Science Arena Publications
Specialty Journal of Biological Sciences
ISSN: 2412-7396
Available online at www.sciarena.com
2020, Vol, 6 (1): 25-30

Macroinvertebrate using as bioindicators in Kurangani Falls

Sivaruban Thambiratnam[1], Harmitha[1], Isack Rajasekaran[1]*, Bernath Rosi[1], Srinivasan Pandiarajan[1], Barathy Sivaruban[2]

[1]PG and research Department of Zoology, The American College (Autonomous), Madurai- 625 002. South India.

[2]Department of Zoology, Fatima College, Madurai-625018, South India.

***Corresponding Author**

Abstract: *In the present study analysed the distribution of macro invertebrates communities and they are useful as bioindicators by assessing the water quality parameters in freshwater stream of kurangani in Theni district. A total number of 1234 aquatic insects belonging to 15 genera and 17 families from 10 orders were collected from August 2017 to March 2018. Three different sites were selected for the insect collection among three sites, site one and site two were less polluted. The physico- chemical water quality parameters were analysed the results falls within the acceptable range. The diversity indices like Margalef indices, Shannon and Simpson were found to be a maximum significant compare to other indices.*

Keywords: *Diversity, Macro invertebrate, Margalef index, Shannon index, Simpson index.*

INTRODUCTION

Biodiversity is an extremely important part of life on Earth. It thus creates and maintains ecological systems. The current public emphasis on biodiversity is fairly new, and it is interesting to consider how the concept developed. During the past half-century or so there has been a growing awareness of the importance of natural ecosystems and a desire to conserve rather than simply exploit our environment. (Silvert, 2002) Technology has also increased the quantity of environmental degradation. Human interaction with the environment has increased very fast. It is now felt that we have entered an era characterized by global change that arises from the interdependence between human development and their environment. The building of dams changes the character of rivers, making them less suitable for some species. (Thirmurthy, 2004)

Macro invertebrates live in many different places in a water body. Each type of habitat provides a surface or spaces on or within which macro invertebrates can live. The use of aquatic insects for assessing water quality provides information to environmental managers and decision makers to take accurate and justifiable actions in regards to the quality and state of the water quality. (Ikomi et al., 2005) The influence of heavy metal pollution from an abandoned mine on benthic macro invertebrates, at population and community levels showed, mayfly diversity and abundance was relatively sensitive to heavy metal pollution. (Iwasaki et al., 2009) This project is focused on how fresh water resources are polluted due to the anthropogenic effects, which can be monitored by macro invertebrates that thrive in the water body. Present study to investigate the

hydrology, biodiversity and trophic relationships of macroinverebrates at Kurangani Falls, southern Western Ghats.

Materials and Methods

Study area

The selected area for study is Kurangani falls. It is a small hamlet at the base of the eastern side of Munnar hills on the Western Ghats in Tamil Nadu. The region covers an area of 1.6 lakhs sq kilometers supporting a population of 442 lakhs people. (Census of India, 1991) Kurangani is an amazing hill spot which is situated in theni district (11° N and 77° 5 E) at an altitude of 650 above meter sea level. Kurangani situated on the under rain shadow region the average rainfall is 1300mm which is surrounded by dry deciduous forest cover. This tiny village has a historical past, being the main entrance to Munnar for the British where they built a ropeway and power station. This village is 16 km away from famous spice trade town – Bodinaykannur and is accessible by road. Samples were collected from Upstream Middle stream and Downstream. The sites are chosen based on their different aquatic habitats.

Measuring water quality parameters and habitat parameters

The physico- chemical parameters of stream water, habitat parameter, water flow, air temperature and water temperature were analysed for every month in the three sites by using the guidelines of APHA (2005).

Macroinvertebrates collection

Aquatic insects were collected by using 1cm wide Kick- net with mesh size of about 1mm. The insets collected from the target habitats stored in 70% ethyl alcohol and labeled separately in the field for each sampling session.

