

MATURITY AND SPAWNING OF THE CAT FISH *TACHYSURUS THALASSINUS* (RUPPEL) OFF WALTAIR COAST

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ABSTRACT

Tachysurus thalassinus breeds once a year, during April to August, with peak period between May and July. The fish probably breeds in deep offshore waters which are not fished regularly at present. The average length at first maturity is 36 cm. The sexes are equally distributed in the commercial catch. Fecundity (total number of mature eggs per female) varies between 25 and 42. Parental care is exhibited by males.

INTRODUCTION

Catfishes form 21% of the demersal-fish catches of the exploratory trawlers based at Visakhapatnam and operated along the North-western part of the Bay of Bengal (Sekharan et al 1973). They form 4% of the annual commercial fish landings along the Andhra coast (Anon 1972). The catfish catches along the North-east coast are composed mostly of two species, *Tachysurus thalassinus* and *T. tenuispinis* (Sekharan et al 1973). Their depth distribution has been studied by Sekharan (1973 a & b), who also states that the species *T. thalassinus* forms 38% of catfish landings in this region.

Published information on the biology of *T. thalassinus* is meagre (Mojumder 1969 and 1971).

The present study forms part of an investigation of the biology on this species and deals with some aspects of spawning habits, classification of maturity stages, size at first maturity, development of ova to maturity and fecundity.

MATERIAL AND METHODS

The material for this study was collected during the years 1964-67, from the catches obtained off Waltair coast, either at the time of fishing on board the trawlers or at the time of unloading the catches at the jetty. Particulars of date, fishing area, total length, standard length and total weight were recorded for each fish. Since it was not possible to determine the sex by morphological characters, abdominal incision was made and the sex and stage of maturity were noted in fresh condition. The gonads were removed and preserved in 5% formalin for later examination.

For determining maturity stages of the fish, ovaries were utilised. A mature ovary had three types of ova, viz, mature, maturing and immature. Unlike in other fishes, the mature eggs of *T. thalassinus* grow to a very large size. The maturing ova are also large. The diameters of both mature and maturing ova were, therefore, measured with the help of a Vernier Callipers to an accuracy of 0.01 mm. Immature ova only were measured under the microscope with the help of ocular micrometer. One micrometer division of the ocular micrometer corresponded to 0.02 mm. Two hundred or more ova from each ovary were measured.

MATURITY

Classification of maturity stages

The maturity stages were classified both on macroscopic study of the gonads and microscopic examination of ova. As in other fishes, maturation of ova from the immature to mature stage depends on the heavy yolk deposition, along with the enlargement in size and change in colour and consistency.

The testes first appear as slender thread-like structures in the abdomen near the vent. As maturity advances they appear as two prominent strips and when fully mature they extend to the anterior region of the body cavity.

In the ovary, the two lobes form a U-shaped loop and open to the outside by a common oviduct. Fishes, attaining the size of 15 cm in total length, have well differentiated gonads and sexes which can easily be made put with naked eye. Ovaries in all stages of maturity contain immature ova measuring up to 30 m.d. (0.6 mm).

The results of macroscopic studies of the gonads and microscopic examination of ova to differentiate the various stages of maturity, are given below:

Stage I (Immature):

Ovary is short and its two lobes appear as two flesh-coloured, thread-like structures extending to slightly less than one-third of body cavity. Yolk formation has not yet started. Majority of the ova in this stage range in size between 0.06 mm to 0.6 mm with the mode at 0.2 mm. Testes appear as very slender, white thread-like structures occupying about the same space as the ovary.

Stage II: (Intermediate):

Ovary in this stage is slightly larger in size occupying about one-third of the body cavity. The first batch of eggs gets separated from the immature egg-stock. The separated group of eggs are translucent, whitish in colour due to commencement of yolk deposition. The mode of the enlarged group of eggs falls at 2.0 mm, with the maximum size of ova up to 4.0 mm. Testes are slightly thick, whitish in colour, occupying about one-third of the body cavity.

