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Assessment of pollock in Divisions 4VWX and Subarea 5

by

J. M. McGlade and D. Beanlands
Marine Fish Division
Fisheries Research Branch
Department of Fisheries and Oceans
P.O. Box 1006
Dartmouth, Nova Scotia
B2Y 4A2

[1] This series documents the scientific basis for fisheries management advice in Atlantic Canada. As such, it addresses the issues of the day in the time frames required and the Research Documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Abstract

Research vessel survey results are inconclusive for pollock, however commercial catch rates would indicate that the 1979 year-class is strong whilst the 1978 year-class is not as large as previously thought. Cohort analyses further suggest that fishing mortality has been underestimated in past assessments, such that year-classes preceding 1979 have been exploited to a greater extent. A terminal F of 0.35 was considered the most appropriate level to provide the best estimate of stock status in 1981. Projections with $F_{0.1}$ catches in 1982 and 1983 gave 42,000 and 48,000 mt respectively. If the TAC is taken in 1982 (54,000 mt) then the projected catch for 1983 is 45,000 mt.

Résumé

Les relevés par navire de recherche ne donnent pas de résultats concluants en ce qui a trait à la goberge. Cependant, les taux de captures commerciales sembleraient indiquer que la classe d'âge de 1979 est abondante tandis que celle de 1978 ne l'est pas autant qu'on ne l'avait cru. En outre, des analyses de cohortes donnent à penser que, dans les évaluations antérieures, la mortalité par pêche avait été sous-estimée, de sorte que les classes d'âge d'avant 1979 ont été exploitées plus intensivement. On a cru qu'un F de dernière année de 0,35 convenait le mieux à une projection des prises; les prises à $F_{0,1}$ en 1982 et 1983 ont été de 42 000 et 48 000 t respectivement. Si le TPA est atteint en 1982 (54 000 t), les projections des prises de 1983 sont alors de 45 000 t.

Introduction

Pollock within Divs. 4VWX and Subarea 5 are currently managed as a single stock, although there are demonstrable differences between growth rates and spawning sites for the whole area. Catches have steadily risen since the middle part of the 1970's, to a potential peak[1] in 1981 of 57,202 mt (Table 1). However uncertainty concerning misreporting of haddock as pollock has masked some of the potential indications of strong year-classes passing through the fishery.

Nominal Catches

The fishery is prosecuted in both offshore and inshore areas, and generally throughout the year (Tables 2 and 3). It is clear that there is a similar pattern of fishing during 1974 - 1980 by both the Canadian and U.S.A. fleets in terms of catches (Figs. 1 and 2). However the pattern was broken in 1981 by the allocation of 14,000 mt to both inshore and offshore sectors of the fleet in the form of a bycatch increase from 20 to 30% in September. This bycatch was taken predominantly in 4W by OTB-1,2 TC 5 (Table 4, Fig. 3), where it was incorporated into the directed fishery for October to December.

Recent catches and TAC's ('000 mt) have been as follows:

	1975	1976	1977	1978	1979	1980	1981
TAC	55	55	30	30	30	40	54*
Nominal catch	39	38	38	45	47	55	57**

*Provisional Statistics ** Raised from 40 to 54 effective August 25, 1981.

Age Composition of Reported Landings

Sampling of the commercial fishery was increased during 1981. A total of 71 samples were taken, although the majority were restricted to OTB-1,2 (TC 3,4 and 5): gillnet samples were obtained from the periods during which most catches were taken (Table 5). The only gears poorly sampled were long-liners and inshore vessels of TC 1 and 2, but the catches taken by these categories only represented 9% of the total Canadian landing. Values for the U.S.A. removals were obtained from the National Marine Fisheries Service, Woods Hole, Massachusetts. Weights-at-age (Fig. 4) were significantly different between gears and areas, thus prorating of the landings was done by

[1] Statistics are given provisionally for 1981 at 57,202 MT, because the reports from the U.S.A. were only available for January to September; thus the total U.S.A. catches were based on 1980 proportions. No figures were available for foreign fleets.

gear, quarter and area.

The commercial removals-at-age matrix shows that the potentially strong year-class in 1979 is probably a reality (Table 6): all the gears sampled in the Canadian fishery consistently picked up fish at age 2. Hence the percentage at age in 1981 is quite different. The absence of supporting numbers of 3 year olds however lays some doubt on the potential of the 1978 year-class as one which would radically increase catches in the future, as suggested in the 1981 assessment of this stock (McGlade et al. 1981).

Stock Size Indices and Total Mortality Estimates

Results from the research vessel surveys run by the U.S.A. (spring) indicate that there is some increase in biomass throughout Subarea 5 (Tables 7 and 8). This pattern is not vindicated by the Canadian surveys in Divs. 4VWX, where there has been a substantial drop in both numbers per tow and weight per tow (Table 9). This decrease (Fig. 5) is almost entirely due to sets in strata 60 and 62 which increased the catch rates in 1981 by very high catches, a phenomenon not uncommon in schooling fish. However, the age structure of the population would suggest that some stability exists in those ages greater than age 5, when pollock are fully recruited to the research gear. The spatial absence of earlier ages in areas surveyed during the Canadian summer bottom surveys compounds the problem of year-class classification (Table 10).

Indications from research surveys and commercial catch rate indices are that an increase occurred across the fishery of catch per unit effort; the exceptions to this are of course the Canadian summer survey (for reasons described above) and the OTB-1,2 TC 4 vessels. The decline in catch rates for the latter category cannot be explained at this time. The multiplicative catch rate series, derived by a model constructed to combine heterogeneous catch and effort data (Gavaris 1980) also showed an increase in 1981 (Table 11). The effort data shows a corresponding decrease for the catch rates which increased in 1981 (Table 12).

Total mortality estimates were high for both OTB-1,2 TC4 and 5 categories, giving little indication as to the fishing mortality once natural mortality is set at 0.2 (Table 13). Estimates from the research survey abundance estimates were even more uncertain.

Estimation of Stock Abundance

Cohort runs (using Pope's formula) were made initially using the PR vector in the 1980 assessment of this stock (McGlade et al. 1981); this comprised of a vector of 0.046, 0.398, 0.936 1.000 for fish at ages 2,3,4 and 5, and a fully recruited F of 0.25 to 0.35. The results were examined with regard to 5+ biomass versus the standardized catch rates for OTB-1,2 TC 5 and the CPUE from the multiplicative model (Table 14). With the above relationships we were unable to resolve the most appropriate terminal F. However, the run at F_t = 0.275 forced the terminal fishing mortalities up

in previous years, and was inconsistent with the reported fishing effort. The cohort run which gave the most significant relationship between 5+ biomass from the research vessel data and catch rates from OTB-1, 2 vessels of TC5 produced an F_t = 0.35 (Table 15, Figure 6). This run brought the 1981 point onto a line drawn through the origin but led to the exclusion of the 1979 point, which had an extremely high catch rate possibly as a result of haddock misreporting. The actual regression line had an intercept of -0.014 and an R value of 0.87.

Partial Recruitment

A revised PR vector was obtained from dividing the F-at-age by the fully recruited F in each year and then averaging these results over the 1973-80 period. The vector was also adjusted for age 2 to make the estimate of the 1979 year-class at age 2 comparable with the largest observed year-classes (viz. 1975 and 1976). The final vector was:

Age	2	3	4	5	6	7	8	9	10	11	12
PR	0.057	0.322	0.79	1	1	1	1	1	1	1	1

This vector was obtained from the final cohort run at F_t = 0.35.

Yield-per-recruit

A Thompson-Bell yield per recruit analysis was run using the P.R. vector given above, and the weights-at-age for 1981. The results gave $F_{0.1}$ = 0.28, F_{max} = 0.60 and a yield per recruit of 1.264 kg at $F_{0.1}$ (Table 16).

Catch Projections

The results from the catch projections (Table 17, a, b) using the above criteria, plus a geometric mean (1977-1981) of 2 year olds of 40762, presented fairly constant population biomasses. The two catch projections were a) assuming that the $F_{0.1}$ catch is caught in 1982, and b) that the TAC is caught. In both cases the potential biomass available is less than the TAC currently in effect, (viz. 48 and 45,000 mt). However, the results given in this analysis indicate that in the past the fishing mortality may have been underestimated, and as such the effects on the population are only now apparent.

Conclusions

Research vessel survey results are inconclusive for pollock, however, commercial catch rates would indicate that the 1979 year-class is strong whilst the 1978 year-class is not as large as previously thought. Cohort analyses further suggest that fishing mortality has been underestimated in the past, such that the year-classes preceding 1979 have been exploited to a greater extent. The final outcome is therefore a reduction in the available biomass when either the $F_{0.1}$ catch or the TAC are taken in 1982 for 1983.

References

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

McGlade, J.M., K. Zwanenburg, and J.J. Maguire. 1981. Assessment of the Division 4VWX and Subarea 5 pollock stock complex. CAFSAC Res. Doc. 81/31.

Table 1. Pollock landings (mt round weight) by country for divisions 4VWX and subareas 5 and 6, 1960 - 1980.

