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Effects of shelter on growth and survival of Asian catfish (*Clarias batrachus*)

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Abstract
An experiment was conducted for 28 days to determine the effect of different shelters on growth and survival rate of Asian catfish, *Clarias batrachus. The* Larvae were investigated in aquariums (50× 30× 30cm^3) each containing 25 L of water. Initial average length of larva was 2.30 cm which weighed 0.19 g were released into aquarium: floating shelter (T_1), earthen vat shelter (T_2), PVC pipe shelter (T_3), without shelter (T_0 is control group). Each treatment was conducted with three replications. The larvae were fed *Tubifex* sp. twice a day until satiation. Water quality parameters were found within the productive range (temperature: 28.65±0.79°C, DO: 6.22±0.50 mg L^{-1}, pH: 7.76±0.19, and NH_3: 0.8±0.7 mg L^{-1}) for all treatments. Larva reared in aquaria with floating shelter showed the highest growth rate, specific growth rate (SGR), coefficient of variance (CV) compared to others. The average final weight at the end of 28 days experiment in control, floating shelter, earthen vat shelter and PVC pipe shelter was 0.62, 0.77, 0.72, 0.66 gm respectively while the average final length in these treatments was 3.32, 4.53, 4.32, 3.86 cm respectively. On the contrary, there was almost no effect of shelter was found on the survival rate (96-98%) of the larvae during the experimental period. Based on these findings, availability of floating shelters appears to be comfortable for *C. batrachus.*

Keywords: shelter, growth, survival, *Clarias batrachus,* larvae, aquarium

1. Introduction

Asian catfish, *Clarias batrachus,* has become a popular species for pond culture due to its special qualities such as attainment of maturity within the first year of life, medicinal use, hardiness, efficient food conversion, excellent nutritional profile, ability to spawn in open and confined water, reasonable growth rate, and high market value. To advance management of wild catfish stocks and improve production on fish farms, scientists have extensively studied on a number of biotic and abiotic factors affecting its growth [1]. The former studies includes the influence of body weight, maturity and sex, while among the later, water quality, temperature, light regime, shelter, and stocking density are known to be important. The growth rate of *C. gariepinus* larvae was found to increase with shorter light periods and cover was found to enhance the growth rate of larvae reared under a continuous light period [2].

The use of shelter has been effective in many stream fish species including Atlantic salmon [3], Burbot (*Lotalota*) [4], Stone loach (*Nemacheilus barbatulus*) [4, 5], and Bullhead (*Cottusgobio*) [5]. Many freshwater fish use shelters to hide from potential predators [6]. There is a positive relationship between presence of shelter and growth rates in fish [7, 8]. Absence of shelter can have indirect negative impacts on the metabolism, growth performance and population demographic rates of stream fishes. The growth of Mud eel (*Monopterus Cuchia)* in the water where the eel can use hyacinth as a shelter is the best among the other shelters [9]. The highest weight gain found for rearing of estuarine grouper (*Epinephelus Salmoides*) after using car tyres as shelters [10]; submerged aquatic plants as a shelter for *Penaeus monododn found* the highest growth and survival rates [11].

The supply of *C. batrachus* fry comes from natural sources. This is one of the major limiting factors towards catfish farming. While it is now possible to obtain seeds through artificial means, larval rearing and subsequent development of fry remain to be investigated which withholds the widespread adaption of this species commercially. Thus, the purpose of the present study was to test the effect of shelter on growth performance and survivability of *Clarias batrachus* larvae.

2. Materials and Methods

2.1 Larvae collection and rearing

Twelve-day-old larvae of Asian catfish (*Clarius batrachus*) were collected from Chachra at Jessore, Bangladesh. They were kept in a large aquarium at the wet fish laboratory of Fisheries and Marine Resource Technology Discipline, Khulna University, Khulna and had been acclimatized for two days before starting the experiment.

