Fishery Technology
1994, Vol. 31(2) pp : 112-117

Studies on Square Mesh Codend in Trawls - I Studies with 30 mm Mesh Size

K.K. Kunjipalu, M.D. Varghese
Fishing Technology Division
and A.K. Kesavan Nair
Extension Information & Statistics Division
Central Institute of Fisheries Technology
Cochin - 682 029, India

Covered codend experiments were conducted to determine the selective properties of 30 mm stretched square meshes compared to diamond meshes of same size. Selection curves for square and diamond meshes in respect of six finfish groups namely, *Johnius* spp. *Leiognathus* spp., *Nemipterus japonicus, Saurida tumbil, Dussumieria acuta* and *Thryssa purava;* two species of prawns namely, *Parapenaeopsis stylifera* and *Metapenaeus dobsoni* and squid, *Loligo* sp. have been presented along with parameters such as mean selection lengths, selection ranges and selection factors. The mean selection lengths with respect to *S. tumbil* and *D. acuta* were greater in square mesh than in diamond mesh codend.

The size and shape of codend meshes are the main factors which determine its selectivity (Pope, 1966). The filtering capacity of the trawl can be increased either by enlarging the mesh size or by preventing closure of its lumen under tow. Since the mesh size cannot be increased beyond a certain limit, the other alternative left is to effect changes in mesh shape in order to keep it open under operation. This measure of maintaining square shape for the meshes in the codend facilitates easy escape of smaller size groups and enhances the filtering efficiency.

Investigations were carried out by many workers to study the effect of codend mesh size on the catch. Gulland (1969) suggested the method to find out the mean selection length (L_{50}) which is proportional to the mesh size (m) of codend of trawl. Pope (1966) studied the selectivity of codends of otter trawls. Panicker & Sivan (1965) studied the effect of mesh size of codends of shrimp trawls and recommended the necessity of increasing the mesh size of codend. Sathyanarayana (1985) has studied the size groups of prawns landed by four shrimp trawls having different mesh sizes. George *et al.* (1974) suggested suitable mesh size for the codend of stake nets. Kunjipalu *et al.* (1991) reported that larger mesh size (40 mm) in the codend of *Dol* net (Bag net) has an adverse effect on the catch of secondary species like nonpenaeid prawns and total catch.

Present studies were undertaken to find out the suitability of introducing square mesh in the codend of demersal trawls. This is based on the principle that the square mesh is not distorted by stress and strain during operation unlike the conventional diamond mesh. Codend with square mesh retains its square shape, and hence lumen remains open. The selectivity of square mesh codends has been studied by Robertson (1982, 1983 a, b; 1984; 1986; Robertson & Polanski, 1984; Robertson *et al.*, 1986; Robertson & Stewart, 1986). Kunjipalu & Varghese (1989) have suggested square mesh codend as a conservation and management measure in demersal trawls.

Materials and Methods

Two codends, one in the conventional diamond shape and the other as square mesh,

both with the same mesh size of 30 mm stretched length, were fabricated using 2 mm dia. PE twine. Both the codends were fitted with small meshed covers (nylon; 10 mm stretched mesh) to study the extent of escapement as suggested by Gulland (1969). Both the codends were fabricated as detachable units so as to enable their use with the trawls in sequential rotation. Two trawl designs namely a 40 m demersal trawl (scaled up version of 32 m large mesh demersal trawl, Kunjipalu *et al.*, 1979) and a 32 m high opening trawl (Kunjipalu *et al.*, 1990) were used for the studies. All steel V-form otterboards of size 1500 x 890 mm and 150 kg in weight (Kunjipalu *et al.*, 1984) were used along with the trawls. Investigations were conducted from research vessel, MFV *Matsyakumari*, (17.5 m LOA; 270 hp) off Cochin, southwest coast of India, during 1988-90.

Thirty comparative hauls were taken with codends of diamond mesh and square mesh by alternate tows under identical conditions. Details of catch composition and length statistics of predominant species, both in the codend and cover were estimated from random samples, separately during each haul. Six finfishes, viz., *Johnius* spp., *Leiognathus* spp., *Nemipterus japonicus*, *Saurida tumbil*, *Dussumieria acuta* and *Thryssa purava*; two species of prawns, viz., *Parapenaeopsis stylifera* and *Metapenaeus dobsoni* and the squid *Loligo* sp. were selected for the studies.

Selectivity can be expressed as the proportion of fish of each length entering the net which are retained in the codend (Gulland, 1969). When these proportions are plotted against the length, the selection curve for the particular species is obtained.