Year	Canada	Fed. Rep. Germany	German Dem. Rep.	Japan	Spain	USSR	United Kingdom	U.S.A.	Other	Total
1960	29470	-	-	-	763	-	-	10132	1	40386
1961	26323	-	-	-	982	-	-	10265	1	37571
1962	31721	-	-	-	-	-	-	7391	-	39112
1963	28999	126	-	-	-	906	28	6653	-	36712
1964	30007	208	-	-	-	4603	374	6006	55	41253
1965	27316	71	-	-	1361	2667	11	5303	-	36729
1966	18271	-	-	-	2384	9865	12	3791	-	34323
1967	17567	-	9	-	1779	644	1	3312	-	23317
1968	18062	-	-	-	1128	372	-	3280	7	22849
1969	15968	1188	2195	-	1515	227	-	3943	7	25043
1970	10753	3233	4710	40	532	527	-	3976	-	23771
1971	11757	633	6849	15	912	2216	-	4890	3	27275
1972	18022	475	4816	8	616	3495	4	5729	54	33219
1973	26990	1124	948	1570	3113	3092	-	6303	36	43176
1974	24975	149	2	40	1500	2348	48	8726	14	37802
1975	26548	236	96	-	709	2004	-	9318	124	39035
1976	23568	994	24	-	303	1466	-	10861	390	37606
1977	24653	368	-	1	2	268	-	13056	53	38401
1978	26801	-	-	110	-	502	-	17714	180	45307
1979	29967	7	-	19	-	1025	-	15541	72	46631
1980	35927	-	-	81	-	950	-	18278	135	55371
1981	40202	-*	-*	-*	-*	-*	-*	17000*	-*	57202*

*Provisional

Table 2. Pollock landings by month and country for NAFO divisions 4VWX - 5 - 6.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total[2]
							CANADA						
1972	204	993	296	930	1004	3084	3718	1192	1755	2188	2191	467	18022
1973	498	981	1521	2922	2135	4785	3239	3403	2331	2181	1955	1039	26990
1974	288	187	869	1012	1986	3730	5073	2206	2202	1634	2461	3327	24975
1975	333	230	475	2021	1524	2920	2736	3691	2312	2833	2993	4480	26548
1976	297	263	445	1498	2604	4270	3814	2327	2347	1669	1413	2621	23568
1977	1062	1748	2271	1859	1006	2202	2097	2003	2304	1333	2309	4459	24653
1978	2511	3265	1864	2070	3425	2772	2755	1228	1262	839	706	4101	26801
1979	935	1536	1523	1970	2597	4664	4850	3389	1866	1645	1486	3506	29967
1980	1460	3035	2431	1901	3476	5599	5299	3086	2218	3604	2018	1800	35927
1981	2562	1780	3419	2048	1195	2365	2875	3350	4432	2461	4828	8887	40202
							U.S.A.						
1972	455	318	228	229	200	394	329	294	314	488	1082	1397	5729
1973	419	313	311	406	331	418	335	302	262	573	1111	1519	6303
1974	946	558	508	650	479	388	644	570	480	661	1097	1385	8726
1975	740	721	486	594	477	924	684	743	765	598	1108	1061	9318
1976	706	658	501	665	936	1035	985	800	1125	669	813	1305	10861
1977	1017	661	460	817	1061	1038	1350	1149	933	924	1188	1709	13056
1978	884	1065	1035	1394	1150	1347	988	1593	925	1251	2665	2620	17714
1979	1196	434	505	753	1298	1332	1252	1706	1392	1352	1876	1605	15541
1980	1006	1094	710	977	1540	1437	1605	1538	1504	1287	1961	2281	18278
1981	1845	1076	927	1192	1386	1276	1087	1020	820	1465	2293	2613	170003*
							OTHERS						
1972	599	481	440	686	538	627	867	270	183	47	385	4278	9468
1973	513	1808	442	966	48	812	117	367	700	407	1996	1689	9883
1974	42	567	165	132	751	235	612	463	412	228	176	268	4101
1975	154	382	311	129	645	339	234	51	195	156	327	245	3169
1976	33	129	273	312	228	265	257	275	659	543	113	89	3177
1977	-	2	84	43	398	96	11	17	5	8	2	-	692
1978	-	-	-	9	109	172	152	105	7	92	2	8	792
1979	-	19	3	10	705	226	101	4	48	3	4	-	1123
1980	5	53	12	153	549	264	47	14	9	27	29	-	1166
1981*	No Figures Available												
							TOTALS						
1972	1258	1792	964	1845	1742	4105	4914	1756	2252	2723	3658	6142	33219
1973	1430	3102	2274	4294	2514	6015	3691	4072	3293	3161	5062	4247	43176
1974	1276	1312	1542	1794	3216	4353	6329	3239	3094	2523	3734	4980	37802
1975	1227	1333	1272	2744	2646	4183	3654	4485	3272	3587	4428	5786	39035
1976	1036	1050	1219	2475	3768	5571	5056	3402	4131	2881	2339	4015	37606
1977	2079	2411	2815	2719	2465	3336	3458	3169	3242	2265	3499	6168	38401
1978	3395	4330	2899	3473	4684	4291	3895	2926	2194	2182	3373	6732	45307
1979	2131	1989	2031	2733	4600	6222	6203	5099	3306	3000	3366	5111	46631
1980	2471	4182	3153	3031	5565	7300	6951	4638	3731	4918	4008	4081	55371
1981*	4407	2856	4346	3240	2581	3641	3962	4370	5252	3926	7121	11500	57202

* Provisional

[2] Includes NK months of the year

[3] Prorated on 1980 figures

Table 3. Pollock landings (mt, round fresh) for divisions 4VWX, subarea 5, and statistical area 6, 1960 - 80.

Year	4Vn	4Vs	4W	4NK	4NK	Total 4VWX	5Y	5Ze	5Zw	Total 5Z	5NK	Total SA 5	SA6	Total
1960	691	811	8354	20132	-	29988	6545	-	-	3834	18	10397	-	40385
1961	811	1053	13167	14321	-	29352	5017	-	-	3177	25	8219	-	37571
1962	554	738	12045	19624	-	32961	2560	-	-	3576	15	6151	-	39112
1963	400	274	9152	20645	-	30471	2168	-	-	3947	10	6125	116	36712
1964	337	137	12488	19283	-	32245	1754	-	-	7250	-	9004	4	41253
1965	147	1058	13134	13390	-	27729	1933	-	-	7065	-	8998	2	36729
1966	226	562	11040	12648	-	24476	953	-	-	8846	-	9799	48	34323
1967	147	510	5836	8290	-	14783	1728	-	-	6790	14	8532	2	23319
1968	256	757	5954	10656	-	17623	1416	3724	82	3806	-	5222	4	22849
1969	91	209	3938	10983	-	15221	4635	5025	162	5187	-	9822	-	25043
1970	130	519	2952	8194	-	11795	6281	5157	123	5280	-	11561	415	23771
1971	214	317	1802	9739	-	12072	7016	7096	142	7238	58	14312	891	27275
1972	102	495	3419	16190	-	20206	6419	6519	51	6570	-	12989	24	33219
1973	170	834	5871	23225	-	30100	5202	6235	1618	7853	-	13055	21	43176
1974	68	239	4740	20362	-	25409	6106	6233	5	6238	-	12344	49	37802
1975	179	620	5697	18668	-	25164	6015	7848	3	7851	-	13866	5	39035
1976	52	1050	3424	19700	-	24226	6441	6915	11	6929	12	13379	3	37608
1977	166	1181	6082	14700	-	22129	8278	7846	79	7925	36	16239	34	38402
1978	98	2833	4910	15161	-	23002	12238	9943	17	9960	91	22289	16	45307
1979	356	4521	4963	18340	-	28180	9856	8356	11	8367	221	18444	7	46631
1980	574	3310	7443	20504	-	31831	11388	11880	20	11900	249	23537	3	55371
1981*	195	2026	15314	18624	438	36597	10740	-	-	9623	242	20605	-	57202

* Provisional

Table 4. Distribution of Canadian catches by area, quarter and gear. (Other includes LL, LHP and SSC).

	Jan - Mar.	Apr - Jun	July - Sept	Oct - Dec
4V OTB-1,2 T.C.5	482	670	439	372
4	86	109	45	30
3	0	13	1	0
Other	0	2	1	0
4W OTB-1,2 T.C.5	2114	599	649	7283
4	531	309	31	628
3	4	161	107	18
GN	42	25	2259	256
Other	11	54	158	45
4X/OTB-1,2 T.C.5	1859	787	514	2375
5Y 4	536	167	241	235
3	473	1282	1597	816
GN	389	286	2132	2292
Other	211	883	1772	487
5Z OTB-1,2 T.C.5	970	133	546	1220
4	53	80	33	38
3	0	15	49	19
Other	0	33	83	61

Table 5. 1981 Canadian commercial samples available for pollock in NAFO Div. 4V,4W,4X and Subarea 5. (fish aged/fish measured)

Gear	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						4V						
OTB2	77/807						27/300	26/202				
						4W						
OTB1	31/305				34/237							
OTB2	79/685				50/396	84/757			24/144	39/301		29/228
Fix							26/234	22/175				
						4X						
OTB1				29/220		28/200						
OTB2	31/308	66/454	265/1863	143/908		109/766		171/1125			130/821	30/231
Fix				20/188		53/417			31/304			
LL				31/224								
						5Z						
OTB1						27/236						
OTB2			164/1146									
						4V 4X						
OTB2			34/294	59/662								
						4W 4X						
OTB1	34/214											
OTB2		27/401										35/258
						4V 4W						
OTB2			37/303									33/264
						4V 4X 4W						
OTB2			23/249	26/189					25/276			
						4X 5Ze						
OTB2											29/354	
						4X 4W 5Ze						
OTB2			39/321									

Table 6. Commercial catch-at-age ($x10^{-3}$), percentage composition, and commercial weights-at age (kg.).

