SELECTIVITY OF GILL NETS FOR *SCOMBEROMORUS COMMERSONI*

P. SULOCHANAN, K. A. SADANANDAN, T. JOSEPH MATHAI & M. SYED ABBAS
Central Institute of Fisheries Technology, Craft & Gear Division, Cochin-5

Selectivity of gill nets for *S. commersoni* was studied with nets made of 4 different mesh sizes fabricated with 4 different specifications of nylon twines. Fishing operations were conducted off Cochin through the fishing seasons 1968-72. The commercially significant size group of *S. commersoni* was found to fall in the length range of 850-950 mm. The optimum mesh size required for the capture of this group of *S. commersoni* was estimated as 76 mm. bar in nylon twine 210/12/3. The relationship between the twine size and mesh size was also worked out.

Introduction

Gill nets by way of its construction and mechanism of capture have proved to be highly selective. Hogson (1927), Havinga and Deelder(1958), Baranov (1948), Holt (1957), Olsen (1959), Joseph *et al.* (1964), Sulochanan *et al.* (1968) and Koura and Shahun (1969) carried out elaborate studies on the selective action of gill nets in relation to different species of fish. Sreekrishna *et al.* (1972) made an attempt to evolve a suitable mesh size for the commercially significant size groups of *Scomberomorus guttatus*. Gill nets employed mainly for the capture of *Scomberomorus commersoni* off Kerala coast were studied comprehensively by the present authors, emphasising the efficiency indices of the different shots due to difference in mesh and twine size.

Material and Methods

Nets of 70, 75, 80 and 85mm. bar, fabricated with nylon twine 210/6/3, 210/8/3, 210/9/3 and 210/12/3 were selected as the experimental gear. Each shot was of 25m. in hung length and 10m. hung depth. The design details of the experimental nets are given in Table I.

Four nets in each mesh size and twine size were operated simultaneously on a statistically designed method, at a fishing depth ranging from 10-36 m. off Cochin through the fishing seasons in 1968-72. The nets were drifted during nights and a total of 64 operations in 4 cycles of 16 each were made. Morphometric data such as fork length, gill girth, gilled girth, maximum girth, weight etc. of the fish caught by each net were recorded sepa-

TABLE I

Design details of the experimental nets

Net Nos.	Twine size	Mesh size bar in mm.	No. of meshes in length	No. of meshes in depth	Horizontal hanging coefficient	Vertical hanging coefficient	Horizontal hung length in m.	Vertical hung length in m.	Aluminium floats 6"θ	Aluminium floats 3"θ	Extra buoyancy of floats 6"	Extra buoyancy of floats 3"	Sinkers circular iron rings Dia; in inch	Sinkers circular iron rings Weight in gm.
1	210/6/3	70	357	87	0.5	0.86	25	10	1	6	1662.12 gm.	146.85 gm.	6	200
2	,,	75	334	78	,,	,,	,,	,,	,,	,,			,,	,,
3	,,	80	313	73	,,	,,	,,	,,	,,	,,			,,	,,
4	,,	85	294	68	,,	,,	,,	,,	,,	,,			,,	,,
5	210/8/3	70	357	87	,,	,,	,,	,,	,,	,,			,,	,,
6	,,	75	334	78	,,	,,	,,	,,	,,	,,			,,	,,
7	,,	80	313	73	,,	,,	,,	,,	,,	,,			,,	,,
8	,,	85	294	68	,,	,,	,,	,,	,,	,,			,,	,,
9	210/9/3	70	357	87	,,	,,	,,	,,	,,	,,			,,	,,
10	,,	75	334	78	,,	,,	,,	,,	,,	,,			,,	,,
11	,,	80	313	73	,,	,,	,,	,,	,,	,,			,,	,,
12	,,	85	294	68	,,	,,	,,	,,	,,	,,			,,	,,
13	210/12/3	70	357	87	,,	,,	,,	,,	,,	,,			,,	,,
14	,,	75	334	78	,,	,,	,,	,,	,,	,,			,,	,,
15	,,	80	313	73	,,	,,	,,	,,	,,	,,			,,	,,
16	,,	87	294	68	,,	,,	,,	,,	,,	,,			,,	,,

TABLE II

Number of fishes caught in different mesh size indicating the body region of the fish where they are caught

Mesh bar mm.	Catch at maximum girth Number	%	Catch below maximum girth Number	%	Total catch Number	Weight 8n kg.	Average weight of fish (kg.)
70	34	71.5	14	28.5	48	213.700	4.45
75	49	80.0	14	20.0	63	321.200	5.10
80	33	85.0	7	15.0	40	197.500	4.94
85	27	87.0	6	13.0	33	164.000	5.00
Total	143	77.7	41	22.3	184	896.400	4.90

TABLE III

Length frequency distribution in percentage of *S. commersoni* caught in dtfferent mesh sizes.

