



## **SEASONAL BIOLOGICAL WATER QUALITY ASSESSMENT OF RIVER KSHIPRA USING BENTHIC MACRO-INVERTEBRATES**

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### **ABSTRACT**

The water quality of River Kshipra in stretch of 195 km was studied for water quality status using benthic macro invertebrates for all three seasons' monsoon, winter and summer. The River water quality is subject to severe domestic and industrial pollution at compete stretch of River. In the present investigation a total of 13 Orders of macrobenthic fauna i.e. Ephemeroptera, Trichoptera, Placoptera, Coleoptera, Hemiptera, Odonata, Crustacea, Diptera, Pulmonata, Operculata, Pulmonata, Oligochaeta and Hirudinea belong to 3 Phylum's Arthropoda, Mollusca and Annelida were reported. Arthropoda was the most dominant group in all seasons. On seasonal comparison of benthic fauna is observe that abundance were decreasing order were, Winter > Monsoon > summer. To monitor the water quality samples from two years (2010-12) from different stations were collected monthly. The works highlighted the condition of the River water in various seasons with respect of the seasonal abundance of the benthic macro-invertebrates organisms mentioned above.

#### **Keywords:**

*Kshipra River, Water quality, Benthic macro-invertebrates, Pollution indicator, Seasonal pollution.*

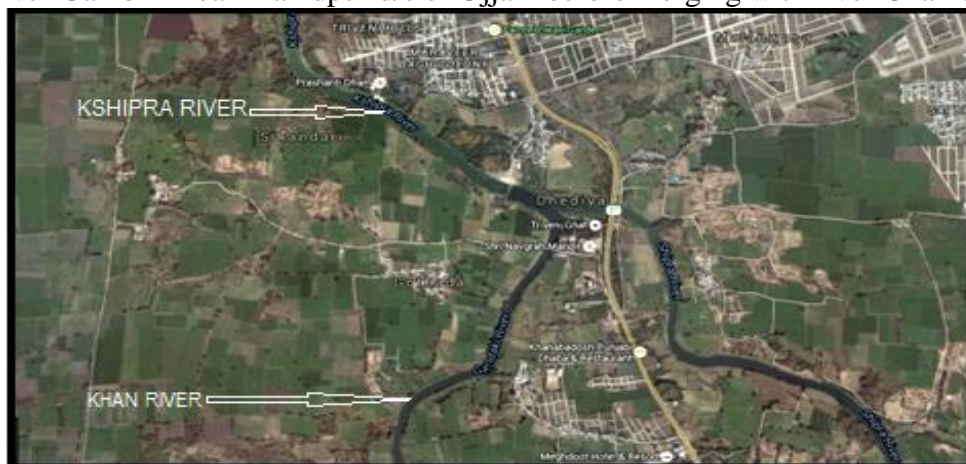
### **INTRODUCTION**

River water pollution is an acute problem in all rivers of India. Bio-monitoring is a valuable assessment tool that is receiving increased use in water quality monitoring. Benthos are one of the best biological indicators of water quality monitoring, their presence and absence provide a reliable picture of the River ecosystem Nasiru *et al.*, (2209). Benthic macro-invertebrates have a sedentary and long life span, sensitive communities these organisms are regarded as the most reliable and informative bio-indicators of water pollution. The abundance of benthic community depends on physical and chemical properties of the substrate. The benthic macro-invertebrates communities' response a changes in water quality, food and predation integrate impacts over a time period because of their extended residency period in specific habitat Weigel *et al.*, (2012). The diversity and density of benthic macro-invertebrate also widely fluctuated with seasonal change too Hynes, (1978). The main object of the study was identified and uses macro-benthic invertebrates to evaluating the seasonal water quality status of Kshipra River in respect of benthic organism.

