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An Updated Assessment of the Cod Stock in NAFO Divisions 3NO

by

R.M. Rideout, R. Rogers, D.W. Ings

Science Branch, Fisheries and Oceans Canada,
P. O. Box 5667, St. John's, Newfoundland, Canada A1C-5X1

Abstract

Cod in Divisions 3NO inhabit the southern Grand Bank of Newfoundland. The stock declined dramatically during the mid-1980's and has been under a fishing moratorium since 1994. Estimates from a population model utilizing the ADAPTive framework (Gavaris 1988) indicate that the stock size during the moratorium remained low and without trend until 2010. SSB increased between 2010 and 2015 due to the presence and maturation of the relatively strong 2006 year class. However, subsequent year classes have not been strong and SSB after 2015 declined to near the time series low in 2020 (7200 t, 12% of B_{lim}). Fishing mortality (ages 4-6) has been below F_{lim} (0.3) in 16 consecutive years. The 2006 year class comprised the majority of the SSB (59%) in 2018. This year class left the virtual population in 2019. Although SSB estimates after 2018 were clearly influenced by the absence of a plus-group in the current model formulation, it can be safely concluded that this would have had little or no influence on the advice stemming from this assessment. This stock was already far below Blim before the 2006 year class left the population in 2019 and SSB had already been declining prior to that point. The current model formulation could not estimate population size for 2021 because catch-at-age estimates were not available for 2020.

Introduction

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

This assessment updates the status of the stock, based primarily on a population model incorporating Canadian spring and fall research vessel surveys conducted in Div. 3NO. Population and spawner stock biomass estimates for 1959-2019 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 400 t and 1100 t since that time. The total catch in 2020 was 587 t. The Canadian catch made up less than 20% of the total catch in 2018-2020 and was taken predominantly as bycatch from the yellowtail flounder bottom trawl fishery (Table 2).

Inadequate sampling of commercial catches in recent years has provided a significant challenge for the estimation of catch-at-age (Table 3). In fact, Rideout et al. (2018) emphasized that the future of the current VPA-based assessment was "in jeopardy if the extent of commercial sampling of cod by-catch in Divs. 3NO does not improve". Sampling has not improved since that time. In 2018 and 2019, commercial sampling was available for the Canadian otter trawl fishery (Healey and Parrill 2019, Rogers and Simpson 2020). Commercial sampling data was also available from the 130 mm Spanish otter trawl fishery but not the 280 mm Spanish otter trawl fishery (González-Costas et al. 2019, 2020). In 2018, sampling data was available for the Portuguese 130 mm otter trawl fishery but not the 280 mm trawl fishery, and no sampling of either Portuguese fishery was available for 2019 (Vargas et al. 2019, 2020). No Russian commercial sampling data for 3NO cod was available in either year (Fomin and Pochtar 2019, 2020). Given these sampling deficiencies, the total catch-at-age from by-catches in 2018-2019 (Fig. 2) was compiled in the most judicious manner possible and similar to other recent years (Table 3). Annual length frequencies for Canadian catch were applied to the Spanish 280 mm otter trawl catch, and frequencies from the 130 mm Spanish otter trawl fishery were applied to all other catch for which length frequencies were not available. Canadian research survey keys from spring and autumn surveys were used to age all catch. No commercial sampling of cod by-catch was available from any country for 2020 so no estimates of catch-at-age were produced for that year. The complete catch at age time series is demonstrated in Table 4 and Figs. 2a and 2b. Estimates of mean weight at age from commercial sampling is presented in Table 5.

Research vessel survey data

Stratified-random bottom trawl surveys have been conducted in spring by Canadian research vessels in Divs. 3N and 3O since 1971 and 1973, respectively, with the exceptions of 1983 in Div. 3N, and 1974 and 1983 in Div. 3O. The stratification scheme used for these surveys is based on depth (Fig. 3, Table 6). The surveys from 1991 onwards covered areas to a maximum of 732m (400 fathoms) but prior to this only covered to a maximum of 367m (200 fathoms). The current assessment is based only on index strata < 367 m. Surveys from 1971 to 1982 were conducted by the research vessel *A.T. CAMERON* and those since 1984 were conducted primarily by the *WILFRED TEMPLEMAN* or its sister ship *ALFRED NEEDLER* (Table 7). In recent years, with the decommissioning of the *WILFRED TEMPLEMAN*, and mechanical issues with the ALFRED NEEDLER it has sometimes been necessary to use another vessel, the *TELEOST*, to complete the spring survey. In 2006 survey coverage was incomplete and the 2006 spring survey is not considered an index of population size. In 2018 and 2019 all index strata were completed, albeit with reduced set densities in some cases (See Rideout et al. 2021 for details on set coverage for these surveys). In 2020, the spring survey was cancelled due to the emerging Covid-19 pandemic.

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*. The Autumn survey of Divisions 3NO in 2014 was not completed due to vessel mechanical issues. All index strata were completed in 2018-2020 autumn surveys. Details on the number of successful sets for each survey are available in Rideout et al. 2021.

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

The location of fishing sets for the Spring and Autumn surveys and the standardized total weight of fish caught at each station are demonstrated in Fig. 4 and Fig. 5 respectively. Overall, catches of 3NO cod in the RV surveys have been low in recent years. The largest survey catches of 3NO cod in recent years have come from southern 3N in or near the NAFO Regulatory Area. The spring survey is more likely to produce a few larger fishing sets than the autumn survey due to the spawning aggregating nature of cod in the spring. Relative estimates of biomass per stratum are presented in Fig. 6 and Fig. 7.

Abundance and biomass estimates for the entire stock area are presented in Table 8-Table 15. Trends in the total abundance and biomass estimates are plotted for the index strata (<200 fathoms) in Fig. 8-Fig. 9. Spring abundance and biomass estimates were extremely low in both Div. 3N and Div. 3O from 1994 to about 2006. Survey indices increased after 2006, particularly from 2011-2014 and particularly in Div. 3N, but estimates since that time have been much lower. Trends in the autumn survey were similar to the spring, particularly in Div. 3N, with a decline in indices after 2014. The swept area survey biomass estimate for Divs. 3NO combined for the 2019 spring survey was 26,655 t (there was no 2020 spring survey) and for the 2020 autumn survey was 16,260 t.

Analysis

Maturity at age

Annual proportion mature was modeled by fitting a probit model with a logit link function by cohort to observed proportions mature at age from sampling conducted during Canadian spring surveys. The model fitted the data for all cohorts from 1953 to 2014, 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. Age at 50% maturity has been relatively variable for subsequent cohorts but averaged ~5.5 years of age. 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 (i.e. cohorts without significant model fits) 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 1975-2019 are plotted (Fig. 11) to show trends for selected ages. These trends generally reflect the overall change in size at maturity.

Sequential Population Analysis

Survey Indices: Cohort Tracking

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

For the Canadian Spring survey, the 1989 and 1990 year classes were the most dominant in the series from 1990 to 2008 (Fig. 12) but at different ages. For example, the 1989 year class was dominant at ages 2, 4, 7, 9 and 10 whereas the 1990 year class was dominant at ages 3 and 8. The 2006 year class shows up strong as age 3 in 2009 and generally tracks through the survey as strong. It's relative strength was lessened somewhat at age 10 (Fig. 14). Pairwise plots and correlations (Fig. 13) indicate generally good tracking between ages for cohorts.

For the Canadian Autumn survey the 1989 and 1990 year classes were amongst the most dominant in the series (Fig. 15) and also illustrate a similar pattern as the spring. The 1997 and/or 1998 cohorts were also very apparent at ages 3-9, something not so obvious in the spring series. The 2006 year class also tracks as relatively strong from ages 2-10 in the autumn survey (Fig. 17). The pairwise plots and correlations (Fig. 16) 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. 18. The EU-Spain survey is also included for comparison. The results indicate generally good tracking for the Canadian surveys.

ADAPTive Framework

The catch at age (Table 4) was used in a sequential population analysis applying the ADAPT framework (Gavaris 1988). The catch for age 2 is from the NAFO SCR Docs series presented from 1988 to 1998. Zero catch was assumed for age 2 in years 1959-1987. Due to inadequate sampling of removals, total catch for 1996-1998 was proportioned by age using the average partial recruitment vector from 1990-93 (from a previous ADAPT run) with the fully recruited F estimated from a catch projection so as to match the observed catch. Catches since that time have been based on fishery sampling. However, in many cases sampling of commercial catches has been poor in recent years and created significant challenges for the creation of catch at age estimates. Estimates of the commercial catch at age has generally required the use of Canadian RV age-length keys in recent years (see Table 3). A lack of commercial sampling resulted in no estimates for catch at age for 2020. Therefore the assessment model was run with only data inputs up to 2019.

The ADAPT was calibrated with Canadian RV survey indices at age from spring 1984-2005 and 2007-2019 (Table 16), autumn 1990-2013 and 2015-2019 (Table 17) and a Canadian juvenile survey 1989-94 (Table 18) to estimate population numbers $N_{i,t}$,

where i = 3 to 12, for t = 2020 (10 parameters) and i =12, for t=1994 to 2019 (26 parameters),

and Catchabilities

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

The following structure was imposed:

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

Input data were:

Catch numbers at age,
Ci,t where i = 2 to 12 and t = 1959 to 2019 ,
Canadian Research Vessel survey estimates of mean numbers per tow-at-age (Campelen or Campelen equivalent values),
RV1i,t where i = 2 to 10 and t = 1984 to 2005 and 2007-2019, spring
RV2i,t where i = 2 to 10 and t = 1990 to 2013 and 2015-2019, autumn

and Canadian juvenile Research Vessel survey estimates of mean numbers per tow-at-age (Yankee 41.5 shrimp trawl in August – September)
RV3i,t where i = 2 to 10 and t = 1989 to 1994 .

The objective function minimized is

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

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

This particular model formulation has been the longstanding acceptable assessment model for this stock and effectively deals with problems associated with zeros in the catch matrix at 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 0.624. For the survivors estimated in 2020, the relative error in the parameter estimates decreased with age from a high of 57% at age 3 to 25-32% at ages 8-12.

The estimated survey catchabilities (q's) with associated standard errors are also provided in Table 20 and Fig. 19. 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 much higher than that for the Campelen surveys.

Diagnostic residual plots from the ADAPT run are presented in Fig. 20-Fig. 21. Overall the spring and autumn surveys show little pattern in the residuals over most of the time series, although there are some year effects. The fall 1997 estimates have large negative residuals, particularly for ages 5, 6 and 7. The 2018-2020 autumn residuals at age are also largely negative, contributing to overall downward trend in the mean annual residual in recent years.

Bias-adjusted estimates of population numbers (Fig. 22) and fishing mortality at age (Fig. 23) are given in Table 21 and Table 22 respectively. The age 2 value in 2020 is the geometric mean of the 2015-2017 age 2 estimates from the ADAPT. Population numbers remain low. There was a small increase between 2006-2008 but there has been a declining trend since that time. No good recruitment (Fig. 24) has been observed since 2009 (i.e. the 2006 year class). Fishing mortality (Table 22, Fig. 23) on the prominent age groups in the fishery has been very low for well over a decade.

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. The maturities computed from the cohort model were applied to the biomass numbers to compute the spawning stock biomass (Table 25, Fig. 25). SSB increased from 2010-2015, reaching a high of 23,299 t, but subsequently declined back to an estimated 7279 t in 2020 (12% of Blim (60,000 t)).

In the previous assessment of this stock (Rideout et al. 2018) concern was expressed over the lack of a plus-group in the assessment model formulation and the potential that strong year classes exiting the virtual population (i.e. older than age 12) could have on perceived stock dynamics and status. Attempts to modify the current ADAPT model formulation to incorporate a plus-group resulted in unsatisfactory model fits (Rideout et al. 2021) and it was proposed that alternative model formulations be explored beyond the current VPA that might successfully utilize a broader age range. In the meantime, the potential impacts of the restricted age range in the current assessment and any potential impacts on the quality of advice provided for this stock need to be evaluated. The relative strength of the 2006 year class, coupled with the poor strength of subsequent year classes resulted in the 2006 year class comprising the majority of the SSB (59%) in 2018. This year class left the virtual population in 2019, which contributed to the sharp decline in SSB between 2018 and 2019. However, the exiting of the 2006 year class from the virtual population should have little or no influence on the advice stemming from this assessment. This stock was already far below Blim before the 2006 year class left the population in 2019 and SSB had already been declining sharply prior to that point. There is no doubt that the status of this stock is still very poor. However, the model limitations discussed here may be a concern when it comes to examining stock-recruitment relationships and the ability to project stock size into the future.

The current model formulation could not estimate population size for 2021 because catch-at-age estimates were not available for 2020. The shortage and sometimes complete lack of commercial sampling data has been very problematic for the estimation of commercial catch at age. The fact that estimates of catch at age are necessary to run the VPA, and the fact that these catch estimates are assumed to be estimated without error also lends support to potential exploration of other assessment models for this stock. In terms of the current assessment, stock size in 2020 could potentially be projected forward one year to estimate 2021 stock size, but the concerns previously raised regarding the potential impacts of the assessment model's restricted age structure would apply.

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. In general, retrospective patterns were not large but in some cases there is evidence of a relatively consistent bias in the retrospective plots (Fig. 26).

References

Fomin, K., and Pochtar, M. 2019. Russian Research Report for 2018. SCS Doc. 19/11. Ser. No. N6929.

Fomin, K., and Pochtar, M. 2020. Russian Research Report for 2019. SCS Doc. 20/13. Ser. No. N7077.

Gavaris, S. MS 1988. An adaptive framework for the estimation of population size. CAFSAC Res. Doc. 88/29, 12p.

González-Costas F., Ramilo,G., Román, E., Lorenzo, J., Gago, E., González-Troncoso, D., del Rio, J.L., and Sacau, M. MS 2019. Spanish Research Report for 2018. NAFO SCS Doc. 19/10, Ser. No. N6922.

González-Costas F., Ramilo,G., Román, E., Lorenzo, J., Gago, A., González-Troncoso, D., M., Sacau, Duran, P., Casas M., and del Rio, J.L. MS 2020. Spanish Research Report for 2019. NAFO SCS Doc. 20/7, Ser. No. N7045.

Healey, B., and Parrill, E. 2019. Canadian research report for 2018 Newfoundland and Labrador Region. NAFO SCS Doc. 19/13, Ser. No. N6953.

Rideout, R.M., Rogers, B., and Ings, D.W. 2018. An assessment of the cod stock in NAFO Divisions 3NO. NAFO SCR Doc. 18/28, Ser. No. N6812.

Rideout, R.M., Ings, D.W., and Koen-Alonso, M. 2021. Temporal and Spatial Coverage of Canadian (Newfoundland and Labrador Region) Spring and Autumn Multi-Species RV Bottom Trawl Surveys, with an emphasis on surveys conducted in 2020. NAFO SCR Doc. 21/4.

Rideout, R.M., Regular, P.M., Varkey, D. 2021. Exploration of alternative ADAPT model formulations for the assessment of Atlantic cod in Divs. 3NO. NAFO SCR Doc. 21/030 Ser No. N7198.

Rogers, B., and Simpson, M. 2020. Canadian Research Report for 2019. NAFO SCS Doc. 20/11, Ser. No. N7064.

Stansbury, D.E. MS 1996. Conversion factors from comparative fishing grids for Engels 145 otter trawl on the FRV Gadus Atlantica and the Campelen 1800 shrimp trawl on the FRV Teleost. NAFO SCR Doc. 96/77.

Stansbury, D.E. MS 1997. Conversion factors from comparative fishing grids for Engels 145 otter trawl and the Campelen 1800 shrimp trawl used on research vessels. NAFO SCR Doc. 97/31.

Stansbury, D.E., P.A. Shelton, E.F. Murphy and J. Brattey. MS 1999. An assessment of the cod stock in NAFO Div. 3NO. NAFO SCR Doc. 99/62 (revised), Ser No. N4121, 41p.

Vargas, J., Alpoim, R., Santos, E. and Ávila de Melo, A.M. MS 2019. Portuguese Research Report for 2018. NAFO SCS Doc. 19/09, Ser. No. N6921.

Vargas, J., Alpoim, R., Santos, E. and Ávila de Melo, A.M. MS 2020. Portuguese Research Report for 2019. NAFO SCS Doc. 20/09, Ser. No. N7050.

Warren, W.G. MS 1997. Report on the comparative fishing trial between the Gadus Atlantica and Teleost. NAFO Sci. Coun. Studies 2: 81-92.

Warren, W.G., Brodie, W., Stansbury, D., Walsh, S., Morgan, J., and Orr, D. MS 1997. Analysis of the 1996 comparative fishing trial between the Alfred Needler with the Engel 145 trawl and the Wilfred Templeman with the Campelen 1800 trawl. NAFO SCR Doc. 97/68.

Table 1. Catch (t) of cod in NAFO Divisions 3NO.

Year	Canada	Others	Total	TAC
1953	39884	26313	66197	
1954	17392	117369	134761	
1955	6053	108303	114356	
1956	5363	59519	64882	
1957	9641	80549	90190	
1958	4812	43239	48051	
1959	3687	60683	64370	
1960	3408	76269	79677	
1961	5428	67296	72724	
1962	3235	31749	34984	
1963	5079	64663	69742	
1964	2882	61579	64461	
1965	4229	94958	99187	
1966	6501	102418	108919	
1967	3446	223338	226784	
1968	3287	162224	165511	
1969	3664	114041	117705	
1970	4771	106790	111561	
1971	2311	123985	126296	
1972	1736	101638	103374	
1973	1832	78597	80429	103000
1974	1360	72029	73389	101000
1975	1189	42985	44174	88000
1976	2065	22218	24283	43000
1977	2532	15072	17604	30000
1978	6246	8472	14718	15000
1979	9938	17913	27851	25000
1980	5589	14402	19991	26000
1981	6096	18248	24344	26000
1982	10185	21420	31605	17000
1983	11374	17445	28819	17000
1984	8705	18398	27103	26000
1985	18179	18720	36899	33000
1986	18035	32610	50645	33000
1987	18652	22967	41619	33000
1988	19727	23423	43150	40000
1989	13433	19782	33215	25000
1990	10620	18226	28846	18600
1991	12056 [2]	17396 [3]	29454	13600
1992	7859	4893 [3]	12752	13600
1993	5370	5276 [3]	10646	10200
1994	47	2655 [3]	2702	6000 [5]
1995	64	108 [3]	172	ndf
1996	99	75 [3]	174	ndf
1997	286	97 [3]	383	ndf
1998	396	151 [3]	547	ndf
1999	568	351 [3]	919	ndf
2000	207	843 [3]	1050	ndf
2001	560	750 [3]	1310	ndf
2002	444	1750 [3]	2194	ndf
2003	818	4052 [3]	4870 [4]	ndf
2004	442	492 [3]	934	ndf
2005	461	263 [3]	724	ndf
2006	108	492 [3]	600	ndf
2007	203	645 [3]	848	ndf
2008	247	676 [3]	923	ndf
2009	165	918 [3]	1083	ndf
2010	107	839 [3]	946	ndf
2011	44	823	867	ndf
2012	26	708	734	ndf
2013	226	887	1113	ndf
2014	197	537	734	ndf
2015	151	435	586	ndf
2016	147	519	666	ndf
2017	91	558	649	ndf
2018 [1]	76	324	400	ndf
2019 [1]	104	423	527	ndf
2020 [1]	82	505	587	ndf

[1] Provisional
[2] Includes an estimate of 4000 t deemed misreported to Div. 3L.
[3] Includes estimates by Canadian Surveillance and by NAFO Scientific Council.
[4] Catch could not be precisely estimated but is in the range of 4, 280 - 5, 460 tons
[5] There has been no directed fishery since February 1994.

Table 2. Cod landings (t) by month and gear from NAFO Divisions 3NO by Canada in 2018-2020.

2018	Canada (N)						Canada (M)				
	3N		3O				3N		3O		
Month	Ottertrawl	Longline	Ottertrawl	Gillnet	Longline	Other	Ottertrawl	Longline	Ottertrawl	Longline	
Jan	0.08										
Feb	0.01										
Mar			0.12								
Apr			0.12						0.59		
May	1.19		1.42						0.05	4.41	
Jun	15.10		0.63								
Jul	2.46							1.53	0.00	1.41	
Aug		0.29						1.20		1.58	
Sep	1.40		1.55								
Oct	14.80		2.56								
Nov	21.23		1.07								
Dec	1.48		0.08								
	57.75	0.29	7.54	0.00	0.00	0.00	0.00	2.73	0.64	7.40	76.34

2019	Canada (N)						Canada (M)				
	3N		3O				3N		3O		
Month	Ottertrawl	Longline	Ottertrawl	Gillnet	Longline	Other	Ottertrawl	Longline	Ottertrawl	Longline	
Jan	3.83										
Feb	3.23										
Mar	7.95		1.29								
Apr	1.42		0.82						0.08	1.27	
May	15.49							0.17	0.01	1.51	
Jun	11.55	1.28							0.00		
Jul	2.33	0.09						2.11		1.51	
Aug										0.02	
Sep	3.76		2.28								
Oct	9.90										
Nov	9.14										
Dec	18.16										
	86.76	1.37	4.40	0.00	0.00	0.00	0.00	2.28	0.09	4.31	99.22

2020	Canada (N)						Canada (M)				
	3N		3O				3N		3O		
Month	Ottertrawl	Longline	Ottertrawl	Gillnet	Longline	Other	Ottertrawl	Longline	Ottertrawl	Longline	
Jan	10.77										
Feb	3.41										
Mar	1.79		0.44								
Apr	3.55		0.03							1.84	
May	9.98								0.02		
Jun	0.25		0.03					0.14	0.01	0.06	
Jul								2.55		0.04	
Aug	5.18				0.67			4.11		0.00	
Sep	6.31		3.14					0.86		0.00	
Oct	13.29		0.32					1.30			
Nov	4.80										
Dec	2.82		2.58								
	62.13	0.00	6.54	0.00	0.67	0.00	0.00	8.97	0.03	1.95	80.28

Table 3. A review of sampling used to compile catch at age for 3NO cod. Details for the estimation of catch at age for previous years are available in Rideout et al. (2015).

	Sampling	Canada	Spain	Portugal	Other
2005	Bycatch in Canadian ottertrawl fishery was adequetly sampled providing frequencies and keys. Length frequencies provided by Spain and Russia were used in conjunction with Canadian Research Surveys keys to create catch at age for Spain, Portugal, Russia and Estonia.	2/LL 4706/OT	6109/OT		125/OT
2006	Canadian cod bycatch was taken mainly in the ottertrawl and gillnet fishery for redfish and hake , sampling was limited mainly to frequencies. Canadian autumn research keys were used. Frequencies provided by Portugal and Russia were used in conjunction with Canadian autumn research keys to compile catch at age for Portugal, Spain, Estonia and Lithuania.	44/GN 478/OT		3269/OT	125/OT
2007	Canadian cod by catch was taken in the ottertrawl fishery for yellow-tail, redfish and hake. The ottertrawl fishery was sampled by observers. About 40 % of the Canadian catch was taken in longline fisheries and no sampling exist for this catch	1457/ OT NO LL	401 (135 mm mesh) /OT No sampling for 280mm mesh	376 (130mm mesh)/OT; 18 (280mm mesh)/OT	811 /OT /Russian fishery
2008	Canadian cod by catch was taken in the ottertrawl fishery for yellow-tail, redfish and hake. The ottertrawl fishery was sampled by observers. About 25 % of the Canadian catch was taken in longline fisheries and no sampling exist for this catch	1796 OT NO LL	408 OT	41 OT for 3O	519 OT
2009	Canadian cod by catch was taken in the ottertrawl fishery for yellow-tail, redfish and hake. The ottertrawl fishery was sampled by observers. About 20 % of the Canadian catch was taken in longline fisheries and no sampling exist for this catch. Canadian research survey keys used to age all catch	246/OT length and 24 aged fish	511(130mm, 3N)/OT; 98(280mm, 3N)/OT	1935 OT	
2010	Canadian cod by catch was taken in the ottertrawl fishery for yellow-tail and amounted to 109 t. Canadian research survey keys used to age all catch	90 comercial and 997 research ages	1354 measured	2467 130mm and 223 280mm mesh measured	171 measured
2011	Canadian cod by catch was taken in the ottertrawl fishery for yellow-tailand amounted to 54 t. Canadian research survey keys used to age all catch.	23 commercial and 959 research aged	396 measured	5042 measured	100 measured
2012	Canadian cod by catch was taken in the ottertrawl fishery for yellow-tailand amounted to 26 t. Canadian research survey keys used to age all catch	1441 research ages	2411 measured	4484 measured	
2013	Canadian cod bycatch was taken primarily in the ottertrawl fishery for yellowtail flounder. The ottertrawl fishery was sampled by observers. Q4 length frequencies for otter trawls (130 mm) from Spain applied to Q4 Canadian otter trawl catch. Canadian research survey keys used to age all catch.	1120 / OT and 66 aged fish	174 (130 mm, 3NO)/OT, 865 (280mm, 3N)/ OT	6293 (130 mm, 3NO)/OT, 561 (280mm, 3N)/OT	387 OT/Estonia
2014	Canadian cod bycatch was primarily taken in the ottertrawl fishery for yellowtail flounder. Annual length frequencies for EU Spain otter trawls (130 mm) applied to all Canadian otter trawl catch. Canadian research survey keys from spring 2014 used to age 2014 spring catch, but fall 2013 keys used to age fall catch.	no length or age data available	454 (130 mm, 3NO)/OT, 795 (280 mm, 3NO)/OT	4327 (130 mm, 3NO)/OT, 84 (280 mm, 3N)/OT	none
2015	Canadian cod bycatch was taken in the ottertrawl fishery for …. . Annual length frequencies for EU Spain otter trawls (130 mm) applied to all Canadian otter trawl catch. Canadian research survey keys from spring and fall 2015 were used to age all catch.	no length or age data available	246 (130 mm, 3N)/OT, 539 (280 mm, 3NO)/OT	7460 (130 mm, 3NO)/OT	101 OT/Estonia , 255 OT/Russia
2016	Canadian cod bycatch was taken in the ottertrawl fishery for yellowtail flounder and witch flounder. Annual length frequencies for EU Spain otter trawls (130 mm) applied to all Canadian otter trawl catch. Canadian research survey keys from spring and fall 2016 were used to age all catch.	no length or age data available	141 (130 mm, 3O)/OT, 902 (280 mm, 3NO)/OT	1888 (130 mm, 3NO)/OT	221 OT/Estonia , 40 OT/Russia
2017	Canadian cod bycatch was taken in the ottertrawl fishery for yellowtail flounder and witch flounder. Annual length frequencies for EU Spain otter trawls (130 & 280 mm combined) applied to all Canadian otter trawl catch. Annual length frequencies for EU Spain otter trawls (130 mm) applied to Portuguese catch. Canadian research survey keys from spring and fall 2017 were used to age all catch.	no length or age data available	329 (130 mm, 3NO)/OT,48 (280 mm, 3O)/OT	no length or age data available	192 OT/Russia
2018	Canadian cod bycatch was taken in the ottertrawl fishery for yellowtail flounder and witch flounder with minimal catch in redfish and Atlantic halibut fisheries. Annual length frequencies for Canadian catch were applied to Spainsh 280 mm OT catch. Spain otter trawls (130 mm) applied to all other catch for which length frequencies were not available. Canadian research survey keys from spring and fall 2018 were used to age all catch.	45/OT length	350 (130 mm, 3NO)/OT	247 (130 mm, 3N)/OT	none
2019	Canadian cod bycatch was taken priamrily in the ottertrawl fishery for yellowtail flounder and witch flounder with minimal catch in redfish, Greenland halibut, and Atlantic halibut fisheries. Annual length frequencies for Canadian catch were applied to Spainsh 280 mm OT catch. Spain otter trawls (130 mm) applied to all other catch for which length frequencies were not available. Canadian research survey keys from spring and fall 2019 were used to age all catch.	398/OT length; 19/LT length	225 (130 mm, 3NO)/OT	no length or age data available	none
2020	Canadian cod bycatch was taken in the ottertrawl fishery for yellowtail flounder and witch flounder, with some small catch taken in the Atlantic halibut fishery. No annual length frequencies were available for either EU Spain, EU Portugal, or Canada. As such, analysis of catch at age was not undertaken.	no length or age data available	no length or age data available	no length or age data available	none

