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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 although at a low level, has experienced an improvement in recent years. Estimates from a population model utilizing the ADAPTive framework (Gavaris 1988) indicate the spawner biomass has doubled since 2010. However, the 2013 estimate of 25,000 t still only represents 42% of B_{lim} (60,000 t). Fishing mortality in the last 5 years has been less than 0.1 for ages 4-6 and amongst the lowest in the time series. The relatively strong 2005 and 2006 year classes observed in the previous assessment continue to be strong in 2013 and the fact that these cohorts have entered the spawner biomass is responsible for the sharp increase in this index. More recent year classes, however, are not as strong. Stochastic projections indicate the stock will increase in the next 3 years but there is >95% probability that the stock will remain below B_{lim} by 2016.

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.

The 2007 assessment of this stock suggested that catch levels coupled with poor recruitment were resulting in high fishing mortality and impeding stock recovery. The 2010 assessment reported very low fishing mortality in 2008-09 and signs of improved recruitment. 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 1959-2013 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 catch in 2012 was 734 t.

Length frequencies for 2010-2012 were available from Canadian, Spanish (González-Costas et al., MS 2011, 2012, 2013), Portuguese (Vargas et al., MS 2011, 2012, 2013) and Russian (Pochtar and Fomin MS 2012, Pochtar et al. MS 2013, Skryabin and Pochtar MS 2011) otter trawl fisheries. Due to considerable deficiencies in the number of aged otoliths from commercial catches (Table 5), the catch-at-age for these years was constructed by applying Canadian survey age length keys to the available length sampling from all countries. This has been the typical approach used for this stock when faced with sampling deficiencies (Table 5). 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 and 2000 there are also gaps in the data but through the use of sampling collected by other contracting countries and by making use of Canadian research vessel survey age length keys, the catch at age was estimated. The catch at age time series reveals that ages 3-6 have dominated the catch for this stock (Table 6, Fig. 2).

Inadequate sampling has also presented problems historically 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 (Table 7).

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 2). 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 3).

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 the *Teleost*.

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).

Abundance and biomass estimates for these surveys are presented in Tables 8-15 and are plotted for the index strata (<200 fathoms) in Figs. 4-5. Spring and Autumn distribution plots are provided in Figs. 6 and 7 respectively. Abundance and biomass have been extremely low in both Div. 3N and Div. 3O from 1994 to about 2006. Levels have been slightly higher after 2006. The swept area survey biomass estimate from index strata (<200 fathoms) surveyed in 3NO combined for 2012 spring and autumn are about 80, 000 t and 99, 000 t respectively.

The mean numbers per tow at age for the index strata (< 200 fathoms) in 3NO combined are given in Table 16 for the spring survey and Table 17 for the autumn survey, and are plotted in Fig. 8 (age aggregated). Both the spring and autumn indices were extremely low from 1994-2006. MNPT increased for both surveys for the 2007-2009 period but have since declined. A large peak in the spring survey in 2009 was influenced by two very large fishing sets of ~6000 fish. An index derived from a juvenile flatfish survey conducted by Canada from 1989 to 1994 is presented in Table 18.

Fixed station grid surveys conducted in July by a Canadian based fishing company in cooperation with the Canadian Department of Fisheries and Oceans were available for the period 1996 to 2004 for Div. 3NO and are described in Maddock Parsons et al. (MS 2005). Catch rate of cod (kg/hour) increased from about 70 kg in 1997 to 193 kg in 1999, declined sharply to about 70 kg in 2000 and was stable to 2002. Catch rate declined to the lowest level in the time series at about 36 kg in 2004. These surveys have been discontinued.

Stratified-random surveys were conducted by Spain in the NRA area of Div. 3NO from 1995-2012 (Gonzales-Troncoso et al MS 2013). The series began utilizing a Pedreira trawl on the C/V Playa de Menduiña then converted to a Campelen 1800 trawl on the R/V Vizconde de Eza in 2001. The 1997-2000 data were converted into Campelen units by modeling data collected during comparative fishing trials in 2001. The data for 1995-1996 were not presented because the deeper strata in the area of coverage were not sampled. The mean weight per tow (Fig. 9) increased from 2.5 kg in 1997 to 19.5 kg in 1998 then declined to 3.5 kg in 1999. The index increased again to 37 kg in 2001 then declined rapidly to 11 kg in 2002 followed by successive declines to 4 kg in 2004. Since 2005 there has been a steady increase to the highest estimate in the series in 2011 at 155 kg. The 2012 estimate was quite a bit lower at 97 kg. The peaks in 1998 and 2001 were influenced by large single tows in those years. The abundance follows a similar pattern.

Analysis

Maturity at age

Annual proportion mature is modeled by cohort. This method has been used to estimate maturities of cod in NAFO Sub-Div 3Ps (Brattey et al. 2002), NAFO Divs. 2J+3KL (Lilly et al. 2003), and also for American Plaice in NAFO Divs. 3LNO (Morgan et al. 2002). A probit model with a logit link function was fitted 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. 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 1975-2012 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 thorough 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. For each survey series that extended to 2012 in 3NO (Canadian Spring, Canadian Autumn) the following were evaluated: (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) and by year across ages (SPYA). 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 SPYA plots a similar procedure was followed, but the proportions for each age were computed across years prior to standardizing by the mean and variance computed across all ages.

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 very strong as age 3 in

2009 and the 2005 year class is strong at age 4 in 2009 and age 7 in 2012. pairwise plots and correlations (Fig. 12b) indicate generally good tracking between ages for cohorts.

For the 1990-2009 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 6) 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 5).

The ADAPT was calibrated with Canadian RV survey indices at age from spring 1984-2005 and 2007-2012, autumn 1990-2012 and a Canadian juvenile survey 1989-94 to estimate population numbers $N_{i,t}$,

where $i = 3$ to 12, for $t = 2013$ (10 parameters) and $i = 12$, for $t = 1994$ to 2012 (19 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,
 $C_{i,t}$ where $i = 2$ to 12 and $t = 1959$ to 2012 ,
 Canadian Research Vessel survey estimates of mean numbers per tow-at-age (Campelen or Campelen equivalent values),
 $RV1_{i,t}$ where $i = 2$ to 10 and $t = 1984$ to 2005 and 2007-2012, spring
 $RV2_{i,t}$ where $i = 2$ to 10 and $t = 1990$ to 2012, fall
 and Canadian juvenile Research Vessel survey estimates of mean numbers per tow-at-age (Yankee 41.5 shrimp trawl in August – September)
 $RV3_{i,t}$ 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 2010 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 0.617 based on an estimation of 56 parameters. For the survivors estimated in 2013, the relative error in the parameter estimates decreased with age from a high of 57% at age 3 to 28% at age 12. Relative bias was a high of 17% at age 3 decreasing to 4% 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) (Fig. 16-17). 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 2013 is the geometric mean of the 2010-2012 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. The recent improvement in recruitment from the 2005 and 2006 year classes has accounted for much of this increase (Fig. 20). The previously dominant 1989 year-class is no longer contributing to the VPA population (since 2001). The relatively strong 2005 and 2006 cohorts noted in the 2010 assessment continue to be strong in 2013. The strength of these year classes is still low relative to historic estimates. Fishing mortality (Table 22, Fig. 19) has been very low since 2008 (< 0.1) on the prominent age groups in the fishery.

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 2013 which is the highest level since 1991. 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 doubled since the 2010 assessment as the relatively strong 2005 and 2006 cohorts have become part of the spawner biomass. Current SSB is estimated to be about 25,100 t, which is approximately 42% of B_{lim} (60,000 t). 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. There was very little evidence of a retrospective pattern for fishing mortality but more so for recruitment and SSB (Fig. 22).

Stochastic Projections

Simulations were carried out to examine the trajectory of the stock under two scenarios of fishing mortality: $F=0$, $F=0.04$ (the average F on ages 4-6 from 2010-2012). For these simulations the terminal year survivors from the ADAPT (i.e. Jan 2013 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 2013 population numbers (’000)	Relative error on population estimate	Weight-at-age mid-year (avg. 2010-2012)	Weight-at-age beginning of year (avg. 2010-2012)	Maturity-at-age (avg. 2010-2012)	PR rescaled relative to ages 4-6 (avg. 2010-2012)
3	1045.7	0.573	0.46	0.45	0.01	1.94
4	2244.9	0.426	0.68	0.53	0.06	1.36
5	2468.3	0.358	1.05	0.84	0.20	0.85
6	1512.0	0.306	1.73	1.31	0.54	0.79
7	4490.9	0.277	2.70	2.20	0.87	0.95
8	2289.4	0.255	4.04	3.62	0.98	1.27
9	754.9	0.264	5.73	4.69	1.00	0.59
10	558.4	0.263	5.21	5.53	1.00	1.24
11	140.3	0.265	8.12	6.07	1.00	0.46
12	54.9	0.278	9.85	8.62	1.00	0.06

Given the current estimate of SSB is well below Blim simulations were limited to a 3-year period. In addition, recruitment (at age 3) was only re-sampled from 1994-2012 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.

At F=0 spawner stock biomass is estimated to increase and there is an 88% probability that SSB will remain under Blim by 2013 (Table 26, Fig. 23). At F=0.07 the population is estimated to grow more slowly. If the fishing mortality in 2010-2012 remains at the average estimated in 2007-2009 then yield is estimated to increase over the 3-year time period.

Conclusion

Fishing mortality on 3NO cod has been very low (<0.1) for the past five years and amongst the lowest values in the time series. Recruitment of the 2005 and 2006 year classes was strong relative to other recent year classes and these cohorts continue to be strong as they begin to mature and enter the SSB. Spawner biomass has doubled since the last assessment in 2010. The current estimate of spawner stock biomass is 25 000 t which is still well below the current best estimate of Blim (60,000 t).

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Table 1. Catch (t) of cod in NAFO Divisions 3NO from 1953-2012

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	17396 ³	29452	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 ^b
1996	99	75 ³	174	ndf ⁵
1997	286	97 ³	383	ndf ^b
1998	396	151 ³	547	ndf ⁵
1999	568	351 ³	919	ndf ⁵
2000	207	843 ³	1050	ndf ⁵
2001	560	750 ³	1310	ndf ⁵
2002	444	1750 ³	2194	ndf ^b
2003	818	4052 ³	4870	ndf ⁵
2004	442	492 ³	934	ndf ^b
2005	461	263 ³	724	ndf ⁵
2006	108	492 ³	600	ndf ⁵
2007	203	645 ³	848	ndf ^b
2008	247	676 ³	923	ndf ⁵
2009	165	918 ³	1083	ndf ^b
2010	107	839 ³	946	ndf ⁵
2011	44	823	867	ndf ⁵
2012 ¹	26	708	734	ndf ^b

¹ Provisional² 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 tons⁵ There has been no directed fishery since February 1994.

Table 2. 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
	51-100	353	1282
		329	1721
		332	1047
		337	948
		339	585
	101-150	354	474
		333	151
		336	121
	151-200	355	103
		334	92
		335	58
	201-300	356	61
		717	166
		719	76
	301-400	721	76
		718	134
		720	105
		722	93

Table 3. 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

Table 4. Cod landings (t) by month and gear from NAFO Divisions 3NO by Canada in 2010, 2011 and 2012.

	Canada (N)					Canada (M)			
2010	3N		3O			3N	3O		
Month	Ottertrawl	Longline	Ottertrawl	Gillnet	Longline	Longline	Ottertrawl	Longline	
Jan									
Feb		0.86							
Mar									
Apr		1.37				2.84		0.01	
May	1.88						0.06		
Jun			0.70			0.87			
Jul						1.94			
Aug									
Sep	10.06		11.75			0.16			
Oct	21.96		6.93						
Nov	13.07		11.68						
Dec	14.93		4.36						
	61.91	2.23	35.42	0.00	0.00	5.81	0.06	0.01	105.43

	Canada (N)					Canada (M)			
2011	3N		3O			3N	3O		
Month	Ottertrawl	Longline	Ottertrawl	Gillnet	Longline	Longline	Ottertrawl	Longline	
Jan	24.05								
Feb							2.34		
Mar									
Apr									
May	0.71		4.86						
Jun	2.49	2.76				0.71		0.06	
Jul			1.16			1.98		0.55	
Aug									
Sep									
Oct									
Nov									
Dec									
	27.25	2.76	6.02	0.00	0.00	2.69	2.34	0.60	41.65

	Canada (N)					Canada (M)			
2012	3N		3O			3N	3O		
Month	Ottertrawl	Longline	Ottertrawl	Gillnet	Longline	Longline	Ottertrawl	Longline	
Jan								0.16	
Feb									
Mar									
Apr									
May	1.05								
Jun	3.93		3.35						
Jul									
Aug									
Sep				0.55					
Oct									
Nov	1.69		7.29						
Dec			3.83						
	6.67	0.00	14.47	0.55	0.00	0.00	0.00	0.16	21.85

Table 5. A review of sampling used to compile catch at age for 3NO cod from 1995 to 2009.
 Highlighted years note use of Canadian RV age/length keys to some commercial catches

Sampling	Canada	Spain	Portugal	Other
1995 No Spanish sampling. Sampling available from Portuguese gill net and otter trawl fisheries	14/GN 60/LL	29	15/OT 15/GN	79
1996 No Spanish sampling. Sampling insufficient	19/OT 31/GN 47/LL 1 MWT Total 98	5	26/OT 6/GN	38
1997 Sampling insufficient	203/GN 83/OT 40/LL 2/MWT 329 Total		113	
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 used 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 straddling 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 Adequate length measurement 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 Adequate length measurement 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 sparse 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 Length and age sampling for Canadian by-catch was limited to the otter trawl fishery in 3N and 3O. 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	90 comercial and 997 research ages measured	1354 measured	2467 130mm and 223 280mm mesh measured	171 measured
2011 Canadian cod by catch was taken in the ottertrawl fishery for yellow-tail and amounted to 54 t	23 comercial and 959 research aged measured	396 measured	5042 measured	100 measured
2012 Canadian cod by catch was taken in the ottertrawl fishery for yellow-tail and amounted to 26 t	1441 research ages measured	2411 measured	4484 measured	

Table 6. Catch-at-age used in this assessment for Divisions 3NO cod, 1959-2012 ('000s)

Year/Age	2	3	4	5	6	7	8	9	10	11	12	Total
1959	0	1711	13036	5068	6025	3935	1392	757	926	1220	103	34173
1960	0	1846	6503	22050	3095	2377	2504	583	387	898	242	40485
1961	0	812	4400	11696	15258	2014	1672	847	196	25	245	37165
1962	0	1026	3882	2206	1581	3594	773	668	433	226	216	14605
1963	0	313	5757	11210	4849	1935	3840	1165	608	322	208	30207
1964	0	6202	15555	19496	7919	2273	1109	788	328	37	112	53819
1965	0	1013	7611	7619	13258	9861	4827	1081	1248	163	141	46822
1966	0	753	18413	19681	11795	8486	4467	1829	1694	122	57	67297
1967	0	20086	62442	50317	18517	4774	4651	236	180	71	45	161319
1968	0	16359	56775	48608	18485	6337	1592	505	178	90	45	148974
1969	0	8154	12924	26949	11191	2089	1393	518	292	134	202	63846
1970	0	2105	19703	10799	9481	3646	1635	541	149	227	90	48376
1971	0	950	26900	30300	11700	3500	2500	500	200	100	50	76700
1972	0	69	19797	12289	13432	5883	1686	285	216	78	74	53809
1973	0	10058	27600	15098	5989	1971	972	707	243	137	116	62891
1974	0	6425	9501	10907	10872	2247	2147	1015	676	428	257	44475
1975	0	671	8781	3528	2505	3057	1059	921	461	252	152	21387
1976	0	4054	7534	5945	1084	211	238	44	37	13	9	19169
1977	0	607	2469	2531	1500	572	177	209	65	41	25	8196
1978	0	920	4337	2518	818	354	102	58	51	8	5	9171
1979	0	72	3827	9208	2784	883	265	58	17	12	7	17133
1980	0	266	1055	3812	2275	761	222	92	31	8	13	8535
1981	0	505	1091	1262	2297	1902	574	192	94	41	13	7971
1982	0	305	1978	1591	1012	1528	1492	595	211	162	27	8901
1983	0	1179	647	1893	1204	686	1152	774	238	81	41	7895
1984	0	58	1000	1411	2324	1220	720	918	551	106	42	8350
1985	0	57	2953	6203	3036	2519	797	459	533	261	97	16915
1986	0	153	2865	6423	4370	1512	948	558	373	349	135	17686
1987	195	516	422	3491	3445	1213	653	845	494	398	404	12076
1988	256	277	318	1527	6347	3955	1009	567	425	249	142	15072
1989	127	1917	2182	1502	1260	1887	1284	485	233	168	100	11145
1990	410	1064	4505	4341	895	422	721	581	439	150	83	13611
1991	6028	1103	673	995	544	282	368	568	502	383	202	11648
1992	83	4508	1769	837	612	235	64	99	128	153	100	8588
1993	33	1314	3209	637	479	321	74	25	39	49	53	6233
1994	0	232	2326	1117	125	93	26	8	1	0	0	3928
1995	0	0	72	20	40	2	0	1	0	0	0	135
1996	2	4	5	3	17	25	3	2	3	1	0	66
1997	1	12	18	11	5	31	45	5	4	5	3	140
1998	1	3	23	21	10	5	28	41	4	4	5	144
1999	46	94	41	101	40	14	6	23	55	3	2	424
2000	10	356	339	87	62	21	12	4	13	12	2	918
2001	10	187	302	160	11	43	23	7	2	9	12	766
2002	100	218	550	427	141	9	27	13	3	1	6	1495
2003	43	337	810	1274	669	133	5	18	8	2	1	3301
2004	11	37	45	50	92	73	21	1	7	3	1	342
2005	1	1	1	2	4	28	55	20	1	3	2	118
2006	45	214	168	82	21	5	10	2	2	0	0	551
2007	4	205	289	93	25	9	6	9	10	2	0	653
2008	1	4	58	165	41	20	2	3	20	13	7	333
2009	12	262	167	136	90	26	11	1	4	7	16	731
2010	249	214	459	195	75	39	13	0	2	0	1	1248
2011	44	187	56	133	44	47	46	7	4	1	0	570
2012	26	217	197	38	96	35	16	14	5	1	0	643

Table 7. Catch weight-at-age used in this assessment for Divisions 3NO cod, 1959-2012.
(Shaded values are estimates based on a geometric mean - see text)

Year/Age	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

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 for non-sampled strata.

