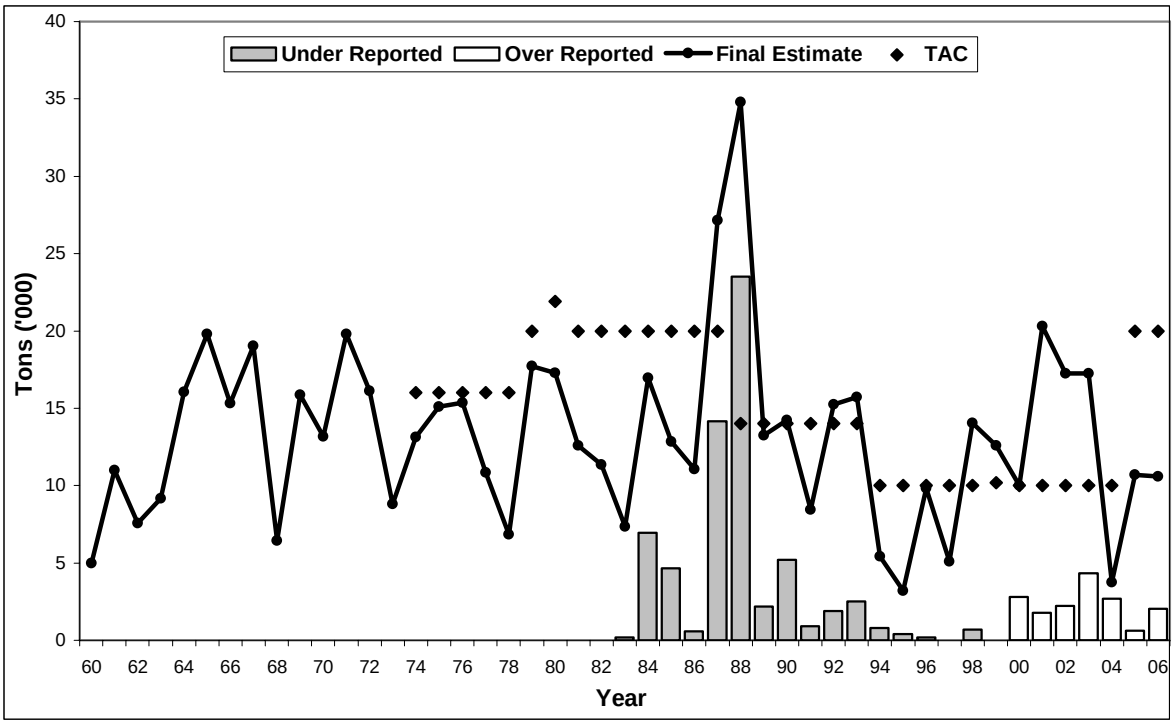
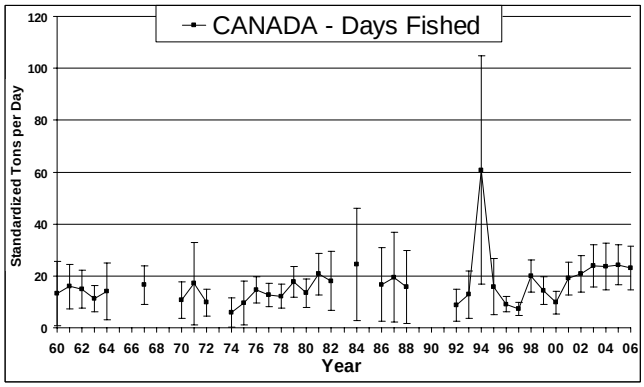


Fig. 1: Nominal catches and TACs of redfish in Div. 3O. TAC to 2004 was only for Canadian fishery zone.



