Gillnet Selectivity for Big Eye Barracuda, *Sphyraena forsteri* (Cuvier, 1829) in Thoothukudi Waters, Southeast Coast of India

Karthiga Priya P, Sundaramoorthy B, Neethiselvan N, Sukumar D and Masilan K*

Department of Fish Processing Technology, Tamil Nadu Fisheries University, Nagapattinam, Tamil Nadu, India

*Corresponding author: Masilan K, Department of Fish Processing Technology, Tamil Nadu Fisheries University, Nagapattinam, Tamil Nadu, India, Tel: +91 7373444482; E-mail: masilanakmsara@gmail.com

Abstract

The present study is the first concerning gillnet selectivity in Thoothukudi waters, Tamil Nadu, India. Selectivity estimates were made for *Sphyraena forsteri*. Sampling took places at three landing centers in Thoothukudi Coast from the period between April 2012 to March 2013. Samples were collected with gillnets of mesh sizes of 28 mm, 50 mm and 52 mm. Selection factors for *S. forsteri* is 7.04 whereas the commercial significant length group is 40.42 cm. Optimum size for this species is 5.82 cm.

Keywords: *S. forsteri*; Gear selectivity; Mesh size; Thoothukudi

Introduction

Thoothukudi (lat 8°47ʹN and long 78°9ʹE) is one of the important fish landing centres in south east coast on India [1]. The mesh size of gillnets of Thoothukudi coast range from 28 mm to 128 mm. The fishing season for *S. forsteri* (*Sphyraenidae*) in this coast is from November to June. This species form fishery in the coastal region, 20 to 30 nautical miles away from the shore at the depth ranging from 30 m to 40 m.

Selectivity of fishing gear has a direct influence on the exploited stock. Gillnet Selectivity may be estimated by either indirectly or directly. Indirectly, it is inferred by examining the size distribution of gillnet catches or from maximum girth and head girth measurement. By direct method, the selectivity parameters are estimated based on the proportions of fish caught from different size classes of a population with known length frequency distribution [1].

Gillnet selectivity studies in Indian waters are mainly concerned with optimization of mesh size for the commercial exploitation of important marine and fresh water fishes. Attempts have been made by a few researchers' workers to arrive at optimum length of capture of certain important fish based on the length at first maturity. Knowledge on the length at first maturity of the species to be captures is essential for optimizing the mesh size for sustained commercial exploitation of any species [1].

This species are indiscriminately fished indiscriminately fish and no attempt has so far been made to optimize the mesh size of gillnets to capture *S. forsteri*. The present study deals with the estimation of the gillnet selection factors of *S. forsteri* so as to optimize the mesh size for its commercial exploitation.

Materials and Methods

The study was carried out for one year from April 2012 to March 2013 at Threspuram, Inigonagar and Tharuvaikulam landing centers for traditional crafts of Thoothukudi Coast (Tamil Nadu, Southeast Coast, India). Nets with the mesh size of 28 mm, 50 mm and 52 mm were sampled from the gillnets operated from the commercial fishing boats of Thoothukudi origin, (Popularly called "Vallam"). The nets with the mesh size of 28 mm, 50 mm and 52 mm were named as net 'A', 'B', and 'C' respectively. The features of the net A, B and C are given in Table 1.

S. No	Parameters	Types of gillnets		
		A	**B**	**C**
1	Webbing material	Polyethylene	Polyethylene	Polyethylene
2	Mesh size	28 mm	50 mm	52 mm
3	No. of meshes in length	1,500	2,640	2,640
4	No. of meshes in depth	400	110	110
5	Twine Specification	1.0 mm φ	0.5 mm φ	0.5 mm φ
6	Horizontal hanging co-efficient	0.5	0.5	0.5

7	Type of float	HDPE	PVC	HDPE
8	No. of floats/Net	10	20	20
9	No. of Sinkers/Net	5	10	10
10	Type of sinkers	Stone	Stone	Stone
11	Head rope material	PP	PP	PP
12	Thickness of head rope	-	-	-
13	Length of head rope	25.2 m	20.5 m	22.8 m
14	Foot Rope material	PE	-	-
15	Size of foot rope	3 mm φ	-	-
16	Thickness of foot rope	2.4 m	-	-

Table 1: Description of the gillnets operated for fishing barracuda along Thoothukudi coast.

