

## BREEDING BIOLOGY OF *THRYSSEA MYSTAX* (BLOCH & SCHNEIDER, 1801) OFF MANGALURU COAST

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**ABSTRACT :** The maturation studies were carried out on *Thryssa mystax* samples collected from commercial landings. Maturity stages were classified based on macroscopic appearance of ovary. The overall sex ratio of 1:1.72 (M: F) was skewed towards female in *T. mystax*. Sex ratio differed in different months and size classes. Gonado-Somatic Index (GSI) indicated protracted spawning which extended from December (2014) to February (2015) with evidence of ova diameter studies. The size at first maturity of *T. mystax* was estimated at 16.2 cm (TL) and 16.5 cm (TL) for male and female respectively. Fecundity of *T. mystax* ranged between 13,916 to 22,894 eggs respectively, with an average of 18,328 eggs.

**Key words :** *Thryssa mystax*, maturation, spawning, Mangaluru coast.

### INTRODUCTION

*Thryssa mystax* is a pelagic, schooling species, found inshore in estuaries, mangroves, and brackishwater. It can be found to depths of 50 m. This species is tolerant to range of salinities (Anon, 2014b). *Thryssa mystax* distribution ranges from the coast of Pakistan to Australia, including the coasts of India, Myanmar, Malaysia, Indonesia, the Philippines, and China (Anon, 2014b). It is also found in the Gulf of Thailand.

The anchovies are widely distributed along the Indian coast. The Indian anchovies include 5 genera, *Stolephorus*, *Coilia*, *Setipinna*, *Thryssa* & *Thryssina* that constitutes seasonal-fisheries almost along the coast of Andhra Pradesh, Tamil Nadu, Kerala, Karnataka and Maharashtra. The average annual catch during 1990-2008 was 0.13 million tonne, constituting 10% of the total pelagic fish production in India. During 1990-2008 overall anchovy production was 0.127 million tonnes. *Thryssa* formed 27 percent. The major gears employed for exploiting anchovies are boat-seines, shore-seines, bagnets and gill-nets operated mainly by the catamarans and other small country crafts. Purse-seines, ring-seine and trawl nets are also used in fishery.

A small fraction of fresh fish is used as baits in hooks and line fishery. Improvements in cold storage facilities, introduction of artificial dryers and canning in tomato sauce are some of the ways by which better utilization of anchovies could be ensured (Ayyappan, 2011).

### MATERIALS AND METHODS

*Thryssa mystax* specimens were collected monthly

over a period September 2014 to April 2015 at Mangalore main fish landing center (Bunder jetty) and fish market. A total of 468 specimens were examined for study. Total length (TL) and Standard length (SL) of each individual was measured to nearest 0.5 mm. Month wise sex ratio was determined and Chi-square test was performed to examine the homogeneity of male and female distribution. The size at first maturity ( $L_{50}$ ) was determined by plotting cumulative percentage for male and female considering all maturity stages of fish against size groups of different length (James and Badrudeen, 1981). Total weight of specimen and weight of gonad weight was recorded after dissecting to the accuracy of 0.01 with an electronic balance.

Gonado Somatic Index (GSI) was calculated by commonly followed method (James, 1967; Baragi, 1977) is expressed as  $GSI = \text{gonad weight} / \text{fish weight} \times 100$ . The gonad were then preserved in 5% buffered formalin for subsequent analysis. Fecundity was estimated gravimetrically and ovaries of the stages III, IV, V and VI were considered for fecundity estimation. Number of mature ova in the sample was counted physically. Absolute and relative fecundity were calculated by following the standard formulas (Garg *et al*, 2002).

### RESULTS AND DISCUSSION

#### Maturity stages and its occurrence in different months

Classification of maturity stages is a paradigm in fisheries biology for initiation of studies on breeding seasonality with reproductive biology of fish. Based on

gross macroscopic characteristics gonads were classified into seven stages by following standard key for *Thryssa mystax*. In female *T. mystax* the coloration of ovary noticed was pale orange to turgid yellow color from stage I to VI with increase in size and prominent network of blood vessels whereas in male testis pale to pink color was imparted from stage I to VI with development of lobes and blood infusion. Microscopically eggs were examined mainly based on yolk deposition, the eggs appeared with clear perivitelline space and the chorion was very smooth without any ornamentation, means there is absence of spines and other markings.