COMMERCIAL CATCH-AT-AGE FOR CANADA + OTHER NATIONS (EXCEPT USA)

AGE	1973	1974	1975	1976	1977	1978	1979	1980	1981
2	197	303	231	392	150	104	31	176	1585
3	1017	4417	2290	2149	2233	2297	2269	1278	973
4	9770	1808	5832	2554	3029	4136	4575	3016	2330
5	3881	2425	1570	3240	1750	3016	2883	4815	4569
6	894	1147	1397	860	2111	1193	1823	2531	2660
7	689	397	432	638	775	1135	474	661	1065
8	289	318	96	155	348	311	163	161	259
9	431	84	34	18	75	96	77	91	261
10	406	92	42	25	21	18	27	21	73
11	79	89	30	17	24	27	13	11	19

COMMERCIAL CATCH-AT-AGE FOR USA

AGE	1973	1974	1975	1976	1977	1978	1979	1980	1981
2	1659	314	141	122	20	92	202	192	1915
3	578	2864	1056	803	293	726	1359	416	678
4	1218	1091	2602	1029	943	550	1773	1955	1132
5	460	1200	320	1212	681	649	1039	1555	1961
6	155	180	258	373	826	631	500	964	939
7	106	115	123	323	326	936	243	542	301
8	74	96	42	104	261	349	285	195	57
9	26	28	21	11	99	270	114	168	49
10	15	32	28	7	62	134	47	78	12
11	0	14	17	17	20	84	25	36	3

TOTAL COMMERCIAL CATCH-AT-AGE

AGE	1973	1974	1975	1976	1977	1978	1979	1980	1981
2	1856	617	372	514	170	196	234	489	3500
3	1595	7281	3346	2952	2526	3023	3628	1950	1651
4	4722	2899	8434	3583	3972	4686	6349	5718	3462
5	4341	3625	1890	4452	2431	3665	3922	5951	6530
6	1049	1327	1655	1233	2937	1824	2323	3100	3599
7	795	512	555	961	1101	2071	717	1114	1366
8	363	414	138	259	609	660	448	411	316
9	457	112	55	29	174	366	191	331	310
10	421	124	70	32	83	152	74	140	85
11	79	103	47	34	44	111	38	78	22

COMMERCIAL CATCH-AT-AGE (PERCENTAGE)

	1973	1974	1975	1976	1977	1978	1979	1980	1981
2	8.5	3.6	2.2	3.7	1.2	1.2	1.3	2.5	16.8
3	7.3	42.8	20.2	21.0	18.0	18.0	20.2	10.1	7.9
4	50.1	17.0	50.9	25.5	28.3	28.0	35.4	29.7	16.6
5	19.8	21.3	11.4	31.7	17.3	21.9	21.9	30.9	31.3
6	4.8	7.8	10.0	8.8	20.9	10.9	13.0	16.1	17.3
7	3.6	3.0	3.4	6.8	7.8	12.4	4.0	5.8	6.6
8	1.7	2.4	0.8	1.8	4.3	3.9	2.5	2.1	1.5
9	2.1	0.7	0.3	0.2	1.2	2.2	1.1	1.7	1.5
10	1.9	0.7	0.4	0.2	0.6	0.9	0.4	0.7	0.4
11	0.4	0.6	0.3	0.2	0.3	0.7	0.2	0.4	0.1

COMMERCIAL WEIGHTS-AT-AGE (KG)

AGE	1973	1974	1975	1976	1977	1978	1979	1980	1981
2	0.78	0.81	0.89	0.81	0.93	0.86	0.91	1.22	1.03
3	1.58	1.44	1.47	1.55	1.10	1.07	1.39	1.87	1.77
4	2.38	2.18	2.10	2.20	1.55	1.57	1.95	2.27	2.53
5	3.12	3.07	2.97	2.97	2.45	2.64	2.86	3.07	2.87
6	3.67	4.10	3.95	3.76	3.35	3.65	3.72	3.34	3.50
7	4.42	5.10	5.00	4.51	4.34	4.86	4.46	4.14	4.31
8	4.96	6.11	6.24	5.18	5.63	5.44	6.33	5.92	5.51
9	5.70	6.68	7.07	6.14	6.38	6.52	6.00	6.24	6.51
10	5.64	7.27	7.29	7.64	7.22	7.08	7.34	7.87	7.78
11	7.40	8.01	7.83	7.66	8.32	7.97	8.04	8.48	8.21
12	7.59	8.65	8.88	7.26	9.11	8.76	8.84	12.78	9.44

Table 7. Stratified mean catch per tow in weight (kg) and numbers for Scotian Shelf, Gulf of Maine, and Georges Bank pollock in NEFC offshore spring[1], summer[2], and autumn[3] bottom trawl surveys, 1963-1981.

	SPRING		SUMMER		AUTUMN	
Year	Weight	Numbers	Weight	Numbers	Weight	Numbers
1963	-	-	10.28	2.31	5.79	1.46
1964	-	-	5.27	2.06	4.40	1.64
1965	-	-	2.56	1.72	2.74	0.83
1966	-	-	-	-	2.35	0.97
1967	-	-	-	-	1.80	0.52
1968	4.47	1.09	-	-	3.17	0.69
1969	2.66	1.12	1.75	0.70	6.58	1.31
1970	4.91	1.67	-	-	2.59	0.64
1971	4.39	1.18	-	-	3.96	1.09
1972	5.67	4.43	-	-	4.37	1.41
1973	4.82	4.00	-	-	4.71	1.64
1974	4.10	1.39	-	-	3.17	0.90
1975	5.90	1.67	-	-	2.04	0.70
1976	6.84	1.59	-	-	16.66	3.69
1977	3.44	1.63	9.98	2.07	8.78	2.14
1978	6.56	2.48	4.05	1.29	5.83	0.98
1979	4.75	1.06	17.57	2.96	5.81	1.28
1980	4.40	1.52	9.83	12.21	4.63	0.83
1981	6.30	2.00	-	-	-	-

[1] Strata 13-40

[2] Strata 21-28 and 37-40.

[3] The "36 Yankee" trawl was used from 1968-1972, and the "41 Yankee" trawl was used from 1973-1981. No gear conversion factors are available to adjust for differences in fishing power.

Table 8. U.S.A. Research Survey catch rates (Nos. per Tow).

AGE	SPRING												SUMMER				AUTUMN										
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1977	1978	1979	1980	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
0	0.01	0.01															0.01	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01
1	0.52	0.15	1.20	0.01	0.01	0.01	0.08	0.14	0.00	0.10	0.15	0.02	0.05	0.00	0.05	10.85	0.13	0.11	0.38	0.03	0.00	0.22	0.03	0.06	0.03	0.01	0.13
2	0.05	0.13	1.49	2.80	0.10	0.33	0.11	0.38	0.22	0.05	0.15	0.70	0.23	0.57	0.00	0.00	0.08	0.38	0.27	0.71	0.08	0.06	0.03	0.17	0.19	0.02	0.01
3	0.17	0.13	0.90	0.51	0.53	0.20	0.14	0.23	0.42	0.07	0.09	0.13	0.09	0.17	0.38	0.06	0.01	0.16	0.20	0.12	0.28	0.03	0.15	0.24	0.04	0.26	0.01
4	0.20	0.09	0.20	0.15	0.14	0.34	0.15	0.06	0.65	0.08	0.28	0.15	0.26	0.09	0.26	0.29	0.09	0.02	0.08	0.17	0.20	0.11	0.55	0.29	0.04	0.33	0.05
5	0.05	0.07	0.05	0.14	0.08	0.08	0.24	0.16	0.63	0.15	0.25	0.21	0.29	0.08	0.36	0.25	0.08	0.06	0.07	0.11	0.11	0.07	1.63	0.42	0.09	0.19	0.11
6	0.07	0.08	0.05	0.04	0.16	0.09	0.13	0.32	0.15	0.14	0.20	0.22	0.32	0.08	0.55	0.30	0.08	0.09	0.08	0.11	0.08	0.04	0.50	0.38	0.09	0.13	0.06
7	0.09	0.04	0.07	0.03	0.07	0.10	0.15	0.13	0.11	0.08	0.23	0.09	0.15	0.05	0.36	0.22	0.04	0.04	0.07	0.09	0.09	0.09	0.31	0.22	0.15	0.08	0.07
8	0.12	0.09	0.12	0.10	0.03	0.08	0.17	0.11	0.08	0.16	0.08	0.07	0.23	0.09	0.49	0.03	0.02	0.08	0.05	0.07	0.01	0.01	0.14	0.11	0.08	0.09	0.13
9	0.08	0.06	0.04	0.04	0.00	0.05	0.11	0.02	0.07	0.08	0.04	0.06	0.07	0.03	0.06	0.02	0.01	0.03	0.04	0.00	0.02	0.01	0.05	0.09	0.06	0.05	0.08
10	0.04	0.07	0.07	0.09	0.01	0.06	0.03	0.02	0.05	0.03	0.02	0.08	0.08	0.01	0.21	0.07	0.02	0.01	0.03	0.12	0.00	0.01	0.01	0.02	0.04	0.04	0.06
11	0.04	0.07	0.04	0.02	0.10	0.02	0.04	0.01	0.04	0.03	0.00	0.06	0.07	0.05	0.00	0.05	0.01	0.01	0.03	0.02	0.02	0.01	0.01	0.00	0.03	0.01	0.04
12+	0.23	0.20	0.17	0.09	0.16	0.29	0.24	0.04	0.07	0.08	0.05	0.19	0.23	0.08	0.23	0.13	0.07	0.09	0.10	0.10	0.02	0.03	0.29	0.14	0.12	0.06	0.07
Totals																											
1+	1.66	1.18	4.40	4.02	1.39	1.65	1.59	1.62	2.49	1.05	1.54	1.98	2.07	1.30	2.95	12.20	0.64	1.08	1.40	1.65	0.91	0.68	3.70	2.14	0.96	1.27	0.82
2+	1.14	1.03	3.20	4.01	1.38	1.64	1.51	1.48	2.49	0.95	1.39	1.96	2.02	1.30	2.90	1.53	0.51	0.97	1.02	1.62	0.91	0.46	3.67	2.08	0.93	1.26	0.69
3+	1.09	0.90	1.71	1.21	1.28	1.31	1.40	1.10	2.27	0.90	1.24	1.26	1.79	0.73	2.90	1.42	0.43	0.59	0.75	0.91	0.83	0.40	3.64	1.91	0.74	1.24	0.68
4+	0.92	0.77	0.81	0.70	0.75	1.11	1.26	0.87	1.85	0.83	1.15	1.13	1.70	0.56	2.52	1.36	0.42	0.43	0.55	0.79	0.55	0.37	3.49	1.67	0.70	0.98	0.67
5+	0.72	0.68	0.61	0.55	0.61	0.77	1.11	0.81	1.20	0.75	0.87	0.98	1.44	0.47	2.26	1.07	0.33	0.41	0.47	0.62	0.35	0.26	2.94	1.38	0.66	0.65	0.62

