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Assessment of the Cod Stock in NAFO Divisions 2J+3KL

by

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Nominal Catch

Catches of cod from Divisions 2J3KL declined from a peak of about 800,000 t. in 1968 to a low of about 139,000 t. in 1978. Quota regulation came into effect in 1973. Inshore and offshore historical catches by division are given in Table 1 and recent nominal catches and TACs are as follows ('000 t).

Year	1979	1980	1981	1982	1983	1984	1985
TAC	180	180	200	230	260	266	266
Nominal catch	167	176	171	230	230[a]	229[a]	

[a]Provisional data

Nominal catches by country, month and division for 1984 are given in Table 2. These were obtained from the Department of Fisheries and Oceans for Canadian based vessels and from NAFO circular letters and the FLASH database for others. As in recent years the Canadian fishery took a major portion of the 1984 catch (90%). The inshore catch in 1984 declined slightly from 1983, but remained at a level similar to that reported in the mid 1960's (Fig.1). Forty-seven percent of the Canadian catch was landed by inshore gears, the same proportion as last year.

Catch at age

The catch breakdown shown in Table 2 and the sampling data shown in Table 3 were used to derive catch numbers, average weight and average length at age for 1984. Sampling coverage of the catch was well distributed (Table 3) and there were adequate data to treat each division separately. The coefficient of variation for estimated catch numbers of ages 4-11 was about 5% or less (Table 4). These age groups comprised about 99% of the total catch in numbers. The discrepancy between reported catch and calculated catch was about 2.5%. Catch at age by division for otter trawl, inshore and other gears is given in Table 5. All of the inshore catches were obtained by Canada-Newfoundland based vessels. The following relationship was applied in deriving average weight at age: Log weight = 3.0879 log length - 5.2106. Historical catch and average weight at age are shown in Table 6, along with the 1984 results. Table 7 shows the discrepancy between the historical reported and calculated catch. In all but three of the 23 years in this series the reported catch was within 10% of the calculated catch, and in 8 of the last 10 years the reported catch was within 5% of the calculated catch.

Research Vessel Surveys

Research vessel surveys were conducted during the fall by the Gadus Atlantica in Divisions 2J and 3K since 1977 and 1978 respectively. Biomass and abundance estimates from these surveys are given in Tables 8 to 11. Spring surveys were conducted in Division 3L from 1971-82 by the A. T. Cameron. The survey could not be conducted in 1983 and in 1984 a survey of only limited coverage (100 ftm) could be completed. Biomass and abundance estimates for the 1971-82 surveys are shown in Tables 12 and 13. As part of a seasonal survey program research vessel surveys have been conducted in the fall for the years 1981 to 1984 (Tables 14 and 15). The 1984 fall 3L survey was conducted earlier than in the three previous fall 3L surveys (Aug.-Sept. as opposed to Oct-Nov.). For this reason a winter 1985 3L survey was

included with these results (Tables 14 and 15). Fall surveys for Division 3L were conducted by the A. T. Cameron in 1981-82 and by the Wilfred Templeman in 1983-84. The 1985 Division 3L winter survey was also conducted by the Wilfred Templeman. Mean numbers and weights per standard tow with associated confidence limits for selected strata are given Tables 16 to 19 and Fig. 2 and 9. Selected strata were chosen as those with depths less than 400 meters and common to all years in a particular series. Two strata were added to the survey area in the 1984 survey. (Division 3K, No's 618 and 619 and Fig. 10). These, strata which were within the depth range 101-200 meters, were included to provide additional information on cod distribution in near shore areas. Abundance and biomass decreased in Division 2J, remained stable in Division 3K, and showed a considerable increase in Division 3L from 1983 to 1984. Mean numbers per standard tow at age from Division 3L spring surveys (Table 20) were presented in a previous assessment and were included for reference purposes as no new information was available. The 1980 year class was strong in Divisions 3K and 3L with that for 1979 predominating in Division 2J (Tables 21 to 23). Year class strength patterns for older age groups were similar to that observed in previous years and as was observed in the previous assessment the 1980-81 year classes are showing continued strength in all Divisions. It would appear that the 1982 year class may also be strong in all Divisions.

A survey biomass index was obtained by combining fall survey results from Divisions 2J, 3K and 3L. Only strata common to all years and less than 400 m were used. The 1977 biomass estimate for Division 3K was calculated by taking the proportion of the 3K to 2J average biomass for the 1978-84 period. The 1977-80 biomass estimates for Division 3L were calculated by taking the proportion of the 3L to 2J3K average biomass for the 1981-84 period. This survey index is shown in Table 24. In last years assessment (Gavaris et al, 1984) a survey biomass index was derived using surveys from Canada and the Federal Republic of Germany. The Federal Republic of Germany survey results were not used this year because no new information was available for 1984.

Catch-effort

As catch and effort data are available by Division, month, country and gear, the multiplicative model (Gavaris, 1980) was used to account for the country-gear, seasonal, and divisional differences. Data for 1962-79 were obtained from NAFO (ICNAF) Statistical Bulletins and data for 1979-84 were obtained from the Department of Fisheries and Oceans, Canada. For the 1962-79 series, data from Canada-Newfoundland, Spain, and Portugal were used, and for the 1979-84 series data from Canada-Newfoundland, Canada-Maritimes, and Portugal were used. To reduce the possible effect of truncation and rounding errors data with less than 10 tons catch or 10 hours effort were excluded from the analysis. As in previous assessments plots of residuals showed that data with greater catch or effort were less variable, therefore, estimated weights (log catch x effort), calculated according to Judge et. al. (1980 p. 132), were applied in a weighted regression of the multiplicative model. The seasonal patterns were similar in both series but were more pronounced in the 1979-84 series (Tables 25 and 26). The catch rate index (Table 27, Figure 11) shows a general decline from the late 1960's to the mid 1970's and a subsesquent increase.

Sequential Population Analysis

The historical partial selection (Table 28) was calculated by dividing the fishing mortality matrix by the total fishing mortality for ages 8-11 in that year. All values for fully recruited ages were set to 1 (ages 8-13). The total fishing mortality for ages 8-11 was derived from the ratio of the ages 8-10 population numbers and ages 9-11 population numbers in the succeeding year. The partial selection of ages 4-7 used as input for 1984 in the cohort analysis was obtained as an average of selectivities from 1977 to 1982. It was assumed that partial selection for ages 8-13 in 1984 was 1.0.

Assuming a natural mortality of 0.2, cohort analysis was performed for a range of fully recruited fishing mortalities in 1984. The fishing mortality for age 13 for 1962-84 was assumed to be equal to the total fishing mortality for ages 8-11. The relationship between age 4+ beginning of the year biomass from cohort analyis versus survey biomass indices for Division 2J3K and Divisions 2J3KL lagged 1 year (Table 29) were not significant and therefore not used were for cohort tuning . The relationship beween the catch rate index and average exploitable biomass was also examined to determine which fully recruited fishing mortality agreed best with the data. Average exploitable biomass was calculated by multiplying average biomass by the partial selection. The results, shown in Table 30, indicated that a fully recruited fishing mortality of 0.175 agrees best with the data. Population numbers, population biomass and fishing mortality from a cohort analysis using a fully recruited fishing mortality of 0.175 are shown in Table 31. The regression of exploitable biomass versus catch rate index for a fully recruited fishing mortality of 0.175 is given in Fig. 12.

References

Gavaris, S. 1980. Use of a multiplicative model to estimate catch rate and effort from commercial data. Can. J. Fish. Aquat. Sci. 37: 2272-2275.

Gavaris, S., C. A. Bishop, and J. W. Baird. 1984. Assessment of the cod stock in Divisions 2J+3KL. NAFO SCR Doc. 84/73, Ser. No. N862. 31 p.

Judge, C. C., W. E. Griffiths, R. C. Hill, and T. C. Lee. 1980. The theory and practice of econometrics. John Wiley and Sons, New York. 793 p.

Table 1. Historical catches of cod from NAFO Divisions 2J3KL for the years 1959-84.

Year	2J Inshore	2J Offshore Can.	2J Offshore Other	3K Inshore	3K Offshore Can.	3K Offshore Other	3L Inshore	3L Offshore Can.	3L Offshore Other	2J3KL Offshore Not Specified	Total Inshore	Total Offshore	Total	TAC
1959	17533	-	39405	56264	-	83003	85695	4515	43097	30060	159492	200080	359572	-
1960	15418	1	164036	47676	53	69855	94192	7355	60213	-	157286	301513	458799	-
1961	17545	1	243144	31159	-	60574	70659	4675	70318	3	119363	378715	498078	-
1962	23424	-	226841	42816	-	45554	72271	4383	87463	-	138511	364241	502752	-
1963	23767	1	187925	47486	-	75344	73295	4446	78620	9020	144548	355356	499904	-
1964	14787	13	180232	40705	30	110887	75806	10158	129135	41832	131298	472287	603585	-
1965	25117	-	227206	26467	21	46146	58943	7353	119529	44872	110527	445127	555654	-
1966	22645	39	221004	32208	13	57543	55990	8253	117231	7381	110843	411464	522307	-
1967	27721	28	212327	24905	114	76900	49233	13478	195494	10335	101859	508676	610535	-
1968	12937	4592	323280	40768	1849	114123	47330	15784	202998	43809	101035	706435	807470	-
1969	4328	30	356543	24923	56	74397	67973	18255	142954	58974	97224	651209	748433	-
1970	1963	-	196823	21511	93	69396	53113	14471	128975	29868	76587	439626	516213	-
1971	3229	84	146903	21111	31	58404	38115	11976	140664	11979	62455	370041	432496	-
1972	1725	-	148038	14054	7	132122	46273	4380	107991	3580	62052	396118	458170	-
1973	3619	1123	52985	13190	110	159651	24839	1258	97734	-	41648	312861	354509	666000
1974	1804	-	119463	10747	19	149189	22630	880	67918	-	35181	337469	372650	657000
1975	3000	410	78578	15518	13	112854	22695	670	53770	-	41213	246295	287508	554000
1976	3851	94	30691	20879	646	79665	35209	2187	40998	-	59939	154281	214220	300000
1977	3523	525	39584	28818	1039	26788	40282	5362	26799	-	72623	100097	172720	160000
1978	6638	4682	17546	29623	5859	7541	45194	9213	12263	-	81455	57104	138559	135000
1979	8445	9194	6536	27018	15190	23275	50359	14184	12690	-	85822	81069	166891	180000
1980	17210	13592	7435	37015	21920	6828	42298	15523	13961	-	96523	79259	175782	180000
1981	11582	24794	4760	22770	23344	3847	42835	21746	15070	-	77187	93561	170748	200000
1982	15330	57483	8923	42410	8614	4072	57881	25788	9273	-	115621	114153	229774	230000
1983	10638	37341	3640	40803	31565	2352	54683	39423	9768	-	106124	124089	230213	260000
1984	12689	11005	1203	34996	47850	9647	49088	49633	13118	-	96773	132456	229229	266000

Table 2. Cod landings (tons) from Divisions 2J, 3K, and 3L by country during 1984.

2J

Month	Can (N) Ins.	Can (N) Off.	Can M	FRG	France	Port	Poland	GDR	USSR	Japan	UK
J		26					32				
F											
M		2480	1722		397						
A		1684[a]	2186								
M		172	96								
J	7	69	129				1				
J	2392	446	323	426							
A	7080	64							6		
S	2686	4							1	2	
O	477									4	
N	47							2		8	
D		1604[b]				314		10			
	12689	6549	4456	426	397	314	33	12	7	14	

2J Total = 24897

3K

J		3770	1835	6715							
F	1	9219	5459								
M		3973	2423		38						
A	2	3461	1747		610		2				
M	356	2258	3214			50	39				
J	4865	3098	3367				21				613
J	14670	1893	857	3							
A	8584	195	36						12		
S	4264	189	45							20	
O	2023	294	84					1		3	
N	194	70	12			26		3		3	
D	37	351				1470	15	3			
	34996	28771[c]	19079	6718	648	1546	77	7	12	26	613

3K Total = 92493

3L

Month	Can (N) Ins.	Can (N) Off.	Can M	France	Port OT	Port GN	UK	GDR	Spain
J	93	7335	1195						58
F	94	7530	1202	63					28
M	35	5977	77	180					581
A	29	4718	20						958
M	2948	5477	2046			117	26		1008
J	10317	3156	227	120		67			656
J	18924	2539	182			448			393
A	10181	701	122			773			1555
S	4424	726	76			92		62	1225
O	1789	904	64			532		1	251
N	227	1139	937		5	589			1562
D	27	2128	1155		1757	11			
	49088	42330[d]	7303	363	1762	2629	26	63	8275

3L Total = 111839

[a]Includes RSPP-Resource Short Plant Program - GN landings (436 t).
[b]Includes RSPP - OT landings.
[c]Includes RSPP - GN landings (617 t).
[d]Includes RSPP - GN landings (2005 t).

Table 3. Commercial sampling for Divisions 2J+3KL cod in 1984.

Div.	Gear	Qtr.	Country	No. aged	Month	No. meas.	Landings (tons) Country Month	Total
2J	OT	1	Can(N)	400	Mar.	7947	2480	2480
			France(M)		Mar.	749	397	397
			Other					1780
				400		8696		4657
		2	Can(M)		Apr.	229	2186	2412
			Can(N)	267	Apr.	1791	1248	1489
				267		2020		3901
		3	Can(N)	76	July	286	446	837
			FRG	45	July	1039	426	435
				121		1325		1272
		4	Can(N)	100	Dec.	6614	1604	1628
			Port	187	Dec.	2879	314	314
				287		9493		1942
		1-2-3-4	Other					436
	Trap	3	Can(N)		Aug.	7168	3218	5327
	GN	3	Can(N)	459	Aug.	3822	3180	6014
	HL	3	Can(N)		Aug.	1287	613	976
			Other					372
				459		12277		12689
2J	Total			1534		33811		24897
3K	OT	1	Can(M)		Jan.	983	1835	1835
			Can(M)		Feb.	2460	5459	5459
			Can(M)		Mar.	382	2423	2423
			Can(N)		Jan.	6234	3738	3738
			Can(N)	479	Feb.	5639	8716	8716
			Can(N)		Mar.	2567	3973	3973
			FRG	460	Jan.	6309	6715	6715
			France(M)	28	Mar.	1634	38	38
				967		26208		32897
		2	France(M)	70	Apr.	530	610	5814
			Can(N)		Apr.	4056	3455	
			Can(N)	416	May	279	2258	2258
			Can(N)		June	725	3098	6465
			Can(M)		May	729	3214	3214
			Poland		May	462	39	89
			UK	168	June	2958	613	634
				654		9739		18474
		3	Can(N)		July	281	1893	2753
			Can(N)	a	Sept.	257	189	254
			Other					243
						538		3250
		4	Can(N)		Oct.	699	294	382
			Can(N)	164	Nov.	266	28	72
			Can(N)		Dec.	674	317	335
			Port	76	Dec.	2880	1470	1470
				240		4519		2259
		1-2-3-4	Other					617

Table 3. (Cont'd.)

