Northwest Atlantic Fisheries Organization

Serial No. N4450 **NAFO SCR Doc. 01/72**

SCIENTIFIC COUNCIL MEETING – JUNE 2001

An Assessment of the Cod Stock in NAFO Divisions 3NO

by

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Abstract

The Divisions 3NO cod stock occupies the southern part of the Grand Bank of Newfoundland. This stock declined in the late-1980s and early-1990s and is currently at a low biomass level. Although it has been under moratorium to all directed fishing since February 1994, levels of removals as by-catch in other directed fisheries has been increasing. Population estimates for the beginning of 2001 are provided from an ADAPT applied to the catch at age and three Canadian research vessel surveys. Estimates of recent year-class size from survey data indicate that recruitment has been almost non-existent since the 1990 year-class. Low spawner biomass, low recruitment and high fishing mortality on age 4 and 5 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 and by-catch mortality be kept at an extremely low level.

Introduction

The Div. 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 Div. 3O and Subdiv. 3Ps may occur. This stock declined in the late-1980s and early-1990s 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 1999 and 2000. Population estimates for the beginning of 2001 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 tons in 1967, mainly by the former USSR and Spain, but declined steadily thereafter to a low of 15,000 tons in 1978. From 1979 to 1991 catches ranged from 20,000 to 50,000 tons (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 tons 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 increasing from 170 tons in 1995 to 900 tons in 1999. A total of 1,050 tons was landed in 2000; 207 tons by Canada,

mainly in the yellow tail fishery (Table 2). Canadian surveillance estimates were 200 tons for EU-Portugal and 500 tons for EU-Spain. The Russian research report stated a catch of 137 tons.

Sampling data for 1999 were limited to Canadian (Table 3), Portuguese (SCS Doc. 00/16) and Russian (SCS Doc. 00/09) otter trawl fisheries. Sampling data for 2000 came from Canadian (Table 3), Portuguese (SCS Doc. 01/09), Spanish (01/18) and Russian (SCS Doc. 01/11) research reports. The total catch at age from the by-catch in 1999 and 2000 is presented in Table 4. Table 5 provides a review of the sampling over the period 1990-2000 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 1996, 1997, and 1998 the sampling was considered to be inadequate to develop a catch at age. An approach for developing catch at age for this period based on using an average partial recruitment vector, is presented in Stansbury *et al*. (1999). In 1999 and 2000 there are still gaps in the data but through the use of sampling collected by other contracting countries and by making use of Canadian research vessel survey age length keys, the catch at age was calculated. This appears to be representative of the total removals in 1999 and 2000. 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 Div. 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 Div. 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 1500 m. Because of vessel difficulties in 1996 the *ALFRED NEEDLER* concluded the survey in strata less than 731 m.

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

Abundance and biomass estimates for these surveys are presented in Tables 8-17 and plotted for the index strata in Fig. 3-4. Abundance and biomass have been extremely low in both Div. 3N and Div. 3O from 1994 onwards. The swept area biomass estimate from index surveyed strata in Div. 3N and 3O combined for 1999 spring and fall are 70,598 tons and 60,622 tons, respectively. The swept area estimates for 2000 spring and fall are 96,899 tons and 55,107 tons, respectively. No large concentration of cod has been encountered in these surveys as seen in Fig. 5 since 1996.

The mean numbers per tow at age 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 (age aggregated). 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

Temperature and depth distribution

Cumulative probability plots for temperature for the spring RV survey were computed and compared with cumulative probability plots for temperature weighted by the RV catch in terms of numbers and weights, following the approach of Perry and Smith (1994). The results show that large bottom temperature changes have occurred over the period 1972-2000 in Div. 3NO with 1983 and 1999 having very large areas of warm water and 1972, 1990 and

1992 being particularly influence by cold water. There was considerable annual difference in terms of habitat selection between cold and warm years. The data for two years, 1990 (cool bottom temperatures) and 1995 (relatively warmer bottom temperatures) are provided as examples (Fig. 7). During the cold year (1990) fish appeared to be nearly randomly distributed with respect to temperature, whereas in the warm year fish appeared to select the even warmer tail of the temperature distribution (1995). In a number of years the occurrence of a few large sets makes the distributions difficult to interpret with respect to habitat selection. In these instances, the large aggregations tend to occur at intermediate temperatures of around 1-4˚C. Cadigan and Shelton (1997) in an analysis of Div. 2J+3KL temperature and cod distribution data found that associations of cod and temperature differed over the period 1981-94. Two cold periods were encompassed in the time series and in the first, cod were associated with cold temperatures whereas in the second ,cod were associated with warmer temperatures.

Maturity at age

Female proportions mature at age sampled on the spring research vessel survey together with parameter estimates from a probit model with a logit link function fitted to the data are given in Table 21 and plotted in Fig. 8. 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. 9). The age at 50% maturity in 1999 increased to 5. The model could not fit the data for 2000 (only one age group has an estimated proportion mature different from either 0 or 1). Consequently average values for the previous 4 years could be used. The model predicted proportion of females mature at age is given in Table 22.

Estimates of relative year-class strength from survey data

A multiplicative model was used to estimate the relative year-class strength produced by the spawning stock from survey indices (at age 2 and 3). In the previous assessment of this stock Stansbury *et al*. (1999) estimated relative year-class strength by fitting a general linear model to the survey data (using ages 2-14 with Engel data converted to Campelen equivalent units). Fixed effects estimated were age, survey and year-class. In the current model, a survey*age interaction effect is estimated. Similar approaches have been implemented by Healey *et al*. (2001) for Greenland Halibut in Div. 2GHJ3KLMNO, and by Morgan *et al*. (2001) for American Plaice in Div. 3LNO.

On a log-scale the model can be written as follows:

$$\log(I_{s,a,y}) = \mu + Y_y + (SA)_{s,a} + \varepsilon_{s,a,y}$$

where: μ = overall mean
s = survey subscript
a = age subscript
y = year-class subscript
I = Index (Abundance in 000's)
Y = year-class effect
SA = Survey * Age effect, and
ε = error term.

It is assumed that $\varepsilon_{s,a,y} \sim N(0, \sigma^2_{group})$, (independently and identically) for pre-specified groups (e.g. *group*=survey estimates a unique variance parameter for each survey). Index values of zero were adjusted as in Healey *et al*.(2001). Likelihood ratio tests indicate that a constant variance model (general linear model) is not statistically different than the full model, which estimates a variance parameter for each survey-age combination.

Null Model	Test Statistic	df	p-val
FALL_CAMP[1]	1.3502	1	0.2452
FALL_ENGL[1]	0.0212	1	0.8843
SPR_ENGL[1]	0.1848	1	0.6673
SPR_CAMP[1]	1.0757	1	0.2997
Juvenile[1]	0.7524	1	0.3857
Survey vp[2]	3.0239	5	0.6963
Common vp[3]	5.4863	9	0.7900

[1]Survey for which survey*age variance parameters are collapsed to a survey variance parameter.
[2]Survey variance parameter estimated for each survey.
[3]One variance parameter estimated (GLM).

Estimates (Fig. 10) are back-transformed. Estimates of year-class strength indicate that all cohorts since 1990 have been extremely weak; however, the 1997 and 1998 year-classes are the strongest in the recent period. The standardized residuals (Fig. 10) show no systematic patterns, which might indicate violation of model assumptions; however year effects are evident.

Production model

A preliminary, discrete form of a non-equilibrium production model was fit to the Canadian spring, fall and juvenile survey swept area biomass indices, accounting for total catch. The preliminary model applied here is

$$B_{t+1} = B_t + (rB_t(1-\frac{B_t}{K})) - C_t$$

.

The objective function that was minimized is

$$\min \sum_{i,t} (\ln(I_{i,t}) - \ln(\hat{I}_{i,t}))^2 ,$$

where $I_{i,t}$ is the observed value for index *i* in year *t* and $\hat{I}_{i,t} = q_i \hat{B}_t$ is the model estimate of the corresponding index. Indices were weighted equally in the analysis.

The model fit to the indices are show in Fig 11. The parameter estimates are:

Spring survey q = 2.458
Fall Survey q = 2.300
Juvenile Survey q = 0.936
r = 0.099
K = 1 858 305 t
B_{1968} = 790 719 t

Swept area estimates which exceed the model estimates of biomass, as reflected by estimates of q > 1, are always of interest because they suggest that the spatial extrapolation of stratum means is inappropriate or that that the net is somehow concentrating fish within its path. The value of *r* is somewhat lower than what might be expected for a cod stock - Myers *et al*. (1997) give a range 0.17-1.15 for cod stocks. This could reflect a natural mortality greater than 0.2 or considerable non-reporting of deaths due to fishing.

The biomass estimates from the production model for the recent period are compared with the estimates from the ADAPT run in Fig. 12. The production model gives slightly higher current estimates of population biomass and does not track the low biomass estimated by ADAPT around 1976 and the recovery to the mid-1980s.

Following the preliminary run, the continuous form of the non-equilibrium production model was applied using the ASPIC framework of Prager (1994). The juvenile index was eliminated because it was found to be negatively correlated with the fall index. This model is in much closer agreement with the ADAPT estimates (Fig. 12). The following parameters were estimated:

Spring survey q = 4.763
Fall Survey q = 5.528
r = 0.2539
K = 1 649 000 t
B_{1968} = 488 952 t

While both models confirm that current biomass levels are extremely low compared with historic levels, the two model fits give very different parameter estimates. The usefulness of the application of production models to the Div. 3NO cod data requires further investigation. While the absolute estimates of biomass may not be reliable, ratios, such as the ratio between current biomass and the biomass at MSY may be more useful.

Sequential population analysis

The catch at age used in the sequential population analysis applying 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 1996-1998 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 in the last two years have been age-disaggregated using samples from contracting parties and Canadian RV age-length data.

The ADAPT was calibrated with Canadian RV survey spring 1984-2000, Canadian RV survey fall 1990-2000 at age and Canadian juvenile survey 1989-94 indices was applied to estimate terminal numbers $N_{i,\,t}$,

where i = 3 to 12, for t = 2001 and i =12, for t=1994 to 2000
and Catchabilities

$q1_i$ where i = 2 to 10 for the Canadian Research Vessel survey spring
$q2_i$ where i = 2 to 10 for the Canadian Research Vessel survey fall
$q3_i$ where i = 2 to 10 for the Juvenile Research Vessel survey.

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;
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 2000 ,

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 2000, spring
RV2i,t where i = 2 to 10 and t = 1990 to 2000, fall

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

RV3i,t where i = 2 to 10 and t = 1989 to 1994 .

The objective function to minimizes is:a

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

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

The statistics associated with the ADAPT output are given in Table 24. The mean square error for the model fit (MSE) was 0.80. The relative error in the parameter estimates of abundance decreased with age from a high of 66% at age 3 to a low of 30% at age 11. Average CV is 0.42. Relative bias was a high of 23% at age 3 and decreased to 5% at age 10.

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 13). The Yankee 41.5 (juvenile survey) has twice the catchability for age 2 compared with the Campelen surveys

Year effects are evident in the spring survey in 1987 (positive) and 1995 (negative) (Fig 14). Fall 1996 have large negative residuals. The juvenile survey residuals 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. 15a,b,c). Predicted and observed log survey numbers are plotted over time in Fig. 16a,b,c as well as observed and predicted log abundance index *versus* ln population numbers from spring and fall surveys (Fig. 17a,b). The slope in these plots is the estimated *q*.

Bias-adjusted estimates of population numbers and fishing mortality at age are given in Tables 25 and 26, respectively. Beginning of year mean weights at age calculated from the commercial catch are given in Table 27 and are used to calculate biomass in Table 28. The 1989 year-class is still contributing to the population in 2001 and constitutes 37% of the 3^+ biomass in 2001. The 1998 year-class (age 3) is now the dominant year-class but is estimated with low precision.

Estimates of fishing mortalities in 2000 for ages 4 and 5 are greater that 0.5 and are cause for concern for a stock under moratorium. These mortalities are higher than the long term average (1959-2000) and higher than the average fishing mortalities from 1982 to 1993 at these ages. This may indicate an increase effect of by-catch mortality and may have implications for the recovery of the stock.

Retrospective analysis

Population numbers and SSB display persistent trends for under estimation as successive years of data were excluded from the analysis. Conversely, mean $\overline{F}_{6-9}$ was over estimated in the year of the assessment (Fig. 18).

Exploratory runs

Two exploratory runs were carried out to examine the influence of the tuning indices on the estimates. One run was carried out with spring and juvenile surveys (run 14) and another run was carried out with fall and juvenile (run 15). Assessment using spring or fall alone produced an estimate at age 3 with greater than 100% bias, and was dropped. Summary plots of population numbers SSB mean F6-9 and Recruits for the three assessments are given in Fig. 19. Tuning with run 14 gives higher estimate of population numbers and tuning with run 15 gives lower estimates.

Conclusion

The 2000 spring and fall research vessel surveys indicate that the current stock size remains at a low level but is 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. The dominant year-class in this stock is the 1998 year-class. As was reported in the last assessment of this stock, the Canadian pelagic 0-group survey that indicated that the 1998 year-class was relatively strong, being the most abundant in the 5-year time series (Anderson *et al*. 1999). Low spawner biomass, low recruitment and high fishing mortality on age 4 and 5 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. It will also require that by-catch mortality should be kept at an extremely low level.

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Table 1. Catch (t) of cod in NAFO Divisions 3NO. 1953 -2000

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
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]	286	1	96			383	0 [4]
1998 [1]	396		95		56	547	[4]
1999 [1]	568	3	322	26		919	[4]
2000 [1]	207	200	500	137	6	1050 [3]	[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 1999.

Month	Canada N										Canada N	
	3N				3O						3NO	
	GN	LL	OT	TOT	GN	LL	MWT	ST	OT	TOT	Total	
Jan				0.00	13.40	0.51				13.91	13.91	
Feb				0.00	18.04	5.82	0.01			23.86	23.86	
Mar				0.00	7.02	2.96	10.00			19.97	19.97	
Apr			0.42	0.42	19.83	1.05			10.88	31.75	32.17	
May			1.74	1.74	179.45		5.29		3.77	188.51	190.25	
Jun	17.46		3.95	21.41	85.90	0.46	0.05	1.69	0.94	89.06	110.47	
Jul	0.00		1.08	1.08	3.58				10.11	13.69	14.77	
Aug	0.00		11.55	11.55	5.45		1.48	0.01	0.88	7.82	19.37	
Sep	0.00		19.27	19.27	0.83			0.57	1.38	2.77	22.04	
Oct			13.32	13.32					2.78	2.78	16.10	
Nov	0.00		1.74	1.74	0.01	0.22	0.01		18.18	18.42	20.16	
Dec	0.00			0.00						0.00	0.00	
Total	17.46	0.00	53.07	70.53	333.49	11.01	16.84	2.27	48.91	412.53	483.06	
Month	Canada M										Canada M	Canada M
	3N				3O						3NO	3NO
	GN	LL	OT	TOT	GN	LL	MWT	ST	OT	TOT	Total	Total
Jan				0.00						0.00	0.00	13.91
Feb				0.00						0.00	0.00	23.86
Mar				0.00		2.42				2.42	2.42	22.39
Apr				0.00		6.64				6.64	6.64	38.81
May				0.00					2.22	2.22	2.22	192.47
Jun		1.62		1.62		17.24			0.43	17.67	19.29	129.76
Jul		2.95		2.95		2.84				2.84	5.79	20.57
Aug		7.42		7.42		3.40				3.40	10.82	30.19
Sep		4.03		4.03						0.00	4.03	26.08
Oct		3.65		3.65						0.00	3.65	19.74
Nov		2.40	0.53	2.93		0.20			0.23	0.43	3.36	23.51
Dec				0.00					0.39	0.39	0.39	0.39
Total	0.00	22.07	0.53	22.60	0.00	32.74	0.00	0.00	3.27	36.01	58.61	541.67

Table 2 (cont.). Cod landings (t) by month and gear from NAFO Divisions 3NO by Canada in 2000.

Month	Canada N								Canada N	
	3N			3O					3NO	
	LL	OT	TOT	GN	LL	MWT	OT	TOT	Total	
Jan			0	2.388				2.388	2.388	
Feb			0	0.907		0.521		1.428	1.428	
Mar			0	0.337			0.307	0.644	0.644	
Apr		0.134	0.134	18.035				18.035	18.169	
May		0.802	0.802	2.538	12.546		3.047	18.131	18.933	
Jun		1.752	1.752	2.586	2.063		13.71	18.359	20.111	
Jul		2.136	2.136	1.811			2.5	4.311	6.447	
Aug		0.531	0.531	0.726			0.594	1.32	1.851	
Sep		21.338	21.338		2.217		0.014	2.231	23.569	
Oct		55.868	55.868				1.532	1.532	57.4	
Nov		7.412	7.412		1.896		0.058	1.954	9.366	
Dec		0.057	0.057				0.021	0.021	0.078	
Total	0	90.03	90.03	29.328	18.722	0.521	21.783	70.354	160.384	
Month	Canada M								Canada M	Canada
	3N			3O					3NO	3NO
	LL	OT	TOT	GN	LL	MWT	OT	TOT	Total	Total
Jan			0					0	0	2.39
Feb			0					0	0	1.43
Mar			0		9.75			9.75	9.75	10.39
Apr			0				5.553	5.553	5.553	23.72
May	4.263		4.263		2.23		2.77	5	9.263	28.20
Jun	2.56		2.56		0.015		0.982	0.997	3.557	23.67
Jul			0		0.68			0.68	0.68	7.13
Aug	0.391		0.391					0	0.391	2.24
Sep	0.688		0.688				0.258	0.258	0.946	24.52
Oct	2.793		2.793				0.46	0.46	3.253	60.65
Nov	0.91		0.91					0	0.91	10.28
Dec		0.318	0.318		0.099		5.173	5.272	5.59	5.67
Total	11.605	0.318	11.923	0	12.774	0	15.196	27.97	39.89	200.28 [1]

[1] *Does not include 7 tonnes from unknown gear*

Table 3. Commercial sampling by Canada used to estimate catch at age for Divisions 3NO in 1999.

Qtr.	Gear	Div.	No. Aged	Month	No. meas
	GN	3O	161	Feb	214
				Mar	224
			450	May	949
1	OT	3O		Jan	
				Feb	
				Mar	
2	OT	3O		Apr	
				May	
				June	
3	OT	3O		July	
				Aug	
				Sep	
2	OT	3N	89	Apr	
				May	
				June	283
3	OT	3N	223	July	
				Aug	283
				Sep	260
4	OT	3N		Oct	150
				Nov	174
				Dec	

Table 3. Commercial sampling by Canada used to estimate catch at age for Divisions 3NO in 2000.

Qtr.	Gear	Div.	No. Aged	Month	No. meas
	LL	3O	130		
1	GN	3O		Jan	26
				Feb	
				Mar	
2	OT	3O	51	Apr	202
				May	
				June	
3	OT	3O		July	
				Aug	
				Sep	
3	OT	3N		July	
				Aug	
				Sep	396
4	OT	3N		Oct	1435
				Nov	105
				Dec	

Table 4. Total catch, average weight and length at age for the fishery in Division 3NO during 1999 and 2000 .

1999	AVERAGE		Catch	2000	AVERAGE		Catch
	WEIGHT	LENGTH	NUMBER		WEIGHT	LENGTH	NUMBER
AGE	(kg.)	(cm.)	(000'S)	AGE	(kg.)	(cm.)	(000'S)
1	0.10	22.99	0	1	0.21	29.37	0
2	0.31	33.38	46	2	0.33	34.04	10
3	0.50	38.81	94	3	0.60	41.19	356
4	0.94	47.66	41	4	0.82	45.71	339
5	1.59	56.61	101	5	1.45	54.86	87
6	2.07	61.63	40	6	2.39	64.56	62
7	2.23	63.10	14	7	3.44	72.65	21
8	2.83	68.21	6	8	2.90	68.76	12
9	3.99	76.24	23	9	2.64	66.65	4
10	6.05	87.19	55	10	3.78	74.92	13
11	6.73	90.28	3	11	5.25	83.28	12
12	7.38	93.01	2	12	6.07	87.33	2
13	9.26	100.11	1	13	10.41	103.97	0
14	6.90	91.03	1	14	15.79	119.00	0
15	15.98	119.45	0	15	13.70	113.64	0
16	16.44	120.55	0	16	4.46	79.00	0
17	18.04	124.24	0	17	0.00	0.00	0
18	18.79	125.89	0	18	0.00	0.00	0
19	17.87	123.86	0	19	0.00	0.00	0
20	19.22	126.81	0	20	22.27	133.00	0

Table 5. A review of sampling used to compile catch at age for 3NO cod from 1990 to 2000.

	Sampling	Canada	Spain	Portugal	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	11,430
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	692/OT 369/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 521Total	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 2/GN 9/OT 1/MWT 47 total	1,783	44/OT 5/GN 49 Total	823
1995	No Spanish sampling.Sampling available from Portuguese gill net and otter trawl fisheries	14/GN 60/LL	29	15/OT 15/GN	79
1996	No Spanish sampling.Sampling insufficient	19/OT 31/GN 47/LL 1 MWT Total 98	5	26/OT 6/GN	38
1997	Sampling insufficient	203/GN 83/OT 40/LL 2/MWT 329 Total		113	
1998	Some Canadian otter trawl frequencies and age samples but nothing for gillnets. Portuguese length frequencies but no aging.	185/OT 160/GN 50/LL 396 Total		95/OT	56
1999	Length and age sampling for Canadian by-catch was limited to the otter trawl fishery in 3N and gillnet fishery in 3O. Where deemed appropriate sampling was used for the adjacent division. Canadian catch at age was prorated by 135 t for catch with no sampling was available. Some monthly frequencies by division were provided by Portugal and these in conjunction with keys from the Canadian Spring RV surveys were use to partition the Portuguese and Spanish catch. Age composition by division was provided by Russia.	122OT 351/GN 66/LL 2/ST 26/UK	3	322	26
2000	Length sampling for Canadian by-catch was limited to the otter trawl fishery in 3N and 3O. Age sampling was inadequate so spring and fall rv keys were used. Canadian catch at age was prorated for 77 t of catch with no sampling. Frequencies provided by Portugal and Spain were used with Canadian RV survey key to calculate catch for Portugal and Spain. Age composition by division was provided by Russia.	128/OT 29/GN 43/LL 7/UK	200	500	143

Table 6. Catch-at-age for Divisions 3NO cod, 1959-2000 (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	1996	1997	1998	1999	2000
3	4508	1314	232	0				94	356
4	1769	3209	2326	72				41	339
5	837	637	1117	20				101	87
6	612	479	125	40				40	62
7	235	321	93	2				14	21
8	64	74	26	0				6	12
9	99	25	8	1				23	4
10	128	39	1	0				55	13
11	153	49	0.03	0				3	12
12	100	53	0.07	0				2	2
13	217	160	0.03	0				3	1
3+	8722	6360	3928	135				380	909
6+	1608	1200	253	43				144	127

Table 7. Mean weight-at-age for Divisions 3NO cod, 1959-2000.
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	1996	1997	1998	1999	2000
3	0.33	0.36	0.27	0.00				0.50	0.60
4	0.65	0.78	0.46	0.75				0.94	0.82
5	1.06	1.35	0.91	1.21				1.59	1.45
6	1.80	1.84	1.63	2.03				2.07	2.39
7	2.82	2.82	1.84	2.29				2.23	3.44
8	4.85	4.11	4.04	2.08				2.83	2.90
9	5.56	5.87	4.94	6.60				3.99	2.64
10	7.43	7.76	7.54	6.22				6.05	3.78
11	8.64	8.79	3.44	0.00				6.73	5.25
12	10.65	8.67	7.52	0.00				7.38	6.07
13	14.11	12.74	10.00	0.00				11.70	10.19

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. Data for 1984-1995 has been converted to Campellan equivalent units.

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	WT 188-189 1996	WT 204-208 1997	WT 221-222 1998	WT 238-241 1999	WT 315-318 2000
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	25-May-96	16-May-97	22-May-98	31-May-99	30-May-00
0-30	375	1593	22302	12390	2240	6223	3134	4868	3236	111	148	74	0	0	0	131	292	5259	329
	376	1499	149223	149	787	88795	2533	599	268	119	0	0	0	69	165	0	1272	103	206
31-50	360	2992	136658	27167	9750	31721	35911	1053	3020	900	2731	907	0	0	449	86	823	150	41
	361	1853	29339	50443	5585	47837	15405	9136	6634	2574	804	836	103	625	1077	549	2258	2650	1869
	362	2520	68550	20045	5400	117654	6860	7054	8400	1120	58	117	0	0	39	50	139	1042	1271
	373	2520	27500	4161	1600	11738	2625	3096	1575	223	0	0	0	0	39	50	35	77	0
	374	931	10431	776	86	931	879	52	388	26	129	0	0	0	85	38	0	85	0
	383	674	62	0	0	967	686	499	47	62	0	0	0	0	0	0	0	0	0
51-100	359	421	2339	0	40375	7163	5584	1637	819	1199	1696	2193	0	0	33	138	26	58	29
	377	100	1771	2451	465	6396	0	424	0	0	0	28	49	0	0	0	7	0	0
	382	647	0	3572	22	60	180	1588	3325	0	0	0	0	0	0	0	0	45	134
101-150	358	225	2703	5766	4063	4359	5328	3984	8297	1047	16484	3391	109	156	310	261	41	1254	69
	378	139	2481	43824	6313	2124	1921	1612	2751	875	3707	608	222	97	163	136	96	38	209
	381	182	1534	12968	8249	392	3185	3741	3665	202	88	0	13	114	160	13	0	150	0
151-200	357	164	0	11571	444	**1428**	11	68	888	2528	2676	68	433	23	90	20	219	73	282
	379	106	788	3195	5010	7	44	206	1318	2311	8782	545	191	66	204	194	72	58	21
	380	116	209	3681	526	934	1498	967	2062	3859	870	20654	0	32	471	6239	48	96	117
total all strata fished < 200 fathoms			455890	202158	90915	327301	85786	40583	46692	17156	38174	29420	1120	1182	3283	7905	5328	11138	4577
total <200 fathoms adjusted			455890	202159	90915	328729	85784	40584	46693	17156	38173	29421	1120	1182	3285	7905	5328	11138	4577
1 std dev			157039	27576	35654	91793	15324	5543	7693	4176	5808	20213	520	651	787	6106	1582	1967	11

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. Data for 1984-1995 has been converted to Campellan equivalent units.

