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Assessment of the Cod Stock in Divisions 3NO

by

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INTRODUCTION

Cod catches in 3NO have been severely reduced in recent years as compared with those of late 60's and early 70's. After a peak catch of 227,000 tons in 1967 there was a steady decline to 15,000 tons in 1978 with a rise to approximately 27,000 tons in 1979. Recent catches and TAC's are as follows:

	1973	1974	1975	1976	1977	1978	1979
TAC (000 t)	103	101	88	43	30	15	25
Catch (000 t)	80	73	44	24	18	15	27*

*provisional data.

Sampling and age compositions

Sampling data in 3NO for the period 1972-79 by country is indicated in Table 1. In 1979 length measurements were obtained by the commerical sampling Unit of Fisheries and Oceans for seven months in 30 and for four months in 3N. Otoliths were sampled on a quarterly basis. Sampling data for the Portuguese gillnet and Spainish pair trawl fisheries were obtained by the Foreign Co-operative Research unit of Fisheries and Oceans.

Age compositions for the 1979 commercial catch are shown in Table 2. The 1974 year-class was predominant (48%) followed by the 1975 year-class (26%) and the 1973 year-class (15%). A revised age composition of the 1978 catch is shown in Table 3. The figures previously presented in ICNAF Res. Doc. 79/VI/67 were revised after catch data for 1978 were updated.

Fishing mortality and stock sizes

The catch-at-age data for 1972-79 were used in a cohort analysis to determine fishing mortalities and stock sizes. The partial recruitment or selection pattern for 1979 that was used in the cohort was derived by comparing the numbers-at-age from the commercial fishery and the numbers at corresponding ages from the Canadian survey results. Relative exploitation rates were derived (Table 4) and the selection pattern (%) obtained assuming full recruitment at age 6. The results of a cohort run with the F on the fully recruited age groups in 1979 of 0.25 and with the 1978 average weights as indicated are shown in Table 5. Table 6 shows the results of a cohort run assuming F on the fully recruited age groups of 0.6.

The Canadian research survey catch in 3NO in number per standard tow by age for the years 1971-79 are shown in Table 7. The per mille breakdown of numbers-

at-age for Divisions 3N and 3O along with total population estimates for the same period are shown in Tables 8 and 9.

It was found that the population numbers at age 3+ from the cohort run at F=0.25 in 1979 was very well correlated with the research survey numbers per standard set (age 3+) in 1972-79 (Table 10, Fig. 1). The number of three year-olds from the cohort were correlated with the number of three year-olds per standard set from the Canadian surveys for 1972-79 as well as with the number of two year-olds from these surveys. The results are indicated in Table 11 and Fig. 2. Correlations between: the biomass of fish (age 3+) from the cohort analysis and CPUE from the commercial fishery, using the standard CPUE's from SCR Doc. 80/11/10; and between catch per hour (age 3+) from USSR survey's and cohort numbers (age 3+) for 1972-79 are shown in Table 12. In either case there was no significant correlation.

Using the biomass data from the cohort analysis assuming an F in 1979 of 0.60 for the fully recruited age groups,similar correlations were derived (Table 13). These included: the relationship of cohort numbers at age 3+ with Canadian survey numbers per tow (age 3+) and with USSR survey numbers per tow (age 3+);along with the relationship of cohort biomass (age 3+) with CPUE (SCR Doc. 80/II/10). Only cohort biomass and CPUE showed any relationship (r^2=0.88). However both the 1976 and 1979 points were not included as they were well outside the range of the correlation.

Recruitment

Estimation of recruitment at age 3 for the 1975-77 year-classes were shown in Table 10. The cohort analysis at F=0.25 for the fully recruited age groups was used because of its good correlation with Canadian survey results. The recruitment estimates obtained from in the cohort analysis at F=0.25 for 1978 and 79 were 61.8 and 18.2 millions. This agreed fairly well with those shown in Table 10, namely 53 and 24 millions from the correlation of cohort age 3 vs survey age 3.

Projection of catches and biomass

Using the stock size for 1979 as calculated from the cohort and a recruitment of 25 million in 1980, a catch projection was made to 1985 at F =0.18. Recruitment in 1981-85 was assumed to be equal to the geometric mean of the recruitment in 1972-79 from the cohort. This value was 40 million fish. The projected catch in 1980 is approximately 26,000 tons (Table 14).

Table 1. Sampling data available for 3NO cod for the period 1972-79.