Laboratory, sorting, identification and enumeration

The specimens were sorted, observed and identified up to the best possible taxonomical level using with the help of field guide by Sivaramakrishnan *et al.,* (1998).

Data analysis

The biodiversity indices like Margalef's index, Shannon- Weiner diversity and Simpson were calculated using the software PAST (Hammer et al., 2005) to measure the various diversity indices.

Results and Discussion

The present study discuss about the macroinvertebrates and analysing the water quality parameters of the Kurangani hill stream water which is located in the Bodi mettu of Theni district, Western Ghats. Three sites were selected along the stream.

Physio-Chemical parameters

The physiochemical parameters of the sampling points are presented in table 1 from Kurangani falls, Bodinayakanur, Theni District. The air temperature of the upstream and middle stream was moderate and it does not affect the stream water temperature hence the macro invertebrate population and diversity were rich.

Few physiochemical parameters like pH, alkalinity, Biological oxygen demand and dissolved oxygen were compared to predict the pollution level. The highest pH level was observed on the site three however that exceeds slightly above the neutral pH. In few collections the pH measured up to 8. This may be due to the usage of detergents. During dry months there is not much water flow hence the pollutants remains stagnant in the stream this may be a reason for the high pH level in the samples. (Yllana Deza G. Saavedra, 2012) The biological oxygen demand ranges from 1 to 3 in both the sites and also the site three was also having reasonable BOD levels. This indicates that pollution level in these streams is building up slowly some years later this stream will be heavily polluted. The highest dissolved oxygen value was observed in the downstream area, while the least value was observed on the upstream area. The three sampling sites have DO level above maximum which indicated that the stream was capable of supplying enough oxygen to sustain

macro invertebrates. As increasing amounts of acid are added to a water body, the pH of the water decreases, and the buffering capacity of the water is consumed. (Sheila, 2013)

Canonical Correspondence Analysis (CCA)

The value of the physiochemical parameters given in the Canonic Correspondence Analysis (Figure 1) relationship between macroinvertebrates and physiochemical parameters in sampling period (2017- 2018). According to CCA, there are also tolerant taxa of *Baetidae (Baetis conservatus), (Baetis frequentus), Heptageniidae (Afronurus Kumbakkaraiensis), Leptophlebiidae (Choroterpsr trifurcate), Perllidae (Neoperla sp), chironomidae (Chiromomus sp)* positively correlated with high values of dissolved oxygen, calcium, water flow, water temperature, magnesium, BOD, and negatively correlated with the Total dissolved oxgen and pH. Table 2 which represents the CCA value and it includes total number of individual 1,234 species from six collections belonging to 10 orders and 17 families and 15 genus and species.Ephemeroptera (50%) was the most dominant order with the highest number of individuals in three sites. In the Downstream, less number of individual species were recorded and it exhibits that the water quality is affected. It was followed by Trichoptera (40%), Plecoptera (5%), Diptera (2.5%), and Hemiptera (2.5%) in Kurangani stream.

Solids are found in streams and lakes in two forms, suspended and dissolved. Suspended solids include silt, stirred up bottom sediment, decaying plant matter, or sewage treatment effluent. (Chapman, 1992) Nitrate pollution will cause eutrophication of a stream where algae and aquatic plant growth will consume the oxygen and increase the total suspended solid of the water. Water naturally contains less than 1 milligram of nitrate-nitrogen per liter and is not a major source of exposure. Higher levels indicate that the water has been contaminated. (Scott, 2012) Fluoride exists naturally in water sources and is derived from fluorine, the thirteenth most common element in the Earth's crust. Many places in the Theni district has recorded high fluoride levels in the drinking as well as bore well water. (Ramesh and Bhuvana Jagadeeswari, 2012) On average, magnesium hardness represents about 1/3 of total hardness and calcium hardness about 2/3. The result showed high levels of total dissolved solids this may be due to turbid sampling. All the other values showed that the stream is not highly polluted.

