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Research Article

REPRODUCTIVE PERIODICITY, FECUNDITY, SEX RATIO AND PARENTAL CARE OF ANGELFISH *PTEROPHYLLUM SCALARE* (PERCIFORMES: CICHLIDAE) UNDER LABORATORY CONDITION

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ABSTRACT

The present study showed that *Pterophyllum scalare* breeds within April to May i.e. in summer season in freshwater and laboratory condition. It is a single breeder and highest percentage of gravid female occurs in May (90.91%). Five stages of maturity of ova include immature 0.23±0.08, maturing 0.54±0.11, mature 0.88±0.10, ripe 1.64±0.09 and spent 0.44±0.12. The GSI and GLI ranged from 2.36 to 6.24 and 9.92 to 18.50 respectively. The mature and ripe ova occur April to July, the mean and s.d. in April, May, June and July were 1.66±0.05, 1.59±0.06, 1.47±0.08 and 1.39±0.077 respectively. The relationship between fecundity and total length; fecundity and body weight and fecundity and ovary length were y = 0.003x+99.40; y = 0.005x+11.42 and y = 0.002x+15.97 respectively.

Keywords: Semicircle angelfish, fecundity, sex ratio, gonad, parental care

1. INTRODUCTION

Pterophyllum scalare, most commonly referred as angelfish or freshwater angelfish [1]. These angelfish are among the most highly prized of the coral reef fish [2-4]. The family Pomacanthidae (Angelfishes) is listed among the top ten families of fishes that make up the international trade of marine aquarium species [5]. This is primarily due to their brilliant colors and small size at adulthood. Few documented studies exist regarding the reproduction and life history of *P. scalare* because of its rarity and likewise for the captive care of this species. The aim of this paper was to count and calculate fecundity, reproductive cycle, sex ratio and parental care of *P. scalare*.

2. MATERIAL AND METHODS

A total of 189 fishes were collected from local market, Rajshahi, from January 2010 to December 2010. The fish were collected monthly and cultured in aquarium (2½′×1½′×2½′). Standard morphometric parameters of each fish were taken in the laboratory. Each fish specimen was opened ventrally from the anus to the pectoral fin and its sex and stage of gonadal maturation determined visually [6].

All gonads were removed, weighed and gonadal stages noted [7]. Gonadosomatic index was calculated for individual fish [8, 9]. The ovaries collected from each fish specimen were preserved separately in modified Gilson's fluid [10, 11]. The preserved ovaries were periodically shaken to ensure the separation of eggs from ovarian tissues. All the eggs in each pair of ovaries were determined by direct counting. The diameters of all eggs were measured with ocular micrometer under a binocular microscope. The stages of gonadal development were determined according to their size and coloration. Five methods were applied for the study of reproductive cycle. The total length (TL) and body weight (BW) were taken to the nearest (mm) (0.01 gm) respectively. Excess moisture was removed from the surface of fish as well as from the ovaries with blotting paper before their weight was taken. The pH value ranged from 7.8 to 8.3 and temperature of the water was 30 to 32°C.

Fecundity was estimated by gravimetric method [12]. The spawning period was estimated from the gonad development, Gonado-somatic Index (GSI), Gonadal Length Index (GLI), direct observation of gonads and monthly variations of individuals in different maturity stages [13].

3. RESULTS AND DISCUSSION

The stages of maturation of females can be traced by observing the color of ovary and by taking the diameter of the ovum [14]. In the present study the color of the ovary noted with the diameter of the ova. No shrinkages or swelling of ova was noticed due to preservation. On the basis of these studies development of the ovary could be divided into 5 different stages as follows and detail statistics of maturity stages of *P. scalare* are given in Table 1.

(i) Immature stage: The immature ovaries were small, thread-like, not visible with naked eye, whitish in color having a diameter ranging from 0.15 to 0.32 mm

(0.23±0.08) with a distinct nucleus, and the yolk is totally absent.

(ii) Maturing stage: The ovaries during the maturity stages have a diameter ranging from 0.32 to 0.69 mm (0.54±0.11). Cytoplasm and yolk materials start appearing. The color whitish, ova were transparent and irregular in shape.

