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Growth Ecology of *Pila globosa* (Swainson) (Gastropoda: Pilidae) in Simulated Habitat

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Abstract: Growth ecology of *Pila globosa* was studied in the simulated habitat with reference to its natural food habit. Growth rate and obesity index value for the snail population reared on natural aquatic food plants were higher than those, reared on cultivated food, Puni (*Basela rubra*).
For natural food, the minimum and maximum mortality rates at age intervals of 224-238 days and 0-14 days were calculated as 0.00% and 16.00% while, on supplied cultivated vegetable food, *(B. rubra)* at 252-266 days and 0-14 days age intervals, were obtained as 0.00% and 18.00% respectively. The life table was constructed on 266 days study of snails, reared on both types of food plants. The findings indicate the possibility of snail culture on large scale, in simulated habitats provided with physico-chemical parameters, like water temperature, pH, turbidity and dissolve oxygen of water, strictly maintained.

Key words: *Pila globosa*, growth rate, obesity index, physico-chemical parameters.

Introduction

The freshwater gastropod, *Pila globosa* (Swainson) usually occurs in all types of temporary and permanent water bodies, *e.g.* ponds, canals, ditches, *beels* and *haors* of Bangladesh. Works on the ecology of Pilidae has been reported by many workers, Saxena (1956) and Subba Rao (1989) in India.
Recently, some aspects of ecology and economic importance of the snail fauna of Bangladesh have been investigated by Jahan *et al.* (1998, 1999) and Rahman (2000). Moreover, along with food and feed behaviour, reproductive biology and economic status of *P. globosa* in Bangladesh has been presented by Saha (1998). He mentioned that 29 groups of tribal people of Bangladesh consume the flesh of *P. globosa*. At the same time flesh of *P. globosa* is extensively utilized in freshwater prawn *(Macrobrachium rosenbergii)* and brackish water prawn, *(Penaeus monodon)* cultures in the south-western part of the country. The domestic duck and the catfish, *Clarias gariepinus* are also fed on the flesh of the snail. Accordingly, locally known as 'Gala Market', had been developed in Godaraghat of Fakirhat thana in the district of Bagerhat, where in one season approximately Tk. 3,53,00,000.00 is transacted for snail trading. Biological activities of any kind of aquatic organisms are closely related to the physico-chemical and biotic parameters of the habitat concerned. The relationship between the snails, and their biotic and abiotic environmental components are not isolated but are interacting. The snails also play an active role as an ecological component to maintain the healthy aquatic environment which is a pre-requisite for the conservation of bio-diversity. In one hand, the scientific management of snail fauna is out of practice and on the other hand, over exploitation of *P. globosa* is going on to earn the livelihood of the poor people and foreign currency for the nation through prawn culture. The situation very much deserves the development of supplementary *P. globosa* culture techniques for commercial purposes through diminishing pressure on natural populations. Considering this idea, the present study on the growth of *P. globosa* rearing on natural aquatic and cultivated food plants in simulated habitats was carried out.

Materials and Methods

Twenty charred earthen pots (45cm diameter and 35cm depth) provided with thick clay soil at the bottom were taken as simulated habitats for snail culture. Ten pots were provided with *Ottelia alismoides, Vallisneria spiralis, Pistia stratiotes* and *Eichhornia crassipes* as natural food plants and the other ten with *Besella rubra* (*Puni*) as cultivated vegetables food plants for snails. All the twenty pots were provided with tank water and 100 juvenile (0-day old) snails from the stock culture were released in each of them. After every 72 hours the water was changed and the dead snails were discarded. The experiment was continued for 266 days starting from 16^{th} May, 1999 in the premises of the Department of Zoology, Rajshahi University, Rajshahi, Bangladesh.
The number of dead snails at 14-days intervals was carefully counted and recorded throughout the experiment. For the construction of life table, the life table model first used by Andrewartha and Birch (1954) was followed. The calculation of "expectation of further life" $_{e}{}^{x}$ was performed according to Krebs (1985).
Growth was ascertained by measuring the shell diameter and body weight regularly at 2-week intervals. The shell length (SL), shell width (SW), spire length (SPL), base length (BL) and aperture length (AL) of the shells were measured with the help of Vernier Calipers, and weight of snails was taken with the help of an Electronic Balance (Model No.HF-200h, Max-210g, d = 0.001 gm). The air temperature was recorded regularly with a Thermo-Hygrometer (Model: HN – AK series). Ten snails were randomly selected for each replicate. The obesity index (length divided by width) and the additive growth rate were also calculated following Simpson and Roe (1939).
To find out the effect of snail culture on the physico-chemical parameters of water, dissolve oxygen, pH, turbidity and water temperature were recorded after every 72 hours with the help of a water quality checker (No. WQC-20A, Japan).

