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Further Considerations in Assessment of the Cod Stock in Div. 2J+3KL

by

C. A. Bishop and S. Gavaris

Fisheries Research Branch, Department of Fisheries and Oceans
P. O. Box 5667, St. John's, Newfoundland, Canada A1C 5X1

INTRODUCTION

The report of the Standing Committee on Fishery Science (STACFIS) presented at the June 1982 Scientific Council meeting (NAFO SCS Doc. 82/VI/18) indicated that advice concerning the 1983 TAC for cod in Div. 2J3KL could not be provided. Uncertainties with the data presented (SCR Doc. 82/VI/68) caused conflicting interpretations of an appropriate terminal F in 1981 and consequently advice on the 1983 TAC. Advice concerning this stock was deferred to the present meeting so that additional information from the research vessel surveys and commercial fishery might be considered. The present paper presents new material available for 1982 along with some elaboration of data presented in the previous assessment (SCR Doc. 82/VI/68).

SURVEYS

During the years 1978-80 two Can(N) research surveys were conducted each fall in Div. 2J and 3K such that one trip fished 2J3K at depths up to 400 m while the other fished depths 200 m and greater. In 1977 a survey was conducted in 2J only while in 1981 two surveys were conducted; one in 2J at all depths and the other at all depths in 3K only. In past assessments the two fall surveys were combined and the average of the two, in terms of mean number per tow, was presented. The survey data also indicated that almost all of the cod were found in depths up to 400 m. The results from surveys which fished from 100-400 m are thus presented in the paper as it was felt that they would be more representative. It was also found that in at least one year the two surveys were separated in time by at least one month and may not be strictly comparable.

Biomass and abundance estimates from the surveys for Div. 2J and 3K with the associated confidence limits are shown in Table 1-4 and Fig. 1 and 2. Figure 3 and 4 show the stratification plans on which the surveys are conducted for Div. 2J and 3K.

Surveys in Div. 3L have been conducted by a different vessel (A. T. Cameron) and in the spring (April-June). Biomass and abundance estimates from the surveys are shown in Table 5 and 6 and in Fig. 5.

Table 7-9 show the mean number per tow estimates by age for 2J, 3K and 3L from the above mentioned surveys.

Biomass estimates show considerable fluctuation but indicate a slight increasing trend in Div. 2J and 3L. Abundance figures show considerable variation as well but are without a significant trend. From the mean number per tow data it can be seen that the 1978 year-class shows considerable strength, the 1976 and 77 year-classes are weak and that the 1973, 74, and 75 year-classes dominate the remaining ages.

AGE COMPOSITION OF THE COMMERCIAL CATCH IN 1982

Age compositions of the CanN (OT) catch in 2J3KL from January to June 1982 are shown in Table 10. Per mille age compositions were available for other contries from 2J, 3K, and 3L as shown in Tables 11-13. The 1973, 74 and 75 year-classes were important in Div. 2J and 3K but less so in 3L. The 1977 and 78 year-classes gave some indication of strength in 3L.

The per mille age compositions of Can(N) inshore gears in Div. 3K and 3L for the month of July in 1982 are shown in Table 14. Landings by individual inshore gears in 1982 are not available but the total inshore catch by Can(N) for the period Jan.-July 1982 is shown in Table 15 and Fig. 6. Table 15 also shows the inshore catch by Division for the same months from 1960-81 along with total inshore catches for the year. Fig. 6 also shows the inshore catch by year for 2J3KL. Inshore age compositions for Div. 2J inshore fishery were not available but length frequencies from the August 1982 inshore fishery by gear are shown in Fig. 7.

CATCH RATE INDEX

At the June 1982 meeting of STACFIS there was concern expressed regarding an apparent change in catchability during the mid 70's. Since the catchability coefficient was derived from the catch rate index a closer examination of the catch and effort data was warranted. Data for 1962-79 was derived from NAFO (ICNAF) Statistical Bulletins. For 1980-82 data for Canada Newfoundland vessels was obtained from the Economics Branch. Catch and effort data for other countries was available from the Foreign Observer Program for 1979-82.

The data were analyzed separately by country-gear type using a multiplicative model to take into account monthly and spatial variation. The series for Spain PT-4, Portugal OT-6 and Canada-Newfoundland OT-5 show the same general features displayed by the exploitable biomass (Fig. 8), however, there is considerable variation. These country-gear types account for the bulk of the offshore catch and will be the only ones considered in subsequent analyses. It is of interest that catch rates in 1975-76 do not decline as does the exploitable biomass, particularly for the Spanish and Portuguese series. The Canadian series appears to be lagged, especially in earlier years. It should be noted that few data are available for Canadian vessels prior to 1977 and for other countries after the mid 70's.

For the purpose of increasing the information contained in an annual catch rate index the series could be combined. Examination of the monthly pattern for the individual series (Table 16) indicated that the Spanish pair trawlers did not display the same seasonality as other trawlers. Furthermore, it appears that the increasing fishing activity in Div. 2J by the Canadian fleet altered some of the relationships in the latter years. Due to these considerations only the data for Portugal OT-6 and OT-7 and Canada-Newfoundland OT-5 were combined using a multiplicative model. The analysis was performed separately on the data for 1962-79, derived from the Statistical Bulletin, and for 1979-82, obtained from Economics Branch and the Foreign Observer Program. The latter series was scaled to the 1979 point in the first series (Fig. 9).

The resultant index agrees fairly well mid-year with exploitable biomass except for 1971-72 where the catch rate index is low and 1974-76 where the catch rate index is high. With the addition of more data for 1982 the catch rate index does not decrease relative to 1981 (Table 17) as was the case in SCR Doc. 82/VI/68. For the catch rate index series presented in SCR Doc. 82/VI/68 the data for Spanish and Portuguese vessels during 1977-79 was excluded because the catch rates seemed low. Examination of Fig. 8 suggests that these catch rates may appear low only because the catch rates for 1974-76 were relatively higher than what might be expected. In the present analysis, all data reported to NAFO by Portugal for the period 1974-79 was included. This inclusion accounts for the major differences between the series presented in SCR Doc. 82/VI/68 and the combined series presented here.

COHORT ANALYSIS

The catch at age, average weight at age and partial selection presented in SCR Document 81/VI/66 were used in cohort analyses over a range of terminal F values for 1981. A constant value of 0.2 was assumed for natural mortality. Regression analyses of the relationship between mid-year exploitable biomass and catch rate index for the periods 1962-81 and 1962-78 (Tables 18 and 19) indicated that the best fit in terms of R^2 and distribution of residuals was with a terminal F in 1981 of 0.15.

The years 1974 to 1976 were excluded in all regressions. The population numbers at the beginning of the year, mid year biomass, and fishing mortality from the cohort analysis with $F_t=0.15$ in 1981 are shown in Table 20. A plot of the regression between exploitable biomass and catch rate index using a terminal F of 0.15 in 1981 is shown in Fig. 10.

Table 1. Cod biomass estimates from research vessel surveys in NAFO Division 2J.

Depth range (meters)	Stratum number	Stratum area (mi ²)	Gadus 3 1977 (Nov. -Dec.)	Gadus 15 1978 (Nov.)	Gadus 29 1979 (Nov.)	Gadus 44 1980 (Nov.)	Gadus 58 1981 (Nov.)
101-200	201	1427	12377	4847	3256	11319	15998
	205	1823	2761	16200	2669	1676	10126
	206	2582	5328	2074	2671	3849	13153
	207	<u>2246</u>	<u>16809</u>	<u>8209</u>	<u>4192</u>	<u>7738</u>	<u>12284</u>
Total		<u>8078</u>	<u>37275</u>	<u>31330</u>	<u>12788</u>	<u>24582</u>	<u>51561</u>
201-300	202	440	3074	525	749	12964	6292
	209	1608	15336	5384	43569	12810	22275
	210	774	10481	5572	5771	5810	823
	213	1725	6525	31627	31100	34068	5622
	214	1171	24370	20791	13231	25095	9669
	215	1270	31757	55780	19546	64301	96161
	228	1428	3930		12374	16972	23904
	234	<u>508</u>	<u>2857</u>	<u>1030</u>	<u>553</u>	<u>3699</u>	<u>1192</u>
Total		<u>8924</u>	<u>98330</u>	<u>120709</u>	<u>126893</u>	<u>175719</u>	<u>165938</u>
301-400	203	480	1930			7467	230
	208	448	1962	438	3341	631	908
	211	330	1738	10285	5685	9384	4747
	216	384	0		484	10204	454
	222	441	43	2029	653	2780	281
	229	<u>567</u>	<u>1009</u>	<u>319</u>	<u>7394</u>	<u>3150</u>	<u>1144</u>
Total		<u>2650</u>	<u>6682</u>	<u>13071</u>	<u>17557</u>	<u>33616</u>	<u>7764</u>
401-500	204	354	308				3149
	217	268	0				0
	223	180	0				0
	227	686	131				0
	235	<u>420</u>	<u>75</u>				<u>347</u>
Total		<u>1908</u>	<u>514</u>				<u>3496</u>
101-200		8078	37275	31330	12788	24582	51561
201-300		8924	98330	120709	126893	175719	165938
301-400		2650	6682	13071	17557	33616	7764
401-500		1908	<u>514</u>				<u>3496</u>
Total			<u>142801</u>	<u>165110</u>	<u>157238</u>	<u>233917</u>	<u>228759</u>
Mean			142961	165109	157237	233916	228894
Upper limit			199808	222301	253553	314419	424737
Lower limit			86113	107917	60921	153412	33051

Table 2. Cod abundance estimates from research vessel surveys in NAFO Division 2J.

