

Effect of Mesh Size on Selectivity of Square Mesh Codends

K.K. Kunjipalu, B. Meenakumari, T. Joseph Mathai,
M.R. Boopendranath and R.S. Manoharadoss

Central Institute of Fisheries Technology
Matsyapuri P.O., Cochin-682 029, India

The effect of mesh size on the selective escapement of length class of trawl resources including nine fin fishes and three shell fishes was studied using 20, 25, 30 and 40 mm square mesh codends. Comparatively more juveniles and sub adults were retained in 20 mm square mesh cod ends while 40 mm square mesh permitted escapement of many commercially important groups such as penaeid prawns and squid. 30 mm square mesh cod end has shown compromise size selection properties by providing escapement of most of the juveniles while retaining bulk of economically important species groups. Selectivity parameters and selection curves were determined in respect of twelve species selected for the study.

Key words: Codend selectivity, square mesh, trawl

Pope (1966) has reported that the size and shape of codend meshes determine the selectivity of codend in trawls. Gulland (1969) suggested a method to find out the mean selection length (L_{50}) which is proportional to the mesh size (mm) of codend of trawl. The selectivity of square mesh codends was studied by Robertson (1982, 1983a,b; 1984, 1986), Robertson & Stewart (1986), Kunjipalu *et al.* (1994a,b; 1997), Varghese *et al.* (1996) and Pillai *et al.* (1996). The present study was undertaken to find out the effectiveness of four mesh sizes in square mesh codends in facilitating escapement of juveniles.

Materials and Methods

Data for the study were collected from experiments carried out with covered codends, conducted during July 1995-June 1997, off Cochin, Kerala. Four square mesh codends with 20, 25 30 and 40 mm mesh size were fabricated and fitted with covers of small mesh size of 10 mm as described by Kunjipalu *et al.* (1994a,b). Experimental square mesh codends were operated with semi balloon trawls and demersal trawls described by Kunjipalu *et al.* (1998a,b).

Fishes collected in the cover and inner codend were sorted out species-wise and length statistics were taken for determining percentage escapement. Selectivity parameters and selection curves in respect of different species were determined as described by Sparre *et al.* (1969).

Results and Discussion

Percentage escapement of different length classes of 9 fin fish resources viz. *Lactarius* sp., *Johnius* sp., *Leiognathus* sp., *Dussumieria* sp., *Caranx* sp., *Stolephorus* sp., *Thryssa* sp., *Cynoglossus* sp., *Decapterus* sp. and three shellfish resources viz. *Metapenaeus dobsoni*, *Parapenaeopsis stylifera* and *Loligo* sp. are given in Tables 1-12, separately for 20, 25, 30 and 40 mm codends. Selectivity curves and estimated selectivity parameters in respect of these species for square mesh codend are given in Figs. 1-12 and Table 13, respectively.

As seen from Tables escapement of juveniles and sub-adults of all species was found to be less from 20 mm square mesh codend compared to the other three mesh sizes. On the contrary, 40 and 30 mm square

Table 1. Percentage escapement of different length groups of *Lactarius lactarius* in 20, 25, 30 and 40 mm square mesh codends

Length group (mm)	Escapement			
	20 mm	25 mm	30 mm	40 mm
20-39	59.00	100.00	100.00	100.00
40-59	76.61	100.00	97.21	100.00
60-79	46.74	27.59	90.96	100.00
80-99	0.00	6.75	52.83	100.00
100-119	0.00	0.94	0.00	0.00
120-139	0.00	0.00	0.00	0.00
140-159	0.00	0.00	0.00	0.00
160-179	0.00	0.00	0.00	0.00
180-199	0.00	0.00	0.00	0.00

Table 2. Percentage escapement of different length groups of *Johnius* sp. in 20, 25, 30, and 40 mm square mesh codends

Length group (mm)	Escapement			
	20 mm	25 mm	30 mm	40 mm
20-39	59.09	100.00	100.00	100.00
40-59	58.24	79.66	96.35	100.00
60-79	19.95	38.79	83.33	98.36
80-99	2.15	3.08	16.56	58.79
100-119	0.07	0.50	0.17	32.81
120-139	0.00	0.00	0.00	5.60
140-159	0.00	0.00	0.00	0.00
160-179	0.00	0.00	0.00	0.00
180-199	0.00	0.00	0.00	0.00
200-219	0.00	0.00	0.00	0.00
220-239	0.00	0.00	0.00	0.00
240-259	-	0.00	0.00	0.00

