



RESEARCH PAPER

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Distribution and plant diversity of mangroves in the west coast of Kerala, India

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Abstract

Mangroves in India account for about 5 per cent of the world's mangrove vegetation and are spread over an area of about 4,500 km² along the coastal States/UTs of the country. Various studies showed that mangrove vegetation cover only 1,095 ha in Kerala (Kurien, *et al.*, 1994). According to another estimate, Kerala once supported about 700 km² mangroves and what we see now are only relics of a great past (Ramachandran *et al.*, 1985). It can be noted that out of the total 1671 ha of mangroves in Kerala, 1470 ha are with private holders (Basha, 1991). The present investigation was carried out in the mangrove areas of Kerala to document the extent of mangroves, various attributes of plant diversity, causes of degradation and regeneration etc. during 2010- 2012 by involving experts, activists, scientists etc. under the leadership of Kerala Sasthrasahithya Parishath, an NGO working in Kerala. Data collection was based on frequent visit to mangroves areas and gathering information from the local activists, scientists and local self government officials. According to the estimate of this study, the extent of mangroves of Kerala is 2502 ha out of which 1189 ha belongs to the state but 1313 ha is under private ownership. The mangrove flora is unique in nature due to its restricted distribution only to the tidal zones. A total of 15 pure mangroves species and about 33 semi mangrove species were recorded in the study. It is also observed that except few areas, most of the mangroves in Kerala are in an irreversible process of degradation. The Mangroves had been degraded due to construction of a number of barrages for irrigation purposes, clear felling and lack of fresh water supply, lack of tidal flushing of the degraded areas, release of pollutants from various domestic and industrial sources, changes in water quality, Illegal sand mining etc. Natural regeneration in underutilized lands in backwater systems, afforestation programmes, conservation initiatives and growing awareness on the mangrove ecosystems have highlighted the need to conserve and manage them sustainably.

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Introduction

Mangroves are salt tolerant plants of tropical and subtropical intertidal regions of the world distributed mainly between latitudes 25° N and 25° S. Mangroves were found in more than 120 countries and territories around the world. Mangroves in India account for about 5 percent of the world's mangrove vegetation and are spread over an area of about 4,500 km² along the coastal States/UTs of the country. Mangrove forests are extremely important coastal resources, which are vital to our socio-economic development. A vast majority of human population lives in coastal area, and most communities depend on local resources for their livelihood. The mangroves are sources of highly valued commercial products and fishery resources and also as sites for developing a burgeoning ecotourism.

Kerala was once blessed with this amazing ecosystem but is now going in a declined state. Certain reports on Kerala mangroves state that Kerala once had 700 km² of Mangroves forests. However, it has declined to 17 km² (Basha, 1991). Various studies showed that mangrove vegetation cover only 1,095 ha in Kerala (Kurien, *et al.*, 1994). A number of physical and biological features like tide, salinity, geomorphology, species interaction etc are the determining factors for the existence of different species of mangroves (Khaleel, 2005). Floristic diversity of mangroves in Kanuur is very rich as compared to other districts of Kerala (Vidyasagan *et al.* 2011). Apart from the details on the extend, there has no attempt to assess the status of mangrove areas in the State. Only few studies on the extent and plant diversity had done. Hence an attempt is made here to study the distribution and plant diversity of mangroves in Kerala.

Materials and methods

Study area and method

A detailed investigation on the extent of distribution and plant diversity was carried out in the mangrove formations all along the coastal districts of Kerala. A team of scientists, environmentalists, social workers,

volunteers of Kerala Sasthrasahithya Parishath could able to visit various mangrove sites of different districts and documented information on extent, floristic diversity, structural attributes, degradation status etc. Distribution of mangroves in various districts was studied by the specific visits followed by the collection of secondary data from resource survey details of the land use board and resource map prepared at Panchayat level. There was also discussion with local experts, social workers, environmentalists, Panchayath officials to gather secondary data pertaining to the mangroves of specific sites. Plant diversity was studied by the spot identification of plant species. Plant specimens of unidentified species were collected and identified with the help of taxonomists.



Fig. 1. Kerala map showing backwaters and mangroves in the west coast.

Results and discussion

Extent of mangroves in Kerala

Mangroves in Kerala are distributed in the backwaters, estuaries and deltas etc. of the west coast. Out of 44 rivers of Kerala, 41 rivers are flowing to western direction and joins with the Arabian Sea through backwater system. Mangroves are growing in the mud flats, deltas, estuarine ridges and edges of island systems according to the specific geographical formations of the area. Table 1 shows the percentage

contribution of mangroves in different districts and also the extent of mangroves under private and state ownership. It indicates that Kannur district occupies maximum extent of mangroves. (1100 ha) followed by Ernakulam (600 ha) and Kasaragod (315 ha). Similarly minimum extend was represented by three districts namely Malappuram (26 ha), Thiruvanthapuram (28 ha) and Thrissur (30 ha).

