Journal of Positive School Psychology
2022, Vol.6, No.4, 3935 – 3940

http://journalppw.com

Seasonal variation of macroinvertebrate density and impact of anthropogenic activities in an Ephemeral stream, Baghjan in the Lakhimpur district of Assam

Rimjim Dutta[1], Debojit Baruah[2]

[1]Department of Zoology, Pandit Deendayal Upadhyaya Adarsha Mahavidyalaya, Dalgaon, Darrang, Assam (India)
[2]Pandit Deendayal Upadhyaya Adarsha Mahavidyalaya, Behali, Biswanath, Assam (India)

Email: rimmousumi89@gmail.com

Abstract

This study is based on assessment of different factors affecting distribution of certain macro invertebrate species as well as health of one forested ephemeral stream, Baghjan situated in the Lakhimpur district of Assam. A total of 23 macro invertebrate species belonging to 13 families, 5 orders of class Insecta of phylum Arthropoda have been recorded from the stream with monthly fluctuation. Post monsoon showed comparatively more numbers of macro invertebrates than monsoon. Effects of different physicochemical parameters are also considered. Estimation of different physico-chemical parameters such as dissolved oxygen, free carbondioxide,total acidity,total alkalinity,chloride,pH,conductivity was done.Correlation was performed among macroinvertebrate density and physicochemical parameters. Dissolved oxygen, total alkalinity,pH were found to be positively correlated with macro invertebrate density, but free carbondioxide,total acidity,conductivity,stream depth and stream width were found to be negatively correlated with macro invertebrate density. Different anthropogenic activities are considered to have significant effect on the macro invertebrate assemblage. The main anthropogenic disturbances in the studied stream such as sand and gravel mining, illegal felling of trees, live stock grazing, construction of rail road, open defecation, laundry activities, disposal of domestic waste materials etc. in the studied stream were recorded.

Keywords: density, ephemeral, macro invertebrate, monsoon, post monsoon, anthropogenic activities

1. INTRODUCTION

An ephemeral stream is typically defined as “a stream or portion of a stream which flows briefly in direct response to precipitation in the immediate vicinity and whose channel is at all times above the ground water reservoir.” (Levick et al., 2008). These streams are very sensitive to anthropogenic disturbance as they have a disproportionately large interface with terrestrial ecosystems. Out of different important components of the aquatic food chain macro invertebrates play special role in understanding as well as assessing health of different aquatic ecosystem. Macro invertebrates are food of different aquatic and terrestrial animals. So they can act as indicator species of stream health and proper functioning of an ecosystem. Many of the invertebrates play a vital role in transforming this coarse particulate organic matter by scraping, gouging and shredding it, making it available to other invertebrates and facilitating microbial colonization and decomposition(Pearson and Connolly,2000).Sensitivities of macro invertebrates to the health of surrounding environments make this group as indicator for assessment of health.The main objective of this particular study is to study

the seasonal variation of macro invertebrate density and also to identify different anthropogenic factors that can affect distribution of macro invertebrates and overall health of the stream.

2. MATERIALS AND METHODS

The study area, Baghjan is situated in the Lakhimpur district of Assam within $27^0 26' 701'' N$ and $94^0 12' 869'' E$. Baghjan is an ephemeral stream and therefore it is dependent on monsoon rain. The study was carried out for consecutive three years (June 2011-May 2014) on monthly (June, July, August, September, October and November) basis.

Macro invertebrate sampling were done in Baghjan using a 600 micron mesh "D" net. Contents were then deposited periodically in some plastic containers and preserved in plastic jars containing 10% formalin. The identification of macro invertebrates were done up to genus level by use of keys of Needham and Needham, 1966; Edmonson, 1992.

By using the following formula densities of abundant species were calculated for the sampling streams:

D = n/ A, where, D = Density, n= total number of macro invertebrates sampled, A= area of sampling unit

By using GPS (GarminGPSMAP76), location of the study area was measured. By using a Mercury thermometer water temperature was measured.By using portable pH meter (Cyber scan pH 300 series) pH was measured. By using Digital conductivity meter (CD600, Milwaukee) conductivity was measured, current velocity was measured by Digital flow meter (Swoffer 3000 Flow Meter, GeoScientific Ltd.). By using Winkler's modified method (Trivedy and Goel, 1986) dissolved Oxygen was measured, free carbon dioxide, total acidity, total alkalinity and chloride were measured titrimetrically following the method of (APHA,1995) and (Trivedy and Goel, 1986).

