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REPORT FROM MESH SELECTION EXPERIMENTS ON PANDALUS BOREALIS IN NORWEGIAN WATERS

By

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I INTRODUCTION

Since 1968 the Institute of Marine Research, Bergen, has carried out several mesh-selection experiments on the deep sea prawn Pandalus borealis (unpub.). These experiments have mostly been executed in connection with tests of new types of prawn-trawls. They were all carried out by the alternate haul method. To complete these data a new experiment was planed where the selection should be estimated both by alternate haul method and directly by using covered cod-ends in half of the hauls.

II MATERIAL AND METHODS

The experiment took place in the Saltfjord, near Bodø, Northern Norway from June 4th to June 18th, 1974.

Table 1 gives data on ship and gear used in this experiment.

The cover was made as recommended by ICES 1964.

The commercial prawn-trawlers in the Saltfjord area made 3 hauls per day, each lasting for about three hours. The experiment was divided into two periods with regard to fishing-time per haul, the first one (Period I) with 1 hour per haul, and the last one (Period II) with 3 hours per haul. The towing speed was 1-1½ knots.

The sample-sizes were 3 litres from the cod-end and 2 litres from the cover. The samples were cooked on board in the same manner as the rest of the catches, i.e. in sea-water, and thereafter frozen.

Length-measurements were done by measuring the carapace from the base of the eye to the posterior dorsal edge to the nearest mm below. Total length is obtained by taking the carapace-length 5.3 times (RASMUSSEN, 1953).

Of a total of 32 hauls, 3 failed due to clogging of the cod-end by clay and mud. This was haul no. 1, 9 and 32.

III RESULTS

By comparing the length composition of the prawns in cod-end when cover was used with the length composition in the catch with the same mesh size but without cover (Table 3) it is clear that the cover had a significant effect on the selection. In Fig. 1 are shown for Period I the mean length composition in cod-end with and without cover for the three mesh sizes, and in the table below are shown for both periods the mean percentages of prawns of length $\leq$ 14 mm (carapace) in cod-end for the different mesh-sizes with and without cover.

Mean percentage of length ≤ 14 mm (carapace) in cod-end

Mesh size	Period I		Period II	
	With cover	Without cover	With cover	Without cover
30	39.3	24.7	17.7	12.9
36	38.8	19.7	14.8	10.7
41	25.6	14.5	-	-

It is not clear whether the difference in percentages between Period I and Period II in the table above reflet changes in selectivety when the duration of the hauls is increased or if they only reflect changes in length composition of the population between the two periods. In Table 4 are shown the length compositions in the total catch in cod-end and cover for the different hauls with cover and the mean length compositions for the two periods. Taking these lengthcompositions as the length composition in the population it is clear that there is a difference between the two periods. The difference in percentage of for example prawns of length ≤ 14 mm (carapace) is 13.3 with an estimated standard deviation of 3.4, which means that the difference is highly significant.

In view of the significant effect the cover appearently had on the selectivety the selection curves could not be estimated directly from the catch in cod-end and cover. It was therefore decided to estimate the curves by comparing the mean length composition in cod-end in hauls where cover was not used with the mean length composition in the population, taken as the mean length composition in the total catch in cod-end and cover in all the hauls, regardless of mesh size, where cover was used. Because of the difference in length composition of the population between the two periods the calculations were made separately for Period I and Period II.

All selection curves were fitted by eye.

In Fig. 2 are shown the estimated selection curves for Period I for the three mesh sizes. For 30 mm mesh size the percentage retained of length group 1 was estimated by

$$\% \text{ retained} = \frac{p_1}{p_{1,\text{population}}} \times k$$

where

p_1 = mean percentage of prawns of length 1 in catch when cover was not used

$p_{1,\text{population}}$ = percentage of prawns of length 1 in population

and

$$k = \frac{\sum_{1 \geq 20} p_{1,\text{population}}}{\sum_{1 \geq 20} p_1,}$$

thus assuming that all prawns of length 20 mm (carapace) or more were retained in the net.

For 36 and 41 mm mesh size it was found that the material to base the calculations of k on would be too scarce because one would be very near the upper end of the length composition in catch before one could assume that all prawns were retained in the net. The percentage retained of the different length groups was therefore estimated from the ratios between the mean number caught per hour of the different length groups with the actual mesh size when cover was not used and the total mean number caught per hour in cod-end and cover of the different length groups in all hauls with cover (regardless of mesh size). The mean number caught per hour of length 1 was estimated from the mean length composition and the mean total number caught per hour.

