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Stock Status of Pollock in NAFO

Division 4VWX and Subarea 5

by

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Abstract

Commercial and research vessel survey catch rates for all ages were similar to those in 1981, however, research catch rates at age for fish of ages 3-5 were very different. Overall landings dropped from approximately 58,000 t to 55,000 t. In a series of SPAs, it was possible to discriminate amongst terminal fishing mortalities for 1982, by using commercial catch rates. Total stock biomass showed a slight decrease in 1982 compared to 1980-1981. A terminal F of 0.3 was considered most appropriate for the projection of catches. $F_{0.1}$ catches in 1983 and 1984 were 52,500 t and 53,000 t respectively. If the TAC is taken in 1983 (45,000 t) the projected catch for 1984 is 55,000 t.

Résumé

Les taux de capture des bateaux de pêche commerciale et des navires de recherche, pour tous les âges, sont identiques à ceux de 1981. Cependant, les taux de capture des poissons de 3-5 ans par navire de recherche sont différents. Les débarquements totaux ont diminué, passant d'environ 58 000 t à 55 000 t. Dans une série d'analyses de populations séquentielles, on a pu séparer les diverses mortalités par pêche de dernière année, en utilisant les taux de pêche commerciaux. La biomasse de stock totale accuse une légère diminution en 1982 par rapport à 1980-1981. On croit qu'un F de dernière année de 0,3 est plus approprié dans les calculs de projections de prises. Les prises à $F_{0,1}$ en 1983 et 1984 sont de 52 500 t et 53 000 t respectivement. Si le TPA est capturé en 1983 (45 000 t), la projection des prises de 1984 est de 55 000 t.

Introduction

Catches of pollock in NAFO Divisions 4VWX and Subarea 5 have risen steadily since the inception of a TAC for this species, to a maximum of 58,057 t in 1981 (Table 1). These statistics represent increases in the Canadian and USA landings, rather than those of distant-water fleets, which have decreased to less than 1% of the total. The fishery for this species has also changed from one that was predominantly a bycatch fishery in the early 1970's, to one that is now directed. Indeed, seasonal trends in landings by area, would indicate that the fishery is often age-specific (see under Age composition of reported landings).

Discontinuities in the distributions of eggs, larvae, and ripe adults (Clark et al. 1977, McGlade, unpublished MS) suggest the existence of more than one major spawning area in the Gulf of Maine, Georges Bank and Scotian Shelf area (Clark et al. 1981). However, the population dynamics and genetic structure of these components have yet to be established. Thus pollock are herein considered as a single management unit.

Nominal Catches

The fishery is prosecuted throughout the year, although peaks occur at the beginning, middle and end of the year in the Canadian sector (Table 2, Fig. 1a, b). In 1981, the highest landings recorded (58,057 t) in the time series, were mainly the result of increased landings during November and December. Whereas in 1979, 1980, and 1982, the largest portion of the landings were taken during June to August. In both the USA and Canadian sectors of the fishery, the provisional landings for 1982 were less than those in 1981. Indeed, the total landings (51,552 t) were less than the TAC (54,000 t):

Recent catches and TAC's ('000 t) have been as follows:

	1975	1976	1977	1978	1979	1980	1981*	1982*
TAC	55	55	30	30	30	40	54**	55
Nominal catch	39	38	38	45	47	55	58	52

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

Most of the catch since the early 1970's has been taken in NAFO Divisions 4VWX, to which Division 4X has contributed the most (Table 3). In 1981, however, an increase in the bycatch allocation in the last quarter gave rise to high landings from Division 4W (Table 4) (McGlade and Beanlands, 1982).

The Canadian pollock fishery is predominantly offshore in Divisions 4VW and 5Z, and inshore in Division 4X where it is prosecuted by inshore draggers and gillnetters (Table 5). An increased percentage of landings taken by gillnets has been observed in the Canadian fishery and also in the USA fishery in the Gulf of Maine; in the latter values have increased from 7% in 1970-71 to 45% in 1978-1979 and 38% in 1980 (Clark et al. 1981). There is also a recreational fishery in the USA, which from surveys in 1960, 1965, 1970, 1974 and 1979, was estimated to represent annual catches between 1,600 and 9,800 t (ibid., 1981).

Unfortunately, it is impossible to obtain samples of the fish caught in the recreational fishery as it is a fishery primarily directed at "harbour" pollock (Steele 1963). Estimates of this part of the catch have not been included in this assessment.

Age composition of reported landings

The "mixed" gear aspect of the pollock fishery is important in estimating the age composition of the landings. Commercial samples from the 1982 Canadian fishery were approximately 50 (Table 6). Length frequency distributions were also available from the USSR fleets from the International Observer Program. However, no commercial samples were available for 1981 or 1982 from the USA fishery. The catch-at-age and commercial weights-at-age for the USA and other nations, were thus obtained from Canadian and USSR samples and; Canadian data are given separately (Table 7a, b, c, d, e, f). The total catch-at-age and percentage at age are given (Table 8a, b). Revisions to the catch-at-age matrix given by McGlade and Beanlands (1982) were made following publication of an assessment of the stock status by Clark et al. (1981). These revisions affected the 1980 and 1981 estimates, and served mainly to reduce the number of fish at ages 2-5 years. Further revisions were made to the 1981 catch-at-age, by using commercial samples taken during the first months of 1982 in Division 4X and 5Z. In particular, the catch-at-age of 2 and 3 year olds was reduced (Table 8a, b). The major problem that exists in constructing the catch-at-age matrix for this species is that certain gears, used at a particular time and place, can exert an age specific mortality that is higher than that for all the other ages put together. In 1981, in Division 4X 3, 4 and 5 year olds were consistently exploited (Table 9): in 1982 the number of 5 year olds was negligible. Yet these catches represent a major part of the total landings; as such the total catch-at-age matrix will reflect a drastic decline in the number of age 5 fish in the catch. This same matrix also shows that the 1979 year class is extremely large in all Divisions and Subarea 5, corroborating the evidence given by Clark et al. (1981) and McGlade and Beanlands (1982).

Stock size indices and total mortality estimates

Results from the US research vessel surveys remain unchanged from those given by McGlade and Beanlands (1982) (Tables 10, 11).

The Canadian research vessel survey results are given (Table 12). The time series for the summer survey for the A.T. Cameron (1970-1981) is extended by a single survey result from the Lady Hammond. There is no single means for comparison of the two, and as such, the R.V. catch rates will be used only as an indication of year class strength. The major impact on the population is the 1979 year class which appears to be stronger than any other observed in the historical data set (Table 13). Mortality estimates from the Canadian research survey catches rates suggest fishing mortalities between .28 and .46, whilst the US surveys suggest fishing mortalities between 0.15 and 0.35 (Clark et al., 1981).

Catch rate indices from the commercial fleets are given (Table 14). All indicate a an increase after 1976 amd a stabilization between 1980 and 1982. Effort however has shown a decrease in 1982 (Table 15). Total mortality

coefficients from the commercial data suggest fishing mortalities between .5 and .34 for the period 1974-1982 (Table 16).

Estimation of stock abundance

Cohort runs (using Pope's formula) were made initially using the historical PR vectors from the fishing mortality matrix given by McGlade and Beanlands (1982). Fully recruited F was set at 0.275, 0.3 and 0.35. The results were examined with regard to the SPA 3+, 4+ and 5+ biomass versus the catch-per-unit of effort series of the OTB-1, 2 (TC5) vessels for all months and January to June. The results are presented in the form of the correlation coefficient of regressions between the above criteria, dropping the 1982 values from the calculation (Table 17). A second series of cohort analyses were performed, using an average partial recruitment for the years 1974 to 1982. The partial recruitment value for fish of age 3 was adjusted to 0.61 to bring the population numbers into line with the largest previously observed value. The most significant relationships were obtained from this second run at F = 0.3, between SPA biomass and CPUE for January to June. The results are given (Table 18, Figs. 2a, b, c, d, e, f).

Yield per recruit

A Thompson-Bell yield per recruit analysis was run using the P.R. vector derived above (0.04, .62, .86, 1....1) and the weights-at-age for 1982 on ages 1 to 12 years. The $F_{0.1}$ = 0.29, F_{max} = 0.63 and the yield per recruit at $F_{0.1}$ = 1.298 kg (Table 19). This compares to an $F_{0.1}$ = 0.28, F_{max} = 0.60 and yield of 1.264 kg in 1982.

Catch projections

The results from the catch projections (Table 20) using the above criteria, plus a geometric mean (1974-1982, excluding 1979) of 2 year olds (40134) showed that fishing at $F_{0.1}$, in 1983 or with the TAC gave catch biomasses of 52 and 54 t for 1984 respectively, plus long term catches of approximately 50 t.

References

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Table 1. Pollock Landings (T Round Weight) by Country for Divisions 4VWX and Subareas 5 and 6, 1960 - 1982.

Year	Canada	Fed. Rep. Germany	German Dem. Rep.	Japan	Spain	USSR	United Kingdom	U.S.A.	Other	Total
1960	29470	-	-	-	763	-	-	10132	1	40366
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	-	23312
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	35986	-	-	81	-	950	-	18280	131	55428
1981*	40270*	-*	-*	15*	-*	358*	-*	17324*	90*	58057*
1982*	37999*	-*	-*	3*	-*	297*	-*	13168*	85*	51552*

*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[1]
							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	1465	3037	2441	1903	3511	5501	5382	3095	2220	3617	2014	1800	35986
1981*	2562	1811	3421	2054	1193	2364	2670	3380	4632	2462	4832	8889	40270
1982*	2731	1013	1289	1080	2482	5281	5621	5350	3917	3119	2363	3720	37999
							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	1001	1093	705	977	1534	1437	1603	1536	1501	1285	1961	2276	18280
1981*	1845	1076	927	1192	1386	1276	1087	1020	819	1635	2621	2440	17324
1982*	822	769	914	775	867	903	1289	1062	----------	5767	----------		13168
							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	-	1162
1981*	26	38	24	49	114	108	80	14	8	2	-	-	463
1982*	-	-	-	-	263	87	32	1	1	-	-	-	385

[1] Includes NK months of the year
* Provisional

Table 3. Pollock landings (t, round fresh) for Divisions 4VWX, Subarea 5, and Statistical Area 6, 1960 - 80.

Year	4Vn	4Vs	4W	4X	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	583	3310	7511	20485	-	31889	11388	11883	20	11900	245	23536	3	55428
1981	(see Table 4)													
1982	(see Table 4)													

Table 4. Pollock landings (t, round fresh) for Divisions 4VWX, Subarea 5, and Statistical Area 6, 1980 - 82.

