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Diversity of Phytoplankton Communities in Tambraparani River, Kanyakumari District, Tamilandu, India

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Abstract: The present investigation accounts of phytoplankton diversity, dominance index and richness index in different stations of the river Tambraparani from Feb 2009 to Jan 2010. A total of 77 algae were collected which belonged to five groups, namely, Bacillariophyceae (25), Chlorophyceae (27), Cyanophyceae (17), Euglenophyceae (5) and Dinoflagelaceae (2) were recorded. In all the four stations, the total cell density recorded was 40 $\times 10^3$ cells/m^3during February 2009. A bimodal peak of phytoplankton cell density was observed during the study period in this river. Dominance index, species richness and species diversity index were calculated. Studies revealed the diverse phytoplankton population among all four stations. The dominance index observed in the river shows much fluctuation in the phytoplankton distribution and high values were noticed during summer and north east monsoon season.

Keywords: Phytoplankton, Freshwater, Diversity

1. INTRODUCTION

The biotic factors of freshwater ecosystem comprise planktons, fishes, amphibians, plants, snakes and birds [1]. In all kinds of aquatic eco-systems phytoplankton act as a good bio-indicator to reflect the quality of water and is the important primary producers and control the dynamic of productivity. In freshwater ecosystem algae involve trapping of energy and transformation of energy by photosynthesis using inorganic substances. Phytoplankton forms the very basic link in the food pyramid of all aquatic animals. The nutrient factors, physico-chemical parameter, biological interactions, and carbon exchange significantly influence the diversity and population of phytoplankton [2]. Rivers have been the very important fresh water resources, and directly involve most developmental activities. These carry industrial and municipal waste water, manure discharge and runoff which are important factor in river pollution [3,4]. In India, rivers are generally used for irrigation purposes. Rapid industrialization, poorly planned urbanization, and excessive use of artificial fertilizers in agriculture sector causing heavy pollution in the aquatic ecosystem leading to depletion of biota [5].

Phytoplanktons are sensitive to the fluctuation of environment they live and any alteration in the particular environment leads to the change in the plankton communities in term of abundance, dominance and diversity in the habitat. Hence, plankton population observation is highly reliable tool for biomonitoring the pollution status of aquatic environment and also used to measure the effectiveness of restoration and management programmes or regulatory actions [6,7]. Phytoplankton ecology plays a critical role for indicating the eutrophication. Considering the importance of algae in the river ecosystem, the present study was carried out to evaluate the phytoplankton diversity.

2. MATERIALS AND METHODS

2.1 Sample collection

The present study was carried out along four different stations from Tambraparani river. All four sampling stations were from Muthukuzhivayal to Parakani in Kanyakumari District, Tamilnadu for assessing phytoplankton diversity. The first station is located at Pechipparari dam (8º 26′ 52.3″N and 77º 18′30.4″E). The second sampling was made at Moovathumugam (8°33′387″N and 77°28′511″) and the third sampling station is near to Kuzhithurai bridge (8.3129° N, 77.2041° E). The fourth sampling station was at Parakani. The collections were made early in the morning by using a standard plankton net (No. 25) with 30 cm mouth diameter and length of 1 M. 100 litre of surface water was filtered and the filtrate was stored into a clean labelled plastic containers. The volume of the concentrate was adjusted to 25 ml and it was preserved immediately with 4% formalin for further analysis.

2.2 Counting and identification of algae

From the collected and concentrated filtrate 1 ml of the sample was taken, the concentrate was shaken, in order to get an even distribution of planktonic organisms for analysis. The analysis was repeated for 10 times and computed. The average number is expressed in per cubic/meter. The collected microalgae were identified by using standard literatures [8,9].

2.3 Dominance index, species richness and species diversity index

The dominance index, species richness and species diversity index were calculated using the following formulae.

(a) Dominance index [10]

$$C = \frac{n_1 + n_2}{N}$$

Where,
C= Dominance index equal to the percentage of total standing crop contributed by the two most exuberant species
n_1 and n_2 = Percentage of total population contributed by the two most abundant species in the sample.
N= Concentration of standing crop in the same series of the sample.