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	WT 188-189 1996	WT 204-208 1997	WT 221-222 1998	WT 238-241 1999	WT 315-318 2000
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	25-May-96	16-May-97	22-May-98	31-May-99	30-May-00
0-30	375	1593	7018	26266	21041	13506	23154	25148	16134	1835	2331	1145	0	0	0	92	108	3225	54
	376	1499	16673	713	2954	9148	6555	1256	3791	1483	0	0	0	51	62	0	75	4	43
31-50	360	2992	21843	17007	3781	4155	3792	2145	10488	1032	1445	46	0	0	457	15	12	315	19
	361	1853	20008	52794	61130	50358	25677	19517	30149	16646	399	3455	64	47	647	378	682	3496	533
	362	2520	75781	29914	31327	144250	19890	26588	37344	4343	668	1522	0	0	21	317	407	946	1328
	373	2520	33487	5274	4378	14596	9738	8996	5802	856	0	0	0	0	9	168	9	50	0
	374	931	14987	1523	1338	1832	5872	937	5050	516	30	0	0	0	11	136	0	11	0
	383	674	502	0	0	1664	236	574	615	224	0	0	0	0	0	0	0	0	0
51-100	359	421	308	0	2639	779	637	213	101	66	113	433	0	0	36	199	1	114	194
	377	100	145	219	138	1720	0	46	0	0	0	9	8	0	0	0	15	0	0
	382	647	0	257	84	42	59	782	298	0	0	0	0	0	0	0	0	9	27
101-150	358	225	822	906	1724	4255	1317	1701	1089	131	2650	1699	164	135	131	104	73	1171	23
	378	139	692	4601	1084	358	441	432	399	145	413	247	64	76	84	109	80	21	184
	381	182	765	5397	2913	247	786	216	800	399	15	0	57	44	40	2		16	0
151-200	357	164	0	6352	640	**566**	33	64	274	331	706	46	237	24	18	9	221	51	242
	379	106	382	1198	1587	9	37	98	318	852	2592	205	121	46	66	104	24	12	8
	380	116	411	2128	366	1018	656	498	704	676	181	9823	0	9	100	3457	13	18	14
total all strata fished < 200 fathoms			193825	154547	137124	247937	98880	89212	113355	29536	11544	18629	714	433	1682	5090	1720	9459	2669
total <200 fathoms adjusted			193824	154549	137124	248503	98880	89211	113356	29535	11543	18630	715	432	1682	5090	1720	9459	2669
1 std dev			29836	18270	33801	37740	12640	12355	13694	8520	2748	9845	287	118	553	3438	497	3022	1362

Table 10. Cod abundance (000's) from Canadian spring RV surveys in Division 3N for depths > 200 fathoms.Data for 1991-1995 has been converted to Campellan equivalent units.

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	WT 238-241 1999	WT 315-318 2000
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	31-May-99	30-May-00
201-300	723	155	1970	13573	43	32	0	46	77	53	0	139
	725	105	401	**nf**	0	95	73	34	16	49	33	361
	727	160	833	2144	1444	222	211	1394	109	55	44	383
301-400	724	124	69	112	9	34	17	0	50	61	0	0
	726	72	0	0	0	0	70	0	12	0	0	0
	728	156	0	0	0	0	43	0	0	0	0	0
401-500	752	134	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**
	756	106	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**
	760	154	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**
total all strata fished			20429	54003	30916	1504	1597	4789	8165	5545	11214	883
1 STD			4280	12445	20228	555	659	1519	6107	1586	1969	3319

Table 11. Cod biomass (t)) from Canadian spring RV surveys in Division 3N for depths > 200 fathoms.Data for 1991-1995 has been converted to Campellan equivalent units.

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	WT 238-241 1999	WT 315-318 2000
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	31-May-99	30-May-00
201-300	723	155	662	3415	30	26	0	35	80	77	0	270
	725	105	186	**nf**	0	32	8	19	9	10	13	163
	727	160	486	805	313	86	41	677	71	25	6	180
301-400	724	124	30	32	9	22	26	0	40	191	0	0
	726	72	0	0	0	0	31	0	5	0	0	0
	728	156	0	0	0	0	26	0	0	0	0	0
401-500	752	134	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**
	756	106	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**
	760	154	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**
total all strata fished			30901	15795	18982	880	566	2430	5295	2024	9479	613
1 STD			8541	3853	9846	295	125	866	3439	537	3021	2576

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 strata. Data for 1984-1995 have been converted to Campellen equivalent units

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	WT 188-189 1996	WT 204-208 1997	WT 221-222 1998	WT 238-241 1999	WT 315-318 2000
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	11-May-96	16-May-97	22-May-98	19-May-99	16-May-00
31-50	330	2089	7761	7892	3707	11315	5384	1609	4990	1424	203	373	0	0	4824	509	4310	4037	8680
	331	456	3863	1921	744	1900	1425	792	**1052**	158	32	0	0	0	348	0	8343	452	2635
	338	1898	23356	9724	8933	20210	6623	20166	8436	24463	2285	835	132	264	2109	160	895	15015	6571
	340	1716	10606	9414	10282	146151	2826	1960	3628	2569	334	119	286	0	1441	529	173	1770	3682
	351	2520	78342	17578	117725	71723	13335	6112	6242	2071	1050	350	250	0	525	453	277	1631	12046
	352	2580	41362	17656	9803	35888	56193	10474	14499	9752	3852	1331	1299	1111	1115	927	1278	14932	5481
	353	1282	0	2226	2773	29082	44478	4731	6499	1297	4229	223	0	285	677	0	564	507	1693
51-100	329	1721	5928	2390	2838	133032	5259	5577	13147	22309	508	1673	13959	1100	330	765	8194	8370	1278
	332	1047	436	3432	1115	30014	2908	3112	5700	683773	29607	296105	0	2399	3184	432	720	8121	27653
	337	948	1909	5688	1369	1799	2337	10402	2133	22436	6913	231602	132	527	2502	681	1239	9389	3032
	339	585	14625	894	135	2383	488	27	1625	1571	609	406	0	0	46	0	121	497	40
	354	474	2238	1843	2216	65669	2271	593	395	9019	1679	1415	0	0	66	0	4583	4864	587
101-150	333	151	0	42	105	566	0	378	136	692	975	514	2205	10	688	1447	194	25	92
	336	121	0	17	126	17	8	8	143	160	5537	437	605	0	8	128	25	17	0
	355	103	0	4070	29	207	43	987	193	2339	944	236	50	7	2573	6	50	44	39
151-200	334	92	0	236	1323	26	121	141	543	1214	971	1137	533	200	184	94	26	28	70
	335	58	0	0	68	8	12	16	97	27	1275	342	157	52	490	211	36	37	13
	356	61	0	0	13	4	51	131	110	546	2665	424	491	13	93	70	82	67	96
total strata fished < 200 fathoms			190427	85023	163306	549997	143763	67215	68515	785821	63667	537522	20100	5967	21202	6412	31110	69803	73688
total <200 fathoms adjusted			190426	85023	163304	549994	143762	67216	69568	785820	63668	537522	20099	5968	21203	6412	31110	69803	73688
1 std dev			23492	12072	92856	118784	39030	10972	10310	669240	22549	271901	13845	1800	4574	1513	12293	14900	14847

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. Data for 1984-1995 have been converted to Campellen equivalent units

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	WT 188-189 1996	WT 204-208 1997	WT 221-222 1998	WT 238-241 1999	WT 315-318 2000
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	11-May-96	16-May-97	22-May-98	19-May-99	16-May-00
31-50	330	2089	7964	9372	4167	12075	4486	3318	5091	266	32	92	0	0	7103	357	12526	8593	8401
	331	456	4536	4891	1295	1982	2176	481	**2191**	236	224	0	0	0	983	0	34685	1105	6842
	338	1898	43090	13670	23245	20013	14538	25430	9315	10283	11883	4981	1841	3439	1535	196	5069	9416	6982
	340	1716	13654	10780	12024	161120	16447	5478	10296	384	52	1936	160	0	239	186	512	3857	2164
	351	2520	68620	34516	90852	114632	25324	19777	22343	6595	2063	1198	131	0	104	286	1888	5269	47572
	352	2580	51655	41868	24245	76430	82226	43865	38424	22512	16671	8225	1584	3784	1528	2869	5341	14309	8226
	353	1282	0	9451	1831	15552	4512	4012	5892	1267	1780	3260	0	609	118	0	18	1719	7130
51-100	329	1721	1776	1931	1114	116331	16127	1690	4684	4195	97	219	10523	2187	191	614	13037	9671	628
	332	1047	4410	17134	4092	12848	11718	2156	11266	39264	3927	108245	0	1702	1534	1558	2136	1350	4360
	337	948	741	2976	11644	4299	1005	5735	3354	5566	20721	79783	813	1659	3299	527	1720	3095	1040
	339	585	3355	730	73	943	496	219	385	92	87	43	0	0	5	0	441	1210	1
	354	474	955	660	569	6915	1211	87	562	3325	191	1319	0	0	85	0	2258	1088	218
101-150	333	151	0	330	411	1837	0	1486	381	877	273	1661	8549	26	1625	974	255	26	77
	336	121	0	81	120	35	39	44	318	111	1733	375	661	0	19	322	16	18	0
	355	103	0	724	29	259	38	538	198	329	63	169	32	31	2344	15	74	26	13
151-200	334	92	0	898	4773	120	473	294	826	1385	1018	1408	959	333	259	305	46	72	98
	335	58	0	0	159	38	82	16	110	10	276	2522	453	342	680	734	75	207	37
	356	61	0	0	42	15	178	154	219	88	308	387	257	16	46	47	102	108	442
total strata fished < 200 fathoms			200758	150013	180686	545446	181076	114780	113664	96783	61399	215824	25964	14127	21696	8990	80199	61139	94231
total <200 fathoms adjusted			200756	150012	180685	545444	181076	114780	115855	96785	61399	215823	25963	14128	21697	8990	80199	61139	94231
1 std dev			26557	18667	57045	107416	34873	32407	14933	35395	21352	92888	11823	3094	4742	3056	36701	11992	47545

Table 14. Cod abundance (000's) from Canadian Spring RV Surveys in Division 3O for depths >200 fathoms Data for 1991-1995 have been converted to Campellen equivalent units.

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	WT 238-241 1999	WT 315-318 2000
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	19-May-99	16-May-00
201-300	717		3701	336	1615	1441	242	27	176	20	37	122
	719		274	749	301	443	164	21	39	5	107	18
	721		190	72390	348	11	5	84	103	5	5	7
301-400	718		15	0	100	503	102	0	7	0	0	0
	720		0	569	15	211	29	6	103	12	7	0
	722		0	149	0	0	0	11	6	0	0	0
401-500	764		**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**
	772		**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**
total all strata fished			790001	137860	539900	22708	6510	21352	6844	31153	69960	73837
upper			2510624	1092111	3994696	61281	10713	32169	26139.7	65326	102739	110211
t-value			2.571	12.706	12.706	2.776	2.306	2.365	12.706	2.78	2.2	2.45
1 STD			669243	75102	271903	13895	1823	4574	1519	12292	14900	14847

Table 15. Cod biomass (t) from Canadian Spring RV Surveys in Division 3O for depths >200 fathoms Data for 1991-1995 have been converted to Campellen equivalent units.

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	WT 238-241 1999	WT 315-318 2000
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	19-May-99	16-May-00
201-300	717	717	15218	436	1870	2094	339	57	238	30	47	108
	719	719	143	179	330	727	927	37	133	2	243	59
	721	721	88	12153	304	16	10	95	53	16	11	20
301-400	718	718	7	0	159	791	91	0	16	0	0	0
	720	720	0	139	9	222	34	3	164	11	20	0
	722	722	0	70	0	0	0	28	5	0	0	0
401-500	764	764	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**
	772	772	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**
total all strata fished			112240	74377	218496	29814	15528	21915	9598	80256	61459	94418
upper			202678	137245	1398738	60382	22196	32850	16345	546724	86530	206626
t-value			2.447	2.571	12.706	2.571	2.069	2.306	2.201	12.71	2.09	2.36
1 STD			36959	24453	92889	11890	3223	4742	3065	36701	11996	47546

Table 16. Abundance ('000) and Biomass (t) of cod from autumn stratified random surveys in Division 3N.
Data for 1990-1994 have been converted to Campellen equivalent units.

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 244-247 1999 13-Nov-99	*Tel 338-339* WT 319-323 2000 12-Nov-00
0-30	375	1593	5421	66596	**nf**	2047	1947	5001	0	603	329	14518	8163
	376	1499	32419	455280	354763	260	312	3956	93	41	1598	361	819
31-50	360	2992	28703	12311	8311	3463	0	437 `		137	309	2367	1132
	361	1853	6273	14155	20718	6177	7549	3788	2025	2156	5761	1733	3161
	362	2520	12855	73045	49583	1300	622	910	104	898	792	7924	6478
	373	2520	1336	22575	1400	750	0	70	130	50	149	3004	341
	374	931	879	20754	**nf**	819	1034	57	65	43	171	512	85
	383	674	530	530	**nf**	0	0	47	0	0	46	0	0
51-100	359	421	702	0	497	88	0	29	52	29	0	0	550
	377	100	243	**nf**	493	0	7	7	12	0	0	21	21
	382	647	210	359	270	494	0	0	33	0	0	134	134
101-15	358	225	766	1500	5063	47	94	56	14	15	247	340	1156
	378	139	550	2046	1602	48	10	10	0	17	10	1472	1785
	381	182	**nf**	0	**nf**	202	0	0	233	8	13	138	338
151-20	357	164	683	399	194	1526	57	20	39	0	124		168
	379	106	213	**nf**	596	655	81	33	52	79	13	988	164
	380	116	**nf**	798	**nf**	48	16	57	24	16	0	383	563
total strata fished <= 200			91783	670348	443490	17924	11729	14478	3359	4092	9561	33894	25066
UPPER			156111	1657056	1675218	26592	20479	21567	6774	5741	14597	59471	41671
TVALUE			2.201	2.776	4.303	2.145	2.447	2.201	2.571	2.179	2.26	2.78	2.2
1 std			29227	355442	286249	4041	3576	3221	1328	757	2228	9200	7548
201-30	723	155	**nf**	0	**nf**	97	0	0	43	6	0	0	*0*
	725	105	**nf**	**nf**	0	80	0	12	22	0	7	7	*0*
	727	160	**nf**	**nf**	**nf**	878	11	9	267	0	0	22	*49*
301-40	724	124	**nf**	0	**nf**	17	0	0	19	0	0	0	*0*
	726	72	**nf**	**nf**	**nf**	0	0	0	10	0	0	0	*0*
	728	156	**nf**	**nf**	**nf**	**nf**	0	0	76	0	0	0	*0*
Total strata > 200 fathoms			0	0	0	1072	11	21	437	6	7	29	*49*
Total all strata fished			91783	670348	443490	18996	11741	14498	3795	4098	9568	33924	*25115*
1 std			29227	355442	286251	4137	3575	3221	1375	757	2228	9200	7548

Biomass

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 244-247 1999 13-Nov-99	*Tel 338-339* WT 319-323 2000 12-Nov-00
0-30	375	1593	31395	69276	**nf**	3305	9447	3162	0	594	839	2022	8642
	376	1499	5147	80732	116390	152	993	4035	806	12	791	46	2677
31-50	360	2992	7585	4456	4572	8072	0	1329	319	1226	1258	8681	1536
	361	1853	24777	16326	12485	12996	12111	8626	1734	3255	3811	1060	1986
	362	2520	9636	40955	22852	1576	1001	337	29	2581	713	4955	2840
	373	2520	9722	26255	4114	254	0	39	49	26	60	1948	125
	374	931	2501	9699	**nf**	1102	2414	15	27	45	196	111	21
	383	674	216	164	**nf**	0	0	54	0	0	0	0	0
51-100	359	421	39	0	156	39	0	12	36	25	0	0	458
	377	100	122	**nf**	257	0	13	11	11	0	0	6	3
	382	647	129	73	115	168	0	0	93	0	0	93	116
101-15	358	225	404	430	2464	45	51	61	10	80	327	197	933
	378	139	362	635	461	12	11	8	0	21	9	729	1156
	381	182	**nf**	0	**nf**	119	0	0	118	5	8	39	86
151-20	357	164	370	205	120	629	42	46	19	0	245		311
	379	106	318	**nf**	317	240	96	20	27	108	8	644	129
	380	116	**nf**	117	**nf**	32	10	26	12	10	0	223	178
total strata <= 200 fathoms			92723	249323	164303	28741	26189	17781	3290	7988	8265	20773	21196
UPPER			151903	392215	555906	46078	45182	26812	6083	11520	16104	33819	32744
TVALUE			2.365	2.228	4.303	2.179	2.62	2.101	2.356	2.101	2.45	2.26	2.16
1 std			25023	64135	91007	7956	7249	4298	1185	1681	3200	5773	5346
201-30	723	155	**nf**	0	**nf**	63	0	0	24	18	0	0	0
	725	105	**nf**	**nf**	0	90	0	10	13	0	18	10	0
	727	160	**nf**	**nf**	**nf**	484	12	3	97	0	0	39	34
301-40	724	124	**nf**	0	**nf**	12	0	0	40	0	0	0	0
	726	72	**nf**	**nf**	**nf**	0	0	0	15	0	0	0	0
	728	156	**nf**	**nf**	**nf**	**nf**	0	0	34	0	0	0	0
Total strata > 200 fathoms			0	0	0	649	12	13	223	18	18	49	34
Total all strata fished			92723	249323	16303	29389	26200	17793	3510	8006	8283	20823	21230
1 std			25023	64135	125400	7972	8397	4299	1186	1681	3200	5773	5347

Table 17. Abundance ('000) and Biomass (t) of cod from autumn stratified random surveys in Division 3O. Data for 1990-1994 have been converted to Campellen equivalent units.

Abundance

Depth Range	Strata	Area	WT 101-102	WT 113-115	WT 128-130	WT 144-146	WT 160-161	WT 176-177	WT 200 Tel 41-42 AN 253	WT 212-214	Tel 76 WT 229-233	WT 244-247	Tel 338-339 WT 319-323
mean survey date			1990 26-Nov-90	1991 24-Oct-91	1992 23-Oct-92	1993 27-Oct-93	1994 31-Oct-94	1995 10-Oct-95	1996 10-Dec-96	1997 16-Oct-97	1998 20-Nov-98	1999 22-Oct-99	2000 18-Oct-00
31-50	330	2089	10709	10264	7036	5271	2072	3946	279	1006	3113	6178	4428
	331	456	507	6682	222	222	95	760	32	31	408	721	1505
	338	1898	20199	10334	857	6221	330	2478	264	52	835	4804	3580
	340	1716	4158	5625	7746	1859	763	1668	95	519	1747	5665	6945
	351	2520	29085	24185	3558	10450	661	2709	198	1684	347	9244	11737
	352	2580	10248	24761	2747	4710	717	972	287	1006	761	2789	9419
	353	1282	1781	223	0	0	0	415	0	0	0	661	0
51-100	329	1721	531	1605	558	239	1036	574	478	95	710	521	255
	332	1047	1721	1127	436	2036	242	0	0	48	288	576	624
	337	948	1001	66	198	307	0	0	0	0	0	130	82
	339	585	163	0	41	528	41	41	0	80	126		40
	354	474	1580	0	1712	0	0	165	340	130	33	554	33
101-150	333	151	21	0	10	0	0	0	**nf**	0	0	0	10
	336	121	6	0	0	67	0	0	8	0	0	0	42
	355	103	**nf**	887	64	172	0	13	342	0	0	28	14
151-200	334	92	13	0	0	9	0	0	**nf**	0	0	0	0
	335	58	12	4	0	0	0	0	133	12	4	0	4
	356	61	**nf**	4	0	102	0	0	40	0	17	7	25
Total strata fished <= 200 fathoms			81735	85767	25185	32193	5957	13741	2496	4663	8388	31880	38743
upper			117569	117451	40427	48506	11071	18760	3870	6604	11951	43691	51707
t-value			2.093	2.049	2.447	2.145	2.365	2.12	2.447	2.12	2.23	2.09	2.13
1 std			17121	15463	6229	7605	2162	2367	562	916	1598	5651	6086
201-300	717	93	0	**nf**	**nf**	0	0	0	**nf**	0	0	10	0
	719	76	0	0	**nf**	0	5	0	37	0	0	0	3
	721	76	**nf**	0	**nf**	0	0	0	0	0	5	0	0
301-400	718	111	**nf**	**nf**	**nf**	0	0	0	**nf**	0	0	0	0
	720	105	**nf**	**nf**	**nf**	0	0	0	0	0	0	0	0
	722	93	**nf**	0	**nf**	0	0	0	0	0	0	0	0
total strata fished > 200 fathoms			0	0	0	0	5	0	37	0	5	10	3
total all strata fished			81735	85767	25185	32193	5961	13740	2534	4663	8394	31891	38746
1 STD			17574	15471	6229	7605	2163	2368	561	916	1598	5653	6086

Biomass

Depth Range	Strata	Area	WT 101-102	WT 113-115	WT 128-130	WT 144-146	WT 160-161	WT 176-177	WT 200 Tel 41-42 AN 253	WT 212-214	Tel 76 WT 229-233	WT 244-247	Tel 338-339 WT 319-323
mean survey date			1990 26-Nov-90	1991 24-Oct-91	1992 23-Oct-92	1993 27-Oct-93	1994 31-Oct-94	1995 10-Oct-95	1996 10-Dec-96	1997 16-Oct-97	1998 20-Nov-98	1999 22-Oct-99	2000 18-Oct-00
31-50	330	2089	6651	2374	2574	4278	1928	6035	302	1779	2027	2379	1817
	331	456	27	1047	191	267	172	1455	11	85	735	367	574
	338	1898	13966	7122	2760	3763	91	5283	26	167	1786	16088	5978
	340	1716	3635	6247	6711	1231	832	3149	37	951	2108	2902	5371
	351	2520	17027	21473	3142	9895	679	5052	74	4806	815	7355	5249
	352	2580	21151	32262	3137	4920	4775	3195	1353	3220	1198	9096	14518
	353	1282	4593	56	0	0	0	2238	0	0	0	716	0
51-100	329	1721	1291	1019	109	245	1546	1052	370	159	820	684	86
	332	1047	767	74	254	1323	452	0	0	0.48	1	18	33
	337	948	2331	70	373	176	0	0	0	0	0	21	12
	339	585	1242	0	64	447	56	46	0	276	606		161
	354	474	66	0	896	0	0	161	260	96	42	184	18
101-150	333	151	12	0	12	0	0	0	**nf**	0	0	0	4
	336	121	29	0	0	107	0	0	11	0	0	0	49
	355	103	**nf**	155	31	104	0	15	235	0	0	25	11
151-200	334	92	16	0	0	21	0	0	**nf**	0	0	0	0
	335	58	13	8	0	0	0	0	303	16	8	0	1
	356	61	**nf**	8	0	68	0	0	39	0	30	13	28
Total strata fished <= 200 fathoms			72817	71915	20254	26845	10531	27681	3021	11555.48	10177	39849	33912
upper			97492	98551	29947	43938	17481	41388	6586	16785	13788	84258	48733
t-value			2.093	2.093	2.201	2.306	2.201	2.16	2.571	2.12	2.06	2.78	2.2
1 std			11789	12726	4404	7412	3158	6346	1387	2467	1753	15974	6737
201-300	717	93	0	**nf**	**nf**	0	0	0	**nf**	0	0	1	0
	719	76	0	0	**nf**	0	14	0	55	0	0	0	5
	721	76	**nf**	0	**nf**	0	0	0	0	0	9	0	0
301-400	718	111	**nf**	**nf**	**nf**	0	0	0	**nf**	0	0	0	0
	720	105	**nf**	**nf**	**nf**	0	0	0	0	0	0	0	0
	722	93	**nf**	0	**nf**	0	0	0	0	0	0	0	0
total strata fished > 200 fathoms			0	0	0	0	14	0	55	0	9	1	5
total all strata fished			72817	7195	20254	26845	10546	27681	3078	11555	10186	39850	33917
1 STD			11789	43649	4404	7412	3158	6346	1386	2467	1753	15974	6737

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 -2000 are actual Campelen surveys.