The mean selection length L_{50} or the length at which 50% of the fish is retained by the codend was computed by equating the areas on the selections curves as described by Gulland (1969).

The mean selection length is generally proportional to the mesh size of codend meshes over a certain range (Mc Cracken, 1963) and is given by $L_{50} = bm$, where 'b' is the selection factor, and 'm' the stretched mesh size.

To have an idea as to whether the selection occurs over a small or wide range of sizes, the difference between the lengths at which 75% and 25% of the fish are retained by the gear, i.e., the difference between L_{75} and L_{25}, are usually computed. This difference is termed the selection range. Length at which 25% of the fish entering the net are retained, L_{25} and that, at which 75% are retained, L_{75} were read off from the selection curves.

Results and Discussion

Percentage escapement of different species from square and diamond mesh codends are given in Table 1. Percentage escapement of different length classes of fishes from codends of diamond and square mesh are given in Table 2a-i. The mean selection length and the selection factors in respect of two types of codend for six finfishes, two species of prawns and squid are furnished in Table 3. Selection curves of the two types of codend for the above fishes are shown in Fig. 1a-i.

Table 1. *Percentage escapement from codends of 30 mm diamond and square mesh codends*

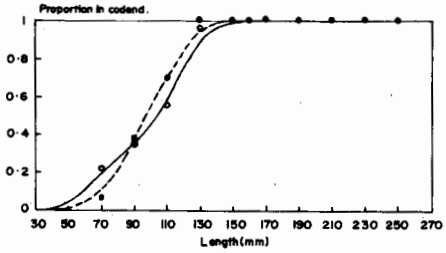
Name of fish	Percentage escapement	
	Diamond mesh	Square mesh
Johnius spp.	9.8	10.4
Leiognathus spp.	67.5	66.1
Nemipterus japonicus	11.5	14.0
Saurida tumbil	24.6	30.3
Dussumieria acuta	58.3	29.6
Thryssa purava	40.7	41.0
Parapenaeopsis stylifera	21.4	19.0
Metapenaeus dobsoni	61.4	56.4
Loligo sp.	30.5	31.9
Total	23.3	27.3

Table 2. *Percentage escapement of different length classes of species groups from 30 mm diamond and square mesh codends*

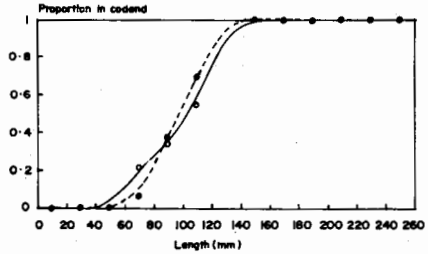
Mid-point of length class, mm	Percentage escapement Diamond mesh	Square mesh
a) *Johnius* spp		
50	100	100
70	79	94
90	67	63
110	45	31
130	6	0
150	0	0
b) *Leiognathus* spp		
30	95	100
50	91	89
70	38	32
90	9	0
110	0	0
c) *Nemipterus japonicus*		
70	100	100
90	63	62
110	44	32
130	11	8
150	0	0
d) *Saurida tumbil*		
70	-	100
90	100	100
110	74	82
130	43	52
150	4	24
170	0	0
e) *Dussumieria acuta*		
50	-	100
70	54	100
90	50	88
110	50	25
130	35	50
150	25	0
170	0	0
190	0	0
f) *Thryssa purava*		
30	-	100
50	-	100
70	100	100
90	81	95
110	75	39
130	9	0
150	0	0
170	0	0
g) *Parapenaeopsis stylifera*		
30	100	100
50	88	98
70	63	43
90	19	16
110	0	12
130	-	-
h) *Metapenaeus dobsoni*		
30	100	100
50	68	83
70	61	59
90	41	24
110	0	0
130	0	-
i) *Loligo* sp.		
30	100	100
50	95	98
70	74	68
90	26	8
110	4	0
130	0	0
150	0	0

Smooth sigmoid curves were obtained for *Johnius* spp., *Leiognathus* spp., *N. japonicus*, *S. tumbil*, *T. purava* and *Loligo* sp. For *D. acuta*, the lack of identity with the sigmoid curve can be attributed to the smaller number of fish in different length groups; for instance, in the size group 120-140 mm. For prawn species, *M. dobsoni* and *P. stylifera*, the selectivity curves differ from the sigmoid pattern. This suggests that there could be factors other than the size which influence the selectivity of prawns.