Stage III (Maturing):

In this stage, the ovary, occupying more than half of body-cavity, consists of three groups of ova, viz, immature, intermediate and maturing. The maturing group of ova are slightly brownish in colour, probably on account of thick accumulation of yolk. The mode of the largest group of ova falls at 7.0 mm, the maximum size of ova being about 9.0 mm. Testes are white, thin ribbon-like structures, irregular in shape and occupying more than one-third of the body cavity.

Stage IV (Mature):

Ovary occupying almost whole of the body cavity and yellow in colour. The ovarian wall becomes thin and the ova are clearly visible from outside. Ova are fully packed with yolk. The mode of the largest group of ova falls at 15.0 mm, the maximum size of ova being 18.0 mm. Testes are white, long and ribbon-shaped and extend up to more than three fourth of the body cavity.

Stage V (Ripe):

Ovary occupies the entire body cavity and light-yellow in colour. The ovarian wall is very thin. The ova are slightly larger than those in Stage IV. Testes are flat, swollen and white ribbon-like structures extending almost the entire body cavity.

Stage VI (Spawning):

Ovary occupying entire body cavity, is soft to touch and ova ooze out easily at slight pressure on the abdomen. The size of the ova is almost same as in Stage V. Testes are white, flat, ribbon-shaped and irregular, occupying almost the entire length of the body cavity.

Stage VII (Spent):

In this stage, ovaries are shrunk and occupying nearly half of the body cavity. Immature and Intermediate groups of ova are present, loosely packed. The ovary is slightly reddish in colour and flaccid to touch. Testes appear shrunk and partly empty. Classification of maturity stages based on varies is given below:

Stage of maturity	Description of intra-ovarian eggs	Mode of largest group of eggs (in mm)	Maximum sizes of intra-ovarian egg (mm)	Stages followed by I.C.E.S.
I	Immature	0.2	0.6	I
II	Intermediate	2.0	4.0	II
III	Maturing	7.0	9.0	III
IV	Mature	15.0	18.0	IV
V	Ripe	16.0	18.0	V & VI
VI	Spawning	16.0	18.0	
VII	Spent	2.0	3.0	VII

Development of ova to maturity:

Only immature ova with nuclei ranging in diameter up to 0.6 mm (Fig. 1, A.) are present in Stage I. This group may be termed as the 'General Immature Egg-stock' and are present in the ovaries of all stages of maturity.

In Stage II (Fig. 1, B), a batch of ova has separated from the general immature egg-stock, called 'Intermediate group,' with a mode 'a' at 2.0 mm, the maximum size of the ova is about 4.0 mm. The Intermediate group of ova are translucent due to onset of yolk deposition.

In Stage III the maturing (Intermediate) group of ova, observed in stage II increases further in size with thick deposition of yolk and is light brown in colour. The developing ova are covered with a net-work of blood vessels and are attached to follicle. The mode 'b' of the largest group of ova falls at 7.0mm, the maximum size reaching upto 9.00 mm (Fig. 1, C).

In Stage IV, the first batch of maturing ova, which are opaque, advances further in size at a fast rate towards maturity with the mode 'b' of the largest group of mature ova at about 15.0 mm, along with a change in colour to yellow. Ova are still attached to the follicle and are covered with blood vessels. The maximum diameter of ova is about 18.0 mm. The second batch of maturing ova showed some progress in development but the rate of growth is appreciably less, compared to that of mature ova (Fig. 1, D). Development process in stage IV is a prolonged one.

In Stage V and VI (Fig. 1, E), the modes of Ripe and Spawning groups of ova are same (16.0 mm), excepting that in Stage VI the colour of ova changes from yellow to pale-yellow (almost translucent). The ova are comparatively soft to touch, are completely separated from the follicle and ooze out easily when slight pressure is applied. The maximum size of ova in both the stages is 18 mm.

In the spent ovary (Fig. 1, F), the sizes of ova are observed to be almost similar to those in the Intermediate Stage II.

SPAWNING

Frequency of spawning:

On the basis of observations on the ova diameter measurements (Hickling and Reutenberg 1936, De jong 1940, Prabhu 1956, Karekar and Bal 1960), the spawning activity in fishes have been classified into four types:

Type 'A' : Spawning takes place only once a year during a definite short period.

