Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(2): 2431-2434

Received: 22-01-2018
Accepted: 24-02-2018

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Seasonal variation of heteroptera community of a Gorewada reservoir, Nagpur (Maharashtra)

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Abstract
In the present study an attempt has been made to evaluate the heteropteran insect community structure and seasonal variation in the population and its correlation with physico-chemical parameters in the Gorewada reservoir. During present investigation, a total of 8 species of heteroptera representing 05 families and 7 genera were recorded from the Gorewada reservoir in different seasons. Heteropteran families identified during entire study were Corixidae, Gerridae, Notonectidae, Nepidae and Belostomatidae. Eight species of heteroptera recorded were Corixa (Corixidae); Jerris (Gerridae); Notonecta (Notonectidae); Anisops bouvieri (Notonectidae); Nepa (Nepidae); Ranatra lacustri(Nepidae); Ranatra filiformis (Nepidae); Belostoma indicum(Belostomatidae). The α- diversity indices for heteroptera species that are Simpson index, Dominance index, Berger Parker index of dominance, Shannon-Weiner index, Margalef richness index, Menhink index, Equitability index were also calculated to assess the species richness and dominance of the heteroptera. Pearson correlation coefficient analysis showed that dissolved oxygen of the water was positively correlated with the density of heteroptera taxon in the reservoir. Density of heteroptera was low during winter as compared to the summer and monsoon season. Shannon Weiner diversity index of the resrervoir was in the range of 2.91 to 1.85.

Keywords: Gorewada reservoir, heteroptera, physico-chemical parameters, α- diversity indices

Introduction
There are about 45000 species of insects, known to inhabit diverse freshwater ecosystems [1]. Among them Hemiptera formed the first most abundant group of insect fauna in the water body. Hemiptera has been classified into four orders viz. Auchenorrhyncha, Coleorrhyncha, Heteroptera, and Sternorrhyncha [2]. Heteroptera is divided into 7 infraorders that are Enicocephalomorpha and Dipsocoromorpha (terrestrial in habitat); Gerromorpha (semiaquatic in habitat), Nepomorpha (aquatic in habitat), Leptopodomorpha (intertidal in habitat), Cimicomorpha (terrestrial in habitat) and Pentatomomorpha (terrestrial in habitat) [3, 4]. Andersen [5] had classified infraorder gerromorpha into 8 families that were Gerridae, Veliidae, Hydrometridae, Mesoveliidae, Hebridae, Macroveliidae, Paraphrynoveliidae and Hermatobatidae. Andersen [6], Thirumalai [7, 8], Bal and Basu [9, 10], Chen and Zettel [11], Thirumalai and Krishnan [12] had recorded the species diversity and taxanomic description of hemiptera from India. Hemipteran insects possess respiratory apparatus (siphon, plastron, presence of hemoglobin etc.) [13-15]. Thus these are having the ability to utilize atmospheric oxygen and survive in heavily polluted water bodies. Hemipterans are useful as a bioindicators and used to gauge the toxins in an environment [16, 17]. Seasonal changes in the physico-chemical variables may affect the heteropteran community structure. Thus this study aimed to record the heteropteran species and impact of seasonal variation of physico-chemical characteristics of water on composition of heteropteran community in the Gorewada reservoir.

Materials and Methods
Gorewada lake is one of the fresh water and artificial lake situated in the north –west corner of the Nagpur city. (79^{O}.11' E latitude, 21^{O}.11' N, longitude and 303m (M.S.L) altitude. Samples were collected from Gorewada reservoir from January 2016 and June 2016 on a monthly basis for assessing the physico-chemical parameters. The collection and analysis of various physic-chemical parameters of water samples were carried out by following the standard methods [18]. The physico-chemical parameters considered were: water temperature, pH, transparency, electrical conductivity, dissolved oxygen, total hardness, biological oxygen demand and chemical oxygen demand. Triplicates of each analysis were performed and mean values were used for calculation.

Collection of Heteropteran community was done by using the nylon plankton net. All collected specimens were fixed in 70% formalin soon after collection and were preserved in specimen jars for further study. These specimens were brought to the laboratory and further identification was carried out by using available taxonomic keys for Hemiptera [19, 7, 8, 20, 21].

