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Assessment of Yellowtail Flounder in ICNAF Divisions 3L and 3N

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Introduction

The yellowtail flounder fishery on the Grand Bank has increased from practically nil in 1966 to nearly 26 thousand tons in 1970. There is evidence that this species has increased in abundance in this area since 1962 (Pitt, 1970). Some estimates of the total mortality were presented at the 1971 ICNAF Annual Meeting. These were based on annual catch curves, but because the stock was probably increasing in abundance it was felt that the mortality rates were probably overestimated. With the inclusion of the 1970 data some mortality estimates from a limited number of year-classes are available. Thus, the best available information has been used to give an indication of the status of this stock.

Materials and methods

In calculating the total number landed (Table 2) the USSR 1970 breakdown of unspecified flounder (Res. Doc. 71/26) was used to determine the nominal catch of yellowtail flounder for countries other than Canada (Table 1). No adjustments for discards were made; however, judging from a comparison with research age frequencies the 4-year-olds only would be affected to any great degree. Ageing of yellowtail flounder was by otoliths from random and stratified samples taken from landings at fish plants.

American plaice and yellowtail flounder are both fished on the shallow part of the Grand Bank (< 90 m) with the fishery for plaice extending beyond the 50-fath (90-m) contour, which for all practical purposes is the lower depth limit for yellowtail flounder. The calculation of fishing effort was based on the nominal catch per unit effort of yellowtail flounder by Canada (N) stern trawlers (501-900 tons). In calculating the catch per hour, all tows with recorded depths less than 50 fath (90 m) containing yellowtail flounder in sufficient numbers to be recorded on the log of the commercial vessel were used. In addition to this the catch per hour where yellowtail accounted for more than 50% of the catch was also calculated (Fig. 1).

It seems highly likely that Grand Bank yellowtail flounder belong to one stock and nearly all of the landings were reported from Divisions 3L and 3N. In the case of American plaice there are major differences in the size at age between 3L and 3N, however, for yellowtail flounder the growth curves are practically identical (Fig. 2). As yet no tagging data are available to indicate seasonal migrations, but spring and fall research vessel catches

suggest a possible southern movement of yellowtail flounder from the area north of 46°N (3L) in the autumn. Thus on the basis of present knowledge it must be assumed that there is a single Grand Bank stock of yellowtail.

Although the males usually spawn about one year earlier and grow at a slightly lower rate than the females the differences were not considered to be great enough to warrant treatment of the sexes separately.

Yield curves (Fig. 3) were calculated using FAO tables (Beverton and Holt, 1966). The parameters necessary to produce the curves were as follows:

l_c = 34.20 cm (50% selection point)
K = 0.241
L_∞ = 52.08 cm

Curves for three values of M were plotted, M = 0.20, 0.30 and 0.40.

From an examination of catch data and the survival ratios (Tables 3-4) yellowtail flounder were considered to be fully recruited at age 7 (about 40 cm). This is about the same size as reported by Lux (1969) for New England yellowtail flounder but at a younger age (age 4).

Results and discussion

The estimation of total mortality from survival ratios based on the number of yellowtail flounder caught per unit effort (Table 3) gave high values for Z with mean values of Z for 1965 to 1970 at 1.52 and 1.77 (Table 4). Estimates of Z from the catch curves of 1958 to 1961 year-classes (Fig. 4) for ages 7 and over also gave high values of Z, ranging from 1.21 to 1.89 with a mean value for the four year-classes of 1.51.

Unfortunately no estimates of natural mortality are available for Grand Bank yellowtail flounder. Lux (1969) suggested a natural mortality rate for New England yellowtail flounder of about 20% (M = 0.22). It was previously shown (Pitt, 1971) that research vessel catch curves from 3N, 1951-52, gave a Z of 0.77. However, it was pointed out that the population of yellowtail flounder was apparently at a low level and the large haddock fishery probably removed quantities of yellowtail flounder that were not recorded; hence a possible reason for the apparent high total mortality.

If a natural mortality rate of 0.20 is accepted the apparent fishing mortality rate would in recent years would be somewhat in the vicinity of 1.3 to 1.5. This would appear to be an extremely high fishing mortality rate. However, there has been a rapid increase in the total fishing effort for yellowtail flounder (Table 3) from 4,472 hours in 1965 to 54,275 in 1970. In addition to the recorded landings of plaice, quantities may have been removed and not reported by vessels fishing cod for salting.

With the uncertainty about the value of M it seemed appropriate to present three yield curves (Fig. 3) using M = 0.20, 0.30 and 0.40.

(a) M = 0.20. The optimal value of F occurs at about 0.30 which is approximately 90% of the maximum yield. The maximum sustainable yield occurs at F = 0.80 hence if the estimated value of F for recent years (1.30 to 1.50) is realistic, the fishing is well beyond the maximum.

