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American plaice in ICNAF Divisions 3LNØ, a stock assessment update

by

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This stock has been under quota regulation since 1973 with TAC's and nominal catches as follows:

	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>
TAC('000 tons)	60.5	60.0	60.0	47.0	47.0	47.0
Catch('000 tons)	53.0	46.0	43.0	51.8	43.2*	

*Preliminary

The highest recorded catch from this stock was in 1967 when 94,000 tons (Fig. 1) were reported. The 1977 catch was lower at 43,200 tons than in 1976 when 51,800 tons were taken when the TAC was 47,000 tons.

Catch per hour (Canadian stern otter trawlers) has decreased generally from 1967 to 1974 at which point it has remained relatively stable with "total" CPUE between 360 and 400 kg/hr and "main species" rate between 400 and 520 kg/hr.

Assessment

Terminal or Starting F (F_T)

The values of F used to initiate the Cohort Analysis using the 1977 catch data for Divisions 3L and 3N were taken from the regression of fully recruited F on total fishing effort (Fig. 2). In 1977 approximately 100,000 hours were calculated for Divisions 3LN. This gives values of 0.60 and 0.45 for males and females respectively. F_T for Division 3Ø were the same as those used in the 1977 assessment, 0.5 for males and 0.4 for females

Partial Recruitment

Partial recruitment was determined from the matrix of catch numbers at age 1974-77. F for the final age group of each year was as shown in Tables 3 and 4, however, for each cohort the starting or terminal F was the average at age for 1974-77. In this way, the matrix of fishing mortality for this exercise was calculated and the recruitment pattern determined from the average F's at age.

Average Weights

Average weights were calculated from monthly length frequencies and age samples collected during 1977 weighted by the calculated numbers caught each month and converted to weights by the following relationship:

$$\text{Log } w = 3.041 \text{ Log } l - 5.080$$

The mean weights are practically identical to those used in the 1976 assessment.

Catch Projections (Tables 7-10)

Catch projections for both 3LN and 3Ø were based on the 1976 stock size calculated by the Cohort Analysis method except that for the youngest ages average values for 1972-76 were used for Divisions 3LN and these recruitment levels projected to 1979. For Division 3Ø recruitment values were average for 1973-76. The projected catch for 1979 was based on a fishing mortality at $F_{0.1}$, 0.5 for males and 0.45 for females (Fig. 3). This gives a combined projected catch for 1979 for Divisions 3LNØ of 43,100 tons.

In addition to the detailed catch projection tables a general summary of projected catches and fishing mortalities are given in Table 1. Also included here are values calculated in the 1977 assessment (Pitt 1977) as comparisons with the current projections.

Spawning Biomass and Spawning Population Numbers

From Cohort Analysis (Tables 3, 4, 5 and 6) and catch projections (Tables 7, 8, 9 and 10) a summary of the spawning stock abundance for a number of years is shown in Table 2. Divisions 3LN and Division 3Ø are shown separately since for the latter Division Cohort Analysis was only available for data back to 1973. The spawning biomass and spawning population for Divisions 3LN in the mid-1970's was about half of the value calculated for 1967. Assuming constant recruitment, stock projections indicate a gradual increase in abundance over the next several years.

The Division 3Ø segment of the stock appeared to have been at a very low level with regards to spawning stock in 1976, but projections indicate a gradual improvement to close to the 1973 level by 1985, again assuming constant recruitment.

Discussion

Comparisons of the current projections with those from the 1977 assessment (Table 1) show that while the expected catches for 1977 and those projected for 1978 agree with the 1978 assessment for the Divisions 3LN segment, the catches from Division 3Ø were below those anticipated. Prior to 1977, an allowance of 5,000 to 10,000 tons was added to the projected TAC for Divisions 3LN to give a total Divisions 3LNØ TAC. The Division 3Ø value was based at first on recent average catches and later on a yield-per-recruitment assessment. It should be pointed out that the high catches reported from Division 3Ø in the mid-1960's (Table 2) may not have been entirely accurate since landings by the USSR, who reported most of the catch in this Division, were originally reported as "unspecified flounder" and only later assigned to individual species categories. However, there are confirmed landings of our 10,000 tons during the late 1960's and early 1970's.

The spawning biomass appears to have been at a low level in the early to mid-1970's and shows signs of gradual improvement. The catch per hour has stabilized (Fig. 1) and fishing mortalities have declined, but it might be a few years before the full effect of the recent management strategies become evident in increased catch rates.

Table 1. A summary of the projected catches, catches and fishing mortalities. TAC's and catches are in thousands of tons. Numbers in brackets are the values predicted from the 1977 assessment.

Div.	1976			1977			1978			1979		
	3LN	F	3Ø	3LN	F	3Ø	3LN	F	3Ø	3LN	F	3Ø
Male	15.0*	0.70	1.8	15.2 (14.8)	0.70 (0.6)	0.9 (2.6)	15.1 (13.6)	0.68 (0.48)	1.2 (2.2)	13.0	0.51	0.9
Female	31.6*	0.51	4.1	25.7 (25.5)	0.45 (0.48)	2.3 (3.1)	25.7 (26.2)	0.45 (0.42)	3.3 (3.0)	26.3	0.41	2.9
TOTAL 3LNØ*		52.5		44.0 (46.0)			45.3 (45.0)			43.1		
TAC				47.0			47.0			47.0		
CATCH				51.8		43.2						

*Catches from these lines were calculated in the assessment.

Table 2. A spawning biomass, spawning population numbers and catches of plaice for (A) Divisions 3LN, and (B) Division 3Ø.

	<u>1963</u>	<u>1967</u>	<u>1971</u>	<u>1973</u>	<u>1976</u>	<u>1979</u>	<u>1982</u>	<u>1985</u>
A. <u>3LN</u>								
Spawning Biomass	297.6	299.7	193.8	130.2	135.9	219.5	250.0	254.5
Spawning Population	334	349	217	150	179.9	267.4	281.5	285.0
Catch	24.0	62.9	60.8	41.0	43.7	39.3	50.6	52.7
B. <u>3Ø</u>								
Spawning Biomass				28.1	13.7	17.6	21.4	23.3
Spawning Population				38.2	19.6	25.4	28.2	30.7
Catch	1.7	31.5	7.1	11.8	8.1	3.8	5.0	5.6

Table 3

PLAICE 3LN MALE 1963=1977

NATURAL MORTALITY 0.25

PARTIAL RECRUITMENT MULTIPLIER 0.0100 0.0400 0.1300 0.3000 0.4700 0.6800 1.0000 1.4000 1.5000 1.0000 1.0000

ASSUMED FISHING MORTALITY FOR LAST AGES 0.2000 0.3000 0.3500 0.3800 0.4000 0.5000 0.6000 0.8000 0.8500 0.9000 0.9000 0.9000 0.7000 0.6500 0.6000

