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An Assessment of the Cod Stock in NAFO Div. 3NO

by

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Nominal catch and catch at age

During the 1953-91 period the highest catch of about 227,000 tons occurred during 1967 with the lowest catch of 15,000 tons occurring during 1978 (Table 1, Figure 1). Catches increased after 1978, reaching a recent high in 1986 of 50,000 tons. The catch for all countries has been decreasing in the most recent years with the 1990 catch of 28,800 tons the lowest since 1984. The catch for 1991 has increased slightly however, and is approximately 29,400t. In several of the past 15 years the catches have been in excess of the TAC. The total catch (estimated + reported) for 1991 was more than double the TAC of 13,600t.

Canadian landings by month and division are presented in Table 2. The Canadian catch is generally distributed throughout the year and during 1991 about 80% was taken from Division 3O. The catches by other countries, primarily Spain and Portugal, occur in the NAFO Regulatory Area, mainly in Division 3N. An estimated 4,000t of Canadian GN catch (Dept. of Fisheries and Oceans, Canada), not included in Table 2, was reported for Div. 3L but was actually taken in Div. 3NO.

In recent years catches from the Regulatory Area have been estimated by Canadian surveillance authorities. During 1991 these as well as estimates derived by the Scientific Council indicate that 1700 tons of cod in Divisions 3NO was taken by non-Contracting Parties of NAFO. These estimates are included in this assessment.

Sampling data available for the Canadian fishery in 1991 (Table 3), obtained from Canadian port samplers and offshore observers, was used to adjust monthly catches by Canada. In total 5,882 fish were measured for length and 1,054 were aged during 1991. Catch, average weight and average length at age for the 1991 Canadian catch are presented in Table 4. Average weights at age were determined by applying a length weight relationship (log weight = 3.0879 x log length - 5.2106) to length frequencies and age length keys. The dominant yearclasses in the Canadian fishery during 1991 were those of 1985 and 1986, ages 6 and 5 respectively (Table 4). These same two yearclasses also dominated the Canadian catch in 1990.

Catch numbers at age for the Spanish and Portuguese fleets fishing in the Regulatory Area were obtained from data included in national research reports (Vazquez et al, 1992; Alpoim et al, 1992). Sampling for the Spanish pair-trawl catch was available only for October to December of 1991, however most of the catch by this fleet occurred during the second half of the year. Sampling for the Portuguese trawl and gillnet fisheries was distributed throughout the year. There was no sampling for estimated catches from the Regulatory Area, consequently a combination of the sampling provided by Spain and Portugal was considered appropriate to adjust this catch. The dominant yearclass in all the trawl fisheries

in the Regulatory Area was that of 1989, age 2 in 1991 (Table 5). It is estimated that in excess of six million cod were taken in these fisheries. This is by far the largest number of age 2 cod ever caught (reported or estimated) in a single year from this stock. The 1981 and 1982 yearclasses, ages 9 and 10 in 1991, dominated the Portuguese gillnet fishery in 1991, but the total catch by this fleet was relatively small.

Catch at age and mean weights at age for the 1959-1991 period are presented in Tables 6 and 7 respectively. During recent years the 1981 and 1982 yearclasses have been dominant in the Division 3NO cod catches. These yearclasses are still well represented in the 1991 catch, as indicated by the mode in the total age composition at ages 9-10. The most dominant yearclasses in 1991 are those of 1988 and 1989, age 2 and 3 in 1991. This is the first time in any single year for this stock that fish as young as these have dominated the catch. These young, small cod were taken in trawl fisheries by Spain, Portugal and non-contracting parties in the Regulatory Area. With respect to the mean weights, there does not appear to be any discernable trends in recent years with the 1991 values within the range of recently-observed mean weights.

Commercial catch and effort

Catch and effort from the Canadian otter trawl fishery was analyzed using a multiplicative model (Gavaris, 1980). Annual catch rates were standardized by country/gear/tonnage class, NAFO division, and month. The model explained just over 40% of the variation in the data (Table 8). Monthly coefficients (Table 9) indicate that highest catch rates for this fleet occur during January and December while the lowest occur during summer months. Trends in catch rates for the Canadian otter trawl fleet are shown in Table 10 and Figure 2. In general, C/E increased from 1977 to 1982 and have declined steadily since that time. There was a sharp decline from 1990 to 1991 with the 1991 value almost half the next lowest value in the 15 year time series.

In previous assessments Spanish catch and effort, as reported to NAFO was also analyzed using methodology similar to that used for the Canadian otter trawl fleet (Baird et. al., 1991). It is now considered that these data may be unreliable and were not analyzed for this assessment.

Although it had been determined that catch rates are not suitable for quantitative calibrations of SPA they are still used to provide a general description of the status of this resource.

Research vessel survey data

Stratified-random research vessel surveys have been conducted by Canada in Divisions 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 have been conducted by the sister ships **ALFRED NEEDLER** and **WILFRED TEMPLEMAN**. Comparative fishing studies indicated that the conversion factor between the two vessel/gear combinations was not different from 1. The stratification scheme used for these surveys is based on depth and is presented in Figure 3.

Biomass estimates for these surveys are presented in Tables 13-14 and in Figure 5. Biomass for Divisions 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. The Division 3NO total biomass in 1991 and 1992 are the lowest observed since 1982.

Abundance estimates are shown in Tables 11-12 and Figure 6. Trends in Division 3NO cod abundance are similar to those observed for biomass with a large spike again occurring in 1987, caused mainly by a high estimate for Division 3O. The abundances estimated for the 1988 to 1991 period are all among the lowest observed in the Canadian time series of RV abundance for this stock with the estimate for 1992 even lower than those of the 1988-91 period.

Age composition data for 1971 to 1991 are presented in Table 15. The age structure for the 1992 survey was not available in time for the June meeting. The dominant age in the 1991 survey was age 2 (the 1989 yearclass) with about 60% of the total abundance occurring at this age. The yearclasses from 1983 to 1988 (ages 3 to 8 in 1991) are among the lowest observed in the time series.

An additional stratified random survey was conducted by Canada during autumn in 1990 and 1991. The results of this survey are presented in Tables 16 and 17. Biomass and abundance are at similar levels in both years in Division 3O with estimates considerably higher in Division 3N during 1991. The age composition from the 1991 survey also indicated that the 1989 yearclass is strong.

Estimation of stock parameters

ADAPT Calibration

The adaptive framework used in this assessment included catch per tow from both Canadian and USSR research vessel surveys, both disaggregated by age. The USSR data was that presented in a document by Kuzmin (1992). The formulation used with ADAPT is described as follows:

Parameters estimated by ADAPT:

- Yearclass estimates
  $N_{i,1991}$ i = 3 to 11
- Catchabilities for RV numbers at age
  $K(Can)_i$ i = 3 to 11
  $K(USSR)_i$ 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 40% of the weighted (by population numbers) F for age groups 7-10.
- Intercepts not fitted.

Input data

- $C_{i,t}$ i = 3 to 12 t = 1977-91
- $RV(Can)_{i,t}$ i = 3 to 11 t = 1977-82, 1984-91
- $RV(USSR)_{i,t}$ i = 3 to 11 t = 1977-91

Objective function

- Minimize

$$\sum_{age}\sum_{year}\{obs(lnRV(Can)_{i,t})\text{-}pred(lnRV(Can)_{i,t})\}^2 +$$
$$\sum_{age}\sum_{year}\{obs(lnRV(USSR)_{i,t})\text{-}pred(lnRV(USSR)_{i,t})\}^2$$

Summary

- Number of observations = 261
- Number of parameters estimated = 27

The coefficients of variation (CV's) on the age 4 to 11 abundance estimates were in the range of 40% to 50%, while that on age 3 was somewhat higher at 54% (Table 19). All research vessel catchabilities were estimated with CV's between 25% and 30%. Residuals indicate that both the Canadian and Soviet survey indices contain several year effects, both negative and positive (Table 20). The high CV's on most abundance estimates and the patterns observed in the residuals suggest uncertainty with the results of this analysis. This could be the result of highly variable survey indices as well as poorly estimated removals at age.

Laurec-Shepherd Calibration

An analysis using the Laurec-Shepherd technique was also conducted. Most of the structure and data were the same as included in the ADAPT analysis. There were two differences: the fishing mortality on the oldest age group was set to 40% of the mean of the previous five ages 7-11 as opposed to ages 7-10 for ADAPT; and only year 1984-1991 from the Canadian RV were included. The catchabilities for both RV indices were quite similar at each age and no discernable trend was observed in the respective time series (Table 22).

Assessment Results

The results of both analyses were quite similar with the age 3+ population abundance only different by 4% in the terminal year. The pattern of fishing mortality and yearclass size were also very similar in both analysis (Tables 21 and 22). While the ADAPT results are associated with rather high CVs the consistent results between the two techniques indicate that the population estimates are at least approximately correct and are probably suitable to provide catch and biomass projections.

The assessment results indicate that the fishing mortalities for ages 7-10 for 1965 to 1976 displayed large year to year variation and were in the range of 0.2 and 1.2 (Table 23, Figure 6). During 1978 to 1981 F's were less than 0.2 and from 1982 to 1990 were in the range of 0.2 to 0.3. The 1991 mean F for ages 7 to 10 was estimated to be 0.40. During the 1991 assessment of this stock (Baird et.al., 1991) high fishing mortalities at ages 4 to 6 cast considerable doubt on the results of the calibration. These ages in 1990 are still associated with high F's while the same yearclasses in 1991 are associated with F's considered to be more suitable.

Beginning of the year population biomass for ages 3 and older increased in the early 1960's and peaked at about 470,000 tons in 1967 (Table 24, Figure 7). A subsequent decline followed and the estimate for 1976 was 55,000 tons. Biomass again increased and reached 220,000 tons in 1984. Another decline occurred in recent years and the age 3+ beginning of the year biomass for 1991 is estimated to be approximately 90,000t, the lowest estimate since 1977.

Age 3 population estimates from the sequential population analysis are presented in Table 25 and Figure 8. The highest recruitment levels occurred during the 1960's when several yearclasses were estimated to be above 100 million fish. Recruitment estimates for the early 1970's to the mid-1980's were at a lower level than the 1960's with most being less than 50 million fish. There has been a recruitment failure in recent years with the age 3 estimates for 1986 to 1991 (1983-1988 yearclasses) the lowest in the time series, averaging below 10 million fish. The geometric mean recruitment for the period of the calibration analyses (1977-91) is about 20 million fish.

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

Year	Canada	Spain	Portugal	USSR	Others	Total
1953	39,884	12,633	7,919	-	5,761	66,197
1954	17,392	88,674	24,045	-	4,650	134,761
1955	6,053	64,987	27,711	-	15,605	114,356
1956	5,363	42,624	15,505	-	1,390	64,882
1957	9,641	51,990	21,740	-	6,819	90,190
1958	4,812	29,436	11,608	-	2,195	48,051
1959	3,687	39,994	17,730	48	2,911	64,370
1960	3,408	33,972	14,347	24,204	3,746	79,677
1961	5,428	32,284	9,059	22,854	3,099	72,724
1962	3,235	17,413	3,653	7,971	2,712	34,984
1963	5,079	37,632	10,004	10,184	6,843	69,742
1964	2,882	37,185	8,095	9,510	6,789	64,461
1965	4,229	64,652	1,692	17,166	11,448	99,187
1966	6,501	52,533	5,070	39,023	5,792	108,919
1967	3,446	77,948	9,703	118,845	16,842	226,784
1968	3,287	69,752	6,752	78,820	6,900	165,511
1969	3,664	71,160	4,940	29,173	8,768	117,705
1970	4,771	67,034	3,185	28,338	8,233	111,561
1971	2,311	89,915	6,589	19,307	8,174	126,296
1972	1,736	76,324	11,537	12,198	1,579	103,374
1973	1,832	42,403	7,759	27,849	586	80,429
1974	1,360	38,338	6,602	26,911	178	73,389
1975	1,189	16,616	5,560	20,785	24	44,174
1976	2,065	9,880	2,620	8,992	726	24,283
1977	2,532	8,827	1,742	4,041	462	17,604
1978	6,246	5,813	641	1,819	199	14,718
1979	9,938	13,782	1,140	2,446	545	27,941
1980	5,589	8,999	1,145	3,261	997	19,993
1981	6,096	13,299	1,091	3,187	671	24,344
1982	10,185	14,361	2,466	3,985	608	31,605
1983	11,374	12,320	1,109	3,238	778	28,818
1984	8,705	13,590	1,071	3,306	431	27,103
1985	18,179	13,682	608	3,968	462	36,899
1986	18,035	23,395	6,890	1,181	1,144	50,645
1987	18,652	15,788	4,108	764	2,307	41,619
1988	19,727	15,889	3,927	2,973	634	43,150
1989[a]	13,514	17,904	913	108	504[b]	32,943
1990[a]	10,620	4,678	2,145	18	11,385[b]	28,846
1991*	12,056	3,976	1,061	-	12,296[b]	29,389

[a] provisional
[b] includes estimates from Canadian surveillance and NAFO Scientific Council

Table 2. Cod landings (t) from NAFO by Canada in 1991 by month and year.

