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An Assessment of the Cod Stock in NAFO Divisions 3NO

by

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Nominal catch and catch at age

Catches from this stock peaked at 227,000t in 1967 but declined steadily thereafter to a low of 15,000t in 1978. From 1979 to 1991 catches ranged from 20,000 to 50,000t (Table 1, Figure 1). The continued reduction in recommended TAC's have contributed to reduced catches in recent years to a level of about 10,000t in 1993. Fisheries on this cod stock ceased about mid-year in 1994 as the TAC of 6,000t had been reached. There was no directed cod fishery in Divs. 3NO during 1995. The 1995 Scientific Council Report recommended that there should be no directed fishing for cod in Divs. 3NO in 1996 and that by-catches in fisheries targeting other species should be kept at the lowest possible level.

Landings during 1995 (Table 1) totaled 172 tons comprised of 64 tons as by-catch primarily from Canadian longline fisheries and 108 tons from non-contracting parties fishing in the Regulatory Area.

Over the past several years, catches from the Regulatory Area have been those reported by contracting parties combined with estimates from Canadian surveillance authorities. Other catches (non-contracting parties) are those estimated by Canadian surveillance.

Sampling data for 1995 were available from by-catch in the Portuguese gill net and otter trawl fisheries (NAFO SCS Doc. 96/12). An estimate of total removals at age for the 1995 catch was obtained using this sampling data. Catch and average weigh-at-age for 1995 are presented in Table 2. The most abundant year-classes in the fishery during 1995 were the 1991 (age 4), 1989 (age 6) and the 1990 (age 5). The 1989 and 1990 year-classes were dominant in the commercial catches in Divs. 3NO over the period 1992-1994.

Catch-at-age, and mean weights-at-age 1959-95 period are presented in Tables 3 and 4. There appears to be a decline in mean weights-at-age from 1993 to 1994 although this may have resulted from the area sampled (only from the Regulatory Area), the time of year (1st half of year only), the small sample size and lack of sampling from the Canadian long line by-catch which was roughly one-third of the catch. Mean weights-at-age were higher at most ages in 1995 relative to 1994.

Research vessel survey data

Stratified-random research vessel surveys have been conducted in spring by Canada in Divs. 3N and 3O since 1971 and 1973 respectively with the exceptions of 1983 in Div. 3N and 1974 and 1983 in Div. 3O. Surveys from 1971 to 1982 were conducted by the research vessel *A.T. CAMERON* and those since 1984 were conducted by the sister ships *ALFRED NEEDLER* and *WILFRED TEMPLEMAN*. The stratification scheme used for these surveys is based on depth and is presented in Figure 2.

Changes in Survey Trawls

In the fall of 1995, the Campelen 1800 trawl was introduced in the Canadian groundfish survey, replacing the Engel 145 hi-rise trawl. The selectivities of the two nets were tested through intensive comparative fishing experiments in 1995 and 1996 and their selectivities were found to be markedly different (Warren 1996). An analysis of the data to derive appropriate conversion factors for Engel catches vs. Campelen equivalents are ongoing. Until the conversion has been carried out, the 1995 fall and 1996 spring survey estimates cannot be compared directly with the preceding estimates.

Abundance and biomass estimates for these surveys are presented in Tables 5-8 and in Figure 3. Biomass for Divs. 3N and 3O combined increased gradually from the early 1970's to the early 1980's with a sharp increase between 1982 and 1984. Since 1984 biomass has been declining steadily, with the exception of what appears to be an anomalously high 1987 estimate. The increase in 1987 was caused by a large increase in Division 3O. Estimates of the Divs. 3NO total biomass in 1993 increased to about 75,000t, up from 46000t and 58000t in 1992 and 1991 respectively. The 1994 and 1995 3NO biomasses were observed to have declined further to 17000t and 9000t, the lowest in the time series.

Trends in Divs. 3NO cod abundance are similar to those observed for biomass with a large value occurring in 1987. While the abundances estimated for the 1988 to 1992 period are all among the lowest observed in the Canadian time series of RV abundance for this stock, the 1993 estimate was considerably higher. This resulted from increased estimates for the 1989 and 1990 year-classes. Abundance was much lower in 1994 and 1995 and was the lowest in the time series.

Age composition data for Canadian spring surveys from 1971 to 1995 are presented in Table 11. The dominant year classes in the 1992 to 1995 surveys have been from the 1989 and 1990 cohort. However, catch numbers were very low during the 1995 spring survey.

Stratified random surveys have been conducted by Canada during the autumn from 1990 to 1995. Since the 1995 autumn survey was conducted with the Campelen 1800 shrimp trawl, the biomass and abundance estimates are not directly comparable with earlier years. However, the results of these surveys are presented in Tables 9-10 and Figures 4-5. Biomass and abundance increased from 1990-91 but declined substantially until 1994. The 1989 year-class was abundant in the 1991 and 1992 surveys but declined sharply in 1993 and further in 1994. It was the most abundant age class in 1995 (Table 12).

Comparison of Canadian and Spanish Surveys in the Regulatory Area.

In 1995 and 1996, Canada and Spain conducted research surveys in the Regulatory Area of Divs. 3NO within a month of one another. A comparison of biomass and abundance for strata in which both countries conducted tows is presented in Table 13. It should be noted that the research trawls were not the same between the two countries and Canada changed research trawls between years. Consequently, the data should be considered illustrative only.

Survey Distribution

Figure 6 shows the distribution of survey sets as well as the numbers caught per tow, for the Canadian spring and autumn surveys during 1995. Abundance was relatively low for all surveys. When found, cod were located mainly on the slope in the spring and more scattered on top of the shelf in the autumn.

Estimation of stock parameters

ADAPT Calibration

The adaptive framework (Gavaris 1988) used in this assessment included catch per tow data from both Canadian and Russian research vessel surveys, all disaggregated by age. The Russian data from 1977-92 was that presented in a document by Kuzmin (1992) while that for 1993 was provided by Russian scientists. In a preliminary analysis using ADAPT, input data was the same as that used previously with the addition of data from the 1995 spring survey.

The formulation used with ADAPT is described as follows:

Parameters estimated by ADAPT:

- Year-class estimates
 $N_{i,1995}$ i = 3 to 11
- Catchabilities for RV numbers at age
 - $K(\text{Can Spring})_i$ i = 3 to 11
 - $K(\text{USSR})_i$ i = 3 to 11
 - $K(\text{Can Autumn})_i$ i = 3 to 11
 - $K(\text{Can Juv})_i$ i = 3 to 11

Additional structure imposed

- Natural mortality was assumed to be 0.20.
- Error in the catch-at-age was assumed negligible.
- F on oldest age group (12) set at the mean weighted F for age group 7-10.
- Intercepts not fitted.

Input data

- $C_{i,t}$ i = 3 to 12 t = 1977-95
- $RV(\text{Can-Spring})_{i,t}$ i = 3 to 11 t = 1977-82, 1984-95
- $RV(\text{USSR})_{i,t}$ i = 3 to 11 t = 1977-91, 1993
- $RV(\text{Can-Autumn})_{i,t}$ i = 3 to 11 t = 1990-95
- $RV(\text{Can-Juv.})_{i,t}$ i = 3 to 11 t = 1989-94

Objective function

- Minimize

$$\begin{aligned} & \sum_{\text{age}} \sum_{\text{year}} \{ \text{obs}(\ln RV(\text{Can-spring})_{i,t}) - \text{pred}(\ln RV(\text{Can-spring})_{i,t}) \}^2 + \\ & \sum_{\text{age}} \sum_{\text{year}} \{ \text{obs}(\ln RV(\text{USSR})_{i,t}) - \text{pred}(\ln RV(\text{USSR})_{i,t}) \}^2 + \\ & \sum_{\text{age}} \sum_{\text{year}} \{ \text{obs}(\ln RV(\text{Can-autumn})_{i,t}) - \text{pred}(\ln RV(\text{Can-autumn})_{i,t}) \}^2 + \\ & \sum_{\text{age}} \sum_{\text{year}} \{ \text{obs}(\ln RV(\text{Can-Juv.})_{i,t}) - \text{pred}(\ln RV(\text{Can-Juv.})_{i,t}) \}^2 \end{aligned}$$

Summary

- Number of observations = 387
- Number of parameters estimated = 45

Assessment Results

Since the Canadian survey trawl was changed in 1995, the autumn 1995 and spring 1996 survey data were excluded. As in 1994, the results from ADAPT indicated that coefficients of variation (CVs) were relatively high and that year effects in the residual pattern suggested some uncertainty in the calibration analysis. It was considered that some of the uncertainty may have resulted from inclusion of data from the 1993 Canadian and Russian spring surveys. These have previously been considered to be outliers in their respective time series as both estimates were very high relative to previous surveys but had large variances associated with their estimates. The low biomass and abundance from the 1994 and 1995 surveys were a further indication that the 1993 values were anomalous. Consequently, an ADAPT run is presented with the 1993 data also excluded (Table 14). Because of the uncertainty in the ADAPT, the results were not considered useful for catch projections. However, they do give an indication of historical trends in the size of the stock. Population numbers (age 3+) have been declining for most years since the mid-1980s. The spawning stock biomass has also declined substantially since the relatively high levels in the mid-1980s and remains low.

Maturity at age

Maturity-at-age has been estimated from the spring survey female maturity data using a probit model (Morgan, pers comm) (Table 15). The estimate of age at 50% maturity has varied around 6 for the time period 1975 to 1994. The 1993-1994 estimates are the lowest in the time series and are significantly lower than the age at maturity in the late 1980s (Fig. 7).

Spawner stock biomass

Using age 6+ biomass from the ADAPT estimate indicates that the current spawner biomass is exceptionally low (Fig. 8). The 1989 year class is beginning to enter the spawning population and might alleviate the spawner biomass decline to some extent.

Recruitment

Estimate of year class strength were obtained by fitting the following general linear model to the survey indices from the four sources used in the ADAPT runs with all years included (see above).

$$\log(N_{i,j,k,t}) = \tau + \alpha_i + \beta_j + \gamma_k + \varepsilon$$

where $N_{i,j,k,t}$ = mean numbers per tow of age i from survey index j , belonging to cohort k in year t , and

τ = intercept,

α_i = age effect for $i = 1 \dots 13$ and $i = 2 \dots 5$ in two different formulations,

β_j = survey effect where $j = 1 \dots 4$ for the different survey indices

γ_k = cohort effect,

and ϵ = residuals from the fitted model.

The predicted cohort strengths were then back-transformed (bias not corrected) and plotted together with the ADAPT estimates of the cohort at age 3 (Fig. 9). Basic statistics for the fit are given in Table 16.

In the first formulation, in which ages 1 to 13 are used, strong year classes arose in 1974-75, 1978 and 1981-82. Subsequent year classes were relatively weak. The 1986 and 1989 year classes are the strongest of these but are very much smaller than those that arose in the 1970s and 1980s. The overall temporal pattern is similar to that estimated by ADAPT (all four indices but omitting the 1993 Canadian spring and Russian survey estimates and the Canadian 1995 fall survey), although the relative heights of the peaks differ. ADAPT estimates indicate that the strongest year class was the 1981 cohort, whereas the multiplicative model indicates that the 1974-75 and 1978 cohorts were stronger.

In the second formulation, in which only ages 2 to 5 were used, the pattern of relative year class strength is very similar to that estimated by ADAPT. This formulation is less influenced by the fact that fishery removals are ignored in the multiplicative model.

Estimates of recruitment from ADAPT and both formulations of the multiplicative model indicate that recruitment has been very weak from 1983 onwards. The 1989 year class, although relatively strong for the latter period, is small compared to the strong year classes that sustained the fishery in the 1970s and early 1980s.

