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An Assessment of the Cod Stock in NAFO Divisions 3NO

by

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Abstract

Cod in Divisions 3NO inhabit the southern Grand Bank of Newfoundland. The stock declined dramatically during the mid-1980's and has been under a fishing moratorium since 1994. Estimates from a population model utilizing the ADAPTive framework (Gavaris 1988) indicate that the spawner biomass has increased considerably over the past five years. However, the 2015 estimate of 38,000 t still only represents 64% of B_{lim} (60,000 t). Fishing mortality in the last 7 years has been less than 0.1 for ages 4-6 (F_{lim}=0.3) and amongst the lowest values in the time series. The strong 2005 and 2006 year classes observed in the previous assessment continue to be strong in 2015 and at ages 10 and 9 comprise 62% of the total spawner biomass. More recent year classes, however, do not appear strong, which raises concern for the stock going forward. Despite the recent increase in SSB, overall abundance estimates have remained steady or decreased slightly, suggesting the growth in SSB is primarily a result of survival and growth of existing spawners rather than strong new cohorts entering the SSB. Stochastic projections indicate that growth of SSB will not continue beyond 2016 or 2017 and the stock will then decline somewhat in 2018.

Introduction

The Divisions 3NO cod stock occupies the southern part of the Grand Bank of Newfoundland. Fish are distributed over the shallower parts of the bank in summer, particularly in the Southeast Shoal area (Div. 3N), and on the slopes of the bank in winter when cooling occurs. Some seasonal mixing between fish in Division 3O and Subdivision 3Ps may occur. This stock has been under moratorium to all directed fishing both inside and outside the Regulatory Area since February 1994. In 1998 the Scientific Council Report recommended that there should be no directed fishing for cod in Div. 3N and 3O in 1999 and that by-catches in fisheries targeting other species should be kept at the lowest possible level. All subsequent assessments have re-iterated this advice.

This assessment updates the status of the stock, based primarily on a population model incorporating Canadian spring and fall research vessel surveys conducted in Div. 3NO. Population and spawner stock biomass estimates for 1959-2014 are provided from ADAPT utilizing the catch at age and calibrated using three Canadian research vessel surveys.

Nominal catch and catch at age

Catches from this stock peaked at 227,000 tons (t) in 1967, mainly by the former USSR and Spain, but declined steadily thereafter to 15,000 t in 1978. From 1979 to 1991 catches ranged from 20,000 to 50,000 t (Table 1, Fig. 1). A consecutive decline in TAC's in the early 1990's reduced catches to a level of about 10,000 t in 1993 the last full year of a directed fishery. Total catches since the moratorium (Table 1, Fig 1), increased from 170 t in 1995, peaked at about 4 800 t in 2003 and have been between 600 t and 1100 t since that time. The total catch in 2014 was 734 t. The Canadian catch in 2013 and 2014 made up 20% and 27% respectively of the total catch and was taken predominantly (>95%) as bycatch from the yellowtail flounder bottom trawl fishery (Table 2).

Sampling data for 2013-2014 was available from Canadian, Spanish (González-Costas et al., MS 2014, 2015), Portuguese (Vargas et al., MS 2014, 2015), Russian (Fomin and Khlivnoy MS 2014, Fomin et al. MS 2015) and

Estonian (Tõrra and Sirp MS 2015) otter trawl fisheries. The total catch-at-age from by-catches in 2013-2014 (Fig 2) was compiled in the most judicious manner possible given the sampling deficiencies noted (Table 3). The catch-at-age for non-Canadian fleets was constructed by applying Canadian survey age length keys to the available length sampling. A review of the sampling over the period 1995-2014 used to produce a catch-at-age for this stock (Table 4) indicates considerable sampling deficiencies.

In 1996, 1997, and 1998 the sampling was considered to be inadequate to develop a catch-at-age. An approach for developing catch at age for this period based on using an average partial recruitment pattern is presented in Stansbury et al. (1999). For 1999, 2000 and 2013 there are also gaps in the data but catch at age was estimated via the use of sampling collected by other contracting countries and by making use of Canadian research vessel survey age length keys. Age length keys available for 2013 did not adequately cover the range of ages sampled in the catch and a gap from age 11 to 16 was filled by eye. Sampling data for the 2014 Canadian catch was not available for the assessment so catch at age was estimated using annual length frequency data from EU Spain, which historically sampled cod in a size range similar to that by Canada. For 2014, there was no autumn survey to provide age length keys. Therefore, autumn 2013 keys were applied to the autumn 2014 catch.

Catch-at-age and mean weights-at-age from the fisheries in the 1959-2014 period are presented in Tables 4 and 5. Generally, abundant age classes observed in 2012 and earlier catch at age tracked through to 2014. Inadequate sampling also presents problems for computing mean weight at age. To fill the 1996-1998 gaps, a geometric mean was computed at each age, using the three nearest non-zero values on either side of the three year window.

Research vessel survey data

Stratified-random bottom trawl surveys have been conducted in spring by Canadian research vessels in Divs. 3N and 3O since 1971 and 1973, respectively, with the exceptions of 1983 in Div. 3N, and 1974 and 1983 in Div. 3O. The stratification scheme used for these surveys is based on depth (Fig. 3, Table 6). The surveys from 1991 onwards covered areas to a maximum of 732m (400 fathoms) but prior to this only covered to a maximum of 367m (200 fathoms). In 2006 survey coverage was incomplete and the 2006 spring survey is not considered an index of population size. Surveys from 1971 to 1982 were conducted by the research vessel *A.T. CAMERON* and those since 1984 were conducted primarily by the *WILFRED TEMPLEMAN* or its sister ship *ALFRED NEEDLER* (Table 7). The 2014 spring survey was conducted by the *TELEOST.* Although set coverage was reduced in 2014 (95/134 sets completed), all index strata were covered.

Autumn surveys have been carried out in Divisions 3NO from 1990 to 2008 using the *WILFRED TEMPLEMAN* for strata less than 732 m. Starting in 1995 the *Teleost* was used for sampling strata greater than 732m to a maximum depth of 1463m (800 fathoms), but coverage has not been consistent in these greater depths. Because of vessel difficulties in 1996 the *ALFRED NEEDLER* conducted the survey in strata less than 732m. In 2009 the autumn survey was conducted by the *ALFRED NEEDLER* with only partial coverage of Div. 3N strata greater than 732m by Teleost. The Autumn survey of Divisions 3NO in 2014 was not completed due to vessel mechanical issues.

In the autumn of 1995, the Campelen 1800 shrimp trawl with rockhopper footgear was introduced in the Canadian groundfish survey, replacing the Engel 145 Hi-rise trawl that had been previously used. The Campelen trawl is towed at 3.0 knots for 15 min instead of 3.5 knots for 30 minutes in the case of the Engel trawl. The selectivities of the two nets were estimated in comparative fishing experiments in 1995 and 1996 and were found to be markedly different, with the Campelen being far more effective at catching small cod and slightly less effective at catching large cod (Warren 1997; Warren et al. 1997). Conversion of Engels catches to Campelen equivalent catches are reported by Stansbury (1996, 1997).

The location of fishing sets for the Spring and Autumn surveys and the standardized total weight of fish caught at each station are demonstrated in Figs. 4 and 5 respectively. It is clear from these plots that the largest survey catches of 3NO cod in recent years have come from southern 3N in the NAFO Regulatory Area. The impact of these larger catches on survey estimates of biomass can be explored via plots with strata colour-coded to represent the overall biomass estimate for each stratum (Figs. 6 and 7). These indicate that strata in the NRA account for a large portion of the overall survey biomass estimates in recent years. In spring 2013, 45% of the total biomass estimate was attributed to strata 358 and 359. In spring 2014, 60% of the total survey biomass estimate was attributed to strata 359 and 377. The biomass is more widely distributed over the bank in the autumn.

The per stratum estimates of the indices are combined to give a total abundance and biomass estimate for the entire stock area. Abundance and biomass estimates are presented in Tables 8-15. Trends in the total abundance and

biomass estimates are plotted for the index strata (<200 fathoms) in Figs. 8-9. Spring abundance and biomass estimates were extremely low in both Div. 3N and Div. 3O from 1994 to about 2006. Levels have been slightly higher after 2006. In particular, biomass has been increasing since 2011 in Div. 3N. A similar recent increase is also evident in the autumn survey results. The swept area survey biomass estimate from index strata (<200 fathoms) surveyed in 3NO combined for 2014 spring is 121,781 t. The swept area survey biomass estimate for the most recent autumn survey (2013; no survey in 2014) is 107,888 t.

Analysis

Maturity at age

Annual proportion mature was modeled by fitting a probit model with a logit link function by cohort to observed proportions mature at age from sampling conducted during Canadian spring surveys. The model fitted the data for all cohorts from 1953 to 2007, except for the 1991 and 2000 cohorts. The estimated age at 50% maturity (A50) ranged between 5.6 and 7.4 years for cohorts produced from the 1950's to 1980's (Fig. 10). Age at 50% maturity declined between 1980 and the late 1990's from approximately 6.8 to 4.5. More recently, age at 50% maturity appears to be increasing, although there is much inter-annual variability. The estimated proportion of females mature at age from the fitted cohort model is given in Table 19. Estimates for the 1991 and 2000 cohorts were produced by averaging the observed proportions from the two adjacent years. As the estimation is by cohort, special considerations are needed to fill the older ages for the starting years, and also for the younger ages for current years. These values were produced by averaging estimates from the 3 previous and 3 subsequent years for the appropriate age (shaded cells in table 19). Estimated annual maturities for 1975-2014 are plotted (Fig. 11) to show trends for selected ages. Estimated proportion mature for these ages increased up to the mid-2000's, and in most cases have shown a general decreasing trend since that time.

Sequential Population Analysis

Survey Indices: Cohort Tracking

The last assessment of this stock utilized a sequential population analysis applying the ADAPT framework (Gavaris 1988) estimation of population size. Prior to the implementation of this analysis on the updated database, cohort tracking and consistency within the survey data was evaluated by a number of illustrative and standardized age-disaggregated plots, including (a) age-disaggregated plots of mean number per tow 3NO, (b) pair-wise scatter plots and correlations of age-disaggregated survey data (log-scale) and (c) standardized proportions by age across years (SPAY). In the SPAY plots the annual index proportions were standardized at each age to have a mean of 0 and a variance of 1.

For the Canadian Spring survey, the 1989 and 1990 year classes were the most dominant in the series from 1990 to 2008 (Fig. 12a) but at different ages. For example, the 1989 year class was dominant at ages 2, 4, 7, 9 and 10 whereas the 1990 year class was dominant at ages 3 and 8. The 2006 year class shows up strong as age 3 in 2009. In 2013 and 2014 this cohort continued to show up as strong at ages 7 and 8 respectively. Pairwise plots and correlations (Fig. 12b) indicate generally good tracking between ages for cohorts.

For the Canadian Autumn survey the 1989 and 1990 year classes were amongst the most dominant in the series (Fig. 13a) and also illustrate a similar pattern as the spring. The 1989 year class was dominant at ages except 7 whereas the 1990 cohort is only dominant at age 7, 8. The 1997 and/or 1998 cohorts were also very apparent at ages 3-9, something not so obvious in the spring series. A decline in density is also quite dramatic by age 5 for most cohorts. The pairwise plots and correlations (Fig. 13b) also indicate generally good tracking between ages for cohorts although correlations were not as good as in the spring.

Standardized indices by age for the Canadian Spring and Autumn surveys are compared in Fig. 14. The EU-Spain survey is also included for comparison. The results indicate generally good tracking for the Canadian surveys.

ADAPTive Framework

The catch at age (Table 4) was used in a sequential population analysis applying the ADAPT framework (Gavaris 1988). The catch for age 2 is from the NAFO SCR Docs series presented from 1988 to 1998. Zero catch was assumed for age 2 in years 1959-1987. Due to inadequate sampling of removals, total catch for 1996-1998 was proportioned by age using the average partial recruitment vector from 1990-93 (from a previous ADAPT run) with the fully recruited F estimated from a catch projection so as to match the observed catch (further details in catch-at-age

section). Catches since that time have been based on fishery sampling although for some contracting parties constructing catch at age required using Canadian RV age-length keys (see table 3).

The ADAPT was calibrated with Canadian RV survey indices at age from spring 1984-2005 and 2007-2014 (Table 16), autumn 1990-2013 (Table 17) and a Canadian juvenile survey 1989-94 (Table 18) to estimate population numbers $N_{i,t}$,

where i = 3 to 12, for t = 2015 (10 parameters) and i =12, for t=1994 to 2014 (21 parameters),

and Catchabilities

$q1_i$ where i = 2 to 10 for the Canadian Research Vessel survey spring (RV1) (9 parameters)
$q2_i$ where i = 2 to 10 for the Canadian Research Vessel survey autumn (RV2) (9 parameters)
$q3_i$ where i = 2 to 10 for the Juvenile Research Vessel survey (RV3) (9 parameters)

The following structure was imposed:

natural mortality was assumed to be 0.2,
fishing mortality on the oldest age (12) set equal to the average F for ages 6 to 9 for years 1959-1993,
no "plus" age class,
equal weighting of all indices,
no error in the catch numbers-at-age.

Input data were:

Catch numbers at age,
Ci,t where i = 2 to 12 and t = 1959 to 2014 ,
Canadian Research Vessel survey estimates of mean numbers per tow-at-age (Campelen or Campelen equivalent values),
RV1i,t where i = 2 to 10 and t = 1984 to 2005 and 2007-2014, spring
RV2i,t where i = 2 to 10 and t = 1990 to 2013, fall
and Canadian juvenile Research Vessel survey estimates of mean numbers per tow-at-age (Yankee 41.5 shrimp trawl in August – September)
RV3i,t where i = 2 to 10 and t = 1989 to 1994 .

The objective function minimized is

$$SS = \sum_{s,i,t} \{\ln(RV_{s,i,t}) - \ln(q_{s,i} N_{i,t})\}^2$$

where s= Survey 1 to 3 , i =age 2 to 10, t= year of survey.

This particular model formulation was selected since it follows the accepted VPA from the last assessment in 2013 and effectively deals with problems associated with zeros in the catch matrix at the age 12 (by estimating survivors at age 12 in these years). The statistics associated with the ADAPT output are given in Table 20. The mean square error of the residuals of the model fit was 0.597 based on an estimation of 58 parameters. For the survivors estimated in 2015, the relative error in the parameter estimates decreased with age from a high of 80% at age 3 to 25% at age 12.

The estimated survey catchabilities (q's) with associated standard errors are also provided in Table 20 and Fig. 15. Survey catchabilities (q's) generally decrease with age for all three surveys with the spring and autumn tending to having similar q's for ages 7-10. The Yankee 41.5 (juvenile survey) catchability for age 2 is more than three times that for the Campelen surveys.

Diagnostic residual plots from the ADAPT run are presented in Fig. 16-17. Overall the spring and autumn surveys show little pattern in the residuals, although there are some year effects. These are evident in the spring survey in 1987, 1993, 1996 and 1998 (mostly positive) and 1989, 1995, 2002 (mostly negative). The fall 1997 estimates have large negative residuals, particularly for ages 5, 6 and 7.

Bias-adjusted estimates of population numbers (Fig. 18) and fishing mortality at age (Fig. 19) are given in Tables 21 and 22 respectively. The age 2 value in 2015 is the geometric mean of the 2012-2014 age 2 estimates from the ADAPT. Population numbers remain low. There was a small increase between 2006-2008 but there has been a

leveling or declining trend since that time. Improvement in recruitment from the 2005 and 2006 year classes has accounted for much of this increase (Fig. 20).

The relatively strong 2005 and 2006 cohorts noted in the 2013 assessment continue to be strong in 2015. The strength of these year classes is still low relative to historic estimates. Fishing mortality (Table 22, Fig. 19) on the prominent age groups in the fishery has been very low since 2008 (< 0.1).

Beginning of year mean weight-at-age calculated from the commercial catch is presented in Table 23. These weights are used to calculate biomass, given in Table 24. Stock biomass reached an historic low in 1995 before a period of marginal increase which peaked in 2001 and declined to 2004. Since then there has been a steady increase to 2015. The maturities computed from the cohort model were applied to the population numbers to compute the spawner stock biomass (Table 25, Fig. 21). SSB has increased considerably over the past five years. However, the 2015 estimate of 38,454 t still only represents 64% of Blim (60,000 t). The increasing trend in SSB can be attributed to the survival and growth of the relatively strong 2005 and 2006 cohorts which account for 62% of the SSB in 2015 at ages 10 and 9 respectively. This increase in SSB may be short-lived as subsequent year classes do not appear to be as strong.

Retrospective analysis

A retrospective analysis was conducted to investigate whether systematic trends were apparent in the population modeling. A 5 year period was chosen to evaluate whereby a complete year of data was removed, one year at a time in succession (for catch at age and survey indices at age), and the estimation with identical structure to the VPA formulation above was repeated for each case. The resulting retrospective patterns were considered minor (Fig. 22).

Stochastic Projections

Simulations were carried out to examine the trajectory of the stock under two scenarios of fishing mortality: F=0, F=0.057 (the average F on ages 4-6 from 2012-2014). For these simulations the terminal year survivors from the ADAPT (i.e. Jan 2015 Population numbers), estimates of age by age relative error and the correlation matrix of population estimates were used. The following inputs were the basis of these projections:

Age	Estimate of 2015 population numbers ('000)	Relative error on population estimate	Weight-at-age mid-year (avg. 2012-2014)	Weight-at-age beginning of year (avg. 2012-2014)	Maturity-at-age (avg. 2012-2014)	PR rescaled relative to ages 4-6 (avg. 2012-2014)
3	849.6	0.807	0.48	0.38	0.03	1.75
4	2138.4	0.486	0.75	0.61	0.11	1.73
5	724.6	0.435	1.16	0.89	0.38	0.83
6	1820.4	0.348	1.52	1.30	0.69	0.44
7	2233.7	0.294	2.04	1.80	0.84	0.50
8	945.4	0.274	2.85	2.67	0.96	0.38
9	3582.3	0.244	4.42	4.07	0.99	0.47
10	1606.7	0.231	6.41	5.79	1.00	0.50
11	499.3	0.241	7.41	6.47	1.00	0.38
12	368.4	0.246	10.73	8.61	1.00	0.00

Given the current estimate of SSB is well below B_{lim} simulations were limited to a 3-year period. In addition, recruitment (at age 3) was only re-sampled from 1994-2013 as this represents a reasonable expectation of what has occurred under low stock sizes during the moratorium. The fishery selectivity (i.e. partial recruitment – PR) was rescaled to ensure these age groups would endure the projected fishing mortality.

The results of three-year projections of spawner stock biomass were very similar under F=0 and F_{SQ}=0.057. In both scenarios spawner stock biomass initially increased, then levelled off, and finally declined in the third year of the projection (Table 26, Fig. 23). In all years in both projection scenarios there is a >99% chance of remaining below B_{lim} (Table 27).

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Table 1. Catch (t) of cod in NAFO Divisions 3NO from 1953-2014

Year	Canada	Others	Total	TAC
1953	39884	26313	66197	
1954	17392	117369	134761	
1955	6053	108303	114356	
1956	5363	59519	64882	
1957	9641	80549	90190	
1958	4812	43239	48051	
1959	3687	60683	64370	
1960	3408	76269	79677	
1961	5428	67296	72724	
1962	3235	31749	34984	
1963	5079	64663	69742	
1964	2882	61579	64461	
1965	4229	94958	99187	
1966	6501	102418	108919	
1967	3446	223338	226784	
1968	3287	162224	165511	
1969	3664	114041	117705	
1970	4771	106790	111561	
1971	2311	123985	126296	
1972	1736	101638	103374	
1973	1832	78597	80429	103000
1974	1360	72029	73389	101000
1975	1189	42985	44174	88000
1976	2065	22218	24283	43000
1977	2532	15072	17604	30000
1978	6246	8472	14718	15000
1979	9938	17913	27851	25000
1980	5589	14402	19991	26000
1981	6096	18248	24344	26000
1982	10185	21420	31605	17000
1983	11374	17445	28819	17000
1984	8705	18398	27103	26000
1985	18179	18720	36899	33000
1986	18035	32610	50645	33000
1987	18652	22967	41619	33000
1988	19727	23423	43150	40000
1989	13433	19782	33215	25000
1990	10620	18226	28846	18600
1991	12056 [2]	17396 [3]	29454	13600
1992	7859	4893 [3]	12752	13600
1993	5370	5276 [3]	10646	10200
1994	47	2655 [3]	2702	6000 [5]
1995	64	108 [3]	172	ndf
1996	99	75 [3]	174	ndf
1997	286	97 [3]	383	ndf
1998	396	151 [3]	547	ndf
1999	568	351 [3]	919	ndf
2000	207	843 [3]	1050	ndf
2001	560	750 [3]	1310	ndf
2002	444	1750 [3]	2194	ndf
2003	818	4052 [3]	4870 [4]	ndf
2004	442	492 [3]	934	ndf
2005	461	263 [3]	724	ndf
2006	108	492 [3]	600	ndf
2007	203	645 [3]	848	ndf
2008	247	676 [3]	923	ndf
2009	165	918 [3]	1083	ndf
2010	107	839 [3]	946	ndf
2011	44	823	867	ndf
2012	26	708	734	ndf
2013	226	887	1113	ndf
2014 [1]	197	537	734	ndf

[1] Provisional

[2] Includes an estimate of 4000 t deemed misreported to Div. 3L.

[3] Includes estimates by Canadian Surveillance and by NAFO Scientific Council.

[4] Catch could not be precisely estimated but is in the range of 4, 280 - 5, 460 tons

[5] There has been no directed fishery since February 1994.

Table 2. Cod landings (t) by month and gear from NAFO Divisions 3NO by Canada in 2013 and 2014

	Canada (N)					Canada (M)				
2013	3N		3O			3N		3O		
Month	Ottertrawl	Longline	Ottertrawl	Gillnet	Longline	Ottertrawl	Longline	Ottertrawl	Longline	
Jan	0.28									
Feb	0.57									
Mar	9.50								0.08	
Apr	11.56	0.41	0.37		0.02					
May	3.54	0.21	0.89		0.02		0.54	0.03	0.14	
Jun	18.66	0.54	12.03					0.01	0.05	
Jul	1.71	0.73					0.48		1.29	
Aug		0.76					0.25		0.05	
Sep	19.64		34.59				2.10			
Oct	16.18		33.92	0.10		0.05				
Nov	8.08		12.48							
Dec	3.19		33.77							
	92.89		128.03	0.10	0.04	0.05	3.37	0.03	1.61	226.12

	Canada (N)					Canada (M)				
2014	3N		3O			3N		3O		
Month	Ottertrawl	Longline	Ottertrawl	Gillnet	Longline	Ottertrawl	Longline	Ottertrawl	Longline	
Jan	9.90		22.66							
Feb	1.08								0.00	
Mar	2.83						0.03			
Apr	14.78	0.21	0.86				0.12		1.04	
May	51.94	0.87	16.50				0.53	1.23	0.18	
Jun	2.74	1.58	3.30		0.01		0.26	0.10	0.15	
Jul	7.71	1.13					2.23		1.32	
Aug		1.23		0.03			0.26			
Sep		0.81			2.29					
Oct		0.81	8.11							
Nov	2.84		12.71				0.91			
Dec	9.60		10.82							
	103.43	6.63	74.94	0.03	2.29	0.00	4.35	1.33	2.69	195.69

Table 3. A review of sampling used to compile catch at age for 3NO cod from 1998 to 2014.
Highlighted years note use of Canadian RV age/length keys to some commercial catches

