Northwest Atlantic Fisheries Organization

Serial No. N6190 **NAFO SCR Doc. 13/036**

SCIENTIFIC COUNCIL MEETING – JUNE 2013

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

by

D. W. Ings, D. Power and R.M. Rideout

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 t and 35 000 t since 1960. Up to 1986 catches averaged 13 000 tons and subsequently increased to a maximum value of 35 000 tons in 1988, exceeding the TAC by 21,000 tons. Following 1988 catches generally declined to a low of 3,000 tons in 1995, partly due to reductions in foreign allocations within the Canadian fishery zone since 1993. There was an overall increasing trend in catch over the next five years to a high value of 20 000 tons in 2001. Catch has been declining since that time with a mean of approximately 6500 t taken annually during 2010-2012. Assessment of this stock has been based primarily on research survey 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 between the early and mid 1990s, fluctuated over 100,000 tons from 1994 to 1999 and declined to 20,000 t in 2002. The index generally has increased since that time up to a mean of 191,000 t for 2010-2012. The Canadian autumn survey, while more stable in the early 1990s, generally supports the pattern of the spring survey index indicating a gradual increase from 18,000 t in 2003 to 150 000 t in 2010 and stable values since that time. Canadian RV surveys do not adequately sample fish greater than 25 cm, which in some years comprise a large portion of the fishery, making interpretation of survey estimates difficult. The fishery since 1998 appeared to target the relatively strong 1988 year class, but recently a strong year class born in the early 2000s has grown sufficiently to provide some individuals exceeding 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

Two species of redfish have been commercially fished in Div. 3O, the deep sea redfish (*Sebastes mentella)* and the Acadian redfish (*Sebastes fasciatus*). The two species are difficult to distinguish based on external characteristics, and as a consequence are reported collectively as "redfish" in the commercial fishery statistics. Most of the habitable redfish area in Div. 3O lies within Canada's 200 mile exclusive fishery zone and has been subject to management regulation since 1974. Approximately 8% of the habitable redfish area within Div. 3O lies within the NAFO Regulatory Area (NRA) and was brought under TAC regulation starting in 2005.

Nominal Catches and TACs

Nominal catches have ranged between 3 000 tons and 35 000 tons since 1960 (Table 1, Fig. 1). Catches averaged 13 000 t up to 1986 and then increased to 27 000 t in 1987 and 35 000 t in 1988 (exceeding TACs by 7 000 t and 21 000 t, respectively). Catches declined to 16 000 t by 1993 then to about 3 000 t in 1995, partly due to reductions in foreign allocations within the Canadian fishery zone since 1993. Catches increased to 20 000 t by 2001 and subsequently declined to 4000 t in 2008 and have been in the 6000 to 6500 t range since 2009.

The large redfish catches in 1987 and 1988 were due mainly to increased activity in the NRA by South Korea and non-Contracting parties (NCPs), primarily Panama. There has been no activity by NCPs in the NRA since 1994. Estimates of under-reported catch which have occurred primarily before 1995, have ranged from 200 tons to 23 500 tons. There have also been estimates of over-reported catch in the recent period since 2000, with a maximum value of 4 300 t in 2003. There were no alternate sources of catch estimates available for 2011 or 2012 to compare with reported catch

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. In September 2004, the NAFO Fisheries Commission adopted TAC regulation for redfish in 3O, implementing a level of 20 000 tons for the entire division in 2005 and remaining in effect up to 2012.

Description of the Fishery

Russia predominated in the 3O redfish fishery up until 1993 (Table 2) and generally caught about 50% of the total non-Canadian allocation, which accounted for about 2/3 of the Canadian TAC. 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 t in 2004. Catches have been steadily increasing from 50 t in 2007 to 970 t in 2012. Portugal began fishing redfish in Div. 3O in 1992 and averaged about 1 800 tons between 1992 and 1998. Their catches escalated to 5 500 tons in 1999 and have ranged between 3 200 – 6 400 tons thereafter with 3 600 t taken in 2012. Spain, which had taken less than 50 tons before 1996, 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. Since then, Spanish catch ranged between 600 – 1 700 with about 1 600 t taken in 2012.

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 reduced catch to less than 200 tons in 1995. Between 1996 and 1999 Canadian catches 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 averaged about 3 600 tons, followed by a decrease to 1000 tons in 2007 and ranged between 100 - 200 tons during 2008 to 2011. No landings of redfish were reported by Canada for 2012.

Although the redfish fishery in Div. 3O has generally occurred throughout the year in the most recent decade, the majority of catch has been taken during the last three quarters of the year (Table 3a). The vast majority (>90%) of catch has been taken via bottom trawling by Canadian, Portuguese and Spanish fleets (Table 3b). Catches via midwater trawl prior to 2005 were taken predominantly by Russia.

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 2000-2011 STATLANT 21B data and 2012 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. 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 effort in days fished were extracted. Catches 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.

Consistent with catch rate analyses since 2003, separate analyses were conducted for the Canadian fleet, which fishes within it's exclusive fishery zone, and for fleets that fish in the NRA because of different trends over time between these two groups (Power, MS 2003). In the past, Canada had bi-lateral fisheries agreements with Russia, Japan and Cuba which enabled their fleets to fish within 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 49% of the variation in catch rate (Table 4). The standardized catch rate (Table 5, Fig. 2 right panel) shows much within year variability and fluctuation prior to 1992. The index increased from 1988 to 1990, amongst the highest values in the series, then declined by 50% to the lowest value in 1996. Catch rates increased again peaking in 2000 close to the 1990 value, then declined to a value near the series low in 2006. Since then, the index doubled to a relatively high value in 2008 and has remained relatively stable thereafter.

For the CANADIAN FLEET "days fished" standardization, the regression was significant (P <0.05), explaining 55% of the variation in catch rate (Table 6). ANOVA results indicate only a marginally non-significant month effect (P =0.0524). The catch rate index (Table 7, Fig. 2 left panel) shows much within year variability. There are also only short periods of sustained directed effort prior to 1996. The catch rate index increased from 1997 to 2003 and was relatively stable to 2007 with catch rates amongst the highest values in the series. There have been low levels of directed effort for redfish since 2007 (<260 tons per year) with highly variable results. In 2011 there were only 2 directed trips with less than 3 days effort and no directed trips in 2012.

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, with activity being determined by market conditions. Fleets may search for larger fish rather than simply maximizing catch rate. The trend in the Canadian catch rate series indicates stability since 2003 whereas the index in the NRA has shown a decline from 2003 to 2006, an increase to 2008, then stability. In recent years, in both series, the rates are amongst the highest in each series. In summary, these catch rate indices may simply be reflecting fishing success of fleets within their 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 which are 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-Costas *et al*., MS 2013), Portugal (Vargas *et al*., MS 2013), and Russia (Pochtar *et al*. MS 2013) from the 2012 trawl fishery (Fig. 3). The Portuguese fleet fished between 178 and 520 m while the Russian fleet fished from 125-585 m. Sampling details for the Canadian fleets over time are given in Table 8. There were no Canadian redfish landings in 2012. Lengths between 20-23 cm (range 8-38 cm) dominated the Portuguese catch. The Spanish catch was dominated by 20-23 cm fish (range 15-34 cm).

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 2012 and compared to Canadian RV survey numbers at length in Figure 3.

Research Survey Data

Abundance Indices

Stratified random groundfish surveys have been conducted by Canada in the spring and autumn in Div. 3O since 1991, with regular coverage of depths to 730 m (and sporadic coverage of deeper strata in the autumn). In addition, a summer survey was conducted in 1993. Surveys utilized an Engel 145 otter trawl (1.75 n. mi. standard tow) from 1991 to spring 1995 and a Campelen 1800 shrimp trawl (0.75 n. mi. standard tow) from autumn 1995 to the present. The Engel 145 data were converted into Campelen 1800 trawl equivalent data based on comparative fishing trials (see Power and Atkinson MS 1998a). Vessel problems during the 2006 spring survey resulted in the completion of only a single tow in redfish depths.

Abundance (Tables 9 and 11) and biomass (Tables 10 and 11) estimates based on spring and autumn data from the Canadian surveys demonstrate large fluctuations between seasons and years for some strata. 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 between the early and mid 1990s, and subsequently declined to 2002 (21 000 t, 24 kg per tow). The low 1997 value is considered a sampling anomaly. The biomass index increased in 2003 and again in 2004 (103 kg per tow) but in 2004 was influenced by one large set in a stratum that represented 40% of the biomass index of 85 000 t. The biomass index has alternated between 60 000 t and 90 000 t between 2005 and 2009 (no data for 2006) and increased steadily to an estimate of 232 000 t (280 kg per tow) in 2012. Biomass estimates from the autumn surveys, while more stable in the early 1990s, generally support the pattern of the spring survey index but with a more gradual increase in biomass index from 2003 (18 600 t: 22.5 kg per tow) to 2010 (150 000 t: 181 kg per tow) and stable values since then. It should be noted that the 1996 autumn estimate does not include important strata that were not sampled due to problems on the survey.

Density estimates per stratum were generally lower in the NAFO Regulatory Area (denoted in Tables 9 - 12 as strata 354, 355, 356, 721, 722) compared to strata inside the Canadian 200 mile exclusive fishery zone, although it should be pointed out that part of these NRA strata overlap the Canadian zone. Estimates of the proportion of survey biomass within the NRA have ranged from 3% to 53% (average 15.0%) for the spring survey and 4% to 36% (average 19.4%) for the autumn survey.

Data were available from EU-Spain spring surveys conducted in the NAFO regulatory area (NRA) of Div. 3O from 1997 to 2012. These surveys use the same stratification scheme as the Canadian surveys and the area of redfish habitat covered in Div. 3O is less than 8% compared to the Canadian surveys for strata <732m. The surveys covered depths to 1500m (800 fathoms). Until 2001, these surveys were conducted with a Pedreira type bottom trawl and thereafter with a Campelen trawl similar to that used in Canadian surveys. The data prior to 2001 were converted into Campelen equivalent units.

The biomass indices for Div. 3O from the EU-Spain survey increased sharply from 2008 to 2010, then declined to 2012 (Fig. 5). Although the recent surveys show large fluctuation, they are amongst the largest values in the survey series. These surveys generally agree with the Canadian spring surveys except for the opposite trend in the past two years.

<u>Recruitment</u>

Size distributions from the Canadian spring (Fig. 6) and autumn surveys (Fig. 7) in terms of mean number per tow at length indicates a bimodal distribution in 1991 corresponding to a 1988 and 1984 year-class respectively. The 1984 year-class progressed at about one cm per year up to 1994 and cannot be traced any further. The 1988 year-class remained dominant but progressed slowly between 22-25 cm based on the 2001-2007 surveys, then decreased substantially. Recruitment pulses detected in both surveys in 1999 were greatly diminished by 2002. There was a new relatively large pulse at 17cm in the 2007 surveys corresponding to a year class born in the early 2000s that has remained the dominant mode to 2012. Although their presence was detected at smaller sizes in previous surveys, the sudden increase in density at 17cm in 2007 is unusual. Nevertheless, this represents the best sign of recruitment in the population since the 1988 year-class.