Depth range (meters)	Stratum number	Stratum area (mi ²)	Gadus 3 1977	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58 1981
101-200	201	1427	13336	3071	1500	5749	8355
	205	1823	2894	8039	1574	787	4550
	206	2582	6889	1634	1236	2104	6220
	207	<u>2246</u>	<u>9745</u>	<u>5100</u>	<u>2664</u>	<u>3406</u>	<u>5479</u>
Total		<u>8078</u>	<u>32864</u>	<u>17844</u>	<u>6974</u>	<u>12046</u>	<u>24604</u>
201-300	202	440	2097	462	396	5681	2378
	209	1608	10174	3531	21485	3410	10099
	210	774	6166	4154	2760	2982	445
	213	1725	6944	19617	18516	19811	2158
	214	1171	16716	10658	6527	10958	3956
	215	1270	19281	34205	9986	25692	35768
	228	1428	2948		6780	8254	10701
	234	<u>508</u>	<u>1258</u>	<u>553</u>	<u>267</u>	<u>1506</u>	<u>534</u>
Total		<u>8924</u>	<u>65584</u>	<u>73180</u>	<u>66717</u>	<u>78294</u>	<u>66039</u>
301-400	203	480	883			3081	81
	208	448	1017	247	1480	202	303
	211	330	632	5450	2737	4659	1746
	216	384	0		202	3603	86
	222	441	50	1479	149	1258	132
	229	<u>567</u>	<u>415</u>	<u>234</u>	<u>2873</u>	<u>1319</u>	<u>447</u>
Total		<u>2650</u>	<u>2997</u>	<u>7410</u>	<u>7441</u>	<u>14122</u>	<u>2795</u>
101-200			32864	17844	6974	12046	24604
201-300			65584	73180	66717	78294	66039
301-400			2997	7410	7441	14122	2795
Total			101477	98432	81130	104461	93461
Upper limit			150376	131104	128646	139530	161198
Lower limit			52578	65761	33613	69392	25723

Table 3. Cod biomass estimates from research vessel surveys in NAFO Division 3K.

Depth Range (meters)	Stratum No.	Stratum Area (m ²)	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58 & 59 1981
201-300	620	2709	32708	55286	33699	33603
	621	2859	25889	63106	5939	10935
	624	668	29936	40531	1742	7973
	632	447	873	3896	10165	7566
	634	1618	6907	29309	29404	40573
	635	1274	3702	2551	7902	10271
	636	1455	2248	5040	11959	8428
	637	1132	3540	10613	7871	9829
Total		<u>12162</u>	<u>105803</u>	<u>210332</u>	<u>108681</u>	<u>129178</u>
301-400	623	1027	11293	7522	15746	2175
	625	850	1825	5538	4626	2640
	626	919	6976	1940	3242	4781
	628	1085	2729	6206	2739	3848
	629	495	1136	1062	337	150
	630	544		1019	1174	939
	633	2179	6947	6379	8073	8406
	638	2059	4210	13362	7161	17706
	639	1463	2204	5734	1949	3225
Total		<u>10621</u>	<u>37320</u>	<u>48762</u>	<u>45047</u>	<u>43870</u>
401-500	622	632				1297
	627	1194				267
	631	1202				451
	640	198				0
	645	204				0
Total		<u>3430</u>				<u>2015</u>
201-300			105803	210332	108681	129178
301-400			37320	48762	45047	43870
Total			143123	259093	153728	175023
Upper limit			215048	421005	201839	237798
Lower limit			71198	97181	105619	112247

Table 4. Cod abundance estimates from research vessel surveys in NAFO Division 3K.

Depth Range (meters)	Stratum No.	Stratum Area (m ²)	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58 & 59 1981
201-300	620	2709	17720	26203	15206	12689
	621	2859	14563	25646	2739	7453
	624	668	13121	23166	627	3686
	632	447	727	2265	5078	3171
	634	1618	4105	18157	13651	19455
	635	1274	3825	1492	3706	4743
	636	1455	1820	2446	6051	3695
	637	1132	2528	5778	3909	4744
Total		<u>12162</u>	<u>58409</u>	<u>105153</u>	<u>50967</u>	<u>59636</u>
301-400	623	1027	6167	2981	7593	876
	625	850	1340	2488	1515	1021
	626	919	3191	759	1012	2235
	628	1085	1433	2891	1008	1371
	629	495	718	446	144	50
	630	544		388	315	225
	633	2179	4283	3044	2944	3106
	638	2059	2720	8081	3246	9158
	639	1463	1603	3075	741	1303
	Total		<u>10621</u>	<u>21455</u>	<u>24153</u>	<u>18518</u>
401-500	622	632				356
	627	1194				104
	631	1202				162
	640	198				0
	645	204				0
Total		<u>3430</u>				<u>622</u>
201-300			58409	105153	50967	59636
301-400			21455	24153	18518	19345
Total			79865	129306	69484	79602
upper limit			113311	218233	93324	104928
lower limit			46420	40380	45645	54276

Table 5. Cod biomass estimates from research vessel surveys in NAFO Div. 3L.

Depth Range (Ftm)	Stratum Number	Stratum Area (mi ²)	ATC 262 1977	ATC 276 1978	ATC 290 1979	ATC 304-5 1980	ATC 317-8 1981	ATC 329 1982
31-50	350	2071	5187	2106	13637	7124	2539	4775
	363	1780	5399	3919	11237	4182	7082	6721
	371	1121	535	1490	2439	8148	0	789
	372	2460	1685	7006	8342	7448	7155	3978
	384	1120	10	19	3521	2480	462	231
Total		8552	12996	14540	39176	29382	17238	16494
51-100	328	1519	38		518		0	893
	341	1574	3916	1006	2468	3291	2038	8495
	342	585	1196	3010	409	961		871
	343	525	438	1789	1190	2936	946	4768
	348	2120	1701	3546	7128	7855	1966	5709
	349	2114	10746	8879	8800	7282	321	10182
	364	2817	1101	928	7884	7154	1533	3938
	365	1041	1112	532	2953	2442		6056
	360	1320	330	367	1046	3807	0	99
	385	2356	422	80	1118	6278	413	0
	390	1481	505	795	2125	2798	500	217
Total		17452	21505	20932	35639	43804	8717	41228
101-150	344	1494	7784	20366	19398	10172	50712	19583
	347	983	1128	8492	7705	16019	8043	21435
	366	1394	6211		11509	5912	81497	21817
	369	961	2050	999	2448	7406	9378	4959
	386	983	1228	251	2881	2361	4593	1279
	389	821	1343	1063	1098	6923	478	1664
	391	282	634	356	1048	2064	1212	95
Total		6918	20378	31527	46087	50857	155913	70832
151-200	345	1432	13271	10687	4844	11674	29493	6060
	346	865	990		2137	2154	4307	1223
	368	334	404		239	796	1761	809
	387	718	122	184	459	256	243	2353
	388	361	1181	181	349	108	190	1321
	392	145	30	66	189	0	128	256
Total		3855	15998	11118	8217	14988	36122	12022
31-50		8552	12996	14540	39176	29382	17238	16494
51-100		17452	21505	20932	35639	43804	8717	41228
101-150		6918	20378	31527	46087	50857	155913	70832
151-200		3855	15998	11118	8217	14988	36122	12022
Total			70877	78118	129117	139030	218214	140578
upper limit			93640	100261	154966	166965	405205	171826
lower limit			48114	55974	103267	111094	31224	109329

Table 6. Cod abundance estimates from research vessel surveys in NAFO Div. 3L.

