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Preliminary studies on epibiotic protista in the mangrove ecosystem of Ayiramthengu, Kerala coast

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Original Article

Abstract

The present study evaluates the distribution and abundance of epibiont protists in the prop root of mangrove *Rhizophora apiculata* and in the submerged litters found near the mangroves in Ayiramthengu. A total of 15 genera of epibiotic protista were identified. Ciliates were dominated with 12 genera (*Vorticella, Thuricola, Zoothamnium, Vaginicola, Rhabdostyla, Cothurnia, Pyxicola, Stentor, Paramecium, Euplotes, Epistylis,* and *Prorodon)* and the remaining 3 genera (*Acineta, Peranema* and *Euglena*) were contributed by flagellates. Maximum density and abundance of organisms were found in prop root. Total population density of ciliates in roots and litters were 284 cm^2 and 174 cm^2 respectively while the density of flagellates was comparatively low with 142 cm^2 in root and 11 cm^2 in litter. The most dominant ciliate in root was *Vorticella* (50.79 %) and least was *Vaginicola* (0.17%). *Acineta* represent the most dominant flagellate in root (77.46%) and the minimum was *Euglena* (1.40%). *Zoothamnium* was the dominant ciliate in litter (44.66%) and least was *Rhabdostyla* (0.29%). *Peranema* was the most dominant flagellates in litter (72.72%). Most of the species were common in root and litter except *Pyxicola* and *Prorodon* which were found only in litters.

Key words: *Mangrove, epibionts, protista, prop root*

Introduction

Mangroves inhabit the inter-tidal regions which occur predominantly in the tropical region of the world. Diverse communities of flora and fauna are existing in mangrove ecosystem. The muddy or sandy sediments of mangroves support a variety of epibenthic, infaunal, and meiofaunal invertebrates. Most of the organisms in mangroves possess interaction with other species for their survival, and this interaction may be temporary or last for their entire life time. Epibiosis is a non-symbiotic, facultative and interspecific association, whereby one organism lives on the surface (epibiont) of another organism (basibiont). Epibionts are organisms that colonize and grow on virtually any living, solid, exposed surface in the marine environment (Wahl,1989, 1997). The ecology of mangrove root fouling communities revealed that the prop roots are colonized by diverse assemblages of organisms such as macro algae, hydrozoans, ascidians, sponges, isopod, crustaceans and cnidarians (Ellison and Farnsworth, 1992). However, no information is available on the epibiotic protista from the proproots and submerged litters of mangrove ecosystem of Indo-Pacific region and the present paper elucidates this aspect from the Ayiramthengu mangrove ecosystem of Kerala coast, southwest coast of India.

Material and methods

Study area

The study area was located in Ayiramthengu, a part of Kayamkulam estuary (lat. 9°6' to 9°8'N long. 76°28' to 76°29'E) in Kollam district of Kerala, on the west coast of India. The mangroves extend an area of 20 acres and the flora consists of 9 species belonging to 6 families (Myrsinaceae, Avicenniaceae, Rhizophoraceae, Euphorbiacea, Combretaceae and Sonneratiaceae). Avicenniaceae is the largest family in the region followed by Rhizophoracea (Vishal *et al.*, 2015). A total of 10 stations, located 50 m apart were fixed in the mangrove area and sampling was done from each station.

Collection, Identification and Enumeration of Epibionts

Mangrove prop roots and submerged litters were covered and attached by epibionts films. Epibionts were collected on July 2014 from the Ayiramthengu mangroves. Random sampling was made to collect epibionts from prop root and litters. Samples were taken by scraping 1 cm^2 patch of moist film in to sterile 15 ml collecting tubes containing 5ml of 3% formalin. For proper identification of epibionts, they were isolated and treated using the silver carbonate technique of Fernandez and Castro (1986). The systematic scheme proposed by Lynn (2008) was followed. Enumeration of the organisms was made by taking 1ml sample from the preserved bottle, to a Sedgewick cavity chamber. The measurement was made using micrometry. The environmental parameters of the water such as temperature, dissolved oxygen, salinity, pH, conductivity, phosphate, nitrate and sulphate were determined following standard methods (APHA, AWWA and WPCF, 1995). Statistical analysis for species diversity and dominance index were made using the software Biodiversity Pro beta version developed by Mc Aleece (1997).

