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RESEARCH ARTICLE

Benthic Macro Invertebrate abundance and its correlations with Physico-chemical Parameters from Kunda river, Khargone (M.P.), India

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Abstract

The Benthic macro-invertebrate fauna and physico-chemical parameters in Kunda river was studied for a period of one year. A total of Fourty two (42) species of benthic macro-invertebrates fauna belonging three (3) phyla (Annelida, Arthropoda and Mollusca), five (5) classes (Oligochaeta, Crustacea, Hexapoda, Gastropoda, Pelecypoda) and five (5) families (Baetidae, Caenoidae, Ephemeridae, Heptagenidae, and Chironomidae) were found in the Kunda river during the study. Molluscs and Arthropods species and percentage composition of respectively 47% and 35.57% occurred most and Annelids species and percentage composition of 17.35% occurred least. All Benthic macro-invertebrates (Phylum-Annelida (Oligochaeta), Arthropoda (Crustacea and Hexapoda) Mollusca (Gastropoda and Pelecypoda) showed positive correlation with Transparancy, Nitrate while Temperature showed positive correlation with Annelids and Total Hardness showed positive correlation with Annelids and Arthropods. All Benthic macro-invertebrates (Phylum-Annelida (Oligochaeta), Arthropoda (Crustacea and Hexapoda) Mollusca (Gastropoda and Pelecypoda) showed negative correlation with pH, D.O., B.O.D., Alkalinity, Chloride and Phosphate while Temperature showed negative correlation with Arthropods and Mollusca and Total Hardness showed negative correlation with Molluscs Benthic Macro-invertebrates.

Introduction

Benthic macro fauna are those organisms that live on or inside the deposit at the bottom of a water body (Idowu and Ugwumba, 2005). In Benthos include several species of organisms, which cut across different phyla including annelids, arthropods, molluscs. These organisms play a vital role in the circulation and recirculation of nutrients in aquatic ecosystems. They constitute the link between the unavailable nutrients in detritus and useful protein materials in fish and shellfish. Most benthic organisms feed on debris that settle on the bottom of the water and in turn serve as food for a wide range of fishes (Ugwumba, 2005). They also accelerate the breakdown of decaying organic matter into simpler inorganic forms such as phosphates and nitrates (Gallep *et al.,* 1978). Macro benthic invertebrates are useful bio-indicators providing a more accurate understanding of changing aquatic conditions (Ikomi *et al.,* 2005). Odiete (1999) stated that the most popular biological method in assessment of freshwater bodies receiving domestic and industrial wastewaters is the use of benthic macro-invertebrates. Their composition, abundance and distribution can be influenced by water quality (Odiete, 1999). They all stated that variations in the distribution of macro benthic organisms could be as a result of differences in the local environmental conditions. The present study has been carried out to evaluate the physico-chemical parameter of river Kunda by using standard method, which enables the common man to understand the quality of water.

Material and Methods

Duration of the present study was one years from August 2010 to July 2011. In the proposed work, studies of various benthic macro-invertebrates and physicochemical parameters of the Kunda River were

planed on monthly basis at selected study sites. The samples were taken between 7.00 AM to 10 AM throughout the study sites. The physicochemical analysis of water was performed as per methods given in APHA (2005). Net of mesh size 500µm is used for collecting the benthic macro-invertebrates.

Study Area:

The Kunda River is a Main river of Khargone district. It is a tributary river of Narmada river. It is originated from forest, Amba and Sirvel village. River Kunda has a length of approximately 169Kms. and its catchment area of 3825sq.km. This river is situated in the west directions of M.P. and it flows from South to North through four block of Khargone district Bhagwanpura, Goganwa, Khargone, and Kasrawad. On the Kunda River there are two Dams constructed Dejla-Devada dam & Vanihar dam. It provides drinking water for the Khargone city. There is on a Shiv temple and Ahilyaghat before Siddhi vinayak ganesh temple at the bank of Kunda River in Khargone. There are 7 stop dams is being constructed in last two years. These Stop dams provide drinking water & irrigation facility to Khargone District. Its water works water capacity is 20 crore litre. Its water holding capacity of 7 stop dams is 0.646 million cubic meters. Its capacity in stop water 1.5 million cubic meter and these stopdams are made in front of Kalika mata temple.