Fish biologists have devised schemes to identify maturity into number of stages, usually 4-5 but sometimes up to 7-8 stages also (Clark, 1934; Hlickling and Rutenberg, 1936; Prabhu, 1956; Quasim, 1973; Crossland, 1977). Occurrence of maturity stages in different months for male and female indicated that *T. mystax* was found to have a prolonged spawning twice in a year from January to March with peak in February and another peak in September and October.

Direct evidence on the spawning period (season) of a species was identified by the occurrence of different maturity stages (especially mature and spent) in various months. A perusal of data on distribution of maturity stages showed that almost all stages were present throughout the study period, at least 3-4 stages of maturity were found in most of the months. Clark (1934) reported that if there is any periodicity in the spawning, all the fish collected at any particular time are expected to belong to same stage of maturity. However, observation on *T. mystax* did not indicate any such periodicity. Ripe specimens of female *T. mystax* occurred during the period September (2014) to March (2015) with peak in the month of January (2015), indicating this as a spawning season.

#### Size at first maturity

The timing of sexual maturity was a critical transition where onset of sexual maturity correlated with size of the fish. Cumulative percentage frequencies of male and female were calculated and plotted against different size groups present in Fig. 1. The size at first maturity of *T. mystax* was 16.2 cm (TL) and 16.5 cm (TL) for both male and female, both sexes exhibited same growth rate which resulted in equal size at maturity, attaining maturity at same time may result in reproduction success. Yogeesh (2004) studied the size at first maturity of *Thryssa mystax* along Mangalore coast and reported that the male and female attained first maturity at 14.7 cm and 15.6 cm TL respectively. Masurekar and Rege (1960) reported that

*Thryssa hamiltonii* attained first maturity at a size of 15 cm in Bombay water.

#### Sex-ratio

The data (Tables 1, 2 and Figs. 2, 3) on sex-ratio of *T. mystax* showed that in most of the months male were dominant. Number of male and female proportion may reflect certain change in fish population. The sex-ratio between male and female was 1:1.72. Chi-square test showed no significant difference from the theoretical ratio of 1:1 showing the equal proportion of male and female in most of the months. The data were also analyzed by Chi-square test using the number of male and female in various size groups. In size group 7 - 9 cm, 9 - 11 cm and 11 - 13 cm the males dominated the females whereas in the size group 13 - 15 cm, 15 - 17 cm, 17 - 19 cm and 19 - 21 cm females dominated over males. Values indicated significant difference in the size group of 11 - 21 cm.

The diversity might be due to partial segregation of mature forms, either through habitat predominance or because of school formation thus rendering one sex more easily caught than other (Reynolds, 1974). The differences in sex ratio and deviation from 1:1 may be due to gear selectivity in relation to sex differences, physiological activity, fishing pressure, differential behaviour of sexes. Similar observations were reported by Del Zarka and El-sedfy (1970) and Bal and Rao (1984).

#### Gonado-Somatic Index

Gonado-Somatic Index (GSI) was calculated for each individual fish with male and female were taken into consideration separately. The average GSI values were plotted against each month and the results are presented in (Fig. 4). The G.S.I. values ranged between 0.58 to 1.87 in male fish. The lowest G.S.I. value was recorded in April, while the highest was in January.

In case of female, highest GSI value 2.35 was encountered in the month of January indicating peak spawning activity and lowest value of 0.58 recorded in April. Hoda (1976) observed that in *Thryssa mystax* spawning occurred twice a year, with two peak spawning seasons recorded one from January to March another from June to July.

#### Fecundity:

Knowledge about fecundity of a fish is essential for evaluating commercial potentialities of its stock, life history, potential culture and actual management of fishery. Fig. 5(a,b,c) represents the relation between fecundity of fish with length, weight and ovary weight of fish. In *T. mystax* fecundity varied from 13916 to 22894 eggs, with an average of 18328 eggs per individual. In case of *T.*