Table 3. Percentage escapement of different length groups of *Leiognathus* sp. in 20, 25, 30 and 40 mm square mesh codends

Length group (mm)	Escapement			
	20 mm	25 mm	30 mm	40 mm
20-39	98.00	91.27	100.00	100.0
40-59	53.83	64.58	93.85	100.0
60-79	10.81	13.21	43.97	93.5
80-99	1.50	0.00	3.33	1.85
100-119	0.00	0.00	0.00	0.00
120-139	0.00	0.00	0.00	0.00
140-159	0.00	0.00	0.00	0.00

Table 4. Percentage escapement of different length groups of *Dussumieria acuta* in 20, 25, 30 and 40 mm square mesh codends

Length group (mm)	Escapement			
	20 mm	25 mm	30 mm	40 mm
20-39	0.00	0.00	0.00	0.00
40-59	0.00	0.00	0.00	0.00
60-79	54.22	100.00	100.00	100.00
80-99	21.85	76.06	61.52	100.00
100-119	8.44	27.40	38.26	100.00
120-139	0.00	0.96	1.02	74.16
140-159	0.00	0.35	0.00	0.00
160-179	0.00	0.00	0.00	0.00
180-199	0.00	0.00	0.00	0.00
200-219	0.00	0.00	0.00	0.00

Table 5. Percentage escapement of different length groups of *Caranx para* in 20, 25, 30 and 40 mm square mesh codends

Length group (mm)	Escapement			
	20 mm	25 mm	30 mm	40 mm
20-39	0.00	0.00	100.00	100.00
40-59	96.32	0.00	94.29	100.00
60-79	13.70	100.00	53.95	85.96
80-99	21.07	17.46	25.14	50.84
100-119	0.00	2.27	10.41	31.89
120-139	0.00	0.00	0.50	4.38
140-159	0.00	0.00	0.00	0.00
160-179	0.00	0.00	0.00	0.00

Table 6. Percentage escapement of different length groups of *Stolephorus* sp. in 20, 25, 30 and 40 mm square mesh codends

Length group (mm)	Escapement			
	20 mm	25 mm	30 mm	40 mm
20-39	99.70	98.96	100.00	100.00
40-59	92.40	95.75	94.95	100.00
60-79	80.01	84.02	79.88	99.81
80-99	87.00	79.78	89.33	97.70
100-119	0.00	22.54	4.92	75.00
120-139	0.00	0.00	0.00	0.00

Table 7. Percentage escapement of different length groups of *Thryssa* sp. in 20, 25, 30 and 40 mm square mesh codends

Length group (mm)	Escapement			
	20 mm	25 mm	30 mm	40 mm
20-39	100.00	100.00	100.00	100.00
40-59	100.00	100.00	100.00	100.00
60-79	80.20	67.52	92.09	100.00
80-99	41.83	16.40	66.34	100.00
100-119	4.61	5.88	55.98	90.00
120-139	0.00	0.00	0.00	6.25
140-159	0.00	0.00	0.00	0.00
160-179	0.00	0.00	0.00	0.00
180-199	0.00	0.00	0.00	0.00

Table 8. Percentage escapement of different length groups of *Cynoglossus* sp. in 20, 25, 30 and 40 mm square mesh codends

Length group (mm)	Escapement			
	20 mm	25 mm	30 mm	40 mm
60-79	92.45	100.00	100.00	100.00
80-99	63.43	100.00	87.05	100.00
100-119	49.35	3.05	42.01	100.00
120-139	0.00	0.00	30.77	79.02
140-159	0.00	0.00	0.00	0.00
160-179	0.00	0.00	0.00	0.00
180-199	0.00	0.00	0.00	0.00

Table 9. Percentage escapement of different length groups of *Decapterus* sp. in 20, 25, 30 and 40 mm square mesh codends

Length group (mm)	Escapement			
	20 mm	25 mm	30 mm	40 mm
40-59	100.00	100.00	100.00	100.00
60-79	100.00	100.00	100.00	100.00
80-99	82.22	100.00	99.15	92.89
100-119	0.00	11.00	64.71	51.72
120-139	0.00	6.00	0.00	52.94
140-159	0.00	0.00	0.00	0.00
160-179	0.00	0.00	0.00	0.00
180-199	0.00	0.00	0.00	0.00
200-219	0.00	0.00	0.00	0.00

Table 10. Percentage escapement of different length groups of *Metapenaeus dobsoni* in 20, 25, 30 and 40 mm square mesh codends

