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Growth performance of *Lamellidens marginalis*, *Lamelliden corrianus* and *Hyriopsis cumingii* under captive condition in pond ecology of Bangladesh

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ABSTRACT

A study was conducted to compare the growth performance of *Lamellidens marginalis, L. corrianus* and *Hyriopsis cumingii* in the pond complex of Bangladesh Fisheries research Institute, Mymensingh, Bangladesh from July 2017 to June 2018. Relative growth rate for the mussels were evaluated. The growth (shell length, and weight) of three different mussels were calculated and recorded on a monthly basis throughout the study period. Average initial shell length of *L. marginalis, L. corrianus* and *H. cumingii* were measured at 5.69±0.5cm, 5.06±0.28cm and 17.65±0.19cm and weight measured at 11.86±1.73g, 11.97±2.98g and 429.51±42.25g. After one year of rearing the average final shell length and weight were recorded for 8.59±0.39cm, 8.14±0.29cm, 18.13±0.14cm and 23.58±1.65g, 23.5±2.85g, 465.13±39.59g respectively. The health condition of mussels were found 2.74 ± 0.36g cm^{-1}, 2.88± 0.32g cm^{-1}, 25.65 ± 0.35g cm^{-1} respectively. The relative growth rate was calculated for weight of *L. marginalis, L. corrianus* and *Hyriopsis cumingii* at 98.81±2.69%, 96.32±1.89% and 8.29±3.32% respectively. Water quality parameters also monitored during the culture period which did not affect the growth and survival of these three *Lamellidens* species. The native mussel *L. marginalis* and *L. corrianus* showed better performance than *H. cumingii* because imported *H. cumingii* may struggle to adapt with new the aquatic habitat of Bangladesh.

Introduction

Bivalves is the second largest class of mollusks with about 10,000 living species are known throughout the world (Wye, 1989) of which there are 6 freshwater and 142 marine and brackish water species are available in Bangladesh (Siddiqui *et al.* 2007). There are numerous ponds, lake, haor, baor, beels, bays and estuaries in Bangladesh which can be devoted for mussel culture as well as pearl production. Freshwater mussel *L. marginalis, L. corrianus* are abundant in inland water bodies such as lakes, rivers and ponds of Bangladesh, India, Myanmar, Sri Lanka and Pakistan (Ghosh and ghose, 1972; Dan *et al.,* 2001). In addition Barman et al., (2018) reported availability of *L. marginalis L. corrianus, L. jenkensianus* and *L. phenchooganjensis* in natural waters of Bangladesh. Triangle sail (*Hyriopsis cumingii*) mussel is a freshwater pearl mussel distributed in China and Northern Vietnam. *H. cumingii contributes* 80% freshwater pearl production in China (Yan *et al.,* 2009), of which is achieved by the triangle sail mussel (Prabu, *et al.* 2010; Tang *et al.,* 2015). Triangle sail mussel *Hyriopsis cumingii* is important mussel species cultured in China (Bai *et al.,* 2013). So far, the triangle sail mussel is the most important and widely used freshwater pearly mussel (Li and Liu, 2011). In the recent time realizing the reality, *H. cumingii* has been introduced in the country. *L. marginalis, L. corrianus and H. cumingii* all the mussels might have good potentiality for the development of the pearl sector in Bangladesh. So the comparative growth study of the three mussels needs to be recorded. From the above context the present study was taken to generate knowledge on the growth performance of *H. cumingii* compared to native mussel *L. marginalis and L. corrianus*.

Materials and Methods

Pond preparation

A pond having 30 decimal areas was taken for stocking mussels. Pond was separated by bamboo fence (bana) in three equal parts to make it 10 decimal for each operated mussel. The pond contained sandy soil, clean water, pollution free bottom was selected. Following standard procedure was used for preparation of pond. Water from pond were totally drained out and dried. After drying lime and salt were applied at the rate of 1kg/decimal to remove the insect and earthworm. After 15 days of liming freshwater was supplied to the pond.