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

Cn	2	3	4	5	6	7	8	9	10	11	12
1959	0	1711	13036	5068	6025	3935	1392	757	926	1220	103
1960	0	1846	6503	22050	3095	2377	2504	583	387	898	242
1961	0	812	4400	11696	15258	2014	1672	847	196	25	245
1962	0	1026	3882	2206	1581	3594	773	668	433	226	216
1963	0	313	5757	11210	4849	1935	3840	1165	608	322	208
1964	0	6202	15555	19496	7919	2273	1109	788	328	37	112
1965	0	1013	7611	7619	13258	9861	4827	1081	1248	163	141
1966	0	753	18413	19681	11795	8486	4467	1829	1694	122	57
1967	0	20086	62442	50317	18517	4774	4651	236	180	71	45
1968	0	16359	56775	48608	18485	6337	1592	505	178	90	45
1969	0	8154	12924	26949	11191	2089	1393	518	292	134	202
1970	0	2105	19703	10799	9481	3646	1635	541	149	227	90
1971	0	950	26900	30300	11700	3500	2500	500	200	100	50
1972	0	69	19797	12289	13432	5883	1686	285	216	78	74
1973	0	10058	27600	15098	5989	1971	972	707	243	137	116
1974	0	6425	9501	10907	10872	2247	2147	1015	676	428	257
1975	0	671	8781	3528	2505	3057	1059	921	461	252	152
1976	0	4054	7534	5945	1084	211	238	44	37	13	9
1977	0	607	2469	2531	1500	572	177	209	65	41	25
1978	0	920	4337	2518	818	354	102	58	51	8	5
1979	0	72	3827	9208	2784	883	265	58	17	12	7
1980	0	266	1055	3812	2275	761	222	92	31	8	13
1981	0	505	1091	1262	2297	1902	574	192	94	41	13
1982	0	305	1978	1591	1012	1528	1492	595	211	162	27
1983	0	1179	647	1893	1204	686	1152	774	238	81	41
1984	0	58	1000	1411	2324	1220	720	918	551	106	42
1985	0	57	2953	6203	3036	2519	797	459	533	261	97
1986	0	153	2865	6423	4370	1512	948	558	373	349	135
1987	195	516	422	3491	3445	1213	653	845	494	398	404
1988	256	277	318	1527	6347	3955	1009	567	425	249	142
1989	127	1917	2182	1502	1260	1887	1284	485	233	168	100
1990	410	1064	4505	4341	895	422	721	581	439	150	83
1991	6028	1103	673	995	544	282	368	568	502	383	202
1992	83	4508	1769	837	612	235	64	99	128	153	100
1993	33	1314	3209	637	479	321	74	25	39	49	53
1994	0	232	2326	1117	125	93	26	8	1	0	0
1995	0	0	72	20	40	2	0	1	0	0	0
1996	2	4	5	3	17	25	3	2	3	1	0
1997	1	12	18	11	5	31	45	5	4	5	3
1998	1	3	23	21	10	5	28	41	4	4	5
1999	46	94	41	101	40	14	6	23	55	3	2
2000	10	356	339	87	62	21	12	4	13	12	2
2001	10	187	302	160	11	43	23	7	2	9	12
2002	100	218	550	427	141	9	27	13	3	1	6
2003	43	337	810	1274	669	133	5	18	8	2	1
2004	11	37	45	50	92	73	21	1	7	3	1
2005	1	1	1	2	4	28	55	20	1	3	2
2006	45	214	168	82	21	5	10	2	2	0	0
2007	4	205	289	93	25	9	6	9	10	2	0
2008	1	4	58	165	41	20	2	3	20	13	7
2009	12	262	167	136	90	26	11	1	4	7	16
2010	249	214	459	195	75	39	13	0	2	0	1
2011	44	187	56	133	44	47	46	7	4	1	0
2012	26	217	197	38	96	35	16	14	5	1	0
2013	21	169	239	151	41	121	54	24	10	4	0
2014	60	194	144	156	59	55	29	13	4	2	0
2015	10	60	101	51	82	32	9	38	7	2	0
2016	12	81	103	77	30	45	30	5	29	15	0
2017	45	147	124	44	32	21	20	9	1	15	7
2018	0	9	22	32	19	15	6	11	8	2	14
2019	22	55	103	44	34	16	9	15	5	6	4
2020											

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

Cw	3	4	5	6	7	8	9	10	11	12
1959	0.42	0.82	1.25	1.95	2.82	3.39	3.98	4.68	5.25	6.17
1960	0.42	0.82	1.25	1.95	2.82	3.39	3.98	4.68	5.25	6.17
1961	0.42	0.82	1.25	1.95	2.82	3.39	3.98	4.68	5.25	6.17
1962	0.42	0.82	1.25	1.95	2.82	3.39	3.98	4.68	5.25	6.17
1963	0.42	0.82	1.25	1.95	2.82	3.39	3.98	4.68	5.25	6.17
1964	0.42	0.82	1.25	1.95	2.82	3.39	3.98	4.68	5.25	6.17
1965	0.42	0.82	1.25	1.95	2.82	3.39	3.98	4.68	5.25	6.17
1966	0.48	0.90	1.35	2.14	3.16	4.21	6.34	7.69	8.46	10.24
1967	0.48	0.90	1.35	2.14	3.16	4.21	6.34	7.69	8.46	10.24
1968	0.48	0.90	1.35	2.14	3.16	4.21	6.34	7.69	8.46	10.24
1969	0.48	0.90	1.35	2.14	3.16	4.21	6.34	7.69	8.46	10.24
1970	0.48	0.90	1.35	2.14	3.16	4.21	6.34	7.69	8.46	10.24
1971	0.48	0.90	1.35	2.14	3.16	4.21	6.34	7.69	8.46	10.24
1972	0.54	0.97	1.44	2.08	2.89	3.56	5.95	7.95	8.32	10.14
1973	0.57	1.00	1.43	2.19	3.63	4.63	6.25	9.56	11.17	13.99
1974	0.42	0.73	1.20	1.96	2.86	4.67	7.32	5.46	8.40	7.51
1975	0.38	0.89	1.28	2.13	3.14	4.16	5.53	6.74	5.27	7.09
1976	0.50	0.91	1.41	2.33	3.25	4.03	6.67	8.74	9.14	12.49
1977	0.57	1.00	1.48	2.48	3.51	4.74	7.17	8.81	11.70	11.47
1978	0.72	1.05	1.55	2.25	3.74	4.61	6.19	7.23	9.48	12.87
1979	0.65	0.98	1.39	2.09	2.87	3.70	4.75	7.15	7.98	10.11
1980	0.71	1.04	1.69	2.50	3.69	5.49	7.98	9.22	10.60	12.61
1981	0.90	1.27	1.84	2.69	3.55	5.33	7.13	9.10	9.01	10.15
1982	0.94	1.17	1.50	2.20	3.83	5.26	7.49	8.80	9.82	12.28
1983	0.85	1.17	1.87	2.63	3.80	5.20	6.27	8.08	8.99	11.01
1984	0.79	1.15	1.51	2.28	3.04	4.05	5.76	7.22	8.92	12.61
1985	0.48	0.86	1.37	2.05	3.25	4.65	6.62	8.32	9.15	11.13
1986	0.39	1.01	1.52	2.16	3.49	5.41	7.95	9.82	9.94	9.88
1987	0.49	0.82	1.30	1.83	2.89	4.76	7.26	8.95	9.85	12.59
1988	0.74	1.00	1.38	1.79	2.23	3.77	5.12	6.88	9.37	11.07
1989	0.51	0.97	1.60	2.24	3.27	4.61	7.08	8.31	9.47	12.25
1990	0.55	1.01	1.46	2.51	2.73	4.14	5.02	8.37	9.29	11.25
1991	0.55	0.85	1.59	2.30	3.83	5.56	7.53	9.04	11.98	13.98
1992	0.33	0.65	1.06	1.80	2.82	4.85	5.56	7.43	8.64	10.65
1993	0.36	0.78	1.35	1.84	2.82	4.11	5.87	7.76	8.79	8.67
1994	0.27	0.46	0.91	1.63	1.84	4.04	4.94	7.54	3.44	7.52
1995	0.42	0.75	1.21	2.03	2.29	2.08	6.60	6.22	6.41	8.03
1996	0.42	0.78	1.30	1.99	2.68	3.38	4.70	5.98	6.41	8.03
1997	0.42	0.78	1.30	1.99	2.68	3.38	4.70	5.98	6.41	8.03
1998	0.42	0.78	1.30	1.99	2.68	3.38	4.70	5.98	6.41	8.03
1999	0.50	0.94	1.59	2.07	2.23	2.83	3.99	6.05	6.73	7.38
2000	0.60	0.82	1.45	2.39	3.44	2.90	2.64	3.78	5.25	6.07
2001	0.58	1.09	1.38	2.07	4.06	5.22	5.32	5.51	7.51	8.60
2002	0.67	1.01	1.52	2.24	3.38	5.15	5.99	7.11	8.47	9.32
2003	0.67	0.94	1.40	2.02	3.01	4.10	7.63	7.74	8.52	9.23
2004	0.69	0.92	1.38	2.17	3.03	3.93	5.79	8.54	9.70	8.77
2005	0.49	1.41	2.46	3.43	3.95	4.94	5.90	9.30	10.28	11.42
2006	0.68	1.11	1.36	2.05	2.60	3.26	4.66	7.07	7.39	14.86
2007	0.61	1.00	1.39	2.52	2.90	4.71	5.16	6.75	6.67	8.39
2008	0.35	1.04	1.59	1.95	2.91	2.63	5.84	5.90	6.36	10.03
2009	0.46	0.65	1.31	2.16	2.68	3.80	4.55	8.20	7.51	8.81
2010	0.33	0.67	0.89	1.95	2.73	3.14	6.04	4.42	10.06	10.19
2011	0.49	0.62	1.13	1.60	3.47	4.77	5.53	4.72	5.58	9.68
2012	0.55	0.75	1.13	1.64	1.91	4.20	5.64	6.50	8.72	9.68
2013	0.43	0.70	1.12	1.52	2.17	2.29	4.60	6.05	6.54	12.04
2014	0.46	0.82	1.22	1.39	2.06	2.05	3.02	6.69	6.96	10.47
2015	0.56	0.84	1.24	1.87	2.27	2.41	2.96	3.35	4.05	14.34
2016	0.51	0.73	0.98	1.34	2.51	2.61	2.60	4.21	4.72	15.27
2017	0.49	0.66	1.13	1.52	3.20	4.15	7.88	3.76	5.34	5.47
2018	0.48	0.78	0.98	1.48	1.69	2.74	3.37	4.19	4.68	5.82
2019	0.54	0.96	1.12	1.45	1.79	2.26	2.26	7.78	5.39	6.41

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

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

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

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

Year	Spring Survey			Autumn Survey		
	Vessel(s) & Trips	Start Date (mm/dd)	End Date (mm/dd)	Vessel(s) & Trips	Start Date (mm/dd)	End Date (mm/dd)
1984	AN 27	04/28	05/08			
1985	AN 43	04/11	04/25			
1986	WT 47	04/18	05/04			
1987	WT 58-60	04/23	05/14			
1988	WT 70	04/21	05/05			
1989	WT 82	04/20	05/06			
1990	WT 95-96	05/05	06/01	WT 101-102	11/22	12/09
1991	WT 105-106	04/19	05/11	WT 113-115	10/19	11/10
1992	WT 119-120	04/22	05/13	WT 128-130	10/20	11/05
1993	WT 136-137	04/27	05/18	WT 144-146	10/24	11/12
1994	WT 152-153	04/30	05/22	WT 160-161	10/25	11/13
1995	WT 168-169	05/03	05/27	WT 176-177	09/26	10/26
1996	WT 188-189	05/07	05/30	WT 200, TEL 42, AN 253	11/24	12/17
1997	WT 204-208	04/30	06/04	WT 212-214	09/26	11/05
1998	WT 221-222	05/12	06/04	WT 229-233, TEL 76	10/10	12/16
1999	WT 238-241	05/11	06/07	WT 244-247	10/13	11/22
2000	WT 315-318	05/11	06/09	WT 319-323, TEL 338-339	10/11	12/05
2001	WT 367-369	05/05	06/06	WT 372-373, TEL 357	09/22	10/29
2002	WT 419-424	04/27	05/29	WT 427-428, TEL 411-412	10/05	10/26
2003	WT 479-481	05/08	06/04	WT 485-487, TEL 469	09/23	11/07
2004	WT 546-548	05/12	06/08	WT 557-558	10/31	11/23
2005	WT 618-621	05/09	06/19	WT 627-628,630, TEL 608-609, AN 657	10/04	11/19
2006				WT 704-706	09/30	10/21
2007	WT 759-762	05/03	06/29	WT 770-772, TEL 750-751	10/06	11/14
2008	WT 827-829	05/23	06/22	WT 835-837	10/03	11/01
2009	AN 904-906	05/13	06/11	AN 913-916, TEL 894-895	10/02	11/12
2010	AN 932-934	05/08	06/06	AN 942-944, TEL 979	09/30	12/12
2011	AN 403-404	05/08	05/30	AN 409-413	09/29	11/20
2012	AN 417-420	04/27	06/03	AN 424-426	09/30	11/05
2013	AN 432-434	04/24	05/22	AN 438-442	09/19	10/18
2014	TEL 139-140	05/29	06/17			
2015	AN 452-454	05/10	06/03	AN 458-461	09/25	10/26
2016	TEL 159, 169-170	05/19	05/31	AN 466-467,469	09/16	11/07
2017	AN 484,486	05/12	06/14	AN 479-481	09/14	10/22
2018	AN 496,497, TEL 194,195	05/24	06/12	AN 500,501	09/14	10/05
2019	AN 508-510	05/04	05/28	AN 514-516	09/17	10/16
2020				AN 528-530	08/29	09/26

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 Campelan equivalent units. Values in brackets are estimates from non-sampled strata.

Year	Index Strata (<200 fathoms)																	Total	1 std	Deep Strata (≥200 fathoms)						Total
	375	**376**	**360**	**361**	**362**	**373**	**374**	**383**	**359**	**377**	**382**	**358**	**378**	**381**	**357**	**379**	**380**	**Index**		**723**	**725**	**727**	**724**	**726**	**728**	>200
1984	22089	147797	135352	29059	67895	27237	10331	62	2317	1754	0	2677	2457	1519	0	780	207	**451532**	158609	nf	nf	nf	nf	nf	nf	-
1985	12272	147	26907	49961	19854	4121	768	0	0	2428	3538	5711	43405	12844	11460	3164	3646	**200225**	28273	nf	nf	nf	nf	nf	nf	-
1986	2219	779	9656	5531	5348	1585	85	0	39989	461	22	4024	6253	8170	440	4963	521	**90046**	35723	nf	nf	nf	nf	nf	nf	-
1987	6163	87946	31417	47380	116529	11626	922	958	7094	6335	59	4318	2103	388	(1428)	7	926	**324172**	93197	nf	nf	nf	nf	nf	nf	-
1988	3104	2509	35568	15258	6794	2600	871	680	5531	0	178	5277	1903	3155	11	44	1484	**84966**	15707	nf	nf	nf	nf	nf	nf	-
1989	4821	593	1043	9049	6986	3067	51	494	1622	420	1572	3946	1597	3705	68	204	957	**40195**	5707	nf	nf	nf	nf	nf	nf	-
1990	3205	265	2991	6571	8320	1560	384	46	811	0	3293	8218	2725	3630	880	1305	2043	**46246**	7797	nf	nf	nf	nf	nf	nf	-
1991	110	118	892	2549	1109	221	26	62	1187	0	0	1037	867	200	2504	2289	3822	**16992**	4214	1970	401	833	69	0	0	3273
1992	146	0	2705	797	58	0	128	0	1679	0	0	16327	3671	88	2651	8698	862	**37809**	5893	13573	nf	2144	112	0	0	15829
1993	73	0	898	828	116	0	0	0	2172	28	0	3358	602	0	68	540	20457	**29139**	20236	43	0	1444	9	0	0	1496
1994	0	0	0	102	0	0	0	0	0	48	0	108	220	13	429	190	0	**1109**	521	32	95	222	34	0	0	383
1995	0	69	0	619	0	0	0	0	0	0	0	155	96	113	23	66	32	**1171**	655	0	73	211	17	70	43	414
1996	0	165	449	1077	39	39	85	0	33	0	0	310	163	160	90	204	471	**3283**	787	46	34	1394	0	0	0	1474
1997	131	0	86	549	50	50	38	0	138	0	0	261	136	13	20	194	6239	**7906**	6106	77	16	109	50	12	0	264
1998	292	1272	823	2258	139	35	0	0	26	7	0	41	96	0	219	72	48	**5327**	1583	53	49	55	61	0	0	218
1999	5259	103	150	2650	1042	77	85	0	58	0	45	1254	38	150	73	58	96	**11137**	1968	0	33	44	0	0	0	77
2000	329	206	41	1869	1271	0	0	0	29	0	134	69	209	0	282	21	117	**4577**	1098	139	361	383	0	0	0	883
2001	351	41	82	510	1078	193	128	0	87	0	0	3111	108	1152	872	642	511	**8865**	3107	3179	661	528	45	0	0	4413
2002	131	0	453	1997	193	77	43	0	29	0	0	234	44	0	168	105	23	**3495**	880	1658	148	446	62	36	0	2350
2003	263	41	659	892	39	0	0	0	0	0	0	8940	1523	113	110	129	609	**13318**	8976	550	0	50	8	0	0	608
2004	175	1004	2552	3035	314	39	0	0	0	7	0	155	1000	300	43	49	207	**8878**	3353	85	0	0	9	0	0	94
2005	877	41	1784	2185	260	193	43	46	463	199	579	1045	365	7489	60	65	145	**15839**	6363	0	0	0	0	0	0	0
2006																										
2007	11213	18046	11271	17801	3983	435	43	0	927	138	102	4380	1635	307	158	93	14	**70544**	11497	19	0	0	0	0	13	32
2008	14846	11599	10290	9023	1425	87	192	46	1332	1204	0	4591	2798	1828	23	10	95	**59389**	8949	0	0	0	nf	0	0	0
2009	394	330	1957	3271	762	390	0	0	8108	17	0	97233	4214	22	9656	241	186	**126781**	97974	81	12	105624	0	0	0	105717
2010	1402	1871	700	2337	900	0	85	0	0	96	45	4154	6283	49	43	1222	31985	**51172**	32121	11	6	439	0	5	0	461
2011	52412	371	864	821	265	270	43	0	0	30	0	12	61	11	6820	1326	323	**63629**	51873	69	593	1068	0	22	11	1763
2012	2260	124	4392	3417	4151	1682	4269	93	8513	7146	0	3002	3263	4967	135	110	1147	**48673**	9517	10	217	46	nf	7	0	280
2013	1972	660	1171	2129	847	1964	1323	211	8867	9410	79	9244	3260	13	662	557	391	**42760**	11212	45	10	35	0	0	0	90
2014	682	137	755	1020	1040	555	192	424	27316	11122	5785	318	3276	2466	41	97	170	**55396**	29066	0	0	13	0	0	0	13
2015	565	516	412	5319	1634	495	0	46	1042	392	267	4746	2132	10009	305	29	2074	**29983**	10047	0	0	0	0	0	0	0
2016	175	495	4898	807	501	563	0	46	434	0	0	325	218	1052	4791	3235	487	**18026**	5458	0	14	506	0	0	0	521
2017	274	137	522	1020	136	520	0	0	993	76	0	307	11582	25	184	739	419	**16933**	9562	0	144	1082	nf	0	976	2202
2018	438	595	1129	2300	462	83	0	0	7036	96	45	1207	392	3555	60	51	303	**17753**	7904	23	48	11	0	0	0	82
2019	44	155	2830	3671	520	248	49	0	232	0	0	1165	609	22466	150	702	1231	**34070**	22479	21	202	1988	0	0	0	2212
2020																										

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 Campelan equivalent units. Values in brackets are estimates for non-sampled strata.

Year	Index Strata (<200 fathoms)																	**Total**	1 std	Deep Strata (≥200 fathoms)						Total
	375	**376**	**360**	**361**	**362**	**373**	**374**	**383**	**359**	**377**	**382**	**358**	**378**	**381**	**357**	**379**	**380**	**Index**		**723**	**725**	**727**	**724**	**726**	**728**	>200
1984	6951	16514	21635	19816	75056	33166	14844	497	305	144	0	814	686	758	0	378	407	**191972**	30721	nf	nf	nf	nf	nf	nf	-
1985	26015	706	16845	52290	29628	5223	1508	0	0	217	254	897	4557	5345	6291	1186	2108	**153070**	18986	nf	nf	nf	nf	nf	nf	-
1986	20840	2926	3745	60545	31028	4336	1325	0	2614	137	83	1708	1074	2885	634	1571	362	**135813**	34396	nf	nf	nf	nf	nf	nf	-
1987	13377	9060	4115	49876	142872	14456	1815	1648	771	1703	41	4214	355	245	(566)	9	1008	**245567**	38873	nf	nf	nf	nf	nf	nf	-
1988	22932	6492	3755	25431	19700	9645	5816	234	631	0	58	1305	436	779	32	37	650	**97934**	13093	nf	nf	nf	nf	nf	nf	-
1989	24907	1244	2125	19331	26333	8910	928	569	211	45	775	1685	428	214	64	97	493	**88359**	12759	nf	nf	nf	nf	nf	nf	-
1990	15980	3754	10388	29860	36987	5747	5002	609	100	0	295	1079	396	792	271	315	697	**112271**	14230	nf	nf	nf	nf	nf	nf	-
1991	1818	1468	1022	16487	4301	847	512	222	66	0	0	129	144	395	328	844	670	**29254**	8642	662	186	486	30	0	0	1364
1992	2309	0	1431	395	661	0	29	0	112	0	0	2625	409	15	699	2567	180	**11433**	2788	3415	nf	805	32	0	0	4252
1993	1134	0	45	3422	1508	0	0	0	429	9	0	1683	244	0	46	203	9729	**18451**	9859	30	0	313	9	0	0	352
1994	0	0	0	63	0	0	0	0	0	8	0	162	63	56	235	120	0	**708**	289	26	32	86	22	0	0	166
1995	0	51	0	47	0	0	0	0	0	0	0	133	75	44	24	46	9	**429**	120	0	8	41	26	31	26	132
1996	0	62	457	647	21	9	11	0	36	0	0	131	84	40	18	66	100	**1682**	553	35	19	677	0	0	0	731
1997	92	0	15	378	317	168	136	0	199	0	0	104	109	2	9	104	3457	**5090**	3438	80	9	71	40	5	0	205
1998	108	75	12	682	407	9	0	0	1	15	0	73	80	0	221	25	13	**1721**	496	77	10	25	191	0	0	303
1999	3225	4	315	3496	946	50	11	0	114	0	9	1171	21	16	51	12	18	**9461**	3021	0	13	6	0	0	0	19
2000	54	43	19	533	1328	0	0	0	194	0	27	23	184	0	242	8	14	**2669**	1362	270	163	180	0	0	0	613
2001	592	6	589	241	1110	8	30	0	54	0	0	1818	92	708	676	536	71	**6529**	1995	2233	443	295	100	0	0	3071
2002	88	0	244	1856	22	11	15	0	7	0	0	327	16	0	158	74	14	**2832**	1522	1598	100	96	36	12	0	1842
2003	1229	458	1417	1987	2	0	0	0	0	0	0	14117	739	12	204	68	97	**20329**	14168	956	0	25	25	0	0	1006
2004	89	286	84	299	2134	2	0	0	0	29	0	258	377	49	60	22	36	**3726**	2160	46	0	0	6	0	0	52
2005	632	1	1798	2582	1746	74	10	42	71	298	239	611	118	2276	59	82	53	**10692**	2768	0	0	0	0	0	0	0
2006																										
2007	2669	528	1057	7983	5449	603	6	0	2385	33	79	3049	1101	171	262	72	6	**25452**	5245	60	0	0	0	0	4	64
2008	2016	1810	8204	1619	2499	3	327	9	434	990	0	4361	711	702	28	5	51	**23769**	3653	0	0	0	nf	0	0	0
2009	208	451	89	885	128	76	0	0	9025	8	0	39777	1927	2	3063	242	18	**55898**	40813	168	5	33157	0	0	0	33330
2010	43	4913	0	82	1595	1245	0	26	160	1423	32	3946	641	14002	18	5	0	**28131**	14733	56	34	377	0	2	0	469
2011	11042	56	248	302	463	135	8	0	0	23	0	6	33	1	5469	1019	61	**18865**	12119	125	476	950	0	17	15	1583
2012	2407	398	15514	1764	2970	878	3227	32	8550	4683	0	3025	4331	3184	297	149	558	**51966**	11191	13	51	41	nf	16	0	121
2013	1271	63	2393	3842	1400	1587	951	158	14188	8663	74	18176	5130	1	1298	742	183	**60120**	15879	178	7	54	0	0	0	239
2014	45	25	940	55	956	565	470	192	54329	19272	9802	341	4205	2783	79	273	196	**94527**	57143	0	0	12	0	0	0	12
2015	898	4011	1240	5527	5014	792	0	22	2388	434	797	11035	2070	2822	716	69	469	**38303**	6280	0	0	0	0	0	0	0
2016	11	16	219	119	451	22	0	3	36	0	0	1203	39	322	6140	2058	39	**10678**	6345	0	28	237	0	0	0	265
2017	33	17	867	76	16	398	0	0	345	49	0	209	8316	2	558	251	192	**11328**	6948	0	433	494	nf	0	599	1526
2018	2163	3792	2340	862	82	331	0	0	6108	83	8	1075	149	2534	415	49	475	**20465**	7265	73	36	2	0	0	0	110
2019	6	4	1471	235	1041	18	10	0	19	0	0	808	119	16912	129	231	1349	**22351**	17014	25	378	352	0	0	0	755
2020																										

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

Year	Index Strata (<200 fathoms)																		**Total**	1 std	Deep Strata (≥200 fathoms)						Total
	330	**331**	**338**	**340**	**351**	**352**	**353**	**329**	**332**	**337**	**339**	**354**	**333**	**336**	**355**	**334**	**335**	**356**	**Index**		**717**	**719**	**721**	**718**	**720**	**722**	>200
1984	7687	3826	23133	10504	77593	40966	0	5871	432	1891	14485	2217	0	0	0	0	0	0	**188606**	24310	nf	nf	nf	nf	nf	nf	-
1985	7816	1903	9631	9324	17410	17487	2204	2367	3399	5634	885	1826	42	17	4031	234	0	0	**84210**	12468	nf	nf	nf	nf	nf	nf	-
1986	3672	737	8848	10184	116600	9709	2746	2811	1104	1356	134	2195	104	125	28	1310	68	13	**161744**	93579	nf	nf	nf	nf	nf	nf	-
1987	11207	1882	20017	144754	71037	35545	28804	131760	29727	1782	2361	65041	561	17	205	25	8	4	**544739**	121065	nf	nf	nf	nf	nf	nf	-
1988	5332	1411	6560	2799	13208	55656	44053	5208	2881	2315	483	2250	0	8	43	120	12	50	**142388**	39654	nf	nf	nf	nf	nf	nf	-
1989	1594	784	19973	1941	6053	10374	4686	5524	3082	10302	27	587	374	8	978	139	16	130	**66572**	11285	nf	nf	nf	nf	nf	nf	-
1990	4943	(1052)	8355	3593	6182	14360	6437	13021	5646	2113	1609	391	135	141	191	538	96	109	**67860**	10620	nf	nf	nf	nf	nf	nf	-
1991	1411	157	24229	2544	2051	9659	1285	22096	677236	22222	1556	8933	685	158	2317	1202	27	541	**778308**	672162	3701	274	190	15	0	0	4180
1992	201	31	2263	330	1040	3815	4188	503	29324	6846	604	1663	966	5484	935	962	1263	2639	**63059**	22768	336	749	72390	0	569	149	74193
1993	369	0	827	118	347	1318	220	1657	293274	229388	402	1402	509	433	234	1126	339	420	**532383**	272306	1615	301	348	100	15	0	2379
1994	0	0	131	283	248	1287	0	13826	0	130	0	0	2184	599	50	528	156	487	**19907**	13914	1441	443	11	503	211	0	2609
1995	0	0	261	0	0	1100	282	1089	2376	522	0	0	10	0	7	198	52	13	**5910**	1824	242	164	5	102	29	0	542
1996	4777	345	2089	1428	520	1104	670	327	3153	2478	46	65	682	8	2548	182	485	92	**21000**	4659	27	21	84	0	6	11	149
1997	509	0	160	529	453	927	0	765	432	681	0	0	1447	128	6	94	211	70	**6411**	1513	176	39	103	7	103	6	434
1998	4310	8343	895	173	277	1278	564	8194	720	1239	121	4583	194	25	50	26	36	82	**31111**	12292	20	5	5	0	12	0	42
1999	4037	452	15015	1770	1631	14932	507	8370	8121	9389	497	4864	25	17	44	28	37	67	**69804**	14900	37	107	5	0	7	0	156
2000	8680	2635	6571	3682	12046	5481	1693	1278	27653	3032	40	587	92	0	39	70	13	96	**73690**	14846	122	18	7	0	0	0	147
2001	1519	3858	7006	567	1820	3372	397	2746	816	1130	282	163	71	42	234	54	278	62	**24415**	3171	838	134	67	0	7	17	1063
2002	616	220	3264	189	545	1730	321	379	672	478	201	33	20	92	31	1017	357	149	**10312**	1796	183	0	9	18	17	0	227
2003	270	63	1044	330	217	754	220	2557	96	565	0	33	9	0	21	19	4	22	**6224**	2402	114	21	19	0	0	0	154
2004	1204	1725	970	283	43	877	139	440	3271	366	0	0	10	67	65	17	0	67	**9545**	2217	553	8	5	0	0	0	566
2005	5090	1976	9095	519	1127	5989	887	1868	0	452	80	246	10	0	6	0	0	0	**27346**	6772	34	52	0	0	0	0	86
2006																											
2007	3818	502	4700	923	2080	22182	18473	4545	1296	1130	138	3130	48	7	50	44	4	50	**63119**	12101	44	0	0	0	0	0	44
2008	2504	27036	4700	354	7106	12625	529	710	4081	1000	0	0	9	17	21	17	4	15	**60727**	26891	170	0	48	0	0	0	218
2009	1514	215407	2176	13691	520	5790	0	1089	23834	956	0	0	0	0	50	634	12	35	**265709**	213186	180	21	12	0	0	0	213
2010	3800	63	9269	226	515	2524	176	1415	21503	1377	80	94	27	0	25	11	32	28	**41164**	20330	154	23	0	0	0	0	177
2011	2641	376	1649	451	303	2755	250	5471	0	464	179	217	9	33	62	28	4	28	**14921**	5418	54	0	0	0	nf	0	54
2012	2668	439	2008	944	1541	6073	1411	3064	192	149	121	33	23	8	0	0	8	29	**18711**	3995	15	0	0	0	0	0	15
2013	6269	1084	1392	661	1430	6344	3615	4674	0	0	80	0	10	0	0	12	5	0	**25578**	5702	0	0	0	0	0	0	0
2014	4310	376	4439	1495	763	5820	705	4735	792	0	604	1299	10	0	0	0	0	21	**25370**	5480	26	0	0	0	0	0	26
2015	1197	533	3916	803	1486	2310	294	5634	912	0	0	33	0	17	14	83	16	8	**17256**	5453	497	0	16	0	0	0	513
2016	845	753	3264	2549	1295	1341	3792	4309	14979	1695	0	98	0	19	85	7	0	4	**35033**	10134	nf	6	17	nf	10	0	33
2017	944	94	3603	59	1758	1538	59	237	0	65	80	0	0	8	40	0	0	8	**8495**	3382	11	0	0	0	0	0	11
2018	3654	851	9443	1888	1950	5501	44	3125	883	522	563	1304	0	0	0	7	0	8	**29744**	9125	0	0	0	0	0	0	0
2019	1191	63	1567	1039	1560	1977	397	3598	432	43	80	424	0	0	0	15	5	0	**12391**	2881	0	6	0	nf	0	0	6
2020																											

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 Campelan equivalent units. Values in brackets are estimates for non-sampled strata.

