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Escapement Pattern of *Nemipterus japonicus* from Bottom Trawl

K.C. Bellarmine[1], K.V. Pauly[2] and M. Shahul Hameed[3]
School of Industrial Fisheries, Cochin University of Science and Technology
Fine Arts Avenue, Cochin - 682 016, Kerala, India

Knowledge of the escapement pattern of fishes through various sections of the trawl is necessary for improving capture efficiency and trawl selectivity. In the present study, the escapement pattern of Japanese threadfin bream (*Nemipterus japonicus*) through the upper panel of a demersal fish trawl is presented. The study revealed that the escapement of the Japanese threadfin bream is mostly restricted to mid-belly and hind belly sections, throat and codend, where crowding occurs. No exclusion was observed through the wings, square and anterior belly sections, though having larger meshes ranging from 120 to 160 mm, which is attributed to herding effect of the netting panels in these sections where the fish are less crowded.

Keywords : Demersal trawl, trawl selectivity, *Nemipterus japonicus*

In a trawl system, escapement of fishes tend to take place at different sections from the time it enters the trawl mouth and is guided and concentrated in the codend. Escapement of fishes may depend on the mesh size and mesh configuration, load on twine, material and thickness of twine, hanging ratio, towing speed, underwater visibility, behavioural response of the fishes to external stimuli and crowding and other factors (Brandt, 1963; Clark, 1963; Briggs, 1986). While most of the size selection has been reported to occur in the codend, escapes of fish are also known to take place through the forward net panels and underneath the ground rope (Ellis, 1963; Clark, 1963; Giudicelli, 1978; Bennett, 1984; Godo & Walsh, 1992) indicating the importance of studies on whole trawl selection. Selectivity of trawls has been reviewed by Wileman *et al.* (1996), Boopendranath & Pravin (2004) and others. Information on the escapement pattern of target species in the trawl system will be useful in optimizing the design in terms of available towing force, by selection of netting with appropriate specifications for different sections of the trawl. In this paper, the escapement pattern of Japanese threadfin bream (*Nemipterus japonicus*), which is a significant component of trawl landings, through the upper panel of a demersal fish trawl is presented.

Materials and Methods

A demersal bottom trawl with 33 m head rope length was used for the experiments. Design details of the trawl are given in Fig. 1. Bags constructed of small mesh netting positioned in different sections of the trawl were used for retention of fishes that were excluded through the panel sections (Ellis, 1963; Clark, 1963; Giudicelli, 1978). The bags were constructed of polyamide netting of 15 mm mesh size (Fig. 2). The small mesh bags were positioned in different sections of the upper panel of the trawl as shown in Fig. 3. The bag for the wing section was positioned in the right and left wing on alternate days. Estimation of escapement through the bottom panel of the trawl was not attempted due to operational constraints, as the demersal trawl is dragged along the sea bottom.

The experimental operations were carried out from a 11 m L_{OA} mechanised trawler equipped with 90 hp engine, in the commercial fishing ground off Cochin. Data were

Present address:
[1] 18/952 Water land Road, Palluruthy, Cochin - 682 006, India
[2] Lecturer (Sl.Gr.), Prajyoti Niketan College, Pudukad, Kerala, India
[3] Aneez Manzil, Fourth Lane, Kaloor-Kadavanthra Road, Kaloor, Cochin - 682 017, India

