Proc. Indian natn. Sci. Acad., **B62**, No. 2, pp. 105-110 (1996)

Phytoplankton Diversity in the Drift of a Tropical River Tunga, Western Ghats (India)

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(Received on 19 June 1995; after revision 21 November 1995; Accepted on 13 April 1996)

Form diversity of various phytoplankton recorded in the drift of Tunga river between 1990 and 1992 is detailed. Phytoplankton in drift is dominated by the members of Chlorophyceae and Bacillariophyceae with 31 and 24 forms respectively. At the three sampling sites of the river total percentage form diversity of Chlorophyceae varied between 45-51% and that of Bacillariophyceae ranged from 37-45%. Among the Bacillariophyceae true planktonic forms were dominant, while in Chlorophyceae benthic/epiphytic forms were predominant.

Key Words : **Phytoplankton, Diversity, Drift, River**

Introduction

Information on the primary producers in tropical Asian waters is concerned mainly with phytoplankton, and is confined to only large rivers and floodplains of smaller systems. The limited data on phytoplankton indicate their low productivity and as well, largely limited by factors like turbidity (Dudgeon 1992). Although documented literature on ecological aspects of some Indian rivers are available (see Prasad & Saxena 1980, Jhingran 1982, Reddy & Venkateswaralu 1986, Trivedy 1988, Chopra et al. 1990, Mishra et al. 1995), that of phytoplankton alone is very meagre (Tripathi 1989, Nandan & Patel 1992, Choudhary et al. 1992, Jha 1992). Further, there is no information on the occurrence and form diversity of phytoplankton in drift of Indian rivers.

The ecology of temperate streams is greatly affected by terrestrial influences as

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evidenced by studies of Cumins et al. (1989), while in tropical streams, there are limited data showing the terrestrial influences on aquatic community (Dudgeon 1988, 1989, 1994). Decline in aquatic biota in association with an increase in diverse anthropogenic activity in drainage region has been well documented for various Asian rivers (Dudgeon 1992). Beside deforestation there is a great stress on biota of Western Ghat rivers, due to either damming or mining activities. Taking this into consideration to assess the components of biological diversity in/or associated with inland water to provide information on the status of community, the form diversity of phytoplankton in drift of Tunga river recorded from 1990 through 1992 is presented in this paper.

Material and Methods

The sampling was carried out over a period of two years (at an intervals of 30 days), at three selected sampling sites located 8 km upstream (SS1), 1 km (SS2) and 3 km (SS3) downstream respectively from the Sringeri town (latitude 13°15′ - 13° 36′ N and longitude 75°04′ - 75°22′ E). These sampling sites are located 10-20 km stretch in the downstream from the proposed iron mining area located in the drainage terrain. Drift sampling was carried out between 8.00 and 12.00 hr at the three sampling sites on the same day of collection. Samples were collected using plankton net (size 30 × 30 × 75 cm, mesh size 25 μ, made of bolten silk) suspended across the current direction for 30 min. The collected samples were preserved in 5% formaldehyde, prepared with habitat water. In the laboratory, analysis of plankton was made using a Sedgewick-Rafter plankton cell under a binocular microscope (Meopta; PRAHA 52027) following the method of Welch (1947) and APHA AWWA WPCF (1981). Using taxonomic keys of Edmondson (1959), Desikachary (1959), Needham & Needham (1962), Allan (1984) and Kamat & Sarode (1984) the forms were identified, to the species level as far as possible.

The coefficient of similarity in phytoplankton forms between the two sampling sites was calculated using the formula:

$$S(\%) = \frac{2C}{a+b}$$

Where S is the similarity index; C, the number of species/forms common in the two habitats; a, the number present in the first habitat; and b the number in the second habitat.

Results

Major phytoplankton forms recorded in the drift belonged to Chlorophyceae and Bacillariophyceae. The concentration annually varied between 5873 to 18437 ind/m^3 and 15148 to 32348 ind/m^3 in the two years respectively. In addition, members of Cyanophyceae and Rhodophyceae were also recorded. However, their density is comparatively low (range : 66 to 987 ind/m^3 and 0 to 123 ind/m^3 respectively) and were found to occur infrequently (Krishnamurthy 1994).