Type 'B' : Spawning takes place only once a year but with a longer duration.

Type 'C' : Spawning twice a year.

Type 'D' : Spawning throughout the year, but intermitantly.

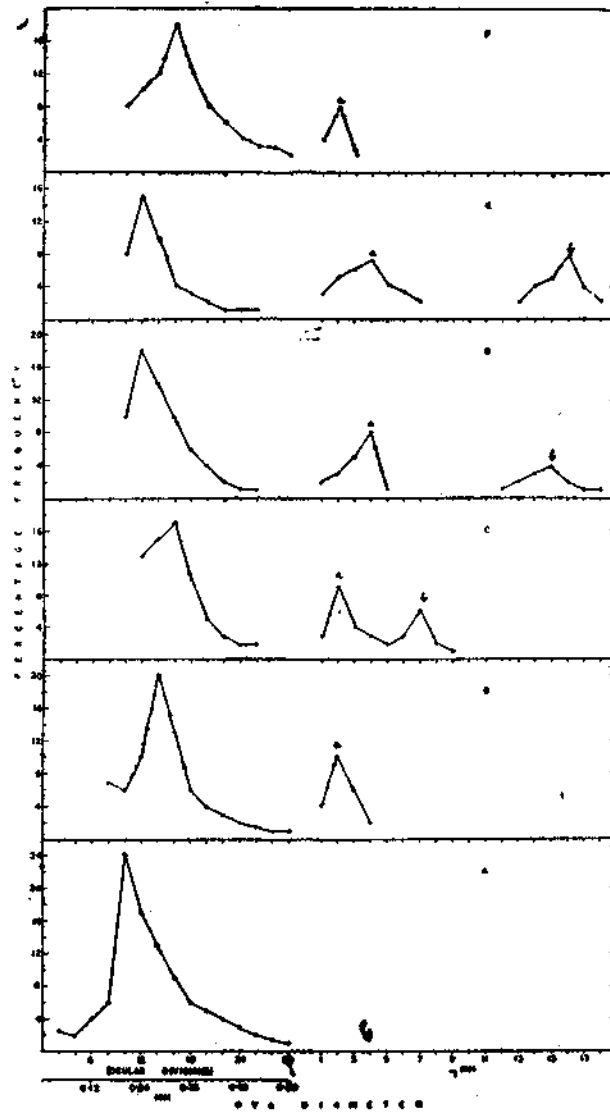


FIG. 1 (A-F). Ova-diameter-frequency polygons showing the growth of immature ova of *T. thalassinus* towards maturity.

The frequency distribution of ova-diameter measurements from a ripe ovary (Stage V) of *T. thalassinus* shows that there are three groups of ova, viz, Immature, Maturing and Mature (Fig. 1, E). These three groups of ova are well separated. The mature group of eggs with a mode at 16 mm comprises ripe ova which will be released very shortly. The maturing group of ova with mode at 4.0 mm, compared to the mature/ripe ova, are very small and have undergone less than half the process of maturation and probably will take months to be mature fully. These may, perhaps, be ready for release only in the next spawning season.

Thus the spawning habits of *T. thalassinus* appears to correspond to type 'A' (spawning taking place only once in a year during a definite short period) of spawning activities of fishes mentioned above.

TABLE 1. Percentage occurrence of gonads of *T. thalassinus* in different stages of maturity. (April, 1964 to March 1965)