Results and discussion

Environmental characteristics

Environmental parameters of the study area are given in Table 1. Temperature ranged from 28° to 30.5° C and this may be due to the influx of water from estuary. Pillai *et al.* (1975) reported such a profound influence of fresh water influx on the distribution of temperature in a backwater system. pH was slightly alkaline during the period of study. The maximum and minimum values of conductivity were 24.7 s/m in station 10 and 19.6 s/m in station 2 respectively which was due to fresh water influx and tidal flow. The higher value of conductivity was recorded from the mangroves of Mahanadi river delta indicating the pollution level in the water (Behera *et al.*, 2014). Maximum dissolved oxygen of 6.2 mg/l was reported in stations 3, 7 and 9. The increased value of oxygen in the water may be due to the flow of dissolved oxygen enriched inland water into the mangrove ecosystem (Rahman *et al.*, 2013).The most fluctuating factor of the study area was salinity and it varied from 0.006 to 0.012 ‰. The variation in salinity was due to the influence of rain water and influx of fresh water in to the system (Kesavan *et al.*, 2007). The phosphate values were high and the highest of 2.87 mg/l was recorded at station 4. High concentration of phosphate during monsoon season was also reported by Qasim and Wyatt, 1972 and Kumar *et al.*, 2009. The sulphate content ranged from 74.41 to 78.56 mg/l during the present study and the average sulphate concentration (76.52 mg/l) indicates the presence of available sulphate in the water body (Rahaman *et al.*, 2014). The nitrate values varied from 2.16 to 2.69 mg/l in the stations studied, which may be due to the influence of prolonged rainy days (Kumar *et al.*, 2009).

Species composition, population density and diversity

Microscopic examination of organisms collected from mangrove prop root and litter revealed the occurrence of a

Table 1. Environmental parameters of the study area

Station	Temperature (°C)	pH	Conductivity (s/m)	DO (mg/l)	Salinity (ppt)	Phosphate (mg/l)	Sulphate (mg/l)	Nitrate (mg/l)
1	28.0	7.69	24.1	5.9	0.012	2.40	77.67	2.41
2	29.0	7.45	19.6	6.0	0.009	2.57	74.41	2.69
3	29.5	7.61	21.8	6.2	0.008	2.45	76.04	2.43
4	29.0	7.39	21.9	5.8	0.007	2.87	74.85	2.18
5	28.5	7.68	21.4	4.4	0.007	2.34	76.19	2.46
6	30.0	7.54	21.9	5.2	0.007	2.33	77.08	2.46
7	29.5	7.50	23.3	6.2	0.006	2.44	76.19	2.48
8	30.5	7.61	21.5	6.0	0.009	2.44	77.23	2.16
9	30.0	7.63	21.6	6.2	0.009	2.50	76.93	2.39
10	29.5	7.65	24.7	6.0	0.009	2.51	78.56	2.37

heterogeneous variety of protists consisting of twelve ciliates and three flagellates. *Vorticella, Thuricola, Zoothamnium, Vaginicola, Rhabdostyla, Cothurnia, Pyxicola, Stentor, Paramecium, Euplotes, Epistylis* and *Prorodon* were the twelve genera of ciliates. Flagellates include the genera *Acineta, Peranema* and *Euglena*. The observation also revealed the fact that out of 15 epibionts, the genera namely *Vorticella, Thuricola, Zoothamnium, Vaginicola, Pyxicola, Rhabdostyla, Cothurnia, Acineta* and *Epistylis* were found to be attached to the surface of other organisms like micro algae and non-living materials, and the remaining organisms *Stentor, Euglena, Peranema, Prorodon, Paramecium* and *Euplotes* were found freely in the samples (Fig.1). Maximum density and abundance of organisms were found in prop root compared to litters. Total population density of ciliates in roots and litters were 284 cm^2 and 174 cm^2 respectively, while the density of flagellates was comparatively low with 142 cm^2 in root and 11 cm^2 in litter (Tables 2 and 3). The most dominant ciliate in root was *Vorticella* (50.26%) and minimum was *Vaginicola* (0.34%). *Acineta* represents the most dominant flagellate

Table 2. Population density (no/cm^2) of ciliates and flagellates on the prop roots

Generic Name	Stations										Average
	1	2	3	4	5	6	7	8	9	10	
Ciliates											
Vorticella	110	130	-	375	250	60	225	75	40	175	144
Thuricola	-	10	-	10	10	-	-	5	-	5	4
Zoothamnium	135	10	5	400	60		100	10	10	15	74.5
Vaginicola	5	-	-	-	-	-	-	-	-	-	5
Rhabdostyla	-	-	5	-	5	-	-	-	-	-	1
Cothurnia	-	-	-	5	-	-	-	-	-	5	1
Stentor	30	30	-	10	10	5	-		5	15	10.5
Paramecium	20	75	65	20	45	45	25	25	15	20	35.5
Euplotes	55	-	-	-	-	-	-	-	-	-	5.5
Epistylis	5	10	5	-	5	15	-	20	10	-	7
Total	360	265	80	820	385	125	350	135	80	235	283.5
Flagellates											
Acineta	50	35	-	55	45	30	700	15	105	65	111
Peranema	150	10	-	25	25	-	10	-	65	15	30
Euglena	-	-	-	-	15	-	-	-	5	-	2
Total	200	45	-	80	85	30	710	15	175	80	143

