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Effects of Changes in Codend Mesh Size Upon Yield Per Recruit of Redfish in Division 3M

by

W. D. McKone
Department of Fisheries and Oceans
Research and Resource Services
P.O. Box 5667
St. John's, Newfoundland
A1C 5X1

INTRODUCTION

The relationship between the physical properties of fishing gear and the catch composition has been studied by biologists for many years. By far the most common experiment has been concerned with factors that affect the size of fish caught, since optimum yields for a fish species are usually defined by the appropriate sizes from the stock that should be harvested. Long-term yields can theoretically be shown to change appreciably with a slight change in mesh size. Whether these changes can be demonstrated empirically during the fishery are yet to be proven. The major emphasis on selectivity of redfish by codend was during the 1960's. A number of experiments were carried out both in the ICES and ICNAF convention areas and a cooperative review of this work was assembled by Holden (1971). This paper attempts to bring together historic findings on codend mesh selectivity of redfish with current yield per recruit curves for various codend mesh sizes as applied to 3M redfish.

METHODS AND RESULTS

YIELD PER RECRUIT

Mesh regulations currently in place restrict fishing by otter trawls on Flemish Cap to the use of a mesh size no less than 130 mm (5 1/8") manila ~~codend~~. As no selection ogives are available for 130 mm mesh this study assumes that an ogive based on 126 mm mesh (Hodder 1962) will be acceptable to demonstrate the magnitude of gains or losses.

The long-term loss or gain as a result of changing the codend mesh size was derived by McKone (1979) from selection ogives presented in Hodder (1962). Yield per recruit for 101, 114, and 126 mm mesh codend are again presented in this paper based on ages 1 to 29 years old for three levels of natural mortality (Fig. 1-3). Yield per recruit at F increases marginally with increasing mesh size up to 114 mm but decreases at larger mesh sizes (Table 1). Thus, it would appear that the optimum mesh size for redfish would be approximately 114 mm, although the differences in Y/R between 101 and 126 mm are so small as to be meaningless in practical terms.

SELECTION FACTORS

Selection factors for redfish were derived from Hodder (1962) (Table 2) and from Holden (1971) (Table 3) who reviewed the literature and summarized the available data. The method of evaluating mean selection factors in Table 3 is outlined in Holden (1971). Further, Holden did not use all the available data on redfish selection as a great deal of the information varied in accuracy and the 50% retention points vary widely.

EQUIVALENTS

Holden (1971) omitted calculating equivalents for redfish because "selection factors are heavily dependent upon catch size" and redfish are known to be gregarious. For evaluation the equivalent has been calculated between manila and polyamide and presented (Table 3).

CONCLUSIONS

Selectivities and the calculated selectivity equivalents are subject to variation from biological causes, fishery conditions, net construction and the way the net is used, and to features of the twines including their basic chemical nature. Some selective influences may remain relatively constant while others fluctuate markedly in space and time. Patterns of behaviour and distribution of redfish as well as fleets change seasonally and these changes vary from year to year. Changes in the duration of the tow indicate escapement increases with an increase in the tow length. Further, for a given length of tow, lower escapement is associated with larger catches. The speed and direction of the tow relative to currents probably influence the catches and size selectivity as do other actions followed by fishermen.

There is a considerable amount of information on different materials, however, there is little on differences within a material type. This is particularly important in polyamides which can vary from country to country and between factories within a country.

Gulland (1964) found that the data available on a variety of species have confidence limits much wider than the actual differentials. Similarly, Holden (1971) indicates the redfish historical data comprises of varying number of experiments of different accuracy. Thus, it is not possible to evaluate precisely the statistical variance of the estimates. Variances estimated from a single determination as used by Pope (1966) indicate the standard error of ±0.07 for each average selection factor and ±0.08 for each equivalent. The 95% confidence limits can be obtained by adding or subtracting twice the standard error figures. The confidence interval for redfish caught in a manila codend would be 1.00± 0.16 = 0.84 to 1.16 and for polyamide 1.09 ± 0.16 = 0.93 to 1.25. The degree of overlap of the confidence interval thus indicates that for manila and polyamide (material with greatest stretch) there is no statistical justification for setting an equivalent.

In conclusion, selectivity experiments can be designed to determine the optimal mesh size and selectivity equivalents for a set of circumstances for various material types. These experiments, however, are only valid within the methods used and changes in the methods would result in significant changes in the results. Thus, it would be extremely difficult to attempt to determine the optimal mesh size and establish selectivity equivalents which would, on the average, be useful as a regulation for the fishery.