YEAR	DIV.	COUNTRY	GEAR	MONTH	TYPE		NO. MEAS.	NO. AGED	MESH SIZE
1972	3N	Spain	PT	June	Comm.	Cat.	178	-	-
				July	"	"	135	-	-
	3O	Portugal	GN	August	"	"	1057	-	-
				Sept.	"	"	4213	-	-
				May	"	"	50	-	-
				June	"	"	2485	-	-
1973	3N	France	OT	June	Res.		1425	-	50
		Portugal	GN	Aug.	Comm.	Cat.	3111	-	193
				Sept.	"	"	571	-	193
		Spain	PT	May	Comm.		1917)	422	-
				June	"		1742		-
				July	"		726	38	-
		France	OT	June	Res.		1648	-	50
	3O	Portugal	GN	May	Comm.		2012	-	193
				Aug.	Comm.		2570	355	193
		Spain	PT	June	Comm.		1621	196	-
1974	3N	Spain	PT	June	Comm.		379	69	-
				July	"		1215	111	-
	3O	Can(N)	OT	March	Comm.		482	178	-
1975	3N	Can(N)	OT	May	Comm.		133	131	-
			PT	July	Comm.		1258	202	-
1976	3N	USSR	OT	April	Comm.		4327	-	130
		Can(N)	OT	May	Comm.		465)	304	-
				June	"		504		-
	3O	Can(N)	OT	Sept.	Comm.		392	43	-
1977	3N	Can(N)	OT	June	Comm.		1679	272	-
				July	"		366)	103	-
				Sept.	"		233		-
		Portugal	GN	Aug.	Comm.		215)	251	150
				Sept.	"		884		150
		Spain	PT	June	Comm.		9671	1300	-
				July	"		9017	488	-
	3O	Can(N)	OT	May	Comm.		683)	238	-
				June	"		1108		-
				Nov.	"		582	60	-
1977	3O	Portugal	GN	Aug.	Comm.		82)	84	150
				Sept.	"		103		150
		Spain	PT	Mar.	Comm.		377	175	-
				June	"		545	115	-
1978	3N	Can(N)	OT	Feb.	Comm.		757	78	120-130
				June	"		1157	100	120-130
				Sept.	"		264	110	120-130
				Nov.	"		1641	230	120-130
		USSR	OT	Feb.	Comm.		1297	-	130
				Mar.	"		1062	-	130
				May	"		675	-	130

Table 1. (Cont'd)

YEAR	DIV.	COUNTRY	GEAR	MONTH	TYPE	NO. MEAS.	NO. AGED	MESH SIZE
1978	30	Can(N)	OT	Jan.	Comm.	309	66	120-130
				May	"	1246)	572	120-130
				June	"	592)		120-130
				Sept.	"	735	62	120-130
				Nov.	"	2456)	430	120-130
				Dec.	"	1449)		120-130
	3N*	Port.	GN	July	Catch	1029	89	
		Spain	PT	June	Catch	1037	125	
			OT	Aug.	"	628	90	
	30*	Port.	GN	July	Catch	253)	105	
				Aug.	"	642]		
		Spain	PT	July	Catch	884	89	
				Nov.	"	1774	186	
1979	30	Can(N)	OT	Jan.	Landings	2577	201	
				May	"	1260	286	
				June	"	1047)		
				Aug.	"	992	182	
				Sept.	"	901)		
				Oct.	"	341	99	
				Nov.	"	466)		
	*	Portugal	GN	May	Landings	204	502	
				June	"	539		
				July	"	116	122	
				Oct.	"	1276		
				Nov.	"	10007]	790	
				Dec.	"	887		
	*	Spain	PT	Aug.	"	439	61	
	3N	Can(N)	OT	May	Landings	1767	253	
				July	Landings	952		
				Aug.		175]	251	
				Sept.		502		
	*	Portugal	GN	May	Landings	2035]	502	
				June	"	1304]		
				July	"	1940	122	
	*	Spain	PT	Aug.	Landings	4128	61	

*Sampling by Foreign Co-operative Research of Fisheries & Oceans

Table 2. Age compositions of the 3NO cod catch in 1979

Age	Canada(N) + Others*	Spain	Portugal	Total
3	30	93	36	123
4	1616	2235	96	3887
5	4158	2989	96	7243
6	1122	1014	86	2222
7	363	452	57	872
8	120	238	33	391
9	18	93	17	128
10	8	50	3	61
11	3	14	1	18
12	2	7		9
13	2	7		9
14	-	14		14
14+	4	-		4
Total	7446	7206	329	14,981
Catch (MT)	11,915	13,980	1225	27,120
Ave. Wt.	1.60	1.94	3.73	1.81

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*Can M  - 2671
 USSR   - 2208
 Rom.   -    5
 Cuba   -    8
 France-   77
           ____
          4969
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Table 3. Revised cod age composition of the 1978 catch in Div. 3NO

Age	Canada	Spain	Portugal	Other *	Total 3NO
2	1	22			23
3	223	625		72	920
4	1300	2609	5	423	4337
5	1215	836	22	395	2518
6	382	253	59	124	818
7	157	106	40	51	354
8	52	18	15	17	102
9	25	20	5	8	58
10	28	9	5	9	51
11	4	1	2	1	8
12	3		1	1	5
13	1				1
14	3	1		1	5
15					
16					
17	1				1
18		5			5
19	1				1
20	3	4		1	8
NK					
#	3339	4559	154	1103	9215
Landings	6254	5813	641	2030	14,738
Ave. Wt.	1.84	1.28	4.16	1.84	1.60

*Cuba - 25
France - 151
GDR - 13
Japan - 22
USSR - 1819

Table 4. Selection pattern used for 1979 in the Division 3NO Cohort Analysis.