Length group (mm)	Escapement			
	20 mm	25 mm	30 mm	40 mm
20-39	96.16	100.00	100.00	100.00
40-59	42.30	51.13	73.28	100.00
60-79	3.96	19.55	51.00	29.73
80-99	0.30	0.00	1.02	12.23
100-119	0.00	0.00	0.00	0.00

Table 11. Percentage escapement of different length groups of *Parapenaeopsis stylifera* in 20, 25, 30 and 40 mm square mesh codends

Length group (mm)	Escapement			
	20 mm	25 mm	30 mm	40 mm
20-39	91.67	87.02	100.00	100.00
40-59	73.58	67.58	82.01	100.00
60-79	15.46	7.76	43.51	31.00
80-99	0.14	1.36	2.91	9.00
100-119	0.00	0.00	0.00	0.00

Table 12. Percentage escapement of different length groups of *Loligo* sp. in 20, 25, 30 and 40 mm square mesh codends

Length group (mm)	Escapement			
	20 mm	25 mm	30 mm	40 mm
20-39	89.60	94.67	98.78	100.00
40-59	45.08	54.17	81.91	100.00
60-79	0.00	0.00	34.45	76.40
80-99	0.00	0.00	0.00	34.78
100-119	0.00	0.00	0.00	7.41
120-139	0.00	0.00	0.00	0.00
140-159	-	0.00	0.00	0.00
160-179	-	0.00	0.00	0.00
180-199	-	0.00	0.00	0.00
200-219	-	0.00	0.00	0.00
220-239	-	-	0.00	0.00
240-259	-	-	-	0.00