Statistical Analysis

The correlation coefficient matrix between each pair of parameters was estimated by using statistical package for social sciences (SPSS 10.0).

Results and Discussion

A total of eight species of order heteroptera representing five families and seven subfamilies and seven genera were recorded from the Gorewada reservoir during the entire study period. In the present study eight species of heteroptera recorded were *Corixa* (Corixidae); *Jerris* (Gerridae); *Notonecta* (Notonectidae); *Anisops bouvieri* (Notonectidae); *Nepa* (Nepidae); *Ranatra lacustri* (Nepidae); *Ranatra filiformis* (Nepidae); *Belostoma indicum* (Belostomatidae) is represented in the table 1. In the current study density of heteroptera was maximum in the pre-monsoon and the monsoon season and the minimum density was recorded in the winter.

Table 1: Heteroptera community recorded in Gorewada reservoir, during January 2016 to June, 2016.

Sr. No.	Class	Order	Family	Subfamily	Genus and species
1.	Insecta	Heteroptera	Corixidae	Corixinae	*Corixa*
2.			Gerridae	Gerrinae	*Jerris*
3.			Notonectidae	Anisopinae	*Anisops bouvieri*
4.			Notonectidae	Notonectinae	*Notonecta*
5.			Nepidae	Nepinae	*Nepa*
6.			Nepidae	Ranatrinae	*Ranatra lacustri*
7.			Nepidae	Ranatrinae	*Ranatra filiformis*
8.			Belostomatidae	Belostomatinae	*Belostoma indicum*

The values for biodiversity indices that is Simpson index, Dominance index, Shannon-weiner index, Menhinik index, Equitability index, Berger Parker Dominance index and Margalef Richness index are represented in the Table 2. Shannon-weiner index values are in the range of 2.91 to 1.85. Maximum value was reported in the month of June during monsoon season and minimum value was reported in the month of April during the summer. Margalef richness index fluctuated seasonally in the range of 2.14 to 1.47 indicating the moderate pollution of the lake [22]. Maximum Species richness was observed during the winter season. In the month of January and it does not much fluctuate during February and March. However species richness remarkably falls at the onset of summer, thus minimum species richness was observed in the month of April (Table 2). Species evenness was calculated by using Equitability index which ranged from 0.96 to 0.79 indicating the even distribution of heteropteran species [23]. Berger Parker Dominance index was higher in the summer during the month of April and varied from 0.20 to 0.53. Lower Berger Parker Dominance index supports the even distribution of heteroptera community in the reservoir.

Table 2: Diversity indices of Gorewada Lake during January, 2016 to June, 2016.

Months	Diversity indices						
	Simpson index	Dominance index	Shannon Weiner index	Menhinick index	Equitability index	Berger Parker Dominance index	Margalef Richness index
Jan	0.1138	0.8862	2.803	1.512	0.9611	0.2143	2.101
Feb	0.123	0.877	2.843	1.414	0.9475	0.2188	2.02
Mar	0.1262	0.8738	2.805	1.569	0.935	0.2308	2.148
Apr	0.3048	0.6952	1.857	1.291	0.7996	0.5333	1.477
May	0.1619	0.8381	2.366	1.549	0.9151	0.3333	1.846
June	0.1205	0.8795	2.914	1.206	0.9712	0.2045	1.85

Physico-chemical parameters of water

The physico-chemical parameters of water at Gorewada lake is represented in the Table 3. The observed values for water temperature, pH, Transparency, Electrical conductivity, dissolved oxygen, total hardness, BOD and COD values are in the permissible limit of drinking water [24].

Table 3: Range of variation, Mean ± standard error of the physico-chemical characteristics of water of Gorewada lake during January, 2016 to June, 2016.

