

Pollution Assessment using Bioindicator (Odonata and Mollusca) in Narmada basin at Jabalpur: A Developing Smart City

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Abstract

The smart city mission of Jabalpur intends to promote adoption with basic infrastructure to give a decent quality of life, a clean and sustainable environment through application of smart solutions where environment disturbed through anthropogenic activities. Odonata and Mollusca are biological indicators so without using chemicals we aimed to know the pollution intensity of river Narmada basin. Benthos assemblage from Narmada basin in Jabalpur has been investigated. A total of 37 species of Odonata and 13 species of Mollusca were sampled.

Keywords: smart city, benthic macroinvertebrates, diversity, Jabalpur.

1. Introduction

Jabalpur is recently announced under developing smart city. It situated in the bank of the river Narmada basin lies between east longitudes 72° 32' to 81°45' and north latitudes 21°20' to 23°45'. Smart city uses information and communication technologies to improve contact between citizens and government and to enhance quality, performance and interactivity of urban services to reduce cost and resource consumption with waste management. Major technological, economic, climates change and environmental changes caused by pollution enhancement which generate interest in smart city to use biological indicator. Odonata and Mollusca are easy-to-study groups and are useful to monitor the overall biodiversity of aquatic habitats and had been identified as good indicators of environmental health [1,2].

Perennial river system with different habitat types provides good opportunities to Odonata, the wonderful insect groups to flourish and survive. Narmada basin in the Jabalpur region created an excellent habit and source of alteration for many faunal species like insects, reptiles, birds and mammals [3]. Odonata is good indicator of environmental changes as their larvae and adult both are sensitive to habitat degradation and climate changes [4]. Ecological indicators can be defined as a taxon or community that reflects the biotic or abiotic

state of an environment [5]. Larval Odonata diversity and abundance was positively correlated with macroinvertebrates diversity and abundance and it was efficient bioindicators of intactness and diversity of overall macroinvertebrates [6]. Although a large number of biological indicators are reported but benthic macroinvertebrates are most commonly used as biological indicators. The tropics have faced massive biodiversity loss due to intensive anthropogenic activities such as changes in land use and degradation of environment. Recent reports suggest that the tropics are losing biodiversity at an alarming rate [7]. However, there is very little knowledge on the extent of loss in lesser known groups, especially the invertebrates. In this paper, we highlight the diversity and abundance of invertebrate fauna and the need for their conservation. The aim of study of the biodiversity of Odonata and Mollusca species in Narmada valley of Jabalpur region for pollution for the assessment of pollution using bioindicators in the environment to make Jabalpur, the smartest city.

2. Material and Method

2.1 Sampling stations

The present study was carried out during year September 2013 to September 2015. The whole Narmada valley of Jabalpur region including river, forest, grassland and urban area were selected as study

site for the collection of sample. Four study sites were selected for the investigation these were Bargi dam, Gwarighat, Tilwaraghat and Bhedaghat shown in Figure 1. The sites visited from 5 to 9 in the morning and 5 to 7 in the evening for one year during January 2015 to December 2015.

2.2 Identification

The adult specimens of Odonata were identified with the help of identification keys provided by [8-14] Mollusca were identified by using standard keys, such as, [15-17]. The benthos were categorized on the basis of their abundance in Narmada basin region of Jabalpur which abbreviated as VC - very common, C - common, R - rare, VR - very rare [18].



Figure 1: Map of Narmada basin at Jabalpur region

Table 1: The observed species of Odonata and their Relative Status in Jabalpur district around river Narmada basin

