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Distribution Patterns of Vector Snails and Trematode Cercaria in their Vectors in Some Selected Areas of Mymensingh

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Abstract

Different species of vector snails carry larval stages of different trematodes. Studies were performed to investigate different snail species and parthinate of trematodes carried by them, in some selected areas of Mymensingh Sadar, Mymensingh. Snails were collected by hand picking method and examined after crushing. Among 864 tested snails, it revealed the presence of six species of snails like *Lymnaea auricularia* 145 (16.8%), *Lymnaea luteola* 205 (23.7%), *Indoplanorbis exustus* 273 (31.6%), *Vivipara* spp. 164 (18.9%), *Brotia* spp. 35 (4.1%) and *Pila* spp. 42 (4.8%) in the study areas. Among them 5.8% *L. luteola* and 6.2% *L. auricularia* were infected with gymnacephalus cercariae. Again, 1.4% *L. auricularia* and 1.8% *I. exustus* were infected with echinostome cercaria. In this study, 1.8% *Vivipara* spp. and 2.6% *I. exustus* were positive for furcocercus cercaria. On the other hand, 1.8% *Vivipara* spp. was positive for xiphidocercus cercariae and 1.8% *I. exustus* was also positive for amphistome cercariae. One or more species of snails were found to harbor single or mixed types of cercariae such as gymnacepahlus, echinostome and furcocercous. Population densities of different species of snails were determined in per unit time which were statistically significant ($p<0.01$). More studies are needed to focus on the determination of different vector snails and cercariae carried by them throughout the Bangladesh especially from plain lands, hilly areas, alluvial lands and coastal areas during four conventional seasons.

Key words: Vector snails, Trematode cercaria, Distribution, Mymensingh

Introduction

Trematodes are of extreme economic importance, especially in tropical developing countries. There is considerable economic loss in the form of mortality, reduced weight gain, decreased meat and milk production, low fertility, reduction in draft power and poor hide quality in Bangladesh due to fascioliasis in ruminants (Begum, 1993). An estimation of annual economic loss of about 0.6 million taka from liver damage due to fascioliasis in goats was reported by Bhuiyan (1970). Besides, some trematodes cercariae produce "swimmer's itch" (cercarial dermatitis) in man (Sandosham, 1954). The freshwater snails are involved in the transmission of trematode species belonging to the superfamilies Schistosomatoidea, Fascioloidea,Clinostomoidea, Paramphistomoidea, Ehinostomatoidea, Diplostomoidea and Pronocephaloidea.

The larval trematodes have received great attention in order to establish the biological relationship of the species with the intermediate hosts they utilize for the completion of their life cycles. The climatic condition of Bangladesh is favorable to the ecological conditions and suitable for survival and breeding of snail intermediate hosts. Long standing summer and rain in the country facilitate least stagnation of water in various pools where fresh water snails shelter and reproduce in abundance. Due to availability of scanty pasture lands in Bangladesh, animals are to eat infected grass in marshy areas inhabited by snails. So, control of important snails is very essential in certain areas as one of the feasible measures to reduce the economic loss impaired by the parasites which they harbor.

A number of studies have been made on the snail intermediate hosts of harmful trematodes in Bangladesh (Qadir, 1982; Begum, 1993; Rahman *et al.*, 1997; Mondal *et al.*, 2003; Alam, 2010). However, these investigations were kept limited within plain lands and hilly areas of the country. Mymensingh Sadar is relatively a low land of which many parts goes under water during rainy season. Again there are many canals, ponds, drains; paddy field with irrigation channels and marshy lands (beels).The river Bhramamaputra is also flowing through the areas. As such identification of snail vectors and their role in the transmission of harmful trematodes are acknowledged as a prelude to address the anticipated problems. The present study was performed with the objectives to collect and identify the fresh water snails from different pools of water in some selected areas of Mymensingh Sadar for the determination of snail density; and examine the cercariae developing in these snails.

Materials and Methods

Study area and duration

Snails and other related materials e.g. water, soil etc. were collected from snail inhabited areas in some selected areas of Mymensingh Sadar, Mynensingh from March 2011 to May 2011. All laboratory activities were performed at the laboratory of Parasitology Department, Bangladesh Agricultural University, Mymensingh.

