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Estimation of the yield per recruit with 60 and 90 mm mesh codends in the Divisions 4VWX silver hake fishery

by

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Introduction

Joint mesh selection studies were carried out on the Scotian Shelf silver hake (Merluccius bilinearis) fishery in 1977 (Clay, 1978 and 1979a). Unfortunately these studies were not conclusive and as a result ICNAF recommended a large scale commercial comparison of 90 mm and 60 mm codend trawls for 1980 fishery (ICNAF, 1979). Preliminary to this commercial experiment a theoretical investigation of the YPR has been carried out.

Methods

Two separate models are compared for their YPR estimates using the parameters of silver hake from the Scotian Shelf. The first model is that of Beverton and Holt (1957) and uses the Table of Yield Functions (Beverton and Holt, 1966) to provide the YPR using the parameters L_∞ and k of the von Bertlanaffy growth equation, M as used in previous assessments (0.4), mean selection length l_c, and E the rate of exploitation (F/Z). The second model, the Thompson and Bell YPR (Ricker, 1975) requires the parameters M (as above), the weight-at-age, the normalized partial recruitments. This later model was fitted by the computer program YIELD (Rivard and Doubleday, 1979).

Results and Discussion

Clay (1979b) showed the variation in experimental mesh selection studies to be very great. So great in fact, that for most species it was very important to utilize all available data and create a "commercial average" selectivity. This was done for silver hake and gives the following equation relating the mean (or modal) size of fish retained to the codend mesh size:-

$$TL = 4.04M - 26.12; \ (r^2 = .77, \ n = 58)$$

From this equation the L_c parameters required for the approximation to the Beverton and Holt YPR model can be calculated.

The parameters for the Beverton and Holt YPR are:-

$L_\infty = 60.58$ cm ($n = 698$; $r^2 = 0.78$)
$K = 0.1688$
$T_o = -1.22$
$M = 0.4$

Case 1 L_c = 24 cm for a 60 mm codend assuming a selection factor of 4
Case 2 L_c = 36 cm for a 90 mm codend assuming a selection factor of 4
Case 3 L_c = 21.6 cm for a 60 mm codend using data of Clay (1979b)
Case 4 L_c = 33.7 cm for a 90 mm codend using data of Clay (1979b)

From these parameters the following values were calculated to enable the YPR to be looked up in the appropriate tables.

Case/Parameters	M/K	c[1]	E
1	2.37[2]	0.40	F/F+0.4
2	2.37	0.59	F/F+0.4
3	2.37	0.36	F/F+0.4
4	2.37	0.56	F/F+0.4

1 $c = L_c/L_\infty$

2 Although M/K = 2.37 a value of 2.50 was used to correspond to available tables.

The data (YPR) for the above values show close similiarity for cases 1 and 3, the 60 mm net, and for cases 2 and 4, the 90 mm net (Table 1). These values show (looking at an F of 0.6) the importance of the 50% point of the mesh sizes - the difference in YPR when using a selection factor of 4 is approximately -12%, while using the general selection factor the difference is only -3%.

These two mesh sizes are not fully comparable for the yield tables give the yield per recruit entering the fishery at the 50% selection length, as these lengths change so the time of estimating recruitment changes.

Using the Thompson and Bell (Ricker, 1975) YPR model and the data (Table 2) available from the most recent assessments (Noskov, 1980; and Clay, 1980) YPR estimates were run over the same range of F values as previously (Table 3). The values (partial recruitments) for 90 mm had to be estimated using the relationship:-

PARTIAL RECRUITMENT = SELECTIVITY X AVAILABILITY

The selectivity at age were taken from Clay (1979a). The YPR in this case shows a greater drop with the input data taken from Clay (1980) than from Noskov (1980). It does however indicate (from data currently available) that the drop in YPR would be about 10%.

Such variation in possible answers indicates our present knowledge (based on research studies) is not precise enough to allow predictions of future affects. In order to obtain the necessary data a large scale commercial experiment - as recommended by ICNAF in 1979 is necessary.

References

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Table 1. The YPR (kg) for the four cases explained in the text. Values from the YPR tables of Beverton & Holt (1966).

F	Mesh	60 mm		90 mm	
	Case	1	3	2	4
0.1		0.0103	0.0106	0.0073	0.0080
0.2		0.0149	0.0150	0.0110	0.0121
0.3		0.0175	0.0175	0.0136	0.0150
0.4		0.0190	0.0187	0.0157	0.0168
0.5		0.0197	0.0191	0.0169	0.0179
0.6		0.0202	0.0194	0.0177	0.0188
0.7		0.0204	0.0194	0.0185	0.0194
0.8		0.0204	0.0193	0.0188	0.0201
0.9		0.0205	0.0193	0.0193	0.0203
1.0		0.0204	0.0193	0.0195	0.0205
1.1		0.0204	0.0191	0.0198	0.0207
1.2		0.0204	0.0189	0.0201	0.0210
1.3		0.0203	0.0188	0.0202	0.0211
1.4		0.0202	0.0185	0.0205	0.0213
1.5		0.0201	0.0184	0.0206	0.0215

Table 2. The parameters used in the Thompson and Bell YPR model.

AGE	Clay (1980) Weights (kg)	Clay (1980) NPR*	Noskov (1980) Weights (kg)	Noskov (1980) NPR*	Clay (1980) 90 mm NPR	Noskov (1980) 90 mm NPR
1	0.050	0.035	-	-	0.030	-
2	0.135	0.500	0.095	0.013	0.349	0.010
3	0.200	1.000	0.151	0.133	0.680	0.090
4	0.245	0.700	0.214	0.200	0.468	0.133
5	0.285	0.600	0.319	0.333	0.427	0.230
6	0.344	0.600	0.478	1.000	0.509	0.840
7	0.411	0.550	0.590	1.000	0.498	1.000
8	0.520	0.500	-	-	0.498	-
9	0.553	0.450	-	-	0.449	-
10	1.189	0.400	-	-	0.399	-

* Normalized partial recruitment of 60 mm fishery.

Table 3. The YPR (kg) for 4 options of input parameters (see text) with the Thompson and Bell YPR model.

F	Mesh 60 mm		Mesh 90 mm	
	Clay (1980)	Noskov (1980)	Clay (1980)	Noskov (1980)
0.1	0.021	0.018	0.016	0.015
0.2	0.036	0.031	0.028	0.028
0.3	0.046	0.042	0.038	0.038
0.4	0.053	0.051	0.045	0.046
0.5	0.058	0.057	0.050	0.052
0.6	0.062	0.062	0.054	0.058
0.7	0.065	0.066	0.058	0.062
0.8	0.067	0.070	0.060	0.066
0.9	0.068	0.072	0.062	0.068
1.0	0.070	0.074	0.064	0.071
1.1	0.071	0.076	0.054	0.073
1.2	0.072	0.077	0.067	0.074
1.3	0.072	0.078	0.068	0.076
1.4	0.073	0.079	0.069	0.077
1.5	0.074	0.080	0.070	0.078