	Sampling	Canada	Spain	Portugal	Other
1998	Some Canadian otter trawl frequencies and age samples but nothing for gillnets. Portuguese length frequencies but no aging.	185/OT 160/GN 50/LL 396 Total		95/OT	56
1999	Length and age sampling for Canadian by-catch was limited to the otter trawl fishery in 3N and gillnet fishery in 3O. Where deemed appropriate sampling was used for the adjacent division. Canadian catch at age was prorated by 135 t for catch with no sampling was available. Some monthly frequencies by division were provided by Portugal and these in conjunction with keys from the Canadian Spring RV surveys were use to partition the Portuguese and Spanish catch. Age composition by division was provided by Russia.	122OT 351/GN 66/LL 2/ST 26/UK	3	322	26
2000	Length sampling for Canadian by-catch was limited to the otter trawl fishery in 3N and 3O. Age sampling was inadequate so spring and fall rv keys were used. Canadian catch at age was prorated for 77 t of catch with no sampling. Frequencies provided by Portugal and Spain were used with Canadian RV survey key to calculate catch for Portugal and Spain. Age composition by division was provided by Russia.	128/OT 29/GN 43/LL 7/UK	200	500	143
2001	Length sampling for Canadian by-catch was limited to the otter trawl fishery in 3N and 3O.However this comprised 85% of the Canadian catch.89 t caught in other gears added to the overall Canadian, Spanish and Portuguese catch at age. Age sampling for Canadian catch adequate . Portugal provided catch by area and month and length sampling. Spain provided catch by division and length sampling. Portuguese catch at age compiled using monthly sampling and keys created from Canadian Spring and Autumn RV surveys using only data from strata stradiling or outside 200mile limit. Spanish catch at age compiled using yearly frequencies by division provided and a key created by combining the two RV keys. Russia provided catch at age for sampled fish. Estonian catch at age based on Russian data. Individual countries catch at age scaled to catch agreed on at June 2002 STACFIS meeting.	470/OT 24/GN 61/LL 4/SS	89/OT	392/OT	271
2002	Adequete length measurment from Canadian ottertrawl fishery by-catch . Canadian sampling of the gillnet by-catch is minimal however this gear accounts for less than 5% of the catch. With such small amounts being landed it's next to impossible to capture a representative sample. Longline by-catch makes up ~8 % of the Canadian catch and it is not sampled at all. Frequencies from Portugal, Spain and Russia were used with Canadian commercial keys to partition catch into catch at age.	370/GN 2933/OR	255/OT	8484/OT	9577/OT
2003	Adequete length measurment from Canadian ottertrawl fishery by-catch . However by-catch in other Canadian fisheries accounted for ~25% of the Canadian catch. This was poorly sampled and age distribution of this catch may not reflect reality. Ample length samples were provided by the Portugal and Russia. these were used inconjunction with Canadian Research survey keys to create catch at age for Russia and Portugal. Catch by Spain was partitioned using frequencies from Portugal. Catch by Norway, Lithuania and Estonia was partitioned using frequencies from Russia.	45/GN 86/LL 5437/OT		13236/OT	5291/OT
2004	Length sampling limited to Canadian by-catch in the otter trawl fishery. This sampling is sparce and should be improved as there are observers aboard the vessels fishing Yellow tail flounder. By-catch by other gears accounted for 6% of the catch and this not sampled. Monthly and quarterly frequencies provided by Portugal and Russia were used in conjunction with Canadian Research Survey keys to create catch at age for Portugal, Spain, Russia and Estonia.	14/LL 2777/OT	905/OT	2333/OT	1508/OT
2005	Bycatch in Canadian ottertrawl fishery was adequetly sampled providing frequencies and keys. Length frequencies provided by Spain and Russia were used in conjunction with Canadian Research Surveys keys to create catch at age for Spain, Portugal, Russia and Estonia.	2/LL 4706/OT	6109/OT		125/OT
2006	Canadian cod bycatch was taken mainly in the ottertrawl and gillnet fishery for redfish and hake , sampling was limited mainly to frequencies. Canadian autumn research keys were used. Frequencies provided by Portugal and Russia were used in conjunction with Canadian autumn research keys to compile catch at age for Portugal, Spain, Estonia and Lithuania.	44/GN 478/OT		3269/OT	125/OT
2007	Canadian cod by catch was taken in the ottertrawl fishery for yellow-tail, redfish and hake. The ottertrawl fishery was sampled by observers. About 40 % of the Canadian catch was taken in longline fisheries and no sampling exist for this catch	1457/ OT NO LL	401 (135 mm mesh) /OT No sampling for 280mm mesh	376 (130mm mesh)/OT; 18 (280mm mesh)/OT	811 /OT /Russian fishery
2008	Canadian cod by catch was taken in the ottertrawl fishery for yellow-tail, redfish and hake. The ottertrawl fishery was sampled by observers. About 25 % of the Canadian catch was taken in longline fisheries and no sampling exist for this catch	1796 OT NO LL	408 OT	41 OT for 3O	519 OT
2009	Canadian cod by catch was taken in the ottertrawl fishery for yellow-tail, redfish and hake. The ottertrawl fishery was sampled by observers. About 20 % of the Canadian catch was taken in longline fisheries and no sampling exist for this catch. Canadian research survey keys used to age all catch	246/OT length and 24 aged fish	511(130mm, 3N)/OT; 98(280mm, 3N)/OT	1935 OT	
2010	Canadian cod by catch was taken in the ottertrawl fishery for yellow-tail and amounted to 109 t. Canadian research survey keys used to age all catch	90 comercial and 997 research ages	1354 measured	2467 130mm and 223 280mm mesh measured	171 measured
2011	Canadian cod by catch was taken in the ottertrawl fishery for yellow-tailand amounted to 54 t. Canadian research survey keys used to age all catch.	23 commercial and 959 research aged	396 measured	5042 measured	100 measured
2012	Canadian cod by catch was taken in the ottertrawl fishery for yellow-tailand amounted to 26 t. Canadian research survey keys used to age all catch	1441 research ages	2411 measured	4484 measured	
2013	Canadian cod bycatch was taken primarily in the ottertrawl fishery for yellow tail flounder. The ottertrawl fishery was sampled by observers. Q4 length frequencies for otter trawls (130 mm) from Spain applied to Q4 Canadian otter trawl catch. Canadian research survey keys used to age all catch.	1120 / OT and 66 aged fish	174 (130 mm, 3NO)/OT, 865 (280mm, 3N)/ OT	6293 (130 mm, 3NO)/OT, 561 (280mm, 3N)/OT	387 OT/Estonia
2014	Canadian cod bycatch was primarily taken in the ottertrawl fishery for yellow tail flounder. Annual length frequencies for EU Spain otter trawls (130 mm) applied to all Canadian otter trawl catch. Canadian research survey keys from spring 2014 used to age 2014 spring catch, but fall 2013 keys used to age fall catch.	no length or age data available	454 (130 mm, 3NO)/OT, 795 (280 mm, 3NO)/OT	4327 (130 mm, 3NO)/OT, 84 (280 mm, 3N)/OT	none

Table 4. Catch at age used in this assessment for Divisions 3NO cod ('000s).

Cn	2	3	4	5	6	7	8	9	10	11	12
1959	0	1711	13036	5068	6025	3935	1392	757	926	1220	103
1960	0	1846	6503	22050	3095	2377	2504	583	387	898	242
1961	0	812	4400	11696	15258	2014	1672	847	196	25	245
1962	0	1026	3882	2206	1581	3594	773	668	433	226	216
1963	0	313	5757	11210	4849	1935	3840	1165	608	322	208
1964	0	6202	15555	19496	7919	2273	1109	788	328	37	112
1965	0	1013	7611	7619	13258	9861	4827	1081	1248	163	141
1966	0	753	18413	19681	11795	8486	4467	1829	1694	122	57
1967	0	20086	62442	50317	18517	4774	4651	236	180	71	45
1968	0	16359	56775	48608	18485	6337	1592	505	178	90	45
1969	0	8154	12924	26949	11191	2089	1393	518	292	134	202
1970	0	2105	19703	10799	9481	3646	1635	541	149	227	90
1971	0	950	26900	30300	11700	3500	2500	500	200	100	50
1972	0	69	19797	12289	13432	5883	1686	285	216	78	74
1973	0	10058	27600	15098	5989	1971	972	707	243	137	116
1974	0	6425	9501	10907	10872	2247	2147	1015	676	428	257
1975	0	671	8781	3528	2505	3057	1059	921	461	252	152
1976	0	4054	7534	5945	1084	211	238	44	37	13	9
1977	0	607	2469	2531	1500	572	177	209	65	41	25
1978	0	920	4337	2518	818	354	102	58	51	8	5
1979	0	72	3827	9208	2784	883	265	58	17	12	7
1980	0	266	1055	3812	2275	761	222	92	31	8	13
1981	0	505	1091	1262	2297	1902	574	192	94	41	13
1982	0	305	1978	1591	1012	1528	1492	595	211	162	27
1983	0	1179	647	1893	1204	686	1152	774	238	81	41
1984	0	58	1000	1411	2324	1220	720	918	551	106	42
1985	0	57	2953	6203	3036	2519	797	459	533	261	97
1986	0	153	2865	6423	4370	1512	948	558	373	349	135
1987	195	516	422	3491	3445	1213	653	845	494	398	404
1988	256	277	318	1527	6347	3955	1009	567	425	249	142
1989	127	1917	2182	1502	1260	1887	1284	485	233	168	100
1990	410	1064	4505	4341	895	422	721	581	439	150	83
1991	6028	1103	673	995	544	282	368	568	502	383	202
1992	83	4508	1769	837	612	235	64	99	128	153	100
1993	33	1314	3209	637	479	321	74	25	39	49	53
1994	0	232	2326	1117	125	93	26	8	1	0	0
1995	0	0	72	20	40	2	0	1	0	0	0
1996	2	4	5	3	17	25	3	2	3	1	0
1997	1	12	18	11	5	31	45	5	4	5	3
1998	1	3	23	21	10	5	28	41	4	4	5
1999	46	94	41	101	40	14	6	23	55	3	2
2000	10	356	339	87	62	21	12	4	13	12	2
2001	10	187	302	160	11	43	23	7	2	9	12
2002	100	218	550	427	141	9	27	13	3	1	6
2003	43	337	810	1274	669	133	5	18	8	2	1
2004	11	37	45	50	92	73	21	1	7	3	1
2005	1	1	1	2	4	28	55	20	1	3	2
2006	45	214	168	82	21	5	10	2	2	0	0
2007	4	205	289	93	25	9	6	9	10	2	0
2008	1	4	58	165	41	20	2	3	20	13	7
2009	12	262	167	136	90	26	11	1	4	7	16
2010	249	214	459	195	75	39	13	0	2	0	1
2011	44	187	56	133	44	47	46	7	4	1	0
2012	26	217	197	38	96	35	16	14	5	1	0
2013	21	169	239	151	41	121	54	24	10	4	0
2014	60	194	144	156	59	55	29	13	4	2	0

Table 5. Catch weight at age used in this assessment for Divisions 3NO cod.

Cw	3	4	5	6	7	8	9	10	11	12
1959	0.42	0.82	1.25	1.95	2.82	3.39	3.98	4.68	5.25	6.17
1960	0.42	0.82	1.25	1.95	2.82	3.39	3.98	4.68	5.25	6.17
1961	0.42	0.82	1.25	1.95	2.82	3.39	3.98	4.68	5.25	6.17
1962	0.42	0.82	1.25	1.95	2.82	3.39	3.98	4.68	5.25	6.17
1963	0.42	0.82	1.25	1.95	2.82	3.39	3.98	4.68	5.25	6.17
1964	0.42	0.82	1.25	1.95	2.82	3.39	3.98	4.68	5.25	6.17
1965	0.42	0.82	1.25	1.95	2.82	3.39	3.98	4.68	5.25	6.17
1966	0.48	0.90	1.35	2.14	3.16	4.21	6.34	7.69	8.46	10.24
1967	0.48	0.90	1.35	2.14	3.16	4.21	6.34	7.69	8.46	10.24
1968	0.48	0.90	1.35	2.14	3.16	4.21	6.34	7.69	8.46	10.24
1969	0.48	0.90	1.35	2.14	3.16	4.21	6.34	7.69	8.46	10.24
1970	0.48	0.90	1.35	2.14	3.16	4.21	6.34	7.69	8.46	10.24
1971	0.48	0.90	1.35	2.14	3.16	4.21	6.34	7.69	8.46	10.24
1972	0.54	0.97	1.44	2.08	2.89	3.56	5.95	7.95	8.32	10.14
1973	0.57	1.00	1.43	2.19	3.63	4.63	6.25	9.56	11.17	13.99
1974	0.42	0.73	1.20	1.96	2.86	4.67	7.32	5.46	8.40	7.51
1975	0.38	0.89	1.28	2.13	3.14	4.16	5.53	6.74	5.27	7.09
1976	0.50	0.91	1.41	2.33	3.25	4.03	6.67	8.74	9.14	12.49
1977	0.57	1.00	1.48	2.48	3.51	4.74	7.17	8.81	11.70	11.47
1978	0.72	1.05	1.55	2.25	3.74	4.61	6.19	7.23	9.48	12.87
1979	0.65	0.98	1.39	2.09	2.87	3.70	4.75	7.15	7.98	10.11
1980	0.71	1.04	1.69	2.50	3.69	5.49	7.98	9.22	10.60	12.61
1981	0.90	1.27	1.84	2.69	3.55	5.33	7.13	9.10	9.01	10.15
1982	0.94	1.17	1.50	2.20	3.83	5.26	7.49	8.80	9.82	12.28
1983	0.85	1.17	1.87	2.63	3.80	5.20	6.27	8.08	8.99	11.01
1984	0.79	1.15	1.51	2.28	3.04	4.05	5.76	7.22	8.92	12.61
1985	0.48	0.86	1.37	2.05	3.25	4.65	6.62	8.32	9.15	11.13
1986	0.39	1.01	1.52	2.16	3.49	5.41	7.95	9.82	9.94	9.88
1987	0.49	0.82	1.30	1.83	2.89	4.76	7.26	8.95	9.85	12.59
1988	0.74	1.00	1.38	1.79	2.23	3.77	5.12	6.88	9.37	11.07
1989	0.51	0.97	1.60	2.24	3.27	4.61	7.08	8.31	9.47	12.25
1990	0.55	1.01	1.46	2.51	2.73	4.14	5.02	8.37	9.29	11.25
1991	0.55	0.85	1.59	2.30	3.83	5.56	7.53	9.04	11.98	13.98
1992	0.33	0.65	1.06	1.80	2.82	4.85	5.56	7.43	8.64	10.65
1993	0.36	0.78	1.35	1.84	2.82	4.11	5.87	7.76	8.79	8.67
1994	0.27	0.46	0.91	1.63	1.84	4.04	4.94	7.54	3.44	7.52
1995	0.42	0.75	1.21	2.03	2.29	2.08	6.60	6.22	6.41	8.03
1996	0.42	0.78	1.30	1.99	2.68	3.38	4.70	5.98	6.41	8.03
1997	0.42	0.78	1.30	1.99	2.68	3.38	4.70	5.98	6.41	8.03
1998	0.42	0.78	1.30	1.99	2.68	3.38	4.70	5.98	6.41	8.03
1999	0.50	0.94	1.59	2.07	2.23	2.83	3.99	6.05	6.73	7.38
2000	0.60	0.82	1.45	2.39	3.44	2.90	2.64	3.78	5.25	6.07
2001	0.58	1.09	1.38	2.07	4.06	5.22	5.32	5.51	7.51	8.60
2002	0.67	1.01	1.52	2.24	3.38	5.15	5.99	7.11	8.47	9.32
2003	0.67	0.94	1.40	2.02	3.01	4.10	7.63	7.74	8.52	9.23
2004	0.69	0.92	1.38	2.17	3.03	3.93	5.79	8.54	9.70	8.77
2005	0.49	1.41	2.46	3.43	3.95	4.94	5.90	9.30	10.28	11.42
2006	0.68	1.11	1.36	2.05	2.60	3.26	4.66	7.07	7.39	14.86
2007	0.61	1.00	1.39	2.52	2.90	4.71	5.16	6.75	6.67	8.39
2008	0.35	1.04	1.59	1.95	2.91	2.63	5.84	5.90	6.36	10.03
2009	0.46	0.65	1.31	2.16	2.68	3.80	4.55	8.20	7.51	8.81
2010	0.33	0.67	0.89	1.95	2.73	3.14	6.04	4.42	10.06	10.19
2011	0.49	0.62	1.13	1.60	3.47	4.77	5.53	4.72	5.58	9.68
2012	0.55	0.75	1.13	1.64	1.91	4.20	5.64	6.50	8.72	9.68
2013	0.43	0.70	1.12	1.52	2.17	2.29	4.60	6.05	6.54	12.04
2014	0.46	0.82	1.22	1.39	2.06	2.05	3.02	6.69	6.96	10.47

Table 6. Details on the stratification scheme used for the assessment of 3NO cod.

NAFO Div.	Depth Range (fathoms)	Strata	Area Sq. mi.
3N	0-30	375	1593
		376	1499
	31-50	360	2992
		361	1853
		362	2520
		373	2520
		374	931
		383	674
	51-100	359	421
		377	100
		382	647
	101-150	358	225
		378	139
		381	182
	151-200	357	164
		379	106
		380	116
	201-300	723	155
		725	105
		727	160
	301-400	724	124
		726	72
		728	156

NAFO Div.	Depth Range (fathoms)	Strata	Area Sq. mi.
3O	31-50	330	2089
		331	456
		338	1898
		340	1716
		351	2520
		352	2580
		353	1282
	51-100	329	1721
		332	1047
		337	948
		339	585
		354	474
	101-150	333	151
		336	121
		355	103
	151-200	334	92
		335	58
		356	61
	201-300	717	166
		719	76
		721	76
	301-400	718	134
		720	105
		722	93

Table 7. Information on the timing and vessel/trip numbers for the Canadian Spring and Autumn surveys.

Year	Spring Survey			Autumn Survey		
	Vessel(s) & Trips	Start Date (mm/dd)	End Date (mm/dd)	Vessel(s) & Trips	Start Date (mm/dd)	End Date (mm/dd)
1984	AN 27	04/28	05/08			
1985	AN 43	04/11	04/25			
1986	WT 47	04/18	05/04			
1987	WT 58-60	04/23	05/14			
1988	WT 70	04/21	05/05			
1989	WT 82	04/20	05/06			
1990	WT 95-96	05/05	06/01	WT 101-102	11/22	12/09
1991	WT 105-106	04/19	05/11	WT 113-115	10/19	11/10
1992	WT 119-120	04/22	05/13	WT 128-130	10/20	11/05
1993	WT 136-137	04/27	05/18	WT 144-146	10/24	11/12
1994	WT 152-153	04/30	05/22	WT 160-161	10/25	11/13
1995	WT 168-169	05/03	05/27	WT 176-177	09/26	10/26
1996	WT 188-189	05/07	05/30	WT 200, TEL 42, AN 253	11/24	12/17
1997	WT 204-208	04/30	06/04	WT 212-214	09/26	11/05
1998	WT 221-222	05/12	06/04	WT 229-233, TEL 76	10/10	12/16
1999	WT 238-241	05/11	06/07	WT 244-247	10/13	11/22
2000	WT 315-318	05/11	06/09	WT 319-323, TEL 338-339	10/11	12/05
2001	WT 367-369	05/05	06/06	WT 372-373, TEL 357	09/22	10/29
2002	WT 419-424	04/27	05/29	WT 427-428, TEL 411-412	10/05	10/26
2003	WT 479-481	05/08	06/04	WT 485-487, TEL 469	09/23	11/07
2004	WT 546-548	05/12	06/08	WT 557-558	10/31	11/23
2005	WT 618-621	05/09	06/19	WT 627-628,630, TEL 608-609, AN 657	10/04	11/19
2006				WT 704-706	09/30	10/21
2007	WT 759-762	05/03	06/29	WT 770-772, TEL 750-751	10/06	11/14
2008	WT 827-829	05/23	06/22	WT 835-837	10/03	11/01
2009	AN 904-906	05/13	06/11	AN 913-916, TEL 894-895	10/02	11/12
2010	AN 932-934	05/08	06/06	AN 942-944, TEL 979	09/30	12/12
2011	AN 403-404	05/08	05/30	AN 409-413	09/29	11/20
2012	AN 417-420	04/27	06/03	AN 424-426	09/30	11/05
2013	AN 432-434	04/24	05/22	AN 438-442	09/19	10/18
2014	TEL 139-140	05/29	06/17			

Table 8. Cod abundance (000's) from Canadian spring RV surveys in Division 3N. Both index strata and the most commonly fished deep strata are shown. The index strata are the basis for the assessment. Data for 1984-1995 have been converted to Campellan equivalent units. Values in brackets are estimates fornon-sampled strata.

Year	Index Strata (<200 fathoms)																	**Total**	1 std	Deep Strata (≥200 fathoms)						Total
	375	**376**	**360**	**361**	**362**	**373**	**374**	**383**	**359**	**377**	**382**	**358**	**378**	**381**	**357**	**379**	**380**	**Index**		**723**	**725**	**727**	**724**	**726**	**728**	>200
1984	22089	147797	135352	29059	67895	27237	10331	62	2317	1754	0	2677	2457	1519	0	780	207	**451532**	158609	nf	nf	nf	nf	nf	nf	-
1985	12272	147	26907	49961	19854	4121	768	0	0	2428	3538	5711	43405	12844	11460	3164	3646	**200225**	28273	nf	nf	nf	nf	nf	nf	-
1986	2219	779	9656	5531	5348	1585	85	0	39989	461	22	4024	6253	8170	440	4963	521	**90046**	35723	nf	nf	nf	nf	nf	nf	-
1987	6163	87946	31417	47380	116529	11626	922	958	7094	6335	59	4318	2103	388	(1428)	7	926	**324172**	93197	nf	nf	nf	nf	nf	nf	-
1988	3104	2509	35568	15258	6794	2600	871	680	5531	0	178	5277	1903	3155	11	44	1484	**84966**	15707	nf	nf	nf	nf	nf	nf	-
1989	4821	593	1043	9049	6986	3067	51	494	1622	420	1572	3946	1597	3705	68	204	957	**40195**	5707	nf	nf	nf	nf	nf	nf	-
1990	3205	265	2991	6571	8320	1560	384	46	811	0	3293	8218	2725	3630	880	1305	2043	**46246**	7797	nf	nf	nf	nf	nf	nf	-
1991	110	118	892	2549	1109	221	26	62	1187	0	0	1037	867	200	2504	2289	3822	**16992**	4214	1970	401	833	69	0	0	3273
1992	146	0	2705	797	58	0	128	0	1679	0	0	16327	3671	88	2651	8698	862	**37809**	5893	13573	nf	2144	112	0	0	15829
1993	73	0	898	828	116	0	0	0	2172	28	0	3358	602	0	68	540	20457	**29139**	20236	43	0	1444	9	0	0	1496
1994	0	0	0	102	0	0	0	0	0	48	0	108	220	13	429	190	0	**1109**	521	32	95	222	34	0	0	383
1995	0	69	0	619	0	0	0	0	0	0	0	155	96	113	23	66	32	**1171**	655	0	73	211	17	70	43	414
1996	0	165	449	1077	39	39	85	0	33	0	0	310	163	160	90	204	471	**3283**	787	46	34	1394	0	0	0	1474
1997	131	0	86	549	50	50	38	0	138	0	0	261	136	13	20	194	6239	**7906**	6106	77	16	109	50	12	0	264
1998	292	1272	823	2258	139	35	0	0	26	7	0	41	96	0	219	72	48	**5327**	1583	53	49	55	61	0	0	218
1999	5259	103	150	2650	1042	77	85	0	58	0	45	1254	38	150	73	58	96	**11137**	1968	0	33	44	0	0	0	77
2000	329	206	41	1869	1271	0	0	0	29	0	134	69	209	0	282	21	117	**4577**	1098	139	361	383	0	0	0	883
2001	351	41	82	510	1078	193	128	0	87	0	0	3111	108	1152	872	642	511	**8865**	3107	3179	661	528	45	0	0	4413
2002	131	0	453	1997	193	77	43	0	29	0	0	234	44	0	168	105	23	**3495**	880	1658	148	446	62	36	0	2350
2003	263	41	659	892	39	0	0	0	0	0	0	8940	1523	113	110	129	609	**13318**	8976	550	0	50	8	0	0	608
2004	175	1004	2552	3035	314	39	0	0	0	7	0	155	1000	300	43	49	207	**8878**	3353	85	0	0	9	0	0	94
2005	877	41	1784	2185	260	193	43	46	463	199	579	1045	365	7489	60	65	145	**15839**	6363	0	0	0	0	0	0	0
2006																										
2007	11213	18046	11271	17801	3983	435	43	0	927	138	102	4380	1635	307	158	93	14	**70544**	11497	19	0	0	0	0	13	32
2008	14846	11599	10290	9023	1425	87	192	46	1332	1204	0	4591	2798	1828	23	10	95	**59389**	8949	0	0	0	nf	0	0	0
2009	394	330	1957	3271	762	390	0	0	8108	17	0	97233	4214	22	9656	241	186	**126781**	97974	81	12	105624	0	0	0	105717
2010	1402	1871	700	2337	900	0	85	0	0	96	45	4154	6283	49	43	1222	31985	**51172**	32121	11	6	439	0	5	0	461
2011	52412	371	864	821	265	270	43	0	0	30	0	12	61	11	6820	1326	323	**63629**	51873	69	593	1068	0	22	11	1763
2012	2260	124	4392	3417	4151	1682	4269	93	8513	7146	0	3002	3263	4967	135	110	1147	**48673**	9517	10	217	46	nf	7	0	280
2013	1972	660	1171	2129	847	1964	1323	211	8867	9410	79	9244	3260	13	662	557	391	**42760**	11212	45	10	35	0	0	0	90
2014	682	137	755	1020	1040	555	192	424	27316	11122	5785	318	3276	2466	41	97	170	**55396**	29066	0	0	13	0	0	0	13

Table 9. Cod biomass (t) from Canadian spring RV surveys in Division 3N. Both index strata and the most commonly fished deep strata are shown. The index strata are the basis for the assessment. Data for 1984-1995 have been converted to Campellan equivalent units. Values in brackets are estimates for non-sampled strata.