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

Year	Canada	Spain	Portugal	Russia	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	3976	1061	-	12296	29391	13600
1992	7859	1927	448	68	2450	12752 ³	13600
1993	5370	3764	525	150	700	10509 ³	10200
1994 ¹	47	1783	49		823	2702 ³	6000 ⁴
1995 ¹	64				108	172 ³	0 ⁴

¹ Provisional

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

³ Includes Canadian Surveillance Estimates and NAFO Scientific Council Estimates

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

Table 2. Catch numbers (000's) and mean weight at age of Atlantic cod from the fisheries in NAFO divisions 3NO during 1995

AGE	3N	3O	3NO	3NO	3NO	3O MEAN WGT	
	OTTER	OTTER	GILL	TOTAL		MEAN	OTTER
	TRAWL	TRAWL	NET+L	# @ AGE	WEIGHT	TRAWL	NET
3	0.000	0.000	0.000	0.00	0.00	0.000	0.000
4	0.000	1.048	71.352	72.40	0.75	0.534	0.757
5	0.000	7.344	12.890	20.23	1.21	0.832	1.425
6	0.000	5.201	34.054	39.26	2.03	1.383	2.124
7	0.000	0.449	1.519	1.97	2.29	2.161	2.328
8	0.000	0.232	0.000	0.23	2.08	2.082	0.000
9	0.000	0.020	0.935	0.96	6.60	4.247	6.646
10	0.000	0.000	0.182	0.18	6.22	0.000	6.220
11	0.000	0.000	0.000	0.00	0.00	0.000	0.000
12	0.000	0.000	0.000	0.00	0.00	0.000	0.000
# 000's	0.000	14.293	120.933	135.229			
WGT. t	0.0	15.4	155.6	171.0			

TABLE 3. CATCH AT AGE FOR DIV. 3NO COD, 1959 - 1995 (000s) AGE 13 IS A PLUS GROUP

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	
3	1711	1846	812	1026	313	6202	1013	753	20096	16359	
4	13036	6503	4400	3892	5757	15555	7611	19413	62442	56775	
5	5068	22050	11696	3206	11210	19496	7619	19681	50317	42609	
6	5025	3095	15258	1581	4849	7919	13252	11795	19517	18495	
7	3935	2377	2014	3594	1935	2273	9861	9496	4774	6337	
8	1392	2504	1672	773	3840	1109	4827	4467	4651	1592	
9	757	593	847	668	1165	788	1081	1829	236	505	
10	926	387	196	433	608	328	1248	1694	180	178	
11	1220	898	25	226	322	37	163	122	71	90	
12	103	242	245	216	208	112	141	57	45	45	
13	1128	1409	392	846	473	56	275	193	335	51	
3+	35301	41894	37557	15451	30680	53875	47098	67480	161654	149023	
4+	33590	40048	36745	14425	30367	47673	46085	66727	141566	132666	
5+	20554	33545	32245	10543	24610	32118	38474	49314	79126	75991	
6+	15486	11495	20649	9337	13400	12622	30855	29633	28909	27293	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
3	8154	2105	950	63	10058	6425	671	4054	607	920	72
4	12924	19703	26900	19797	27600	9501	8781	7534	2469	4337	3827
5	26949	10799	30300	12289	15098	10907	3528	5945	2531	2518	9208
6	11191	9481	11700	13432	5989	10872	2505	1084	1500	818	2784
7	2089	3646	3500	5893	1971	2247	3057	211	572	354	883
8	1393	1625	2500	1686	972	2147	1059	238	177	102	265
9	519	541	500	285	707	1015	921	44	209	58	52
10	292	149	200	216	243	676	461	37	65	51	17
11	134	227	100	78	137	428	252	13	41	8	12
12	202	90	50	74	116	257	152	9	25	5	7
13	574	1472	700	350	173	881	396	17	36	21	16
3+	64420	49649	77400	54159	63064	45356	21783	19186	8232	9192	17149
4+	56266	47743	76450	54090	53006	38931	21112	15132	7625	8272	17077
5+	43342	28040	49550	34293	25406	29430	12331	7598	5156	3935	13250
6+	16393	17241	19250	22004	10308	19523	8803	1653	2625	1417	4042
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
3	256	505	305	1179	58	57	153	516	277	1917	1064
4	1055	1091	1978	647	1000	2953	2865	422	318	2182	4505
5	3912	1262	1591	1993	1411	6203	6423	3491	1527	1502	4341
6	2275	2297	1012	1204	2324	3036	4370	3445	6347	1260	895
7	761	1902	1528	686	1220	2519	1512	1213	3955	1987	422
8	222	574	1492	1152	720	797	948	653	1009	1284	721
9	92	192	595	774	918	459	558	845	567	485	581
10	31	94	211	238	551	533	373	424	425	233	439
11	9	41	162	81	106	261	349	399	249	168	150
12	13	13	27	41	42	97	135	404	142	100	83
13	2	32	52	36	70	71	86	198	298	285	106
3+	9537	8003	8953	7931	8420	16986	17772	12069	15114	11303	13307
4+	8271	7498	8648	6752	8362	16929	17619	11853	14837	9386	12243
5+	7216	6407	6670	6105	7362	13976	14754	11131	14519	7204	7738
6+	3404	5145	5079	4212	5951	7773	9331	7640	12992	5702	3397
	1991	1992	1993	1994	1995						
3	1103	4508	1314	232	0						
4	673	1769	3209	2326	72						
5	995	837	637	1117	20						
6	544	612	479	128	40						
7	282	235	321	93	2						
8	368	64	74	26	0						
9	568	99	25	8	1						
10	502	129	39	1	0						
11	383	153	49	0	0						
12	202	100	53	0	0						
13	337	217	150	0	0						
3+	5957	8722	6360	3928	135						
4+	4854	4214	5046	3696	135						
5+	4181	2445	1937	1370	63						
6+	3196	1608	1200	253	43						

TABLE 4. AVERAGE WEIGHT AT AGE FOR DIV. 3NO COD, 1959 - 1994
AGE 13 IS A PLUS GROUP.

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
3	0.42	0.42	0.42	0.42	0.42	0.42	0.42	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
5	1.25	1.25	1.25	1.25	1.25	1.25	1.25	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
7	2.82	2.82	2.82	2.82	2.82	2.82	2.82	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
9	3.98	3.98	3.98	3.98	3.98	3.98	3.98	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
11	5.25	5.25	5.25	5.25	5.25	5.25	5.25	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
13	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	0.48	0.48	0.48	0.54	0.57	0.42	0.38	0.50	0.57	0.72
4	0.90	0.90	0.90	0.97	1.00	0.73	0.89	0.91	1.00	1.05
5	1.35	1.35	1.35	1.44	1.43	1.20	1.28	1.41	1.48	1.55
6	2.14	2.14	2.14	2.08	2.19	1.96	2.13	2.33	2.48	2.25
7	3.16	3.16	3.16	2.89	3.63	2.86	3.14	3.25	3.51	3.74
8	4.21	4.21	4.21	3.56	4.63	4.67	4.16	4.03	4.74	4.61
9	6.34	6.34	6.34	5.95	6.25	7.32	5.53	6.67	7.17	6.19
10	7.69	7.69	7.69	7.95	9.56	5.46	6.74	6.74	8.81	7.23
11	8.46	8.46	8.46	8.32	11.17	8.40	5.27	9.14	11.70	9.48
12	10.24	10.24	10.24	10.14	13.99	7.51	7.09	12.49	11.47	12.97
13	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	0.65	0.71	0.90	0.94	0.85	0.79	0.48	0.39	0.49	0.74
4	0.98	1.04	1.27	1.17	1.17	1.15	0.86	1.01	0.82	1.00
5	1.39	1.69	1.84	1.50	1.87	1.51	1.37	1.52	1.30	1.38
6	2.09	2.50	2.69	2.20	2.63	2.28	2.05	2.16	1.83	1.79
7	2.87	3.69	3.55	3.83	3.80	3.04	3.25	3.49	2.89	2.23
8	3.70	5.49	5.33	5.26	5.20	4.05	4.65	5.41	4.76	3.77
9	4.75	7.98	7.13	7.49	6.27	5.76	6.62	7.95	7.26	5.12
10	7.15	9.22	9.10	8.80	8.08	7.22	8.32	9.82	8.95	6.88
11	7.98	10.60	9.01	9.82	8.99	8.92	9.15	9.94	9.85	9.37
12	10.11	12.61	10.15	12.28	11.01	12.61	11.13	9.88	12.59	11.07
13	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50
	1989	1990	1991	1992	1993	1994	1995			
3	0.51	0.55	0.55	0.33	0.36	0.27	0.00			
4	0.97	1.01	0.85	0.65	0.78	0.46	0.75			
5	1.60	1.46	1.59	1.06	1.35	0.91	1.21			
6	2.24	2.51	2.30	1.80	1.84	1.63	2.03			
7	3.27	2.73	3.83	2.82	2.82	1.84	2.29			
8	4.61	4.14	5.56	4.85	4.11	4.04	2.08			
9	7.08	5.02	7.53	5.56	5.87	4.94	6.60			
10	8.31	8.37	9.04	7.43	7.76	7.54	6.22			
11	9.47	9.29	11.98	8.64	8.79	3.44	0.00			
12	12.25	11.25	13.98	10.65	8.67	7.52	0.00			
13	13.50	11.91	13.60	14.11	12.74	10.00	0.00			

Table 5. Cod abundance from Canadian spring RV surveys in Division 3N. Shaded numbers are estimates for non sampled strata.

Depth range (fath)	Vessel Area Sq. mi	ATC	ATC	ATC	ATC	ATC	ATC	ATC	ATC	ATC	ATC	ATC	AN	
		199	206	209	222	233	245	263	277	289+291	304	318-319	328	27
	Strata	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1984	
0-30	375	1593	3826	399	1435	6617	611	7474	4329	263	508	10583	1578	1746
	376	1499	788	38	128	1294	113	3601	225	225	113	225	32	7933
31-50	360	2992	1516	420	544	2302	3425	4211	1011	1273	2695	524	2118	5679
	361	1853	5796	835	904	3624	723	5610	4764	1165	1808	3111	4961	3283
	362	2520	11823	984	1466	431	1021	5830	7440	757	1204	3859	1608	18970
	373	2520	3831	142	426	1137	76	946	5959	327	331	1892	1589	8161
	374	931	175	175	0	140	101	1607	1817	297	0	163	1677	2893
383	674	1644	51	25	80	17	320	1493	34	0	118	25	34	
51-100	359	421	822	622	152	357	4709	1359	745	561	2133	611	126	95
	377	100	1066	143	613	413	18	2800	105	73	490	1146	278	56
	382	647	4347	16	130	150	24	2639	1943	243	255	146	194	0
101-150	358	225	861	4189	280	804	280	262	1299	439	1993	135	1343	380
	378	139	3673	459	1683	409	180	657	120	403	1445	193	1236	318
	381	182	779	861	79	156	173	3267	364	155	379	779	1851	200
151-200	357	164	254	1157	43	105	46	12	216	49	336	37	382	0
	379	106	295	1802	785	124	58	24	0	671	408	40	322	175
	380	116	118	641	70	122	95	22	248	96	26	15	121	83
0-30	3092	4614	437	1563	7911	924	11075	4554	488	621	10808	1610	9679	
31-50	11490	24785	2607	3365	7714	5361	18524	22484	3853	6038	9667	11978	39020	
51-100	1168	6235	781	895	930	4779	6798	2793	877	2878	1903	598	151	
101-150	546	5313	5509	2022	1169	643	4186	1693	997	3818	1107	4430	898	
151-200	386	667	3600	858	351	157	48	462	816	770	92	825	258	
201-300	420	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	
301-400	352	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	
Mean #/tow ¹		33.23	10.33	6.98	14.43	9.48	32.45	25.54	5.60	11.28	18.82	15.53	40.02	
Adjusted total ¹		41612	12930	8741	18073	11867	40640	31985	7008	14124	23574	19444	50107	
Unadjusted total ²		41062	12511	7615	14976	10108	40641	29569	7030	14125	20464	19321	50006	
Upper limit		60525	19420	10765	25131	25080	58111	38156	9512	18899	38028	24878	72633	
1 std dev		9732	3455	1575	5078	7486	8735	4294	1241	2387	8782	2779	11314	

Depth range (fath)	Vessel Area Sq. mi	WT 29	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT
		AN 43	47	58-59	70	82	95-96	105-106	119-120	136-137	152-153	168-169	188-189
	Strata	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996 ³
0-30	375	1593	3184	912	2167	1116	1674	1226	60	80	40	0	0
	376	1499	48	177	2813	375	113	177	48	0	0	19	165
31-50	360	2992	3004	553	1198	1422	165	569	56	112	20	0	449
	361	1853	10293	3310	10484	2841	1904	2380	817	35	226	28	1020
	362	2520	4385	2392	43871	1702	2605	3443	170	32	63	0	39
	373	2520	769	676	4307	1097	822	227	52	0	0	0	39
	374	931	175	47	266	363	28	210	14	14	0	0	85
383	674	0	0	422	51	84	25	34	0	0	0	0	
51-100	359	421	0	1264	332	269	95	47	32	47	190	0	29
	377	100	105	23	758	0	19	0	0	4	4	0	0
	382	647	134	12	16	24	81	130	0	0	0	0	0
101-150	358	225	448	760	1478	549	709	456	59	1478	709	34	310
	378	139	2181	433	151	157	198	172	122	89	31	41	163
	381	182	2391	1312	68	191	102	273	55	7	7	20	163
151-200	357	164	2831	137	253	6	18	123	148	302	12	105	102
	379	106	525	801	4	8	44	139	406	1126	56	44	204
	380	116	788	136	313	226	118	270	300	57	4119	4	471
0-30	3092	3232	1089	4980	1491	1787	1403	108	80	34	0	19	165
31-50	11490	18626	6978	60548	7476	5608	6854	1143	193	304	28	20	1632
51-100	1168	239	1299	1106	293	195	177	32	47	198	4	0	29
101-150	546	5020	2505	1697	897	1009	901	236	1657	796	72	124	636
151-200	386	4144	1074	570	240	180	532	854	1485	4161	149	36	777
201-300	420	nf	nf	nf	nf	nf	nf	539	1982	138	67	22	1476
301-400	352	nf	nf	nf	nf	nf	nf	14	14	5	4	35	0
Mean #/tow ¹		24.97	10.34	55.02	8.30	7.01	7.88	1.90	3.94	4.33	0.20	0.20	1.41
Adjusted total ¹		31262	12943	68902	10397	8772	9866	2372	5132	5675	252	199	3239
Unadjusted total ²		31260	12943	68649	10399	8778	9867	2372	5132	5675	331	257	4715
Upper limit		39382	18459	94509	12770	11226	11844	3550	11869	57178	597	444	23608
1 std dev		4061	2758	12930	1186	1224	989	589	3369	25752	133	94	9447

¹ Means and adjusted totals are for strata to 200 fathoms, a multiplicative model using data to 1991 is used to estimate missing strata.

² Unadjusted total is for all strata fished.