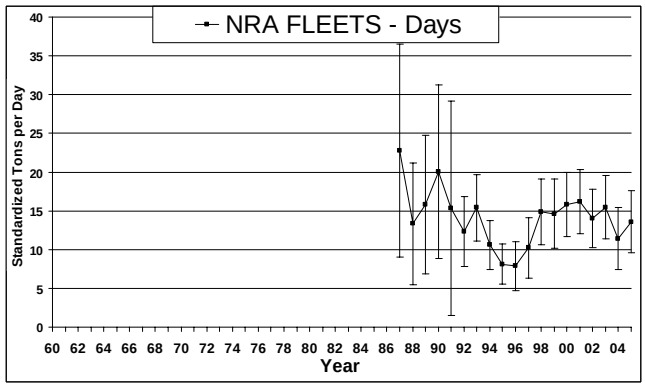


Fig. 2. Standardized Mean CPUE ± 2 standard errors for Redfish in Div. 3O from 1960-2006 utilizing effort in DAYS fished.

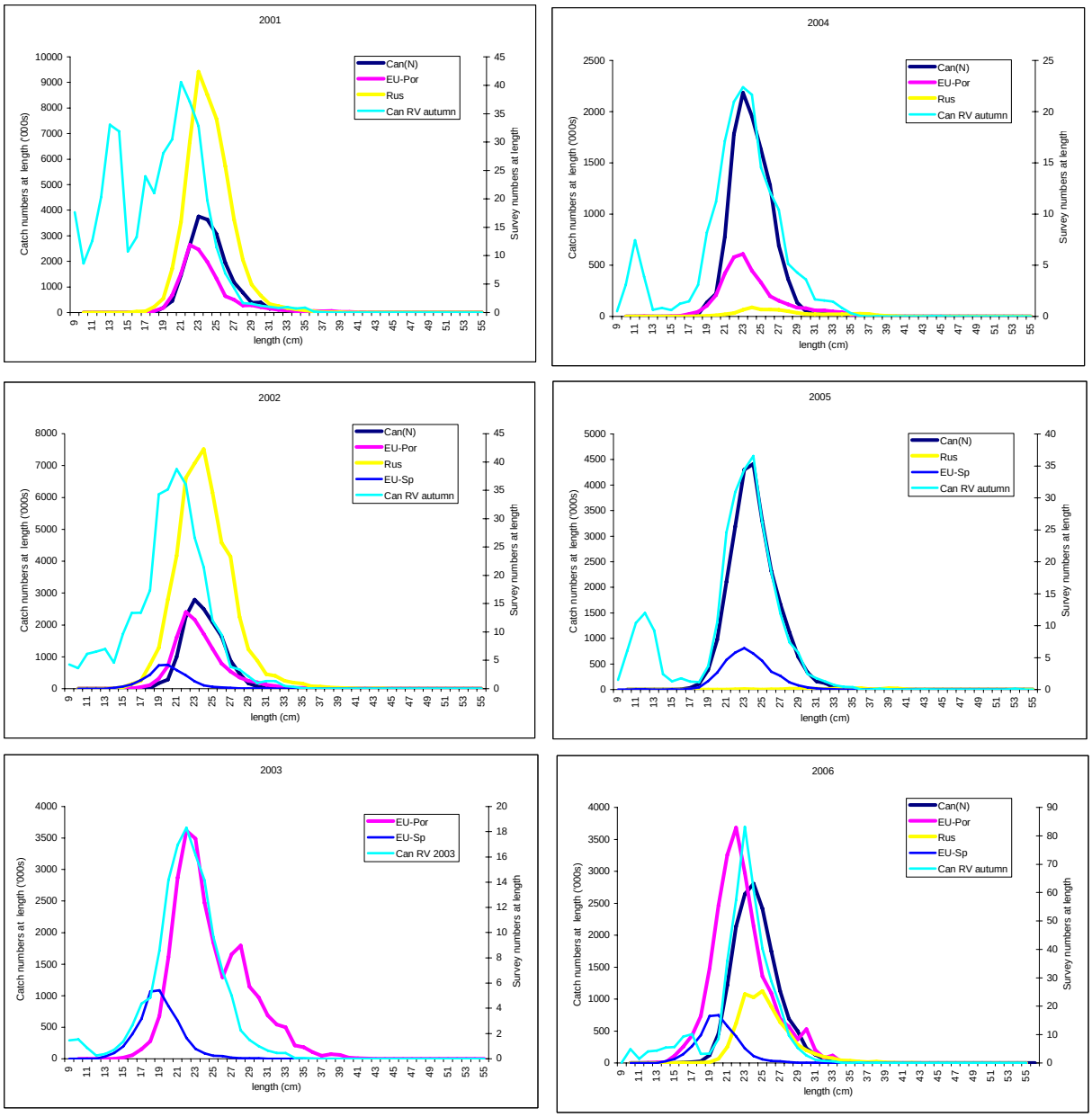


Figure 3. Catch numbers at length ('000s) and Canadian RV survey numbers at length.