Year	Index Strata (<200 fathoms)																	**Total**	1 std	Deep Strata (≥200 fathoms)						Total
	375	**376**	**360**	**361**	**362**	**373**	**374**	**383**	**359**	**377**	**382**	**358**	**378**	**381**	**357**	**379**	**380**	**Index**		**723**	**725**	**727**	**724**	**726**	**728**	>200
1984	6951	16514	21635	19816	75056	33166	14844	497	305	144	0	814	686	758	0	378	407	**191972**	30721	nf	nf	nf	nf	nf	nf	-
1985	26015	706	16845	52290	29628	5223	1508	0	0	217	254	897	4557	5345	6291	1186	2108	**153070**	18986	nf	nf	nf	nf	nf	nf	-
1986	20840	2926	3745	60545	31028	4336	1325	0	2614	137	83	1708	1074	2885	634	1571	362	**135813**	34396	nf	nf	nf	nf	nf	nf	-
1987	13377	9060	4115	49876	142872	14456	1815	1648	771	1703	41	4214	355	245	(566)	9	1008	**245567**	38873	nf	nf	nf	nf	nf	nf	-
1988	22932	6492	3755	25431	19700	9645	5816	234	631	0	58	1305	436	779	32	37	650	**97934**	13093	nf	nf	nf	nf	nf	nf	-
1989	24907	1244	2125	19331	26333	8910	928	569	211	45	775	1685	428	214	64	97	493	**88359**	12759	nf	nf	nf	nf	nf	nf	-
1990	15980	3754	10388	29860	36987	5747	5002	609	100	0	295	1079	396	792	271	315	697	**112271**	14230	nf	nf	nf	nf	nf	nf	-
1991	1818	1468	1022	16487	4301	847	512	222	66	0	0	129	144	395	328	844	670	**29254**	8642	662	186	486	30	0	0	1364
1992	2309	0	1431	395	661	0	29	0	112	0	0	2625	409	15	699	2567	180	**11433**	2788	3415	nf	805	32	0	0	4252
1993	1134	0	45	3422	1508	0	0	0	429	9	0	1683	244	0	46	203	9729	**18451**	9859	30	0	313	9	0	0	352
1994	0	0	0	63	0	0	0	0	0	8	0	162	63	56	235	120	0	**708**	289	26	32	86	22	0	0	166
1995	0	51	0	47	0	0	0	0	0	0	0	133	75	44	24	46	9	**429**	120	0	8	41	26	31	26	132
1996	0	62	457	647	21	9	11	0	36	0	0	131	84	40	18	66	100	**1682**	553	35	19	677	0	0	0	731
1997	92	0	15	378	317	168	136	0	199	0	0	104	109	2	9	104	3457	**5090**	3438	80	9	71	40	5	0	205
1998	108	75	12	682	407	9	0	0	1	15	0	73	80	0	221	25	13	**1721**	496	77	10	25	191	0	0	303
1999	3225	4	315	3496	946	50	11	0	114	0	9	1171	21	16	51	12	18	**9461**	3021	0	13	6	0	0	0	19
2000	54	43	19	533	1328	0	0	0	194	0	27	23	184	0	242	8	14	**2669**	1362	270	163	180	0	0	0	613
2001	592	6	589	241	1110	8	30	0	54	0	0	1818	92	708	676	536	71	**6529**	1995	2233	443	295	100	0	0	3071
2002	88	0	244	1856	22	11	15	0	7	0	0	327	16	0	158	74	14	**2832**	1522	1598	100	96	36	12	0	1842
2003	1229	458	1417	1987	2	0	0	0	0	0	0	14117	739	12	204	68	97	**20329**	14168	956	0	25	25	0	0	1006
2004	89	286	84	299	2134	2	0	0	0	29	0	258	377	49	60	22	36	**3726**	2160	46	0	0	6	0	0	52
2005	632	1	1798	2582	1746	74	10	42	71	298	239	611	118	2276	59	82	53	**10692**	2768	0	0	0	0	0	0	0
2006																										
2007	2669	528	1057	7983	5449	603	6	0	2385	33	79	3049	1101	171	262	72	6	**25452**	5245	60	0	0	0	0	4	64
2008	2016	1810	8204	1619	2499	3	327	9	434	990	0	4361	711	702	28	5	51	**23769**	3653	0	0	0	nf	0	0	0
2009	208	451	89	885	128	76	0	0	9025	8	0	39777	1927	2	3063	242	18	**55898**	40813	168	5	33157	0	0	0	33330
2010	43	4913	0	82	1595	1245	0	26	160	1423	32	3946	641	14002	18	5	0	**28131**	14733	56	34	377	0	2	0	469
2011	11042	56	248	302	463	135	8	0	0	23	0	6	33	1	5469	1019	61	**18865**	12119	125	476	950	0	17	15	1583
2012	2407	398	15514	1764	2970	878	3227	32	8550	4683	0	3025	4331	3184	297	149	558	**51966**	11191	13	51	41	nf	16	0	121
2013	1271	63	2393	3842	1400	1587	951	158	14188	8663	74	18176	5130	1	1298	742	183	**60120**	15879	178	7	54	0	0	0	239
2014	45	25	940	55	956	565	470	192	54329	19272	9802	341	4205	2783	79	273	196	**94527**	57143	0	0	12	0	0	0	12

Table 10. Cod abundance (000's) from Canadian spring RV surveys in Division 3O. Both index strata and the most commonly fished deep strata are shown. The index strata are the basis for the assessment. Data for 1984-1995 have been converted to Campellan equivalent units. Values in brackets are estimates for non-sampled strata.

Year	Index Strata (<200 fathoms)																		**Total**	1 std	Deep Strata (≥200 fathoms)						Total
	330	**331**	**338**	**340**	**351**	**352**	**353**	**329**	**332**	**337**	**339**	**354**	**333**	**336**	**355**	**334**	**335**	**356**	**Index**		**717**	**719**	**721**	**718**	**720**	**722**	>200
1984	7687	3826	23133	10504	77593	40966	0	5871	432	1891	14485	2217	0	0	0	0	0	0	**188606**	24310	nf	nf	nf	nf	nf	nf	-
1985	7816	1903	9631	9324	17410	17487	2204	2367	3399	5634	885	1826	42	17	4031	234	0	0	**84210**	12468	nf	nf	nf	nf	nf	nf	-
1986	3672	737	8848	10184	116600	9709	2746	2811	1104	1356	134	2195	104	125	28	1310	68	13	**161744**	93579	nf	nf	nf	nf	nf	nf	-
1987	11207	1882	20017	144754	71037	35545	28804	131760	29727	1782	2361	65041	561	17	205.45	25	8	4	**544739**	121065	nf	nf	nf	nf	nf	nf	-
1988	5332	1411	6560	2799	13208	55656	44053	5208	2881	2315	483	2250	0	8	43	120	12	50	**142388**	39654	nf	nf	nf	nf	nf	nf	-
1989	1594	784	19973	1941	6053	10374	4686	5524	3082	10302	27	587	374	8	978	139	16	130	**66572**	11285	nf	nf	nf	nf	nf	nf	-
1990	4943	(1052)	8355	3593	6182	14360	6437	13021	5646	2113	1609	391	135	141	191	538	96	109	**67860**	10620	nf	nf	nf	nf	nf	nf	-
1991	1411	157	24229	2544	2051	9659	1285	22096	677236	22222	1556	8933	685	158	2317	1202	27	541	**778308**	672162	3701	274	190	15	0	0	4180
1992	201	31	2263	330	1040	3815	4188	503	29324	6846	604	1663	966	5484	935	962	1263	2639	**63059**	22768	336	749	72390	0	569	149	74193
1993	369	0	827	118	347	1318	220	1657	293274	229388	402	1402	509	433	234	1126	339	420	**532383**	272306	1615	301	348	100	15	0	2379
1994	0	0	131	283	248	1287	0	13826	0	130	0	0	2184	599	50	528	156	487	**19907**	13914	1441	443	11	503	211	0	2609
1995	0	0	261	0	0	1100	282	1089	2376	522	0	0	10	0	7	198	52	13	**5910**	1824	242	164	5	102	29	0	542
1996	4777	345	2089	1428	520	1104	670	327	3153	2478	46	65	682	8	2548	182	485	92	**21000**	4659	27	21	84	0	6	11	149
1997	509	0	160	529	453	927	0	765	432	681	0	0	1447	128	6	94	211	70	**6411**	1513	176	39	103	7	103	6	434
1998	4310	8343	895	173	277	1278	564	8194	720	1239	121	4583	194	25	50	26	36	82	**31111**	12292	20	5	5	0	12	0	42
1999	4037	452	15015	1770	1631	14932	507	8370	8121	9389	497	4864	25	17	44	28	37	67	**69804**	14900	37	107	5	0	7	0	156
2000	8680	2635	6571	3682	12046	5481	1693	1278	27653	3032	40	587	92	0	39	70	13	96	**73690**	14846	122	18	7	0	0	0	147
2001	1519	3858	7006	567	1820	3372	397	2746	816	1130	282	163	71	42	234	54	278	62	**24415**	3171	838	134	67	0	7	17	1063
2002	616	220	3264	189	545	1730	321	379	672	478	201	33	20	92	31	1017	357	149	**10312**	1796	183	0	9	18	17	0	227
2003	270	63	1044	330	217	754	220	2557	96	565	0	33	9	0	21	19	4	22	**6224**	2402	114	21	19	0	0	0	154
2004	1204	1725	970	283	43	877	139	440	3271	366	0	0	10	67	65	17	0	67	**9545**	2217	553	8	5	0	0	0	566
2005	5090	1976	9095	519	1127	5989	887	1868	0	452	80	246	10	0	6	0	0	0	**27346**	6772	34	52	0	0	0	0	86
2006																											
2007	3818	502	4700	923	2080	22182	18473	4545	1296	1130	138	3130	48	7	50	44	4	50	**63119**	12101	44	0	0	0	0	0	44
2008	2504	27036	4700	354	7106	12625	529	710	4081	1000	0	0	9	17	21	17	4	15	**60727**	26891	170	0	48	0	0	0	218
2009	1514	215407	2176	13691	520	5790	0	1089	23834	956	0	0	0	0	50	634	12	35	**265709**	213186	180	21	12	0	0	0	213
2010	3800	63	9269	226	515	2524	176	1415	21503	1377	80	94	27	0	25	11	32	28	**41164**	20330	154	23	0	0	0	0	177
2011	2641	376	1649	451	303	2755	250	5471	0	464	179	217	9	33	62	28	4	28	**14921**	5418	54	0	0	0	nf	0	54
2012	2668	439	2008	944	1541	6073	1411	3064	192	149	121	33	23	8	0	0	8	29	**18711**	3995	15	0	0	0	0	0	15
2013	6269	1084	1392	661	1430	6344	3615	4674	0	0	80	0	10	0	0	12	5	0	**25578**	5702	0	0	0	0	0	0	0
2014	4310	376	4439	1495	763	5820	705	4735	792	0	604	1299	10	0	0	0	0	21	**25370**	5480	26	0	0	0	0	0	26

Table 11. Cod biomass (t) from Canadian spring RV surveys in Division 3O. Both index strata and the most commonly fished deep strata are shown. The index strata are the basis for the assessment. Data for 1984-1995 have been converted to Campellan equivalent units. Values in brackets are estimates for non-sampled strata.

Year	Index Strata (<200 fathoms)																		**Total**	1 std	Deep Strata (≥200 fathoms)						Total
	330	**331**	**338**	**340**	**351**	**352**	**353**	**329**	**332**	**337**	**339**	**354**	**333**	**336**	**355**	**334**	**335**	**356**	**Index**		**717**	**719**	**721**	**718**	**720**	**722**	>200
1984	7888	4493	42678	13523	67964	51161	0	1759	4368	734	3323	946	0	0	0	0	0	0	**198839**	27418	nf	nf	nf	nf	nf	nf	-
1985	9282	4844	13539	10677	34186	41468	9360	1913	16971	2948	723	654	327	81	717	889	0	0	**148579**	19373	nf	nf	nf	nf	nf	nf	-
1986	4128	1282	23022	11909	89983	24013	1814	1104	4052	11533	72	564	408	119	28	4728	157	42	**178959**	57845	nf	nf	nf	nf	nf	nf	-
1987	11960	1963	19822	159580	113537	75699	15404	115219	12725	4258	934	6849	1819	34	256.53	119	38	15	**540232**	109863	nf	nf	nf	nf	nf	nf	-
1988	4443	2155	14399	16289	25082	81440	4469	15973	11606	995	491	1199	0	39	38	469	81	177	**179345**	35693	nf	nf	nf	nf	nf	nf	-
1989	3287	476	25187	5426	19588	43446	3974	1674	2136	5680	216	86	1472	43	533	291	15	153	**113683**	32915	nf	nf	nf	nf	nf	nf	-
1990	5042	(2191)	9226	10198	22130	38056	5836	4639	11158	3321	381	557	378	315	196	818	109	216	**112578**	15471	nf	nf	nf	nf	nf	nf	-
1991	264	233	10185	380	6532	22297	1255	4155	38888	5512	91	3293	868	110	326	1372	10	87	**95858**	35755	15218	143	88	7	0	0	15456
1992	31	222	11769	51	2043	16512	1763	96	3889	20523	87	189	270	1716	63	1009	274	305	**60812**	21564	436	179	12153	0	139	70	12977
1993	91	0	4934	1918	1187	8147	3229	217	107210	79021	43	1307	1645	371	167	1395	2498	383	**213762**	93050	1870	330	304	159	9	0	2672
1994	0	0	1824	159	129	1569	0	10423	0	805	0	0	8467	655	32	950	449	255	**25716**	11919	2094	727	16	791	222	0	3850
1995	0	0	3406	0	0	3748	603	2166	1685	1643	0	0	26	0	31	330	339	16	**13992**	3159	339	927	10	91	34	0	1401
1996	7035	974	1520	237	103	1514	117	189	1519	3267	5	84	1610	19	2321	256	673	46	**21489**	4831	57	37	95	0	3	28	220
1997	357	0	196	186	286	2869	0	614	1558	527	0	0	974	322	15	305	734	47	**8990**	3056	238	133	53	16	164	5	609
1998	12526	34685	5069	512	1888	5341	18	13037	2136	1720	441	2258	255	16	74	46	75	102	**80197**	36701	30	2	16	0	11	0	59
1999	8593	1105	9416	3857	5269	14308	1719	9671	1350	3095	1210	1088	26	18	26	72	207	108	**61137**	11993	47	243	11	0	20	0	321
2000	8401	6842	6982	2164	47572	8226	7130	628	4360	1040	1	218	77	0	13	98	37	442	**94231**	47545	108	59	20	0	0	0	187
2001	2296	1738	13092	1469	4266	11344	529	896	272	553	733	737	43	46	169	33	254	69	**38539**	6458	585	137	323	0	41	52	1138
2002	190	1251	2456	33	38	6932	4394	63	42	160	48	218	31	95	27	1241	437	142	**17799**	4457	164	0	22	18	25	0	229
2003	20	326	4712	25	38	3093	607	1623	462	171	0	474	13	0	2	18	8	26	**11618**	3229	190	33	39	0	0	0	262
2004	2806	8186	1625	1735	583	3130	758	173	906	891	0	0	2	96	51	87	0	131	**21158**	8974	1224	23	9	0	0	0	1256
2005	5951	773	1688	1901	1293	6446	141	1569	0	360	3	484	20	0	22	0	0	0	**20650**	4670	71	26	0	0	0	0	97
2006																											
2007	1345	218	3486	1178	237	9602	1129	2050	241	211	1	438	32	3	33	67	3	45	**20318**	5263	147	0	0	0	0	0	147
2008	1014	2641	2607	381	3401	9189	523	430	494	1399	0	0	6	20	17	28	5	19	**22175**	4487	191	0	74	0	0	0	265
2009	509	53267	2622	5325	65	5946	0	170	19689	504	0	0	0	0	48	227	26	53	**88452**	48368	110	48	19	0	0	0	177
2010	1614	506	1468	39	756	1463	5	460	1897	111	46	74	18	0	43	6	37	23	**8567**	2165	100	47	0	0	0	0	147
2011	1030	298	690	746	217	3347	1148	7367	0	87	781	471	34	34	98	81	11	82	**16523**	7243	151	0	0	0	nf	0	151
2012	696	527	239	824	2922	7950	12683	2694	54	63	25	55	19	7	0	0	20	74	**28853**	13497	23	0	0	0	0	0	23
2013	959	198	1374	88	172	5458	642	1479	0	0	6	0	12	0	0	24	15	0	**10427**	2086	0	0	0	0	0	0	0
2014	5896	332	1411	725	860	4048	4869	3772	1054	0	882	3296	60	0	0	0	0	50	**27254**	7632	140	0	0	0	0	0	140

Table 12. Cod abundance (000's) from Canadian Autumn RV surveys in Division 3N. Both index strata and the most commonly fished deep strata are shown. The index strata are the basis for the assessment. Data for 1984-1995 have been converted to Campellan equivalent units. Values in brackets are estimates for non-sampled strata.

Year	Index Strata (<200 fathoms)																	**Total**	1 std	Deep Strata (≥200 fathoms)						Total
	375	**376**	**360**	**361**	**362**	**373**	**374**	**383**	**359**	**377**	**382**	**358**	**378**	**381**	**357**	**379**	**380**	**Index**		**723**	**725**	**727**	**724**	**726**	**728**	>200
1990	5421	32419	28703	6273	12855	1336	879	530	702	243	210	766	550	nf	683	213	nf	**91783**	29227	nf	nf	nf	nf	nf	nf	-
1991	66596	455280	12311	14155	73045	22575	20754	530	0	nf	359	1500	2046	0	399	nf	798	**670348**	355442	0	nf	nf	0	nf	nf	0
1992	nf	354763	8311	20718	49583	1400	nf	nf	497	493	270	5063	1602	nf	194	596	nf	**443490**	286249	nf	0	nf	nf	nf	nf	0
1993	2047	260	3463	6177	1300	750	819	0	88	0	494	47	48	202	1526	655	48	**17924**	4041	97	80	878	17	0	nf	1072
1994	1947	312	0	7549	622	0	1034	0	0	7	0	94	10	0	57	81	16	**11729**	3576	0	0	11	0	0	0	11
1995	4954	3918	433	3751	901	69	57	46	29	7	0	55	10	0	20	32	57	**14339**	3284	0	12	9	0	0	0	21
1996	0	92	480	2005	103	129	64	0	51	12	32	14	0	230	38	52	24	**3326**	1341	43	22	267	19	10	76	437
1997	603	41	137	2156	898	50	43	0	29	0	0	15	17	8	0	79	16	**4092**	757	6	0	0	0	0	0	6
1998	329	1598	309	5761	792	149	171	46	0	0	0	247	10	13	124	13	0	**9562**	2228	0	7	0	0	0	0	7
1999	14518	361	2367	1733	7924	3004	512	0	0	21	134	340	1472	138		988	383	**33895**	9200	0	7	22	0	0	0	29
2000	8163	819	1132	3161	6478	341	85	0	550	21	134	1156	1785	338	168	164	563	**25058**	7551	0	0	49	0	0	0	49
2001	4492	876	2315	6780	6438	446	1836	0	290	481	0	342	226	1702	61	663	14	**26962**	4867	0	7	0	0	0	0	7
2002	2849	317	360	1173	314	149	256	0	463	51	45	437	476	13	10	47	465	**7425**	2909	0	14	11	0	0	0	25
2003	446	324	1242	4952	99	57	0	0	434	0	0	356	36	0	102	52	104	**8204**	1013	0	0	25	nf	0	0	25
2004	438	2062	1543	4282	198	149	171	46	116	206	0	279	315	2078	124	54	96	**12158**	3027	0	nf	0	0	0	43	43
2005	3671	7099	2036	12672	1882	106	0	0	608	35	89	512	1520	82	229	91	56	**30688**	11059	0	7	0	0	0	0	7
2006	3999	987	14200	4384	495	248	640	46	145	76	0	1024	1430	138	302	58	83	**28255**	13287	0	63	9	0	0	0	72
2007	4024	10516	12142	30180	4727	451	840	0	1319	297	316	4797	850	5858	56	73	32	**76478**	15069	31	0	0	60	0	0	91
2008	13586	20758	470	9431	14906	2253	3522	0	898	5475	0	3363	8824	3089	124	131	326	**87156**	21572	9	7	0	0	0	0	16
2009	4821	112129	6709	9198	520	469	1729	46	347	2586	158	584	3142	67	121	32	199	**142857**	74196	0	0	39	0	16	0	55
2010	10902	16032	4956	16569	1684	545	1195	46	319	467	0	552		114	113	40	32	**53566**	12251	17	nf	11	0	0	0	28
2011	6793	1804	3013	3257	870	485	1409	46	2734	3384	140	867	4646	11129	56	645	454	**41732**	12798	0	17	0	0	23	0	39
2012	2763	22786	2337	16183	2427	1634	1708	46	931	812	45	851	180	38	53	144	769	**53704**	10810	14	7	279	17	0	0	317
2013	25853	4691	5362	13612	6834	3518	14051	185	116	813	134	297	4872	2790	11	7	993	**84138**	21554	0	0	11.005	0	0	0	11

Table 13. Cod biomass (t) from Canadian Autumn RV surveys in Division 3N. Both index strata and the most commonly fished deep strata are shown. The index strata are the basis for the assessment. Data for 1984-1995 have been converted to Campellan equivalent units. Values in brackets are estimates for non-sampled strata.

Year	Index Strata (<200 fathoms)																	**Total**	1 std	Deep Strata (≥200 fathoms)						Total
	375	**376**	**360**	**361**	**362**	**373**	**374**	**383**	**359**	**377**	**382**	**358**	**378**	**381**	**357**	**379**	**380**	**Index**		**723**	**725**	**727**	**724**	**726**	**728**	>200
1990	31395	5147	7585	24777	9636	9722	2501	216	39	122	129	404	362	nf	370	318	nf	**92723**	25023	nf	nf	nf	nf	nf	nf	-
1991	69276	80732	4456	16326	40955	26255	9699	164	0	nf	73	430	635	0	205	nf	117	**249323**	64135	0	nf	nf	0	nf	nf	0
1992	nf	116390	4572	12485	22852	4114	nf	nf	156	257	115	2464	461	nf	120	317	nf	**164303**	91007	nf	0	nf	nf	nf	nf	0
1993	3305	152	8072	12996	1576	254	1102	0	39	0	168	45	12	119	629	240	32	**28741**	7956	63	90	484	12	0	nf	649
1994	9447	993	0	12111	1001	0	2414	0	0	13	0	51	11	0	42	96	10	**26189**	7249	0	0	12	0	0	0	12
1995	3162	4035	1329	8626	337	39	15	54	12	11	0	61	8	0	46	20	26	**17781**	4298	0	10	3	0	0	0	13
1996	0	799	316	1717	28	49	26	0	36	11	92	9	0	117	19	27	12	**3258**	1199	24	13	97	40	15	34	223
1997	594	12	1226	3255	2581	26	45	0	25	0	0	80	21	5	0	108	10	**7988**	1681	18	0	0	0	0	0	18
1998	839	791	1258	3811	713	60	196	0	0	0	0	327	9	8	245	8	0	**8265**	3200	0	18	0	0	0	0	18
1999	2022	46	8681	1060	4955	1948	111	0	0	6	93	197	729	39		664	223	**20774**	5772	0	10	39	0	0	0	49
2000	8642	2677	1536	1986	2840	125	20	0	458	3	116	933	1156	86	311	129	178	**21196**	5346	0	0	34	0	0	0	34
2001	1490	2351	3183	3319	4146	324	1042	0	249	660	0	470	174	1583	172	675	3	**19841**	4203	0	6	0	0	0	0	6
2002	2135	813	217	4519	1597	154	172	0	601	68	12	467	276	9	9	79	879	**12007**	3490	0	6	11	0	0	0	17
2003	192	1025	2917	6749	582	1	0	0	814	0	0	358	43	0	66	53	48	**12848**	3571	0	0	10	nf	0	0	10
2004	47	23	5334	9089	54	14	31	6	94	382	0	105	99	1890	201	133	54	**17558**	6793	0	nf	0	0	0	44	44
2005	487	5798	2220	8438	3160	33	0	0	317	19	16	262	711	80	221	41	48	**21851**	6469	0	4	0	0	0	0	4
2006	6913	2112	12038	2887	1582	95	1501	34	217	89	0	468	832	34	184	38	37	**29061**	11576	0	49	3	0	0	0	52
2007	6277	910	2291	3624	1640	99	99	0	296	66	93	4112	486	3303	50	27	28	**23401**	7102	49	0	0	65	0	0	114
2008	5111	11121	2231	8548	6235	544	1015	0	456	1720	0	1613	2644	888	89	102	205	**42522**	12646	27	11	0	0	0	0	38
2009	3038	31762	7251	9296	247	815	793	23	328	1601	42	400	2144	21	214	33	106	**58114**	23590	0	0	17	0	13	0	30
2010	2963	17484	8031	4621	3604	315	755	51	257	310	0	638		165	130	55	26	**39405**	14438	27	nf	6	0	0	0	32.333
2011	3120	1139	10504	2562	834	286	661	22	3173	3416	180	1104	4836	5166	154	841	421	**38419**	9968	0	22	0	0	18	0	40
2012	1946	27994	11207	23494	2873	1635	427	34	1254	1102	13	974	138	15	116	254	850	**74327**	24017	66	16	534	40	0	0	656
2013	5440	4200	17535	12422	3913	5647	28073	244	66	994	96	266	9370	2856	43	8	1192	**92366**	32654	0	0	3	0	0	0	3

Table 14. Cod abundance (000's) from Canadian Autumn RV surveys in Division 3O. Both index strata and the most commonly fished deep strata are shown. The index strata are the basis for the assessment. Data for 1984-1995 have been converted to Campellan equivalent units. Values in brackets are estimates for non-sampled strata.

Year	Index Strata (<200 fathoms)																		**Total**	1 std	Deep Strata (≥200 fathoms)						Total
	330	**331**	**338**	**340**	**351**	**352**	**353**	**329**	**332**	**337**	**339**	**354**	**333**	**336**	**355**	**334**	**335**	**356**	**Index**		**717**	**719**	**721**	**718**	**720**	**722**	>200
1990	10709	507	20199	4158	29085	10248	1781	531	1721	1001	163	1580	21	6	nf	13	12	nf	**81735**	17121	0	0	nf	nf	nf	nf	0
1991	10264	6682	10334	5625	24185	24761	223	1605	1127	66	0	0	0	0	887	0	4	4	**85767**	15463	nf	0	0	nf	nf	0	0
1992	7036	222	857	7746	3558	2747	0	558	436	198	41	1712	10	0	64	0	0	0	**25185**	6229	nf	nf	nf	nf	nf	nf	0
1993	5271	222	6221	1859	10450	4710	0	239	2036	307	528	0	0	67	172	9	0	102	**32193**	7605	0	0	0	0	0	0	0
1994	2072	95	330	763	661	717	0	1036	242	0	41	0	0	0	0	0	0	0	**5957**	2162	0	5	0	0	0	0	5
1995	3946	760	2478	1668	2709	972	415	574	0	0	41	165	0	0	13	0	0	0	**13741**	2367	0	0	0	0	0	0	0
1996	277	31	261	94	196	284	0	473	0	0	0	337	nf	8	339	nf	132	40	**2472**	571	nf	37	0	nf	0	0	37
1997	1006	31	52	519	1684	1006	0	95	48	0	80	130	0	0	0	0	12	0	**4663**	916	0	0	0	0	0	0	0
1998	3113	408	835	1747	347	761	0	710	288	0	126	33	0	0	0	0	4	17	**8389**	1597	0	0	5	0	0	0	5
1999	6178	721	4804	5665	9244	2789	661	521	576	130		554	0	0	28	0	0	7	**31878**	5652	10	0	0	0	0	0	10
2000	4428	1505	3580	6945	11737	9419	0	255	624	82	40	33	10	42	14	0	4	25	**38743**	6086	0	3	0	0	0	0	3
2001	9339	265	209	2172	9013	6405	0	710	96	130	80	0	0	0	0	0	0	4	**28423**	3443	0	0	0	0	0	0	0
2002	4133	376	835	2408	2091	2980	0	326	331	0	322	6181	0	0	0	0	0	4	**19987**	6278	0	0	0	0	0	0	0
2003	1293	94	261	1369	1436	4780	44	331	48	174	443	0	0	0	0	0	0	0	**10273**	2516	0	0	0	0	0	0	0
2004	886	157	112	1039	842	1680	756	101	1296	0	46	37	0	0	28	0	0	0	**6980**	1681	0	0	0	0	0	0	0
2005	1533	470	3081	964	2327	3397	1146	0	946	143	80	32	0	0	0	0	0	0	**14119**	2807	0	0	0	0	0	0	0
2006	1485	345	2611	991	2526	4741	453	221	288	43	80	65	0	0	63	6	0	4	**13922**	2345	0	0	0	nf	0	0	0
2007	14991	4610	5065	1457	22015	32905	882	900	2358	7694	201	10610	27	0	38	0	0	4	**103757**	13838	0	0	0	0	0	0	0
2008	15403	1004	5993	2859	6586	6033	118	1631	912	297	268	1710	9	15	25	0	4	0	**42867**	11520	0	0	0	0	0	0	0
2009	6540	1157	1484	2822	6718	3042	44	473	43	87	46	58	0	nf	6	7	0	17	**22544**	3796	0	0	0	0	0	0	0
2010	3044	282	2402	1665	3075	9492	88	384	43	82	40	811	9	0	7	6	0	0	**21430**	4311	0	0	0	0	0	0	0
2011	3496	282	2611	2408	2080	6236	485	832	55	43	0	65	0	0	0	0	0	4	**18597**	4272	0	0	0	0	0	0	0
2012	10409	860	6313	1416	3566	6794	88	421	128	87	112	65	0	0	0	0	0	0	**30259**	6479	0	0	0	0	0	0	0
2013	4922	188	3916	1175	8133	4107	44	605	0	0	241	0	0	0	0	0	0	0	**23332**	4085	0	0	0	0	0	0	0

Table 15. Cod biomass (t) from Canadian Autumn RV surveys in Division 3O. Both index strata and the most commonly fished deep strata are shown. The index strata are the basis for the assessment. Data for 1984-1995 have been converted to Campellan equivalent units. Values in brackets are estimates for non-sampled strata.

