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

by

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Nominal catch and catch at age

Cod catches, along with corresponding TACs, from NAFO Div. 3NØ for a recent period are as follows (000s t):

	1981	1982	1983	1984	1985	1986	1987	1988	1989
TAC	26	17	17	26	33	33	33	40	25
Catch	24	32	29	27	37	51	42	43	30

Catch for 1988 is provisional and for 1989 only from Canada, Spain and Portugal.
TACs for 1982 and 1983 exclude expected catches by Spain.

Catches from this stock declined from a peak of about 227,000 t in 1967 to a low of about 15,000 t in 1978 (Table 1; Fig. 1). With the exception of that for 1986, catches have averaged about 41,000 t from 1985 to 1988. Canadian catches were stable at about 19,000 t from 1985 to 1988 but have declined to 30,000[1] t in 1989. In 1989 the Canadian catch was taken from Div. 3N and 3Ø in similar proportions (45% and 55% respectively). Catches by Spain have been stable at approximately 16,000 t since 1986 while those by Portugal have declined.

Sampling data available for the Canadian fishing in 1989 (Table 3), as obtained by Canadian Port Samplers, were used to adjust monthly catches (Table 2) to produce catch, average weight, and length at age for the 1989 Canadian catch (Table 4). Average weights at age were determined by applying a length-weight relationship (log weight = 3.0879 log length -5.2106) to length frequencies and age length keys. For the Canadian fishery, the calculated catch was less than 0.5% different than the reported catch. The catch was obtained from a wide range of age groups (Table 4) with ages 6 to 8 dominating.

Catch at age for the Spanish and Portuguese fleets were obtained from research reports. Catches by Spain were obtained almost entirely by pair trawl in Div. 3N. The age composition of the catch was substantially different than that obtained for the Canadian catch (Table 5). Spanish catches were comprised mainly of fish aged 3 to 5. Portuguese catches were obtained mainly by gillnets with ages 9 and 10 being most abundant ages. Average weights at age were available only from Canadian and Portuguese sampling data (Table 5). These indicate that the average weights were higher for most age groups than those observed in 1988.

Commercial catch-effort data

Catch and effort data for 1977-87 were obtained from NAFO statistical bulletins. Data for the Canadian otter trawl fleet for 1988-89 were provided by the Department of Fisheries and Oceans, Canada, while Spanish pair trawl data for the same years were obtained from Spanish research reports. Seasonal patterns for the otter trawl and pair trawl fisheries are different (Tables 7 & 10), therefore, catch rates from both fleets were analyzed separately

[1] The provisional nominal catch for Div. 3NO as reported in NAFO SCS Doc. 90/21 was somewhat higher than that used in the current assessment. The difference of approximately 10% resulted from an update of Spanish pair trawl catches from 15,277 tons to 17,904 tons. This information was not provided in sufficient time for incorporation in the current assessment, however, this omission is likely to have only a marginal effect on the estimation of population size for 1989.

using a multiplicative model (Gavaris, 1980). Weights were calculated as in previous analyses (Baird & Bishop, 1989) and data with less than 10 t catch or 10 hours effort were excluded. Four category types were used in the model: country/gear/tonnage class, NAFO Division, month and year.

The model only explained about 38% of the variation in the Canadian otter trawl data (Table 6), but with the exception of NAFO Division, all categories were significant. Regression coefficients, presented in Table 7, indicate that the best otter trawl catch rates occur during December-January and are lowest during early summer. The catch rate trends are given in Table 8 and Figure 3. Generally, otter trawl rates increased from 1977 to 1982 then declined until 1986. C/E for the 1986-89 period have been stable.

For the Spanish pair trawl data the model explained about 55% of the variation and all category types were significant (Table 9). The highest pair trawl catch rates occur during summer, with the lowest C/E observed during March and April (Table 10). Pair trawl catch rates (Table 11, Figure 4) have been variable during the 1977-89 period with three peaks occurring (1979,1984 and 1988). The increase in C/E during 1988 is lower than the peaks observed for either 1979 or 1984. Catch and effort for the PT fleet given in the Spanish Research Report for 1988 (Vazquez & Gandaras, 1989) was not presented by tonnage class. This data was included in the pair trawl standardization, coded as tonnage class 4. In recent years TC 4 vessels have dominated the pair trawl catch in the Regulatory Area.

During the last assessment of this stock (NAFO SC Reports, 1989) commercial catch rate indices, when used in calibration gave unrealistic estimates of population size and fishing mortality, and were not used in the final assessment calibration model. It is starting to become apparent that commercial catch rates for Div. 3NØ have limited usefulness as calibration indices. For a number of years the Canadian OT index has been questioned because of the uncertain definition of directed fishing effort as a consequence of the large by-catch of cod in directed American plaice fisheries. The Spanish pair-trawl index only relates to a portion of the stock, has been extremely variable and in itself has not been a useful calibration tool. Because of the problems with past commercial C/E calibration and the points noted above commercial C/E indices are not considered further for this assessment.

Research vessel survey data

Stratified-random research vessel surveys have been conducted by Canada in Div. 3N since 1971, with the exception of 1983, and in Div. 3Ø since 1973, with the exception of 1974 and 1983. Surveys from 1971 to 1982 were conducted by the research vessel A. T. CAMERON, and those since 1984 were conducted by the sister ships A. NEEDLER and W. TEMPLEMAN. The stratification scheme used for the stratified-random research vessel surveys in Div. 3NØ is shown in Figure 2. Biomass estimates by strata for these surveys are presented in Tables 12 & 13, with mean number and weight per tow values in Table 14, and Figure 5. Biomass in both divisions increased sharply from 1982 to 1984, was somewhat stable from 1984 to 1986, and increased sharply again in 1987, especially in Div. 3Ø. Estimates decreased substantially in 1988 for both Divisions with those for Div. 3Ø showing a further large biomass decrease in 1989. Preliminary results for 1990 indicate that both biomass and abundance showed a moderate increase in 1990. The biomass increase was largest in Div. 3N.

As survey coverage is incomplete, mostly in the earlier period, estimates of abundance for non-sampled strata were obtained using an analysis of variance of the ln catch per tow for sampled strata. As in recent assessments, the current analysis weights each stratum mean by its stratum area in square nautical miles. Tables 15 and 16 show survey abundance estimates for Div. 3N and 3Ø respectively with estimated values for strata which were not surveyed. Estimated abundances for Div. 3N and 3Ø in 1989 were the second and third lowest in their respective time series. The 1990 survey results show only a slight increase over the 1989 levels. Estimates of mean no. of cod per standard tow at age are shown in Table 17 with similar estimates adjusted for non-sampled strata shown in Table 18. Although no year class was abundant, year classes which were present in the commercial fisheries (ages 3-5 for Spain; ages 6-8 for Canada) were generally the most numerous.

Revised catch-at-age

Catch-at-age presented in Table 5 was revised to account for discrepancies in the reported Spanish estimates. A sample for one month (March) was very small, and was included while those for two others (October and November) were adjusted to account for some underestimation of older fish. Average weight-at-age for the Spanish fishery were provided and were combined with that for Canada and Portugal. The revised total catch-at-age (Table 21) also includes reported catches by other countries (117 tons). A sum of products check indicated that the calculated catch in 1989 was less than 10% different than the reported catch.

Estimation of stock size

Stock size was estimated from a formulation of ADAPT which used Canadian and USSR research vessel data for the 1977-89 period. The USSR data was taken from Bulatova (1990). Data for all surveys in this time period were used even though some had been considered anomalous in previous assessments. It was decided to include data for all years and determine anomalies from the residual pattern.

The accepted formulation is as follows:

Parameters:

- year-class estimates

  N_i, 1989 $\quad i = 3\text{-}11$

- calibration coefficients for RV numbers

  $K(Can)_i \quad i = 3\text{-}11$

  $K(USSR)_i \quad i = 3\text{-}11$

Structure

- Natural mortality was assumed = 0.20
- Error in catch-at-age assumed negligible
- F on oldest age (12) was calculated as 40% of the weighted (by population numbers) F for age-groups 7-10
- Intercepts were not fitted

Input

- $C_{i,t} \quad i = 3\text{-}12 \quad t = 1977\text{-}89$
- $RV(Can)_{i,t} \quad i = 3\text{-}12 \quad t = 1977\text{-}82, 1984\text{-}89$
- $RV(USSR)_{i,t} \quad i = 3\text{-}12 \quad t = 1977\text{-}89$

Objective Function

- Minimize

$$\sum_{it}\sum [\text{obs } (\ln RV(CAN)_{it}) - \text{pred } (\ln RV(CAN)_{it})]^2 +$$

$$\sum_{it}\sum [\text{obs } (\ln RV(USSR)_{it}) - \text{pred } (\ln RV(USSR)_{it})]^2$$

Summary

Number of observations = 225

Number of parameters = 27

Previously, it had been established that intercepts were not significant and hence were not included in this analysis. With the exception of age 3 abundance, all estimated parameters were significant (Table 22), however, the coefficients of variation on most other abundance estimates were high, ranging between 44% and 48%. All of the research vessel slopes were estimated with CV's around 0.30. Residuals, given in Table 23 and seen in Fig. 6 and 7, indicate a great deal of annual variation in the data for both the Canadian and Soviet results. In some years all residuals are negative while in other years the opposite is true. These patterns are to be expected given that a number of RV survey years that were considered anomalous last year and deleted were left in this year's analysis. Correlations between estimated parameters are given in Table 24. Although none of the correlations are greater than 0.50, there is some relationship between catchabilities for the Canadian and USSR RV at the same age. Population numbers at January 1 and fishing mortality derived for this analysis are given in Table 25. The 1983-86 year-classes at age 3 are all estimated to be the lowest in the series while fishing mortalities on younger ages are high.

Preliminary formulations of ADAPT indicated that flat-topped partial recruitment produced catchability estimates for RV that increased with age through the oldest age. Table 26 shows catchability estimates for the Canadian RV index with a flat-topped PR. The catchabilities for the Soviet index showed a similar pattern. RV catchabilities should be at least stable if not declining, through older ages. It was demonstrated that a fishing mortality on the oldest age (12), set at about 40% at that on ages 7-10 would produce stable catchabilities for older ages in the RV indices.

Data for both Canadian and Soviet research vessel indices were also analyzed in separate formulations of the adaptive framework. The Canadian data on its own indicated that the 1989 population (Table 28) was considerably larger than that estimated in the combined analysis, however, none of the population estimates were significant (Table 27), and the CV's on the estimated slopes were quite high (40%-50%).

For the analysis using only the Soviet data, estimated abundance for ages 5-8 were significant (Table 29) and all CV's on estimated slopes were about 30%. In this analysis, however, the estimated population for 1989 numbers only 17 million fish. The population of this size in 1989 implies fishing mortalities on the same ages in excess of 2. There has never been fishing mortalities observed for this stock at those levels.

Fishing mortality and population estimates for a longer time period are given in Tables 31 to 34. For these estimates, fishing mortality on the oldest age (12) for the 1959-76 period was set equal to the weighted (by population numbers) F for ages 7-10. For the year 1977-89, the F on the oldest age is from the final adapt analysis. Population biomass at January 1 increased from about 64,000 tons in 1976 to about 250,000 tons in 1983-84 and has subsequently declined to about 100,000 tons. The large decline in biomass is caused by the extremely weak 1983-86 year-classes. These year-classes are all estimated to be lower than any previously observed year-class.

Yield-per-recruit

The most recent yield-per-recruit analysis for this stock was conducted during the 1988 assessment. Input data included average weights-at-age from the commercial fishery from 1977-87 and partial recruitment estimates for the period 1977-86. The latter were flat topped and the age range from 3 to 20 was considered appropriate.

In the current assessment a yield-per-recruit analysis was conducted based on a dome shaped partial recruitment. The exploitation pattern of the fishery appeared to have changed in that younger fish were being more heavily exploited. Input data for the analysis are indicated in Table 35. Partial recruitment and average weights-at-age estimates used were averages over the period 1982-88. The age 3 partial recruitment value for 1987 was not included in the average for that age because it was a higher than normal value on a very weak year-class. Some recent analysis of yield-per-recruit on cod stocks in Canadian waters indicated that ages to age 15 were appropriate and these were used in the present analysis. The reference fishing mortality levels estimates were $F_{0.1}$ = 0.25 and F_{max} = 0.40 (Fig. 8) with yield-per-recruits of 1.03 and 1.08 kg respectively.

References

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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	2307	41,619
1988[a]	19,721	15,889	3,927	2,973	391	42,901
1989[a]	13,489	15,277	913	5	117	29,556

[a]Provisional.

Table 2. Cod landings (t) from NAFO Divisions 3NØ by country, month, year and Division in 1989.

	3N										3Ø							
	Can(N)				Can(M)		Spain		Portugal		Can(N)				Can(M)			Portugal
Mo.	OT	GN	LL	SSc	OT	LL	pT	OT[a]	OT	GN	OT	GN	LL	SSc	OT	LL	SSc	GN
J	1						165				1		27		459			
F						15	45								292	102	17	
M			33			18	36				70	96	61		466	26		
A	7	4				44	247		12	15	385	32	94	116	148	65		
M	319		16	8	11	155	993			146	555	87	137	256	112	131	6	8
J	233	81		25	21	60	2394			91	790	46	2	108	32	55		78
J	1111	229	27	15	77	95	2372			127	399	3	13	28	51	74		22
A	572	14		75		18	1439			146	152		44	8	10	67		
S	381	5			2	67	1583		71	30	87	1			4	49		10
O	491			65		30	2490		13		181	2		38	13	33		
N	733	91		81	187	9	1649		88		74	6		99	3	22		
D	565	12				56	1390		56		1011				76	108		
	4413	436	76	269	298	567	14803	474	240	555	3705	273	378	653	1666	732	23	118

[a] 3NØ

Total 3N = 21657
3Ø = 7548
3NØ = 29679

Table 3. Commercial sampling by Can(N) for cod in NAFO Divisions 3NØ during 1989.

Quarter	Gear	Division	No. aged	Month	No. Measured	Landings (t) Country/ mo.	Landings (t) Canada (N & S.F.)
1	OT	3Ø	73[a]	Mar	232	70	1571[c]
2	OT	3Ø	296[a]	Jun	875	790	3372[c]
3	OT	3N	226	Jul	945	1111	2350
		3N		Sept	391	381	
		3Ø	252	Jul	731	399	950
			478		2067		2300
4	OT	3N	291	Oct	193	491	2071
				Nov	659	733	
		3Ø	213	Nov	320	74	1521
				Dec	696	1011	
			504		1868		3592
2	SSc	3Ø	142[a]	Apr	298	116	519
				Jun	414	108	
4	"	3N	100[b]	Oct	320	65	283
1-4	"	3NØ			1032		945
2	GN	3Ø	34[a]	Apr	332	32	709[d]
1-4		3NØ	1527		6406		13489

[a] A/L keys from Quarters 1 and 2 were combined (Tot. = 545).

[b] A/L keys from SSc was combined with OT (Tot. = 604).

[c] Total for 3NØ includes LL catches.

[d] Total for year.

TABLE 4. CATCH AND AVERAGE WEIGHT AT AGE OF COD TAKEN IN DIV. 3NO BY CANADIAN VESSELS DURING 1989.

	AVERAGE		CATCH		
AGE	WEIGHT	LENGTH	MEAN	STD. ERR.	C. V.
3	0.773	44.618	11	2.22	0.20
4	1.100	49.937	235	12.64	0.05
5	1.468	54.705	260	17.35	0.07
6	2.166	62.046	619	31.52	0.05
7	2.932	68.331	899	34.96	0.04
8	4.005	75.310	485	25.12	0.05
9	5.703	84.152	184	13.83	0.08
10	7.477	92.611	130	9.25	0.07
11	9.039	98.366	137	9.16	0.07
12	10.974	104.661	63	5.72	0.09
13	11.980	108.158	76	6.57	0.09
14	12.751	110.086	72	6.35	0.09
15	13.632	112.699	47	4.90	0.10
16	15.790	118.545	15	2.83	0.19
17	16.818	120.551	8	1.73	0.22
18	17.365	122.489	2	1.01	0.44
19	16.991	121.279	1	0.80	0.59
20	23.246	134.259	1	0.39	0.68

Table 5. Catch and average weights at age of Divisions 3NØ cod obtained from Canadian, Spanish and Portuguese fisheries during 1989.

