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Effects of Changes in Mesh Size upon Yield Per Recruit of Cod in Division 3M

by

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INTRODUCTION

Estimates are available of the percentage retention-at-age of cod from the Flemish Cap as well as yield per recruit curves for a variety of mesh sizes of manila codends. Values of yield per recruit at the $F_{0.1}$ and F_{MAX} levels are given here.

MATERIALS AND RESULTS

SELECTION FACTORS

Holden (1971) reviewed the literature and with respect to cod summarized the experiments dealing with selection factors as in Table 1. The selection factor for double manila was about 3.47. From selection ogives for cod in Hodder (1964), the lengths at which 50% of cod were retained in double manila codends of various mesh sizes were derived and used to estimate selection factors (Table 2). The overall mean selection factor was 3.49, in excellent agreement with Holden (1971).

YIELD PER RECRUIT

The percent retention-at-age of cod from the Flemish Cap was derived by Wells (1979) from material presented in Hodder (1964). Average weights were calculated by the application of a length-weight relationship to the average length-at-age of cod taken in research vessel cruises in 1977-79.

Assuming a constant number of 1-year-old cod and that cod are available from age 1-19 years, yield per recruit increases at both the $F_{0.1}$ and F_{MAX} values as the mesh size increases up to 6 inches (Table 3).

If it is assumed that only cod of age 4 and older are retained and younger cod are discarded, discards for mesh sizes less than 5 inches are substantial.

EQUIVALENTS

It is clear from Table 1 that codends of the same mesh size but of different materials may have different selection factors. Holden (1971) further reports that, because the range of values for the percentage elongation of polyamide at the half knot breaking load was quite wide (Table 4), mean selection factors were calculated separately for those experiments in which the polyamide used had an elongation greater than 25% and for those in which it had an elongation equal to or less than this value termed polyamide A and polyamide B respectively. The mean selection factors for cod based on this division were 4.07 for polyamide A and 3.63 for polyamide B.

The equivalent values for the various materials as derived in Holden (1971) for cod were as follows:

Material	Selection factor	Equivalent
manila	3.47	1.00
polamide	3.96	1.14
polyamide A	4.07	1.17
polyamide B	3.63	1.05
polyethylene	3.41	0.98
polyester	3.95	1.14
polypropylene	3.67	1.06

An indication of the variation about the mean selection factors is given in Fig. 1 which is a copy of page 43 of Holden (1971). It would seem that the selection factors of synthetic materials are not necessarily different from that of manila.

CONCLUSIONS

At present growth rates of cod on the Flemish Cap, increases in yield per recruit are indicated with mesh sizes up to 6 inches (152 mm) with codends of manila. The mesh size equivalent to 6 inch manila in polyamide and polyester may be about 5¼ inches although the variation about the mean estimates of selection factors is very wide.

REFERENCES

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Holden, M. J. [ed.] 1971. Report of the ICES/ICNAF Working Group on Selectivity Analysis. ICES Cooperative Research Report, Series A, No. 25.

Wells, R. 1979(a). Observations of the distribution, abundance, growth, mortality, and sex and maturity of cod from the Flemish Cap. ICNAF Res. Doc. 79/VI/63, Ser. No. 5404, 20 p.

1979(b). Effects of changes in codend mesh size on cod catches in the Flemish Cap area. ICNAF Res. Doc. 79/VI/122, Ser. No. 5490, 6 p.

Table 1. Frequency distributions of selection factors of otter trawls of different material with respect to cod (from table 12 of Holden, 1971).

	Number of experiments				
Selection factor	M	PA	PES	PE	PP
2.7					
2.8	3				
2.9	3				
3.0	2				
3.1	2				
3.2	2			1	3
3.3	4			1	5
3.4	15	1		2	0
3.5	7	5		1	4
3.6	7	2		0	1
3.7	6	3		0	1
3.8	8	4		1	1
3.9	0	2	1		0
4.0	5	5	1		3
4.1	3	2			3
4.2	0	4			4
4.3	2	2			1
4.4		3			1
Total	69	33	2	6	27
Mean 1	3.52	3.92	3.95	3.43	3.74
Mean 2	3.48	4.00	3.95	3.42	3.70
Mean 3	3.45	4.02	3.95	3.37	3.60
Mean 4	3.42	3.89	3.95	3.41	3.63
Grand Mean	3.47	3.96	3.95	3.41	3.67

Mean 1 = unweighted mean
Mean 2 = mean weighted by number of hauls
Mean 3 = mean weighted - 3 component method
Mean 4 = mean weighted by inverse of variance
Grand Mean = mean of means 1 to 4

M = double manila
PA = double polyamide
PES = double polyester
PE = double polyethylene
PP = double polypropylene

Table 2. Selection factors of cod for double manila codends of various mesh sizes in the codend (derived from Hodder (1964)).