AGE	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
5	108464	121487	129596	115158	102112	71168	62702	60016	70842	81031	97263	91832	119913	233981	74808
6	78646	84471	94445	100562	88590	79354	52338	48398	46503	34721	62938	78431	71416	93170	174107
7	70197	60821	64620	71710	76059	67866	61488	42592	37092	35595	21682	25838	35638	33287	70888
8	55719	53846	45394	46961	51428	55106	50235	43835	31735	25353	26939	29316	30281	20231	38736
9	32972	42670	40689	31268	31687	32853	37683	32491	28170	20539	15839	18410	19478	22862	24591
10	21815	24981	29964	27892	20907	20813	23189	19747	19461	15443	15845	8133	9690	11968	12337
11	14779	15813	15571	13537	16226	10650	10775	11855	10888	9430	5858	4244	1196	5071	3063
12	14058	9892	9925	8847	12517	9758	4408	4408	4933	5444	2759	1430	1592	1770	2115
13	9233	8613	5442	5533	5112	5834	3344	1534	1701	1856	1757	289	447	427	536
14	4349	5219	5008	2857	2412	2300	2064	1144	592	663	459	59	61	86	127
15	4023	1722	2653	2971	772	964	736	351	373	254	89	16	20	21	30
16	1900	2366	429	2057	976	228	363	178	52	112	84	21	2	14	7

KNOWN CATCHES

AGE	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
5	1	192	416	1241	194	213	492	269	510	192	351	116	248	373	396
6	483	1322	2089	2500	1279	317	484	680	706	1105	653	3521	1509	1859	3655
7	933	2236	3813	5097	1678	2947	4574	1627	4005	864	2850	4200	3522	4015	4714
8	821	1412	4629	5537	3169	5930	7516	6083	4232	4436	5198	4328	3970	7631	5667
9	790	3702	4302	3903	4379	6601	10879	5847	7890	6970	4754	3502	3697	6311	5378
10	1334	3912	4282	3506	6394	6135	5122	5722	6173	5230	3549	2423	2805	4071	3688
11	1844	2708	3319	3076	5382	3593	4514	4874	3423	6230	3549	1941	1697	2078	2289
12	2653	2450	2489	2015	4435	4825	2811	1962	2551	2813	2081	756	1922	953	975
13	2234	1928	1653	2150	1905	2810	1655	1962	2551	1118	1494	186	297	232	275
14	1887	1365	1505	1577	1036	1195	1424	587	234	488	388	28	30	42	57
15	846	1033	192	1163	423	438	447	250	202	129	52	12	1	10	13
16	306	551	113	580	287	92	180	92	29	60	45	10	1	6	13

ESTIMATE FISHING MORTALITY

AGE	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
5	0.0000	0.0018	0.0036	0.0123	0.0022	0.0034	0.0089	0.0051	0.0082	0.0027	0.0041	0.0014	0.0023	0.0019	0.0
6	0.0070	0.0179	0.0254	0.0293	0.0165	0.0034	0.0100	0.0160	0.0174	0.0231	0.0118	0.0043	0.0242	0.0253	0.0
7	0.0152	0.0426	0.0692	0.0825	0.0723	0.0508	0.0881	0.0442	0.1305	0.0279	0.0807	0.1034	0.0744	0.0878	0.0
8	0.0168	0.0302	0.1228	0.1434	0.0724	0.1300	0.1858	0.1711	0.1851	0.2210	0.2464	0.1791	0.1418	0.2450	0.0
9	0.0278	0.1035	0.1276	0.1525	0.1703	0.2241	0.3952	0.2729	0.3722	0.4934	0.4150	0.2768	0.2422	0.3726	0.0
10	0.0718	0.2521	0.1767	0.1537	0.4255	0.4084	0.4207	0.3472	0.4642	0.7194	0.5914	0.4119	0.3975	0.4932	0.0
11	0.1515	0.2157	0.2860	0.1963	0.3966	0.4728	0.5438	0.6269	0.4413	0.9900	1.1600	0.7303	0.6130	0.6243	0.0
12	0.2406	0.2394	0.3343	0.2985	0.5133	0.8208	0.9623	0.7019	0.7278	0.8908	1.9959	1.0674	1.0674	0.9417	0.0
13	0.2508	0.2826	0.4123	0.5803	0.5487	0.7892	0.9227	0.7025	0.6921	1.1480	3.1489	1.3085	1.4006	0.9581	0.0
14	0.2506	0.2518	0.4165	1.0591	0.6670	0.8898	1.5227	0.8709	0.5946	1.7539	3.0783	0.8173	0.8194	0.8102	0.0
15	0.2721	1.1389	0.0791	0.7187	0.9708	0.7256	1.1664	1.6503	0.9513	0.8557	1.1943	1.7553	0.1187	0.7834	0.0
16	0.2000	0.3900	0.3500	0.3400	0.4400	0.6000	0.8000	0.8500	0.9500	0.9000	0.9000	0.7500	0.7000	0.6500	0.6000

POPULATION WTS AND NDS

WT	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
WT	160407	162437	161239	159744	150596	136283	119151	99993	91167	84479	79009	79409	86637	118813	124911
NO	416166	431922	443590	434974	411198	361285	312952	266553	252725	250443	265443	276224	316476	453949	403949

POPULATION WTS AND NOS AGE 8 TU 16

WT	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
WT	102576	104056	97801	94312	89089	83837	76637	65668	57422	47500	35735	31225	35756	42485	43979
NO	158850	165182	154929	147543	144437	142498	133584	115344	94286	79095	65610	60519	69308	82511	84143

Table 4

PLAICE 3LN FEMALE 1963-1977

NATURAL MORTALITY		0.20															
PARTIAL RECRUITMENT MULTIPLIER		0.2500															
ASSUMED FISHING MORTALITY FOR LAST AGES		0.3500															
ESTIMATED POPULATION		0.4500															
AGE YEAR	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977		
6	127001	127935	115858	111282	102351	91045	78690	64482	87192	108506	159370	217689	135912	114183	708161		
7	110345	104323	93995	82722	68765	52222	44500	34350	68105	70771	87947	130050	177048	110442	35089		
8	96824	89613	82582	73942	63842	52842	44500	34350	58842	53507	56842	71122	103397	142086	87184		
9	70304	78590	71900	63692	54856	48446	44259	39143	45148	39576	41872	43900	54844	80788	108791		
10	48184	56970	62781	56617	48446	42781	37882	32179	37011	32104	29058	31258	33072	41188	58115		
11	42700	48700	42781	38392	43990	36862	37882	32179	27421	24056	22738	20251	21684	23784	27677		
12	25903	38000	28317	33034	36945	32447	27119	26043	21592	16974	15974	15135	12997	15196	15139		
13	15911	20059	24863	20387	24405	25175	20163	16514	16335	12562	19974	9443	9603	7965	9437		
14	13912	11662	15427	17307	14055	15662	16185	12372	9583	9923	6032	4862	2539	5317	4546		
15	10306	9848	8222	10216	11650	8437	10330	6540	6540	4827	5185	2430	2430	2348	2596		
16	6543	7119	7076	5302	6534	4925	4940	4940	4940	2770	2304	1374	1277	1004	860		
17	4291	4445	5085	4017	3192	3259	3403	2731	2164	2376	689	587	587	511	422		
18	4357	2908	3090	3014	2261	1370	1513	1802	1118	977	553	201	316	125	244		
19	1583	3007	1874	2027	1534	837	532	666	721	413	260	151	105	89	62		
20	2323	939	1974	973	1274	919	357	152	200	264	106	11	106	14	54		

