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Research Article

Diversity and conservation status of malacofauna from the river Teesta, West Bengal, India

Tapan Sarkar

Department of Zoology, Raiganj University, Raiganj, Uttar Dinajpur 733 134, W.B., India

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ABSTRACT

A survey on malacofauna in the river Teesta from March 2014 to February 2016 was done by using caste net of mesh size 0.5 mm. A total of 9 species belonging to 7 families were reported. All thesespecies are under Least Concern (LC) category. One invasive species *Physellaacuta* also reported from the river Teesta. Of the 9 species, 7 are edible molluscs. Diversity indices and PCA were done by PAST software. Number of taxa, dominance index, Shannon diversity index, evenness index and Margalef's richness index were ranged from3-7, 0.123-0.50, 0.868-2.149, 0.5659-0.9531 and 0.8049-2.25respectively. Shannon diversity index and evenness index were maximum during monsoon and minimum during winter season.

Key words: Malacofauna, invasive species, Diversity indices

INTRODUCTION

The Molluscs are cosmopolitan in distribution living in sea water, freshwater and terrestrial environment. Molluscs are ranked second after arthropods in number of species in the Animal Kingdom. Freshwater molluscs are found in ponds, beels, ditches, streams, rivers etc. They play vital role as environmental bioindicators (Oehlmann *et al*.,2003). Fresh water molluscs are an important source of food for birds, fish and mammals including human beings besides having medicinal andornament value (Wood and Wells 1995; Sonowal, 2021). People in certain areas of North Bengal used freshwater molluscs as food (Sarkar *et al*., 2021). Karna and Shrestha (2006) found that *Lamellidens sp, Bellamya bengalensis* and *Pila globosa* are rich in protein sources. The Molluscs are important water purifier because they are scavengers of algae and aquatic plants and help in processing decaying organic matter of the plants (Gosling,2003; Dillon, 2006). Boss (1973) reported eighty thousand to one lakh thirty-five thousands of molluscs species from the world.

But no such study on malacofauna diversity was done in the North Bengal, West Bengal, India. Therefore, a study on the malacofauna of the river Teesta in North Bengal, West Bengal, India was taken up with. The main objectives of the present study were- i) Prepare a check list and conservation status of molluscs species in the river Teesta and ii) Determine the diversity indices of the molluscs in the river Teesta.

MATERIAL AND METHODS

Three sampling sites of the river Teesta were selected for study. Site 1 (latitude-$26^0$44'55.4''N and longitude - $88^0$35'37.0''E) is situated at Gajoldoba, site 2 is situated at Jalpaiguri city (latitude-$26^0$55'69.83''N and longitude - $88^0$76'13.0''E).) and site 3 is at Haldi Bari (latitude-$26^0$23'01.2''N and longitude - $88^0$50'38.0''E) (Figure 1). Duration of study was two years from March 2014 to February 2016.Sampling was done at monthly interval.

The molluscs were collected by cast net with mesh size 0.5 mm and cover an area of 10 m^2. Netting was done ten times during each sampling and cover an area of 100 m^2. The collected molluscs were first washed with water and then preserved in 70% ethanol. The molluscs were also collected by hand from the river. Fresh water molluscs were also collected from local river side fish market. The identification of freshwater molluscs were done by (Subba,1989; Dey,2007; Ramakrishna and Dey, 2007). The number of specimens recorded each month for two years was added, and then the diversity indices were calculated. Biodiversity indices like Shannon diversity index, Margalef's species richness index, dominance index, evenness index and PCA were calculated by PAST 3.0 software (Hammer *et al*., 2001).

RESULT AND DISCUSSION

A total of 911 individuals of malacofauna were reported during the whole study period. A total of 9 species of molluscs belonging to7 families were reported during the study. Among them Gastropoda (7 species) was dominant than Bivalvia (2 species) (Table 1). Freshwater is inhabited by two groups of molluscs namely Gastropoda and Bivalvia and dominance of the former class (Lydeard, 2004) and corroborates the present findings. Budha (2010) reported more than 180 freshwater molluscs from the eastern Himalaya.