Table 1. Pure mangroves of Kerala

Sl. No.	Scientific Name	Family	Habit
1	<i>Aegiceras corniculatum</i>	Myrsinaceae	Tree
2	<i>Avicennia marina</i>	Avicenniaceae	Tree
3	<i>Avicennia officinalis</i>	Avicenniaceae	Tree
4	<i>Bruguiera cylindrica</i>	Rhizophoraceae	Tree
5	<i>Bruguiera gymnorrhiza</i>	Rhizophoraceae	Tree
6	<i>Bruguiera sexangula</i>	Rhizophoraceae	Tree
7	<i>Ceriops tagal</i>	Rhizophoraceae	Tree
8	<i>Excoecaria agallocha</i>	Euphorbiaceae	Tree
9	<i>Excoecaria indica</i>	Euphorbiaceae	Tree
10	<i>Kandelia candel</i>	Rhizophoraceae	Tree
11	<i>Lumnitzera racemosa</i>	Combretaceae	Shrub/ tree
12	<i>Rhizophora apiculata</i>	Rhizophoraceae	Tree
13	<i>Rhizophora mucronata</i>	Rhizophoraceae	Tree
14	<i>Sonneratia alba</i>	Sonneratiaceae	Tree
15	<i>Sonneratia caseolaris</i>	Sonneratiaceae	Tree

Though Kannur district occupy highest area (756 ha) of private forests as well as state forest (348 ha), Kollam district contribute maximum percentage of private forest (73.3%) when compared to forest under state ownership (26.7 %). Kasaragod district occupy lowest mangrove area under private ownership which is 8 ha (2.5%) whereas forests under state ownership is high as 307 ha (97.5%). Out of the total extent of mangroves in Kerala (2502 ha), 1313 ha under private ownership and 1189 km belongs to State. Blasco, (1975) reported mangrove ecosystem in Kerala is as 70,000 ha. Various studies showed that mangrove vegetation cover only 1,095 ha in Kerala (Kurien, *et al.*, 1994). Basha (1991) reported that out of the total 1671 ha of mangroves in Kerala, 1470 ha are with private holders.

Floristic composition

Floristic composition of mangroves in various locations is furnished in Table 2. The mangrove vegetation in the above areas is mainly influenced by

the halophytic adaptations. During the study, a total of 15 pure mangroves species were recorded from the mangrove areas and are belonging to 9 genera and 6 families. Rhizophoraceae represented 7 species followed by two each from families, Avicenniaceae, Sonnaraceae and Euphorbiaceae respectively. Jose (2003) studied structural features of the mangroves at Kunhimangalam, Valapatanam and Dharmadam areas of Kannur. He found that *Avicennia officinalis* represented highest IVI (141.86) followed by *Excoecaria agallocha* (112.14). Similarly, in the present study there were 33 mangrove associates were identified from various locations in different districts. Fabaceae was representing four species and two species each by Verbinacea, Clusiaceae and Malvaceae (Table 3). Krishnamurthy *et al.* (1981) reported 110 species belonging to 60 genera and 35 families from Pitchavaram mangroves of Tamil Nadu.

Table 2. Mangrove associates in Kerala.

Sl. No	Scientific Name	Family	Habit
1	<i>Acanthus ilicifolius</i>	Acanthaceae	Shrub
2	<i>Acrostichum aureum</i>	Pteridaceae	Shrub
3	<i>Annona glabra</i>	Annonaceae	Tree
4	<i>Ardisia elliptica</i>	Myrsinaceae	Tree
5	<i>Ardisia solanacea</i>	Myrsinaceae	Tree
6	<i>Barringtonia racemosa</i>	Lecythidaceae	Tree
7	<i>Caesalpinia nuga</i>	Fabaceae	Climbing shrub
8	<i>Calamus rotang</i>	Arecaceae	Climber
9	<i>Calophyllum calaba</i>	Clusiaceae	Tree
10	<i>Calophyllum inophyllum</i>	Clusiaceae	Tree
11	<i>Cerbera odollam</i>	Apocynaceae	Tree
12	<i>Clerodendron inerme</i>	Verbenaceae	Shrub
13	<i>Crinum defixum</i>	Amaryllidaceae	Herb
14	<i>Derris scandens</i>	Fabaceae	Climbing herb
15	<i>Derris trifoliata</i>	Fabaceae	Climbing herb
16	<i>Dolichandrone spathacea</i>	Bignoniaceae	Tree