Div.	Gear	Qtr.	Country	No. aged	Month	No. meas.	Landings (tons) Country Month	Total
	Trap	3	Can(N)		June	691	640	9872
	Trap	3	Can(N)		July	7798	6799	
	GN	3	Can(N)		June	2709	3775	4022
	GN	3	Can(N)		July	2699	5994	5994
	GN	3	Can(N)	815	Aug.	1170	2714	2714
	HL	3	Can(N)		June	836	208	212
	HL	3	Can(N)		July	937	1582	1582
	HL	3	Can(N)		Aug.	3959	3619	3619
	LT	3	Can(N)		Aug.	172	501	1128
				815		20971		29143
3K	GN	4	Can(N)		Sept.	1360	1100	1100
	GN		Can(N)		Oct.	763	407	495
	HL		Can(N)	695	Sept.	1851	1984	2990
	LT		Can(N)		Sept.	4576	541	541
	LT		Can(N)		Oct.	1449	666	727
				695		9999		5853
3K Total				3371		71974		92493
3L	OT	1	France(M)		Feb.	653	63	8634
			Can(N)		Feb.	10068	7341	
			Can(N)	531	Jan.	25196	6755	8008
			Can(N)		Mar.	12222	5974	6812
			France(M)	73	Mar.	703	180	
				604		48842		23454
		2	Can(M)		May	303	2046	8097
			Can(N)		May	1362	5017	
			Can(N)	544	Apr.	2852	4513	5491
			Can(N)		June	2557	3077	4080
			STPM		June	256	120	
				544		7330		17668
		3	Can(N)	392	July	2568	2539	3114
			Can(N)		Aug.	222	701	4467
				392		2790		7581
		4	Can(N)		Oct.	851	904	1220
			Can(N)	626	Nov.	6475	780	3279
			Can(N)		Dec.	4965	1198	3153
			Port	265	Dec.	4193	1762	1762
				891		16484		9414
	Trap	2	Can(N)	752	May	1676	1260	1260
			Can(N)		May	8912	1621	1766
				752		10588		3026
	Trap	3	Can(N)		June	6640	5761	5761
	Trap	3	Can(N)		July	6184	12325	12325
	Trap	3	Can(N)		Aug.	393	3512	3654
	GN	3	Can(N)		June	2807	3949	3949
	GN	3	Can(N)	1165	July	3441	5858	5858
	GN	3	Can(N)		Aug.	812	2417	2417
	HL	3	Can(N)		June	3689	596	698
	HL	3	Can(N)		July	263	700	700
3L	HL	3	Can(N)		Aug.	4340	3030	3030
	LT	3	Can(N)		Aug.	1000	1222	1345
				1165		29549		39737

Table 3. (Cont'd.)

Div.	Gear	Qtr.	Country	No. aged	Month	No. meas.	Landings (tons) Country	Landings (tons) Month	Landings (tons) Total
3L	GN	4	Can(N)		Sept.	1683		644	907
	HL		Can(N)	439	Sept.	1688		2028	2959
	LT		Can(N)		Sept.	3382		1643	2459
				439		6753			6325
	GN	2	Port.		Apr.	1960		205	977
	GN		Port.	324	May	5091		577	577
	GN		Port.		June	1084		67	146
				324		8135			1700
	GN	3	Port.		July	2666		448	448
	GN		Port.	351	Aug.	3857		773	773
	GN		Port.		Sept.	2591		92	92
				351		9114			1313
	GN	4	Port.	70	Oct.	2415		532	532
	GN		Port.	271	Nov.	3213		948	1089
				341		5628			1621
3L Total				5803		145213			111839
2J3KL Total				10708		250998			229229

[a]Adjusted using quarter 2 age-length key.

Table 4. Estimated average weight, average length, and catch numbers at age for the commercial cod fishery in Divisions 2J3KL during 1983.

Age	Average Weight (kg)	Average Length (cm)	Mean (x10-3)	STD. ERR.	C.V.
2	0.338	33.835	3	1.13	0.38
3	0.590	40.533	778	74.52	0.10
4	0.885	46.435	14800	463.51	0.03
5	1.202	51.265	31578	738.88	0.02
6	1.786	58.338	38494	786.93	0.02
7	2.280	63.115	12451	529.00	0.04
8	2.714	66.678	7205	365.29	0.05
9	2.968	68.456	8843	335.66	0.04
10	3.649	72.949	4196	211.80	0.05
11	4.281	76.836	2515	135.77	0.05
12	6.199	86.132	448	42.09	0.09
13	8.396	95.665	144	14.97	0.10
14	10.266	102.270	48	7.32	0.15
15	11.448	105.609	41	7.08	0.17
16	11.615	106.875	32	7.04	0.22
17	17.477	121.352	8	2.90	0.38
18	12.947	110.498	6	2.21	0.36
19	15.216	114.519	3	1.46	0.44
20	12.815	110.652	3	1.58	0.48
21	15.295	117.511	1	0.44	0.38
22					
23					
24	14.146	114.819	1	1.54	1.03

Table 5. Catch at age by division and gear for the commercial cod fishery in Divisions 2J3KL during 1984 (number x 10^{-3}).

Age	Otter trawl			Inshore			Others
	2J	3K	3L	2J	3K	3L	2J3KL
2			3				
3	40	97	139	8	164	330	
4	285	1312	2895	403	2300	7582	24
5	1448	8347	5445	1626	5618	9017	78
6	1381	8145	13810	1512	4950	8103	595
7	453	2977	3578	945	2493	1667	340
8	459	1866	1501	672	1172	1332	203
9	1074	4261	920	713	933	784	157
10	480	1677	485	340	698	443	73
11	369	1235	148	275	347	128	12
12	40	203	57	30	78	37	3
13	5	56	15	19	34	12	2
14	3	16	8	2	11	9	
15	1	10	17		9	5	
16	2	16	6		4	3	
17		2	3			2	
18	1	2	1		1	2	
19	1	1			1	1	
20		1			2	1	
21		1					
22							
23							
24			1				

Table 6. Catch Numbers (X 10^{-5}) and weights at age (kg) for cod in Divisions 2J3KL.

CATCH AT AGE

AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
4	267	271	267	280	663	785	916	381	572	690	798	407	138	150	644	528	169	121	118
5	658	592	563	456	942	1009	1990	964	773	921	1166	945	355	259	346	464	396	382	280
6	600	1159	590	655	632	972	1450	1534	940	944	762	592	747	347	251	143	213	302	289
7	486	579	981	629	598	553	809	1006	788	557	560	353	613	389	180	62	83	116	172
8	284	288	498	671	307	388	379	493	269	241	296	273	361	356	149	38	32	36	47
9	207	152	202	334	240	172	224	184	100	113	118	142	186	133	113	33	15	14	12
10	186	114	118	147	88	161	76	115	36	43	64	76	102	77	45	20	11	8	5
11	108	81	84	68	47	60	54	60	19	21	30	38	55	24	19	8	4	6	2
12	98	41	61	37	23	34	34	42	11	12	17	22	29	13	7	3	2	2	2
13	80	39	48	39	18	21	19	28	5	11	14	12	10	9	4	3	1	1	1
4+	2974	3316	3412	3316	3558	4155	5951	4807	3513	3553	3825	2860	2596	1757	1758	1302	926	988	928
5+	2707	3045	3145	3036	2895	3370	5035	4426	2941	2863	3027	2453	2458	1607	1114	774	757	867	810

AGE	1981	1982	1983	1984
4	65	327	134	148
5	118	187	414	316
6	218	143	187	385
7	191	251	118	125
8	105	167	145	72
9	29	118	88	88
10	7	19	64	42
11	3	3	10	25
12	2	2	2	4
13	1	1	1	1
4+	739	1218	1163	1206
5+	674	891	1029	1058

AVERAGE WEIGHT AT AGE

AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
4	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.77	0.70	0.74	0.77
5	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	1.02	0.99	1.12	1.16
6	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.73	1.59	1.68	1.72
7	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	2.51	2.53	2.49	2.39
8	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	3.29	3.40	3.60	3.58
9	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	3.99	4.26	4.46	5.03
10	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	4.81	4.75	5.31	5.59
11	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	5.61	5.51	5.86	6.78
12	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	6.48	7.32	7.18	7.89
13	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	8.05	8.25	9.02	8.73

AGE	1981	1982	1983	1984
4	0.77	0.84	0.86	0.89
5	1.15	1.21	1.31	1.20
6	1.63	1.77	1.74	1.79
7	2.21	2.10	2.27	2.28
8	2.87	2.67	2.59	2.71
9	3.82	3.09	3.16	2.97
10	5.31	4.18	3.49	3.65
11	6.34	6.23	4.78	4.28
12	7.12	7.20	7.73	6.20
13	7.48	8.05	9.05	8.40

Table 7. Historical sum of products for NAFO Divisions 2J3KL for the years 1962-84.

Year	Calculated Catch	Reported Catch	Percent Discrepancy
1962	530827	502752	+5.6
1963	514213	499904	+2.9
1964	582060	603585	-3.6
1965	582238	555654	+4.8
1966	490918	522307	-6.0
1967	571579	610535	-6.4
1968	747724	807470	-7.4
1969	708085	748433	-5.4
1970	455527	516213	-11.8
1971	441712	432496	+2.1
1972	474259	458170	+3.5
1973	387181	354509	+9.2
1974	429316	372650	+15.2
1975	293240	287508	+2.0
1976	214824	214220	+0.3
1977	172421	172720	-0.2
1978	132888	138559	-4.1
1979	160664	166891	-3.7
1980	161836	175782	-7.9
1981	145267	170748	-14.9
1982	221223	229774	-3.7
1983	220012	230213	-4.4
1984	223505	229229	-2.5

Table 8. Cod abundance estimates (No. x 10^3) from research vessel surveys in NAFO Division 2J.

Depth Range (mtrs)	Stratum Number	Stratum area (mi^2)	Gadus 3 1977	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58 1981	Gadus 71 1982	Gadus 86-88 1983	Gadus 101-102 1984
101-200	201	1427	13336	3071	1500	5749	8355	16692	16246	10533
	205	1823	2894	8039	1574	787	4550	21765	13547	25230
	206	2582	6889	1634	1236	2104	6220	5868	8694	30077
	207	2246	9745	5100	2664	3406	5479	9049	13024	14210
Total		8078	32864	17844	6974	12046	24604	53419	51511	80050
201-300	202	440	2097	462	396	5681	2378	2378	1833	1866
	209	1608	10174	3531	21485	3410	10099	7681	29567	3862
	210	774	6166	4154	2760	2982	445	4713	59785	4953
	213	1725	6944	19617	18516	19811	2158	5807	12806	6915
	214	1171	16716	10658	6527	10958	3956	5900	4659	25667
	215	1270	19281	34205	9986	25692	35768	27583	7233	8040
	228	1428	2948		6780	8254	10701	2187	2269	1853
	234	508	1258	553	267	1506	554	2250	4698	3005
Total		8924	65584	73180	66717	78294	66039	58499	122850	56161
301-400	203	480	883			3081	81	1117	462	703
	208	448	1017	247	1480	202	303	1368	1749	224
	211	330	632	5450	2737	4659	1746	2415	1325	297
	216	384	0		202	3603	86	14	10	331
	222	441	50	1479	149	1258	132	0	11	11
	229	567	415	234	2873	1319	447	298	670	71
Total		2650	2997	7410	7441	14122	2795	5212	4227	1637
401-500	204	354	199				1342	142	540	1422
	217	268	0				0	0	0	-
	223	180	0				0	0	0	0
	227	686	51				0	21	26	0
	235	420	32				158	126	1135	63
Total		1908	282				1500	289	1701	1485
101-200			32864	17844	6974	12046	24604	53419	51511	80050
201-300			65584	73180	66717	78294	66039	58499	122850	56161
301-400			2997	7410	7441	14122	2795	5212	4227	1637
401-500		1908	282				1500	289	1701	1485
Total			101786	98432	81130	104461	94988	117469	180290	139366
Upper limit			149969	131104	128646	139530	162744	151085	744785	184179
Lower limit			53602	65761	33613	69392	27234	83853	384206	94552

Table 9. Cod biomass estimates (t) from research vessel surveys in NAFO Division 2J.