Results

At the end of 266 days the shell length, shell width and body weight of *P. globosa* were 4.10±0.03 cm. 3.98±0.03 cm. and 12.18±0.15 gm. respectively on natural food. When reared on the cultivated vegetable (puni) the same parameters were valued as 2.68±0.02cm, 2.60±0.02cm and 9.43±0.23 gm respectively (Table 1).
For natural food, the minimum and maximum mortality rates were calculated at 224 - 238 days and 0-14 days age intervals as 0.00 and 16.00% and in case of supplied cultivated vegetable food, at 252-266 days and 0 -14 days age intervals as 0.00 and 18.00% respectively. The

Table 1: Morphometrical parameters of *P. globosa* reared on natural and cultivated foods for consecutive 266 days.

Days	Shell length (cm) (M ±SE)		Shell width (cm) (M ±SE)		Body weight (gm) (M ±SE)	
	Natural food	Cultivated food	Natural food	Cultivated food	Natural food	Cultivated food
14	0.36±0.01	0.31±.008	0.29±0.01	0.26±0.01	0.01041± 0.0002	0.013± 0.0001
28	0.42±0.01	0.38±0.01	0.38±0.01	0.33±0.01	0.0498± 0.003	0.035± 0.022
42	0.81±0.03	0.45±0.02	0.71±0.02	0.42±0.02	0.2687± 0.02	0.178± 0.01
56	1.25±0.02	0.85±0.02	1.11±0.01	0.82±0.02	0.552± 0.02	0.451± 0.02
70	1.48±0.03	1.08±0.02	1.40±0.03	1.06±0.02	0.968± 0.04	0.803± 0.03
84	1.75±0.05	1.28±0.03	1.70±0.05	1.25±0.02	1.173± 0.05	0.960± 0.07
98	2.07±0.04	1.35±0.03	1.93±0.04	1.30±0.03	1.473± 0.05	1.224± 0.30
112	2.42±0.05	1.45±0.03	2.22±0.04	1.42±0.03	2.423± 0.05	2.051± 0.07
126	2.85±0.04	1.85±0.04	2.66±004	1.80±0.06	2.652± 0.18	2.250± 0.13
140	3.11±0.05	2.05±0.04	2.12±0.05	2.00±0.04	5.253± 0.25	3.261± 0.09
154	3.29±0.05	2.15±0.03	3.11±0.05	2.10±0.03	8.472± 0.16	6.425± 0.18
168	3.49±0.05	2.25±0.04	3.29±0.05	2.20±0.04	9.173± 0.14	7.097± 1.11
182	3.63±0.05	2.3±0.04	3.44±0.05	2.30±0.04	9.263± 0.15	7.229± 0.11
196	3.75±0.04	2.40±0.03	3.53±0.04	2.35±0.03	9.505± 0.16	7.389± 0.12
210	3.87±0.04	2.51±0.03	3.67±0.04	2.48±0.03	10.41± 0.19	8.074± 0.13
224	0.94±0.04	2.57±0.03	3.74±0.04	2.50±0.03	10.942± 0.15	8.491± 0.150
238	3.97±0.03	2.59±0.03	3.88±0.03	2.56±0.03	11.821± 0.17	9.076± 0.15
252	3.98±0.03	2.60±0.03	3.92±0.03	2.57±0.03	12.236± 0.16	9.391± 0.15
266	4.10±0.03	2.68±0.02	3.98±0.03	2.60±0.02	12.186± 0.15	9.431± 0.239

Table 2: Physico-chemical parameters of water with and without snail.