(b) Species richness [11]

$$d = \frac{(S-1)}{\log N}$$

Where,
S= The number of species of a particular sample
N= Logarithm of the total number of individuals of all the species of the sample.

(c) Species diversity [12]

Shannon – Wiener Diversity index was employed to determine species diversity (H′).

$$H' = -\sum_{I=1}^{K} Pi \log Pi$$

Where,
Pi = proportion of the observation of the total found in the category
K= number of categories

3. RESULTS AND DISCUSSION

In the present investigation the population density of phytoplankton showed tremendous fluctuation in the four stations of the river Tambraparani. In all the four stations, the total cell density recorded was 40 $\times 10^3$ cells/m^3during February 2009. In September a primary peak was noticed with higher cell density of 165 $\times 10^3$ cells/m^3 and it gradually decreased in October (149 $\times 10^3$ cells/m^3) and November (130 $\times 10^3$ cells/m^3). In April the cell density was found to be 108 $\times 10^3$ cells/m^3 and then decreased. During May the cell density decreased (84 $\times 10^3$ cells/m^3) and decreased gradually. A bimodal peak of phytoplankton cell density was observed during the study period in the river Tambraparani (Fig. 1). Similar observations were reported in the Ramjan river [13]. The south west monsoonal peaks reported during the study periods coincide with the findings of Mathivanan et al. [7] in the river Cauvery. Such a peak season observed in the river of the present study is identical with the diatom pulse of Couchin back water [14] and Thengapattanam estuay [15].

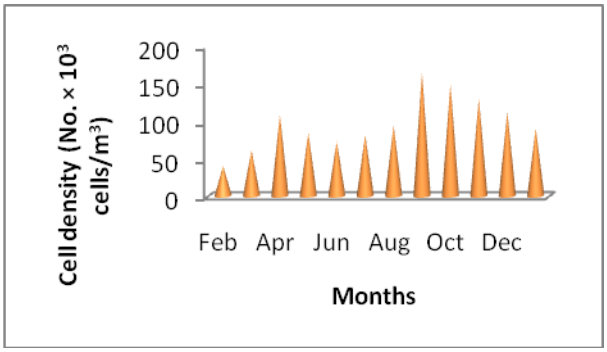

Fig. 1 Total phytoplankton cell density of river Tambraparani during the study period (February 2009 – January 2010).

The population of phytoplankton groups such as Bacillariophyceae, Chlorophyceae, Cyanophyceae, Euglenophyceae and Dinoflagelacae varied widely. In station I, four groups of phytoplankton namely, Bacillariophyceae, Chlorophyceae, Cyanophyceae and Euglenophyceae were recorded. The percentage of these groups varied much. In the first station, the dominant group recorded was Bacillariophyceae with a total percentage of 49%. The second and third dominated groups in the station was Chlorophyceae (30%) and Cyanophyceae (21%). Among the four groups, the minimum contribution was by Euginophyceae (0.2%) (Fig 2a). Statistical analysis by Two way ANOVA on cell density of Bacilliariophyceae as a function of sample stations and seasons showed that the influence of stations are statistically significant ($F = 9.105$; $p<0.05$) during the study period. In station II the highest contribution was by Bacillariophyceae (39%). Chlorophyceae and Cyanophyceae were about 31% and 28%, respectively. The smallest group noticed in the river was Euglenophyceae with a minimum percentage contribution of 2% (Fig. 2b). At station III, 36% of the total population of phytoplankton was formed by Cyanophyceae. About 23% of Chlorophycean member, 29% Bacillariophycea algae and 12% Euglenophytes were identified (Fig. 2c). Statistical analysis by Two way ANOVA on cell density of Chlorophyceae as a function of sample stations and seasons showed that the influence of stations are not statistically significant during the study period, however it was significant in relation to seasons ($p>0.05$) ($F=5.879$; $p<0.05$). In station IV, the percentage contribution of phytoplankton consists of 40% Bacillariophyceae, 31% Chlorophyceae,19%Cyanophyceae,6% Euglenophyt-phyceae and 7% Dinophyceae (Fig. 2d). Statistical analysis by Two way ANOVA on cell density of Cyanophyceae as a function of sample stations and seasons showed that the influence of stations ($F = 6.7058$; $p<0.05$) and seasons ($F = 14.22641$; $p<0.05$) are statistically significant during the study period.