Year	Index Strata (<200 fathoms)																		Total Index	Upper limit	t-value	1 std	Deep Strata (≥200 fathoms)						Total >200
	375	376	360	361	362	373	374	383	359	377	382	358	378	381	357	379	380	723					725	727	724	726	728		
1984	22302	149223	136658	29339	68550	27500	10431	62	2339	1771	0	2703	2481	1534	0	788	209	455890	891831	2.78	157039	nf	nf	nf	nf	nf	nf	nf	-
1985	12390	149	27167	50443	20045	4161	776	0	0	2451	3572	5766	43824	12968	11571	3195	3681	202159	278710	2.78	27576	nf	nf	nf	nf	nf	nf	nf	-
1986	2240	787	9750	5585	5400	1600	86	0	40375	465	22	4063	6313	8249	444	5010	526	90915	543939	12.71	35654	nf	nf	nf	nf	nf	nf	nf	-
1987	6223	88795	31721	47837	117654	11738	931	967	7163	6396	60	4359	2124	392	(1428)	7	934	328729	531816	2.23	91793	nf	nf	nf	nf	nf	nf	nf	-
1988	3134	2533	35911	15405	6860	2625	879	686	5584	0	180	5328	1921	3185	11	44	1498	85784	118657	2.15	15325	nf	nf	nf	nf	nf	nf	nf	-
1989	4868	599	1053	9136	7054	3096	52	499	1637	424	1588	3984	1612	3741	68	206	967	40584	53692	2.37	5542	nf	nf	nf	nf	nf	nf	nf	-
1990	3236	268	3020	6634	8400	1575	388	47	819	0	3325	8297	2751	3665	888	1318	2062	46693	79795	4.30	7693	nf	nf	nf	nf	nf	nf	nf	-
1991	111	119	900	2574	1120	223	26	62	1199	0	0	1047	875	202	2528	2311	3859	17156	35126	4.30	4176	1970	401	833	69	0	0	0	3273
1992	148	0	2731	804	58	0	129	0	1696	0	0	16484	3707	88	2676	8782	870	38173	63165	4.30	5808	13573	nf	2144	112	0	0	0	15829
1993	74	0	907	836	117	0	0	0	2193	28	0	3391	608	0	68	545	20654	29421	286252	12.71	20213	43	0	1444	9	0	0	0	1496
1994	0	0	0	103	0	0	0	0	0	49	0	109	222	13	433	191	0	1120	7723	12.71	520	32	95	222	34	0	0	0	383
1995	0	69	0	625	0	0	0	0	0	0	0	156	97	114	23	66	32	1182	2774	2.45	651	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	3285	5144	2.37	786	46	34	1394	0	0	0	0	1474
1997	131	0	86	549	50	50	38	0	138	0	0	261	136	13	20	194	6239	7905	85516	12.71	6106	77	16	109	50	12	0	0	264
1998	292	1272	823	2258	139	35	0	0	26	7	0	41	96	0	219	72	48	5328	8714	2.14	1582	53	49	55	61	0	0	0	218
1999	5259	103	150	2650	1042	77	85	0	58	0	45	1254	38	150	73	58	96	11138	15958	2.45	1967	0	33	44	0	0	0	0	77
2000	329	206	41	1869	1271	0	0	0	29	0	134	69	209	0	282	21	117	4577	6928	2.14	1099	139	361	383	0	0	0	0	883
2001	351	41	82	510	1078	193	128	0	87	0	0	3111	108	1152	872	642	511	8866	48358	12.71	3107	3179	661	528	45	0	0	0	4413
2002	131	0	453	1997	193	77	43	0	29	0	0	234	44	0	168	105	23	3497	5573	2.36	880	1658	148	446	62	36	0	0	2350
2003	263	41	659	892	39	0	0	0	0	0	0	8940	1523	113	110	129	609	13318	127402	12.71	8976	550	0	50	8	0	0	0	608
2004	175	1004	2552	3035	314	39	0	0	0	7	0	155	1000	300	43	49	207	8878	16024	2.13	3353	85	0	0	9	0	0	0	94
2005	877	41	1784	2185	260	193	43	46	463	199	579	1045	365	7489	60	65	145	15839	96713	12.71	6363	0	0	0	0	0	0	0	0
2007	11213	18046	11271	17801	3983	354	43	0	927	138	102	4380	1635	235	160	93	19	70400	95034	2.13	11565	19	0	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	78719	2.16	8949	0	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	1372029	12.71	97974	81	12	105624	0	0	0	0	105717
2010	1402	1871	700	2337	900	0	85	0	0	96	45	4154	6283	49	43	1222	31985	51172	459425	12.71	32121	11	6	439	0	5	0	0	461
2011	52412	371	864	821	265	270	43	0	0	30	0	12	61	11	6820	1326	323	63629	207835	2.78	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	75130	2.78	9517	10	217	46	nf	7	0	0	280

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 Index	Upper limit	t-value	1 std	Deep Strata (≥200 fathoms)						Total >200
	375	376	360	361	362	373	374	383	359	377	382	358	378	381	357	379	380	723					725	727	724	726	728		
1984	7018	16673	21843	20008	75781	33487	14987	502	308	145	0	822	692	765	0	382	411	193824	256272	2.09	29837	nf	nf	nf	nf	nf	nf	nf	-
1985	26266	713	17007	52794	29914	5274	1523	0	0	219	257	906	4601	5397	6352	1198	2128	154549	192257	2.06	18269	nf	nf	nf	nf	nf	nf	nf	-
1986	21041	2954	3781	61130	31327	4378	1338	0	2639	138	84	1724	1084	2913	640	1587	366	137124	211519	2.20	33801	nf	nf	nf	nf	nf	nf	nf	-
1987	13506	9148	4155	50358	144250	14596	1832	1664	779	1720	42	4255	358	247	(566)	9	1018	248503	326927	2.09	37740	nf	nf	nf	nf	nf	nf	nf	-
1988	23154	6555	3792	25677	19890	9738	5872	236	637	0	59	1317	441	786	33	37	656	98880	125247	2.09	12640	nf	nf	nf	nf	nf	nf	nf	-
1989	25148	1256	2145	19517	26588	8996	937	574	213	46	782	1701	432	216	64	98	498	89211	115281	2.11	12355	nf	nf	nf	nf	nf	nf	nf	-
1990	16134	3791	10488	30149	37344	5802	5050	615	101	0	298	1089	399	800	274	318	704	113356	141017	2.02	13694	nf	nf	nf	nf	nf	nf	nf	-
1991	1835	1483	1032	16646	4343	856	516	224	66	0	0	131	145	399	331	852	676	29535	49183	2.31	8520	662	186	486	30	0	0	0	1364
1992	2331	0	1445	399	668	0	30	0	113	0	0	2650	413	15	706	2592	181	11543	19173	2.78	2749	3415	nf	805	32	0	0	0	4252
1993	1145	0	46	3455	1522	0	0	0	433	9	0	1699	247	0	46	205	9823	18630	143715	12.71	9845	30	0	313	9	0	0	0	352
1994	0	0	0	64	0	0	0	0	0	8	0	164	64	57	237	121	0	715	1950	4.30	287	26	32	86	22	0	0	0	166
1995	0	51	0	47	0	0	0	0	0	0	0	135	76	44	24	46	9	432	761	2.78	119	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	2843	2.10	553	35	19	677	0	0	0	0	731
1997	92	0	15	378	317	168	136	0	199	0	0	104	109	2	9	104	3457	5090	48785	12.71	3438	80	9	71	40	5	0	0	205
1998	108	75	12	682	407	9	0	0	1	15	0	73	80		221	24	13	1720	2783	2.14	497	77	10	25	191	0	0	0	303
1999	3225	4	315	3496	946	50	11	0	114	0	9	1171	21	16	51	12	18	9459	16197	2.23	3022	0	13	6	0	0	0	0	19
2000	54	43	19	533	1328	0	0	0	194	0	27	23	184	0	242	8	14	2669	5747	2.26	1362	270	163	180	0	0	0	0	613
2001	592	6	588	240	1110	8	30	0	54	0	0	1818	92	708	676	536	71	6529	12873	3.18	1995	2233	443	295	100	0	0	0	3071
2002	88	0	244	1856	22	11	15	0	7	0	0	327	16	0	158	74	14	2832	6743	2.57	1522	1598	100	96	36	12	0	0	1842
2003	1229	458	1417	1987	2	0	0	0	0	0	0	14117	739	12	204	68	97	20330	200410	12.71	14168	956	0	25	25	0	0	0	1006
2004	89	286	84	299	2134	2	0	0	0	29	0	258	377	49	60	22	36	3726	8706	2.31	2160	46	0	0	6	0	0	0	52
2005	632	8	1798	2582	1746	74	10	42	71	298	239	611	118	2276	59	82	43	10689	17805	2.57	2769	0	0	0	0	0	0	0	0
2007	2669	528	1057	7983	5449	458	6	0	2385	33	79	3049	1101	159	262	72	8	25298	36782	2.16	5317	60	0	0	0	0	0	4	64
2008	2016	1810	8204	1619	2499	3	327	9	434	990	0	4361	710	702	28	5	51	23768	35391	3.18	3653	0	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	55899	574634	12.71	40813	168	5	33157	0	0	0	0	33330
2010	43	4913	0	82	1595	1245	0	26	160	1423	32	3946	641	14002	18	5	0	28131	215389	12.71	14733	56	34	377	0	2	0	0	469
2011	11042	56	248	302	463	135	8	0	0	23	0	6	33	1	5469	1019	61	18865	50011	2.57	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	76139	2.16	11191	13	51	41	nf	16	0	0	121

Table 10. Cod abundance (000's) from Canadian spring RV surveys in Division 30. 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 Index	Upper limit	t-value	1 std	Deep Strata (≥200 fathoms)						Total >200			
	330	331	338	340	351	352	353	329	332	337	339	354	333	336	355	334					335	356	717	719	721	718		720	722	
1984	7761	3863	23356	10606	78342	41362	0	5928	436	1909	14625	2238	0	0	0	0	0	0	190426	242768	2.23	23493	nf	nf	nf	nf	nf	nf	-	
1985	7892	1921	9724	9414	17578	17656	2226	2390	3432	5688	894	1843	42	17	4070	236	0	0	85023	109795	2.05	12072	nf	nf	nf	nf	nf	nf	-	
1986	3707	744	8933	10282	117725	9803	2773	2838	1115	1369	135	2216	105	126	29	1323	68	13	163304	363874	2.16	92856	nf	nf	nf	nf	nf	nf	-	
1987	11315	1900	20210	146151	71723	35888	29082	133032	30014	1799	2383	65669	566	17	207	26	8	4	549994	823914	2.31	118786	nf	nf	nf	nf	nf	nf	-	
1988	5384	1425	6623	2826	13335	56193	44478	5259	2908	2337	488	2271	0	8	43	121	12	51	143762	229667	2.20	39030	nf	nf	nf	nf	nf	nf	-	
1989	1609	792	20166	1960	6112	10474	4731	5577	3112	10402	27	593	378	8	987	141	16	131	67216	89730	2.05	10972	nf	nf	nf	nf	nf	nf	-	
1990	4990	(1052)	8436	3628	6242	14499	6499	13147	5700	2133	1625	395	136	143	193	543	97	110	69568	90269	2.11	10309	nf	nf	nf	nf	nf	nf	-	
1991	1424	158	24463	2569	2071	9752	1297	22309	683773	22436	1571	9019	692	160	2339	1214	27	546	785820	2506436	2.57	669240	3701	274	190	15	0	0	4180	
1992	203	32	2285	334	1050	3852	4229	508	29607	6913	609	1679	975	5537	944	971	1275	2665	63668	126262	2.78	22548	336	749	72390	0	569	149	74193	
1993	373	0	835	119	350	1331	223	1673	296105	231602	406	1415	514	437	236	1137	342	424	537522	3992300	12.71	271901	1615	301	348	100	15	0	2379	
1994	0	0	132	286	250	1299	0	13959	0	132	0	0	2205	605	50	533	157	491	20099	58534	2.78	13845	1441	443	11	503	211	0	2609	
1995	0	0	264	0	0	1111	285	1100	2399	527	0	0	10	0	7	200	52	13	5968	10117	2.31	1799	242	164	5	102	29	0	542	
1996	4824	348	2109	1441	525	1115	677	330	3184	2502	46	66	688	8	2573	184	490	93	21203	32019	2.37	4573	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	6412	25638	12.71	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	31110	65284	2.78	12293	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	69803	102583	2.20	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	73688	110064	2.45	14847	122	18	7	0	0	0	147	
2001	1519	3858	7006	567	1820	3372	397	2746	816	1130	281	163	71	42	234	54	278	62	24416	31201	2.14	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	10314	14550	2.36	1795	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	12891	2.78	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	19085	4.30	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	27345	43328	2.36	6772	34	52	0	0	0	0	86	
2007	3818	502	4700	923	2080	22182	18473	4545	1296	1130	138	3130	48	7	50	44	4	50	63120	91678	2.36	12101	44	0	0	0	0	0	44	
2008	2504	27035	4700	354	7106	12625	529	710	4081	1000	0	0	9	17	21	17	4	15	60727	402410	12.71	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	265708	2975301	12.71	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	128584	4.30	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	28195	2.45	5418	54	0	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	27341	2.16	3995	15	0	0	0	0	0	15	

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 Index	Upper limit	t-value	1 std	Deep Strata (≥200 fathoms)					Total >200	
	330	331	338	340	351	352	353	329	332	337	339	354	333	336	355	334	335	356					717	719	721	718	720		722
1984	7964	4536	43090	13654	68620	51655	0	1776	4410	741	3355	955	0	0	0	0	0	0	200756	259926	2.23	26557	nf	nf	nf	nf	nf	nf	-
1985	9372	4891	13670	10780	34516	41868	9451	1931	17134	2976	730	660	330	81	724	898	0	0	150012	187944	2.03	18667	nf	nf	nf	nf	nf	nf	-
1986	4167	1295	23245	12024	90852	24245	1831	1114	4092	11644	73	569	411	120	29	4773	159	42	180685	303904	2.16	57046	nf	nf	nf	nf	nf	nf	-
1987	12075	1982	20013	161120	114632	76430	15552	116331	12848	4299	943	6915	1837	35	259	120	38	15	545444	774350	2.13	107417	nf	nf	nf	nf	nf	nf	-
1988	4486	2176	14538	16447	25324	82226	4512	16127	11718	1005	496	1211	0	39	38	473	82	178	181076	254658	2.11	34873	nf	nf	nf	nf	nf	nf	-
1989	3318	481	25430	5478	19777	43865	4012	1690	2156	5735	219	87	1486	44	538	294	16	154	114780	184780	2.16	32407	nf	nf	nf	nf	nf	nf	-
1990	5091	(2191)	9315	10296	22343	38424	5892	4684	11266	3354	385	562	381	318	198	826	110	219	115855	143844	2.02	14933	nf	nf	nf	nf	nf	nf	-
1991	266	236	10283	384	6595	22512	1267	4195	39264	5566	92	3325	877	111	329	1385	10	88	96785	187783	2.57	35394	15218	143	88	7	0	0	15456
1992	32	224	11883	52	2063	16671	1780	97	3927	20721	87	191	273	1733	63	1018	276	308	61399	120673	2.78	21352	436	179	12153	0	139	70	12977
1993	92	0	4981	1936	1198	8225	3260	219	108245	79783	43	1319	1661	375	169	1408	2522	387	215823	1396053	12.71	92888	1870	330	304	159	9	0	2672
1994	0	0	1841	160	131	1584	0	10523	0	813	0	0	8549	661	32	959	453	257	25963	56360	2.57	11823	2094	727	16	791	222	0	3850
1995	0	0	3439	0	0	3784	609	2187	1702	1659	0	0	26	0	31	333	342	16	14128	20543	2.07	3093	339	927	10	91	34	0	1401
1996	7103	983	1535	239	104	1528	118	191	1534	3299	5	85	1625	19	2344	259	680	46	21697	32630	2.31	4741	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	15716	2.20	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	80199	546664	12.71	36701	30	2	16	0	11	0	59
1999	8593	1105	9416	3857	5269	14309	1719	9671	1350	3095	1210	1088	26	18	26	72	207	108	61139	86203	2.09	11992	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	206438	2.36	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	52036	2.09	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	17798	27516	2.18	4458	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	18496	2.13	3229	190	33	39	0	0	0	262
2004	2806	8186	1625	1735	583	3130	758	173	906	890	0	0	2	96	51	87	0	131	21158	135184	12.71	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	20651	30645	2.14	4670	71	26	0	0	0	0	97
2007	1345	218	3486	1178	237	9602	1129	2050	240	211	1	438	32	3	33	67	3	45	20318	32054	2.23	5263	147	0	0	0	0	0	147
2008	10114	2641	2607	381	3401	9189	523	430	494	1399	0	0	6	20	17	28	5	19	31274	32051	2.20	353	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	88451	703206	12.71	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	13201	2.14	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	35137	2.57	7243	151	0	0	0	0	nf	151
2012	696	527	239	824	2922	7950	12683	2694	54	63	25	55	19	7	0	0	20	74	28853	71774	3.18	13497	23	0	0	0	0	0	23

