MANGROVES OF KERALA

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Mangroves plants are salt tolerant plants of tropical and subtropical intertidal regions of the world. These highly adapted plants have many peculiar features than their terrestrial and aquatic counterparts. The word 'mangrove' can also be used to describe the habitat as well as the plants. Mangroves are distributed in the tropical countries of the world. The mangrove ecosystem covers only 0.037 per cent of the world's surface or 0.12 per cent of the Earth's land area.

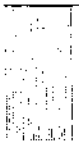
Mangroves in India account for about 5 per cent of the world's mangrove vegetation and are spread over an area of about 4,500 km 2 along the coastal States/UTs of the country.

Sunderbans in West Bengal accounts for a little less than half of the total area under mangroves in India.

In Kerala, only Kannur district has good natural patches. There were approximately 755 hectare of mangrove forest in Kannur. However, it has now become reduced to 17 km ^{2}. Forest Survey of India (FSI, 2003) further showed that mangrove vegetation in Kerala is now restricted largely to river mouths and tidal creeks and that there has been no significant mangrove cover to the south of Cochin.

TABLE 1 List of Mangrove vegetation found in Kerala

S.No	Family	Genus	Species	Local name
1	Myrsinaceae	*Aegiceros*	*corniculatum*	*pookandal*
2	Acanthaceae	*Avicennia*	*officinalis*	*uppotti*
3	Acanthaceae	*Avicennia*	*marina*	*cheruuppotti*
4	Acanthaceae	*Acanthus*	*ilicifolius*	*chullikandal*
5	Rhizophoraceae	*Rhizophora*	*apiculata*	*Kayakandal/ vallikandal*
6	Rhizophoraceae	*Rhizophora*	*mucronata*	*Peekandal*
7	Rhizophoraceae	*Kandelia*	*candel*	*Cherukandal/ ezhuthanikandal*
8	Goodeniaceae	*Scaevola*	*taccada*	



9	Lythraceae	*Sonneratia*	*alba*	*nakshatrakandal*
10	Lythraceae	*Sonneratia*	*caseolaris*	*chakarakandal*
11	Rhizophoraceae	*Ceriops*	*tagal*	*Manja kandal*
12	Euphorbiaceae	*Excoecaria*	*agallocha*	*kannampotti*
13	Rhizophoraceae	*Bruguiera*	*gymnorhiza*	*kuttikandal*
14	Rhizophoraceae	*Bruguiera*	*Cylindrica*	*kuttikandal*
15	Combretaceae	*Lumnitzera*	*racemosa*	
	Associates			
1	Fabaceae	*Derris*	*trifollata*	*ponnumvally*
2	Fabaceae	*Derris*	*scandens*	*poonjamvally*
3	Pteridophyte	*Achrostichum*	*aureum*	*machintholu*
4	Verbenaceae	*Clerodendrum*	*innerme*	*puzhamulla*
5	Acanthaceae	*Cerebra*	*odollum*	*odalanga*
6	Rubicaceae	*Morinda*	*citriflolium*	*cherumanjanathi*
7	Anonaceae	*Anona*	*glabra*	*Aligator apple, kadalatha*
8	Barringtoniaceae	*Barringtonia*	*racemosa*	*samudrachampa*

1. *Aegiceros corniculatum* **Family: Myrsinaceae**

Common name : Black mangrove, River mangrove or Khalsi

Vernacular names : *Pookandal* (Malayalam)

Habit : Shrubs to small trees, branches horizontally spreading, bark smooth, no aerial roots, stipules absent,