(b) M = 0.30. The optimal F = 0.45 (approximately) at about 85% of the maximum and if F is 1.20 to 1.40 the fishing is very close to the maximum (99%).

(c) M = 0.40. The optimal F = 0.65 and the present level of fishing (1.1 to 1.3) would be about 90% of the maximum.

The catch per unit effort (Fig. 1) indicates that with the total catch and effort of yellowtail flounder the catch per hour has remained relatively stable since 1967. The "main species" catch per unit effort on the other hand shows a gradual decline from 1965 to 1969 and a stabilization in the last three years.

Division 3N was the only area from which substantial landings were reported for 1965 to 1967, but for 1968 to the present year, 3L has also been an important source (Table 1). Research data indicate that yellowtail flounder apparently only spread into 3L during the 1966-68 period (Pitt, 1970). Whether the recent increase in abundance of the species will continue is not known at present. So far research cruises have not been able to give good indications of recruitment with relatively small numbers of 3-year-olds and no 2-year-olds being recorded in the past 5 or 6 years at least. Both the research and commercial age composition data have indicated a progression of year-classes of roughly equal strength.

It would appear that the yellowtail flounder stock is being exploited at too high a level, although the catch per hour has stabilized in the past year or two in spite of increased effort. This may be the result of expanding stock at least up to now. Some control of fishing effort on this stock is desirable and the data suggest that a reduction may be necessary. When the complete 1971 and 1972 landings are available a better indication of the appropriate level might be forthcoming. However, even if the degree of reduction cannot be determined at present it would appear prudent to at least hold to the 1970 level of 25 thousand tons which could be split between 3L and 3N if necessary in the proportion of the landings from these divisions in the past 3 years.

References

Beverton, R.J.H. and S. J. Holt. 1966. Manual of method for fish stock assessment. Pt. II. Tables of yield functions. FAO Fisheries Technical Paper No. 38,

Lux, F. E. 1969. Landings per unit of effort, age composition, and total mortality of yellowtail flounder, *Limanda ferruginea* (Storer), off New England. Int. Comm. Northwest Atl. Fish. Res. Bull. 6: 47-52.

Pitt, T. K. 1970. Distribution, abundance and spawning of yellowtail flounder, *Limanda ferruginea*, in the Newfoundland area of the northwest Atlantic. J. Fish. Res. Bd. Canada 27: 2261-2271.

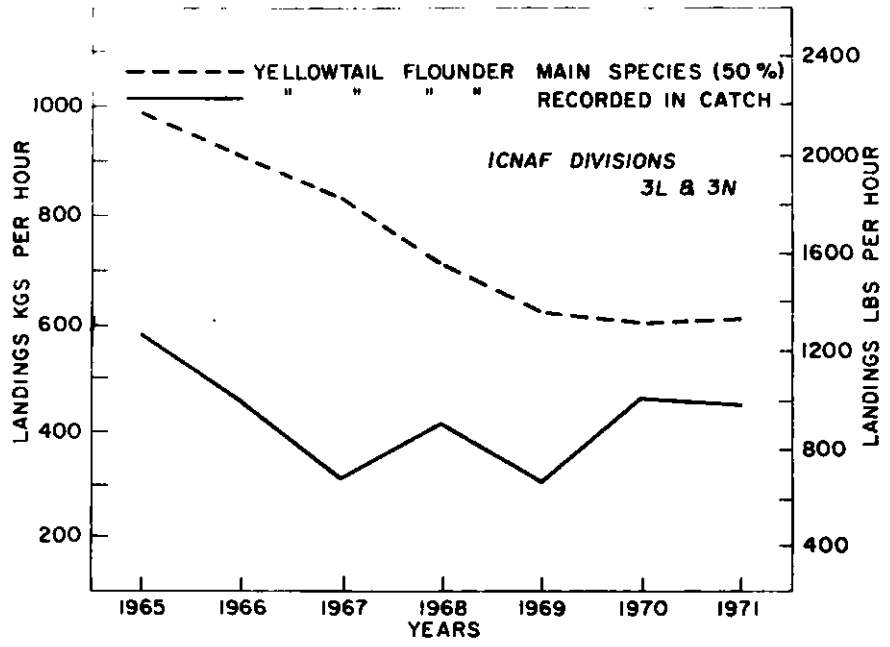

Fig. 1. Catch per hour of yellowtail flounder by Canada (N) stern trawlers. Broken lines, main species (50%) and solid line some yellowtail flounder recorded in catch.

