Mangroves of Karnataka Importance and Identification

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Mangroves are vital coastal ecosystems that provide a variety of benefits to both people and environment. They are salt-tolerant and distributed along coastlines, lagoons, estuaries, rivers or deltas in over 120 tropical and subtropical nations and forms less than 1 percent of all tropical forest. In 2020 it was estimated that mangroves areal extent is 14.8 million ha (FAO, 2023). Mangrove coverage in the nations Indonesia, Brazil, Nigeria, Mexico and Australia account for 47 percent in the world (FAO, 2020).

Mangrove ecosystem services include fuel, fodder, non-wood forest products, carbon sequestration, biodiversity conservation, coastal disaster mitigation, etc. But in spite of these, mangrove ecosystem is often converted to other uses, including aquaculture, agriculture, urban development and other related infrastructure. Land subsidence due to climate change and increasing salinity fluctuations due to reduced river flow also contribute to the reduced diversity of mangroves. It is estimated that within a period of two decades from 2000 around 677 thousand ha of mangroves were lost, which was partially offset by the expansion of 393 thousand ha of mangroves, resulting in net loss of 284 thousand ha (FAO, 2020). Indian mangroves form 3% of South Asia (ISFR, 2019) with an aerial extent of 4975 km^2. East Coast of India has the maximum mangrove coverage of 57% followed by 23% in the west coast, and 20% in Andaman and Nicobar Islands (Venkataraman and Wafar, 2005).

Adaptations

Morphological adaptations of mangroves to survive the tidal variations include aerial roots, salt excretion glands and vivipary of seeds (Tomlinson, 1986).The aerial roots assist in respiration and anchorage (Fig.1) especially in waterlogged soils and enhance the plants ability to adapt to salinity changes in the ecosystem (excess salt is excluded by the roots and leaves); propagules are also adapted to tidal dispersal by seedvivipary and excellent methods of nutrient retention(Ball, 1988; Hogarth, 2015).

The mangroves diversity varies according to the ecosystem depending largely on the climate, salinity, topography, also the structure and composition of soil of the area.In very high saline areas patches of dwarf and tree having irregular and distorted growth pattern can be observed while favourable conditions for certain species forests with canopies exceeding 40 m in height (FAO, 2007) can be observed as in the Sundarbans. The perennial rivers Ganges, the Meghna and the Brahmaputra of India and Bangladesh, bring with it rich nutrients and forms the Sundarbans delta.In arid zones, the diversity is often limited and irregular canopy can be observed as in Karnataka where nutrient flow occurs mainly during monsoon.These mangroves still play a major role in the ecosystem as well as for the economy of the local people.

Fig. 1 Modifications of root in mangroves A Buttress B Prop roots C Cone roots D Pneumatophores E Cable roots and feeding roots

Importance

Mangrove forests support many marine species which also include some of the endangered and threatened species as they form the breeding and feeding ground and provide shelter and cool oxygenated water (FAO, 2020).Especially, the Sundarbans mangrove ecosystem shelters, a number of mammals and reptiles. This also includes the endangered Bengal tiger (*Panthera tigristigris*). A number of migratory bird species also rely on mangroves as wintering and roosting

sites, as was sighted along Karnataka Coast. Thus, mangroves provide a key habitat and support a number of endemic, restricted-range and migratory bird (Fig. 2).

Fig. 2 A. Black kite *Milvus migrans.*B. Indian Shag *Phalacrocorax fuscicolli.s* C.Indian pond heron *Ardeola grayii.*D. Median Egret *Mesophoyx intermedia.*E. Great cormorant *Phalacrocorax carbo.* F. Black-Crowned Night-Heron *Nycticorax nycticorax.*

It is estimated that mangroves store 12 billion metric tons of carbondioxide world wide and when these systems are damaged, they emit their stored carbon back into the atmosphere, where it contributes to climate change (Cawood 2023). In India the ecosystem services of mangroves are region specific due to their diverse nature, which includes tourism, water filtration; it is estimated that 2 to 5 hectares of mangroves may treat effluents of 1 ha of aquaculture, supports more than 3000 species of fishes, regulates climate; as carbon storage potential is 3-5 times higher than that of the tropical forest, supports livelihood of 120 million people directly or indirectly, is a source of fuel and timber and offers coastal protection (www. insightsonindia.com).

Diversity in Karnataka

Rao and Suresh (2001) and Chandran et al. (2012) have reported the occurrence and distribution of eumangrove species such as *Rhizophora mucronata*, *R. apiculata*, *Acanthus ilicifolius* (Fig. 3), *Avicennia alba*, *A. marina*, *A. officinalis*, *Bruguiera cylindrica*, *B. gymnorrhzia*, *Lumnitzera racemosa*, *Excoecaria agallocha*, *Kandelia candel*, *Sonneratia alba*, *S.caseolaris*, *Aegiceras corniculatum* and *Ceriops decandra* along the estuaries of Karnataka.