Collection and examination of snails

A total of 864 aquatic snails were collected from different ponds, marshy lands (beels), irrigation channels & rice fields, drain, lake and river (Bhramaputra). The snails were either collected with handpicked method or with the help of scooped-net as described by Malek (1962). After collection, the snails were kept in plastic container with perforated lids, and containing saline, brought to the laboratory and washed in running tap water for 15 minutes. Snails containing different water vegetation and other debrises on the shells were cleansed with soft brush and washed in running tap water. The snails were identified by their characteristic shell characters as described by Hubendick (1951) and Malek and Cheng (1974).

The snails were placed individually in test tubes or glass petridishes containing saline and subjected 60 W bulb heats to liberate cercariae slowly. The snails from which cercariae did not emerge were crushed softly with the help of morter and pastle to examine their viscera. The visceral organs of the Lymnaeidae snails were taken out easily by slow and gentle traction with the help of a curved needle. The shells were separated by the needles and the entire alimentary tract and the associated glands were placed in normal saline and dissected for the detection of parthinate. These were dissected and processed for histological examination to detect the presence of parthinate using the methods described by Cable (1950). The examination was first made under stereomicroscope. In the positive cases, living cercariae were drawn with the help of a medicinal dropper and placed on glass slide. The cercariae were examined under high power objective after adding a drop of 1% methylene blue with the motile cercariae. Identification of different types of cercariae was done as described by Cable (1950) and Rahman (1969).

Population density of snails

The population density of snails in per unit time was determined as described by Olivier and Schneiderman (1956). This technique involves counting the number of snails that are collected systematically with sieves mounted on handles or handpicked by one or more experienced collectors in a measured and marked area of the habitat for a given interval of time usually per hour.

Study of water characteristics

The physical condition of water such as transparency, presence or absence of water current and depth of water of a particular habitat of snail were recorded. For determination the pH of water, at least 60 ml of water from each habitat was carried to the laboratory in plastic or glass bottles. The pH was determined by Glass Electrode pH Meter as described by Black (1965). The water vegetation available in a particular snail habitat was studied. The special affinity and attachment of snails with the vegetation was recorded.

Study of soil

The soil of a particular habitat was studied. At least 100 grams of soil was collected from different parts of a particular habitat, dried up and mixed thoroughly and the nature of the soil was determined by following the method as described by Brady (1974). The pH of soil was determined by Glass Electrode pH Meter as described by Black (1965).

Meteorological data and correlation with the prevalence of snails

The meteorological data were collected from the meteorological station located at the Bangladesh Agricultural University Campus, Mymensingh in every month (Table 1) to correlate the prevalence of snails, cercariae, snail density and snail ecology with the temperature, rainfall and humidity.

Statistical Analysis

Statistical analysis of the prevalence of cercariae in snails and the climatic factors were determined by using Pearson Chi-Square test and F test (Gupta, 1988).

Results

Overall prevalence of snails and different types of cercariae recovered from snails

In the present study, a total of 864 snails were collected for identification. Amongst them six different species were identified such as *Lymnaea luteola, Lymnaea auricularia, Vivipara*, spp. *Indoplanorbis exustus, Pila* spp. and *Brotia* spp. (Figure 1- a, b, c, d, e, f). Overall prevalence of these species were 23.7%, 16.8%, 18.9%, 31.6%, 4.8% and

4.1%, respectively. Out of the 864 snails, 205 *Lymnaea luteola*, 145 *Lymnaea auricularia*, 164 *Vivipara* spp., 273 *Indoplanorbis exustus*, 42 *Pila* spp. and 35 *Brotia* spp. were examined for detection of cercariae. Nevertheless, overall cercarial prevalence in the examined snail species was 5.3%. Five different types of cercariae were detected such as furcocercus, gymnacephalus, amphistome, echinostome and xiphidocercous cercariae (Figure 2- g, h, I, j). Gymnacephalus cercariae were detected from *Lymnaea luteola* (5.9%) and *L. auricularia* (6.2%). Echinostome cercariae were detected from *L. auricularia* (1.4%) and *Indoplanorbis exustus* (1.8%). Furcocercus cercariae were recovered from *Vivipara* spp. (1.8%) and *Indoplanorbis exustus* (2.6%). Amphistome cercariae were recovered from *Indoplanorbis exus*tus (1.8%). Again, xiphidocercous cercaria was recovered from *Vivipara* spp. (1.8%). No cercariae were found in *Pila* spp. and *Brotia* spp.

