

**MATURITY, SPAWNING AND SEX RATIO OF THE RIBBONFISH  
*TRICHIURUS LEPTURUS* LINNAEUS OFF KAKINADA\***

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ABSTRACT

The results of a study conducted on *Trichiurus lepturus* during 1967-70 and supplemented by observations made during 1986-87 are presented in this paper. Majority of males attain maturity at 42 cm and females at 46 cm length. Spawning is prolonged and takes place during January-August period. The individual fish spawns atleast twice during the spawning season. Fecundity varied from 2,380 ova in 42 cm fish to 27,320 ova in 77 cm fish. The annual sex ratio indicated that males outnumbered females in all the years. The sex ratio in relation to the length of fish showed that males dominated between 26-70 cm, the proportion of males and females was equal at 74 cm, females outnumbered between 78 to 94 cm and all the fish were females beyond the 94 cm length group.

INTRODUCTION

FROM INDIAN waters information on the reproductive biology of the ribbonfish *Trichiurus lepturus* Linnaeus is available from Madras (Prabhu, 1955; Tampi *et al.*, 1971) and Mangalore (James and Baragi, 1980, James *et al.*, 1983). The results of a study from the Kakinada area are given in this paper.

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MATERIAL AND METHODS

The ribbonfish were collected during 1967-70 at weekly intervals, depending upon availability, from the fishermen catches from Dummulapeta, Uppada and Kakinada Fishing

Harbour landing centres. At Dummulapeta and Uppada, non-powered country craft operated shoreseines, boatseines and gillnets whereas at Kakinada Fishing Harbour small-sized mechanised boats (9.14-11.41 m long with 20-75 H.P. engines) fished with otter trawls. All the fishing units operated off Kakinada upto 5-50 m depth; non-powered craft usually fished in 25 m depth. For ova diameter distribution and fecundity studies, fish collected from otter trawls during May 1986 - March 1987 were used.

The fish measured 26.2 - 115.0 cm in standard length and 21-141 specimens were examined in a month. Data on length, sex and maturity stage were taken from fresh specimens. The classification of the maturity stages is the same as given by James *et al.* (1983) except that the stage VII A given by them was taken as stage III since, except for the presence of a few residual ova it is a maturing stage and stage VII B as stage VII. The length data were

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grouped into 4 cm class intervals and represented by the mid point. Fish in the maturity stage III and above were considered as mature in determining the length at first maturity. The spawning period was determined by considering the fish above the length at first maturity. The gravimetric method was followed to estimate the fecundity of 5% formalin preserved ovaries in stages IV to VI. Fecundity was calculated for the group of ova having larger diameter. The ova diameter measurements were made following the procedure of Clark (1934). The numerous transparent

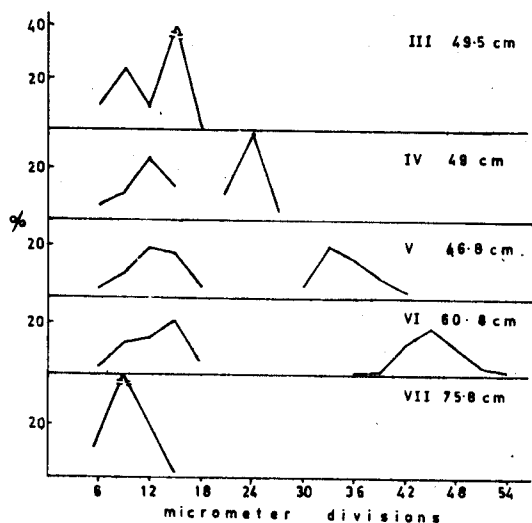


Fig. 1. Ova diameter distribution polygons in *T. lepturus* (24 micrometer divisions = 1 mm).

immature ova measuring below 0.2 mm were not measured as they are present in all the maturity stages. The Chi-square test (Snedecor and Cochran, 1967) was applied for the monthly sex ratio.