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 Index	Upper limit	t-value	1 std	Deep Strata (≥200 fathoms)						Total >200	
	375	376	360	361	362	373	374	383	359	377	382	358	378	381	357	379	380					723	725	727	724	726	728		
1990	5421	32419	28703	6273	12855	1336	879	530	702	243	210	766	550	nf	683	213	nf	91783	156111	2.20	29227	nf	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	1657056	2.78	355442	0	nf	nf	0	nf	nf	0	0
1992	nf	354763	8311	20718	49583	1400	nf	nf	497	493	270	5063	1602	nf	194	596	nf	443490	1675218	4.30	286249	nf	0	nf	nf	nf	nf	0	0
1993	2047	260	3463	6177	1300	750	819	0	88	0	494	47	48	202	1526	655	48	17924	26592	2.15	4041	97	80	878	17	0	nf	1072	0
1994	1947	312	0	7549	622	0	1034	0	0	7	0	94	10	0	57	81	16	11729	20479	2.45	3576	0	0	11	0	0	0	11	0
1995	5001	3956	437	3788	910	70	57	47	29	7	0	56	10	0	20	33	57	14478	21567	2.20	3221	0	12	9	0	0	0	21	0
1996	0	93		2025	104	130	65	0	52	12	33	14	0	233	39	52	24	2876	6774	2.57	1516	43	22	267	19	10	76	437	0
1997	603	41	137	2156	898	50	43	0	29	0	0	15	17	8	0	79	16	4092	5741	2.18	757	6	0	0	0	0	0	6	0
1998	329	1598	309	5761	792	149	171	46	0	0	0	247	10	13	124	13	0	9562	14597	2.26	2228	0	7	0	0	0	0	7	0
1999	14518	361	2367	1733	7924	3004	512	0	0	21	134	340	1472	138		988	383	33895	59471	2.78	9200	0	7	22	0	0	0	29	0
2000	8163	819	1132	3161	6478	341	85	0	550	21	134	1156	1785	338	168	164	563	25058	41671	2.20	7551	0	0	49	0	0	0	49	0
2001	4492	876	2345	6780	6438	446	1836	0	290	481	0	342	226	1702	61	663	14	26992	37378	2.14	4853	0	7	0	0	0	0	7	0
2002	2849	317	360	1173	314	149	256	0	463	51	45	437	476	13	10	47	465	7425	16677	3.18	2909	0	14	11	0	0	0	25	0
2003	446	324	1242	4952	99	57	0	0	434	0	0	356	36	0	102	52	104	8204	10433	2.20	1013	0	0	25	nf	0	0	25	0
2004	438	2062	1543	4282	198	149	171	46	116	206	0	279	315	2078	124	54	96	12158	20572	2.78	3027	0	nf	0	0	0	43	43	0
2005	3671	7099	2036	12672	1882	106	0	0	608	35	89	512	1520	82	229	91	56	30688	57783	2.45	11059	0	7	0	0	0	0	7	0
2006	3999	987	14200	4384	495	248	640	46	145	76	0	1024	1430	138	302	58	83	28255	59612	2.36	13287	0	63	9	0	0	0	72	0
2007	4024	10516	12142	30180	4727	451	840	0	1319	297	316	4797	850	5858	56	73	32	76478	110533	2.26	15069	31	0	0	60	0	0	91	0
2008	13586	20758	470	9431	14906	2253	3522	0	898	5475	0	3363	8824	3089	124	131	326	87156	147039	2.78	21572	9	7	0	0	0	0	16	0
2009	4821	112129	6709	9198	520	469	1729	46	347	2586	158	584	3142	67	121	32	199	142857	461901	4.30	74196	0	0	39	0	16	0	55	0
2010	10902	16032	4956	16569	1684	545	1195	46	319	467	0	552		114	113	40	32	53566	81866	2.31	12251	17	nf	11	0	0	0	28	0
2011	6793	1804	3013	3257	870	485	1409	46	2734	3384	140	867	4646	11129	56	645	454	41732	204400	12.71	12798	0	17	0	0	23	0	39	0
2012	2763	22786	2337	16183	2427	1634	1708	46	931	812	45	851	180	38	53	144	769	53704	81485	2.57	10810	14	7	279	17	0	0	317	0

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 Index	Upper limit	t-value	1 std	Deep Strata (≥200 fathoms)						Total >200
	375	376	360	361	362	373	374	383	359	377	382	358	378	381	357	379	380					723	725	727	724	726	728	
1990	31395	5147	7585	24777	9636	9722	2501	216	39	122	129	404	362	nf	370	318	nf	92723	151903	2.37	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	392215	2.23	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	555906	4.30	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	46078	2.18	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	45182	2.62	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	26812	2.10	4298	0	10	3	0	0	0	13
1996	0	806	319	1734	29	49	27	0	36	11	93	10	0	118	19	27	12	3290	6083	2.36	1185	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	11520	2.10	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	16104	2.45	3200	0	18	0	0	0	0	18
1999	2022	46	8681	1060	4955	1948	111	0	0	6	93	197	729	39		644	223	20754	33819	2.26	5781	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	32744	2.16	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	28793	2.13	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	19789	2.23	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	20811	2.23	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	33657	2.37	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	37701	2.45	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	55222	2.26	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	41653	2.57	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	82763	3.18	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	159551	4.30	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	85319	3.18	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	61445	2.31	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	141094	2.78	24017	66	16	534	40	0	0	656

Table 14. Cod abundance (000's) from Canadian Autumn RV surveys in Division 30. 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 Index	Upper limit	t-value	1 std	Deep Strata (≥200 fathoms)						Total >200	
	330	331	338	340	351	352	353	329	332	337	339	354	333	336	355	334					335	356	717	719	721	718		720
1990	10709	507	20199	4158	29085	10248	1781	531	1721	1001	163	1580	21	6	nf	13	12	nf	81735	117569	2.09	17121	0	0	nf	nf	nf	0
1991	10264	6682	10334	5625	24185	24761	223	1605	1127	66	0	0	0	0	887	0	4	4	85767	117451	2.05	15463	nf	0	0	nf	nf	0
1992	7036	222	857	7746	3558	2747	0	558	436	198	41	1712	10	0	64	0	0	0	25185	40427	2.45	6229	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	48506	2.15	7605	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	11071	2.37	2162	0	5	0	0	0	5
1995	3946	760	2478	1668	2709	972	415	574	0	0	41	165	0	0	13	0	0	0	13741	18760	2.12	2367	0	0	0	0	0	0
1996	279	32	264	95	198	287	0	478	0	0	0	340	nf	8	342	nf	133	40	2496	3870	2.45	562	nf	37	0	nf	0	37
1997	1006	31	52	519	1684	1006	0	95	48	0	80	130	0	0	0	0	12	0	4663	6604	2.12	916	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	11951	2.23	1597	0	0	5	0	0	5
1999	6178	721	4804	5665	9244	2789	661	521	576	130	554	0	0	28	0	0	0	7	31878	43691	2.09	5652	10	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	51707	2.13	6086	0	3	0	0	0	3
2001	9339	265	209	2172	9013	6405	0	710	96	130	80	0	0	0	0	0	0	4	28423	35723	2.12	3443	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	99783	12.71	6278	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	15883	2.23	2516	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	10678	2.20	1681	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	20041	2.11	2807	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	18846	2.10	2345	0	0	0	nf	0	0
2007	14991	4610	5065	1457	22015	32905	882	900	2358	7694	201	10610	27	0	38	0	0	4	103757	133648	2.16	13838	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	69431	2.31	11520	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	30439	2.08	3796	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	30828	2.18	4311	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	27739	2.14	4272	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	44058	2.13	6479	0	0	0	0	0	0

Table 15. Cod biomass (t) from Canadian Autumn RV surveys in Division 30. 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 Index	Upper limit	t-value	1 std	Deep Strata (≥200 fathoms)						Total >200
	330	331	338	340	351	352	353	329	332	337	339	354	333	336	355	334	335					356	717	719	721	718	720	
1990	6651	27	13966	3635	17027	21151	4593	1291	767	2331	1242	66	12	29	nf	16	13	nf	72817	97492	2.09	11789	0	0	nf	nf	nf	0
1991	2374	1047	7122	6247	21473	32262	56	1019	74	70	0	0	0	0	155	0	8	8	71915	98551	2.09	12726	nf	0	0	nf	nf	0
1992	2574	191	2760	6711	3142	3137	0	109	254	373	64	896	12	0	31	0	0	0	20254	29947	2.20	4404	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	43938	2.31	7412	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	17481	2.20	3158	0	14	0	0	0	14
1995	6035	1455	5283	3149	5052	3195	2238	1052	0	0	46	161	0	0	15	0	0	0	27681	41388	2.16	6346	0	0	0	0	0	0
1996	302	11	26	37	74	1353	0	370	0	0	0	260	nf	11	235	nf	303	39	3021	6586	2.57	1387	nf	55	0	nf	0	55
1997	1779	85	167	951	4806	3220	0	159	0	0	276	96	0	0	0	0	16	0	11555	16785	2.12	2467	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	13788	2.06	1753	0	0	9	0	0	9
1999	2379	367	16088	2902	7355	9096	716	684	18	21	184	0	0	0	25	0	0	13	39848	84258	2.78	15975	1	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	48733	2.20	6738	0	5	0	0	0	5
2001	5922	155	558	1785	8149	7207	0	810	41	91	50	0	0	0	0	0	0	2	24770	33277	2.10	4051	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	139889	12.70	8993	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	30377	2.37	5988	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	14807	2.20	2867	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	28652	2.14	4624	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	17312	2.09	2469	0	0	0	nf	0	0
2007	1463	141	1010	1540	4093	19781	184	292	165	2891	111	11472	1	0	30	0	0	5	43179	90433	2.78	16998	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	17152	2.18	2472	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	23929	2.11	3409	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	24902	2.31	4027	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	29259	2.23	4645	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	39785	2.23	6811	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																				1+
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
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	1.19	0.89	4.03	2.62	1.29	1.79	1.19	0.37	0.13	0.04	0.04	0.00	0.04	0.57	0.00	0.00	0.00	0.00	0.00	14.19

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																				1+
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
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	0.00	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	4.15	2.10	2.97	2.28	0.71	2.76	1.09	0.43	0.29	0.15	0.00	0.02	0.03	0.02	0.00	0.01	0.00	0.00	0.00	17.01

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															1+
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
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 17. Estimated proportions mature for female cod from NAFO Divs. 3NO from DFO surveys from 1975 to 2012 projected forward to 2015 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	Age 2	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	0.9999	1.0000	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	0.0006	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	0.0003	0.0033	0.0486	0.0587	0.3844	0.8725	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2007	0.0021	0.0014	0.0182	0.1892	0.2264	0.7516	0.9680	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2008	0.0003	0.0074	0.0062	0.0929	0.5162	0.5783	0.9361	0.9931	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2009	0.0009	0.0015	0.0254	0.0272	0.3612	0.8299	0.8654	0.9861	0.9986	1.0000	1.0000	1.0000	1.0000	1.0000
2010	0.0009	0.0035	0.0095	0.0834	0.1113	0.7575	0.9571	0.9679	0.9971	0.9997	1.0000	1.0000	1.0000	1.0000
2011	0.0009	0.0035	0.0137	0.0558	0.2410	0.3589	0.9452	0.9903	0.9930	0.9994	0.9999	1.0000	1.0000	1.0000
2012	0.0009	0.0035	0.0137	0.0555	0.2674	0.5257	0.7146	0.9896	0.9979	0.9985	0.9999	1.0000	1.0000	1.0000
2013	0.0009	0.0035	0.0137	0.0555	0.2066	0.6927	0.7946	0.9180	0.9981	0.9995	0.9997	1.0000	1.0000	1.0000
2014	0.0009	0.0035	0.0137	0.0555	0.2066	0.5258	0.9330	0.9311	0.9804	0.9997	0.9999	0.9999	1.0000	1.0000
2015	0.0009	0.0035	0.0137	0.0555	0.2066	0.5258	0.8141	0.9885	0.9792	0.9956	0.9999	1.0000	1.0000	1.0000

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

ORTHOGONALITY OFFSET..... 0.000735
 MEAN SQUARE RESIDUALS 0.617398

Survivors	Year	Age	Estimate	Standard Error	Relative Error	Bias	Relative Bias
	1994	12	91.80	67.60	0.736	13.700	0.149
	1995	12	54.60	25.20	0.462	4.640	0.085
	1996	12	32.70	11.40	0.349	1.820	0.056
	1997	12	69.70	22.10	0.317	3.400	0.049
	1998	12	98.00	32.60	0.332	5.190	0.053
	1999	12	48.60	16.90	0.348	2.670	0.055
	2000	12	53.40	16.20	0.303	2.310	0.043
	2001	12	474.00	132.00	0.279	17.600	0.037
	2002	12	226.00	61.90	0.274	8.250	0.037
	2003	12	32.10	8.82	0.274	1.150	0.036
	2004	12	40.40	11.70	0.291	1.530	0.038
	2005	12	68.20	20.40	0.299	2.670	0.039
	2006	12	73.10	23.40	0.32	3.190	0.044
	2007	12	18.30	5.71	0.312	0.836	0.046
	2008	12	115.00	37.90	0.328	5.570	0.048
	2009	12	246.00	78.20	0.318	11.400	0.046
	2010	12	172.00	54.00	0.314	78.300	0.046
	2011	12	49.60	14.80	0.299	21.800	0.044
	2012	12	33.20	10.50	0.317	15.700	0.047
	2013	3	1260.00	723.00	0.573	215.000	0.171
	2013	4	2480.00	1060.00	0.426	233.000	0.094
	2013	5	2650.00	947.00	0.358	178.000	0.067
	2013	6	1590.00	488.00	0.306	82.800	0.052
	2013	7	4700.00	1300.00	0.277	205.000	0.044
	2013	8	2380.00	608.00	0.255	90.100	0.038
	2013	9	785.00	207.00	0.264	30.000	0.038
	2013	10	579.00	152.00	0.263	21.100	0.036
	2013	11	145.00	38.50	0.265	5.080	0.035
	2013	12	57.00	15.90	0.278	2.120	0.037

Catchabilities	Age	Estimate	Standard Error	Relative Error	Bias	Relative Bias
RV_Spr	2	0.000996	0.000157	0.157	0.000006	0.006
RV_Spr	3	0.001440	0.000226	0.156	0.000008	0.006
RV_Spr	4	0.000698	0.000110	0.157	0.000004	0.006
RV_Spr	5	0.000477	0.000076	0.160	0.000003	0.007
RV_Spr	6	0.000327	0.000054	0.163	0.000002	0.007
RV_Spr	7	0.000348	0.000058	0.168	0.000003	0.009
RV_Spr	8	0.000338	0.000058	0.172	0.000004	0.011
RV_Spr	9	0.000332	0.000059	0.176	0.000004	0.013
RV_Spr	10	0.000476	0.000086	0.181	0.000008	0.016
RV_Fall	2	0.001030	0.000181	0.176	0.000008	0.008
RV_Fall	3	0.001100	0.000193	0.176	0.000009	0.008
RV_Fall	4	0.000816	0.000146	0.179	0.000007	0.008
RV_Fall	5	0.000683	0.000125	0.183	0.000006	0.009
RV_Fall	6	0.000583	0.000110	0.188	0.000006	0.011
RV_Fall	7	0.000410	0.000080	0.195	0.000006	0.014
RV_Fall	8	0.000422	0.000086	0.204	0.000007	0.017
RV_Fall	9	0.000315	0.000067	0.213	0.000007	0.021
RV_Fall	10	0.000447	0.000104	0.232	0.000014	0.030
RV_Juvenile	2	0.003580	0.001160	0.324	0.000169	0.047
RV_Juvenile	3	0.001880	0.000606	0.323	0.000088	0.047
RV_Juvenile	4	0.001360	0.000442	0.324	0.000064	0.047
RV_Juvenile	5	0.001120	0.000364	0.325	0.000052	0.046
RV_Juvenile	6	0.000824	0.000270	0.328	0.000037	0.045
RV_Juvenile	7	0.000610	0.000203	0.333	0.000028	0.046
RV_Juvenile	8	0.000486	0.000164	0.338	0.000024	0.049
RV_Juvenile	9	0.000314	0.000108	0.344	0.000017	0.054
RV_Juvenile	10	0.000279	0.000099	0.355	0.000019	0.066

