



**STUDY OF MACROINVERTEBRATE AS A BIOLOGICAL INDICATOR OF
POLLUTION IN RIVER WAINGANGA AT MARKANDADEO VILLAGE, TAH-
CHAMORSHI, DISTRICT-GADCHIROLI (M.S.) INDIA.**

S. G. Gedekar and R.V.Tijare ,

Department of Zoology, Institute of Science, Nagpur
Corresponding author Email : rvtijare@rediffmail.com

Abstract:

Macroinvertebrate communities were biomonitoring any aquatic ecosystem since long term. Macroinvertebrate assemblages in Wainganga River were assessed in July 2010 to June 2012 as indicators of water quality. The diversity of macroinvertebrates were studied qualitatively by taking random samples from three sampling sites of Wainganga river at Markandadeo village, Tah - Chamorshi, Dist.- Gadchiroli. During the investigation period, total 24 species were recorded from three invertebrate phyla viz. Annelida, Arthropoda and Mollusca. Phylum Arthropoda was represented dominantly in the study including 12 species among the total population of macroinvertebrates. Phylum Mollusca represented 9 species which is followed by phylum Annelida including 3 species. The presence of indicator species like Chironomid larvae, Limnodrilus sp. and Lymnaea sp. in abundance indicates the pollution status of the ecosystem. Significant relationship between the monthly analysed physico-chemical parameters i.e. water temperature, pH, transparency, CO₂, DO, EC, total hardness, total alkalinity, TDS, TS, nitrates, sulphates and phosphates and the occurrence of specific genera calculated. Significant changes in macroinvertebrate assemblages were primarily found due to changes in water quality.

Keywords:

Macroinvertebrate, Wainganga river, Markandadeo

Introduction:

Benthic macroinvertebrates act as bioindicators of water quality and their population can assist the assessment of the overall health of the ecosystem. Macroinvertebrates forms the basis of the trophic level of any aquatic ecosystem and any negative effects caused by pollution in the community structure can in turn affect the trophic relationship. The abundance of benthic fauna greatly depends on the physical and chemical properties of the





substratum. Macroenthic invertebrates are ubiquitous and diverse group of long lived species that react strongly and often predictably to human influences in aquatic ecosystem (Sharma and Chaudhary, 2011). Lot of work is done on macroinvertebrates of lotic ecosystems in India by several workers such as Khan (1982), Shukla, et al.,(1989), Krishnamoorthy and Sarkar (1979), and Fricova, et al.,(2007). In Gadchiroli district, Bhandarkar et. al. (2013) have studied the benthic macroinvertebrate diversity in three freshwater lotic ecosystems. Yet, no studies have been done on the macroinvertebrate fauna of Wainganga River at Markandadeo village, Tah-Chamorshi, Dist. Gadchiroli. Several workers monitored the water pollution using benthic macroinvertebrates as a bioindicators. As the Markandadeo village is situated on the bank of Wainganga River, the river receives different pollutants. Hence, the present study was undertaken to find out the pollution status of river Wainganga at Markandadeo intriguing macroinvertebrates inhabiting there for making an effective contribution to holistic studies in the riverine management.

* Corresponding Author The present study was carried out from July 2010 to June 2012 and covered the river Wainganga at Markandadeo village; district Gadchiroli, MS. (India). This river is one of the major tributary of Godavari river system and situated at latitude 19° 59' 55" North and 79° 51'59" East. The Markandadeo village is historical and tourist place in the district, famous for the Hemandpanthi temples. These temples are constructed on the bank of the river Wainganga. The river is also very liable to floods which occur at the time of the periodical rains of monsoon season. Three sampling sites were selected namely site S1, S2 & S3 for the present study. Site S1 and site S3 were surrounded by agricultural fields and the site S2 had temples on its bank. People from all over Maharashtra visit the temples and take holy bath adding further anthropogenic wastes to river. All the sites are disturbed with anthropogenic activities like cloth washing, idol immersion and animal washing activities, etc. The water of river is the sole source of drinking water for the





inhabitants of Markandadeo village. Besides, river water is also used for irrigation, recreation, sewage disposal, farming and fishing also.