Year	Index Strata (<200 fathoms)																			Total	1 std	Deep Strata (≥200 fathoms)						Total
	330	331	338	340	351	352	353	329	332	337	339	354	333	336	355	334	335	356		Index		717	719	721	718	720	722	>200
1984	7888	4493	42678	13523	67964	51161	0	1759	4368	734	3323	946	0	0	0	0	0	0		**198839**	27418	nf	nf	nf	nf	nf	nf	-
1985	9282	4844	13539	10677	34186	41468	9360	1913	16971	2948	723	654	327	81	717	889	0	0		**148579**	19373	nf	nf	nf	nf	nf	nf	-
1986	4128	1282	23022	11909	89983	24013	1814	1104	4052	11533	72	564	408	119	28	4728	157	42		**178959**	57845	nf	nf	nf	nf	nf	nf	-
1987	11960	1963	19822	159580	113537	75699	15404	115219	12725	4258	934	6849	1819	34	256.5	119	38	15		**540232**	109863	nf	nf	nf	nf	nf	nf	-
1988	4443	2155	14399	16289	25082	81440	4469	15973	11606	995	491	1199	0	39	38	469	81	177		**179345**	35693	nf	nf	nf	nf	nf	nf	-
1989	3287	476	25187	5426	19588	43446	3974	1674	2136	5680	216	86	1472	43	533	291	15	153		**113683**	32915	nf	nf	nf	nf	nf	nf	-
1990	5042	(2191)	9226	10198	22130	38056	5836	4639	11158	3321	381	557	378	315	196	818	109	216		**112578**	15471	nf	nf	nf	nf	nf	nf	-
1991	264	233	10185	380	6532	22297	1255	4155	38888	5512	91	3293	868	110	326	1372	10	87		**95858**	35755	15218	143	88	7	0	0	15456
1992	31	222	11769	51	2043	16512	1763	96	3889	20523	87	189	270	1716	63	1009	274	305		**60812**	21564	436	179	12153	0	139	70	12977
1993	91	0	4934	1918	1187	8147	3229	217	107210	79021	43	1307	1645	371	167	1395	2498	383		**213762**	93050	1870	330	304	159	9	0	2672
1994	0	0	1824	159	129	1569	0	10423	0	805	0	0	8467	655	32	950	449	255		**25716**	11919	2094	727	16	791	222	0	3850
1995	0	0	3406	0	0	3748	603	2166	1685	1643	0	0	26	0	31	330	339	16		**13992**	3159	339	927	10	91	34	0	1401
1996	7035	974	1520	237	103	1514	117	189	1519	3267	5	84	1610	19	2321	256	673	46		**21489**	4831	57	37	95	0	3	28	220
1997	357	0	196	186	286	2869	0	614	1558	527	0	0	974	322	15	305	734	47		**8990**	3056	238	133	53	16	164	5	609
1998	12526	34685	5069	512	1888	5341	18	13037	2136	1720	441	2258	255	16	74	46	75	102		**80197**	36701	30	2	16	0	11	0	59
1999	8593	1105	9416	3857	5269	14308	1719	9671	1350	3095	1210	1088	26	18	26	72	207	108		**61137**	11993	47	243	11	0	20	0	321
2000	8401	6842	6982	2164	47572	8226	7130	628	4360	1040	1	218	77	0	13	98	37	442		**94231**	47545	108	59	20	0	0	0	187
2001	2296	1738	13092	1469	4266	11344	529	896	272	553	733	737	43	46	169	33	254	69		**38539**	6458	585	137	323	0	41	52	1138
2002	190	1251	2456	33	38	6932	4394	63	42	160	48	218	31	95	27	1241	437	142		**17799**	4457	164	0	22	18	25	0	229
2003	20	326	4712	25	38	3093	607	1623	462	171	0	474	13	0	2	18	8	26		**11618**	3229	190	33	39	0	0	0	262
2004	2806	8186	1625	1735	583	3130	758	173	906	891	0	0	2	96	51	87	0	131		**21158**	8974	1224	23	9	0	0	0	1256
2005	5951	773	1688	1901	1293	6446	141	1569	0	360	3	484	20	0	22	0	0	0		**20650**	4670	71	26	0	0	0	0	97
2006																												
2007	1345	218	3486	1178	237	9602	1129	2050	241	211	1	438	32	3	33	67	3	45		**20318**	5263	147	0	0	0	0	0	147
2008	1014	2641	2607	381	3401	9189	523	430	494	1399	0	0	6	20	17	28	5	19		**22175**	4487	191	0	74	0	0	0	265
2009	509	53267	2622	5325	65	5946	0	170	19689	504	0	0	0	0	48	227	26	53		**88452**	48368	110	48	19	0	0	0	177
2010	1614	506	1468	39	756	1463	5	460	1897	111	46	74	18	0	43	6	37	23		**8567**	2165	100	47	0	0	0	0	147
2011	1030	298	690	746	217	3347	1148	7367	0	87	781	471	34	34	98	81	11	82		**16523**	7243	151	0	0	0	nf	0	151
2012	696	527	239	824	2922	7950	12683	2694	54	63	25	55	19	7	0	0	20	74		**28853**	13497	23	0	0	0	0	0	23
2013	959	198	1374	88	172	5458	642	1479	0	0	6	0	12	0	0	24	15	0		**10427**	2086	0	0	0	0	0	0	0
2014	5896	332	1411	725	860	4048	4869	3772	1054	0	882	3296	60	0	0	0	0	50		**27254**	7632	140	0	0	0	0	0	140
2015	156	460	1840	345	1392	3478	2108	1577	341	0	0	156	0	38	41	147	20	45		**12147**	2840	479	0	29	0	0	0	507
2016	66	61	1733	319	197	751	466	950	764	610	0	2	0	14	150	20	0	8		**6111**	1329	nf	28	57	nf	25	0	110
2017	72	24	406	4	244	551	11	73	0	10	3	0	0	5	124	0	0	64		**1590**	546	15	0	0	0	0	0	15
2018	1191	97	4033	329	491	5501	1	264	84	17	504	91	0	0	0	8	0	13		**12624**	5332	0	0	0	0	0	0	0
2019	1081	7	223	214	252	1026	978	424	40	5	11	33	0	0	0	7	2	0		**4303**	1603	0	15	0	nf	0	0	15
2020																												

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 Campelan equivalent units. Values in brackets are estimates for non-sampled strata.

Year	Index Strata (<200 fathoms)																	Total	1 std	Deep Strata (≥200 fathoms)						Total
	375	**376**	**360**	**361**	**362**	**373**	**374**	**383**	**359**	**377**	**382**	**358**	**378**	**381**	**357**	**379**	**380**	**Index**		**723**	**725**	**727**	**724**	**726**	**728**	>200
1990	5421	32419	28703	6273	12855	1336	879	530	702	243	210	766	550	nf	683	213	nf	**91783**	29227	nf	nf	nf	nf	nf	nf	-
1991	66596	455280	12311	14155	73045	22575	20754	530	0	nf	359	1500	2046	0	399	nf	798	**670348**	355442	0	nf	nf	0	nf	nf	0
1992	nf	354763	8311	20718	49583	1400	nf	nf	497	493	270	5063	1602	nf	194	596	nf	**443490**	286249	nf	0	nf	nf	nf	nf	0
1993	2047	260	3463	6177	1300	750	819	0	88	0	494	47	48	202	1526	655	48	**17924**	4041	97	80	878	17	0	nf	1072
1994	1947	312	0	7549	622	0	1034	0	0	7	0	94	10	0	57	81	16	**11729**	3576	0	0	11	0	0	0	11
1995	4954	3918	433	3751	901	69	57	46	29	7	0	55	10	0	20	32	57	**14339**	3284	0	12	9	0	0	0	21
1996	0	92	480	2005	103	129	64	0	51	12	32	14	0	230	38	52	24	**3326**	1341	43	22	267	19	10	76	437
1997	603	41	137	2156	898	50	43	0	29	0	0	15	17	8	0	79	16	**4092**	757	6	0	0	0	0	0	6
1998	329	1598	309	5761	792	149	171	46	0	0	0	247	10	13	124	13	0	**9562**	2228	0	7	0	0	0	0	7
1999	14518	361	2367	1733	7924	3004	512	0	0	21	134	340	1472	138		988	383	**33895**	9200	0	7	22	0	0	0	29
2000	8163	819	1132	3161	6478	341	85	0	550	21	134	1156	1785	338	168	164	563	**25058**	7551	0	0	49	0	0	0	49
2001	4492	876	2315	6780	6438	446	1836	0	290	481	0	342	226	1702	61	663	14	**26962**	4867	0	7	0	0	0	0	7
2002	2849	317	360	1173	314	149	256	0	463	51	45	437	476	13	10	47	465	**7425**	2909	0	14	11	0	0	0	25
2003	446	324	1242	4952	99	57	0	0	434	0	0	356	36	0	102	52	104	**8204**	1013	0	0	25	nf	0	0	25
2004	438	2062	1543	4282	198	149	171	46	116	206	0	279	315	2078	124	54	96	**12158**	3027	0	nf	0	0	0	43	43
2005	3671	7099	2036	12672	1882	106	0	0	608	35	89	512	1520	82	229	91	56	**30688**	11059	0	7	0	0	0	0	7
2006	3999	987	14200	4384	495	248	640	46	145	76	0	1024	1430	138	302	58	83	**28255**	13287	0	63	9	0	0	0	72
2007	4024	10516	12142	30180	4727	451	840	0	1319	297	316	4797	850	5858	56	73	32	**76478**	15069	31	0	0	60	0	0	91
2008	13586	20758	470	9431	14906	2253	3522	0	898	5475	0	3363	8824	3089	124	131	326	**87156**	21572	9	7	0	0	0	0	16
2009	4821	112129	6709	9198	520	469	1729	46	347	2586	158	584	3142	67	121	32	199	**142857**	74196	0	0	39	0	16	0	55
2010	10902	16032	4956	16569	1684	545	1195	46	319	467	0	552		114	113	40	32	**53566**	12251	17	nf	11	0	0	0	28
2011	6793	1804	3013	3257	870	485	1409	46	2734	3384	140	867	4646	11129	56	645	454	**41732**	12798	0	17	0	0	23	0	39
2012	2763	22786	2337	16183	2427	1634	1708	46	931	812	45	851	180	38	53	144	769	**53704**	10810	14	7	279	17	0	0	317
2013	25853	4691	5362	13612	6834	3518	14051	185	116	813	134	297	4872	2790	11	7	993	**84138**	21554	0	0	11	0	0	0	11
2014																										
2015	5478	2114	875	15167	792	545	683	0	596	289	0	93	3038	225	30	414	828	**31167**	4354.7	11	7	20	0	0	0	37
2016	4531	2217	11987	12252	1387	149	384	0	232	307	89	46	3751	224	34	17	1657	**39264**	10940	0	0	11	0	0	0	11
2017	2144	2784	3293	7749	255	297	1224	0	87	126	89	860	2263	22	35	205	646	**22079**	5930	24	124	0	11	0	57	217
2018	1644	464	51	3824	955	1189	128	46	58	34	0	430	2540	150	30	7	105	**11656**	2549	0	0	0	0	0	0	0
2019	1589	1071	720	6016	198	132	256	0	29	413	45	495	2275	1302	55	137	988	**15720**	3200	11	21	0	0	0	0	32
2020	438	103	5968	8582	2253	87	256	0	0	124	89	138	2342	412	169	8	398	**21367**	4696	0	0	42	0	nf	0	42

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 Campelan equivalent units. Values in brackets are estimates for non-sampled strata.

Year	Index Strata (<200 fathoms)																	Total	1 std	Deep Strata (≥200 fathoms)						Total
	375	**376**	**360**	**361**	**362**	**373**	**374**	**383**	**359**	**377**	**382**	**358**	**378**	**381**	**357**	**379**	**380**	**Index**		**723**	**725**	**727**	**724**	**726**	**728**	>200
1990	31395	5147	7585	24777	9636	9722	2501	216	39	122	129	404	362	nf	370	318	nf	**92723**	25023	nf	nf	nf	nf	nf	nf	-
1991	69276	80732	4456	16326	40955	26255	9699	164	0	nf	73	430	635	0	205	nf	117	**249323**	64135	0	nf	nf	0	nf	nf	0
1992	nf	116390	4572	12485	22852	4114	nf	nf	156	257	115	2464	461	nf	120	317	nf	**164303**	91007	nf	0	nf	nf	nf	nf	0
1993	3305	152	8072	12996	1576	254	1102	0	39	0	168	45	12	119	629	240	32	**28741**	7956	63	90	484	12	0	nf	649
1994	9447	993	0	12111	1001	0	2414	0	0	13	0	51	11	0	42	96	10	**26189**	7249	0	0	12	0	0	0	12
1995	3162	4035	1329	8626	337	39	15	54	12	11	0	61	8	0	46	20	26	**17781**	4298	0	10	3	0	0	0	13
1996	0	799	316	1717	28	49	26	0	36	11	92	9	0	117	19	27	12	**3258**	1199	24	13	97	40	15	34	223
1997	594	12	1226	3255	2581	26	45	0	25	0	0	80	21	5	0	108	10	**7988**	1681	18	0	0	0	0	0	18
1998	839	791	1258	3811	713	60	196	0	0	0	0	327	9	8	245	8	0	**8265**	3200	0	18	0	0	0	0	18
1999	2022	46	8681	1060	4955	1948	111	0	0	6	93	197	729	39		664	223	**20774**	5772	0	10	39	0	0	0	49
2000	8642	2677	1536	1986	2840	125	20	0	458	3	116	933	1156	86	311	129	178	**21196**	5346	0	0	34	0	0	0	34
2001	1490	2351	3183	3319	4146	324	1042	0	249	660	0	470	174	1583	172	675	3	**19841**	4203	0	6	0	0	0	0	6
2002	2135	813	217	4519	1597	154	172	0	601	68	12	467	276	9	9	79	879	**12007**	3490	0	6	11	0	0	0	17
2003	192	1025	2917	6749	582	1	0	0	814	0	0	358	43	0	66	53	48	**12848**	3571	0	0	10	nf	0	0	10
2004	47	23	5334	9089	54	14	31	6	94	382	0	105	99	1890	201	133	54	**17558**	6793	0	nf	0	0	0	44	44
2005	487	5798	2220	8438	3160	33	0	0	317	19	16	262	711	80	221	41	48	**21851**	6469	0	4	0	0	0	0	4
2006	6913	2112	12038	2887	1582	95	1501	34	217	89	0	468	832	34	184	38	37	**29061**	11576	0	49	3	0	0	0	52
2007	6277	910	2291	3624	1640	99	99	0	296	66	93	4112	486	3303	50	27	28	**23401**	7102	49	0	0	65	0	0	114
2008	5111	11121	2231	8548	6235	544	1015	0	456	1720	0	1613	2644	888	89	102	205	**42522**	12646	27	11	0	0	0	0	38
2009	3038	31762	7251	9296	247	815	793	23	328	1601	42	400	2144	21	214	33	106	**58114**	23590	0	0	17	0	13	0	30
2010	2963	17484	8031	4621	3604	315	755	51	257	310	0	638		165	130	55	26	**39405**	14438	27	nf	6	0	0	0	32.33
2011	3120	1139	10504	2562	834	286	661	22	3173	3416	180	1104	4836	5166	154	841	421	**38419**	9968	0	22	0	0	18	0	40
2012	1946	27994	11207	23494	2873	1635	427	34	1254	1102	13	974	138	15	116	254	850	**74327**	24017	66	16	534	40	0	0	656
2013	5440	4200	17535	12422	3913	5647	28073	244	66	994	96	266	9370	2856	43	8	1192	**92366**	32654	0	0	3	0	0	0	3
2014																										
2015	8095	2729	2716	10597	1022	171	1235	0	918	178	0	119	1808	76	17	341	657	**30680**	8058	18	13	18	0	0	0	49
2016	5571	943	19136	6320	276	154	245	0	307	92	37	17	2779	143	63	55	729	**36866**	11042	0	0	6	0	0	0	6
2017	675	1998	3526	3950	109	549	479	0	28	39	4	311	1801	22	50	116	215	**13873**	3633	19	89	0	6	0	27	142
2018	5357	258	1	7603	1025	64	50	11	30	25	0	299	1729	56	44	28	56	**16636**	8212	0	0	0	0	0	0	0
2019	244	91	882	2712	177	85	140	0	25	519	2	218	1848	326	189	181	393	**8033**	2126	9	27	0	0	0	0	35
2020	214	285	2857	2435	1469	87	61	0	0	111	11	110	1621	117	163	15	191	**9746**	2837	0	0	26	0	nf	0	26

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

Year	Index Strata (<200 fathoms)																			Total	1 std	Deep Strata (≥200 fathoms)						Total
	330	331	338	340	351	352	353	329	332	337	339	354	333	336	355	334	335	356		Index		717	719	721	718	720	722	>200
1990	10709	507	20199	4158	29085	10248	1781	531	1721	1001	163	1580	21	6	nf	13	12	nf		**81735**	17121	0	0	nf	nf	nf	nf	0
1991	10264	6682	10334	5625	24185	24761	223	1605	1127	66	0	0	0	0	887	0	4	4		**85767**	15463	nf	0	0	nf	nf	0	0
1992	7036	222	857	7746	3558	2747	0	558	436	198	41	1712	10	0	64	0	0	0		**25185**	6229	nf	nf	nf	nf	nf	nf	0
1993	5271	222	6221	1859	10450	4710	0	239	2036	307	528	0	0	67	172	9	0	102		**32193**	7605	0	0	0	0	0	0	0
1994	2072	95	330	763	661	717	0	1036	242	0	41	0	0	0	0	0	0	0		**5957**	2162	0	5	0	0	0	0	5
1995	3946	760	2478	1668	2709	972	415	574	0	0	41	165	0	0	13	0	0	0		**13741**	2367	0	0	0	0	0	0	0
1996	277	31	261	94	196	284	0	473	0	0	0	337	nf	8	339	nf	132	40		**2472**	571	nf	37	0	nf	0	0	37
1997	1006	31	52	519	1684	1006	0	95	48	0	80	130	0	0	0	0	12	0		**4663**	916	0	0	0	0	0	0	0
1998	3113	408	835	1747	347	761	0	710	288	0	126	33	0	0	0	0	4	17		**8389**	1597	0	0	5	0	0	0	5
1999	6178	721	4804	5665	9244	2789	661	521	576	130		554	0	0	28	0	0	7		**31878**	5652	10	0	0	0	0	0	10
2000	4428	1505	3580	6945	11737	9419	0	255	624	82	40	33	10	42	14	0	4	25		**38743**	6086	0	3	0	0	0	0	3
2001	9339	265	209	2172	9013	6405	0	710	96	130	80	0	0	0	0	0	0	4		**28423**	3443	0	0	0	0	0	0	0
2002	4133	376	835	2408	2091	2980	0	326	331	0	322	6181	0	0	0	0	0	4		**19987**	6278	0	0	0	0	0	0	0
2003	1293	94	261	1369	1436	4780	44	331	48	174	443	0	0	0	0	0	0	0		**10273**	2516	0	0	0	0	0	0	0
2004	886	157	112	1039	842	1680	756	101	1296	0	46	37	0	0	28	0	0	0		**6980**	1681	0	0	0	0	0	0	0
2005	1533	470	3081	964	2327	3397	1146	0	946	143	80	32	0	0	0	0	0	0		**14119**	2807	0	0	0	0	0	0	0
2006	1485	345	2611	991	2526	4741	453	221	288	43	80	65	0	0	63	6	0	4		**13922**	2345	0	0	0	nf	0	0	0
2007	14991	4610	5065	1457	22015	32905	882	900	2358	7694	201	10610	27	0	38	0	0	4		**103757**	13838	0	0	0	0	0	0	0
2008	15403	1004	5993	2859	6586	6033	118	1631	912	297	268	1710	9	15	25	0	4	0		**42867**	11520	0	0	0	0	0	0	0
2009	6540	1157	1484	2822	6718	3042	44	473	43	87	46	58	0	nf	6	7	0	17		**22544**	3796	0	0	0	0	0	0	0
2010	3044	282	2402	1665	3075	9492	88	384	43	82	40	811	9	0	7	6	0	0		**21430**	4311	0	0	0	0	0	0	0
2011	3496	282	2611	2408	2080	6236	485	832	55	43	0	65	0	0	0	0	0	4		**18597**	4272	0	0	0	0	0	0	0
2012	10409	860	6313	1416	3566	6794	88	421	128	87	112	65	0	0	0	0	0	0		**30259**	6479	0	0	0	0	0	0	0
2013	4922	188	3916	1175	8133	4107	44	605	0	0	241	0	0	0	0	0	0	0		**23332**	4085	0	0	0	0	0	0	0
2014																												
2015	3079	282	5065	2630	2328	8501	265	1705	576	261	40	0	0	0	0	0	0	0		**24731**	5690	0	0	0	0	0	0	0
2016	1581	878	3290	1511	1684	9633	0	473	192	130	40	0	0	nf	0	0	0	0		**19412**	3592	0	0	0	0	0	0	0
2017	4146	596	4909	6185	4110	3078	0	379	1440	43	161	0	0	0	0	7	0	0		**25054**	7582	11	0	0	0	0	nf	11
2018	1437	314	8877	661	1288	2999	0	1136	144	0	40	98	0	8	0	0	0	0		**17001**	7954	0	0	0	0	0	0	0
2019	516	0	888	10150	2328	2738	132	521	1440	0	0	1565	0	0	0	0	0	0		**20278**	6280	0	0	5	0	0	0	5
2020	1221	345	87	2754	4853	12729	59	3157	0	0	201	0	0	7	0	0	4	0		**25417**	6207	0	0	0	0	0	0	0

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

Year	Index Strata (<200 fathoms)																		**Total**	1 std	Deep Strata (≥200 fathoms)						Total
	330	**331**	**338**	**340**	**351**	**352**	**353**	**329**	**332**	**337**	**339**	**354**	**333**	**336**	**355**	**334**	**335**	**356**	**Index**		**717**	**719**	**721**	**718**	**720**	**722**	>200
1990	6651	27	13966	3635	17027	21151	4593	1291	767	2331	1242	66	12	29	nf	16	13	nf	**72817**	11789	0	0	nf	nf	nf	nf	0
1991	2374	1047	7122	6247	21473	32262	56	1019	74	70	0	0	0	0	155	0	8	8	**71915**	12726	nf	0	0	nf	nf	0	0
1992	2574	191	2760	6711	3142	3137	0	109	254	373	64	896	12	0	31	0	0	0	**20254**	4404	nf	nf	nf	nf	nf	nf	0
1993	4278	267	3763	1231	9895	4920	0	245	1323	176	447	0	0	107	104	21	0	68	**26845**	7412	0	0	0	0	0	0	0
1994	1928	172	91	832	679	4775	0	1546	452	0	56	0	0	0	0	0	0	0	**10531**	3158	0	14	0	0	0	0	14
1995	6035	1455	5283	3149	5052	3195	2238	1052	0	0	46	161	0	0	15	0	0	0	**27681**	6346	0	0	0	0	0	0	0
1996	299	11	26	37	73	1340	0	367	0	0	0	258	nf	11	233	nf	300	39	**2994**	1397	nf	55	0	nf	0	0	55
1997	1779	85	167	951	4806	3220	0	159	0	0	276	96	0	0	0	0	16	0	**11555**	2467	0	0	0	0	0	0	0
1998	2027	735	1786	2108	815	1198	0	820	1	0	606	42	0	0	0	0	8	30	**10176**	1753	0	0	9	0	0	0	9
1999	2379	367	16088	2902	7355	9096	716	684	18	21		184	0	0	25	0	0	13	**39848**	15975	1	0	0	0	0	0	1
2000	1817	574	5978	5371	5249	14518	0	86	33	12	161	18	4	49	11	0	1	28	**33910**	6738	0	5	0	0	0	0	5
2001	5922	155	558	1785	8149	7207	0	810	41	91	50	0	0	0	0	0	0	2	**24770**	4051	0	0	0	0	0	0	0
2002	4037	481	493	2542	2296	4081	0	1407	960	0	447	8920	0	0	0	0	0	11	**25675**	8993	0	0	0	0	0	0	0
2003	1547	243	238	2028	2002	8617	2	566	62	111	769	0	0	0	0	0	0	0	**16185**	5988	0	0	0	0	0	0	0
2004	440	641	267	2663	685	3025	239	267	225	0	23	3	0	0	19	0	0	0	**8499**	2867	0	0	0	0	0	0	0
2005	1664	442	3592	3002	4017	4231	1604	0	31	25	145	4	0	0	0	0	0	0	**18757**	4624	0	0	0	0	0	0	0
2006	1347	713	1804	421	1348	4782	1105	185	312	17	25	26	0	0	51	6	0	9	**12151**	2469	0	0	0	nf	0	0	0
2007	1463	141	1010	1540	4093	19781	184	292	165	2891	111	11472	1	0	30	0	0	5	**43179**	16998	0	0	0	0	0	0	0
2008	1813	296	1220	1305	1907	3344	91	333	167	175	59	991	5	24	30	0	6	0	**11766**	2472	0	0	0	0	0	0	0
2009	3019	189	1712	1714	4705	4502	53	622	21	13	100	43	0	nf	4	6	0	33	**16736**	3409	0	0	0	0	0	0	0
2010	1596	214	508	940	3003	8294	64	210	38	50	2	651	14	0	11	4	0	0	**15599**	4027	0	0	0	0	0	0	0
2011	2049	198	3527	1500	2296	6939	1457	754	86	24	0	62	0	0	0	0	0	8	**18900**	4645	0	0	0	0	0	0	0
2012	10556	256	1587	1270	2896	7022	300	376	2	123	156	52	0	0	0	0	0	0	**24596**	6811	0	0	0	0	0	0	0
2013	1671	177	2502	890	5549	4081	12	629	0	0	11	0	0	0	0	0	0	0	**15522**	3010	0	0	0	0	0	0	0
2014																											0
2015	3282	145	409	827	3013	2511	1265	1059	85	72	42	0	0	0	0	0	0	0	**12711**	3285	0	0	0	0	0	0	0
2016	634	366	1279	1232	352	5296	0	629	5	9	0	0	0	nf	0	0	0	0	**9801**	2413	0	0	0	0	0	0	0
2017	2649	21	1825	959	1636	2275	0	53	770	17	4	0	0	0	0	4	0	0	**10212**	2938	5	0	0	0	0	nf	5
2018	466	42	1091	214	1189	1293	0	245	8	0	1	22	0	5	0	0	0	0	**4576**	1261	0	0	0	0	0	0	0
2019	39	0	198	2064	2416	3023	11	308	97	0	0	188	0	0	0	0	0	0	**8344**	3654	0	0	0	0	0	0	0
2020	1397	180	16	780	747	2564	13	589	0	0	210	0	0	3	0	0	15	0	**6514**	1504	0	0	0	0	0	0	0

Table 16. Mean number per tow at age of cod from spring RV surveys in NAFO Divisions 3NO as calculated using the conversion from Warren (1997) for surveys in 1984-1995. Results for 1996 -2020 are actual Campelen surveys.

