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Northwest Atlantic



Fisheries Organization

Serial No. N712

NAFO SCR Doc. 83/VI/54

SCIENTIFIC COUNCIL MEETING - JUNE 1983

Assessment of the cod stock in Divisions 2J3KL

by

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Nominal catch

Cod catches from Divisions 2J3KL have ranged between 800,000 t in 1968 and 139,000 t in 1978. With quota control coming into effect in 1973. Recent nominal catches and TAC's are as follows:

	1977	1978	1979	1980	1981	1982	1983
TAC(000 t)	160	135	180	180	200	230	260
Catch(000 t)	173	139	167	176	161	228*	

* Provisional data

Nominal catches for 1982 (Table 1) were obtained from Department of Fisheries and Oceans for Canadian based vessels and from NAFO Circular Letters and/or the FLASH database for others. A major portion of the 1982 catch was taken by the Canadian fishery with 54% of that due to inshore gears. The inshore catch in 1982 was at its highest level since the mid 1960's.

Catch numbers, average weight, and average length at age were derived using the catch and sampling data as shown in Table 2. With the exception of the fourth quarter for otter trawlers there was sufficient sampling to treat each division separately. The coefficient of variation for estimated catch numbers of dominant age groups was 5% or less (Table 3) and the discrepancy between reported catch and calculated catch was 2%, indicating that no major problems occurred with the sampling coverage. In deriving average weight at age the relationship $\log \text{weight} = \log \text{length} \times 3.0879 - 5.2106$ was applied. Table 4 shows the catch and average weights at age for 1982 along with historical results.

Surveys

Biomass and abundance estimates for research surveys in Divisions 2J, 3K, and 3L with associated confidence limits are shown in Figs 1 to 3. Once again the survey in 3L was conducted in the spring by the A.T. Cameron while those for 2J and 3K were in November and December and by the Gadus Atlantica. Tables 5 to 7 show the mean number per tow estimates by age for 2J, 3K, and 3L. In Div. 2J the mean number per tow continued an increasing trend in 1982 with biomass showing a slight decrease. The mean number per tow estimates in 1982 would suggest strong 1979 and 1980 year classes. Biomass and abundance estimates for Div. 3K showed no consistent trend but appear to be somewhat stable over the period surveyed. Biomass and abundance levels in Div. 3L increased since 1977 but appear to have stabilized since 1979. The 1978 year class has predominated in recent years and the 1982 survey would suggest a relatively strong 1980 year class.

Catch-effort

Catch and effort information for 1962-79 was derived from NAFO(ICNAF) Statistical Bulletins and data for 1979-82 was obtained from the Statistics and Systems Branch and the Foreign Cooperative Research program. Only data from Canada (Newfoundland), Portugal, and Spain otter trawlers were used in calculating a catch rate index. The multiplicative model was applied to each series, 1962-79 and 1979-82, separately using 1979 as the reference in

both. The month and division patterns were similar in both series but were more pronounced in the latter (Tables 8 and 9). In general the catch rate index shows a decline through the late 1960's to the mid 1970's with a subsequent increase (Table 10, Fig. 4).

Cohort analysis

The historical partial selection was calculated by dividing the fishing mortality matrix by the total fishing mortality for ages 8-11. The total fishing mortality for ages 8-11 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. The 1982 partial selection of ages 4-7 used as input for cohort analysis was the average from 1975-80 (Table 11). Ages 8-13 were assumed to be fully recruited to the fishery.

Assuming a natural mortality of 0.2, cohort analysis was performed for a range of fully recruited fishing mortalities in 1982. The fishing mortality for age 13 in years 1962-81 was assumed to be equal to the total fishing mortality for ages 8-11. Exploitable midyear biomass was computed by multiplying mid year biomass by the partial selection matrix. All values greater than 1 in the partial selection matrix were replaced by 1 and all values for ages 8-15 were assumed to be 1. Regressions of exploitable midyear biomass with the catch rate index indicated that the fully recruited fishing mortality for 1982 was between 0.20 and 0.25 (Table 12). The years 1974-76 were not used in the regressions (NAFO SCR Doc. 82/IX/III). The plot of the regression using $F_{1982} = 0.225$ is presented (Fig. 5) to give an indication of the fit. Population numbers, midyear population biomass, and fishing mortality for the cohort analysis using $F_{1982} = 0.225$ are shown in Table 13.

Table 1. Cod landings (tons) from Div. 2J, 3K and 3L by country during 1982.

2J

Month	Can(N)	Can(M)	FRG	France	UK	Den(F) (LL)	Nor (LL)	Port	Poland	Total
J	332									
F	10130	3037	5459							
M	13046	7666		198						
A	12674	5309			69					
M	2040	962				26	90	912		
J	2316	477						184		1
J	5143	48							11	
A	7588	39							4	
S	2539	43								
O	395	3								
N	134									
D	24	14							3	
	56361	17598	5459	198	69	26	90	1114	1	80916

3K

Month	Can(N)	Can(M)	France	Norway (LL)	Den(F) (LL)	UK	Port	Poland	USSR	GDR	Total
J	333										
F	844										
M	2338	43	524	151							
A	2874	160		471	456	11					
M	5146	180		298	248	563					
J	7026	9					3		2		
J	19720							1	1		
A	9552										
S	2650										
O	695		58					16			
N	214	6						73		1	
D	412							431		2	1
	51804	398	582	920	704	574	523	3	4	1	55513

3L

Month	Can(N)	Can(M)	USSR	France	Port GN	Port GN	Norway (LL)	Poland	Total
J	2441	201	6						
F	303								
M	3470			137					
A	3326	35			113				
M	7629	372			850		75		6
J	13134	94			3	94			
J	24735	14		211		1076			
A	11087								
S	5123	12			162		55		
O	3057	28			53	182	261		
N	5441				119	187	174		
D	4922	2080					258	7	
	84668	2836	6	520	1755	1667	75	6	91533

Table 2. Commercial sampling for Div. 2J+3K cod in 1982.

