Current Botany 2012, 3(2): 03-09
ISSN: 2220-4822
Available Online: http://currentbotany.org/

Diversity of true mangroves and their associates in the Kundapura region, Udupi district, Karnataka, Southwest coast of India

Vijaya Kumar.K.M[1*] and Vijaya Kumara[2]

[1]Department of Zoology, Bhandarkars' Arts and Science College, Kundapura-576 201, India
[2]Department of Post Graduate Studies and Research in Wildlife and Management, Bioscience Block, Kuvempu University, Shankaraghatta-577 451

Abstract
The present study documents the diversity of true mangroves and their associates, in four selected sites of Kundapura, Udupi district, Karnataka, Southwest coast of India, for a period of two years from April-2010 to March-2012. These places are far from one another and the mangrove species diversity varies from one place to another, due to factors such as climate, tidal factors and anthropogenic pressures. Nine true mangrove floral species belonging to six families and ten associated floral species belonging to nine families were identified along the inundated and the adjacent regions at the study sites. This write up discusses the need of present study is to gain knowledge about the mangrove flora in order help conservation of mangrove ecosystem.

Keywords: Mangroves, flora, diversity, climate, tidal factors, anthropogenic pressures, ecosystem.

INTRODUCTION

Mangroves are trees and shrubs that grow in saline coastal habitats in the tropics and subtropics. They fall into two groups according to their habitats in nature: true mangroves and mangrove associates. True mangroves refer to species that specifically grow in intertidal zones, while mangrove associates are capable of occurring in either littoral or terrestrial habitats. Mangrove formations depend on terrestrial and tidal waters for their nourishment and silt deposits from upland erosion as substrate for support. Mangrove is one of the most productive ecosystems and a natural renewable resource (*Kathiresan, 2003*). Mangroves are a taxonomically diverse group of salt-tolerant, mainly arboreal, flowering plants that grow primarily in tropical and subtropical regions (*Ellison and Stoddart, 1991*).

MANGROVE HABITAT:

A "mangrove" has been defined as a "tree, shrub, palm or ground fern, generally exceeding more than half a meter in height and which normally grows above mean sea level in the intertidal zones of marine coastal environments or estuarine margins" (*Duke, 1992*). The term "mangrove" can refer to either the ecosystem or individual plants (*Tomlinson, 1986*). Mangrove ecosystems have been called "mangals" (*Macnae, 1968*) to distinguish them from the individual plant species. However, across the globe, the world's mangroves are threatened. Mangrove habitats are being destroyed as rivers are dammed, their waters diverted and the intertidal zone extensively developed for agriculture or aquaculture. Mangroves are distributed globally, occurring in over 112 countries. India with a long coastline of about 7516.6 km, including the island territories (*Anonymous, 1984*), has a mangrove cover of about 6,749 km2, the fourth largest mangrove area in the world (*Naskar & Mandal, 1999*). These mangrove habitats (69°E- 89.5°E longitude and 7°N-23°N latitude) comprise three distinct zones: East coast habitats having a coast line of about 2700 km, facing Bay of Bengal, West coast habitats with a coast line of about 3000 km, facing Arabian sea, and Island territories with about 1816.6 km coastline (*Naskar and Mandal,2008*). In South India, Pichavaram and Muthupet are two places, which have dense mangrove vegetation in the state of Tamilnadu (*Krishnamurthy and Jeyaseelan 1983; Kathiresan, 2000; Rajkumar et al., 2009*). Mangroves have tremendous social and ecological value. The mangrove ecosystem provides income from the collection of the mollusks, crustaceans and fish that live there. Mangroves are harvested for fuel wood, charcoal, timber, and wood chips. Services include the role of mangroves as nurseries for economically important fisheries, especially for shrimp. Mangroves also provide habitats for a large number of molluscs, crustaceans, birds, insects, monkeys and reptiles. Other mangrove services include the filtering and trapping of pollutants and the stabilization of coastal land by trapping sediment and protection against storm damage (*Elizabeth McLeod and Rodney V. Salm-2006*). They also support the growth of microbial flora. Some antibiotic producing actinomycetes are present in this environment, which is essential for inhibition of pathogenic microorganisms. Some novel chemical molecules and metabolites have been identified from mangroves and

Received: March 15, 2012; Revised: April 18, 2012; Accepted: June 02, 2012.