Year	AGE																				
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	1+
1984	0.00	0.16	53.39	41.57	21.35	7.17	5.04	1.51	0.72	1.36	1.15	0.61	0.25	0.10	0.03	0.05	0.08	0.05	0.01	0.00	134.60
1985	0.00	0.37	9.88	29.27	16.14	2.76	0.90	1.03	0.66	0.84	1.18	0.88	0.48	0.23	0.14	0.08	0.08	0.03	0.01	0.02	64.98
1986	0.00	0.38	12.77	3.63	17.87	11.53	2.11	0.82	0.58	0.42	0.61	1.02	0.51	0.31	0.15	0.08	0.04	0.04	0.03	0.03	52.93
1987	0.00	5.00	54.15	14.13	19.67	50.35	26.41	7.38	1.71	1.63	0.54	0.70	0.60	0.68	0.23	0.21	0.12	0.00	0.01	0.02	183.54
1988	0.00	0.18	26.45	12.91	1.02	0.47	1.10	1.13	0.66	0.67	0.75	0.35	0.44	0.69	0.55	0.21	0.11	0.11	0.04	0.03	47.87
1989	0.00	0.38	4.77	10.39	2.40	0.34	0.31	0.61	0.52	0.36	0.40	0.51	0.33	0.27	0.39	0.21	0.11	0.09	0.04	0.03	22.46
1990	0.00	0.90	7.25	6.77	3.80	1.46	0.25	0.41	0.52	0.61	0.46	0.34	0.34	0.16	0.37	0.44	0.22	0.14	0.06	0.05	24.55
1991	0.00	0.57	147.62	15.44	1.59	0.47	0.16	0.07	0.06	0.14	0.12	0.11	0.09	0.12	0.13	0.12	0.18	0.07	0.04	0.00	167.10
1992	0.00	0.00	10.07	9.66	0.24	0.11	0.09	0.03	0.03	0.08	0.11	0.13	0.14	0.12	0.10	0.09	0.09	0.06	0.01	0.01	21.17
1993	0.00	0.00	1.17	58.27	53.63	1.25	0.68	0.46	0.22	0.05	0.08	0.17	0.12	0.07	0.07	0.09	0.05	0.02	0.01	0.01	116.42
1994	0.00	0.00	0.22	0.91	1.63	1.05	0.07	0.12	0.07	0.07	0.02	0.04	0.05	0.07	0.02	0.03	0.01	0.00	0.03	0.01	4.42
1995	0.00	0.00	0.76	0.20	0.04	0.15	0.10	0.01	0.02	0.05	0.01	0.01	0.02	0.05	0.02	0.03	0.02	0.00	0.00	0.00	1.49
1996	0.00	0.10	1.35	1.65	0.44	0.24	0.57	0.56	0.05	0.04	0.03	0.02	0.00	0.00	0.03	0.02	0.00	0.01	0.00	0.00	5.11
1997	0.00	0.06	0.24	1.67	0.58	0.16	0.03	0.09	0.07	0.01	0.02	0.03	0.02	0.01	0.00	0.01	0.00	0.00	0.01	0.00	3.01
1998	0.00	1.71	0.16	0.51	1.23	0.52	0.17	0.13	1.35	1.61	0.15	0.03	0.01	0.03	0.00	0.02	0.01	0.00	0.00	0.00	7.64
1999	0.00	4.69	4.71	4.55	0.38	0.70	0.30	0.11	0.12	0.42	0.84	0.07	0.03	0.03	0.02	0.01	0.00	0.02	0.00	0.00	17.00
2000	0.00	2.15	6.46	4.58	0.69	0.10	0.20	0.29	0.07	0.06	0.57	1.10	0.13	0.02	0.00	0.01	0.02	0.00	0.00	0.00	16.45
2001	0.00	0.15	1.88	2.91	1.01	0.26	0.01	0.06	0.07	0.01	0.01	0.16	0.40	0.04	0.02	0.00	0.01	0.00	0.00	0.00	7.00
2002	0.00	0.23	0.66	0.98	0.40	0.23	0.10	0.01	0.06	0.01	0.02	0.01	0.03	0.16	0.00	0.01	0.00	0.00	0.00	0.00	2.91
2003	0.00	0.30	0.58	0.47	0.51	1.03	0.82	0.12	0.01	0.05	0.02	0.02	0.01	0.08	0.08	0.01	0.00	0.00	0.00	0.00	4.11
2004	0.00	1.18	1.12	0.50	0.19	0.13	0.18	0.18	0.07	0.02	0.08	0.02	0.03	0.02	0.02	0.10	0.01	0.00	0.01	0.00	3.86
2005	0.00	2.64	2.05	2.76	0.48	0.20	0.07	0.33	0.26	0.13	0.02	0.07	0.02	0.00	0.00	0.03	0.02	0.00	0.00	0.00	9.08
2006																					
2007	0.00	14.87	6.12	3.91	1.95	0.46	0.11	0.05	0.09	0.14	0.13	0.11	0.01	0.01	0.01	0.00	0.03	0.01	0.04	0.01	28.06
2008	0.00	0.36	12.89	9.63	1.37	1.03	0.21	0.07	0.01	0.02	0.18	0.14	0.08	0.00	0.02	0.01	0.01	0.01	0.01	0.00	26.05
2009	0.00	0.65	7.02	59.57	8.28	3.94	1.94	0.61	0.14	0.02	0.07	0.08	0.16	0.02	0.01	0.01	0.00	0.00	0.00	0.00	82.52
2010	0.00	4.30	4.21	3.09	5.08	1.57	0.64	0.36	0.06	0.01	0.02	0.01	0.04	0.02	0.00	0.01	0.00	0.00	0.00	0.00	19.42
2011	0.00	0.04	3.92	8.01	1.72	1.65	0.69	0.25	0.16	0.01	0.02	0.01	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	16.51
2012	0.00	1.13	1.04	3.80	3.01	0.70	2.56	0.94	0.34	0.32	0.06	0.05	0.03	0.07	0.08	0.01	0.01	0.00	0.00	0.00	14.16
2013	0.00	1.12	3.43	1.48	2.11	1.99	0.46	2.13	1.04	0.37	0.19	0.04	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	14.37
2014	0.00	1.21	1.40	2.16	0.61	2.59	2.78	0.57	3.90	1.46	0.23	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.96
2015	0.00	1.29	3.58	1.84	0.70	0.27	0.55	0.40	0.11	0.82	0.19	0.17	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.93
2016	0.00	1.94	6.20	1.38	0.51	0.28	0.14	0.23	0.20	0.03	0.16	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.15
2017	0.00	0.49	1.49	1.28	1.12	0.43	0.21	0.06	0.10	0.08	0.02	0.08	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.36
2018	0.00	1.76	3.47	2.15	1.01	0.67	0.19	0.15	0.03	0.08	0.09	0.05	0.26	0.06	0.00	0.00	0.00	0.00	0.00	0.00	9.98
2019	0.00	1.67	2.06	1.43	2.22	1.20	0.48	0.21	0.18	0.07	0.07	0.05	0.01	0.10	0.01	0.01	0.00	0.00	0.00	0.00	9.77
2020																					

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 -2017 are actual Campelen surveys.

Year	AGE																				
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	1+
1990	0.00	18.89	6.15	3.25	3.56	1.73	0.37	0.29	0.38	0.40	0.24	0.20	0.09	0.15	0.07	0.16	0.21	0.07	0.02	0.03	36.26
1991	0.00	14.87	129.66	4.36	2.19	2.73	1.33	0.37	0.31	0.53	0.37	0.45	0.33	0.27	0.21	0.12	0.38	0.16	0.06	0.00	158.70
1992	0.00	0.41	49.65	65.00	4.70	1.02	0.61	0.18	0.03	0.03	0.07	0.00	0.06	0.12	0.03	0.03	0.02	0.03	0.08	0.00	122.07
1993	0.00	1.30	0.72	3.63	3.59	0.30	0.27	0.18	0.10	0.02	0.02	0.06	0.04	0.04	0.05	0.06	0.02	0.01	0.02	0.00	10.43
1994	0.00	0.00	0.62	0.28	0.96	1.32	0.16	0.04	0.06	0.01	0.01	0.03	0.03	0.02	0.06	0.01	0.03	0.02	0.01	0.00	3.67
1995	0.00	1.15	1.02	0.46	0.20	0.94	1.64	0.11	0.05	0.06	0.05	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	5.72
1996	0.00	0.08	0.74	0.29	0.06	0.01	0.02	0.02	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.00	1.26
1997	0.00	0.03	0.10	0.40	0.33	0.14	0.06	0.28	0.28	0.05	0.04	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.01	1.74
1998	0.00	1.67	0.29	0.20	0.32	0.11	0.06	0.01	0.16	0.22	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	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	4.16	2.12	2.95	2.25	0.73	2.76	1.09	0.43	0.28	0.15	0.00	0.02	0.02	0.02	0.00	0.01	0.00	0.00	0.00	17.00
2013	0.16	5.19	5.98	2.07	2.25	2.50	0.86	2.26	0.80	0.25	0.15	0.10	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	22.43
2014																					
2015	1.18	3.52	3.19	1.36	0.72	0.30	0.52	0.25	0.14	0.36	0.16	0.05	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	10.57
2016	0.26	2.29	5.95	1.98	0.39	0.34	0.08	0.29	0.15	0.03	0.37	0.18	0.02	0.03	0.00	0.01	0.00	0.00	0.00	0.00	12.11
2017	0.57	2.21	3.35	2.40	0.59	0.23	0.19	0.09	0.11	0.05	0.01	0.05	0.03	0.00	0.02	0.01	0.00	0.00	0.00	0.00	9.34
2018	0.52	1.42	1.74	1.15	0.51	0.22	0.10	0.03	0.01	0.05	0.11	0.01	0.11	0.02	0.00	0.00	0.00	0.00	0.00	0.00	5.49
2019	0.77	2.92	2.46	0.65	0.40	0.11	0.06	0.01	0.02	0.01	0.06	0.04	0.00	0.03	0.00	0.00	0.01	0.00	0.00	0.00	6.78
2020	0.39	4.02	3.48	0.80	0.26	0.24	0.21	0.03	0.01	0.03	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.11

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

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

Table 19. Estimated proportions mature for female cod from NAFO Divs. 3NO from DFO surveys from 1975 to 2020 projected forward to 2020 and back to 1954. Estimates were obtained from a probit model fitted by cohort to observed proportions mature at age. When the model did not fit the data for a particular cohort (I.e 1991 and 2000 cohorts) the average of estimates for the same age group from adjacent years was used; dark shaded cells are averages extrapolated forward or backward from the same age group from 3 previous (or next) years.

Year	Age 1	Age2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14
1954	0.0000	0.0004	0.0020	0.0112	0.0592	0.2424	0.5895	0.8856	0.9812	0.9972	0.9996	0.9999	1.0000	1.0000
1955	0.0001	0.0000	0.0020	0.0112	0.0592	0.2424	0.5895	0.8856	0.9812	0.9972	0.9996	0.9999	1.0000	1.0000
1956	0.0001	0.0003	0.0001	0.0112	0.0592	0.2424	0.5895	0.8856	0.9812	0.9972	0.9996	0.9999	1.0000	1.0000
1957	0.0003	0.0007	0.0018	0.0008	0.0592	0.2424	0.5895	0.8856	0.9812	0.9972	0.9996	0.9999	1.0000	1.0000
1958	0.0001	0.0016	0.0041	0.0102	0.0065	0.2424	0.5895	0.8856	0.9812	0.9972	0.9996	0.9999	1.0000	1.0000
1959	0.0000	0.0006	0.0079	0.0226	0.0555	0.0509	0.5895	0.8856	0.9812	0.9972	0.9996	0.9999	1.0000	1.0000
1960	0.0000	0.0000	0.0033	0.0393	0.1157	0.2512	0.3043	0.8856	0.9812	0.9972	0.9996	0.9999	1.0000	1.0000
1961	0.0002	0.0001	0.0001	0.0168	0.1731	0.4251	0.6572	0.7809	0.9812	0.9972	0.9996	0.9999	1.0000	1.0000
1962	0.0000	0.0012	0.0009	0.0012	0.0825	0.5172	0.8069	0.9164	0.9667	0.9972	0.9996	0.9999	1.0000	1.0000
1963	0.0000	0.0002	0.0056	0.0099	0.0229	0.3206	0.8458	0.9594	0.9843	0.9958	0.9996	0.9999	1.0000	1.0000
1964	0.0000	0.0000	0.0010	0.0266	0.1000	0.3219	0.7124	0.9656	0.9926	0.9972	0.9995	0.9999	1.0000	1.0000
1965	0.0014	0.0000	0.0000	0.0049	0.1162	0.5526	0.9057	0.9286	0.9931	0.9987	0.9995	0.9999	1.0000	1.0000
1966	0.0000	0.0043	0.0005	0.0006	0.0234	0.3875	0.9321	0.9949	0.9856	0.9986	0.9998	0.9999	1.0000	1.0000
1967	0.0000	0.0001	0.0132	0.0067	0.0097	0.1037	0.7527	0.9935	0.9997	0.9972	0.9997	1.0000	1.0000	1.0000
1968	0.0000	0.0000	0.0012	0.0398	0.0820	0.1450	0.3587	0.9361	0.9994	1.0000	0.9995	0.9999	1.0000	1.0000
1969	0.0000	0.0000	0.0003	0.0090	0.1144	0.5429	0.7457	0.7301	0.9860	0.9999	1.0000	0.9999	1.0000	1.0000
1970	0.0032	0.0000	0.0001	0.0029	0.0665	0.2866	0.9405	0.9807	0.9290	0.9971	1.0000	1.0000	1.0000	1.0000
1971	0.0000	0.0093	0.0000	0.0009	0.0275	0.3582	0.5555	0.9953	0.9989	0.9844	0.9994	1.0000	1.0000	1.0000
1972	0.0000	0.0002	0.0269	0.0000	0.0101	0.2176	0.8140	0.7954	0.9996	0.9999	0.9967	0.9999	1.0000	1.0000
1973	0.0001	0.0000	0.0013	0.0754	0.0038	0.1018	0.7320	0.9717	0.9236	1.0000	1.0000	0.9993	1.0000	1.0000
1974	0.0000	0.0006	0.0001	0.0083	0.1939	0.2928	0.5582	0.9641	0.9963	0.9741	1.0000	1.0000	0.9999	1.0000
1975	0.0000	0.0003	0.0033	0.0017	0.0530	0.4148	0.9780	0.9337	0.9962	0.9995	0.9915	1.0000	1.0000	1.0000
1976	0.0000	0.0001	0.0020	0.0186	0.0221	0.2715	0.6763	0.9998	0.9937	0.9996	0.9999	0.9973	1.0000	1.0000
1977	0.0006	0.0001	0.0009	0.0142	0.0978	0.2269	0.7128	0.8603	1.0000	0.9994	1.0000	1.0000	0.9991	1.0000
1978	0.0001	0.0029	0.0014	0.0083	0.0935	0.3823	0.7922	0.9429	0.9478	1.0000	0.9999	1.0000	1.0000	0.9997
1979	0.0000	0.0005	0.0145	0.0133	0.0733	0.4248	0.7794	0.9802	0.9910	0.9817	1.0000	1.0000	1.0000	1.0000
1980	0.0002	0.0002	0.0034	0.0695	0.1140	0.4292	0.8410	0.9528	0.9984	0.9986	0.9937	1.0000	1.0000	1.0000
1981	0.0000	0.0007	0.0020	0.0236	0.2749	0.5518	0.8773	0.9743	0.9914	0.9999	0.9998	0.9979	1.0000	1.0000
1982	0.0000	0.0000	0.0035	0.0162	0.1460	0.6579	0.9218	0.9855	0.9963	0.9985	1.0000	1.0000	0.9993	1.0000
1983	0.0000	0.0001	0.0003	0.0163	0.1219	0.5474	0.9070	0.9912	0.9985	0.9995	0.9997	1.0000	1.0000	0.9998
1984	0.0000	0.0003	0.0008	0.0028	0.0726	0.5389	0.8953	0.9802	0.9991	0.9998	0.9999	1.0000	1.0000	1.0000
1985	0.0002	0.0002	0.0019	0.0058	0.0261	0.2703	0.9078	0.9837	0.9960	0.9999	1.0000	1.0000	1.0000	1.0000
1986	0.0000	0.0010	0.0021	0.0134	0.0409	0.2049	0.6369	0.9881	0.9977	0.9992	1.0000	1.0000	1.0000	1.0000
1987	0.0001	0.0000	0.0058	0.0194	0.0869	0.2358	0.7128	0.8925	0.9986	0.9997	0.9998	1.0000	1.0000	1.0000
1988	0.0011	0.0006	0.0002	0.0335	0.1570	0.3994	0.6908	0.9598	0.9752	0.9998	1.0000	1.0000	1.0000	1.0000
1989	0.0001	0.0043	0.0047	0.0031	0.1702	0.6371	0.8229	0.9418	0.9957	0.9947	1.0000	1.0000	1.0000	1.0000
1990	0.0000	0.0011	0.0170	0.0377	0.0441	0.5486	0.9431	0.9701	0.9915	0.9995	0.9989	1.0000	1.0000	1.0000
1991	0.0000	0.0000	0.0079	0.0645	0.2438	0.4047	0.8780	0.9936	0.9956	0.9988	1.0000	0.9998	1.0000	1.0000
1992	0.0000	0.0000	0.0004	0.0557	0.2155	0.7265	0.9092	0.9771	0.9993	0.9994	0.9998	1.0000	0.9999	1.0000
1993	0.0001	0.0004	0.0002	0.0121	0.3045	0.5225	0.9563	0.9933	0.9961	0.9999	0.9999	1.0000	1.0000	1.0000
1994	0.0004	0.0008	0.0040	0.0153	0.2825	0.7646	0.8134	0.9945	0.9995	0.9993	1.0000	1.0000	1.0000	1.0000
1995	0.0002	0.0030	0.0078	0.0418	0.5844	0.9266	0.9602	0.9455	0.9993	1.0000	0.9999	1.0000	1.0000	1.0000
1996	0.0004	0.0014	0.0229	0.0683	0.4952	0.9922	0.9975	0.9944	0.9857	0.9999	1.0000	1.0000	1.0000	1.0000
1997	0.0000	0.0026	0.0130	0.1536	0.4059	0.9282	0.9999	0.9999	0.9992	0.9964	1.0000	1.0000	1.0000	1.0000
1998	0.0000	0.0001	0.0170	0.1076	0.5837	0.8642	0.9917	1.0000	1.0000	0.9999	0.9991	1.0000	1.0000	1.0000
1999	0.0000	0.0000	0.0009	0.1035	0.5240	0.9155	0.9834	0.9991	1.0000	1.0000	1.0000	0.9998	1.0000	1.0000
2000	0.0000	0.0003	0.0011	0.0135	0.4356	0.9095	0.9882	0.9982	0.9999	1.0000	1.0000	1.0000	0.9999	1.0000
2001	0.0006	0.0002	0.0066	0.0278	0.1676	0.8377	0.9892	0.9985	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000
2002	0.0011	0.0029	0.0067	0.1366	0.4280	0.7473	0.9718	0.9988	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000
2003	0.0006	0.0055	0.0163	0.1598	0.7908	0.9514	0.9775	0.9957	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000
2004	0.0024	0.0028	0.0259	0.1370	0.8429	0.9891	0.9981	0.9984	0.9994	1.0000	1.0000	1.0000	1.0000	1.0000
2005	0.0025	0.0110	0.0132	0.1143	0.6138	0.9934	0.9995	0.9999	0.9999	0.9999	1.0000	1.0000	1.0000	1.0000
2006	0.0001	0.0094	0.0484	0.0589	0.3846	0.8726	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2007	0.0008	0.0007	0.0344	0.1889	0.2269	0.7518	0.9680	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2008	0.0012	0.0036	0.0039	0.1179	0.5160	0.5793	0.9362	0.9931	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2009	0.0004	0.0044	0.0159	0.0202	0.3343	0.8299	0.8660	0.9861	0.9986	1.0000	1.0000	1.0000	1.0000	1.0000
2010	0.0000	0.0026	0.0160	0.0662	0.0991	0.6534	0.9571	0.9681	0.9971	0.9997	1.0000	1.0000	1.0000	1.0000
2011	0.0035	0.0000	0.0165	0.0561	0.2379	0.3696	0.8762	0.9903	0.9930	0.9994	0.9999	1.0000	1.0000	1.0000
2012	0.0037	0.0119	0.0005	0.0981	0.1781	0.5788	0.7575	0.9637	0.9979	0.9985	0.9999	1.0000	1.0000	1.0000
2013	0.0006	0.0122	0.0395	0.0212	0.4134	0.4415	0.8581	0.9433	0.9901	0.9995	0.9997	1.0000	1.0000	1.0000
2014	0.0000	0.0034	0.0388	0.1233	0.5010	0.8202	0.7425	0.9638	0.9888	0.9973	0.9999	0.9999	1.0000	1.0000
2015	0.0006	0.0003	0.0182	0.1169	0.3243	0.9789	0.9673	0.9132	0.9915	0.9979	0.9993	1.0000	1.0000	1.0000
2016	0.0004	0.0034	0.0023	0.0910	0.3026	0.6210	0.9995	0.9948	0.9746	0.9981	0.9996	0.9998	1.0000	1.0000
2017	0.0004	0.0023	0.0187	0.0205	0.3507	0.5871	0.8484	1.0000	0.9992	0.9929	0.9996	0.9999	0.9999	1.0000
2018	0.0004	0.0023	0.0131	0.0979	0.1585	0.7444	0.8233	0.9503	1.0000	0.9999	0.9980	0.9999	1.0000	1.0000
2019	0.0004	0.0023	0.0131	0.0698	0.3813	0.6286	0.9401	0.9385	0.9849	1.0000	1.0000	0.9995	1.0000	1.0000
2020	0.0004	0.0023	0.0131	0.0698	0.2968	0.7778	0.9383	0.9883	0.9804	0.9955	1.0000	1.0000	0.9999	1.0000
2021	0.0004	0.0023	0.0131	0.0698	0.2968	0.7169	0.9521	0.9927	0.9978	0.9939	0.9987	1.0000	1.0000	1.0000

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

ORTHOGONALITY OFFSET..... 0.000339
MEAN SQUARE RESIDUALS 0.624444

Survivors			Standard	Relative		Relative
Year	Age	Estimate	Error	Error	Bias	Bias
1994	12	160.00	94.10	0.588	17.700	0.111
1995	12	77.90	33.50	0.43	5.830	0.075
1996	12	44.10	14.90	0.337	2.320	0.053
1997	12	90.90	28.10	0.309	4.250	0.047
1998	12	123.00	39.80	0.324	6.250	0.051
1999	12	61.60	20.70	0.337	3.250	0.053
2000	12	65.50	19.30	0.295	2.750	0.042
2001	12	565.00	154.00	0.272	20.500	0.036
2002	12	264.00	71.10	0.269	9.490	0.036
2003	12	37.20	10.00	0.269	1.300	0.035
2004	12	45.10	12.90	0.285	1.680	0.037
2005	12	79.90	23.20	0.29	3.030	0.038
2006	12	87.50	27.00	0.308	3.640	0.042
2007	12	21.10	6.47	0.306	9.37Eý1	0.044
2008	12	134.00	42.90	0.32	6.230	0.046
2009	12	293.00	90.80	0.31	13.100	0.044
2010	12	206.00	63.00	0.306	9.100	0.044
2011	12	57.10	16.90	0.296	2.470	0.043
2012	12	36.40	11.40	0.314	1.700	0.047
2013	12	66.30	18.10	0.273	2.410	0.036
2014	12	139.00	37.00	0.267	4.880	0.035
2015	12	436.00	108.00	0.249	14.100	0.032
2016	12	467.00	115.00	0.246	15.300	0.033
2017	12	991.00	228.00	0.23	29.700	0.03
2018	12	1580.00	366.00	0.232	47.400	0.03
2019	12	192.00	48.20	0.251	6.310	0.033
2020	3	1820.00	1040.00	0.573	311.000	0.171
2020	4	1030.00	431.00	0.418	95.600	0.093
2020	5	1010.00	363.00	0.358	68.900	0.068
2020	6	900.00	282.00	0.313	48.300	0.054
2020	7	532.00	161.00	0.302	25.700	0.048
2020	8	223.00	68.40	0.307	10.700	0.048
2020	9	240.00	68.70	0.286	10.200	0.042
2020	10	90.40	28.90	0.32	4.230	0.047
2020	11	308.00	79.70	0.259	10.600	0.034
2020	12	395.00	97.90	0.248	12.700	0.032