	1984	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	4.69	2.15
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	0.16	4.71	6.46
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	4.55	4.58
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	0.38	0.69
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	0.70	0.10
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	0.30	0.20
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	0.11	0.29
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	0.12	0.07
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	0.42	0.06
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	0.84	0.57
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	0.07	1.10
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	0.03	0.13
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	0.03	0.02
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	0.02	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	0.01	0.01
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	0.00	0.02
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	0.02	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	0.00	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	0.00	0.00
1+	134.60	64.98	52.93	183.54	47.87	22.46	24.55	167.10	21.17	116.42	4.42	1.49	5.11	3.01	7.64	17.01	16.46

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 1984-1994. 1995-2000 are actual Campelen surveys.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.07
1	18.89	14.87	0.41	1.30	0.00	1.15	0.08	0.03	1.67	4.44	2.01
2	6.15	129.66	49.65	0.72	0.62	1.02	0.74	0.10	0.29	5.01	3.65
3	3.25	4.36	65.00	3.63	0.28	0.46	0.29	0.40	0.20	2.52	5.03
4	3.56	2.19	4.70	3.59	0.96	0.20	0.06	0.33	0.32	0.13	1.79
5	1.73	2.73	1.02	0.30	1.32	0.94	0.01	0.14	0.11	0.37	0.18
6	0.37	1.33	0.61	0.27	0.16	1.64	0.02	0.06	0.06	0.30	0.23
7	0.29	0.37	0.18	0.18	0.04	0.11	0.02	0.28	0.01	0.08	0.11
8	0.38	0.31	0.03	0.10	0.06	0.05	0.01	0.28	0.16	0.04	0.03
9	0.40	0.53	0.03	0.02	0.01	0.06	0.00	0.05	0.22	0.12	0.01
10	0.24	0.37	0.07	0.02	0.01	0.05	0.00	0.04	0.03	0.55	0.04
11	0.20	0.45	0.00	0.06	0.03	0.00	0.00	0.00	0.01	0.04	0.25
12	0.09	0.33	0.06	0.04	0.03	0.02	0.00	0.00	0.00	0.00	0.01
13	0.15	0.27	0.12	0.04	0.02	0.02	0.01	0.00	0.00	0.00	0.01
14	0.07	0.21	0.03	0.05	0.06	0.00	0.01	0.01	0.00	0.02	0.00
15	0.16	0.12	0.03	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.00
16	0.21	0.38	0.02	0.02	0.03	0.00	0.01	0.01	0.00	0.02	0.00
17	0.07	0.16	0.03	0.01	0.02	0.00	0.00	0.00	0.00	0.03	0.00
18	0.02	0.06	0.08	0.02	0.01	0.00	0.00	0.00	0.01	0.00	0.00
19	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.01		0.01	0.00
1+	36.26	158.70	122.07	10.43	3.67	5.72	1.26	1.74	3.09	13.68	13.35

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

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
1	0	0 .		0	0	0	0	0		.	0	0	0
2	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
4	0	0.03	0	0	0.02	0	0.07	0.00		0	0	0	0
5	0	0.05	0.08	0.07	0.06	0.13	0.53	0.10		0.05	0.04	0.04	0.11
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
7	0.97	1	0.62	0.81	0.89	0.84	0.87	0.96		0.88	0.93	0.56	0.75
8	0.98	1	0.89	1	1	0.84	1	1		0.96	1	1	0.87
9	1	1	1	1	1	1	1	0.89		1	1	1	0.94
10	1	1	1	1 .		1	1	1		1	1	1	1
11 .		1 .	.		1	1	1	1		1	0.99	1	1
12	1 .		1	1 .		1	0.78	1		1	1	1	1
13	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
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
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
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
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
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
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
n	244	184	270	297	471	440	290	481		648	810	606	535

AGE	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	.	.	0	0	.	.	.	.	0	0	0	0	0
2	0	0	0	0	0	0	.	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0.01	0.03	0.07	0	0.01	0	0	0.07	0.34	0.16	0.19	0
5	0.09	0.20	0.03	0.30	0.35	0.43	0.30	0.44	0.53	0.25	0.60	0.48	0.61
6	0.28	0.85	0.61	0.41	0.58	0.48	0.62	0.85	0.98	1	1	0.85	1
7	0.50	0.95	0.87	0.84	1	0.97	0.79	0.7	1	1	1	1	1
8	0.93	0.98	0.85	1	1	0.97	1	1	1	1	1	1 .	
9	0.98	1	1	1	1	0.84	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	.	1	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1	.	.	.	1	1	1
13	1	1	1	1	1	1	1	1	.	1	1	1 .	
A50	6.75	5.59	6.24	5.82	5.59	5.71	5.73	5.19	4.90	4.85	4.76	5.02	nf
L 95%	6.47	5.34	5.97	5.51	5.25	5.45	5.42	4.65	4.70	4.56	4.53	4.74	nf
U 95%	7.02	5.83	6.51	6.22	5.98	5.97	6.12	5.58	5.12	5.23	5.08	5.33	nf
Slope	1.65	2.34	1.69	1.5	2.24	1.82	1.62	1.76	3.21	2.01	2.45	2.06	nf
SE	0.22	0.28	0.18	0.21	0.43	0.22	0.27	0.51	0.49	0.30	0.47	0.374	nf
Int	-11.16	-13.06	-10.56	-8.74	-12.51	-10.41	-9.27	-9.14	-15.74	-9.73	-11.67	-10.34	nf
SE	1.53	1.64	1.14	1.12	2.39	1.27	1.47	2.74	2.39	1.34	2.12	1.84	nf
n	409	567	552	379	268	318	188	76	303	233	216	259	273

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	1	1
[1]	1960	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1	1	1
[1]	1961	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1	1	1
[1]	1962	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1	1	1
[1]	1963	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1	1	1
[1]	1964	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1	1	1
[1]	1965	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1	1	1
[1]	1966	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1	1	1
[1]	1967	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1	1	1
[1]	1968	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1	1	1
[1]	1969	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1	1	1
[1]	1970	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1	1	1
[1]	1971	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1	1	1
[1]	1972	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1	1	1
[1]	1973	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1	1	1
[1]	1974	0.0001	0.0043	0.0616	0.3824	0.8056	0.9657	0.9965	0.9998	1	1	1
	1975	0.0000	0.0000	0.0230	0.4722	0.9683	0.9999	1.0000	1.0000	1	1	1
	1976	0.0002	0.0075	0.0894	0.3997	0.7985	0.9730	0.9987	1.0000	1	1	1
	1977	0.0002	0.0050	0.0518	0.2488	0.6069	0.8889	0.9850	0.9991	1	1	1
	1978	0.0000	0.0018	0.0541	0.3821	0.8430	0.9897	0.9999	1.0000	1	1	1
	1979	0.0002	0.0070	0.0896	0.4091	0.8114	0.9770	0.9991	1.0000	1	1	1
	1980	0.0015	0.0211	0.1347	0.4298	0.7737	0.9534	0.9954	0.9998	1	1	1
	1981	0.0318	0.1141	0.2895	0.5378	0.7718	0.9184	0.9796	0.9965	1	1	1
	1982	0.0001	0.0053	0.0935	0.4665	0.8752	0.9915	0.9999	1	1	1	1
[2]	1983	0.0001	0.0053	0.0935	0.4665	0.8752	0.9915	0.9999	1	1	1	1
	1984	0.0000	0.0013	0.0666	0.5010	0.9340	0.9987	1.0000	1	1	1	1
	1985	0.0000	0.0017	0.0513	0.3702	0.8340	0.9884	0.9998	1	1	1	1
	1986	0.0000	0.0017	0.0327	0.2258	0.6321	0.9233	0.9941	0.9999	1	1	1
	1987	0.0012	0.0154	0.1014	0.3490	0.6907	0.9168	0.9884	0.9992	1	1	1
	1988	0.0003	0.0059	0.0550	0.2482	0.5940	0.8761	0.9809	0.9986	1	1	1
	1989	0.0004	0.0192	0.2114	0.6795	0.9586	0.9987	1.0000	1	1	1	1
	1990	0.0011	0.0166	0.1156	0.3960	0.7485	0.9456	0.9944	0.9997	1	1	1
	1991	0.0070	0.0565	0.2381	0.5637	0.8493	0.9717	0.9973	0.9999	1	1	1
	1992	0.0001	0.0128	0.2059	0.7223	0.9773	0.9997	1.0000	1	1	1	1
	1993	0.0002	0.0147	0.2066	0.7058	0.9713	0.9994	1.0000	1	1	1	1
	1994	0.0120	0.0576	0.2356	0.6087	0.8870	0.9754	0.9950	0.9990	0.9998	1	1
	1995	0.0207	0.1094	0.4168	0.8061	0.9603	0.9930	0.9988	1	1	1	1
	1996	0.0022	0.0520	0.5757	0.9711	0.9988	1.0000	1	1	1	1	1
	1997	0.0239	0.1541	0.5755	0.9098	0.9869	0.9982	0.9998	1	1	1	1
	1998	0.0131	0.1336	0.6409	0.9538	0.9958	0.9996	1	1	1	1	1
	1999	0.0003	0.0020	0.0154	0.1097	0.4918	0.8838	0.9835	0.9979	0.9997	1	1
[3]	2000	0.0001	0.0008	0.0098	0.1035	0.5751	0.9407	0.9947	0.9995	1	1	1
	2001	0.0001	0.0008	0.0098	0.1035	0.5751	0.9407	0.9947	0.9995	1	1	1

[1] Ogive for 1959 - 74 calculated as the mean of 1975-79

[2] Ogive for 1983 is the 1982 ogive

[3] *note: the model did not fit the data for 2000 and the values for 2000 and 2001 are based in fitting the model to data from 1996-1999.

Table 23. Catch-at-age used in this assessment for Divisions 3NO cod, 1959-2000 (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	46	94	41	101	40	14	6	23	55	3	2
2000	10	356	339	87	62	21	12	4	13	12	2

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

	Year age	PAR. EST.	STD. ERR.	REL. ERR.	BIAS	REL. BIAS
Survivors	94 12	80	73	0.909	18	0.220
	95 12	51	28	0.545	6	0.120
	96 12	31	13	0.407	2	0.077
	97 12	67	25	0.369	5	0.067
	98 12	95	36	0.385	7	0.072
	99 12	48	19	0.402	4	0.074
	00 12	53	18	0.350	3	0.058
	2001 3	4000	2650	0.663	919	0.230
	4	3160	1590	0.502	408	0.129
	5	536	291	0.543	68	0.126
	6	98	54	0.555	12	0.122
	7	364	140	0.383	25	0.070
	8	286	93	0.324	16	0.055
	9	104	32	0.310	5	0.050
	10	55	17	0.316	3	0.050
	11	288	88	0.304	14	0.047
	12	466	150	0.322	23	0.050
Survey Catchabilities						
Spring	2	0.0011	0.0003	0.2290	1.97E-05	0.0170
	3	0.0015	0.0003	0.2250	2.64E-05	0.0170
	4	0.0008	0.0002	0.2250	1.38E-05	0.0180
	5	0.0004	0.0001	0.2260	8.74E-06	0.0200
	6	0.0003	0.0001	0.2270	5.83E-06	0.0190
	7	0.0003	0.0001	0.2300	6.37E-06	0.0190
	8	0.0003	0.0001	0.2340	7.14E-06	0.0210
	9	0.0005	0.0001	0.2380	1.06E-05	0.0230
	10	0.0005	0.0001	0.2440	1.54E-05	0.0290
Fall	2	0.0011	0.0003	0.2920	3.50E-05	0.0310
	3	0.0011	0.0003	0.2870	3.36E-05	0.0300
	4	0.0009	0.0003	0.2890	3.01E-05	0.0340
	5	0.0007	0.0002	0.2920	2.44E-05	0.0370
	6	0.0006	0.0002	0.2920	1.94E-05	0.0340
	7	0.0004	0.0001	0.2980	1.29E-05	0.0360
	8	0.0004	0.0001	0.3050	1.42E-05	0.0380
	9	0.0003	0.0001	0.3260	1.63E-05	0.0480
	10	0.0004	0.0001	0.3380	2.71E-05	0.0620
Juv	2	0.0035	0.0013	0.3690	2.13E-04	0.0610
	3	0.0019	0.0007	0.3680	1.13E-04	0.0600
	4	0.0014	0.0005	0.3690	8.32E-05	0.0610
	5	0.0011	0.0004	0.3700	6.73E-05	0.0600
	6	0.0008	0.0003	0.3730	4.83E-05	0.0580
	7	0.0006	0.0002	0.3800	3.68E-05	0.0590
	8	0.0005	0.0002	0.3860	3.11E-05	0.0630
	9	0.0003	0.0001	0.3940	2.24E-05	0.0700
	10	0.0003	0.0001	0.4070	2.50E-05	0.0870

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

popnum	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	330,518
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	154111	99509	130150	82351	28883	11073	3234	1531	719	719	86	512,366
1969	96818	126175	66742	55815	24240	7265	3431	1228	801	429	508	383,452
1970	101648	79268	95947	43016	21651	9853	4073	1563	542	394	231	358,185
1971	74517	83223	62998	60832	25515	9253	4801	1872	795	310	121	324,237
1972	42188	61009	67279	27529	22783	10441	4442	1704	1083	471	164	239,094
1973	44123	34540	49888	37315	11560	6720	3316	2127	1138	693	316	191,735
1974	27761	36125	19251	16285	17043	4127	3733	1842	1108	713	444	128,432
1975	32960	22728	23793	7287	3682	4318	1379	1147	605	307	204	98,411
1976	54552	26985	18003	11616	2818	800	837	198	132	90	31	116,061
1977	49994	44663	18442	8002	4211	1337	465	471	123	75	62	127,846
1978	20882	40932	36019	12875	4281	2104	583	223	199	43	25	118,165
1979	23686	17097	32681	25581	8276	2769	1404	386	130	117	28	112,154
1980	33035	19392	13933	23308	12695	4280	1475	911	264	91	85	109,469
1981	26219	27047	15637	10456	15651	8346	2819	1008	663	188	67	108,100
1982	42421	21466	21688	11818	7423	10745	5123	1792	652	458	117	123,704
1983	49758	34732	17300	15973	8242	5166	7421	2855	933	345	230	142,955
1984	39353	40738	27372	13580	11372	5664	3611	5038	1643	550	210	149,131
1985	10580	32220	33301	21507	9846	7220	3540	2309	3299	851	355	125,028
1986	7764	8662	26328	24602	12040	5337	3654	2182	1477	2221	463	94,730
1987	15490	6357	6954	18973	14373	5943	3012	2140	1285	875	1504	76,905
1988	15387	12506	4739	5312	12392	8671	3775	1879	996	610	361	66,627
1989	6153	12367	9989	3593	2979	4488	3567	2184	1030	435	277	47,061
1990	6814	4923	8399	6216	1598	1312	1987	1770	1352	634	206	35,212
1991	24283	5209	3074	2865	1255	513	696	981	928	713	384	40,901
1992	7734	14465	3273	1911	1454	541	169	242	299	313	243	30,643
1993	794	6257	7799	1104	817	643	233	81	109	130	120	18,087
1994	542	620	3941	3515	338	243	240	124	44	55	63	9,724
1995	1137	444	300	1160	1876	165	116	173	95	35	45	5,544
1996	1333	931	363	181	932	1500	133	95	141	77	29	5,714
1997	436	1090	758	293	145	747	1205	106	76	113	63	5,032
1998	1534	356	881	605	230	114	584	946	82	58	88	5,479
1999	4631	1255	289	700	476	179	89	453	738	64	44	8,918
2000	3771	3750	943	200	482	354	134	68	350	554	50	10,654
2001	2992	3078	2749	468	86	339	271	99	52	275	443	10,851

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

f adjusted	2	3	4	5	6	7	8	9	10	11	12	FBAR 6-9	FBAR 4-6
1959	0	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	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	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	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	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	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	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	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	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	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	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	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	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	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	0.385	0.920	0.584	0.830	0.388	0.388	0.453	0.267	0.245	0.515	0.515	0.778
1974	0	0.218	0.771	1.287	1.173	0.896	0.980	0.913	1.084	1.052	0.991	0.991	1.077
1975	0	0.033	0.517	0.750	1.327	1.441	1.740	1.960	1.705	2.097	1.617	1.617	0.865
1976	0	0.181	0.611	0.815	0.546	0.342	0.374	0.279	0.366	0.173	0.385	0.385	0.657
1977	0	0.015	0.159	0.425	0.494	0.629	0.538	0.662	0.859	0.899	0.581	0.581	0.360
1978	0	0.025	0.142	0.242	0.236	0.205	0.213	0.337	0.330	0.231	0.248	0.248	0.207
1979	0	0.005	0.138	0.501	0.459	0.430	0.233	0.181	0.155	0.120	0.326	0.326	0.366
1980	0	0.015	0.087	0.198	0.219	0.218	0.181	0.118	0.139	0.102	0.184	0.184	0.168
1981	0	0.021	0.080	0.143	0.176	0.288	0.253	0.235	0.170	0.274	0.238	0.238	0.133
1982	0	0.016	0.106	0.160	0.163	0.170	0.385	0.452	0.437	0.490	0.292	0.292	0.143
1983	0	0.038	0.042	0.140	0.175	0.158	0.187	0.353	0.328	0.298	0.218	0.218	0.119
1984	0	0.002	0.041	0.122	0.254	0.270	0.247	0.224	0.458	0.238	0.249	0.249	0.139
1985	0	0.002	0.103	0.380	0.412	0.481	0.284	0.246	0.196	0.410	0.356	0.356	0.298
1986	0	0.020	0.128	0.337	0.506	0.372	0.335	0.329	0.324	0.190	0.386	0.386	0.324
1987	0.014	0.094	0.069	0.226	0.305	0.254	0.272	0.565	0.545	0.686	0.349	0.349	0.200
1988	0.019	0.025	0.077	0.379	0.816	0.688	0.347	0.402	0.628	0.591	0.563	0.563	0.424
1989	0.023	0.187	0.274	0.610	0.620	0.615	0.501	0.280	0.286	0.548	0.504	0.504	0.501
1990	0.069	0.271	0.876	1.400	0.937	0.434	0.506	0.446	0.439	0.301	0.581	0.581	1.071
1991	0.318	0.265	0.275	0.478	0.641	0.912	0.857	0.990	0.887	0.877	0.850	0.850	0.465
1992	0.012	0.418	0.886	0.650	0.616	0.643	0.536	0.593	0.631	0.761	0.597	0.597	0.717
1993	0.047	0.262	0.597	0.984	1.012	0.785	0.428	0.414	0.494	0.531	0.660	0.660	0.864
1994	0.000	0.526	1.023	0.428	0.518	0.542	0.127	0.073	0.026	0.001	0.001	0.315	0.656
1995	0.000	0.000	0.306	0.019	0.024	0.013	0.000	0.006	0.000	0.000	0.000	0.011	0.116
1996	0.002	0.005	0.015	0.018	0.020	0.019	0.025	0.024	0.024	0.014	0.000	0.022	0.018
1997	0.003	0.012	0.027	0.042	0.039	0.047	0.042	0.053	0.060	0.050	0.054	0.045	0.036
1998	0.001	0.009	0.030	0.039	0.049	0.049	0.054	0.049	0.055	0.078	0.065	0.050	0.040
1999	0.011	0.086	0.170	0.173	0.097	0.090	0.077	0.058	0.086	0.053	0.051	0.080	0.147
2000	0.003	0.110	0.500	0.646	0.153	0.068	0.104	0.067	0.042	0.024	0.045	0.098	0.433

		2	3	4	5	6	7	8	9	10	11	12	mean 6-9	mean 4-6
mean f	1959-2000	0.012	0.092	0.306	0.464	0.514	0.460	0.476	0.407	0.466	0.437	0.455	0.464	0.428
	1959-81	0.000	0.065	0.315	0.525	0.603	0.541	0.636	0.505	0.595	0.514	0.571	0.584	0.497
	1982-93	0.042	0.133	0.289	0.489	0.538	0.482	0.407	0.441	0.471	0.490	0.467	0.328	0.353
	1994-2000	0.003	0.107	0.296	0.195	0.129	0.118	0.061	0.047	0.042	0.032	0.031	0.089	0.207
	1999-2000	0.007	0.098	0.335	0.409	0.125	0.079	0.090	0.063	0.064	0.039	0.048	0.089	0.290

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.

Year/Age	2	3	4	5	6	7	8	9	10	11	12	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
2000		0.326	0.229	0.520	0.983	1.791	1.840	4.836	5.416	8.546	8.130	9.246
2001		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	19343	26729	30989	13354	11291	14215	11073	1846	206,498	109,498
1960		15658	24591	65125	17597	18992	19590	8251	7934	8935	4471	191,145	85,771
1961		24361	24050	28804	51368	15123	13906	10823	5677	5736	3842	183,689	106,474
1962		32017	38510	29954	20034	31221	10739	8025	7130	4463	5263	187,356	86,875
1963		23282	50634	50847	34712	21295	23723	7892	5133	4777	3040	225,336	100,572
1964		33233	37050	66260	48461	32461	17607	10497	3116	2141	2848	253,674	117,130
1965		48109	49838	38180	56341	42910	28715	13461	7044	1478	1822	287,898	151,770
1966		59424	80003	65934	39288	43864	21368	15310	11231	1504	726	338,654	133,293
1967		63476	111006	99150	57199	23783	25148	5877	7515	1474	809	395,437	121,805
1968		34882	85543	90774	49092	28795	11796	7909	5020	5801	801	320,413	109,214
1969		44230	43868	61523	41201	18893	12516	6344	5590	3458	4725	242,347	92,726
1970		27787	63063	47415	36800	25622	14856	8076	3785	3177	2148	232,728	94,464
1971		29173	41407	67053	43369	24062	17513	9670	5551	2501	1123	241,421	103,788
1972		20600	45908	31340	38178	25966	14898	8526	7691	3769	1521	198,397	100,549
1973		13706	36660	43948	20528	18465	12129	10034	8584	6527	3404	173,985	79,671
1974		18195	12418	17839	28533	10329	15369	10726	6471	6392	4065	130,337	81,885
1975		6558	14547	7044	5887	10712	4756	5831	4250	1646	1574	62,805	34,656
1976		6626	10586	13012	4867	2104	2976	1044	920	707	250	43,094	12,869
1977		15791	13041	9286	7875	3824	1826	2533	940	760	635	56,511	18,393
1978		17190	27865	16029	7812	6407	2346	1205	1433	389	307	80,985	19,901
1979		10551	27452	30905	14895	7037	5222	1805	865	890	271	99,893	30,985
1980		9965	11455	29996	23665	11885	5855	4949	1744	794	854	101,163	49,747
1981		14358	14848	14464	33370	24864	12502	6305	5648	1712	699	128,771	85,101
1982		16944	22255	16311	14935	34489	22139	11320	5167	4329	1230	149,121	93,610
1983		29263	18142	23627	16371	14936	33117	16398	7261	3067	2390	164,573	93,541
1984		29770	27062	18050	23481	16015	14167	27574	11053	4672	2231	174,074	99,193
1985		24396	27449	26996	17323	19653	13310	11956	22837	6917	3539	174,375	95,534
1986		2866	18331	28128	20712	14276	15320	13265	11913	20197	4398	149,408	100,082
1987		1710	3932	21740	23971	14849	12278	13410	10839	8601	16826	128,156	100,774
1988		4289	3317	5651	18903	17517	12460	9277	7036	5584	3765	87,800	74,542
1989		7993	8463	4545	5237	10859	11437	11285	6717	3513	2963	73,011	52,010
1990		1784	6028	7397	3203	3245	7313	8515	10410	5567	2125	55,587	40,378
1991		2305	2102	3630	2300	1589	2711	5479	6253	7144	4375	37,888	29,851
1992		7318	1957	1814	2459	1378	727	1345	2233	2766	2746	24,744	13,655
1993		1343	3957	1035	1141	1448	793	431	719	1051	1037	12,955	6,620
1994		197	1604	2961	501	447	810	561	291	283	509	8,164	3,402
1995		145	69	603	1844	295	213	837	513	298	364	5,180	4,364
1996		303	83	94	916	2686	245	459	763	662	232	6,443	5,962
1997		355	174	152	143	1339	2217	514	411	962	508	6,776	6,095
1998		116	202	314	226	205	1075	4575	447	500	713	8,372	7,740
1999		409	66	364	468	321	164	2190	3995	546	360	8,883	8,044
2000		1222	216	104	474	633	247	327	1896	4736	404	10,259	8,717
2001		1004	629	243	84	607	498	479	280	2349	3601	9,774	7,898