Table 9. Stratified mean catch per tow at age for pollock in Canadian summer bottom trawl surveys.(strata 43-95)

RESEARCH VESSEL CATCH RATES (NOS/TOW) 4VW

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	1.821	0.361	0.000	0.078	0.000	0.000	0.015	0.000	0.000	0.000	0.613	0.128
3	0.352	0.339	0.000	0.033	0.914	0.007	0.015	0.072	0.144	0.007	0.672	0.010
4	0.041	0.074	0.007	0.048	0.237	0.304	0.036	0.031	0.144	0.153	1.879	0.007
5	0.011	0.011	0.011	0.000	0.137	0.200	0.107	0.041	0.179	0.107	3.102	0.015
6	0.019	0.000	0.000	0.000	0.096	0.218	0.037	0.089	0.158	0.047	0.795	0.094
7	0.000	0.002	0.000	0.000	0.041	0.022	0.019	0.037	0.075	0.012	0.401	0.058
8	0.000	0.000	0.000	0.000	0.015	0.078	0.000	0.037	0.041	0.000	0.119	0.028
9	0.000	0.000	0.011	0.015	0.015	0.011	0.000	0.030	0.026	0.000	0.040	0.020
10	0.000	0.000	0.000	0.000	0.048	0.000	0.000	0.000	0.002	0.000	0.000	0.017
11	0.019	0.000	0.000	0.000	0.067	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000	0.048	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12+	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.017	0.000

RESEARCH VESSEL CATCH RATES (NOS/TOW) 4X

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	0.008	0.000	0.012	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.011	0.004
2	0.095	0.414	0.103	0.350	0.044	0.008	0.020	0.278	0.004	0.000	0.000	0.046
3	0.119	0.239	0.203	0.366	0.095	0.012	0.199	0.763	0.040	0.107	0.048	0.178
4	0.247	0.103	1.328	1.189	0.016	0.048	0.577	1.026	0.529	0.557	0.176	0.049
5	0.199	0.032	0.386	0.433	0.195	0.099	0.970	2.135	0.811	0.712	0.541	0.510
6	0.187	0.020	0.123	0.060	0.083	0.175	0.223	1.439	0.207	0.561	0.467	0.351
7	0.171	0.032	0.036	0.024	0.163	0.044	0.410	0.179	0.258	0.239	0.355	0.246
8	0.103	0.012	0.064	0.044	0.103	0.020	0.155	0.346	0.064	0.163	0.169	0.219
9	0.040	0.008	0.044	0.040	0.076	0.020	0.044	0.099	0.020	0.012	0.071	0.067
10	0.000	0.024	0.028	0.004	0.008	0.004	0.048	0.068	0.000	0.040	0.065	0.075
11	0.028	0.000	0.012	0.028	0.068	0.008	0.020	0.036	0.000	0.000	0.000	0.024
12	0.012	0.000	0.008	0.012	0.000	0.000	0.020	0.016	0.016	0.000	0.000	0.000
12+	0.000	0.000	0.020	0.000	0.000	0.000	0.028	0.000	0.012	0.000	0.023	0.056

RESEARCH VESSEL CATCH RATES (NOS/TOW) 4VWX

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	0.008	0.000	0.012	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.011	0.004
2	1.916	0.775	0.103	0.428	0.044	0.008	0.035	0.278	0.004	0.000	0.613	0.174
3	0.471	0.578	0.203	0.399	1.010	0.019	0.214	0.836	0.184	0.115	0.720	0.188
4	0.287	0.177	1.335	1.237	0.253	0.351	0.612	1.056	0.673	0.709	2.055	0.056
5	0.210	0.043	0.397	0.433	0.332	0.299	1.077	2.176	0.990	0.818	3.643	0.525
6	0.205	0.020	0.123	0.060	0.180	0.393	0.260	1.528	0.365	0.608	1.262	0.445
7	0.171	0.034	0.036	0.024	0.204	0.066	0.428	0.216	0.333	0.250	0.756	0.304
8	0.103	0.012	0.064	0.044	0.118	0.098	0.155	0.383	0.104	0.163	0.288	0.247
9	0.040	0.008	0.055	0.055	0.090	0.031	0.044	0.129	0.046	0.012	0.111	0.087
10	0.000	0.024	0.028	0.004	0.056	0.004	0.048	0.068	0.002	0.040	0.065	0.092
11	0.046	0.000	0.012	0.028	0.134	0.008	0.020	0.036	0.000	0.000	0.000	0.024
12	0.012	0.000	0.008	0.012	0.048	0.000	0.020	0.016	0.016	0.000	0.000	0.000
12+	0.000	0.000	0.020	0.000	0.000	0.000	0.028	0.000	0.012	0.000	0.040	0.056

RESEARCH VESSEL CATCH RATES (KG/TOW) 4VWX

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	0.001	0.000	0.002	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001
2	0.802	0.360	0.068	0.200	0.022	0.002	0.019	0.186	0.003	0.000	0.472	0.116
3	0.522	0.531	0.207	0.480	1.045	0.022	0.324	0.972	0.167	0.145	0.942	0.334
4	0.616	0.380	2.372	2.676	0.384	0.615	1.440	2.236	1.472	1.595	3.947	0.136
5	0.730	0.133	1.372	1.326	1.010	0.930	3.329	6.350	3.034	2.631	8.585	1.685
6	1.034	0.083	0.631	0.255	0.813	1.515	1.028	5.529	1.622	2.552	4.172	1.803
7	1.082	0.168	0.209	0.128	1.110	0.357	2.136	1.058	1.660	1.326	2.982	1.470
8	0.749	0.072	0.400	0.276	0.721	0.659	0.867	2.193	0.684	1.110	1.808	1.373
9	0.322	0.053	0.398	0.361	0.641	0.240	0.303	0.848	0.345	0.083	0.758	0.592
10	0.000	0.144	0.192	0.039	0.444	0.036	0.470	0.534	0.015	0.309	0.453	0.769
11	0.422	0.000	0.095	0.248	1.199	0.079	0.165	0.000	0.000	0.000	0.000	0.184
12	0.105	0.000	0.070	0.151	0.490	0.000	0.149	0.139	0.139	0.000	0.000	0.000
12+	0.000	0.000	0.159	0.000	0.000	0.000	0.284	0.000	0.115	0.000	0.000	0.387

Table 10. Catch-at-age (estimated total population numbers x 10^{-3}) from the Canadian summer bottom trawl surveys, strata 43-95.

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
2	8879	3579	479	1929	203	37	161	787	18	1747	146	327
3	2181	2666	939	1849	4677	89	989	4037	852	531	232	858
4	1330	822	6187	5731	1171	1541	2825	2901	3118	3093	815	255
5	972	199	1838	2007	1537	1386	4992	3094	4563	3503	2512	2426
6	951	92	570	276	832	1822	1202	3760	1678	2665	2199	2038
7	792	147	165	110	943	305	1983	947	1523	1173	1690	1589
8	479	55	294	202	547	452	718	1820	483	755	794	1114
9	184	36	254	252	418	142	202	862	211	55	328	307
10	159	110	129	18	260	18	220	527	173	184	180	422
11	214	187	55	129	621	36	92	231	187	187	188	118
12	55	87	36	55	223	87	92	157	73	87	88	105

Table 11. Pollock research and commercial catch-per-unit of effort in NAFO Div. 4VWX-5 and 6.