Material and Method:

Macroinvertebrates were collected by Ekman-dredge of scooping capacity 15.2x 15.2 sq. cm. of the river substrate and screened through metallic sieve no.40 of mesh size 0.545 mm. The collected bottom sediment brought to laboratory as early as possible. The residue was transferred to white enamel tray partially filled with water and little sugar solution was added to it. Due to increase in water density, the benthic organisms floated on surface and were picked up with the help of dropper and forceps and preserved in 70% alcohol. Then, they were classified species wise and identified up to species using standard keys from Edmondson,(1959); Tonapi,(1980); Subba Rao, (1989); Pennak,(1989) and Naidu,(2005). Water temperature was recorded by mercury bulb thermometer, transparency by secchi disc, dissolved oxygen, free CO₂, pH, total alkalinity, total hardness, calcium hardness, magnesium hardness, T.D.S., total solids, chlorides, conductivity, nitrates, phosphates, sulphates analysed according to guidelines of APHA (1985).

Result and Discussion:

Many aquatic invertebrates have specific and narrow habitat requirement and are therefore restricted to places that vary little from year to year. In the present lotic ecosystem, total 24 species of the macroinvertebrate fauna were recorded from three sampling sites (S1, S2, & S3) belonging to 3 major invertebrate phyla viz., annelida, arthropoda and mollusca, from 5 classes, 10 orders and 20 families (Table 1). Phylum arthropoda showed the dominant contribution of 50.00% among the total macroinvertebrate fauna observed in the river, consisting 12 species from 5 orders belongs to two classes. Class crustacea represented 4.17% of the total macroinvertebrate fauna from order decapoda with one family Palaeminidae (Table 1 and Fig. 1b). Class insecta





represented the major component of the macroinvertebrate fauna contributing 45.83% of the total macroinvertebrate. It is dominated by order Hemiptera (20.83%) including 4 families, namely, Nepidae, Corixidae, Notonectidae and Gerridae. Secondly, order Diptera was contributed to 12.50% of the total population of macroinvertebrate fauna with 2 families, namely Culicidae, Mucidae and Chironomidae as its representatives. Order Coleoptera represented 4.17% of the total macroinvertebrate fauna including family Hydrophilidae. The contributions of order Odonata was 8.33% of the total macroinvertebrates in the river and were represented by nymphs of family Libellulidae and Gomphidae. In the present study, Mollusca being the second dominant phylum shown the contribution of 37.50% to the total macroinvertebrates including 8 species from class Gastropoda (33.33%) and 1 species from Bivalvia (4.17%) (Fig, 1b). Gastropods showed dominance over bivalves. Gastropoda consists 3 orders, Mesogastropod (16.67%), Basmatophora (12.50%) and Caenogastropoda (4.17%). Mesogastropoda belonged to 3 families, namely, Viviparidae, Thiaridae, Ampullaridae. Basmatophora included 2 families, namely, Lymnaeidae and Planorbidae. Caenogastropoda were from family Pachychilidae. Individuals from class Bivalvia were recorded with order Unionoidea belonging to family Unionidae. Gastropods were recorded from various parts of macrophytes and bivalves were from root tufts. Phylum Annelida represented 12.50% contribution to the total population of macroinvertebrate fauna, consisting 3 species from class Oligochaeta with order Haplotoxida including 2 families, Tubificidae (8.33%) and Naididae (4.17%). The average values of physico-chemical parameters ranged from $23.38 \pm 0.960\text{C}$ to $32.13 \pm 3.050\text{C}$ for water temperature, 4.72 ± 0.33 mg/ltr to 8.75 ± 0.31 mg/ltr for dissolved oxygen, 8.08 ± 0.06 to 8.47 ± 0.06 for pH, 1.31 ± 0.09 mg/ltr to 4.31 ± 0.55 mg/ltr for free carbon dioxide, 31.25 ± 3.91 c.m. to 57.75 ± 4.62 cm for transparency, 562.50 ± 38.16 mg/ltr to 767.50 ± 39.45 mg/ltr for total solids, 359.75 ± 80.72 mg/ltr to 539.25 ± 40.72 mg/ltr for total dissolved solids, 0.30 ± 0.02 mg/ltr to 0.57 ± 0.09 mg/ltr