Ephemeroptera, Plecoptera and Trichoptera (EPT) were significantly abundant in streams, especially at the upstreams Members of EPT are considered to be sensitive to environmental stress, thus their presence in high abundance at the upstream signified a relatively clean environment. Therefore, EPT were found to be a potential bioindicatios for a clean ecosystem. Spatial and temporal variability of environmental factors may determine the organization of communities of aquatic insects. (Armitage et al., 1983) The stream invertebrates demonstrate preferential feeding, which depends on food resources available. Filter feeders are also sensitive in low-gradient streams. The highest percent filterer was observed on downstream site. Scrapers mostly consume the periphytons attached to the rocks on the substrate of riverbeds. Highest percent scraper was found in the downstream area, since it had the area with the most algae found attached to the rocks on the riverbed. Highest percent of shredders are found on the upstream area since both sides of the river are surrounded with trees and the leaves fall directly on the stream. The highest percent of predators were also found on the upstream area since it is assumed that more foods were available for them in order to survive. Midstream area had the highest percent of gatherers since a wide range of food can be found in the area. Highest percent scraper was found in the downstream area, since it had the area with the most algae found attached to the rocks on the riverbed.

The margalef index is having a very good discriminating ability. However it is sensitive to sample size. It is a measure of the number of species present for a given number of individuals. Simpson index shows that the values may exceed more than 1 unlike in the other indices where the values will be varying from 0 to 1. This way comparing the species richness between different samples collected from various habitats is simple. This simple intrinsic index expresses the proportional importance of the most abundant species. It indicates that the water quality of streams was excellent based on the BMWP value.

Conclusion

Monitoring the water quality of the stream can be carried by using macroinvertebrate as biological indicators, along with the measurement of the physical parameters. The human activities along the stream had influenced the physicochemical characteristics of the stream water. Macroinvertebrates need optimum characteristics of water in order to survive. When there are changes in the physicochemical parameters of the stream water, the abundance and richness of the macroinvertebrate community was affected as well. The study site selected for this research project is Kurangani Falls, Southern Western Ghats. Among the three study sites, site three is more polluted. There is no much variation between the site one and site two. Physio-chemical parameters like Ph, alkalinity, calcium, chloride, magnesium were analysed, the results falls within the acceptable range. Biodiversity indices were also used to predict speciess evenness, species diversity, species dominance and species abundance.

Acknowledgements

It is our privilege to acknowledge our college Principal and Secretary Dr. M. Davamani Christober for giving permission to do such project in the esteemed institution. We honor to thanks PG and UG department of Zoology Heads for their continued support in doing this project.

References

1. APHA (American Public Health Association), (2005). Standard methods for the examination of water and waste water. 21 st Edition, *Washington D.C*.
2. Armitage, P. D., Moss, D., Wright, J. F., & Furse, M. T. (1983). The performance of a new biological water quality score system based on macroinvertebrates over a wide range of unpolluted running-water sites. *Water research, 17*(3), 333-347.
3. Census of India. (1991). final population totals, paper 1, voume 1, the controller of Indian census publications, New Delhi, 8-13.
4. Chapman, D. (1992). Water quality assessment. A guide to use of biota, sediments and water in environmental monitoring. Chapman and Hall Publishing, Cambridge.
5. Hammer O., Harper, D.A.T. and Ryan, P.D, PAST (Paleontological Statistics software package for education and data analysis). (Version 3.20), Palaeontologia Electronica, 2005, 4(1), 9.
6. Ikomi, R. B., Arimoro, F. O., & Odihirin, O. K. (2005). Composition, distribution and abundance of macroinvertebrates of the upper reaches of River Ethiope, Delta State, Nigeria. *The Zoologist*, *3*, 68-81.
7. Iwasaki, Y., Kagaya T., Miyamoto K and Matsuda H. (2009). Heavy metal pollution and macroinvertebrates, Graduate School of Environment and Information Sciences, Yokohama National University, 79-7, Tokiwadai, Hodogaya-ku, Yokohama, Japan, 240-8501.
8. Ramesh, K. and Bhuvana Jagadeeswari, P. (2012). Hydrochemical Characteristics of Groundwater for Domestic and Irrigation Purposes in Periyakulam Taluk of Theni District, Tamil Nadu. *I Research Journal of Environment Sciences*. *1*(1), 19-27.
9. Scott R. (2012). Connecticut water pollution abatement association, the Atlantic States Rural Water & Wastewater Association, 234-240.
10. Sheila M. (2013). USGS water quality monitoring, *BASIN Water Quality Terminology*, 1-11.
11. Silvert W. (2002). The Meaning of Biodiversity, Novosibirsk Institute of Cytology and Genetics SB RAS, 363-366.
12. Sivaramakrishnan, K. G., Madhyasta, N. A., & Subramanian, K. A. (1998). Field guide to aquatic macroinvertebrates. *Project Lifescape. Developed for Western Ghats Biodiversity Monitoring Network. Centre for Ecological Sciences, Indian Institute of Science, Bangalore.*
13. Thirmurthy, A.M. (2004). Macroinverebrates as a bioindicator of stream health, 50(8), 7-11.
14. Yllana Deza G. Saavedra (2012) Water quality assessment using benthic macroinvertebrates in Malingin stream, *Campo Siete*, Minglanilla, 3-33.