#### RESULTS

**Maturation and spawning season :** The figures of the ova diameter frequency polygons of different maturity stages in *Trichiurus lepturus* are given by Prabhu (1955), Misu (1959), James and Baragi (1980) and James *et*

*al.* (1983). In stage II, two groups of ova are present and they are not separated from each other. From stage III onwards the group having larger diameter develops faster and gets separated from the preceding group of ova of

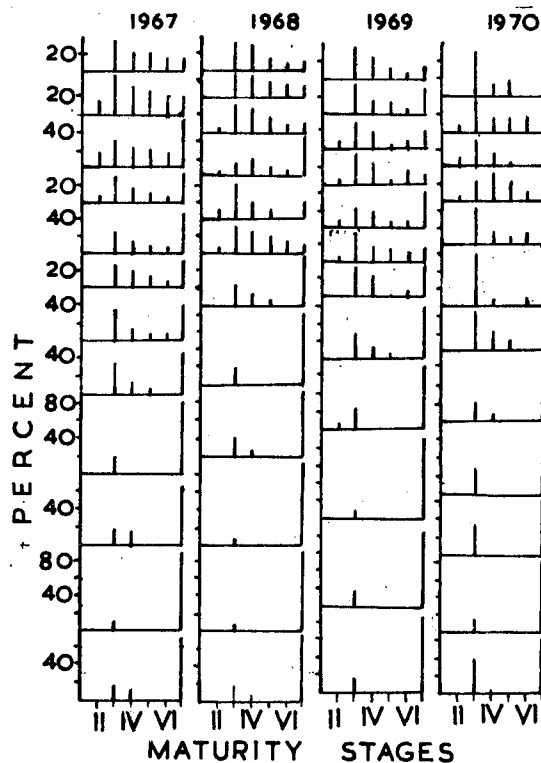


Fig. 2. Monthly percentage occurrence of maturity stages in *T. lepturus* during 1967-70

smaller diameter; in stage V the latter forms a mode at about 0.46 mm and the former at 1.33 mm respectively (Fig. 1). In this stage the latter group is compact and, sharply differentiated from the former. In stage VI also these two groups of ova are sharply differentiated; the smaller groups of ova have a mode at 0.58 mm and the larger group of ova further develop (mode at about 1.83 mm) become transparent to be shed. On the completion of spawning, the fish either revert to stage III (where they

contain a few residual eggs in addition to large number of maturing ova) or pass on to stage VII. The former situation was usually encountered during the beginning of spawning season and the latter condition during the close of the spawning period. The presence of two distinct groups of ova in the mature ovary of *T. lepturus* suggests that the fish spawns atleast twice during the spawning season.

The monthly occurrence of different maturity stages during the four year study shows that the pattern is comparable between years (Fig. 2). Maturity stages III and VII occurred in all the months, the latter stage becoming dominant towards the close of the year i.e. August-December. Fish in stage IV were mostly available for 7-8 months during

January-August. Stage V fish were observed in the catches for 5 to 8 months during January-August and stage VI for 4 to 7 months during January-July. From these data it is reasonable to conclude that off Kakinada,

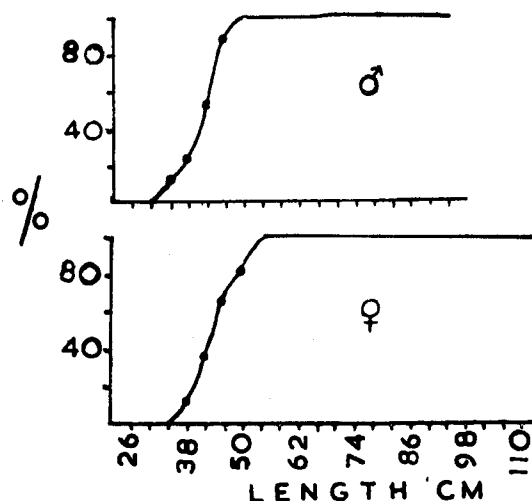


Fig. 3. Length at first maturity in *T. lepturus*.

spawning in *T. lepturus* is prolonged and that it takes place during January-August period.

**Fecundity :** The fecundity of 27 specimens measuring from 420 to 770 mm in length showed that the number of mature ova varied from 2,380 to 27,320 and they increased with increase in fish length (Table 1).

**Length at first maturity :** Females measuring 26-34 cm length were all immature. At 38 cm length 11.8%, at 42 cm 37.8% and at 46 cm majority (66.7%) were mature (Fig. 3). All the fish at 54 cm length and beyond were mature.

Males measuring 26-30 cm length were all immature; at 34 cm 12.7% and at 38 cm 23.4% were mature (Fig. 3). Majority of males (52.5%) were mature at 42 cm length and fish measuring 50 cm and above were all mature. Thus males attain first maturity at a smaller length than females.