Depth Range (Ftm)	Stratum Number	Stratum Area (mi ²)	ATC 262 1977	ATC 276 1978	ATC 290 1979	ATC 304-5 1980	ATC 317-8 1981	ATC 329 1982
31-50	350	2071	2993	1373	7756	2798	829	1221
	363	1780	4783	2352	7616	1817	3296	1924
	371	1121	112	477	1599	2917	0	189
	372	2460	2247	8969	6135	3293	5032	1477
	384	1120	42	56	2711	1555	42	42
Total		8552	10177	13227	25817	12380	9199	4853
51-100	328	1519	72		296		0	342
	341	1574	3161	325	827	1024	1004	2150
	342	585	768	747	132	417		278
	343	525	335	867	768	1399	867	2374
	348	2120	875	2361	3687	3456	887	2467
	349	2114	3385	4337	4035	2997	595	3729
	364	2817	967	599	4705	2996	952	1304
	365	1041	781	391	2481	1035		4689
	370	1320	66	330	817	1486	0	248
	385	2356	383	59	783	3139	59	0
	390	1481	1223	1056	2223	1223	389	139
Total		17452	12016	11072	20754	19172	4753	17720
101-150	344	1494	7327	11635	15981	7947	29001	9196
	347	983	861	6254	5737	10212	3247	10773
	366	1394	10461		11118	5232	56749	18521
	369	961	761	577	2813	6757	7286	1876
	386	983	1599	639	2749	2066	2693	812
	389	821	2178	1130	1464	5259	1140	2712
	391	282	921	201	1117	1757	688	191
	Total		6918	24108	20436	40979	39230	100804
151-200	345	1432	5505	5321	1800	6385	15264	2714
	346	865	782		1380	1125	2727	801
	368	334	319		56	113	1880	639
	387	718	108	198	256	108	296	1419
	388	361	881	257	190	41	393	989
	392	145	44	44	178	5	196	218
Total		3855	7639	5820	3860	7777	20756	6780
31-50		8552	10177	13227	25817	12380	9199	4853
51-100		17452	12016	11072	20754	19172	4753	17720
101-150		6918	24108	20436	40979	39230	100804	44081
151-200		3855	7639	5820	3860	7777	20756	6780
Total			53938	50554	91410	78560	135716	73433
Upper Limit			67857	70457	112937	93294	266824	94202
Lower Limit			40018	30651	69883	63827	4608	52665

Table 7. Mean number of cod per standard tow from research vessel surveys in Division 2J.

Age	Gadus 3 1977	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58 1981
1				.38	
2	3.62	.60	.34	1.69	4.43
3	10.51	8.86	1.52	1.36	3.12
4	31.83	16.35	12.80	4.71	2.44
5	14.57	33.07	18.78	21.53	4.50
6	3.22	11.32	18.10	23.06	18.14
7	1.50	2.51	2.58	14.11	16.26
8	1.37	.91	.82	2.14	0.30
9	1.10	.72	.55	.59	2.14
10	.61	.52	.31	.41	.54
11	.21	.28	.32	.26	.09
12	.11	.13	.12	.31	.15
13	.04	.16	.05	.10	.16
14	.03	.14	.05	.05	.07
15	.02	.05	.01	.05	.08
16		.03	.03	.02	.04
17		.03			.02
18		.03			.01
19				.02	
20					
>20	.02				
Total	68.79	75.70	56.37	70.81	62.50

Table 8. Mean number of cod per standard tow from research vessel surveys in Division 3K.

Age	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58 & 59 1981
1			.22	.01
2	.31	.15	1.24	1.51
3	3.23	2.54	1.69	6.22
4	14.11	17.31	2.44	3.90
5	17.20	28.48	13.73	4.25
6	7.89	16.94	15.00	14.19
7	2.52	4.35	3.24	10.26
8	1.18	2.18	1.57	3.19
9	.73	.53	.58	.58
10	.57	.46	.39	.27
11	.04	.31	.03	.22
12	.12	.07	.24	.23
13	.04	.05	.08	.07
13+	.04	.14	.17	.14
Total	47.99	73.50	40.61	45.02

Table 9. Mean number of cod per standard tow from research surveys in Division 3L.

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	.12	0.0	0.0	.16	0.0	0.0	0.0	0.0	.06	0.09	.24	.03
2	7.81	1.54	3.77	.51	1.56	2.07	0.91	0.07	.08	1.94	.67	1.72
3	22.07	5.55	12.93	5.77	3.46	18.25	4.13	3.35	.84	0.90	12.22	1.56
4	6.99	15.19	7.33	8.20	4.95	9.39	5.94	6.26	9.16	3.48	9.79	9.25
5	4.58	1.23	3.89	5.82	2.64	3.76	4.61	4.98	13.89	10.65	8.72	2.34
6	1.62	1.23	.54	2.38	2.11	2.63	2.15	3.22	6.48	8.60	14.91	2.96
7	1.70	.53	.41	.57	1.78	1.47	0.64	1.45	1.53	2.17	15.20	4.15
8	.61	.59	.28	.24	0.29	0.70	0.66	0.47	.46	0.79	4.05	3.08
9	.46	.31	.28	.17	0.16	0.12	0.44	0.40	.12	0.16	1.05	.93
10	.49	.24	.15	.09	0.05	0.03	0.15	0.23	.19	0.07	.35	.20
11	.18	.08	.12	.04	0.08	0.03	0.10	0.17	.08	0.12	.10	.07
12	.24	.06	.17	.07	0.02	0.06	0.06	0.12	.04	0.07	.10	.05
13+	1.17	.31	.41	.12	0.20	0.09	0.16	0.17	.18	0.15	.10	.26
Total	48.04	26.86	30.28	24.14	17.38	38.58	19.95	20.89	33.12	29.19	67.49	26.59
# sets	57	38	29	70	55	64	102	94	141	115	78	103

Table 10. Age composition of the Can N(OT) catch in 2J3KL from January to June 1982.

Age	2J	3K	3L	2J3KL
3			1	1
4	364	239	425	1028
5	1692	558	879	3129
6	2330	1019	1013	4362
7	7026	1173	1218	9417
8	4757	586	1012	6355
9	3023	214	269	3506
10	362	90	83	535
11	74	16	23	113
12	31	6	11	48
13	13	2	4	19
14	47	4	4	55
15	6			6
16		1		1
Total	19725	3908	4942	28575
Ave wt.	2.04	1.94	2.27	2.06
No. samples	71	16	33	120
No. measured	23704	5927	9936	39567
Landings	40194	7575	11000	50769

Table 11. Per mille age compositions of cod in Division 2J in 1982.

Age	FRG (OT)		Port (OT)
	January	February	May
3	2	3	16
4	8	25	36
5	24	26	24
6	27	27	47
7	299	320	303
8	150	156	262
9	470	430	273
10	14	10	33
11	1	1	4
12	2	1	1
13			1
14	1		3
15	1		
16	1		
Total	1000	999	1003
Ave. Wt.	2.43	2.41	2.21
No. Samples	3	69	12
No. Meas.	516	14584	2503

Table 12. Per mille age compositions of cod in Division 3K in 1982.

Age	Den F (LT)		Norway (LT)	
	April	May	April	May
3		2		
4	16	10	6	5
5	36	21	7	4
6	50	39	33	26
7	185	177	140	128
8	231	237	388	378
9	365	389	356	375
10	80	84	42	47
11	13	13	7	9
12	5	5	6	7
13	8	12	3	3
14	6	8	5	8
15	3	3	5	6
16	1	1	1	1
17	1	1		
Tot.	1000	1002	999	997
Ave. wt.	2.63	2.76	2.99	3.01
No. Samples	27	5	27	13
No. Meas.	5599	1116	5917	3129

Table 13. Per mille age compositions of cod in Division 3L in 1982.

Age	Japan (OT)			Port (OT)	
	January	February	March	April	May
2					1
3					4
4	188	85	171	193	146
5	260	236	249	329	308
6	163	182	156	161	186
7	228	281	226	162	190
8	151	199	170	111	127
9	8	12	16	32	33
10	1	2	5	6	7
11			2		
12					
13					
14					
15					
Total	999	998	996	1001	1002
Ave. wt.	1.97	2.15	2.06	1.68	1.84
No. samples	5	12	16	13	8
No. measured	1207	2841	3412	3152	1924

Table 14. Per mille age compositions of cod from the Can(N) inshore fishery in Div. 3K and 3L during July, 1982

Age	3K			3L		
	Trap	Gillnet	Handline	Trap	Gillnet	Handline
3	32	1	3	29	1	7
4	406	9	168	723	44	253
5	321	47	265	169	89	221
6	114	178	203	44	255	217
7	75	280	183	21	275	160
8	32	238	104	14	269	126
9	15	172	57	1	47	14
10		55	15		12	2
11		12	2		3	
12		6	1		1	
13		3			1	
14		2				
15						
16						
17						
18						
18+						
	998	1003	1001	1001	997	1000
Av. Wt.	1.19	2.67	1.76	1.06	2.70	1.79

Table 15. Inshore cod catches by Can (N) from Jan. to July along with total yearly inshore catches for the period 1960-82.