Age	Survey Abundance Estimates (1979)	Catch Estimate (1969)	Relative Exploitation Rate	% Selection Pattern Used
1	8284			
2	2235			
3	5398	123	.02	4
4	22,472	3887	.17	40
5	22,541	7243	.32	74
6	5166	2222	.43	100
7	1668	872	.52	100
8	705	391	.55	100
9	279	128	.45	91
10	35	61		76
11	117	18	.15	30
12		9		30
13	87	9	.10	30
14	16	18		30
15	20			
16+	397			
Total	69,420	14,981		

Table 5. Cod 3NO - 1972-79 - Cohort Analysis at F=0.25 for the fully recruited age groups.

NATURAL MORTALITY=   0.20

PARTIAL RECRUITMENT MULTIPLIER
| 0.0300 | 0.3600 | 0.7600 | 1.0000 | 1.0000 | 1.0000 | 0.9100 | 0.7600 | 0.3000 | 0.3000 |

ASSUMED FISHING MORTALITY FOR LAST AGES
| 0.3100 | 0.3100 | 0.8800 | 1.0000 | 0.4000 | 0.8000 | 0.5000 | 0.2500 |

ESTIMATED POPULATION

AGE YEAR	1972	1973	1974	1975	1976	1977	1978	1979
3	63026.	36064.	34716.	26668.	31706.	75204.	61786.	18160.
4	68642.	51538.	20426.	22610.	21227.	22593.	61022.	49754.
5	28540.	38286.	17223.	8127.	10566.	10363.	16264.	46037.
6	23684.	12247.	17685.	4232.	3461.	5033.	6194.	11037.
7	11468.	7237.	4608.	4642.	1198.	1801.	2763.	4331.
8	4684.	4066.	4142.	1740.	1034.	852.	957.	1942.
9	1809.	2309.	2450.	1448.	466.	709.	538.	691.
10	1034.	1223.	1251.	1087.	352.	287.	392.	388.
11	1229.	651.	782.	413.	473.	257.	176.	275.
12	396.	936.	409.	253.	110.	347.	173.	137.
13	291.	258.	661.	102.	69.	68.	262.	137.
14	87.	198.	123.	220.	19.	36.	40.	214.

KNOWN CATCHES

AGE YEAR	1972	1973	1974	1975	1976	1977	1978	1979
3	69.	10058.	6425.	671.	3719.	607.	920.	123.
4	19797.	27600.	9501.	8781.	7754.	2469.	4337.	3887.
5	12289.	15098.	10907.	3528.	3998.	2531.	2518.	7243.
6	13432.	5989.	10872.	2505.	1141.	1500.	818.	2222.
7	5883.	1971.	2247.	3057.	142.	572.	354.	872.
8	1686.	972.	2147.	1059.	152.	177.	102.	391.
9	285.	707.	1015.	921.	104.	209.	58.	128.
10	216.	243.	676.	461.	35.	65.	51.	61.
11	78.	137.	428.	252.	44.	41.	8.	18.
12	74.	116.	257.	152.	24.	25.	5.	9.
13	44.	97.	355.	71.	23.	18.	1.	9.
14	7.	16.	26.	52.	2.	7.	5.	14.

ESTIMATE FISHING MORTALITY

AGE YEAR	1972	1973	1974	1975	1976	1977	1978	1979
3	0.0012	0.3685	0.2288	0.0282	0.1388	0.0090	0.0166	0.0
4	0.3838	0.8961	0.7217	0.5608	0.5170	0.1287	0.0818	0.0
5	0.6460	0.5724	1.2036	0.6535	0.5416	0.3146	0.1877	0.0
6	0.9856	0.7775	1.1376	1.0620	0.4531	0.3995	0.1578	0.0
7	0.8368	0.3581	0.7742	1.3013	0.1404	0.4322	0.1527	0.0
8	0.5072	0.3068	0.8508	1.1172	0.1772	0.2607	0.1253	0.0
9	0.1913	0.4130	0.6123	1.2134	0.2832	0.3940	0.1269	0.0
10	0.2626	0.2478	0.9093	0.6322	0.1163	0.2876	0.1554	0.0
11	0.0727	0.2648	0.9289	1.1241	0.1085	0.1941	0.0514	0.0
12	0.2311	0.1473	1.1861	1.0920	0.2766	0.0828	0.0324	0.0
13	0.1828	0.5383	0.8995	1.4583	0.4557	0.3452	0.0042	0.0
14	0.3100	0.3100	0.8800	1.0000	0.4000	0.8000	0.5000	0.2500

TOTAL F   AGES 5 TO 13

	1972	1973	1974	1975	1976	1977	1978
	0.7207	0.5387	1.0473	0.9212	0.4354	0.3396	0.1697

POPULATION WTS AND NOS

	1972	1973	1974	1975	1976	1977	1978	1979
WT	320932.	261677.	198528.	119932.	91278.	131000.	177257.	204031.
NO	204890.	155015.	104475.	71541.	70682.	117552.	150567.	133103.

POPULATION WTS AND NOS AGE 6 TO 14

	1972	1973	1974	1975	1976	1977	1978	1979
WT	159242.	122252.	125390.	64394.	29785.	37068.	43489.	67357.
NO	44683.	29126.	32111.	14136.	7184.	9392.	11496.	19153.