The ponds were prepared by dewatering, liming and organic fertilizer. The lime and fertilizer doses were given in Table 1

Table 1: Lime and fertilizer doses for preparation of pond

Input	g dec-1	Application time
Lime	1000	Pond preparation time
Urea	100-150	Every 15 days interval
TSP	150-200	Every 15 days interval

Water supply and quality

The underground water was supplied from deep tube well. The pond environment parameters such as surface water temperature, water depth, transparency, dissolved oxygen and pH 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.

Stocking mussel

The prepared ponds were then stocked with collected *H. cumingii, L. marginalis* and *L. corrianus*at the rate of 80 /decimal and cultured in grazing method. At the same time *Ctenpharyngodonidella, Cirrhinuscirrhosus, Channapunctatus* and *Heteropneustes fossilis* were stocked at the rate of 40/decimal.

Growth study

Length wise growth data was collected 15 days intervals through marking and tagging method (Figure 1). The length and weight 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).

Growth performance in culture

Shell size of collected specimens were measured with vernier calipers. Initial weight was recorded. Feed was applied regularly at 5% body weight for stocked fish. Different organic and inorganic fertilizers were applied at the rate of 5kg organic manure/decimal, urea 0.10 kg/decimal and TSP 0.125 kg/decimal. Lime applied if necessary at the rate of 0.3-0.5 kg/ decimal (depending on pH condition). Water quality parameters, temperature, dissolved oxygen, free carbon dioxide, ammonia, hardness and alkalinity was observed fortnightly during entire study period. Monthly sampling of the mussel was done during the experiment. Growth performance was recorded. Final harvest of the mussels was done at the end of the experiment.

