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Reproductive biology of the masked triggerfish *Sufflamen fraenatus*

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Abstract

The reproductive biology of the masked triggerfish *Sufflamen fraenatus* was studied. Three distinct stages, viz. immature, maturing and mature were identified based on the external appearance of the ovary and the ova diameter studies. The fish appeared to attain maturity at 166-170mm in total length. In the mature stage, the ova had a diameter range of 2 – 42 m.d. and indicated multiple modes. The species showed a prolonged breeding season with peak during September and March/April. The fecundity varied from 404 and 3,41,516 in fishes of total length (TL) 264 mm and 272 mm respectively.

Key words: Reproductive biology, triggerfish, *Sufflamen fraenatus*

Introduction

Trigger fishes of the family Balistidae, are cosmopolitan in the tropical seas and constitute an important component of the coral reef community. Several species of this family are held in high esteem by marine aquarists throughout the world because of their striking colour pattern. They are beautiful, robust, eat a wide variety of food and can be tamed. In India, triggerfishes are consumed by some fisherfolks at Vizhinjam and Colachel areas along the southwest coast of India. They are caught by a type of bag net locally called *Kachal*. At Kanyakumari and Tuticorin (southeast coast, India), enormous quantities of these fishes landed by trawlers during the end of northeast monsoon, are sun-dried, to make poultry feed.

As the prospects for commercial exploitation of the balistids is slowly being realised it is essential to know in detail the fishery and biological aspects of various species. The review of literature shows that the information on the biology of these fishes is limited to the works of Nzioka (1979), Lobel and Johannes (1980) Fricke (1980), Aiken (1983), Menezes (1985), Danson (1990) and Gladstone (1994). However, not much work has been carried on balistids in India. The present study, therefore, was undertaken to obtain information on the maturation and spawning of the masked triggerfish, *Sufflamen fraenatus* off the southeast coast of India.

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Material and methods

Samples of *S. fraenatus* were collected during May 1999 to April 2000 at monthly intervals from the hooks and line landings at Tuticorin. The sample consisted of 289 males and 252 females of total length (tip of snout to tip of upper caudal lobe) ranging from 175-358 mm. Data on total length (TL), weight, sex and appearance of gonads were noted from fresh specimens. Dissected gonads were preserved in 5% formalin for further studies.

The classification of maturity stages was based on the colour, size and girth of the ovary. The ova were examined under microscope following Prabhu (1956). The method employed by Clark (1934), De Jong (1940) was adopted for ova diameter frequency distribution studies. For determining length at first maturity, specimens with mature ovaries only were considered. Monthly data on maturity stages were used for determining the spawning period. Gonado-somatic index was estimated by following June (1953) and Yuen (1955) and relative condition factor was determined by the method of Le Cren (1951). Periodicity of spawning was determined following Hickling and Rutenberg (1936) and De Jong (1940). Fecundity was estimated from mature ovaries as described by Holden and Raitt (1974).

Results

Maturity stages

In *S. fraenatus*, the ovaries are short, cylindrical and sac like lying in the posterior part of the body cavity. Both the lobes are of equal size with a narrow oviduct ventrally. A small yellow globular tissue is found on the paired ovary wall, where the oviduct meets the ovary.

The maturity scale suggested by Prabhu (1956) was followed. Only three stages of maturity (immature, maturing and mature) could be encountered during the study period mostly due to the absence of fishes in ripe stage in the area of fishing (Table 1).

In Testis, two stages were identified: 1) immature (it is paired globular structures, white in colour) and 2) mature (it is globular or kidney shaped with many small lobes).

Distribution of ova in the ovary

The distribution of ova from the anterior, middle and posterior regions (200 ova from each region were measured) of a mature ovary (222 mm TL) was studied. The percentage frequency distribution of ova of different sizes was calculated. The frequency polygon of ova from these three regions showed no difference (Fig.1.A-C). Hence diameter of ova from middle of the ovary was taken in further studies.