Length group of fish cm.	Number of fishes caught in % in nets with mesh bar mm. 70	75	80	85
70 - 75	—	1.8	—	—
75 - 80	9.1	5.3	10.53	—
80 - 85	27.3	22.7	28.95	29.03
85 - 90	38.6	29.7	26.31	16.12
90 - 95	18.2	24.6	10.53	32.25
95 - 100	4.5	12.3	13.16	12.93
100 - 105	2.3	1.8	10.53	9.67
105 - 110	—	1.8	—	—

rately. The relation between mesh size and selection length of fish was worked out by the method of Baranov (1948) based on length frequency distribution of *S. commersoni.* The theoretical estimate thus made was further checked by studying the ratio between gilled girth and mesh perimeter ratio as well as maximum girth and mesh perimeter ratio following the method described by McCombie and Berst (1969). The output of the different shots was taken as the efficiency indices to determine the selectivity of the gear in relation to the twine size. The relation between the twine size and mesh size was worked out based on the method formulated by Baranov (1960).

Results

The morphometric data of 184 specimens of *S. commersoni* landed were recorded. The number of fish caught, indicating the body region of the fish where they were caught and the length frequency distribution of the fish, in different mesh sizes are shown in Table II and Table III respectively.

The out put of the different shots fabricated with different specifications of twines, irrespective of mesh size and in relation to mesh size is indicated in Tables IV and V.

Discussion

Effect of mesh size: The catch data from the experimental nets were analysed statistically to estimate theoretically the mesh size required for catching predominent size group of *S. commersoni.* According to Baranov (1948) the mesh size is a function of the length of fish caught and can be represented as

$$a = Kl$$

where a is mesh bar in mm., K the coefficient of proportionality and l the modal length in mm. K is determined with the formula

$$K = \frac{2\,a1\;a2}{l_o\,(a1 + a2)}$$

where a1 and a2 are the mesh bars in mm. of the two experimental nets and l_o is the length of fish in mm. caught in equal proportion in both the nets.

From Table II, it can be seen that *S. commersoni* has a length range of 850 - 950 mm. and the size range remains almost the same for nets with 70, 75 and 80 mm. bar and differs only for 85mm. bar. Therefore, for determining l_o the length frequency distribution of catch for 70 (a1) and 85 (a2) mm. bar nets only were taken and are represented in Text Fig. 1. The frequency curve in Text Fig. 1 is approximately normal in shape. The value of l_o is 915 mm. and K = 0.084.

With the value of K as 0.084, the theoretical estimate of mesh size required for the exploitation of the commercially significant size group of *S. commersoni* (850 - 950 mm.) works out as 71.4 and 79.8 mm. bar with an average of 75.6 mm. or 76 mm.

The ratios between gilled girth to mesh perimeter and maximum girth to mesh perimeter (McCombie and Berst 1969) were plotted separately, with % frequency distribution of the catch under different

TABLE IV

Out put of different shots fabricated with sizes irrespective of mesh size.

Twine size	Catch in Number	Catch in Weight (kg.)	Average weight of fish (kg.)
210/6/3	29	118.50	4.10
210/8/3	29	136.70	4.30
210/9/3	52	249.50	4.80
210/12/3	74	391.70	5.30
Total	184	896·40	

TABLE V

Out put of different shots fabricated with different specifications of twines and mesh.

Sl. No.	Twine size	Mesh bar	Catch in Number	Catch in Weight (kg.)	Average weight of fish (kg.)
1	210/6/3	70	8	26.75	3.35
2	,,	75	10	38.75	3.88
3	,,	80	7	33.75	4.56
4	,,	85	4	19.30	4.80
5	210/8/3	70	10	51.00	5.10
6	,,	75	7	33.20	4.74
7	,,	80	5	23.25	4.65
8	,,	85	7	29.25	4.18
9	210/9/3	70	10	47.00	4.70
10	,,	75	16	82.50	5.20
11	,,	80	14	65.00	4.65
12	,,	85	11	54.50	5.00
13	210/12/3	70	20	88.95	4.50
14	,,	75	30	166.75	5.60
15	,,	80	13	75.00	5.80
16	,,	85	11	61.00	5.55

mesh sizes, in Text Figures 2a & 2b. Text Fig. 2a shows that as mesh bar increases beyond 75 mm. bar there is a shifting of peak to lower values. The peak values for the meshes 70, 75, 80 and 85 mm. bar nets are 1.15 to 1.30, 1.20, 1.175 and 1.075 respectively. It can be noted that the peak value of 75 mm. bar coincides with the average value of the peak for 70 mm. bar. The ratio remaining the same, the size of fish caught is larger for a bigger mesh size (Table III). Therefore by increasing the size of mesh from 70 to 75 mm. bar the size of fish