	3N							3Ø							
Mo.	Can N				Can M			Can N				Can M			Total
	OT	SSc	GN	LL	OT	SSc	LL	OT	SSc	GN	LL	OT	SSc	LL	
J					1			38			35	226	20	26	346
F			2				18	457		53	59	228		122	939
M							3	314		53	12	331		118	831
A	17				1	6	7	464		29	29	120	43	188	904
M	114	4		11	3	8	57	596	102	28	128	50	16	238	1355
J	168	36			11	2	13	563	33			4	25	48	903
J	56	24			10		16	489	19	38	3	26	12	30	723
A	188	30			2	9	16	240	23	11			5	6	530
S	222	24	10		46	5	50	76		27				31	491
O	34	13			27	6	118	44		1		5		13	261
N	14	45			12	6	43	4	69	124		12		29	358
D	6	5					16	82	17	169		67		53	415
Tot.	819	181	12	11	113	42	357	3367	263	533	266	1069	121	902	8056

Table 3. Commercial sampling by Can(N) in NAFO Divisions 3NO during 1991.

Qtr.	Gear	Div.	No. aged	Month	No. meas.	Landings (t) Month	Landings (t) Total (3NO)
1	OT	3Ø	308	Jan	179	264	265
				Feb	819	685	685
				Mar	233	645	645
2	OT	3Ø	314	Apr	558	584	602
				May	150	646	763
				Jun	522	567	746
3	OT	3Ø	290	Jul	390	515	581
				Aug	805	240	430
		3N		Sep	412	222	344
4	OT	3Ø	142[a]	Dec	156	149	307
1-4	OT	3NO	1054		4224		5368
1	LL	3Ø		Jan	724	61	393
3	LL	3Ø		Jul	396	49	49
				Aug	55	22	22
				Sep	164	81	81
4				Oct	110	131	272
1-4	LL	3NO			1449		1536
4	GN	3Ø	142	Dec	209	169	294
1-4	GN	3NO			209		545
1-4	ALL	3NO	1054		5882		8056[b]

[a]

[b]Includes 607 t from SSc adjusted using OT age composition.

Table 4. Catch, average weight and length at age for the cod fishery by canada in Divisions 3NO during 1991.

	AVERAGE		CATCH		
AGE	WEIGHT	LENGTH	MEAN	STD. ERR.	C. V.
2	0.128	25.000		0.00	0.02
3	0.711	43.566	4	2.14	0.51
4	1.087	49.663	49	9.95	0.20
5	1.364	53.418	313	20.47	0.07
6	1.952	59.833	313	20.95	0.07
7	3.343	70.802	164	18.12	0.11
8	4.401	77.742	157	19.47	0.12
9	5.840	85.359	242	26.36	0.11
10	7.256	91.720	267	27.20	0.10
11	8.431	96.478	159	22.96	0.14
12	10.234	102.168	90	15.21	0.17
13	11.731	107.334	76	12.66	0.17
14	13.067	110.985	61	9.88	0.16
15	13.885	113.298	48	7.40	0.15
16	15.106	116.793	64	9.51	0.15
17	14.946	116.369	36	6.32	0.18
18	18.096	123.806	15	2.27	0.16
19	13.544	112.745	5	1.96	0.40
20	13.801	112.857	2	0.94	0.54
21	15.387	118.000	1	0.53	0.77
22	30.971	148.000		0.00	0.02

Table 5. Catch and average weight at age of cod from the fisheries in NAFO Divisions 3NO during 1991.

	Canada		Portugal		Spain		Other		Total	
Age	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
1			10	0.08	1	0.07	19	0.08	30	0.08
2			1658	0.20	472	0.31	3898	0.24	6028	0.23
3	4	0.71	259	0.40	115	0.77	725	0.56	1103	0.55
4	49	1.09	144	0.65	68	1.09	412	0.85	673	0.85
5	313	1.36	53	1.21	145	1.81	484	1.71	995	1.59
6	313	1.95	14	1.98	52	2.92	165	2.79	544	2.30
7	164	3.34	3	3.73	29	4.56	86	4.51	282	3.83
8	157	4.40	5	5.19	53	6.49	153	6.43	368	5.56
9	242	5.84	12	6.00	81	8.95	233	8.86	568	7.53
10	267	7.26	14	7.78	56	11.42	165	11.20	502	9.04
11	159	8.43	5	9.84	57	14.70	162	14.58	383	11.98
12	90	10.23	4	10.85	28	17.38	80	17.16	202	13.98
13	76	11.73	2	12.34	5	20.59	14	19.82	97	13.37
14	61	10.07	1	12.89			1	12.89	63	10.16
15	48	13.89	1	14.11					49	13.89
16	64	15.11	2	15.63			1	16.39	67	15.14
17	36	14.95	1	15.21			1	15.21	38	14.96
18	15	18.10							15	18.10
19	5	13.54							5	13.54
20+	3	14.31							3	14.31
No.	2066		2188		1162		6599		12015	
Wt.(t)	12056		1061		3976		12296		29389	

TABLE 6. CATCH AT AGE FOR DIV. 3NO COD, 1959-91.

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
3	1711	1846	812	1026	313	6202	1013	753	20086	16359	8154	2105
4	13036	6503	4400	3882	5757	15555	7611	18413	62442	56775	12924	19703
5	5068	22050	11696	2206	11210	19496	7619	19681	50317	48608	26949	10799
6	6025	3095	15258	1581	4849	7919	13258	11795	18517	18485	11191	9481
7	3935	2377	2014	3594	1935	2273	9861	8486	4774	6337	2089	3646
8	1392	2504	1672	773	3840	1109	4827	4467	4651	1592	1393	1635
9	757	583	847	668	1165	788	1081	1829	236	505	518	541
10	926	387	196	433	608	328	1248	1694	180	178	292	149
11	1220	898	25	226	322	37	163	122	71	90	134	227
12	103	242	245	216	208	112	141	57	45	45	202	90
13	1128	1409	392	846	473	56	276	183	335	51	574	1472
3+	35301	41894	37557	15451	30680	53875	47098	67480	161654	149025	64420	49848
4+	33590	40048	36745	14425	30367	47673	46085	66727	141568	132666	56266	47743
5+	20554	33545	32345	10543	24610	32118	38474	48314	79126	75891	43342	28040
6+	15486	11495	20649	8337	13400	12622	30855	28633	28809	27283	16393	17241

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
3	950	69	10058	6425	671	4054	607	920	72	266	505	305	1179
4	26900	19797	27600	9501	8781	7534	2469	4337	3827	1055	1091	1978	647
5	30300	12289	15098	10907	3528	5945	2531	2518	9208	3812	1262	1591	1893
6	11700	13432	5989	10872	2505	1084	1500	818	2784	2275	2297	1012	1204
7	3500	5883	1971	2247	3057	211	572	354	883	761	1902	1528	686
8	2500	1686	972	2147	1059	238	177	102	265	222	574	1492	1152
9	500	285	707	1015	921	44	209	58	58	92	192	595	774
10	200	216	243	676	461	37	65	51	17	31	94	211	238
11	100	78	137	428	252	13	41	8	12	8	41	162	81
12	50	74	116	257	152	9	25	5	7	13	13	27	41
13	700	350	173	881	396	17	36	21	16	2	32	52	36
3+	77400	54159	63064	45356	21783	19186	8232	9192	17149	8537	8003	8953	7931
4+	76450	54090	53006	38931	21112	15132	7625	8272	17077	8271	7498	8648	6752
5+	49550	34293	25406	29430	12331	7598	5156	3935	13250	7216	6407	6670	6105
6+	19250	22004	10308	18523	8803	1653	2625	1417	4042	3404	5145	5079	4212

	1984	1985	1986	1987	1988	1989	1990	1991
3	58	57	153	516	277	1917	1064	1103
4	1000	2953	2865	422	318	2182	4505	673
5	1411	6203	6423	3491	1527	1502	4341	995
6	2324	3036	4370	3445	6347	1260	895	544
7	1220	2519	1512	1213	3955	1887	422	282
8	720	797	948	653	1009	1284	721	368
9	918	459	558	845	567	485	581	568
10	551	533	373	494	425	233	439	502
11	106	261	349	398	249	168	150	383
12	42	97	135	404	142	100	83	202
13	70	71	86	188	298	285	106	337
3+	8420	16986	17772	12069	15114	11303	13307	5957
4+	8362	16929	17619	11553	14837	9386	12243	4854
5+	7362	13976	14754	11131	14519	7204	7738	4181
6+	5951	7773	8331	7640	12992	5702	3397	3186

TABLE 7. WEIGHT AT AGE FOR DIV. 3NO COD, 1959-91.

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
3	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.48	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	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	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	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	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	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	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	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	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	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	13.50

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
3	0.48	0.54	0.57	0.42	0.38	0.50	0.57	0.72	0.65	0.71	0.90	0.94
4	0.90	0.97	1.00	0.73	0.89	0.91	1.00	1.05	0.98	1.04	1.27	1.17
5	1.35	1.44	1.43	1.20	1.28	1.41	1.48	1.55	1.39	1.69	1.84	1.50
6	2.14	2.08	2.19	1.96	2.13	2.33	2.48	2.25	2.09	2.50	2.69	2.20
7	3.16	2.89	3.63	2.86	3.14	3.25	3.51	3.74	2.87	3.69	3.55	3.83
8	4.21	3.56	4.63	4.67	4.16	4.03	4.74	4.61	3.70	5.49	5.33	5.26
9	6.34	5.95	6.25	7.32	5.53	6.67	7.17	6.19	4.75	7.98	7.13	7.49
10	7.69	7.95	9.56	5.46	6.74	8.74	8.81	7.23	7.15	9.22	9.10	8.80
11	8.46	8.32	11.17	8.40	5.27	9.14	11.70	9.48	7.98	10.60	9.01	9.82
12	10.24	10.14	13.99	7.51	7.09	12.49	11.47	12.87	10.11	12.61	10.15	12.28
13	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50

	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.85	0.79	0.48	0.39	0.49	0.74	0.51	0.55	0.55
4	1.17	1.15	0.86	1.01	0.82	1.00	0.97	1.01	0.85
5	1.87	1.51	1.37	1.52	1.30	1.38	1.60	1.46	1.59
6	2.63	2.28	2.05	2.16	1.83	1.79	2.24	2.51	2.30
7	3.80	3.04	3.25	3.49	2.89	2.23	3.27	2.73	3.83
8	5.20	4.05	4.65	5.41	4.76	3.77	4.61	4.14	5.56
9	6.27	5.76	6.62	7.95	7.26	5.12	7.08	5.02	7.53
10	8.08	7.22	8.32	9.82	8.95	6.88	8.31	8.37	9.04
11	8.99	8.92	9.15	9.94	9.85	9.37	9.47	9.29	11.98
12	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	11.91	13.60

TABLE 8. ANALYSIS OF VARIANCE FOR THE REGRESSION OF LN CATCH RATE OF OF COD FOR CANADIAN OTTER TRAWLERS IN NAFO DIVISIONS 3NO.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.655
MULTIPLE R SQUARED..... 0.429

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	1.686E1	1.686E1	
REGRESSION	29	1.711E1	5.902E-1	12.350
TYPE 1	3	2.950E0	9.833E-1	20.577
TYPE 2	1	4.339E-2	4.339E-2	0.908
TYPE 3	11	6.929E0	6.299E-1	13.183
TYPE 4	14	4.325E0	3.089E-1	6.465
RESIDUALS	477	2.279E1	4.779E-2	
TOTAL	507	5.677E1		

TABLE 9. REGRESSION COEFFICIENTS FROM THE REGRESSION OF LN CATCH RATE OF CANADIAN OTTER TRAWLERS FOR COD IN DIVISIONS 3NO.

