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

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Abstract:

Macroinvertebrate communities were biomonitored 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 Chironomous larvae, Limnodrillus 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 bioindicaters 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. Macrobenthic 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 bioindicaters. 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 190 59" 55"" North and 790 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 classess,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 macoinvertebrate 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 consistes 3 orders, Mesogastropod (16.67%), Basmmatophora (12.50%) and Caenogastropoda (4.17%). Mesogastropoda belonged to 3 families, namely, Viviparidae, Thiaridae, Ampullaridae. Basmmatophora included 2 families, namely, Lymnaedae 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 ± 0.960C to 32.13 ± 3.050C for water temperature ,4.72 ± 0.33 mg/ltr to 8.75 ± 0.31mg/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 ± 3.91c.m. to 57.75 ± 4.62 cm for transparancy, 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

Conclusion

The present study reveals that the presence of pollution indicator species such as Tubifex tubifex, Chironomous 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.

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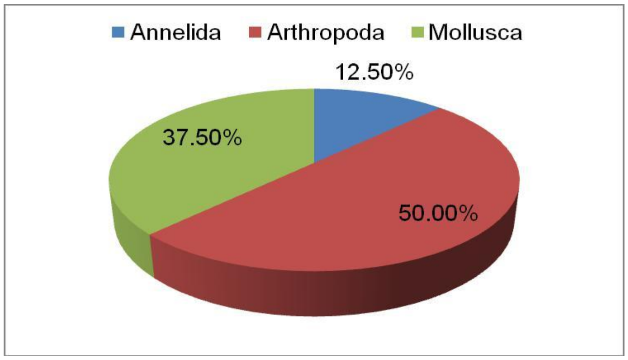

Fig. 1a: .Percent contribution of different macroinvertebrate phyla

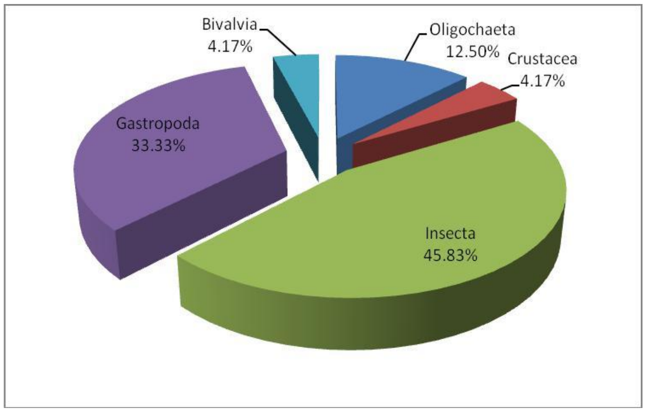

Fig.1b: Percent contribution of different classess among different invertebrate phyla

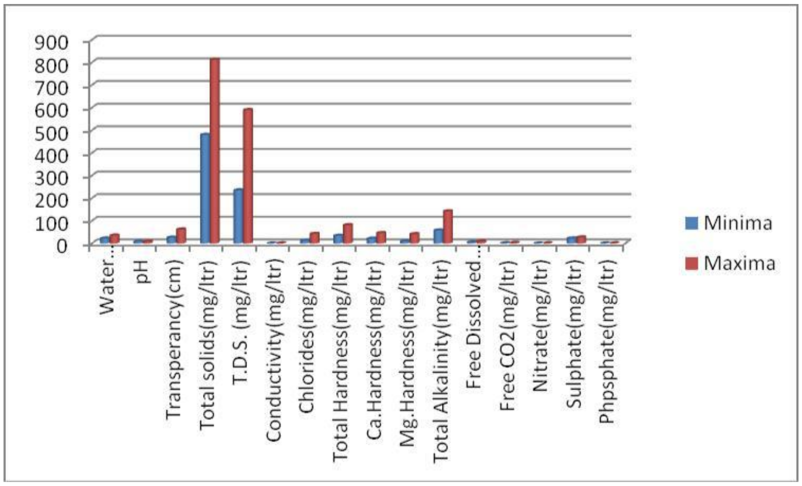

Fig.3. Minimum and maximum range of some chemical and physical parameters recorded from Wainganga river.

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

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

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 ± SD
1.	Water Temperature(^{0}C)	22.00	35.00	23.38 ± 0.96 – 32.13 ± 3.05
2.	pH	7.99	8.57	8.08 ± 0.06 – 8.47± 0.06
3.	Transperancy(cm)	26.00	62.00	31.25 ± 3.91 - 57.75± 4.62
4.	Total solids(mg/ltr)	480	812	562.50± 38.16 – 767.50± 39.45
5.	T.D.S. (mg/ltr)	235	590	359.75± 80.72 – 539.25 ± 40.72
6.	Conductivity(mg/ltr)	0.271	0.678	0.30±0.02 – 0.57± 0.09
7.	Chlorides(mg/ltr)	12.44	42.58	23.27±3.03 - 39.04±2.56
8.	Total Hardness(mg/ltr)	34.05	80.69	40.39±5.33 – 74.34±4.43
9.	Ca.Hardness(mg/ltr)	21.29	45.91	23.10±1.19 - 40.47±4.28
10.	Mg.Hardness(mg/ltr)	9.56	41.60	17.29±7.23 - 38.00± 2.47
11.	Total Alkalinity(mg/ltr)	57.50	142.00	91.50±8.26 – 120.00±15.48
12.	Free Dissolved 0_2(mg/ltr)	4.52	9.02	4.72± 0.33 – 8.75±0.31
13.	Free CO_2(mg/ltr)	1.18	2.86	1.31±0.09 - 4.31± 0.55
14.	Nitrate(mg/ltr)	0.326	1.121	0.46±0.08 - 0.93±0.13
15.	Sulphate(mg/ltr)	22.09	26.97	22.79±0.61 - 24.94±0.95
16.	Phpsphate(mg/ltr)	0.628	0.922	0.67±0.05 - 0.85±0.06