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Mangrove Diversity of Southern East Coast of Andhrapradesh, India

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Abstract **- The state's vast coastline is 1030 kms and is second largest in the country next to Gujarat. Andhra Pradesh has the longest coast line on the Eastern coast of India. Andhra Pradesh's total coastal area is spread over 92,906 Sq.kms in nine coastal districts: Nellore, Prakasam, Guntur,Krishna,WestGodavari,EastGodavari,Visakhapatnam, Vizianagaram and Srikakulam. The Mangroves occupy 352 Sq.km.**

A comprehensive survey along the 55 Sq. km. coastline of Nellore,Prakasam and Guntur districts of Andhra Pradesh was conducted to assess the present status of mangrove wetlands and their diversity. Total extent of mangrove cover in these two districts is 2541 Ha occurring in 30 different locations, of which 23 are in Nellore district and 8 are in Prakasam and4 in Guntur districts. Twelve true mangroves from 06 families and 19 mangrove associates from 11 families were recorded in the present study. *Avicennia marina, Rhizophora mucronata, Excoecaria agallocha and Aegiceras corniculatum* are the dominant mangroves in the major wetlands of the three districts. *Kandelia candel* is a new record for the state while *Sonneratia apetala* is confmed to Ponnapudi wetland in the Iskapalli lagoon of Nellore district. The mangrove wetland is under threat like other parts of the world. The state stands fourth in the country for its mangrove area. Nizampatnam brakish water wetland region is also studied and 20species are recorded.

Key words: Mangrove wetlands, Biodiversity, True mangroves, Mangrove associates.

I. INTRODUCTION

Mangroves are a unique, dynamic and multi functional ecosystem typically occurring along the jnter tidal zones of tropical and subtropical belts, inhabiting estuaries, deltas, tidal creeks, lagoons and water-logged broad muddy flats. They are also described as marine tidal forests or coastal wetlands. These complex ecosystems are found between latitudes 38° north and 38° south along the tropical coasts of Australia, Asia and the Americas. The greatest mangrove diversity exists in south-east Asia. Mangroves are a diverse group of trees and shrubs, highly evolved plants adapted to tolerate high salinity and environmental stress by special anatomical, morphological, physiological and reproductive features (Clark l996; Knox 2001; Kathiresan and Qasim, 2005; Ranade, 2007; Naskar and Mandal, 1994: Along 2002) and Anon. (2005).

Mangrove soils are poorly drained, hence these plants adapt to the environment through special features like breathing roots, stilt and buttress roots, salt glands, salt-excluding mechanism, a thick cuticle, coriaceous leaves and viviparous seeds. In India the mangrove cover is variously estimated to be about 5,00,000 ha. (FSI, 1999), 7,00,000 ha. (Untawale, 1996) and 6,81,000 ha. (Sidhu, 1963). In Andhra Pradesh, along the coast of Bay of Bengal mangroves occur from Srikakulam district in the north to Nellore district in the south. But large extent of mangroves is confined to Godavari and Krishna estuaries due to copious freshwater supply along with sediments and dissolved nutrients. Mangroves of Andhra Pradesh in Krishna and Godavari basins were extensively studied (Banerjee et al., 1998; Lakshminarayana, 1998;Naithani et al., 2004; Pullaiah and Chennaiah, 1997; Pullaiah and Moulali, 1997; Rao et al., 198S;1999; Rao and Rao, 1988; Reddy, 1982; Satyanarayanaetal., 2002; Venkanna and Rao, 1993; Venkateswarlu, 1944). Regarding mangroves of Nellore district, except for some references to those of Krishnapatnam, Pennar and Pulicat lake (Selvam et al.. 2005) there are no other reports. Mangroves of Prakasam district of Andhra Pradesh were studied by Swain and Rama Rao (2008). The present study was carried out between February 2016 and January 2018 to understand the mangrove wetlands of Nellore, Prakasam and Guntur districts.