3. RESULT AND DISCUSSION

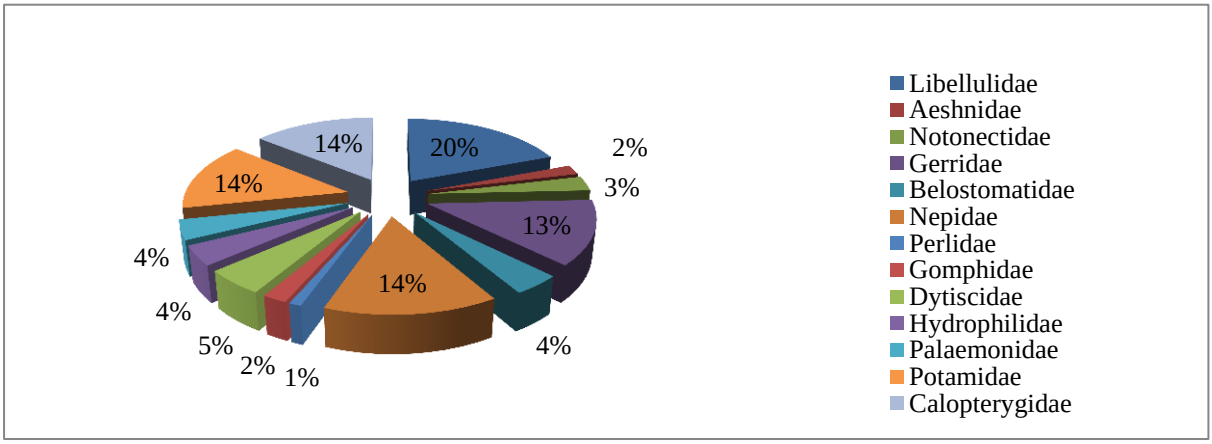
A total of 23 species of macro invertebrate (Libellula sp., Pantala sp., Plathemis sp., Tramea sp., Aeshna sp., Dromogomphus sp., Calopteryx sp., Trepobates sp., Limnogonus sp., Potamobates sp., Gerris sp., Belostoma sp., Nepa sp., Ranatra sp., Notonecta sp., Buenoa sp., Coptotomus sp., Hydaticus sp., Cybister sp., Hydrophilus sp., Palaemonetes sp., Potamon sp., Neoperla sp.,belonging to 13 families (Libellulidae, Aeshnide, Gomphidae, Calopterygidae, Perlidae, Belostomatidae, Gerridae, Notonectidae, Dytiscidae, Hydrophilidae, Nepidae, Palaemonidae, Potamidae) ; 5 orders (Odonata, Hemiptera, Coleoptera, Decapoda, Plecoptera) of class Insecta of phylum Arthropoda have been collected from the three streams (**Table1**)

Table 1: Inventory of macro invertebrates in Bagh Jan

Phylum	**Class**	**Order**	**Family**	**Genus**
Arthropoda	Insecta	Odonata	Libellulidae	Libellula sp.
				Pantala sp.
				Plathemis sp.
				Tramea sp.
			Aeshnidae	Aeshna sp.
			Gomphidae	Dromogomphus sp.
			Calopterygidae	Calopteryx sp.
				Trepobates sp.

		Hemiptera	Gerridae	Limnogonus sp.
				Potamobates sp.
				Gerris sp.
			Belostomatidae	Belostoma sp.
			Nepidae	Nepa sp.
				Ranatra sp.
			Notonectidae	Notonecta sp.
				Buenoa sp.
		Coleoptera	Dytiscidae	Coptotomus sp.
				Hydaticus sp.
				Cybister sp.
			Hydrophilidae	Hydrophilus sp.
		Decapoda	Palaemonidae	Palaemonetes sp.
			Potamidae	Potamon sp.
		Plecoptera	Perlidae	Neoperla sp.

Fig 1: Percent composition of macroinvertebrate families of Baghjan



Percent composition of different macroinvertebrate families is shown in **Fig 1.** Libellulidae of order Odonata was recorded as dominant family (21%) and Perlidae of order Plecoptera was recorded as least available family (1%).