Length at first maturity

Gonads of 252 females of length range 166 mm to 290 mm were studied to determine the size at first maturity. The

Table 1. *Maturity stages observed in* S. fraenatus

Stage	Ovary
Immature	Ovary small, pink, round, with four globular structures. Ova transparent with out yolk, diameter ranging from 2 to 8 m.d. (0.022 - 0.088 mm).
Maturing	Ovary cylindrical, pink. Ova shape irregular or spherical, yolk deposition initiated, yellowish-brown, translucent, nucleus barely visible, ova diameter ranging from 2-16 m.d. (0.022 - 0.17 mm).
Mature	Ovary yellow, occupy ¼ the body cavity, mature ova - shape spherical, opaque, diameter ranging from 2 - 42 m.d. (0.022 - 0.462 mm).
Ripe	This stage was not encountered in the fishing ground during the present study.

observations indicated that the fishes in the length group 166-170mm and 176-180mm available in the hooks and line catches were all mature (Fig.2).

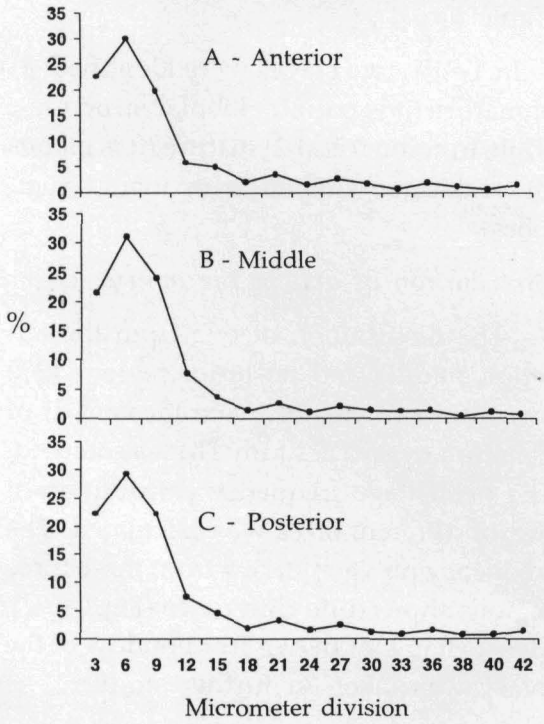

Fig. 1 A-C. *Percentage frequency distribution of ova diameter measurements in anterior, middle and posterior portion of the ovary of* Sufflamen fraenatus

Spawning period

Mature specimens occurred almost throughout the year (Table 2). A maximum of 40% of mature specimens were noticed during March followed by September (34%) and November (26.6%).

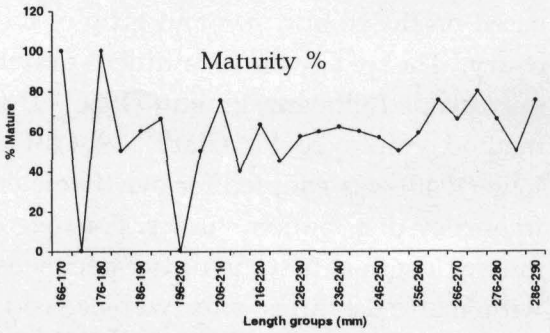

Fig. 2 *Percentage of mature female* - S.fraenatus

From this it is evident that this species spawns almost throughout the year with peak during September and in March/ April.

Gonado-somatic index

The G.S.I. values in males ranged from 0.003 to 0.317 and in females from 0.009 to 3.83. The values were: immature (0.154), maturing (0.211) and mature (0.750), which indicated an increase with

maturity. From the graph it is evident that in females the values were found to be higher during September, November and April. In the case of males the values were constant during all the months except during April when it increased. The increase in the values indicated development of the gonad (Fig. 3 A).

Relative condition factor

The monthly relative condition factor (Kn) values were calculated separately for the both sexes, employing the formula Kn = w/w^ (Fig. 3B). The maximum values for males and females were recorded during September, December and April. From the above studies it can be concluded that the breeding season of this fish is protracted with two peaks one during September and the other during March/April.

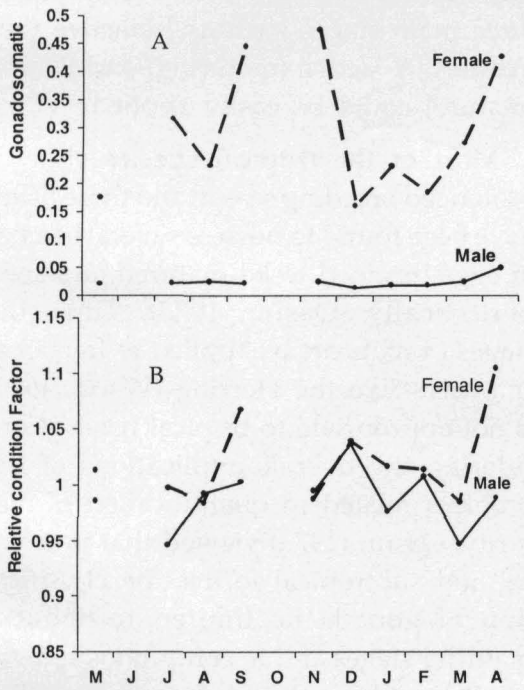

Fig. 3 *A) distribution of monthly average values of gonado-somatic index and B) The relative condition factor in* S. fraenatus

