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An Assessment of the Cod Stock in NAFO Divisions 3NO

by

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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 declined in the late 1980's and early 1990's and is currently at a low biomass level. It has been under moratorium to all directed fishing both inside and outside the Regulatory Area since February 1994. This assessment updates the status of the stock, based mainly on the Canadian spring and fall research vessel surveys carried out in 1998. Population estimates for the beginning of 1999 are provided from an ADAPT applied to the catch at age and three Canadian research vessel surveys.

Nominal catch and catch at age

Catches from this stock peaked at 227,000 t in 1967, mainly by the former USSR and Spain, but declined steadily thereafter to a low of 15,000 t in 1978. From 1979 to 1991 catches ranged from 20,000 to 50,000 t (Table 1, Fig. 1). Continued reduction in recommended TAC's have contributed to reduced catches in recent years to a level of about 10,000 t in 1993. The fishery on this stock was suspended in February 1994 and has been under NAFO moratorium since then. 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.

Landings since 1994, including Canadian surveillance and NAFO Scientific Council estimates (Table 1) have been less than 600 t in each year. A total of 546 t was landed in 1998, 396 t by Canada (Table 2) 94 by Portugal and 56 t by other countries mainly as by-catch in gillnet and otter trawl fisheries for skate and redfish.

Sampling data for 1998 were limited to Canadian (Table 3) and Portuguese (SCS 99/16) otter trawl fisheries. The catch at age from the by-catch in the 1998 Canadian otter trawl fishery is presented in Table 4. Table 5 provides a review of the sampling over the period 1990-98 used to produce a catch at age for this stock. This Table suggests considerable sampling deficiencies in recent years. The last year for which catch at age data have been presented is 1995. In 1998 there is no sampling data available from the 158 t of gillnet by-catch from the Canadian skate fishery. It is considered that the Canadian otter trawl fishery is not representative of the total removals at age in 1998. Under the section on the ADAPT formulation, a method is presented for deriving a catch at age for the 1996 to 1998 period from total catch in the absence of adequate sampling. Catch-at-age, and mean weights-at-age from the fisheries in the 1959-95 period are presented in Tables 6 and 7.

Research vessel survey data

Stratified-random bottom trawl surveys have been conducted in spring by Canadian research vessel 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. Surveys from 1971 to 1982 were conducted by the research vessel *A.T. CAMERON* and those since 1984 were conducted by the sister ships *ALFRED NEEDLER* and *WILFRED TEMPLEMAN*. The stratification scheme used for these surveys is based on depth and is presented in Fig. 2. Fall surveys have been carried out in Divisions 3NO from 1990 to 1998 using the *WILFRED TEMPLEMAN* for strata less than 730 m and the *Teleost* for strata greater than 731 to a maximum depth of 1500m. Because of vessel difficulties in 1996 the *ALFRED NEEDLER* concluded the survey in strata less than 731m.

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

Abundance and biomass estimates for these surveys are presented in Tables 8-17 and plotted for the index strata in Figs. 3-4. Abundance and biomass have been extremely low in both Div. 3N and Div. 30 from 1994 onwards. The swept area biomass estimate from index surveyed strata in 3N and 3O combined is 81 918 t . Seventy-five percent of this estimate is from three strata in the western region of 3O (Fig. 5).

The mean numbers per tow (age aggregated) for the index strata (i.e. strata with depths < 200 fathoms) are given in Table 18 for the spring survey and Table 19 for the fall survey, and are plotted in Fig. 6. Both the spring and fall indices have been extremely low in all years after 1993. An index derived from a juvenile flatfish survey conducted by Canada from 1989 to 1994 is presented in table 20.

Analysis

Maturity at age

Female proportions mature at age sampled on the spring research vessel survey together with parameter estimates for a probit model with a logit link function fitted to the data are given in Table 21 and plotted in Fig. 7. The observed data are quite variable, particularly in recent years, partly as a consequence of small sample sizes. The estimated age at 50% maturity declined in the late 1980's and early 1990's and there has been a further steady decline since 1994 to an all time low of 4.7 in 1998(Fig. 8). The model predicted proportion of females mature at age is given in 23.

Estimates of relative year-class strength from survey data

Estimate of year class strength were obtained by fitting the following general linear model to the Spring, fall and juvenile survey mean numbers per tow index data for ages 2 to 14:

$$\ln(N_{a,j,k,y}) = m + a_a + bj + gk + e$$

where $N_{a,j,k,y}$ = mean numbers per tow of age a from survey index j, belonging to cohort k in year y , and μ = intercept, α_a = age effect for a = 2...14, β_j = survey effect where j = 1 denotes the spring survey , j = 2 denotes the fall survey and j=3 denotes the juvenile survey, γ_k = cohort effect, and ε = residuals from the fitted model.

This model explained 86% of the variation in the survey index at age values with all main effects being significant at the $\alpha = 0.05$ level. A second, similar model, was applied to the commercial catch at age data for ages 2 to 13, accounting for age and year-class effects. This model explained 71% of the variation in the catch at age with both main effects being significant at the $\alpha = 0.05$ level. The estimated parameters for relative cohort strength from both

models were back-transformed (corrected for bias) and are plotted in Fig. 9. Both the survey at age index and the catch at age data suggest that year-classes arising in the late 1980s and early 1990s have been relatively weak. Only the 1989 year-class and, to a lesser extent (and only in the catch data) the 1986 year class, can be distinguished. The survey and catch data differ in terms of their information content for year-classes arising in the late 1970s and early 1980s. The survey data suggest a steady decline in year-class strength after the 1973 year-class, whereas the catch data suggest that 1977 to 1980 year-classes were relatively strong. The reason why the signals in the survey and catch data should differ is not known.

Estimates of total mortality (Z) from survey data

The spring and fall survey mean numbers per tow index was used to calculate total mortality (Z) from one year to the next for cohorts over the ages of 3 to 7 by means of the equation

$$Z_{a,y} = \ln\left(\frac{RV_{a+1,y+1}}{RV_{a,y}}\right),$$

where $R_{a,y}$ is the research vessel mean number per tow index at age a in year y.

The estimates are quite variable because of year effects in the survey data. There is some evidence that post-moratorium mortality has not decreased as much as might have been expected (Fig. 10). A general linear model with survey, cohort (class) and age (continuous) effects (separate slopes model) was fitted to spring mean number per tow index for ages 3 to 7 for the period 1994 to 1998 (i.e. post-moratorium). The survey and cohort effects were not significant at $\alpha = 0.05$. The model was rerun with only an age effect and gave an estimate of average $Z = 0.51$ (SE=0.12). This estimate of Z is high given that the stock is presently under a moratorium and should be considered cause for concern .

Virtual population analysis

The catch at age used in the VPA using the ADAPT framework (Gavaris 1988) is presented in Table 23. 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 1996-98 was proportioned by age using the partial recruitment vector from 1990-93 (from a previous ADAPT run) applied to an F in a catch projection chosen to match projected catch with observed catch.

The ADAPT applied to total catch and calibrated with Canadian RV survey spring 1984-1998, Canadian RV survey fall 1990-98 at age and Canadian juvenile survey 1989-94 indices was applied to estimate terminal numbers $N_{i,t.}$

where i = 3 to 12, t = 1999 and i =12,t=95 to 98

and Catchabilities

$K1_i$	where i = 2 to 10 for the Canadian Research Vessel survey spring
$K2_i$	where i = 2 to 10 for the Canadian Research Vessel survey fall
$K3_i$	where i = 2 to 10 for the Juvenile Research Vessel survey.

The following structure was imposed:

(i)	natural mortality was assumed to be 0.2;
(ii)	fishing mortality on the oldest age (12) set equal to the average F for ages 6 to 9 for years 1959-1995.
(iii)	no “plus” age class;
(iv)	no error in the catch numbers-at-age.

Input data were:

Catch numbers at age

$C_{i,t}$ where i = 2 to 12 and t = 1959 to 1998,

Canadian Research Vessel survey estimates of mean numbers per tow-at-age (Campelen or Campelen equivalent values)

$RV1_{i,t}$ where i = 2 to 10 and t = 1984 to 1998, spring

$RV2_{i,t}$ where i = 2 to 10 and t = 1990 to 1998, fall

and Canadian juvenile Research Vessel survey estimates of mean numbers per tow-at-age (Yankee 41.5 shrimp trawl in August – September)

$RV3_{i,t}$ where i = 2 to 10 and t = 1989 to 1994 .

The objective function that was minimized is

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

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

Results

The statistics associated with the ADAPT are given in Table 24. The mean square error for the model fit (MSE) was 0.77. The relative error in the parameter estimates of abundance decreased with age from a high of 66% at age 3 to a low of 32% at age 8. Relative bias was a high of 22% at age 3 and decreased to 5% at age 10.

Year effects are evident in the spring survey in 1987(positive) and 1995(negative) (Fig 11). Fall 1996 have large negative residuals. The juvenile survey residual show no pattern. Large residuals in the fall survey for 1996 are ages 5, 6 and 7 while all other years for the three ages are positive(Fig. 12). Predicted and observed log survey numbers are plotted over time in Figure 13.

The estimated survivors and catchabilities together with standard errors of the estimates are provided in Table 24. Catchabilities decrease with age for all three surveys with the spring and fall having nearly equal Q's for ages 5-10 (Fig 14). The Yankee 41.5 (juvenile survey) has twice the catchability for age 2 than the Campelen surveys. The 1989 year-class is the dominate year-class in 1999.

Bias-adjusted estimates of population numbers and fishing mortality at age are given in Tables 25 and 26 respectively . The ADAPT estimate of 2+ abundance is less than the swept area estimate of abundance from spring and fall surveys for unexplained reasons (Fig. 15). Beginning of year mean weights at age calculated from the commercial catches are given in Table 27 and are used to calculate biomass in Table 28.

Spawner –recruit

Spawner biomass (Table 29) derived from bias-adjusted ADAPT estimates of population numbers, beginning of year mean weights and model predicted maturities are plotted with age 3 numbers (recruits) and average F for ages 6 to 9 in Fig 16.

Figure 16 panel 2 suggests there are two distinct time periods of productivity in this stock. A period of high productivity from 1959 to 1981 with mean recruitment of 72 million, and a period of extremely low productivity from 1982-1996, with a mean recruitment of 7 million. This is in keeping with the findings from the PA meeting in San Sebastian (May 1999).

An alternative smoothers using a cauchy kernel was applied to the stock-recruit data for the whole time period (Fig. 17). The shape parameter for the kernel was estimated by minimizing the cross validation prediction sums of squares for the entire data set . The point of inflexion at about 65,000 t that was found in the application of a cauchy smoother to the ADAPT estimates from the 1998 assessment of this stock (Stansbury et al. 1998) is not as clearly defined in the present estimates. Decisions regarding appropriate treatment of the stock-recruit data are very

important with respect to deciding on biological reference points and in choosing the kind of projections that are carried out for risk analysis and time to reach B_{lim} etc.

Conclusion

The 1998 spring and fall research vessel surveys indicate that the current stock size remains at a low level but showing a slight increase. Estimates of recent year-class size from survey data indicates that recruitment has been almost non-existent since the 1990 year-class, however, if the estimates of one year olds from the spring survey hold , then this is the first positive sign in this stock since the 1990 year-class. A pelagic 0-group survey also indicated that the 1998 year-class is relatively strong, being the most abundant in the 5 year time series (Anderson et al. 1999). Total mortality estimated from the VPA(F+M) are similar to the survey calculated Zs for ages 3 to 7. Low spawner biomass, low recruitment and high total mortality point to poor prospects for this stock in the medium term. Recovery will require a number of relatively strong year-classes that survive to maturity, rebuilding the spawner biomass.

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Table 1. Catch (t) of cod in NAFO Divisions 3NO. 1953 -1998

Year	Canada	Spain	Portugal	USSR	Others	Total	TAC
1953	39884	12633	7919		5761	66197	
1954	17392	88674	24045		4650	134761	
1955	6053	64987	27711		15605	114356	
1956	5363	42624	15505		1390	64882	
1957	9641	51990	21740		6819	90190	
1958	4812	29436	11608		2195	48051	
1959	3687	39994	17730	48	2911	64370	
1960	3408	33972	14347	24204	3746	79677	
1961	5428	32284	9059	22854	3099	72724	
1962	3235	17413	3653	7971	2712	34984	
1963	5079	37632	10004	10184	6843	69742	
1964	2882	37185	8095	9510	6789	64461	
1965	4229	64652	1692	17166	11448	99187	
1966	6501	52533	5070	39023	5792	108919	
1967	3446	77948	9703	118845	16842	226784	
1968	3287	69752	6752	78820	6900	165511	
1969	3664	71160	4940	29173	8768	117705	
1970	4771	67034	3185	28338	8233	111561	
1971	2311	89915	6589	19307	8174	126296	
1972	1736	76324	11537	12198	1579	103374	
1973	1832	42403	7759	27849	586	80429	103000
1974	1360	38338	6602	26911	178	73389	101000
1975	1189	16616	5560	20785	24	44174	88000
1976	2065	9880	2620	8992	726	24283	43000
1977	2532	8827	1742	4041	462	17604	30000
1978	6246	5813	641	1819	199	14718	15000
1979	9938	13782	1140	2446	545	27851	25000
1980	5589	8999	1145	3261	997	19991	26000
1981	6096	13299	1091	3187	671	24344	26000
1982	10185	14361	2466	3985	608	31605	17000
1983	11374	12320	1109	3238	778	28819	17000
1984	8705	13590	1071	3306	431	27103	26000
1985	18179	13682	608	3968	462	36899	33000
1986	18035	23395	6890	1181	1144	50645	33000
1987	18652	15788	4108	764	2307	41619	33000
1988	19727	15889	3927	2973	634	43150	40000
1989	13433	17904	913	108	857	33215	25000
1990	10620	4678	2145	18	11385	28846	18600
1991	12056 [2]	5448	1063	61	10824 [3]	29454 [3]	13600
1992	7859	1927	449	68	2449 [3]	12752 [3]	13600
				Russia			
1993 [1]	5370	3764	525	287	700 [3]	10646 [3]	10200
1994 [1]	47	1783	50		822 [3]	2702 [3]	6000 [4]
1995 [1]	64	29			79 [3]	172 [3]	0 [4]
1996 [1]	99		33		42 [3]	174 [3]	0 [4]
1997 [1]	329		113			442	0 [4]
1998 [1]	396		94		56 [3]	546	0 [4]

[1] Provisional

[2] Figure is 4000 t higher than Canadian Statistics as this is an amount deemed to be misreported as 3L catch.

[3] Includes Canadian Surveillance Estimates and NAFO Scientific Council Estimates

[4] The fishery for cod was suspended in February 1994 and has been under a NAFO moratiun since then.

Table 2. Cod landings (t) by month and gear from NAFO Divisions 3NO by Canada in 1998.

Month	Can/N						All Gears
	3N		**3O**				3NO
	OT	GN	OT	GN	LL	MWT	Can/N
Jan			0				0
Feb			12	1	0		13
Mar			6	0			7
Apr			3	8			11
May			16	91	3		110
Jun	1		18	52			71
Jul	1		6	3			11
Aug	9		1	0			10
Sep	33		6	2	1		42
Oct	21		1				22
Nov	0		5				5
Dec	0		3				3
Total	66		77	158	4		304

Month	Can/M							All Gears	Totals
	3N			3O				3NO	3NO
	OT	GN	LL	OT	MWT	GN	LL	Can/M	Cdn
Jan						2		2	2
Feb			0				2	2	15
Mar				12			8	20	27
Apr				4			12	16	27
May			0	5			13	18	128
Jun				2			6	8	79
Jul				0				0	11
Aug	4			9				13	23
Sep	2			4				6	48
Oct			1	0			0	1	24
Nov			1				2	3	8
Dec								0	
Total	6	0	3	36	0	2	44	91	395

Table 3. Commercial sampling by Canada used to estimate catch at age for Divisions 3NO in 1998.

Qtr.	Gear	Div.	No. Aged	Month	No. meas
1	OT	3O	224	Jan	
				Feb	1148
				Mar	
2	OT	3O	163	Apr	510
				May	267
				June	
3	OT	3O		July	
				Aug	106
				Sep	21
3	OT	3N		July	
				Aug	100
				Sep	1086
4	OT	3N	162	Oct	514
				Nov	
				Dec	

Table 4. Catch, average weight and length at age for the otter trawl fishery by Canada in Division 3NO during 1998.

	AVERAGE		CATCH		
AGE	WEIGHT (kg.)	LENGTH (cm.)	NUMBER (000'S)	STD ERR.	CV
1	0	0			0.00
2	0	0	0.00	0.00	
3	0.84	46.00	0.12	0.08	0.68
4	1.04	48.99	15.08	1.24	0.08
5	1.48	54.58	11.83	1.27	0.11
6	2.06	60.92	6.26	0.82	0.13
7	2.48	64.64	3.63	0.56	0.15
8	4.09	76.22	6.50	0.60	0.09
9	5.19	82.18	15.28	0.69	0.04
10	5.71	84.98	0.99	0.25	0.25
11	4.67	78.55	0.47	0.16	0.34
12	9.65	100.55	0.21	0.06	0.29
13	12.27	109.30	0.07	0.03	0.45

Table 5. A review of sampling used to compile catch at age for 3NO cod from 1990 to 1998.

