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REPRODUCTIVE BIOLOGY OF THE FILAMENT BARB *PUNTIUS FILAMENTOSUS* (VALENCIENNES, 1844) POPULATION IN MEENACHIL RIVER, KERALA

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ABSTRACT
Aspects of reproductive biology such as maturity, sex ratio, gonadosomatic index and ova diameter studies were conducted for two seasons in the Filament Barb *Puntius filamentosus* from the Meenachil River, Kerala. The observed sex ratio (over all) was 1male:1.01female with higher proportion of males in the smaller size groups and higher proportion of females in larger size groups. The gonadosomatic index values fluctuated from 0.23 to 9.99 and the GSI of females was higher than that of males. GSI values (mean) were found maximum during the post monsoon season (3.20) compared to the premonsoon value (1.83). The fecundity increased with increasing length and weight. Fecundity of the fish was found in range from 177 (pre monsoon) to 6990 (post monsoon), the average being 2397. Relative fecundity (mean) for each gram of female fish was 93 eggs and each gram ovary consists of 3929 eggs prior to spawning. Egg size varied seasonally and the egg diameters ranged from 0.62 mm to 0.96 mm. Egg size correlated negatively with the number of eggs in the ovary.

KEYWORDS: *Puntius filamentosus***,** Meenachil River, Size at first maturity, Fecundity, GSI.

INTRODUCTION
Reproductive potential is a measure of the capacity of a population to produce viable eggs and larvae. A clear knowledge on reproductive cycles plays a significant role in evaluating the commercial potentialities of the fish stock. A study on the reproductive biology of a species is very important for productive aquaculture and scientific based fishery management in aquatic habitats. In fishery biological investigations, knowledge on reproductive parameters helps in assessing the rate of regeneration of fish stocks in space and time (Biswas, 1993). Manipulation of a fish's reproductive characteristics under captive conditions requires an understanding of natural spawning patterns in varied environments. Reproductive biology of many commercially important fishes has been studied (Bagenal, 1978; Kurup and Kurikose, 1994; Azadi and Mamun, 2004; Euphrasia and Kurup, 2008; Mercy *et al*., 2013).

Rivers of Kerala originating from the Western Ghats have the distinct entity of harbouring rich and diversified rare and endemic fishes (Mercy *et al*. 2002). These rivers are harbouring 174 fish species, of which 32 species are found to be strictly endemic (Kurup *et al*., 2004). *Puntius filamentosus* are endemic to but wide spread within the Western Ghats mountain region of southern India particularly in the states of Karnataka, Tamil Nadu and Kerala. The species is most common in low-land coastal flood plains and has commercial value as food fish as well as attractive ornamental fish that fetch high price in the aquarium trade (Talwar and Jhingran, 1991). Wild ornamental fishes are threatened by heavy fishing, habitat loss, and commercial trade. Kerala has got a promising domestic market for ornamental fishes (Ramachandran, 2002) and some species are in high demand in the national and international markets. Considering the importance of *Puntius filamentosus* in the ornamental as well as table fish trade of Kerala, the present study aimed to determine the reproductive aspects such as sex ratio, size at first maturity, gonado somatic index, fecundity and ova diameter studies in wild population of *Puntius filamentosus* from the Meenachil River, Kerala. The study is of great significance in the rational exploitation through proper management of the species, development of selective breeding, brood stock development, domestication and its genetic improvement.

MATERIALS AND METHODS
Kottayam district of Kerala has three rivers in its credit and Meenachil River is the major one. The 78 km long Meenachil River formed by several streams originating from the Western Ghats flows through the heart of Kottayam district, through the taluks Meenachil, Vaikom and Kottayam. Samples of *Puntius filamentosus* were collected from Meenachil River at Kottayam district during the period October 2016 to March 2017 with cast net. The total length (cm) and total weight (g) of each

fish sampled were recorded. All the fish were dissected; their gonads were removed and weighed (g). Using these data the Gonado somatic index (GSI) was determined by the equation,

GSI = weight of gonad (g)/ total weight of fish (g) x 100

The gonads were then subjected to maturation studies; the proportion of mature and immature fishes in different size classes was determined and the mean length at 50% maturity was plotted to study the maturation pattern and the extent of breeding season. Ovaries were then fixed in Gilson's fluid for fecundity studies and fecundity was estimated by the gravimetric method. For this purpose, three 0.5 g subsamples from the front, middle and back sections from each ovary were taken and the number of eggs was counted in each subsample and then the total fecundity (F) was estimated using the equation,

F = Gonad weight X egg number in the subsample/ sample weight

The diameters of 10 oocytes from each subsample were measured under calibrated ocular micrometers for determining egg size.