³ Survey gear changed to Campeten 1800 nf strata not fished

Table 6. Cod biomass (t) from Canadian (Spring) RV Surveys in Division 3N. Shaded numbers are estimates for non-sampled strata.

Depth range (fath)	Vessel		ATC												AN
	Strata	Sq. mi	199	208	209	222	233	245	263	276-278	289+291	304	318-319	328	
0-30	375	1593	9691	1012	955	10591	2148	5424	3598	369	3229	29835	5943	2404	
	376	1499	1837	783	174	383	77	9663	102	868	855	2208	2	1049	
31-50	360	2992	1910	819	882	305	1948	4037	2182	1416	1738	3743	1238	7877	
	361	1853	4395	2453	350	3243	2616	5889	8203	2666	4173	12196	8125	12838	
	362	2520	9416	4101	2231	306	1664	6830	6621	1632	5847	8701	3708	40764	
	373	2520	3325	1802	2359	758	1030	1749	4300	1838	857	4578	6647	17916	
	374	931	681	266	0	135	227	1247	1324	479	0	146	2369	8335	
	383	674	1572	1	17	14	46	338	1564	146	0	430	5	295	
51-100	359	421	303	251	6	7	659	147	76	190	478	208	13	71	
	377	100	535	14	83	283	14	1379	130	22	287	428	22	29	
	382	647	2032	7	59	10	44	991	2215	220	285	182	36	0	
101-150	358	225	1030	1721	34	68	111	383	200	483	1054	229	236	182	
	378	139	4028	393	631	48	78	686	90	281	939	104	303	133	
	381	182	883	1475	228	128	136	2797	393	196	427	533	2186	319	
151-200	357	164	104	1343	13	14	25	29	74	52	332	135	92	0	
	379	106	107	1776	515	18	27	50	0	601	178	53	179	129	
	380	116	273	1116	180	30	49	55	135	232	57	25	86	224	
0-30		3092	11528	1795	1129	10974	2225	15087	3700	1237	4084	32043	5945	3453	
31-50		11490	21299	9542	5339	4761	7531	20090	24194	8177	12615	29794	22092	88025	
51-100		1168	2870	272	148	300	717	2517	2421	432	1050	818	71	100	
101-150		546	5941	3589	923	246	335	3866	783	960	2420	866	2725	634	
151-200		386	484	4235	708	60	101	134	209	885	567	213	357	353	
201-300		420	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	
301-400		196	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	
Mean wt./tow ¹			33.64	15.52	6.58	13.05	8.71	33.30	25.00	9.34	16.56	50.90	24.91	73.92	
Adjusted total ¹			42123	19433	8245	16340	10911	41698	31307	11694	20737	63734	31196	92564	
Unadjusted total ²			41912	18513	7607	15372	8084	41695	30722	11692	20736	51538	31104	92566	
Upper limit			57120	27613	13059	36966	13775	62035	38492	16493	28150	120670	46068	123679	
1 std dev			7604	4550	2726	10797	2846	10170	3885	2401	3707	34566	7482	15557	

Depth range (fath)	Vessel		WT											
	Strata	Sq. mi	AN43	47	58-59	70	82	94-95	105-106	119-120	136-137	152-153	168-169	188-189
0-30	375	1593	18475	14585	8034	16512	20104	10230	1141	1391	678	0	0	0
	376	1499	391	1883	2876	4454	745	2745	751	0	0	0	12	62
31-50	360	2992	9161	1945	1282	494	1202	9486	581	842	1	0	0	457
	361	1853	29220	50957	27584	15887	12722	20240	11883	278	2232	21	1	637
	362	2520	16509	19686	69852	12714	16464	24747	2361	446	873	0	0	21
	373	2520	2446	2897	6788	5959	6090	3441	392	0	0	0	0	9
	374	931	877	769	1058	4032	489	3296	361	3	0	0	0	11
	383	674	0	0	818	71	335	326	113	0	0	0	0	0
51-100	359	421	0	134	43	44	21	6	15	3	51	0	0	32
	377	100	13	54	328	0	9	0	0	0	1	1	0	0
	382	647	16	61	12	7	419	40	0	0	0	0	0	0
101-150	358	225	122	547	1803	229	486	159	56	284	450	87	59	131
	378	139	470	256	73	96	81	62	82	62	68	11	34	84
	381	182	1544	747	82	270	39	212	232	1	0	37	9	41
151-200	357	164	2102	259	142	18	22	62	59	158	17	68	15	20
	379	106	324	365	4	15	22	61	204	633	60	42	13	66
	380	116	847	135	454	181	176	180	110	56	3061	0	1	100
0-30		3092	18866	16468	10910	20966	20849	12975	1892	1391	678	0	12	62
31-50		11490	58213	76254	107382	39157	37302	61536	15691	1569	3106	21	1	1135
51-100		1168	29	249	383	51	449	46	15	3	52	1	0	32
101-150		546	2136	1550	1958	595	606	433	370	347	518	135	102	256
151-200		386	3273	759	600	214	220	303	373	847	3138	110	29	186
201-300		420	nf	nf	nf	nf	nf	nf	351	802	58	34	7	733
301-400		196	nf	nf	nf	nf	nf	nf	6	5	4	4	28	0
Mean wt./tow ¹			65.90	76.09	96.81	48.70	47.46	60.13	14.65	3.32	5.98	0.21	0.13	0.73
Adjusted total ¹			82515	95278	121233	60981	59426	75293	18342	4158	7492	268	144	1671
Unadjusted total ²			82515	95280	121091	60982	59426	75293	18699	4941	7554	310	179	2404
Upper limit			108356	162514	159883	80483	81925	98258	33984	7761	48311	597	367	6089
1 std dev			12921	33617	19396	9751	11250	11482.5	7643	1410	20379	144	94	1843

¹ Means and adjusted totals are for strata to 200 fathoms, a multiplicative model using data to 1991 is used to estimate missing strata.

² Unadjusted total is for all strata fished.

³ Survey gear changed to Campelen 1800

nf strata not fished

Table 7. Cod abundance (1000's) from Canadian (Spring) RV Surveys in Division 30. Shaded numbers are estimates for non-sampled strata.

Depth range (fath)	Vessel Area Sq. mi.	ATC	ATC	ATC	ATC	ATC	ATC	ATC	ATC	ATC	ATC	AN	AN
		207-209 1973	233 1975	245 1976	263 1977	277 1978	289+291 1979	303 1980	318-319 1981	327/328 1982	27 1984	43 1985	
31-50	330	2089	2143	418	680	889	1072	3674	1411	941	358	1921	1461
	331	456	34	49	624	186	240	205	1284	134	377	993	548
	338	1898	2451	4987	3229	9047	1311	2666	1681	1797	4103	10116	2390
	340	1716	979	215	4165	258	708	1730	386	859	2340	2898	2734
	351	2520	2837	936	615	4843	2535	39982	1513	3689	8701	18538	4413
	352	2580	3409	1289	1791	5965	4648	2292	2113	2264	3486	11814	4859
353	1282	225	706	48	321	1732	4388	48	227	257	0	674	
51-100	329	1721	129	380	3682	172	1731	1012	65	129	754	775	501
	332	1047	1031	1729	367	1729	7309	2613	118	814	5678	236	1839
	337	948	735	688	356	249	320	516	47	234	285	142	939
	339	585	220	22	109	129	329	1361	100	198	2459	1054	88
	354	474	261	105	712	36	230	729	2076	107	107	142	261
101-150	333	151	19	958	85	0	4	0	6	14	60	0	17
	336	121	9	0	0	141	5	2	95	27	0	0	9
	355	103	19	0	4	18	23	19	128	19	151	0	398
151-200	334	92	11	7	7	0	2	0	21	3	0	0	152
	335	58	7	0	1	0	0	0	3	0	4	0	0
	356	61	2	1	2	3	4	5	18	2	48	0	0
31-50	12541	12078	8600	11152	21508	12246	54937	8436	9891	19622	46280	17079	
51-100	4775	2376	2934	5226	2315	9919	6231	2366	1482	9283	2349	3628	
101-150	375	47	958	89	159	33	21	229	37	238	0	424	
151-200	211	20	8	10	3	6	5	42	10	55	0	152	
201-300	245	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	
301-400	309	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	
Mean num/tow ¹		10.80	9.30	12.26	17.85	16.52	45.54	8.24	8.50	21.73	36.19	15.84	
Adjusted total ¹		14518	12500	16476	23983	22204	61193	11073	11419	29199	48628	21283	
Unadjusted total ²		12481	11996	16365	23648	21946	61195	11013	5943	29198	48628	21282	
1 STD DEV		2249	30391	10008	7626	16404	26941	3696	2900	8147	7299	3120	
Upper limit		16978	72778	36380	38899	54753	115076	18404	11743	45492	63225	27522	

Depth range (fath)	Vessel Area Sq. mi.	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT
		47 1986	58 1987	70 1988	82 1989	94-95 1990	105-106 1991	119-120 1992	136-137 1993	152-153 1994	168-169 1995	188-189 1996	
31-50	330	2089	824	3763	993	342	949	86	16	45	0	0	4777
	331	456	214	650	240	137	186	34	17	0	0	0	345
	338	1898	2976	5303	1781	3818	1371	1382	855	356	71	142	2089
	340	1716	2576	55431	1178	615	873	186	26	64	77	0	1416
	351	2520	32509	28753	2913	1470	2033	315	151	63	54	0	893
	352	2580	2988	12097	8821	3769	4320	1439	775	443	121	174	1104
353	1282	165	1700	1674	385	529	69	192	144	0	38	670	
51-100	329	1721	501	42933	2233	388	1200	1608	48	108	3385	388	316
	332	1047	458	2546	1297	393	1556	19059	1305	49906	0	255	3133
	337	948	882	451	249	1281	285	939	1583	37573	47	125	2478
	339	585	29	278	102	15	132	44	44	22	0	0	40
	354	474	178	1975	160	36	53	368	71	267	0	0	65
101-150	333	151	53	340	0	283	74	193	130	176	1050	6	597
	336	121	45	9	5	5	59	27	763	132	195	0	8
	355	103	12	54	12	178	50	97	27	66	12	4	2862
151-200	334	92	856	14	70	52	235	483	173	414	202	86	198
	335	58	40	4	7	4	26	4	131	234	72	26	519
	356	61	9	2	30	37	40	44	135	130	124	7	92
31-50	12541	42252	107697	17600	10536	10261	3511	2032	1115	323	354	11094	
51-100	4775	2048	48183	4041	2113	3226	22018	3051	87876	3432	768	6032	
101-150	375	110	403	17	466	183	317	920	374	1257	10	3467	
151-200	211	905	20	107	93	301	531	439	778	398	119	809	
201-300	245	nf	nf	nf	nf	nf	2347	6369	752	539	205	133	
301-400	309	nf	nf	nf	nf	nf	4	102	46	270	48	20	
Mean num/tow ¹		33.72	116.31	16.20	9.83	10.4	19.63	4.8	67.08	4.03	1.08	8.69	
Adjusted total ¹		45316	156302	21764	13208	13974	26377	6446	90143	5409	1505	21402	
Unadjusted total ²		45315	156304	21764	13208	13786	28727	12915	90953	6573	1251	21535	
1 STD DEV		28003	40760	3478	3189	1692	23325	39878	279932	4104	587	5968.5	
Upper limit		101321	237824	28720	19586	17170	75377	92671	650816	14781	2424	33472	

¹ Means and adjusted totals are for strata to 200 fathoms, a multiplicative model using data to 1991 is used to estimate missing strata.

² Unadjusted total is for all strata fished.

³ Survey gear changed to Campelen 1800

nf strata not fished

Table 8. Cod biomass (t) from Canadian (Spring) RV Surveys in Division 3O. Shaded numbers are estimates for non-sampled strata.

