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MOLLUSCAN DIVERSITY AT MIGRATORY BIRD VISITING AND NON-VISITING LAKES OF JAHANGIRNAGAR UNIVERSITY CAMPUS,SAVAR

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Abstract: This study was conducted to compare mollusc diversity in migratory bird visiting and non-visiting lakes of Jahangirnagar University campus, Savar, Bangladesh from July, 2016 to June, 2017. A total of 13 species belonging to 6 families under 2 classes of Mollusca were encountered. The class Gastropoda dominated the faunal composition (91%) with 11 species under 5 families and the class Bivalvia constituting (9%) with 2 species under single family. Among them *Bellamya bengalensis, Lymnaea accuminata, Indoplnorbis exeutus, Gyraulus convexiusculus, Melanoides tuberculata* and *Lamellidens marginalis* were the most dominating taxa. The highest number of molluscan taxa was from the family Viviparidae (3 spp.) 29% followed by Planorbidae (2 spp.) 27%, Lymnaedae (3 spp.) 23%, Unionidae (2 spp.) 9%, Thiaridae (1 sp.) 8% and lowest from Piladae (2 spp.) 4%. Seasonal variation showed maximum density in the summer and minimum in the monsoon. Correlation ($p > 0.05$) indicate that *B. bengalensis, L. accuminata*, *I. exustus, L. marginalis* had close dependency to soil pH, soil organic Carbon, Soil organic matter and sand particle whereas *M. tuberculata* and *G. convexiusculus* show significant positive correlation with silt and clay particle. Biodiversity indices indicating low species diversity and richness of molluscs in both migratory bird visiting and non-visiting lakes. These findings emphasized the importance of protection and management of molluscs fauna in the lakes for supporting the food for the migratory birds.

Key words: Freshwater Mollusca, biodiversity, migratory birds, wetlands

INTRODUCTION

The Mollusca are one of the most diverse groups of benthos considered as the second largest animal phylum next to Arthropod and include snails, slugs, clams, oysters, etc. They are good bio-filters and purify water as they are saprophytic and consume algae, zooplankton, and diatom and recycle both nutrients and energy by breaking down organic matters and constitute energy pyramid of bottom stratum and serves as nutrition for fish (Dillon *et al.* 2000 and Siddique *et al.* 2007). They provide food for fishes, birds and also for human being and are important component of food chain transferring the energy in the aquatic ecosystem (Bardi 2008).

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Jahangirnagar University campus is called the realm of natural beauty. Thousands of people visit this university every year to observe the winter birds. Among 29 wetlands (including lake, pond, doba) in the campus four lakes usually provide natural aquatic habitats for wintering migratory birds which make an excellent habitat for their temporary shelter. The migratory bird visiting lakes have an importance from ecological point of view (Momtaz *et al.* 2010). Feeroz *et al.* (1988) reported the existence of 76 species of birds including 8 migrants in Jahangirnagar University campus and the list of birds is growing through the course of time due to availability of food, habitat and less human disturbance (Mohsanin and Khan 2009).

Freshwater molluscs have been affected by both extrinsic factors such as habitat destruction, temperature variation , siltation, water pollution, reduction of host plant or organism like fish or substrates, eutrophication and intrinsic factor such as growth and reproduction which are closely related to habitats (Ritcher *et al.* 1997 and Primack 2002). Moreover, domestic and agricultural pollution are the main reason for the reduction of their number and abundance (Siddique *et al*. 2007). There is relationship between the distribution of molluscs and water quality and physicochemical parameter of water such as water temperature, dissolved oxygen (DO), pH and Ca^{+2} influence the distribution and abundance of freshwater molluscs. Vyas *et al.* (2012), Ikpeze and Obikwelu (2016) and EL Deeb *et al.* (2017) found that rainfall, calcium ion, aquatic vegetation and habitat volume strongly influence the dynamics of snail population. Kumar *et al* (2004) and Sharmin *et al.* (2018) found that sediment particle, soil pH, soil organic carbon, soil organic matter influenced mollusc abundance either positively or negatively. Ahmed *et al*. (1978), Jahan (1993), Ahmed (2003), Jahan *et al*. (2003), Siddique *et al*. (2007), Hossain and Baki (2014) and Baki *et al*. (2016) investigated on this subject areas in Bangladesh but no work has done in Jahangirnagar University campus, specially in the winter migratory bird visiting lakes. The present study was carried out in six selected lakes with the aim of determining Mollusca diversity and to determine their relationship with some selected lake parameters at Jahangirnagar University campus Savar, Bangladesh.