Year	4VWX + 5 + 6 NK	4Vn	4Vs	4W	4X	4NK	Total 4VWX	5Y	5Z	5NK	Total SA 5	SA 6	Total
							CANADA						
1980	-	484	3306	6637	19925	-	30352	530	5104	-	5634	-	35986
1981*	-	197	2029	15322	18672	-	36220	713	3337	-	4050	-	40270
1982*	618	151	2378	8966	20515	-	32627	941	4430	-	5371	-	37999
							USA						
1980	-	-	-	-	375	-	375	10858	6799	245	17902	3	18280
1981*	-	-	-	-	-	-	-	-	-	-	17324	-	17324
1982*	-	-	-	-	451	-	451	8341	4376	-	12717	-	13168
							OTHERS						
1980	-	99	4	874	185	-	1162	-	-	-	-	-	1162
1881*	-	90	-	356	17	-	463	-	-	-	-	-	463
1982*	-	-	-	-	-	-	385	-	-	-	-	-	385

* Provisional

Table 5. Distribution of Canadian (Maritime and Newfoundland) catches by area, quarter, and gear for 1982. (Other includes LL, LHP, and SSC).**

				Jan-Mar	Apr-June	July-Sept	Oct-Dec	Total for Area
4VN	OTB 1, 2	T.C.	6					
			5	50	13	5	2	
			4	43	20	5	7	
			3				2	
	GN		1, 2				1	
	Other						3	151
4VS	OTB 1, 2	T.C.	6			56	11	
			5	156	304	1277	182	
			4	94	100	88	71	
			3	2			1	
			1, 2					
	GN				2	33		
	Other						1	2378
4W	OTB 1, 2	T.C.	6			72	155	
			5	1844	662	642	3198	
			4	185	135	125	238	
			3	28	60	8		
			1, 2	1	47	165	55	
	GN			45	176	822	239	
	Other			2	10	29	23	8966
4X	OTB 1, 2	T.C.	6		105	51	63	
			5	595	1943	458	818	
			4	88	67	370	179	
			3	359	1721	2188	257	
			1, 2	162	729	966	192	
	GN			309	1481	4033	648	
	Other			30	522	1813	368	20515
4VWX* Nfld.				173	376	6	63	618
5Y	OTB 1, 2	T.C.	6					
			5					
			4				2	
			3		7	407	162	
			1, 2		3	31	6	
	GN				51	219	6	
	Other				5	20	8	
Nfld.*					11		3	941
5Z	OTB 1, 2	T.C.	6		4	23	288	
			5	874	1	775	1879	
			4		250	47	58	
			3		31	82	1	
			1, 2		2	34	9	
	GN			-	-	-	-	
	Other			1	5	59	7	4430
								All Areas
Totals				5041	8843	14909	9206	37999

* Unknown gear
** Long Line (LL), Handlines (LHP), Scottish seine (SSC), Gillnet (GN), OTB-1,2 (stern and side otter trawl), Tonnage Class (TC)

Table 6. 1982 Canadian commercial samples available for pollock in NAFO Divisions 4V, 4W, 4X, and Subarea 5 (fish aged/fish measured).

Gear	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						4V						
OTB 2		34/188		47/317	26/241	39/301		73/490				
						4W						
OTB 1		31/260						40/229				
OTB 2	63/551			54/370		35/225					46/222	100/690
FIX							27/134			19/199		
						4X						
OTB 1		34/202	28/273	66/425					38/218			
OTB 2	22/205	77/536	75/517	102/657	269/2031	105/774	228/1205	165/40		30/169		
FIX				32/269	56/524	25/241		87/695			65/172	
LL						49/193	42/178					
						5Z						
OTB 2		35/227							46/226	109/655	72/568	
						4VS - 4W						
OTB 2					15/137							
						4X - 5Z						
OTB 2								74/500		3/339		70/431
						4W - 4X						
OTB 2			50/296		44/366	65/606					36/243	44/252
						4V, 4W, 4X						
OTB 2							32/238			49/281		

Table 7 a. CANADIAN CATCH AT AGE (NOS. (10-3) FOR4VWX5 POLLOCK 1982 29/ 4/83

SA	2	3	4	5	6	7	8	9	10	11	12
4	0.00	0.17	4.48	2.69	5.12	6.10	4.65	0.09	0.00	0.00	0.00
4	1.84	363.49	23.62	5.24	3.27	29.57	7.85	3.75	1.55	0.30	0.00
4	0.00	31.31	42.14	12.71	58.45	14.79	4.89	0.00	0.00	0.00	0.00
4	0.00	3.42	2.54	6.47	35.08	12.94	14.27	3.79	0.00	0.00	0.00
4	0.00	1.38	79.46	25.51	56.25	139.55	24.27	34.12	1.38	0.00	0.00
4	0.00	0.00	9.97	10.60	27.82	41.39	24.80	1.51	0.00	0.00	0.00
4	0.00	0.81	5.20	1.88	6.49	5.00	2.70	0.50	0.47	0.00	0.00
4	0.07	4.53	6.82	7.64	22.27	16.33	10.79	7.28	0.75	0.00	0.00
4	0.00	64.60	68.47	4.08	7.72	0.00	0.61	0.00	0.00	0.00	0.00
4	0.00	1.43	5.26	0.00	3.18	15.82	2.07	0.85	0.00	0.00	0.00
4	0.20	27.42	56.43	23.23	68.39	60.72	9.87	7.08	1.60	1.79	0.00
4	10.15	233.73	92.23	5.76	8.98	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.17	1.60	0.37	1.68	12.65	1.47	0.43	0.17	0.00	0.00
4	1.64	24.28	8.75	0.14	0.89	0.37	0.00	0.00	0.00	0.00	0.00
4	0.00	59.83	93.75	62.60	94.89	81.42	31.50	40.21	7.73	7.53	0.00
4	0.00	61.46	42.60	0.00	82.85	113.49	93.73	22.12	0.00	4.71	0.00
4	0.00	56.50	162.65	23.24	253.23	165.65	116.17	183.73	23.24	0.00	0.00
4	0.00	17.39	31.30	27.63	59.12	51.00	21.67	4.83	4.06	4.35	2.80
4	48.26	898.70	436.22	11.70	52.16	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	38.09	20.48	13.68	20.74	17.80	6.88	8.79	1.69	1.65	0.00
4	0.00	4.41	5.66	9.98	20.16	12.69	2.16	0.70	0.35	0.00	0.00
4	0.00	11.14	39.54	1.35	8.85	5.94	0.31	0.94	0.00	0.00	0.00
4	0.00	4.30	35.68	43.12	104.41	103.25	48.40	7.76	7.76	1.98	0.00
4	0.00	19.19	2.33	0.00	12.40	13.36	26.92	17.81	56.29	55.33	0.00
4	0.00	1.05	5.89	6.10	103.78	132.19	111.99	54.31	42.73	18.53	8.63
4	0.00	15.30	0.67	0.67	34.94	33.86	24.35	0.67	2.00	0.00	0.00
4	0.00	256.88	9.83	1.82	0.94	23.35	38.90	6.86	3.70	0.00	1.82
4	0.00	1.84	1.84	10.24	34.20	93.59	78.34	17.72	0.00	1.84	1.34
4	0.00	319.83	17.12	6.12	8.56	6.12	34.15	16.44	0.00	0.00	11.07
4	0.00	0.38	2.66	0.00	7.16	51.64	18.54	0.38	0.00	0.00	0.00
4	0.24	4.19	7.26	0.57	8.23	15.07	8.47	3.78	1.93	2.64	0.00
4	31.25	93.40	52.33	8.35	194.42	306.70	71.23	71.95	38.52	0.00	0.00
4	0.00	11.62	3.17	0.52	41.33	23.90	17.59	1.04	0.00	0.00	0.00
4	0.00	21.06	2.46	0.31	4.10	15.92	4.99	0.16	0.55	0.16	0.00
4	0.00	5.64	1.06	0.00	0.86	41.37	30.33	0.75	0.00	0.53	0.00
4	0.00	2.77	0.65	1.31	0.28	3.87	1.18	0.24	0.00	0.06	0.00
4	0.00	934.76	28.55	0.00	20.35	35.87	37.91	14.49	5.12	5.66	0.00
5	28.77	565.60	193.33	19.26	7.25	3.57	0.00	0.00	0.00	0.00	0.00
5	54.26	294.69	36.41	8.82	29.27	39.78	11.11	6.32	6.83	0.00	1.22
5	2.37	24.19	8.89	3.14	5.08	19.89	3.25	3.07	1.70	0.00	0.00
5	11.04	125.41	81.84	9.71	38.67	21.75	16.35	1.25	0.00	0.00	0.00
5	6.53	68.90	132.58	37.30	103.71	33.38	7.96	0.59	0.12	0.59	0.00

