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Optimization of Mesh Size of Gill Nets to Capture *Amblygaster sirm* (Walbaum) in Thoothukkudi Coastal Waters, Southeast Coast of India

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Amblygastar sirm, a lesser sardine, popularly called 'Keeri Meen Chalai' form a notable fishery in Thoothukkudi coastal waters with peak season from September to February. *A. sirm* are captured in small meshed drift gill nets with the mesh size ranging from 26 mm to 32 mm. The fishery is mainly constituted by the size group 65-210 mm. The present study deals with the optimization of mesh size to capture the commercially significant length group (141-190 mm) and enmeshing pattern of *A. sirm* in gill nets with various mesh sizes. The optimum mesh size for the commercial exploitation of *A. sirm* in Thoothukkudi coastal waters is found to be 30.5 mm

Key words: ***Amblygaster sirm,*** **mesh size, gill nets**

Amblygaster sirm, a shoal forming clupeid fish, form notable fishery in Thoothukkudi coastal waters. Among the lesser sardines that form fishery in Thoothukkudi coast (Tamil Nadu, India), fishermen prefer to capture this species because *A. sirm* has good consumer preference and potential local market next to *Sardinella gibbosa.* Being a neritic species, it is captured mainly by non-motorized/ motorized catamarams and motorized 'vallam' (a plank built boat of Thoothukkudi origin). Small-meshed nylon gill nets with mesh size ranging from 26 to 32 mm are used to capture this species in the coastal waters. The fishing grounds are about 10 nautical miles away from the shore with depth ranging from 20 m to 25 m and the actual fishing time is from 2 a.m. to 6 a.m.

Attempts have been made to optimize the mesh size for the exploitation of some of the commercially important inland and marine fishes of India (Sreekrishna *et al.,* 1972; Sulochanan *et al.,* 1975; Panicker *et al.,* 1978; Khan *et al.,* 1989; Kartha & Rao, 1991 and Luther *et al.,* 1994). Karunasinghe & Wijeyaratne (1991) estimated the selectivity parameters of *A. sirm* caught in the small-meshed gill nets in the west coast of Sri Lanka. Preliminary survey undertaken along Thoothukkudi coast indicated that *A. sirm* was fished indiscriminately using gill nets with mesh size ranging from 26 to 32 mm. Therefore, an attempt was made to optimize the mesh size for the exploitation of the commercially significant size group of this species.

Materials and Methods

The design details of the experimental nets are given in the Table 1. Nets of mesh size 26 mm, 28 mm, 30 mm and 32 mm each in quadruplicate were made from machine made nylon webbing, fabricated using 210D/ 1/2 twine. The webbings were mounted to head and foot ropes, maintaining a uniform horizontal hanging co-efficient of 0.5. All the sixteen nets were connected serially and a total of 50 fishing operations were carried out off ship anchorage of Thoothukkudi Port (8°47'N 78°14'E) from September 1997 to February 1998 between 4 a.m. and 5 a.m. The sequence of the nets were randomly changed during each operation. The fishing

Table 1. Details of the experimental gill nets

Webbing material	Nylon
Twine specification	210D/1/2
No. of meshes in length	1500
No. of meshes in breadth	400
Mesh size	A - 26 mm B - 28 mm C - 30 mm D - 32 mm
Horizontal hanging co-efficient	0.5
Vertical hanging co-efficient	0.86
No. of floats	10
Specification of float	PVC Cylindrical 55 mm x 50 mm
No. of sinkers	5
Specification of sinker	Stone - 250 g
Selvedge	5 meshes of 75 mm polyethylene

operations were carried out from a 'vallam' fitted with a 10 HP onboard engine. After every operation, the fish caught in each net were segregated and morphometric measurement such as total length, gilled girth and maximum girth of the fish were recorded. The proportionality coefficient 'k' in the equation a = kl was estimated using the method described by Baranov (1948) as follows.

$$k = \frac{2\ a_1\ a_2}{l_0\ (a_1+a_2)}$$

Where a_1 = mesh bar size (mm) of the first experimental net, a_2 = mesh bar size (mm) of second experimental net, l_0 = length of fish (mm) caught in equal proportion in two experimental nets. To estimate 'l_0' the length frequency data from the nets A and D were exempted as the catches from the net A were constituted mainly by juveniles and the catch from the net D was very low. The 'l_0' was obtained by plotting the length frequency data of the nets B and C, taking the percentage of each on y axis and length in mm on x axis. The length corresponding to the point of intersection of two curves was taken as l_0. Using the estimated value of k, the optimum mesh size to capture commercially significant size group of *A. sirm* was estimated using the relation a = kl. where a = optimum mesh bar length in mm, k = proportionality co-efficient, and l = modal length of the fish in mm.