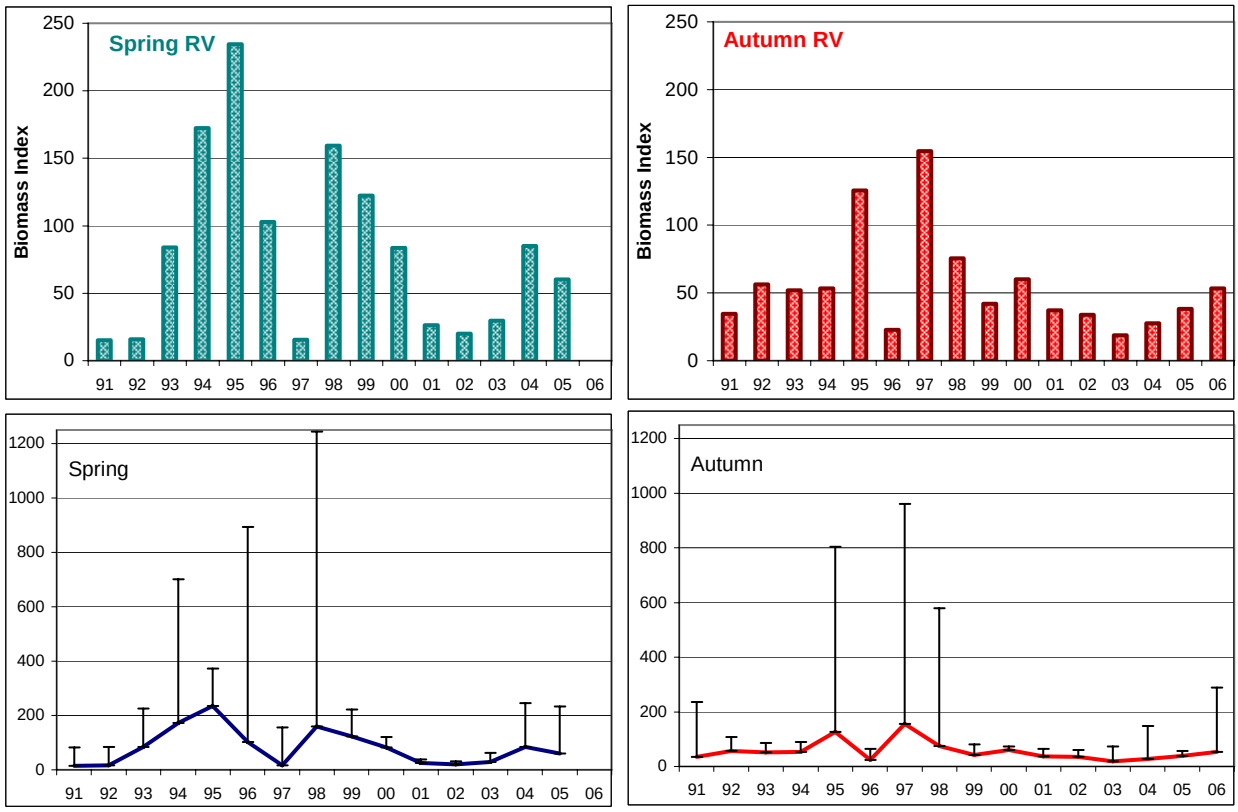


Fig. 4. Survey biomass index for redfish in Div. 3O for spring and autumn surveys from 1991-2006 (upper panel) with 95% CI (lower panels). Surveys prior to autumn 1995 utilized an Engel trawl. Estimates were converted into Campelen equivalents based on comparative fishing trials.

