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Assessment of the cod stock in NAFO Divisions 2J3KL

by

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Nominal catch and catch at age

Cod catches from Divisions 2J3KL since 1973 along with corresponding TAC's are as follows:

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
TAC (000 t)	666	657	554	300	160	135	180	180	200	230
Catch (000 t)	355	373	288	214	173	139	167	172	151[a]	

[a]Provisional data.

Nominal catches by country and gear for 1981 are shown in Table 1. Catch data for Can (N) and Can (M) were obtained from the Economics and Statistics branch of Fisheries and Oceans. Data for other countries were obtained from NAFO circular letters and/or the FLASH database. The 1981 catch was almost entirely by Canada and as in other years mainly by inshore gears. The 1981 catch was less than the TAC mainly due to a lower than expected catch in the inshore fishery. The inshore catch decreased from 1980-81 (Fig. 1) rather than showing a predicted increase. Availability factors due mainly to environmental conditions were considered the major reason for the decrease. The cod trap fishery (Fig. 1) experienced the largest decline when compared with other inshore gears.

Catch-at-age for the 1981 commercial fishery was obtained using catch and sampling data as shown in Tables 2a and 2b. Sampling was obtained by the Commerical sampling and Foreign Cooperative sampling units of the Department of Fisheries and Oceans. Age length keys from different countries were combined by division, gear, and quarter. Length frequencies from the same gear and from months in this quarter were adjusted to the age length key and weighted by the catch in that month. The age length key per division and quarter was obtained for inshore gears and the appropriate frequencies applied. Numbers at age were determined for each division and then combined to produce the total for 2J3KL. The estimated total catch at age with its variance is shown in Table 3. Average weights at age were derived by applying a length-weight relationship (weight = log length X 3.0879 - 5.2106) to the length frequencies and age length keys. The calculated total catch was found to be 147,800 t or 98% of total reported catch.

Surveys

Research vessel survey results in 2J3KL in 1981 in terms of mean number per tow are shown in Tables 5 and 6. In all three divisions there is an indication of increased abundance in the 1981 totals over those for 1980. It is also evident that there is considerable fluctuation within and between divisions. The 1974 and 75 year-classes are strong in all divisions and it would appear that the 1978 year-class is better than average in 3K and 3L.

Catch-effort

Catch and effort information for 1959-79 was derived from NAFO (ICNAF) Statistical Bulletins. The data for Spanish and Portuguese vessels was not used from 1977-79 due to inconsistencies. For 1979-82 catch and effort data for Canadian vessels was obtained from the Economics and Statistics Branch of the Department of Fisheries and Oceans.

The multiplicative model (Gavaris 1980) was applied to each of these series separately. The seasonal and spatial patterns were more pronounced in the latter years (Tables 7 and 8). A combined annual catch rate index series was obtained by scaling the 1979-82 series to the 1979 point in the 1959-79 series (Table 9).

Cohort analysis

The historical partial selection was calculated by dividing the fishing mortality matrix by the fully recruited fishing mortality. The fully recruited fishing mortality was derived from the ratio of the population numbers for ages 8-10 and the population numbers for ages 9-11 in the succeeding year. For ages 4-6, the average partial selection for 1975-79 was used in subsequent computations (Table 10).

A natural mortality of 0.2 was assumed and cohort analysis was performed for a range of fishing mortalities in 1981. The fishing mortality for age 13 was assumed to be equal to the fully recruited fishing mortality. Exploitable biomass was computed by multiplying the mid-year biomass by the partial selection matrix. All values greater than 1 in the partial selection matrix were replaced by 1 and a value of 1 was assumed for all ages over 8. The exploitable biomass was regressed against a modified catch rate index (Table 11). The catch rate index was modified by using the lower 90% confidence bound for 1981 since the 1981 value appeared high and preliminary data for 1982 did not support this (Fig. 2). The effort coefficient of determination showed little change but was higher for F = 0.10. The intercept also did not change much but was closer to zero for F = 0.14. The fit of the 1980 and 1981 data points to the regression line was best for F = 0.12 (Fig. 3). The population numbers, mid-year biomass, and fishing mortality from the cohort analysis with F = 0.12 in 1981 are shown in Table 12.

Table 1. Cod landings from the commercial fishery in NAFO Divisions 2J3KL in 1981.