S. No.	Name of Species	Common Name	Status
Order: Odonata; Sub order: Zygoptera (Damselflies); Family: Coenagrionoidae (12 species)			
1.	<i>Agriocnemis femina</i> (Brauer, 1868)	White-backed Wisp	Common
2.	<i>Agriocnemis pygmaea</i> (Rambur, 1842)	Pygmy Dartlet	Very Common
3.	<i>Agriocnemis pieris</i> (Laidlaw, 1919)	White Dartlet	Rare
4.	<i>Ceriagrion coromandelianum</i> (Fabricius, 1798)	Coromandel Marsh Dart	Rare
5.	<i>Disparoneura quadrimaculata</i> (Rambur, 1842)	Black-winged Bamboo-tail	Rare
6.	<i>Enallagma parvum</i> (Selys, 1876)	Azure Dartlet	Rare
7.	<i>Ischnura aurora</i> (Brauer, 1868)	Golden Dartlet	Common
8.	<i>Ischnura senegalensis</i> (Rambur, 1842)	Senegal Golden Dartlet	Very Common
9.	<i>Pseudagrion decorum</i> (Rambur, 1842)	Elegant Sprite	Common
10.	<i>Pseudagrion rubriceps</i> (Selys, 1876)	Saffron Faced Blue Dart	Very common
11.	<i>Pseudagrion spencei</i> (Fraser, 1922)	Brook Sprite	Very Common
12.	<i>Rhodischnura nursei</i> (Morton, 1907)	Pixie Dartlet	Rare
Family: Platycnemididae (1 species)			
13.	<i>Copera marginipes</i> (Rambur, 1842)	Yellow Bush Dart	Common
Family: Lestidae (1 species)			
14.	<i>Lestes umbrinus</i> (Selys, 1891)	Brown Spread-wing	Very Common
Family: Chlorocyphidae (1 species)			
15.	<i>Libellago lineata indica</i> (Fraser, 1928)	Golden Gem	Rare
Sub-order: Anisoptera (Dragonflies); Family: Aeshnidae (3 species)			
16.	<i>Anax guttatus</i> (Burmeister, 1839)	Pale Spotted Emperor	Very Common
17.	<i>Gynacantha bayadera</i> Selys, 1891	Small Dusk hawker	Rare
18.	<i>Hemianax ephippiger</i> (Burmeister, 1839)	Vagrant Emperor	Rare
Family: Gomphidae (2 species)			
19.	<i>Macrogomphus annulatus</i> (Selys, 1854)	Keiser's Forktail	Common
20.	<i>Paragomphus lineatus</i> (Selys, 1850)	Lined Hooktail	Common
Family: Libellulidae (17 species)			
21.	<i>Acisoma panorpoides</i> (Rambur, 1842)	Grizzled Pintail	Rare
22.	<i>Brachythemis contaminata</i> (Fabricius, 1793)	Ditch Jewel	Very Common
23.	<i>Bradinyopyga geminate</i> (Rambur, 1842)	Granite Ghost	Rare
24.	<i>Crocothemis servilia</i> (Drury, 1770)	Scarlet Skimmer	Very Common
25.	<i>Diplacodes trivialis</i> (Rambur, 1842)	Blue-Ground Skimmer	Common
26.	<i>Neurothemis intermedia</i> (Rambur, 1842)	Paddy Field Parasol	Rare
27.	<i>Neurothemis tullia</i> (Drury, 1773)	Pied Paddy Skimmer	Very Rare
28.	<i>Orthetrum luzonicum</i> (Brauer, 1868)	Slender Blue Skimmer	Rare
29.	<i>Orthetrum pruinosum</i> (Burmeister, 1839)	Crimson-tailed Marsh Hawk	Common
30.	<i>Orthetrum sabina</i> (Drury, 1773)	Slender Skimmer	Very Common
31.	<i>Orthetrum taeniolatum</i> (Schneider, 1845)	Small Skimmer	Very Rare
32.	<i>Pantala flavescens</i> (Fabricius, 1798)	Globe Skimmer	Common
33.	<i>Rhyothemis variegata</i> (Linnaeus, 1763)	Common Picture Wing	Rare
34.	<i>Tholymis tillarga</i> (Fabricius, 1798)	Coral Tailed Cloud-wing	Rare
35.	<i>Trithemis aurora</i> (Burmeister, 1839)	Crimson Mars Glider	Very Rare
36.	<i>Trithemis festiva</i> (Rambur, 1842)	Black stream glider	Very Common
37.	<i>Trithemis pallidinervis</i> (Kirby, 1889)	Long-legged Mars Glider	Very Common

Table1. The observed species of Mollusca and their Relative Status in Jabalpur district around river Narmada basin.