Table 7 b. CANADIAN WEIGHTS AT AGE (KG.) FOR 4VWX5 POLLOCK 1982 29/ 4/83

SA	2	3	4	5	6	7	8	9	10	11	12
4	0.00	1.33	2.59	2.85	3.79	4.16	4.96	6.67	0.00	0.00	0.00
4	0.51	0.87	2.50	2.40	3.27	3.78	5.01	5.19	6.74	7.66	0.00
4	0.00	1.46	2.41	3.90	3.72	4.48	5.85	0.00	0.00	0.00	0.00
4	0.00	2.33	2.32	3.25	4.23	4.80	5.15	4.98	0.00	0.00	0.00
4	0.00	1.71	2.88	4.38	4.11	4.42	6.13	5.45	8.06	0.00	0.00
4	4.51	4.51	4.51	4.51	4.51	4.51	4.51	4.51	4.51	4.51	4.51
4	0.00	1.50	2.96	3.72	4.24	4.49	5.26	6.04	6.97	0.00	0.00
4	0.67	1.83	2.64	3.46	4.09	4.98	5.22	5.77	6.04	0.00	0.00
4	0.00	1.48	2.30	3.53	4.06	0.00	5.45	0.00	0.00	0.00	0.00
4	0.00	1.30	2.54	0.00	3.55	3.93	5.12	6.04	0.00	0.00	0.00
4	0.67	1.70	2.88	3.74	4.11	4.81	5.98	6.40	7.34	6.98	0.00
4	0.82	1.44	2.46	3.54	3.09	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	1.71	2.46	2.31	3.45	3.98	5.34	6.04	6.97	0.00	0.00
4	0.67	1.42	2.36	3.90	4.01	4.78	0.00	0.00	0.00	0.00	0.00
4	0.00	1.43	2.63	3.30	4.75	5.23	5.60	6.93	7.29	9.62	0.00
4	0.00	1.40	2.98	0.00	4.38	4.62	5.79	6.38	0.00	8.06	0.00
4	0.00	2.02	3.05	3.45	4.24	4.83	5.00	5.57	6.04	0.00	0.00
4	0.00	1.39	2.63	3.43	4.49	5.02	6.11	6.36	8.06	8.32	8.81
4	0.95	1.42	2.49	3.45	2.74	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	1.43	2.63	3.30	4.75	5.23	5.60	6.93	7.29	9.62	0.00
4	0.00	1.60	2.60	3.74	4.41	5.02	6.34	7.34	8.06	0.00	0.00
4	0.00	1.85	2.81	3.90	4.39	3.54	5.45	5.84	0.00	0.00	0.00
4	0.00	2.01	3.20	3.89	4.53	4.64	5.75	8.06	7.50	8.81	0.00
4	0.00	1.49	3.45	0.00	4.51	4.35	5.37	5.95	7.14	8.81	0.00
4	0.00	1.35	1.96	2.53	3.34	3.61	4.32	5.79	6.75	7.42	8.36
4	0.00	0.96	1.90	2.20	3.86	3.88	4.82	5.78	6.74	0.00	0.00
4	0.00	1.17	1.80	3.27	2.89	3.81	4.76	6.62	7.61	0.00	0.00
4	0.00	1.90	2.53	3.27	3.90	3.75	4.73	5.60	0.00	8.32	7.61
4	0.00	1.40	1.48	2.89	3.51	3.94	5.31	6.04	0.00	0.00	7.61
4	0.00	1.90	2.89	0.00	3.27	4.11	4.83	0.00	0.00	0.00	0.00
4	0.97	1.80	3.45	2.89	4.09	4.65	5.41	5.44	6.94	7.61	0.00
4	0.59	1.27	3.30	3.27	4.23	4.49	5.58	6.85	8.32	0.00	0.00
4	0.00	1.20	1.94	1.70	3.54	3.02	4.42	5.29	0.00	0.00	0.00
4	0.00	1.12	1.59	2.53	3.19	3.85	4.44	8.32	6.41	7.61	0.00
4	0.00	1.03	2.33	0.00	2.53	3.41	3.96	5.78	0.00	5.42	0.00
4	0.00	1.32	2.42	2.42	2.89	3.38	4.40	4.63	0.00	6.30	0.00
4	0.00	1.03	1.54	0.00	3.61	3.44	3.95	4.60	4.93	6.22	0.00
5	0.79	1.18	2.06	3.05	4.14	3.90	0.00	0.00	0.00	0.00	0.00
5	1.08	1.38	2.69	3.73	4.24	4.58	5.97	6.67	7.34	0.00	11.35
5	0.83	1.08	3.17	3.90	4.38	4.57	5.38	6.45	9.62	0.00	0.00
5	0.99	1.77	2.67	3.34	4.03	4.41	5.53	6.40	0.00	0.00	0.00
5	1.29	1.93	2.69	3.42	3.74	3.97	4.61	6.35	7.34	8.38	0.00

Table 7 c. BIOMASS AT AGE(T) FOR THE CANADIAN 4VWX5 POLLOCK FISHERY 1982 29/ 4/83

SA	2	3	4	5	6	7	8	9	10	11	12
4	0.00	0.23	11.60	7.67	19.40	25.38	23.06	0.60	0.00	0.00	0.00
4	0.94	316.24	59.05	12.58	27.04	111.77	39.33	19.46	10.76	2.30	0.00
4	0.00	45.71	101.56	49.57	229.12	66.26	28.61	0.00	0.00	0.00	0.00
4	0.00	7.97	5.89	21.03	148.39	62.11	73.49	18.87	0.00	0.00	0.00
4	0.00	2.36	228.84	111.73	231.19	616.81	148.78	185.95	11.12	0.00	0.00
4	0.00	0.00	44.96	47.81	125.47	186.67	111.85	6.81	0.00	0.00	0.00
4	0.00	1.21	15.39	6.99	27.52	22.45	16.09	3.02	3.28	0.00	0.00
4	0.05	8.29	18.00	26.43	91.08	81.32	56.32	42.01	4.53	0.00	0.00
4	0.00	95.61	157.48	14.40	31.34	0.00	3.32	0.00	0.00	0.00	0.00
4	0.00	1.86	13.36	0.00	11.29	62.17	10.60	5.13	0.00	0.00	0.00
4	0.13	46.61	162.52	86.88	281.08	292.06	59.02	45.31	11.74	12.49	0.00
4	8.32	336.57	226.89	20.39	27.75	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.29	3.94	0.85	5.80	50.35	7.85	2.60	1.18	0.00	0.00
4	1.10	34.48	20.65	0.55	3.57	1.77	0.00	0.00	0.00	0.00	0.00
4	0.00	85.56	246.56	206.58	450.73	425.83	176.40	278.66	56.35	72.44	0.00
4	0.00	86.04	126.95	0.00	362.88	524.32	542.70	141.13	0.00	37.96	0.00
4	0.00	114.13	496.08	80.18	1073.70	800.09	580.85	1023.38	140.37	0.00	0.00
4	0.00	24.17	82.32	94.77	265.45	256.02	132.40	30.72	32.72	36.19	24.67
4	45.85	1276.15	1086.19	40.36	142.92	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	54.47	53.86	45.14	98.51	93.09	38.53	60.91	12.32	15.87	0.00
4	0.00	7.06	14.72	37.33	88.91	63.70	13.69	5.14	2.82	0.00	0.00
4	0.00	20.61	111.11	5.26	38.85	21.03	1.69	5.49	0.00	0.00	0.00
4	0.00	8.64	114.18	167.74	472.98	479.08	278.30	62.55	58.20	17.44	0.00
4	0.00	28.59	8.04	0.00	55.92	58.12	144.56	105.97	401.91	487.46	0.00
4	0.00	1.42	11.54	15.43	346.63	477.21	483.80	314.45	288.43	137.49	72.15
4	0.00	14.69	1.27	1.47	134.87	131.38	117.37	3.87	13.48	0.00	0.00
4	0.00	300.55	17.69	5.95	2.72	88.96	185.16	45.41	28.16	0.00	0.00
4	0.00	3.50	4.66	33.48	133.38	350.96	370.55	99.23	0.00	15.31	14.00
4	0.00	447.76	25.34	17.69	30.05	24.11	181.34	99.30	0.00	0.00	84.24
4	0.00	0.72	7.69	0.00	7.06	212.24	89.55	0.00	0.00	0.00	0.00
4	0.23	7.54	25.05	1.65	33.66	70.08	45.82	20.56	13.39	20.09	0.00
4	18.44	118.62	172.69	27.30	822.40	1377.08	397.46	492.86	320.49	0.00	0.00
4	0.00	13.94	6.15	0.99	146.31	72.18	77.75	5.50	0.00	0.00	0.00
4	0.00	23.59	3.91	0.78	13.08	61.29	22.16	1.33	3.53	1.22	0.00
4	0.00	5.81	2.47	0.00	2.18	141.07	120.11	4.33	0.00	2.87	0.00
4	0.00	3.66	1.57	3.17	0.81	13.08	5.19	1.11	0.00	0.38	0.00
4	0.00	962.80	43.97	0.00	73.46	123.39	149.74	66.65	25.24	35.21	0.00
5	22.73	667.41	398.26	58.74	30.01	13.92	0.00	0.00	0.00	0.00	0.00
5	58.60	406.67	97.94	32.90	124.10	182.19	66.33	42.15	50.13	0.00	13.85
5	1.97	26.13	28.18	12.25	22.25	90.90	17.48	19.80	16.35	0.00	0.00
5	10.82	221.98	218.51	32.43	155.84	95.92	90.42	8.00	0.00	0.00	0.00
5	8.36	132.98	356.64	127.57	387.88	132.52	36.70	3.75	0.88	4.94	0.00

Table 7 d. CATCH AT AGE (NS,X10-3) (USA,USSR,JAPAN,OTHERS) 4VWX5 POLLOCK 1982 29/ 4/83

SA	2	3	4	5	6	7	8	9	10	11	12
4-5	60.61	1191.60	407.30	40.58	15.27	7.52	0.00	0.00	0.00	0.00	0.00
4-5	61.58	1210.67	413.82	41.23	15.51	7.64	0.00	0.00	0.00	0.00	0.00
4-5	0.00	30.32	88.86	12.70	138.46	90.51	63.47	100.38	12.70	0.00	0.00
4-5	31.69	334.47	643.11	181.07	503.45	162.04	38.64	2.86	0.58	2.86	0.00
4	0.00	146.76	7.86	2.81	3.92	2.81	15.67	7.54	0.00	0.00	5.08

Table 7 e. WEIGHT AT AGE (KG) (USA,USSR,JAPAN,OTHER) 4VWX5 POLLOCK 1982 29/ 4/83

SA	2	3	4	5	6	7	8	9	10	11	12
4-5	0.79	1.18	2.06	3.05	4.14	3.90	0.00	0.00	0.00	0.00	0.00
4-5	0.79	1.18	2.07	3.05	4.14	3.90	0.00	0.00	0.00	0.00	0.00
4-5	0.00	2.02	3.05	3.45	4.24	4.83	5.00	5.57	6.04	0.00	0.00
4-5	1.28	1.93	2.69	3.42	3.61	3.97	4.61	6.35	7.34	8.38	0.00
4	0.00	1.40	1.48	2.89	3.51	3.94	5.31	6.04	0.00	0.00	7.61

Table 7 f. BIOMASS AT AGE (T) FOR 4VWX5 POLLOCK (OTHER NATIONS) 1982 29/ 4/83

SA	2	3	4	5	6	7	8	9	10	11	12
4-5	47.88	1406.09	839.04	123.77	63.22	29.33	0.00	0.00	0.00	0.00	0.00
4-5	48.65	1428.59	856.61	125.75	64.21	29.80	0.00	0.00	0.00	0.00	0.00
4-5	0.00	61.25	271.02	43.81	587.07	437.16	317.35	559.12	76.71	0.00	0.00
4-5	40.56	645.53	1729.97	619.26	1817.45	643.30	178.13	18.16	4.26	23.97	0.00
4	0.00	205.46	11.63	8.12	13.76	11.07	83.21	45.54	0.00	0.00	38.66

Table 8a. Total catch-at-age (numbers x 10^3) for pollock Divisions 4VWX and Subarea 5.

