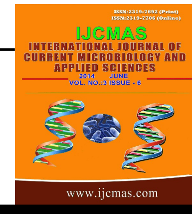

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Original Research Article

Habitat Wise Variation in Periphytic Microalgal Assemblages in the Vazhachal forest division of Chalakkudy River basin

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A B S T R A C T

Periphytic algae growing on stones, aquatic macrophytes and other submerged surfaces form a major group of autotrophs in shallow lotic waters. Variability of periphytic microalgal communities in different stream habitats in Chalakkudy river basin were investigated during the period of study. Samples were collected from Cascade, Step Pool, Riffle, Pool, and Reservoir habitats under the Vazhachal forest division. A total of 97 species of periphytic microalgae were recorded from the different habitats comes under six different classes namely Chlorophyceae, Desmidiaceae, Bacillariophyceae, Euglenophyceae, Cyanophyceae and Chrysophyceae. High variability in Periphytic microalgal community structure has been observed from these five different habitats. The highest microalgal diversity was recorded from reservoir habitat and lowest was from cascade habitat. Result from the present investigation provide information on variation in species and community structure due to the change of environment and this can be regarded as the ecological and environmental impact on community.

Keywords

Microalgae, Chalakkudy river basin, Habitat, community structure

Introduction

The microalgal community as primary producers has to play a significant role in the biotic and abiotic interactions of any aquatic ecosystem. Any change in the habitat can alter the normal algal functions, thus inducing major changes in its community structure. Whenever a community is exposed to different habitat, variation in responses can occur because of the difference in the potential of the individuals to acclimatize.

The habitats also impart changes on the organism and selection can occur favouring resistant genotypes within a population, and selection among species can result in changes in the community structure (Forbes and Forbes, 1994). The ability of periphytic microalgae to grow and prosper in a habitat is the outcome of a series of complex interactions between hydrological, climatic and nutrient factors (Biggs, 1996). The variability of the periphytic organisms in the freshwater habitats are influenced mainly by currents, substratum type, temperature and light. The availability of nutrients and impact of animal grazing in different habitats may also differ and that results in variability. The habitat differs in substratum type and microclimates which are the major influencing factors determine the growth of biotic communities. Hence variabilities in the influencing parameters in the different habitats manifest on specific periphyton dominance and attend community structure. Streams are confluence of multiple aquatic habitats that vary in ecological parameters and probably a habitat wise variability can be expected in their flora and fauna (Schweiger *et al*., 2005).

The ecological niche is composed of many dimensions and direct estimation of community habitat relationships is a daunting challenge even for species systems with poor species richness. Keast and Webb (1966) described the association of morphological characters and ecological habitats in invertebrates. Stevenson (1990) analyzed the differences in biomass and species composition of periphytic algal communities in pool, river and riffle habitats in unshaded streams and observed spatial differences. Lundberg and Wittakker (1998) analysed the patterns of variation in algal communities in different habitats of Mediterranean coast of Israel viz, platform, wall and rocky sea floor and concluded that habitat is the most important factor determining algal community composition and availability. Yahr *et al.* (2006) recorded the variation of *Cladonia subtenuis* and observed that the frequency of algal genotype was significantly different among habitats. The habitat variability highly influences the benthic ecosystem (Babcock *et al.*, 2006). The abundance and diversity of diatom communities showed variability in pools and riffle habitats with respect to its hydrological systems (Trick *et al.*, 2002). Jorve (2008) studied the morphological variability in the red algae, *Mastocarpus* sp. in central California and observed morphological variability created by distinct microclimates associated with different habitats. Angeler and Johnson (2013) reported variation in diversity and community structure of flagellate algae in littoral and sub littoral and habitats of boreal lake.

Range of variation in species and community structure is due to the change of environment and this can be regarded as the ecological and environmental impact on community. However magnitude of impact may vary according to the habitat. In this context an attempt has been made to understand the variability of periphytic microalgal communities in different stream habitats in Chalakkudy river basin.