Depth range (fath)	Vessel Area Sq. mi	ATC	ATC	ATC	ATC	ATC	ATC	ATC	ATC	ATC	ATC	AN	AN
		207-209	233	245	263	277	289+291	303	318-319	327-328	1980	1981	1982
31-50	330	2089	8986	474	287	592	2218	3753	470	3371	123	3626	4642
	331	456	279	728	454	183	342	150	609	410	38	2630	3423
	338	1898	4174	5558	1874	6947	1334	5729	1795	5873	5659	29905	7485
	340	1716	2043	2028	2688	298	966	3718	386	4294	2849	6827	5431
	351	2520	3003	1561	2681	8134	4334	47954	5629	6621	4498	43255	23490
	352	2580	2986	425	1428	6114	3961	6235	5625	9618	6236	34168	29692
	353	1282	3172	77	2	262	84	1573	2	641	472	0	6083
51-100	329	1721	205	221	6417	180	2008	357	19	517	396	594	840
	332	1047	1579	829	351	939	4525	2266	9	2068	3474	2358	13471
	337	948	75	1904	32	629	614	23	133	623	610	434	1203
	339	585	1086	40	24	70	249	1475	31	505	610	1087	359
	354	474	427	35	38	8	33	34	273	44	125	489	219
101-150	333	151	38	524	82	0	2	0	28	49	153	0	147
	336	121	28	0	0	136	3	1	286	19	70	0	34
	355	103	74	0	4	39	12	24	367	32	135	0	135
151-200	334	92	21	6	6	0	6	0	43	28	8	0	570
	335	58	22	0	3	0	0	0	10	2	11	0	0
	356	61	10	0	0	0	0	12	49	9	166	0	0
31-50	12541	24643	10851	9414	22530	13239	69112	14516	30728	19875	120411	80246	
51-100	4775	3372	3029	6882	1826	7479	4155	465	3757	5215	4962	16092	
101-150	375	138	524	86	145	17	25	681	96	358	0	316	
151-200	211	53	6	9	2	9	12	102	39	185	0	570	
201-300	245	245	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	
301-400	309	309	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	
Mean wt./tow ¹		20.99	10.72	12.20	18.23	15.44	54.55	11.73	25.76	19.08	93.30	72.35	
Adjusted total ¹		28204	14411	16391	24502	20743	73302	15768	34619	25633	125375	97224	
Unadjusted total ²		24527	14148	16346	24238	20647	73304	15735	15393	25632	125373	97223	
Upper limit		35742	87352	89006	38369	35818	135612	24518	25204	33925	169977	126100	
1 Std Dev		5608	36602	36330	7066	7586	31154	4392	4906	4147	22302	14439	

Depth range (fath)	Vessel Area Sq. mi	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT								
		47	58-60	70	82	95-96	105-106	119-120	136-137	152-154	168-169	188-189	1986	1987	1988	1989	1990	1991	1992	1993	1994
31-50	330	2089	2136	5654	2767	1713	2262	90	2	11	0	0	7034								
	331	456	685	804	1224	183	848	98	97	0	0	0	974								
	338	1898	14405	9838	9124	14874	5475	6271	8466	2959	1006	1974	1520								
	340	1716	5796	77479	12421	2977	6338	70	4	979	49	0	234								
	351	2520	38217	66032	15852	11619	16567	3890	1128	696	30	0	137								
	352	2580	15071	49765	57457	34373	28930	16762	9958	4879	944	2171	1514								
	353	1282	951	9610	626	2371	3544	688	972	2222	0	377	117								
51-100	329	1721	304	45335	9436	682	1611	1627	10	17	4456	1167	188								
	332	1047	2499	9808	8681	1369	8728	4097	960	30014	0	1140	1496								
	337	948	8497	2674	382	2787	1997	2373	17045	19121	370	831	3267								
	339	585	29	354	233	146	103	3	7	3	0	0	4								
	354	474	180	2179	530	25	317	2312	39	540	0	0	84								
101-150	333	151	232	1057	0	1040	225	500	53	916	7131	12	1408								
	336	121	45	17	18	23	191	40	438	147	298	0	19								
	355	103	12	114	19	195	96	86	3	58	11	19	2609								
151-200	334	92	3481	59	248	136	425	776	514	781	487	165	274								
	335	58	126	18	39	7	63	2	44	2088	248	178	729								
	356	61	32	7	102	74	142	11	45	154	79	16	46								
31-50	12541	77261	219182	99471	68110	63964	27869	20627	11746	2029	4522	11530									
51-100	4775	11509	60350	19262	5009	12756	10412	18061	49695	4826	3138	5039									
101-150	375	289	1188	37	1258	512	626	494	1121	7440	31	4036									
151-200	211	3639	84	389	217	630	789	603	3023	814	359	1049									
201-300	245	nf	nf	nf	nf	nf	nf	1516	1212	896	733	186									
301-400	309	nf	nf	nf	nf	nf	nf	41	78	499	57	34									
Mean wt./tow ¹		68.98	208.97	88.67	55.51	57.94	29.54	29.61	48.81	11.24	6.34	8.79									
Adjusted total ¹		92698	280808	119156	74594	77862	39696	39786	65585	15104	8050	21654									
Unadjusted total ²		92699	280807	119157	74595	77016	51566	41342	66875	16962	8940	21841									
Upper limit		136099	382599	179304	134314	101143	87556	91140	353969	46641	12880	33157									
1 Std Dev		21700	50896	30074	29860	12064	17995	24899	143547	14840	2020	5658									

¹ Means and adjusted totals are for strata to 200 fathoms, a multiplicative model using data to 1991 is used to estimate missing strata.

² Unadjusted total is for all strata fished.

³ Survey gear changed to Campelen 1800
nf strata not fished

Table 9. Biomass (t) and Abundance ('000) of cod from autumn stratified random surveys in Division 3N.

Depth Range	Strata	Area	abundance						Biomass					
			WT 1990	WT 1991	WT 1992	WT 1993	WT 1994	WT 1995	WT 1990	WT 1991	WT 1992	WT 1993	WT 1994	WT 1995
0-30	375	1593	1814	11988	nf	628	622	4954	21899	38662	nf	1499	5955	3132
	376	1499	1067	28265	47484	56	169	3916	2089	14770	22566	66	900	3997
31-50	360	2992	1492	842	861	898	0	433	3727	1611	1817	4550	0	1316
	361	1853	1913	2156	2956	1474	2967	3751	14530	8568	4456	7393	6175	8543
	362	2520	2218	7623	7756	405	105	901	4180	21096	6986	659	382	333
	373	2520	447	3247	378	108	0	69	4897	16186	1660	40	0	39
31-100	374	931	196	2097	nf	163	314	57	1129	3356	nf	418	1209	15
	383	674	84	67	nf	0	0	46	40	34	nf	0	0	53
51-100	359	421	16	0	63	16	0	29	1	0	35	7	0	12
	377	100	49	nf	101	0	4	7	36	nf	74	0	8	11
	382	647	49	32	49	73	0	0	47	10	27	28	0	0
101-150	358	225	127	160	988	17	17	55	130	95	607	18	11	60
	378	139	110	261	151	5	5	10	116	158	103	1	5	8
	381	182	nf	0	nf	48	0	0	nf	0	nf	31	0	0
151-200	357	164	111	68	43	277	12	20	128	64	37	143	15	45
	379	106	156	nf	119	95	28	32	140	nf	93	58	43	19
	380	116	nf	48	nf	13	4	57	nf	13	nf	8	3	26
201-300	723	155	nf	nf	nf	23	0	0	nf	nf	nf	21	0	0
	725	105	nf	nf	nf	28	0	10	nf	nf	nf	35	0	10
	727	160	nf	nf	nf	204	6	3	nf	nf	nf	104	7	3
301-400	724	124	nf	nf	nf	5	0	0	nf	nf	nf	4	0	0
	726	72	nf	nf	nf	0	0	0	nf	nf	nf	0	0	0
0-30	3092		2881	40253	47484	684	791	8870	23988	53432	22566	1565	6855	7129
	11490		6350	16032	11951	3048	3386	5257	28503	50851	14919	13060	7766	10299
	1168		114	32	213	89	4	36	84	10	136	35	8	23
	546		237	421	1139	70	22	65	246	253	710	50	16	68
151-200	386		267	116	162	385	44	109	268	77	130	209	61	90
	420		nf	nf	nf	255	6	13	nf	nf	nf	160	7	13
301-400	196		nf	nf	nf	5	0	0	nf	nf	nf	4	0	0
Total			9849	56854	60949	4536	4253	14350	53089	104623	38461	15083	14713	17622
Upper limit			13724	113966	226427	6399	8494	21382	96410	164110	110465	25418	26217	26568
1 std dev			1937.5	28556	82739	931.5	2120.5	3516	21661	29744	36002	5167.5	5752	4473

'Note the fall index has not been filled for missing strata .
nf strata not fished.

Table 10. Biomass (t) and Abundance (000's) of cod from autumn stratified random surveys in Division 30.

Depth Range	Strata	Area	Abundance										Biomass													
			WT		WT		WT		WT		WT		WT		WT		WT		WT							
			101-102	113-115	128-130	144-146	160-161	176-177	1990	1991	1992	1993	1994	1995	101-102	113-115	128-130	144-146	160-161	176-177	1990	1991	1992	1993	1994	1995
31-50	330	2089	1625	745	902	86	694	3908	2465	681	876	1668	787	5978	1	232	83	127	82	1441	6639	3771	1533	1710	9	5233
	331	456	11	377	88	826	51	753	1	232	83	127	82	1441	6639	3771	1533	1710	9	5233	1697	3520	2839	474	305	3119
	338	1898	3437	1311	249	464	37	2454	7031	9922	1296	4276	296	5003	11930	18064	1960	2338	2489	3164	2866	7	0	0	0	2216
	340	1716	644	1520	2222	3297	258	1652	683	496	9	98	709	1042	683	496	9	98	709	1042	345	4	85	506	234	0
	351	2520	4634	5334	662	968	210	2683	1301	46	174	38	0	0	618	0	40	162	26	45	2	0	319	0	0	160
352	2580	3060	4532	613	0	387	963	4	0	6	0	0	0	4	0	6	0	0	0	16	0	0	48	0	0	
353	1282	674	24	0	1542	0	411	nf	66	116	37	0	13	nf	15	6	30	0	15	8	0	0	10	0	0	
51-100	329	1721	215	129	43	78	409	568	7	0	0	5	0	0	7	0	0	0	0	0	4	2	0	0	0	0
	332	1047	196	39	79	393	131	0	4	2	0	0	0	0	4	2	0	0	0	0	nf	2	0	27	0	0
	337	948	213	36	108	71	0	0	0	nf	nf	0	0	0	0	nf	nf	0	0	0	0	0	0	0	0	0
	339	585	73	0	22	176	22	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
354	474	36	0	249	0	0	163	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
101-150	333	151	6	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	336	121	3	0	0	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	355	103	nf	66	116	37	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
151-200	334	92	7	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	335	58	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	356	61	nf	2	0	0	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
201-300	717	83	0	nf	nf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	719	76	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	721	76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
301-400	718	111	0	nf	nf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	720	105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	722	93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31-50		12541	14085	13843	4716	7183	1637	12824	32429	36197	8587	10593	3968	26154	2949	546	627	804	969	1247	20	15	12	78	0	15
	51-100	4775	733	204	501	718	562	771	13	8	0	36	0	0	13	8	0	0	0	0	0	0	0	0	0	0
	101-150	375	9	66	122	64	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	151-200	211	11	4	0	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	201-300	245	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
301-400	309	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total			14838	14117	5339	7997	2202	13608	35411	36766	9226	11511	4945	27416	21022	19938	8452	13057	3876	18580	6287	7426.5	2426	4248	1706.5	6789.5
	Upper 1 std		3092	2910.5	1556.5	2530	837	2496	47985	51619	14078	20007	8358	40995												

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

Table 11. Mean number per tow at age of cod from Spring RV surveys conducted by Canada in Divisions 3NO.

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1984	1985
1	0.00	0.01	0.06	0.04	0.41	0.55	0.01	0.56	3.00	0.01	0.33	1.40	0.01	0.01
2	2.57	1.15	2.35	1.13	2.84	3.67	2.30	0.72	0.90	5.32	0.35	8.40	3.29	0.41
3	25.88	8.84	2.39	4.05	4.22	2.73	9.50	7.18	2.27	1.36	5.02	1.06	6.21	4.50
4	3.56	18.94	1.67	0.73	2.37	1.73	6.16	8.29	8.99	0.66	1.47	3.17	9.92	6.09
5	2.72	1.69	2.21	0.36	0.53	1.57	4.53	2.52	7.62	1.06	1.71	0.54	5.30	2.43
6	0.65	0.70	0.44	0.31	0.28	0.25	1.51	0.97	1.71	0.43	2.16	0.42	5.61	0.89
7	0.66	0.57	0.25	0.11	0.54	0.07	0.48	0.62	0.51	0.21	1.05	0.70	1.87	0.98
8	0.29	0.40	0.18	0.03	0.22	0.12	0.22	0.04	0.25	0.18	0.47	0.52	1.00	0.74
9	0.15	0.29	0.20	0.01	0.22	0.06	0.10	0.01	0.10	0.18	0.49	0.23	1.81	0.89
10	0.02	0.17	0.12	0.06	0.07	0.07	0.10	0.03	0.02	0.09	0.22	0.14	1.57	1.35
11	0.05	0.08	0.05	0.02	0.01	0.02	0.01	0.04	0.06	0.05	0.04	0.06	0.86	0.99
12	0.09	0.05	0.08	0.00	0.02	0.00	0.04	0.00	0.00	0.07	0.13	0.04	0.32	0.49
13	0.00	0.00	0.12	0.00	0.01	0.00	0.09	0.04	0.04	0.03	0.06	0.01	0.11	0.24
14	0.29	0.35	0.44	0.12	0.13	0.05	0.12	0.01	0.10	0.12	0.16	0.13	0.22	0.39
1+	36.93	33.24	10.56	6.97	11.87	10.89	25.17	21.03	25.57	9.77	13.66	16.82	38.10	20.40
2+	36.93	33.23	10.50	6.93	11.46	10.34	25.16	20.47	22.57	9.76	13.33	15.42	38.09	20.39
3+	34.36	32.08	8.15	5.80	8.62	6.67	22.86	19.75	21.67	4.44	12.98	7.02	34.80	19.98
4+	8.48	23.24	5.76	1.75	4.40	3.94	13.36	12.57	19.40	3.08	7.96	5.96	28.59	15.48
5+	4.92	4.30	4.09	1.02	2.03	2.21	7.20	4.28	10.41	2.42	6.49	2.79	18.67	9.39
6+	2.20	2.61	1.88	0.66	1.50	0.64	2.67	1.76	2.79	1.36	4.78	2.25	13.37	6.96
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995				
1	0.02	0.21	0.01	0.02	0.04	0.02	0.00	0.00	0.00	0.00				
2	0.68	2.73	1.68	0.25	0.47	6.30	0.65	0.14	0.01	0.05				
3	0.69	2.80	2.23	1.89	0.95	1.24	4.42	13.86	0.15	0.05				
4	7.54	9.18	0.46	1.09	1.34	0.60	0.17	18.32	0.69	0.01				
5	6.32	34.30	0.41	0.28	1.09	0.41	0.10	1.09	0.84	0.10				
6	1.58	20.91	1.07	0.30	0.24	0.18	0.13	0.69	0.14	0.09				
7	0.67	8.20	1.18	0.68	0.47	0.13	0.05	0.59	0.16	0.01				
8	0.64	1.75	0.78	0.62	0.61	0.17	0.03	0.28	0.09	0.02				
9	0.49	1.91	0.82	0.44	0.73	0.34	0.11	0.07	0.10	0.06				
10	0.72	0.68	0.87	0.48	0.51	0.22	0.13	0.10	0.02	0.01				
11	1.17	0.76	0.44	0.64	0.42	0.18	0.16	0.20	0.05	0.01				
12	0.64	0.70	0.55	0.42	0.41	0.11	0.17	0.15	0.06	0.01				
13	0.35	0.80	0.79	0.33	0.22	0.15	0.15	0.08	0.09	0.05				
14+	0.51	0.76	1.25	1.00	1.65	0.72	0.13	0.08	0.02	0.10				
1+	22.02	85.69	12.54	8.44	9.15	10.77	6.40	35.65	2.42	0.57				
2+	22.00	85.48	12.53	8.42	9.11	10.75	6.40	35.65	2.42	0.57				
3+	21.32	82.75	10.85	8.17	8.64	4.45	5.75	35.51	2.41	0.52				
4+	20.63	79.95	8.62	6.28	7.69	3.21	1.33	21.65	2.26	0.47				
5+	13.09	70.77	8.16	5.19	6.35	2.61	1.16	3.33	1.57	0.46				
6+	6.77	36.47	7.75	4.91	5.26	2.20	1.06	2.24	0.73	0.36				