TOTAL CATCH-AT-AGE 4VWX+5 POLLOCK

Age	1974	1975	1976	1977	1978	1979	1980	1981	1982	(McGlade & Beanlands, 1982) 1980	1981
2	617	372	514	170	196	234	368	1641	351	489	3500
3	7281	3346	2952	2526	3023	3628	1694	2104	7589	1950	1651
4	2899	8434	3583	3972	4686	6349	4971	3025	3425	5718	3462
5	3625	1890	4452	2431	3665	3922	6370	5506	692	5951	6530
6	1327	1655	1233	2937	1824	2323	3495	3878	2334	3100	3599
7	512	555	961	1101	2071	717	1203	1790	2092	1114	1366
8	414	138	259	609	660	448	356	614	1090	411	3166
9	112	55	29	174	366	191	259	315	657	331	310
10	124	70	32	83	152	74	99	185	224	140	85
11	103	47	34	44	111	38	47	26	111	78	22

Table 8b. Percent catch-at-age (numbers x 10^3) for pollock Divisions 4VWX and Subarea 5.

PERCENT CATCH-AT-AGE 4VWX+5 POLLOCK

Age	1974	1975	1976	1977	1978	1979	1980	1981	1982
2	4	2	4	1	1	1	2	9	2
3	43	20	21	18	18	20	9	11	41
4	17	51	26	28	28	35	26	16	18
5	21	11	32	17	22	22	34	29	4
6	8	10	9	21	11	13	19	20	13
7	3	3	7	8	12	4	6	9	11
8	2	1	2	4	4	2	2	3	6
9	1	0	0	1	2	1	1	2	4
10	1	0	0	1	1	0	1	1	1
11	1	0	0	0	1	0	0	0	1

Table 9. Catch-at-age (%) for OTB 1,2 (TC5) [Canadian] by quarter and NAFO Division for 1981 and 1982.

		1981							1982						
		AGES							AGES						
		2	3	4	5	6	7	8	2	3	4	5	6	7	8
4V	1Q	-	-	-	6	54	27	14	-	12	3	0	42	24	18
	2Q	no sample							-	7	1	0	1	52	38
	3Q	-	2	-	3	70	21	4	-	72	5	0	1	7	14
	4Q	-	2	1	1	46	37	7	-	-	-	-	-	-	-
4W	1Q	-	-	-	16	46	18	6	-	-	-	1	3	27	38
	2Q	-	3	3	7	63	17	7	-	14	-	-	31	30	21
	3Q	-	1	10	2	29	58	-	-	76	4	1	2	1	8
	4Q	1	6	-	7	28	27	20	-	23	4	0	37	21	2
4X	1Q	-	16	3	27	37	8	4	-	13	26	3	0	55	1
	2Q	-	16	7	29	19	17	8	4	67	24	0	2	1	0
	3Q	1	25	25	30	12	5	-	-	16	58	2	13	8	0
	4Q	1	35	22	9	32	1	-	-	10	1	0	7	7	14
5Z	1Q	1	8	5	32	35	10	7	4	69	23	2	0	0	0
	2Q	1	11	-	47	24	14	3	-	-	-	-	-	-	-
	3Q	no sample							0	21	17	1	21	31	1
	4Q	1	4	3	28	28	13	6	6	23	5	3	37	17	7

Table 10. 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 11 U.S.A. Research Survey catch rates (Nos. per Tow). (source Clarke et al. 1981)

AGE	SPRING 1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
0	0.01	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
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
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
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
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
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
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
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
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
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
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
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
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+	1.14	1.03	3.20	4.01	1.38	1.64	1.51	1.48	2.49	0.95	1.39	1.96
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
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
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

AGE	SUMMER 1977	1978	1979	1980
0				
1	0.05	0.00	0.05	10.85
2	0.23	0.57	0.00	0.00
3	0.09	0.17	0.38	0.06
4	0.26	0.09	0.26	0.29
5	0.29	0.08	0.36	0.25
6	0.32	0.08	0.55	0.30
7	0.15	0.05	0.36	0.22
8	0.23	0.09	0.49	0.03
9	0.07	0.03	0.06	0.02
10	0.08	0.01	0.21	0.07
11	0.07	0.05	0.00	0.05
12+	0.23	0.08	0.23	0.13
Totals				
1+	2.07	1.30	2.95	12.20
2+	2.02	1.30	2.90	1.53
3+	1.79	0.73	2.90	1.42
4+	1.70	0.56	2.52	1.36
5+	1.44	0.47	2.26	1.07

AGE	AUTUMN 1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
0	0.01	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01
1	0.13	0.11	0.38	0.03	0.00	0.22	0.03	0.06	0.03	0.01	0.13
2	0.08	0.38	0.27	0.71	0.08	0.06	0.03	0.17	0.19	0.02	0.01
3	0.01	0.16	0.20	0.12	0.28	0.03	0.15	0.24	0.04	0.26	0.01
4	0.09	0.02	0.08	0.17	0.20	0.11	0.55	0.29	0.04	0.33	0.05
5	0.08	0.06	0.07	0.11	0.11	0.07	1.63	0.42	0.09	0.19	0.11
6	0.08	0.09	0.08	0.11	0.08	0.04	0.50	0.38	0.09	0.13	0.06
7	0.04	0.04	0.07	0.09	0.09	0.09	0.31	0.22	0.15	0.08	0.07
8	0.02	0.08	0.05	0.07	0.01	0.01	0.14	0.11	0.08	0.09	0.13
9	0.01	0.03	0.04	0.00	0.02	0.01	0.05	0.09	0.06	0.05	0.08
10	0.02	0.01	0.03	0.12	0.00	0.01	0.01	0.02	0.04	0.04	0.06
11	0.01	0.01	0.03	0.02	0.02	0.01	0.01	0.00	0.03	0.01	0.04
12+	0.07	0.09	0.10	0.10	0.02	0.03	0.29	0.14	0.12	0.06	0.07
Totals											
1+	0.64	1.08	1.40	1.65	0.91	0.68	3.70	2.14	0.96	1.27	0.82
2+	0.51	0.97	1.02	1.62	0.91	0.46	3.67	2.08	0.93	1.26	0.69
3+	0.43	0.59	0.75	0.91	0.83	0.40	3.64	1.91	0.74	1.24	0.68
4+	0.42	0.43	0.55	0.79	0.55	0.37	3.49	1.67	0.70	0.98	0.67
5+	0.33	0.41	0.47	0.62	0.35	0.26	2.94	1.38	0.66	0.65	0.62

Table 12 Stratified mean catch per tow at age for pollock in Canadian summer bottom trawl surveys (strata 43-95).

	A.T. CAMERON												LADY HAMMOND
Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	0.008	0.000	0.012	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.011	0.007	0.000
2	1.916	0.775	0.103	0.428	0.044	0.008	0.035	0.278	0.004	0.000	0.610	0.167	0.258
3	0.471	0.578	0.203	0.399	1.010	0.019	0.214	0.836	0.184	0.118	0.723	0.188	2.919
4	0.287	0.177	1.335	1.237	0.253	0.351	0.612	1.056	0.673	0.709	2.056	0.062	0.285
5	0.210	0.043	0.397	0.433	0.332	0.299	1.077	2.176	0.990	0.819	3.648	0.587	0.119
6	0.205	0.020	0.123	0.060	0.180	0.393	0.260	1.528	0.365	0.608	1.266	0.413	0.362
7	0.171	0.034	0.036	0.024	0.204	0.066	0.428	0.216	0.333	0.250	0.764	0.270	0.319
8	0.103	0.012	0.064	0.044	0.118	0.098	0.155	0.383	0.104	0.163	0.289	0.234	0.160
9	0.040	0.008	0.055	0.055	0.090	0.031	0.044	0.129	0.046	0.012	0.111	0.075	0.128
10	0.000	0.024	0.028	0.004	0.056	0.004	0.048	0.068	0.002	0.040	0.066	0.073	0.076
11	0.046	0.000	0.012	0.028	0.134	0.008	0.020	0.036	0.000	0.000	0.000	0.027	0.022
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	0.030
12+	0.000	0.000	0.020	0.000	0.000	0.000	0.028	0.000	0.12	0.000	0.000	0.001	0.046
NK	0.008	0.000	0.012	0.000	0.000	0.000	0.008	0.004	0.041	0.046	0.006	0.043	0.000
TOTALS													
4+	1.074	0.318	2.078	1.897	1.415	1.250	2.692	5.608	2.541	2.601	8.200	1.742	1.547
5+	0.787	0.141	0.743	0.660	1.162	0.899	2.080	4.552	1.868	1.892	6.144	1.680	1.262
6+	0.577	0.098	0.346	0.227	0.830	0.600	1.003	2.376	0.878	1.073	2.496	1.093	1.143
$Z^{4/5}$	2.04	-0.86	1.10	0.51	0.45	-0.51	-0.52	0.78	0.52	-0.86	1.59	0.32	
$Z^{5/6}$	2.10	-0.93	1.05	-0.18	0.66	-0.12	-0.13	0.87	0.84	-0.28	1.73	0.39	

$\bar{Z}^{4/5}$ 1970 - 1982 = 0.76 $\bar{Z}^{4/5}$ 1974 - 1982 = 0.48

$\bar{Z}^{5/6}$ 1970 - 1982 = 0.85 $\bar{Z}^{5/6}$ 1974 - 1982 = 0.66

Table 13. Catch-at-age (estimated total population numbers x 10^{-3}) from the Canadian summer bottom trawl surveys, strata 43 - 95.

	A.T. CAMERON												LADY HAMMOND
Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982[1]
2	8879	3579	479	1929	203	37	161	1290	19	0	2826	774	991
3	2181	2666	939	1849	4677	89	989	3743	852	47	3350	871	11161
4	1330	822	6187	5731	1171	1541	2825	4873	3118	3285	9525	287	1088
5	972	199	1838	2007	1537	1386	4992	10081	4587	3794	16901	2720	458
6	951	92	570	276	832	1822	1202	7080	1691	2817	5865	1913	1357
7	792	147	165	110	943	305	1983	1001	1543	1158	3540	1251	1207
8	479	55	294	202	547	452	718	1775	482	755	1339	1084	614
9	184	36	254	252	418	142	202	598	213	56	514	347	491
10	159	110	129	18	260	18	220	313	9	185	304	338	284
11	214	187	55	129	621	36	92	166	0	0	0	125	87
12	56	0	37	56	222	0	93	74	74	0	0	0	70

[1] Provisional

Table 14. Pollock research and commercial catch-per-unit of effort in NAFO Division 4VWX 5 and 6.