MATERIAL AND METHODS

Study area: The experimental work was carried out in six selected lakes of Jahangirnagar University (JU), Savar, Bangladesh (Fig.1). The area stands on the western side of the Asian Highway (popularly known as the Dhaka-Aricha highway) and 32 kilometers north away from Dhaka, the capital of Bangladesh. The description of the study area is given in Table 1.

Study procedure: The study was carried out from July 2016 to June 2017 with two replication from each site between 8:30 a.m. to 12:00 a.m. Collected monthly data were presented under three seasons: monsoon (July-October), winter (November-February) and summer (March-June) relating with the visit of migratory birds.

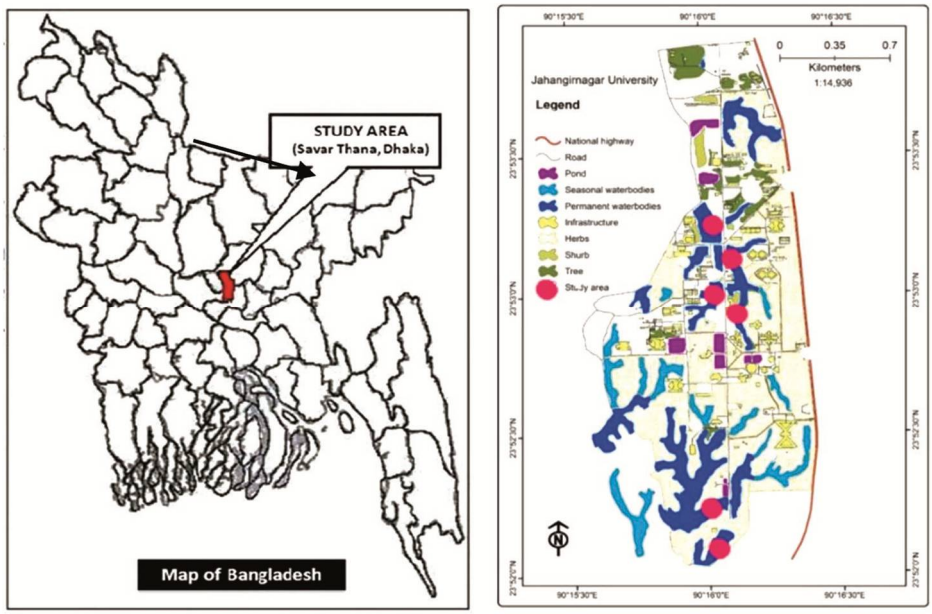

Fig. 1. Map of Jahangirnagar University campus showing the lakes.

Collection and identification of molluscs: Molluscs were collected by using an Ekman Dredge (covering an area of 225 sq. cm) with two replications from each site and the sediments were sieved using a sieve mesh of 0.5 mm. A dip net (30 cm × 40 cm) was also used to collect snail from aquatic vegetation if necessary. The molluscs were then washed in situ and transported to Bergen laboratory of Zoology, University of Dhaka and preserved in 70% ethyl alcohol or in 5% formaldehyde. In laboratory they were identified on the basis of morphological characteristics of shell and taxa recognized by Preston (1915), Subba Rao (1989), Ahmed (2003), Ramkhrishna and Dey (2007), Prabhakar and Roy (2008) and Siddique *et al.* (2007). Species were identified by using of a stereo microscope and photographed by a digital camera and relative sizes of identified snail were depicted in mm. The abundance of molluscs was expressed as density (ind / m^2).