	Observations 1	2	3	4	5	6	7	8	9	10	Cummulative mean	t-value
With Natural food												
DO												
With snails	2.36 ±0.22	2.26 ±0.31	1.92 ±0.37	3.76 ±0.30	2.54 ±0.29	2.86 ±0.13	2.66 ±0.26	3.26 ±0.16	3.02 ±0.19	3.3 ±0.29	2.79 ±0.16	3.395
Without snails	3.82 ±0.21	3.66 ±0.30	2.58 ±0.13	4.32 ±0.31	3.38 ±0.23	4.4 ±0.22	4.68 ±0.10	4.88 ±0.35	4.48 ±0.15	4.44 ±0.09	4.06 ±0.21	($p<0.01$)
pH												
With snails	8.37 ±0.21	8.23 ±0.16	8.08 ±0.08	8.09 ±0.03	8.46 ±0.11	8.32 ±0.14	7.93 ±0.09	8.43 ±0.07	8.32 ±0.14	8.32 ±0.09	8.25 ±0.05	3.543
Without snails	7.92 ±0.10	7.94 ±0.09	8.06 ±0.11	7.77 ±0.20	7.98 ±0.09	7.98 ±0.11	7.27 ±0.30	7.58 ±0.17	7.43 ±0.16	8.13 ±0.09	7.80 ±0.08	($p<0.01$)
Turbidity												
With snails	574.8 ±0.99	657.2 ±74.42	823.00 ±91.47	745 ±89.56	581 ±3.04	739.6 ±91.29	746.6 ±89.01	656.6 ±74.57	741 ±90.94	738.2 ±91.95	700.3 ±23.99	3.676
Without snails	573 ±1.35	571.8 ±0.43	575 ±1.01	583 ±68	573.6 ±1.34	572.6 ±1.28	576.4 ±3.14	570.6 ±0.21	657.8 ±74.30	574.6 ±0.69	582.84 ±7.96	($p<0.01$)
Water temperature (°C)												
With snails	30.1 ±0.94	29.18 ±1.04	28.14 ±0.73	27.94 ±0.42	30.18 ±0.53	30.2 ±0.34	27.4 ±40	30.3 ±0.76	30.02 ±0.60	29.6 ±0.80	29.30 ±0.32	NS
Without snails	28.42 ±0.73	28.58 ±0.17	26.92 ±1.39	27.0 ±2.03	26.58 ±0.37	28.8 ±0.58	23.02 ±1.90	29.3 ±0.33	28.84 ±0.66	28.68 ±0.59	27.61 ±0.56	NS
With Cultivated food												
DO												
With snails	2.36 ±0.22	2.26 ±0.31	1.86 ±0.20	2.28 ±0.16	1.92 ±0.16	2.86 ±0.13	2.66 ±0.26	3.2 ±0.21	3.02 ±0.19	3.24 ±0.09	2.56 ±0.15	2.188
Without snails	2.74 ±0.27	3.12 ±0.22	1.92 ±0.37	4.32 ±0.31	3.38 ±0.23	3.6 ±0.25	3.9 ±0.06	3.26 ±0.16	3.56 ±0.20	3.3 ±0.29	3.31 ±0.19	($p<0.05$)
pH												
With snails	8.00 ±0.04	8.29 ±0.11	8.25 ±0.09	8.04 ±0.04	8.57 ±2.23	8.15 ±0.10	7.93 ±0.09	8.09 ±0.25	8.16 ±0.10	8.13 ±0.09	8.16 ±0.05	2.840
Without snails	7.92 ±0.10	7.94 ±0.09	8.08 ±0.08	7.77 ±0.20	7.98 ±0.09	7.98 ±0.11	6.93 ±0.43	7.58 ±0.17	7.43 ±0.16	7.91 ±0.06	7.75 ±0.10	($p<0.05$)
Turbidity												
With snails	573.2 ±3.84	657.6 ±74.34	659.6 ±73.92	583 ±3.68	741.2 ±90.87	577.8 ±4.91	669.8 ±71.51	571.4 ±1.61	657.8 ±74.30	574.6 ±0.69	627.24 ±17.38	2.897
Without snails	573 ±1.35	571.8 ±0.43	575 ±1.01	573.2 ±1.10	573.6 ±1.34	572.6 ±1.28	576.4 ±3.14	570.6 ±0.21	578.4 ±4.74	571.4 ±0.35	573.8 ±0.65	($p<0.01$)
Water temperature (°C)												
With snails	28.42 ±0.73	29.36 ±0.65	28.64 ±0.34	27.36 ±0.04	30.18 ±0.53	30.04 ±0.18	27.4 ±0.40	29.32 ±0.24	29.9 ±0.47	29.6 ±0.80	29.02 ±0.30	NS
Without snails	28.28 ±0.61	22.6 ±0.31	28.14 ±0.73	27.0 ±2.03	26.58 ±0.20	28.8 ±0.58	22.8 ±1.61	29.3 ±0.33	28.84 ±0.66	29.42 ±0.59	27.17 ±0.75	NS

