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An Assessment of American Plaice in Subdivision 3Ps

by

W. B. Brodie and T. K. Pitt
Department of Fisheries and Oceans
Research and Resource Services
P.O. Box 5667
St. John's, Newfoundland
A1C 5X1

ABSTRACT

An assessment using virtual population analysis was performed but there were difficulties in deriving important parameters, particularly a value for terminal fishing mortality in 1980. Projections using a partial recruitment pattern calculated from the 1977-80 catch matrix and a series of population numbers generated from VPA's with terminal F 's ranging from 0.25 down to 0.15 indicated an $F_{0.1}$ yield in 1982 between 4000 t and 8500 t. Due to the problems in arriving at precise values for certain parameters, it seems wise, in view of the fact that the stock is in fairly stable condition, to leave the TAC for 1982 at 5000 t which is close to the level of the average catch, 1974-80.

RESUME

Une évaluation utilisant l'analyse de population virtuelle a été effectuée, mais il a été difficile de trouver des valeurs pour certains paramètres importants, en particulier, une valeur de mortalité par pêche de dernière année, 1980. Un recrutement partiel calculé à partir de la matrice des prises de 1977-80 et une série d'effectifs de population obtenus par APV avec un F de dernière année variant de 0,25 à 0,15 permettent de prédire un rendement entre 4 000 t et 8 500 t au niveau $F_{0.1}$ en 1982. Parce qu'il a été difficile d'obtenir des valeurs précises de certains paramètres, et considérant que le stock est dans un état relativement stable, il semble sage de maintenir le TPA de 1982 à 5 000 t, ce qui est proche de la moyenne des prises de 1974-80.

INTRODUCTION

This stock has been under catch quota management since 1973. Catches and TAC's are listed in Table 1. This fishery has been almost entirely by Canada since 1970. Nominal catches averaged around 9200 t, 1967-73, and around 4500 t 1974-80. Although this fishery is partially a by-catch fishery, a substantial proportion of the landings since 1973 came from directed effort. (Table 2).

ASSESSMENT

Listed below is the record of otoliths and measurements etc. from this stock in 1980.

<u>Quarter</u>	<u>Measured</u>	<u>Otoliths</u>	<u>Samples</u>	<u>Catch*</u>
1	959	235	3	630
2	-	-	-	590
3	-	-	-	411
<u>4</u>	<u>977</u>	<u>441</u>	<u>4</u>	<u>869</u>
Total	1936	676	7	2500

*Preliminary - Canada (N) offshore

Numbers at age were available from 1973, although the sampling level in 1973 and 1974 was low and hence the numbers at age breakdown was especially unreliable in these years. The numbers at age in 1980 were calculated in the usual way from the age length keys and length frequencies from the commercial fishery, (Table 5).

Average weights at age were calculated from average lengths at age using available monthly samples weighted by the numbers caught at age. Average lengths were converted to weight by the length-weight regression, $W = 0.0000028 L^{3.3247}$.

Partial recruitment rates were determined from a preliminary cohort run using the catch numbers matrix 1977-80. This run calculates average F's across years to give starting values for each cohort in 1980. The partial recruitment rates were calculated from these average F's in 1980 and plotted with a line drawn by eye to give the values listed in Table 3b, Pitt (1980).

Yield per recruit was calculated using the average weights at age for 1980 and the partial recruitment vector listed (Table 3b). An age span of 19 years was used. $F_{0.1}$ was calculated at 0.24 and F_{max} 0.42 (Table 3a).

Virtual Population Analysis was performed using the parameters described above over a range of terminal F's from 0.15 to 0.35. Fine-tuning of the VPA was difficult in that regression of VPA biomass on CPUE was not significant. Regression of fishing mortality on effort showed that terminal F for 1980 may be in the range of 0.15 to 0.25, (Tables 4, 6, 8 and 10).

Recruitment estimates for the projections were the geometric mean of the age six VPA numbers over the years 1973-79.

Projections were done using the VPA population numbers for 1980 at terminal F 's = 0.15, 0.20 and 0.25 as starting values. Assuming that the 1981 TAC of 5000 t will be taken, the projections indicated an $F_{0.1}$ catch in 1982 between 4400 t and 8200 t (Tables 7, 9 and 11).

DISCUSSION

CPUE for this stock has remained relatively constant since 1974 (Figure 1). Attempts however, to correlate biomass with CPUE proved unsuccessful. In view of the difficulty in arriving at a value for terminal F and allowing that the stock is in a reasonably stable condition, it would seem best to keep the 1982 TAC at 5000 t.