Year	2J	3K	3L	2J3KL	Total Inshore 2J3KL
1960	12,264	28,949	67,651	108,864	157,288
61	11,591	20,248	42,299	74,138	119,363
62	4,143	23,463	49,958	77,564	138,511
63	9,986	34,016	54,008	98,010	144,548
64	5,324	23,539	49,713	78,576	131,299
65	11,897	16,442	37,983	66,322	110,527
66	13,341	19,881	35,298	68,520	110,843
67	15,104	15,996	30,364	61,464	101,859
68	3,336	30,953	38,291	72,580	101,035
69	2,199	17,939	57,531	77,669	97,224
70	238	16,654	44,088	60,980	76,587
71	1,243	16,892	27,887	46,022	62,539
72	501	8,168	35,835	44,504	62,052
73	866	8,021	16,705	25,592	42,723
74	55	2,513	13,635	16,203	35,133
75	495	7,873	15,206	23,574	41,207
76	1,946	14,749	25,551	42,246	59,939
77	997	19,866	27,380	48,243	72,651
78	1970	19,712	29,777	51,459	81,637
79	2,444	15,490	31,915	49,849	86,772
80	3,197	20,944	21,752	45,893	96,777
81	3,752	14,707	25,502	43,961	77,187
82				71,853	

Table 16. Regression coefficients from the multiplicative model for each country-gear analyzed separately. The period of years in each analysis is indicated.

	CanN OT-5 1965-78	CanN OT-5 1965-82	Prt OT-6 1962-82	Prt OT-7 1967-82	Spa PT-4 1962-80
Jan.	0.0	0.0	0.0	0.0	0.0
Feb.	0.050	0.163	0.030	-0.128	0.234
March	-0.216	-0.074	-0.140	-0.377	0.162
April	-0.073	-0.050	0.032	-0.001	0.262
May	-0.240	-0.332	-0.192	-0.346	0.271
June	-0.155	-0.467	-0.441	-0.699	0.432
July	-0.295	-0.521	-0.779	-0.933	0.472
Aug.	-0.082	-0.312	-0.747	-0.911	0.230
Sept.	-0.237	-0.392	-0.761	-0.914	0.207
Oct.	-0.292	-0.478	-0.760	-0.916	0.218
Nov.	-0.389	-0.446	-0.681	-0.822	0.384
Dec.	-0.226	-0.239	-0.390	-0.464	0.879
2J	0.0	0.0	0.0	0.0	0.0
3K	-0.339	-0.520	-0.176	-0.175	0.050
3L	-0.336	-0.796	-0.229	-0.269	-0.317

Table 17. Mean catch rate index of cod in NAFO Divisions 2J+3KL for 1962-82 relative to 1962. The series was derived from data for Portugal OT-6 and OT-7 and Canada Newfoundland OT-5.

YEAR	TOTAL CATCH	PROP.	RELATIVE CATCH		EFFORT
			MEAN	S.E.	
1962	502752	0.174	1.000	0.000	502752
1963	499904	0.235	1.126	0.094	443851
1964	603585	0.175	0.997	0.083	605660
1965	555654	0.162	0.869	0.072	639146
1966	522307	0.168	0.988	0.081	528501
1967	610535	0.210	1.044	0.081	584732
1968	807470	0.159	0.997	0.077	809939
1969	748433	0.158	0.824	0.064	908203
1970	516213	0.191	0.712	0.056	725185
1971	432496	0.221	0.568	0.044	762011
1972	458170	0.122	0.496	0.041	923671
1973	354509	0.193	0.502	0.040	706014
1974	372650	0.210	0.612	0.051	608440
1975	287508	0.141	0.525	0.043	547719
1976	214220	0.152	0.437	0.040	490007
1977	172720	0.100	0.268	0.023	644332
1978	138559	0.124	0.311	0.030	445619
1979	166743	0.203	0.531	0.048	314176
1980	171863	0.231	0.638	0.063	269378
1981	150824	0.334	0.753	0.076	200297
1982	230000	0.242	0.780	0.079	294872

AVERAGE C.V. FOR THE MEAN: 0.082

Table 18. Results from regression analysis of the midyear exploitable biomass versus catch rate index for cod in Divisions 2J3KL. Years 1962-81, excluding 1974-76, were used in the regression.

	0.10	F ₁₉₈₁ 0.15	0.20
R ²	0.632	0.796	0.778
Intercept	2527	1025	273
Slope	10403	11501	12051
1979 Residual	-1419	-2134	-2493
1980 Residual	4315	1109	-494
1981 Residual	4166	-1	-2084

Table 19. Results from regression analysis of the midyear exploitable biomass versus catch rate index for cod in Divs. 2J3KL. Years 1962-78, excluding 1974-76, were used in the regression.

	R ²	0.805	Residuals for F ₁₉₈₁		
			0.10	0.15	0.20
Intercept		1354			
Slope		11167			
		<u>Predicted biomass</u>			
1979		7284	-652	-2286	-3105
1980		8479	5001	993	-1011
1981		9763	4764	-79	-2500

Table 20. Results from cohort analysis for cod in NAFO Divisions 2J3KL using a fishing mortality of 0.15 for fully recruited ages in 1981.

AGE		POPULATION NUMBERS																			
		1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
4	5	5419	5778	5959	6849	8167	9254	6710	5786	5369	5915	4764	2119	1276	1344	2461	3809	4380	4105	2417	2691
5	6	4866	4195	4866	3901	5354	6087	6864	4865	4392	3878	4764	3118	1366	926	965	1596	2687	3433	3352	1972
6	7	3999	4967	3175	3175	2781	3531	4071	3891	2947	2897	2342	2338	1747	797	519	1477	2897	1804	2465	2409
7	8	3018	2459	3018	1833	1997	1705	2012	2011	1740	1566	1975	1726	1428	755	379	1198	2041	1533	2607	1757
8	9	1977	1138	1497	1583	1937	1094	948	915	744	712	726	736	689	635	266	106	196	138	2607	2229
9	10	1058	609	671	1775	689	489	545	370	304	366	365	367	355	123	72	48	59	138	381	55
10	11	584	401	361	367	333	347	245	243	153	158	197	192	172	48	31	20	38	21	54	24
11	12	394	308	189	189	167	138	138	138	95	95	90	47	50	22	18	8	2	10	34	18
12	13	292	225	179	101	103	47	47	54	34	34	39	31	18	15	17	8	4	15	12	16
13	14	277	150	99	55	55	56	54	64	15	15	15	15	18	18	17	8	4	15	12	16
4+	5+	21139	29240	18842	18846	20574	22850	21632	18913	15813	15675	14365	10399	7189	4874	5958	6357	8402	10145	9826	9890
5+	6+	15720	17462	13865	12017	12406	12596	11822	10443	8760	8760	9001	9231	9445	3730	2396	2548	4083	6036	7109	7199
6+	7+	8727	12167	8997	8116	7057	7507	6556	6051	4682	5882	5382	5102	5515	2740	1732	2952	1832	2606	4157	5327
7+	8+	548	5200	698	493	4271	3978	3985	3104	3819	2985	3040	2794	2798	1813	913	426	295	803	1482	7918
8+		3321	2832	3081	3114	2274	2273	1773	1364	1423	1423	1523	1478	1370	1058	574	278	234	269	1489	1161

AGE		POPULATION BIOMASS (MID-YEAR)																			
		1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
4	5	26229	2808	2350	339	3892	4400	3094	2382	3521	2760	2355	943	599	629	1166	2456	2721	2710	1442	1842
5	6	3132	4811	3332	3119	3854	4410	4372	3291	3162	2680	2356	2302	930	618	609	1231	2174	3273	3598	1800
6	7	2487	3255	2651	2228	2491	2087	2311	3240	2284	2624	2122	2105	1454	659	409	619	1106	2492	3576	3388
7	8	1734	1825	1370	1174	1461	1670	1190	1174	1130	1864	1193	1548	1002	778	343	369	1489	1057	2402	3305
8	9	1438	1325	999	869	1315	932	987	569	588	1100	1157	1108	893	752	333	277	269	385	993	2012
9	10	1355	993	730	590	480	721	580	501	588	721	710	424	578	364	240	229	136	201	338	799
10	11	1135	693	540	480	480	539	363	328	388	384	463	278	309	211	149	149	184	147	161	248
11	12	882	761	599	500	480	539	363	328	388	384	463	278	309	211	149	149	184	147	161	248
12	13	1272	705	658	378	246	239	195	178	178	203	178	159	182	115	67	67	44	73	125	1125
4+	5+	21802	2385	18637	17270	17561	18601	17309	14463	12907	12765	11831	9643	6733	4231	3353	5482	7246	10466	1254	13684
5+	6+	19172	18577	16187	13931	13669	14201	14215	11681	10386	10004	9676	8700	6135	3601	2217	3027	4525	7756	11012	11883
6+	7+	14040	14491	12855	11018	9815	9791	9443	8390	7224	7324	6839	6595	5205	2985	1608	1796	2352	4483	7753	9963
7+	8+	10309	14880	9591	17900	7109	6469	6042	5116	4541	4700	4717	4293	3251	2326	1176	1176	1246	1991	4157	6573
8+		7821	6455	6599	5679	4619	4382	3331	3014	2631	2836	2924	2748	2149	1548	856	808	1757	934	1455	3270