		Catch (t)			
Catch year	**Sampling**	**Canada**	**Spain**	**Portuguese**	**Other**
1990	Canadian frequencies and age composition provided. Spanish frequencies and age composition. Portuguese frequencies and age composition provided. 10600 t of catch (either reported or estimated) in the NRA by contracting and non-contracting parties. The sampling from Spanish pair trawl was applied to the NRA catch. This sampling was applied to approximately 40% of the catch and may not have been representative. Sampling was available for Portuguese gill net catch.	10,620	4,598/OT 4,678 total	1,069/OT 1,075/GN 2,145 total	11,403
1991	Canadian frequencies and age composition provided. Spanish frequencies and age composition provided. Portuguese frequencies and age composition provided. Combination Spanish and Portuguese sampling applied to estimated catch in the NRA.	12,056	3,976	691.7/OT 369.0/GN 1,061 total	12,296
1992	Canadian frequencies and age composition provided. No sampling for the 3NO Spanish catch. Portuguese frequencies and age composition provided. Portuguese otter trawl used for Spanish and estimated catch in NRA	7,684	1,948	253/GN 195/OT 448 total	2,501
1993	Canadian frequencies and age composition provided. Spanish frequencies and age composition provided. Portuguese frequencies and age composition provided for June meeting. Spanish pair trawl sampling used for other catch in NRA.	5,326	3,031	225/OT 296/GN 521 total	700
1994	No Spanish sampling this was a large portion of the catch 1783/2702, No Canadian sampling but only a small part of catch 47/2702, Portuguese catch sampled 49/2702 and this was used to construct the entire catch at age. This sampling may not be representative.	35/LL 02/GN 09/OT 01/MWT 47 total	1,783	44.2/OT 04.9/GN 49.1 total	823
1995	No Spanish sampling. Sampling available from Portuguese gill net and otter trawl fisheries	64/74 14/GN 60/LL	29	15/OT 15/GN	79
1996	No Spanish sampling. Sampling insufficient	19/OT 31/GN 47/LL 01/MWT 98 total	5	26.2/OT 06.4/GN 32.6 total	38
1997	Sampling insufficient	203/GN 83/OT 40/LL 02/MWT 329 total		113	
1998	Some Canadian otter trawl frequencies and age samples but nothing for gillnets. Portuguese length frequencies but no aging.	185/OT 160/GN 050/LL 396 total		95/OT	56

Table 6. Catch-at-age for Divisions 3NO cod, 1959-1995 (000s) . Age 13 is a plus group

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
3	1711	1846	812	1026	313	6202	1013	753	20086	16359	8154
4	13036	6503	4400	3882	5757	15555	7611	18413	62442	56775	12924
5	5068	22050	11696	2206	11210	19496	7619	19681	50317	48608	26949
6	6025	3095	15258	1581	4849	7919	13258	11795	18517	18485	11191
7	3935	2377	2014	3594	1935	2273	9861	8486	4774	6337	2089
8	1392	2504	1672	773	3840	1109	4827	4467	4651	1592	1393
9	757	583	847	668	1165	788	1081	1829	236	505	518
10	926	387	196	433	608	328	1248	1694	180	178	292
11	1220	898	25	226	322	37	163	122	71	90	134
12	103	242	245	216	208	112	141	57	45	45	202
13	1128	1409	392	846	473	56	276	183	335	51	574
3+	35301	41894	37557	15451	30680	53875	47098	67480	161654	149025	64420
6+	15486	11495	20649	8337	13400	12622	30855	28633	28809	27283	16393

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
3	2105	950	69	10058	6425	671	4054	607	920	72	266
4	19703	26900	19797	27600	9501	8781	7534	2469	4337	3827	1055
5	10799	30300	12289	15098	10907	3528	5945	2531	2518	9208	3812
6	9481	11700	13432	5989	10872	2505	1084	1500	818	2784	2275
7	3646	3500	5883	1971	2247	3057	211	572	354	883	761
8	1635	2500	1686	972	2147	1059	238	177	102	265	222
9	541	500	285	707	1015	921	44	209	58	58	92
10	149	200	216	243	676	461	37	65	51	17	31
11	227	100	78	137	428	252	13	41	8	12	8
12	90	50	74	116	257	152	9	25	5	7	13
13	1472	700	350	173	881	396	17	36	21	16	2
3+	49848	77400	54159	63064	45356	21783	19186	8232	9192	17149	8537
6+	17241	19250	22004	10308	18523	8803	1653	2625	1417	4042	3404

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	505	305	1179	58	57	153	516	277	1917	1064	1103
4	1091	1978	647	1000	2953	2865	422	318	2182	4505	673
5	1262	1591	1893	1411	6203	6423	3491	1527	1502	4341	995
6	2297	1012	1204	2324	3036	4370	3445	6347	1260	895	544
7	1902	1528	686	1220	2519	1512	1213	3955	1887	422	282
8	574	1492	1152	720	797	948	653	1009	1284	721	368
9	192	595	774	918	459	558	845	567	485	581	568
10	94	211	238	551	533	373	494	425	233	439	502
11	41	162	81	106	261	349	398	249	168	150	383
12	13	27	41	42	97	135	404	142	100	83	202
13	32	52	36	70	71	86	188	298	285	106	337
3+	8003	8953	7931	8420	16986	17772	12069	15114	11303	13307	5957
6+	5145	5079	4212	5951	7773	8331	7640	12992	5702	3397	3186

	1992	1993	1994	1995
3	4508	1314	232	0
4	1769	3209	2326	72
5	837	637	1117	20
6	612	479	125	40
7	235	321	93	2
8	64	74	26	0
9	99	25	8	1
10	128	39	1	0
11	153	49	0.03	0
12	100	53	0.07	0
13	217	160	0.03	0
3+	8722	6360	3928.13	135
6+	1608	1200	253.13	43

Table 7. Mean weight-at-age for Divisions 3NO cod, 1959-1995. Values for age 13 is the average of the plus group

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
3	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.48	0.48	0.48	0.48
4	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.90	0.90	0.90	0.90
5	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.35	1.35	1.35	1.35
6	1.95	1.95	1.95	1.95	1.95	1.95	1.95	2.14	2.14	2.14	2.14
7	2.82	2.82	2.82	2.82	2.82	2.82	2.82	3.16	3.16	3.16	3.16
8	3.39	3.39	3.39	3.39	3.39	3.39	3.39	4.21	4.21	4.21	4.21
9	3.98	3.98	3.98	3.98	3.98	3.98	3.98	6.34	6.34	6.34	6.34
10	4.68	4.68	4.68	4.68	4.68	4.68	4.68	7.69	7.69	7.69	7.69
11	5.25	5.25	5.25	5.25	5.25	5.25	5.25	8.46	8.46	8.46	8.46
12	6.17	6.17	6.17	6.17	6.17	6.17	6.17	10.24	10.24	10.24	10.24
13	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
3	0.48	0.48	0.54	0.57	0.42	0.38	0.50	0.57	0.72	0.65	0.71
4	0.90	0.90	0.97	1.00	0.73	0.89	0.91	1.00	1.05	0.98	1.04
5	1.35	1.35	1.44	1.43	1.20	1.28	1.41	1.48	1.55	1.39	1.69
6	2.14	2.14	2.08	2.19	1.96	2.13	2.33	2.48	2.25	2.09	2.50
7	3.16	3.16	2.89	3.63	2.86	3.14	3.25	3.51	3.74	2.87	3.69
8	4.21	4.21	3.56	4.63	4.67	4.16	4.03	4.74	4.61	3.70	5.49
9	6.34	6.34	5.95	6.25	7.32	5.53	6.67	7.17	6.19	4.75	7.98
10	7.69	7.69	7.95	9.56	5.46	6.74	8.74	8.81	7.23	7.15	9.22
11	8.46	8.46	8.32	11.17	8.40	5.27	9.14	11.70	9.48	7.98	10.60
12	10.24	10.24	10.14	13.99	7.51	7.09	12.49	11.47	12.87	10.11	12.61
13	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.90	0.94	0.85	0.79	0.48	0.39	0.49	0.74	0.51	0.55	0.55
4	1.27	1.17	1.17	1.15	0.86	1.01	0.82	1.00	0.97	1.01	0.85
5	1.84	1.50	1.87	1.51	1.37	1.52	1.30	1.38	1.60	1.46	1.59
6	2.69	2.20	2.63	2.28	2.05	2.16	1.83	1.79	2.24	2.51	2.30
7	3.55	3.83	3.80	3.04	3.25	3.49	2.89	2.23	3.27	2.73	3.83
8	5.33	5.26	5.20	4.05	4.65	5.41	4.76	3.77	4.61	4.14	5.56
9	7.13	7.49	6.27	5.76	6.62	7.95	7.26	5.12	7.08	5.02	7.53
10	9.10	8.80	8.08	7.22	8.32	9.82	8.95	6.88	8.31	8.37	9.04
11	9.01	9.82	8.99	8.92	9.15	9.94	9.85	9.37	9.47	9.29	11.98
12	10.15	12.28	11.01	12.61	11.13	9.88	12.59	11.07	12.25	11.25	13.98
13	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	11.91	13.60

	1992	1993	1994	1995
3	0.33	0.36	0.27	0.00
4	0.65	0.78	0.46	0.75
5	1.06	1.35	0.91	1.21
6	1.80	1.84	1.63	2.03
7	2.82	2.82	1.84	2.29
8	4.85	4.11	4.04	2.08
9	5.56	5.87	4.94	6.60
10	7.43	7.76	7.54	6.22
11	8.64	8.79	3.44	0.00
12	10.65	8.67	7.52	0.00
13	14.11	12.74	10.00	0.00

Table 8. Cod abundance (000's) from Canadian **spring** RV surveys in Division **3N** for depths <200 fathoms.Shaded Numbers are estimates for non sampled strata

Depth range (fath)	Strata	Vessel Area Sq. mi.	AN 27 1984	WT 29 AN 43 1985	WT 47 1986	WT 58-59 1987	WT 70 1988	WT 82 1989	WT 95-96 1990	WT 105-106 1991	WT 119-120 1992	WT 136-137 1993	WT 152-153 1994	WT 168-169 1995
mean survey date			2-May-84	27-Apr-85	29-Apr-86	9-May-87	1-May-88	2-May-89	12-May-90	7-May-91	8-May-92	13-May-93	18-May-94	18-May-95
0-30	375	1593	22302	12390	2240	6223	3134	4868	3236	111	148	74	0	0
	376	1499	149223	149	787	88795	2533	599	268	119	0	0	0	69
31-50	360	2992	136658	27167	9750	31721	35911	1053	3020	900	2731	907	0	0
	361	1853	29339	50443	5585	47837	15405	9136	6634	2574	804	836	103	625
	362	2520	68550	20045	5400	117654	6860	7054	8400	1120	58	117	0	0
	373	2520	27500	4161	1600	11738	2625	3096	1575	223	0	0	0	0
	374	931	10431	776	86	931	879	52	388	26	129	0	0	0
	383	674	62	0	0	967	686	499	47	62	0	0	0	0
51-100	359	421	2339	0	40375	7163	5584	1637	819	1199	1696	2193	0	0
	377	100	1771	2451	465	6396	0	424	0	0	0	28	49	0
	382	647	0	3572	22	60	180	1588	3325	0	0	0	0	0
101-150	358	225	2703	5766	4063	4359	5328	3984	8297	1047	16484	3391	109	156
	378	139	2481	43824	6313	2124	1921	1612	2751	875	3707	608	222	97
	381	182	1534	12968	8249	392	3185	3741	3665	202	88	0	13	114
151-200	357	164	0	11571	444	**1428**	11	68	888	2528	2676	68	433	23
	379	106	788	3195	5010	7	44	206	1318	2311	8782	545	191	66
	380	116	209	3681	526	934	1498	967	2062	3859	870	20654	0	32
total all strata fished < 200 fathoms			455890	202158	90915	327301	85786	40583	46692	17156	38174	29420	1120	1182
total <200 fathoms adjusted			455890	202159	90915	328729	85784	40584	46693	17156	38173	29421	1120	1182
upper limit			891831	278710	543939	531816	118657	53692	79795	35126	63165	286252	7723	2774
t-value			2.776	2.776	12.706	2.228	2.145	2.365	4.303	4.303	4.303	12.706	12.706	2.447
1 std dev			157039	27576	35654	91793	15324	5543	7693	4176	5808	20213	520	651

Table 9. Cod biomass (t) from Canadian **spring** RV surveys in Division **3N** for depths < 200 fathoms. Shaded Numbers are estimates for non sampled strata.

Depth range (fath)	Strata	Vessel Area Sq. mi.	AN 27 1984	WT 29 AN 43 1985	WT 47 1986	WT 58-59 1987	WT 70 1988	WT 82 1989	WT 95-96 1990	WT 105-106 1991	WT 119-120 1992	WT 136-137 1993	WT 152-153 1994	WT 168-169 1995
mean survey date			2-May-84	27-Apr-85	29-Apr-86	9-May-87	1-May-88	2-May-89	12-May-90	7-May-91	8-May-92	13-May-93	18-May-94	18-May-95
0-30	375	1593	7018	26266	21041	13506	23154	25148	16134	1835	2331	1145	0	0
	376	1499	16673	713	2954	9148	6555	1256	3791	1483	0	0	0	51
31-50	360	2992	21843	17007	3781	4155	3792	2145	10488	1032	1445	46	0	0
	361	1853	20008	52794	61130	50358	25677	19517	30149	16646	399	3455	64	47
	362	2520	75781	29914	31327	144250	19890	26588	37344	4343	668	1522	0	0
	373	2520	33487	5274	4378	14596	9738	8996	5802	856	0	0	0	0
	374	931	14987	1523	1338	1832	5872	937	5050	516	30	0	0	0
	383	674	502	0	0	1664	236	574	615	224	0	0	0	0
51-100	359	421	308	0	2639	779	637	213	101	66	113	433	0	0
	377	100	145	219	138	1720	0	46	0	0	0	9	8	0
	382	647	0	257	84	42	59	782	298	0	0	0	0	0
101-150	358	225	822	906	1724	4255	1317	1701	1089	131	2650	1699	164	135
	378	139	692	4601	1084	358	441	432	399	145	413	247	64	76
	381	182	765	5397	2913	247	786	216	800	399	15	0	57	44
151-200	357	164	0	6352	640	**566**	33	64	274	331	706	46	237	24
	379	106	382	1198	1587	9	37	98	318	852	2592	205	121	46
	380	116	411	2128	366	1018	656	498	704	676	181	9823	0	9
total all strata fished < 200 fathoms			193825	154547	137124	247937	98880	89212	113355	29536	11544	18629	714	433
total <200 fathoms adjusted			193824	154549	137124	248503	98880	89211	113356	29535	11543	18630	715	432
upper limit			256272	192257	211519	326927	125247	115281	141017	49183	19173	143715	1950	761
t-value			2.093	2.064	2.201	2.093	2.086	2.11	2.02	2.306	2.776	12.706	4.303	2.776
1 std dev			29836	18270	33801	37740	12640	12355	13694	8520	2748	9845	287	118
			394583	304560	317810	793383	279956	203992	227019	126319	72943	234453	26678	14560

Table 10. Cod abundance (000's) from Canadian **spring** RV surveys in Division **3N**
for depths > 200 fathoms.Shaded Numbers are estimates for non sampled strata.

Depth range (fath)	Strata	Vessel Area Sq. mi.	WT 105-106 1991	WT 119-120 1992	WT 136-137 1993	WT 152-153 1994	WT 168-169 1995	WT 188-189 1996	WT 204-208 1997	WT 221-222 1998
mean survey date			7-May-91	8-May-92	13-May-93	18-May-94	18-May-95	25-May-96	16-May-97	22-May-98
201-300	723	155	1970	13573	43	32	0	46	77	53
	725	105	401	**nf**	0	95	73	34	16	49
	727	160	833	2144	1444	222	211	1394	109	55
301-400	724	124	69	112	9	34	17	0	50	61
	726	72	0	0	0	0	70	0	12	0
	728	156	0	0	0	0	43	0	0	0
401-500	752	134	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**
	756	106	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**
	760	154	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**
total all strata fished			20429	54003	30916	1504	1597	4789	8165	5545
upper			38845	212125	287928	3892	3156	24093	85786	8939
t-value			4.303	12.706	12.706	4.303	2.365	12.706	12.71	2.14
1 STD			4280	12445	20228	555	659	1519	6107	1586

Table 11. Cod biomass (t) from Canadian **spring** RV surveys in Division **3N**
for depths >200 fathoms.Shaded Numbers are estimates for non sampled strata.

Depth range (fath)	Strata	Vessel Area Sq. mi.	WT 105-106 1991	WT 119-120 1992	WT 136-137 1993	WT 152-153 1994	WT 168-169 1995	WT 188-189 1996	WT 204-208 1997	WT 221-222 1998
mean survey date			7-May-91	8-May-92	13-May-93	18-May-94	18-May-95	25-May-96	16-May-97	22-May-98
201-300	723	155	662	3415	30	26	0	35	80	77
	725	105	186	**nf**	0	32	8	19	9	10
	727	160	486	805	313	86	41	677	71	25
301-400	724	124	30	32	9	22	26	0	40	191
	726	72	0	0	0	0	31	0	5	0
	728	156	0	0	0	0	26	0	0	0
401-500	752	134	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**
	756	106	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**
	760	154	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**
total all strata fished			30901	15795	18982	880	566	2430	5295	2024
upper			50596	28054	144081	2151	888	6155	49001	3168
t-value			2.306	3.182	12.706	4.303	2.571	4.303	12.71	2.13
1 STD			8541	3853	9846	295	125	866	3439	537

Table 12. Cod abundance (000's) from Canadian **Spring** RV Surveys in Division **3O** for depths <200 fathoms.Shaded Numbers are estimates for non-sampled stra

Depth range (fath)	Strata	Vessel Area Sq. mi	AN 27 1984	AN 43 1985	WT 47 1986	WT 58-60 1987	WT 70 1988	WT 82 1989	WT 95-96 1990	WT 105-106 1991	WT 119-120 1992	WT 136-137 1993	WT 152-154 1994	WT 168-169 1995
mean survey date			3-May-84	15-Apr-85	22-Apr-86	27-Apr-87	24-Apr-88	23-Apr-89	27-Apr-90	24-Apr-91	26-Apr-92	30-Apr-93	4-May-94	7-May-95
31-50	330	2089	7761	7892	3707	11315	5384	1609	4990	1424	203	373	0	0
	331	456	3863	1921	744	1900	1425	792	**1052**	158	32	0	0	0
	338	1898	23356	9724	8933	20210	6623	20166	8436	24463	2285	835	132	264
	340	1716	10606	9414	10282	146151	2826	1960	3628	2569	334	119	286	0
	351	2520	78342	17578	117725	71723	13335	6112	6242	2071	1050	350	250	0
	352	2580	41362	17656	9803	35888	56193	10474	14499	9752	3852	1331	1299	1111
	353	1282	0	2226	2773	29082	44478	4731	6499	1297	4229	223	0	285
51-100	329	1721	5928	2390	2838	133032	5259	5577	13147	22309	508	1673	13959	1100
	332	1047	436	3432	1115	30014	2908	3112	5700	683773	29607	296105	0	2399
	337	948	1909	5688	1369	1799	2337	10402	2133	22436	6913	231602	132	527
	339	585	14625	894	135	2383	488	27	1625	1571	609	406	0	0
	354	474	2238	1843	2216	65669	2271	593	395	9019	1679	1415	0	0
101-150	333	151	0	42	105	566	0	378	136	692	975	514	2205	10
	336	121	0	17	126	17	8	8	143	160	5537	437	605	0
	355	103	0	4070	29	207	43	987	193	2339	944	236	50	7
151-200	334	92	0	236	1323	26	121	141	543	1214	971	1137	533	200
	335	58	0	0	68	8	12	16	97	27	1275	342	157	52
	356	61	0	0	13	4	51	131	110	546	2665	424	491	13
total strata fished < 200 fathoms			190427	85023	163306	549997	143763	67215	68515	785821	63667	537522	20100	5967
total <200 fathoms adjusted			190426	85023	163304	549994	143762	67216	69568	785820	63668	537522	20099	5968
1 std dev			23492	12072	92856	118784	39030	10972	10310	669240	22549	271901	13845	1800

Table 13. Cod biomass (t) from Canadian **Spring** RV Surveys in Division **3O** for depths < 200 fathoms.Shaded Numbers are estimates for non-sampled strata.