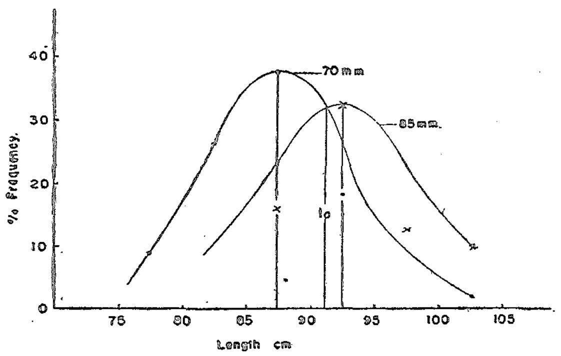

Fig. 1

Length frequency distribution of catches in nets of 70 & 85 mm. bar.

is correspondingly increased and the efficiency indices also show a higher value of the peak (Text Fig. 2a) whereas for nets of 80 and 85 mm. bar there is no proportionate increase in the size of fish. The efficiency indices of these nets show declining tendencies as evidenced by the shifting of the peaks of these meshes to lower values. These low efficiency indices of 80 and 85 mm. bar can reasonably be attributed to the escapement of the predominent size group of *S. commersoni* retained in 75 mm. bar mesh.

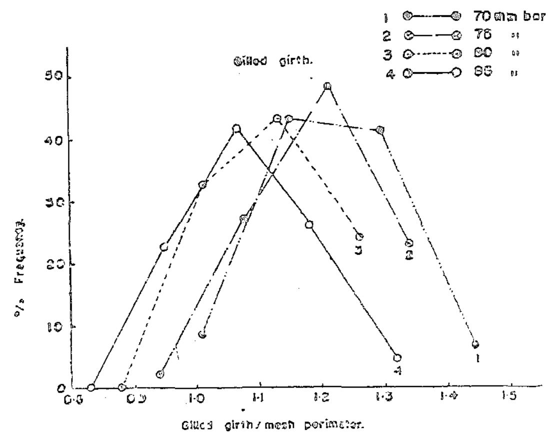

Fig. 2a

% Frequency distribution of catch based on Gilled girth/mesh perimeter

Graph drawn with the ratio of maximum girth to mesh perimeter also showed the same characteristics of the graph drawn with the ratio of gilled girth to mesh perimeter. It can be seen from Text Fig. 2a that the catching efficiency was high when the gilled girth of the fish was 1.05 to 1.25 times as great as the perimeter of the mesh. Low efficiency indices were observed at girth perimeter ratios less than 0.95 and beyond 1.25. Similarly, Text Fig. 2b also showed high catching efficiency ratios of 1.1 - 1.25 for the three meshes 75, 80 and 85mm. bar with the slightly higher value of 1.3 for 70 mm. bar. The similarity of efficiency indices shown by both the graphs can probably be attributed to the unique mechanism of gilling of greater percentage of *S. commersoni* by jamming of the single mesh at the maximum girth region. From Table II it may be seen that 77 - 87% of *S. commersoni* landed in the different mesh sizes are caught at the maximum girth region unlike that of the perches (McCombie & Berst, 1969) where fishes