Country	Division	Gear OT	Trap	GN	LT	HL	Other	Total
Can(N)	2J	15,905	2,090	9,199	72	181	40	27,487
	3K	18,525	3,926	10,468	6,365	2,011		41,295
	3L	20,831	10,198	13,570	11,410	7,657		63,666
								132,448
Can(M)	2J	6,218						6,218
	3K	4,585						4,585
	3L	836			6			842
								11,645
Den(F)	2J				641			641
GDR	2J3KL	21						21
Poland	2J3KL	135						135
Norway	2J3KL				790			790
Portugal	2J	354						354
	3K	357						357
	3L	2,449		1,669				4,118
								4,829
USSR	2J3KL	22						22
All	2J3KL							150,531

Table 2a. Commercial sampling for 2J3KL cod in 1981.

Div.	Gear	Qtr.	Country	No. aged		Month	No. measured	Monthly landings	Total adjusted landings
2J	OT	1	Can(N)	377		Jan.	15,353	7,081	15,896
					601	Feb.	10,121	8,695	
			Can(M)	224		Jan.	922	2,032	6,218
						Feb.	714	3,897	
		4	Port.	330		Nov.	1,141	73	73
						Dec.	3,966	281	281
			Poland			Oct.	257	11	11
	Trap	3	Can(N)	537		July	1,092	1,550	2,090
	GN	3				July	269	1,739	9,199
						Aug.	1,688	4,648	
								Total	35,318
2J3K	LT	2	Den(F)	51 (2J)		April	986	300	
				238 (3K)		April	2,390	325	790
					489	May	618	16	
			Norway	8 (2J)		May	2,267	120	760
				192 (3K)		April	6,837	544	
3K	OT	1	Can	535		Jan.	3,033	2,636	2,636
						Feb.	11,185	17,010	17,010
						Mar.	445	355	355
		2+3	Can	448		April	2,772	859	
						May	389	738	
						June	1,339	514	2,480
						July	520	282	
						Aug.	253	62	
		4	Can(N)	161		Nov.	1,274	664	
			Port.	107		Oct.	1,153	11	
					324	Nov.	207	54	1,160
						Dec.	2,380	292	
			USSR	56		Nov.	373	13	
	Trap	3	Can(N)	642		July	4,633	2,015	3,926
	GN					Aug.	2,237	1,704	9,774
	LT					July	1,040	1,533	6,365
	HL					July	3,534	633	1,432
	GN	4	Can(N)	503		Sept.	2,211	639	694
	HL					Sept.	2,511	326	579
								Total	46,411

Div.	Gear	Qtr.	Country	No. aged		Month	No. measured	Monthly landings	Total adjusted landings
3L	OT	1	Can(N)	438	504	January	11,280	4,487	
						February	129	278	
						March	373	428	
			Can(M)	66		January	315	369	
		2	Can	501		April	2,552	1,390	
						May	3,455	1,564	
						June	1,619	3,319	
		3	Can	370	437	July	946	804	
						August	457	161	
						September	2,569	981	
			Port.	67		September	549	47	
		4	Can	351		October	1,059	1,263	
						November	4,237	1,829	
						December	913	2,151	
			Port.	301	701	October	14,210	1,264	
						November	15,442	763	
						December	5,271	365	
			Japan	49		October	2,503	239	
						November	12,266	1,232	
						December	5,628	1,184	
	GN	4	Port	760		September	7,137	465	
						October	11,551	277	1,849
						November	2,710	927	
	Trap	2	Can(N)	648		May	1,629	360	406
	GN					May	4,601	2,439	3,038
	Trap	3	Can(N)	855		June	2,273	3,649	9792
						July	5,204	5,476	
	GN					June	1,396	2,128	10,532
						July	1,902	4,910	
	LT					July	775	1,989	7,204
	HL					June	1,050	642	5,429
						July	2,029	1,960	
	LT	4	Can(N)	329		September	1,674	2,866	4,206
						September	1,887	1,314	2,228
								Total	68,802
								Total 2J3KL =	150,531

Table 3. Estimated average weight, catch, and variance of the catch from commercial statistics for cod in NAFO Divisions 2J3KL during 1981.