Table 2: Monthly mean variation of macroinvertebrate density (no./m^2) in Baghjan

Fam	**Months**					
	Jun	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**
Lib	2.75±1.25	2.25±0.95	2.75±1.25	4.25±1.5	4.5±1.29	4.25±1.5
Aes	0.25±0.5	---	0.25±0.5	1.5±0.57	1.5±0.57	---
Gom	---	---	0.25±0.5	1.5±0.57	2.25±0.95	2.25±0.95
Cal	---	2.25±0.95	---	2.75±1.25	4.25±1.5	---
Per	---	---	---	0.25±0.5	0.25±0.5	---
Bel	0.25±0.5	---	0.25±0.5	1.5±0.57	2.25±0.95	2.5±0.57
Ger	---	0.25±0.5	---	1.5±0.57	2.25±0.95	2.5±0.57

Not	---	0.25±0.5	---	---	1.5± 0.57	---
Dyt	---	---	2.25±0.95	---	4.75±0.95	3.75±0.95
Hyd	---	---	1.5±0.57	2.25±0.95	4.25±1.5	3.5±1.0
Nep	2.25±0.95	1.0±1.15	---	---	2.75±1.25	2.25±0.95
Pal	4.5±1.29	3.25±1.5	4.25±1.5	3.75±0.95	4.75±0.5	3.5±0.57
Pot	4.5±1.29	3.75±0.5	5.5±0.57	4.75±0.5	6.5±1.29	5.75±1.7
Tot	12.67±5.15	10.37±4.95	15.68±6.15	20.25±5.61	34.45±8.14	25.62±4.75

Key: Fam=Family, **Lib=**Libellulidae, **Aes=**Aeshnidae, **Gom=**Gomphidae**, Cal=**Calopterygidae**, Ger=**Gerridae, **Bel=**Belostomatidae, **Nep=**Nepidae, **Not=** Notonectidae, **Dyt=** Dytiscidae**, Hyd=**Hydrophilidae, **Pal=** Palaemonidae**, , Pot=** Potamidae, **Per=**Perlidae, **Tot=**Total,

The monthly mean variations of macroinvertebrate density (no./m^2) are given in **Table 2.** In Baghjan, maximum density was recorded in October (34.45±8.14 no./m^2) and minimum in July (10.37±4.95 no./m^2).Monsoon showed lower macro invertebrate density than post monsoon in the studied stream. High rainfall with gradual increase of solids that suspended in stream bed is considered to be one of the main reasons behind it. Consequence of such heavy rainfall leads to habitat destruction which finally results in decrease of total number of macro invertebrates. Comparatively in post monsoon current velocity slows down and substrate heterogeneity increases that facilitate formation of diverse microhabitat suitable for survival of macro invertebrates. There observed a negative correlation between macro invertebrate density with precipitation ($p<0.01$) and water discharge ($p<0.01$) in the stream. Similar findings have also been observed by many workers (Duffield and Nelson, 1993). Hynes (1970) had discussed in general the changes in faunal composition with longitudinal distance in lotic ecosystems and also mentioned oxygen, temperature and nature of substratum as possible contributor to this change.The low benthic macroinvertebrate density in the monsoon season due to the effect of heavy rainfall was also previously observed by Saravanakumar et al., (2007).

Table 3: Monthly variation of physicochemical parameters in Baghjan

Parameter	months					
	Jun	Jul	Aug	Sep	Oct	Nov
Temp(^{0}C)	26.08±0.08	26.79±0.21	26.37±0.20	25.72±0.55	25.88±0.38	25.63±0.52
pH	5.88±0.03	5.80±0.10	5.71±0.01	6.22±0.04	6.36±0.10	6.46±0.02
Current velocity(m/sec)	0.39±0.02	0.54±0.07	0.63±0.02	0.37±0.02	0.48±0.08	0.57±0.05
Conductivity(µS/cm)	618.19±1.04	618.19±1.33	620.68±2.63	593.21±4.72	597.06±4.39	586.99±2.55
D.O.(mg/l)	3.07±0.16	3.01±0.26	3.16±0.31	5.28±0.24	4.83±0.53	4.36±0.09

FCO_2.(mg/l)	13.64±0.61	16.15±2.61	18.79±1.11	13.14±0.52	13.94±0.67	14.51±0.39
Total Acidity(mg/l)	19.54±0.59	20.96±0.79	19.32±0.18	18.21±0.31	19.43±1.49	20.09±1.13
Total Alkalinity(mg/l)	21.16±0.88	67.17±1.07	68.57±2.31	73.29±0.96	77.31±3.99	82.78±3.01
Chloride(mg/l)	18.55±0.31	19.44±0.77	19.52±0.61	23.41±0.33	22.56±1.19	21.62±0.69
Stream depth(m)	0.38±0.05	0.37±0.04	0.39±0.03	0.29±0.01	0.29±0.01	0.26±0.01
Stream width(m)	10.54±0.41	9.81±1.16	8.16±0.77	7.31±0.32	7.55±0.41	7.86±0.36

Water temperature also has a marked effect on macro invertebrate density and abundance. There observed negative correlation ($p<0.05$) between macro-invertebrate density and water temperature in Baghjan. Higher density of macro invertebrate in post monsoon is due to high level of dissolved oxygen as compared to monsoon. Dissolved oxygen was found to be positively correlated with macro invertebrate density ($p<0.01$).Also macro invertebrate density was found to be positively correlated with pH ($p<0.01$), total alkalinity ($p<0.01$), chloride ($p<0.05$) but negatively correlated with free carbon dioxide ($p>0.05$), total acidity ($p>0.05$), conductivity ($p<0.01$), stream depth ($p<0.05$) and stream width ($p<0.05$).