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	12896	11252	14212	11073	1846	87,922
1960	2	105	4010	6729	15300	18918	8222	7933	8935	4471	74,626
1961	3	102	1774	19642	12183	13429	10786	5676	5736	3842	73,172
1962	4	164	1845	7660	25152	10371	7997	7129	4463	5263	70,048
1963	3	216	3131	13273	17156	22909	7865	5132	4777	3040	77,502
1964	4	158	4080	18530	26151	17003	10460	3115	2141	2848	84,491
1965	6	212	2351	21544	34569	27730	13414	7042	1478	1822	110,169
1966	7	341	4060	15023	35338	20636	15257	11229	1504	726	104,121
1967	8	473	6106	21872	19160	24285	5856	7514	1474	809	87,556
1968	4	364	5590	18772	23198	11392	7882	5020	5801	801	78,822
1969	5	187	3789	15755	15220	12086	6322	5589	3458	4725	67,136
1970	3	269	2920	14072	20642	14346	8048	3785	3177	2148	69,409
1971	4	176	4129	16583	19385	16912	9636	5550	2501	1123	76,000
1972	2	196	1930	14598	20919	14387	8497	7690	3769	1521	73,508
1973	2	156	2706	7849	14876	11713	9999	8583	6527	3404	65,815
1974	2	53	1099	10911	8321	14841	10689	6470	6392	4065	62,842
1975	0	0	162	2780	10372	4756	5831	4250	1646	1574	31,371
1976	1	79	1163	1945	1680	2895	1043	920	707	250	10,685
1977	3	65	481	1959	2321	1623	2495	940	760	635	11,282
1978	0	50	867	2985	5401	2322	1205	1433	389	307	14,961
1979	2	192	2769	6094	5709	5102	1804	865	890	271	23,698
1980	15	242	4040	10171	9195	5583	4927	1744	794	854	37,565
1981	457	1694	4187	17946	19190	11481	6177	5628	1712	699	69,172
1982	2	118	1525	6967	30185	21951	11319	5167	4329	1230	82,794
1983	3	96	2209	7637	13072	32836	16397	7261	3067	2390	84,968
1984	0	35	1202	11764	14958	14149	27574	11053	4672	2231	87,638
1985	0	47	1385	6413	16391	13155	11953	22837	6917	3539	82,637
1986	0	31	920	4677	9024	14145	13187	11911	20197	4398	78,490
1987	2	61	2204	8366	10256	11257	13254	10830	8601	16826	81,657
1988	1	20	311	4692	10405	10916	9100	7027	5584	3765	51,820
1989	3	162	961	3559	10410	11422	11285	6717	3513	2963	50,994
1990	2	100	855	1269	2429	6915	8467	10407	5567	2125	38,136
1991	16	119	864	1296	1350	2634	5464	6252	7144	4375	29,516
1992	1	25	374	1776	1347	727	1345	2233	2766	2746	13,340
1993	0	58	214	805	1407	793	431	719	1051	1037	6,515
1994	2	92	698	305	397	791	558	290	283	509	3,925
1995	3	8	251	1486	283	212	836	513	298	364	4,254
1996	1	4	54	889	2683	245	459	763	662	232	5,992
1997	8	27	88	130	1321	2213	514	411	962	508	6,183
1998	2	27	201	216	204	1074	4575	447	500	713	7,958
1999	0	0	6	51	158	145	2154	3986	546	360	7,406
2000	0	0	1	49	364	232	325	1895	4736	404	8,007
2001	0	1	2	9	349	468	476	280	2348	3601	7,535

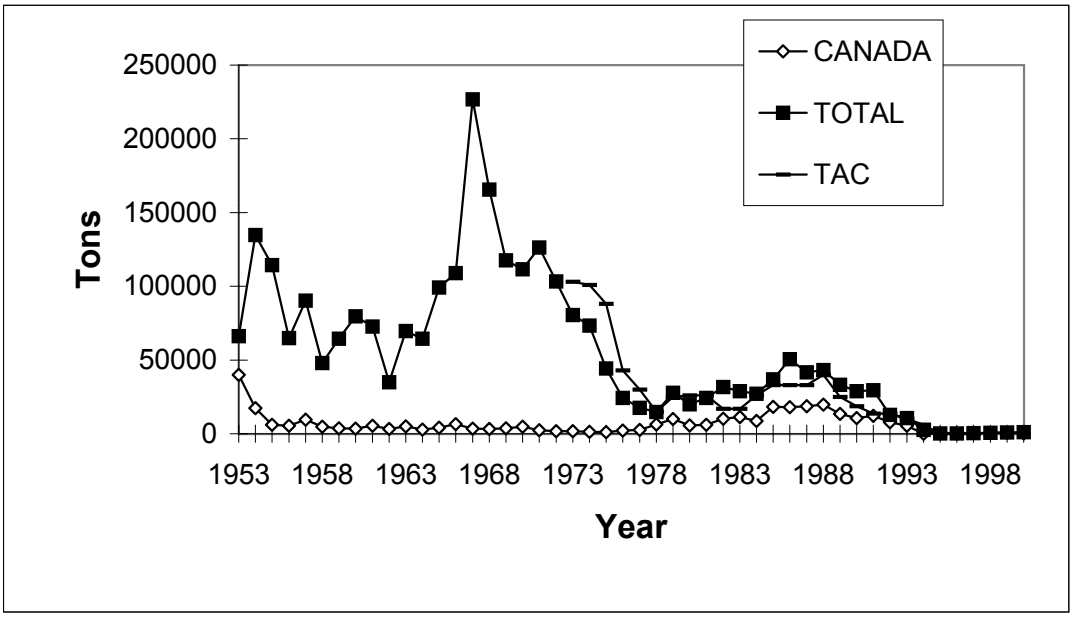


Fig 1. Landings of Cod in NAFO Divisions 3NO from 1953-2000

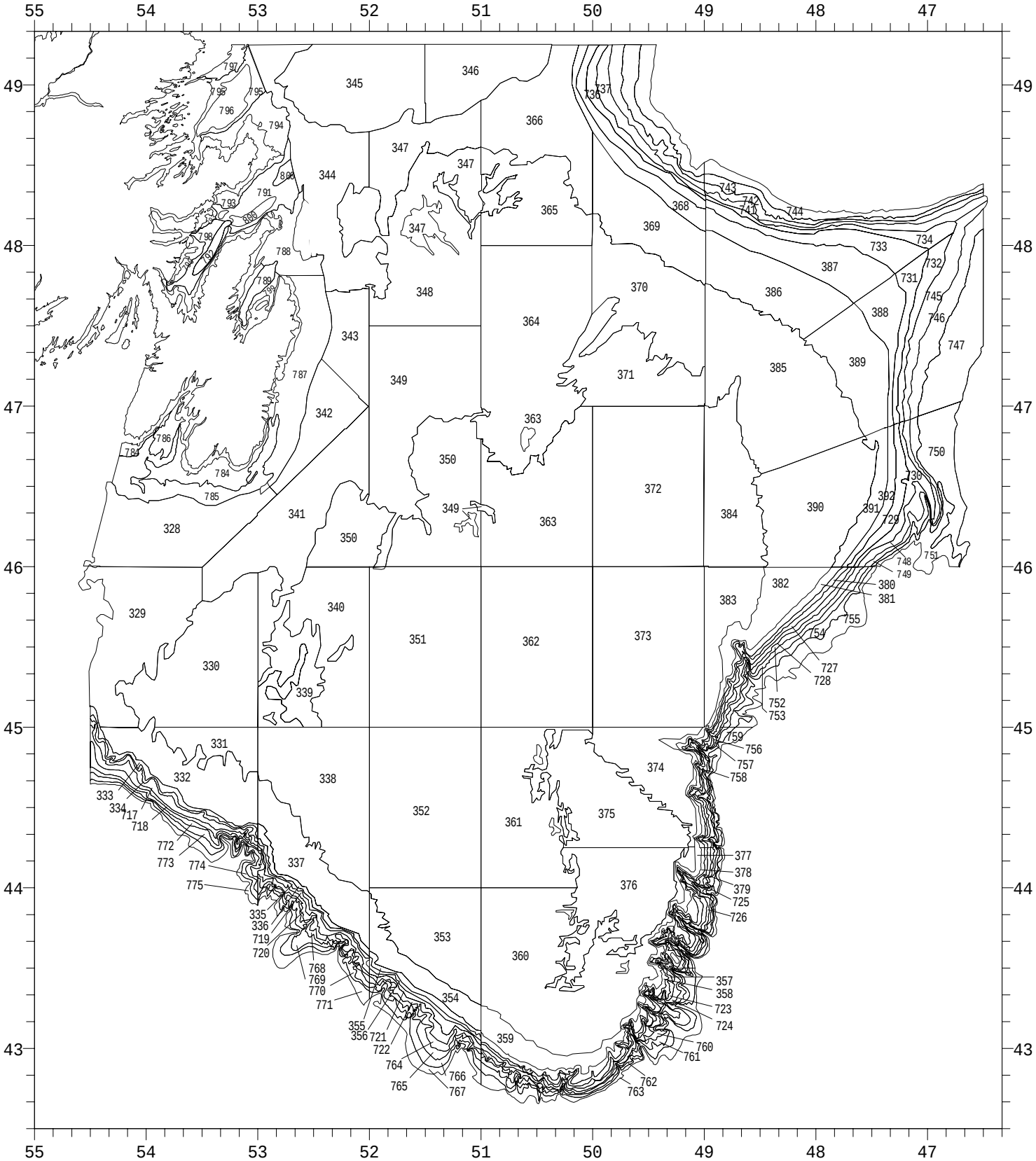


Fig. 2. Stratification scheme for Divisions 3LNO.

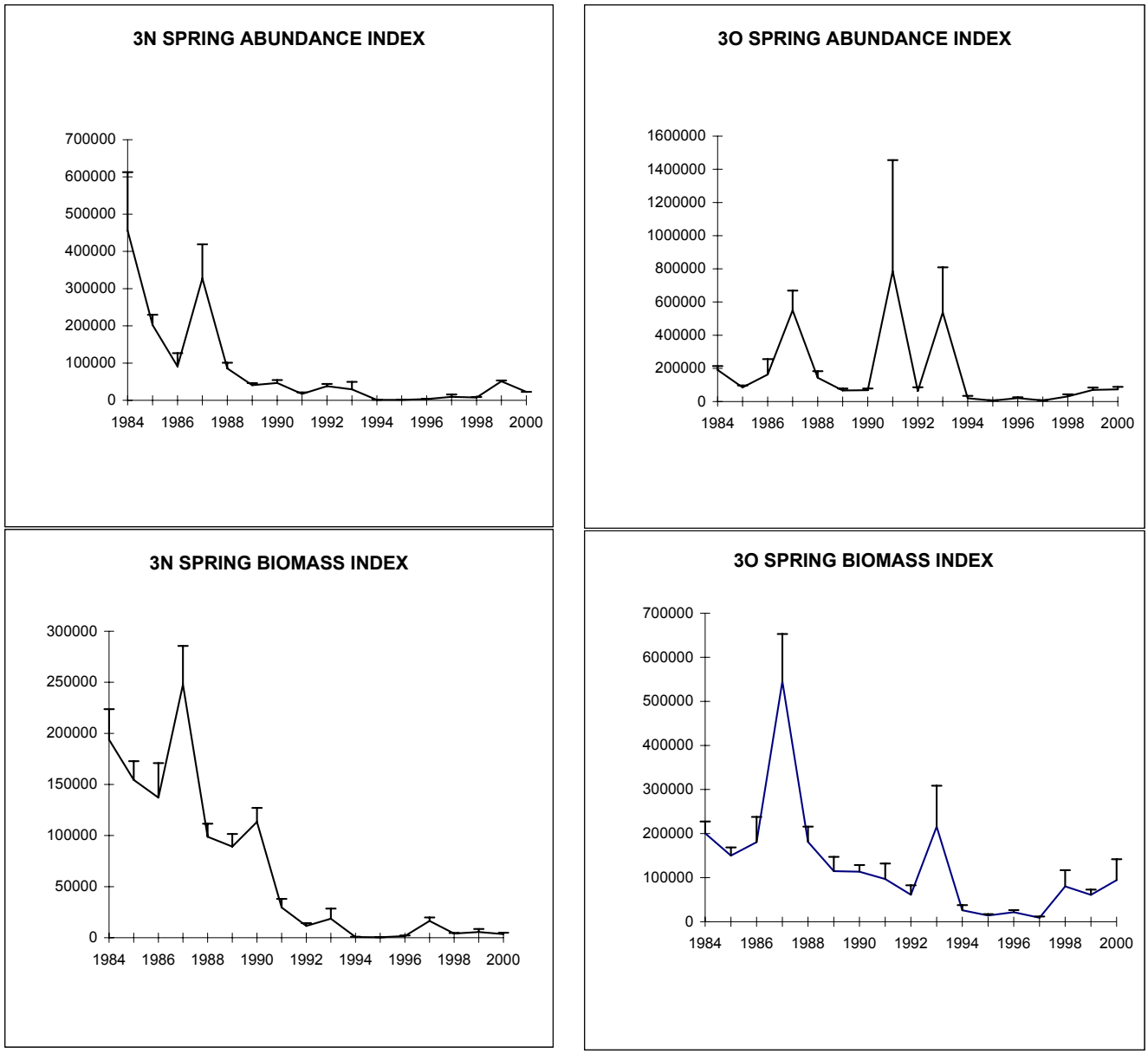


Fig. 3. Abundance (000's) and biomass (t) for the Canadian Spring Research Vessel survey series with 1 standard deviation.

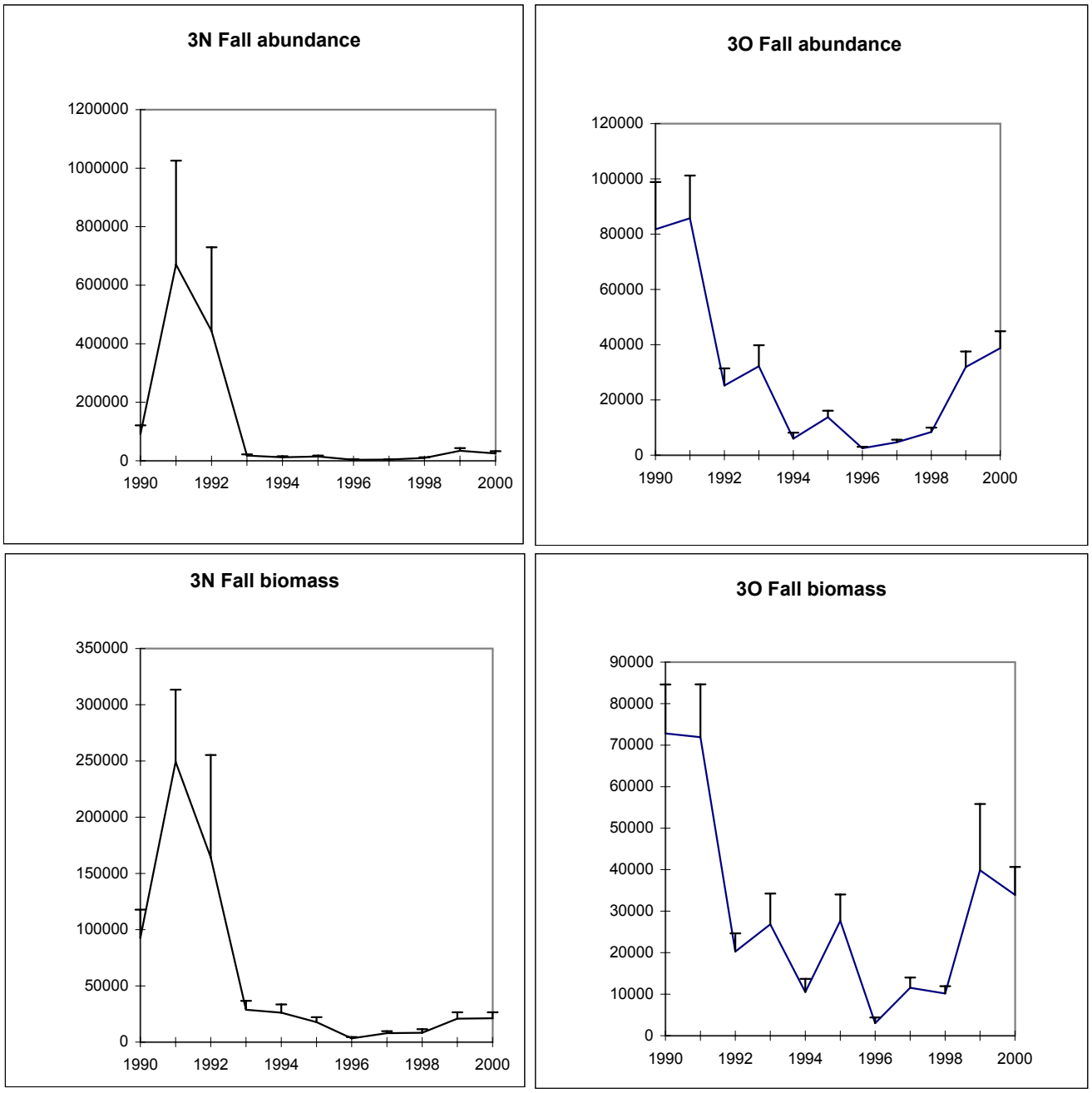


Fig. 4. Abundance (000's) and biomass (t) for the Canadian Fall Research Vessel survey Vertical bars indicate 1 standard deviation.