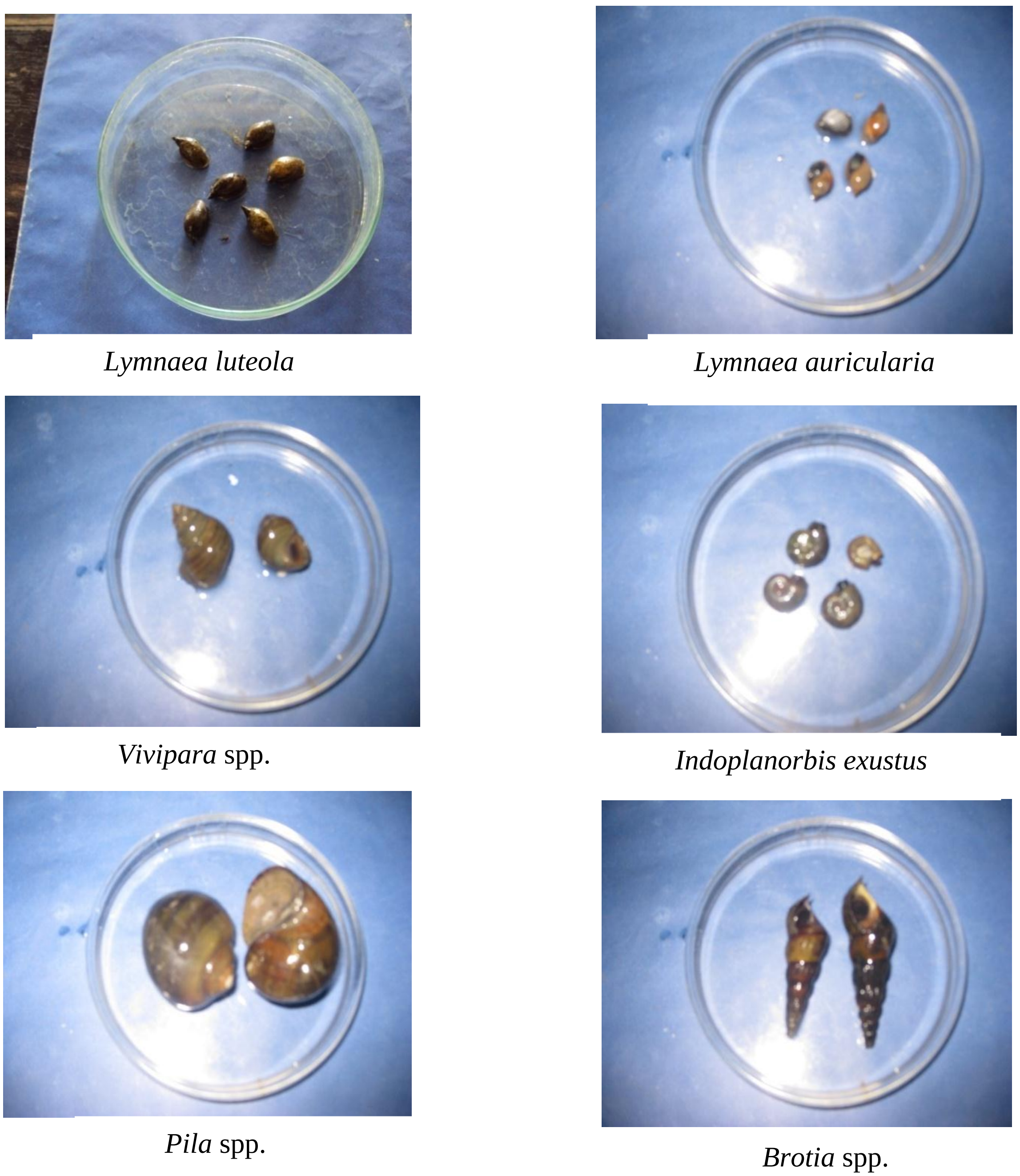
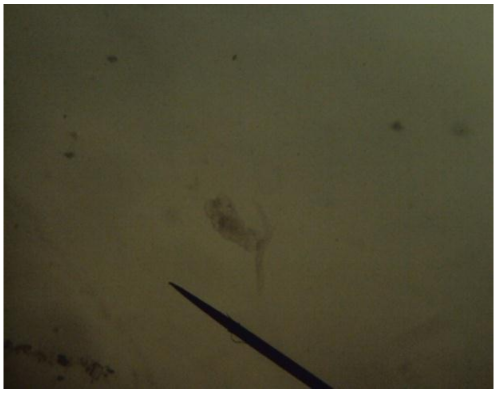
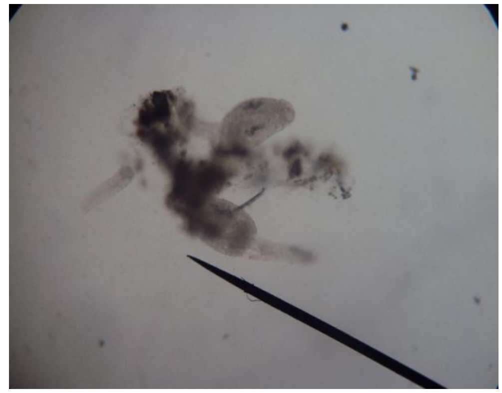