S. No.	Name of The Species	Abundance status
Class : Gastropoda		
1	<i>Pila globosa</i> (Swainsn,1822)	Very common
2	<i>Thiara lineate</i> (Gray, 1828)	Common
3	<i>Thiara tuberculata</i> (Mueller, 1774)	Rare
4	<i>Vivipara bengalensis</i> (Lamarck, 1822)	Rare
5	<i>Bellamya bengalensis</i> (Lamarck, 1822)	Common
6	<i>Indoplanobris exustus</i> (Deshayes, 1834)	Common
7	<i>Unio species</i> (Philipsson, 1788)	Very Common
8	<i>Thiara scabra</i> (Mueller, 1774)	Rare
9	<i>Bellamya dissimilis</i> (Mueller, 1774)	Not common
Class : Pelecypoda		
10	<i>Pissidium clarkeanum</i>	Rare
11	<i>Lymnaea acuminata</i> (Lamarck, 1822)	Very common
12	<i>Perreysia favidens</i> (Benson,1862)	Not common
13	<i>Perreysia caerulea</i>	Rare

3. Result

During the intensive survey of Insects in Jabalpur district, 37 species of Odonata and 13 species of Mollusca were revealed among these a total of 7 families belonging to order Odonata and 2 classes belonging to phylum Mollusca recorded from selected sites.

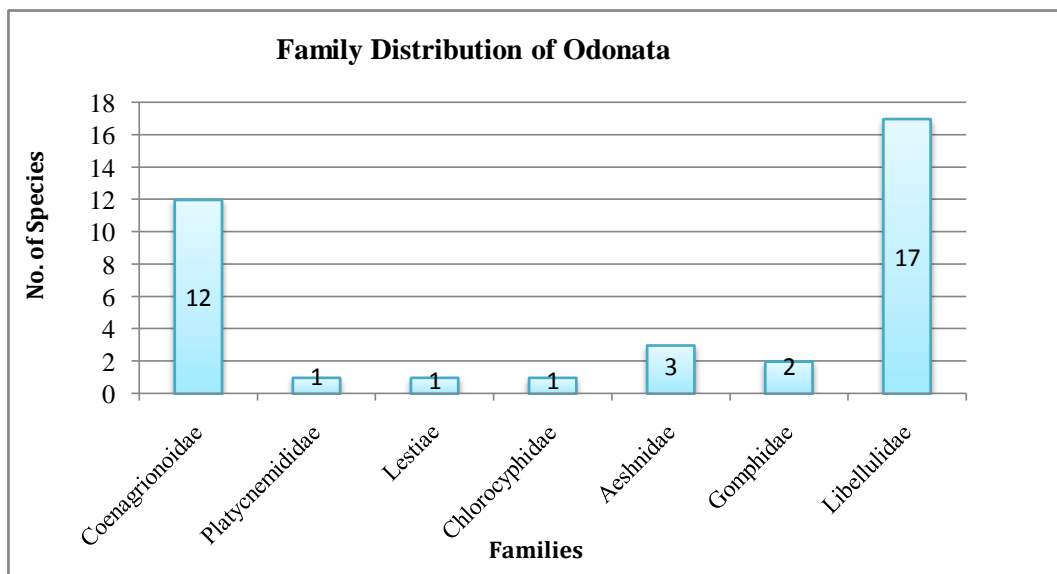


Figure 2: Families distribution of Odonata in Jabalpur region of river Narmada

Relative Abundance:

