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Seasonal Variation in Micro-Biodiversity in Mixed Water of River Jhelum and Chenab at Head Trimmu, District Jhang, Punjab, Pakistan

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Abstract: The current study was undertaken from September 2007 till June 2008. Purpose of the study was to investigate the seasonal variation in micro-biodiversity in the mixed water of River Jhelum and River Chenab at Head Trimmu, District Jhang by analyzing the frequency of occurrence, relative abundance and diversity index of planktonic life. The total number of observed genera was 84. Of the total 74 genera were of phytoplankton and zooplankton was embodied to 8 genera. A total of 1116 organisms were observed, of which 1092 organisms were of phytoplankton and 24 were belonging to zooplankton. Relative abundance of phytoplankton in all samples was 97.85% and of zooplankton was 2.2%. Diversity index of both phytoplankton and zooplankton was the highest in September. Maximum diversity index for phytoplankton was observed in September (3.47) and minimum in June (0.45). Maximum diversity index for zooplankton was in February (1.12) whereas zero (0) in all months except September and February. The most dominant phylum of phytoplankton was Bacillariophyta while Protozoa was the dominant one among zooplankton.

Key words: Seasonal Variation · Micro-Biodiversity · Mixed Water · Jhelum · Chenab

INTRODUCTION

The term "water quality" in its broadest sense includes all physical, chemical and biological characteristics of water [1]. Water quality is the physical, chemical and biological characteristics of water in relationship to a set of standards. Water quality standards are created for different types of water bodies and water body locations per desired uses. A continuous monitoring of water quality is very essential to determine the state of pollution in our rivers. This information is important to be communicated to the general public and the Government in order to develop policies for the conservation of the precious fresh water resources [2, 3].

Aquatic biodiversity can be defined as the variety of life and the ecosystems that make up the freshwater, tidal and marine regions of the world and their interactions. Aquatic biodiversity encompasses freshwater ecosystems, including lakes, ponds and reservoirs, rivers and streams, groundwater and wetlands. Aquatic ecosystems also provide a home to many species including phytoplankton, zooplankton, aquatic plants, insects, fish, birds, mammals and others. Fresh water environments unlike the marine ones are subjected to variations in the environmental factors such as temperature, dissolved oxygen, light penetration, turbidity, density etc. These factors are responsible for distribution of organisms in different fresh water habitats according to their adaptations, which allow them to survive in that specific habitat [4]. Plankton community is a heterogeneous group of tiny plant (phytoplankton) and animals (zooplankton) adapted to suspension in the sea and fresh water [5, 6]. The component of phytoplankton communities and relative abundance of component species undergo continuous changes and on varying scale [6, 7]. The climate characteristics influence the water quality and quantity affects the biodiversity [6, 8].

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Pakistan's biodiversity is a blend of elements from different origins - diverse and interesting species in a number of rich ecosystems. The river Jhelum rises from a spring at Verinag situated at the foot of the Pir Panjal in the south-eastern part of the valley of Kashmir. The Jhelum enters the Punjab in the Jhelum District. It ends in a confluence with the Chenab at Trimmu in District Jhang. The total length of river Jhelum is 480 miles (772 km) and in Pakistan its length is 379 miles.

The River Chenab originates in the Kulu and Kangra districts of the Himachal Pardesh province of India. The two chief streams of the Chenab-the Chandrs and the Bhaga-rise on opposite sides of Baralcha. It enters Pakistan through the Sialkot district, near Diawara Village. The Chenab flows through the alluvial plains of the Punjab province in Pakistan for a distance of 3,398 miles. It is then joined by the Jhelum River at Trimmu. 40 miles downstream of Trimmu, the River Ravi joins it. The total length of the river is about 772 miles, of which approximately 453 miles flow through Pakistan.

The biodiversity of any aquatic body depicts its picture portraying its pollution status, community composition in general and diversity specifically. There the current study was undertaken at district Jhang on mix water of river Jhelum and Chenab in order to evaluate its micro biodiversity and seasonal variation in occurrence of phytoplankton and zooplankton.

MATERIALS AND METHODS

Water Collection and Preservation: Water samples preserved in 20% formalin solution were for qualitative and quantitative study of phytoplankton and zooplankton [5]. Temporary slides were prepared of 8 drops of each sample and examine under electric microscope.

By using standard literature the phytoplankton and zooplankton were identified up to the generic level such as [5, 9-14].

Frequency of occurrence (%) and relative abundance (%) of each genus and phytoplankton and zooplankton was calculated in 10 samples of the union site of river Jhelum and Chenab at Head Trimmu.

The frequency of occurrence (%) of different divisions of phytoplankton and zooplankton was also calculated by using formula:

$$Frequency\ of\ occurrence\ (\%) = \frac{\text{Present in no drops / sample} \times 100}{Total\ number\ of\ drops / sample}$$

$$\text{Relative abundance}\ (\%) = \frac{No.of\ individual\ of\ each\ genus\ or\ division \times 100}{Total\ number\ of\ organism}$$

+ = + Relative abundance of each genus/ division of phytoplankton and zooplankton

Diversity Indices: A diversity index of phytoplankton and zooplankton was calculated with the help of following formula:

$$H = \frac{S-1}{InN}$$

In = natural log
H = Diversity index
S = total number of genera of phytoplankton or zooplankton
N = total number of phytoplankton or zooplankton

RESULTS AND DISCUSSION

Biological Parameters: The distribution of phytoplankton and zooplankton are given in detail in the following lines. During the study period 74 genera of phytoplankton were observed. Those were Bacillariophyta (6 genera), Cyanophyta (10 genera), Chrysophyta (2 genera), Chlorophyta (11 genera) and Xanthophyta (1 genus). The genera of zooplankton in numbers were 8 including 6 genera of Protozoa and 1 genus of Rotifera. Total number of organisms (phytoplankton + zooplankton) observed were 1116. Out of the total, number of phytoplankton was 1092 and of zooplankton were 24.