AGE	WEIGHT	CATCH	VAR(CATCH)	STD.ERROR	COEF.VAR
2	0.297		0.013	0.11	0.30
3	0.536	1945	26178.832	161.80	0.08
4	0.765	6473	76504.137	276.59	0.04
5	1.147	11844	169629.099	411.86	0.03
6	1.632	21773	329943.570	574.41	0.03
7	2.206	19109	295406.245	543.51	0.03
8	2.874	10502	120763.036	347.51	0.03
9	3.821	2917	28534.616	168.92	0.06
10	5.310	733	4651.960	68.21	0.09
11	6.339	285	939.186	30.65	0.11
12	7.117	183	667.305	25.83	0.14
13	7.477	106	278.018	16.67	0.16
14	9.259	56	111.233	10.55	0.19
15	9.018	18	45.922	6.78	0.39
16	11.197	26	47.288	6.88	0.27
17	10.209	21	47.600	6.90	0.33
18	11.307	7	19.545	4.42	0.59
19	9.694	5	7.243	2.69	0.52
20	12.679	6	7.248	2.69	0.47

Table 4. Catch and average weight matrices used in cohort analysis of cod in NAFO Divisions 2J3KL.

CATCH NUMBERS (x10E-5)

AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
4	267	271	267	280	663	785	916	381	572	690	798	407	138	150	644	528	169	121	118	65
5	658	592	563	456	942	1009	1990	964	773	921	1166	945	355	259	346	464	396	382	280	118
6	600	1159	590	655	632	972	1450	1534	940	944	762	592	747	347	251	143	213	302	289	218
7	486	579	981	629	598	553	809	1006	788	557	560	353	613	389	180	62	83	116	172	191
8	284	288	498	671	307	388	379	493	269	241	296	273	361	356	149	38	32	36	47	105
9	207	152	202	334	240	172	224	184	100	113	118	142	186	133	113	33	15	14	12	29
10	186	114	118	147	88	161	76	115	36	43	64	76	102	77	45	20	11	8	5	7
11	108	81	84	68	47	60	54	60	19	21	30	38	55	24	19	8	4	6	2	3
12	98	41	61	37	23	34	34	42	11	12	17	22	29	13	7	3	2	2	2	2
13	80	39	48	39	18	21	19	28	5	11	14	12	10	9	4	3	1	1	1	1

AVERAGE WEIGHT (KG)

AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
4	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.77	0.70	0.74	0.77	0.77
5	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	1.02	0.99	1.12	1.16	1.15
6	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.73	1.59	1.68	1.72	1.63
7	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	2.51	2.53	2.49	2.39	2.21
8	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	3.29	3.40	3.60	3.58	2.87
9	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	3.99	4.26	4.46	5.03	3.82
10	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	4.81	4.75	5.31	5.59	5.31
11	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	5.61	5.51	5.86	6.73	6.34
12	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	6.48	7.32	7.18	7.89	7.12
13	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	8.05	8.25	9.02	8.73	7.48

Table 5. Catch of cod per half-hour tow in Divisions 2J3K in depths to 400 m.

Age	Nov. 1977	2J Aug.-Sept. 1978	Oct.-Nov. 1979	Oct.-Nov. 1980	Nov.-Dec. 1981
1	0.0	0.24	0.0	0.20	.38
2	3.57	0.55	0.17	1.17	1.69
3	10.37	7.28	1.03	1.05	1.36
4	31.40	19.42	14.45	4.92	4.71
5	14.37	38.74	22.23	19.06	21.53
6	3.18	10.90	22.82	16.73	23.06
7	1.48	1.98	3.85	9.88	14.11
8	1.35	0.63	1.29	1.43	2.14
9	1.08	0.56	0.37	0.39	.59
10	0.59	0.40	0.30	0.27	.41
11	0.22	0.23	0.18	0.16	.26
12	0.10	0.08	0.06	0.20	.31
13	0.04	0.08	0.02	0.06	.10
13+	0.10	0.17	0.05	0.07	.14
TOTAL	67.85	81.26	66.82	55.59	70.81

Age	3K Aug.-Sept. 1978	Oct.-Nov. 1979	Oct.-Nov. 1980	Nov.-Dec. 1981
1	0.0	0.0	0.25	.01
2	0.16	0.27	1.07	1.51
3	2.60	1.61	1.12	6.22
4	10.61	11.35	1.79	3.90
5	11.91	19.51	10.47	4.25
6	5.53	11.38	11.29	14.19
7	1.96	2.98	2.18	10.26
8	0.84	1.30	1.03	3.19
9	0.56	0.40	0.36	.58
10	0.38	0.29	0.24	.27
11	0.08	0.21	0.02	.22
12	0.08	0.04	0.14	.23
13	0.03	0.04	0.05	.07
13-	0.05	0.07	0.13	.14
TOTAL	34.79	49.45	30.14	45.02

Table 6. Mean number of cod per standard tow from research surveys in Division 3L.