Table 2. *Monthly percentage frequency distribution of various maturity stages in females* (S. fraenatus) *during May 1999- April 2000*

Months	Immature (%)	Maturing (%)	Mature (%)	Sample size
May	36	56	8	25
Jun.	-	-	-	-
Jul.	0	81.5	18.5	27
Aug.	39.1	56.6	4.3	23
Sep.	27.7	37.9	34.4	29
Oct.	-	-	-	-
Nov.	36.6	36.8	26.6	15
Dec.	57.4	35.6	7	42
Jan.	38.2	61.8	0	21
Feb.	75.2	12.4	12.4	16
Mar.	48	12	40	25
Apr.	50	43	7	14

Development of ova to maturity

In the immature stage, majority of the ova belonged to 2-8 micrometer division (m.d.) with major modes at 5 m.d. (45%), 2-3 m.d. (40 %) and 8 m.d. (5%). This immature stock was always present in maturing and mature ovaries. The ova in maturing ovary were of 2 - 16 m.d. Ova of 4 m.d. constituted 36% and 10 m.d.formed 5%. In the mature stage, ova were of 2 - 42 m.d. and indicated multiple modes. The first mode was at 6 m.d. (23%) the others were at 16, 20, 26, 28, 34, 36

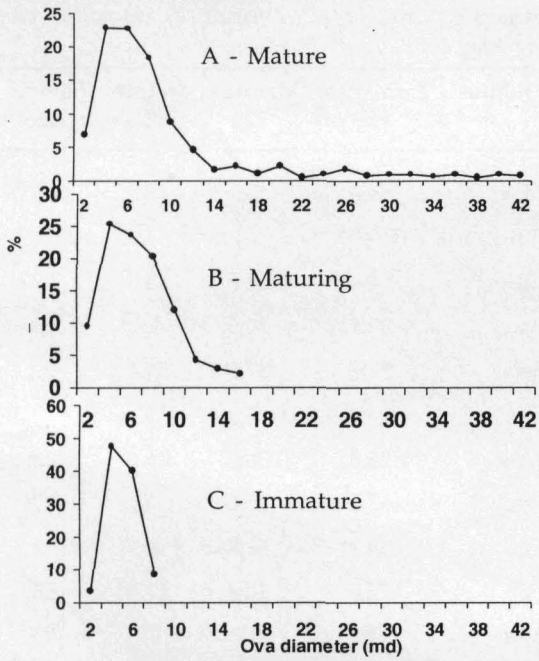

Fig. 4 A-C. *Percentage frequency distribution of ova diameter measurements in mature, maturing and immature ovary of* S. fraenatus

and 40 m.d., each forming less than 5 %. (Fig. 4 A-C).

Fecundity

The fecundity estimates were based on 20 mature specimens of size range 222 to 286 mm in total length. The number of ova varied from 404 in a fish of 264 mm to 3,41,516 in a largest specimen of 272-mm (TL). The average fecundity was 62,205. The relationship between fecundity and length, weight and weight of ovary was found to be insignificant.

Discussion

In *S. fraenatus*, landed by the hooks and liners at Tuticorin, three distinctive stages, viz. immature, maturing and mature could be observed. Ripe stage fishes are not available in the fishing ground of this unit. Nzioka (1979) made a similar observation (Inactive, Active and Ripe) in *Abalistes stellatus*. Aiken (1983) has classified the gonads of *Balistes vetula* into three stages (I-inactive, A- active, R- ripe). However, Menezes (1985) has applied 5 stages of maturation in *B.vetula*. Danson (1990) distinguished four stages : 1) immature, 2) maturing virgin and recovering spent, 3) ripe and 4) spent in the *B. capriscus*. The wide range of classification in maturity stages in balistids reported by the previous workers clearly showed that I.C.E.S. system of classification is not applicable in these fishes, instead only three main stages such as I-inactive (immature), A- active (maturing) and R- ripe (mature) could be easily applied.