REFERENCES

Pitt, T. K. 1980. American plaice in ICNAF Subdivision 3Ps - an assessment update. CAFSAC Res. Doc. 80/53.

Table 1. Catch for plaice in Subdivision 3Ps

Year	Canada (tons)	All countries (tons)	TAC (tons)
1967	3,275	4,494	
1968	5,523	14,280	
1969	4,066	6,491	
1970	11,545	12,328	
1971	5,953	7,182	
1972	5,922	6,538	
1973	12,812	13,360	
1974	6,330	6,598	11.0
1975	3,813	4,211	11.0
1976	5,383	5,428	8.0
1977	4,605	4,605	6.0
1978	3,611	3,658	4.0
1979	3,405	3,666	4.0
1980	2,709	3,369	5.0
1981			5.0

*Preliminary

Table 2. Catch and effort for American plaice 3Ps. Catch rates calculated from Canada(N) OT-5 catch and effort data

Year	Total catch (tons)	CPUE (t/hr)	Calculated effort (hr)	Directed catch (tons)
1967	4,494	0.740	6,073	1,342
1968	14,280	0.677	37,878	2,735
1969	6,491	0.553	11,738	1,754
1970	12,328	0.679	18,153	5,539
1971	7,182	0.530	13,550	2,778
1972	6,538	0.494	13,235	3,212
1973	13,360	0.506	26,403	9,542
1974	6,594	0.331	19,921	4,218
1975	4,211	0.307	13,717	1,797
1976	5,428	0.311	17,453	4,340
1977	4,605	0.326	14,126	3,045
1978	3,658	0.302	12,113	2,361
1979	3,666	0.407	9,007	2,276
1980	3,369	0.317	10,628	1,175

Table 3a. SUMMARY OF YIELD PER RECRUIT CALCULATED FROM PARTIAL RECRUITMENT AND AVERAGE WEIGHT AT AGE OVER AGES 6 TO 19

F	Y/R(KG)
0.001	0.0025
0.050	0.1004
0.100	0.1635
0.150	0.2027
0.200	0.2266
0.250	0.2407
0.300	0.2486
0.350	0.2525
0.400	0.2540
0.450	0.2540
0.500	0.2532
0.550	0.2518
0.600	0.2502
0.650	0.2484
0.700	0.2467
0.750	0.2450
0.800	0.2435
0.850	0.2420
0.900	0.2406
0.950	0.2394
1.000	0.2383
1.050	0.2372
1.100	0.2363
1.150	0.2354
1.200	0.2347
1.250	0.2340
1.300	0.2333
1.350	0.2328
1.400	0.2323
1.450	0.2318
1.500	0.2314
1.550	0.2310
1.600	0.2307
1.650	0.2303
1.700	0.2301
1.750	0.2298
1.800	0.2296
1.850	0.2294
1.900	0.2292
1.950	0.2290
2.000	0.2289

F0.1 IS 0.235 AND Y/R IS 0.2372
 FMAX IS 0.424 AND Y/R IS 0.2542

Table 3b. Parameters used in yield per recruit calculations.

NATURAL MORTALITY= 0.20

NO.OF AGES= 14 FIRST AGE= 6

AGE	AVG.WT.(g)	P.REC.
6	250.	0.010
7	313.	0.030
8	366.	0.100
9	457.	0.280
10	525.	0.400
11	717.	0.550
12	868.	0.780
13	1246.	1.000
14	2038.	1.000
15	1957.	1.000
16	2415.	1.000
17	2879.	1.000
18	3128.	1.000
19	3250.	1.000

Table 4. Regression of average F (weighted by population numbers) on effort.

Year	Effort (hrs X 10 ⁻³)	Ave. F from Y. P., Ages 13-18					
		F _T = 0.15	F _T = 0.20	F _T = 0.25	F _T = 0.30	F _T = 0.35	
1973	26.4	0.921	0.921	0.921	0.921	0.921	
1974	19.9	0.574	0.576	0.576	0.577	0.577	
1975	13.7	0.362	0.370	0.375	0.378	0.381	
1976	17.5	0.406	0.425	0.438	0.447	0.454	
1977	14.1	0.568	0.628	0.670	0.702	0.726	
1978	12.1	0.298	0.356	0.402	0.440	0.472	
1979	9.0	0.253	0.318	0.377	0.429	0.477	
1980	10.6						
		r ²	0.840	0.761	0.678	0.594	0.511
		a	-0.105	-0.009	0.070	0.136	0.194
		b	0.036	0.032	0.029	0.026	0.024