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

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

A formal description of the model and its parameterization and fitting framework within ASPIC are outlined fully in Prager (1994, and 2005) and will not be reproduced here. The basic ASPIC setup for Div. 3O datasets are as follows. The model was conditioned on total fishery catch paired with the Canadian autumn survey biomass index (CC in ASPIC terminology) and implemented with the logistic form of the generalized production model. Several other indices (covariate information) were used in building the objective function which was minimized using sum of squared errors (SSE). Those indices are described as follows:

(1) Canadian spring survey biomass index (1991-2005, 2007-2012) from this paper used as an average year index (I1),
(2) Russian Spring/Summer Biomass Index (1983-91, 1993) from Vaskov (MS 2003) used as an average year index (I1),
(3) Spanish Spring survey of the NRA area of Div. 3O (1996-2012) from Diana González-Troncoso (pers. comm.), used as an average year index (I1)
(4) A CPUE series from fisheries in the NRA area from 1987-2011 (see Table 5), used as an average year index (I1)
(5) A CPUE series from Canadian fisheries that operate within the 200 mile EEZ from 1960-2010 with 10 years missing due to insufficient directed effort (see Table 7), used as an average year index (I1).

Starting parameter values were input as suggested by Prager (2005). Initially, all indices were run simultaneously with no penalty constraint on B_1 (biomass at beginning of data series) being greater than K (carrying capacity). A presentation of the sequence of runs and diagnostics (Fig. 9) did not produce any useful results. Although all the runs converged, there were issues with negative correlations between indices in the initial run and subsequent runs with parameter estimates near program set boundaries (on various q's) or near minimum bounds (on K). These suggest trivial solutions that could not be mitigated by usual measures (Prager 2005). All models had a relatively high total objective function, low r^2 in CPUE and residual patterns that suggest there is not a lot of information content in the indices consistent with a stock under the assumption of logistic growth. Given these caveats, further investigations into model input are warranted and alternate models should be investigated for this stock.

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 to be less than one. All fish sizes were included in the survey biomass estimate. The results (Fig. 8) 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. In 2007-2008 the estimate of fishing mortality dropped to some of the lowest levels since the mid 1990s and has remained at similar levels up to 2012.

Size at maturity

No new maturity at length data were analysed for this assessment. However, based on previous analyses of size at maturity for this stock estimated L50 is about 28 cm for females and 21 cm for males (Power and Atkinson MS 1998). Based on current catches dominated by lengths between 18cm-24 cm, it is clear that the fishery is based predominantly on immature fish.

State of the Stock

It is still not possible to determine absolute size of the stock. It is difficult to accept that the CPUE series are representative of the trends in the stock. RV survey estimates suggest that stock size has been gradually increasing since the early 2000s. Using the ratio of catch:biomass as a proxy for fishing mortality suggests a value less than 0.1 for 2007-2012, among the lowest levels observed since the mid 1990s. The appearance of a relatively strong year class (born in the early 2000s) in the 2007 and subsequent surveys constitutes the best sign of recruitment to the population since the relatively strong 1988 year-class. The bulk of the catches in recent years are comprised of fish less than 25 cm, suggesting that these fisheries continue to be comprised of predominantly immature fish (Power and Atkinson 1998 MS).

References

González-Costas, F., D. González-Troncoso, G. Ramilo, E. Román , J. Lorenzo, M. Casas, , C. Gonzalez, A. Vázquez and M. Sacau MS 2013. Spanish Research Report for 2012. NAFO SCS Doc. 13/07. Serial No. N6150, 41 p.

Gavaris, S. 1980. Use of a multiplicative model to estimate catch rate and effort from commercial data. Can. J. Fish. Aquat. Sci., 37: 2272-2275.

Power, D. MS 1995. Status of redfish in Subarea 2 + Division 3K. DFO Atl. Fish. Res. Doc. 95/25, 25 p.

Power, D., and D. B. Atkinson. MS 1998a. Update on the status of Redfish in 3O. CSAS Res. Doc. 98/110, 20 p.

Power, D., and D. B. Atkinson. MS 1998b. The status of Redfish in Unit 2 (Laurentian Channel Management Unit). CSAS Res. Doc. 98/21, 41 p.

Power, D., MS 2005. An Assessment of the status of Redfish in NAFO Division 3O. NAFO SCR Doc. 05/59. Serial No. N5145, 19pp.

Pochtar, M., K. Fomen and V. Zabovnikov. MS 2013. Russian Research Report for 2012. NAFO SCS Doc. 13/09. Serial No. N6159. 27 p.

Prager, M. H., 1994. A suite of extensions to a non-equilibrium surplus-production model. Fish. Bull. U.S., 90(4): 374-389.

Prager, M. H., 2005. User's Manual for ASPIC: A Stock Production Model incorporating CXovariates (ver. 5) and Auxiliary Programs. NMFS Beaufort Lab. Doc. BL–2004–01. rev. Jan 2005, 27pp

Vargas, J., R. Alpoim, E. Santos and A. M. Ávila de Melo MS 2012. Portuguese Research Report for 2012. NAFO SCS Doc. 13/05. Serial No. N6145, 51 p.

Vascov, A. A. MS 2003. Distribution of Redfish in Division 3O Based on Data from Russian Trawl Surveys in 1983-1993. NAFO SCR Doc. 03/12. Serial No. N4818, 13pp.

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

Year	Canada	Others	Catch [a]	TAC	Yea	Canada	Others	Catch [a]	TAC
1960	100	4900	5000		1987	183	12837	27170	20000
1961	1000	10000	11000		1988	181	11111	34792	14000
1962	1046	6511	7557		1989	27	11029	13256	14000
1963	2155	7025	9180		1990	155	8887	14242	14000
1964	1320	14724	16044		1991	28	7533	8461	14000
1965	203	19588	19791		1992	1219	12149	15268	14000
1966	107	15198	15305		1993	698	12522	15720	14000
1967	645	18392	19037		1994	1624	3004	5428	10000
1968	52	6393	6445		1995	177	2637	3214	10000
1969	186	15692	15878		1996	7255	2390	9845	10000
1970	288	12904	13192		1997	2554	2558	5112	10000
1971	165	19627	19792		1998	8972	4380	14052	10000
1972	508	15609	16117		1999	2344	10249	12593	10200
1973	133	8664	8797		2000	2206	10584	10003	10000
1974	91	13033	13124	16000	2001	4893	17681	20274	10000
1975	103	15007	15110	16000	2002	3000	16453	17234 [b]	10000
1976	3664	11684	15348	16000	2003	3125	18466	17246	10000
1977	2972	7878	10850	16000	2004	2616	3848	3753	10000 [c]
1978	1841	5019	6860	16000	2005	5501	6409	11305	20000
1979	6404	11333	17737	20000	2006	3580	7455	12610	20000
1980	1541	15765	17306	21900	2007	1053	6472	5179	20000
1981	2577	10027	12604	20000	2008	203	4816	4020	20000
1982	491	10869	11360	20000	2009	255	6233	6431	20000
1983	7	7133	7340	20000	2010	260	6285	6545	20000
1984	167	9861	16978	20000	2011	97	6445	6542	20000
1985	104	8106	12860	20000	2012	0	6418	6418	20000
1986	141	10314	11055	20000					

[a] **Totals since 1983 may include adjustments for estimated catches from various sources.**
[b] **midpoint of estimates ranging from 16100-18400.**
[c] **prior to 2005, TACs were set by Canada within its fisheries jurisdiction.**

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

Year	Can (M)	Can (N)	France (SPM)	Japan	Portugal	Spain	Russia	Cuba	Ukraine	Estonia	Lithuania	South Korea	Faroe Islands	Latvia	Estimate [a]	Total	TAC [b]
1992	27	1192	-	125	1468	-	5845	2776	-	-	-	1935	-	-	1900	15268	14000
1993	21	677	-	159	4794	-	6887	665	-	-	-	17	-	-	2500	15720	14000
1994	779	845	-	-	2918	26	60	-	-	-	-	-	-	-	800	5428	10000
1995	4	173	-	264	1935	22	416	-	-	-	-	-	-	-	400	3214	10000
1996	2124	5131	-	417	1635	338	-	-	-	-	-	-	-	-	200	9845	10000
1997	693	1861	134	285	894	1245	-	-	-	-	-	-	-	-	-	5112	10000
1998	2851	6121	266	355	1875	1884	-	-	-	-	-	-	-	-	700	14052	10000
1999	317	2027	-	-	5469	4549	231	-	-	-	-	-	-	-	-	12593	10200
2000	1326	880	-	-	4555	3747	2233	-	-	49	-	-	-	-	2787	10003	10000
2001	336	4557	-	-	3537	2792	11343	-	-	9	-	-	-	-	2300	20274	10000
2002	12	2988	-	-	4610	660	11182	-	-	-	1	-	-	-	2219	17234	10000
2003	32	3093	-	-	6382	1289	10794	-	1	-	-	-	-	-	4345	17246	10000
2004	276	2340	-	2	3279	320	242	-	3	2	-	-	-	-	2711	3753	10000
2005	137	5364	-	1	4555	1683	170	-	-	-	-	-	-	-	605	11305	20000
2006	-	3580	-	0	5184	1294	977	-	-	-	-	-	-	-	1575	12610	20000
2007	-	1053	-	61	4755	1502	54	-	-	100	-	-	-	-	2346	5179	20000
2008	0	203	-	-	3850	603	82	-	-	42	139	-	100	-	999	4020	20000
2009	-	255	-	-	4273	1691	169	-	-	100	-	-	-	-	57	6431	20000
2010	218	42	-	-	3853	1692	474	-	-	103	-	-	163	-	1311	5234	20000
2011	-	97	-	-	4006	1661	570	-	-	121	5	-	-	82	-	6542	20000
2012	-	0	-	-	3593	1572	971	-	-	181	-	-	101	-	-	6418	20000

[a] Estimates of catch from other sources (shaded cells are estimates of over-reporting)

[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
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
2006	743	485	49	1044	617	654	885	1436	1303	1786	1566	467		11035
2007	225	132	214	475	858	657	950	1298	966	859	358	479		7471
2008	124	328	56	289	187	72	97	433	350	689	1247	966		4838
2009	223	660	136	307	525	901	310	1118	778	368	754	234		6314
2010	242	298	303	211	435	1148	1246	202	1205	879	189	187		6545
2011	331	574	466	734	764	275	405	768	528	380	373	374		5972

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
2004	6308	156	0	0	6464
2005	11908	0	0	0	11908
2006	10058	0	0	977	11035
2007	7525	0	0	0	7525
2008	4880	0	0	0	4880
2009	6314	0	0	0	6314
2010	6545	0	0	0	6545
2011	5890	82	0	0	5972

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.