Sr. No.	Parameter	Unit	Range of Variation		Mean ± Std. Error
			Min	Max	
1.	pH	--	7.6	8.4	7.72 ± 0.4
2.	Water Temp.	^{0}C	19.4	30.3	23.9 ±1.66
3.	Transparency	Cm.	19.0	30.2	26.6 ± 1.07
4.	Electrical Conductivity	µmho Cm^{-1}	300	614	477 ± 47.4
5.	Dissolved Oxygen	mgL^{-1}	5.0	8.0	6.6 ± 0.52
6.	Total Hardness	mgL^{-1}	110	177	143.83 ±10.4
7.	B.O.D.	mgL^{-1}	2.1	4.0	2.56 ± 0.31
8.	C.O.D.	mgL^{-1}	8.9	12.4	10.08 ± 0.53

Correlation between the density of Heteroptera and Physico-chemical parameters

Correlation matrix of the physico-chemical variables with heteropteran density is shown in Table 4. Dissolved oxygen (DO) showed a significant positive correlation and transparency showed negative correlation with the density of heteroptera. Other physico-chemical variables of water do not show any significant relationship with the density of heteroptera in the reservoir.

Table 4: Correlation matrix of the physico-chemical variables and density of heteropteran community of Gorewada reservoir. (Method = Pearson)

r	Temp	pH	Transparency	Conductivity	DO	Hardness	BOD	COD	Density Org/Sq.Mtr
Temp	1								
pH	0.905	1							
Transparency	-0.498	-0.728	1						
Conductivity	0.626	0.343	0.335	1					
DO	-0.099	0.272	-0.723	-0.733	1				
Hardness	0.963	0.814	-0.306	0.793	-0.283	1			
BOD	0.915	0.753	-0.423	0.655	-0.258	0.937	1		
COD	0.873	0.888	-0.625	0.48	0.087	0.873	0.902	1	
Density Org/Sq.Mtr	0.308	0.651	-0.928	-0.469	0.888	0.115	0.15	0.469	1

*The values (r) ranging from 0.666 and above, 0.798 and above are significant at $P \leq 0.05$ (2-tailed) and $P \leq 0.01$(2-tailed), respectively.

Aquatic insects have limited ability to migrate. These require specific habitat and are vulnerable to loss of physical integrity of aquatic ecosystem. Thus these are used as bioindicator species. Oertli *et al.* [25] had studied the macroinvertebrates and reported the correlation between environmental variables and their impact on aquatic insects. Karina *et al.* [26] had studied the influence of habitat integrity and physical-chemical water variables on the structure of aquatic and semi-aquatic heteroptera and observed that, there is no correlation between the environmental variables and habitat integrity index. Karaouzas and Gritzalis [27] had reported that, aquatic insects can tolerate wide spectrum of changes in environmental conditions. These may survive at such environmental conditions, which is lethal to other invertebrate species. Some members of corixidae can survive at acidic pH less than 3 [17]. Thus our findings of present investigation is in agreement with Karina *et al.* [26] and Karaouzas and Gritzalis [27].

Conclusion

In the present investigation eight species of order heteroptera have been reported. Physico-chemical characteristics of the Gorewada reservoir suggests that, values for all parameters are well within limit as per the guidelines of the WHO [24] for drinking water. Thus water from the reservoir can be utilized for drinking purpose and domestic use. Dissolved oxygen (DO) showed a significant positive correlation and transparency showed negative correlation with the density of heteroptera. There is no significant correlation between other Physic-chemical parameters and density of the heteroptera. This may be due to unique ability of aquatic heteroptera to tolerate to the changes in the environmental conditions [17].