## MATERIALS AND METHOD

### Description of river Kshipra-

River Kshipra is of the sacred Indian rivers. It is also known as “Awanti nadi”. It originates from Kakri Bardi hills (747 meters above MSL) about 11 Km South East of Indore, a major town of Malwa region. River Kshipra flows through the city of Ujjain (23°18’N, 75°77’E) in Western part of Madhya Pradesh. Total length of the river is about 195 km out of which 95 km flow through Ujjain (Fig.-1). River enters the city at Trivani ghat it receives its tributary river Khan just up Ujjain and river Gambhir near Mahidpur d/s of Ujjain before merging with river Chambal.



**Figure 1:** Satellite image of the Kshipra River and its tributary Khan River.

### Sampling method for Macro-invertebrates-

The present study samples were collected from different stations of Kshipra River from entire stretch, for a period of two years from July 2010 to June 2012. The substratum of River Kshipra is mainly composed of gravels, silt, clay, detritus, rock and macrophytic vegetation. Two sampling devices used; sieve (mesh size 0.6 mm) and hand net of the similar size. The sampling was carried out from the bank of river. Sample was placed on a sieve and washed with river water. Alive benthic Macro-invertebrates were picked up from the sample by forceps pins and preserved in 70% alcohol, for microscopic identification at laboratory. After isolation the macrobenthic organisms were counted and identified to using keys provided by Edmondson (1959), Needham and Needham (1974), Tonapi (1980), Mitra and Kumar (1998), Subba Rao (1989) and De zwart *et al.*, (1995).

## RESULTS AND DISCUSSION

The Kshipra River was found to be inhibited by a verity of benthic fauna all through the period of investigation. During the present investigation of a total 13 order of macro- invertebrates belongs to 3 Phylum Arthropoda, Mollusca and Annelida were recorded from Kshipra River. During monsoon Arthropoda contribute the largest share constituting 68.90% of total macro benthic-invertebrate fauna, followed by Mollusca (23.04%) and Annelida (8.05%) respectively showed in (Fig.- 2). In winter and summer Arthropoda also contributing largest share constituting (69.19%), (51.29%) of total macrobenthic invertebrates fauna, followed by Mollusca 21.15%, 9.66% and Annelida 9.66%, 21.03% respectively (Fig.- 3,4). Shukla and Shrivastava (2004) also reported similar observations.

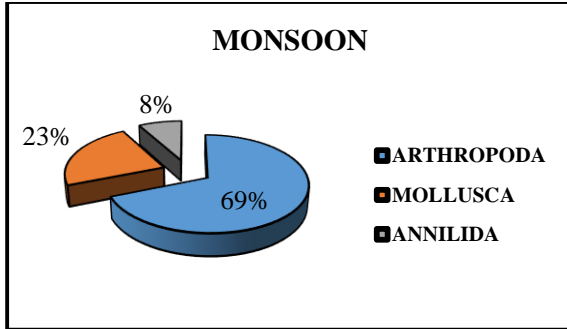


Figure 2: Seasonal percentage dominance of Benthic Macro-invertebrate Phylum's during monsoon.

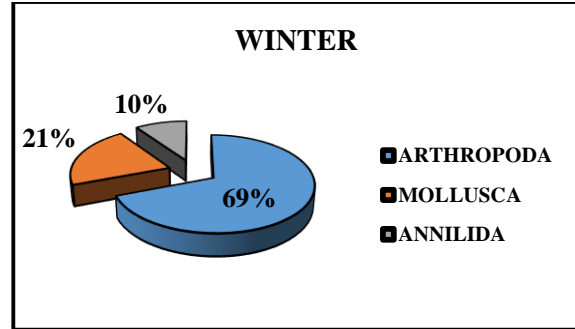


Figure 03: Seasonal percentage dominance of Benthic Macro-invertebrate Phylum's during winter.

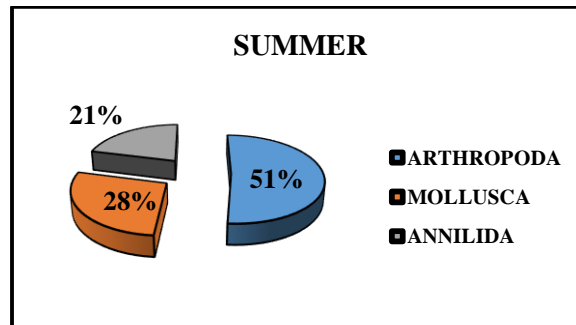


Figure 4: Seasonal percentage dominance of Benthic Macro-invertebrate Phylum's during summer.