Mesh Size		50% retention	
In.	MM	length(MM)	Selection factor
3	76.2	261.3	3.43
4	101.6	363.1	3.57
4 1/2	114.3	400.0	3.50
5	127.0	439.4	3.46
5 1/2	139.7	490.0	3.51
6	152.4	531.3	3.49
		Mean	3.49

Table 3. Yield per one-year old recruit at two levels of fishing mortality for each of various codend mesh sizes

Mesh Size Inches	Mesh Size MM	$F_{0.1}$	Yield per recruit Ages 1-19 Number	Yield per recruit Ages 1-19 Weight	Yield per recruit Ages 4-19 Number	Yield per recruit Ages 4-19 Weight	Discards (%) Number	Discards (%) Weight
3	76	0.112	0.244	0.681	0.174	0.664	29	2
4	102	0.126	0.227	0.749	0.197	0.740	13	1
4 1/2	114	0.133	0.220	0.778	0.203	0.773	8	1
5	127	0.141	0.213	0.811	0.205	0.809	4	+
5 1/2	140	0.152	0.204	0.852	0.202	0.851	1	+
6	152	0.161	0.196	0.884	0.195	0.884	1	+
		F MAX	Ages 1-19 Number	Ages 1-19 Weight	Ages 4-19 Number	Ages 4-19 Weight		
3	76	0.163	0.307	0.712	0.207	0.687	33	4
4	102	0.191	0.289	0.788	0.244	0.774	16	2
4 1/2	114	0.206	0.282	0.821	0.256	0.813	9	1
5	127	0.224	0.275	0.858	0.263	0.854	4	+
5 1/2	140	0.252	0.265	0.906	0.262	0.905	1	+
6	152	0.277	0.258	0.944	0.256	0.943	1	+

Table 4. The range, for each material considered, of the percentage elongation at the load of the half knot breaking load. (Table 11 of Holden, 1971.)

Material	Percentage elongation
Double manila	6.5 - 7.8
Double polyamide	15.5 - 47.0
Double polyester	8.3 - 12.3
Double polyethylene	8.4 - 22.2
Double polypropylene	10.4 - 21.3

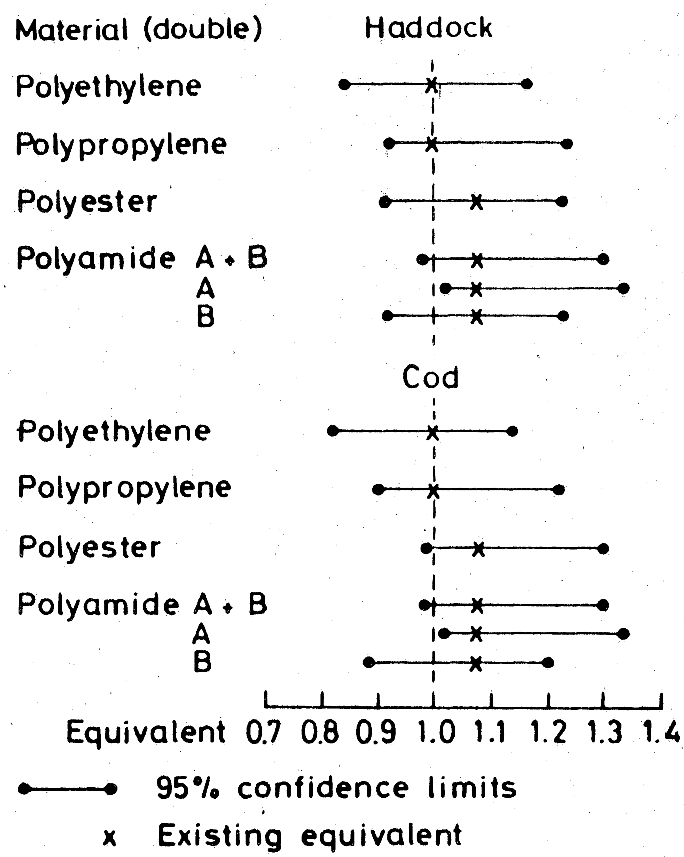

Fig. 1. 95% confidence limits of calculated equivalents and position of equivalents currently in force for trawls in NEAFC Region 1, excluding ICES Division Vb, and NAFO Subareas 1, 2 and 3 (results for four or more sets of data only). N.B. The distinction made between Polyamide A and Polyamide B is that made by the Working Groups and it is NOT recognized in the current mesh regulations.