Depth range (fath)	Strata	Vessel Area Sq. mi	AN 27 1984	AN 43 1985	WT 47 1986	WT 58-60 1987	WT 70 1988	WT 82 1989	WT 95-96 1990	WT 105-106 1991	WT 119-120 1992	WT 136-137 1993	WT 152-154 1994	WT 168-169 1995
mean survey date			3-May-84	15-Apr-85	22-Apr-86	27-Apr-87	24-Apr-88	23-Apr-89	27-Apr-90	24-Apr-91	26-Apr-92	30-Apr-93	4-May-94	7-May-95
31-50	330	2089	7964	9372	4167	12075	4486	3318	5091	266	32	92	0	0
	331	456	4536	4891	1295	1982	2176	481	**2191**	236	224	0	0	0
	338	1898	43090	13670	23245	20013	14538	25430	9315	10283	11883	4981	1841	3439
	340	1716	13654	10780	12024	161120	16447	5478	10296	384	52	1936	160	0
	351	2520	68620	34516	90852	114632	25324	19777	22343	6595	2063	1198	131	0
	352	2580	51655	41868	24245	76430	82226	43865	38424	22512	16671	8225	1584	3784
	353	1282	0	9451	1831	15552	4512	4012	5892	1267	1780	3260	0	609
51-100	329	1721	1776	1931	1114	116331	16127	1690	4684	4195	97	219	10523	2187
	332	1047	4410	17134	4092	12848	11718	2156	11266	39264	3927	108245	0	1702
	337	948	741	2976	11644	4299	1005	5735	3354	5566	20721	79783	813	1659
	339	585	3355	730	73	943	496	219	385	92	87	43	0	0
	354	474	955	660	569	6915	1211	87	562	3325	191	1319	0	0
101-150	333	151	0	330	411	1837	0	1486	381	877	273	1661	8549	26
	336	121	0	81	120	35	39	44	318	111	1733	375	661	0
	355	103	0	724	29	259	38	538	198	329	63	169	32	31
151-200	334	92	0	898	4773	120	473	294	826	1385	1018	1408	959	333
	335	58	0	0	159	38	82	16	110	10	276	2522	453	342
	356	61	0	0	42	15	178	154	219	88	308	387	257	16
total strata fished < 200 fathoms			200758	150013	180686	545446	181076	114780	113664	96783	61399	215824	25964	14127
total <200 fathoms adjusted			200756	150012	180685	545444	181076	114780	115855	96785	61399	215823	25963	14128
1 std dev			26557	18667	57045	107416	34873	32407	14933	35395	21352	92888	11823	3094

Table 14. Cod abundance (000's) from Canadian **Spring** RV Surveys in Division **3O** for depths >200 fathoms

Depth range (fath)	Strata	Vessel Area Sq. mi	WT 105-106 1991	WT 119-120 1992	WT 136-137 1993	WT 152-154 1994	WT 168-169 1995	WT 188-189 1996	WT 204-208 1997	WT 221-222 1998
mean survey date			24-Apr-91	26-Apr-92	30-Apr-93	4-May-94	7-May-95	11-May-96	16-May-97	22-May-98
201-300	717		3701	336	1615	1441	242	27	176	20
	719		274	749	301	443	164	21	39	5
	721		190	72390	348	11	5	84	103	5
301-400	718		15	0	100	503	102	0	7	0
	720		0	569	15	211	29	6	103	12
	722		0	149	0	0	0	11	6	0
401-500	764		**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**
	772		**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**
total all strata fished			790001	137860	539900	22708	6510	21352	6844	31153
upper			2510624	1092111	3994696	61281	10713	32169	26139.7	65326
t-value			2.571	12.706	12.706	2.776	2.306	2.365	12.706	2.78
1 STD			669243	75102	271903	13895	1823	4574	1519	12292

Table 15. Cod biomass (t) from Canadian **Spring** RV Surveys in Division **3O** for depths <200 fathoms.

Depth range (fath)	Strata	Vessel Area Sq. mi	WT 105-106 1991	WT 119-120 1992	WT 136-137 1993	WT 152-154 1994	WT 168-169 1995	WT 188-189 1996	WT 204-208 1997	WT 221-222 1998
mean survey date			24-Apr-91	26-Apr-92	30-Apr-93	4-May-94	7-May-95	11-May-96	16-May-97	22-May-98
201-300	717	717	15218	436	1870	2094	339	57	238	30
	719	719	143	179	330	727	927	37	133	2
	721	721	88	12153	304	16	10	95	53	16
301-400	718	718	7	0	159	791	91	0	16	0
	720	720	0	139	9	222	34	3	164	11
	722	722	0	70	0	0	0	28	5	0
401-500	764	764	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**
	772	772	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**
total all strata fished			112240	74377	218496	29814	15528	21915	9598	80256
upper			202678	137245	1398738	60382	22196	32850	16345	546724
t-value			2.447	2.571	12.706	2.571	2.069	2.306	2.201	12.71
1 STD			36959	24453	92889	11890	3223	4742	3065	36701

Table 16. Abundance ('000) and Biomass (t) of cod from **autumn** stratified random surveys in Division **3N**.

abundance

Depth Range	Strata	Area	WT 101-102 1990 6-Dec-90	WT 113-115 1991 3-Nov-91	WT 128-130 1992 29-Oct-92	WT 144-146 1993 7-Nov-93	WT 160-161 1994 2-Nov-94	WT 176-177 1995 13-Oct-95	Tel 42 AN253 WT 200 1996 1-Dec-96	WT 212-214 1997 16-Oct-97	Tel 76 WT 229-233 1998 20-Nov-98	WT 101-102 1990 6-Dec-90	WT 113-115 1991 3-Nov-91	WT 128-130 1992 29-Oct-92
0-30	375	1593	5421	66596	**nf**	2047	1947	5001	0	603	329	31395	69276	**nf**
	376	1499	32419	455280	354763	260	312	3956	93	41	1598	5147	80732	116390
31-50	360	2992	28703	12311	8311	3463	0	437 `		137	309	7585	4456	4572
	361	1853	6273	14155	20718	6177	7549	3788	2025	2156	5761	24777	16326	12485
	362	2520	12855	73045	49583	1300	622	910	104	898	792	9636	40955	22852
	373	2520	1336	22575	1400	750	0	70	130	50	149	9722	26255	4114
	374	931	879	20754	**nf**	819	1034	57	65	43	171	2501	9699	**nf**
	383	674	530	530	**nf**	0	0	47	0	0	46	216	164	**nf**
51-100	359	421	702	0	497	88	0	29	52	29	0	39	0	156
	377	100	243	**nf**	493	0	7	7	12	0	0	122	**nf**	257
	382	647	210	359	270	494	0	0	33	0	0	129	73	115
101-150	358	225	766	1500	5063	47	94	56	14	15	247	404	430	2464
	378	139	550	2046	1602	48	10	10	0	17	10	362	635	461
	381	182	**nf**	0	**nf**	202	0	0	233	8	13	**nf**	0	**nf**
151-200	357	164	683	399	194	1526	57	20	39	0	124	370	205	120
	379	106	213	**nf**	596	655	81	33	52	79	13	318	**nf**	317
	380	116	**nf**	798	**nf**	48	16	57	24	16	0	**nf**	117	**nf**
total strata fished <= 200 fathom			91783	670348	443490	17924	11729	14478	3359	4092	9561	92723	249323	164303
UPPER			156111	1657056	1675218	26592	20479	21567	6774	5741	14597	151903	392215	555906
TVALUE			2.201	2.776	4.303	2.145	2.447	2.201	2.571	2.179	2.26	2.365	2.228	4.303
1 std			29227	355442	286249	4041	3576	3221	1328	757	2228	25023	64135	91007
201-300	723	155	**nf**	0	**nf**	97	0	0	43	6	0	**nf**	0	**nf**
	725	105	**nf**	**nf**	0	80	0	12	22	0	7	**nf**	**nf**	0
	727	160	**nf**	**nf**	**nf**	878	11	9	267	0	0	**nf**	**nf**	**nf**
301-400	724	124	**nf**	0	**nf**	17	0	0	19	0	0	**nf**	0	**nf**
	726	72	**nf**	**nf**	**nf**	0	0	0	10	0	0	**nf**	**nf**	**nf**
	728	156	**nf**	**nf**	**nf**	**nf**	0	0	76	0	0	**nf**	**nf**	**nf**
Total strata > 200 fathoms			0	0	0	1072	11	21	437	6	7	0	0	0
Total all strata fished			91783	670348	443490	18996	11741	14498	3795	4098	9568	92723	249323	16303
Upper limit			156111	1657056	1675228	27812	20490	21588	7257	5747	14604	151903	392216	555901
t-value			2.201	2.776	4.303	2.131	2.447	2.201	2.517	2.179	2.26	2.365	2.228	4.303
1 std			29227	355442	286251	4137	3575	3221	1375	757	2228	25023	64135	125400
												165540	321238	184557

[1] Note the fall index has not been filled for missing strata .
nf strata not fished.

Table 17. Abundance ('000) and Biomass (t) of cod from **autumn** stratified random surveys in Division **3O**.

			Abundance									Biom		
									WT 200		Tel 76			
			WT	WT	WT	WT	WT	WT	Tel 41-42	WT	WT	WT	WT	WT
Depth			101-102	113-115	128-130	144-146	160-161	176-177	AN 253	212-214	229-233	101-102	113-115	128-130
Range	Strata	Area	1990	1991	1992	1993	1994	1995	1996	1997	1998	1990	1991	1992
	mean survey date		26-Nov-90	24-Oct-91	23-Oct-92	27-Oct-93	31-Oct-94	10-Oct-95	10-Dec-96	16-Oct-97	20-Nov-98	26-Nov-90	24-Oct-91	23-Oct-92
31-50	330	2089	10709	10264	7036	5271	2072	3946	279	1006	3113	6651	2374	2574
	331	456	507	6682	222	222	95	760	32	31	408	27	1047	191
	338	1898	20199	10334	857	6221	330	2478	264	52	835	13966	7122	2760
	340	1716	4158	5625	7746	1859	763	1668	95	519	1747	3635	6247	6711
	351	2520	29085	24185	3558	10450	661	2709	198	1684	347	17027	21473	3142
	352	2580	10248	24761	2747	4710	717	972	287	1006	761	21151	32262	3137
	353	1282	1781	223	0	0	0	415	0	0	0	4593	56	0
51-100	329	1721	531	1605	558	239	1036	574	478	95	710	1291	1019	109
	332	1047	1721	1127	436	2036	242	0	0	48	288	767	74	254
	337	948	1001	66	198	307	0	0	0	0	0	2331	70	373
	339	585	163	0	41	528	41	41	0	80	126	1242	0	64
	354	474	1580	0	1712	0	0	165	340	130	33	66	0	896
101-150	333	151	21	0	10	0	0	0	**nf**	0	0	12	0	12
	336	121	6	0	0	67	0	0	8	0	0	29	0	0
	355	103	**nf**	887	64	172	0	13	342	0	0	**nf**	155	31
151-200	334	92	13	0	0	9	0	0	**nf**	0	0	16	0	0
	335	58	12	4	0	0	0	0	133	12	4	13	8	0
	356	61	**nf**	4	0	102	0	0	40	0	17	**nf**	8	0
Total strata fished <= 200 fathoms			81735	85767	25185	32193	5957	13741	2496	4663	8388	72817	71915	20254
upper			117569	117451	40427	48506	11071	18760	3870	6604	11951	97492	98551	29947
t-value			2.093	2.049	2.447	2.145	2.365	2.12	2.447	2.12	2.23	2.093	2.093	2.201
1 std			17121	15463	6229	7605	2162	2367	562	916	1598	11789	12726	4404
201-300	717	93	0	**nf**	**nf**	0	0	0	**nf**	0	0	0	**nf**	**nf**
	719	76	0	0	**nf**	0	5	0	37	0	0	0	0	**nf**
	721	76	**nf**	0	**nf**	0	0	0	0	0	5	**nf**	0	**nf**
301-400	718	111	**nf**	**nf**	**nf**	0	0	0	**nf**	0	0	**nf**	**nf**	**nf**
	720	105	**nf**	**nf**	**nf**	0	0	0	0	0	0	**nf**	**nf**	**nf**
	722	93	**nf**	0	**nf**	0	0	0	0	0	0	**nf**	0	**nf**
total strata fished > 200 fathoms			0	0	0	0	5	0	37	0	5	0	0	0
total all strata fished			81735	85767	25185	32193	5961	13740	2534	4663	8394	72817	7195	20254
upper			117569	117451	40427	48506	11077	18760	3907	6604	11957	97492	98552	29947
t-value			2.039	2.048	2.447	2.145	2.365	2.12	2.447	2.12	2.23	2.093	2.093	2.201
1 STD			17574	15471	6229	7605	2163	2368	561	916	1598	11789	43649	4404

[1] Note the fall index has not been filled for missing strata .
nf strata not fished.

Table 18. Mean number per tow of cod from spring RV surveys in NAFO Divisions 3NO as calculated using the conversion from Warren 1997 for surveys in 1984-1995. 1996 ,1997 and 1998 are actual Campelen surveys.

	1984	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**
1	0.16	0.37	0.38	5.00	0.18	0.38	0.90	0.57	0.00	0.00	0.00	0.00	0.10	0.06	1.71
2	53.39	9.88	12.77	54.15	26.45	4.77	7.25	147.62	10.07	1.17	0.22	0.76	1.35	0.24	2.16
3	41.57	29.27	3.63	14.13	12.91	10.39	6.77	15.44	9.66	58.27	0.91	0.20	1.65	1.67	0.51
4	21.35	16.14	17.87	19.67	1.02	2.40	3.80	1.59	0.24	53.63	1.63	0.04	0.44	0.58	1.23
5	7.17	2.76	11.53	50.35	0.47	0.34	1.46	0.47	0.11	1.25	1.05	0.15	0.24	0.16	0.52
6	5.04	0.90	2.11	26.41	1.10	0.31	0.25	0.16	0.09	0.68	0.07	0.10	0.57	0.03	0.17
7	1.51	1.03	0.82	7.38	1.13	0.61	0.41	0.07	0.03	0.46	0.12	0.01	0.56	0.09	0.13
8	0.72	0.66	0.58	1.71	0.66	0.52	0.52	0.06	0.03	0.22	0.07	0.02	0.05	0.07	1.35
9	1.36	0.84	0.42	1.63	0.67	0.36	0.61	0.14	0.08	0.05	0.07	0.05	0.04	0.01	1.61
10	1.15	1.18	0.61	0.54	0.75	0.40	0.46	0.12	0.11	0.08	0.02	0.01	0.03	0.02	0.15
11	0.61	0.88	1.02	0.70	0.35	0.51	0.34	0.11	0.13	0.17	0.04	0.01	0.02	0.03	0.03
12	0.25	0.48	0.51	0.60	0.44	0.33	0.34	0.09	0.14	0.12	0.05	0.02	0.00	0.02	0.01
13	0.10	0.23	0.31	0.68	0.69	0.27	0.16	0.12	0.12	0.07	0.07	0.05	0.00	0.01	0.03
14	0.03	0.14	0.15	0.23	0.55	0.39	0.37	0.13	0.10	0.07	0.02	0.02	0.03	0.00	0.00
15	0.05	0.08	0.08	0.21	0.21	0.21	0.44	0.12	0.09	0.09	0.03	0.03	0.02	0.01	0.02
16	0.08	0.08	0.04	0.12	0.11	0.11	0.22	0.18	0.09	0.05	0.01	0.02	0.00	0.00	0.01
17	0.05	0.03	0.04	0.00	0.11	0.09	0.14	0.07	0.06	0.02	0.00	0.00	0.01	0.00	0.00
18	0.01	0.01	0.03	0.01	0.04	0.04	0.06	0.04	0.01	0.01	0.03	0.00	0.00	0.01	0.00
19	0.00	0.02	0.03	0.02	0.03	0.03	0.05	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00
1+	134.6	64.98	52.93	183.54	47.87	22.46	24.55	167.1	21.17	116.42	4.42	1.49	5.11	3.01	7.66

Table 19. Mean number per tow of cod from autumn RV surveys in NAFO Divisions 3NO as calculated using the conversion from Warren 1997 for surveys in 1984-1995. 1996 ,1997 and 1998 are actual Campelen surveys.

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	18.89	14.87	0.41	1.30	0.00	1.15	0.08	0.03	1.67
2	6.15	129.66	49.65	0.72	0.62	1.02	0.74	0.10	0.29
3	3.25	4.36	65.00	3.63	0.28	0.46	0.29	0.40	0.2
4	3.56	2.19	4.70	3.59	0.96	0.20	0.06	0.33	0.32
5	1.73	2.73	1.02	0.30	1.32	0.94	0.01	0.14	0.11
6	0.37	1.33	0.61	0.27	0.16	1.64	0.02	0.06	0.06
7	0.29	0.37	0.18	0.18	0.04	0.11	0.02	0.28	0.01
8	0.38	0.31	0.03	0.10	0.06	0.05	0.01	0.28	0.16
9	0.40	0.53	0.03	0.02	0.01	0.06	0.00	0.05	0.22
10	0.24	0.37	0.07	0.02	0.01	0.05	0.00	0.04	0.03
11	0.20	0.45	0.00	0.06	0.03	0.00	0.00	0.00	0.01
12	0.09	0.33	0.06	0.04	0.03	0.02	0.00	0.00	0
13	0.15	0.27	0.12	0.04	0.02	0.02	0.01	0.00	0
14	0.07	0.21	0.03	0.05	0.06	0.00	0.01	0.01	0
15	0.16	0.12	0.03	0.06	0.01	0.00	0.00	0.00	0
16	0.21	0.38	0.02	0.02	0.03	0.00	0.01	0.01	0
17	0.07	0.16	0.03	0.01	0.02	0.00	0.00	0.00	0
18	0.02	0.06	0.08	0.02	0.01	0.00	0.00	0.00	0.01
19	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
1+	36.3	158.7	122.1	10.4	3.7	5.7	1.3	1.7	3.77

Table20. Mean number per tow at age of cod from Juvenile Surveys conducted by Canada in Divisions 3NO during August and September

Age	1989	1990	1991	1992	1993	1994
1	1.40	60.88	36.33	0.84	1.98	2.75
2	14.16	11.62	74.04	12.28	3.70	4.03
3	12.58	6.53	8.54	12.89	8.85	1.25
4	5.82	8.99	2.45	1.42	7.91	4.07
5	1.21	3.62	1.96	0.69	0.80	4.79
6	0.72	0.67	0.72	0.52	0.30	0.41
7	1.22	0.50	0.19	0.22	0.28	0.08
8	0.79	0.63	0.17	0.05	0.10	0.13
9	0.25	0.53	0.24	0.03	0.02	0.05
10	0.17	0.28	0.19	0.03	0.04	0.01
11	0.2	0.21	0.23	0	0.10	0.05
12	0.11	0.04	0.18	0.02	0.08	0.06
13	0.09	0.08	0.17	0.10	0.06	0.08
14	0.16	0.27	0.48	0.13	0.09	0.09
1+	38.88	94.85	125.89	29.22	24.31	17.85

1984	1985	1986	1987	1988	1989	1990	1991
					38.88	94.85	125.89

Table 21. Proportion mature at age of female Atlantic cod (~~Gadus morhua~~) in NAFO Div. 3NO (1975-1998). A50=median age at maturity (years); L95% and U95%=lower and upper 95% confidence intervals. Parameter estimates of the logit model are shown: Int=intercept; SE=standard error; n=sample size; period=no fish sampled. Data are from spring RV surveys, are unconverted (Engels trawl prior to 1996, Campelen trawl thereafter) and incude all strata fished.