Lactarius lactarius
25 mm Square mesh

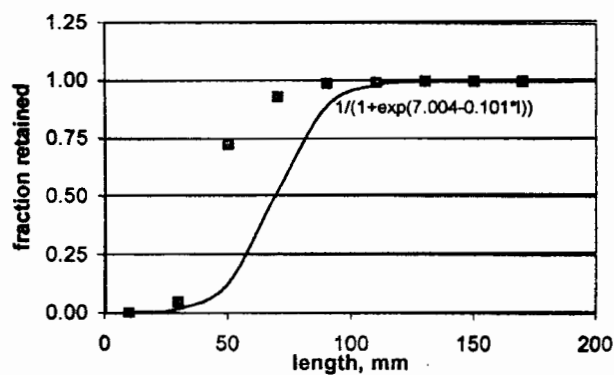


Fig. 1. Selectivity curve for *Lactarius lactarius*

Dussumieria acuta
40 mm square mesh

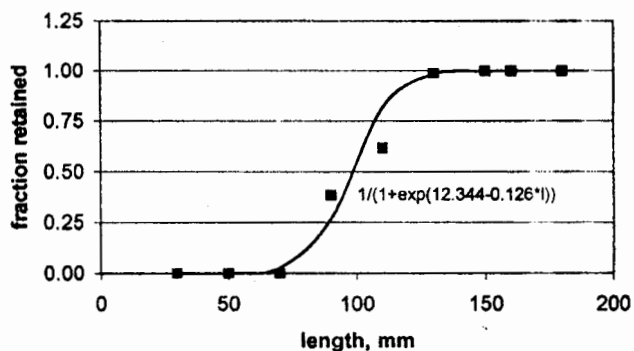


Fig. 4. Selectivity curve for *Dussumieria acuta*

Johnius sp.
40 mm square mesh

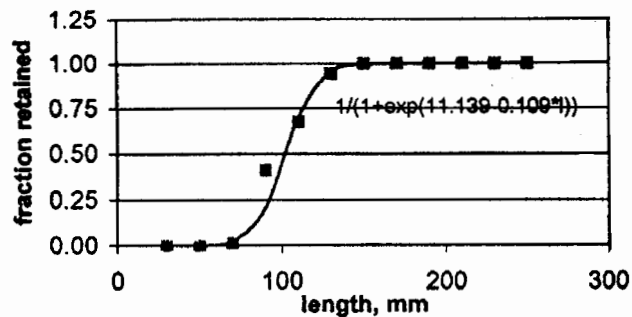


Fig. 2. Selectivity curve for *Johnius sp.*

Caranx para
40 mm square mesh

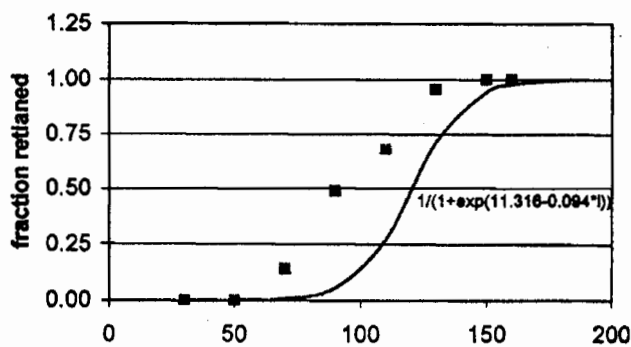


Fig. 5. Selectivity curve for *Caranx para*

Leiognathus sp.
40 mm square mesh

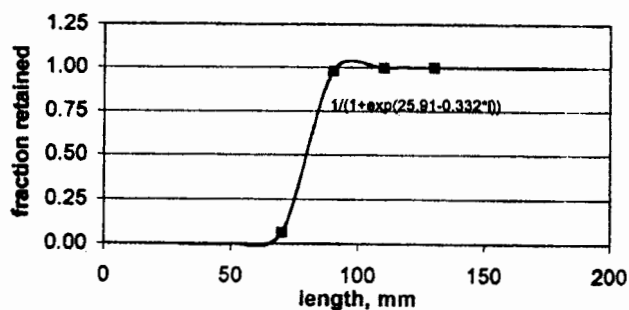


Fig. 3. Selectivity curve for *Leiognathus sp.*

Stolephorus sp.
20 mm square mesh

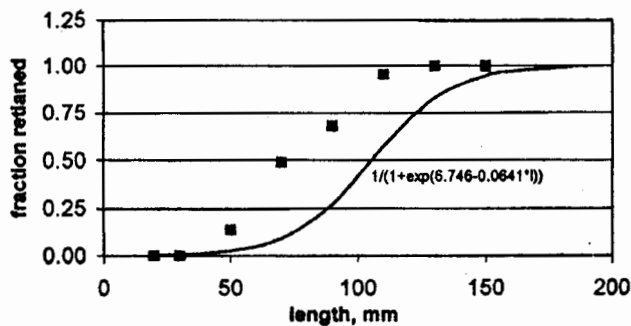
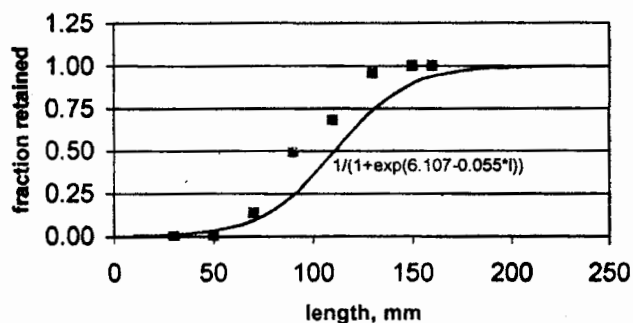


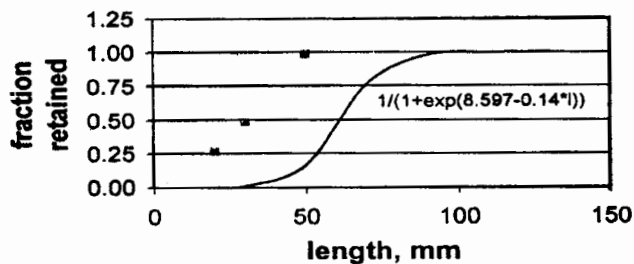
Fig. 6. Selectivity curve for *Stolephorus sp.*

