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Aquatic and Semi Aquatic Macrophytic Flora of Brackish Waters of Kodungallur, Thrissur Dist, Kerala

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Abstract: Ten sites from three biotopes of Kodungallur, Thrissur dist, Kerala were selected for the study. These comprised of one station from the estuarine region, six from backwaters and three from a coastal canal. A hundred and twenty one species of aquatic and semi-aquatic vascular macrophytes were enumerated. The flora indicates that the aquatic ecosystem has undergone eutrophication and the estuary is experiencing stress. The analysis of the macrophytic flora shows that the area lacks diversity of mangroves, though 23 mangrove associates reported from various parts of Kerala are found here. The wetland plants were the most common growth forms present. Several medicinal plants were also observed. It is the wetland plants, moisture loving plants and mangrove associates that contribute more to the stability of the water bodies of the study area rather than the mangroves. Completely aquatic families did not contribute much to the diversity.

Key Words: Aquatic and semi-aquatic macrophytes, mangrove, mangrove associates, eutrophication.

Introduction

Increased globalization has escalated species invasion to an unprecedented scale. High rate of extinction and invasion has put various ecosystems under enormous strain, making it imperative to understand how loss or addition of species influences the stability and function of the ecosystem[1]. The coastal ecosystems of Kerala are the abode of a multitude of living organisms, each with its own ecological adaptability. Climatic, geological and biological factors interact to produce a fascinating variety of coastal habitats inhabited by a range of distinct species. These ecologically sensitive regions support a flora which encompasses not only mangroves and semi mangroves, but also species of varied ecology, which exhibit an assortment of growth habits. The aquatic macrophytes can modify the physico-chemical conditions, form structural habitats for epiphytes and fauna, trap detritus, provide shelter, compete with algae and provide a detritus input to food chains[2]. Joseph[3], Vidyasagaran and Gopakumar[4], Sylas *et al.,* [5-6] Ghokhale and Chavan[7], Palit and Mukherjee[8] have investigated on the wetland macrophytes of India.

Materials and Method

The Azhikode Estuary and the adjoining brackish water *kayals* of Kodungallur are situated at the northern most ends of the Vembanad Lake and the Cochin estuarine system. Ten sites from three biotopes of Kodungallur, Kerala, were selected for the study. These comprised of one station from the estuarine region, six from backwaters and three from a coastal canal. These water bodies lie along the south west coast of India between latitude 10^0 11' and 10^0 18'N and longitude 76^0 08' and 76^0 12' E. The macrophytic vascular plants were enumerated. 1x1 meter quadrats were laid along the aquatic ecosystems to study the herbaceous community and 4x4 meter quadrats were used to study the shrubby vegetation[9-10]. A total of 102 quadrats were analysed. The surface waters of ten sites were sampled for a year from February 2005 to January 2006(APHA) [11]. The plants were identified using literature[12-13]. Growth forms were analysed using Cook[12] (modified). Shannon-Weaver's diversity index[14], Margalef's richness index[15] and Pielou's evenness index[16] were calculated to understand the community structure of these plants.

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Results and Discussion

A total of 120 aquatic and semi aquatic species, including mangroves and their associates belonging to 100 genera and 46 families, were recorded of which three were Pteridophyte families. The majority of the Angiosperms belonged to Cyperaceae, Poaceae and Asteraceae. The dominant representatives of Cyperaceae were *Cyperus haspan*, *Eleocharis dulsis*, *Fimbristylis miliacea*, *F. ferruginea*, *F. dichotoma* and *F. accuminata*. Lakshmi[17] has observed that members of Cyperaceae and Asteraceae were in highest density in the mangroves of Valapattanam and Thalassery river basin. Sylas *et al.* [5] have reported the dominance of Cyperaceae in the Kuttanad wetland system.