Age	Canada		Portugal		Spain	Total	
	No.	Av.wt.	No.	Av.wt.		no.'s	Av. wt.
2					113	113	
3	11	0.77			1583	1594	0.77
4	235	1.10			1609	1844	1.10
5	260	1.47			1023	1283	1.47
6	619	2.17			520	1139	2.17
7	899	2.93	1	5.19	795	1695	2.93
8	485	4.00	5	6.56	646	1136	4.03
9	184	5.70	21	7.68	208	413	5.90
10	130	7.48	16	9.05	38	184	7.65
11	137	9.04	11	10.26		148	9.13
12	63	10.97	6	11.57	10	79	11.02
13	76	11.98	4	13.07	12	92	12.03
14	72	12.75	4	13.94		76	12.81
15	47	13.63	2	14.61		49	13.67
16	15	15.79				15	15.79
17	8	16.82				8	16.82
18	2	17.36				2	17.36
19	1	16.99				1	16.99
20	1	23.25				1	23.25
#	3245		71		6557	9873	
Wt.	13489		673		15277	29439	

TABLE 6 . ANALYSIS OF VARIANCE FROM THE REGRESSION OF LN CATCH RATE FOR CANADIAN OTTER TRAWLS OF COD IN DIV. 3NO FOR THE YEARS 1977-89.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.617
MULTIPLE R SQUARED..... 0.380

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	8.861E0	8.861E0	
REGRESSION	27	8.792E0	3.256E-1	9.596
TYPE 1	3	2.242E0	7.472E-1	22.018
TYPE 2	1	3.312E-2	3.312E-2	0.976
TYPE 3	11	4.224E0	3.840E-1	11.314
TYPE 4	12	1.495E0	1.246E-1	3.670
RESIDUALS	422	1.432E1	3.394E-2	
TOTAL	450	3.198E1		

TYPE 1 - COUNTRY/GEAR/TONNAGE CLASS
TYPE 2 - NAFO DIVISION
TYPE 3 - MONTHS
TYPE 4 - YEARS

TABLE 7 . REGRESSION COEFFICIENTS FROM THE REGRESSION OF LN CATCH RATE FOR CANADIAN OTTER TRAWLS OF COD IN DIV. 3NO FOR THE YEARS 1977-89.

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	3124	INTERCEPT	0.148	0.210	450
2	34				
3	1				
4	77				
1	3125	1	0.112	0.065	206
	27124	2	0.422	0.093	58
	27125	3	0.517	0.077	89
2	35	4	0.054	0.055	296
3	2	5	0.341	0.147	29
	3	6	0.498	0.138	35
	4	7	0.589	0.137	41
	5	8	0.840	0.132	51
	6	9	0.805	0.131	50
	7	10	0.686	0.141	38
	8	11	0.650	0.147	32
	9	12	0.650	0.154	23
	10	13	0.697	0.138	39
	11	14	0.309	0.130	51
	12	15	0.070	0.134	44
4	78	16	0.126	0.179	35
	79	17	0.207	0.175	43
	80	18	0.073	0.197	18
	81	19	0.170	0.195	19
	82	20	0.458	0.176	33
	83	21	0.400	0.173	39
	84	22	0.226	0.175	38
	85	23	0.229	0.173	39
	86	24	0.113	0.170	44
	87	25	0.090	0.169	49
	88	26	0.125	0.170	47
	89	27	0.097	0.172	36

CODE 03124 - CANADA-N/OTTER TRAWL/TC 4
CODE 03125 - CANADA-N/OTTER TRAWL/TC 5
CODE 27124 - CANADA-M/OTTER TRAWL/TC 4
CODE 27125 - CANADA-M/OTTER TRAWL/TC 5
CODE 34 - DIVISION 3N
CODE 35 - DIVISION 3O

TABLE 8 . COMMERCIAL CATCH RATE FOR CANADIAN OTTER TRAWLS OF COD IN DIVISIONS 3NO FOR THE 1977-89 PERIOD.

PREDICTED CATCH RATE

	LN TRANSFORM		RETRANSFORMED			
YEAR	MEAN	S.E.	MEAN	S.E.	CATCH	EFFORT
1977	0.8405	0.0279	0.433	0.072	2532	5850
1978	0.9664	0.0138	0.384	0.045	6246	16252
1979	0.6336	0.0113	0.537	0.057	9938	18516
1980	0.9140	0.0204	0.404	0.057	5589	13846
1981	0.6702	0.0193	0.515	0.071	6096	11828
1982	0.3822	0.0116	0.690	0.074	10185	14760
1983	0.4405	0.0111	0.651	0.068	11374	17467
1984	0.6150	0.0112	0.547	0.058	8705	15919
1985	0.6117	0.0101	0.549	0.055	18179	33115
1986	0.7273	0.0089	0.489	0.046	18035	36857
1987	0.7507	0.0092	0.478	0.046	18652	39026
1988	0.7159	0.0094	0.495	0.048	19721	39857
1989	0.7440	0.0100	0.481	0.048	13489	28046

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.114

TABLE 9 . ANALYSIS OF VARIANCE FROM THE REGRESSION OF LN CATCH RATE FOR SPANISH PAIR TRAWLS OF COD IN DIV. 3NO FOR THE YEARS 1977-89.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.743
MULTIPLE R SQUARED..... 0.552

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	2.662E1	2.662E1	
REGRESSION	26	2.388E1	9.183E-1	12.060
TYPE 1	2	6.382E-1	3.191E-1	4.190
TYPE 2	1	2.805E-1	2.805E-1	3.684
TYPE 3	11	2.850E0	2.591E-1	3.402
TYPE 4	12	1.902E1	1.585E0	20.820
RESIDUALS	254	1.934E1	7.615E-2	
TOTAL	281	6.983E1		

TYPE 1 - COUNTRY/GEAR/TONNAGE CLASS
TYPE 2 - NAFO DIVISION
TYPE 3 - MONTHS
TYPE 4 - YEARS

TABLE 10 . REGRESSION COEFFICIENTS FROM THE REGRESSION OF LN CATCH RATE FOR SPANISH PAIR TRAWLS OF COD IN DIV. 3NO FOR THE YEARS 1977-89.

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	19164	INTERCEPT	1.316	0.252	281
2	34				
3	1				
4	77				
1	19165	1	0.159	0.073	124
	19166	2	0.528	0.252	10
2	35	3	0.241	0.126	45
3	2	4	0.021	0.307	11
	3	5	0.077	0.260	17
	4	6	0.038	0.254	18
	5	7	0.138	0.232	29
	6	8	0.442	0.230	31
	7	9	0.583	0.238	27
	8	10	0.292	0.243	25
	9	11	0.074	0.239	26
	10	12	0.191	0.233	30
	11	13	0.197	0.233	31
	12	14	0.606	0.243	25
4	78	15	1.096	0.161	30
	79	16	1.069	0.209	16
	80	17	0.150	0.175	30
	81	18	0.637	0.191	20
	82	19	0.423	0.180	23
	83	20	0.664	0.188	20
	84	21	1.183	0.183	23
	85	22	0.733	0.181	21
	86	23	0.263	0.177	21
	87	24	0.398	0.191	16
	88	25	0.848	0.198	12
	89	26	0.419	0.183	22

CODE 19164 - SPAIN/PAIR TRAWL/TC 4
CODE 19165 - SPAIN/PAIR TRAWL/TC 5
CODE 19166 - SPAIN/PAIR TRAWL/TC 6
CODE 34 - DIVISION 3N
CODE 35 - DIVISION 3O

TABLE 11 . COMMERCIAL CATCH RATE FOR SPANISH PAIR TRAWLS OF COD IN DIVISIONS 3NO FOR THE 1977-89 PERIOD.

PREDICTED CATCH RATE

	LN TRANSFORM		RETRANSFORMED			
YEAR	MEAN	S.E.	MEAN	S.E.	CATCH	EFFORT
1977	0.7146	0.0245	0.502	0.078	8827	17575
1978	1.8106	0.0216	0.168	0.025	5813	34582
1979	0.3543	0.0378	1.453	0.280	13782	9486
1980	0.8651	0.0266	0.432	0.070	8999	20849
1981	0.0773	0.0270	0.949	0.155	13299	14017
1982	0.2917	0.0220	0.768	0.114	14361	18710
1983	0.0502	0.0258	0.975	0.156	12320	12630
1984	0.4684	0.0235	1.640	0.251	13590	8285
1985	0.0184	0.0228	1.046	0.157	13682	13077
1986	0.4518	0.0212	0.654	0.095	23395	35757
1987	0.3167	0.0275	0.747	0.123	15788	21147
1988	0.1336	0.0321	1.168	0.208	15889	13598
1989	0.2957	0.0233	0.764	0.116	15277	19997

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.159

Table 12. Biomass estimates (MT) by stratum from survey cruises in Div. 3N.

Strata	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1984	1985	1986	1987	1988	1989	1990
357			1383				29		52	332	135	92	0	2102	259		18	22	61
358		1061	1772				383		483	1054	229	236	182	122	547	1803	229	486	159
359		312	258			660	147		190	478	208	13	71	0	134	43	44	21	6
360		1966			306	1950	4040	2182	1416	1738	3743	1238	7877	9161	1945	1282	494	1202	9486
361	2909	4525	2525	350	3246	2618	5894	8203	2666	4173		8125	12838	29220	50957	27584	15887	12722	20240
362	2127	9695	4222	2233	306	1666	6836	6621	1632	5847	8701	3708	40764	16509	19686	69852	12714	16464	24747
373	8159	3423	1855	2362		1031	1750	4300	1838	857	4578	6647	17916	2446	2897	6788	5959	6090	3441
374	501	702	273	0	135		1248	1324	479	0	146	2369	8335	877	769	1058	4032	489	3296
375	3270	9977	1042	955	1060		5429	3598	369	3229	29835	5943	2404	18475	14586	8034	16512	20104	10230
376		1892	806		383	77	9672	102	868	855	2208	2	1049	391	1883	2876	4454	745	2745
377		550	14	83	283		1380	130	22	287	428	22	29	13	54	328	0	9	0
378	530	4146	404	632			687	90	281	939	104	303	133	470	256	73	96	81	62
379			1828	515			50	0	601	178	53	179	129	324	365	4	15	22	61
380	9	322	1317	206			52		232	57	25		224	847	135	454	181	176	
381	480	1429	2386	359	122		2677	393	196	427	533	2186	478	1544	747	82	270	39	
382	142	2458	9	69		42	948	2215	220	285	182	36	0	16	61	12	7	419	
383	231	1479	1	16		44	324	1564	146	0	430	5	294	0	0	818	71	335	
Total	18357	43935	20096	7781	15381	8088	41546	30722	11692	20736	51538	31104	92725	82515	95280	121091	60982	59425	74536
Upper limit	35959	58509	29260	13257	35224	13399	61360	37915	16334	28150	120675	46068	123845	108355	162513	159883	80483	81925	97520
Lower limit	755	29362	10931	2304	-4462	2776	21732	23529	7051	13322	-17600	16141	61605	56674	28046	82300	41481	36925	51552

Table 13. Biomass estimates (MT) by stratum from survey cruises in Division 3O.

Strata	1973	1975	1976	1977	1978	1979	1980	1981	1982	1984	1985	1986	1987	1988	1989	1990
329	211		6422	180	2008	357	18	487	373	560	840	304	45335	9436	682	1611
330	9251	475	287	593	2218	3753	470	3371	123	3626	4642	2130	5654	2767	1713	2262
331	288	729	454		342	150	609		38	2630	3423	685	804	1224	183	-
332		830	351	940	4525	2266	9		3474	2358	13471	2499	9808	8681	1369	8728
333		525	82	0	2	0	28		153	0	147	232	1057	0	1040	225
334			6	0	6	0	43		8	0	570	3481	59	248	136	425
335	22		3		0	0	10		11	0	0	126	18	39	7	63
336	29	0	0	136	3	1	286		104	0	34	45	17	18	23	191
337	78	1906	32	630	614	23	133		610	434	1203	8497	2674	382	2787	1997
338	4298	5563	1876	6953	1334	5729	1795		5659	29905	7485	14405	9838	9124	14874	5475
339	1547	40			249	1475		505	610	1087	359	29	354	233	146	103
340		2029	2690	298	966	3718	386	4294	2849	6827	5431	5796	77479	12421	2977	6338
351	3092	1562	2684	8141	4334	47954	5629	6621	4498	43455	23490	38217	66032	15852	11619	16567
352	3075	426	1429	6120	3961	10008		5625	6236	34168	29692	15071	49765	57457	34373	28930
353	3265	77	2	262	84	1573	2		472	0	6083	951	9610	626	2371	3544
354	439		38	8		34	273	44	125	489	219	180	2179	530	25	317
355	76	0	4			24	367	32	135	0	135	12	114	19	195	96
356	11					12	49	9		0	0	32	7	102	74	142
Total	25681	14161	16360	24261	20646	76966	15733	15363	25478	125339	97223	92699	280807	119157	74595	77015
Upper Limit	35514	58392	65071	38015	34853	133278	24517	25164	33764	169942	126100	136099	382599	179304	134314	101143
Lower Limit	15848	30070	-32350	10508	6442	20645	6950	5561	17191	80736	68346	49299	179014	59009	14876	52888

Table 14. Mean number and weight of cod per standard tow from research vessel surveys in NAFO Division 3N, 3O, and 3NO.

Div.	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1984	1985	1986	1987	1988	1989	1990
Mean Number per tow																			
3N	44.60	33.33	12.17	8.91	17.10	10.30	32.37	25.00	5.59	11.28	18.38	15.54	40.01	24.96	10.34	55.37	8.30	7.01	8.11
3O			10.48		10.31	12.63	18.93	16.93	46.36	8.52	8.62	21.86	36.36	15.84	33.72	116.31	16.20	9.82	10.53
3NO			12.46		13.23	11.61	25.70	20.78	26.28	9.85	14.60	18.77	38.03	20.24	22.44	87.07	12.39	8.46	9.41
Mean Weight per tow																			
3N	24.51	34.05	18.03	8.91	17.57	8.24	33.32	25.98	9.34	16.56	46.30	25.01	74.05	65.90	76.09	97.66	48.70	47.43	65.92
3O			25.19		12.17	12.63	19.42	15.93	57.28	12.17	22.32	19.13	93.8	72.35	68.98	208.96	88.67	55.48	58.81
3NO			21.40		14.48	10.71	26.36	20.72	32.74	14.29	37.00	21.92	84.01	69.24	72.41	155.55	69.39	51.60	62.10

Table 15. Cod abundance (000s) from stratified-random cruises in Division 3N. Numbers in brackets are estimates for non-sampled strata.

Depth range (fath)	Strata	Area	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1984	1985	1986	1987	1988	1989	1990
0-30	375	1593	5076	3826	398	1435	6616	(835)	7474	4329	263	508	10583	1578	1746	3184	912	2167	1116	1674	1225
	376	1499	(1015)	788	37	(122)	1294	113	3601	225	225	113	225	33	7933	48	177	2813	375	113	177
31-50	360	2992	(3957)	1516	(439)	(565)	2302	3425	4211	1011	1273	2695	523	2118	5680	3005	552	1198	1422	165	569
	361	1853	5747	5796	835	904	3623	723	5610	4764	1166	1808	(2901)	4961	3283	10293	3310	10484	2841	1904	2380
	362	2520	2484	11823	984	1466	431	1021	5830	7440	757	1203	3859	1608	18971	4385	2391	43871	1702	2605	3443
	373	2520	18897	3831	142	426	(1208)	76	946	5959	327	331	1892	1589	8160	770	675	4307	1097	822	227
	374	931	1563	175	175	1	140	(96)	1607	1817	297	1	163	1677	2893	175	47	266	363	28	209
	383	674	74	1644	51	25	(73)	17	320	1493	34	1	118	25	34	1	1	422	51	84	
51-100	359	421	(1092)	822	622	(169)	(404)	4709	1359	(815)	549	2133	611	126	95	0	1264	332	269	95	47
	377	100	(352)	1066	143	613	413	(59)	2800	105	73	490	1146	278	56	105	23	758	0	19	0
	382	647	425	3447	16	130	(146)	24	2639	1943	243	255	146	194	0	134	12	16	24	81	
101-150	358	225	(1583)	861	4189	(257)	(594)	(274)	262	(1186)	431	1993	135	1343	380	448	760	1478	549	729	456
	378	139	619	3673	459	1683	(390)	(180)	657	120	400	1445	193	1236	318	2181	433	151	157	198	172
	381	182	1195	779	861	79	156	(167)	3267	364	155	379	779	1851	301	2391	1312	68	191	102	
151-200	357	164	(214)	(188)	1157	(30)	(77)	(33)	12	(159)	49	336	37	382	0	2381	137	(187)	6	18	123
	379	106	(248)	(217)	1802	785	(91)	(41)	24	0	671	408	40	322	175	525	801	4	8	44	139
	380	116	17	118	641	70	(71)	(31)	22	(144)	96	26	15	(70)	83	788	136	313	226	118	
Total		16682	50712	41732	13373	9709	19861	12844	40640	33220	7008	14124	25085	19426	50108	31262	12943	68968	10397	8772	9168
Estimated mean no. per tow			40.50	33.33	10.68	7.75	15.86	10.28	32.45	26.53	5.60	11.28	20.03	15.01	40.02	24.97	10.34	55.08	8.30	7.01	8.11

Table 16. Cod abundance (000s) from stratified-random cruises in Division 3Ø. Numbers in brackets are estimates for non-sampled strata.