Analysis of sediment sample: Sediments were collected using a Ekman Dredge with two replication from each site between 8:30 am to 12:00 a.m. at a depth of 20- 30 cm. The pH of freshly collected moist soil was determined by

using Griffin pH meter (Model no.40), Soil Organic Carbon (SOC) content was estimated by following Walkley and Black's (1934) wet oxidation method as described by Snyder and Trofymow (1984) and Soil Organic Matter (SOM) was determined by multiplying the percentage of Organic Carbon with conventional van Bemmelen's factor of 1.724 (Piper 1950). Soil textures were determined by Hydrometer method (Bouyoucos 1962).

Table 1. Geographical locations and some features of the six migratory bird visiting and non-visiting lakes of Jahngirnagar University campus, Savar

Lake no and location	Type	Shape, area, and average depth	Geographical location	Water sources
Lake-1 (Eastern side of old arts building)	Permanent and non -migratory bird visiting lake (NV)	Irregular,8 acre, average depth 5-8 feet	Latitude-23°53'12.3" N Longitude 090°16'03.9"E	Rain water, drainage water of old arts building
Lake-2 (Eastern side of transport office)	Permanent, and migratory bird visiting lake (MB)	Irregular,9 acre, average depth 2.5 - 5.5feet	Latitude-23°53'02.3"N Longitude 090°16'05.9"E	Rain water, drainage water of two ladies hostel Pritilota hall, Jahahanara Imam hall and Post office
Lake-3 (Western side of register building)	Permanent and migratory bird visiting (MB)	Irregular,7 acre, average depth 2-5 feet	Latitude-23°53'01.8.2" N Longitude 09° 016'04.9E	Rain water, drainage water of Salam Barkat hall, extension of Al-Beruni and transport office.
Lake-4 (Eastern side of bank)	permanent and non -migratory bird visiting (NV)	Irregular,2 acre, average depth 4-7 feet	Latitude-23°53'06.2" N Longitude 090°16'20.1" E	Rain water, drainage water from old Register building, new arts building and social science building
Lake- 5 (Western side of botanical garden)	permanent and non -migratory bird visiting (NV)	Irregular,3 acre average depth 2-6 feet	Latitude-23°52'09.3", N Longitude 90°15'50.9"E	Rain water, drainage water from Gymnasium
Lake-6 (Southern side of WRC)	Permanent, migratory bird visiting (MB)	Irregular,2 acre, average depth 2-3.5 feet	Latitude-23°52'.05" N Longitude 090°16'15.1" E	Rain water

Evaluation of diversity indices for molluscs: Total individuals, taxa richness, and Diversity indices of molluscs were evaluated by using the following equation:

Shannon-Wiener's diversity index (H') = $-\sum^{s}_{i=1} p_i \ln p_i$

$p_i = n_i / N$, where n_i is the number of individuals in species i

N = The total number of individuals

Pielou's evenness index (J') = H'/H' max

H'= the observed value of Shannon index, H'max= ln(S)

ln= Natural log base n of the number

S=Total number of species

Margalef diversity index (d) = (S -1) / log n (n)

S = Total number of species

N = Total number of individuals

Relationships between dominant species of molluscs and sediment quality: Correlation between dominant species of molluscs and sediment quality were analyzed by using Pearson correlation (Islam 2001) aided by the Microsoft Excel 2010 software. The significance level was set at $p < 0.05$.

