

Maturity, spawning and fecundity of *Saurida tumbil* from Mumbai water

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ABSTRACT

The absolute fecundity of *Saurida tumbil* ranged between 24,160 to 1,72,000 eggs with weight range of 230-670 g. Linear relationship between fecundity and weight was more valid than that of length and ovary weight. The fish bred once a year during November to march. The length at which 50% of the females mature was calculated as 296 mm. The female dominated the commercial catch and overall male to female ratio of population was 1:1.62 throughout the year

Key words : Lizard fish, *Saurida tumbil*, Fecundity, Spawning

The average annual catch of lizardfish during the period 1991-2003 was estimated 26,536 tonnes which contributed on an average of 1.10% of total marine landings and 3.50% of total demersal catch of India (Anonymous, 2003). Rao (1983) studied maturation and spawning of lizardfishes (*Saurida* spp.) from northwestern part of Bay of Bengal. Some aspects of biology and fecundity of *S. tumbil* have been studied from Mumbai waters (Dighe, 1977; Singh *et al.*, 1995). There are also reports on maturation and spawning of *S. tumbil* from the foreign waters (Okada and Kyushin, 1955; Liu and Tung, 1959; Yamada *et al.*, 1965; Tiews *et al.*, 1972). The present investigation is the detailed study of reproductive biology of *S. tumbil* from Mumbai coast.

MATERIALS AND METHODS

Fresh specimens of *S. tumbil* were collected weekly from the New Ferry Wharf and Sassoon docks landing centres, Mumbai. In order to study the maturity and spawning season, 290 females of *S. tumbil* were observed. Gonads were weighed to the nearest milli-grams on a sensitive electronic balance. Samples of ovaries were preserved in 5% formalin for ova diameter studies. The diameters of ova were measured in straight line under a compound microscope magnified 100 times with eyepiece fitted with an ocular micrometer. Ova samples were measured to the nearest micrometer division (1µm division = 0.016mm).

The maturity stages were classified exclusively depending on the stages of ovary, size of ova and other

observations of the ova.

The Gonado-Somatic Index (GSI) was calculated for females by using the formula:

$$GSI = \frac{\text{Weight of gonad}}{\text{Weight of the fish}} \times 100$$

The females in stage III and above were considered as mature for the determining the length at first maturity. The data collected for twenty one months were pooled and percentage of cumulative frequency were plotted against the size to determine the size at which 50 % fishes mature.

Developmental stages were determined by the ICES scale as per Wood (1930) as: Immature, Early maturing, Maturing, Late maturing, Mature, Ripe and Spent.. To know the homogeneity of the distribution of males and females, Chi square test (Snedecor and Cochran, 1967) was applied.

RESULTS AND DISCUSSION

The results of the study have been discussed in the following sub heads:

Morphology of gonad with development:

The following developmental stages of testis and ovary of *S. tumbil* were identified after the thorough examination:

Males:

Immature:

The testes were long and slender thread-like structure extending upto ¾ length of the body cavity.

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Table 1: Monthwise percentage distribution of maturity stages of females of *S. tumbil*

Months	No. examined	Maturity stages						
		I	II	III	IV	V	VI	VII
January	2	-	-	-	-	-	-	100
February	28	60.71	21.43	-	-	-	-	17.86
March	40	50.00	20.00	2.5	-	-	-	27.5
April	75	61.34	30.66	4.00	-	-	-	4.00
May	48	52.10	39.58	4.16	-	-	-	4.16
June	NA	-	-	-	-	-	-	-
July	NA	-	-	-	-	-	-	-
August	11		18.18	18.18	54.55	9.09	-	-
September	11	9.09	18.18	9.09	18.18	27.27	18.18	-
October	24	33.33	25.00	20.83	12.50	8.34	-	-
November	48	16.67	31.25	29.16	14.58	-	-	-
December	3	-	100	-	-	-	-	-

Maturing:

The testes were long, ribbon-like bands extending from 2/3 to 3/4 length of the body cavity; white or creamy in colour. No milt exuded on application of pressure on abdomen.

Mature:

The testes were ribbon like bands extending up to 3/4 of the body cavity. They were broader, thicker and softer than those in stage II. White or creamy in colour. Milt oozed out on slight pressure on abdomen.

Spent:

The testes were flaccid and blood-shot, ribbon-like bands extending up to 2/3 length of the body cavity. No milt came out on application of pressure on abdomen.

Females:

The following stages of maturity were identified:

Stage I:

The ovaries were narrow ribbon-like bands, extending to the 1/2 length of the body cavity. Ovaries were light red or pink in colour, ova not discernible. Only immature ova (0.02 to 0.16 mm), completely transparent, were present.