AGE	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	0	0 .		0	0	0	0	0		.	0	0	0	.	.	0	0
2	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0
3	0	0	0	0	0	0.01	0	0		0	0	0	0	0	0	0	0
4	0	0.03	0	0	0.02	0	0.07	0.00		0	0	0	0	0	0.01	0.03	0.07
5	0	0.05	0.08	0.07	0.06	0.13	0.53	0.10		0.05	0.04	0.04	0.11	0.09	0.20	0.03	0.30
6	0.56	0.48	0.19	0.39	0.48	0.47	0.47	0.48		0.56	0.37	0.17	0.34	0.28	0.85	0.61	0.41
7	0.97	1	0.62	0.81	0.89	0.84	0.87	0.96		0.88	0.93	0.56	0.75	0.50	0.95	0.87	0.84
8	0.98	1	0.89	1	1	0.84	1	1		0.96	1	1	0.87	0.93	0.98	0.85	1
9	1	1	1	1	1	1	1	0.89		1	1	1	0.94	0.98	1	1	1
10	1	1	1	1 .		1	1	1		1	1	1	1	1	1	1	1
11 .		1 .	.		1	1	1	1		1	0.99	1	1	1	1	1	1
12	1 .		1	1 .		1	0.78	1		1	1	1	1	1	1	1	1
13	1 .		1	1	1	1	1	1		1	1	1	1	1	1	1	1
A50	5.98	6.09	6.74	6.24	6.06	6.14	5.73	6.00		5.98	6.17	6.70	6.45	6.75	5.59	6.24	5.82
L 95%	5.73	5.72	6.44	6.03	5.87	5.92	5.42	5.78		5.86	6.02	6.51	6.23	6.47	5.34	5.97	5.51
U 95%	6.19	6.93	7.15	6.55	6.30	6.42	6.09	6.23		6.11	6.33	6.90	6.69	7.02	5.83	6.51	6.22
Slope	3.50	2.34	1.70	2.25	2.32	1.69	1.24	2.46		2.48	2.74	2.22	1.49	1.65	2.34	1.69	1.5
SE	0.74	0.62	0.27	0.34	0.29	0.21	0.15	0.30		0.27	0.27	0.24	0.15	0.22	0.28	0.18	0.21
Int	-20.90	-14.26	-11.48	-14.08	-14.05	-10.37	-7.12	-14.78		-14.86	-16.90	-14.90	-9.62	-11.16	-13.06	-10.56	-8.74
SE	4.48	3.38	1.68	2.00	1.66	1.20	0.83	1.81		1.63	1.66	1.60	0.98	1.53	1.64	1.14	1.12
n	244	184	270	297	471	440	290	481		648	810	606	535	409	567	552	379

Table 22. Model predicted proportion mature at age for female cod in Divisions 3NO from Canadian spring surveys.

		3	4	5	6	7	8	9	10	11	12	13
[1]	1959	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1.0000	1.0000	1.0000
[1]	1960	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1.0000	1.0000	1.0000
[1]	1961	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1.0000	1.0000	1.0000
[1]	1962	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1.0000	1.0000	1.0000
[1]	1963	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1.0000	1.0000	1.0000
[1]	1964	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1.0000	1.0000	1.0000
[1]	1965	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1.0000	1.0000	1.0000
[1]	1966	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1.0000	1.0000	1.0000
[1]	1967	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1.0000	1.0000	1.0000
[1]	1968	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1.0000	1.0000	1.0000
[1]	1969	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1.0000	1.0000	1.0000
[1]	1970	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1.0000	1.0000	1.0000
[1]	1971	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1.0000	1.0000	1.0000
[1]	1972	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1.0000	1.0000	1.0000
[1]	1973	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1.0000	1.0000	1.0000
[1]	1974	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1.0000	1.0000	1.0000
	1975	0.0000	0.0000	0.0230	0.4722	0.9683	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000
	1976	0.0002	0.0075	0.0894	0.3997	0.7985	0.9730	0.9987	1.0000	1.0000	1.0000	1.0000
	1977	0.0002	0.0050	0.0518	0.2488	0.6069	0.8889	0.9850	0.9991	1.0000	1.0000	1.0000
	1978	0.0000	0.0018	0.0541	0.3821	0.8430	0.9897	0.9999	1.0000	1.0000	1.0000	1.0000
	1979	0.0002	0.0070	0.0896	0.4091	0.8114	0.9770	0.9991	1.0000	1.0000	1.0000	1.0000
	1980	0.0015	0.0211	0.1347	0.4298	0.7737	0.9534	0.9954	0.9998	1.0000	1.0000	1.0000
	1981	0.0318	0.1141	0.2895	0.5378	0.7718	0.9184	0.9796	0.9965	0.9996	1.0000	1.0000
	1982	0.0001	0.0053	0.0935	0.4665	0.8752	0.9915	0.9999	1.0000	1.0000	1.0000	1.0000
[2]	1983	0.0001	0.0053	0.0935	0.4665	0.8752	0.9915	0.9999	1.0000	1.0000	1.0000	1.0000
	1984	0.0000	0.0013	0.0666	0.5010	0.9340	0.9987	1.0000	1.0000	1.0000	1.0000	1.0000
	1985	0.0000	0.0017	0.0513	0.3702	0.8340	0.9884	0.9998	1.0000	1.0000	1.0000	1.0000
	1986	0.0000	0.0017	0.0327	0.2258	0.6321	0.9233	0.9941	0.9999	1.0000	1.0000	1.0000
	1987	0.0012	0.0154	0.1014	0.3490	0.6907	0.9168	0.9884	0.9992	1.0000	1.0000	1.0000
	1988	0.0003	0.0059	0.0550	0.2482	0.5940	0.8761	0.9809	0.9986	1.0000	1.0000	1.0000
	1989	0.0004	0.0192	0.2114	0.6795	0.9586	0.9987	1.0000	1.0000	1.0000	1.0000	1.0000
	1990	0.0011	0.0166	0.1156	0.3960	0.7485	0.9456	0.9944	0.9997	1.0000	1.0000	1.0000
	1991	0.0070	0.0565	0.2381	0.5637	0.8493	0.9717	0.9973	0.9999	1.0000	1.0000	1.0000
	1992	0.0001	0.0128	0.2059	0.7223	0.9773	0.9997	1.0000	1.0000	1.0000	1.0000	1.0000
	1993	0.0002	0.0147	0.2066	0.7058	0.9713	0.9994	1.0000	1.0000	1.0000	1.0000	1.0000
	1994	0.0120	0.0576	0.2356	0.6087	0.8870	0.9754	0.9950	0.9990	0.9998	1.0000	1.0000
	1995	0.0207	0.1094	0.4168	0.8061	0.9603	0.9930	0.9988	1.0000	1.0000	1.0000	1.0000
	1996	0.0022	0.0520	0.5757	0.9711	0.9988	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1997	0.0239	0.1541	0.5755	0.9098	0.9869	0.9982	0.9998	1.0000	1.0000	1.0000	1.0000
	1998	0.0131	0.1336	0.6409	0.9538	0.9958	0.9996	1.0000	1.0000	1.0000	1.0000	1.0000

[1] Ogive for 1959 - 74 calculated as the mean of 1975-79
[2] Ogive for 1983 is the 1982 ogive

Table 23. Catch-at-age used in this assessment for Divisions 3NO cod, 1959-1998 (000s) .

	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	0.03	0.07
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											

Table 24. Estimated survivors and catchabilities in linear scale from ADAPT

	Year age	PAR. EST.	STD. ERR.	REL. ERR.	BIAS	REL. BIAS
Survivors	95 12	42	22.90	0.55	5	0.117
	96 12	27	10.60	0.40	2	0.071
	97 12	60	21.60	0.36	4	0.061
	98 12	87	33.10	0.38	6	0.067
	99 3	113	74.50	0.66	25	0.225
	4	113	53.80	0.48	13	0.118
	5	437	176.00	0.40	37	0.084
	6	297	107.00	0.36	20	0.067
	7	136	43.30	0.32	7	0.053
	8	64	22.50	0.35	4	0.06
	9	394	131.00	0.33	22	0.056
	10	568	184.00	0.32	29	0.051
	11	62	20.20	0.33	3	0.052
	12	44	17.50	0.40	3	0.07
Survey Catchabilities						
	2	0.0016	0.0004	0.24	0.00004	0.02
Spring	3	0.0018	0.0004	0.24	0.00004	0.02
	4	0.0008	0.0002	0.23	0.00002	0.02
	5	0.0005	0.0001	0.24	0.00001	0.02
	6	0.0003	0.0001	0.24	0.00001	0.02
	7	0.0003	0.0001	0.24	0.00001	0.02
	8	0.0003	0.0001	0.24	0.00001	0.03
	9	0.0004	0.0001	0.24	0.00001	0.03
	10	0.0005	0.0001	0.24	0.00002	0.03
Fall	2	0.0020	0.0007	0.32	0.00009	0.04
	3	0.0013	0.0004	0.31	0.00005	0.04
	4	0.0010	0.0003	0.31	0.00004	0.04
	5	0.0007	0.0002	0.31	0.00003	0.04
	6	0.0006	0.0002	0.31	0.00003	0.04
	7	0.0004	0.0001	0.32	0.00002	0.04
	8	0.0004	0.0001	0.32	0.00002	0.05
	9	0.0004	0.0001	0.34	0.00003	0.06
	10	0.0006	0.0002	0.35	0.00004	0.07
Juv	2	0.0038	0.0014	0.37	0.00023	0.06
	3	0.0020	0.0007	0.36	0.00012	0.06
	4	0.0014	0.0005	0.36	0.00009	0.06
	5	0.0012	0.0004	0.37	0.00007	0.06
	6	0.0009	0.0003	0.37	0.00005	0.06
	7	0.0007	0.0002	0.37	0.00004	0.06
	8	0.0005	0.0002	0.38	0.00003	0.06
	9	0.0004	0.0001	0.38	0.00003	0.07
	10	0.0004	0.0001	0.38	0.00003	0.08

Table 25. Estimated bias adjusted population numbers from ADAPT for cod in NAFO Division 3NO.

	2	3	4	5	6	7	8	9	10	11	12	2+
1959	63623	53067	92911	19327	16484	12049	4268	3076	3217	2287	324	270,633
1960	98989	52090	41903	64326	11271	8099	6336	2246	1838	1803	786	289,687
1961	130098	81045	40981	28451	32902	6449	4497	2947	1315	1157	675	330,517
1962	94606	106515	65621	29586	12832	13314	3473	2185	1652	900	925	331,609
1963	135041	77456	86281	50223	22233	9081	7673	2149	1189	964	534	392,824
1964	195488	110562	63133	65447	31040	13843	5695	2858	722	432	500	489,720
1965	252970	160052	84924	37711	36087	18299	9287	3665	1632	298	320	605,245
1966	221171	207114	130125	62667	24021	17671	6202	3302	2030	239	99	674,641
1967	121541	181079	168890	89951	33653	9146	6895	1137	1076	183	87	613,638
1968	154110	99509	130150	82351	28883	11073	3234	1531	719	719	86	512,365
1969	96818	126175	66742	55815	24240	7265	3431	1228	801	429	508	383,452
1970	101648	79267	95947	43016	21651	9853	4073	1563	542	394	231	358,185
1971	74516	83222	62998	60832	25515	9253	4801	1872	795	310	121	324,235
1972	42186	61009	67279	27529	22783	10441	4442	1704	1083	471	164	239,091
1973	44119	34539	49887	37315	11560	6720	3316	2127	1138	693	316	191,730
1974	27757	36122	19250	16284	17043	4127	3733	1842	1108	713	444	128,423
1975	32948	22725	23791	7286	3682	4318	1379	1147	605	307	204	98,392
1976	54533	26976	18000	11614	2818	800	836	198	132	90	31	116,028
1977	49925	44648	18435	8000	4210	1337	465	471	123	75	62	127,751
1978	20848	40875	36007	12869	4279	2103	583	222	199	43	25	118,053
1979	23648	17069	32635	25571	8271	2768	1403	385	130	117	28	112,025
1980	32997	19361	13910	23270	12687	4276	1474	910	263	91	85	109,324
1981	26047	27015	15611	10437	15620	8339	2816	1007	662	188	67	107,809
1982	42348	21326	21662	11797	7408	10719	5118	1789	652	457	117	123,393
1983	49724	34672	17185	15952	8225	5153	7400	2851	931	344	229	142,666
1984	38849	40710	27322	13486	11354	5650	3601	5021	1639	549	209	148,390
1985	10520	31807	33278	21467	9769	7206	3529	2301	3285	848	354	124,364
1986	7734	8613	25990	24583	12008	5275	3642	2172	1471	2209	460	94,157
1987	15438	6332	6913	18696	14357	5916	2961	2130	1277	869	1495	76,384
1988	15338	12464	4719	5279	12165	8658	3753	1837	988	604	356	66,161
1989	6127	12326	9954	3576	2952	4305	3557	2166	995	429	271	46,658
1990	6779	4902	8366	6188	1585	1290	1838	1762	1338	606	201	34,855
1991	23281	5180	3056	2838	1233	502	678	860	921	702	361	39,612
1992	7400	13646	3249	1897	1432	523	160	227	201	307	233	29,275
1993	696	5984	7130	1085	805	625	218	74	98	51	115	16,881
1994	404	540	3718	2971	323	234	226	112	38	45	0	8,611
1995	694	331	235	981	1432	152	108	161	85	30	37	4,246
1996	785	568	271	128	785	1137	123	89	131	69	25	4,111
1997	154	641	462	217	102	627	908	98	71	105	56	3,441
1998	108	125	514	362	168	79	486	703	76	54	81	2,756
1999	235	87	99	400	277	129	60	372	538	58	41	2,296
geomean												

Table26 Bias adjusted fishing mortality from ADAPT for cod in NAFO Divisions 3NO.

f adjust	2	3	4	5	6	7	8	9	10	11	12	FBAR 6-9
1959	0	0.036	0.168	0.339	0.511	0.443	0.442	0.315	0.379	0.868	0.428	0.428
1960	0	0.04	0.187	0.47	0.358	0.388	0.566	0.335	0.263	0.782	0.412	0.412
1961	0	0.011	0.126	0.596	0.705	0.419	0.522	0.379	0.179	0.024	0.506	0.506
1962	0	0.011	0.067	0.086	0.146	0.351	0.28	0.408	0.339	0.322	0.296	0.296
1963	0	0.004	0.076	0.281	0.274	0.267	0.788	0.891	0.813	0.456	0.555	0.555
1964	0	0.064	0.315	0.395	0.328	0.199	0.241	0.36	0.684	0.099	0.282	0.282
1965	0	0.007	0.104	0.251	0.514	0.882	0.834	0.391	1.721	0.902	0.655	0.655
1966	0	0.004	0.169	0.422	0.766	0.741	1.496	0.921	2.208	0.811	0.981	0.981
1967	0	0.13	0.518	0.936	0.912	0.839	1.305	0.259	0.203	0.553	0.829	0.829
1968	0	0.199	0.647	1.023	1.18	0.972	0.768	0.448	0.317	0.148	0.842	0.842
1969	0	0.074	0.239	0.747	0.7	0.379	0.586	0.618	0.509	0.419	0.571	0.571
1970	0	0.03	0.256	0.322	0.65	0.519	0.578	0.476	0.359	0.983	0.556	0.556
1971	0	0.013	0.628	0.782	0.694	0.534	0.836	0.347	0.323	0.436	0.603	0.603
1972	0	0.001	0.389	0.668	1.021	0.947	0.536	0.203	0.247	0.201	0.677	0.677
1973	0	0.385	0.92	0.584	0.83	0.388	0.388	0.453	0.267	0.245	0.515	0.515
1974	0	0.218	0.772	1.287	1.173	0.896	0.98	0.913	1.084	1.052	0.991	0.991
1975	0	0.033	0.517	0.75	1.327	1.441	1.74	1.96	1.705	2.097	1.617	1.617
1976	0	0.181	0.611	0.815	0.546	0.342	0.374	0.28	0.366	0.173	0.385	0.386
1977	0	0.015	0.159	0.426	0.494	0.63	0.538	0.662	0.859	0.899	0.581	0.581
1978	0	0.025	0.142	0.242	0.236	0.205	0.214	0.337	0.33	0.232	0.248	0.248
1979	0	0.005	0.138	0.501	0.46	0.43	0.233	0.181	0.155	0.12	0.326	0.326
1980	0	0.015	0.087	0.199	0.22	0.218	0.181	0.118	0.139	0.102	0.184	0.184
1981	0	0.021	0.08	0.143	0.176	0.288	0.254	0.235	0.17	0.274	0.238	0.238
1982	0	0.016	0.106	0.161	0.163	0.171	0.385	0.453	0.438	0.49	0.293	0.293
1983	0	0.038	0.042	0.14	0.176	0.158	0.188	0.354	0.329	0.299	0.219	0.219
1984	0	0.002	0.041	0.122	0.255	0.271	0.248	0.224	0.459	0.239	0.249	0.250
1985	0	0.002	0.103	0.381	0.416	0.482	0.285	0.247	0.197	0.411	0.358	0.358
1986	0	0.02	0.129	0.338	0.508	0.377	0.336	0.331	0.326	0.191	0.388	0.388
1987	0.014	0.094	0.07	0.23	0.306	0.255	0.277	0.568	0.55	0.692	0.352	0.352
1988	0.019	0.025	0.077	0.381	0.839	0.69	0.349	0.413	0.634	0.599	0.573	0.573
1989	0.023	0.188	0.275	0.614	0.628	0.651	0.503	0.282	0.297	0.559	0.516	0.516
1990	0.069	0.272	0.881	1.413	0.95	0.444	0.56	0.448	0.445	0.317	0.601	0.601
1991	0.334	0.266	0.277	0.484	0.657	0.943	0.892	1.253	0.897	0.9	0.936	0.936
1992	0.012	0.449	0.896	0.657	0.629	0.674	0.575	0.645	1.168	0.781	0.631	0.631
1993	0.054	0.276	0.675	1.013	1.036	0.819	0.464	0.465	0.573	5.045	0.696	0.696
1994	0	0.633	1.132	0.53	0.551	0.57	0.136	0.082	0.03	0.001	0.335	0.335
1995	0	0	0.409	0.023	0.031	0.015	0	0.007	0	0	0	0.013
1996	0.003	0.008	0.021	0.026	0.024	0.025	0.027	0.025	0.026	0.016	0	0.025
1997	0.007	0.021	0.044	0.057	0.056	0.056	0.056	0.058	0.064	0.054	0.061	0.057
1998	0.01	0.027	0.051	0.066	0.068	0.072	0.066	0.066	0.06	0.085	0.07	0.068

		2	3	4	5	6	7	8	9	10	11	12	mean 6-9
mean f	1959-81	0.000	0.066	0.318	0.533	0.618	0.553	0.638	0.500	0.592	0.530	0.577	0.577
	1982-93	0.044	0.137	0.298	0.495	0.547	0.495	0.422	0.474	0.526	0.877	0.484	0.484
	1994-98	0.004	0.138	0.331	0.140	0.146	0.148	0.057	0.048	0.036	0.031	0.093	0.041
Pr	1959-81	0.00	0.11	0.55	0.92	1	1	1	1	1	1	1	
	1982-93	0.09	0.28	0.61	1.02	1	1	1	1	1	1	1	
	1994-98												

Table 27. Beginning of year mean weights at age calculated form the commercial catches for cod in Divisions 3NO.
Mean weights for 1995 are used in 1996-99 ages 3-11. Mean weight for age 12 and 13 are from 1994.