RESULTS AND DISCUSSION

Population dynamics of molluscs: A total 5522 individuals of molluscs (5043 Gastropods and 479 Bivalves) were sampled and examined. The gastropods were dominant in all lakes as compared to bivalves. A similar finding was documented by Raina *et al.* (2016) and Vyas *et al.* (2012). Seasonal variation showed molluscs abundance in the summer following in the winter and in the monsoon (Fig. 2) and this summer dominance of Mollusca was reported earlier by Sharma *et al*. (2010). On the basis of the number of molluscs collected in three seasons, the lakes can be ranked as: Lake-2> Lake-3> Lake-6> Lake-5 > Lake-1> Lake-4. The biodiversity indices showed variations among lakes (Fig. 3). The Shannon-Wiener index, Evenness, and Margalef's values ranged from 1.6-2.2; 0.77-0.97; and 0.90-1.39, respectively (Fig. 3) indicating maximum species diversity and richness in lake-2 and lake-3 minimum in lake-4 and lake-1 and species evenness indicates the lower variation in the number of species among the lakes. Such low species diversity and species richness in the studying lakes for molluscs were in close agreement with Sharma *et al.* (2010).

Quantitative analysis of molluscs: A total of 13 species including 11 gastropod and 2 bivalves were recorded belonging to 6 family and 2 class during present study. Kakar *et al*. (2012) observed similar result but Hossain and Baki (2014) and Raina *et al.* (2016) observed more diversity of species in their studies. The Gastropod fauna is represented by 5 family namely Viviparidae (29%), Planorbidae (27%), Lymnaedae (23%), Thiaridae (8%) and Piladae (4%), whereas the bivalves include one family Unionidae (9%). Among Mollusca *Bellamya bengalensis, Lymnaea accuminata, Indoplnorbis exeutus, Gyraulus convexiusculus, Lammellidens marginalis* were recorded most dominating taxa whereas *M. tuberculata, B. crassa, B. discimillis, L. luteola* were common in

occurrence and *Pila globosa, P. virens, L. stagnalis and L. jenkinsianus* were rare species (Table 2, Plate 1). This result is partially in accordance with Raina *et al.* (2016) but Kakar *et al*. (2017) reported *B. bengalensis, G. euphraticus, I. exeutus* and *T. scraba* were threatened species in some region in dry areas like Baluchistan province of Pakistan.

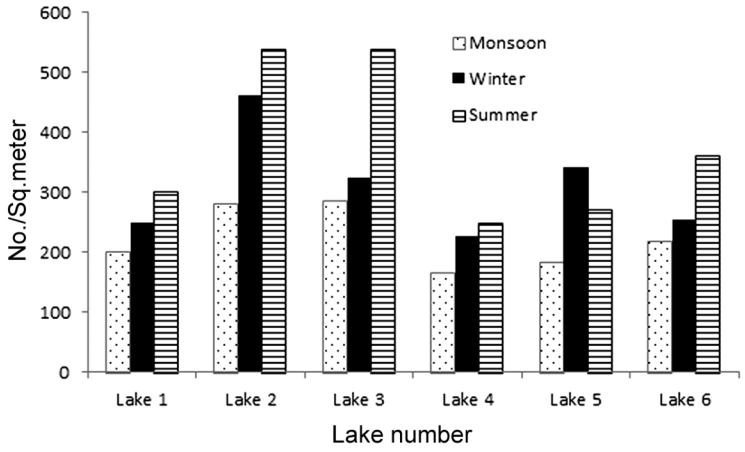

Fig. 2. Seasonal distribution of molluscs in six lakes.

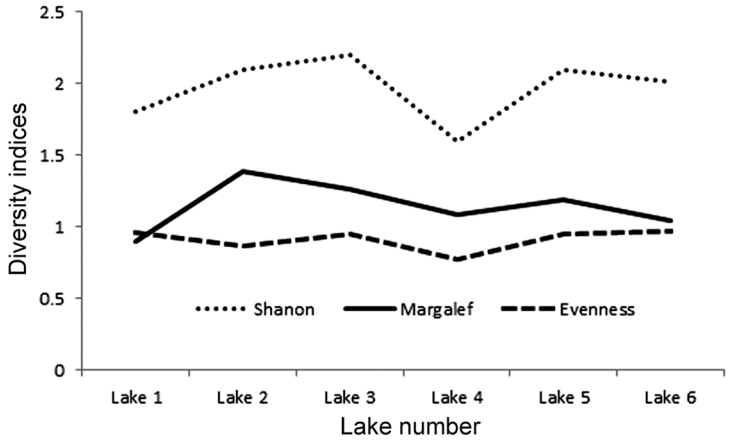

Fig. 3. Diversity indices of molluscs in six lakes.

