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Size selectivity of diamond and square mesh codends for largehead hairtail *Trichiurus lepturus* Linnaeus, 1758

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ABSTRACT

Trawl codend mesh selectivity with respect to largehead hairtail *Trichiurus lepturus* was studied along Andhra Pradesh coast. Covered codend method was used to obtain the selectivity data. The L_{25}, L_{50} and L_{75} values for 40 mm square mesh codend were 30.75, 36.2 and 41.65 mm respectively with the selection range, selection factor and selection ratio being 10.9 and 9.05 and 0.30 respectively. The L_{25}, L_{50} andL_{75} values for 40 mm diamond mesh codend were 25.96, 33.4 and 40.95 mm, the selection range, selection factor and selection ratio being 14.9, 8.35 and 0.44 respectively The retention mean length in square mesh was found to be greater than diamond mesh. The square mesh was also found to be more efficient in eliminating juveniles than conventional diamond mesh codend .

Keywords: Diamond mesh codend, Size selectivity, Square mesh codend, Trawl net, *Trichiurus lepturus*

Introduction

Conventional otter trawls indiscriminately catch undersized fish by using smaller meshes in codends and huge quantities of bycatch are discarded at sea. The size and shape of meshes in the codend of trawls play a very important role in the exclusion of under sized fishes. When compared to diamond mesh, square mesh codend has been reported to be more selective, for several species (Stergiou *et al*., 1997). Impact of codend mesh size on trawl fishery has been studied by Rajeswari *et al*. (1998). Lumen of the diamond meshes tend to close under tension, particularly, at the middle of the codend and prevent escapement of small fishes during trawling. In the square mesh codends, the mesh will remain open and facilitate the escapement of juvenile fish (Robertson,1983; Robertson and Ferrow, 1988; Kunjipalu *et al*., 1994; Varghese *et al*, 1996; Boopendranath and Pravin, 2005; Raghu Prakash *et al*., 2008; 2010; Rajeswari *et al*., 2010). Selectivity information is an important tool for fishery managers for regulating the mesh sizes for fisheries conservation purposes.

The ribbonfishes of the family Trichiuridae are an important group of food fishes in India, forming 4.8% of the total marine fish production and 9.3% of the pelagic resources (Reuben *et al*., 1997). Ribbonfishes are widely distributed throughout tropical and temperate waters. It forms a major component of trawl catches along Visakhapatnam coast. Largehead hairtail *Trichiurus lepturus* Linnaeus, 1758, forms the mainstay of the ribbonfish fishery, contributing to the bulk of the landings along the coastline (James *et al.,* 1986). In Andhra Pradesh, *T. lepturus* is targeted by commercial trawlers using demersal trawls and drift gill nets. The present study was undertaken to compare the size selectivity of diamond and square mesh codends for the ribbon fish, *Trichiurus lepturus*

Material and methods

Codends of 40 mm diamond mesh and 40 mm square mesh were fabricated out of 1 mm dia polyethylene (PE) netting. The experiments were carried out onboard CIFT Research Vessel CIFTECH-I (15.5 m L_{OA}; 122 hp) in commercial fishing grounds off Visakhapatnam coast (lat.17°38'-17° 42; long. 83°21'-83°30). Selectivty experiments were conducted using a 28 m demersal trawl rigged with a pair of V- form otter boards. The covered codend method was used to assess the selectivity of the codends (Pope *et al*., 1975; Sparre *et al*., 1989). The codend cover was about one and half times the codend in dimensions. Forty hauls of one hour duration each were taken with the trawl rigged with diamond and square mesh codends with small mesh cover at depth range of 40-50 m. The towing speed was maintained at 2.1-2.3 kn. The quantity and size of the fishes retained and excluded in both the codends were recorded. The length frequency data were collected for the catch in the codend and cover.

The logistic model commonly used to describe trawl selectivity ogive (Sparre *et al*., 1989) was used in the study.

