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On the Effect of Mesh Size Increase in the Trawl Codend on Silver Hake Fishing Mortality Rate in Divisions 4VWX

by

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Abstract

Fishing mortality values ($F_{opt.}$) was chosen as the index of optimum fishing intensity. The method for the calculation of the latter is described. The variation of the given index with the increase of the mesh size in the trawl cod ends is discussed. The data obtained indicate that great losses in the catches resulting from the mesh size increase to 90 mm cannot be compensated for.

Introduction

In April, 1979, during the meeting of the ICNAF Subcommittee on Assessment, the problem of the mesh size increase from 60 mm to 90 mm when introducing the directed silver hake fishery in the Nova Scotian Shelf area was discussed. Because of lack of information the participants could not give any specific recommendation, limiting themselves to the enumeration of some possible consequences of the mesh size increase, one of which may be an increase in the fishing effort corresponding to the level $F_{0.1}$ (ICNAF Redbook, 1979, STACRES Proceedings). In this paper an attempt is made to reveal a correlation between the mesh size and the fishing intensity rate(fishing mortality) for the silver hake from Divisions 4V,W,X which, in our opinion, can be useful in estimation of possible consequences of such a measure as the mesh size increase.

Material and Methods

The data on the instantaneous natural mortality rate (M), the parameters for the growth equation of Bertalanfy (K and L_∞) and the selectivity factor for silver hake from the Nova Scotian shelf were used in calculations. The value of M=0.4 (Terré, Mari, 1977) was used to compare the results with the Subcommittee estimates, although, according to Noskov (1976), the actual natural mortality rate for silver hake was probably higher (within the range of 0.5-0.8). The accepted values of the parameters L_∞ and K were 52.67 cm and 0.23 cm (Halliday, 1973). The selectivity factor obtained as a result of the joint investigations in 1977 was 4.0 (Gley, 1978). Yield per recruitment ($\frac{Yw}{R}$) at different values of the instantaneous fishing mortality (F) and at different mesh sizes, as well as the catches per unit effort, were determined from the tables of Beverton and Holt (1966). Fish length at 50% retention was taken as the mean recruitment length (l_c). The data on the yields per recruitment given in the Table 1 were used as basic ones for subsequent calculations.

The level of the optimal fishing intensity (fishing mortality rate) was calculated as follows. The Baranov's idea (1960) that the optimal exploitation level ($F_{opt.}$) can be estimated from the dependence of the fishing intensity rate, which is proportionate to operational expenses, on the catches was applied.

This idea in a somewhat modified form was used by Rikhter (1970) who suggested that the red hake catches increase with increasing operational expenses. This modification is used in the present paper, where, to estimate the increase of operational expenses, the values of the instantaneous fishing mortality rate have been converted to the indices of annual losses due to fishing (%).

Results

The increase of operational expenses and increased catches at varying mesh sizes and fishing mortality rates are shown in Table 2.

As is evident from the table, a difference between the increase of operational expenses and increased catches at the same values of F reduces with increasing mesh sizes, and the point of abrupt retardation in the increase of catches shifts more and more to the right side. According to Baranov (1960), the values of F taken as the levels of the optimal fishing intensity ($F_{opt.}$) were such that their overstatement by a unit would result in an increase of the cumulative growth rate of the catches no more than by 1%. The figures which correspond to the unknown values of F are underlined.

The estimated values of $F_{opt.}$ are given in Table 3.

From the data it appears that in contrast to the concept of eumetric catch (Beverton and Holt, 1957), when the catch curve never attains the maximum, a peak is observed here which can be determined by the only possible combination of values, that is, by the mesh size and corresponding value of $F_{opt.}$.

Discussion

Let us suppose that the mesh size in the silver hake fishery is increased to 90 mm. Then, with the selectivity factor of 4.0 the length of the fish at 50% retention will be 36 cm.

Silver hake of 36 cm or more in length is likely to be very scanty. So, over the entire observation period including the first year of fishing, the catches of large fish of 36 cm or more were extremely small (Noskov, 1976). The abundance of large-sized silver hake is evidently controlled by the natural mortality.

Taking into account low abundance and possible significant increase of the natural mortality rate on older age groups one can hardly anticipate that the yield per recruitment will increase due to the growth of biomass of large individuals if the mesh size of 90 mm is used. The data from Table 3 indicate that in comparison with the fishery where the mesh size of 60 mm is used the fishing effort should be doubled and the catch per unit effort decreased, which will probably result in an unprofitable fishery. The only feasible conditions that can provide a certain increase of catch per recruitment are the introduction of the 70 mm mesh size and the increase of the fishing effort by 33%. Under these conditions, the catch per unit effort will decrease by 20%.

Conclusions

1. The optimal fishing intensity level increases or decreases with increasing or decreasing mesh sizes in the trawl codends.

2. The increase of the mesh size to 90 mm means that the silver hake fishery will practically come to an end, since no compensation can be achieved by a corresponding increase of the fishing effort in this case.

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Table 1. Catch per recruitment ($\frac{Vw}{R}$) at different values of fishing mortality (F) and different mesh size (mm).

F	Mesh size					
	40	50	60	70	80	90
0.1	0.019510	0.019533	0.018969	0.017652	0.016104	0.013284
0.2	0.027200	0.028122	0.027980	0.026781	0.024823	0.020853
0.3	0.030475	0.032490	0.033314	0.032467	0.030519	0.026052
0.4	0.031453	0.034408	0.036041	0.035742	0.033967	0.029352
0.5	0.031429	0.035134	0.037450	0.037665	0.036107	0.031505
0.6	0.030871	0.035369	0.038439	0.039257	0.037989	0.033492
0.7	0.030026	0.035177	0.038898	0.040263	0.039282	0.034943
0.8	0.029211	0.034853	0.039079	0.040884	0.040144	0.035960
0.9	0.028608	0.034577	0.039145	0.041253	0.040683	0.036614
1.0	0.027927	0.034219	0.039132	0.041556	0.041168	0.037231
1.1	0.027168	0.033781	0.039041	0.041792	0.041598	0.037812
1.2	0.026410	0.033336	0.038951	0.042028	0.042028	0.038393
1.3	0.025968	0.033001	0.038831	0.042080	0.042188	0.038646
1.4	0.025084	0.032332	0.038592	0.042186	0.042510	0.039152
1.5	0.246420	0.032151	0.038473	0.042239	0.042671	0.039405

Table 2. Cumulative rates of increase of operational expenses and silver hake catches (%%) at varying fishing mortality (F) and mesh size (mm).

Mesh size		F												
		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3
	Rate of increase of operational expenses		91	134	161	180	194	206	216	224	230	236	241	245
40	Rate of catch increase		39	51	54									
50	- " -		44	60	66	68	69							
60	- " -		48	67	75	79	82	83						
70	- " -		52	73	83	88	92	95	97	98				
80	- " -		54	77	88	94	99	102	104	105				
90	- " -		57	82	95	102	108	112	115	117	119	121	123	124

Table 3. **Estimates of optimum fishing intensity levels ($F_{opt.}$), at $\frac{Vw}{R}$ values and catches per unit effort at different mesh size (mm)**

Mesh size	F_{max}	$F_{opt.}$	$\frac{Vw}{R}$ at $F_{opt.}$	Catch per unit effort at $F_{opt.}$
40	0.40	0.40	0.0314	0.0314
50	0.60	0.50	0.0351	0.0280
60	0.90	0.60	0.0384	0.0256
70	1.60	0.80	0.0409	0.0204
80	7.60	0.80	0.0394	0.0197
90	∞	1.20	0.0384	0.0128