(iii) Maturity stage: Ovary increases in size; diameter of the ova ranged from 0.67 to 1.74 mm (0.88±0.10), yolk deposition is moderate; the ovary is light brownish in color. Ova spherical in majority of cases and in the rest slightly oval and transparent in the periphery.

(iv) Ripe stage: In the ripe stages, the ovary becomes brownish in color; the whole cytoplasmic region was full of yolk materials, and the diameter of ova was from 1.00 to 1.73 mm (1.64±0.09). In this stage ova gain the full size and are liberated from ovary through the oviduct. Majority of ova were spherical and ovary occupy the entire body cavity.

(v) Spent stage: The spent ovary seems to not compact in shape and whitish to pale brownish in color, and the ova diameter ranged from 0.33 to 0.59 mm (0.44±0.12). The spent ovary possesses some immature, maturing ova, a few ripe and mostly degenerating ova, and the ovaries were flaccid nature.

It is also observed that the ovary of a single specimen sometimes possesses more than one stages of developing oocytes.

Table 1. Classification of maturity stages of P. scalare

Stages of maturity of *P. scalare*	Description of intraovarian ova	Mode of longest group of ova (mm)	Mean±s.d.
I	Immature	0.32	0.23±0.08
II	Maturing	0.69	0.54±0.11
III	Mature	0.99	0.88±0.10
IV	Ripe	1.73	1.64±0.09
V	Spent	0.59	0.44±0.12

3.1. Reproductive cycle

To determine the reproductive cycle five methods were used in this present study:

3.1.1. Percentage of gravid female against time

The data obtained from 140 mature females of *P. scalare* reveal that the gravid female occurs from March to May. It is observed from Fig.1 that in the month of May percentage of gravid female was the highest (90.91%), followed by April (90%), March (86.67%), February (81.8%), January (80%), June (76.92%), July (75%), August (71.43%), December (68.75%), November (65%) and October (62%). No gravid female was found during the month of September.

3.1.2. Gonado-somatic Index (GSI)

Higher values of GSI were observed during February (6.24) to June (5.81) (Fig.2), which indicated the breeding seasons of the fish. The values of GSI showed single peak distinctly in the month of April (6.50). The GSI value was found to be low from July and the lowest value was found in the month of September (2.36), which started to increase gradually from October indicated the onset of maturation. The mean GSI proportion of fish in different maturity stages indicates the spawning season.

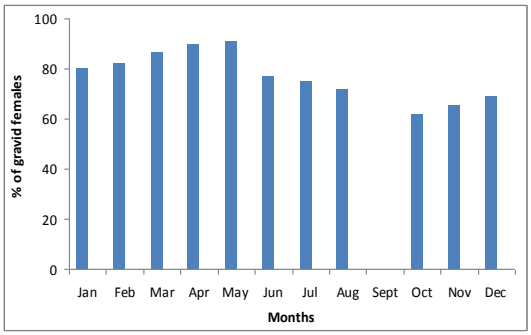

Fig 1. Monthly percentage of gravid females of P. scalarie

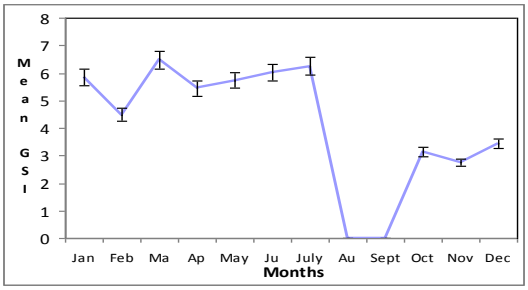

Fig 2. Monthly mean Gonado-somatic Index of P. scalare

3.1.3. Gonadal Length Index

The variation of GLI due to variable condition of gonad for 12 months is given in Fig.3. A single peak in the month of April indicates single breeding season of the fish. The maximum mean value was 18.50 for the month of April and minimum mean value was 9.92 for the month of September.