2.2 Experimental Design

The fishes were divided into four groups: T_0 was control group with no shelter, and T_1, T_2, T_3 were treatment groups with shelters. Floating shelters (T_1), earthen vats (T_2), circular polyvinyl chloride (PVC) pipes (T_3) of various sizes were added into the treatment groups as shelters. To quantify the growth performance, the change in mass and length over time was used as the growth rate for this experiment. Measuring of the wet mass (g) and length (cm) of the fishes was done on the initial day (day 0) and at every 7 days interval during the experiment (day 7, 14, 21, 28). Each experiment consists of the replication of three.

2.3 Water quality management

About three fourth (3/4) of water was changed at 2 days interval. Water exchange was done by siphoning to remove feces, uneaten feed and the dead juveniles (if any). Adhered dirt inside the aquarium walls and shelters was cleaned once a week. Continuous aeration was ensured for rearing throughout the experimental periods. Temperature, dissolved oxygen (DO), pH and Ammonia (NH_4) of water in larval rearing system were monitored regularly. Temperature reading was taken with a Celsius thermometer, dissolved oxygen (DO) of water was measured by titration and also with a digital DO meter (Lutron DO-5510) and pH reading was taken with the help of a portable pH meter.

2.4 Stocking

After proper sorting, twelve-day-old larvae of Asian catfish (*Clarius batrachus*) of initial total length of 2.3 cm and weight 0.19 g were stocked in aquarium (50 × 30 ×30 cm^3) containing 25 liters of water at a stocking density of 50 larvae per aquarium.

2.5 Feeding management

Fresh *Tubifex* was left in continuous water flow to keep them alive for three to four days. *Tubifex* worms were also preserved in a refrigerator in small cubes. Before feeding, cube was thawed and given to the fish.

2.6 Feeding frequency

The feeding frequency was 2 times per day (9.00 am and 8.00 pm) at their satiation level.

2.7 Biological data collection

Samplings were done by scoop nets and fifteen fishes were caught randomly from each aquarium to measure their length and weight. Weekly measurements were carried out for weight gain (to the nearest g) with an electric balance (Mettler Toledo, B303-S; accuracy 0.0000 g) and for length gain (to the nearest cm) with a measuring scale. The dead larvae were counted for assessing the survival rate. Length gain, weight gain, specific growth rate (SGR), coefficient of variance (CV) of length and weight, and survival rate were determined according to the following formula:

Length gain =
Mean final length (cm) – mean initial length (cm) (1)

Weight gain =
Mean final weight (g) – mean initial weight (g); (2)

SGR (% per day) =
{(ln final weight – ln initial weight)/culture period} × 100; (3)

CV of length =
(Standard deviation of final length/mean of final length) × 100; (4)

CV of weight =
(Standard deviation of final weight /mean of final weight) × 100 (5)

Survival rates =
(Number of live fish/total number stocked fish) × 100 (6)

2.8 Statistical analysis

Simple statistical tools such as average, percentage and range were used as and when necessary. Statistical analysis was done using computer based word processing system, Microsoft excel and SPSS (version16). One way analysis of variance (ANOVA) was applied on the data to assess the treatment effect.

3. Results

3.1 Water quality parameters

Ammonia, pH and temperature level was found almost equal in each treatment (Table1). Statistical analysis also showed that there is no significant difference (P>0.05) in DO, pH, ammonia ion and temperature among different treatments.

Table 1: The water quality parameters of *C. batrachus* larvae-rearing aquaria. Each value represents mean ± SD.

Parameters	Types of Shelter			
	Control	Float	Earthen vat	PVC pipe
Temperature (ºC)	28.52 ± 0.91	28.61 ± 0.62	28.83 ± 0.81	28.63 ± 0.52
DO (mg/l)	6.21 ± 0.35	6.31 ± 0.54	6.13 ± 0.45	6.42 ± 0.07
pH	7.62 ± 0.18	7.83 ± 0.11	7.82 ± 0.14	7.71 ± 0.15
NH_3 (mg/l)	0.09 ± 0.06	0.07 ± 0.07	0.04 ± 0.07	0.06 ± 0.05

3.2 Growth performance

Growth parameters such as length, weight, % weight gain, specific growth rate (SGR) and co-efficient of variances (CV) were measured during the study period (Table2). Among them the data of length and weight were taken regularly at 7 days interval and the other parameters were calculated after the end of the experimental period.