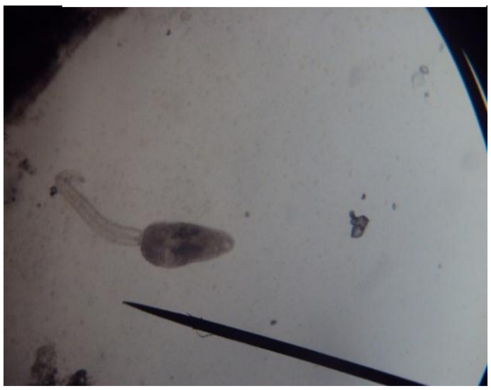
Fig. 1. Different species of snails



Furcocercus cercaria



Gymnacephalus cercaria



Amphistome cercaria

Echinostome cercaria

Fig. 2. Different types of cercariae recovered from snails

Monthly prevalence of different types of cercariae

The present study revealed non-significant (p>0.05 monthly fluctuation of the prevalence of cercarial infection in snails. The average temperature, humidity and rainfall were higher in May, 2011 which was 27.6^{0}C, 82.5% and 304.6 mm, respectively and lower in March, 2011 which was 24.9^{0}C, 73.7% and 32.6 mm, respectively (Table 1). Prevalence of cercarial infection was higher in May, 2011 (6.8%) and lower in March, 2011 (2.7%). The highest rate of infection was found in May, 2011 with gymnacephalus cercariae (19.2%) and lowest with amphistome cercariae (00%). In March, 2011 infection was found only with furcocerus cercariae (7%) and gymnacephalus cercariae (3.1%) and no infection with others (Table 2).

Table 1. Meteorological data collected from the meteorological station at Bangladesh Agricultural University campus from March, 2011 to May, 2011

Month	Average temperature (^{0}C)	Average Humidity (%)	Rainfall (mm)	Average water temperature (^{0}C)
March	24.9	73.7	32.6	24.8
April	26.9	77.7	80.3	26.4
May	27.6	82.5	304.6	27.3

Table 2. Monthly prevalence of different types of *cercariae*

Months	Species of snails tested with No.	No. of infected snails	No. of types of cercariae found with percentage				
			Gymnac-ephalus	Echinos-tome	Amphist-ome	Furcocer-cus	Xiphid-ocercus
March/2011	*Pila* spp.(42)						
	Brotia spp. (6)						
	L. luteola (96)	3	3±0.05 (3.1%)				
	I. exustus (59)	1				1±0.00 (1.7%)	
	Vivipara spp. (57)	3				3±0.37 (5.3%)	
Total	**260**	**7**	**2.7±0.14**				
April/2011	*Brotia* spp. (14)						
	L. luteola (41)						
	L. auricularia (100)	6	6±0.3 (6%)				
	I. exustus (107)	12		3±0.17 (2.8%)	5±0.25 (4.7%)	4±0.21 (3.7%)	
	Vivipara spp. (33)						
Total	**295**	**18**	**6.1±0.23**				
May/2011	*Brotia* spp. (15)						
	L. luteola (68)	9	9±0.33 (13.2%)				
	L. auricularia (45)	5	3±0.14 (6.7%)	2±0.06 (4.4%)			
	I. exustus (107)	4		2±0.08 (1.9%)		2±0.09 (1.9%)	
	Vivipara spp. (74)	3					3±0.18 (4%)
Total	**309**	**21**	**6.8±0.22**				
Grand total	**864**	**46**	**5.3±0.19**				
P value & level of significance			**0. 347 NS**				