References

1. Balaram P. Insect of tropical streams. Current Science. 2005; 89:914.
2. Integrated Taxonomic Information System (ITIS). Hemiptera Linnaeus, 1758. ITIS Taxonomic Serial No.: 103359, 2006.
3. Polhemus JT, Polhemus DA. Global diversity of true bugs (Heteroptera; Insecta) in freshwater. Freshwater Animal Diversity Assessment. Developments in Hydrobiology. 2008; 198:379-391.
4. Henry TJ. Biodiversity of the Heteroptera. In: Foottit R.G., Adler P.H., eds. Insect biodiversity: Science and society. Oxford: Wiley-Blackwell. 2009, 223-263.
5. Andersen NM. The semi-aquatic bugs (Hemiptera, Gerromorpha). Phylogeny, adaptation, biogeography, and classification. Entomonograph. 1982; 3:1-455.
6. Andersen NM. Semiaquatic bugs: phylogeny and classification of Hebridae (Heteroptera: Gerromorpha) with a revision of TImasius, Neotimasius and Hyrcanus. Systematic Entolnology. 1981; 6:377-412.
7. Thirumalai G. Aquatic and semi aquatic Hemiptera (Insecta) of Javadi Hills, Tamil Nadu. Occasional paper Zoological Survey of India, Culcutta. 1989, 118.
8. Thirumalai G. In: Aquatic and semi-aquatic Heteroptera of India. Indian Association of Aquatic Biologists, Hyderabad, Publication. 1999; 7:1-74.
9. Bal A, Basu RC. Insecta: Hemiptera: Mesoveliidae, Hydrometridae: Veliidae and Gerridae; Belostomatidae; Nepidae: Notonectidae and Pleidae. State Fauna Series 3: Fauna of West Bengal. 1994; 5:511-558.
10. Bal A, Basu RC. Hemiptera - Water Bugs. Fauna of Delhi. Zoo I. Surv. India, State Fauna Series. 1997; 6:261-276.
11. Chen PP, Zettel H. Five new species of the Halobatinae genus Metrocoris Mayr, 1865 (Inecta: Hemiptera: Gerridae) from the Continental Asia. Annl. naturh. Mus. Wien. 1999; 101D:13-32.
12. Thirumalai G, Krishnan S. Diversity of Gerromorpha (Heteroptera: Hemiptera: Insecta) in the Western Ghats States of India. Rec. zool. Surv. India. 2000; 98(4):59-77.
13. Fernando CH, Cheng L. A preliminary study on the fauna and distribution of aquatic Hemiptera in Malaya and Singapore. Federation Museums J 1974; 19:21-46.
14. Lansbury I. A revision of the genus Telmatotrephes Stal (Hemiptera – Heteroptera, Nepidae). Zoologica Scripta. 1972; 1:271-286.
15. Wells RMG, Hudson MJQ, Brittain T. Function of the haemoglobin and the gas bubble in the backswimmer Anisops *assimilis* (Hemiptera, Notonectidae). J Comparative Physiology. 1981; 142:515-522.
16. Papacek M. Small aquatic and ripicolous bugs (Heteroptera: Nepomorpha) as predators and prey: The question of economic importance. European Journal of Entomology. 2001; 98(1):1-12.
17. Wollmann K. Corixidae (Hemiptera, Heteroptera) in acidic mining lakes with pH ≤ 3 in Lusatia, Germany. Hydrobiologia. 2000; 433(3):181-183.
18. APHA. Standard methods for the examination of water and waste water. 21st edition; American public health Association, American water works association, Water

environment federation, Washington DC, USA, 2005.
19. Tonapi GT. Freshwater animals of India. Oxford and IBH Publishing company Poona. 1980; xx+313.
20. Morse CJ. Yang Lianfang and Tian Lixin (ed.) Aquatic Insects of China Useful For Monitoring Water Quality. Hohai University Press, Nanjiing People's Republic of China. 1994, 569.
21. Subramanian KA, Sivaramakrishnan K G. Aquatic Insects for Biomonitoring Freshwater Ecosystems A Methodology Manual, 2007, 1-30
22. Lenat DR, Smock LA, Penrose DL. Use of benthic macroinvertebrates as Indicators of Environmental Quality. In: Douglass L.W. (ed.), Biological Monitoring for Environmental Effects, Lexington books, Toronto. 1980; 97-114.
23. Turkmen G, Kazanci N. Applications of various biodiversity indices to benthic macroinvertebrate assemblages in streams of a national park in Turkey. Rev. Hydrobiol. 2010; 3:111-125.
24. World Health Organization. Guidelines for Drinking-water Quality. 3rd ed. Geneva. 2004, 1.
25. Oertli B, Indermuehle N, Angelibert S, Hinden H, Stoll A. Macroinvertebrate assemblages in 25 high alpine ponds of the Swiss National Park (Cirque of Macun) and relation to environmental variables. Hydrobiologia. 2008; 597:29-41.
26. Karina DS, Cabette HSR, Juen L, Jr Paulo DM. The influence of habitat integrity and physical-chemical water variables on the structure of aquatic and semi-aquatic Heteroptera. Zoologia (Curitiba). 2010; 27(6):918-930.
27. Karaouzas I, Gritzalis KC. Local and regional factors determining aquatic and semi-aquatic bug (Heteroptera) assemblages in rivers and streams of Greece. Hydrobiologia. 2006; 573:199-212.