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An insight into the length at first maturity and sex ratio of four Hairtails from Indian waters

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Short communication

Abstract

This study estimated the length at first maturity and sex ratio of four fishes belonging to the Family Trichiuridae namely, Ganges hairtail *Trichiurus gangeticus,* Gupta, 1966, Sparse-rayed frostfish, *Benthodesmus oligoradiatus,* Parin& Becker, 1970, Longtooth hairtail *Eupleurogrammus glossodon,* (Bleeker, 1860), Coromandel hairtail *Lepturacanthus pantului*, Gupta,1966, from Indian waters. Specimens were collected from August 2020 to September 2021. The length at first maturity, of males, ranged from 34.6 to 43.2cm and for females it was 36.4 to 41.4cm. The sex ratio ranged from 0.95-1.34 (M: F). The present study aimed to give an insight into the parameters such as L_{50} and sex ratio of *Trichiurus gangeticus* and *Benthodesmus oligoradiatus*.

Keywords: *Maturity, hairtail, Indian waters, sex ratio, fishery, Trichiuridae*

Introduction

In India, 15 Species of ribbon fishes were recorded and among them, largehead hairtail *Trichiurus lepturus*, Linnaeus, 1758 is the most abundantly caught species. Biological study of ribbonfishes inhabiting Indian waters is limited to Venkataraman (1944); Mahadevan (1950); Prabhu (1950); Vijayaraghavan (1951); Prabhu (1955); Sekharan (1955); Gupta (1967 a, b; 1968 b); James (1967); Tampi *et al.* (1968); Narasimham (1972); Silas and Rajagopal (1974); Narasimham (1976); Narasimham (1983); Narasimham (1994); Reuben *et al.* (1997); Chakravarty *et al.* (2013); Ghosh *et al.* (2014); Pakhmode and Mohite (2015); Rajesh *et al.* (2015) and Pakhmode and Mohite (2016). Gupta (1967 a) described the taxonomy of the species Coromandel hairtail *Lepturacanthus pantului*, Gupta, 1966 and Ganges hairtail *Trichiurus gangeticus,* Gupta, 1966 from the Hooghly Estuary, West Bengal. Later, Gupta (1967 b) furnished information on the biology of *L. pantului*. Taxonomic, biological and fishery on Longtooth hairtail *Eupleurogrammus glossodon,* (Bleeker, 1860) from Indian waters is limited to Narasimham (1976) and Sastry (1980). Fewer studies on the taxonomy of the Genus *Benthodesmus* were available along the Indian coast (Tholasilingam *et al.,* 1964; James, 1967; Goode and Bean, 1882; Renzhai and Shiquin, 1991; Kim *et al.,* 2012). However, no information on biology is available concerning Sparse-rayed frostfish, *B. oligoradiatus,* and *T. gangeticus*. Hence present study attempted to estimate the length at first maturity (L_{50}) and sex ratio of four ribbon fishes namely *T. gangeticus, B. oligoradiatus*, *E. glossodon* and *L. pantului* inhabiting Indian waters.

Material and methods

Specimens of *T. gangeticus* and *L. pantului* were collected from fish catches of deep sea trawlers of landing centres of Shankarpur (West Bengal, India), *Specimens of B. oligoradiatus* from Sakhthikulangara (Kerala, India) and *E. glossodon* from Tuticorin (Tamil Nadu, India) during August 2020 to September 2021. Total length (TL) in centimetres (cm), and total weight (TW) in gram (g) of all specimens were recorded. Maturity stages were noted as I, II, III, IV, and V for each specimen following Qasim (1973). Stage I and II were considered as juveniles and it is indicated as "0". Similarly, stage III and above are considered as adults and indicated with "1". The estimates of the parameters of the logistic regression model for the sample, the plot of the observed proportions and the fitted sigmoid curve were calculated following Sajeevan and Kurup (2020). The L_{50} was calculated from the fitted model (Mollet *et al.,* 2000; Neer and Cailliet, 2001). The probability that a fish is mature was estimated following the logistic regression model (R Core Team, 2021).

$P(x) = eb\hat{}0+b\hat{}1x/ (1 + e (b\hat{}0+b\hat{}1x))$

Where, $b\hat{}_0$ and $b\hat{}_1$ are the parameters in the model, which determine the shape and location of the sigmoid curve. P(x) is the probability that a fish is mature at a given length x. When plotting the maturity of fish to the length that gives a sigmoid curve. If the parameters are estimated using this model once, then the length corresponding to any required proportion can be worked out using the following expression (except for 0 and 100%)

$x = (\ln (p| (1 - p)) - b\hat{}_0)/ b\hat{}_1$

Where b^0and b^1 are the estimates of the parameters in the logistic regression model. These parameters were estimated using the method of maximum likelihood. All the statistical analyses were performed using R (R Core Team, 2021).

Sex ratios of *T. gangeticus, B. oligoradiatus*, *E. glossodon* and *L. pantului* were estimated by counting the number of male and female specimens. The significance of the sex ratio obtained was tested using the Chi-square test (Rao, 1983) using the following formula.

$X^2 = \sum i=1 (Oi–Ei) 2/ Ei$

Where, $O_i$refers to the value of observation, E_i refers to the value of expectations.

Results and discussion

Results of the logistic regression model of length at first maturity concerning *T. gangeticus, B. oligoradiatus*, *E. glossodon* and *L. pantului* are shown in Table 1. As shown in Table 1, the lengths at first maturity of *T. gangeticus* male and female were 43.2 cm and 41.4 cm and the female *T. gangeticus* matured at a smaller size than the male. However, the values obtained for males and females were not significant (*P>0.05*).

