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IMPACT OF PHYSICOCHEMICAL FACTORS ON DISTRIBUTION OF BENTHIC MACRO INVERTEBRATES IN LOTIC ECOSYSTEMS NEAR CHANDRAPUR, MAHARASHTRA, INDIA

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ABSTRACT:
The present work reports the results of an intensive study on the impact of physicochemical parameters on distribution of macro benthic invertebrates in lotic ecosystems near Chandrapur, Maharashtra, India. The research was carried out at four different lotic ecosystems near Chandrapur, includes river Wardha, Erai, Zarpat and Lohara nullah for one year from October 2017 to September 2018. Various physicochemical parameters were evaluated with the diversity of benthic macro-invertebrates. Total 25 macroinvertebrate species belonging to Annelida, Insecta, Gastropoda and Pelycepoda were recorded. The presence of an indicator species like Limnodrillus, Corbicula, and Lymnea in more amounts in river Zarpat reflects its polluted nature.

Keywords :- Chandrapur, Zarpat river, Macroinvertebrates, Physico-chemical, Wardha river.

INTRODUCTION :

Water and life have an inseparable unique relationship. It is the elixir of life from which all life springs forth is vital for the existence of all living organisms. Rivers are vital and vulnerable freshwater ecosystems that are crucial for the sustenance of aquatic life with variability in their physicochemical composition.

Almost all the rivers in India are facing acute water pollution problem due to rapid industrialization and urbanization. The rivers are contaminated with effluents. Pollution in river first affects its physico-chemical quality and then systematically destroys the biotic community as well as human population. Therefore, it is necessary to check the water quality at regular interval of time.

Impact of physicochemical parameters on benthic macro-invertebrates cannot be disregarded since various aquatic habitats, particularly lotic water bodies and water with acceptable water quality support an array of macro invertebrate communities. However, many aquatic bodies especially contaminated one are dominated by few indicator species. The composition, abundance and distribution pattern of benthic macro invertebrates acts as an ecosystem index, thereby indicating trophic structure, water quality and eutrophication level of the ecosystem (Mehdi et al., 2005).

The present study aims to investigate the impact of physicochemical parameters on distribution and abundance of benthic macro invertebrates so as to determine interaction between occurrence and assemblage of benthos and quality of water of lotic ecosystems near Chandrapur.

MATERIALS AND METHODS:

The studies were carried out for 12 months from October 2017 to September 2018. Samples were collected from four different lotic ecosystems. The parameters like water Temperature, pH and D.O. were analyzed at the sampling sites while remaining were analyzed in the laboratory using pertinent literature, APHA (1985). Macro benthic invertebrates were collected by metal scoop and

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analysed, using standard keys (Tonapi, 1980 and Naidu K. Vanmala, 2005).

RESULTS AND DISCUSSION:

Physico- chemical properties of water

Physico-chemical characteristics are very important as they have direct effect on the diversity of aquatic organisms. The Physico-chemical parameters are represented in Table 1.

All the metabolic and physiological activities of life processes are greatly influenced by water temperature. The physical factors influencing water temperature include basin morphometry, altitude, topography and vegetation (Unni, 1990), current, velocity and discharge (Smith, 1972), Latitude, Altitude and continental physical variables (Ward, 1985). The rate of biochemical reactions is directly proportional to the environmental temperature of hottest summer months, the oxygen demand increases, leading to serious oxygen depletion problems in aquatic ecosystem (Harishkumar, 1998).

In the present investigation, the minimum annual average water temperature (29.15 ^{O}C ± 2.45) was recorded in river Wardha and maximum (29.76 ^{O}C ± 2.19) in river Zarpat. Panda *et al.,* (1991) reported maximum temperature due to discharge of municipal and Industrial wastes in the river Brahmani. Shanthi *et al.,* (2006) in river Varga, Tamilnadu recorded temperature variation in between 28°C to 32°C.

The PH was alkaline at all four lotic ecosystems throughout the year. The values of PH were recorded in-between 7 to 8. Most of the aquatic lives are adapted to average pH, so water quality is good for aquatic life. The maximum PH (7.99 ± 0.16) was observed in river Zarpat whereas minimum (7.80 ± 0.05) in river Erai.

