*Asian Journal of Water, Environment and Pollution,* Vol. 8, No. 3 (2011), pp. 83-87.

Short Note

# Studies on Pollution in River Chambal: Zooplankton in Relation to Water Quality

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*Received July 18, 2008; revised and accepted January 20, 2011*

**Abstract:** Progressive increase of pollution at three sampling stations selected on river Chambal is indicated by the physico-chemical characteristics and zooplankton. A total of 25 genera of zooplankton are recorded from three stations with a maximum (22) at the least polluted station and the minimum (13) at highly polluted station. *Keratella, Branchionus, Filinia, Daphnia, Cyclops* and *Cypridopsis* were found tolerant to different physico-chemical conditions. The diversity index was minimum (1.0 to 2.7) at highly polluted station and maximum (3.1 to 4.9) at the least polluted station.

**Key words**: Chambal river, physico-chemical factors, zooplankton, seasonal variation, diversity index.

## Introduction

The input of increasing load of pollutants and toxic substances into the surface waters has been causing serious disturbances in the aquatic ecosystems. The physico-chemical methods are used to detect effects of pollution on the water quality but changes in the tropic conditions in water are reflected in the biotic community structures as shown by occurrence, diversity and abundance pattern of the species (Cairns, 1979). The changes in community structures can be explained numerically with diversity index and are useful in assessing water quality based on the principle that clean water supports high community diversity while polluted waters have less diversified biota (Margalef, 1968). Zooplanktons are major trophic link in food chain and being heterotrophic organisms play a key role in cycling of organic materials in aquatic ecosystem. Thus monitoring them as biological indicators could act as forewarning, when pollution affects food chain (Mahajan, 1981). Thus, there are some studies on the utility of zooplankton in assessing water quality and pollution level (Zutshi et al., 1981; Gulati et al., 1982). This communication deals with the qualitative and quantitative study of zooplankton community of river Chambal, using Margalef's diversity index (Margalef, 1958), and to identify tolerant indicator genera of zooplankton.

## Materials and Methods

River Chambal, a principal tributary of river Yamuna, originates in the Vindhyanchal ranges near Mhow in Indore District of Madhya Pradesh. The river receives a large number of drains carrying inorganic and organic waste effluents. Three sampling stations were selected on the river: one at Bundi, second at Baran and third at Jhalawar (Longitudes: 73°20' and Latitudes: 22°27'), based upon different physico-chemical characteristics and pollutional loads (Figure 1). Three surface water samples were collected during monsoon (July/August), post-monsoon (October), winter (November/December) and summer (April/May) during 2005-2006 at each of the three study sites, Zooplankton were collected by filtering 20 litres of water using plankton net of bolting silk No. 40 and preserved in 4% formaline. The physico-chemical characteristics like temperature, dissolved oxygen, pH, free $CO_2$ and alkalinity were analysed at the site itself while $BOD_5$, hardness, chlorides, total solids,


**Figure 1: Map showing different sampling sites on River Chambal.**

conductivity, orthophosphate and nitrogen were analysed in the laboratory. The methods recommended by APHA (1991) are followed. Zooplankton density was estimated by counting them under microscope in Sedwick rafter cell. Identification was done according to (Fitter and Manual, 1986).

S1 – Upstream at Bundi.

S2 – Close to city area Baran where a large number of sewage channels join the river.

S3 – In Jhalawar near outside the city, where the river receives sewage and industrial effluents (44 km down stream).

Diversity index ($d$) was calculated using Margalef's formula (1958):

$$d = (S–1/\log N)$$

where, $S$ = total number of species (genera here)

$N$ = total number of individuals.

## Results

The alkalinity, hardness, conductivity, chloride, contents of total solids, orthophosphate and BOD, increased progressively from station S1 to S3 whereas dissolved oxygen content decreased in all seasons (Table 1). Twenty five genera of zooplankton were recorded from the study area. These included 9 rotifers, 6 cladocerans, 4 copepods, 3 ostracods, 2 protozoans and one arthopod larva (Table 2). The highest density of zooplankton was recorded during post-monsoon season (780 individuals $1^{-1}$) at S1 and the lowest (100 individuals $1^{-1}$) during winter season at station S3 (Figure 2).