*Corresponding Author's E-mail: tapan.ruzoo@gmail.com

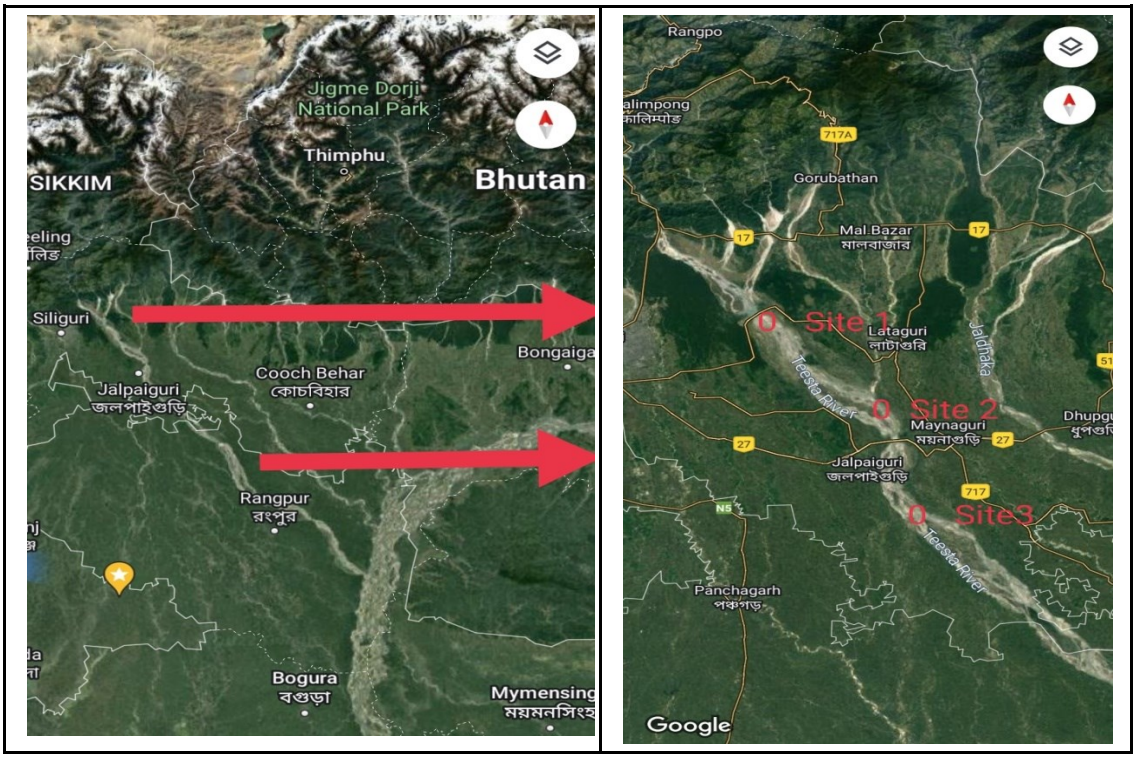

Figure 1. Photograph of sampling sites (Google map, 2022)

Sonowal *et al*. (2001) recorded 45 freshwater molluscs from the upper Brahmaputra Basin, Assam. Mir and Bakhtiyar (2022) reported 12 species of malacofauna from the Aripal stream of Kashmir Himalaya, India.

Roy and Gupta (2010) recorded 16 molluscs from the river Barak and its Tributaries. So, all the authors reported more malacofauna diversity in comparison to the present study. One invasive species namely *Physella acuta* was reported at all sites. Mir and Bakhtiyar (2022) also reported this exotic species *Physella acuta* from the Aripal stream of Kashmir Himalaya, India. *Filopaludina bengalensis* was the most dominant species and *Physella acuta* species was less reported. *Lamellidens marginalis, Lamellidens corrianus, Pila globosa, Filopaludina bengalensis, Idiopoma dissimilis* and *Brotia costula* are the most important edible molluscs (Sarkar *et al*., 2021). Chanda (2017) reported 8 edible molluscs from undivided Paschim Medinipur District of West Bengal. According to IUCN category (2001) all species are under Least Concern category (LC), except *Physella acuta* which is exotic species (Table 1). Köhler *et al*. (2012) advocated that 49.76% of malacofauna in the Indo-Burma region are categorised as Least Concern (LC) species. Presence of exotic species *Physella acuta* is very great concern in respect to biodiversity of the river Teesta.

