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Assessment Update for Yellowtail Flounder in Divisions 3LNO[1]

by

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Trends in Catch

The yellowtail fishery on the Grand Bank developed following the decline of the haddock fishery in the early 1960's, and nominal catches increased to a peak of 39,000 tons in 1972. There was a rapid decline to 9,000 tons in 1976, but some improvement in the stock is indicated by gradual increases in the TACs and nominal catches up to 1978. The TAC's and nominal catches for Div. 3LNO since 1973 are as follows:

	1973	1974	1975	1976	1977	1978	1979
TAC (000 tons)	50.0	40.0	35.0	9.0	12.0	15.0	18.0
Catch (000 tons)	32.8	24.2	22.9	8.6	11.6	15.5*	

* Preliminary

Sampling Data

Age and length compositions of the catches in 1978 are based on otolith samples and total length measurements collected from the Canadian (Nfld) offshore fleet by the Commercial Sampling Group of the Research and Resource Services Branch, Dept. of Fisheries and Oceans, St. John's, Newfoundland, as follows:

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[1] Based on data presented as a working paper at the April 1979 Meeting of the Assessments Subcommittee.

Quarter	Number measured			Otolith specimens			No. of
	3L	3N	30	3L	3N	30	samples
1	–	440	–	–	87	–	1
2	4720	3006	3520	405	374	361	23
3	1819	3074	538	221	401	76	11
4	–	3708	772	–	851	152	11
Total	6539	10228	4830	626	1413	589	46

Assessment

Terminal fishing mortality (F_t)

Terminal F to initiate the cohort analysis was obtained from the regression of weighted F's of fully-recruited age-groups on the directed effort of Canada (N) otter trawlers for yellowtail in 1969-76 (Table 1, Fig. 1). A value of F_t = 0.53 was obtained for 1978 and this value was used in the analysis presented in Table 2. (F = 0.53 spread over the partial recruitment array at the top of Table 2 gives F = 0.45 where the partial recruitment multiplier equals 1.)

Partial recruitment

These values were determined from the matrix of catch in numbers at age (1975-78) with the starting F values for each cohort analysis in 1978 being the average for the four years.

Average weights

These values were calculated from monthly length frequencies and age samples collected during 1978 using the following relationship:

$$\log W = 3.449 \log L - 5.424$$

each calculated value being multiplied by 0.454 to convert from pounds to kg.

Recruitment

The recruitment at age 4 (110 million fish) used in the projections of Table 3 is based on the average value for 1976-77.

Stock projections

Projections were made for 1980 based on $F_{0.1}$ = 0.45 (Fig. 2) using the 1978 population numbers generated in the cohort analysis (Table 2), except that the average recruitment was used for age 4. It is obvious that removal of the TAC for 1979 (18,000 tons) will generate a fishing mortality of 0.53, which is a little higher than $F_{0.1}$ (Tables 3 and 4). Projection to 1980, assuming the same recruitment value of 110 million fish, indicates a probable allowable catch level similar to that for 1979 (18,000 tons). Projections beyond 1980 are not very informative, since the recruitment input value used for 1978 would generate a large proportion of the total stock. In fact, even for 1980, the projection is highly dependent on this recruitment level (110 million fish). However, recruit-

ment has not fluctuated widely in the past 7 or 8 years (Table 2).

A comparison of the spawning stock sizes (weight and numbers) indicates that there was a reduction in the mid-1970's, probably due to the high level of removals in the early 1970's, but there has been a gradual recovery since 1976 (Table 4).

Research and commercial catch per unit effort

Research vessel survey data indicate a slight decline in biomass from the 1977 level both in average number and average weight per survey set. The lower level recorded in 1978 may have been due to the fact that a key locality for yellowtail in Div. 3N was unavoidably ommitted from the survey. On the other hand, the commercial catch per hour data indicate an upswing in abundance to the highest level since 1973. (See Fig. 3 and 4.)

Discussion

Although the recommended TAC for 1980 is at the same level as that for 1979 (18,000 tons), there are indications that the stock is recovering from the low level of abundance recorded in 1976. If recruitment remains at the average level for 1976 and 1977, there should be a gradual continuing increase in the stock both in numbers and weight.

The reduction in the directed fishery for cod in Div. 3NO in recent years very likely will have a beneficial effect on the yellowtail stock, because of the reduction in by-catch of yellowtail in the cod fishery. However, what effect the rebuilding of the cod stock will have on the yellowtail population is unknown.