	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	13
1959	0.301	0.664	1.001	1.622	2.572	3.129	3.670	4.419	4.843	5.691	6.689
1960	0.301	0.587	1.012	1.561	2.345	3.092	3.673	4.316	4.957	5.691	6.689
1961	0.301	0.587	1.012	1.561	2.345	3.092	3.673	4.316	4.957	5.691	6.689
1962	0.301	0.587	1.012	1.561	2.345	3.092	3.673	4.316	4.957	5.691	6.689
1963	0.301	0.587	1.012	1.561	2.345	3.092	3.673	4.316	4.957	5.691	6.689
1964	0.301	0.587	1.012	1.561	2.345	3.092	3.673	4.316	4.957	5.691	6.689
1965	0.301	0.587	1.012	1.561	2.345	3.092	3.673	4.316	4.957	5.691	6.689
1966	0.287	0.615	1.052	1.636	2.482	3.446	4.636	5.532	6.292	7.332	5.192
1967	0.351	0.657	1.102	1.700	2.600	3.647	5.166	6.982	8.066	9.308	11.266
1968	0.351	0.657	1.102	1.700	2.600	3.647	5.166	6.982	8.066	9.308	11.266
1969	0.351	0.657	1.102	1.700	2.600	3.647	5.166	6.982	8.066	9.308	11.266
1970	0.351	0.657	1.102	1.700	2.600	3.647	5.166	6.982	8.066	9.308	11.266
1971	0.351	0.657	1.102	1.700	2.600	3.647	5.166	6.982	8.066	9.308	11.266
1972	0.338	0.682	1.138	1.676	2.487	3.354	5.005	7.100	7.999	9.262	11.321
1973	0.397	0.735	1.178	1.776	2.748	3.658	4.717	7.542	9.423	10.789	9.530
1974	0.504	0.645	1.095	1.674	2.503	4.117	5.822	5.842	8.961	9.159	21.369
1975	0.289	0.611	0.967	1.599	2.481	3.449	5.082	7.024	5.364	7.717	7.308
1976	0.246	0.588	1.120	1.727	2.631	3.557	5.268	6.952	7.849	8.113	6.196
1977	0.354	0.707	1.161	1.870	2.860	3.925	5.375	7.666	10.112	10.239	15.236
1978	0.420	0.774	1.245	1.825	3.046	4.023	5.417	7.200	9.139	12.271	10.721
1979	0.617	0.840	1.208	1.800	2.541	3.720	4.679	6.653	7.596	9.790	16.919
1980	0.514	0.822	1.287	1.864	2.777	3.969	5.434	6.618	8.706	10.031	10.189
1981	0.531	0.950	1.383	2.132	2.979	4.435	6.256	8.522	9.114	10.373	15.330
1982	0.789	1.026	1.380	2.012	3.210	4.321	6.318	7.921	9.453	10.519	9.794
1983	0.843	1.049	1.479	1.986	2.891	4.463	5.743	7.779	8.894	10.398	14.503
1984	0.731	0.989	1.329	2.065	2.828	3.923	5.473	6.728	8.490	10.647	11.385
1985	0.757	0.824	1.255	1.759	2.722	3.760	5.178	6.923	8.128	9.964	15.959
1986	0.331	0.696	1.143	1.720	2.675	4.193	6.080	8.063	9.094	9.508	13.029
1987	0.269	0.566	1.146	1.668	2.498	4.076	6.267	8.435	9.835	11.187	8.726
1988	0.343	0.700	1.064	1.525	2.020	3.301	4.937	7.067	9.158	10.442	15.180
1989	0.646	0.847	1.265	1.758	2.419	3.206	5.166	6.523	8.072	10.714	11.438
1990	0.362	0.718	1.190	2.004	2.473	3.679	4.811	7.698	8.786	10.322	14.539
1991	0.442	0.684	1.267	1.832	3.101	3.896	5.583	6.737	10.014	11.396	11.106
1992	0.506	0.598	0.949	1.692	2.547	4.310	5.560	7.480	8.838	11.295	17.303
1993	0.215	0.507	0.937	1.397	2.253	3.404	5.336	6.569	8.081	8.655	13.105
1994	0.318	0.407	0.842	1.483	1.840	3.375	4.506	6.653	5.167	8.130	9.246
1995	0.326	0.229	0.520	0.983	1.791	1.840	4.836	5.416	8.546	8.130	9.246
1996	0.326	0.229	0.520	0.983	1.791	1.840	4.836	5.416	8.546	8.130	9.246
1997	0.326	0.229	0.520	0.983	1.791	1.840	4.836	5.416	8.546	8.130	9.246
1998	0.326	0.229	0.520	0.983	1.791	1.840	4.836	5.416	8.546	8.130	9.246
1999	0.326	0.229	0.520	0.983	1.791	1.840	4.836	5.416	8.546	8.130	9.246

Table 28. Estimated biomass using beginning of the year weights and bias adjusted population numbers from ADAPT for cod in NAFO Divisions 3NO.

	2	3	4	5	6	7	8	9	10	11	12	3+	6+
1959		15951	61707	19342	26729	30990	13353	11290	14215	11075	1844	206,497.32	109,497
1960		15657	24591	65125	17597	18992	19590	8250	7932	8937	4473	191,145.84	85,772
1961		24361	24050	28804	51368	15123	13904	10825	5675	5735	3842	183,687.54	106,472
1962		32017	38510	29954	20034	31221	10738	8026	7130	4461	5265	187,355.12	86,875
1963		23282	50635	50847	34711	21295	23724	7894	5132	4778	3039	225,336.55	100,573
1964		33233	37050	66260	48461	32462	17608	10498	3116	2141	2846	253,675.57	117,132
1965		48109	49838	38179	56341	42911	28714	13462	7043	1477	1821	287,897.12	151,770
1966		59424	80003	65934	39287	43865	21370	15308	11231	1504	726	338,652.40	133,291
1967		63476	111006	99150	57200	23784	25149	5874	7513	1476	810	395,438.03	121,806
1968		34882	85543	90773	49093	28795	11796	7910	5020	5799	800	320,411.61	109,213
1969		44230	43867	61523	41201	18892	12514	6344	5593	3460	4728	242,353.43	92,733
1970		27786	63063	47415	36800	25622	14856	8075	3784	3178	2150	232,730.60	94,466
1971		29173	41407	67053	43368	24062	17511	9671	5551	2500	1126	241,423.06	103,790
1972		20600	45908	31340	38178	25966	14899	8528	7689	3767	1519	198,392.94	100,545
1973		13706	36659	43948	20529	18465	12130	10033	8583	6530	3409	173,992.05	79,679
1974		18194	12417	17838	28533	10329	15370	10723	6473	6389	4067	130,332.41	81,883
1975		6557	14546	7043	5887	10712	4757	5829	4250	1647	1574	62,800.06	34,655
1976		6624	10585	13010	4867	2105	2974	1043	918	706	252	43,083.18	12,864
1977		15785	13036	9284	7873	3824	1825	2532	943	758	635	56,494.23	18,389
1978		17166	27856	16022	7808	6405	2345	1203	1433	393	307	80,937.42	19,893
1979		10534	27413	30892	14887	7034	5219	1802	865	889	274	99,808.62	30,969
1980		9949	11437	29947	23650	11875	5851	4945	1740	792	853	101,038.75	49,706
1981		14341	14824	14438	33304	24843	12488	6300	5641	1714	695	128,588.58	84,986
1982		16834	22229	16282	14905	34406	22116	11304	5165	4320	1231	148,789.99	93,445
1983		29213	18022	23595	16337	14899	33024	16373	7243	3060	2381	164,147.00	93,316
1984		29750	27013	17925	23444	15976	14127	27479	11028	4661	2225	173,627.35	98,940
1985		24083	27430	26945	17188	19616	13268	11914	22741	6892	3527	173,604.61	95,147
1986		2850	18096	28106	20657	14110	15271	13206	11860	20089	4374	148,618.86	99,566
1987		1703	3909	21423	23945	14781	12069	13349	10772	8547	16724	127,221.35	100,186
1988		4275	3303	5616	18557	17490	12388	9069	6983	5531	3717	86,929.33	73,735
1989		7967	8433	4523	5190	10415	11405	11190	6490	3463	2903	71,980.53	51,057
1990		1777	6004	7364	3176	3190	6763	8476	10300	5325	2075	54,449.35	39,305
1991		2292	2090	3596	2259	1556	2641	4802	6204	7030	4114	36,584.74	28,607
1992		6904	1943	1801	2423	1332	690	1262	1503	2713	2632	23,201.86	12,555
1993		1284	3617	1016	1124	1408	742	395	644	412	995	11,638.76	5,721
1994		172	1513	2503	479	431	763	505	253	232	0	6,850.53	2,662
1995		108	54	510	1408	272	199	779	460	256	301	4,346.29	3,675
1996		185	62	67	772	2036	226	430	709	590	203	5,280.86	4,967
1997		209	106	113	100	1123	1671	474	385	897	455	5,532.52	5,105
1998		41	118	188	165	141	894	3399	412	461	659	6,478.52	6,132
1999		28	23	208	272	231	110	1799	2914	496	333	6,414.29	6,155

Table 29. Estimated spawner biomass using annual ogives, beginning of the year weights and bias adjusted population numbers from ADAPT for cod in NAFO Division 3NO.

spawners	3	4	5	6	7	8	9	10	11	12	SSB
1959	2	263	1191	10221	24966	12895	11251	14212	11075	1844	87921
1960	2	105	4010	6729	15300	18918	8221	7931	8937	4473	74628
1961	3	102	1774	19642	12183	13427	10787	5674	5735	3842	73170
1962	4	164	1845	7661	25152	10370	7998	7128	4461	5265	70048
1963	3	216	3131	13273	17156	22910	7866	5131	4778	3039	77503
1964	4	158	4080	18531	26152	17004	10462	3115	2141	2846	84493
1965	6	212	2351	21544	34570	27730	13416	7042	1477	1821	110168
1966	7	341	4060	15023	35339	20637	15255	11229	1504	726	104120
1967	8	473	6106	21872	19161	24286	5854	7512	1476	810	87557
1968	4	364	5590	18772	23198	11391	7882	5019	5799	800	78821
1969	5	187	3789	15754	15220	12085	6322	5592	3460	4728	67143
1970	3	269	2920	14072	20642	14346	8047	3784	3178	2150	69411
1971	4	176	4129	16583	19385	16911	9638	5550	2500	1126	76002
1972	2	196	1930	14598	20918	14388	8499	7687	3767	1519	73505
1973	2	156	2706	7850	14876	11714	9998	8581	6530	3409	65823
1974	2	53	1098	10910	8321	14843	10686	6471	6389	4067	62841
1975	0	0	162	2780	10373	4756	5829	4250	1647	1574	31370
1976	1	79	1163	1945	1681	2894	1042	918	706	252	10681
1977	3	65	481	1959	2320	1622	2494	942	758	635	11280
1978	0	50	867	2984	5399	2321	1202	1433	393	307	14956
1979	2	192	2768	6090	5707	5099	1800	865	889	274	23686
1980	15	241	4034	10165	9187	5578	4922	1740	792	853	37528
1981	456	1691	4180	17911	19174	11469	6172	5622	1713	695	69082
1982	2	118	1522	6953	30112	21928	11302	5165	4320	1231	82653
1983	3	96	2206	7621	13040	32744	16371	7243	3060	2381	84764
1984	0	35	1194	11746	14921	14108	27479	11028	4661	2225	87397
1985	0	47	1382	6363	16359	13114	11912	22741	6892	3527	82338
1986	0	31	919	4664	8919	14100	13128	11859	20089	4374	78082
1987	2	60	2172	8357	10209	11064	13194	10763	8547	16724	81093
1988	1	19	309	4606	10389	10853	8896	6973	5531	3717	51295
1989	3	162	956	3527	9984	11390	11190	6490	3463	2903	50069
1990	2	100	851	1258	2388	6395	8429	10297	5325	2075	37118
1991	16	118	856	1274	1322	2567	4789	6204	7030	4114	28289
1992	1	25	371	1750	1302	689	1262	1503	2713	2632	12248
1993	0	53	210	793	1368	742	395	644	412	995	5612
1994	2	87	590	292	382	744	502	253	232	0	3084
1995	2	6	213	1135	261	197	778	460	256	301	3609
1996	0	3	38	749	2034	226	430	709	590	203	4984
1997	5	16	65	91	1108	1668	474	385	897	455	5164
1998	1	16	121	158	141	894	3399	412	461	659	6260
1999	0	3	133	260	230	110	1799	2914	496	333	6278

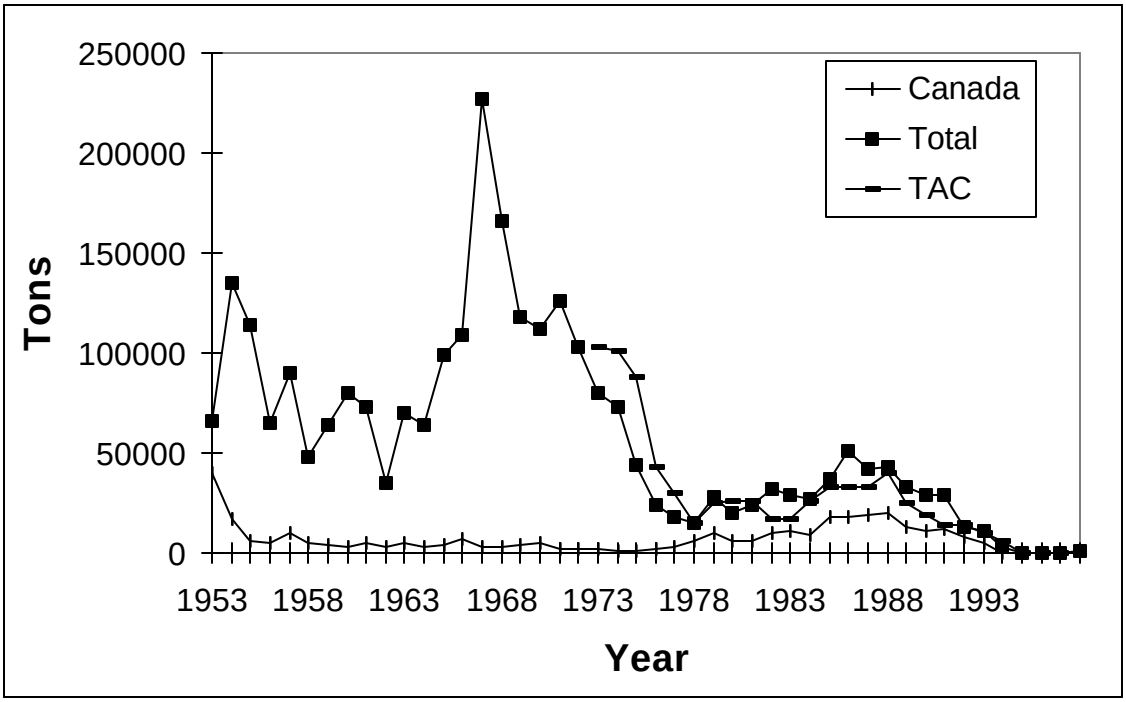


Fig. 1 Landings of cod in NAFO Divisions 3NO from 1953-1996.

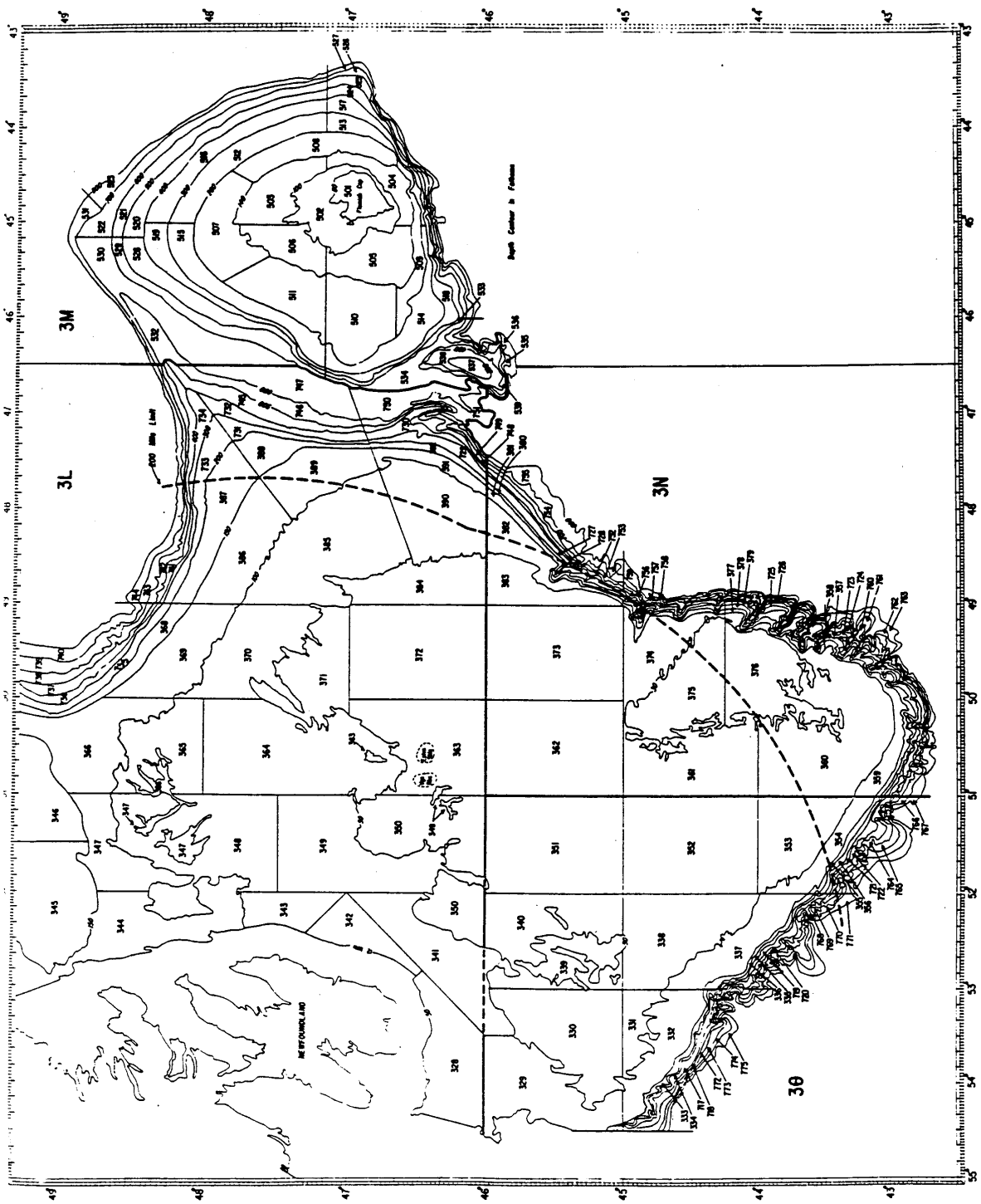


Fig 2. Stratification scheme for Divisions 3LMNO.