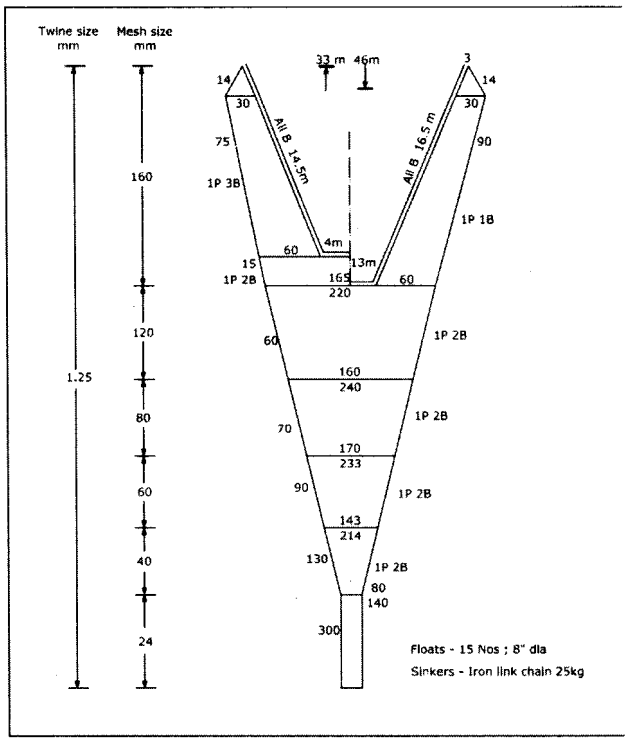

Fig. 1. Design of 33 m demersal fish trawl

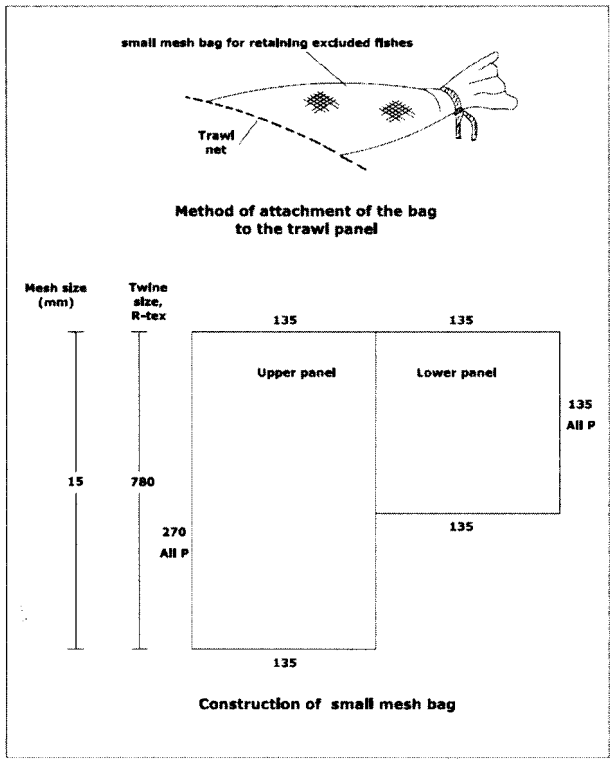

Fig. 2. Construction and mode of attachment of small mesh bag

collected for a total of 24 hauls (60 towing hours). At the end of each haul, the catch of *Nemipterus japonicus* were collected separately from each of the bags and codend. The

