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A new assessment for the American plaice in ICNAF Subdivision 3Ps

by

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Introduction

This stock has been regulated since 1974 with TACs based on catch statistics for 1974 and 1975 set at 11,000 tons (Table 1). A yield-per-recruit assessment presented at the 1975 ICNAF Assessments Subcommittee indicated that the TAC should be reduced to 8,000 tons in 1976. At the 1976 Assessments Subcommittee Meeting it appeared that the average annual catch of 5,500 tons for 1974-75 was generating a fishing mortality of about $F_{0.1}$ (0.23 females and 0.40 males) and hence the TAC was reduced to 6,000 tons.

Materials and Methods

Numbers at age data (1973-76) were available to make a more comprehensive assessment of this stock. Thus, a cohort analysis was made using these data as presented in Table 2. The selection of terminal F for 1976 was roughly estimated from the relationship between total effort and estimates of F (weighed) from cohort analyses, thus

	1973	1974	1975	1976
'Effort ('000 tons)	37.3	24.2	21.5	21.5
Fishing mortality, Male	1.50	0.55	0.35	
Female	0.90	0.65	0.45	

M = 0.25 and 0.20 for males and females respectively.

Based on these, the cohort was run at $F_n 0.4$ (males) and 0.5 (females).

Partial recruitment was calculated from a cohort analysis program that produces average F values for the last year (1976) of each cohort. Thus, for example, starting with the 14-year-olds for males in 1974 (1962 year-class) and working through the younger cohorts average Fs were calculated at each age in 1976 and these were used to give an approximate fishing mortality at age array (partial recruitment rates) (Table 2).

The calculated population size in 1975 from cohort analysis was projected to 1978 to give the following (catch in thousands of tons): (Table 5)

	1976		1977		1978	
	Catch	F	Catch	F	Catch	F
Male	1869	0.46	2674	0.46	1984	0.41
Female	4036	0.57	3401	0.47	2250	0.26
TOTAL	5905		6075		4134	
TAC	8000		6000			
CATCH	5383					

Discussion

The TAC from this stock has not been taken since it was regulated in 1974. Canada has always removed 75-80% of the total allocation. Most of the fishing is by otter trawl, both stern and side.

It appears that the effort used to take the 1973 catch of 13,360 tons generated very high F values (1.50 and 0.92 for males and females respectively). Similarly, the Fs in 1974,when approximately 6600 tons were removed, were above $F_{0.1}$ at 0.55 (males) and 0.65 (females). In 1975 with the catch down to 4100 tons, the Fs were lower, but apparently still higher than $F_{0.1}$.

It appears that fishing mortality is higher in the female fish, just why this is so is difficult to say, but the fact that males mature much younger and the females live longer probably are factors. However, on the Grand Bank the opposite is true, i.e. the mortality is greater in the females. Management at $F_{0.1}$ would, however, imply a lower F for females than for males (Fig. 1).

