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Study on Breeding Behaviour of Freshwater Angelfish (*Pterophyllum scalare*)

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ABSTRACT

In the present study, it was observed that the hatching rate, survival rate and spawning frequency were varied with parental care and water quality maintained for captive breeding of freshwater angelfish (*Pterophyllum scalare*). There were two types of experimental conditions were kept up for hatching, with and without parental care and hatching done at 27-28^{0}c temperature. It was observed that the hatching rate 67.89 ± 0.25 to 73.85±0.20 and 57.58±0.32 to 63.42±0.32 obtained in rain and bore-well water respectively. Hatching rate was varied in different temperature, within 36-48hrs. hatching start and a positive linear correlation was found between hatching rate and temperature at 5% level of significance ($r=0.86$; $p<0.05$; $n=5$), hatching rate decreased above and below the optimum temperature (28°C). In the rain water and bore-well water there was a negatively linear relation were observed at 5% significant level ($t= -15.65$; $p<0.05$; $n=3$) and ($t= -17.98$; $p<0.05$; $n=3$) respectively. In this study the hatching rate was always more in without parental care system than with parental care and spawning frequency time was less in without parental care hatching than with parental care.

Key words : Angelfish (*Pterophyllum scalare*), Parental care, Water quality, Hatching.

Introduction

Today, angelfish (*Pterophyllum scalare*) is one of the utmost widespread aquarium fish natives to the Amazon Basin of Brazil and is exported as an ornamental fish ((Keenleyside, 1991; Yamamoto *et al.,* 1999 and Cacho *et al.*, 2006). The *Pterophyllum scalare* is a multi-spawning, synchronic fish, with a relatively constant spawning cycle (Degani *et al.,* 1996). From several hundred years ago in Eastern China aquarium keeping, started as hobby and in ancient Rome they were the first to keeping ornamental fishes.

Ornamental fishes are called as “living jewels” and it can be defined as “an attractive flamboyant fishes of peaceable nature that are kept as pets in confined space”. it first imported into Hamburg; Germany in 1909 and USA in 1911.

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Angelfish is the most demandable popular fish species as an ornamental fish for the aquarium trade (Swann, 1993). This freshwater estuarine habitat cichlidae fish species consists of 105 genera with 1300 species (Keenleyside, 1991) and in India, *Etroplus suratensis* and *E. maculatus* cichlids found in costal river of Orissa and Ceylon.

The *P. scalare* generally develop biparental care and during courtship, females, by means of phenotypic characteristics, assess the ability and willingness of males to invest in raising the offspring (Goodenough *et al.*, 1993). The reproductive and parental behaviour of this species under laboratory conditions have been described quantitatively by Chien *et al.*, 1972 and qualitatively by Bergman (1986). In angelfish, diligence, and the aggressive response of experienced males towards intruders is fundamental practices for protecting eggs, reduced risk of predation of the offspring (Cacho *et al.*, 2006). During larval care, experienced males protected their young better with significant effects on their survival. Both parents participate in care of the eggs, but males are more assiduous, spending more time near the nest and more time aerating the eggs (Cacho, 1997). After the eggs hatch (48 hrs.), the fry remains attached to the leaves, hanging from a specialized gland on the head and still receiving care from both parents. Attendance at the nest remains steady in females during this phase, but drops in males, which are now more active at defensive brooding of the fry (Cacho, 1997).

In nature, angelfish select a stout plant leaf as a spawning site. Usually, two to three days before spawning, the pair selects and begins cleaning the spawning site, using their mouths to bite and scrub the surface of the leaf, slate, or whatever has been chosen. The aquarium strain of *P. scalare* will lay their eggs on any vertical surface that can be nipped clean. After a few false passes at the site, the female passes over the site and deposits eggs, which adhere to the surface. The male makes alternate passes and releases spermatozoa, fertilizing the eggs. Continual movement of the angels over the eggs after the spawning serves the purpose of creating circulation through fanning movement of the pectoral fins (Scheurmann, 1990).

Angelfish can tolerate a wide range of water quality, pH 6.0 - 8.0; dH range: 5.0 - 13.0, temp.: 24 - 30°C (Fernner, 2008.). The adult has a length up to 6 inches. They are mainly omnivore in nature, and they can accept all types of live foods. Once they pair up, they can become territorial. During the entire brooding cycle, bonding of the original pair of parents is maintained complete with defense of each partner against aggression or potential rivals. Sexing of angelfish can be difficult.