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	101649	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	239095
1973	44124	34541	49888	37315	11560	6720	3316	2127	1138	693	316	191737
1974	27762	36126	19252	16285	17044	4127	3733	1842	1108	713	444	128435
1975	32963	22729	23794	7287	3683	4318	1379	1147	605	307	204	98417
1976	54559	26988	18004	11616	2819	800	837	198	132	90	31	116073
1977	50020	44669	18445	8003	4212	1337	465	471	123	75	62	127882
1978	20892	40953	36024	12877	4282	2104	583	223	199	43	25	118205
1979	23698	17105	32699	25585	8277	2770	1404	386	130	117	28	112199
1980	33048	19403	13940	23322	12698	4281	1476	911	264	91	85	109519
1981	26272	27058	15645	10461	15662	8349	2820	1008	663	188	67	108194
1982	42467	21510	21697	11825	7428	10754	5125	1793	653	458	117	123826
1983	49779	34769	17335	15980	8248	5169	7429	2857	934	345	230	143076
1984	39474	40755	27402	13609	11378	5669	3614	5045	1644	551	210	149350
1985	10619	32319	33315	21532	9870	7225	3544	2311	3304	852	356	125247
1986	7782	8694	26409	24613	12061	5357	3658	2185	1480	2225	463	94927
1987	15519	6371	6980	19039	14382	5960	3028	2143	1288	876	1508	77094
1988	15426	12530	4751	5334	12446	8679	3788	1892	998	612	362	66819
1989	6165	12399	10008	3603	2996	4532	3573	2195	1040	437	278	47229
1990	6825	4933	8425	6232	1607	1326	2023	1775	1361	642	208	35358
1991	24383	5218	3082	2886	1268	519	707	1010	932	721	391	41118
1992	7738	14546	3280	1918	1471	551	174	251	322	316	249	30818
1993	784	6260	7865	1111	822	657	241	85	117	149	122	18215
1994	489	612	3944	3569	343	248	252	131	47	61	78	9773
1995	928	400	293	1162	1920	169	119	183	100	38	50	5363
1996	1293	760	327	175	934	1536	136	98	149	82	31	5521
1997	457	1057	619	264	141	749	1235	109	78	119	66	4893
1998	2748	373	854	490	206	111	585	970	85	60	93	6576
1999	5813	2249	303	679	382	160	86	454	757	66	46	10994
2000	5442	4717	1756	211	465	277	118	65	351	571	51	14024
2001	2143	4446	3541	1133	95	325	208	86	50	276	456	12759
2002	978	1746	3472	2627	783	68	227	149	64	39	217	10371
2003	858	711	1233	2347	1766	515	47	162	111	50	31	7830
2004	1609	664	281	292	787	847	302	34	116	83	39	5055
2005	4429	1307	510	190	194	562	628	228	27	89	66	8230
2006	4139	3625	1069	417	153	155	435	464	169	21	70	10718
2007	8490	3348	2775	724	268	107	123	347	378	136	17	16714
2008	13819	6948	2556	2012	509	196	79	95	276	301	110	26901
2009	3835	11313	5685	2040	1498	380	143	63	75	208	234	25475
2010	5348	3129	9026	4503	1548	1145	288	107	51	58	164	25366
2011	3690	4154	2369	6976	3511	1200	903	224	88	40	47	23199
2012	1306	2981	3232	1889	5591	2835	940	697	177	68	32	19747
2013	2954	1046	2245	2468	1512	4491	2289	755	558	140	55	18513

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	0.514	0.514	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	1.959	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	0.355	0.355	0.298
1986	0.000	0.020	0.127	0.337	0.505	0.370	0.335	0.329	0.324	0.189	0.385	0.385	0.323
1987	0.014	0.093	0.069	0.225	0.305	0.253	0.270	0.564	0.544	0.684	0.348	0.348	0.200
1988	0.018	0.025	0.077	0.377	0.810	0.687	0.346	0.398	0.625	0.588	0.560	0.560	0.421
1989	0.023	0.186	0.274	0.608	0.615	0.607	0.500	0.278	0.282	0.545	0.500	0.500	0.499
1990	0.068	0.270	0.871	1.393	0.930	0.429	0.494	0.444	0.436	0.296	0.574	0.574	1.065
1991	0.317	0.264	0.274	0.474	0.632	0.893	0.835	0.943	0.881	0.863	0.826	0.826	0.460
1992	0.012	0.415	0.883	0.647	0.606	0.626	0.515	0.563	0.570	0.749	0.578	0.578	0.712
1993	0.048	0.262	0.590	0.975	1.000	0.760	0.409	0.389	0.453	0.446	0.640	0.640	0.855
1994	0.000	0.536	1.022	0.420	0.509	0.529	0.121	0.070	0.024	0.000	0.000	0.307	0.650
1995	0.000	0.000	0.314	0.019	0.023	0.013	0.000	0.006	0.000	0.000	0.000	0.011	0.119
1996	0.002	0.006	0.017	0.019	0.020	0.018	0.025	0.023	0.023	0.014	0.000	0.021	0.019
1997	0.002	0.013	0.033	0.047	0.040	0.047	0.041	0.052	0.058	0.047	0.051	0.045	0.040
1998	0.000	0.009	0.030	0.048	0.055	0.051	0.054	0.048	0.053	0.076	0.061	0.052	0.045
1999	0.009	0.047	0.161	0.179	0.122	0.102	0.080	0.057	0.083	0.052	0.049	0.090	0.154
2000	0.002	0.087	0.238	0.599	0.159	0.087	0.119	0.070	0.042	0.023	0.044	0.109	0.332
2001	0.005	0.047	0.099	0.169	0.137	0.158	0.130	0.094	0.045	0.037	0.029	0.130	0.135
2002	0.119	0.148	0.191	0.197	0.220	0.158	0.140	0.101	0.053	0.029	0.031	0.155	0.203
2003	0.057	0.728	1.240	0.892	0.535	0.334	0.123	0.131	0.083	0.045	0.036	0.281	0.889
2004	0.008	0.063	0.194	0.208	0.138	0.100	0.080	0.033	0.069	0.040	0.029	0.087	0.180
2005	0.000	0.001	0.002	0.012	0.023	0.057	0.101	0.102	0.041	0.038	0.034	0.071	0.012
2006	0.012	0.067	0.190	0.244	0.163	0.036	0.026	0.005	0.013	0.000	0.000	0.057	0.199
2007	0.001	0.070	0.122	0.152	0.109	0.098	0.055	0.029	0.030	0.016	0.000	0.073	0.128
2008	0.000	0.001	0.025	0.095	0.093	0.119	0.028	0.035	0.083	0.049	0.073	0.069	0.071
2009	0.003	0.026	0.033	0.076	0.068	0.078	0.089	0.018	0.060	0.038	0.078	0.063	0.059
2010	0.053	0.078	0.058	0.049	0.055	0.038	0.051	0.000	0.044	0.000	0.007	0.036	0.054
2011	0.013	0.051	0.026	0.021	0.014	0.044	0.058	0.035	0.052	0.028	0.000	0.038	0.021
2012	0.022	0.084	0.070	0.022	0.019	0.014	0.019	0.022	0.032	0.016	0.000	0.019	0.037

Table 23. Beginning of year mean weights at age calculated from the commercial catches for cod in Divisions 3NO.
Values in 2013 are the geometric mean of the previous three years.

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	0.555	0.605	0.836	1.360	1.749	3.818	5.186	5.990	6.416	7.347
2013	0.399	0.537	0.821	1.384	2.258	3.442	4.714	5.271	6.823	8.654

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	177677	79671
1974	10423	12418	17839	28533	10329	15369	10726	6471	6392	4065	122566	81885
1975	5581	14548	7044	5887	10712	4756	5831	4250	1646	1574	61830	34657
1976	9542	10587	13013	4868	2105	2976	1044	920	707	250	46011	12870
1977	18760	13042	9287	7876	3824	1827	2533	941	760	635	59485	18396
1978	25274	27869	16032	7813	6409	2347	1206	1433	389	307	89079	19904
1979	8790	27467	30909	14898	7038	5223	1806	866	890	271	98157	30991
1980	10300	11461	30014	23671	11889	5857	4951	1745	794	854	101536	49761
1981	21358	14856	14471	33395	24872	12506	6307	5650	1713	700	135829	85143
1982	18123	22265	16321	14944	34519	22148	11326	5169	4331	1231	150378	93669
1983	25408	18180	23637	16382	14947	33152	16408	7267	3069	2391	160842	93617
1984	30859	27092	18089	23493	16028	14179	27608	11062	4677	2233	175320	99281
1985	10694	27460	27027	17365	19666	13324	11968	22872	6926	3544	160849	95667
1986	2338	18388	28141	20747	14329	15337	13284	11929	20236	4407	149136	100269
1987	2185	3947	21816	23986	14891	12344	13430	10861	8617	16865	128942	100993
1988	8098	3326	5674	18986	17532	12505	9342	7055	5603	3779	91900	74802
1989	4493	8479	4557	5268	10965	11456	11342	6787	3530	2981	69860	52330
1990	2183	6047	7416	3219	3280	7444	8539	10480	5644	2143	56396	40750
1991	2640	2107	3657	2323	1609	2756	5642	6280	7219	4457	38691	30286
1992	3122	1961	1821	2489	1404	750	1397	2409	2796	2813	20962	14058
1993	1994	3990	1040	1149	1480	822	454	770	1205	1060	13964	6939
1994	99	1605	3007	509	456	849	591	314	315	635	8380	3669
1995	124	132	867	2610	326	234	943	556	262	262	6315	5192
1996	235	188	173	1449	3581	379	306	934	518	222	7984	7389
1997	327	354	265	226	1730	3714	434	415	736	475	8677	7731
1998	105	489	493	331	256	1760	3864	449	375	666	8788	7700
1999	867	190	756	626	336	237	1667	4036	417	316	9449	7636
2000	2086	1122	245	907	740	300	178	1364	3213	327	10482	7028
2001	1975	2849	1209	164	1011	881	337	190	1469	3065	13149	7117
2002	993	2663	3375	1380	179	1038	836	393	266	1819	12941	5911
2003	406	980	2789	3096	1338	176	1012	753	386	274	11210	7036
2004	321	221	332	1374	2096	1039	167	937	722	336	7545	6671
2005	424	503	285	422	1646	2428	1099	199	831	690	8528	7317
2006	2007	787	577	344	464	1559	2227	1090	177	864	10097	6726
2007	1582	2286	898	496	260	430	1421	2121	936	138	10568	5802
2008	1765	2044	2540	837	533	219	499	1522	1970	898	12827	6478
2009	4299	2695	2379	2772	868	475	218	520	1384	1755	17367	7993
2010	760	4980	3423	2469	2780	834	513	228	526	1433	17946	8783
2011	1661	1075	6039	4200	3118	3257	932	468	197	468	21414	12639
2012	1655	1957	1579	7604	4958	3587	3617	1059	437	232	26686	21495
2013	418	1205	2026	2092	10142	7880	3559	2943	957	475	31698	28049

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	1572	2533	940	760	635	12062
1978	35	230	1498	2987	5077	2213	1143	1433	389	307	15313
1979	128	364	2266	6329	5485	5120	1789	850	890	271	23492
1980	35	797	3420	10160	9999	5580	4943	1743	789	854	38321
1981	42	351	3978	18428	21820	12185	6253	5650	1713	698	71116
1982	63	361	2384	9832	31820	21827	11284	5162	4331	1231	88294
1983	7	296	2880	8967	13557	32861	16383	7263	3069	2391	87674
1984	25	75	1313	12661	14350	13898	27583	11060	4677	2233	87875
1985	21	161	704	4694	17853	13107	11921	22870	6926	3544	81802
1986	5	247	1150	4251	9126	15154	13253	11920	20236	4407	79748
1987	13	76	1896	5655	10614	11017	13411	10857	8616	16865	79020
1988	2	111	891	7583	12112	12003	9110	7054	5603	3778	58247
1989	21	26	776	3356	9023	10790	11293	6750	3530	2981	48547
1990	37	228	327	1766	3093	7222	8467	10475	5638	2143	39396
1991	21	136	892	940	1413	2739	5617	6273	7218	4456	29704
1992	1	109	392	1808	1277	732	1396	2407	2795	2813	13733
1993	0	48	317	600	1416	816	452	770	1205	1060	6684
1994	0	25	849	389	371	845	591	314	315	635	4334
1995	1	6	507	2418	313	221	942	556	262	262	5488
1996	5	13	86	1438	3573	377	301	934	518	222	7466
1997	4	54	108	210	1730	3713	433	414	736	475	7878
1998	2	53	288	286	254	1760	3864	449	374	666	7995
1999	1	20	396	573	330	237	1667	4036	417	316	7994
2000	2	15	107	825	731	300	178	1364	3213	327	7061
2001	13	79	203	138	1000	879	337	190	1469	3065	7373
2002	7	364	1444	1031	174	1036	835	393	266	1819	7370
2003	7	157	2205	2946	1308	176	1012	753	386	274	9223
2004	8	30	280	1359	2092	1037	167	937	722	336	6969
2005	6	57	175	419	1646	2428	1099	199	831	690	7551
2006	97	46	222	300	464	1559	2227	1090	177	864	7047
2007	29	433	203	373	252	430	1421	2121	936	138	6335
2008	11	190	1311	484	499	217	499	1522	1970	898	7602
2009	109	73	859	2301	751	469	218	520	1384	1755	8440
2010	7	415	381	1870	2661	807	511	227	526	1433	8840
2011	23	60	1456	1507	2947	3225	926	467	197	468	11276
2012	23	109	422	3997	3543	3550	3609	1058	437	232	16980
2013	6	67	418	1449	8059	7234	3552	2942	957	475	25160

Table 26. Results of stochastic projections for Divs. 3NO cod at $F=0$ and $F_{\text{status quo}}=0.04$.

F=0		Beginning of Year SSB			
Percentile		2013	2014	2015	2016
0.95		43676	54413	60894	58401
0.75		36050	45526	50133	49199
0.5		31861	39993	44287	43742
0.25		28454	35985	39898	39224
0.05		23676	29881	33396	34007

F=0.04		Beginning of Year SSB			
Percentile		2013	2014	2015	2016
0.95		42775	52057	55459	51639
0.75		35464	43220	46285	43736
0.5		31342	38214	40712	38903
0.25		28003	34139	36655	34741
0.05		23534	28574	30635	29175

F=0.04		Yield			
Percentile		2013	2014	2015	2016
0.95		1535	1688	1483	1600
0.75		1281	1395	1268	1336
0.5		1127	1214	1114	1175
0.25		998	1080	980	1031
0.05		834	893	823	862

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

Fishing Mortality	Yield			P(SSB < B_{lim})			P(SSB ₂₀₁₇ < SSB ₂₀₁₃)
	2014	2015	2016	2014	2015	2016	
F=0	-	-	-	>95%	>95%	>95%	<5%
$F_{SQ}=0.04$	1214	1114	1175	>95%	>95%	>95%	<5%

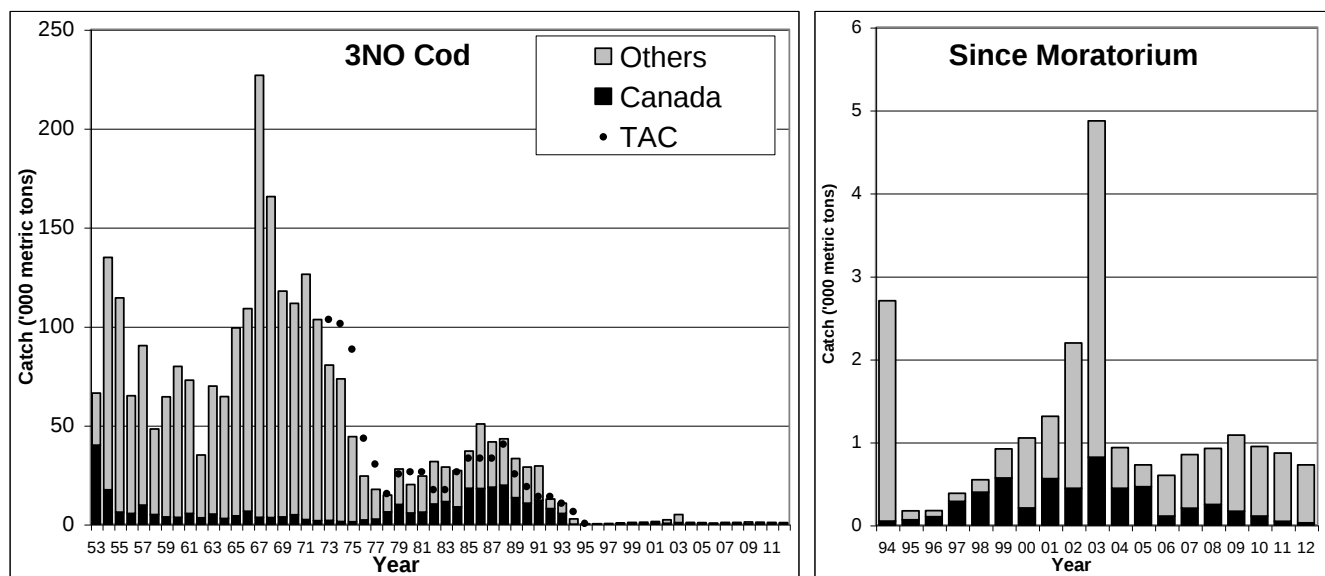


Fig. 1. Catches of cod in NAFO Div. 3NO from 1953-2011. Panel on right for years since the moratorium in Feb. 1994.