Table 6 - Cod 3NO 1972-79 - Cohort Analysis at F=0.60 for the fully recruited age groups.
NATURAL MORTALITY=   0.20

PARTIAL RECRUITMENT MULTIPLIER

0.0300	0.3600	0.7600	1.0000	1.0000	1.0000	0.9100	0.7600	0.3000	0.3000

ASSUMED FISHING MORTALITY FOR LAST AGES

0.3100	0.3100	0.8800	1.0000	0.4000	0.8000	0.5000	0.6000	.

ESTIMATED POPULATION

AGE YEAR	1972	1973	1974	1975	1976	1977	1978	1979
3	62193.	34873.	32010.	21727.	21398.	38837.	27884.	7605.
4	68017.	50857.	19451.	20394.	17182.	14154.	31248.	21997.
5	28227.	37774.	16665.	7328.	8752.	7051.	9354.	21659.
6	23371.	11991.	17266.	3775.	2807.	3548.	3483.	5380.
7	10982.	6981.	4398.	4298.	824.	1266.	1548.	2111.
8	4684.	3668.	3932.	1568.	753.	546.	519.	947.
9	1809.	2309.	2124.	1277.	325.	479.	287.	333.
10	1034.	1223.	1251.	820.	212.	172.	203.	182.
11	1229.	651.	782.	413.	254.	142.	82.	120.
12	396.	936.	409.	253.	110.	168.	79.	60.
13	291.	258.	661.	102.	69.	68.	115.	60.
14	87.	198.	123.	220.	19.	36.	40.	93.

KNOWN CATCHES

AGE YEAR	1972	1973	1974	1975	1976	1977	1978	1979
3	69.	10058.	6425.	671.	3719.	607.	920.	123.
4	19797.	27600.	9501.	8781.	7754.	2469.	4337.	3887.
5	12289.	15098.	10907.	3528.	3998.	2531.	2518.	7243.
6	13432.	5989.	10872.	2505.	1141.	1500.	818.	2222.
7	5883.	1971.	2247.	3057.	142.	572.	354.	872.
8	1686.	972.	2147.	1059.	152.	177.	102.	391.
9	285.	707.	1015.	921.	104.	209.	58.	128.
10	216.	243.	676.	461.	35.	65.	51.	61.
11	78.	137.	428.	252.	44.	41.	8.	18.
12	74.	116.	257.	152.	24.	25.	5.	9.
13	44.	97.	355.	71.	23.	18.	1.	9.
14	7.	16.	26.	52.	2.	7.	5.	14.

ESTIMATE FISHING MORTALITY

AGE YEAR	1972	1973	1974	1975	1976	1977	1978	1979
3	0.0012	0.3838	0.2508	0.0347	0.2133	0.0174	0.0371	0.0
4	0.3881	0.9157	0.7762	0.6460	0.6907	0.2142	0.1665	0.0
5	0.6561	0.5829	1.2850	0.7594	0.7029	0.5053	0.3531	0.0
6	1.0083	0.8029	1.1905	1.3221	0.5963	0.6297	0.3005	0.0
7	0.8966	0.3740	0.8315	1.5417	0.2113	0.6917	0.2914	0.0
8	0.5072	0.3465	0.9250	1.3724	0.2523	0.4436	0.2449	0.0
9	0.1913	0.4130	0.7513	1.5964	0.4358	0.6579	0.2529	0.0
10	0.2626	0.2478	0.9093	0.9707	0.2017	0.5395	0.3249	0.0
11	0.0727	0.2648	0.9289	1.1241	0.2122	0.3853	0.1137	0.0
12	0.2311	0.1473	1.1861	1.0920	0.2766	0.1792	0.0726	0.0
13	0.1828	0.5383	0.8995	1.4583	0.4557	0.3452	0.0096	0.0
14	0.3100	0.3100	0.8800	1.0000	0.4000	0.8000	0.5000	0.6000

TOTAL F   AGES 5 TO 13

0.7371	0.5543	1.1168	1.1057	0.5864	0.5490	0.3231

POPULATION WTS AND NOS

	1972	1973	1974	1975	1976	1977	1978	1979
WT	316666.	255938.	189976.	106712.	68672.	78408.	90924.	94393.
NO	202320.	151719.	99071.	62175.	52706.	66468.	74841.	60549.

POPULATION WTS AND NOS AGE 6 TO 14

	1972	1973	1974	1975	1976	1977	1978	1979
WT	156718.	118880.	120675.	58296.	21659.	24655.	23539.	32249.
NO	43883.	28215.	30945.	12726.	5375.	6426.	6355.	9287.