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	.12	0.0	0.0	.16	0.0	0.0	0.0	0.0	.06	0.09	.24
2	7.81	1.54	3.77	.51	1.56	2.07	0.91	0.07	.08	1.94	.67
3	22.07	5.55	12.93	5.77	3.46	18.25	4.13	3.35	.84	0.90	12.22
4	6.99	15.19	7.33	8.20	4.95	9.39	5.94	6.26	9.16	3.48	9.79
5	4.58	1.23	3.89	5.82	2.64	3.76	4.61	4.98	13.89	10.65	8.72
6	1.62	1.23	.54	2.38	2.11	2.63	2.15	3.22	6.48	8.60	14.91
7	1.70	.53	.41	.57	1.78	1.47	0.64	1.45	1.53	2.17	15.20
8	.61	.59	.28	.24	0.29	0.70	0.66	0.47	.46	0.79	4.05
9	.46	.31	.28	.17	0.16	0.12	0.44	0.40	.12	0.16	1.05
10	.49	.24	.15	.09	0.05	0.03	0.15	0.23	.19	0.07	.35
11	.18	.08	.12	.04	0.08	0.03	0.10	0.17	.08	0.12	.10
12	.24	.06	.17	.07	0.02	0.06	0.06	0.12	.04	0.07	.10
13+	1.17	.31	.41	.12	0.20	0.09	0.16	0.17	.18	0.15	.10
Total	48.04	26.86	30.28	24.14	17.38	38.58	19.95	20.89	33.12	22.19	67.49
# sets	57	38	29	70	55	6402	94	141	1158		

Table 7. Regression coefficients for grouped categories and the analysis of variance from the regression of ln catch rate for cod in NAFO Divisions 2J3KL rom 1959-79.

Country	Gear	ln Power	Month	ln Power
CAN-N	OTB-4		October	-0.720
SUN	OTB-5	-0.170		
SUN	OTB-6		August	
			September	-0.643
E/GBR	OTB-6	-0.065	November	
CAN-M	OTB-4	0.000	July	-0.550
CAN-N	OTB-5			
			December	-0.453
SUN	OTB-7	0.390		
			June	-0.342
CAN-M	OTB-5	0.471		
ESP	OTB-6		May	-0.194
ESP	PTB-4		March	-0.108
POL	OTB-7	0.626		
PRT	OTB-6		January	0.000
			April	
E/DEU	OTB-6	0.767		
			February	0.154
DDR	OTB-5			
E/DEU	OTB-7	0.926	Division	ln Power
ESP	PTB-5			
PRT	OTB-7		3L	-0.281
DDR	OTB-6	0.964	3K	-0.168
ESP	PTB-6			
			2J	0.000

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.745
MULTIPLE R SQUARED.....0.555

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	9.112E1	9.112E1	
REGRESSION	38	5.460E2	1.437E1	82.806
TYPE 1	8	2.094E2	2.617E1	150.811
TYPE 2	8	2.079E2	2.599E1	149.761
TYPE 3	2	2.665E1	1.333E1	76.797
TYPE 4	20	2.004E2	1.002E1	57.754
RESIDUALS	2520	4.373E2	1.735E-1	
TOTAL	2559	1.074E3		

Table 8. Regression coefficients for grouped categories and the analysis of variance from the regression of ln catch rate for cod in NAFO Divisions 2J3KL rom 1979-82.

Country	Gear	ln Power	Month	ln Power
CAN-N	OTB-4	-0.248	August	-1.001
CAN-N	OTB-5	0.000	June	
CAN-M	OTB-4		July September	-0.914
CAN-M	OTB-5	0.285		
			October November	-0.763
Division	ln Power			
3L	-0.844		May	-0.564
3L	-0.844			
			December	-0.295
3K	-0.467			
			April	-0.278
2J	0.000			
			January March	0.000
			February	0.212

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.851
MULTIPLE R SQUARED.....0.724

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	2.147E1	2.147E1	
REGRESSION	14	7.130E1	5.093E0	28.158
TYPE 1	2	1.827E1	9.136E0	50.514
TYPE 2	7	1.970E1	2.814E0	15.557
TYPE 3	2	5.641E0	2.820E0	15.594
TYPE 4	3	1.605E1	5.350E0	29.583
RESIDUALS	150	2.713E1	1.809E-1	
TOTAL	165	1.199E2		

Table 9. Mean catch rate indices of cod in NAFO Divisions 2J3KL for 1959-82 relative to 1959 with their respective standard errors. The proportion of the total catch which was used in the analysis for each year is indicated.

