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Growth performance of *Lamellidens marginalis* under captive condition in semi-arid zone of Bangladesh

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ABSTRACT

Freshwater mussels (*Lamellidens marginalis*) are very important components of aquatic ecosystems. The study was undertaken to know population ecology of *Lamellidens marginalis.* The pearl growing freshwater mussels were cultured in two earthen ponds and one cemented tank was studied for a period of five months (November 2015 to March 2016) in freshwater sub-station, Saidpur, Nilphamari district. The main goal of the study was to know growth and survival factors and discussed with reference to similar work. In the study period, the instantaneous and relative growth rate, and survival rate (%) for the pearl mussels were evaluated. A total of 60 mussels were collected and the growth (shell length and total weight) and survival of mussels were measured and recorded on 15 days interval basis throughout the study. Average shell length and total weight of three treatments were 5.92 ± 0.39 cm, 5.19 ± 0.29 cm, 5.12 ± 0.66 cm and 13.08 ± 1.65g, 13.5 ± 2.85g, 18.33 ± 2.65g and the health condition of mussels were found 2.01 ± 0.34 g cm^{-1}, 2.36 ± 0.50 g cm^{-1}, 3.25 ± 0.33 g cm^{-1} respectively. Water quality parameters are also tested during the culture period which did not affect on the growth and survival of the mussels. The results obtained from the present investigation of pond water shall be useful in culturing the freshwater mussel, *L. marginalis*.

INTRODUCTION

Freshwater mussels are key components of freshwater ecosystems, and have worldwide ecological and economic significance (Lacrane, 1951). The freshwater bivalves are commonly found in freshwater resources like reservoirs, dam, rivers, lake and pond in India. The study, of growth and survival of the freshwater mussel, is important because it describes mathematical relationship. Change in growth is according to their habitat and life cycle; Size of shell is more affected than their shape by fluctuation of environment. Many of the scientists have studied the length weight relationship in fresh water mussels (Moorthy et al., 1983). Similar observation is also made and reported a non linear relationship (Desai et al. 1989). Fresh water mussels plays a very significant role in benthic ecosystem, Tribal people consume them and also support small fishery in different parts of India. They have medicinal value and also used for pearl culture (Suryawanshi and KulKami, 2014). The natural aquatic resources are causing heavy and varied pollution in aquatic environment leading to pollute water quality and depletion of aquatic biota (Basavaraja et al., 2011). Pollution refers to undesirable changes in the physical, chemical or biological characteristics of our environment. This has adversely affected the humans and other species of our biosphere directly or indirectly (Kuzhali et al., 2012). Some other scientists did further work on pearl culture from *L. marginalis* (Lamarck), an important pink pearl producing freshwater mussel is increasing demand in pearl producing countries. *Placuna, Placenta, Mytilus, Hyriosis* species are found abundantly in many places of the world (Begum et al., 1990). Despite their importance, many aspects of ecology are restricted to their growth (Ercan et al., 2013) ontogeny (Cek et al., 2006) species description distribution abundance and effects of pollution (Celiloglu et al., 2002). Freshwater mussels are sensitive to a variety of pollutants and have a dramatic effect on the reproduction, physiology and survival of the species. Considering the importance of fresh water mussels in aquatic

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ecosystem present study was to evaluate the growth performance and survival rate of *L. marginalis* in captive condition during the period of culture.

MATERIALS AND METHODS

Experiment

The experiment was performed in the freshwater Sub-station, Saidpur, Nilphamari. Two nursery ponds and one cemented cistern was used for the experiment and the culture period was 5 (five) months (November 2015 to March 2016). Two hundred freshwater bivalve *L. marginalis* samples were collected during November, 2015 from the Chikli River near Saidpur upazila in Nilphamari district. The collected samples were stocked in pre-prepared nursery pond of the sub-station. A total of 16 cages were made by using 2 mm mesh size net, steel plate and nylon rock which was hanged from the upper surface of water body. Eight cages was set in a nursery pond and 3 (three) pieces of bivalve species was stocked in a single cage. Water samples were collected during the initial and final periods of study for physico-chemical analysis in sterile bottles and taken to the laboratory aseptically. The collection was usually completed during morning hours between 6:00 am. to 10:00 am. For each sampling event, turbidity (Tur), temperature (Tem), pH and dissolved oxygen (DO) were monitored at the sampling sites. These mussels were collected by hand from different depths ranging from 5-10 cm. The mussels were kept in a container along with pond water and transferred to the laboratory for acclimatization for five days with pond water for conditioning. The average water depth of the pond varied from 1-2 meter. The bottom mud of the pond was silty and muddy with a depth ranged from 10-20 cm. Samples were usually collected from sediment's surface of the river. Overall, 60 samples were collected. Samples were transferred alive to laboratory after washing with river water. Table 1 represent the growth performance of *L. marginalis* in captive condition. Two earthen ponds and one cemented tank were selected for this experiment. *L. marginalis* were stocked as per design. The experimented design is presented in Table 1.