Distribution : Palakode, Kunjimangalam, Kumbala estuaries

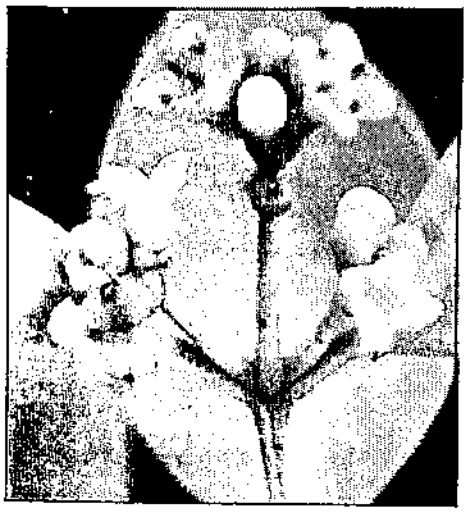
Leaves : glabrous both sides

Flowers : Pentamerous, red coloured

Fruits : Curved shape, red coloured

2. *Avicennia officinalis* Family: Verbenaceae/ Avicennaiaceae

Common name	:	Indian mangrove. Grey mangrove
Vernacular names	:	*Uppotti* (Malayalam)
Habit	:	Large trees, 20- 30 m height, pencil like pneumatophores, Bark is smooth, slightly fissured and does not flake, found sporadically on the banks of rivers and rarely found near the sea. It prefers clay soil and usually found inland.
Distribution	:	Occur in all major estuaries in Kerala
Leaves	:	Elliptic, oblong, dorsal side green and ventral side pale green, apex rounded , grow in opposite
Flowers	:	Largest among the *Avicennia* species (diameter of 6 to 10 mm after anthesis), Petals - orange yellow to lemon yellow in colour, Zygomorphic, Sessile, Cymes, Tetramerous
Fruits	:	Heart shaped, flattened, testa shiny and pubescent



3. *Avicennia marina* Family: Verbenaceae/ Avicennaiaceae

Common name	:	Grey mangrove, white mangrove
Vernacular names	:	*Cheruuppotti* (Malayalam)
Habit	:	Shrubs, less than 5 m height, pencil like pneumatophores, Bark is whitish to greyish or yellow-green in colour, smooth, often powdery and scaly. The grey mangrove

can experience stunted growth in water conditions that are too saline, but thrive to their full height in waters where both salt and fresh water are present. The species can tolerate high salinity by excreting salts through its leaves

Distribution : Seaward areas, of Thalaserry, Kannur and Kunjimangalam

Leaves : Thick, Elliptic, yellowish-green and hairless above and silver-grey below with pointed tip. Underside of the leaf has special glands for secreting excess salt.

Flowers : Flowers are small, 0.3 to 0.5 cm across, sessile, fragrant, pale-yellow in colour Zygomorphic, Sessile, Cymes, Tetramerous, Petals orange/ yellow

Fruits : Fruit is heartshaped, rounded or sometimes shortly beaked; outer skin is greyish with fine hairsand inside is radiant green or russet brown

4. *Acanthus ilicifolius* **Family: Acanthaceae**

Common name : Holly-leaved acanthus, Sea Holly or Holy Mangrove

Vernacular names : *Chullikandal* (Malayalam)

Habit : Shrubs, occurs in water front areas

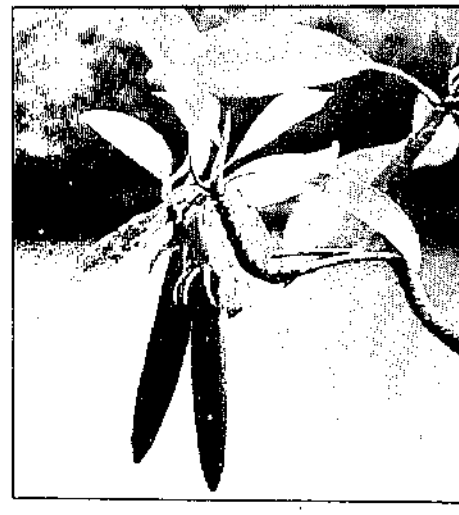
Distribution : Occur in all major estuaries in Kerala

Leaves : Large, spiny margins and tip, deccusate phyllotaxi

Flowers : Terminal inflorescence , Spikes, Light blue to violet flowers, with two persistant bractioles, Zygomorphic, Sympetalous

