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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 Div. 2J3KL peaked at a high of 807,000 t in 1968 and subsequently declined to a low of 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 along with associated TAC's are as follows ('000 t):

Year	1980	1981	1982	1983	1984	1985	1986
TAC	180	200	230	260	266	266	266
Nominal catch	176	171	230	232	230 ^a	230 ^a	

^aprovisional data.

Nominal catches by country, month, and division for 1985 are given in Table 2. These were obtained from the Department of Fisheries and Oceans for Canadian based vessels and from NAFO circular letters, FLASH data base, and Department of Fisheries and Oceans surveillance estimates for others. Surveillance estimates are based on calculating catch rate information from logbooks on inspected vessels and applying this catch rate to the uninspected portion of the foreign fleet. Surveillance estimates are calculated by country. There seemed to be some discrepancy between catches obtained from various sources, so in an attempt to arrive at a suitable estimate for total landings the largest of these catch statistics were used. As in recent years the Canadian fishery took a major portion of the 1985 catch (80%), but the foreign catch in NAFO Div. 3L was at a ten year high (34,000 t). It appears that 1985 was a poor year for the inshore fishery with the total inshore catch declining by 20,000 t from 1984 (Fig. 1). A document by Lear et al. (1986) gives some possible explanations for this decline.

Catch and average weight at age - 1985

Catch numbers, average weight, and average length at age for 1985, as derived from the catch breakdown shown in Table 2 and the sampling data shown in Table 3, are given in Table 4. Sampling coverage of the catch was again well distributed (Table 3) and data was available to treat each division separately. With the volume of sampling data used the precision on the catch-at-age was quite good with the major age groups in the population having coefficients of variation well below 10%. The following relationship was applied in deriving average weight at age: $\log \text{weight} = 3.0879 \log \text{length} - 5.2106$. The discrepancy between reported catch and catch calculated from these average weights for 1985 was about 2%.

* Further assessment of this stock is given in the Appendix.

A breakdown of catch at age during 1985 by inshore and offshore gears and by division is presented in Table 5. All of the inshore catch were taken by Canada-Newfoundland based vessels. Some concern was expressed at previous assessment meetings about the historical average weights used. During the investigation of the sampling data, to re-examine the average weights, the catch-at-age was also re-examined. Historical catch and weights at age used previously and those matrices recalculated for this assessment are presented in Tables 6 and 7. Table 8 gives the percent discrepancy between the historical calculated and reported catch using the new matrices. For reference purposes, the cohort analysis that was accepted at last years assessment meeting ($F_T = 0.23$) (Baird and Bishop, 1985) is presented in Table 9 with a cohort analysis, using the new catch and weights at age given in Table 10. An explanation of the changes in catch and weight at age are given in the following section.

Catch and average weight at age - Historical

The average weight at age matrix used in cohort analyses during assessments of this stock has been constructed using an average value for the period 1962-76 along with values obtained from the commercial fishery each year since 1977. This matrix has indicated a somewhat abrupt change in weights at age between 1976 and 1977 and it was suggested during the 1985 assessment meeting that this change be investigated.

For this purpose sampling data from the period 1972-76 were reexamined to determine average weights and removals at age by NAFO division and by major gear components (inshore and offshore). Sampling data for the period 1977-84 were also re-examined to reconstruct the matrices by division and gear. This latter re-analysis produced some significant changes in individual years as indicated in Tables 6 and 7. These changes resulted mainly from: (1) the reanalysis by division; (2) updating of catches originally used with those currently documented, and (3) re-evaluation of some sampling data used to construct the original catch at age.

Year	Catch (t) used in assessment year	Updated catch (t) as per NAFO Statistical Bulletin	
		458257	454590
1972			
1973	354509		354509
1974	352278		372650
1975	287523		287508
1976	259437		214220
1977	169873		172717
1978	136010		138559
1979	159960		166743
1980	170419		175782
1981	150531		170748
1982	227962		229774
1983	226965		232340
1984	229229		230387

For most years the values of catch at age were not different from those originally obtained as catches and sampling were essentially unchanged. In the period 1972-76 only 1976 showed major changes particularly in the younger age groups. Reasons for this change include a downward adjustment in the estimated catch (text table) and a change in adjustment methods. The data and rationale for adjustment of catch to numbers at age for 1976 were originally described in ICNAF Res. Doc. 77/VI/26. During re-analysis it was determined that sampling data provided by GDR as obtained from 90 mm research gear was used to adjust catches for that country in Div. 2J and 3L. These frequencies were originally described as being from 120 mm gear. The use of these frequencies converted a significant amount of catch into large numbers of small fish. (The average length of catch in 2J was 33 cm and in 3L, 30 cm.). In the present re-analysis it was felt that these frequencies were not representative of commercial catch and were not used. Catches were adjusted on the basis of remaining sampling for each division.

Adjustments by division with revised catches also produced substantial changes in the recent period, 1977-84, particularly in 1977 and 1981. In the first part of this recent period catches for countries other than Canada were often adjusted to the stock area (2J3KL).

When divisional sampling was available, catches by the country-gear were adjusted and individual country age compositions were combined by division. Catches by division with no sampling were not adjusted to the division but were eventually adjusted based on the proportion at age obtained from combining divisional totals which were obtained only from sampled catches.

In the re-analysis, age compositions were obtained from available sampling by division. Country catches with no sampling were adjusted to the division. For this reason, along with the use of some additional sampling data, the 1977 numbers and average weights at age were substantially different from that previously used. Sampling data was available from Poland for catches in 2J and 3K and FRG in 3K. The effect of inclusion of this sampling was mainly that of increasing the proportion of ages 3 and 4.

In 1981 the new age composition was different because of changes in estimated catch levels and the analysis by division. The increase in catch by division was: 5,525 t in 2J; 3,550 in 3K; and 10849 in 3L.

Research vessel surveys

Research vessel surveys were conducted in the fall by the GADUS ATLANTICA in Div. 2J and 3K since 1977 and 1978 respectively. Fall surveys for Div. 3L were conducted by the A. T. CAMERON during 1981-82 and by the WILFRED TEMPLEMAN in 1983-85. The 1984 fall survey was conducted earlier than in other years (Aug.-Sept. as opposed to Oct.-Nov.). Biomass and abundance estimates from these surveys are shown in Tables 11-16. Spring surveys were carried out in Div. 3L from 1971-82 by the A. T. CAMERON and in 1985 by the WILFRED TEMPLEMAN. This survey could not be conducted in 1983 and in 1984 a survey of limited coverage (100 fath) could be completed. Tables 17 and 18 show biomass and abundance from these surveys. Biomass and abundance estimates from a short time series of winter surveys are given in Tables 19 and 20. The 1985 and 1986 winter surveys in Div. 3L were conducted by the WILFRED TEMPLEMAN while the 1986 winter survey in Div. 2J and 3K was conducted by the GADUS ATLANTICA. Mean numbers and weights per tow along with associated confidence limits for selected strata in fall and spring surveys are given in Tables 21-24. Selected strata were chosen as those common to all years in particular survey series.

Biomass and abundance estimates in Div. 2J have declined from a high in 1983 (although variance estimates are quite large) to the lowest value in the series in 1985. The depth ranges where the decline occurred are 101-200 m and 201-300 m. Although the survey population estimates in Div. 3K have been fairly stable since 1978, there was a dramatic decrease in 1985 with the biomass and abundance dropping to almost one-half the 1984 levels. The entire decrease in these estimates occurred in only one depth range, 201-300 m. A possible explanation for the decline in 2J and 3K population estimates may be an availability problem caused by environmental factors. Tables 25-27 show mean temperature and depth by depth zone in Div. 2J, 3K, and 3L. For depths less than 300 m in Div. 2J and 3K there has been a considerable cooling trend in bottom temperature for the time period with recent bottom temperatures at these depths being the lowest in the series. These conditions may have forced part of the population out of the survey area or up in the water column to find more favorable temperatures. It is interesting to note that population estimates for other species from the 1985 Div. 2J and 3K survey also showed a significant decline. These species such as American plaice, Greenland halibut, and witch are species for which there is low exploitation, therefore, the declines observed in 1985 may be explained by these environmental factors (Table 28). Biomass and abundance estimates from the fall Div. 3L surveys declined slightly but they are still the second highest values in the 5 year time series. Results from the 1985 Div. 3L spring surveys after a two year absence of surveys show population estimates to be the highest in the time series. Preliminary results from the 1986 Div. 3L spring survey give estimates almost at the levels of those in 1985 (Biomass = 242,000 t). The 1986 Div. 3L spring survey was conducted only to 200 fathoms while the 1985 survey was conducted to 400 fathoms. Another dramatic decline in survey population estimates occurred during the winter of 1986 in Div. 3L. Although there are only two years of data to evaluate, the biomass dropped from 320,000 t in 1985 to 50,000 t in 1986. With only one year to examine and limited coverage due to ice and time-constraints the results from the 1986 winter survey in Div. 2J and 3K are inconclusive. It is interesting to note that in 4 out of 19 tows in Div. 3K catches greater than 10 t were observed (38 t, 19 t, 16 t, 12 t).

Tables 29-33 give mean numbers per tow at age for surveys in all divisions. It should be noted that these values were estimated from coverage of all depths fished in a particular year. In Div. 2J for example, there was no survey coverage greater than 400 m for 1978-80 while the more recent surveys fished depths to 1500 m. To make these numbers more comparable they should be adjusted by the mean numbers per tow for selected strata given in Tables 21-24. In virtually all of the survey series the 1980 and 1981 year-classes appear to be strongest. The 1979 year-class shows up quite well in Div. 3L winter and Div. 2J surveys, with the 1982 year class showing some promise in all the Div. 3L surveys.

Tables 34 and 35 show comparisons of survey catch rates for Federal Republic of Germany and Canadian surveys. Federal Republic of Germany survey results were taken from Messstorff (1984). The 1985 Canadian survey estimate for Div. 3K was omitted from comparisons because it was thought to be anomalously low. When comparing total numbers per tow, the relationship between series are not significant in any cases. The highest r^2 value obtained was between Canadian 3K and 3L fall surveys ($r^2 = .57$), with only 4 data points compared. When making

comparisons of survey catch rate series using age 6+ numbers per tow the relationships improved considerably. There was some relationship between the FRG Div. 2J survey and the Canadian Div. 2J, 3K, and Div. 3L spring surveys, although there was no relationship between the Canadian Div. 2J and 3K surveys. The best relationship was between the FRG Div. 2J and the Canadian Div. 3K surveys ($r^2 = 0.74$). There was also a significant relationship between the Canadian Div. 2J and Div. 3L spring surveys. From these results it is difficult to determine which survey series, if any, should be combined in the constructing of a survey biomass index.

A recruitment index was calculated and is presented in Table 36. Data used for this index were Canadian Div. 2J, 3K, and Div. 3L spring surveys. These surveys were chosen because any of the longer recruitment series still had the effect of the 1968 year class and of the shortened series, this one gave the best agreement with the converged portion of the accepted cohort analysis ($F_t = 0.23$) in last years assessment. Ages 3 and 4 were selected from each survey as it was thought to be the best representation of the youngest age in the cohort. All values were normalized to their respective 1975-78 mean values, which were the only common year-classes in all surveys. The normalized values were then averaged to arrive at the recruitment index. Although there were some non-significant correlations between survey series, they were common in many respects (i.e. the strength of the 1981 year-class and the weakness of the 1976 and 1977 year-classes). Using this recruitment index, the value for the 1982 year-class would be set at 350 million.

Commercial catch-effort

A major problem with the assessment of many groundfish stocks is obtaining an estimate of inshore effort. In this assessment an attempt was made to use purchase slip data as a proxy for this information. Purchase slips are completed at fish plants and are then returned to the Statistics Branch of the Dept. of Fisheries and Oceans for compilation. The information recorded on each slip consists of identification and landings information for inshore fishermen. A problem with using these slips as units of effort is that the amount of gear that is used varies and this piece of information is not recorded. Because of this any catch per slip index may well be biased, but at the present time this is the only available measure of inshore catch rate. At present the only data available are for 1984 and 1985 and the numbers of purchase slips for these years are presented in Table 37. Table 38 gives the associated inshore catch for these years along with the estimates of catch per slip by unit area (Fig. 2) and gear type. It is interesting to note, that although the inshore catch declined from 1984 to 1985 the catch per individual purchase slip, for the most part, remained stable. The authors present this data to the subcommittee with the intention of creating some discussion as to the appropriateness of its use in this manner.

As offshore catch and effort 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 were obtained from NAFO (ICNAF) Statistical Bulletins for the 1962-79 period and from the Department of Fisheries and Oceans, Canada for the 1978-85 period. The analysis is done separately for both these series and a resultant catch rate index is derived by using 1978-79 as a reference in both time periods. For the earlier series data from Canada-Newfoundland, Spain and Portugal were used and for the latter data from Canada-Newfoundland, Canada-Maritimes, and Portugal were used. As in previous assessments plots of residuals showed that data with greater catch and effort were less variable, therefore, estimated weights calculated according to Judge et al. (1980, p. 132) were applied in a weighted regression of the multiplicative model. To reduce the possible effect of truncation and rounding errors, data with less than 10 t catch or 10 hours effort were excluded from the analysis. The seasonal and divisional patterns are similar in both periods but are more pronounced in the latter (Tables 39 and 40). The catch rate index given in Table 41 and Fig. 3 shows a general decline from the late 1960's to the mid 1970's and a subsequent increase. The 1985 value is about the same as those in the early 1960's. For this years assessment, in an attempt to test the assumptions of the multiplicative model, catch/effort information was also analysed by Division. This analysis is similar to that carried out for Div. 2J3KL, with the data analysed in two time periods and combined using 1978-79. Tables 42-47 give the regression coefficients and analysis of variance for each Division and time period. There are small amounts of variation in the country/gear patterns, but the seasonal patterns compare quite well. From examination of the catch rate indices for each Division, it is evident that the same trend in catch rate appears throughout.

It was suggested that the results from the multiplicative model may be affected by the proportion of the catch for which there was available data. To investigate this empirical data from the 1978-85 time period (Table 51, Fig. 7) were compared with the standardized CPUE from the multiplicative model. For the Canadian data, which comprises the bulk of the offshore catch there was a significant relationship ($r^2 = 0.70$). Excluding the 1981 value the Portuguese data also shows a significant relationship ($r^2 = 0.66$). The following paragraphs provide a brief summary of the analysis carried out for this stock using the multiplicative model since 1980.

1980: Data for catch rate standardization was obtained from ICNAF statistical bulletins for 1959-77, preliminary information from the NAFO secretariat for 1978, and FLASH reports in 1979. Days fished were converted to hours fished from FLASH reports and only information from Newfoundland vessels was available for 1979. Each point on the regression of ln catch rate was weighted by the fourth root of catch x effort.

1981: Data was obtained from ICNAF statistical bulletins for 1959-78. The NAFO secretariat provided preliminary data from some countries for 1979 and data from Economics Branch and the observer program of the Department of Fisheries and Oceans was used for 1980. The same weighting procedure as 1980 was used again.

1982: Originally data was obtained from NAFO (ICNAF) statistical bulletins for 1959-79 and from the Economics and Statistics Branch of Fisheries and Oceans for Canadian based vessels. Data for Spanish and Portuguese vessels were not used for the 1977-79 period because of inconsistencies. With a closer examination of the catch rate series in the fall of this same year data from 1962-79 was obtained from NAFO statistical bulletins but only information from Portuguese, Spanish, and Canadian otter trawlers were used. Spanish pair trawl data was excluded from the standardization because pair trawlers exhibited a different seasonal pattern than otter trawlers. Two series 1962-79 and 1979-82 were analyzed separately and the combined catch rate index was scaled to a single year (1979). In recent years the Portuguese, Spanish, and Canadian fleets had taken the major portion of the offshore catch. The same weighting procedure as in previous years was again used in 1982.

1983: The same country-gear combinations as last year were used and the data was derived from the same sources. The analysis this year was similar to the previous year.

1984: Data was again supplied from the same sources as in previous years and this year (Can-M) otter trawl data was included in the 1979-83 series. Data with less than 10 t catch or 10 hours effort were excluded from the analysis to reduce the possible effect of truncation and rounding errors. Plots of residuals indicated that data with greater catch or effort were less variable. This being the case, weights, calculated according to Judge et al. (1982, p. 132) were applied in the regression of the multiplicative model.

1985: Data was again obtained from the same sources, but the latter series was extended to include 1978 and this data was obtained from the Department of Fisheries and Oceans. In past assessments, two time periods (1962-79 and 1979-84) were scaled to a single year (1979). Because choice of reference period is critical to the resultant catch rate series it was decided to use two years as a reference (1978 and 1979). It is impossible to include any other years as reference because only in 1978-79 does any overlap in fishing patterns occur. Most of the overlap occurs in 1979 with only a small amount in 1978. To determine if seasonal and divisional patterns were similar throughout the 1962-79 time period, this series was further divided (1962-70 and 1971-79) and analyzed separately. It was determined that the patterns in question were reasonably similar in both periods and the trend in the annual catch rate indices compared well with those from the entire 1962-79 time period. With these results obtained the 1962-79 series was accepted. Data with less than 10 t catch or 10 hours effort were again excluded and the same weighting procedure as last year was used.

Historical summary of calibrations: Calibrations for the 1980-82 assessments were done using regressions of standardized CPUE and 4+ average biomass. For the 1982-84 assessments regressions of standardized CPUE and exploitable biomass were used for calibration. Exploitable biomass was calculated by multiplying the partial selection matrix by average biomass. The partial selection matrix is calculated by dividing fishing mortality matrix by total fishing mortality for ages 8-11. Total fishing mortality is derived from the ratio of ages 8-10 population numbers to ages 9-11 population numbers in the succeeding year. Values greater than 1 were replaced by 1. For the 1985 assessment regressions of standardized catch rate and offshore exploitable biomass were used for calibration. Offshore exploitable biomass was calculated by multiplying the offshore partial selection matrix by average biomass. Offshore partial selection was obtained by multiplying the fishing mortality matrix by the proportion offshore and dividing this result by weighted fishing mortality. Weighted fishing mortality is the average fishing mortality in each year weighted by population numbers. Again values greater than 1 were replaced by 1.

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Table 1. Historical catches of cod from NAFO Divisions 2J3KL for the years 1959-85.