Table 1: Diversity Indices of aquatic and semi aquatic macrophytes of Kodungallur

No.	S	H'	d	J'
1	58	3.120	6.99	0.054
2	35	3.003	4.17	0.086
3	17	2.288	1.96	0.135
4	23	2.749	2.70	0.120
5	24	2.763	2.82	0.115
6	36	2.991	4.29	0.083
7	35	1.620	4.17	0.046
8	38	1.137	4.53	0.030
9	17	2.228	1.96	0.131
10	27	2.631	3.19	0.097

S: Number of Species, H': Shannon's index, d: Margalef's Index J': Pielou's Index

The members of Poaceae were more common in oligo/mesohaline conditions (Stations 1, 7 and 8 with a salinity range of 0.3 to 9.10 ppt). (Fig.1). 42% of growth forms were of wetland hydrophytes' category (W.H.). 31% of the plants enlisted are moisture loving (M.L.). Mangrove associates (MA) formed the third largest group comprising of 23%. The true mangroves, (M) 3%, free floating forms (F.F.) 7%, and the emergent hydrophytes (E.H.) constituted 5% of the population. All other categories fell below 3%. (Fig. 3)

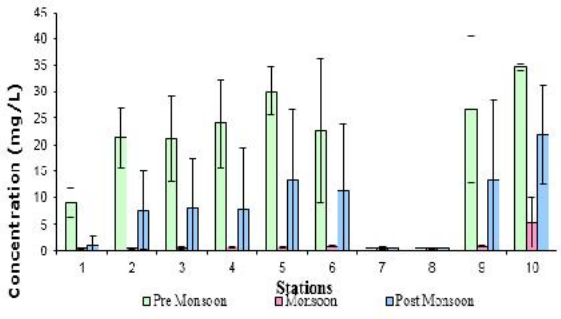


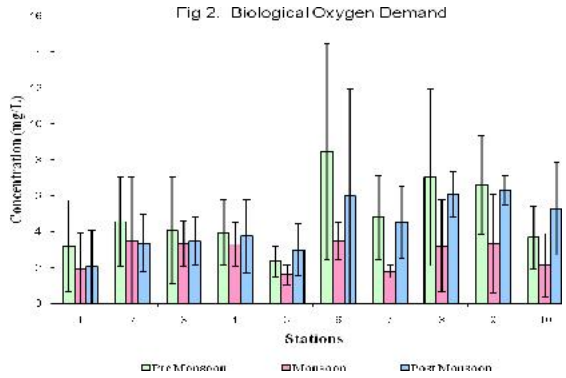
Fig.1: Salinity

The mangroves observed were *Avicennia officinalis*, *Acanthus ilicifolius* and *Excoecaria agallocha*. The dominant mangroves associates recorded were *Acrostichum aureum*, *Cleorodendron inerme*, *Calophyllum inophyllum*, *Cerebra odollum*, *Cyperus javanicus*, *Cyperus malaccensis*, *Cyperus haspan*, *Fimbristylis miliacea*, *Frimbristylis dichotoma*, *Mariscus javanicus*, *Hibiscus teliaceus* and *Thespesia populena.*

The wetland category of plants dominates in the study area. It is the wetland plants, moisture loving plants and mangrove associates that contribute more to the stability of the water bodies of the study area rather than the mangroves. Completely aquatic families like Nymphaceae, Menyanthaceae, Lentibulariaceae, Ceratophyllaceae, Hydrocharitaceae, Pontederiaceae, Aponogetonaceae and Lemnaceae were confined to the oligohaline-mesohaline regions, and did not contribute much to the diversity. Compared to the mangroves of Cochin[17] the mangroves of Kodungallur are lacking in diversity and abundance. Though the water salinity range is congenial for mangrove growth, factors like nature of the substratum and anthropogenic interference do not allow the group to flourish. *Acrostichum aureum* considered a vegetative pest that interferes with growth and regeneration of mangrove trees in many parts of the world is present here.

Exotic invasive species *Eichhornia crassipes, Salvinia molesta, Alternanthera philoxeroides* and *Ipomoea* sp. constitute a major threat to aquatic biodiversity. Dense mats of *Eichhornia crassipes* covers entire water body at station 7. Brendonck *et al.*, .[18] opines that the physical presence of water hyacinth greatly blocks sunlight and oxygen exchange and hence prevents growth of emerged and submerged plants. The low diversity Shannon diversity index (H`1.62, (Table1) at this station stress this point. The water hyacinth dies when the salinity is higher in the premonsoon months. These plants degenerate and contribute their own biomass to the pollutant load. This has caused the increase in the B.O.D. values in Stations 7 and 8, which are 4.76 ± 2.3mg/l and 7.02 ±4.9 mg/l during the premonsoon and 4.52 mg/l and 6.08 mg/l during the postmonsoon respectively (Fig.2). Addition of plant nutrients to the water body has caused eutrophication, increasing the local biological