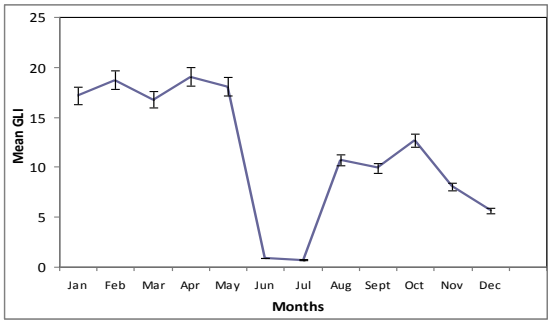

Fig 3. Monthly mean Gonodal Length Index of P. scalare

3.1.4. Diameter of the ova

Ovum size may be used as an indicator of the spawning period in fishes [15]. The mean of the month wise average diameter of ova varied from 0.32 to 1.73 mm during the period of five months (from March to July). It was observed from Fig.4 that the fish had a single spawning season extending from March to July having a peak in April. In April, May, June and July the mean and s.d. were 1.66±0.05, 1.59±0.06, 1.47±0.08 and 1.39±0.077 respectively. The number of mature and ripe females was found more in these four months than the other months.

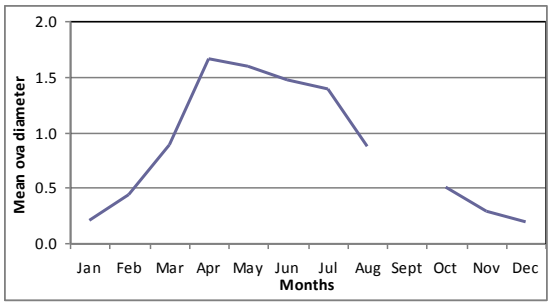

Fig 4. Monthly ova diameter

3.1.5. Coloration of gonad

The color changes of the ovary of a species depend on the degrees of maturity of the ova. In the immature stage of gonad, the color was whitish in *P. scalare* and the ovary was transparent. Gradually the color becomes more intense and bright with the attainment of maturity. In *P. scalare*, immature ova were white in color and ripe ova were brownish in color. With the start of maturation color of the ovary begins to change from white through brownish. In the months of April, May, June and July most of the females were provided with a deep orange ovary, indicated the ripeness of ovary and active breeding months.

3.2. Parental Care

The parental care in angelfish typically involved guarding eggs from predators, fanning eggs to increase oxygen supply, and cleaning the eggs to eliminate fungus. It was quite common for angelfish to eat eggs or fry, especially during the first few spawning but after that it was very fascinating to watch an angelfish pair taking care of their own offspring. In this time, the parent pair chased other fishes in the aquarium tank and maintained a distinct territory around the spawning area. The fry eat from the skin and fins of their parents when they were 5 to 6 weeks old. This behavior can make their parents very weak and sometimes even cause them to die. Plate 1(a and b) shows angelfish with ovary and a ripe egg and parental care along with eggs and newly hatched larva of angelfish are shown in Plate 1(c and d).

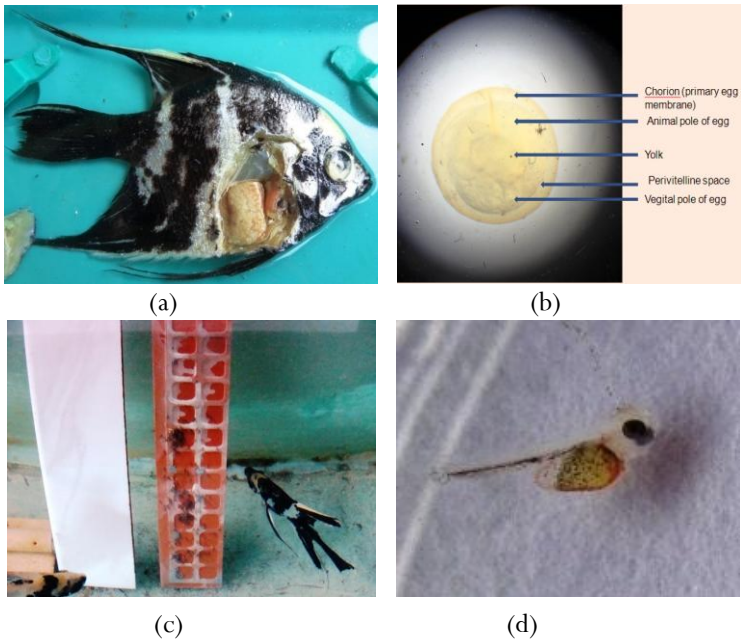

Plate 1. (a) Gravid female with ovary; (b) Egg magnified under 10x; (c) Parent angelfish guarding newly hatched larva; (d) Newly hatched larva

3.3. Fecundity

Only fish with well-developed ovaries were used in the determination of fecundity. Details on the fecundity are given in Table 2. This table indicates that the number of eggs produced per fish varied widely within nearly the same length. Specimen examined ranged in length from 94 to 107 mm and weight from 10.76 to 20.29 gm. Number of eggs produced per female ranged from 22400 to 90700.