Stage II:

External appearance of stage II was same like stage I. Maturing (0.16 to 0.28 mm) ova wherein yolk formation has commenced in the central part were present in good numbers, but majority of ova still were immature.

Stage III:

Ovary was longer, broader and thicker than in the

stage II, extending up to 2/3 length of the body cavity; red or reddish-brown in colour. Immature, maturing and completely opaque mature (0.29 to 0.50 mm) ova were present. Immature ova formed the majority.

Stage IV:

Ovary was long and broad, filling 2/3 to 3/4 body cavity; red or reddish yellow in colour. Immature, maturing and mature (0.51 to 0.70 mm) ova were seen present. Mature ova were predominant than maturing ova.

Stage V:

Ovary was long and broad, swollen and almost filling the body cavity; red or reddish yellow in colour. Immature, maturing and mature ova were present. Ripening ova which were transparent in periphery measuring 0.71 to 0.85 mm in diameter were also present. Opaque mature ova were predominant than maturing or ripening ova.

Stage VI:

Ovary was long and broad, round completely swollen, reddish-yellow or red in colour and almost filling the body cavity. Ripening and ripe ova, which were completely transparent (0.86 to 1.08 mm) with hexagonal markings, were numerous. Mature ova were also more or less equally numerous.

Stage VII:

Ovary was extending upto 1/2 to 2/3 of body cavity. Ovary shrunken, flaccid, hollow and blood shot, deep red in colour. Many distorted and disintegrating ripe and mature ova were present in the ovary besides the immature ova on the ovigerous lamellae.

Annual ovarian cycle:

The ovary 'A' showed two distinct modes, 'a' at 0.52 mm showing maturing eggs and 'b' at 0.84 mm showing early mature eggs. The ovary 'B' again showed two distinct modes at 'a' with eggs measuring 0.68 mm which belonged to maturing stock and mode at 'b' showing ova of maturing stock of 0.96 mm. The largest eggs shown in this is measuring 1.088 mm (Fig. 1).

The ovary 'C' belonged to maturing stocks with modes 'a' and 'b' at 0.52 mm and 0.68 mm, respectively. The ovary 'D' showed mature eggs at 0.76 mm at mode 'a' and mode 'b' showed advanced mature eggs at 1.0 cm. The largest egg recorded in this ovary was 1.08 mm.

Ovary 'E' showed maturing eggs of 0.68 mm at mode 'a' and mature eggs at 0.84 mm as mode 'b'. The largest ova observed here was 1.0 mm. The ovary 'F' showed only one mode of maturing eggs at mode 'a' of 0.68 mm. The ovary 'G' again showed only one prominent mode at 0.36 mm of immature stock. Similarly, ovary 'H' showed a prominent mode at 0.52 mm of maturing eggs.

Spawning:

Spawning season:

Monthwise percentage of maturity stages of females of *S. tumbil* has been shown in the Table 1. Except in some months, the stage I, II and III were observed throughout the year. Stage I was absent in January and August, II in January and III in January and February. Stage IV was seen from August to November. Stage V was available during the month of August to October. Running ovary (Stage VI) was reported during the month of September. Spent ovary was seen from January to May.

Length at maturity:

The specimen between III and VI stage of maturity were considered for this purpose. The cumulative percentage of females was plotted against their length groups at 20 mm class intervals and maturity curve was plotted (Fig. 2).

The percentage distribution of maturity stages according to different length groups are presented in Table 2. The length at which 50% of the fishes attain maturity