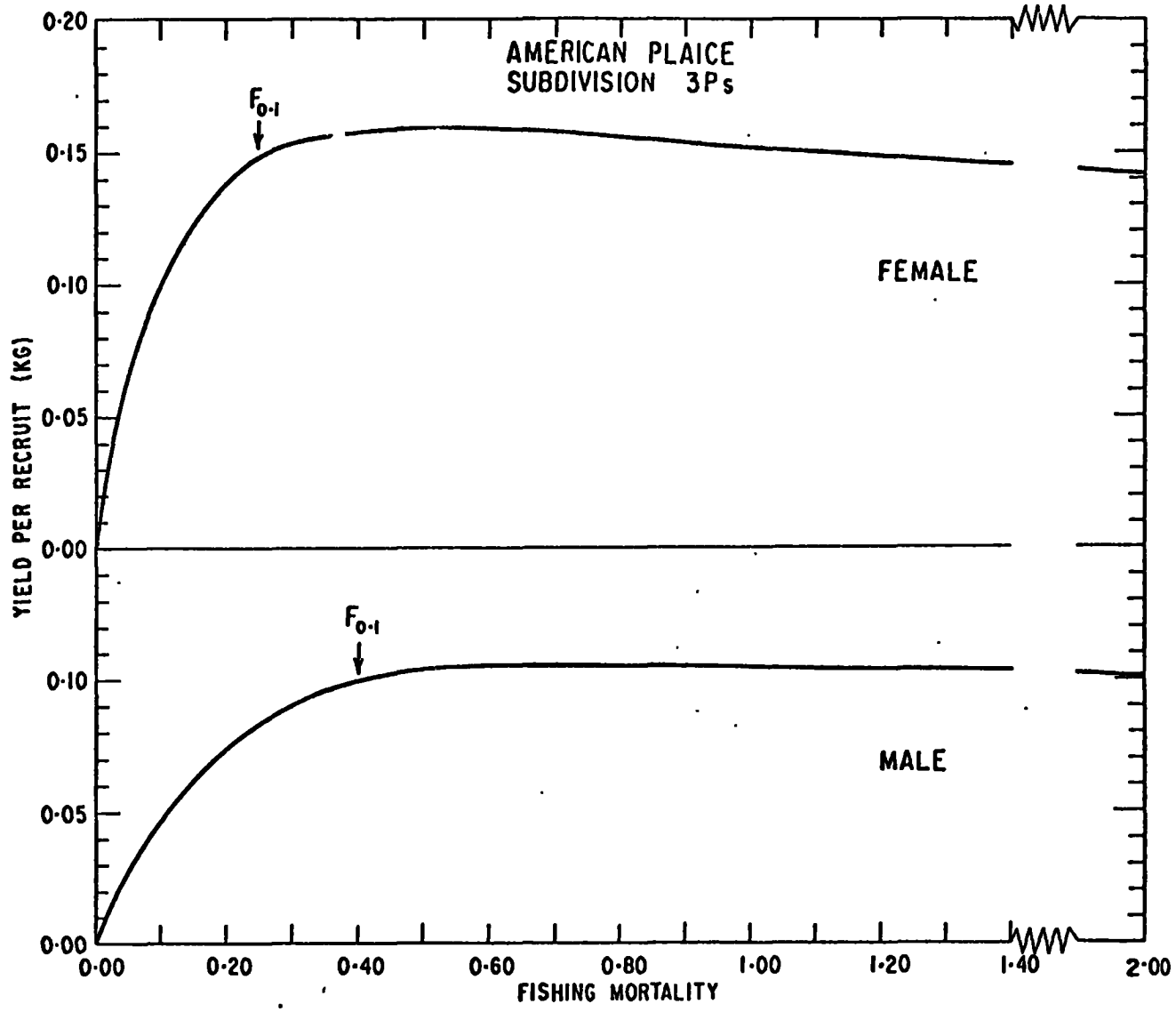

Fig. 1. Yield-per-recruit for male and female plaice, ICNAF Subdivision 3Ps. M = 0.25 for males and 0.20 for females.

Table 1. Nominal catch of plaice in ICNAF Subdivision 3Ps, 1966-76.

YEAR	CATCH					Total*[1] Effort	Catch Per hour (total)
	Canada	France	USSR	Other	Total		
1966	2,494	667	218	27	3,406	23,329	147
1967	3,275	533	678	8	4,494	14,881	302
1968	5,523	524	8,233		14,280	42,177	332
1969	4,066	245	2,180		6,491	21,637	300
1970	11,595	397	336		12,328	25,314	487
1971	5,953	820	409		7,182	28,843	249
1972	5,922	383	220	13	6,538	18,627	351
1973	12,812	547		1	13,360	37,295	396
1974	6,330	268			6,598	24,193	262
1975	3,818	65	128	200	4,211	21,469	196
1976	5,383	3	9	7	5,402*[2]	21,522	251

*[1]Canada stern trawler

*[2]Preliminary

Table 2(a)

PLAICE MALE 3PS

NATURAL MORTALITY= 0.25

PARTIAL RECRUITMENT MULTIPLIER

0.0300	0.0900	0.2100	0.3800	0.7100	1.0000	1.0000	1.4000

ASSUMED FISHING MORTALITY FOR LAST AGES

1.3000	1.2000	1.3000	0.4000

ESTIMATED POPULATION

AGE YEAR	1973	1974	1975	1976
6	13329.	13816.	9704.	8525.
7	6079.	10351.	10692.	7474.
8	4113.	4397.	7816.	8150.
9	3225.	2870.	3134.	5904.
10	1541.	1964.	1874.	2318.
11	2132.	778.	1216.	1282.
12	1117.	474.	414.	802.
13	437.	90.	179.	182.
14	1.	10.	16.	52.