SL = 1/ 1+ exp (S1-S2*L)

where SL is the function of the ogive defining for each length L, the fraction of fish retained in the codend. S1 and S2 are constants determined by linear least square estimation for each species.

L_{25}, L_{50}, L_{75}, selection range, selection factor and selection ratio were calculated as below:

L_{50} = (S1/S2)

L_{25} = (S1-In 3) / S2

L_{75} = (S1+ In 3) / S2

Selection range = L_{75}-L_{25}

Selection factor = L_{50}/mesh size

Selection ratio = Selection range / mesh size

Results and discussion

During the field trials, a total of 80 valid hauls, 40 each for diamond and square mesh codends, were carried out. The selectivity parameters are given in Table 1. The length frequencies of *Trichiurus lepturus* retained and excluded from 40 mm square mesh cod end are given in Fig. 1. The selectivity curve of *T. lepturus* with 40 mm square mesh codend is given in Fig. 2. The L_{25}, L_{50} and L_{75} values in respect of *T. lepturus* for 40 mm square mesh codend were 30.75, 36.2 and 41.65 mm, respectively (Table 1). The selection range, selection factor and selection ratio were 10.9, 9.05 and 0.30, respectively. The length frequencies of *T. lepturus* retained and excluded from 40 mm diamond mesh cod end is given in Fig. 3. Selectivity curve of *T. lepturus* with 40 mm diamond mesh codend is given in Fig. 4. The L_{25}, L_{50} and L_{75} values for 40 mm diamond mesh codend in respect of *T. lepturus* were 25.96, 33.4 and 40.95 mm, respectively. The selection range, selection factor and selection ratio were 14.9, 8.35 and 0.44 respectively. The retention lengths of *T. lepturus* in square mesh codends are comparatively higher than in diamond mesh codend.

Pope *et al*. (1991) reported that the lumen of the diamond mesh becomes narrow during trawling. The shape of the mesh affects the selectivity of codend and further, the flow of the water through netting also depends on the shape of mesh (Pope,1966). The size composition of fish in commercial landings are affected by mesh size. However, the effect of mesh shape on codend selectivity depends on the body shape of the target species. Square mesh codends have generally been found to be more selective than the diamond mesh codends of similar mesh

Table 1. Selectivity parameters of 40 mm square and diamond mesh codends for *Trichiurus lepturus*

Selectivity parameters	40 mm square mesh	40 mm diamond mesh
L_{25}, TL cm	30.75	25.96
L_{50}, TL cm	36.2	33.4
L_{75}, TL cm	41.65	40.95
Selection range, cm	10.9	14.9
Selection factor	9.05	8.35
Selection ratio	0.30	0.44

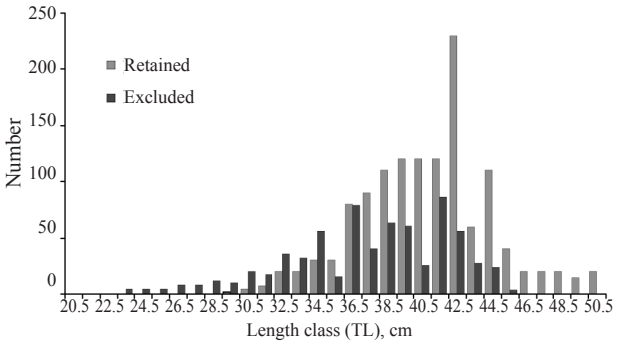

Fig. 1. The length frequencies of *Trichiurus lepturus* retained and excluded from 40 mm square mesh cod end

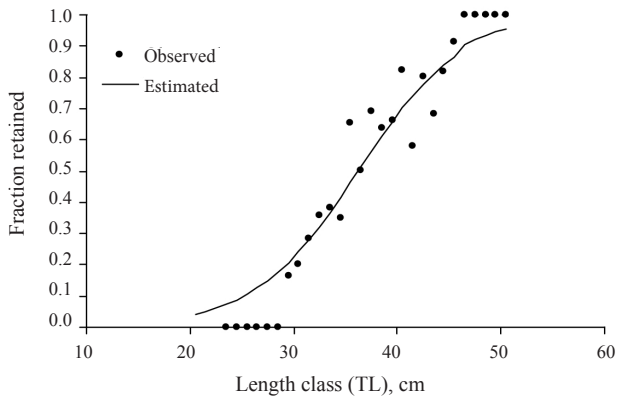

Fig. 2. Selectivity curve of *Trichiurus lepturus* in respect of 40 mm square mesh codend