Div.	Gear	Qtr.	Country	No. aged	Month	No. meas.	Landings (tons)	
							Country month	Total
2J	OT	1	Can (M)		Feb.	310	3,037	3,037
			Can (M)		Mar.	592	7,666	7,666
			Can (N)	403	Jan.	2,737	196	196
			Can (N)		Feb.	18,443	10,130	13,046
			Can (N)		Mar.	22,134	13,046	13,046
			France (M)		Feb.	1,609	198	198
			FRG	465	Feb.	14,584	5,459	5,459
			Port.	56	Jan.	374	136	136
					933		39,868	
					793		24,843	
2J	OT	2	Can (M)		8	635	5,309	6,748
			Can (N)	357	Apr.	10,262	12,674	12,674
			Can (N)		May	3,405	2,036	2,036
			Can (N)		June	1,712	2,219	2,219
			Port.	383	May	6,285	912	912
			Port.		June	244	184	184
			U.K.		Apr.	919	70	70
					793		24,843	
			Can (M)	143	July	259	48	130
			Can (N)		Aug.	883	262	570
			Other					59
2J	OT	3	Can (N)	433	143		759	
			HL		Aug.	2,681	5,052	5,052
			GN		Aug.	484	898	898
			Can (N)		Aug.	4,114	9,380	9,380
					433		15,330	
			LT	87	Apr.-May	353	26	26
			Nor.		Apr.-May	1,906	90	90
					87		116	
			2J Total		2,389	94,925	80,916	
3K	OT	1	Can (N)	273	Feb.	324	844	857
			Can (N)		Mar.	1,671	1,763	1,763
			France (M)		Mar.	694	524	524
			Japan	30	Mar.	1,915	411	411
			Port.	246	Jan.	1,602	318	318
			Port.		Mar.	1,429	157	157
			Other					43
					657		4,073	
			2	346	Apr.	4,853	2,800	2,800
			Can (N)		May	4,699	2,105	2,105
			Can (N)		June	393	87	87
			UK		Apr.	1,098	11	11
			UK		May	3,054	563	563
			Other					354
					414		5,920	

Table 2. (Cont'd.)

Div.	Gear	Qtr.	Country	No. aged	Month	No. meas.	Landings (tons)		
							Country	month	Total
Trap	3	Can (N)			June	1,410	2,226	2,376	
Trap		Can (N)			July	8,313	11,592	14,052	
GN		Can (N)		836	June	595	4,120	7,046	
GN		Can (N)			July	5,466	6,678	9,961	
HL		Can (N)			July	1,248	1,397	2,038	
HL		Can (N)			Aug.	4,052	3,834		
					836			39,307	
GN	4	Can (N)			Sept.	218	658	783	
LT		Can (N)		416	Sept.	2,248	1,357	1,670	
HL		Can (N)			Sept.	370	411	650	
				416				3,103	
LT	2	Den (F)		507	Apr.	5,599	456	456	
		Den (F)			May	1,116	248	248	
		Nor.			Mar.	406	151	151	
		Nor.		150	Apr.	5,917	471	471	
		Nor.			May	3,129	298	298	
				657				1,624	
3K	Total			2,980		61,819		54,027	
3L	OT	1	Can (N)	391	Jan.	2,015	1,708	1,993	
		Can (N)			Mar.	1,434	1,971	1,971	
		France (M)	35		Mar.	373	137	137	
		Japan	204		Jan.	1,207	569	569	
		Japan			Mar.	3,412	1,261	1,261	
		Port.	93		Jan.	413	151	151	
		Port.			Mar.	1,226	225	225	
		Other						206	
				723				6,513	
	2	Can (M)			Jan.	357	94	501	
		Can (N)			Apr.	3,911	2,448	2,448	
		Can (N)		401	May	1,332	2,592	2,592	
		Can (N)			June	4,158	2,287	2,287	
		Port.	347		Apr.	3,152	113	113	
		Port.			May	1,924	850	853	
		Other						6	
				748				8,800	
	3	Can (N)		118	July	428	1301	1500	
		Port			Sept.	629	208	208	
		Other	197		Sept.	2442	162	162	
				315				495	
								2365	
	2	Can (N)		365	Apr.	272	700	738	
		Can (N)			May	3,090	3,915	3,915	
				365				4,653	
LT	2	Nor.		150	May	1,195	75	75	
				150				75	

Table 2. (Cont'd.)

Div.	Gear	Qtr.	Country	No. aged	Month	No. meas.	Landings (tons)	
							Country month	Total
Trap	3	Can (N)	907	June	6,349	7,145	8,405	
	Trap	Can (N)		July	5,293	13,545	16,131	
	GN	Can (N)		June	209	2,916	2,916	
	GN	Can (N)		July	3,107	8,368	8,368	
	GN	Can (N)		Aug.	694	4,068	4,068	
	LT	Can (N)		Aug.	2,292	2,349	2,877	
	HL	Can (N)		June	1,992	603	624	
	HL	Can (N)		July	1,331	1,201	1,201	
	HL	Can (N)		Aug.	608	2,150	2,150	
						907		46,740
GN	2+3	Port.	67	June	429	94	94	
		Port.	495	July	8,041	1,076	1,076	
			—	Sept.	484	55	55	
				562				1,225
3L	GN	4	Can (N)	262	Sept.	184	1,093	1,384
	LT	Can (N)	Sept.		738	2,041	2,853	
	HL	Can (N)	Sept.		460	1,525	1,525	
	HL	Can (N)	Oct.		131	633	726	
								6,488
GN	4	Port.	177	Oct.	1,139	261	442	
			—					442
3L	Total			4,209		66,451		77,301
3K	OT	4	Can (N)	34	Dec.	447	356	641
			France (M)		Oct.	444	58	58
			Port.		Oct.	248	16	16
			Port.		Nov.	1,029	73	504
			Other					10
3L	OT	4	Can (M)	425	Dec.	373	2,080	2,108
			Can (N)		Oct.	790	1,591	1,591
			Can (N)		Nov.	15,576	5,102	5,102
			Can (N)		Dec.	6,831	4,889	4,889
			France (M)		Nov.	743	119	172
			Port.		Oct.	2,062	182	182
			Port.		Nov.	2,489	187	445
						898		14,489
3KL	Total			898		31,032		15,718
2J3KL				10,476		254,227		227,962