Table 12. Mean No./Tow at age for Div. 3NO combined from Fall Research Vessel surveys

Age	1990	1991	1992	1993	1994	1995
1	0.81	0.51	0.01	0.05	0.00	1.15
2	1.05	14.98	5.71	0.12	0.14	1.02
3	1.06	1.92	17.89	1.13	0.10	0.46
4	2.23	1.47	2.40	2.20	0.63	0.20
5	1.46	2.55	0.95	0.27	1.54	0.94
6	0.37	1.36	0.60	0.24	0.27	1.64
7	0.29	0.41	0.18	0.18	0.02	0.11
8	0.40	0.40	0.04	0.10	0.08	0.05
9	0.42	0.68	0.05	0.02	0.02	0.06
10	0.27	0.46	0.06	0.02	0.02	0.05
11	0.23	0.51	0.00	0.07	0.06	0.00
12	0.10	0.37	0.05	0.05	0.05	0.02
13	0.17	0.31	0.11	0.04	0.06	0.02
14+	0.69	1.07	0.20	0.18	0.12	0.15
Total	9.55	26.99	28.26	4.67	3.11	5.87

Table 13. Comparison of the 1995 and 1996 Canadian and Spanish Surveys in the Regulatory Area

Strata	1995		1996		1995		1996		1995		1996	
	Canada	Spain	Canada	Spain	Canada	Spain	Canada	Spain	Canada	Spain	Canada	Spain
	Abundance ('000)	Abundance ('000)	Abundance ('000)	Abundance ('000)	Abundance ('000)	Abundance ('000)	Biomass (Tons)	Biomass (Tons)	Biomass (Tons)	Biomass (Tons)	Biomass (Tons)	Biomass (Tons)
353	38	670	0	0	0	377	117	0	4			
354	0	65	14	419	84	0	84	13	171			
355	4	2862	75	75	2609	19	2609	77	77			
356	7	92	81	81	46	16	46	49	49			
357	12	102	91	515	20	15	20	108	323			
358	63	310	5214	845	131	59	131	5745	685			
359	0	29	0	0	0	0	32	0	11			
360	0	449	344	12133	457	0	457	127	2291			
374	0	85	10	0	11	0	11	2	5			
375	0	0	0	0	0	0	0	0	11			
376	19	165	39	0	62	12	62	44	103			
377	0	0	0	74	0	0	0	0	45			
378	41	163	447	859	84	34	84	198	429			
379	20	204	1155	312	66	13	66	510	188			
380	4	471	112	112	100	1	100	37	37			
381	20	163	57	191	41	9	41	42	76			
382	0	0	132	132	0	0	0	76	119			
721			1191	1191				1509	1509			
722			542	542				392	392			
723			31	31				22	22			
724			1521	1521				891	891			
725			10898	10898				489	489			
726			297	297				92	92			
727			1684	1684				918	918			
728			0	0				0	0			
752			0	0				0	0			
753			0	0				12	12			
756			0	0				0	0			
757			0	0				0	0			
760			0	0				0	0			
761			0	0				0	0			
764			0	0				0	0			
765			0	0				0	0			
Depth Range (Fath)												
201-300			22	1476		7	733					
301-400			35	153		28	220					
Total	285	7459	8001	32069	590	4813	7199	8991				

For the Canadian Survey, abundance and biomass estimates for the 700 series strata are summarized in the lower portion of the table as depth ranges of 201-400 fathoms.

Spanish data from SCR Doc. 96/49, 95/55

Table 14. Results from ADAPT: 1993 Canadian and Russian data and 1995 autumn Canadian data masked.

POPULATION NUMBERS (000S)											10/ 6/96
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	
3	45312	40018	17311	19683	27401	21267	34653	40831	32233	8477	
4	18818	36549	31931	14108	15874	21977	17136	27305	33377	26338	
5	7938	13172	26000	22680	10596	12009	16203	13444	21451	24655	
6	4155	4209	8506	12955	15120	7533	8393	11553	9731	11950	
7	1292	2045	2706	4445	8548	10301	5252	5782	7356	5220	
8	468	540	1354	1416	2951	5278	7051	3679	3630	3743	
9	486	223	350	868	959	1897	2971	4730	2361	2251	
10	132	209	130	234	628	611	1014	1732	3042	1518	
11	73	50	125	91	164	429	309	615	920	2009	
12	57	23	33	91	67	97	205	180	408	517	
3+	78730	97036	88445	76572	82307	81399	93188	109853	114508	86677	
	1987	1988	1989	1990	1991	1992	1993	1994	1995		
3	6353	12676	13724	5057	6960	15314	6134	503	296		
4	6802	4735	10128	9501	3177	4700	8459	3833	202		
5	18972	5187	3589	6317	3703	1992	2248	4022	1034		
6	14374	12374	2865	1579	1244	2131	874	1264	2282		
7	5829	8651	4388	1206	483	527	1191	282	922		
8	2905	3675	3504	1885	605	140	219	685	147		
9	2207	1788	2096	1707	891	163	57	112	537		
10	1338	1042	951	1277	872	216	44	24	84		
11	905	648	469	568	648	260	61	0	19		
12	1329	381	306	232	329	184	74	5	0		
3+	61015	51158	42019	29330	18913	25627	19360	10731	5523		

ADAPT (6 INDEX) TUNING JUNE 1991
3NO CODS 6/10/96 22:24

FISHING MORTALITY												10/ 6/96	
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	
3	0.015	0.026	0.005	0.015	0.021	0.016	0.038	0.002	0.002	0.020	0.094	0.024	
4	0.157	0.141	0.142	0.086	0.079	0.105	0.043	0.041	0.103	0.128	0.071	0.077	
5	0.434	0.237	0.497	0.205	0.141	0.158	0.138	0.123	0.385	0.340	0.227	0.394	
6	0.509	0.242	0.449	0.216	0.184	0.161	0.173	0.251	0.423	0.518	0.308	0.837	
7	0.672	0.212	0.447	0.210	0.282	0.179	0.156	0.266	0.476	0.386	0.261	0.704	
8	0.542	0.234	0.244	0.190	0.242	0.375	0.199	0.244	0.278	0.328	0.286	0.362	
9	0.645	0.339	0.202	0.125	0.250	0.426	0.340	0.241	0.242	0.320	0.550	0.432	
10	0.783	0.315	0.156	0.158	0.181	0.481	0.300	0.433	0.215	0.317	0.524	0.599	
11	0.965	0.197	0.113	0.102	0.324	0.540	0.342	0.211	0.376	0.213	0.666	0.552	
12	0.659	0.275	0.262	0.171	0.239	0.365	0.249	0.296	0.303	0.338	0.405	0.524	
	1989	1990	1991	1992	1993	1994	1995						
3	0.168	0.265	0.193	0.394	0.270	0.712	0.000						
4	0.272	0.742	0.267	0.538	0.543	1.110	0.494						
5	0.621	1.425	0.352	0.624	0.376	0.367	0.022						
6	0.665	0.985	0.660	0.382	0.931	0.116	0.020						
7	0.545	0.489	1.037	0.680	0.354	0.453	0.002						
8	0.519	0.549	1.114	0.702	0.469	0.043	0.000						
9	0.295	0.472	1.219	1.116	0.665	0.082	0.002						
10	0.316	0.478	1.011	1.068	4.369	0.047	0.000						
11	0.504	0.345	1.058	1.052	2.233	1.319	0.000						
12	0.444	0.497	1.095	0.891	1.464	0.156	0.001						

Table 14. (Continued)

RV1

	1977	1978	1979	1980	1981	1982	1984	1985	1986
3	0.223	0.072	-0.254	-0.986	0.091	-1.215	-0.105	-0.190	-0.714
4	0.658	0.284	0.501	-1.320	-0.641	-0.185	0.705	0.048	0.511
5	1.302	0.109	-0.667	-1.319	-0.110	-1.381	0.776	0.340	0.454
6	1.026	0.444	0.407	-1.503	-0.067	-1.017	1.189	0.398	0.024
7	0.907	0.468	0.103	1.404	0.396	1.043	0.562	0.224	-0.310
8	0.942	1.024	0.109	-0.534	0.278	-0.683	0.258	-0.011	-0.162
9	0.252	1.902	0.162	-0.507	0.479	-0.866	0.179	0.159	-0.349
10	0.815	1.041	-1.096	-0.164	-0.216	-0.483	0.845	0.020	0.144
11	-1.467	-0.037	-0.639	-0.497	-1.253	-1.588	0.506	0.323	-0.367

	1987	1988	1989	1990	1991	1992	1994	1995
3	1.007	0.053	-0.122	0.238	0.148	0.732	0.923	0.000
4	2.033	-0.590	-0.393	0.107	0.158	-1.353	0.538	-1.061
5	2.352	-0.690	-0.600	0.600	-0.371	-1.034	0.263	-0.679
6	2.314	-0.248	-0.144	0.384	0.202	-0.820	-0.357	-1.458
7	2.028	-0.087	0.009	0.849	0.751	-0.458	1.216	-2.966
8	1.084	0.083	-0.031	0.600	0.706	0.256	-0.561	-0.546
9	1.147	0.459	-0.402	0.407	0.663	1.184	0.946	-1.173
10	0.309	0.350	0.194	0.056	-0.145	0.754	0.568	-1.408
11	0.218	-0.043	0.521	-0.075	-0.669	0.104	5.428	-0.563

SUM OF RV RESIDUALS : 0.001414561054 MEAN RESIDUAL : 0.000009245497083

LOG RESIDUALS FROM RV2

10/ 6/96

	1977	1978	1979	1980	1981	1982	1983	1984	1985
3	0.276	0.183	-0.567	-0.744	-0.466	0.200	-0.062	0.747	1.639
4	0.732	0.309	-1.042	-0.712	-0.274	0.310	0.437	0.952	1.479
5	1.221	0.981	-0.726	-1.003	-0.588	0.976	0.386	1.049	1.884
6	1.164	1.095	-0.555	-0.640	-1.416	0.421	1.012	0.479	1.503
7	1.670	0.963	0.007	-0.203	-1.226	-0.324	0.615	0.633	1.146
8	1.783	1.197	-0.122	0.366	-0.902	-2.111	-0.185	0.382	0.854
9	0.570	0.791	0.270	-0.272	-0.713	0.484	0.451	-0.609	0.173
10	0.554	-0.135	0.952	0.364	-1.304	0.819	0.473	-0.113	-0.380
11	0.915	3.224	-0.043	0.267	-0.209	0.033	0.548	-0.897	-0.118

	1986	1987	1988	1989	1990	1991
3	1.337	-0.113	0.394	-1.058	-1.458	-0.309
4	1.539	-0.866	-1.194	-1.164	-1.375	0.869
5	1.169	-1.769	-1.998	-1.516	-0.987	0.921
6	1.126	-1.486	-1.765	-1.304	-0.549	0.914
7	1.068	-0.853	-1.720	-1.071	-1.243	0.639
8	1.254	-0.172	-1.062	-0.713	-1.687	1.117
9	0.994	-0.011	-0.330	-1.473	-1.873	1.549
10	0.446	0.057	0.007	-1.652	-1.173	1.085
11	-0.981	-0.140	-0.374	-1.172	-1.443	0.390