Most of the domestic angelfish are raised without parental care. The differences between parental spawning and egg removal method occur after the eggs are fertilized. Once brood fish start to exhibit courtship behavior, they are transferred to an 80-liter spawning tank. Fish eggs usually are small (between 1.5 and 3 mm on the average) and round. Spawns numbering 500 eggs are not unusual. Egg size depends on the availability and quality of food fed to the

spawners. Eggs are translucent when first laid. Infertile eggs turn white and are removed by the parents. Eggs hatch in 36 to 48 hours (Walker, 1974; Swann, 1993). The pair chews the zygotes out of their eggshells 36 hours post-spawning. The larvae are initially shifted from one vertical resting place to another; but as they grow more active, their parents often move them to shallow pits in the substratum. The fry first attempt swimming 4 to 5 days later, but they usually require an additional day and a half to two days to become fully proficient. At this stage, they are called swim-up fry (Scheurmann, 1990; Swann, 1993).

The environs of India offer vast scope for trapping both freshwater and marine ornamental fish resources, The climatic condition is also suitable for culture, breeding, and rearing, with market demand are the factors that encourage venturing into this sector. In West Bengal a persistent drift from village the urban areas for job and more income have resulted in the overcrowding in cities and loss of manpower in the rural areas. In such condition breeding and culture of ornamental fish is an attractive alternative to check such (Das, 2003; Chattopadhyay, 2003). In this experiment, it was observed that hatching rate (%) was increased, without parental care than with parental care.

Materials and method

a) Hatching :

Eggs hatched in 36 to 48 hours. The pair chewed the zygotes out of their eggshells 36 hours post-spawning. After hatching the spawns continuously moved their tail. The larvae were initially shifted from one vertical resting place to another; but as they grow more active, their parents often move them to shallow pits in the substratum. During this time spawn were attached to the substrate using their top portion of head and seen hanging. The spawn was first noted to attempt swimming 4 to 5 days later, but after a half to two days they became fully proficient. At this stage, they are called swim-up fry. Parental care persists up to eight weeks in captivity, but it is prudent to remove the fry from the breeding tank no later than the fourth week post spawning. By in this present study, most pairs showed signs of wishing to re-spawn. In the present study, following experiments was done.

Experiment 1 : Hatching rate (%) in rain water with parental care.

The breeding condition was same as natural breeding. Breeding was done in rain water. After spawning the eggs were hatched with parental care and the hatching rates were noted down.

Experiment 2 : Hatching rate (%) in rain water without parental care.

The breeding condition was same as natural breeding. After spawning eggs were placed in a special hatching tank (44×25×25 cm) and were disinfected with 6-8 drops of Methylene blue @ 1 g/liter. The water level was maintained at 15 cm; water temperature of the hatching tank was maintained at 26-29°C with continuous aeration. Without parental hatching rate was noted.

Experiment 3 : Comparisons between hatching rate in with and with-out parental care.

Breeding condition of these experiments was same as natural breeding. The hatching rate (%) with and without

parents in rain water and bore-well water were compared, and the percentage of hatching was calculated.

Experiment 4 : Hatching rate (%) with temperature.

The conditions of this experiment were same as natural breeding. The hatching rates with different temperature were calculated, APHA (1995).

Experiment 5 : Hatching rate (%) in rain water without parental care.

The breeding condition was same as described in 3.10.2. After spawning eggs were placed in a special hatching tank (44×25×25 cm) and disinfected using 6-8 drops of methylene blue @ 1 g/liter. In this tank used 0.5 ml of methylene blue @ 1 g/ liter. The water level was maintained at 15 cm whereas water temperature of the hatching tank was maintained at 26-29^{0}C with continuous aeration. Without parental care hatching rate was noted.

Statistical analysis

All the recorded data and observation were processed and analyzed keeping in view the objectives of the study. The following statistical methods were used in the study: **Student's t test (**Student's t-test, Fisher/ Snedecor's F test was used to identify differences between treatments), **Correlation** (Pearson's correlation was used). Statistical tests were performed with MS-Excel software using analysis of variance. The mean values were compared according to DMRT test (Gomez and Gomez, 1987).

Results and discussion

Sexing and hatching rate in different water sources: Based on following experiments, i.e.,

1. Study on sexual dimorphisms and breeding behaviour of freshwater angelfish.

2. Hatching rate (%) with and without parental care rearing

1. Hatching rate (%) in rainwater and bore-well water with parental care.

It was observed that, maximum and minimum hatching rate (%) with parental care were 67.40%, 68.23% and 57.05%, 58.15% in rainwater and bore-well water respectively. The hatching rate was found to be 67.89±0.25 and 57.58±0.32 in rainwater and bore-well water respectively (Table 1). A significant difference was found between hatching rate (%) in rainwater and bore-well water at 5% level ($t=25.41$; $p<0.001$, $n=3$). It was observed that hatching rate (%) with parental care in rainwater was higher than the bore-well water (Fig.1).