AGE		FISHING MORTALITY																			
		1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
4	5	0.056	0.057	0.060	0.046	0.094	0.164	0.076	0.125	0.138	0.205	0.339	0.378	0.132	0.311	0.166	0.044	0.033	0.055	0.027	0.027
5	6	0.119	0.208	0.255	0.220	0.269	0.384	0.258	0.415	0.404	0.444	0.398	0.338	0.132	0.505	0.388	0.181	0.131	0.100	0.139	0.072
6	7	0.327	0.328	0.445	0.475	0.402	0.588	0.579	0.694	0.501	0.524	0.444	0.443	0.654	0.884	0.403	0.308	0.205	0.172	0.105	0.127
7	8	0.352	0.358	0.458	0.475	0.450	0.631	0.595	0.510	0.469	0.548	0.528	0.811	1.022	0.966	0.456	0.407	0.339	0.179	0.150	0.150
8	9	0.434	0.328	0.404	0.565	0.486	0.606	0.746	0.453	0.459	0.444	0.376	0.848	1.184	1.171	0.580	0.527	0.313	0.175	0.150	0.150
9	10	0.434	0.328	0.404	0.565	0.486	0.606	0.746	0.453	0.459	0.444	0.376	0.848	1.184	1.171	0.580	0.527	0.313	0.175	0.150	0.150
10	11	0.464	0.343	0.473	0.476	0.442	0.565	0.708	0.250	0.247	0.458	0.520	1.067	1.019	1.149	0.660	0.337	0.177	0.108	0.150	0.150
11	12	0.381	0.335	0.442	0.442	0.444	0.589	1.178	0.257	0.247	0.400	0.735	1.088	1.019	1.057	0.537	0.339	0.178	0.142	0.150	0.150
12	13	0.381	0.335	0.442	0.442	0.444	0.589	1.178	0.257	0.247	0.400	0.735	1.088	1.019	1.057	0.537	0.339	0.178	0.142	0.150	0.150

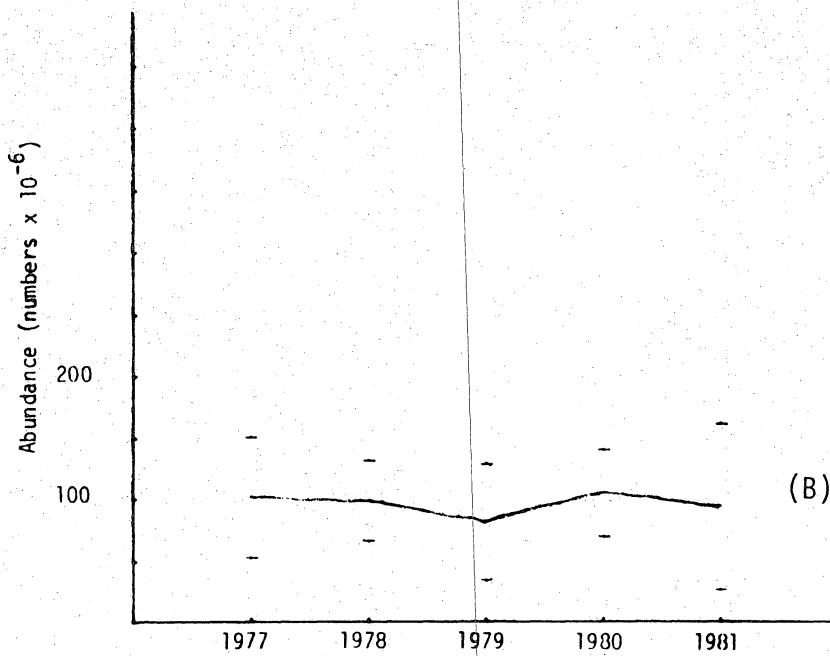
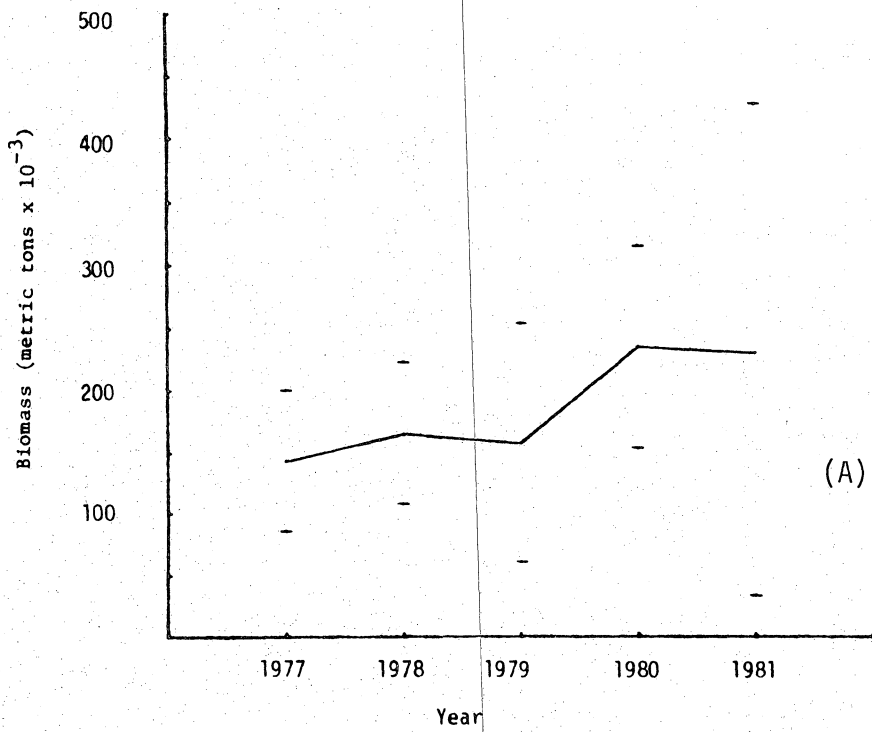


Fig. 1. Biomass (A) and abundance estimates (B) along with their associated confidence limits from research surveys in Div. 25.

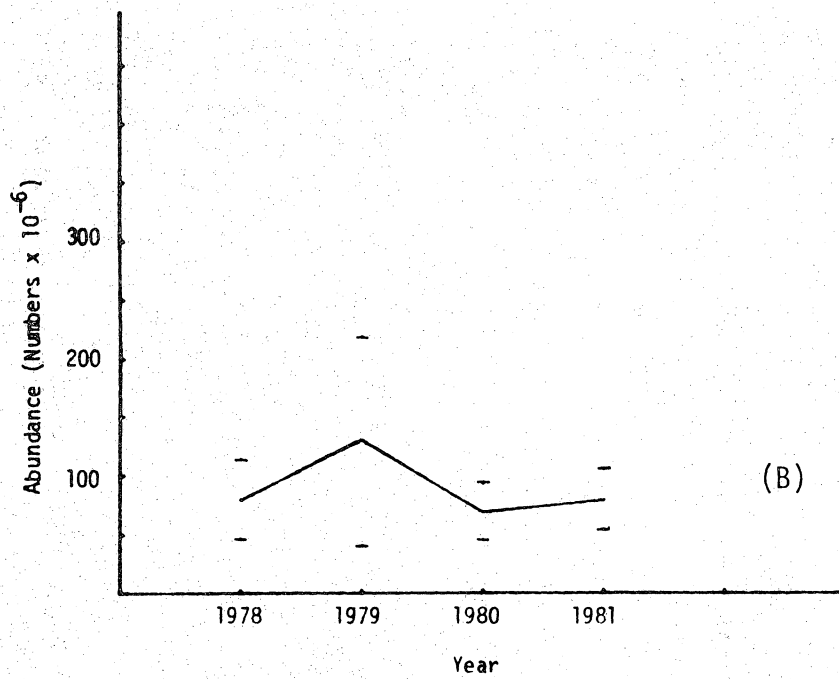
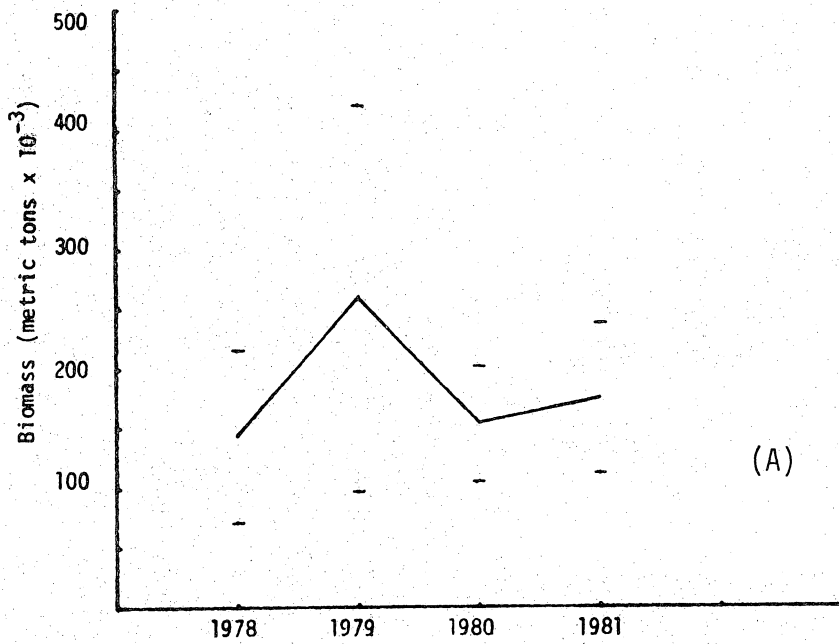


Fig. 2. Biomass (A) and abundance estimates (B) along with their associated confidence limits from research surveys in Div. 3K.