SUM OF RV RESIDUALS : 0.00005567984862 MEAN RESIDUAL : 4.124433231E-7

LOG RESIDUALS FROM RV3

10/ 6/96

	1990	1991	1992	1993	1994
3	-0.447	-0.232	1.378	-0.572	-0.127
4	-0.155	0.127	0.452	-0.218	-0.205
5	0.330	0.528	0.387	-1.198	-0.047
6	-0.049	1.220	-0.368	0.064	-0.866
7	-0.080	1.638	0.431	-0.657	-1.331
8	-0.342	1.264	0.081	0.359	-1.361
9	-0.477	1.278	0.282	0.040	-1.122
10	-1.431	-0.073	-0.664	2.585	-0.417
11	-0.822	0.435	-1.192	1.798	5.780

SUM OF RV RESIDUALS : 0.001604239874 MEAN RESIDUAL : 0.00003564977497

LOG RESIDUALS FROM RV4

10/ 6/96

	1989	1990	1991	1992	1993	1994
3	-0.458	-0.042	-0.147	-0.374	0.073	0.948
4	-0.439	0.413	-0.148	-0.882	0.252	0.804
5	-0.392	0.741	-0.143	-0.363	-0.522	0.679
6	-0.284	0.479	0.546	-0.526	0.227	-0.441
7	-0.141	0.142	0.500	0.292	-0.527	-0.265
8	-0.303	0.113	0.363	0.292	0.367	-0.932
9	-1.027	0.061	0.480	0.023	0.330	0.133
10	-1.217	-0.894	-0.501	-0.920	3.382	0.151
11	-1.350	-2.101	-1.607	0.771	0.717	4.070

3NO CODS 1993 masked Cdn & Russia and 1995 fall masked

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

Table14. (Continued)

ORTHOGONALITY OFFSET..... 0.014253
 MEAN SQUARE RESIDUALS 1.286452

PARAMETER	AGE	ESTIMATE	STD. ERR.	T-STAT	C.V.
NUMBERS					
	3	296	347	0.854	1.171
	4	204	124	1.650	0.606
	5	1036	715	1.448	0.691
	6	2287	1307	1.749	0.572
	7	923	432	2.137	0.468
	8	147	85	1.736	0.576
	9	538	236	2.275	0.440
	10	85	42	2.021	0.495
	11	19	9	1.987	0.503
INDEX 1: RV1					
	3	1.87E ⁻⁴	5.34E ⁻⁵	3.501	0.286
	4	2.02E ⁻⁴	5.70E ⁻⁵	3.553	0.281
	5	2.13E ⁻⁴	5.98E ⁻⁵	3.564	0.281
	6	1.85E ⁻⁴	5.18E ⁻⁵	3.577	0.280
	7	2.33E ⁻⁴	6.49E ⁻⁵	3.588	0.279
	8	2.60E ⁻⁴	7.26E ⁻⁵	3.582	0.279
	9	4.00E ⁻⁴	1.11E ⁻⁴	3.595	0.278
	10	5.35E ⁻⁴	1.49E ⁻⁴	3.586	0.279
	11	1.04E ⁻³	2.88E ⁻⁴	3.605	0.277
INDEX 2: RV2					
	3	4.29E ⁻⁴	1.26E ⁻⁴	3.412	0.293
	4	4.00E ⁻⁴	1.17E ⁻⁴	3.413	0.293
	5	3.83E ⁻⁴	1.12E ⁻⁴	3.412	0.293
	6	3.96E ⁻⁴	1.16E ⁻⁴	3.413	0.293
	7	4.06E ⁻⁴	1.19E ⁻⁴	3.414	0.293
	8	4.17E ⁻⁴	1.22E ⁻⁴	3.415	0.293
	9	5.33E ⁻⁴	1.56E ⁻⁴	3.415	0.293
	10	7.10E ⁻⁴	2.08E ⁻⁴	3.415	0.293
	11	9.79E ⁻⁴	2.87E ⁻⁴	3.415	0.293
INDEX 3: RV3					
	3	4.83E ⁻⁴	2.54E ⁻⁴	1.899	0.527
	4	6.01E ⁻⁴	3.22E ⁻⁴	1.868	0.535
	5	6.43E ⁻⁴	3.42E ⁻⁴	1.883	0.531
	6	6.61E ⁻⁴	3.48E ⁻⁴	1.898	0.527
	7	4.62E ⁻⁴	2.46E ⁻⁴	1.878	0.532
	8	5.58E ⁻⁴	2.94E ⁻⁴	1.897	0.527
	9	6.94E ⁻⁴	3.65E ⁻⁴	1.900	0.526
	10	1.56E ⁻³	8.06E ⁻⁴	1.929	0.518
	11	1.45E ⁻³	7.49E ⁻⁴	1.937	0.516
INDEX 4: RV4					
	3	1.91E ⁻³	9.11E ⁻⁴	2.096	0.477
	4	1.27E ⁻³	6.12E ⁻⁴	2.073	0.482
	5	9.24E ⁻⁴	4.44E ⁻⁴	2.082	0.480
	6	6.39E ⁻⁴	3.05E ⁻⁴	2.095	0.477
	7	6.03E ⁻⁴	2.90E ⁻⁴	2.078	0.481
	8	5.23E ⁻⁴	2.50E ⁻⁴	2.094	0.478
	9	4.83E ⁻⁴	2.31E ⁻⁴	2.095	0.477
	10	8.01E ⁻⁴	3.78E ⁻⁴	2.120	0.472
	11	4.83E ⁻³	2.27E ⁻³	2.132	0.469

Table 15. Maturity at age for cod in 3NO, 1975-1994

AGE	1975	1976	1977	1978	1979	1980	1981	1982	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0.03	0	0	0.02	0	0.07	0	0	0	0	0	0	0.01	0.03	0.07	0	0	0
5	0	0.05	0.08	0.07	0.06	0.13	0.53	0.1	0.05	0.04	0.04	0.11	0.09	0.2	0.03	0.3	0.35	0.43	0.3
6	0.56	0.48	0.19	0.39	0.48	0.47	0.47	0.48	0.56	0.37	0.17	0.34	0.28	0.65	0.61	0.41	0.58	0.48	0.62
7	0.97	1	0.62	0.81	0.89	0.84	0.87	0.96	0.88	0.93	0.56	0.75	0.5	0.95	0.87	0.84	1	0.97	0.79
8	0.98	1	0.89	1	1	0.84	1	1	0.96	1	1	0.87	0.93	0.98	0.85	1	1	0.97	1
9	1	1	1	1	1	1	1	0.89	1	1	1	0.94	0.98	1	1	1	1	0.84	1
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1	1	0.99	1	1	1	1	1	1	1	1	1
12	1	1	1	1	1	1	0.78	1	1	1	1	1	1	1	1	1	1	1	1
13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A50	5.98	6.09	6.74	6.24	6.06	6.14	5.73	6	5.98	6.17	6.7	6.45	6.75	5.59	6.24	5.82	5.59	5.71	5.73
L 95%	5.73	5.72	6.44	6.03	5.87	5.92	5.42	5.78	5.86	6.02	6.51	6.23	6.47	5.34	5.97	5.51	5.25	5.45	5.42
U 95%	6.19	6.93	7.15	6.55	6.3	6.42	6.09	6.23	6.11	6.33	6.9	6.69	7.02	5.83	6.51	6.22	5.98	5.97	6.12
Slope	3.5	2.34	1.7	2.25	2.32	1.69	1.24	2.46	2.48	2.74	2.22	1.49	1.65	2.34	1.69	1.5	2.24	1.82	1.62
SE	0.74	0.62	0.27	0.34	0.29	0.21	0.15	0.3	0.27	0.27	0.24	0.15	0.22	0.28	0.18	0.21	0.43	0.22	0.27
Int	-20.9	-14.26	-11.48	-14.08	-14.05	-10.37	-7.12	-14.78	-14.86	-16.9	-14.9	-9.62	-11.16	-13.06	-10.56	-6.74	-12.51	-10.41	-9.27
SE	4.48	3.38	1.68	2	1.66	1.2	0.83	1.81	1.63	1.66	1.6	0.98	1.53	1.64	1.14	1.12	2.39	1.27	1.47
n	244	184	270	297	471	440	290	481	648	810	608	535	409	567	552	379	268	318	188

Table 16. Basic statistics for the general linear model estimates of cohort strength from spring, autumn and juvenile survey at age indices.					
Ages 1 - 13					
R2 = 0.526947					
	Source	DF	Sums of Squares	F Ratio	Prob>F
	Survey	3	215.76944	25.2584	0.0000
	Age	12	725.85038	21.2424	0.0000
	Cohort	24	534.69258	7.824	0.0000
Ages 2 - 5					
	Source	DF	Sums of Squares	F Ratio	Prob>F
	Survey	3	68.74476	9.3807	0.0000
	Age	3	17.91069	2.444	0.0666
	Cohort	23	278.46356	4.9563	0.0000