Depth range (fath)	Strata	Area	1973	1975	1976	1977	1978	1979	1980	1981	1982	1984	1985	1986	1987	1988	1989	1990
31-50	330	2089	2144	419	679	889	1071	3674	1411	941	359	1921	1461	823	3763	993	342	949
	331	456	34	49	624	(199)	240	205	1284	(138)	377	993	548	214	650	240	137	
	338	1898	2451	4987	3230	9047	1311	2666	1681	(1801)	4103	10116	2391	2976	5305	1781	3818	1371
	340	1716	(1048)	215	4164	258	708	1730	386	859	2340	2898	2733	2576	55431	1178	615	873
	351	2520	2837	936	615	4843	2535	39981	1513	3689	8701	18538	4413	32509	28753	2913	1470	2033
	352	2580	3409	1290	1791	5965	4648	3486	2113	(2218)	3486	11814	4859	2988	12097	8821	3769	4320
	353	1282	224	705	48	320	1732	4388	48	(198)	257	1	674	165	1700	1674	385	529
51-100	329	1721	129	(323)	3682	172	1731	1012	65	129	753	775	501	501	42933	22133	388	1200
	332	1047	(753)	1729	367	1729	7309	2613	118	(579)	5678	236	1839	458	2546	1297	393	1556
	337	948	735	688	356	249	320	516	48	(199)	285	142	939	882	451	249	1281	285
	339	585	220	22	(112)	(133)	329	1361	(62)	198	2448	1054	88	29	278	102	15	132
	354	474	261	(101)	712	36	(226)	729	2075	107	107	142	261	178	1975	160	36	53
101-150	333	151	(13)	958	85	0	4	0	6	(9)	60	0	17	53	340	0	283	74
	336	121	9	0	0	141	5	2	95	(2)	41	0	9	45	9	5	5	59
	355	103	19	0	4	(14)	(18)	19	128	19	151	0	398	12	54	12	178	50
151-200	334	92	(5)	(2)	7	0	2	0	21	(3)	3	0	152	856	14	70	52	235
	335	58	7	(0)	1	(0)	0	0	3	(0)	4	0	0	40	4	7	4	26
	356	61	2	(0)	(0)	(0)	(1)	5	18	2	(2)	0	0	9	2	30	37	40
Total		17902	15498	12738	16580	24242	22372	62388	11140	13609	29155	48628	21283	45316	156302	21767	13200	13785
Estimated mean no. per tow			11.53	9.48	12.34	18.04	16.65	46.43	8.29	10.13	21.70	36.19	15.84	33.72	116.31	16.20	9.82	10.53

Table 17. Mean number of cod at age and per standard tow from research vessel surveys in NAFO Divisions 3NO.

# Sets	1971[a] 45	1972[a] 45	1973 94	1974[a] 37	1975 58	1976 78	1977 88	1978 88	1979 172	1980 140	1981 77	1982 130	1984 116	1985 178	1986 203	1987 191	1988 161	1989 195
Age																		
1	0.0	0.01	0.07	0.05	0.46	0.58	0.01	0.55	3.09	0.01	0.35	1.56	0.01	0.01	.02	.21	.01	0.02
2	4.18	1.17	2.64	1.39	3.16	3.89	2.35	0.71	0.93	5.39	0.38	9.37	3.28	0.41	.70	2.77	1.67	0.25
3	42.14	9.01	2.69	4.97	4.70	2.89	9.71	7.07	2.33	1.38	5.39	1.18	6.20	4.47	.71	2.85	2.22	1.90
4	5.80	19.28	1.88	0.89	2.64	1.83	6.29	8.17	9.25	0.67	1.58	3.54	9.90	6.05	7.71	9.33	.46	1.10
5	4.43	1.72	2.48	0.44	0.59	1.66	4.63	2.48	7.84	1.07	1.83	.60	5.29	2.41	6.46	34.86	.41	0.28
6	1.06	.71	0.50	0.38	0.31	0.26	1.54	0.96	1.76	0.44	2.32	.47	5.60	.88	1.62	21.25	1.06	0.30
7	1.08	.58	0.28	0.14	0.60	0.07	0.49	0.61	0.52	0.21	1.13	.78	1.87	.97	.68	8.33	1.17	0.68
8	0.48	.41	0.20	0.04	0.25	0.13	0.22	0.04	0.26	0.18	0.50	.58	1.00	.73	.65	1.78	.78	0.62
9	0.24	.30	0.22	0.01	0.25	0.06	0.10	0.01	0.10	0.18	0.53	.26	1.81	.88	.50	1.94	.82	0.44
10	0.03	.17	0.13	0.07	0.08	0.07	0.10	0.03	0.02	0.09	0.24	.16	1.57	1.34	.74	.69	.87	0.48
11	0.08	.08	0.06	0.03	0.01	0.02	0.01	0.04	0.06	0.05	0.04	.07	.86	.98	1.20	.77	.44	0.64
12	0.14	.05	0.09		0.02		0.04	0	0	0.07	0.14	.05	.32	.49	.65	.71	.55	0.42
13			0.14		0.01		0.09	0.04	0.04	0.03	0.06	.01	.11	.24	.36	.81	.79	0.33
14+	0.47	.36	0.50	0.15	0.15	0.05	0.12	0.01	0.10	0.12	0.17	.14	.22	.39	.52	.77	1.24	1.01
Mean no. per tow	60.13	33.85	11.89	8.56	13.23	11.51	25.70	20.72	26.30	9.89	14.66	18.76	38.03	20.24	22.42	87.07	12.39	8.47
Upper Limit	117.35	51.51	15.47	12.50	25.93	17.94	33.96	31.81	47.18	12.85	23.61	25.28	47.82	24.06	44.11	119.64	15.18	11.07
Lower Limit	2.93	16.10	8.33	4.62	0.52	5.09	17.45	9.90	5.49	6.91	5.70	12.24	28.25	16.42	0.74	54.49	9.60	5.86

[a]Survey 3N only.

TABLE 18 . MEAN NUMBER PER TOW AT AGE OF COD FROM RV SURVEYS CONDUCTED BY CANADA IN DIV. 3NO (SURVEY ADJUSTED FOR MISSING STRATA).

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	0.00	0.01	0.07	0.05	0.44	0.57	0.01	0.57	3.14	0.01	0.36
2	2.82	1.15	2.47	1.26	3.00	3.84	2.29	0.73	0.95	5.30	0.39
3	28.38	8.87	2.52	4.50	4.46	2.85	9.44	7.31	2.37	1.36	5.48
4	3.91	18.98	1.76	0.81	2.51	1.80	6.12	8.45	9.40	0.66	1.61
5	2.98	1.69	2.32	0.40	0.56	1.64	4.50	2.56	7.97	1.05	1.86
6	0.71	0.70	0.47	0.34	0.29	0.26	1.50	0.99	1.79	0.43	2.36
7	0.73	0.57	0.26	0.13	0.57	0.07	0.48	0.63	0.53	0.21	1.15
8	0.32	0.40	0.19	0.04	0.24	0.13	0.21	0.04	0.26	0.18	0.51
9	0.16	0.30	0.21	0.01	0.24	0.06	0.10	0.01	0.10	0.18	0.54
10	0.02	0.17	0.12	0.06	0.08	0.07	0.10	0.03	0.02	0.09	0.24
11	0.05	0.08	0.06	0.03	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	0.14
13	0.00	0.00	0.13	0.00	0.01	0.00	0.09	0.04	0.04	0.03	0.06
14	0.32	0.35	0.47	0.14	0.14	0.05	0.12	0.01	0.10	0.12	0.17
1+	40.50	33.33	11.11	7.75	12.56	11.35	24.99	21.42	26.74	9.73	14.91
2+	40.50	33.32	11.05	7.70	12.12	10.78	24.98	20.85	23.60	9.72	14.55
3+	37.68	32.17	8.58	6.45	9.12	6.94	22.70	20.12	22.65	4.42	14.17
4+	9.30	23.30	6.06	1.95	4.66	4.09	13.25	12.81	20.28	3.06	8.69
5+	5.40	4.31	4.30	1.14	2.16	2.29	7.14	4.36	10.88	2.40	7.08
6+	2.41	2.62	1.98	0.74	1.59	0.65	2.64	1.80	2.91	1.35	5.22

	1982	1984	1985	1986	1987	1988	1989
1	1.54	0.01	0.01	0.02	0.21	0.01	0.02
2	9.23	3.28	0.41	0.70	2.76	1.67	0.25
3	1.16	6.20	4.47	0.71	2.84	2.22	1.90
4	3.49	9.90	6.05	7.72	9.30	0.46	1.10
5	0.59	5.29	2.41	6.47	34.75	0.41	0.28
6	0.46	5.60	0.88	1.62	21.18	1.06	0.30
7	0.77	1.87	0.97	0.68	8.30	1.17	0.68
8	0.57	1.00	0.73	0.65	1.77	0.78	0.62
9	0.26	1.81	0.88	0.50	1.93	0.82	0.44
10	0.16	1.57	1.34	0.74	0.69	0.87	0.48
11	0.07	0.86	0.98	1.20	0.77	0.44	0.64
12	0.05	0.32	0.49	0.65	0.71	0.55	0.42
13	0.01	0.11	0.24	0.36	0.81	0.79	0.33
14	0.14	0.22	0.39	0.52	0.77	1.24	1.01
1+	18.48	38.05	20.25	22.54	86.80	12.49	8.47
2+	16.94	38.04	20.24	22.52	86.59	12.48	8.45
3+	7.72	34.76	19.83	21.82	83.83	10.81	8.20
4+	6.56	28.56	15.36	21.11	80.99	8.59	6.30
5+	3.07	18.65	9.31	13.39	71.69	8.13	5.20
6+	2.48	13.36	6.90	6.93	36.94	7.72	4.92

1971, 1972 AND 1974 SURVEYS IN DIV. 3N ONLY

TABLE 19. CATCH AT AGE OF COD IN DIV. 3NO FOR THE YEARS 1959-89.

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
3	1711	1846	812	1026	313	6202	1013	753	20086	16359
4	13036	6503	4400	3882	5757	15555	7611	18413	62442	56775
5	5068	22050	11696	2206	11210	19496	7619	19681	50317	48608
6	6025	3095	15258	1581	4849	7919	13258	11795	18517	18485
7	3935	2377	2014	3594	1935	2273	9861	8486	4774	6337
8	1392	2504	1672	773	3840	1109	4827	4467	4651	1592
9	757	583	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
3+	34173	40485	37165	14605	30207	53819	46822	67297	161319	148974
4+	32462	38639	36353	13579	29894	47617	45809	66544	141233	132615
5+	19426	32136	31953	9697	24137	32062	38198	48131	78791	75840
6+	14358	10086	20257	7491	12927	12566	30579	28450	28474	27232

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
3	8154	2105	950	69	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	5883	1971	2247	3057	211	572	354	883
8	1393	1635	2500	1686	972	2147	1059	238	177	102	265
9	518	541	500	285	707	1015	921	44	209	58	58
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
3+	63846	48376	76700	53809	62891	44475	21387	19169	8196	9171	17133
4+	55692	46271	75750	53740	52833	38050	20716	15115	7589	8251	17061
5+	42768	26568	48850	33943	25233	28549	11935	7581	5120	3914	13234
6+	15819	15769	18550	21654	10135	17642	8407	1636	2589	1396	4026

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
3	266	505	305	1179	58	57	153	516	276	1603
4	1055	1091	1978	647	1000	2953	2865	422	314	1857
5	3812	1262	1591	1893	1411	6203	6423	3491	1499	1293
6	2275	2297	1012	1204	2324	3036	4370	3445	6211	1143
7	761	1902	1528	686	1220	2519	1512	1213	3872	1707
8	222	574	1492	1152	720	797	948	653	993	1143
9	92	192	595	774	918	459	558	845	561	438
10	31	94	211	238	551	533	373	494	421	216
11	8	41	162	81	106	261	349	398	247	163
12	13	13	27	41	42	97	135	404	141	93
3+	8535	7971	8901	7895	8350	16915	17686	11881	14535	9656
4+	8269	7466	8596	6716	8292	16858	17533	11365	14259	8053
5+	7214	6375	6618	6069	7292	13905	14668	10943	13945	6196
6+	3402	5113	5027	4176	5881	7702	8245	7452	12446	4903

TABLE 20. WEIGHT AT AGE OF COD IN DIV. 3NO FOR THE YEARS 1959-89.

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

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

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

Table 21. Revised catch and average weights at age for cod in Divisions 3NO for 1989.

	Canada		Portugal		Spain		Total		Total All
Age	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	Countries
2					112	0.17	112	0.17	112
3	11	0.77			1586	0.51	1597	0.51	1603
4	235	1.10			1615	0.93	1850	0.97	1857
5	260	1.47			1028	1.63	1288	1.60	1293
6	619	2.17			519	2.33	1138	2.24	1143
7	899	2.93	1	5.19	800	3.65	1700	3.27	1707
8	485	4.00	5	6.56	649	5.05	1139	4.61	1143
9	184	5.70	21	7.68	228	8.14	433	7.08	438
10	130	7.48	16	9.05	69	9.69	215	8.31	216
11	137	9.04	11	10.26	14	13.00	162	9.47	163
12	63	10.97	6	11.57	24	15.78	93	12.25	93
13	76	11.98	4	13.07	26	14.76	106	12.70	106
14	72	12.75	4	13.94	14	15.00	90	13.15	90
15	47	13.63	2	14.61			49	13.67	49
16	15	15.79					15	15.79	15
17	8	16.82					8	16.82	8
18	2	17.36					2	17.36	2
19	1	16.99					1	16.99	1
20	1	23.25					1	23.25	1
#	3245		70		6684		9999		10040
wt.	13489		673		15277		29439		29556

TABLE 22. PARAMETER ESTIMATES FROM ADAPT FOR DIV. 3NO COD USING RV SURVEY DATA FOR CANADA AND THE USSR IN A SINGLE ANALYSIS.

ESTIMATED PARAMETERS AND STANDARD ERRORS
APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.071351
MEAN SQUARE RESIDUALS 0.870790

AGE	PARAMETER	ESTIMATE	STD. ERR.	T-STATISTIC	C.V.
3	ABUNDANCE	7.75071E3	4.76659E3	1.62605E0	0.61
4	ABUNDANCE	7.16846E3	3.26647E3	2.19456E0	0.46
5	ABUNDANCE	2.00431E3	5.81954E2	3.44410E0	0.29
6	ABUNDANCE	1.91492E3	6.33834E2	3.02117E0	0.33
7	ABUNDANCE	4.70166E3	2.06679E3	2.27487E0	0.44
8	ABUNDANCE	5.91582E3	2.68724E3	2.20145E0	0.45
9	ABUNDANCE	2.12253E3	1.01270E3	2.09590E0	0.48
10	ABUNDANCE	1.40726E3	6.62940E2	2.12275E0	0.47
11	ABUNDANCE	1.50033E3	7.25768E2	2.06724E0	0.48
3	RV1 SLOPE	1.61613E-4	4.68577E-5	3.44903E0	0.29
4	RV1 SLOPE	2.22377E-4	6.33556E-5	3.50999E0	0.28
5	RV1 SLOPE	2.13336E-4	6.15932E-5	3.46363E0	0.29
6	RV1 SLOPE	1.68845E-4	5.02327E-5	3.36125E0	0.30
7	RV1 SLOPE	1.53897E-4	4.75184E-5	3.23868E0	0.31
8	RV1 SLOPE	1.37652E-4	4.31628E-5	3.18914E0	0.31
9	RV1 SLOPE	1.56022E-4	4.98837E-5	3.12772E0	0.32
10	RV1 SLOPE	2.00202E-4	6.40979E-5	3.12337E0	0.32
11	RV1 SLOPE	2.06121E-4	6.61017E-5	3.11824E0	0.32
3	RV2 SLOPE	4.90895E-4	1.36664E-4	3.59200E0	0.28
4	RV2 SLOPE	3.87703E-4	1.06435E-4	3.64263E0	0.27
5	RV2 SLOPE	3.36263E-4	9.36104E-5	3.59216E0	0.28
6	RV2 SLOPE	2.90720E-4	8.34183E-5	3.48508E0	0.29
7	RV2 SLOPE	2.63533E-4	7.84947E-5	3.35734E0	0.30
8	RV2 SLOPE	2.30482E-4	7.02293E-5	3.28185E0	0.30
9	RV2 SLOPE	2.49633E-4	7.70565E-5	3.23960E0	0.31
10	RV2 SLOPE	2.57742E-4	7.99663E-5	3.22313E0	0.31
11	RV2 SLOPE	2.43946E-4	7.56915E-5	3.22290E0	0.31

TABLE 23. RESIDUALS FOR BOTH CANADIAN AND SOVIET RV SURVEY INDICES FROM ADAPT ANALALYSIS FOR DIV. 3NO COD.