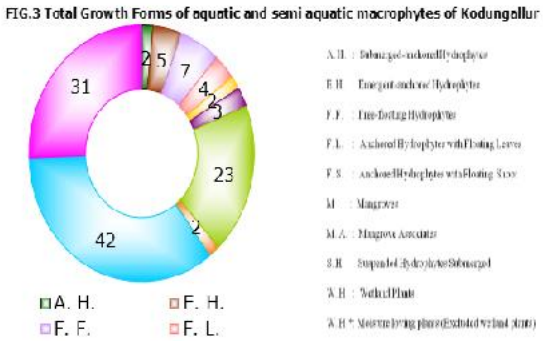
oxygen demand of this water body. The aggressive alien plants in smaller water bodies appeared to pose a threat to the indigenous medicinal plants. *Eichhornia crassipes*, *Salvinia molesta* and *Ipomoea* sps. are the major threats to aquatic environment [19]. Sylas *et al.*,[5] have reported that this plant is causing serious threat to the biodiversity of Kuttanad.



The medicinal plants recorded from the study area were *Nymphaea nouchali, Biophytum sensitivum, Mimosa pudica, Centella asiatica, Eclipta alba, Emilia sonchifolia, Bacopa monnieri, Scoparia dulcis, Alternanthera sessilis* and *Kyllinga brevifolia. Alternanthera philoxeroides* has replaced the habitat of native species, especially medicinal taxa such as *Bacopa moneri, Centella asiatica, Alternanthera sessilis* and *Biophytum sensitivum.* Sanilkumar and Thomas [20] have expressed concern that local extinction of medicinal plants may lead to loss of traditional knowledge of the medicinal properties of these plants.

Aponogeton appendiculatus, a hydrophyte endemic to Kerala, occupied the waters of stations 1, 2, 3 and 4.

Avicennia and *Clerodendron inerme* were observed to be in direct contact with salt water and the tides, at Station 10 whereas the bank flora along Station 1 comprised of *Ceratopteris thalictroides*, *Colocasia esculenta*, *Melastoma malabathricum*, *Crinum defixum*, *Cyperus malaccensis*, *Fimbristylis miliacea* and *Acrostichum aureum. Saccharum spontaneum*, *Aeschynomene indica*, *Colocasia esculenta, Panicum repens* and *Paspalum distichum* were found at the Stations 7 and 8. *Pandanus kaida*, *Thespesia populena* and *Wodina odiyar* were very common on the banks. These trees fulfill much the same ecological role as the species of mangroves in terms of bank stabilization and protection of habitat. *Sphenoclea zeylanica* and *Eclipta alba* grew in the rich organic substratum formed from coir husk.



Biodiversity has long been considered a community attribute or a measure of community structure and it is mostly approached by means of species diversity or richness of a given area. The diversity indices (Table 1), in terms of Shannon index H` showed that Station 1 had the highest diversity (3.12) and Stations 7 and 8 ranked the least with 1.62 and 1.14 respectively. Stations 7 and 8 are less diverse and more prone to infestation by alien species. McCann[1] concluded that diversity can be expected to increase stability of an ecosystem, which in turn depends on the ability of the community to contain groups that are capable of differential responses.Diversified communities are resistant to invasive species than non diversified ones.

Station 1 was the richest, species wise (6.99, Margalef's index); station 9 had the least value (1.96). The evenness index, in terms of Pielou's index J' indicated the evenness values to be very low. The highest evenness index of 0.135 was recorded at Station 3. Since values close to 0 indicate very uneven distribution[16], it could be concluded that the aquatic and semi aquatic macrophytes of the sites studied are irregularly distributed. The heterogeneous nature of the sites selected for the study may be the reason for this. Anthropogenic interventions in the form of land filling, blocking the natural flow of water by obstructing the interlinking channels, exploitation of plants for medicinal purposes, dumping of domestic, slaughterhouse and poultry wastes, coir retting, sewage and plastic strewn all over the water body apart from encroachment and sand mining, have

reduced the aesthetic value of these water bodies. Aquatic plants are impacted by eutrophication, yet provide a buffer against water quality degradation and long term data are essential to understand the trajectory of changes in the macrophytic community. Such data are essentially lacking in the ecological aspects of the macrophytes associated with the brackish waters of Kerala and hence this part of the study can be considered as an endeavour in that direction.

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