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Table 1. Yield per recruit of redfish at a natural mortality of 0.10 for various codend mesh sizes

Mesh size	Sex	$F_{0.1}$	Number	Weight
101	M	0.173	0.417	0.146
	F	0.161	0.401	0.155
114	M	0.206	0.355	0.148
	F	0.191	0.341	0.159
126	M	0.274	0.253	0.134
	F	0.248	0.256	0.153

Table 2. Redfish selection factors for double manila codends of various mesh sizes (derived from Hodder 1964)

Mesh size inches	Mesh size mm	50% Retention length (mm)	Selection factor
3	76	173.8	2.29
4	101	246.7	2.44
4½	114	280.0	2.46
5	126	315.6	2.50
5½	139	352.5	2.54
6	152	385.7	2.54
		Mean	2.46

Table 3. Frequency distributions of selection factors of bottom trawls for double manila (M) and polyamide (PA) codends (from Holden 1971, Table 12)

Selection factor	M	PA
2.1	1	
2.2	2	
2.3	0	
2.4	1	
2.5	3	
2.6	3	1
2.7	3	4
2.8	2	1
2.9	5	2
3.0	2	0
3.1	2	2
3.2	1	0
3.3		1
3.4		0
3.5		1
Total	25	12
Mean 1	2.71	2.92
Mean 2	2.62	2.95
Mean 3	2.64	2.84
Mean 4	2.62	2.87
Grand Mean	2.65	2.90
Equivalent	1.00	1.09