LOG RESIDUALS FOR CANADIAN RV SURVEY INDEX 12/ 6/90

!	1977	1978	1979	1980	1981	1982	1984	1985	1986	1987	1988	1989
3 !	0.191	-0.218	-0.309	-0.933	0.094	-1.143	-0.123	-0.080	-0.317	1.646	0.518	0.612
4 !	0.280	0.018	-0.038	-1.677	-0.849	-0.434	0.566	-0.230	0.401	2.190	-0.146	-0.144
5 !	0.914	-0.204	0.437	-1.884	-0.313	-1.516	0.583	-0.426	0.247	2.314	-0.410	0.194
6 !	0.447	0.082	0.099	-1.743	-0.532	-1.158	0.950	-0.573	0.035	2.132	-0.282	0.478
7 !	0.403	0.075	-0.060	-1.540	-0.299	-1.267	0.660	-0.269	-0.220	2.352	-0.138	0.241
8 !	0.811	-1.531	-0.387	-0.657	-0.200	-0.477	0.465	0.228	-0.093	1.296	0.576	-0.091
9 !	-0.285	-1.935	-0.490	-0.639	0.628	-0.655	0.157	0.568	0.124	1.287	0.814	0.363
10 !	0.822	-1.286	-1.211	-0.629	-0.318	-0.521	0.952	-0.108	0.504	0.627	0.670	0.434
11 !	-1.405	0.347	-0.372	-0.114	-1.187	-1.323	0.931	0.814	0.023	0.927	0.606	0.692

SUM OF RV 1 RESIDUALS : -0.5638344940 MEAN RESIDUAL : -0.0052206898

LOG RESIDUALS FOR SOVIET RV SURVEY INDEX 12/ 6/90

!	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
3 !	-0.029	-0.406	-0.948	-1.069	-0.832	-0.102	-0.240	0.449	1.475	1.432	0.233	0.583	-0.610
4 !	0.486	0.150	-1.500	-0.941	-0.444	0.094	0.296	0.940	1.335	1.532	-0.596	-0.618	-0.795
5 !	0.970	0.779	-0.870	-1.435	-0.747	0.878	0.239	0.988	1.935	1.070	-1.689	-1.583	-0.598
6 !	0.809	0.933	-0.690	-0.660	-1.751	0.404	1.062	0.459	1.553	1.331	-1.465	-1.577	-0.470
7 !	1.194	0.468	-0.183	-0.318	-1.199	-0.625	0.677	0.748	1.125	1.153	-0.526	-1.749	-0.828
8 !	1.614	0.628	-0.488	0.201	-0.956	-2.042	-0.425	0.537	1.057	1.256	-0.016	-0.607	-0.822
9 !	0.372	0.557	-0.283	-0.582	-0.833	0.420	0.539	-0.811	0.408	1.262	-0.065	-0.151	-0.896
10 !	0.598	-0.367	0.822	-0.067	-1.463	0.718	0.460	0.025	-0.471	0.814	0.392	-0.137	-1.387
11 !	0.757	1.061	-0.046	0.427	-0.456	-0.021	0.546	-0.697	0.155	-0.840	0.330	0.054	-1.333

SUM OF RV 2 RESIDUALS : -0.5633302010 MEAN RESIDUAL : -0.0048147880

TABLE 24. CORRELATIONS BETWEEN ESTIMATED PARAMETERS FROM AN ADAPT ANALYSIS FOR COD IN DIV. 3NO USING CANADIAN AND SOVIET RV DATA.

PARAMETER CORRELATION MATRIX 7/ 6/90

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1.00	0.07	0.05	0.05	0.06	0.07	0.06	0.07	0.07	-0.23	-0.04	-0.04	-0.04	-0.05
2	0.07	1.00	0.07	0.07	0.08	0.10	0.09	0.10	0.11	-0.18	-0.20	-0.05	-0.06	-0.07
3	0.05	0.07	1.00	0.08	0.10	0.13	0.12	0.12	0.13	-0.12	-0.13	-0.23	-0.08	-0.09
4	0.05	0.07	0.08	1.00	0.13	0.16	0.15	0.16	0.17	-0.12	-0.12	-0.14	-0.25	-0.11
5	0.06	0.08	0.10	0.13	1.00	0.18	0.22	0.24	0.26	-0.14	-0.15	-0.17	-0.21	-0.31
6	0.07	0.10	0.13	0.16	0.18	1.00	0.29	0.33	0.35	-0.18	-0.18	-0.21	-0.26	-0.30
7	0.06	0.09	0.12	0.15	0.22	0.29	1.00	0.32	0.35	-0.14	-0.17	-0.20	-0.26	-0.31
8	0.07	0.10	0.12	0.16	0.24	0.33	0.32	1.00	0.39	-0.18	-0.15	-0.21	-0.26	-0.32
9	0.07	0.11	0.13	0.17	0.26	0.35	0.35	0.39	1.00	-0.18	-0.19	-0.19	-0.28	-0.33
10	-0.23	-0.18	-0.12	-0.12	-0.14	-0.18	-0.14	-0.18	-0.18	1.00	0.10	0.09	0.11	0.12
11	-0.04	-0.20	-0.13	-0.12	-0.15	-0.18	-0.17	-0.15	-0.19	0.10	1.00	0.09	0.11	0.12
12	-0.04	-0.05	-0.23	-0.14	-0.17	-0.21	-0.20	-0.21	-0.19	0.09	0.09	1.00	0.13	0.14
13	-0.04	-0.06	-0.08	-0.25	-0.21	-0.26	-0.26	-0.26	-0.28	0.11	0.11	0.13	1.00	0.18
14	-0.05	-0.07	-0.09	-0.11	-0.31	-0.30	-0.31	-0.32	-0.33	0.12	0.12	0.14	0.18	1.00
15	-0.05	-0.07	-0.09	-0.11	-0.19	-0.37	-0.34	-0.35	-0.36	0.12	0.13	0.15	0.19	0.23
16	-0.05	-0.08	-0.09	-0.12	-0.21	-0.30	-0.40	-0.38	-0.40	0.13	0.13	0.15	0.20	0.24
17	-0.05	-0.08	-0.09	-0.12	-0.22	-0.31	-0.31	-0.42	-0.42	0.13	0.13	0.15	0.20	0.24
18	-0.05	-0.08	-0.09	-0.12	-0.23	-0.33	-0.33	-0.35	-0.46	0.13	0.13	0.15	0.20	0.24
19	-0.23	-0.17	-0.12	-0.12	-0.14	-0.18	-0.17	-0.18	-0.19	0.13	0.10	0.09	0.11	0.12
20	-0.04	-0.19	-0.13	-0.12	-0.15	-0.19	-0.17	-0.19	-0.20	0.10	0.10	0.10	0.11	0.13
21	-0.04	-0.06	-0.22	-0.14	-0.17	-0.22	-0.20	-0.22	-0.23	0.10	0.10	0.13	0.13	0.15
22	-0.05	-0.06	-0.08	-0.25	-0.22	-0.27	-0.26	-0.27	-0.28	0.11	0.11	0.13	0.18	0.19
23	-0.05	-0.07	-0.09	-0.11	-0.30	-0.32	-0.32	-0.32	-0.34	0.12	0.12	0.15	0.19	0.23
24	-0.05	-0.08	-0.09	-0.12	-0.20	-0.37	-0.36	-0.36	-0.38	0.13	0.13	0.15	0.20	0.24
25	-0.05	-0.08	-0.09	-0.12	-0.21	-0.30	-0.40	-0.39	-0.41	0.13	0.13	0.15	0.20	0.24
26	-0.06	-0.08	-0.09	-0.12	-0.22	-0.32	-0.32	-0.42	-0.44	0.13	0.13	0.15	0.20	0.25
27	-0.06	-0.08	-0.09	-0.12	-0.24	-0.34	-0.33	-0.36	-0.47	0.13	0.14	0.15	0.20	0.25

TABLE 24. CONTINUED

PARAMETER CORRELATION MATRIX 7/ 6/90

	15	16	17	18	19	20	21	22	23	24	25	26	27
1	-0.05	-0.05	-0.05	-0.05	-0.23	-0.04	-0.04	-0.05	-0.05	-0.05	-0.05	-0.06	-0.06
2	-0.07	-0.08	-0.08	-0.08	-0.17	-0.19	-0.06	-0.06	-0.07	-0.08	-0.08	-0.08	-0.08
3	-0.09	-0.09	-0.09	-0.09	-0.12	-0.13	-0.22	-0.08	-0.09	-0.09	-0.09	-0.09	-0.09
4	-0.11	-0.12	-0.12	-0.12	-0.12	-0.12	-0.14	-0.25	-0.11	-0.12	-0.12	-0.12	-0.12
5	-0.19	-0.21	-0.22	-0.23	-0.14	-0.15	-0.17	-0.22	-0.30	-0.20	-0.21	-0.22	-0.24
6	-0.37	-0.30	-0.31	-0.33	-0.18	-0.19	-0.22	-0.27	-0.32	-0.37	-0.30	-0.32	-0.34
7	-0.34	-0.40	-0.31	-0.33	-0.17	-0.17	-0.20	-0.26	-0.32	-0.36	-0.40	-0.32	-0.33
8	-0.35	-0.38	-0.42	-0.35	-0.18	-0.19	-0.22	-0.27	-0.32	-0.36	-0.39	-0.42	-0.36
9	-0.36	-0.40	-0.42	-0.46	-0.19	-0.20	-0.23	-0.28	-0.34	-0.38	-0.41	-0.44	-0.47
10	0.12	0.13	0.13	0.13	0.13	0.10	0.10	0.11	0.12	0.13	0.13	0.13	0.13
11	0.13	0.13	0.13	0.13	0.10	0.10	0.10	0.11	0.12	0.13	0.13	0.13	0.14
12	0.15	0.15	0.15	0.15	0.09	0.10	0.13	0.13	0.15	0.15	0.15	0.15	0.15
13	0.19	0.20	0.20	0.20	0.11	0.11	0.13	0.18	0.19	0.20	0.20	0.20	0.20
14	0.23	0.24	0.24	0.24	0.12	0.13	0.15	0.19	0.23	0.24	0.24	0.25	0.25
15	1.00	0.26	0.26	0.26	0.13	0.13	0.16	0.19	0.23	0.26	0.26	0.26	0.27
16	0.26	1.00	0.28	0.28	0.13	0.14	0.16	0.20	0.25	0.27	0.29	0.28	0.28
17	0.26	0.28	1.00	0.28	0.13	0.14	0.16	0.20	0.25	0.27	0.28	0.29	0.28
18	0.26	0.28	0.28	1.00	0.14	0.14	0.16	0.20	0.25	0.27	0.28	0.29	0.29
19	0.13	0.13	0.13	0.14	1.00	0.10	0.10	0.11	0.13	0.13	0.14	0.14	0.14
20	0.13	0.14	0.14	0.14	0.10	1.00	0.10	0.12	0.13	0.14	0.14	0.14	0.14
21	0.16	0.16	0.16	0.16	0.10	0.10	1.00	0.14	0.15	0.16	0.16	0.17	0.17
22	0.19	0.20	0.20	0.20	0.11	0.12	0.14	1.00	0.19	0.20	0.20	0.21	0.21
23	0.23	0.25	0.25	0.25	0.13	0.13	0.15	0.19	1.00	0.24	0.25	0.25	0.25
24	0.26	0.27	0.27	0.27	0.13	0.14	0.16	0.20	0.24	1.00	0.27	0.27	0.27
25	0.26	0.29	0.28	0.28	0.14	0.14	0.16	0.20	0.25	0.27	1.00	0.29	0.28
26	0.26	0.28	0.29	0.29	0.14	0.14	0.17	0.21	0.25	0.27	0.29	1.00	0.29
27	0.27	0.28	0.28	0.29	0.14	0.14	0.17	0.21	0.25	0.27	0.28	0.29	1.00

TABLE 25. POPULATION NUMBERS AND FISHING MORTALITY DERIVED FROM AN ADAPT USING CANADIAN AND SOVIET RV DATA FOR COD IN DIV. 3NO.

POPULATION NUMBERS (000S) 12/ 6/90

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
3	52714	61550	21741	23341	33807	24654	35438	47204	32588	6630	3931	9026	7719
4	23778	42610	49560	17735	18869	27222	19909	27947	38595	26630	5290	2752	7140
5	10466	17233	30961	37114	13566	14462	20498	15715	21976	28927	19210	3949	1969
6	6909	6278	11831	17017	26937	9965	10401	15069	11589	12380	17872	12569	1877
7	2535	4299	4400	7167	11874	19976	7243	7426	10235	6742	6182	11515	4671
8	839	1558	3200	2804	5180	8001	14972	5309	4976	6100	4151	3964	5924
9	1004	526	1183	2380	2095	3721	5200	11216	3695	3353	4137	2808	2347
10	265	633	379	916	1865	1541	2508	3557	8352	2610	2240	2622	1791
11	229	158	472	295	722	1442	1071	1838	2414	6356	1799	1387	1766
12	261	151	122	376	234	554	1034	803	1409	1740	4888	1113	912
3+	98999	134996	123850	109144	115149	111538	118274	136085	135831	101467	69700	51705	36116

FISHING MORTALITY 12/ 6/90

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
3	0.013	0.017	0.004	0.013	0.017	0.014	0.037	0.001	0.002	0.026	0.157	0.034	0.259
4	0.122	0.119	0.089	0.068	0.066	0.084	0.037	0.040	0.088	0.127	0.092	0.135	0.336
5	0.311	0.176	0.399	0.120	0.108	0.130	0.108	0.105	0.374	0.282	0.224	0.544	1.259
6	0.274	0.155	0.301	0.160	0.099	0.119	0.137	0.187	0.342	0.494	0.240	0.790	1.080
7	0.287	0.095	0.251	0.125	0.195	0.088	0.111	0.200	0.317	0.285	0.244	0.465	0.511
8	0.266	0.075	0.096	0.092	0.131	0.231	0.089	0.162	0.195	0.188	0.191	0.324	0.238
9	0.261	0.130	0.056	0.044	0.107	0.194	0.180	0.095	0.148	0.203	0.256	0.249	0.230
10	0.317	0.093	0.051	0.038	0.057	0.164	0.111	0.188	0.073	0.172	0.279	0.195	0.142
11	0.220	0.058	0.028	0.030	0.065	0.133	0.087	0.066	0.127	0.063	0.280	0.219	0.107
12	0.112	0.037	0.065	0.039	0.063	0.055	0.045	0.059	0.079	0.089	0.095	0.150	0.119

TABLE 26. PARAMETER ESTIMATES FROM ADAPT USING CANADIAN RV DATA AS WELL FLAT-TOPPED PR FOR COD IN DIVISIONS 3NO.

ESTIMATED PARAMETERS AND STANDARD ERRORS
APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.002506
MEAN SQUARE RESIDUALS 0.678606

AGE	PARAMETER	ESTIMATE	STD. ERR.	T-STATISTIC	C.V.
3	ABUNDANCE	1.50660E4	1.23432E4	1.22059E0	0.82
4	ABUNDANCE	9.00256E3	5.22740E3	1.72219E0	0.58
5	ABUNDANCE	3.15698E3	1.46831E3	2.15008E0	0.47
6	ABUNDANCE	3.06834E3	1.49332E3	2.05471E0	0.49
7	ABUNDANCE	8.09602E3	4.35493E3	1.85905E0	0.54
8	ABUNDANCE	8.02247E3	4.14445E3	1.93571E0	0.52
9	ABUNDANCE	3.82185E3	1.97180E3	1.93825E0	0.52
10	ABUNDANCE	1.84800E3	9.75876E2	1.89369E0	0.53
11	ABUNDANCE	1.84368E3	9.72828E2	1.89517E0	0.53
3	RV SLOPE	1.44930E-4	3.89390E-5	3.72197E0	0.27
4	RV SLOPE	2.12151E-4	5.49992E-5	3.85735E0	0.26
5	RV SLOPE	2.07803E-4	5.36288E-5	3.87485E0	0.26
6	RV SLOPE	1.76535E-4	4.62879E-5	3.81384E0	0.26
7	RV SLOPE	1.81889E-4	4.85021E-5	3.75012E0	0.27
8	RV SLOPE	1.86844E-4	4.98784E-5	3.74600E0	0.27
9	RV SLOPE	2.52516E-4	6.80112E-5	3.71286E0	0.27
10	RV SLOPE	4.00535E-4	1.07518E-4	3.72527E0	0.27
11	RV SLOPE	5.24513E-4	1.41486E-4	3.70718E0	0.27

TABLE 27. ESTIMATED PARAMETERS AND RESIDUALS FOR ADAPT USING CANADIAN RV DATA FOR COD IN DIVISIONS 3NO.