REGRESSION OF MULTIPLICATIVE MODEL
MULTIPLE R............. 0.700
MULTIPLE R SQUARED..... 0.490

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARE	F-VALUE
INTERCEPT	1	2.12E3	2.12E3	
REGRESSION	48	4.36E1	9.08E-1	5.287
Cntry|Gear|TC(1)	9	4.03E0	4.48E-1	2.608
Month(2)	11	3.05E0	2.77E-1	1.614
Bycatch(3)	4	4.77E0	1.19E0	6.946
Year(4)	24	1.41E1	5.87E-1	3.415
RESIDUALS	264	4.53E1	1.72E-1	
TOTAL	313	2.21E3		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VAR #	REG. COEF	STD. ERR	NO. OBS
Cntry|Gear|TC	17126	INT	3.065	0.340	313
Month	6				
Bycatch	95				
Year	87				
(1)	17127	1	0.327	0.154	11
	19125	2	0.154	0.081	43
	19126	3	0.437	0.125	15
	25126	4	0.199	0.322	7
	25127	5	0.372	0.236	16
	34126	6	0.201	0.096	39
	34127	7	0.296	0.139	14
	34156	8	0.223	0.162	10
	34157	9	0.326	0.168	8
(2)	1	10	-0.194	0.134	16
	2	11	-0.133	0.129	17
	3	12	-0.037	0.121	23
	4	13	-0.098	0.118	22
	5	14	0.112	0.108	29
	7	15	0.170	0.113	26
	8	16	0.193	0.108	30
	9	17	0.034	0.107	31
	10	18	-0.015	0.105	35
	11	19	0.068	0.110	28
	12	20	0.049	0.117	23
(3)	55	21	-0.526	0.122	21
	65	22	-0.327	0.098	30
	75	23	-0.296	0.084	43
	85	24	-0.092	0.066	81
(4)	88	25	-0.572	0.323	4
	89	26	-0.379	0.275	6
	90	27	-0.248	0.317	4
	91	28	-0.314	0.487	1
	92	29	-0.659	0.300	10
	93	30	-0.428	0.357	10
(4)	94	31	-0.783	0.361	9
	95	32	-1.078	0.367	8
	96	33	-1.096	0.391	4
	97	34	-0.925	0.370	7
	98	35	-0.340	0.353	13
	99	36	-0.502	0.361	9
	100	37	-0.192	0.347	19
	101	38	-0.344	0.345	24
	102	39	-0.503	0.347	31
	103	40	-0.388	0.343	39
	104	41	-0.690	0.372	7
	105	42	-0.499	0.353	12
	106	43	-0.927	0.346	19
	107	44	-0.472	0.346	18
	108	45	-0.269	0.362	12
	109	46	-0.531	0.348	23
	110	47	-0.272	0.349	18
	111	48	-0.166	0.457	2

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

Table 5. Standardized catch rate index for Redfish in Div. 3O from a multiplicative model utilizing DAYS FISHED as a measure of effort. Index is for FLEETS IN THE NRA.

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT	% OF CATCH IN THIS ANALYSIS
1987	3.0646	0.1155	22.041	7.292	12837	582	12.1
1988	2.4924	0.1082	12.481	4.005	11111	890	14.9
1989	2.6857	0.1006	15.202	4.711	11029	725	22.9
1990	2.8167	0.0926	17.400	5.184	8887	511	7.8
1991	2.7502	0.2832	14.796	7.359	7533	509	1.2
1992	2.4060	0.0387	11.856	2.313	12149	1025	25.4
1993	2.6368	0.0226	15.055	2.254	12522	832	37.9
1994	2.2815	0.0253	10.539	1.668	3004	285	94.5
1995	1.9862	0.0291	7.829	1.329	2637	337	82.4
1996	1.9685	0.0485	7.617	1.660	2390	314	67.4
1997	2.1395	0.0383	9.084	1.764	2558	282	30.4
1998	2.7248	0.0216	16.448	2.408	4380	266	76.1
1999	2.5626	0.0260	13.954	2.241	10249	734	37.7
2000	2.8727	0.0170	19.114	2.483	10584	554	86.4
2001	2.7206	0.0162	16.423	2.085	17203	1047	86.2
2002	2.5615	0.0174	13.999	1.843	16452	1175	95.2
2003	2.6770	0.0161	15.724	1.989	18466	1174	91.8
2004	2.3745	0.0339	11.515	2.107	3837	333	70.4
2005	2.5659	0.0226	14.025	2.101	5806	414	98.0
2006	2.1375	0.0172	9.162	1.198	9310	1016	67.7
2007	2.5930	0.0163	14.455	1.843	4126	285	141.1
2008	2.7954	0.0278	17.596	2.920	3817	217	106.8
2009	2.5334	0.0170	13.614	1.773	6176	454	84.5
2010	2.7926	0.0185	17.628	2.389	4973	282	101.3
2011	2.8988	0.1034	18.785	5.899	6444	343	6.4

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.200

Table 6. 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.

REGRESSION OF MULTIPLICATIVE MODEL
MULTIPLE R............. 0.742
MULTIPLE R SQUARED..... 0.551

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARE	F-VALUE
INTERCEPT	1	1.65E3	1.65E3	
REGRESSION	63	5.81E1	9.23E-1	4.397
Cntry|Gear|TC(1)	10	1.35E1	1.35E0	6.425
Month(2)	9	3.59E0	3.99E-1	1.904
Bycatch(3)	4	7.10E0	1.77E0	8.457
Year(4)	40	2.29E1	5.72E-1	2.725
RESIDUALS	226	4.74E1	2.10E-1	
TOTAL	290	1.76E3		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VAR #	REG. COEF	STD. ERR	NO. OBS
Cntry|Gear|TC	3125	INT	2.644	0.522	290
Month	9				
Bycatch	95				
Year	60				
(1)	2114	1	-0.133	0.235	13
	2125	2	0.340	0.190	14
	3114	3	0.128	0.130	51
	3121	4	-0.096	0.162	16
	3123	5	-0.362	0.123	59
	3124	6	0.114	0.126	53
	3154	7	0.110	0.269	5
	3155	8	0.404	0.226	10
	27123	9	-0.449	0.202	8
	27125	10	0.495	0.134	21
(2)	3	11	-0.424	0.267	6
	4	12	-0.447	0.154	18
	5	13	-0.216	0.128	28
	6	14	-0.309	0.112	36
	7	15	-0.122	0.113	37
	8	16	-0.214	0.109	36
	10	17	-0.059	0.103	45
	11	18	-0.027	0.122	27
	12	19	-0.038	0.156	13
(3)	55	20	-0.724	0.212	11
	65	21	-0.569	0.176	10
	75	22	-0.600	0.149	15
	85	23	-0.359	0.097	38
(4)	61	24	0.027	0.510	6
	62	25	-0.032	0.525	5
	63	26	-0.341	0.531	6
	64	27	-0.097	0.639	2
	67	28	0.083	0.535	5
	70	29	-0.275	0.620	2
	71	30	0.165	0.665	1
	72	31	-0.452	0.545	5
	74	32	-0.934	0.720	1
	75	33	-0.359	0.697	1
	76	34	-0.040	0.537	10
	77	35	-0.206	0.524	12
	78	36	-0.232	0.522	10
	79	37	0.120	0.528	13
	80	38	-0.057	0.534	8
	81	39	0.160	0.538	9
	82	40	0.172	0.612	2
	84	41	0.582	0.692	1
	86	42	0.133	0.709	1
	87	43	0.362	0.697	1
	88	44	0.146	0.697	1
	92	45	-0.659	0.632	2
	93	46	-0.260	0.636	2
	94	47	0.503	0.608	3
	95	48	-0.160	0.638	2
	96	49	-0.565	0.542	15
	97	50	-0.763	0.542	14
	98	51	0.127	0.541	27
	99	52	-0.123	0.546	16
	100	53	-0.131	0.554	10
	101	54	0.123	0.545	18
	102	55	0.213	0.548	16
	103	56	0.346	0.551	15
	104	57	0.334	0.556	11
	105	58	0.373	0.549	14
	106	59	0.349	0.556	11
	107	60	0.444	0.577	5
	108	61	0.887	0.639	2
	109	62	0.350	0.604	3
	110	63	-0.309	0.713	1

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
27123 =	Can(M)	(Stern)	Otter Trawl		TC 3
27125 =	"	"	"		TC 5

Table 7. 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.

PREDICTED CATCH RATE

	LN TRANSFORM		RETRANSFORMED				% OF CATCH IN
YEAR	MEAN	S.E.	MEAN	S.E.	CATCH	EFFORT	THIS ANALYSIS
1960	2.6438	0.2726	13.630	6.670	100	7	43.0
1961	2.6710	0.0839	15.397	4.378	1000	65	89.5
1962	2.6115	0.0697	14.613	3.801	1046	72	39.1
1963	2.3025	0.0591	10.785	2.590	2155	200	36.5
1964	2.5467	0.1796	12.960	5.266	1320	102	14.2
1967	2.7270	0.0589	16.491	3.954	645	39	76.4
1970	2.3685	0.1264	11.139	3.846	288	26	65.3
1971	2.8091	0.2715	16.089	7.861	165	10	54.5
1972	2.1915	0.0805	9.549	2.661	508	53	58.7
1974	1.7100	0.2855	5.323	2.658	91	17	22.0
1975	2.2851	0.2411	9.674	4.486	103	11	43.7
1976	2.6041	0.0335	14.770	2.688	3664	248	94.7
1977	2.4377	0.0350	12.497	2.322	2972	238	93.0
1978	2.4113	0.0410	12.135	2.438	1841	152	93.1
1979	2.7640	0.0282	17.377	2.906	6404	369	91.5
1980	2.5871	0.0381	14.489	2.807	1541	106	89.4
1981	2.8036	0.0361	18.008	3.397	2577	143	95.2
1982	2.8154	0.1168	17.500	5.821	491	28	83.9
1984	3.2260	0.2389	24.813	11.461	167	7	62.9
1986	2.7769	0.2227	15.966	7.147	141	9	90.8
1987	3.0056	0.2411	19.885	9.221	183	9	80.9
1988	2.7898	0.2411	16.025	7.431	181	11	90.6
1992	1.9845	0.1413	7.530	2.739	1219	162	12.1
1993	2.3838	0.1436	11.213	4.109	698	62	81.8
1994	3.1469	0.1038	24.537	7.720	1624	66	50.0
1995	2.4843	0.1351	12.451	4.435	177	14	91.0
1996	2.0788	0.0250	8.773	1.380	7255	827	94.0
1997	1.8806	0.0263	7.191	1.161	2554	355	82.9
1998	2.7706	0.0209	17.557	2.528	8972	511	93.0
1999	2.5204	0.0338	13.582	2.480	2344	173	83.0
2000	2.5131	0.0347	13.478	2.495	2206	164	74.1
2001	2.7663	0.0271	17.428	2.854	4893	281	92.9
2002	2.8571	0.0305	19.051	3.307	3000	157	90.6
2003	2.9893	0.0312	21.738	3.816	3125	144	98.5
2004	2.9779	0.0387	21.410	4.178	2533	118	79.5
2005	3.0169	0.0276	22.385	3.701	5499	246	67.2
2006	2.9932	0.0357	21.772	4.085	3580	164	74.0
2007	3.0881	0.0612	23.636	5.770	1053	45	76.7
2008	3.5313	0.1371	35.437	12.712	203	6	100.0
2009	2.9938	0.0929	21.169	6.319	254	12	98.8
2010	2.3345	0.2395	10.172	4.703	260	26	16.2

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.291

Table 8. Commercial sampling of redfish catches from CAN (N) in 2007-2012.

