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Variation in Epifloral Community Composition according to heavy metals in sediment of Tapi, Surat, India

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Abstract— Epifloral communities play a significant role in monitoring the environmental pollution. The study was undertaken to understand the epifloral community composition in relation to heavy metals (Cu, Zn, Ni, Pb, Cd) in sediment at different sites of Tapi River. During the study total 23 species of 3 group of epifloral community were identified Bacillariophyceae, Chlorophyceae and Cyanophyceae. Among these groups Chlorophyceae were most abundant in both season and cyanophyceae were reported least dominant at all the sites. Number of species of Bacillariophyceae was reported higher during wet season at all sampling sites. According to heavy metal concentration epifloral community composition was also changed.

Keywords— Epifloral communities, Heavy metals, Sediment, Tapi river

I. INTRODUCTION

Epifloral communities are unicellular eukaryotic algae and cyanobacteria that grow within the upper several millimetres of illuminated sediment, typically appearing only as brownish or greenish shading [1]. They are primary producers for the sediment ecosystems. They are susceptible to the environment in which they live and any changes in them leads to change in the plankton communities in terms of tolerance, abundance, dominance, diversity and in the habitat [2]. The importance of benthic algal photosynthesis to aquatic food webs is often unappreciated [3].They can grow on the surface of the sediment which is directly exposed to the sunlight. Point sources of nutrients may result in increased benthic algal productivity with little increase in benthic algal biomass because of rapid transfer of organic matter to grazers [4]. Epifloral communities play a significant role in monitoring the environmental pollution. Zoo benthos is depended on epifloral communities for nutrition.

The major cause of pollution of the river Tapi with the heavy metals is due to drainage release coming from all villages as well as cities on the banks of the river and its tributaries. In the same way heavy metals contamination also takes place due to small-scale industries, small brick industry and farming runoff water comprising fertilizer and pesticides.

The higher concentration of heavy metals in the ecosystem could be harmful due to their toxicity and increasing behaviors with serious public health implication [5].

This study was aimed to evaluate the variation of epifloral communities and investigate the distribution of heavy metals (Cd, Pb, Zn, Ni and Cu) in sediment of Tapi river at three different locations.

II. RELATED WORK

In previous study in fresh water epifloral communities have been performed which are Comparative studies of the metal sensitivity of microalgae [6], [7] and marine species [8], [9]. Dotaniya *et al.*, (2017) investigated the heavy metal polluted soil in India and reported that excessive concentration of heavy metals *viz*.Cr, Cd, As, Ni, Se and Pb have been reported in soils of agricultural land close by cities, mines and industrial areas around the world. Remediation of heavy metal contaminated sediment is a necessity in order to have a secure and healthy environment, which will maintain our life on the earth [10].

III. METHODOLOGY

Study area

To fulfill the aims of the present study, three different sites along the stretch of freshwater zone of Tapi River was selected based on the accessibility and point sources of pollution; Galteshwar as a reference site as it has least interference of human activities, Utran as a site receiving sewage of the urban area and waste from the Gas based power station as a pollution source and Ashwanikumar as a site under the influence of pollution from cremation ground as well as domestic sewage.

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Sampling sites along the stretch of Tapi River

Sample collection and analysis

Sediment Samples have been collected monthly during morning hours from June- 2015 to October-2015 (Wet season) and November - 2015 to May- 2016 (Dry season) at selected sites. The sample collection from all three sites has been done on the same day of last week of every month. Sediment samples have been collected by using 30 cm long acrylic core of 7.5 cm diameter which has been pushed into mudflats up to 5cm and the sediments have been scooped out per m^2 area. Total five core samples have been collected at different points and pooled together. At each sample site, two sediment samples have been collected, pooled and stored in polythene bags. One sediment sample has been dried and analyzed the selected heavy metals by AAS method [11].

For the epiflora, the uppermost layer of sediment has been collected by scooping carefully with the help of glass slide and preserved in 4% formalin solution. These samples were identified with the help of Sarode and Kamat (1984) [12] &Venkataram (1939) [13].

IV. RESULTS AND DISCUSSION

Heavy metal concentration

Cadmium and Nickel presented the lowest level during both the seasons. However, cadmium shows very high toxicity to both aquatic and terrestrial organisms even at low concentrations [14]. Copper and Zinc presented highest level during the both seasons. The cadmium concentration was range from 1.37 - 7.6 mg/kg and 2.11 to 4.77 mg/kg for wet and dry season respectively. Higher concentration was reported at site -1 during the wet season and lower concentration was reported at site-3 during dry season (Table-1 and 2).

The copper concentration was range from 57.82 - 102.27 mg/kg and 75.90 to 101.4 mg/kg for wet and dry season respectively. Higher concentration was reported at site -1 during the wet season and lower concentration was reported at site -2 during wet season.

The Lead concentration was range from 33.85–125.35 mg/kg and 16.58 to 22.28 mg/kg for wet and dry season respectively. Higher concentration was reported at site -1 during the wet season and lower concentration was reported at site -2 during dry season.