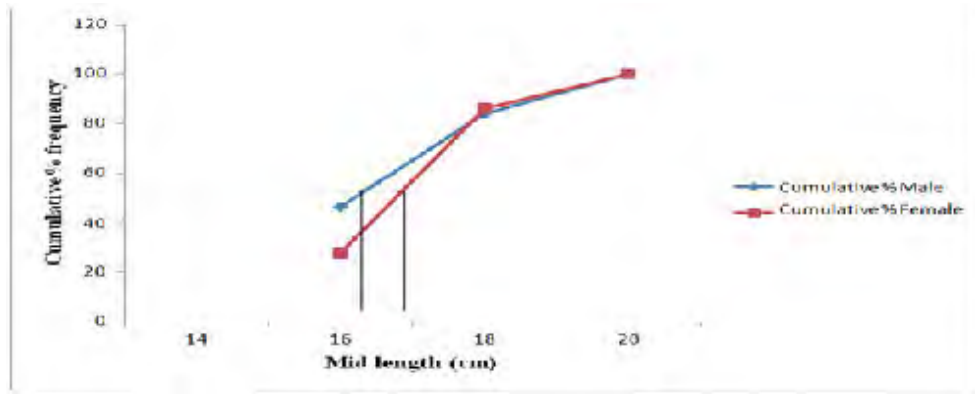


Fig. 1 : Estimation of size at maturity by cummulative percentage frequency method.

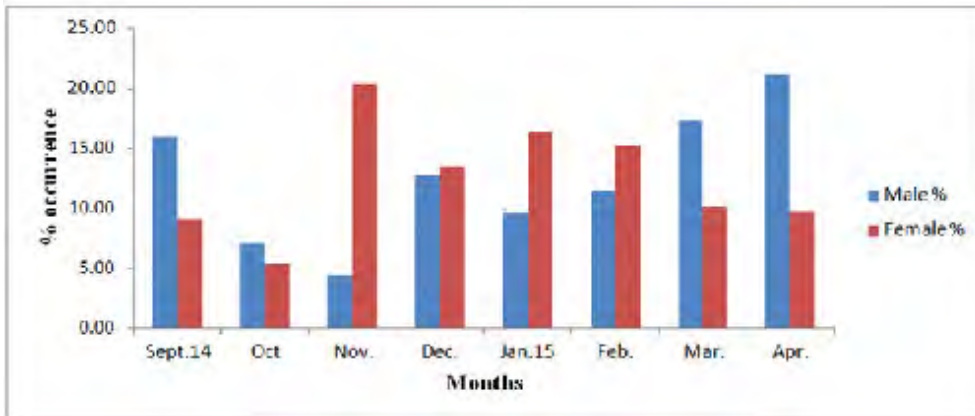


Fig. 2 : Sex - ratio of *Thyrrsa mystax* in different months.