Max. girth

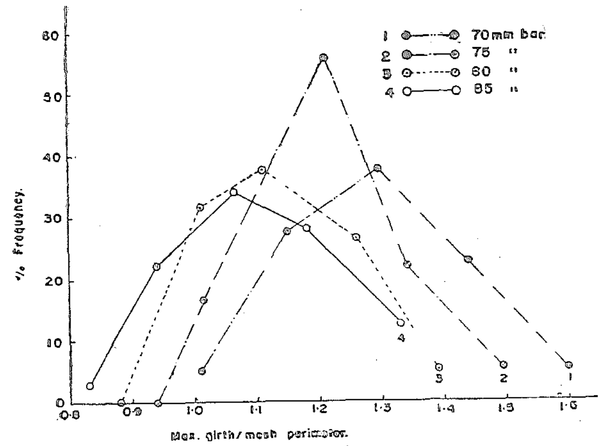

Fig. 2b

% Frequency distribution of catch based on maximum girth/mesh perimeter

are reported to be gilled at different regions of the body. *S. commersoni* being strongly muscled and fast swimming the fish avails of a major share of the elasticity of the twine and gets caught at the maximum girth region where the anterior extremity of the posterio dorsal and corresponding portion of the ventral fins obstruct the mesh and brings about the effect of a break in the effort of the fish to riggle out of the mesh. This mechanism of capture explains the reason for the escapement of fishes through mesh sizes 80 and 85 mm. bar where the force exerted enables a good number of fishes of the dominent size group to escape. The declining efficiency at ratios 1.0 and less (Text Fig. 2b) can be attributed to the escapement of the fish through the mesh and the same beyond the ratio 1.3 to the inability of the fish to enter the mesh. However the presence of some catch beyond the ratio 1.3 and upto 1.45 in the graph based on gilled girth and 1.3 - 1.6 in the case of graph drawn with maximum girth values can be explained as due to the capture of restricted numbers of larger fishes either due to the higher elasticity of the twine availed by the fish or by entangling.

EFFECT OF TWINE SIZE:

In order to study the effect of twine size, the number of fishes caught in nets of different specifications of nylon twines viz. 210/6/3, 210/8/3, 210/9/3 and 210/12/3 (Table IV) have been analysed statistically. Chi square test was carried out to find out whether the efficiency indices of all the four twine sizes are equal. The calculated Chi square with three degrees of freedom is 29.23 which is significant at 1% level indicating that the efficiency indices of these twines are not uniform. The twine 210/12/3 was catching significantly higher numbers of fishes compared to other twine sizes (Table IV).

MESH AND TWINE SIZE RELATIONSHIP:

There exists a difinite relationship between the twine diameter and the mesh bar in gill nets (Baranov 1960). The importance of reducing the twine diameter from the point of view of efficiency of the gear has been emphasised by Von Brandt (1964), Baranov (1960), Sulochanan *et al.* (1968). Baranov has worked out the relationship of twine size and mesh size in gill nets emperically as

$$d/a = 0.01 \text{ to } 0.02 \text{ where}$$

'd' is diameter of the twine in mm. and 'a' mesh bar in mm.

However, the significance of variation in the range, depending on the nature of fish population, that is a smaller ratio for sparse population and higher ratio for shoaling type is also given due emphasis. In the present case it may be seen that the relation between the most efficient mesh bar 76 mm. and the nylon twine 210/12/3 can be expressad as

$$d/a = \frac{1.79}{76} = 0.023$$

which is only slightly higher than the maximum in the range formulated. The larger size, strong masculature, fast swimming and shoaling nature of the fish mentioned elsewhere in this communication explain this requirement of a thicker twine for the effective capture of *S. commersoni*. The optimum requirements in mesh size and twine size are well combined in the net made of nylon 210/12/3 with mesh size 75mm. bar as shown by the maximum out put of the shot (Table V).

ACKNOWLEDGEMENT

The authors wish to express their thanks to Shri. G. K. Kuriyan, Director, Central Institute of Fisheries Technology, Cochin, for guidance and valuable suggestions in carrying out the work and for granting permission to publish this paper. Thanks are also due to Shri. S. Gopalan Nayar, Junior Fishery Scientist for critically going through the manuscript and offering suggestions for its improvement. The work of Shri. H. Krishna Iyer, Asistant Statistician for statistical anaylysis of the data is also greatefully acknowledged.

REFERENCES

Baranov, F. I. 1948. *Pischepromizdat*; Moscow: 435.

Baranov, F. I. 1960. Techniques of Industrial fishing, Moscow.

Havinga, B. & C. L. Deelder. 1948. *Rapp. Cons. Explor. Mer*; **125**, 11:249.

Hogson, W. C. 1927. *Cons. Explor. Mer*; **2**, 1:356.

Holt, S. J. 1957. *Joint. Sci. Meet*; ICNAF, ICES & FAO Paper No. 515, Lisbon.

Joseph, K. M. & A. V. Sebastian. 1964. *Fish. Technol*; **1**, 2:180.

Koura, R. & A. A. Shahun. 1969. *Stud. & Rev. Gen. Fish. Coun. Med*; 39:1

McCombie, A. M. & A. H. Berst. 1959. *J. Fish. Res. Bd Canada*; **26**, 10: 2681.

Olsen, S. 1959. *J. Fish. Res. Bd Canada*; **16**:339.

Sreekrishna, Y., J. Sitarama Rao, Percy Dawson, T. Joseph Mathai & P. Sulochanan. 1972. *Fish. Technol.*, **9**, 2:133.

Sulochanan, P., V. C. George & R. M. Naidu. 1968. *Fish. Technol*; **5**, 2:81.

Von Brandt, A. 1964. *Fish catching methods of the world.* Fishing News, Books, London.