Table 7. . Cod 3NO - mean number per standard tow from Research Surveys

Age	1971*	1972*	1973	1974*	1975	1976	1977	1978	1979
Sets	38	45	95	37	56	75	87	88	166
1	.00	.01	.07	.05	.44	.58	.01	.54	3.19
2	4.18	1.17	2.54	1.39	3.15	3.88	2.34	.70	.86
3	42.14	9.01	2.76	4.97	4.58	2.85	9.69	6.99	2.08
4	5.80	19.28	1.81	.89	2.58	1.84	6.27	8.40	8.65
5	4.43	1.78	2.43	.44	.54	1.70	4.62	2.62	8.68
6	1.06	.71	.58	.38	.29	.26	1.54	.76	1.99
7	1.08	.58	.30	.14	.49	.07	.49	.56	.64
8	.48	.41	.19	.04	.21	.13	.22	.07	.27
9	.24	.30	.27	.01	.17	.06	.10	.02	.11
10	.03	.17	.08	.07	.09	.07	.10	.03	.01
11	.08	.08	.05	.03	.00	.02	.01	.03	.05
12	.14	.05	.06	.00	.02	.00	.04	.04	.00
13	.47	.36	.49	.15	.13	.06	.20	.04	.03
13+								.03	.11
Total age 3+		32.73	9.02	7.12	9.10	7.06	23.28	19.59	22.62

* Survey in 3N only

Table 8. 3N Cod - Population at age (per mille) and population (per mille) from Research Surveys along with percent of total possible survey area represented by the total population estimates.

Age/Survey Year	1971	1972	1973	1974	1975	1976	1977	1978	1979
1			5	5	31	59			66
2	69	34	159	163	258	587	85	23	107
3	701	266	278	580	342	200	398	357	156
4	96	569	151	104	178	59	250	412	266
5	74	51	222	51	47	63	162	134	242
6	18	21	64	44	33	12	56	34	71
7	18	17	29	16	63	5	19	27	35
8	8	12	20	5	26	3	9	4	30
9	4	9	19	1	14	-	5	1	7
10	1	5	13	8	6	7	4	1	5
11	1	2	6	3	-	-	-	-	7
12	2	2	2					1	3
13+	8	10	32	18	3	7	10	3	9
Totals:	1000	999	1000	998	1001	999	999	999	1001
Total pop^n	70,697	43,315	13,279	7,637	14,252	10,308	41,754	26,695	7,302
% coverage	91	100	83	70	70	78	100	92	100

Table 9. 30 Cod - Population at age (per mille) and total population (per mille) from Research Surveys along with percent of total possible survey area represented by the total population estimates.

Age/Survey Year	1973	1975	1976	1977	1978	1979
1	8	39	45	2	61	125
2	280	237	182	102	49	24
3	194	382	276	343	307	69
4	160	233	222	236	391	330
5	194	38	200	211	114	334
6	36	12	30	67	40	75
7	23	9	7	20	26	23
8	12	7	17	8	2	8
9	27	13	8	2	1	4
10	1	9	6	3	2	
11	2		2		3	1
12	7	4		2		
13+	55	18	4	6	4	8
	999	1001	999	1002	1000	1001
Total pop	12,778	12,207	16,687	24,191	21,946	62,391
% coverage	84	86	96	93	94	100

Table 10. Number of cod (Ages 3+) per standard tow compared with cohort population numbers (Ages 3+) at $F_t = 0.25$

YEAR	SURVEY NO/TOW	POPULATION NUMBERS $(X\ 10^{-6})$		
1972	32.73	205	Incl. 1973	$R^2 = 0.55$
1973	9.02	155		$y = 69.3 + 3.49\ X$
1974	7.12	105		$t = 2.7204$
1975	9.10	72		$df = 6$
1976	7.06	71	Without 1973	
1977	23.28	118		$R^2 = 0.80$
1978	19.59	151		$y = 48.13 + 4.26x$
1979	22.62	133		$t = 4.4737$
				$df = 5$

Table 11. Numbers of cod at age 3 from Cohort Analysis vs. number of cod of the same year-classes as 3-year-olds and 2-year-olds per survey tow.

YEAR-CLASS	CATCH PER TOW AGE 2	CATCH PER TOW AGE 3	POPULATION SIZE SIZE AT AGE 3
1969	4.18	9.01	63.0
1970	1.17	2.76	36.1
1971	2.54	4.97	34.7
1972	1.39	4.58	26.7
1973	3.15	2.85	31.7
1974	3.88	9.69	75.2
1975	2.34	6.99	
1976	.70	2.08	
1977	.86		

Age 3 (catch per tow) $y=10.76+5.99x$

vs

Age 3 (cohort) $r^2=0.84$

Predicted Age 3's

1975 year-class = 52.6
1976 year-class = 23.2

Age 2 (catch per tow) $y=11.54+12.15x$

vs

Age 3 (cohort) $r^2=0.60$

Predicted Age 3's

1975 year-class = 40.00
1976 year-class = 20.0
1977 year-class = 22.0

Table 12. Relationship of Cohort Biomass Age 3+ (F_t=0.25) with C.P.U.E.
(SCR. Doc. 80/11/10) and Cohort Numbers Age 3+(F_t=0.25) with USSR
survey No's per hour (Age 3+)

YEAR	Cohort Biomass Age 3+ F_t = 0.25	Cohort Numbers Age 3+ F_t= 0.25	CPUE	USSR Surveys #s per hour Age 3+
1972	320.9	204.9	1.05	148
1973	261.7	155.0	.81	106
1974	198.5	104.5	.68	188
1975	119.9	71.5	.61	156
1976	91.3	70.7	.93	168
1977	131.0	117.6	.44	423
1978	177.3	150.6	.30	222
1979	204.0	133.1	1.00	104

	R^2	T	DF.
Cohort Biomass vs. CPUE Age 3+	.19	1.1735	6

Cohort Numbers Age 3+

vs.