Year	2J			3K			3L			2J3KL		
	Offshore		Other	Inshore		Can.	Offshore		Other	Inshore	Can.	Total
	Offshore	Other	Inshore	Can.	Other	Offshore	Not Specified	Other	Inshore	Offshore	Total	TAC
1959	17533	-	39405	56264	-	83003	85695	4515	43097	30060	159492	200080
1960	15418	1	164036	47676	53	69855	94192	7355	60213	-	157286	301513
1961	17545	1	243144	31159	-	60574	70659	4675	70318	3	119463	378715
1962	23424	-	226841	42816	-	45554	72271	4383	87463	-	138511	364241
1963	23767	1	187925	47486	-	75344	73295	4446	78620	9020	144548	355356
1964	14787	13	180232	40705	30	110887	75806	10158	129135	41832	131298	472287
1965	25117	-	227206	26467	21	46146	58943	7353	119529	44872	110527	445127
1966	22645	39	221004	32208	13	57543	55940	8253	117231	7381	110843	411464
1967	27721	28	212327	24905	114	76900	49233	13478	195494	10335	101859	508676
1968	12937	4592	323280	40768	1849	114123	47330	15784	202998	43809	101035	706435
1969	4328	30	356543	24923	56	74397	67973	18255	142954	58974	97224	651209
1970	1963	-	196823	21511	93	69396	53113	14471	128975	29868	765687	439626
1971	3229	84	146903	21111	31	58404	38115	11976	140664	11979	62455	370041
1972	1725	-	148038	14054	7	132122	46273	4380	107991	3580	62052	396118
1973	3619	1123	52985	13190	110	159651	24839	1258	97734	-	41648	312861
1974	1804	-	119453	10747	19	149189	22630	880	67918	-	35181	337469
1975	3000	410	78578	15518	13	112854	22695	670	53770	-	41213	246295
1976	3851	94	30691	20879	646	79665	35209	2187	40998	-	59939	154281
1977	3523	525	39584	28818	1039	26788	40282	5362	26799	-	72623	100097
1978	6638	4682	17546	29623	5859	7541	45194	9213	12263	-	81455	57104
1979	8445	9194	6536	27018	15190	23275	50359	14184	12690	-	85822	81069
1980	17210	13592	7435	37015	21920	6828	42298	15523	13961	-	96523	79259
1981	11582	24794	4760	22770	23344	3847	42835	21746	15070	-	77187	93561
1982	15330	57483	8923	42410	8614	4072	57881	25788	9273	-	115621	114153
1983	10638	37341	3640	40803	31565	2352	54683	39423	9768	-	106124	124089
1984	12772	10994	1523	35100	47866	10127	49428	49603	12974	-	97300	133087
1985	9267	1628	10	30263	64244	8698	38197	34329	-	-	152106	230418
											77727	266000

Table 2. Cod landings (t) from Divisions 2J, 3K, and 3L by country during 1985.

Month	CanN Off.	Ins.	Can-M	GDR	EEC	Japan	Port.			Total	
							OT	GN	USSR		
2J											
Jan.											
Feb.	1									1	
Mar.	13									13	
Apr.	304				66					370	
May											
June	160	1	80							241	
July	752	1151								1903	
Aug.	27	5422	9	1						5459	
Sept.	11	2375	1							2387	
Oct.	19	316				2				337	
Nov.	14	2				7				23	
Dec.	12		159							171	
	1313 ^a	9267	315	1	7	2				10905	
3K											
Jan.	2852	2652	7066				5			12575	
Feb.	5628	5092								11720	
Mar.	9111	1	3777							12889	
Apr.	10969	5343								16312	
May	7619	9	5048			900			1	13577	
June	4336	1428	3652			537	6			9959	
July	288	13178	257			2			4	13731	
Aug.	82	9040	293			5			85	9505	
Sept.	58	5124	51			7			33	5273	
Oct.	48	1398	26			9				1481	
Nov.	222	83	44			2			1	361	
Dec.	796	2							4	822	
	42009 ^b	30263	27235	20	7066	23	1439	6	127	17	108205
3L											
Jan.	9	37	238							165	
Feb.	446	16	300	1572						430	
Mar.	574	16	118	8014						1465	
Apr.	1682	101	153	5327						1894	
May	4955	656	662	111		55				1858	
June	2920	5294	176			5	604			696	
July	1127	18278	102				638			253	
Aug.	2343	8581	695				656			117	
Sept.	5131	3945	526				443			338	
Oct.	3995	1564	304				334			466	
Nov.	4976	202	2721	21			51			1220	
Dec.	4044	92								1704	
	32202 ^c	38782	5995	21	15024		60	2726		10606	
					18489 ^d		5243 ^d			6885 ^d	
										111308	

^aIncludes RSPP (Port OT 50 t).

^bIncludes RSPP (Port OT 1576 t, GN 61 t).

^cIncludes RSPP (Port OT 1301 t, GN 1573 t).

^dTotal landings for country based on surveillance estimates for 1985.
2J3KL = 224,526 Including Surveillance = 230,418

Table 3. Commercial sampling for Divisions 2J+3KL cod in 1985.

Div.	Gear	Qtr.	Country	No. aged	Month	No. meas.	Landings (t)	
							Country/month	Total
2J	OT	1-2	Can(N)	a	Feb.	210	1	14
			"		Apr.	310	304	370
			Other			520		240
								624
	OT	4	Can(N)	a	Oct.	262	19	21
			"		Dec.	184	12	171
			Other			446		21
								213
	OT	1-2-3-4	Other					801
	Trap	3	Can(N)	467	July	1819	770	4607
			"		Aug.	5112	3217	
			GN		July	181	359	2668
			"		Aug.	2998	1478	
	HL	"	"	467	July	606	6	1781
			"		Aug.	1412	687	
						12128		9267
2J Total				467		13094		10905
3K	OT	1	Can(N)	630	Jan.	2382	2852	2852
			Can(M)		Jan.	844	2652	
			FRG		Jan.	12566	7071	
			Can(N)		Feb.	3246	5628	11720
			"		Mar.	16122	3777	
			Can(M)		Mar.	1419	9111	9111
				1064		36579		37183
		2	Can(N)	555	Apr.	10828	10969	16312
			"		May	14775	7619	
			Can(M)		May	795	5048	5048
			Port		May	9219	901	
			Can(N)		June	833	4336	7988
			Port		June	2080	543	
				1042		38530		38411
		3						1167 ^b
			Can(N)	C	Nov.	275	222	361
			Can(N)		Dec.	1249	796	820
						1524		1181
3K	Trap	3	Can(N)	797	July	11488	7928	8373
			"		Aug.	1796	3972	
			GN		July	2080	4296	5262
			"		Aug.	259	1734	
			HL		July	209	658	674
			"		Aug.	4969	2893	
		LT	"		July	907	296	307
			"		Aug.	710	441	
			"			22418		24702
				797				
		4	Can(N)	641	Sept.	1437	741	1018
			"		Sept.	4013	2427	3039
			LT-Trap		Sept.	5450		1504
				641				5561
3K Total				3544		104524		108205
3L	OT	1	Can(M)	159	Feb.	236	300	656
			Can(N)		Feb.	1012	446	1029
			FRG		Mar.	1090	8014	9586
			Other			291		2060
				641		2338		13331

Table 3' (Cont'd.)

Div.	Gear	Qtr.	Country	No. aged	Month	No. meas.	Landings (t)	
							Country/month	Total
3L	Trap GN	2	FRG	48	Apr.	1146	5327	5438
			Can(N)	478	Apr.	810	1678	1831
			"		May	1665	3643	4360
			"		June	1214	2681	2862
			"d	127	Apr.	540	4	4
			"d		May	13699	1312	1312
			"d		June	2564	239	239
			Other			653	21638	20494
		3	Can(N)	418	July	1501	1127	1229
			"		Aug.	213	2343	3038
			"		Sept.	2343	5131	5657
		4	Other			418	4057	10632
			Can(N)	464	Oct.	2235	3995	4299
			"		Nov.	6588	4958	7679
			"d		Nov.	300	18	18
			"		Dec.	7135	4044	4044
			GDR	47	Dec.	259	21	21
			Other			511	16517	3390
								19451
3L	Trap GN	2	Can(N)	422	May	568	263	332
			"		May	2579	377	467
				422		3147		799
		3	Can(N)	1257	June	8847	3774	3774
			"		July	7418	13290	13290
			"		Aug.	408	4266	4266
		GN	"		June	3324	1267	1267
			"		July	2738	4309	4309
			"		Aug.	841	1868	1868
		HL	"		June	925	123	139
			"		July	2228	616	616
			"		Aug.	2402	1886	1886
		LT	"		Aug.	1064	561	765
						1257	30195	32180
3L	GN	4	Can(N)	987	Sept.	1140	533	533
			"		Oct.	494	241	327
			"			3173	2154	3024
		HL	"		Sept.	2798	1170	1806
			"					113
			"			987	7605	5803
		LT	Port.	465	June	7932	604	604
			"			161	638	638
			"			5535	656	1099
		Other	Port.			161	14088	1737
			"					
3L Total	GN	4	Port.	228	Oct.	7241	334	385
						5393	114758	105416
								111308
2J3KL Total				9404	232376			230418

^a 3rd quarter age-length key used.

^bAdjusted using 2nd and 4th quarter sampling.

2nd quarter age length key used.

d_{RSPP} sampling. (Port GN)

^eIncludes surveillance estimates (adjusted by total 3L offshore sampling.)

Table 4 . Estimated average weight, average length, and catch numbers at age for the commercial cod fishery in NAFO Divs. 2J3KL during 1985.

AGE	AVERAGE		CATCH		
	WEIGHT	LENGTH	MEAN	STD. ERR.	C. V.
3	0.474	37.841	698	168.38	0.24
4	0.726	43.535	15176	587.43	0.04
5	1.099	49.752	37152	885.77	0.02
6	1.434	54.237	33582	842.76	0.03
7	2.072	61.050	27655	736.47	0.03
8	2.674	66.356	6970	356.01	0.05
9	3.245	70.458	3728	232.04	0.06
10	3.338	70.966	5003	257.94	0.05
11	4.096	75.472	2853	173.64	0.06
12	4.574	78.301	1627	111.05	0.07
13	7.070	90.097	256	37.20	0.15
14	9.757	100.557	107	11.50	0.11
15	11.475	106.135	38	6.52	0.17
16	11.349	105.245	21	5.23	0.25
17	12.992	109.262	17	4.40	0.25
18	12.431	109.810	1	0.65	0.72
19	14.329	114.959	3	1.54	0.49
20	19.800	126.940	5	1.47	0.28
21	11.754	107.843	1	0.92	1.08
22	13.097	112.000	1	0.84	1.09
23	16.628	121.000	1	1.39	1.11
24	29.073	145.000	1	0.01	0.01

Table 5. Offshore and inshore catch at age by division for the commercial cod fishery in NAFO Divs. 2J3KL during 1985 (numbers $\times 10^{-3}$).

Age	Offshore			Inshore		
	2J	3K	3L	2J	3K	3K
3		6	341	5	202	136
4	10	521	4165	218	3192	7071
5	75	5793	13386	1341	5875	10682
6	171	15906	7309	1883	4383	3931
7	183	10909	8705	1402	3148	3308
8	79	2789	1830	363	927	984
9	47	1716	820	229	565	352
10	70	3144	778	279	436	296
11	36	1655	542	135	282	203
12	25	1245	135	87	76	60
13	12	103	88	21	15	16
14	2	53	25	3	19	4
15		17	7	1	8	6
16	1	8	6		3	3
17		11	4			2
18		1				
19		2	1			
20		1	4			
21					1	
22			1			
23			1			
24				1		

Table 6. Catch numbers ($\times 10^{-5}$) and weights at age (kg) for cod in Divisions 2J3KL used in last years assessment.

Table 7. Catch numbers ($\times 10^{-5}$) and weights at age (kg) for cod in Divisions 2J3KL after re-evaluation of available sampling data.

Age	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	CATCHES AT AGE				
4	267	274	267	256	463	705	916	381	574	650	733	407	145	140	317	256	174	124	120	70	305	177	140	150	150	150			
5	458	562	562	454	742	1069	1296	564	773	921	1165	945	352	352	493	493	493	493	493	493	493	493	493	493	493	493	493		
6	500	615	615	500	732	1074	1450	1034	1450	1534	1740	1450	352	352	574	574	574	574	574	574	574	574	574	574	574	574	574		
7	486	579	627	567	627	809	953	553	809	789	953	944	352	352	574	574	574	574	574	574	574	574	574	574	574	574	574		
8	254	309	499	499	307	372	507	379	493	474	593	579	352	352	574	574	574	574	574	574	574	574	574	574	574	574	574		
9	207	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152		
10	186	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114		
11	109	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	
12	95	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	
13	89	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	
14	70	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	
15	57	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	
16	47	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	
17	34	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	
18	26	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	
19	19	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	
20	14	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
21	9	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
22	7	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
23	6	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
24	5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
25	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
26	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
27	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
28	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

AVERAGE WEIGHT AT AGE

Table. 8. Historical sum of products for NAFO Divisions 2J3KL cod for the years 1962-85.

Year	Calculated catch	Reported catch	Percent discrepancy
1962	530827	502572	+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	428580	454590	-5.7
1973	316654	354509	-10.7
1974	354994	372650	-4.7
1975	256646	287508	-10.7
1976	184745	214220	-13.8
1977	140053	172717	-18.9
1978	130103	138559	-6.1
1979	155585	166743	-6.7
1980	166389	175782	-5.3
1981	164635	170748	-3.6
1982	222498	229774	-1.9
1983	224861	232340	-3.2
1984	224686	230387	-2.5
1985	225460	230418	-2.2

Table 9. Results of cohort analysis for years catch and average weight matrices.

g fully recruited $F = 0.23$ in 1984 using last

Table 10. Results of cohort analysis for cod in Divisions 2J3KL using fully recruited $F = 0.23$ in 1984 using re-evaluated catch and average weight matrices.

AGE	1984																					
	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
4	54118	57776	50558	68559	8157	9251	6671	5755	5341	5860	4737	2032	1142	1094	1934	3515	3104	1850	1861	4016	3025	3484
5	6793	4194	4483	3900	5365	6078	6663	4633	4367	3855	4173	3156	1295	803	769	1278	2265	2350	2229	1461	2794	2353
6	36779	4766	2898	3161	2780	3538	4063	2817	2921	2876	2323	2362	1729	429	377	682	1517	1726	877	1027	2065	
7	1927	2469	3017	1857	1996	1704	2017	1738	2015	1541	1500	1208	1398	754	296	163	1979	1026	1189	603	669	
8	1059	1136	1498	1583	937	1093	695	920	737	737	710	758	669	598	264	94	207	637	744	412	385	
9	7119	610	671	776	689	487	544	390	397	362	363	352	344	299	159	71	41	45	416	373	475	
10	581	401	362	367	353	347	245	245	153	161	191	160	113	66	32	34	22	22	233	223	223	
11	395	306	225	187	167	193	136	132	94	92	73	101	87	25	12	14	11	11	13	14	134	
12	290	290	179	179	164	164	164	164	53	60	57	49	46	19	9	7	7	7	9	9	27	
13	277	148	148	148	91	55	56	47	54	15	34	38	31	20	13	5	2	3	4	6	5	
14	21139	20237	18540	18834	20556	22943	21587	16923	15726	15551	14236	10203	6693	4403	3756	5549	6416	7530	6737	6722	9056	9822
15	15721	14461	13482	12413	12044	11352	14516	12569	10396	9671	9497	9171	5751	3309	2022	2033	3350	4426	5289	4812	6031	6338
16	5449	10267	8778	8115	7514	8052	7635	6021	5836	5326	5015	4456	2505	1253	755	1066	2076	2861	3559	3245	3637	3785
17	3321	2831	5391	6100	4953	4270	3976	3987	3817	3100	2960	3063	2653	2727	1763	824	378	559	1276	1842	2346	2010
18																		1446	1329	1009	528	1252

POPULATION ETOWAH (AVERAGE)

FISHING MORTALITY

Table 11. Cod abundance estimates (No. x 10³) from research vessel surveys in NAFO Division 2J (Fall).

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	Gadus 116-115 1985
101-200	201	1427	13336	3071	1500	5749	8355	16692	16246	10533	15246
	205	1823	2894	8039	1574	787	4550	21765	13547	25230	8159
	206	2582	6889	1634	1236	2104	6220	5868	8694	30077	12764
	207	2246	9745	5100	2664	3406	5479	9049	13024	14210	27849
Total		8078	32864	17844	6974	12046	24604	53419	51511	80050	64018
201-300	202	440	2097	462	396	5681	2378	2378	1833	1866	760
	209	1608	10174	3531	21485	3410	10099	7681	29567	3862	8599
	210	774	6166	4154	2760	2982	445	4713	59785	4953	299
	213	1725	6944	19617	18516	19811	2158	5807	12806	6915	14028
	214	1171	16716	10658	6527	10958	3956	5900	4659	25667	19030
	215	1270	19281	34205	9986	25692	35768	27583	7233	8040	7424
	228	1428	2948	-	6780	8254	10701	2187	2269	1853	352
	234	508	1258	553	267	1506	534	2250	4698	3005	2339
Total		8924	65584	73180	66717	78294	66039	58499	122850	56161	52831
301-400	203	480	883	-	-	3081	81	1117	462	703	156
	208	448	1017	247	1480	202	303	1368	1749	224	1043
	211	330	632	5450	2737	4659	1746	2415	1325	297	776
	216	384	0	-	202	3603	86	14	10	331	115
	222	441	50	1479	149	1258	132	0	11	11	182
	229	567	415	234	2873	1319	447	298	670	71	936
Total		2650	2997	7410	7441	14122	2795	5212	4227	1637	3208
401-500	204	354	199	-	-	-	1342	142	540	1422	0
	217	268	0	-	-	-	0	0	0	-	0
	223	180	0	-	-	-	0	0	0	0	0
	227	686	51	-	-	-	0	21	26	0	0
	235	420	32	-	-	-	158	126	1135	63	32
Total		1908	282	-	-	-	1500	289	1701	1485	32
101-200		32864	17844	6974	12046	24604	53419	51511	80050	64018	
201-300		65584	73180	66717	78294	66039	58499	122850	56161	52831	
301-400		2997	7410	7441	14122	2795	5212	4227	1637	3208	
401-500		1908	282	-	-	1500	289	1701	1485	32	
Total		101786	98432	81130	104461	94988	117469	180290	139366	120103	
Upper Limit		149969	131104	128646	139530	162744	151085	744785	184179	154186	
Lower Limit		53602	65761	33613	69392	27234	83853	-384206	94552	86020	

Table 12. Cod biomass estimates (t) from research vessel surveys in NAFO Division 2J (Fall).

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	Gadus 116-118 1985
101-200	201	1427	12377	4847	3256	11319	15998	18085	16764	12033	14952
	205	1823	2761	16200	2669	1676	10126	39216	17742	25093	7526
	206	2582	5328	2074	2671	3849	13153	8533	11442	39133	13186
	207	2246	16809	8209	4192	7738	12284	12612	12608	18136	27954
Total		8078	37275	31330	12788	24582	51561	78446	58556	94395	63618
201-300	202	440	3074	525	749	12964	6292	5681	3798	2948	850
	209	1608	15336	5384	43569	12810	22275	18351	53925	7678	12245
	210	774	10481	5572	5771	5810	823	10428	97578	9448	782
	213	1725	6525	31627	31100	34068	5622	8073	14748	9401	16121
	214	1171	24370	20791	13231	25095	9669	10993	6944	33853	24715
	215	1270	31757	55780	19546	64301	96161	60996	12584	10471	10732
	228	1428	3930	-	12374	16972	23904	4357	2215	3012	299
	234	508	2857	1030	553	3699	1192	4614	5370	3657	2402
Total		8924	98330	120709	126893	175719	165938	123493	197162	80468	68146
301-400	203	480	1930	-	-	7467	230	3141	1369	2054	192
	208	448	1962	438	3341	631	908	3750	3153	454	1454
	211	330	1738	10285	5685	9384	4747	6490	3016	954	1400
	216	384	0	-	484	10204	454	86	24	908	180
	222	441	43	2029	653	2780	281	0	105	22	281
	229	567	1009	319	7394	3150	1144	467	516	106	1397
Total		2650	6682	13071	17557	33616	7764	13934	8183	4498	4904
401-500	204	354	308	-	-	-	3149	316	1506	2192	0
	217	268	0	-	-	-	0	0	0	-	0
	223	180	0	-	-	-	0	0	0	0	0
	227	686	131	-	-	-	0	36	129	0	0
	235	420	75	-	-	-	347	315	1584	121	24
Total		1908	514	-	-	-	3496	667	3219	2312	24
101-200		8078	37275	31330	12788	24582	51561	78446	58556	94395	63618
201-300		8924	98330	120709	126893	175719	165938	123493	197162	80468	68146
301-400		2650	6682	13071	17557	33616	7764	13934	8183	4498	4904
401-500		1908	514	-	-	-	3496	667	3219	2312	24
Total		142961	165109	157237	233916	228894	216679	267120	181731	136723	
Upper limit		199808	222301	253553	314419	424737	288880	1175017	241662	174398	
Lower limit		86113	107917	60921	153412	33051	144478	-640777	121800	99048	

Table 13. Cod abundance estimates ($\text{No.} \times 10^{-3}$) from research vessel surveys in NAFO Division 3K. (Fall).