Depth Range (mtrs)	Stratum Number	Stratum area (mi^2)	Gadus 3 1977	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58 1981	Gadus 71 1982	Gadus 86-88 1983	Gadus 101-102 1984
101-200	201	1427	12377	4847	3256	11319	15998	18085	16764	12033
	205	1823	2761	16200	2669	1676	10126	39216	17742	25093
	206	2582	5328	2074	2671	3849	13153	8533	11442	39133
	207	2246	16809	8209	4192	7738	12284	12612	12608	18136
Total		8078	37275	31330	12788	24582	51561	78446	58556	94395
201-300	202	440	3074	525	749	12964	6292	5681	3798	2948
	209	1608	15336	5384	43569	12810	22275	18351	53925	7678
	210	774	10481	5572	5771	5810	823	10428	97578	9448
	213	1725	6525	31627	31100	34068	5622	8073	14748	9401
	214	1171	24370	20791	13231	25095	9669	10993	6944	33853
	215	1270	31757	55780	19546	64301	96161	60996	12584	10471
	228	1428	3930		12374	16972	23904	4357	2215	3012
	234	508	2857	1030	553	3699	1192	4614	5370	3657
Total		8924	98330	120709	126893	175719	165938	123493	197162	80468
301-400	203	480	1930			7467	230	3141	1369	2054
	208	448	1962	438	3341	631	908	3750	3153	454
	211	330	1738	10285	5685	9384	4747	6490	3016	954
	216	384	0		484	10204	454	86	24	908
	222	441	43	2029	653	2780	281	0	105	22
	229	567	1009	319	7394	3150	1144	467	516	106
Total		2650	6682	13071	17557	33616	7764	13934	8183	4498
401-500	204	354	308				3149	316	1506	2192
	217	268	0				0	0	0	-
	223	180	0				0	0	0	0
	227	686	131				0	36	129	0
	235	420	75				347	315	1584	121
Total		1908	514				3496	667	3219	2312
101-200		8078	37275	31330	12788	24582	51561	78446	58556	94395
201-300		8924	98330	120709	126893	175719	165938	123493	197162	80468
301-400		2650	6682	13071	17557	33616	7764	13934	8183	4498
401-500		1908	514				3496	667	3219	2312
Total			142801	165110	157238	233917	228759	216540	267120	181674
Total			142961	165109	157237	233916	228894	216679	267120	181731
Upper limit			199808	222301	253553	314419	424737	288880	1175017	241662
Lower limit			86113	107917	60921	153412	33051	144478	640777	121800

Table 10. Cod abundance estimates (No. x 10^{-3}) from research vessel surveys in NAFO Division 3K.

Depth Range (mtrs)	Stratum Number	Stratum area (mi^2)	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58,59 1981	Gadus 71,72 1982	Gadus 86-88 1983	Gadus 101-103 1984
101-200	618	1455							4806
	619	1588							1243
									6049
201-300	620	2709	17720	26203	15206	12689	4284	17610	22825
	621	2859	14563	25646	2739	7453	6471	4603	6070
	624	668	13121	23166	627	3686	2470	1128	965
	632	447	727	2265	5078	3171	2494	8321	-
	634	1618	4105	18157	13651	19455	11384	14186	6229
	635	1274	3825	1492	3706	4743	3175	1227	3275
	636	1455	1820	2446	6051	3695	7001	2603	3413
	637	1132	2528	5778	3909	4744	6409	8718	19062
Total		12162	58409	105153	50967	59636	43652	58396	61839
301-400	623	1027	6167	2981	7593	876	1557	5769	11764
	625	850	1340	2488	1515	1021	2169	1276	574
	626	919	3191	759	1012	2235	911	1276	770
	628	1085	1433	2891	1008	1371	570	1955	1140
	629	495	718	446	144	50	412	562	459
	630	544		388	315	225		306	414
	633	2179	4283	3044	2944	3106	3552	3748	5954
	638	2059	2720	8081	3246	9158	5699	13643	3323
	639	1463	1603	3075	741	1303	2921	4095	1304
Total		10621	21455	24153	18518	19345	17791	32630	25702
401-500	622	632				356	190	142	308
	627	1194				104	152	193	178
	631	1202				162	0	523	18
	640	198				0	0		7
	645	204				0	5	8	15
Total		3430				622	347	866	526
101-200									6049
201-300			58409	105153	50967	59636	43652	58396	61839
301-400			21455	24153	18518	19345	17791	32630	25702
Total			79865	129306	69484	79602	61791	91907	94118
Upper limit			113311	218233	93324	104928	75262	119955	125225
Lower limit			46420	40380	45645	54276	48320	63859	63010

Table 11. Cod biomass estimates (t) from research vessel surveys in NAFO Division 3K.

Depth Range (mtrs)	Stratum Number	Stratum area (mi^2)	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58,59 1981	Gadus 71,72 1982	Gadus 86-88 1983	Gadus 101-102 1984
101-200	618	1455							9363
	619	1588							3004
Total									12367
201-300	620	2709	32708	55286	33699	33603	9851	33248	41781
	621	2859	25889	63106	5939	10935	11764	6750	14149
	624	668	29936	40531	1742	7973	5365	1586	959
	632	447	873	3896	10165	7566	5721	13992	
	634	1618	6907	29309	29404	40573	23579	22967	11703
	635	1274	3702	2551	7902	10271	7249	3236	5457
	636	1455	2248	5040	11959	8428	14144	6335	7065
	637	1132	3540	10613	7871	9829	13256	17317	34548
Total		12162	105803	210332	108681	129178	90929	105431	115662
301-400	623	1027	11293	7522	15746	2175	4849	12071	20190
	625	850	1825	5538	4626	2640	4817	3499	1397
	626	919	6976	1940	3242	4781	2076	3932	1653
	628	1085	2729	6206	2739	3848	1480	3841	2112
	629	495	1136	1062	337	150	1255	1167	832
	630	544		1019	1174	939		847	708
	633	2179	6947	6379	8073	8406	8482	6558	10861
	638	2059	4210	13362	7161	17706	10143	23310	5511
	639	1463	2204	5734	1949	3225	8335	9295	2684
Total		10621	37320	48762	45047	43870	41437	64520	45948
401-500	622	632				1297	561	289	646
	627	1194				267	330	601	318
	631	1202				451	0	1489	72
	640	198				0	0		119
	645	204				0	54	42	176
Total		3430				2015	945	2419	1331
101-200									12367
201-300			105803	210332	108681	129178	90929	105431	115662
301-400			37320	48762	45047	43870	41437	64520	45948
Total			143123	259093	153728	175023	133310	172458	175307
Upper limit			215048	421005	201839	237798	159091	216590	228070
Lower limit			71198	97181	105619	112247	107529	128325	122544

Table 12. Cod abundance estimates (No. x 10^{-3}) from research vessel surveys in NAFO Division 3L.

Depth range (fath)	Stratum number	Stratum area (mi2)	ATC 262 1977	ATC 276 1978	ATC 290 1979	ATC 304-5 1980	ATC 317-8 1981	ATC 329 1982
31-50	350	2,071	2,993	1,373	7,756	2,798	829	1,221
	363	1,780	4,783	2,352	7,616	1,817	3,296	1,924
	371	1,121	112	477	1,599	2,917	0	189
	372	2,460	2,247	8,969	6,135	3,293	5,032	1,477
	384	1,120	42	56	2,711	1,555	42	42
Total		8,552	10,177	13,227	25,817	12,380	9,199	4,853
51-100	328	1,519	72		296		0	342
	341	1,574	3,161	325	827	1,024	1,004	2,150
	342	585	768	747	132	417		278
	343	525	335	867	768	1,399	867	2,374
	348	2,120	875	2,361	3,687	3,456	887	2,467
	349	2,114	3,385	4,337	4,035	2,997	595	3,729
	364	2,817	967	599	4,705	2,996	952	1,304
	365	1,041	781	391	2,481	1,035		4,689
	370	1,320	66	390	817	1,486	0	248
	385	2,356	383	59	783	3,139	59	0
	390	1,481	1,223	1,056	2,223	1,223	389	139
Total		17,452	12,016	11,072	20,754	19,172	4,753	17,720
101-150	344	1,494	7,327	11,635	15,981	7,947	29,001	9,196
	347	983	861	6,254	5,737	10,212	3,247	10,773
	366	1,394	10,461		11,118	5,232	56,749	18,521
	369	961	761	577	2,813	6,757	7,286	1,876
	386	983	1,599	639	2,749	2,066	2,693	812
	389	821	2,178	1,130	1,464	5,259	1,140	2,712
	391	282	921	201	1,117	1,757	688	191
Total		6,918	24,108	20,436	40,979	39,230	100,804	44,081
151-200	345	1,432	5,505	5,321	1,800	6,385	15,264	2,714
	346	865	782		1,380	1,125	2,727	801
	368	334	319		56	113	1,880	639
	387	718	108	198	256	108	296	1,419
	388	361	881	257	190	41	393	989
	392	145	44	44	178	5	196	218
Total		3,855	7,639	5,820	3,860	7,777	20,756	6,780
31-50		8,551	10,177	13,227	25,817	12,380	9,199	4,853
51-100		17,452	12,016	11,072	20,754	19,172	4,753	17,720
101-200		6,918	24,108	20,436	40,979	39,230	100,804	44,081
151-200		3,855	7,639	5,820	3,860	7,777	20,756	6,780
Total			53,938	50,554	91,410	78,560	135,716	73,433
Upper Limit			67,857	70,457	112,937	93,294	266,824	94,202
Lower Limit			40,018	30,651	69,883	63,827	4,608	52,665

Table 13. Cod abundance estimates (t) from research vessel surveys in NAFO Div 3L.

Depth range (fath)	Stratum number	Stratum area (mi^2)	ATC 262 1977	ATC 276 1978	ATC 290 1979	ATC 304-5 1980	ATC 317-8 1981	ATC 329 1982
31-50	350	2,071	5,187	2,106	13,637	7,124	2,539	4,775
	363	1,780	5,399	3,919	11,237	4,182	7,082	6,721
	371	1,121	535	1,490	2,439	8,148	0	789
	372	2,460	1,685	7,006	8,342	7,448	7,155	3,978
	384	1,120	10	19	3,521	2,480	462	231
Total		8,552	12,996	14,540	39,176	29,382	17,238	16,494
51-100	328	1,519	38		518		0	893
	341	1,574	3,916	1,006	2,468	3,291	2,038	8,495
	342	585	1,196	3,010	409	961		871
	343	525	438	1,789	1,190	2,936	946	4,768
	348	2,120	1,701	3,546	7,128	7,855	1,966	5,709
	349	2,114	10,746	8,879	8,800	7,282	321	10,182
	364	2,817	1,101	928	7,884	7,154	1,533	3,938
	365	1,041	1,112	532	2,953	2,442		6,056
	370	1,320	330	367	1,046	3,807	0	99
	385	2,356	422	80	1,118	6,278	413	0
	390	1,481	505	795	2,125	2,798	500	217
Total		17,452	21,505	20,932	35,639	43,804	8,717	41,228
101-150	344	1,494	7,784	20,366	19,398	10,172	50,712	19,583
	347	983	1,128	8,492	7,705	16,019	9,043	21,435
	366	1,394	6,211		11,509	5,912	81,497	21,817
	369	961	2,050	999	2,448	7,406	9,378	4,959
	386	983	1,228	251	2,881	2,361	4,593	1,279
	389	821	1,343	1,063	1,098	6,923	478	1,664
	391	282	634	356	1,048	2,064	1,212	95
Total		6,918	20,378	31,527	46,087	50,857	155,913	70,832
151-200	345	1,432	13,271	10,687	4,844	11,674	29,493	6,060
	346	865	990		2,137	2,154	4,307	1,223
	368	334	404		239	796	1,761	809
	387	718	122	184	459	256	243	2,353
	388	361	1,181	181	349	108	190	1,321
	392	145	30	66	189	0	128	256
Total		3,855	15,998	11,118	8,217	14,988	36,122	12,022
31-50		8,552	12,996	14,540	39,176	29,382	17,238	16,494
51-100		17,452	21,505	20,932	35,639	43,804	8,717	41,228
		6,918	20,378	31,527	46,087	50,857	155,913	70,832
Total			70,877	78,118	129,117	139,030	218,214	140,578
upper limit			93,640	100,261	154,966	166,965	405,205	171,826
lower limit			48,114	55,974	103,267	111,094	31,224	109,329

Table 14. Cod abundance (No. x 10^{-3}) from stratified random cruises in Division 3L (fall).

Depth Range	Stratum No.	Stratum Area	ATC 323-325 1981	ATC 333-334 1982	W. Templeman 7-9 1983	W. Templeman 16-18 1984	W. Templeman 22-24 1985
31-50	350	2071	4923	2332	6335	15455	4957
	363	1780	802	1960	13050	19374	4025
	371	1121	105	1010	4679	8018	449
	372	2460	14256	8679	37532	27415	3592
	384	1120	-	273	6025	20303	273
Total		8552	20086	14254	67621	90565	9704
51-100	328	1519	-	-	-	285	1159
	341	1574	1930	975	1359	1512	1772
	342	585	381	1039	274	439	59
	343	525	897	-	328	2089	2312
	348	2120	1724	3310	1953	7002	12114
	349	2114	2154	1492	1622	8059	9283
	364	2817	963	1113	1629	8162	3401
	365	1041	8693	2090	578	8400	4444
	370	1320	173	413	727	7799	2958
	385	2356	44	309	318	1827	7781
	390	1481	37	111	111	2483	2446
Total		17452	16996	10852	8899	48057	47729
101-150	344	1494	2075	5047	1103	3701	2483
	347	983	2706	2915	2041	2976	3306
	366	1394	5197	8022	4473	6221	1737
	369	961	2669	1371	2525	2803	18077
	386	983	861	553	-	1513	35861
	389	821	-	1756	-	811	33248
	391	282	-	95	635	32	7705
	Total	6918	13508	19759	10777	18057	102417
151-200	345	1432	2015	3637	2929	2300	3368
	346	865	5822	2337	4389	1731	19025
	368	334	1316	1429	-	602	6920
	387	718	808	3000	-	3072	29387
	388	361	-	253	-	528	13504
	392	145	-	147	33	103	2634
	Total	3855	9961	10803	7351	8336	71470
31-50		8552	20086	14254	67621	90565	9704
51-100		17452	16996	10852	8899	48057	47729
101-150		6918	13508	19759	10777	18057	102417
151-200		3855	9961	10803	7351	8336	71470
Total			60550	55688	94649	165427	240033
Upper limit			83240	67092	123077	197373	295546
Lower limit			37860	44285	66220	133481	184520

Table 15. Cod biomass (t) from stratified random cruises in Division 3L (fall).