*Corresponding Author
Vijaya Kumara
Department of Post Graduate Studies and Research in Wildlife and Management, Bioscience Block, Kuvempu University, Shankaraghatta-577451, India

Tel: +91-9448206428
Email: vijay15675@gmail.com

their associates (*Bandaranayake, 1998*). Mangrove habitats of India have been facing tremendous threats due to indiscriminate exploitation of mangrove resources for multiple uses like fodder, fuel wood, timber for building material, alcohol, paper, charcoal and medicine (*Upadhyay et al. 2002*). Apart from those, conversion of forest area to aquaculture and agriculture, construction of port and harbour, extension of human inhabitation, over-grazing, urbanization, industrialization and chemical pollution are major common occurrences that dwindle mangrove area (*Blasco & Aizpuru 1997; Naskar 2004; Upadhyay et al. 2002*). Owing to these threats > 33% of the Indian mangrove areas has been lost within the last 15 years. Of this, East coast area has lost about 28%; West coast area about 44%; and Andaman & Nicobar Islands about 32% (*Jagtap et al. 1993; Naskar 2004*).

The main objective of the present study is to understand the diversity of mangrove flora and their associates, which is helpful in deriving taxonomical information based on species diversity, morphological changes and economical importance from the four selected sites of Kundapura.

MATERIALS AND METHODOLOGY

Study area

The southwest coast of India in general and the Karnataka coast in particular mangrove vegetation is found in three districts viz., Dakshina Kannada, Udupi and Uttara Kannada in the estuarine regions of the principal rivers. The total coastal line in Karnataka is approximately 320 kms which represents varied geomorphological feature in the form of long beaches, sometimes intercepted by rocks forming attractive beaches. Sometimes coastal land is dissected by the rivers joining sea with the formation of shallow lagoons or estuaries. In Dakshina Kannada and Udupi districts, ten main rivers join the Arebian Sea. Those are Netravathi, Gurupur, Udyavar, Mulki, Pavanje, Sita, Swarna, Varahi, Chakra, Sowparnika and Baindur rivers.

The selected area for the study is Kundapura.Geograpically Kundapura is located 445 kms west of Bangalore and 36 kms north to Udupi (13° 37' 24" N Latitude and 74° 41' 30" E Longitude and 58 ft. asl). The annual rainfall 4848 mm normal and actual of 4182 mm. Kundapura forest division falls both in Udupi and Dakshina Kannada district. It has about 105 km coastal stretches, starting Shiroor in Kundapura Taluk to Mulky of Mangalore Taluk. There are two sub divisions and eight ranges. However only four ranges of this division are touching coastal area are having mangroves. They are Byndoor, Kundapura, Udupi and Moodbidri.

Data collection and curation

The areas where mangroves and mangrove associated vegetation are exist around Kundapura region is first identified and documented. For the assessment of present biodiversity status, the mangroves, mangrove associated vegetations existing around the study area were considered for identification. Regular surveys were made along the beaches, deltaic regions, river channels and the mouth of estuaries to explore the successful results of the true mangroves and their associates. The mangroves and mangrove associated vegetation were plucked during their flowering and fruiting seasons for identification and took photographs with the help of camera. The nomenclature of the specimens followed *Gamble (1957)* and *Matthew (1983)*. The collected specimens have been manually curated.

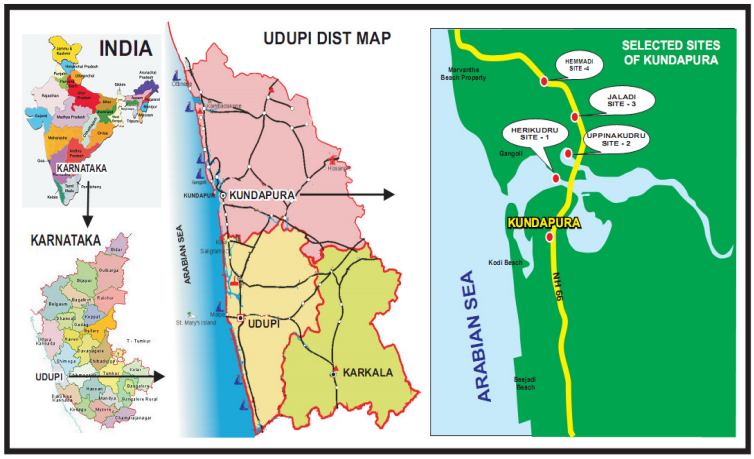


Fig 1. Map showing the geographical location of study sites

Table 1. Study sites

Study sites	Latitude	Longitude	Elevation
Site-1. Herikudru	13°38'28"N	74°42'01"E	28'
Site-2 .Uppinakudru	13°39'21"N	74°41'59"E	25'
Site-3. Jaladi	13°39'41"N	74°42'16"E	16'
Site-4 .Hemmadi	13°40'46"N	74°41'20"E	32'