The Rotifera accounted for 27.3% to 52.9% of total zooplankton at station S1, 18.2% to 47% at S2 and 29.5% to 50% at S3 (Figure 3). The dominant rotifers at three stations were *Keratella, Kellicottia, Brachionus* and *Filinia. Copepoda,* the next abundant group ranged from 29.4% to 42.5% at station S1, 23.6% to 45.4% at S2 and 15.5% to 60% at S3. Among copepods *Cyclops* was dominant. Cladocera, the third largest group ranged from 5.9% to 23.8% at S1, 7.2% to 23.5% at S2 and 15% to 53% at S3. Ostracoda were fewer and increased in their proportion from S1 only (Table 2 and Figure 3). Data on Margalef's diversity index (Table 1) shows that the diversity decreased from S1 to S3 in all seasons. A progressive decrease in the number of genera (22 to 13) was also recorded.

## Conclusion

A comparison of physico-chemical characteristics recorded in river Chambal with ISI tolerance limits for water quality (1982) shows that values for most parameters were below permissible limits, except BOD at station S1. At station S2, although most values exhibited an increase they were still below permissible limits. Here, BOD was higher while DO is low. Total solids, hardness and BOD were above permissible limits at S3. Dissolved oxygen content was lower. These observations clearly show increasing levels of organic pollution from station S1 to S3. Bhatti and Rana (1987) has emphasized the role of rotifers in assessing the water quality and stated the presence of *Keratella tropica, Filinia longiseta, Polyarthra multiappendiculata* and

**Table 1: Counts of Zooplankton collected from river Chambal**

| *Stations Seasons* | *Water Temp. °C* | *pH* | *Total solids mg $l^{-1}$* | *D.O. mg $l^{-1}$* | *Alkalinity mg $l^{-1}$* | *BOD mg $l^{-1}$* | *Chlorides mg $l^{-1}$* | *Total Hard mg $l^{-1}$* | *Cond. $\mu Scm^{-1}$* | *T.N. mg $l^{-1}$* | *Diversity* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **S1** | | | | | | | | | | | |
| Monsoon | 24.6 | 8.4 | 210 | 5.2 | 98 | 20.6 | 24.9 | 112 | 490 | 2.09 | 3.17 |
| Post Monsoon | 24.3 | 8.4 | 330 | 5.7 | 300 | 21.3 | 60.3 | 187 | 1051 | 1.78 | 3.52 |
| Winter | 20.5 | 7.6 | 375 | 6 | 170 | 10.8 | 17.2 | 145 | 430 | 2.8 | 3.81 |
| Summer | 23.8 | 8.4 | 415 | 4.8 | 140 | 14.7 | 17.5 | 132 | 560 | 1.8 | 4.98 |
| **S2** | | | | | | | | | | | |
| Monsoon | 23.9 | 8.4 | 267 | 3.5 | 126 | 25.6 | 58 | 142 | 420 | 3.8 | 2.46 |
| Post Monsoon | 25.1 | 8.4 | 365 | 5.1 | 316 | 21.2 | 69.3 | 165 | 1306 | 4.5 | 3.56 |
| Winter | 22.2 | 8.4 | 415 | 4.9 | 298 | 23.1 | 66.7 | 168 | 1412 | 3.9 | 3.54 |
| Summer | 24.6 | 8.4 | 390 | 3.9 | 175 | 19.2 | 63.2 | 190 | 756 | 3.6 | 3.24 |
| **S3** | | | | | | | | | | | |
| Monsoon | 25.7 | 8.4 | 570 | 2.6 | 155 | 33.2 | 85.1 | 203 | 347 | 7.1 | 2.5 |
| Post Monsoon | 25.2 | 8.4 | 490 | 3.9 | 456 | 38 | 82.2 | 218 | 1465 | 8 | 3.9 |
| Winter | 22.3 | 9.2 | 885 | 4.9 | 438 | 37.3 | 122.3 | 388 | 1670 | 8 | 1.8 |
| Summer | 26.2 | 7.6 | 810 | 3.5 | 516 | 20.3 | 213.5 | 450 | 2230 | 13.34 | 2.98 |
| **ISI (1982) Tolerance Limit** | | 6.5 –8.5 | 500 | 6 | — | 20 | 250 | 300 | — | — | — |