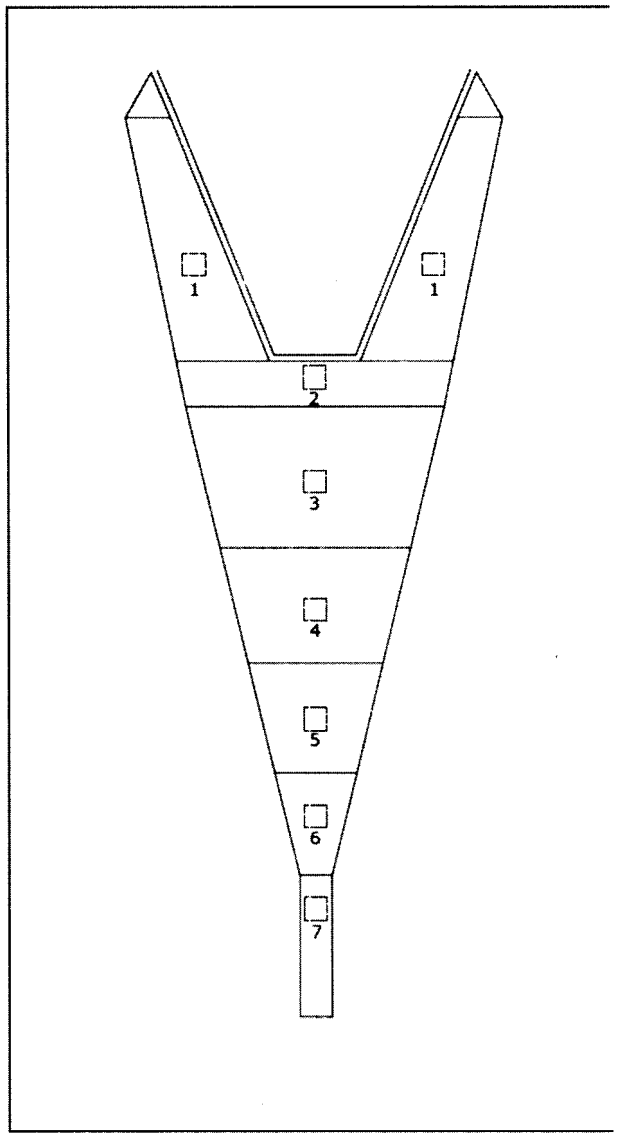

Fig. 3. Position of the small mesh bags in the upper panel of experimental trawl

number, weight and length (TL) of the species from each bag were determined for analysis. In the case of catch retained in the codend, a sub-sample was taken for analysis. The total number of fishes which has escaped through each panel section was estimated by multiplying the number of fishes caught in each bag by a scaling factor derived from the ratio of total number of meshes in each panel section and the number of meshes of the panel covered by the bag.

Results and Discussion

The results of the experiment are summarized in Tables 1 and 2. Of the 50790 numbers of *Nemipterus japonicus* that has

Table 1. Escapement pattern of *Nemipterus japonicus* in the bottom trawl, in terms of number

Length class, mm	Excluded *Nemipterus japonicus* retained in the bags, (No.)							Total excluded fish, (No.)	Catch retained in codend (No.)	Total number that has entered the trawl
	Codend	Throat	Hind belly	Mid-belly	Fore-belly	Square	Wings			
<50	1717	1395	119	22	0	0	0	3253	2325	5578
50-59	572	1052	89	45	0	0	0	1758	1981	3739
60-69	106	1104	178	0	0	0	0	1388	2173	3561
70-79	0	925	149	22	0	0	0	1096	2688	3784
80-89	0	328	104	0	0	0	0	432	1573	2005
90-99	0	60	134	22	0	0	0	216	1827	2043
100-109	0	0	59	67	0	0	0	127	2865	2992
110-119	0	0	59	45	0	0	0	104	2736	2840
120-129	0	0	30	22	0	0	0	52	3792	3844
130-139	0	0	0	22	0	0	0	22	4961	4983
140-149	0	0	0	22	0	0	0	22	3648	3670
150-159	0	0	0	0	0	0	0	0	3720	3720
160-169	0	0	0	0	0	0	0	0	2951	2951
170-179	0	0	0	0	0	0	0	0	1876	1876
180-189	0	0	0	0	0	0	0	0	1928	1928
190-199	0	0	0	0	0	0	0	0	872	872
>200	0	0	0	0	0	0	0	0	403	403
Total, (No.)	2395	4864	921	291	0	0	0	8471	42319	50790

Table 2. Experiment pattern of *Nemipterus japonicus* in the bottom trawl, in terms of weight

Length class, mm	Excluded *Nemipterus japonicus* retained in the bag, kg							Total excluded fish (No.)	Catch retained in codend, (kg)	Fish that has entered the trawl (kg)
	Codend	Throat	Hind belly	Mid-belly	Fore-belly	Square	Wings			
<50	6.01	4.88	0.42	0.08	0.00	0.00	0.00	11.39	8.14	19.52
50-59	4.46	8.20	0.69	0.35	0.00	0.00	0.00	13.71	15.45	29.16
60-69	1.05	10.92	1.76	0.00	0.00	0.00	0.00	13.73	21.49	35.22
70-79	0.00	13.45	2.16	0.33	0.00	0.00	0.00	15.93	39.08	55.02
80-89	0.00	6.77	2.14	0.00	0.00	0.00	0.00	8.91	32.44	41.35
90-99	0.00	1.74	3.89	0.65	0.00	0.00	0.00	6.28	53.17	59.44
100-109	0.00	0.00	2.29	2.59	0.00	0.00	0.00	4.89	110.56	115.45
110-119	0.00	0.00	3.18	2.40	0.00	0.00	0.00	5.57	146.32	151.89
120-129	0.00	0.00	2.03	1.53	0.00	0.00	0.00	3.56	259.15	262.71
130-139	0.00	0.00	0.00	1.84	0.00	0.00	0.00	1.84	407.10	408.94
140-149	0.00	0.00	0.00	2.04	0.00	0.00	0.00	2.04	332.44	334.48
150-159	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	373.82	373.82
160-169	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	398.95	398.95
170-179	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	304.64	304.64
180-189	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	339.79	339.79
190-199	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	191.71	191.71
>200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	94.52	94.52
Total, kg	11.52	45.96	18.56	11.80	0.00	0.00	0.00	87.85	3128.77	3216.62