Table 3. Population density (no/cm^2) of ciliates and flagellates on the litters

Generic Name	Stations										Average
	1	2	3	4	5	6	7	8	9	10	
Ciliates											
Vorticella	15	-	25	15	20	15	75	75	5	15	26
Thuricola	5	-	5	10	30	5	-		5	15	7.5
Zoothamnium	85	-	10	-	15	25	400	100	25	115	77.5
Vaginicola	5	-	5	-	5	-	-	-	-	-	1.5
Rhabdostyla	-	-	-	-	-	-	-	5	-	-	5
Cothurnia	-	-	-	-	-	-	-	5		5	1
Stentor	5	5	10	15		10	-	-	-	-	4.5
Paramecium	105	65	55	65	125	20	-	-	5	5	44.5
Euplotes	-	10	-	-	5	5	-	-	-	-	0.2
Epistylis	-	-	-	-	5	-	-	-	-	5	1
Pyxicola	-	-	25	-	-	-	-	-	-	-	2.5
Prorodon	-	-	-	-	40	10	-	-	-	-	5
Total	220	80	135	105	245	90	475	185	40	160	173.5
Flagellates											
Acineta	5	-	-	-	-	10	-	-	-	-	1.5
Peranema	-	-	-	-	40	10	-	-	-	30	8
Euglena	-	5	-	-	5	-	5	-	-	-	1.5
Total	5	5	-	-	45	20	5	-	-	30	11

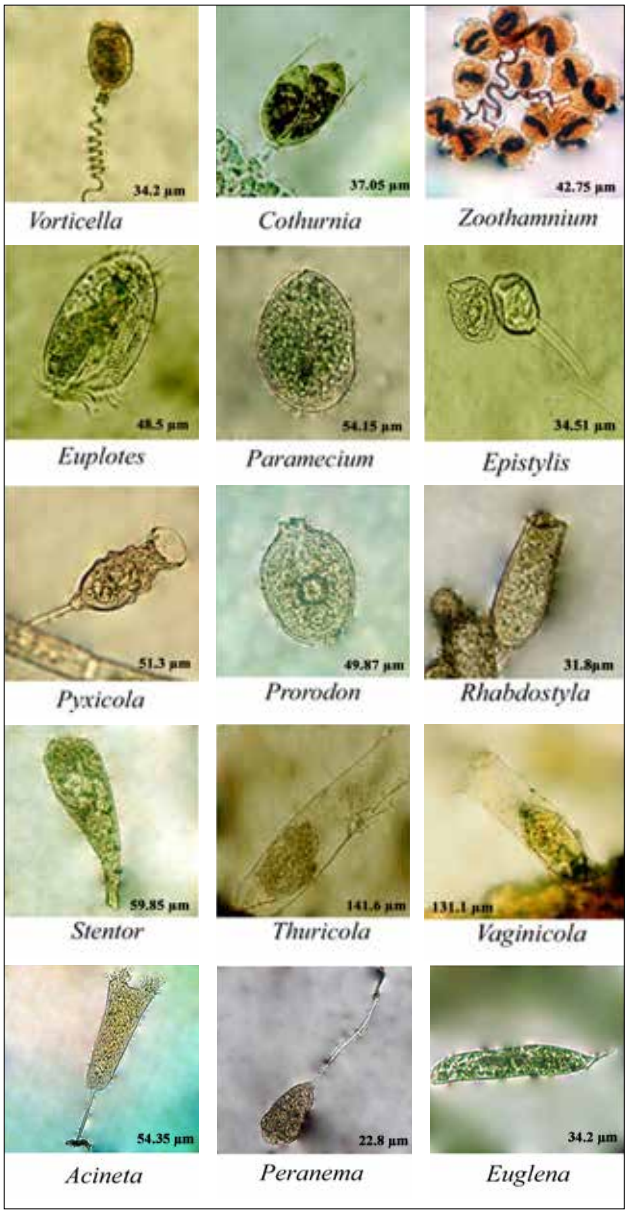

Fig. 1. Photographs of Ciliates and Flagellates

in root (88.61%) and the minimum was *Euglena* (1.57%). *Zoothamnium* was the dominant ciliate in litters (44.66%) and minimum was *Rhabdostyla*.