RESEARCH CRUISES	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Canadian summer bottom trawl survey (No-Tow^{-1}) strata 43-95	4.53	2.17	3.14	3.53	3.22	1.64	3.84	8.72	3.59	3.42	12.44	2.20
U.S.A autumn bottom trawl survey (No-Tow^{-1})	0.63	1.09	1.41	1.64	0.90	0.70	3.69	2.14	0.98	1.27	0.82	---
U.S.A. spring bottom trawl survey (No-Tow^{-1})	--	--	--	4.00	1.39	1.65	1.59	1.63	2.47	1.06	1.51	1.98
U.S.A. summer bottom trawl survey (No-Tow^{-1})	--	--	--	--	--	--	--	2.07	1.30	2.95	12.20	--
COMMERCIAL												
Canadian OTB-1,2 TC5												
C.P.U.E. for $\leq$ 50% of pollock in total catch (mt-hr^{-1})	--	--	0.78	0.67	0.67	0.69	0.55	1.05	0.85	2.32	1.07	1.21
Canadian OTB-1,2 TC4												
C.P.U.E. for $\leq$ 50% of pollock in total catch (mt-hr^{-1})	--	--	0.52	0.70	0.51	0.48	0.47	0.50	0.25	1.73	1.00	0.36
Canadian and U.S.A. OTB-1,2 TC3,4,5 and U.S.A. gillnet (mt-hr^{-1} or mt-day^{-1}) derived from multiplicative model (Gavaris 1980) for $\leq$ 50% of pollock in total catch.	--	--	--	--	--	0.99	0.92	1.20	1.25	1.46	1.38	1.48

Table 12. Effort calculated with total landings divided by catch rates for pollock.

RESEARCH CRUISES	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Canadian summer bottom trawl survey	5,246	12,587	10,593	12,224	11,721	23,529	9,803	4,405	12,638	13,619	4,446	26,001
American autumn bottom trawl survey	37,731	25,023	23,559	26,327	42,002	55,764	10,192	17,944	46,231	36,707	67,446	----
American spring bottom trawl survey	---	---	---	10,794	27,196	23,657	23,653	23,559	18,343	43,979	36,626	28,890
COMMERCIAL												
Canadian OTB 1,2 TC5 500-999 G.R.T. $\geq$ 50% of pollock in total catch	---	---	42,588	64,442	56,421	56,572	68,378	36,572	53,302	20,094	51,688	47,274
Canadian OTB 1,2 TC4 150-499.9 G.R.T. $\geq$ 50% of pollock in total catch	---	---	63,882	61,680	74,121	86,744	80,017	76,802	181,228	26,946	55,306	158,894
Canadian and U.S.A. OTB 1,2 TC3,4,5 and U.S.A. gillnet ($mt\text{-}hr^{-1}$ or $mt\text{-}day^{-1}$) derived from multiplicative model (Gavaris 1980) for $\geq$ 50% of pollock in total catch	---	---	---	---	---	39,264	40,859	32,062	36,117	32,038	40,200	38,792

Table 13. Total mortality coefficients (Z) for pollock from total commercial catch-at-age data using efforts estimated from Canadian commercial otter trawl (TC4 = 150-499.9 GRT, TC5 = 500-999.9)

	1973	1974	1975	1976	1977	1978	1979	1980	1981
Numbers									
6-11	3164	2591	2518	2545	4715	4672	3791	5174	5698
7-12		1304	887	1337	3710	2933	1580	2150	2099
TC5 Effort	64442	56421	56572	68378	36572	53302	20094	51688	47274
Numbers/Effort									
6-11	0.0491	0.059	0.044	0.0372	0.1289	0.088	0.1887	0.1001	0.1205
7-12		0.0231	0.017	0.0196	0.1014	0.055	0.0786	0.0416	0.0444
$\bar{Z}a$		0.75	1.24	0.81	-1.00	0.85	0.11	1.51	0.99
TC4 Effort	61680	74121	86744	80017	76802	181228	26946	55306	158894
Numbers/Effort									
6-11	0.0513	0.0350	0.0290	0.0318	0.0614	0.0258	0.1407	0.0936	0.0359
7-12	---	0.0176	0.0102	0.0153	0.0483	0.0162	0.0586	0.0389	0.0132
$\bar{Z}a$		1.07	1.23	0.63	-0.42	1.33	-0.82	1.29	1.00

Table 14. Standardized catch rates and biomasses (standardized to 1973-1976) using smoothed values from median smoothing, for different F's in 1981 (5^+ biomass) from cohort analyses.

Year	TC4	TC5	Mult. CPUE	F 0.25	F 0.275	F 0.30	F 0.35
1973	1.16	1.09	-	0.86	0.90	0.86	0.86
1974	1.06	1.05	-	0.91	0.91	0.91	0.91
1975	0.93	1.00	0.99	1.06	1.06	1.06	1.06
1976	0.91	1.18	0.92	1.14	1.13	1.13	1.12
1977	0.78	1.27	1.20	1.23	1.22	1.20	1.18
1978	1.57	2.18	1.25	1.33	1.30	1.26	1.20
1979	1.88	2.19	1.45	1.73	1.65	1.57	1.46
1980	1.91	2.37	1.37	2.34	2.18	2.04	1.81
1981	1.26	1.76	1.47	2.60	2.41	2.32	1.98
TC5							
r_{81} datum excluded				0.86	0.87	0.85	0.83
r_{81} datum included				0.72	0.72	0.70	0.72
CPUE							
r_{81} datum excluded				0.77	0.77	0.76	0.76
r_{81} datum included				0.48	0.81	0.86	0.84

Table 15. Cohort analysis using $F_{0.1} = 0.35$

POPULATION NUMBERS

5/ 5/82

	1973	1974	1975	1976	1977	1978	1979	1980	1981
2	52883	28814	31283	41021	56472	58740	26116	21866	57059
3	17700	41618	23032	25276	33120	46082	47915	21170	17460
4	25636	13048	27486	15830	18023	24831	34993	35947	15569
5	9351	11046	8060	14872	9718	11162	16090	22906	24257
6	3264	3728	5764	4889	8148	5757	5823	9625	13369
7	1898	1723	1852	3222	2887	4014	3063	2665	5075
8	884	835	947	1014	1768	1367	1412	1859	1174
9	941	395	309	651	596	897	522	750	1150
10	824	357	222	203	507	330	403	255	315
11	177	293	180	119	137	339	133	263	82
2+	113558	101858	99135	107096	131376	153518	136469	117305	135510
3+	60674	73044	67852	66075	74904	94778	110353	95439	78451
4+	42975	31426	44820	40799	41784	48697	62438	74269	60991
5+	17339	18378	17334	24969	23761	23866	27445	38322	45422

MEAN POPULATION BIOMASS (KG)

5/ 5/82

	1973	1974	1975	1976	1977	1978	1979	1980	1981
2	36680	20910	25074	29913	47524	45704	21436	23888	51505
3	24104	49053	28234	33241	31654	43103	57886	34083	26573
4	41244	22572	43128	27558	22196	31628	55622	67463	31283
5	19079	24931	18837	33189	18536	18379	35984	54374	53548
6	8852	10994	17263	14289	19560	14174	15030	23744	35991
7	5721	6614	6956	10926	8824	10285	10754	7529	16826
8	3012	3231	4929	4074	7225	4775	6625	8741	4975
9	3432	2008	1783	3535	2871	4023	2234	3130	5760
10	2897	1877	1204	1284	3014	1535	2406	1197	1885
11	876	1701	1089	691	847	1993	811	1682	516
2+	145898	143893	148496	158699	162251	175598	208787	225832	228862
3+	109218	122982	123422	128786	114727	129894	187350	201943	177357
4+	85114	73929	95188	95546	83072	86791	129464	167860	150784
5+	43870	51357	52060	67987	60877	55163	73843	100397	119501

CATCH BIOMASS

5/ 5/82

	1973	1974	1975	1976	1977	1978	1979	1980	1981
2	1448	500	331	416	158	168	213	596	3605
3	2520	10485	4919	4576	2778	3234	5043	3646	2923
4	26151	6320	17711	7883	6157	7357	12380	12979	8759
5	13544	11129	5613	13222	5956	8209	11217	18269	18742
6	3850	5441	6537	4636	9839	6056	8642	10353	12597
7	3514	2611	2775	4334	4778	8554	3197	4613	5889
8	1800	2530	861	1342	3429	3593	2838	2433	1741
9	2605	748	389	178	1112	2388	1145	2064	2016
10	2374	901	510	244	601	1075	543	1102	660
11	585	825	368	260	364	887	307	659	180
2+	58391	41489	40015	37092	35174	41520	45525	56714	57113
3+	56944	40989	39684	36675	35015	41352	45312	56118	53508
4+	54424	30505	34765	32100	32237	38117	40269	52472	50585
5+	28272	24185	17054	24217	26080	30761	27889	39493	41825