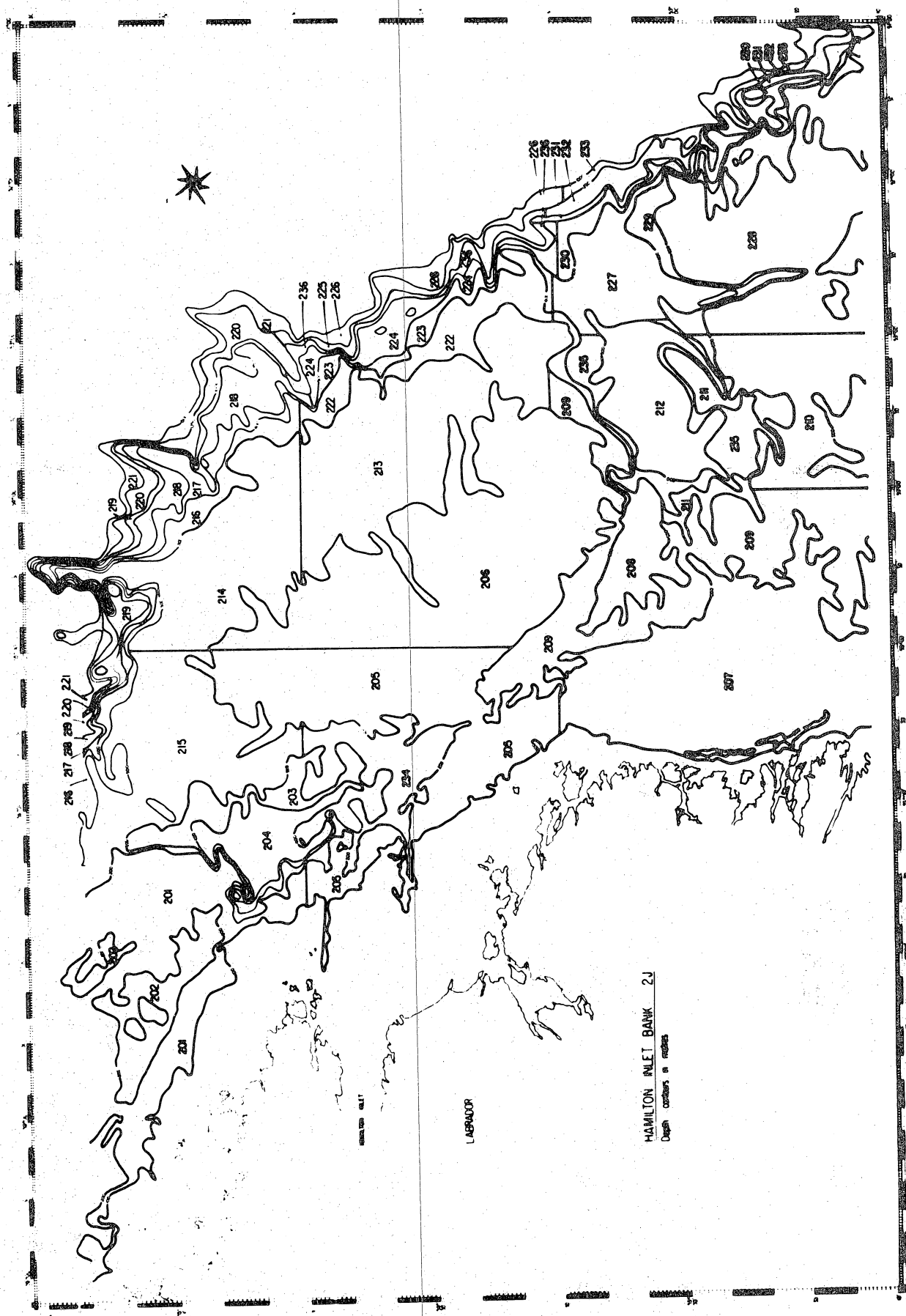


Fig. 3. Diagram of stratification scheme for Division 2J.

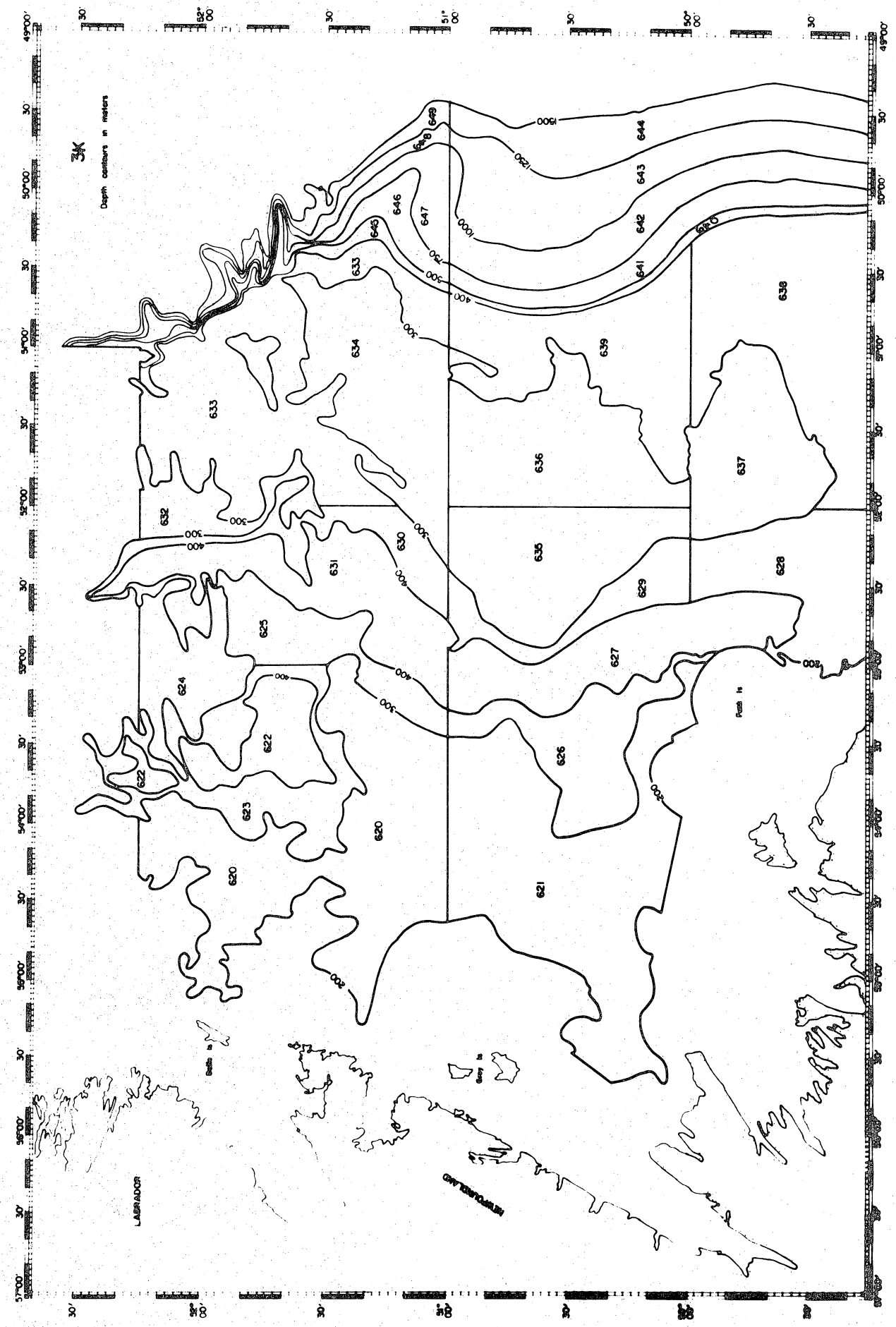


Fig. 4. Diagram of stratification scheme for Division 3K.