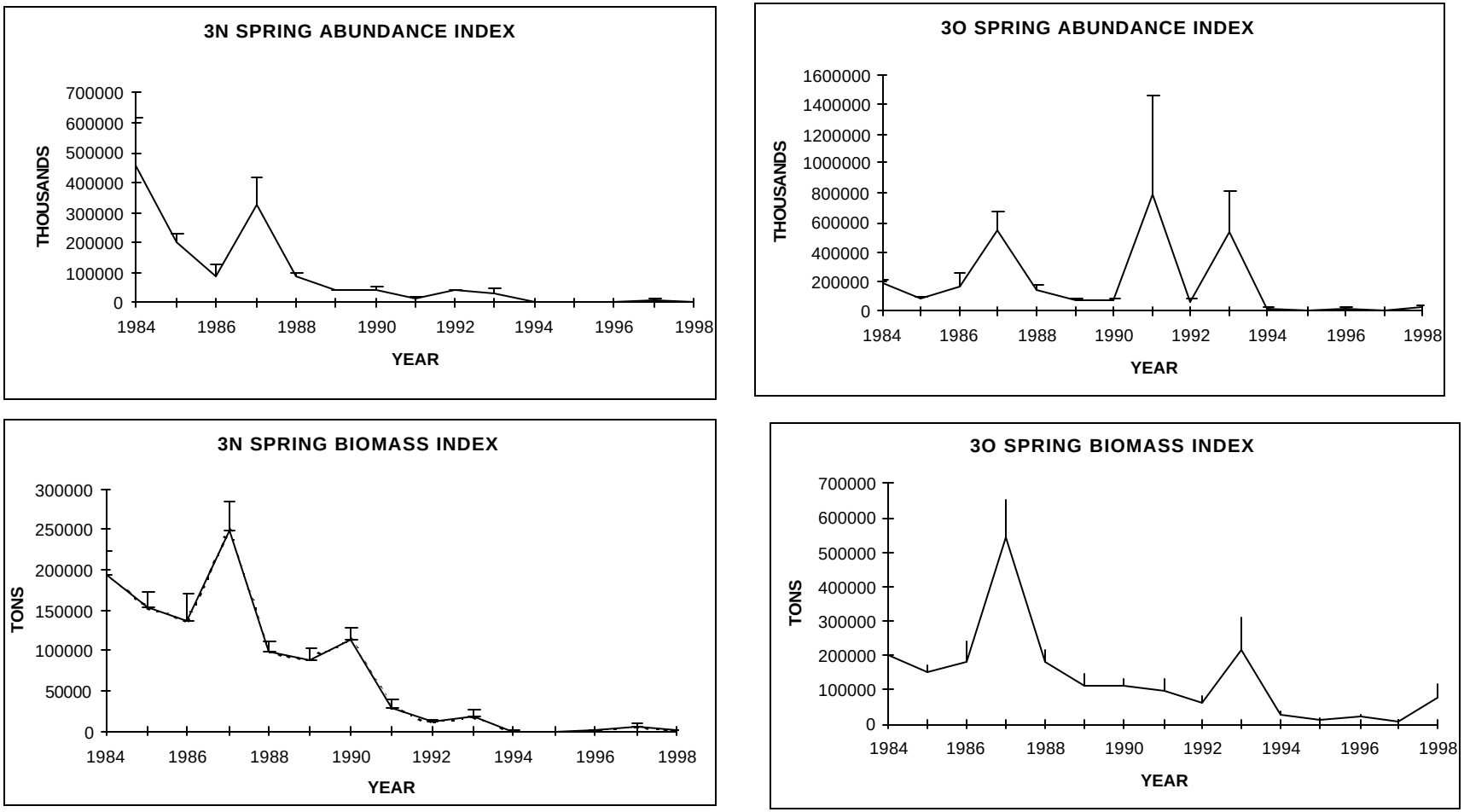


Figure 3. Abundance (000's) and biomass (t) for the Canadian Spring Research Vessel survey series with 1 standard deviation.

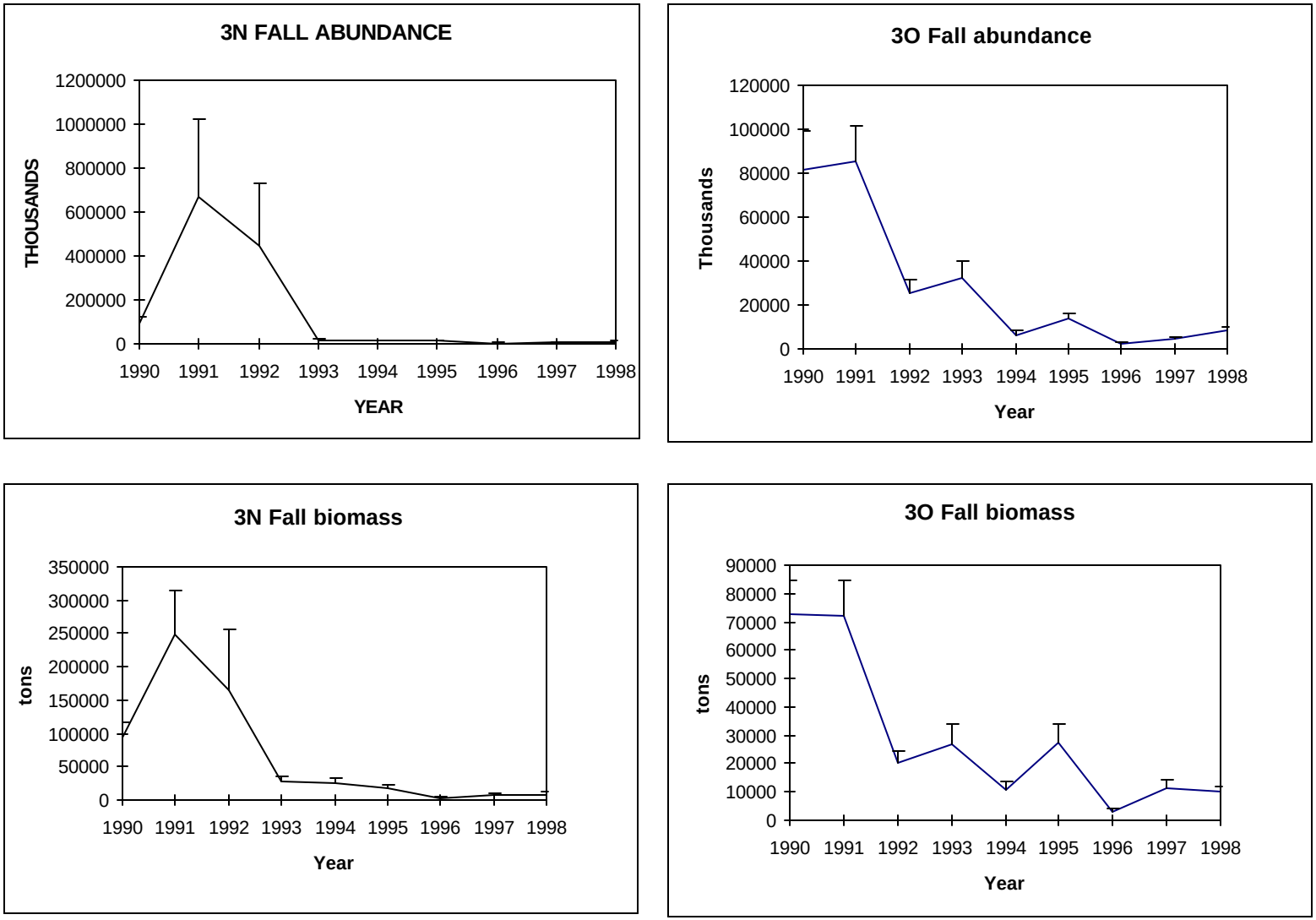


Fig. 4 Abundance (000's) and biomass (t) for the Canadian fall research vessel survey series. Vertical bars indicate 1 standard deviation.

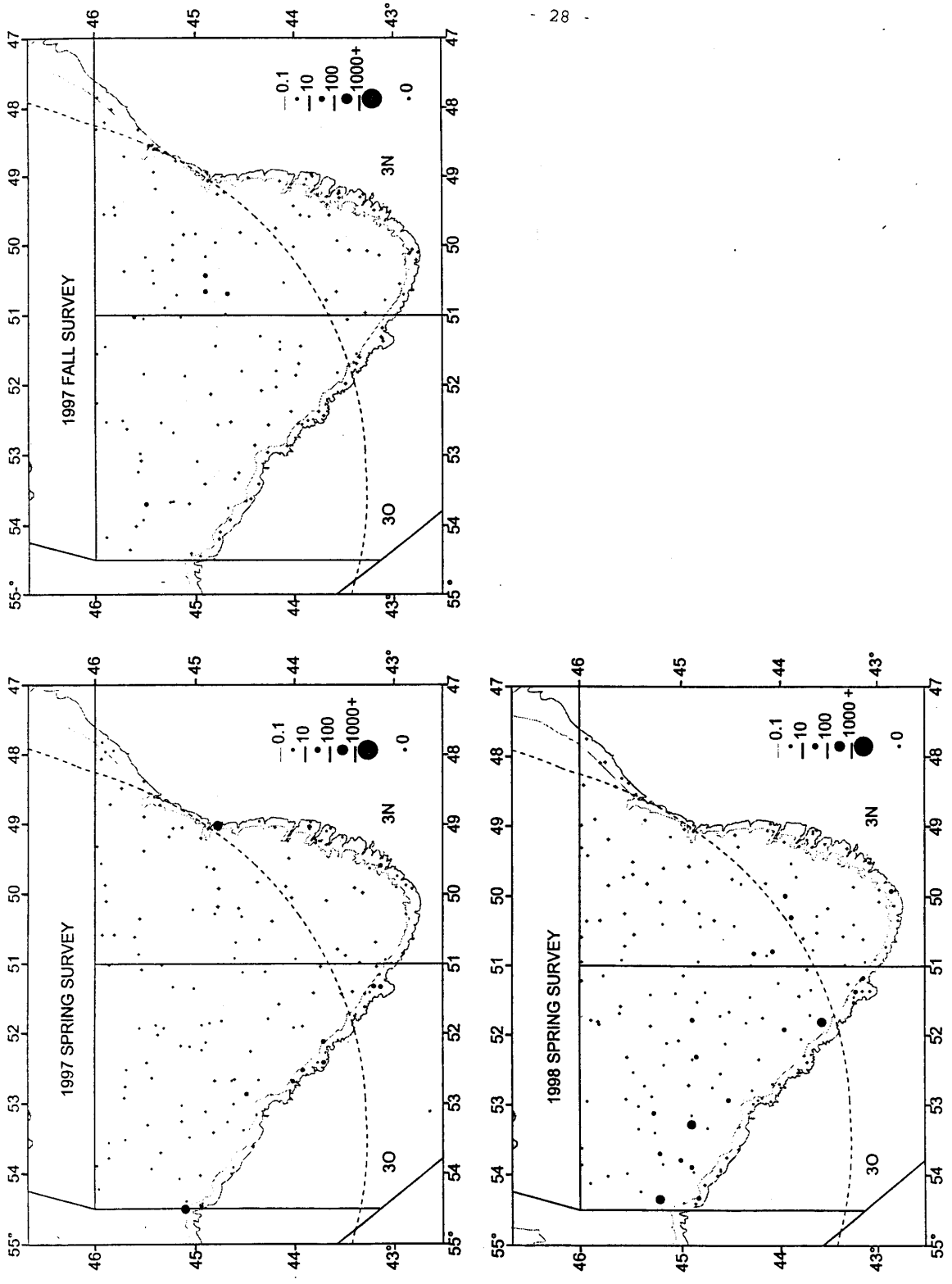


Fig 5 . Cod distribution number per tow.

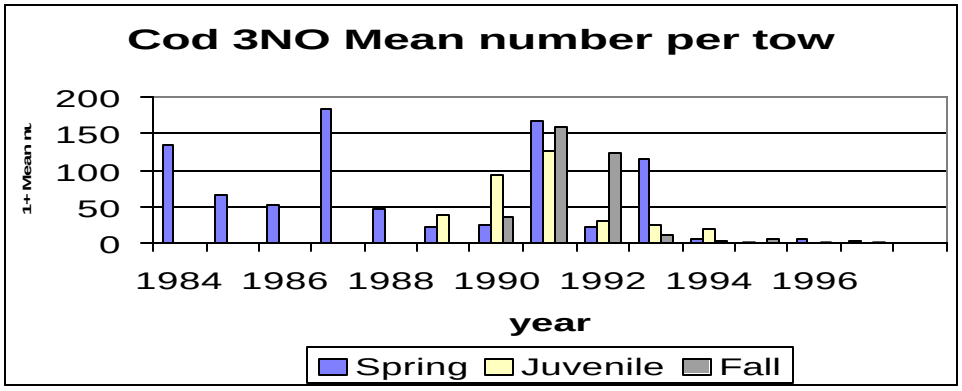


Fig. 6. Spring and autumn Canadian RV estimates of 1+ mean number/tow of cod in Divisions 3NO.

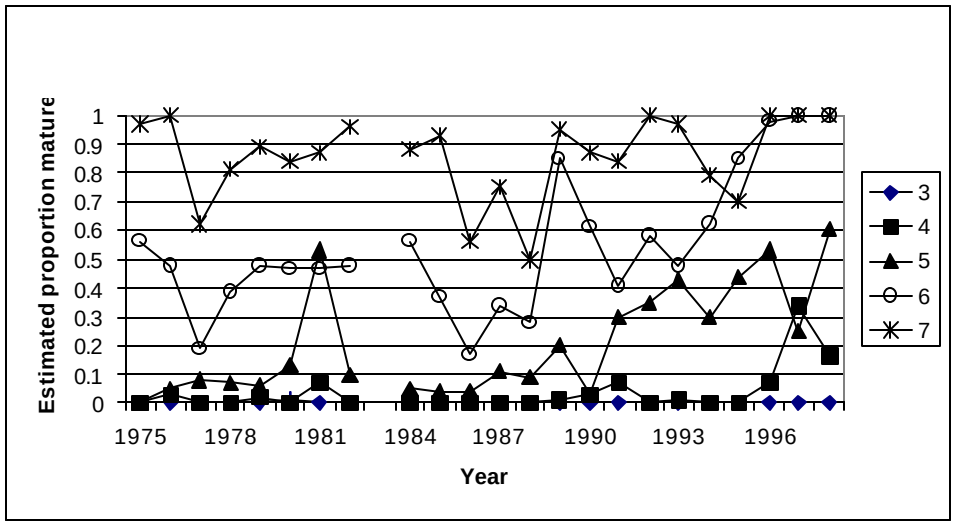


Fig. 7. Estimated proportion mature at ages 3-7 for female cod in NAFO Divisions 3NO for 1975 to 1998.

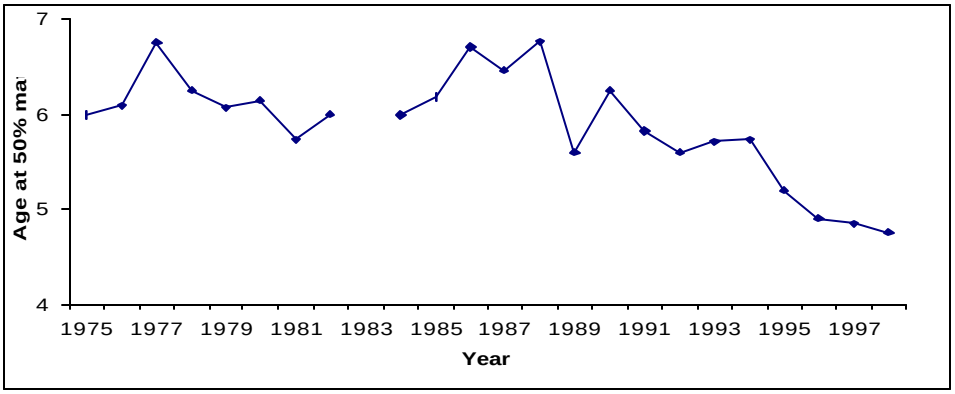


Fig. 8. Age at 50% maturity for female cod in NAFO Divisions 3NO.

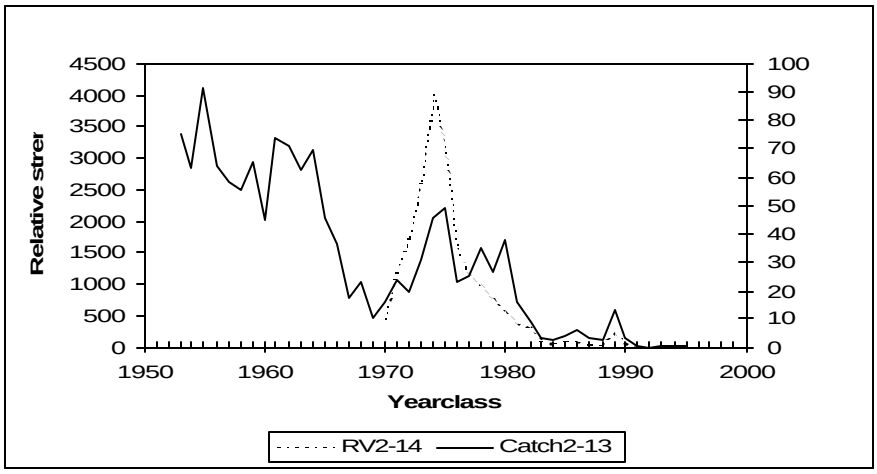
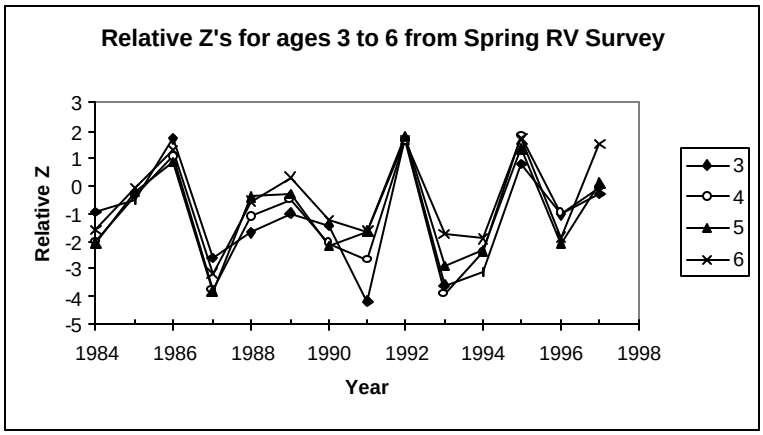


Fig. 9. Relative yearclass strength from general linear models fitted to the log-transformed research vessel and catch at age. Estimates are back transformed and bias corrected.



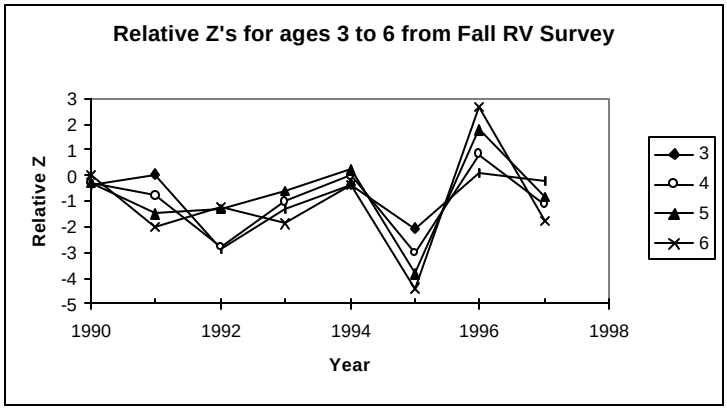


Fig. 10. Estimates of Z from spring and fall Canadian RV survey mean numbers per tow at age for ages 3 to 7.