Depth Range	Stratum No.	Stratum Area	ATC 323-325 1981	ATC 333-334 1982	W. Templeman 7-9 1983	W. Templeman 16-18 1984	W. Templeman 22-24 1985
31-50	350	2071	6244	3849	8463	16498	3084
	363	1780	852	2009	17993	20017	4497
	371	1121	137	1363	6126	11210	489
	372	2460	20737	6882	44364	27045	7067
	384	1120	-	1090	5941	27463	193
	Total	8552	29970	15193	82887	102233	15330
51-100	328	1519	-	-	-	299	114
	341	1574	2146	901	1949	1760	447
	342	585	834	951	263	736	23
	343	525	1419	-	661	2261	926
	348	2120	2651	4249	3125	11537	9518
	349	2114	3604	3174	2266	8257	7964
	364	2817	1932	1800	1946	4536	5903
	365	1041	17904	3702	961	3624	5699
	370	1320	300	446	1184	7891	3263
	385	2356	38	43	1019	1886	11322
	390	1481	9	58	852	1130	5347
Total		17452	30837	15324	14226	43917	50526
101-150	344	1494	3869	7701	1682	6121	1457
	347	983	4550	4805	3167	5731	2236
	366	1394	9313	11920	8999	7101	2260
	369	961	7755	2290	5849	3962	29179
	386	983	1414	1430	-	2546	46147
	389	821	-	3428	-	2737	35844
	391	282	-	487	159	79	2710
Total		6918	26901	32061	19856	28277	119833
151-200	345	1432	4703	7686	6443	3673	430
	346	865	12012	4212	7746	3003	35605
	368	334	5948	3604	-	1222	12498
	387	718	1334	9216	-	7465	54145
	388	361	-	461	-	616	22162
	392	145	-	220	109	68	2182
Total		3855	23997	25399	14298	16047	127022
31-50		8552	29970	15193	82887	102233	15330
51-100		17452	30837	15324	14226	43917	50526
101-150		6918	26901	32061	19856	28277	119833
151-200		3855	23997	25399	14298	16047	127022
Total			109706	87997	131267	191701	318563
Upper limit			153131	105967	175407	226108	421863
Lower limit			66281	70027	87127	157294	215263

Table 16. Mean numbers and weights per tow of cod from research vessel surveys in Division 2J for strata common to all years and less than 400 m.

Year	1977	1978	1979	1980	1981	1982	1983	1984
Numbers								
Mean	71.30	75.68	57.38	69.33	66.14	82.25	126.30	97.01
Upper	105.98	104.08	91.88	93.31	114.16	106.07	526.46	128.77
Lower	36.63	47.28	22.88	45.36	18.11	58.43	-273.87	65.25
Weights								
Mean	99.43	126.70	111.15	153.33	159.24	150.78	186.14	125.08
Upper	144.30	175.60	180.53	209.05	298.06	201.92	829.70	167.54
Lower	54.57	77.81	41.77	97.61	20.42	99.64	-457.43	82.62

Table 17. Mean numbers and weights per tow of cod from research vessel surveys in Division 3K for strata common to all years and less than 400 m.

Year	1978	1979	1980	1981	1982	1983	1984
Numbers							
Mean	48.00	77.21	41.43	47.17	36.80	54.34	53.56
Upper	70.76	131.19	55.71	62.33	44.87	71.13	71.94
Lower	25.24	23.24	27.15	32.01	28.73	37.54	34.58
Weights							
Mean	85.73	154.57	91.37	103.08	79.28	101.28	98.34
Upper	129.63	254.69	120.17	140.64	94.72	127.69	129.84
Lower	41.82	54.45	62.56	65.52	63.84	74.88	66.85

Table 18. Mean numbers and weights per tow of cod from research vessel spring surveys in Division 3L for strata less than 366 meters.

Year	1977	1978	1979	1980	1981	1982
Numbers						
Mean	19.54	20.62	33.11	29.68	51.04	26.60
Upper	24.58	28.73	40.91	35.25	100.35	34.12
Lower	14.50	12.50	25.31	24.12	1.73	19.08
Weights						
Mean	25.67	31.86	46.77	52.33	82.07	50.92
Upper	33.92	40.89	56.13	63.09	152.39	62.24
Lower	17.43	22.83	37.41	41.98	11.74	39.60

Table 19. Mean numbers and weights per tow of cod from research vessel fall surveys in Division 3L for strata common to all years and less than 366 meters.

Year	1981	1982	1983	1984
Numbers				
Mean	25.19	21.41	38.94	60.31
Upper	35.26	26.36	51.37	72.40
Lower	15.12	16.46	26.51	48.23
Weights				
Mean	44.27	30.25	55.30	64.78
Upper	63.92	37.47	74.90	75.72
Lower	24.62	23.02	35.70	53.83

Table 20. Mean number of cod per standard tow from research surveys in Divison 3L (spring).

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	.12	0.0	0.0	.16	0.0	0.0	0.0	0.0	.06	0.09	.24	.03
2	7.81	1.54	3.77	.51	1.56	2.07	0.91	0.07	.08	1.94	.67	1.72
3	22.07	5.55	12.93	5.77	3.46	18.25	4.13	3.35	.84	0.90	12.22	1.56
4	6.99	15.19	7.33	8.20	4.95	9.39	5.94	6.26	9.16	3.48	9.79	9.25
5	4.58	1.23	3.89	5.82	2.64	3.76	4.61	4.98	13.89	10.65	8.72	2.34
6	1.62	1.23	.54	2.38	2.11	2.63	2.15	3.22	6.48	8.60	14.91	2.96
7	1.70	.53	.41	.57	1.78	1.47	0.64	1.45	1.53	2.17	15.20	4.15
8	.61	.59	.28	.24	0.29	0.70	0.66	0.47	.46	0.79	4.05	3.08
9	.46	.31	.28	.17	0.16	0.12	0.44	0.40	.12	0.16	1.05	.93
10	.49	.24	.15	.09	0.05	0.03	0.15	0.23	.19	0.07	.35	.20
11	.18	.08	.12	.04	0.08	0.03	0.10	0.17	.08	0.12	.10	.07
12	.24	.06	.17	.07	0.02	0.06	0.06	0.12	.04	0.07	.10	.05
13+	1.17	.31	.41	.12	0.20	0.09	0.16	0.17	.18	0.15	.10	.26
Total	48.04	26.86	30.28	24.14	17.38	38.58	19.95	20.89	33.12	29.20	67.49	26.59
Upper limit	101.26	36.85	70.83	59.78	26.94	57.57	26.06	31.15	42.38	34.73	207.49	34.11
Lower limit	5.08	16.91	-10.18	-11.51	7.89	19.67	13.85	10.63	23.87	23.67	-72.50	19.07
# sets	57	38	29	70	55	64	102	94	141	115	78	103

Table 21. Mean number of cod per standard tow from research vessel surveys in Division 2J.

Age	Gadus 3 1977	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58 1981	Gadus 71 1982	Gadus 86-88 1983	Gadus 101-103 1984
1	0.0	0.0	0.0	0.38	0.0	1.20	2.26	.59
2	3.79	0.60	0.35	1.66	4.70	3.50	15.99	5.97
3	10.95	8.86	1.55	1.41	3.31	20.67	19.08	18.86
4	33.03	16.35	13.04	4.81	2.59	7.27	29.39	18.64
5	15.11	33.07	19.12	21.87	4.77	5.06	18.66	30.07
6	3.32	11.32	18.41	22.33	19.22	4.84	10.03	11.48
7	1.54	2.51	2.62	13.25	17.21	14.99	5.15	2.77
8	1.39	0.91	0.83	1.92	10.88	13.18	13.99	1.75
9	1.09	0.72	0.56	0.56	2.25	8.95	6.36	3.94
10	0.60	0.52	0.32	0.40	0.57	1.50	4.03	1.69
11	0.23	0.28	0.32	0.26	0.09	0.40	.84	.74
12	0.11	0.13	0.12	0.31	0.16	0.19	.27	.36
13	0.05	0.16	0.05	0.10	0.17	0.11	.12	.06
14	0.03	0.14	0.05	0.05	0.08	0.15	.10	.02
15	0.02	0.05	0.01	0.06	0.08	0.01	.02	.01
16	0.0	0.03	0.03	0.02	0.05	0.02	-	-
17	0.0	0.03		0.0	0.02	0.02	.03	-
18	0.0	0.03		0.0	0.01	0.02		
19	0.0			0.2				
20	0.0					0.01		
>20	0.02					0.02		
Total	71.33	75.70	57.38	69.33	66.15	82.12	126.3	96.96
Upper limit	106.00	104.10	91.88	93.31	114.18	105.95	526.52	128.77
Lower limit	36.66	47.30	22.88	45.36	18.12	58.30	273.92	65.25

Table 22. Mean number of cod per standard tow from research vessel surveys in Division 3K

Age	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58&59 1981	Gadus 72 1982	Gadus 86-88 1983	Gadus 101-103 1984
1	0.0	0.0	0.22	0.01	0.28	1.05	0.31
2	0.31	0.15	1.24	1.51	2.18	4.24	3.92
3	3.23	2.54	1.69	6.22	2.10	9.20	6.77
4	14.11	17.31	2.44	3.90	5.99	7.79	11.70
5	17.20	28.48	13.73	4.25	5.90	13.72	9.43
6	7.89	16.94	15.00	14.19	3.31	4.20	9.68
7	2.52	4.35	3.24	10.26	6.98	2.84	3.59
8	1.18	2.18	1.57	3.19	6.80	5.00	1.80
9	0.73	0.53	0.58	0.58	1.97	3.87	2.88
10	0.57	0.46	0.39	0.27	0.77	1.35	1.74
11	0.04	0.31	0.03	0.22	0.20	.47	.71
12	0.12	0.07	0.24	0.23	0.09	.21	.34
13	0.04	0.05	0.08	0.07	0.07	.09	.12
13+	0.04	0.14	0.17	0.14	0.15	.29	.26
Total	47.99	73.50	40.61	45.02	36.80	54.33	53.26
Upper limit	70.75	126.26	54.54	59.86	44.87	71.13	71.94
Lower limit	25.22	20.74	26.68	30.18	28.73	37.54	34.58

Table 23. Mean number of cod per standard tow from reseach vessel survey in Division 3L (Fall).

Age	1981	1982	1983	1984
1	0.40	0.40	0.67	0.34
2	0.39	2.64	3.69	7.24
3	6.92	1.90	14.06	10.93
4	2.88	6.34	5.43	18.06
5	2.74	2.69	7.84	4.95
6	4.10	1.99	1.46	10.06
7	5.77	1.66	1.40	1.61
8	1.07	1.50	2.43	1.13
9	0.22	0.28	1.31	0.99
10	0.08	0.08	0.46	1.03
11	0.04	0.05	0.13	0.41
12	0.03	0.06	0.06	0.24
13+	0.13	0.06	0.19	0.17
Total	24.76	19.82	39.13	57.17
Upper limit	34.09	23.57	50.88	68.21
Lower limit	15.51	16.07	27.37	46.13
Dates	Sept. 22 Nov. 19	Oct. 30 Dec. 06	Oct. 13 Nov. 15	July 26 Sept. 03
No. Sets	97	121	126	209

Table 24. Survey biomass indices for NAFO Divisions 2J3K and 2J3KL from fall Canadian Research vessel surveys. (Numbers in parinthisis are estimates.)

Year	Biomass 2J	3K	3L	2J3K	2J3KL
1977	140	(118)	(75)	258	333
1978	165	143	(89)	308	397
1979	157	258	(120)	415	535
1980	216	153	(107)	369	476
1981	225	172	100	397	497
1982	213	132	68	345	413
1983	263	169	124	432	556
1984	176	161	146	337	483

Table 25. Analysis of variance and regression coefficients from the regression of ln catch rate in Divisions 2J3KL for the years 1962-79.

Country / Gear		ln Power
Can-N	OTB-4	-0.331
Can-N	OTB-5	0.000
ESP	OTB-6	0.236
PRT	OTB-6	0.325
PRT	OTB-7	0.655

Division	ln Power
3L	-0.288
3K	-1.168
2J	0.000

Month	ln Power
July Aug. Sept. Oct. Nov.	-0.639
June Dec.	-0.447
May	-0.214
Jan. Feb. Mar. Apr.	0.000

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.769
MULTIPLE R SQUARED....0.592

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	4.687E0	4.687E0	
REGRESSION	26	3.885E2	1.494E1	84.885
TYPE 1	4	6.433E1	1.608E1	91.360
TYPE 2	3	1.143E2	3.810E1	216.435
TYPE 3	2	1.999E1	9.996E0	56.782
TYPE 4	17	2.001E2	1.177E1	66.861
RESIDUALS	1523	2.681E2	1.760E-1	
TOTAL	1550	6.613E2		

Table 26. Analysis of variance and regression coefficients from the regression of ln catch rate for cod in Divisions 2J3KL for the years 1979-84.

Country / Gear		ln Power	Month	ln Power
PRT	OTB-7	-0.646	Aug.	-1.286
PRT	OTB-6	-0.344	Sept.	
CAN-N	OTB-4	-0.239	July	-1.135
CAN-N	OTB-5	-0.059	June	
CAN-M	OTB-4	0.000	Oct.	-0.925
CAN-M	OTB-5	0.394	Nov.	
			May	-0.699
			Dec.	-0.498
			Apr.	-0.330
Division		ln Power	Mar.	-0.200
3L		-0.863	Jan.	0.000
3K		-0.487	Feb.	
2J		0.000		

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.831
MULTIPLE R SQUARED.....0.690

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	5.510E1	5.510E1	
REGRESSION	19	1.881E2	9.898E0	44.723
TYPE 1	5	2.500E1	5.000E0	22.593
TYPE 2	7	5.888E1	8.412E0	38.006
TYPE 3	2	4.200E1	2.100E1	94.896
TYPE 4	5	1.561E1	3.121E0	14.104
RESIDUALS	382	8.454E1	2.213E-1	
TOTAL	402	3.277E2		

Table 27. Catch rate index series for cod in Div. 2J3KL for 1962-79 and 1979-84, using 1979 as reference in both series.

YEAR	TOTAL CATCH	CATCH RATE MEAN	S.E.	EFFORT
1962	502752	1.916	0.136	262458
1963	499904	2.007	0.137	249043
1964	603585	1.873	0.125	322176
1965	555654	1.611	0.106	344924
1966	522307	1.690	0.106	309026
1967	610535	1.860	0.112	328329
1968	807470	1.774	0.102	455210
1969	748433	1.446	0.085	517482
1970	516213	1.250	0.076	412981
1971	432496	1.050	0.063	411969
1972	458170	0.935	0.059	490135
1973	354509	0.925	0.062	383413
1974	372650	1.033	0.072	360792
1975	287508	1.076	0.072	267128
1976	214220	0.878	0.067	243936
1977	172720	0.518	0.033	333279
1978	138559	0.514	0.034	269453
1979	166891	1.000	0.095	166891
1980	175782	1.191	0.114	147619
1981	170748	1.506	0.135	113393
1982	229774	1.374	0.115	167269
1983	230213	1.628	0.135	141427
1984	229229	1.895	0.169	120951

AVERAGE C.V. FOR THE MEAN:0.071

Table 28. Historical partial recruitment for 1962-84. The average for the years 1976-82 was used as an estimate for cohort analysis.

