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An assessment update of yellowtail from ICNAF Divisions 3LNØ

by

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The Grand Bank yellowtail stock has been regulated since 1973 with TAC's and catches as follows:

	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>
TAC ('000 tons)	50.0	40.0	35.0	9.0	12.0	15.0
CATCH ('000 tons)	32.8	24.2	22.9	8.6	11.2*	

* Preliminary

Nominal catches from this stock increased from 3,100 tons in 1965 to 25,600 tons in 1970 and 39,300 tons in 1972 with a gradual decline since then as indicated above. The 1975 assessment pointed to the fact that the stock was being rapidly depleted and hence the TAC for 1976 was reduced to 9,000 tons. In 1977 and 1978 the recommended TAC increased by approximately 33 and 25% respectively.

Assessment

Terminal or Starting F (F_T)

The regression of fishing mortality on effort did not give a particularly good correlation (Fig. 1). The reason for this is not clear, but could be caused by the underestimation of effort during the peak fishing period. An alternate method of getting some idea of the value of F in the current year was attempted using the estimated population numbers from the correlation of average number per set with population numbers from cohort analysis (Fig. 2). The population numbers and the catch numbers at age for 1977 gave the following results using the Baranov catch equation relationship:

<u>Age</u>	<u>Population Numbers ('000)</u>	<u>Catch ('000)</u>	<u>F</u>
7	43,000	7,331	.23
8	25,600	4,078	.22
9	5,300	1,433	.38

F = .28

Because of catch limitations imposed on the Canadian trawler fleet both in 1976 and 1977, it is possible that there was a substantial discard in this fishery, hence the catch numbers could be minimal. Thus, to be on the safe side a somewhat higher value was selected: 0.40. This was the value that was projected to be required to catch the TAC in 1977 in last year's assessment.

Partial Recruitment

The partial recruitment pattern was calculated from the matrix of the catch at age numbers for 1974-77 with the starting F values for each cohort in 1977 being the average for the four years (see Res. Doc. 78/IV/). The partial recruitment pattern then is basically determined from the average F values for 1974-76.

Average Weights

Average weights were calculated from monthly length frequencies and age samples collected during 1977. Average lengths were converted to weights using the following relationship:

$$\text{Log } W = 3.443 \text{ Log } L - 5.434$$

Average weights at age were somewhat lower than those used in the 1977 assessment.

Catch Projections (Table 2)

The 1976 stock size from the current Cohort Analysis (Table 1) was used to project catches for 1978 and 1979. Recruitment values were averages for 1974-76. The projected catch for 1979 at $F_{0.1} = 0.50$ (Fig. 3) was calculated to be approximately 14,000 tons, assuming 85 million fish recruited at age 4. A summary of catch and F values for 1976 to 1979 and a comparison with last year's projected values are listed below with detailed calculation presented in Table 2.

	1976		1977		1978		1979	
	Catch ('000)	F	Catch ('000)	F	Catch ('000)	F	Catch ('000)	F
From 1977 Assessment	8.6	0.22	11.2	0.43	14.3*	0.48	14.1*	0.48
			(11.6)	(0.42)	(14.8)	(0.47)		
TAC	9.0		12.0		15.0			

*Projected () from 1977 assessment

With the uncertainty about recruitment, catch projections for 1979 were calculated at three recruitment levels, i.e. 100, 95 and 70 million fish at age 4 in 1977 and subsequent years.

Recruitment at Age 4 $\times 10^{-6}$	Catch
100	14.9
95	14.6
85	14.1
70	13.3

Biomass Estimates

Fifty percent of the males are mature at age 5 and 50% of the females at age 7. Hence, the 7 year and older contain about 75% of the mature fish. The calculated biomass values from the current assessment are listed below with the values for 1977 and beyond based on 85 million fish recruited at age 4.

	1968	1970	1972	1974	1976	1977	1979	1982
Biomass 5 years & older ('000 tons)	60.8	94.6	78.1	62.7	57.0	65.3	67.0	65.6
Biomass 7 years & older ('000 tons)	12.0	33.4	33.7	14.5	20.6	30.0	30.0	28.0
CATCH ('000 tons)	15.8	25.6	39.3	24.2	8.0	11.2	14.1	13.6

Discussion

The major difficulties in yellowtail assessment is the determination of F_T and the recruitment levels. The use of research vessel average catches to predict current stock size (Fig. 2) should become more useful as the research vessel survey series continues and hopefully will be more precise.

It is evident that biomass of mature fish (7 years and older) in particular was drastically reduced, but since 1974 the biomass appears to be returning to a somewhat higher level. The catch per set from research vessel surveys (Res. Doc. 78/IV/) indicates a stabilization in the population since 1975. It would appear, however, that we are unlikely to return to the high catch levels recorded in 1970-72.

Table 1.