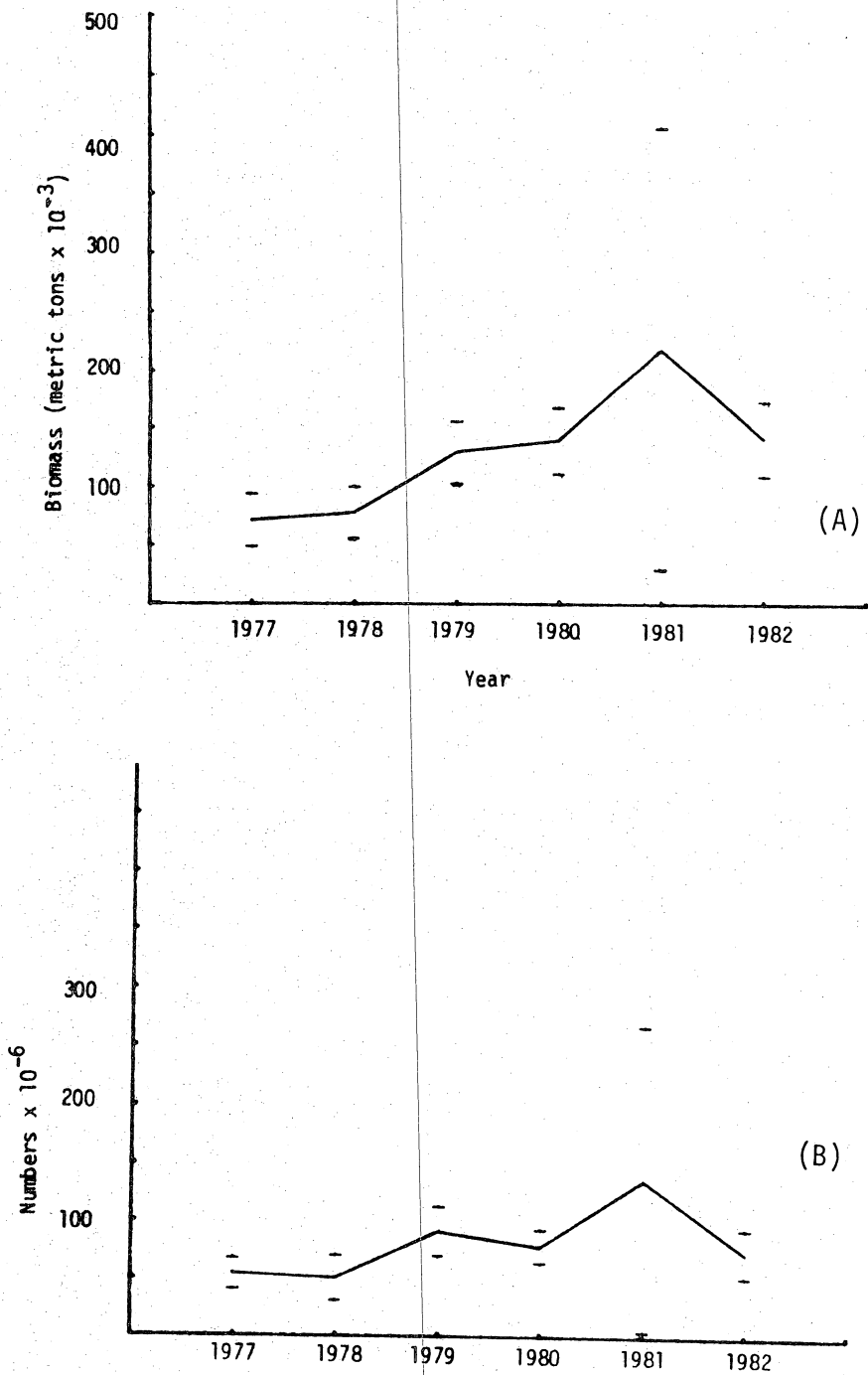


Fig. 5. Biomass (A) and abundance estimates (B) along with their associated confidence limits from research surveys in Division 3L.

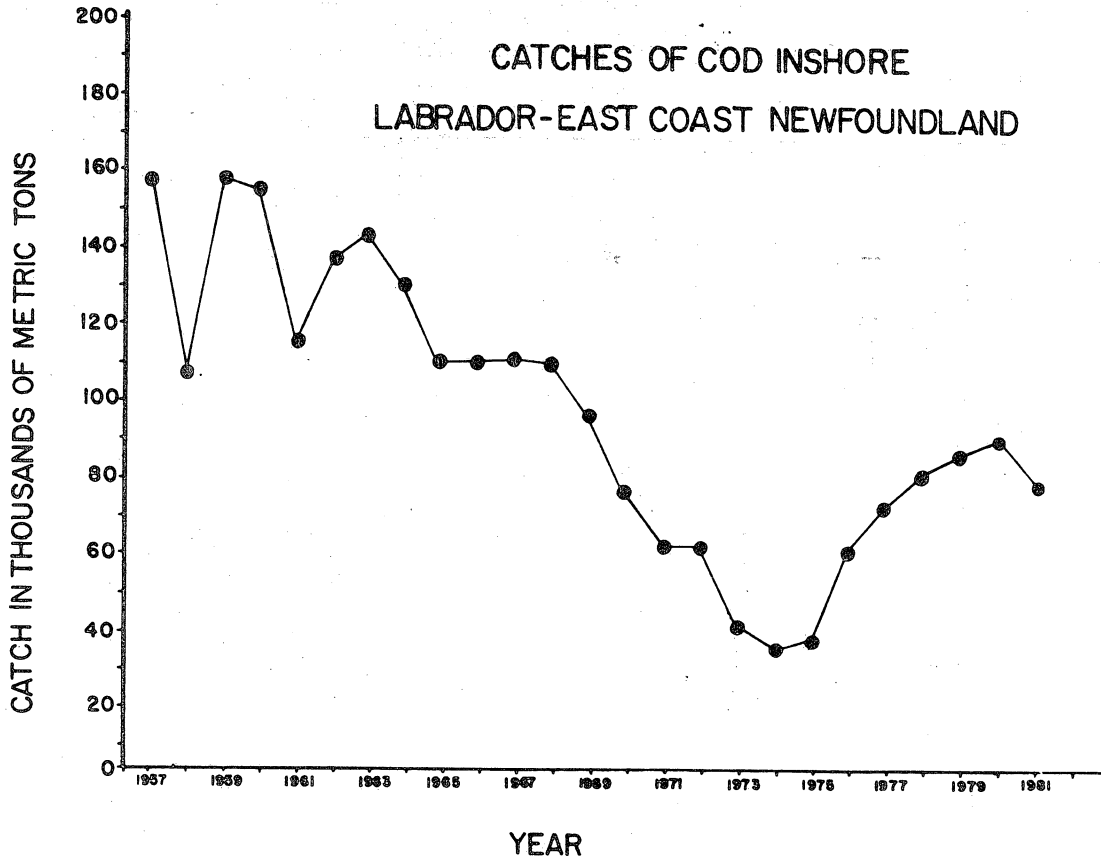


Fig. 6. Inshore cod catches from 2J3K1 from 1957 to 1981

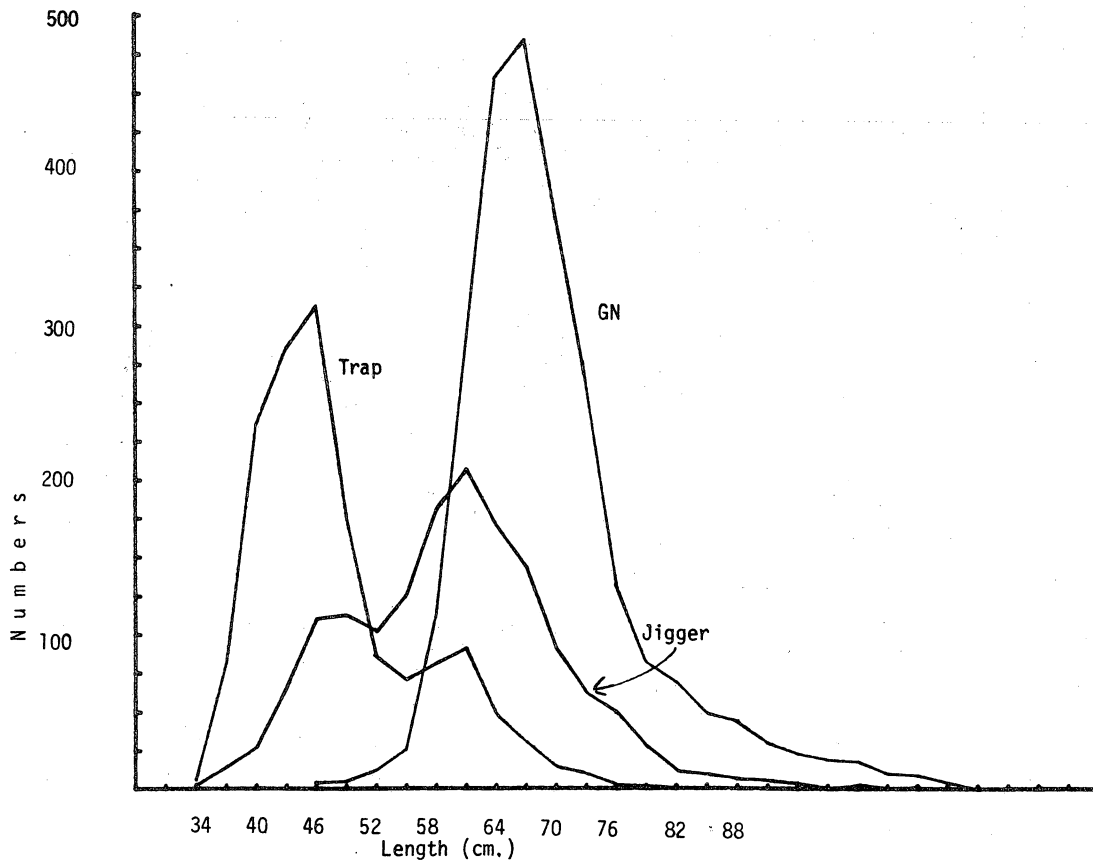


Fig. 7. Length frequency for the August 1982 inshore fishery in Division 2J.