II. STUDY AREA

Nellore district is located at 13°30' to 15 °10' N and 79°5' to 80 ° 16' E. The district has a coastline of 175 km along Bay of Bengal. The water way, Buckingham canal, situated 1-2.5 km away, runs parallel along the coast from Chennai to Kakinada, in East Godavari district. In Nellore district there are no major rivers. The Pennar, Swarnamukhi and Kandaleru are non-perennial rivers traversing the district before joining the Bay of Bengal. Smaller rivers, Kaivalya, Kalangi and other water bodies like the Pulicat Lake, Chippaleru, Pyderu, Mamidi kalva, Challa kalva and Pamula kalva flow eastwards and support mangrove wetlands. However, these water bodies are active during the north-east monsoon (October- December) carrying surplus flood waters and mineral nutrients to the wetlands. The mean annual rainfall for Nellore district is 1080 mm. Prakasam district, situated at the north of Nellore district, lies between 14° 57' to 16" 17' N and 78° 43' to 80° 25' E with a coast line of 120 km . The district records a normal annual rainfall of 616 mm, most of the precipitation is due to south-west monsoon while the north-east monsoon brings marginal rainfall. In Prakasam district, Gundlakamma is the only river passing through the district. There are some other streams viz, Musi, Paleru, Maneru and the Romperu drain flowing

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eastwards and merging with Bay of Bengal. Nizampatnam estuarine has been studied during the year 20016-20018. The present study has been conducted in the Guntur mangrove forest area along the (West) east coast of Andhra Pradesh for a period of three years i.e. from June 2016 to June 2018. Several field trips are made to select the field stations, to study the distribution of mangrove vegetation, geographic nature of riverine system, environmental quality and human interference. While selecting the study area, high tidal impact villages Nizampatnam and Dindi are considered. The distributaries, along with other criteria like vegetation structure, inundation frequency and the extent of human interference are taken into account while selecting a main field station. The above criteria have been selected (Smith, 1992) to observe the factors responsible for the degradation of mangrove belts. Consequently the region-I is divided into two main field stations, each main field station having its ecological significance for the quantification of mangrove vegetation.

All the deltas/estuaries of the two districts were surveyed. In Nellore district, the survey included Venadu island in Pulicatlake at the southern most tip and Lakshmipuram of Annagaripalem, in Chippaleru estuary in the extreme north of the district. In between, mangrove wetlands in the deltas/estuaries of Swarnamukhi, Kandaleru, Pennar, Pyderu and Iskapalli lagoon were studied to analyse the extent of each mangrove wetland and mangrove biodiversity and density of the species. In Prakasam district, continuous to the north of Nellore district, the study included Karedu Pallepalem in Chillakaluva estuary in the extreme south and Etimoga sustained by Romperu drain in the north. In between, mangrove wetlands of Maneru, Musi-paleru, Gundlakamma and Etimoga estuaries were studied in a like manner.

Field trips were undertaken to mangrove wetlands covering almost the 295 km. coast line of the three districts. They include major, medium and minor wetlands. Mangrove wetlands are located with the help of Topo sheets of Survey of India and Google earth maps. The extent of each mangrove wetland is measured using Google earth imagery.

III. MATERIALS AND METHODS

Identification of mangroves and their associates was done using the manuals of Banerjee et al., 1989; Gamble, 1915-1938; Cook, 1967; Ramasbramanian et al., 2003 and Selvam and Karunagaran, 2004. Vernacular names were ascertained from local people living near mangrove habitats and compared with those of standard literature. For preparation of herbarium, the procedure described by Jain and Rao(1977) was adopted. Voucher specimens were deposited with the Department of Botany, Vikrama simhapuri university P.G.Centre, Kavali.

SPECIES-WISE DISTRIBUTION OF MANGROVES IN THE WETLANDS

Distribution of true mangroves in the major mangrove wetlands was determined using quadrants of 10x10 m. five random samples were taken within a distance of about 500 m. Average of each species of all the quadrants in a wetland is calculated in respect of each major wetland. Accordingly the level of density of each species is expressed on scale from + to ++++.

