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Diversity of Mangroves in Asramam, Kollam District, Kerala

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Abstract

A study was conducted on the floristic diversity and structural analysis of the Mangroves in Asramam, Kollam District. A total of 6 mangrove species belonging to 4 families were enumerated. The true mangrove species are confined to salty-marshy environment along back waters, where as the mangrove associate species were also found in other areas apart from the mangrove environment The study resulted dominance of *Sonneratia caseolaris* L, which distributed in all quadrates studied, followed by *Rhizophora apiculata.* The mangrove species *Avicennia officinalis* recorded lowest density. Maximum relative basal area was represented by *Sonneratia caseolaris* followed by *Rhizophora apiculata.* Hence these species registered the highest Importance Value Index. At present the mangrove continuity in this area are lost and are faced destruction. Urbanization, tourism development and chemical discharge are some of the major common threats that dwindle mangrove ecosystems in the study area. Conservation strategies are to be made to conserve the existing pristine ecosystem in the area.

Key words: Mangroves, diversity, abundance , Important Value Index,

Introduction

Mangrove forest otherwise called mangrove community, mangrove ecosystem, tidal forest, etc., grow in conditions where no other plant species can survive (Hutchings and Saenger 1987). The mangrove environment is primarily saline and the muddy or sandy sediments home of variety of epibenthic, in faunal and mesofaunal invertebrates. They are highly productive ecosystems with an average production of 2,500 mg/ cm^2 per day (Bunt 1992). Due to their high primary productivity, turnover rates of organic matter and the permanent exchange with the terrestrial and marine ecosystems mangroves are of particular interest for the biogeochemical cycling of carbon and associated elements along tropical continental margins (Jennerjahn and Ittekkot 2002). Also these biological barriers reduce damaged caused by storms by limiting wave energy and preventing the land from being flooded. This has become even more apparent after 2004 Asian tsunami (Radhika 2006).

Kerala was once blessed with this amazing ecosystem (Basha 1991) but now going in a declined state. Various studies show that mangrove vegetation cover only 1905 ha in Kerala (Kurien, 1994). The distribution of mangrove in Kerala is discontinuous and patchy. Only Kannur district has good natural patches. There are approximately 755 hectare of mangrove forest. However it was reduced to 17km^2 (Kaladharan and Asokan 2012), followed by Kozhikode (293ha.) and Ernakulam (260 ha) (Mohan Kumar 1996).

The threats to the mangrove ecosystems could be broadly grouped into both natural as well as anthropogenic. The mangroves in the State are threatened with unprecedented destruction, which includes commercial exploitation of raw materials, land reclamation for agriculture, aquaculture and housing (Muraleedharan et al 2009).

In Kollam district mangrove are present in three places, namely Adventure Park Asramam, Munrothuruth islands and Kumbalam area. Asramam is the one of the most famous mangrove site in Kollam District and the mangrove spread was habitat to the highly endangered species of mangroves. The mangrove species present in the area are *Sonneratia caeseolaris, Rhizophora mucronata* and *Rhizophora apiculata.* In addition to being a major spawning ground for several edible marine species, the Asramam mangroves in the past was also home to otters and migratory birds and years ago this area contain thick and continuous mangrove without patches. Species like *Brugiera gymnorhiza* and species of *Rhizophora* are common in regions of Kollam district. But in the present scenario the disappearance of all this species along this coast. Now a day the continuity was lost and severe disruption and degradation due to developmental activities of tourism, real estate and pollutant discharges from various sources. In this ground the present study was undertaken to understand the distribution, diversity and structural analysis of mangrove ecosystem at Asramum, Kollam District and also aim to create awareness on the declining mangrove species and its future conservation strategies.