Table 1 : relation between hatching rate in different conditions

Hatching with parental care		**Hatching without parental care**	
Rain water	Bore-well water	Rain water	Bore-well water
Mean ± SE			
67.89±0.25	57.58±0.32	73.85±0.20	63.42±0.32

It was observed that hatching rate (%) was varied from rainwater to bore-well water. In the present study, experiments were done in two different waters i.e., rain water (one-month seasoned water) and bore-well water. Hatching rate (%) was more in rain water (70.87%) than the bore-well water (60.50%) in both natural and induced breeding (Table 1). As rainwater contained less alkalinity and hardness, it was very much ideal for hatching (Table 1). A positively significant difference was observed at 1% level. In rainwater, pH and total alkalinity and hardness was ideal for breeding (Table 1). Swain (2006) reported that the ideal water quality for angel is pH 6.5-6.9 (but successful breeding occurs at pH 6.8) and an alkalinity 50-100 mg/l. But, in bore-well water pH, total alkalinity and hardness was higher than rainwater (Table 1). Thus, the hatching rate (%) was decreased in bore-well water.

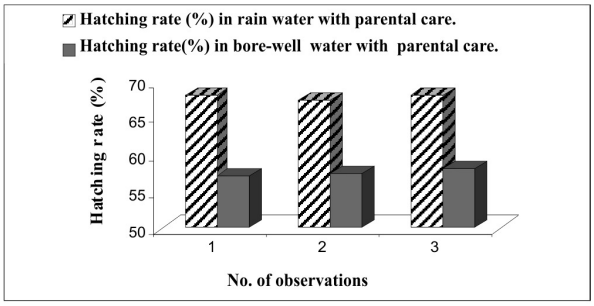

Fig. 1 : Diagrammatic representation of hatching rate (%) with parental care in rainwater and bore-well water.

2. Hatching rate (%) in rainwater and bore-well water without parental care.

The hatching rate in rainwater and bore-well water varied from 73.45 % to 74.08 % and 63.01% to 64.04% respectively. The mean ±SE were 73.85 ± 0.20 and 63.42±0.32 in rainwater and bore-well water respectively (Table 1). A positively significant difference was observed between the means of two groups at 5% level (t = 27.89; p< 0.001, n =3). It was found that without parental care hatching rate (%) was increased in rainwater than bore-well water (Fig. 2).

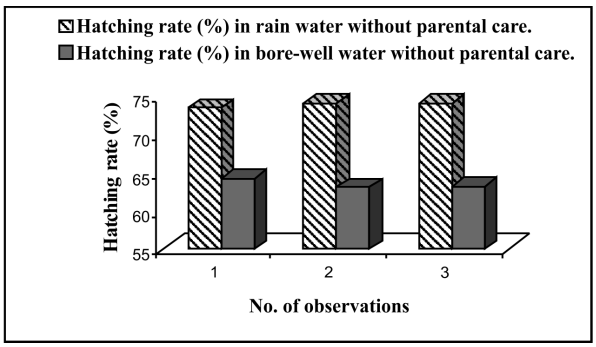

Fig. 2 : Relation between hatching rate (%) without parental care in rainwater and bore-well water.

3. Relation between hatching rate (%) with or with-out parental care.

The hatching rate (%) with and without parental care were found 62.04% and 74.88%. It is observed that there was positively significant difference between with and without parental care hatching rate (%) at 5% level (Pearson's r = 0.94; p<0.05). In Figure-3, it is cleared that hatching rate (%) with parental care was less than without parental care.

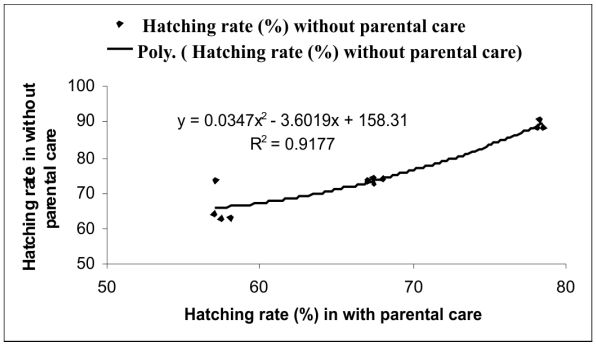

Fig. 3 : Relation between hatching rate (%) with or without parental care.