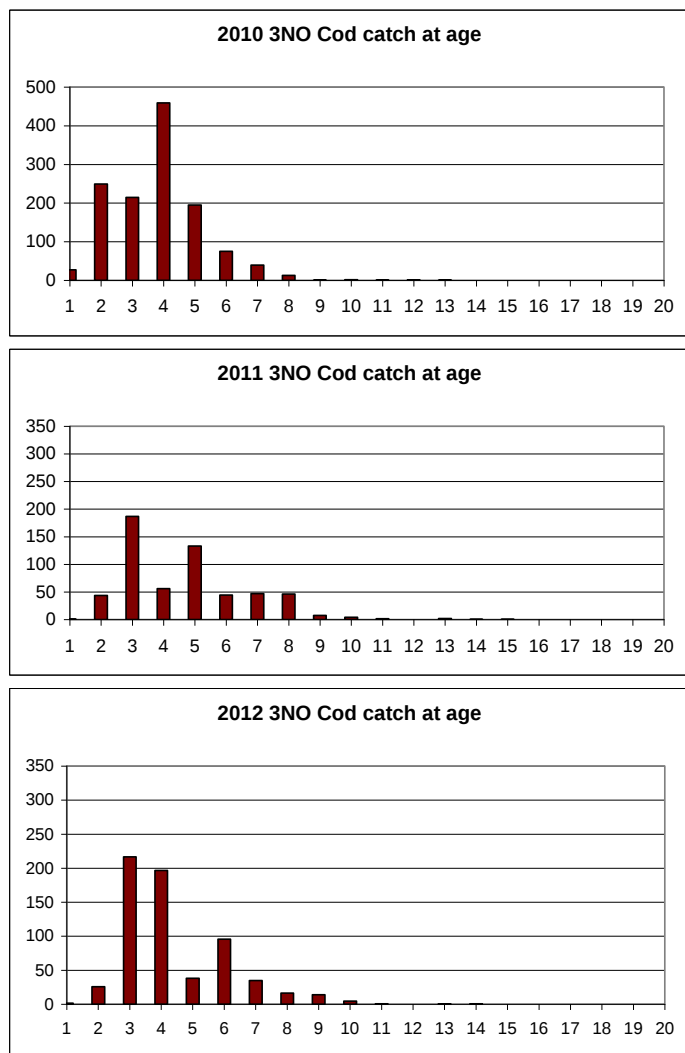


Fig. 2. Plot of Div. 3NO Cod catch-at-age for 2010-2012

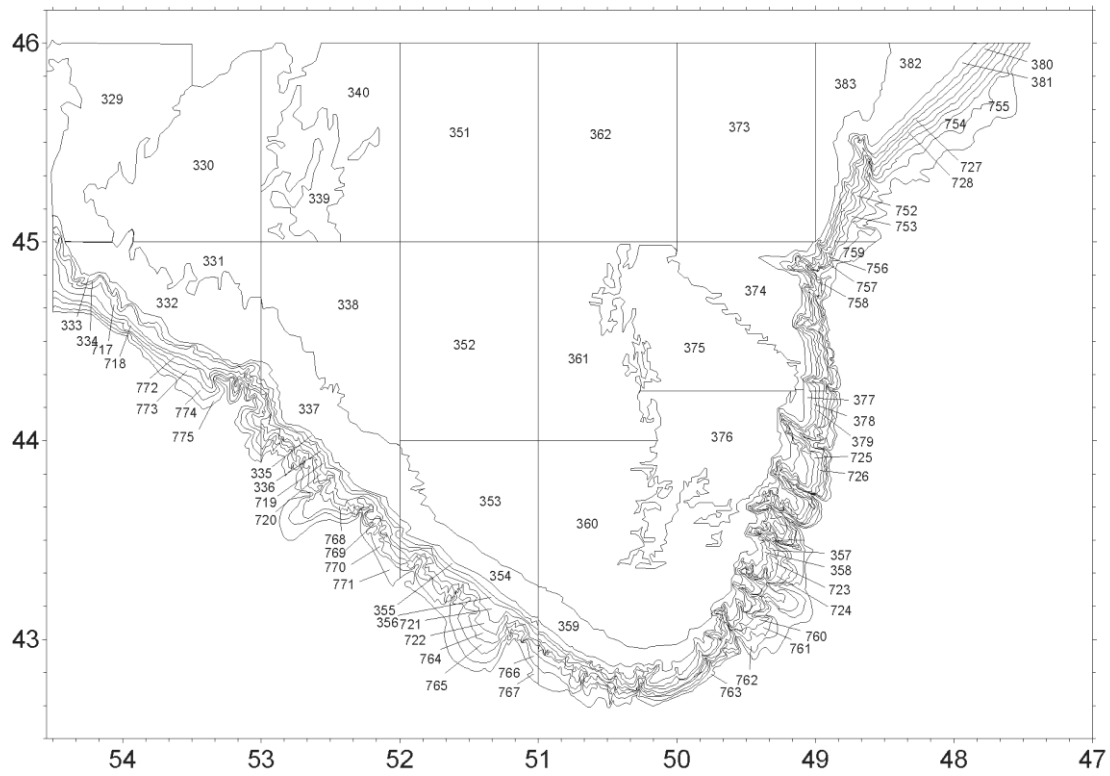


Figure 3 - Stratification scheme for Divisions 3NO.

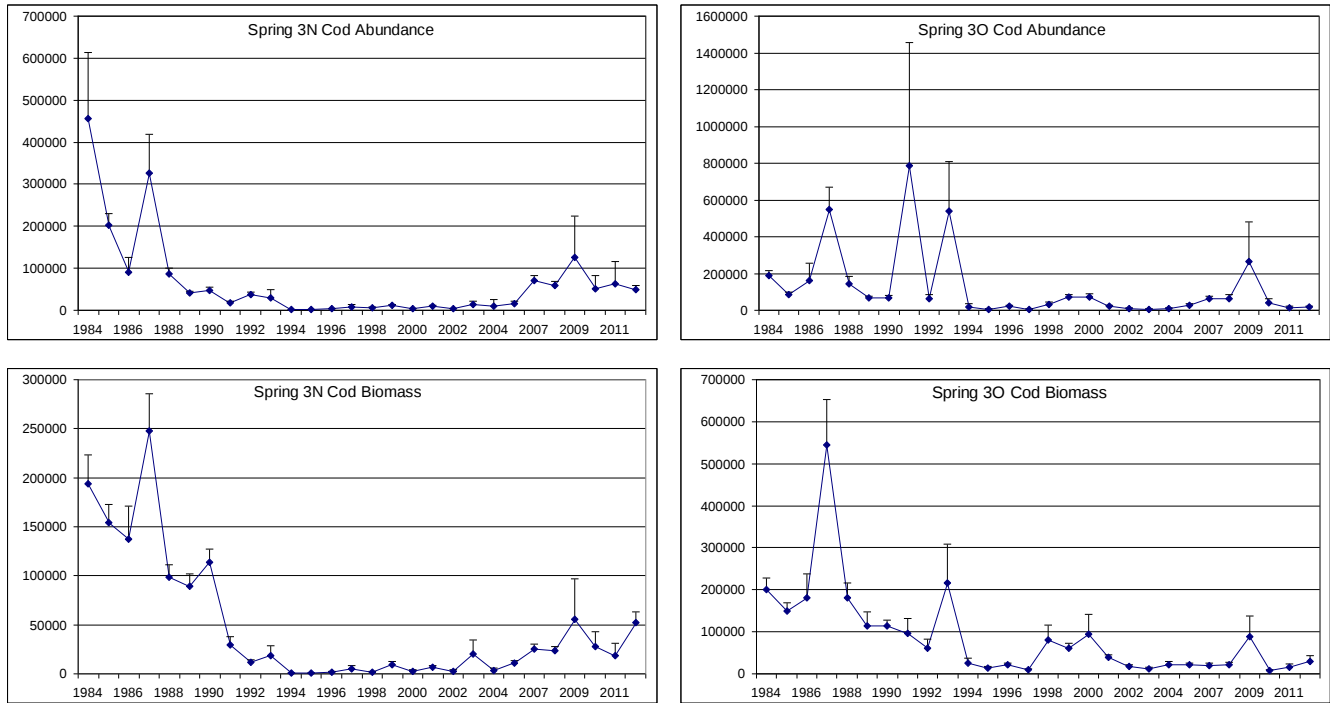


Figure 4 – Abundance (000's) and biomass (t) for the Canadian Spring Research Vessel survey series with 1 standard deviation for strata<200 fathoms.

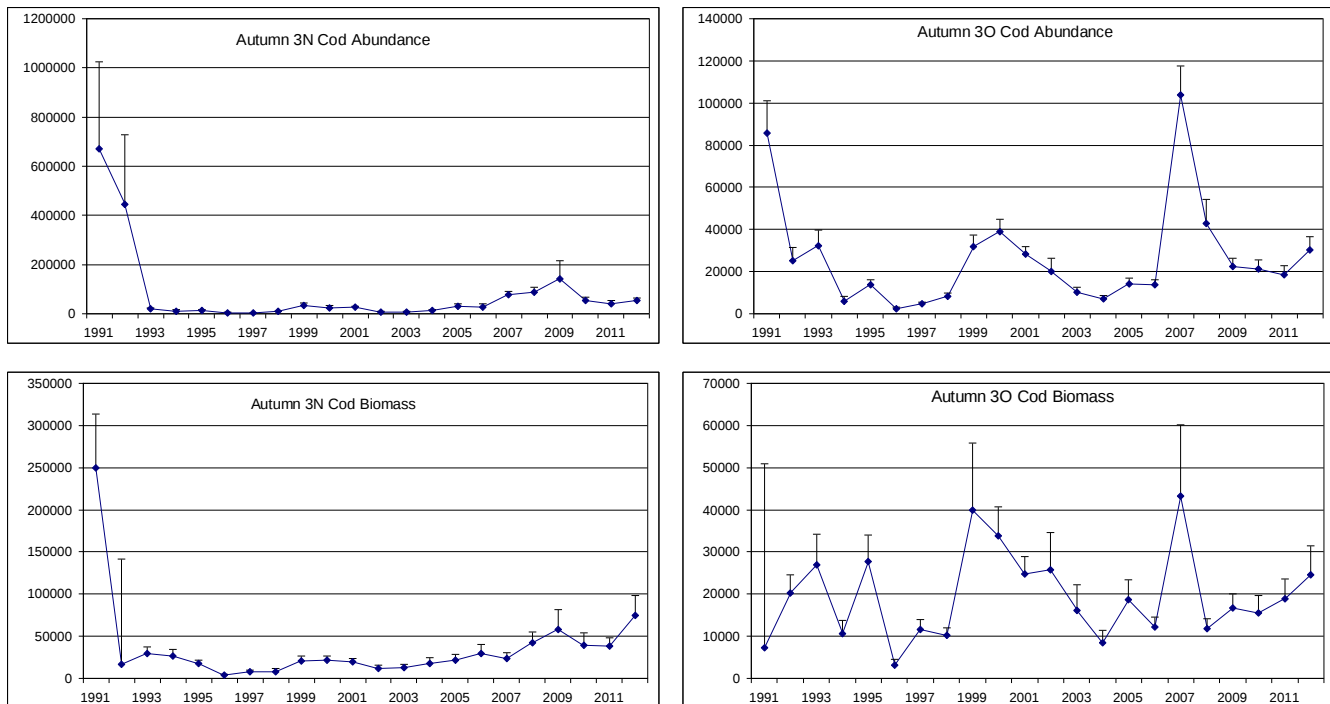


Figure 5– Abundance (000's) and biomass (t) for the Canadian Autumn Research Vessel survey series with 1 standard deviation for strata<200 fathoms.

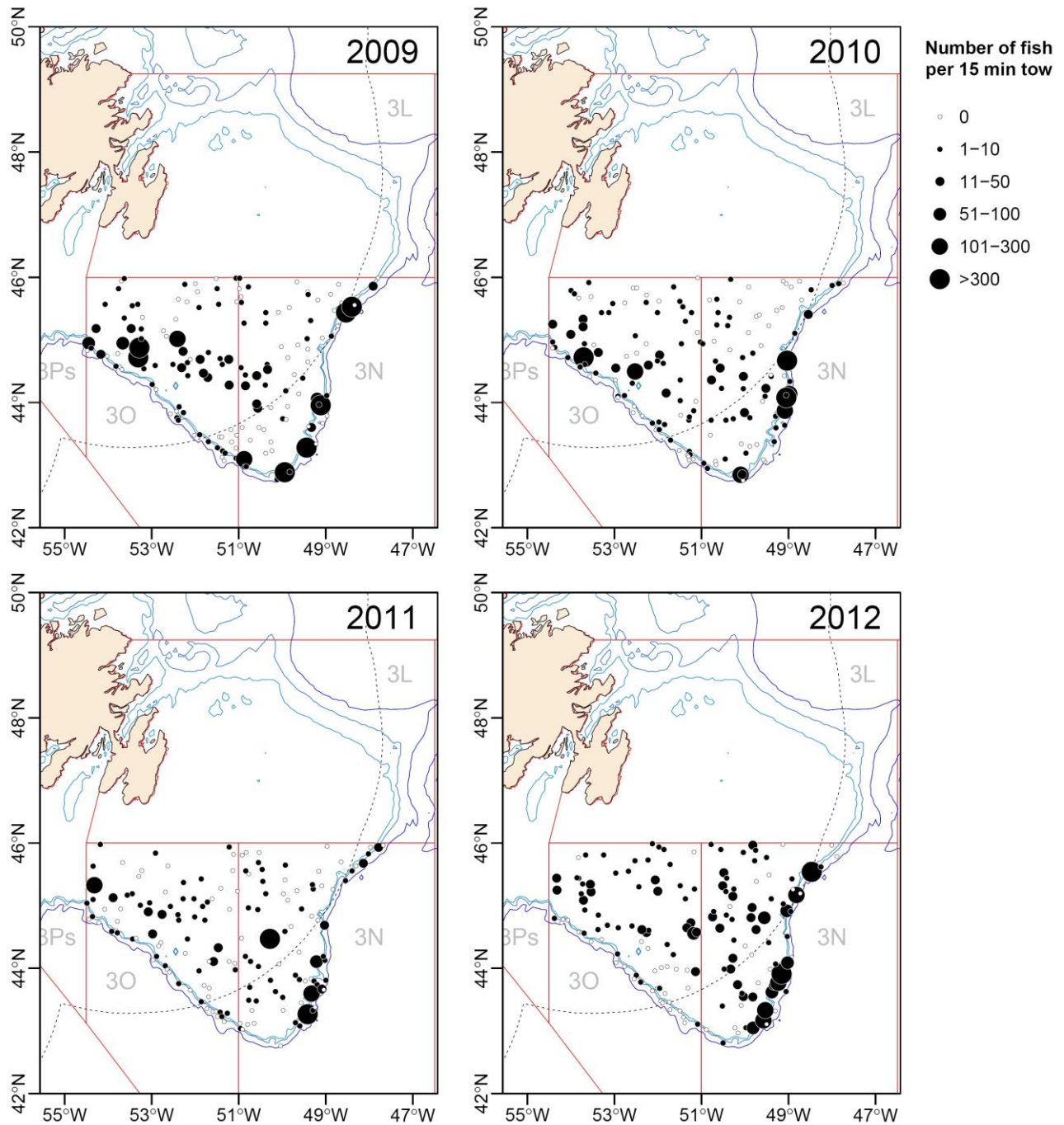


Figure 6. Distribution plots for Divs. 3NO cod from the Canadian Spring survey.