Sediment quality: Soil parameters seasonally and spatially showed slight difference. Sand, silt and clay ranged from 18.65 - 42.16, 36.15 - 49.25 and 21.59 - 34.8%. Percentage of sand particle was highest in lake-2 and minimum in lake-1, silt was maximum in lake-3 and minimum in lake-2 and clay was maximum in lake-1 whereas minimum lake-2 (Fig. 4). The soil pH was slightly

acidic to neutral and ranged (6.3 - 7.3) minimum in lake-4 and maximum in lake-2 during winter. The high value of soil pH was reported by Alam *et al.* (2014) in September to which present finding showed dissimilarity. Soil organic carbon and soil organic matter ranged (0.94 - 1.88)% and (1.70 - 3.24)% with maximum content of SOC and SOM in lake-3 and minimum in lake-5 (Fig. 5). Spatial distribution of soil properties of present study partially supported the findings of Sharmin *et al*. (2013).

Table 2. Mollusca species and their annual density contribution (%) in six migratory bird visiting and non-visiting lakes of Jahangirnagar University campus, Savar

Family (%)	Species	Lake-1	Lake-2	Lake-3	Lake-4	Lake-5	Lake-6
Viviparidae (29%)	*B.bengalensis*	17.16	19.98	18.16	15.07	12.17	17.43
	B.crassa	0	39.06	33.85	0	27.08	0
	B.discimillis	23.33	23.66	30	0	0	23
Piladae (4%)	*Pila globosa*	0	0	0	48.17	51.82	0
	Pila virens	0	45.71	54.28	0	0	0
Thiaridae (8%)	*M. tuberculata*	28.14	0	0	15.78	27.91	28.14
Lymnaedae (23%)	*L.acc*uminata	9.65	31.90	35.45	0	9.53	13.44
	L. luteola	0	30.13	35.89	18.08	0	15.89
	L. stagnalis	0	37.61	62.38	0	0	0
Planorbidae (27%)	*I .exeustus*	11.59	26.74	18.18	13.17	16.60	13.70
	G.convexiusculus	16.38	25.27	15.83	14.02	15.27	13.19
Unionidae (9%)	*L. marginalis*	31.71642	6.716	35.8209	0	25.74	23.64
	L.jenkinsianus	0	51.94	0	16.88	31.16	0

Interrelationships between abundant species of molluscs and sediment quality: The relationship between bottom sediments and snail abundance showed that *Belamya bengalensis*, *Lymnaea accuminata*, *Indoplanorbis exeustus* showed strong positive correlation soil pH, Soil Organic Carbon (SOC), Soil Organic Matter (SOM) and Sand particle. *Lamellidens marginalis* showed weak but positive correlation with soil pH, SOC, SOM and sand particle whereas negative correlation with the percentage of silt and clay. *Gyraulus convexiusculus* and *Melanoides tuberculata* showed positive correlation with silt and clay and negative correlation with soil pH, SOC, SOM and sand particle (Table 3). Kakar *et al*. (2012), El Deeb *et al.* (2017) documented harmony of mollusc population with water quality but Sharmin *et al.* (2018) reported the influence of soil properties with molluscs to which present finding showed similarity.