Materials and Methods

1. Study Area

The present study conducted in the mangrove forest at Asramam area of Kollam District. Asramam located

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in the core of Kollam city in the State. The thick mangrove forest in the area is very popular all over the state. The Asramam banks of Astamudi Lake bordering the government guest house complex were a major mangrove forest belt of the state. But towards the mid 1980's a systematic destruction of mangrove was launched through a tourist development programme of State government. It paved for the creation of Adventure Park. At present major part of the mangroves are situated in Asramam Adventure Park. It was opened to public on 1980 with an area of 48 acers. So many endangering species like *Syzygium tranvencorium* and other trees are surviving there. Some of the old flora still survived there it include 250 year old *Hopea*. Years ago this area contain thick and continuous mangrove without patches but now a days the continuity was lost and due to the over exploitation and human interference.

2. Methods

An area of 48 acres in the Asramam adventure park and near the link road portion was selected for detailed studies. Structural analytical studies of mangroves vegetation in Asramam was carried out during the months of March - June, 2016. The study was based on species area estimation and quadrant analysis (Michael, 1998). The quadrant size of 5x5m was fixed by species area curve method and altogether seven quadrates were selected randomly. The plant species and their individuals occurring in each quadrant were recorded. Basal area of mangrove species was measured 1.37m above the ground or highest prop root using tailoring tape. Approximate tree height should also measured. From the observations, the quantitative characters such as frequency, density, abundance, relative frequency, relative density, relative dominance, Importance Value Index (IVI) were calculated. Importance value index of each species was calculated as the sum of relative density, relative frequency and relative dominance (Ellison and Farnsworth, 2001) so as to reveal relative contribution of each species to the overall stand composition. The vegetation data were analyzed to calculate the diversity indices and species richness, Shannon– Weiner diversity (H'), Simpson index and equitability were measured (Legendre and Legendre, 2012). Species richness were measured (Margalef, 1958). Frequency, density and abundance were calculated using following formulae:

$$\textit{Frequency (F)} = \frac{\text{Number of quadrants in which the species present}}{\text{Total number of quadrates studied}} \; X100$$

$$\textit{Abundance (Ab)} = \frac{\text{Number of individuals of the species in all quadrants}}{\text{Number of quadrants of occurrence of the species}}$$

$$\textit{Density (D)} = \frac{\text{Number of individuals of the species in all quadrants}}{\text{Total number of quadrants studied}}$$

In addition to this relative frequency, relative density and relative dominance were calculated using following formulae:

$$\text{Relative density (RF)} = \frac{\text{Number of individuals of a species}}{\text{Total number of individuals}} \; X100$$

$$\text{Relative dominance (RD)} = \frac{\text{Total basal area of a species}}{\text{Basal area of all species}} \; X100$$

$$\text{Relative frequency} = \frac{\text{Frequency of a species}}{\text{Sum frequency of all species}} \; X100$$

$$\text{Importance value Index (IVI)} = \text{Relative Density} + \text{Relative Dominance} + \text{Relative Frequency}$$

Results and Discussion

The present study discusses the occurrence of six true mangroves species (Table.1) belonging to 4 plant families (Avicenniaceae, Rhizophoraceae, Sonneratiaceae and Acanthaceae) and several mangrove associates in the study area (Table 2). The plant family Rhizophoraceae has three species- *Kandelia candal, Rhizophora apiculata* and *Bruguiera gymnorrhiza* (Table .3). Among this, *Rhizophora apiculata* showed highest abundance.

Table 1. True mangrove flora of the study area at Asramam, Kollam

Sl.No	Species	Family	IUCN Status	Habit
1	*Acanthus ilicifolius* L.	Acanthaceae	Endangered	Sub shrub
2	*Avicennia officinalis* L.	Avicenniaceae	Endangered	Small tree
3	*Bruguiera sexangula*	Rhizophoraceae	Endangered	Shrub
4	*Kandelia kandal*	Rhizophoraceae	Least Concern	Small tree
5	*Rhizophora apiculata* Blume.	Rhizophoraceae	Vulnerable	Small tree
6	*Sonneratia caseolaris* L.	Sonneratiaceae	Threatened	Tree

While species like *Sonneratia caseolaris,*which is a rare and threatened species, present large quantity in Link Road area, it is listed critically endangered in IUCN Red list. During the course of survey, various types of habits like trees, shrubs and herbs were observed. One Pteridophyte species, *Acrostichum aureum* was noticed in the study area indicating fairly rich species diversity even in a highly degraded condition. Years ago this area contain thick and continuous mangroves without patches and rich species diversity but the present study show that continuity was lost generating patches. Now mangrove growing area is restricted in link road portion and Asramam Adventure Park only.