ESTIMATED PARAMETERS AND STANDARD ERRORS
APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.003833
MEAN SQUARE RESIDUALS 0.781374

AGE	PARAMETER	ESTIMATE	STD. ERR.	T-STATISTIC	C.V.
3	ABUNDANCE	2.60666E4	2.46408E4	1.05786E0	0.95
4	ABUNDANCE	1.58247E4	1.11075E4	1.42469E0	0.70
5	ABUNDANCE	5.93465E3	3.59766E3	1.64958E0	0.61
6	ABUNDANCE	6.80851E3	4.20584E3	1.61882E0	0.62
7	ABUNDANCE	2.94659E4	1.88650E4	1.56194E0	0.64
8	ABUNDANCE	2.55653E4	1.63985E4	1.55900E0	0.64
9	ABUNDANCE	9.17254E3	6.31746E3	1.45194E0	0.69
10	ABUNDANCE	5.60335E3	3.92515E3	1.42755E0	0.70
11	ABUNDANCE	6.48256E3	4.62480E3	1.40170E0	0.71
3	RV SLOPE	8.18084E-5	3.36774E-5	2.42918E0	0.41
4	RV SLOPE	1.18641E-4	4.78116E-5	2.48143E0	0.40
5	RV SLOPE	1.09178E-4	4.47694E-5	2.43867E0	0.41
6	RV SLOPE	7.86100E-5	3.52714E-5	2.22872E0	0.45
7	RV SLOPE	7.15211E-5	3.35215E-5	2.13359E0	0.47
8	RV SLOPE	6.68403E-5	3.20305E-5	2.08677E0	0.48
9	RV SLOPE	7.54090E-5	3.72997E-5	2.02171E0	0.49
10	RV SLOPE	9.89487E-5	4.90881E-5	2.01574E0	0.50
11	RV SLOPE	1.01130E-4	5.06404E-5	1.99702E0	0.50

LOG RESIDUALS FOR CANADIAN RV SURVEY INDEX 7/ 6/90

	1977	1978	1979	1980	1981	1982	1984	1985	1986	1987	1988	1989
3	0.66	-0.09	-0.17	-0.41	0.25	-0.95	-0.20	-0.39	-0.49	1.37	0.42	0.00
4	0.61	0.42	0.02	-1.60	-0.38	-0.35	0.68	-0.38	0.01	1.93	-0.56	-0.39
5	1.30	0.13	0.83	-1.83	-0.23	-1.02	0.73	-0.35	0.04	1.85	-0.81	-0.64
6	0.76	0.50	0.46	-1.33	-0.44	-1.04	1.06	-0.42	-0.01	1.86	-1.00	-0.40
7	0.69	0.31	0.30	-1.26	0.06	-1.22	1.19	-0.28	-0.22	2.08	-0.64	-1.02
8	1.19	-1.36	-0.23	-0.41	-0.01	-0.24	0.42	0.67	-0.30	1.11	0.07	-0.91
9	0.03	-1.62	-0.35	-0.51	0.85	-0.53	0.07	0.44	0.52	0.95	0.50	-0.35
10	1.12	-1.06	-0.95	-0.53	-0.24	-0.38	1.00	-0.27	0.26	0.93	0.16	-0.04
11	-1.16	0.58	-0.16	0.14	-1.10	-1.28	0.92	0.79	-0.17	0.55	0.83	0.07

SUM OF CANADIAN RV RESIDUALS : 0.0006837416 MEAN RESIDUAL : 0.0000063309

TABLE 28. POPULATION NUMBERS AND FISHING MORTALITY DERIVED FROM AN ADAPT ANALYSIS USING CANADIAN RV DATA FOR COD IN DIV. 3NO.

POPULATION NUMBERS (000S) 7/ 6/90

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
3	65013	106688	37325	27309	57102	40062	58025	100421	87590	15553	9793	19557	25993
4	31467	52679	86517	30494	22118	46294	32524	46440	82165	71661	12595	7551	15762
5	13429	23529	39205	67371	24012	17122	36113	26043	37117	64599	56079	9930	5898
6	10432	8705	16986	23767	51709	18517	12578	27854	20045	24776	47078	42755	6774
7	3900	7184	6387	11388	17400	40258	14245	9209	20702	13665	16331	35427	29385
8	1148	2675	5561	4430	8635	12525	31578	11042	6436	14670	9820	12273	25501
9	1459	780	2098	4313	3426	6550	8905	24811	8389	4548	11153	7449	9150
10	380	1006	586	1665	3448	2631	4824	6590	19483	6453	3219	8367	5591
11	354	252	777	464	1335	2738	1963	3735	4897	15469	4946	2188	6469
12	397	253	199	625	373	1056	2095	1534	2962	3773	12349	3689	1568
3+	127979	203750	195641	171827	189559	187754	202851	257679	289786	235168	183362	149185	132091

FISHING MORTALITY 7/ 6/90

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
3	0.010	0.010	0.002	0.011	0.010	0.008	0.023	0.001	0.001	0.011	0.060	0.016	0.070
4	0.091	0.095	0.050	0.039	0.056	0.048	0.022	0.024	0.041	0.045	0.038	0.047	0.138
5	0.234	0.126	0.301	0.065	0.060	0.108	0.060	0.062	0.204	0.116	0.071	0.183	0.274
6	0.173	0.110	0.200	0.112	0.050	0.062	0.112	0.097	0.183	0.217	0.084	0.175	0.205
7	0.177	0.056	0.166	0.077	0.129	0.043	0.055	0.158	0.144	0.130	0.086	0.129	0.066
8	0.187	0.043	0.054	0.057	0.076	0.141	0.041	0.075	0.147	0.074	0.076	0.094	0.050
9	0.172	0.086	0.031	0.024	0.064	0.106	0.101	0.042	0.062	0.146	0.087	0.087	0.049
10	0.209	0.058	0.033	0.021	0.031	0.093	0.056	0.097	0.031	0.066	0.186	0.057	0.034
11	0.137	0.036	0.017	0.019	0.035	0.068	0.047	0.032	0.061	0.025	0.093	0.133	0.024
12	0.072	0.022	0.039	0.023	0.039	0.029	0.022	0.031	0.037	0.040	0.037	0.043	0.053

TABLE 29. ESTIMATED PARAMETERS AND RESIDUALS FOR ADAPT USING SOVIET RV DATA FOR COD IN DIVISIONS 3NO.

ESTIMATED PARAMETERS AND STANDARD ERRORS
APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.000195
MEAN SQUARE RESIDUALS 0.873744

AGE	PARAMETER	ESTIMATE	STD. ERR.	T-STATISTIC	C.V.
3	ABUNDANCE	3.79025E3	2.67908E3	1.41476E0	0.71
4	ABUNDANCE	4.82391E3	2.85907E3	1.68723E0	0.59
5	ABUNDANCE	1.51952E3	1.97980E2	7.67515E0	0.13
6	ABUNDANCE	1.36983E3	2.14124E2	6.39738E0	0.16
7	ABUNDANCE	2.27188E3	6.98559E2	3.25223E0	0.31
8	ABUNDANCE	1.86781E3	9.01094E2	2.07283E0	0.48
9	ABUNDANCE	7.02751E2	3.70904E2	1.89470E0	0.53
10	ABUNDANCE	4.82290E2	3.14837E2	1.53187E0	0.65
11	ABUNDANCE	4.34325E2	2.91158E2	1.49171E0	0.67
3	RV SLOPE	6.41065E-4	1.76462E-4	3.63288E0	0.28
4	RV SLOPE	4.86312E-4	1.30032E-4	3.73994E0	0.27
5	RV SLOPE	4.44844E-4	1.20580E-4	3.68919E0	0.27
6	RV SLOPE	4.10229E-4	1.11852E-4	3.66759E0	0.27
7	RV SLOPE	4.07304E-4	1.12514E-4	3.62002E0	0.28
8	RV SLOPE	3.74826E-4	1.05002E-4	3.56970E0	0.28
9	RV SLOPE	4.13922E-4	1.17232E-4	3.53080E0	0.28
10	RV SLOPE	4.30867E-4	1.21972E-4	3.53252E0	0.28
11	RV SLOPE	4.15767E-4	1.16829E-4	3.55878E0	0.28

LOG RESIDUALS FOR SOVIET RV SURVEY INDEX 7/ 6/90

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
3	-0.23	-0.39	-1.02	-1.10	-0.88	-0.12	-0.33	0.45	1.39	1.33	0.20	0.71	0.00
4	0.37	-0.01	-1.43	-0.97	-0.43	0.10	0.32	0.89	1.39	1.50	-0.64	-0.57	-0.53
5	0.81	0.63	-1.06	-1.38	-0.81	0.87	0.22	0.98	1.88	1.14	-1.73	-1.60	0.06
6	0.65	0.74	-0.86	-0.88	-1.72	0.31	1.03	0.42	1.56	1.36	-1.33	-1.45	0.16
7	0.97	0.26	-0.43	-0.53	-1.49	-0.63	0.52	0.70	1.10	1.24	-0.37	-1.36	0.01
8	1.25	0.41	-0.72	-0.05	-1.19	-2.34	-0.43	0.38	1.07	1.34	0.22	-0.17	0.23
9	0.03	0.20	-0.50	-0.81	-1.08	0.22	0.27	-0.78	0.30	1.41	0.22	0.39	0.13
10	0.23	-0.68	0.47	-0.28	-1.68	0.51	0.32	-0.20	-0.38	0.79	0.83	0.51	-0.43
11	0.41	0.71	-0.36	0.07	-0.67	-0.23	0.37	-0.82	-0.03	-0.71	0.46	1.11	-0.32

SUM OF SOVIET RV RESIDUALS : 0.0000001485 MEAN RESIDUAL : 0.0000000013

TABLE 30. POPULATION NUMBERS AND FISHING MORTALITY DERIVED FROM AN ADAPT ANALYSIS USING SOVIET RV DATA FOR COD IN DIV. 3NO.

POPULATION NUMBERS (000S) 7/ 6/90

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
3	49400	46685	17959	18493	27192	19326	29939	36079	27104	5609	3167	6134	3745
4	21317	39896	37390	14638	14900	21806	15547	23446	29486	22139	4453	2126	4772
5	9442	15218	28740	27150	11030	11212	16064	12144	18291	21469	15533	3264	1457
6	5873	5440	10181	15198	18779	7889	7740	11439	8666	9363	11766	9559	1316
7	2106	3451	3714	5817	10385	13297	5543	5248	7263	4348	3711	6516	2206
8	754	1207	2505	2242	4074	6781	9504	3918	3193	3667	2191	1941	1831
9	868	457	896	1811	1634	2816	4202	6739	2556	1893	2144	1203	691
10	234	522	322	681	1400	1164	1767	2740	4686	1677	1045	991	478
11	193	133	381	248	529	1061	762	1231	1745	3355	1036	408	431
12	220	121	102	301	196	396	722	551	912	1192	2431	488	111
3+	90407	113130	102189	86579	90120	85749	91791	103533	103901	74711	47478	32631	17037

FISHING MORTALITY 7/ 6/90

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
3	0.014	0.022	0.004	0.016	0.021	0.018	0.044	0.002	0.002	0.031	0.199	0.051	0.628
4	0.137	0.128	0.120	0.083	0.084	0.106	0.047	0.048	0.117	0.154	0.111	0.178	0.552
5	0.351	0.202	0.437	0.169	0.135	0.171	0.140	0.137	0.470	0.401	0.286	0.708	2.761
6	0.332	0.182	0.360	0.181	0.145	0.153	0.189	0.254	0.490	0.725	0.391	1.266	2.564
7	0.357	0.120	0.305	0.156	0.226	0.136	0.147	0.297	0.483	0.485	0.448	1.069	1.757
8	0.300	0.098	0.124	0.116	0.169	0.279	0.144	0.227	0.323	0.336	0.399	0.833	1.113
9	0.309	0.151	0.074	0.058	0.139	0.266	0.228	0.163	0.221	0.394	0.572	0.724	0.967
10	0.366	0.114	0.060	0.052	0.077	0.223	0.161	0.251	0.134	0.282	0.739	0.634	0.490
11	0.267	0.069	0.035	0.036	0.089	0.185	0.125	0.100	0.181	0.122	0.553	1.104	0.433
12	0.133	0.047	0.079	0.049	0.076	0.078	0.065	0.088	0.125	0.133	0.202	0.381	1.246

TABLE 31. FISHING MORTALITY MATRIX FOR COD IN DIV. 3NO FROM ACCEPTED FORMULATION OF ADAPT USING RV INDICES FROM CANADA AND THE USSR.

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
3	0.036	0.039	0.011	0.011	0.004	0.063	0.007	0.004	0.129	0.196	0.073	0.029	0.012	0.001	0.351	0.187
4	0.167	0.186	0.123	0.067	0.076	0.314	0.102	0.167	0.515	0.645	0.234	0.252	0.620	0.377	0.893	0.662
5	0.339	0.469	0.594	0.084	0.279	0.393	0.249	0.416	0.933	1.023	0.746	0.313	0.770	0.653	0.556	1.191
6	0.518	0.358	0.705	0.144	0.268	0.325	0.511	0.766	0.898	1.176	0.695	0.646	0.667	0.990	0.794	1.062
7	0.434	0.396	0.418	0.349	0.263	0.193	0.876	0.738	0.842	0.936	0.370	0.510	0.527	0.874	0.361	0.811
8	0.446	0.548	0.541	0.279	0.787	0.237	0.806	1.492	1.310	0.773	0.537	0.559	0.815	0.524	0.331	0.865
9	0.342	0.340	0.359	0.431	0.896	0.357	0.383	0.852	0.252	0.445	0.622	0.412	0.328	0.193	0.435	0.695
10	0.358	0.294	0.182	0.314	0.912	0.690	1.766	2.232	0.176	0.306	0.503	0.361	0.262	0.230	0.250	1.012
11	0.903	0.713	0.027	0.329	0.408	0.117	0.925	0.865	0.555	0.125	0.399	0.970	0.441	0.154	0.223	0.945
12	0.413	0.434	0.421	0.342	0.568	0.239	0.846	1.018	0.939	0.834	0.450	0.508	0.572	0.683	0.356	0.829

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
3	0.028	0.144	0.013	0.017	0.004	0.013	0.017	0.014	0.037	0.001	0.002	0.026	0.157	0.034	0.259
4	0.421	0.501	0.122	0.119	0.089	0.068	0.066	0.084	0.037	0.040	0.088	0.127	0.092	0.135	0.336
5	0.555	0.568	0.310	0.176	0.398	0.120	0.108	0.130	0.108	0.104	0.374	0.281	0.224	0.544	1.239
6	1.029	0.326	0.268	0.155	0.301	0.160	0.099	0.119	0.137	0.187	0.341	0.495	0.239	0.790	1.080
7	1.051	0.205	0.286	0.093	0.250	0.125	0.195	0.088	0.111	0.200	0.317	0.284	0.245	0.464	0.511
8	1.272	0.195	0.265	0.075	0.093	0.091	0.131	0.230	0.089	0.162	0.195	0.188	0.191	0.325	0.238
9	1.276	0.140	0.262	0.129	0.056	0.042	0.106	0.195	0.179	0.094	0.148	0.203	0.256	0.249	0.230
10	0.814	0.136	0.315	0.093	0.051	0.038	0.055	0.163	0.111	0.187	0.073	0.172	0.279	0.195	0.142
11	1.599	0.044	0.219	0.057	0.029	0.030	0.065	0.128	0.087	0.066	0.127	0.062	0.280	0.219	0.107
12	1.104	0.188	0.112	0.037	0.065	0.039	0.063	0.055	0.043	0.059	0.079	0.089	0.095	0.150	0.119

TABLE 32. POPULATION BIOMASS AT THE BEGINNING OF THE YEAR (TONS) FOR COD IN DIV. 3NO FROM ACCEPTED FORMULATION OF ADAPT USING RV INDICES.

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
3	16141	15985	24688	32389	23531	33821	46699	73699	64285	35655	45079	28361
4	62364	24892	24571	39032	51229	37448	50768	81366	112689	86739	45006	64353
5	19513	65893	29202	30674	51575	67084	38643	67275	101069	92450	62472	48905
6	26704	17763	52044	20346	35612	49280	57156	39835	58712	50213	41960	37424
7	31792	18833	15277	31625	21666	33504	43798	44624	24102	29973	19402	26228
8	13365	20282	13681	10857	24084	17975	29809	21946	25676	11922	13505	15386
9	10605	8220	11405	7749	7991	10663	13797	16345	6059	8034	6384	9150
10	15024	7254	5631	7663	4846	3138	7180	11602	8600	5213	5700	3791
11	10984	9646	5085	4416	5264	1830	1479	1465	1486	6820	3631	3259
12	1897	4286	4443	4651	2988	3290	1530	710	747	806	5685	2302
3+	208389	193053	186026	189404	228785	258032	290860	358868	403426	327826	248825	239159
4+	192248	177068	161338	157015	205254	224211	244161	285169	339141	292171	203746	210798
5+	129884	152176	136767	117983	154025	186764	193393	203803	226451	205432	158740	146446

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
3	29079	25064	18935	11998	6520	11847	22154	38070	11175	12393	26698	20788
4	42285	47526	37955	13984	17262	12427	16806	32988	41726	14585	17921	27947
5	68708	32255	46064	18967	8847	16995	12167	21445	37436	47882	18771	19964
6	45134	39577	21448	30739	6886	7428	13168	11485	21282	31762	57595	20055
7	24569	27738	19737	11185	12888	3314	7265	13424	11213	19889	35426	64316
8	18086	15322	13933	16870	5608	5291	3298	6285	12233	11169	22950	34634
9	10200	8997	10446	13034	7175	1964	5389	2859	5554	13327	13157	23488
10	6706	8264	9155	6855	6425	2243	2035	4548	2526	6084	16403	12262
11	2498	4842	7139	6936	1872	2604	2333	1449	3577	2572	6604	14093
12	1168	1511	4586	4546	1902	469	2661	1863	1200	3759	2434	5850
3+	248434	211096	189399	135114	75386	64582	87276	134416	147922	163422	217958	243398
4+	219354	186032	170464	123116	68865	52734	65121	96346	136747	151029	191260	222610
5+	177069	138506	132508	109132	51603	40308	48316	63357	95022	136444	173339	194662

	1983	1984	1985	1986	1987	1988	1989
3	25888	35755	10781	1783	1348	5833	3438
4	20895	27621	31825	18538	2991	1926	6049
5	30335	20904	27574	33087	22007	4200	2490
6	20662	31133	20409	21285	29823	19168	3299
7	20949	21002	27880	18055	15432	23278	11293
8	67043	20836	18714	25604	16949	13069	19016
9	29932	61609	19143	20392	25955	13890	12105
10	19489	23999	58054	21056	18904	18560	11715
11	9574	15585	19684	58053	17709	12709	14280
12	11168	8603	14020	16606	54935	11633	9779
3+	255934	267049	248082	234458	206052	124267	93464
4+	230046	231293	237301	232676	204704	118434	90026
5+	209151	203672	205476	214138	201713	116508	83977

TABLE 33. AVERAGE POPULATION BIOMASS (TONS) FOR COD IN DIV. 3NO FROM ACCEPTED FORMULATION OF ADAPT USING RV INDICES.