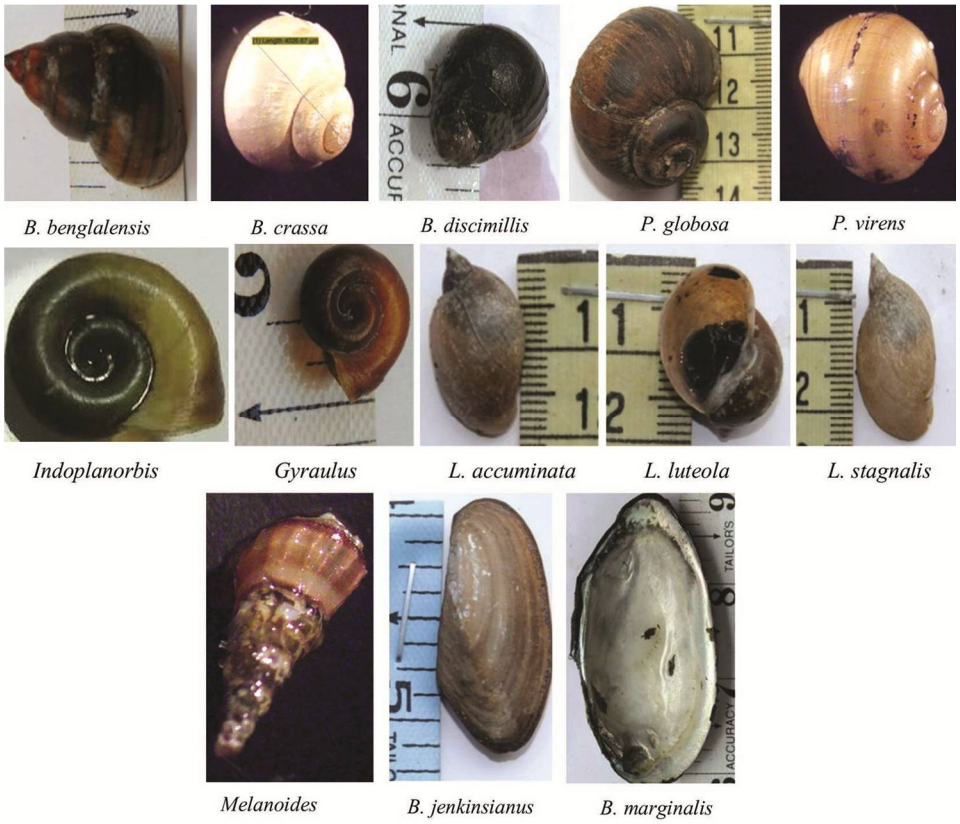

Plate 1. Molluscan species recorded from in six migratory bird visiting and non-visiting lakes of Jahngirnagar University, Savar.

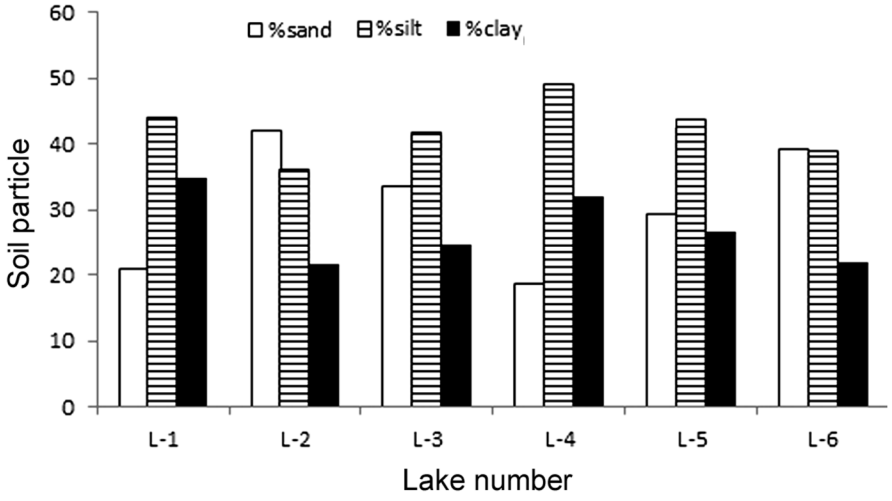

Fig. 4. Percent (%) distribution of soil particles in six lakes.