Table 1. Mean value of physiochemical parameters of Kurangani stream from August 2018 to March 2019

Parameters	SiteI	SiteII	SiteIII
Water temperature (°C)	19.25	20.75	22
Air temperature (°C)	27.16	29.16	31.05
Water flow (S/M)	4	6	8
Water pH	7	7.5	8.5
Dissolved oxugen (mg/l)	8.1	6.8	5.0
BOD (mg/l)	2.6	3.08	4.36
Alkalinity (mg/l)	19.34	22.86	29.02
Calcium (mg/l)	2.45	3.48	4.36
Magnesium (mg/l)	1.92	2.73	4.49
Chloride (mg/l)	2.35	3.27	15.40`
Total dissolved solid	256	372	431

Table-2: Taxonomical investigation of Macroinvertebrates from Kurangani falls

Order	**Family**	**Genus And Species**
Ephemeroptera	Baetidae	Baetis conservatus
		Baetis frequentus
		Liebebiella vera
	Heptageniidae	Afronurus kumbakkaraiensis
		Eperous petersi
		Thalerosphyrus flowersi
	Leptophlebiidae	Choroterpsr trifurcate
		Choroterpes alagarensis
		Edmundsula lotica
	Teloganodidae	Teloganodes dentate
		Teloganodes kodai
	Ephemerellidae	Ephemera nadinae
	Caenidae	Caenis sp
Plecoptera	Perillidae	Neoperla sp
Trichoptera	Rhyacophilidae	Rhyacophila sp
	Philopotamidae	Wormaldia sp
	Stenopsychidae	Stenopsyche kodaikanalensis
	Polycentropodidae	Polycentropus sp
	Hydropsychidae	Hydropsyche sp
		Chematopshcye
	lepidostomatidae	Goerodes sp
	leptoceridae	Setodes sp
Diptera	Chironomidae	Chiromomus sp