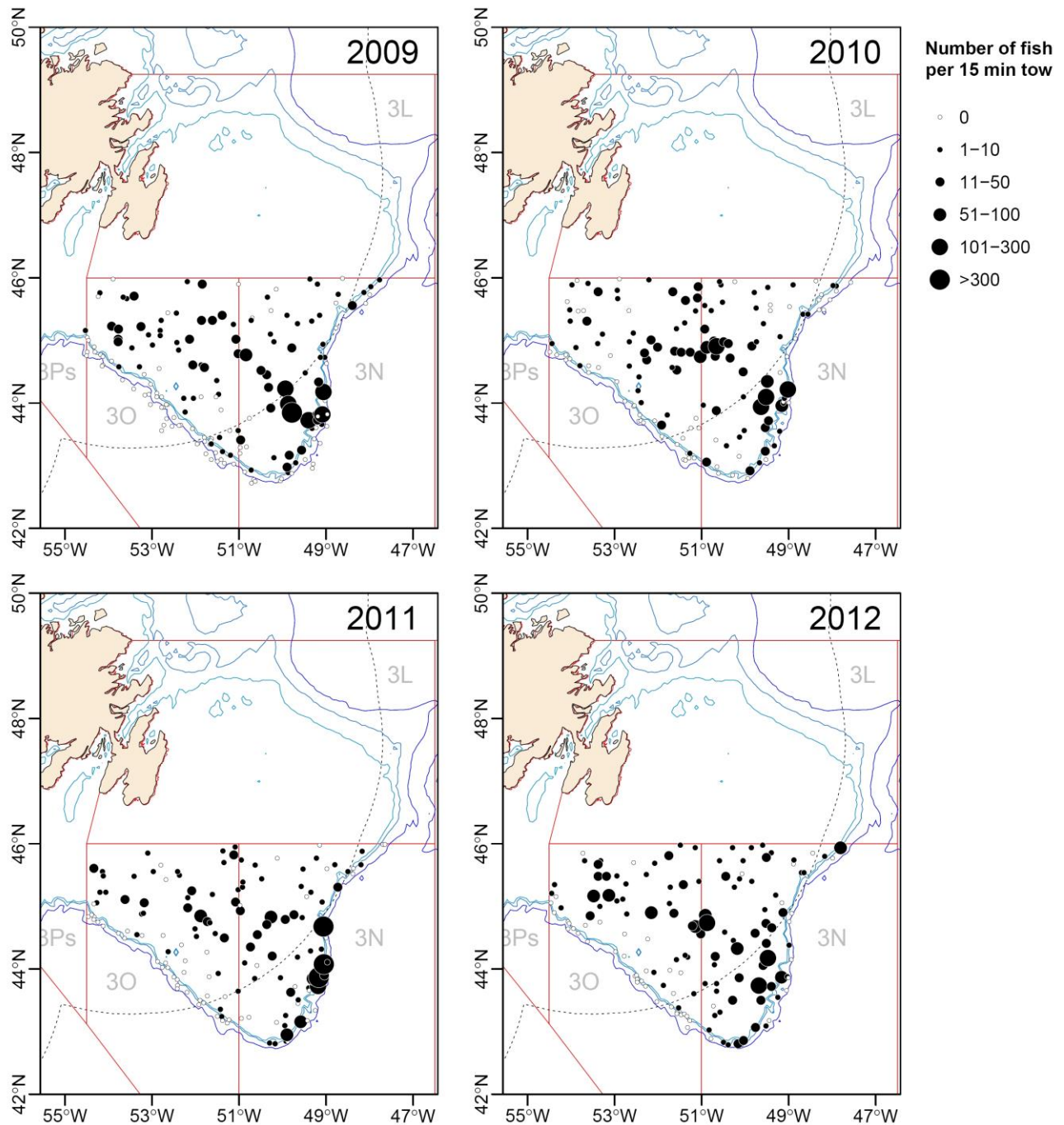


Figure 7. Distribution plots for Divs. 3NO cod from the Canadian Autumn survey.

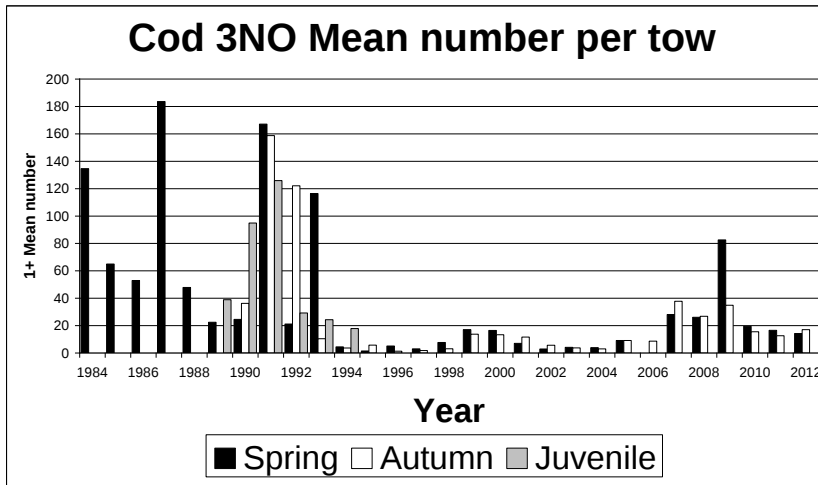


Fig 8. Spring and autumn Canadian RV estimates of 1+ mean number/tow of cod in Divisions 3NO

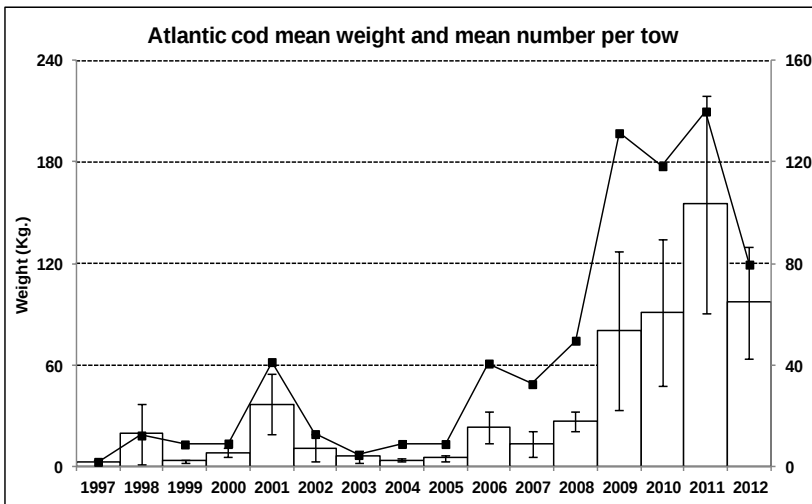


Fig. 9. Mean number and weight (kg) per tow from Spain Div. 3NO surveys of the regulatory area .

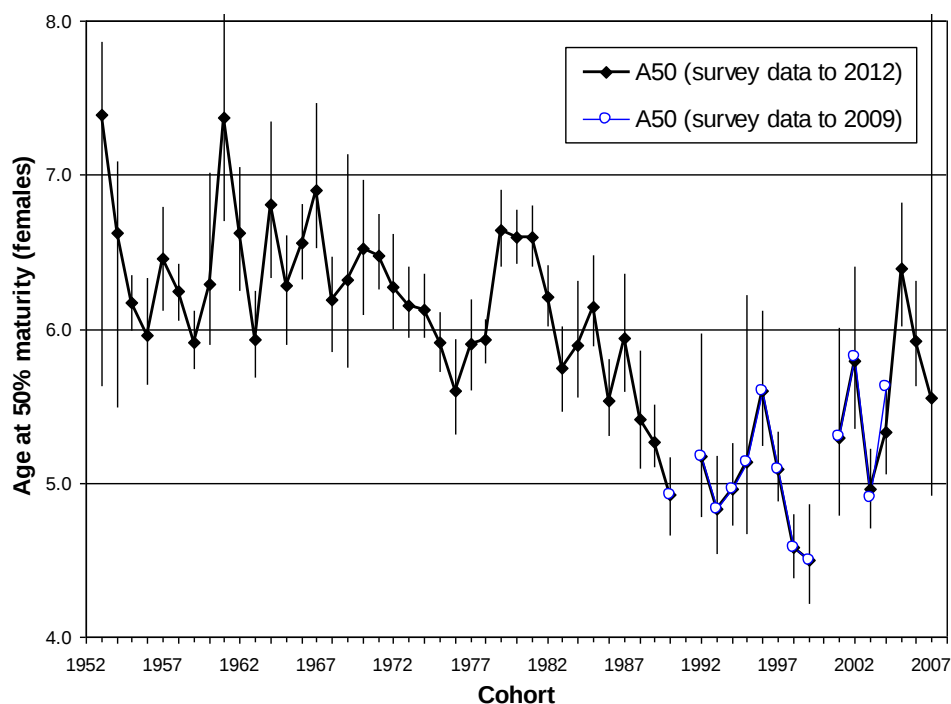


Fig. 10 - Age at 50% maturity by cohort (1953-2007, excluding 1991 and 2000) for female cod sampled during DFO spring research vessel bottom-trawl surveys of NAFO Divs. 3NO. Error bars are 95% fiducial limits.

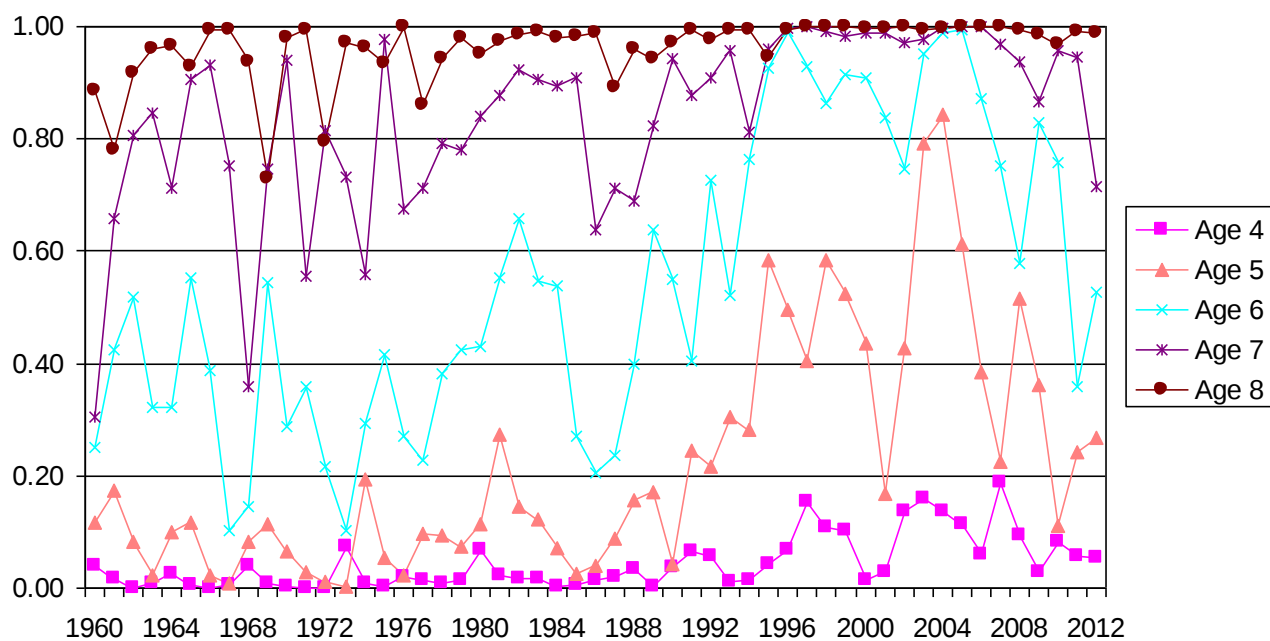


Fig. 11. Estimated proportions mature at ages 4-8 for female cod sampled during Canadian research vessel bottom-trawl surveys in NAFO Divs 3NO. Model fitted by cohort to observed proportions mature at age from 1975-2012.

3NO Cod, CAN_Spr

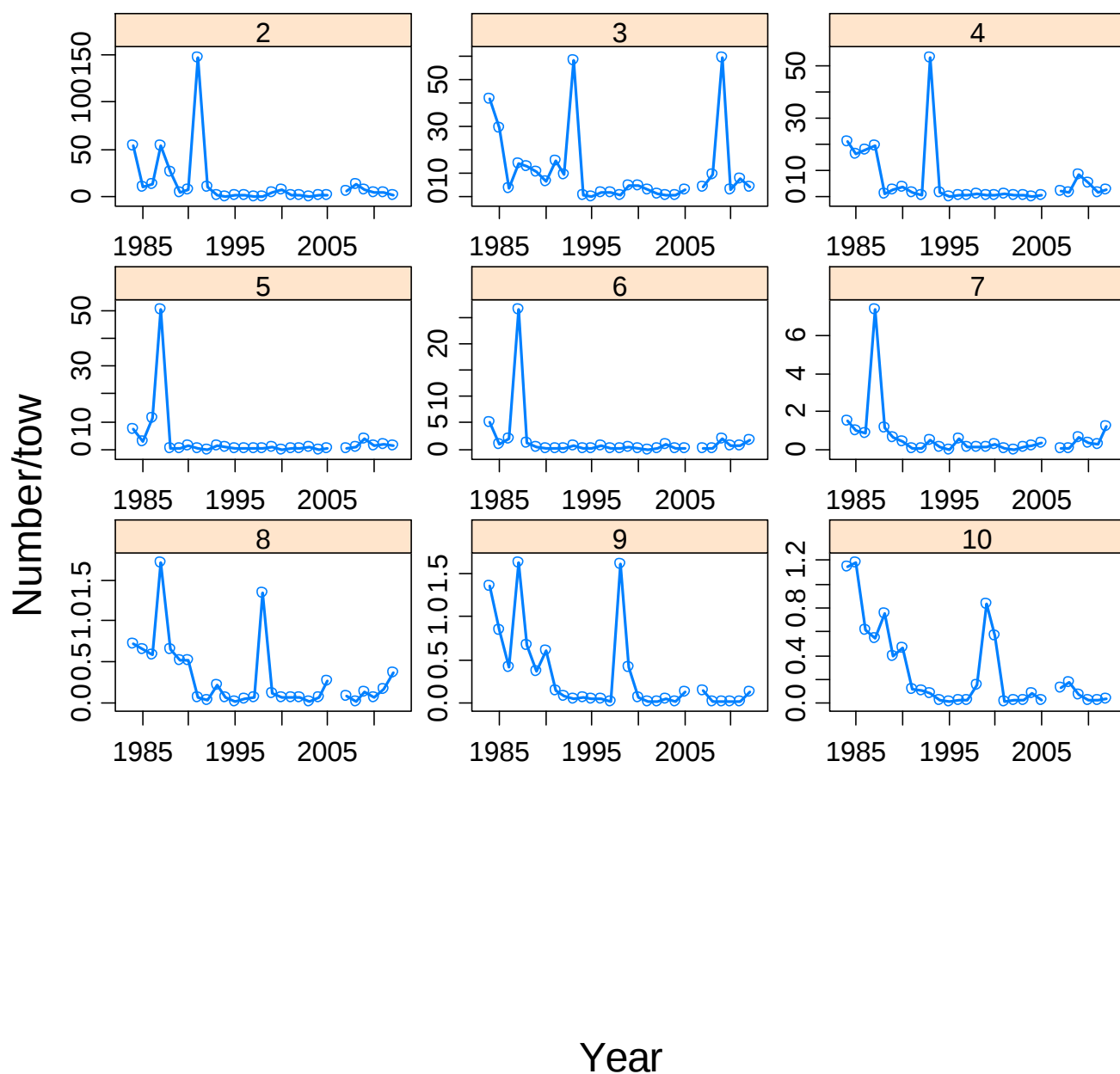


Fig. 12a. Age by age disaggregated plots of mean number per tow from Canadian SPRING surveys from 1984-2012.