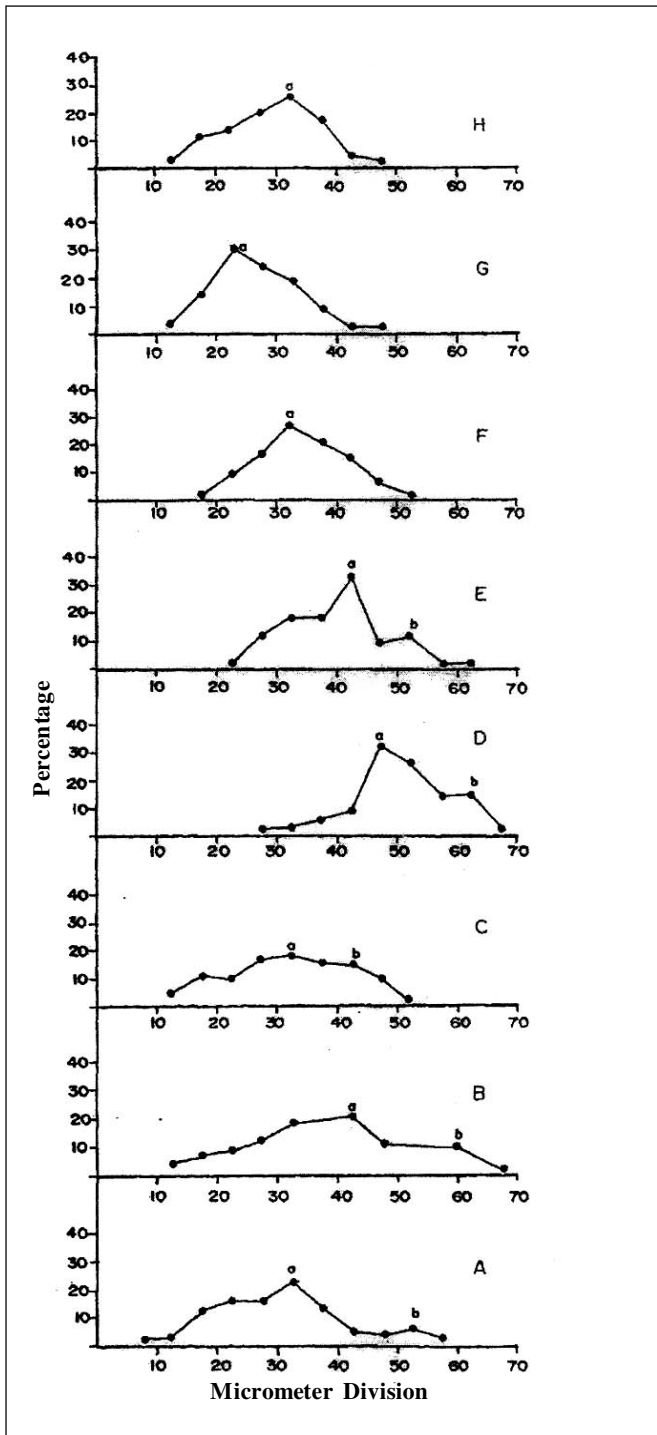


Fig. 1: Ova diameter frequencies for different stages of maturity for *S. tumbil*

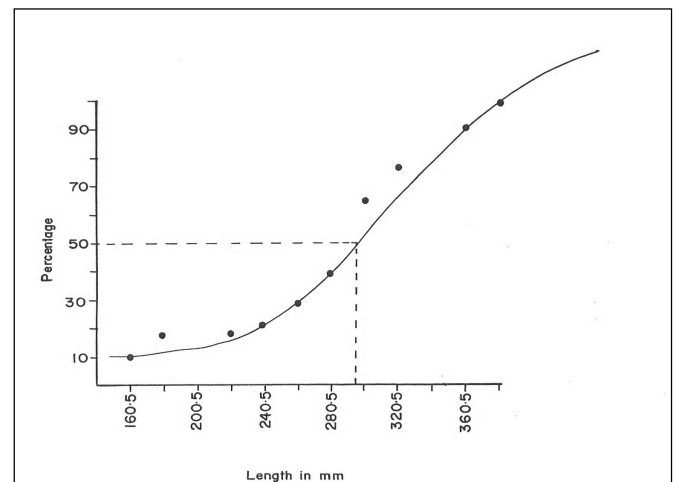


Fig. 2: Size at first maturity in *S. tumbil*

Table 2: Lengthwise percentage distribution of maturity stages in females of *S. tumbil*

Length group (mm)	No. examined	Maturity stages						
		I	II	III	IV	V	VI	VII
151 – 170	3	66.67	-	23.33	-	-	-	-
171 – 190	7	85.71	-	14.29	-	-	-	-
191- 210	23	73.91	26.09	-	-	-	-	-
211– 230	44	54.55	15.91	-	-	2.27	-	27.27
231 – 250	42	61.90	26.19	2.38	-	-	-	9.52
251-270	47	42.55	40.43	8.51	2.13	-	2.13	4.26
271-290	53	28.30	35.85	18.87	5.67	5.67	-	5.67
291-310	43	16.00	20.00	30.00	20.00	2.00	2.00	8.00
311-330	25	6.67	46.67	13.34	6.67	6.67	-	20.00
331-350	13	15.38	61.54	-	-	-	-	23.08
351-370	7	42.86	14.29	-	-	14.29	14.29	14.29
371-390	5	40.00	40.00	-	-	-	20.00	-

was calculated as 295.5 (296 mm). Based on growth estimates the age at 296 mm length worked out to be 0.925 years.