NS means (p>0.05)

***Location-wise* prevalence of different types of cercariae**

Ponds were found to harbor cercariae of furcocercus (2%) and xiphidocercus (2%), canals harbor cercariae of furcocercus (2.3%), xiphidocercus (4.7%), echinostome (2%) and amphistome (2%). Drains harbor cercariae of gymnacephalus (6.1%), paddy field with irrigation channel harbor cercariae of *g*ymnacephalus (21.9%) and furcocercus (1.8%). On the other hand, river was found to harbor cercariae of gymnacephalus (14.7%), echinostome (9.9%), amphistome (2.1%) and furcocercus (4.9%). Marshy lands (beels) were found to harbor cercariae of *g*ymnacephalus (13.8%), echinostome (6%), amphistome (1%) and furcocercus (1%). In this study, ponds represented 4.1%, canals 10.9%, drains 6.1%, paddy field with irrigation channel 23.7%, river 28.8% and marshy lands (beels) 22.6% of total cercariae and was statistically non-significant ($p>0.05$) (Table 3).

Population density of different species of snails

In the present study, the population densities in per man per hour of different species of snails were determined. In ponds, *Lymnaea luteola*, *Vivipara* spp. and *Pila* spp. were present and statistically significant ($p<0.01$). The highest number was found in case of *Lymnaea luteola* (24±0.27) and lowest in case of *Pila* spp. (16±0.23). In canals, the highest number was found in *Lymnaea luteola* (24±0.17) and lowest in *Pila* spp. (12±0.14) and was statistically significant ($p<0.01$). In drains, the highest number was found in *Lymnaea luteola* (20±0.11) and lowest in *Pila* spp. (8±0.09) and statistically significant ($p<0.01$). During the study, paddy fields with irrigation channel were found infested with *Lymnaea luteola*, *Indoplanorbis exustus* and *Lymnaea auricularia*. The highest number was found in *Indoplanorbis exustus* (32±0.23) and lowest in *Lymnaea auricularia* (16±0.18). In river, *Lymnaea luteola, Indoplanorbis exustus, Vivipara* spp. *Pila* spp. and *Brotia* spp. were observed. The highest number was found in *Indoplanorbis exustus* (28±0.29) and lowest in *Pila* spp. *(8*±0.07). In marshy lands (beels), *Lymnaea luteola, Lymnaea auricularia*, *Indoplanorbis exustus*, *Vivipara* spp. and *Pila* spp. were found. The highest number was found in case of *Indoplanorbis exustus* (32±0.24) and lowest in case of *Pila* spp. (12±0.09) (Table 4).

Water characteristics

The snails *L. auricularia* was found in the water bodies containing clear transparent, slow flowing water with vegetation. The snail was found more in the river, rice fields under irrigation system, irrigation channels and ponds containing clear water. *L. luteola* was found in the same places with *L. auricularia.* In the river *L. luteola* was found in less number and on the other hand, this snail was found in the water bodies with a little bit turbid water. *Indoplanorbis exustus* were found in the habitat containing clear as well as turbid water with abundant fresh or decaying vegetations. *Indoplanorbis exustus* was found in less number in the river. The *Vivipara* spp. was found in clear, muddy or turbid water usually attached to vegetations in various locations. *Pila* spp. was recovered from clear or turbid stagnant or slow flowing water usually attached to vegetations in various locations. The *Brotia* spp. was found lying in the bottom of river with clear, slow flowing water. All these species were found in the water bodies with the pH of water ranging from 5.7 to 5.9 and temperature of water ranging from 24.8 to 27.3 (^{0}C) with a rainfall ranging from 32.6 to 304.6 mm (Table 1).

Soil characteristics

The *L. auricularia*, *L. luteola*, *Vivipara* spp., *Indoplanorbis exustus* and *Pila* spp. were found more in the clay soil. These snails were also found in loamy clay or sandy clay soil in good number. All these species were found in different types of soil with the pH ranging from 5.9 to 6.6.