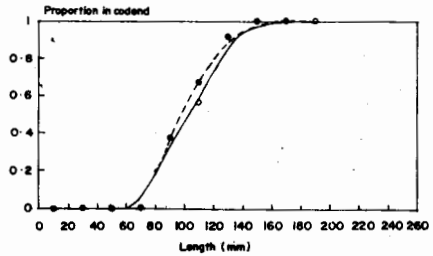
As can be seen from the Tables 1 and 2, difference in the escapement of juveniles



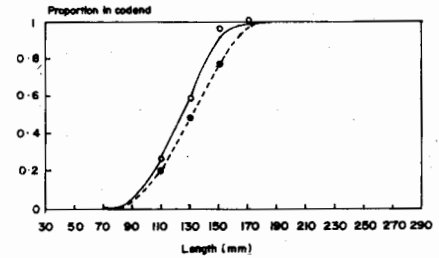
a. *Johnius* spp.



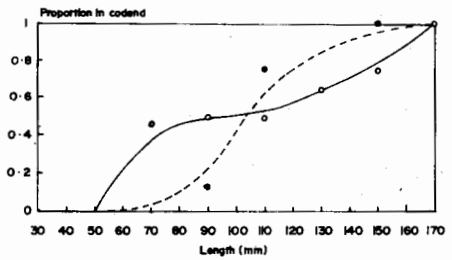
b. *Leiognathus* spp.



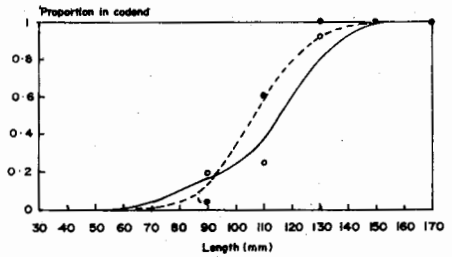
c. *Nemipterus japonicus*



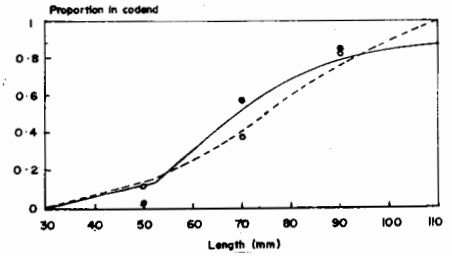
d. *Saurida tumbil*



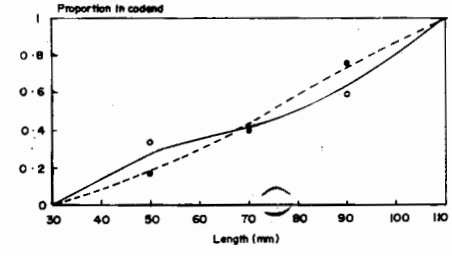
e. *Dussumieria acuta*



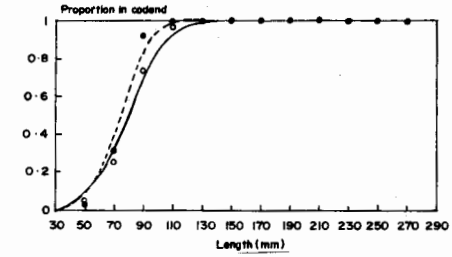
f. *Thryssa purava*



g. *Parapenaeopsis stylifera*



h. *Metapenaeus dobsoni*



i. *Loligo* sp.

Fig. 1. Selection curves for diamond (o——o) and square (● - - - ●) meshes of 30 mm size

Table 3. *Selection lengths corresponding to 25%, 50% and 75% retentions, selection ranges and selection factors*

Name of fish	Shape of codend mesh	L_{25} mm	L_{50} mm	L_{75} mm	Selection range	Selection factor
Johnius spp	Diamond	76.3	99.2	121.5	45.2	3.3
	Square	82.6	97.5	115.3	32.7	3.3
Leiognathus spp	Diamond	56.7	66.6	80.0	23.3	2.2
	Square	53.9	64.1	77.8	23.9	2.1
Nemipterus japonicus	Diamond	84.8	103.6	123.3	38.5	3.5
	Square	84.3	100.6	117.6	33.3	3.4
Saurida tumbil	Diamond	110.0	124.3	140.0	30.0	4.2
	Square	114.8	131.5	150.0	35.2	4.4
Thryssa purava	Diamond	102.8	113.0	128.0	26.1	3.8
	Square	96.7	106.9	118.9	22.2	3.6
Loligo Sp.	Diamond	67.0	80.0	95.0	28.0	2.7
	Square	63.0	75.0	87.0	24.0	2.5
Dussumieria acuta	Diamond	-	102.7	-	-	3.4
	Square	-	112.95	-	-	3.8
Parapenaeopsis stylifera	Diamond	-	84.2	-	-	2.8
	Square	-	73.9	-	-	2.5
Metapenaeus dobsoni	Diamond	-	73.9	-	-	2.5
	Square	-	73.2	-	-	2.4