DO = Dissolved oxygen NS = Non significant

minimum and maximum mean expectation of further life for *P. globosa* on the natural food were 0.50 and 8.20 at the age of 252 - 266 days and 42–56 days respectively. On the other hand the minimum and maximum mean expectation of further life for *P. globosa* on *puni* were 0.50 and 7.60 at the age group, 266 and 42–56 days. The survivorship curves drawn from the life table are presented in Fig. 1. The additive growth (in length and weight) and obesity index of the shell increased throughout the consecutive 266 days, which are presented in Figures 2, 3 and 4. The dissolve

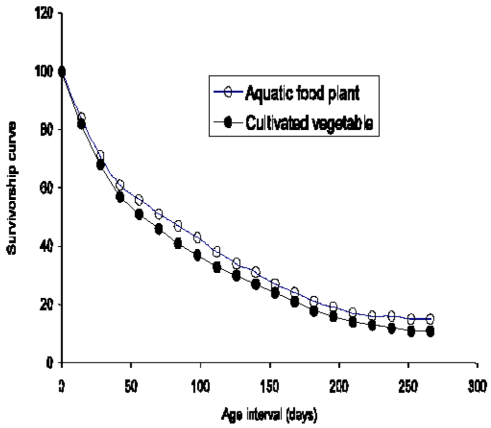

Fig. 1: Survivorship curves of *P. globosa* reared on aquatic food plants and cultivated vegetable, Puni (*B. rubra*) in simulated habitat

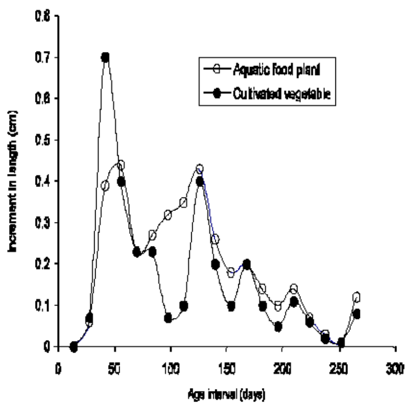

Fig. 2: Linear graphic representation of the growth rate of *P. globosa* reared on aquatic food plants and cultivated vegetable Puni (*B. rubra*) in simulated habitat

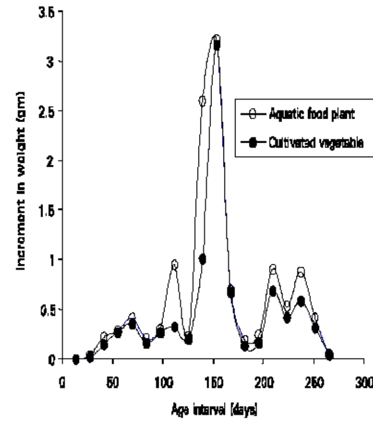

Fig. 3: Linear graphic representation of the additive growth rate of *P. globosa* reared on aquatic food plants and cultivated vegetable Puni (*B. rubra*) in simulated habitat

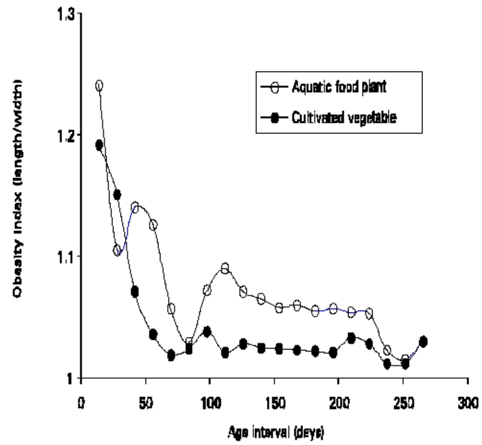

Fig. 4: Linear graphic representation of the obesity index of *P. globosa* reared on aquatic food plants and cultivated vegetable Puni (*B. rubra*) in simulated habitat

oxygen, pH and turbidity of water with and without snails were significantly different (Table 2), using both cultivated and natural food.

Discussion

The survivorship curves (Fig.1) for the snails reared on natural aquatic food plants, always runs over that for cultivated vegetable food plants. In both the cases, the maximum mortality rates were calculated at 0-14 days age intervals whereas the minimum mortality rates were calculated at 224-238 days and 252-266 days age intervals for natural food and cultivated vegetables respectively. The life-table could not be explained clearly due to lack of time to continue the experiment after 266 days. A good number of snails remained alive. This requires further study.