Table 3. Estimated average weight, average length, and catch numbers at age for the commercial fishery of cod in Division 2J3KL. The precision of the catch numbers is also shown.

AGE	WEIGHT (kg)	LENGTH (cm)	CATCH (X10 ⁻³)	VAR (CATCH)	STD. ERROR	COEF. VAR
2	0.193	27.398	1	0.142	0.38	0.55
3	0.522	39.199	2372	86259.588	293.70	0.12
4	0.841	45.666	32716	429157.520	655.10	0.02
5	1.206	51.332	18670	431658.966	657.01	0.04
6	1.771	58.162	14301	305815.317	553.01	0.04
7	2.101	61.447	25097	466553.304	683.05	0.03
8	2.667	66.246	16732	332648.946	576.76	0.03
9	3.086	69.338	11776	200312.093	447.56	0.04
10	4.185	76.246	1914	21418.367	146.35	0.08
11	6.230	86.871	327	1396.567	37.37	0.11
12	7.195	91.288	152	400.675	20.02	0.13
13	8.052	94.435	84	214.458	14.64	0.17
14	8.376	95.914	151	264.063	16.25	0.11
15	7.830	93.993	37	83.137	9.12	0.25
16	8.407	96.137	12	24.686	4.97	0.42
17	9.615	98.743	12	28.967	5.38	0.45
18	13.018	109.538	4	1.285	1.13	0.29
19	10.112	103.000		0.196	0.44	1.06
20						
21	13.097	112.000				0.01
22						
23	14.211	115.000	1			

Table 4. Catch numbers and average weight at age for cod in Divisions 2J3KL.

Table 5. Mean number of cod per standard tow from research vessel surveys in Division 2J.

Age	Gadus 3 1977	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58 1981	Gadus 71 1982
1	0.0	0.0	0.0	0.38	0.0	1.20
2	3.79	0.60	0.35	1.66	4.70	3.50
3	10.95	8.86	1.55	1.41	3.31	20.67
4	33.03	16.35	13.04	4.81	2.59	7.27
5	15.11	33.07	19.12	21.87	4.77	5.06
6	3.32	11.32	18.41	22.33	19.22	4.84
7	1.54	2.51	2.62	13.25	17.21	14.99
8	1.39	0.91	0.83	1.92	10.88	13.18
9	1.09	0.72	0.56	0.56	2.25	8.95
10	0.60	0.52	0.32	0.40	0.57	1.50
11	0.23	0.28	0.32	0.26	0.09	0.40
12	0.11	0.13	0.12	0.31	0.16	0.19
13	0.05	0.16	0.05	0.10	0.17	0.11
14	0.03	0.14	0.05	0.05	0.08	0.15
15	0.02	0.05	0.01	0.06	0.08	0.01
16	0.0	0.03	0.03	0.02	0.05	0.02
17	0.0	0.03		0.0	0.02	0.02
18	0.0	0.03		0.0	0.01	0.02
19	0.0			0.02		0.0
20	0.0					0.01
>20	0.02					0.02
Total	71.33	75.70	57.38	69.33	66.15	82.12
Upper Limit	106.00	104.10	91.88	93.31	114.18	105.95
Lower Limit	36.66	47.30	22.88	45.36	18.12	58.30

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

Age	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58&59 1981	Gadus 72 1982
1	0.0	0.0	0.22	0.01	0.28
2	0.31	0.15	1.24	1.51	2.18
3	3.23	2.54	1.69	6.22	2.10
4	14.11	17.31	2.44	3.90	5.99
5	17.20	28.48	13.73	4.25	5.90
6	7.89	16.94	15.00	14.19	3.31
7	2.52	4.35	3.24	10.26	6.98
8	1.18	2.18	1.57	3.19	6.80
9	0.73	0.53	0.58	0.58	1.97
10	0.57	0.46	0.39	0.27	0.77
11	0.04	0.31	0.03	0.22	0.20
12	0.12	0.07	0.24	0.23	0.09
13	0.04	0.05	0.08	0.07	0.07
13+	0.04	0.14	0.17	0.14	0.15
Total	47.99	73.50	40.61	45.02	36.80
Upper Limit	70.75	126.26	54.54	59.86	44.87
Lower Limit	25.22	20.74	26.68	30.18	28.73

Table 7. 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	29.20	67.49	26.59
Upper limit	101.26	36.85	70.83	59.78	26.94	57.57	26.06	31.15	42.38	34.73	207.49	34.11
Lower limit	5.08	16.91	-10.18	-11.51	7.89	19.67	13.85	10.63	23.87	23.67	-72.50	19.07
# sets	57	38	29	70	55	64	102	94	141	115	78	103