Year	Observer samples					Port samples			
	Month	Samples	n	depth min	depth max	Samples	n	depth min	depth max
2007	APR	2	489	411	457	-	-	-	-
	MAY	5	1325	278	508	2	602	365	457
2008	APR	-	-	-	-	2	622	487	487
	MAY	2	488	361	450	-	-	-	-
2009	NOV	6	572	357	505	-	-	-	-
2010	OCT	5	1190	362	477	-	-	-	-
2011	-	-	-	-	-	-	-	-	-
2012	-	-	-	-	-	-	-	-	-

Table 9. Mean number per standard tow from Canadian SPRING surveys in Div. 3O covering strata from 93 to 731 m (400ftm.). 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=Gadus Atlantica, W=Wilfred Templeman, A=Alfred Needler.

Stratum	Depth Range (M)	Area sq mi	Area within NRA 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
329	093-183	1721	0	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)
332	093-183	1047	0	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)
337	093-183	948	0	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)
339	093-183	585	0	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)
354	093-183	474	246	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)
333	185-274	151(147)	0	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)
336	185-274	121	0	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)
355	185-274	103	74	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)
334	275-366	92(96)	0	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)
335	275-366	58	0	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)
356	275-366	61	47	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)
717	367-549	93(166)	0	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)
719	367-549	76	0	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)
721	367-549	76	58	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)
718	550-731	111(134)	0	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)
720	550-731	105	0	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)
722	550-731	93	71	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)
	Total:	6011	496	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
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
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
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
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
% within NRA					4.7	28.6	31.9	4.8	4.8	51.4	6.0	9.7	20.0	45.2	11.1

Table 9 continued.

Stratum	Depth Range (M)	Area sq mi	Area within NRA sq mi	% Area within NRA	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	May 2007-Q2 W759-761	May 2008-Q2 W827	May 2009-Q2 A904-05	May 2010-Q2 A932-33	May 2011-Q2 A403-04	May 2012-Q2 A417-19
329	093-183	1721	0	0.00	0.0 (5)	80.0 (5)	0.0 (5)	0.2 (5)	---	25.0 (5)	399.8 (5)	0.0 (5)	3.2 (5)	1271.1 (5)	3.4 (5)
332	093-183	1047	0	0.00	23.7 (3)	79.7 (3)	94.8 (3)	69.3 (3)	---	83.7 (3)	0.7 (3)	8.5 (3)	78.8 (3)	798.2 (3)	3020.2 (3)
337	093-183	948	0	0.00	2.7 (3)	429.7 (3)	1048.8 (3)	18.5 (3)	---	2886.0 (3)	29.0 (3)	13.0 (3)	3314.6 (3)	78.8 (3)	1037.0 (3)
339	093-183	585	0	0.00	0.5 (2)	0.0 (2)	0.0 (2)	0.5 (2)	0.4 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.5 (2)
354	093-183	474	246	0.52	0.0 (2)	3.0 (2)	1.0 (2)	433.3 (2)	---	27.5 (2)	0.0 (2)	0.0 (2)	3465.0 (2)	3050.8 (2)	3745.5 (2)
333	185-274	151(147)	0	0.00	941.5 (2)	534.3 (2)	2759.2 (2)	5329.0 (2)	---	1683.1 (2)	4605.1 (2)	614.0 (2)	8921.3 (2)	8974.2 (2)	4727.6 (2)
336	185-274	121	0	0.00	1048.0 (2)	1456.5 (2)	12646.5 (2)	4701.9 (2)	---	694.2 (2)	8781.5 (2)	726.9 (2)	10791.5 (2)	7300.4 (2)	20363.5 (2)
355	185-274	103	74	0.72	515.2 (2)	1191.0 (2)	1321.6 (2)	643.6 (2)	---	540.0 (2)	3929.5 (2)	9261.3 (2)	2168.0 (2)	7279.1 (2)	4179.7 (2)
334	275-366	92(96)	0	0.00	916.5 (2)	3154.1 (2)	1387.1 (2)	2364.5 (2)	---	617.4 (2)	9238.5 (2)	16761.3 (2)	1790.8 (2)	4545.8 (2)	5887.9 (2)
335	275-366	58	0	0.00	4291.9 (2)	1155.1 (2)	1037.1 (2)	2563.6 (2)	---	3760.2 (2)	2560.9 (2)	13134.5 (2)	10498.7 (2)	28306.9 (2)	7583.5 (2)
356	275-366	61	47	0.77	2020.9 (2)	521.3 (2)	658.0 (2)	3515.6 (2)	---	924.8 (2)	1489.8 (2)	3027.2 (2)	1580.3 (2)	5820.2 (2)	10444.5 (2)
717	367-549	93(166)	0	0.00	242.0 (2)	584.0 (2)	1349.7 (2)	1211.4 (2)	---	2633.9 (2)	2404.6 (2)	2612.7 (2)	1325.7 (2)	4881.9 (2)	3101.3 (2)
719	367-549	76	0	0.00	208.8 (2)	602.5 (2)	326.5 (2)	1346.0 (2)	---	2653.8 (2)	1508.8 (2)	3134.0 (2)	4963.6 (2)	375.2 (2)	8938.9 (2)
721	367-549	76	58	0.76	94.7 (2)	304.4 (2)	116.5 (2)	566.2 (2)	---	470.0 (2)	253.6 (2)	1688.0 (2)	1122.4 (2)	501.0 (2)	2148.0 (2)
718	550-731	111(134)	0	0.00	79.0 (2)	0.0 (2)	30.2 (2)	55.1 (2)	---	20.5 (2)	18.0 (2)	58.7 (2)	0.0 (2)	39.9 (2)	70.7 (2)
720	550-731	105	0	0.00	93.1 (2)	31.5 (2)	42.0 (2)	23.1 (2)	---	112.4 (2)	32.6 (2)	270.5 (2)	191.3 (2)	---	239.0 (2)
722	550-731	93	71	0.76	86.7 (2)	71.9 (2)	69.5 (2)	60.9 (2)	---	21.8 (2)	2.0 (2)	52.0 (2)	3.7 -3	15.2 (2)	202.4 (2)
	Total:	6011	496	8.25											
Upper (95% CI)					234.6	490.9	1861.6	1909.1		2655.9	1302.7	1033.3	3985.2	3157.5	4094.6
Weighted mean (by area)					149.3	263.6	610.9	443.6		714.0	752.9	757.0	1546.1	1830.9	2091.0
Lower (95% CI)					64.1	36.3	-639.8	-1021.9		-1228.0	203.2	480.7	-893.0	504.4	87.5
SURVEY ABUNDANCE($x10^6$)					123.5	218.0	505.1	366.8		590.4	622.6	625.9	12784.4	1487.5	1729.0
ABUNDANCE within NRA					19.9	18.7	19.4	49.1		16.4	51.7	127.8	158.5	219.1	256.0
% within NRA					16.1	8.6	3.8	13.4		2.8	8.3	20.4	1.2	14.7	14.8

Table 10. Mean weight (kg) per standard tow from Canadian SPRING surveys in Div. 3O covering strata from 93 to 731 m (400ftm.). 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=Gadus Atlantica, W=Wilfred Templeman, A=Alfred Needler.

Stratum	Depth Range (M)	Area sq mi	Area within NRA 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
329	093-183	1721	0	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)
332	093-183	1047	0	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)
337	093-183	948	0	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)
339	093-183	585	0	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)
354	093-183	474	246	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)
333	185-274	151(147)	0	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)
336	185-274	121	0	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)
355	185-274	103	74	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)
334	275-366	92(96)	0	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)
335	275-366	58	0	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)
356	275-366	61	47	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)
717	367-549	93(166)	0	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)
719	367-549	76	0	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)
721	367-549	76	58	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)
718	550-731	111(134)	0	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)
720	550-731	105	0	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)
722	550-731	93	71	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)
	Total:	6011	496	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
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
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
SURVEY BIOMASS(tons)					15278	15961	83874	172264	234648	102695	15699	159313	122550	83508	26183
BIOMASS within NRA					1553	2347	23733	8478	14641	54177	410	18024	19914	36624	3048
% within NRA					10.2	14.7	28.3	4.9	6.2	52.8	2.6	11.3	16.2	43.9	11.6

Table 10 continued.

Stratum	Depth Range (M)	Area sq mi	Area within NRA sq mi	% Area within NRA	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	May 2007-Q2 W759-761	May 2008-Q2 W827	May 2009-Q2 A904-05	May 2010-Q2 A932-33	May 2011-Q2 A403-04	May 2012-Q2 A417-19
329	093-183	1721	0	0.00	0.0 (5)	3.0 (5)	0.0 (5)	0.0 (5)	---	0.1 (5)	15.3 (5)	0.0 (5)	0.1 (5)	109.0 (5)	0.1 (5)
332	093-183	1047	0	0.00	3.1 (3)	10.3 (3)	5.5 (3)	3.6 (3)	---	0.7 (3)	0.0 (3)	0.1 (3)	7.9 (3)	193.5 (3)	456.6 (3)
337	093-183	948	0	0.00	0.0 (3)	58.3 (3)	152.1 (3)	2.4 (3)	---	405.0 (3)	0.3 (3)	0.2 (3)	332.3 (3)	9.1 (3)	121.6 (3)
339	093-183	585	0	0.00	0.0 (2)	0.0 (2)	0.0 (2)	0.2 (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	246	0.52	0.0 (2)	0.7 (2)	0.2 (2)	43.2 (2)	---	7.5 (2)	0.0 (2)	0.0 (2)	341.6 (2)	446.1 (2)	463.3 (2)
333	185-274	151(147)	0	0.00	154.9 (2)	71.3 (2)	426.0 (2)	705.6 (2)	---	276.7 (2)	301.8 (2)	47.3 (2)	1025.7 (2)	1055.4 (2)	568.3 (2)
336	185-274	121	0	0.00	133.7 (2)	202.3 (2)	2033.3 (2)	698.5 (2)	---	82.1 (2)	739.2 (2)	63.0 (2)	1012.6 (2)	901.0 (2)	2527.7 (2)
355	185-274	103	74	0.72	78.3 (2)	154.9 (2)	232.5 (2)	80.3 (2)	---	41.0 (2)	496.2 (2)	849.2 (2)	217.4 (2)	883.4 (2)	429.3 (2)
334	275-366	92(96)	0	0.00	142.3 (2)	447.8 (2)	284.9 (2)	418.2 (2)	---	102.5 (2)	957.5 (2)	2325.4 (2)	200.6 (2)	659.9 (2)	795.1 (2)
335	275-366	58	0	0.00	740.4 (2)	164.1 (2)	192.7 (2)	496.1 (2)	---	605.2 (2)	381.6 (2)	1351.7 (2)	1144.9 (2)	3452.4 (2)	1014.5 (2)
356	275-366	61	47	0.77	302.7 (2)	66.3 (2)	133.5 (2)	713.4 (2)	---	127.9 (2)	255.6 (2)	360.0 (2)	241.6 (2)	837.3 (2)	1330.5 (2)
717	367-549	93(166)	0	0.00	45.3 (2)	135.8 (2)	452.0 (2)	352.7 (2)	---	658.3 (2)	720.5 (2)	746.4 (2)	235.5 (2)	1007.3 (2)	528.4 (2)
719	367-549	76	0	0.00	52.4 (2)	113.0 (2)	99.1 (2)	312.1 (2)	---	618.7 (2)	396.5 (2)	634.3 (2)	875.5 (2)	115.7 (2)	1342.0 (2)
721	367-549	76	58	0.76	17.2 (2)	43.0 (2)	30.0 (2)	154.0 (2)	---	147.0 (2)	64.0 (2)	289.9 (2)	330.9 (2)	90.4 (2)	298.7 (2)
718	550-731	111(134)	0	0.00	18.1 (2)	0.0 (2)	9.3 (2)	33.3 (2)	---	7.1 (2)	7.9 (2)	34.9 (2)	0.0 (2)	9.3 (2)	18.8 (2)
720	550-731	105	0	0.00	30.9 (2)	5.8 (2)	15.0 (2)	6.9 (2)	---	47.5 (2)	11.0 (2)	84.5 (2)	48.3 (2)	---	64.5 (2)
722	550-731	93	71	0.76	26.6 (2)	16.3 (2)	23.2 (2)	25.4 (2)	---	8.7 (2)	1.2 (2)	15.5 (2)	2.2 (2)	4.1 (2)	43.2 (2)
	Total:	6011	496	8.25											
Upper (95% CI)					37.4	75.9	298.4	282.2		387.4	126.4	179.9	419.7	418.8	568.7
Weighted mean (by area)					24.3	35.8	103.0	72.7		111.5	82.9	105.7	169.3	248.0	280.9
Lower (95% CI)					11.3	-4.2	-92.4	-136.7		-164.4	39.3	31.4	-81.2	77.1	-6.8
SURVEY BIOMASS(tons)					20126	29642	85170	60138		92202	68519	87362	139960	201458	232298
BIOMASS within NRA					3151	2529	3702	8369		2754	7226	13437	17997	30263	31456
% within NRA					15.7	8.5	4.3	13.9		3.0	10.5	15.4	12.9	15.0	13.5