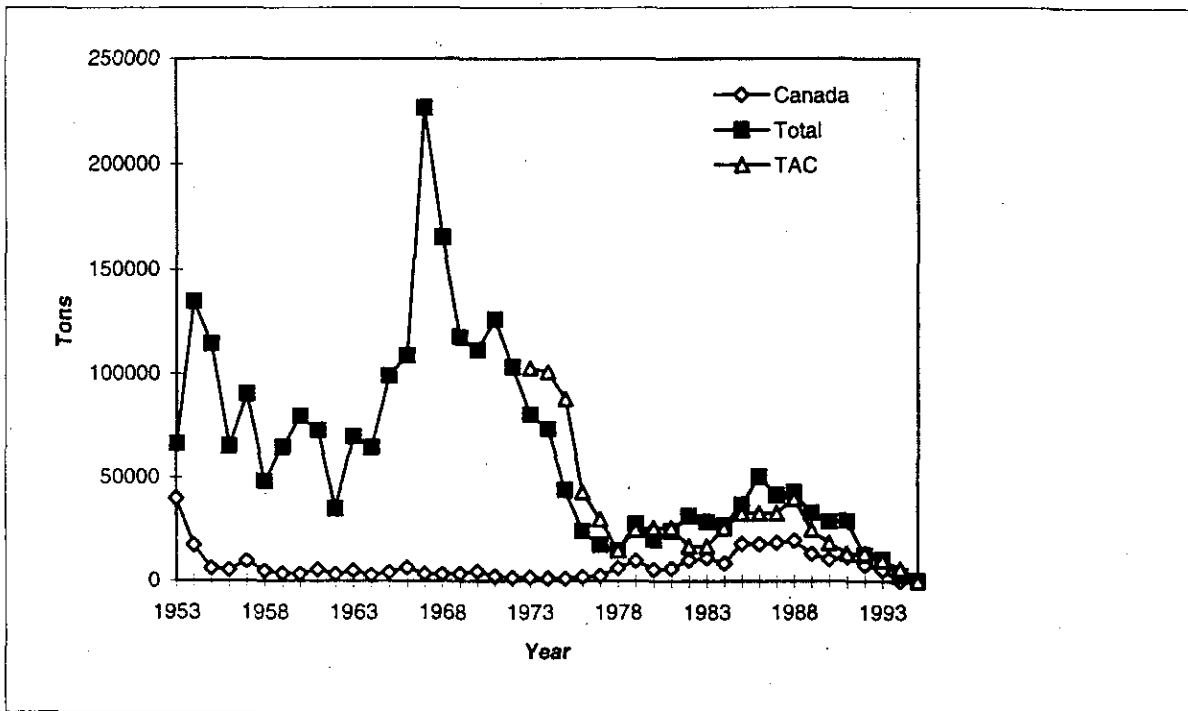


Figure 1. Landings of cod in NAFO Divisions 3NO 1953-1995

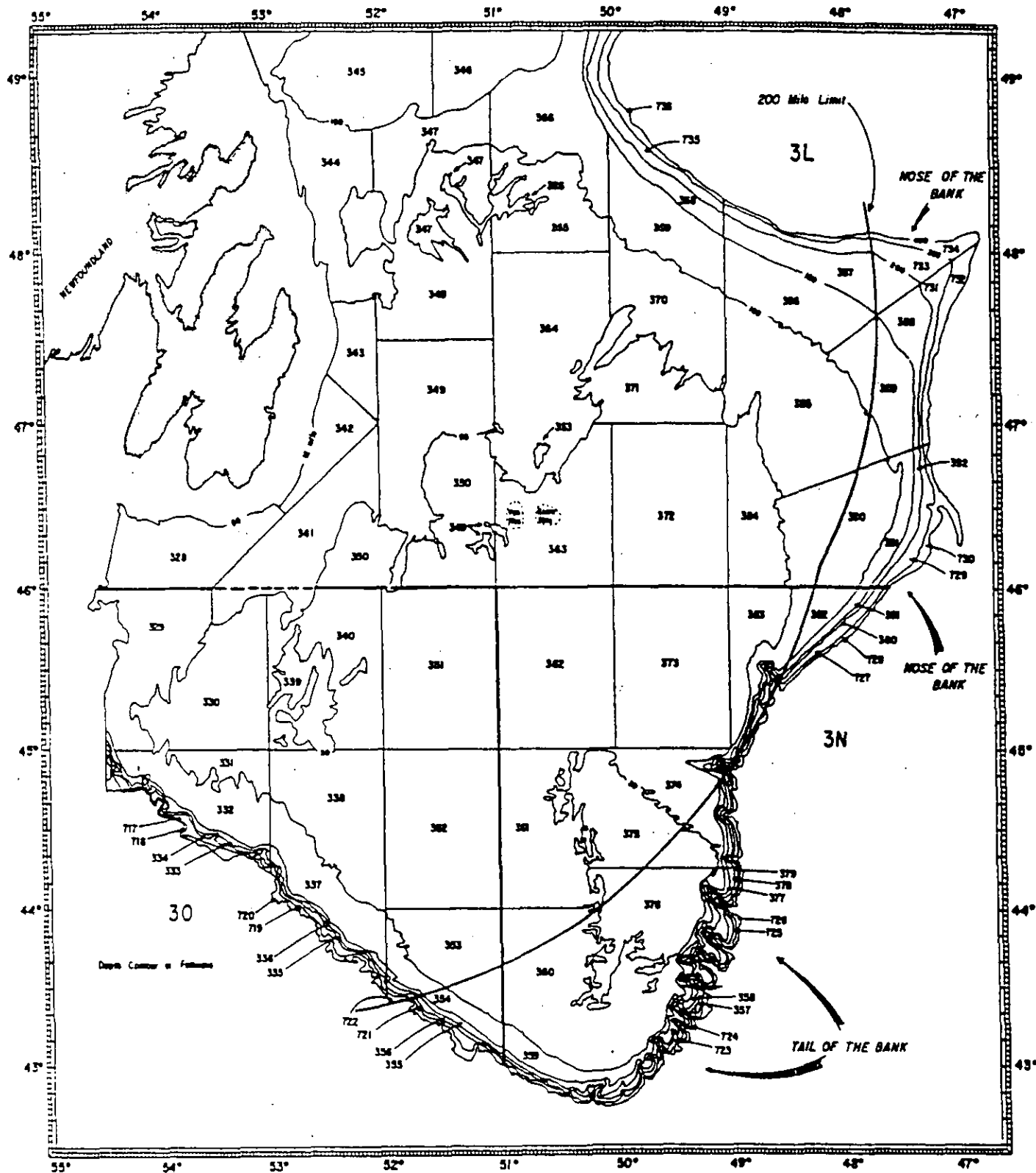


Figure 2. Stratification scheme for NAFO Divisions 3LNO showing the Canadian 200-mile limit.

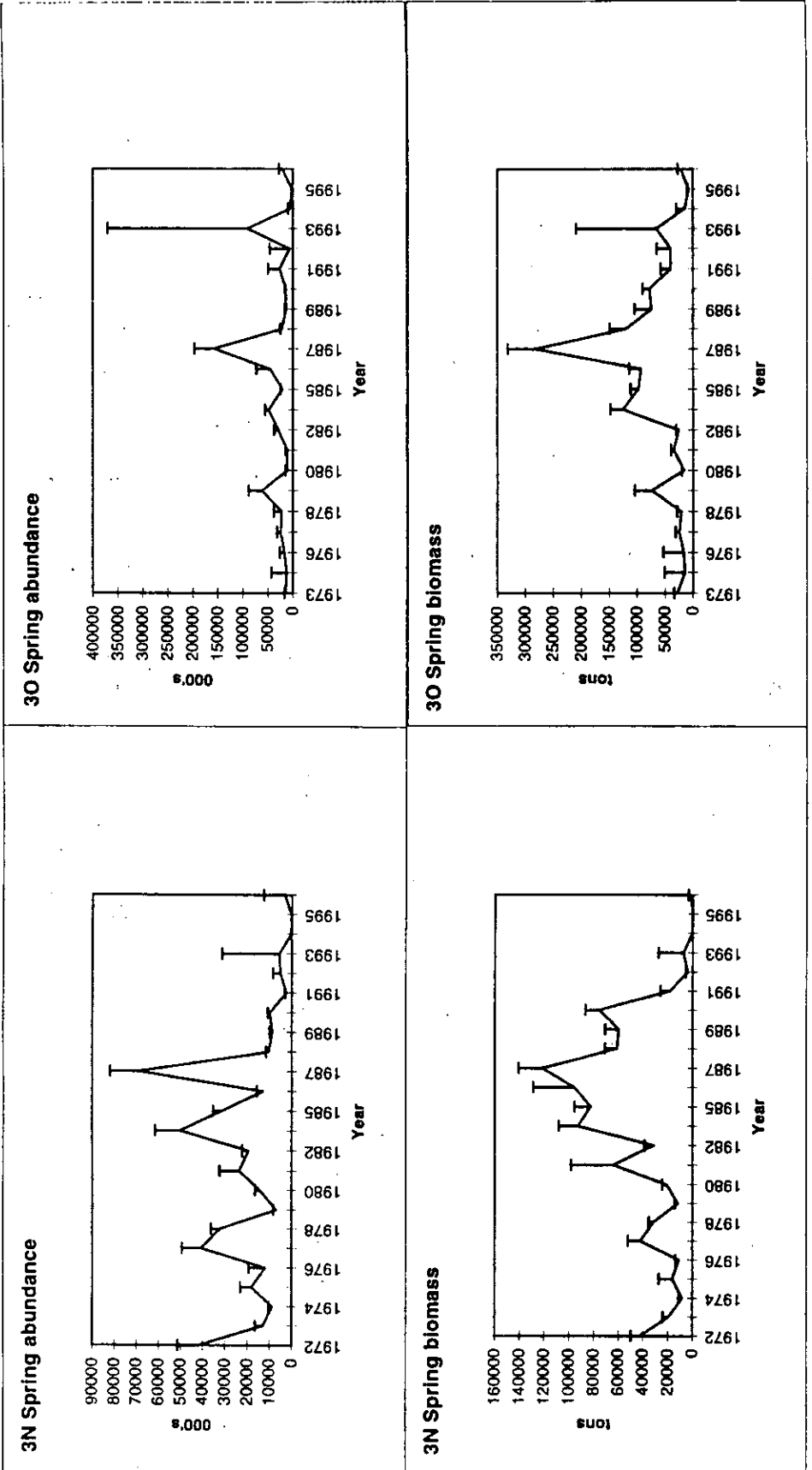


Figure 3. Abundance (000's) and biomass (t) for the Canadian Spring Research Vessel survey series. Vertical bars indicate 1 standard deviation.

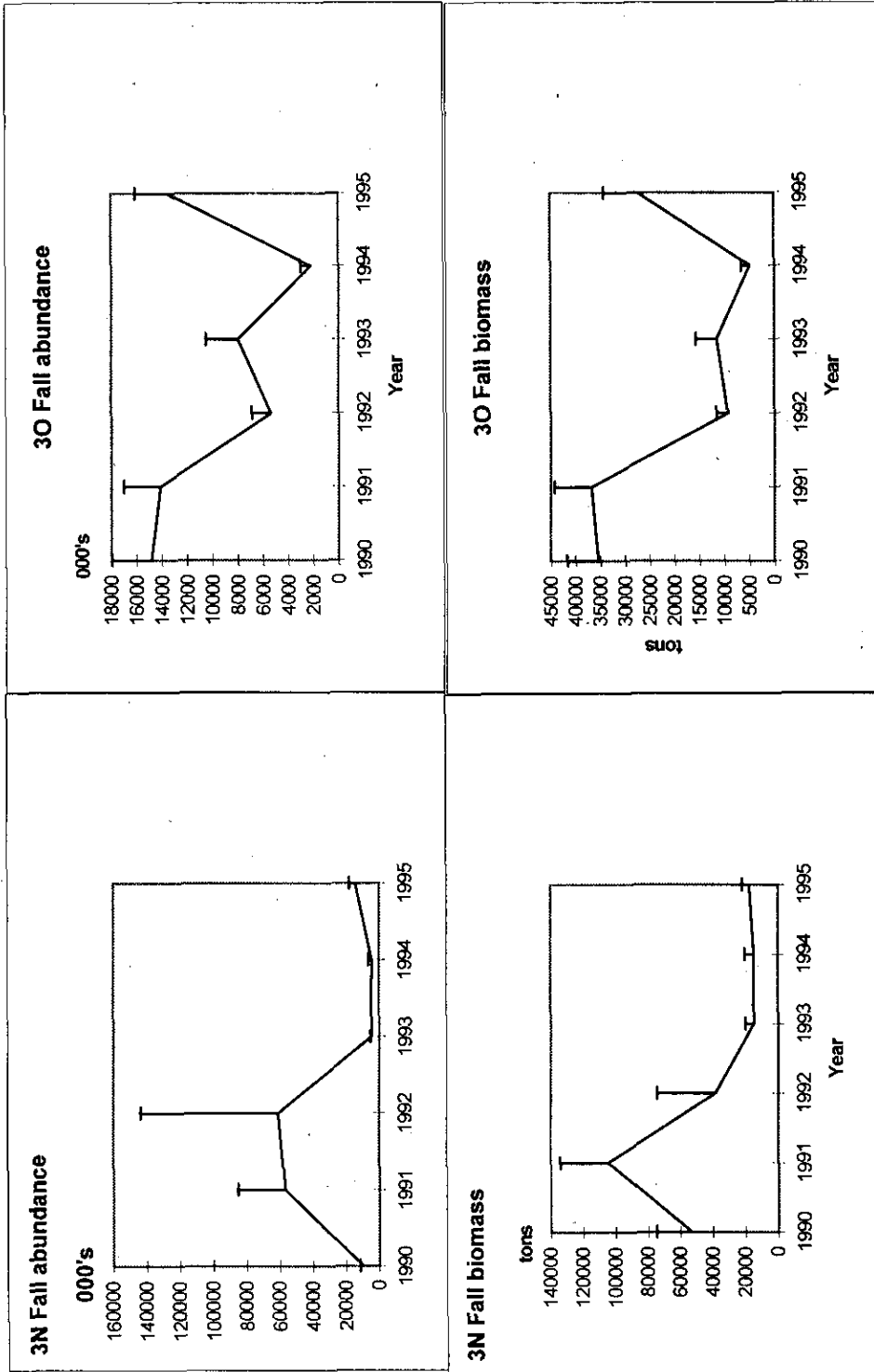


Figure 4. Abundance (000's) and biomass (t) for the Canadian Fall Research Vessel survey series. Vertical bars indicate 1 standard deviation.

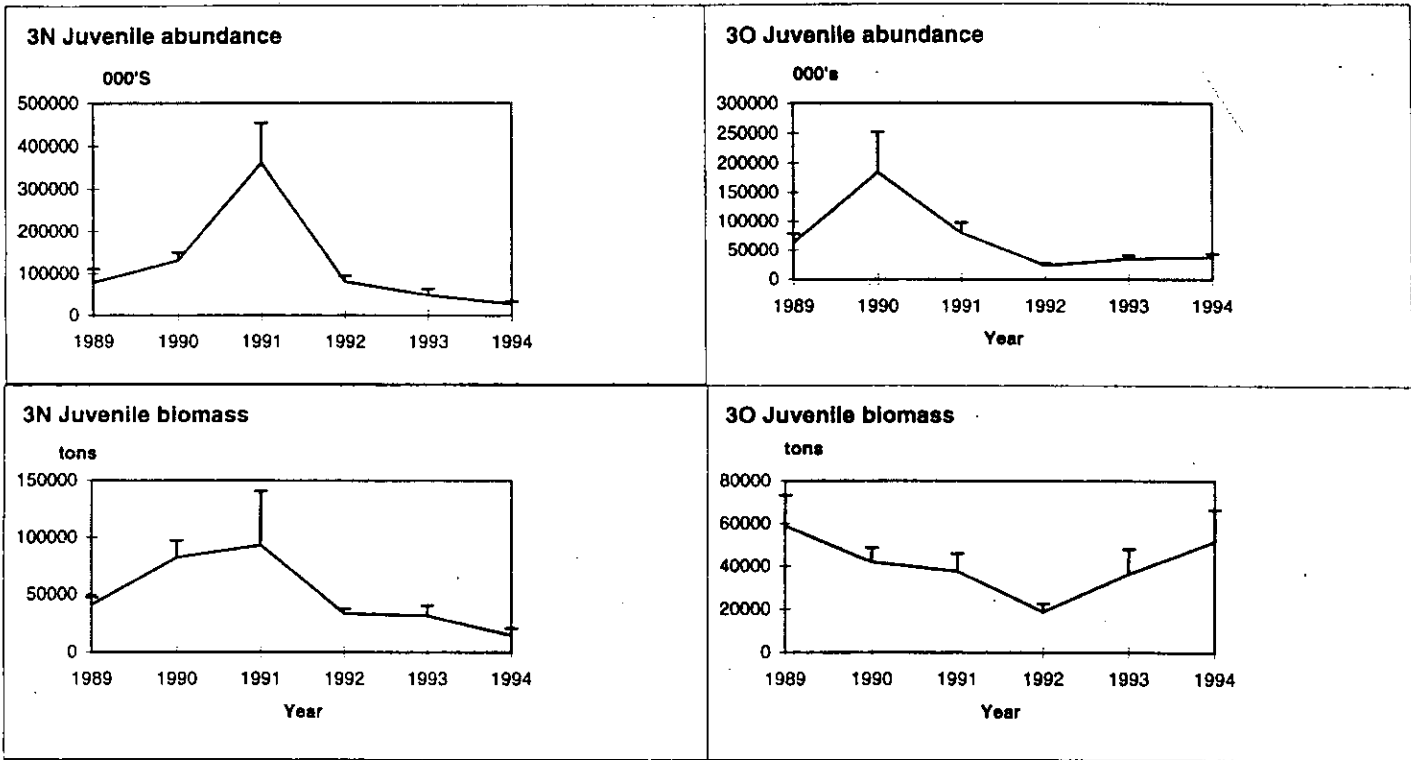


Figure 5. Abundance (000's) and biomass (t) for the Canadian Juvenile Research Vessel survey series. Vertical bars indicate 1 standard deviation.