TABLE 1. Fecundity in *Trichiurus lepturus*

Date	Length (cm)	Maturity stage	Fecundity
5.1.87	42.0	IV	2380
30.5.86	43.0	VI	6721
7.2.87	43.8	IV	5991
5.1.87	44.0	IV	4337
24.2.87	44.7	VI	7196
7.2.87	45.6	VI	7757
2.1.87	45.8	IV	5287
30.5.86	46.0	VI	6906
5.1.87	46.4	IV	4934
7.2.87	46.8	V	3642
2.1.87	47.0	IV	4228
7.2.87	48.0	IV	7144
7.2.87	48.8	IV	7094
3.3.87	48.8	VI	10657
3.3.87	49.0	IV	7580
5.1.87	49.3	IV	6378
3.3.87	50.5	VI	16206
5.1.87	51.9	IV	5747
5.1.87	53.9	IV	6175
17.6.86	55.2	IV	13003
2.1.87	55.3	IV	5314
2.1.87	57.2	V	9243
7.2.87	60.2	IV	11363
13.3.87	65.0	VI	11337
13.3.87	72.6	IV	13076
13.3.87	76.0	IV	15906
30.5.86	77.0	VI	27320

**Sex ratio :** The Chi-square test on the monthly sex ratio during the four year study showed that the value of  $\chi^2$  was significantly different at 5% probability from the expected 1:1 ratio of the sexes in only 13 months during February-April 1967, August-September 1967, December 1967 and 1968, February-May 1970 and November-December 1970 (Fig. 4 a, b). The data revealed that in majority of these months (9), males were dominant. The annual sex ratio indicated that males invariably outnumbered females by the ratio of 1.83:1 in 1967, 1.41:1 in 1968, 1.15:1 in 1969 and 1.06:1 in 1970.

The sex ratio in relation to the length of fish showed (Fig. 4 c) males dominated between 26-70 cm length, the proportion of males and females was equal at 74 cm, females outnumbered males between 78 to 94 cm and all the fish were females beyond 94 cm length group.

#### DISCUSSION

Prabhu (1955) inferred that spawning in *T. haumela* (= *T. lepturus*) was restricted to a short and definite period in June. Tampi *et al.* (1971) stated that off Madras, the two spawning seasons for this species are May-June and November-December. Rao *et al.* (1977) suggested that the species breeds over an extended period, probably with two intensive spawning periods in December-January and May-August in the shelf area along the southwest coast. All the above authors did not present any data on the monthly occurrence of different maturity stages. James *et al.* (1983) concluded that off Mangalore, *T. lepturus* spawns throughout the year. Based on the occurrence of early juveniles, Narasimham (1972) inferred that Off Kakinada, the spawning period in *T. lepturus* is prolonged with peak activity in February-June. The present study also shows that spawning in this species is prolonged and that it takes place during

