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# Size Selectivity of Square Mesh Codends for *Saurida tumbil* (Bloch 1795) and *Nibea maculata* (Bloch & Schneider, 1801) in Bay of Bengal

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## Abstract

*Saurida tumbil* and *Nibea maculata* are widely exploited by the trawl fishery. Due to the use of conventional diamond mesh codends of small mesh size in the trawl nets, large quantities of juveniles of these species are landed along the east coast of India. The size selectivity of 40 mm square mesh codend for *S. tumbil* and *N. maculata* was studied with a 30 m demersal trawl, following covered codend method. The $L_{25}$, $L_{50}$ and $L_{75}$ values for S. *tumbil* with 40 mm square mesh codend was estimated as 16.2, 19.3 and 22.5 cm respectively. selection range, selection factor and selection ratio for *S. tumbil* were 6.2, 4.8 and 1.5 respectively. The $L_{25}$, $L_{50}$ and $L_{75}$ values for *N. maculata* with 40 mm square mesh codend were 9.3, 10.9, and 12.5 cm respectively. Selection range, selection factor and Selection ratio for *N. maculata* were 3.2, 2.7 and 0.8 respectively. Characteristic smooth sigmoid curves typical for towed gears were obtained for *S. tumbil* and *N. maculata*.

**Keywords:** Codend selectivity, square mesh codend, mean selection length, selection factor, *Saurida tumbil, Nibea maculata*

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## Introduction

Codend selectivity plays a very important role in minimising the capture of juveniles by regulating the size at first capture, increasing the yield per recruit of targeted species, reducing the discards and hence the impact of fishing on ecosystems (Armstrong et al., 1990). Knowledge on selectivity of codend mesh size for all the commercially important species, in a given fishing area, is of great significance in determining the judicious exploitation of fish stocks. The size selectivity of the trawl codend is primarily affected by mesh size and by other factors such as mesh shape, twine characteristics and net construction. Mesh selectivity studies on commercially important species are essential to identify the fishable segment of the stock (Alagaraja et al., 1986).

*Saurida tumbil* (Bloch, 1795) and *Nibea maculata (Bloch & Schneider, 1801)* are two commercially exploited species along the east coast of India. Large quantities of juveniles of both the species are landed at Visakhpapatnam, in trawl nets with conventional codends having 10-20 mm diamond mesh. The use of diamond mesh leads to narrowing at the middle of the codend causing the mesh lumen to almost close during trawling and hence smaller fishes are retained in the codend (Robertson & Stewart, 1988). The shape of the codend effects the selectivity of codends and the superiority of square mesh has been proven by many workers (Robertson et al., 1986; Robertson & Stewart, 1988; Robertson & Ferrow, 1988; Petrakis & Stergiou, 1997). Trawl codend selectivity studies in Indian waters have been conducted by Kunjipalu et al. (1994), Varghese & Kunjipalu (1996), Raghu et al. (2008, 2010), Rajeswari et al. (2010), Pravin et al. (2010), Remesan et al. (2010) Madhu et al. (2010, 2011, 2013) and Boopendranath et al. (2012). Although various aspects of taxonomy, biology, population dynamics and ecology of *S. tumbil* and *N.maculata* in Indian waters has been reported (Murthy & Ramalingam, 1996) and Rao (1983, 1984) no work has been reported on the selectivity of these species from east coast of India.

## Materials and Methods

Selectivity experiments were carried out onboard Research Vessel CIFTECH 1 (l5.5 m $L_{OA}$; 122 hp), off Visakhapatnam coast during 2011, with a 30 m demersal trawl fitted with 40 mm square mesh codend made of HDPE twine of 1 mm dia using covered codend method as per (Pope, 1975; Sparre et al., 1989). The square mesh codend was covered with a cover made of HDPE netting with 20 mm diamond mesh size and having about 1.5 times the size of codend in length. Hauls of 1 h duration were made at a depth of 30-40 m. Towing speed was about 2.3 to 2.5 kn. The length frequency data were collected for the catch in the codend and cover from 25 hauls.