SELECTIVITY COEFFICIENTS

AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
4	0.15	0.16	0.14	0.07	0.21	0.18	0.28	0.09	0.27	0.32	0.41	0.45	0.15	0.13	0.31	0.28	0.12	0.08	0.24	0.14	0.18	0.12	0.19
5	0.30	0.51	0.34	0.22	0.49	0.38	0.65	0.31	0.46	0.69	0.73	0.73	0.39	0.37	0.50	0.73	0.41	0.36	0.41	0.47	0.37	0.41	0.46
6	0.52	0.89	0.58	0.41	0.65	0.68	0.85	0.70	0.93	1.00	0.89	0.59	0.71	0.65	0.73	0.75	0.83	0.45	0.70	0.66	0.53	0.69	0.66
7	0.86	0.89	1.00	0.75	0.91	0.83	1.00	0.96	1.00	1.00	1.00	0.70	0.72	0.81	0.88	0.77	1.00	0.81	0.67	1.00	0.74	0.87	0.84
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 29. Results of regression analysis of age 4+ beginning of the year population biomass and survey indices for 2J3K and 2J3KL lagged 1 year.

Index	2J3KL		2J3K	
F_T	0.25	0.30	0.25	0.30
R^2	0.32	0.30	0.32	0.26
Slope	11020	15053	11000	14211
Intercept	-931	-3319	-910	-2475
F statistics	2.84	2.55	2.81	2.16

Table 30. Results of regression analyses of mid-year exploitable biomass versus commercial catch rate index for cod in Divisions 2J3KL using fully recruited fishing mortalities of 0.15, 0.175 and 0.2 (1962-84)

Year	0.15 Obs.	0.15 Res.	0.175 Obs.	0.175 Res.	0.20 Obs.	0.20 Res.
1979	3159	-2582	3160	-2494	3160	-2430
1980	5587	-1700	5381	-1751	5226	-1789
1981	7436	-2403	6930	-2639	6551	-2817
1982	8024	-746	7303	-1245	6761	-1621
1983	10970	143	9665	-849	8686	-1593
1984	14887	1898	12766	186	11175	-1098
R^2	0.76		0.74		0.71	
Slope	80.99		77.38		74.67	
Intercept	-23.57		-20.83		-18.78	

Table 31. Results of cohort analysis for cod in Div. 2J3KL using a fishing mortality of 0.175 in 1984 for fully recruited ages. Population numbers are 10^{-5}. Population biomass (average) is X 10^{-2} tons.

POPULATION NUMBERS

AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
4	5418	5776	5058	6848	8167	9252	6702	5780	5358	5899	4752	2077	1237	1252	2376
5	6793	4194	4483	3900	5354	6086	6865	4658	4388	3870	4198	3169	1332	888	889
6	3679	4966	2898	3161	2780	3531	4070	3820	2941	2893	2335	2382	1739	769	493
7	1927	2469	3017	1839	1996	1704	2011	2020	1739	1558	1514	1222	1414	748	316
8	1059	1138	1498	1583	937	1093	895	915	744	711	771	733	681	603	261
9	719	610	671	776	689	489	544	390	303	366	364	364	353	231	172
10	581	401	362	367	333	347	245	242	153	157	197	191	169	121	69
11	395	308	225	189	167	193	138	132	94	92	90	103	88	46	29
12	290	226	179	109	94	94	104	64	53	60	57	47	50	22	16
13	277	148	148	91	55	56	47	54	15	34	38	31	18	15	6
4+	21139	20237	18540	18863	20570	22845	21620	18075	15789	15630	14317	10318	7083	4696	4627
5+	15721	14461	13482	12014	12404	13593	14918	12295	10430	9740	9564	8242	5846	3444	2351
6+	8928	10267	8998	8115	7050	7507	8053	7637	6043	5871	5367	5073	4514	2556	1362
7+	5249	5301	6100	4953	4270	3976	3983	3817	3101	2978	3032	2691	2774	1787	869

AGE	1977	1978	1979	1980	1981	1982	1983	1984
4	3505	3194	3372	1861	2466	6719	5647	4990
5	1362	2392	2462	2652	1417	1960	5205	4502
6	415	696	1600	1670	1918	1053	1436	3887
7	176	210	377	1037	1106	1373	733	1006
8	96	88	97	204	693	733	897	493
9	79	44	43	47	124	472	449	603
10	38	34	22	23	28	75	280	288
11	16	13	18	11	14	16	45	171
12	7	6	7	9	7	9	11	27
13	7	3	3	4	6	4	5	7
4+	5700	6680	8002	7518	7779	12415	14706	15975
5+	2196	3486	4630	5657	5313	5696	9060	10985
6+	833	1094	2168	3005	3896	3736	3855	6483
7+	418	399	568	1335	1978	2682	2419	2596

Table 31. Continued.....

POPULATION BIOMASS (AVERAGE)

AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
4	2629	2806	2450	3339	3892	4400	3090	2779	2515	2748	2149	922	579	583	1002
5	5132	3086	3330	2911	3854	4409	4571	3286	3158	2673	2820	2097	902	591	548
6	3732	4811	2864	3117	2704	3321	3600	3253	2677	2620	2114	2283	1445	627	379
7	2487	3226	3691	2220	2489	2086	2310	2121	1908	1857	1788	1536	1580	767	306
8	1725	1875	2326	2278	1460	1667	1289	1173	1129	1099	1150	1103	882	728	322
9	1438	1254	1330	1382	1315	932	985	668	587	720	709	671	572	353	235
10	1368	970	847	808	816	721	580	499	382	383	462	423	302	205	114
11	1137	893	601	511	479	540	363	326	286	275	248	277	179	108	58
12	877	763	540	328	303	281	316	139	178	201	177	125	121	53	45
13	1276	695	661	375	248	240	195	204	64	151	166	132	67	51	21
4+	21802	20378	18640	17269	17560	18597	17298	14448	12885	12727	11782	9570	6630	4067	3030
5+	19173	17572	16191	13930	13668	14198	14208	11670	10369	9980	9633	8648	6050	3484	2028
6+	14040	14486	12861	11019	9814	9788	9637	8384	7211	7306	6813	6551	5148	2893	1480
7+	10309	9676	9996	7902	7110	6467	6038	5131	4534	4687	4699	4267	3703	2267	1102

AGE	1977	1978	1979	1980	1981	1982	1983	1984
4	2243	1969	2218	1254	1686	4981	4345	3962
5	1012	1950	2286	2627	1406	2038	5913	4711
6	521	827	2180	2354	2660	1564	2103	5967
7	319	371	701	2039	2090	2348	1374	1939
8	219	215	248	575	1654	1546	1917	1115
9	213	137	142	183	373	1137	1145	1493
10	114	121	86	101	114	245	772	876
11	54	55	78	61	72	82	169	611
12	29	29	40	60	40	50	66	142
13	38	17	18	29	37	26	40	48
4+	4763	5689	7998	9284	10012	14018	17844	20863
5+	2520	3720	5780	8030	8356	9037	13499	16902
6+	1508	1771	3494	5403	6950	6999	7586	12191
7+	987	944	1314	3048	4290	5435	5483	6224

FISHING MORTALITY

AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
4	0.056	0.053	0.060	0.046	0.094	0.098	0.164	0.076	0.126	0.139	0.205	0.244	0.132	0.142	0.356	0.182
5	0.113	0.170	0.149	0.138	0.216	0.202	0.386	0.260	0.217	0.305	0.367	0.400	0.349	0.389	0.562	0.472
6	0.199	0.298	0.255	0.260	0.289	0.363	0.500	0.587	0.436	0.447	0.447	0.321	0.644	0.690	0.828	0.479
7	0.327	0.300	0.445	0.475	0.402	0.444	0.588	0.799	0.695	0.503	0.525	0.385	0.652	0.855	0.994	0.492
8	0.352	0.328	0.458	0.632	0.450	0.498	0.631	0.905	0.510	0.469	0.552	0.530	0.881	1.056	1.000	0.577
9	0.383	0.322	0.404	0.646	0.486	0.492	0.608	0.737	0.454	0.418	0.443	0.565	0.872	1.011	1.297	0.625
10	0.436	0.377	0.447	0.585	0.346	0.720	0.420	0.743	0.302	0.359	0.445	0.578	1.096	1.218	1.284	0.855
11	0.360	0.344	0.531	0.505	0.372	0.421	0.566	0.701	0.252	0.289	0.460	0.521	1.177	0.850	1.264	0.837
12	0.468	0.224	0.474	0.473	0.317	0.507	0.451	1.282	0.258	0.249	0.403	0.739	1.014	1.043	0.649	0.673
13	0.380	0.340	0.440	0.630	0.440	0.530	0.590	0.830	0.470	0.440	0.510	0.550	0.910	1.060	1.130	0.640

AGE	1978	1979	1980	1981	1982	1983	1984
4	0.060	0.040	0.073	0.030	0.055	0.027	0.033
5	0.202	0.188	0.124	0.097	0.111	0.092	0.081
6	0.413	0.234	0.212	0.134	0.163	0.155	0.116
7	0.573	0.416	0.203	0.212	0.226	0.196	0.147
8	0.512	0.527	0.295	0.183	0.290	0.197	0.175
9	0.473	0.442	0.332	0.299	0.323	0.244	0.175
10	0.436	0.500	0.278	0.329	0.326	0.291	0.175
11	0.401	0.452	0.221	0.268	0.228	0.285	0.175
12	0.510	0.358	0.265	0.359	0.287	0.234	0.175
13	0.490	0.515	0.303	0.204	0.304	0.226	0.175

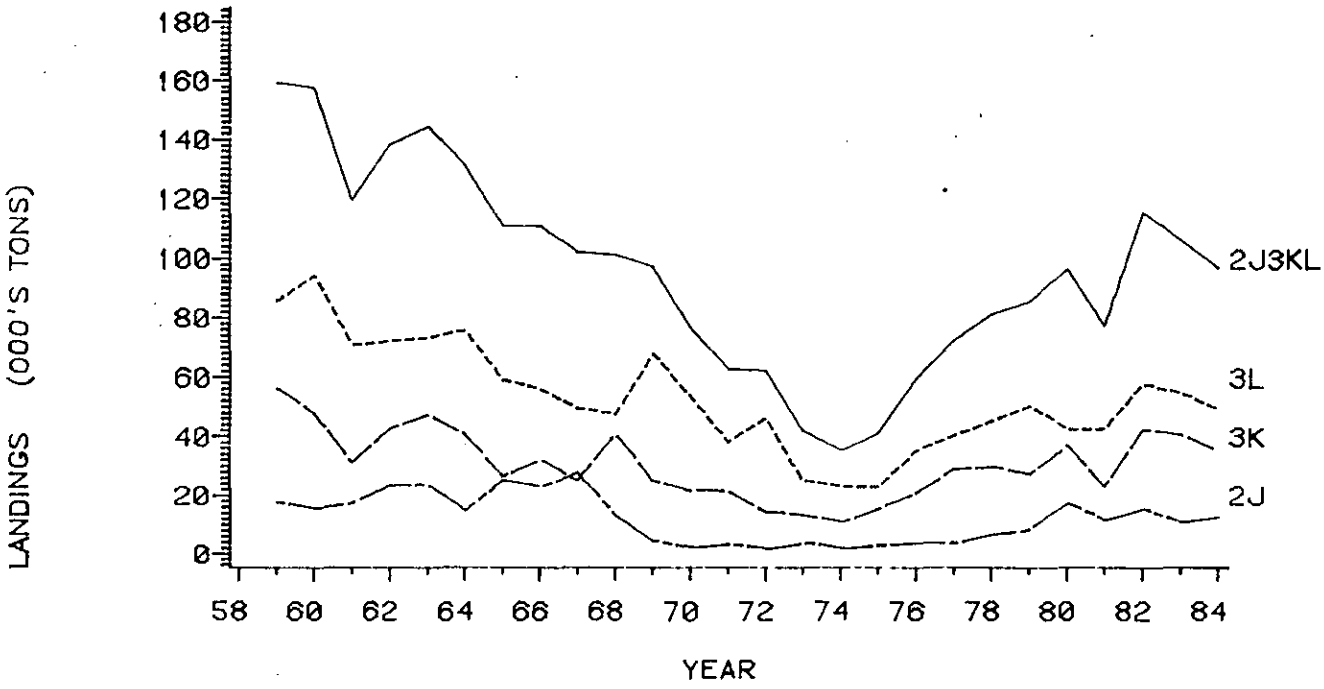

FIG. 1. INSHORE COD CATCHES FROM DIVISIONS 2J3KL FOR THE YEARS 1959-1984.

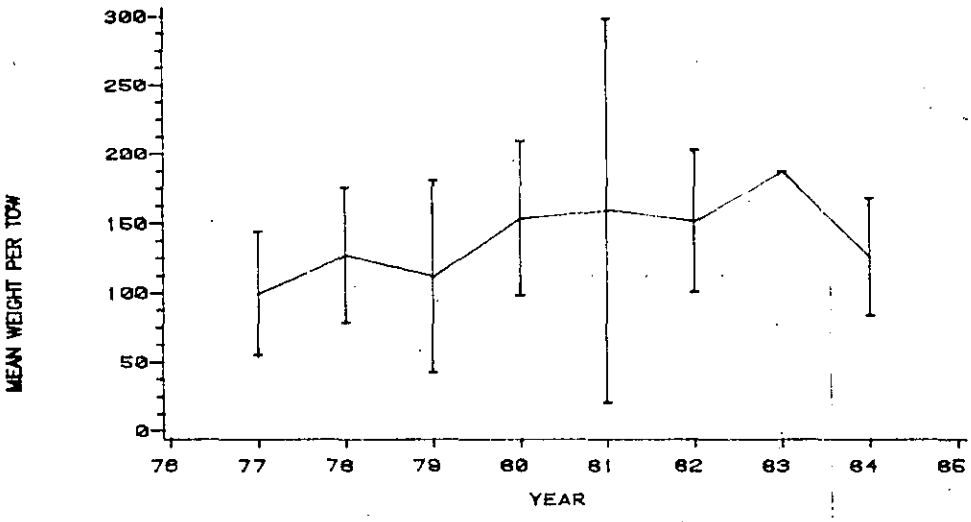

FIG. 2. MEAN WEIGHT PER TOW FROM RESEARCH VESSEL SURVEYS IN DIV. 2J FOR STRATA COMMON TO ALL YEARS AND LESS THAN 400 M. (CONFIDENCE LIMITS FOR 1983 ARE 829.70 AND -457.49).