IV. RESULTS

GEOGRAPHICAL LOCATION AND EXTENT OF MANGROVE WET

The length of coast of Nellore and Prakasam districts covering a distance of 295 km was surveyed for mangrove wetlands.

The geographical location of the wetlands and their extent is given in Table 1.

The estuaries / delta-wise distribution and extent of mangrove wetlands in these two districts are shown in table 2.

Estuary/delta-wise mangrove wetlands may be classified as major (> 100 ha.), medium (20 - 50 ha.) and minor /miscellaneous

1. Kandaleru (813.25 ha.) which includes Krishnapatnm, Gummalladibba-Thamminapatnam, Epuru Bit I, Epuru Bit IB, Varagali-Lingavaram, Momidi-Tirumalammapalem and Eruru.
2. Swarnamukhi: (330.81 ha) which includes Siddavaram and Govindapalli,
3. Ponnapudi-Iskapalli lagoon (233.9 ha.) which includes Iskapalli-Kurru and Ponnapudi
4. Pennar (181.86 ha.) which includes Utukuru, Ramudupalem, Gangapatnam and Kesepallidibba.

In Prakasam district the major mangrove wetlands in the respective estuaries/ deltas are:

1. Romperu drain with Etimoga (592 ha.)
2. Musi-Paleru with Pathapalem-Gundamala. (301 ha.)
3. Gundlakamma estuary (20.26 ha.)

True mangroves and mangrove associates recorded in Nellore and Prakasam districts are shown in Table 3 and Table 4, respectively.

Species-wise distribution of true mangroves in the major wetlands: (Table 5 and 6) A. *Marina* is the most dominant true mangrove found in all the wetlands. It is followed by *E. agallocha* and *A. corniculatum*. *R. mucronata* and *C. decandra* are recorded in all but Chinnathota (Pulicatlake). *B.cylindrica* and *B. gymnorrhiza* seem to go together by virtue of their occurrence in all the major wetlands and are conspicuous by their absence at Chinnathota.

L.racemosa is recorded in Kandaleru, Iskapalli, Etimoga and Musi-Paleru wetlands and very conspicuous at Chinnathota. *L. apetala* is found only at Ponnapudi (Iskapalli lagoon Status of mangrove wetlands of Nellore and Prakasam and Guntur districts, Andhra Pradesh, India.

Incidentally, Ponnapudi (Iskapalli lagoon) is the only wetland where all the twelve mangrove species are recorded. At Swarnamukhi estuary the mangrove biodiversity and density are. the least . In Prakasam district, both at Etimoga and Musi- Paleru ten true mangroves are recorded all are evenly distributed with respect to their density.

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Among the mangrove associates (Table 7 and 8), *Arthrocnemum indicum, Atriplex repens, Sarcolobus carinatus, Tamarix gallica* and *Cressacretica* are of restricted occurrence, being confined to one wetland each. *Prosopis chilensis* is rampant in all the wetlands except at Iskapalli lagoon and Etimoga where the wetlands are water-logged round the year.