Information on the growth rates in shell length, and weight of the snails should be considered to explain the phenomenon involved in the growth of the snail population (Rahman & Jahan, 1999). Snails reared on the natural food plant and cultivated vegetable food in simulated habitats show different growth rates. It is clear from Fig. 2 and 3 that the natural food plants enhanced both the length and weight of the snail in comparison with cultivated vegetable food. This was also true for the obesity index of the snail. Obesity indices for both food plants remained in a state of decrease starting from 28th to 100th days and then maintained a more or less steady state up to 240 days (Fig. 4). The higher obesity index for snails fed on natural food plants indicates the rapid growth of the shell. A comparison of the morphometrical parameters showed that the size of the snails was increased on the natural food.

Boycott (1934) concluded that the chief consideration for aquatic molluscs was water which was clean and transparent and not overcharged with the products of animals and vegetable decay. Patnaik and Ray (1968) mentioned that turbidity of water due to suspended organic matter, plankton or silt was the second important limiting factor for *Lymnaea auricularia*. Saha (1998) found that abundance of *P. globosa* was positively correlated with dissolved oxygen in water body. Hubendick (1951) opined that pH was intricately entangled in the complex biological system of a water body and indirectly its snail fauna. Raut (1989) stated that the development of *L. luteola* was highly influenced by pH of water and beyond the range of 6.0-9.5, eggs of the snail are not hatched.

The effects of snail culture on the physico-chemical parameters, *eg.* water temperature, pH, turbidity and dissolved oxygen of water showed that the first three parameters significantly increased and the last one was decreased due to the presence of the snails in water. Perhaps the release of CO_2 through the expiration of the snails is the cause of increased temperature, and the production of snail excreta and decayed organic matters are the causes of increased turbidity and pH. This suggests that the culture of *P. globosa* in mini-tanks deserves frequent change of water, and rapid cleaning of the dead snails and decayed food plants.

The present investigation is a preliminary work on examining the possibilities of successful snail culture at a place out of the natural habitats. *B. rubra* or other aquatic plants may be used in simulated habitats for *P. globosa* culture. The observations made, open a new avenue for future workers to establish snail culture farms. However, much more research is solicited in this line.

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References

Andrewartha, H.G. and L.C. Birch, 1954. *The distribution and abundance of animals*. The University of Chicago and London, pp: 782.

Boycott, A.E., 1934. The habitats of freshwater Mollusca in Britain. J. Ecol., 27 : 116-186.

Hubendick, B., 1951. Recent Lymnaeidae : Their variation, morphology, nomenclature and distribution. Kungl. Svenska, Ventens. Hand. Fjar. Sea, 3 :1-223.

Jahan, M.S., M. R. Rahman, M.A. Al-Mahmud and M.M. Sarker, 1998. Ecology of a freshwater snail, *Lymnaea luteola* Lamarck, 1822 (Grastropoda: Lymnaeidae). Bangladesh. J. Zool., 26: 67 - 75.

Jahan, M.S., M.R. Rahman and L. Biswas, 1999. Comparative morphometrical indices of freshwater Lymnaeid snails of Bangladesh. Bangladesh J. Zool., 27: 165-168.

Krebs, C. J., 1985. *Ecology* : *The experimental Analysis of Distribution and abundance*. 3rd edn. Hanpper Pollins Publishers.

Patnaik, M.M. and S.K. Ray, 1968. Studies on geographical distribution and ecology of *Lymnaea auricularia* var. *rufescens*, the intermediate host of *Fasciola gigantica* in Orissa. Indian J. Vet. Sci., 32.

Rahman, M.R., 2000. Freshwater Gastropods in Relation to Helminth Parasites of Bangladesh. Ph.D. Thesis, Rajshahi University, pp: 264.

Rahman, M.R. and M.S. Jahan, 1999. Growth indices of *Lymnaea* (*Radix*) *acuminata* Lamarck (Gastropoda : Lymnaeidae). Bull. Environ. Sci., 17 : 17-22.

Raut, S.K., 1989. Laboratory rearing of medically and economically important molluscs. Jairajpuri, M.S. (Edn.) Snails, Flukes and Man, Zoological Survey of India, Calcutta, pp: 81-88.

Saha, B.K., 1998. Ecology and Bio-Economics of the Freshwater Edible Snails of Bangladesh. Ph.D. Thesis, Rajshahi University, pp: 162.

Saxena, B. B., 1956. Some observations on the ecology and behaviour of the common Indian apple snail, *Pila globosa* (Swainson). J. Bombay nat. Hist. Soc., 53 : 733-736.

Simpson, G.G. and A. Roe, 1939. *Quantitative Zoology*, New York. PP: xvii+414.

Subba Rao, N.V., 1989. *Handbook of Freshwater Molluscs of India*, The Director (Ed.). Zoological Survey of India. Calcutta, pp: 289.