Table 8. Analysis of variance and regression coefficients from the regression of ln catch rate for cod in Divisions 2J3KL using years 1962-79.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.767
MULTIPLE R SQUARED....0.588

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	2.553E0	2.553E0	
REGRESSION	28	4.508E2	1.610E1	84.512
TYPE 1	4	8.119E1	2.030E1	106.541
TYPE 2	5	1.294E2	2.588E1	135.826
TYPE 3	2	2.348E1	1.174E1	61.614
TYPE 4	17	2.153E2	1.266E1	66.473
RESIDUALS	1656	3.155E2	1.905E-1	
TOTAL	1685	7.689E2		

Country/Gear	In power	Month	In power
Can-N OTB-4	-0.390	July	
Can-N OTB-5	0.000	Aug.	-0.653
ESP OTB-6	0.256	Sept.	
PRT OTB-6	0.348	Oct.	
PRT OTB-7	0.678	Nov.	-0.593
		Dec.	-0.438
		June	-0.435
		May	-0.203
Division	In power	Jan.	
3L	-0.278	Feb.	
3K	-0.160	Mar.	0.000
2J	0.000	April	

Table 9. Analysis of variance and regression coefficients from the regression of ln catch rate for cod in Divisions 2J3KL using years 1979-82.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.749

MULTIPLE R SQUARED.....0.561

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	1.464E0	1.464E0	
REGRESSION	14	5.790E1	4.135E0	18.103
TYPE 1	3	1.450E1	4.832E0	21.155
TYPE 2	6	2.104E1	3.507E0	15.352
TYPE 3	2	9.134E0	4.567E0	19.992
TYPE 4	3	1.970E1	6.566E0	28.744
RESIDUALS	198	4.523E1	2.284E-1	
TOTAL	213	1.046E2		

Country/Gear	In power	Month	In power
PRT OTB-7	-0.434	July	
PRT OTB-6	-0.265	Aug.	-1.008
CAN-N OTB-4	-0.031	Sept.	
CAN-N OTB-5	0.000	June	-0.799
		Oct.	-0.641
		Nov.	-0.480
Division	In power		
3L	-0.802	May	-0.458
3K	-0.548	Dec.	-0.212
2J	0.000	Jan.	
		Feb.	
		Mar.	0.000
		Apr.	

Table 10. Catch rate index series for cod in Divisions 2J3KL for 1962-79 and 1979-82, using 1979 as reference in both series. The proportion of the total catch which was used for the analysis in each year is indicated.

YEAR	TOTAL CATCH	PROF.	CATCH RATE INDEX			EFFORT
			MEAN	S.E.		
1962	502752	0.344	2.054	0.160	244708	
1963	499904	0.386	2.113	0.159	236578	
1964	603585	0.321	1.949	0.143	309661	
1965	555654	0.289	1.687	0.123	329451	
1966	522307	0.313	1.761	0.124	296619	
1967	610535	0.338	1.945	0.132	313936	
1968	807470	0.273	1.840	0.123	438923	
1969	748433	0.242	1.527	0.104	490290	
1970	516213	0.242	1.319	0.091	391265	
1971	432496	0.266	1.074	0.074	402588	
1972	458170	0.145	0.961	0.068	476761	
1973	354509	0.197	0.953	0.070	371848	
1974	372650	0.221	1.084	0.082	343894	
1975	287508	0.156	1.120	0.081	256640	
1976	214220	0.174	0.905	0.074	236818	
1977	172720	0.131	0.550	0.040	314310	
1978	138559	0.142	0.495	0.039	279654	
1979	166891	0.215	1.000	0.000	166891	

YEAR	TOTAL CATCH	PROF.	CATCH RATE INDEX			EFFORT
			MEAN	S.E.		
1979	166891	0.184	1.000	0.000	0.000	166891
1980	175782	0.231	1.239	0.127	0.127	141841
1981	160688	0.324	1.308	0.125	0.125	122877
1982	227962	0.303	1.346	0.124	0.124	169363

Table 11. Historical partial selection for 1975-80. The average for these years shown in the last column, was used for cohort analysis.

PARTIAL SELECTION							
AGE	1975	1976	1977	1978	1979	1980	
4	0.13	0.31	0.26	0.12	0.07	0.28	0.20
5	0.36	0.51	0.73	0.38	0.34	0.42	0.46
6	0.65	0.73	0.79	0.83	0.40	0.72	0.69
7	0.80	0.88	0.78	1.00	0.75	0.63	0.81

Table 12. Results from regression analyses of mid year exploitable biomass versus catch rate index for cod in Divisions 2J3KL. Years 1962-1982, excluding 1974-1976, were used in the regression.

	F 1982		
	0.20	0.225	0.25
R ²	0.78	0.80	0.79
intercept	384	97	-133
slope	6455	6545	6617
1980 residual	-1393	-1713	-1969
1981 residual	1033	286	-312
1982 residual	1989	926	76

Table 13. Results from cohort analysis for cod in Divisions 2J3KL using a fishing mortality of 0.225 in 1982 for fully recruited ages.