Table 2. Mangrove associates from the study area

Sl no	Species	Family	Habit
1	*Acalypha indica*	Euphorbiaceae	Herb
2	*Acrostichum aureum*	Pteridaceae	Herb
3	*Acacia auriculiformis*	Fabaceae	Tree
4	*Aerva lanata*	Amaranthaceae	Herb
5	*Borhavia diffusa* L	Nyctaginaceae	Herb
6	*Clerodendrum inerme*	Verbenaceae	Shrub
7	*Crotalaria striata*	Fabaceae	Shrub
8	*Cyperus distans*	Cyperaceae	Herb
9	*Euphorbia geniculata*	Euphorbiaceae	Herb
10	*Euphorbia hirta*	Euphorbaceae	Herb
11	*Ficus religiosa*	Moraceae	Tree
12	*Hyptis suaveolens*	Lamiaceae	Shrub
13	*Ipomoes biloba.* Forssk.	Convolvulaceae	Creeping herb
14	*Mimosa pudica*	Mimosaceae	Herb
15	*Passiflora foetida*	Passifloraceae	Climbing shrub
16	*Tridax procumbens*	Asteraceae	Herb

In the present study structural features of the mangroves were studied. Structural analysis encompasses not only the study of vegetation and its internal social relationships, but also provides information on classifications of plant communities and their structure, composition, and succession relations. Importance Value Index of each species was calculated as the sum of relative density, relative frequency, relative dominance and relative basal area, so as to reveal relative contribution of each species to the overall stand composition. It was found that the highest IVI were recorded for *Rhizophora apiculata* (93.62). The lowest IVI were recorded for *Avicennia officinalis* (31.01). *Kandelia kandal* also a rare species is presence in Asramam Adventure Park, which is now included in IUCN Red list. *Avicennia officnalis* is one of the common species in Kerala but its occurrence in the present study areas are very few in number. *Bruguiera gymnorrhiza* is the another pure mangrove present in Asramam region.

Density of various mangrove species present in the study area was much varied between them. Highest density was observed in *Rhizophora apiculata* (5.7 individuals/m^2) followed by *Sonneratia caseolaris* (4 individuals/m^2). On the other hand the *Kandelia candal* and *Avicennia officinalis* show same density value (1.28 individuals/m^2). The species *Bruguiera gymnorrhizae* showed with lowest density (1.7 individuals/m^2). While relative frequency of *Sonneratia caseolaris* (25.8%) is high in all regions, *Rhizophora apiculata Bruguiera gymnorrhizae* and *Kandelia candal* showed same relative frequency (20.68%). Relative density of *Sonneratia caseolaris* is high in link road area. While in other areas *Rhizophora apiculata* (40.8%) showed highest.

Table 3. Frequency, Density, Abundance, Relative frequency, Important Value Index of true mangrove species in the study area

Species	Frequency (%)	Density (Individuals / m^2)	Abundance	Relative frequency (%)	Relative density (%)	Relative dominance (%)	Importance Value Index (IVI)
Acanthus ilicifolius L.	44.3	1.30	3.5	14.60	15.20	11.86	41.02
Avicennia officinalis	33.3	1.28	3	12.06	9.18	9.77	31.01
Brugaria gymnorrhiza	57.1	1.7	3	20.6	12.24	13.63	46.55
Kandelia kandal	57.1	1.28	2.24	20.68	9.18	9.18	37.95
Rhizophora apiculata	57.1	5.7	10	20.68	40.81	32.13	93.62
Sonneratia caseolaris	71	4	5.6	25.8	28.57	36.36	90.01

Detailed investigation on the structural features of mangroves in Kerala and elsewhere studied and reported by various workers. Structural analysis of the mangrove communities at different estuarine formations revealed that there was a site specific domination of species which intern supported by adaptability of species to specific site conditions (Ewel and Bourgeois,1998). The present investigation also support this, of the several species present the *Rhizohora apiculata* shows the highest abundance. Ecosystem evaluation with respect to adaptation of species to the specific site may be attributed by physical, biological and edaphic factors (Ewel and Bourgeois,1998).

