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OBSERVATIONS ON THE BIOLOGY OF *THRYSSA MYSTAX* OFF TUTICORIN COAST, GULF OF MANNAR, EAST COAST OF INDIA *

I. NALLUCHINNAPPAN AND Y. JEYABASKARAN [1]

Tamilnadu Fisheries Department, Madras-600 006

ABSTRACT

The second important pelagic fishery at Tuticorin is *Thryssa* spp. The food of *T. mystax* is mainly zooplankton. Juvenile and adult fish differ in their food habits. The length weight relationship is in accordance with cube law ($W=0.00002383\ L^{2.1043}$). The point of inflexion in the ponderal index is noticed at 122 mm size which denotes the size at first maturity of this species. It has a prolonged spawning season right from December to June with a mean fecundity value of 12,703. Based on the ova diameter frequency polygons, it may be inferred that *T. mystax* spawns during a definite period between December to June.

INTRODUCTION

'KOLA' FISHERY is one of the important pelagic fisheries off Tuticorin (78°09'E and 08°48' N) Coast. The fishery is mainly constituted by three species of the genus *Thryssa* viz., *T. mystax* (Schneider), *T. dussumieri* (Cuvier and Valenciennes) and *T. setirostris* (Brouss) coming only next to lesser sardine fishery. Of the three species *T. mystax* fishery is the most dominant in this area, the main gear used in the exploitation being the drift gillnet. Studies on the biology of this fish was carried out in the east coast by Dharmamba (1959), Basheerudin and Nayar (1962) and Ganapati and Rao (1962) and in the west coast by Venkataraman (1956). In the present investigations, an attempt has been made to study the biology of this species from the Gulf of Mannar area.

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MATERIAL AND METHODS

Fish samples were collected from Tuticorin centre during January 1974 - December 1975 and the data on size, sex and stage of maturity were recorded for each fish. Totally 1,188 specimens were subjected to these studies.

The percentage composition of various food items were analysed by the numerical method (Pillay, 1952). Volumetric method was also employed for analysis of food contents using a graduated measuring cylinder. The intensity of feeding was determined by the degree of distension of the stomach and also the amount of food it contained, the stomach being graded as full, ½ full, ¼ full and empty. Percentage occurrence of these different degrees of disten-

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[1] Tamilnadu Fisheries Development Corporation Ltd., Madras 600 006.

sion of the stomach was calculated from the total number of fish examined in a month.

All the specimens ranging from 70 to 210 mm in total length and 1.9 - 50.0 gm in weight were treated for 'K' value determination for male and female separately by employing the formula $K = 100\ W/L3$ where W is the weight of fish in grams and L is the length of fish in centimetres.

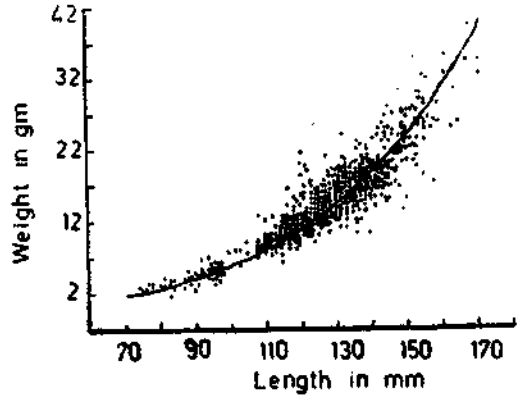

Fig. 1. Length-weight relationship in *Thryssa mystax*.

Maturity stages of *T. mystax* were classified following the scale given by the International Council for the Exploration of Sea. For fecundity and ova diameter study, ovaries preserved in Gilson's fluid were used. Ova diameter measurements of intraovarian eggs were made according to the methods recommended by Clark (1934) and Palekar and Karandikar (1952).

Fecundity was determined in 20 specimens (stages IV and V) ranging in size between 118 and 153 mm. After removing the surface moisture, approximately 2/3 portion of the ovary from the middle region was removed and weighed to the nearest milligram. All the mature ova visible to the naked eye and measuring roughly 0.5 mm and above were counted and the fecundity was computed. A total of 14 ovaries, 2 to 3 ovaries in each maturity stage including spent ones were selected for the ova-diameter study. A sample study of ova taken from anterior, middle and posterior regions of a few ovaries in advanced stages of maturity indicated a more or less uniform pattern of size distribution in different parts of both the lobes and hence 1,000 ova from middle portion of each ovary were measured by means of an ocular micrometer scale at a magnification of 20μ to each micrometer division. Ova samller than 5 md were not measured. Ova diameter from ovaries of the same stage of maturity were combined and grouped into size intervals of 0.1 mm and the pooled data were used in plotting the graph.