YELLOWTAIL 3LNO 1968-77											
NATURAL MORTALITY=		0.30									
PARTIAL RECRUITMENT MULTIPLIER		0.0200 0.1800 0.5000 1.0000 1.0000 1.1000 1.2000									
ASSUMED FISHING MORTALITY FOR LAST AGES		0.8100 0.9000 0.9000 0.7700 1.9500 1.5000 1.8500 0.8000 0.3000 0.4000									
ESTIMATED POPULATION		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
AGE	YEAR										
4	1968	156728.	147093.	119887.	113591.	134679.	142088.	98102.	84392.	72565.	202024.
5	1968	109210.	115614.	108901.	88693.	84079.	98101.	102048.	71492.	61697.	53405.
6	1968	53716.	75567.	83073.	78286.	59221.	53570.	54359.	58557.	43288.	43529.
7	1968	17998.	29050.	43041.	44466.	31861.	24504.	19279.	24691.	25364.	25484.
8	1968	2374.	5454.	11127.	14142.	13905.	6891.	3476.	4642.	7329.	14176.
9	1968	147.	535.	1329.	4321.	5425.	1218.	1044.	509.	1256.	4609.
10	1968	2.	68.	116.	460.	1349.	399.	160.	42.	57.	867.
KNOWN CATCHES		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
AGE	YEAR										
4	1968	573.	80.	141.	169.	1943.	3734.	1375.	955.	409.	1391.
5	1968	6202.	2993.	2776.	7534.	10128.	21280.	19800.	11240.	2529.	3211.
6	1968	12483.	15035.	19839.	30365.	22502.	23709.	18100.	20931.	7650.	6851.
7	1968	9154.	12076.	20615.	22117.	19416.	17053.	11200.	12737.	5361.	7331.
8	1968	1421.	3150.	4557.	5869.	10553.	4718.	2400.	2536.	953.	4078.
9	1968	47.	326.	610.	2152.	4209.	862.	850.	372.	74.	1433.
10	1968	1.	40.	68.	245.	1110.	300.	130.	23.	15.	289.
ESTIMATE FISHING MORTALITY		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
AGE	YEAR										
4	1968	0.0043	0.0006	0.0014	0.0017	0.0169	0.0310	0.0164	0.0132	0.0066	0.0
5	1968	0.0683	0.0305	0.0301	0.1039	0.1508	0.2904	0.2554	0.2017	0.0488	0.0
6	1968	0.3147	0.2629	0.3250	0.5990	0.5824	0.7220	0.4892	0.5366	0.2298	0.0
7	1968	0.8939	0.6597	0.8130	0.8625	1.2311	1.6531	1.1238	0.9146	0.2818	0.0
8	1968	1.1891	1.1117	0.6460	0.6581	2.1349	1.5868	1.6210	1.0069	0.1638	0.0
9	1968	0.4652	1.2287	0.7618	0.8644	2.3102	1.7269	2.9102	1.8909	0.0709	0.0
10	1968	0.8100	0.9000	0.9000	0.7700	1.9500	1.5000	1.8500	0.8000	0.3000	0.4000
POPULATION WTS AND NOS		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
WT	NO										
WT	NO	94358.	111831.	120242.	117318.	106954.	96448.	83726.	77481.	69189.	100369.
NO		340174.	373381.	367472.	344058.	330518.	326771.	278468.	244325.	211557.	344096.
POPULATION WTS AND NOS AGE 7 TO 10		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
WT	NO										
WT	NO	12044.	20844.	33383.	39227.	33730.	20129.	14476.	17753.	20594.	29014.
NO		20520.	35108.	55613.	63388.	52539.	33013.	23960.	29885.	34007.	45137.

YELLOWTAIL 3LND **Table 2**

NATURAL MORTALITY# 0.3000		YEAR 1976					
AGE	POP. NO. x10-3x	CATCH NO. x10-3x	FISHING MORT.	MEAN WT. KG.	POP. WT. METRIC TONS<	CATCH WT. METRIC TONS<	RESIDUAL POP. NOS.
4	85000.	409.	0.006	0.214	18190.0	87.5	62592.9
5	61697.	2520.	0.049	0.324	19989.8	819.4	43520.6
6	42288.	7520.	0.228	0.309	17704.8	3128.8	25530.6
7	25304.	5341.	0.219	0.332	13483.6	2852.1	14215.5
8	12329.	953.	0.163	0.648	4749.2	617.5	4612.8
9	1256.	74.	0.071	0.809	1016.1	59.9	866.7
10	57.	15.	0.360	0.905	51.6	13.6	29.5
TOTAL	223991.	16991.			75195.1	7574.8	151368.5

NATURAL MORTALITY# 0.3000		YEAR 1977					
AGE	POP. NO. x10-3x	CATCH NO. x10-3x	FISHING MORT.	MEAN WT. KG.	POP. WT. METRIC TONS<	CATCH WT. METRIC TONS<	RESIDUAL POP. NOS.
4	85000.	1391.	0.020	0.214	18190.0	297.7	61722.7
5	62593.	3211.	0.062	0.324	20280.1	1040.4	43542.3
6	43521.	6851.	0.201	0.409	17799.9	2802.1	26370.3
7	25531.	7331.	0.400	0.532	13582.3	3900.1	12674.2
8	14216.	4078.	0.399	0.648	9211.6	2442.5	7066.3
9	4613.	1433.	0.440	0.809	3711.8	1159.3	2200.9
10	867.	289.	0.481	0.905	784.4	261.5	396.6
TOTAL	236339.	24584.			83579.9	12103.6	154017.2