Table 5. Catch numbers, 3Ps Am. plaice (X 10⁻³)

CATCH AGE YEAR	1973	1974	1975	1976	1977	1978	1979	1980
6	46.	312.	264.	121.	24.	53.	97.	2.
7	568.	783.	619.	442.	150.	206.	182.	148.
8	823.	857.	613.	1110.	370.	498.	545.	609.
9	1170.	1165.	570.	1499.	896.	994.	900.	925.
10	941.	1221.	422.	1249.	917.	1033.	845.	897.
11	2003.	777.	403.	963.	1055.	769.	654.	720.
12	1344.	880.	480.	705.	384.	729.	382.	633.
13	1272.	844.	401.	454.	280.	329.	241.	401.
14	1140.	490.	239.	219.	249.	228.	162.	73.
15	974.	220.	77.	161.	191.	120.	133.	87.
16	827.	173.	100.	127.	209.	76.	48.	50.
17	426.	96.	95.	99.	138.	21.	25.	21.
18	377.	145.	64.	42.	91.	11.	3.	12.
19	239.	61.	60.	3.	31.	5.	1.	1.

Table 6. Results of virtual population analysis, $F_T = 0.15$

		POPULATION NUMBERS ($\times 10^3$)							
		1973	1974	1975	1976	1977	1978	1979	1980
6		23913	30253	32796	40747	46382	67616	44525	1472
7		13175	19536	24487	26612	33252	37953	55311	36366
8		10393	10274	15288	19490	21389	27089	30887	45121
9		8450	7767	7639	11964	14955	17178	21729	24796
10		5584	5864	5310	5740	8444	11436	13167	16978
11		5631	3724	3703	3967	3576	6087	8431	10018
12		3914	2816	2350	2668	2382	1981	4291	6313
13		2795	2000	1516	1493	1551	1605	969	3168
14		2172	1152	883	881	815	1018	1018	577
15		1721	762	505	508	524	444	629	687
16		1136	542	427	344	272	258	255	395
17		834	201	289	259	168	39	143	166
18		588	303	79	151	124	17	13	95
19		410	148	119	8	86	21	4	8
6+		80715	85343	95390	114833	133921	172741	181373	146160
7+		56802	55090	62594	74086	87539	105125	136848	144688
8+		43627	35553	38107	47473	54287	67172	81536	108322
9+		33234	25280	22819	27984	32898	40083	50649	63201

MEAN POPULATION BIOMASS ($\text{kg} \times 10^{-3}$) 1/ 5/81

		1973	1974	1975	1976	1977	1978	1979	1980
6		5413	6817	7399	9218	10507	15314	10077	333
7		3651	5423	6853	7483	9410	10736	15664	10294
8		3300	3254	4962	6267	7030	8898	10149	14860
9		3235	2952	3036	4617	5994	6893	8800	10065
10		2411	2468	2418	2401	3781	5175	6048	7849
11		2913	2140	2264	2228	1936	3683	5249	6257
12		2474	1822	1640	1788	1708	1228	3213	4696
13		2310	1702	1458	1395	1578	1606	942	3331
14		2744	1600	1382	1401	1244	1646	1716	992
15		1997	1132	822	739	736	667	984	1135
16		1303	972	812	594	288	471	501	805
17		1510	375	613	528	190	68	338	403
18		997	615	98	362	182	29	32	250
19		777	330	244	19	201	54	11	22
6+		35033	31603	34000	39039	44785	56469	63723	61292
7+		29621	24786	26600	29821	34279	41154	53646	60959
8+		25970	19363	19748	22338	24868	30419	37983	50665
9+		22670	16109	14786	16071	17839	21521	27834	35805

FISHING MORTALITY 1/ 5/81

		1973	1974	1975	1976	1977	1978	1979	1980
6		0.002	0.011	0.009	0.003	0.001	0.001	0.002	0.001
7		0.049	0.045	0.028	0.018	0.005	0.006	0.004	0.005
8		0.091	0.096	0.045	0.065	0.019	0.020	0.020	0.015
9		0.165	0.180	0.086	0.148	0.068	0.066	0.047	0.042
10		0.205	0.260	0.092	0.273	0.127	0.105	0.073	0.060
11		0.493	0.260	0.128	0.310	0.391	0.150	0.089	0.082
12		0.471	0.419	0.254	0.342	0.195	0.515	0.103	0.117
13		0.686	0.618	0.343	0.405	0.221	0.255	0.319	0.150
14		0.847	0.624	0.352	0.319	0.408	0.282	0.192	0.150
15		0.954	0.380	0.183	0.426	0.508	0.352	0.264	0.150
16		1.533	0.430	0.297	0.516	1.750	0.389	0.231	0.150
17		0.812	0.737	0.446	0.540	2.088	0.894	0.213	0.150
18		1.182	0.737	2.043	0.363	1.566	1.194	0.294	0.150
19		1.000	0.600	0.800	0.500	0.500	0.300	0.300	0.150
6+		0.220	0.120	0.056	0.077	0.049	0.035	0.027	0.036

Table 7. Results of catch projections, $F_T = 0.15$.