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	3124	INTERCEPT	0.058	0.211	507
2	34				
3	1				
4	77				
1	3125	1	0.032	0.065	240
	27124	2	0.336	0.097	59
	27125	3	0.458	0.077	103
2	35	4	-0.052	0.055	334
3	2	5	-0.323	0.144	34
	3	6	-0.526	0.135	39
	4	7	-0.672	0.135	43
	5	8	-0.985	0.129	58
	6	9	-0.937	0.130	56
	7	10	-0.824	0.136	43
	8	11	-0.729	0.146	35
	9	12	-0.882	0.149	29
	10	13	-0.774	0.138	44
	11	14	-0.402	0.129	53
	12	15	-0.221	0.131	52
4	78	16	-0.198	0.186	35
	79	17	0.114	0.182	43
	80	18	-0.070	0.208	18
	81	19	0.116	0.203	19
	82	20	0.420	0.184	33
	83	21	0.330	0.181	39
	84	22	0.164	0.182	38
	85	23	0.165	0.179	39
	86	24	0.077	0.177	44
	87	25	0.046	0.175	49
	88	26	0.073	0.176	42
	89	27	0.015	0.179	35
	90	28	-0.005	0.182	33
	91	29	-0.593	0.186	30

TABLE 10. CATCH RATE INDEX OF CANADIAN OTTER TRAWLERS FOR COD IN DIV. 3NO.

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
1977	0.0902	0.0414	1.098	0.221	2532	2306
1978	-0.1075	0.0257	0.908	0.145	6246	6878
1979	0.2040	0.0235	1.241	0.189	9938	8006
1980	0.0197	0.0340	1.027	0.188	5589	5442
1981	0.2057	0.0307	1.239	0.216	6096	4920
1982	0.5101	0.0250	1.685	0.265	10185	6046
1983	0.4202	0.0204	1.543	0.220	11374	7370
1984	0.2544	0.0210	1.307	0.189	8705	6660
1985	0.2552	0.0211	1.308	0.189	18179	13897
1986	0.1667	0.0196	1.198	0.167	18035	15052
1987	0.1362	0.0186	1.163	0.158	18652	16040
1988	0.1631	0.0198	1.194	0.167	19727	16524
1989	0.1052	0.0205	1.126	0.161	13514	12000
1990	0.0855	0.0209	1.104	0.159	10620	9619
1991	-0.5024	0.0240	0.612	0.094	8056	13156

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.154

Table 11. Abundance (000's) from stratified random spring surveys in Division 3O. Numbers in brackets are estimates for non-sampled strata.

Depth range (fath)	Strata	Area	ATC 207-209 1973	ATC 233 1975	ATC 245 1976	ATC 263 1977	ATC 277 1978	ATC 289+291 1979	ATC 303 1980	ATC 318-319 1981	ATC 327-328 1982	AN 27 1984	AN 43 1985	WT 47 1986	WT 58 1987	WT 70 1988	WT 82 1989	WT 94+95 1990	WT 105-106 1991	WT[a] 119-120 1992
31-50	330	2089	2143	418	680	889	1072	3674	1411	941	358	1921	1461	824	3763	993	342	949	86	16
	331	456	34	49	624	(185)	240	205	1284	(134)	377	993	548	214	650	240	137	(186)	34	17
	338	1898	2451	4987	3229	9047	1311	2666	1681	(1797)	4103	10116	2390	2976	5303	1781	3818	1371	1382	855
	340	1716	(979)	215	4165	258	708	1730	386	859	2340	2898	2734	2576	55431	1178	615	873	186	26
	351	2520	2837	936	615	4843	2535	39982	1513	3689	8701	18538	4413	32509	28753	2913	1470	2033	315	151
	352	2580	3409	1289	1791	5965	4648	2292	2113	(2264)	3486	11814	4859	2988	12097	8821	3769	4320	1439	775
	353	1282	225	706	48	321	1732	4388	48	(207)	257	0	674	165	1700	1674	385	529	69	192
51-100	329	1721	129	(380)	3682	172	1731	1012	65	129	754	775	501	501	42933	2233	388	1200	1608	48
	332	1047	(1031)	1729	367	1729	7309	2613	118	(814)	5678	236	1839	458	2546	1297	393	1556	19059	1305
	337	948	735	688	356	249	320	516	47	(234)	285	142	939	882	451	249	1281	285	939	1583
	339	585	220	22	(109)	(129)	329	1361	(60)	198	2459	1054	88	29	278	102	15	132	44	44
	354	474	261	(105)	712	36	(230)	729	2076	107	107	142	261	178	1975	160	36	53	368	71
101-150	333	151	(19)	958	85	0	4	0	6	(14)	60	0	17	53	340	0	283	74	193	130
	336	121	9	0	0	141	5	2	95	(4)	27	0	9	45	9	5	5	59	27	763
	355	103	19	0	4	(18)	(24)	19	128	19	151	0	398	12	54	12	178	50	97	27
151-200	334	92	(11)	(7)	7	0	2	0	21	(8)	3	0	152	856	14	70	52	235	483	173
	335	58	7	(0)	1	(0)	0	0	3	(0)	4	0	0	40	4	7	4	26	4	131
	356	61	2	(1)	(2)	(3)	(4)	5	18	2	48	0	0	9	2	30	37	40	44	135
31-50		12541	12078	8600	11152	21508	12246	54937	8436	9891	19622	46280	17079	42252	107697	17600	10536	10261	3511	2032
51-100		4775	2376	2934	5226	2315	9919	6231	2366	1482	9283	2349	3628	2048	48183	4041	2113	3226	22018	3051
101-150		375	47	958	89	159	33	21	229	37	238	0	424	110	403	17	466	183	317	920
151-200		211	20	8	10	3	6	5	42	10	55	0	152	905	20	107	93	301	531	439
201-300		245	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2347	6369
301-400		309	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	102
Mean #/tow			10.80	9.30	12.26	17.85	16.52	45.54	8.24	8.50	21.73	36.19	15.84	33.72	116.31	16.20	9.83	10.40	19.63	
Adjusted total		17902	14518	12500	16476	23983	22204	61193	11073	11419	29199	48628	21283	45316	156302	21764	13204	13978	26375	6442
Unadjusted total			12481	11996	16365	23648	21946	61195	11013	5943	29198	48628	21282	45315	156304	21764	13206	13786	26375	
Upper limit			16978	72778	36380	38899	54753	115076	18404	11743	45492	63225	27522	101321	237824	28720	19586	17170	72880	
Lower limit			7983	-48786	-3649	8397	-10861	7314	3621	144	12904	34031	15043	-10690	74784	14808	6827	10401	-20130	

[a] 1992 data are not used to adjust for missing strata; strata > 200 fathoms are not included in means + totals.

Table 12. Cod abundance (000's) from stratified random spring surveys in Division 3N. Numbers in brackets are estimates for non-sampled strata.

Depth range (fath)	Strata	Area	ATC 199 1972	ATC 208-209 1973	ATC 222 1974	ATC 233 1975	ATC 245 1976	ATC 263 1977	ATC 277 1978	ATC 289+291 1979	ATC 304 1980	ATC 318-319 1981	ATC 328 1982	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[a] 119-120 1992
0-30	375	1593	3826	399	1435	6617	(811)	7474	4329	263	508	10583	1578	1746	3184	912	2167	1116	1674	1226	60	80
	376	1499	788	38	(128)	1294	113	3601	225	225	113	225	32	7933	48	177	2813	375	113	177	48	0
31-50	360	2992	1516	(420)	(544)	2302	3425	4211	1011	1273	2695	524	2118	5679	3004	553	1198	1422	165	569	56	112
	361	1853	5796	835	904	3624	723	5610	4764	1165	1808	(3111)	4961	3283	10293	3310	10484	2841	1904	2380	817	35
	362	2520	11823	984	1466	431	1021	5830	7440	757	1204	3859	1608	18970	4385	2392	43871	1702	2605	3443	170	32
	373	2520	3831	142	426	(1137)	76	946	5959	327	331	1892	1589	8161	769	676	4307	1097	822	227	52	0
	374	931	175	175	0	140	(101)	1607	1817	297	0	163	1677	2893	175	47	266	363	28	210	14	14
	383	674	1644	51	25	(80)	17	320	1493	34	0	118	25	34	0	0	422	51	84	25	34	0
51-100	359	421	822	622	(152)	(367)	4709	1359	(745)	561	2133	611	126	95	0	1264	332	269	95	47	32	47
	377	100	1066	143	613	413	(46)	2800	105	73	490	1146	278	56	105	23	758	0	19	0	0	0
	382	647	4347	16	130	(150)	24	2639	1943	243	255	146	194	0	134	12	16	24	81	130	0	0
101-150	358	225	861	4189	(260)	(604)	(280)	262	(1209)	439	1993	135	1343	380	448	760	1478	549	709	456	59	1478
	378	139	3673	459	1683	(409)	(190)	657	120	403	1445	193	1236	318	2181	433	151	157	198	172	122	172
	381	182	779	861	79	156	(173)	3267	364	155	379	779	1851	200	2391	1312	68	191	102	273	55	7
151-200	357	164	(254)	1157	(43)	(105)	(46)	12	(216)	49	336	37	382	0	2831	137	(253)	6	18	123	148	302
	379	106	(295)	1802	785	(124)	(56)	24	0	671	408	40	322	175	525	801	4	8	44	139	406	1126
	380	116	118	641	70	(122)	(55)	22	(246)	96	26	15	(121)	83	788	136	313	226	118	270	300	57
0-30		3092	4614	437	1563	7911	924	11075	4554	488	621	10808	1610	9679	3232	1089	4980	1491	1787	1403	108	80
31-50		11490	24785	2607	3365	7714	5361	18524	22484	3853	6038	9667	11978	39020	18626	6978	60548	7476	5608	6854	1143	193
51-100		1168	6235	781	895	930	4779	6798	2793	877	2878	1903	598	151	239	1299	1106	293	195	177	32	47
101-150		546	5313	5509	2022	1169	643	4186	1693	997	3818	1107	4430	898	5020	2505	1697	897	1009	901	236	1657
151-200		386	667	3600	858	351	157	48	462	816	770	92	825	258	4144	1074	570	240	180	532	854	1485
201-300		420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	539	1982
301-400		352	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	14
Mean #/tow			33.23	10.33	6.98	14.43	9.48	32.45	25.54	5.60	11.28	18.82	15.53	40.02	24.97	10.34	55.02	8.30	7.01	7.88	1.90	
Adjusted total			41612	12930	8741	18073	11867	40640	31985	7008	14124	23574	19444	50107	31262	12943	68902	10397	8772	9866	2372	3462
Unadjusted total			41062	12511	7615	14976	10108	40641	29569	7030	14125	20464	19321	50006	31260	12943	68649	10399	8778	9867	2372	
Upper limit			60525	19420	10765	25131	25080	58111	38156	9512	18899	38028	24878	72633	39382	18459	94509	12770	11226	11844	3550	
Lower limit			21600	5602	4465	4821	-4864	23171	20982	4547	9351	2900	13765	27378	23139	7427	42788	8028	6330	7890	1193	

[a]1992 data are not used to adjust for missing strata; strata > 200 fathoms are not included in means or totals.