NATURAL MORTALITY# 0.3000		YEAR 1978					
AGE	POP. NO. x10-3x	CATCH NO. x10-3x	FISHING MORT.	MEAN WT. KG.	POP. WT. METRIC TONS<	CATCH WT. METRIC TONS<	RESIDUAL POP. NOS.
4	85000.	658.	0.009	0.214	18190.0	140.8	62405.4
5	61723.	4157.	0.081	0.324	19989.1	1347.0	42167.6
6	43582.	7629.	0.225	0.409	17822.2	3120.3	25781.3
7	26370.	8348.	0.450	0.532	14062.0	4441.3	12456.4
8	12676.	4014.	0.450	0.648	9215.5	2600.8	5988.7
9	7066.	2413.	0.495	0.809	5716.6	1952.1	3191.0
10	2201.	804.	0.540	0.905	1991.8	727.7	950.1
TOTAL	238620.	28023.			85966.1	14329.9	152940.4

NATURAL MORTALITY# 0.3000		YEAR 1979					
AGE	POP. NO. x10-3x	CATCH NO. x10-3x	FISHING MORT.	MEAN WT. KG.	POP. WT. METRIC TONS<	CATCH WT. METRIC TONS<	RESIDUAL POP. NOS.
4	85000.	658.	0.009	0.214	18190.0	140.8	62405.4
5	62405.	4203.	0.081	0.324	20219.3	1361.9	42634.0
6	42168.	7381.	0.225	0.409	17246.5	3019.0	24944.4
7	25781.	8162.	0.450	0.532	13715.7	4342.1	12178.2
8	12456.	3943.	0.450	0.648	8071.8	2555.4	5884.0
9	5989.	2045.	0.495	0.809	4844.9	1654.4	2704.4
10	3191.	1166.	0.540	0.905	2887.9	1055.0	1377.6
TOTAL	236990.	27559.			85175.9	14124.5	152127.9

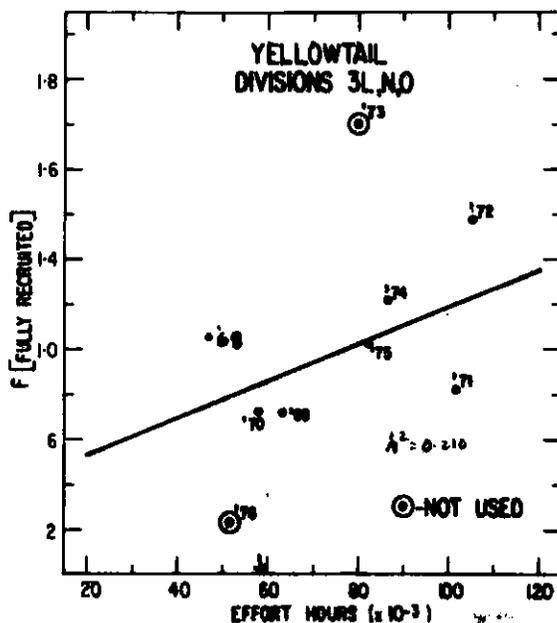


Fig. 1. Regression of fishing mortality in the fully recruited age group on effort.

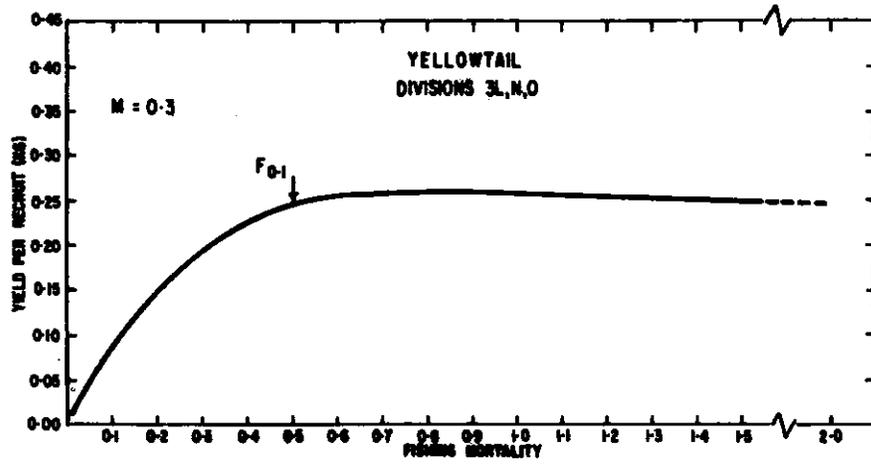


Fig. 3. Yield-per-recruit for yellowtail from ICNAF Divisions 3LN0.