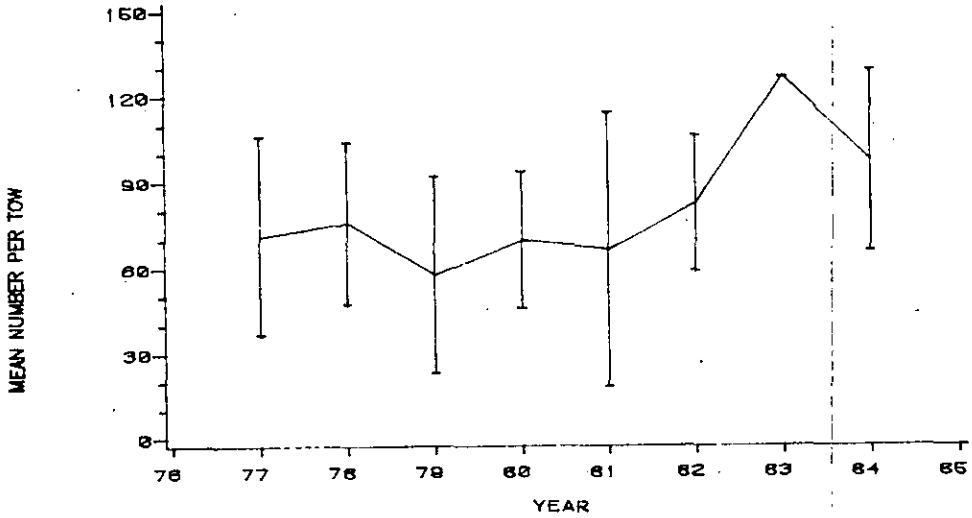

FIG. 3. MEAN NUMBER PER TOW FROM RESEARCH VESSEL SURVEYS IN DIV. 2J FOR STRATA COMMON TO ALL YEARS AND LESS THAN 400 M. (CONFIDENCE LIMITS FOR 1983 ARE 528.46 AND -273.87).

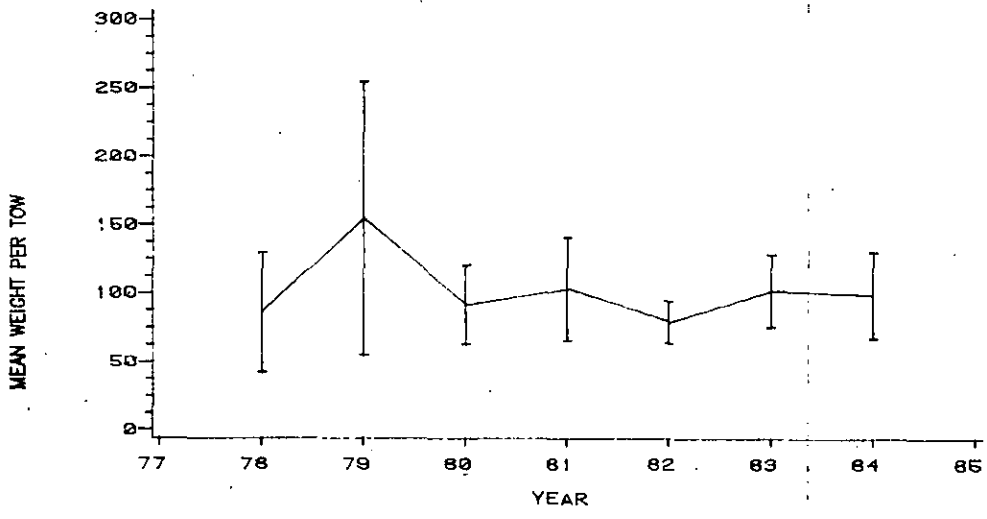

FIG. 4. MEAN WEIGHT PER TOW FROM RESEARCH VESSEL SURVEYS IN DIV. 3K FOR STRATA COMMON TO ALL YEARS AND LESS THAN 400 M.

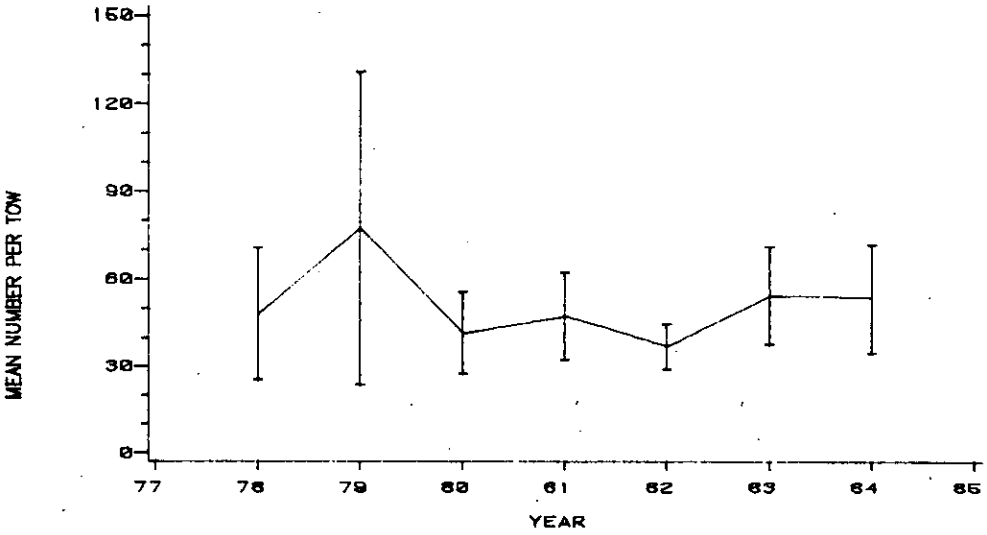

FIG. 5. MEAN NUMBER PER TOW FROM RESEARCH VESSEL SURVEYS IN DIV. 3K FOR STRATA COMMON TO ALL YEARS AND LESS THAN 400 M.

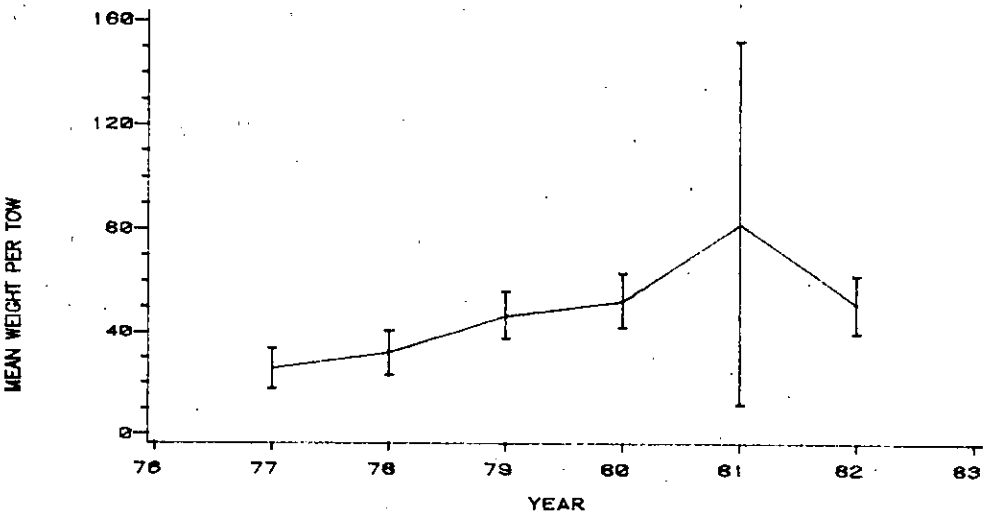

FIG. 6. MEAN WEIGHT PER TOW FROM RESEARCH VESSEL SPRING SURVEYS IN DIV. 3L, FOR STRATA LESS THAN 200 FATH.

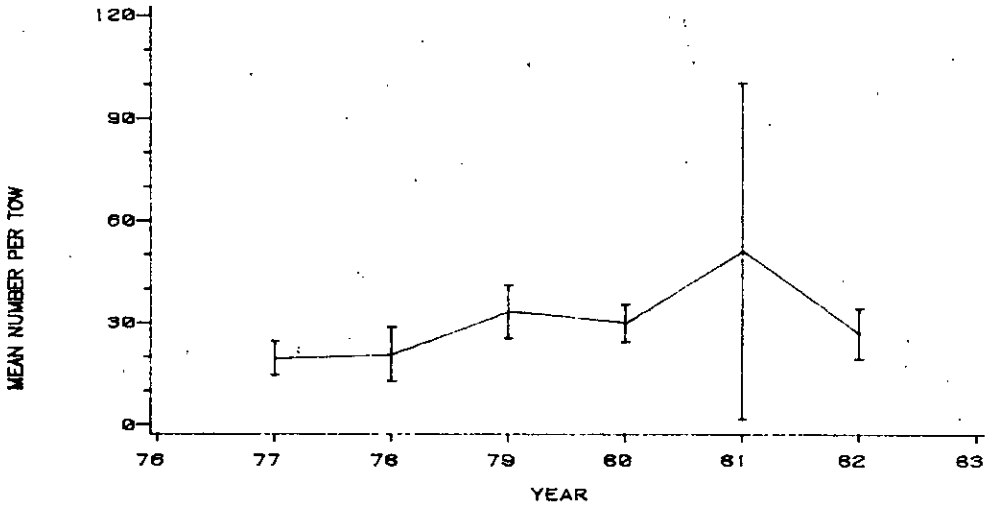

FIG. 7. MEAN NUMBER PER TOW FROM RESEARCH VESSEL SPRING SURVEYS IN DIV. 3L FOR STRATA LESS THAN 200 FATH.

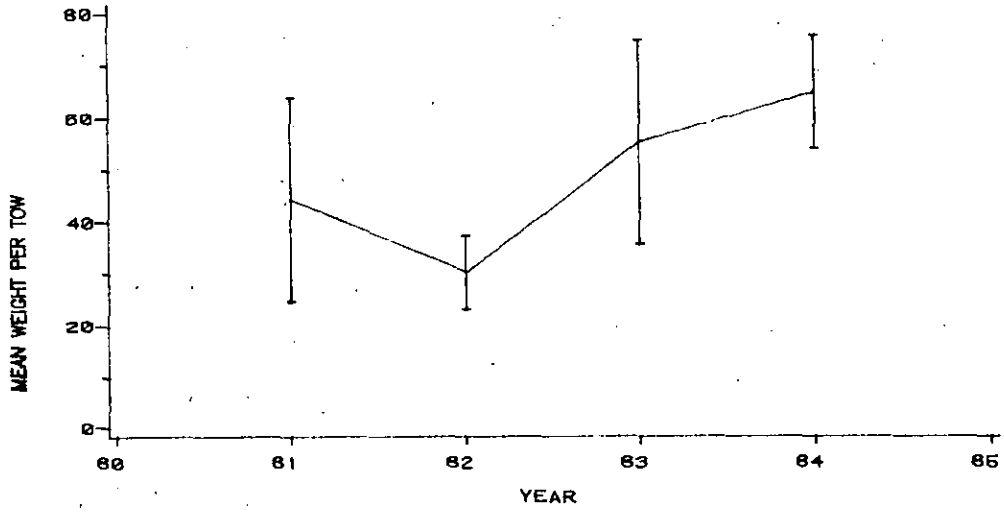

FIG. 8. MEAN WEIGHT PER TOW FROM RESEARCH VESSEL FALL SURVEYS IN DIV. 3L FOR STRATA COMMON TO ALL YEARS AND LESS THAN 200 FATHOMS.

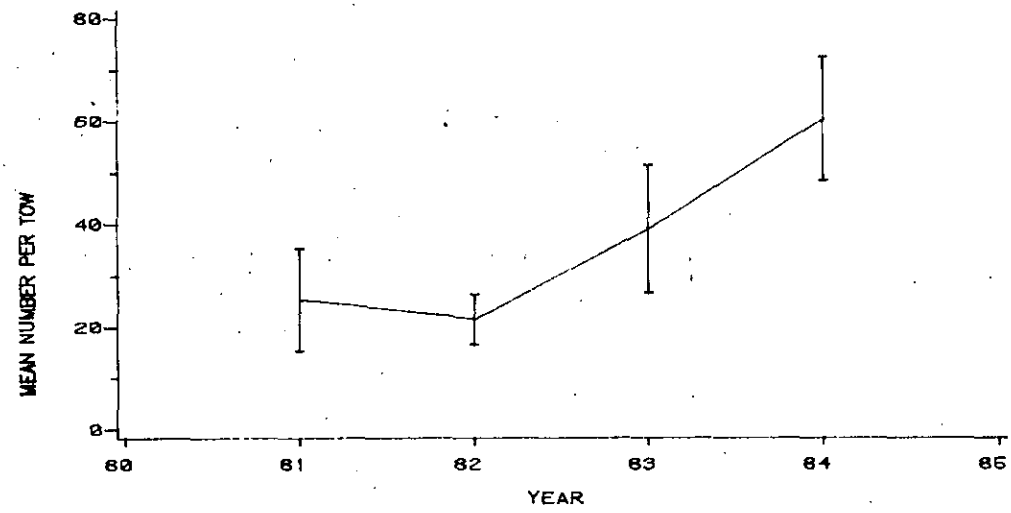

FIG. 9. MEAN NUMBER PER TOW FROM RESEARCH VESSEL FALL SURVEYS DIV. 3L FOR STRATA COMMON TO ALL YEARS AND LESS THAN 200 FATHOMS.