RESULTS AND DISCUSSION

Site-1. Herikudru

The study site is an island along the back waters of the river Haladi. The area is dominated by *Rhizophora mucronata* and in the borders *Acanthus ilicifolius* is occupying about 2.00 meters from the banks. A few trees of *Bruguiera gymnorrhiza, Avicennia officinalis, Aegicerus corniculatum, Kandelia candel, Rhizophora apiculata* were recorded. *Excocaria agallocha* is found sparsely distributed along the banks. Mangrove associates such as *Acrostichum aureum,*

Chlerodendron inerme, Derris trifoliata, Ipomoea pes-carpae, Sesuvium portulacastrum, Aeluropus lagopoides, and Fimbristylis ferruginea were recorded during the study period.

Site-2 .Uppinakudru

The study site is an island along the back waters of the river Haladi. This area is being completely under the tidal influx and dominated by *Rhizophora mucronata.* There are several mangrove patches measuring about 1 to 4 acres. Many of the plots were not possible to traverse because of the existing swamps. The area is completely dominated by *Rhizophora mucronata* with good growth, followed by *Sonneratia alba*, *Acanthus ilicifolius, Kandelia candel*, *Avicennia officinalis, Excocaria agallocha*, *Bruguiera gymnorrhiza* and *Aegicerus corniculatum.* Mangrove associates such as *Acrostichum aureum, Chlerodendron inerme, Derris trifoliata, Ipomoea pes-carpae, Sesuvium portulacastrum, Pandanus odoratissimus, Aeluropus lagopoides, Caesalpinia crista and Fimbristylis ferruginea* were recorded during the study period.

Site-3. Jaladi

An area covering the backwaters of the river Haladi. This area is known as Jaladi or Rajadi bridge and is completely under tidal influence. In view of this situation there is a good formation of mangroves. The trees here are about 70 years old. In frequently, patches of land have been planted by *Rhizophora mucronata and Avicennia officinalis* to protect their agricultural fields from erosion and floods. Totally about 20-25 acres of land is reserved for mangrove regeneration. The area is completely dominated by pure formations of *Rhizophora mucronata* and on the borders *Acanthus ilicifolius* was seen measuring 2m in height. Only a few trees of *Bruguiera gymnorrhiza, Avicennia officinalis, Sonneratia alba and Kandelia candel are* observed. In some places the area is represented only by *Rhizophora mucronata and Kandelia candel. Excocaria agallocha* is found sparsely distributed along the banks. *Aegicerus corniculatum* is fond distributed in groups in association with *Acanthus ilicifolius*. Mangrove associates such as *Acrostichum aureum, Dalbergia spinosa, Chlerodendron inerme, Derris trifoliata, Ipomoea pes-carpae, Sesuvium portulacastrum, Aeluropus lagopoides, Caesalpinia crista and Fimbristylis ferruginea* were recorded during the study period.

Site-4 .Hemmadi

The study site is a riverine bank along the back waters of the river Haladi and the area is completely under the tidal influence. Good formations of mangroves were recorded. This area is dominated *by Rhizophora mucronata, Avicennia officinalis and Chlerodendron inerme. Acanthus ilicifolius* is seen all along the banks reaching to a height of 2m, in association with *Aegicerus corniculatum. Rhizophora mucronata* dominates the areas under a gradient, whereas *Sonneratia alba* occupies elevated areas with its innumerable pneumatophores. Excocaria agallocha is found sparsely distributed along the banks. Mangrove associates such as *Acrostichum aureum, Dalbergia spinosa, Chlerodendron inerme, Derris trifoliata, Ipomoea pes-carpae, Sesuvium portulacastrum, Aeluropus lagopoides, Caesalpinia crista and Fimbristylis ferruginea* were recorded during the study period.

Table 2.The diversity of true mangroves in selected sites of Kundapura.

Sl.No	Botanical Name	Family Name	Life forms	Site-1	Site-2	Site-3	Site-4
1	*Avicennia officinalis*	Avicenniaceae	T	+	+	+	+
2	*Rhizophora mucronata*	Rhizophoraceae	T	+	+	+	+
3	*Rhizophora apiculata*	Rhizophoraceae	T	+	-	+	-
4	*Bruguiera gymnorrhiza*	Rhizophoraceae	T	+	+	+	+
5	*Kandelia candel*	Rhizophoraceae	T	+	+	+	+
6	*Sonneratia alba*	Sonneratiaceae	T	+	+	+	+
7	*Aegicerus corniculatum*	Myrsinaceae	S	+	+	+	+
8	*Acantus ilicifolius*	Acanthaceae	S	+	+	+	+
9	*Excocaria agallocha*	Euphorbiaceae	T	+	+	+	+

Tablle 3. The diversity of mangrove associates in selected sites of Kundapura.