Results and Discussion

Enmeshing pattern of *A. sirm* in the gill nets A, B, C and D are given in the Tables 2, 3, 4 & 5. The fishes enmeshed in the nets were grouped as (i) Fishes caught before opercular margin (entangled) (ii) fishes caught at opercular margin (gilled), and (iii) fishes caught after the opercular margin. The catch details of *A. sirm* in the experimental nets are given in Table 6. Of the four types of nets used, the catches from the net C contributed 50% of the total catch. The catch from net A consisted of mainly juveniles and hence its contribution to the total catch by weight was only 13.09%. The catches from the net B moderately contributed to total catch (20.24%). Even though the catches from the net D consisted of mainly larger length group of above 135 mm, its contribution by weight to the total catch was only 16.67% due to poor catch. The details on the

Table 2. Enmeshing pattern of various size groups of *Amblygaster sirm* in the net A

Size range (mm)	Percentage of enmeshing		
	Before opercular margin	At opercular margin	Between opercular margin and maximum girth
66-70	-	62	38
71-75	-	66	34
76-80	-	70	30
81-85	5	74	21
86-90	8	80	12
91-95	9	82	9
96-100	10	85	5
101-105	10	90	-
106-110	16	84	-
111-115	21	79	-
116-120	35	65	-
121-125	46	54	-
126-130	63	37	-
131-135	75	25	-
136-140	81	19	-
141-145	86	14	-
146-150	88	12	-

Table 3. Enmeshing pattern of various size groups of *Amblygaster sirm* in the net B

Size range (mm)	Percentage of enmeshing		
	Before opercular margin	At opercular margin	Between opercular margin and maximum girth
111-115	-	50	50
116-120	-	64	36
121-125	-	75	25
126-130	2	84	14
131-135	1	97	2
136-140	10	90	-
141-145	14	86	-
146-150	22	78	-
151-155	25	75	-
156-160	30	70	-
161-165	57	43	-
166-170	60	40	-
171-175	72	28	-
176-180	81	19	-

length composition of landings of *A. sirm* in Thoothukkudi coast from September 1997 to February 1998 are given in Table 7.

The l_0 and k derived from the length frequency data of the nets B and C was 157 mm and 0.092, respectively. The commercially significant size group was found to be

Table 4. Enmeshing pattern of various size groups of *Amblygaster sirm* in the net C

Size range (mm)	Percentage of enmeshing		
	Before opercular margin	At opercular margin	Between opercular margin and maximum girth
136-140	-	52	48
141-145	-	74	26
146-150	-	80	20
151-155	2	98	-
156-160	5	95	-
161-165	8	92	-
166-170	10	90	-
171-175	13	87	-
176-180	22	78	-
181-185	28	72	-
186-190	46	54	-
191-195	64	36	-
196-200	75	25	-
201-205	81	19	-
206-210	90	10	-

Table 5. Enmeshing pattern of various size groups of *Amblygaster sirm* in the net D

Size range (mm)	Percentage of enmeshing		
	Before opercular margin	At opercular margin	Between opercular margin and maximum girth
156-160	-	65	-
161-165	-	72	28
166-170	7	78	15
171-175	12	88	-
176-180	14	86	-
181-185	17	83	-
186-190	23	77	-
191-195	34	66	-
196-200	65	35	-
201-205	79	21	-
206-210	88	12	-

141-190 mm which contributed 84.38% of the total catch (Table 7). The mean value of this length group, 165.5 mm, was considered as the optimum length of capture (l). Using the relation a = kl, the optimum mesh size for the commercial exploitation of *A. sirm* was estimated as 30.5 mm.

Indiscriminate fishing of juveniles owing to the use of gill nets of small mesh size may lead to overfishing and should be avoided to ensure sustained fishery. Luther *et al.* (1994) has recommended discouraging the use of nets with mesh size less than 28 mm to avoid fishing of juveniles of lesser sardines of Visakhapatnam coast. The present investigation reveals that the use of gill nets with 26 mm mesh may lead to growth overfishing of *A. sirm* in Thoothukkudi coast as the net A of the present study captured juveniles. Therefore

Table 6. Catch details of *Amblygaster sirm* in experimental nets

Type of net	Total catch for 50 trials (kg)	Average catch per net (kg)	Percentage contribution
A	220	1.1	13.09
B	340	1.7	20.24
C	840	4.2	50.00
D	280	1.4	16.67
Total	1,680	8.4	100.00

Table 6. Composition of landings of *Amblygaster sirm* in Thoothukkudi coast from September 1997 to February 1998

Length range (mm)	Percentage composition
111-115	0.21
116-120	0.43
121-125	0.85
126-130	1.71
131-135	2.99
136-140	3.41
141-145	8.53
146-150	9.17
151-155	10.23
156-160	11.73
161-165	9.11
166-170	8.32
171-175	7.25
176-180	7.25
181-185	6.61
186-190	6.18
191-195	3.20
196-200	1.71
201-205	0.86
206-210	0.21

the use of gill nets with mesh size 26 mm and below should be avoided in Thoothukkudi waters to ensure sustained fishery of *A. sirm.*

Further, in the present study, the commercially significant size group was found to be represented by a wide length range of fishes and the mean length of the economically significant size group was found to be 165.5 mm. From the studies of Conand (1991) on the biology of *A. sirm,* it is evident that the length group beyond 165.5 mm would have spawned at least once, as the length at first maturity of *A. sirm* is found to be 160-170 mm, which is attained when the fish reach the age of one year. Therefore, though the operation of the proposed net with 30.5 mm mesh would partly capture maturing group, it would also capture *A. sirm* that have spawned once, thus giving way for further recruitment. Gilling would be proper in the proposed gill net with 30.5 mm mesh (78.90%) as in the nets C and D (with 30 and 32 mm mesh respectively), the commercially significant size group was caught by 'gilling' at the point of opercular margin to about 92% and 72% respectively (Tables 4 and 5).

It may therefore be concluded that use of nets with recommended mesh size is essential for maintaining a sustainable fishery of *A. sirm* in these waters.

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