Frequency of Occurrence: Members of two phyla *i.e.* Bacillariophyta and Chlorophyta were present throughout the study period. Members of Cyanophyta were present in all months except five months i.e. February, March, April, May and June. Members of Xanthophyta were present only in the months of December and January. Members of Chrysophyta were seen only in the month of September.

Among zooplanktons members of Protozoa were present only in September, November, February and March. Members of Rotifers were seen only in September. Among Bacillariophyta, *Nitzschia* was most abundant and found in all months. *Melosira* was absent in the months of November, December, January, February and April. *Synedra* was absent in February, *Tabellaria* was absent in September, March, April, May and June. *Epithemia* was present in just the months of November, December and February. *Gyrosigma* was observed only in September and February.

Among Cyanophyta, *Phormidium* was absent in February, March, April, May and June. *Raphidiopsis* was

present in the months of September, October, November and January. *Gloeotrichia* was present in October, November and January. *Spirulina* was present only in October and November. *Tetrastrum* was present only in September and December. *Tetrastrum* was present only in September and December. *Anabaene* was present in December. *Coelosphaerium*, *Snowella, Lyngbya* and *Aphanotheca* were present only in September.

Among Chrysophyta, *Asterionella* and *Rhizosolenia*, both were present only in September and were absent in all other months.

Among Chlorophyta, *Closteriopsis* was present only in October, January, April, May and June. *Gonatozygon* was present only in September, December and March. *Treubaria* was present only in October, February and March. *Micrasterias* was absent in all months except November and December. *Pleurotaenium* was absent in all months except October and April. *Scenedesmus* and *Closterium* were present only in September. *Chlamydomonas* and *Echinosphaerella* was absent in all months except November. *Staurastrum* was present only in March. Among Xanthophyta, *Tribonema* was absent in all months except December and January.

Among zooplankton, Protozoan has 6 genera of which *Aursella* and *Acanthocystis* were present only in September and *Lionotus* and *Actinophaerium* were present only in February. *Difflugia* was present in February and March. *Frontonia* was present only in November. Among Rotifers, *Scaridium* was present only in September and was absent in all other months.

Relative Abundance: Phytoplankton was most abundant as compared to zooplankton during the whole study time. Zooplankton was maximum in September and minimum in February.

Diversity Indices: Diversity index of phytoplankton ranges from 0.45 to 2.92. It was maximum in September and minimum in June. Diversity index showing the decreasing trend from September to October then from October to December it shows increasing trend. From January to June it shows decreasing trend.

Diversity index of zooplankton was from 0 to 1.12. It was Maximum in February and minimum, that is zero, in October, December, January, March, April, May and June.

River Jhelum and Chenab show great variation in the seasonal distribution of organisms. The present study was conducted from September 2007 to June 2008. Sampling was done at day time from the surface of the river at union site. It was observed that the phytoplankton was remaining dominant as compared to zooplankton because phytoplankton was present on the surface due to photosynthesis activity. Highest value of temperature that was recorded during the study period at union site of river Jhelum and Chenab as 38°C in the month of June. This high temperature affected the number of zooplankton. Zooplankton was even not found in the months of April, May and June. Phytoplankton was found but their percentage was very low. In other months the temperature was in ideal range.

Turbidity shows an inverse relationship with light penetration because due to the high turbidity light can't reach into the water. Any variation beyond acceptable range could be fatal to a particular organism [15]. During study period, it was observed that the turbidity was low. It may be due to the reason that sampling was done from September to June. In these months water becomes less turbid as these are not moon soon months in which water show different chemistry as comparing to others. Floods and rains make water highly turbid with the presence of clay, organic matter and sand [2] reached the same conclusion working on physicochemical characteristics of mixed water of river Ravi and Chenab.

The pH of water is important because many biological activities can occur within a narrow range. During the study period pH ranging from 6.3 to 7.55 was recorded. A pH 6.3 was recorded in December and January which shows slow growth of organisms as described in safe levels of different parameters.

Diversity index is a good indicator of pollution in aquatic ecosystem [16]. When the value of diversity index becomes greater than 3, it indicates that water is clear, when it is in the range of 1-3, water becomes moderately polluted, but when is less than 1 and water becomes highly turbid [17, 18]. In the present study diversity index ranged from 0.45 to 3.47. In the months of October, November, December, January, February and March the water was moderately polluted because the diversity index was1 to 3 in the months of April, May and June the water was highly turbid because the diversity index was less than 1.

CONCLUSION AND RECOMMENDATIONS

The present study showed a normal range of all important parameters. The values of diversity indices were falling between 0 and 2.9. The water is moderately polluted. It is favorable for irrigation purposes but not for drinking.

To save the water from future pollution some suggestions should be follow so that water remains in safe condition and more biodiversity occur in water which will be important for the survival of aquatic organisms.

- Governmental agencies and organizations should initiate programs to aware the people about aqua culture and biodiversity so that people try to keep clean the water bodies.
- Garbage and other waste should be properly disposed of so that it may not enter in the water with air or any other source.
- Dams and power plants should be constructed on the rivers to keep water clean and useful.
- Periodic research projects should be carrying on for the checking of water quality to identify any problem in the right time.

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