KNOWN CATCHES

AGE YEAR	1973	1974	1975	1976
6	34.	76.	95.	90.
7	382.	278.	201.	234.
8	377.	330.	207.	582.
9	621.	410.	139.	739.
10	478.	355.	201.	510.
11	1344.	217.	164.	377.
12	884.	215.	159.	236.
13	375.	61.	99.	70.
14	1.	7.	12.	19.

ESTIMATE FISHING MORTALITY

AGE YEAR	1973	1974	1975	1976
6	0.0029	0.0063	0.0112	
7	0.0739	0.0309	0.0215	
8	0.1097	0.0889	0.0305	
9	0.2461	0.1766	0.0516	
10	0.4332	0.2292	0.1296	
11	1.2533	0.3799	0.1658	
12	2.2710	0.7214	0.5706	
13	3.5576	1.4693	0.9811	
14	1.3000	1.2000	1.3000	

POPULATION WTS AND NOS

	1973	1974	1975	1976
WT	12826.	11708.	12935.	14289.
NO	31974.	34749.	35046.	34690.

POPULATION WTS AND NOS AGE 9 TO 14

	1973	1974	1975	1976
WT	6951.	4408.	4971.	7338.
NO	8453.	6186.	6833.	10541.

Table 3.(1)

PLAICE FEMALE 3PS

NATURAL MORTALITY= 0.20

PARTIAL RECRUITMENT MULTIPLIER

0.0300	0.0700	0.1100	0.2100	0.2900	0.3900	
0.5800	1.0000	1.1000	1.1500	1.2500	1.2500	1.2500

ASSUMED FISHING MORTALITY FOR LAST AGES

1.0000	1.0000	1.0000	0.5000

ESTIMATED POPULATION

AGE YEAR	1973	1974	1975	1976
6	16666.	17050.	8332.	2297.
7	12608.	13634.	13746.	6668.
8	8505.	10154.	10706.	10876.
9	5897.	6559.	7837.	8398.
10	3743.	4332.	4687.	6026.
11	3066.	2645.	2763.	3638.
12	2673.	1914.	1659.	2046.
13	2314.	1772.	965.	1066.
14	1930.	1083.	742.	517.
15	1646.	550.	450.	402.
16	1162.	467.	251.	298.
17	802.	203.	226.	115.
18	530.	271.	79.	99.
19	362.	92.	91.	7.

KNOWN CATCHES

AGE YEAR	1973	1974	1975	1976
6	12.	236.	169.	31.
7	186.	505.	418.	208.
8	446.	527.	406.	528.
9	549.	755.	431.	760.
10	463.	866.	221.	739.
11	659.	560.	239.	586.
12	460.	665.	321.	469.
13	897.	783.	302.	384.
14	1139.	483.	227.	200.
15	974.	220.	77.	161.
16	827.	173.	100.	127.
17	426.	96.	95.	49.
18	377.	145.	64.	42.
19	239.	61.	60.	3.

ESTIMATE FISHING MORTALITY

AGE YEAR	1973	1974	1975	1976
6	0.0008	0.0154	0.0227	
7	0.0164	0.0418	0.0342	
8	0.0597	0.0591	0.0428	
9	0.1086	0.1361	0.0627	
10	0.1470	0.2497	0.0535	
11	0.2712	0.2665	0.1005	
12	0.2110	0.4846	0.2406	
13	0.5593	0.6701	0.4244	
14	1.0558	0.6791	0.4124	
15	1.0608	0.5837	0.2098	
16	1.5446	0.5271	0.5799	
17	0.8841	0.7395	0.6265	
18	1.5454	0.8932	2.2208	
19	1.0000	1.0000	1.0000	

POPULATION WTS AND NOS

	1973	1974	1975	1976
WT	39866.	30632.	26915.	25207.
NO	61904.	60727.	52533.	42455.