YEAR	TOTAL CATCH	PROP.	RELATIVE POWER MEAN	S.E.	EFFORT
1959	329572	0.251	1.000	0.000	329572
1960	393577	0.302	1.016	0.074	387191
1961	498078	0.306	1.045	0.074	476593
1962	502752	0.480	1.086	0.073	463124
1963	499904	0.491	1.129	0.075	442840
1964	603585	0.378	1.097	0.072	550250
1965	555654	0.446	0.936	0.061	593682
1966	522307	0.425	1.010	0.066	517270
1967	610535	0.416	1.052	0.067	580407
1968	807470	0.323	1.070	0.069	754663
1969	748433	0.303	0.901	0.058	830908
1970	516213	0.338	0.797	0.053	647391
1971	432496	0.382	0.664	0.044	650942
1972	458170	0.331	0.608	0.040	753271
1973	354509	0.424	0.519	0.035	683171
1974	372650	0.518	0.580	0.039	641948
1975	287508	0.477	0.531	0.036	541878
1976	214220	0.420	0.496	0.036	431925
1977	172720	0.154	0.406	0.037	425692
1978	138559	0.145	0.652	0.063	212565
1979	166743	0.311	0.890	0.074	187296
1980	171863	0.248	0.945	0.084	181844
1981	150824	0.392	1.272	0.111	118560
1982	230000	0.090	1.091	0.145	210751

AVERAGE C.V. FOR THE MEAN: 0.072

Table 10. Historical partial selection for 1975-79, their average and the partial selection pattern used in the current cohort analysis for cod in NAFO Divisions 2J3KL.

SELECTIVITY

AGE	1975	1976	1977	1978	1979	AVG.	USED
4	0.12	0.28	0.29	0.11	0.10	0.18	0.18
5	0.35	0.46	0.71	0.47	0.40	0.48	0.48
6	0.62	0.69	0.74	0.81	0.63	0.70	0.70
7	0.80	0.80	0.78	1.15	0.84	0.87	0.85
8	0.98	0.89	0.83	1.08	1.05	0.96	1.00
9	0.94	1.11	1.08	0.85	0.96	0.99	1.00
10	1.14	1.11	1.30	1.03	0.88	1.09	1.00
11	0.76	1.09	1.31	0.76	1.17	1.02	1.00
12	0.98	0.54	1.06	0.99	0.71	0.86	1.00
13	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 11. Results from regression analyses of exploitable biomass versus catch rate index for cod in NAFO Divisions 2J3KL using years 1962-81 in the regression.

	F_{1981} 0.10	0.12	0.14
R^2	0.76	0.74	0.70
Intercept	-2,981	-2,682	-2,467
Slope	14,799	14,079	13,566
1980 residual	2,476	853	-306
1981 residual	1,229	-700	-2,077

Table 12. Results from cohort analysis for cod in NAFO Divisions 2J3KL using a fishing mortality of 0.12 in 1981 for fully recruited ages.

POPULATION NUMBERS

AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
4	5419	5778	5059	6849	8167	9254	6710	5786	5369	5915	4775	2137	1298	1387	2806	4238	5132	4959	2969	3355
5	6793	4195	4486	3901	5354	6087	6866	4665	4392	3878	4218	3188	1381	938	1000	1715	2992	4049	3951	2324
6	3678	4967	2899	3163	2781	3531	4071	3821	2947	2897	2342	2398	1755	810	534	505	984	2091	2969	2981
7	1928	2469	3018	1839	1997	1705	2012	2021	1740	1562	1518	1228	1428	761	349	210	284	613	1439	2170
8	1058	1138	1497	1583	937	1094	896	915	744	712	775	736	686	615	271	123	116	158	397	1022
9	718	609	671	775	689	489	545	390	303	366	365	367	355	235	181	87	66	66	97	282
10	582	401	361	367	333	347	245	243	153	158	197	192	172	123	72	46	41	41	41	68
11	394	308	225	189	167	193	138	132	95	93	90	104	88	48	31	18	20	24	26	39
12	292	225	179	108	93	95	103	64	54	61	57	47	50	22	18	8	8	12	14	19
13	277	150	147	91	55	56	47	54	15	34	39	31	18	15	7	8	4	5	8	10
4+	21139	20240	18542	18866	20574	22850	21632	18091	15813	15675	14376	10427	7233	4953	5267	6958	9647	12017	11911	12261
5+	15720	14462	13483	12017	12406	13596	14922	12305	10443	9760	9601	8290	5934	3567	2461	2720	4515	7058	8942	8906
6+	8927	10267	8997	8116	7052	7509	8056	7640	6051	5882	5382	5102	4553	2628	1462	1005	1523	3009	4991	6582
7+	5249	5300	6098	4953	4271	3978	3985	3819	3104	2985	3040	2704	2798	1819	928	500	539	918	2022	3601
8+	3321	2832	3081	3114	2274	2273	1973	1799	1364	1423	1523	1476	1370	1058	579	290	254	305	583	1431