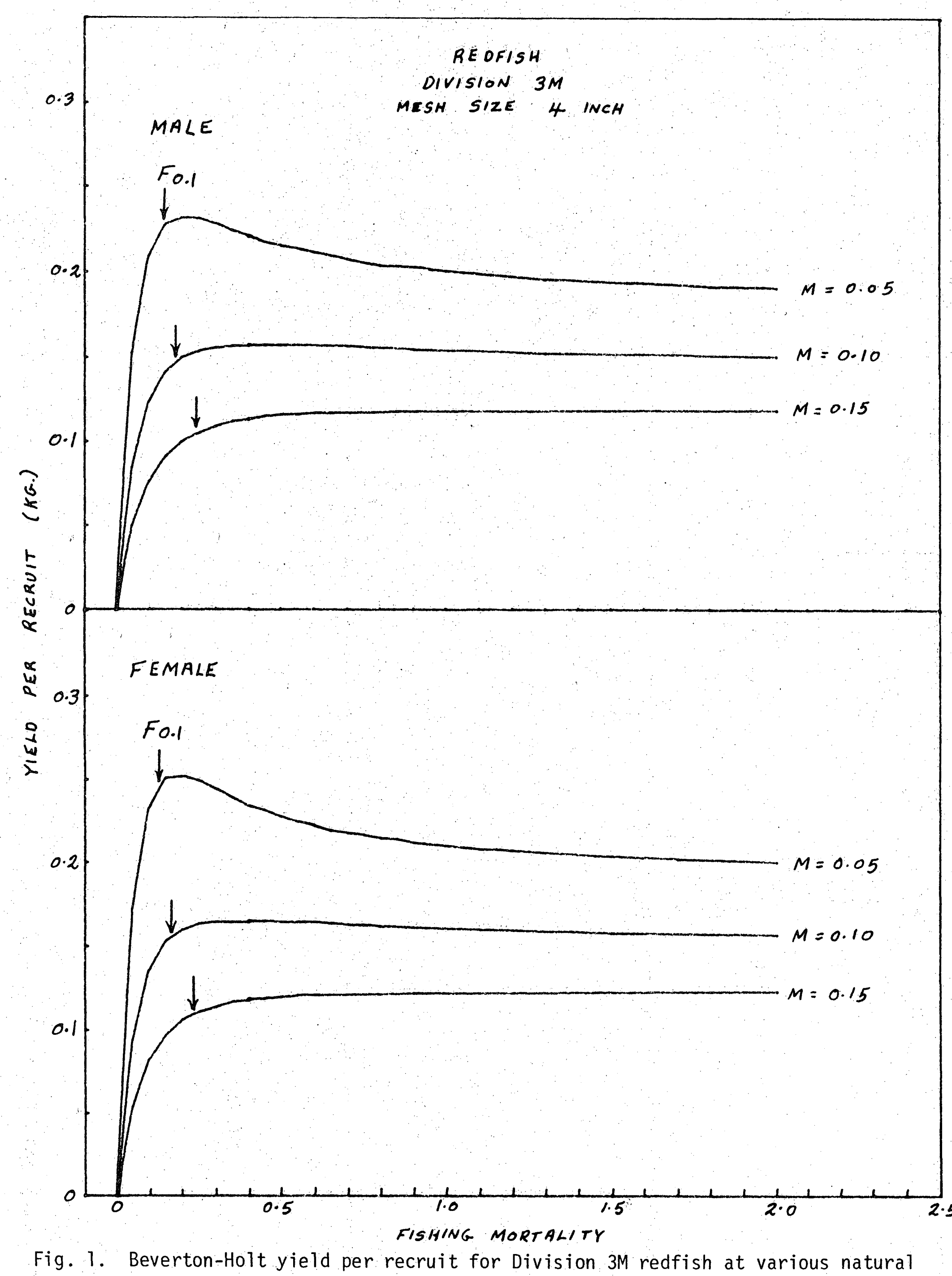

Fig. 1. Beverton-Holt yield per recruit for Division 3M redfish at various natural mortality levels using 4" codend mesh size.

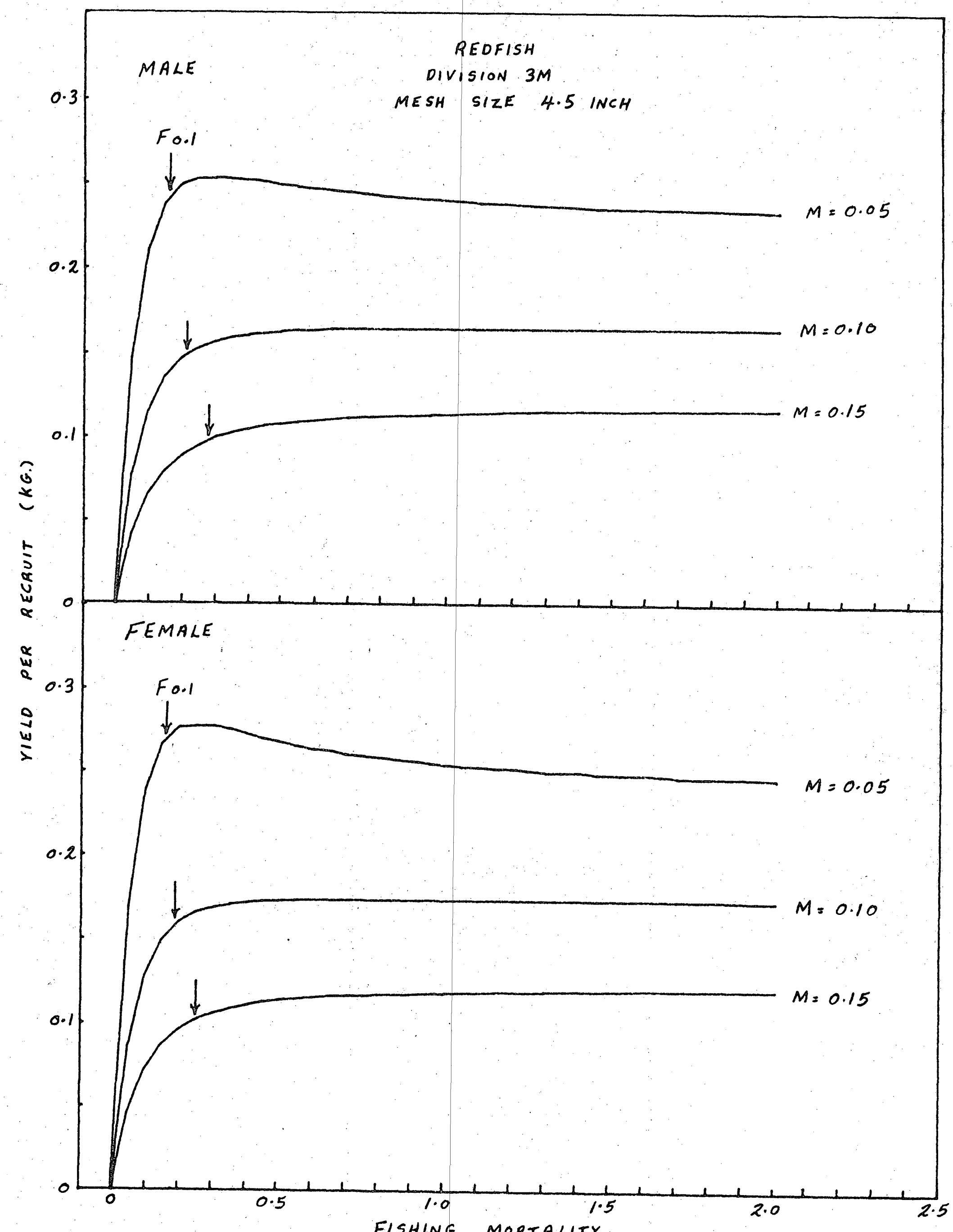

Fig. 2. Beverton-Holt yield per recruit for Division 3M redfish at various natural mortality levels using 4½" mesh size.