V. DISCUSSION

In Nellore district four major mangrove wetlands of more than 100 ha are: Kandaleru estuary, Swarnamukhi estuary, Iskapalli-Ponnapudi lagoon and Utukuru delta/estuary while in Prakasam district two major wetlands namely Etimoga and Musi- Paleru estuaries are observed. In Nellore district, the total mangrove wetland area is about 1615.88 ha. in which 50% area (813.25 ha.) is from Krishnapatnam to Eruru hamlet is in the Kandaleru creek. In the adjoining Prakasam district the total mangrove extent is about 925.4 ha. With Etimoga occupying 592.47 ha. (64%) of the mangrove cover. The mangrove cover in Nellore district is 42.73% higher than that of Prakasam district. This is commensurate with the length of the coast and the estuaries/water bodies in the two districts. *Excoecariaagallocha* is dominant species in Nizampatnam estuary. The true mangrove biodiversity is also alike in the two districts except for the additional occurrence of *Kandelia candel* and *Sonneratia apetela* in Nellore district. Selvam et al. (2005) reported that in Krishnapatnam the extent of mangroves as 20 ha. and 50 ha. In Kandaleru creek while 1200 ha. at Pennar and 2000 ha. at Pulicat lake totalling a mangrove cover of 3270 Ha. in Nellore district and 65 Ha.at Chinnaganjam, Prakasam district. The bulk of the mangroves in Andhra Pradesh are ocuuring in Krishna ,Godavari wetlands found in four districts namey East Godavari, West Godavari, Krishna and Guntur with a mangrove cover of 58,263 ha. (Ravishankar et al.,2004). The mangrove cover in Srikakulam, Vizianagaram and Visakhapatnam comprising north coastal Andhra Pradesh is marginal, being 135 ha only (Selvam et al., 2005). The total mangrove cover in these two districts under study is a mere 0.437% of the total mangrove cover (58263 ha.) in the state of Andhra Pradesh with a coast length of 972 km. The richness of mangrove diversity in Godavari and Krishna basins is attributed to the fresh water flow from Godavari and Krishna which during the course of flow carry huge quantity of nutrients to sustain the thick mangrove forests at the estuaries. Besides, the periodicity and quantum of fresh water flow, continuous sediment supply and higher tidal amplitude are other factors in favor of Godavari and Krishna mangroves in contrast with those of Nellore and Prakasam districts. There is a drastic decrease in tidal amplitude and periodicity of fresh water flow in the mangrove wetlands of Prakasam and Nellore districts compared to that of Godavari-Krishna basins. The rivers in Nellore and Prakasam districts are seasonal. All these factors are responsible for lesser extent of mangrove wetlands, mangrove diversity and density and their decreased robustness.

VI. CONCLUSION

Nineteen mangrove associates belonging to seventeen genera and eleven families are recorded in this study. *Hibiscus tiliaceus L, Caesalpinia crista L. Dalbergia spinosa* Roxb.reported by Ravishankar et al. (2004) could not be detected in the present study while *Arthrocnemum indicum, Atriplex repens, Cressa cretica* are the halophytic mangrove associates recorded in the present study. Shrimp ponds are a major threat to the mangroveforests. The wetlands are cleared off for shrimp farming. A perusal of goggle land sat imagery in the neighborhood of mangrove wetlands in the study area shows the awful extent to which these wetlands are converted to shrimp farms. Besides, there is water pollution in the form of harmful chemicals, which find their way into mangrove wetlands. This trend should be arrested and reversed. *Prosopis chilensis* is another serious threat to mangrove forests. It competes with mangroves for water and nutrients to the disadvantage of the latter besides delimiting the landward migration of species like *A. marina* and *E. agallocha*. Hence the threat posed by *Prosopis chilensis* has to be addressed at the earliest by the stake-holders. In mangrove wetlands of Ponnapudi besides shrimp ponds, there are salt pans in the close vicinity of the forest. Mangroves are cleared off in hundreds of acres for salt-farming. Steps should be taken to stop salt-farming to avoid further damage. At Krishnapatnam there is a sea port and a super thermal power station. Besides, along the Kandaleru creek dozens of thermal power plants have sprang up. They have already polluted the atmosphere and are bound to cause serious damage to the residual mangrove forests of the Kandaleru creek. In Etimoga, Pathapadu and Gundayapalem shrimp-farming and siltation of the creeks are the major threats. Conservation of the residual mangrove wetlands and endangered species should be the top priority. Government, N.G.Os and local stake-holders have to initiate steps in this direction. There is plenty of scope for afforestration in the fertile mangrove wetlands of Kandaleru creek, Utukuru estuary and Iskapalli lagoon in Nellore district, the Pathapadu- Gundamala stretch and also the Etimoga mangrove wetlands in Prakasam district. These mangrove belts offer good scope for increasing the mangrove exent in these two districts. In Nellore district only the Krishnapatnam-Varagali-Momidi stretch is under the jurisdiction of the Forest department while the rest of the mangrove wetlands are under the revenue lands.