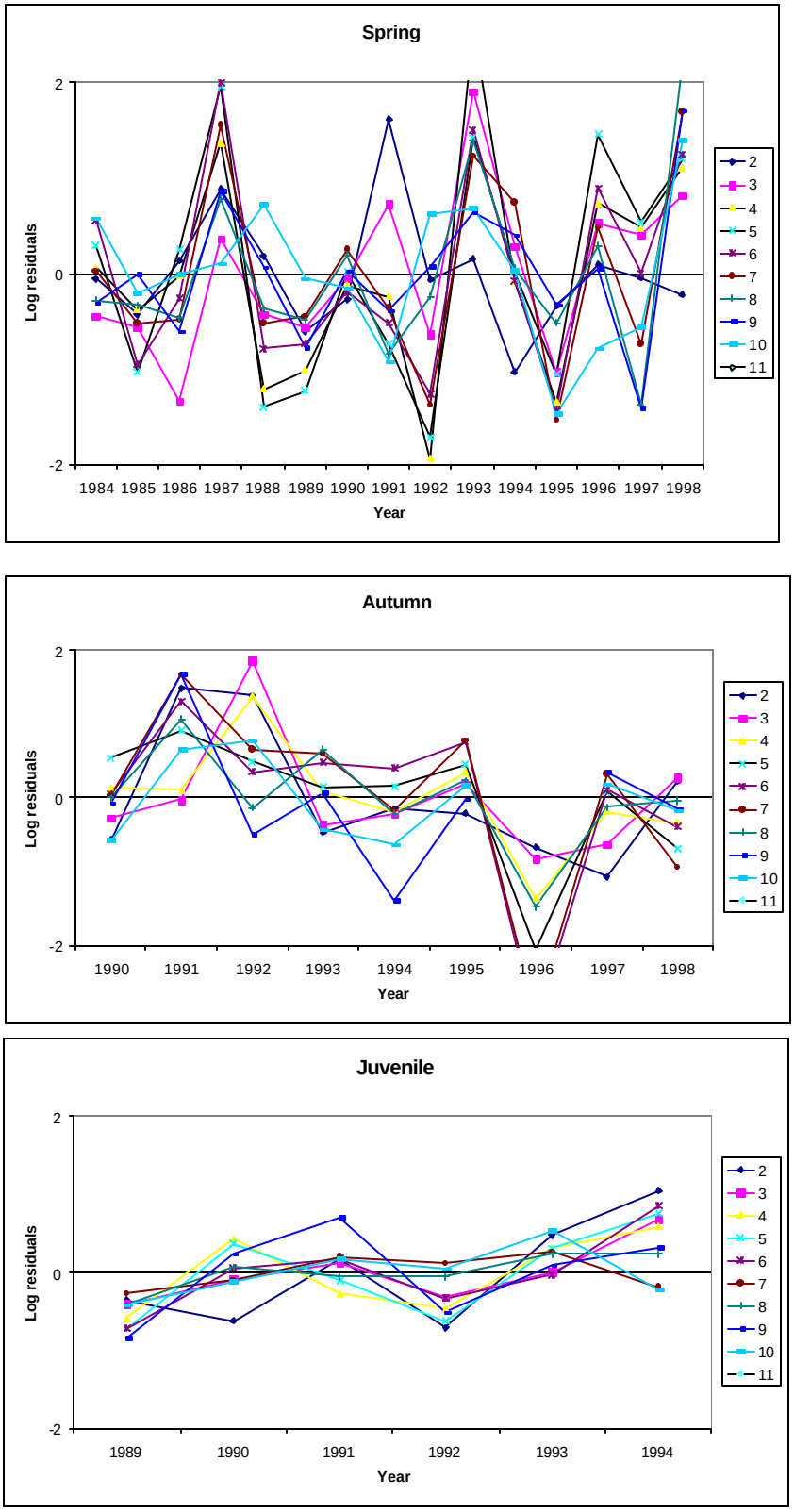


Fig. 11. Log residuals from ADAPT for three Canadian research vessel surveys.

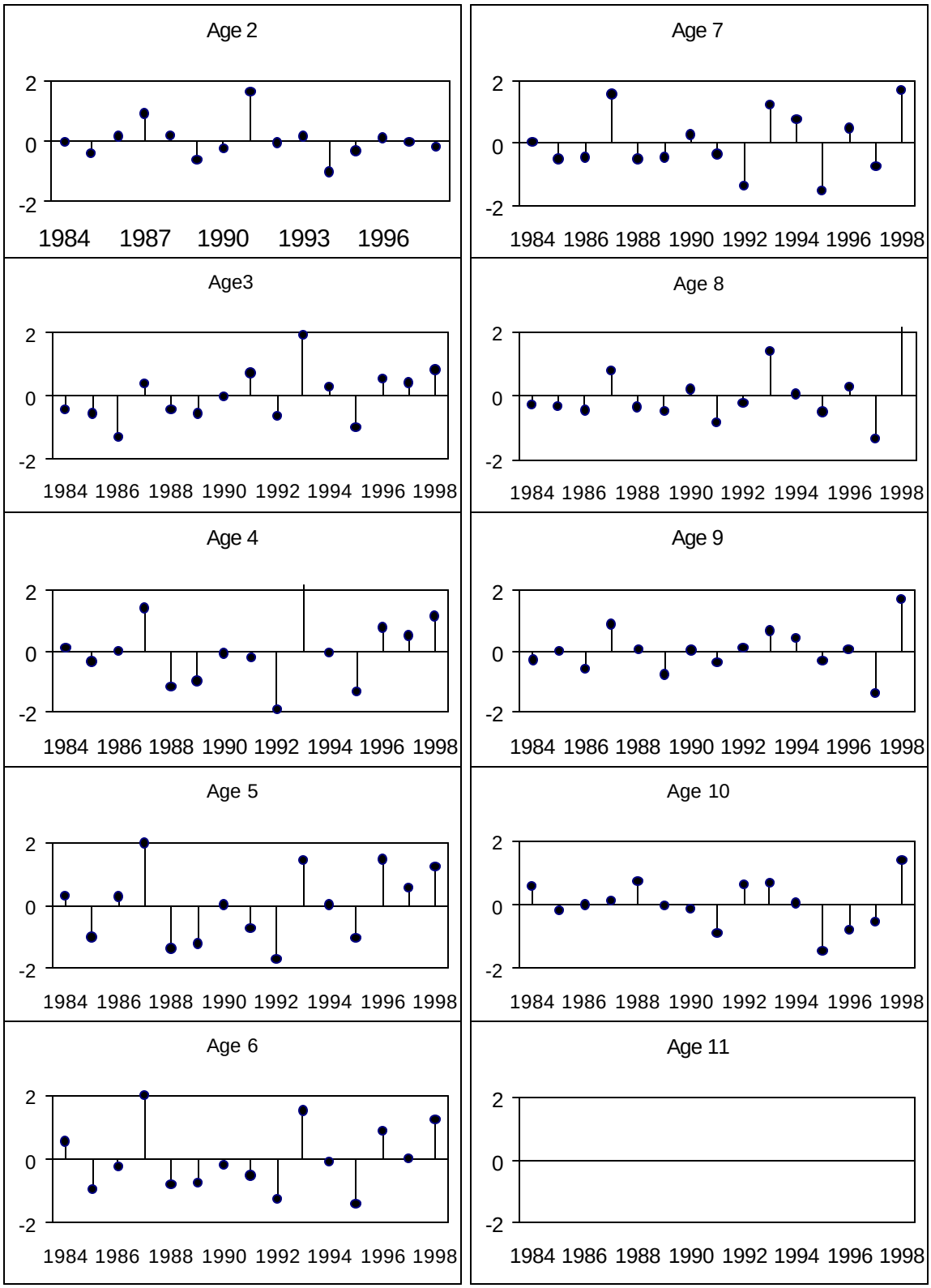


Fig. 12. Age by age log residuals from Canadian spring surveys.

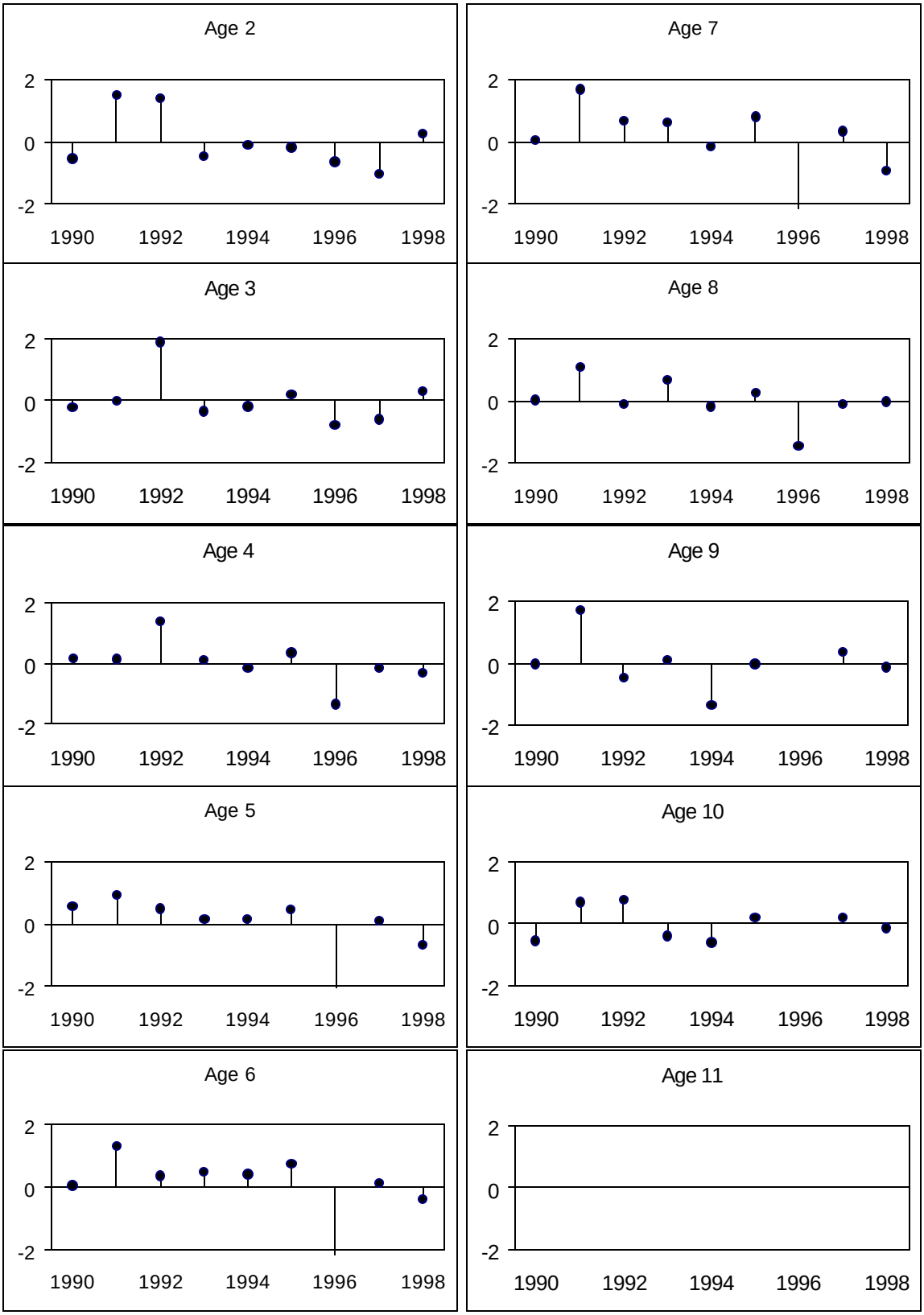


Fig. 12 (continued) Age by age log residuals from Canadian fall surveys.

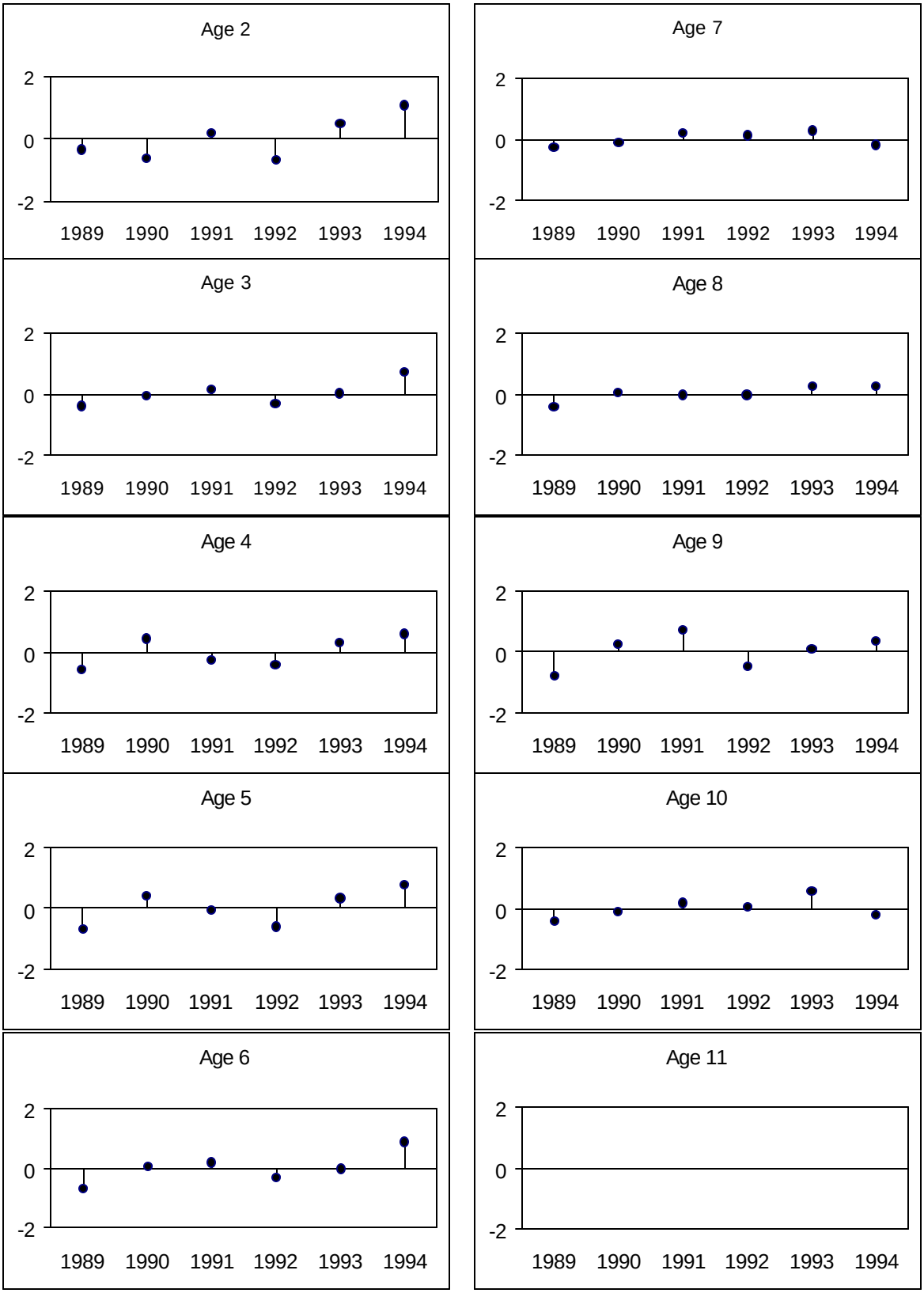


Fig. 12 (continued) Age by age log residuals from Canadian juvenile surveys.

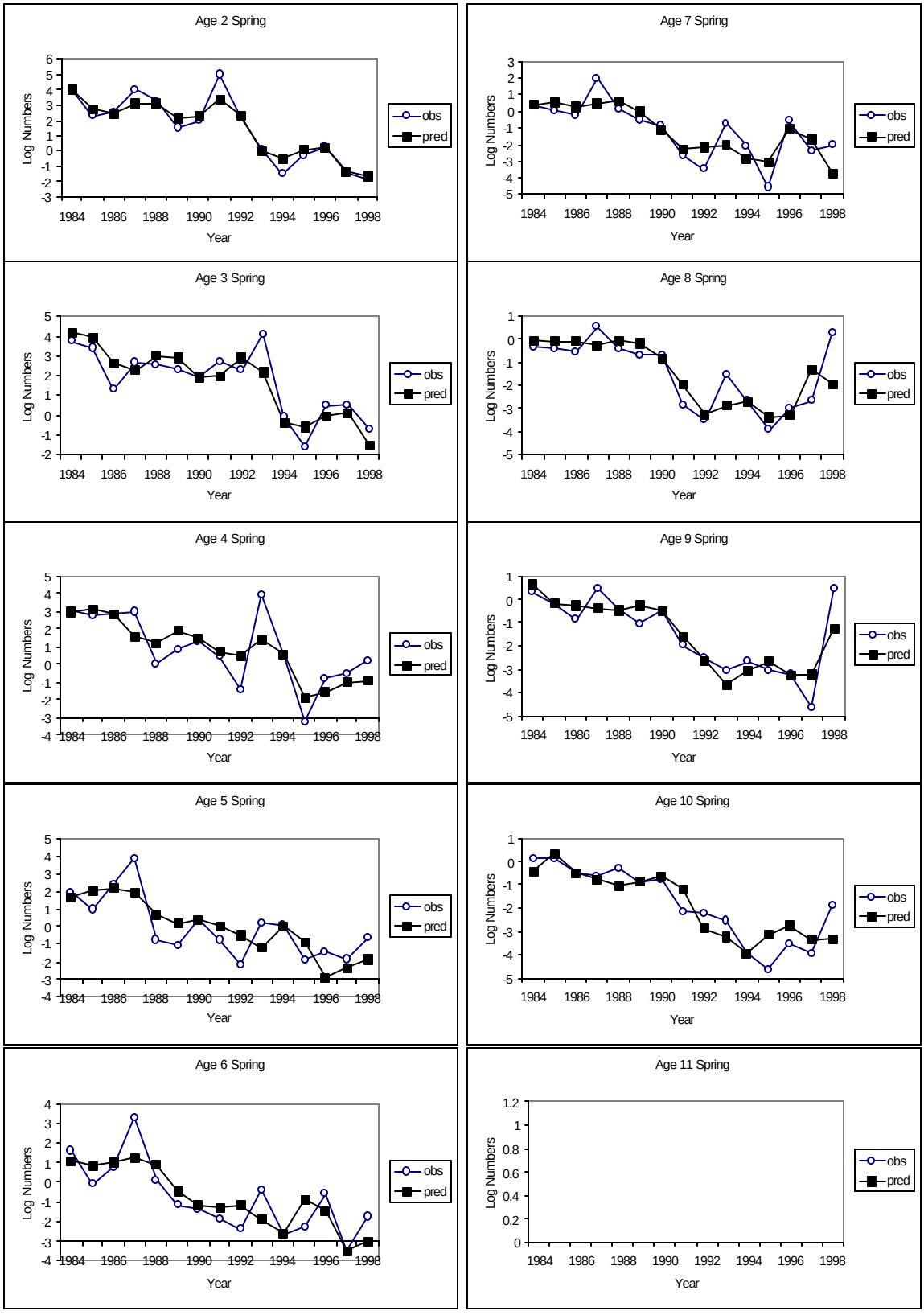


Fig 13 Age by age observed and predicted log abundance index over time from Canadian spring surveys for cod in NAFO Divisions 3NO.