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	Gadus 116-118 1985
101-200	618	1455	-	-	-	-	-	-	4806	6458
	619	1588	-	-	-	-	-	-	1243	221
									<u>6049</u>	<u>6679</u>
201-300	620	2709	17720	26203	15206	12689	4284	17610	22825	1728
	621	2859	14563	25646	2739	7453	6471	4603	6070	1531
	624	668	13121	23166	627	3686	2470	1128	965	552
	632	447	727	2265	5078	3171	2494	8321	-	1029
	634	1618	4105	18157	13651	19455	11384	14186	6229	7112
	635	1274	3825	1492	3706	4743	3175	1227	3275	874
	636	1455	1820	2446	6051	3695	7001	2603	3413	928
	637	1132	2528	5778	3909	4744	6409	8718	19062	3824
Total		<u>12162</u>	<u>58409</u>	<u>105153</u>	<u>50967</u>	<u>59636</u>	<u>43652</u>	<u>58396</u>	<u>61839</u>	<u>17578</u>
301-400	623	1027	6167	2981	7593	876	1557	5769	11764	1015
	625	850	1340	2488	1515	1021	2169	1276	574	1723
	626	919	3191	759	1012	2235	911	1276	770	826
	628	1085	1433	2891	1008	1371	570	1955	1140	1826
	629	495	718	446	144	50	412	562	459	272
	630	544	-	388	315	225	-	306	414	82
	633	2179	4283	3044	2944	3106	3552	3748	5954	10059
	638	2059	2720	8081	3246	9158	5699	13643	3323	9189
	639	<u>1463</u>	<u>1603</u>	<u>3075</u>	<u>741</u>	<u>1303</u>	<u>2921</u>	<u>4095</u>	<u>1304</u>	<u>2128</u>
Total		<u>10621</u>	<u>21455</u>	<u>24153</u>	<u>18518</u>	<u>19345</u>	<u>17791</u>	<u>32630</u>	<u>25702</u>	<u>27120</u>
401-500	622	632	-	-	-	356	190	142	308	59
	627	1194	-	-	-	104	152	193	178	89
	631	1202	-	-	-	162	0	523	18	103
	640	198	-	-	-	0	0	-	7	10
	645	204	-	-	-	0	5	8	15	15
Total		<u>3430</u>	-	-	-	<u>622</u>	<u>347</u>	<u>866</u>	<u>526</u>	<u>276</u>
101-200									6049	6679
201-300			58409	105153	50967	59636	43652	58396	61839	17578
301-400			21455	24153	18518	19345	17791	32630	25702	27120
401-500						622	347	866	526	276
Total			79865	129306	69484	79602	61791	91907	94118	51653
Upper Limit			113311	218233	93324	104928	75262	119955	125225	65201
Lower Limit			46420	40380	45645	54276	48320	63859	63010	38104

Table 14. Cod biomass estimates (t) from research vessel surveys in NAFO Division 3K (Fall).

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	Gadus 116-118 1985
101-200	618	1455	-	-	-	-	-	-	9363	10318
	619	1588	-	-	-	-	-	-	3004	652
Total									12367	10970
201-300	620	2709	32708	55286	33699	33603	9851	33248	41781	4190
	621	2859	25889	63106	5939	10935	11764	6750	14149	2229
	624	668	29936	40531	1742	7973	5365	1586	959	953
	632	447	873	3896	10165	7566	5721	13992		1667
	634	1618	6907	29309	29404	40573	23579	22967	11703	1161
	635	1274	3702	2551	7902	10271	7249	3236	5457	1619
	636	1455	2248	5040	11959	8428	14144	6335	7065	1884
	637	1132	3540	10613	7871	9829	13256	17317	34548	6209
Total		12162	105803	210332	108681	129178	90929	105431	115662	29912
301-400	623	1027	11293	7522	15746	2175	4849	12071	20190	2303
	625	850	1825	5538	4626	2640	4817	3499	1397	2935
	626	919	6976	1940	3242	4781	2076	3932	1653	1735
	628	1085	2729	6206	2739	3848	1480	3841	2112	3000
	629	495	1136	1062	337	150	1255	1167	832	346
	630	544	-	1019	1174	939	-	847	708	230
	633	2179	6947	6379	8073	8406	8482	6558	10861	16779
	638	2059	4210	13362	7161	17706	10143	23310	5511	13854
	639	1463	2204	5734	1949	3225	8335	9295	2684	3349
Total		10621	37320	48762	45047	43870	41437	64520	45948	44351
401-500	622	632	-	-	-	1297	561	289	646	79
	627	1194	-	-	-	267	330	601	318	127
	631	1202	-	-	-	451	0	1489	72	220
	640	198	-	-	-	0	0		119	59
	645	204	-	-	-	0	54	42	176	130
Total		3430	-	-	-	2015	945	2419	1331	615
101-200									12367	10970
201-300			105803	210332	108681	129178	90929	105431	115662	29912
301-400			37320	48762	45047	43870	41437	64520	45948	443451
401-500						2015	945	2419	1331	615
Total		143123	259093	153728	175023	133310	172458	175307	86029	
Upper Limit		215048	421005	201839	237798	159091	216590	228070	107721	
Lower Limit		71198	97181	105619	112247	107529	128325	122544	64338	

Table 15. Cod abundance (No. $\times 10^{-3}$) from stratified random cruises in Division 3L (Fall).

Depth Range	Stratum No.	Stratum Area	ATC 323-325 1981	ATC 333-334 1982	W. T. 7-9 1983	W. T. 16-18 1984	W. T. 37-39 1985
31-50	350	2071	4923	2332	6335	15455	13698
	363	1780	802	1960	13050	19374	40659
	371	1121	105	1010	4679	8018	1058
	372	2460	14256	8679	37532	27415	20303
	384	1120	-	273	6025	452	-
Total		8552	20086	14254	67621	90565	77320
51-100	328	1519	1574	1930	975	1359	1512
	341	585	381	1039	274	439	205
	343	525	897	-	328	2089	263
	348	2120	1724	3310	1953	7002	1284
	349	2114	2154	1492	1622	8059	3047
	364	2817	963	1113	1629	8162	1774
	365	1041	8693	2090	578	8400	684
	370	1320	173	413	727	799	561
	385	2356	44	309	318	1827	118
	390	1481	37	111	2483	48	-
Total		17452	16996	10852	8899	48057	9364
101-150	344	1494	2075	5047	1103	3701	2978
	347	983	2706	2915	2041	2976	719
	366	1394	5197	8022	4473	6221	18207
	369	961	2669	1371	2525	2803	1960
	386	983	861	553	-	1513	1269
	389	821	-	1756	-	811	961
	391	282	-	-	95	635	32
Total		6918	13508	19759	10777	18057	26729
151-200	345	1432	2015	3637	2929	2300	4658
	346	865	5822	2337	4389	1731	3441
	368	334	1316	1429	-	602	2871
	387	718	808	3000	-	3072	1253
	388	361	-	253	-	528	461
	392	145	-	-	147	33	60
Total		3855	9961	10803	7351	8336	12744
31-50		8652	20086	14254	67621	90565	77320
51-100		17452	16996	10852	8899	48057	9364
101-150		6918	13508	19759	10777	18057	26729
151-200		3855	9961	10803	7351	8336	12744
Total		60550	55688	20086	14254	67621	90565
Upper limit		83240	67092	12307	19373	17516	125937
Lower limit		37860	44285	66220	133481	76355	13481

Table 16. 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. T. 7-9 1983	ATC 323-325 1981	ATC 333-334 1982	W. T. 7-9 1983	ATC 323-325 1981	ATC 333-334 1982	W. T. 7-9 1983
31-50	350	2071	4923	2332	6335	15455	13698	10498	3849	8463	16498
	363	1780	802	1960	13050	19374	40659	20017	2009	17993	20017
	371	1121	105	1010	4679	8018	1058	11210	1363	6126	11210
	372	2460	14256	8679	37532	27415	21453	27045	6882	44364	27045
	384	1120	-	273	6025	452	452	27463	1090	5941	27463
Total		8552	20086	14254	67621	90565	77320	-	15193	82887	102233
51-100	328	1519	1574	1930	975	1359	1512	-	901	1949	299
	341	585	381	1039	274	439	205	-	951	2146	656
	343	525	897	-	328	2089	263	-	342	585	957
	348	2120	1724	3310	1953	7002	1284	-	343	525	205
	349	2114	2154	1492	1622	8059	3047	-	348	525	99
	364	2817	963	1113	1629	8162	1774	-	349	2114	11537
	365	1041	8693	2090	578	8400	684	-	364	2817	1995
	370	1320	173	413	727	799	561	-	365	2817	3856
	385	2356	44	309	318	1827	118	-	370	2817	1419
	390	1481	37	111	2483	48	-	-	370	2817	979
Total		17452	16996	10852	8899	48057	9364	-	17452	30837	43917
101-150	344	1494	2075	5047	1103	3701	2978	-	101-150	14226	4010
	347	983	2706	2915	2041	2976	719	-	347	4805	1245
	366	1394	5197	8022	4473	6221	18207	-	347	4805	27549
	369	961	2669	1371	2525	2803	1960	-	366	9313	7101
	386	983	861	553	-	1513	1269	-	366	9313	27549
	389	821	-	1756	-	811	961	-	366	9313	3962
	391	282	-	-	95	635	32	-	366	9313	4557
Total		6918	13508	19759	10777	18057	26729	-	6918	32061	44369
151-200	345	1432	2015	3637	2929	2300	4658	-	151-200	4703	3673
	346	865	5822	2337	4389	1731	3441	-	346	4865	3003
	368	334	1316	1429	-	602	2871	-	346	4865	1222
	387	718	808	3000	-	3072	1253	-	346	4865	6011
	388	361	-	253	-	528	461	-	346	4865	4056
	392	145	-	-	147	33	60	-	346	4865	4056
Total		3855	9961	10803	7351	8336	12744	-	3855	23997	14298
31-50		8652	20086	14254	67621	90565	77320	31-50	8552	29970	3673
51-100		17452	16996	10852	8899	48057	9364	51-100	17452	30837	43917
101-150		6918	13508	19759	10777	18057	26729	101-150	6918	26901	43917
151-200		3855	9961	10803	7351	8336	12744	151-200	3855	23997	43917
Total		60550	55688	20086	14254	67621	90565	-	109706	87997	131267
Upper limit		83240	67092	12307	19373	17516	125937	-	105131	105967	175407
Lower limit		37860	44285	66220	133481	76355	13481	-	66281	70027	87127

Table 17. Cod abundance estimates (No. $\times 10^{-3}$) from research vessel surveys in NAFO Division 3L (Spring).

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	W.T. 28-30 1985
31-50	350 363 371 372 384	2,071 1,780 1,221 2,460 1,120	2,993 4,783 1,122 2,447 2,447	1,373 2,352 1,599 8,969 6,135	7,756 7,616 1,817 3,293 2,711	2,798 1,817 1,817 3,293 1,555	829 3,296 5,000 5,032 5,422	1,221 1,924 1,189 8,061 4,427	15,883 1,182 8,061 27,098 27,098
Total		8,552	10,177	13,227	25,817	12,380	9,199	4,853	56,323
51-100	328 341 342 343 348	1,519 1,574 1,585 1,525 2,120	72 3,161 3,255 3,215 4,337	325 747 867 2,361 4,337	295 132 139 3,687 3,687	1,024 4,417 3,599 3,556 2,997	0 867 887 887 952	3,432 2,374 2,374 2,467 3,729	2,150 2,787 1,103 4,966 7,016
	349 364 365 370 385 390	1,114 2,817 1,041 1,320 1,223 1,481	3,885 967 781 66 383 1,223	4,337 599 781 390 59 1,056	4,0785 2,996 2,481 2,486 783 2,223	2,997 2,996 1,035 1,486 3,339 1,223	952 - 0 0 59 389	5,821 4,420 5,821 2,448 7,394 2,087	5,821 4,420 5,821 2,448 7,394 2,087
Total		17,452	12,016	11,072	20,754	19,172	4,753	17,720	34,937
101-150	344 347 366 369 386 389 391	1,494 983 10,461 961 1,593 821 217 282 1,117	7,327 861 10,461 761 1,593 639 1,464 1,464 1,757	11,635 6,254 11,188 577 2,813 2,796 5,259 5,259 1,757	15,981 5,737 11,212 5,232 6,757 6,757 2,693 2,693 688	7,947 5,737 4,420 5,232 6,757 6,757 1,440 1,440 688	29,001 29,001 18,527 56,749 7,286 7,286 1,875 1,875 688	9,196 9,196 41,420 18,527 1,875 1,875 10,950 10,950 688	695 1,638 41,420 18,527 1,875 1,875 5,317 5,317 688
	345 368 387 388 392	1,432 334 718 361 145	5,605 319 108 881 44	5,321 - 198 257 44	1,800 1,380 108 150 178	6,385 1,125 1,113 108 5	15,264 2,127 1,880 2,996 196	2,714 2,714 1,880 1,419 2,18	2,107 7,714 1,492 2,226 1,818
Total		3,855	7,639	5,820	3,860	7,777	20,756	6,780	30,845
151-200	346 368 387 388 392	1,432 334 718 361 145	5,605 319 108 881 44	5,321 - 198 257 44	1,800 1,380 108 150 178	6,385 1,125 1,113 108 5	15,264 2,127 1,880 2,996 196	2,714 2,714 1,880 1,419 2,18	2,107 7,714 1,492 2,226 1,818
	345 368 387 388 392	1,432 334 718 361 145	5,605 319 108 881 44	5,321 - 198 257 44	1,800 1,380 108 150 178	6,385 1,125 1,113 108 5	15,264 2,127 1,880 2,996 196	2,714 2,714 1,880 1,419 2,18	2,107 7,714 1,492 2,226 1,818
Total		53,938 67,857 70,457 70,457 40,018	50,554 112,937 112,937 93,294 30,651	91,410 8,061 8,061 6,883 69,883	78,560 39,230 39,230 6,780 69,883	135,716 11,720 11,720 10,804 30,845	133,433 14,202 14,202 14,081 30,845	193,335 255,581 255,581 69,257 131,090	
Total		53,938 67,857 70,457 70,457 40,018	50,554 112,937 112,937 93,294 30,651	91,410 8,061 8,061 6,883 69,883	78,560 39,230 39,230 6,780 69,883	135,716 11,720 11,720 10,804 30,845	133,433 14,202 14,202 14,081 30,845	193,335 255,581 255,581 69,257 131,090	
Total		53,938 67,857 70,457 70,457 40,018	50,554 112,937 112,937 93,294 30,651	91,410 8,061 8,061 6,883 69,883	78,560 39,230 39,230 6,780 69,883	135,716 11,720 11,720 10,804 30,845	133,433 14,202 14,202 14,081 30,845	193,335 255,581 255,581 69,257 131,090	

Table 18. Cod biomass estimates (t) from research vessel surveys in NAFO Div 3L (Spring).

Depth (fath)	Stratum number	Stratum area (mi ²)	ATC 1977	ATC 1978	ATC 1979	ATC 1980	ATC 1981	ATC 1982	WT 28-30 1985
31-50	350	2,070	5,187	2,106	11,637	7,124	539	4,775	31,785
	353	1,780	5,399	3,916	11,237	4,182	7,082	6,721	14,881
	371	1,221	1,535	1,90	2,339	8,148	7,050	7,869	15,647
	372	2,460	1,680	7,006	8,442	7,438	7,155	3,978	44,792
	384	1,120	10	19	3,521	2,480	4,62	2,331	284
Total		8,552	12,996	14,540	39,176	29,382	17,238	16,494	107,389
51-100	328	1,519	38	3,916	1,006	518	2,261	0	893
	341	1,514	3,916	1,006	2,668	3,261	2,038	8,495	4,735
	343	585	1,996	3,010	409	961	871	871	429
	344	525	1,438	1,789	1,790	2,936	946	4,768	795
	348	2,120	1,701	3,546	7,128	7,955	1,966	5,709	7,904
	349	2,114	10,746	8,879	8,790	7,252	1,533	10,182	16,05
	364	2,114	1,101	928	7,884	7,154	1,533	3,938	9,837
	365	1,041	1,112	523	2,954	2,447	0	6,056	2,160
	370	1,320	330	367	1,046	3,807	0	99	7,054
	385	2,556	422	80	1,118	6,258	413	0	2,084
	390	1,881	505	795	2,125	2,598	500	217	261
Total		17,452	21,505	20,932	35,639	43,804	8,717	41,228	51,338
101-150	344	1,494	7,784	20,366	19,398	10,172	50,712	21,583	648
	347	1,983	1,128	8,492	17,705	16,912	9,043	21,435	3,416
	366	1,994	6,211	-	11,509	5,912	8,497	24,817	45,776
	369	1,961	2,050	999	2,348	7,006	3,378	4,959	19,297
	386	983	1,228	251	2,881	2,361	4,593	1,279	3,877
	389	821	1,343	1,063	1,098	6,923	4,478	1,664	6,169
	391	282	336	356	1,048	2,054	1,212	955	429
Total		6,918	20,378	31,527	46,087	50,857	155,913	70,832	79,014
151-200	345	1,432	13,271	10,687	4,844	11,674	29,493	6,060	2,939
	346	865	1,996	-	2,137	2,137	4,307	1,223	341
	368	334	404	-	2,139	7,956	1,761	8,609	1,536
	388	718	1,122	184	459	256	243	3,353	21,491
	392	361	1,181	181	349	108	190	1,321	2,237
Total		3,855	15,998	11,118	8,217	14,988	36,122	12,022	28,890
31-50	8,552	12,996	14,540	39,176	29,382	17,238	16,494	107,389	
51-100	17,452	21,505	20,932	35,639	43,804	8,717	41,228	51,338	
101-150	6,918	20,378	31,527	46,087	50,857	155,913	70,832	79,014	
Total		70,877	78,118	129,117	139,030	218,214	140,578	266,528	
Upper limit		93,610	100,261	154,966	166,965	405,205	171,825	337,779	
Lower limit		48,114	55,974	103,267	111,094	311,224	109,329	195,476	

Table 19. Cod biomass (t) and abundance (000's) from stratified random cruises in Division 3L (winter).

Depth range	Stratum	W.T. 22-24 1985		W.T. 42-44 1986	
		Biomass	Abundance	Biomass	Abundance
31-50	350	3084	4957	5494	6962
	363	4497	4025	1531	1098
	371	489	449	435	831
	372	7067	3592	2281	1574
	384	193	273	490	355
	Total	15330	9704	10231	10820
51-100	328	114	1159	1279	1340
	341	447	1772	2491	3728
	342	23	59	0	0
	343	926	2312	4	18
	348	9518	12114	8	40
	349	7964	9283	5743	5889
	364	5903	3401	609	529
	365	5699	4444	0	0
	370	3263	2958	92	223
	385	11322	7781	416	475
	390	5347	2446	39	91
	Total	50526	47729	10681	12333
101-150	344	1457	2483	56	67
	347	2236	3306	4	55
	366	2260	1737	5	52
	369	29179	18077	123	264
	386	46147	35861	248	348
	389	35844	33248	1702	1910
	391	2710	7705	92	49
	Total	119833	102417	2230	2745
151-200	345	430	3368	54	466
	346	35605	19025	11	114
	368	12498	6920	-	-
	387	54145	29387	23227	23121
	388	22162	13504	2199	3017
	392	2182	2634	902	330
	Total	127022	71470	26388	27048
	31-50	15330	9704	10231	10820
	51-100	50526	47729	10681	12333
	101-150	119833	102417	2230	2745
	151-200	127022	71470	26388	27048
	Total	318563	240033	49531	52950
	Upper limit	421863	295546	107252	105300
	Lower limit	215263	185520	-8189	599

Table 20. Results from a winter survey on the GADUS ATLANTICA during the winter of 1986 in Divisions 2J and 3K (biomass (t), abundance (000's)).