Fecundity was related here to different parameters of fish, namely total length (TL) (Fig.5), body weight (BW) (Fig.6), ovary length (OL) (Fig.7), and the equations obtained were:

F+TL	y = 0.003x+ 99.40;	r = 0.33
F+BW	y = 0.005x+ 11.42;	r = 0.76
F+OL	y = 0.002x+ 15.97;	r = 0.24

In all the reactions, the coefficient of correlation (r) was significant at 0.01% level. The lowest r value was with ovary length (r = 0.24) while the highest was with body weight (r = 0.76) and with total length (r = 0.33).

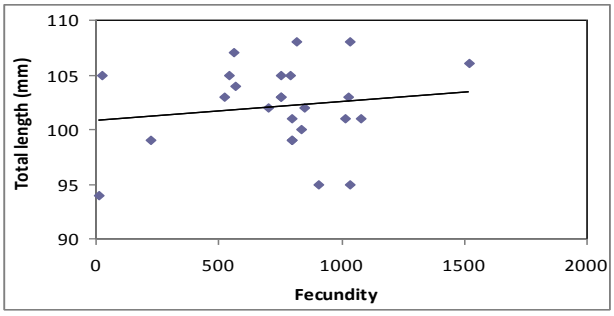

Fig 5. Relation between fecundity and total length of P. scalare

Table 2: Total length (TL), body weight (BW), ovary weight (OW), ovary length (OL), number of ova in 100 mg and estimated number of ova of P. scalare

No.	TL (mm)	BW (gm)	OW (gm)	OL (mm)	No. of ova in 100 mg	Estimated no. of ova
1.	102	14.03	0.78	18.36	65	507.0
2.	103	14.29	0.86	17.95	82	705.2
3.	102	14.04	0.79	18.01	66	521.4
4.	105	17.22	0.99	18.78	86	851.4
5.	104	15.18	0.91	19.06	83	755.3
6.	100	16.25	0.73	18.01	78	569.4
7.	103	15.26	0.91	17.25	92	837.2
8.	105	17.35	1.00	18.76	103	1030.0
9.	94	16.19	0.81	18.13	98	793.8
10.	108	19.38	1.50	18.81	95	1425.0
11.	101	15.08	1.10	16.81	94	1034.0
12.	99	15.26	0.99	18.39	81	801.9
13.	95	16.78	0.80	16.32	100	800.0
14.	101	15.08	1.10	19.82	94	1034.0
15.	106	20.29	1.08	19.21	94	1015.2
16.	108	19.71	1.60	20.20	95	1520.0
17.	99	17.19	0.99	18.26	83	821.7
18.	95	17.04	0.99	18.22	81	801.9
19.	103	18.71	1.02	19.00	89	907.8
20.	101	18.21	1.01	18.15	75	757.5
21.	107	18.36	1.30	19.31	83	1079.0
22.	105	15.21	0.91	18.05	62	564.2
23.	103	15.21	0.92	16.42	59	542.8
24.	99	14.71	0.97	17.31	78	756.6
25.	105	10.76	0.32	13.92	70	224.0