Population numbers ($\times 10^{-5}$)														
AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	
4	5420	5779	5059	6848	8167	9253	6703	5781	5360	5894	4763	2084	1247	
5	6794	4196	4486	3901	5353	6087	6865	4659	4389	3871	4202	3177	1338	
6	3679	4967	2900	3164	2781	3531	4070	3820	2942	2894	2336	2385	1746	
7	1927	2469	3018	1840	1998	1705	2011	2020	1740	1558	1515	1223	1417	
8	1059	1138	1498	1583	938	1094	896	915	744	711	772	734	682	
9	719	610	671	776	689	490	545	390	303	366	364	364	354	
10	582	401	362	367	333	347	245	243	153	157	197	191	170	
11	393	309	225	189	167	193	139	132	95	93	90	103	88	
12	292	224	179	109	94	94	104	65	54	61	57	46	50	
13	277	150	146	92	55	56	47	54	15	34	39	31	18	
4+	21143	20244	18546	18868	20575	22849	21624	18080	15794	15639	14334	10340	7110	
5+	15723	14465	13486	12020	12408	13597	14921	12299	10434	9745	9571	8255	5863	
6+	8729	10269	9000	8119	7054	7510	8056	7639	6046	5874	5370	5078	4525	
7+	5250	5302	6100	4956	4273	3979	3986	3819	3103	2980	3034	2693	2778	
8+	3323	2832	3082	3115	2276	2274	1975	1799	1364	1422	1519	1470	1361	
AGE	1975	1976	1977	1978	1979	1980	1981	1982						
4	1252	2470	3971	3591	3891	1922	2630	8193						
5	896	890	1439	2773	2787	3076	1467	2095						
6	774	500	415	759	1912	1936	2265	1094						
7	754	320	182	211	428	1292	1324	1657						
8	605	265	99	93	97	246	902	911						
9	231	174	82	47	47	47	159	644						
10	121	69	40	38	25	28	28	104						
11	47	30	16	15	21	13	17	16						
12	22	16	7	6	8	12	9	11						
13	15	6	7	3	3	5	8	5						
4+	4719	4739	6258	7534	9220	8575	8808	14731						
5+	3467	2270	2288	3943	5329	6653	6178	6538						
6+	2570	1380	849	1170	2542	3577	4711	4443						
7+	1796	881	433	411	629	1640	2446	3348						
8+	1042	560	251	201	201	348	1122	1691						
Population biomass (mid-year) (00 tons)														
AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	
4	2630	2808	2450	3339	3892	4400	3091	2779	2516	2750	2154	926	584	
5	5133	3087	3332	2912	3853	4410	4571	3287	3159	2674	2823	2104	907	
6	3732	4812	2866	3119	2705	3321	3600	3253	2678	2621	2115	2287	1453	
7	2487	3226	3692	2222	2492	2087	2310	2121	1909	1858	1789	1537	1584	
8	1725	1875	2326	2279	1462	1671	1290	1173	1129	1099	1151	1104	884	
9	1438	1254	1330	1382	1317	934	988	669	586	720	709	672	573	
10	1371	970	847	808	816	722	582	502	383	383	462	423	303	
11	1131	895	601	511	479	540	364	328	289	276	247	277	180	
12	885	757	542	328	303	281	316	140	180	204	178	125	121	
13	1276	705	654	378	248	240	195	204	66	153	170	133	66	
4+	21808	20390	18641	17278	17567	18605	17306	14457	12894	12738	11798	9589	6655	
5+	19178	17581	16191	13940	13675	14205	14216	11678	10378	9988	9643	8663	6071	
6+	14045	14494	12859	11027	9821	9795	9644	8391	7219	7314	6820	6559	5164	
7+	10313	9683	9993	7908	7116	6474	6045	5138	4541	4694	4705	4272	3711	
8+	7826	6457	6301	5686	4625	4387	3735	3017	2632	2835	2917	2735	2127	
AGE	1975	1976	1977	1978	1979	1980	1981	1982						
4	583	1050	2569	2221	2566	1297	1800	6104						
5	597	548	1084	2293	2616	3074	1459	2186						
6	633	387	522	919	2658	2771	3175	1630						
7	776	313	332	371	818	2595	2437	2892						
8	733	331	230	229	249	713	2201	1982						
9	355	240	227	148	158	184	494	1621						
10	207	115	121	135	97	117	114	353						
11	109	59	56	61	92	73	86	83						
12	53	46	31	31	47	75	50	64						
13	52	22	39	19	19	35	48	36						
4+	4097	3111	5211	6425	9320	10932	11863	16951						
5+	3514	2041	2642	4204	6754	9635	10063	10847						
6+	2917	1513	1558	1912	4138	6561	8605	8661						
7+	2284	1127	1036	993	1480	3791	5430	7030						
8+	1508	814	704	622	662	1196	2993	4138						

Table 13 continued

AGE	FISHING MORTALITY													
	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
4	0.056	0.053	0.060	0.046	0.094	0.098	0.164	0.076	0.126	0.139	0.205	0.243	0.130	0.142
5	0.113	0.170	0.149	0.138	0.216	0.202	0.386	0.260	0.216	0.305	0.366	0.399	0.347	0.385
6	0.199	0.298	0.255	0.260	0.289	0.363	0.500	0.587	0.436	0.447	0.447	0.321	0.640	0.684
7	0.327	0.300	0.445	0.474	0.402	0.444	0.588	0.799	0.694	0.503	0.525	0.384	0.650	0.845
8	0.352	0.328	0.458	0.632	0.449	0.497	0.631	0.906	0.510	0.469	0.551	0.530	0.880	1.049
9	0.383	0.322	0.404	0.646	0.486	0.491	0.606	0.736	0.454	0.418	0.443	0.564	0.870	1.008
10	0.435	0.377	0.447	0.585	0.346	0.719	0.419	0.738	0.301	0.360	0.444	0.578	1.092	1.210
11	0.362	0.343	0.531	0.505	0.372	0.421	0.564	0.697	0.249	0.288	0.460	0.521	1.174	0.842
12	0.464	0.226	0.471	0.473	0.317	0.507	0.451	1.270	0.256	0.246	0.400	0.741	1.012	1.037
13	0.380	0.335	0.445	0.625	0.440	0.530	0.590	0.830	0.460	0.435	0.500	0.545	0.915	1.055
AGE	1976	1977	1978	1979	1980	1981	1982							
4	0.340	0.159	0.053	0.035	0.070	0.028	0.045							
5	0.562	0.440	0.172	0.164	0.106	0.093	0.104							
6	0.810	0.479	0.372	0.192	0.180	0.112	0.155							
7	0.971	0.473	0.572	0.356	0.159	0.174	0.182							
8	0.970	0.550	0.480	0.525	0.237	0.138	0.225							
9	1.271	0.585	0.437	0.399	0.330	0.226	0.225							
10	1.270	0.809	0.392	0.441	0.240	0.327	0.225							
11	1.236	0.812	0.363	0.385	0.186	0.222	0.225							
12	0.636	0.637	0.482	0.311	0.212	0.286	0.225							
13	1.110	0.615	0.445	0.470	0.250	0.155	0.225							