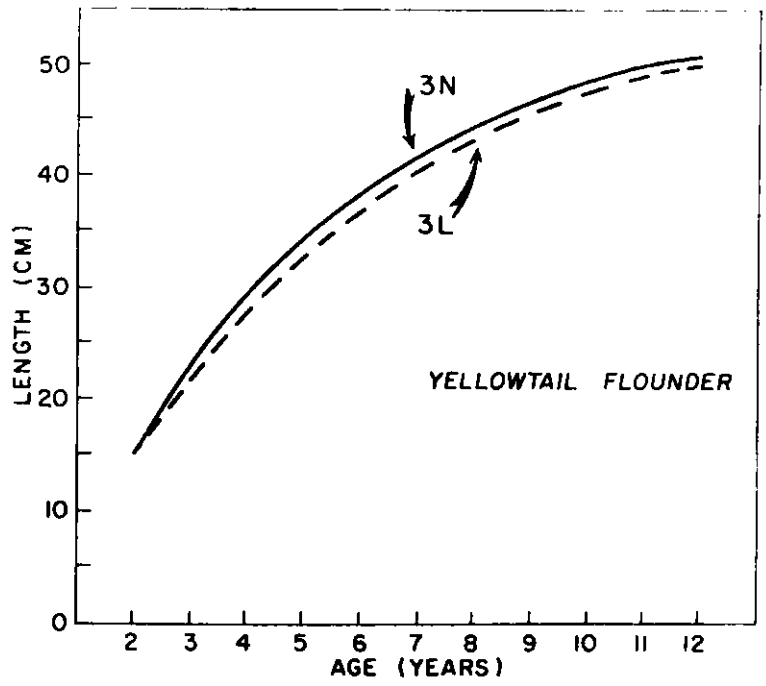

Fig. 2. Growth curves of yellowtail flounder from Divisions 3L and 3N.

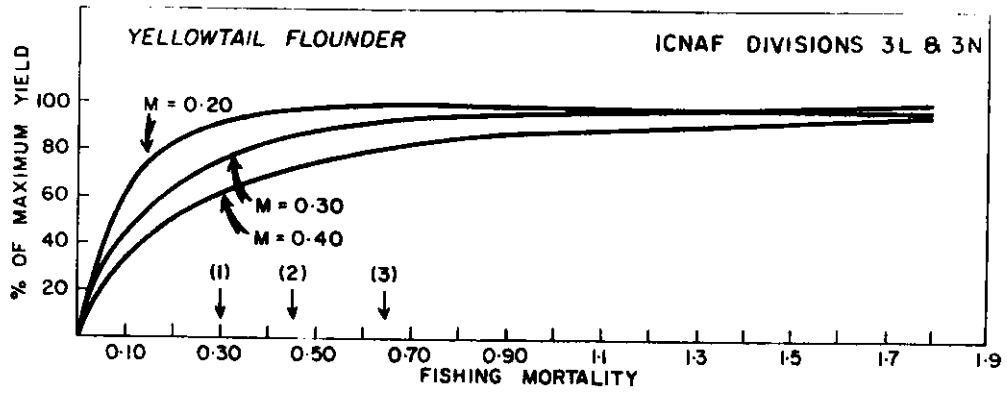

Fig. 3. Yield curves for yellowtail flounder for three levels of natural mortality. Arrows at base indicate "optimal fish level" for (1) M = 0.20, (2) M = 0.30 and (3) M = 0.40.