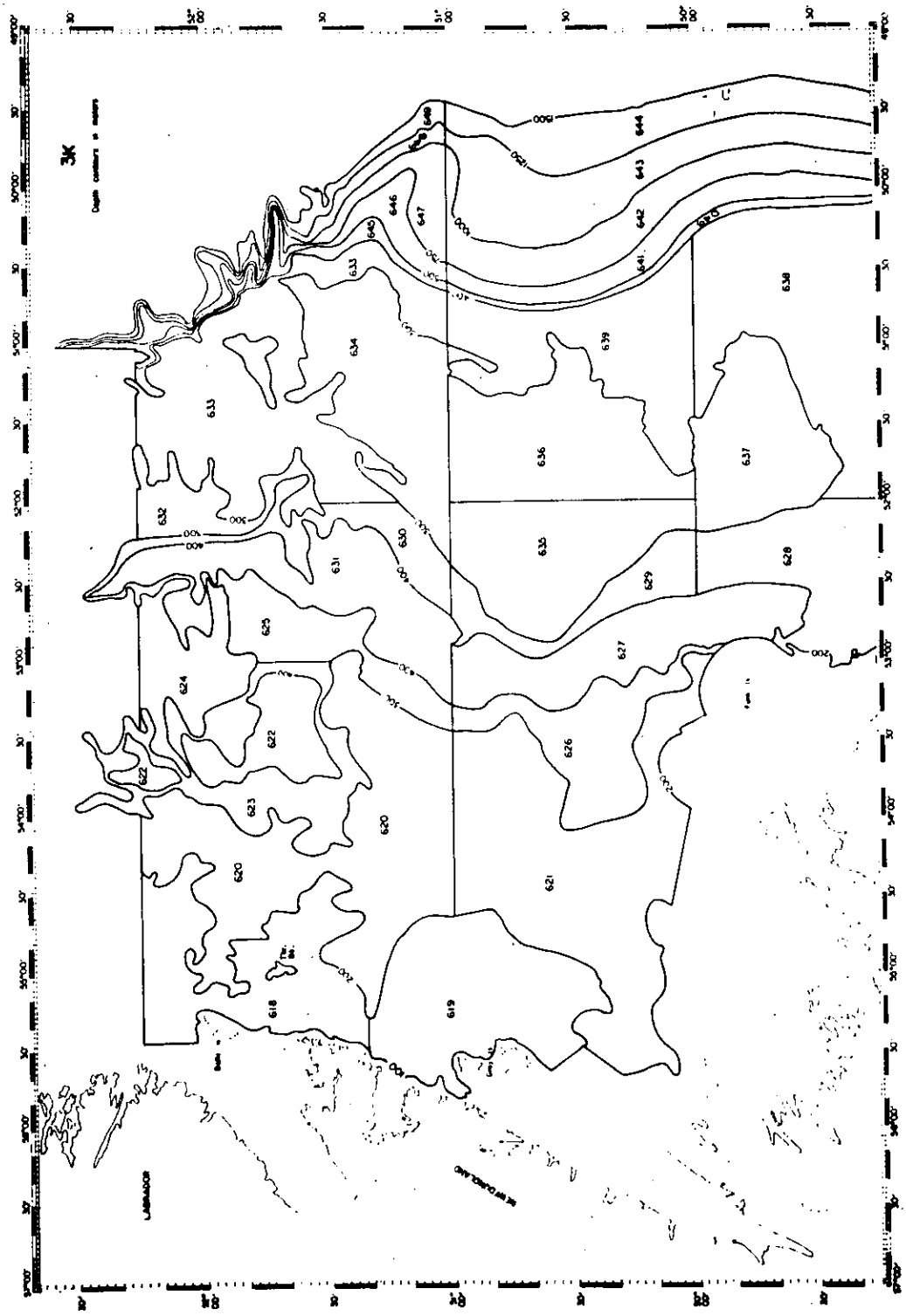

Fig. 10. Survey area for NAFO Div. 3K showing two new near shore strata. (Nos 618 and 619).

Fig. 11. Catch rate index with approximate 90% confidence interval for cod in Div. 2J3KL.

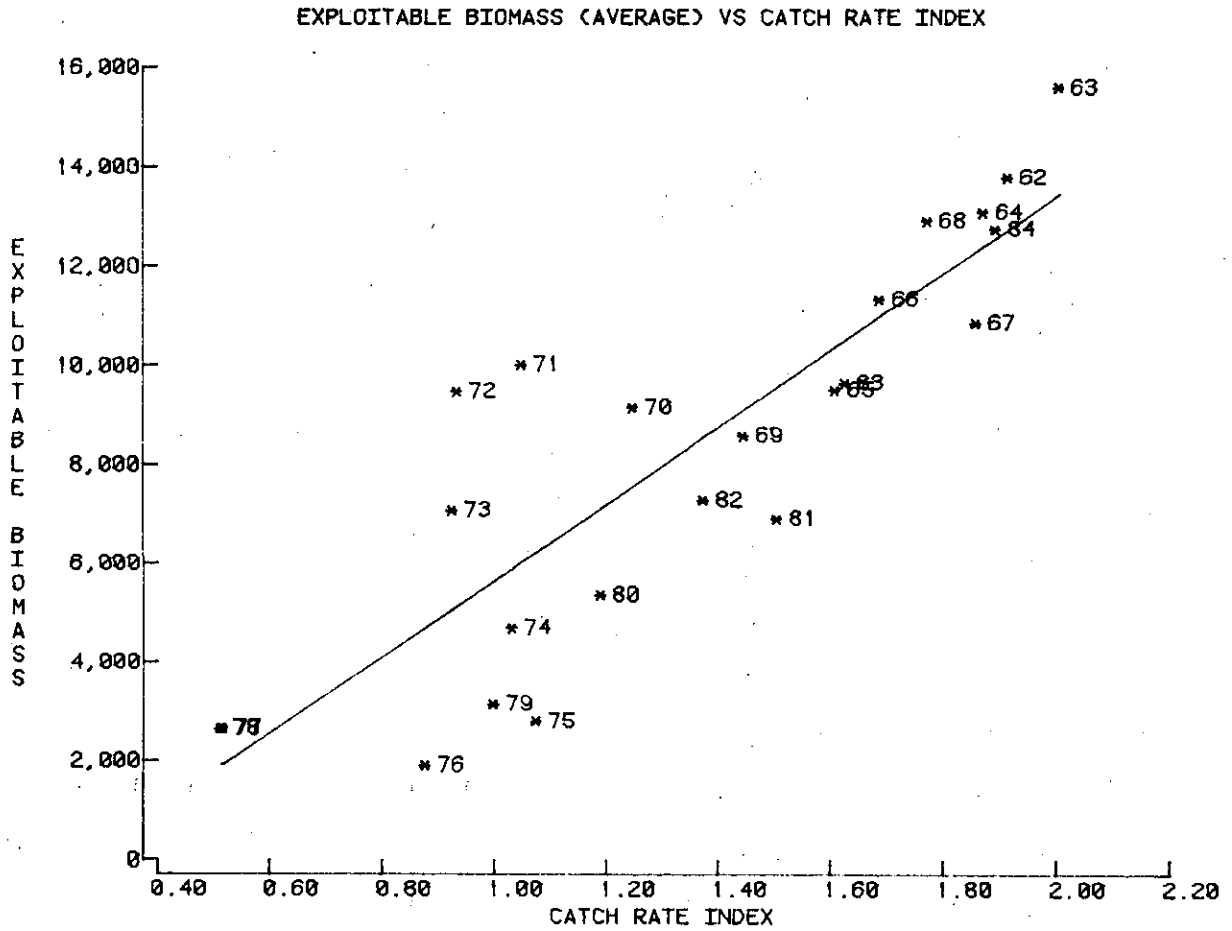

Fig. 12. Plot of the regression of exploitable biomass versus catch rate index for cod in Div. 2J3KL using a fishing mortality of 0.175 for fully recruited ages in 1984.

Appendix

Further Assessment of the Cod Stock in Division 2J+3KL

To determine if seasonal and divisional patterns in the 1962-79 catch rate series this series was subdivided. The periods 1962-70 and 1971-79 were analysed separately. The catch rates for each of these periods were scaled to their respective means and the 1962-79 series was scaled similarly (Table 1). It was determined that the trends in annual catch rate indices when analysed separately compared well with those from the 1962-79 period. In past assessments, when combining catch rate series (1962-79 and 1979-84) only a single year, 1979, was used for scaling. As the choice of reference period is critical to the resultant catch rate series it was determined to use the years 1978 and 1979 as only for these years was there enough overlap in the country/gear components of the fishery. This catch rate series is shown in Table 2, Fig. 1.

A survey biomass index using Canadian (2J3K) and FRG(2J) fall surveys is shown in Table 3. A geometric mean regression between countries for the period 1977-83 was used to estimate values for years when there were no surveys. The canadian and FRG surveys were then averaged to give the resultant index. A survey abundance index for ages 6+ was calculated in a similar manner.

Results of cohort tuning using survey data are given in Tables 4-7. Table 4 shows the relationship between the survey biomass index to 4^+ beginnng of the year population biomass over the period 1972-84. Tables 5-7 show the relationships of age 6^+ survey abundance from Canadian and FRG fall surveys at age 7^+ cohort beginning of the year population numbers over the periods 1972-83, 1977-83 and 1977-84 respectively. Relationships of catch rate index (scaled to 1978-79 values) to offshore exploitable biomass over the periods 1962-84 and 1977-84 are given in Tables 8 and 9 respectively.

The results of cohort analysis (population numbers, poulation biomass and fishing mortality) using a fully recruited fishing mortality of 0.23 in 1984 are given in Table 10.

Table 1. Catch rate indices for the period 1962-79 for cod in Division 2J3KL. Series A was analysed in two parts (1962-70 and 1971-79). Series B was analysed as a unit from 1962-79.

Year	Catch Rate A	Catch Rate B
1962	1.09	1.12
1963	1.15	1.17
1964	1.10	1.09
1965	0.97	0.94
1966	0.98	0.99
1967	1.10	1.09
1968	1.04	1.04
1969	0.85	0.84
1970	0.73	0.73
1971	1.17	1.19
1972	1.09	1.06
1973	1.08	1.05
1974	1.17	1.17
1975	1.37	1.22
1976	0.96	1.00
1977	0.63	0.59
1978	0.52	0.58
1979	1.03	1.14

Table 2. Catch rate index for cod in Division 2J3KL analysed separately and combined using the average of 1978-79 values. As a reference in both series.

Year	Catch Rate
1962	2.530
1963	2.651
1964	2.474
1965	2.127
1966	2.232
1967	2.455
1968	2.342
1969	1.910
1970	1.650
1971	1.386
1972	1.234
1973	1.221
1974	1.364
1975	1.421
1976	1.160
1977	0.684
1978	0.793
1979	1.206
1980	1.300
1981	1.613
1982	1.490
1983	1.756
1984	2.031

Table 3. FRG, Canadian, and averaged survey biomass indices for cod in Division 2J3KL. Years when no surveys were conducted were estimated by geometric mean regression and are indicated by parenthesis.

Year	Canada 2J3K	FRG 2J	Average
1972	(1.155)	1.540	1.348
1973	(0.971)	0.900	0.936
1974	(0.827)	0.398	0.613
1975	(0.765)	0.182	0.474
1976	(0.802)	0.311	0.557
1977	0.716	0.320	0.518
1978	0.854	0.260	0.557
1979	1.151	1.367	1.259
1980	1.023	0.718	0.871
1981	1.101	1.826	1.464
1982	0.957	1.012	0.985
1983	1.198	1.497	1.348
1984	0.935	(0.774)	0.855

Table 4. Relationship of total survey biomass (Can. 2J+3K; FRG 2J-combined) to 4+ Biomass (beginning of year) for Division 2J3KL cod.

Year	Survey Biomass Index	0.40 OBS	0.40 RES	0.45 OBS	0.45 RES	0.50 OBS	0.50 RES
1972	1.348	1082	138	1082	185	1082	222
1973	0.936	849	115	849	145	849	168
1974	0.613	538	-31	538	-16	538	-3
1975	0.474	387	-111	387	-101	386	-94
1976	0.557	379	-161	377	-150	376	-141
1977	0.518	562	42	556	47	552	52
1978	0.557	637	97	626	99	618	102
1979	1.259	710	-188	694	-162	680	-141
1980	0.871	740	40	716	42	696	43
1981	1.464	859	-143	817	-135	782	-128
1982	0.985	930	171	862	135	807	105
1983	1.348	960	16	867	-30	792	-68
1984	0.855	707	15	607	-59	527	-118
Slope		510.3		467.9		434	
Intercept		255.8		266.2		274.7	
r^2		0.70		0.66		0.60	

Table 5. Relationship of 6+ survey abundance index from Can. & FRG surveys to age 7+ cohort beginning of the year population numbers for cod in Division 2J3KL over the period 1972-83.

Year	6+ survey Abundance Index	0.225 OBS	0.225 RES	0.25 OBS	0.25 RES	0.275 OBS	0.275 RES
1972	2.23	2691	-366	2691	-281	2691	-212
1973	1.65	2774	430	2774	496	2774	549
1974	0.74	1785	559	1785	595	1785	624
1975	0.43	867	23	867	48	867	68
1976	0.28	415	-245	415	-225	415	-209
1977	0.16	383	-120	393	-103	393	-90
1978	0.38	548	-235	543	-216	539	-201
1979	1.18	1241	-525	1209	-507	1184	-491
1980	1.02	1795	225	1731	206	1680	192
1981	1.71	2349	-69	2233	-117	2139	-156
1982	1.40	2024	-13	1886	-93	1773	-160
1983	1.15	2065	336	1879	199	1727	87
Slope		1.23		1.20		1.17	
Intercept		316		305		296	
r^2		0.85		0.85		0.84	

Table 6. Relationship of 6+ survey abundance index from Can. and FRG surveys to age 7+ cohort beginning of the year population numbers for cod in Division 2J3KL over the period 1977-83.