5. *Bruguiera gymnorrhiza* Family: Rhizophoraceae

Common name	:	Orange mangrove
Vernacular names	:	*Kuttikandal* (Malayalam)
Habit	:	Tall tree, spreading, Trunk and branches are marked with leaf and stipule scars. Aerial roots are short or shallow buttress like, Trunk base is thick and robust, Bark is pale grey or brown, thick, hard and rough Pneumatophores knee shaped
Distribution	:	Puthuvypu, Kumbalanzhi
Leaves	:	Elliptic, oblong acute apex, coriaceous, margin entire, more than 12 cm long , tip acute, opposite arrangement, leathery, dark green coloured with 2-5 cm long petioles
Flowers	:	Solitary, axillary, campanulate large. Calyx- claw like tip acute, deep red to scarlet coloured. Petals -Orange brown coloured, tip acute with tassels (appendages)
Fruits	:	Hypocotyl cigar shaped, 15 to 25 cm in length, 1.5 to 2 cm in diameter, stocky with blunt narrowed apex and calyx persistent.



6. *Bruguiera cylindrica* Family: Rhizophoraceae

Common name	:	Orange mangrove
Vernacular names	:	*kuttikandal* (Malayalam)
Habit	:	A small, erect, evergreen tree 6 to 10 m tall with knee-like above-ground breathing roots. Bark smooth, grey

with few lenticells, or shallow buttress like aerial roots, Trunk base is thick ,robust and scaly at the bottom

Distribution : Valapatanam, Puthuvypu & Kumbalanzhi

Leaves : Simple, Oblong, lanceolate rarely elliptic, tip acute, bluntly pointed

Flowers : Inflorescence is three-flowered cyme, White in colour, Calyx- greenish, Sepals eight lobed, greenish yellow coloured, stout, upto 5 mm persistent to fruit forming cap like structure above the propogules,
Petals-3-4 mm long

Fruits : upto 1.5 cm , conical. Hypocotyl - calyx persistent, spindle shaped, 10 to 15 cm long, 0.5 to 1 cm in diameter .

7. *Ceriops tagal*

Family: Rhizophoraceae

Common name : Yellow mangrove, spurred mangrove or Tagal Mangrove

Vernacular names : *Manja kandal* (Malayalam)

Habit : Evergreen small to moderate tree, Canopy conical Aerial roots- shallow buttress and form flange like plank roots at the base of the trunk. Bark is pale grey to reddish brown in colour, smooth in young trees, deeply fissured in old ones and flaky at the bottom.

Distribution : Valapatnam, Kunjimangalam

Leaves : Simple , opposite, size smaller than Bruguiera , Obvate to oblong, Apex rounded , glabrous, blades dark green in shade, shiny, bright greenish yellow in full sun, upside down egg-shaped.

Flowers : Very small, in axillary cyme, Calyx 5 lobed, persistent but dried, less prominenet, Petals white, shorter than sepals, five petals, white in colour turns brown soon.

Fruits : Slightly conical 1.5- 2.0 cm long, pointed apex, hypocotyl ridged calyx persistent, but dried, Outer surface of the propagules are warty and ridged.

Uses : The trunk is used for house building. One of the best firewood sources and the bark is excellent for tanning. The fruit is sometimes eaten.

8. *Excoecaria agallocha* **Family: Euphorbiaceae**

Common name : Milky mangrove, Blind-your-eye mangrove or River poison tree

Vernacular names : *Kannampotty* (Malayalam)

Habit : Medium sized tree up to 15 m height, partially deciduous, Latex poisonous. Bark grey, No aerial roots. sexes seperate

Distribution : Cosmopolitan, Almost in all the estuaries

Leaves : Simple, Spirally arranged or opposite, pointed apex, Petiole - 1to 2 cm long,

Flowers : Unisexual flowers, in axillary inflorescence, raceme, trilocular ovary, Male and female flowers are present on

separate trees and inflorescence is spike. Male spike is catkin like in appearance, yellowish and up to 7 cm long. Female spike is shorter than male spike. Flowers are tiny, about 0.2 to 0.3 cm across,

Fruits : Trilobed, Shizocarpic, 1.5 - 2 cm diam

Male plant

Female plant

9. *Kandelia candal*

Family: Rhizophoraceae

Common name : Narrow leaved kandal

Vernacular names : Cherukandal/ Ezhuthani kandal (Malayalam)

Habit : Small to medium tree, upto 7 m height, bark smooth greenish or reddish brown , without any aerial or stilt roots, no pneumatophores

Distribution : Chettuva, Ponnani, Kadalundi, Valapatnam, Payyoli, Kunjimangalam and Kumbala estuaries.