In Prakasam district only the Gundayapalem mangrove forest is under the forest department while the large chunk of mangrove wetlands are in revenue lands. The mangrove wetlands in the revenue lands are exploited heavily, especially for shrimp farming and thermal power plants. It is important to note that the forest department is able to act upon the mangrove forest cover in reserve forest area under its jurisdiction, while other areas are under revenue control and their protection is the responsibility of Coastal Development Authority. Increased political interference and lack of stringent laws against encroachers are also said to be the other reasons for the declining mangrove cover in Andhra Pradesh.

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TABLE 1: TRUE MANGROVES RECORDED IN THE PRESENT STUDY IN NELLORE AND PRAKASAM DISTRICTS

S.No.	Name of species	Family
1	*Avicennia marina L*	Avicenniaceae
2	*Avicennia officinalis L*	Avicenniaceae
3	*Aegiceras corniculatum (L) Blanco*	Myrsinaceae
4	*Rhizophora mucronata P*	Rhizophoraceae
5	*Rhizophora apiculata Blume*	Rhizophoraceae
6	*Ceriops decandra (Griff) Ding Ho*	Rhizophoraceae
7	*Bruguiera cylindrica (L) Blum*	Rhizophpraceae
8	*Bruguiera gymnorrhiza (L) Savigny*	Rhizophoraceae
9	*Lumnitzera racemosa Willd*	Combretaceae
10	*Excoecaria agallocha*	Euphorbiaceae
11	*Sonneratia apetala Buch.-Ham*	Sonneratiaceae
12	*Kandelia candel(L.) Druce*	Rhizophoraceae

TABLE2: MANGROVE ASSOCIATES RECORDED IN THE PRESENT STUDY IN NELLORE AND PRAKASAM GUNTUR DISTRICTS

S.No	Name of species	Family
1	*Acanthus ilicifolius L*	Acanthaceae
2	*Ipomoea pes-caprae (L) Sweet*	Convolvulaceae
3	*Ipomoea tuba L*	Convolvulaceae
4	*Arthrocnemum indicum (Willd) Mo*	Chenopodaceae
5	*Clerodendrum inerme (L) Gaert*	Verbenaceae
6	*Fimbristylis ferruginea (L) Vahl*	Cyperaceae
7	*Aeluro puslagopoides (L) Tr*	Poaceae
8	*Derris trifoliata L.*	Fabaceae
9	*Myriostachya wightiana (Nees ex Steud)*	Poaceae
10	*Arip„. ™p,ns Roth*	Chenopodiaceae
11	*Salicornia brachiate*	Chenopodiaceae
12	*Suaeda maritima (L) Dumont*	Chenopodiaceae
13	*S.nudiflora (Willd) Moq*	Chenopodiaceae
14	*Sesuvium portulacastrum(L.) L*	Aizoaceae
15	*Thespesia populneoides (Roxb) Kos*	Aizoaceae
16	*Tamarix gallica L*	Tamarsicaceae
17	*Cressa cretica L*	Convolvulaceae
18	*Porteresiac oactata(Roxb.) Tateak*	Poaceae
19	*Sarcolobus carinatusWal*	Asclepiadaceae

TABLE 3: SPECIES-WISE DISTRIBUTION OF TRUE MANGROVES IN THE MAJOR WETLANDS OF NELLORE DISTRICT

S.No	Name of species
1	*Avicennia marina*
2	*Avicennia officinalis*
3	*Aegiceras crniculatum*
4	*Rhizophora mucronat*
5	*Rhizophora apiculata*
6	*Ceriops decandra*
7	*Bruguiera cylindrical*
8	*Bruguiera gymnorrhiza*
9	*Lumnitzera racemos*
10	*Excoecaria agallocha*
11	*Sonnerati aapetala*
12	*Kandelia candels*

TABLE 4: SPECIES WISE DISTRIBUTION OF TRUE MANGROVES IN THE MAJOR WETLAND OF PRAKASAM DISTRICT.