Year	6+Survey Abundance Index	0.30		0.35		0.40	
		OBS	RES	OBS	RES	OBS	RES
1977	0.16	393	5	393	3	393	3
1978	0.38	535	-91	530	-75	525	-65
1979	1.18	1162	-328	1129	-261	1103	-212
1980	1.02	1637	320	1569	336	1519	349
1981	1.71	2060	-2	1936	27	1844	49
1982	1.40	1679	-48	1532	-73	1422	-92
1983	1.15	1601	144	1403	43	1255	-32
Slope		1.08		0.98		0.91	
Intercept		215		233		245	
r^2		0.90		0.90		0.89	

Table 7. Relationship of age 6+ survey abundance index from Can. and FRG surveys to age 7+ cohort beginning of the year population numbers for cod in Division 2J3KL over the period 1977-84.

Year	6+survey abundance index	0.45		0.50	
		OBS	RES	OBS	RES
1977	0.16	393	-79	393	-52
1978	0.38	522	-130	519	-98
1979	1.18	1083	-223	1068	-174
1980	1.02	1479	304	1449	330
1981	1.71	1771	32	1715	57
1982	1.40	1336	-150	1269	-146
1983	1.15	1139	-142	1048	-172
1984	.86	1431	387	1248	255
slope		818		782	
intercept		341		320	
r^2		0.77		0.80	

Table 8. Relationship of C.P.U.E. indices (scaled to 1978-79 values) to Offshore Exploitable Biomass for cod in Division 2J3KL.

Year	CPUE	0.15 Obs.	0.15 Res.	0.175 Obs.	0.175 Res.	0.20 Obs.	0.20 Res.
1962	2.53	1335	-4.6				
1963	2.65	1576	164.4				
1964	2.47	1278	-28.8				
1965	2.13	942	159.7				
1966	2.23	1140	-23.5				
1967	2.46	1103	-192.9				
1968	2.34	1269	40 .4				
1969	1.91	844	-130.3				
1970	1.65	898	77.5				
1971	1.39	1003	338.4				
1972	1.23	937	362.0				
1973	1.22	706	139.3				
1974	1.36	456	-195.6				
1975	1.42	271	-414.5	271	-398.4	271	-382.6
1976	1.16	176	-354.7	177	-339.9	176	-325.0
1977	.68	252	2.2	255	15.4	252	27.7
1978	.79	291	-23.7	293	-10.3	287	-0.8
1979	1.21	522	-36.0	534	-9.9	518	-10.3
1980	1.30	781	167.5	754	155.9	722	138.8
1981	1.61	821	22.8	768	-12.5	722	-42.6
1982	1.49	688	-37.6	629	-80.8	581	-112.4
1983	1.76	886	3.1	782	-82.6	702	-146.3
1984	2.03	1329	284.1	1141	115.8	998	-10.0
slope		590		583		582	
intercept		-153.8		-159.5		-173.4	
r^2		0.75		0.76		0.76	

Table 9. Results of regressions of catch rate index (scaled to 1978-79 mean) with exploitable biomass for cod in Division 2J3KL over the period 1977-84.

Year	CPUE	0.75 Obs.	0.75 Res.	0.25 Obs.	0.25 Res.
1977	0.68	2547	126	2522	-327
1978	0.79	2925	-145	2850	-405
1979	1.21	5337	-194	5068	274
1980	1.30	7544	1453	6829	1685
1981	1.61	7685	-271	6578	268
1982	1.49	6285	-938	5164	-688
1983	1.76	7818	-990	5912	-931
1984	2.02	11406	959	7992	124
slope		5959		3726	
intercept		-1655		301	
r^2		0.91		0.82	

Table 10. Results of cohort analysis (population biomass, population numbers, fishing mortality) for cod in Division 2J+3KL using fully recruited F = 0.23 in 1984.

POPULATION BIOMASS (AVERAGE)

AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
4	2629	2806	2450	3339	3892	4400	3090	2779	2516	2748	2148	921	578	581	987	2136	1636	1977	1086	1259	2905	2285	2727
5	5132	3086	3330	2911	3854	4409	4571	3286	3158	2673	2820	2096	901	589	544	989	1837	2111	2317	1231	1485	3260	2355
6	3732	4811	2864	3117	2704	3321	3600	3253	2677	2620	2114	2283	1443	625	376	516	798	2024	2134	2303	1304	1450	2996
7	2487	3226	3691	2220	2489	2086	2310	2121	1908	1857	1788	1536	1580	765	305	316	365	663	1957	1769	1970	1101	1239
8	1725	1875	2326	2278	1460	1667	1289	1173	1129	1099	1150	1103	883	728	319	217	211	241	531	1476	1317	1536	848
9	1438	1254	1330	1382	1315	932	985	668	587	720	709	671	572	354	235	210	134	138	175	335	978	933	1136
10	1368	970	847	808	816	721	590	499	392	383	462	423	302	205	114	114	118	83	97	107	211	626	667
11	1137	893	601	511	479	540	363	326	286	275	248	277	179	108	58	55	55	75	59	67	76	137	465
12	877	763	540	328	303	281	316	139	178	201	177	125	121	53	45	29	30	40	56	38	47	60	108
13	1276	695	661	375	248	240	195	204	64	151	166	132	87	51	21	38	17	18	28	34	24	36	41
4+	21802	20378	18640	17269	17560	18597	17298	14448	12885	12727	11780	9568	6625	4059	3006	4619	5399	7371	8342	8589	10316	11413	12584
5+	19173	17572	16191	13930	13668	14198	14208	11670	10369	9980	9633	8646	6047	3478	2019	2483	3563	5394	7255	7330	7411	9128	9856
6+	14040	14486	12861	11019	9814	9788	9637	8384	7211	7306	6813	6551	5146	2890	1474	1494	1726	3283	4938	6129	5926	5868	7501
7+	10309	9676	9996	7902	7110	6467	6038	5131	4534	4687	4699	4268	3703	2264	1098	978	928	1259	2804	3826	4622	4418	4505
8+	7822	6450	6306	5682	4622	4381	3727	3010	2626	2830	2911	2731	2123	1499	793	662	564	576	946	2057	2652	3317	3266

POPULATION NUMBERS

AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
4	5418	5776	5038	6848	8167	9252	6702	5780	5359	5889	4750	2075	1234	1247	2346	3352	2985	3013	1620	1851	3993	3004	3460
5	6793	4194	4483	3900	5354	6086	6865	4658	4388	3870	4197	3167	1331	886	885	1338	2267	2291	2357	1220	1457	2973	2338
6	3679	4966	2898	3161	2780	3531	4070	3820	2941	2893	2335	2381	1738	768	491	412	676	1498	1530	1677	892	1023	2060
7	1927	2469	3017	1839	1996	1704	2011	2020	1739	1558	1514	1222	1414	747	315	175	208	360	953	991	1175	601	669
8	1059	1138	1498	1583	937	1093	895	915	744	711	771	733	681	603	259	95	87	95	190	625	639	735	385
9	719	610	671	776	689	489	544	390	303	366	364	364	353	231	172	78	43	42	45	113	416	372	471
10	581	401	362	347	333	347	245	242	153	157	197	191	169	121	69	38	34	22	22	26	66	234	225
11	395	308	225	189	167	193	138	132	94	92	90	103	88	46	29	16	13	18	11	13	15	37	134
12	290	226	179	109	94	94	104	64	53	60	57	47	50	22	16	7	6	7	9	7	8	10	21
13	277	148	148	91	55	56	47	54	15	34	38	31	18	15	6	7	3	3	4	6	4	5	6
4+	21139	20237	18540	18863	20570	22845	21620	18075	15789	15630	14314	10315	7077	4686	4589	5517	6321	7348	6741	6528	8665	8994	9769
5+	15721	14461	13492	12014	12404	13593	14918	12295	10430	9741	9564	8240	5843	3439	2243	2165	3336	4336	5121	4677	4672	5990	6308
6+	8928	10267	8998	8115	7050	7507	8053	7637	6043	5871	5367	5073	4512	2554	1358	827	1069	2045	2764	3457	3216	3017	3970
7+	5249	5301	6100	4953	4270	3976	3983	3817	3101	2978	3032	2691	2774	1785	867	415	393	547	1234	1781	2324	1994	1910
8+	3321	2831	3093	3114	2274	2272	1972	1797	1362	1420	1518	1469	1360	1039	552	240	186	187	281	790	1149	1393	1242

FISHING MORTALITY

AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
4	0.056	0.053	0.060	0.046	0.094	0.098	0.164	0.076	0.126	0.139	0.205	0.244	0.132	0.143	0.362	0.191	0.065	0.045	0.084	0.040	0.095	0.051	0.049
5	0.113	0.170	0.149	0.138	0.216	0.202	0.386	0.260	0.217	0.365	0.367	0.400	0.349	0.390	0.565	0.483	0.215	0.204	0.141	0.113	0.153	0.167	0.161
6	0.199	0.298	0.255	0.260	0.289	0.363	0.500	0.587	0.436	0.447	0.447	0.321	0.644	0.692	0.833	0.484	0.428	0.252	0.234	0.155	0.195	0.226	0.230
7	0.327	0.300	0.445	0.475	0.402	0.444	0.588	0.799	0.695	0.503	0.525	0.384	0.652	0.857	0.999	0.498	0.583	0.439	0.223	0.240	0.269	0.245	0.230
8	0.352	0.328	0.458	0.632	0.450	0.498	0.631	0.905	0.510	0.469	0.552	0.530	0.881	1.057	1.007	0.584	0.522	0.543	0.319	0.206	0.341	0.246	0.230
9	0.383	0.322	0.404	0.646	0.486	0.492	0.608	0.737	0.454	0.418	0.443	0.565	0.872	1.010	1.300	0.635	0.481	0.456	0.347	0.333	0.376	0.303	0.230
10	0.436	0.377	0.447	0.586	0.346	0.720	0.620	0.743	0.302	0.359	0.446	0.578	1.096	1.219	1.280	0.861	0.447	0.515	0.290	0.351	0.380	0.360	0.230
11	0.360	0.344	0.531	0.506	0.372	0.421	0.586	0.701	0.252	0.389	0.460	0.521	1.177	0.850	1.264	0.829	0.405	0.472	0.231	0.284	0.249	0.353	0.230
12	0.468	0.224	0.474	0.473	0.317	0.507	0.451	1.282	0.258	0.249	0.403	0.739	1.014	1.043	0.649	0.673	0.501	0.364	0.281	0.381	0.311	0.261	0.230
13	0.380	0.340	0.440	0.630	0.440	0.530	0.590	0.930	0.470	0.440	0.510	0.550	0.910	1.060	1.130	0.640	0.490	0.500	0.310	0.220	0.330	0.250	0.230

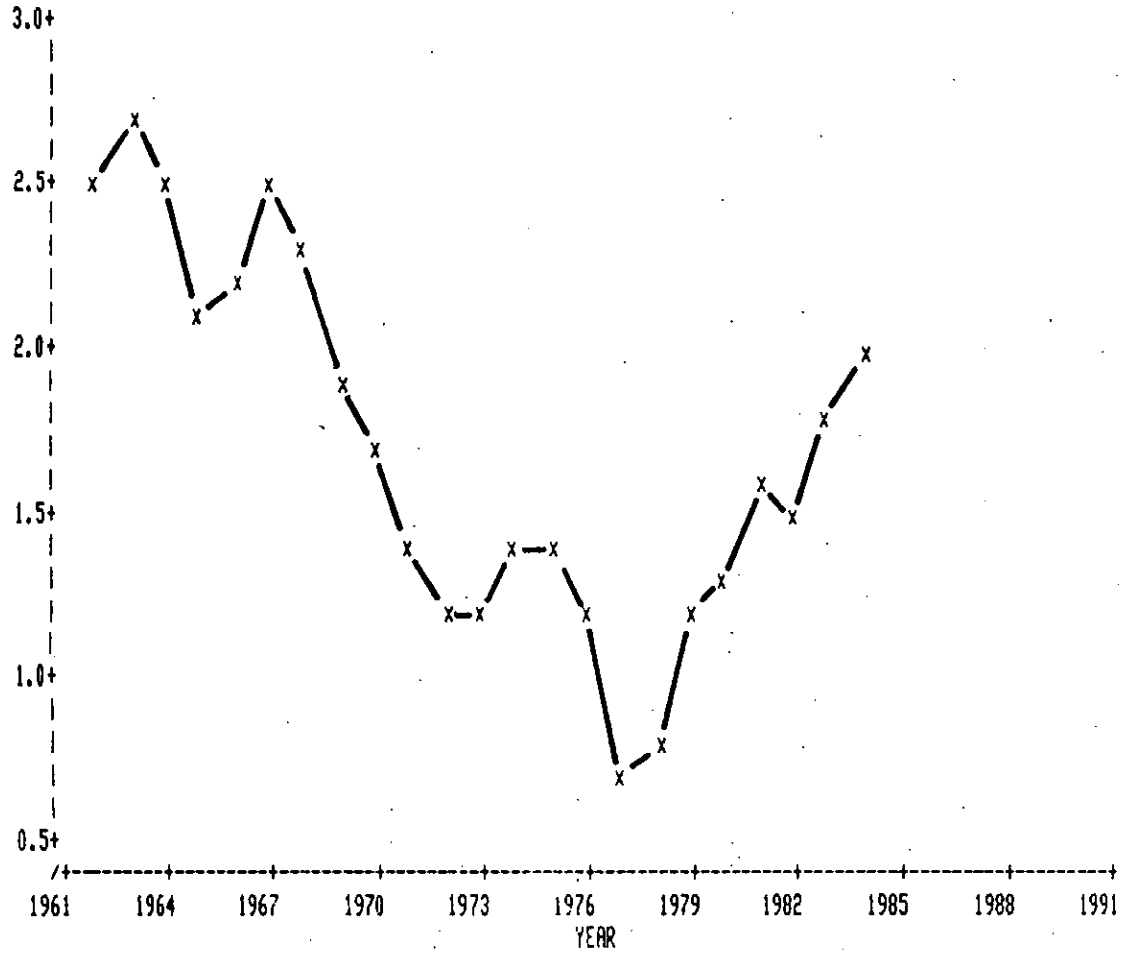

Fig. 1. Catch rate index for cod in Div. 2J3KL analysed separately and using the average of 1978-79 as a reference in both series.