The zinc concentration was range from 46.66–106.84 mg/kg and 64.75 to 94.40 mg/kg for wet and dry season respectively. Higher concentration was reported at site -3 during the wet season and lower concentration was reported at site -1 during wet season.

The Nickel concentration was range from 17.02–35.23 mg/kg and 21.38 to 35.82 mg/kg for wet and dry season respectively. Higher concentration was reported at site -2 during the wet season and lower concentration was reported at site -3 during dry season (Fig. 1, 2 and 3).

Currently, there is no sediment quality guidelines (SQGs) in India for metal concentration in freshwater sediments and therefore the SQGs of the Canadian Council of Ministers of the Environment (CCME) for sediments in freshwater was employed in this study.Average concentration of all heavy metals Cadmium, copper, lead, zinc and nickel at all site were remain under permissible limit according to ISQG/PEL guidelines.

Epifloral communities

During the study total 29 species of 3 group of epifloral communities were identified i.e., epifloral community were identified Bacillariophyceae (12 species), Chlorophyceae (11 species) and Cyanophyceae (6 species) (Table-3). Among these groups Chlorophyceae were most abundant in both season Foster (1982) [15] and Fathi *et.,al* (2001) [16] revealed that resistance to heavy metals may be a phenomenon occurring especially among these green algae. Cyanophyceae were reported least dominant at all the sites. Species of Bacillariophyceae were recorded higher in wet season at all sampling sites. Bacillariophyceae appeared to be sensitive to metal treatments, whereas Cyanophyceae had no regular trend in their response to heavy metals treatments, which confirm the results of Fathi and El-Shahed (1998) [17] and Shehata *et.al.*, (1999) [18].

Bacillariophyceae were represented as *Coscinodiscus sp., Coscinodiscus granii, Coscinodiscus radiatus, Fragilaria brevistriata Grun., Fragilaria intermedia Grun., Navicula cuspidate Kutz., Gyrosigma accuminatum, Melosira granulata, Melosira varians, Melosira ambigua, Synedra ulna (Nitzch) Ehr, Surirella elegans Ehr.*

Chlorophyceae were represented as*Spirogyra maxima, Spirogyra majuscula, Pediastrum duplex, Pediastrum* *simplex, Closterium acerosum, Closterium regulare, Volvox aureus, Volvox globator, Ulothrix tenuissima, Ulothrix variabili, Ulothrix fimbriata.*

Cyanophyceaewere represented as *Oscillatoria major,Lyngbya sp., Lyngbya majuscula, Merismo pediatenuissima Lemm., Spirulina major, Spirulina subsalsa.*

Bacillariophyceae was observed highest when nickel and copper concentration was reported minimum and Bacillariophyceae was reported lowest when lead concentration was reprted minimum. Chlorophyceae were reported highest in number when lead was at minimum level and minimum number of species reported when cadmium, copper and lead concentration was highest. Highest cyanophyceae species were identified when cadmium, copper and lead concentration was reported maximum (Fig.4, 5 and 6).

Table 1. Average concentration of heavy metals in wet season (June-2015 to Oct-2015)

Wet season	Heavy metals (mg/kg)				
Sites	**Cd**	**Cu**	**Pb**	**Zn**	**Ni**
Site 1	7.86	102.27	125.35	46.66	29.88
Site 2	3.61	57.82	71.92	51.25	17.02
Site 3	1.37	101.41	33.85	106.84	35.23

Table 2. Average concentration of heavy metals in dry season (Nov-2015 to May-2016)

Dry season	Heavy metals (mg/kg)				
Sites	**Cd**	**Cu**	**Pb**	**Zn**	**Ni**
Site 1	4.68	76.71	17.67	64.75	30.51
Site 2	4.77	75.90	16.58	77.00	21.38
Site 3	2.11	101.4	22.28	94.40	35.82

Table 3. Eipfloral communities found during wet and dry season at different sites

Epifloral community	**Number of species**					
	Wet season			***Dry season***		
	Site-1	***Site-2***	***Site-3***	***Site-1***	***Site-2***	***Site-3***
Bacillariophyceae	3	5	3	2	2	1
Chlorophyceae	5	7	5	6	7	6
Cyanophyceae	5	2	3	1	2	4

