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BIOFOULING ORGANISMS ATTACHED ON MANGROVE PLANTS IN AYIRAMTHENGU REGION, KERALA, INDIA

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ABSTRACT

Epibionts that colonize on the mangrove areial roots and stem was analysed during February 2016 to January 2017 covering all the seasons. Micro and macro foulers were attached to the mangrove plants. *Balanus sp.* was dominant macrofouler while *Conscinodiscus sp*, *Pleurosigma sp*, *Chlorella sp*, were the abundant microfoulers. Maximum settlement was on the premonsoon period and poor during monsoon season. Hydrological parameters showed a seasonal variation throughout the study period. Temperature ranges from 27. 5^{0}C to 30^{0}C, dissolved oxygen (4. 6 to 5. 8mg/l), salinity(19. 8 to 32. 7ppt). The epibionts exhibited distinct seasonal trends in abundance with fluctuating temperature and salinity. Species richness, abundance and diversity was higher during premonsoon and lower on monsoon period.

KEYWORDS: Epibionts, Mangrove, Microfouler, Macrofouler, Species Richness

Biofouling is the undesirable accumulation of sessile micro and macro organism with time (Wahl, 1987; Railkin 2004; Durr and Thomason 2010). The species composition of fouling community change considerably over space for biofouling is inferred as the process of accumulation of micro-organism, diatoms algae, plants and animals on wetted surface. Fouling occurs world wide in various industries, shiphull, underwater equipments beach well structures (Haderlie, 1981) and also in the roots of mangrove plants (Karuppayian and Raja, 2007; Rani et al 2010). Fouling is not a simple process its sequence and specific composition depends upon location, year, seasons and various physicochemical factors (O' Neil & Wilcox 1971).

Extensive work has been done all over the world on understanding biofouling on mangroves and their deleterious effect (Cancinni et al, 2008). Biofouler form thick hard encrustation on roots, branches, leaves and stem of the mangrove. Epibionts are found on world wide on mangrove roots (Rutzler 1969, Alvare Z I, 1989; Ellison 1992). Marine tidal forest, the mangroves cover about 137,800 sqkm of the world's tropical and sub-tropical region. In Kerala total extent of mangrove is in 2502 ha (Mini et al 2012). Researches has been carried out in Ayiramthengu mangrove to study the various aspects; but this is the first report of biofouling in the mangrove roots and stem from Kerala. Preliminary studies on epibiotic protist in the mangrove ecosystem of Ayiramthengu showed that 15 species were identified from the prop roots of *R. apiculata* (Chitra and Sunil,,Kumar, 2015).Oyster infestation on mangroves are reported from Vietnam (Hoang and Nhuong, 2004), Africa (Gillikin and Verheyden, 2002), Hong Kong (Chiu 2000) and India (Rani et al, 2010, Rajani Panchang, 2014). The present study was to analyze the biofouling (epibionts) on the roots and stem of mangroves plants in Ayiramthengu region during February 2016 to January 2017.

MATERIALS AND METHODS

Study Area

Ayiramthengu Mangrove (9^0 6' 8'' N Latitude to 76^0 28' 29'' E Longitude) is situated on the Kollam district, Kerala, India. The mangrove ecosystem is a part of Kayamkulam estuary which is a narrow stretch of tropical backwater on the west coast of Peninsular India. Mangrove is dominated by *Avicennia marina* and *Rhizopora apiculata*.This mangrove was declared as an Environmental Hot Spot after it was ravaged by 2004 Indian Ocean Tsunami and threatened with extinction due to human interference.

Collection of Samples

Fouling organism were scraped and from the mangrove roots and stem of *A. marina* and *R.apculata*, kept in plastic bottles. The samples were brought to the laboratory for further analysis. The microfoulers were identified by using compound microscope its number were noted and recorded. The macrofoulers were identified from the site itself and its number recorded. To assess the diversity of the epibionts indices like species richness, species abundance, Simpson dominance, species diversityindex(Shannon Weiner) were used. Water samples were collected for the analysis of hydrological parameters like temperature, dissolved oxygen and salinity by using standard methods (APHA, 2005).

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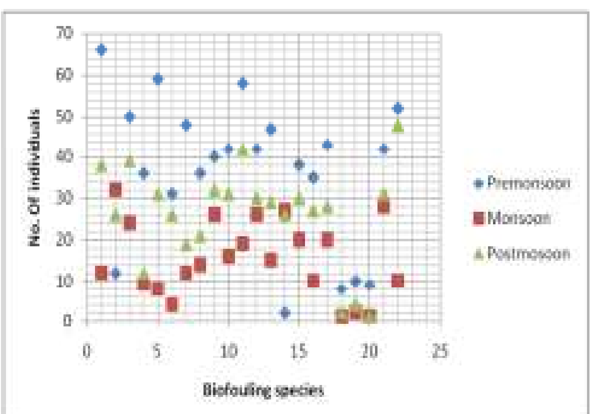
RESULTS AND DISCUSSION

Biofouling organisms on the mangrove roots of Ayiramthengu mangrove during the premonsoon, monsoon and post monsoon were collected and identified. The abundance of the fouling organisms were subjected to geographical and seasonal variation. For this water quality parameters like temperature. dissolved oxygen and salinity were calculated and the mean temperature ranges from 27.5^{0}C to 30^{0}C. Dissolved oxygen and salinity depicts the values 4.6 mg/l, 5.8 mg/l, 5.2 mg/l and 32.7 ppt, 19.2 ppt, 29 ppt during the premonsoon, monsoon and post monsoon respectively (Table 1).