Its Latitude 21º49'16" N and Longitude 75º36'4"E.

Study Stations:

1. **DEJLA-DEVADA DAM:**

Dejla-Devada Dam is situated on Kunda River. It is 5km. away from Bhagwanpura Tehsil in Khargone district of western Madhya Pradesh. Its total length is 6010m. and Its 357.20m. Hight from the deepest foundation level. Its Irrigation area is about 8000 hectare. Its water holding area is 335.40 sq. km. and its complete storage capacity is 56.35million cubic meter, its total dam surface 383.20m. And its maximum dam surface 38920m.

Its latitude $21^0$36'45'' (DMS) N & longitude $75^0$37'30'' (DMS) E

Water analysis

The water samples were collected from the selected sampling stations Dejla-Devada dam in the Kunda River for the period of one year from August 2010 to July 2011. In the analysis of the physico-chemical properties of water, standard methods prescribed in limnological literature were used. Temperature, pH, Transparency, Dissolved Oxygen were determined at the site while Biochemical oxygen demand, Total Hardness, Alkanity, Chloride, Nitrate, Phosphate were determined in the laboratory. The Physico-Chemical parameters were determined by standard methods of APHA (2005), Welch (1998), Golterman (1991).

Biological Analysis

Collection and Identification of Benthic macro-invertebrates with the help of standard books A.P.H.A. (2005), Tonapi (1989), Needham & Needham (1969), Pennak (1978).

CORRELATION COEFFICIENT: -

- The correlation coefficient computed from the sample data measures the strength and direction of a relationship between two variables.
- The range of the correlation coefficient is. - 1 to + 1 and is identified by *r*.

Formula for correlation coefficient

The formula to compute a correlation coefficient is:

$r = [n (\sum xy) - (\sum x) (\sum y)] /$

$\{[n(\sum x2) - (\sum x) 2] [n (\sum y2) - (\sum y) 2]\}0.5$

Where *n* is the number of data pairs, x is the independent variable and y the dependent variable.

Results and Discussion

Analysis of Physico-chemical parameters of water: Water quality assessment can be defined as the evaluation of the physical, chemical and biological nature of water in relation to natural quality, human effects and intended uses. The Physico-chemical characteristics of the sampling site are given in Table 2.

In general, **water temperature** varied between 25°C to 42°C. The minimum temperature of 25°C was recorded in January 2011 and maximum temperature 42°C was recorded in May 2011. The value of **Hydrogen ion concentration** of the river varied between 7.61 to 9.22. The minimum value 7.61 was recorded in December 2010 and the maximum value 9.22 in June 2011. **Transparency** fluctuated from 15 NTU to 53 NTU. The minimum transparency of 15 NTU was recorded in July 2011 and the maximum transparency 53 NTU was recorded in January 2010. In general, **Dissolved oxygen** showed variation from 6.21 mg/l. to 9.12 mg/l. The minimum dissolved oxygen of 6.21 mg/l. was recorded in January2010 and maximum dissolved oxygen 9.12 mg/l. in July 2011. **Biochemical oxygen demand** varied between 3.1 mg/l. to 5.63 mg/l. The minimum biochemical oxygen demand of 3.1 mg/l. was recorded in November 2010 and maximum of 5.63 mg/l. in August 2010. In general, **Total hardness** varied from 71 mg/l. to 190 mg/l. The minimum value of 71

mg/l. was recorded in November 2010 and maximum value of 190 mg/l. was recorded in June 2011. **Alkalinity** varied from 230 mg/l. to 300 mg/1. The minimum alkalinity of 230 mg/l. was recorded in October 2010 and the maximum of 300 mg/l in January 2011. **Chloride** varied from 0.3 mg/l. to 53.4 mg/l. The minimum chloride of 0.3 mg/l. was recorded in October 2010 and maximum of 53.4 mg/l. in January 2011. **Nitrate** showed variation from 0.11 mg/l. to 0.131 mg/l. The minimum value of 0.11 mg/l. was obtained in December 2010 and the maximum value 0.131 mg/l. in October 2010. **Phosphate** of the river varied between 0.5 mg/l. to 0.49 mg/l. The minimum phosphate value of 0.5 mg/l. was recorded in October 2010 and maximum of o.49 mg/l. in September 2010.