for conductivity, 40.39 ± 5.33 mg/ltr to 74.34 ± 4.43 mg/ltr for total hardness, 23.10 ± 1.19 mg/ltr to 40.47 ± 4.28 mg/ltr for calcium hardness, 17.29 ± 7.23 mg/ltr to 38.00 ± 2.47 mg/ltr for magnesium hardness, 23.27 ± 3.03 mg/ltr to 39.04 ± 2.56 mg/ltr for chloride, 91.50 ± 8.26 mg/ltr to 120.00 ± 15.48 mg/ltr for total alkalinity, 0.46 ± 0.08 mg/ltr to 0.93 ± 0.13 mg/ltr for nitrates, 22.79 ± 0.61 mg/ltr to 24.94 ± 0.95 mg/ltr for sulphates and 0.67 ± 0.05 mg/ltr to 0.85 ± 0.06 mg/ltr for phosphates. The values of minima, maxima, mean and standard deviation of the physico-chemical parameters recorded during the study is depicted in table 2 and fig 3.

Discussion:

Among phylum Annelida, class Oligochaetes represented the 3 genera, *Pristina*, *Limnodrilus* and *Tubifex* from all sites. The same genera were found by Bhandarkar and Bhandarkar (2013) in Wainganga river, near Wadsa city, Gadchiroli. Abundance of Li

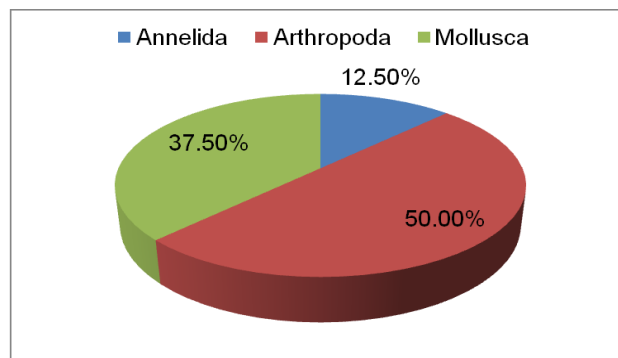


Fig. 1a: .Percent contribution of different macroinvertebrate phyla



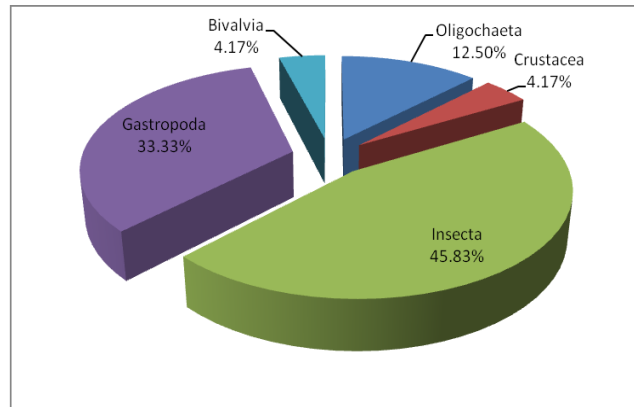


Fig.1b: Percent contribution of different classes among different invertebrate phyla