A study at west coast in Ayiramthengu mangroves, Kollam. District, Kerala, revealed twenty seven species belonging to 17 families (Jisha. *et al.,* 2004). In another study the mangrove flora of Ayiramthengu comprise of totally 9 mangrove species (Vishal, *et al.* 2015). In agreement with these, six species were observed at a small portion of the mangrove at Asramam in the present study.

In most of the estuaries of Kerala, the mangroves had been to large extent, converted to mixed silvi-agri-aqua cultural system and used as water ways, but were later destroyed for uses such as firewood, building materials and as a source of tannin. Quantitative structure of true mangroves was studied in terms of frequencies, density and abundance. Compared to Sundarbens of west Bengal, Kerala has very few area of mangrove forest. It was estimated that out of the 17km2 of mangroves of Kerala, a major share is present in Kannur district (Khaleel, 2005). Kollam District encompasses with highest extent of mangroves among Southern Districts. However, degradation and conversion of mangroves is profoundly experienced in many parts of Kollam especially Kayamkulam, Ashtamudi, Paravoor areas. Asramam is one of the most famous mangrove site in Kollam District had undergone severe disruption due to conversion and real estate activities. The most critically endangered species *Syzygium travancoricum* is found in very few numbers here. Similarly, *Lumnitzera racemosa*, which is one of the rare mangrove species in Kerala, has shown its restricted distribution in Asramam area of this District.

Now Asramam area consist of six species of mangrove coming under four families, of this *Sonneratia caseolaris* occur throughout the area but the number is limited compared to *Rhizophora apiculata*. The first three quadrant study shows the complete absence of *Rhizophora apiculata.* The rare species *Kandelia candel* is occurring in this area. Usually this species is occurring in Malabar region.

At present the species diversity in Asramam is drastically decreasing due to human activities such as cutting of mangroves, dumping of hospitals and house hold wastes, tourism development, improper planning of developmental activities such as aquaculture, agriculture, construction of human inhabitants, mining and industrialization. Another major problem is by the difficulties of protection because of scattered geographic distribution of mangroves. Years ago this area has rich diversity of mangrove and mangrove associates, and also it was a major place for migratory birds.

Compared to other mangrove forest this area has only limited species diversity. The study shows that this area has six species it included in three family and continuity of mangrove forest was lost and now it appears as patches. Asramam is one of the famous tourist centers of Kollam District with adventure park, house boating, etc. Though beneficial to our economy it is also harmful to our environment as the area is modified for tourism development. Another important fact is pollution which causes major threat to mangrove ecosystem (Basha, 1991). Polluted water affects the growth and multiplication of micro flora and fauna of Ashtamudi lake and also affect the mangroves. Dumping of hospital waste, house hold waste, plastics, etc. will destroy the physical and chemical characteristics of Ashtamudi lake, and due to all these human activities now this area look like a waste land (Fig 1).

We need to adopt certain strategies for conservation and management of mangrove ecosystems in the Asramam. Some of the conservation strategies proposed are; identification of potential mangrove areas for declaration as national park or sanctuaries, restoration of degraded and critical mangrove areas by planting suitable species, identification of endangered mangrove species and full protection for their rehabilitation, checking encroachment destruction and reclamation of mangrove areas and raising awareness among the public on the importance of mangrove and the need of their preservation.

Fig. 1. One of the polluted areas in the study site at Asramam, Kollam

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