The number of taxa ranged from 3 to 9 during the survey. The highest and lowest dominance indices were 0.121 and 0.50 respectively. The maximum Shannon diversity index was 2.149 and the lowest was 0.867. The evenness index ranged from 0.5659 to 0.9531. The highest and the lowest Margalef richness indices were 2.25 and 0.805 respectively. The lowest Dominance index was found in monsoon season and the highest in winter season at all sites (Table 2). Mir and Bakhtiyar (2022) found lowest Dominance index in monsoon season and highest in winter season. Maximum Shannon diversity index and Evenness index were recorded in monsoon season at both sites. Lowest Margalef richness index was recorded in monsoon season at both sites. Mir and Bakhtiyar (2022) found maximum Shannon diversity index and Evenness index in monsoon season. In winter season most of the molluscs remain in dormant state. High temperature in monsoon accelerates the decomposition of plant organic matter and thus increases the nutrients content in the river bottom. This provides suitable nutrients for the molluscs (Malhotra *et al*.,1996 and Bath *et al*. 1999).

Number of taxa showed positive and significant correlation with number of individuals ($r=0.481$, $P<0.01$), Shannon diversity index ($r=0.900$, $P<0.01$), evenness index ($r=0.353$, $P<0.05$), and Margalef species richness index ($r=0.471$, $P<0.01$) but inversely correlated with the dominance index ($r=-0.803$, $P<0.01$). Number of individuals showed positive and significant correlation with number of taxa ($r=0.481$, $P<0.01$), Shannon diversity index ($r=0.418$, $P<0.01$) and Margalef species richness index ($r=0.324$, $P<0.05$) but inversely correlated with the dominance index ($r=-0.342$, $P<0.05$). Dominance index showed positive and significant correlation with the number of taxa ($r=-0.803$, $P<0.05$), number of individuals index ($r=-0.342$, $P<0.05$), Shannon diversity index ($r=-0.964$, $P<0.05$), evenness index ($r=-0.7522$, $P<0.05$) and Margalef species richness index ($r=-0.560$, $P<0.05$). Shannon diversity index had positively correlated with the number of taxa ($r=0.900$, $P<0.01$), number of individuals index ($r=0.415$, $P<0.01$) and Margalef species richness index ($r=0.525$, $P<0.01$) but inversely related with the Dominance index ($r=0.965$, $P<0.01$). Margalef species

Table 1. Check list of malacofauna, including class, family, and number of added individuals for the same month of two years for each species, from March 2014 to February 2016 at two sites along the Teesta River.

