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IMPACT OF SQUARE MESH CODEND ON CONSERVATION OF RESOURCES

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ABSTRACT

Retention of immature and undersized species of fishes and shrimps in the conventional diamond mesh codends of trawls, results in indiscriminate exploitation and consequent resource crunch. Replacement of diamond mesh codend with square mesh which remain open under tow unlike the former, facilitates escape of juveniles through better filtration. Length frequency studies were undertaken with codends of different shape and size to compare the size pattern of different species caught in the diamond and square mesh codends and also to evaluate the performance in reducing the retention of discards and immature fish. The analysis of the data revealed that the square mesh codends retained considerably less small fish. The length at 50% retention was more in square mesh codends in respect of certain species. But this phenomenon was not applicable to some species in view of the morphological differences between species and also when the codend is saturated with high catch.

Introduction

The continued operation of conventional trawls led to indiscriminate capture of immature fish and shrimps smaller than commercial size. This state of affairs calls for appropriate management strategies to conserve young fish and to protect over exploited species for a sustainable yield. Recent work on fishing gear is concentrated mainly on mesh selection. In order to release more small fish from conventional codend, the basic requirement is to increase mesh opening and provide conditions, which stimulate the fish to leave the codend. Pope (1966) observed that the size and shape of codend mesh determines its selectivity. The benefit of mesh selection is insufficiently attained by conventional diamond mesh as its lumen is closed during trawling. The diamond mesh has a tendency to close up once the netting comes under tension due to filling up of the codend and the consequent pull exerted in the direction of drag. Since the selection is dependant on the mesh opening, the process is vulnerable to changes in the shape of webbing in the codend. Robertson and Stewart (1986) stated that the selection curve is steeper for square mesh than diamond mesh and the mesh selection parameters for the former tended to be less variable. Sharper selections should be found in codends having least variability in shape and opening (Jones 1963 and McCracken 1963). This condition is satisfied by square mesh as it retains its shape under load without characteristic stretching as in diamond mesh codend (Robertson and Stewart, 1988).

Much attention has been given to assessing selective properties of square mesh codends on trawl gear especially demersal trawls (Carr, 1989). According to Fontyne and Rabit (1992) square mesh may reduce the catch of small round fish. Kunjipalu (1994) proposed replacement of diamond mesh to avoid capture of small and immature fishes. Varghese *et.al.* (1996) found that the selection length was more in square mesh releasing juveniles. It was observed that mesh size is more critical than the shape of mesh (Kunjipalu *et.al.*, 1998). and more fishes tended to escape through square mesh panel. Gudni (1992) observed that square mesh is superior to diamond mesh in releasing small fish. Broadhurst and Kennelly (1994) found that square mesh codend showed 52% reduction in the mean weight of shrimps compared to conventional codends.

The selectivity of codend is dependant on the morphometry and biological state of individuals of the species. In the case of American plaice, larger L50, retention length is observed in diamond mesh which may be related to its laterally compressed body. Unlike round fish, this difference in shape would favour escapement through elongated meshes of diamond mesh (Simpson, 1963). According to Jose *et.al.* (1998) 50% retention length increased with increasing mesh size for both diamond and square mesh, with rock fish providing on average larger values than flat fish.

The present investigation was carried out to compare the selection pattern of diamond and square mesh cod-ends and also to prescribe optimum mesh size for commercial size groups.

Materials and methods

Three types of detachable codends that differed in size (20, 30 and 40 mm) and shape (square and diamond) were designed and fabricated using 1.5 mm dia PE twine. These were provided covers with nylon webbing of 10 mm mesh size (Fig.1). The dimensions of these covers were 1.5 times more than the codends. The codends with covers were attached to standard trawl gear, 31.6 m (HR) and operated during the period April 1996 to September 1998 in combination with `V' form otter board, 1370 x 820 mm (110 kg) from the departmental vessels, **MFV Matsyakumari** (OAL 17 m, 270 HP) and **MFV Sagar Shakti** (OAL 15.24 m, 223 HP) off Cochin at a depth range 9 to 15 m.

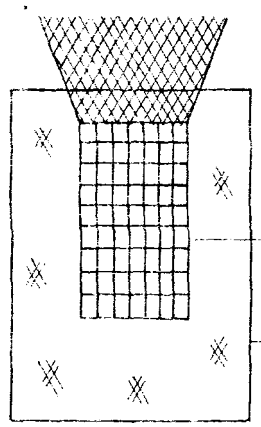

Fig.1 Square mesh codend with cover

Alternate hauls were made with diamond and square mesh codends, and in all 150 hauls were taken using 20, 30 and 40 mm mesh codends under identical conditions providing equal chances to individual codends. During each day the mesh size of the codend was measured with ICES pressure gauge, set at 2 kg tension (Fig.2) for upto 35 mm and 4 kg above 35 mm.