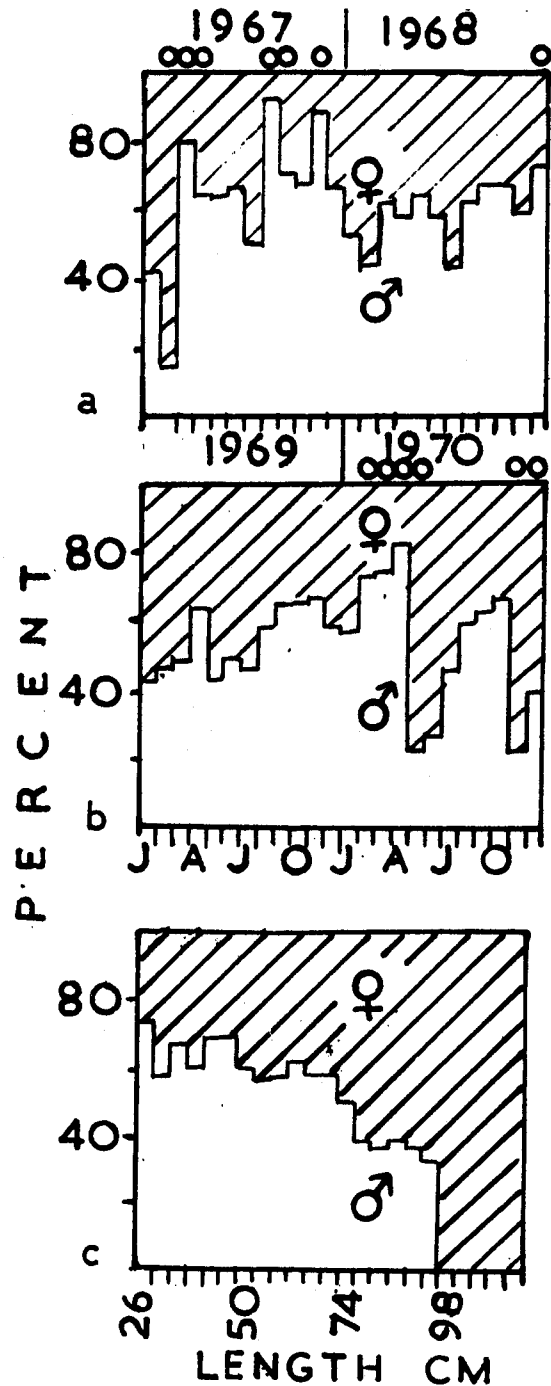


Fig. 4. a and b. Monthly percentage occurrence of sexes in *T. lepturus* during 1967-68 and 1969-70 respectively and c. Percentage occurrence of sexes in different length groups in *T. lepturus*.

January-August. In the east China Sea and Yellow Sea, Misu (1959) stated that *T. lepturus* spawns for 3 months from May to July. However, Yamada (1971) and Bingzheng *et al.* (1982) observed that in the east China Sea spawning in this species is protracted and takes place from April to August and April to October respectively. Thus the recent studies both from India and elsewhere indicate prolonged spawning in *T. lepturus*.

The ova diameter frequency studies by various authors (Prabhu, 1955; Misu, 1959; Tampi *et al.*, 1971; James *et al.*, 1983) showed that in a mature ovary, apart from the immature translucent ova which measure upto 0.2 mm, two groups of ova, one maturing and the other mature are discernible; these two groups are sharply differentiated. Based on this Tampi *et al.* (1971) and James *et al.* (1983) inferred that the fish spawns more than once. These observations are in agreement with the present study. James and Baragi (1980) stated that in this species two major lots of ova seem to mature and succeed one another, each lot being released in atleast three batches. This suggests fractional spawning. However, in the present study no attempt was made to ascertain the number of times the fish spawns during the spawning season.

From Indian waters, Prabhu (1955) found that the fecundity increased from about 4,000 to about 16,000 ova (read from his figure) in fish below 60 cm in length. In larger fish measuring 74.3 to 87.2 cm, Tampi *et al.* (1971) estimated the number of mature ova at 24,288 to 61,595. James *et al.* (1983) observed that the number of mature ova ranged from 1,000 to 1,34,000 in fishes measuring 42.4 to 92.3 cm. In the east China and Yellow Seas, Misu (1959) gave the average fecundity in *T. lepturus* at 16,127 to 69,316 ova for age groups 1 to 6 respectively. The fecundity range of 2,380 to

27,320 ova obtained in this study is well within the range given by the above authors. Also in all the above studies, generally fecundity increased with increase in fish length; the rate of fecundity increase was substantially greater than the fourth power of length (Prabhu, 1955) or close to the third power of length (James *et al.*, 1983).

Prabhu (1955) gave the minimum size at first maturity as 47-48 cm and over 50% maturity as 51 cm length while James *et al.* (1983) found it to be 41.2 cm in males and 43.1 cm in females. The present study showed that majority of males attain maturity at 42 cm and females at 46 cm in length. As noted by James *et al.* (1983) males attain maturity at a slightly smaller length than females.

Studies on the monthly sex ratio by James *et al.* (1983) indicated highly significant dominance of females over males in most of the months. In the present study the sex ratio conformed to 1:1 in 35 months and of the remaining 13 months, male dominance over the females was significant in 9 months. It may be noted that in this study significant differences in the sex ratio were observed both during the spawning period and in the non-spawning months. Misu (1959) stated that, during the spawning period, *T. lepturus* moves in many schools with either of the sex being dominant in these schools and after spawning the sex ratio becomes normal. As suggested by James *et al.* (1986) examination of *T. lepturus* from actual spawning grounds may throw light about the schooling behaviour in relation to spawning. Yamada (1971) found that in *T. lepturus* males are dominant in fish below 250 mm snout-vent length; beyond this length females outnumbered males. In the present study also female dominance in the larger size groups was observed.

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