Biological Analysis

The result for the phyla, classes, families and genus/species of Benthic macro-invertebrate fauna present in Kunda river is presented in Table 1 and the Benthic macro-invertebrates percentage of group and community in Kunda river is presented in Table 1 and Correlation coefficient (r) between Benthic macro-invertebrates with physico-chemical parameters of Kunda river is presented in Table 4.

The Benthic macro-invertebrate fauna and physico-chemical parameters in Kunda river was studied for a period of one year. A total of Forty two (42) species of benthic macro-invertebrates fauna belonging three (3) phyla (Annelida, Arthropoda and Mollusca), five (5) classes (Oligochaeta, Crustacea, Hexapoda, Gastropoda, Pelecypoda) and five (5) families (Baetidae, Caenoidae, Ephemeridae, Heptagenidae, and Chironomidae) were found in the Kunda river during the study.

A total of Forty two (42) Benthic macro-invertebrates species In the present study; 9 species of **Phylum Annelida Class- Oligochaeta**, (*Tubifex- tubifex, Limnodrilus hoffmeisteri, Telmatodrilus multispinosus, Dero dorsalis, Stylaria fossularis, Branchiodrillus hortensis, Tubifex albicola, Dero digitata, Dero cooperi)*; 7 species of **Phylum Arthropods Class- Crustacea** *(Daphnia cercinata, Pina dubia, Cypris, Cyclopes, Neso Cyclopes, Nauplius, Prawn;* 10 species of **Aquatic insects Family- Baetidae** *(Baetiella sp., Baetis sp., Baetis simplex, Baetis festivus)***Family- Caenoidae** (*Caehis sp.*) **Family –Ephemeridae** (*Ephemera Nadinac*) **Family- Heptageniidae** *(Epeorus sp., Heptagenia nubile*) **Family- Chironomidae** *(chironomus sp., Chaoborus sp.)* 16 species of **Phylum- Mollusca;** 8 species **Class- Gastropoda** (*Pila globosa, Thiara scabra, Bellamya bengalensis, Thiara lineata, Thiara tuberculata, Vivipara bengalensis, Digiostana pulchella, Gyraulco convexiculus***)** 8 species of **Class- Pelecypoda** (*Lymnaea acuminate, Lymnea auricularia, Lamellidens corricaunus, Lamellidens consobrinus, Lamellidens lamellatus, Pisidium clarkeanum, Corbicula striatella, Melanoides tuberculates*). These benthic macro-invertebrates species can be used to establish biological criteria to classify the river ecosystem as being healthy or polluted.

Molluscs and Arthropods species and percentage composition of respectively 47% and 35.57% occurred most and Annelids species and percentage composition of 17.35% occurred least. Hart (1994) reported forty-three species from mangrove swamp of Port Harcourt area of the Niger Delta. Also Umeozor (1995) recorded twenty three species in the New Calabar river; Ansa (2005) in her study of Adoni flats reported twenty eight families, six classes and five phyla, Hart and Zabbey (2005) recorded thirty taxa belonging to twenty families and five classes of macro invertebrates in Woji Creek in the upper reaches of Bonny River in the Lower Niger Delta; while Sikoki and Zabbey (2006) identified fourteen species representing eleven families of macro invertebrates in Imo River.

The Correlation coefficient results showed strong relationship between the physico-chemical parameters and the Benthic macro-invertebrates with Transparancy, Nitrate while Temperature showed positive correlation with Annelids and Total Hardness showed positive correlation with Annelids and Arthropods. This is an indication of the ability of the organisms to survive, adapt, migrate or die under favorable and unfavorable environmental conditions as was also reported by Tyokumbur *et al*., (2002). Similar trends in the correlation between the physico-chemical quality and the distribution of organisms have been reported by Ajao and Fagade (1990), M atagi (1996) and Ogbogu (2001).