KNOWN CATCHES		1971															
AGE YEAR	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977		
6	475	466	952	2592	1189	81	84	1175	681	984	477	1486	1253	438	2882		
7	807	2426	3156	3332	3131	1152	2824	687	2889	1189	962	3402	3171	3373	3351		
8	510	1623	4305	3023	2279	3578	5784	2965	3571	3182	3632	3752	4392	3172	3160		
9	552	2058	2481	4089	2328	3958	5786	4411	5371	3698	3382	3172	4102	8265	7271		
10	752	4268	3032	2912	3119	4279	4484	5113	6033	3920	3910	3118	3610	6581	5615		
11	1060	3785	2202	2656	3945	2965	4492	6085	6033	4636	3847	3860	2827	6584	3665		
12	1270	3287	3091	2919	3606	7075	6288	5511	5844	4335	3590	3082	2956	3350	2755		
13	1399	1100	3370	2914	4883	4093	4269	3511	3514	4678	3652	2813	2813	3350	2755		
14	1704	1464	2663	2785	3393	4241	3257	3636	3371	3248	2710	1714	2145	1142	1253		
15	1462	1091	1581	2022	3278	2191	2590	3601	3127	1821	3174	853	1089	1174	859		
16	1093	819	1963	1270	2311	1738	2084	2084	2099	1735	1427	594	594	442	307		
17	623	607	1270	1136	1374	1295	1088	1236	878	1439	405	187	393	193	161		
18	650	556	1032	1032	1121	1270	633	834	555	597	333	65	190	55	45		
19	395	539	618	426	379	363	310	315	360	256	223	20	80	20	25		
20	383	189	863	262	343	302	138	64	120	128	62	4	35	5	18		

ESTIMATE FISHING MORTALITY		1971															
AGE YEAR	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977		
6	0.0041	0.0040	0.0091	0.0261	0.0129	0.0010	0.0012	0.0155	0.0087	0.0101	0.0033	0.0076	0.0102	0.0042	0.0		
7	0.0081	0.0262	0.0340	0.0400	0.0398	0.0155	0.0428	0.0119	0.0412	0.0183	0.0123	0.0293	0.0200	0.0344	0.0		
8	0.0103	0.0202	0.0388	0.0413	0.0347	0.0339	0.0862	0.0581	0.0742	0.0452	0.0523	0.0599	0.0470	0.0370	0.0		
9	0.0103	0.0202	0.0388	0.0413	0.0347	0.0339	0.0862	0.0581	0.0742	0.0452	0.0523	0.0599	0.0470	0.0370	0.0		
10	0.0174	0.0084	0.0582	0.0523	0.0738	0.0873	0.1187	0.1559	0.2308	0.1450	0.1610	0.1632	0.0863	0.1592	0.0		
11	0.0378	0.1142	0.0586	0.0699	0.1044	0.1064	0.1176	0.1590	0.2397	0.2395	0.2070	0.2435	0.1556	0.2517	0.0		
12	0.0357	0.1130	0.1288	0.1028	0.1838	0.2257	0.2961	0.2654	0.3416	0.3316	0.2937	0.2950	0.2697	0.2764	0.0		
13	0.1030	0.0625	0.1623	0.1719	0.2499	0.2478	0.2684	0.3442	0.3485	0.5303	0.5186	0.5391	0.3912	0.3508	0.0		
14	0.1455	0.1494	0.2152	0.1958	0.3103	0.3584	0.2515	0.3827	0.3859	0.4490	0.6830	0.4937	0.6024	0.5169	0.0		
15	0.1868	0.1361	0.2359	0.2469	0.3725	0.3383	0.3876	0.4882	0.7037	0.5395	1.1285	0.4727	0.6839	0.8040	0.0		
16	0.1772	0.1636	0.3078	0.3078	0.4957	0.4380	0.3896	0.6266	0.5789	1.1911	1.1535	0.6500	0.7161	0.6667	0.0		
17	0.1711	0.2407	0.3270	0.3768	0.6857	0.5875	0.6359	0.6938	0.5349	1.2582	1.0383	0.4265	1.3483	0.5003	0.0		
18	0.3228	0.2208	0.4540	0.4755	0.7940	0.7483	0.6208	0.7164	0.7957	1.1241	1.0958	0.4434	1.0789	0.5069	0.0		
19	0.3228	0.2208	0.4540	0.4755	0.7940	0.7483	0.6208	0.7164	0.7957	1.1241	1.0958	0.4434	1.0789	0.5069	0.0		
20	0.2000	0.2500	0.3000	0.3500	0.3500	0.4500	0.4500	0.6000	0.7000	0.7500	1.0000	0.7500	1.8255	0.2872	0.4500		

POPULATION WTS AND NOS		1964															
AGE YEAR	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977		
WT	342569	352604	354650	343347	332023	306235	278083	252913	227578	208185	211110	236218	247577	257353	428750		
N0	580019	589381	575830	552810	524200	484533	439296	404215	380732	379607	438501	548744	558620	544718	1116311		

POPULATION WTS AND NOS AGE 10 TO 20		1964															
AGE YEAR	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977		
WT	195100	205565	217319	214703	210601	194958	176378	158272	136345	112333	92905	81476	82613	88568	104253		
N0	175845	189723	201165	201285	198286	182407	168238	146854	128223	107247	92419	85743	87419	97540	119152		