Hemiptera	Naucordiae	Naucoris sp
	Gerridae	Gerris sp
	Belostomatidae	

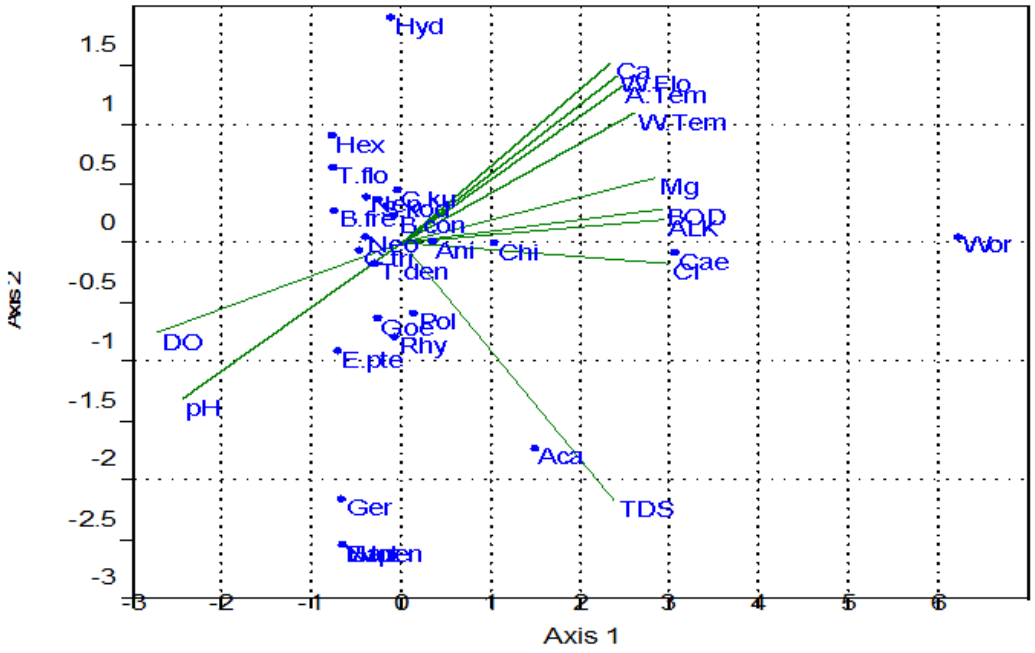

Figure 1: Canonic Correspondence Analysis (CCA) from the three sites in Kurangani

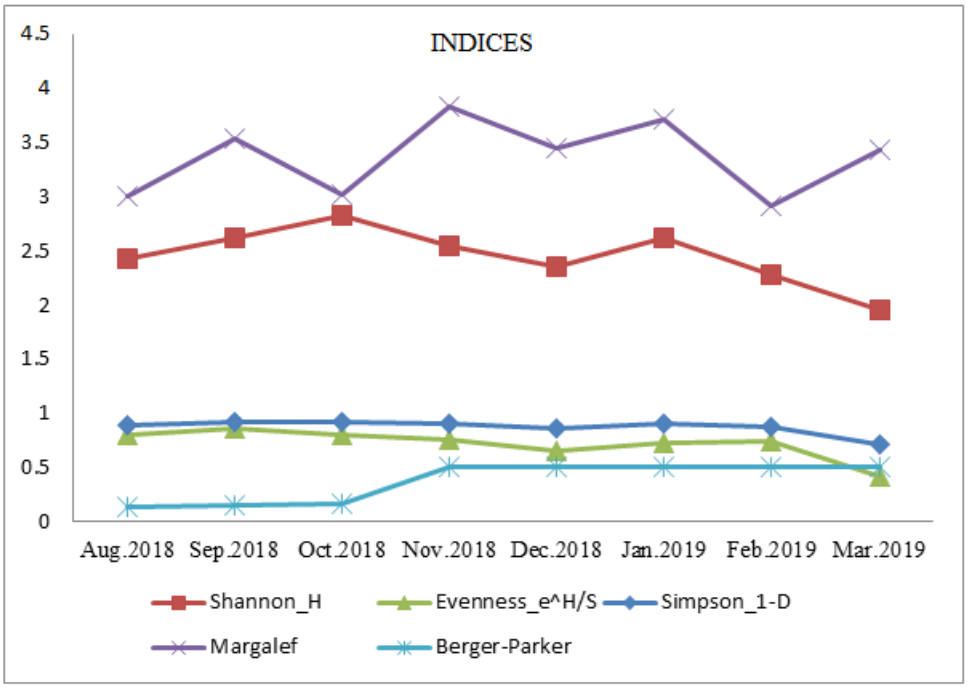

Figure 2: The Statistical indices for the datas collected from Kurangani Falls from August 2018 to March 2019