			Standard	Relative		Relative
Catchabilities	Age	Estimate	Error	Error	Bias	Bias
RV Spr	2	0.001112	0.000161	0.145	0.000003	0.003
RV Spr	3	0.001425	0.000205	0.144	0.000005	0.003
RV Spr	4	0.000753	0.000110	0.146	0.000003	0.004
RV Spr	5	0.000524	0.000078	0.150	0.000003	0.005
RV Spr	6	0.000362	0.000056	0.154	0.000002	0.006
RV Spr	7	0.000344	0.000054	0.158	0.000003	0.008
RV Spr	8	0.000313	0.000051	0.162	0.000003	0.010
RV Spr	9	0.000299	0.000049	0.166	0.000003	0.011
RV Spr	10	0.000347	0.000058	0.168	0.000005	0.014
RV_Fall	2	0.001203	0.000194	0.161	0.000006	0.005
RV_Fall	3	0.001151	0.000186	0.162	0.000006	0.005
RV_Fall	4	0.000779	0.000129	0.166	0.000005	0.006
RV_Fall	5	0.000624	0.000106	0.170	0.000005	0.008
RV_Fall	6	0.000503	0.000088	0.176	0.000005	0.009
RV_Fall	7	0.000330	0.000060	0.182	0.000004	0.012
RV_Fall	8	0.000315	0.000060	0.189	0.000005	0.014
RV_Fall	9	0.000229	0.000045	0.195	0.000004	0.018
RV_Fall	10	0.000295	0.000061	0.206	0.000007	0.023
RV_Juvenile	2	0.003458	0.001127	0.326	0.000164	0.047
RV_Juvenile	3	0.001812	0.000589	0.325	0.000086	0.047
RV_Juvenile	4	0.001301	0.000424	0.326	0.000062	0.048
RV_Juvenile	5	0.001053	0.000345	0.328	0.000049	0.047
RV_Juvenile	6	0.000757	0.000250	0.331	0.000035	0.046
RV_Juvenile	7	0.000541	0.000182	0.337	0.000026	0.048
RV_Juvenile	8	0.000421	0.000144	0.342	0.000021	0.051
RV_Juvenile	9	0.000265	0.000092	0.348	0.000015	0.057
RV_Juvenile	10	0.000232	0.000082	0.355	0.000015	0.066

Table 21. Estimated bias adjusted population numbers ('000) from ADAPT for cod in NAFO Divs. 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	195489	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	168891	89951	33653	9146	6895	1137	1076	183	87	613638
1968	154111	99509	130150	82351	28883	11073	3234	1531	719	719	86	512367
1969	96818	126175	66743	55815	24240	7265	3431	1228	801	429	508	383453
1970	101649	79268	95947	43016	21651	9853	4073	1563	542	394	231	358187
1971	74518	83223	62998	60832	25515	9253	4802	1872	795	310	121	324239
1972	42190	61010	67280	27530	22783	10441	4442	1704	1083	471	164	239098
1973	44129	34542	49889	37316	11560	6720	3316	2127	1138	693	316	191745
1974	27768	36130	19253	16285	17044	4127	3733	1842	1108	713	444	128448
1975	32978	22734	23798	7289	3683	4318	1379	1147	605	307	204	98443
1976	54589	27000	18007	11619	2819	800	837	198	132	90	31	116124
1977	50132	44694	18455	8006	4214	1338	466	471	123	75	62	128036
1978	20935	41045	36044	12885	4284	2106	584	223	199	43	25	118373
1979	23752	17140	32774	25602	8284	2772	1406	386	130	117	28	112391
1980	33105	19447	13968	23384	12712	4287	1477	913	264	91	85	109732
1981	26501	27104	15681	10485	15713	8360	2825	1010	664	188	68	108597
1982	42674	21697	21735	11854	7447	10796	5134	1796	654	459	117	124364
1983	49882	34939	17488	16012	8272	5185	7462	2864	937	346	231	143619
1984	39968	40840	27541	13734	11403	5688	3627	5072	1650	553	210	150288
1985	10787	32723	33385	21646	9973	7246	3560	2322	3327	857	358	126182
1986	7865	8832	26740	24670	12154	5441	3675	2198	1488	2244	467	95773
1987	15677	6439	7093	19310	14428	6036	3097	2157	1298	883	1523	77941
1988	15606	12659	4807	5426	12668	8717	3850	1948	1010	621	368	67679
1989	6260	12546	10114	3649	3072	4712	3604	2246	1086	447	285	48020
1990	6915	5010	8546	6319	1644	1388	2169	1800	1403	680	215	36088
1991	25042	5291	3145	2983	1336	549	758	1130	953	755	422	42364
1992	8018	15085	3340	1970	1551	607	198	292	418	333	276	32089
1993	820	6489	8305	1159	864	722	287	105	150	228	136	19265
1994	522	642	4131	3927	382	282	304	168	63	88	142	10652
1995	1012	428	318	1313	2212	201	147	226	131	51	72	6110
1996	1396	829	350	195	1057	1775	162	120	184	107	42	6218
1997	477	1141	675	282	157	850	1431	130	97	148	87	5475
1998	2880	390	923	536	221	124	668	1131	102	76	116	7168
1999	6153	2357	316	735	420	172	97	522	889	80	58	11800
2000	5687	4996	1845	222	511	308	128	74	406	678	63	14919
2001	2198	4647	3769	1206	104	363	233	94	57	321	544	13537
2002	1001	1791	3636	2814	843	75	258	170	71	45	255	10958
2003	925	729	1270	2482	1919	563	53	187	128	55	36	8347
2004	1775	718	296	322	896	972	342	39	137	97	43	5638
2005	4849	1444	555	202	218	651	730	261	31	106	77	9122
2006	4559	3969	1181	453	163	175	508	548	195	25	84	11860
2007	8390	3692	3056	816	297	115	139	407	447	158	20	17536
2008	13827	6865	2837	2242	584	221	86	108	325	357	128	27580
2009	2182	11320	5617	2271	1686	441	163	69	86	248	280	24363
2010	4455	1776	9031	4448	1736	1300	338	123	55	67	197	23526
2011	3330	3423	1261	6980	3466	1354	1029	265	101	43	55	21307
2012	1246	2687	2634	982	5595	2798	1066	801	210	79	35	18132
2013	1692	997	2004	1978	770	4494	2259	858	643	168	64	15927
2014	1203	1366	664	1425	1484	593	3570	1801	681	517	134	13438
2015	1847	931	944	414	1026	1161	436	2897	1463	554	422	12095
2016	2232	1503	708	682	293	766	922	349	2337	1191	452	11435
2017	1953	1816	1158	487	489	213	587	728	281	1887	962	10560
2018	1468	1558	1355	836	359	371	155	462	588	229	1532	8913
2019	1862	1202	1268	1089	656	277	290	122	369	474	186	7794
2020	1761	1505	934	945	852	506	212	230	86	297	383	7711

Table 22. Bias adjusted fishing mortality from ADAPT for cod in NAFO Divs. 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	0.864
1976	0.000	0.181	0.611	0.814	0.545	0.341	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	0.537	0.661	0.858	0.898	0.580	0.580	0.359
1978	0.000	0.025	0.142	0.242	0.236	0.204	0.213	0.336	0.330	0.231	0.247	0.247	0.206
1979	0.000	0.005	0.138	0.500	0.459	0.429	0.232	0.180	0.155	0.119	0.325	0.325	0.366
1980	0.000	0.015	0.087	0.198	0.219	0.217	0.181	0.118	0.138	0.101	0.184	0.184	0.168
1981	0.000	0.021	0.080	0.142	0.175	0.287	0.253	0.234	0.169	0.273	0.237	0.237	0.132
1982	0.000	0.016	0.106	0.160	0.162	0.169	0.384	0.451	0.436	0.488	0.291	0.291	0.142
1983	0.000	0.038	0.042	0.139	0.174	0.157	0.186	0.352	0.327	0.297	0.217	0.217	0.119
1984	0.000	0.002	0.041	0.120	0.253	0.269	0.246	0.222	0.455	0.236	0.248	0.248	0.138
1985	0.000	0.002	0.103	0.377	0.406	0.479	0.282	0.245	0.194	0.406	0.353	0.353	0.295
1986	0.000	0.019	0.126	0.336	0.500	0.364	0.333	0.327	0.322	0.188	0.381	0.381	0.321
1987	0.014	0.092	0.068	0.222	0.304	0.250	0.263	0.559	0.538	0.677	0.344	0.344	0.198
1988	0.018	0.024	0.076	0.369	0.789	0.683	0.339	0.384	0.616	0.577	0.549	0.549	0.411
1989	0.023	0.184	0.270	0.597	0.595	0.576	0.494	0.271	0.269	0.530	0.484	0.484	0.487
1990	0.068	0.266	0.852	1.354	0.897	0.405	0.453	0.436	0.420	0.278	0.548	0.548	1.034
1991	0.307	0.260	0.268	0.454	0.589	0.819	0.754	0.793	0.852	0.804	0.739	0.739	0.437
1992	0.011	0.397	0.859	0.624	0.565	0.550	0.437	0.464	0.408	0.696	0.504	0.504	0.682
1993	0.045	0.252	0.549	0.910	0.922	0.664	0.333	0.303	0.335	0.270	0.556	0.556	0.794
1994	0.000	0.504	0.946	0.374	0.444	0.449	0.099	0.054	0.018	0.000	0.000	0.261	0.588
1995	0.000	0.000	0.286	0.017	0.020	0.011	0.000	0.005	0.000	0.000	0.000	0.009	0.108
1996	0.002	0.005	0.016	0.017	0.018	0.016	0.021	0.018	0.018	0.010	0.000	0.018	0.017
1997	0.002	0.012	0.030	0.044	0.036	0.041	0.035	0.043	0.047	0.038	0.039	0.039	0.037
1998	0.000	0.009	0.028	0.044	0.051	0.045	0.047	0.041	0.044	0.060	0.048	0.046	0.041
1999	0.008	0.045	0.154	0.164	0.111	0.094	0.071	0.050	0.071	0.042	0.039	0.081	0.143
2000	0.002	0.082	0.226	0.559	0.143	0.078	0.109	0.061	0.036	0.020	0.036	0.098	0.309
2001	0.005	0.045	0.092	0.158	0.124	0.140	0.115	0.086	0.039	0.031	0.025	0.116	0.125
2002	0.117	0.144	0.182	0.183	0.203	0.141	0.122	0.088	0.048	0.025	0.026	0.139	0.189
2003	0.053	0.701	1.173	0.818	0.481	0.300	0.109	0.112	0.072	0.041	0.031	0.250	0.824
2004	0.007	0.058	0.183	0.188	0.120	0.086	0.070	0.029	0.058	0.035	0.026	0.076	0.163
2005	0.000	0.001	0.002	0.011	0.020	0.049	0.087	0.088	0.036	0.032	0.029	0.061	0.011
2006	0.011	0.061	0.170	0.222	0.152	0.032	0.022	0.004	0.011	0.000	0.000	0.053	0.181
2007	0.001	0.063	0.110	0.134	0.097	0.090	0.049	0.025	0.025	0.014	0.000	0.065	0.114
2008	0.000	0.001	0.023	0.085	0.081	0.105	0.026	0.031	0.070	0.041	0.062	0.061	0.063
2009	0.006	0.026	0.033	0.068	0.061	0.067	0.077	0.016	0.053	0.032	0.065	0.055	0.054
2010	0.064	0.142	0.058	0.050	0.049	0.034	0.043	0.000	0.041	0.000	0.006	0.031	0.052
2011	0.015	0.062	0.050	0.021	0.014	0.039	0.051	0.030	0.045	0.026	0.000	0.033	0.029
2012	0.023	0.093	0.086	0.044	0.019	0.014	0.017	0.019	0.027	0.014	0.000	0.017	0.050
2013	0.014	0.206	0.141	0.088	0.061	0.030	0.027	0.031	0.017	0.027	0.000	0.037	0.096
2014	0.057	0.170	0.272	0.128	0.045	0.108	0.009	0.008	0.006	0.004	0.000	0.042	0.148
2015	0.006	0.074	0.125	0.146	0.092	0.031	0.023	0.015	0.005	0.004	0.000	0.040	0.121
2016	0.006	0.061	0.174	0.133	0.120	0.067	0.037	0.016	0.014	0.014	0.000	0.060	0.142
2017	0.026	0.093	0.125	0.105	0.075	0.115	0.038	0.014	0.004	0.009	0.008	0.060	0.102
2018	0.000	0.006	0.018	0.043	0.060	0.046	0.044	0.027	0.015	0.010	0.010	0.044	0.040
2019	0.013	0.052	0.094	0.046	0.059	0.066	0.035	0.146	0.015	0.014	0.024	0.076	0.066

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

Year\Age	3	4	5	6	7	8	9	10	11	12
1959	0.301	0.664	1.001	1.622	2.572	3.129	3.670	4.419	4.843	5.691
1960	0.301	0.587	1.012	1.561	2.345	3.092	3.673	4.316	4.957	5.691
1961	0.301	0.587	1.012	1.561	2.345	3.092	3.673	4.316	4.957	5.691
1962	0.301	0.587	1.012	1.561	2.345	3.092	3.673	4.316	4.957	5.691
1963	0.301	0.587	1.012	1.561	2.345	3.092	3.673	4.316	4.957	5.691
1964	0.301	0.587	1.012	1.561	2.345	3.092	3.673	4.316	4.957	5.691
1965	0.287	0.587	1.012	1.561	2.345	3.092	3.673	4.316	4.957	5.691
1966	0.351	0.615	1.052	1.636	2.482	3.446	4.636	5.532	6.292	7.332
1967	0.351	0.657	1.102	1.700	2.600	3.647	5.166	6.982	8.066	9.308
1968	0.351	0.657	1.102	1.700	2.600	3.647	5.166	6.982	8.066	9.308
1969	0.351	0.657	1.102	1.700	2.600	3.647	5.166	6.982	8.066	9.308
1970	0.351	0.657	1.102	1.700	2.600	3.647	5.166	6.982	8.066	9.308
1971	0.338	0.657	1.102	1.700	2.600	3.647	5.166	6.982	8.066	9.308
1972	0.397	0.682	1.138	1.676	2.487	3.354	5.005	7.100	7.999	9.262
1973	0.504	0.735	1.178	1.776	2.748	3.658	4.717	7.542	9.423	10.789
1974	0.289	0.645	1.095	1.674	2.503	4.117	5.822	5.842	8.961	9.159
1975	0.246	0.611	0.967	1.599	2.481	3.449	5.082	7.024	5.364	7.717
1976	0.354	0.588	1.120	1.727	2.631	3.557	5.268	6.952	7.849	8.113
1977	0.420	0.707	1.161	1.870	2.860	3.925	5.375	7.666	10.112	10.239
1978	0.617	0.774	1.245	1.825	3.046	4.023	5.417	7.200	9.139	12.271
1979	0.514	0.840	1.208	1.800	2.541	3.720	4.679	6.653	7.596	9.790
1980	0.531	0.822	1.287	1.864	2.777	3.969	5.434	6.618	8.706	10.031
1981	0.789	0.950	1.383	2.132	2.979	4.435	6.256	8.522	9.114	10.373
1982	0.843	1.026	1.380	2.012	3.210	4.321	6.318	7.921	9.453	10.519
1983	0.731	1.049	1.479	1.986	2.891	4.463	5.743	7.779	8.894	10.398
1984	0.757	0.989	1.329	2.065	2.828	3.923	5.473	6.728	8.490	10.647
1985	0.331	0.824	1.255	1.759	2.722	3.760	5.178	6.923	8.128	9.964
1986	0.269	0.696	1.143	1.720	2.675	4.193	6.080	8.063	9.094	9.508
1987	0.343	0.566	1.146	1.668	2.498	4.076	6.267	8.435	9.835	11.187
1988	0.646	0.700	1.064	1.525	2.020	3.301	4.937	7.067	9.158	10.442
1989	0.362	0.847	1.265	1.758	2.419	3.206	5.166	6.523	8.072	10.714
1990	0.442	0.718	1.190	2.004	2.473	3.679	4.811	7.698	8.786	10.322
1991	0.506	0.684	1.267	1.832	3.101	3.896	5.583	6.737	10.014	11.396
1992	0.215	0.598	0.949	1.692	2.547	4.310	5.560	7.480	8.838	11.295
1993	0.318	0.507	0.937	1.397	2.253	3.404	5.336	6.569	8.081	8.655
1994	0.162	0.407	0.842	1.483	1.840	3.375	4.506	6.653	5.167	8.130
1995	0.309	0.450	0.746	1.359	1.932	1.956	5.164	5.543	6.951	5.255
1996	0.309	0.573	0.986	1.552	2.332	2.781	3.125	6.284	6.314	7.173
1997	0.309	0.573	1.005	1.606	2.310	3.007	3.982	5.301	6.193	7.173
1998	0.282	0.573	1.005	1.606	2.310	3.007	3.982	5.301	6.193	7.173
1999	0.386	0.628	1.114	1.638	2.106	2.754	3.672	5.328	6.346	6.877
2000	0.442	0.639	1.163	1.951	2.669	2.543	2.732	3.887	5.632	6.394
2001	0.444	0.805	1.067	1.730	3.115	4.237	3.931	3.813	5.330	6.717
2002	0.569	0.767	1.285	1.762	2.643	4.569	5.590	6.151	6.834	8.364
2003	0.571	0.795	1.188	1.753	2.600	3.722	6.264	6.807	7.782	8.841
2004	0.483	0.785	1.138	1.745	2.474	3.442	4.876	8.072	8.664	8.647
2005	0.324	0.985	1.505	2.173	2.931	3.868	4.819	7.340	9.371	10.525
2006	0.554	0.736	1.385	2.243	2.987	3.587	4.796	6.460	8.287	12.359
2007	0.473	0.824	1.240	1.855	2.435	3.502	4.097	5.607	6.864	7.874
2008	0.254	0.799	1.263	1.645	2.712	2.762	5.245	5.516	6.552	8.178
2009	0.380	0.474	1.166	1.851	2.285	3.329	3.458	6.921	6.658	7.486
2010	0.243	0.552	0.760	1.595	2.427	2.900	4.790	4.485	9.086	8.748
2011	0.400	0.454	0.866	1.196	2.599	3.608	4.166	5.337	4.968	9.868
2012	0.481	0.605	0.836	1.360	1.749	3.818	5.186	5.990	6.416	7.302
2013	0.317	0.620	0.912	1.307	1.886	2.092	4.393	5.841	6.517	10.249
2014	0.336	0.595	0.926	1.247	1.765	2.110	2.633	5.546	6.488	8.274
2015	0.491	0.617	1.005	1.512	1.780	2.227	2.464	3.180	5.208	9.990
2016	0.493	0.637	0.906	1.289	2.170	2.437	2.504	3.528	3.972	7.867
2017	0.264	0.519	0.745	1.074	1.301	3.161	3.702	3.380	4.623	5.074
2018	0.378	0.610	0.938	1.340	2.007	2.632	3.168	3.278	4.641	5.574
2019	0.486	0.608	0.916	1.283	2.083	2.766	3.403	3.310	4.452	5.478
2020	0.417	0.598	0.919	1.281	2.054	2.876	3.703	3.238	4.612	5.377

Table 24. Estimated biomass using beginning of the year weights and bias adjusted population numbers from ADAPT for cod in NAFO Divs. 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	242348	92727
1970	27787	63063	47415	36800	25622	14856	8076	3785	3177	2148	232729	94465
1971	28101	41407	67053	43369	24062	17513	9670	5551	2501	1123	240350	103789
1972	24210	45908	31340	38178	25966	14898	8526	7691	3769	1521	202008	100550
1973	17398	36660	43949	20528	18465	12130	10034	8584	6527	3404	177680	79672
1974	10424	12419	17840	28534	10329	15369	10726	6471	6392	4065	122570	81887
1975	5583	14550	7045	5888	10712	4756	5831	4251	1646	1574	61837	34659
1976	9546	10589	13016	4869	2106	2977	1044	921	707	251	46026	12874
1977	18770	13050	9291	7880	3826	1828	2534	941	760	635	59516	18405
1978	25330	27885	16042	7818	6415	2349	1207	1435	389	308	89177	19921
1979	8808	27530	30929	14910	7043	5230	1808	867	891	271	98287	31020
1980	10324	11485	30093	23696	11904	5864	4958	1748	795	855	101722	49821
1981	21395	14891	14504	33502	24905	12527	6316	5660	1716	701	136115	85326
1982	18281	22304	16362	14983	34652	22187	11349	5178	4340	1234	150869	93923
1983	25532	18340	23684	16430	14992	33302	16450	7291	3078	2399	161498	93942
1984	30923	27229	18255	23546	16084	14229	27759	11103	4699	2241	176068	99661
1985	10828	27518	27170	17546	19723	13385	12023	23029	6966	3565	161751	96236
1986	2375	18618	28206	20907	14553	15408	13365	11998	20403	4445	150279	101080
1987	2209	4011	22127	24064	15080	12622	13518	10952	8686	17033	130301	101955
1988	8182	3365	5772	19324	17609	12709	9618	7136	5684	3838	93236	75917
1989	4547	8569	4615	5400	11400	11555	11604	7085	3605	3057	71437	53706
1990	2217	6133	7519	3294	3432	7981	8660	10799	5972	2221	58228	42359
1991	2677	2151	3781	2448	1702	2951	6307	6419	7557	4805	40798	32190
1992	3238	1997	1870	2623	1547	854	1623	3129	2942	3122	22946	15841
1993	2067	4214	1086	1207	1626	977	559	987	1840	1176	15739	8373
1994	104	1681	3309	566	518	1027	759	422	455	1157	9997	4903
1995	132	143	980	3007	387	288	1165	724	354	378	7559	6304
1996	256	200	192	1641	4140	452	376	1155	675	299	9388	8739
1997	353	386	284	252	1964	4303	519	513	915	622	10110	9088
1998	110	529	539	355	287	2009	4503	541	468	835	10177	8999
1999	909	198	819	688	362	267	1916	4736	508	401	10805	8879
2000	2209	1179	258	997	822	326	202	1580	3819	401	11794	8147
2001	2064	3033	1286	180	1129	988	370	218	1711	3657	14634	8251
2002	1019	2789	3615	1485	199	1179	951	435	307	2130	14108	6686
2003	416	1009	2948	3364	1465	199	1171	868	430	317	12187	7813
2004	347	232	366	1564	2404	1176	191	1104	842	375	8602	7657
2005	468	546	304	474	1907	2823	1256	229	990	809	9807	8489
2006	2197	869	628	367	523	1821	2627	1262	204	1036	11534	7840
2007	1745	2517	1012	552	280	486	1666	2505	1086	159	12006	6733
2008	1744	2268	2831	961	599	237	568	1791	2337	1044	14381	7538
2009	4302	2663	2647	3121	1008	542	237	595	1650	2099	18864	9252
2010	431	4982	3381	2770	3154	979	591	248	606	1720	18864	10068
2011	1368	572	6043	4146	3519	3712	1103	539	216	539	21758	13774
2012	1293	1594	821	7608	4893	4070	4153	1261	507	253	26454	22745
2013	315	1242	1805	1006	8476	4725	3771	3755	1093	654	26844	23482
2014	459	395	1321	1851	1047	7533	4742	3777	3357	1107	25589	23414
2015	457	582	416	1552	2067	971	7136	4652	2885	4214	24933	23478
2016	742	451	618	378	1663	2247	874	8247	4732	3554	23504	21694
2017	480	601	363	525	277	1855	2694	950	8726	4880	21350	19907
2018	588	826	784	481	745	409	1465	1926	1064	8538	16828	14629
2019	584	770	998	841	576	803	414	1221	2110	1018	9336	6984
2020	627	559	869	1092	1039	610	850	279	1371	2058	9354	7299

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	15537	13367	17430	9659	5464	2499	1123	66963
1972	652	2	316	8306	21136	11851	8523	7691	3756	1520	63752
1973	22	2766	169	2090	13517	11786	9268	8584	6527	3402	58131
1974	1	104	3459	8354	5766	14817	10686	6303	6392	4065	59948
1975	19	25	373	2443	10477	4441	5809	4249	1632	1574	31042
1976	19	197	288	1322	1424	2976	1038	920	707	250	9141
1977	16	185	909	1788	2727	1572	2534	940	760	635	12068
1978	35	230	1499	2988	5082	2215	1144	1435	389	308	15326
1979	128	365	2267	6334	5489	5126	1792	851	891	271	23514
1980	35	798	3429	10171	10012	5587	4951	1745	790	855	38374
1981	42	352	3987	18487	21848	12205	6262	5659	1716	700	71256
1982	64	361	2389	9857	31942	21865	11308	5171	4340	1234	88531
1983	7	298	2886	8993	13598	33010	16425	7287	3077	2399	87980
1984	25	75	1325	12689	14400	13948	27734	11101	4698	2241	88236
1985	21	161	708	4743	17905	13167	11975	23026	6966	3565	82237
1986	5	250	1152	4284	9269	15225	13333	11989	20403	4445	80355
1987	13	78	1923	5674	10749	11266	13498	10948	8685	17033	79867
1988	2	113	906	7718	12165	12199	9379	7134	5684	3838	59137
1989	21	27	786	3441	9380	10883	11554	7047	3605	3057	49801
1990	38	231	332	1807	3236	7743	8587	10794	5965	2221	40954
1991	21	139	922	991	1495	2933	6279	6411	7557	4804	31551
1992	1	111	403	1906	1406	835	1622	3127	2942	3122	15475
1993	0	51	331	631	1555	970	557	987	1840	1176	8098
1994	0	26	935	433	421	1021	758	421	455	1157	5628
1995	1	6	573	2786	372	272	1164	724	354	378	6631
1996	6	14	95	1628	4130	449	371	1155	675	299	8822
1997	5	59	115	234	1964	4303	518	511	915	622	9246
1998	2	57	315	307	284	2009	4503	541	468	835	9322
1999	1	21	429	630	356	267	1916	4736	508	401	9265
2000	2	16	112	907	812	325	202	1580	3819	401	8178
2001	14	84	216	151	1117	986	370	218	1711	3657	8522
2002	7	381	1547	1110	193	1178	951	435	307	2130	8238
2003	7	161	2332	3201	1432	198	1171	868	430	317	10116
2004	9	32	308	1547	2400	1174	191	1104	842	375	7982
2005	6	62	186	471	1906	2822	1256	229	990	809	8740
2006	106	51	241	320	523	1821	2627	1262	204	1036	8193
2007	60	476	230	415	271	486	1666	2505	1086	159	7352
2008	7	268	1461	556	561	236	568	1791	2337	1044	8829
2009	68	54	885	2590	873	534	237	595	1650	2099	9585
2010	7	330	335	1810	3019	948	589	248	606	1720	9612
2011	23	32	1438	1532	3084	3676	1095	539	216	539	12173
2012	1	156	146	4404	3707	3922	4144	1259	507	253	18499
2013	12	26	746	444	7274	4457	3734	3754	1093	654	22195
2014	18	49	662	1518	777	7261	4690	3767	3356	1107	23204
2015	8	68	135	1520	1999	887	7076	4642	2883	4214	23432
2016	2	41	187	235	1662	2235	851	8231	4730	3554	21727
2017	9	12	127	308	235	1855	2692	943	8722	4879	19784
2018	8	81	124	358	613	388	1465	1926	1062	8538	14564
2019	8	54	380	529	542	754	408	1221	2110	1018	7023
2020	8	39	258	849	975	603	834	278	1371	2058	7273

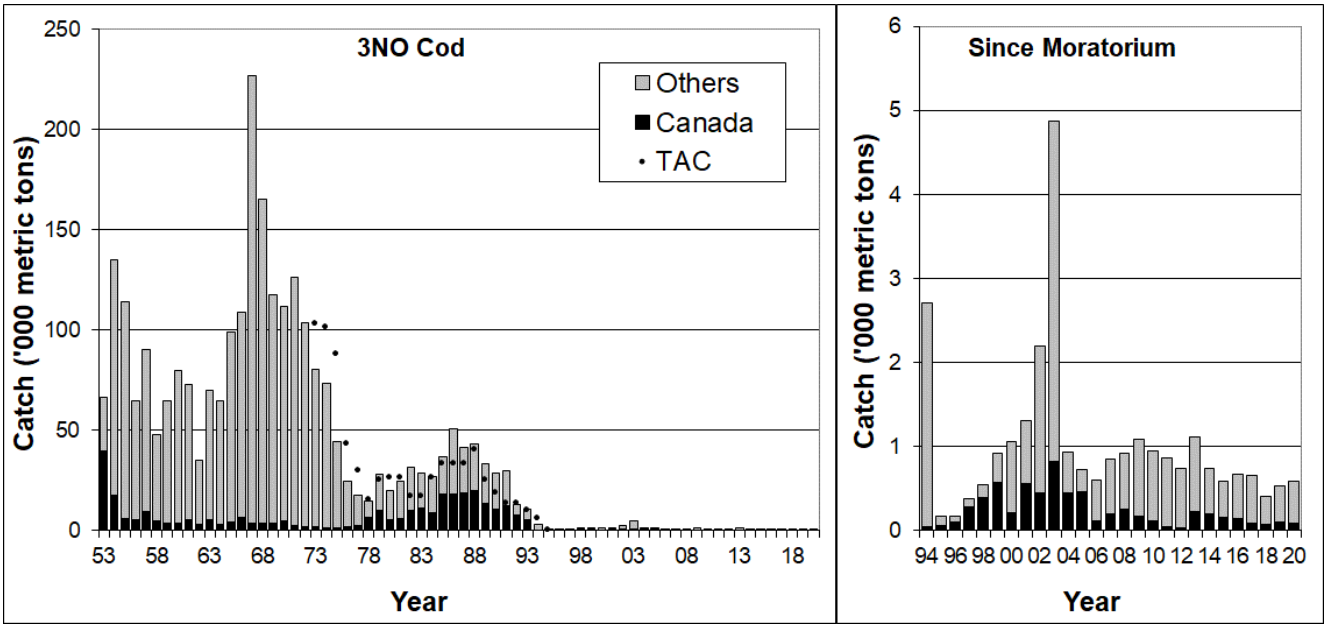

Figure 1. Catches of cod in NAFO Divs. 3NO. The panel on the right represents catches since the moratorium in Feb. 1994.