Table 5

PLAIC 30 MALE 1973-77

		NATURAL MORTALITY= 0.25								
		PARTIAL RECRUITMENT MULTIPLIER								
		0.0600	0.1200	0.4000	0.5000	0.7000	0.9000	1.4000	1.3000	1.0000
		ASSUMED FISHING MORTALITY FOR LAST AGES								
		1.5000	0.3800	1.3000	0.5000	0.5000				
ESTIMATED POPULATION										
AGE	YEAR	1973	1974	1975	1976	1977				
6		6778.	7563.	5780.	9948.	5198.				
7		6286.	5234.	5491.	4478.	7579.				
8		6423.	4348.	2969.	4101.	3136.				
9		5824.	3202.	2398.	1934.	2343.				
10		3315.	1562.	1904.	1490.	885.				
11		1311.	590.	875.	1091.	565.				
12		575.	156.	293.	396.	319.				
13		243.	24.	85.	61.	98.				
14		28.	4.	18.	17.	3.				
KNOWN CATCHES										
AGE	YEAR	1973	1974	1975	1976	1977				
6		50.	452.	26.	191.	136.				
7		620.	1255.	199.	399.	391.				
8		2040.	1120.	428.	964.	505.				
9		3370.	668.	428.	704.	461.				
10		2256.	387.	444.	674.	233.				
11		980.	189.	324.	602.	183.				
12		480.	41.	189.	238.	144.				
13		210.	1.	56.	51.	42.				
14		20.	1.	12.	6.	1.				
ESTIMATE FISHING MORTALITY										
AGE	YEAR	1973	1974	1975	1976	1977				
6		0.0084	0.0701	0.0051	0.0220	0.0				
7		0.1185	0.3170	0.0419	0.1064	0.0				
8		0.4461	0.3451	0.1784	0.3097	0.0				
9		1.0661	0.2697	0.2260	0.5317	0.0				
10		1.4752	0.3295	0.3068	0.7188	0.0				
11		1.8782	0.4505	0.5440	0.9810	0.0				
12		2.9081	0.3534	1.3123	1.1453	0.0				
13		3.9750	0.0474	1.3603	2.8233	0.0				
14		1.5000	0.3800	1.3000	0.5000	0.5000				
POPULATION WTS AND NOS										
	YEAR	1973	1974	1975	1976	1977				
WT		10934.	6966.	6534.	7162.	6264.				
NO		30783.	22685.	19814.	23517.	20126.				
POPULATION WTS AND NOS AGE 8 TO 14										
	YEAR	1973	1974	1975	1976	1977				
WT		7939.	4115.	3943.	4075.	3205.				
NO		17719.	9887.	8543.	9091.	7349.				

Table 6.

PLATICE 30 FEMALE 30 1973-77

		NATURAL MORTALITY* 0.20								
		PARTIAL RECRUITMENT MULTIPLIER								
		0.0400	0.0800	0.0700	0.2000	0.3000	0.4000	0.7000	1.0000	
		ASSUMED FISHING MORTALITY FOR LAST AGES								
		0.7400	0.6900	0.6300	0.5000	0.4000				
ESTIMATED POPULATION										
AGE	YEAR	1973	1974	1975	1976	1977				
6		16279.	14857.	22974.	11583.	3058.				
7		9342.	13317.	11844.	18735.	9244.				
8		7185.	7492.	9523.	9587.	18538.				
9		6928.	5028.	5300.	7545.	5862.				
10		7157.	4387.	3522.	3907.	5697.				
11		5606.	2949.	2579.	2446.	2642.				
12		3556.	2674.	1683.	1711.	1885.				
13		2885.	1650.	1363.	1040.	977.				
14		1286.	1134.	662.	763.	459.				
15		476.	543.	502.	281.	392.				
16		381.	214.	225.	191.	106.				
17		80.	187.	118.	79.	60.				
18		96.	26.	75.	44.	27.				
KNOWN CATCHES										
AGE	YEAR	1973	1974	1975	1976	1977				
6		12.	354.	82.	265.	44.				
7		173.	1525.	1214.	885.	264.				
8		908.	922.	279.	2197.	364.				
9		1420.	657.	478.	531.	409.				
10		3217.	1119.	484.	615.	585.				
11		2117.	808.	443.	568.	355.				
12		1395.	913.	374.	468.	331.				
13		1357.	761.	390.	434.	294.				
14		563.	472.	288.	257.	170.				
15		194.	242.	243.	137.	118.				
16		138.	63.	117.	106.	32.				
17		43.	67.	58.	42.	21.				
18		46.	12.	32.	16.	8.				
ESTIMATE FISHING MORTALITY										
AGE	YEAR	1973	1974	1975	1976	1977				
6		0.0008	0.0267	0.0040	0.0256	0.0				
7		0.0207	0.1353	0.0114	0.0536	0.0				
8		0.1513	0.1462	0.0329	0.2920	0.0				
9		0.2569	0.1560	0.1050	0.0810	0.0				
10		0.6867	0.3311	0.1647	0.1911	0.0				
11		0.5402	0.3607	0.2105	0.2966	0.0				
12		0.5683	0.4738	0.2818	0.3599	0.0				
13		0.7336	0.7131	0.3801	0.6186	0.0				
14		0.6617	0.6160	0.6556	0.4655	0.0				
15		0.5984	0.6782	0.7666	0.7725	0.0				
16		0.5105	0.3929	0.8509	0.9519	0.0				
17		0.9088	0.7193	0.7791	0.8874	0.0				
18		0.7400	0.6900	0.6300	0.5000	0.4000				
POPULATION WTS AND NOS										
	YEAR	1973	1974	1975	1976	1977				
WT		30933.	24396.	23297.	23168.	20419.				
NO		61217.	54460.	60371.	57913.	44550.				
POPULATION WTS AND NOS AGE 10 TO 18										
	YEAR	1973	1974	1975	1976	1977				
WT		20154.	13544.	10523.	9752.	10110.				
NO		21523.	13765.	10731.	10462.	11849.				

Table 7
PLAICE 3LN MALE

NATURAL MORTALITY# 0.2500		YEAR 1976					
AGE	POP. NO. XX10-3<	CATCH NO. XX10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONS<	CATCH WT. %METRIC TONS<	RESIDUAL POP. NOS.
5	103000.	373.	0.005	0.238	24514.0	88.8	79816.4
6	93170.	1895.	0.024	0.321	29907.6	608.3	70840.1
7	54287.	4015.	0.088	0.349	18946.2	1401.2	38717.2
8	40223.	7631.	0.240	0.441	17738.3	3365.3	24641.7
9	22992.	6311.	0.368	0.567	13036.5	3578.3	12393.2
10	11908.	4091.	0.486	0.724	8621.4	2961.9	5704.3
11	5071.	2078.	0.612	0.855	4335.7	1776.7	2141.6
12	1770.	953.	0.910	0.988	1748.8	941.6	554.9
13	427.	232.	0.923	1.078	460.3	250.1	132.1
14	86.	42.	0.784	1.324	113.9	55.6	30.6
15	21.	10.	0.755	1.394	29.3	13.9	7.7
16	14.	6.	0.650	1.536	21.5	9.2	5.7
TOTAL	332969.	27637.			119473.1	15050.9	234985.3