Year	Index Strata (<200 fathoms)																		**Total**	1 std	Deep Strata (≥200 fathoms)						Total
	330	**331**	**338**	**340**	**351**	**352**	**353**	**329**	**332**	**337**	**339**	**354**	**333**	**336**	**355**	**334**	**335**	**356**	**Index**		**717**	**719**	**721**	**718**	**720**	**722**	>200
1990	6651	27	13966	3635	17027	21151	4593	1291	767	2331	1242	66	12	29	nf	16	13	nf	**72817**	11789	0	0	nf	nf	nf	nf	0
1991	2374	1047	7122	6247	21473	32262	56	1019	74	70	0	0	0	0	155	0	8	8	**71915**	12726	nf	0	0	nf	nf	0	0
1992	2574	191	2760	6711	3142	3137	0	109	254	373	64	896	12	0	31	0	0	0	**20254**	4404	nf	nf	nf	nf	nf	nf	0
1993	4278	267	3763	1231	9895	4920	0	245	1323	176	447	0	0	107	104	21	0	68	**26845**	7412	0	0	0	0	0	0	0
1994	1928	172	91	832	679	4775	0	1546	452	0	56	0	0	0	0	0	0	0	**10531**	3158	0	14	0	0	0	0	14
1995	6035	1455	5283	3149	5052	3195	2238	1052	0	0	46	161	0	0	15	0	0	0	**27681**	6346	0	0	0	0	0	0	0
1996	299	11	26	37	73	1340	0	367	0	0	0	258	nf	11	233	nf	300	39	**2994**	1397	nf	55	0	nf	0	0	55
1997	1779	85	167	951	4806	3220	0	159	0	0	276	96	0	0	0	0	16	0	**11555**	2467	0	0	0	0	0	0	0
1998	2027	735	1786	2108	815	1198	0	820	1	0	606	42	0	0	0	0	8	30	**10176**	1753	0	0	9	0	0	0	9
1999	2379	367	16088	2902	7355	9096	716	684	18	21		184	0	0	25	0	0	13	**39848**	15975	1	0	0	0	0	0	1
2000	1817	574	5978	5371	5249	14518	0	86	33	12	161	18	4	49	11	0	1	28	**33910**	6738	0	5	0	0	0	0	5
2001	5922	155	558	1785	8149	7207	0	810	41	91	50	0	0	0	0	0	0	2	**24770**	4051	0	0	0	0	0	0	0
2002	4037	481	493	2542	2296	4081	0	1407	960	0	447	8920	0	0	0	0	0	11	**25675**	8993	0	0	0	0	0	0	0
2003	1547	243	238	2028	2002	8617	2	566	62	111	769	0	0	0	0	0	0	0	**16185**	5988	0	0	0	0	0	0	0
2004	440	641	267	2663	685	3025	239	267	225	0	23	3	0	0	19	0	0	0	**8499**	2867	0	0	0	0	0	0	0
2005	1664	442	3592	3002	4017	4231	1604	0	31	25	145	4	0	0	0	0	0	0	**18757**	4624	0	0	0	0	0	0	0
2006	1347	713	1804	421	1348	4782	1105	185	312	17	25	26	0	0	51	6	0	9	**12151**	2469	0	0	0	nf	0	0	0
2007	1463	141	1010	1540	4093	19781	184	292	165	2891	111	11472	1	0	30	0	0	5	**43179**	16998	0	0	0	0	0	0	0
2008	1813	296	1220	1305	1907	3344	91	333	167	175	59	991	5	24	30	0	6	0	**11766**	2472	0	0	0	0	0	0	0
2009	3019	189	1712	1714	4705	4502	53	622	21	13	100	43	0	nf	4	6	0	33	**16736**	3409	0	0	0	0	0	0	0
2010	1596	214	508	940	3003	8294	64	210	38	50	2	651	14	0	11	4	0	0	**15599**	4027	0	0	0	0	0	0	0
2011	2049	198	3527	1500	2296	6939	1457	754	86	24	0	62	0	0	0	0	0	8	**18900**	4645	0	0	0	0	0	0	0
2012	10556	256	1587	1270	2896	7022	300	376	2	123	156	52	0	0	0	0	0	0	**24596**	6811	0	0	0	0	0	0	0
2013	1671	177	2502	890	5549	4081	12	629	0	0	11	0	0	0	0	0	0	0	**15522**	3010	0	0	0	0	0	0	0

Table 16. Mean number per tow at age of cod from spring RV surveys in NAFO Divisions 3NO as calculated using the conversion from Warren (1997) for surveys in 1984-1995. Results for 1996 -2009 are actual Campelen surveys.

Year	AGE																				
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	1+
1984	0.00	0.16	53.39	41.57	21.35	7.17	5.04	1.51	0.72	1.36	1.15	0.61	0.25	0.10	0.03	0.05	0.08	0.05	0.01	0.00	134.60
1985	0.00	0.37	9.88	29.27	16.14	2.76	0.90	1.03	0.66	0.84	1.18	0.88	0.48	0.23	0.14	0.08	0.08	0.03	0.01	0.02	64.98
1986	0.00	0.38	12.77	3.63	17.87	11.53	2.11	0.82	0.58	0.42	0.61	1.02	0.51	0.31	0.15	0.08	0.04	0.04	0.03	0.03	52.93
1987	0.00	5.00	54.15	14.13	19.67	50.35	26.41	7.38	1.71	1.63	0.54	0.70	0.60	0.68	0.23	0.21	0.12	0.00	0.01	0.02	183.54
1988	0.00	0.18	26.45	12.91	1.02	0.47	1.10	1.13	0.66	0.67	0.75	0.35	0.44	0.69	0.55	0.21	0.11	0.11	0.04	0.03	47.87
1989	0.00	0.38	4.77	10.39	2.40	0.34	0.31	0.61	0.52	0.36	0.40	0.51	0.33	0.27	0.39	0.21	0.11	0.09	0.04	0.03	22.46
1990	0.00	0.90	7.25	6.77	3.80	1.46	0.25	0.41	0.52	0.61	0.46	0.34	0.34	0.16	0.37	0.44	0.22	0.14	0.06	0.05	24.55
1991	0.00	0.57	147.62	15.44	1.59	0.47	0.16	0.07	0.06	0.14	0.12	0.11	0.09	0.12	0.13	0.12	0.18	0.07	0.04	0.00	167.10
1992	0.00	0.00	10.07	9.66	0.24	0.11	0.09	0.03	0.03	0.08	0.11	0.13	0.14	0.12	0.10	0.09	0.09	0.06	0.01	0.01	21.17
1993	0.00	0.00	1.17	58.27	53.63	1.25	0.68	0.46	0.22	0.05	0.08	0.17	0.12	0.07	0.07	0.09	0.05	0.02	0.01	0.01	116.42
1994	0.00	0.00	0.22	0.91	1.63	1.05	0.07	0.12	0.07	0.07	0.02	0.04	0.05	0.07	0.02	0.03	0.01	0.00	0.03	0.01	4.42
1995	0.00	0.00	0.76	0.20	0.04	0.15	0.10	0.01	0.02	0.05	0.01	0.01	0.02	0.05	0.02	0.03	0.02	0.00	0.00	0.00	1.49
1996	0.00	0.10	1.35	1.65	0.44	0.24	0.57	0.56	0.05	0.04	0.03	0.02	0.00	0.00	0.03	0.02	0.00	0.01	0.00	0.00	5.11
1997	0.00	0.06	0.24	1.67	0.58	0.16	0.03	0.09	0.07	0.01	0.02	0.03	0.02	0.01	0.00	0.01	0.00	0.00	0.01	0.00	3.01
1998	0.00	1.71	0.16	0.51	1.23	0.52	0.17	0.13	1.35	1.61	0.15	0.03	0.01	0.03	0.00	0.02	0.01	0.00	0.00	0.00	7.64
1999	0.00	4.69	4.71	4.55	0.38	0.70	0.30	0.11	0.12	0.42	0.84	0.07	0.03	0.03	0.02	0.01	0.00	0.02	0.00	0.00	17.00
2000	0.00	2.15	6.46	4.58	0.69	0.10	0.20	0.29	0.07	0.06	0.57	1.10	0.13	0.02	0.00	0.01	0.02	0.00	0.00	0.00	16.45
2001	0.00	0.15	1.88	2.91	1.01	0.26	0.01	0.06	0.07	0.01	0.01	0.16	0.40	0.04	0.02	0.00	0.01	0.00	0.00	0.00	7.00
2002	0.00	0.23	0.66	0.98	0.40	0.23	0.10	0.01	0.06	0.01	0.02	0.01	0.03	0.16	0.00	0.01	0.00	0.00	0.00	0.00	2.91
2003	0.00	0.30	0.58	0.47	0.51	1.03	0.82	0.12	0.01	0.05	0.02	0.02	0.01	0.08	0.08	0.01	0.00	0.00	0.00	0.00	4.11
2004	0.00	1.18	1.12	0.50	0.19	0.13	0.18	0.18	0.07	0.02	0.08	0.02	0.03	0.02	0.02	0.10	0.01	0.00	0.01	0.00	3.86
2005	0.00	2.64	2.05	2.76	0.48	0.20	0.07	0.33	0.26	0.13	0.02	0.07	0.02	0.00	0.00	0.03	0.02	0.00	0.00	0.00	9.08
2006																					
2007	0.00	14.87	6.12	3.91	1.95	0.46	0.11	0.05	0.09	0.14	0.13	0.11	0.01	0.01	0.01	0.00	0.03	0.01	0.04	0.01	28.06
2008	0.00	0.36	12.89	9.63	1.37	1.03	0.21	0.07	0.01	0.02	0.18	0.14	0.08	0.00	0.02	0.01	0.01	0.01	0.01	0.00	26.05
2009	0.00	0.65	7.02	59.57	8.28	3.94	1.94	0.61	0.14	0.02	0.07	0.08	0.16	0.02	0.01	0.01	0.00	0.00	0.00	0.00	82.52
2010	0.00	4.30	4.21	3.09	5.08	1.57	0.64	0.36	0.06	0.01	0.02	0.01	0.04	0.02	0.00	0.01	0.00	0.00	0.00	0.00	19.42
2011	0.00	0.04	3.92	8.01	1.72	1.65	0.69	0.25	0.16	0.01	0.02	0.01	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	16.51
2012	0.00	1.13	1.04	3.80	3.01	0.70	2.56	0.94	0.34	0.32	0.06	0.05	0.03	0.07	0.08	0.01	0.01	0.00	0.00	0.00	14.16
2013	0.00	1.12	3.43	1.48	2.11	1.99	0.46	2.13	1.04	0.37	0.19	0.04	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	14.37
2014	0.00	1.21	1.40	2.16	0.61	2.59	2.78	0.57	3.90	1.46	0.23	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.96

Table 17. Mean number per tow at age of cod from Autumn RV surveys in NAFO Divisions 3NO as calculated using the conversion from Warren (1997) for surveys in 1984-1994. Results for 1995 -2009 are actual Campelen surveys.

Year	AGE																				
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	1+
1990	0.00	18.89	6.15	3.25	3.56	1.73	0.37	0.29	0.38	0.40	0.24	0.20	0.09	0.15	0.07	0.16	0.21	0.07	0.02	0.03	36.26
1991	0.00	14.87	129.66	4.36	2.19	2.73	1.33	0.37	0.31	0.53	0.37	0.45	0.33	0.27	0.21	0.12	0.38	0.16	0.06	0.00	158.70
1992	0.00	0.41	49.65	65.00	4.70	1.02	0.61	0.18	0.03	0.03	0.07	0.00	0.06	0.12	0.03	0.03	0.02	0.03	0.08	0.00	122.07
1993	0.00	1.30	0.72	3.63	3.59	0.30	0.27	0.18	0.10	0.02	0.02	0.06	0.04	0.04	0.05	0.06	0.02	0.01	0.02	0.00	10.43
1994	0.00	0.00	0.62	0.28	0.96	1.32	0.16	0.04	0.06	0.01	0.01	0.03	0.03	0.02	0.06	0.01	0.03	0.02	0.01	0.00	3.67
1995	0.00	1.15	1.02	0.46	0.20	0.94	1.64	0.11	0.05	0.06	0.05	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	5.72
1996	0.00	0.08	0.74	0.29	0.06	0.01	0.02	0.02	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.00	1.26
1997	0.00	0.03	0.10	0.40	0.33	0.14	0.06	0.28	0.28	0.05	0.04	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.01	1.74
1998	0.00	1.67	0.29	0.20	0.32	0.11	0.06	0.01	0.16	0.22	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01		3.09
1999	0.39	4.44	5.01	2.52	0.13	0.37	0.30	0.08	0.04	0.12	0.55	0.04	0.00	0.00	0.02	0.00	0.02	0.03	0.00	0.01	13.68
2000	0.07	2.12	3.77	4.75	1.81	0.20	0.24	0.11	0.03	0.01	0.03	0.24	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	13.33
2001	0.06	0.34	2.64	4.70	2.55	0.98	0.07	0.16	0.06	0.02	0.02	0.00	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	11.60
2002	0.13	0.33	0.61	1.13	1.58	1.31	0.39	0.03	0.06	0.04	0.00	0.03	0.03	0.05	0.01	0.00	0.01	0.00	0.00	0.00	5.61
2003	0.16	0.96	0.27	0.26	0.35	0.78	0.83	0.14	0.01	0.02	0.05	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	3.71
2004	1.08	0.97	0.63	0.35	0.14	0.12	0.23	0.24	0.12	0.01	0.04	0.00	0.00	0.00	0.07	0.03	0.00	0.00	0.00	0.00	2.95
2005	0.27	4.24	2.42	1.24	0.23	0.07	0.06	0.27	0.38	0.10	0.00	0.04	0.01	0.03	0.00	0.02	0.03	0.00	0.00	0.00	9.14
2006	0.21	0.19	2.10	3.94	1.27	0.47	0.13	0.05	0.20	0.09	0.12	0.04	0.01	0.00	0.00	0.01	0.02	0.00	0.00	0.00	8.64
2007	0.15	13.95	15.61	3.70	3.28	0.44	0.18	0.05	0.05	0.14	0.23	0.06	0.00	0.02	0.01	0.01	0.01	0.00	0.00	0.00	37.74
2008	0.53	1.32	13.79	8.96	1.30	0.92	0.20	0.07	0.00	0.01	0.03	0.03	0.09	0.00	0.03	0.01	0.00	0.00	0.03	0.00	26.79
2009	0.08	3.25	8.10	16.37	5.11	1.07	0.65	0.12	0.06	0.00	0.00	0.03	0.05	0.01	0.00	0.01	0.00	0.00	0.00	0.00	34.83
2010	0.29	4.52	3.37	2.07	3.09	1.38	0.41	0.30	0.21	0.05	0.00	0.03	0.02	0.07	0.01	0.00	0.00	0.00	0.00	0.00	15.53
2011	0.13	0.66	3.10	3.55	0.73	2.99	0.82	0.32	0.24	0.03	0.03	0.01	0.00	0.06	0.01	0.00	0.01	0.00	0.00	0.00	12.56
2012	0.64	4.16	2.12	2.95	2.25	0.73	2.76	1.09	0.43	0.28	0.15	0.00	0.02	0.02	0.02	0.00	0.01	0.00	0.00	0.00	17.00
2013	0.16	5.19	5.98	2.07	2.25	2.50	0.86	2.26	0.80	0.25	0.15	0.10	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	22.43

Table 18. Mean number per tow at age of cod from Juvenile Surveys conducted by Canada in Divisions 3NO during August and September

Year	Age															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	1+
1989	0.00	1.40	14.16	12.58	5.82	1.21	0.72	1.22	0.79	0.25	0.17	0.20	0.11	0.09	0.16	38.88
1990	0.00	60.88	11.62	6.53	8.99	3.62	0.67	0.50	0.63	0.53	0.28	0.21	0.04	0.08	0.27	94.85
1991	0.00	36.33	74.04	8.54	2.45	1.96	0.72	0.19	0.17	0.24	0.19	0.23	0.18	0.17	0.48	125.89
1992	0.00	0.84	12.28	12.89	1.42	0.69	0.52	0.22	0.05	0.03	0.03	0.00	0.02	0.10	0.13	29.22
1993	0.00	1.98	3.70	8.85	7.91	0.80	0.30	0.28	0.10	0.02	0.04	0.10	0.08	0.06	0.09	24.31
1994	0.00	2.75	4.03	1.25	4.07	4.79	0.41	0.08	0.13	0.05	0.01	0.05	0.06	0.08	0.09	17.85

Table 19. Estimated proportions mature for female cod from NAFO Divs. 3NO from DFO surveys from 1975 to 2014 projected forward to 2016 and back to 1954. Estimates were obtained from a probit model fitted by cohort to observed proportions mature at age. When the model did not fit the data for a particular cohort (I.e 1991 and 2000 cohorts) the average of estimates for the same age group from adjacent years was used; dark shaded cells are averages extrapolated forward or backward from the same age group from 3 previous (or next) years.

Year	Age 1	Age2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14
1954	0.0000	0.0004	0.0020	0.0112	0.0592	0.2424	0.5895	0.8856	0.9812	0.9972	0.9996	0.9999	1.0000	1.0000
1955	0.0001	0.0000	0.0020	0.0112	0.0592	0.2424	0.5895	0.8856	0.9812	0.9972	0.9996	0.9999	1.0000	1.0000
1956	0.0001	0.0003	0.0001	0.0112	0.0592	0.2424	0.5895	0.8856	0.9812	0.9972	0.9996	0.9999	1.0000	1.0000
1957	0.0003	0.0007	0.0018	0.0008	0.0592	0.2424	0.5895	0.8856	0.9812	0.9972	0.9996	0.9999	1.0000	1.0000
1958	0.0001	0.0016	0.0041	0.0102	0.0065	0.2424	0.5895	0.8856	0.9812	0.9972	0.9996	0.9999	1.0000	1.0000
1959	0.0000	0.0006	0.0079	0.0226	0.0555	0.0509	0.5895	0.8856	0.9812	0.9972	0.9996	0.9999	1.0000	1.0000
1960	0.0000	0.0000	0.0033	0.0393	0.1157	0.2512	0.3043	0.8856	0.9812	0.9972	0.9996	0.9999	1.0000	1.0000
1961	0.0002	0.0001	0.0001	0.0168	0.1731	0.4251	0.6572	0.7809	0.9812	0.9972	0.9996	0.9999	1.0000	1.0000
1962	0.0000	0.0012	0.0009	0.0012	0.0825	0.5172	0.8069	0.9164	0.9667	0.9972	0.9996	0.9999	1.0000	1.0000
1963	0.0000	0.0002	0.0056	0.0099	0.0229	0.3206	0.8458	0.9594	0.9843	0.9958	0.9996	0.9999	1.0000	1.0000
1964	0.0000	0.0000	0.0010	0.0266	0.1000	0.3219	0.7124	0.9656	0.9926	0.9972	0.9995	0.9999	1.0000	1.0000
1965	0.0014	0.0000	0.0000	0.0049	0.1162	0.5526	0.9057	0.9286	0.9931	0.9987	0.9995	0.9999	1.0000	1.0000
1966	0.0000	0.0043	0.0005	0.0006	0.0234	0.3875	0.9321	0.9949	0.9856	0.9986	0.9998	0.9999	1.0000	1.0000
1967	0.0000	0.0001	0.0132	0.0067	0.0097	0.1037	0.7527	0.9935	0.9997	0.9972	0.9997	1.0000	1.0000	1.0000
1968	0.0000	0.0000	0.0012	0.0398	0.0820	0.1450	0.3587	0.9361	0.9994	1.0000	0.9995	0.9999	1.0000	1.0000
1969	0.0000	0.0000	0.0003	0.0090	0.1144	0.5429	0.7457	0.7301	0.9860	0.9999	1.0000	0.9999	1.0000	1.0000
1970	0.0032	0.0000	0.0001	0.0029	0.0665	0.2866	0.9405	0.9807	0.9290	0.9971	1.0000	1.0000	1.0000	1.0000
1971	0.0000	0.0093	0.0000	0.0009	0.0275	0.3582	0.5555	0.9953	0.9989	0.9844	0.9994	1.0000	1.0000	1.0000
1972	0.0000	0.0002	0.0269	0.0000	0.0101	0.2176	0.8140	0.7954	0.9996	0.9999	0.9967	0.9999	1.0000	1.0000
1973	0.0001	0.0000	0.0013	0.0754	0.0038	0.1018	0.7320	0.9717	0.9236	1.0000	1.0000	0.9993	1.0000	1.0000
1974	0.0000	0.0006	0.0001	0.0083	0.1939	0.2928	0.5582	0.9641	0.9963	0.9741	1.0000	1.0000	0.9999	1.0000
1975	0.0000	0.0003	0.0033	0.0017	0.0530	0.4148	0.9780	0.9337	0.9962	0.9995	0.9915	1.0000	1.0000	1.0000
1976	0.0000	0.0001	0.0020	0.0186	0.0221	0.2715	0.6763	0.9998	0.9937	0.9996	0.9999	0.9973	1.0000	1.0000
1977	0.0006	0.0001	0.0009	0.0142	0.0978	0.2269	0.7128	0.8603	1.0000	0.9994	1.0000	1.0000	0.9991	1.0000
1978	0.0001	0.0029	0.0014	0.0083	0.0935	0.3823	0.7922	0.9429	0.9478	1.0000	0.9999	1.0000	1.0000	0.9997
1979	0.0000	0.0005	0.0145	0.0133	0.0733	0.4248	0.7794	0.9802	0.9910	0.9817	1.0000	1.0000	1.0000	1.0000
1980	0.0002	0.0002	0.0034	0.0695	0.1140	0.4292	0.8410	0.9528	0.9984	0.9986	0.9937	1.0000	1.0000	1.0000
1981	0.0000	0.0007	0.0020	0.0236	0.2749	0.5518	0.8773	0.9743	0.9914	0.9999	0.9998	0.9979	1.0000	1.0000
1982	0.0000	0.0000	0.0035	0.0162	0.1460	0.6579	0.9218	0.9855	0.9963	0.9985	1.0000	1.0000	0.9993	1.0000
1983	0.0000	0.0001	0.0003	0.0163	0.1219	0.5474	0.9070	0.9912	0.9985	0.9995	0.9997	1.0000	1.0000	0.9998
1984	0.0000	0.0003	0.0008	0.0028	0.0726	0.5389	0.8953	0.9802	0.9991	0.9998	0.9999	1.0000	1.0000	1.0000
1985	0.0002	0.0002	0.0019	0.0058	0.0261	0.2703	0.9078	0.9837	0.9960	0.9999	1.0000	1.0000	1.0000	1.0000
1986	0.0000	0.0010	0.0021	0.0134	0.0409	0.2049	0.6369	0.9881	0.9977	0.9992	1.0000	1.0000	1.0000	1.0000
1987	0.0001	0.0000	0.0058	0.0194	0.0869	0.2358	0.7128	0.8925	0.9986	0.9997	0.9998	1.0000	1.0000	1.0000
1988	0.0011	0.0006	0.0002	0.0335	0.1570	0.3994	0.6908	0.9598	0.9752	0.9998	1.0000	1.0000	1.0000	1.0000
1989	0.0001	0.0043	0.0047	0.0031	0.1702	0.6371	0.8229	0.9418	0.9957	0.9947	1.0000	1.0000	1.0000	1.0000
1990	0.0000	0.0011	0.0170	0.0377	0.0441	0.5486	0.9431	0.9701	0.9915	0.9995	0.9989	1.0000	1.0000	1.0000
1991	0.0000	0.0000	0.0079	0.0645	0.2438	0.4047	0.8780	0.9936	0.9956	0.9988	1.0000	0.9998	1.0000	1.0000
1992	0.0000	0.0000	0.0004	0.0557	0.2155	0.7265	0.9092	0.9771	0.9993	0.9994	0.9998	1.0000	0.9999	1.0000
1993	0.0001	0.0004	0.0002	0.0121	0.3045	0.5225	0.9563	0.9933	0.9961	0.9999	0.9999	1.0000	1.0000	1.0000
1994	0.0004	0.0008	0.0040	0.0153	0.2825	0.7646	0.8134	0.9945	0.9995	0.9993	1.0000	1.0000	1.0000	1.0000
1995	0.0002	0.0030	0.0078	0.0418	0.5844	0.9266	0.9602	0.9455	0.9993	1.0000	0.9999	1.0000	1.0000	1.0000
1996	0.0004	0.0014	0.0229	0.0683	0.4952	0.9922	0.9975	0.9944	0.9857	0.9999	1.0000	1.0000	1.0000	1.0000
1997	0.0000	0.0026	0.0130	0.1536	0.4059	0.9282	0.9999	0.9999	0.9992	0.9964	1.0000	1.0000	1.0000	1.0000
1998	0.0000	0.0001	0.0170	0.1076	0.5837	0.8642	0.9917	1.0000	1.0000	0.9999	0.9991	1.0000	1.0000	1.0000
1999	0.0000	0.0000	0.0009	0.1035	0.5240	0.9155	0.9834	0.9991	1.0000	1.0000	1.0000	0.9998	1.0000	1.0000
2000	0.0000	0.0003	0.0011	0.0135	0.4356	0.9095	0.9882	0.9982	0.9999	1.0000	1.0000	1.0000	0.9999	1.0000
2001	0.0006	0.0002	0.0066	0.0278	0.1676	0.8377	0.9892	0.9985	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000
2002	0.0011	0.0028	0.0067	0.1366	0.4280	0.7473	0.9718	0.9988	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000
2003	0.0006	0.0055	0.0163	0.1598	0.7908	0.9514	0.9775	0.9957	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000
2004	0.0024	0.0028	0.0259	0.1370	0.8429	0.9891	0.9981	0.9984	0.9994	1.0000	1.0000	1.0000	1.0000	1.0000
2005	0.0025	0.0110	0.0131	0.1142	0.6136	0.9934	0.9995	0.9999	0.9999	0.9999	1.0000	1.0000	1.0000	1.0000
2006	0.0001	0.0094	0.0484	0.0588	0.3844	0.8725	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2007	0.0010	0.0008	0.0345	0.1889	0.2267	0.7516	0.9680	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2008	0.0028	0.0041	0.0040	0.1182	0.5160	0.5791	0.9361	0.9931	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2009	0.0006	0.0108	0.0172	0.0206	0.3345	0.8299	0.8659	0.9861	0.9986	1.0000	1.0000	1.0000	1.0000	1.0000
2010	0.0015	0.0036	0.0409	0.0692	0.1002	0.6534	0.9571	0.9680	0.9971	0.9997	1.0000	1.0000	1.0000	1.0000
2011	0.0015	0.0062	0.0202	0.1431	0.2401	0.3708	0.8761	0.9903	0.9930	0.9994	0.9999	1.0000	1.0000	1.0000
2012	0.0015	0.0062	0.0261	0.1049	0.3953	0.5732	0.7571	0.9637	0.9979	0.9985	0.9999	1.0000	1.0000	1.0000
2013	0.0015	0.0062	0.0261	0.1057	0.3996	0.7191	0.8509	0.9428	0.9900	0.9995	0.9997	1.0000	1.0000	1.0000
2014	0.0015	0.0062	0.0261	0.1057	0.3450	0.7908	0.9093	0.9604	0.9887	0.9973	0.9999	0.9999	1.0000	1.0000
2015	0.0015	0.0062	0.0261	0.1057	0.3450	0.6944	0.9555	0.9752	0.9904	0.9978	0.9993	1.0000	1.0000	1.0000
2016	0.0015	0.0062	0.0261	0.1057	0.3450	0.6944	0.9052	0.9919	0.9935	0.9977	0.9996	0.9998	1.0000	1.0000

Table 20. Estimated survivors and catchabilities in linear scale from ADAPT.