Research Cruises	1974	1975	1976	A.T. CAMERON 1977	1978	1979	1980	1981	LADY HAMMOND 1982
Canadian summer bottom trawl survey (No-Tow^{-1}) strata 43 - 95	3.22	1.64	3.84	8.72	3.59	3.42	12.44	2.20	2.73
U.S.A. autumn bottom trawl survey (No-Tow^{-1})	0.90	0.70	3.69	2.14	0.98	1.27	0.82	-	
U.S.A. spring bottom trawl survey (No-Tow^{-1})	1.39	1.65	1.59	1.63	2.47	1.06	1.51	1.98	
U.S.A. summer bottom trawl	-	-	-	2.07	1.30	2.95	12.20	-	
Commercial									
Canadian OTB 1,2 (TC5) CPUE for ≥ 50% of pollock in total catch (t-hr^{-1})									
All Months	0.69	0.69	0.58	0.94	1.08	1.39	1.06	1.23	1.22
Jan-Jun	0.76	0.69	0.67	0.83	1.05	1.29	1.23	1.28	1.27
Jun-Aug	0.67	0.72	0.60	0.75	0.84	1.71	1.03	1.39	1.47
Jun-Dec	0.67	0.67	0.56	0.99	1.07	1.76	0.89	1.19	1.30
Sep-Dec	0.73	0.75	0.59	1.11	1.46	1.57	0.73	1.20	1.06

Table 15. Effort calculated with total landings divided by catch rates for pollock.

RESEARCH CRUISES	1974	1975	1976	1977	1978	1979	1980	1981	1982
Canadian summer bottom trawl survey	15304	30496	12748	5706	15732	16895	5810	26390	10922
American autumn bottom trawl survey	42002	55764	10192	17944	46231	36707	67446	-	-
American spring bottom trawl survey	27196	23657	23653	23559	18343	43979	36626	28890	-
COMMERCIAL									
Canadian OTB 1,2 (TC5) (≥50% of pollock in total catch)									
All Months	54865	56820	64397	41072	42107	33668	52291	47163	42221
Jan-June	53926	56737	56216	46379	43315	36148	45100	45322	40497

Table 16. Total mortality coefficients (Z) for pollock from total commercial catch-at-age data using efforts estimated from Canadian commercial OTB 1,2 (TC5).

	1974	1975	1976	1977	1978	1979	1980	1981	1982
Numbers									
6-11	2591	2518	2545	4715	4672	3791	5559	6808	6431
7-12	1304	887	1337	3710	2933	1580	4356	2930	4097
TC5 Effort Jan-Jun	53926	56737	56216	46379	43315	36148	45100	45322	40497
Numbers/Effort									
6-11	0.0480	0.044	0.0453	0.1017	0.1079	0.1029	0.1233	0.1502	0.1588
7-12	0.0242	0.016	0.0213	0.0800	0.068	0.0437	0.0946	0.0646	0.1012
$\overline{Z}a$	1.0986	0.7255	-.5687	0.4025	0.9039	0.8564	0.6464	0.8438	
TC5 Effort All Months	54865	56820	64397	41072	42107	33668	52291	47163	42221
Numbers/Effort									
6-11	0.0472	0.0443	0.0395	0.1148	0.1110	0.1126	0.1063	0.1444	0.1523
7-12	0.0238	0.0156	0.0208	0.0903	0.0697	0.0469	0.0833	0.621	0.0980
$\overline{Z}a$	1.1071	0.7560	-.8268	0.4990	0.8615	0.3014	0.2438	0.3979	

TC5
Z Jan-Jun 1974-1982 = .70

Z All Months 1974 - 1982 = .54

Table 17. Correlation coefficients of relationships used to obtain fully recruited fishing mortality in 1982.

A. Partial recruitment for these runs was as follows:

Age:	2	3	4	5	6	7	8	9	10	11
PR:	.04	.37	.86	1	1	1	1	1	1	1

SPA (3+ biomass)
1 = vs CPUE (Jan-Jun)
4 = vs CPUE (all months)

SPA (4+ biomass)
2 = vs CPUE (Jan-Jun)
5 = vs CPUE (all months)

SPA (5+ biomass)
3 = vs CPUE (Jan-Jun)
6 = vs CPUE (all months)

1982 F	1	2	3	4	5	6
0.275	.91	.87	.89	.83	.76	.73
0.30	.93	.89	.90	.85	.78	.74
0.35	.91	.87	.89	.83	.76	.73

B. Partial recruitment for this run was as follows:

Age:	2	3	4	5	6	7	8	9	10	11
PR:	.04	.61	.86	1	1	1	1	1	1	1

1982 F	1	2	3	4	5	6
0.30	.93	.89	.90	.85	.78	.73

Table 18. Cohort analysis with F_{1982} = 0.3 and P.R. = 0.04 .62 .861

POPULATION NUMBERS — 3/ 5/83

	1974	1975	1976	1977	1978	1979	1980	1981	1982
2	30059	41131	48905	51190	46400	12874	28015	62180	29979
3	43234	24966	33588	39675	49944	37912	10328	22604	47124
4	12957	28809	16635	24664	30115	38155	27675	5923	13603
5	10711	7905	15985	10402	16600	20413	25394	19160	7031
6	3791	5314	3823	7035	5317	10274	13167	15109	9994
7	1720	1903	3017	2037	4740	3521	6310	7618	9851
8	846	945	1256	1501	1206	2006	2234	4078	4617
9	401	319	349	330	759	439	1237	1507	2783
10	330	207	217	205	357	291	227	779	949
11	330	133	123	144	338	156	171	97	470
2+	104411	111128	124795	150582	154899	125995	114860	139055	124502
3+	74352	69937	75891	99392	110498	113121	86844	76875	96505
4+	31118	45985	42503	49817	60554	75309	76516	54270	47191
5+	18160	17076	25839	25153	30439	37154	48841	47347	33499

MEAN POPULATION BIOMASS (KG) — 3/ 5/83

	1974	1975	1976	1977	1978	1979	1980	1981	1982
2	20734	31412	33716	48925	34291	9989	29022	54363	21902
3	48612	29116	42417	36188	44508	42990	15123	32705	55[illegible]
4	21272	43577	27772	29990	37217	58170	48704	11120	33171
5	22863	17704	34334	19062	32068	44905	57895	37099	[illegible]
6	10671	15538	13375	21188	14587	28738	32175	39932	[illegible]
7	6271	6832	9573	9192	14630	11987	20109	24937	28029
8	3134	4671	4060	6034	4336	9568	10386	17741	19190
9	1943	1755	2249	2020	3022	1947	5871	7461	[illegible]
10	1805	1175	1271	2955	1637	1572	1142	4520	[illegible]
11	1684	1053	183	350	1889	933	1055	579	[illegible]
2+	138968	151650	170750	174205	191205	210697	221682	229056	217142
3+	118234	120237	136835	127280	156944	200709	192460	174693	195639
4+	69623	90122	94417	91092	112436	157819	177337	141999	137573
5+	48351	48725	66645	61102	75220	99649	129634	130868	104403

CATCH BIOMASS — 3/ 5/83

	1974	1975	1976	1977	1978	1979	1980	1981	1982
2	475	315	396	150	160	202	427	1606	293
3	9950	4673	4347	2140	3073	4791	3009	3538	10742
4	6004	16826	7488	5949	6989	11762	10720	7342	3525
5	10570	[illegible]	12661	5168	9190	10656	18578	16815	[illegible]
6	5169	6210	4404	9547	6325	9209	11390	12994	3916
7	2481	2636	4117	4539	9562	3038	4731	7329	9427
8	2403	949	1275	3057	3411	2494	2002	3214	5457
9	711	539	729	1055	3267	1089	1555	1948	3832
10	956	485	272	369	1022	516	740	1367	1568
11	784	350	247	348	340	290	379	203	352
2+	39415	38014	35237	33412	42341	43247	53211	54353	50871
3+	38940	37700	34842	33262	42681	43045	52785	52748	50538
4+	28979	33027	30495	30622	39608	38254	49775	49210	39946
5+	22975	16201	23006	24774	32619	26492	39055	41958	31321

MEAN WEIGHT OF INDIVIDUALS IN CATCH — 3/ 5/83

1974	1975	1976	1977	1978	1979	1980	1981	1982
2.32	2.30	2.51	2.38	2.56	2.41	2.82	2.85	2.74

MEAN AGE OF INDIVIDUALS IN CATCH — 3/ 5/83

1974	1975	1976	1977	1978	1979	1980	1981	1982
4.18	4.26	4.53	4.92	4.97	4.56	4.76	4.97	4.71

FISHING MORTALITY — 3/ 5/83

	1974	1975	1976	1977	1978	1979	1980	1981	1982
2	0.023	0.010	0.012	0.003	0.005	0.020	0.015	0.030	0.013
3	0.206	0.167	0.103	0.073	0.069	0.112	0.200	0.199	0.195
4	0.284	0.391	0.271	0.194	0.189	0.203	0.224	0.169	0.257
5	0.367	0.303	0.319	0.299	0.250	0.239	0.323	0.408	0.300
6	0.489	0.403	0.332	0.445	0.334	0.298	0.347	0.334	0.300
7	0.399	0.389	0.434	0.560	0.390	0.355	0.237	0.301	0.300
8	0.778	0.176	0.316	0.546	0.279	0.292	0.194	0.192	0.300
9	0.369	0.212	0.051	0.354	0.751	0.525	0.253	0.235	0.300
10	0.479	0.416	0.194	0.200	0.332	0.331	0.456	0.305	0.300
11	0.471	0.332	0.352	0.409	0.445	0.311	0.359	0.350	0.300
5+	0.478	0.338	0.358	0.377	0.401	0.261	0.313	0.341	0.300

Table 19. Yield per recruit analysis (P.R. = 0.04, .62, .86, 1, 1...1).

YIELD PER RECRUIT ANALYSIS

	FISHING MORTALITY	CATCH (NUMBER)	YIELD (KG)	AVG. WEIGHT (KG)	YIELD PER UNIT EFFORT
	0.1000	0.218	0.784	3.589	1.000
	0.2000	0.346	1.142	3.301	0.729
F0.1---	0.2930	0.421	1.298	3.080	0.565
	0.3000	0.426	1.305	3.065	0.555
	0.4000	0.480	1.379	2.873	0.440
	0.5000	0.518	1.408	2.718	0.359
	0.6000	0.547	1.417	2.590	0.301
FMAX---	0.6299	0.555	1.418	2.557	0.287
	0.7000	0.570	1.416	2.484	0.258
	0.8000	0.589	1.409	2.394	0.225
	0.9000	0.604	1.400	2.316	0.198
	1.0000	0.618	1.389	2.249	0.177

Table 20a. Projections using $F_{0.1}$ =0.3 in 1982-1984.