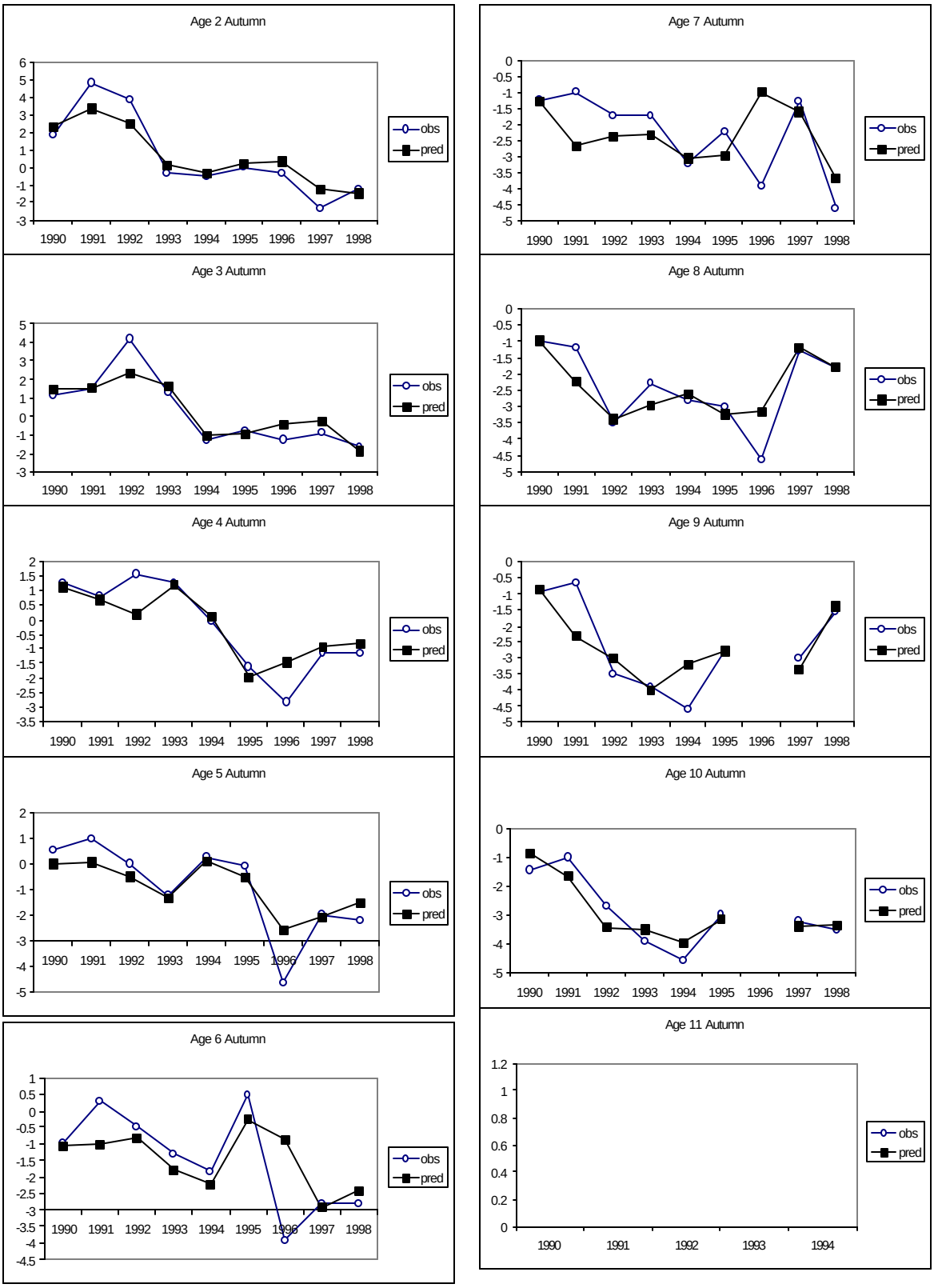


Fig 13 (continued) Age by age observed and predicted log abundance index over time from Canadian autumn surveys for cod in NAFO Divisions 3NO.

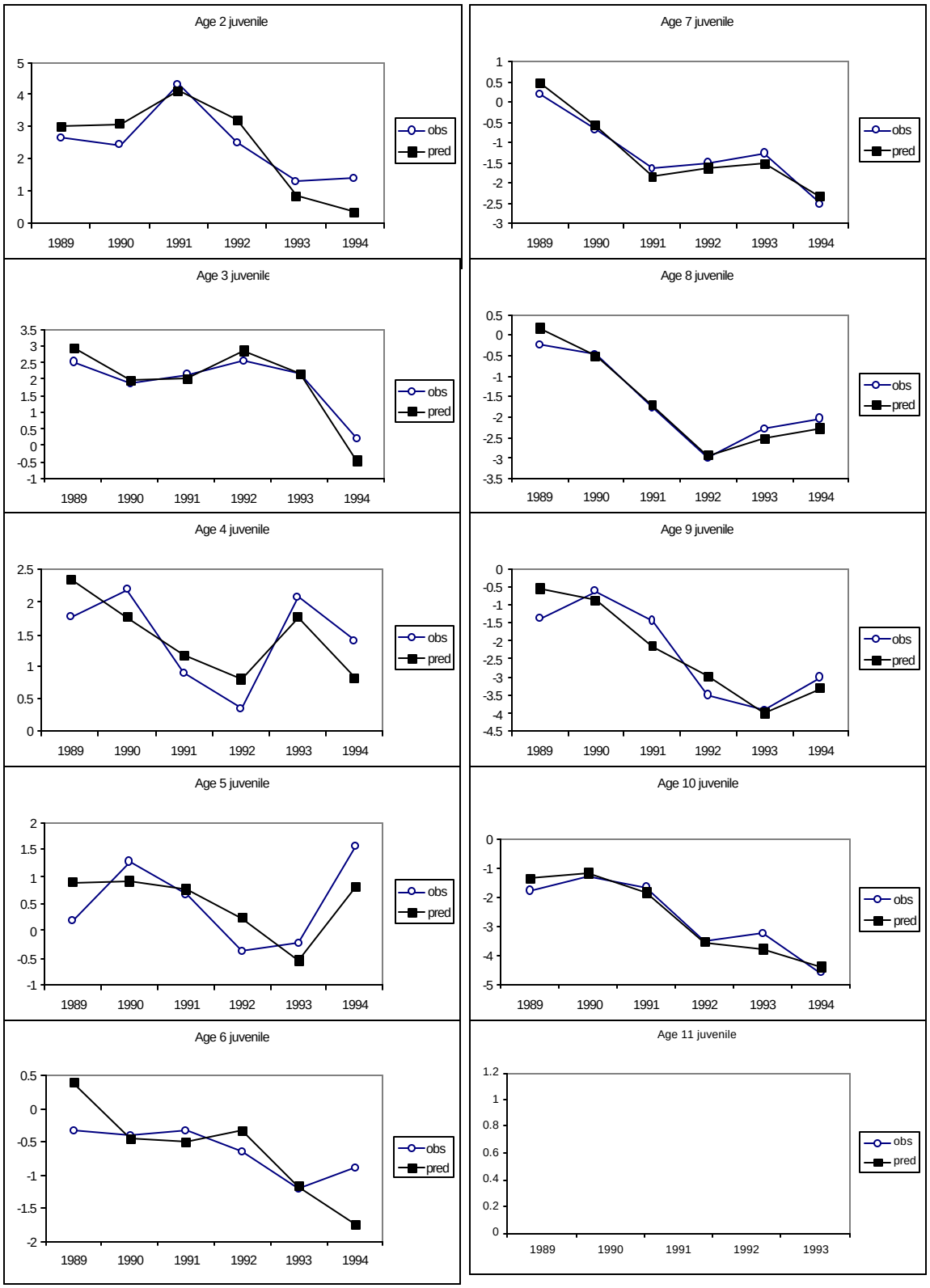


Fig 13 (continued) Age by age observed and predicted log abundance index over time from Canadian juvenile surveys for cod in NAFO Divisions 3NO.

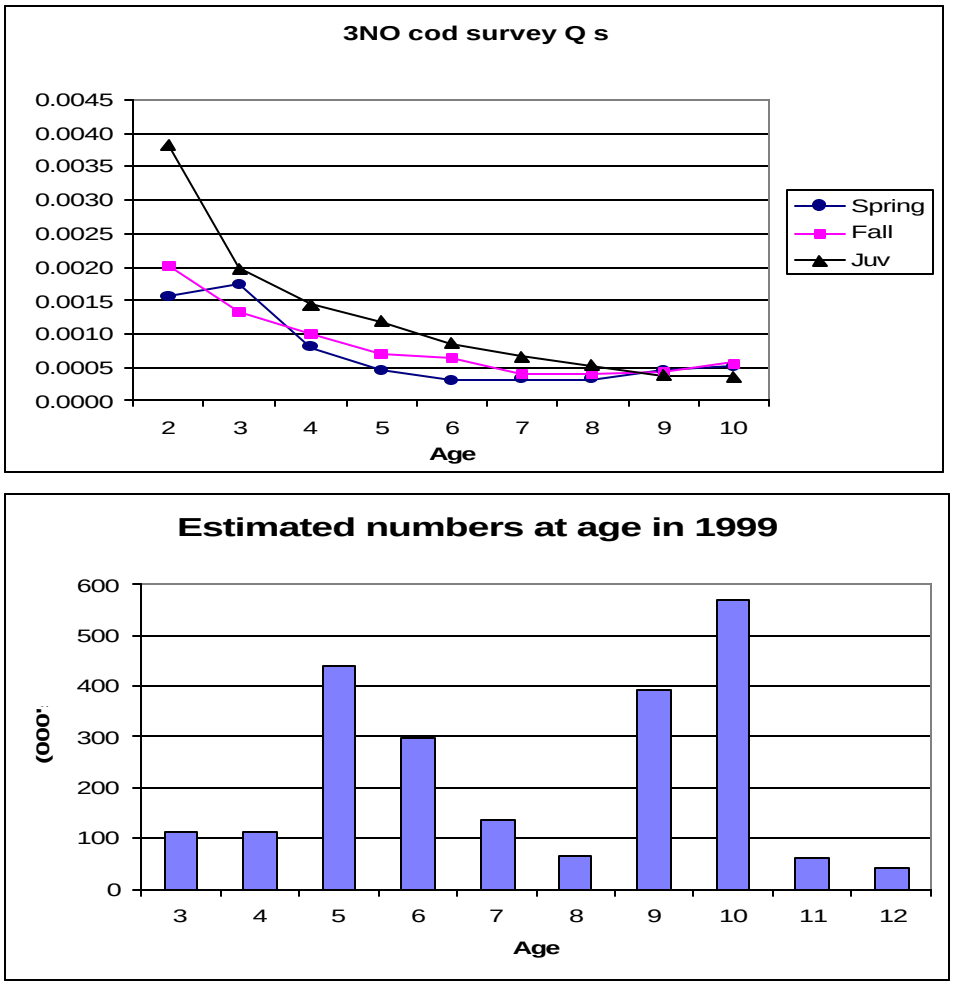


Fig. 14 Estimated catchabilities at age for Canadian spring, fall and juvenile surveys (Top). Estimated survivors in 1999 (Bottom).

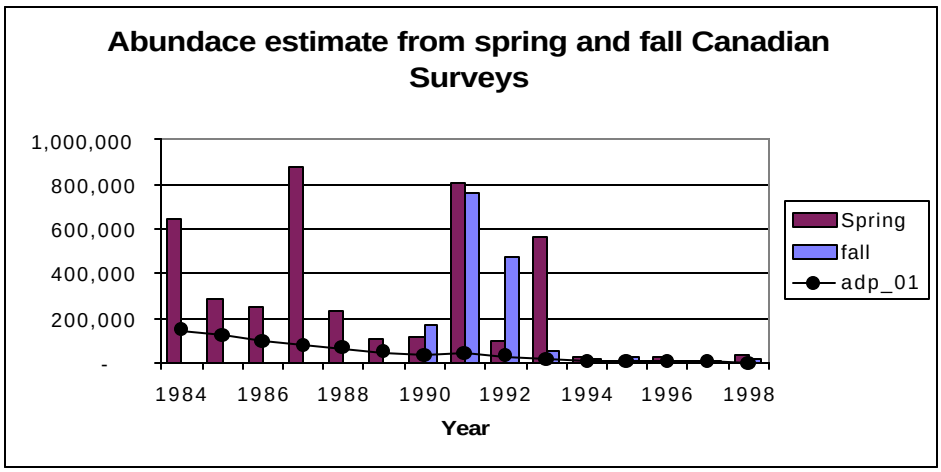


Fig. 15. Spring and fall swept area survey abundance estimates and ADAPT estimates of 2+ abundance.

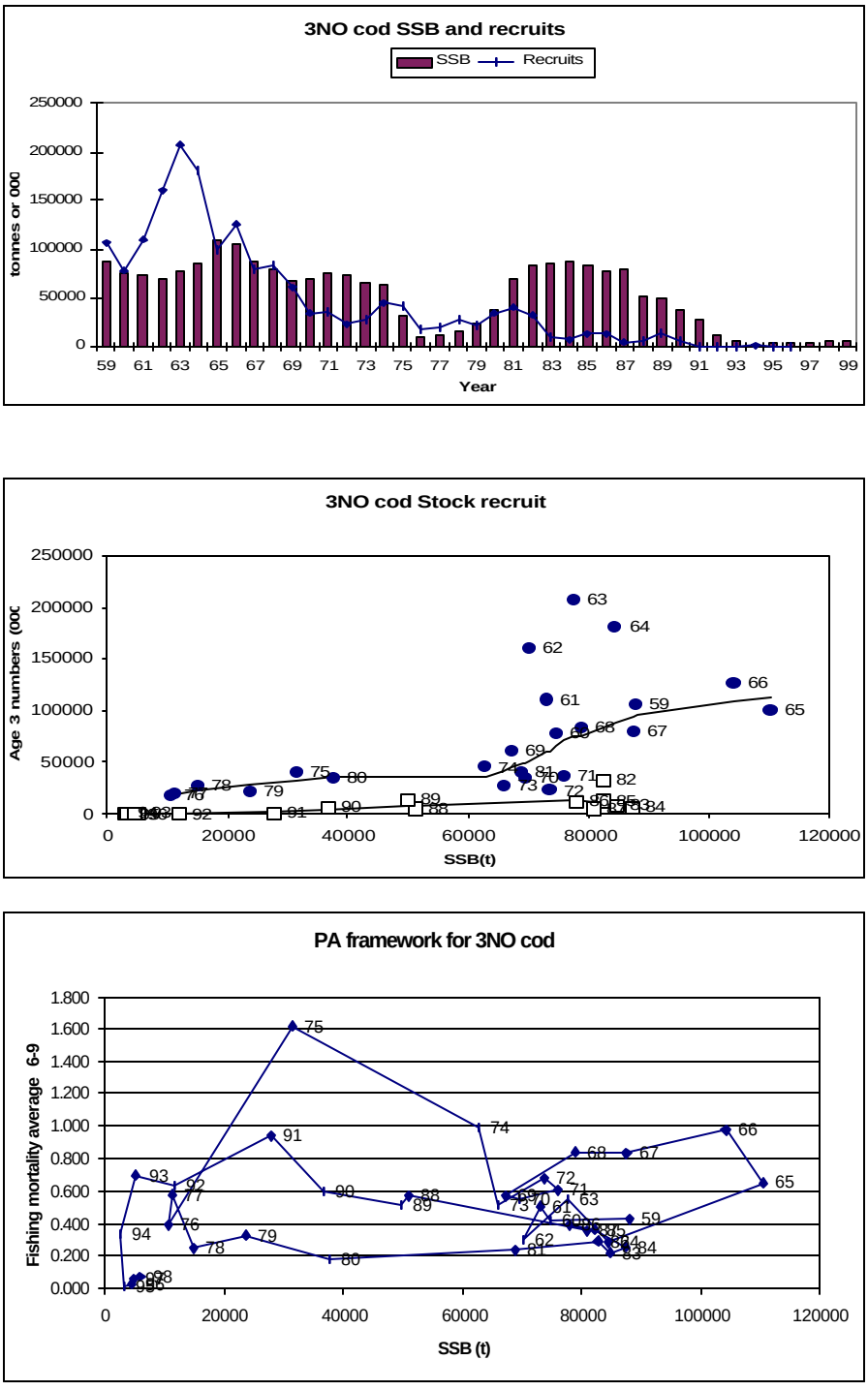


Fig. 16. Spawners biomass and corresponding recruitment at age 3 over time (Panel 1). Spawners stock-recruitment scatter. A lowess smoother is fitted for two time periods, 1959-81 and 1982-96. Year class is the label (Panel 2). Fishing mortality vs Spawners stock scatter. Year is the label (Panel 3).

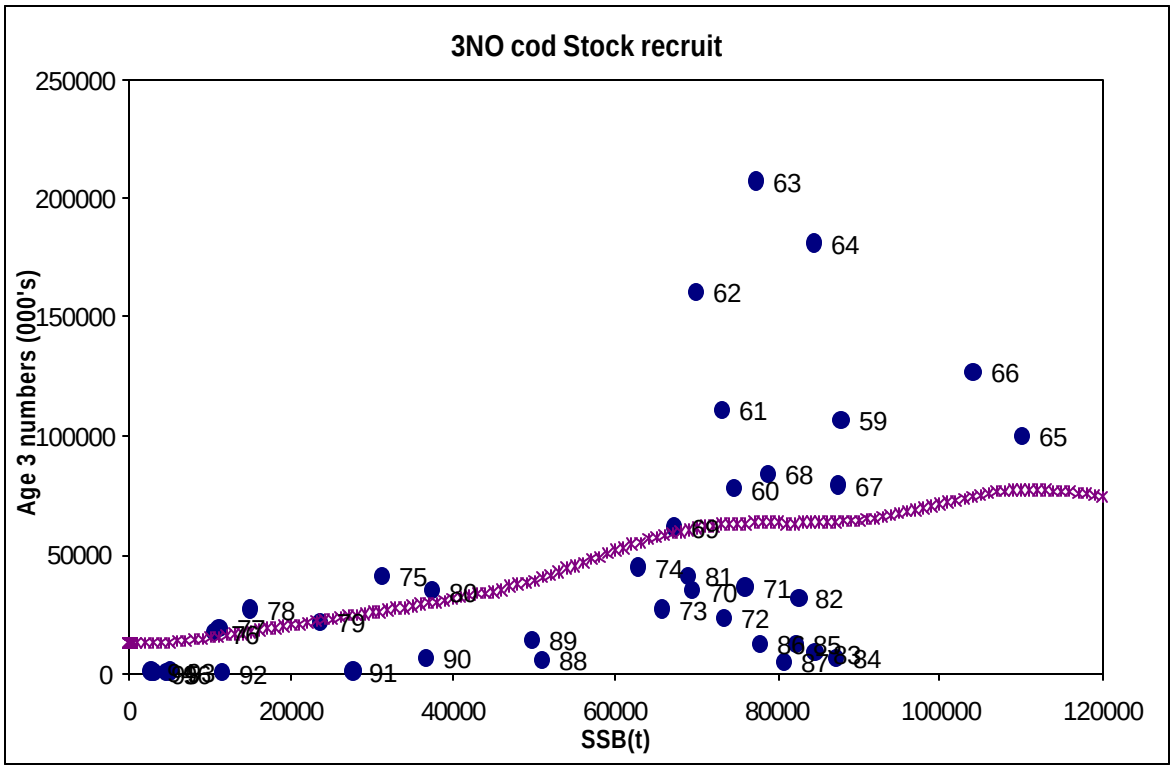


Fig. 17. Spawner stock-recruits using a cauchy smoother for the whole time period.