The selection curves for 30 mm and 36 mm mesh size in Period II are shown in Fig. 3. Only two hauls with 30 mm mesh size

(without cover) were taken, and the selection curve for 36 mm mesh size is based on only one haul (two hauls were taken but one of them could not be used). These selection curves should therefore be regarded as very uncertain. The percentage retained of the different length groups was estimated by the method used for 30 mm mesh size in Period I, assuming that all prawns of length $\geq$ 21 mm (carapace) were retained for 36 mm mesh size. A 3-point moving average was applied on the length compositions.

Because of the scarce material in Period II no decisive conclusions can be drawn whether the larger duration of the hauls in this period had an effect on the selection. In the table below are shown the estimated 50 % retention lengths for the two periods. For comparison are also shown 50 % lengths obtained from experiments carried out in earlier years (alternate haul method). These estimates are however based on poor data.

Estimated 50 % retention length

Experiment	Mesh size	50 % retention length (mm carapace)
Saltfjord 1974, Period I	30	12.0
	36	15.5
	41	20.5
Saltfjord 1974, Period II	30	13.0
	36	16.0
Vestfjord 1968	35	16.0
Finmark 1969	40	20.5, 21,0, 19.0
Finmark 1971	35	16.5

From Table 4 is seen that the length composition in the population shows two marked peaks, one around 12-13 mm and one around 17 mm. This length-composition corresponds very well with the data on

Pandalus borealis from the Ofoten Fjord (in the same area as Saltfjord) given by RASMUSSEN 1953. According to his data the two peaks in the length distribution should be the age-groups I and II, 14 and 26 months old respectively. With the estimated selection curves 30 mm mesh size would retain more than half of the 1 years old and allmost all of the two years old, while most of 1 years old and a little below half of the 2 years old would go through 36 mm mesh size. Most of the prawns in both these yearclasses and some prawns above 20 mm (3 years old and older) would go through 41 mm mesh size.

REFERENCES

ICES, 1964. Report of the Mesh Selection Working Group, 1959-1960. ICES Coop.Res.Rep.,Ser.A, No.2, 1-156.

RASMUSSEN, B. 1953. On the Geographical Variation in Growth and Sexual Development of the Deep Sea Prawn (Pandalus borealis kr.). FiskDir.Skr.Ser. HavUnders.,10(3): 1-160.

Table 1. Data on ship and gear

Ship:	Length	:	13.25 m
	Horse-power	:	155
Trawl:	Material	:	nylon
	Length of ground-rope	:	48,0 m
	Length of head-rope	:	37.0 m
	Circumference at head-rope	:	38,0 m : 1050 meshes
	Thread no.	:	6 (8 in front of cod-end)
	Length of cod-end	:	2,9 m
	Circumference of cod-end	:	4,3 m
	Thread no.	:	12
	Mesh-sizes in cod-ends (internal stretched)	:	30 mm, 36 mm, 41 mm
Cover:	Material, upper half	:	courlene
	lower half (lining the cod-end)	:	nylon
	Length	:	4,5 m
	Width of upper half	:	4.0 m
	Mesh size	:	5 mm

Table 2. Mean catch per hour, and number per liter.

Meshsize in mm	Cover	No. of hauls	Hour/haul	Cod-end N	Cod-end %	Cover N	Cover %	Total	Liter per hour in cod-end	Number/liter in cod-end
41	yes	3	1	6600	85.2	1145	14.8	7745	34.2	198
41	no	4	1	1930	100.0	-	-	1930	11.3	170
36	yes	3	1	5661	90.2	614	9.8	6275	33.0	227
36	no	7	1	4289	100.0	-	-	4289	23.0	186
30	yes	2	1	8000	96.0	335	4.0	8335	34.0	235
30	no	3	1	8698	100.0	-	-	8698	34.9	205
36	yes	2	3	5154	72.3	1974	27.7	7128	31.8	162
36	no	1	2	2315	100.0	-	-	2315	15.5	149
30	yes	2	3	6450	90.7	662	9.3	7112	37.0	175
30	no	2	3	5094	100.0	-	-	5094	28.9	172

Table 3. Size composition of Pandalus borealis from cod-end catches.