POPULATION BIOMASS (MID-YEAR)

AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
4	2629	2808	2450	3339	3892	4400	3094	2782	2521	2760	2160	952	610	650	1219	2756	3198	3282	2027	2302
5	5132	3086	3332	2912	3854	4410	4572	3291	3162	2680	2836	2112	942	631	638	1342	2490	3899	3994	2350
6	3731	4811	2865	3119	2705	3322	3600	3254	2684	2624	2122	2302	1463	673	427	665	1246	2931	4383	4235
7	2487	3225	3691	2221	2491	2087	2311	2121	1910	1864	1793	1545	1602	787	359	397	543	1238	2913	4131
8	1724	1875	2326	2278	1461	1670	1290	1174	1130	1100	1157	1108	893	752	343	301	301	449	1204	2515
9	1436	1253	1330	1381	1316	932	987	669	588	721	710	678	578	364	260	245	223	234	410	923
10	1369	968	846	809	815	721	580	501	383	384	463	424	309	211	125	149	151	174	195	310
11	1135	893	599	510	480	539	363	327	288	276	249	278	181	115	63	69	86	109	152	158
12	885	761	540	326	302	281	315	139	178	203	178	126	122	54	52	37	44	73	93	119
13	1272	705	658	376	246	239	195	204	65	152	169	133	67	52	23	48	24	32	61	62
4+	21802	20385	18637	17270	17561	18601	17309	14463	12907	12765	11836	9660	6765	4290	3508	6007	8307	12422	15434	17105
5+	19172	17577	16187	13931	13669	14201	14215	11681	10386	10004	9676	8707	6155	3640	2290	3251	5109	9139	13406	14803
6+	14040	14491	12855	11018	9815	9791	9643	8390	7224	7324	6839	6595	5214	3009	1652	1909	2619	5240	9412	12454
7+	10309	9680	9991	7900	7109	6469	6042	5136	4541	4700	4717	4293	3751	2336	1225	1245	1373	2309	5029	8218
8+	7821	6455	6299	5679	4619	4382	3731	3014	2631	2836	2924	2748	2149	1548	866	848	829	1071	2116	4087

FISHING MORTALITY

AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
4	0.056	0.053	0.060	0.046	0.094	0.098	0.164	0.076	0.125	0.138	0.204	0.236	0.125	0.127	0.293	0.148	0.037	0.027	0.045	0.022
5	0.113	0.170	0.149	0.138	0.216	0.202	0.386	0.259	0.216	0.304	0.365	0.397	0.334	0.364	0.482	0.355	0.158	0.110	0.082	0.058
6	0.199	0.298	0.255	0.260	0.289	0.363	0.500	0.586	0.435	0.447	0.446	0.319	0.636	0.642	0.733	0.375	0.273	0.174	0.114	0.084
7	0.327	0.300	0.445	0.475	0.402	0.444	0.588	0.799	0.694	0.501	0.524	0.382	0.643	0.833	0.844	0.395	0.390	0.235	0.142	0.102
8	0.352	0.328	0.458	0.632	0.450	0.498	0.631	0.905	0.510	0.469	0.548	0.528	0.871	1.022	0.937	0.419	0.365	0.291	0.140	0.120
9	0.384	0.322	0.404	0.646	0.486	0.492	0.606	0.736	0.453	0.418	0.443	0.559	0.864	0.982	1.171	0.544	0.288	0.268	0.148	0.120
10	0.436	0.378	0.448	0.585	0.346	0.720	0.420	0.740	0.301	0.359	0.444	0.576	1.068	1.184	1.171	0.656	0.349	0.246	0.144	0.120
11	0.361	0.343	0.533	0.506	0.371	0.422	0.565	0.700	0.250	0.288	0.458	0.520	1.167	0.797	1.149	0.660	0.257	0.326	0.089	0.120
12	0.464	0.225	0.473	0.476	0.318	0.507	0.451	1.278	0.257	0.247	0.400	0.735	1.008	1.019	0.569	0.537	0.336	0.197	0.170	0.120
13	0.381	0.335	0.442	0.629	0.444	0.533	0.589	0.833	0.467	0.439	0.503	0.545	0.898	1.042	1.057	0.506	0.339	0.278	0.142	0.120