Materials and Methods

The area selected for the present study were the different habitats under the Vazhachal forest division viz. Cascade, Step Pool, Riffle, Pool, and Reservoir .The sample collections were made during the post-monsoon seasons of the 2012-2013 period. Samples in quadruplicate were collected, adopting systematic random sampling, from each habitat for algal identification and enumeration. From the habitat, submerged pebbles were selected for the study and about 15 cm^2 area of each pebble surface was scrapped with a tooth brush and the loosened material was rinsed with distilled water and preserved by adding 1 ml of 4% formalin. Semi permanent slides were prepared in the laboratory. Microalgae were identified using standard keys (Desikachary, 1959; Agarkar, 1979; Prescott, 1982; Sarode and Kamat, 1984; Anand, 1998, Kargupta 2004) and enumerated with the help of

Haemocytometer and research microscope. Diversity indices were calculated as per the methods of Clark and Warwick (2001) using PRIMER 6.0 software.

Results and Discussion

From the five different habitats, twenty samples were collected during post-monsoon season. A total of 97 species of periphytic microalgae were recorded from the different habitats comes under six different classes namely Chlorophyceae, Desmidiaceae, Bacillariophyceae, Euglenophyceae, Cyanophyceae and Chrysophyceae.

From the results it is observed that lower occurrence of periphytic microalgae were recorded from cascade habitat and belong to a single group, Bacillariophyceae. Three different groups of microalgae were observed from step pool habitat, viz, Chlorophyceae, Desmidiaceae and Bacillariophyceae. From riffle habitat five different groups were represented viz, Chlorophyceae, Desmidiaceae, Bacillariophyceae, Cyanophyceae and Chrysophyceae. A single genus *Dinobryon* was recorded from Chrysophyceae. In pool habitat also five different groups were recorded however highest number of microalgae observed from the reservoir habitat provided with four groups viz, Chlorophyceae, Desmidiaceae, Bacillariophyceae, and Cyanophyceae. *Pinnularia interrupta* and *Nitzschia mirocephala* were recorded from all five habitats from the study area (Table.1).

The abundance of periphytic microalgae recorded from different habitats is presented in the Fig. 2. The highest number of individuals was observed in the reservoir habitat and the lowest number was represented in the cascade, while in step pool, riffle and pool similar abundance was observed. However, in riffle habitat comparatively lower abundance was recorded. The abundance of microalgae showed significant variation ($P<0.01$) between the habitats. When compared to abundance and number of species Shannon Wiener diversity index showed a narrow fluctuation in different habitats studied. However a pattern similar to the variability of abundance and number of species observed here also. The diversity between Cascade, step pool and riffle habitat does not show significant variation (Fig. 2). The diversity was lowest in the riffle habitat. The average values of average taxonomic distinctness (AvTD) of the community structure of microalgae with respect to the different habitats are depicted in the Fig. 2. Though the pool habitat showed low abundance, and diversity, AvTD was higher in the pool denoting the representation of algae from different higher taxonomic groups. Highest AvTD was recorded from pool and lowest from Cascade habitat. The higher AvTD of algal community in both riffle and pool showed no significant variation and indicates a uniform distribution of higher taxa from these habitats, however in cascade, step pool and reservoir the values showed variability.

For finding out the similarities between habitat based on the community structure, non metric multi dimensional scaling (MDS) plot were developed (Fig. 3). Both the Riffle and Pool habitats formed a single cluster and exhibited 40% similarity. Riffle, pool and step pool formed a clustr with 20% similarity. However microalgal community structure in cascade and reservoir vary distinctly from other habitats with more than 80% dissimilarity between them. The similarity between the habitats were further differentiated by cluster analysis (Fig. 3).