Haul no.	Mesh size (mm)	Fish. hours	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	mm carapace
2	41*	1	-	0.2	2.2	10.3	10.2	2.8	3.1	16.1	19.6	11.0	6.4	4.2	3.8	6.3	2.8	0.8	0.2	-	-	%
3	41*	1	0.4	0.8	4.1	7.1	7.2	1.8	6.4	15.9	21.6	13.4	7.2	4.8	4.6	3.2	1.6	0.2	-	-	-	%
14	41*	1	-	1.4	6.3	11.9	7.0	3.0	8.8	16.2	16.6	7.5	5.8	4.4	6.1	3.9	1.1	0.4	-	-	0.2	%
		mean:	0.1	0.8	4.2	9.8	8.1	2.5	6.1	16.1	19.3	10.6	6.5	4.5	4.8	4.5	1.8	0.5	0.1	-	0.1	%

			9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	mm carapace
4	41	1	-	0.2	1.5	5.9	6.6	3.4	5.9	13.4	17.8	10.6	6.0	3.8	7.8	10.2	4.5	1.9	0.4	-	0.2	%
12	41	1	-	-	0.2	2.7	3.7	2.1	2.1	11.6	19.5	11.6	7.5	8.7	9.3	11.0	6.8	2.1	0.8	0.4	-	
13	41	1	-	0.4	0.9	3.0	4.4	2.7	8.1	13.8	22.0	14.8	10.0	4.7	6.1	5.1	2.3	-	0.9	0.8	-	%
19	41	1	-	0.2	3.0	5.6	6.2	4.8	3.4	13.7	16.3	10.9	6.0	6.0	8.7	6.6	5.0	2.6	0.4	0.2	0.2	%
		mean:	-	0.2	1.4	4.3	5.2	3.3	4.9	13.1	18.9	12.0	7.4	5.8	8.0	8.2	4.7	1.7	0.6	0.4	0.1	%

* with cover

Table 3. (cont.)

Haul no.	Mesh size (mm)	Fish. hours	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	mm carapace
6	36*	1	0.1	1.7	5.9	15.2	10.6	3.7	7.6	14.9	16.4	6.9	4.8	3.4	5.6	2.5	0.6	0.1	-	-	-	%
16	36*	1	-	0.4	2.8	9.5	12.9	4.3	4.8	8.4	18.9	8.5	5.1	6.5	6.0	8.4	2.6	1.4	0.2	-	-	%
17	36*	1	0.1	2.5	6.6	19.4	15.5	5.2	6.6	15.3	11.5	5.5	2.2	1.9	3.6	3.1	0.8	0.1	0.1	-	-	%
		mean:	0.1	1.5	5.1	14.7	13.0	4.4	6.3	12.9	15.6	7.0	4.0	3.9	5.1	4.7	1.3	0.5	0.1	-	-	%

			9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	mm carapace
5	36	1	-	1.2	2.6	1.9	13.6	4.3	5.9	13.3	17.1	9.3	5.0	4.3	4.6	4.6	1.4	0.9	0.2	-	-	%
7	36	1	-	0.2	1.2	4.6	6.6	2.1	5.2	13.7	21.0	11.0	6.9	6.6	8.5	8.1	3.1	1.0	0.2	-	-	%
11	36	1	-	-	0.9	5.3	6.5	3.4	6.4	17.8	24.1	10.1	3.9	5.5	6.0	6.4	3.2	0.7	0.2	0.2	-	%
15	36	1	-	-	1.8	8.0	6.4	2.0	3.3	12.1	20.1	13.2	6.4	6.2	7.1	7.1	4.0	1.6	0.4	0.2	-	%
18	36	1	-	-	0.6	2.1	6.6	0.8	3.5	12.6	23.1	12.4	6.6	8.1	10.1	8.3	3.5	1.4	0.2	-	-	%
23	36	1	-	-	1.4	8.1	6.0	4.6	3.9	10.6	17.0	13.7	6.6	6.8	6.2	8.7	4.3	1.4	0.8	-	-	%
24	36	1	0.2	0.2	1.9	10.2	9.6	2.5	8.8	18.9	15.3	10.5	5.1	5.3	4.9	3.9	2.1	0.2	0.5	-	-	%
		mean:	-	0.2	1.5	7.2	7.9	2.8	5.3	14.1	19.7	11.5	5.8	6.1	6.8	6.7	3.1	1.0	0.4	0.1	-	%

* with cover

Table 3. (cont.)