17	<i>Entada sp.</i>	Mimosaceae	Climber
18	<i>Flagellaria indica</i>	Flagellariaceae	Climber
19	<i>Hibiscus tiliaceus</i>	Malvaceae	Tree
20	<i>Holigarna arnottiana</i>	Anacardiaceae	Tree
21	<i>Ipomoea pes-caprae</i>	Convolvulaceae	Perennial vine
22	<i>Lansea coromandelica</i>	Anacardiaceae	Tree
23	<i>Melastoma malabathricum</i>	Melastomataceae	Shrub
24	<i>Morinda citrifolia</i>	Rubiaceae	Tree
25	<i>Pandanus tectorius</i>	Pandanaceae	Tree
26	<i>Pongamia pinnata</i>	Fabaceae	Tree
27	<i>Premna latifolia</i>	Verbenaceae	Shrub
28	<i>Premna serratifolia</i>	Lamiaceae	Tree
29	<i>Scaevola sericea</i>	Goodeniaceae	Shrub
30	<i>Stenochlaena palustris</i>	Blechnaceae	Climber
31	<i>Syzygium travencoricum</i>	Myrtaceae	Tree
32	<i>Terminalia catappa</i>	Combretaceae	Tree
33	<i>Thespesia populnea</i>	Malvaceae	Tree

Table 3. Distribution of pure mangroves in Kerala.

Sl.No.	Name of the Species	TVM	KLM	ALP	KTM	EKM	TCR	MLPM	KKD	KNR	KSD
1	<i>Rhizophora mucronata</i>	4	3	2	4	1	2	3	2	1	2
2	<i>Rhizophora apiculata</i>	4	1	3	4	3	4	4	3	1	3
3	<i>Avicennia officinalis</i>	4	1	2	3	1	3	2	1	1	1
4	<i>Avicennia marina</i>	2	1	2	5	1	4	3	1	1	3
5	<i>Bruguiera cylindrica</i>	4	2	2	4	2	3	3	3	1	5
6	<i>Bruguiera gymnorrhiza</i>	4	3	3	4	1	4	4	4	4	4
7	<i>Kandelia candal</i>	4	4	5	4	4	4	4	2	2	5
8	<i>Bruguiera sexangula</i>	4	4	5	2	5	4	2	4	4	3
9	<i>Sonneratia alba</i>	4	3	3	4	2	4	4	4	1	4
10	<i>Sonneratia Caseolaris</i>	3	3	2	3	1	4	2	2	1	2
11	<i>Excoecaria agallocha</i>	1	1	1	3	2	2	2	1	1	2
12	<i>Excoecaria indica</i>	5	4	4	4	4	4	4	4	4	4
13	<i>Aegiceras corniculatum</i>	4	2	3	4	4	3	3	2	1	2
14	<i>Lumnitzera racemosa</i>	4	3	4	4	4	4	4	4	5	4
15	<i>Ceriops tagal</i>	4	5	4	4	4	4	4	4	4	4

1. Profuse 2. Frequent 3. Rare 4. Not found 5. Threatened

Distribution of pure mangroves

District wise distribution of pure mangroves in the coastal districts of Kerala is depicted in table 4. It indicates that *Rhizophora mucronata* is profusely distributed in Kannur and Ernakulam districts where as it was not seen in Kottayam and Trivandrum districts. *Rhizophora apiculata* is widely distributed in Kannur and Kollam district but not found its presence in Trivandrum, Kottayam, Thrissur and Malappuram districts. *Avicennia officinalis* is one of the common species which could able to establish in different mangrove formations in the state. It is noticed in all the districts except Trivnadrum. However this is not the case with *A.marina* which

was not seen in Thrissur and is one of the threatened mangrove species in Kerala.