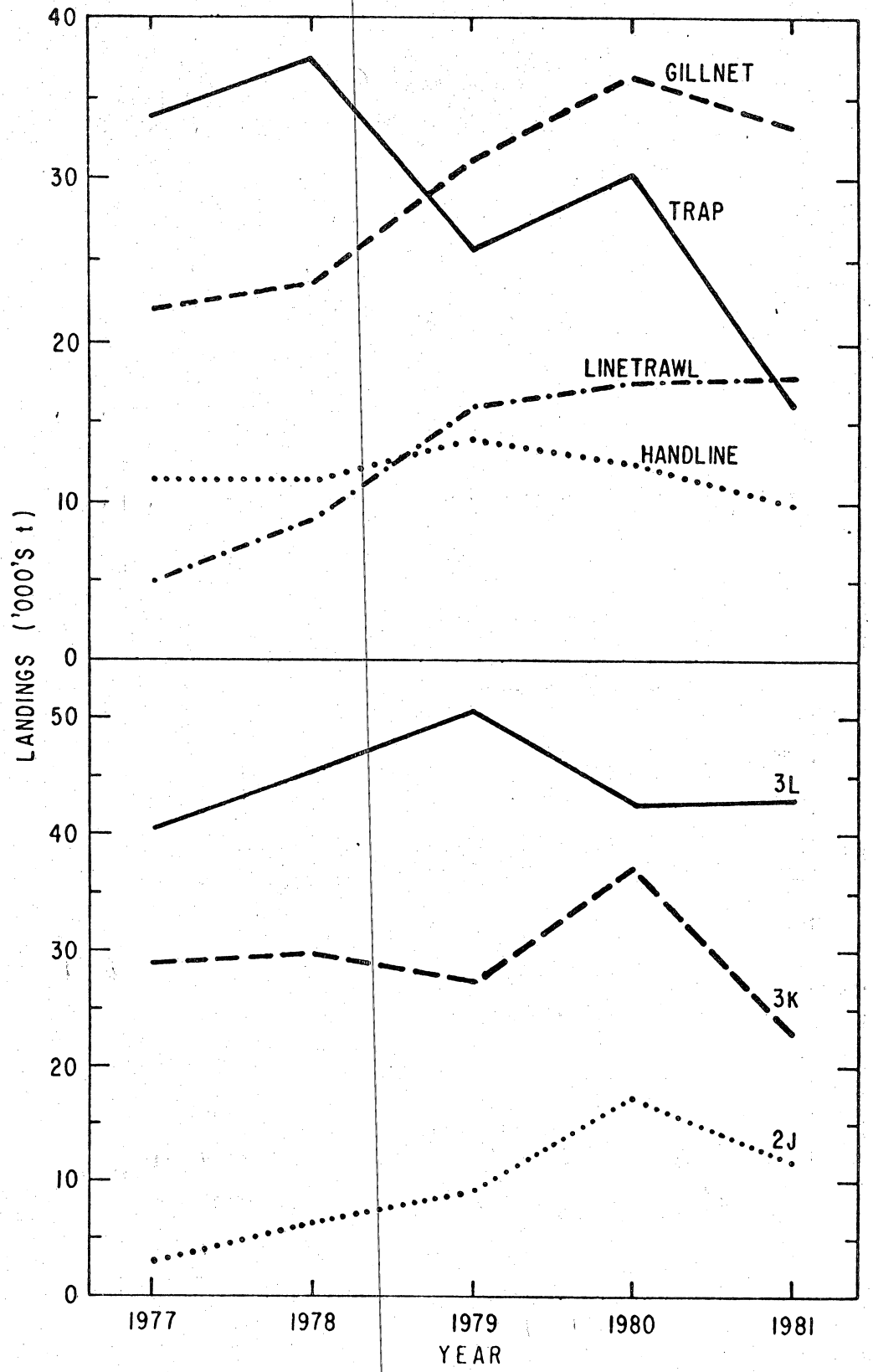

Fig. 1. Inshore cod landings by Can(N) in NAFO Divisions 2J3KL by gear and division for the period 1977-81.