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
3	20091	19865	31100	40809	29736	41556	61752	91291	75010	40320	54028	34706
4	64464	28860	29333	47872	62562	40915	61219	99699	110239	80173	49997	70909
5	18844	59315	24877	32971	50604	62472	38434	64452	74078	65330	49485	46848
6	22911	17007	42771	21503	35525	47892	51086	33418	44876	34338	34906	31794
7	25820	17061	13704	29268	20853	33311	32262	36864	18191	21770	17969	22819
8	10665	15658	10596	9459	16783	15968	20608	12929	15291	8799	11027	12444
9	8878	6884	9467	6228	5260	8860	11329	13829	5983	7267	5341	8398
10	12195	6208	5076	6497	3171	2253	3406	6048	7894	4506	4508	3195
11	7214	6698	4817	3632	4177	1661	941	1212	1094	6107	2866	2015
12	1537	3441	3587	3892	2261	2886	1028	574	491	553	4600	1815
3+	192619	180996	175329	202132	230931	257774	282065	360316	353147	269164	234727	234944
4+	172528	161131	144229	161323	201194	216217	220313	269026	278137	228844	180699	200238
5+	108064	132271	114895	113451	138633	175302	159094	169327	167898	148671	130702	129329

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
3	37245	30895	16479	14482	9021	14180	27085	39934	12789	14931	27369	20881
4	39511	51333	31416	10604	18717	13824	20321	38330	42277	16184	21045	27744
5	53855	27452	39241	11219	8223	14934	12153	22251	32417	53806	21484	18483
6	37995	28719	16760	20440	5279	7791	13943	11920	19435	35777	62816	18775
7	21220	19756	19952	8042	9309	3366	7062	14290	10199	22563	34882	66680
8	13115	11572	13680	11771	3540	4953	3185	6298	10546	13402	23485	34259
9	9724	8846	10246	10829	4081	2109	5756	2784	4975	17381	12914	23006
10	5916	7523	9345	3712	3874	2396	1828	3958	2401	7543	15457	11422
11	1934	4243	6900	3872	853	2690	2205	1325	3360	2797	5736	12482
12	895	1098	4562	2328	976	598	2560	1739	1089	4203	2094	6028
3+	221410	191439	168582	97299	63873	66841	96099	142828	139487	188588	227284	239762
4+	184164	160543	152103	82817	54853	52661	69014	102894	126698	173657	199915	218881
5+	144654	109210	120687	72213	36135	38837	48694	64565	84421	157473	178870	191137

	1983	1984	1985	1986	1987	1988	1989
3	26803	33790	14161	2314	1620	5954	3156
4	20760	28558	28847	22940	3761	2338	5361
5	33013	20474	22899	34912	20347	3843	1670
6	23228	28510	18362	19265	26481	14275	2371
7	23667	18608	25989	18671	14409	18776	10923
8	67858	18044	19123	27376	16386	11615	22140
9	27196	56168	20673	21944	24150	11607	13483
10	17398	21353	61064	21417	15936	14926	12641
11	8413	14378	18902	55813	14085	10623	14426
12	10498	8977	13666	14987	53541	10406	9574
3+	258835	248860	243685	239640	190714	104363	95744
4+	232031	215070	229523	237325	189094	98410	92588
5+	211271	186512	200677	214385	185334	96071	87227

TABLE 34. POPULATION NUMBERS AT THE BEGINNING OF THE YEAR (000s) FOR COD IN DIV. 3NO FROM ACCEPTED FORMULATION OF ADAPT USING RV INDICES.

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
3	53698	53179	82134	107755	78284	112516	162762	210243	183387	101714	128599	80905
4	93901	42416	41869	66511	87294	63810	86509	132342	171451	131970	68474	97910
5	19498	65084	28843	30298	50942	66261	38169	63941	91692	83873	56676	44368
6	16468	11378	33335	13032	22810	31565	36609	24356	34542	29542	24687	22018
7	12361	8031	6515	13486	9239	14288	18677	17977	9268	11526	7461	10086
8	4272	6560	4425	3511	7790	5813	9641	6369	7040	3269	3703	4218
9	2889	2238	3105	2110	2176	2903	3756	3526	1173	1555	1236	1771
10	3400	1681	1305	1776	1123	727	1664	2097	1232	747	816	543
11	2268	1946	1026	891	1062	369	298	233	184	846	450	404
12	333	753	781	817	525	578	269	97	80	87	611	247
3+	209088	193265	203336	240187	261244	298831	358355	461181	500049	365127	292712	262470
4+	155390	140086	121202	132432	182959	186314	195592	250937	316662	263413	164113	181565
5+	61489	97670	79334	65921	95666	122504	109083	118595	145211	131443	95639	83655

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
3	86121	63163	37594	41586	26552	33510	52753	61688	21747	23345	33823	24673
4	64335	69651	51651	21679	28234	21132	23767	42641	49673	17740	18872	27235
5	62334	28333	39112	17315	9152	15171	10484	17225	30987	37206	13569	14464
6	26554	23618	12078	18361	4307	4301	7042	6294	11824	17038	27013	9968
7	9448	11154	7183	4469	5195	1260	2541	4408	4413	7162	11891	20038
8	4959	4568	3809	4097	1626	1487	840	1562	3289	2814	5175	8015
9	1974	1798	2215	2239	1412	373	1002	528	1187	2453	2103	3717
10	960	1164	1214	1173	915	323	266	632	380	919	1925	1548
11	310	605	758	774	349	332	231	159	471	295	725	1491
12	125	163	425	496	246	58	260	152	123	375	235	556
3+	257120	204216	156038	112190	77989	77945	99185	135287	124093	109347	115331	111705
4+	170999	141054	118443	70604	51437	44436	46432	73600	102346	86002	81508	87032
5+	106664	71403	66792	48925	23202	23304	22665	30959	52673	68262	62635	59797

	1983	1984	1985	1986	1987	1988	1989
3	35426	47223	32581	6629	3931	9025	7718
4	19925	27937	38610	26624	5289	2751	7140
5	20508	15727	21968	28939	19205	3948	1969
6	10403	15078	11600	12373	17882	12565	1876
7	7245	7428	10242	6750	6176	11523	4668
8	15023	5311	4977	6106	4158	3959	5931
9	5212	11257	3697	3354	4141	2814	2343
10	2505	3567	8386	2611	2241	2626	1796
11	1076	1836	2422	6384	1801	1388	1769
12	1074	808	1407	1747	4911	1114	913
3+	118397	136172	135891	101517	69736	51715	36122
4+	82971	88949	103309	94888	65805	42689	28404
5+	63047	61012	64699	68264	60516	39938	21264

Table 35. Input parameters for yield per recruit calculation for cod in Divisions 3NO.

AGE	WEIGHT AT AGE (kg)	PARTIAL RECRUITMENT
3	0.68	0.10
4	1.04	0.36
5	1.49	0.83
6	2.14	1.00
7	3.18	1.00
8	4.64	0.71
9	6.55	0.69
10	8.22	0.68
11	9.40	0.57
12	11.45	0.33
13	12.33	0.30
14	13.90	0.30
15	15.22	0.30
16	16.64	0.30

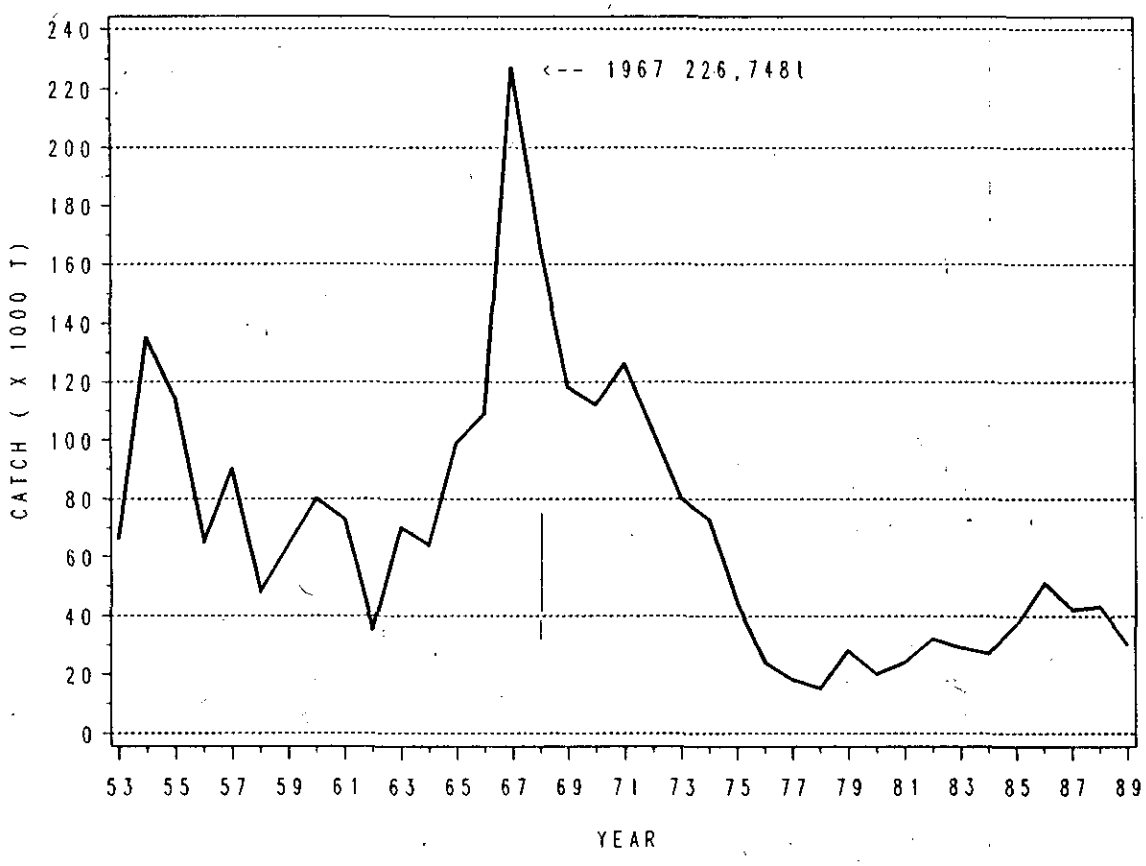


FIG. 1. Catches of cod in Divisions 3NO for 1953-89.

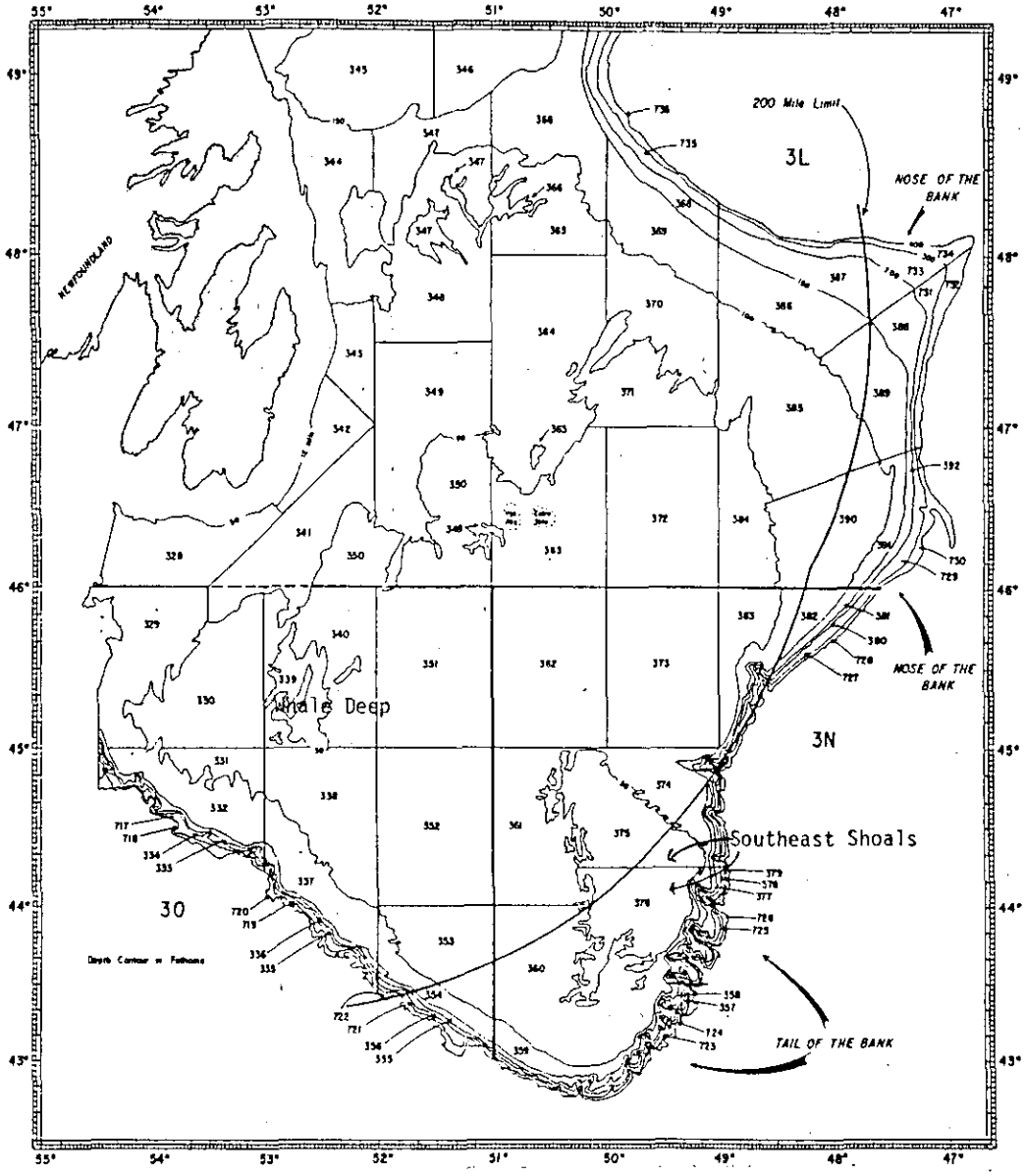


Fig. 2. Depth stratification chart of the Grand Bank, NAFO Div. 3LNO

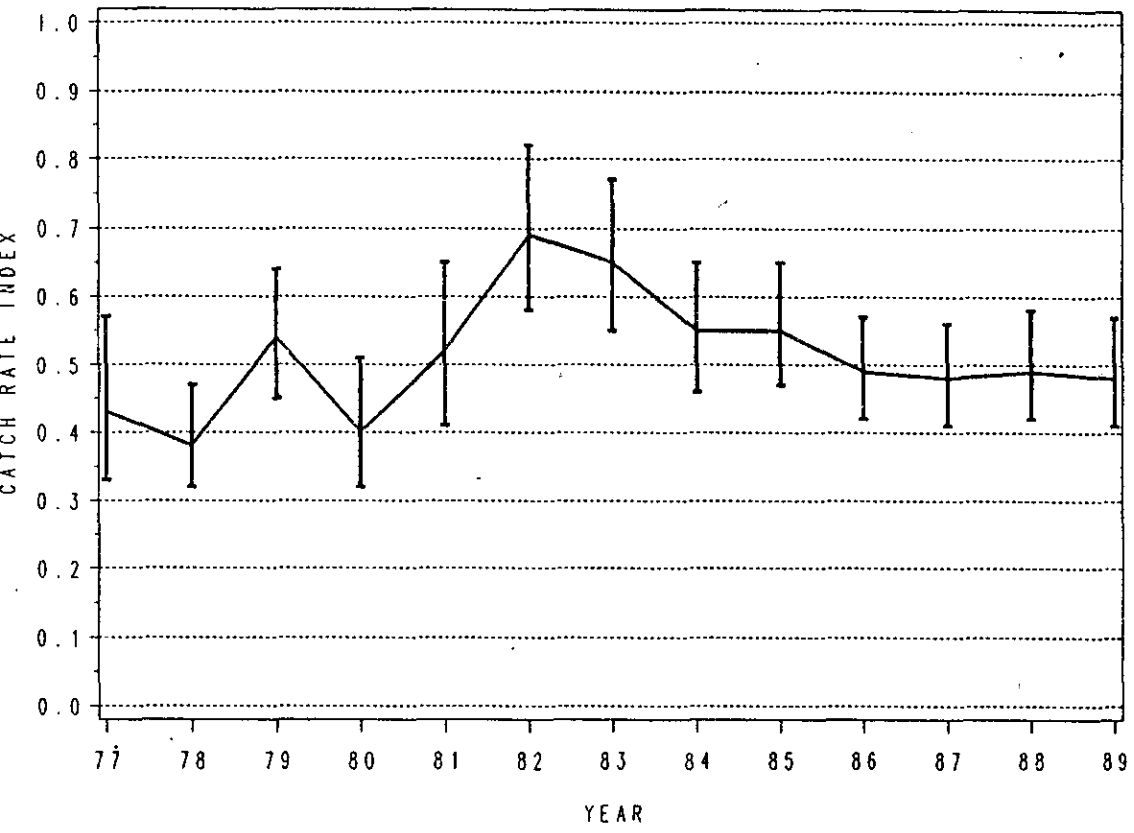


FIG 3 . Catch rate index with approximate 90% C. I. for Div. 3NO cod using Canadian otter trawl data.