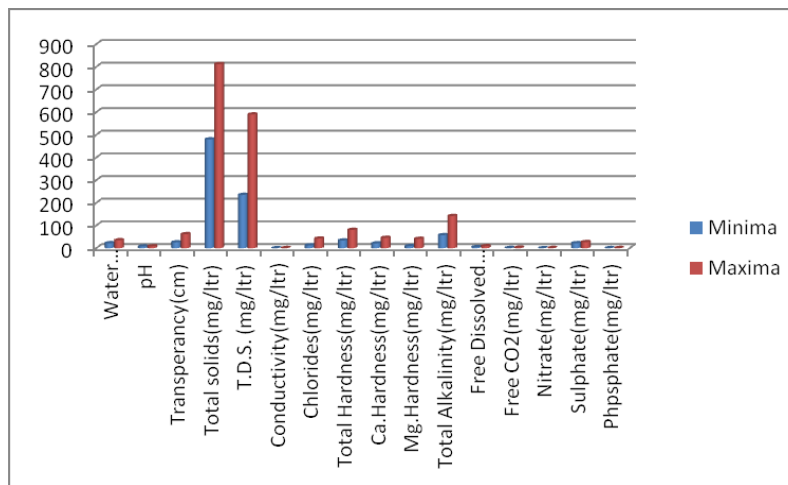


Fig.3. Minimum and maximum range of some chemical and physical parameters recorded from Wainganga river.





Table 1: Macroinvertebrate fauna in Wainganga river at Markandadeo village, Dist.- Gadchiroli

Phylum	Class	Order	Family	Genus and Species
Annelida	Oligochaeta	Haplotoxida	Tubificidae	<i>Tubifex tubifex</i>
				<i>Limnodrilus sp.</i>
			Naididae	<i>Pristina sp.</i>
Arthropoda	Crustacea	Decapoda	Palaemonidae	<i>Macrobrachium sp.</i>
		Insecta	Coleoptera	Hydrophilidae
	Hemiptera		Nepidae	<i>Laccotrephes maculates,</i> <i>Ranatra elongata</i>
			Corixidae	<i>Corixa sp.</i>
			Notonectidae	<i>Notonecta sp.</i>
			Gerridae	<i>Gerris sp.</i>
	Diptera		Culicidae	<i>Culex larvae</i>
		Mucidae	<i>Limnophora sp.</i>	
		Chironomidae	<i>Chironomous sp.</i>	
	Odonata	Libellulidae	<i>Dragonfly nymph (Libellula sp.)</i>	
		Gomphidae	<i>Dragonfly nymph (Gomphus sp.)</i>	
Mollusca	Gastropoda	Mesogastropoda	Viviparidae	<i>Bellamyia dissimilis,</i> <i>Bellamyia bengalensis</i>
			Thiaridae	<i>Melanoides sp.</i>
			Ampullariidae	<i>Pila globosa</i>
		Caenogastropoda	Pachychilidae	<i>Faunus ater</i>
		Basmatophora	Lymnaeidae	<i>Lymnaea sp.</i>
			Planorbidae	<i>Indoplanorbis exustus,</i> <i>Anisus convexisculus</i>
	Bivalvia	Unionoida	Unionidae	<i>Lamellidens sp.</i>

Table 2: Minima , maxima, range of mean and Standard deviation of the Physico-chemical parameters recorded from Wainganga River, Markandadeo, Gadchiroli.