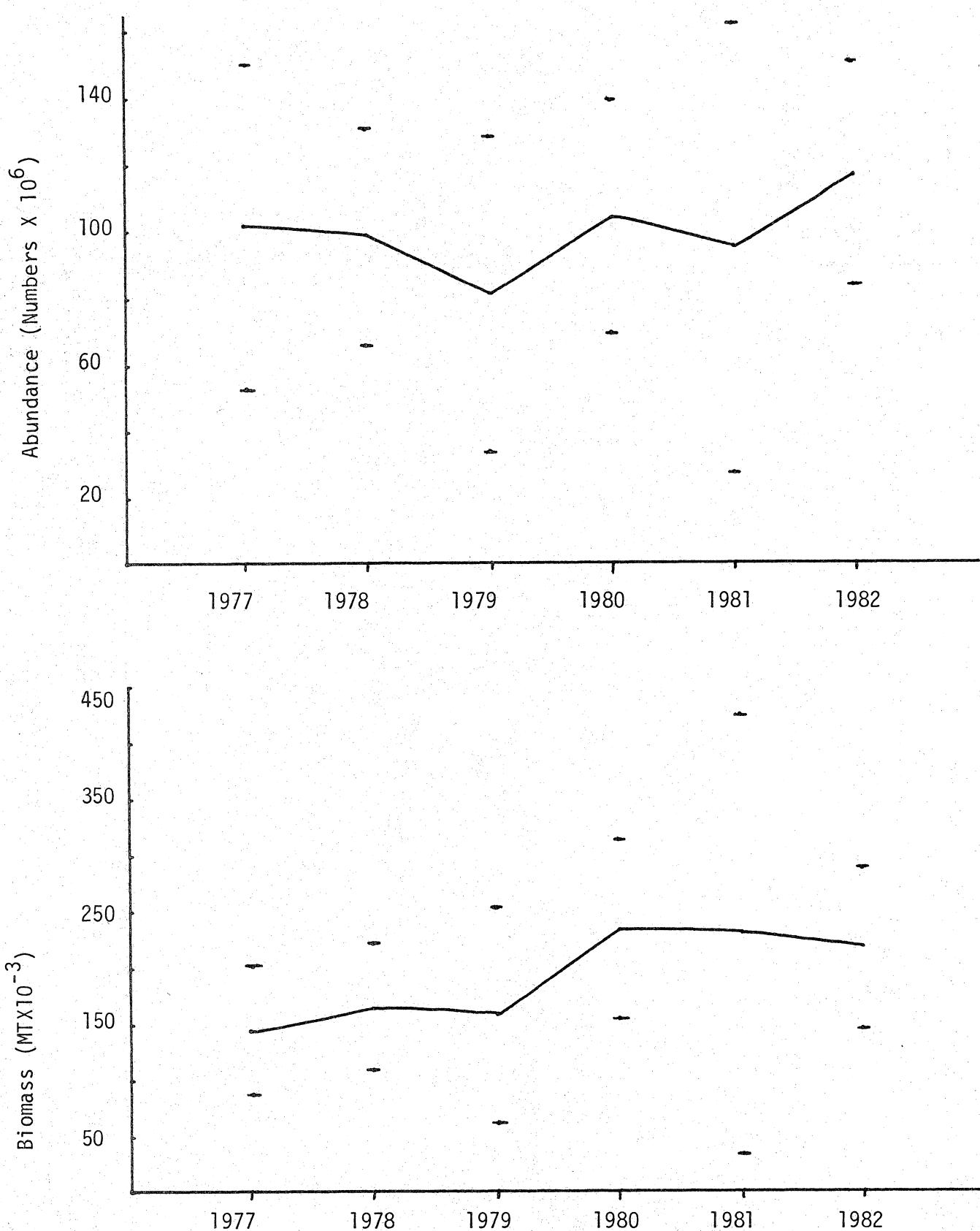


Fig. 1. Abundance (A) and Biomass (B) estimates with their associated confidence limits for cod from research surveys in Div. 2J.