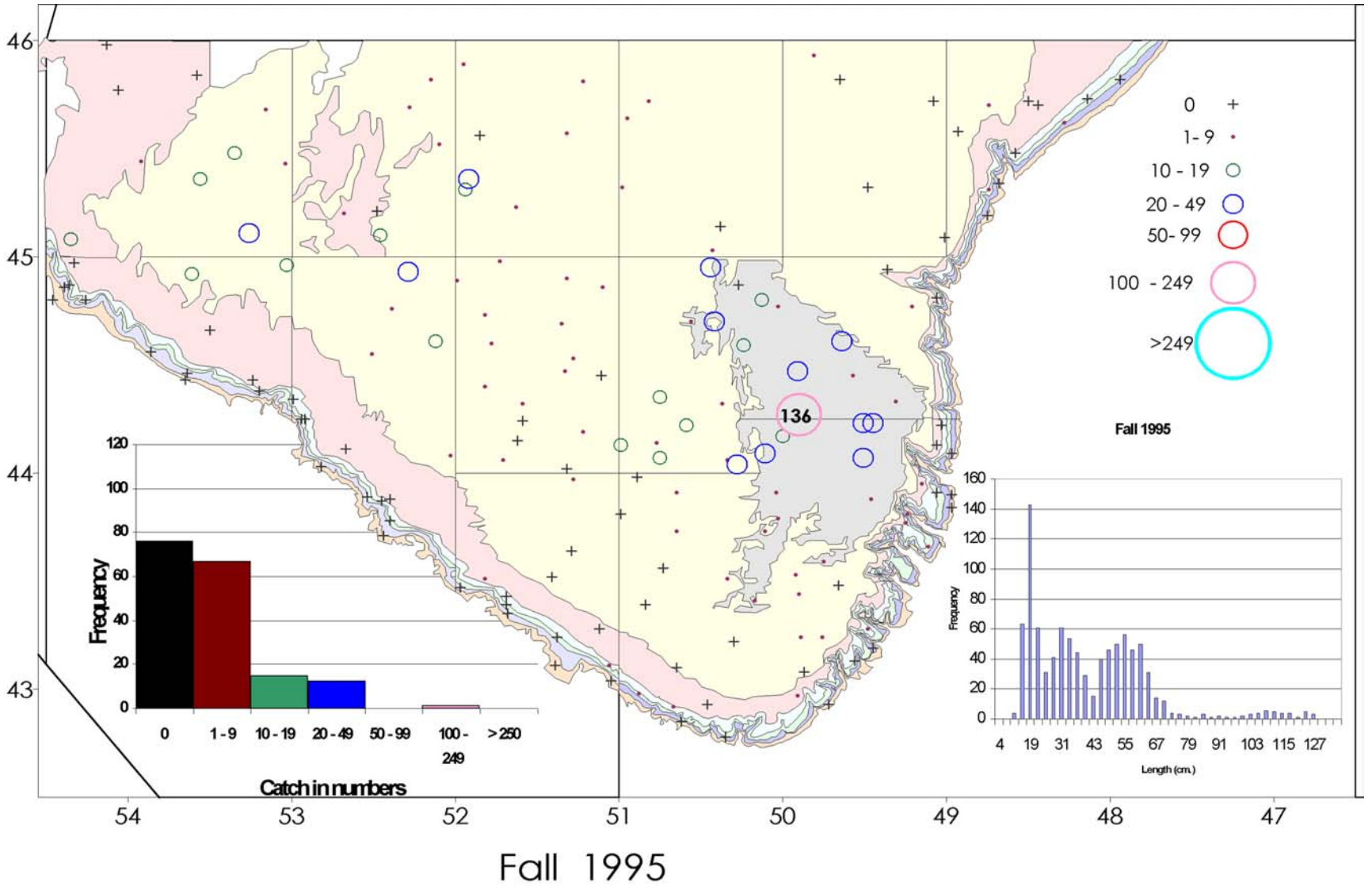


Fig.5. Catch Numbers From Canadian Research Surveys

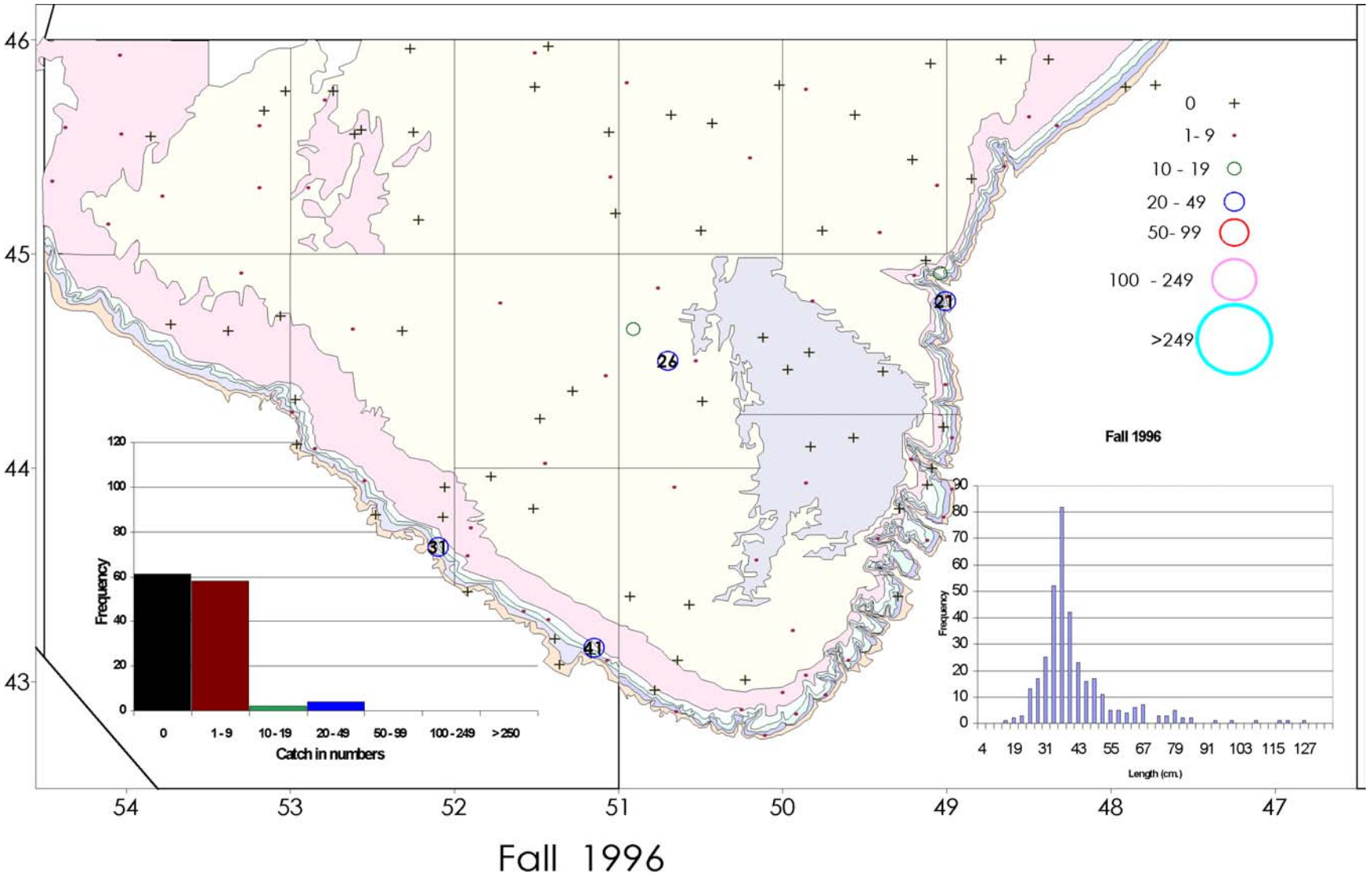


Fig.5. (cont.) Catch Numbers From Canadian Research Surveys

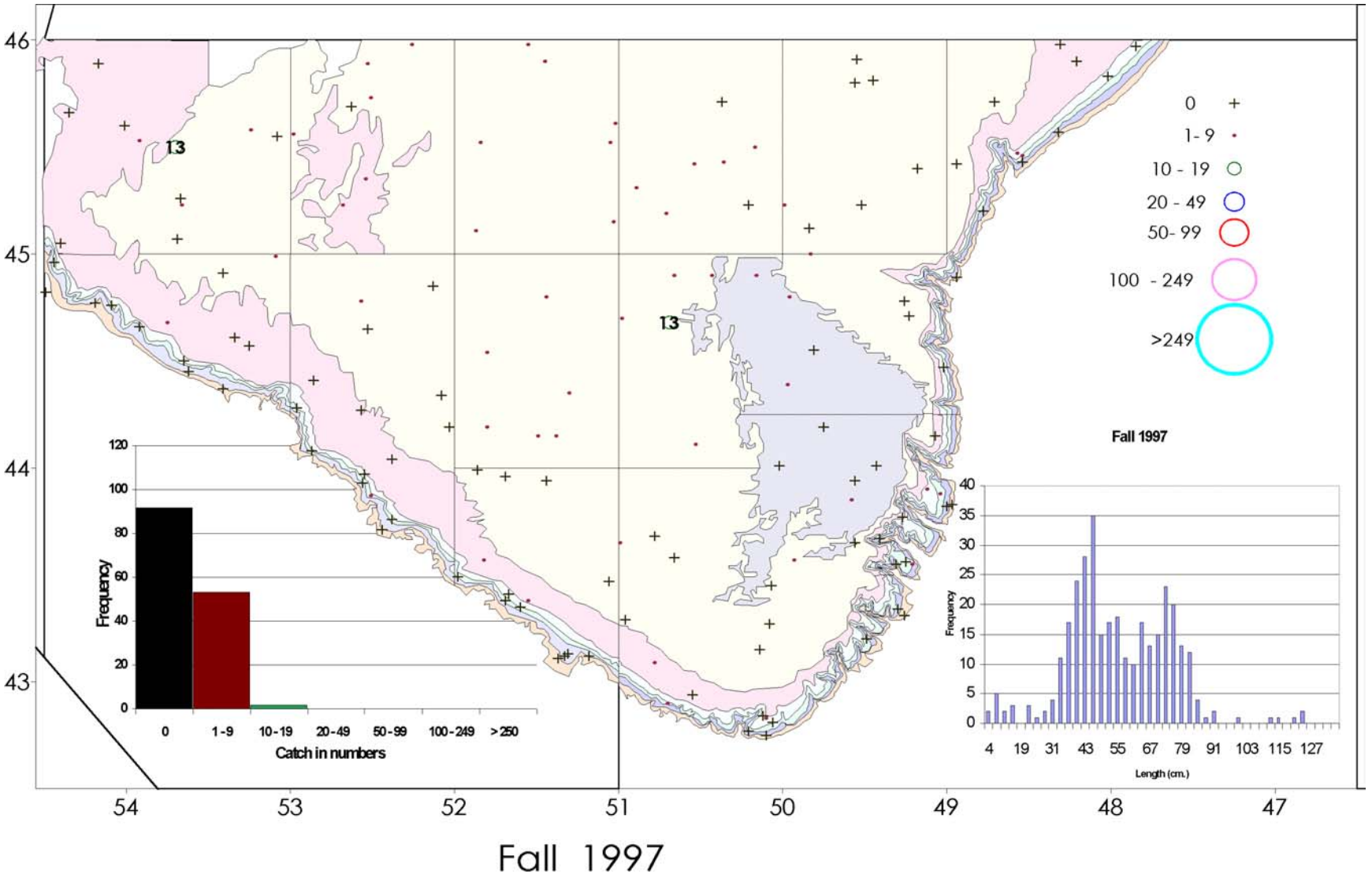
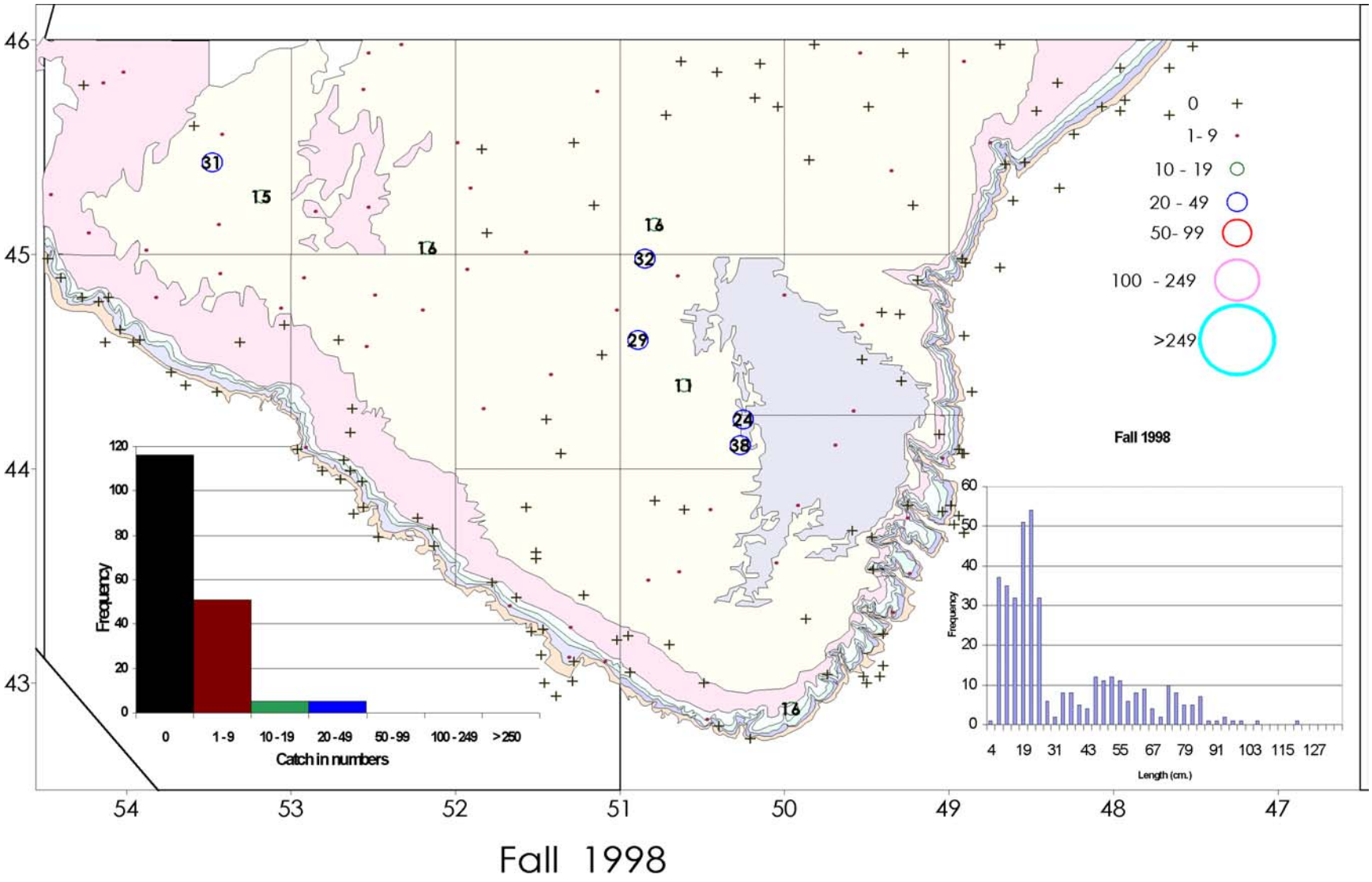