Table 11. Mean number per standard tow from Canadian AUTUMN surveys in Div. 3O covering strata from 93 to 731 m (400ftm.). 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=Gadus Atlantica, W=Wilfred Templeman, A=Alfred Needler.

Stratum	Depth Range (M)	Area sq mi	Area within NRA 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
329	093-183	1721	0	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)
332	093-183	1047	0	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)
337	093-183	948	0	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)
339	093-183	585	0	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)
354	093-183	474	246	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)
333	185-274	151(147)	0	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)
336	185-274	121	0	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)
355	185-274	103	74	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)
334	275-366	92(96)	0	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)
335	275-366	58	0	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)
356	275-366	61	47	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)
717	367-549	93(166)	0	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)
719	367-549	76	0	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)
721	367-549	76	58	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)
718	550-731	111(134)	0	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)
720	550-731	105	0	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)
722	550-731	93	71	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)
764	732-914	105	105	1.00	---	---	---	---	---	---	---	5.0 (2)	---	4.5 (2)	0.0 (2)
768	732-914	99	0	0.00	---	---	---	---	---	---	---	0.5 (2)	---	0.0 (2)	0.0 (2)
772	732-914	135	0	0.00	---	---	---	---	---	---	---	0.0 (2)	---	6.3 (2)	---
	Total:	6350	601	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
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
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
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
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
% within NRA					32.2	26.3	8.3	13.1	39.6	20.8	23.9	15.8	28.7	17.3	14.8

Table 11 continued.

Stratum	Depth Range (M)	Area sq mi	Area within NRA sq mi	% Area within NRA	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	Oct 2007-Q4 W770-771 T750	Oct 2008-Q4 W835-836	Oct 2009-Q4 A913-15 TI894-95	Sep-Oct 2010-Q4 A942-43	Sep-Oct 2011-Q4 A409-10	Sep-Oct 2012-Q4 A424
329	093-183	1721	0	0.00	405.8 (5)	0.4 (5)	0.0 (5)	14.2 (5)	74.2 (5)	0.0 (5)	3.0 (3)	91.8 (5)	0.0 (5)	86.2 (5)	634.8 (5)
332	093-183	1047	0	0.00	12.8 (3)	37.4 (3)	29.7 (3)	41.2 (3)	0.3 (3)	27.3 (3)	0.7 (3)	261.9 (3)	107.9 (3)	84.9 (3)	36.7 (3)
337	093-183	948	0	0.00	61.9 (3)	55.3 (3)	54.9 (3)	90.3 (3)	38.3 (3)	402.0 (3)	0.0 (2)	383.5 (3)	1564.2 (3)	56.0 (3)	125.6 (3)
339	093-183	585	0	0.00	0.5 (2)	0.0 (2)	0.6 (2)	3.0 (2)	0.0 (2)	1.5 (2)	0.0 (2)	0.0 (2)	0.5 (2)	0.0 (2)	0.0 (2)
354	093-183	474	246	0.52	150.9 (2)	0.0 (2)	171.6 (2)	69.5 (2)	6.0 (2)	1124.9 (2)	363.6 (2)	1172.9 (2)	263.6 (2)	776.0 (2)	42.5 (2)
333	185-274	151(147)	0	0.00	31.6 (2)	96.5 (2)	77.5 (2)	674.0 (2)	103.8 (2)	159.6 (2)	963.1 (2)	389.3 (2)	1362.7 (2)	148.9 (2)	796.2 (2)
336	185-274	121	0	0.00	87.5 (2)	85.5 (2)	273.5 (2)	255.0 (2)	744.0 (2)	722.2 (2)	7145.3 (2)	---	149.3 (2)	342.5 (2)	630.9 (2)
355	185-274	103	74	0.72	614.5 (2)	61.5 (2)	527.0 (2)	643.4 (2)	963.8 (2)	2225.3 (2)	11598.4 (2)	1738.7 (2)	1148.0 (2)	970.0 (2)	2039.1 (2)
334	275-366	92(96)	0	0.00	106.2 (2)	872.5 (2)	256.3 (2)	816.5 (2)	569.8 (2)	1474.5 (2)	754.2 (2)	9905.8 (2)	1576.9 (2)	1971.6 (2)	3259.8 (2)
335	275-366	58	0	0.00	781.7 (2)	1051.0 (2)	2291.6 (2)	626.7 (2)	898.0 (2)	7626.0 (2)	8416.0 (2)	4935.4 (2)	2917.0 (2)	6197.7 (2)	6804.8 (2)
356	275-366	61	47	0.77	692.0 (2)	828.0 (2)	603.4 (2)	2484.4 (2)	5727.5 (2)	1123.1 (2)	8649.7 (2)	3298.4 (2)	65720.0 (2)	497.4 (2)	732.0 (2)
717	367-549	93(166)	0	0.00	488.9 (2)	675.7 (2)	2530.3 (2)	1382.2 (2)	1756.3 (2)	2576.0 (2)	2205.3 (2)	8353.8 (2)	8394.6 (2)	20038.4 (2)	8641.1 (2)
719	367-549	76	0	0.00	6420.9 (2)	1265.0 (2)	1844.2 (2)	3854.5 (2)	14161.4 (2)	7449.1 (2)	5984.2 (2)	15486.3 (2)	11698.5 (2)	12566.3 (2)	55983.3 (2)
721	367-549	76	58	0.76	4210.8 (2)	3567.9 (2)	927.6 (2)	648.0 (2)	410.2 (2)	2007.9 (2)	1472.6 (2)	8545.8 (2)	4935.2 (2)	4239.3 (2)	2881.4 (2)
718	550-731	111(134)	0	0.00	545.3 (2)	16.0 (2)	120.5 (2)	45.2 (2)	---	928.7 (2)	64.7 (2)	725.3 (2)	207.1 (2)	25.0 (2)	751.9 (2)
720	550-731	105	0	0.00	12.7 (2)	236.4 (2)	478.9 (2)	4489.7 (2)	1761.3 (2)	786.6 (2)	1005.3 (2)	424.5 (2)	669.2 (2)	2606.9 (2)	1048.0 (2)
722	550-731	93	71	0.76	336.4 (2)	112.4 (2)	106.9 (2)	35.1 (2)	9.0 (2)	35.6 (2)	7.5 (2)	9.6 (2)	9.5 (2)	391.5 (2)	443.5 (2)
764	732-914	105	105	1.00	0.5 (2)	---	---	0.0 (2)	---	0.0 (2)	---	73.7 (2)	---	---	---
768	732-914	99	0	0.00	0.0 (2)	---	---	0.0 (2)	---	0.0 (2)	---	2.5 (2)	---	---	---
772	732-914	135	0	0.00	0.6 (2)	1.3 (2)	---	0.0 (2)	---	0.0 (2)	---	0.0 (2)	---	---	---
	Total:	6350	601	9.46											
Upper (95% CI)					618.7	457.2	915.3	394.0	2367.8	894.6	2855.5	1524.0	9812.3	7379.0	9783.7
Weighted mean (by area)					317.1	135.9	193.8	268.1	410.5	518.6	751.1	1083.6	1521.2	1051.0	1428.4
Lower (95% CI)					15.5	-185.4	-527.7	142.3	-1546.7	142.6	-1353.3	643.2	-6770.0	-5277.0	-6926.9
SURVEY ABUNDANCE($x10^6$)					277.0	114.9	160.2	234.2	331.9	453.0	621.1	878.0	1257.0	869.1	1181.1
ABUNDANCE within NRA					52.7	35.5	23.5	30.5	50.4	84.4	198.1	147.0	485.0	77.0	54.3
% within NRA					19.0	30.9	14.7	13.0	15.2	18.6	31.9	16.7	38.6	8.9	4.6

Table 12. Mean weight (kg) per standard tow from Canadian AUTUMN surveys in Div. 3O covering strata from 93 to 731 m (400ftm.). 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=Gadus Atlantica, W=Wilfred Templeman, A=Alfred Needler.

Stratum	Depth Range (M)	Area sq mi	Area within NRA 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
329	093-183	1721	0	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)
332	093-183	1047	0	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)
337	093-183	948	0	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)
339	093-183	585	0	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)
354	093-183	474	246	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)
333	185-274	151(147)	0	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)
336	185-274	121	0	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)
355	185-274	103	74	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)
334	275-366	92(96)	0	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)
335	275-366	58	0	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)
356	275-366	61	47	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)
717	367-549	93(166)	0	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)
719	367-549	76	0	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)
721	367-549	76	58	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)
718	550-731	111(134)	0	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)
720	550-731	105	0	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)
722	550-731	93	71	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)
764	732-914	105	105	1.00	---	---	---	---	---	---	---	1.6	---	2.6 (2)	0.0 (2)
768	732-914	99	0	0.00	---	---	---	---	---	---	---	0.3	---	0.0 (2)	0.0 (2)
772	732-914	135	0	0.00	---	---	---	---	---	---	---	0.0	---	2.2 (2)	---
	Total:	6350	601	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
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
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
SURVEY BIOMASS(tons)					34618	56247	51782	53324	125578	22974	154622	75676	42100	60004	37286
BIOMASS within NRA					4473	14818	3584	5008	46022	3565	37798	11459	11585	8700	8567
% within NRA					12.9	26.3	6.9	9.4	36.6	15.5	24.4	15.1	27.5	14.5	23.0

Table 12 continued.