Haul no.	Mesh size (mm)	Fish. hours	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	mm cara-pace
8	30*	1	0.3	1.1	5.8	17.7	11.8	2.4	8.8	17.7	12.9	5.1	4.3	4.0	3.9	2.9	1.5	0.3	0.1	-	-	%
22	30*	1	-	0.6	1.9	9.2	19.4	8.4	3.4	0.2	20.2	9.3	4.4	2.7	4.6	2.5	1.8	0.9	0.6	-	-	%
		mean:	0.1	0.9	3.9	13.5	15.6	5.4	6.1	14.0	16.6	7.2	4.4	3.4	4.3	2.7	1.7	0.6	0.4	-	-	%

			9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	mm cara-pace
10	30	1	-	-	2.0	11.0	11.1	4.0	4.5	15.3	20.7	11.1	5.1	4.8	3.9	3.6	2.5	0.3	-	-	-	%
20	30	1	-	-	1.0	6.1	6.1	2.6	3.8	15.8	25.9	11.5	7.3	6.6	6.3	4.3	1.4	0.7	0.5	-	-	%
21	30	1	-	0.7	2.9	12.5	10.8	3.2	10.9	18.8	16.8	6.3	5.0	2.8	4.2	3.9	1.0	0.5	0.2	0.2	-	%
		mean:	-	0.2	2.0	9.9	9.3	3.3	6.4	16.6	21.1	9.6	5.8	4.7	4.8	3.9	1.6	0.5	0.2	0.1	-	%

* with cover

Table 3. (cont.)

Haul no.	Mesh size (mm)	Fish. hours	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	mm carapace
26	36*	3	-	-	2.5	5.3	6.5	2.3	6.9	17.4	22.2	7.7	6.5	10.1	7.5	4.1	1.7	-	-	-	-	%
27	36*	3	-	-	1.1	3.4	4.4	4.0	2.5	8.8	21.7	16.8	9.9	6.9	8.0	6.3	3.8	1.1	0.6	0.6	-	%
		mean:	-	-	1.8	4.4	5.5	3.2	4.7	13.1	22.0	12.3	8.2	8.5	7.8	5.2	2.8	0.6	0.3	0.3	-	%
			9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	mm carapace
25	36	2	-	-	-	1.3	2.7	1.1	4.5	14.1	21.4	12.7	7.4	8.9	11.4	8.9	4.5	0.4	0.4	0.2	-	%
			9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	mm carapace
28	30*	3	-	-	0.2	4.2	8.9	6.6	3.2	10.6	21.0	17.9	6.3	5.6	6.3	3.3	4.2	1.3	1.1	0.2	-	%
29	30*	3	-	-	0.6	3.6	8.3	3.0	2.1	8.3	16.0	20.4	8.9	7.7	9.1	8.5	2.8	0.2	-	0.2	0.2	%
		mean:	-	-	0.4	3.9	8.6	4.8	2.7	9.5	18.5	19.2	7.6	6.7	7.7	5.9	3.5	0.7	0.6	0.2	0.1	%
			9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	mm carapace
30	30	3	-	0.4	1.1	1.0	6.8	4.4	4.4	10.1	21.1	15.8	8.0	8.9	7.8	5.5	3.0	1.0	0.6	-	0.2	%
31	30	3	-	-	1.6	2.4	4.0	4.0	5.0	15.6	25.9	12.3	8.3	5.5	6.9	6.5	1.4	0.6	-	-	-	%
		mean:	-	0.2	1.4	1.7	5.4	4.2	4.7	12.9	23.5	14.1	8.2	7.2	7.4	6.0	2.2	0.8	0.3	-	0.1	%

* with cover

Table 4. Length composition in total catch in cod-end and cover

Period I

Length (mm carapace)