Fig.5. (cont.) Catch Numbers From Canadian Research Surveys



Fall 1998

Fig.5. (cont.) Catch Numbers From Canadian Research Surveys

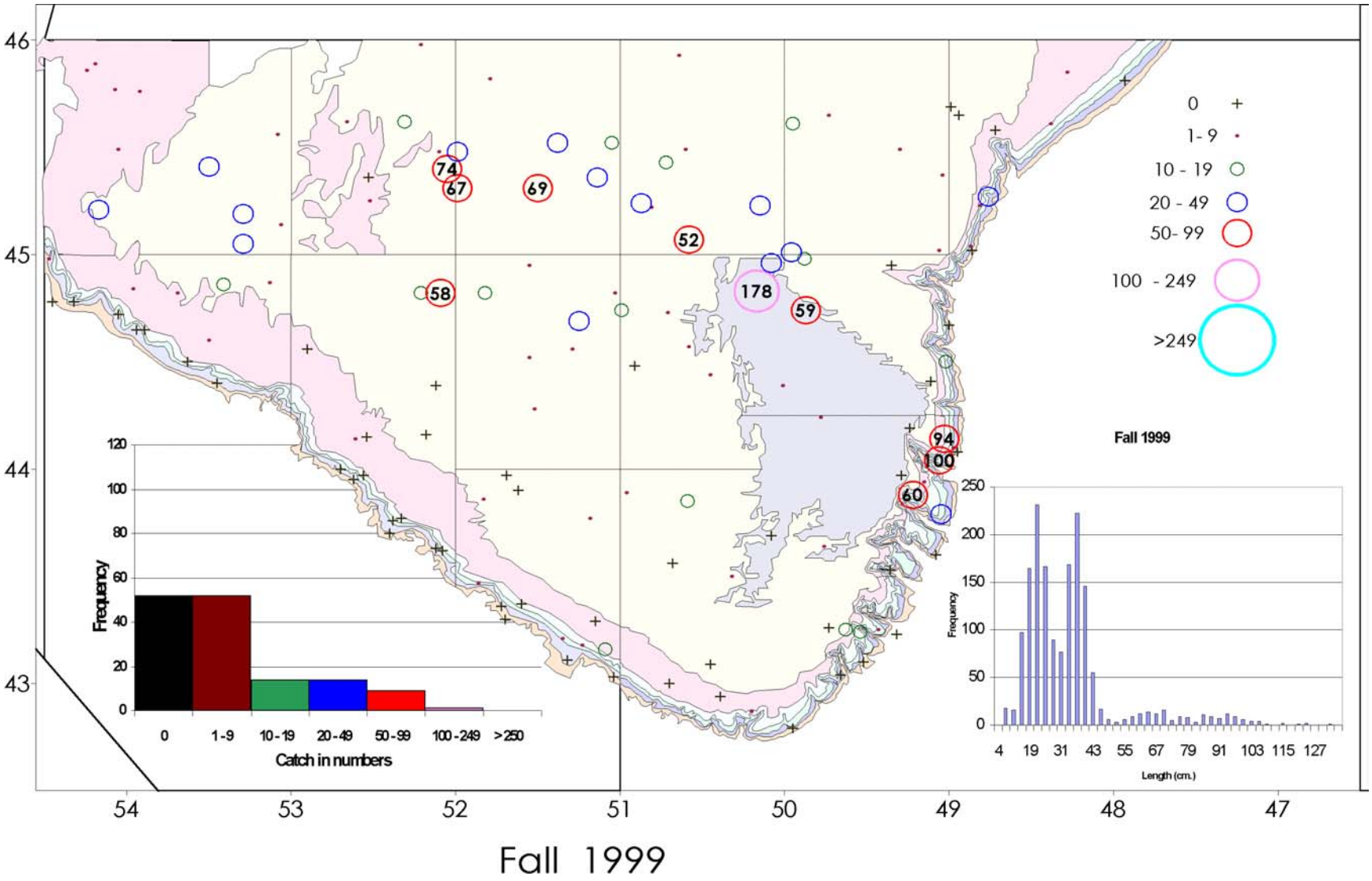


Fig.5. (cont.) Catch Numbers From Canadian Research Surveys

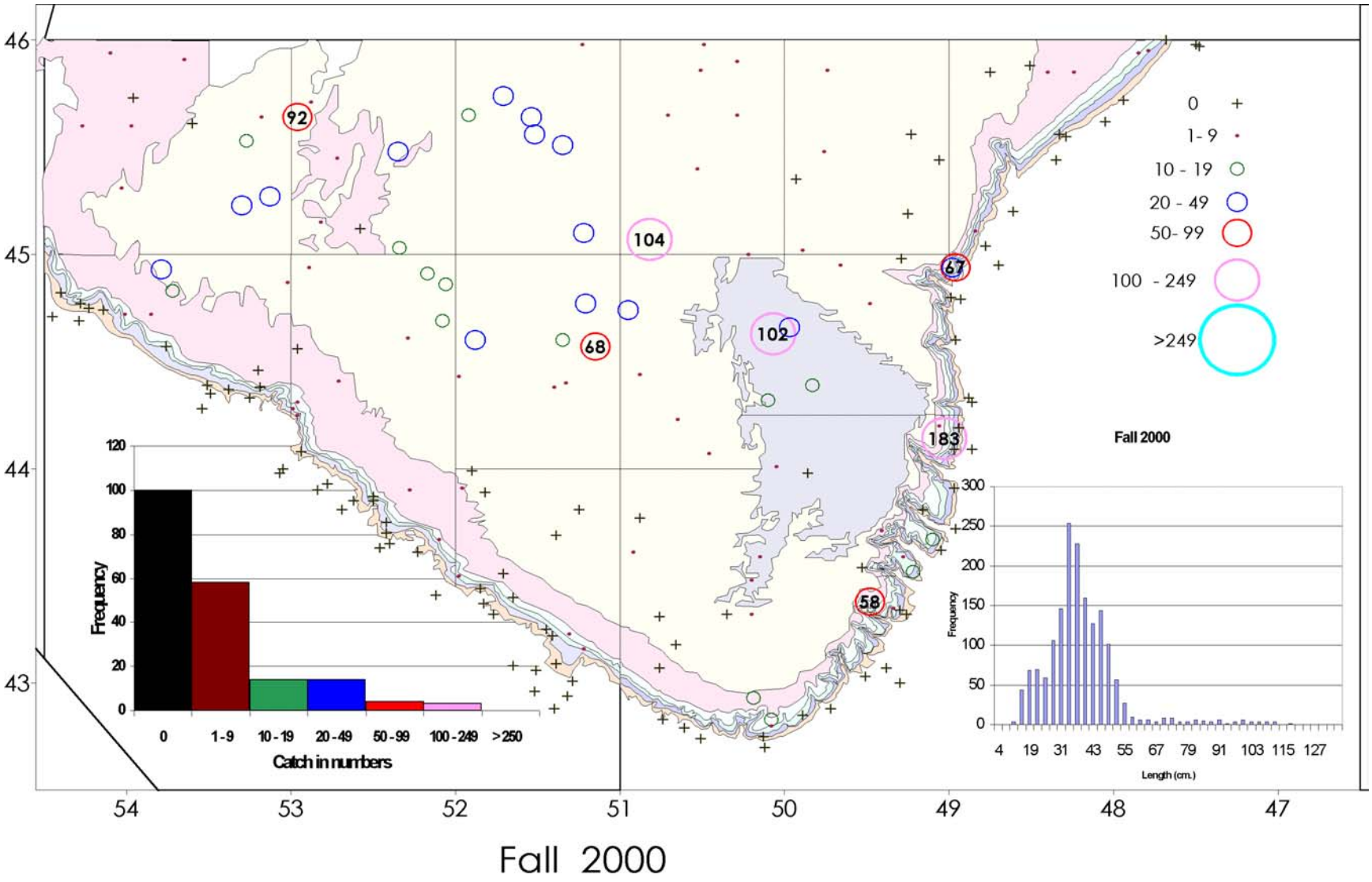


Fig.5. (cont.) Catch Numbers From Canadian Research Surveys

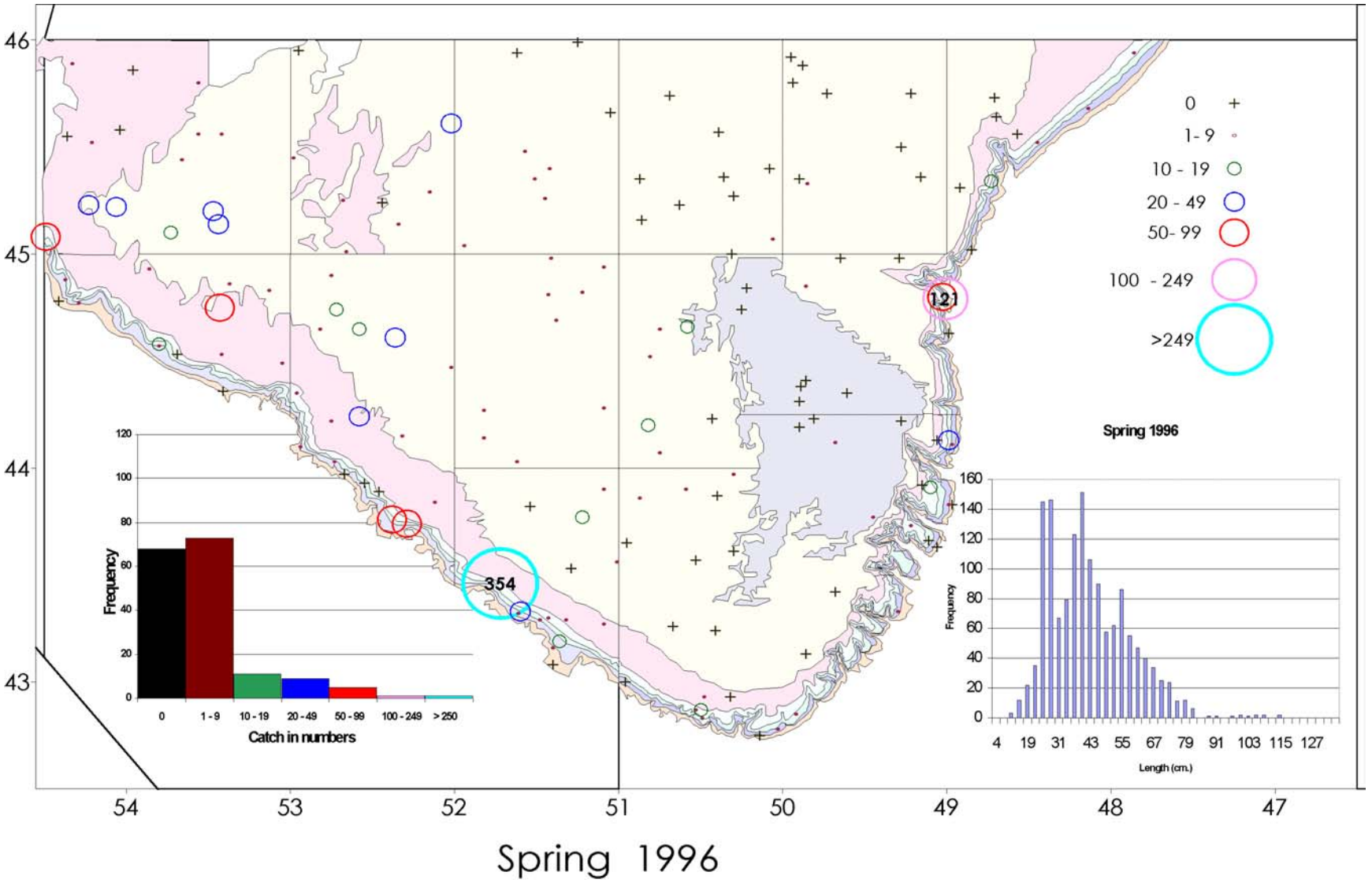


Fig.5. (cont.) Catch Numbers From Canadian Research Surveys

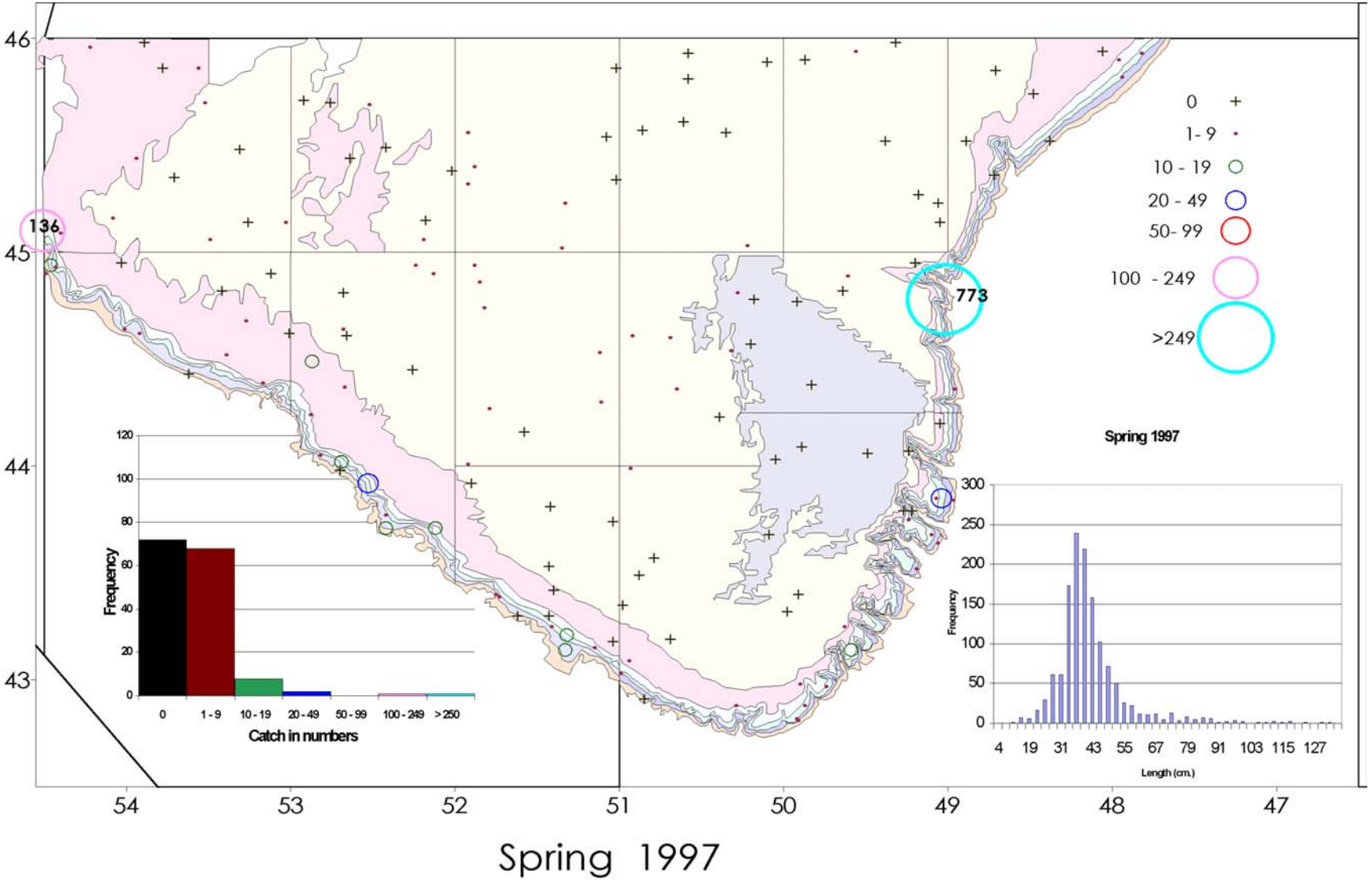


Fig.5. (cont.) Catch Numbers From Canadian Research Surveys

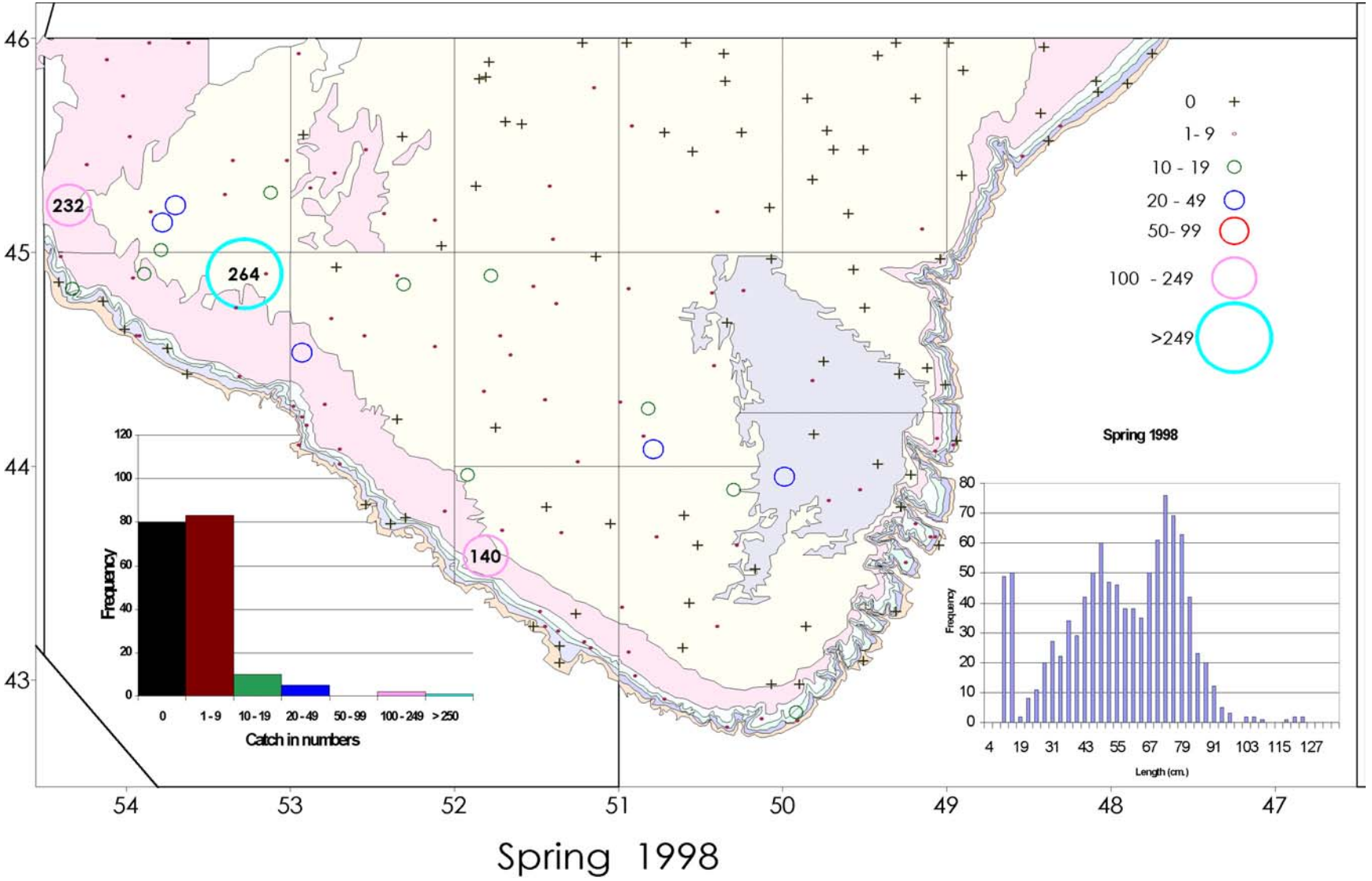


Fig.5. (cont.) Catch Numbers From Canadian Research Surveys

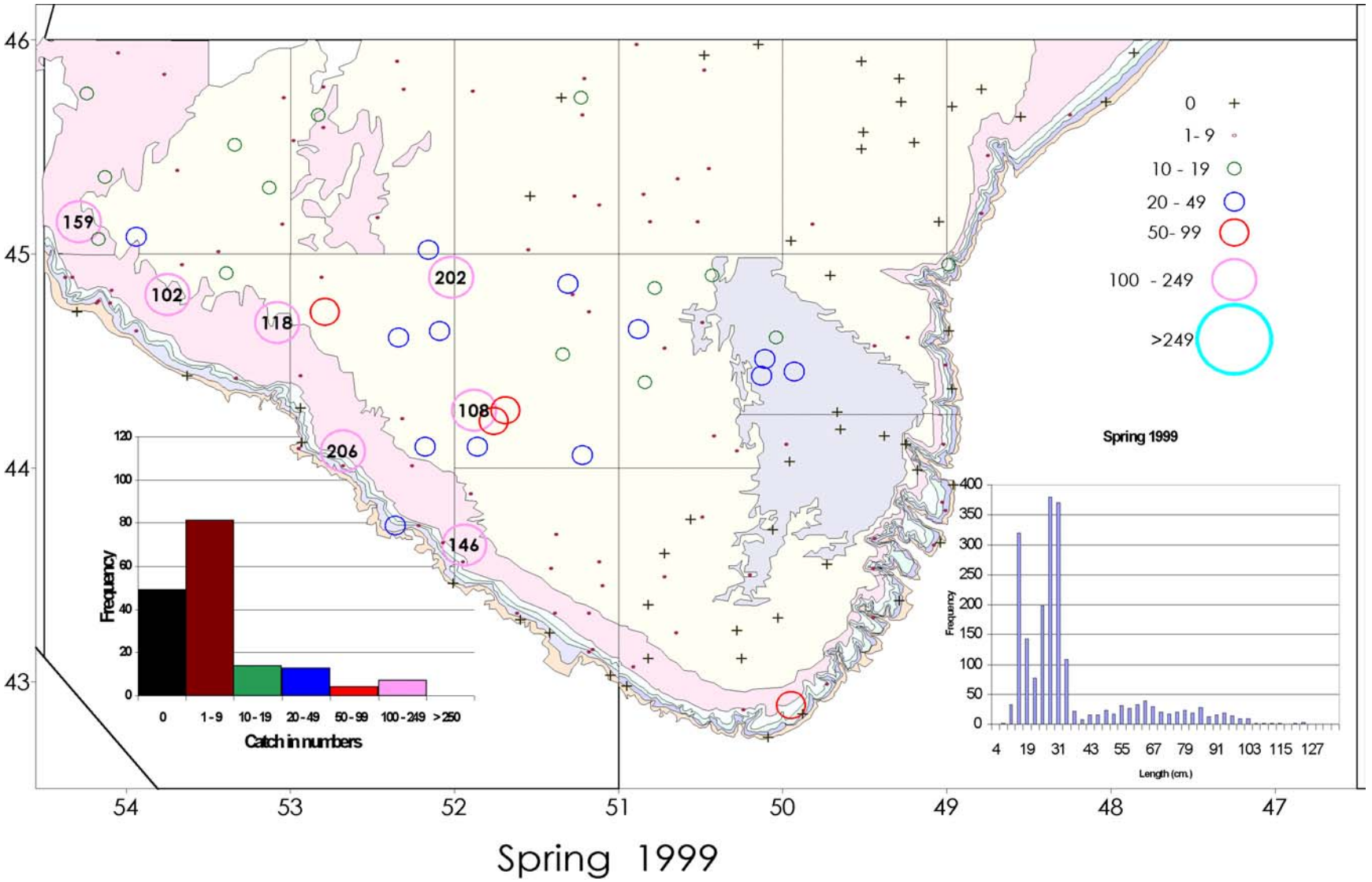


Fig.5. (cont.) Catch Numbers From Canadian Research Surveys

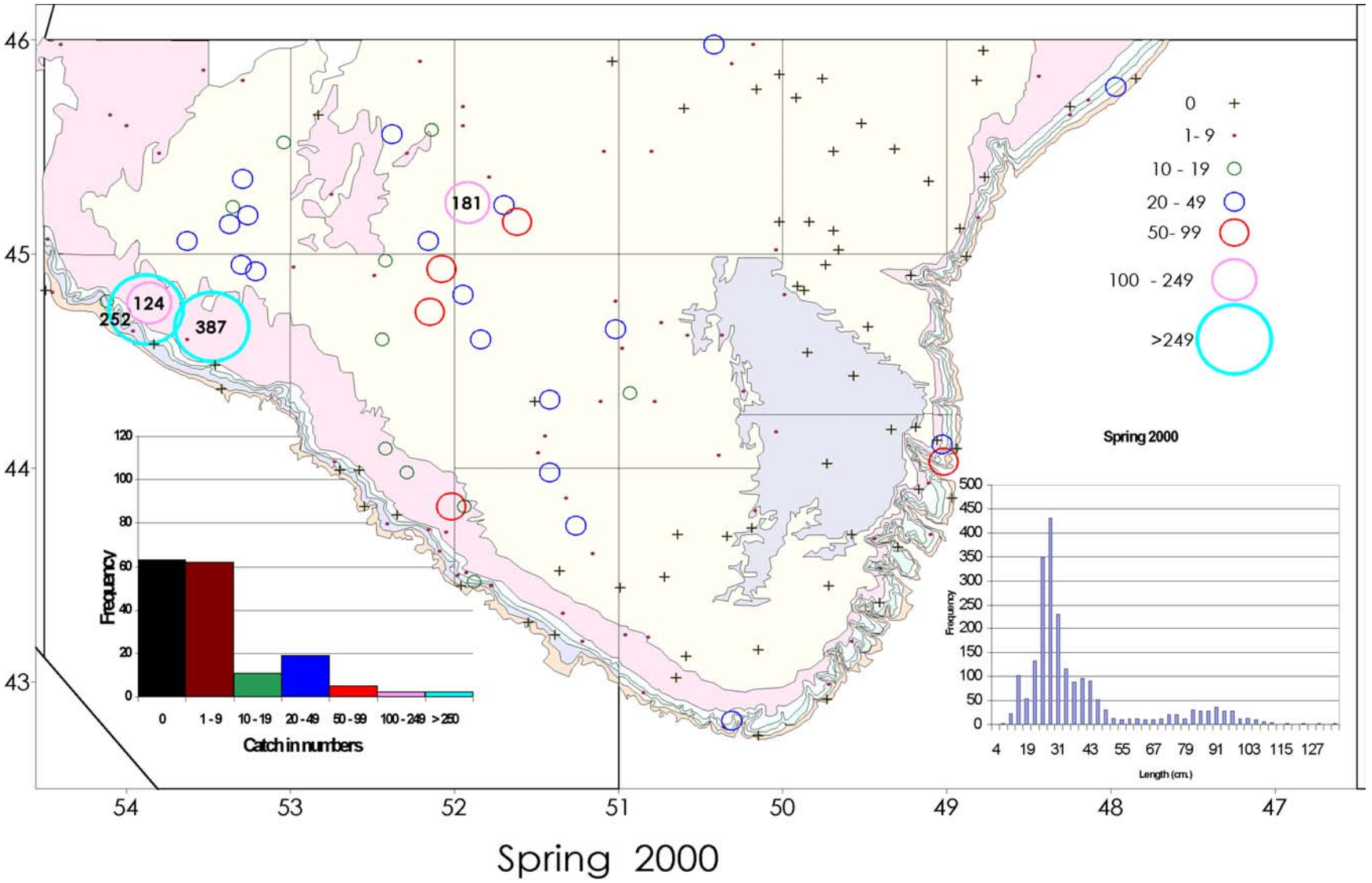
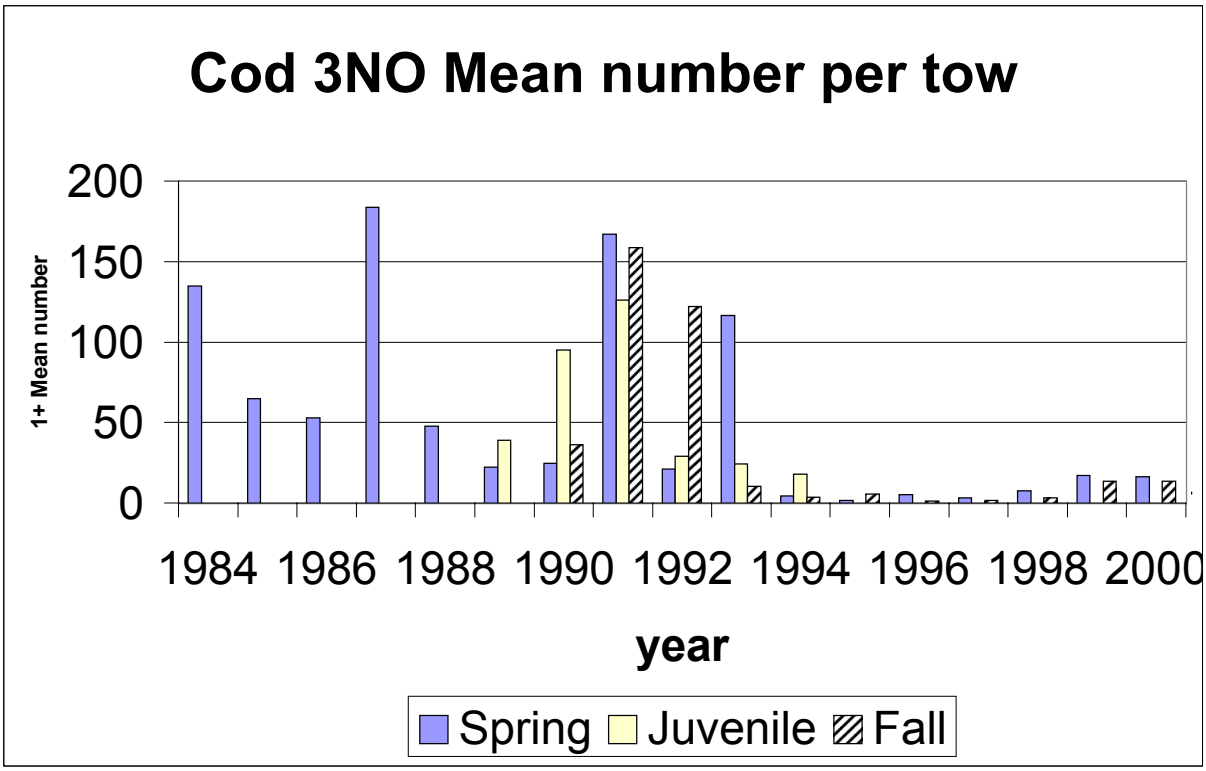


Fig.5. (cont.) Catch Numbers From Canadian Research Surveys



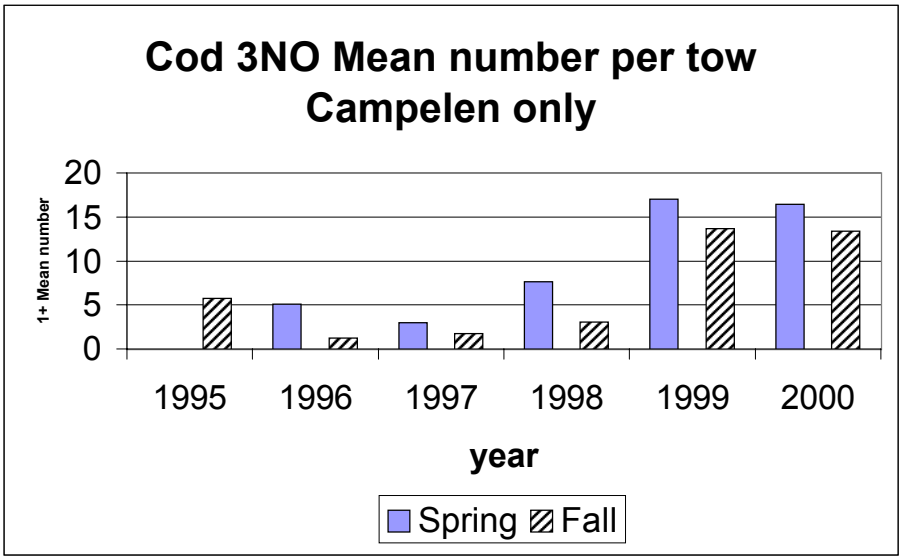


Fig 6. Spring Juvenile and autumn Canadian RV estimates of 1+ mean number/tow of cod in Divisions 3NO Data for 1984-1995 has been converted to Campelen equivalent units.

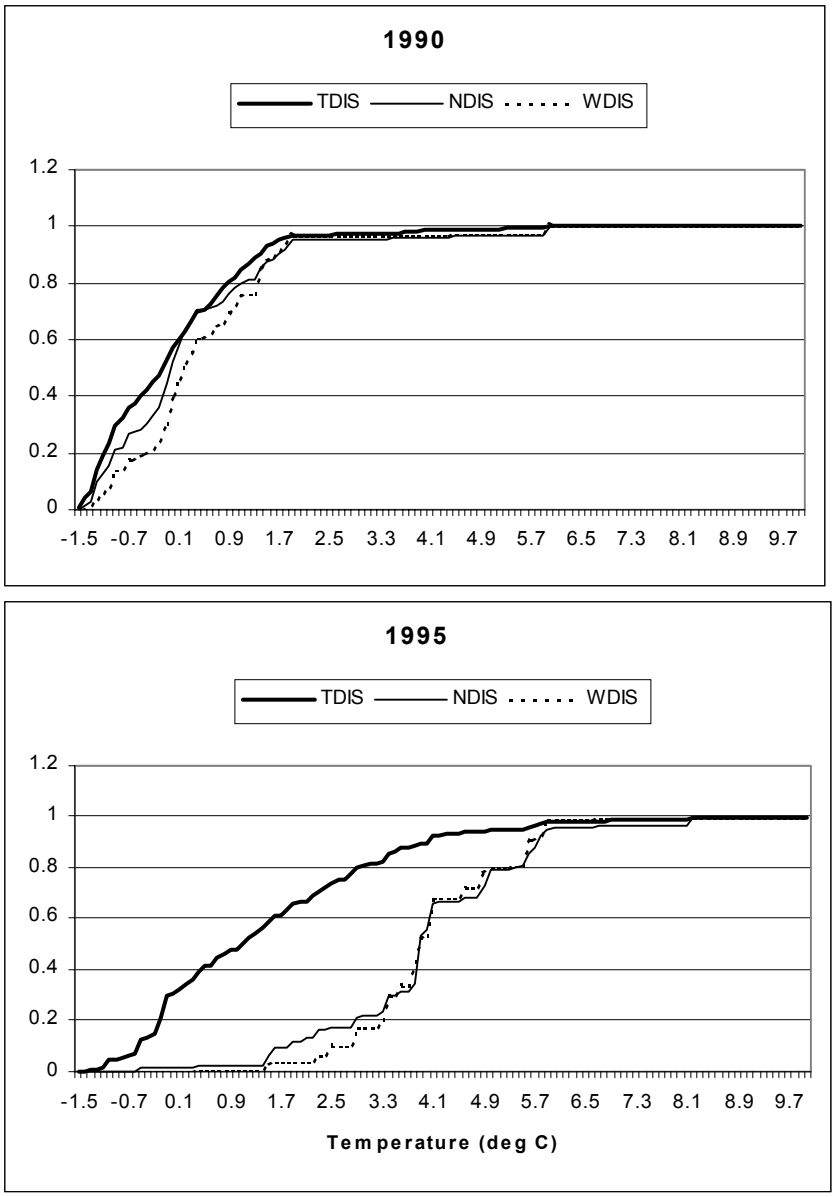


Fig. 7. Cumulative probability distribution for temperature in the spring RV trawl surveys for 1990 and 1995 compared with cumulative temperature distributions weighted with survey estimates of numbers and biomass.

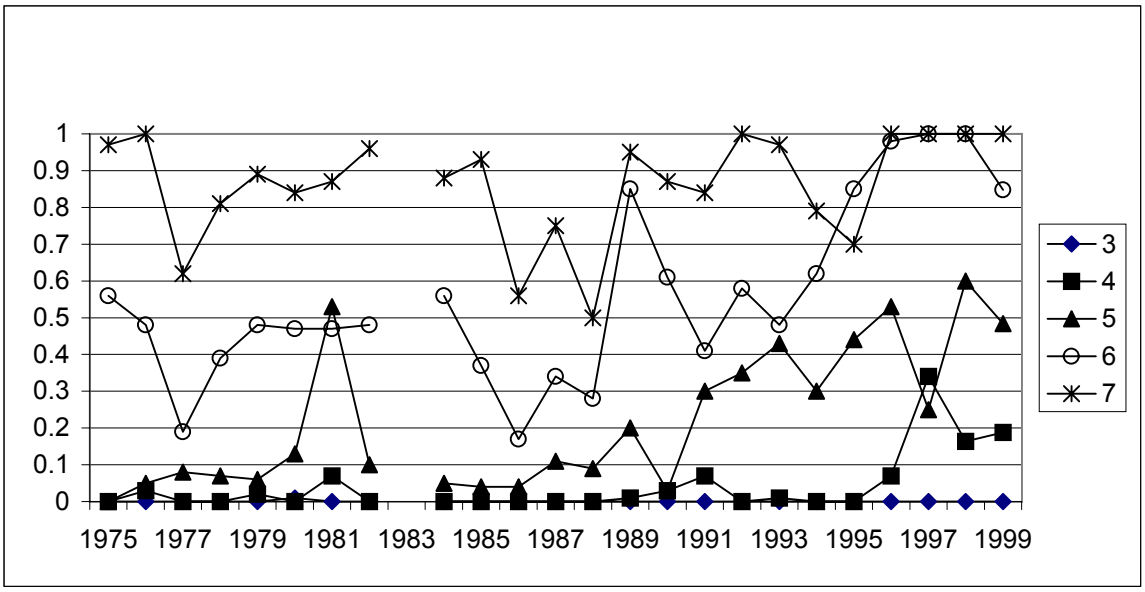


Fig. 8 Estimated proportion mature at ages 3-7 for female cod in NAFO Divisions 3NO for 1975 to 1998

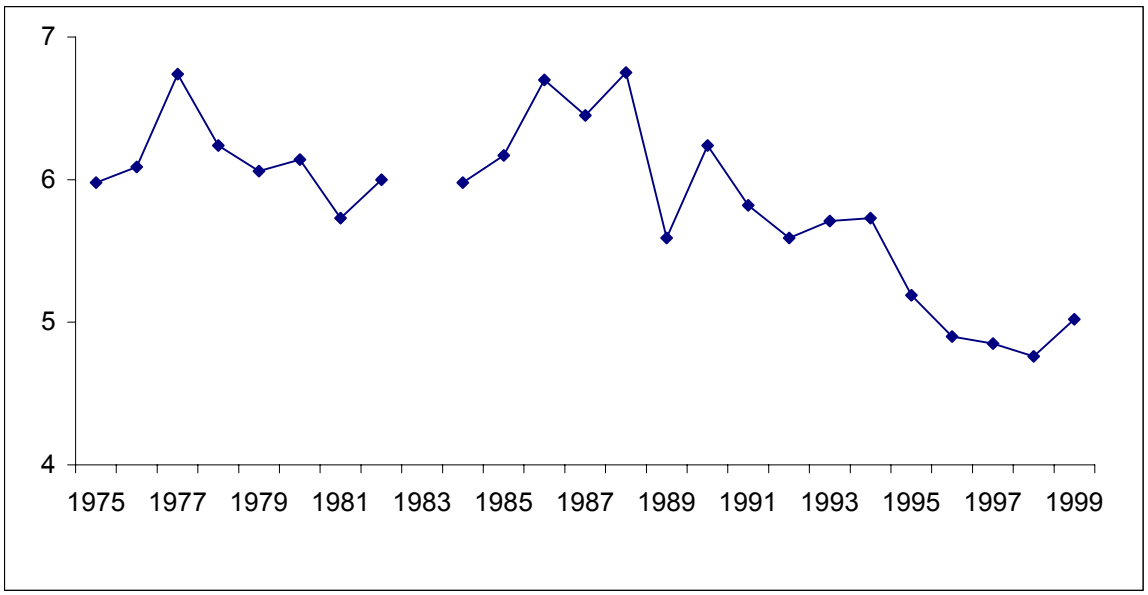


Fig. 9 Age at 50% maturity for female cod in NAFO Divisions 3NO.