USSR surveys #s per hour Age 3+	$(-o.14)^2$	-.3379	6

Table 13. Relationship of Cohort No's (Age 3+ - F_t = 0.60) to Can. and USSR
survey no's per tow (Age 3+);and cohort biomass (Age 3+ - F_t=0.60)
with C.P.U.E. (SCR Doc. 80/11/10).

Year	Numbers at Age 3+ from Cohort F_t=0.60	Canadian Survey No's per stand. set (Age 3+)	USSR Survey No's per hour (Age 3+)	CPUE.	Cohort Biomass Age 3+ F_t=0.60
1972	202.3	32.73	148	1.05	316.7
1973	151.7	9.02	106	.81	255.9
1974	99.1	7.12	188	.68	190.0
1975	62.2	9.10	156	.61	106.7
1976	52.7	7.06	168	.93	68.7
1977	66.5	23.28	423	.44	78.4
1978	74.8	19.59	222	.30	90.9
1979	60.5	22.62	104	1.00	94.4

			R^2	T	D.F.
Cohort numbers Age 3+	vs	Can. Survey #s per tow Age 3+	0.16	1.0870	6
"	vs	USSR Survey #s per tow Age 3+	$(-0.317)^2$	- .7753	6
CPUE	vs	Cohort Biomass Age 3+ (not incl. 1976 or 1979)	.88	5.5066	4

Table 14   3NO COD PROJECTION OF CATCHES

NATURAL MORTALITY# 0.2000   YEAR   1979

AGE	POP. NO. %X10-3<	CATCH NO. %X10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONS<	CATCH WT. %METRIC TONS<	RESIDUAL POP. NOS.
3	18160.	123.	0.008	0.720	13075.2	88.6	14749.7
4	49754.	3887.	0.090	1.050	52241.7	4081.4	37229.1
5	46037.	7243.	0.191	1.550	71357.3	11226.6	31138.6
6	11037.	2222.	0.251	2.250	24833.2	4999.5	7030.5
7	4331.	872.	0.251	3.740	16197.9	3261.3	2758.8
8	1942.	391.	0.251	4.610	8952.6	1802.5	1237.0
9	691.	128.	0.228	6.190	4277.3	792.3	450.4
10	388.	61.	0.190	7.230	2805.2	441.0	202.7
11	275.	18.	0.075	9.480	2607.0	170.6	208.9
12	137.	9.	0.076	12.870	1763.2	115.8	104.0
13	137.	9.	0.076	15.380	2107.1	138.4	104.0
14	214.	14.	0.075	17.850	3819.9	249.9	162.5
TOTAL	133103.	14977.			204037.4	27368.0	95435.9

NATURAL MORTALITY# 0.2000   YEAR   1980

AGE	POP. NO. %X10-3<	CATCH NO. %X10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONS<	CATCH WT. %METRIC TONS<	RESIDUAL POP. NOS.
3	25000.	225.	0.010	0.720	18000.0	162.4	20264.6
4	14750.	779.	0.060	1.050	15487.2	818.3	11372.8
5	37229.	4418.	0.140	1.550	57705.1	6848.6	26498.6
6	31139.	4663.	0.180	2.250	70061.7	10491.7	21294.5
7	7030.	1053.	0.180	3.740	26294.0	3937.5	4807.9
8	2759.	413.	0.180	4.610	12718.1	1904.5	1886.6
9	1237.	166.	0.160	6.190	7657.3	1028.9	863.1
10	450.	53.	0.140	7.230	3256.4	386.5	320.6
11	263.	12.	0.050	9.480	2490.4	110.2	204.6
12	209.	9.	0.050	12.870	2688.3	118.9	162.7
13	104.	5.	0.050	15.380	1598.9	70.7	81.0
14	104.	5.	0.050	17.850	1855.6	82.1	81.0
TOTAL	120273.	11802.			219812.9	25960.3	87837.5

Table 14 (cont'd) AND COD PROJECTION OF CATCHES

NATURAL MORTALITY* 0.2000   YEAR 1981

AGE	POP. NO. %X10-3	CATCH NO. %X10-3	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONS	CATCH WT. %METRIC TONS	RESIDUAL POP. NOS.
3	40000.	361.	0.010	0.720	28800.0	259.8	32423.4
4	20265.	1071.	0.060	1.050	21277.8	1124.2	15625.1
5	11373.	1350.	0.140	1.550	17627.8	2092.1	8094.8
6	26499.	3968.	0.180	2.250	59621.6	8926.4	18121.4
7	21294.	3189.	0.180	3.740	79641.2	11926.3	14562.5
8	4808.	720.	0.180	4.610	22164.3	3319.1	3287.9
9	1887.	254.	0.160	6.190	11678.3	1569.2	1316.3
10	863.	102.	0.140	7.230	6239.9	740.6	614.3
11	321.	14.	0.050	9.480	3039.1	134.5	249.7
12	205.	9.	0.050	12.870	2633.1	116.5	159.3
13	163.	7.	0.050	15.380	2502.0	110.7	126.7
14	61.	4.	0.050	17.850	1445.2	63.9	63.1
TOTAL	127757.	11048.			256670.2	30385.1	94644.0