RESULTS AND DISCUSSION

Length Frequency and Sex ratio

Males and females of fishes usually differ not only in reproductive organs, but also in external structures that are not directly related to reproduction. The wide spectrum of reproductive strategies supports a diversity of adaptive process by which species have adapted and populated in the environment. The total length of the sampled fishes varied from 7.9 cm to16.2 cm and in total weight from 5.06 to 63.39 g. The length of males varied from 7.9 to 14.9 cm, while the females ranged from 8.1 to 16.2 cm. Females were heavier than males, varied in total weight from 8.15 to 63.39 gm, comparable to that of males between 5.06 and 41.81 g. The sampled fishes were divided in to 5 size groups based on their body length. The length frequency distribution of sampled fishes (165) is presented in Fig.1. The ratio of males to female was 1:1.01, very close to the ratio of 1:1. Sex ratio revealed higher proportion of males in the smaller size groups and higher proportion of females in larger size groups which indicate the tendency of males to mature earlier. The increase in contribution of females in higher size groups might be due to heavy mortality of males in smaller size groups either due to natural death or fishing pressure as they were more active and caught easily or more exposed to predation.

Maturity stages of Gonads and Size at first maturity

Immature specimens (Stage I) were seen throughout the study period and the oocytes at this stage were not visible with the naked eye. Maturing ovaries and testes were (stage IV and above) considered mature for determination of the minimum size at first maturity. Data regarding maturity of specimens in relation to size category revealed that size at first maturity was 11-13 cm as 50% of mature male and female fishes were found first in this size category. Males attain sexual maturity at a smaller length than females and a dominance of mature males in smaller size groups and dominance of mature females in larger size groups (Table I). The smallest mature male was 9.2 cm in total length and11.8 g in total weight while the smallest mature female was 10.8 cm in total length and 13.1 g in total weight. Information on initial sexual maturity provides the ornamental fish producers the idea on the age at which the fish starts to be mature, thus they could prepare for the reproduction and appropriate nourishment for the fish to spawn and obtain the maximum number of fry.

Gonadosomatic Index

Gonadosomatic index (GSI) presumes a constant arithmetic relationship of gonad weight over the range of fish weight. The most common practice of determining the spawning season of fish species is the establishment of its gonadosomatic index (Wang *et al.*, 1980). In the absence of direct observation of breeding, GSI seemed to be the best indicator of the fluctuations of the breeding activity of a species throughout the year. Higher GSI values correspond to the breeding season (Stoumboudi *et al.*, 1993). GSI values fluctuated from 0.23 to 9.99 and the GSI of females was higher than that of males in all months. GSI increases with increase in size (Table II), the least value (mean = 1.39) of GSI was for the smallest size group (7-9 cm) while the highest value (mean = 3.61) for the largest size group analysed (15-17 cm). GSI (mean) was found to be maximum during the post monsoon season (3.20) compared to the premonsoon value (1.83). Fig.2 shows the seasonal variations in the gonad weight and gonadosomatic index. Months of great number of females with mature oocytes, followed by months with empty gonads are clues to the egg- laying period (Guraya, 1986).

Fecundity

Studies on fecundity have great significance, especially for a species in conservation point of view. Knowledge on the total number of eggs produced by a fish is important in determining the spawning potential of the fish. Fecundity, even in the same species is related to varying environmental conditions which work through the food supply and is the basic means of regulating the rate of reproduction in changing conditions. Fecundity estimates based on 83 ovaries of advanced maturing and mature females varied from 177 to 6990. Fecundity is very much closer to body parameters such as body length, weight, and ovary length and ovary weight (Biswas, 1993; Kurup and Kuriakose, 1994; Kaul, 1994). Size and species differences probably determine how fecund a female fish is at a given time. Absolute fecundity tends to increase with the size of the fish and was greater in the largest size category (Table III). Relative fecundity (mean) for each gram of female fish was 93 eggs and each gram ovary consists of 3929 eggs prior to spawning and it tend to decrease with increasing body size of the fish. Absolute fecundity (mean) was

2818 during the post monsoon period and 1330 during the pre monsoon period.