In order to find out the length weight relationship, the individual weights and measurements of 1,188 specimens grouped into 5 mm size groups were taken and analysed. The average length and weight of each size group worked out and the relationship was determined by using the formula $W = CL^n$, where W and L represent the weight and length of the fish respectively and C and n the constants.

Observations and Discussion

Food and Feeding

The study reveals that the food of *T. mystax* consisted mostly of zooplankton. The average percentage value of different food items showed clear difference between the feeding habit of juvenile and adult fish (Table 1). The main food items of adult fish comprised of prawn young ones, molluscan larvae, *Acetes* sp., fish eggs and larvae, *cypris* larvae, amphipods and polychaetes, while in juveniles nauplius larvae, prawn young ones, *Acetes* sp., copepod, molluscan larvae, cypris larvae, *Lucifer* sp., amphipods and alima larvae (Table 1). An analysis of the condition of the stomach in the fish revealed that during 1974 and 1975 the feeding intensity was high during May-July corresponding to the spawning activity.

The food and feeding habit differs in different species of the same family. *T. kammalensis* and *T. dussumierii* feed on both zooplankton and diatoms, but *T. purava* and *T. hamiltonii* are carnivorous surface feeders, prawns and copepods being the main food items (Bapat and Bal, 1950 ; Venkataraman, 1960). Carnivorous feeding habit is reported for *T. malabaricus*, *T. setirostris* and *T. mystax* (Venkataraman, 1960 ; Basheerudin and Nayar, 1962 ; Ganapati and Rao, 1962).

TABLE 1. *Percentage by number of different food items consumed by juveniles (less than 100 mm) and adults (100 mm and above) of* T. mystax *at Tuticorin*

Name of organisms	Juvenile	Adult
Copepod	9.6	1.5
Alima larvae	4.0	—
Megalopa larvae	1.5	1.0
Amphipods	7.0	5.5
Isopods	0.8	2.0
Nauplius larvae	22.0	—
Acetes sp.	14.0	11.5
Prawn young ones	15.0	32.5
Lucifer sp.	7.0	1.5
Cladocerans	2.0	3.5
Cypris larvae	7.5	8.0
Zoea larvae	0.8	0.5
Molluscan larvae	7.8	17.0
Fish eggs and larvae	—	11.0
Polychaetes	—	4.5

The present observations made at Tuticorin on *T. mystax* shows that its feeding habit corresponds with the observations made by Bapat and Bal (1950) for *T. hamiltonii* by Venkataraman (1956) for *T. mystax* and by Marichamy (1972) for *T. baelama*. The juveniles being smaller and not in a position to feed on larger animals, tend to prefer smaller copepods, amphipods, ostracods, isopods, cladocerans, polychaete and crustacean larvae as their food rather than prawn juveniles, lucifers, molluscs, polychaete worms. As they grow bigger, organisms like young molluscs, polychaete worms, prawn juveniles, fish eggs and fry, etc. were found in appreciable numbers in their gut.

Length-weight relation

The length weight calculated was $W = 0.00002382\ L^{2.1068}$.

Sex Ratio

Pattern of sex distribution among *T. mystax* was found to be unequal. During 1974, out of 598 fishes examined 342 were males 195 females and 61 indeterminates, in 1975 out of 590 fishes, 222 were males, 141 females and 227 indeterminates. The males were dominating over females in lower size groups (Table 2).

TABLE 2. *Sex ratio in* T. mystax *at different size groups*

Size groups (mm)	No. of Fishes	Males (%)	Females (%)
70- 74	2	100.0	—
75- 79	8	87.5	12.5
80- 84	13	84.6	15.4
85- 89	12	83.4	16.6
90- 94	19	84.3	15.7
95- 99	30	66.7	33.3
100-104	12	100.0	—
105-109	21	95.1	4.9
110-114	43	72.1	27.9
115-119	85	69.4	30.6
120-124	113	70.8	29.2
125-129	151	79.4	20.6
130-134	183	68.9	30.1
135-139	154	56.5	43.5
140-144	111	54.1	45.9
145-149	55	41.8	58.2
150-154	35	40.0	60.0
155-159	22	17.3	82.7
160-164	4	25.0	75.0
165-169	3	33.3	66.7
170-174	3	66.7	33.3
175-209	Not represented in the study		
210-214	1	—	100.00