Discussion

Vector snails and the parthinate of trematodes inside them is a common problem in Bangladesh (Rahman *et al.,* 1997; Mondal *et al.,* 2003). Results of some studies showed the existence of vector snails and cercariae in Mymensingh district with overall 3.7% infection (Qadir, 1982). In the present study, six different species of snails were detected such as *Lymnaea luteola*, *Lymnaea auricularia*, *Vivipara* spp., *Indoplanorbis exustus, Pila* spp. and *Brotia* spp. Present findings confirm the findings of Mondal *et al.* (2003), Alim (1997), Rahman *et al.* (1997), Islam (2008) who reported the prevalence of snails in Bangladesh. In this study, gymnacephalus cercaria was recovered from *Lymnaea luteola* and echinostome cercaria from *L. auricularia* which confirms the earlier findings of Alim (1997) and Sharif *et al.* (2010).

Table 3. Location-wise *prevalence of different types of cercariae*

Location	Species of snails tested with No.	No. of infected snails	No. of types of cercariae found with percentage				
			Gymnac-ephalus	Echino-stome	Amphi-stome	Furcoce-rcus	Xiphidoc-ercus
Pond	*Pila* spp.(10)						
	Vivipara spp. (49)	2				1±0.00 (2%)	1±0.00 (2%)
	L. luteola (33)						
Canal	*Pila* spp.(5)						
	Vivipara spp. (43)	3				1±0.00 (2.3%)	2±0.033 (4.7%)
	L. luteola (41)						
	I. exustus (50)	2		1±0.00 (2%)	1±0.00 (2%)		
Drain	*Pila* spp.(6)						
	Vivipara spp. (20)						
	L. luteola (33)	2	2±0.029 (6.1%)				
	I. exustus (20)						
Paddy field with irrigation channel	*L. luteola* (39)	5	5±0.087 (12.8%)				
	I. exustus (55)	1				1±0.00 (1.8%)	
	L. auricularia (22)	2	2±0.04 (9.1%)				
River	*L. luteola* (27)	2	2±0.031 (7.4%)				
	I. exustus (48)	5		3±0.074 (6.3%)	1±0.00 (2.1%)	1±0.00 (2.1%)	
	L. auricularia (55)	6	4±0.074 (7.3%)	2±0.05 (3.6%)			
	Pila spp.(13)						
	Vivipara spp. (36)	1				1±0.00 (2.8%)	
	Brotia spp. (35)						
Marshy lands (Beel)	*L. luteola* (32)	3	3±0.11 (9.4%)				
	I. exustus (100)	9		6±0.14 (6%)	1±0.00 (1%)	2±0.051 (1%)	
	L. auricularia (68)	3	3±0.089 (4.4%)				
	Pila spp.(8)						
	Vivipara spp. *(16)*						
Total	**864**	**46**	**5.3±0.079**				
P value & level of significance			**0.494 NS**				

NS means (p>0.05)

Table 4. Population density of different species of snail

Locations	Species of Snails collected	No. of snail collected per man per hour (Mean±SE)	P-value and Level of significance
Pond	*Pila* spp. *Vivipara* spp. *L. luteola*	16 ± 0.23^{c} 20 ± 0.19^{b} 24 ± 0.27^{a}	0.012**
Canal	*Pila spp.* *Vivipara spp.* *L. luteola* *I. exustus*	12 ± 0.14^{d} 16 ± 0.13^{c} 24 ± 0.17^{a} 20 ± 0.16^{b}	0.0001**
Drain	*L. luteola* *Pila* spp.	20 ± 0.11^{a} 8 ± 0.09^{b}	0.001**
Paddy field with irrigation chann	*L. luteola* *I. exustus* *L. auricularia*	24 ± 0.18^{b} 32 ± 0.23^{a} 16 ± 0.18^{c}	0.0001**
River	*L. luteola* *I. exustus* *Vivipara* spp. *Pila* spp. Brotia *spp.*	20 ± 0.25^{b} 28 ± 0.29^{a} 20 ± 0.22^{b} 8 ± 0.07^{d} 12 ± 0.10^{c}	0.0001**
Marshy lands (Beel)	*L. luteola* *I. exustus* *Vivipara* spp. *Pila* spp. *L. auricularia*	16 ± 0.16^{d} 32 ± 0.24^{a} 24 ± 0.19^{b} 12 ± 0.09^{e} 20 ± 0.21^{c}	0.0001**