POPULATION NUMBERS ($\times 10^{-3}$)				POPULATION BIOMASS _s (AVERAGE) ($\text{kg} \times 10^{-3}$)			
I	1980	1981	1982	I	1980	1981	1982
6 I	39000	39000	39000	6 I	8836.63	8829.58	8826.85
7 I	36366	31929	31876	7 I	10294.13	9035.32	9012.03
8 I	45121	29640	26007	8 I	14859.67	9751.57	8529.97
9 I	24796	36392	23856	9 I	10064.85	14730.27	9573.62
10 I	16978	19466	28403	10 I	7848.93	8963.30	12919.39
11 I	10018	13091	14884	11 I	6257.48	8132.22	9093.13
12 I	6313	7553	9756	12 I	4696.09	5574.95	7034.38
13 I	3168	4598	5412	13 I	3330.52	4786.55	5467.76
14 I	577	2232	3173	14 I	992.21	3801.18	5243.67
15 I	687	407	1541	15 I	1134.33	664.86	2444.73
16 I	395	484	281	16 I	804.86	976.72	549.52
17 I	166	278	334	17 I	403.25	669.52	779.87
18 I	95	117	192	18 I	250.77	305.73	487.21
19 I	8	67	81	19 I	21.96	181.84	212.76
6+I	183688	185254	184796	6+I	69795.70	76403.62	80174.89
7+I	144688	146254	145796	7+I	60959.06	67574.04	71348.05
8+I	108322	114325	113920	8+I	50664.93	58538.71	62336.01
9+I	63201	84685	87912	9+I	35805.26	48787.14	53806.04

CATCH NUMBERS ($\times 10^{-3}$)				CATCH BIOMASS ($\text{kg} \times 10^{-3}$)				FISHING MORTALITY			
I	1980	1981	1982	I	1980	1981	1982	I	1980	1981	1982
6 I	2	60	83	6 I	1	15	21	6 I	0.000	0.002	0.002
7 I	148	148	203	7 I	46	46	64	7 I	0.005	0.005	0.007
8 I	609	455	548	8 I	223	167	200	8 I	0.015	0.017	0.024
9 I	925	1543	1378	9 I	423	705	630	9 I	0.042	0.048	0.066
10 I	897	1167	2313	10 I	471	613	1214	10 I	0.060	0.068	0.094
11 I	720	1066	1639	11 I	516	765	1175	11 I	0.082	0.094	0.129
12 I	633	856	1485	12 I	549	743	1289	12 I	0.117	0.133	0.183
13 I	401	657	1031	13 I	500	818	1285	13 I	0.150	0.171	0.235
14 I	73	319	605	14 I	149	650	1232	14 I	0.150	0.171	0.235
15 I	87	58	294	15 I	170	114	575	15 I	0.150	0.171	0.235
16 I	50	69	53	16 I	121	167	129	16 I	0.150	0.171	0.235
17 I	21	40	64	17 I	60	114	183	17 I	0.150	0.171	0.235
18 I	12	17	37	18 I	38	52	114	18 I	0.150	0.171	0.235
19 I	1	10	15	19 I	3	31	50	19 I	0.148	0.171	0.235
6+I	4579	6465	9748	6+I	3270	5000	8162	6+I	0.028	0.040	0.062
7+I	4577	6405	9666	7+I	3269	4985	8142				
8+I	4429	6257	9463	8+I	3223	4939	8078				
9+I	3820	5801	8915	9+I	3000	4772	7878				

Table 8. Results of virtual population analysis, $F_T = 0.20$,

POPULATION NUMBERS ($\times 10^{-3}$)