The selectivity parameters were estimated using the software CC 2000 (Constant DK). The CC 2000 program is based on the SELECT method (Millar, 1992) which has been adopted as the standard method for the analysis of data from experiments with selective gears (Wileman et al., 1996). The logistic model used to describe trawl selection ogive used in the study was specified by

$$r\ (l;\Phi) = \exp(\alpha+\beta-l)/1+\exp(\alpha+\beta-l)$$

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

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 or maximum likelihood estimation for each species. The 50% retention length of the species was calculated as $L_{50}$ = S1/S2. $L_{25}$, $L_{50}$ and $L_{75}$, selection range and selection factor were calculated as $L_{25}$ = (S1 - ln 3) / S2, $L_{75}$ = (S1 + ln 3) / S2, selection range = $L_{75}$-$L_{25}$ and selection factor = $L_{50}$/mesh size.

## Results and Discussion

The length frequencies of *S. tumbil* and *N. maculata* retained and excluded from 40 mm square mesh codend are given in Fig. 1 and Fig. 2 respectively. The selectivity curves of *S. tumbil* and *N. maculata* are given in Fig. 3 and Fig. 4. The $L_{25}$, $L_{50}$ and $L_{75}$ values for *S. tumbil* with 40 mm square mesh codend was 16.2, 19.3, and 22.5 cm respectively. Selection range, selection factor and selection ratio for *S. tumbil* were 6.2, 4.8 and 1.5 respectively. The $L_{25}$, $L_{50}$ and $L_{75}$ values for *N. maculata* with 40 mm square mesh codend was 9.3, 10.9, and 12.5 cm respectively. Selection range, selection factor and selection ratio for *N. maculata* were 3.2, 2.7, 0.8 respectively. Characteristic smooth sigmoid curves typical for towed gears (Wileman et al., 1996) were obtained for *S. tumbil* and *N. maculata.* As size increases, the percentage of fish retained also increases until escapement is zero and all fishes are retained. Kunjipalu & Varghese (1994) studied the selectivity profile of 30 mm square mesh cod end with respect *to S. tumbil* and $L_{50}$, selection range and selection factor were reported as 13.1 cm and 3.5 and 4.4 respectively, along the west coast of India. The results of these study cannot be directly compared due to difference in mesh size. When compared to square mesh, diamond-shaped mesh elongate under tension. During hauling, as the codend fills with fish, the end meshes are obstructed, water flow is diverted and the codend becomes bulbous (Robertson & Stewart, 1988). Fish escape mainly through the open meshes at the front of the bulb while forward of this, most meshes are stretched and closed. In contrast, square-shaped meshes remain open during towing and do not acquire a bulbous shape. Square

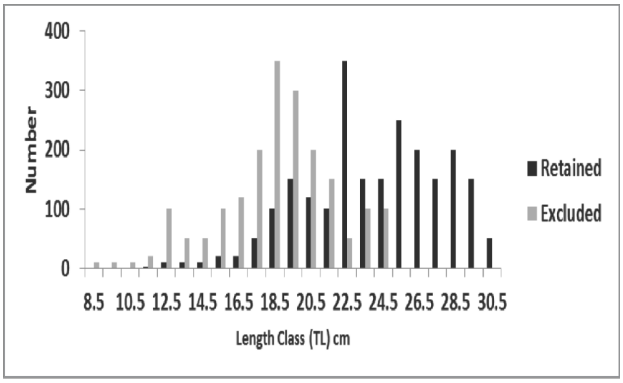


Fig. 1. Length frequency of *Saurida tumbil* retained and excluded from 40 mm square mesh codend