Table 13. Biomass (MT) from random stratified cruises in Division 3N. Numbers in brackets are estimates for non-sampled strata.

Depth range (fath)	Strata	Area	ATC 207-209 1973	ATC 233 1975	ATC 245 1976	ATC 263 1977	ATC 277 1978	ATC 289+291 1979	ATC 303 1980	ATC 318-319 1981	ATC 327-328 1982	AN 27 1984	AN 43 1985	WT 47 1986	WT 58 1987	WT 70 1988	WT 82 1989	WT 94+95 1990	WT 105-106 1991	WT[a] 119-120 1992
31-50	330	2089	8986	474	287	592	2218	3753	470	3371	123	3626	4642	2136	5654	2767	1713	2262	90	2
	331	456	279	728	454	(183)	342	150	609	(410)	38	2630	3423	685	804	1224	183	(848)	98	97
	338	1898	4174	5558	1874	6947	1334	5729	1795	(5873)	5659	29905	7485	14405	9838	9124	14874	5475	6271	8466
	340	1716	(2043)	2028	2688	298	966	3718	386	4294	2849	6827	5431	5796	77479	12421	2977	6338	70	4
	351	2520	3003	1561	2681	8134	4334	47954	5629	6621	4498	43255	23490	38217	66032	15852	11619	16567	3890	1128
	352	2580	2986	425	1428	6114	3961	6235	5625	(9618)	6236	34168	29692	15071	49765	57457	34373	28930	16762	9958
	353	1282	3172	77	2	262	84	1573	2	(541)	472	0	6083	951	9610	626	2371	3544	688	972
51-100	329	1721	205	(221)	6417	180	2008	357	19	517	396	594	840	304	45335	9436	682	1611	1627	10
	332	1047	(1579)	829	351	939	4525	2266	9	(2068)	3474	2358	13471	2499	9808	8681	1369	8728	4097	960
	337	948	75	1904	32	629	614	23	133	(623)	610	434	1203	8497	2674	362	2787	1997	2373	17045
	339	585	1086	40	(44)	(70)	249	1475	(31)	505	610	1087	359	29	354	233	146	103	3	7
	354	474	427	(35)	38	8	(83)	34	273	44	125	489	219	180	2179	530	25	317	2312	39
101-150	333	151	(36)	524	82	0	2	0	28	(49)	153	0	147	232	1057	0	1040	225	500	53
	336	121	28	0	0	136	3	1	286	(15)	70	0	34	45	17	18	23	191	40	438
	355	103	74	0	4	(9)	(12)	24	367	32	135	0	135	12	114	19	195	96	86	3
151-200	334	92	(21)	(6)	6	0	6	0	43	(28)	8	0	570	3481	59	248	136	425	776	514
	335	58	22	(0)	3	(0)	0	0	10	(2)	11	0	0	126	18	39	7	63	2	44
	356	61	10	(0)	(0)	(2)	(3)	12	49	9	166	0	0	32	7	102	74	142	11	43
31-50		12541	24643	10851	9414	22530	13239	69112	14516	30728	19875	120411	80246	77261	219182	99471	68110	63964	27869	20627
51-100		4775	3372	3029	6882	1826	7479	4155	481	3757	5215	4962	16092	11509	60350	19262	5009	12756	10412	18061
101-150		375	138	524	86	145	16	25	681	96	358	0	316	289	1188	37	1258	512	626	494
151-200		211	53	6	9	2	9	12	102	31	185	0	570	3639	84	389	217	630	789	603
201-300		245	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11868	1516
301-400		309	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	41
Mean wt./tow			20.99	10.72	12.20	18.23	15.44	54.55	11.73	25.76	19.08	93.30	72.35	68.98	208.97	88.67	55.51	57.84	29.54	
Adjusted total			28204	14411	16391	24502	20743	73302	15768	34619	25633	125375	97224	92698	280808	119156	74594	77863	39696	
Unadjusted total			24527	14148	16346	24238	20647	73304	15735	15393	25632	125373	97223	92699	280807	119157	74595	77016	39697	39785
Upper limit			35742	87352	89006	38369	35818	135612	24518	25204	33925	169977	126100	136099	382599	179304	134314	101143	55540	
Lower limit			13312	-59055	-56313	10108	5477	10995	6951	5582	17338	80769	68346	49299	179014	59009	14876	52888	23854	

[a]1992 data are not used to adjust for missing strata; strata > 200 fathoms are not included in totals or means.

Table 14. Cod biomass (MT) from stratified random spring surveys in Division 3N. Numbers in brackets are estimates for non-sampled strata.

Depth range (fath)	Strata	Area	ATC 199 1972	ATC 208–209 1973	ATC 222 1974	ATC 233 1975	ATC 245 1976	ATC 263 1977	ATC 277 1978	ATC 289+291 1979	ATC 304 1980	ATC 318–319 1981	ATC 328 1982	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[a] 119–120 1992
0–30	375	1593	9691	1012	955	10591	(2148)	5424	3598	369	3229	29835	5943	2404	18475	14585	8034	16512	20104	10230	1141	1391
	376	1499	1837	783	(174)	383	77	9663	102	868	855	2208	2	1049	391	1883	2876	4454	745	2745	751	0
31–50	360	2992	1910	(919)	(382)	305	1948	4037	2182	1416	1738	3743	1238	7877	9161	1945	1282	494	1202	9486	581	842
	361	1853	4395	2453	350	3243	2616	5889	8203	2666	4173	(12196)	8125	12838	29220	50957	27584	15887	12722	20240	11883	278
	362	2520	9416	4101	2231	306	1664	6830	6621	1632	5847	8701	3708	40764	16509	19686	69852	12714	16464	24747	2361	446
	373	2520	3325	1802	2359	(758)	1030	1749	4300	1838	857	4578	6647	17916	2446	2897	6788	5959	6090	3441	392	0
	374	931	681	266	0	135	(227)	1247	1324	479	0	146	2369	8335	877	769	1058	4032	489	3296	361	3
	383	674	1572	1	17	(14)	46	338	1564	146	0	430	5	295	0	0	818	71	335	326	113	0
51–100	359	421	303	251	(6)	(7)	659	147	(76)	190	478	208	13	71	0	134	43	44	21	6	15	3
	377	100	535	14	83	283	(14)	1379	130	22	287	428	22	29	13	54	328	0	9	0	0	0
	382	647	2032	7	59	(10)	44	991	2215	220	285	182	36	0	16	61	12	7	419	40	0	0
101–150	358	225	1030	1721	(64)	(69)	(111)	383	(300)	483	1054	229	236	182	122	547	1803	229	486	159	56	284
	378	139	4028	393	631	(49)	(78)	686	90	281	939	104	303	133	470	256	73	96	81	62	82	62
	381	182	883	1475	228	128	(146)	2797	393	196	427	533	2186	319	1544	747	82	270	39	212	232	1
151–200	357	164	(104)	1343	(13)	(14)	(25)	29	(74)	52	332	135	92	0	2102	259	(142)	18	22	62	59	158
	379	106	(107)	1776	515	(16)	(27)	50	0	601	178	53	179	129	324	365	4	15	22	61	204	633
	380	116	273	1116	180	(30)	(49)	55	(135)	232	57	25	(86)	224	847	135	454	181	176	180	110	56
0–30		3092	11528	1795	1127	10974	2225	15087	3700	1237	4084	32043	5945	3453	18866	16468	10910	20966	20849	12975	1892	1391
31–50		11490	21299	9542	5339	4761	7531	20090	24194	8177	12615	29784	22092	88025	58213	76254	107382	39157	37302	61536	15691	1569
51–100		1168	2870	272	148	300	717	2517	2421	432	1050	818	71	100	29	249	383	51	449	46	15	3
101–150		546	5941	3589	923	246	335	3866	783	960	2420	866	2725	634	2136	1550	1958	595	606	433	370	347
151–200		386	484	4235	708	60	101	134	209	885	567	213	357	353	3273	759	600	214	220	303	373	847
201–300		420	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	351	802
301–400		352	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	5
Mean wt./tow			33.64	15.52	6.58	13.05	8.71	33.30	25.00	9.34	16.56	50.90	24.91	73.92	65.90	76.09	96.81	48.70	47.46	60.13	14.65	
Adjusted total			42123	19433	8245	16340	10911	41698	31307	11694	20737	63734	31196	92564	82515	95278	121233	60981	59425	75294	18340	4154
Unadjusted total			41912	18513	7607	15372	8084	41695	30722	11692	20736	51538	31104	92566	82515	95280	121091	60982	59425	75293	18342	
Upper limit			57120	27613	13059	36966	13775	62035	38492	16493	28150	120670	46068	123679	108356	162514	159883	80483	81925	98258	33620	
Lower limit			26704	9413	2155	–6222	2393	21355	22952	6891	13322	–17595	16141	61452	56675	28046	82300	41481	36925	52329	3064	

[a]1992 data are not used to adjust for missing strata; strata > 200 fathoms are not included in means + totals.

TABLE 15. MEAN NUMBER PER TOW AT AGE OF COD FROM RV SURVEYS CONDUCTED BY CANADA IN DIVISIONS 3NO (ADJUSTED FOR MISSING STRATA).

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	0.00	0.01	0.06	0.04	0.41	0.55	0.01	0.56	3.00	0.01	0.33
2	2.57	1.15	2.35	1.13	2.84	3.67	2.30	0.72	0.90	5.32	0.35
3	25.88	8.84	2.39	4.05	4.22	2.73	9.50	7.18	2.27	1.36	5.02
4	3.56	18.93	1.67	0.73	2.37	1.73	6.16	8.29	8.99	0.66	1.47
5	2.72	1.69	2.21	0.36	0.53	1.57	4.53	2.52	7.62	1.06	1.71
6	0.65	0.70	0.44	0.31	0.28	0.25	1.51	0.97	1.71	0.43	2.16
7	0.66	0.57	0.25	0.11	0.54	0.07	0.48	0.62	0.51	0.21	1.05
8	0.29	0.40	0.18	0.03	0.22	0.12	0.22	0.04	0.25	0.18	0.47
9	0.15	0.29	0.20	0.01	0.22	0.06	0.10	0.01	0.10	0.18	0.49
10	0.02	0.17	0.12	0.06	0.07	0.07	0.10	0.03	0.02	0.09	0.22
11	0.05	0.08	0.05	0.02	0.01	0.02	0.01	0.04	0.06	0.05	0.04
12	0.09	0.05	0.08	0.00	0.02	0.00	0.04	0.00	0.00	0.07	0.13
13	0.00	0.00	0.12	0.00	0.01	0.00	0.09	0.04	0.04	0.03	0.06
14	0.29	0.35	0.44	0.12	0.13	0.05	0.12	0.01	0.10	0.12	0.16
1+	36.93	33.23	10.57	6.98	11.87	10.87	25.15	21.03	25.57	9.76	13.66
2+	36.93	33.22	10.51	6.94	11.46	10.32	25.14	20.47	22.57	9.75	13.33
3+	34.36	32.07	8.16	5.81	8.62	6.65	22.84	19.75	21.66	4.43	12.98
4+	8.48	23.23	5.77	1.75	4.41	3.92	13.34	12.58	19.40	3.07	7.96
5+	4.92	4.30	4.09	1.03	2.04	2.19	7.18	4.28	10.40	2.41	6.49
6+	2.20	2.61	1.89	0.67	1.51	0.62	2.65	1.77	2.78	1.35	4.78

	1982	1984	1985	1986	1987	1988	1989	1990	1991
1	1.40	0.01	0.01	0.02	0.21	0.01	0.02	0.04	0.02
2	8.40	3.29	0.41	0.68	2.73	1.68	0.25	0.47	6.30
3	1.06	6.21	4.50	0.69	2.80	2.23	1.89	0.95	1.24
4	3.17	9.92	6.09	7.54	9.18	0.46	1.09	1.34	0.60
5	0.54	5.30	2.43	6.32	34.30	0.41	0.28	1.09	0.41
6	0.42	5.61	0.89	1.58	20.91	1.07	0.30	0.24	0.18
7	0.70	1.87	0.98	0.67	8.20	1.18	0.68	0.47	0.13
8	0.52	1.00	0.74	0.64	1.75	0.78	0.62	0.61	0.17
9	0.23	1.81	0.89	0.49	1.91	0.82	0.44	0.73	0.34
10	0.14	1.57	1.35	0.72	0.68	0.87	0.48	0.51	0.22
11	0.06	0.86	0.99	1.17	0.76	0.44	0.64	0.42	0.18
12	0.04	0.32	0.49	0.64	0.70	0.55	0.42	0.41	0.11
13	0.01	0.11	0.24	0.35	0.80	0.79	0.33	0.22	0.15
14	0.13	0.22	0.39	0.51	0.76	1.25	1.00	1.65	0.72
1+	16.83	38.10	20.40	22.03	85.67	12.56	8.42	9.14	10.76
2+	15.43	38.09	20.39	22.01	85.46	12.55	8.40	9.10	10.74
3+	7.03	34.80	19.98	21.33	82.74	10.87	8.15	8.63	4.44
4+	5.97	28.60	15.47	20.63	79.93	8.64	6.26	7.68	3.20
5+	2.80	18.68	9.38	13.09	70.75	8.18	5.17	6.35	2.61
6+	2.26	13.38	6.95	6.77	36.45	7.76	4.89	5.26	2.19

1971, 1972, AND 1974 SURVEYS IN DIVISION 3N ONLY

Table 16. Biomass (t) and abundance (000's) of cod from autumn stratified random surveys in Div. 3Ø.