High conductivity values are not suitable for agricultural or for drinking purposes (Atthappan *et al.,* 1992) and reflects the pollution status of the aquatic body (Anitha, 2002). Less flow during summer is responsible to increase the ionic content which results in the increased level of conductivity. In the present investigation, the conductivity of water was recorded high (0.387± 0.07 mmhoscm^{-1}) in Lohara Nullah. Conductivity totally depends upon the concentration of ions in the water.

Total dissolved solids play an important role in community structure due to its limiting impact on primary production and trophodynamics. In the present investigation, the minimum Total Dissolved Solids, (129.00 ± 59.9 mgL^{-1}) was recorded at Lohara nullah and maximum (304.00 ± 85.4 mgL^{-1}) at river Zarpat. Dora and Rai (1987) reported average T.D.S. values i.e. 204.2 mg/l to 366.0 mg/l in Subarnarekha River.

Somashekhar (1988) reported a minimum chloride value 19.29 ± 0.18 at unpolluted station and 72.29 ± 0.32 at polluted station of river Cauvery as well as 20.96 ± 0.31 at unpolluted station and 82.0 ± 0.41 at polluted station of river Kapila. In our study, the minimum yearly average value of Chlorides (37.13 ± 10.58 mgL^{-1}) was recorded in river Wardha and maximum (104.33 ± 30.30 mgL^{-1}) in river Zarpat.

Dissolved Oxygen has been extensively used as a parameter delineating water quality and to evaluate the degree of freshness of river (Fakayode, 2005). Dissolved Oxygen is essential in the metabolism of all aerobic aquatic organisms. Oxygen distribution is important for the direct needs of most of the organisms and affects the solubility and availability of many nutrients (Wetzel, 1975).

The free carbon dioxide of any aquatic body is one of the best indexes to understand the quality of water. It is found in a larger amount in polluted water when compare with freshwater bodies. The free CO_2 range was found between 2.39 ± 1.11 mgL^{-1} to 4.11 ± 1.27 mgL^{-1}. Shinde *et al.,* (1997) recorded the values of free CO_2 as 3.7 mg/l, 11.2 mg/l and 14.9 mg/l at station A, B and C respectively during the study of river Godavari at Nasik. Hanifa *et al.,* (1993) recorded

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a range of Free Carbon dioxide between 2.16 to 6.52 mg/l in the perennial river Tambaraparani.

Nitrate is an excellent parameter to judge organic pollution and it represents the highest oxidized form of nitrogen. The nitrates are the important source of nitrogen for phytoplankton. Domestic sewage may be the principal contributor of nitrogenous substance in an aquatic ecosystem. Small quantity of nitrogen is enough for rapid growth of blue green algae in a water body (Swarup and Singh, 1979).

Phosphate is considered as the most critical single element for biological productivity (Banarjee, 1967). An increased concentration of phosphate is taken up by the phytoplankton which leads to algal blooms.

Phosphates and nitrates are the two main nutrients responsible for the process of eutrophication that leads to ultimate degradation of an aquatic ecosystem (Reynolds 1991, Kodarkar *et al.,* 1991, Kodarkar and Chandrasekhar 1995) unlike nitrate, phosphate often becomes a limiting nutrient and its constant supply reduces classical manifestation like blooms of algae and wild growth of aquatic weeds (Srinivas Rao, 2004).

In present investigation, the values of Phosphate and Nitrate were recorded in the range of 0.129 ± 0.20 mgL^{-1} to 0.575 ± 0.27 mgL^{-1} and 0.237 ± 0.20 mgL^{-1} to 0.571 ± 0.19 mgL^{-1} respectively. Bhadra *et al.,* (2003) recorded nitrate content in the range of 0.09 to 2.2 mg/l in river Torsa. Shanthi *et al.,* (2006) observed a significant variation in nitrates and recorded the range in 1 to 4 mg/l in River Varga.

Diversity of benthic macro- invertebrates

The benthic macroinvertebrate community may be particularly susceptible to water-level changes that alter sediment exposure, temperature regime, wave-induced sediment redistribution and basal productivity (McEwen, Butler 2010). The benthic macro- invertebrates collected from the four lotic ecosystems during the study period consists of 25 species belonging to four major taxa. The benthos is jointly dominated by Arthropoda and Mollusca consisting of eight species each.