with regard to the shape of codend were observed for the fish species *S. tumbil* and *D. acuta* and for the prawn species *M. dobsoni*. But the difference in the case of *D. acuta* does not appear to be conclusive, as the data were insufficient, as already mentioned. For *S. tumbil*, the diamond shaped mesh appears to retain more of the catch, compared to square shaped mesh. Table 3 also confirms this, as 25%, 50% and 75% retention lengths are all smaller for diamond shaped codend for this species. For *M. dobsoni*, square shaped mesh appear to retain more of the catch than diamond shaped codend (Table 1). Since some factors other than the size appears to define the shape of the selectivity curves for these species, the 25% and 75% retention lengths for prawns have not been presented. If one considers the performance of the shape of the codend meshes with respect to the total catch, diamond codend appears to retain more of the catch. This, of course, may depend on the composition of fish comprising the total catch.

The authors are thankful to Dr. K. Gopakumar, Director, Central Institute of Fisheries Technology, Cochin for according permission to publish this paper; Shri M.R. Nair, former Director, CIFT for his support and encouragement during the course of the investigations and to Shri P.A. Panicker, Head of Division, Fishing Technology for his keen interest and encouragement during the study. They also express their thanks to Shri M.S. Fernando, Skipper and his crew for their co-operation during the field trials.

References

Gulland, J.A. (1969) *Manual of methods for fish stock assessment - Part I : Fish population analysis.*, FAO Manuals in Fisheries science, No. 4 FRS/M4

George, V.C., Gopalan Nayar, S. & Krishna

Iyer, H. (1974) *Fish. Technol.* **10**, 117

Kunjipalu, K.K., Boopendranath, M.R. & Mohammed Zafar Khan (1991) in *Proc. National Workshop on Low Energy Fishing*, p. 225, Society of Fisheries Technologists (India), Cochin, India

Kunjipalu, K.K. & Varghese, M.D. (1989) Paper presented at the First Kerala Science Congress, 26-28 February, 1989, Cochin, India

Kunjipalu, K.K., Kuttappan, A.C. & George Mathai, P. (1979) *Fish. Technol.* **16**, 19

Kunjipalu, K.K., Pillai, N.S. & Boopendranath, M.R. (1990) *Fish. Technol.* **27**, 1

Kunjipalu, K.K. Boopendranath, M.R. Kuttappan, A.C. & Krishna Iyer, H. (1984) *Fish. Technol.* **21**, 113

Mc Cracken, F.D. (1963) *ICNAF Spec. Publ.* **5**, 131

Panicker, P.A. & Sivan, T.M. (1965) *Fish. Technol.* **2**, 220

Pope, J.A (1966) *Manual of methods for fish stock assessment - Part III Selectivity of Fishing Gear*, FAO Fisheries Technical Paper No. 41

Robertson, J.H.B. (1982) *Scottish Fisheries Working Paper*, **3**, 11 p

Robertson, J.H.B. (1983 a) *Int. Coun. for the Explor. of the Sea*, CM 1983/B: 25, 4 p

Robertson, J.H.B. (1983 b) *Scottish Fisheries Working Paper*, **3**, 4 p

Robertson, J.H.B. (1984) *Int. Coun. for the Explor of the Sea.*, CM 1984/B: 30, 5 p

Robertson, J.H.B. (1986) *Scottish Fisheries Information Pamphlet*, **12**, ISS No. 309, 9105

Robertson J.H.B. & Polanski, J. (1984) *Scottish Fisheries Working Paper*, **9**, 3 p

Robertson, J.H.B. & Stewart, P.A.M. (1986) *Scottish Fisheries Working Paper*, **9**, 8 p

Robertson, J.H.B., Emslie, D.C., Ballantyne, K.A. & Chapman, C.J. (1986) *Int. Coun. for the Explor. of the Sea*, CM 1986/B: 12, 5 p

Satyanarayana, A.V.V. (1985) *Fish. Technol.* **2**, 87