Stratum	2J		Stratum	3K	
	Biomass	Abundance		Biomass	Abundance
213	29	178	632	92	587
214	65	396	633	4185	13647
215	64	413	639	1578326	1276701
216	86	404	645	33714	73465
217	372	1227	646	231329	251713
218	257	662			
222	42	177			
223	496	1166			
224	368	723			
227	2459	4377			
228	330	1483			
229	116	255			
230	578	1228			
Total	5265	12688		1847640	1616111
Upper	7265	16321		5075042	4130396
Lower	3265	9055		-1379763	-898174
Mean	7.75	18.68		5320.82	4654.07
Upper	10.70	24.03		14615.08	11894.69
Lower	4.81	13.13		-3973.43	-2586.56

Table 21. Mean numbers and weights per tow of cod from research vessel surveys in Division 2J for strata surveyed in all years (fall surveys).

Year	1977	1978	1979	1980	1981	1982	1983	1984	1985
Numbers									
Mean	74.91	75.68	56.90	68.70	63.36	87.34	134.94	103.57	91.65
Upper	112.36	104.08	94.09	95.06	118.77	113.11	567.98	137.91	117.81
Lower	37.45	47.28	19.71	42.34	7.96	61.57	-298.09	69.22	65.50
Weights									
Mean	104.60	126.70	110.80	152.92	154.00	159.84	199.75	133.06	104.36
Upper	153.79	175.60	185.66	212.54	302.83	215.17	896.24	178.95	133.27
Lower	55.41	77.81	35.94	93.30	5.17	104.51	-496.75	87.16	75.45

Table 22. Mean numbers and weights per tow of cod from research vessel surveys in Division 3K for strata surveyed in all years (fall surveys).

Year	1978	1979	1980	1981	1982	1983	1984	1985
Numbers								
Mean	48.54	77.41	39.17	46.20	36.03	50.36	53.26	26.64
Upper	71.77	132.49	52.66	61.60	44.23	65.59	71.94	34.01
Lower	25.31	22.34	25.69	30.79	27.84	35.14	34.58	19.27
Weights								
Mean	86.95	155.36	87.03	100.57	77.41	94.81	98.34	44.34
Upper	131.76	257.53	113.99	138.67	93.15	116.93	129.84	56.49
Lower	42.14	53.20	60.07	64.47	61.66	72.68	66.85	32.19

Table 23. 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	1985
Numbers					
Mean	25.19	21.41	38.94	60.31	52.23
Upper	35.26	26.36	51.37	72.40	74.21
Lower	15.12	16.46	26.51	48.23	30.25
Weights					
Mean	44.27	30.25	55.30	64.78	64.11
Upper	63.92	37.47	74.90	75.72	85.34
Lower	24.62	23.02	35.70	53.83	42.88

Table 24. 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	1985
Numbers							
Mean	19.54	20.62	33.11	29.68	51.04	26.60	69.70
Upper	24.58	28.73	40.91	35.25	100.35	34.12	92.14
Lower	14.50	12.50	25.31	24.12	1.73	19.08	47.26
Weights							
Mean	25.67	31.86	46.77	52.33	82.07	50.92	96.12
Upper	33.92	40.89	56.13	63.09	152.39	62.24	121.78
Lower	17.43	22.83	37.41	41.98	11.74	39.60	70.47

Table 25. Number of sets, mean bottom temperatures and mean depths by depth zone from fall research vessel surveys in NAFO Div. 2J.

Depth range (m)	1977	1978	1979	1980	1981	1982	1983	1984	1985
<u>No. of sets</u>									
101-200	22	18	17	19	33	51	38	29	41
201-300	43	23	27	22	35	59	46	34	46
301-400	18	12	11	13	12	17	17	15	16
401-500	15	-	-	-	10	16	13	10	12
<u>Mean temperature</u>									
101-200	2.53	0.78	1.27	0.59	1.04	0.13	-0.48	-0.70	-0.32
201-300	2.87	1.87	2.42	2.04	2.14	1.25	1.14	0.27	0.33
301-400	3.51	3.15	3.38	2.58	3.09	2.36	2.88	2.13	1.83
401-500	3.75	-	-	-	2.92	3.27	3.68	3.38	3.32
<u>Mean depth</u>									
101-200	175	175	173	168	165	166	167	173	170
201-300	241	265	253	269	236	255	255	252	239
301-400	346	347	341	339	343	339	339	349	342
401-500	452	-	-	-	433	419	463	456	450

Table 26. Number of sets, mean bottom temperatures and mean depths by depth zone from fall research vessel surveys in NAFO Div. 3K.

Depth range (m)	1978	1979	1980	1981	1982	1983	1984	1985
<u>No. of sets</u>								
101-200	-	-	-	-	-	-	11	13
201-300	37	39	41	49	63	51	62	67
301-400	33	30	37	46	52	54	58	61
401-500	-	-	-	17	17	15	21	24
<u>Mean temperature</u>								
101-200	-	-	-	-	-	-	-1.14	-1.11
201-300	2.61	1.91	1.73	1.64	1.26	0.98	0.79	0.64
301-400	3.51	3.06	1.70	2.96	2.84	2.82	2.46	2.03
401-500	-	-	-	3.30	3.13	3.34	3.20	2.65
<u>Mean depth</u>								
101-200	-	-	-	-	-	-	178	170
201-300	256	258	258	251	255	256	254	257
301-400	328	340	332	332	329	330	340	340
401-500	-	-	-	454	444	447	452	452

Table 27. Number of sets, mean bottom temperatures, and mean depth by depth zone from fall research vessel surveys in NAFO Div. 3L.

Depth range (fath)	1982	1982	1983	1984	1985
<u>No. of sets</u>					
31-50	22	21	23	46	51
51-100	51	51	80	76	111
101-150	15	27	39	46	53
151-200	11	20	24	22	30
<u>Mean temperature</u>					
31-50	0.18	1.24	-0.17	-0.67	-0.12
51-100	-0.43	-0.67	-1.16	-0.96	-1.14
101-150	0.63	0.46	-0.31	-0.22	0.15
151-200	2.66	2.39	2.18	2.26	1.66
<u>Mean depth</u>					
31-50	77	76	79	76	76
51-100	133	142	147	139	136
101-150	214	233	221	225	220
151-200	317	322	315	319	311

Table 28. Biomass for four species from NAFO Division 2J and 3K fall surveys for the period 1978-85.

Year	Cod	American plaice	Greenland halibut	Witch
1978	308,232	115,181	184,270	18,855
1979	416,330	69,737	133,300 ^b	33,896
1980	310,965	91,469	145,187 ^b	31,002
1981	403,917	105,331	154,627 ^b	31,210
1982	349,989	115,451	175,103	22,220 ^a
1983	439,578	127,426	176,336	36,090
1984	357,038	93,968	192,846	35,730
1985	222,752	68,477	141,407	23,569

^aKey strata not surveyed this year.

^bSurveyed only to 400 m.

Table 29. Mean number of cod per standard tow from research vessel surveys in Division 2J (Fall).

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	0.0	0.0	0.0	0.38	0.0	1.20	2.26	0.59	0.05
2	3.79	0.60	0.35	1.66	4.70	3.50	15.99	5.97	1.37
3	10.95	8.86	1.55	1.41	3.31	20.67	19.08	18.86	8.25
4	33.03	16.35	13.04	4.81	2.59	7.27	29.39	18.64	20.10
5	15.11	33.07	19.12	21.87	4.77	5.06	18.66	30.07	12.43
6	3.32	11.32	18.41	22.33	19.22	4.84	10.03	11.48	15.07
7	1.54	2.51	2.62	13.25	17.21	14.99	5.15	2.77	6.67
8	1.39	0.91	0.83	1.92	10.88	13.18	13.99	1.75	1.15
9	1.09	0.72	0.56	0.56	2.25	8.95	6.36	3.94	0.78
10	0.60	0.52	0.32	0.40	0.57	1.50	4.03	1.69	1.08
11	0.23	0.28	0.32	0.26	0.09	0.40	0.84	0.74	0.39
12	0.11	0.13	0.12	0.31	0.16	0.19	0.27	0.36	0.20
13	0.05	0.16	0.05	0.10	0.17	0.11	0.12	0.06	0.03
14+	0.07	0.25	0.09	0.33	0.24	0.25	0.15	0.03	0.02
Total	71.33	75.70	57.38	69.33	66.15	82.12	126.3	96.96	67.60
Upper limit	106.00	104.10	91.88	93.31	114.18	105.95	526.52	128.77	86.79
Lower limit	36.66	47.30	22.88	45.36	18.12	58.30	273.92	65.25	48.42

Table 30. Mean number of cod per standard tow from research vessel surveys in Division 3K (Fall).

Age	1978	1979	1980	1981	1982	1983	1984	1985
1	0.0	0.0	0.22	0.01	0.28	1.05	0.31	0.01
2	0.31	0.15	1.24	1.51	2.18	4.24	3.92	0.60
3	3.23	2.54	1.69	6.22	2.10	9.20	6.77	2.75
4	14.11	17.31	2.44	3.90	5.99	7.79	11.70	4.26
5	17.20	28.48	13.73	4.25	5.90	13.72	9.43	5.76
6	7.89	16.94	15.00	14.19	3.31	4.20	9.68	2.87
7	2.52	4.35	3.24	10.26	6.98	2.84	3.59	2.76
8	1.18	2.18	1.57	3.19	6.80	5.00	1.80	0.85
9	0.73	0.53	0.58	0.58	1.97	3.87	2.88	0.64
10	0.57	0.46	0.39	0.27	0.77	1.35	1.74	0.59
11	0.04	0.31	0.03	0.22	0.20	.47	.71	0.50
12	0.12	0.07	0.24	0.23	0.09	.21	.34	0.15
13	0.04	0.05	0.08	0.07	0.07	.09	.12	0.06
14+	0.04	0.14	0.17	0.14	0.15	.29	.26	0.05
Total	47.99	73.50	40.61	45.02	36.80	54.33	53.26	21.84
Upper limit	70.75	126.26	54.54	59.86	44.87	71.13	71.94	27.57
Lower limit	25.22	20.74	26.68	30.18	28.73	37.54	34.58	16.11

Table 31. Mean number of cod per standard tow from research vessel survey in Division 3L (Fall).

Age	1981	1982	1983	1984	1985
1	0.40	0.40	0.67	0.34	0.01
2	0.39	2.64	3.69	7.24	1.16
3	6.92	1.90	14.06	10.93	9.14
4	2.88	6.34	5.43	18.06	12.17
5	2.74	2.69	7.84	4.95	10.34
6	4.10	1.99	1.46	10.06	4.90
7	5.77	1.66	1.40	1.61	3.25
8	1.07	1.50	2.43	1.13	0.67
9	0.22	0.28	1.31	0.99	0.77
10	0.08	0.08	0.46	1.03	0.38
11	0.04	0.05	0.13	0.41	0.27
12	0.03	0.06	0.06	0.24	0.11
13+	0.13	0.06	0.19	0.17	0.07
Total	24.76	19.82	39.13	57.17	43.26
Upper limit	34.09	23.57	50.88	68.21	60.33
Lower limit	15.51	16.07	27.37	46.13	26.19
Dates	Sept. 22 Nov. 19	Oct. 30 Dec. 06	Oct. 13 Nov. 15	July 26 Sept. 03	Oct. Nov.
No. Sets	97	121	126	209	231

Table 32. Mean number of cod per standard tow from research surveys in Division 3L (Spring).

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1985
1	.12	0.0	0.0	.16	0.0	0.0	0.0	0.0	.06	0.09	.24	.03	0.0
2	7.81	1.54	3.77	.51	1.56	2.07	0.91	0.07	.08	1.94	.67	1.72	1.32
3	22.07	5.55	12.93	5.77	3.46	18.25	4.13	3.35	.84	0.90	12.22	1.56	11.57
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	17.32
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	15.62
6	1.62	1.23	.54	2.38	2.11	2.63	2.15	3.22	6.48	8.60	14.91	2.96	7.84
7	1.70	.53	.41	.57	1.78	1.47	0.64	1.45	1.53	2.17	15.20	4.15	7.75
8	.61	.59	.28	.24	0.29	0.70	0.66	0.47	.46	0.79	4.05	3.08	1.63
9	.46	.31	.28	.17	0.16	0.12	0.44	0.40	.12	0.16	1.05	.93	0.73
10	.49	.24	.15	.09	0.05	0.03	0.15	0.23	.19	0.07	.35	.20	1.02
11	.18	.08	.12	.04	0.08	0.03	0.10	0.17	.08	0.12	.10	.07	1.14
12	.24	.06	.17	.07	0.02	0.06	0.06	0.12	.04	0.07	.10	.05	0.38
13+	1.17	.31	.41	.12	0.20	0.09	0.16	0.17	.18	0.15	.10	.26	0.31
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	66.62
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	88.04
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	45.21
19.07													
# sets	57	38	29	70	55	64	102	94	141	115	78	103	221

Table 33. Mean number at age of cod per standard tow from winter research vessel surveys in NAFO Divisions 2J3KL.

Age	3L 1985	3L 1986	3K 1986	2J 1986
1	0.02	0.02	0.0	0.0
2	0.61	0.17	1.02	0.20
3	9.10	1.45	42.46	3.07
4	15.63	6.80	569.19	6.56
5	23.97	5.76	1198.50	6.92
6	14.36	3.29	812.34	0.77
7	11.17	0.74	1262.94	0.97
8	3.83	0.45	509.54	0.18
9	1.82	0.07	100.83	0.0
10	1.22	0.06	23.38	0.0
11	0.70	0.06	72.13	0.01
12	0.25	0.06	30.82	0.0
13	0.10	0.04	18.95	0.0
14+	0.13	0.04	12.47	0.0
Total	82.91	18.99	4654.51	18.68
Upper	102.12	37.68	11895.27	24.03
Lower	63.70	0.31	-2586.25	13.33
# Sets	182	206	19	51

Table 34. Comparison of total numbers per tow from Canadian and FRG research vessel surveys in NAFO Divisions 2J3KL.

Year	Fall surveys			Spring survey	
	FRG 2J	CAN 2J	CAN 3K	CAN 3L	CAN 3L
1972	219.67				
1973	84.19				
1974	37.21				
1975	47.83				
1976	48.00				
1977	33.93	74.91			19.54
1978	14.90	75.68	48.54		20.62
1979	76.90	56.90	77.41		33.11
1980	39.27	68.70	39.17		29.68
1981	107.81	63.36	46.20	25.19	51.04
1982	97.64	87.34	36.03	21.41	26.60
1983	129.02	134.94	50.36	38.94	-
1984		103.57	53.26	60.31	-
1985		91.65	26.64 ^a	52.23	69.70

Correlation Matrix

	2J	3K	3L	Spring
FRG	1.00	0.26	0.00	0.57
CAN		1.00	0.04	0.07
3K			1.00	0.01
3L Fall				1.00
Spring				1.00

^aAnomalous value not included.

Table 35. Comparison of age 6+ numbers per tow from Canadian and FRG research vessel surveys in NAFO Divisions 2J3KL.

Year	Fall surveys			Spring survey	
	FRG 2J	CAN 2J	CAN 3K	CAN 3L	CAN 3L
1972	92.61				
1973	66.35				
1974	25.30				
1975	11.30				
1976	4.77				
1977	1.45	8.82			4.27
1978	6.56	16.83	13.28		6.15
1979	50.70	23.12	26.36		9.08
1980	31.43	39.10	20.54		12.33
1981	68.22	48.65	29.91	11.64	27.11
1982	57.24	47.23	19.91	6.14	11.70
1983	33.68	43.74	16.98	7.50	-
1984		24.38	21.12	16.50	-
1985		34.42	10.33 ^a	12.58	21.76

Correlation Matrix

	2J	3K	3L	Spring
FRG	1.00	0.63	0.74	0.61
CAN		1.00	0.12	0.66 ^b
3K			1.00	0.58
3L Fall				1.00
Spring				1.00

^aAnomalous value not included.

^bNegative correlation.

Table 36. Recruitment index for 2J3KL cod using Canadian 2J3K fall and 3L spring research vessel surveys.

Y/C	2J		3K		3L		
	3	4	3	4	3	4	
a) Empirical Data							
1973	-	34.69	-	-	18.25	5.82	
1974	11.50	16.35	-	14.27	4.05	6.18	
1975	8.86	12.93	3.27	18.23	3.31	9.16	
1976	1.54	4.77	2.68	2.35	0.84	3.54	
1977	1.40	2.48	1.63	4.00	0.91	7.40	
1978	3.17	7.73	6.38	5.86	9.24	9.25	
1979	21.98	31.40	2.06	7.22	1.56	-	
1980	20.39	19.91	8.53	11.70	-	-	
1981	20.15	27.25	6.77	-	-	18.12	
1982	11.19	-	-	-	12.10	-	
75-78							
Mean	3.74	6.98	3.49	7.61	3.58	7.34	
b) Values normalized to the 75-78 mean							
1973	-	4.97	-	-	5.09	0.79	3.62
1974	3.07	2.34	-	1.88	1.13	0.84	1.85
1975	2.37	1.85	0.94	2.40	0.92	1.25	1.62
1976	0.41	0.68	0.77	0.31	0.23	0.48	0.48
1977	0.37	0.36	0.46	0.53	0.25	1.01	0.50
1978	0.85	1.11	1.82	0.77	2.58	1.26	1.40
1979	5.88	4.50	0.59	0.95	0.44	-	2.47
1980	5.45	2.85	2.44	1.54	-	-	3.07
1981	5.39	3.90	1.94	-	-	2.47	3.43
1982	2.99	-	-	-	3.38	-	3.19
c) Correlation matrix							
2J 3	1.00	0.92	0.61 ^a	0.42 ^a	0.22 ^a	0.64	
4		1.00	0.56 ^a	0.59 ^a	0.74 ^a	0.64 ^b	
3K 3			1.00	0.08	0.95	0.55	
4				1.00	0.97 ^c	0.20	
3L 3					1.00	0.38 ^b	
4						1.00	

^aExcluding 1979 year-class.

^bExcluding 1973 year-class.

^cExcluding 1975 and 1978 year-classes.

Table 37. Number of purchase slips returned to the Statistics Branch of the Department of Fisheries and Oceans by division and inshore gear for the years 1984-85.

Unit Area	1984				1985					
	Trap	Inshore gears	GN	HL	LT	Trap	Inshore gears	GN	HL	LT
3L	334	466	1724	890	162	1229	1335	506	228	
	335	5942	2310	7052	1856	5103	1538	6036	1199	
	336	3487	1754	1554	634	2268	1198	686	336	
	337	8093	4322	2055	441	3609	3403	1582	250	
	338	5164	8138	4936	1239	4149	4963	4228	501	
	Total	23152	18248	16490	4332	16358	12437	13038	2514	
3K	339	4285	7085	15822	1407	6209	6890	12429	1189	
	340	2998	9405	10253	2319	5064	5424	8860	1642	
	341	1290	2945	1770	387	1662	2139	1123	707	
	342	1800	2841	247	2419	5903	4084	500	2197	
	Total	10373	22276	28092	6532	18838	18537	22912	5735	
2J	201	1493	1754	22	267	1816	568	44	427	
	208	12	524	-	2	-	86	-	-	
	209	-	367	15	-	1	542	162	-	
	Total	1505	2645	37	269	1817	1196	206	427	
2J3KL	35030	43169	44619	11133	37013	32170	36156	8676		

Table 38. Landings by inshore gear and division for cod in Divisions 2J3KL along with associated catch per purchase slip information for the years 1984-85.