***Thryssa* sp.**

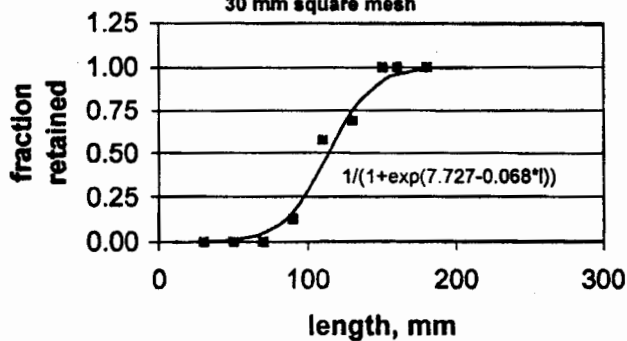
30 mm square mesh

Fig. 7. Selectivity curve for *Thryssa* sp.***Metapenaeus dobsoni***

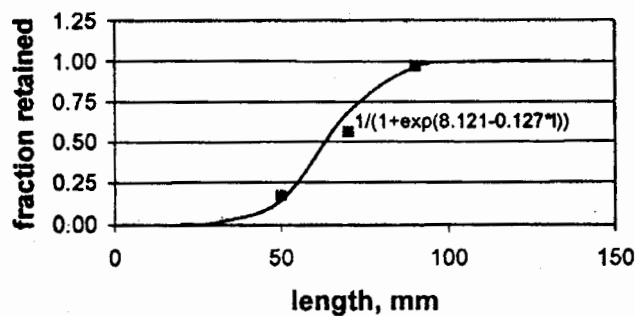
30 mm square mesh

Fig. 10. Selectivity curve for *Metapenaeus dobsoni****Cynoglossus* sp.**

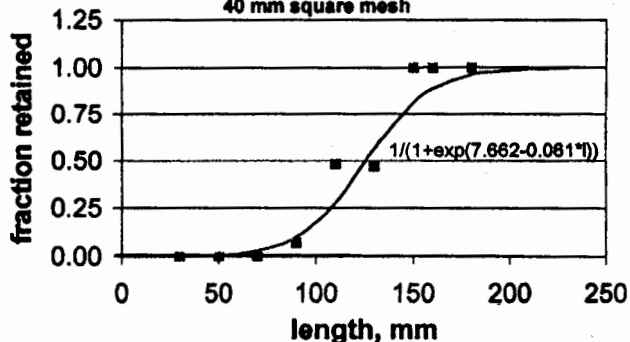
30 mm square mesh

Fig. 8. Selectivity curve for *Cynoglossus* sp.***Parapenaeopsis stylifera***

30 mm square mesh

Fig. 11. Selectivity curve for *Parapenaeopsis stylifera****Decapterus* sp.**

40 mm square mesh

Fig. 9. Selectivity curve for *Decapterus* sp.***Loligo* sp.**

30 mm square mesh

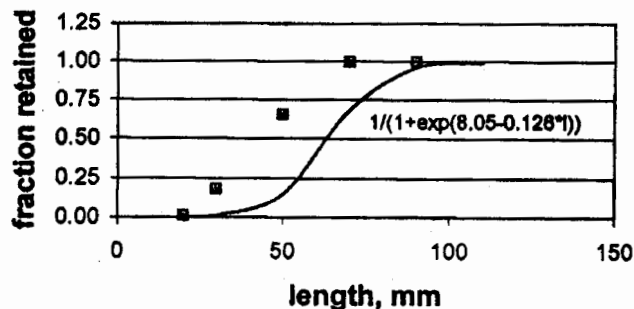
Fig. 12. Selectivity curve for *Loligo* sp.

Table 13. Selectivity parameters for square mesh codend

Species	Mesh size, mm	L _{25%} mm	L _{50%} mm	L _{75%} mm	Selection range, mm	Selection factor
<i>L. lactarius</i>	25	58.47	69.35	80.22	21.75	2.77
<i>Johnius</i> sp.	40	92.11	102.19	112.27	20.16	-2.56
<i>Leiognathus</i> sp	40	74.73	78.04	81.35	6.62	1.95
<i>D. acuta</i>	30	89.25	97.97	106.69	17.44	3.27
<i>C. para</i>	40	108.70	120.38	132.07	23.37	3.01
<i>Stolephorus</i> sp.	20	88.24	105.41	122.57	34.33	5.27
<i>Thryssa</i> sp.	30	91.06	111.04	131.01	39.95	3.70
<i>Cynoglossus</i> sp.	30	90.86	107.01	123.17	32.31	3.57
<i>Decapterus</i> sp.	40	107.60	125.61	143.62	36.02	3.14
<i>M. dobsoni</i>	30	53.56	61.41	69.25	15.69	2.05
<i>P. stylifera</i>	30	55.29	63.94	72.60	17.30	2.13
<i>Loligo</i> sp.	30	55.17	63.89	72.61	17.44	2.13

mesh codends provided 100 percent or near 100 percent escapement of juveniles of all species considered for the study. 25 mm square mesh codend also facilitated the escapement of a certain percentage of juveniles next to 30 mm square mesh codend. However, 40 mm square mesh codend permitted escapement of some quantity of commercial size groups of economically important fishes especially penaeid prawns (*M. dobsoni* and *P. stylifera*) Tables 10 and 11) and squid (*Loligo* sp.) (Table 12).