CATCH BIOMASS

	1982	1983	1984
2	283	356	356
3	10742	5292	7196
4	8525	17256	8450
5	2268	8134	16480
6	8916	1603	5750
7	8427	5702	1025
8	5457	6352	4298
9	3832	3856	4489
10	1568	2790	2808
11	852	1044	1856
2+	50871	52385	52708
3+	50588	52029	52352
4+	39846	46737	45157
5+	31321	29482	36707

Table 20b. Projections using 45,000 t in 1983, and $F_{0.1}$ = 0.3 (1983-1988).

CATCH BIOMASS

	1982	1983	1984
2	283	299	356
3	10742	4512	7209
4	8525	14849	8740
5	2268	6992	17150
6	8916	1378	6032
7	8427	4901	1075
8	5457	5460	4509
9	3832	3315	4708
10	1568	2398	2945
11	852	897	1947
2+	50871	45000	54671
3+	50588	44701	54315
4+	39846	40189	47106
5+	31321	25340	38366

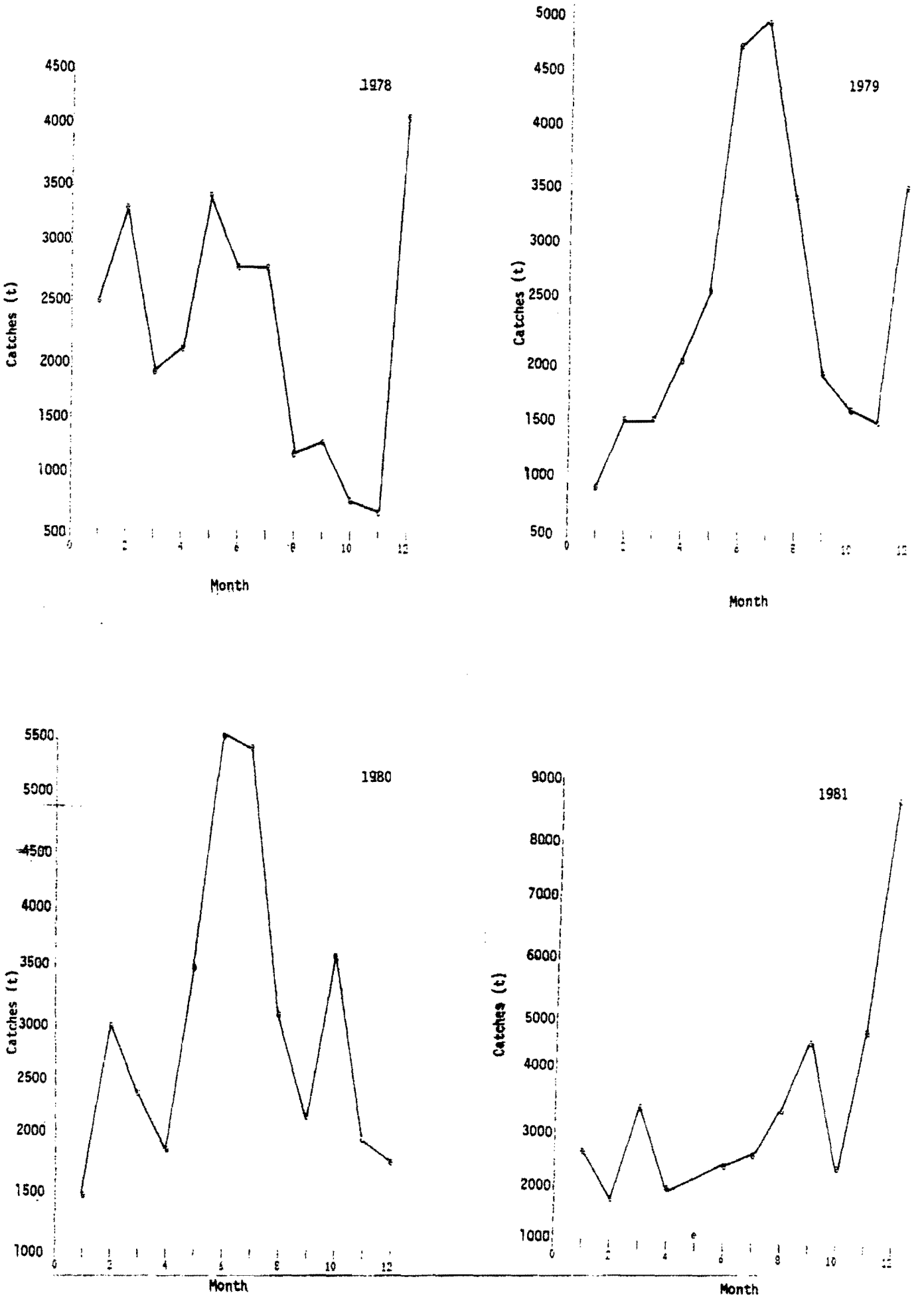


Figure 1a. Canadian catches (t) by month 1978 - 1981.

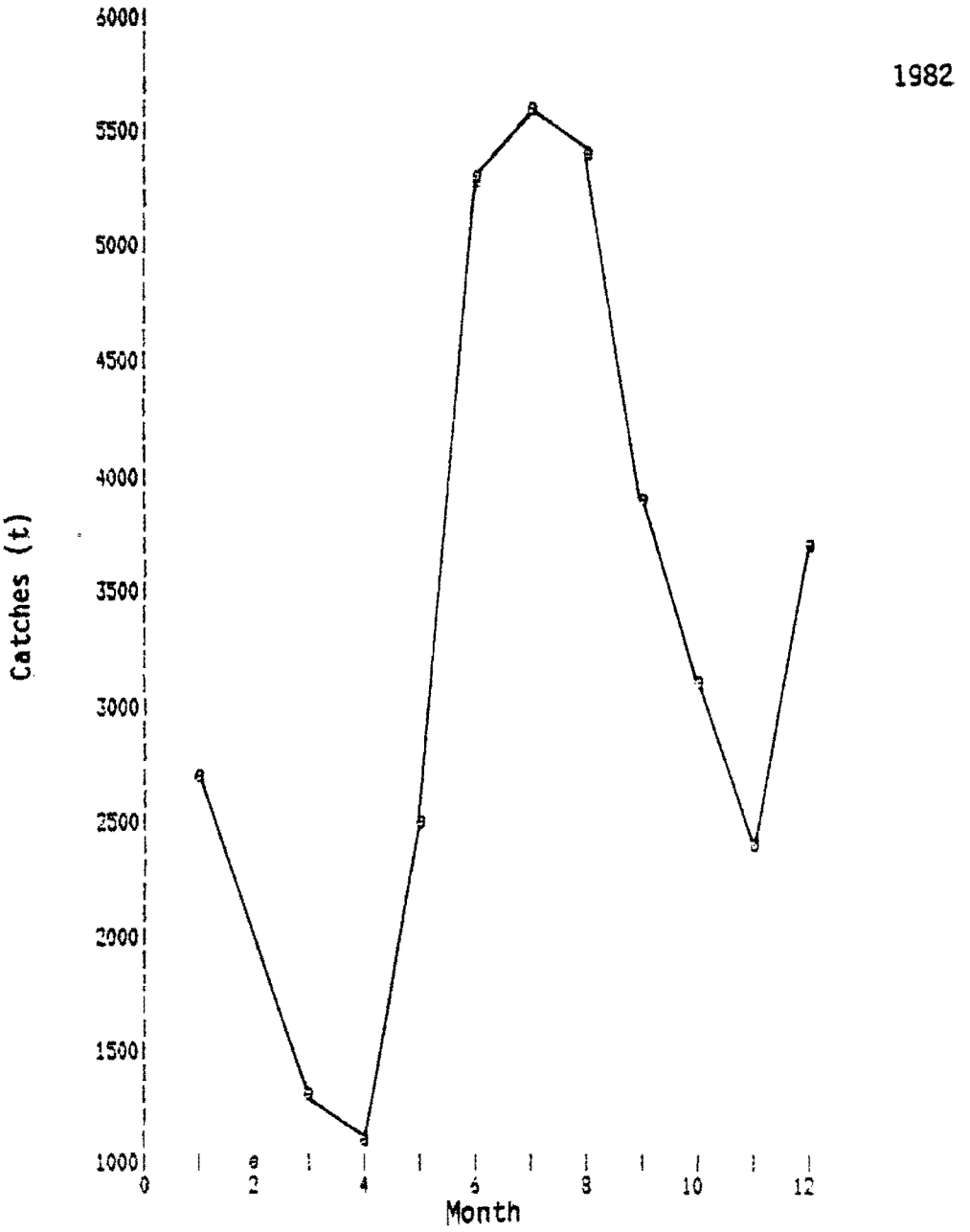
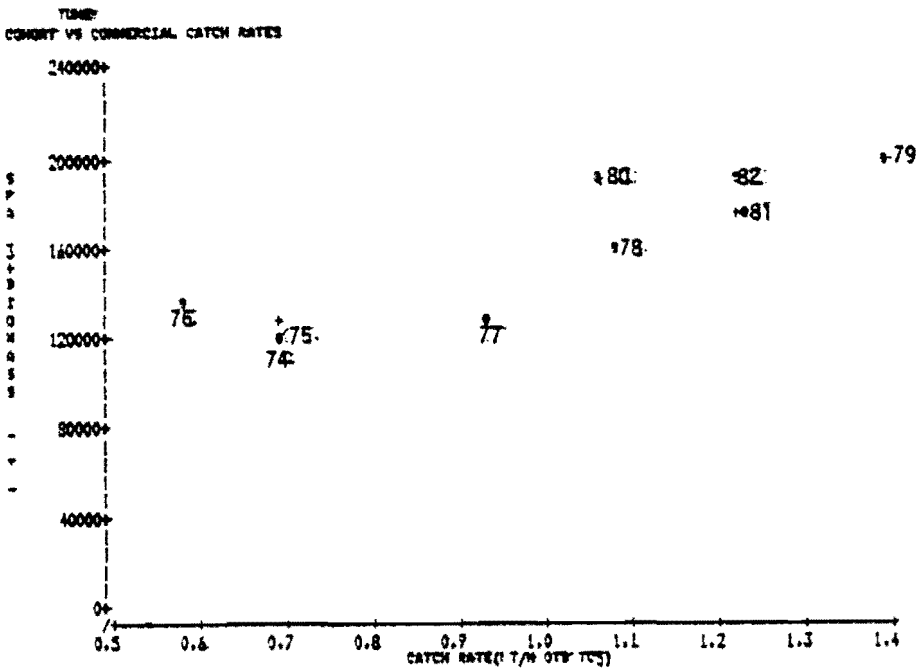


Figure 1b. Canadian catches (t) by month 1982.