Unit Area	1984 Inshore gears				1985 Inshore gears				
	Trap	GN	HL	LT	Trap	GN	HL	LT	
3L	334	976	2856	652	880	3800	2062	342	364
	335	7502	1680	2419	1406	8548	985	1939	1083
	336	4418	1509	512	547	4044	1141	516	366
	337	5502	3588	397	258	2942	2367	307	170
	338	4511	5275	1478	473	2438	2208	1212	189
	Total	22909	14908	5458	3564	21772	8763	4316	2182
3K	339	5234	6090	3671	688	5758	3860	2847	890
	340	1784	4877	2072	669	2310	1785	1315	470
	341	1805	2067	437	183	2095	922	224	252
	342	1034	984	45	729	3226	1445	118	641
	Total	9857	14018	6225	2269	13389	8012	4504	2253
2J	201	5301	2340	23	127	4640	999	42	235
	208	79	1311	-	0.5	-	487	-	-
	209	-	2173	2	-	3	1204	30	-
	Total	5380	5824	25	T28	4643	2690	72	235
2J3KL									38146
Catch per purchase slip									
3L	0.99	0.82	0.33	0.82	1.33	0.70	0.33	0.87	
3K	0.95	0.63	0.22	0.34	0.71	0.43	0.20	0.39	
2J	3.57	2.20	0.68	0.48	2.55	2.25	0.35	0.55	
2J3KL	1.09	0.80	0.26	0.54	1.08	0.61	0.25	0.54	

Table 39. Analysis of variance and regression coefficients from the regression of ln catch rate in Divisions 2J3KL for the years 1978-85.

Country/gear	LN Power	Month	LN Power
PRT OTB-7	-0.461	Aug.	-1.310
CAN-N OTB-4	-0.231	July.	-1.130
PRT OTB-6	-	Sept.	-
CAN-M OTB-4	0.000	June	-
CAN-N OTB-5	-	Oct.	-0.959
CAN-M OTB-5	0.431	Nov.	-
-	-	May	-0.680
-	-	Dec.	-0.603
Division	LN Power	Mar.	-0.267
3L	-0.751	Apr.	-
3K	-0.385	Jan.	0.000
2J	0.000	Feb.	-

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.808
MULTIPLE R SQUARED....0.652

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	6.117E1	6.117E1	-
REGRESSION	18	2.279E2	1.266E1	51.069
TYPE 1	3	2.830E1	9.433E0	38.041
TYPE 2	6	7.364E1	1.227E1	49.497
TYPE 3	2	3.260E1	1.730E1	79.532
TYPE 4	7	4.314E1	6.163E0	24.856
RESIDUALS	490	1.215E2	2.480E-1	-
TOTAL	509	4.106E2	-	-

Table 40. 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	Month	LN Power
CAN-N OTB-4	-0.331	July	
CAN-N OTB-5	0.000	Aug.	-0.639
ESP OTB-6	0.236	Sept.	
PRT OTB-6	0.325	Oct.	
PRT OTB-7	0.655	Nov.	
		June	-0.447
		Dec.	
		May	-0.214
Division	LN Power	Jan. Feb. Mar. Apr.	0.000
3L	-0.288		
3K	-0.168		
2J	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	1.603E1	91.330
TYPE 2	3	1.143E2	3.810E1	216.435
TYPE 3	2	1.999E1	9.996E0	56.702
TYPE 4	17	2.001E2	1.177E1	36.861
RESIDUALS	1523	2.681E2	1.760E-1	
TOTAL	1550	6.613E2		

Table 41. Catch rate index for cod in Div. 2J3KL for 1962-79 and 1978-85, using 1978-79 as a reference in both series.

YEAR	CATCH	CATCH RATE		
		MEAN	S.E.	EFFORT
1962	502752	2.530	0.179	198714
1963	499904	2.651	0.180	188557
1964	603585	2.474	0.165	243928
1965	555654	2.128	0.140	261151
1966	522307	2.232	0.140	233972
1967	610535	2.456	0.148	248586
1968	807470	2.343	0.138	344651
1969	748433	1.910	0.112	391799
1970	516213	1.651	0.100	312679
1971	432496	1.387	0.084	311913
1972	458170	1.235	0.078	371094
1973	354509	1.221	0.081	290292
1974	372650	1.364	0.095	273185
1975	287508	1.422	0.095	202250
1976	214220	1.160	0.088	184691
1977	172720	0.684	0.044	252335
1978	138559	0.833	0.092	166368
1979	166891	1.167	0.110	142990
1980	175782	1.386	0.132	126863
1981	170748	1.727	0.156	98858
1982	229774	1.603	0.134	143346
1983	232340	1.905	0.159	121993
1984	230287	2.180	0.191	105614
1985	230418	2.575	0.244	89491

AVERAGE C.V. FOR THE MEAN: 0.074

Table 42. Analysis of variance and regression coefficients from the regression of ln catch rate in Division 3L for the years 1978-85.

Country/Gear	In Power	Month	In Power	Month	In Power	Month	In Power
Port OTB-7	-0.541	June	-0.871	July	-0.265	Oct.	-0.642
Can-N OTB-4	-0.437	July		Aug.	0.000	July	
Can-N OTB-5	-0.154	May		Sept.	0.417	Aug.	
Port OTB-6	-0.621	Oct.		Port	0.526	Sept.	
Can-M OTB-4	0.000	Nov.		Port	0.832	June	
Can-M OTB-5	0.318	Apr.				Nov.	-0.507
		Dec.				Dec.	
						May	-0.279
						Mar.	-0.115
						Jan.	
						Feb.	
						Apr.	0.000
							0.454

Table 43. Analysis of variance and regression coefficients from the regression of ln catch rate in Division 3L for the years 1962-79.

Country/Gear	In Power	Month	In Power	Month	In Power	Month	In Power
Can-N OTB-4	-0.437	July	-0.871	July	-0.265	Oct.	-0.642
Can-N OTB-5	-0.154	May		Aug.	0.000	July	
Port OTB-6	-0.621	Sept.		Oct.	0.417	Aug.	
Can-M OTB-4	0.000	Oct.		Port	0.526	Sept.	
Can-M OTB-5	0.318	Nov.		Port	0.832	June	
		Apr.				Nov.	-0.507
		Dec.				Dec.	
						May	-0.279
						Mar.	-0.115
						Jan.	
						Feb.	
						Apr.	0.000
							0.454

-33-

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.752
MULTIPLE R SQUARED....0.565

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	SUMS OF SQUARES	D.F.	F-VALUE	SOURCE OF VARIATION	D.F.	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1.232E-1	1	1.680E1	INTERCEPT	1	1.680E1	1.680E1	
REGRESSION	1.232E-1	1	1.680E1	REGRESSION	26	1.495E2	5.748E0	32.370
TYPE 1	3.387E0	4	5.951E1	TYPE 1	4	5.951E1	1.488E1	83.810
TYPE 2	2.725E0	2	3.60E1	TYPE 2	5	7.280E0	40.997	
TYPE 3	5.267E0	3	7.426E1	TYPE 3	17	4.369E0	24.601	
RESIDUALS	6.392E-1	219	1.149E2	RESIDUALS	647	1.149E2	1.776E1	
TOTAL	7.9223E1	236	2.811E2	TOTAL	674	2.811E2		

Table 44. Analysis of variance and regression coefficients from the regression of \ln catch rate in Division 3K for the years 1978-85.

Country/Gear	In Power	Month	\ln Power
Port OTB-7	-0.520	Aug.	-2.305
Can-N OTB-4	-0.128	Sept.	-1.732
Port OTB-6	0.000	Oct.	-1.509
Can-M OTB-4	0.395	July	-1.203
Can-N OTB-5	0.395	Nov.	-0.995
Can-M OTB-5	0.395	Dec.	-0.995
		June	-0.906
		May	-0.597
		Apr.	-0.387
		Mar.	-0.288
		Jan.	0.000
		Feb.	

Table 45. Analysis of variance and regression coefficients from the regression of \ln catch rate in Division 3K for the years 1962-79.

Country/Gear	In Power	Month	\ln Power
Port OTB-6	0.092	July	-0.813
Can-N OTB-6	0.000	Sept.	-0.716
Can-N OTB-5	0.111	Oct.	
Can-N OTB-4	0.111	Nov.	
Port OTB-7	0.250	June	-0.445
		Dec.	
		Mar.	-0.206
		May	
		Apr.	-0.106
		Jan.	0.000
		Feb.	

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.764
MULTIPLE R SQUARED.....0.584

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.764
MULTIPLE R SQUARED.....0.584

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	MEAN SQUARES	F-VALUE	MEAN SQUARES	F-VALUE
INTERCEPT	9.429E-1	9.429E-1		
REGRESSION	25	9.563E1	3.825E0	24.944
TYPE 1	1	7.321E0	2.448E0	15.912
TYPE 2	5	3.650E1	7.301E0	47.609
TYPE 3	17	7.409E1	4.358E0	28.418
RESIDUALS	445	6.824E1	1.534E-1	
TOTAL	471	1.648E2		

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.881
MULTIPLE R SQUARED.....0.777

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	SUMS OF SQUARES	DF	F-VALUE	SUMS OF SQUARES	DF	F-VALUE
INTERCEPT	1	6.878E1	6.878E1			
REGRESSION	19	8.010E1	4.216E0	26.898	3	7.321E0
TYPE 1	3	6.720E0	2.240E0	14.292	5	3.650E1
TYPE 2	9	2.910E1	3.233E0	20.627	17	7.409E1
TYPE 3	7	4.021E1	5.745E0	36.655		
RESIDUALS	147	2.304E1	1.567E-1			
TOTAL	167	1.719E2				

Table 46. Analysis of variance and regression coefficients from the regression of \ln catch rate in Division 2J for the years 1978-85.

Country/Gear	In Power	Month	In Power
Can-M OTB-4	0.000	Oct.	-2.854
Port OTB-6	0.208	Aug.	-2.141
Port OTB-7	0.368	Sept.	-1.957
Can-N OTB-5	0.774	Nov.	-1.643
Can-N OTB-4	0.923	July	-1.394
Can-M OTB-5	1.076	Dec.	-1.194
		June	-0.987
		May	-0.565
		Feb.-Mar.	-0.167
		Jan.-Apr.	0.000

Table 47. Analysis of variance and regression coefficients from the regression of \ln catch rate in Division 2J for the years 1962-79.

Country/Gear		In Power	Month	In Power
ESP	OTB-6	-0.290	July	-1.108
Port	OTB-5	-0.135	Aug.	-0.915
Can-N	OTB-4	0.000	Sep.	
Can-N	OTB-5		Oct.	
Port	OTB-7	0.214	June	-0.562
			Dec.	-0.469
			Mar.	-0.326
			May	
			Apr.	-0.149
			Jan.	0.000
			Feb.	

MULTIPLE R ++++++ 0.903

REGRESSION OF MULTPLICATIVE MODEL

MULTIPLE R.....0.851
MULTIPLE R SQUARED.....0.723

ANALYSTS OF VARIANCE

ANALYSIS OF VARIANCE				F-VALUE	F-VALUE
SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES		
INTERCEPT	1	6.890E1	6.890E1		
REGRESSION	21	4.007E1	2.880E0	17.604	
TYPE 1	5	7.949E0	1.590E0	9.785	
TYPE 2	9	2.995E1	3.328E0	20.480	
TYPE 3	7	1.867E1	2.668E0	16.418	
RESIDUALS	84	1.365E1	1.625E-1		
TOTAL				405	2.162E2

Table 48. Catch rate index for cod in Division 2J for 1962-79 and 1978-85, using 1978-79 as a reference in both series.

YEAR	TOTAL CATCH	CATCH RATE		
		MEAN	S.E.	EFFORT
1962	250265	4.175	0.572	59938
1963	211693	3.844	0.521	55068
1964	195032	3.427	0.462	56905
1965	252323	3.247	0.425	77711
1966	243688	3.151	0.402	77348
1967	240076	3.500	0.446	68585
1968	340809	3.402	0.398	100010
1969	360901	3.035	0.384	118932
1970	198786	2.307	0.397	66160
1971	150216	2.053	0.264	72808
1972	149763	1.667	0.222	89863
1973	57727	1.351	0.229	34971
1974	121267	2.313	0.332	52431
1975	81988	2.415	0.330	33949
1976	34634	0.805	0.213	43001
1977	43632	0.780	0.109	55947
1978	28966	0.581	0.185	49723
1979	24175	1.419	0.412	17033
1980	38237	1.526	0.408	25059
1981	41136	3.258	0.861	12628
1982	81736	2.357	0.624	34681
1983	51619	4.224	1.156	12221
1984	25289	3.076	0.870	8215
1985	10905	2.735	0.818	3988

AVERAGE C.V. FOR THE MEAN: 0.188

Table 49. Catch rate index for cod in Division 3K for 1962-79 and 1978-85, using 1978-79 as a reference in both series.

YEAR	TOTAL CATCH	CATCH RATE		
		MEAN	S.E.	EFFORT
1962	80370	2.993	0.412	29500
1963	122830	3.420	0.448	35910
1964	151622	3.361	0.436	45108
1965	72634	2.803	0.352	25912
1966	89764	2.617	0.335	34278
1967	101919	3.179	0.396	32060
1968	156740	2.725	0.316	57519
1969	99376	2.403	0.283	41358
1970	91000	2.104	0.263	43243
1971	79546	1.637	0.206	48598
1972	146183	1.727	0.216	84637
1973	172951	1.623	0.199	106551
1974	159955	1.693	0.210	94487
1975	128385	1.950	0.233	65851
1976	101190	1.737	0.230	58267
1977	56788	0.751	0.086	75804
1978	43023	0.748	0.096	57501
1979	65483	1.252	0.131	52314
1980	65763	1.459	0.176	45073
1981	49961	2.150	0.242	23233
1982	55096	1.714	0.203	32145
1983	74720	1.898	0.200	39370
1984	93093	3.483	0.334	26729
1985	108205	3.847	0.363	28124

AVERAGE C.V. FOR THE MEAN: 0.120

Table 50. Catch rate index for cod in Division 3L for 1962-79 and 1978-85, using 1978-79 as a reference in both areas.

YEAR	TOTAL CATCH	CATCH RATE		
		MEAN	S.E.	EFFORT
1962	164117	2.080	0.231	79355
1963	156361	2.335	0.237	66964
1964	215099	2.120	0.203	101467
1965	185825	1.578	0.158	109466
1966	181474	1.870	0.161	97025
1967	258205	2.032	0.152	127056
1968	266112	1.875	0.137	142071
1969	229182	1.963	0.121	146634
1970	196559	1.422	0.109	138243
1971	190755	1.114	0.088	171297
1972	158644	0.982	0.079	161512
1973	123831	0.990	0.090	125027
1974	71428	1.025	0.103	89207
1975	77135	1.001	0.093	77932
1976	78394	0.908	0.084	86373
1977	72443	0.706	0.059	162300
1978	56570	1.007	0.181	66174
1979	77233	0.993	0.162	77817
1980	71782	1.152	0.190	61748
1981	79451	1.152	0.190	58530
1982	92942	1.174	0.187	79159
1983	103874	1.274	0.202	91515
1984	112005	1.377	0.216	81339
1985	111308	1.368	0.279	65935

AVERAGE C.V. FOR THE MEAN: 0.113

Table 51. Comparison of empirical catch rate data with output of multiplicative model for the years 1978-85.

	Canada			Portugal			1985 standardized CPUE
	Total offshore catch	Total offshore effort	C/R	Total offshore catch	Total offshore effort	C/R	
1978	13309	15657	0.85				0.83
1979	37281	30683	1.22	1781	2588	0.69	1.18
1980	43634	33038	1.32	5370	4618	1.16	1.39
1981	58857	26882	2.19	4096	5534	0.74	1.73
1982	87043	44580	1.95	3094	2384	1.30	1.60
1983	96273	48680	1.98	2123	1845	1.15	1.91
1984	89880	46012	1.95	1755	1545	1.14	2.18
1985	89858	43272	2.08	4359	1879	2.32	2.58

$$r^2 = 0.70$$

$$r^2 = 0.60$$

$$r^2 = 0.66^a$$

^aExcluding the 1981 value.

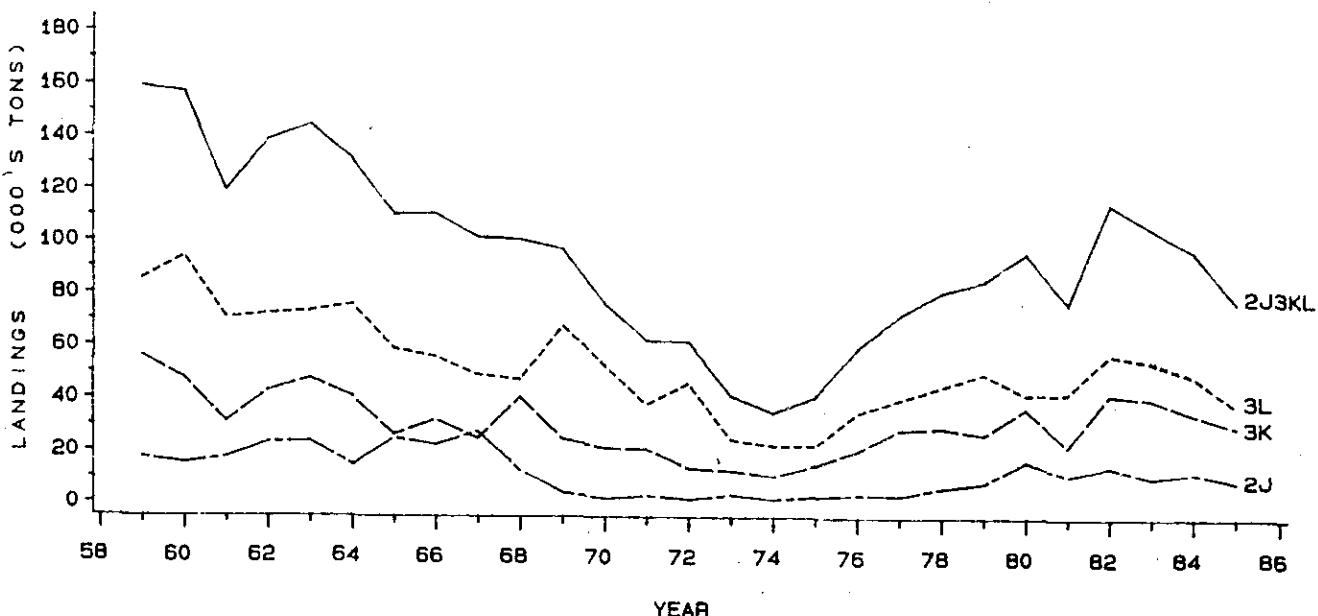


FIG. 1. INSHORE COD CATCHES FROM DIVISIONS 2J3KL FOR THE YEARS 1959-1985.