Sl.No	Botanical Name	Family Name	Life forms	Site-1	Site-2	Site-3	Site-4
1	*Chlerodendron inerme*	Verbenaceae	S	+	+	+	+
2	*Derris trifoliata*	Fabaceae	V	+	+	+	+
3	*Dalbergia spinosa*	Fabaceae	S	-	-	+	-
4	*Acrostichum aureum*	Pteridaceae	S	+	+	+	+
5	*Ipomoea pes-carpae*	Convulvulaceae	V	+	+	+	+
6	*Pandanus odoratissimus*	Pandanaceae	T	-	+	-	-
7	*Sesuvium portulacastrum*	Alzoaceae	v	+	+	+	+
8	*Caesalpinia crista*	Caesalpinaceae	S	-	+	+	+
9	*Aeluropus lagopoides*	Poaceae	G	+	+	+	+
10	*Fimbristylis ferruginea*	Cyperaceae	Se	+	+	+	+

Life Forms: T-tree, S-shrub, V-vine, G-grass, Se-sedge

True mangroves

The results after the intensive survey, made from the selected sites, showed the following Nine true mangrove floral species belonging to six families. A classified list of true mangrove vegetation identified is presented in Table-2. The species *Avicennia officinalis*, *Rhizophora mucronata* are the dominant mangroves found in almost all the sites. The next dominating species are *Kandelia candel, Bruguiera gymnorrhiza*, *Sonneratia alba, Aegicerus corniculatum* found distributed in all the selected sites. The other species are

Excocaria agallocha and *Acanthus ilicifolius* found distributed in all the selected sites. Similar observations were made by *Ananda Rao* and *P.V.Suresh-2001.*

Mangrove associates

About Ten mangrove associated floral species belonging to Nine families were identified along the inundated and the adjacent regions at the study area. A classified list of mangrove associates identified is presented in Table-3.The species such as *Derris trifoliata, Acrostichum aureum, Chlerodendron inerme, Ipomoea pes-carpae, Sesuvium portulacastrum, Aeluropus lagopoides, Fimbristylis ferruginea* were found distributed at all the sites*, whereas Dalbergia spinosa,* are limited in their distribution to site-3, *Pandanus odoratissimus* is seen in site-2*, Caesalpinia crista* found distributed in site-2,3 and 4.

The rich diversity of mangrove species were seen in all the selected sites, this is due to availability of suitable habitat, low lying marshy land, brackish water with low salinity and the addition of fresh water from various rivers, channels and canals, favour the growth and development of this vegetation. *Saenger et al. (1983*) have summarized the role of fresh water on the mangrove ecosystem. *Blasco (1984)* suggested that both temperature and rainfall are the two essential bioclimatic factors for mangrove and other terrestrial ecosystems. The edaphic factor with the micronutrients, rainfall, temperature, humidity and pH of water also favours the growth and development of mangroves *(N. Balachandran et al.).*

Mangrove habitats of Kundapura facing tremendous threats due to exploitation of mangrove resources for multiple uses like fodder, fuel wood, timber for building material, conversion of forest area to aquaculture farms, agriculture land and extension of human inhabitation. Hence diversity of mangroves decline in future if proper protective measures are not taken.