Fecundity:

The total length, total weight, ovary weight and

respective fecundity are presented in Table 3. Absolute fecundity was determined in 23 specimens in the size range of 307 mm to 429 mm in total length and 230 g to 670 g in total weight. The absolute fecundity ranged from 24,160 to 1, 72,000 eggs for the ovary weighing between 4.00 g to 64.27 g.

Table 3: Fecundity of *S. tumbil* in different stages

Sr. No.	Total length (mm)	Total weight (g)	Ovary weight (g)	Fecundity (Numbers of eggs)
1.	375	500	35	1,72,200
2.	390	507	62.49	1,58,712
3.	359	424.5	29.67	98,820
4.	307	230	4	24,160
5.	408	560	25	1,35,660
6.	353	360.5	19.18	39,570
7.	421	670	64.27	1,69,730
8.	433	610.5	17.69	98,717
9.	405	565	22.31	1,36,907
10.	357	348.5	49.47	65,270
11.	381	420.5	27.97	77,590
12.	384	421.5	28.95	88,630
13.	412	547.5	23.98	1,37,920
14.	417	568	31.25	1,56,908
15.	429	667	24.89	1,69,220
16.	326	245	28.10	80,007
17.	347	359.5	57.50	84,960
18.	377	382.5	25.98	94,570
19.	353	348.5	27.80	39,118
20.	392	497.5	24.50	1,11,918
21.	337	310.5	31.28	68,965
22.	386	524.5	18.50	81,912
23.	343	358	57.50	84,912

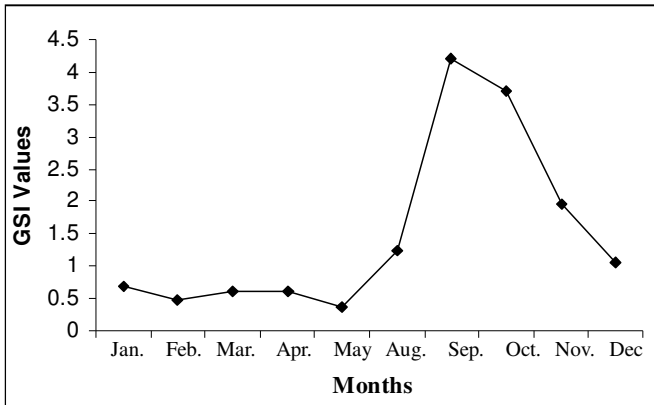


Fig. 3: Gonadosomatic index in *S. tumbil*

Relationship between fecundity and length of fish:

Linear relationship between fecundity and length of fish is given as:

$$F = -259871 + 950.9173 * L \quad (r = 0.7953)$$

Relationship between fecundity and weight of fish:

Linear relationship between fecundity and weight of fish is given as:

$$F = -23808 + 273.6427 * W \quad (r = 0.8336)$$

Relationship between fecundity and weight of ovary:

Linear relationship between fecundity and weight of ovary is given as:

$$F = 67084.48 + 966.7227 * W \quad (r = 0.3718)$$

Comparatively better correlation can be observed between fecundity and weight of fish.

Gonado-somatic Index (GSI):

Two prominent peaks in GSI of *S. tumbil* were observed in September (4.2) and October (3.71). Range of GSI during August to December varied between 1.05 to 4.20 (Fig. 3). Minimum GSI was observed during the month of May (0.38) and February (0.47). The range of GSI during January to May varied between 0.38 to 0.69.

Sex ratio:

There were no external distinguishing characters by means of which the sexes in lizardfish could be distinguished. The sex was recorded after dissecting abdomen of fish. The ratio was tested by 1:1 method of Chi-square.

Lengthwise distribution of sex ratio is presented in Table 4. The sex ratio (male to female) varied from 1:0.31 in 151-170 mm to 1:6 in 351-370 mm group. Lengthwise distribution of sex ratio indicated significant predominance of male at 5% in 151-170 mm group and that of females in 271-290 m, 311-290 mm and 331-350 mm group. The overall sex ratio of population was 1:1.39 throughout the year.

Monthwise sex ratio of male to female varied from 1:0.2 in January to 1:5.34 in May (Table 5). Monthwise distribution of sex ratio indicated significant predominance of male at 5% in January and that of females in March, April, May and November. The overall male to female ratio of population was 1:1.62 throughout the year.