NATURAL MORTALITY# 0.2500		YEAR 1977					
AGE	POP. NO. XX10-3<	CATCH NO. XX10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONS<	CATCH WT. %METRIC TONS<	RESIDUAL POP. NOS.
5	103000.	396.	0.005	0.238	24514.0	94.2	79816.4
6	79816.	3655.	0.054	0.321	25621.1	1173.3	58893.4
7	70840.	4714.	0.079	0.349	24723.2	1645.2	50979.6
8	38717.	5667.	0.181	0.441	17074.3	2499.1	25160.8
9	24642.	5378.	0.282	0.567	13971.9	3049.3	14475.3
10	12393.	3688.	0.406	0.724	8972.7	2670.1	6431.2
11	5704.	3289.	1.018	0.855	4877.2	2812.1	1605.2
12	2142.	975.	0.708	0.988	2115.9	963.3	821.6
13	555.	275.	0.801	1.078	598.2	296.4	194.0
14	132.	57.	0.656	1.324	174.9	75.5	53.4
15	31.	12.	0.577	1.394	42.6	16.7	13.4
16	8.	3.	0.573	1.536	11.8	4.6	3.4
TOTAL	337980.	28109.			122697.4	15299.9	238447.2

NATURAL MORTALITY# 0.2500		YEAR 1978					
AGE	POP. NO. XX10-3<	CATCH NO. XX10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONS<	CATCH WT. %METRIC TONS<	RESIDUAL POP. NOS.
5	103000.	545.	0.006	0.238	24514.0	129.8	79736.6
6	79816.	1676.	0.024	0.321	25621.1	537.9	60686.9
7	58893.	3916.	0.078	0.349	20553.8	1366.8	42424.6
8	50980.	7458.	0.180	0.441	22482.0	3289.1	33162.7
9	25161.	5503.	0.282	0.567	14266.2	3119.9	14780.2
10	14475.	4258.	0.400	0.724	10480.1	3082.5	7556.8
11	6431.	2599.	0.600	0.855	5498.6	2222.4	2748.8
12	1605.	740.	0.720	0.988	1585.9	730.9	608.5
13	822.	420.	0.840	1.078	885.7	453.1	276.3
14	194.	87.	0.690	1.324	256.8	114.9	75.8
15	53.	22.	0.600	1.394	74.4	30.1	22.8
16	13.	5.	0.600	1.536	20.5	8.3	5.7
TOTAL	341444.	27229.			126238.9	15085.6	242085.3

NATURAL MORTALITY# 0.2500		YEAR 1979					
AGE	POP. NO. XX10-3<	CATCH NO. XX10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONS<	CATCH WT. %METRIC TONS<	RESIDUAL POP. NOS.
5	103000.	455.	0.005	0.238	24514.0	108.2	79816.4
6	79737.	1259.	0.018	0.321	25595.4	404.1	60991.1
7	60687.	3080.	0.059	0.349	21179.7	1075.0	44555.2
8	42425.	4754.	0.135	0.441	18709.2	2096.4	28867.9
9	33163.	5630.	0.212	0.567	18803.2	3192.3	20893.2
10	14780.	3469.	0.306	0.724	10700.8	2511.8	8476.4
11	7557.	2446.	0.450	0.855	6461.0	2090.9	3752.6
12	2749.	1026.	0.540	0.988	2715.8	1013.9	1247.5
13	608.	255.	0.630	1.078	656.0	274.8	252.4
14	276.	100.	0.518	1.324	365.8	132.2	128.2
15	76.	25.	0.450	1.394	105.6	34.2	37.6
16	23.	7.	0.450	1.536	35.1	11.3	11.3
TOTAL	345080.	22505.			129841.5	12945.2	249029.5

Table 8

PLATICE FEM 3LN

NATURAL MORTALITY# 0.2000		YEAR 1976					
AGE	POP. NO. XX10-3<	CATCH NO. XX10-3<	FISHING MORT.	MEAN WT. KG.	PDP. WT. %METRIC TONS<	CATCH WT. %METRIC TONS<	RESIDUAL POP. NOS.
6	114183.	438.	0.005	0.286	32656.3	125.3	93018.8
7	110142.	3373.	0.035	0.326	35906.3	1099.6	87075.0
8	142066.	8332.	0.067	0.432	61381.1	3599.4	108791.4
9	80768.	8855.	0.129	0.528	42645.5	4675.4	58124.2
10	41188.	6681.	0.197	0.694	28384.5	4636.6	27692.1
11	23784.	4789.	0.251	0.878	20882.4	4204.7	15150.2
12	15196.	3320.	0.275	1.073	16305.3	3562.4	9450.2
13	7965.	2183.	0.358	1.341	10681.1	2927.4	4558.8
14	5317.	1942.	0.511	1.546	8220.1	3002.3	2611.5
15	2348.	1174.	0.787	1.830	4296.8	2148.4	875.1
16	1004.	442.	0.655	2.177	2185.7	962.2	427.0
17	511.	193.	0.533	2.419	1236.1	466.9	245.5
18	125.	44.	0.501	2.714	339.2	122.1	62.0
19	89.	20.	0.284	2.868	255.3	57.4	54.9
20	14.	5.	0.496	2.997	42.0	15.0	7.0
TOTAL	544720.	41792.			265617.2	31605.1	408143.4

NATURAL MORTALITY# 0.2000		YEAR 1977					
AGE	POP. NO. XX10-3<	CATCH NO. XX10-3<	FISHING MORT.	MEAN WT. KG.	PDP. WT. %METRIC TONS<	CATCH WT. %METRIC TONS<	RESIDUAL POP. NOS.
6	136000.	2882.	0.024	0.286	38896.0	824.3	108706.8
7	93019.	3351.	0.041	0.326	30324.1	1092.4	73098.0
8	87075.	5160.	0.068	0.432	37616.4	2229.1	66604.3
9	108791.	7271.	0.077	0.528	57441.9	3839.1	82469.8
10	58124.	5615.	0.113	0.694	40338.2	3896.8	42503.3
11	27692.	3665.	0.158	0.878	24313.7	3217.9	19358.9
12	15190.	2775.	0.225	1.073	16256.2	2977.6	9904.8
13	9450.	2033.	0.270	1.341	12672.7	2726.3	5906.4
14	4559.	1253.	0.359	1.546	7047.9	1937.1	2606.6
15	2611.	859.	0.447	1.830	4779.0	1572.0	1367.4
16	875.	307.	0.485	2.177	1905.1	668.3	441.1
17	427.	161.	0.532	2.419	1032.9	389.5	205.4
18	246.	93.	0.535	2.714	666.3	252.4	117.7
19	62.	25.	0.581	2.868	177.8	71.7	28.4
20	55.	18.	0.446	2.997	164.4	53.9	28.8
TOTAL	544136.	35468.			273632.3	25748.3	413347.4