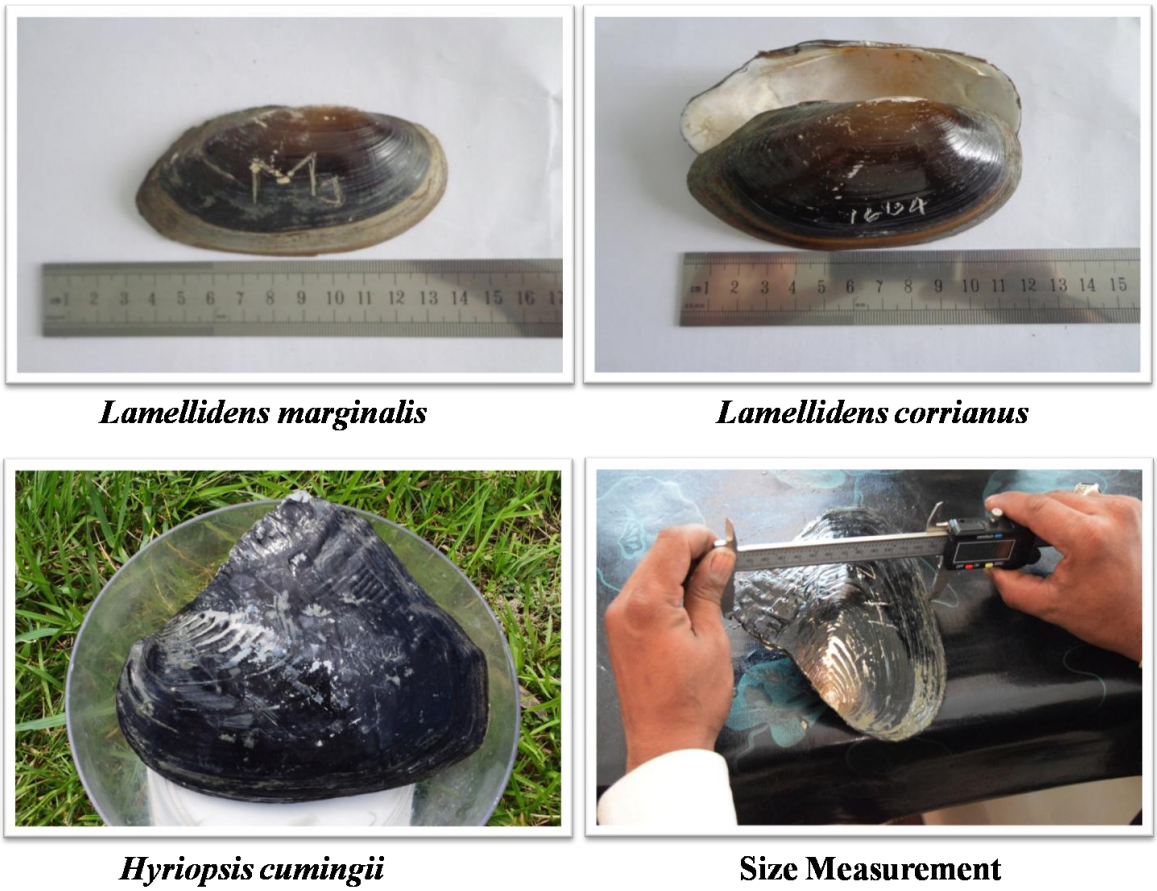

Figure 1: Freshwater mussel used in the study and measuring size

Results and Discussion

This experiment represent the comparative growth parameters and viability of freshwater mussel (*H. cumingii, L. marginalis and L. corrianus*) species in nursery and culture pond condition under application of lime, fertilizer and fish feed at a certain time period inside BFRI Pearl culture pond. The Physico-chemical data of the pond water were collected during the experiment which is presented in Table 2. The water samples of pond were colorless and no objectionable odour.

Table 2: Average water quality parameters of the experimental ponds

Parameters	Average value
Water temperature (^{0}C)	25.36±2.1
Dissolved oxygen (mg/ l)	5.16±0.4
Total alkalinity (mg/ l)	200±10
pH (mg/ l)	7.31±0.6
NH_4-N (mg/ l)	0.02±0.01
Ca^{2+} (mg/l)	15.30±1.1
Phytoplankton (x10^{3}cells/L)	51.20±3.2
Zooplankton (x10^{3}cells/L)	6.71±2.1

The obtained results of physico-chemical parameters were compared with standard 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).

Total stocking density of *H. cumingii, L. marginalis* and *L. corrianus* at the rate of 80/decimal 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 360 days the treatment wise growth performance of *H. cumingii, L. marginalis* and *L. corrianus* parameters are presented in Table 3.

Initial length and weight of *Lamellidens marginalis, L corrianus* and *H. cumingii* were recorded at5.69±0.5 cm, 5.06±0.27cm, 17.65±0.19cm and 11.86±1.73g, 11.97±2.98g, 429.51±42.25 while final length and weight recorded at 8.59±0.34cm, 58.14±0.29cm, 18.13±0.14cm and 23.58±1.65g, 23.5±2.85g, 465.13±39.59 respectively (Table 1). Relative growth rate (%) was found for *Lamellidens marginalis, L corrianus* and *H. cumingii* 98.81±2.69%, 96.32±1.89% and 8.29±3.32%. Water quality parameters also monitored fortnightly and found suitable (Table 2).

Table 3: Relative growth of the mussels (*L. marginalis*, *L. corrianus*and *H. cumingii*) during the study period Each value represents Mean ± SD of six determinations.

Culture period	Parameters	Treatments		
		T_1- *L.marginalis*	T_2- *L.corrianus*	T_3 - *H.cumingii*
360 days	Initial length(cm)	5.69±0.5	5.06±0.28	17.65±0.19
	Final length (cm)	8.59± 0.34	8.14±0.29	18.13±0.14
	Initial weight (g)	11.86±1.73	11.97±2.98	429.51±42.25
	Final weight (g)	23.58±1.65	23.5±2.85	465.13±39.59
	HC (g cm^{-1})	2.74 ± 0.36	2.88± 0.32	25.65 ± 0.35
	SGR (% day^{-1})	3.2 ± 1.44	3.1 ± 0.99	9.8 ± 0.77
	Growth rate (%)	98.81±2.69	96.32±1.89	8.29±3.32

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 morphometric measurement of shell length and total body weight of *L. marginalis*, *L. corrianus* and *H. cumingii* can varies study to study due to some environmental factors that 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). 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) are biotic and abotic factors as example.

Conclusion

In the present study native mussel *L. marginalis* and *L. corrianus* showed better performance than *H. cumingii* due to having suitable biological condition. But *H cumingii* as a foreign species yet not adapted with the native weather that's why it showed lower growth performance. Further studies are needed to compare the native and foreign mussel's performance after adapting in new environment.

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