Table 1. Total catch, directed effort and catch per unit effort for yellowtail in ICNAF Divisions 3LNO.

YEAR	DIVISION 3L CATCH (tons)	EFFORT (hours)	CPUE (tons)	DIVISION 3N CATCH (tons)	EFFORT (hours)	CPUE (tons)	DIVISION 3∅ CATCH (tons)	EFFORT (hours)	CPUE (tons)	TOTALS 3LNO CATCH (tons)	EFFORT (hours)	CPUE (tons)
1965	17			2958	3090	0.957	55			3190		
1966	62			6442	7130	0.907	522	638	0.818	7026	7741	0.904
1967	453	682	0.664	6117	5303	0.867	2308	4788	0.482	8878	10773	0.824
1968	5287	7868	0.672	8459	9870	0.857	2066	3562	0.580	15812	21300	0.742
1969	7419	12365	0.600	7215	11732	0.615	3206	5819	0.551	17840	29915	0.596
1970	6632	12754	0.520	18669	28721	0.650	339	781	0.434	25640	42256	0.434
1971	6631	13450	0.493	25174	39080	0.644	5336	8705	0.570	37341	61235	0.610
1972	9292	20880	0.445	25799	37939	0.680	4179	9085	0.460	39270	67904	0.578
1973	4856	9393	0.517	23693	35898	0.666	4266	7445	0.573	32815	52736	0.622
1974	1542	5056	0.305	19316	44405	0.435	3379	11571	0.292	24237	61032	0.292
1975	2638	8764	0.301	16156	37055	0.436	4100	12424	0.330	22894	58243	0.393
1976	516	2314	0.223	5023	14644	0.343	2518	8096	0.311	8057	25054	0.322
1977	2654	7645	0.347	7381	16398	0.450	1606	6387	0.251	11641	30430	0.383
1978*	2642	8231	0.321	10653	19546	0.545	2221	6419	0.346	15516	34196	0.454

*Provisional

Table 2. Cohort analysis for yellowtail flounder in Divisions 3LNO, 1968-78.

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NATURAL MORTALITY=    0.30

PARTIAL RECRUITMENT MULTIPLIER
0.0200   0.1300   0.5100   1.0000   1.1800   1.5000   1.0000

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   0.4500
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ESTIMATED POPULATION

AGE YEAR	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
4	156791.	147106.	119945.	114523.	122134.	113974.	91998.	105259.	117784.	101945.	89250.
5	109356.	115661.	108910.	88736.	84695.	88807.	81220.	66970.	77156.	86904.	74325.
6	53992.	75675.	83108.	78293.	59253.	54027.	47474.	43128.	39938.	54982.	61617.
7	18142.	29254.	43120.	44492.	31866.	24526.	19617.	19591.	13934.	23003.	34835.
8	2399.	5561.	11278.	14201.	13924.	6895.	3493.	4893.	3550.	5708.	10731.
9	158.	554.	1408.	4433.	5469.	1232.	1052.	522.	1442.	1810.	719.
10	2.	76.	130.	518.	1432.	431.	171.	47.	66.	1005.	107.

KNOWN CATCHES

AGE YEAR	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
4	573.	80.	141.	169.	1943.	3734.	1375.	955.	409.	1391.	691.
5	6202.	2993.	2776.	7534.	10128.	21280.	19800.	11240.	2529.	3211.	3654.
6	12483.	15035.	19839.	30365.	22502.	23709.	18100.	20931.	7650.	6851.	10979.
7	9154.	12076.	20615.	22117.	19416.	17053.	11200.	12737.	5361.	7331.	11028.
8	1421.	3150.	4557.	5869.	10553.	4713.	2400.	2536.	953.	4078.	3870.
9	47.	326.	610.	2152.	4206.	862.	850.	372.	74.	1433.	310.
10	1.	40.	68.	245.	1110.	300.	130.	23.	15.	269.	34.

