INTERNATIONAL JOURNAL OF APPLIED BIOLOGY AND PHARMACEUTICAL TECHNOLOGY

www.ijabpt.com ISSN : 0976-4550

Volume-6, Issue-2, April-June-2015 Coden IJABFP-CAS-USA Copyrights@2015

Received: 26th Mar-2015 *Revised: 24th April -2015* *Accepted: 24th April-2015*

Research article

MACROBENTHIC DIVERSITY DURING PRE AND POST DROUGHT PERIOD OF A FLOODPLAIN WETLAND IN VAISHALI DISTRICT OF BIHAR

Pankaj Patial[1]*, M.A. Hassan[2], A.P. Mishra[1]

[1]P.G. Department of Zoology, B.R.A. Bihar University, Muzaffarpur (Bihar), India- 842002
[2]Central Inland Fisheries Research Institute, Barrackpore, Kolkata (West Bengal), India -700120
*email: patialpankaj24@rediffmail.com

ABSTRACT: Qualitative and quantitative estimation of macrobenthic fauna was done during pre and post drought period. A total of 18 species of macrobenthos were recorded during pre drought and 17 in post drought period. Maximum number of species was reported in Mollusca followed by Diptera and Oligochaeta. The average contribution of Mollusca was 94.72%, Dipetra 2.98% and Oligochaeta 2.30% to total benthic species of the *Chaur*. *Bellamya bengalensis, Gabbia orcula, Gyraulus convexiusculus, Lymnaea acuminata* and *Lymnaea auricularia* were the molluccs which were found in all the monthly samples. Number wise *Gyraulus convexiusculus* was most abundant followed by *Gabbia orcula* while *Lamellidens marginalis* and *Pila glabosa* were the least abundant. In pre drought period average number of macrobenthos was 3176/m^2 while in post drought period, it was 2676/m^2. Analysis of the various index showed that diversity of benthic fauna was higher in WIN season followed by RMON, PRM and MON season. Winter seems to be a favourable season for benthic organisms. Availability of different species of mollusks indicated the good cultural and unpolluted condition of *Chaur*.

Key words: Macrobenthos, Diversity, Drought, Wetland and Bihar.

INTRODUCTION

The flood plain wetlands support a rich variety of biotic communities like benthos, planktons, periphyton, macrophytes, insects, fish and other fauna. Benthos includes organisms that live on and in bottom sediments of water resources. They also live in, on or roam freely over rocks, organic debris, submerged plant parts during their life cycle. They occupy this niche of ecosystem for the purpose of food, shelter and reproduction. Benthic fauna forms an important component of the food chain for the higher animal taxa transferring energy and matter from phytoplankton, macrophytes and zooplankton to fishes, amphibians, reptiles, birds and mammals (Prabhakar and Roy, 2008). The dominant benthic organisms are the immature stages of almost all orders of insect group. Other major benthic fauna include oligochaete, crustacean and mollusk. These groups contain highest animal biodiversity of the biosphere.

Macro benthic organisms can serve as excellent diagnostic indicators for measuring the extent of pollution of aquatic ecosystem. The distribution, composition and abundance of benthic community are biological indicators of water and sediment quality and trophic status at the soil – water interface (Pandey et. al., 1983). Rich bottom coupled with conductive physico-chemical conditions encourage fast colonization of the benthic community. The low number of species and density of benthic life is attributed to low bottom oxygen (Ramulu et. al., 2011).

Among open water resources of Bihar, the floodplain wetland locally called *Chaur* offers immense scope for fisheries development. The relative abundance and dominance of benthos vary in different *Chaurs*, depending on their hydrodynamics and morpho-ecological conditions. They also vary from season to season within the same *Chaur*. There are some studies related to benthos of wetlands in Bihar (Singh et. al., 1994; Prabhakar and Roy, 2008; Ojha et. al., 2010). Study of macro benthic fauna is important for fisheries management in *Chaurs*. Considering its importance, the survey of the benthic community of the Sakari *Chaur* was made and their seasonal fluctuations had been recorded. The objective of this study was to know the standing crop, diversity, abundance and seasonal variations of macrobenthic fauna.

MATERIAL AND METHODS

Sakari *Chaur* measuring water area of 22.3 ha is located at eastern side of River Ganges in Jandaha block, Vaishali district of Bihar, adjacent to National Bird Sanctuary, Baraila *Chaur*. The *Chaur* is flanked by two tributaries of river Ganga viz. Vaya and Noon River. Water abstraction for irrigation, agriculture in marginal area, cattle bathing and traditional fishing are the only anthropogenic activity in the *Chaur*. Both the soil and water of the *Chaur* is being utilized for soil fertility improvement and irrigation of crops, respectively, in the adjacent areas. Profuse growth of higher aquatic plants like *Nelumbo, Nymphoides, Hydrilla, Vallisneria, Ipomea, Bacopa* occupies both column and surface of the water spread.