NATURAL MORTALITY* 0.2000   YEAR 1982

AGE	POP. NO. %X10-3	CATCH NO. %X10-3	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONS	CATCH WT. %METRIC TONS	RESIDUAL POP. NOS.
3	40000.	361.	0.010	0.720	28800.0	259.8	32423.4
4	32423.	1713.	0.060	1.050	34044.5	1798.7	25000.1
5	15625.	1854.	0.140	1.550	24218.8	2874.4	11121.4
6	8095.	1212.	0.180	2.250	18213.3	2727.4	5535.7
7	18121.	2714.	0.180	3.740	67773.8	10149.1	12392.5
8	14562.	2181.	0.180	4.610	67132.9	10053.1	9958.7
9	3288.	442.	0.160	6.190	20352.2	2734.6	2293.9
10	1316.	156.	0.140	7.230	9516.6	1129.5	936.9
11	614.	27.	0.050	9.480	5823.5	257.6	478.4
12	250.	11.	0.050	12.870	3213.3	142.2	194.4
13	159.	7.	0.050	15.380	2450.6	108.4	124.1
14	127.	6.	0.050	17.850	2261.5	100.0	98.7
TOTAL	134581.	10684.			283800.9	32334.9	100557.9

Table 14 (cont'd) 3NO COD PROJECTION OF CATCHES

NATURAL MORTALITY* 0.2000   YEAR 1983

AGE	POP. NO. %X10-3<	CATCH NO. %X10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TUNS<	CATCH WT. %METRIC TUNS<	RESIDUAL POP. NOS.
3	40000.	361.	0.010	0.720	28800.0	259.8	32423.4
4	32423.	1713.	0.060	1.050	34044.5	1798.7	25000.1
5	25000.	2967.	0.140	1.550	38750.1	4599.0	17794.3
6	11121.	1665.	0.180	2.250	25023.3	3747.2	7605.5
7	5536.	829.	0.180	3.740	20703.6	3100.4	3785.7
8	12392.	1856.	0.180	4.610	57129.4	8555.1	8474.7
9	9959.	1338.	0.160	6.190	61644.4	8282.9	6947.9
10	2294.	1272.	0.140	7.230	16584.9	1968.3	1632.7
11	937.	41.	0.050	9.480	8881.6	392.9	729.6
12	478.	21.	0.050	12.870	6157.2	272.4	372.6
13	194.	9.	0.050	15.380	2990.5	132.3	151.4
14	124.	5.	0.050	17.850	2215.0	98.0	96.6
TOTAL	140459.	11078.			302924.2	33207.0	105014.4

NATURAL MORTALITY* 0.2000   YEAR 1984

AGE	POP. NO. %X10-3<	CATCH NO. %X10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TUNS<	CATCH WT. %METRIC TUNS<	RESIDUAL POP. NOS.
3	40000.	361.	0.010	0.720	28800.0	259.8	32423.4
4	32423.	1713.	0.060	1.050	34044.5	1798.7	25000.1
5	25000.	2967.	0.140	1.550	38750.1	4599.0	17794.3
6	17794.	2665.	0.180	2.250	40037.2	5995.6	12168.8
7	7606.	1139.	0.180	3.740	28444.7	4259.6	5201.1
8	3786.	567.	0.160	4.610	17451.9	2613.4	2588.9
9	8475.	1139.	0.160	6.190	52458.7	7048.7	5912.6
10	6948.	825.	0.140	7.230	50233.7	5961.9	4945.3
11	1633.	72.	0.050	9.480	15478.3	684.8	1271.6
12	730.	32.	0.050	12.870	9390.5	415.4	568.2
13	373.	16.	0.050	15.380	5730.4	253.5	290.2
14	151.	7.	0.050	17.850	2703.1	119.6	117.9
TOTAL	144918.	11502.			323522.8	34009.8	108282.2