Class	Family	Species and status		March 2014 to February 2016											
				MARCH	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.
Bivalvia	Unionidae	*Lamellidens marginalis* (Lamarck, 1819) LC	S1	2	3	0	5	8	10	11	8	0	4	2	1
			S2	3	4	0	5	8	12	11	8	2	0	2	1
			S3	5	3	2	0	9	14	16	7	0	5	3	2
		Lamellidens corrianus (Lea, 1834) LC	S1	0	2	2	6	11	15	17	14	3	2	2	0
			S2	2	3	3	7	11	15	17	14	3	2	0	3
			S3	5	6	6	5	14	14	1	11	0	3	6	2
Gastropoda	Planorbidae	*Gyraulus ladacensis* (Nevill, 1878) LC	S1	5	7	4	0	11	15	14	11	2	1	0	5
			S2	5	7	0	0	11	15	14	11	0	0	0	0
			S3	2	3	5	0	4	14	15	13	2	0	2	3
	Ampullariidae	*Pila globosa* (Swainson, 1822) LC	S1	4	7	3	8	15	17	18	14	2	0	2	4
			S2	4	10	3	8	14	17	18	15	2	0	2	4
			S3	5	2	4	7	11	12	14	11	0	2	1	6
	Viviparidae	*Idiopoma dissimilis* (Mueller, 1774) LC	S1	3	0	2	5	9	10	11	9	5	3	0	3
			S2	4	0	2	5	9	10	11	9	5	3	0	3
			S3	2	4	4	5	3	11	12	6	0	2	4	0
		Filopaludina bengalensis (Lamarck, 1882) LC	S1	25	29	15	21	32	40	41	35	14	12	3	12
			S2	22	32	33	37	42	45	47	33	24	22	8	7
			S3	3	4	6	25	44	47	25	26	2	26	7	9
	Pachychilidae	*Brotia costula* (Rafinesque, 1833) LC	S1	12	14	13	15	20	21	25	22	2	1	2	0
			S2	17	20	13	15	20	21	25	22	2	10	2	0
			S3	3	5	6	16	25	22	29	28	8	19	8	9
	Planorbidae	*Gyraulus ladacensis* (Nevil,1878)LC	S1	2	5	0	10	15	16	15	12	0	3	4	5
			S2	2	7	0	10	15	16	15	11	0	3	4	5
			S3	5	8	7	14	16	17	15	8	0	5	2	0
	Physidae	*Physella acuta* (Draparnaud, 1805) EX	S1	2	3	5	7	12	14	12	8	0	0	0	0
			S2	0	0	0	0	9	13	11	8	0	2	5	2
			S3	0	5	4	0	8	6	14	0	0	1	2	0

Table 2. Taxa and diversity indices of malacofauna after adding the number of individuals for the same month of two years for each species, in the river Teesta at two sites from March 2014 to February 2016.

		March 2014 to February 2016												Season		
		MARCH	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	Sum.	Mons.	Winter
Taxa_S	S1	8	8	7	8	9	9	9	9	6	7	6	6	9	9	8
	S2	8	7	5	7	9	9	9	9	6	6	6	7	8	9	8
	S3	8	9	9	6	9	9	9	8	3	8	9	6	9	9	8
Number of indiviuals	S1	55	70	44	77	133	158	164	133	28	26	15	30	246	588	99
	S2	59	83	54	87	139	164	169	131	38	42	23	25	283	603	128
	S3	30	40	44	72	134	157	141	110	12	63	35	31	186	542	141
Dominance_D	S1	0.2747	0.2412	0.2335	0.1628	0.136	0.1375	0.1385	0.1456	0.3087	0.2722	0.1822	0.2444	0.2307	0.1393	0.2988
	S2	0.2433	0.2391	0.439	0.2453	0.158	0.144	0.1481	0.1425	0.4307	0.3458	0.2212	0.1808	0.2703	0.1473	0.2641
	S3	0.14	0.1275	0.1209	0.2269	0.184	0.157	0.136	0.1669	0.5	0.2784	0.1527	0.2237	0.138	0.152	0.217
Shannon_H	S1	1.619	1.708	1.656	1.945	2.101	2.099	2.093	2.066	1.459	1.591	1.749	1.576	1.779	2.09	1.81
	S2	1.681	1.649	1.087	1.666	2.032	2.08	2.063	2.076	1.222	1.347	1.64	1.811	1.633	2.066	1.699
	S3	2.016	2.125	2.149	1.617	1.913	2.031	2.059	1.927	0.8676	1.559	2.012	1.616	2.07	2.04	1.807
Even-ness_e^H/S	S1	0.6312	0.6894	0.7486	0.8745	0.9079	0.9064	0.9014	0.8774	0.717	0.7013	0.9581	0.806	0.658	0.8987	0.764
	S2	0.6716	0.7428	0.5931	0.7558	0.8479	0.8897	0.8743	0.8854	0.5659	0.6412	0.8596	0.874	0.6398	0.8774	0.6833
	S3	0.9386	0.9305	0.9531	0.8397	0.7529	0.8471	0.871	0.8583	0.7937	0.5941	0.8312	0.8385	0.883	0.856	0.675
Margalef	S1	1.747	1.648	1.586	1.611	1.636	1.58	1.569	1.636	1.501	1.842	1.846	1.47	1.51	1.275	1.349
	S2	1.717	1.358	1.003	1.344	1.621	1.569	1.559	1.641	1.375	1.338	1.595	1.864	1.40	1.25	1.438
	S3	2.058	2.169	2.114	1.169	1.633	1.582	1.61	1.489	0.8049	1.69	2.25	1.456	1.52	1.27	1.617