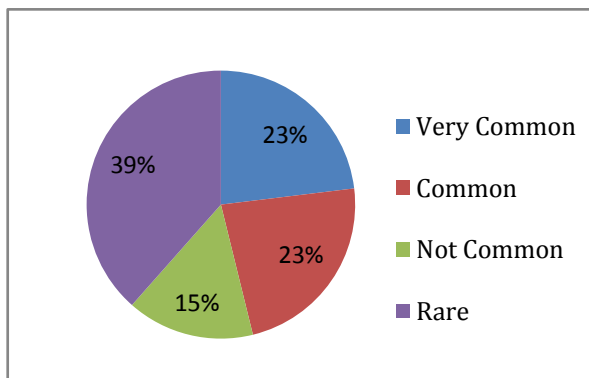


Figure 3: Relative Abundance of Mollusca

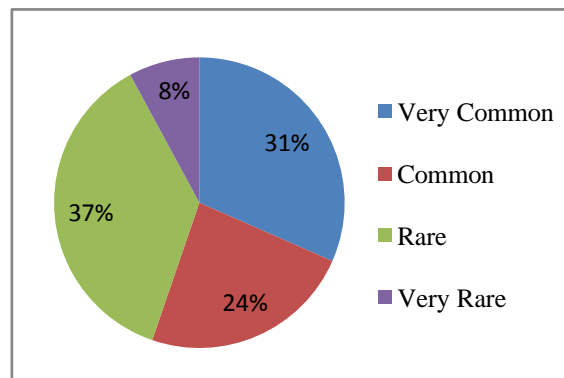


Figure 4: Relative Abundance of Odonata

The relative abundance showed that among the 37 species of Odonata were recorded, 12 species were found to be very common, 9 species were common, 14 species were rare and 3 species were very rare were found to the study areas (Figure 3.) whereas among 13 species of Mollusca 3 were very common, 3 were common, 2 were not common and 5 were rare species. These 37% species of Odonata and 39% of Mollusca from the study area were designated rare, suggesting the need for strict conservation.

4. Discussion

Gastropods usually play a dominant role in the ecology of fresh-waters by providing food for many animals and by grazing on vast amounts of algae and detritus [19]. It is obviously seen that the groups of Mollusca are different with the study sites; this may have been related to the changes in the environment, to the industrial or organic pollution [20]. Benthic macro invertebrates are susceptible to the local environmental perturbation, which are also effective integrators of the environmental contamination, this means, they were responded to all contaminants in the environment not only those were measured in conventional water or sediment quality monitoring program [21].

Subramanian [14] reported 11 dragonfly families, of which 972 species with Libellulidae and 958 species with Gomphidae are major families throughout the world followed by 436 species in Aeshnida, 249 species in Corduliidae and 123 species in Macromiidae. Bhandari [22] studied the diversity of Odonata of river Sone in the surroundings of Bansagar dam and revealed 22 species of Odonata from the catchment of reservoir. Sharma and Shukla [23] reported total 25 species of Odonata in southeast region of river Narmada during January 2015 to August 2015 where Libellulidae family was the most diverse with 10 species than Coenagrionoidae with 7 species but in further study of that same site 5 more species i.e., 30 species were found from Jabalpur region and highlighted the presence of pollution. Manwar [24] in Maharashtra (India) recorded 22 Odonata species of 4 families of which 50% species are of family *Libellulidae*. Tijare and Patil [25] were observed 21 species of dragonflies from Nagpur district and Libellulidae family has high species richness. Odonata indicate input of little organic pollution in the slow moving or standing clean waters and Mollusca are quite intolerant to pollution, while other is tolerant. Clams detect toxicant, insecticides, organic chemicals that cause cancer and metals such as copper, zinc, iron, chromium, and cadmium in water.

5. Conclusion

Pollution in India has now reached to a point of crisis due to unplanned urbanization and rapid industrialization. The entire array of life is affected due to pollution in environment. The problem of atmosphere as well as lithosphere and hydrosphere quality deterioration is mainly due to human activities such as dumping and disposal of waste material and dead bodies, discharge of industrial, automobiles smoke, sewage wastes and agricultural runoff, which are major cause of ecological damage and pose serious health hazards. Urbanization also is associated with habitat degradation including decreased plant species diversity, reduced water quality, and increased air and soil pollutions. In terrestrial ecosystem, insect fauna represent more than 70% and also play an important role in food chain for the natural balance. Bioindicators will be used for the detection of pollution into the river and its surroundings. Every developing city produces heavy pollution and for making Jabalpur a smart city we have to reduce the pollution status and increase use more biological resources for the treatment of environment and reduction of chemical treatment.

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