Depth range	Strata	Area	Biomass 1990	Biomass 1991	Abundance 1990	Abundance 1991
31-50	330	2089	2465	681	1625	745
	331	456	1	232	11	377
	338	1898	6639	3771	3437	1311
	340	1716	1697	3520	644	1520
	351	2520	7031	9922	4634	5334
	352	2580	11930	18064	3060	4532
	353	1282	2666	7	674	24
51-100	329	1721	683	496	215	129
	332	1047	345	4	196	39
	337	948	1301	46	213	36
	339	585	618	0	73	0
	354	474	2	0	36	0
101-150	333	151	4	0	6	0
	336	121	16	0	3	0
	355	103	-	15	-	66
151-200	334	92	8	0	7	0
	335	58	5	4	4	2
	356	61	-	4	-	2
31-50		12541	32429	36197	14085	13843
51-100		4775	2949	546	733	204
101-150		375	19	15	9	66
151-200		211	13	8	11	4
Total			35409	36769	14840	14117
Upper			47985	51619	21022	19938
Lower			22833	21918	8657	8295

Table 17. Biomass (t) and abundance (000's) of cod from autumn stratified random surveys in Div. 3N.

Depth range	Strata	Area	Biomass 1990	Biomass 1991	Abundance 1990	Abundance 1991
0-30	375	1593	21899	38662	1814	11988
	376	1499	2089	14770	1067	28265
31-50	360	2992	3727	1611	1492	842
	361	1853	14530	8568	1913	2156
	362	2520	4180	21096	2218	7623
	373	2520	4897	16186	447	3247
	374	931	1129	3356	196	2097
	383	674	40	34	84	67
51-100	359	421	1	0	16	0
	377	100	36	-	49	-
	382	647	47	10	49	32
101-150	358	225	130	95	127	160
	378	139	116	158	110	261
	381	182	-	0	-	0
151-200	357	164	128	64	111	68
	379	106	140	-	56	-
	380	116	-	13	-	48
0-30		3092	23988	53432	2881	40253
31-50		11490	28503	50851	6350	16032
51-100		1168	84	10	114	32
101-150		546	246	253	237	421
151-200		386	268	77	167	116
Total			53089	104622	9746	56855
Upper			96410	164110	13724	113966
Lower			9760	45134	5768	256

Table 18. Mean No./tow at age Div. 3NO combined from fall r.v. surveys.

	1990	1991
1	0.92	0.51
2	1.25	14.98
3	0.95	1.92
4	2.32	1.47
5	1.37	2.55
6	0.46	1.36
7	0.31	0.41
8	0.29	0.40
9	0.24	0.68
10	0.29	0.46
11	0.13	0.51
12	0.10	0.37
13	0.14	0.31
14+	0.77	1.07
Mean	9.55	26.99
Upper	12.34	48.96
Lower	6.76	5.02

TABLE 19. RESULTS FROM ADAPT FOR DIV. 3NO COD USING CANADIAN AND RUSSIAN SURVEYS: ESTIMATED PARAMETERS WITH ASSOCIATED CVs AND BIAS.

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.000524
MEAN SQUARE RESIDUALS 0.904020

PARAMETER	AGE	ESTIMATE	STD. ERR.	T-STAT	C.V.	BIAS
NUMBERS						
	3	8028	5213	1.540	0.649	24.24
	4	3822	1896	2.016	0.496	14.07
	5	3762	1841	2.043	0.489	13.89
	6	1937	981	1.974	0.507	15.26
	7	687	285	2.407	0.415	15.59
	8	1094	454	2.411	0.415	12.41
	9	2323	1043	2.228	0.449	12.03
	10	2264	1025	2.209	0.453	11.19
	11	1635	697	2.345	0.426	9.60
INDEX 1: RV1						
	3	1.35E-4	3.61E-5	3.745	0.267	2.10
	4	1.85E-4	4.88E-5	3.791	0.264	2.06
	5	1.75E-4	4.65E-5	3.754	0.266	2.42
	6	1.44E-4	3.90E-5	3.687	0.271	2.55
	7	1.53E-4	4.25E-5	3.591	0.278	2.84
	8	1.32E-4	3.74E-5	3.525	0.284	3.57
	9	1.43E-4	4.11E-5	3.471	0.288	4.14
	10	1.70E-4	4.91E-5	3.461	0.289	4.59
	11	1.77E-4	5.09E-5	3.489	0.287	4.79
INDEX 2: RV2						
	3	3.50E-4	9.03E-5	3.878	0.258	1.85
	4	3.18E-4	8.12E-5	3.915	0.255	2.04
	5	2.84E-4	7.32E-5	3.885	0.257	2.25
	6	2.57E-4	6.73E-5	3.811	0.262	2.36
	7	2.29E-4	6.16E-5	3.711	0.270	2.63
	8	1.97E-4	5.41E-5	3.631	0.275	3.37
	9	2.06E-4	5.75E-5	3.587	0.279	3.91
	10	2.25E-4	6.29E-5	3.578	0.280	4.28
	11	2.39E-4	6.62E-5	3.602	0.278	4.48

RV1 - CANADIAN SURVEY
RV2 - RUSSIAN SURVEY

TABLE 20. RESULTS FROM ADAPT FOR DIV. 3NO COD USING CANADIAN AND RUSSIA SURVEYS: RESIDUALS.

LOG RESIDUALS FROM RV1 7/ 6/92

	1977	1978	1979	1980	1981	1982	1984	1985	1986	1987	1988	1989	1990	1991
3	0.3	-0.1	-0.3	-0.8	0.2	-1.2	0.1	-0.0	-0.6	1.2	0.3	0.2	0.4	0.3
4	0.4	0.1	0.0	-1.6	-0.8	-0.3	0.6	-0.0	0.4	2.0	-0.6	-0.4	0.1	0.0
5	1.1	-0.1	0.5	-1.7	-0.3	-1.5	0.6	-0.4	0.4	2.3	-0.7	-0.6	0.4	-0.2
6	0.6	0.2	0.2	-1.6	-0.5	-1.2	1.2	-0.6	-0.0	2.3	-0.4	-0.3	0.3	-0.2
7	0.5	0.1	-0.1	-1.6	-0.5	-1.4	0.6	-0.2	-0.5	2.1	-0.1	-0.1	0.7	0.5
8	0.6	-1.4	-0.4	-0.6	-0.3	-0.6	0.4	0.1	-0.1	1.0	0.3	0.0	0.4	0.4
9	-0.4	-2.1	-0.3	-0.6	0.6	-0.7	0.2	0.5	-0.0	1.5	0.5	0.0	0.6	0.2
10	0.7	-1.4	-1.4	-0.3	-0.3	-0.5	1.0	-0.0	0.5	0.6	1.1	0.1	0.4	-0.4
11	-1.3	0.1	-0.5	-0.3	-1.0	-1.3	1.0	0.8	0.0	0.8	0.5	1.1	0.3	-0.2

SUM OF RV RESIDUALS : 0.000009307796858 MEAN RESIDUAL : 7.387140365E-8

LOG RESIDUALS FROM RV2 7/ 6/92

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.3	-0.1	-0.7	-0.8	-0.4	0.1	-0.0	0.8	1.7	1.4	-0.0	0.5	-0.9	-1.5	-0.3
4	0.7	0.3	-1.4	-0.8	-0.3	0.4	0.3	1.0	1.6	1.6	-0.8	-1.1	-1.1	-1.2	0.9
5	1.1	0.9	-0.8	-1.3	-0.7	1.0	0.5	1.0	2.0	1.3	-1.7	-1.9	-1.4	-1.1	1.2
6	0.9	1.0	-0.6	-0.6	-1.7	0.4	1.1	0.7	1.5	1.3	-1.3	-1.7	-1.2	-0.4	0.7
7	1.4	0.6	-0.1	-0.2	-1.1	-0.6	0.7	0.8	1.4	1.0	-0.7	-1.6	-1.1	-1.2	0.6
8	1.6	0.9	-0.3	0.3	-0.9	-2.0	-0.4	0.6	1.1	1.5	-0.2	-0.8	-0.6	-1.8	0.9
9	0.3	0.5	0.0	-0.4	-0.7	0.5	0.6	-0.7	0.4	1.3	0.3	-0.3	-1.1	-1.8	1.1
10	0.4	-0.5	0.7	0.2	-1.3	0.8	0.5	0.0	-0.4	0.8	0.3	0.2	-1.7	-0.8	0.9
11	0.7	3.0	-0.3	0.1	-0.3	-0.0	0.5	-0.8	0.0	-0.9	0.1	-0.2	-1.1	-1.5	0.5

SUM OF RV RESIDUALS : 0.000008329458721 MEAN RESIDUAL : 6.169969422E-8

aRV1 - CANADA
aRV2 - RUSSIA

TABLE 21. RESULTS OF ADAPT FOR DIV. 3NO COD USING CANADIAN AND RUSSIAN SURVEYS: POPULATION NUMBERS AND FISHING MORTALITY.