The webbings were maintained to head rope, maintaining a uniform horizontal hanging co-efficient of 0.5. The total length of individual fish was measured to the nearest cm. The mesh size determined by measuring the stretched meshes with a centimetre scale [2].

The selectivity was estimated by using the indirect method of Sparrae et al. [3]. According to him, for gilling and wedging, the selection curves are bell shaped and can be described by the following relation

$$SL = \exp - [(L - Lc^2)/2S^2]$$

Where S (L) is the length based gear selectivity, L is the mid length of the size/length group, Lc is the mean selection length per being caught and S is the standard deviation of the normal distribution.

The procedure for estimation of selection curve involved the following steps:

CB=Number of fish caught in net with larger mesh size (m^2)

CA=number if fish caught in A net with smaller mesh size (m^1).

Calculations for log ratios for successive fish lengths Y=Ln (CB/CA)

Linear Regression analysis was made against the mid value of each of the length group as follows

$$Ln(CB/CA) = a_1 + b_1 L$$

Where, a_1=Intercept for BA combination and b_1=slope value for BA combination.

$$Ln(CC/CB) = a_2 + b_2 L$$

Where, a_2=Intercept for CB combination, b_2=slope value for CB combination and L=mid length of a length group. CA,CB and CC refers to catch in number in net with the mesh size A,B and C corresponding to the mid value of length group, L.

Regression analysis of the log ratios against the interval midpoint and expressed as,

$$Y = a + bL$$

Where, Y is the natural logarithm of ratio of catches, L is the mid-point of the length class and a and b are constants. The common selection factors (SF) for three mesh combination viz. A, B and C was derived using the equation.

$$SF = \frac{-2X[(A+B) \times a_1/b_1] + [B+C] \times a_2/b_2]}{(A+B)^2 + (B+C)^2}$$

The common standard deviation(s) for three combinations A, B and C was derived using the equation.

$$S = \sqrt{\frac{1}{3-1}\left[\frac{-2xa_1 \times (B-A)}{b_1^2 \times (A+B)}\right] \times \left[\frac{-2xa_2 \times (C-B)}{b_2^2 \times (B+C)}\right]}$$

The mean selection length (Lc) of each net was estimated from the common selection factor (SF) as follow,

$$L_{ci} = SF \times mi$$

Where, 'L_{ci}' refers to mean selection length of different nets 'mi' refers to different mesh size.

The optimum mesh size for the commercial exploitation of each species of barracuda were worked out bared on the following formula,

$$m = \frac{L_{opt}}{SF}$$

Where 'm' is the stretched measure of mesh in cm and 'L_{opt}' is either the mid-length of the commercially significant length group or mean length at first maturity of the respective species in cm. SF is the mean value of selection factors derived based on different mesh combinations.

Monthly Average catch and effect of barracudas are calculated as; the mean daily catch for a month was worked out by taking the mean total catch estimated during different sampling days of months. The average daily catch was multiplied by the number of fishing days of the month for estimated the monthly catch. The effort was expressed in terms of boat days and the catch was expressed in terms of kilograms and also in tonnes.