Stratum	Depth Range (M)	Area sq mi	Area within NRA sq mi	% Area within NRA	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	Oct 2007-Q4 W770-771 T750	Oct 2008-Q4 W835-836	Oct 2009-Q4 A913-15 TI894-95	Sep-Oct 2010-Q4 A942-43	Sep-Oct 2011-Q4 A409-10	Sep-Oct 2012-Q4 A424
329	093-183	1721	0	0.00	32.2 (5)	0.0 (5)	0.0 (5)	0.2 (5)	4.5 (5)	0.0 (5)	0.0 (3)	3.3 (5)	0.0 (5)	4.0 (5)	61.1 (5)
332	093-183	1047	0	0.00	1.7 (3)	2.9 (3)	0.1 (3)	0.7 (3)	0.0 (3)	0.8 (3)	0.0 (3)	32.2 (3)	7.1 (3)	3.7 (3)	1.5 (3)
337	093-183	948	0	0.00	3.9 (3)	3.8 (3)	0.3 (3)	1.7 (3)	1.1 (3)	49.9 (3)	0.0 (2)	16.2 (3)	140.7 (3)	6.3 (3)	10.1 (3)
339	093-183	585	0	0.00	0.1 (2)	0.0 (2)	0.0 (2)	0.1 (2)	0.0 (2)	0.1 (2)	0.0 (2)	0.0 (2)	0.1 (2)	0.0 (2)	0.0 (2)
354	093-183	474	246	0.52	10.9 (2)	0.0 (2)	7.2 (2)	3.6 (2)	0.6 (2)	131.2 (2)	26.9 (2)	102.3 (2)	18.2 (2)	108.2 (2)	2.8 (2)
333	185-274	151(147)	0	0.00	3.9 (2)	11.3 (2)	3.0 (2)	53.4 (2)	8.0 (2)	12.5 (2)	81.7 (2)	37.0 (2)	150.2 (2)	15.9 (2)	128.2 (2)
336	185-274	121	0	0.00	9.0 (2)	10.0 (2)	31.9 (2)	25.0 (2)	51.0 (2)	47.3 (2)	613.8 (2)	---	15.7 (2)	37.9 (2)	76.9 (2)
355	185-274	103	74	0.72	64.2 (2)	6.3 (2)	67.2 (2)	59.3 (2)	117.1 (2)	161.8 (2)	853.7 (2)	146.1 (2)	119.5 (2)	116.0 (2)	231.6 (2)
334	275-366	92(96)	0	0.00	13.7 (2)	146.6 (2)	54.9 (2)	162.7 (2)	105.4 (2)	256.1 (2)	122.2 (2)	1044.9 (2)	156.2 (2)	244.6 (2)	424.3 (2)
335	275-366	58	0	0.00	82.5 (2)	136.1 (2)	334.0 (2)	92.2 (2)	126.4 (2)	669.5 (2)	1250.5 (2)	549.1 (2)	311.6 (2)	700.7 (2)	816.7 (2)
356	275-366	61	47	0.77	96.4 (2)	91.3 (2)	82.3 (2)	437.8 (2)	1176.1 (2)	157.0 (2)	1903.0 (2)	328.0 (2)	7178.6 (2)	58.6 (2)	98.3 (2)
717	367-549	93(166)	0	0.00	75.9 (2)	115.4 (2)	540.9 (2)	253.7 (2)	355.2 (2)	497.1 (2)	235.5 (2)	1424.6 (2)	1230.5 (2)	3007.8 (2)	1205.6 (2)
719	367-549	76	0	0.00	889.9 (2)	194.9 (2)	385.7 (2)	627.9 (2)	2137.5 (2)	1297.0 (2)	1034.3 (2)	1679.4 (2)	1689.1 (2)	1592.6 (2)	7348.1 (2)
721	367-549	76	58	0.76	762.0 (2)	718.8 (2)	184.1 (2)	119.8 (2)	73.8 (2)	381.7 (2)	339.8 (2)	892.8 (2)	924.5 (2)	593.1 (2)	384.3 (2)
718	550-731	111(134)	0	0.00	118.0 (2)	3.9 (2)	34.8 (2)	12.0 (2)	---	320.0 (2)	24.3 (2)	277.0 (2)	75.8 (2)	9.2 (2)	212.3 (2)
720	550-731	105	0	0.00	2.9 (2)	49.3 (2)	134.1 (2)	1013.5 (2)	403.9 (2)	217.1 (2)	279.2 (2)	103.4 (2)	180.5 (2)	710.2 (2)	290.3 (2)
722	550-731	93	71	0.76	68.1 (2)	33.8 (2)	46.7 (2)	11.2 (2)	3.5 (2)	13.8 (2)	3.5 (2)	2.9 (2)	3.4 (2)	103.3 (2)	116.7 (2)
764	732-914	105	105	1.00	0.4 (2)	---	---	0.0 (2)	(2)	0.0 (2)	---	---	---	---	---
768	732-914	99	0	0.00	0.0 (2)	---	---	0.0 (2)	(2)	0.0 (2)	---	---	---	---	---
772	732-914	135	0	0.00	0.1 (2)	0.2 (2)	---	0.0 (2)	(2)	0.0 (2)	---	---	---	---	---
	Total:	6350	601	9.46											
Upper (95% CI)					68.1	86.6	179.4	65.5	356.1	133.9	144.0	220.5	1069.1	1093.0	1275.9
Weighted mean (by area)					38.9	22.0	33.4	43.6	65.9	76.3	93.8	128.4	181.2	150.6	186.8
Lower (95% CI)					9.7	-42.6	-112.6	21.8	-224.3	18.8	43.6	36.3	-706.7	-791.8	-902.9
SURVEY BIOMASS(tons)					33976	18604	27631	38125	53291	66682	77562	104013	149819	124539	154234
BIOMASS within NRA					8396	6720	3385	4619	9439	10285	24651	14222	55658	10964	7294
% within NRA					24.7	36.1	12.3	12.1	17.7	15.4	31.8	13.7	37.2	8.8	4.7

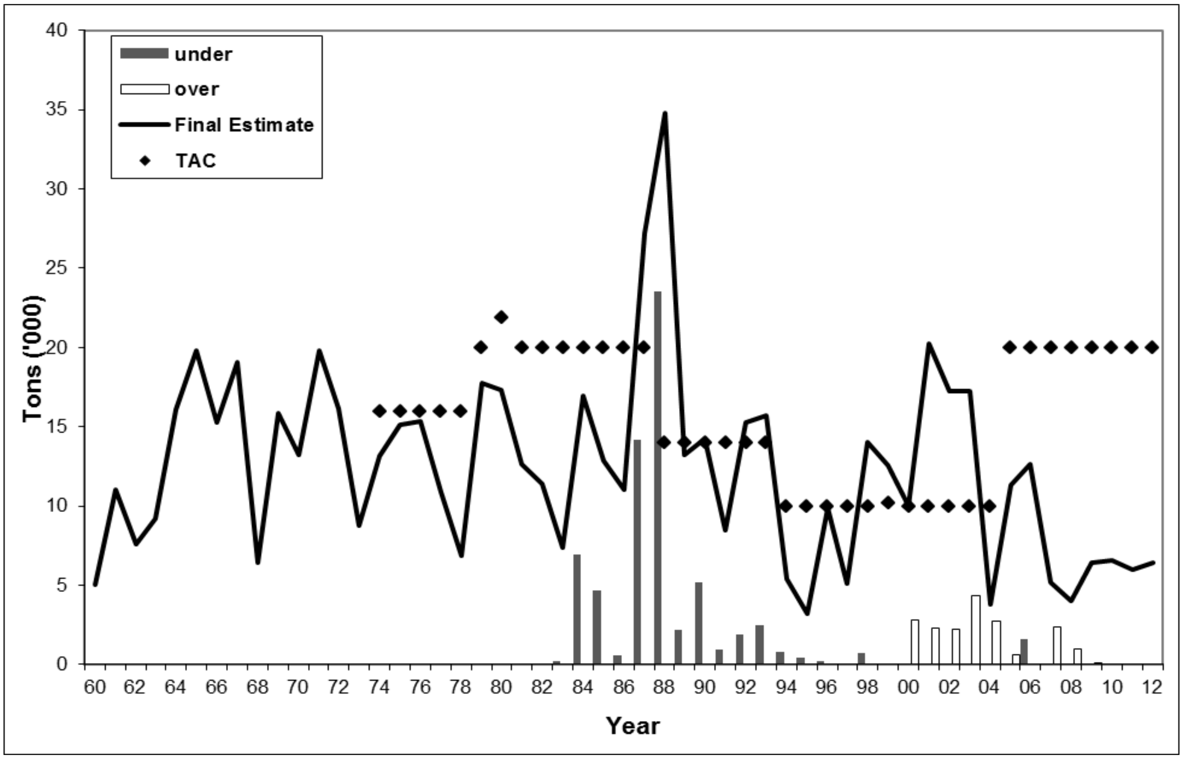

Fig. 1: Nominal catches and TACs of redfish in Div. 3O. TAC to 2004 was only for Canadian fishery zone. Over and under-reported catches represent the difference between reported and final estimates of catch.

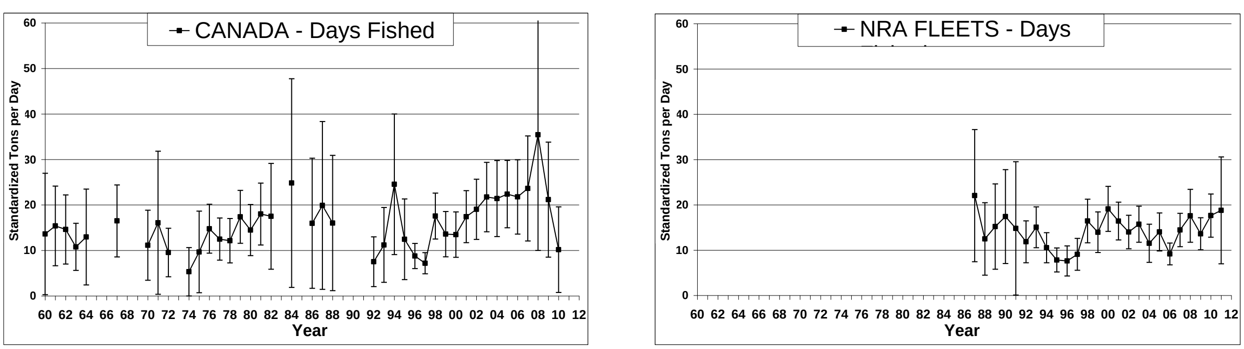

Fig. 2. Standardized Mean CPUE ± 2 standard errors for Redfish in Div. 3O from 1960-2011 utilizing effort in DAYS fished.