Qualitative examination or quantitative estimations of benthic fauna was made from January 2009 to December 2013. Benthic samples from the wetland were collected with the help of an Ekman dredge. Samples were collected, pooled, diluted and sieved through 6 mm sieve. Samples were stored in plastic jars with 4 ml of formalin to 100 ml of sample and analysis was done in laboratory. For qualitative analysis, benthic organisms were examined using inverted microscope and standard keys (Needham and Needham, 1962; Edmondson, 1965; Ward and Whipple, 1992). However, for quantitative analysis, individual were counted species-wise in the whole sample. The number of benthos per unit area was calculated as follows:

$$\text{Benthos nos./m}^2 = \frac{N}{A} \times 10^4$$

Where:

N = Number of organisms per sample and A = Biting area of sampler

Species diversity index, evenness index and dominance were calculated by software PAST Version 2.17. To evaluate the diversity, annual cycle was divided into four seasons as PRM (Pre-monsoon i.e. March-May), MON (Monsoon i.e. June-August), RMON (Retrieving monsoon i.e. September-November) and WIN (Winter i.e. December-February).

RESULTS

A total of 18 species of macrozoobenthos were recorded during pre drought and 17 in post drought period. Maximum number of species was reported in Mollusca followed by Diptera and Oligochaeta. The molluscs reported from the *Chaur* were *Bellamya bengalensis, Bellamya dissimilis, Digoniostroma ceraneopoma, Gabbia orcula, Gyraulus convexiusculus, Indoplanorbis exustus, Lamellidens marginalis, Lymnaea acuminata, Lymnaea auricularia, Melanoides tuberculata, Parreysia corrugata, Pila globosa* and *Segmentina calathus*. Study revealed that Diptera was represented by *Chironomus, Tanypus, Chaoborus* sps. and Oligochaeta by *Lumbriculus and Tubifex* sps. *Bellamya bengalensis, Gabbia orcula, Gyraulus convexiusculus, Lymnaea acuminata* and *Lymnaea auricularia* were the molluccs which were found in all the monthly samples. Number wise *Gyraulus convexiusculus* was most abundant followed by *Gabbia orcula* while *Lamellidens marginalis* and *Pila glabosa* were the least abundant.

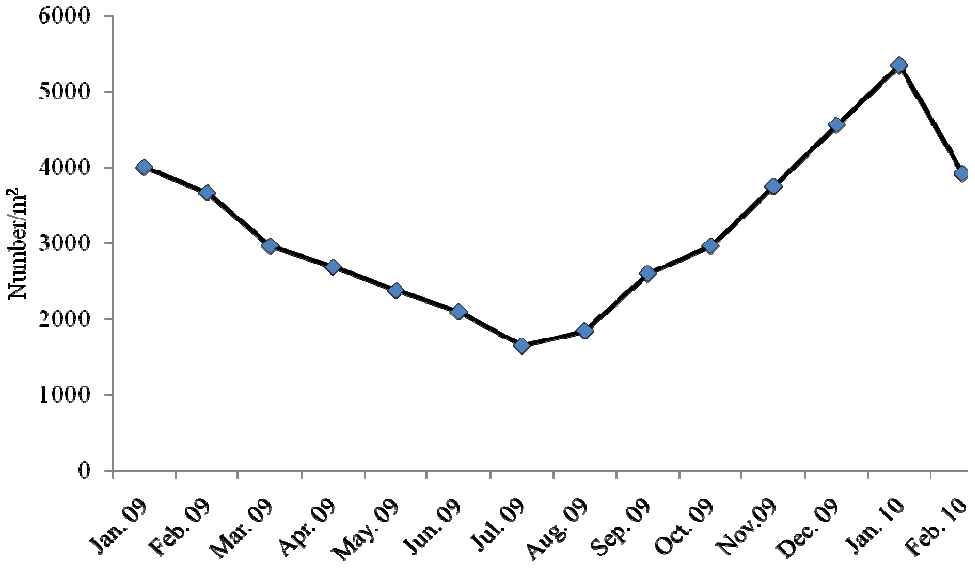

Figure 1: Monthly variations of macrobenthos/m^2 during pre drought period.