Haul no.	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	No. per hour
2		0.5	2.3	10.8	10.5	2.9	3.2	16.0	19.4	10.9	6.2	4.2	3.6	5.9	2.7	0.7	0.1	8065
3	0.3	1.1	5.4	8.8	7.5	1.9	7.1	17.8	20.7	11.5	6.0	4.1	3.8	2.5	1.2	0.1	-	7967
6	0.2	1.8	6.5	15.9	10.9	3.7	7.4	14.8	16.0	6.7	4.6	3.3	5.4	2.4	0.5	0.1	-	6680
8	0.3	1.1	6.0	18.2	12.3	2.6	8.5	17.3	12.6	5.0	4.1	3.8	3.7	2.8	1.5	0.3	0.1	8873
14	-	1.3	6.2	12.6	8.2	3.2	8.3	15.6	16.5	7.5	5.7	4.2	5.6	3.6	1.0	0.3	-	7204
16	-	0.4	3.7	11.8	13.9	4.1	5.0	9.0	17.9	8.1	5.1	5.7	5.1	7.1	2.1	1.1	0.1	5838
17	0.1	2.4	6.7	19.9	16.0	5.3	6.4	14.9	11.5	5.4	2.2	1.9	3.3	2.9	0.8	0.1	0.1	6308
22	-	0.6	2.3	9.9	19.8	8.3	3.4	10.2	19.8	9.1	4.3	2.6	4.4	2.4	1.7	0.8	0.6	7797
Mean	0.1	1.2	4.9	13.5	12.4	4.0	6.2	14.5	16.8	8.0	4.8	3.7	4.4	3.7	1.4	0.4	0.1	7337

Period II

Length (mm carapace)

Haul no.	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	No.per haul
26	0.1	0.1	2.9	9.3	11.0	4.1	5.8	15.4	20.3	7.8	5.5	7.5	5.6	3.1	1.4					6587
27	-	0.1	1.7	5.5	8.1	4.7	2.5	9.8	20.8	15.8	8.5	6.0	6.8	5.0	2.9	0.8	0.5	0.5	-	7668
28	-	-	0.6	5.6	10.1	7.0	3.1	10.7	20.3	16.7	5.8	5.2	5.7	3.0	3.8	1.1	0.9	0.2	-	7871
29	-	-	0.9	5.2	9.8	3.8	2.5	8.2	15.9	19.3	8.2	7.0	8.3	7.7	2.5	0.2	-	0.2	0.2	6352
Mean		0.1	1.5	6.4	9.8	4.9	3.5	11.0	19.3	14.9	7.0	6.4	6.6	4.7	2.7	0.5	0.4	0.2	0.1	7119