Ova diameter

The measurement of diameter of eggs, in ovaries well advanced towards spawning, gives evidence of the duration of spawning in fish. Those species in which the spawning period is short and definite or where there is only one spawning in a year or a given period, there should be only a single group of large sized ova in the frequency distribution. While in case where the spawning period is long and indefinite or where there is more than one spawning, there could be more than one or two batches of ova of the larger size groups in the ova diameter frequency distribution (Murty, 1975). The ova diameter investigation in the present study indicated that maximum size of ripe ova is 0.962 mm. Egg size of fish obtained during the post monsoon period varied from 0.615 mm to 0.794 mm and the egg size for the pre monsoon period was from 0.660 to 0.962 mm.

As the development of gonads in fishes is primarily related to the energy attained from food (Lambert and Dutil, 1998), the dietary status would also influence reproductive success in wild fish populations (Lambert *et al*., 2000). It was evident from the study that *Puntius filamentosus* has a prolonged spawning season in the Meenachil River. The spawning period extends in both the seasons with a peak during post monsoon season when maximum females were in ripe condition. Studies on the characteristics of the oocytes showed that *Puntius filamentosus* of Meenachil River has more number of mature oocytes during the peak spawning period in the post monsoon period.

Table I Percentage of mature fish at different length classes of *Puntius filamentosus*.

Category	% contribution		% contribution of mature fishes		
	Males	Females	Males	Females	Total
7-9 cm	33.33	66.67	-	-	-
9-11 cm	55.55	45.45	27.78	13.89	41.67
11-13 cm	54.67	45.33	32.0	29.33	61.33
13-15 cm	48.28	51.72	31.03	37.93	68.96
15-17 cm	20.0	80.0	20.0	80.0	100
Total	49.70	50.30	23.03	22.42	45.45

Table II Size dependent variations in Gonado Somatic Index (GSI).

Category	Weight of Gonad		GSI	
	Range	Mean	Range	Mean
7-9 cm	0.02 – 5.06	0.45	0.06 – 4.95	1.39
9-11 cm	0.04 – 0.97	0.24	0.57 – 5.73	1.92
11-13 cm	0.04 – 2.71	0.57	0.37 – 9.99	2.48
13-15 cm	0.08 – 4.66	0.99	0.32 – 8.69	2.70
15-17 cm	0.10 – 3.30	1.81	0.23 – 6.81	3.60
Total	0.02- 4.66	0.61	0.23 – 9.99	2.37

Table III Size dependent variations in absolute and relative fecundity (mean) of *Puntius filamentosus*.

Category	Absolute Fecundity	Fecundity/g body weight	Fecundity/g ovary weight
9-11 cm	1062	85	4425
11-13 cm	2111	92	3074
13-15 cm	2750	75	2777
15-17 cm	3536	70	1954
Total	2397	93	3929

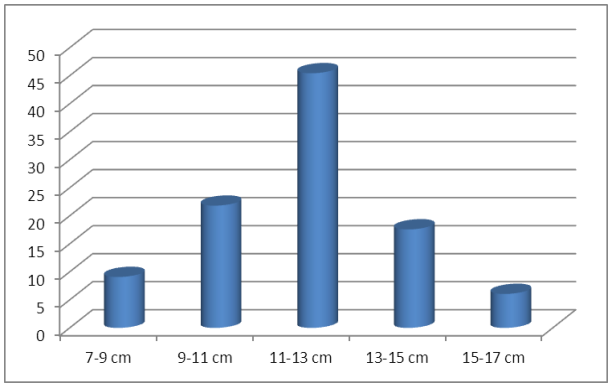

Fig. 1 Length – frequency distribution of *Puntius filamentosus* in Meenachil river.

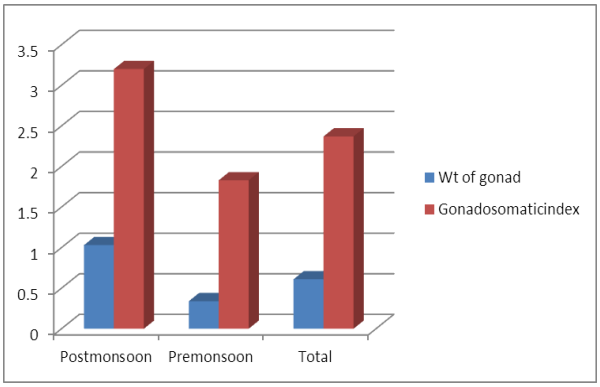

Fig. 2 Seasonal variation in gonad weight and GSI of *Puntius filamentosus*.

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