POPULATION WTS AND NOS AGE 11 TO 19

	1973	1974	1975	1976
WT	23938.	12947.	9758.	10241.
NO	14485.	8997.	7226.	8190.

Table 3(a)

PLAICE MALE 3PS

NATURAL MORTALITY= 0.2500 YEAR 1975

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	9704.	95.	0.012	0.189	1834.1	18.0	7467.3
7	10692.	201.	0.022	0.286	3057.9	57.5	8145.7
8	7816.	207.	0.031	0.393	3071.7	81.4	5901.3
9	3134.	139.	0.052	0.510	1598.3	70.9	2317.1
10	1874.	201.	0.129	0.723	1354.9	145.3	1262.8
11	1216.	164.	0.165	0.968	1177.1	158.8	803.0
12	414.	159.	0.561	1.304	539.9	207.3	184.0
13	179.	99.	0.950	1.533	274.4	151.8	53.9
14	16.	12.	1.713	1.604	25.7	19.2	2.2
TOTAL	35045.	1277.			12933.9	910.1	26157.4

NATURAL MORTALITY= 0.2500 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	10000.	90.	0.011	0.189	1890.0	17.0	7702.8
7	7467.	234.	0.037	0.286	2135.7	66.9	5604.3
8	8146.	582.	0.085	0.393	3201.3	228.7	5827.0
9	5901.	739.	0.153	0.510	3009.7	376.9	3943.9
10	2317.	510.	0.285	0.723	1675.3	368.7	1357.1
11	1283.	377.	0.400	0.968	1241.8	364.9	669.7
12	803.	236.	0.400	1.304	1047.1	307.7	419.2
13	184.	70.	0.554	1.533	282.1	107.3	82.3
14	54.	19.	0.502	1.604	86.5	30.5	25.4
TOTAL	36155.	2857.			14569.2	1868.7	25631.7

Table 3(b)

PLAICE MALE 3PS

NATURAL MORTALITY# 0.2500 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	10000.	106.	0.012	0.189	1890.0	20.0	7695.1
7	7703.	235.	0.035	0.286	2203.0	67.1	5792.6
8	5604.	400.	0.084	0.393	2202.5	157.3	4013.0
9	5627.	1282.	0.284	0.510	2971.7	653.9	3416.1
10	3944.	1160.	0.400	0.723	2851.5	838.7	2058.9
11	1357.	399.	0.400	0.968	1313.6	386.4	708.4
12	670.	197.	0.400	1.304	873.3	256.9	349.6
13	419.	161.	0.560	1.533	642.6	246.6	186.5
14	82.	30.	0.520	1.604	132.1	47.9	38.1
TOTAL	35606.	3969.			15080.3	2674.7	24258.4

NATURAL MORTALITY# 0.2500 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	10000.	97.	0.011	0.189	1890.0	18.3	7702.8
7	7695.	215.	0.032	0.286	2200.8	61.4	5804.2
8	5793.	366.	0.074	0.393	2276.5	143.9	4189.5
9	4013.	443.	0.133	0.510	2046.6	226.1	2736.1
10	3416.	670.	0.249	0.723	2469.8	484.2	2074.0
11	2059.	542.	0.350	0.968	1993.0	524.5	1130.0
12	708.	186.	0.350	1.304	923.8	243.1	388.8
13	350.	121.	0.490	1.533	536.0	185.6	166.8
14	186.	61.	0.455	1.604	299.1	97.7	92.1
TOTAL	34220.	2701.			14635.7	1984.8	24284.4

Table 3(c)