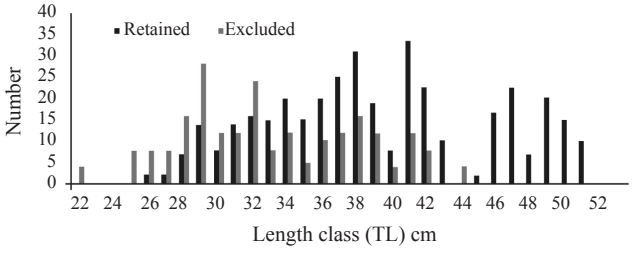

Fig. 3. The length frequencies of *Trichiurus lepturus* retained and excluded from 40 mm diamond mesh cod end

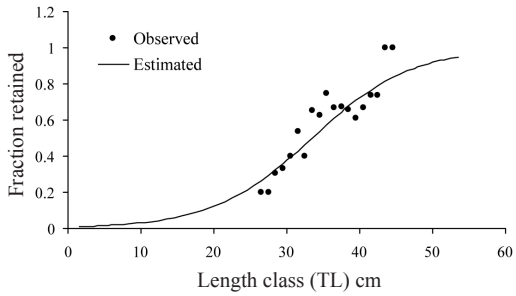

Fig. 4. Selectivity curve of *Trichiurus lepturus* in respect of 40 mm diamond mesh codend

size for round fish such as haddock and whiting (Robertson and Stewart, 1988). In the case of flat fishes, square mesh codend has been reported to be less efficient in excluding juveniles (Walsh *et al*.,1992)

The escapement through the codend meshes depends on several factors such as maximum girth, body shape, stiffness of twine, swimming ability and reaction to the gear panels (Campos and Fonseca, 2003; Campos *et al.*, 2003). The mean selection lengths were reported to be higher for square meshes compared to diamond mesh of same size (Kunjipalu *et al.,* 1994). Pillai *et al.* (1994) observed that percentage escapement of smaller size groups of *Nemipterus* sp*., Decapterus* sp*., Priacanthus* sp. and *Saurida* sp. were more in square meshes, compared to diamond meshes of same size. It is widely reported that the square mesh codends facilitate escapement of small sized fishes (Robertson, 1983; Robertson and Ferrow, 1988; Robertson and Stewart, 1988; Varghese *et al*., 1996; Boopendranath and Pravin, 2005; Raghu Prakash *et al*., 2008; 2010., Rajeswari *et al*., 2010). The results on the selectivity characteristics of square and diamond mesh codends in the present study demonstrated that 40 mm diamond codend is less selective than 40 mm square mesh codend.

The size at first maturity of *T. lepturus* in Visakhapatnam waters have been reported as 42.5 cm (Reuben *et al.,* 1997). The optimum mesh size was estimated as 47 mm for square mesh codend and 51 mm for diamond mesh codend, based on the value of length at first maturity for *T. lepturus* in Visakhapatnam waters and the selection factor determined through trawl selectivity experiments.

The size and shape of the meshes in the codend predominantly determine the selectivity of trawl gear in respect of trawl caught resources. Results of the present study show that the 40 mm square mesh codends have better selective characteristics than 40 mm diamond mesh codend with respect to *T. lepturus*, caught by trawling off Andhra Pradesh. Based on the results of selectivity experiments, it is evident that mesh sizes not less than 47 mm and 51 mm, respectively, are appropriate for square mesh and diamond mesh codends, for protection of the juveniles and sub-adults of *T. lepturus*, caught in Visakhapatnam waters.

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