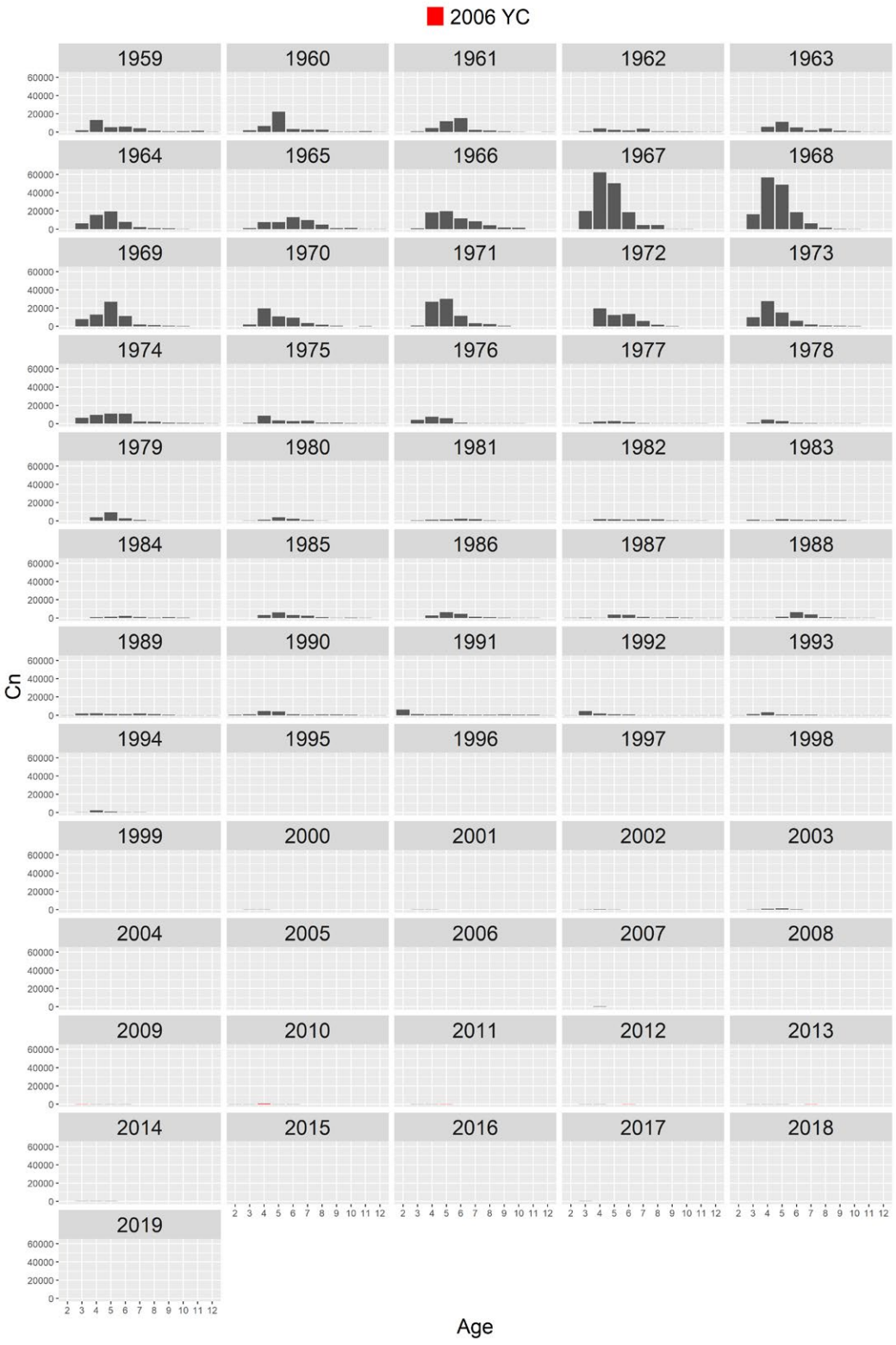

Figure 2a. Catch numbers at age for cod in Divs. 3NO (common scale across all plots). The red bars highlight the relatively strong 2006 year class.

Figure 2b. Catch numbers at age for cod in Divs. 3NO (plots scaled independently). The red bars highlight the relatively strong 2006 year class.

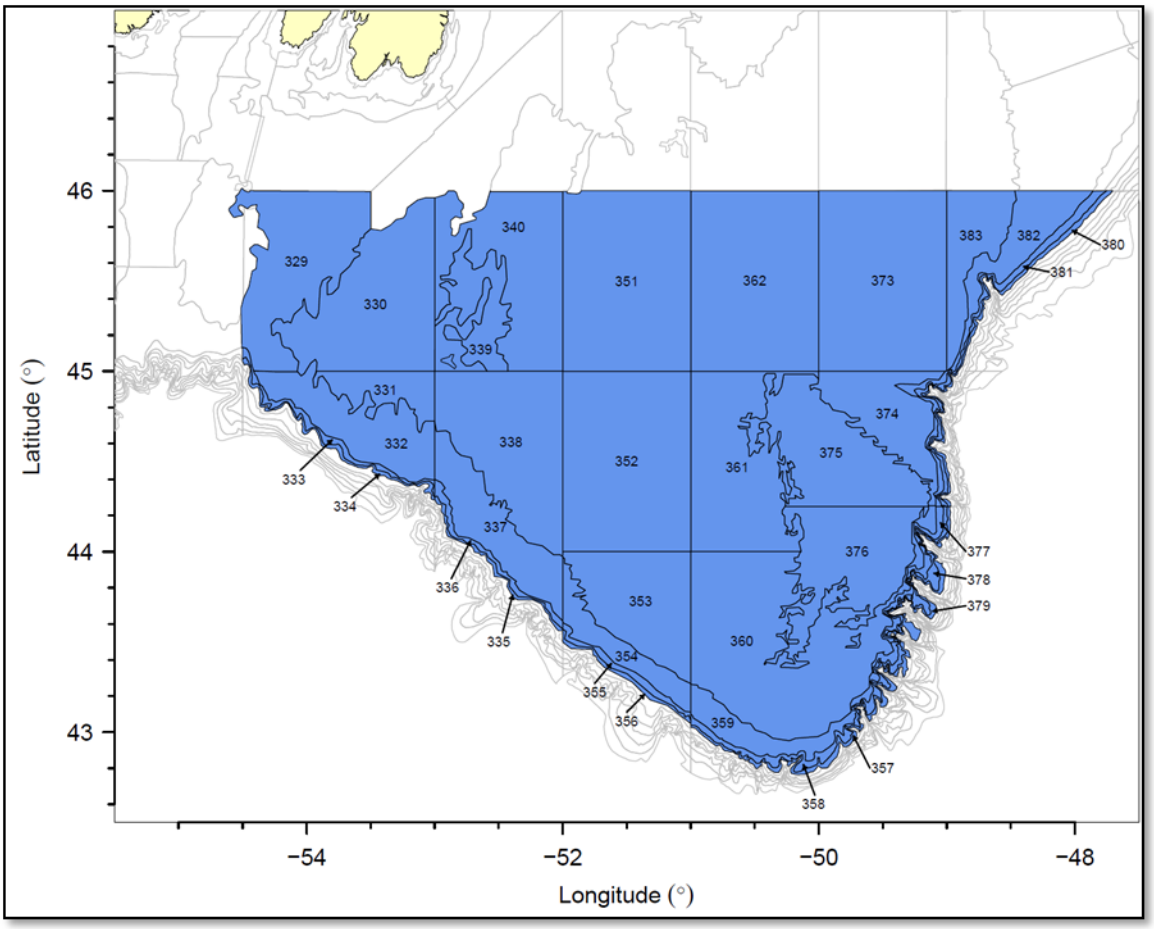

Figure 3. Stratification scheme for Divs. 3NO. Index strata for Divs. 3NO cod are highlighted blue.

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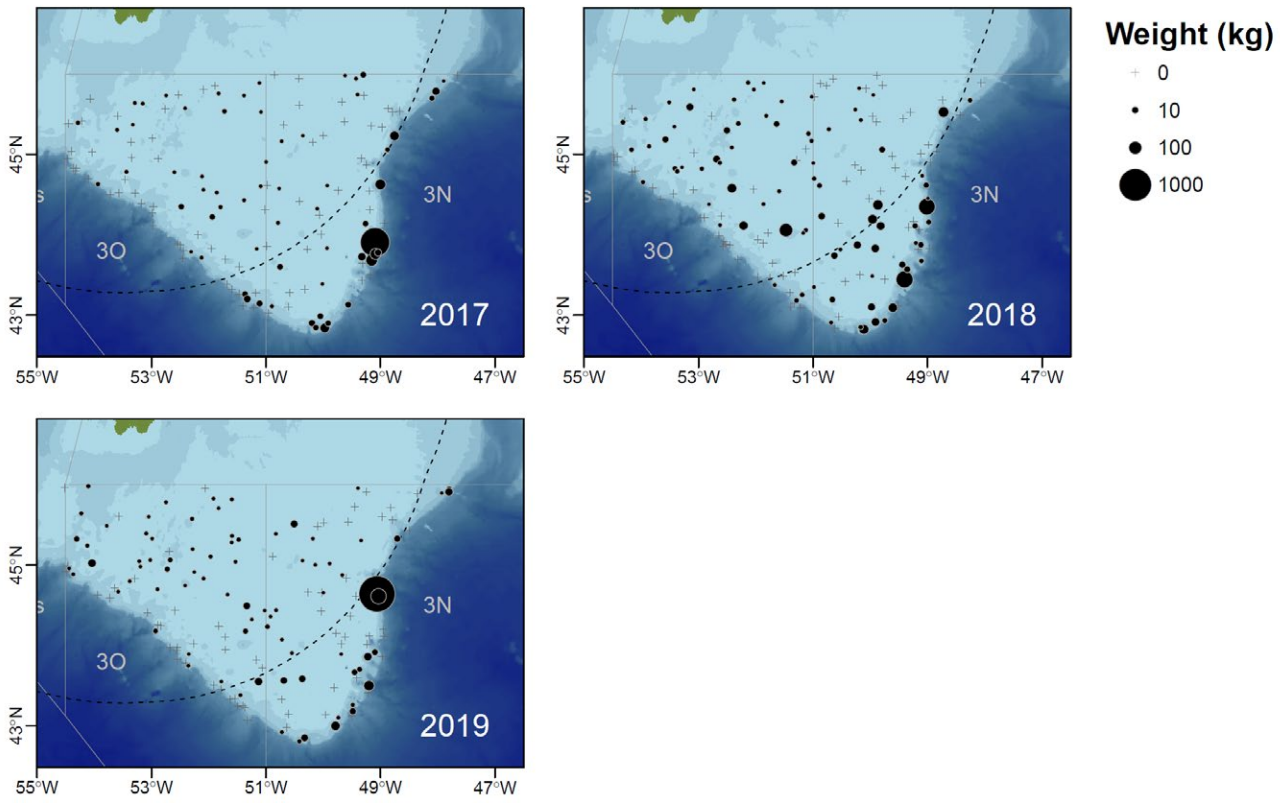

Figure 4. Distribution plots demonstrating Spring survey set locations and total weight of fish caught at each location. Note that there was no Spring survey in 2020. Symbol area is proportional to catch weight.

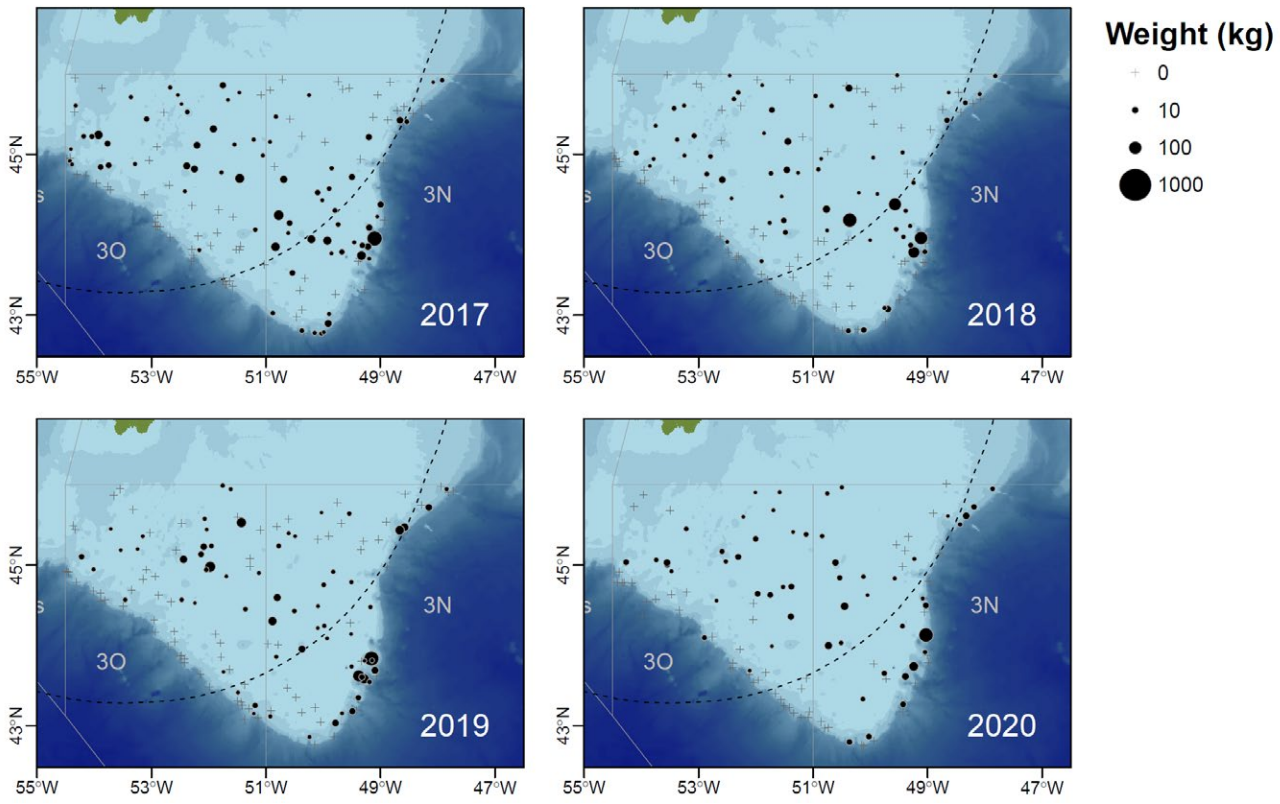

Figure 5. Distribution plots demonstrating Autumn survey set locations and total weight of fish caught at each location. Symbol area is proportional to catch weight. Note that Divs. 3NO were not covered in autumn 2014.

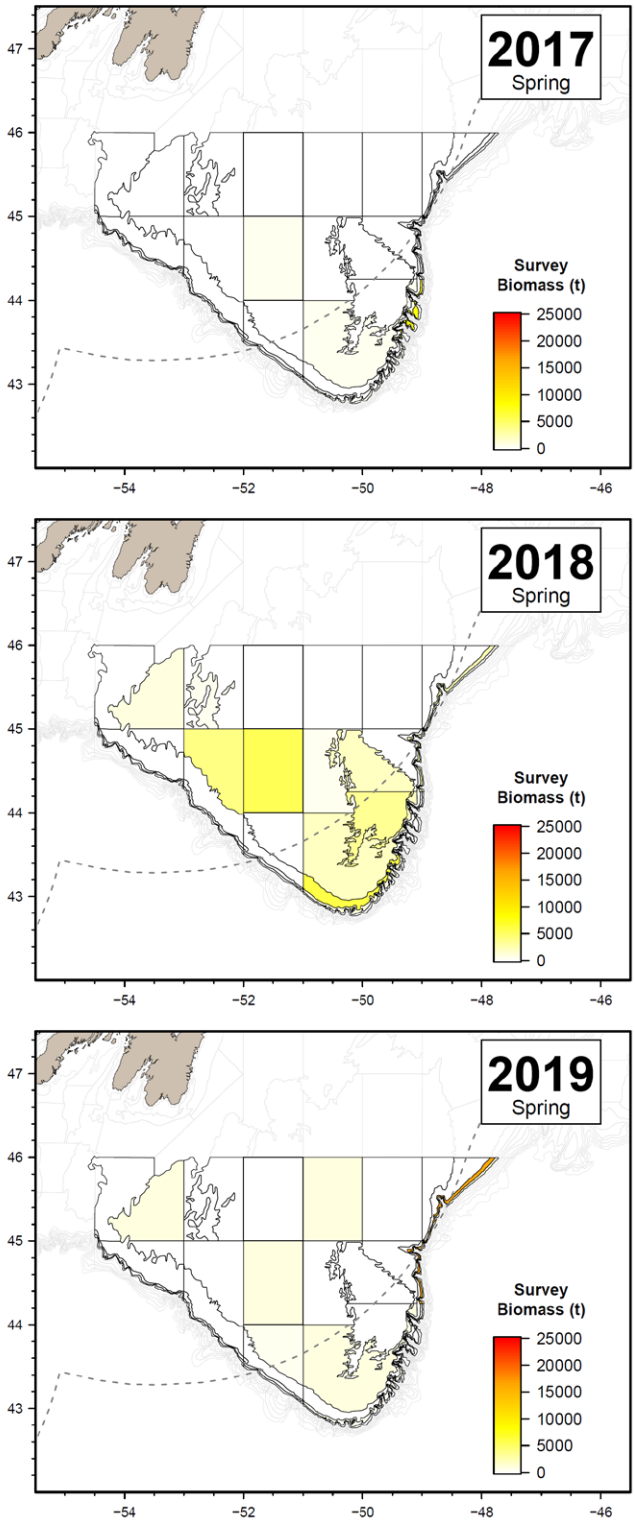

Figure 6. Spring biomass distribution plots for 2017-2019. Note that there was no Spring survey in 2020. Individual strata are colour-coded based on stratum specific biomass estimates from Canadian RV surveys.

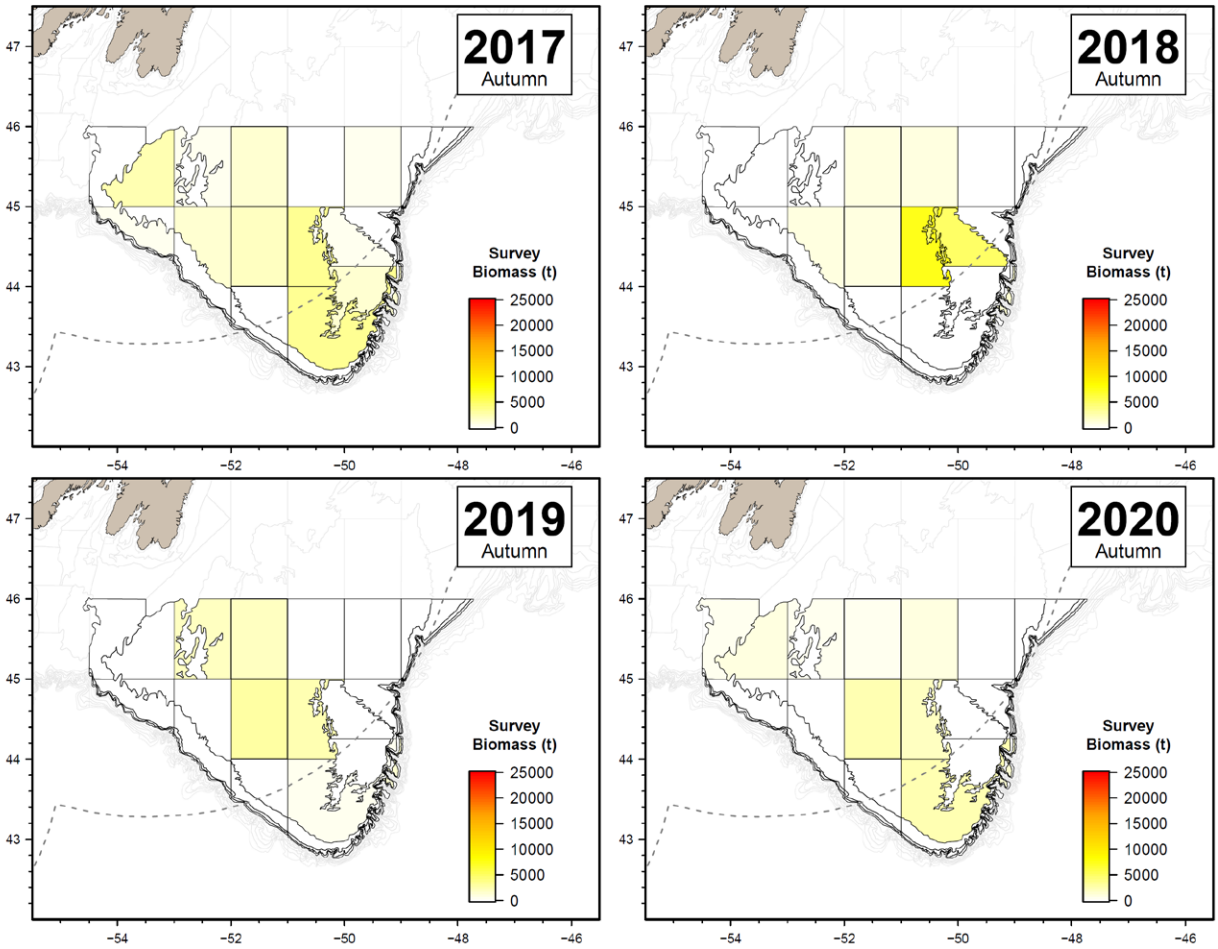

Figure 7. Autumn biomass distribution plot for 2017-2020. Individual strata are colour-coded based on stratum specific biomass estimates from Canadian RV surveys.

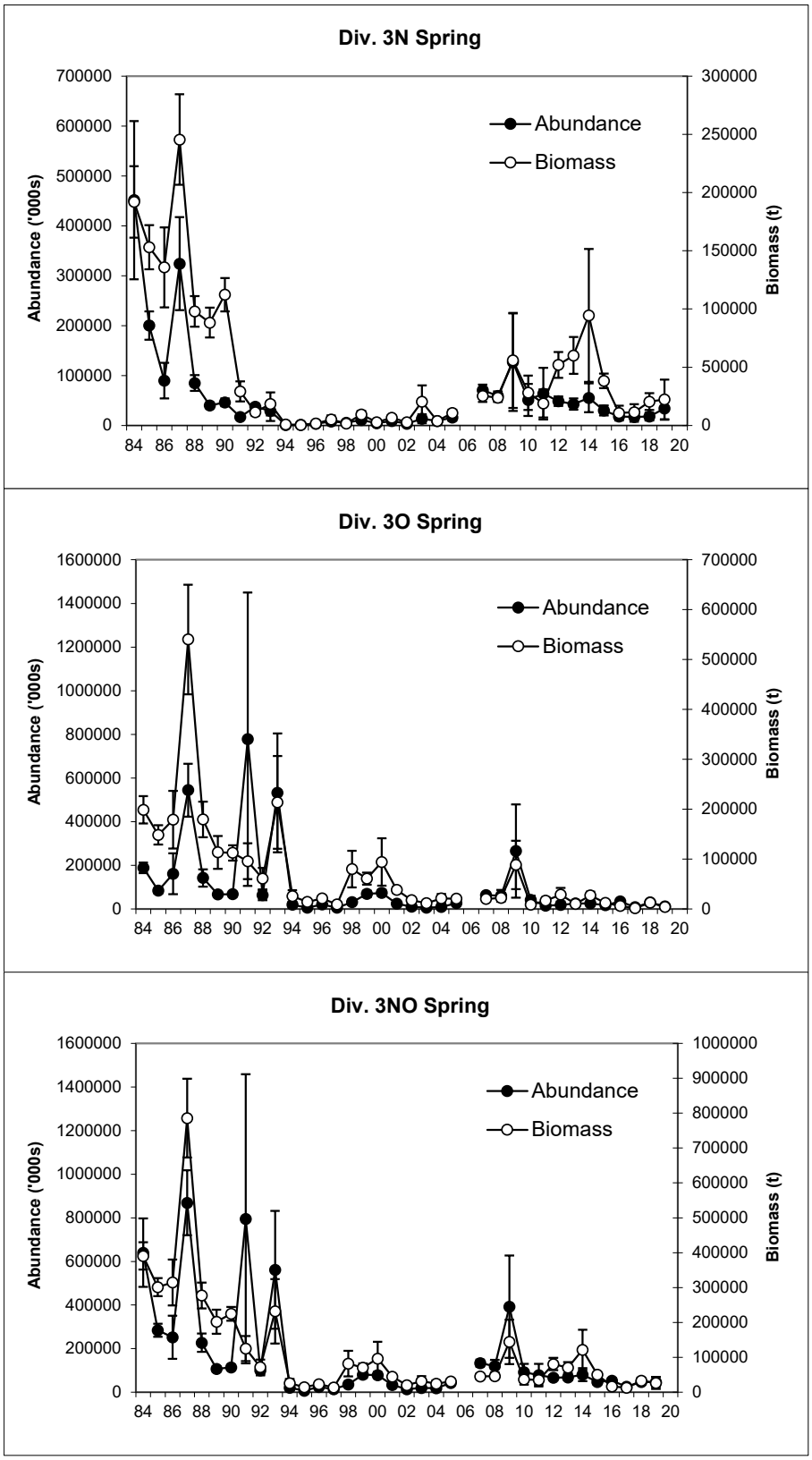

Figure 8. Abundance (000's) and biomass (t) for the Canadian Spring Research Vessel survey series with 1 standard deviation for strata<200 fathoms.