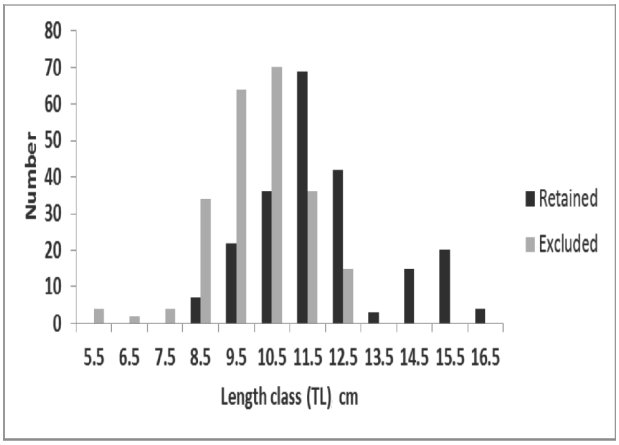


Fig. 2. Length frequency of *Nibea maculata* retained and excluded from 40 mm square mesh codend

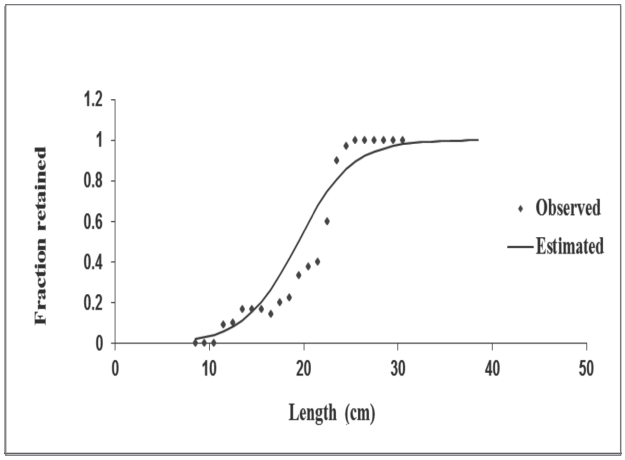


Fig. 3. Selectivity curve for 40 mm square mesh codend in respect of *Saurida tumbil*

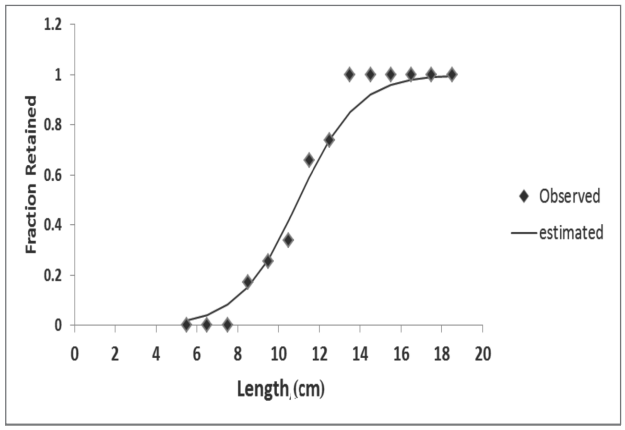


Fig. 4. Selectivity curve for 40 mm square mesh codend in respect of *Nibea maculata*

meshes have generally been more selective than diamond shaped mesh sizes for round fishes like haddock and whiting (Robertson & Stewart, 1988) and hake (Stergiou et al., 1994). In the case of flat fishes where selection is related to width rather girth of fish, square mesh codend is seen to be less effective in releasing young ones (Walsh et al., 1992).

The Length at first maturity (LFM) of *S. tumbil* in Indian waters is reported to be 29.5 cm (Rao, 1984). The $L_{50}$ derived from the present study for *S. tumbil* in 40 mm square mesh codend, was 19.3 cm, which is lower than the length at first maturity values reported. The optimum mesh size derived from the length at first maturity of *S. tumbil* (19.3 cm) and the selection factor of 40 mm square mesh determined through trawl selectivity experiment was 62 mm. The LFM of *N. maculata* is reported to be 18.5 cm (Jayasankar, 1989). The $L_{50}$ of *N. maculata* derived for 40 mm square mesh codend was 10.9 cm which is lower than the reported LFM of this species. The optimum mesh size for *N. maculata* determined from LFM and selection factor for 40 mm square mesh was 68 mm. Based on the results of selectivity experiments, the mesh sizes for square mesh codends, that can be recommended to harvest *S. tumbil* and *N. maculata* are 62 mm and 68 mm respectively in order to protect the juveniles and sub-adults.

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