S.N.	Parameters	Minima	Maxima	Mean \pm SD
1.	Water Temperature($^{\circ}$ C)	22.00	35.00	23.38 \pm 0.96 – 32.13 \pm 3.05
2.	pH	7.99	8.57	8.08 \pm 0.06 – 8.47 \pm 0.06
3.	Transperancy(cm)	26.00	62.00	31.25 \pm 3.91 - 57.75 \pm 4.62
4.	Total solids(mg/ltr)	480	812	562.50 \pm 38.16 – 767.50 \pm 39.45
5.	T.D.S. (mg/ltr)	235	590	359.75 \pm 80.72 – 539.25 \pm 40.72
6.	Conductivity(mg/ltr)	0.271	0.678	0.30 \pm 0.02 – 0.57 \pm 0.09
7.	Chlorides(mg/ltr)	12.44	42.58	23.27 \pm 3.03 - 39.04 \pm 2.56
8.	Total Hardness(mg/ltr)	34.05	80.69	40.39 \pm 5.33 – 74.34 \pm 4.43
9.	Ca.Hardness(mg/ltr)	21.29	45.91	23.10 \pm 1.19 - 40.47 \pm 4.28
10.	Mg.Hardness(mg/ltr)	9.56	41.60	17.29 \pm 7.23 - 38.00 \pm 2.47
11.	Total Alkalinity(mg/ltr)	57.50	142.00	91.50 \pm 8.26 – 120.00 \pm 15.48
12.	Free Dissolved O ₂ (mg/ltr)	4.52	9.02	4.72 \pm 0.33 – 8.75 \pm 0.31
13.	Free CO ₂ (mg/ltr)	1.18	2.86	1.31 \pm 0.09 - 4.31 \pm 0.55
14.	Nitrate(mg/ltr)	0.326	1.121	0.46 \pm 0.08 - 0.93 \pm 0.13
15.	Sulphate(mg/ltr)	22.09	26.97	22.79 \pm 0.61 - 24.94 \pm 0.95
16.	Phosphate(mg/ltr)	0.628	0.922	0.67 \pm 0.05 - 0.85 \pm 0.06





Conclusion

The present study reveals that the presence of pollution indicator species such as *Tubifex tubifex*, *Chironomus* sp., *Limnodrilus* sp., *Culex* larva and *Lymnaea* sp. (Takeda; 1999, Clemente et. al. (2005), Gasim, et al. (2006) and Sharma and Chaudhary, (2011) directly points the shifting of river from non-polluted to polluted status. Insects were well dominant at whole study area because of their potency to tolerate the organic pollution. The survey of macroinvertebrate fauna gives an important sight into the health of the river and helps as a tool in river restoration studies. The increased human population and hence the anthropogenic activities for diverse purposes threatens the life supporting aquatic ecosystem and will contribute towards the process of river biodegradation. So, planned development is the solution available with the developing countries to avoid depletion of the natural environment.

Acknowledgement:

The authors are thankful to, The Director, Institute of Science, Nagpur, research guide and The Head, Dept of Zoology, Institute of Science, Nagpur (MS), India for providing laboratory and library facilities during the present work and the supporters for sparing their valuable time for the identification of collected specimens.

Reference

- APHA, 1998. Standard Methods for Examination of Water and Waste Water. 20th Edn., American Public Health Association, Washington, DC.
- Adoni, A.D., (1985): Workbook on Limnology, Pratibha Publishers, C-10 Gour Nagar, Sagar, India.





- Arce,R.G. and C.E.Boyd (1975): Effect of agricultural limestone on water chemistry,phytoplankton productivity and fish production in soft water ponds. *Trans.Amer.Fish.Soc.*(104) : 308-312.
- Bhandarkar ,S. V. and Bhandarkar ,W. R.(2013): A study on species diversity of benthic macro invertebrates in freshwater lotic ecosystems in Gadchiroli district Maharashtra. *Int. J. of Life Sciences*. Vol. 1(1):22-31.
- Chavhan, R.N. and Lonkar, A.N.(2012) : Study and analysis of benthic macroinvertebrate of Ramsagar lake, Armori,District- Gadchiroli(M.S.) India. *Bionano Frontier*. vol.5(2 -I):155-158.
- Clemente J.M., Mazzeo, N., Gorga, J., Maerhoff, M. (2005): Succession and collapse of macrozoobenthos in a subtropical hypertrophic lake under restoration (lake Rodo, Uruguay). *Aquat. Ecol.*, 39: 455-464.
- Edmondson, W. T. (1959): *Freshwater Biology*. II Ed. John Wiley & Sons, New York.
- Fricova K., Ruzickova J. and Hrebik, S. (2007): Benthic macro-invertebrates as indicator of ecological integrity of lotic ecosystem in the Sumava National Park, Czech Republic.
- Silva Gabreta, 13(1) : 39-55. Gupta, P.K. (1978): Macro benthos of a fresh water pond. *J Geobios* vol 6 (1):19-20.
- Hawkes,H.A.(1979): Invertebrates as indicator of River water quality in biological indication of water quality. John Wiley and Sons, New York.
- Khan R. A. (1982): Biological assessment of the pollution of the four heavily polluted rivers based on macro-invertebrates. *Proc. First. National Environmental Congress*. IARI, New Delhi, Abs. P. 109.
- Krishnamoorthi K. P. and Sarkar S. (1979): Macro-invertebrates as indicators of water quality. *Proc. Symp. Environ. Biol*. 133-138.
- Malhotra,Y.R.,Sharma,K.K. and Thalial,M.R.(1996): Ecology of macroinvertebrates from fish pond. *Proc. Nat. Acad. Sci. India* 66: 53-59.