Benthic macro-invertebrates negative correlation showed with pH, D.O., B.O.D., Alkalinity, Chloride and Phosphate while Temperature showed negative correlation with Arthropods and Molluscans and Total Hardness showed negative correlation with Molluscs Benthic Macro-invertebrates. This weak correlation of some of the fauna to water quality parameters can be attributed to their physiological adaptations to the unfavorable environmental conditions. Similar studies on Ogunpa River were on physico-chemical parameters and macro-invertebrates fauna (Atobatele *et al.,* 2005; Adeyemo *et al.,* 2008 and Ogidiaka Efe 2012). Same results were also reported by (George *et al.,* 2009; Indabawa 2010 and Tampus *et al.,* 2012).

Table:1 Benthic macro-invertebrates percentage group and community in Kunda river by station, August 2010 to July 2011.

Phylum- Annelida			
OLIGOCHEATES	**Total**	**% in group**	**% in Com.**
Tubifex tubifex	101	13.5	2.35
Limmodrilus hoffmeisteri	54	7.23	1.25
Telmatodrilus multispinosus	77	10.32	1.79
Dero dorsalis	77	10.32	1.79
Stylaria fossularis	29	3.88	0.67
Branchiodrillus hortensis	77	10.32	1.79
Tubifex albicola	172	23.06	4.008
Dero digitata	90	12.06	2.09
Dero cooperi	69	9.24	1.61
Total	746	99.93	17.348
Phylum-Arthropods			
CRUSTACIANS			
Daphnia cercinata	51	3.33	1.19
Pina dubia	91	5.95	2.12
Cypris	109	7.13	2.54
Cyclopes	73	4.77	1.7
Neso cyclopes	87	5.69	2.02
Nauplius	96	6.28	2.23
Prawn	45	2.94	1.05
HEXAPODA **Baetidac -**			
Baetiella sp.	-	5	2
Baetis sp.	-	2	8
Baetis simplex	-	1	5
Baetis festivus	--	5	7
Caenoidac -			
Caehis sp.	NIL	5	12
Ephemeridac -			
Ephemera Nadinac	NIL	6	10
Heptageniidac -			
Epeorus sp.	67	4.38	1.56
Heptagenia nubile	92	6.02	2.14
Chironomidae-			
chironomus sp.	161	10.53	3.75
Chaoborus sp.	233	15.24	5.42
Total	**1528**	**99.91**	**35.57**
Phylum- Mollusca			
GASTROPODA			
Pila globosa	179	8.87	4.17
Thiara scabra	175	8.68	4.08
Bellamya bengalensis	115	5.7	2.68
Thiara lineata	167	8.28	3.89
Thiara tuberculata	202	10.01	4.71
Vivipara bengalensis	124	6.15	2.88
Digiostana pulchella	123	6.09	2.87
Pelecypoda (/M^2)			
Lymnaea acuminate	117	5.8	2.73

Lymnea auricularia	124	6.14	2.89
Lamellidens corricaunus	115	5.7	2.68
Lamellidens consobrinus	101	5.007	2.35
Lamellidens lamellatus	123	6.09	2.87
Pisidium clarkeanum	95	4.709	2.21
Corbicula striatella	144	7.14	3.36
Melanoides tuberculates	113	5.602	2.63
Total	**2017**	**99.968**	**47**
Total number of Benthic macro-invertebrates Species=4291			

Table: 2 Correlation coefficient (r) between Benthic macro-invertebrates with physico-chemical parameters of River Kunda.

Parameters	Annelids	Arthropods	Mollusca
Temperature	0.017	-0.299	-0.377
pH	-0.727	-0.864	-0.906
Transparency	0.726	0.907	0.885
D.O.	-0.666	-0.740	-0.698
B.O.D.	-0.681	-0.877	-0.851
Total Hardness	0.146	0.039	-0.016
Alkalinity	-0.346	-0.464	-0.496
Chloride	-0.568	-0.571	-0.557
Nitrate	0.424	0.578	0.438
Phosphate	-0.568	-0.801	-0.791

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