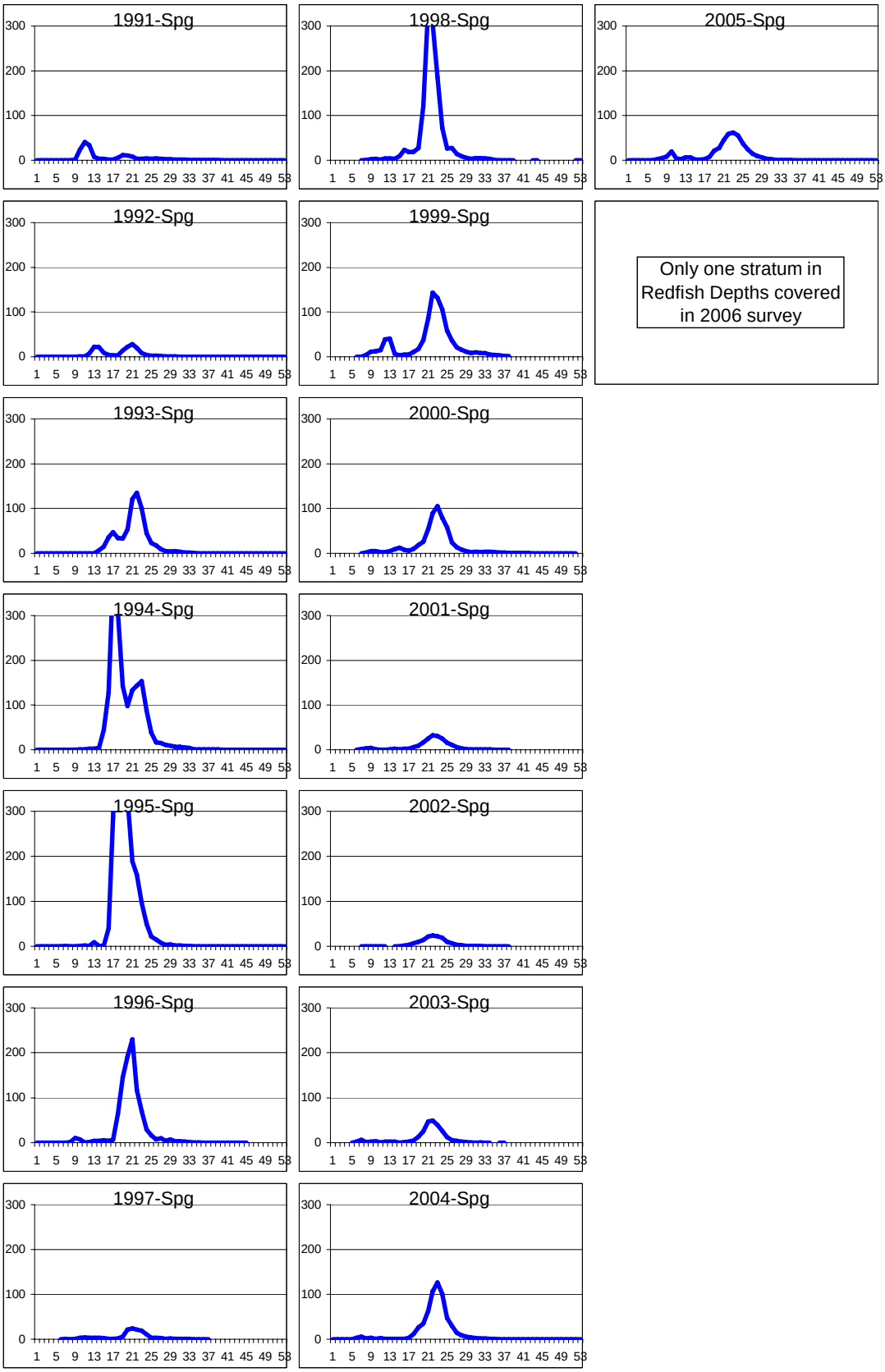


Fig. 5. Length distributions from RV surveys to Div. 3O in SPRING from 1991-2005. Plotted are mea per standard tow. The 1991-1994 data are convertions into Campelen equivalents based on comparative fishing experiments.