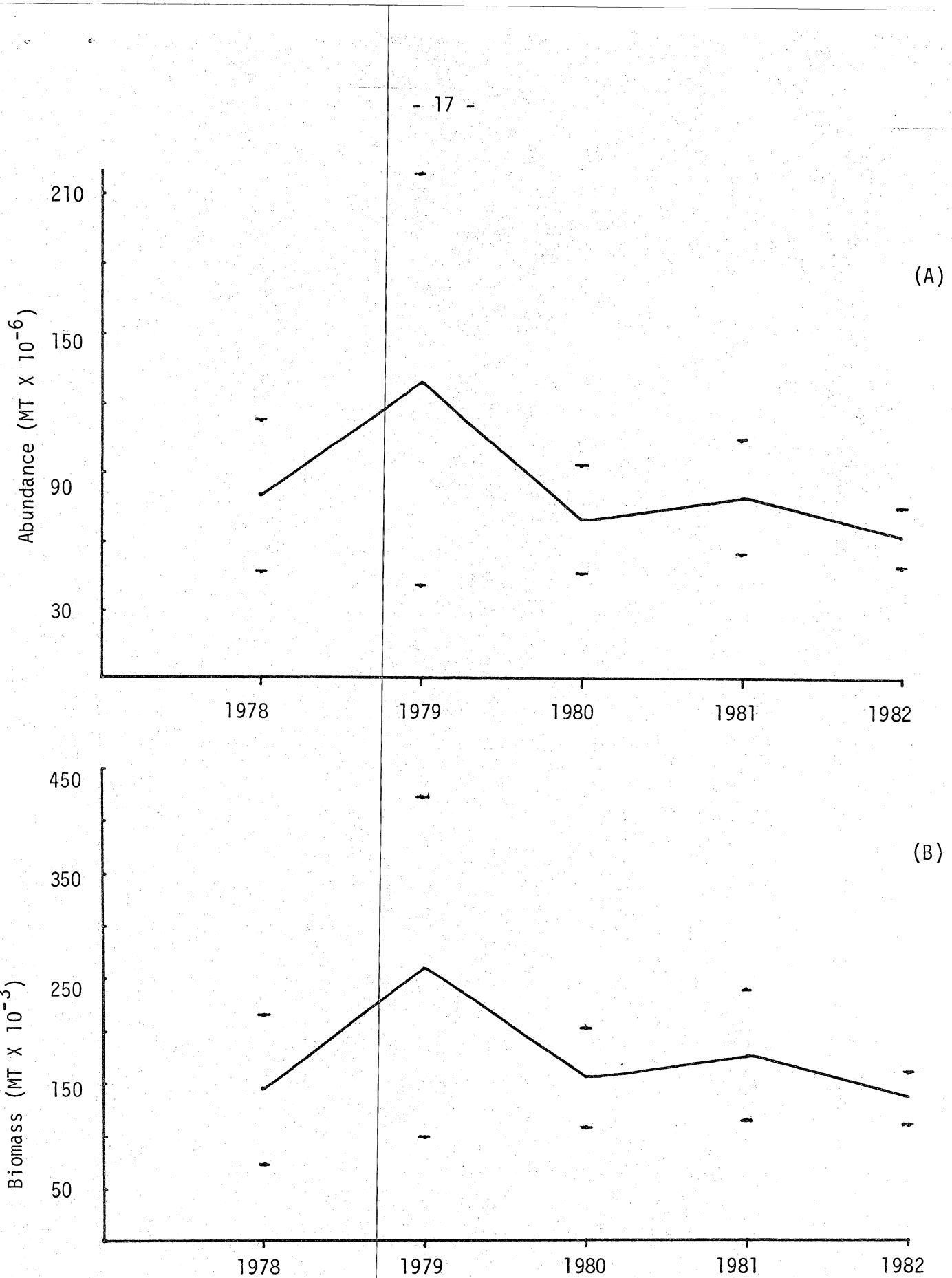


Fig. 2. Abundance (A) and Biomass (B) estimates with their associated confidence limits for cod from research surveys in Division 3K.