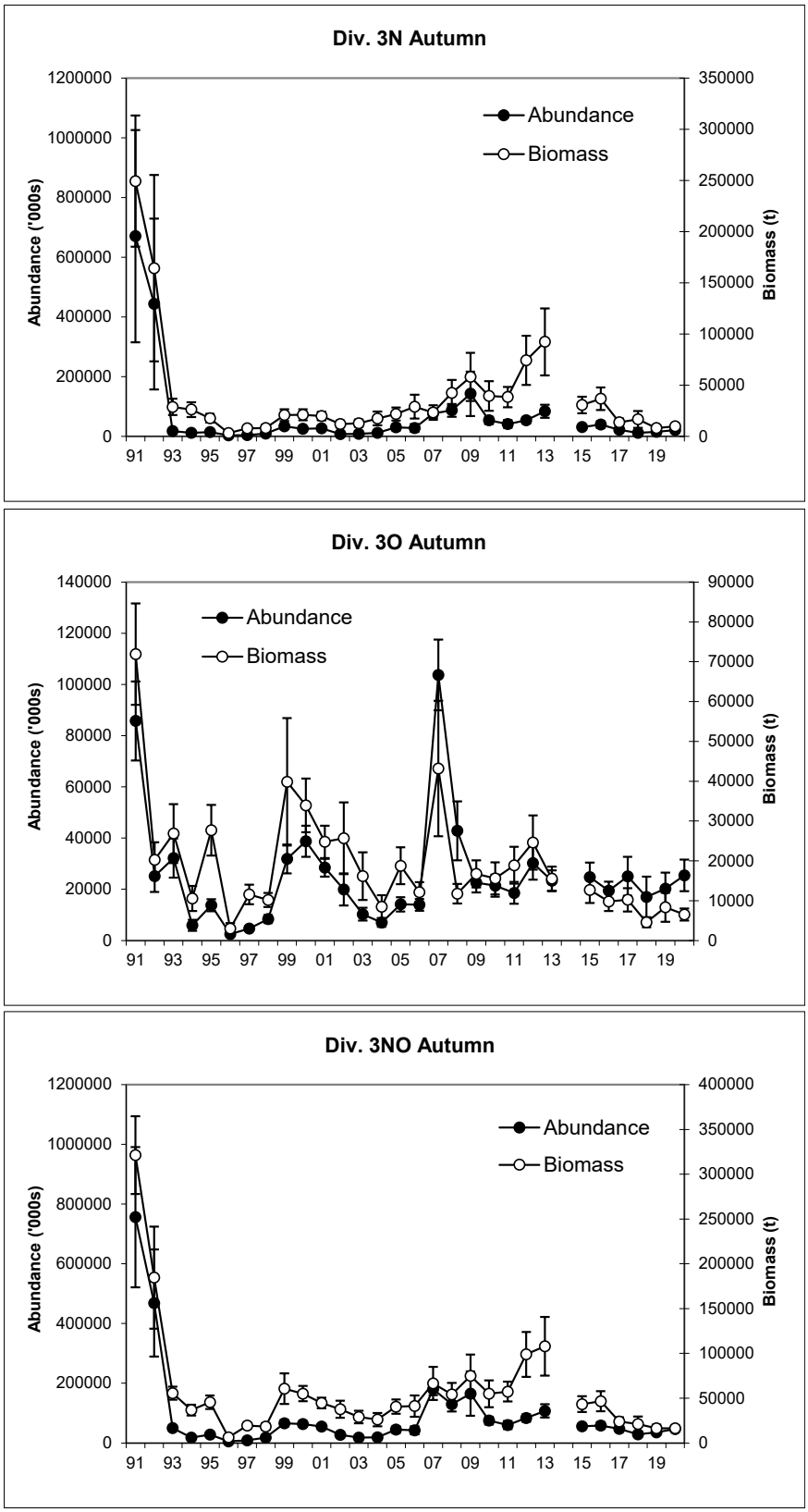

Figure 9. Abundance (000's) and biomass (t) for the Canadian Autumn Research Vessel survey series with 1 standard deviation for strata<200 fathoms.

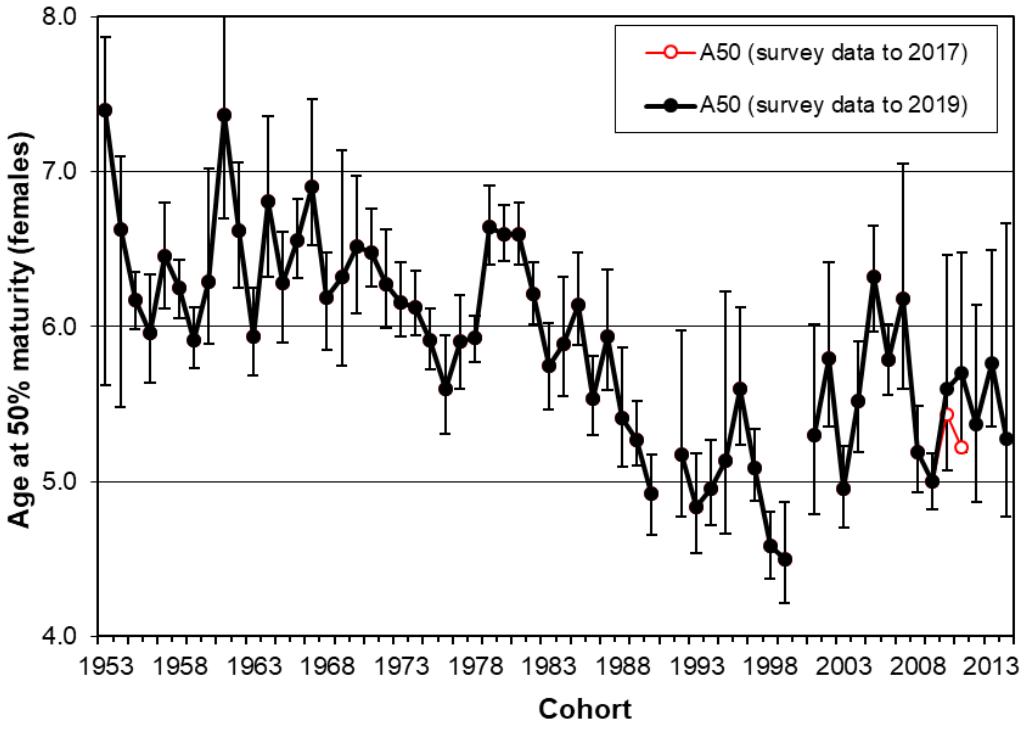

Figure 10. Age at 50% maturity by cohort for female cod sampled during DFO spring research vessel bottom-trawl surveys of NAFO Divs. 3NO. Error bars are 95% fiducial limits.

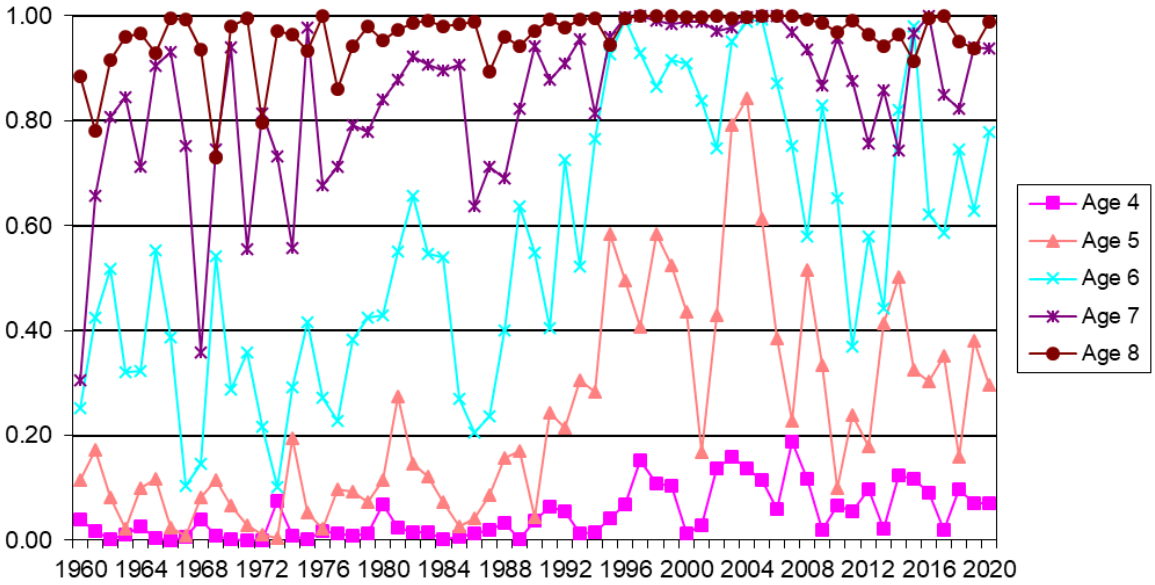

Figure 11. Estimated proportions mature at ages 4-8 for female cod sampled during Canadian research vessel bottom-trawl surveys in NAFO Divs 3NO. Model fitted by cohort to observed proportions mature.

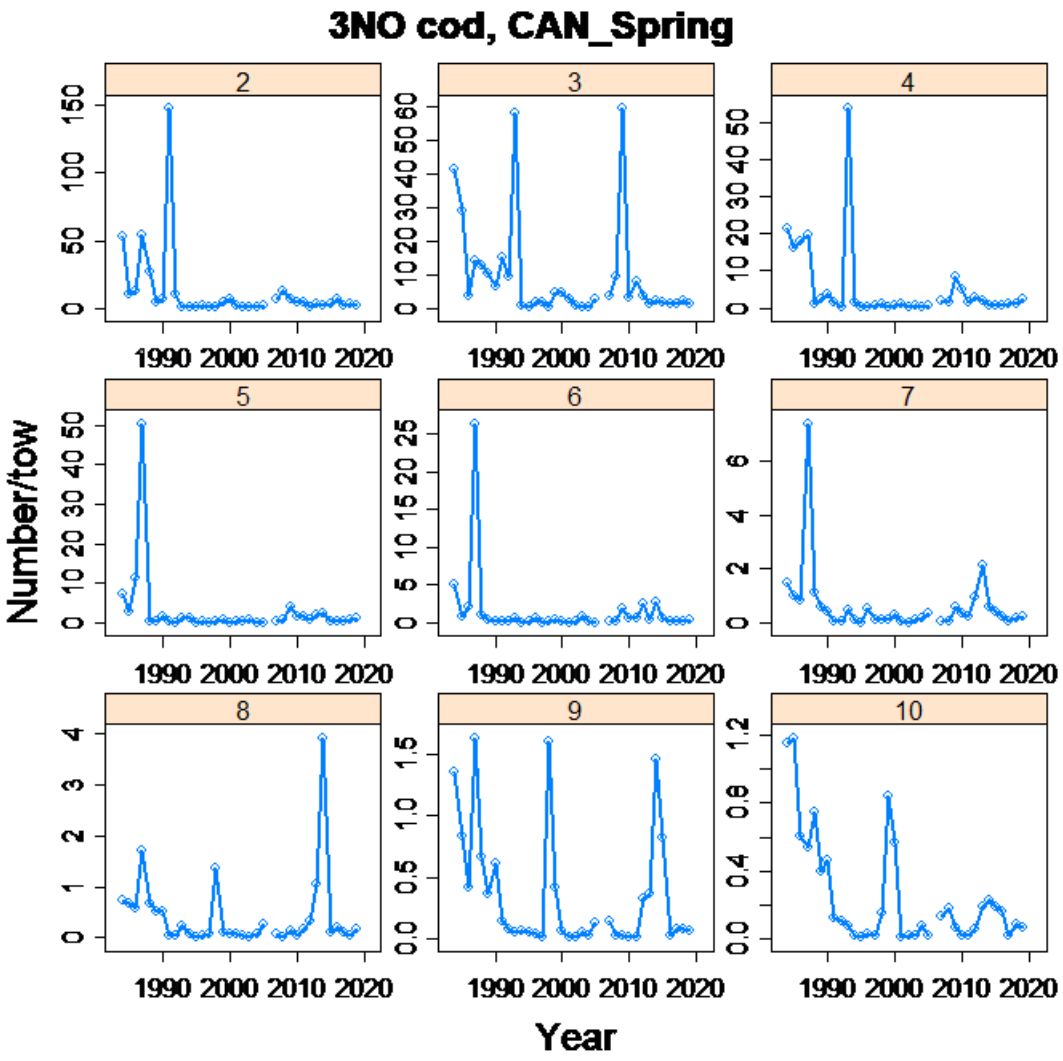

Figure 12. Age by age disaggregated plots of mean number per tow from Canadian SPRING surveys from 1984-2020.

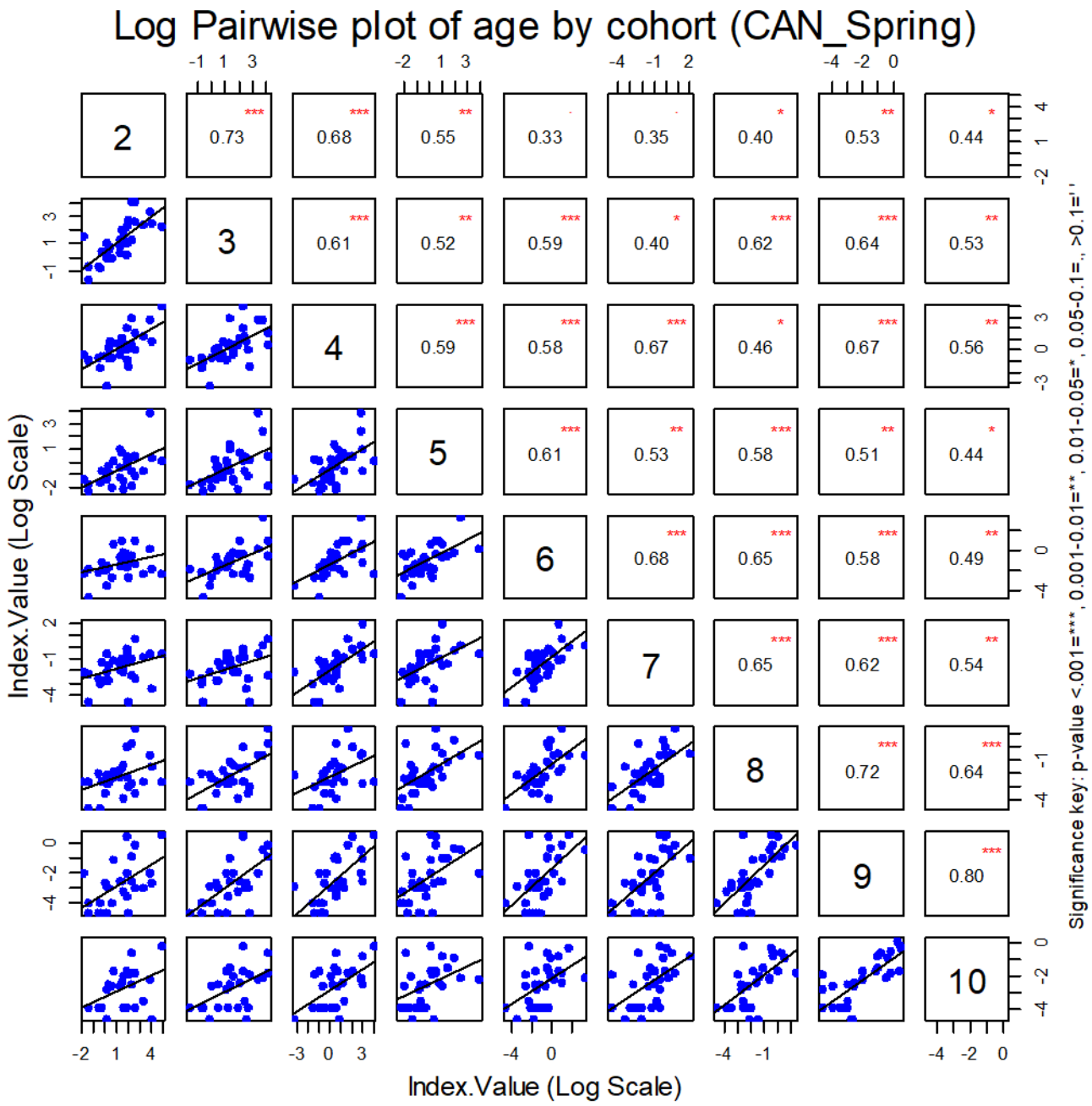

Figure 13. Pair-wise scatter plot of age-disaggregated survey data (log-scale) from Canadian SPRING surveys in Divs. 3NO (1984-2020). Data points in the panels below the numbered diagonal compare the logarithm of survey data at different ages for a common cohort. The solid line in each panel is the linear 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).

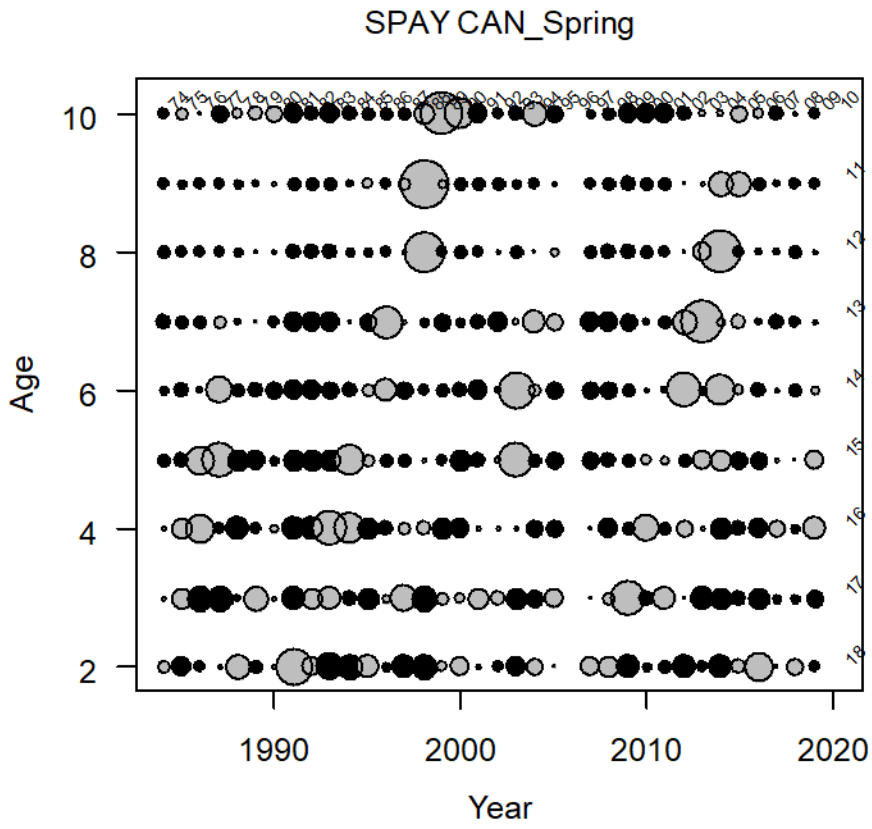

Figure 14. Plot of standardized proportions at age across years (SPAY) for the Canadian Spring surveys in 3NO (1984-2020). Age disaggregated mean number per tow were converted to proportions within an age. For each survey-age, the survey data are standardized to have a mean of 0 and a variance of 1. Symbol sizes are scaled and values greater than average are shown as grey circles, average values are shown as small dots, and less than average values are shown as black circles.

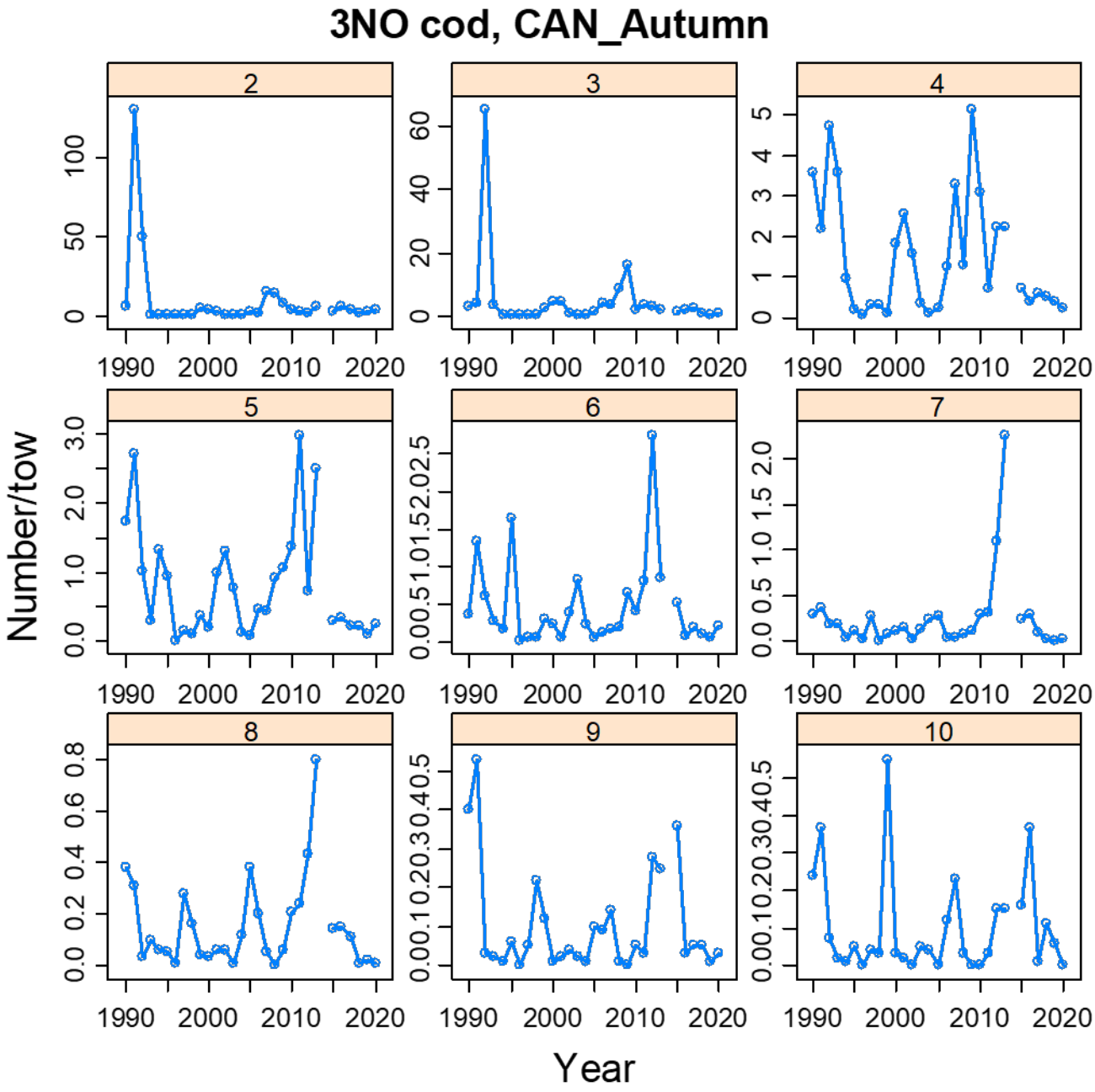

Figure 15. Age by age disaggregated plots of mean number per tow from Canadian AUTUMN surveys from 1984-2020.

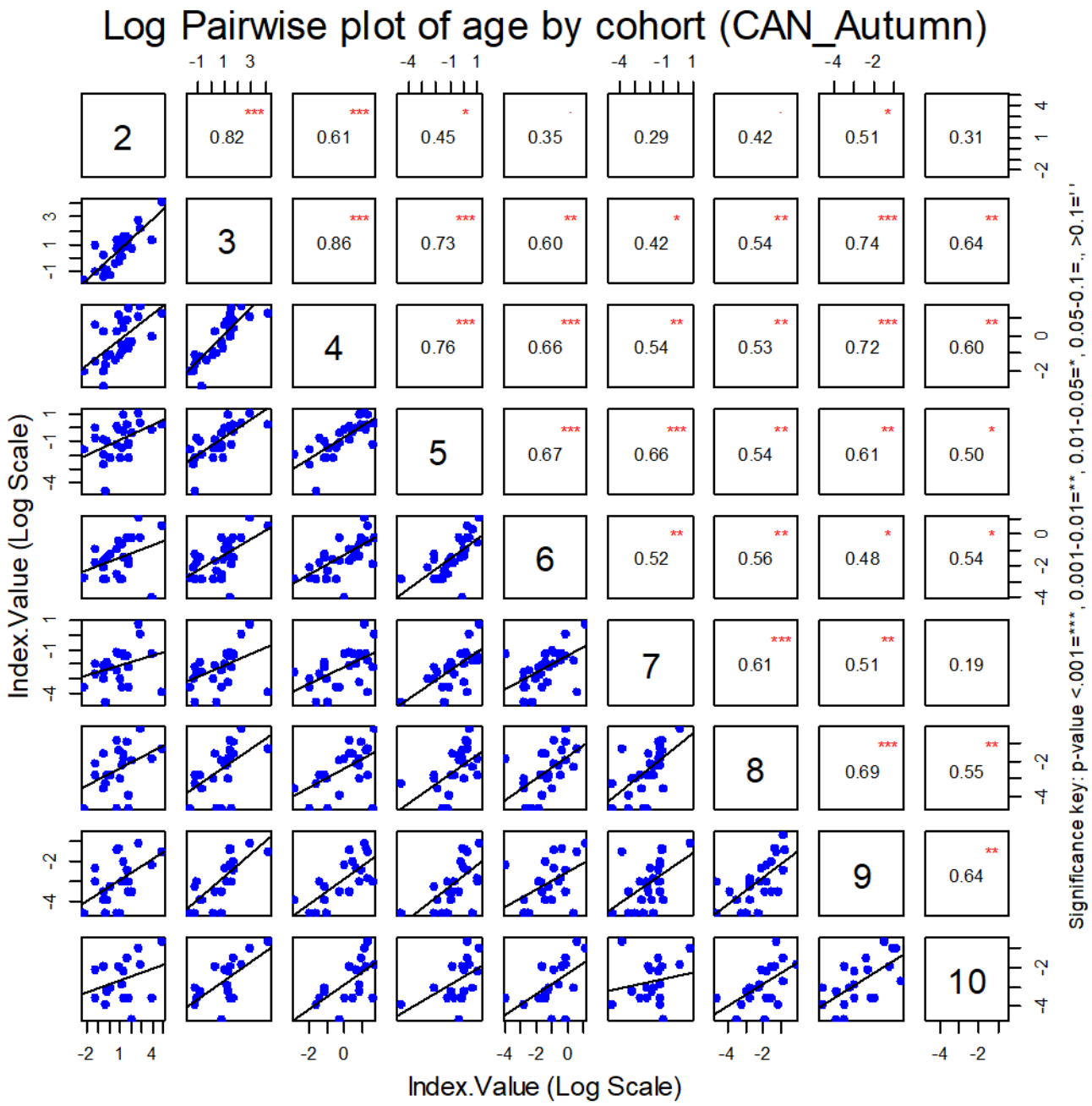

Figure 16. Pair-wise scatter plot of age-disaggregated survey data (log-scale) from Canadian AUTUMN surveys in Divs. 3NO (1990-2020). Data points in the panels below the numbered diagonal compare the logarithm of survey data at different ages for a common cohort. The solid line in each panel is the linear 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).

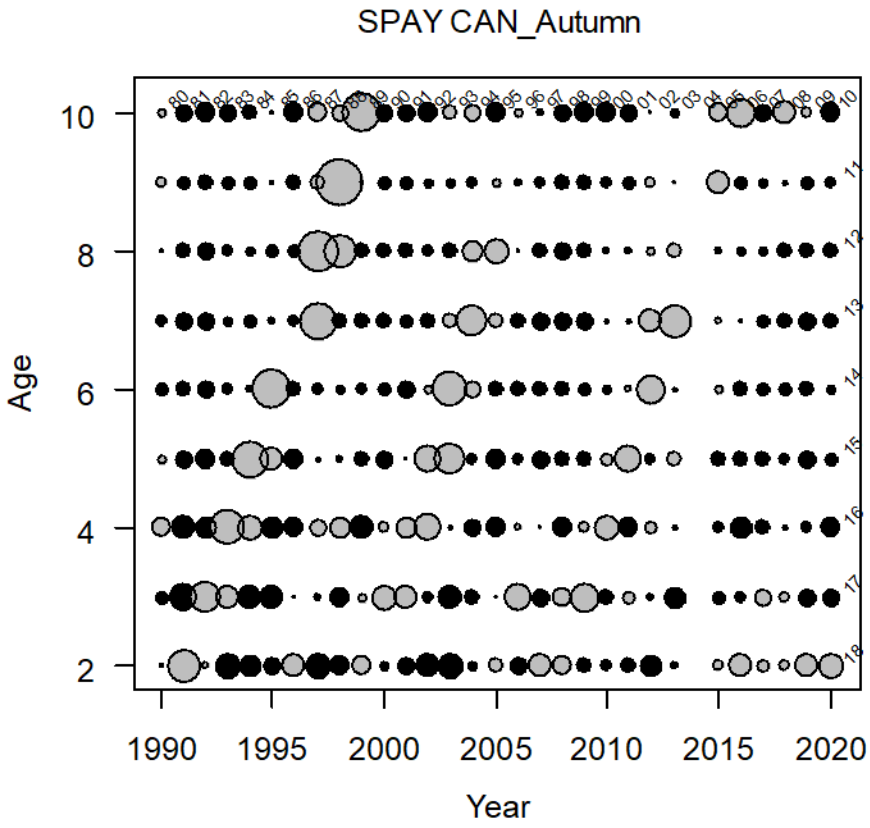

Figure 17. Plot of standardized proportions at age across years (SPAY) for the Canadian Autumn surveys in 3NO (1990-2020). Age disaggregated mean number per tow were converted to proportions within an age. For each survey-age, the survey data are standardized to have a mean of 0 and a variance of 1. Symbol sizes are scaled and values greater than average are shown as grey circles, average values are shown as small dots, and less than average values are shown as black circles.