1/ 5/81

	1	1973	1974	1975	1976	1977	1978	1979	1980
6		20924	25302	26255	31573	35315	50910	33445	1104
7		12625	17090	20434	21257	25740	28892	41633	27295
8		9742	9824	13285	16171	17005	20939	23468	33922
9		8075	7234	7270	10324	12238	13588	16694	18722
10		5426	5557	4874	5438	7102	9212	10229	12855
11		5540	3595	3452	3610	3330	4989	6611	7612
12		3906	2742	2245	2463	2090	1780	3392	4823
13		2795	1993	1455	1406	1384	1366	805	2433
14		2172	1152	877	831	744	881	823	443
15		1721	762	505	504	484	386	516	528
16		1136	542	427	344	268	225	208	303
17		834	201	289	259	168	36	116	127
18		588	303	79	151	124	17	11	73
19		410	148	119	8	86	21	4	6

6+		75894	76445	81566	94341	106079	133241	137955	110247
7+		54969	51143	55311	62768	70764	82331	104510	109142
8+		42344	34053	34877	41510	45023	53439	62877	81848
9+		32602	24230	21591	25340	28019	32501	39408	47926

MEAN POPULATION BIOMASS ($\text{kg} \times 10^{-3}$)

1/ 5/81

	1	1973	1974	1975	1976	1977	1978	1979	1980
6		4736	5695	5917	7139	7999	11529	7566	250
7		3495	4729	5703	5963	7279	8165	11783	7721
8		3084	3105	4298	5165	5575	6857	7688	11145
9		3079	2731	2884	3936	4869	5406	6714	7549
10		2335	2321	2210	2257	3141	4116	4649	5887
11		2852	2056	2101	1994	1774	2968	4065	4693
12		2468	1763	1556	1625	1478	1066	2505	3522
13		2310	1694	1389	1296	1387	1335	755	2498
14		2744	1600	1372	1309	1112	1391	1354	744
15		1997	1132	822	731	662	564	784	851
16		1303	972	812	594	279	398	397	604
17		1510	375	613	528	190	60	267	302
18		997	615	98	362	182	29	26	188
19		777	330	244	19	201	54	11	16

6+		33686	29118	30017	32919	36129	43938	48565	45969
7+		28951	23423	24100	25779	28130	32409	40999	45719
8+		25456	18694	18397	19816	20851	24244	29215	37998
9+		22372	15589	14099	14650	15275	17386	21527	26854

FISHING MORTALITY

1/ 5/81

	1	1973	1974	1975	1976	1977	1978	1979	1980
6		0.002	0.014	0.011	0.004	0.001	0.001	0.003	0.002
7		0.051	0.052	0.034	0.023	0.006	0.008	0.005	0.006
8		0.098	0.101	0.052	0.079	0.024	0.027	0.026	0.020
9		0.174	0.195	0.090	0.174	0.084	0.084	0.061	0.056
10		0.212	0.276	0.100	0.291	0.153	0.132	0.095	0.080
11		0.504	0.271	0.138	0.346	0.426	0.186	0.115	0.110
12		0.473	0.433	0.268	0.377	0.226	0.593	0.132	0.156
13		0.686	0.621	0.360	0.436	0.251	0.307	0.398	0.200
14		0.847	0.624	0.355	0.341	0.456	0.334	0.244	0.200
15		0.954	0.380	0.183	0.431	0.564	0.417	0.332	0.200
16		1.533	0.430	0.297	0.516	1.811	0.461	0.292	0.200
17		0.812	0.737	0.446	0.540	2.088	1.009	0.269	0.200
18		1.182	0.737	2.043	0.363	1.566	1.194	0.367	0.200
19		1.000	0.600	0.800	0.500	0.500	0.300	0.300	0.200
6+		0.234	0.134	0.065	0.095	0.063	0.047	0.036	0.048

Table 9. Results of catch projections, $F_T = 0.20$.

POPULATION NUMBERS ($\times 10^{-3}$)				POPULATION BIOMASS (AVERAGE) ($\text{kg} \times 10^{-3}$)			
	1980	1981	1982		1980	1981	1982
6	31000	31000	31000	6	7023.94	7016.18	7016.21
7	27295	25379	25321	7	7720.81	7175.07	7158.76
8	33922	22214	20632	8	11144.63	7285.39	6766.94
9	18722	27223	17763	9	7548.56	10923.55	7128.42
10	12855	14493	20864	10	5886.37	6591.49	9490.29
11	7612	9716	10798	11	4692.87	5934.12	6596.70
12	4823	5583	6987	12	3522.29	4024.15	5037.54
13	2433	3378	3803	13	2498.62	3412.09	3842.31
14	443	1631	2185	14	744.14	2694.22	3610.71
15	528	297	1055	15	851.68	471.09	1673.81
16	303	354	192	16	603.04	692.89	376.11
17	127	203	229	17	301.26	473.87	534.41
18	73	85	131	18	188.25	215.70	333.09
19	6	49	55	19	16.05	128.99	144.99
6+	140142	141605	141015	6+	52742.51	57038.80	59710.30
7+	109142	110605	110015	7+	45718.57	50022.61	52694.08
8+	81847	85226	84694	8+	37997.76	42847.55	45535.32
9+	47925	63012	64062	9+	26853.13	35562.15	38768.38