NATURAL MORTALITY# 0.2000		YEAR 1978					
AGE	POP. NO. XX10-3<	CATCH NO. XX10-3<	FISHING MORT.	MEAN WT. KG.	PDP. WT. %METRIC TONS<	CATCH WT. %METRIC TONS<	RESIDUAL POP. NOS.
6	136000.	123.	0.001	0.286	38896.0	35.2	111236.1
7	108707.	3486.	0.036	0.326	35438.4	1136.4	85854.5
8	73098.	3862.	0.060	0.432	31578.3	1668.4	56362.3
9	66604.	3973.	0.068	0.528	35167.1	2097.7	50946.2
10	82470.	7125.	0.100	0.694	57234.0	4944.7	61095.1
11	42503.	5044.	0.140	0.878	37317.9	4429.0	30252.6
12	19359.	3191.	0.200	1.073	20772.1	3424.1	12976.6
13	9905.	1923.	0.240	1.341	13282.3	2578.9	6379.0
14	5906.	1474.	0.320	1.546	9131.3	2278.5	3511.5
15	2607.	784.	0.400	1.830	4770.2	1434.8	1430.6
16	1367.	444.	0.440	2.177	2976.9	967.4	721.0
17	441.	154.	0.480	2.419	1067.1	371.6	223.5
18	205.	72.	0.480	2.714	557.3	194.1	104.0
19	118.	44.	0.520	2.868	337.6	125.2	57.3
20	28.	9.	0.400	2.997	85.1	25.6	15.6
TOTAL	549319.	31707.			288611.1	25711.7	421165.5

NATURAL MORTALITY# 0.2000		YEAR 1979					
AGE	POP. NO. XX10-3<	CATCH NO. XX10-3<	FISHING MORT.	MEAN WT. KG.	PDP. WT. %METRIC TONS<	CATCH WT. %METRIC TONS<	RESIDUAL POP. NOS.
6	136000.	492.	0.004	0.286	38896.0	140.7	110902.9
7	111236.	3177.	0.032	0.326	36263.0	1035.6	88204.2
8	85855.	4020.	0.053	0.432	37089.1	1736.8	66663.2
9	56362.	2978.	0.060	0.528	29759.3	1572.3	43458.3
10	50946.	3895.	0.088	0.694	35356.6	2703.4	38197.5
11	61095.	6422.	0.123	0.878	53641.5	5638.4	44231.3
12	30253.	4415.	0.175	1.073	32461.1	4737.1	20792.3
13	12977.	2236.	0.210	1.341	17401.7	2987.9	8611.9
14	6379.	1419.	0.280	1.546	9862.0	2193.1	3947.2
15	3511.	945.	0.350	1.830	6426.0	1730.0	2025.9
16	1431.	417.	0.385	2.177	3114.3	907.8	797.0
17	721.	226.	0.420	2.419	1744.2	545.9	387.9
18	223.	70.	0.420	2.714	606.5	189.8	120.2
19	104.	35.	0.455	2.868	298.4	99.6	54.0
20	57.	19.	0.455	2.997	171.7	57.3	29.8
TOTAL	557150.	30765.			303091.0	26285.7	428423.2

Table 9

PLAICE 30 MALE

NATURAL MORTALITY# 0.2500		YEAR 1976					
AGE	POP. NO. XX10-3<	CATCH NO. XX10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONSK	CATCH WT. %METRIC TONSK	RESIDUAL POP. NOS.
6	9948.	191.	0.022	0.186	1850.3	35.5	7578.9
7	4478.	399.	0.106	0.276	1235.9	110.1	3136.7
8	4101.	964.	0.307	0.301	1234.4	290.2	2349.6
9	1934.	704.	0.523	0.426	823.9	299.9	892.8
10	1490.	674.	0.702	0.549	818.0	370.0	575.1
11	1091.	602.	0.947	0.718	783.3	432.2	329.6
12	396.	238.	1.092	0.843	333.8	200.6	103.5
13	61.	51.	2.344	1.013	61.8	51.7	4.6
14	17.	6.	0.503	1.155	19.6	6.9	8.0
TOTAL	23516.	3829.			7161.1	1797.2	14978.7

NATURAL MORTALITY# 0.2500		YEAR 1977					
AGE	POP. NO. XX10-3<	CATCH NO. XX10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONSK	CATCH WT. %METRIC TONSK	RESIDUAL POP. NOS.
6	7500.	136.	0.021	0.186	1395.0	25.3	5719.6
7	7579.	391.	0.060	0.276	2091.8	107.9	5558.7
8	3137.	505.	0.200	0.301	944.2	152.0	2000.1
9	2350.	461.	0.250	0.426	1000.9	196.4	1425.1
10	893.	233.	0.347	0.549	490.1	127.9	491.4
11	575.	183.	0.441	0.718	412.9	131.4	288.2
12	330.	144.	0.668	0.843	277.8	121.4	131.6
13	103.	42.	0.604	1.013	104.8	42.5	44.1
14	5.	1.	0.284	1.155	5.3	1.2	2.7
TOTAL	22471.	2096.			6722.9	906.0	15661.5

NATURAL MORTALITY# 0.2500		YEAR 1978					
AGE	POP. NO. XX10-3<	CATCH NO. XX10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONSK	CATCH WT. %METRIC TONSK	RESIDUAL POP. NOS.
6	7500.	118.	0.018	0.186	1395.0	22.0	5736.8
7	5720.	352.	0.072	0.276	1578.6	97.2	4145.0
8	5559.	984.	0.222	0.301	1673.2	296.1	3467.3
9	2000.	469.	0.306	0.426	852.0	200.0	1147.0
10	1425.	421.	0.402	0.549	782.4	231.1	742.5
11	491.	187.	0.552	0.718	352.9	134.0	220.4
12	288.	148.	0.846	0.843	242.9	124.8	96.3
13	132.	64.	0.780	1.013	133.3	64.9	47.0
14	44.	18.	0.600	1.155	50.9	20.6	18.8
TOTAL	23159.	2761.			7061.2	1190.6	15621.1

NATURAL MORTALITY# 0.2500		YEAR 1979					
AGE	POP. NO. XX10-3<	CATCH NO. XX10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONSK	CATCH WT. %METRIC TONSK	RESIDUAL POP. NOS.
6	7500.	157.	0.024	0.186	1395.0	29.3	5702.5
7	5737.	238.	0.048	0.276	1583.4	65.7	4258.4
8	4145.	506.	0.148	0.301	1247.6	152.3	2784.0
9	3467.	569.	0.204	0.426	1477.1	242.2	2202.0
10	1147.	240.	0.268	0.549	629.7	131.7	683.3
11	742.	204.	0.368	0.718	533.1	146.3	400.2
12	220.	85.	0.564	0.843	185.8	71.7	97.6
13	96.	35.	0.520	1.013	97.6	35.4	44.6
14	47.	14.	0.400	1.155	54.3	16.0	24.5
TOTAL	23102.	2048.			7203.5	890.6	16197.2