Orthogonality offset	0.000790
Mean square residuals	0.597292

Year	Age	Estimate	Standard Error	Relative Error	Bias	Relative Bias
1994	12	87.371	64.464	0.738	12.921	0.148
1995	12	52.885	24.117	0.456	4.390	0.083
1996	12	31.762	10.887	0.343	1.715	0.054
1997	12	67.633	21.111	0.312	3.200	0.047
1998	12	94.926	31.087	0.327	4.885	0.051
1999	12	47.184	16.208	0.344	2.522	0.053
2000	12	52.056	15.546	0.299	2.186	0.042
2001	12	464.069	127.604	0.275	16.752	0.036
2002	12	221.612	59.844	0.270	7.855	0.035
2003	12	31.630	8.548	0.270	1.098	0.035
2004	12	39.815	11.404	0.286	1.469	0.037
2005	12	67.267	19.826	0.295	2.554	0.038
2006	12	71.843	22.684	0.316	3.051	0.042
2007	12	17.910	5.506	0.307	0.795	0.044
2008	12	113.264	36.612	0.323	5.308	0.047
2009	12	243.152	76.086	0.313	10.884	0.045
2010	12	168.674	52.202	0.309	7.461	0.044
2011	12	48.507	14.293	0.295	2.068	0.043
2012	12	32.717	10.221	0.312	1.497	0.046
2013	12	56.208	15.384	0.274	2.025	0.036
2014	12	118.078	31.494	0.267	4.094	0.035
2015	3	1258.162	1015.222	0.807	408.514	0.325
2016	4	2426.014	1179.090	0.486	287.615	0.119
2017	5	793.432	345.295	0.435	68.783	0.087
2018	6	1938.007	673.763	0.348	117.633	0.061
2019	7	2343.873	689.504	0.294	110.209	0.047
2020	8	985.844	270.030	0.274	40.443	0.041
2021	9	3710.216	903.930	0.244	127.954	0.034
2022	10	1658.364	383.413	0.231	51.665	0.031
2023	11	515.490	124.090	0.241	16.225	0.031
2024	12	380.347	93.725	0.246	11.989	0.032

Catchabilities	Age	Estimate	Standard Error	Relative Error	Bias	Relative Bias
RV Spring	2	0.000967	0.000147	0.152	0.000005	0.005
RV Spring	3	0.001360	0.000204	0.150	0.000007	0.005
RV Spring	4	0.000688	0.000104	0.151	0.000004	0.005
RV Spring	5	0.000482	0.000074	0.153	0.000003	0.006
RV Spring	6	0.000343	0.000054	0.156	0.000002	0.006
RV Spring	7	0.000353	0.000057	0.160	0.000003	0.008
RV Spring	8	0.000355	0.000058	0.165	0.000003	0.010
RV Spring	9	0.000361	0.000061	0.169	0.000004	0.012
RV Spring	10	0.000481	0.000083	0.173	0.000007	0.015
RV Fall	2	0.001009	0.000171	0.169	0.000007	0.007
RV Fall	3	0.001080	0.000183	0.170	0.000008	0.007
RV Fall	4	0.000801	0.000138	0.172	0.000006	0.008
RV Fall	5	0.000686	0.000121	0.177	0.000006	0.009
RV Fall	6	0.000585	0.000106	0.182	0.000006	0.010
RV Fall	7	0.000416	0.000078	0.188	0.000005	0.013
RV Fall	8	0.000425	0.000084	0.197	0.000007	0.015
RV Fall	9	0.000322	0.000066	0.205	0.000006	0.019
RV Fall	10	0.000446	0.000099	0.223	0.000012	0.028
RV Juvenile	2	0.003599	0.001146	0.318	0.000164	0.046
RV Juvenile	3	0.001885	0.000598	0.317	0.000086	0.045
RV Juvenile	4	0.001371	0.000437	0.319	0.000063	0.046
RV Juvenile	5	0.001128	0.000360	0.320	0.000051	0.045
RV Juvenile	6	0.000832	0.000268	0.322	0.000036	0.044
RV Juvenile	7	0.000618	0.000202	0.328	0.000028	0.045
RV Juvenile	8	0.000493	0.000164	0.332	0.000023	0.047
RV Juvenile	9	0.000318	0.000108	0.338	0.000017	0.052
RV Juvenile	10	0.000284	0.000099	0.349	0.000018	0.064

Table 21. Estimated bias adjusted population numbers ('000) from ADAPT for cod in NAFO Division 3NO.

Pop #s Bias Adj(analytical)	2	3	4	5	6	7	8	9	10	11	12	Total
1959	63623	53067	92911	19327	16484	12049	4268	3076	3217	2287	324	270633
1960	98989	52090	41903	64326	11271	8099	6336	2246	1838	1803	786	289687
1961	130098	81045	40981	28451	32902	6449	4497	2947	1315	1157	675	330518
1962	94606	106515	65621	29586	12832	13314	3473	2185	1652	900	925	331609
1963	135041	77456	86281	50223	22233	9081	7673	2149	1189	964	534	392824
1964	195488	110562	63133	65447	31040	13843	5695	2858	722	432	500	489720
1965	252970	160052	84924	37711	36087	18299	9287	3665	1632	298	320	605245
1966	221171	207114	130125	62667	24021	17671	6202	3302	2030	239	99	674641
1967	121541	181079	168890	89951	33653	9146	6895	1137	1076	183	87	613638
1968	154111	99509	130150	82351	28883	11073	3234	1531	719	719	86	512366
1969	96818	126175	66743	55815	24240	7265	3431	1228	801	429	508	383452
1970	101648	79268	95947	43016	21651	9853	4073	1563	542	394	231	358185
1971	74517	83223	62998	60832	25515	9253	4801	1872	795	310	121	324237
1972	42188	61009	67279	27529	22783	10441	4442	1704	1083	471	164	239094
1973	44124	34541	49888	37315	11560	6720	3316	2127	1138	693	316	191736
1974	27761	36125	19252	16285	17043	4127	3733	1842	1108	713	444	128434
1975	32962	22729	23794	7287	3682	4318	1379	1147	605	307	204	98415
1976	54557	26987	18003	11616	2818	800	837	198	132	90	31	116070
1977	50011	44667	18444	8002	4212	1337	465	471	123	75	62	127870
1978	20889	40946	36022	12876	4282	2104	583	223	199	43	25	118192
1979	23695	17103	32693	25584	8277	2769	1404	386	130	117	28	112185
1980	33044	19400	13938	23318	12697	4281	1475	911	264	91	85	109503
1981	26257	27054	15643	10460	15659	8348	2820	1008	663	188	67	108166
1982	42449	21497	21694	11823	7426	10751	5125	1792	653	458	117	123786
1983	49768	34755	17325	15978	8246	5168	7426	2857	934	345	230	143032
1984	39446	40747	27390	13600	11376	5667	3613	5043	1644	551	210	149286
1985	10608	32295	33308	21523	9863	7223	3543	2311	3302	852	356	125184
1986	7775	8685	26390	24608	12053	5351	3656	2184	1479	2224	463	94868
1987	15504	6366	6973	19023	14377	5954	3024	2142	1287	876	1506	77032
1988	15405	12518	4747	5328	12433	8675	3783	1888	997	611	361	66747
1989	6156	12381	9999	3599	2991	4522	3570	2191	1037	437	278	47161
1990	6816	4925	8411	6224	1604	1322	2015	1773	1358	640	207	35294
1991	24316	5210	3076	2874	1261	517	704	1004	930	718	389	40999
1992	7710	14492	3274	1913	1462	546	172	249	316	315	247	30695
1993	780	6237	7820	1105	818	649	237	83	115	145	121	18113
1994	485	609	3925	3532	339	244	245	128	46	59	74	9687
1995	922	397	291	1147	1890	165	117	177	97	37	48	5290
1996	1285	755	325	174	921	1511	134	96	144	80	30	5454
1997	454	1050	614	262	139	739	1215	107	76	115	64	4837
1998	2734	371	849	487	204	110	577	954	83	59	90	6517
1999	5796	2237	301	674	380	158	85	447	744	64	45	10932
2000	5422	4704	1747	209	461	275	117	64	345	560	50	13955
2001	2136	4430	3530	1125	94	322	206	85	49	271	447	12695
2002	975	1740	3458	2618	777	67	225	148	63	38	214	10323
2003	853	708	1228	2336	1759	509	47	160	109	49	31	7789
2004	1629	660	279	288	779	841	298	34	114	82	38	5042
2005	4454	1324	507	188	191	555	623	225	27	87	65	8244
2006	4227	3645	1083	414	152	153	429	460	166	21	69	10819
2007	9103	3420	2791	735	265	106	121	342	375	134	17	17410
2008	16608	7449	2615	2025	518	195	78	93	272	298	108	30260
2009	3874	13596	6095	2089	1509	387	141	62	74	205	232	28265
2010	7370	3161	10895	4840	1587	1154	294	106	50	57	161	29675
2011	5098	5809	2395	8506	3786	1232	910	229	87	39	46	28138
2012	1813	4134	4588	1910	6844	3060	966	703	181	67	31	24298
2013	3474	1461	3189	3578	1530	5517	2474	777	563	144	54	22760
2014	1104	2826	1044	2395	2793	1215	4407	1977	614	452	114	18941
2015	1909	850	2138	725	1820	2234	945	3582	1607	499	368	16677

Table 22. Bias adjusted fishing mortality from ADAPT for cod in NAFO Divisions 3NO.

F Bias Adj(analytical)	2	3	4	5	6	7	8	9	10	11	12	Fbar6-9	Fbar4-6
1959	0.000	0.036	0.168	0.339	0.511	0.443	0.442	0.315	0.379	0.868	0.428	0.428	0.339
1960	0.000	0.040	0.187	0.470	0.358	0.388	0.566	0.335	0.263	0.782	0.412	0.412	0.339
1961	0.000	0.011	0.126	0.596	0.705	0.419	0.522	0.379	0.179	0.024	0.506	0.506	0.476
1962	0.000	0.011	0.067	0.086	0.146	0.351	0.280	0.408	0.339	0.322	0.296	0.296	0.100
1963	0.000	0.004	0.076	0.281	0.274	0.267	0.788	0.891	0.813	0.456	0.555	0.555	0.210
1964	0.000	0.064	0.315	0.395	0.328	0.199	0.241	0.360	0.684	0.099	0.282	0.282	0.346
1965	0.000	0.007	0.104	0.251	0.514	0.882	0.834	0.391	1.721	0.902	0.655	0.655	0.290
1966	0.000	0.004	0.169	0.422	0.766	0.741	1.496	0.921	2.208	0.811	0.981	0.981	0.452
1967	0.000	0.130	0.518	0.936	0.912	0.839	1.305	0.259	0.203	0.553	0.829	0.829	0.789
1968	0.000	0.199	0.647	1.023	1.180	0.972	0.768	0.448	0.317	0.148	0.842	0.842	0.950
1969	0.000	0.074	0.239	0.747	0.700	0.379	0.586	0.618	0.509	0.419	0.571	0.571	0.562
1970	0.000	0.030	0.256	0.322	0.650	0.519	0.578	0.476	0.359	0.983	0.556	0.556	0.409
1971	0.000	0.013	0.628	0.782	0.694	0.534	0.836	0.347	0.323	0.436	0.603	0.603	0.701
1972	0.000	0.001	0.389	0.668	1.021	0.947	0.536	0.203	0.247	0.201	0.677	0.677	0.693
1973	0.000	0.385	0.920	0.584	0.830	0.388	0.388	0.453	0.267	0.245	0.515	0.515	0.778
1974	0.000	0.218	0.771	1.287	1.173	0.896	0.980	0.913	1.083	1.052	0.991	0.991	1.077
1975	0.000	0.033	0.517	0.750	1.327	1.441	1.740	1.960	1.705	2.097	1.617	1.617	0.865
1976	0.000	0.181	0.611	0.815	0.546	0.342	0.374	0.279	0.366	0.173	0.385	0.385	0.657
1977	0.000	0.015	0.159	0.425	0.494	0.629	0.538	0.662	0.859	0.899	0.581	0.581	0.360
1978	0.000	0.025	0.142	0.242	0.236	0.205	0.213	0.337	0.330	0.231	0.248	0.248	0.207
1979	0.000	0.005	0.138	0.501	0.459	0.430	0.232	0.181	0.155	0.120	0.326	0.326	0.366
1980	0.000	0.015	0.087	0.198	0.219	0.217	0.181	0.118	0.139	0.102	0.184	0.184	0.168
1981	0.000	0.021	0.080	0.142	0.176	0.288	0.253	0.235	0.170	0.274	0.238	0.238	0.133
1982	0.000	0.016	0.106	0.160	0.162	0.170	0.384	0.452	0.437	0.489	0.292	0.292	0.143
1983	0.000	0.038	0.042	0.140	0.175	0.158	0.187	0.353	0.328	0.298	0.218	0.218	0.119
1984	0.000	0.002	0.041	0.121	0.254	0.270	0.247	0.223	0.457	0.238	0.249	0.249	0.139
1985	0.000	0.002	0.103	0.380	0.411	0.481	0.284	0.246	0.195	0.409	0.356	0.356	0.298
1986	0.000	0.020	0.127	0.337	0.505	0.371	0.335	0.329	0.324	0.189	0.385	0.385	0.323
1987	0.014	0.094	0.069	0.225	0.305	0.253	0.271	0.564	0.544	0.685	0.348	0.348	0.200
1988	0.018	0.025	0.077	0.377	0.811	0.688	0.346	0.399	0.626	0.589	0.561	0.561	0.422
1989	0.023	0.187	0.274	0.608	0.616	0.608	0.500	0.279	0.283	0.546	0.501	0.501	0.500
1990	0.069	0.271	0.874	1.396	0.933	0.430	0.497	0.445	0.437	0.298	0.576	0.576	1.068
1991	0.318	0.265	0.275	0.476	0.637	0.900	0.841	0.954	0.884	0.868	0.833	0.833	0.463
1992	0.012	0.417	0.886	0.649	0.611	0.634	0.523	0.571	0.583	0.755	0.585	0.585	0.715
1993	0.048	0.263	0.595	0.983	1.009	0.773	0.418	0.398	0.464	0.464	0.650	0.650	0.862
1994	0.000	0.539	1.030	0.425	0.517	0.539	0.124	0.071	0.024	0.000	0.000	0.313	0.657
1995	0.000	0.000	0.317	0.019	0.024	0.013	0.000	0.006	0.000	0.000	0.000	0.011	0.120
1996	0.002	0.006	0.017	0.019	0.021	0.018	0.025	0.023	0.023	0.014	0.000	0.022	0.019
1997	0.002	0.013	0.033	0.047	0.040	0.047	0.042	0.053	0.059	0.049	0.053	0.046	0.040
1998	0.000	0.009	0.030	0.049	0.055	0.052	0.055	0.049	0.055	0.078	0.063	0.053	0.045
1999	0.009	0.047	0.162	0.180	0.123	0.103	0.081	0.058	0.085	0.053	0.051	0.091	0.155
2000	0.002	0.087	0.240	0.605	0.160	0.088	0.120	0.071	0.042	0.024	0.045	0.110	0.335
2001	0.005	0.048	0.099	0.170	0.138	0.159	0.131	0.095	0.046	0.037	0.030	0.131	0.136
2002	0.120	0.148	0.192	0.198	0.222	0.160	0.142	0.102	0.054	0.029	0.031	0.157	0.204
2003	0.057	0.731	1.249	0.899	0.538	0.337	0.126	0.133	0.084	0.046	0.037	0.283	0.895
2004	0.007	0.064	0.195	0.212	0.139	0.100	0.081	0.033	0.070	0.041	0.029	0.089	0.182
2005	0.000	0.001	0.002	0.012	0.023	0.057	0.102	0.103	0.042	0.039	0.035	0.072	0.012
2006	0.012	0.067	0.187	0.245	0.165	0.037	0.026	0.005	0.013	0.000	0.000	0.058	0.199
2007	0.000	0.068	0.121	0.150	0.110	0.099	0.056	0.029	0.030	0.017	0.000	0.074	0.127
2008	0.000	0.001	0.025	0.094	0.091	0.120	0.029	0.036	0.084	0.049	0.074	0.069	0.070
2009	0.003	0.021	0.031	0.074	0.068	0.077	0.090	0.018	0.062	0.038	0.079	0.063	0.058
2010	0.038	0.078	0.048	0.045	0.053	0.038	0.050	0.000	0.045	0.000	0.007	0.035	0.049
2011	0.010	0.036	0.026	0.017	0.013	0.043	0.057	0.034	0.052	0.029	0.000	0.037	0.019
2012	0.016	0.060	0.048	0.022	0.016	0.013	0.018	0.022	0.031	0.017	0.000	0.017	0.029
2013	0.007	0.136	0.086	0.048	0.030	0.024	0.024	0.035	0.020	0.031	0.000	0.028	0.055
2014	0.062	0.079	0.165	0.074	0.024	0.051	0.007	0.007	0.007	0.005	0.000	0.022	0.088

Table 23. Beginning of year mean weights at age calculated from the commercial catches for cod in Divisions 3NO.

Year\Age	3	4	5	6	7	8	9	10	11	12
1959	0.301	0.664	1.001	1.622	2.572	3.129	3.670	4.419	4.843	5.691
1960	0.301	0.587	1.012	1.561	2.345	3.092	3.673	4.316	4.957	5.691
1961	0.301	0.587	1.012	1.561	2.345	3.092	3.673	4.316	4.957	5.691
1962	0.301	0.587	1.012	1.561	2.345	3.092	3.673	4.316	4.957	5.691
1963	0.301	0.587	1.012	1.561	2.345	3.092	3.673	4.316	4.957	5.691
1964	0.301	0.587	1.012	1.561	2.345	3.092	3.673	4.316	4.957	5.691
1965	0.287	0.587	1.012	1.561	2.345	3.092	3.673	4.316	4.957	5.691
1966	0.351	0.615	1.052	1.636	2.482	3.446	4.636	5.532	6.292	7.332
1967	0.351	0.657	1.102	1.700	2.600	3.647	5.166	6.982	8.066	9.308
1968	0.351	0.657	1.102	1.700	2.600	3.647	5.166	6.982	8.066	9.308
1969	0.351	0.657	1.102	1.700	2.600	3.647	5.166	6.982	8.066	9.308
1970	0.351	0.657	1.102	1.700	2.600	3.647	5.166	6.982	8.066	9.308
1971	0.338	0.657	1.102	1.700	2.600	3.647	5.166	6.982	8.066	9.308
1972	0.397	0.682	1.138	1.676	2.487	3.354	5.005	7.100	7.999	9.262
1973	0.504	0.735	1.178	1.776	2.748	3.658	4.717	7.542	9.423	10.789
1974	0.289	0.645	1.095	1.674	2.503	4.117	5.822	5.842	8.961	9.159
1975	0.246	0.611	0.967	1.599	2.481	3.449	5.082	7.024	5.364	7.717
1976	0.354	0.588	1.120	1.727	2.631	3.557	5.268	6.952	7.849	8.113
1977	0.420	0.707	1.161	1.870	2.860	3.925	5.375	7.666	10.112	10.239
1978	0.617	0.774	1.245	1.825	3.046	4.023	5.417	7.200	9.139	12.271
1979	0.514	0.840	1.208	1.800	2.541	3.720	4.679	6.653	7.596	9.790
1980	0.531	0.822	1.287	1.864	2.777	3.969	5.434	6.618	8.706	10.031
1981	0.789	0.950	1.383	2.132	2.979	4.435	6.256	8.522	9.114	10.373
1982	0.843	1.026	1.380	2.012	3.210	4.321	6.318	7.921	9.453	10.519
1983	0.731	1.049	1.479	1.986	2.891	4.463	5.743	7.779	8.894	10.398
1984	0.757	0.989	1.329	2.065	2.828	3.923	5.473	6.728	8.490	10.647
1985	0.331	0.824	1.255	1.759	2.722	3.760	5.178	6.923	8.128	9.964
1986	0.269	0.696	1.143	1.720	2.675	4.193	6.080	8.063	9.094	9.508
1987	0.343	0.566	1.146	1.668	2.498	4.076	6.267	8.435	9.835	11.187
1988	0.646	0.700	1.064	1.525	2.020	3.301	4.937	7.067	9.158	10.442
1989	0.362	0.847	1.265	1.758	2.419	3.206	5.166	6.523	8.072	10.714
1990	0.442	0.718	1.190	2.004	2.473	3.679	4.811	7.698	8.786	10.322
1991	0.506	0.684	1.267	1.832	3.101	3.896	5.583	6.737	10.014	11.396
1992	0.215	0.598	0.949	1.692	2.547	4.310	5.560	7.480	8.838	11.295
1993	0.318	0.507	0.937	1.397	2.253	3.404	5.336	6.569	8.081	8.655
1994	0.162	0.407	0.842	1.483	1.840	3.375	4.506	6.653	5.167	8.130
1995	0.309	0.450	0.746	1.359	1.932	1.956	5.164	5.543	6.951	5.255
1996	0.309	0.573	0.986	1.552	2.332	2.781	3.125	6.284	6.314	7.173
1997	0.309	0.573	1.005	1.606	2.310	3.007	3.982	5.301	6.193	7.173
1998	0.282	0.573	1.005	1.606	2.310	3.007	3.982	5.301	6.193	7.173
1999	0.386	0.628	1.114	1.638	2.106	2.754	3.672	5.328	6.346	6.877
2000	0.442	0.639	1.163	1.951	2.669	2.543	2.732	3.887	5.632	6.394
2001	0.444	0.805	1.067	1.730	3.115	4.237	3.931	3.813	5.330	6.717
2002	0.569	0.767	1.285	1.762	2.643	4.569	5.590	6.151	6.834	8.364
2003	0.571	0.795	1.188	1.753	2.600	3.722	6.264	6.807	7.782	8.841
2004	0.483	0.785	1.138	1.745	2.474	3.442	4.876	8.072	8.664	8.647
2005	0.324	0.985	1.505	2.173	2.931	3.868	4.819	7.340	9.371	10.525
2006	0.554	0.736	1.385	2.243	2.987	3.587	4.796	6.460	8.287	12.359
2007	0.473	0.824	1.240	1.855	2.435	3.502	4.097	5.607	6.864	7.874
2008	0.254	0.799	1.263	1.645	2.712	2.762	5.245	5.516	6.552	8.178
2009	0.380	0.474	1.166	1.851	2.285	3.329	3.458	6.921	6.658	7.486
2010	0.243	0.552	0.760	1.595	2.427	2.900	4.790	4.485	9.086	8.748
2011	0.400	0.454	0.866	1.196	2.599	3.608	4.166	5.337	4.968	9.868
2012	0.481	0.605	0.836	1.360	1.749	3.818	5.186	5.990	6.416	7.302
2013	0.317	0.620	0.912	1.307	1.886	2.092	4.393	5.841	6.517	10.249
2014	0.341	0.595	0.926	1.247	1.765	2.110	2.633	5.546	6.488	8.274
2015	0.380	0.607	0.892	1.305	1.800	2.673	4.071	5.792	6.474	8.608

Table 24. Estimated biomass using beginning of the year weights and bias adjusted population numbers from ADAPT for cod in NAFO Divisions 3NO.