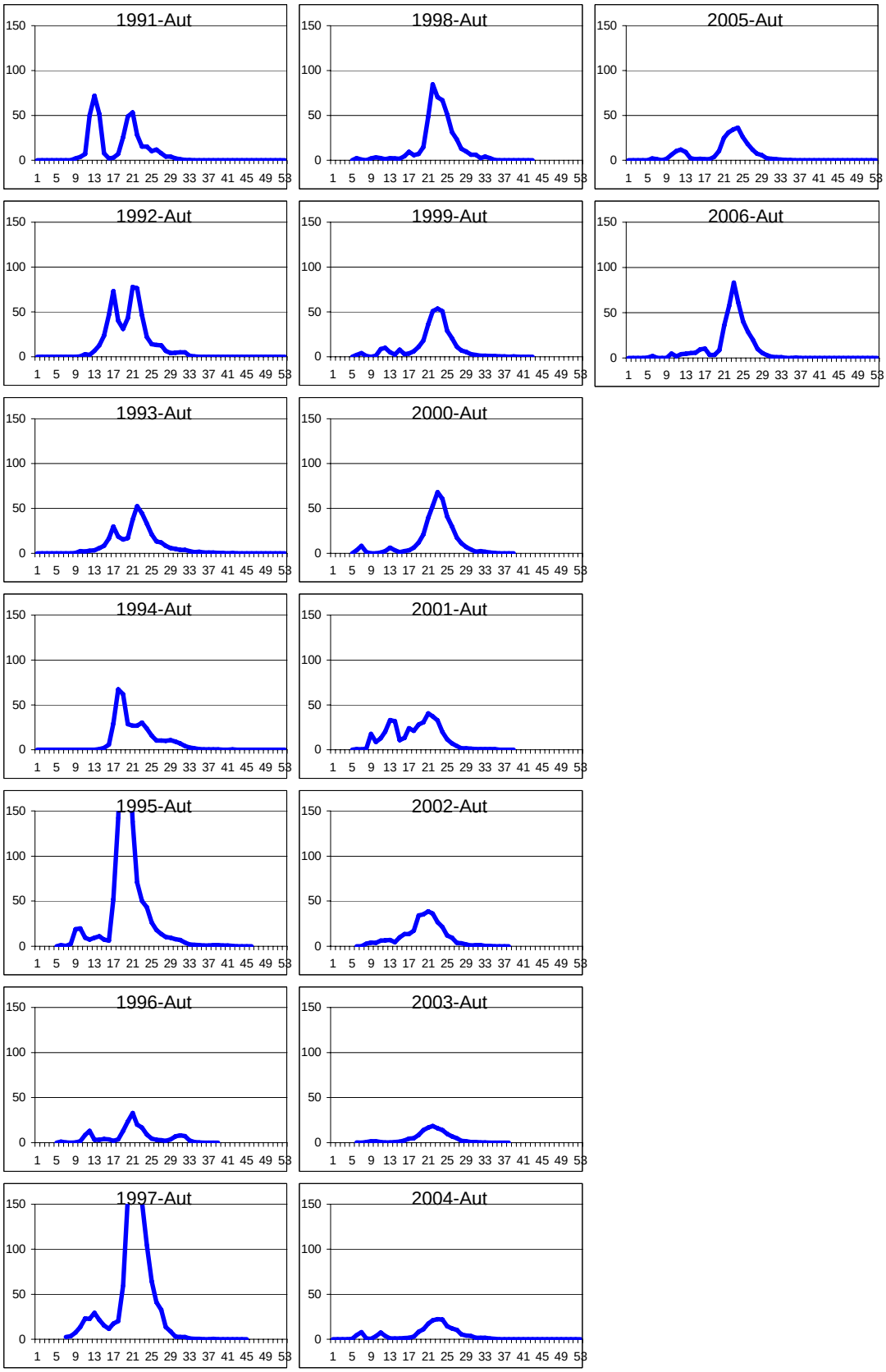


Fig. 6. Length distributions from RV surveys to Div. 3O in AUTUMN from 1991-2006. Plotted are mean per standard tow. The 1991-1994 data are convertions into Campelen equivalents based on comparative fishing experiments.