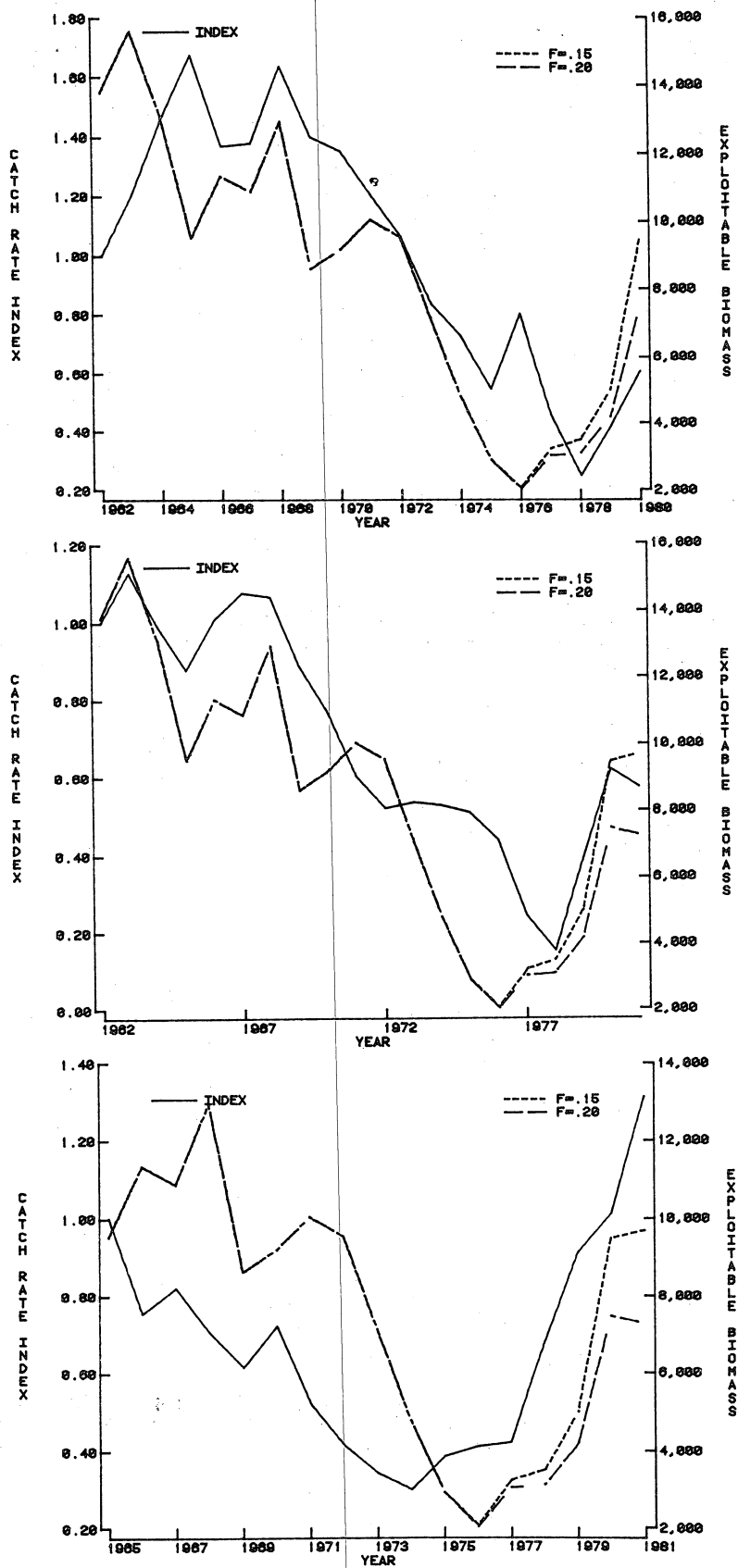


Fig. 8. Catch rate indices for 2J+3KL cod derived from data for a) Spain PT-4, b) Portugal OT-6 and c) Canada Newfoundland OT-5. The mid-year exploitable biomass from cohort analysis is indicated.

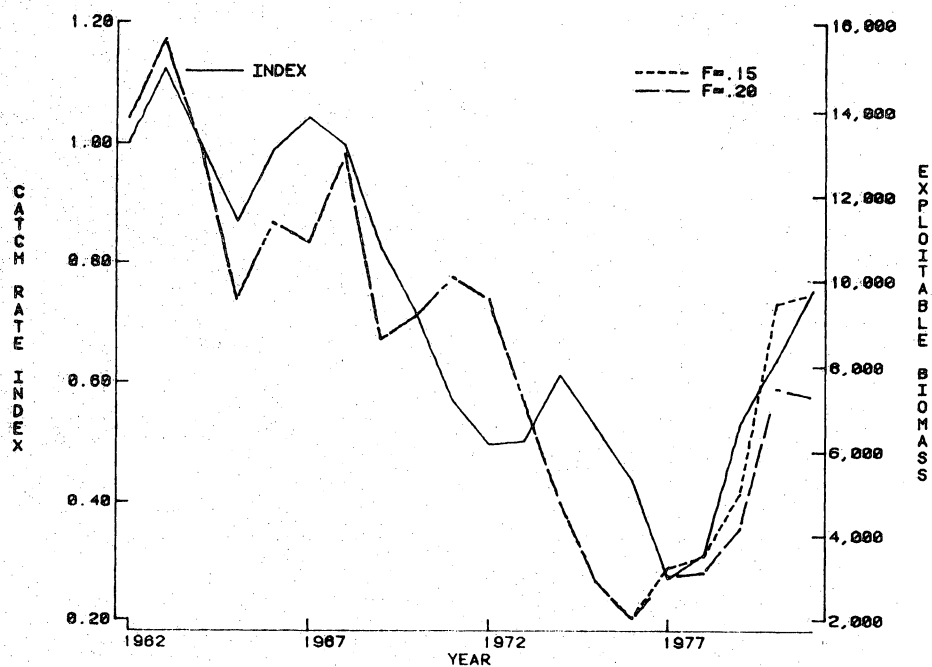


Fig. 9. Catch rate index derived by combining data for Portugal OT-6 and OT-7 and Canada Newfoundland OT-5, treating 1962-79 and 1979-82 separately.

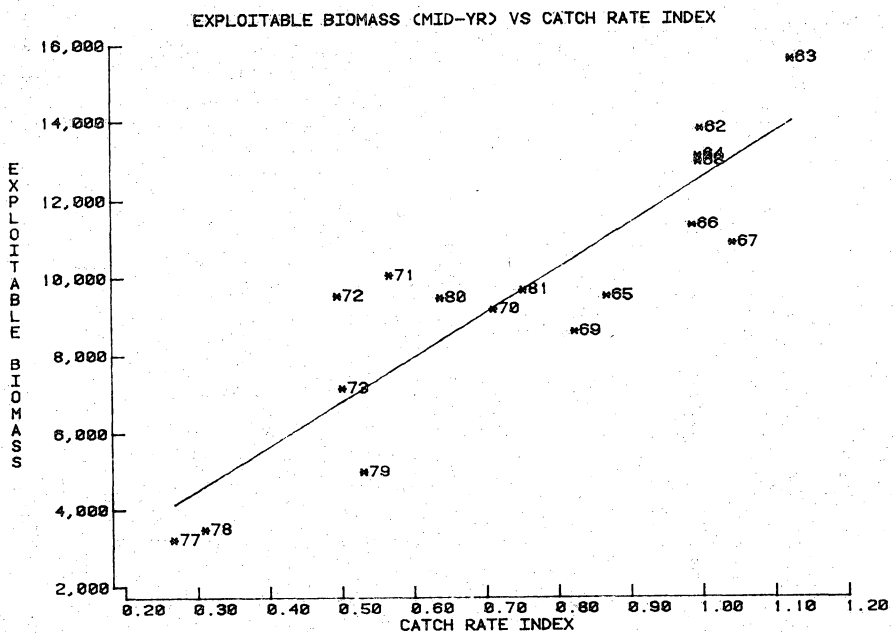


Fig. 10. Plot of the regression of mid-year exploitable biomass versus catch rate index for cod in Divisions 2J3KL using a fishing mortality of 0.15 for fully recruited ages in 1981. (The years 1974-76 were excluded).