**Table 2: Species of Zooplankton collected from river Chambal**

| *Groups* | *Sampling Stations* *S1* | *S2* | *S3* |
|---|---|---|---|
| | *% seasonal distribution of zooplankton (range)* | | |
| Protozoa | *Arcella, Ceratium* (5.81–16.1) | — | — |
| Rotifera | *Keratella, Kellicottia, Brachionus, Filinia, Rotaria, Hexartha* (26.3–51.9) | *Keratella, Kellicottia, Brachionus, Filinia, Rotaria, Trichocerca* (19.2-48) | *Keratella, Kellicottia, Brachionus, Filinia, Trichocerca, Polyartha* (30.5-51) |
| Cladocera | *Daphnia, Ceriodaphnia, Bosmina, Eurycerus, Diaphanosoma* (6.9–22.8) | *Daphnia, Moina, Ceriodaphnia* (6.2–22.5) | *Daphnia, Ceriodaphnia* (5.1–52) |
| Copepoda | *Cyclops, Nauplius, Mesocyclops, Diaptomus* (28.4–41) | *Cyclops, Nauplius, Diaptomus* (22.6–46.5) | *Cyclops, Nauplius, Diaptomus* (16.5–61) |
| Ostracoda | *Cypris, Cypridopsis, Cyprinotus* (3.5–9.8) | *Cypris, Cypridopsis, Cyprinotus* (12.8–22.5) | *Cypris, Cypridopsis, Cyprinotus* (1.0–39) |
| Arthopoda (others) | *Stonefly, Nymph* (5.9) | — | — |
| Total Genera | 22 | 15 | 13 |

*Brachionus angularis* as indicators of pollution. In the present investigation, *Keratella, Kellicottia, Brachionus, Filinia, Daphnia, Ceriodaphnia, Cyclops* and *Cypridopsis* were common to all stations in different seasons, while *polyartha* at S3 only. This indicates their wide range of tolerance to different physico-chemical conditions and indication of pollution in river.