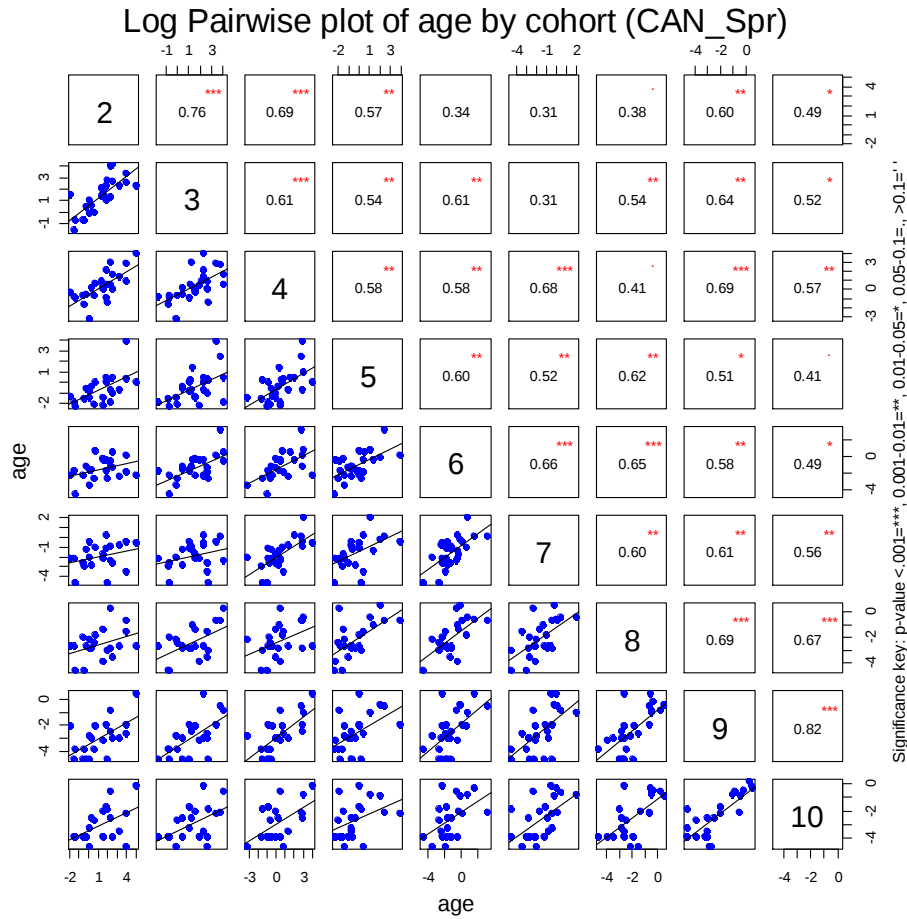


Fig. 12b. Pair-wise scatter plot of age-disaggregated survey data (log-scale) from Canadian SPRING surveys in Divs. 3NO (1984-2012). Data points in the panels below the numbered diagonal compare the logarithm of survey data at different ages for a common cohort. The solid line in each panel is the linear 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)).

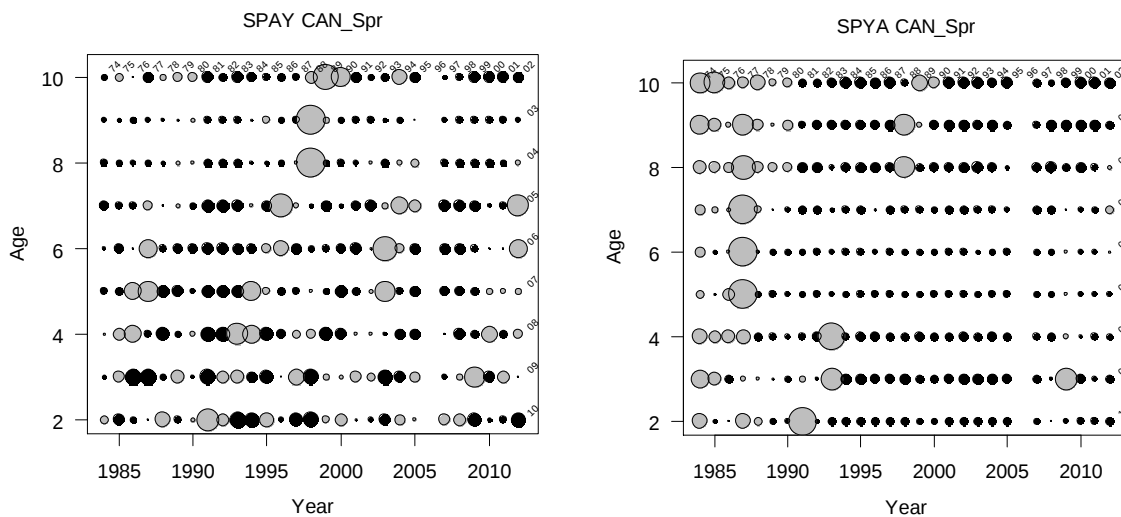


Fig. 12c. Cohort consistency plots for the Canadian Spring surveys in 3NO (1984-2012). Age disaggregated mean number per tow were converted to proportions within an age (left panel, SPAY) or within a year (right panel, SPYA). For each survey-age, the survey data are standardized to have a mean of 0 and 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.

3NO Cod, CAN_F

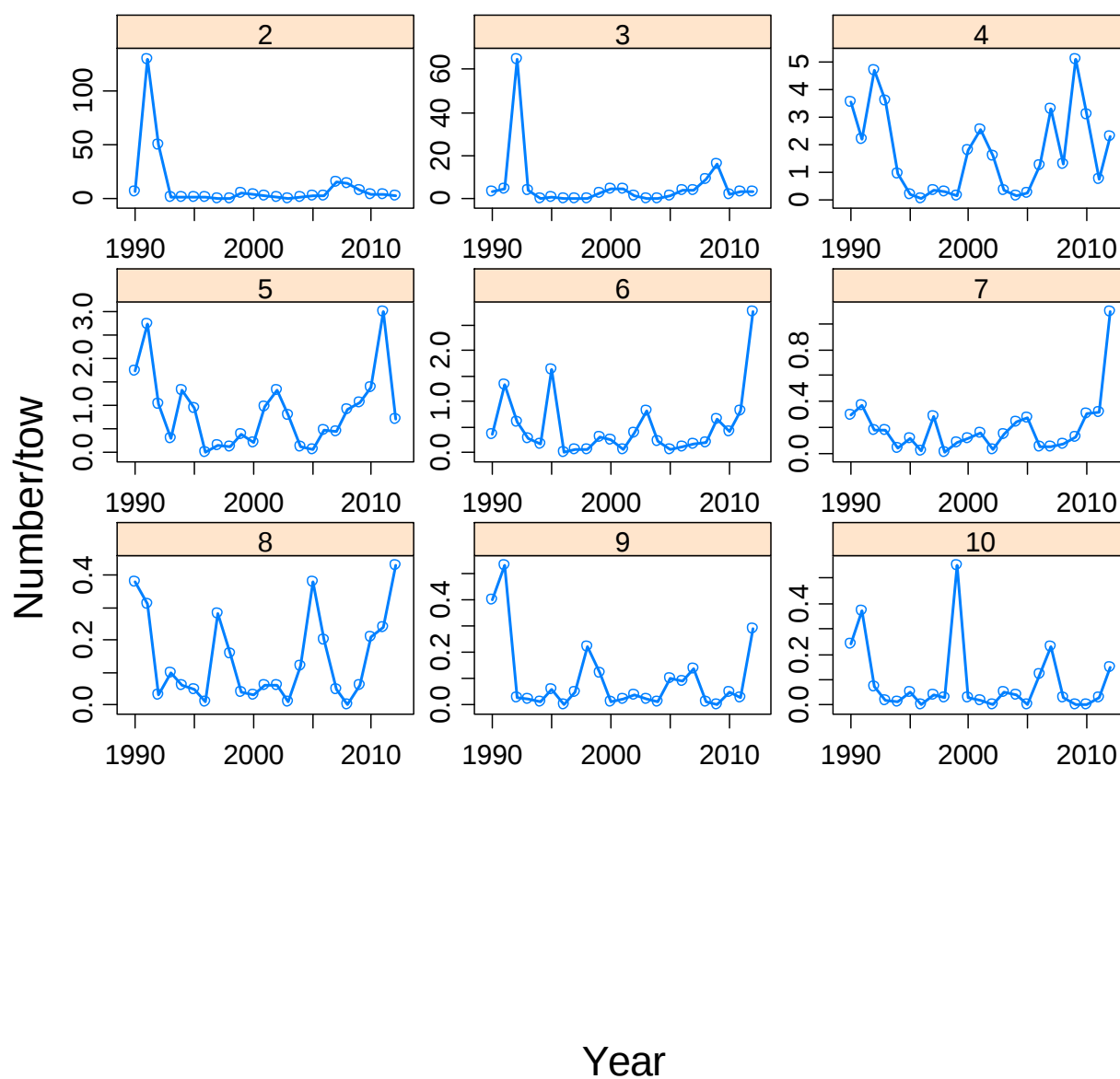


Fig. 13a. Age by age disaggregated plots of mean number per tow from Canadian AUTUMN surveys from 1984-2012.

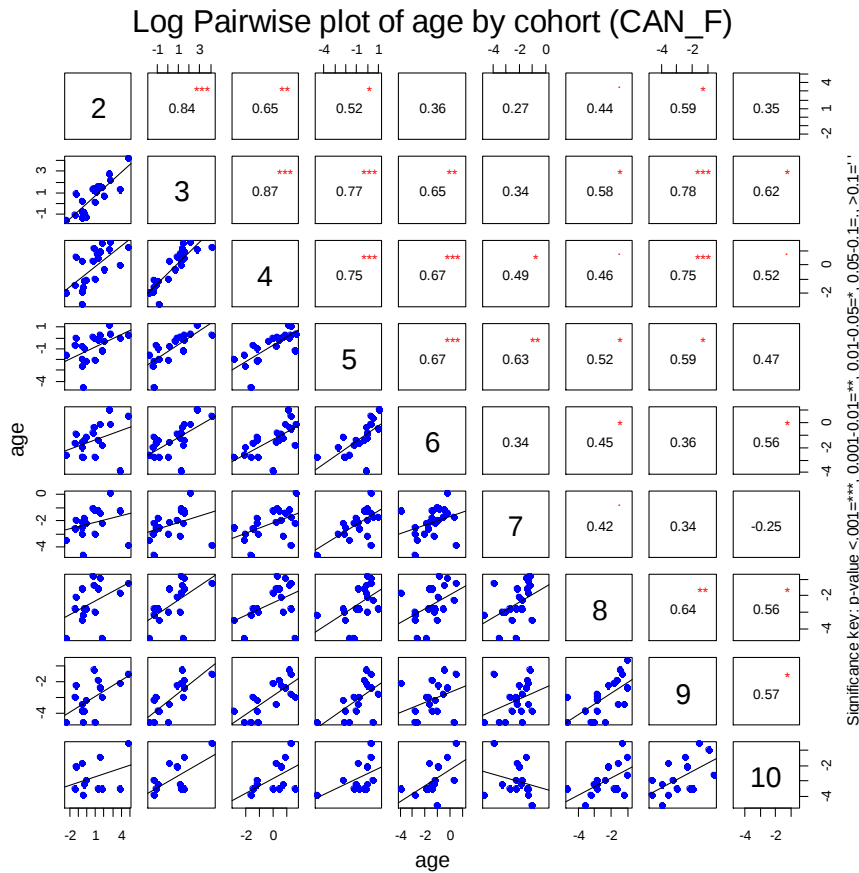


Fig. 13b. Pair-wise scatter plot of age-disaggregated survey data (log-scale) from Canadian AUTUMN surveys in Divs. 3NO (1990-2009). Data points in the panels below the numbered diagonal compare the logarithm of survey data at different ages for a common cohort. The solid line in each panel is the linear 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)).

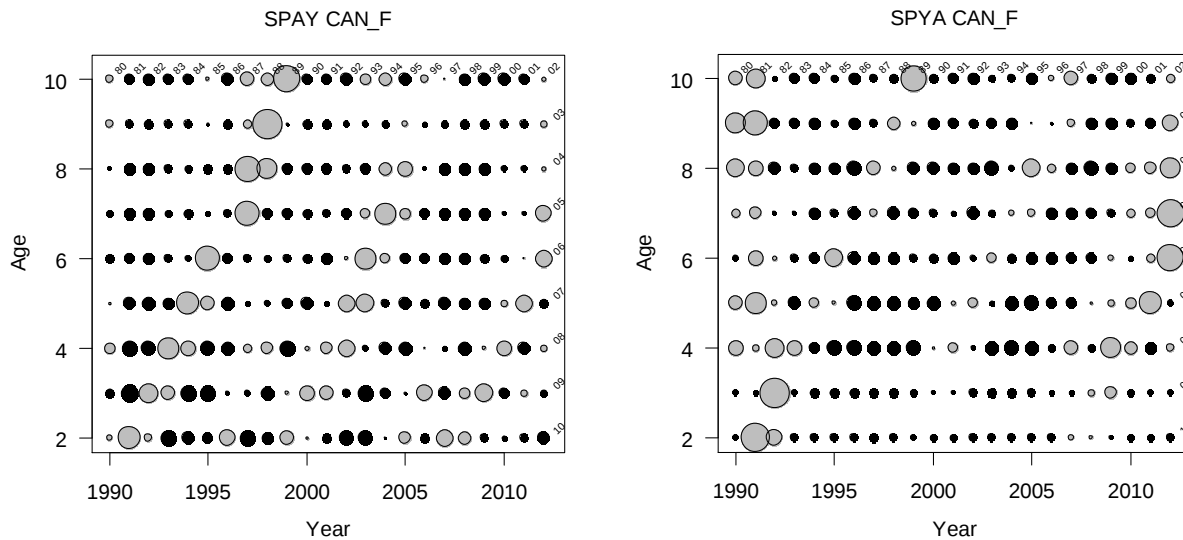


Fig. 13c. Cohort consistency plots for the Canadian AUTUMN surveys in 3NO (1990-2012). Age disaggregated mean number per tow were converted to proportions within an age (left panel, SPAY) or within a year (right panel, SPYA). For each survey-age, the survey data are standardized to have a mean of 0 and 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.

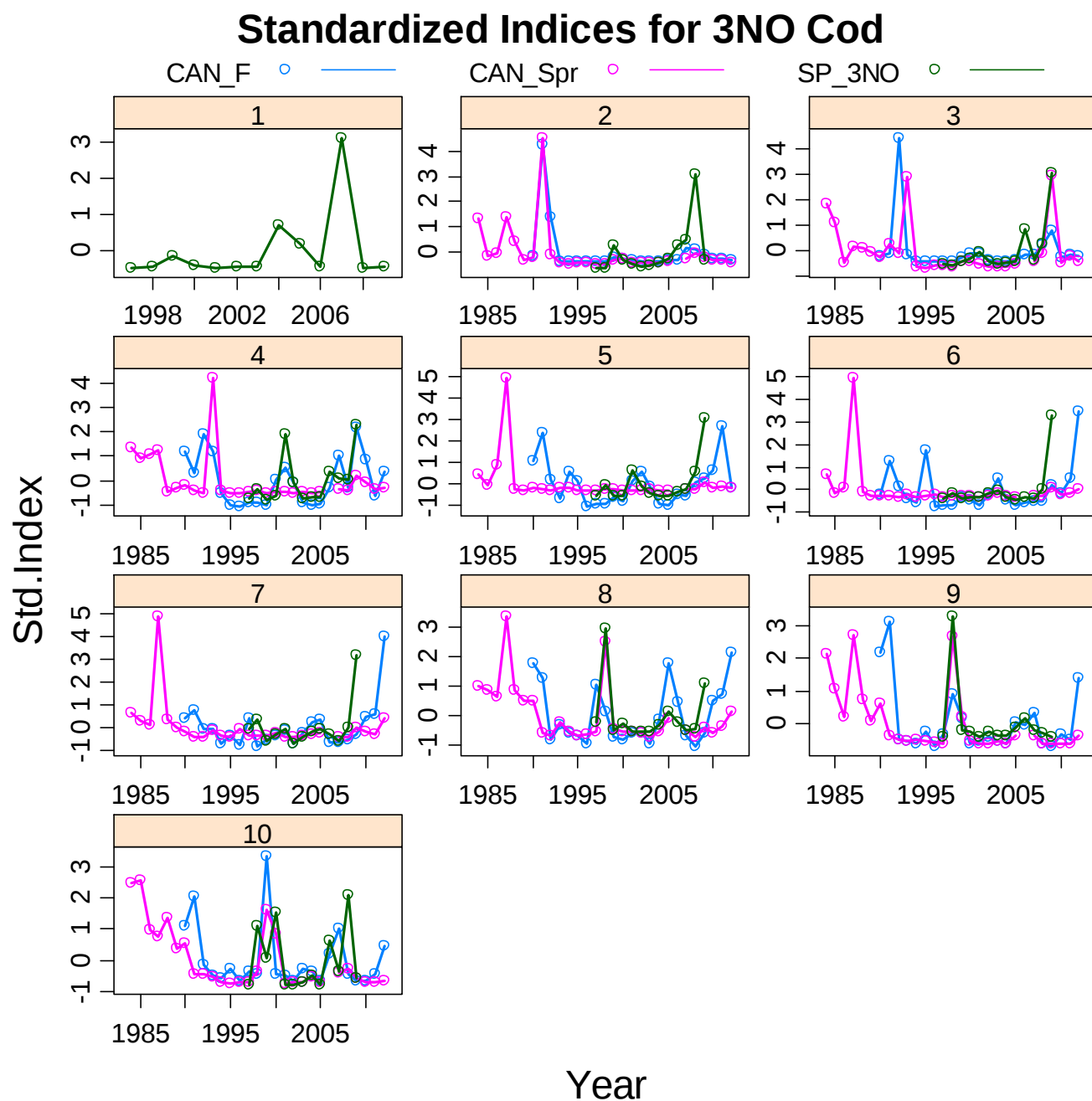


Fig. 14. Cohort consistency plots for survey indices for 3NO cod (Canadian SPRING, Canadian Autumn and Spanish 3NO). Plotted are standardized indices at age.