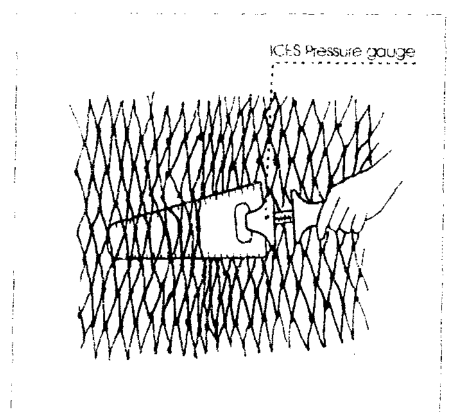

Fig.2 Showing measurement of mesh using ICES Pressure gauge

The fishes and shrimps retained in the codend and those escaped and collected in the respective covers were identified and the total length of individual species was recorded. Length measurements were grouped into classes of width, 10 mm and frequencies in the size classes were compiled. Fraction retained in the codend was calculated and plotted against the respective length (midpoint of the class). The plot showed sigmoid pattern and therefore the logistive curve.

$S\lambda = 1/\{1+\exp(S_1-S_2*1)\}$, was fitted to the plots (Sparre and Venema, 1992). S1 and S2 were estimated by regressing, $Y = \ln(1/S_1-1)$ on x = length. The Y-intercept gives an estimate of S_1, and the slope gives an estimate of $(-S_2)$.

The mean selection length lc, was estimated as the ratio of S_1 to S_2. Selection ranges were obtained as the difference between the 75% and 25% selection lengths, i.e.

Selection range = $l75\% - l25\%$.

The percentage of different species collected in the cod-end and covers were worked out and are given in Table 2. Table 1, depicts the mean size of fish and shrimps escaped from the codends.

Table 1 : Mean size of species (mm) escaped from 20, 30 and 40 mm codends

Species	Square	Diamond
Codend mesh 20 mm		
Parapenaeopsis stylifera	49.12	47.32
Stolephorus spp.	57.10	59.50
Metapeneus dobsoni	55.70	56.82
Codend mesh 30 mm		
Parapenaeopsis stylifera	55.98	56.71
Stolephorus spp.	59.20	55.80
Metapenaeus dobsoni	61.90	58.69
Metapenaeus affinis	59.20	56.00
C. macrostomus	98.09	-
Johnius dussumieri	72.00	64.30
Codend mesh 40 mm		
Pellona spp.	119.80	119.00
Caranx spp.	77.50	79.20
Leiognathus spp.	85.00	82.50
Formio niger	102.00	-

Table 2 : Size range (mm) and retention (%) in 20, 30 and 40 mm square and diamond mesh codend

Species	Square				Diamond			
	Size range	Reten -tion	Size range	Escape ment	Size range	Reten- tion	Size range	Escape ment
Codend mesh	*20 mm*							
P. stylifera	40-120	82.99	10-80	17.01	20.120	51.53	20-80	48.47
Stolephorus spp.	20-80	0.24	0-100	99.76	40-100	1.40	20-100	98.60
M.dobsoni	20-120	93.31	40-80	61.69	40-100	91.34	40-80	8.66
C.macrostomus	80-120	76.91	60-120	23.04	-	-	-	-
Codend mesh	*30 mm*							
P.stylifera	40-100	61.39	20-80	38.61	40-100	71.40	20-80	28.60
Stolephorus spp.	-	-	40-80	100.00	20-120	87.11	20-140	12.89
M.dobsoni	40-120	90.56	20-120	9.44	40-120	47.56	20-80	53.44
C.macrostomus	80-140	23.38	60-140	76.62	100-190	100.00	-	-
J.dussumieri	80-155	51.20	55-95	48.80	60-160	65.00	45-105	35.00
M.affinis	45-85	38.20	40-75	61.80	50-90	51.20	40-75	48.80
Codend mesh	*40 mm*							
Pellona spp.	110-135	63.50	105-130	36.50	105-135	52.00	105-135	48.00
Caranx spp.	60-130	42.00	40-100	58.00	50-140	20.70	30-110	79.30
Leiognathus spp.	75-110	82.50	80-100	17.50	80-105	90.00	85-90	10.00
F.niger	70-160	70.10	70-130	29.90	70-130	100.00	-	-

Results and discussion

The mean size of individual species which were collected in the covers of respective codends is furnished in Table 1. It was observed that in majority of cases, irrespective of the size of codends, the mean size in square mesh was higher than that of diamond mesh. However, in the case of *P. stylifera*, the mean size was low in 30 mm square mesh compared to diamond mesh. The same trend was observed in respect of *Caranx* spp. in 40 mm mesh

Regarding the escapement and retention (%) as shown in Table 2, the retention was more in square mesh (20 mm) in the case of *P. stylifera* whereas it was comparable in diamond mesh. In the case of other species caught in square and diamond mesh, codends did not show much variation. In 30 mm the percentage of escapement was more in square mesh for *P. stylifera*, compared to diamond mesh. The retention of *J. dussumieri* was more in diamond than square mesh. In 40 mm codend, the escapement was 79.3% in diamond mesh whereas it was 58% in square mesh as evident in the case of *Caranx* spp., indicating better retention in the latter.