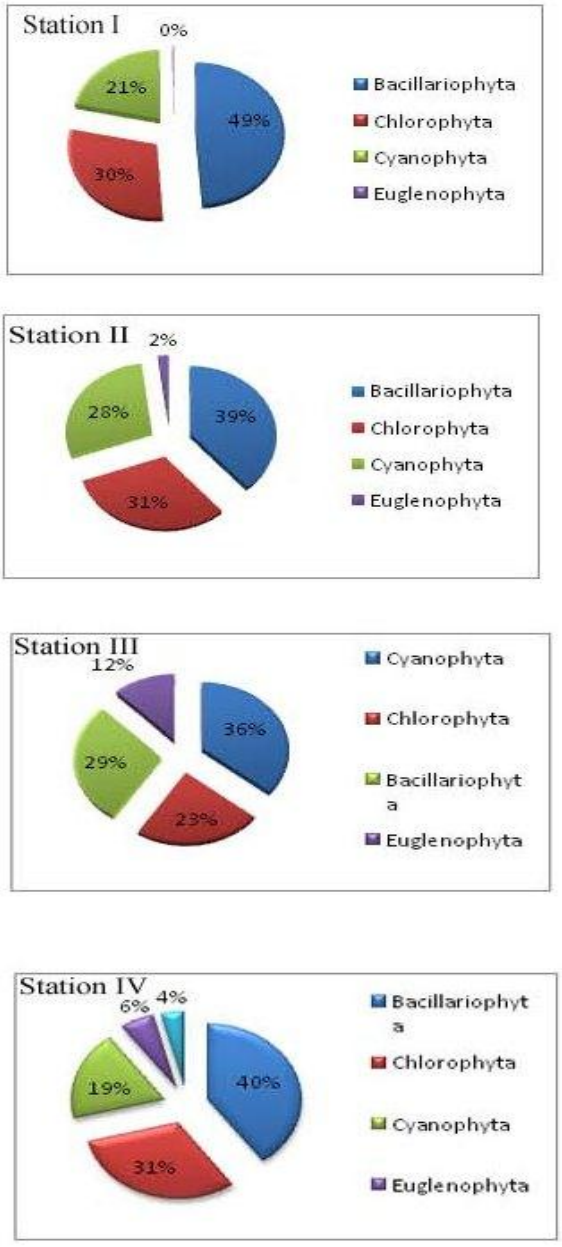

Fig. 2 Percentage distribution of phytoplankton in different stations (station I to IV) during the study period (Feb 2009 – Jan 2010)

The species diversity index (DI), richness index (RI) and dominance index (DI) in the experimental stations of the river during the study period is described in Fig. 3a-d. The DI value for station I, ranged from a minimum of 0.18 during January 2010 to 1.12 during July. Likewise in station II, DI ranged from 0.12 during January 2010 to 0.98

during July. The DI value for station 3 ranged from 0.1 during Januray 2010 to 0.9 during March 2009. The DI value for station 4 ranged from a minimum of 0.1 during March and November to 0.9 during January 2010. In the present study, species diversity values recorded in the four stations showed higher values during summer season. Similar findings were