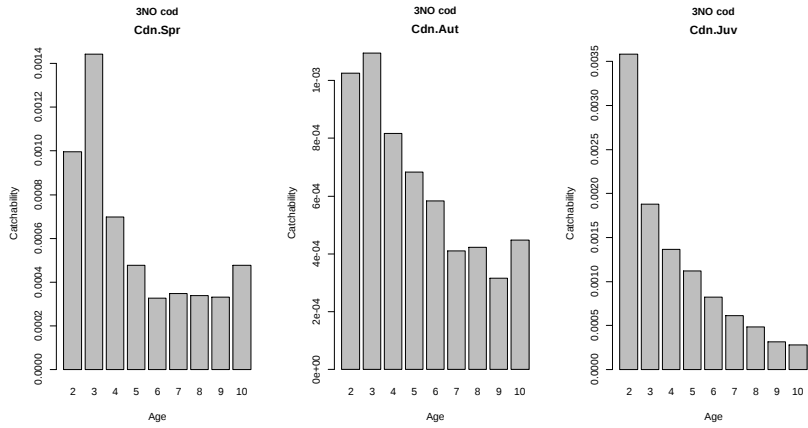


Fig. 15. Estimated catchabilities from ADAPT.

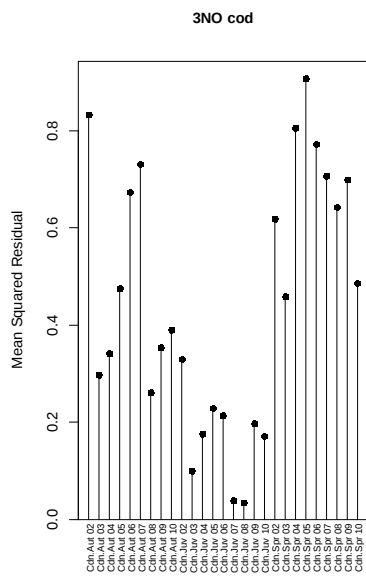


Fig. 16. Mean squared residual at age for each index in the ADAPT.

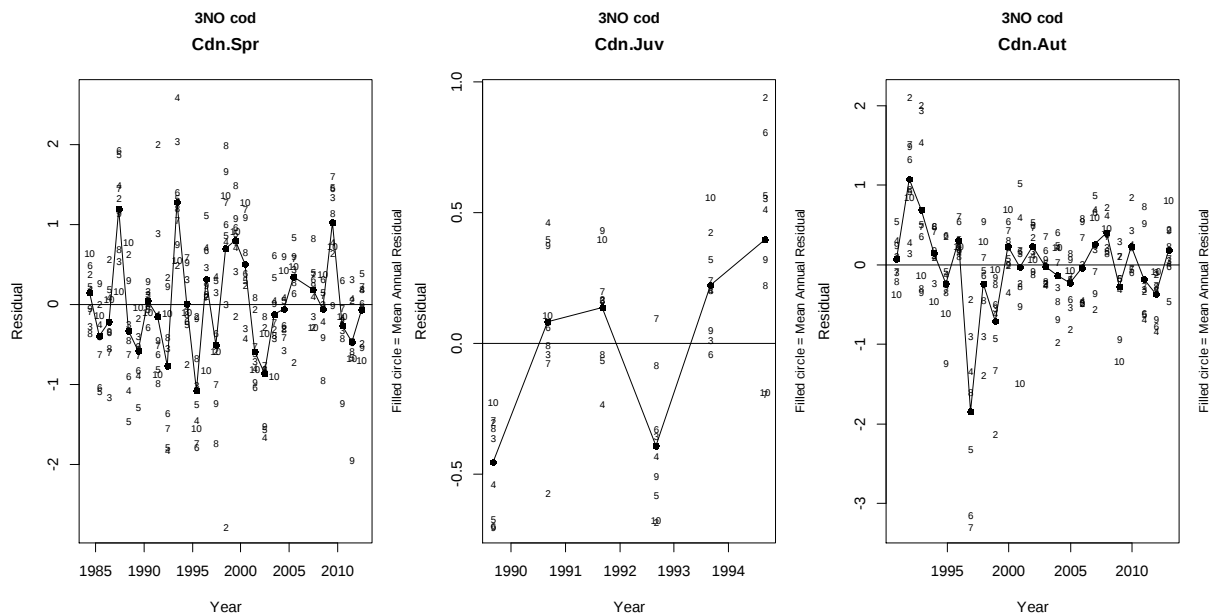


Fig. 17. Residuals at age for each index in the ADAPT.

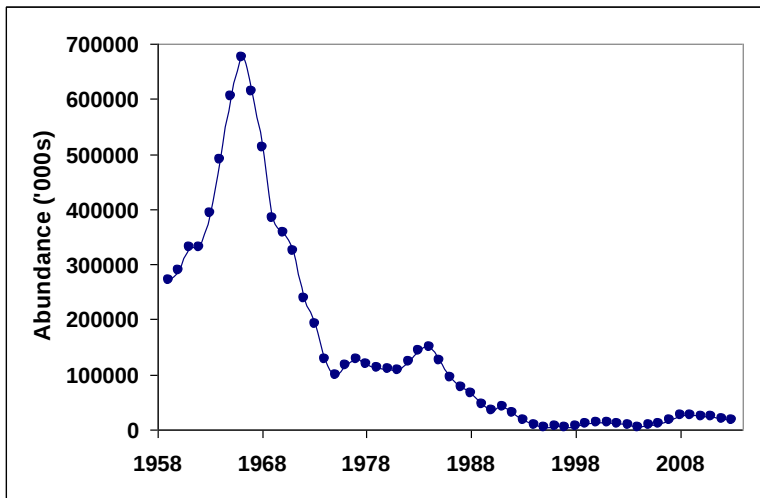


Fig. 18. Bias corrected Population Abundance for cod in Divs. 3NO as estimated from ADAPT

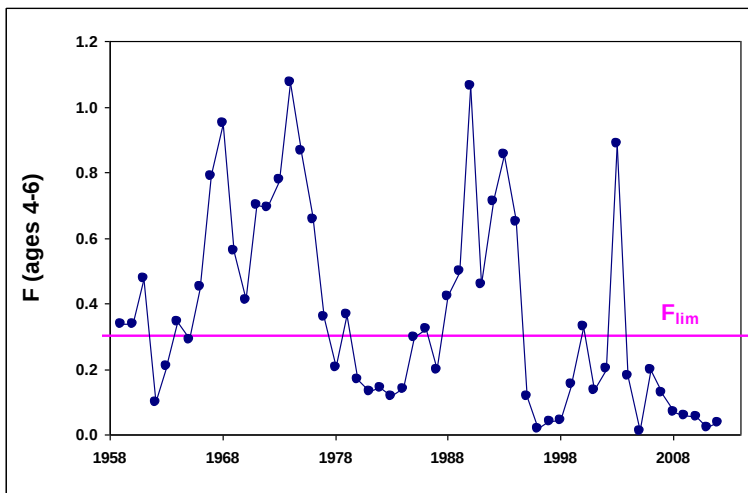


Fig. 19. Fishing Mortality for cod in Div. 3NO as estimated from ADAPT.

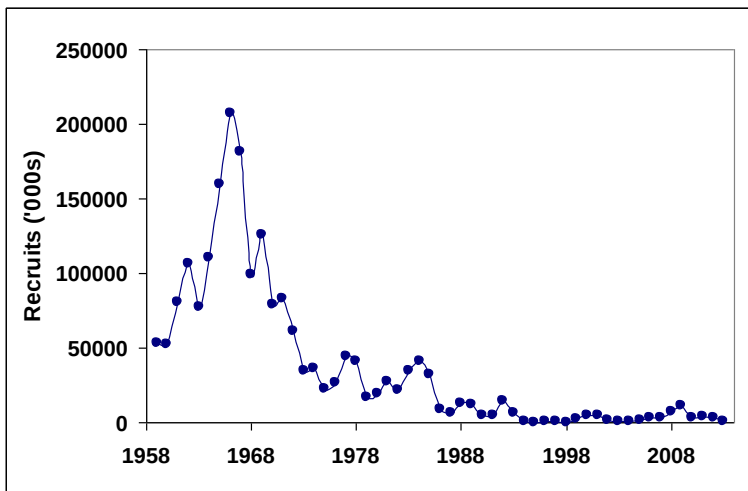


Fig. 20. Age 3 recruits for cod in Div. 3NO as estimated from ADAPT.

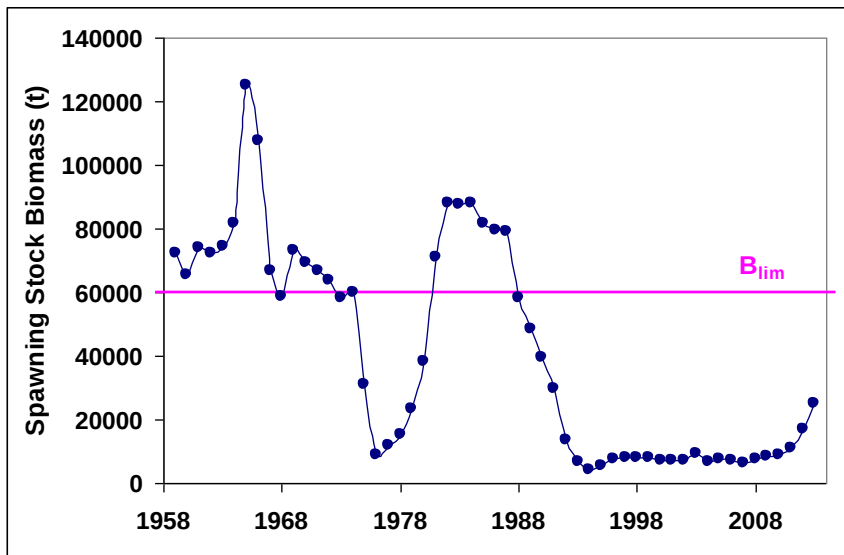


Fig. 21. Spawner biomass for cod in Div. 3NO as estimated from ADAPT.

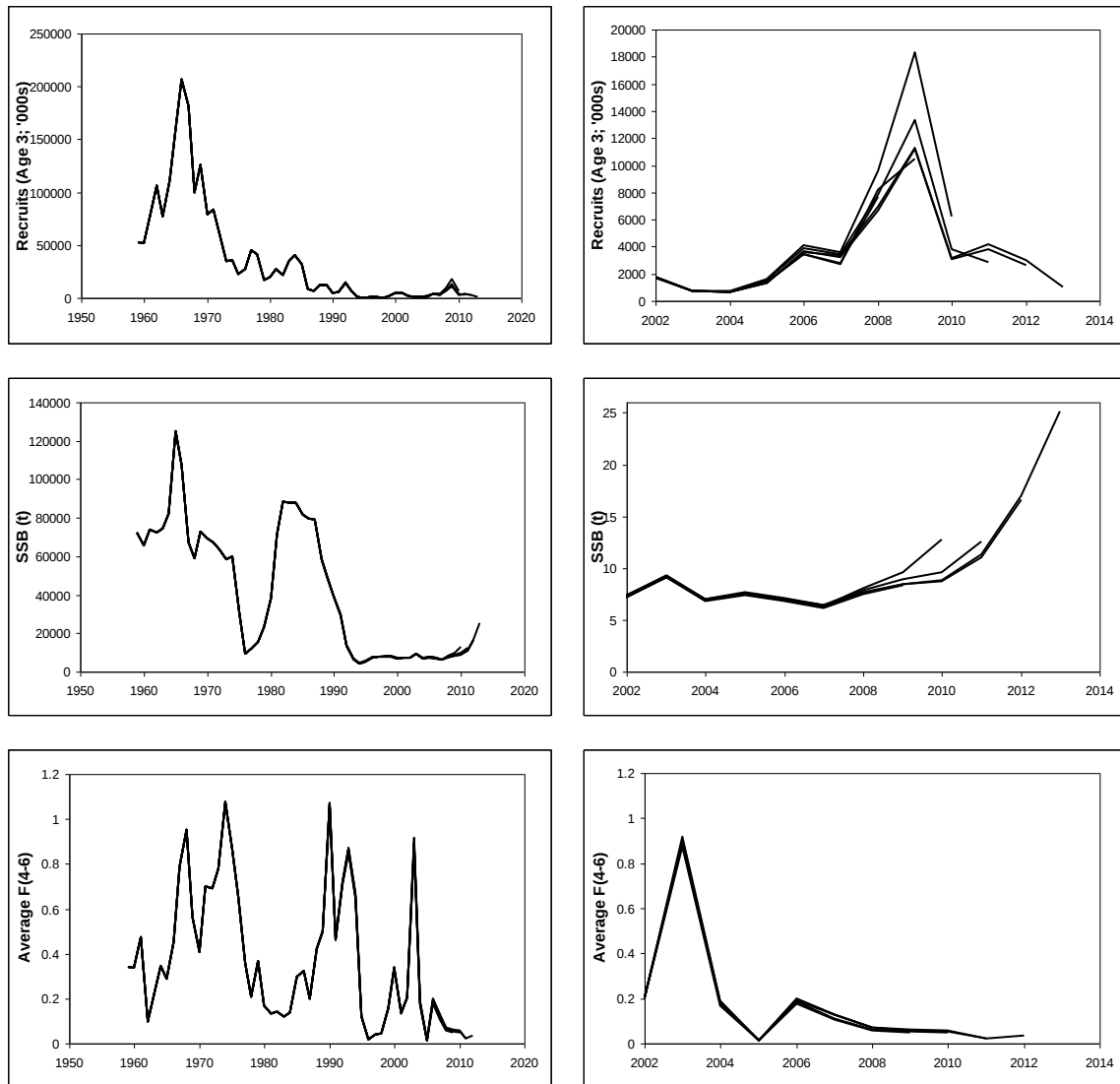


Fig. 22. Retrospective estimates of Age 3 recruits (left panel on log scale), spawner biomass and fishing mortality ($F_{bar\ 4-6}$) for cod in Div. 3NO. Right panels indicate the estimates over a shorter timeframe to emphasize recent trends.

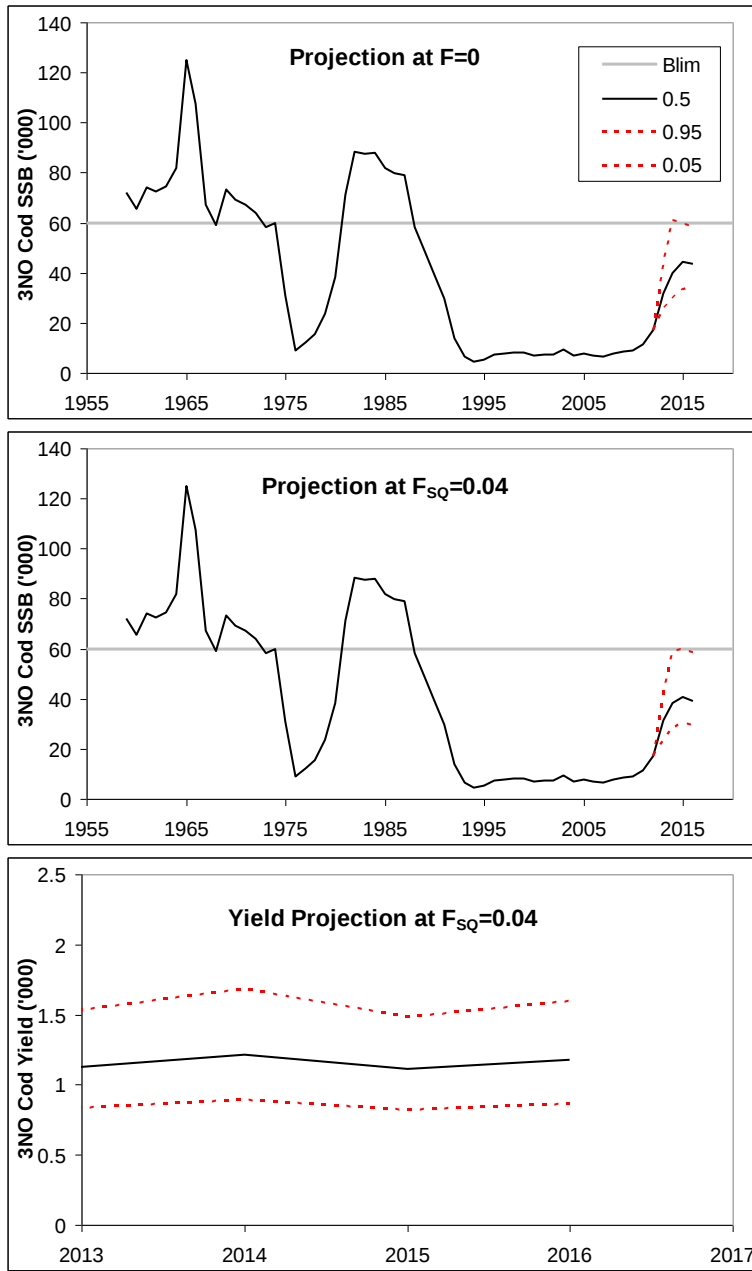


Fig. 23. Stochastic projections of SSB for $F=0$ and SSB and yield for $F_{sq}=0.04$.