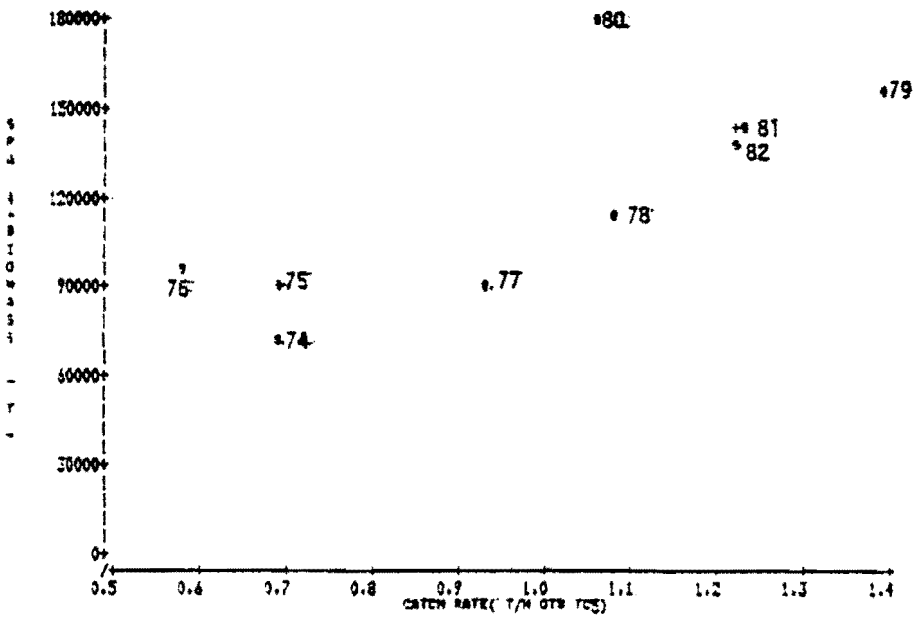
A AND B ARE 60081.0986 97613.4695

R IS 0.8521

YEAR	1974.00	1975.00	1976.00	1977.00	1978.00	1979.00	1980.00	1981.00	1982.00
SPA	118234.34	120237.32	136834.68	127279.95	156944.45	200708.59	192460.01	174492.60	195639.23
CATCH RTE	0.69	0.69	0.58	0.93	1.08	1.37	1.06	1.23	[illegible]
ESTIMATE	127434.39	127434.39	116696.91	150861.63	165503.65	195763.32	163551.28	180145.67	179159.53

FULLY RECRUITED F (AGES 5 PLUS)

0.478 0.338 0.358 0.397 0.401 0.261 0.313 0.341 0.300



A AND B ARE 19248.9926 102332.2411

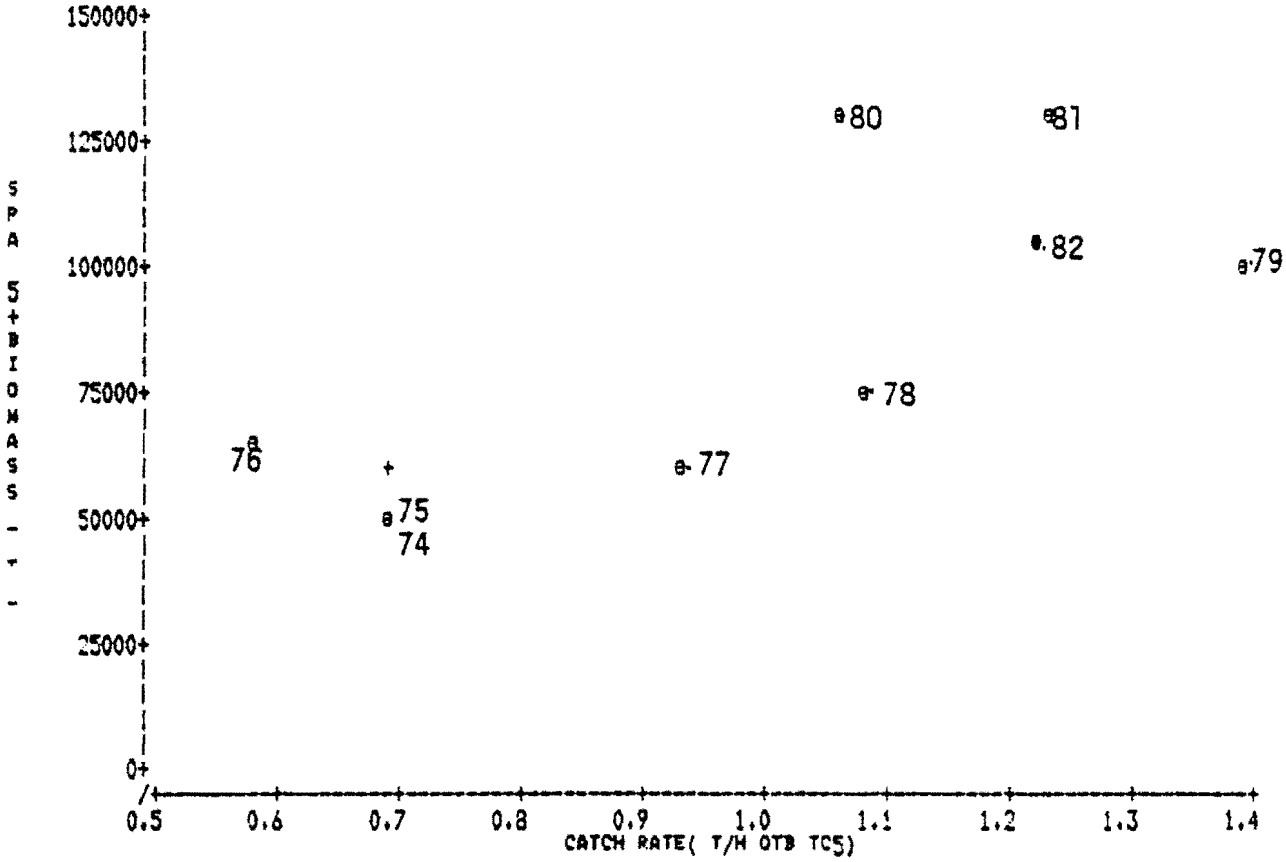
R IS 0.7749

YEAR	1974.00	1975.00	1976.00	1977.00	1978.00	1979.00	1980.00	1981.00	1982.00
SPA	39622.84	72121.65	94417.37	91091.62	112436.34	157819.55	177337.37	141987.36	137573.13
CATCH RTE	0.69	0.69	0.58	0.93	1.08	1.39	1.06	1.23	[illegible]
ESTIMATE	39858.24	39858.24	78601.39	114417.78	129767.81	161490.81	127721.17	145117.65	144094.55

FULLY RECRUITED F (AGES 5 PLUS)

0.478 0.338 0.358 0.397 0.401 0.261 0.313 0.341 0.300

Figure 2a....f. Plots from cohort run of F = 0.3. (2a-2c using commercial catch rate for all months; 2d-2f using commercial catch rate for January to June.)



A AND B ARE 357.7217 85794.9608

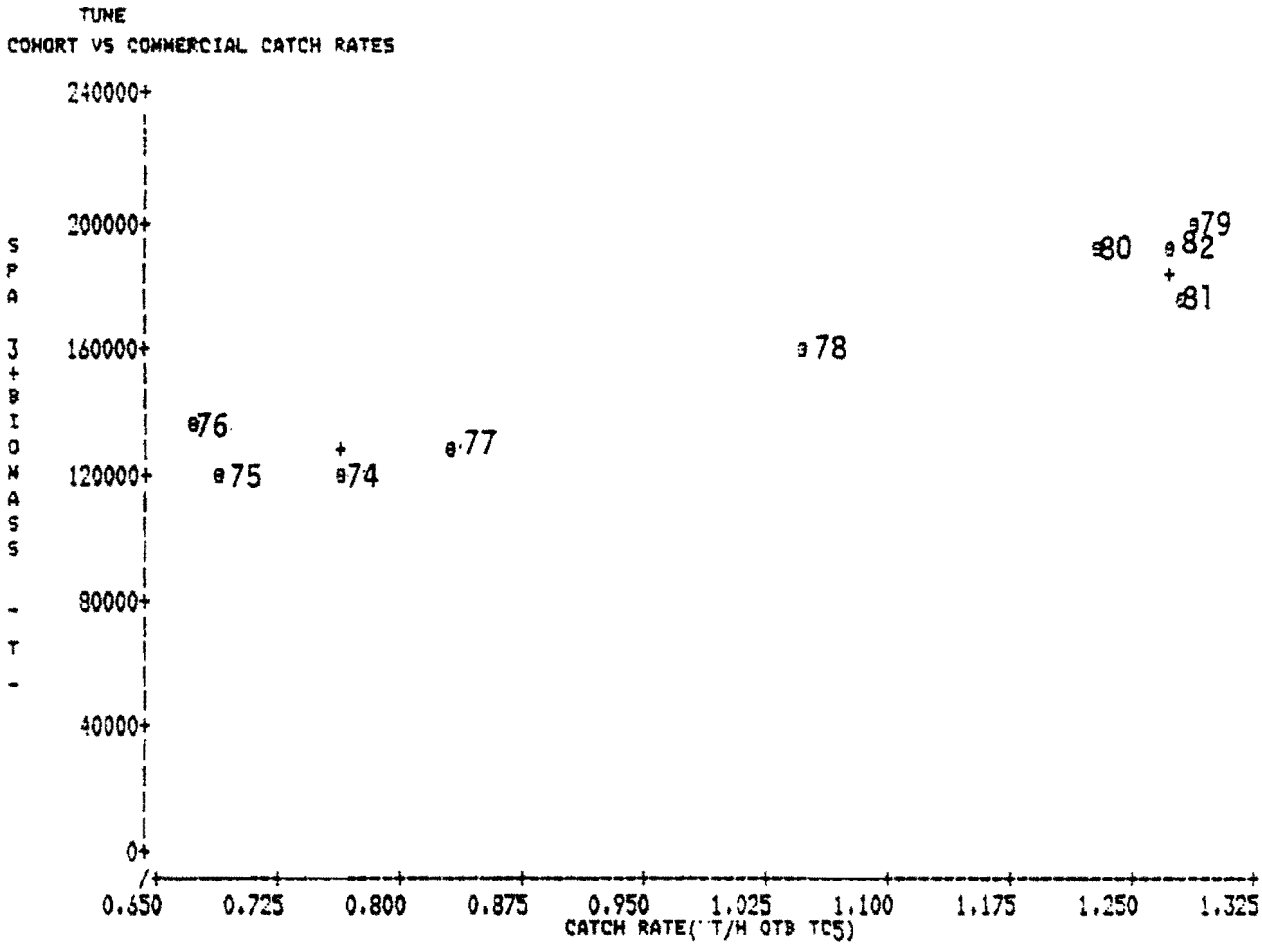
R IS 0.7340

YEAR	1974.00	1975.00	1976.00	1977.00	1978.00	1979.00	1980.00	1981.00	1982.00
SPA	48350.62	48724.86	66645.19	61101.81	75219.83	99648.96	128633.68	130868.27	104402.60
CATCH RTE	0.69	0.69	0.58	0.93	1.08	1.39	1.06	1.23	1.22
ESTIMATE	59556.24	59556.24	50118.30	80147.04	93016.28	119612.72	91300.38	105885.52	105027.57

FULLY RECRUITED F (AGES 5 PLUS)

0.478 0.338 0.358 0.397 0.401 0.261 0.313 0.341 0.300

Figure 2c.