Figure 1 depicts the percentage of total form diversity of various groups of phytoplankton in drift recorded at the three sampling sites. The percentage of total form diversity of Chlorophyceae remained similar in sampling sites one and two and increased in site three. On the other hand, Bacillariophyceae showed maximum percentage of form diversity in sampling site two and least

Table 1 *Form diversity and occurrence of various phytoplankton in the drift to Tunga river over a total period of study (+ present, – absent)*

Genus/species	Sampling sites		
1	2	3	4
CYANOPHYCEAE			
1. *Scytonema* sp.	+	+	+
2. *Microcystis* sp.	+	+	+
3. *Gloeotrichia* sp.	+	+	+
4. *Rivularia* sp.	+	–	–
5. *Oscillatoria* sp.	+	+	–
6. *Calothrix parietina*	–	–	+
BACILLARIOPHYCEAE			
7. *Tabellaria fenestrata*	+	+	+
8. *Asterionella formosa*	+	+	+
9. *Fragilaria capucina*	+	–	–
10. *F. virescens*	+	–	–
11. *Fragilaria* sp.	+	+	+
12. *Synedra capitata*	+	–	–
13. *S. ulna*	–	+	+
14. *S. vulgare*	–	+	–
15. *Diatoma hiemale*	+	+	+
16. *Achanhes* sp.	+	+	+
17. *Frustulia rhombiodes*	+	–	–
18. *Neidium iridis*	+	+	+
19. *Pinnularia biceps*	+	+	+
20. *Stauroneis phoenicicentron*	+	+	+
21. *Navicula* sp.	+	+	+
22. *N. viridula*	+	–	–
23. *Cymbella angustata*	+	+	+
24. *Amphora ovalis*	+	+	+
25. *Gomphonema* sp.	+	+	+
26. *Didymosphenia geminata*	+	–	–
27. *Rhopalodia gibba*	+	+	+
28. *Surirella* sp.	+	+	+
29. *Anomoeonesis* sp.	–	+	–
30. *Denticula* sp.	–	+	–

1	2	3	4
CHLOROPHYCEAE	+	+	+
31. *Pediastrum duplex*	+	+	+
32. *Schroederia setigera*	+	–	–
33. *Spirogyra* sp.	+	+	+
34. *Zygnema*	+	+	+
35. *Mougeotia* sp.	+	–	+
36. *Netrium digitus*	+	+	+
37. *Closterium kuetzingii*	+	+	–
38. *Closterium* sp.	–	–	+
39. *Pleurotaneium* sp.	+	+	+
40. *Euastrum* sp.	+	+	+
41. *Micrasterias americana*	+	+	+
42. *M. jenneri*	+	+	+
43. *M. pinnatifida*	–	–	+
44. *Xanthidium antilopeum*	+	+	+
45. *Staurastrum arctison*	+	+	+
46. *Cosmarium margaritiferum*	+	+	+
47. *Cosmarium*	–	–	+
48. *C. circulare*	+	+	+
49. *C. ralfsii*	+	+	–
50. *C. melanosporum*	+	–	–
51. *C. cucurbita*	–	–	+
52. *C. subcrenatum*	–	–	+
53. *Gonatozygon brebissonii*	+	+	+
54. *Desmidium* sp.	+	–	–
55. *Zygogonium* sp.	+	–	–
56. *Nitella* sp.	+	–	–
57. *Tetmemonas granulatus*	+	+	–
58. *Spondylosium planum*	–	+	+
59. *Tripoceros gracili*	–	+	–
60. *Microspora amoena*	–	–	+
61. *Closteriopsis* sp.	–	–	+
62. *Trentepohlia aurea*	–	–	+
RHODOPHYCEAE			
63. *Phorphyridium* sp.	+	–	–

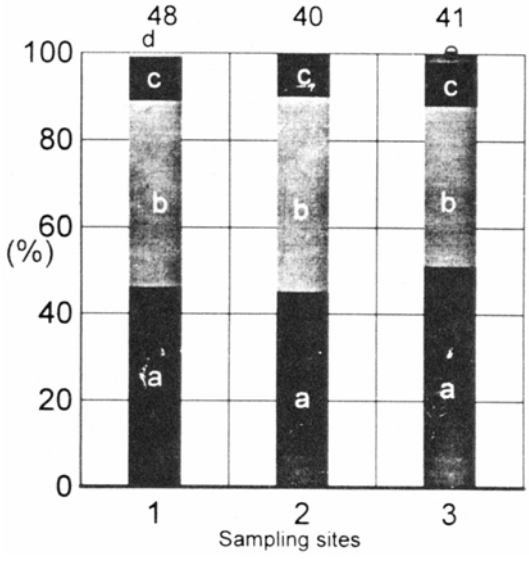

Figure 1 Percentage of form diversity of various groups (a = Chlorophyceae, b = Bacillariophyceae, c = Cyanophyceae, d = Rhodophyceae, e = Xanthophyceae) of phytoplankton in drift at the three sampling sites of Tunga river. The numbers above each histogram denotes the total no. of forms of all groups in the respective sampling sites.

in sampling site three. The percentage form diversity of Cyanophyceae remained similar in all the sampling sites. The form diversity of various groups of phytoplankton recorded at the three sampling sites are listed in table 1. Desmids dominated the drift of Chlorophyceae. From the list it is also clear that 50% of the Cyanophyceae forms were commonly present in drift at a strech of 8 km (from sampling site 1 to 3). The common occurrence of members of Bacillariophyceae exceded 58% while, that of Chlorophyceae was reduced to 42%.