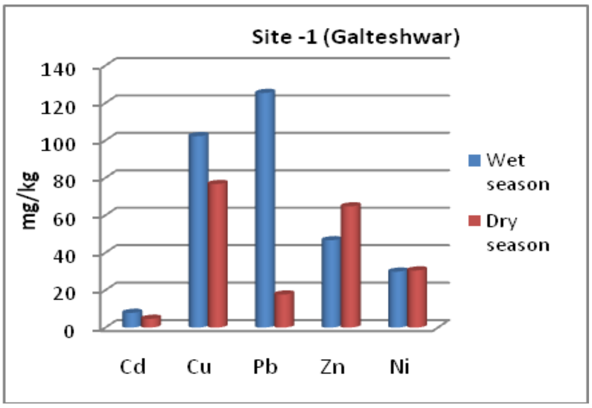

Figure-1

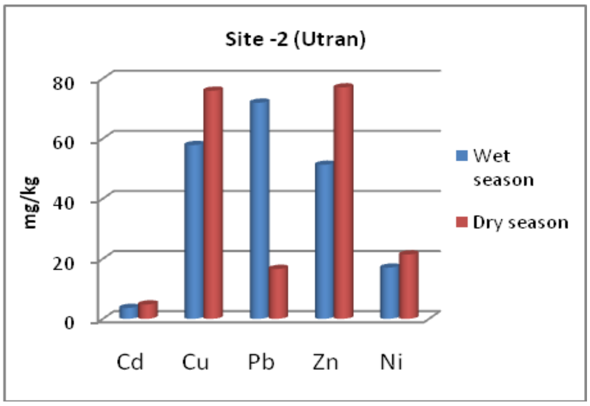

Figure-2

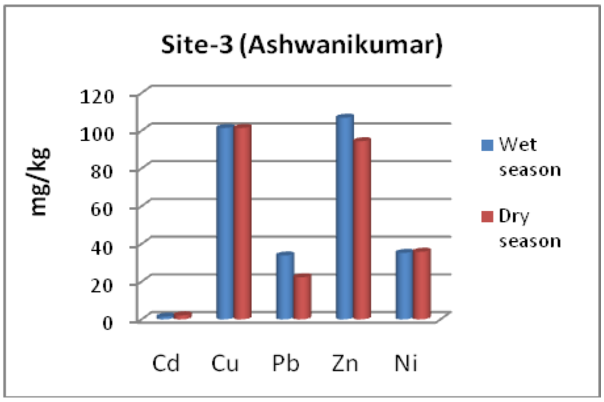

Figure-3

Figure 1, 2, 3 - Comparison of average concentration of heavy metals in both seasons

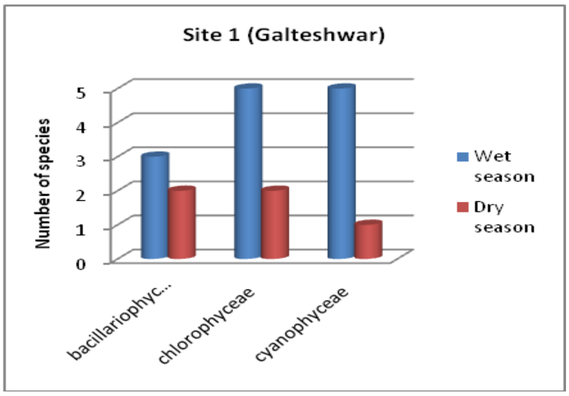

Figure-4

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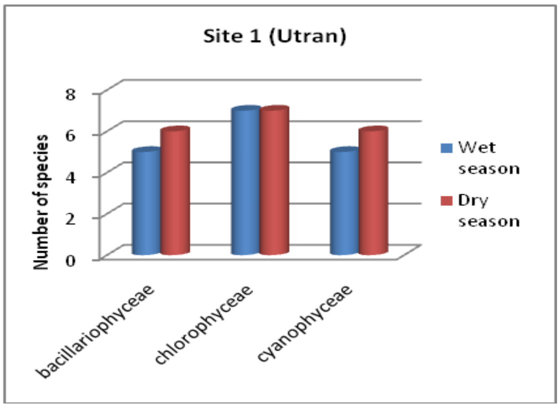

Figure-5

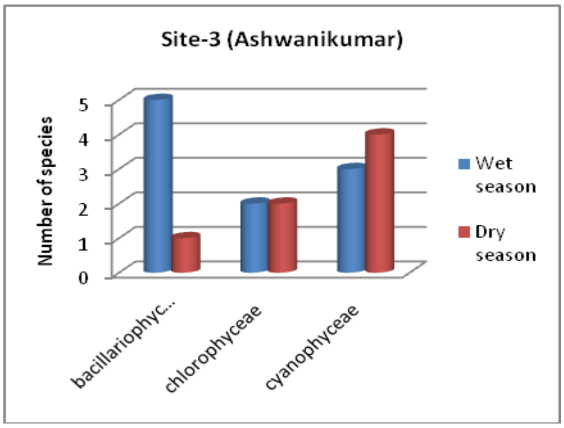

Figure-6

Figure-4, 5, 6 - Comparison of species composition of epifloral communities in both seasons

V. Conclusion

In recent study epifloral community composition were varied according to heavy metal concentration. Chlorophyceae community was occurred higher than other epifloral community. Cadmium concentration affects the Chlorophyceae community species. There were no major differences in species composition during dry and wet season. This species-dependent metal sensitivity and the ecosystem-dependent metal availabilities might influence the composition of epifloral communities. Thus, we can conclude that metal availability might play a selective role in epifloral succession.

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