FISHING MORTALITY

5/ 5/82

	1973	1974	1975	1976	1977	1978	1979	1980	1981
2	0.040	0.024	0.013	0.014	0.003	0.004	0.010	0.025	0.070
3	0.105	0.215	0.175	0.138	0.088	0.075	0.087	0.107	0.110
4	0.642	0.282	0.414	0.288	0.279	0.234	0.224	0.193	0.280
5	0.720	0.450	0.300	0.402	0.324	0.451	0.314	0.338	0.350
6	0.439	0.500	0.382	0.327	0.508	0.431	0.582	0.440	0.350
7	0.622	0.398	0.402	0.400	0.547	0.845	0.299	0.620	0.350
8	0.605	0.794	0.176	0.332	0.479	0.763	0.432	0.280	0.350
9	0.770	0.376	0.219	0.051	0.391	0.600	0.518	0.668	0.350
10	0.832	0.485	0.428	0.191	0.201	0.710	0.227	0.937	0.350
11	0.667	0.485	0.338	0.377	0.430	0.445	0.379	0.392	0.350
5+	0.658	0.471	0.332	0.373	0.425	0.539	0.378	0.391	0.350

Table 16: Yield per recruit analysis (PR 0.57, 0.322 0.79 1)

YIELD PER RECRUIT ANALYSIS

	FISHING MORTALITY	CATCH (NUMBER)	YIELD (KG)	AVG. WEIGHT (KG)	YIELD PER UNIT EFFORT
	0.1000	0.215	0.787	3.662	1.000
	0.2000	0.341	1.135	3.327	0.721
F0.1---	0.2783	0.406	1.264	3.109	0.577
	0.3000	0.421	1.286	3.055	0.545
	0.4000	0.475	1.348	2.840	0.428
	0.5000	0.513	1.371	2.670	0.348
	0.6000	0.543	1.376	2.535	0.291
FMAX---	0.6062	0.544	1.376	2.528	0.288
	0.7000	0.566	1.374	2.427	0.249
	0.8000	0.585	1.369	2.339	0.217
	0.9000	0.601	1.362	2.266	0.192
	1.0000	0.615	1.356	2.204	0.172

Table 17a: Projections using geometric mean of age (40762) 1977-1981) $F_{0.1}$ in 1982.

CATCH BIOMASS 6/ 5/82

	1981	1982	1983
2	3605	598	598
3	2922	5992	4519
4	8759	5811	14797
5	18741	6110	5339
6	12597	10825	4620
7	5887	7347	8265
8	1741	3566	5823
9	2018	975	2612
10	661	1140	722
11	181	329	746
2+	57112	42694	48042
3+	53507	42095	47444
4+	50585	36103	42925
5+	41826	30292	28127

17b: Projection as above using catch of 54,000 mt in 1982.

CATCH BIOMASS 6/ 5/82

	1981	1982	1983
2	3605	781	598
3	2922	7738	4497
4	8759	7369	14395
5	18741	7688	4989
6	12597	13619	4241
7	5887	9243	7586
8	1741	4486	5345
9	2018	1226	2397
10	661	1434	663
11	181	414	685
2+	57112	54000	45395
3+	53507	53219	44797
4+	50585	45481	40300
5+	41826	38112	25905

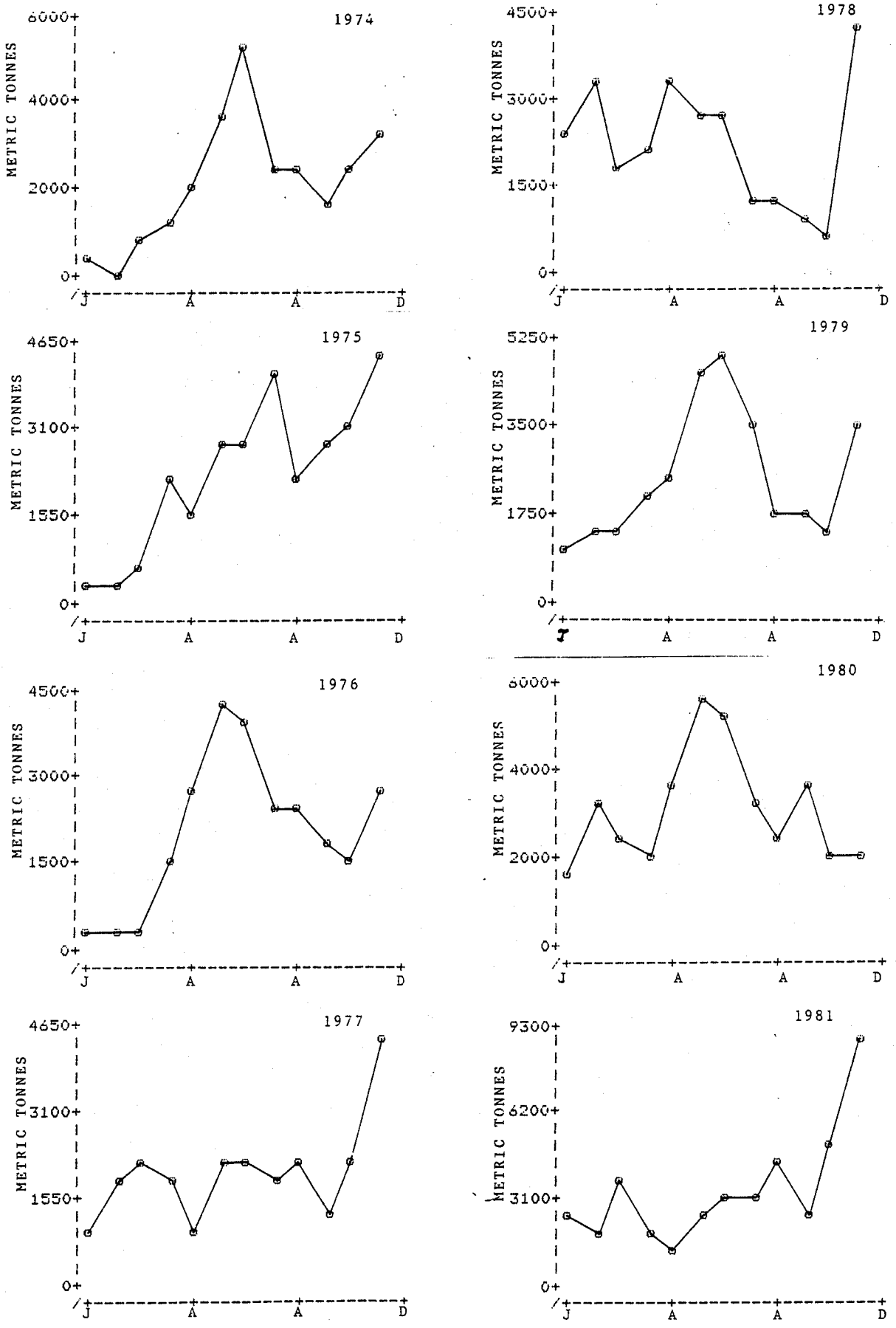


Figure 1. Canadian catches by month (1974 - 1981)

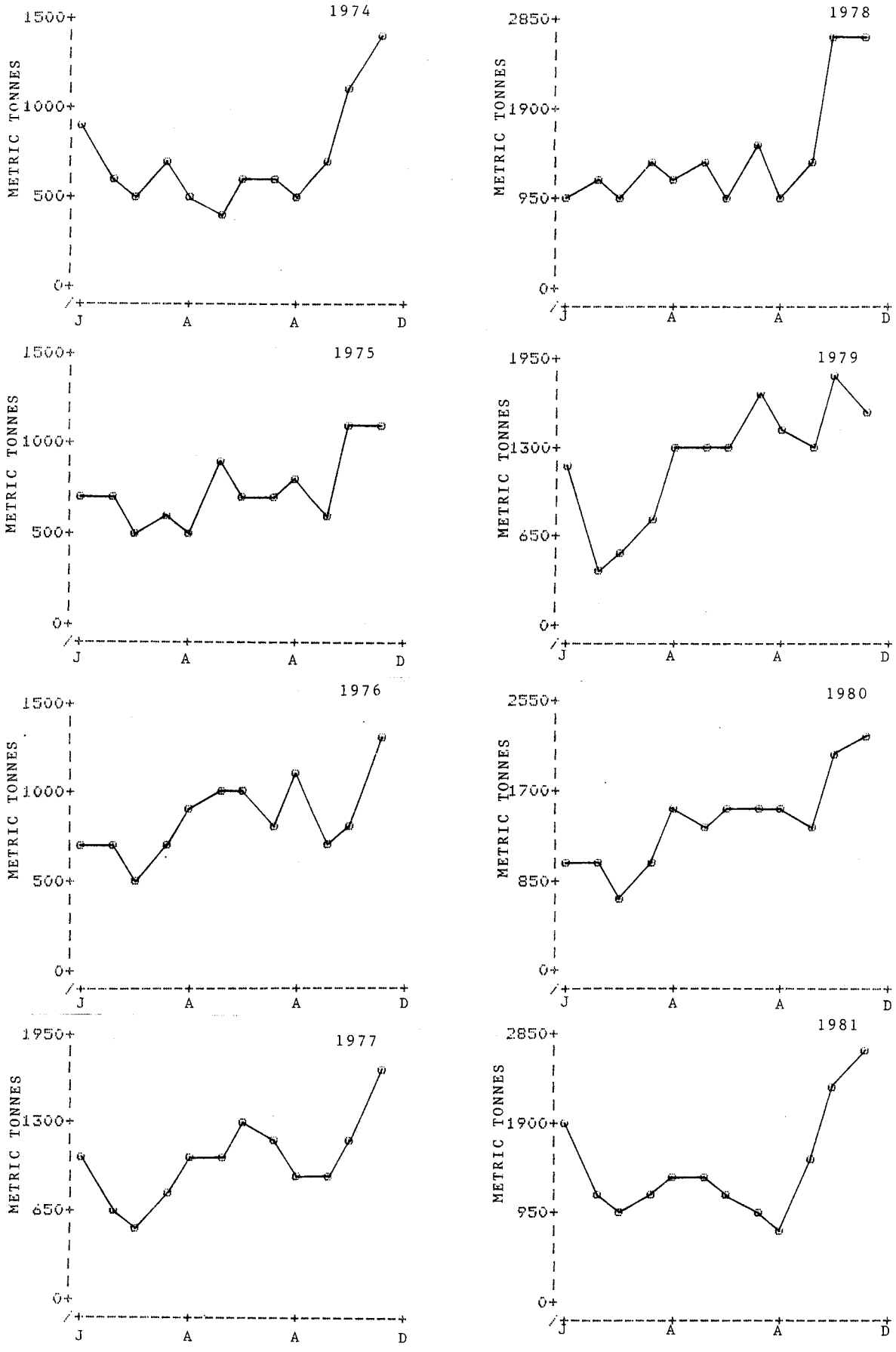


Figure 2. U.S.A catches by month (1974 - 1981)