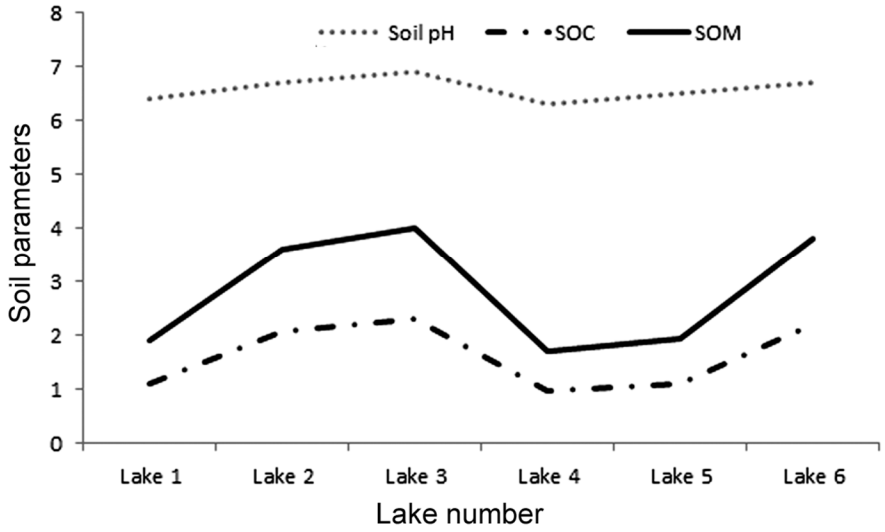

Fig. 5. Distribution of soil pH, Soil organic Carbon and Soil organic matter in six lakes.

Table 3. Relationships between various sediment parameters with the abundance of molluscs species

Mollusca species	Soil pH	SOC	SOM	Sand (%)	Silt (%)	Clay (%)
Bellamya bengalensis	0.40	0.72	0.72	0.47	-0.59	-0.35
Melanoides tuberculata	-0.25	-0.616	-0.616	-0.38	0.32	0.40
Lymnaea accuminata	0.60	0.88	0.88	0.72	-0.72	-0.65
Indoplanorbis exeustus	0.52	0.57	0.57	0.71	-0.69	-0.66
Gyraulus convexiusculus	-0.58	-0.39	-0.39	-0.63	0.57	0. 63
Lamellidens marginalis	0.18	0.25	0.25	0.098	-0.14	0 .044

Table 4. Diversity indices of mollusca from the six lakes

	Lake-1	Lake-2	Lake-3	Lake-4	Lake-5	Lake-6
Total species	7	11	10	8	8	8
Total individuals	752	1283	1249	594	762	834
Shannon (H')	1.8	2.1	2.2	1.6	1.9	2.01
Evenness (E)	0.96	0.87	0.95	0.77	0.95	0.97
Simpson (D)	0.16	0.13	0.12	0.17	0.12	0.14
Margalef (M)	0.90	1.39	1.26	1.09	1.02	1.04

Biodiversity indices: The biodiversity indices showed different values in different lakes (Table 4). The Shannon-Wiener index (H'), Evenness (E), Simpson (D) and Margalef's (M) value ranged from 1.6- 2.2, 0.77- 0.97, 0.12- 0.17 and 0.90-1.39, respectively indicating low species diversity and species richness in both migratory bird visiting and non-visiting lakes and evenness showed

unequal distribution of species in the lakes and such low diversity indices for molluscs are in close agreement with Sharma *et al*. (2010).

CONCLUSION

Among the six lakes, the density and diversity of molluscs were observed and the relationships obtained in this study it is clear that there is a close harmony between distribution of molluscs and sediment quality. The low species diversity and species richness in lake-1, lake-4 and lake-5 were probably due to deeper, weed less water body associated with low organic carbon and low organic matter. Such low molluscs population may be therefore have profound effects on the ecological status of water bodies. So, long-term monitoring of molluscs is required to develop the ongoing abundance, diversity and protection of these lakes for migratory birds. The findings of the present study could be useful for better management and design of conservation of aquatic bird's fauna in the lakes. Besides future research needs to continue to look at the habitat locations of the different species of freshwater mollusca in relation to aquatic vegetation.

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