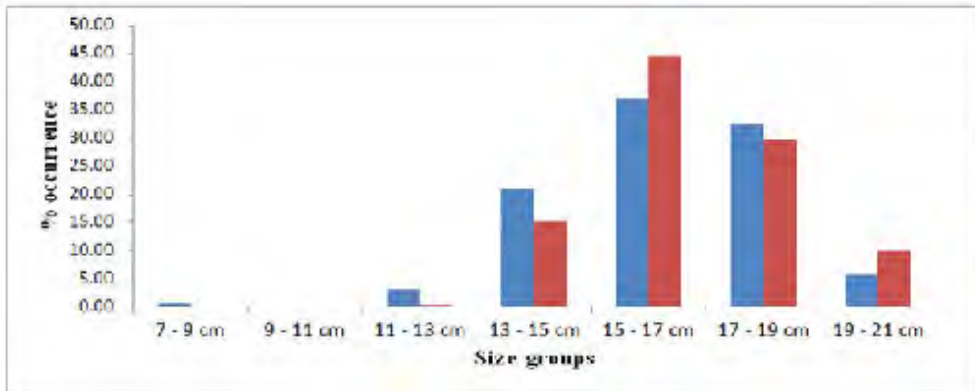
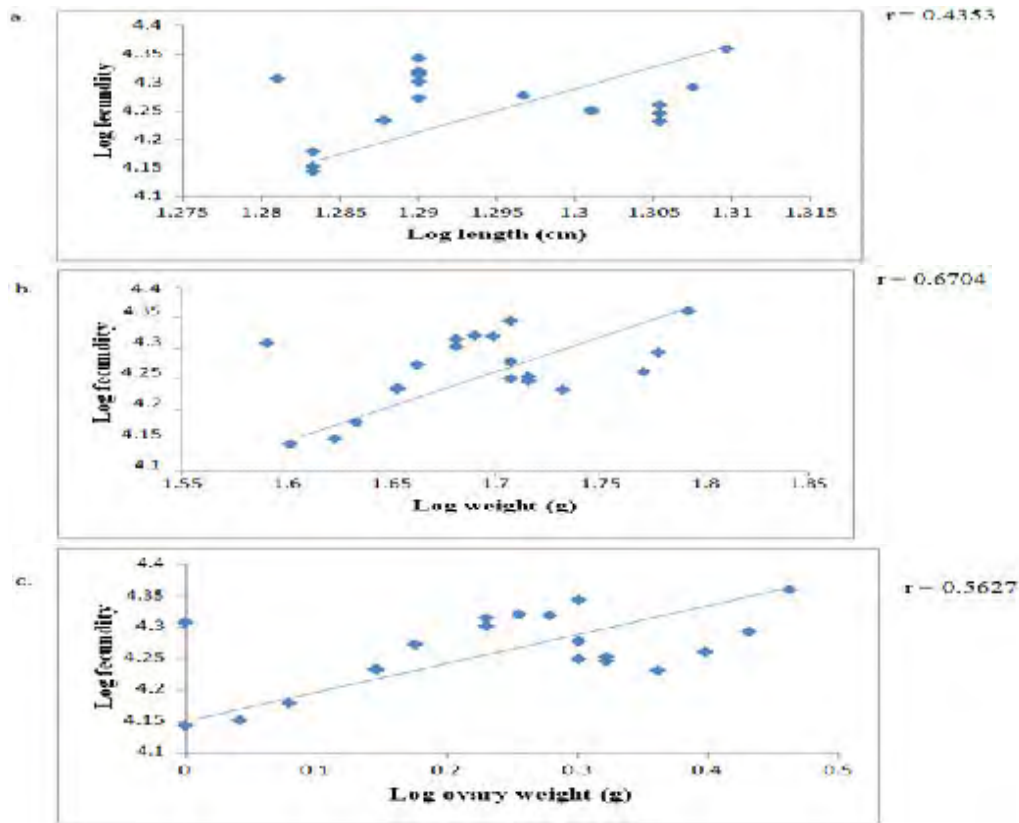


Fig. 3 : Sex - ratio of *Thyrrsa mystax* in different size groups.



Fig. 4 : Monthly variations of GSI of *Thyrrsa mystax*.



**Fig. 5:** Linear regression plot of *Thyssa mystax* representing relation between fecundity of fish with length, weight and ovary weight of fish.

**Table 1:** Sex – ratio of *Thyssa mystax* in different months.

Months	Total no. of fish	Males		Females		Chi-square value	Male : Female
		n	%	n	%		
Sept. 14	50	25	16.03	25	9.09	9.25*	1 : 1
Oct.	26	11	7.05	15	5.45	12.54*	1 : 1.36
Nov.	63	7	4.49	56	20.36	43.02*	1 : 8
Dec.	57	20	12.82	37	13.45	10.26*	1 : 1.85
Jan. 15	60	15	9.62	45	16.36	6.86*	1 : 3
Feb.	60	18	11.54	42	15.27	9.60*	1 : 2.33
Mar.	55	27	17.31	28	10.18	0.07	1 : 1.4
Apr.	60	33	21.15	27	9.82	2.42	1 : 0.82
<b>Total</b>	<b>431</b>	<b>156</b>	<b>100.00</b>	<b>275</b>	<b>100.00</b>	<b>56.88*</b>	<b>1 : 1.76</b>

Significant at 5% level.

*mystax* linear regression of log fecundity showed significant correlation with all the variables *viz.* Log length of fish (0.4353), log weight of fish (0.6704) and log ovary weight (0.5627). Similar fecundity results were reported by earlier workers like Nalluchinnappan and Jeyabaskaran (1991) who observed that the fecundity in *T. mystax* varied from 3,182 and 17,880.