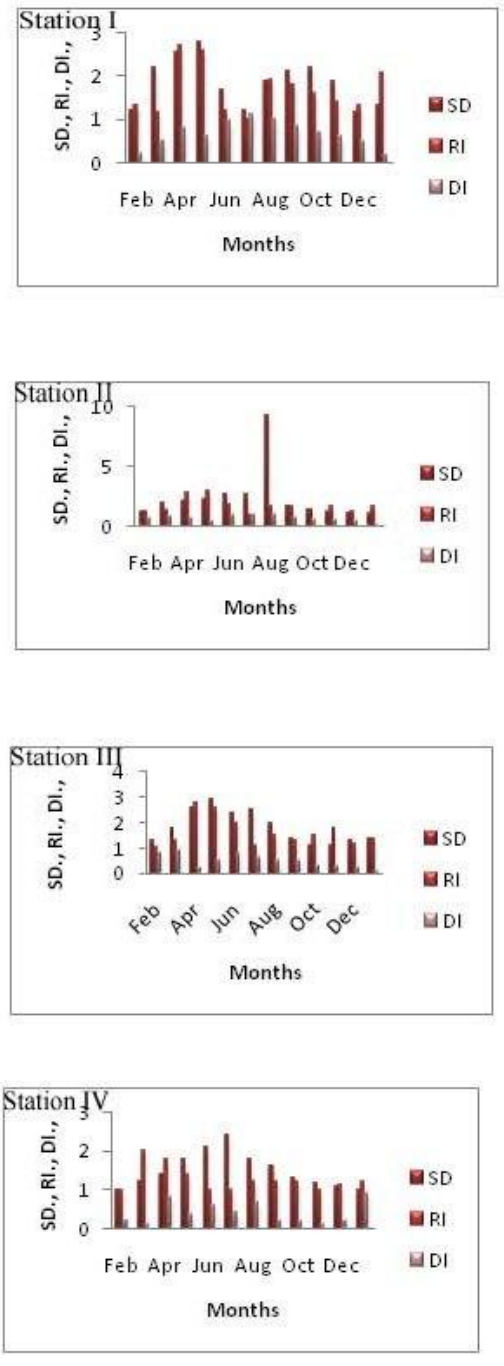

Fig. 3 Phytoplankton Species Diversity (SD), Richness Index (RI) and Dominance Index (DI) in Thambraparani river from Feb 2009 - Jan 2010.

correlated with the earlier results of Sahin [16], Akar and Sahin [17]. It was also observed that the number of species and species diversity was greater in water body receiving sewage as noticed by Nandan and Patel [18]. Similar trend was observed at station IV of the river in the present study which received the sewage effluents which increased the diversity index by the nutrients as evidenced by Davies and Ugwumba [19]. Higher species diversities are the indication of longer food chain with more complex relationships which inturn reflect the sustainability of a system. In river Narmada, phytoplankton population was studied and the diversity index value has been ranged from 0.37 - 1.092 [20].

The richness index (RI) registered in station I showed a minimum of 1.0 (July 2009) and a maximum of 2.7 (April 2009). In station II a minimum RI value of 0.9 (July 2009) and a maximum of 2.9 (May 2009) was observed. The RI varied from 1.0 (Feb 2009) to 2.8 (April 2009) in station III. The richness index varied from 0.98 (Jan 2009) to 2.0 (March 2009) at station IV. Species richness is a measure of uniformity in distribution of individuals among taxa, a phenomenon common to suitable systems. Species richness values remains higher in dry periods by the occurrence of organic carbon which favoured certain species to thrive well in mildly polluted water, sufficient sensitive species remains together with increasing number of tolerant species. Hill et al. [21] pointed out the increased in richness and diversity was under moderate stress. The low degree of species diversity and richness during wet season may be due to the effect of
fast water currents associated with rain storms [22]. In Narmada river, the tested physico-chemical parameter showed considerable variation between season and the phytoplankton population. Studies revealed that the diversity of phytoplankton depends up on the physicochemical status of the river. During the study period the dominance index observed in the river shows much fluctuation in the phytoplankton distribution and high values were noticed during summer and north east monsoon season which coincides with the report of Shukla et al. [23]. It was reported by Stevenson [24] that many species have a specific sensitivity to ecological characters.

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