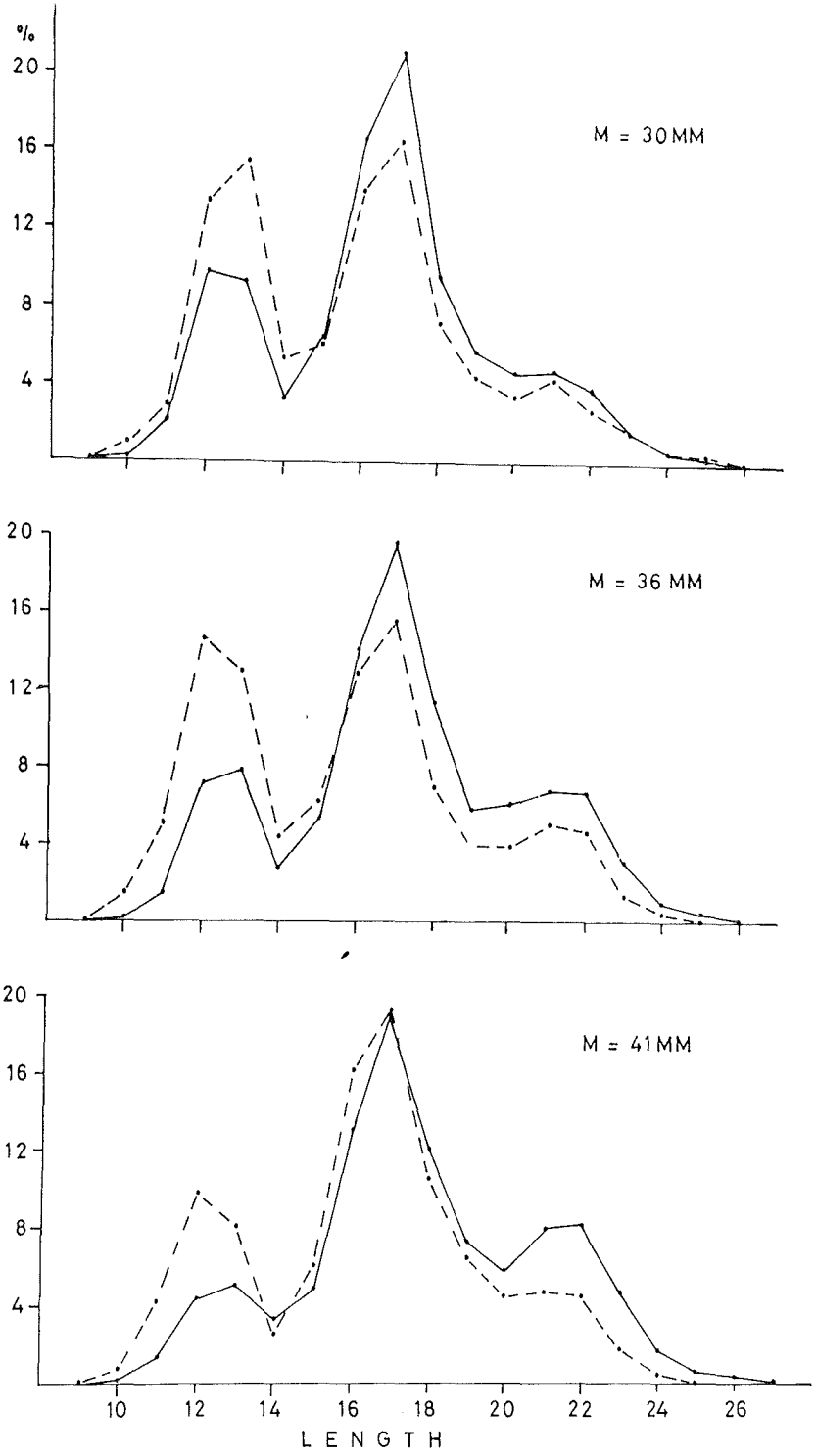

Figure 1. Mean length composition in catch (Period I) for the three mesh sizes compared with length composition in cod-end when cover was used (broken line).