indicating that there were more males than females among smaller size groups measuring less than 140-144 mm, but above this size

groups females outnumbered males. Females were abundant (58.2 - 82.7%) from 145-149 mm size group to 165 - 169 mm size group. The occurrence of such mature fish in relatively high percentage, was noticed during February-June in the commercial catches coinciding with the spawning period of the fish. From July onwards the indeterminates with fat deposition dominated the catch upto December. Venkataraman (1956) also observed such fat ladden immature *T. mystax* during June-August in Calicut waters. Similar variation in sex ratio was observed for *T. baelama* by Marichamy (1970).

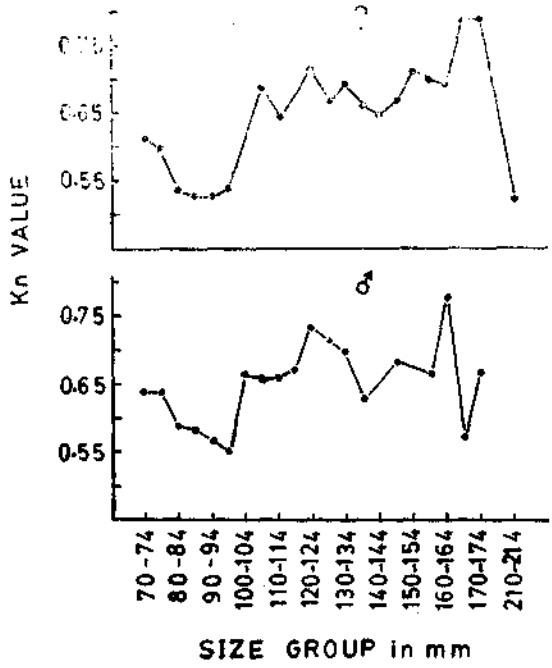

Fig. 2. Ponderal index for male and female separately for *Thryssa mystax*.

Ponderal index and size at first maturity

The ponderal index (' K ' values) were low in smaller fishes. In the case of male, after a fall in the index at 96 mm size (95-99 mm group) a steady rise was noticed upto 122 mm (120-124 mm group) with a slight sag at 105-109 and 110-114 mm group. The peak point reached at 122 mm size (Fig. 2), this point of inflexion can be considered to be the size at which the male of this species attained maturity. There was again an increase in ' K ' value upto 160-164 mm size group with a value of 0.78 the maximum value recorded for male of this fish, which later reduced to 0.57 at 165-169 This fall can be considered as indicative of a second breeding of the male.

Increase in index value noticed for female from 95-99 mm group upto 122 mm (120-124 mm group), with a slight sag at 110-114 mm group. The peak reached at 122 mm size is considered to be the size at which the female attained first maturity (Fig. 2). There was again increase in ' K ' value upto 165-169 and 170-174 mm size groups with a value of 0.79, the maximum value recorded for female of this fish, which later reduced to 0.525 at 210-214 mm group. This fall can be considered as indicative of a second breeding of the female of this species in its life. The size at first maturity for *T. mystax* at Waltair between 90 and 100 mm for male and 110-120 mm for female (Ganapati and Rao, 1967) and at Calicut for female it was 140-150 mm size group (Venkataraman, 1956).

The present observations agree closely with those made on the same species at Waltair.

Spawning season

A large number of mature females with advanced stage of maturity was noticed only during December-July (NE postmonsoon to summer) (Table 3). From August-November all the size groups caught from inshore areas were with fat deposition.

Dharmamba (1959) also reported that mature fish appear in the inshore catch during December-June and immature fish during rest of the period. The prolonged spawning activity of *T. mystax* during February-June was reported from Andhra Coast by Ganapati and Rao (1962). Along Kerala Coast this species is reported to spawn during September-May

by Venkataraman (1956). Thus, the spawning behaviour of *T. mystax* at Tuticorin resembles that of the same species of Waltair (East Coast), but not of Calicut (West Coast).

Fecundity

Fecundity was between 3,182 and 17,880 in the fish ranging in size between 118 mm and 153 mm. The mean fecundity value was 12,703. A logarithmic regression relationship was found between fecundity and length of fish which is expressed as Log F = — 6.8541 + 5.1268 Log where 'F' is the number of ova and 'L' the length of fish in mm. A high degree of correlation was observed between fish length and fecundity with the coefficient of correlation (r) being 0.9082.