A AND B ARE 42326.5457 113946.0853

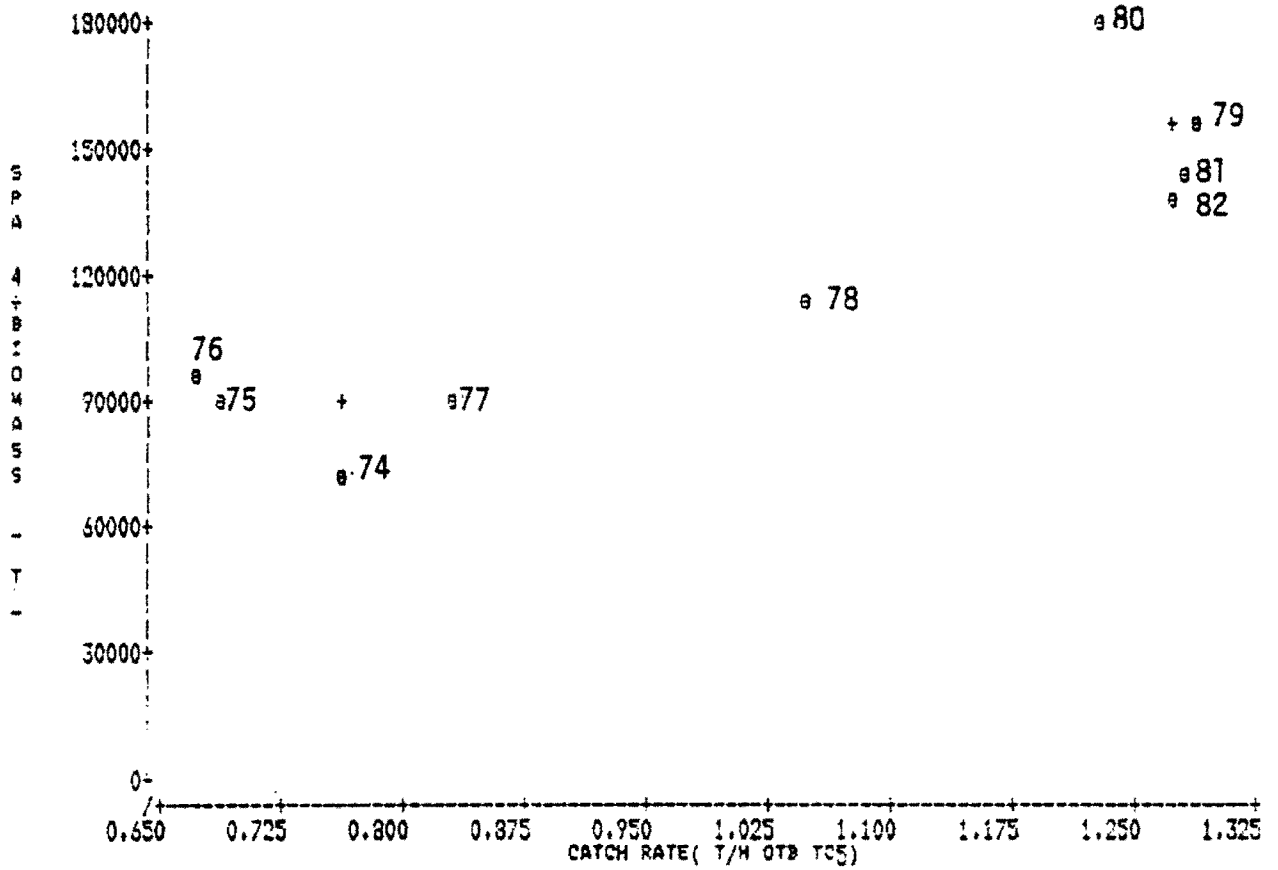
R IS 0.9330

YEAR	1974.00	1975.00	1976.00	1977.00	1978.00	1979.00	1980.00	1981.00	1982.00
SPA	118234.34	120237.32	136834.68	127279.85	156944.45	200708.58	192460.01	174692.60	195639.23
CATCH RTE	0.76	0.69	0.67	0.83	1.05	1.29	1.23	1.28	1.27
ESTIMATE	128925.57	120949.34	118670.42	136901.80	161969.94	189317.00	182480.23	188177.53	187038.07

FULLY RECRUITED F (AGES 5 PLUS)

0.478 0.338 0.358 0.397 0.401 0.261 0.313 0.341 0.300

Figure 2d.



A AND B ARE -5531.8829 125780.5959

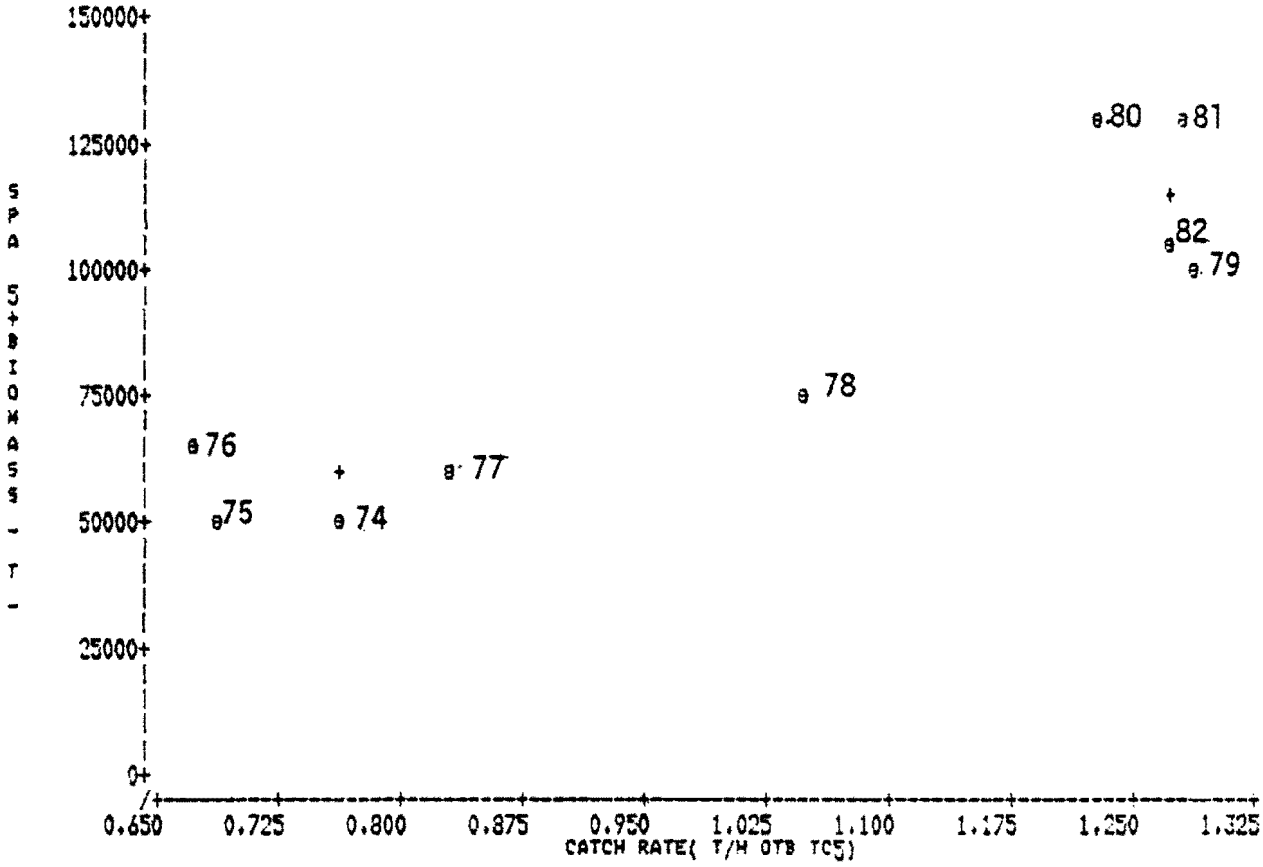
R IS 0.8935

YEAR	1974.00	1975.00	1976.00	1977.00	1978.00	1979.00	1980.00	1981.00	1982.00
SPA	69622.84	92121.65	94417.37	91091.62	112436.34	157818.55	177337.37	141987.86	137573.13
CATCH RTE	0.76	0.69	0.67	0.83	1.05	1.29	1.23	1.28	1.27
ESTIMATE	90061.37	81256.73	78741.12	98866.01	126537.74	156725.09	149178.25	155467.28	154209.47

FULLY RECRUITED F (AGES 5 PLUS)

0.478 0.338 0.358 0.397 0.401 0.261 0.313 0.341 0.300

Figure 2e.



A AND B ARE -26387.1957 111575.7422

R IS 0.8955

YEAR	1974.00	1975.00	1976.00	1977.00	1978.00	1979.00	1980.00	1981.00	1982.00
SPA	48350.62	48724.86	66645.19	61101.81	75219.83	99648.96	128633.68	130868.27	104402.60
CATCH RTE	0.76	0.69	0.67	0.83	1.05	1.29	1.23	1.28	1.27
ESTIMATE	58410.37	50600.07	48368.55	66220.67	90767.33	117545.51	110850.97	116429.75	115314.00

FULLY RECRUITED F (AGES 5 PLUS)

0.478 0.338 0.358 0.397 0.401 0.261 0.313 0.341 0.300

Figure 2f.