A total of 97 species periphytic microalgal species were recorded from five different habitat of the Chalakkudy river basin. They belonged to six different classes of algae. From the above studies it is observed that highest diversity was recorded from reservoir habitat and lowest was from cascade and therefore reservoir was the most suitable habitat for the growth of periphytic microalgae among the habitats studied while cascade was unfavorable for the growth of periphytic microalgae.

The above observations clearly provide an idea that the algal community exhibit variations in accordance with the habitat. Stevenson (1996) observed that the differences in biomass and species composition of periphyton occurred between pool, run and riffle habitats in unshaded streams. The lowest diversity index and species richness were recorded from cascade. In cascade the stress is due to high velocity currents an important factor. In Cascade habitat only diatoms, which are smaller in size were recorded constituted the periphytic community and the filamentous and large sized algae were not observed. Patterson and Stevenson (1990) and Poff *et al.* (1990) observed that stream habitats with shear stress restricts the maximum thickness of algal mat compared with the other habitats and in these areas the communities were often dominated by low growing diatoms like *Cocconeis, Cymbella* and *Nitzschia*. The microalgae growing in the area of higher shear stress may produce bio active compounds to resist high velocity stress (Biggs and Hickey, 1994). In the present investigation cascade habitat seem to be totally distinct from other habitats studied in terms of lower abundance and diversity of algae. Cluster analysis of the habitats also provides dissimilarity of the cascade with other habitats. High rate flow rate in the cascade habitat impart high shear stress on the microlagal community on the rocks. This together with extreme physic-chemical variables brings reduced algal growth or the growth of a specific group in this area. Similarly small sized algae that can with stand stress due to high velocity currents than the longer or filamentous algae and this can be the reason for the dominance of small sized diatoms in this habitat.

In the Reservoir habitat the algal diversity and species richness were more than the other habitats studied. In nutrient enriched waters higher biomass community often develop in low velocity runs and pools and is represented mainly by green algae (Townsend and Hildrew, 1994). Katano (2012) studied benthic invertebrate fauna of different habitats of a Japanese streams and reported higher abundance form reservoir due to the higher nutrient and oxygen availability. Similar results were reported from different habitats of Cinaruco River, Venezuela (Willis *et al*., 2005).

The algal diversity observed from reservoir habitat in the present investigation. May be due to the nutrient enrichment and the lentic nature of the habitat in which the accumulation of the nutrients will be occurred from the forest alluvium during monsoon seasons. Trick *et al.* (2002) reported that the total diatom biomass showed no significant variation between pools and riffles. Corroborates with the above findings in the present study also the diversity of microalgae in pool and riffle are almost similar due to the unique condition of the environment.

Anderson and Miller (2004) studied the spatial variation and effects of habitat on temperate reef assemblages and observed profound variation in the community structure of algal assemblage in north eastern New Zealand. Andrade *et al.* (2006)

studied the inter habitat variation in the benthic algae of upper Missoure River and observed differences in the pattern of benthic assemblages among habitats and concluded that the variations are natural and stress induced. Similar were the findings from the different habitats of the study area. Biggs and Hicky (1994) reported the idea of bioactive production of stress tolerant algae. Hence further attention may be recommend for the isolation and culturing of microalgae identified from cascade habitat which are resistant against heavy stress.