Table 1: The Physico-chemical parameters of Ayiramthengu Mangrove during February 2016 to January 2017

Sl.No	Parameters	Premonsoon	Monsoon	Postmonsoon
1.	Temperature (^{0}C)	30	27.5	28.2
2.	Dissolved Oxygen (mg/l)	4.6	5.8	5.2
3.	Salinity (ppt)	32.7	19.2	29

The epibionts belongs to Phylum Ochrophyta includes the Class Bacillariophyceae comprises 15 genus. Phylum Chlorophyta with one class Trebouxiophyceae constitute the genus *Chlorella sp.* and class Hormogoneae of Cyanobacteria with the *Anabaena sp*. The macrofouling, species is from the Phylum Arthropoda constitute class Malacostraca and Maxillopoda with the genus *Gammarus sp.* and *Balanus sp.* respectively. Altogether the epibionts of the mangrove roots and stem belongs 5 phylum and 6 classes. The abundant microfouling species are *Conscinodiscus sp. Pleurosigma sp.* and *Chlorella sp.* during premonsoon period and macrofouler was *Balanus sp.*(Table 2,Graph 1) The Species richness (22) dominance (0.944, 0.938, 0.941) species abundance (806, 336, 573) of the epibionts during premonsoon, monsoon and postmonsoon respectively. Shannon Weiner Diversity depicts the values 2.995, 2.884 and 2.932 on premonsoon, monsoon and postmonsoon period Table (3).



Graph 1: showing the distribution of biofouling species collected from mangroves

The surface water temperature is influenced by the density of solar radiation, evaporation freshwater influx, cooling and mixup with ebb and flow from adjoining neretic waters. (Santhakumaran and Sawant, 1998). *Balanus sp.* is a predominant fouler of mangrove roots and stem. Their settlement was high during late post monsoon and early premonsoon period due to optimal temperature and salinity for the growth and breeding. Barnacle showed an increasing trend gradually during January and March (Karuppayian and Raja, 2007). Barnacles were present through out the year and were absent in high tide level on mangroves. During low tide level on premonsoon and later during post monsoon there were mangrove settlement. The effects of barnacles occurred erratically on stem seedlings and on leaves had little effect on the growth of mangrove plants. The calcareous base for attachment of this species damage the plants (Satumanatpan and Michael J Keough, 1999). The settlement and distribution of barnacle on mangrove is affected by factors like salinity, depth, canopy, hydrological regime and biotic factors like aminoacid composition and one dimensional structure of barnacle adhesive protein (Xiang et al, 2006). Here the surface water temp, salinity influences the *Balanus sp.* distribution of on mangrove roots and stem. In the mangrove species *Sonneratia apetala* the leaves possess possible anti barnacle defence strategies suggesting that it was less frequent and less abundantly fouled by barnacles (Danquing et al, 2016).

Table 2: Biofouling organisms collected from mangrove roots and stem from Ayiramthengu region during February 2016 to January 2017.

No	Species	Premonsoon	Monsoon	Postmosoon
1.	***Conscinodiscus***	66	12	38
2.	***Melosira***	12	32	26
3.	***Nitzschia***	50	24	39
4.	***Cymbella***	36	9	12
5.	***Pleurosigma***	59	8	31
6.	***Licmophora***	31	4	26
7.	***Ceratium***	48	12	19
8.	***Cocconeis***	36	14	21
9.	***Navicula***	40	26	32
10.	***Diatoma***	42	16	31
11.	***Chorella***	58	19	42
12.	***Rhizosolenia***	42	26	30
13.	***Leptocylidricus***	47	15	29
14.	***Anabena***	2	27	26
15.	***Thalassionema***	38	20	30
16.	***Biddulphia***	35	10	27
17.	***Chaetoceros***	43	20	28
18.	***Golbigerina***	8	1	2
19.	***Elphidium***	10	2	4
20.	***Textularia***	9	1	1
21.	***Gammarus***	42	28	31
22.	***Balanus***	52	10	48

Table 3: Diversity indices of biofoulers collected from the roots and stem of mangrove plants.

Diversity indices	Premonsoon	Monsoon	Postmonsoon
Species richness	22	22	22
Species abundance	806	336	573
Dominance	0.944	0.938	0.941
Species Diversity	2.995	2.844	2.923

The increasing dissolved oxygen in the mangrove is caused due to oxygen exchange at the root system and the flow of dissolved oxygen enriched inland water(Rahman et al,2007). Biofouling on roots cause adverse effect to the mangroves. Postmonsoon favours the settlement of biofoulers. The influx of freshwater and rainwater into the mangrove affect the salinity variation (Kesavan et al, 2013). Salinity was mainly determined by local hydrology where input of salt water from periodic tides and fresh water from rivers, rainfall and runoff (Jadhav, 2011). Low salinity during monsoon favours the settlement of *Melosira sp* and *Anabaena sp.* The phytoplankton microfoulers is high during premonsoon period. The seasonal distribution depends greatly on the degree of variation in salinity and temperature. The fresh water phyto plankton *Melosira sp.* and *Anabaena sp.* showed its abundance during low temperature and salinity (Mitbavkar and Anil, 2008)

On conclusion although 22 species of epibionts including micro and macrofoulers were noticed during the present study. The colonization of epibionts on the roots, stems and leaves may adversely affect their growth. The hydrological parameters, wave exposure to roots and stem influence the biofouling distribution and diversity on the Ayiramthengu mangrove during February 2016 – January 2017. Biofouling in the roots and stem of mangrove plants showed that increase in species richness and abundance with increase in temperature and salinity. Shannon Weiner diversity index showed higher value during premonsoon indicates that diversity is maximum. *Balanus sp.* was the predominant fouler in the mangrove, necessary steps are taken to protect the mangrove trees from the biofouling organisms, especially from the *Balanus* species.

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