ESTIMATE FISHING MORTALITY

AGE YEAR	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
4	0.0043	0.0006	0.0014	0.0017	0.0187	0.0388	0.0175	0.0106	0.0040	0.0160	0.0
5	0.0682	0.0305	0.0301	0.1039	0.1496	0.3263	0.3330	0.2169	0.0388	0.0439	0.0
6	0.3128	0.2624	0.3248	0.5989	0.5820	0.7131	0.5851	0.8298	0.2517	0.1564	0.0
7	0.8825	0.6532	0.8107	0.8617	1.2307	1.6491	1.0886	1.4080	0.5924	0.4625	0.0
8	1.1657	1.0734	0.6338	0.6542	2.1247	1.5806	1.6009	0.9217	0.3738	1.7719	0.0
9	0.4253	1.1514	0.6997	0.8302	2.2400	1.6750	2.7993	1.7605	0.0615	2.5245	0.0
10	0.8100	0.9000	0.9000	0.7700	1.9500	1.5000	1.8500	0.8000	0.3000	0.4000	0.4500

POPULATION WTS AND NOS

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
WT	96950.	113112.	119740.	117034.	105614.	89445.	74629.	72437.	73842.	86169.	89896.
NO	340839.	373886.	367898.	345196.	318772.	289894.	245025.	240410.	253871.	275356.	271584.

POPULATION WTS AND NOS AGE 7 TO 10

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
WT	10940.	19133.	30829.	36643.	32024.	18649.	13416.	13732.	10812.	18240.	25625.
NO	20700.	35445.	55937.	63644.	52690.	33087.	24333.	25053.	18993.	31526.	46392.

Table 3. Projections of stock size to 1980 for yellowtail flounder in Divisions 3LNO.

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.
NATURAL MORTALITY# 0.3000			**YEAR 1978**				
4	110000.	698.	0.008	0.349	38390.0	243.6	80840.6
5	74525.	3654.	0.059	0.315	23475.4	1151.0	52046.3
6	61617.	10979.	0.230	0.430	26495.3	4721.0	36268.2
7	34835.	11028.	0.451	0.557	19403.1	6142.6	16438.5
8	10731.	3870.	0.532	0.740	7940.9	2863.8	4669.9
9	719.	310.	0.675	0.987	709.7	306.0	271.2
10	107.	34.	0.453	1.235	132.1	42.0	50.4
TOTAL	292534.	30573.			116546.4	15469.9	190585.0
NATURAL MORTALITY# 0.3000			**YEAR 1979**				
4	110000.	852.	0.009	0.349	38390.0	297.2	80759.9
5	80841.	3974.	0.058	0.315	25464.8	1251.9	56485.2
6	52046.	9266.	0.229	0.430	22379.9	3984.6	30656.2
7	36268.	11474.	0.450	0.557	20201.4	6390.8	17138.7
8	16439.	5924.	0.530	0.740	12164.5	4383.8	7164.4
9	4670.	2012.	0.674	0.987	4609.2	1986.3	1762.3
10	271.	86.	0.450	1.235	334.9	106.0	128.2
TOTAL	300535.	33588.			123544.6	18400.6	194094.8
NATURAL MORTALITY# 0.3000			**YEAR 1980**				
4	110000.	757.	0.008	0.349	38390.0	264.3	80840.6
5	80760.	3340.	0.049	0.315	25439.4	1052.3	56967.5
6	56485.	8647.	0.194	0.430	24288.7	3718.3	34466.2
7	30656.	8452.	0.380	0.557	17075.5	4707.9	15530.9
8	17139.	5406.	0.448	0.740	12682.6	4000.7	8112.0
9	7164.	2727.	0.570	0.987	7071.3	2691.9	3001.5
10	1762.	486.	0.380	1.235	2176.5	600.1	892.8
TOTAL	303967.	29817.			127123.7	17035.6	199811.4

Table 4. Summary of estimates of biomass, population numbers, catch, fishing mortality and TACs for 1970-78, with projected values for 1979 and 1980.