POPULATION NUMBERS (000S) 7/ 6/92

	1977	1978	1979	1980	1981	1982	1983	1984	1985
3	54672	65001	23766	25232	31925	28520	39485	46415	36934
4	24502	44212	52386	19393	20418	25681	23074	31261	37949
5	10604	17826	32273	39427	14923	15729	19236	18306	24689
6	6958	6392	12317	18092	28831	11076	11438	14036	13711
7	2354	4339	4493	7565	12754	21526	8153	8276	9389
8	1023	1410	3233	2880	5505	8721	16242	6054	5672
9	1224	678	1062	2407	2157	3988	5790	12255	4305
10	350	813	502	817	1887	1592	2727	4040	9203
11	241	228	620	396	641	1460	1113	2017	2809
12	299	161	179	497	317	488	1049	838	1555
3+	102228	141060	130831	116705	119357	118781	128306	143498	146217

	1986	1987	1988	1989	1990	1991
3	9778	6789	13910	13771	5819	7993
4	30187	7867	5092	11138	9540	3802
5	28398	22123	6059	3881	7145	3734
6	14601	17439	14954	3579	1818	1922
7	8479	8000	11160	6500	1790	679
8	5408	5574	5453	5559	3614	1084
9	3922	3570	3972	3551	3389	2307
10	3109	2706	2158	2739	2469	2249
11	7053	2208	1769	1382	2032	1624
12	2064	5458	1448	1223	980	1528
3+	112999	81735	65975	53323	38597	26921

FISHING MORTALITY 7/ 6/92

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.01	0.02	0.00	0.01	0.02	0.01	0.03	0.00	0.00	0.02	0.09	0.02	0.17	0.23	0.16
4	0.12	0.11	0.08	0.06	0.06	0.09	0.03	0.04	0.09	0.11	0.06	0.07	0.24	0.74	0.22
5	0.31	0.17	0.38	0.11	0.10	0.12	0.12	0.09	0.33	0.29	0.19	0.33	0.56	1.11	0.35
6	0.27	0.15	0.29	0.15	0.09	0.11	0.12	0.20	0.28	0.40	0.25	0.63	0.49	0.79	0.37
7	0.31	0.09	0.24	0.12	0.18	0.08	0.10	0.18	0.35	0.22	0.18	0.50	0.39	0.30	0.60
8	0.21	0.08	0.09	0.09	0.12	0.21	0.08	0.14	0.17	0.22	0.14	0.23	0.29	0.25	0.46
9	0.21	0.10	0.06	0.04	0.10	0.18	0.16	0.09	0.13	0.17	0.30	0.17	0.16	0.21	0.32
10	0.23	0.07	0.04	0.04	0.06	0.16	0.10	0.16	0.07	0.14	0.23	0.25	0.10	0.22	0.28
11	0.21	0.04	0.02	0.02	0.07	0.13	0.08	0.06	0.11	0.06	0.22	0.17	0.14	0.09	0.30
12	0.10	0.03	0.04	0.03	0.05	0.06	0.04	0.06	0.07	0.07	0.09	0.11	0.09	0.10	0.16

Table 22. Results of Laurec-Shepherd calibration analysis for cod in Div. 3NO.

```
 COD 3NO 1977-1991 AGES 3-12 COMBSEX, TK8
 DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
 Fleet  1: fleet is Canadian RV has terminal q estimated as the mean
 Fleet  2: fleet is Russian RV  has terminal q estimated as the mean
FLEETS COMBINED by ** VARIANCE **
              Terminal Fs estimated using Laurec/Shepherd method
Regression Weights
  , 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000

Oldest age F =    .40* average of 5 younger ages.
```

Fishing mortalities

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	.012	.016	.003	.012	.018	.012	.036	.001	.002	.017	.081	.022	.157	.186	.162
4	.114	.111	.086	.063	.061	.089	.032	.039	.098	.107	.059	.066	.240	.661	.172
5	.288	.163	.360	.115	.099	.119	.115	.090	.353	.317	.183	.312	.494	1.051	.293
6	.254	.141	.273	.141	.094	.108	.124	.201	.284	.453	.281	.585	.459	.623	.340
7	.288	.087	.223	.111	.168	.084	.099	.178	.347	.223	.217	.602	.343	.273	.406
8	.186	.076	.087	.080	.115	.192	.084	.143	.169	.212	.141	.282	.399	.212	.405
9	.171	.086	.056	.039	.092	.167	.144	.089	.127	.172	.297	.175	.212	.316	.258
10	.180	.057	.033	.038	.051	.139	.093	.145	.068	.145	.226	.239	.101	.303	.496
11	.164	.030	.017	.019	.065	.118	.072	.054	.095	.058	.226	.170	.140	.088	.471
12	.079	.027	.033	.023	.039	.056	.039	.049	.065	.065	.089	.118	.096	.095	.163

Log catchability estimates

Age 3

Fleet	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1								-8.74	-8.95	-9.48	-7.73	-8.64	-8.77	-8.70	-8.61
2	-7.70	-8.04	-8.63	-8.74	-8.38	-7.84	-7.88	-7.05	-6.29	-6.59	-8.02	-7.47	-8.88	-9.57	-8.24

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-8.70	.513	.0002	.1479	.000E+00	.000E+00	-8.702	.171
2	-7.95	.898	.0004	.2153	.000E+00	.000E+00	-7.954	.224

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.162	.445	.162	.445	.132

Age 4

Fleet	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1								-7.86	-8.51	-8.18	-6.66	-9.26	-9.03	-8.53	-8.78
2	-7.41	-7.75	-9.37	-8.86	-8.35	-7.68	-7.68	-6.94	-6.40	-6.47	-8.87	-9.18	-9.12	-9.34	-7.40

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-8.35	.866	.0002	.2647	.000E+00	.000E+00	-8.352	.289
2	-8.05	1.066	.0003	.0892	.000E+00	.000E+00	-8.054	.266

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.172	.672	.532	.672	.628

Age 5

Fleet	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1								-7.99	-8.89	-8.07	-6.32	-9.39	-9.29	-8.24	-9.02
2	-7.07	-7.26	-8.93	-9.45	-8.81	-7.18	-7.67	-7.13	-6.08	-6.77	-9.86	-10.11	-9.63	-9.24	-7.14

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-8.40	1.062	.0002	.5449	.000E+00	.000E+00	-8.401	.354
2	-8.15	1.359	.0003	.1059	.000E+00	.000E+00	-8.155	.340

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.293	.837	.795	.837	.902

Age 6

Fleet	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1								-7.63	-9.40	-8.72	-6.37	-9.22	-9.12	-8.70	-9.09
2	-7.38	-7.28	-8.89	-8.90	-9.92	-7.81	-7.15	-7.58	-6.74	-6.85	-9.41	-9.98	-9.53	-8.88	-7.60

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-8.53	1.092	.0002	.5955	.000E+00	.000E+00	-8.532	.364
2	-8.26	1.179	.0003	.1758	.000E+00	.000E+00	-8.261	.295

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.339	.801	.608	.801	.577

Table 22. continued.

Age 7

Fleet	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1								-8.20	-8.91	-9.22	-6.53	-8.62	-9.00	-8.10	-8.58
2	-7.01	-7.84	-8.51	-8.65	-9.56	-8.89	-7.65	-7.58	-6.99	-7.30	-8.85	-9.71	-9.53	-9.65	-8.15

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-8.40	.898	.0002	.4897	.000E+00	.000E+00	-8.396	.299
2	-8.39	1.002	.0002	.3201	.000E+00	.000E+00	-8.390	.250

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.405	.669	.211	.669	.100

Age 8

Fleet	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1								-8.53	-8.76	-8.85	-7.88	-8.43	-8.56	-8.63	-8.58
2	-7.08	-7.72	-8.94	-8.28	-9.44	-10.57	-8.83	-7.94	-7.43	-6.97	-8.66	-9.10	-8.77	-10.43	-7.73

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-8.53	.311	.0002	.4292	.000E+00	.000E+00	-8.526	.104
2	-8.53	1.129	.0002	.1825	.000E+00	.000E+00	-8.525	.282

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.404	.299	.219	.299	.533

Age 9

Fleet	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1								-8.65	-8.31	-8.80	-7.31	-8.28	-8.55	-7.83	-8.70
2	-8.31	-8.13	-8.55	-8.96	-9.25	-8.00	-7.95	-9.14	-8.01	-7.17	-8.18	-8.77	-9.34	-9.82	-7.60

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-8.31	.548	.0002	.4101	.000E+00	.000E+00	-8.312	.183
2	-8.48	.749	.0002	.1073	.000E+00	.000E+00	-8.479	.187

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.257	.442	.639	.639	2.084

Age 10

Fleet	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1								-7.79	-8.66	-8.18	-8.07	-7.62	-8.47	-7.95	-8.43
2	-8.19	-9.09	-7.87	-8.30	-9.81	-7.68	-7.95	-8.47	-8.78	-7.59	-8.04	-8.17	-10.04	-8.89	-6.92

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-8.15	.380	.0003	.6596	.000E+00	.000E+00	-8.149	.127
2	-8.39	.857	.0002	.1143	.000E+00	.000E+00	-8.387	.214

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.494	.348	.650	.650	3.494

Age 11

Fleet	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1								-7.72	-7.93	-8.54	-7.75	-8.11	-7.53	-8.31	-8.42
2	-7.83	-9.49	-8.86	-8.33	-8.74	-8.43	-7.94	-9.18	-8.43	-9.21	-8.17	-8.49	-9.39	-9.75	-7.39

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-8.04	.385	.0003	.6862	.000E+00	.000E+00	-8.039	.128
2	-8.64	.695	.0002	.1352	.000E+00	.000E+00	-8.642	.174

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.468	.337	.689	.689	4.183

TABLE 22. CONTINUED.

JANUARY 1 POPULATION NUMBERS (000s)

	1977	1978	1979	1980	1981	1982	1983	1984	1985
3	56489	63600	23506	25114	32101	28217	36971	42991	38385
4	25212	45700	51239	19180	20321	25825	22826	29202	35146
5	11134	18408	33492	38488	14749	15650	19354	18103	23004
6	7400	6826	12793	19089	28062	10933	11374	14133	13545
7	2514	4701	4848	7955	13570	20897	8036	8223	9468
8	1152	1541	3529	3170	5824	9389	15726	5958	5628
9	1469	783	1169	2649	2395	4249	6337	11833	4227
10	437	1013	589	905	2086	1787	2940	4488	8858
11	298	299	783	467	713	1623	1272	2192	3176
12	363	207	238	631	375	546	1182	968	1699
3+	106468	143079	132186	117648	120195	119117	126019	138092	143135
4+	49979	79478	108680	92533	88094	90900	89048	95101	104750
5+	24767	33778	57441	73354	67773	65075	66222	65899	69604

	1986	1987	1988	1989	1990	1991
3	10124	7339	14182	14617	6899	8115
4	31376	8150	5542	11360	10233	4686
5	26103	23096	6291	4250	7327	4301
6	13221	15559	15750	3769	2120	2071
7	8342	6871	9622	7152	1946	926
8	5473	5462	4528	4299	4148	1211
9	3887	3623	3881	2794	2358	2744
10	3045	2677	2202	2665	1849	1405
11	6770	2156	1745	1418	1971	1116
12	2364	5227	1405	1203	1009	1478
3+	110705	80160	65147	53527	39859	28053
4+	100581	72821	50965	38910	32960	19938
5+	69205	64671	45423	27550	22727	15252

TABLE 23. FISHING MORTALITY MATRIX FOR COD IN DIV. 3NO, 1959-91.

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
3	0.032	0.030	0.010	0.010	0.004	0.059	0.007	0.004	0.129	0.196	0.073	0.029
4	0.166	0.162	0.094	0.061	0.073	0.307	0.096	0.165	0.516	0.642	0.235	0.252
5	0.298	0.467	0.490	0.062	0.253	0.378	0.242	0.385	0.910	1.026	0.739	0.315
6	0.494	0.300	0.699	0.110	0.189	0.285	0.480	0.728	0.774	1.096	0.700	0.635
7	0.437	0.368	0.325	0.344	0.192	0.127	0.697	0.657	0.755	0.670	0.321	0.517
8	0.501	0.554	0.482	0.199	0.766	0.160	0.434	0.816	0.971	0.615	0.296	0.450
9	0.294	0.405	0.365	0.360	0.519	0.341	0.231	0.289	0.085	0.245	0.411	0.178
10	0.220	0.240	0.229	0.322	0.656	0.266	1.537	0.689	0.041	0.085	0.219	0.197
11	0.734	0.344	0.022	0.450	0.423	0.071	0.205	0.572	0.052	0.026	0.085	0.264
12	0.043	0.304	0.147	0.263	1.020	0.253	0.422	0.102	0.428	0.042	0.075	0.076
13	0.363	0.392	0.350	0.306	0.533	0.224	0.725	0.613	0.463	0.404	0.312	0.336