Results and Discussion

Fishing season of barracuda was found to be from November to June as reported by Mohammed et al. [4,5]. However, a slight deviation in peak season from that reported by Mohammed et al. [4]. Among the two peaks of fishing season of barracuda in the gillnet fishery, one was found to fall on the months of November and May against the November and March as observed by Mohammed et al. [4]. The reason may be attributed to the gear selected for the study. As 15th April to 30th May being closed season for trawl net along the coast of Tamil Nadu, One of the peak seasons has been recorded as March instead of May. The comprehensive study involving catches from all fishing gear such as gillnets, long lines and trawl nets is required to find out the exact fishing of barracuda along Thoothukudi coast regarding depth wise distribution. The peak fishing season found to be from November [4] whose study was based on the catches from commercial trawl nets. The reason may be attributed the fact that the fisherman of Thoothukudi used to switchover to long lining from July to September due to rough weather conditions, though barracudas are reported to migrate and available for fishing in shallow water during south-west monsoon (June to August). Catch and effort particulars of *S. forsteri* are given in Table 2.

S. No	Month	Average No of crafts operated/day	Boat Days	Number of barracuda landed/boat	Total weight of barracudas landed/boat (in kg)	Total no. of barracudas landed	Total. wt. of barracuda landed (in kg)	CPUE
1	Apr.'12	200	24	95	95	2280	2280	3.96
2	May.'12	180	24	100	100	2400	2400	4.17
3	Jun.'12	180	26	55	27.5	1430	715	1.06
4	Jul.'12	180	24	50	25	1200	600	1.04
5	Aug.'12	190	22	35	17.5	770	385	0.8
6	Sep.'12	180	22	30	15	660	330	0.68
7	Oct.'12	180	24	30	15	720	360	0.63
8	Nov.'12	180	24	30	15	720	360	0.63
9	Dec.'12	180	24	50	50	1200	1,200	2.08
10	Jan.'13	180	23	60	60	1380	1,380	2.61
11	Feb.'13	150	23	70	70	1610	1,610	3.04
12	Mar.'13	150	23	90	90	2070	2,070	3.91
	Total		283			16440	13690	2.05

Table 2: Monthly Catch and effort particulars of *S. forsteri* in gillnet for the period from April 2012- March 2013 in Thoothukudi Coast.

Mid length	Net A	Net B	Net C
	50 mm	52 mm	128 mm
8	4	-	-
11	8	-	-
14	12	-	-
17	19	-	-
20	26	2	-
23	18	3	-
26	14	4	1
29	12	8	2
32	7	12	4
35	3	16	6
38	2	16	12
41	-	26	13
44	-	16	18
47	-	12	26
50	-	9	18
53	-	2	13
56	-	-	12
59	-	-	7
62	-	-	4
65	-	-	2

Table 3: Length frequency distribution and the ratios of natural logarithms of number caught under different length group of *S. forsteri* in different gillnet combinations.

Length frequently distribution of *S. forsteri* in gillnets of mesh sizes 28 cm, 50 cm and 52 cm is given in Table 3. The total length of *S.*

forsteri caught ranged from 7 cm to 66 cm. The net 'A' captures more number of immature and maturing animals than net B and C. So, the net A with 28 mm mesh size is not suitable for capture *S. forsteri* in Thoothukudi coast.

Selectivity parameters viz, Lb, Lc and Ld increased with the increase in mesh size irrespective of species, indicating clear cut selectivity by the gillnets (Ag). This is an accordance with the findings of Reis et al. [6] who reported the gillnets are rather than species specific. Increase in Lc and SF of Amblygaster sirm with the increase in mesh size have also been documented by many researchers [7-11]. Lb, Lc and Ld values for *S. obtustata* were given in Table 4 and Figure 1.