Most of the tropical species show a prolonged breeding season and these fishes have been found to possess several batches of eggs destined to be matured and shed periodically (Qasim, 1973). Thus, the stages of maturity as applied to fractional spawners like the Herring (Wood, 1930) is not appropriate to tropical fishes. Considering the overall implications of the problem related to quantification of maturity, Qasim (1973) viewed that in tropical and subtropical forms, the classification of gonads be limited to about 5 maturity stages and in continuous spawners it may be reduced from 5 to 3. But Prabhu (1956) is of the opinion that in tropical fishes, based on the characteristics of ova present in the ovary, four stages (I. Immature II. Maturing, III. Mature,

IV. Ripe) could be made out. This method (4 stages) was found to be most suitable and appropriate for the masked triggerfish, which possesses asynchronous ovary.

The ripe ovaries of *S. fraenatus* were not encountered during the study period mostly due to the migration of the fish to a different place at the time of spawning. According to Gladstone (1994), trigger fishes display pre-courtship, courtship and parental care at the time of spawning. The male migrates to a traditional mating ground where it establishes a territory for building a nest with an egg chamber. The attracted female is led to the nest and the fertilized eggs are deposited in the chamber and guarded by both the parents. Lobel and Johannes (1980) recorded nest building in *Pseudobalistes flavimarginatus* and *Balistapus undulates* on the sandy bottoms or in the channels of the fringing reef at Fanning Atoll. Aiken (1983) is of the opinion that *Balistes vetula* might move to deeper waters on attaining maturity, as most of specimens caught from the Port Royal Reef were small and in maturing stage. Thus it may be concluded that the ripe specimens of *S. fraenatus* were not vulnerable to the hooks and lines operated by the small-mechanised boats at Tuticorin. This gear is operated in areas about 5 – 10 km from the shore. These areas may not be the breeding grounds of these fishes. This possibility is further supported by samples of this species collected from offshore grounds onboard FORV *Sagar Sampada*. Fishes of length range 15-30 mm (more than 500 numbers) caught by Isaac-Kidd Midwater Trawl (IKMT) off Cochin (10° 30′ N – 73° 00′ E), clearly indicated that the species breeds far from the shore in the coral banks (Anon, 1986).

S. fraenatus has a prolonged breeding season and most of the females are in mature condition from September to April. Nzioka (1979) has stated that ripe specimens of *Abalistes stellatus* were encountered during March, August, September and October. A comparison on *S. fraenatus* cannot be made based on the available information in the present study, due to limitation in availability of samples, but details of the spawning seasons of other balistids (Aiken, 1983) clearly indicate that these fishes have prolonged spawning season.

The presence of multiple modes of ova in the mature ovary of the masked triggerfish clearly suggested that the individual fishes spawn in batches. As the mature ova are shed, the immediate maturing group takes their place and the process continues. The diameter study in the present case showed three types of ova (immature maturing and mature) in the mature ovary. Observations of ova diameter study of balistids are not available but the fertilized eggs collected from the nest of some of the balistids like *Balistapus undulates* and *Pseudobalistes flavimarginatus* have a diameter of 0.55 mm (Lobel and Johannes, 1980). According to Kawase and Nakazono (1992) the eggs of *S. chrysopterus* collected from the nest are of the adhesive type having a diameter of 0.75mm.

At 166 mm (TL), the masked triggerfish is mature (100%). The studies by Aiken (1983) clearly suggests that the minimum size at first maturity in balistids ranged from 133 to 175 mm (FL) and the present results agreed with the observation. The estimated average fecundity of the masked triggerfish is 62,205. Lobel and Johannes (1980) while examining the cluster of eggs laid by *Pseudobalistes flavimarginatus* has estimated the number of eggs to be 4,30,000. A study made by Kawase and Nakazono (1992) on the egg mass of *S. chrysopterus* calculated the total number of eggs to be 1,32,800. Aiken (1983) has estimated the fecundity of *B. vetula* and of *Canthidermis sufflamen* from the Port Royal Reef as 49,000 – 83,000., and 2,19,700 – 6,20,000 respectively. The fecundity of *B. vetula* is 8,915 – 64,422 (Menezes, 1985). The observations of previous workers and that of the present study clearly indicate that the fishes of the family Balistidae have high fecundity.

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