Quantity of benthos was found to be increasing from RMON to maximum in WIN and then started decreasing after WIN and minimum in MON season. Maximum number of macrobenthos was recorded in the month of January and minimum in July. In pre drought period average number of macrobenthos was 3176/m^2 while in post drought period, it was 2676/m^2. These numbers indicate suitability of *Chaur* for the growth of macrobenthos. Species *Parreysia corrugata* was not reported in post drought period while all other species composition was same in pre and post drought period. The average contribution of Mollusca was 94.72%, Dipetra 2.98% and Oligochaeta 2.30% to total benthic species of the *Chaur*. Mollusca, Dipetra and Oligochaeta exhibited monthly variations in quality and quantity of benthos. Monthly variations in benthos population before and after drought are represented in Fig. 1and 2. Different diversity indices are given in Table 1. Analysis of the various indices showed that diversity of benthic fauna was higher in WIN season followed by RMON, PRM and MON season.

Table-1: Species Richness, abundance and various Biodiversity Indices during different seasons

	Pre drought				**Post drought**			
SEASON	PRM	MON	RMON	WIN	PRM	MON	RMON	WIN
Taxa_S	16	15	17	18	15	13	16	17
Individuals	2677	1866	3109	4613	2090	1531	2845	4261
Dominance_D	0.2291	0.2318	0.2221	0.2041	0.2287	0.2355	0.2182	0.2121
Simpson_1-D	0.7709	0.7682	0.7779	0.7959	0.7713	0.7645	0.7818	0.7879
Shannon_H	1.934	1.916	1.947	1.98	1.93	1.854	1.966	1.98
Evenness_e^H/S	0.4324	0.453	0.4122	0.4023	0.4593	0.491	0.4465	0.4261
Margalef	1.901	1.859	1.99	2.015	1.831	1.636	1.886	1.915
Equitability_J	0.6976	0.7076	0.6872	0.685	0.7127	0.7227	0.7092	0.6989

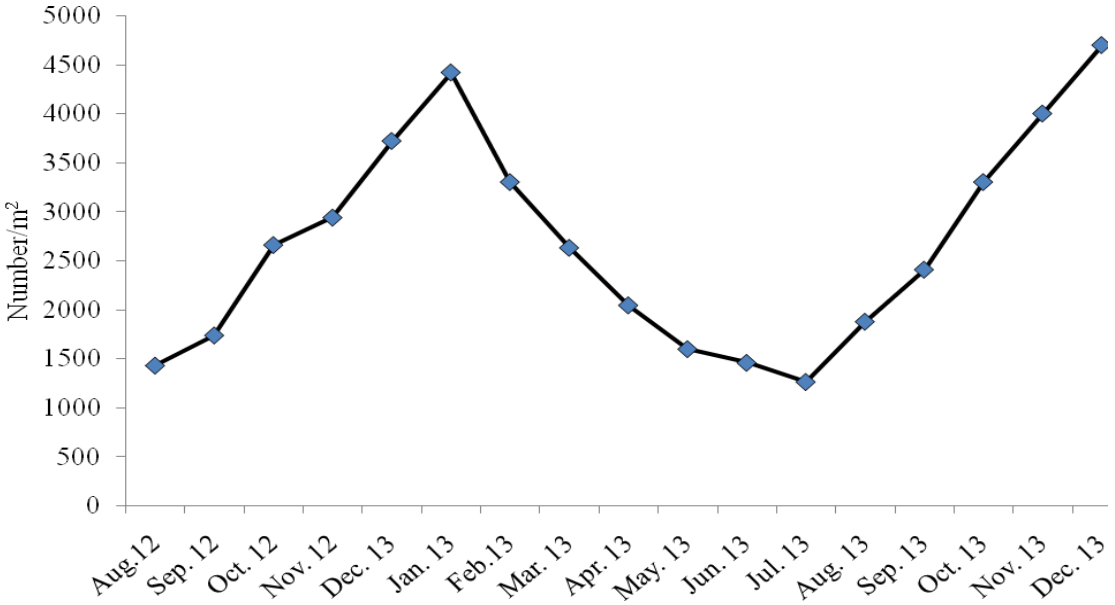

Figure 2: Monthly variations of macrobenthos/m^2 during post drought period.