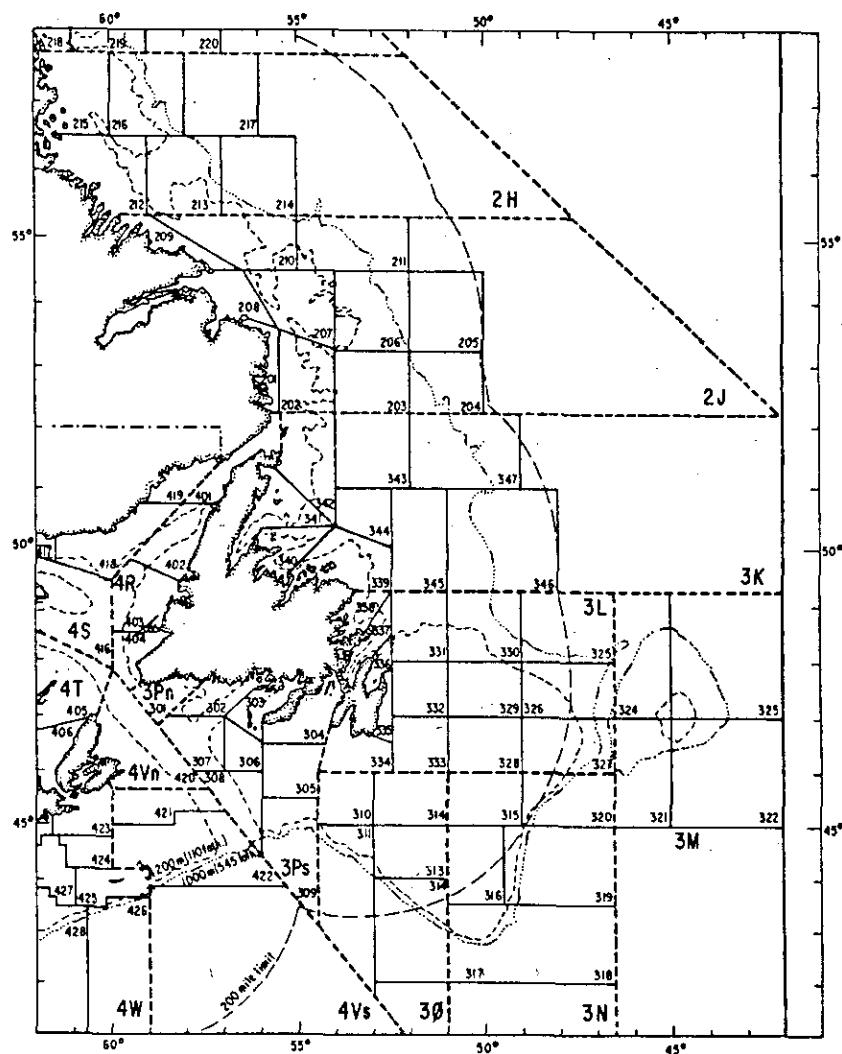


Fig. 2. Map of Newfoundland and Labrador showing the unit areas used by the Statistics Branch for compilation of purchase slip information.

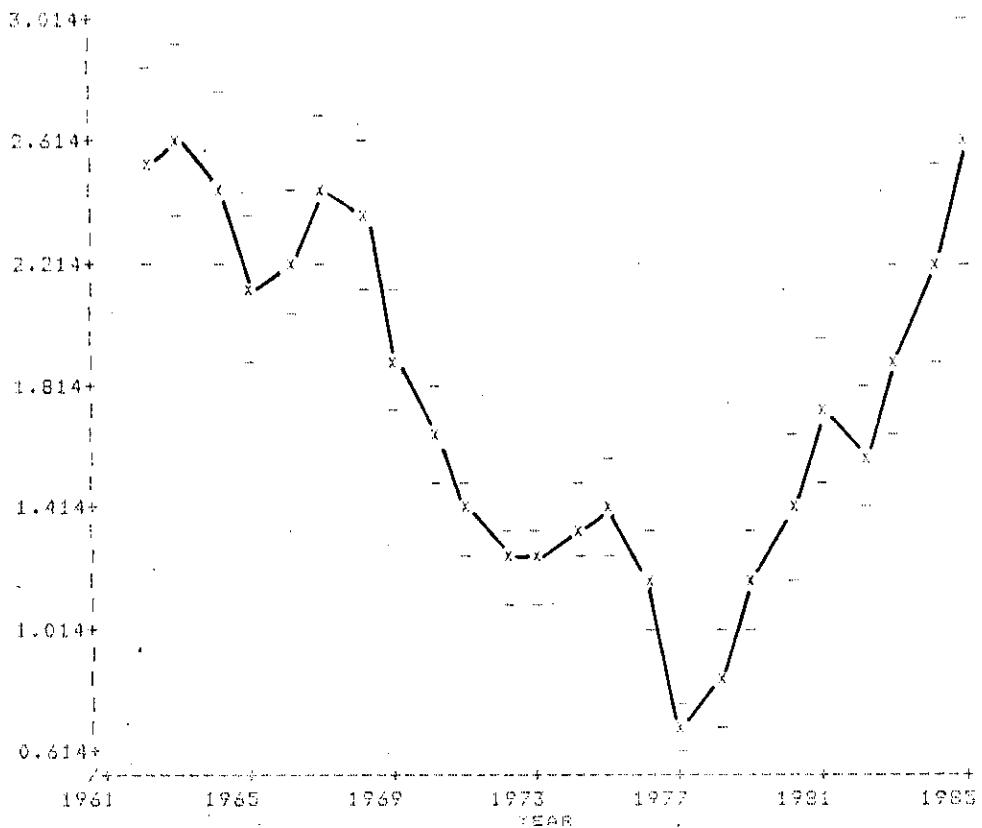


Fig. 3. Catch rate index for cod in Divisions 2J3KL analyzed separately and using the average of 1978-79 as a reference in both series.

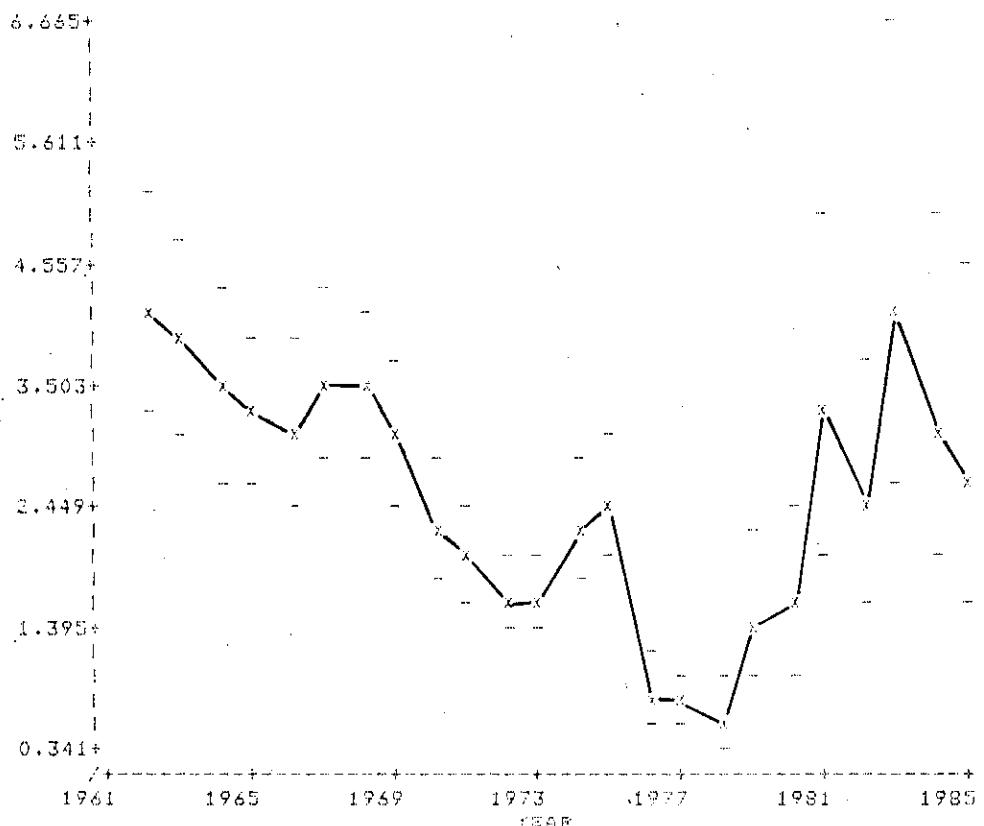


Fig. 4. Catch rate index for cod in Division 2J analyzed separately and using the average of 1978-79 as a reference in both series.

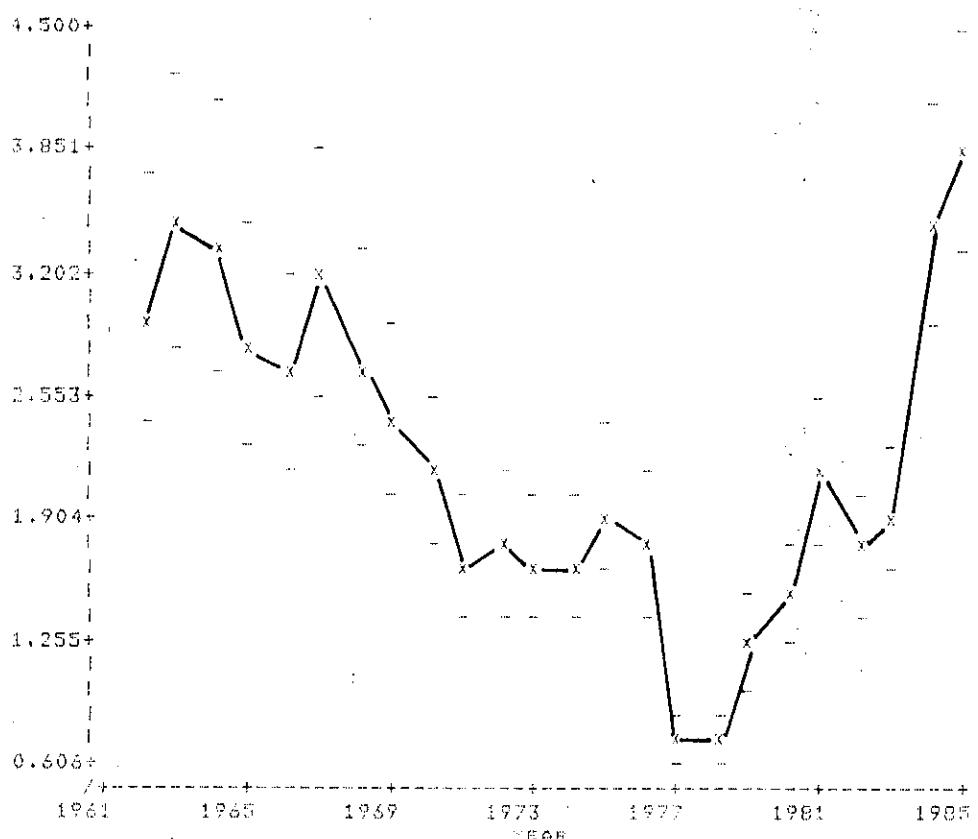


Fig. 5. Catch rate index for cod in Division 3K analyzed separately and using the average of 1978-79 as a reference in both series.

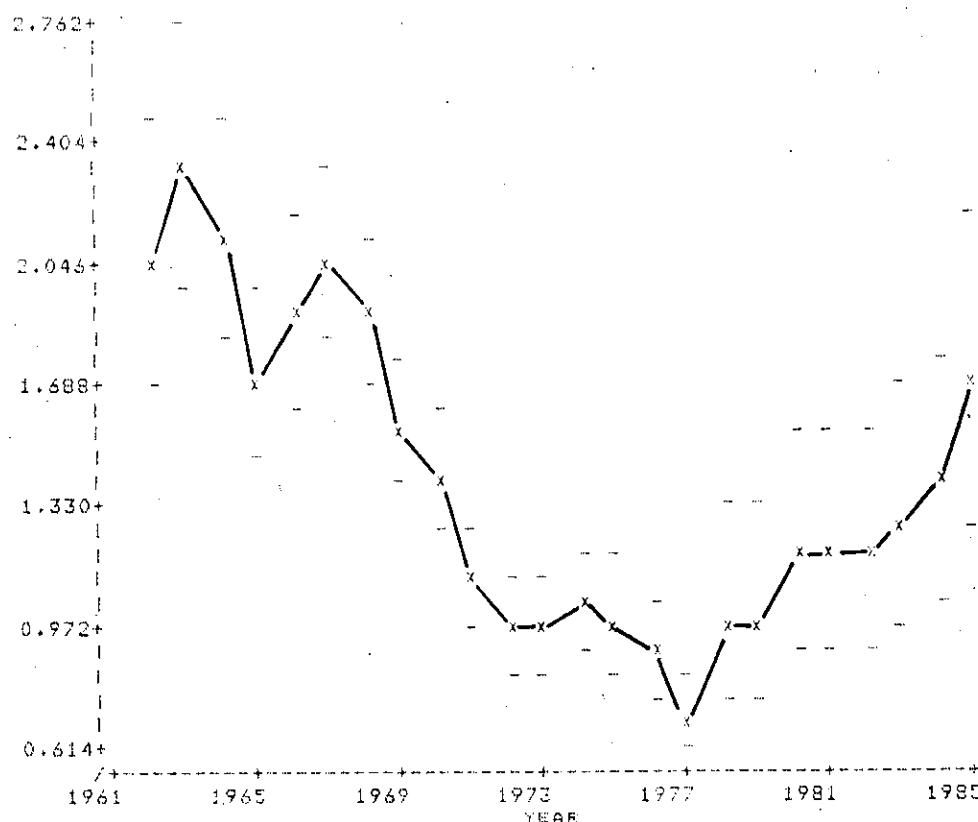


Fig. 6. Catch rate index for cod in Division 3L analyzed separately and using the average of 1978-79 as a reference in both series.

APPENDIX

Research Vessel Surveys.

Tables 1-4 give mean numbers per tow at age for fall surveys in Div. 2J, 3K, and 3L and spring surveys in Div. 3L respectively for selected strata. Selected strata are those which were surveyed in all years of a particular survey series. These values were obtained by adjusting the values in Tables 29-32 of the original paper by the total mean number per tow for selected strata (Tables 21-24 of the original paper). Although spring surveys in Div. 3L have been conducted since 1971, only the years after 1976 are included in Table 4 because prior to this time survey coverage was incomplete.

A survey abundance index for ages 6+ was obtained by combining results from Canadian Div. 2J, 3K, and 3L autumn surveys and is given in Table 5. There were no fall surveys in Div. 3L for 1978-80 and values for these years were estimated from the ratio (1.25) of ages 6+ autumn values to ages 7+ spring Div. 3L values in the following year for two overlapping years (1981 and 1984). The ages 7+ Div. 3L values for 1979-81 were adjusted by this ratio to give ages 6+ autumn Div. 3L estimates for 1978-80.

Sequential Population Analysis

Assuming a natural mortality of 0.2, cohort analysis was performed for a range of fully recruited fishing mortalities in 1985. Partial recruitment values used in the calibration of cohort analysis were derived by adjusting year-class strengths based on a recruitment index calculated during last year's assessment. In determining this PR a cohort analysis using the same terminal fishing mortality accepted last year (0.23) was used. Because of the nature of most of the calibration techniques employed, partial recruitment would not greatly affect the results.

Results of calibration using the Canadian age 6+ survey abundance index described above and age 7+ beginning of the year population numbers in the following year from the cohort are given in Table 6 and Fig. 1. These relationships implied a high level of F_t in 1985 (0.45-0.50). However, the 1981 7+ spring index for Div. 3L seemed anomalously high and if this value was more in line with adjacent year-classes this relationship would imply a somewhat lower estimate for F_t in 1985 (0.35-0.40). The relationship of total abundance from FRG surveys with age 4+ population numbers at the beginning of the following year (Table 7, Fig. 2) implied a fully recruited F_t in 1985 in the range of 0.20-0.30 and probably about 0.25.

Relationships between commercial catch rate index and average offshore exploitable biomass were also examined to determine which fully recruited fishing mortality agreed best with the data. These relationships were examined both for the 1962-85 time period and, because it was felt that the catch rate index may be influenced by changes in fishing pattern in the mid-1970's, the 1979-85 time period. Offshore exploitable biomass was calculated by multiplying the offshore partial selection matrix by average biomass. Offshore partial selection was obtained by multiplying the fishing mortality matrix by the proportion offshore and dividing this result by weighted fishing mortality. Weighted fishing mortality is the average fishing mortality in each year weighted by population numbers. Values greater than 1 were replaced by 1. Calibration using the 1962-85 series of catch rates implied F_t in 1985 to be 0.15. Results of this calibration are given in Table 8 and Fig. 3. Calibration using the 1979-85 series of catch rates implied F_t values in 1985 in the range of 0.15 and 0.20 and probably about 0.18. Results of this calibration are given in Table 9 and Fig. 4. With the range of fishing mortalities observed from these various calibrations the most likely value for fully recruited fishing mortality in 1985 would be about 0.25.

Recruitment

Abundance estimates for ages 3-6 from Canadian surveys were examined as indicators of year-class strength. The objectives of this examination was to determine the strengths of the 1979-81 year-classes at age 4, the 1979-80 year-classes at age 5 and the 1979 year-class at age 6. The regressions used to predict these values were restricted to the 1973-77 year-classes with the 1978 year-class omitted because it was thought to be seriously underestimated by the combined Div. 2J3KL survey indices. The age 4 regression predicted the 1979-81 year-classes to be about 320, 450, and 400 million at this age (Table 10). The regression for age 5 predicted the 1979-80 year-classes at this age to be about 250 and 225 million (Table 11) and the age 6 regression predicted the 1979 year-class to be about 140 million at this age (Table 12). The overall best fit from these estimates resulted in year-class sizes of about 310, 375, and 400 million for the 1979-81 year-classes at age 4, about 240 and 290 for the 1979-80 year classes at age 5 and about 165 million for the 1979 year class at age 6 (Table 13). The partial recruitment vector which gave these values for year-class size is also given in Table 13.

Results from a cohort analysis run using the PR given in Table 13 as a fully recruited fishing mortality = 0.25 is given in Table 14. These results include beginning of the year population numbers, average population biomass, and fishing mortality.

Table 1. Mean number per tow of cod at age from research vessel surveys in Div. 2J for strata surveyed in all years (fall surveys).

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	0.0	0.0	0.0	0.38	0.0	1.28	2.41	0.63	0.07
2	3.98	0.60	0.35	1.64	4.50	3.72	17.08	6.38	1.86
3	11.50	8.86	1.54	1.40	3.31	21.98	20.39	20.15	11.19
4	34.69	16.35	12.93	4.77	2.48	7.73	31.40	19.91	27.25
5	15.87	33.06	18.96	21.67	4.57	5.38	19.94	32.12	16.85
6	3.49	11.32	18.26	22.13	18.41	5.15	10.72	12.26	20.43
7	1.62	2.51	2.60	13.13	16.48	15.94	5.50	2.96	9.04
8	1.46	0.91	0.82	1.90	10.42	14.02	14.95	1.87	1.56
9	1.14	0.72	0.56	0.55	2.16	9.52	6.80	4.21	1.06
10	0.63	0.52	0.32	0.40	0.55	1.60	4.31	1.81	1.46
11	0.24	0.28	0.32	0.26	0.09	0.43	0.90	0.79	0.53
12	0.12	0.13	0.12	0.31	0.15	0.20	0.29	0.38	0.27
13	0.05	0.16	0.05	0.10	0.16	0.12	0.13	0.06	0.04
14+	0.07	0.25	0.09	0.33	0.23	0.27	0.16	0.03	0.03
Total	74.91	75.68	56.90	68.70	63.36	87.34	134.94	103.57	91.65

Table 2. Mean number per tow of cod at age from research vessel surveys in Div. 3K for strata surveyed in all years (fall surveys).