Table 10
PLATICE 30 FEMALE

NATURAL MORTALITY# 0.2000		YEAR 1976					
AGE	POP. NO. %X10-3<	CATCH NO. %X10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONS<	CATCH WT. %METRIC TONS<	RESIDUAL POP. NOS.
6	11583.	265.	0.026	0.186	2154.4	49.3	9240.0
7	18735.	885.	0.054	0.259	4852.4	229.2	14532.6
8	9587.	2197.	0.290	0.334	3202.1	733.8	5873.3
9	7545.	531.	0.081	0.425	3206.6	225.7	5696.7
10	3907.	615.	0.191	0.585	2285.6	359.8	2642.6
11	2446.	568.	0.295	0.792	1937.2	449.9	1491.0
12	1711.	468.	0.357	1.023	1750.4	478.8	980.3
13	1040.	434.	0.609	1.290	1341.6	559.9	463.1
14	763.	257.	0.461	1.569	1197.1	403.2	394.0
15	281.	137.	0.758	1.899	533.6	260.2	107.8
16	191.	106.	0.925	2.167	413.9	229.7	62.0
17	79.	42.	0.864	2.343	185.1	98.4	27.3
18	44.	16.	0.508	2.433	107.1	38.9	21.7
TOTAL	57912.	6521.			23167.1	4116.7	41532.2

NATURAL MORTALITY# 0.2000		YEAR 1977					
AGE	POP. NO. %X10-3<	CATCH NO. %X10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONS<	CATCH WT. %METRIC TONS<	RESIDUAL POP. NOS.
6	18000.	44.	0.003	0.186	3348.0	8.2	14693.0
7	9240.	264.	0.033	0.259	2393.2	68.4	7319.5
8	14533.	364.	0.029	0.334	4853.9	121.6	11558.2
9	5873.	409.	0.080	0.425	2496.1	173.8	4438.9
10	5697.	585.	0.120	0.585	3332.6	342.2	4136.6
11	2643.	355.	0.160	0.792	2093.0	281.2	1843.7
12	1491.	331.	0.280	1.023	1525.3	338.6	922.6
13	980.	294.	0.399	1.290	1264.6	379.3	538.5
14	463.	170.	0.514	1.569	726.6	266.7	226.8
15	394.	118.	0.398	1.899	748.1	224.1	216.6
16	108.	32.	0.394	2.167	233.6	69.3	59.5
17	62.	21.	0.464	2.343	145.3	49.2	31.9
18	27.	8.	0.389	2.433	66.3	19.5	15.1
TOTAL	59511.	2995.			23226.5	2342.0	46001.1

NATURAL MORTALITY# 0.2000		YEAR 1978					
AGE	POP. NO. %X10-3<	CATCH NO. %X10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONS<	CATCH WT. %METRIC TONS<	RESIDUAL POP. NOS.
6	18000.	323.	0.020	0.186	3348.0	60.1	14445.3
7	14693.	394.	0.030	0.259	3805.5	102.0	11674.1
8	7319.	228.	0.035	0.334	2444.7	76.3	5786.6
9	11558.	999.	0.100	0.425	4912.2	424.4	8562.5
10	4439.	562.	0.150	0.585	2596.8	328.7	3128.1
11	4137.	682.	0.200	0.792	3276.2	540.1	2772.9
12	1844.	496.	0.350	1.023	1886.1	507.8	1063.7
13	923.	357.	0.550	1.290	1190.2	460.5	435.8
14	539.	236.	0.650	1.569	845.0	370.0	230.2
15	227.	82.	0.500	1.899	430.7	154.9	112.6
16	217.	78.	0.500	2.167	469.5	168.8	107.6
17	60.	25.	0.600	2.343	139.5	57.6	26.7
18	32.	11.	0.500	2.433	77.7	27.9	15.9
TOTAL	63986.	4472.			25421.9	3278.9	48361.9

NATURAL MORTALITY# 0.2000		YEAR 1979					
AGE	POP. NO. %X10-3<	CATCH NO. %X10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONS<	CATCH WT. %METRIC TONS<	RESIDUAL POP. NOS.
6	18000.	259.	0.016	0.186	3348.0	48.2	14503.2
7	14445.	311.	0.024	0.259	3741.3	80.4	11546.4
8	11674.	292.	0.028	0.334	3899.1	97.6	9294.0
9	5787.	404.	0.080	0.425	2459.3	171.6	4373.4
10	8563.	879.	0.120	0.585	5009.1	514.4	6217.7
11	3128.	420.	0.160	0.792	2477.4	332.9	2182.4
12	2773.	617.	0.280	1.023	2836.7	630.8	1715.8
13	1064.	346.	0.440	1.290	1372.2	445.9	560.9
14	436.	162.	0.520	1.569	683.8	253.5	212.1
15	230.	69.	0.400	1.899	437.1	131.5	126.3
16	113.	34.	0.400	2.167	244.0	73.4	61.8
17	108.	37.	0.480	2.343	252.1	87.8	54.5
18	27.	8.	0.400	2.433	65.1	19.6	14.7
TOTAL	66346.	3838.			26825.2	2887.6	50863.2

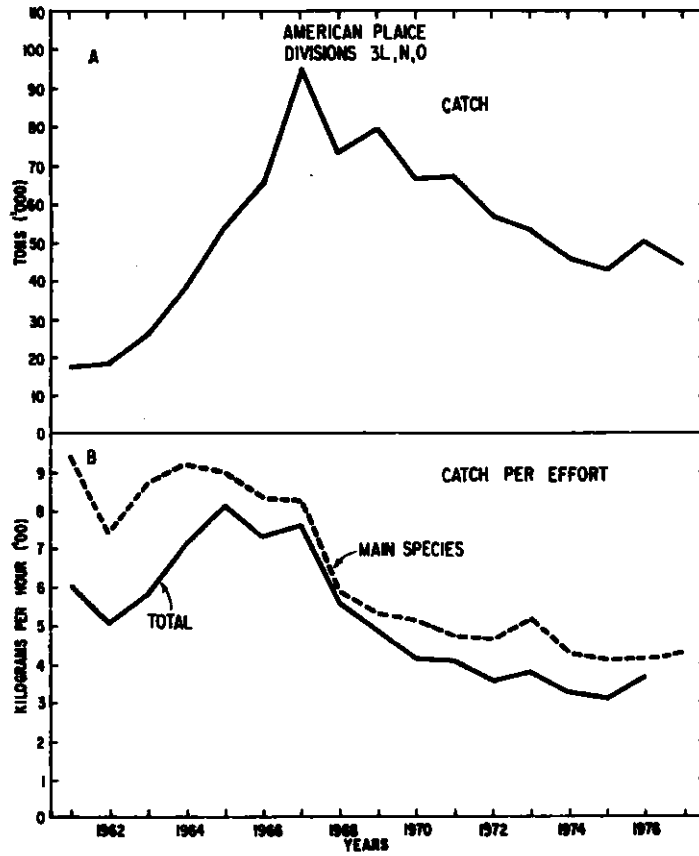


Fig. 1. (A) Nominal catches of American plaice from ICNAF Divs. 3LNØ.
(B) Catch/hour of American plaice in ICNAF Divs. 3LNØ