- Manoharan S, Murugesan V.K., Palaniswamy, R. (2006): Numerical abundance of benthic macroinvertebrates in selected reservoirs of Tamil Nadu. J. Inland Fish. Soc. India, 38(1): 54-59.
- Marcal, S.F. and Callil, C.T.(2008): "Structure of invertebrates community associated with *Eichhornia crassipes* Mart. (Solms-Laubach) after the introduction of *Limnoperna fortunei* (Dunker, 1857) (*Bivalvia*, *Mytilidae*) in the Upper Paraguay River, MT, Brazil". *Acta Limnol. Bras.*, 20(4): 359-371.
- Michael, R.G.(1964): "Limnological investigation on pond plankton, macrofauna and Moorhead, K. K., Reddy, K. R., 1988, "Oxygen transport through selected aquatic macrophytes", *J. Environ Qual.*, 17:138-142.
- Naidu, K. Vanamala (2005) : The Fauna of India and the adjacent countries – Aquatic Oligochaeta: 1-294 (Pub.- Director , Zool, Surv. India, Kolkata).
- Olomukoro JO, Ezemonye LIN (2006): Assessment of the macroinvertebrate fauna of rivers in Southern Nig. *Afr. Zool.*, 42(1): 1-11.
- Pennak, R.W.(1978): *Freshwater invertebrates of the United States*. 2nd Edn., John Wiley and Sons, New York, pp: 810.
- Pennak R.W. (1989). *Freshwater Invertebrates of the United States*. A Wiley Inter science publication. John Wiley and Sons Inc. P. 628.
- Perston, H.B. (1915): *Mollusca (fresh water Gastopoda and Pelycepoda)* The Francis and Taylor, London. 230.
- Purdy, W. C. (1926): *J. Amerowat, Wks. Assn.* 16: 45-54.
- Rajan,M.K.(2005): Biodiversity faunal composition of Arjuna river,Sivakasi,Tamilnadu. Ph.D. Thesis Submitted. Madurai Kamraj University, Madurai.
- Sharma,K.K.and Chowdhary,S.(2011) : Macroinvertebrate assemblages as biological indicators of pollution in a Central Himalayan River,Tawi (J&K).





International Journal of Biodiversity and Conservation .Vol. 3(5) :167-174.

Sharma, Kuldeep K., Bangotra, K., Sharma, A. and Sharma, R. (2013): Association of macroinvertebrate fauna with Eichhornia crassipes (Pontederiales:) in Gho-Manhasan stream, Jammu (J&K). International Journal of Lakes and Rivers. vol.6(1):39-58.

Shukla S. C., Tripathi B. D., Rajanikant D. Kumari and Panday V.S. (1989): Physico-chemical and biological characteristics of river Ganga from Mirzapur to Balia. Indian J. Environ. Hlth., Vol. 31, (3) : 218-227.

Subba Rao N. V. (1989): Handbook of freshwater Mollusca of India Zoological Survey of India. Calcutta, 289 pp.

Tijare, R.V. (2012): Biodiversity of mollusca present in some waterbodies of Gadchiroli District, M.S. (India). Bionano Frontier. vol.5 (2 -I):55-56.

Tonapi, G. T. (1980): Fresh water animals of India an ecological approach., Oxford and IBH Publishing Co. New Delhi.