**Ephemeroptera (May fly)**- May fly often an indicator of clean water quality and are also sensitive to pollution, but some of the tolerant species are also available. In the present study this order was represented by family Baetidae. Ephemeroptera do not tolerant organic enrichment but *Baetis sp.* is an exception in being tolerant of appreciable organic enrichment. The seasonal percentage dominance of Ephemeroptera was in monsoon (8.72%), followed by in winter (3.31%), while in (0.12%) in summer. These clearly indicate that the presence of Ephemeroptera in the monsoon and winter water quality was good in comparison to summer.

**Trichoptera- (Caddies fly)**- Trichoptera are important in aquatic ecosystem because they process organic matter and are an important food source for food fish. It is largest order on insecta, in which most members are truly aquatic. In the present study order Trichoptera represented by family Hydropsychidae. The seasonal percentage dominance of Trichoptera was reported in monsoon (6.49%), followed by (6.35%) in winter and (0.62%) in summer. Low frequency of Trichoptera in summer clearly indicate sever polluted water quality status in summer because Trichoptera are sensitive to pollution but can live in polluted water if good amount availability of food and oxygen. Similar distribution of Trichoptera was recorded by Flores and Zafaralla (2012).

**Placoptera (Stone fly)**- This is a smaller group yet contributing to the richness of fresh water fauna. Animals of this group are very sensitive to pollution. They are most abundant in cold, flowing waters with plenty of dissolve oxygen. They are normally found in the bottom of boulder, cobble or gravel. Order Placoptera represented by Family Chloroperlidae. During the study group Placoptera was reported only in monsoon (0.22%), which clearly indicates that water quality was good in monsoon in comparison to other season. Placoptera are most restricted to flowing water of relatively of abundance contribution of oxygen. Similar observation was reported by Rao *et al.*, (1987).

**Coleoptera-** Coleopterans, commonly known as water beetle. Beetles belong to the most diverse order of living organisms. Adult beetles are tolerant of a wide variety of pollutants. Often more than millions species of insecta at least one third are beetles. Order Coleoptera represented by family Hydrophilidae, Psephenidae, Gyrinidae and Dytiscidae. The seasonal percentage dominance of Coleoptera in monsoon was (11.41%), followed by (8.36%) in winter and (0.66%) in summer. The insects are not particular in their choice of water bodies and occur in wide variety of habitat. The abundance of Coleoptera in monsoon and winter can be related to the availability of food and macrophyte vegetation which helps in growth. Mishra and Prasad, (2013) also reported similar observations.

**Hemiptera-** They are commonly known as water bugs. This is a large order. Aquatic bugs live both in running and standing waters. Most of them are surface dwellers. Some of them are sensitive species but most of them prefer moderately polluted waters. They either carry air bubble while swimming or breathe through abdominal tube like siphon. This order represented by family Notonectidae, Gerridae, Belostomatidae, Corixidae and Nepidae. The seasonal percentage dominance of order Hemiptera in monsoon (18.79%), followed by (8.36%) in winter and (0.06%) in summer. During the study almost absence of Hemiptera in summer is related with high temperature, rainfall and severe pollution status affects the population fluctuation of Hemiptera. Habeeba and Saltant, (2014) also reported similar observations.

**Odonata-** The presence of these animals indicates input of little organic pollution in the slow moving or standing clean waters. They can be observed around water bodies, nymph of dragon is robust while damselfly is slender with distinct head, thorax and abdomen. Order Odonata represented by Family Coenagrionidae, Corduliidae and Gomphidae. The seasonal percentage dominance of order Odonata in monsoon (5.37%), followed by (2.70%) in winter and in summer completely absent. This observation clearly indicates highly polluted status in summer because Odonata nymph were found in only fresh water there is abundance of oxygen and unpolluted water. Lonkar and Kedar, (2014) also reported similar observations.