Age	1978	1979	1980	1981	1982	1983	1984	1985
1	0.0	0.0	0.21	0.01	0.27	0.97	0.31	0.01
2	0.31	0.16	1.20	1.55	2.13	3.93	3.92	0.73
3	3.27	2.68	1.63	6.38	2.06	8.53	6.77	3.35
4	14.27	18.23	2.35	4.00	5.86	7.22	11.70	5.16
5	17.40	30.00	13.24	4.36	5.78	12.72	9.43	7.03
6	7.98	17.84	14.47	14.56	3.24	3.89	9.68	3.50
7	2.55	4.58	3.13	10.53	6.83	2.63	3.59	3.37
8	1.19	2.30	1.51	3.27	6.66	4.63	1.80	1.04
9	0.74	0.56	0.56	0.60	1.94	3.59	2.88	0.78
10	0.58	0.48	0.38	0.28	0.75	1.25	1.74	0.72
11	0.04	0.33	0.03	0.23	0.20	0.44	0.71	0.61
12	0.12	0.07	0.23	0.24	0.09	0.19	0.34	0.18
13	0.04	0.05	0.08	0.07	0.07	0.08	0.12	0.07
14+	0.04	0.15	0.16	0.14	0.15	0.27	0.26	0.06
Total	48.54	77.41	39.17	46.20	36.03	50.36	53.26	26.64

Table 3. Mean number per tow of cod at age from research vessel surveys in Div. 3L for strata surveyed in all years (fall surveys).

Age	1981	1982	1983	1984	1985
1	0.41	0.43	0.67	0.36	0.01
2	0.40	2.85	3.67	7.64	1.40
3	7.04	2.05	13.99	11.53	11.04
4	2.93	6.85	5.40	19.05	14.69
5	2.79	2.91	7.80	5.22	12.48
6	4.17	2.15	1.45	10.61	5.92
7	5.87	1.79	1.39	1.70	3.43
8	1.09	1.62	2.42	1.19	0.71
9	0.22	0.30	1.30	1.04	0.81
10	0.08	0.09	0.46	1.09	0.40
11	0.04	0.05	0.13	0.43	0.28
12	0.03	0.06	0.06	0.25	0.12
13+	0.13	0.06	0.19	0.18	0.07
Total	25.19	21.41	38.94	60.31	52.23

Table 4. Mean number of cod per tow of cod at age from research vessel surveys in Div. 3L for strata surveyed in all years (spring surveys).

Age	1977	1978	1979	1980	1981	1982	1985
1	0.0	0.0	0.06	0.09	0.18	0.03	0.0
2	0.89	0.07	0.08	1.97	0.51	1.72	1.38
3	4.06	3.31	0.84	0.91	9.24	1.56	12.10
4	5.82	6.18	9.16	3.54	7.40	9.25	18.12
5	4.52	4.92	13.89	10.83	6.59	2.34	16.34
6	2.11	3.18	6.48	8.74	11.28	2.96	8.20
7	0.63	1.43	1.53	2.21	11.50	4.15	8.11
8	0.65	0.46	0.46	0.80	3.06	3.08	1.71
9	0.43	0.39	0.12	0.16	0.79	0.93	0.76
10	0.15	0.23	0.19	0.07	0.26	0.20	1.07
11	0.10	0.17	0.08	0.12	0.08	0.07	1.19
12	0.06	0.12	0.04	0.07	0.08	0.05	0.40
13+	0.16	0.17	0.18	0.15	0.08	0.26	0.32
Total	19.54	20.62	33.11	29.68	51.04	26.60	69.70

Table 5. Age 6+ abundance index derived from Canadian surveys conducted in Div. 2J, 3K, and 3L.

Year	2J	3K	3L	Index
1978	16.83	13.28	3.25	9.82
1979	23.12	26.36	4.49	16.06
1980	39.10	20.54	19.80	24.88
1981	48.65	29.91	11.64	26.70
1982	47.23	19.91	6.14	20.80
1983	43.74	16.98	7.50	19.59
1984	24.38	21.12	16.50	19.94
1985	34.42	10.33	12.58	17.36
Area	17,360	21,792	29,969	

Table 6. Results of calibration of cohort analysis using age 6+ survey (Canada) abundance index versus age 7+ cohort versus age 7+ cohort beginning of the year population numbers in the following year.

Year	Survey Abundance Index	F=0.45		F=0.50		F=0.55	
		Obs.	Res.	Obs.	Res.	Obs.	Res.
1978	9.82	562	-77	562	-31	562	0
1979	16.06	1173	87	1163	130	1154	165
1980	24.88	1628	-91	1604	-52	1584	-19
1981	26.70	1885	36	1843	60	1809	79
1982	20.80	1425	-1	1377	10	1338	19
1983	19.59	1169	-170	1109	-173	1061	-174
1984	19.94	1466	101	1350	44	1256	-3
1985	17.36	1295	115	1135	11	1003	-76
r ²		0.93		0.94		0.93	
slope		71.7		70.5		69.6	
intercept		-64.8		-99.9		-129.3	

Table 7. Results of calibration of cohort analysis using total survey (FRG) abundance versus age 4+ cohort beginning of the year population numbers in the following year

Year	Survey Abundance	F=0.15		F=0.20		F=0.25		F=0.30	
		Obs.	Res.	Obs.	Res.	Obs.	Res.	Obs.	Res.
1973	75.4	6893	-1734	6893	-697	6893	-75	6893	338
1974	28.3	4403	-1830	4403	-1559	4403	-1396	4403	-1287
1975	42.1	3961	-2974	3961	-2478	3961	-2180	3961	-1983
1976	43.6	5749	-1262	5603	-888	5516	-663	5458	-513
1977	34.6	6917	364	6582	402	6381	426	6248	442
1978	11.1	8225	2866	7646	2278	7299	1927	7069	1695
1979	90.7	7623	-1782	6965	-1153	6570	-778	6308	-528
1980	45.9	7498	370	6673	103	6179	-57	5850	-163
1981	129.7	10940	-447	9339	-127	8379	63	7741	189
1982	83.0	12388	3374	10158	2306	8821	1664	7932	1237
1983	109.4	14252	3897	11233	2469	9424	1612	8220	1040
1985	220.3	15151	-841	11940	-657	10022	-543	8749	-467
R ²			0.63		0.60		0.56		0.50
Slope			50.8		34.6		24.8		18.4
Intercept			4795		4984		5096		5170

Table 8. Results of calibration of cohort analysis using standardized catch rate versus offshore exploitable biomass for the years 1962-85

Year	Catch Rate	F=0.10		F=0.15		F=0.20	
		Obs.	Res.	Obs.	Res.	Obs.	Res.
1962	2.53	1403	-80				
1963	2.65	1621	52				
1964	2.47	1275	-164				
1965	2.13	1007	-189				
1966	2.23	1159	-108				
1967	2.46	1154	-278				
1968	2.34	1268	-78				
1969	1.91	850	-188				
1970	1.65	786	-66				
1971	1.39	969	303				
1972	1.24	825	268				
1973	1.22	638	95				
1974	1.36	420	-223				
1975	1.42	243	-443				
1976	1.16	153	-347				
1977	0.68	300	144				
1978	0.83	269	5				
1979	1.17	489	-19	489	5	489	17
1980	1.39	903	238	795	173	740	141
1981	1.73	879	-29	742	-92	673	-123
1982	1.60	877	61	697	-55	608	-113
1983	1.90	1158	127	868	-72	723	-172
1984	2.18	1626	394	1147	32	908	-148
1985	2.58	2044	526	1366	2	1027	-260
R ²			0.76		0.82		0.76
Slope			717		625		578
Intercept			-331		-247		-204

Table 9. Results of calibration of cohort analysis using standardized catch rate versus offshore exploitable biomass for the years 1979-85

Year	Catch Rate	F=0.10		F=0.15		F=0.20	
		Obs.	Res.	Obs.	Res.	Obs.	Res.
1979	2.94	488	17	488	-17	488	-33
1980	3.49	903	199	795	161	740	143
1981	4.35	880	-190	742	-92	673	-43
1982	4.04	877	-61	697	-64	608	-65
1983	4.80	1158	-102	868	-70	723	-54
1984	5.50	1626	69	1147	46	908	35
1985	6.49	2044	67	1366	35	1027	19
r^2			0.94		0.91		0.84
slope			424		233		137
intercept			-776		-179		120

Table 10. Recruitment index for cohort age 4 abundance using age 3 abundance from fall surveys in Div. 2J3K and ages 3&4 abundance from spring surveys in Div. 3L.

Yearclass	FALL		SPRING		Ave.- 3L Age 3-4	Recruitment Index
	2J Age 3	3K Age 3	3L Age 3	3L Age 4		
<u>Empirical Data</u>						
1973				18.25	5.82	
1974	11.50			4.05	6.18	
1975	8.86	3.27		3.31	9.16	
1976	1.54	2.68		0.84	3.54	
1977	1.40	1.63		0.91	7.40	
1978	3.17	6.38		9.24	9.25	
1979	21.98	2.06		1.55	-	
1980	20.39	8.53		-	-	
1981	20.15	6.77		-	18.12	
1982	11.19	-		12.10		
75-78 mean	3.74	3.49		3.57	7.33	
<u>Normalized to 75-78 Mean</u>						
1973				5.11	0.79	2.95
1974	3.08			1.13	0.84	0.99
1975	2.37	0.93		0.93	1.25	1.09
1976	0.41	0.77		0.24	0.48	0.36
1977	0.37	0.47		0.26	1.01	0.64
1978	0.85	1.83		2.59	1.26	1.93
1979	5.87	0.59		0.44	-	0.44
1980	5.45	2.44		-	-	2.30
1981	5.39	1.94		-	2.48	3.95
1982	2.99			3.39		3.27
<u>Predictions</u>						
	^a Age 4 Cohort Abundance	Index				
1973	348	2.95				
1974	306	2.04				
1975	290	1.46				
1976	147	0.51				
1977	167	0.49				
1978	(256)	1.54				
1979	(317)	2.30				
1980	(451)	3.95				
1981	(396)	3.27				
1982	(396)	3.19				

^a
Values in Brackets are predicted

$$Y=81.14 X + 130.71 \quad (r^2=0.91)$$

Table 11. Recruitment index for cohort age 5 abundance using age 4 abundance from fall surveys in Div. 2JK and age 5 abundance from spring surveys in Div. 3.

Yearclass	Fall		Spring		Yearclass	Fall		Spring	
	2J	Age 4	3J	Age 5		2J	Age 5	3J	Age 5
<u>Empirical Data</u>									
1973	34.69	14.27	4.92	13.89	1973	33.06	17.40	1.17	1.18
1974	16.35	12.93	10.32	6.59	1974	18.96	30.00	2.02	8.74
1975	4.77	2.35	2.34	5.86	1975	21.67	13.24	0.89	11.38
1976	2.48	4.00	-	5.86	1976	4.57	4.36	0.21	2.96
1977	7.73	7.73	-	-	1977	5.38	5.73	-	-
1978	31.40	7.22	-	16.34	1978	19.94	12.72	-	-
1979	19.91	11.70	-	27.25	1980	19.70	9.43	0.90	8.20
1980	-	-	-	-	73-76, 79 Mean	16.85	22.08	0.63	7.53
1981	-	-	-	-	Normalized to 73-76, 79 mean	14.89	-	-	-
<u>Recruitment Index</u>									
1973	3.07	1.41	0.49	1.39	1973	1.50	1.17	0.86	1.35
1974	1.45	1.60	1.42	1.39	1974	0.86	2.02	1.16	1.12
1975	1.15	0.23	1.34	1.68	1975	0.98	0.89	1.50	0.30
1976	0.42	0.22	0.65	0.65	1976	0.21	0.29	0.39	0.32
1977	0.22	0.40	0.23	0.28	1977	0.24	0.39	0.39	0.88
1978	0.68	0.58	-	0.63	1978	0.90	0.85	1.09	1.06
1979	2.78	0.71	-	1.74	1979	1.46	0.63	-	0.76
1980	1.76	1.16	1.63	1.52	1980	0.76	-	-	-
1981	2.41	-	-	-	Predictors	-	-	-	-
<u>Predictions</u>									
1973	226	1.78	Y=65.56 X +94.95 ($r^2=0.89$)	Index	1973	1.49	1.18	1.35	1.35
1974	234	1.42	-	Index	1974	1.59	-	1.12	-
1975	226	1.34	-	Index	1975	1.59	-	0.30	-
1976	110	0.43	-	Index	1976	78	-	0.32	-
1977	130	0.28	-	Index	1977	90	-	0.88	-
1978	149	0.63	-	Index	1978	(129)	-	1.06	-
1979	245	1.74	-	Index	1979	(143)	-	-	-
1980	226	1.52	-	Index	1980	(120)	-	0.76	-
1981	302	2.41	-	Index	1981	-	-	-	-

^avalues in brackets are predicted

Table 12. Recruitment index for cohort age 6 abundance using age 5 abundance from fall surveys in Div. 2JK and age 6 abundance from spring surveys in Div. 3.

Yearclass	Fall		Spring		Yearclass	Fall		Spring	
	2J	Age 5	3J	Age 6		2J	Age 5	3J	Age 6
<u>Empirical Data</u>									
1973	1973	1974	1975	1976	1973	33.06	17.40	1.17	1.18
1974	1974	1975	1976	1977	1974	18.96	30.00	2.02	8.74
1975	1975	1976	1977	1978	1975	21.67	13.24	0.89	11.38
1976	1976	1977	1978	1979	1976	4.57	4.36	0.21	2.96
1977	1977	1978	1979	1980	1977	5.38	5.73	-	-
1978	1978	1979	1980	1981	1978	19.94	12.72	-	-
1979	1979	1980	1981	1981	1979	32.12	9.43	-	-
1980	1980	1981	1981	1981	1980	16.85	22.08	0.63	7.53
1981	1981	1981	1981	1981	73-76, 79 Mean	14.89	-	-	-
<u>Recruitment Index</u>									
1973	1973	1974	1975	1976	1973	1.50	1.17	0.86	1.35
1974	1974	1975	1976	1977	1974	0.86	2.02	1.16	1.12
1975	1975	1976	1977	1978	1975	0.98	0.89	1.50	0.30
1976	1976	1977	1978	1979	1976	0.21	0.29	0.39	0.32
1977	1977	1978	1979	1980	1977	0.24	0.39	0.39	0.88
1978	1978	1979	1980	1981	1978	0.90	0.85	1.09	1.06
1979	1979	1980	1981	1981	1979	1.46	0.63	-	0.76
1980	1980	1981	1981	1981	1980	0.76	-	-	-
1981	1981	1981	1981	1981	Predictors	-	-	-	-
<u>Predictions</u>									
1973	226	1.78	Y=65.56 X +94.95 ($r^2=0.89$)	Index	1973	1.49	1.18	1.35	1.35
1974	234	1.42	-	Index	1974	1.59	-	1.12	-
1975	226	1.34	-	Index	1975	1.59	-	0.30	-
1976	110	0.43	-	Index	1976	78	-	0.32	-
1977	130	0.28	-	Index	1977	90	-	0.88	-
1978	149	0.63	-	Index	1978	(129)	-	1.06	-
1979	245	1.74	-	Index	1979	(143)	-	-	-
1980	226	1.52	-	Index	1980	(120)	-	0.76	-
1981	302	2.41	-	Index	1981	-	-	-	-
<u>Recruitment Index</u>									
1973	1973	1974	1975	1976	1973	1.49	1.18	1.35	1.35
1974	1974	1975	1976	1977	1974	1.59	-	1.12	-
1975	1975	1976	1977	1978	1975	1.59	-	0.30	-
1976	1976	1977	1978	1979	1976	78	-	0.32	-
1977	1977	1978	1979	1980	1977	90	-	0.88	-
1978	1978	1979	1980	1981	1978	(129)	-	1.06	-
1979	1979	1980	1981	1981	1979	(143)	-	-	-
1980	1980	1981	1981	1981	1980	(120)	-	0.76	-
1981	1981	1981	1981	1981	Predictors	-	-	-	-
<u>Predictions</u>									
1973	226	1.78	Y=65.56 X +94.95 ($r^2=0.89$)	Index	1973	1.49	1.18	1.35	1.35
1974	234	1.42	-	Index	1974	1.59	-	1.12	-
1975	226	1.34	-	Index	1975	1.59	-	0.30	-
1976	110	0.43	-	Index	1976	78	-	0.32	-
1977	130	0.28	-	Index	1977	90	-	0.88	-
1978	149	0.63	-	Index	1978	(129)	-	1.06	-
1979	245	1.74	-	Index	1979	(143)	-	-	-
1980	226	1.52	-	Index	1980	(120)	-	0.76	-
1981	302	2.41	-	Index	1981	-	-	-	-
<u>Recruitment Index</u>									
1973	1973	1974	1975	1976	1973	1.49	1.18	1.35	1.35
1974	1974	1975	1976	1977	1974	1.59	-	1.12	-
1975	1975	1976	1977	1978	1975	1.59	-	0.30	-
1976	1976	1977	1978	1979	1976	78	-	0.32	-
1977	1977	1978	1979	1980	1977	90	-	0.88	-
1978	1978	1979	1980	1981	1978	(129)	-	1.06	-
1979	1979	1980	1981	1981	1979	(143)	-	-	-
1980	1980	1981	1981	1981	1980	(120)	-	0.76	-
1981	1981	1981	1981	1981	Predictors	-	-	-	-

^avalues in brackets are predicted

^avalues in brackets are predicted

Table 13. Comparison of values derived for ages 4-6 abundance from recruitment indices and ages 4-6 abundance from cohort analysis using $F_t = 0.25$ and the given partial recruitment vector.

1) Values derived for ages 4-6 from recruitment indices.

Age	Year		
	1983	1984	1985
4	317	451	396
5		245	226
6			143

2) Values of ages 4-6 from cohort analysis using $F_t=0.25$ and partial recruitment given below.

<u>Age</u>	1983	1984	1985
4	307	376	403
5		239	294
6			162

3) Partial recruitment used in cohort analysis

Age	PR
4	0.17
5	0.60
6	1.00
7	1.00
8	1.00
9	1.00
10	1.00
11	1.00
12	1.00
13	1.00

Table 14. Results of cohort analysis (population numbers, population biomass, fishing mortality) for cod in Div. 2J+3K, using fully recruited $F=0.25$ in 1985.