Station-wise population density of ciliates and flagellages both in prop root and litters showed marked variations (Tables 2 and 3). In the prop root, the maximum density of ciliates and flagellagtes were recorded at stations 4 and 7 respectively. Similarly, with respect to litters, station 7 showed the highest population density of ciliates while station 5 showed the highest density of flagellates. In general, stations 4, 5 and 7 recorded the maximum density of organisms. The mangrove vegetation of the region is not in uniform distribution pattern

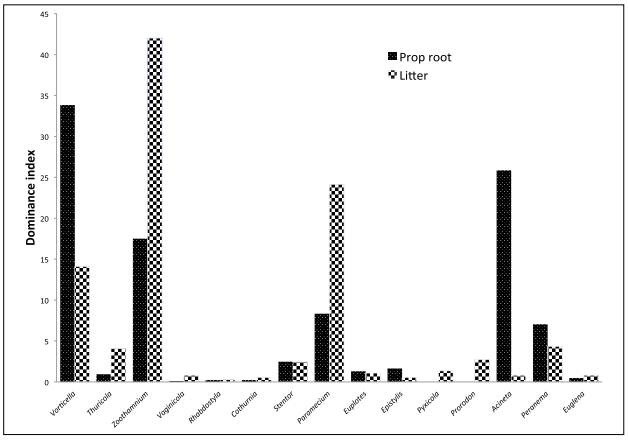

Fig. 2. Dominance index values of organisms in the study area

Table 4. Station wise diversity indices of organisms in the study area

Stations	Prop root	Litter
1	0.790	0.540
2	0.705	0.343
3	0.299	0.704
4	0.525	0.468
5	0.684	0.765
6	0.600	0.900
7	0.416	0.213
8	0.625	0.388
9	0.686	0.466
10	0.605	0.557

and in some areas vegetation being aggregated or randomly distributed. Therefore, the flow of tidal water through the surrounding small canal of the area very adjacent to the fringed mangrove vegetation and eventually the entry of water to the inside area might be varied. This may be the reason for the station wise difference in population density and species diverstiy.

Dominance index and species diversity values of organisms are given in Table 4 and Fig. 2, respectively. Dominance index values varied with respect to prop root and litters. In the prop root a maximum dominance index was found for *Vorticella* (33.84) followed by *Acineta* (25.85) and *Zoothamnium* (17.51) while the minimum value was for *Vaginicola* (0.12). In the litters the highest dominance index value was recorded for *Zoothamnium* (42.12), *Paramecium* (24.18) and *Vorticella* (14.13) in the order of its abundance and the lowest value was found for *Rhabdostyla* (0.27) (Fig. 2). Stations 1, 2 and 9 showed higher species diversity indices of 0.790, 0.705 and 0.686, respectively in the prop root while in the litters the highest diversity index of 0.900 was recorded at station 6 followed by 0.765 at station 5 and 0.704 at station 3. The

minimum species diversity indices of 0.299 for station 3 and 0.213 for station 7 was found in prop root and litters respectively.

Among the 15 epibiont genera found during the present study, *Vorticella* and *Zoothamnium* were the common peritrich distributed both in prop root and litter. Ciliates constitute the most dominant group and the composition of flagellates was comparatively low. As a whole, the study revealed that maximum density of organisms were found in the mangrove prop roots. The prop root epibionts can enhance fish abundance and diversity in mangroves, although the relationship may depend on the specific nature of the epibionts and fishes present (Mac Donald *et al*., 2008). Recent experimental studies have shown that epibionts directly and indirectly affect root growth and production (Perry, 1998; Ellison and Farnsworth, 1990, 1990a) and total energy flow (Wada and Wowor, 1990; Rodriguez and Stoner, 1990). According to Ellison and Farnsworth (1992) the major determinants of mangrove growth and production are the complex interactions of mangroves, root fouling epibionts, root herbivores and benthic predators. Decomposing leaf and associated leached material could play a significant role in determining the initial colonizers and later protozoan species (Dorothy *et al*., 2003). Epibiont layer on roots is more oxygenated relative to the mangrove benthic sediment and this suggest occurrence of more protozoa on roots (Maybruck and Rogerson, 2004). In the present study it seems that mangrove prop roots are not subjected to sedimentation and provide an ideal habitat for epibiotic protista compared to submerged litters found on the intertidal region. Thus the study emphasizes the occurrence of both ciliates and flagellates in the mangrove litters and prop root and their high abundance in roots suggest the inevitable role played by epibionts in promoting the biological process and also diversity of organisms in mangrove ecosystem of Ayiramthengu and elsewhere.

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