**Crustacea-** the animals of this group are moderately intolerant of pollution. These animals can be observed in variety of standing and flowing waters, hiding in plants of shallow waters under the debris and organic detritus. Order was represented by family Palaemonidae. The seasonal percentage dominance of Order Crustacea in monsoon (4.25%) and in winter (0.83%) while absent in summer. Sharma *et al.*, (2013) also reported similar observations.

**Diptera-** Diptera inhabits a wide range of habitat. They are very common indicator of highly polluted waters among the Diptera group. They represent the largest family of aquatic insects. These species are tolerant to the organic pollution and found in high abundance in sedimentation areas. Order Diptera was represented by family Chironomidae, Culicidae, Simuliidae, Dixidae, Ephydriidae, Tanyptodinae and Muscidae. The seasonal percentage dominance of order Diptera in summer (49.14%), followed by winter (23.41%) and (18.79%) in summer. Diptera is the most dominant group of Kshipra River, the most abundance of Diptera in summer related to characteristics and enrichment of nutrients, while minimum in monsoon due to increase volume of water and dilution of nutrients, Lonkar *et al.*, (2015) also reported similar observations.

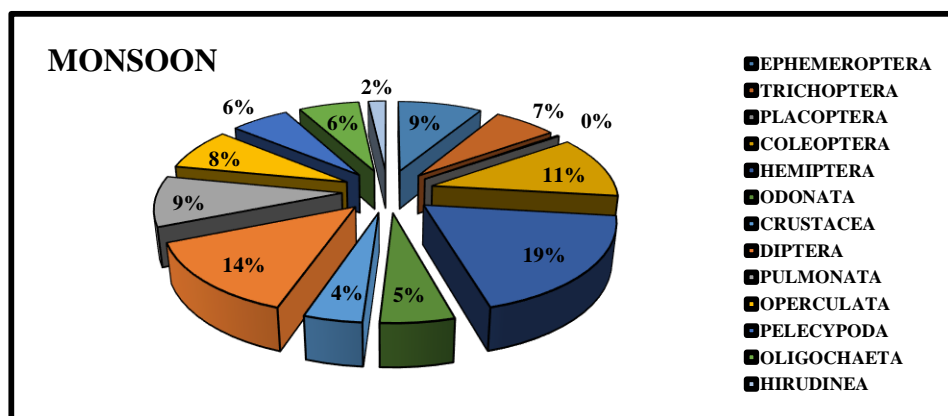
**Gastropoda-** Class Gastropoda represented by two orders Pulmonata and Operculata. Order Placoptera and Pulmonata represented by family Planorbidae, Lymnaeidae, Physidae, Viviparidae and Thiariidae. The seasonal percentage dominance of order Pulmonata was (27.00%) in summer, followed by (11.84%) in winter and (9.17%) in monsoon, although order Operculata higher in monsoon (7.83%), followed by (6.09%) in winter and (0.55%) in summer. Order Pulmonata is tolerant to pollution the abundance reports of this organism where enrichment the organic matter

and macrophyte, however order Operculata are intolerant to pollution. Waghmare *et al.*, (2012) also reported similar observations.

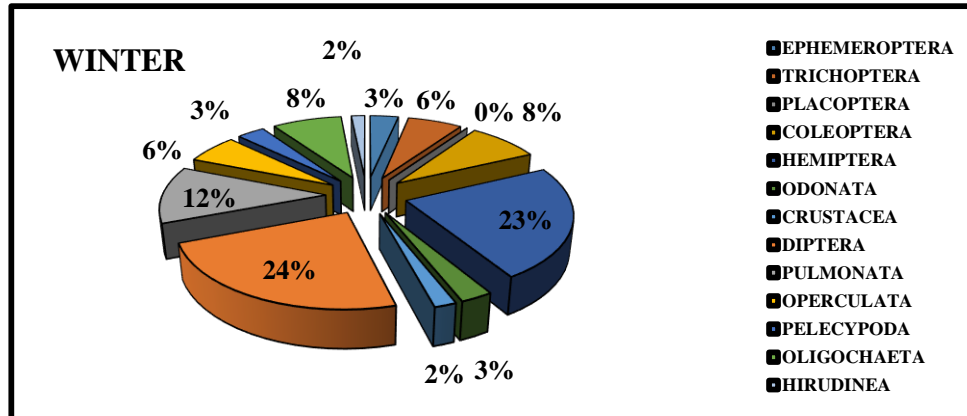
**Bivalvia-** Group Bivalvia represented by order Pelecypoda, family Corbiculidae and Unionidae. Bivalvia are less tolerant to pollution. The seasonal percentage dominance of Order Pelecypoda was (6.04%) in monsoon, followed by (3.22%) in winter and (0.12%) in summer. This observation indicates that water was moderate in monsoon and highly polluted in summer. Kumar and Vyas, (2012) also reported similar observations.