CATCH NUMBERS ($\times 10^{-3}$)				CATCH BIOMASS ($\text{kg} \times 10^{-3}$)				FISHING MORTALITY			
	1980	1981	1982		1980	1981	1982		1980	1981	1982
6	2	66	66	6	1	17	16	6	0.000	0.002	0.002
7	148	162	161	7	46	51	50	7	0.006	0.007	0.007
8	609	469	434	8	223	172	159	8	0.020	0.024	0.024
9	925	1578	1026	9	423	721	469	9	0.056	0.066	0.066
10	897	1184	1699	10	471	622	892	10	0.080	0.094	0.094
11	720	1074	1189	11	516	770	853	11	0.110	0.130	0.129
12	633	853	1064	12	549	740	923	12	0.156	0.184	0.183
13	401	646	725	13	500	805	903	13	0.200	0.236	0.235
14	73	312	416	14	149	635	849	14	0.200	0.236	0.235
15	87	57	201	15	170	111	393	15	0.200	0.236	0.235
16	50	68	37	16	121	163	88	16	0.200	0.236	0.235
17	21	39	44	17	60	112	126	17	0.200	0.236	0.235
18	12	16	25	18	38	51	78	18	0.201	0.236	0.235
19	1	9	10	19	3	30	34	19	0.199	0.236	0.235
6+	4579	6534	7098	6+	3270	5000	5834	6+	0.038	0.054	0.059
7+	4577	6467	7032	7+	3269	4983	5818				
8+	4429	6305	6871	8+	3223	4933	5767				
9+	3820	5836	6436	9+	3000	4761	5608				

Table 10. Results of virtual population analysis, $F_T = 0.25$.

		POPULATION NUMBERS ($\times 10^{-3}$)							1/ 5/81
	I	1973	1974	1975	1976	1977	1978	1979	1980
6	I	19133	22333	22332	26069	28675	40886	26796	884
7	I	12295	15623	18003	18045	21234	23456	33427	21851
8	I	9352	9554	12085	14181	14375	17250	19018	27203
9	I	7850	6914	7049	9341	10609	11435	13673	15078
10	I	5330	5373	4612	5257	6298	7878	8466	10383
11	I	5485	3517	3301	3396	3182	4330	5519	6170
12	I	3901	2697	2181	2340	1916	1659	2853	3929
13	I	2795	1989	1419	1354	1283	1223	707	1992
14	I	2172	1152	874	802	702	799	706	363
15	I	1721	762	505	501	460	351	449	432
16	I	1136	542	427	344	266	206	180	248
17	I	834	201	289	259	168	34	100	104
18	I	588	303	79	151	124	17	9	60
19	I	410	148	119	8	86	21	4	5
6+1		73002	71110	73275	82049	89377	109545	111908	88702
7+1		53869	48776	50943	55980	60702	68659	85112	87819
8+1		41574	33153	32939	37935	39468	45203	51685	65967
9+1		32222	23599	20855	23754	25093	27953	32667	38764
		MEAN POPULATION BIOMASS ($\text{kg} \times 10^{-3}$)							1/ 5/81
	I	1973	1974	1975	1976	1977	1978	1979	1980
6	I	4330	5023	5028	5892	6495	9258	6060	200
7	I	3401	4313	5013	5052	6001	6623	9455	6177
8	I	2954	3015	3899	4505	4703	5634	6212	8916
9	I	2986	2598	2792	3528	4193	4514	5462	6039
10	I	2290	2233	2086	2170	2758	3480	3810	4709
11	I	2816	2005	2003	1854	1676	2539	3355	3754
12	I	2464	1727	1506	1527	1340	969	2080	2818
13	I	2310	1690	1347	1236	1273	1172	643	1999
14	I	2744	1600	1366	1253	1032	1237	1137	595
15	I	1997	1132	822	726	618	501	663	681
16	I	1303	972	812	594	273	354	335	483
17	I	1510	375	613	528	190	55	225	242
18	I	997	615	98	362	182	29	22	150
19	I	777	330	244	19	201	54	11	13
6+1		32878	27628	27628	29247	30935	36418	39470	36775
7+1		28548	22605	22599	23354	24441	27161	33410	36575
8+1		25147	18292	17586	18302	18440	20538	23955	30399
9+1		22193	15277	13687	13797	13737	14904	17743	21483
		FISHING MORTALITY							1/ 5/81
	I	1973	1974	1975	1976	1977	1978	1979	1980
6	I	0.003	0.016	0.013	0.005	0.001	0.001	0.004	0.003
7	I	0.052	0.057	0.039	0.027	0.008	0.010	0.006	0.008
8	I	0.102	0.104	0.058	0.090	0.029	0.032	0.032	0.025
9	I	0.179	0.205	0.093	0.194	0.098	0.101	0.075	0.070
10	I	0.216	0.287	0.106	0.302	0.175	0.156	0.116	0.100
11	I	0.510	0.278	0.144	0.372	0.451	0.217	0.140	0.138
12	I	0.473	0.442	0.277	0.401	0.249	0.653	0.159	0.195
13	I	0.686	0.622	0.371	0.458	0.274	0.350	0.467	0.250
14	I	0.847	0.624	0.357	0.356	0.492	0.375	0.290	0.250
15	I	0.954	0.380	0.183	0.434	0.605	0.468	0.392	0.250
16	I	1.533	0.430	0.297	0.516	1.851	0.518	0.346	0.250
17	I	0.812	0.737	0.446	0.540	2.088	1.096	0.320	0.250
18	I	1.182	0.737	2.043	0.363	1.566	1.194	0.433	0.250
19	I	1.000	0.600	0.800	0.500	0.500	0.300	0.300	0.250
6+1		0.243	0.145	0.073	0.110	0.075	0.058	0.044	0.060