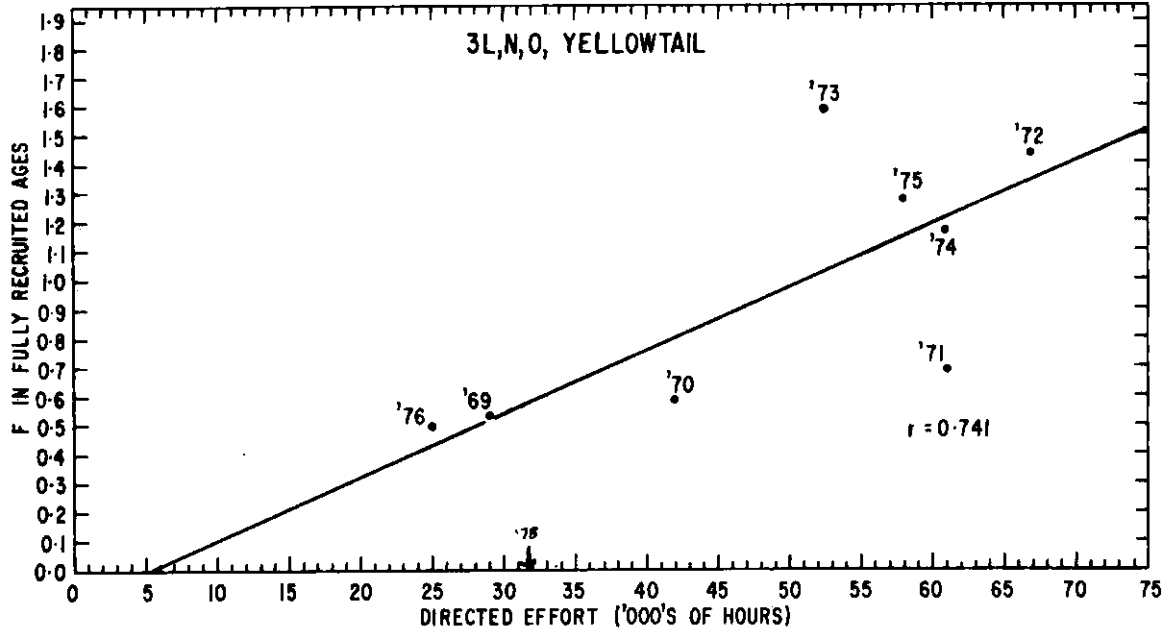|	1970	1972	1974	1976	1978	1979	1980
Biomass (000 tons) (age 7+)	30.8	32.0	13.4	19.0	28.2	37.3	39.0
Population (10^6) (age 7+)	55.9	52.7	24.3	18.9	46.4	57.6	56.7
Catch (000 tons)	25.6	39.3	24.2	9.0	15.5	18.4	17.0
Fishing mortality					0.53	0.53	0.45
TAC (000 tons)	—	—	22.9	8.6	15.0	18.0	

3L,N,O, YELLOWTAIL

Fig. 1. Regression of fishing mortality (F) on directed fishing effort in the Grand Banks Yellowtail fishery.
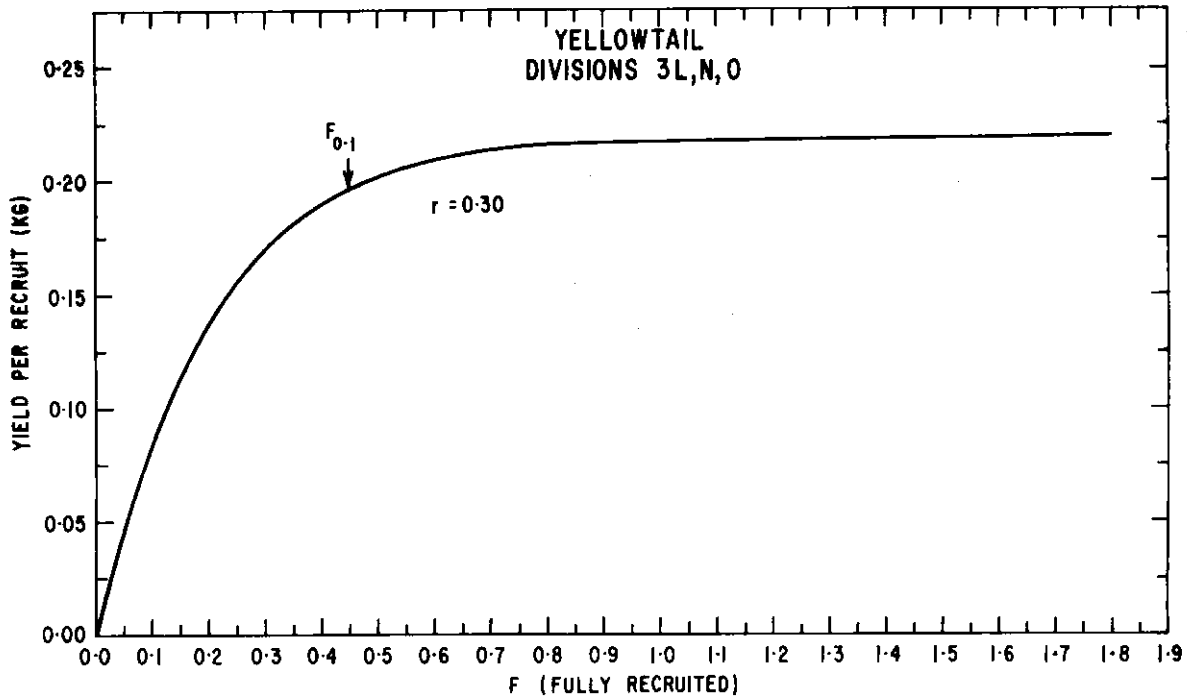
**YELLOWTAIL
DIVISIONS 3L,N,O**