Leaves : Opposite, oblong, apex obtuse, dark green and glabrous dorsal side

Flowers : White, 1.5 to 2 cm long, axillary cyme pentamerous, Petals- bifid, Stamens- numerous

Fruits : 1.5 to 2.5 cm long, hypocotyl slender and pointed

10. *Lumnitzera racemosa*

Family: Combretaceae

Common name : Black mangrove / White-flowered Black Mangrove

Vernacular names : (Malayalam)

Habit : Grows on the terrestrial edge of the mangroves as a shrub more commonly than as a tree. Above-ground breathing roots are normally absent but in moist environments, small looping lateral roots may develop.

Bark is grey in colour and fissured longitudinally in older trees.

Distribution : Valapatnam, Kunjimangalam estuaries.

Leaves : Succulent and small (up to 4cm length, 2cm width). The shape is obovate (broadest above the middle of the leaf), the apex is rounded or emarginated (the indent in the tip of the leaf). Petiole is often absent (leaves are thus often sessile). An obvious characteristic is the serrated edge of the leaf.

Flowers : Flowers are small and erect with green-coloured tube-like calyx, which is divided into five lobes at the tip. Petals are five, white in colour and arranged alternate to sepals. Stamens are ten in number, free, arranged in two whorls, five stamens at the base of the petal and remaining five at the base of the lobes of the calyx.

Fruits : Fruit is fleshy and flattened while on the tree, but fibrous after floating in water. There is no vivipary or cryptovivipary. Fruit is vase- shaped

11. *Rhizophora mucronata* Family: Rhizophoraceae

Common name : Red mangroves

Vernacular names : *Panachikandal* (Malayalam)

Habit : Medium trees, upto 20 m height, branches spreading horizontally, Stem with fallen leaf scars, Extensive stilt roots, looping from the base of the trunk and bow shaped, horizontal branches forms very gregarious growth of succulent cylindrical roots. . These stilt roots also function as above-ground breathing roots. Bark is brown or reddish, smooth and sometimes scaly

Distribution	:	Chettuva, Ponnani, Kadalundi, Valapatnam, Payyoli, Kunjimangalam and Kumbala estuaries.
Leaves	:	Dark glossy green, thick and coated with cuticle, 15 cm long and 8 cm width. Apex pointed and mucronate. Ventral surface with cork warts
Flowers	:	Large, axillary cyme, more than 2 flowers, long petioles, Corolla and Calyx hairy, Smooth bract but woody, stigma sessile
Fruits	:	Coriaceous, 2.5 to 3.5 cm long, Cotyledonary collar absent in the radicle with warted surface and more pointed tip

12. *Rhizophora apiculata*

Family: Rhizophoraceae

Common name	:	Red mangroves
Vernacular names	:	*Kayakandal* (Malayalam)
Habit	:	Medium to tall trees, upto 20 m height, branches spreading horizontally, Stem with fallen leaf scars, Extensive stilt roots, looping from the base of the trunk and bow shaped, horizontal branches forms very gregarious growth of succulent cylindrical roots
Distribution	:	Payyoli, and Kunjimangalam estuaries.
Leaves	:	Dark glossy green, large size. Apex pointed. Bracts and midrib reddish
Flowers	:	Axillary cyme, 2 flowers, Petioles absent or stout, Petals glabrous, hairless, Calyx non reflexed,
Fruits	:	Coriaceous, 2.5 to 3.5 cm long, Cotyledonary collar present in the radicle, Radicle- smooth surface.