Out of three species belonging to genus *Bruguiera*, *B. cylindrica* has relatively wide distribution. However, it is not noticed in Trivandrum and Kottayam districts. *B. gymnorrhiza* is a rare species which had shown its presence in few districts ie. Kollam, Alappuzha and Ernakulam. *B. sexangula* is one of the endangered species, which is represented by three districts in Kerala namely Kottayam, Malappuram and Kasaragod. *Kandelia kandal* is also a rare species which is distributed in Kannur and Kozhikode districts. *Sonneratia caseolaris* is a widely distributed species which is found in all the districts except

Thrissur. Whereas *S.alba* is becoming endangered due to its small populations in the districts of Kollam, Alapusha and Ernakulam. *Excoecaria agallocha* is the only species found in all the districts of Kerala. Whereas *E. indica* is being critically endangered due to its restricted presence in Trivndrum district. *Aegiceras corniculatum* is noticed in all the districts except Trivandrum, Kottayam and Ernakulam. *Lumnitzera racemosa* is one of the rarest mangrove species in Kerala found in two districts namely, Kollam and Kannur. *Ceriops tagal*, the species which believed to be extinct from Kerala coast was rediscovered from Kollam district of Kerala during the present study. It is not reported from any other districts in Kerala so far.

Present study on the distribution of pure mangroves of Kerala revealed that *Excoecaria indica*, *Lumnitzera racemosa* and *Ceriops tagal* are the most threatened species in the west coast. Similarly *Bruguiera sexangula* is also confined in few places wherein their populations is facing further decline.

District level status of mangroves

Status of mangroves at district level was studied as part of the present study. It indicates that in Trivandrum district, once it endowed with luxuriant growth of mangroves has been undergone severe degradation. The major threat was from the reclamation of Veli backwater for housing other developmental activities. The remnants of past glory of mangroves in Veli backwater is remain confined in the areas under the custody of ISRO. 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. *Ceriops tagal*, believed to be extinct in Kerala coast was being rediscovered from Vincent island of Kollam district. Though degradation is vehemently noticed in certain areas of the district, it is observed few signs of regeneration of mangroves in certain other areas.

In Kottayam district, mangroves are mainly distributed in Kumarakom, which is represented as fragmented assemblage of few species. Tourism is causing severe damage to the existing mangroves in Kumarakom. Now good patches of mangroves confined in the protected areas under KTDC. Alapuzha was once famous for backwaters and swamps on which mangroves could able establish profusely. But now it is very difficult to locate good mangrove patches in Alapuzha district. Presently the available patches are confined in Kayamkulam and Vembanad backwater areas. Due to blockade in saline water availability, many areas are invaded by semi mangroves like *Barringtonia racemosa*, *Annona glabra* and *Pendanus tectorius* etc.

Ernakulam district occupy second highest extent of mangroves in the state after Kannur district. In the state, maximum extent of mangrove destruction was reported from this district. When Cochin became industrial capital of the state, there was flooding of developmental projects which took away prime areas of mangroves from Panangad, Gosree, Vallarpadam, Vypin etc. The silver line in the conservation of mangroves in Ernakulam district is one with the declaration of Mangalavanam as bird sanctuary. Thrissur district consists of very less extent of mangrove in the state. Presently mangroves are confined in backwaters of Chettuwai, Kodungallur and few patches in Venkidung and Pavaraty Panchayats. Mangrove destruction is going on in Chettuwai by the name ecotourism where as real estate activities took away good patches of mangroves in Pulloot of Kodungallur.

Malappuram district occupy very less extent of mangroves in the state. Kadalundi, Kerala's first community reserve is endowed with relatively good patches of mangroves. Pulluni of Thirur, Murukummadu, Kootaikadavu are few places where relatively good patches of mangroves are found. However Pulluni mangroves face acute threat from developmental activities. Kozhikode district once occupied good extent of mangroves, but most of these luxuriant mangroves have been taken away by faulty land use and real estate activities. Part of Kadalundi community reserve is located in Kozhikode district also. Beypore, Kottooli, Akalapuzha are still supporting good patches of mangroves which is also under threat.

Kannur district occupy highest extent of mangroves in the state hence it is named as the capital of mangroves in Kerala. More than 60 per cent of the total mangrove areas is under private ownership. Mangroves are luxuriant in certain areas due to the absence of so called development. Plant diversity of pure mangroves is also very high in Kannur when compared to other districts (12 out of 15 pure mangrove species). This is the only district which had undertaken extensive mangrove afforestation programmes with the auspices of Kerala forest department. The uncultivated Kaippad fields are being profusely invaded by mangroves. Dalil, Kunhimangalam Kalliassery, Olavilam, Edat, Thekkumpadu, Cherukunnu are few places where mangroves are protected and devoid of any kind of human interference. Kasaragod is the district one which faced less degradation of mangroves which in turn helped the protection of existing mangroves. Arekode mangroves are found along Kumbalapuzha has been considered as largest patch of mangroves in Kasaragod district. One of the endangered pure mangrove species, *Bruguiera sexangula* is also recorded first time in Kasaragod district during the present study.