Avicennia officinalis

Rhizophora mucronata

Kandelia candel

Bruguiera gymnorrhiza

Sonneratia alba

Aegiceras corniculatum

Acanthus ilicifolius

Excoecaria agallocha

Chlerodendron inerme

Derris trifoliata

Ipomoea pes-carpae

Sesuvium portulacastrum

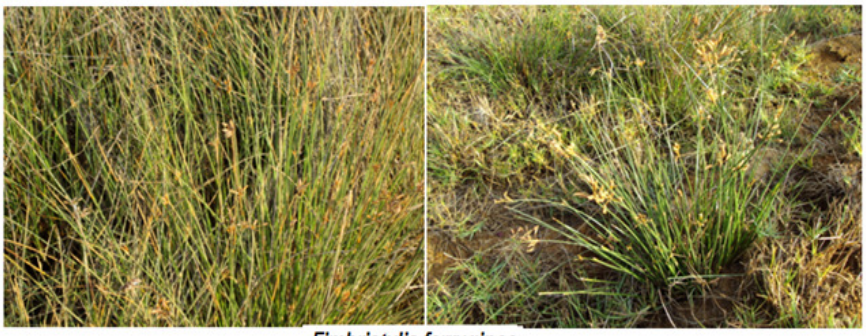
Caesalpinia crista

Aeluropus lagopoides

Acrostichum aureum

Dalbergia spinosa

Pandanus odoratissimus



Fimbristylis ferruginea

CONCLUSION

Kundapura site represents northern region of the Malabar Coast. It is a site that has multiple habitats of sandy beach, mangrove forests and a lagoon. The people use forest resources for fire wood and small timber. The land has been converted to aquaculture farms. The site has no protection. There is a need to cultivate local support to a protected area and to restrict the development of aquaculture farms in the area. This paper highlights the diversity of mangrove habitats in selected sites of Kundapura. The present information would form a useful tool for further studies and monitoring of these coastal ecosystems. The present study can help in formulating strategic plans to afforest mangroves.

REFERENCES

[1] Anonymous. 1984. A profile of the Indian Mangrove. *Bakawan Newsletter* 3: 10.

[2] Bandaranayake WM. 1998. Traditional and medicinal uses of mangroves. *Mangroves and Salt Marshes* 2: 133-148.

[3] Blasco F.1984. The mangrove ecosystem: research methods: Climate factors and the biology of mangrove plants, UNESCO, Paris pp. 18-35.

[4] Blasco, F. & M. Aizpuru. 1997. Classification and evolution of the mangroves of India. *Tropical Ecology* 38: 357-374.

[5] T.Ananda Rao and P.V.Suresh. 2001. Coastal Ecosystems of the Karnataka state, India, I Mangroves. Karnataka state Association for the Advancement of Science, Central College, Bangalore.

[6] Duke, N.C. 1992. Mangrove floristics and biogeography. Pp.63-100 in Tropical Mangrove Ecosystems. A.I. Robertson and D.M. Alongi, Eds. American Geophysical Union, Washington DC., USA.

[7] Elizabeth McLeod and Rodney V. Salm. 2006. Managing Mangroves for Resilience to Climate Change. The World Conservation Union (IUCN), Gland, Switzerland.

[8] Ellison, J.C. and D.R. Stoddart. 1991. Mangrove ecosystem collapse during predicted sea-level rise: Holocene analogues and implications. *Journal of Coastal Research* 7: 151-165.

[9] Gamble J.S .1957. Flora of the Presidency of Madras, Botanical Survey of India, Calcutta.

[10] Jagtap, T.G., V.S. Chavan & A.G. Untawale. 1993. Mangrove Ecosystems of India: A need for protection (synopsis). *AMBIO* 22: 252-254.

[11] Kathiresan K. 2000. A review of studies on Pichavaram mangrove, southeast India. *Hydrobiologia* 430:185-205.

[12] Kathiresan K. 2003. How do mangrove forests induce sedimentation? *Rev. Biol. Trop.* 51: 355-360.

[13] Krishnamurthy K, Jeyaseelan MJP. 1983. The Pitchavaram (India) mangrove ecosystem. *Int. J. Ecol. Environ. Sci.* 9: 79-85.

[14] Macnae, W. 1968. A general account of the fauna and flora of mangrove swamps and forests in the Indo-West-Pacific region. *Advances in Marine Biology* 6:73-270.

[15] Matthew K.M. 1983. The Flora of the Tamilnadu Carnatic, The Rapinat Herbarium, Tiruchirapalli.

[16] Naskar, K.R. & R.N. Mandal. 1999. Ecology and Biodiversity of Indian Mangroves. Daya Publishing House, New Delhi, India.

[17] Naskar, K.R. & R.N. Mandal. 2008. Diversity and classification of Indian mangroves: a review**.** *Tropical Ecology* 49(2): 131-146, ISSN 0564-3295.

[18] Naskar, K.R. 2004. Manual of Indian Mangroves. Daya Publishing House, New Delhi, India.

[19] Rajkumar M, Perumal R, Prabu VA, Perumal NV, Rajasekar KT. 2009. Phytoplankton diversity in Pichavaram mangrove waters from Southeast Coast. *J. Environ. Biol.* 30: 489-498.

[20] Saenger P, Hegerl EJ, Davie JDS. 1983. Global status of mangrove ecosystems, International Union for Conservation of Nature, Gland.

[21] Tomlinson, P.B. 1986. The botany of mangroves. Cambridge University Press.

[22] Upadhyay, V.P., R. Ranjan & J.S. Singh. 2002. Human mangrove conflicts: The way out. *Current Science* 83: 1328-1336.

[23] Nateshan Balachandran *et al.* 2009. *Journal of Ecology and The Natural Environment* Vol. 1(5), pp. 099-105.