Table 14 (cont'd) 3NO COD PROJECTION OF CATCHES

NATURAL MORTALITY# 0.2000   YEAR 1985

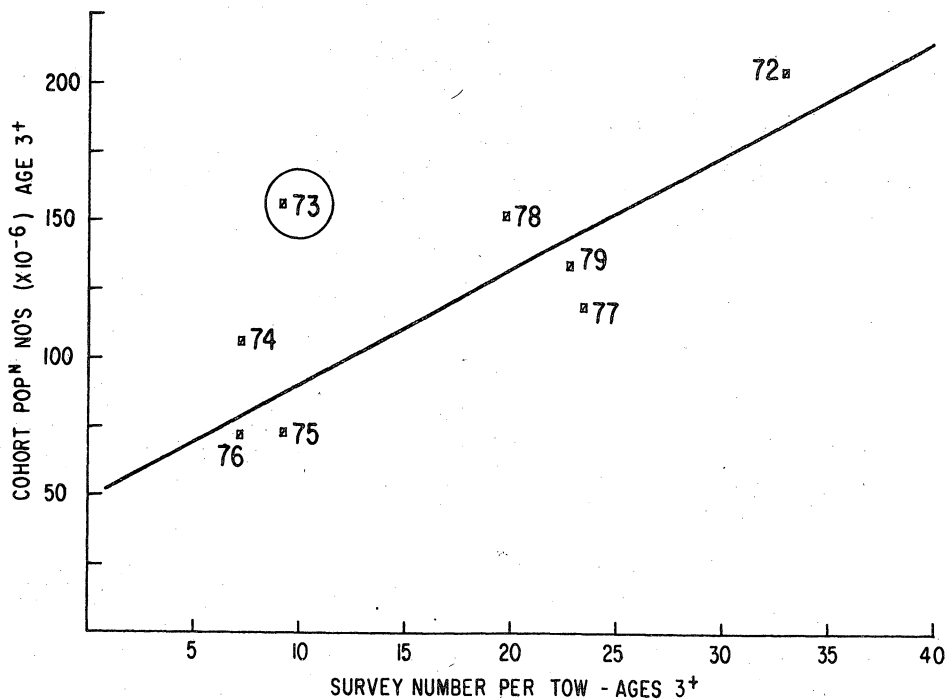| AGE	POP. NO. %X10-3<	CATCH NO. %X10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONS<	CATCH WT. %METRIC TONS<	RESIDUAL POP. NOS.
3	40000.	361.	0.010	0.720	28800.0	259.8	32423.4
4	32423.	1713.	0.060	1.050	34044.5	1798.7	25000.1
5	25000.	2967.	0.140	1.550	38750.1	4599.0	17794.3
6	17794.	2665.	0.180	2.250	40037.2	5995.6	12168.8
7	12169.	1822.	0.180	3.740	45511.5	6815.3	8321.8
8	5201.	779.	0.180	4.610	23977.2	3590.6	3556.8
9	2589.	348.	0.160	6.190	16025.1	2153.2	1806.2
10	5913.	702.	0.140	7.230	42748.3	5073.5	4208.4
11	4945.	219.	0.050	9.480	46881.9	2074.0	3851.4
12	1272.	56.	0.050	12.870	16365.1	724.0	990.3
13	568.	25.	0.050	15.380	8739.6	386.6	442.6
14	290.	13.	0.050	17.850	5179.6	229.1	226.0
TOTAL	148164.	11669.			347059.8	33699.5	110789.8

Fig. 1. Relationship of the number of cod (ages 3+)
per standard tow compared with cohort
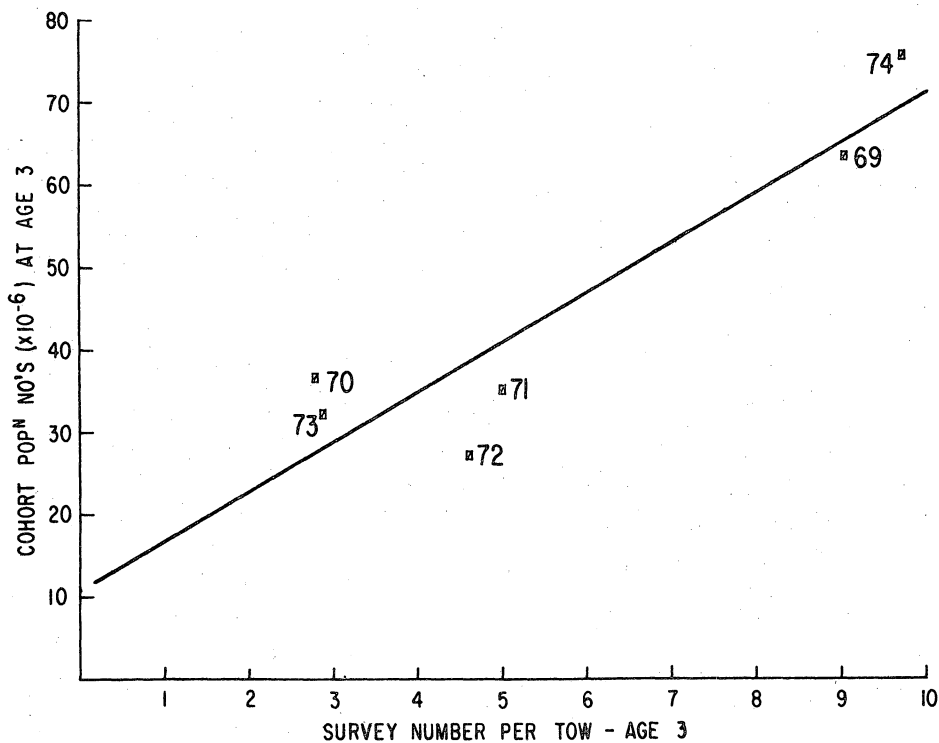population numbers (ages 3+) at F_t=0.25.

Fig. 2. The relationship of numbers of cod at age 3 from a
cohort analysis with the number of cod from the
same year-classes as 3 year-olds per survey tow.