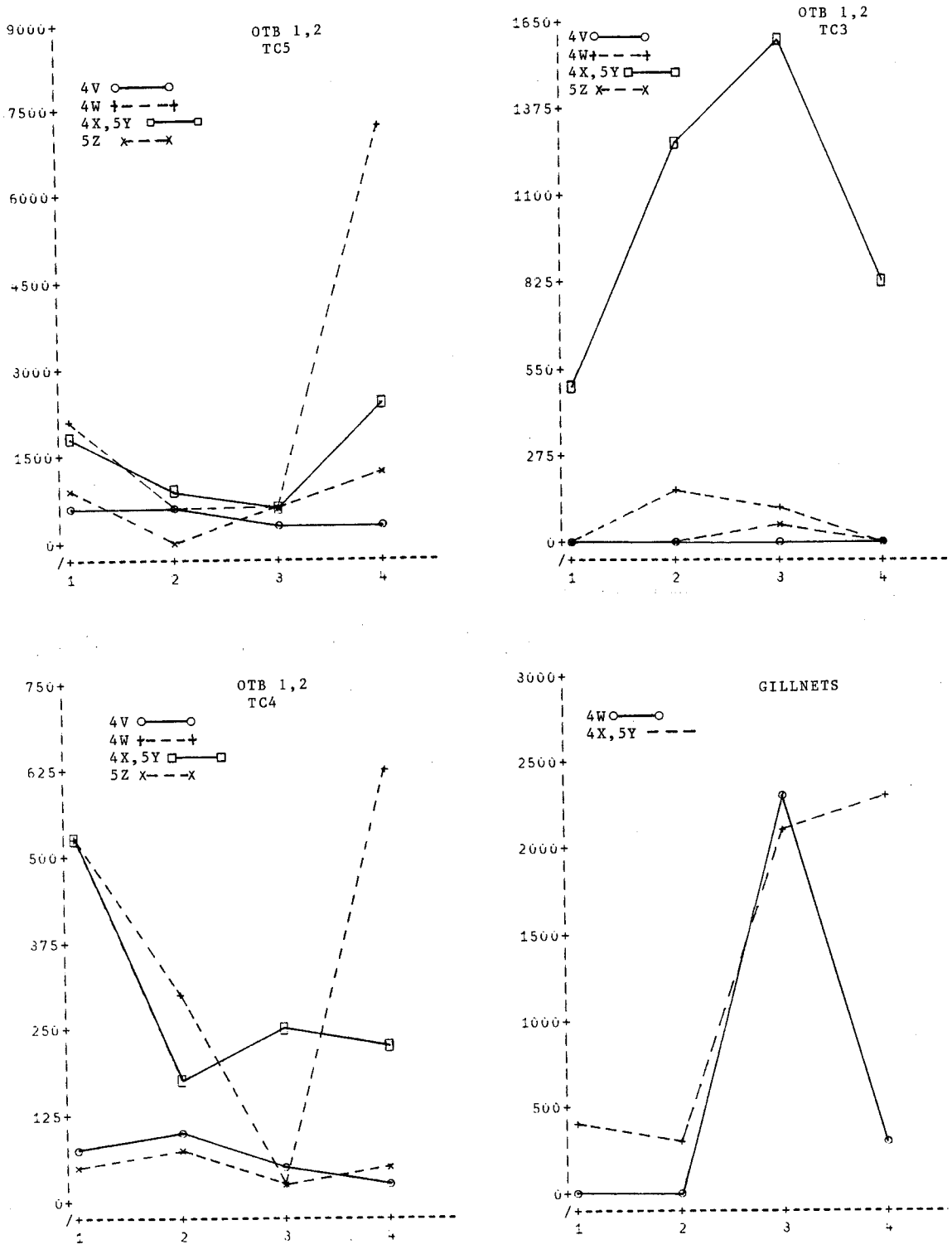


Figure 3. Canadian catches (1981) by gear, division and quarter.

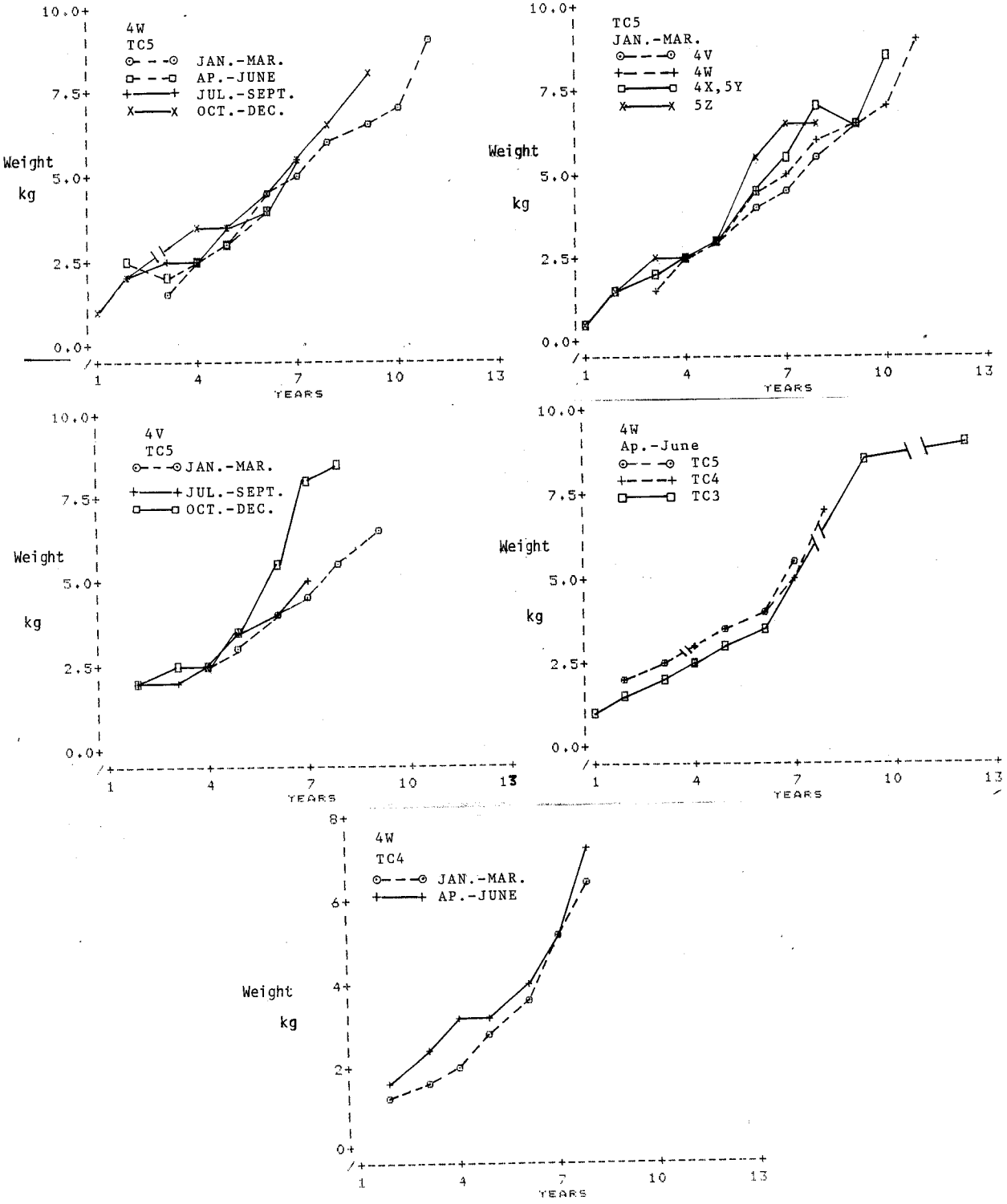
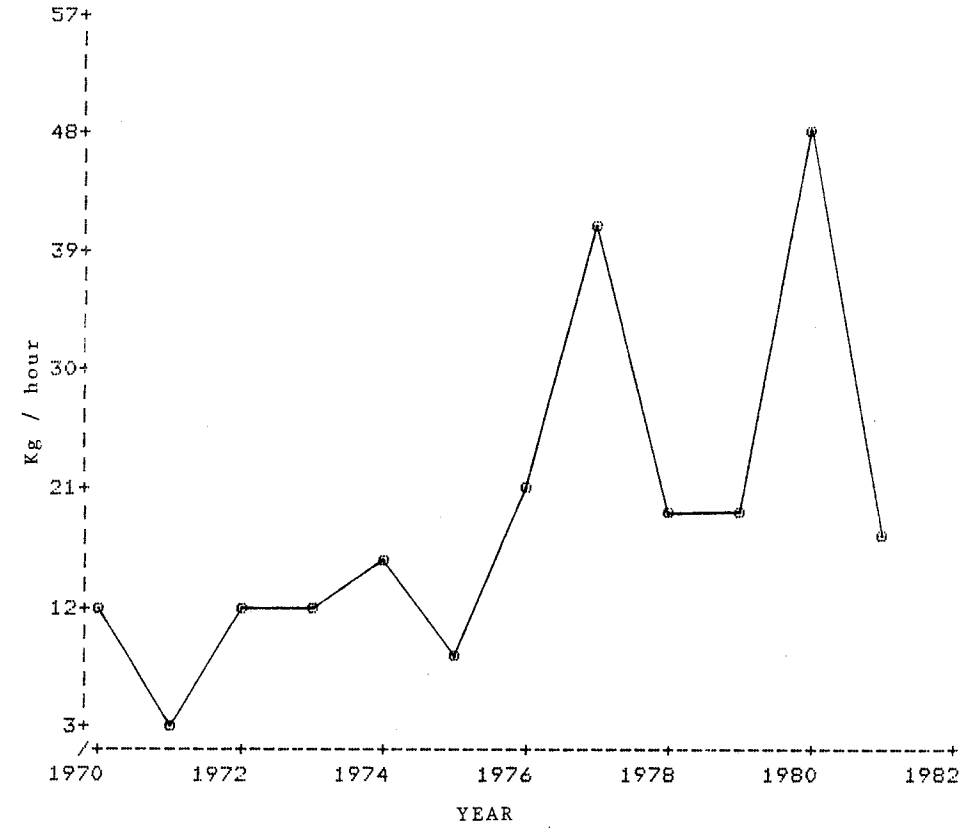