Table 11. Results of catch projections, $F_T = 0.25$.

POPULATION NUMBERS ($\times 10^{-3}$)				POPULATION BIOMASS (AVERAGE) ($\text{kg} \times 10^{-3}$)			
I	1980	1981	1982	I	1980	1981	1982
6 I	26000	26000	26000	6 I	5891.01	5882.56	5884.56
7 I	21851	21285	21222	7 I	6176.41	6011.66	5999.95
8 I	27203	17756	17268	8 I	8915.70	5804.12	5663.59
9 I	15078	21722	14100	9 I	6038.77	8635.60	5658.60
10 I	10383	11510	16327	10 I	4709.41	5166.10	7426.51
11 I	6170	7692	8340	11 I	3754.73	4614.22	5095.11
12 I	3929	4403	5324	12 I	2817.37	3094.19	3838.57
13 I	1992	2647	2841	13 I	1998.72	2588.87	2869.97
14 I	363	1270	1597	14 I	595.82	2032.05	2638.74
15 I	432	232	766	15 I	680.76	355.68	1215.96
16 I	248	275	140	16 I	482.20	522.14	273.52
17 I	104	158	166	17 I	241.02	357.23	387.90
18 I	60	66	95	18 I	151.26	162.69	241.86
19 I	5	38	40	19 I	13.10	97.78	105.34
6+I	113818	115055	114226	6+I	42466.27	45324.89	47300.18
7+I	87818	89055	88226	7+I	36575.27	39442.33	41415.62
8+I	65967	67770	67004	8+I	30398.85	33430.67	35415.67
9+I	38764	50013	49736	9+I	21483.15	27626.55	29752.08

CATCH NUMBERS ($\times 10^{-3}$)				CATCH BIOMASS ($\text{kg} \times 10^{-3}$)				FISHING MORTALITY			
I	1980	1981	1982	I	1980	1981	1982	I	1980	1981	1982
6 I	2	72	55	6 I	1	18	14	6 I	0.000	0.003	0.002
7 I	148	176	135	7 I	46	55	42	7 I	0.008	0.009	0.007
8 I	609	484	364	8 I	223	177	133	8 I	0.025	0.031	0.024
9 I	925	1616	815	9 I	423	738	372	9 I	0.070	0.086	0.066
10 I	897	1202	1330	10 I	471	631	698	10 I	0.100	0.122	0.094
11 I	720	1081	918	11 I	516	775	659	11 I	0.137	0.168	0.129
12 I	633	849	811	12 I	549	737	704	12 I	0.195	0.238	0.183
13 I	401	635	541	13 I	500	791	674	13 I	0.250	0.305	0.235
14 I	73	305	304	14 I	149	621	620	14 I	0.250	0.305	0.235
15 I	87	56	146	15 I	170	109	286	15 I	0.250	0.305	0.235
16 I	50	66	27	16 I	121	159	64	16 I	0.250	0.305	0.235
17 I	21	38	32	17 I	60	109	91	17 I	0.251	0.305	0.235
18 I	12	16	18	18 I	38	50	57	18 I	0.248	0.305	0.235
19 I	1	9	8	19 I	3	30	25	19 I	0.248	0.305	0.235
6+I	4579	6604	5503	6+I	3270	5000	4439	6+I	0.047	0.068	0.057
7+I	4577	6532	5448	7+I	3269	4982	4425				
8+I	4429	6356	5313	8+I	3223	4927	4383				
9+I	3820	5872	4949	9+I	3000	4750	4250				