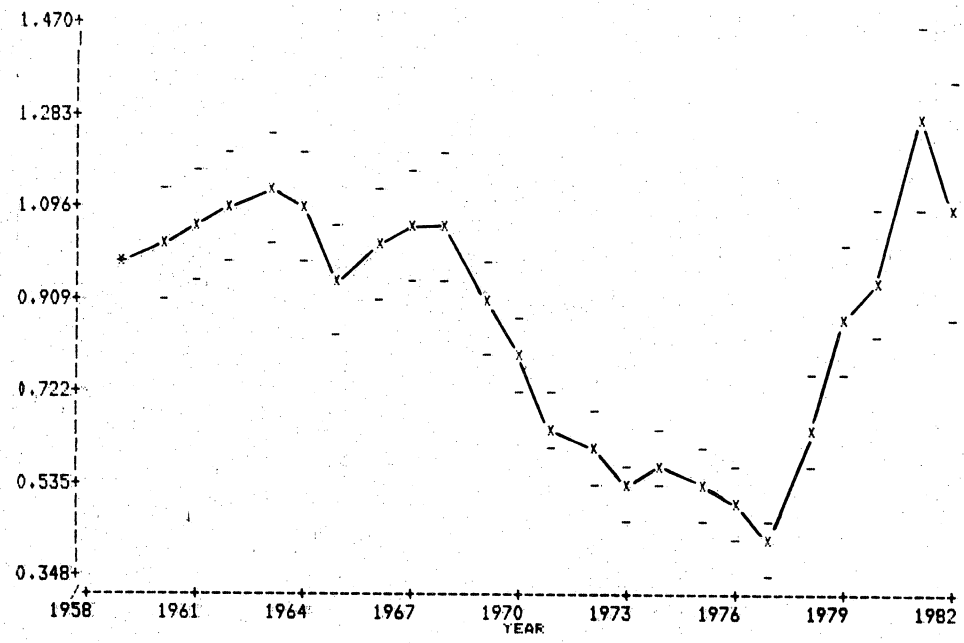

Fig. 2. Relative catch rate index with approximate 90% confidence interval for cod in NAFO Divisions 2J3KL.

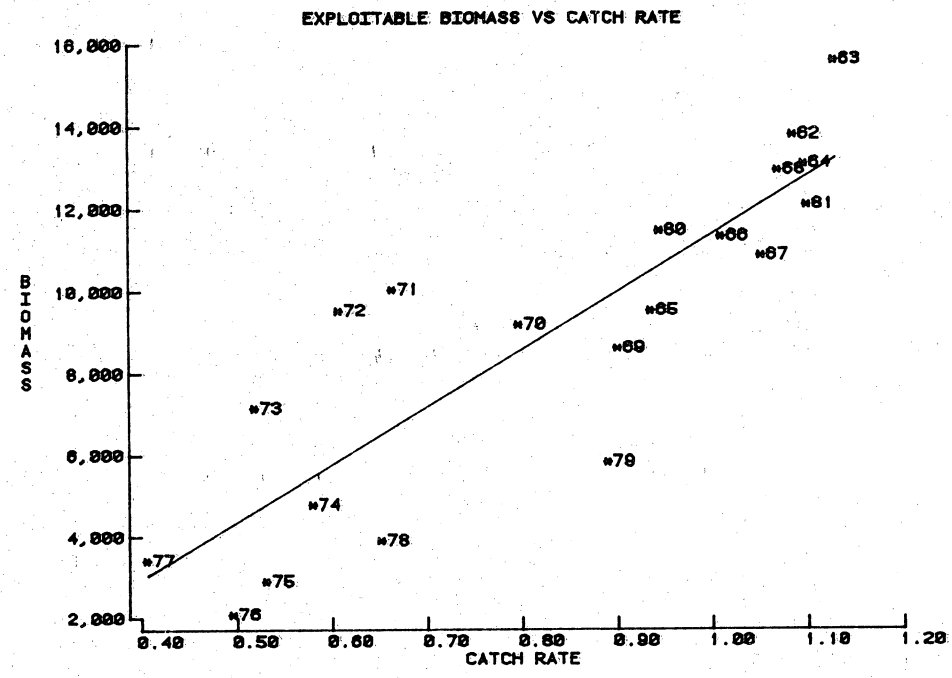

Fig. 3. Plot of the regression of exploitable biomass versus catch rate index for cod in NAFO Divisions 2J3KL using a fishing mortality of 0.12 for fully recruited ages in 1981.