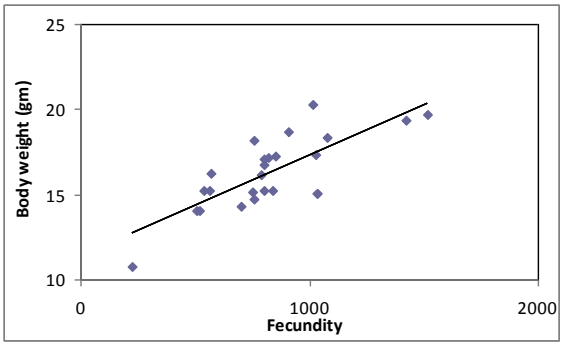

Fig 6. Relation between fecundity and body weight of P. scalare

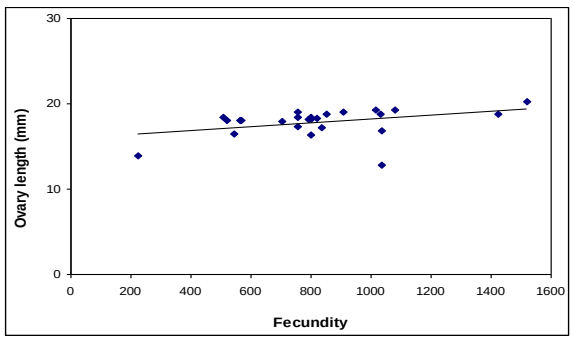

Fig 7. Relation between fecundity and ovary length of P. scalare

3.4. Sex Ratio

Sex of adults of both males and females were determined by their external characters. It is quite difficult to determine the sex of angelfish because male and female looks almost similar. The most common difference between male and female angelfish is the size of the tube located between anal and ventral fin. This tube is much thicker in female than in the male. During spawning season the female abdomen starts to swell up with eggs, which is one of the surest ways to distinguish a female angelfish from a male. Moreover males are more robust and have a more rounded crown, which is the area just above their eyes.

Out of 189 specimens, the percentage of male and female were 50.85 and 49.15% respectively. Male were predominant throughout the months. The chi-square (χ^2) value (0.95) of male and female indicates insignificance at both 0.5 and 0.1% level of significance.

Fig.8 represents data on monthly collection of male and female *P. scalare*. In this study, the occurrence of huge number males of *P. scalare* was in January, December, October, November and March. Higher number of females was found in

January, December, February, March, October and November.

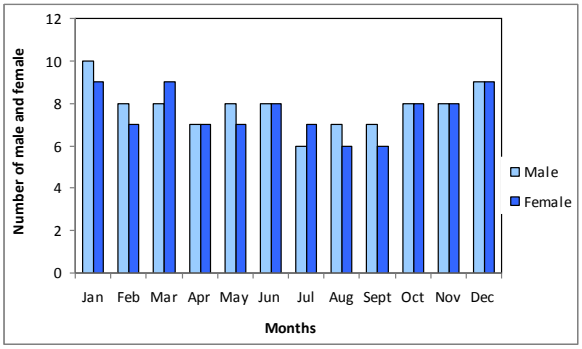

Fig 8. Monthly collection of male and female of P. scalare

Little information on reproductive biology of angelfish exists, but invariably it suggests a strong seasonal change in their reproductive activity [16]. In this sense, it is well established that water temperature is one of the most important environmental factors in the physiological regulation of fish reproduction [17] and the main factor responsible for reproductive seasonality, spawning trigger and the rate of gonadal development in fishes [18]. In some fishes, sudden increases in water temperature appears to be the final cue for stimulating maturation and ovulation [18] and cooler temperature may inhibit gametogenesis. For other species of fish like *Mugil cephalus*, *Dicentrachus labrax*, and *Sparus aurata*, this relationship may be the inverse of that stated above [19].

In temperate regions, the angelfishes spawn during the warmer months [16]. It has been reported that breeding of *P. zonipectus* occurs in the Gulf of California from midsummer to early fall [20]. Similarly, in this study the reproductive cycle of *P. scalare* showed a clear seasonality related to the water temperature. The maximum gravid famales of *P. scalare* occur from March to May and no gravid female were found during winter season. In this case, higher value of GSI and GLI were found from March to June indicates the single breeding season of the fish. The formation of mature and ripe ova were from March to July also indicates that *P. scalare* breeds in summer and is a single breeder. It was also reported that maximum of fecundity was 380000 eggs/female; maximum egg diameter of *C. carassius* population living in Marmara Lake (Turkey) was 1.229 mm [21]. From our experiment we found 722 to 90700 eggs/female having total length 94 to 140 mm; ova diameter was from 0.18 to 1.47 mm and body weight 16.19 to 150 gm. Fecundity was affected by age, size, species, feeding of fishes, season and environmental conditions, as well as between population of the same species and did not remain constant from year to year [22].

4. CONCLUSION

As an ornamental fish, its demand to the aesthetic minded people, huge culture in freshwater condition is required. So, for planning a good production of angelfish it is relevant to know the different aspects about reproduction. For this reason, this research is worked done about different aspects of *P. scalare*.

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