Table 2: The growth and survival of *Clarias batrachus* larvae under different shelter condition

Parameters	Types of shelter			
	Control (T_0)	Float (T_1)	Vat (T_2)	Pipe (T_3)
Initial weight (g)	0.19	0.19	0.19	0.19
Final weight (g)	0.62	0.77	0.72	0.66
Net gain (g)	0.43	0.58	0.53	0.47
% weight gain	226.31	305.26	278.95	247.37
SGR (% per day)	4.22	5.01	4.76	4.45
CV of weight	3.45	1.30	2.78	3.30
Initial length (cm)	2.3	2.3	2.3	2.3
Final length (cm)	3.32	4.53	4.32	3.86
Net gain (cm)	1.02	2.23	2.02	1.56
% length gain	44.35	96.95	87.83	67.83
SGR (% per day)	1.31	2.42	2.25	1.85
CV of length	0.60	0.22	0.46	0.26
Survivability (%)	90.33	93.33	91.67	90.67

3.2.1 Length

The length gain was highest (4.53 ± 0.01 cm) in T_1 followed by T_2 (4.32 ± 0.02 cm) and T_3 (3.86 ± 0.01 cm). The lowest length gain was found in T_0 (3.32 ± 0.02 cm). Fig1 represents the growth performance of *C. batrachus* larvae in term of length in cm.

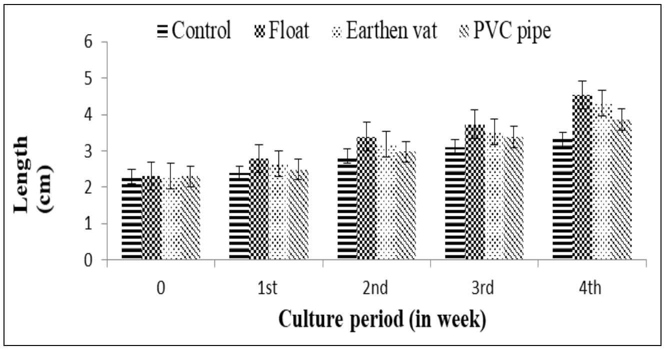

Fig 1: Effect of shelter on growth (length in cm) of *C. batrachus.*

3.2.2 Weight

The weight gain was highest in T_1 (0.77 ± 0.01g) followed by T_2 (0.72 ± 0.02g) and T_3 (0.66 ± 0.02g). The lowest weight gain was found (0.58 ± 0.02g) in T_0. Fig2 represents the growth performance of *C. batrachus* larvae in term of weight in gram.

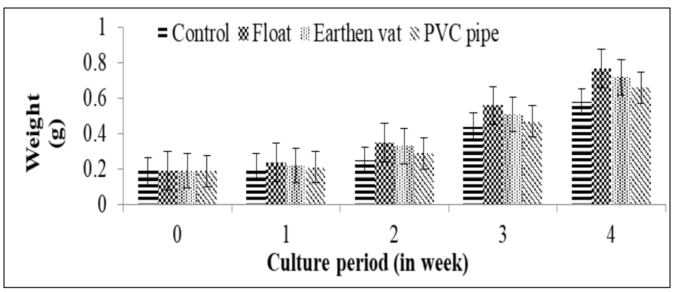

Fig 2: Effect of shelter on growth (weight in g) of *C. batrachus.*

3.2.3 Specific growth rate

The specific growth rate (% per day) of *C. batrachus* in different treatments varied between 4.22 and 5.01. Highest value was obtained in T_1 with floating shelter and lowest in T_0 (Fig3).