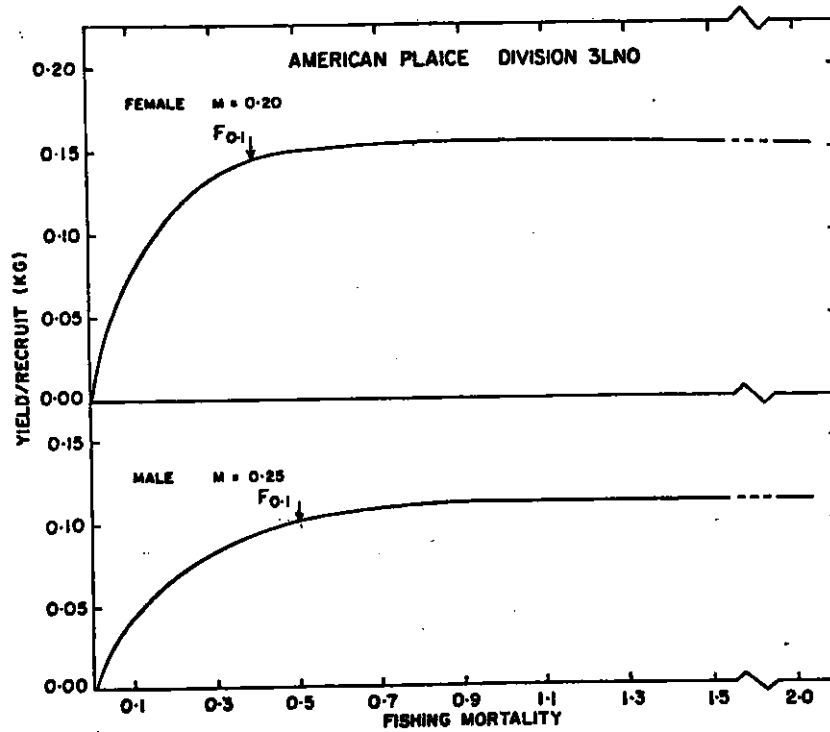


Fig. 2. Regression of fishing mortality on fishing effort for plaice from Divs. 3LN.

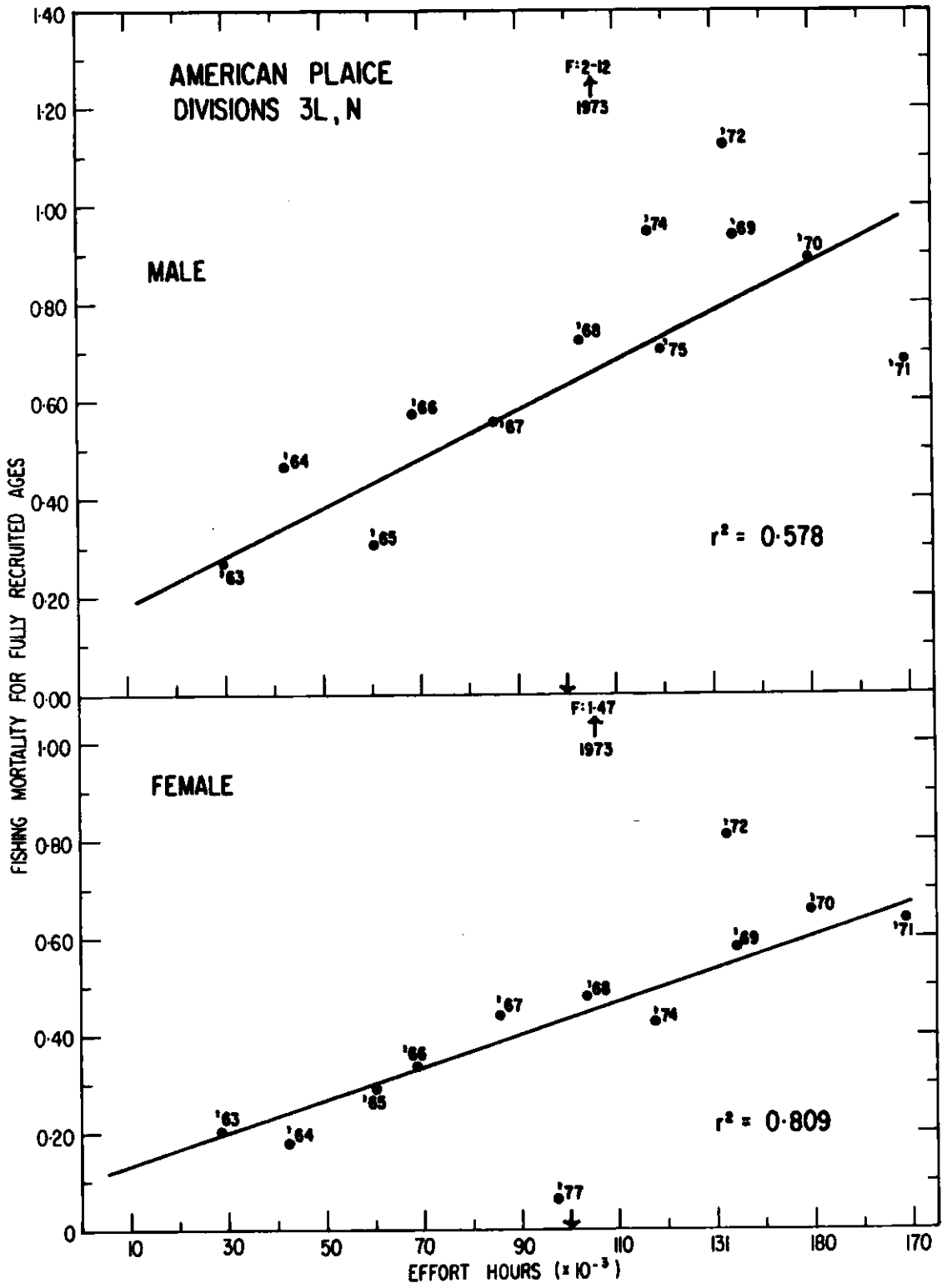


Fig. 3. Yield-per-recruit curves of plaice for ICNAF Divs. 3LNØ