S.No	**Name of species**
1	*Avicennia marina*
2	*Avicennia officinalis*
3	*Aegiceras crniculatum*
4	*Rhizophora mucronat*
5	*Rhizophora apiculata*
6	*Ceriops decandra*
7	*Bruguiera cylindrical*
8	*Bruguiera gymnorrhiza*
9	*Lumnitzera racemos*
10	*Excoecaria agallocha*
11	*Sonneratia apetala*
12	*Kandelia candels*

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TABLE 5: SPECIES-WISE DISTRIBUTION OF MANGROVE ASSOCIATES IN THE MAJOR WETLANDS OF NELLORE DISTRICT

S.No	Name of species
1	*Acanthus ilicifolius*
2	*Ipomoea pes-caprae*
3	*Ipomoea tuba.*
4	*Arthrocnemum indicum*
5	*Clerodendrum inerme*
6	*Fimbristylis ferruginea*
7	*Aeluropus lagopoide*
8	*Myriostachya wightiana*
9	*Atriplex repens*
10	*Salicornia brachiate*
11	*Sesuvium portulacastrum*
12	*Suaeda maritime*
13	*Suaeda nudiflora*
14	*Sarcolobus carinatus*
15	*Thespesia populneoide*
16	*Tamarix gallica*
17	*Derris trifoliate*
18	*Cressa cretica*
19	*Porteresiaco actata*

TABLE 6 SPECIES-WISE DISTRIBUTION OF MANGROVS IN THE MAJOR WETLAND OF GUNTUR DISTICT
(MANGROVES RECORDED IN NIZAMPATNAM, GUNTUR DISTRICT)

S.No.	Name of species	Family	Vernacular Name	Habitat
1	*Aegicerascorniculatu m*(L.)	Myrsinaceae	Guggilam	Tree
2	*Avicennia alba*	Avicenniaceae	Gudammada	Tree
3	*Avicennia marina*	Avicenniaceae	Tellamada	Tree
4	*Avicennia officinalis*(L.)	Avicenniaceae	Nallamada	Tree
5	*Bruguiera cylindrical* (L.	Rhizophorace	Uradu	Tree
6	*Bruguiera gymnorrhiza*(L.)	Rhizophoracee	Thodduponna	Tree
7	*Ceriops decandra*(Griff.)	Rhizophorace	Calhasu /Thogara	Tree
8	*Excoecaria agallocha*(L.)	Euphorbiaceae	Tilla	Tree
9	*Lumnitzera racemosa*	Combretaceae	Thandug	Tree
10	*Rhizophora apiculata*(Bl.,)	Rhizophoracee	Ponna	Tree
11	*Rhizophora mucronata*	Rhizophoracee	UppuPonna	Tree
12	*Sonneratia apetala*	Sonneratiaceae	Peddakalinga	Tree
13	*Acanthus ilicifolius*(L.)	Acanthacea	Allchi	Shrub
14	*Clerodendrum inerme*(L.)	Verbenaceae	Pisingi	Tree
15	*Dalbergias pinosaRoxb*	Fabaceae	Chillangi	Shrub
16	*Derris trifoliate*	Fabaceae	Silasila/NallaTheega	Shrub
17	*Salicorni a brachiata*	Chenopodiacee		Tree
18	*Sessuvium portulacastrum*	Aizoaceae		Herb
19	*Suaeda fruticosa*(L.)	Chenopodiacee	Elakura	Shrub
20	*Suaeda maritima*(L.)	Chenopodiaceae	Elakura	Herb

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