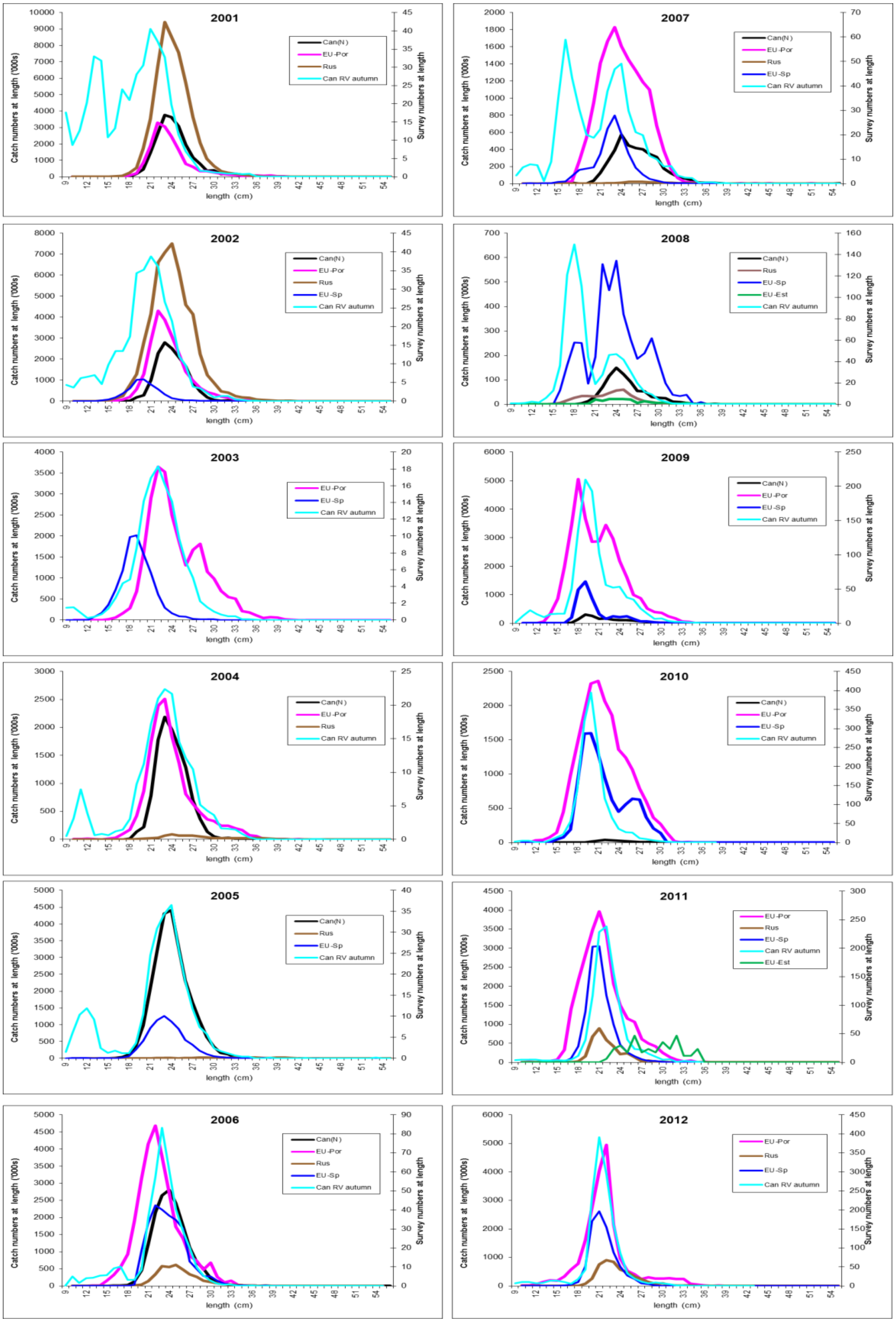

Fig. 3. Catch numbers at length ('000s) and Canadian RV survey numbers at length.

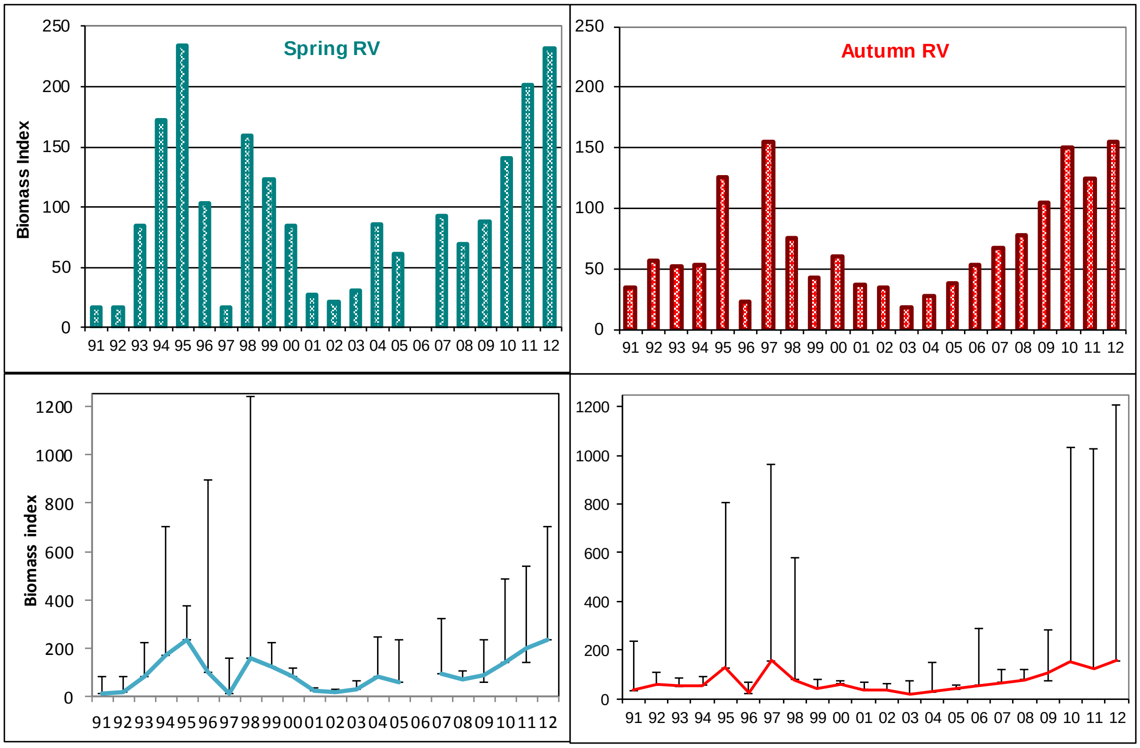

Fig. 4. Survey biomass index for redfish in Div. 3O for spring and autumn surveys from 1991-2012 (upper panel) with 95% CI (lower panels). Surveys prior to autumn 1995 utilized an Engel trawl. Estimates were converted into Campelen equivalents based on comparative fishing trials.

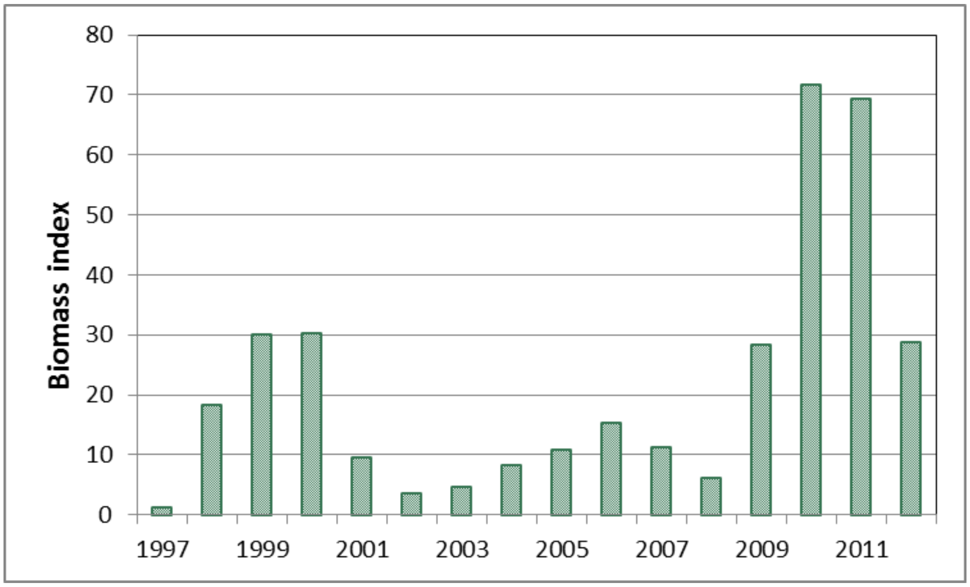

Fig. 5. EU-Spain survey biomass index for redfish in Div. 3O for spring 1997 to 2012. Surveys prior to 2001 used a Pedreira trawl. The data prior to 2001 were converted to Campelen equivalent units.

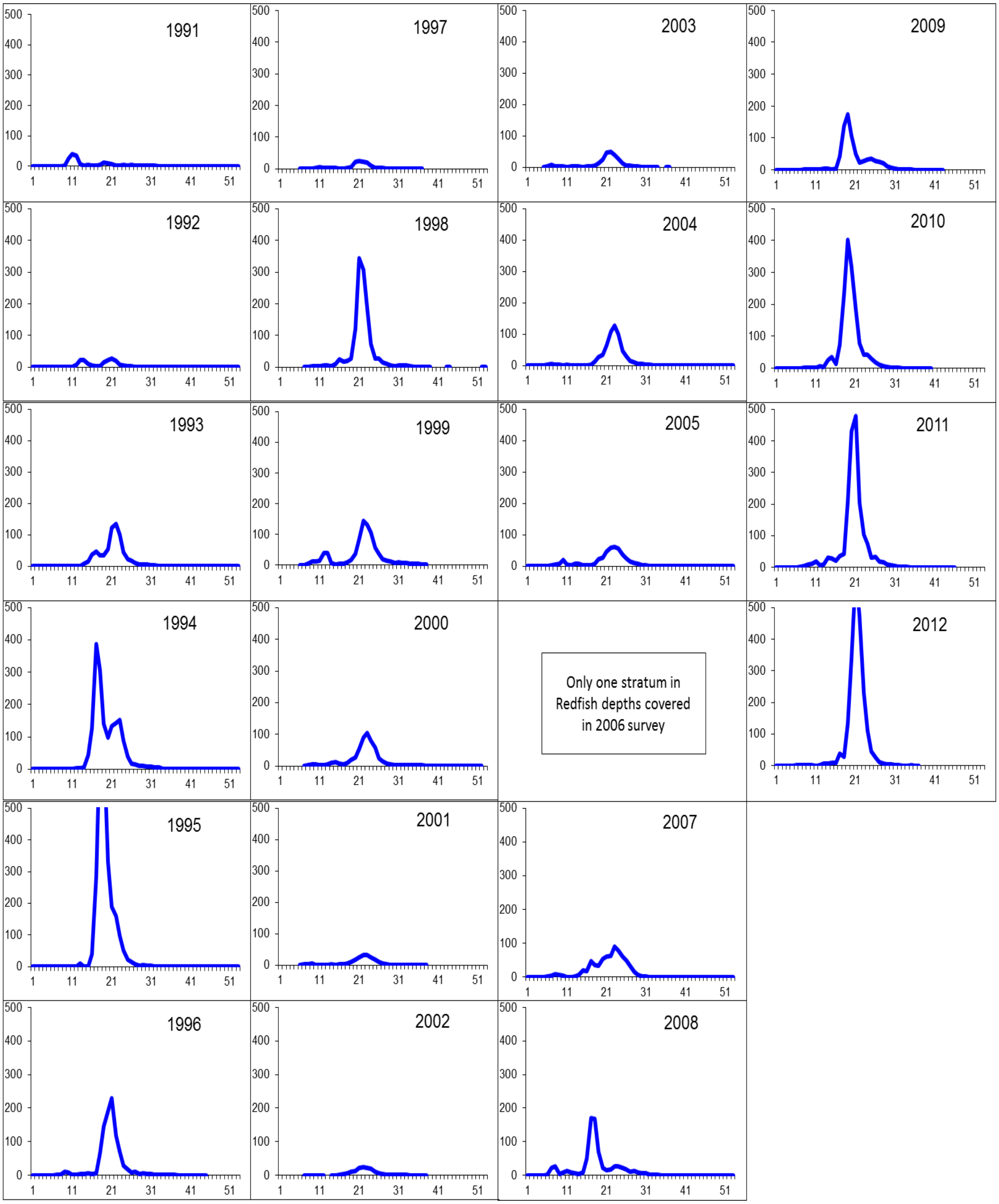

Fig. 6. Length distributions from Canadian RV surveys in Div. 3O during SPRING from 1991-2012. Plotted are mean per standard tow. The 1991-1994 data are conversions into Campelen equivalents based on comparative fishing experiments.