Tables 2, 3 and 4 detail the number and percentage of form diversity of benthic, benthic/epiphytic and true planktonic forms of Cyanophyceae, Bacillariophyceae and Chlorophyceae members in drift. Among the Cyanophyceae and Bacillariophyceae, planktonic forms predominate the form diversity, whereas among the Chlorophyceae, benthic/epiphytic forms contributed nearly 50% of the total form diversity. Interestingly the percentage of benthic (true) forms among Bacillariophyceae and Chlorophyceae remained low. Hence, the least variations in the common occurrence of various forms of Bacillariophyceae and Cyanophyceae within a strech of 8 km could be due to higher numerical density of planktonic forms. Further, the planktonic forms of Chlorophyceae remained nearly 50% less than

Table 2 *Total numbers of different forms (segragated based on literature - Edmondson 1959, Needham & Needham 1962 and Allan 1984) of Cyanophyceae recorded at the three sampling sites of Tunga river. Values in parentheses denote their percentage.*

Types	SS1	SS2	SS3
Benthic form	2(40)	1(25)	2(40)
Benthic/epiphytic form	1(20)	1(25)	1(20)
Planktonic form	2(40)	2(50)	2(40)

Table 3 *Total numbers of different forms (segregated based on literatures- Edmondoson 1959, Needham & Needham 1962 and Allan 1984) of Bacillariophyceae recorded at the three sampling sites of Tunga river. Values in parentheses denote their percentage*

Types	SS1	SS2	SS3
Benthic form	5(26.3)	4(22.2)	4(26.7)
Benthic/epipthytic form	1(26.3)	7(38.9)	5(33.3)
Planktonic form	9(47.4)	7(38.9)	6(40.0)

Table 4 *Total numbers of different forms (segregated based on literature - Edmondson 1959, Needham & Needham 1962 and Allan 1984) of Chlorophyceae recorded at the three sampling sites of Tunga river. Values in parentheses denote their percentage*

Types	SS1	SS2	SS3
Benthic form	6(27.3)	4(22.2)	5(23.8)
Benthic/epiphytic form	11(50.0)	9(50.0)	10(47.6)
Planktonic form	5 (22.7)	5 (27.8)	6(28.6)

their benthic/epiphytic forms and this could be a factor for their least common occurrence within the 8 km stretch of the river.

Table 5 gives the co-efficient of similarity of total form diversity recorded between the sampling sites. Members of Chlorophyceae and Cyanophyceae showed decreasing trend in similarity between upstream to downstream habitat, while Bacillariophyceae exhibited a considerably high similarity between the three sampling habitats.

Table 5 *Co-efficient of similarity (%) of various forms of phytoplankton in drift recorded between the sampling sites. Values in parentheses denote the index of dissimilarity (%)*

Family	SS1 - SS2	SS2 - SS3	SS3 - SS4
Cyanophyceae	89(11)	75(25)	67(23)
Bacillariophyceae	74(26)	90(10)	80(20)
Chlorophyceae	80(20)	67(23)	65(35)

Discussion

Available data on the phytoplankton composition of Indian rivers (Jhingran 1982, Unni et al. 1992, Nandan & Patel 1992) reveals the dominance of members of Bacillariophyceae, Chlorophyceae and Cyanophyceae. Similarly, in the drift of Tunga river, the phytoplankton chiefly composed of the members of the same families. The form diversity as recorded in the drift of Tunga river is comparable to the forms of Chlorophyceae, Bacillariophyceae and Cyanophyceae recorded for Vishwamitri river (Nandan & Patel 1992) and Narmada river (Unni et al. 1992). True planktonic species are known to increase in the downstream, while such an increase among Bacillariophyceae are influenced by spates (Hynes 1979). However, in Tunga river, planktonic forms of Bacillariophyceae decreased from upstream to downstream, while planktonic forms of Chlorophyceae and Cyanophyceae remained constant. The occurrence of high density (9 to 11 forms) of benthic/epiphytic forms among the Chlorophyceae in the phytoplanktonic drift of Tunga river could be due to turbulent flow and nature of river bed. The occurrence of high density of benthic and/or benthic/epiphytic forms among Cyanophyceae and Chlorophyceae could be the contributing factors for the decrease in similarity index between the sampling sites. On the whole taking the 8 kms stretch of Tunga river, it is seen that the river supported as many as 63 forms thus indicating the richness of phytoplankton in the drift.

Acknowledgements

Authors wish to acknowledge the constructive comments from the two anonymous referees which helped them to improve this research paper.

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