The L_{50} of *B. oligoradiatus* were 44.1 cm and 43.8 cm for males and females respectively. Length at first maturity value was significant in the case of males (*P< 0.05*) and was not significant in the case of females (*P >0.05*). Gupta (1966) described the species *T. gangeticus* from the Hooghly River and Parin and Becker (1970) described the species *B. oligoradiatus* from the Arabian Sea. After that, there was no information reported regarding these species elsewhere in the world. Length at first maturity of a species is an essential parameter to understand the status of a fish stock. It plays an important role in the sustainable management of fish stocks within an ecosystem (Ilkyaz *et al.,* 2018). It also has importance in determining the optimal exploitation pattern (Sileesh *et al.,* 2020).

In the present study, *L. pantului* males and females matured at a length of 34.6 cm and 37.4 cm, whereas males matured at smaller sizes than females. Gupta (1968), while describing the species *L. pantului*, mentioned that the length at maturity of the species was 16.2 cm. The present study estimated a length class of 20-42.8 cm with the L_{50} value for males and females as 34.6 cm and 37.4cm (*P >0.05*). Gupta (1968) estimated the length at maturity of *L. pantului* by using a few specimens of smaller size groups. This may be the reason for reporting a lower size of maturity.

The length at first maturity of *E. glossodon* was estimated as 37.5 cm for males and 36.4 cm for females with a length class of 28.1-44.3 cm. L_{50} values of *E. glossodon* showed a significant difference between the growth of males and females (*P<0.05*). Narasimham (1983) estimated the L_{50} of *E. glossodon* as 36cm and the smallest fish with spent gonads were found at 33 cm from the Kakinada coast. Hence it can be presumed that the results of the present study are concurrent with Narasimham (1983). The length maturity curves of all four species were plotted separately for males and females and furnished as Fig 1. It can be inferred that *L. pantului* matures at a smaller size than other hairtails inhabiting Indian waters.

Table 1. Size at first sexual maturity (L50) of *T. gangeticus, B. oligoradiatus, E. glossodon* and *L. pantului* inhabiting Indian waters

Species	Sample size	b^0	b^1	L50	SE(L_{50})	Pr(>|z|)
Trichiurus gangeticus (M)	17	-132.1	3.05	43.2	2.49	0.22
Trichiurus gangeticus (F)	17	-55.35	1.33	41.4	0.93	0.15
Lepturacanthus pantului (M)	21	-50.05	1.44	34.6	0.69	0.38
Lepturacanthus pantului (F)	20	-52.5	1.4	37.4	1.51	0.35
Eupleurogrammus glossodon (M)	35	-103.3	2.75	37.5	1.18	*0.01
Eupleurogrammus glossodon (F)	47	-113.5	3.11	36.4	1.21	*0.01
Benthodesmus oligoradiatus (M)	37	-50.05	1.44	44.1	0.69	*0.03
Benthodesmus oligoradiatus (F)	37	-52.58	1.4	43.8	1.5	0.35

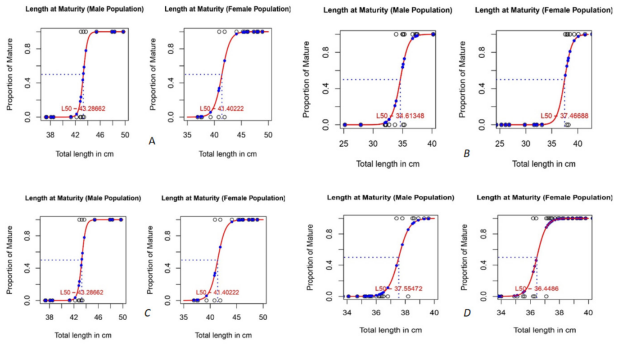

Fig. 1. Length at maturity curves (L50) of four hairtails from Indian waters. (A) *B. oligoradiatus* Parin and Becker, 1970, (B) *L. pantului* Gupta,1966, (C) *T. gangeticus* Gupta, 1966, (D) *E. glossodon* (Bleeker, 1860)

Table 2. Sex ratio of *T. gangeticus, B. oligoradiatus, E. glossodon* and *L. pantului* inhabiting Indian waters

No.	Species	N/Male	N/Female	M:F	P
1	*Trichiurus gangeticus*	17	17	1:1	1
2	*Lepturacanthus pantului*	21	20	0.95:1	0.87
3	*Eupleurogrammus glossodon*	35	47	1.34:1	0.18
4	*Benthodesmus oligoradiatus*	37	37	1:1	1

N/Male: Number of males, N/Female: number of females, M: F: Sex ratio,
P: Probability value

The sex ratios of all four species of ribbonfish were estimated and presented inTable 2. Sex ratio is important information to assess changes in the structure of populations and their reproductive potential. This ratio may vary during the life cycle due to successive events acting differently over individuals of each sex (Santos and Frierie, 2015). The sex ratio of the species *T. gangeticus, B. oligoradiatus*, *E. glossodon* and *L. pantului* were 1:1, 0.95:1, 1.34:1 and 1:1 respectively. A sex ratio of 1:1 was recorded for *T. gangeticus* and *B. oligoradiatus*, while in *L. pantului* and *E. glossodon*, males were dominant over females. The results of the chi-square test to determine if the ratios deviated significantly at .05% are shown in Table 2. The chi-square test proved that there was no departure from the 1:1 sex ratio (*P>0.05*) at 0.5% confidence level.

Conclusion

The present study provided baseline information on the reproductive biology of four hairtails occurring in Indian water. Lengths at first maturity of *T. gangeticus* male and female were 43.2 cm and 41.4 cm, whereas L_{50} of *B. oligoradiatus* were 44.1 cm and 43.8 cm.

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