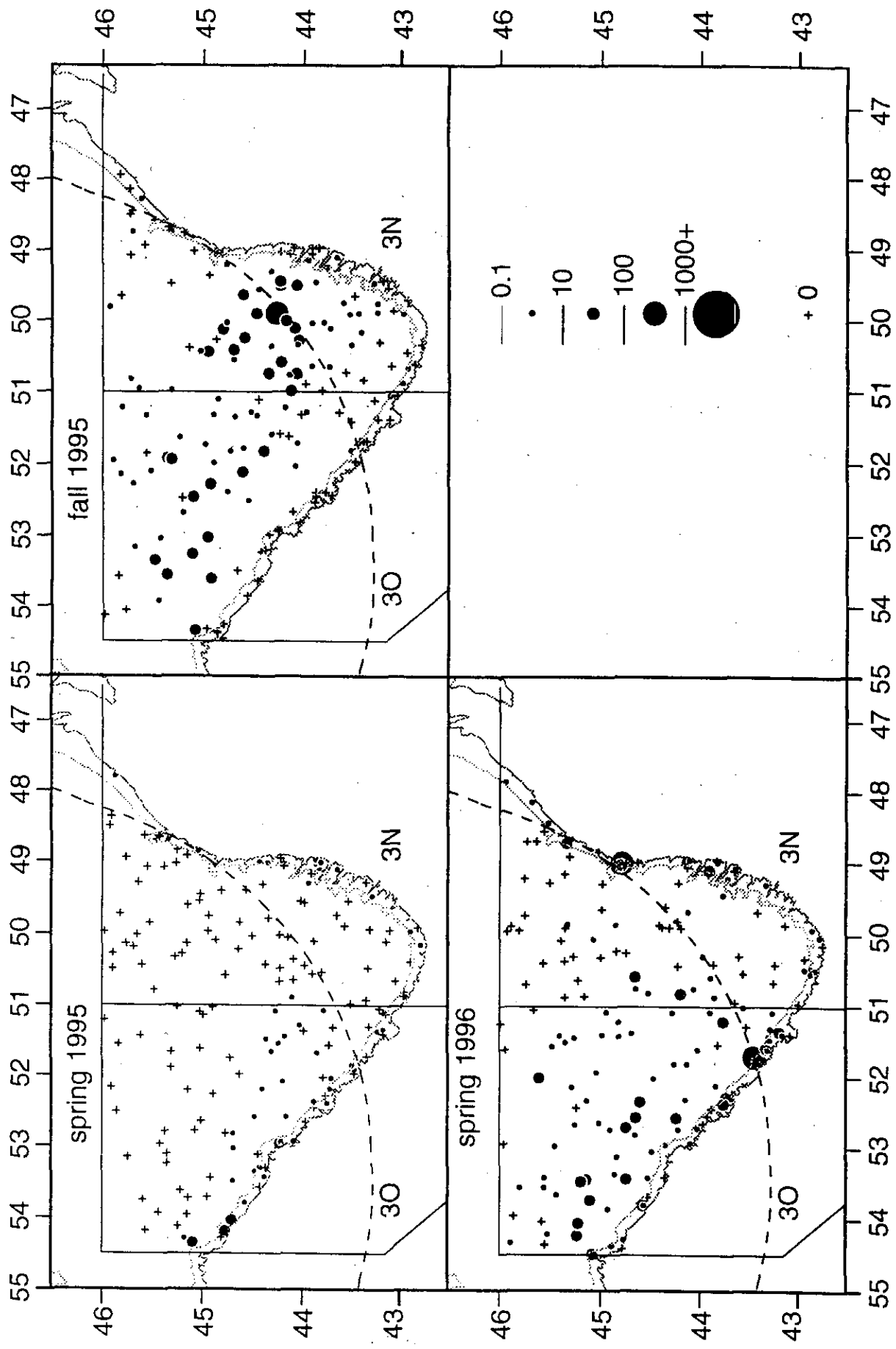


figure 6. Cod distribution number per tow.

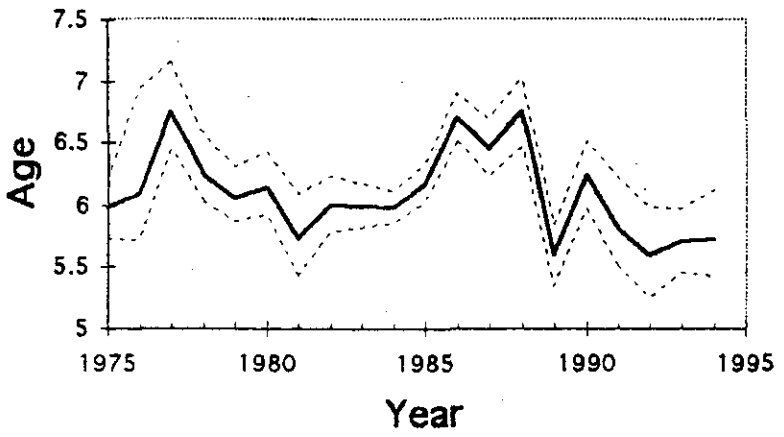
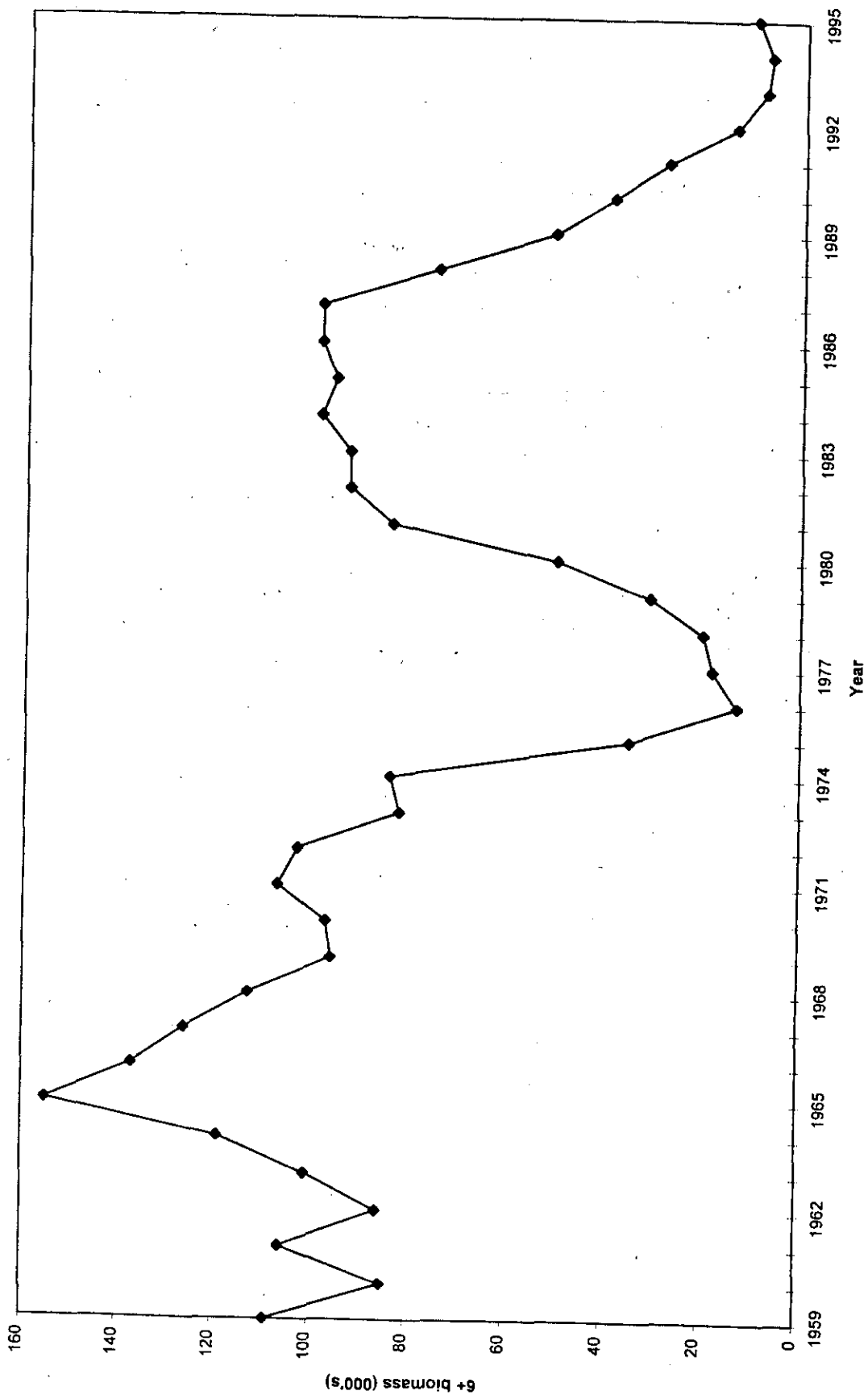


Fig. 7 Estimated age at 50% maturity from a probit model applied to the spring survey maturity data for 1975 to 1994. Broken lines give 95% confidence limits.

Figure 8 Annual 6+ biomass for Div. 3 no cod 1959-95. Population from ADAPT analysis without spring 1993 and fall 1995.



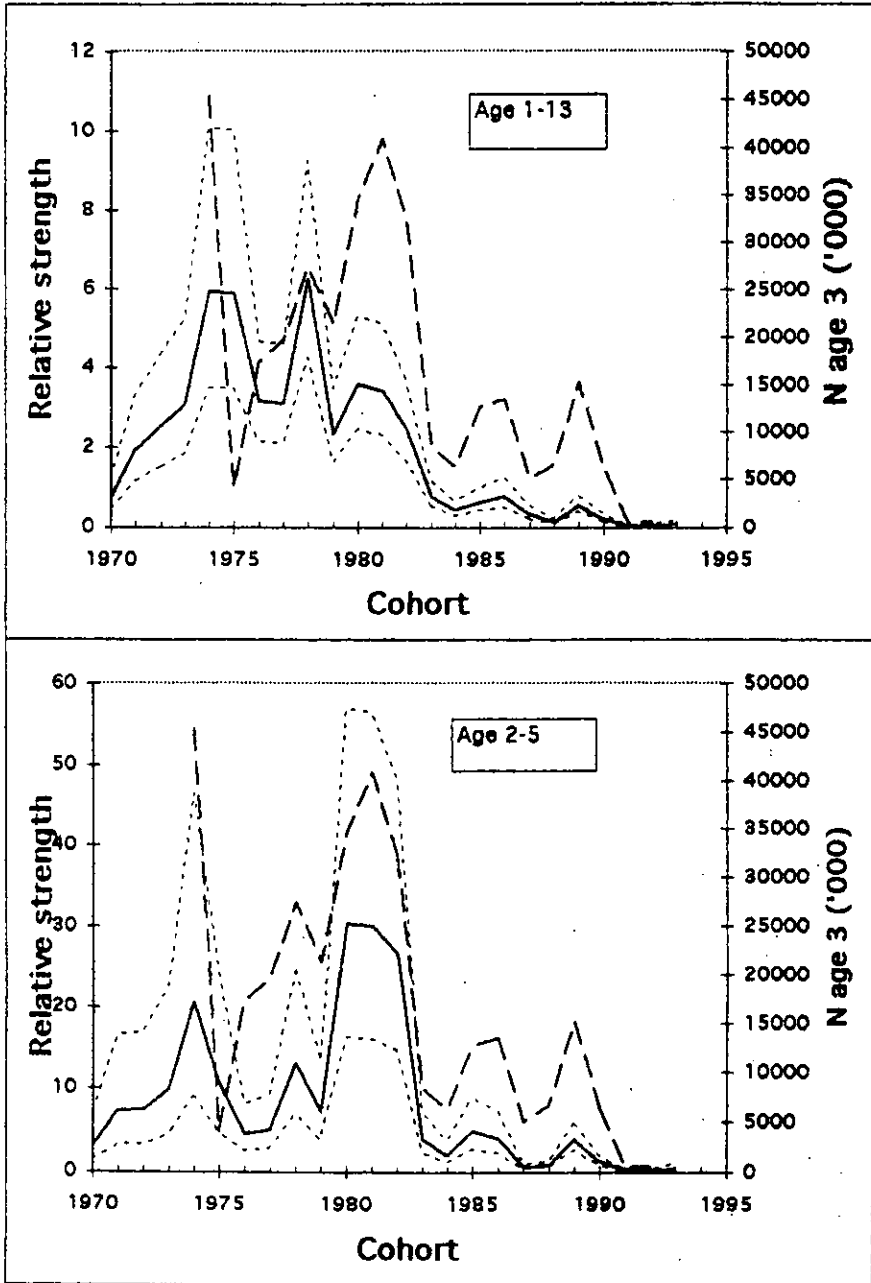


Fig. 4 Multiplicative model estimates of cohort strength for two combinations of ages compared with ADAPT numbers at age 3 (all indices, 1993 omitted). (ADAPT = bold broken line, multiplicative model = solid bold line, ± 1 SE = light broken line. Multiplicative model estimates not bias corrected).