Net	Selectivity Parameters (in cm)		
	Lb	Lc	Ld
A	10.5	19.5	20
B	20	25	36
C	28.5	41	42

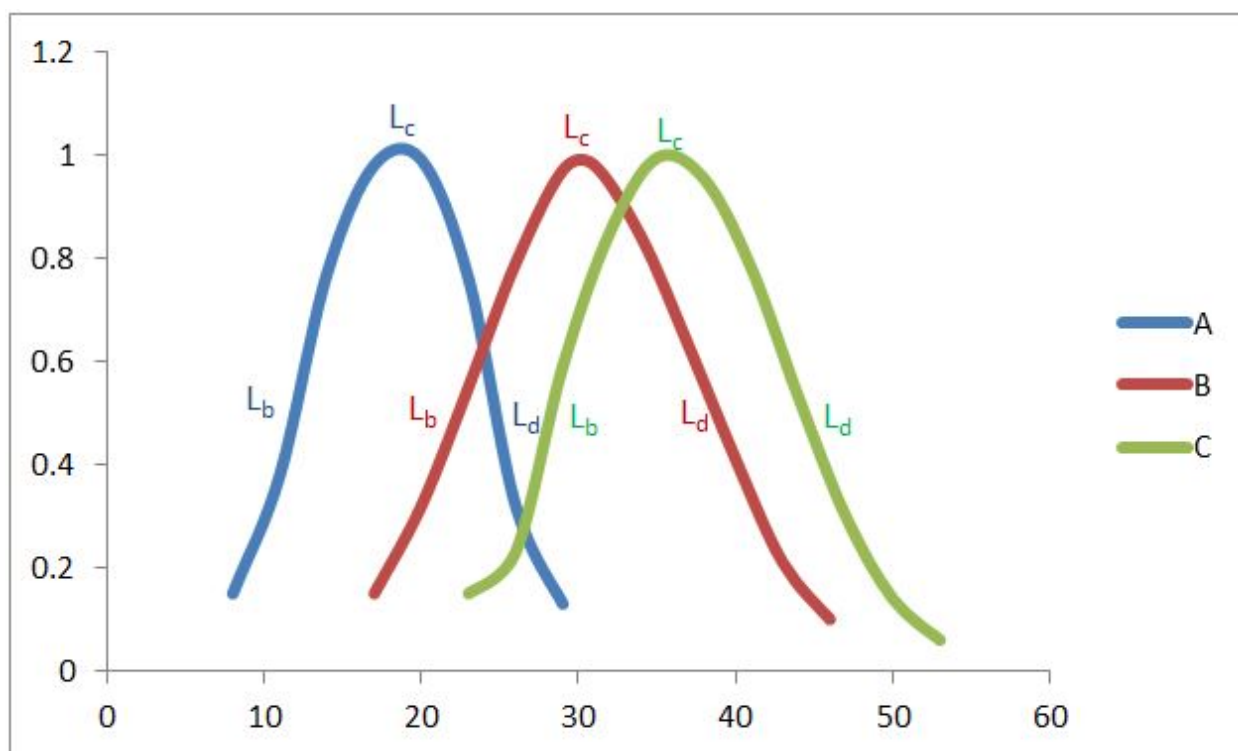**Table 4:** Selectivity parameters of *S. forsteri* with respect to different gillnet.

Figure 1: Selection curves of S. forsteri for gillnet types A, B and C.

Selection factor for this species is 7.04 this is accordance with the findings of Andreev [12] who reported that the selection factors generally ranges between 5 and 10.

Optimum mesh size for the *S. forsteri* is 5.82 cm. It is understood that the net A with the mesh size of 2.8 cm need to be discouraged to capture *S. forsteri*. Further the mesh size of net B 5 cm was too much closer to the estimated mesh size for *S. forsteri* (5.8 cm), Therefore the mesh size of net B may be increased to optionally capture *S. forsteri*. Through fishing with net C with higher mesh size (5.2 cm) was found to better and would considerably reduce the recruitment over fishing of *S. forsteri*.

Luther et al. [13] has recommended discouraging the use of nets with mesh size less than 28 mm to avoid fishing of juveniles of lesser sardines of Vishakhapatnam Coast. The present investigation also recommended to discouraged the gillnet with 28 mm mesh may lead to growth over fishing *S. forsteri* in Thoothukudi Coast and hence the use of gillnets with mesh size 28 mm and below should be avoided in Thoothukudi waters to ensure sustained the barracuda fishery.

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