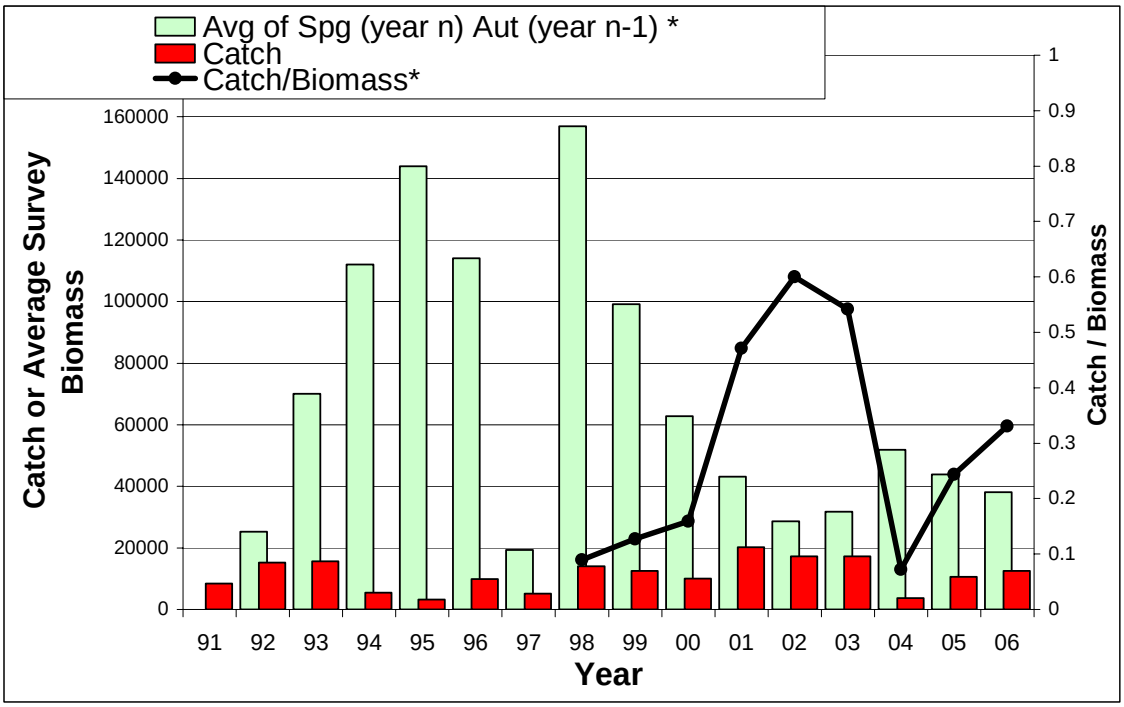


Fig. 7. Catch/Biomass ratios for Div. 3O. Plotted are average survey biomass between spring (n) and autumn (n-1) for year (n) in which catch was taken.
*The 2006 value of biomass comes only from the autumn survey.