Fig. 3 A. *Acanthus ilicifolius* B. *B. gymnorrhzia* C. *Sonneratia alba* D. *S. caseolaris*

Field guide to key features for identification of Eumangroves

Sl No:	Family	Species	Key features
1	**Acanthaceae**	*Acanthus ilicifolius* L.	Pneumatophores rarely present, A woody shrub, with some what green succulent branches, Holly-leaves perennial spike with white to mauve flowers. Pair of stipular spines at the base of leaves and also a pair of bracteoles beneath each flower
2	**Combretaceae**	*Lumnitzera racemosa* Wild.	Pneumatophores absent, Leaves clustered at the end of branches, alternate leaves have notched apex bearing a small gland/Hydathode, white flowers in short axillary racemes, Multi-stemmed to columnar trunk
3	**Euphorbiaceae**	*Excoecaria agallocha* L**.**	Exudes milky latex, abaxial surface of leaves with greyish scales. Bark with longitudinal roes of lenticels, Knobby serpentine root system,with white lenticels on the knobs acting like pneumatophores

4	**Myrsinaceae**	*Aegiceras corniculatum*	Pneumatophores absent, Multi-stemmed or columnar trunk, Flowers stalkes, several in number, fruits cylindrical, curved and acute 3 cm long and 0.5 cm dia
5	**Rhizophoraceae**	*Bruguiera cylindrica* (Roxb.)Wight.	Geniculate pneumatophores, cable roots, Flowers not solitary in axis Peduncles 3 flowered
6	**Rhizophoraceae**	*Bruguiera gymnorrhiza* Merr.	Geniculate pneumatophores, cable roots, Flowers solitary in axil, Petals with 3-4 hairs at the top, viviparous fruit, 10-25cm long, leaf scars 3, distinct, usually horse-shoe shaped vascular bundles
7	**Rhizophoraceae**	*Ceriops decandra* (Griff.) Ding Hou.	Pneumatophores curiously shaped, feeding roots, cable roots and anchoring roots present, stem flanged or buttressed with short plate like protruberances. Petals divided into fringe like lobes. Fruits with spreading calyx lobes. Hypotocyl club shaped, angular to 30 cm long.
8	**Rhizophoraceae**	*Kandelia candel* (L.) Druce.	Pneumatophores absent, tree bushy form with aeriel roots in close assembly from stem and branches, white flowers in axillary pendunculate, dichotomously branched cymes. Fruit 1 celled, 1 seeded grit with the persistent reflexed calyx lobes. Propagule viviparous, bark reddish brown
9	**Rhizophoraceae**	*Rhizophora apiculata* BL.	Pneumatophores absent, multiple leaf scar, Branching stilt roots, cyme with 2 sessile, flowers on thick peduncles under leaf or the leaf with or without black dot, Fruits like an inverted pear, hypocotyl curved at the apex
10	**Rhizophoraceae**	*Rhizophora mucronata* Poir.	Pneumatophores absent, multiple leaf scar, leaves ending with apiculum. Branching stilt roots,Flowers in recurved stalk, style is absent or very short
11	**Sonneratiaceae**	*Sonneratia alba* J. Smith	Pneumatophores present, feeding roots, cable roots and anchoring roots present, stipules absent in leaf, branches swollen at nodes, readily breaking. Flowers large 6-8 oblong sepal lobes. Stamens numerous, long
12	**Sonneratiaceae**	*Sonneratia caseolaris* (L.) Engl.	Pneumatophores present, feeding roots, cable roots and anchoring roots present, leaves have at the tip hydathodes, Flakey bark,brownish in colour
13	**Verbenaceae**	*Avicennia alba* Bl.	Pneumatophores 15-20 cm long, tree height 10m-15m, bark grey, leaf dark green or black shining

			above, flower 3-6 mm, yellow, fragnant, arranged in axillary or terminal spikes, peduncle 2.5-3.5cm long branched. Fruits compressed capsule ovoid or ellipsoid slightly curved at the apex. Seed solitary.
14	**Verbenaceae**	*Avicennia marina* (Forsk.)Vierh.	Pencil like pneumatophores feeding roots, cable roots and anchoring roots present,Gnarled spreading tree, leaves grey dense hairy on abaxial surface. Fruit velvety like, an unopened almond in shape, not acuminate or beaked at the tip.
15	**Verbenaceae**	*Avicennia officinalis* L.	Pneumatophores plenty tree height 8m. salt excreting glands on leaf. Flower 1cm long, fruit green almond shaped

Conclusion

AlongKarnataka Coast it was observed that mangroves prefer silty and clayey soils or mixtures of these soils. Monsoon brings with it large amount of clay, silt and sand from upstream catchment areas especially due to the present rapid land use changes. Hence, when the tide dominates during reduced runoff the sand gets deposited naturally.Climate change impacts, receding shoreline and rapid change in land use plan are some of the factors influencing the water and soil quality and there by impacting the diversity of mangroves in the estuaries of Karnataka. In connection with this sensitizing the administrators as well as the local population regarding the uses of mangroves is very essential. CMFRI has also conducted awareness campaign (Fig.4), but much more needs to be done especially by assessing the sources of pollution and thereby understanding the species wise factors which aid in sustaining the diversity of the region.

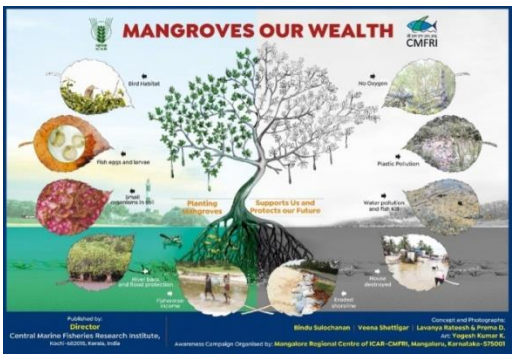

Fig.4 Awareness poster on mangroves protection and conservation

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