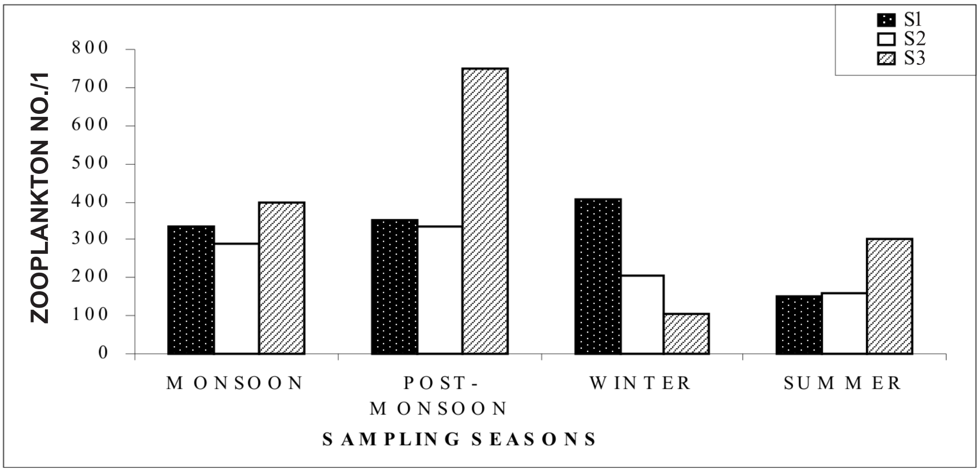


**Figure 2: Total population of zooplankton community during different seasons.**

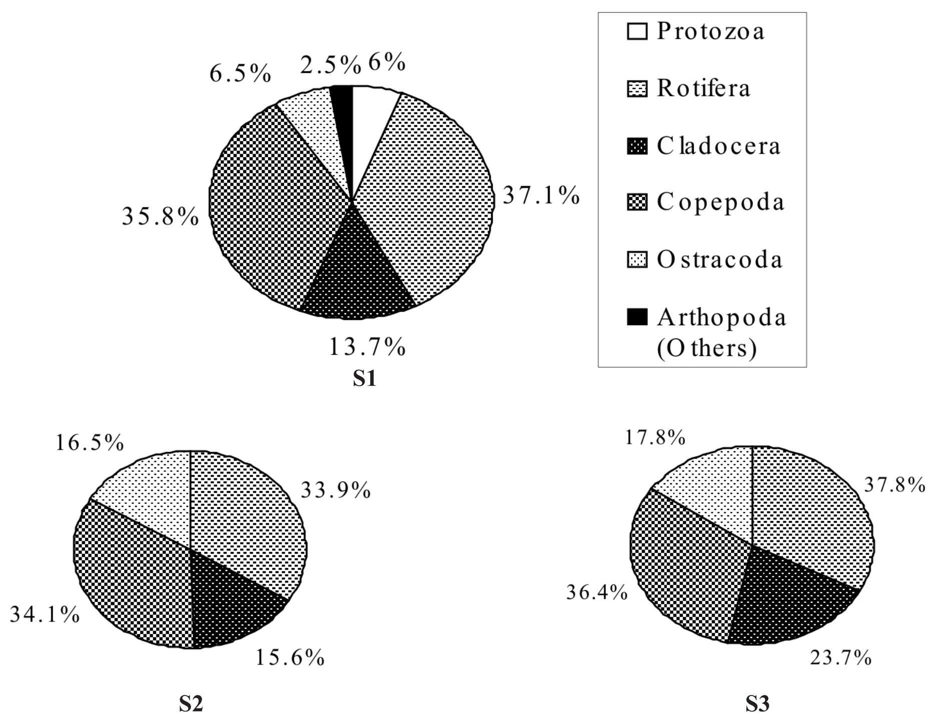


**Figure 3: Average percentage distribution of different zooplanktonic group at river Chambal.**

## Acknowledgements

We are thankful to the Ministry of Environment and Forest, Government of India, New Delhi, for funding the project namely National Water Quality monitoring programme to Central Pollution Control Board (CPCB) and to Dr. B. Sengupta, Member Secretary and Dr. R.C.Trivedi, Head of PAMS division to give me support and encouragement for this research work.

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# Calendar of Events

**The International Conference on Water Resources Management and Engineering (ICWRME 2011)**
22 to 24 July 2011
Zhengzhou, Henan, China
Website: http://icwrme.org/
Contact name: Miss Wang
Organized by: IAMSET

**Water Management in Mining 2011**
26 to 27 July 2011
Brisbane, QLD, Australia
Website: http://www.watermgmtmining.com.au
Contact name: Judy Hizon
Organized by: IQPC Australia/Mining IQ

**International Conference on Environmental Pollution and Remediation (ICEPR'11)**
17 to 19 August 2011
Ottawa, Ontario, Canada
Website: http://ICEPR2011.International-ASET.com
Contact name: ICEPR'11
Organized by: International ASET

**The 1st EIT International Conference on Water Resources Engineering**
18 to 19 August 2011
Cha Am, Phetchaburi, Thailand
Website: http://eitwre2011.fiet.kmutt.ac.th/index.php?lang=en
Contact name: Miss Posjanee Thiangthisong
Organized by: King Mongkut's University of Technology Thonburi

**The 19th International Conference on Environmental Indicators (September 11-14th, 2011) (ISEI)**
11 to 14 September 2011
Haifa, Israel
Website: http://isei2011.technion.ac.il/
Contact name: Prof. Robert Armon
Organized by: International Society of Environmental Indicators (ISEI)

**IV International Conference Lake Ecosystems: Biological Processes, Anthropogenic Transformation, Water Quality**
12 to 17 September 2011
Minsk, Belarus
Website: http://make-your-conference.com/naroch2011/en
Contact name: Alexander Ostapenya
Organized by: Belarusian State University

**Groundwater: Our Source of Security in an Uncertain Future**
19 to 21 September 2011
Pretoria, Gauteng, South Africa
Website: http://www.pdfdownload.org/pdf2html/view_ online.php?url=http%3A%2F%2F-www.gwd.org.za%2Fsites%2F-default%2Ffiles%2FCall%252
Contact name: Cilla Taylor
Organized by: Ground Water Division of the Geological Society of South Africa in association with the International Association of Hydrogeologists

**14th International River Symposium**
26 to 29 September 2011
Brisbane, Queensland, Australia
Website: http://www.riversymposium.com
Contact name: Carla Mathisen
Organized by: International Water Forum