DISCUSSION

The present study on the benthos in sakari *Chaur* revealed that the *Chaur* was rich in diversity of molluscan fauna. In the aquatic ecosystem, mollusks play a key role in aquatic food chain. They are important to mankind due to their nutritive, pathological and commercial importance (Pandey et. al., 1983). Invertebrates are abundant and diverse in most of the aquatic habitats and are relatively easy to sample and analyze (Dahegaonkar et. al., 2011). A total of 18 species of macrobenthos were sampled and identified from Sakari *Chaur*. Out of 18 species, 13 belonged to Mollusca, 3 to Diptera and 2 to Oligochaeta. Many aquatic invertebrates have specific and narrow habitat requirement and are therefore restricted to places that fluctuate little from year to year. Others are general and can survive over a wide range of habitat types. All the mollusks species reported from the *Chaur* have been commercially exploited by the people of North Bihar (Prabhakar and Roy, 2008). These Molluscs are the chief source of food supplement and low cost of protein to middle income group of people and thus also act as intermediate food stuffs between cereals and high protein sources such as fishes and birds.

During pre drought period, the contribution of Mollusca was 94.77%, Dipetra 3.09% and Oligochaeta 2.14% while during post drought period, the contribution of Mollusca was 94.66%, Dipetra 2.87% and Oligochaeta 2.47% to the total benthic species. Number of species reported from *Chaur* was higher (18 species) in pre drought as compared to post drought period (17 species). Species composition was same in pre and post drought except for one species i.e *Parreysia corrugata* which was not reported from *Chaur* in post drought period. In post drought period average number of macrobenthos/m^2 was lower than that of pre drought period. Lower number of macobenthos in post drought period was due to the reason that drought completely dried the *Chaur* and the benthos population takes time to colonize and get established in water body by utilizing available nutrients. In pre drought period minimum number of individual was reported in July (1652 nos./m^2) and maximum in January (5348 nos./m^2). Similarly, in post drought period minimum number of individual was 1260 nos./m^2 (July) and maximum was 4704 nos./m^2 (January). The macrobenthic fauna were found mostly associated with aquatic macrophytes. It was observed that the appreciable seasonal changes of their population may be correlated with the appearance and disappearance of macrovegetations of the *Chaur* (Laal, 1981).

Number of benthos per unit area was found to be increasing with RMON to WIN, then started decreasing after WIN to PRM season and was lowest in MON season. This seasonal variation in the abundance of individuals indicates that temperature have a pronounced influence on their life cycle. In the wetland ecosystem, the significance of bottom fauna as a link in the energy flow from primary productivity to fish yield is well known. The abundance, population density and diversity of benthic fauna mainly depends on physical and chemical properties of their habitat as they respond more quickly if any change in water quality occur (Kumar et. al., 2006; Sharma and Rawat, 2009). Macrobenthic fauna can be used as indicators for bio-assessment (Sharma et. al., 2010) because of presence or absence of particular benthic species in a particular environment and habitat conditions. These can be used as barometer of overall biodiversity of an aquatic ecosystem (Ramulu et. al., 2011). Benthic fauna are especially of great significance for fisheries as they themselves act as food of fishes (Mohan et. al., 2013).

Comparison of different diversity indices for pre and post drought period is given in Table 1. Maximum number of species and individuals was recorded in WIN followed by RMON, PRM and MON, both during pre and post drought period. Diversity indices provide important information about rarity and commonness of species in a community (Naumoski, 2012). Analysis of the Shannon and Simpson index of diversity showed that diversity of benthic fauna was higher in WIN followed by RMON, PRM and MON season. The high values of indices showed high taxon richness and high relative abundance of benthos which was due to favourable physicochemical and trophic factors (Vyas and Bhat, 2010). As the species diversity index and species richness index depend upon the number of species as well as number of individuals in each species and contributes equally to these index values (Ludwig and Reynolds, 1988), hence decreases or increases in any one of these two variables will influence the overall values of these indices. Maximum species richness in term of Maraglef's index was seen in WIN and minimum in MON season. Mohan et. al. (2013) also reported maximum value of these indices in WIN season. Evenness reflects the abundance of population within a habitat. Evenness was highest in case of MON and lowest in WIN season. This means that species evenness decreased with increase in the size of population.

It was observed that resource partitioning and niche specialization are the most common ecological features of the species. The benthic macro invertebrates are the biological community which is most frequently used to assess the water quality in aquatic ecosystem. Mollusks are indicative of non-polluted water and O_2 rich habitat (Prabhakar and Roy, 2008). Presence of peaks of *Chironomus* larvae and *Tubifex* indicate the effect of pollution (Mohan et. al., 2013). In sakari *Chaur*, *Chironomus* (1.2%) and *Tubifex* (1.3%) were very less during pre drought period. Similarity in post drought period *Chironomus* (1.0%) and *Tubifex (*0.8%) were negligible. Existence of diverse taxonomic forms in present study indicated unpolluted environmental conditions of the *Chaur*.