Threats

Mangroves of Kerala are considered as the relics of the past. Invasion of the islands by encroachers made extensive clearing and degradation of many areas. Mangroves have also undergone extensive onslaught from aquaculture and latterly by rapid organization. The degradation of mangroves has affected the land itself resulting in soil erosion and lack of land building activities. Most of the mangroves in Kerala are in an irreversible process of degradation. The Mangroves had also been degraded due to construction of a number of barrages for irrigation purposes depriving the mangroves of its share of fresh water. Decreasing salinity has led to gradual disappearance of species and has been responsible for change in species composition. Besides clear felling and lack of fresh water supply, lack of tidal flushing of the degraded areas has led to hyper-saline conditions, which has prevented establishment of fresh regeneration. The estuaries receive a lot of pollutants from various sources like Kayal Kakkos, domestic sewage, slaughterhouse waste, motorized boats etc. Different mangrove areas under study are invariably undergone various types biotic interventions which caused even disappearance of this unique ecosystem. Mangroves in Veli and Asramom are completely fragmented and destroyed and need immediate conservation. Similarly Kumarakom of Kottayam district are also facing major threat from ecotourism. Major portion of Puthuvyppu mangroves have been disappeared due to the establishment of LNG terminal. Chettuwei mangroves are threatened mainly from Ecotourism and encroachment. Pulluni of Thirur, Malappuram district is facing destruction of good patches of mangroves along with an endangered species *Bruguiera sexangula*. Kallai of Kozhikode district lost its past glory of mangroves due to faulty land use. Kannur though occupy maximum extent of mangroves in Kerala, mangroves are destroyed in few areas ie. Irinavu, Pazhayangadi, Papinissery, Thalassery, Melur, Thazhaekavu etc.

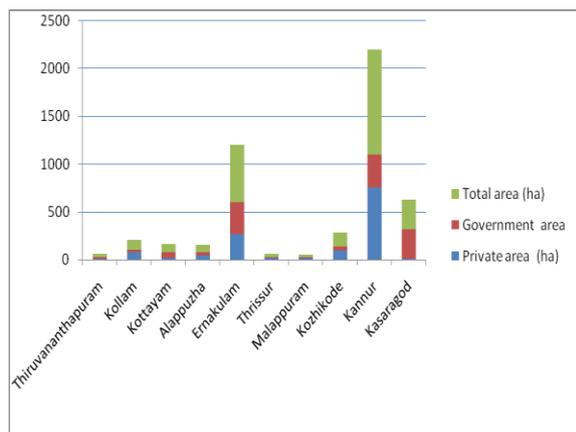


Fig. 2. Estimated mangrove areas in the West coast of Kerala.

Conservation

The mangrove forests are considered to be as unique as human population. Under Sec.2(i) of Forest (Conservation) Act 1980, no forest land can be diverted for non forestry purpose without prior approval of the Central Government. This description covers all statutorily recognized forests whether designated as Reserve, Protected Forest or otherwise for the purpose of Sec.2 (i) of FCA 1980. According to this clarification all mangrove areas qualify for the definition of forest irrespective of ownership.

Keeping in view of the above points there should be complete ban on the conversion of mangrove areas, which are under the control of private agencies. Preparation of a management plan by considering ecological amplitude, zonation, morphological and physiological adaptation of the species to their specific environment etc. should immediately be initiated in order to conserve the remaining mangrove areas. It is high time to have a serious attempt to conserve existing luxuriant patches of mangroves in Vincent island of Kollam, Arikadi of Kasaragod, Puthuvyppu of Ernakulam, Pulluni of Malappuram, Chettuwei of Thrissur districts etc.

Conclusion

Present investigation on the distribution and plant diversity of mangroves revealed that out of the total extent of mangroves in Kerala (2502 ha), 1313 ha under private ownership and 1189 ha belongs to

State. Studies on floristic composition indicated that a total of 15 pure mangroves species were recorded from the mangrove areas and are belonged to 9 genera and 6 families. Similarly, there were 33 mangrove associates were identified from various locations in different districts. Distribution of pure mangroves in Kerala revealed that *Excoecaria indica*, *Lumnitzera racemosa* and *Ceriops tagal* are the most threatened species in the west coast. Similarly *Bruguiera sexangula* is also confined in few places wherein their populations are facing further decline. Mangroves of Kerala are considered as the relics of the past. Invasion of the islands by encroachers made extensive clearing and degradation of many areas. Hence there is an urgent need to protect the remaining mangrove areas and a massive afforestation campaign is to be initiated with the full hearted support of the local governers.

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