Table 1
Experimental design.

Treatment	Species combination	Pond management	Hanging height from water surface	Stocking density (dec^{-1})
T_1 Nursry-1 (S_1-S_8)	*Puntius sorana* + *L. marginalis*	(Fertilizer + lime) 15 days interval + Feeding rate (9-8%)	45.72 cm	(50+24) pieces
T_2 Nursery-2 (S_9-S_{16})	*L. marginalis*	(Fertilizer + lime) 15 days interval	45.72 cm	24 pieces
T_3 Cistern-3 (S_{17})	*L. marginalis*	(Fertilizer + lime)- 15 days interval	Scattered in bottom of water	12 pieces

Growth study

Length wise growth data was collected 15 days intervals through marking and tagging method. The length and weight data was measured from maximum antero-posterior distance by 0.01 millimeter (mm) and total weight was weighed to the nearest 0.01 gram (g) by using Vernier Callipers and Cyberlab-US Sereis portable monopan electronic digital balance (OHAUS Model CS-2000) respectively and was calculated by following formula:

Length gain= Mean final length - Mean initial length.
Weight gain = Mean final weight - Mean initial weight.
SGR (% day^{-1}) = $(LnW_2\text{-}LnW_1)/(T_2\text{-}T_1)100\%$.
HC (g cm^{-1}**)** = Weight (g) / length (cm).

Pond preparation

The ponds were prepared by dewatering, liming and organic manuring. The lime and fertilizer doses were given in table 2

Table 2
Lime and fertilizer doses.

Input	g dec^{-1}	Application time
Lime	1000	Pond preparation time
Urea	100-150	Every 15 days interval
TSP	50-75	Every 15 days interval

Water supply

The underground water was supplied from deep tube well.

Water quality

The pond environment parameters such as surface water temperature, water depth, transparency, dissolved oxygen and p^H were collected fortnightly by celsius thermometer, graduated pole, secchi-disk, portable dissolved oxygen meter (HI 9142, Hanna Instruments, Portugal) and portable pH meter (HI 8424, Hanna Instrument, Portugal) respectively.

Data analysis

Data analysis was done by MS excel & SPSS (var.20)

Final harvest

The mussel (*L. marginalis*) were harvested within last March 2016

RESULTS AND DISCUSSION

This experiment represent the growth parameters and viability of freshwater mussel (*L. marginalis*) species in nursery pond and hatchery cistern condition under application of lime, fertilizer and fish feed at a certain time period in northern semi arid region. The Physico-chemical data of the pond water were collected during the initial and final periods of study which was presented in Table 3. The water samples of pond were colorless and also with no objectionable odour.

Table 3
Water quality parameters

Parameters	Treatments		
	T_1	T_2	T_3
Water pH	7.09 ± 0.36	7.02 ± 0.36	7.14 ± 0.19
Dissolved Oxygen (mgL^{-1})	4.06 ± 0.19	3.95 ± 0.47	3.62 ± 0.56
Temperature (^0C)	21.61 ± 5.69	20.25 ± 4.39	19.62 ± 5.56
Transparency (cm)	27.46 ± 1.96	29.95 ± 1.78	32.28 ± 1.78
Turbidity (NTU)	1.4 ± 0.5	1.6 ± 0.3	1.8 ± 0.1

The obtained results of physico-chemical parameters were compared with standards values prescribed by APHA. The colorless water of pond has no objectionable odor. Temperature is an important biologically significant factor, which plays an important role in the metabolic activities of the organism.These also influences the metabolic behavior of aquatic ecosystem (Alaka, 2013). The pH is a term used to express the intensity of the acid or alkaline condition of a solution. Most of the water samples were slightly alkaline due to presence of carbonates and bicarbonates. The pH Variation was mostly due to diurnal interplay of photosynthesis and community respiration of the biota and also was one of the most important single factors, which influences aquatic production (Hora et al.,1962) The pond water values were more than 7.0 and impart the alkaline condition. Dissolved Oxygen in water is essential for life. Deficiency of dissolved oxygen gives bad odor to water due to anaerobic decomposition of organic waste (Manivasakam, 1980). Dissolved Oxygen in this study ranges from 5.6 mg/l to 6.2 mg/l in pond water. In any aquatic ecosystem the level of dissolved oxygen depends on the factors like temperature of water,