Masurekar and Rage (1960) estimated the fecundity of *T. hamiltonii* to be 12,495 to 23,060 in fish of 150-173 mm total length. Marichamy (1970) reported the fecundity of *T. baelama* to be 1,171 to 3,356 in fish of 110-127 mm total length. The limited data revealed that the fecundity was proportional to the length of fish. The fecundity of *T. mystax* also increased with increase in the size of fish, but considerable variations were seen in the same size. Similar observation was made by Marichamy (1970) in *T. baelama*.

Maturity stages through ova diameter studies

In order to understand the course of maturation of the oocytes in the ovary and to assess stages of maturity the ova of different stages were measured and they were plotted to deplot the changes taking place in the size of ova at different maturity stages (Fig. 3).

The ova were comparatively small at stage II, measuring upto 0.55 mm. A distinct mode appeared at 0.45 mm in stage III, indicating the development of a batch of eggs from the general egg stock for maturation, this mode 'a' has shifted to 0.55 mm in stage IV and also a secondary mode 'b' has appeared at

TABLE 3. *Monthwise occurrence of percentage gonad stages of female* T. Mystax *during* 1974 *and* '75

Maturity	Immature	Maturing		Mature			Spent	Immature	Maturing			Mature		Spent	Remarks
Stages	I	II	III	IV	V	VI	VII	I	II	III	IV	V	VI	VII	
					1974						1975				
Jan.	6	16	21	24	15	18	—	6	17	25	20	18	5	5	During August, Sep-
Feb.	—	40	20	14	10	16	—	2	4	20	15	25	32	1	tember, October and
Mar.	3	18	22	10	18	26	3	—	7	14	14	28	32	5	November fat ladden
Apr.	—	4	6	10	23	44	13	—	12	5	9	10	22	41	intermittents appear
May	—	1	3	5	10	33	48	3	—	12	9	12	33	30	in plenty in the in-
June	—	—	—	—	12	8	80	—	—	5	11	19	49	16	shore gill net catches.
July	—	—	—	—	—	—	100	—	2	2	—	—	8	88	
Aug.				Not observed							Intermitants				
Sept.				Not observed							Intermitants				
Oct.	—	20	—	—	—	—	80	93	7	—	—	—	—	—	
Nov.				Not observed							Rest intermitants				
Dec.	—	3	30	28	13	3	13								

0.35 mm indicating the maturation of second batch of ova beginning from this stage. The mode 'a' has shifted to 0.65 mm in the stage V,

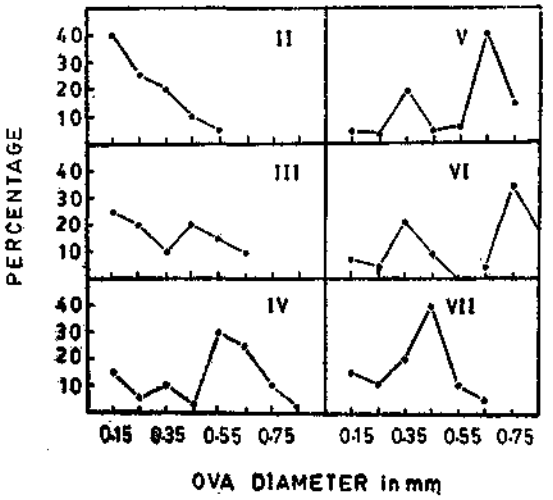

Fig. 3. Ova diameter frequency polygons of *Thryssa mystax*.

but the secondary mode 'b' remained at 0.35 mm, the two successive batches of ova get separated from one another in stage V (0.35 and 0.65 mm). In stage VI the mode 'a' had shifted to 0.75 mm separating itself from maturing ova with the model size at 0.35 mm. In the spent stage the maturing group of ova with the mode 'b' had shifted to 0.45 mm size. Since the maturing group is clearly demarcated and situated halfway between the immature and mature groups of eggs, it is likely that this batch of egg would be liberated in the same season after an interval of time. Thus the fish may spawn a second time in a year.

Based on the pattern of ova diameter polygons, Masurekar and Rege (1960) found two short spawning periods for *T. hamiltonii*. Marichamy (1970) reported that the individual *T. baelama* spawns twice during a year. Dharmamba (1959) concluded that *T. mystax* may spawn twice a year. The present observation for *T. mystax* is in agreement with earlier findings denoting the possibility of its spawning twice during December-June spawning season.

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