Months	Nof. of fish	Sex	Stage of maturity						
			I	II	III	IV	V	VI	VIII
April	3	M	—	33.3	—	33.3	33.3	—	—
	4	F	—	—	25.0	25.0	50.0	—	—
May	34	M	32.3	32.3	8.8	8.8	5.9	5.9	5.9
	12	F	16.6	8.3	16.6	8.3	8.3	16.6	16.6
June	12	M	—	8.3	8.3	25.0	33.2	8.3	16.6
	11	F	—	9.1	18.2	9.1	9.1	27.3	27.3
July	4	M	—	—	—	—	25.0	50.0	25.0
	4	F	—	—	—	25.0	—	25.0	50.0
August	6	M	—	16.7	—	33.3	33.3	16.7	—
	3	F	—	33.3	—	—	33.3	—	33.3
September	25	M	52.0	44.0	4.0	—	—	—	—
	21	F	47.6	33.4	19.0	—	—	—	—
October	9	M	67.0	22.0	11.0	—	—	—	—
	10	F	20.0	70.0	10.0	—	—	—	—
November	10	M	90.0	10.0	—	—	—	—	—
	10	F	70.0	—	30.0	—	—	—	—
December	36	M	60.8	30.8	8.4	—	—	—	—
	32	F	68.2	31.8	—	—	—	—	—
January	8	M	100.0	—	—	—	—	—	—
	8	F	62.5	37.5	—	—	—	—	—
February	15	M	46.8	46.8	6.4	—	—	—	—
	19	F	74.2	10.3	15.5	—	—	—	—
March	66	M	52.5	33.0	14.5	—	—	—	—
	77	F	52.0	40.2	1.3	1.3	1.3	3.9	—

The occurrence of gravid and spent fishes during the peak period of spawning (May-July) suggests that the spawning will be strictly simultaneous in all the individuals.

Spawning season

This was determined on the basis of (1) the period of occurrence of young fish (especially larva and post-larva) in the inshore waters and (2) the period of peak occurrence of mature gonads.

Very young fish could be collected during the period between June and August from inshore waters of Lawson's Bay where commercial fishing takes place. The larva with yolk-sac attached, with a total length of 25-30 mm were obtained during July and the juveniles between 80-100 mm in total length, in September.

TABLE 2. *Percentage occurrence of gonads of T. thalassinus in different stages of maturity. (April, 1965 to March 1966)*

Months	Nof. of fish	Sex	Stages of maturity						
			I	II	III	IV	V	VI	VII
April	31	M	19.2	12.6	25.6	33.0	6.4	3.2	—
	39	F	66.7	10.2	5.1	2.6	7.7	5.1	2.6
May	14	M	14.2	35.8	—	14.0	7.4	14.2	14.2
	20	F	40.0	10.0	5.0	10.0	10.0	15.0	10.0
June	8	M	—	—	12.5	12.5	25.0	12.5	37.5
	5	F	—	—	20.0	—	40.0	—	40.0
July	1	M	—	—	—	100.0	—	—	—
	1	F	—	—	—	—	100.0	—	—
August	24	M	42.0	21.0	37.0	—	—	—	—
	14	F	57.1	28.6	14.3	—	—	—	—
September	8	M	50.0	37.5	12.5	—	—	—	—
	2	F	—	—	—	—	—	—	—
October	4	M	100.1	—	—	—	—	—	—
	10	F	60.0	40.0	—	—	—	—	—
November	19	M	89.4	10.6	—	—	—	—	—
	16	F	100.0	—	—	—	—	—	—
December	6	M	100.0	—	—	—	—	—	—
	8	F	100.0	—	—	—	—	—	—
January	8	M	100.0	—	—	—	—	—	—
	11	F	100.0	—	—	—	—	—	—
February	4	M	100.0	—	—	—	—	—	—
	4	F	50.0	25.0	25.0	—	—	—	—
March	20	M	45.0	35.0	10.0	—	10.0	—	—
	26	F	57.1	7.8	7.8	19.5	7.8	—	—

In Tables 1-3 are presented the percentage-occurrence of gonads of *T. thalassinus* in various stages of maturity during the period April 1964 to March 1967.

In 1964-65, mature fish with advanced stages (Stage IV and above) of maturity were available in the commercial catch during the months between March and August (Table 1). But the period of peak occurrence of fish in Stages VI and VII was May to July. In August 1964, one spent female was obtained which indicated that the spawning period may, sometimes, be extended up to August. After August, however, fish with mature ovary was not noticed. From September onwards the specimens collected were all immature.