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
3	0.012	0.001	0.369	0.209	0.031	0.174	0.014	0.025	0.004	0.014	0.018	0.012
4	0.627	0.383	0.885	0.724	0.492	0.576	0.152	0.133	0.139	0.065	0.074	0.088
5	0.773	0.666	0.569	1.163	0.658	0.746	0.385	0.229	0.462	0.200	0.103	0.148
6	0.672	0.997	0.828	1.122	0.959	0.430	0.418	0.205	0.427	0.195	0.178	0.112
7	0.510	0.887	0.366	0.892	1.244	0.181	0.425	0.162	0.357	0.196	0.248	0.172
8	0.837	0.497	0.340	0.888	1.766	0.268	0.227	0.122	0.175	0.141	0.222	0.315
9	0.239	0.201	0.400	0.726	1.382	0.282	0.399	0.108	0.095	0.085	0.175	0.378
10	0.092	0.153	0.264	0.856	0.895	0.158	0.887	0.158	0.042	0.067	0.117	0.296
11	0.197	0.047	0.138	1.053	0.958	0.051	0.264	0.242	0.050	0.025	0.119	0.302
12	0.085	0.219	0.092	0.412	1.660	0.073	0.131	0.046	0.346	0.071	0.051	0.107
13	0.420	0.435	0.343	0.840	1.322	0.222	0.100	0.030	0.040	0.030	0.050	0.060

	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.034	0.001	0.002	0.017	0.088	0.022	0.167	0.225	0.165
4	0.031	0.036	0.090	0.111	0.061	0.072	0.244	0.738	0.216
5	0.114	0.089	0.325	0.288	0.192	0.326	0.558	1.114	0.346
6	0.159	0.200	0.280	0.402	0.246	0.633	0.493	0.785	0.372
7	0.104	0.240	0.347	0.219	0.183	0.497	0.387	0.302	0.605
8	0.190	0.151	0.245	0.212	0.139	0.229	0.295	0.249	0.465
9	0.267	0.227	0.136	0.270	0.297	0.171	0.164	0.210	0.315
10	0.255	0.310	0.200	0.156	0.409	0.238	0.099	0.219	0.281
11	0.176	0.172	0.236	0.194	0.248	0.373	0.139	0.085	0.300
12	0.115	0.130	0.235	0.184	0.361	0.131	0.250	0.094	0.157
13	0.040	0.060	0.070	0.070	0.090	0.110	0.090	0.100	0.157

TABLE 24. POPULATION BIOMASS AT THE BEGINNING OF THE YEAR (TONS) FOR COD IN DIV. 3NO, 1959-91.

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
3	18166	20497	26715	33397	23992	35703	47297	73617	64463	35580	45018
4	62570	28130	31784	42272	52839	38184	53778	82415	112563	87013	44890
5	21754	66150	33774	40862	56151	69358	39683	71692	102609	92276	62848
6	27692	20625	52368	26119	48475	55057	60027	41211	64554	52158	41740
7	31623	20003	18796	32024	28765	49322	50903	48362	25893	37291	21838
8	12213	20115	14943	14656	24515	25638	46884	30492	30173	13978	21909
9	12049	7113	11243	8978	11686	11082	21251	37307	16551	13249	8768
10	22927	8643	4566	7508	6028	6692	7583	20794	34449	16823	11470
11	12560	16904	6392	3414	5117	2941	4822	1946	12458	31267	14611
12	11318	5803	11267	5880	2046	3153	2574	4758	1330	11172	28782
13	15968	19424	5620	12768	5936	968	3214	2215	5640	897	11076
3+	248840	233407	217468	227878	265549	298099	338017	414810	470682	391703	312951
4+	230674	212910	190753	194481	241557	262396	290719	341193	406219	356123	267933
5+	168104	184780	158969	152209	188718	224212	236942	258778	293657	269110	223043

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
3	28157	28742	25196	18136	10850	5886	9934	19976	25233	11686	11070
4	64258	41972	46968	38155	13145	15269	11183	13672	29703	27420	15255
5	48746	68579	31811	45276	19211	7818	14005	10157	16928	33235	29937
6	37898	44933	39415	20881	29822	7177	5923	9081	8897	15935	26455
7	25952	25163	27498	19520	10531	11776	3707	5225	7975	8263	13134
8	18184	17770	15950	13643	16604	4870	3985	3778	3935	6784	7396
9	18896	13444	8642	11169	12657	6907	1042	3773	3401	3316	6810
10	6430	17491	11914	8717	7588	6052	1942	936	2776	3071	3492
11	8717	4994	14957	11105	6509	2423	2263	1975	376	2047	3156
12	12676	6324	3857	15755	7702	1601	1151	2296	1507	259	2104
13	27619	12152	6008	3205	14989	4591	316	1402	2003	1265	179
3+	297532	281564	232216	205564	149608	74370	55449	72271	102733	113281	118990
4+	269375	252821	207020	187428	138759	68484	45516	52295	77501	101595	107920
5+	205117	210849	160051	149273	125613	53215	34333	38623	47798	74175	92665

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	25382	24040	28849	35148	12222	2630	2328	8989	4989	2578	3530
4	15983	26546	24209	30901	31283	21019	4448	3564	9435	6845	2604
5	19694	17658	28682	24343	30983	32472	25350	6445	4908	8500	4729
6	33254	21154	17945	29244	24135	25110	29089	22812	6292	3643	3519
7	28482	34316	22242	17835	25840	22693	19980	22550	15727	4426	2104
8	14119	26387	32892	22272	15266	23031	22736	17988	17829	13300	4221
9	8287	13188	20959	27321	20695	15827	22807	19629	18335	16312	12882
10	8035	7214	9106	15392	22544	23035	13719	15654	17888	18989	15160
11	3682	6493	4934	6307	11171	19860	19685	8101	11534	17875	16245
12	3004	3089	4324	4056	5105	8454	16470	13351	5345	10506	17435
13	2088	2638	2781	3698	3573	4066	6996	10949	11226	3841	9379
3+	162009	182723	196921	216516	202817	198198	183609	150032	123508	106816	91809
4+	136627	158683	168072	181369	190595	195568	181280	141043	118519	104237	88279
5+	120644	132136	143863	150468	159312	174549	176832	137479	109084	97393	85675

TABLE 25. POPULATION NUMBERS AT THE BEGINNING OF THE YEAR (000s) FOR COD IN DIV. 3NO, 1959-91.

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
3	60436	68191	88876	111106	79817	118780	164847	210008	183896	101499	128423
4	94211	47933	54160	72031	90037	65065	91637	134049	171258	132386	68298
5	21736	65338	33360	40361	55462	68507	39196	68139	93089	83715	57017
6	17077	13210	33542	16730	31049	35265	38448	25197	37979	30686	24557
7	12295	8530	8015	13656	12267	21033	21707	19482	9957	14340	8398
8	3904	6506	4833	4740	7929	8292	15164	8850	8272	3832	6007
9	3283	1937	3061	2444	3181	3017	5786	8047	3204	2565	1697
10	5189	2003	1058	1740	1397	1551	1757	3759	4934	2409	1643
11	2594	3410	1290	689	1032	593	973	309	1545	3876	1811
12	2713	1020	1980	1033	359	554	452	649	143	1200	3092
13	1750	2128	616	1399	650	106	352	243	480	76	942
3+	225187	220205	230790	265929	283180	322763	380319	478732	514756	376585	301885
4+	164751	152014	141914	154823	203363	203983	215471	268724	330861	275087	173462
5+	70540	104082	87754	82792	113326	138918	123835	134675	159602	142700	105164

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
3	80324	85123	63495	36006	37604	23968	28097	47565	40886	22742	20852	32155
4	97766	63859	68833	51923	20379	24974	19016	19335	38394	32642	18554	16832
5	44223	62216	27943	38443	17537	8088	12502	8752	13597	27510	23263	14237
6	22297	26436	23522	11758	17813	4489	3430	4856	4876	8854	14191	15597
7	9980	9676	11057	7104	4208	4747	1409	1827	2619	3252	4730	9560
8	4985	4872	4755	3730	4033	1412	1120	963	978	1824	1863	3184
9	3657	2602	1727	2368	2174	1359	198	702	628	709	1253	1325
10	921	2505	1678	1156	1299	862	279	122	386	462	528	943
11	1081	619	1870	1178	726	452	288	195	41	270	363	404
12	1362	679	416	1460	841	207	142	224	123	26	210	290
13	2349	1034	511	274	1091	456	32	108	161	96	15	160
3+	268945	259621	205808	155401	107705	71014	66513	84650	102688	98385	85822	94685
4+	188621	174498	142313	119394	70101	47046	38416	37085	61801	75643	64970	62530
5+	90855	110639	73479	67471	49722	22072	19400	17749	23407	43001	46416	45698

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	28532	39477	46420	36935	9777	6789	13908	13767	5828	7979
4	25870	23084	31254	37953	30188	7866	5091	11136	9537	3809
5	12793	19391	18315	24684	28401	22123	6058	3880	7143	3732
6	10514	9035	14163	13718	14597	17441	14954	3579	1818	1920
7	10691	7692	6308	9493	8484	7997	11163	6501	1790	679
8	6106	7370	5677	4060	5493	5578	5450	5561	3615	1083
9	2087	3650	4992	3997	2603	3639	3976	3549	3391	2307
10	911	1170	2288	3256	2857	1626	2215	2742	2467	2250
11	687	555	743	1374	2184	2002	885	1429	2034	1622
12	294	416	381	512	889	1472	1279	499	1018	1530
13	225	216	303	274	332	606	840	918	318	758
3+	98711	112056	130844	136257	105805	77140	65818	53560	38958	27670
4+	70178	72579	84423	99322	96028	70351	51910	39793	33130	19691
5+	44309	49495	53169	61369	65840	62485	46819	28657	23593	15882

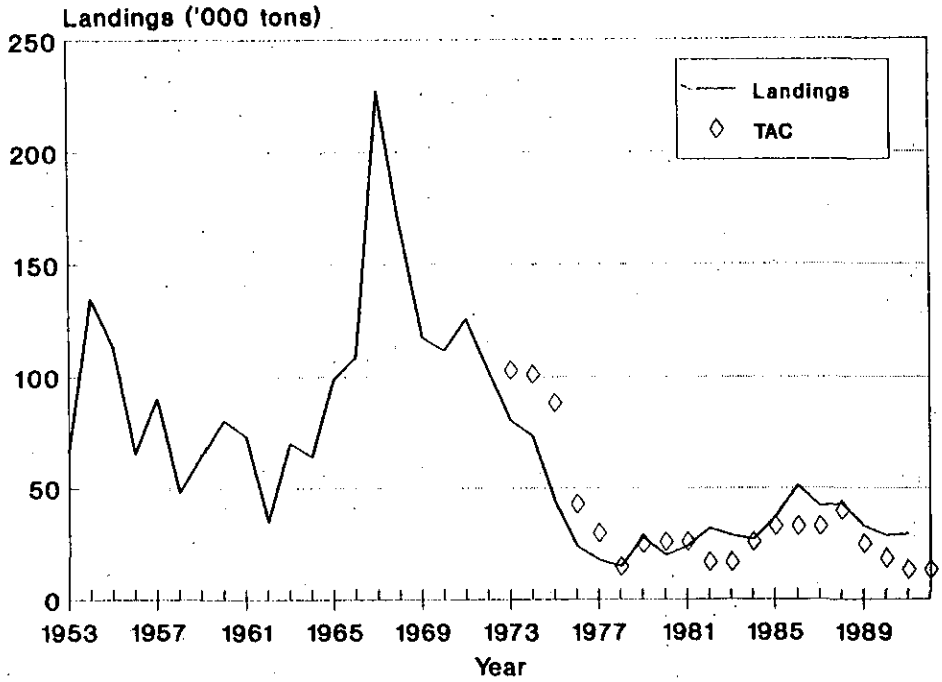

Fig 1. Cod in Div. 3NO:
landings and TAC's.