In the present study, in most of the mature ovaries (B, D and E), it was observed that a batch of mature ova was present along with another batch of ova which had undergone more than half the maturation. Thus, it appears from the present investigation that the fish may be spawning only once and as one batch of eggs are released

Table 4: Lengthwise sex ratio in *S. tumbil*

Length group (mm)	No. of male	No. of female	% of male	% of female	Sex ratio	Chi square value
151 - 170	3	2	60	40.00	1:0.66	0.20
171 - 190	19	6	76	24.00	1:0.31	6.76*
191 - 210	26	16	61.90	38.10	1:0.61	2.38
211 - 230	29	38	43.28	56.72	1:1.31	1.20
231 - 250	30	40	42.86	57.14	1:1.34	1.42
251 - 270	30	45	40.00	60.00	1:1.5	3.00
271 - 290	23	51	31.08	68.92	1:2.12	10.60*
291 - 310	21	34	38.19	61.82	1:1.62	3.08
311 - 330	4	14	22.23	77.78	1:3.5	5.56*
331 - 350	4	13	23.53	76.47	1:3.25	4.76*
351 - 370	1	6	14.29	85.71	1:6	3.58

* indicates significance of value at P=0.05

the next batch of eggs almost gets mature to be released in a short time interval. Thus, the spawning appears to be single and protracted in case of *S. tumbil*. Prabhu (1956) in his study on the spawning periodicities of the fishes had remarked that "fishes which spawn twice a year in their ovaries in addition to the batch of eggs in the ripe condition, there would be another batch of eggs in which yolk formation has already taken place". Based on the ova diameter studies, Rao (1983) also concluded that the spawning period in *S. tumbil* is protracted extending from October to March with peaks in November to December. In the present investigation, also maximum number of mature females were recorded in November to December and the young ones in February to March period. It was also observed that the gap between the batches of ova was not much and as soon as one group of ova was shed, the other batch was almost ready. This indicates a protracted spawning for this species of lizardfish which is in conformity with that of Rao (1983).

The eggs of *S. tumbil* were collected in the plankton of inshore water off Madras by Nair (1952) and Vijayaraghavan (1957) and from Waltair by Raju (1963). Ripe specimens were collected from inshore catches at Madras in December by Kuthalingam (1959), while Annigeri (1963) collected ripe specimens from catches off Mangalore. Rao (1983) collected post larvae of 25-40 mm size in the shore seine catches while fishing in 25-50 meters depth. The above observations clearly show that spawning may take place in coastal waters, not far from the shore and that the eggs and larvae may enter

inshore waters during October- March period. However, the fishery of the species is contributed by the boats fishing in relatively deeper waters.

In the present study, the length at which 50% of the females mature was calculated as 296 mm. Rao (1983) reported the length at first maturity and size at which 50% females matured as 260 and 300 mm, respectively. He also stated that majority of fishes were mature in the size range of 300-320 mm. The present findings are in agreement with Rao (1983). Males were more in small length groups and dominated over females in the month of January and September *i.e.* just prior to spawning and post spawning period.

Singh *et al.* (1995) reported fecundity range from 6,008-17,384 eggs in the fishes ranging 212-420 mm in total lengths and 118-456 g in total weight from Bombay coast. They also stated that fecundity and fish length relationship as slightly curvilinear, indicating that with increase in length, the rate of increase in numbers of ova is slightly more. They also indicated linear relationship between fecundity-fish weight and fecundity-ovary weight. Similarly, Rao (1983) reported the fecundity of *S. tumbil* between 37,569 to 2, 14,981 eggs for fish of size 290-430 mm in total length. He also found linear relationship between fecundity and total length while did not report any relationship between fecundity- total weight and fecundity-ovary weight. The absolute fecundity ranged between 24,160 to 1, 72,000 eggs in the fishes with weight range of 4.00 g to 64.27 g.. There was low correlation between fecundity with total length and ovary weight.

Table 5: Monthwise sex ratio in *S. tumbil*

Months	No. of male	No. of female	% of male	% of female	Sex ratio	Chi square value
January	10	2	83.34	16.67	1:0.2	5.34*
February	28	28	50.00	50	1:1	0.00
March	24	40	37.5	62.50	1:1.67	4.00*
April	42	75	35.90	64.10	1:1.79	9.30*
May	9	48	15.79	84.21	1:5.34	26.68*
June	NA	NA	-	-	-	-
July	NA	NA	-	-	-	-
August	5	11	31.25	68.75	1:2.2	2.25
September	12	11	52.17	47.83	1:0.91	0.04
October	19	24	44.19	55.81	1:1.26	0.58
November	26	48	35.14	64.86	1:1.85	6.54*
December	4	3	57.14	42.86	1:0.75	0.14
Total	179	290			1:1.62	

* indicates significant at 5% level with 1 d.f.

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