STUDY ON ZOOPLANKTON DIVERSITY OF RIVERS KALIANI AND DHANSIRI RECEIVING PETROCHEMICAL EFFLUENT FROM NRL, ASSAM, INDIA

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ABSTRACT

An assessment has been made on Zooplankton diversity ofthe two riversKaliani and Dhansiri receiving oil refinery effluent from NRL. A total of 11 genera of zooplankton belonging to five groups –Cladocera, Copepoda, Ostracoda, Protozoa and Rotifera were recorded from the rivers with the annual fluctuation in the percentage composition of zooplankton - Cladocera 14%, Copepoda 13%, Ostracoda 13%, Protozoa 29% and Rotifera 31%. The seasonal variations of zooplankton abundance were pre monsoon (29%), post monsoon (25%), winter (25%) and monsoon (21%). The highest zooplankton density found in pre monsoon in the sampling station 5 with 24ind/lit and lowest 7ind/lit at theS6(the point of effluent discharge) both in pre monsoon and post monsoon seasons. Shannon-Wiener Index was found highest at theS2(1.54)and lowest at the point of effluent discharge(1.27). Pielou's evenness value was highest at the point of effluent discharge (0.82) and lowest atS1(0.67)

Keywords- Zooplankton, seasonal variations

I. INTRODUCTION

Freshwater zooplankters are primary consumers, feeding on an array of items, typically bacteria, detritus, phytoplankton, and other small zooplankters, and are in turn consumed by predaceous zooplankton, other invertebrates, ichthyoplankton and adult zooplanktivorous fishes[1]. Zooplankton occupies an intermediate position in the food web and mediates the transfer of energy from lower to higher trophic levels [2]. Zooplanktons support the economically important fish population[3] by transferring energy from phytoplankton to fish[4]. Due to short life cycle, zooplankton communities often respond quickly to environmental change[5]. The distribution and diversity of zooplankton in aquatic ecosystems depend mainly on the physicochemical properties of water [6]. The major objective of the study was to assess the ecological health condition of the two rivers Kaliani and Dhansiri receiving oil refinery effluent from Numaligarh Refinery Limited through zooplankton abundance and density along with biological indices. The Kaliani is a tributary of Dhansiri and the Dhansiri is a perennial source of water located within 5-kms radial distance from the NRL. They receive effluent from the refinery and reported to be contaminated since its operation from the year, 2001.

II. MATERIAL AND METHODS

The study was conducted from March 2013 to February 2014 on a seasonal basis – pre-monsoon (March-May), monsoon (June-August), post monsoon (September-November), and winter (December-February). Zooplankton was collected with No. 25 µ plankton net up to depth of 0.5 meter. A known volume (25 lit.) of water was strained through plankton net to assess the quality of the zooplankton.Identification of zooplankton was

followed afterPennak[7]. The total number of zooplankton per liter of water was estimated by the following formula:

$$N = \frac{A \times C}{L}$$

Where, A = Average number of plankton counted per ml concentrated sample, C =Volume of concentrated sample in ml, L = Volume of original water in Liter passed through the plankton net, N = Total number of plankton per liter of original water.Community structure was analyzed by using the Shannon-Wienerdiversity index(H),Pielou's Evenness index(E), Margalef diversity index (M), maximum diversity possible(Hmax) and Simpson's Diversity index (D).

III. RESULT AND DISCUSSION

There were 11 genera of zooplankton have been recorded belonging 2 ofCladocera (*Bosmina*and *Pleuroxus*), 2 of Copepoda(*Cyclops* and*Diaptomus*),1 of Ostracoda (*Cypris*), 1 of Protozoa(Paramecium) and 5 of Rotifers(*Brachionus, Conochilus, Kellicotia, Lecaene and Trichocerca)*. Chowdhury and Raknuzzaman[8]reported 23 taxa of zooplankton of which 12 belonged to Rrotifers, 4 to Copepods, 6 to Cladocerans and 1 to Ostracods from the river Buriganga. In 2003, four groups of zooplankton population, namely Copepods, Rotifers, Cladocera and Ostracods from the river Meghna were reported.Sundar et al.[9]reported the major contribution of phytoplankton (> 97.0%) and lower concentration of zooplankton (0.13 - 2.4%) at three stations in the Guala river of Uttar Pradesh, India. A total of 625 zooplankton were collected from the two rivers Kaliani and Dhansiri of which 87 Cladocera, 81 Copepoda, 83 Ostracoda, 179 Protozoa and 195 Rotifer. The mean annual fluctuation of the percentage composition of zooplankton for 2013-2014 were Cladocera 14%, Copepoda 13%, Ostracoda 13%, Protozoa 29% and Rotifer 31%(Fig2). Thus the increasing order of taxa were Copepoda=Ostracoda<Cladocera<Protozoa <Rotifer. The mean seasonal variations of zooplankton abundance were pre monsoon (29%), post monsoon (25%), winter (25%) and monsoon (21%), shown in Fig1.