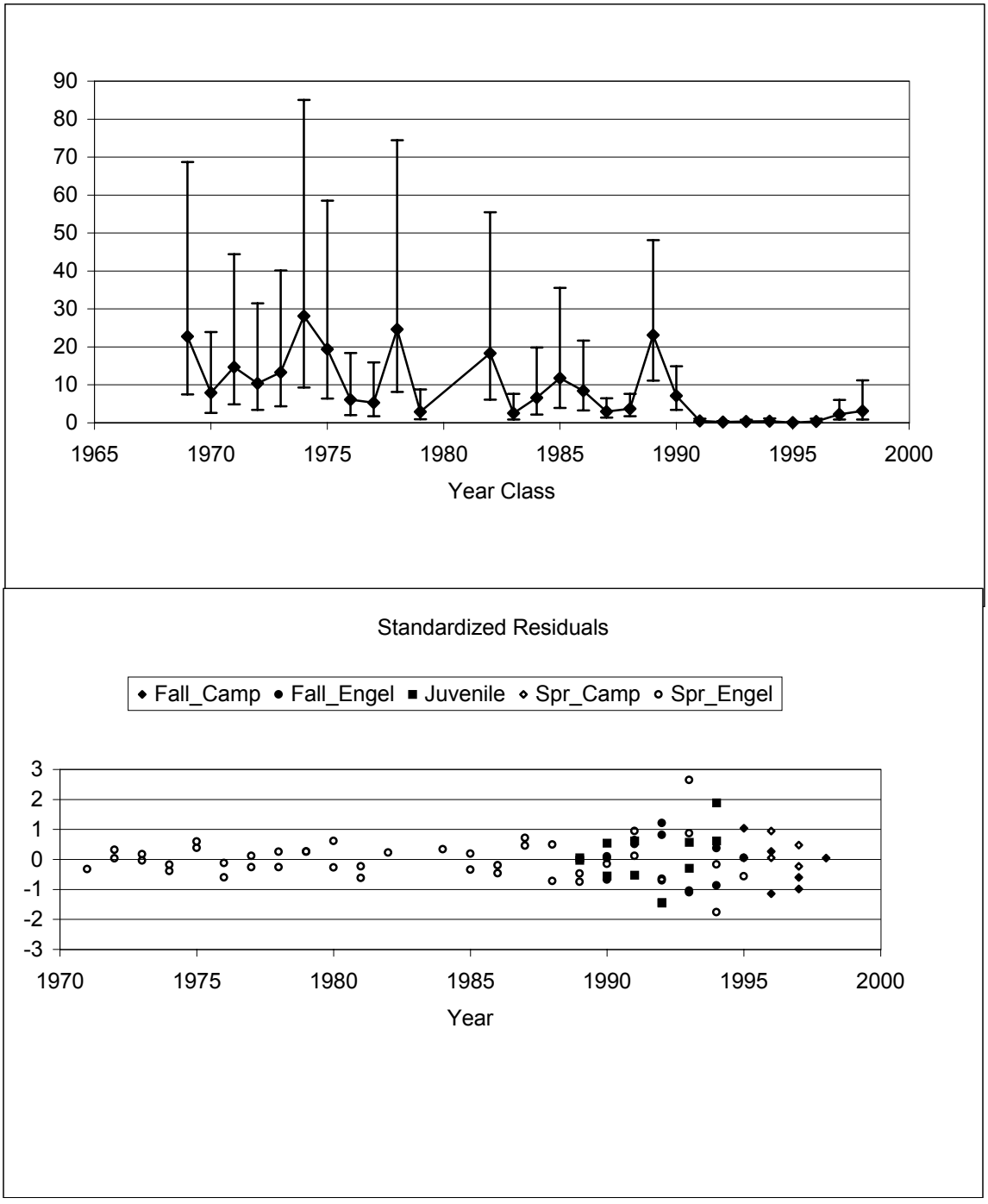


Fig. 10 Relative year-class strength from general linear model fitted to the Log-transformed research vessel indicies at age. Estimates are back transformed (Top panel). Standardized residual from the general linear model (bottom panel)

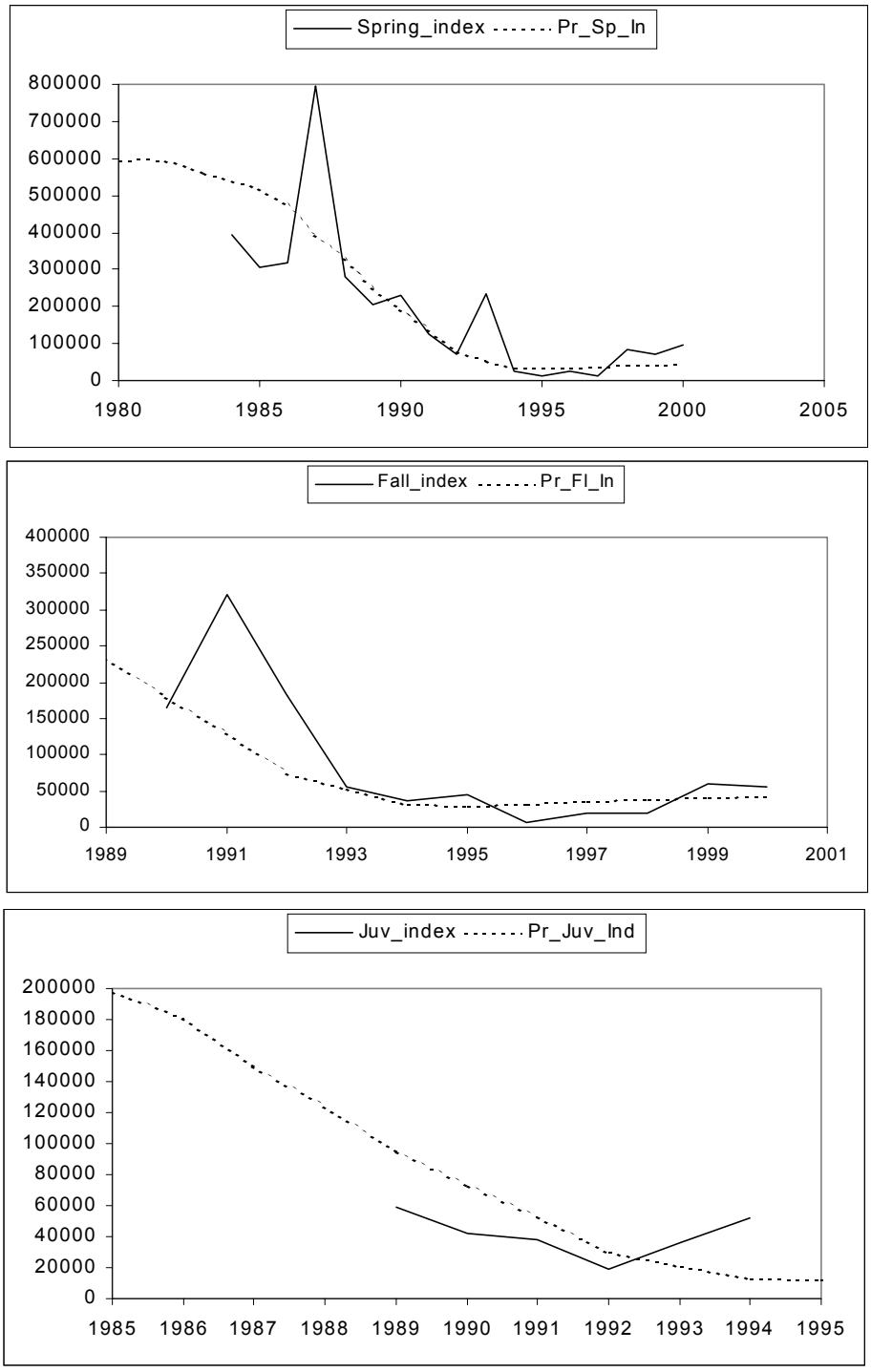


Fig. 11. Fit of the dynamic production model to the survey estimates of swept area biomass.

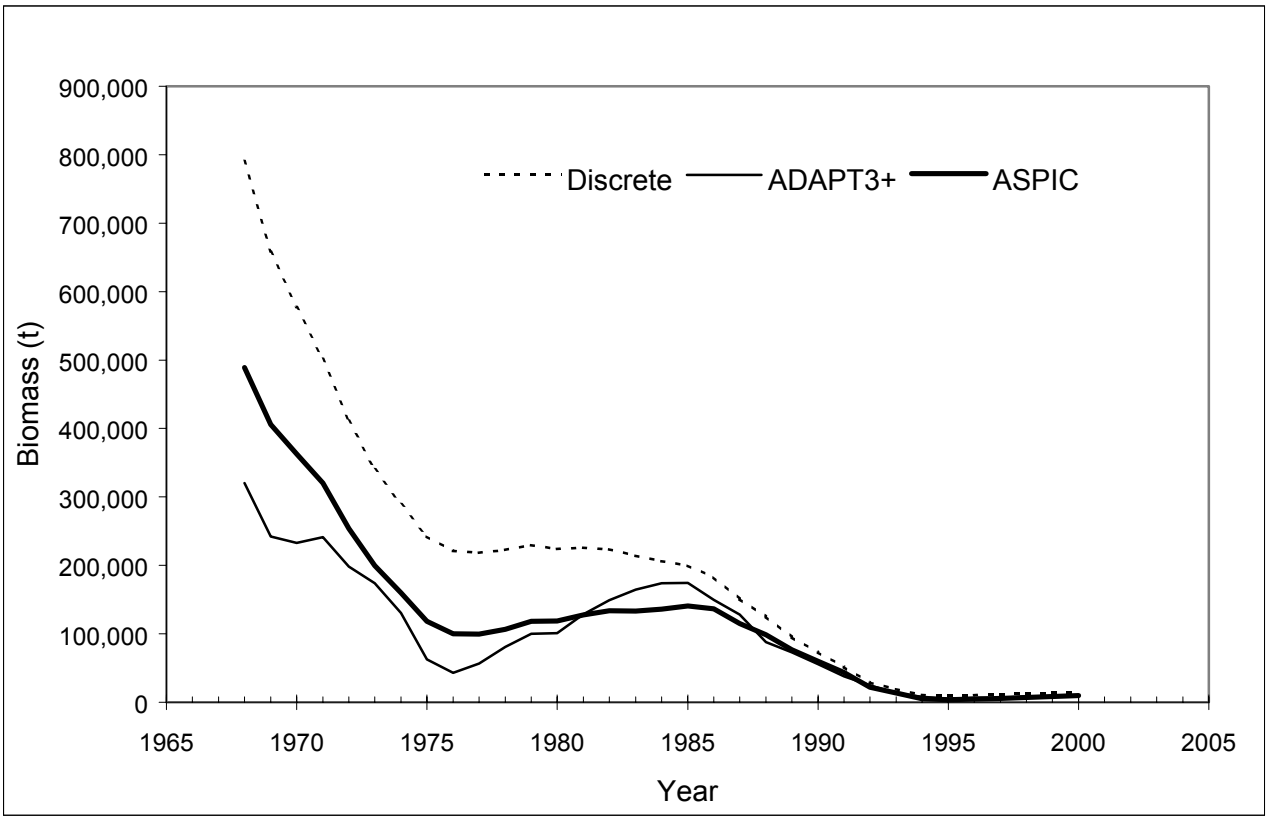


Fig. 12. Camparison of the discrete and continuious (ASPIC) production model estimates of spawner biomass and the 3+ biomass estimate from ADAPT.

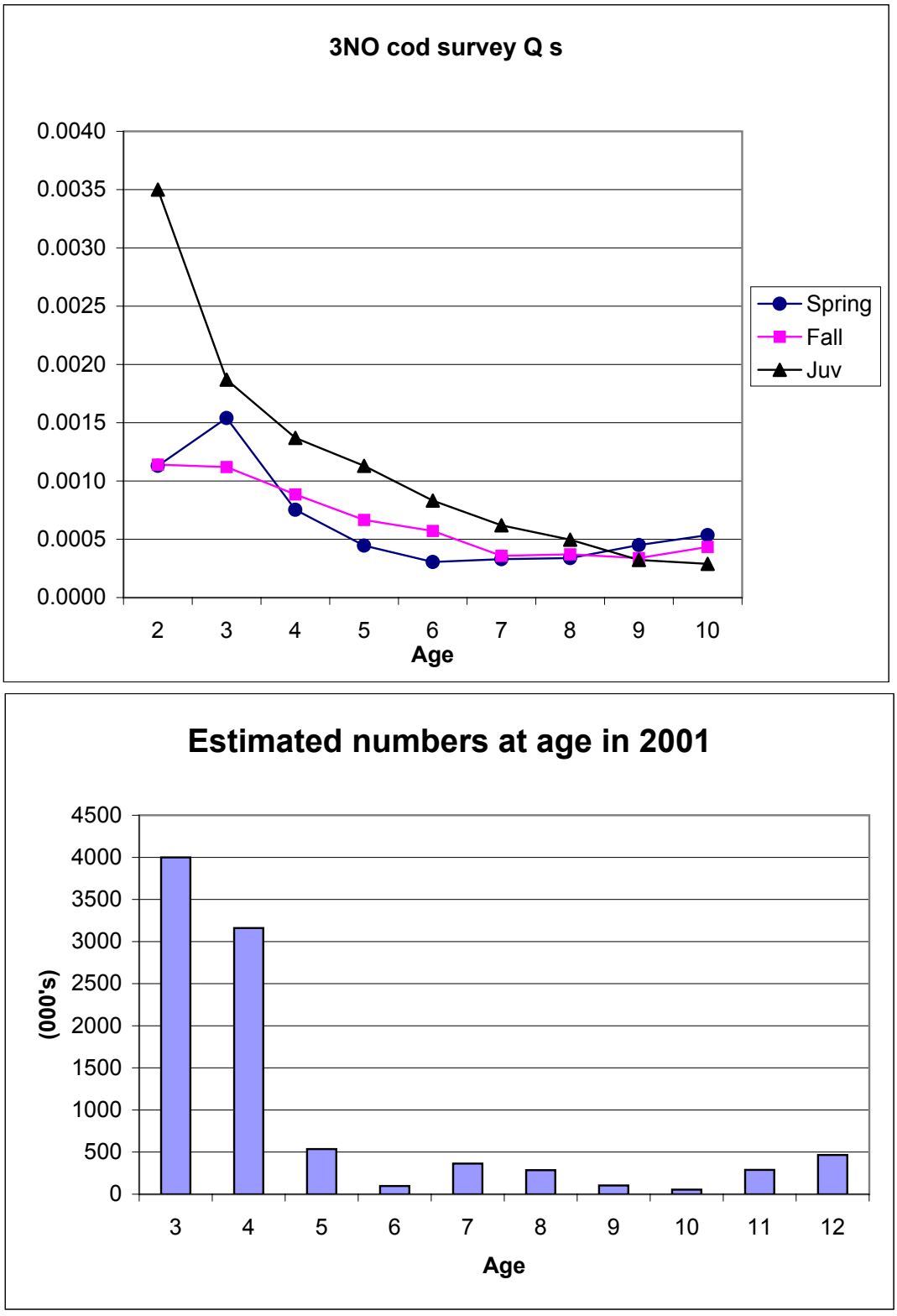


Fig 13. Estimated catchabilities at age for Canadian spring, fall and Juvenile surveys (Top). Estimated survivors in 2001 (Bottom).

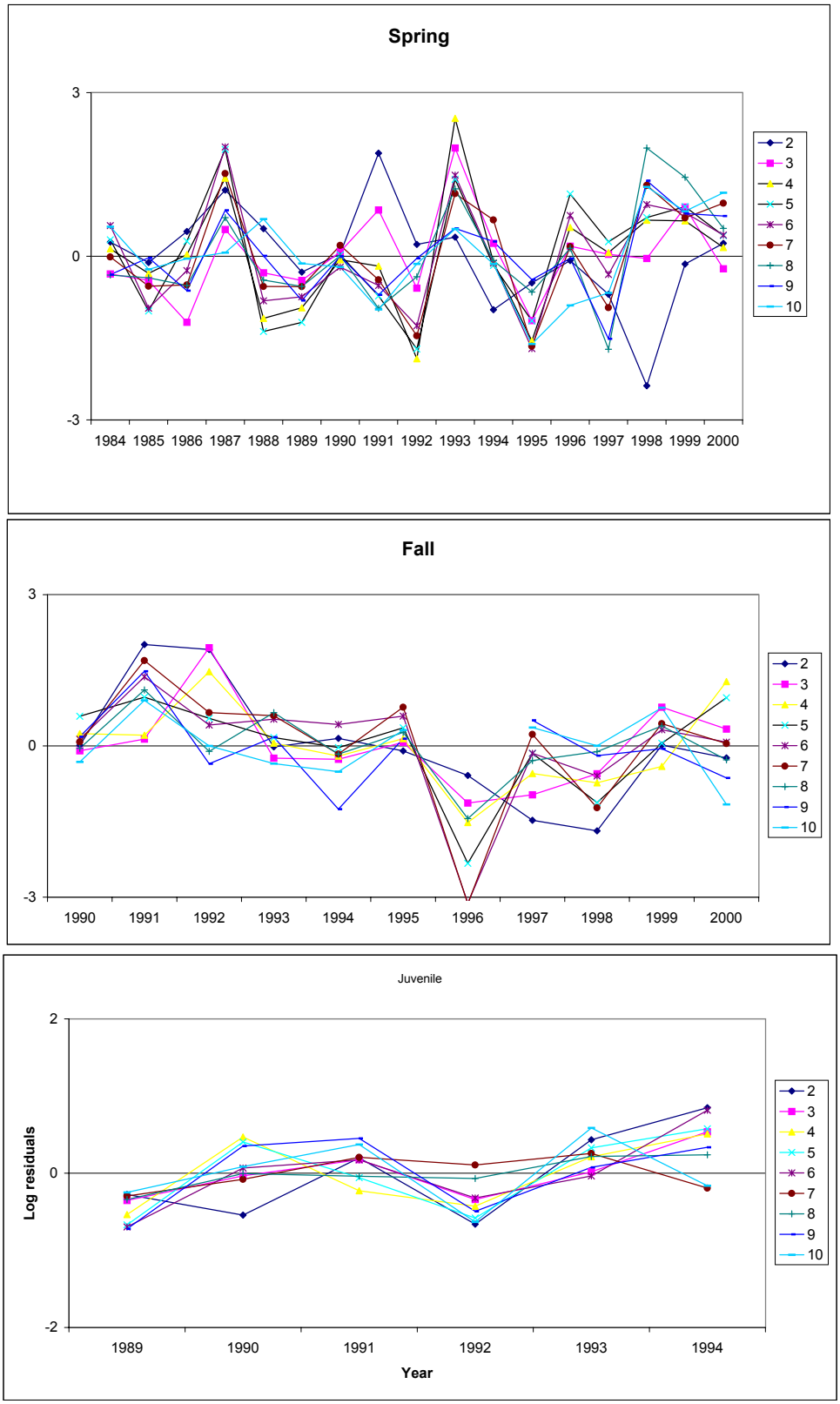


Fig. 14 Log residuals from ADAPT for three Canadian research vessel surveys.

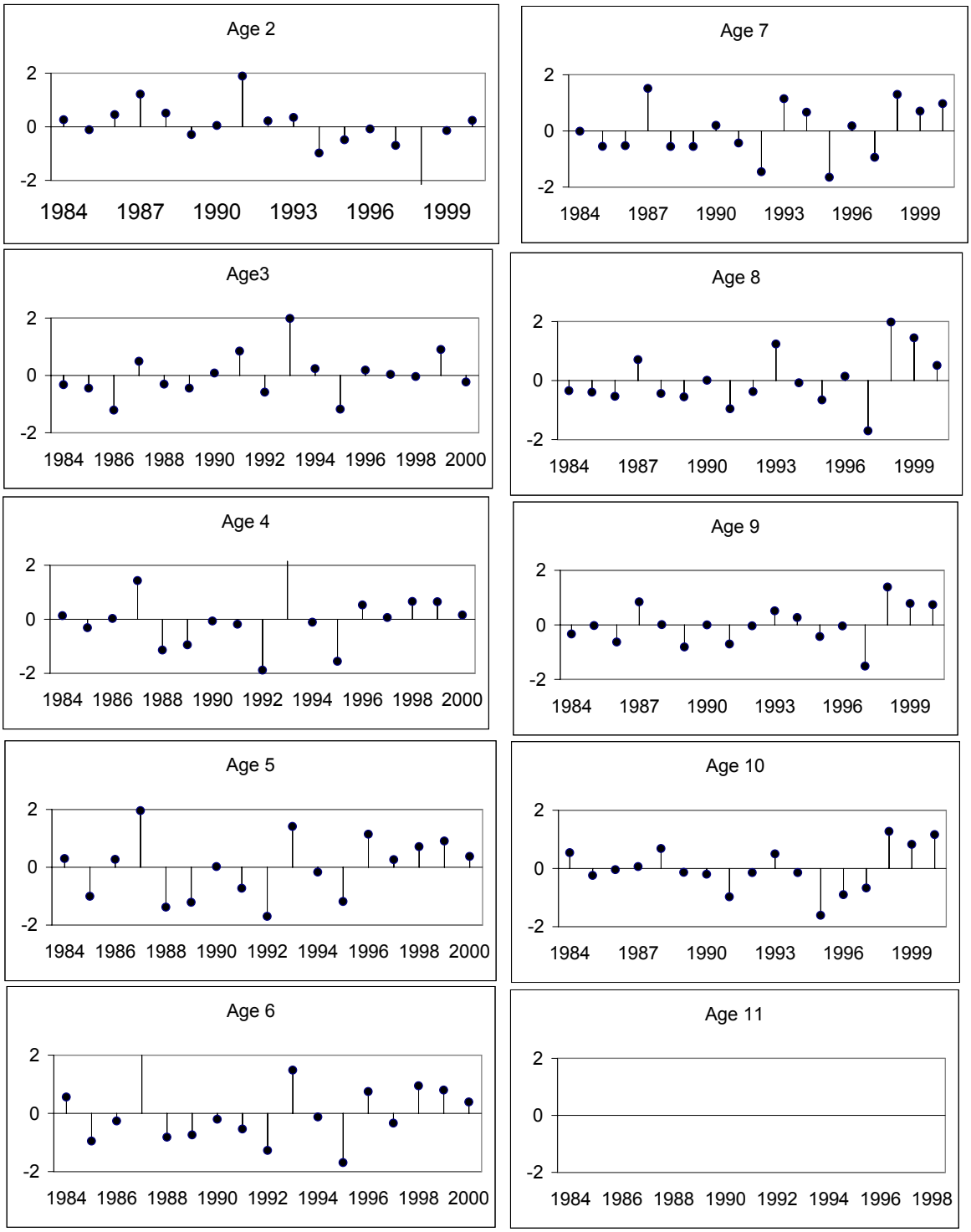


Fig.15 Age by age log residuals from Canadian spring surveys .

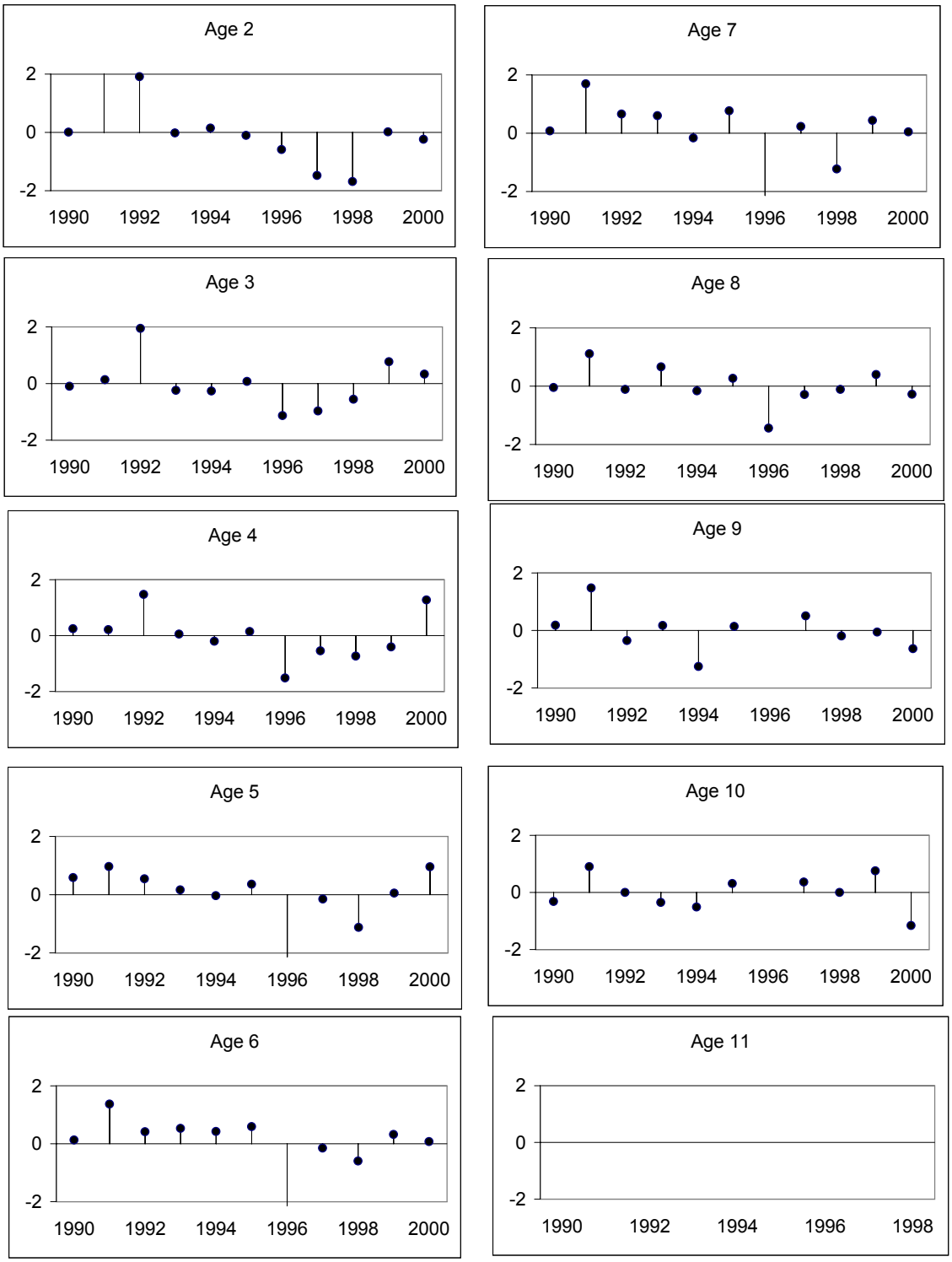


Fig.15 Age by age log residuals from Canadian fall surveys .