entered the trawl, 16.68% (8471 numbers) were estimated to have escaped through the upper panel sections of the experimental trawl and 42319 were retained in the codend (Table 1). Throat section of the trawl was seen to have excluded the maximum number of *Nemipterus japonicus* (57.42%), followed by codend (28.28%), hind-belly (10.87%) and mid-belly (3.44%) panel sections (Fig. 4). There was no escapement through the fore-belly section, square and wings, indicating that the herding effect is adequate in these

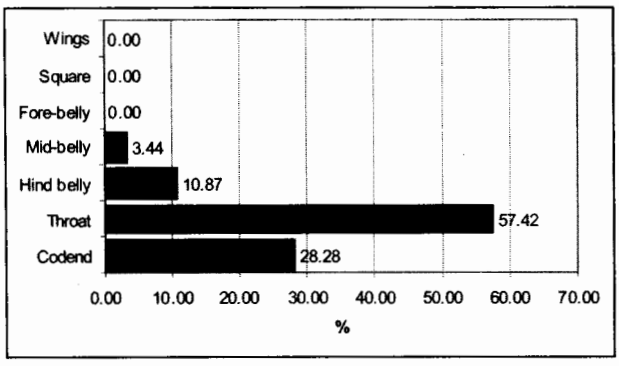

Fig. 4. Percentage escapement rate of *Nemipterus japonicus* (number) through upper panel sections of 33 m demersal trawl

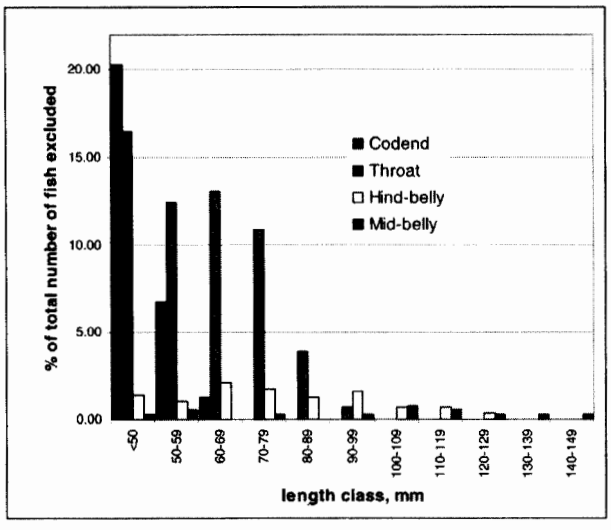

Fig. 5. Percentage escapement rate of length classes of *Nemipterus japonicus* from different trawl sections of 33 m demersal trawl

sections of the trawl. Codend released length classes up to 69 mm, throat section up to 99 mm and hind belly up to 149 mm. Nearly 99.5% of the excluded fish were below the length at first maturity (128 mm) (Fig, 5), indicating that mesh size in these panel sections are appropriate.

In terms of weight of fish, of the 3217 kg of *Nemipterus japonicus* that has entered the trawl, only 2.73% (88 kg) were estimated to have escaped through the upper panel sections of the experimental trawl and 97.27% (3129 kg) were retained in the codend (Table 2).

Information on escapement pattern of the fishes through the various panel sections of the trawl is useful for improving capture efficiency and trawl selectivity. The study revealed that the escapement of the Japanese threadfin bream is mostly restricted to mid-belly and hind belly sections, throat and codend, where crowding occurs and that escaped fishes are below the length at first maturity. No escapement of the fish was observed through the larger meshes (120 to 160 mm) in the wings, square and fore-belly sections which can be attributed to herding effect of the netting panels in these sections where the fish are less crowded. Additional investigations are necessary to find out if mesh sizes in these panel sections can be further increased for Japanese threadfin bream, with resultant reduction in the trawl drag.

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