A similar trend was obtained during 1965-66 (Table 2). *T. thalassinus* with mature ovary could be seen in the commercial catch from March to July. One spent specimen was obtained in April 1965 which was an indication of

TABLE 3. Percentage occurrence of gonads of *T. thalassinus* in different stages of maturity. (April 1966 to March 1967)

Months	Nof. of fish	Sex	Stages of maturity						
			I	II	III	IV	V	VI	VIII
April	5	M	—	—	—	40.0	60.0	—	—
	10	F	—	—	60.0	10.0	10.0	20.0	—
May	15	M	—	—	13.3	26.7	33.3	20.0	6.7
	9	F	—	—	—	22.2	44.5	11.1	22.2
June	10	M	—	—	—	30.0	30.0	30.0	10.0
	14	F	—	—	21.4	14.3	14.3	28.6	21.4
July	2	M	—	—	—	—	—	100.0	—
	2	F	—	—	—	—	—	50.0	50.0
August	6	M	—	66.6	16.7	—	16.7	—	—
	5	F	—	40.0	40.0	—	20.0	—	—
September	25	M	56.0	28.0	16.0	—	—	—	—
	13	F	61.5	38.5	—	—	—	—	—
October	13	M	53.8	46.2	—	—	—	—	—
	13	F	77.0	23.0	—	—	—	—	—
November	18	M	55.0	45.0	—	—	—	—	—
	15	F	66.5	33.5	—	—	—	—	—
December	22	M	68.2	31.8	—	—	—	—	—
	40	F	50.0	50.0	—	—	—	—	—
January	13	M	84.6	15.5	—	—	—	—	—
	14	F	71.4	28.6	—	—	—	—	—
February	6	M	50.1	16.5	33.4	—	—	—	—
	6	F	50.1	16.5	33.4	—	—	—	—
March	17	M	35.3	17.6	11.8	11.8	23.5	—	—
	26	F	53.9	7.7	11.5	11.5	15.4	—	—

onset of breeding season. Peak period of spawning as indicated by the percentage of fish in mature stage VI and VII, was restricted to the months of May and June, 1965. In July, however, only one specimen with ripe ovary could be collected. During the months between August 1965 and February 1966, all the specimens collected had immature gonads. But in March 1966, specimens with mature ovary were available.

It was observed that during the year 1966-67, mature specimens were available between April and August, but the peak period of occurrence of fish in Stages VI and VII was only from May to July, 1966 (Table 3).

Considering the total period of observation for the years 1964-65 to 1966-67, it was, however, seen that although the peak period of spawning of *T. thalassinus* is apparently restricted to the months between May and July, breeding may commence from April and extend up to August. The occurrence of the young ones with yolk-sac attached, having the total length between 25 mm-30 mm collected during the month of July and the juveniles between 80 mm and 100 mm in total length recorded during September in the inshore area, further support the view that the spawning season of the species, perhaps, extend over the period April-August.

SIZE AT FIRST MATURITY

The size at which *T. thalassinus* attains maturity was determined from the examination of 612 female specimens during the period of observation. The percentage occurrence of fish in various stages of maturity in each 2cm group

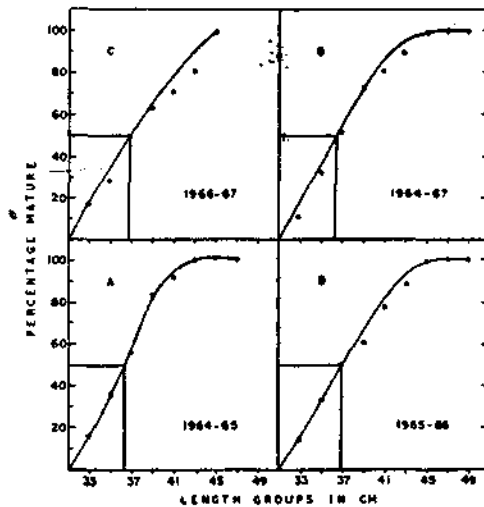


FIG. 2 (A-D). Size at first maturity in females of *T. thalassinus*, during different years.

was calculated. Fishes in I and II stages of maturity were treated as Immature; III stage as Maturing; and the stages IV and above were considered as Mature for the purpose of calculating the size at first maturity.