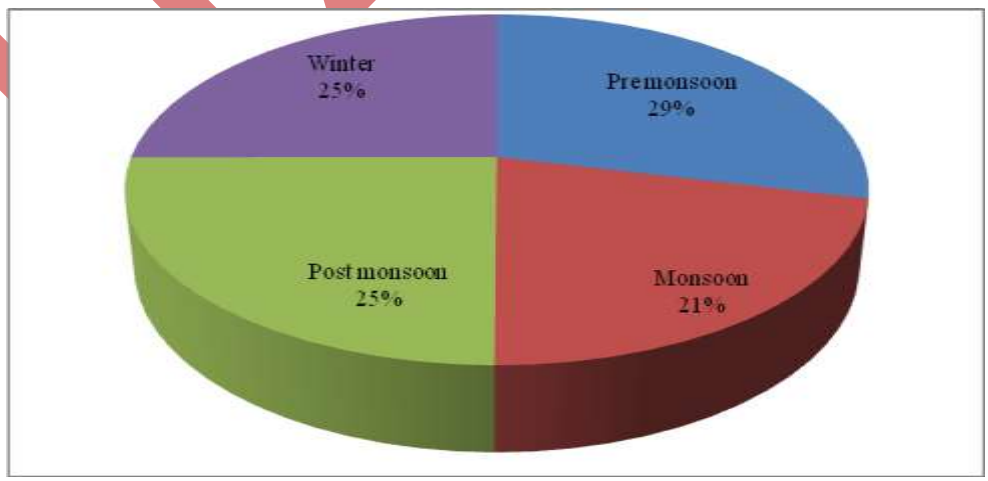

Fig.1: Mean seasonal variations of zooplankton groups of Kaliani and Dhansiri

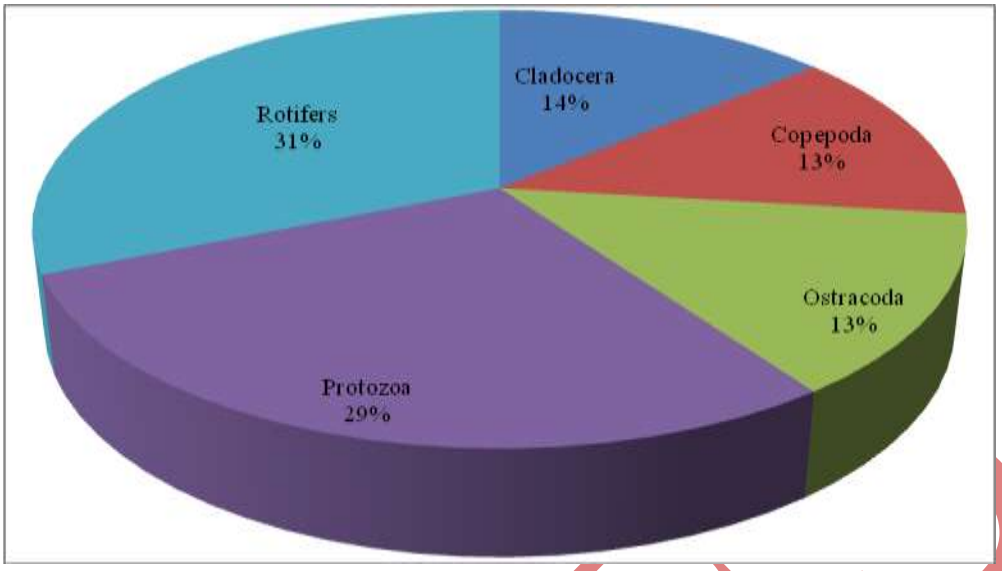

Fig2: Mean annual percent composition of zooplankton groups of Kaliani and Dhansiri