concentration of dissolved solids and biological activity of all life. Total dissolved solids denote mainly the various kinds of minerals available in the water. In natural waters dissolved solids are composed mainly of carbonates, bicarbonates, chlorides, sulfates, phosphates, nitrate, calcium, magnesium, sodium, potassium and iron (Esmaeili et al., 2005). Alkalinity of water is its capacity to neutralize a strong acid and it is normally due to the presence of bicarbonate, carbonate and hydroxide compound of calcium, sodium and potassium (Rath et al., 2000). Total alkalinity was recorded at the standard range between 525 mg/l to 580 mg/l. Calcium is a soft gray alkaline earth metal which is directly related to hardness. Decrease value of magnesium may be due to plankton and algal uptake (Shah et al., 2013). Sodium and Potassium play a vital role in osmoregulation and metabolism of aquatic animal environment respectively and the later is an important macronutrient (Natarajan et al., 2015).

Figure 1: Pictorial view of experiment and data collection procedure.

Data collected from 60 specimens were used to determine the instantaneous and relative growth rates with initial and final values including shell length size and total body weight. After 120 days the treatment wise growth performance of *L. marginalis* parameters are presented in Table 4. Each value represents *Mean ± SD of six determinations. These data were used to determine the instantaneous as well as relative growth of the mussels during the period of study.

Table 4
Growth performances of *L. marginalis.*

Culture period (day)	Parameters	Treatments		
		T_1	T_2	T_3
120 days	Initial length (cm)	5.79 ± 0.4	5.01 ± 0.27	4.93 ± 0.19
	Final length (cm)	5.92 ± 0.39	5.19 ± 0.29	5.12 ± 0.66
	Initial weight (g)	11.86 ± 1.73	11.97 ± 2.98	16.05 ± 2.25
	Final weight (g)	13.08 ± 1.65	13.5 ± 2.85	18.33 ± 2.65
	HC (g cm^{-1})	2.01 ± 0.34	2.36 ± 0.50	3.25 ± 0.33
	SGR (% day-1)	5.37 ± 1.67	7.04 ± 0.97	5.30 ± 0.57

Size and weight are two basic components in the biology of species at the individual and population levels. Information on size and weight measurement is essential for proper assessment and management of these fisheries (Gosling, 2003). The size–weight data are also employed in physiological investigations, and to obtain estimates of seasonal variation in growth or productivity (Kovitvadhi, 2008). The purpose of this research was to investigate the morphometric

measurement of shell length and total body weight of *L. marginalis*. The studies which examine size-weight relationship in *L. marginalis* found that a variety of environmental factors were known to influence shell morphology and the relative proportions. Bivalve shell growth and shape are influenced by biotic (endogenous/physiological) and abiotic (exogenous/environmental) factors (Babaei et al., 2010). For examples, the type and quality of phytoplankton as a food source of the mussels (Alunno-Bruscia et al., 2001), water quality (Lajtner et al., 2004) water depth (Claxton et al., 1998), currents (Blay et al., 1989), water turbulence (Hinch et al., 1988) type of sediment, type of bottom and wave exposure (Akester and Martel, 2000).

In the present study, sampling performed from pond bottom with soft sediments in all parts. Therefore a suitable biological condition is provided for *L. marginalis*. The results from the current study lead to two insights into the application of morphometric data. The results of this study indicated that development and maturation of mussel is important for successful culture and that optimization of the culture environment is critical. When culture technology is optimized to promote good survival and growth of mussels, the majority of mortality related to the culture environment was probably begin later, at about 5 months of culture period. From the results of the physico-chemical parameters in the FSS pond was a non-polluted freshwater body with more nutrients which make the water suitable enough for the survival of aquatic organisms. The results obtained from the present investigation of pond water shall be useful in culturing the freshwater mussel, *L. marginalis*.

CONCLUSION

In this study, it has been shown that the growth and survival rate of *L. marginalis* was significantly impaired in nursery pond. After the study it was determined that *L. marginalis* species is viable for pearl culture for their optimum growth rate in northern semi arid region. The assessment of water quality is an important factor for the growth and survival of the mussel in a better way. This study revealed that the water in the study area was suitable for the culture of freshwater mussels by maintaining the physico-chemical level. The findings of the present study confirmed that *L. marginalis* growth and survival rate records similar to other related pearl producing species.

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