## Ova diameter studies

### Development of ova to maturity

Ova diameter studies have become an integral part of the fishery research, it has been widely accepted that ova diameter studies gives reliable evidence on breeding season. Table 3 and Fig. 6 gives the spectrum of progression of ova diameter in different maturity stages. The ova diameter from stage I to VII ranged between

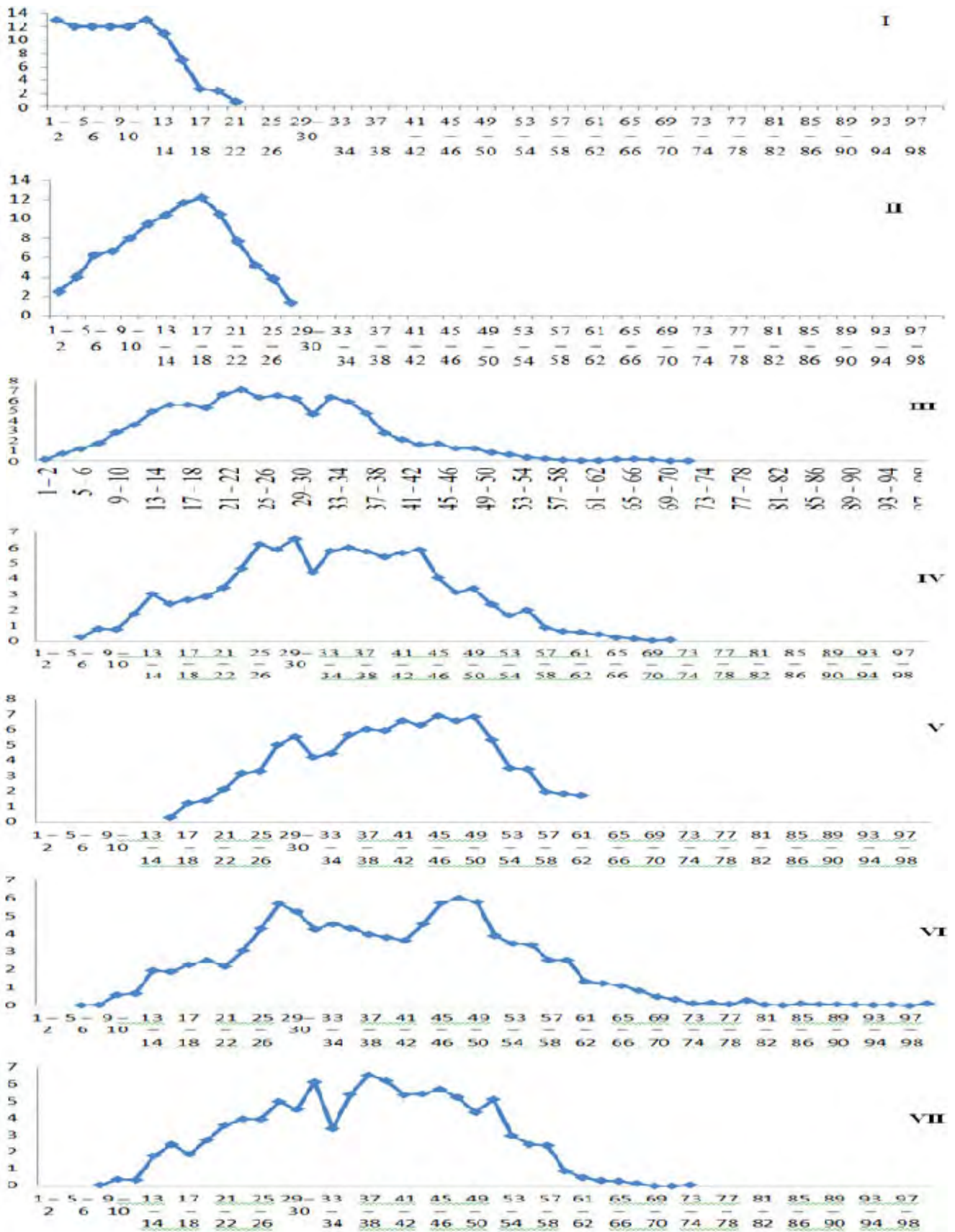


Fig. 6 : Ova diameter frequency polygon of *Thyssa mystax*.  
X axis – Ova diameter range 10.M.D = 0.01mm