The highest zooplankton density found in pre monsoon at theS5 with 24ind/lit and lowest 7 ind/lit at S6(the point of effluent discharge) both in pre monsoon and post monsoon. The Cladocera comprised of 14% in pre monsoon, 11% in monsoon and 15% in both post monsoon and winter. It comprised 14% of total zooplankton annual density of the two rivers. It was found most abundant in the S2 &S4 and lowest 1 both atS6& S7 in pre monsoon and in monsoon no Cladocera was found at the S6(point of effluent discharge) and S7, whereas it was most abundant in S3. Copepoda comprised of 14% in pre monsoon, 11% in monsoon, 13% in post monsoon and 14% in winter with a 13% of total annual zooplankton population. It showed the greatest abundance in pre monsoon and lowest in monsoon season. The low number of zooplanktons in monsoon might be due to the fall in temperature, low light penetration and heavy water flow wash off the surface zooplanktons. The unsettled and disturbed water column was resulting from the rain water and heavy out flow and inflow retard the zooplankton population.Ostracoda constitution was 15% in pre monsoon, 11% in monsoon, 12% in post monsoon and 12% in winter. Its annual abundance was 13% with the increasing trend of monsoon<post monsoon< winter< post monsoon. Protozoa comprised 29% of total zooplankton abundance with 28% in pre monsoon, 26% in monsoon, 32% in post monsoon and 29% in winter seasons with an increasing order of abundance of monsoon<winter<pre monsoon=post monsoon. Rotifer group was dominant with 29% in pre-monsoon, 41% in monsoon, 28% in post monsoon and 29% in winter showing the increasing abundance of post monsoon <winter<pre monsoon<monsoon. Rotifers are the zooplankton group mostly associated with lotic environments [10] because of their short life history and ability to propagate quickly[11], [12].

Zooplankton diversity: Species diversity is a measure of the diversity within an ecological community that incorporates both species richness and the evenness of species abundances. In the present study, Simpson's Diversity Index (D), Shannon-Weiner diversity (H),Maximum species diversity (H max), Pielou's evenness (E), and Margalef diversity index (M) were used to describe the diversity in the community. Mean annual station wise species diversity indices are shown in Fig.3. Shannon-Wiener Index were found highest at theS2(1.54) and lowest at the point of effluent discharge (1.27). The higher value of Shannon-Wiener Index (H) indicated

greater diversity of species, meaning larger food chain and more cases of inter-specific interactions and greater possibilities for negative feedback control which reduced oscillations and hence increases the stability of the community[13]. M index was lowest at point of effluent discharge (1.87) and highest atS1(3.13). Hmaxwere found maximum at theS1(2.29) and minimum at the point of effluent discharge (1.55). Pielou's E value found highest at the point of effluent discharge(0.82) and lowest at S1 (0.67). Evenness generally found higher in the downstream including the point of effluent discharge. Evenness indices indicate whether all species in a sample are equally abundant. This means that species evenness decreases with increasing size of the zooplankton population and vice-versa. D valueswerefound maximum atS1, S2 and S5 (0.77)and minimum at the point of effluent discharge (0.69).

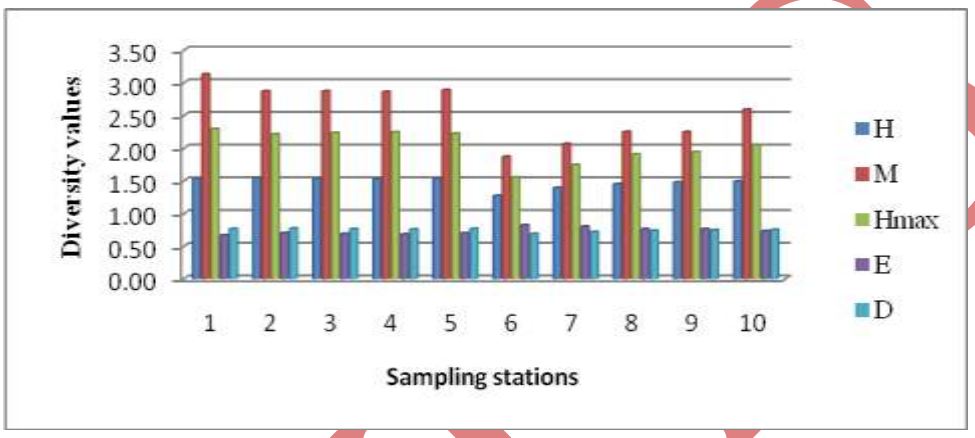

Fig.3: Mean annual Diversity indices of zooplankton in ten sampling stations of Kaliani and Dhansiri

IV. CONCLUSION

Rotifers werethe dominant zooplankton group comprising of 31%; Copepod and Ostracoda werethe least available groupswith a 13% of the total zooplankton population. Presence of pollution tolerant taxa *Brachionus, Trichocerca*, were abundantly recorded from the point of effluent discharge indicate heavy pollution. The upstream of Kaliani river (sampling stations S1, S2, S3, S4, S5) showed greater Shannon-Weiner diversity (H), Margalef diversity index(M), Hmax, Simpson's Diversity index and low Evenness index indicating a comparatively healthier ecosystem. Comparatively greater Evenness index was found at the point of effluent discharge (S6) of Kalianiriver with lower diversity indices. The downstream of Dhansiri (sampling stations S7, S8, S9 andS10) showed a little bit recovery from pollution impact with increasing diversity indices than the point of effluent discharge.Thus the study showed the pollution impact from the NRL in the two rivers- in the point of effluent discharge of Kalianiand downstream of Dhansiriwith a reduction of zooplankton population and diversity indices.

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