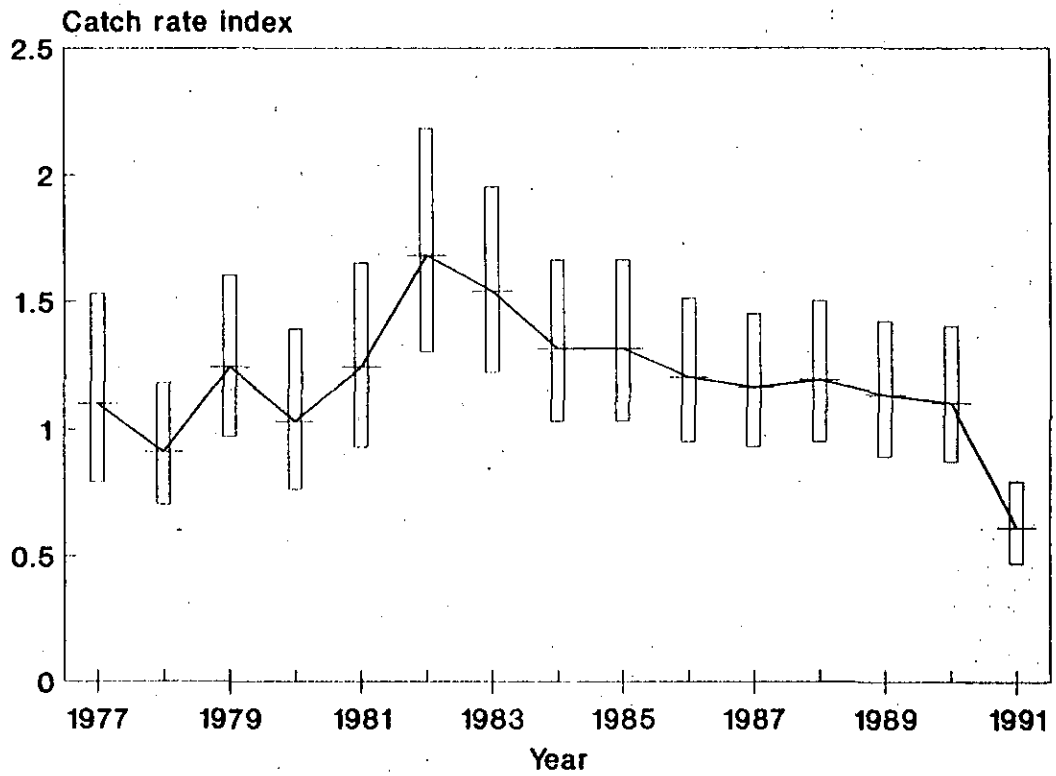

Figure 2. Catch rate index for cod in
Div. 3NO for Canadian otter trawlers.

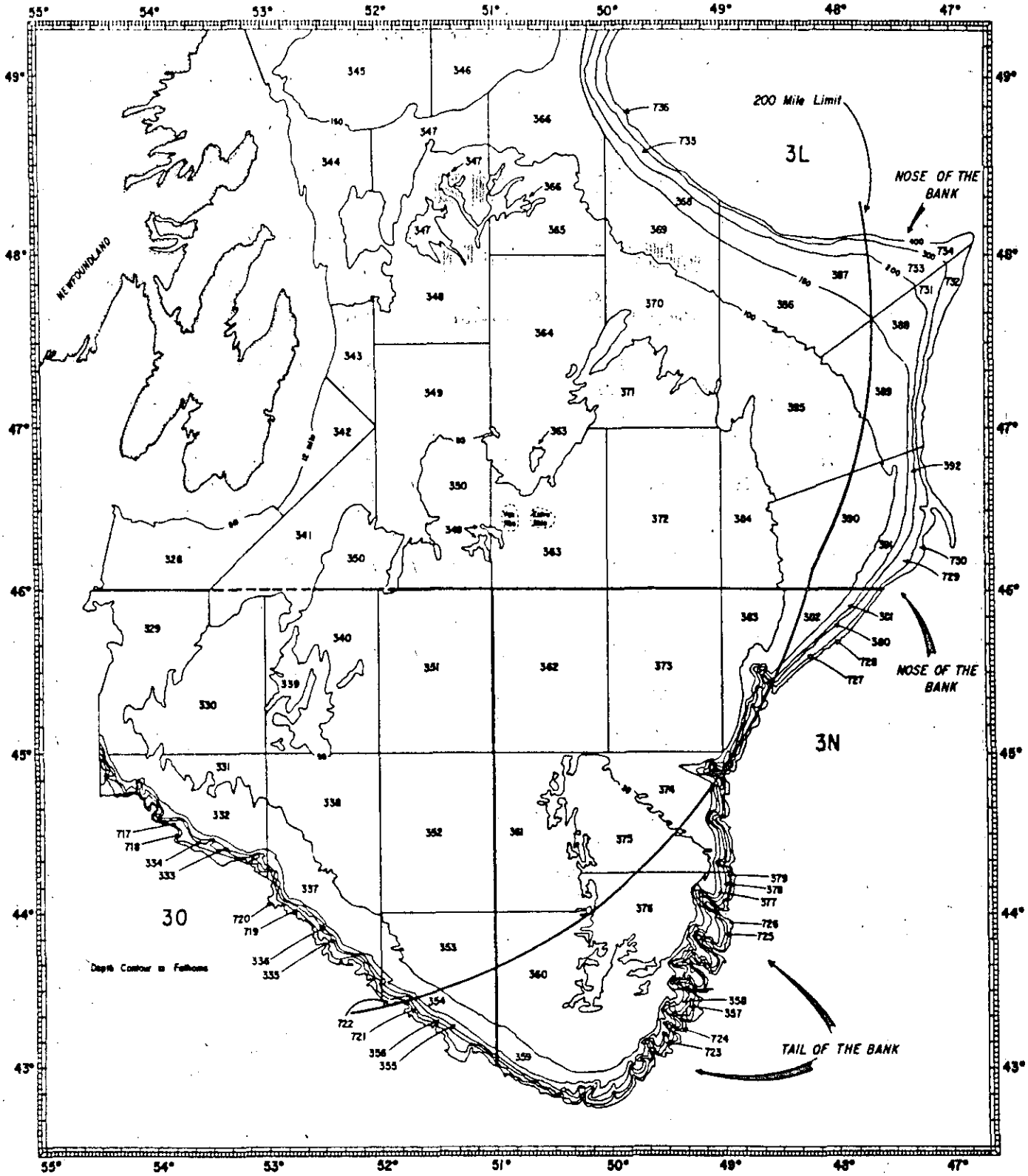

Figure 3. Stratification scheme for NAFO Divisions 3LNO showing the Canadian 200-mile limit.

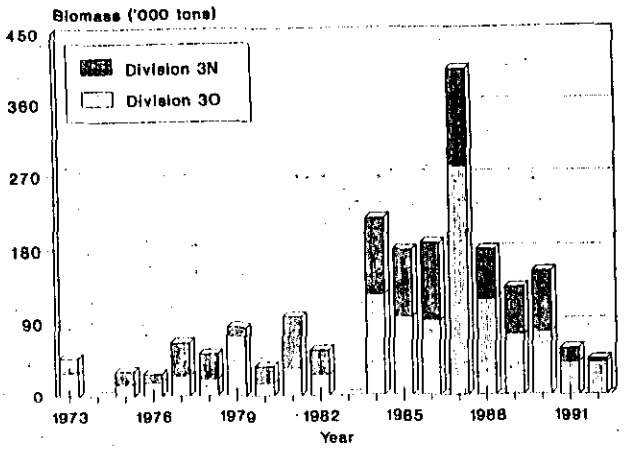

Figure 4. Cod in Divisions 3NO:
RV biomass from Canadian surveys.

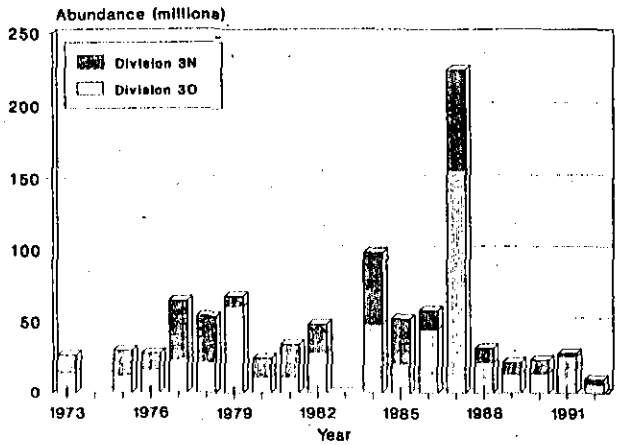

Figure 5. Cod in Divisions 3NO:
RV abundance from Canadian surveys.

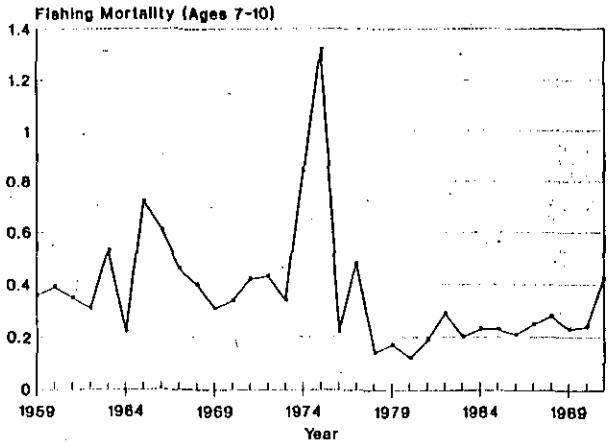

Fig 6. Trends in fishing mortality
(ages 7-10) for cod in Div. 3NO.

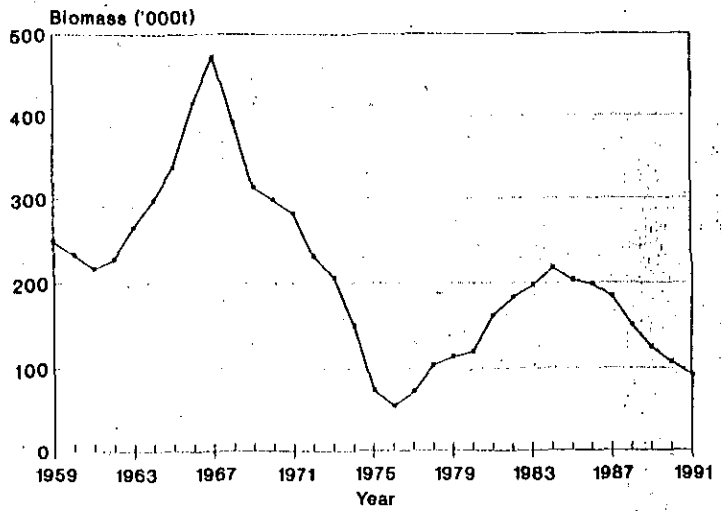

Fig 7. January 1 population biomass for cod in Division 3NO.

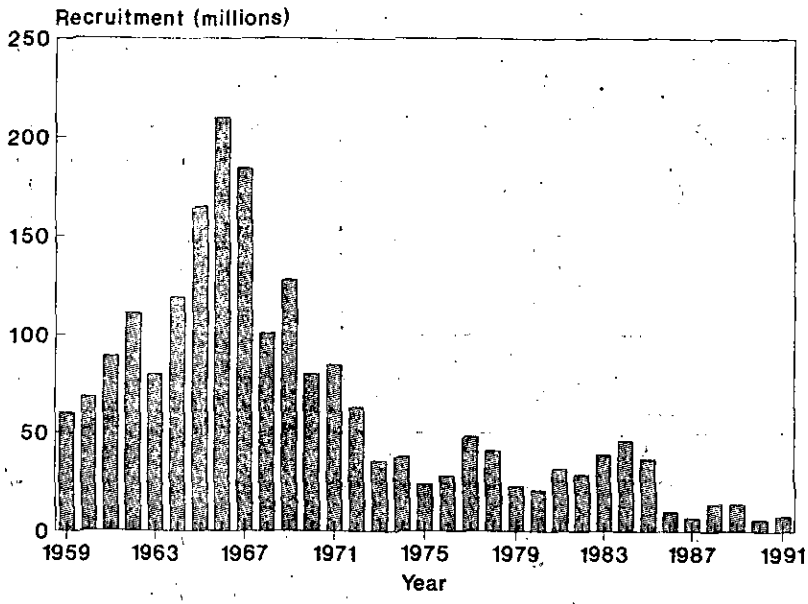

Fig. 8. Age 3 population numbers for cod in Div. 3NO, 1959-91.