PLAICE FEMALE 3PS

NATURAL MORTALITY= 0.2000 YEAR 1975

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.
7	13746.	418.	0.035	0.325	4467.4	135.8	10867.2
8	10706.	406.	0.043	0.379	4057.6	153.9	8396.4
9	7837.	431.	0.063	0.495	3879.3	213.3	6024.6
10	4687.	221.	0.054	0.678	3177.8	149.8	3635.7
11	2763.	239.	0.101	0.897	2478.4	214.4	2044.8
12	1659.	321.	0.240	1.130	1874.7	362.7	1068.5
13	965.	302.	0.420	1.374	1325.9	414.9	519.1
14	742.	227.	0.409	1.702	1262.9	386.4	403.5
15	450.	77.	0.209	2.250	1012.5	173.2	298.9
16	251.	100.	0.572	2.571	645.3	257.1	116.0
17	226.	95.	0.615	2.766	625.1	262.8	100.0
18	79.	64.	2.013	3.100	244.9	198.4	8.6
19	91.	60.	1.249	3.177	289.1	190.6	21.4
TOTAL	44202.	2961.			25340.9	3113.5	33504.8

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.
7	13000.	208.	0.018	0.325	4225.0	67.6	10453.6
8	10867.	528.	0.056	0.379	4118.7	200.1	8412.7
9	8396.	760.	0.106	0.495	4156.2	376.2	6183.0
10	6025.	739.	0.146	0.678	4084.7	501.0	4262.5
11	3636.	586.	0.196	0.897	3261.2	525.6	2446.8
12	2045.	469.	0.291	1.130	2310.7	530.0	1251.5
13	1068.	384.	0.500	1.374	1468.1	527.6	530.6
14	519.	200.	0.547	1.702	883.5	340.4	246.0
15	404.	161.	0.573	2.250	908.0	362.2	186.3
16	299.	127.	0.624	2.571	768.6	326.5	131.1
17	116.	49.	0.619	2.766	320.8	135.5	51.1
18	100.	43.	0.634	3.100	310.1	133.3	43.4
19	9.	3.	0.479	3.177	27.4	9.5	4.4
TOTAL	46683.	4257.			26843.0	4035.7	34203.1

Table 3(d)

PLAICE FEMALE 3PS

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.
7	13000.	325.	0.028	0.325	4225.0	105.8	10349.6
8	10454.	408.	0.044	0.379	3961.9	154.7	8190.3
9	8413.	615.	0.084	0.495	4164.3	304.5	6332.8
10	6183.	615.	0.116	0.678	4192.1	416.9	4507.8
11	4263.	559.	0.156	0.897	3823.5	501.8	2985.8
12	2447.	461.	0.232	1.130	2764.9	520.9	1588.5
13	1251.	376.	0.400	1.374	1719.5	517.2	666.8
14	531.	160.	0.400	1.702	903.1	271.6	291.2
15	246.	88.	0.500	2.250	553.4	199.0	122.1
16	186.	67.	0.500	2.571	479.0	172.2	92.5
17	131.	47.	0.500	2.766	362.7	130.4	65.1
18	51.	18.	0.500	3.100	158.5	57.0	25.4
19	43.	16.	0.500	3.177	138.0	49.6	21.6
TOTAL	47199.	3757.			27445.9	3401.8	35259.5

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.
7	13000.	187.	0.016	0.325	4225.0	60.8	10474.6
8	10350.	232.	0.025	0.379	3922.5	87.8	8264.3
9	8190.	348.	0.048	0.495	4054.2	172.3	6391.4
10	6333.	372.	0.067	0.678	4293.7	252.5	4848.9
11	4508.	352.	0.090	0.897	4043.5	315.9	3373.0
12	2986.	338.	0.133	1.130	3373.9	381.7	2140.1
13	1569.	297.	0.230	1.374	2182.6	408.0	1033.3
14	687.	140.	0.253	1.702	1169.0	237.8	436.5
15	291.	62.	0.265	2.250	655.2	138.8	182.9
16	122.	28.	0.288	2.571	314.0	71.6	75.0
17	93.	21.	0.288	2.766	255.9	58.3	55.8
18	65.	15.	0.288	3.100	201.9	46.0	40.0
19	25.	6.	0.288	3.177	80.7	18.4	15.6
TOTAL	48218.	2407.			28771.9	2249.9	37332.4