Anthropogenic activities have some significant impacts on health of ephemeral streams. Sand and gravel mining has been identified as one of the major anthropogenic activities that posing threats to survival of existing biota of the studied stream. Sand and gravel extraction can cause the increase load of sediment on ephemeral stream bed and ultimately leads to loss of density and abundance of existing benthic organisms, Spawning and nursery action of fish also become disturbed due to destruction of suitable refugia.Also this type of extraction activities lead to disruption of maintained balance between sedimentation and transportation. Spawning as well as survival of fish species is so considered because there is an interrelation among macro invertebrate and fish species in an ecosystem.

Illegal felling of trees is considered to be another factor. A huge number of trees were observed to fell down in the three studied stream. Such destruction may leads to increasing area of impervious surface. An impervious surface area ultimately results decrease of infiltration and stream morphology also become altered. As a result bank becomes less stable along with increasing rate of sedimentation and disruption of habitat of the aquatic organisms.

Livestock grazing is considered to be another anthropogenic disturbance. Cattle eat the vegetation that grows in the stream banks, water quality also deteriorate through mixing of waste. Reduced bank stability ultimately leads to increased erosion and sedimentation.

The railroad above all these ephemeral streams result in alteration and disruption these aquatic habitats. Construction of Rail road activities along a railway alignment is adversely affect wildlife habitats depending on the characteristics of existing vegetation, topographic features, and waterways.

Besides the above mentioned activities, disposal of domestic waste materials from local residential areas, laundry activities

and open defecation in the stream banks ultimately contributing higher organic content that is responsible for pollution in the studied stream and cause disturbance on distribution of macro invertebrate species.

4. CONCLUSION

Although tropical ephemeral streams are often poorly understood but they are critical to the ecological health of the watershed and are placed at an interface between water and land through maintaining a unique flow regime. Monthly and seasonal fluctuation was observed in density of macro invertebrates in Baghjan. The value of density of macro invertebrates revealed less stable condition of the studied stream. Also the present study fairly revealed the inter relationship between macro invertebrate distribution and anthropogenic activities in the studied stream.

5. REFERENCES

1. APHA, 1995: Standard methods for the examination of water and wastewater, 19th edition. American Public Health Association, Washington, DC.
2. Duffield, R. M. and Nelson, C. H. 1993: Seasonal changes in the stonefly (Plecoptera), component of the diet profile of trout in Big Hunting Creek, Maryland, USA. Aquatic Insects, 15: 141 – 148
3. Edmondson, W.T. 1992: Freshwater Biology. 2nd Edition, International books and periodicals supply service, New Delhi, 1248p.
4. Levick, L., Fonseca, J., Goodrich, D., Hernandez, M., Semmens, D., Stromberg, J., Leidy, R., Scianni, M., Guertin, D. P., Tluczek, M. and Kepner, W. 2008: The ecological and hydrological significance of ephemeral and intermittent streams in the arid and semi-arid American Southwest. U.S. Environmental Protection Agency and USDA/ARS Southwest Watershed Research Center, EPA/600/R-08/134, ARS/233046, 116p.
5. Hynes, H. B. N. 1970: The ecology of running waters. University of Toronto Press, Toronto, Canada, 555p.
6. Needham, J. G. and Needham, P. R. 1966: A guide to study of freshwater biology. 5th edition, Holden day Inc., San Francisco, California, USA, 180p.
7. Pearson, R. G. and Connolly, N. M. 2000: Nutrient enhancement, food quality and community dynamics in a tropical rainforest stream. Freshwater Biology, 43 (1): 31-42.
8. Saravanakumar, A., Sesh Serebiah, J., Thivakaran, G. A. and Rajkumar, M. 2007: Benthic macrofaunal assemblage in the arid zone mangroves of gulf of Kachchh, Gujrat. Journal of Ocean University of China, 6: 303-309.
9. Trivedy, R. K. and Goel, P. K. 1986: Chemical and biological methods for water pollution studies. Environmental Publications, Karad, India, 248p.