Fig1. Composition of microalgal community in different habitats

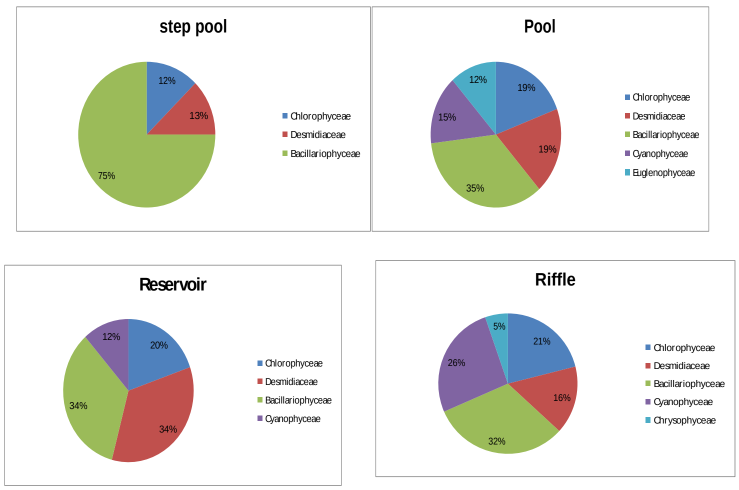

Fig.2 The abundance, Shannon diversity and average taxonomic index of microalgae recorded from the different habitats of Chalakkudy River. (Values in the same superscript does not vary significantly (P<0.01).

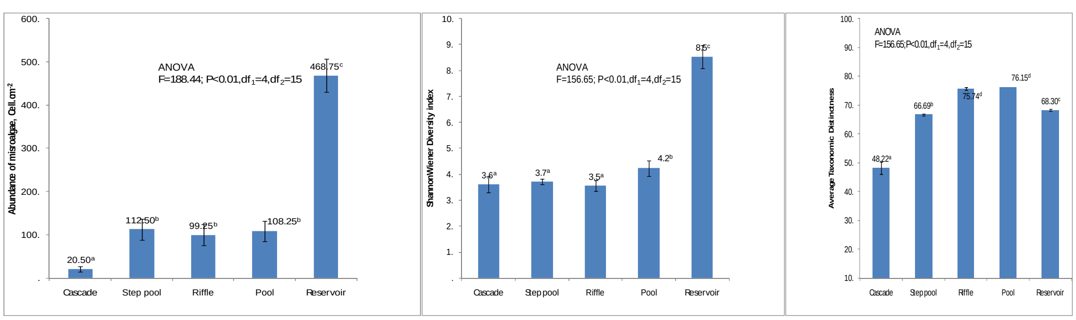

Fig.3 Non metric Multi Dimensional Scaling(MDS) ordination plot and cluster analysis on community structure of periphytic microalge in different habitats.

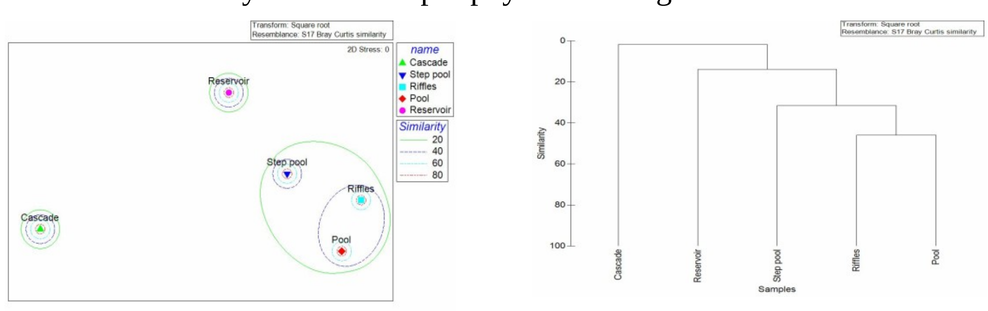

Table.1 Various periphytic microalgal species recorded in the five different habitats of Chalakkudy River