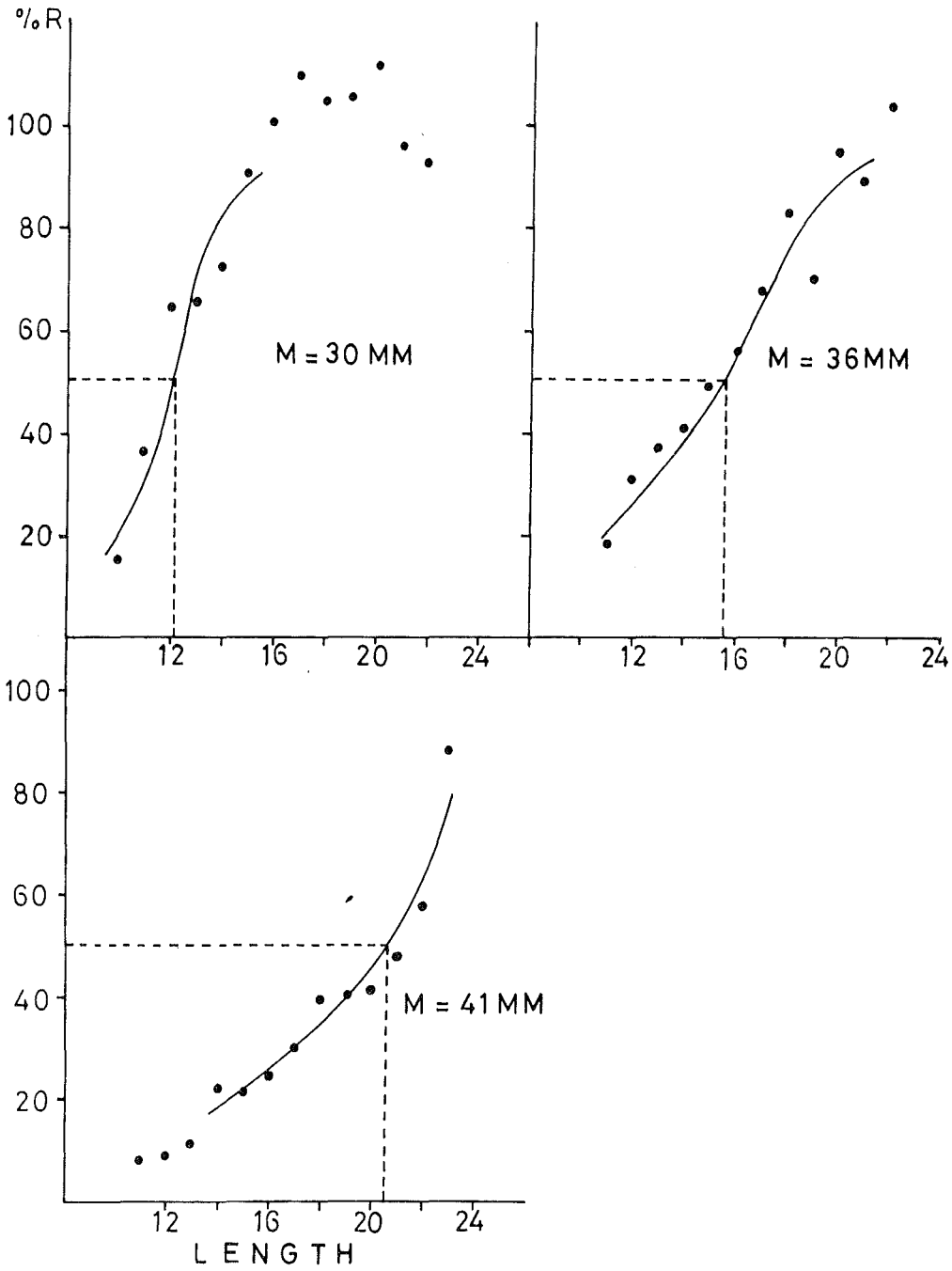

Figure 2. Estimated selection curves for Period I for the three mesh sizes.

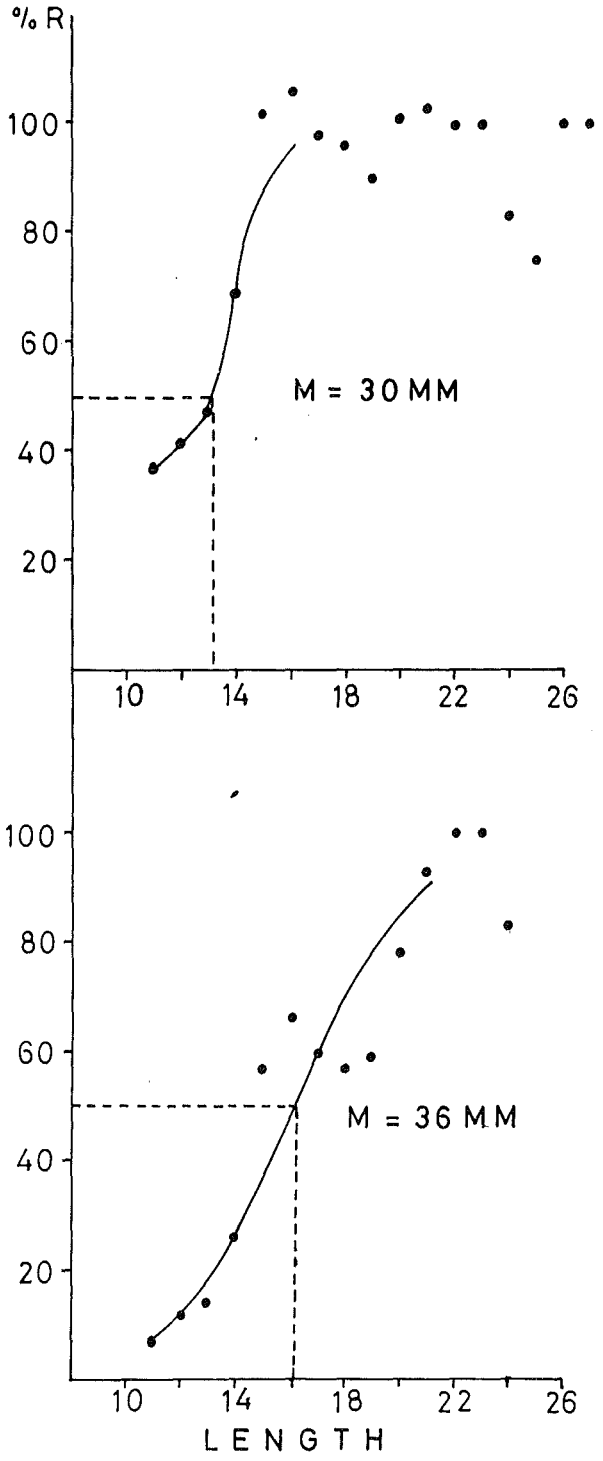

Figure 3. Estimated selection curves for Period II for 30 mm and 36 mm mesh size.