**Annelida-** Class Annelida represented by two orders Oligochaeta and Hirudinea. Oligochaeta are true worms of which the setae are arranged segmentally. The order Annelida represented by family Naididae and Tubificidae. Hirudinea commonly named leeches. These animals are indicator of highly polluted water and can live several days without oxygen. Both orders represented by family Glossiphonidae and Eropobdellidae. The seasonal percentage dominance of Order Oligochaeta (20.79%) in summer, followed by (8.09%) in winter and (6.26%) in monsoon, although percentage dominance of Hirudinea was (1.79%) in monsoon, followed by (1.57%) in winter and (0.25%) in summer. Abundance of Annelida in summer clearly indicates the enrichment of nutrients and severe pollution status. Similar observations reported by Abida (2013).

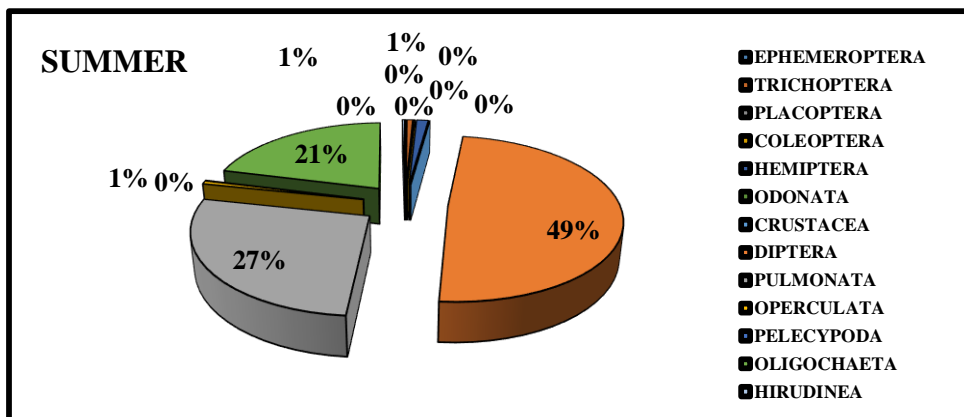
River Khan is the main source of industrial and sewage pollution of River Kshipra. On the basis of CPCB standers benthic macro-invertebrates as pollution indicator monsoon was showed moderate pollution, winter was highly polluted while summer was severe polluted status. It because of Kshipra River is not a perennial river and in summer and it transferred into disconnected turbid ponds, which highly rich of organic pollutants and shows severe pollution, in winter water quality was heavily polluted but enrich of nutrients, which helps to benthic growth, while in monsoon first flash of rain it change into flowing river and water quality improve in comparison to summer.



**Figure 5:** Seasonal percentage dominance of Benthic Macro-invertebrate Order during monsoon.



**Figure 6:** Seasonal percentage dominance of Benthic Macro-invertebrate Order during winter.



**Figure 7:** Seasonal percentage dominance of Benthic Macro-invertebrate Order during summer.

## CONCLUSION

It is conclude that during this study it is observed abundance of Macro benthic invertebrates was decreasing order winter > monsoon > summer. On the basis of abundance of macro benthic-invertebrates as pollution indicators, water quality of Kshipra River was moderately polluted in monsoon, highly polluted in winter and severe polluted in summer.

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