In the case of *Lactarius lactarius*, 100% escapement was observed in the size group of 80-99 mm from 40 mm square mesh codend (Table 1). In the case of *Johnius* sp. (Table 2), escapement of size groups 80-99mm was 58.79% and of 100-119 mm it was 32.81% from 40 mm square mesh codend. On the other hand, escapement of juveniles and sub-adults was in the range of 58.24-59.09% in 20 mm square mesh codend, while it was 79.66-100% in 25 mm, 96.35-100% in 30 mm and 100% in 40 mm square mesh codend (Table 2).

As can be seen from Tables 10, and 11, 29.73% of 60-79 mm size group of *M. dobsoni*

and 31% of *P. stylifera* escaped from 40 mm square mesh codend. Also, 34.78% of 80-90 mm size and 76.40% of 60-79 mm size groups of *Loligo* sp. escaped from 40 mm square mesh codend (Table 12).

It is evident from the analysis that mesh size below 25 mm in square mesh codend provided very little chance of escapement for juveniles; whereas mesh size 30 mm provided better chance of escapement of juveniles and sub-adults. Hence, minimum mesh size is suggested to be above 25 mm and preferably 30 mm for square mesh codends in demersal trawls operated in the inshore waters for better management and conservation of fish stocks. Kunjipalu *et al.* (1997) have already reported that the size of mesh is more effective than the shape of mesh whether diamond or square, especially when the size of mesh is as small as 20 mm.

The authors express their thanks to Dr. K. Devadasan, Director, Central Institute of Fisheries Technology, Cochin for according permission to publish this paper. They also express their thanks to Skippers and crew of MFB Matsyakumari and MFV Sagar Shakti for their co-operation in conducting the field trials and technicians in fabrication of experimental fishing gears and collection of data from the field.

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
- Kunjipalu, K.K., Varghese, M.D. & Nair, A.K.K (1994 a) *Fish. Technol.* 31,112
- Kunjipalu, K.K., Varghese, M.D., Subramonia Pillai, N., Boopendranath, M.R. & Meenakumari, B. (1994 b) *Fish Technology News Letter*, 7, (3 & 4):3
- Kunjipalu, K.K., Varghese, M.D., Subramonia Pillai, N., Boopendranath, M.R. & Meenakumari, B. (1997) In *Proc. Technological Advancements in Fisheries*. (Hameed, M.S. & Kurup, B.M.Ed.) p.197 Publ. No.1. School of Industrial Fisheries Cochin University of Science and Technology.
- Kunjipalu, K.K., Subramonia Pillai, N., Varghese, M.D., Boopendranath, M.R., Meenakumari, B., Joseph Mathai, T. J. & Iyer, H. (1998a) In *Advances and Priorities in Fisheries Technology* (Balachandran, K.K., Iyer, T.S.G., Madhavan, P., Perigreen, P.A., Raghunath, M.R. & Varghese, M.D., Eds.), p.155, SOFT (I) Cochin.
- Kunjipalu, K.K., Boopendranath, M.R., Pillai, N.S., Varghese, M.D., Joseph Mathai, T.J., & Meenakumari, B. (1998b). In *Advances and Priorities in Fisheries Technology*, (Balachandran, K.K., Iyer, T.S.G., Madhavan, P., Perigreen, P.A., Raghunath, M.R. & Varghese, M.D., Eds.), p.160 SOFT (I) Cochin.
- Pillai, N.S., Varghese, M.D., & Kunjipalu, K.K. (1996) *Studies on trawl selectivity with square mesh panel in the codend*. In The Fourth Indian Fisheries Forum Proceed-ings, 24-28 November, Kochi, 461
- 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, p.11
- Robertson, J.H.B. (1983a) *Int. Coun. for the Explor. of the sea*, CM 1983/B:25
- Robertson, J.H.B. (1983b) *Scottish Fisheries Working Paper*
- Robertson, J.H.B. (1984) *Int. Coun. for the explor. of the sea*, CM 1984/B:30
- Robertson, J.H.B. (1986) *Scottish Fisheries Information Pamphlet*, 12, ISSN0.309, 9105
- Robertson, J.H.B. & Stewart, P.A.M. (1986) *Scottish Fisheries Working Paper*, 9, 8
- 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
- Sparre, P., Ursin, E. & Venema, S.C. (1989) *Introduction to tropical fish stock assessment*. FAO Fish. Tech. Pap. 306/1, p.337.
- Varghese, M.D., Kunjipalu, K.K. & Nair, A.K.K. (1996) *Fish Technol.* 33, 96