Chavan and Dhamani (2010) reported Corbicula species from polluted zone of river Wainganga near Bramhapuri. Arvindkumar and Bohara (1999) also reported Lymnaea species from Santhal Pargana (Bihar) and concluded it as a good bioindicator for sewage born heavy pollution and hyper eutrophication. The presence of Corbicula spp only in rive Zarpat indicate polluted nature of the river.

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Table 1.1: Yearly average values of different physico-chemical parameters in Lotic ecosystems near Chandrapur.

S.N.	Parameters	Wardha River			Erai River			Zarpat River			Lohara Nullah		
1	**Temperature**	29.15	±	2.45	29.20	±	±2.79	29.76	±	2.19	29.52	±	2.22
2	**pH**	7.83	±	0.12	7.80	±	0.05	7.99	±	0.19	7.90	±	0.16
3	**Conductivity**	0.189	±	0.02	0.169	±	0.02	0.331	±	0.03	0.387	±	0.07
4	**Transparency**	83.08	±	16.74	76.25	±	6.75	42.25	±	13.78	46.16	±	16.71
5	**Alkalinity**	135.08	±	19.23	232.00	±	45.04	367.08	±	37.42	221.83	±	33.23
6	**Tot. Hardness**	110.25	±	18.79	141.50	±	34.30	226.00	±	46.38	156.17	±	43.08
7	**Ca-Hardness**	65.17	±	11.16	88.25	±	14.65	151.50	±	23.79	107.25	±	33.94
8	**Mg-Hardness**	44.08	±	5.83	53.25	±	19.83	82.58	±	31.73	48.92	±	9.66
9	**T.D.S.**	265.5	±	33.9	283.8	±	84.4	304.0	±	85.4	129.0	±	59.9
10	**D.O.**	5.88	±	0.73	5.43	±	1.02	4.76	±	0.75	5.74	±	0.55
11	**CO_2**	2.39	±	1.11	3.59	±	0.31	4.11	±	1.27	3.78	±	0.95
12	**Chloride**	37.13	±	10.58	56.78	±	5.10	104.33	±	30.30	72.48	±	24.18
13	**B.O.D.**	3.18	±	0.86	4.18	±	1.28	6.26	±	1.64	5.99	±	1.39
14	**C.O.D.**	25.40	±	5.93	43.93	±	4.51	41.46	±	9.66	35.07	±	7.45
15	**Sulphate**	24.94	±	5.38	22.23	±	9.34	31.83	±	6.72	28.46	±	5.63
16	**Phosphate**	0.129	±	0.20	0.365	±	0.23	0.575	±	0.27	0.336	±	0.18
17	**Nitrates**	0.237	±	0.20	0.350	±	0.08	0.571	±	0.19	0.494	±	0.29

Table 1.2 :The diversity of benthic macro invertebrates in the lotic ecosystems near Chandrapur

S.N.	Benthic Macro invertebrates	Wardha river	Erai river	Zarpat river	Lohara Nullah
A	**Annelida**				
1	Pristina spp.	++	++	--	--
2	Aelosoma spp.	++	++	--	--
3	Dero spp.	--	--	++	++
4	Limnodrillus spp.	--	++	++	++
5	Branchiura spp.	--	--	--	++
6	Tubifex spp.	--	++	++	--
7	Nais spp.	--	--	++	++
B	**Insecta**				
1	Odonata nymphs	++	++	++	++
2	Anopheles larva	--	--	++	++
3	Culex larva	--	--	++	++
4	Chironomous tentum	--	++	++	++
5	Chironomous tendipetiformes	--	++	++	++

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6	Eristalis spp.	--	--	--	++
7	Notonecta glauca	++	++	++	--
8	Gerris spp.	++	++	++	--
9	Corixa spp.				
10	Limnophora spp				
C	**Gastropoda**				
1	Melanoid spp.	--	--	++	++
2	Indoplanorbis spp.	++	++	++	--
3	Bellamya spp.	--	++	++	--
4	Lymnea spp.	--	++	++	++
5	Gyrulus spp.	++	++	++	++
6	Pila globosa	++	++	++	--
D	**Pelycepoda**				
1	Lamellidens marginalis	++	++	--	--
2	Corbicula spp.	--	++	++	++

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