4. Relation between hatching rate (%) with water temperature (ºC).

Hatching rate has observed in different temperature. A positive linear correlation was found between hatching rate and temperature at 5% level of significance (r = 0.86; p< 0.05; n = 5) in angelfish. In Fig. 22, it was found that hatching rate (%) was decreased above and below the optimum temperature (°C). However, up to upper limit of optimum temperature i.e. 28°C the correlation is positive and significant at 5% level in both the case. Beyond the upper limit of optimum temperature, the co-efficient of correlation is negatively correlated and significant at 5% level.

Table 2 : Relation between hatching rate (%) with temperature (ºC).

Temperature (°C)	Average hatching rate (%)
24	00.00
26	65.5
27	64.98
28	76.51
29	76.39

In the present study, it was observed that hatching rate (%) was more in hatching without parental care than hatching with parental care in natural as well as induced breeding. This experiment was done at different temperatures 26º, 27º, 28º and 29ºC (Table 2). But the hatching rate was more in hatching without parental care. This may be due to (1) parental skill (inexperienced pairs can't remove unfertilized eggs). (2) disturbance caused cannibalism. (3) insecurity due to presence of tank mates. (4) deterioration of water quality for decomposition of food particles and fungal infection. But in case of hatching without parental care, above mentioned risks could be avoided carefully. Fungal infection was controlled using methylene blue regularly. Similar observation was observed in experiments conducted by Swann (1993) and Klepper (1949).

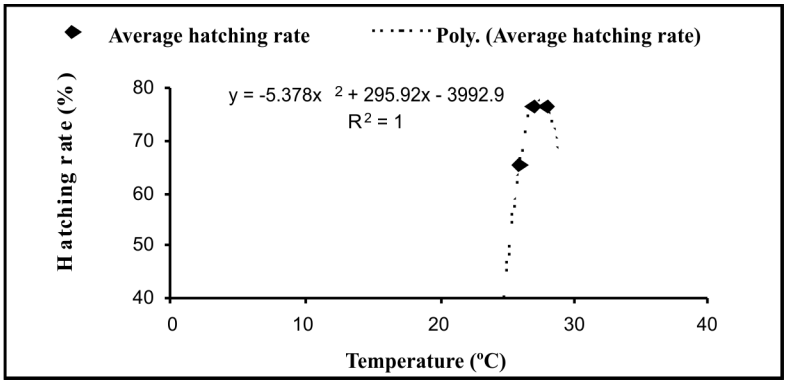

Fig. 4 : Correlation between hatching rate (%) and temperature (ºC)

During these experiments, it was also observed that hatching time was different. In case of hatching with parental care, the hatching time was more than hatching without parental care though, the hatching temperature was same (27°C). Hatching time of eggs in rainwater (avg. 43.71 hrs.) was less. As in natural conditions, hatching of eggs is delayed probably due to temperature and dissolved oxygen of waters, as temperature and dissolved oxygen of water play an important role in incubation time, percentage of hatching and survival of spawn. Rainwater positively influenced on incubation of eggs, and this was due to water qualities (pH, hardness, alkalinity, and salinity) (Table 1). In the present experiment continuous movement of eggs in the hatching tank may have accelerated development and hatching. So, hatching rate (%) was more in without parents than with parents.

It was observed that hatching rate (%) varied with temperature (Table 2 and Fig. 4). A positive linear correlation was found between hatching rate up to optimum level of temperature at 5% level of significance (n=5) in angelfish. Hatching rate (%) was decreased above and below the optimum temperature (28°C). In the present study, it was found that the highest hatching rate (76.51%) obtained at 28 °C temperature. Swain (2006) reported that the ideal hatching temperature is 27°-28 °C in case of gold fish (*Carassious auratus*), 28°-30°C in dwarf gourami (*Colisa lalia*), 27°C in *Betta splendens*. The role of environmental temperature on sexual maturation and breeding of fish has been studied by several investigators like Chaudhuri (1960), Herzing and Winkeler (1986); Hora (1945) and observed that optimum water temperature range (24-31^{0}C) influences the induced breeding of cultured fishes.

Conclusion

In this study it was observed that hatching rate always better in without parental care rearing and it depend upon the optimum water quality, mainly temperature. For the young entrepreneur always maintained a suitable size aquarium for their breeding and hatching purpose.

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