** means significant at 1% level ($p<0.01$)
In a column figures with dissimilar letter differ significantly (as per LSD)

The prevalence of gymnacephalus cercaria and echinostome cercaria in this study is lower than Islam (2008) and Chawdhury *et al.* (1993) who reported 26.7% infection in India and higher than Alim (1997) who reported 0.8% gymnacephalus cercaria and 1.3% echinostome cercaria, respectively. Findings of furcoercous cercariae from *Indoplanorbis exustus* support the earlier findings of Alam (2010) and Mondal *et al.* (2003). In present study, amphistome cercariae were detected in *Indoplanorbis exustus*. The prevalence of amphistome cercariae in this study is lower than Islam (2008) who reported 10% infection and higher than Alim (1997), who reported 2.7%. Xiphidocercus cercariae were detected in *Vivipara spp*. There is no related record about this finding in *Vivipara* spp. However, there is no mention of *Pila* spp. in the available literature as prevalent in Bangladesh. From other countries of the world this species has not been recorded except mentioned by Malek and Cheng (1974) and Sharatkumar and Mohilal (2006) in India. These above variations in the prevalence of cercariae and snails might be due to differences in the geographic location, sample size, duration of study period etc.

In the present study, monthly fluctuations in the cercarial prevalence were observed due to the variations in the temperature, humidity and rainfall of each month. Prevalence of cercarial infection was higher in May, 2011 and lower in March, 2011. Islam (2008) reported 14.5% infection and Alim (1997), Rahman *et al.* (1997) and Qadir (1982) reported 3.7% infection during March to May. The cercarial shedding is related to temperature, humidity and rainfall; temperature between 25-30 ^{0}C, relative humidity > 65% with a rainfall of more than 100 mm are favorable for development and shedding of cercariae (Alim, 1997; Rahman *et al.,* 1997). These conditions favor the growth and development of vector snails and also hasten the development and shedding of cercariae from snails by rapid development of miracidium to sporocyst, redia and finally cercariae. These developments reduced or ceased at a temperature less than 20^{0}C, relative humidity < 60% with a rainfall less than 30 mm (Alim, 1997).This variation in cercarial prevalence might be due to hot weather, dry period or less rainfall followed by moderate rainfall, inadequate access of faeces to water bodies during study period etc.

In the present study, ponds were found to harbor cercariae of furcocercus and xiphidocercus which are higher than the earlier reports of Alim (1997) who reported 1.9% furcocercus cercaria and lower than Alam (2010) and Islam (2008) who reported 2.5% xiphidocercus cercaria. During this study, paddy fields with irrigation channel harbor cercariae of gymnacephalus and furcocercus which are higher than the earlier findings of Alim (1997) who reported 0.8% gymnacephalus cercaria and 1.9% furcocercus cercaria and lower than Chawdhury (1993) who reported 26.7% gymnacephalus cercaria. In the present study, river was found to harbor cercariae of *g*ymnacephalus, echinostome, amphistome and furcocercus. On the other hand, Alim (1997) reported no gymnacephalus and amphistome cercaria in the river Bharamaputra. In the present study, canals were found to harbor cercariae of furcocercus, xiphidocercus, echinostome and amphistome, drains harbor cercariae of gymnacephalus and marshy lands (beels) found to harbor cercariae of gymnacephalus, echinostome, amphistome and furcocercus. However, there is no data available regarding these three location-wise prevalence of cercariae. However, variations in the above findings might be due to differences in the climatic conditions, ecological factors, sample size, duration of study, access of livestock and duck to water bodies and also for using of raw cow dung as manure etc.

The habitat of the snails in this study is confirmed with the findings of Soulsby (1965), Alim (1997) and Islam (1991). The pH of water and soil where the snails were found and weather conditions prevailing during study period (Table 1) confirm the reports of Soulsby (1965) and Islam (1991). It was assumed that snails those like to live in water with vegetation perhaps provide their oxygen requirements and help to dilute and remove the products of metabolic activities and decay (Alim, 1997).

In conclusions, the present study provides some basic idea about different snail species with different cercarial infections, snail habitat together with their density in Mymensingh Sadar, Mymensingh; thus creating a basis for further investigation. Detail research work focused on the determination of different vector snails and cercariae carried by them throughout Bangladesh especially from plain lands, hilly areas, alluvial lands and coastal areas in the four conventional seasons such as winter, summer (pre-monsoon), rainy (monsoon) and autumn (post-monsoon) is warranted.

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