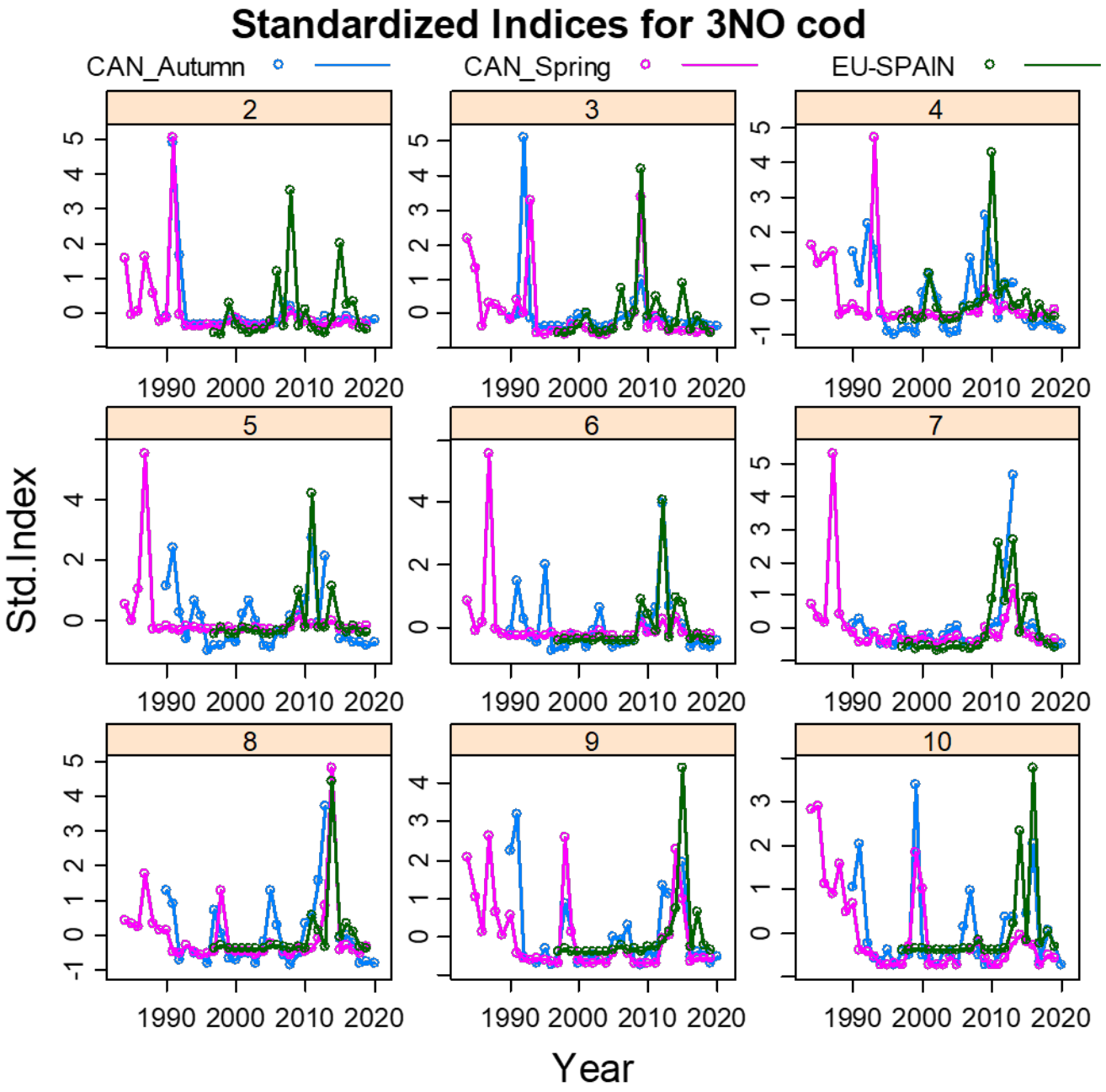

Figure 18. Cohort consistency plots for survey indices for 3NO cod (Canadian SPRING, Canadian Autumn and Spanish 3NO). Plotted are standardized indices at age.

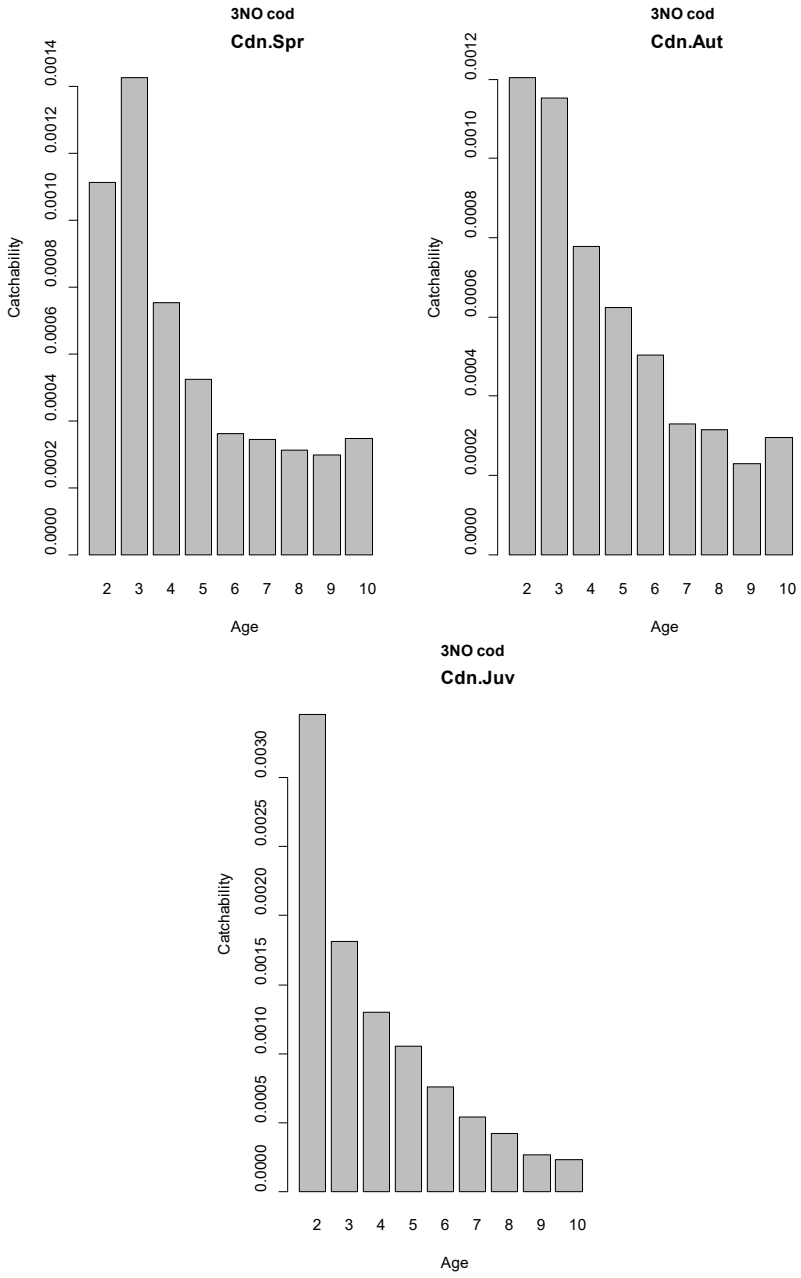

Figure 19. Estimated catchabilities from ADAPT.

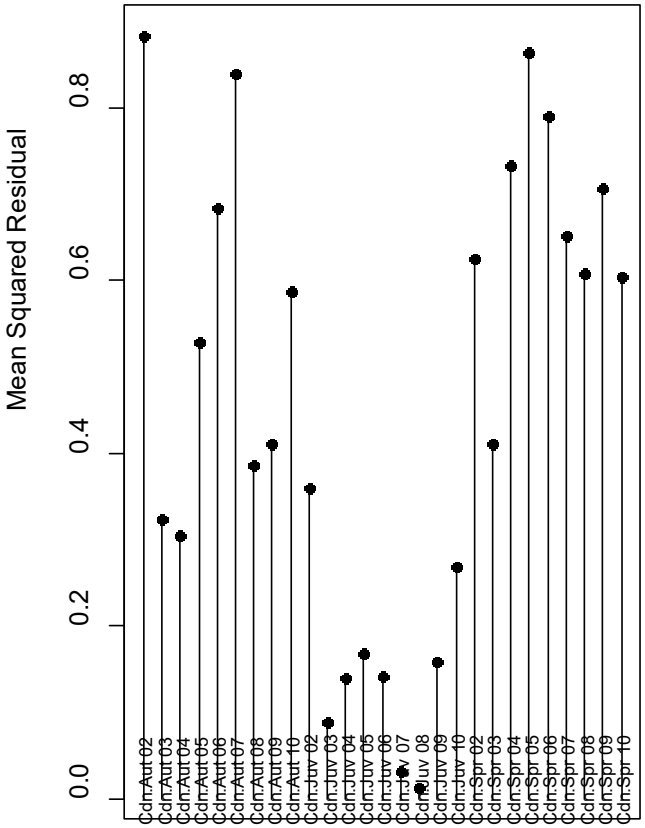

Figure 20. Mean squared residual at age for each index in the ADAPT.

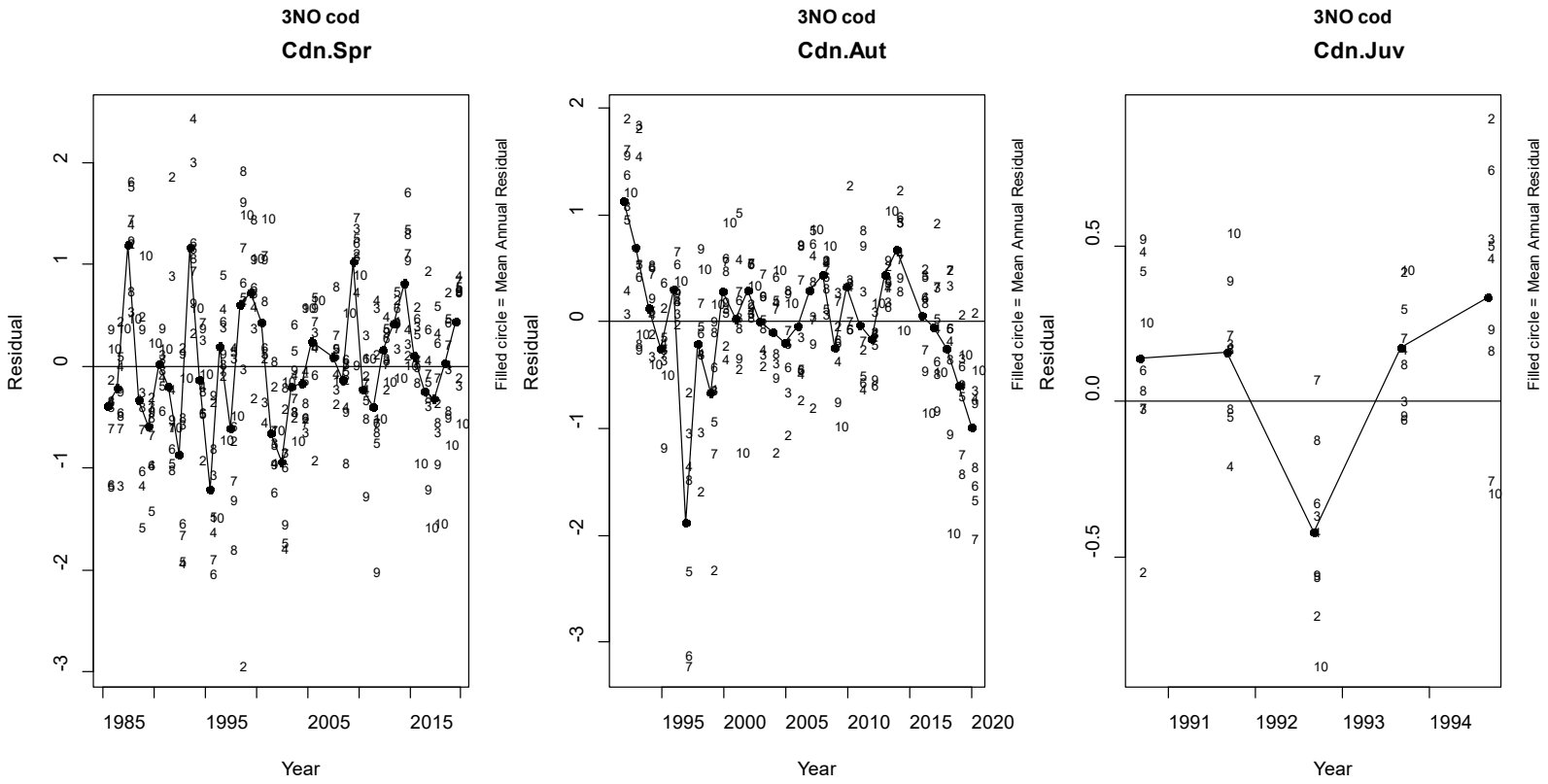

Figure 21. Residuals at age for each index in the ADAPT.

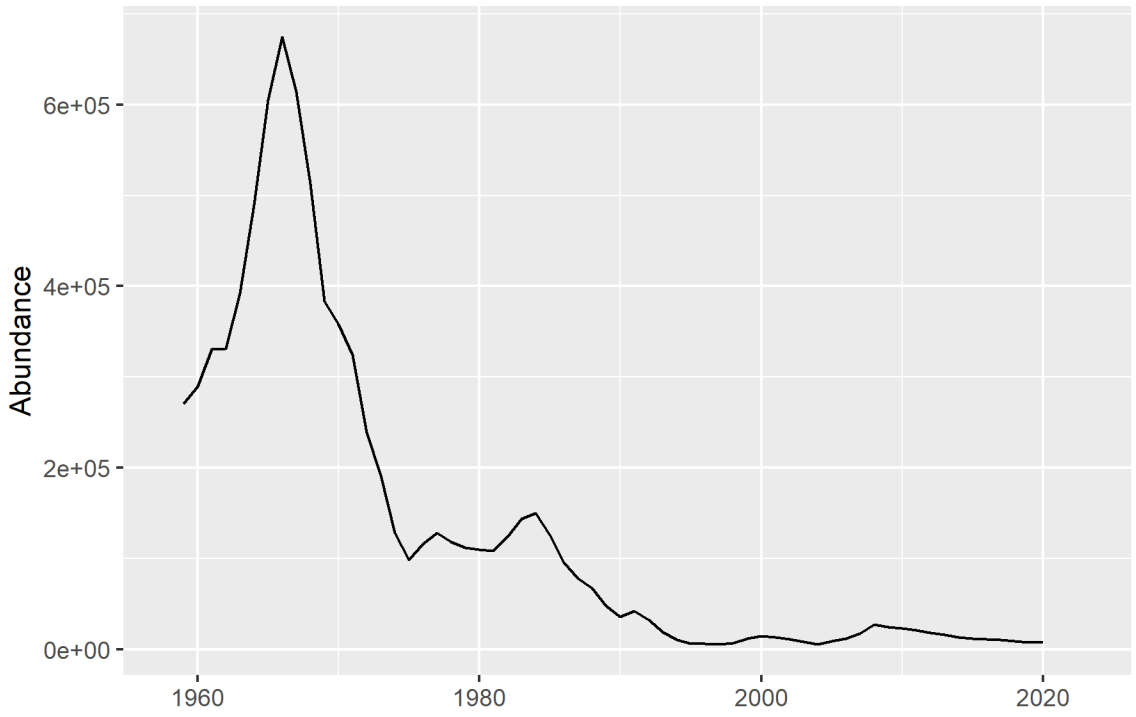

Figure 22. Bias corrected Population Abundance for cod in Divs. 3NO as estimated from ADAPT.

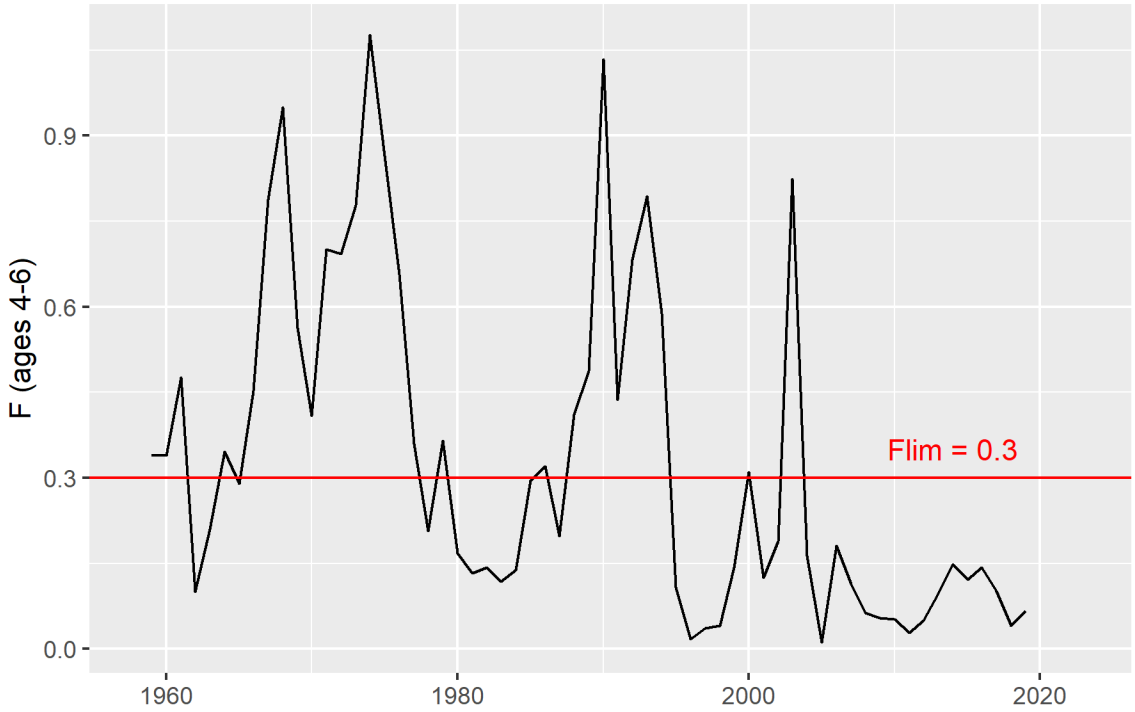

Figure 23. Fishing Mortality for cod in Div. 3NO as estimated from ADAPT.

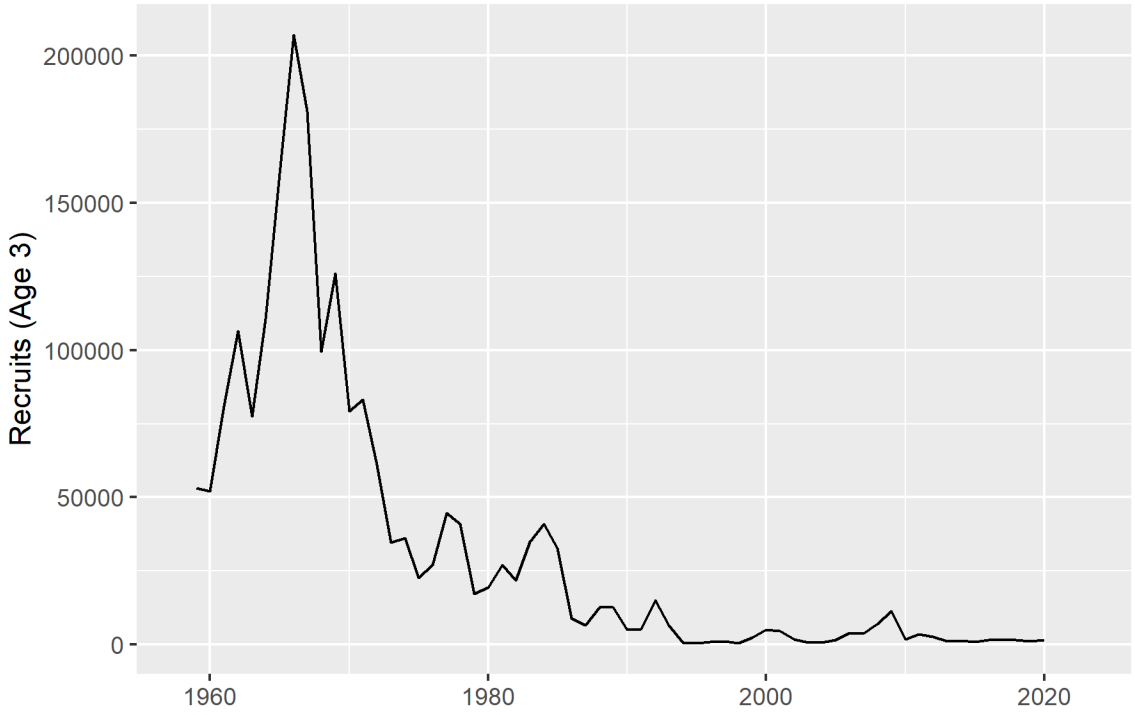

Figure 24. Age 3 recruits for cod in Div. 3NO as estimated from ADAPT.

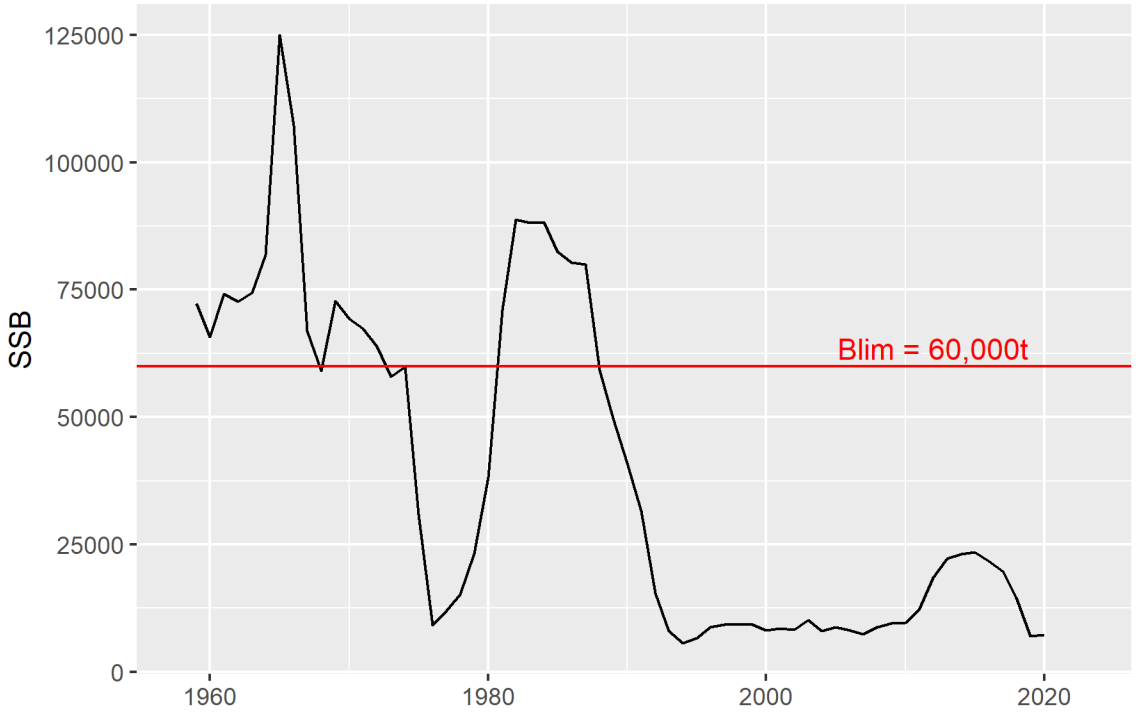

Figure 25. Spawner biomass for cod in Div. 3NO as estimated from ADAPT.

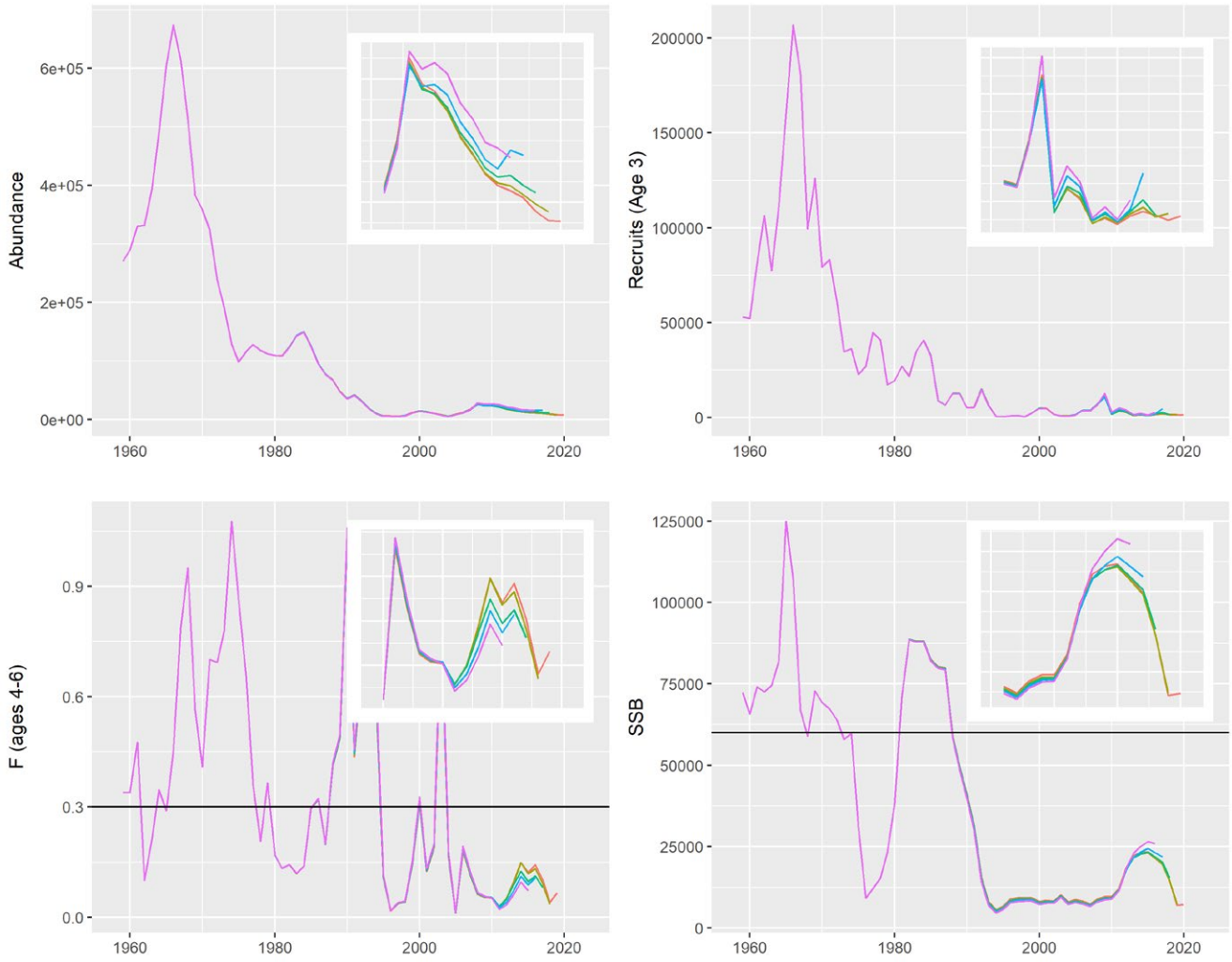

Figure 26. Retrospective estimates of abundance, spawner biomass, age 3 recruits, and fishing mortality for cod in Div. 3NO.