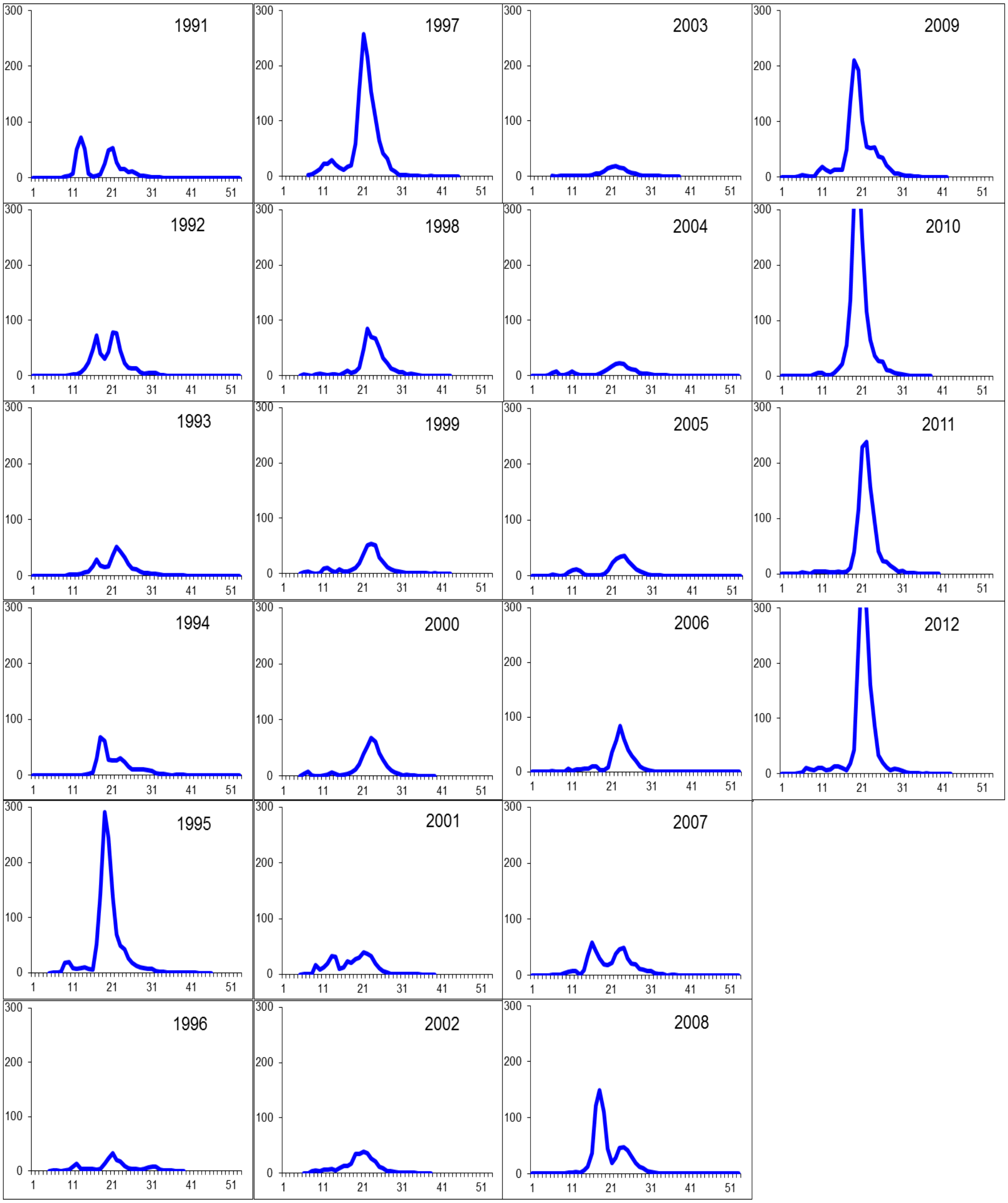

Fig. 7. Length distributions from Canadian RV surveys in Div. 3O during AUTUMN from 1991-2012. Plotted are mean per standard tow. The 1991-1994 data are conversions into Campelen equivalents based on comparative fishing experiments.

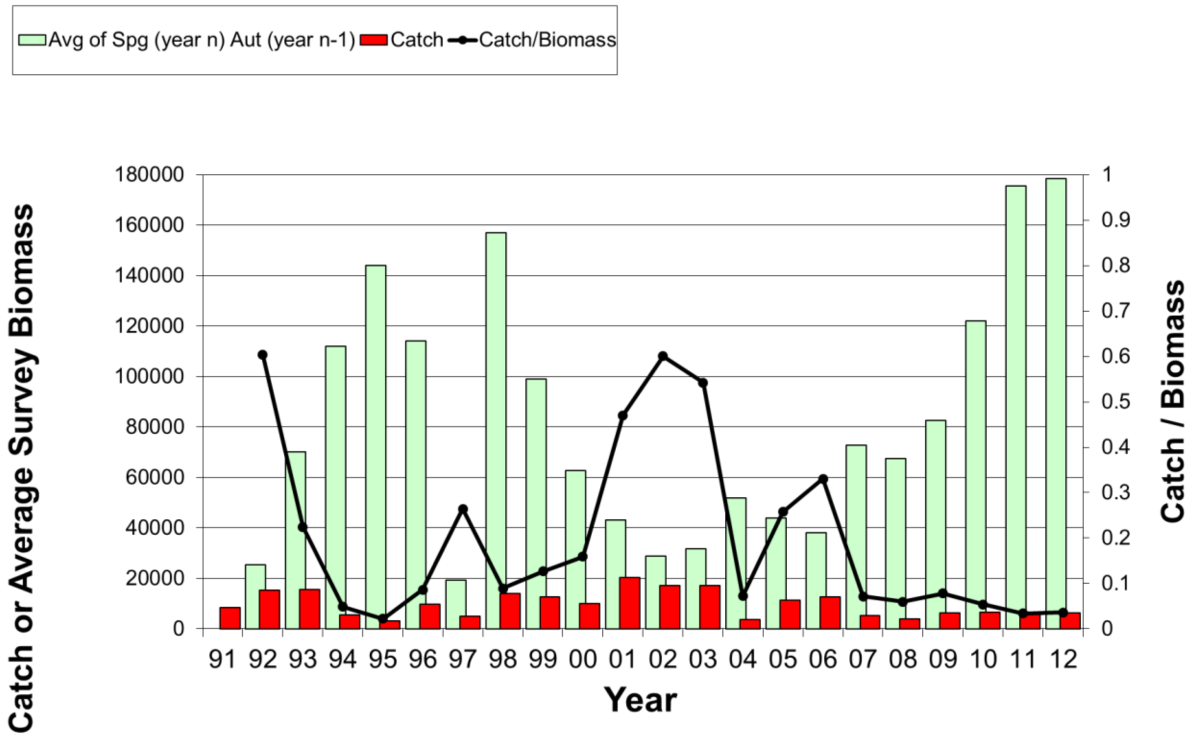

Fig. 8. Catch/Biomass ratios for Div. 3O based on Canadian RV surveys. Plotted are average survey biomass between spring (n) and autumn (n-1) for year (n) in which catch was taken. The 2006 value of biomass comes only from the autumn survey.

Legend to rank ASPIC formulations

N restarts	red	N>=20
	yellow	10<=N<20
	green	N<10
correlation among input series	red	R<0 or no overlap
	red	0<=R<=0.4
	yellow	0.4<R<0.6
	green	R>=0.6
R squared in CPUE	black	R<0
	red	0<=R<0.4
	yellow	0.4<=R<0.6
	green	R>=0.6
contrast index	red	C<0.6
	yellow	0.6<=C<0.7
	green	C>=0.7
nearness index	black	N#1.0000
	green	N=1.0000

Diagnostics and ranking of ASPIC formulations for Div. 3O Redfish (ASPIC Ver. 5.34)

	Series	1	2	3	4	5	6	# Index Values	Restarts	R^2	contrast	nearness	Total obj. function
ASPIC 1													
All Indices	1	**1**						**22**	**237**	**0.382**	**0.346**	**0.9681**	**49.065**
	2	**0.528**	**1**					**21**		**0.094**			
	3*	**1**	**1**	**1**				**10**		**-0.163**			
	4	**0.564**	**0.672**	**0**	**1**			**17**		**0.132**			
	5	**0.039**	**-0.066**	**-0.314**	**0.529**	**1**		**25**		**-0.471**			
	6	**-0.281**	**-0.013**	**-0.707**	**-0.319**	**0.281**	**1**	**41**		**-0.012**			
		1	2	3									
ASPIC 2	1	**1**							**11**	**0.134**	**1.8559**	**1.000**	**28.107**
	2	**0.528**	**1**							**-0.033**			
Surveys Only No Spn	**3***	**1**	**1**	**1**						**-0.152**			
		1	2										
ASPIC 3	1	**1**							**7**	**0.145**	**0.93**	**1**	**19.4381**
Can Surveys Only	2	**0.528**	**1**							**0.020**			

Error codes:	**ASPIC1:**	**Estimate of q is at program-set bound (for Russian Spg estimate was 1.2)**
	ASPIC2:	**Estimate of q is at program-set bound (for Russian Spg estimate was 1.2)**
	ASPIC3:	**Estimate of K is at or near minimum bound, 5.000E+04**
Mitigation 1:	**ASPIC1 with MonteCarlo:**	**Same error**
	ASPIC2 with MonteCarlo:	**Same error, contrast index now 0.9421**
	ASPIC3 with MonteCarlo:	**Same error**
Mitigation 2:	**ASPIC1 with MonteCarlo + reseed:**	**Same error**
	ASPIC2 with MonteCarlo + reseed:	**Same error, contrast index now 4.802**
	ASPIC3 with MonteCarlo + reseed:	**Same error, contrast index now 0.6924**

Fig. 9. Exploratory analyses of a non-equilibrium stock production model (ASPIC).