Figure 4. Weights-at-age (1981) for different components of the fishery



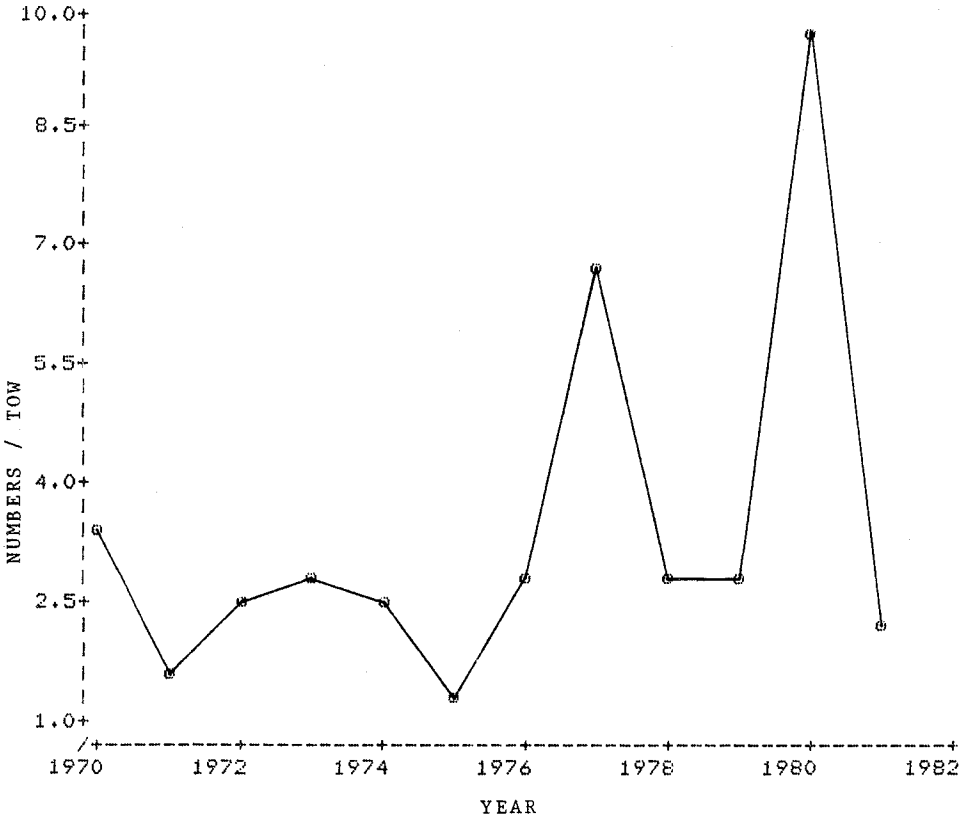


Figure 5. Research vessel catch rates 1970 - 1981.

TC 5 CPUE	1.06	1.06	1.10	0.87	1.67	1.35	3.68	1.70	1.92
biomass 5^+	0.82	0.95	0.97	1.26	1.13	1.02	1.37	1.87	2.22

[std. 1973 – 1976]

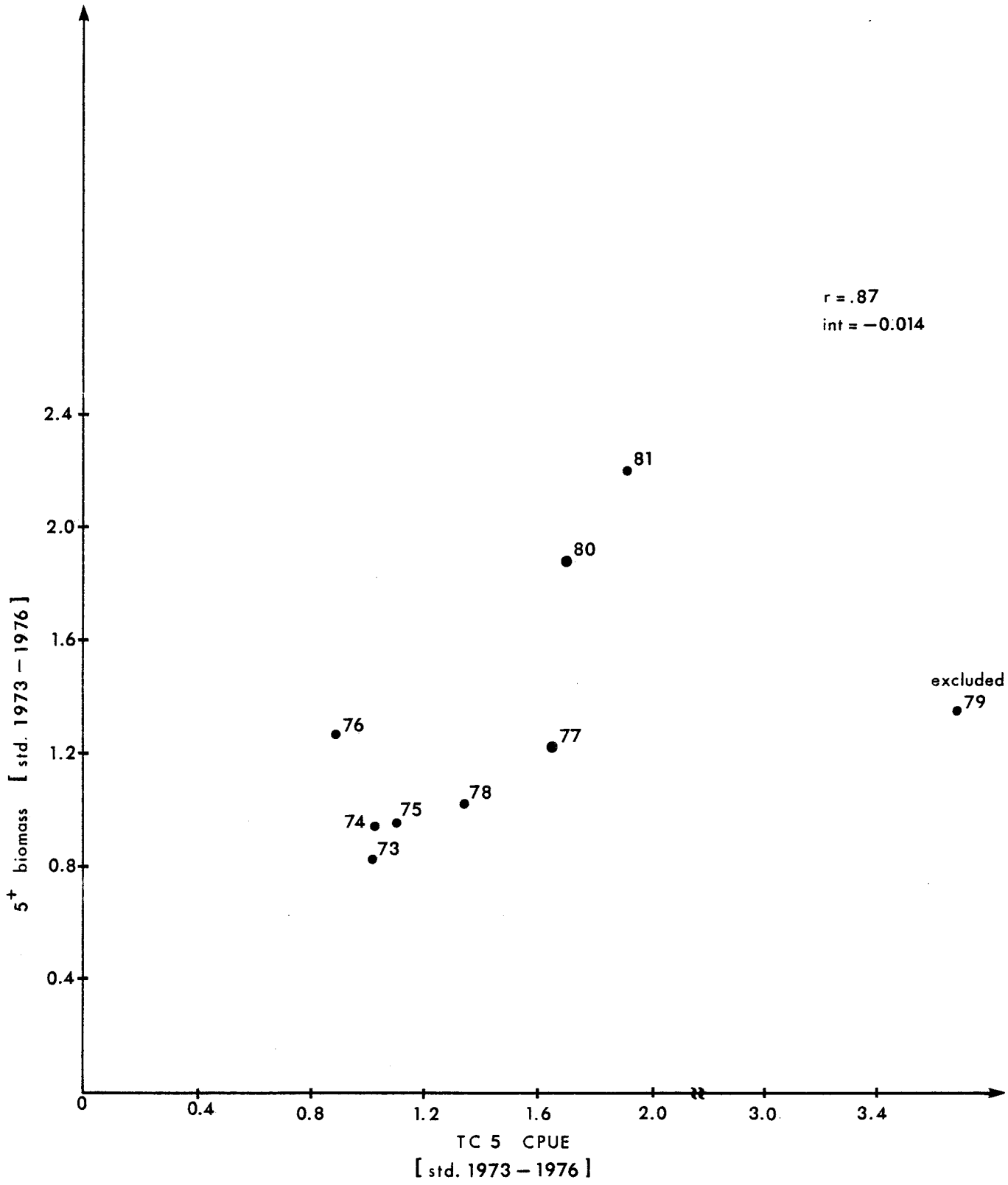


Figure 6: Relationship between 5+ biomass (SPA) and CPUE TC5 (std. 1973-76)