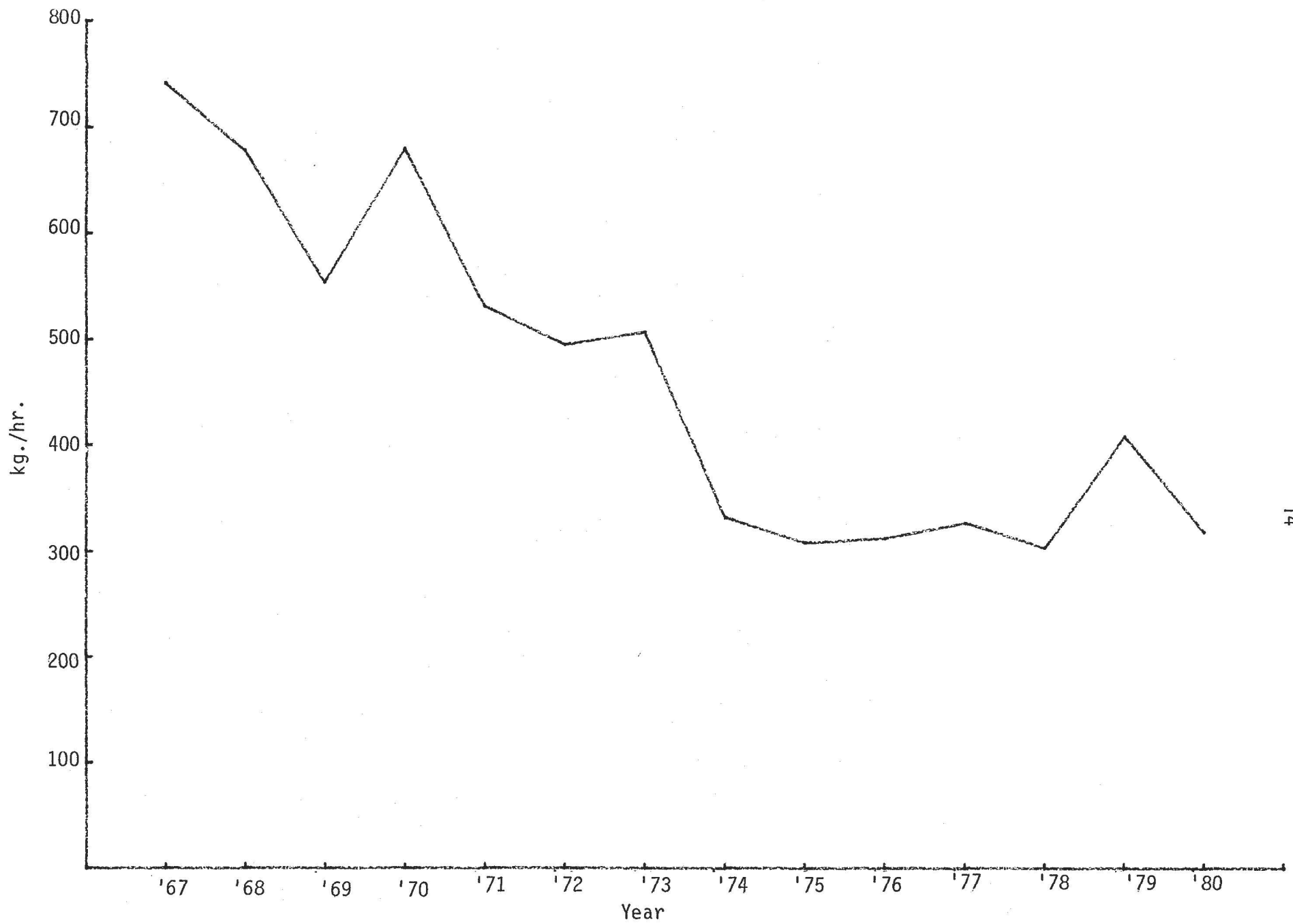


Fig. 1. Catch per hour of American plaice by Can(N) OT-5 in NAFO Subdivision 3Ps.