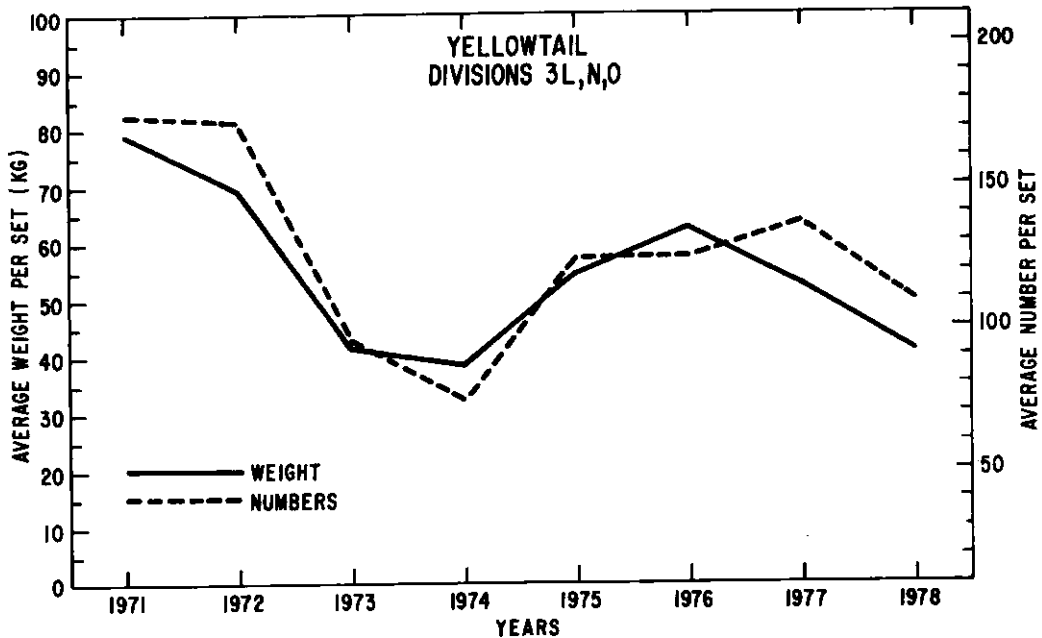Fig. 2. Yield per recruit for Yellowtail - ICNAF Divisions 3L, 3N & 3O.

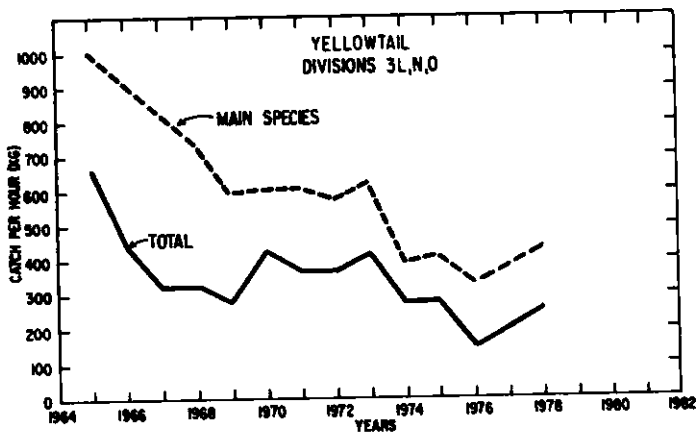Fig. 3. Average number and weight per set of Yellowtail from stratified random surveys in Divisions 3LN.

Fig. 4. Catch per unit effort of Yellowtail by Canada (N) commercial otter trawlers.

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