	3	4	5	6	7	8	9	10	11	12	3+	6+
1959	15951	61693	19346	26737	30989	13355	11290	14216	11074	1846	206498	109507
1960	15658	24591	65125	17597	18992	19590	8251	7934	8935	4471	191145	85771
1961	24361	24050	28804	51368	15123	13906	10823	5677	5736	3842	183689	106474
1962	32017	38510	29954	20034	31221	10739	8025	7130	4463	5263	187356	86875
1963	23282	50634	50847	34712	21295	23723	7892	5133	4777	3040	225336	100572
1964	33233	37050	66260	48461	32461	17607	10497	3116	2141	2848	253674	117130
1965	45921	49838	38180	56341	42910	28715	13461	7044	1478	1822	285710	151770
1966	72602	80003	65934	39288	43864	21368	15310	11231	1504	726	351832	133293
1967	63476	111006	99150	57199	23783	25148	5877	7515	1474	809	395437	121805
1968	34882	85543	90774	49092	28795	11796	7909	5020	5801	801	320413	109214
1969	44230	43868	61523	41201	18893	12516	6344	5590	3458	4725	242347	92726
1970	27787	63063	47415	36800	25622	14856	8076	3785	3177	2148	232729	94464
1971	28101	41407	67053	43369	24062	17513	9670	5551	2501	1123	240349	103789
1972	24210	45908	31340	38178	25966	14898	8526	7691	3769	1521	202006	100549
1973	17397	36660	43948	20528	18465	12129	10034	8584	6527	3404	177676	79671
1974	10423	12418	17839	28533	10329	15369	10726	6471	6392	4065	122566	81885
1975	5581	14547	7044	5887	10712	4756	5831	4250	1646	1574	61830	34657
1976	9541	10587	13013	4867	2105	2976	1044	920	707	250	46010	12869
1977	18759	13042	9287	7876	3824	1827	2533	941	760	635	59483	18395
1978	25270	27868	16031	7813	6408	2347	1205	1433	389	307	89071	19903
1979	8789	27462	30908	14897	7037	5223	1806	866	890	271	98148	30989
1980	10299	11459	30008	23669	11888	5856	4951	1745	794	854	101523	49757
1981	21355	14854	14469	33387	24869	12505	6307	5650	1713	700	135808	85130
1982	18112	22262	16318	14941	34510	22145	11324	5169	4331	1231	150343	93650
1983	25398	18169	23634	16379	14944	33141	16405	7265	3069	2391	160794	93593
1984	30852	27081	18077	23489	16024	14176	27597	11059	4676	2232	175264	99254
1985	10687	27455	27015	17353	19662	13320	11965	22861	6923	3543	160783	95627
1986	2336	18374	28135	20734	14313	15332	13279	11924	20223	4404	149055	100210
1987	2184	3943	21798	23979	14875	12324	13424	10854	8612	16852	128846	100921
1988	8091	3323	5668	18966	17524	12488	9323	7050	5598	3774	91804	74723
1989	4487	8471	4553	5259	10940	11446	11321	6766	3525	2976	69744	52233
1990	2179	6036	7407	3214	3270	7413	8527	10453	5621	2138	56259	40636
1991	2636	2103	3643	2311	1602	2744	5603	6266	7190	4433	38531	30150
1992	3111	1958	1816	2473	1391	741	1383	2367	2781	2788	20808	13924
1993	1986	3968	1036	1143	1463	808	446	756	1168	1048	13821	6831
1994	99	1597	2976	503	449	828	576	306	306	605	8245	3573
1995	123	131	856	2569	320	228	916	540	255	255	6193	5083
1996	233	186	171	1430	3525	372	299	907	504	216	7842	7251
1997	324	352	263	224	1707	3654	425	405	715	462	8531	7592
1998	105	486	489	328	253	1735	3799	439	365	646	8646	7566
1999	863	189	751	622	333	235	1642	3965	408	307	9314	7511
2000	2080	1117	244	899	733	297	176	1342	3151	319	10359	6919
2001	1968	2840	1200	162	1002	873	334	187	1445	3005	13015	7007
2002	990	2652	3363	1369	177	1026	827	389	262	1788	12843	5838
2003	404	976	2776	3083	1325	173	999	745	382	270	11133	6977
2004	319	219	328	1359	2081	1024	164	923	713	332	7462	6596
2005	429	499	283	415	1626	2409	1083	195	818	681	8439	7227
2006	2018	797	573	341	456	1538	2207	1072	173	850	10027	6639
2007	1616	2299	912	492	257	422	1402	2103	920	135	10558	5731
2008	1893	2091	2557	853	528	216	489	1500	1953	883	12962	6422
2009	5167	2890	2435	2793	885	470	216	510	1362	1739	18467	7975
2010	768	6011	3679	2533	2802	852	507	225	515	1410	19300	8843
2011	2323	1087	7364	4529	3202	3283	953	462	195	458	23856	13083
2012	1989	2777	1597	9307	5352	3689	3648	1084	432	228	30104	23740
2013	462	1976	3264	2000	10405	5175	3412	3290	936	555	31475	25773
2014	964	621	2219	3484	2145	9301	5206	3406	2933	943	31223	27419
2015	323	1297	646	2375	4021	2527	14582	9307	3232	3171	41482	39216

Table 25. Estimated spawner biomass using annual ogives, beginning of the year weights and bias adjusted population numbers from ADAPT for cod in NAFO Division 3NO.

	3	4	5	6	7	8	9	10	11	12	SSB
1959	126	1396	1073	1362	18267	11827	11078	14177	11069	1846	72220
1960	51	966	7534	4421	5779	17348	8096	7912	8932	4471	65509
1961	1	405	4985	21835	9939	10859	10620	5661	5733	3842	73881
1962	29	45	2471	10362	25192	9841	7758	7111	4461	5263	72532
1963	131	501	1166	11129	18011	22759	7768	5112	4775	3040	74393
1964	34	985	6627	15600	23125	17002	10419	3107	2139	2847	81886
1965	2	245	4436	31131	38863	26664	13368	7034	1477	1822	125043
1966	37	45	1540	15223	40885	21259	15089	11216	1504	726	107524
1967	836	740	964	5930	17901	24984	5875	7494	1473	809	67006
1968	40	3409	7440	7121	10329	11042	7904	5020	5798	801	58904
1969	13	395	7036	22368	14089	9137	6255	5589	3458	4725	73065
1970	2	181	3152	10547	24097	14568	7502	3774	3177	2148	69149
1971	0	38	1845	15536	13367	17430	9659	5464	2499	1123	66962
1972	652	2	316	8306	21136	11851	8523	7691	3756	1520	63752
1973	22	2766	169	2090	13517	11786	9268	8584	6527	3402	58130
1974	1	103	3459	8354	5766	14817	10686	6303	6392	4065	59946
1975	19	25	373	2442	10476	4441	5809	4248	1632	1574	31040
1976	19	197	288	1322	1423	2975	1037	920	707	250	9138
1977	16	185	908	1787	2726	1571	2533	940	760	635	12062
1978	35	230	1498	2987	5076	2213	1143	1433	389	307	15312
1979	128	364	2266	6329	5485	5120	1789	850	890	271	23490
1980	35	797	3419	10159	9998	5580	4943	1743	789	854	38317
1981	42	351	3977	18423	21817	12183	6252	5649	1713	698	71106
1982	63	361	2383	9830	31811	21824	11282	5161	4331	1231	88277
1983	7	295	2880	8965	13554	32850	16380	7261	3068	2391	87652
1984	25	75	1312	12659	14347	13895	27572	11057	4676	2232	87849
1985	21	161	704	4691	17849	13103	11917	22859	6923	3543	81770
1986	5	247	1149	4248	9116	15149	13248	11915	20223	4404	79705
1987	13	76	1894	5653	10603	11000	13405	10851	8611	16852	78958
1988	2	111	890	7575	12106	11986	9092	7048	5598	3774	58182
1989	21	26	775	3351	9003	10780	11272	6730	3525	2976	48458
1990	37	227	327	1763	3084	7191	8455	10448	5615	2138	39286
1991	21	136	888	935	1407	2726	5579	6259	7190	4432	29572
1992	1	109	391	1796	1265	724	1382	2366	2780	2788	13603
1993	0	48	315	597	1399	802	444	756	1168	1048	6578
1994	0	24	841	384	366	824	576	305	306	605	4231
1995	1	5	500	2380	307	216	916	540	255	255	5376
1996	5	13	85	1419	3516	370	294	907	504	216	7328
1997	4	54	107	208	1707	3653	425	404	715	462	7738
1998	2	52	286	284	251	1735	3799	439	365	646	7858
1999	1	20	394	569	328	235	1642	3965	408	307	7867
2000	2	15	106	818	725	297	176	1342	3151	319	6952
2001	13	79	201	136	991	871	334	187	1445	3005	7261
2002	7	362	1439	1023	172	1025	827	389	262	1788	7294
2003	7	156	2195	2934	1295	173	999	745	382	270	9154
2004	8	30	276	1344	2077	1023	164	923	713	332	6890
2005	6	57	174	412	1625	2409	1083	195	818	681	7460
2006	98	47	220	298	456	1538	2207	1072	173	850	6960
2007	56	434	207	370	249	422	1402	2103	920	135	6297
2008	7	247	1319	494	494	215	489	1500	1953	883	7602
2009	89	60	815	2318	767	464	215	510	1362	1739	8337
2010	31	416	369	1655	2681	825	505	225	515	1410	8632
2011	47	155	1768	1679	2806	3251	946	462	195	458	11768
2012	52	291	632	5335	4052	3555	3640	1082	432	228	19299
2013	12	209	1304	1438	8854	4879	3378	3288	936	555	24854
2014	25	66	766	2756	1951	8932	5147	3397	2933	943	26915
2015	8	137	223	1649	3842	2464	14442	9286	3230	3171	38454

Table 26. Results of stochastic projections for Divs. 3NO cod at F=0 and $F_{status\ quo}$=0.057.

F=0	Beginning of Year SSB			
Percentile	2015	2016	2017	2018
0.90	46556	49712	50407	46414
0.50	39079	41491	41838	37891
0.10	32778	34729	35102	31074

F=0.057	Beginning of Year SSB			
Percentile	2015	2016	2017	2018
0.90	46002	47722	46550	41536
0.50	38816	39973	39086	34068
0.10	32481	33332	32610	27809

F=0.057	Yield			
Percentile	2015	2016	2017	2018
0.90	1453	1715	1642	1297
0.50	1218	1348	1178	833
0.10	1012	1091	902	582

Table 27. Risk assessment of the probability of being below $B_{\lim}$ under various fishing scenarios. Yield is median projected value.

Fishing Mortality	Yield		P(SSB<B_{lim})			P(SSB_{2018}>SSB_{2015})
	2016	2017	2016	2017	2018	
F = 0	-	-	>99%	>99%	>99%	46%
$F_{status\ quo}$ = 0.057	1348	1178	>99%	>99%	>99%	22%

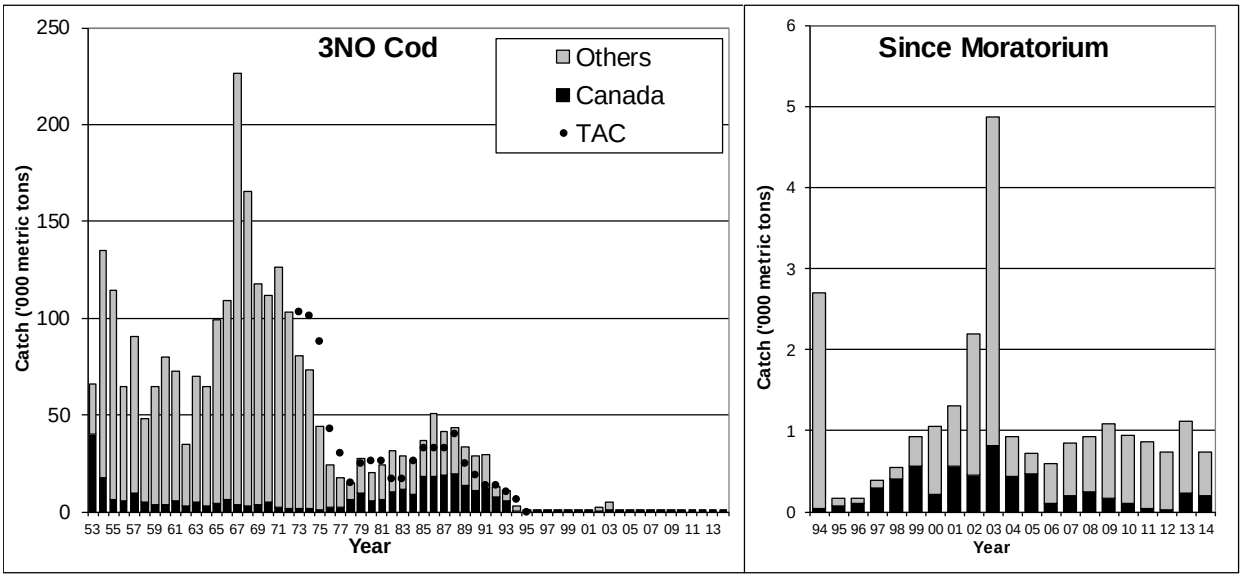

Fig. 1. Catches of cod in NAFO Div. 3NO from 1953-2014. Panel on right for years since the moratorium in Feb. 1994.

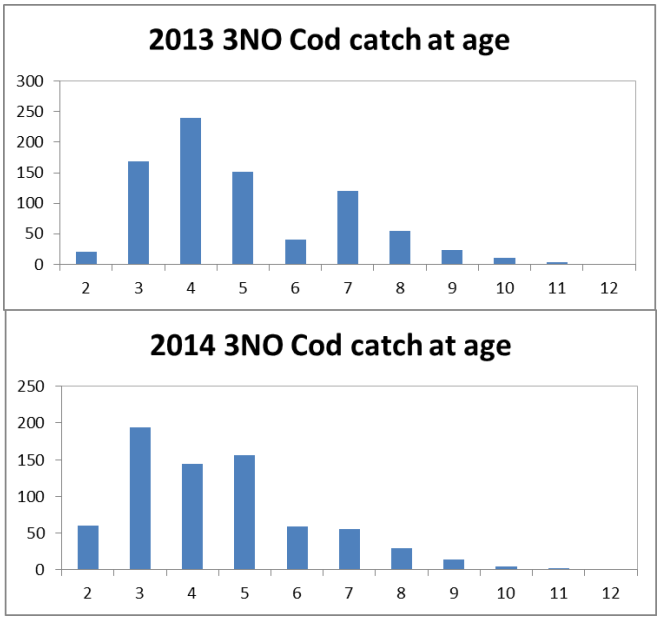

Fig. 2. Plot of Div. 3NO cod catch-at-age for 2013-2014.

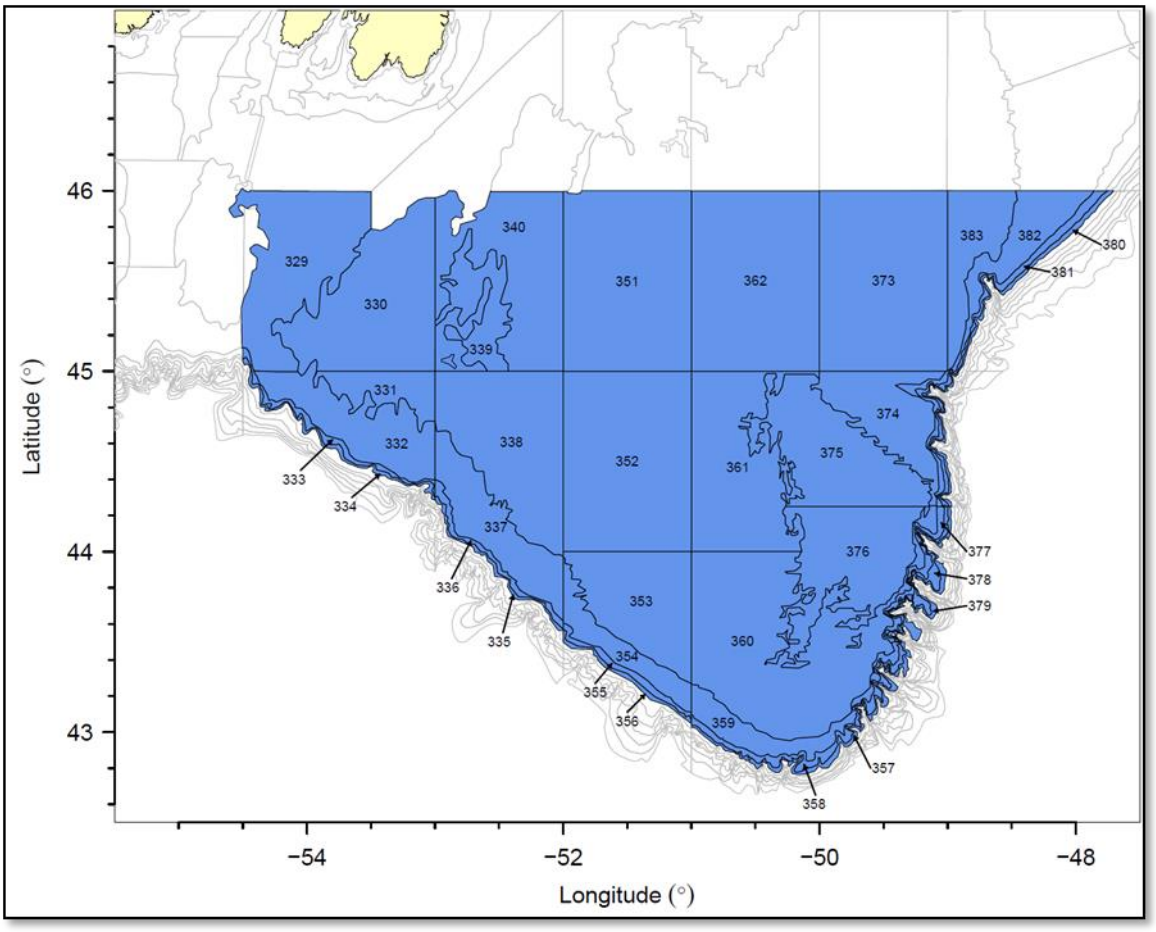

Fig. 3. Stratification scheme for Divisions 3NO. Index strata for 3NO cod are highlighted blue.

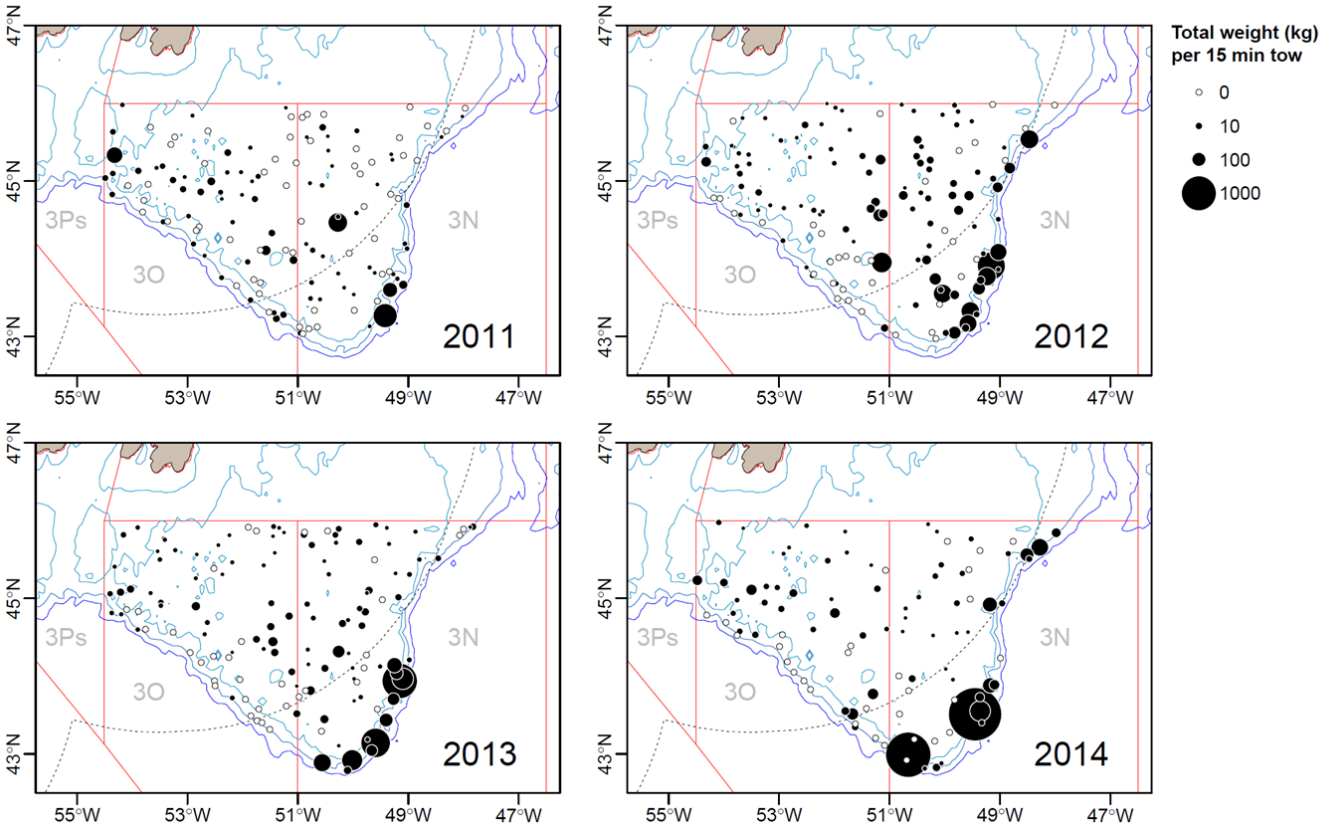

Fig.4. Distribution plots demonstrating Spring survey set locations and total weight of fish caught at each location. Symbol area is proportion to catch weight.

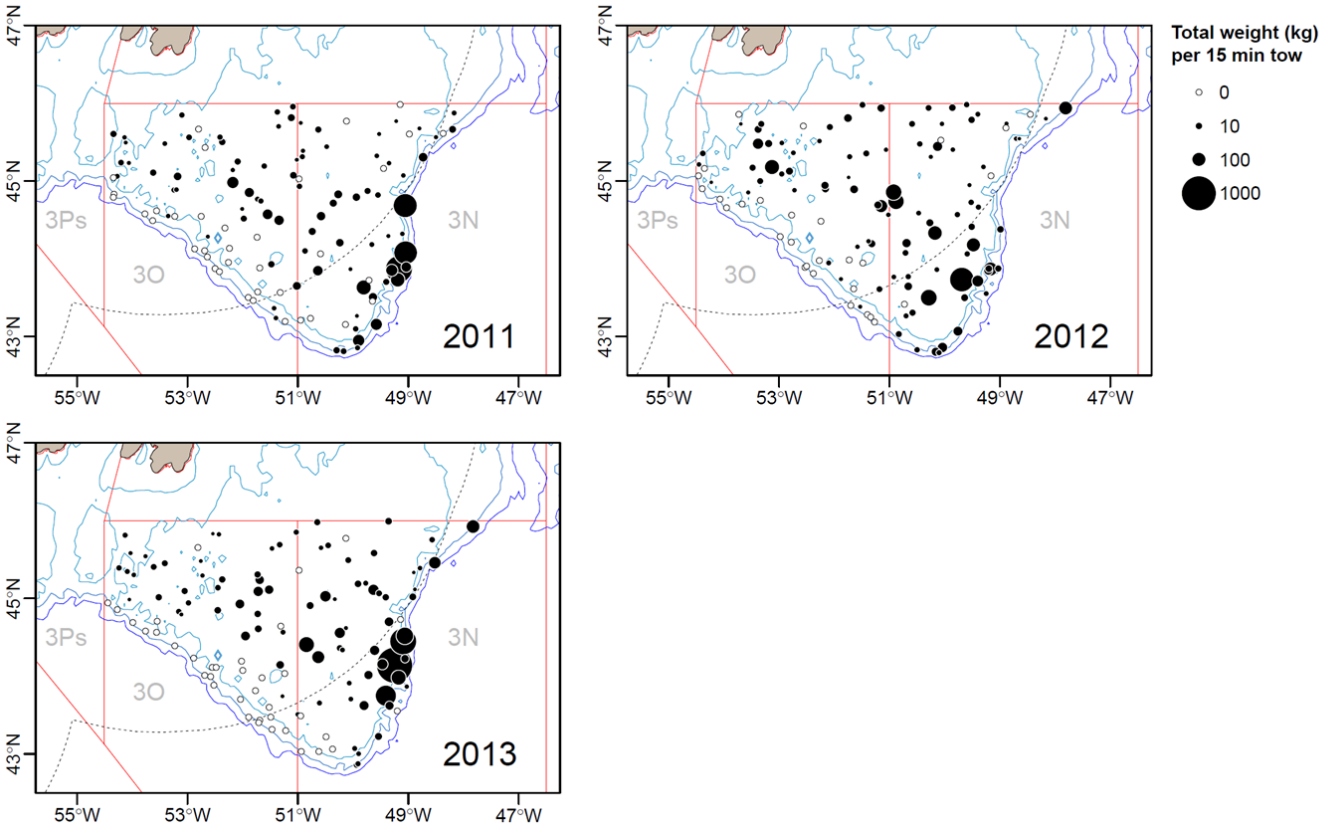

Fig. 5. Distribution plots demonstrating Autumn survey set locations and total weight of fish caught at each location. Symbol area is proportion to catch weight.