14. *Scaevola taccada* **Family: Goodeniaceae**

Common name: Fan-flowers, Half-flowers

Vernacular names: Vella modagam (Malayalam)

Habit	:	Shrubs to small diffuse trees, Grows near to sea in sandy beaches. stem hollow or filled with pith
Distribution	:	Calicut, Thikkodi, Payyoli.
Leaves	:	Large, spoon shaped, succulent, spirally arranged , mostly aggregated at the apex of branches, sessile or short petioles
Flowers	:	Cymes, axillary, bracts and bracteoles small with a tuft of barbate trichomes in axilsWhite, corolla tube thin and splits during anthesis Pentamerous,
Fruits	:	Drupe, white ovoid- globose, 2 locules
Ecological significance	:	Sand binder and recommended for green fence against sea erosion

15. *Sonneratia alba* Family: Lythraceae

Common name	:	Sweet-Scented Apple Mangrove
Vernacular names	:	Chakkara kandal (Malayalam)
Habit	:	Tall trees, horizontally branched
Distribution	:	Chettuva. Ponnani, Valapatnam. Payyoli, esturaries
Leaves	:	pale, elliptic to ovate or obovate, base rounded, tip broad, rounded, with broad recurved mucro.
Flowers	:	Penta or octo merus. Corolla tube shiny. Calyx stongly tinged red. petals white variably semipetalous to absent. Stamen filaments are white.
Fruits	:	Fruit is 2-4.5 cm in diameter. about equal to width of floral tube.

16. *Sonneratia caseolaris* Family: Lythraceae

Common name	:	Apple mangrove, Crabapple mangrove
Vernacular names	:	Nakshatra kandal (Malayalam)
Habit	:	A small- to medium- sized sized, evergreen tree 8 to 10 m tall with open spreading crown, horizontal branches and slender twigs. Above-ground branching roots (pneumatophores) are peg like, 50 to 90 cm tall and up to 7 cm in diameter with spongy outer surface. Bark is grey and flaky in the older trees.
Distribution	:	Chettuva, Ponnani, Kadalundi, Talaserry, Valapatnam, Kunjimangalam and Kumbala estuaries.

Leaves	:	Opposite, elliptic, oblong with short petioles, midrib often red at base
Flowers	:	Solitary, petals slender, reddish, numerous stamens. Flowers open only in the late evening, lasting one night only; nectar is plenty in the calyx
Fruits	:	Fruit is round but flattened, green in colour, with horizontally extended calyx and persistent long style.

ROLE OF KEYSTONE SPECIES IN AQUATIC ECOSYSTEM

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Introduction

"[Keystone species] importance convinced managers and conservationists alike that the ecological impact of single species matters. That is, in order to manage, understand, and restore ecological assemblages, the roles of individual species have to be understood and considered." – Dr. Robert Pain

A keystone species is a species that has a disproportionately large effect on its environment relative to its abundance. Such species play a critical role in maintaining the structure of an ecological community, affecting many other organisms in an ecosystem and helping to determine the types and numbers of various other species in the community.

The role that a keystone species plays in its ecosystem is analogous to the role of a keystone in an arch. While the keystone is under the least pressure of any of the stones in an arch, the arch still collapses without it. Similarly, an ecosystem may experience a dramatic shift if a keystone species is removed, even though that species was a small part of the ecosystem by measures of biomass or productivity. It has become a very popular concept in conservation biology.

The keystone species concept was coined, in 1969, by the zoologist Robert T. Paine, professor emeritus of the University of Washington, to explain the relationship between *Pisaster ochraceus*, a species of starfish, and *Mytilus californianus*, a species of mussel. In his classic 1966 paper, Dr. Robert Paine described such a system in Makah Bay in Washington State. This led to his 1969 paper where he proposed the keystone species concept. The concept has been very popular in conservation, deployed in a range of contexts and mobilized to engender support for conservation.

Given that there are many historical definitions of the keystone species concept, and without a consensus on its exact definition, a list of examples best illustrates the concept of keystone species.