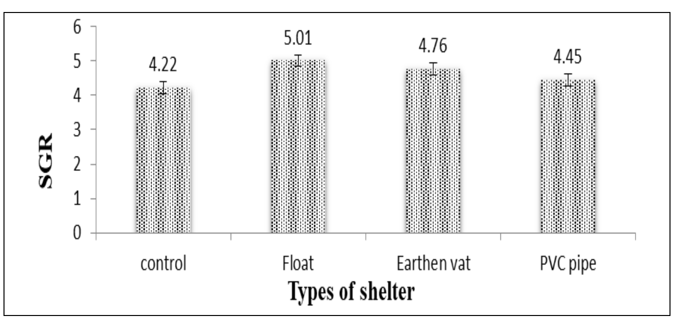

Fig 3: Specific Growth Rate (% per day) of *C. batrachus* larvae during rearing period

3.2.4 Survival rate

The survival rate of *Clarias batrachus* larvae was not affected significantly with different shelters. Survival rates in T_0, T_1, T_2, and T_3 were found as 90.33±1.53%, 93.33±2.08%, 91.67± 2.52%, and 90.67±1.53% respectively.

4. Discussion

Present study revealed that the presence of shelter affects the growth performance of *C. batrachus* larvae apparently. The initial mean length of fishes was 2.3cm. After 28 days of experiment the mean length increase to 3.32 ± 0.02 cm, 4.53±0.01 cm, 4.32±0.02 cm and 3.86±0.01 cm in T_0,T_1,T_2, and T_3 respectively. The initial mean weight of fishes was 0.19 g. After 28 days of experiment the fishes mean weight increases to 0.58 ± 0.02 g, 0.77±0.01 g, 0.72±0.02 g and 0.66±0.02 g in T_0, T_1, T_2, and T_3 respectively. Present results are consistent with previous laboratory and field studies, in which absence of shelter was shown to have negative effects on the metabolic or growth rate of fish [3, 8, 12].

The overall growth performances in terms of average growth and length obtained in this study are lower may due to the feeding frequency. The larvae would obtain more growth and length if they have been provided foods four times in a day [13]. The shelter showed positive effects on the specific growth rate of *C. batrachus* larvae. The specific growth rate (% per day) of *C. batrachus* in different treatments varied from 4.22 to 5.01. Highest value was obtained in T_1 with floating shelter and lowest was in T_0 (without shelter).

To evaluate the effect of any factors on fish growth such as physicochemical parameters must be within ideal ranges [14]. In this study the water quality parameters were within the range of tolerance for growth of *C. batrachus* during the entire period which could reflect the high survival (89-95%) in all treatments. The fact that shelter did not alter survival of *C. batrachus* larvae suggests that intensive culture of this species with shelter is feasible. Even among different shelters, the floating shelters may be more effective, also reported by Narejo *et al.* (2003) [9]. He stated that, it may due to float provide shelter vertically and fish can attach themselves to a suitable place for their comfort to live, aerial respiration and feeding; While control (without shelter) show poor growth. Furthermore, in rearing the fry of C. *batrachus* in aquaria using supplemental feed, Alam and Mollah (1998) found 92.25 to 94% survival rate [15]. This result is similar to our result (89-95%). In this experiment, it was found that larva were gathered either at the dark corner of the tanks in the treatment where there was no shelter (control), which is the evidence of favoring of shelter.

5. Conclusion

The growth of *Clarias batrachus* larvae in tank or aquarium were shelter dependent. In the present rearing trial, no effect of shelter on survivability was found. The average growth rate was the highest in floating shelter followed by earthen vat, PVC pipe and control. Considering overall growth performances of *C. batrachus* larvae, introduction of floating shelter such as aquatic weeds (hyacinth, *pistia*, *lemna* etc.), leaves of coconut trees or even artificial floating devices could be alternative approach for the rearing of this native catfish species.

6. References

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