POPULATION NUMBERS

AGE	1	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
4	1	5404	5772	5062	6873	8160	9250	6674	5754	5343	5365	4732
5	1	6781	4183	4481	3920	5374	6081	6855	4335	4366	3857	4178
6	1	3662	4956	2889	3159	2796	3548	4056	3819	2923	2975	2324
7	1	1927	2472	3009	1832	1994	1718	2025	2017	1738	1542	1509
8	1	1068	1138	1500	1576	931	1091	905	926	741	710	751
9	1	724	618	671	778	683	484	542	399	312	363	363
10	1	597	405	368	367	334	342	241	241	180	165	195
11	1	395	320	229	195	167	194	134	128	94	98	96
12	1	299	226	189	111	98	94	105	61	51	59	62
13	1	290	156	148	99	58	59	47	55	12	32	38
4+	1	21168	20247	16546	16909	29595	22862	21602	18035	15739	15567	14247
5+	1	15764	14475	13484	12036	12435	13611	14923	12281	10396	9702	9515
6+	1	8983	10291	9003	8116	7061	7531	8055	7646	6430	5845	5337
7+	1	5300	5335	6114	4957	4264	3983	4090	3827	3107	2970	3013
8+	1	3373	2863	3105	3126	2271	2265	1975	1810	1369	1428	1513
AGE	1	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
4	1	2032	1136	1089	1919	3479	3058	2961	1470	1669	4079	3671
5	1	3152	1295	799	765	1366	2255	2344	2333	1075	1303	3046
6	1	2365	1726	742	425	374	672	1492	1580	1592	773	977
7	1	1269	1401	751	296	160	197	366	957	1022	1078	504
8	1	721	671	600	261	91	82	91	201	621	639	653
9	1	353	343	230	161	69	43	39	43	121	403	370
10	1	191	161	113	67	33	32	22	20	24	70	222
11	1	102	87	38	25	13	16	16	11	12	13	40
12	1	52	49	19	10	7	6	8	8	7	7	24
13	1	35	22	14	5	3	3	3	5	5	4	4
4+	1	10212	6892	4395	3934	5494	6363	7285	6558	6168	8371	8814
5+	1	8180	5756	3306	2015	2016	3305	4383	5088	4499	4292	5744
6+	1	5028	4460	2507	1251	750	1051	2039	2825	3405	2987	2698
7+	1	2663	2734	1765	825	376	379	547	1245	1812	2213	1801
8+	1	1454	1334	1013	529	216	182	180	288	790	1135	1297
9+	1	1012	912	572	372	212	182	180	288	790	1135	1297
10+	1	502	446	250	125	75	105	203	282	340	298	269
11+	1	266	273	176	82	37	37	54	124	181	221	180
12+	1	145	133	101	52	21	18	18	28	79	113	129
13+	1	101	91	57	37	21	18	18	28	79	113	129

Table 14. continued.....

POPULATION BIOMASS (AVERAGE)														
AGE	1	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972		
4	1	2622	2805	2462	3351	3888	4399	3076	2765	2503	2736	2061		
5	1	5122	3077	3328	2927	3870	4405	4570	3268	3141	2663	2039		
6	1	3736	4799	2854	3114	2722	3340	3594	3251	2656	2600	1843		
7	1	2487	3230	3678	2209	2486	2106	2331	2115	1907	1834	1616		
8	1	1744	1879	2331	2264	1448	1664	1310	1195	1123	1097	1130		
9	1	1450	1273	1330	1386	1302	920	981	690	609	714	766		
10	1	1412	981	866	808	820	707	568	496	403	405	472		
11	1	1137	935	612	529	479	544	350	314	283	295	283		
12	1	913	763	578	338	320	281	320	126	168	198	194		
13	1	1347	739	661	422	260	260	195	209	50	139	135		
4+	1	21971	20477	18701	17349	17595	18626	17297	14431	12847	12681	10539		
5+	1	19349	17672	16239	13998	13707	14228	14221	11666	10339	9945	8478		
6+	1	14226	14596	12911	11071	9837	9822	9651	8398	7199	7282	6439		
7+	1	10491	9796	10057	7957	7114	6482	6056	5147	4543	4683	4596		
8+	1	8003	6566	6379	5748	4629	4376	3725	3032	2636	2849	2979		
AGE	1	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
4	1	769	651	578	958	1694	1933	1901	980	1153	2971	2363	2931	2611
5	1	1681	904	569	508	910	1921	2189	2214	1084	1305	3363	2410	2728
6	1	1768	1301	573	358	458	795	2013	2190	2163	1115	1255	3071	1922
7	1	1188	1200	645	304	272	338	677	1850	1813	1781	902	1018	2282
8	1	917	642	581	300	181	189	229	560	1441	1309	1350	647	749
9	1	538	425	291	182	168	127	127	164	354	937	922	944	478
10	1	373	233	151	98	91	105	62	87	95	224	590	658	664
11	1	230	141	70	50	44	58	68	59	60	62	149	430	471
12	1	132	95	38	26	26	30	46	50	37	40	46	117	291
13	1	116	70	39	16	14	15	21	34	28	24	29	30	84
4+	1	7712	5661	3535	2799	3857	5513	7353	8187	6234	9769	10970	12257	12277
5+	1	6943	5010	2957	1842	2164	3580	5452	7207	7081	6797	8607	9326	9666
6+	1	5262	4106	2388	1334	1254	1659	3263	4993	5997	5492	5244	6916	6938
7+	1	3494	2805	1815	975	796	863	1251	2803	3835	4377	3989	3845	5016
8+	1	2307	1605	1170	672	524	525	574	953	2016	2596	3087	2827	2733
FISHING MORTALITY														
AGE	1	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
4	1	0.056	0.053	0.060	0.046	0.094	0.098	0.165	0.076	0.126	0.139	0.206	0.250	0.152
5	1	0.113	0.170	0.150	0.138	0.215	0.203	0.386	0.261	0.218	0.306	0.369	0.402	0.357
6	1	0.199	0.299	0.256	0.260	0.287	0.361	0.501	0.587	0.439	0.451	0.454	0.324	0.631
7	1	0.327	0.300	0.447	0.477	0.403	0.440	0.583	0.801	0.695	0.509	0.532	0.390	0.647
8	1	0.348	0.328	0.457	0.436	0.454	0.499	0.621	0.888	0.513	0.470	0.564	0.542	0.872
9	1	0.380	0.317	0.404	0.644	0.491	0.499	0.610	0.713	0.437	0.422	0.444	0.587	0.912
10	1	0.422	0.372	0.437	0.585	0.344	0.734	0.429	0.748	0.286	0.340	0.450	0.580	1.253
11	1	0.360	0.328	0.521	0.488	0.372	0.418	0.587	0.728	0.254	0.269	0.423	0.532	1.321
12	1	0.449	0.224	0.442	0.459	0.301	0.507	0.445	1.420	0.274	0.253	0.364	0.638	1.064
13	1	0.360	0.320	0.440	0.560	0.420	0.490	0.590	0.810	0.600	0.480	0.520	0.470	0.770
AGE	1	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985		
4	1	0.153	0.216	0.234	0.066	0.048	0.095	0.047	0.092	0.051	0.045	0.043		
5	1	0.431	0.516	0.434	0.213	0.195	0.152	0.144	0.173	0.168	0.159	0.150		
6	1	0.718	0.777	0.443	0.406	0.244	0.236	0.190	0.231	0.267	0.226	0.250		
7	1	0.856	0.985	0.466	0.567	0.403	0.233	0.270	0.302	0.305	0.282	0.250		
8	1	1.114	1.128	0.536	0.539	0.551	0.307	0.233	0.346	0.286	0.303	0.250		
9	1	1.036	1.373	0.563	0.481	0.456	0.368	0.347	0.396	0.309	0.281	0.250		
10	1	1.324	1.436	0.561	0.472	0.515	0.316	0.450	0.357	0.376	0.234	0.250		
11	1	1.127	1.121	0.554	0.436	0.514	0.231	0.318	0.302	0.323	0.250	0.250		
12	1	1.186	1.093	0.704	0.449	0.311	0.320	0.381	0.364	0.338	0.265	0.250		
13	1	0.990	1.140	0.510	0.530	0.420	0.250	0.260	0.330	0.310	0.280	0.250		

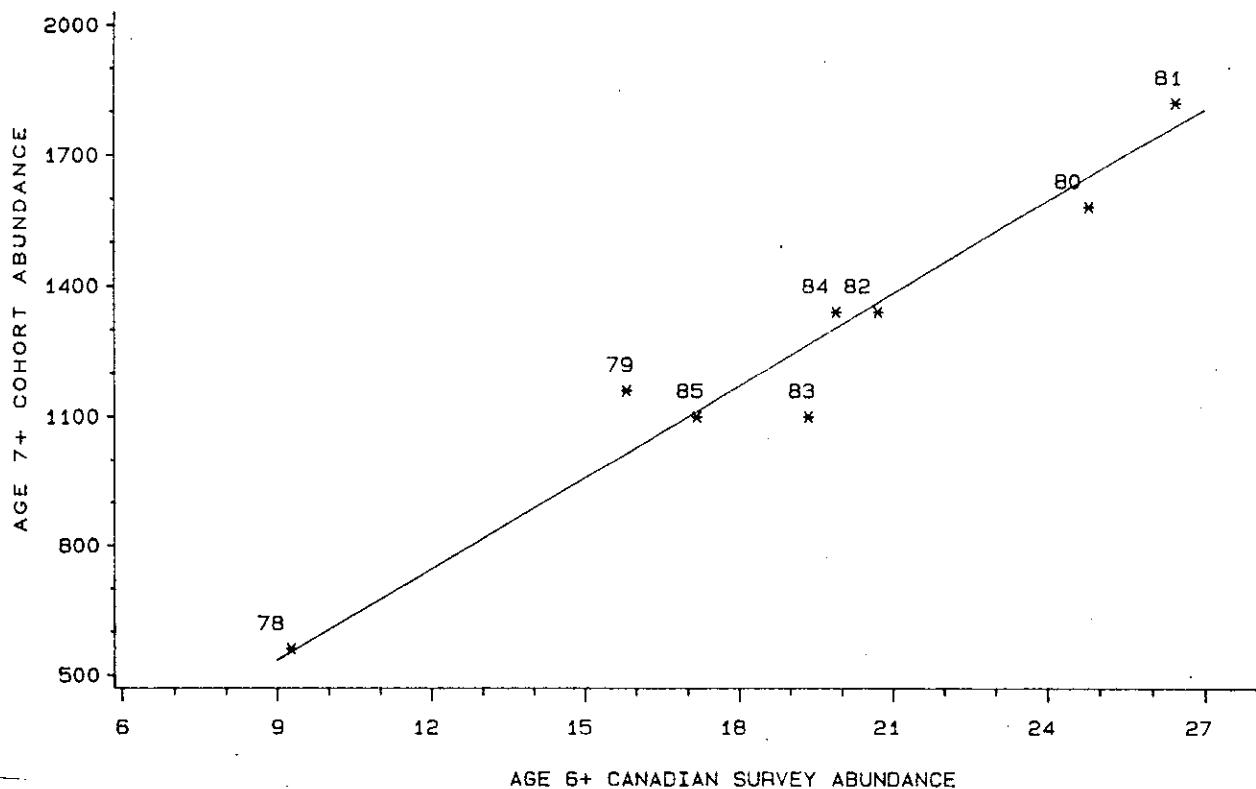


FIG 1. AGE 6+ CANADIAN SURVEY ABUNDANCE INDEX VERSUS AGE 7+ COHORT ABUNDANCE AT THE BEGINNING OF THE FOLLOWING YEAR USING TERMINAL FISHING MORTALITY = 0.50. (1978-85)

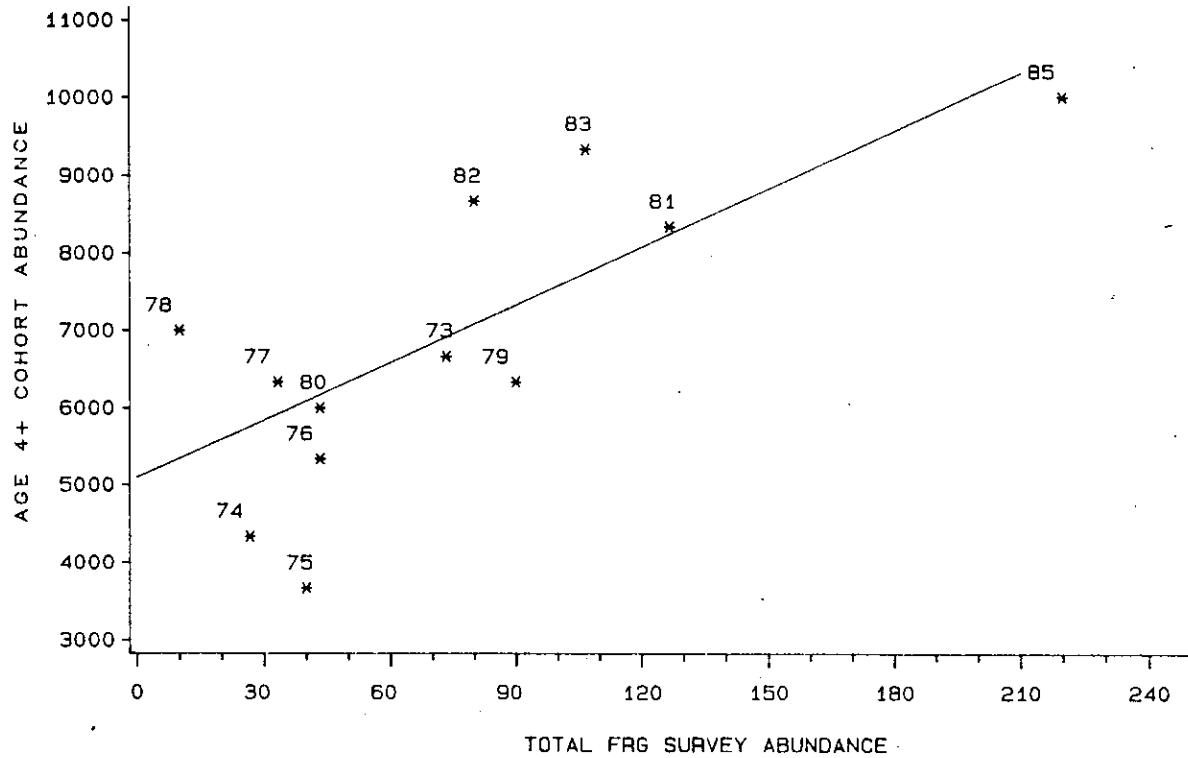


FIG 2. TOTAL FRG SURVEY ABUNDANCE VERSUS AGE 4+ COHORT ABUNDANCE AT THE BEGINNING OF THE FOLLOWING YEAR USING TERMINAL FISHING MORTALITY = 0.25. (1973-85)

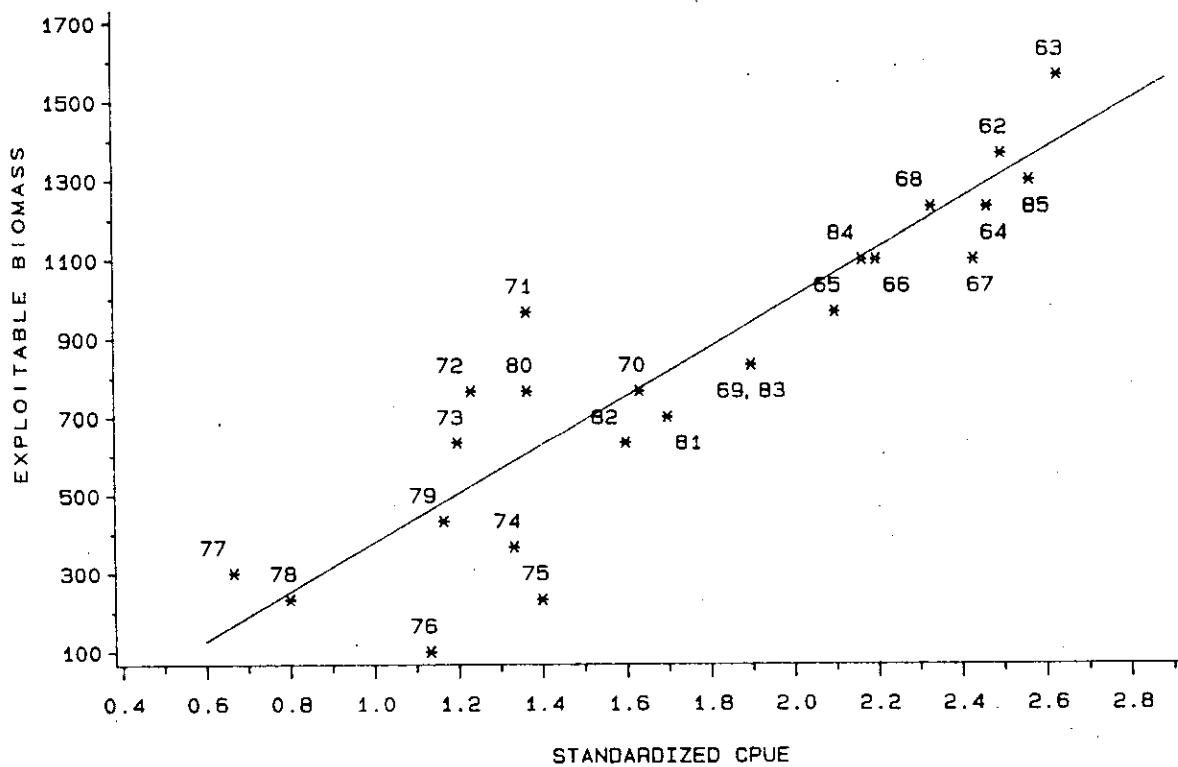


FIG 3. STANDARDIZED CATCH RATE VERSUS AVERAGE EXPLOITABLE BIOMASS FROM COHORT USING TERMINAL FISHING MORTALITY = 0.15. (1962-85)

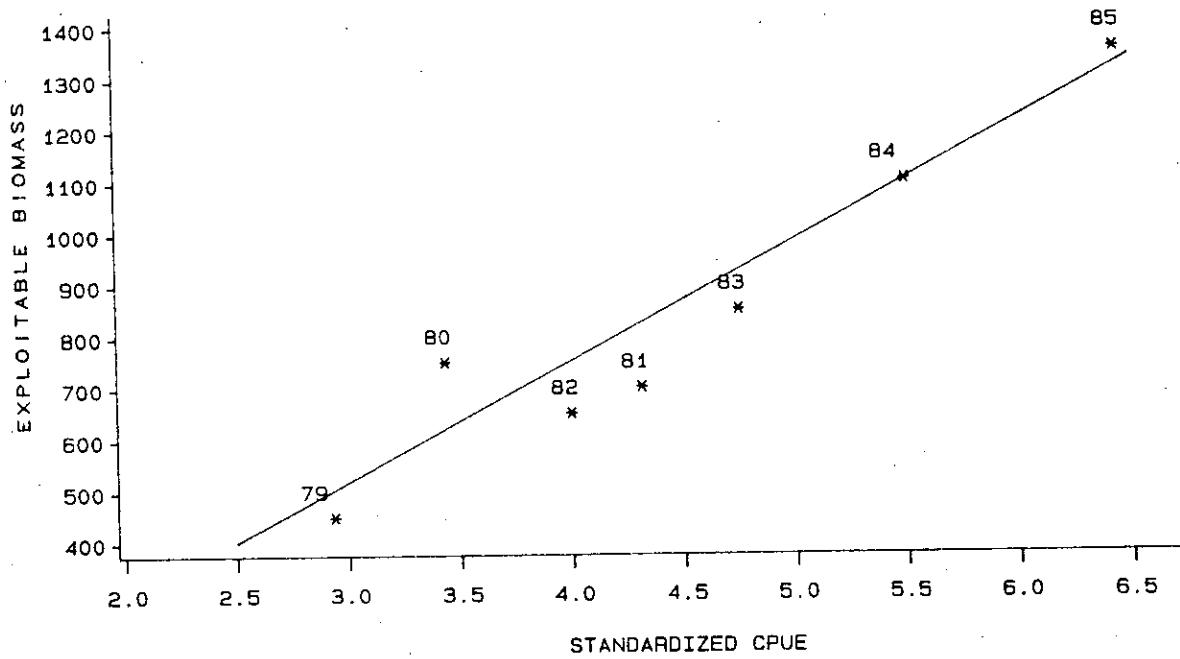


FIG 4. STANDARDIZED CATCH RATE VERSUS AVERAGE EXPLOITABLE BIOMASS FROM COHORT USING TERMINAL FISHING MORTALITY = 0.15. (1979-85)