No	Name of algae	Cascade	Step pool	Riffle	Pool	Reservoir
1	*Eudorina elegans*					●
2	*Pediastrum duplex*					●
3	*Pediastrum tetras*					●
4	*Tetraedron minimum*					●
5	*Ankistrodesmus spiralis*			●		●
6	*Selenastrum* sp.				●	
7	*Kirchneriella lunaris*				●	
8	*Coelastrum cambricum*					●
9	*Scenedesmus quadricauda*			●		
10	*Scenedesmus dimorphus*					●
11	*Geminella* sp.					●
12	*Pithophora* sp.				●	
13	*Chaetophora elegance*					●
14	*Oedogonium* sp.		●	●	●	
15	*Mougeotia operculata*		●		●	●
16	*Spirogyra* sp.		●	●		●
17	*Arthrodesmus convergens*					●
18	*Closterium acutum*					●
19	*Closterium ehrenbergii*		●	●	●	●
20	*Closterium lunula*					●
21	*Closterium parvulum*					●
22	*Cosmarium quadrum*		●		●	
23	*Cosmarium auriculatum*					●
24	*Cosmarium spinuliferum*			●	●	
25	*Cosmarium circulare*					●
26	*Cosmarium curtum*					●
27	*Cosmarium javanicum*					●
28	*Desmidium quadratum*					●
29	*Euastrum ansatum*					●
30	*Euastrum insulare*				●	
31	*Euastrum dubium*					●

No	Name of algae	Cascade	Step pool	Riffle	Pool	Reservoir
32	*Gonatozygon monotaenium*					●
33	*Micrasterias mahabuleshwarensis*					●
34	*Micrasterias pinnatifida*					●
35	*Netrium digitus*		●	●	●	●
36	*Spirotaenia condensata*					●
37	*Penium margaritaceum*					●
38	*Pleurotaenium ehrenbergii*					●
39	*Staurastrum coroniferum*					●
40	*Staurastrum gracile*					●
41	*Staurastrum paradoxum*					●
42	*Melosira varians*		●	●	●	
43	*Melosira granulate*					●
44	*Cyclotella ocellata*		●			
45	*Cyclotella glomerata*	●				
46	*Fragilaria intermedia*		●	●	●	
47	*Fragilaria brevistriata*					●
48	*Synedra acus*					●
49	*Eunotia camelus*					●
50	*Eunotia tumida*	●				
51	*Eunotia monodon*		●		●	●
52	*Achnanthes affinis*	●				
53	*Achnanthes hauckiana*					●
54	*Achnanthes inflate*		●		●	
55	*Cocconeis placentula*	●	●			●
56	*Frustulia indica*					●
57	*Gyrosigma distortum*					●
58	*Gyrosigma parvulum*	●				●
59	*Pleurosigma angulatum*		●			
60	*Diploneis elliptica*		●			●
61	*Navicula cuspidate*					●
62	*Navicula pupula*					●
63	*Navicula microcephala*	●				
64	*Navicula constance*		●		●	

No	*Name of algae*	Cascade	Step pool	Riffle	Pool	Reservoir
65	*Navicula viridula*		●	●		●
66	*Navicula decussis*		●			
67	*Pinnularia gibba*			●	●	●
68	*Pinnularia subcapitata*	●				
69	*Pinnularia acrosphaeria*		●			
70	*Pinnularia interrupta*	●	●	●	●	●
71	*Amphora coffeaeformis*	●				
72	*Cymbella turgid*	●	●			
73	*Cymbella ventricosa*	●	●			
74	*Gomphonema parvulum*	●				
75	*Gomphonema gracile*		●			
76	*Rhopalodia gibberula*	*				
77	*Hantzschia amphioxys*					●
78	*Nitzschia obtuse*					●
79	*Nitzschia frustulum*	●				
80	*Nitzschia mirocephala*	●	●	●	●	●
81	*Nitzschia Closterium*		●		●	
82	*Nitzschia palea*					●
83	*Surirella elegans*					●
84	*Euglena proxima*				●	
85	*Phacus curvicauda*				●	
86	*Trachelomonas dubia*				●	
87	*Aphanocapsa biformis*					●
88	*Aphanocapsa stagnina*					●
89	*Gloeocapsa sp.*			●	●	●
90	*Merismopedia minima*				●	
91	*Microcystis sp.*					●
92	*Oscillatoria acuta*			●	●	●
93	*Lyngbya sp.*			●		
94	*Spirulina gigantea*					●
95	*Spirulina major*					●
96	*Nostoc sp.*			●	●	
97	*Dinobryon sertularia*			●		

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