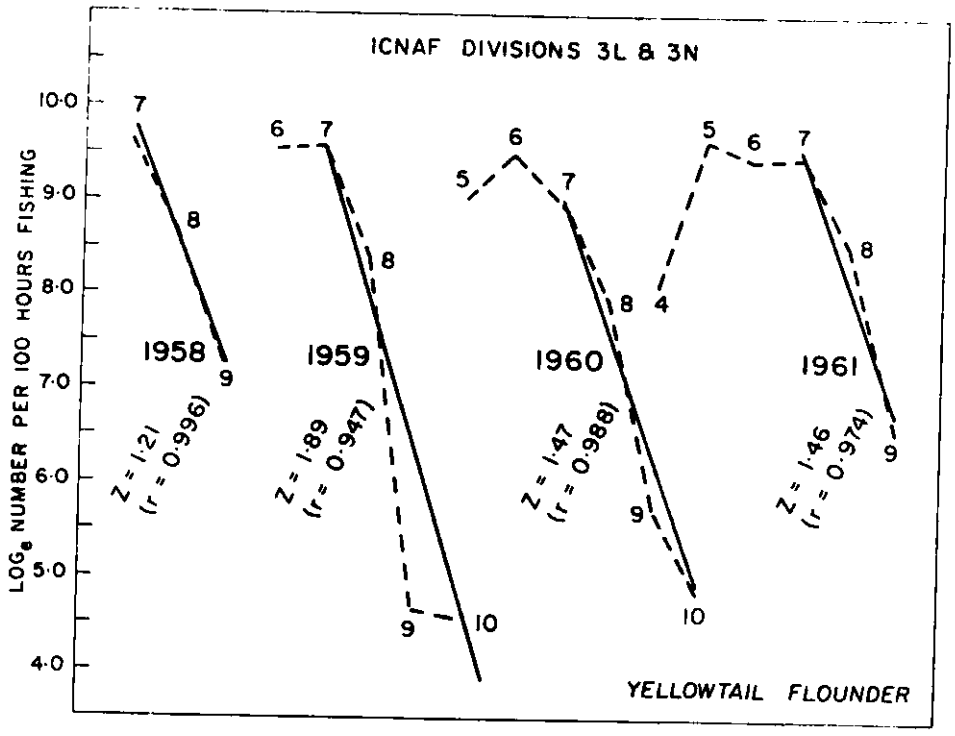

Fig. 4. Catch curves of 4 year-classes of yellowtail flounder with estimates of total mortality (Z).

Table 1. Nominal catches of yellowtail flounder in ICNAF Divisions 3L and 3N (metric tons). "Other" landings based on USSR 1970 breakdown of unspecified flounder.

Year	Country	Division 3L	Division 3N	Total
1965	Canada (M)	115	951	1,066
	Canada (N)		2,001	2,001
	Other		19	19
	TOTAL	115	2,971	3,086
1966	Canada (M)	57	1,737	1,794
	Canada (N)	5	1,948	1,953
	Other		2,035	2,035
	TOTAL	62	5,720	5,782
1967	Canada (M)	118	429	547
	Canada (N)	334	1,081	1,415
	Other		3,451	3,451
	TOTAL	452	4,961	5,413
1968	Canada (M)	632	149	781
	Canada (N)	2,164	1,081	3,245
	France (S.P.)	3	5	8
	Other	60	5,138	5,198
	TOTAL	2,859	6,373	9,232
1969	Canada (M)	3,217	1,048	4,665
	Canada (N)	2,033	3,840	5,873
	Other	19	1,867	1,886
	TOTAL	5,269	6,755	12,424
1970	Canada (M)	718	2,069	2,787
	Canada (N)	6,657	13,003	19,660
	Other	16	3,426	3,442
	TOTAL	7,391	18,498	25,889
1971	Canada (N)	5,741	13,851	19,592

Table 2. Number of yellowtail flounder caught, ICNAF Divisions 3L and 3N ($\times 10^{-3}$).

Age \ Year	1965	1966	1967	1968	1969	1970
4	172	559	385	351	300	105
5	524	3,341	3,097	3,854	789	2,537
6	1,006	2,711	3,041	7,755	7,252	17,850
7	1,201	3,128	1,662	5,670	8,949	18,817
8	1,064	922	769	873	2,708	4,221
9	766	110	227	30	126	398
10	247	116	85		37	67
11	60		28			
12	24					

Table 3. Number of yellowtail flounder caught per 100 hours' fishing with total fishing effort shown at the bottom

Age \ Year	1965	1966	1967	1968	1969	1970
4	3,846	4,454	2,564	1,274	763	193
5	11,717	26,631	20,622	13,988	2,007	4,674
6	22,495	21,603	20,249	28,146	18,450	32,888
7	26,792	24,926	11,067	20,579	22,767	34,670
8	23,792	7,347	5,120	3,168	6,889	7,777
9	17,128	876	1,511	109	320	733
10	5,523	924	566		94	123
11	1,314		186			
12	536					
Total effort (hours)	4,472	12,549	15,018	27,553	39,307	54,275

Table 4. A. Survival ratios of yellowtail flounder based on catch per 100 hours (Table 3) for 1965-70.
B. Survival ratios for Σ 7-9/Σ 8-10.

"A" Age	Years 1965-66	1966-67	1967-68	1968-69	1969-70	
4-5	6.924	4.630	5.456	1.575	6.126	
5-6	1.844	0.760	1.365	1.319	16.387	
6-7	1.108	0.512	1.016	0.809	1.879	
7-8	0.273	0.205	0.286	0.335	0.342	
8-9	0.037	0.206	0.022	0.101	0.106	
9-10	0.054	0.646	-	0.862	0.384	
G.M. 7/8 to 9/10	0.082	0.301	0.079	0.307	0.240	
Z	2.50	1.20	2.53	1.18	1.43	Mean = 1.77
"B" S =	0.135	0.217	0.185	0.306	0.288	
Z =	2.00	1.53	1.69	1.18	1.25	Mean = 1.52