It was seen during all the three years of observation (1964 April to 1967 March) that female specimens measuring below 30 cm in total length were immature. In the size group of 32-34 cms, 15% of the specimens only were mature during 1964-65, 14% in 1965-66 and 17% in the year 1966-67. In the next size group of 34-36 cm 35% of females were found to be mature during the first year, 33% during second year and 28% during the third year of observation. In the size-group of 36-38 cm, as high as 55% of females specimens were mature in 1964-65, and 50% in both the years 1965-66 and 1966-67. In higher groups, however, the percentage occurrence of females were in the increasing order (Fig. 2, A-D). While 100% maturity was observed in the larger groups of 42-44 cm in 1964-65, the corresponding size range during the years 1965-66 and 1966-67 was 44-46 cm. Figure 2,D shows that the average size at first maturity (size at which 50% of the fish mature) is about 36 cm.

SEX RATIO

During the period of observation about 1100 specimens of *T. thalassinus* were examined in a wide range of size between 12 cm and 46 cm in total length.

The ratios of males to females were found to be 1:1.07 in the first year, 1.03:1 in the second year, and 1.08:1 in the third year of observation. Sexes, however, were found to be almost equal in the commercial catch except during few months. The sexes for the pooled data for all the three years of observation was 1:1 in ratio of male and female fishes.

The percentage occurrence of sexes in different months during the years of observations are given in Table 4-6.

TABLE 4. Sex-ratio of *T. thalassinus* in commercial catch. (1964-65)

	No. of Fish	% of Female	% Male
April	7	42.8	57.2
May	46	73.8	26.2
June	23	52.2	47.8
July	8	50.0	50.0
August	11	54.5	45.5
September	46	54.5	45.6
October	19	47.4	52.6
November	19	47.4	52.6
December	68	52.9	47.1
January	16	50.0	50.0
February	34	44.1	55.9
March	144	46.2	53.8
For the year	441	48.3	51.7

TABLE 5. *Sex-ratio of T. thalassinus in commercial catch. (1965-66)*

	No. of Fish	% of Female	% Male
April	71	43.6	56.4
May	34	41.2	58.8
June	13	61.5	38.5
July	2	50.0	50.0
August	39	61.5	38.5
September	10	80.0	20.0
October	14	42.8	57.2
November	35	54.3	45.7
December	14	42.8	57.2
January	19	42.1	57.9
February	8	50.0	50.0
March	44	45.5	54.5
For the year	303	50.8	49.2

TABLE 6. *Sex-ratio of T. thalassinus in commercial catch. (1966-67)*

	No. of Fish	% of Female	% Male
April	15	33.3	66.7
May	24	62.5	37.5
June	24	41.7	58.3
July	4	50.0	50.0
August	36	52.8	47.2
September	44	63.6	36.4
October	29	55.2	44.8
November	33	54.5	45.5
December	65	33.8	66.2
January	27	48.2	51.8
February	12	50.0	50.0
March	43	39.5	48.1
For the year	356	51.9	48.1

Although the percentage occurrence of sexes in different months were more or less same, some fluctuations in the percentage occurrences of females and males were observed during the spawning period between April and August. However, these variations did not show any regular pattern. The variations in sex ratio, perhaps, may not be associated either with spawning or to differential

fishing, since the majority of the specimens are immature females and males. Again, since good number of mature females were not available in the catch, it is difficult to conclude how far the variations are associated with spawning.

Furthermore, since the number of spawners is few in the commercial catch during the breeding season, it is probable that the fish breeds in deeper waters which are not fished at present.

FECUNDITY AND PARENTAL CARE

Of the three groups of ova present in mature ovaries, the number of mature intra-ovarian eggs is taken as fecundity of each individual.

Fecundity of *T. thalassinus* was found to vary between twenty-five and forty-two.

Parental care is exhibited in the case of male *T. thalassinus*. After the oozing out of the ripe eggs by the female catfishes of the species and subsequent fertilization of the ova, the eggs are taken inside the buccal cavity by male fishes for incubation and hatching.

Similar parental care has been observed in two male catfishes of the species *Tachysurus caelatus* (Valenciennes) by Sekharan and Mojumder (1973); in the species *Arius jella* (Day) by Chidambaram (1941) and in the species *Osteogeneiosus militaris* (Linn) by Pantulu (1963).

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