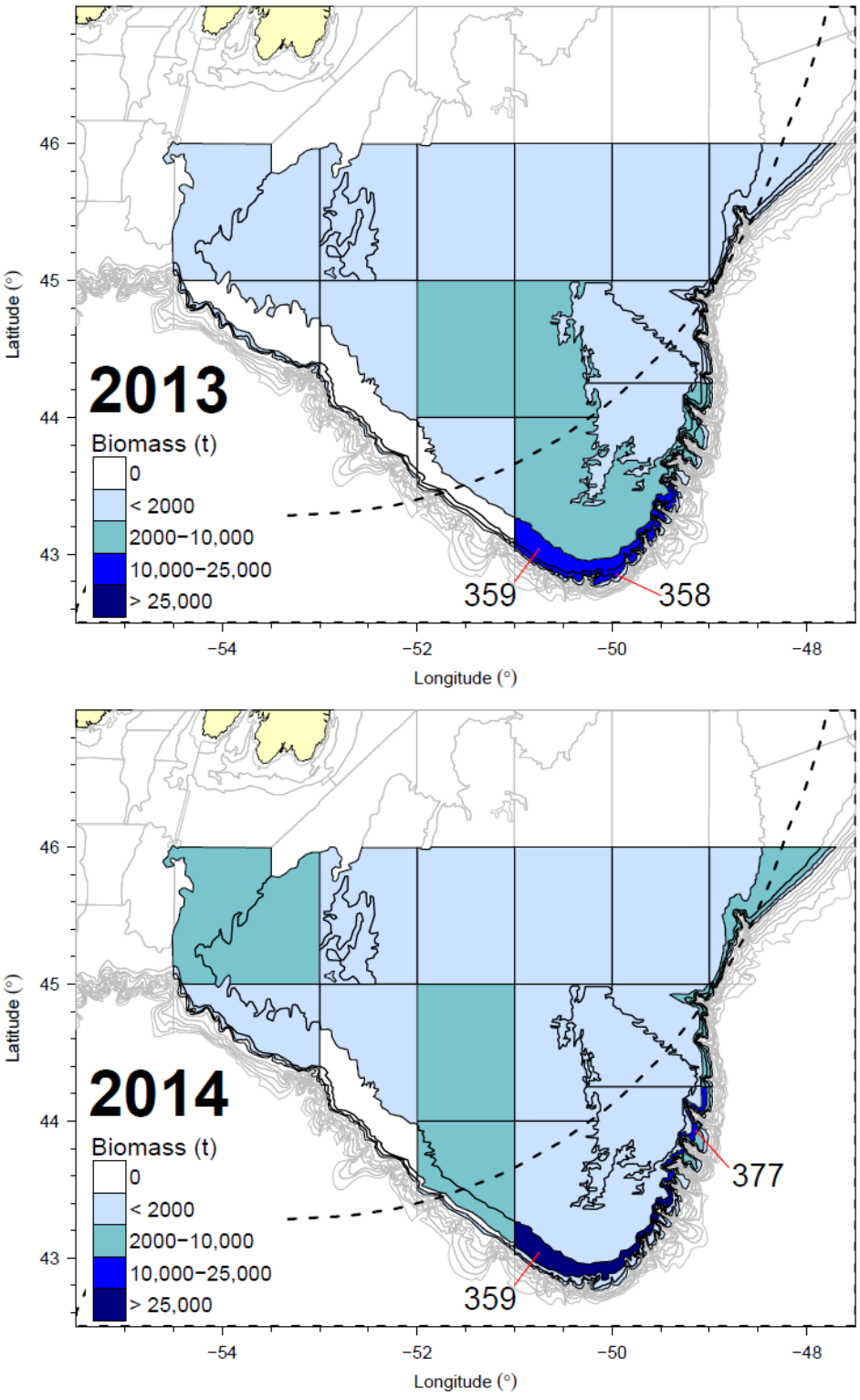

Fig.6. Spring biomass distribution plots for 2013 and 2014. Individual strata are coloured based on the estimate of biomass.

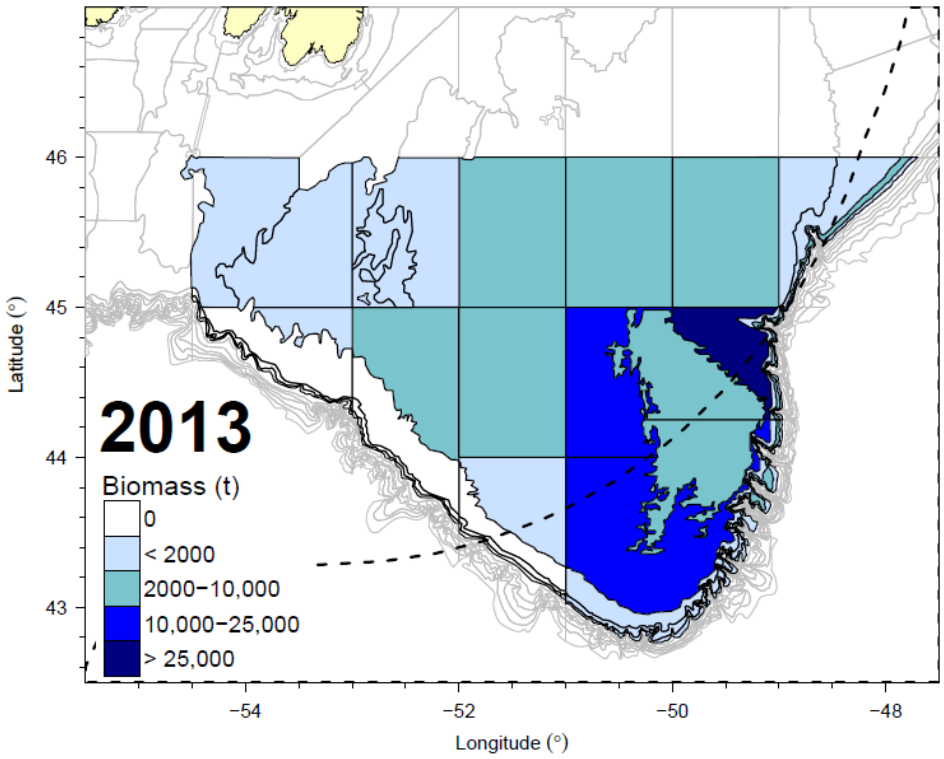

Fig. 7. Autumn biomass distribution plot for 2013. Individual strata are coloured based on the estimate of biomass.

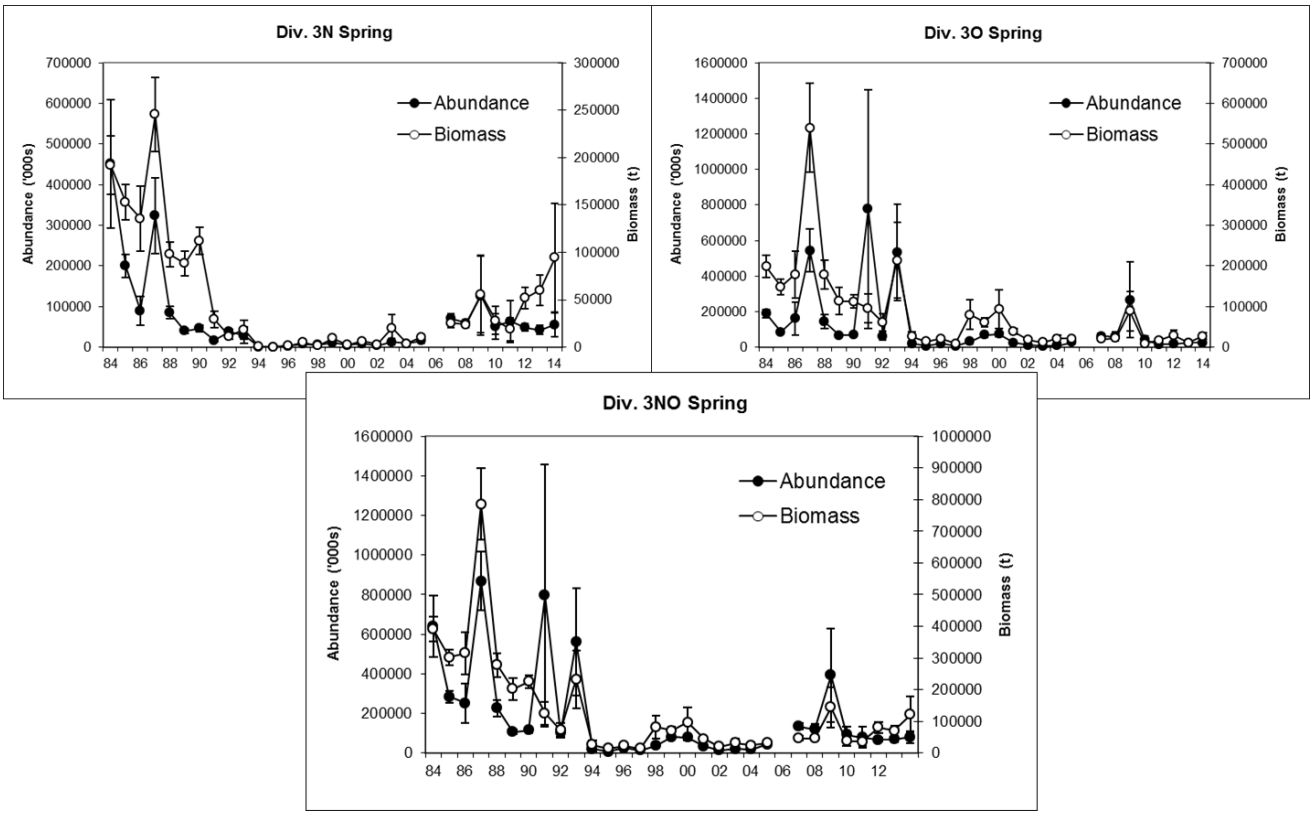

Fig. 8. Abundance (000's) and biomass (t) for the Canadian Spring Research Vessel survey series with 1 standard deviation for strata<200 fathoms.

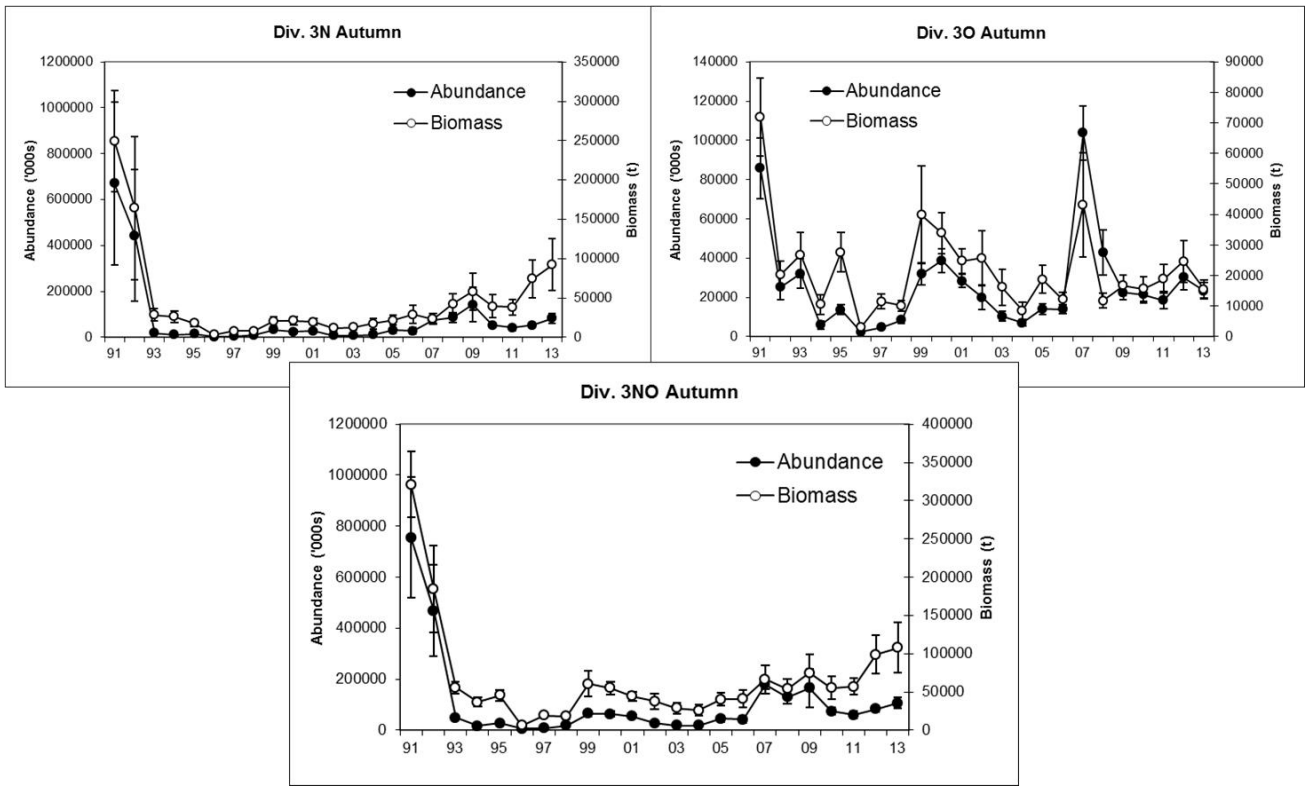

Fig. 9. Abundance (000's) and biomass (t) for the Canadian Autumn Research Vessel survey series with 1 standard deviation for strata<200 fathoms.

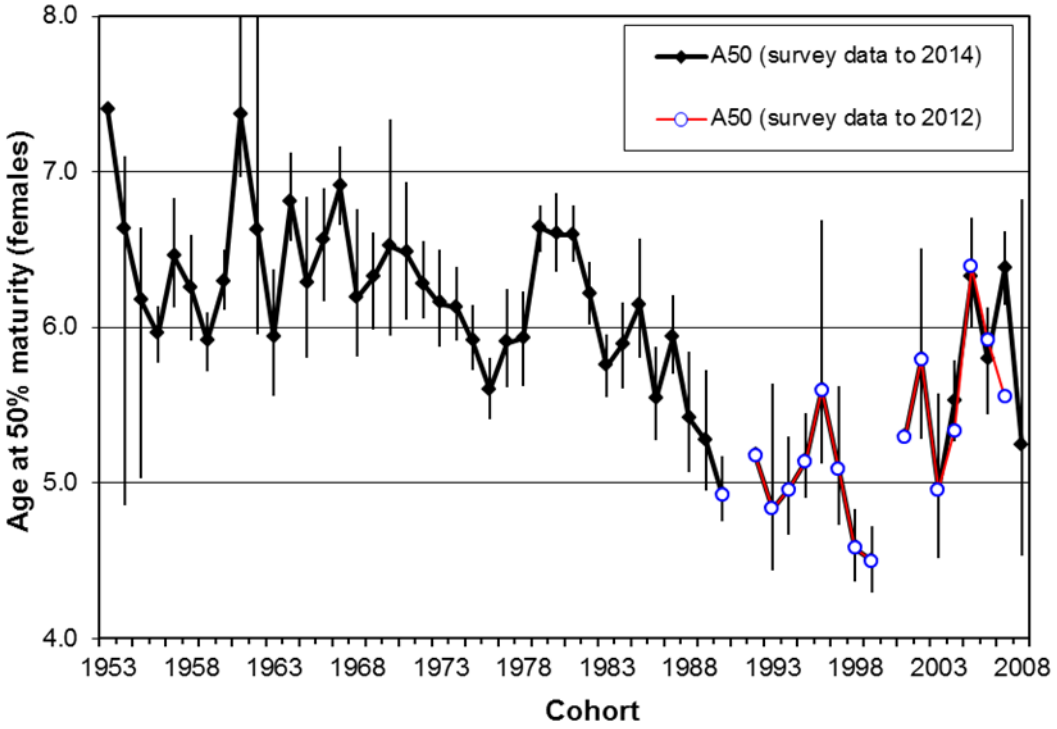

Fig. 10. Age at 50% maturity by cohort for female cod sampled during DFO spring research vessel bottom-trawl surveys of NAFO Divs. 3NO. Error bars are 95% fiducial limits.

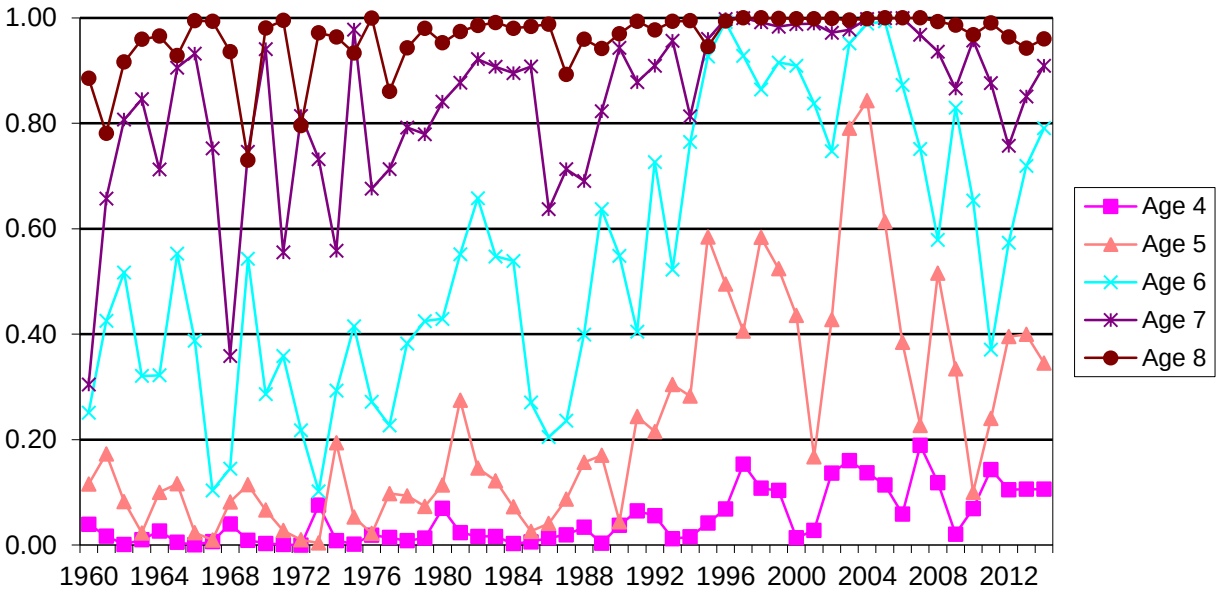

Fig. 11. Estimated proportions mature at ages 4-8 for female cod sampled during Canadian research vessel bottom-trawl surveys in NAFO Divs 3NO. Model fitted by cohort to observed proportions mature.

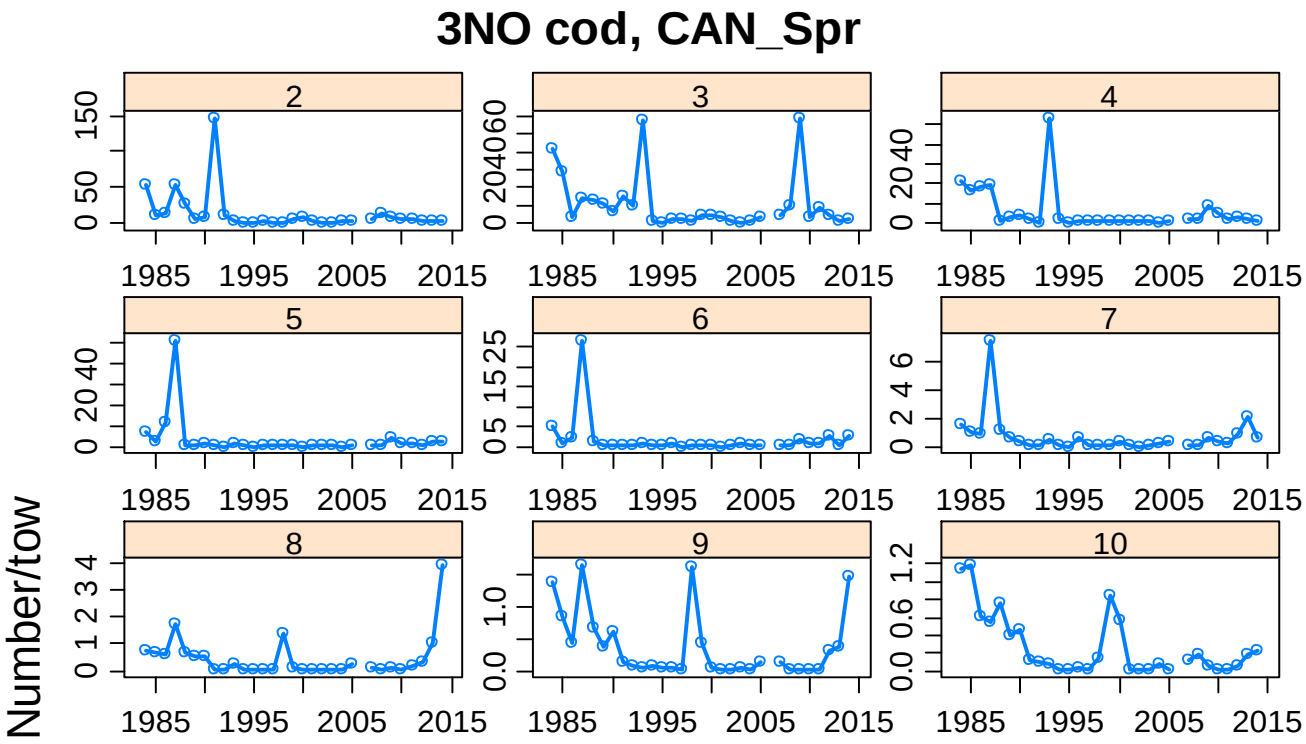

Fig. 12a. Age by age disaggregated plots of mean number per tow from Canadian SPRING surveys from 1984-2014.

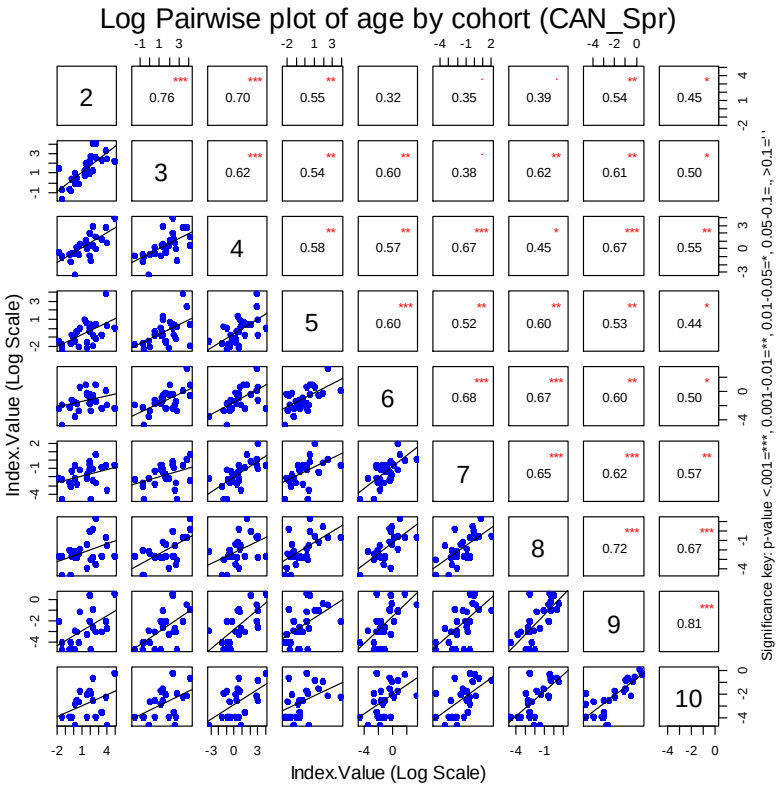

Fig. 12b. Pair-wise scatter plot of age-disaggregated survey data (log-scale) from Canadian SPRING surveys in Divs. 3NO (1984-2014). Data points in the panels below the numbered diagonal compare the logarithm of survey data at different ages for a common cohort. The solid line in each panel is the linear least squares regression line with the correlation coefficient provided in the corresponding diagonal panel (p-values significantly different than 0 noted with asterisk (see key on right side of diagram).

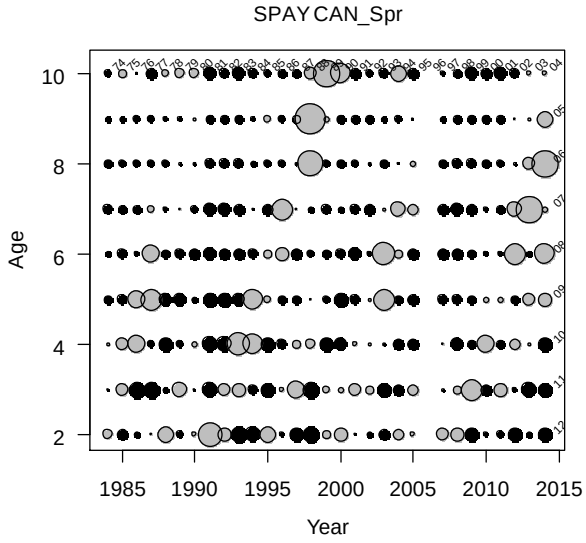

Fig. 12c. Plot of standardized proportions at age across years (SPAY) for the Canadian Spring surveys in 3NO (1984-2014). Age disaggregated mean number per tow were converted to proportions within an age. For each survey-age, the survey data are standardized to have a mean of 0 and a variance of 1. Symbol sizes are scaled and values greater than average are shown as grey circles, average values are shown as small dots, and less than average values are shown as black circles.