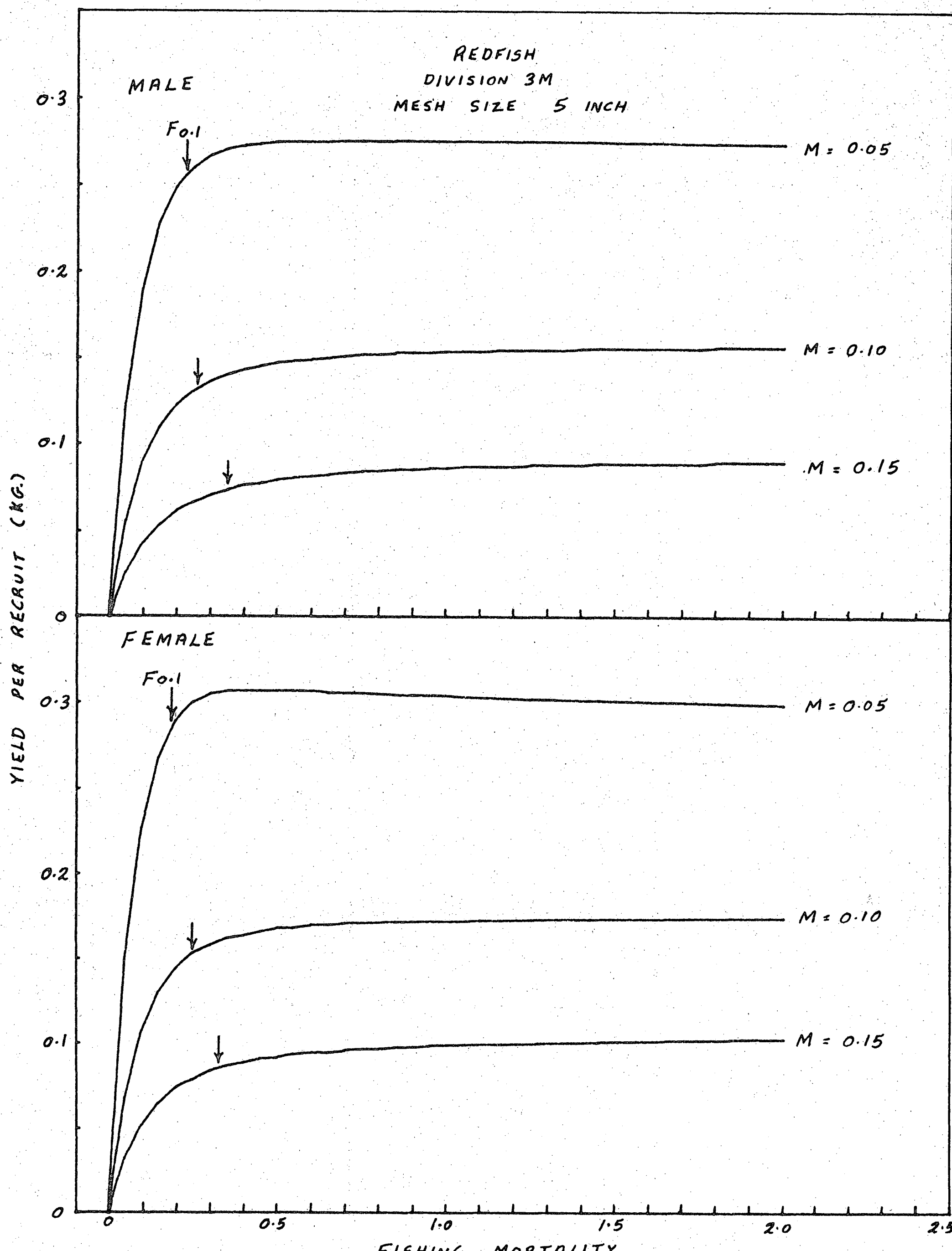

Fig. 3. Beverton-Holt yield per recruit for Division 3M redfish at various natural mortality levels using 5" codend mesh size.