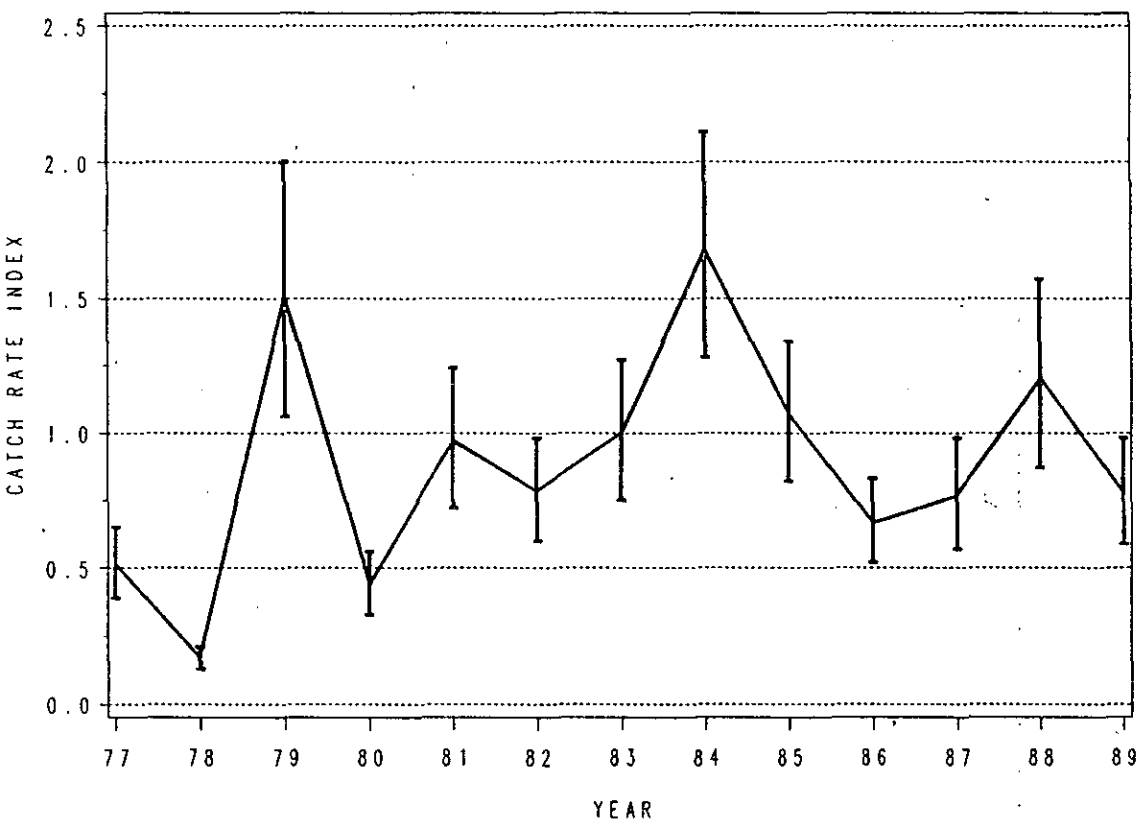


FIG 4 . Catch rate index with approximate 90% C. I. for Div. 3NO cod using Spanish pairtrawl data.

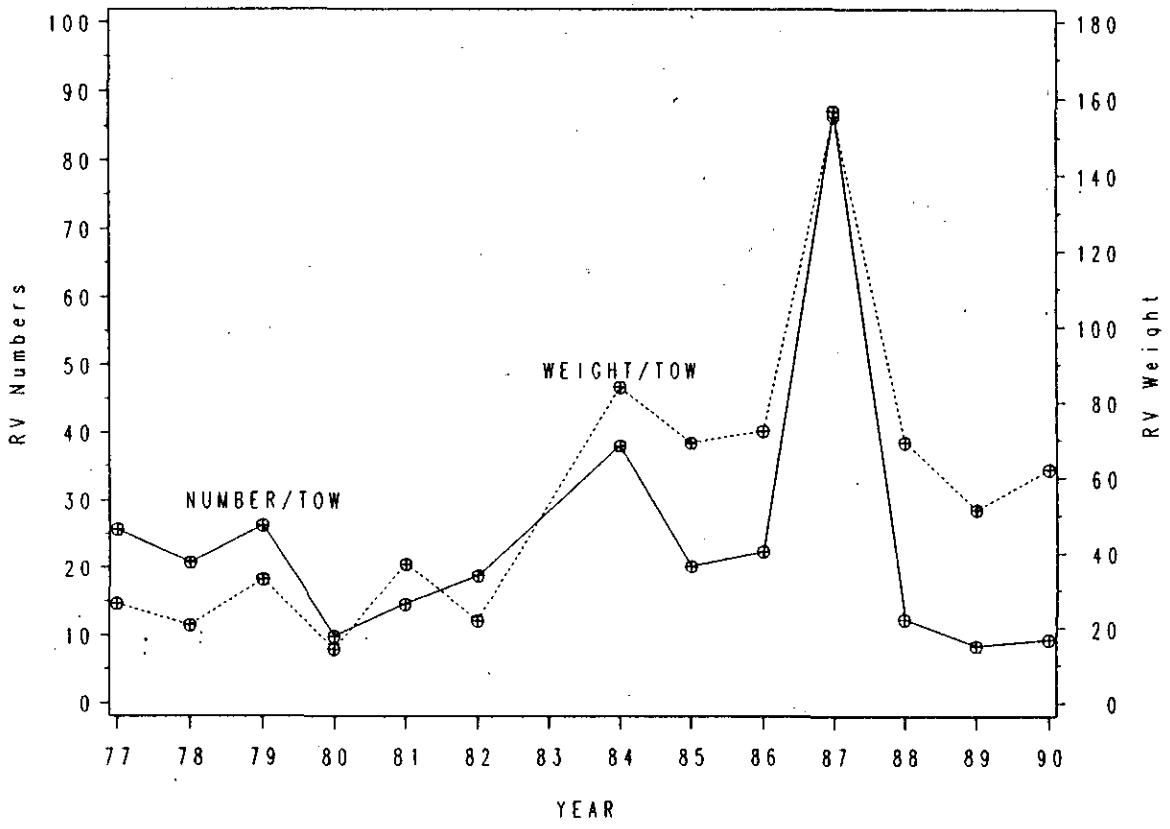
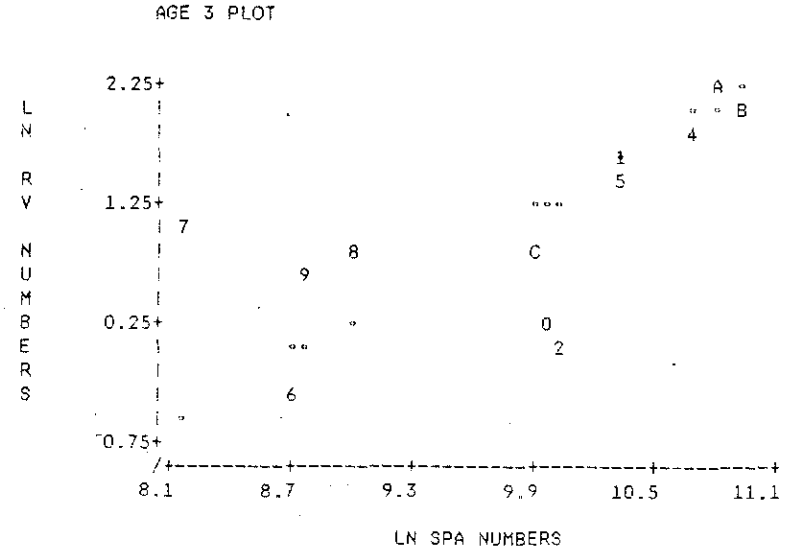


FIG. 5. Mean numbers and weights per tow of cod from Canadian RV surveys in Divisions 3no.



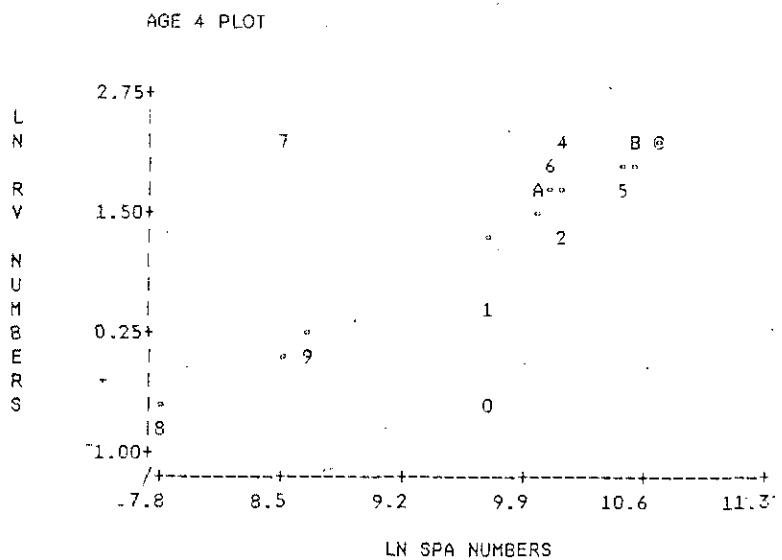
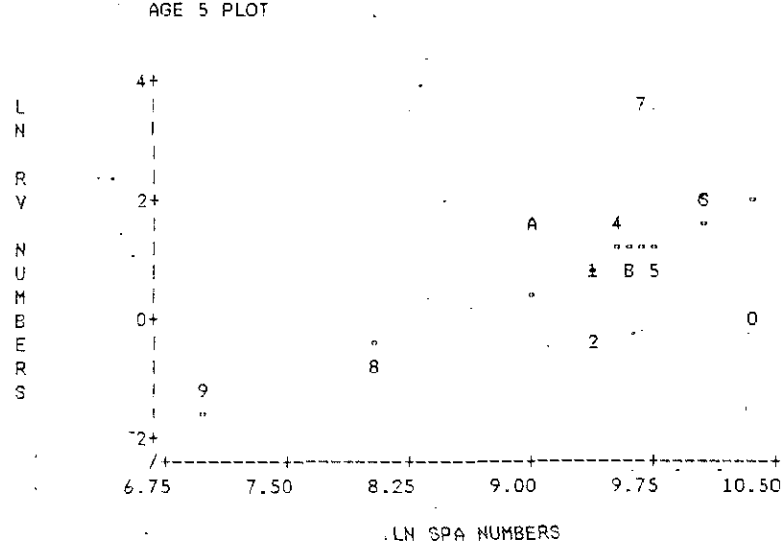


FIGURE 6. AGE BY AGE PLOTS (LN RV VERSUS LN SPA) FROM ADAPT ANALYSIS USING CANADIAN RV DATA FOR COD IN DIV. 3NO.



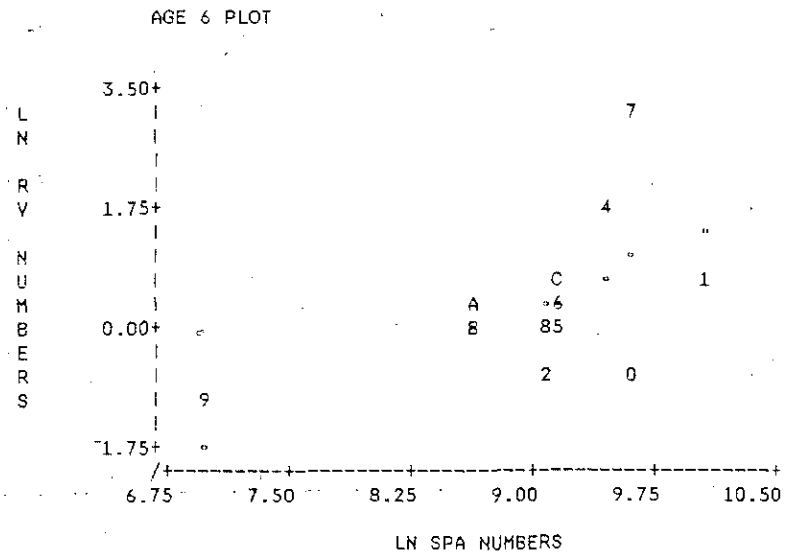
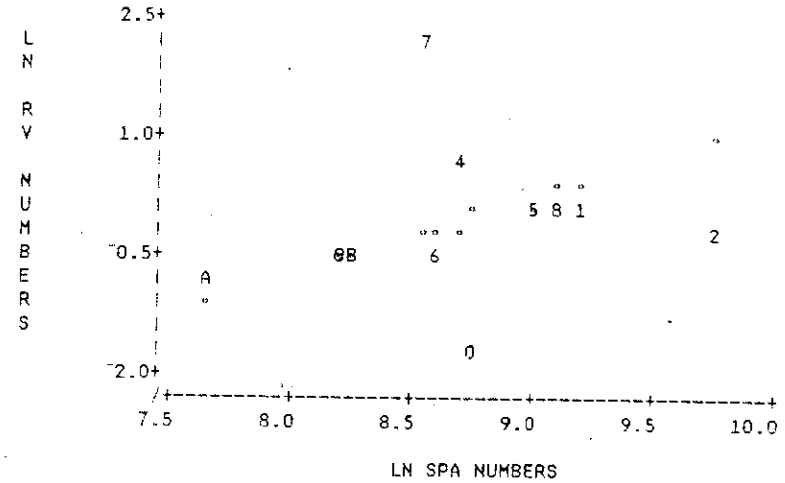


FIGURE 6. CONTINUED.

AGE 7 PLOT



AGE 8 PLOT

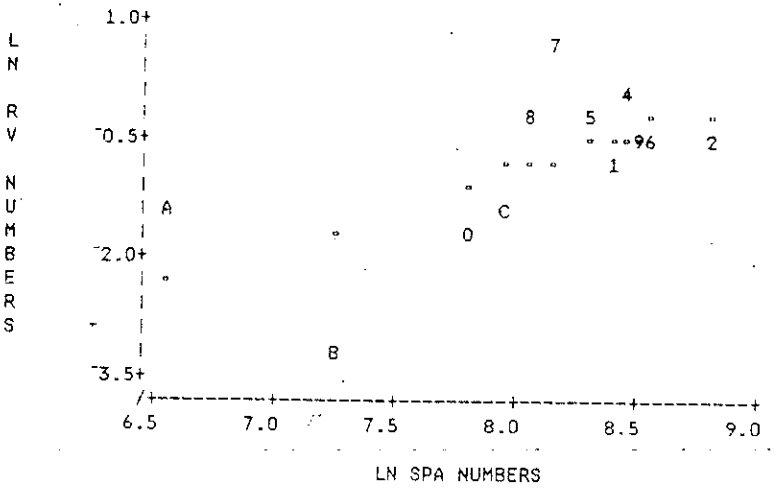
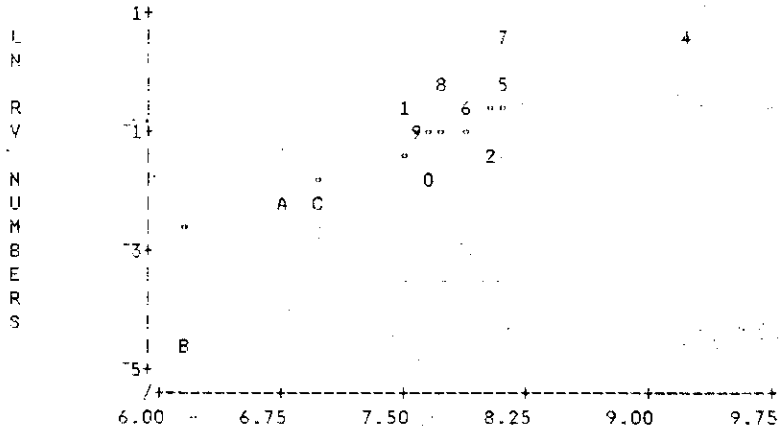


FIGURE 6. CONTINUED.