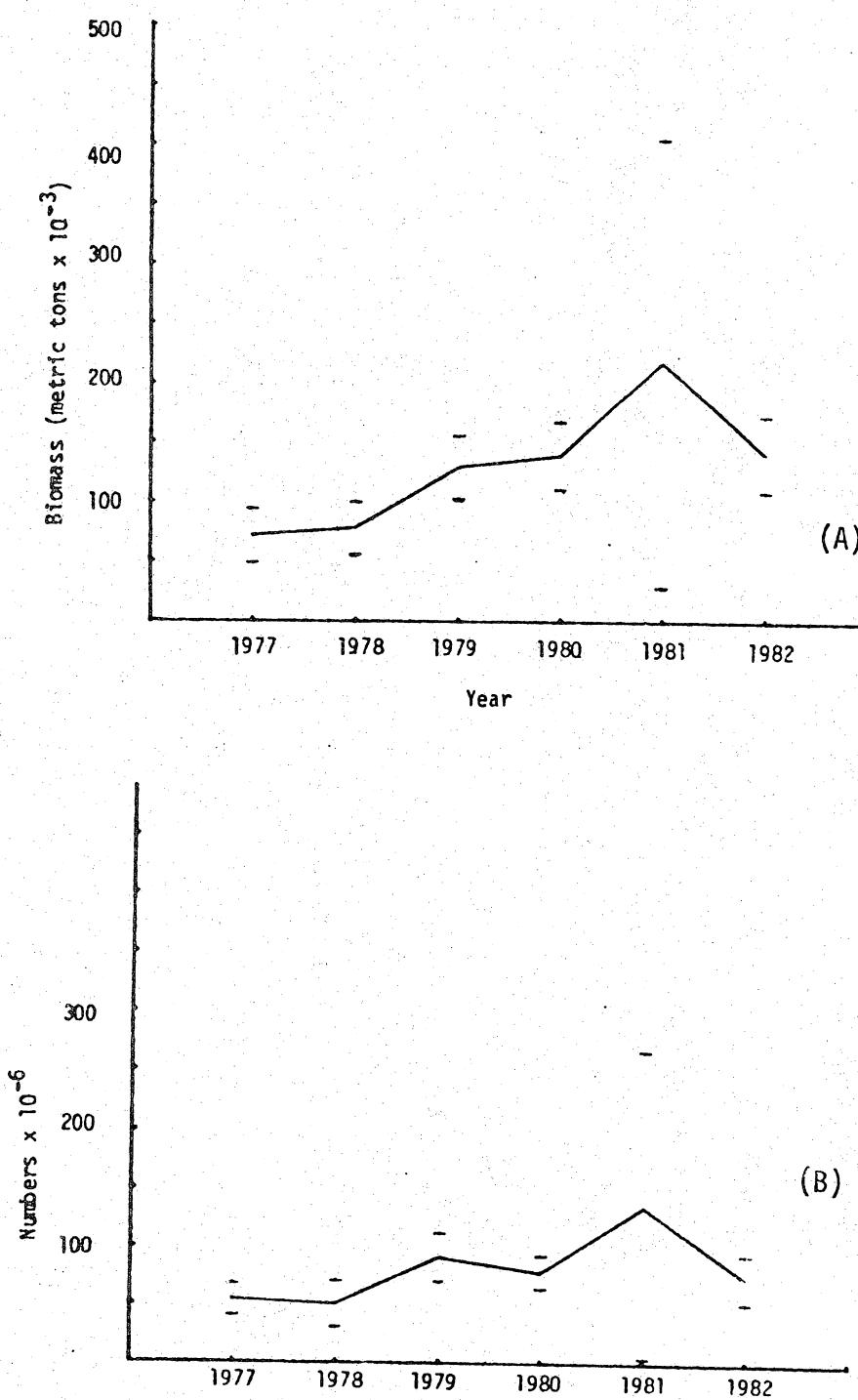


Fig. 3. Biomass (A) and abundance estimates (B) along with their associated confidence limits from research surveys in Division 3L.



Fig. 4. Catch rate index with approximate 90% confidence interval for cod in Divisions 2J3KL.

EXPLOITABLE BIOMASS (MTD-YR) VS CATCH RATE INDEX

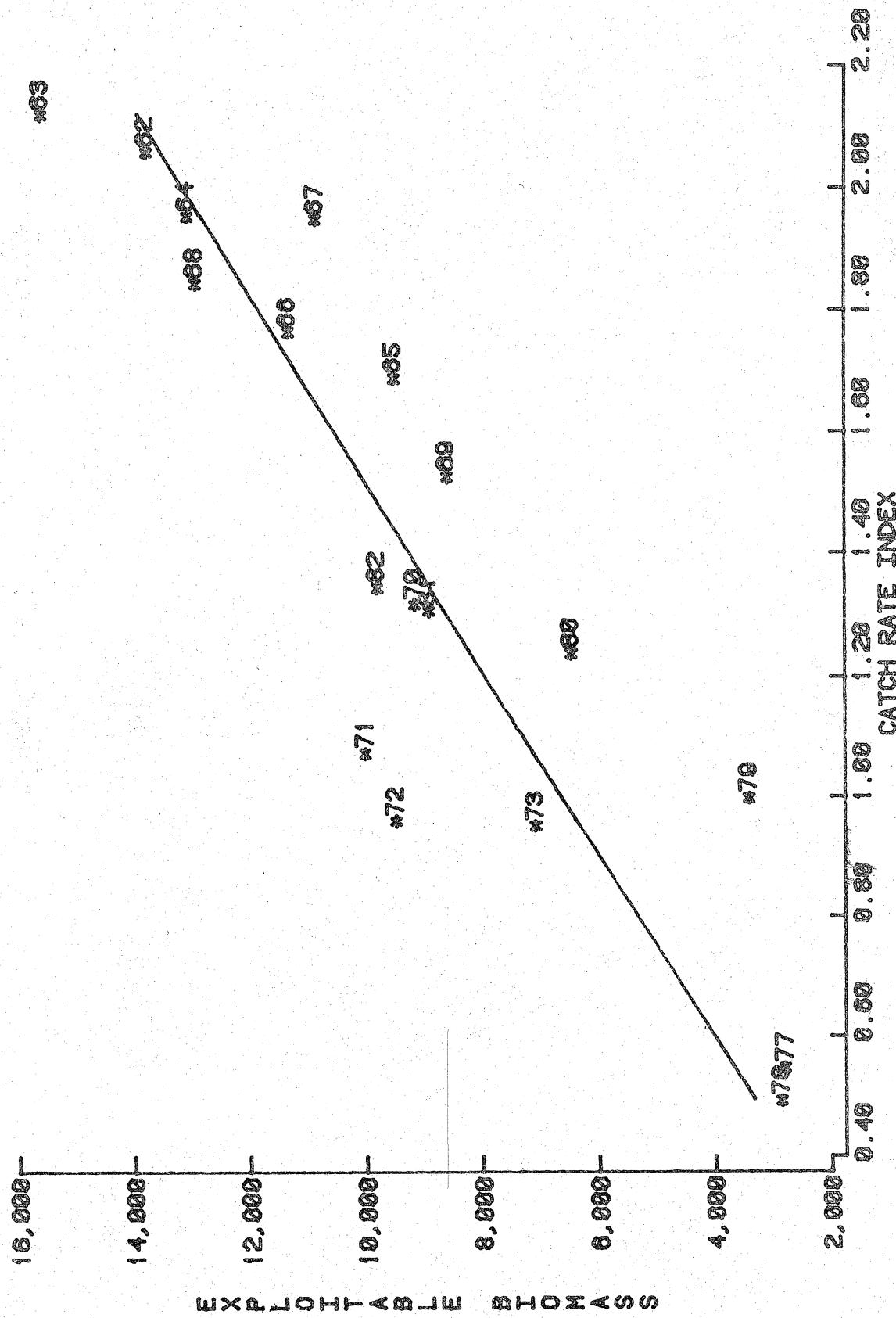


Fig. 5. Plot of the regression of exploitable biomass versus catch rate index for cod in Divisions 2J3KL using a fishing mortality of 0.225 for fully recruited ages in 1982.