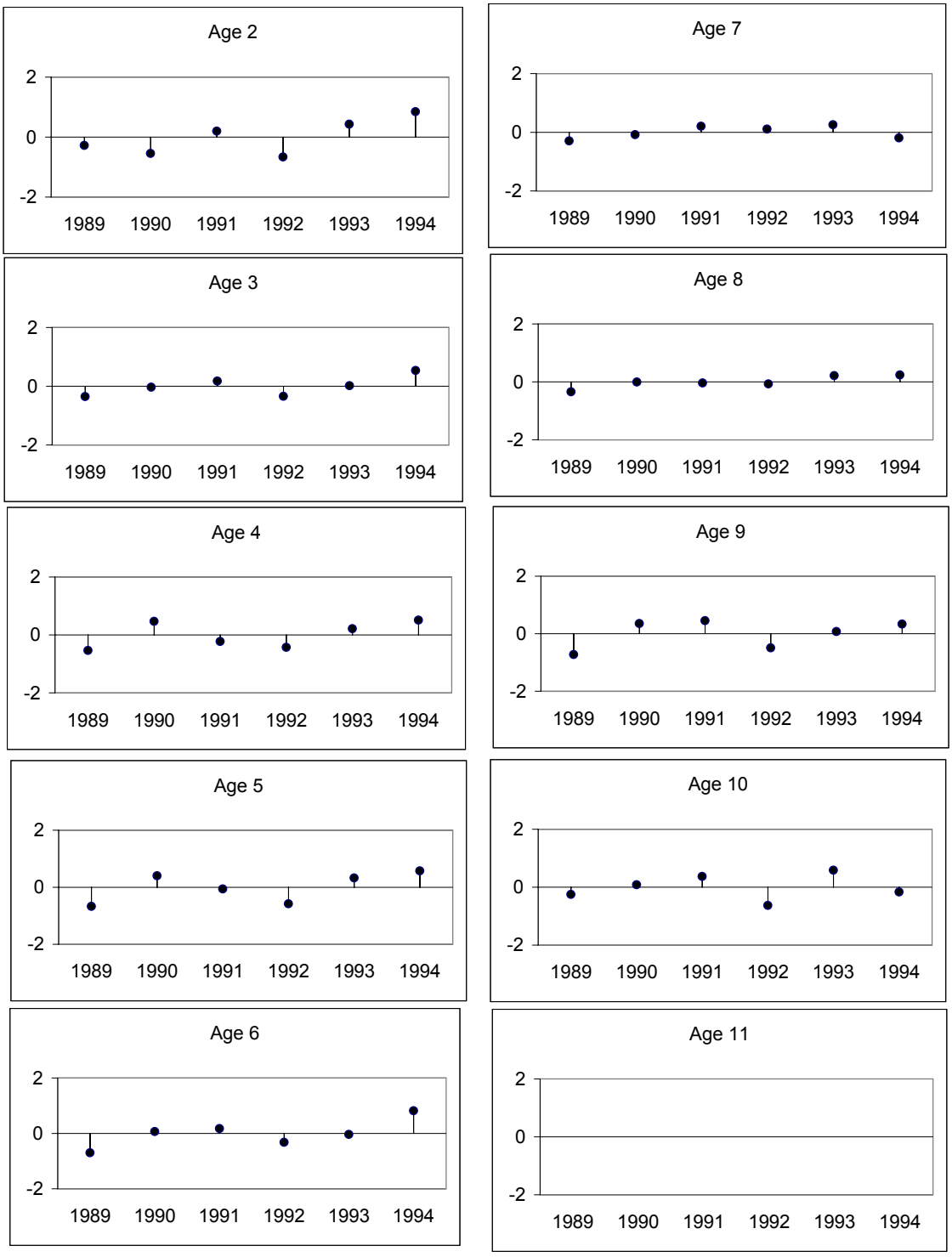


Fig. 15 Age by age log residuals from Canadian juvenile surveys .

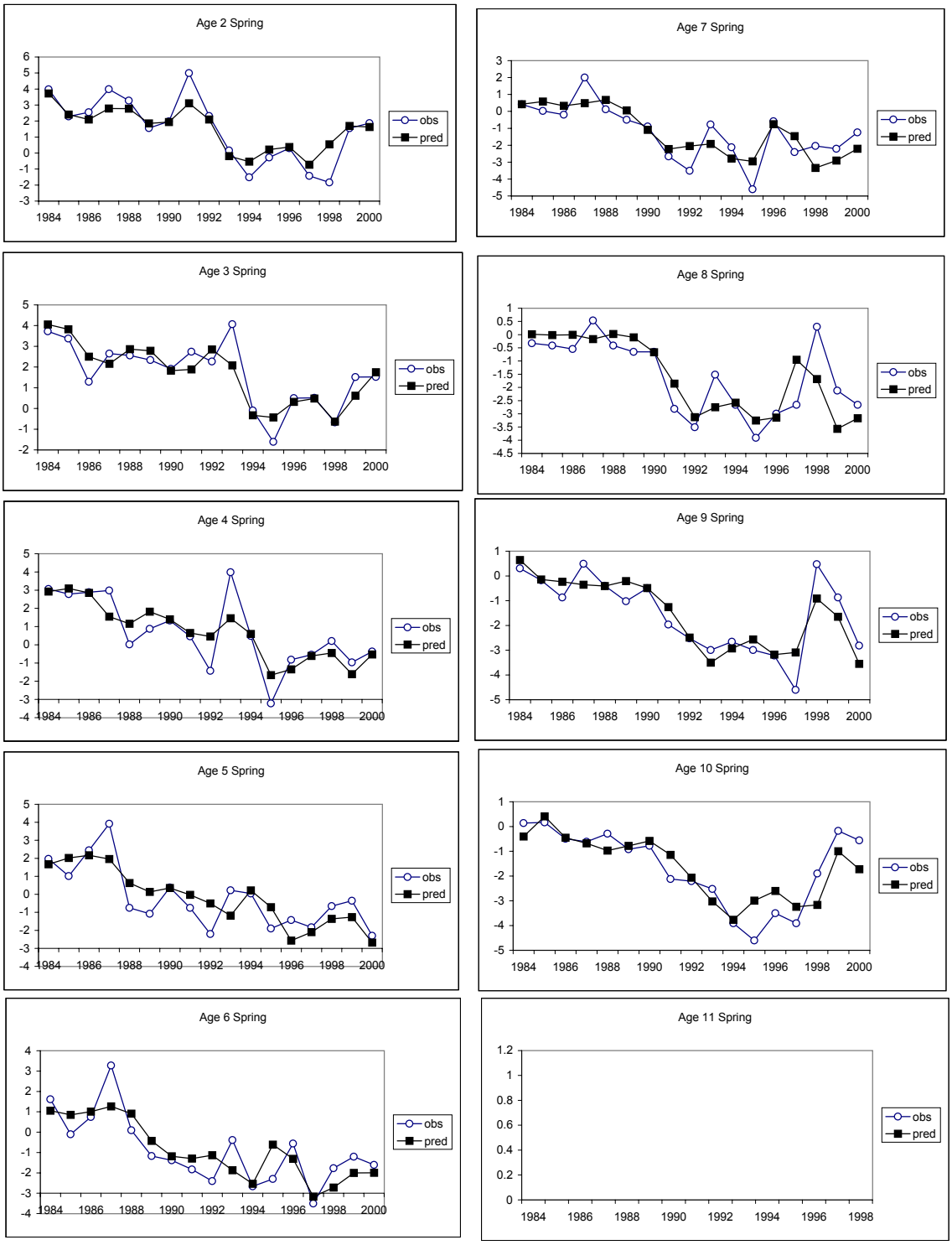


Fig.16 Age by age observed and predicted log abundance index over time from Canadian spring surveys for cod in NAFO Divisions 3NO.

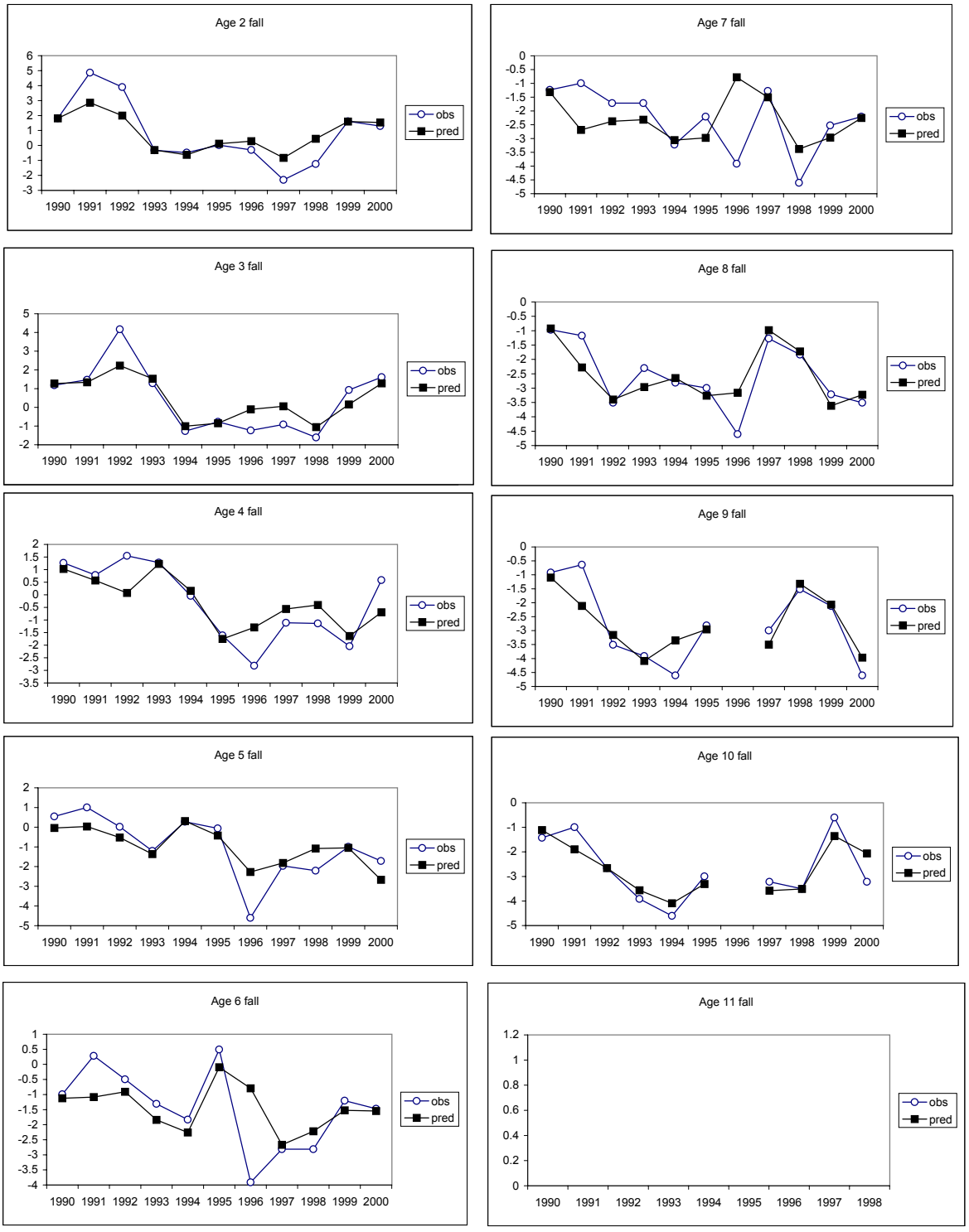


Fig.16 Age by age observed and predicted log abundance index over time from Canadian fall surveys for cod in NAFO Divisions 3NO.

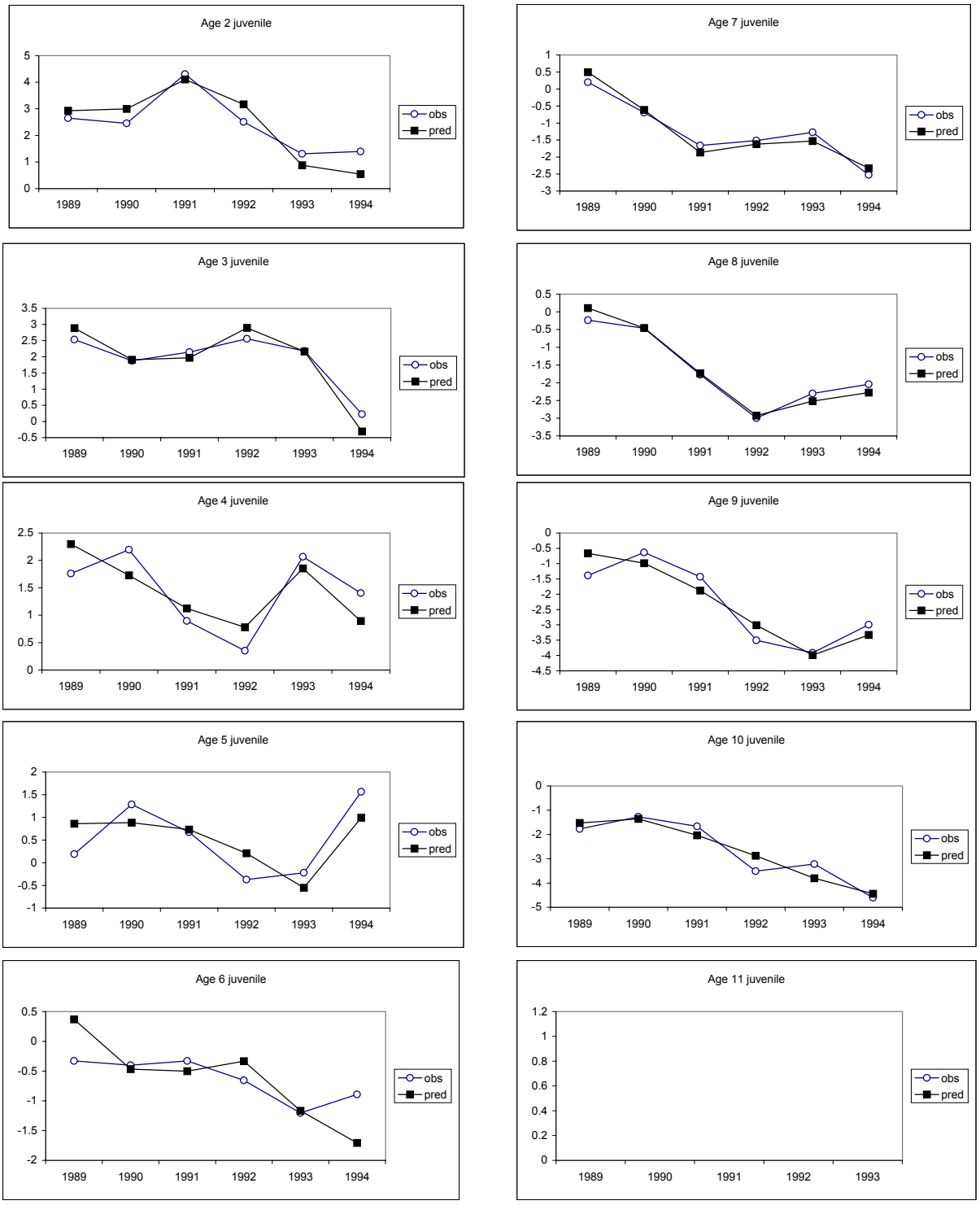


Fig.16 Age by age observed and predicted log abundance index over time from Canadian juvenile surveys for cod in NAFO Divisions 3NO.

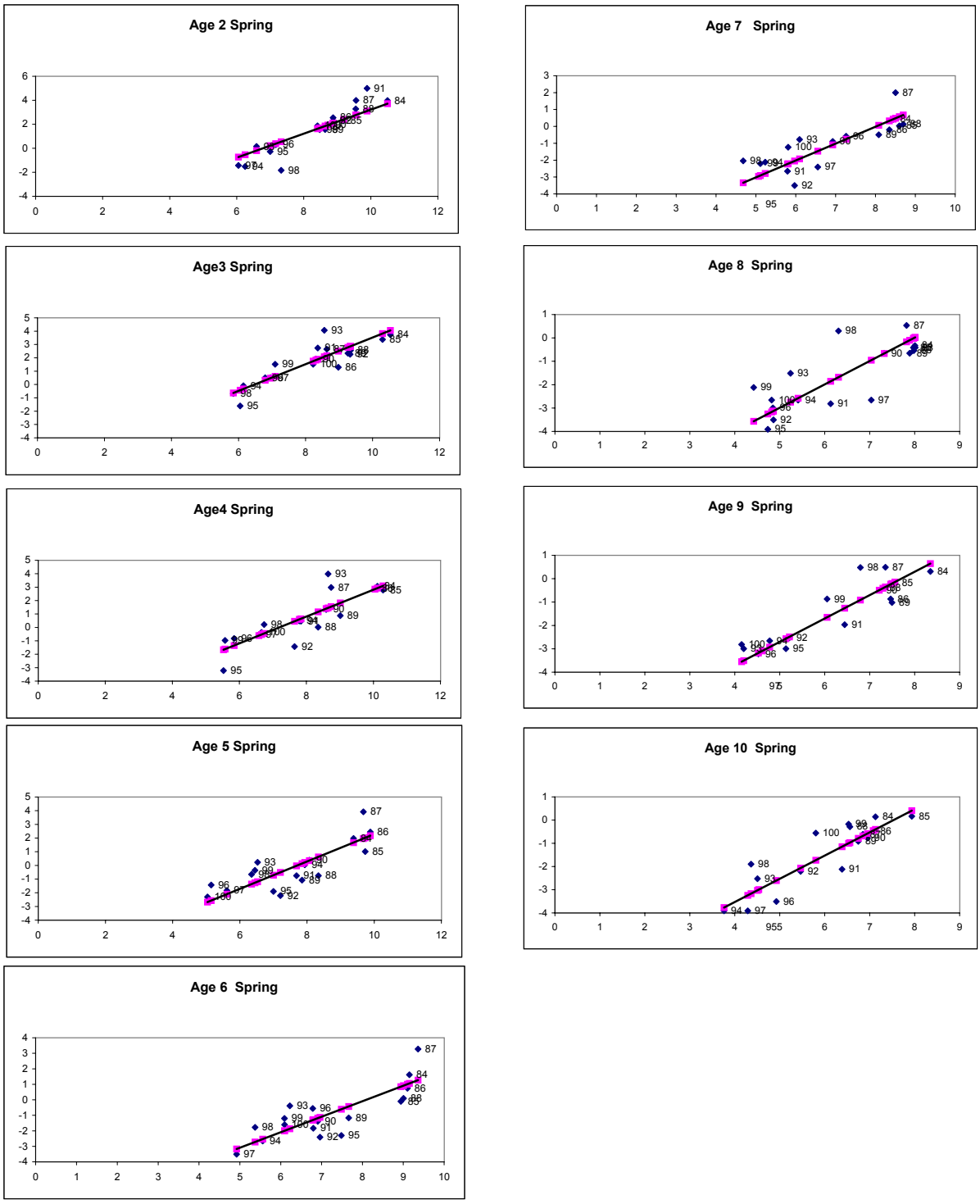


Fig.17 Age by age observed and predicted log abundance index versus ln population numbers from Canad spring surveys for cod in NAFO Divisions 3NO.

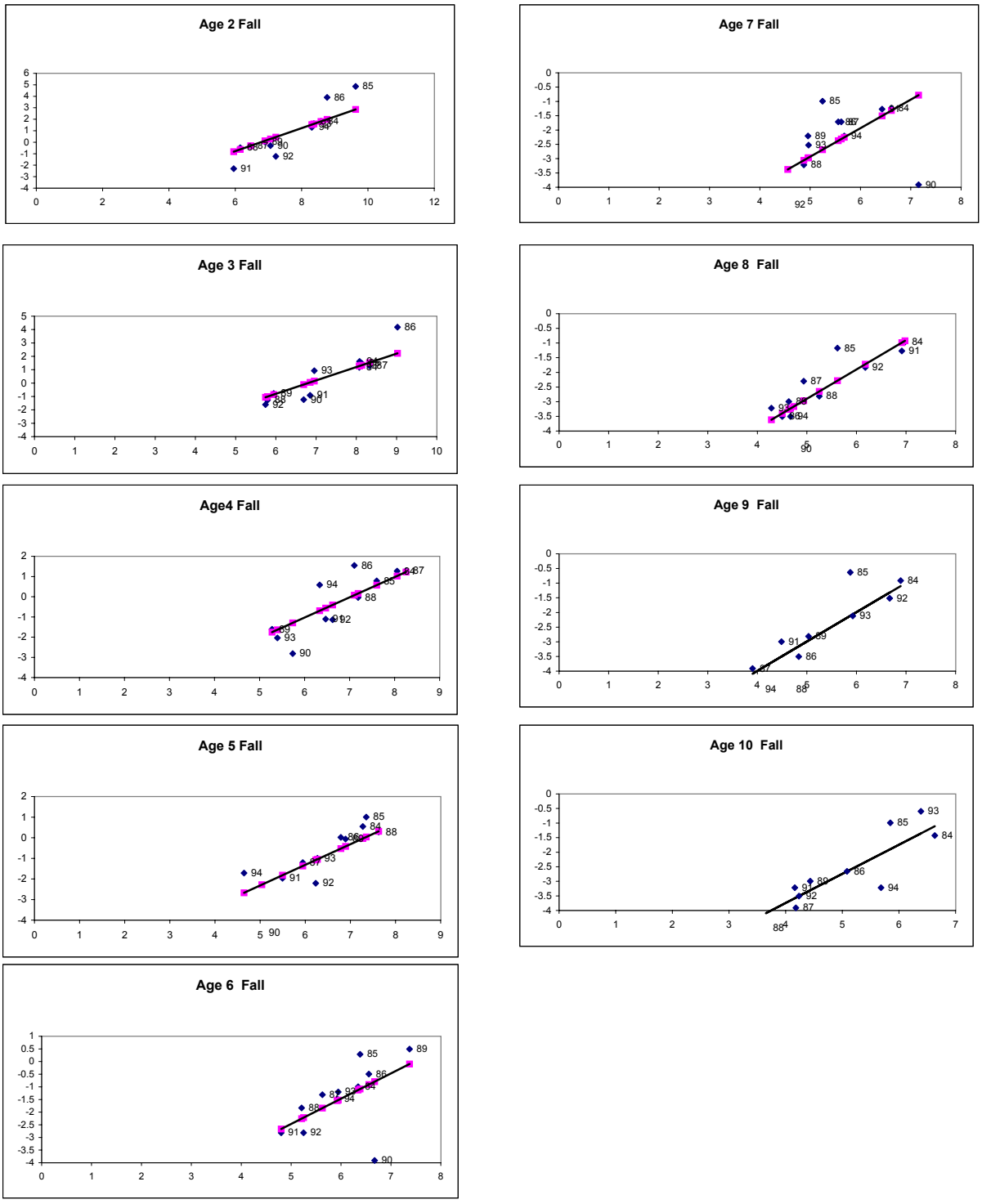


Fig.17 Age by age observed and predicted log abundance index versus ln population numbers from Canadian fall surveys for cod in NAFO Divisions 3NO.

Fig. 18. Retrospective estimates of population numbers, spawner biomass and mean fishing mortality did display persistent trends for under estimation as successive years of data were excluded .

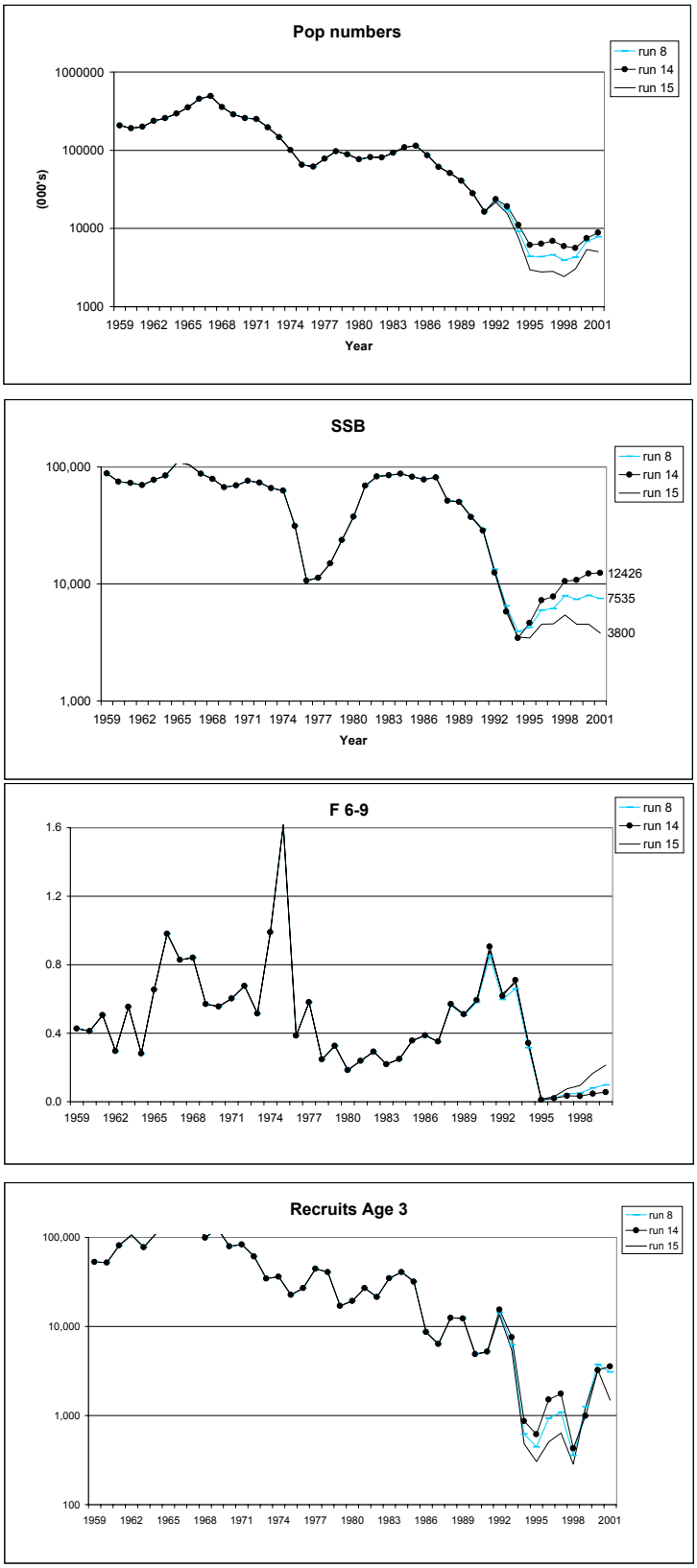


Fig. 19 Two exploratory assessments to investigate sensitivity to survey inputs.