CONCLUSION

The diversity, abundance and dominance of benthos indicate well established balanced ecosystem for supporting a complex food web existing in Sakari *Chaur*. The abundance of benthic communities in terms of species diversity indicates a good life support system for fishes, birds and human. Species composition indicated unpolluted conditions of the *Chaur*. Since benthic communities form an important link in the energy flow from primary producers to fish, a thoughtful utilization and conservation of the benthic community and their habitat may increase the fish production from these water resources. The Present study will be helpful in developing the fisheries management programs in the *Chaur* areas of Bihar.

REFERENCES

Dahegaonkar N.R, Telkhade P.M, Rohankar L.H. and Bhandarkar W.R. (2011). Studies on diversity of benthic macro invertebrates in two lotic ecosystems near Chandrapur, Maharashtra, India. Golden Research Thoughts. I(IV): 1-4.

Edmondson W.T. (1965). Freshwater biology. John Wiley and Sons, Inc. New York.

Kumar A., Qureshi T.A. and Alka P. (2006). Biodiversity assessment of macroinvertebretes in Ranjit Sagar reservoir, Jammu, J&K, India. Journal of Aquaatic Biology. 21(2): 39-44.

Laal A.K. (1981) Studies on the Ecology and productivity of swamps in North Bihar in relation to production of fishes and other agricultural commodities. PhD Thesis, Department of Zoology, Bhagalpur University, Bhagalpur.

Ludwig J.A. and Reynolds J.F. (1988). Statistical Ecology- A Primer on Methods and Computing. John Wiley and Sons, New York.

Mohan V.C., Sharma K.K., Sharma A. and Watts P. (2013) Biodiversity and Abundance of Benthic Macro-invertebrates Community of River Tawi in Vicinity of Udhampur City (J&K) India. International Research Journal of Environment Sciences. 2(5): 17-24.

Naumoski A. (2012). Multi-target modelling of the diatom diversity indices in Lake Prespa. Applied Ecology and Environmental Research. 10(4): 521-529.

Needham J.G. and Needham P.R. (1962). A guide of the study of freshwater biology. Holden Day Inc., San Francisco, p.108.

Ojha N.K. Kumar N., Pandey M.K. and Yadav R.N. (2010). Studies on macrobenthic community of paddy field of rural Chapra. The Bioscan. 2: 579-585.

Pandey K, Radheyshyam, Prasad S. and Chaudhury H.S. (1983). A study on the macrozoo benthos and the physico–chemical characteristics of the bottom of Bakhira Lake, Uttarpradesh, India. International Revue Der Gesamten Hydrobiology und Hydrographie. 68(4): 591-597.

Prabhakar A.K. and Roy S.P. (2008). Taxonomic diversity of shell fishes of Kosi region of North-Bihar (India). The Ecoscan. 2(2): 149-156.

Ramulu K.N, Srikanth K, Ravindar B. and Benarjee G. (2011). Occurrence of macro-zoo benthos in relation to physico-chemical characteristics in nagaram tank of Warangal, Andhra Pradesh. The Bioscan. 6(1): 89-92.

Sharma C. and Rawat J.S. (2009). Montoring of aquatic macroinvertebrates as bioindicator for assessing the health of wetlands, A case study in the central Himalayas, India. Ecological Indicators. (9)**:** 118-128.

Sharma S, Joshi V, Kurde S. and Singhvi M.S. (2010) Biodiversity And Abundance Of Benthic Macroinvertebrates Commiunity Of Kishanpura Lake, Indore (M.P.) India**.** Researcher. 2(10): 57-67.

Singh U.N, Veena O. and Singh G.P. (1994). Qualitative and quantitative study of benthic fauna of Kararia Lake of Motihari, Bihar. Journal of Freshwater Biology. 6(1): 21-25.

Vyas V. and Bhat M.A. (2010). Macrozoobenthic diversity of tropical water body (Upper Lake) Bhopal. The Ecoscan. 4: 69-72.

Ward H.B. and Whipple G.C. (1992). Freshwater biology (2nd Ed.). Indian reprint, International Books and Periodically supply Service, New Delhi. p.1247.

ISSN : 0976-4550

INTERNATIONAL JOURNAL OF APPLIED BIOLOGY AND PHARMACEUTICAL TECHNOLOGY

Email : ijabpt@gmail.com

Website: www.ijabpt.com