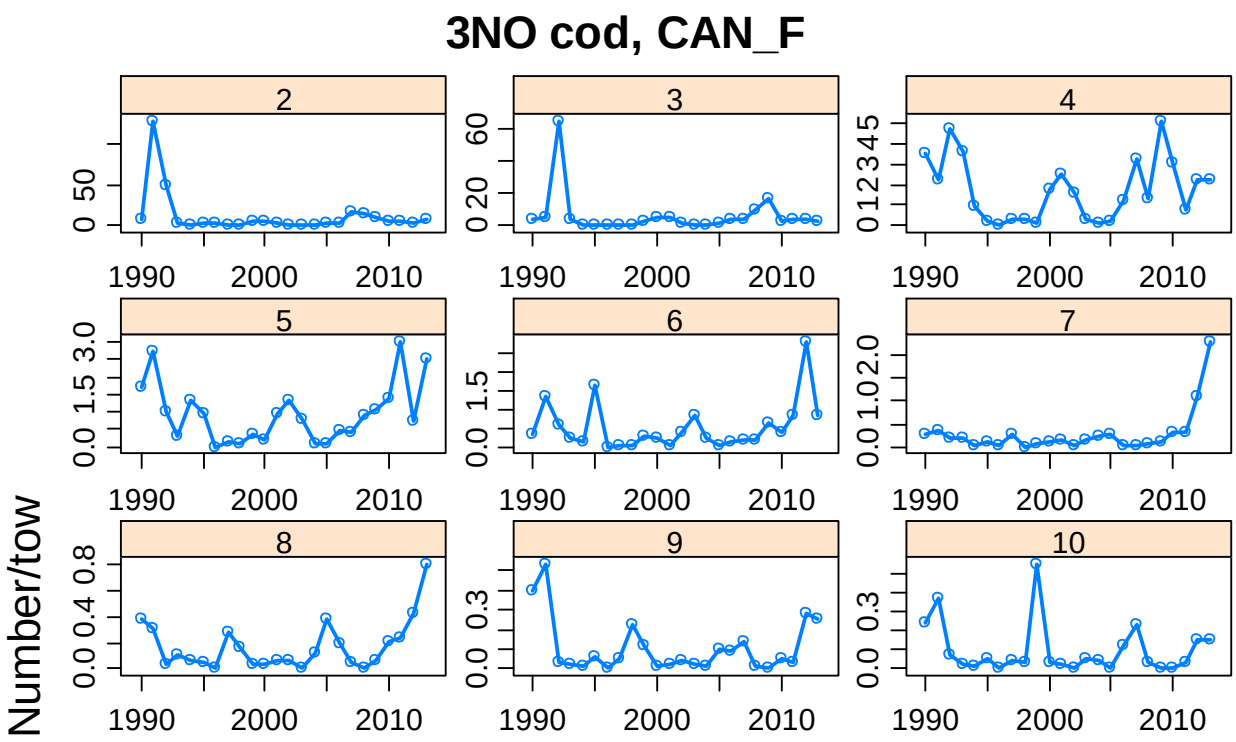

Fig. 13a. Age by age disaggregated plots of mean number per tow from Canadian AUTUMN surveys from 1984-2014.

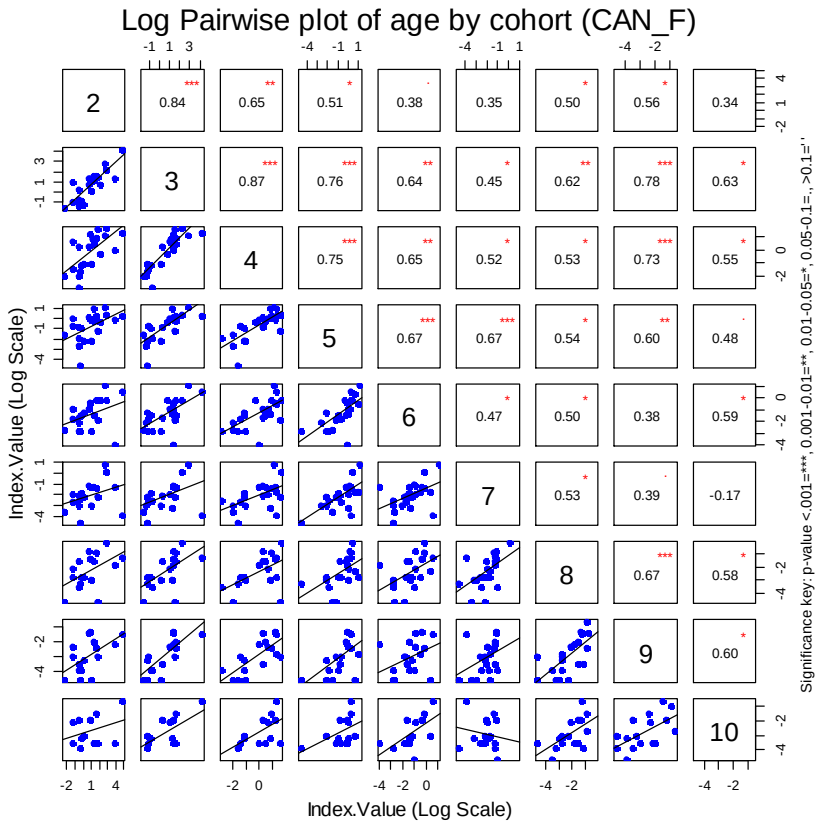

Fig. 13b. Pair-wise scatter plot of age-disaggregated survey data (log-scale) from Canadian AUTUMN surveys in Divs. 3NO (1990-2009). Data points in the panels below the numbered diagonal compare the logarithm of survey data at different ages for a common cohort. The solid line in each panel is the linear least squares regression line with the correlation coefficient provided in the corresponding diagonal panel (p-values significantly different than 0 noted with asterisk (see key on right side of diagram).

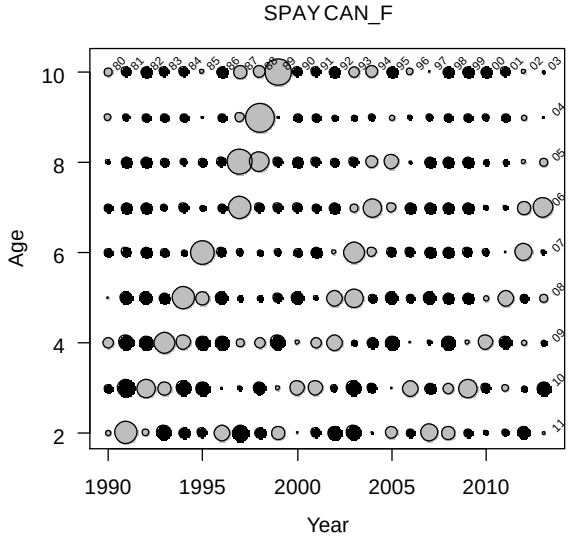

Fig. 13c. Plot of standardized proportions at age across years (SPAY) for the Canadian Autumn surveys in 3NO (1984-2013). Age disaggregated mean number per tow were converted to proportions within an age. For each survey-age, the survey data are standardized to have a mean of 0 and a variance of 1. Symbol sizes are scaled and values greater than average are shown as grey circles, average values are shown as small dots, and less than average values are shown as black circles.

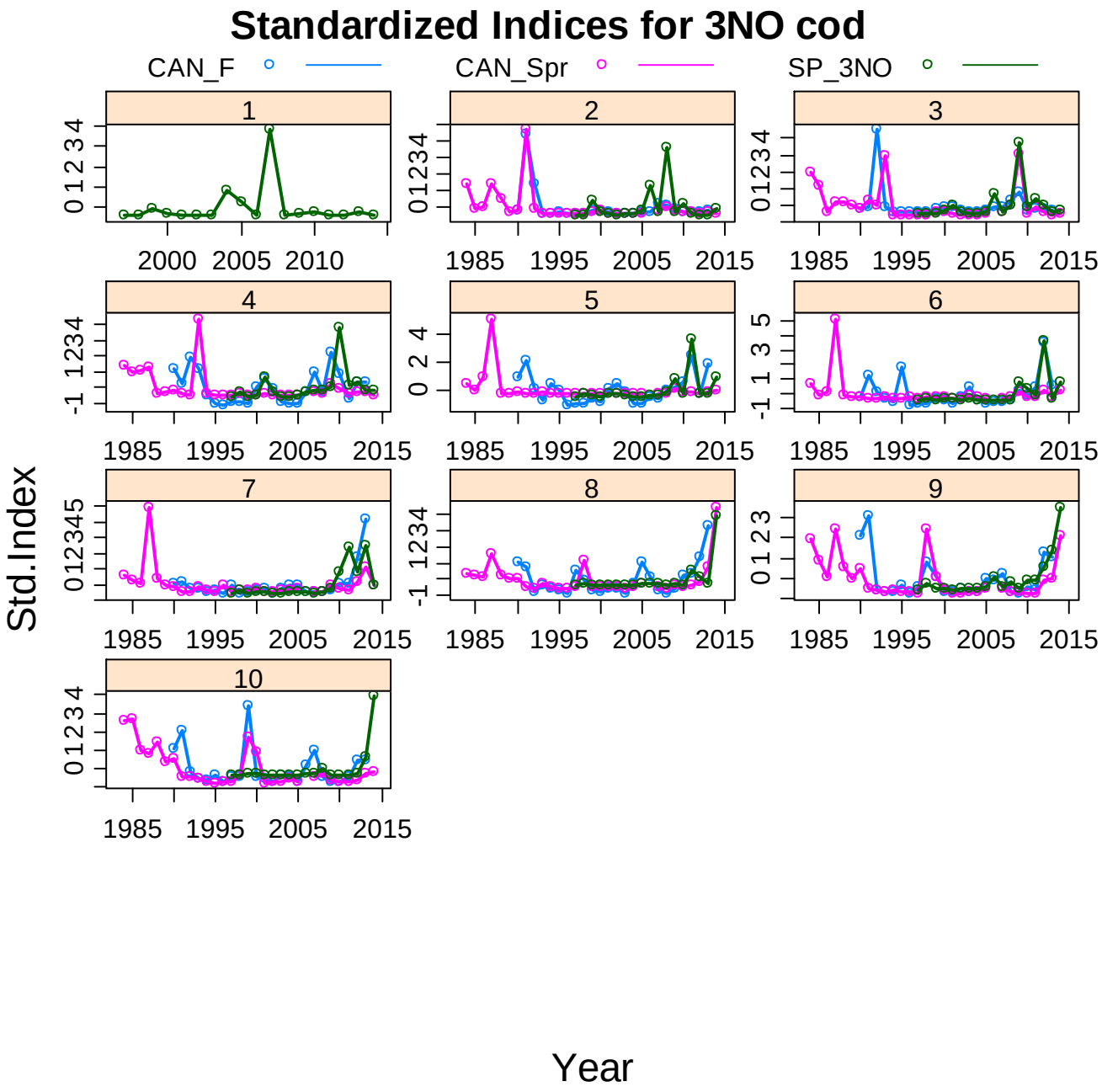

Fig. 14. Cohort consistency plots for survey indices for 3NO cod (Canadian SPRING, Canadian Autumn and Spanish 3NO). Plotted are standardized indices at age.

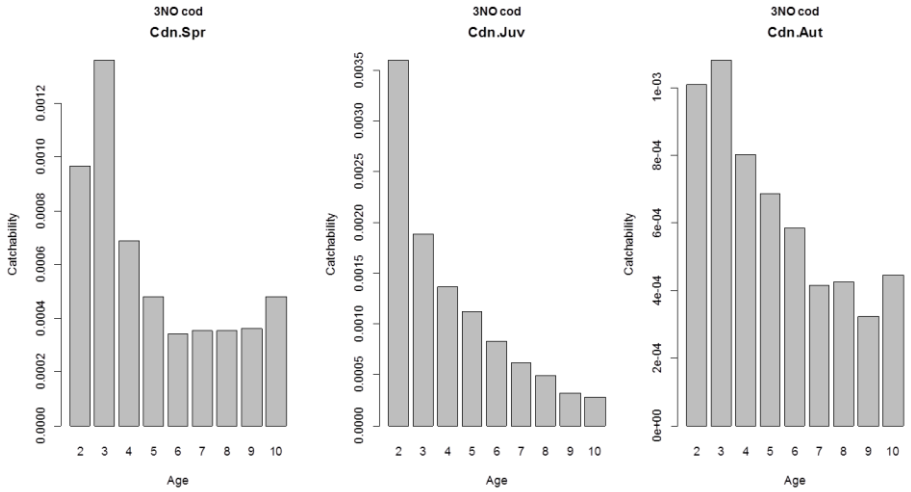

Fig. 15. Estimated catchabilities from ADAPT.

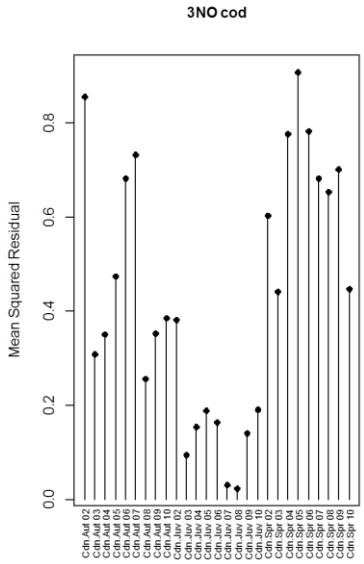

Fig. 16. Mean squared residual at age for each index in the ADAPT.

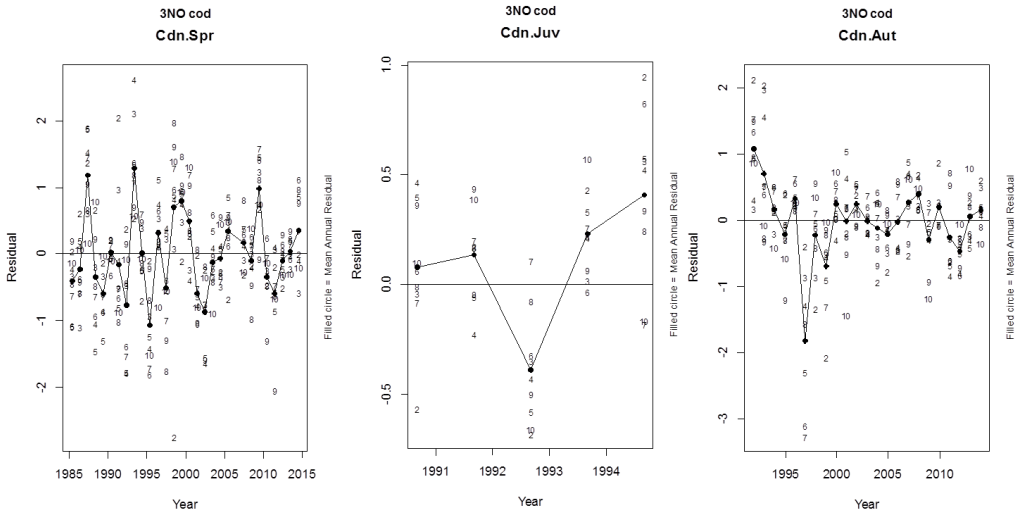

Fig. 17. Residuals at age for each index in the ADAPT.

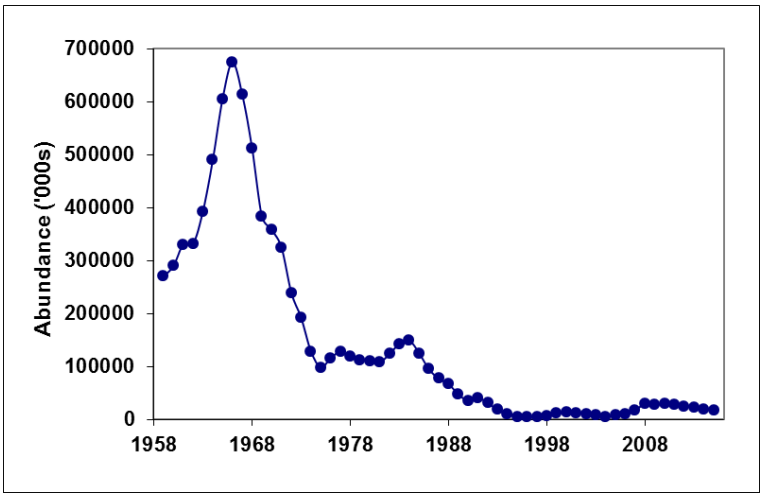

Fig. 18. Bias corrected Population Abundance for cod in Divs. 3NO as estimated from ADAPT

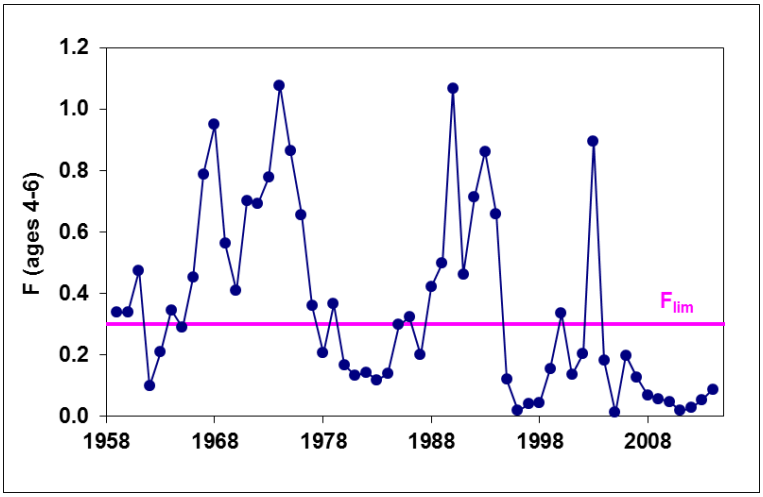

Fig. 19. Fishing Mortality for cod in Div. 3NO as estimated from ADAPT.

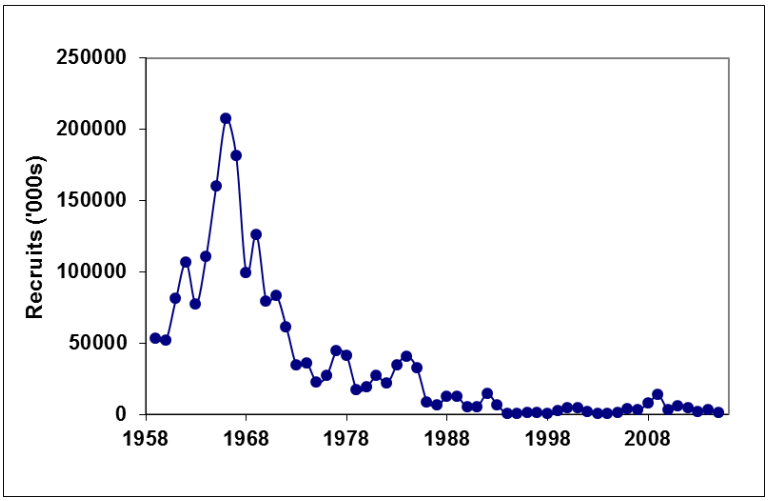

Fig. 20. Age 3 recruits for cod in Div. 3NO as estimated from ADAPT.

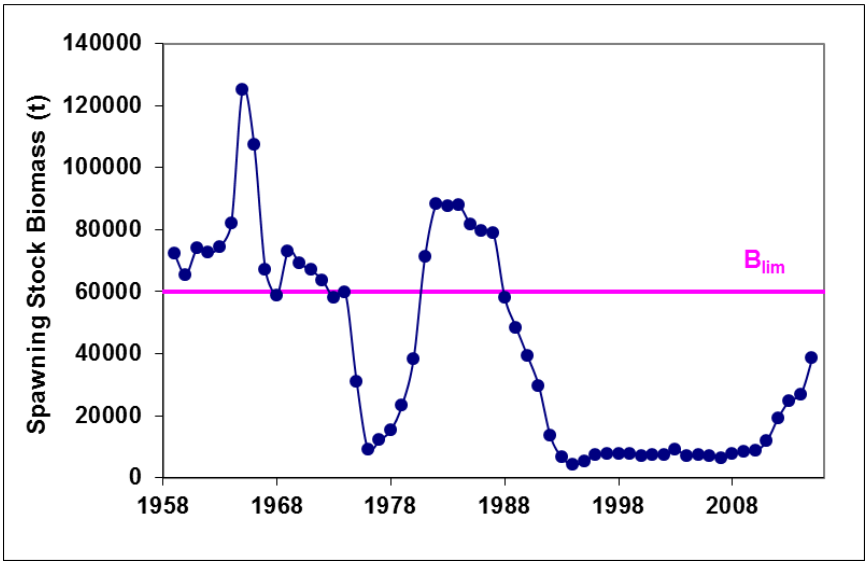

Fig. 21. Spawner biomass for cod in Div. 3NO as estimated from ADAPT.

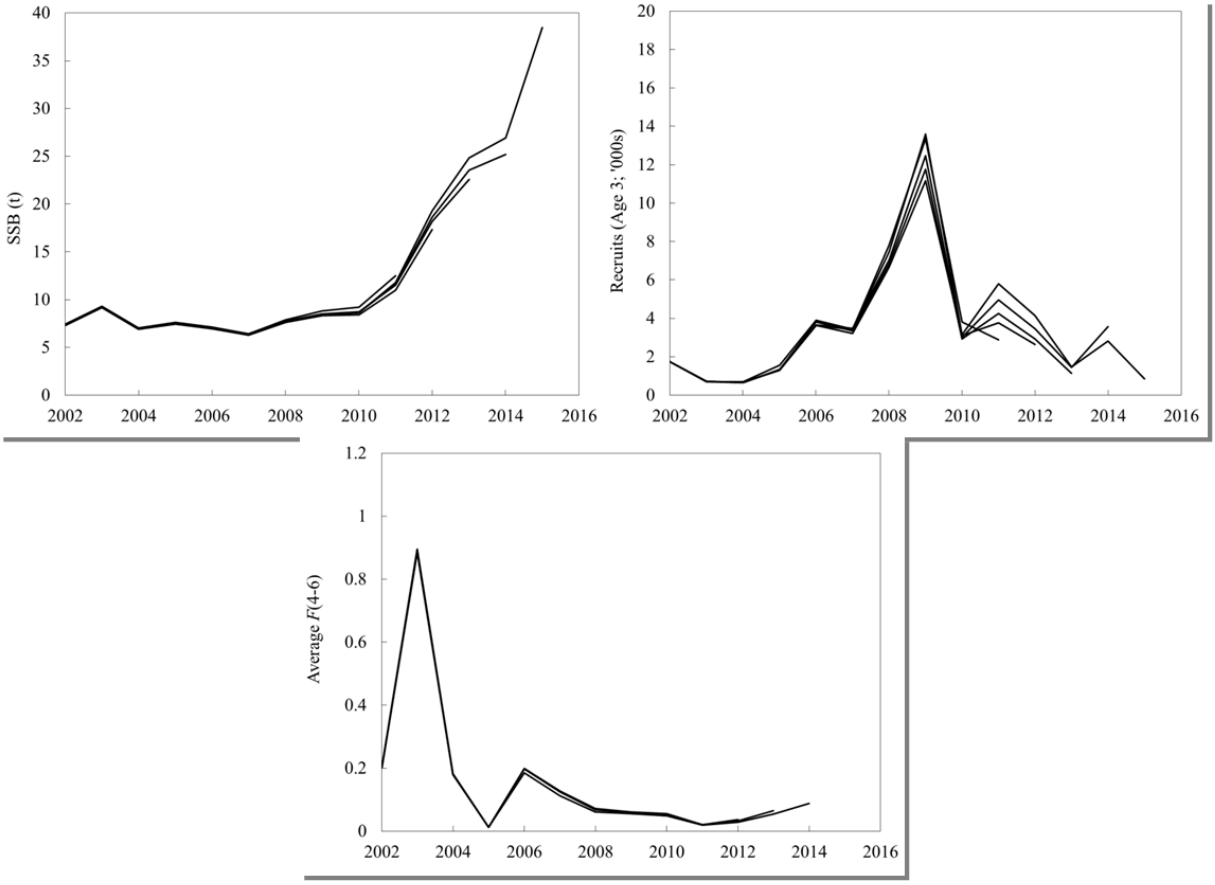

Fig. 22. Retrospective estimates of spawner biomass (top left), age 3 recruits (top right), and fishing mortality (F_{bar} 4-6) for cod in Div. 3NO.

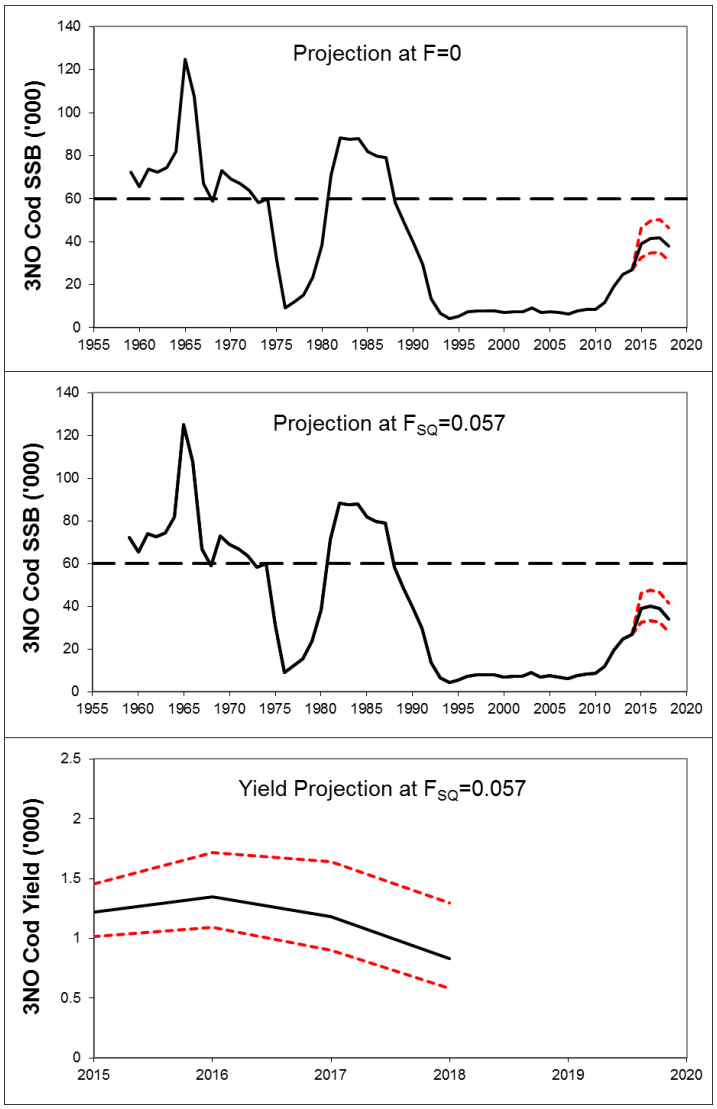

Fig. 23. Stochastic projections of SSB for F=0 and F_{SQ}=0.057 and yield for F_{SQ}=0.057 (the average F on ages 4-6 from 2012-2014). The solid line represents the median projected values and dashed lines are the 10th and 90th percentiles.