**Table 2 :** Sex-ratio of *Thryssa mystax* in different size groups.

Size group (cm)	Total no. of fish	Males		Females		Chi-square value	Male : Female
		n	%	n	%		
7 - 9 cm	1	1	0.64	0	0.00	1.00	1 : 0.00
9 - 11 cm	0	0	0.00	0	0.00	0.00	0 : 0.00
11 - 13 cm	6	5	3.18	1	0.37	19.20*	1 : 0.20
13 - 15 cm	74	33	21.02	41	15.13	11.43*	1 : 1.24
15 - 17 cm	179	58	36.94	121	44.65	44.12*	1 : 2.09
17 - 19 cm	132	51	32.48	81	29.89	24.72*	1 : 1.59
19 - 21 cm	36	9	5.73	27	9.96	23.60*	1 : 3.00
<b>Total</b>	<b>428</b>	<b>157</b>	<b>100.00</b>	<b>271</b>	<b>100.00</b>	<b>79.40*</b>	<b>1 : 1.72</b>

**Table 3 :** Ova diameter studies of *T. mystax*.

Stage	Minimum size of ova (mm)	Maximum size of ova (mm)	Largest mode of ova (mm)	Size range (mm)
I	0.01	0.022	0.12	0.01 - 0.002
II	0.02	0.028	0.18	0.02 - 0.028
III	0.02	0.73	0.24	0.02 - 0.73
IV	0.06	0.72	0.30	0.06 - 0.72
V	0.18	0.64	0.46	0.18 - 0.64
VI	0.06	1.00	0.48	0.06 - 1.00
VII	0.31	0.73	0.38	0.31 - 0.73

0.01mm to 0.73mm. This is in conformity with Yogeesh (2004) observation on *T. mystax*. He reported that the egg diameter from immature stage to mature stage ranged from 0.06 mm to 0.72 mm.

The ova diameter study in the present investigation revealed that the presence of multiple groups of eggs in ovaries of different stages which were destined to be mature and shed periodically by representing unrhythmic spawning bursts which could not be sharply differentiated or separated in each stage depicting prolonged spawning season indicating fish *T. mystax* as a continuous spawner. The presence of highest number of yolked *T. mystax* ova in mature ovary observed during the months of December (2014) and January (2015), confirmed this to be the breeding season. The observation of Prabhu (1956) also supported the above result that spawning period and its duration, as determined by study of intra-ovarian eggs would be more accurate if ova represented by various modes studied in relation to different stages of maturity represented by the respective modes in the ova diameter frequency curve and inference made on periodicity of spawning in different species concluded four distinct types of spawning, type A) Spawning taking place only once a year during definite short period, type B) Spawning taking place only once a year with a longer duration, type C) Spawning twice a year, type D) Spawning throughout

the year but intermittently. Quasim (1973) also reported that in Indian ocean, several species of fish are continuous breeders with Prolonged spawning season, lasting 7-9 months in a year.

In stage I, the size of the ova ranged from 0.01 mm to 0.022 mm and the largest mode observed was 0.12 mm. The stage II, had a modal value at 0.18 mm, the ova ranged from 0.02 mm to 0.028 mm. In stage III, a batch of maturing eggs were withdrawn from the general egg stock, the maturing group had a modal value at 0.24 mm and the diameter of ova ranged between 0.02 mm to 0.73 mm. In stage IV two batch of maturing eggs were withdrawn from the general egg stock, the maturing group had a modal value of 0.30 mm and the diameter ranged between 0.06 mm to 0.72 mm. In stage V also two batch of maturing eggs were withdrawn from general egg stock, the maturing group had a modal value of 0.46 mm with a minimum of 0.18 mm and maximum of 0.64 mm. In stage VI, the size of the ova ranged from 0.06 mm to 1 mm and the largest mode observed was 0.48 mm. In stage VII, the size of the ova ranged from 0.31 mm to 0.73 mm and the largest mode observed was 0.38 mm.

### CONCLUSION

The present study on some aspects of reproductive biology with breeding seasonality of *T. mystax* revealed the following, female and male were in equal proportion in the population and both sex mature at same size. The prolonged spawning twice in a year from January to March with peak in February and another peak in September and October, which was strongly evident by GSI. Ova diameter peaks confirmed that *T. mystax* is a fractional (batch/multiple) spawner and prolonged spawner with asynchronous oocyte development.

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