The fractions retained in the codend were plotted against respective length and selection gives obtained in respect of, *M. affinis, P. stylifera* and *Leiognathus* spp. for 30 mm mesh codend (Figs.3, 4 and 5). The selection curve showed sigmoid pattern, characteristic of trawl nets. The selection parameters along with the equation to the selection curves are furnished in Table 3. The selection length, lc was higher for *M. affinis* and lesser for *Leiognathus* in square mesh. The values for both square and diamond mesh did not show much difference for *P. stylifera*. Pillai *et.al.* (1994) reported that the average length of fishes was high by fitting square mesh panel to the codend. According to Gudni (1992), smaller size groups escaped through square mesh establishing its superiority over diamond mesh in releasing undersized species. In the present case the reduction in mean size and more escapement in square mesh indicated the efficiency of square mesh in protecting the immature and the undersized fish from over exploitation. The increase in selection length, for *Leiognathus* in 30 mm diamond mesh and mean size for *Caranx* spp. in 40 mm diamond mesh can be attributed to morphological differences. The laterally compressed body of these species, is favoured by the elongated meshes of diamond mesh. The same phenomenon was observed by Simpson (1963) in the case of American plaice. The selectivity is affected by the quantum of catch as better selection is obtained in the case of moderate catch.

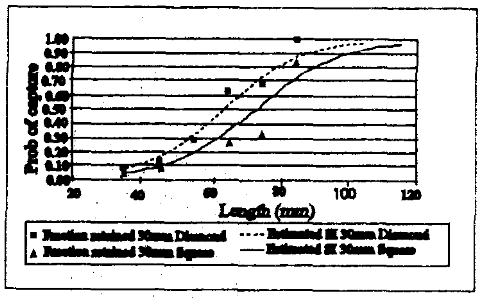

Fig.3 Selectivity of *M.affinis* for 30mm Diamond and Square meshes

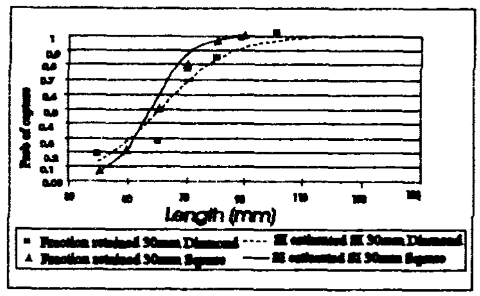

Fig.4 Selectivity of *P. Stylifera* for 30mm Diamond and Square meshes

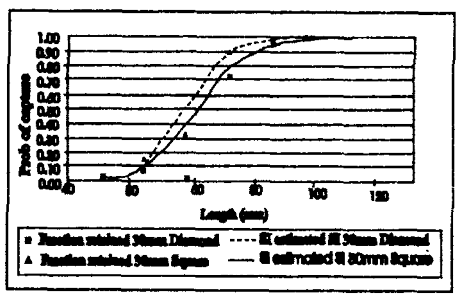

Fig.5 Selectivity of *Leiognathus* sp. for 30mm Diamond and Square meshes

Table 3 : Selection lengths corresponding to 25%, 50% and 75% retentions, selection ranges and selection factors for 30 mm mesh size

Name of fish	Shape of codend mesh	125% (mm)	150% (mm)	175% (mm)	Selection range (mm)	Selection factor	Equation to the selection ogive
Parapenaeopsis stylifera	Diamond	48.1	61.0	73.9	25.7	2.4	S_l=1/{1+exp(5.2112-0.0854*l)}
	Square	50.7	57.6	64.5	13.8	1.7	S_l=1/{1+exp(9.1591-0.1589*l)}
Metapenaeus affinis	Diamond	51.3	63.7	76.1	24.8	1.7	S_l=1/{1+exp(5.6406-0.0885*l)}
	Square	59.2	73.2	87.1	27.8	2.0	S_l=1/{1+exp(5.7752-0.0789*l)}
Leiognathus spp.	Diamond	60.7	67.4	74.1	13.4	2.2	S_l=1/{1+exp(11.0199-0.1635*l)}
	Square	59.0	64.8	70.5	11.5	2.2	S_l=1/{1+exp(12.3641-0.1909*l)}

The above observations confirm that square mesh is superior to diamond mesh in releasing juveniles and undersized, favouring conservation of resources and hence can be adopted as a management measure to control indiscriminate trawling practices for a sustained yield.

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