Table 3. Pearson's correlation coefficient matrices between different biodiversity indices of three sampling sites (N=36, d.f.=34)

	Taxa	Number of indv.	Domn.	Shanon.	Evenness	Margalef
Taxa	1					
Number of ind.	0.481*	1				
Domn.	-0.803*	-0.342**	1			
Shanon.	0.900*	0.415*	-0.965*	1		
Evenness	0.353**	0.180	-0.752*	0.703*	1	
Margalef	0.471*	0.324**	-0.560*	0.525*	0.313	1

* Correlation is significant at the 0.01level (2-tailed); **Correlation is significant at the 0.05 level (2-tailed)

richness index showed positive and significant correlation with the number of taxa (r=0.471, P<0.01), number of individuals (r=-0.324, P<0.05) and Shannon diversity index (r=0.525, P<0.01) but inversely related with Dominance index (r=-0.560, P<0.01) (Table 3).

Two principal components (PC1 and PC2) represent the whole variable and other principal components are negligible. PC1 and PC2 expressed 96.839 and 2.1197 percentage of total variance respectively. Eigen value of PC1 and PC2 are 2.37671 and 0.0520239 respectively. PC 1 is highly influenced by the number of taxa (0.97255) and PC 2 by the Margalef species richness index (0.93591) (Table 4). Among the variable the number of taxa and the Margalef species richness index are the most influential and influenced the other diversity indices of the malacofauna (Figure 2). Margalef species richness index, evenness index and Shannon diversity index are negatively related with the dominance index (Figure 2). Evenness index and Shannon diversity index are very closely related with each other (Figure 2).

Table 4. Loading values along with the Eigen value and % of variance.

	PC 1	PC 2
Taxa	0.97255	-0.17413
Dominance	-0.051013	-0.10686
Shanon div.	0.18854	0.2328
Evenness	0.030126	0.16777
Margalef	0.12282	0.93591
Eigenvalue	2.37671	0.0520239
% variance	96.839	2.1197

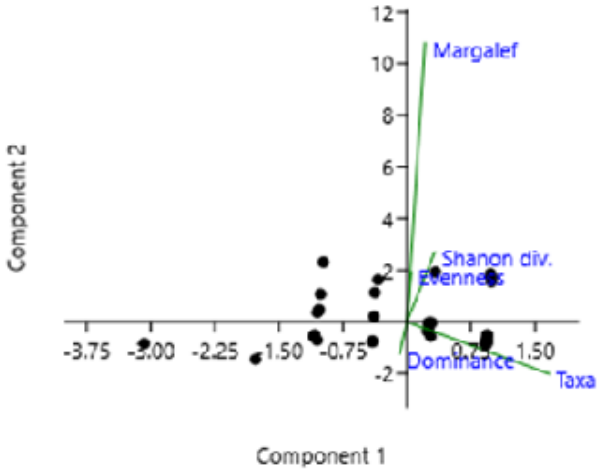

Figure 2. PCA biplots of diversity indices.

CONCLUSION

This study is a pioneer work on the diversity and status of freshwater molluscs in the river Teesta. This river is originated from the Eastern biodiversity hotspot and this area rich in endemic malacofauna. Moderate numbers of molluscs are recorded from the river Teesta. Out of 9 freshwater molluscs, 7 have high food value. One invasive species *Physeela acuta* was reported from the all three sampling sites of the river Teesta.

Pila globosa

Lamellidens corrianus

Lamellidens marginalis

Brotia costula

Idiopoma dissimilis

Filopaludina bengalensis

Physella acuta

Gyraulus ladacensis

Figure 3. Photographs of few malacofauna.

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