AGE 9 PLOT



AGE 10 PLOT

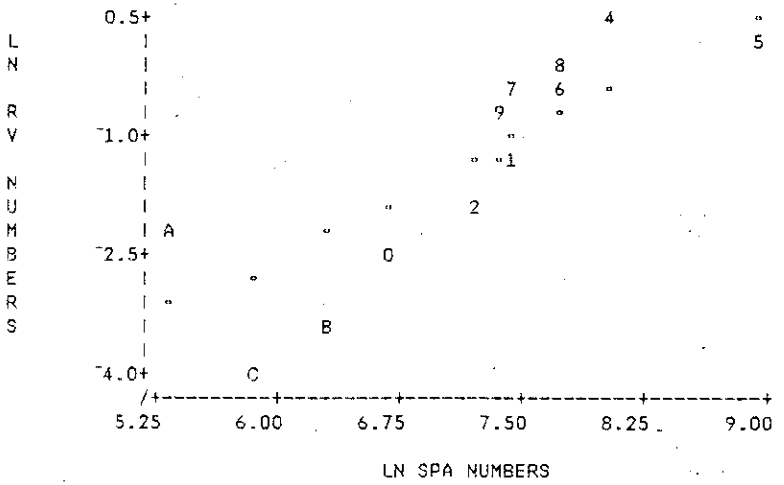


FIGURE 6. CONTINUED.

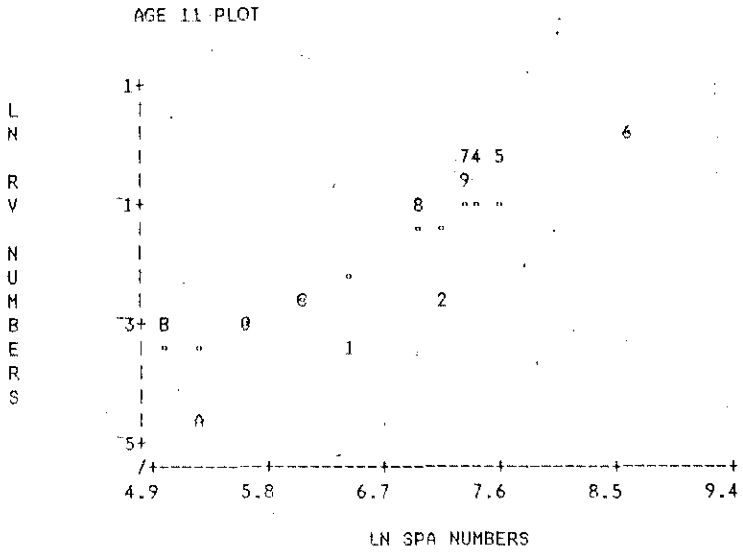
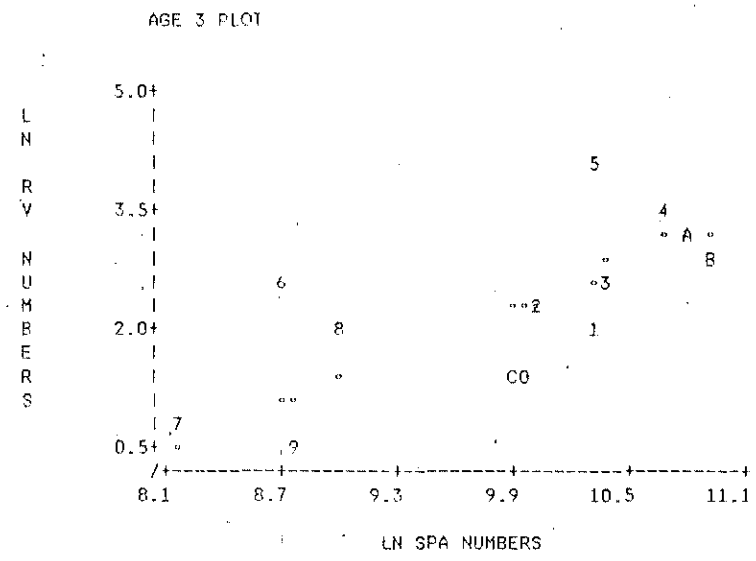


FIGURE 6. CONTINUED.



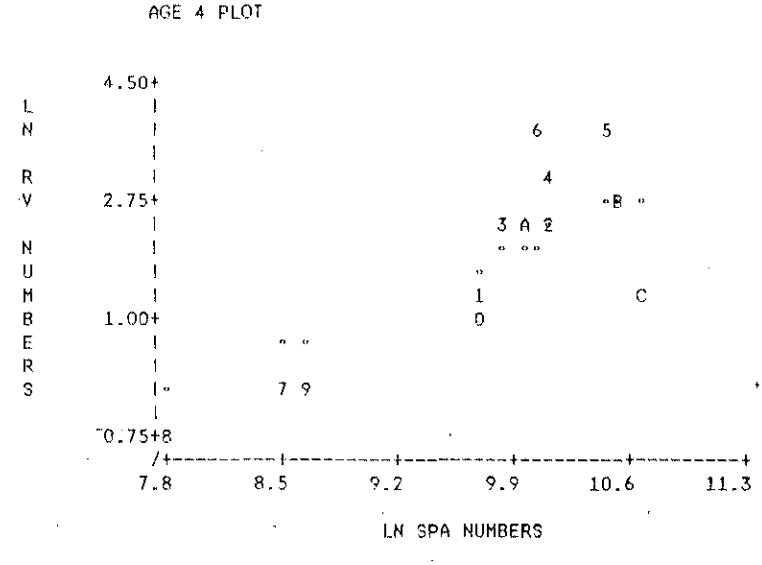
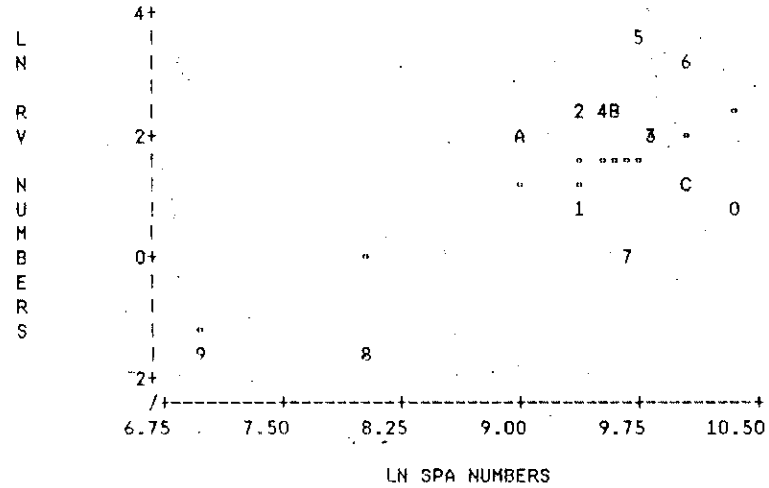
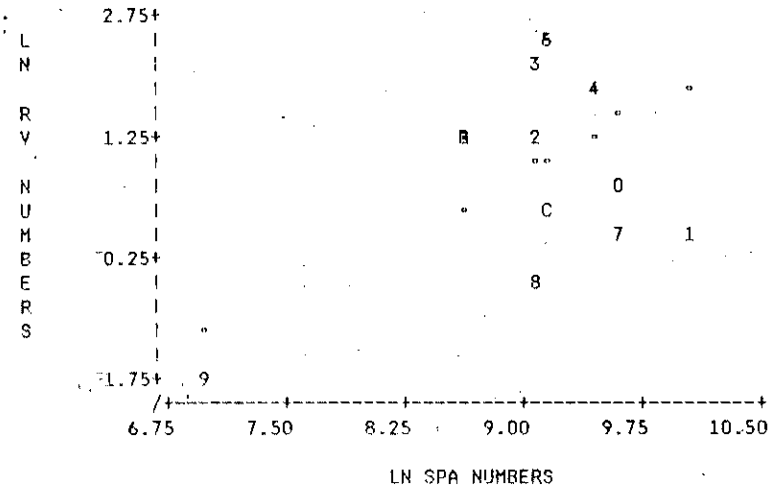


FIGURE 7. AGE BY AGE PLOTS (LN RV VERSUS LN SPA) FROM ADAPT ANALYSIS USING SOVIET RV DATA FOR COD IN DIV. 3NO.

AGE 5 PLOT



AGE 6 PLOT



AGE 7 PLOT

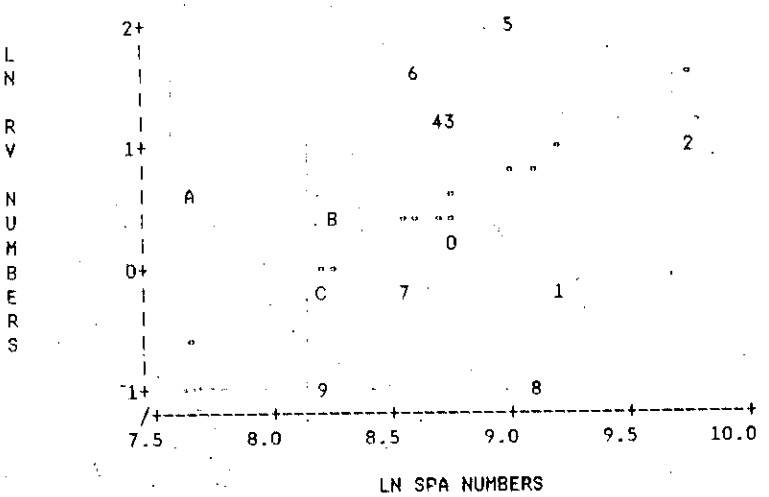
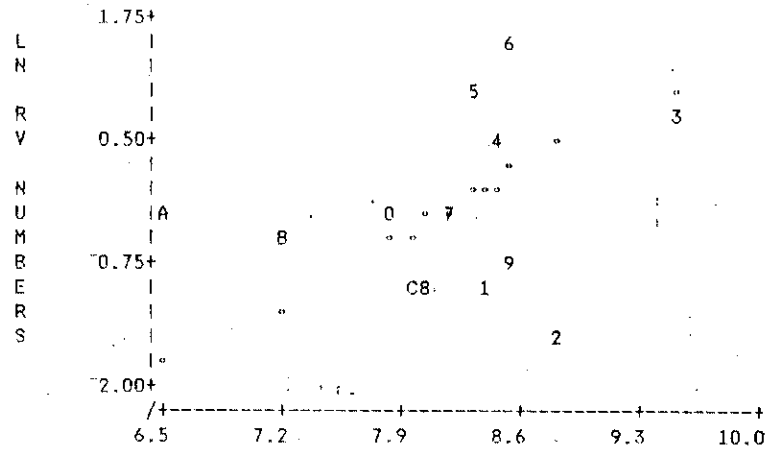
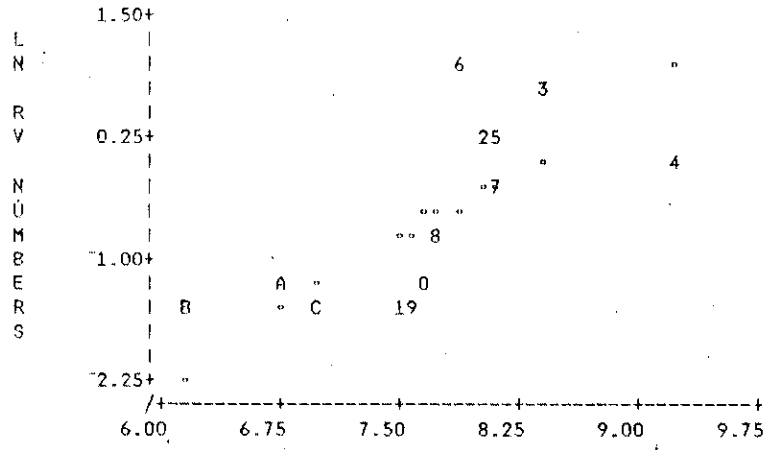


FIGURE 7. CONTINUED.

AGE 8 PLOT



AGE 9 PLOT



AGE 10 PLOT

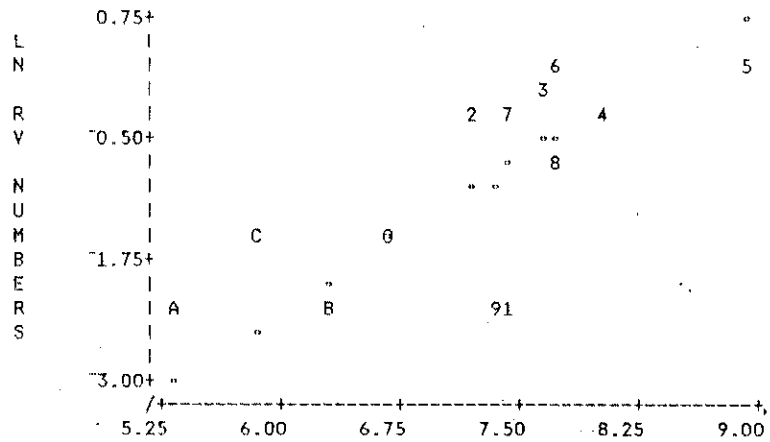


FIGURE 7. CONTINUED.

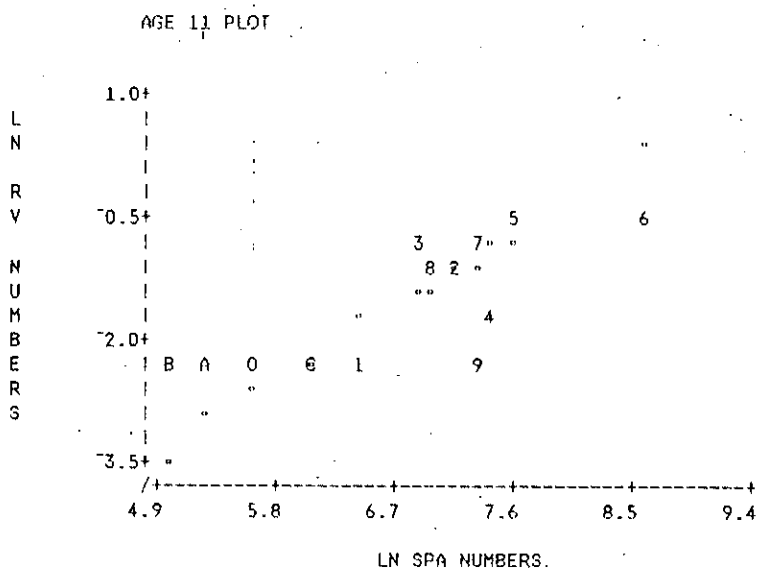


FIGURE 7. CONTINUED.

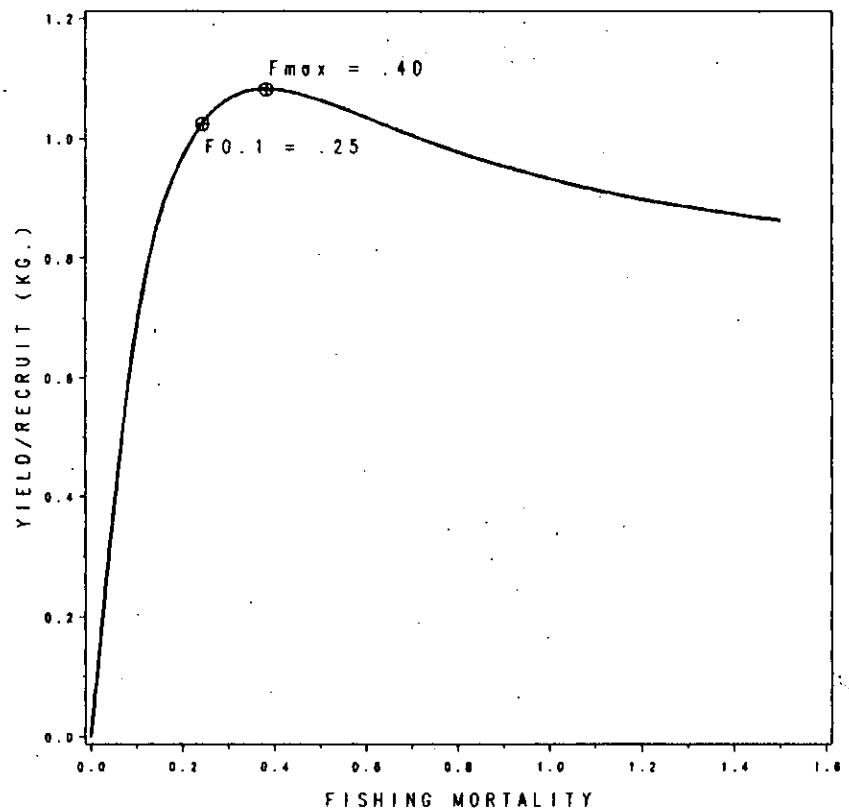


FIG. 8. YIELD PER RECRUIT FOR A RANGE OF F FOR COD IN DIVISIONS 3NO.