

MANGROVES OF MAHANADI DELTA IN THE STATE OF ODISHA AND ASPECTS OF THEIR CONSERVATION

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Abstract

The coast line of Odisha State lying on the east coastal wetland ecosystem of the Indian subcontinent falls within the bounds of tropics and covers a distance of 480kms with a variety of plant habitats. The remarkable mangrove communities within the tidal forest ecosystem along the sheltered places of the coast line bounded by the deltaic and estuarine complex of the rivers Mahanadi, Dhamra, Brahmani and Devi in the districts of Jagatsinghpur, Kendrapara, Balasore and Bhadrak are unique for floristic and ecological values. The mangrove vegetation in Odisha occurs both in continuous as well as fragmented patches along the coastal tract. Mahanadi delta encompassing Kendrapara, Jagatsinghpur and Puri districts harbors a rich diversity of mangroves and their associates. From extensive survey in Mahanadi delta over 3 years (2012-2015), 61 species of mangroves and their associates have been collected and identified. Some mangroves ensure livelihood support to the local communities in many ways. But it is a matter of great concern that this plant communities are under severe threat and pressure due to anthropogenic interferences. So, it is time to adopt massive mangrove restoration programs with special emphasis on conservation of rare and threatened species.

Keywords: Mangroves; Mahanadi delta; Conservation; Restoration programs; Anthropogenic interferences

Introduction

Mangroves are halophytic, littoral plant formations of tropical, subtropical coastlines and estuaries. The mangrove forests are globally important for the productivity of the coastal environment and are good nursery site for aquatic organisms [1]. The plant species occurring in this ecosystem are habitat specific, economically valuable and attract the attention of nature lovers, botanists and ecologists world-wide for peculiar morphological and anatomical adaptations [2]. Mangrove ecosystem and its biodiversity are threatened due to climate change [3]. It is the unique forest ecosystem found in the Eastern and Western coasts of India. The Eastern coast in general and Odisha coast in particular exhibit rich and diverse mangrove elements, due to climatic conditions coupled with varied topography. Littoral and tidal swamp forests are the conspicuous vegetation for the State of Odisha [4]. The state mangrove

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vegetation occurs in fragmented patches in the districts of Balasore, Bhadrak, Kendrapara, Jagatsinghpur, Puri and Ganjam (in part) spreading over 231km² [5]. The riverine estuaries of Brahmani and Baitarani (Bhitarkanika Wildlife Sanctuary) are rich in species composition due to the enforcement of Wildlife Protection Act and considered as second largest mangrove formations in India, after the Sundarbans. Earlier studies reveal that once upon a time Mahanadi delta had rich mangrove cover. But, in course of time the mangrove forests in Mahanadi and Devi estuaries have got smaller under the action of various biotic factors such as pisciculture, paddy cultivation, construction of Paradeep Port and ancillary industries and human settlements. Realizing the ecological as well as socio-economic values of mangroves a status survey was conducted in Mahanadi delta during 2012-2015. The status of mangrove cover as reported by Forest Survey of India for assessment year 2015 is given (Table 1 and 2).

Table 1. State/UT wise mangrove cover in India (India State of Forest Report 2015)

States/UTs	Mangrove Cover (km ²)	States/UTs	Mangrove Cover (km ²)
Andhra Pradesh	367	Odisha	231
Goa	26	Tamil Nadu	47
Gujarat	1,107	West Bengal	2,106
Karnataka	3	A & N Islands	617
Kerala	9	Daman & Diu	3
Maharashtra	222	Puducherry	2
			Total 4,740

Table 2. District wise Mangrove Cover in Odisha (India State of Forest Report 2015)

State	Districts	Mangrove Cover (km ²)
Odisha	Balasore	2
	Bhadrak	30
	Jagatsinghpur	8
	Kendrapara	190
	Puri	1
		Total 231

Mahanadi delta is located between 19° 45' - 20° 30' N latitude and 85° 15' - 86° 50' E longitude in the east coast of India, covering an area of 13,778.09 ha [6]. It extends from Barunei mouth of Kendrapara district in the north to Devi mouth of Jagatsinghpur district in the south (Fig. 1).

The vegetation is the integral part of Gahirmatha, Mahakalapada and Kujang Wildlife Ranges, coming under the administrative control of the Mangrove Forest Division (Wildlife), Rajnagar. The presence of innumerable meandering creeks, channels, islets with regular flushing by tidal water and discharge of large quantities of fresh water for longer duration create suitable niches for the development of luxuriant mangroves in this area. Mahanadi delta is comprised of 48 forest blocks. Out of these, five forest blocks have been notified as Reserve Forest (RF) and 18 forest blocks as Protected Reserve Forest (PRF). The remaining 25 forest blocks are categorized under Protected Forests (PF) status, which dilutes legal protection.



Fig. 1. Location of Mahanadi delta, Odisha.

Topography and Environment

The whole landscape is formed by alluvial fillings of the littoral zone consisting of sandy or muddy soil. These are the recent sediments belonging to Holocene age. The color of the soil ranges from pale grey to deep grey and the soil texture is clay. The deltaic soil is formed from materials brought from catchments by rivers, become conducive and forms the mangrove vegetation. The soil types in the vicinity of sea shore are mostly sandy in nature often mixed with clay.

The climate is tropical monsoonal and this region mostly enjoys three distinct seasons in a year. January and May are the coldest and hottest months respectively. The temperature ranges from 21 – 40°C.

Mahanadi delta receives an average annual rainfall of 1546mm per year. Maximum rainfall occurs during July to October. Soil salinity in most of the Mangrove Blocks is very low, ranging from 7.1 to 9.7 ppt even during the summer season and soil pH is slightly acidic.

Past botanical works

The pioneer plant explorer for Bihar and Odisha, had indicated the existence of dense mangrove forests in Mahanadi delta, Jambu, Hukitola and adjoining regions in his treatise “The Botany of Bihar and Orissa” [7]. He reported 37 mangroves and associates under 30 genera belonging to 23 families from Mahanadi delta and Chilika lagoon without mentioning the precise location. But, he did not botanize the estuaries of river Brahmani, Baitarani, Budhabalanga, Rusikulya and Devi. Being aware of the un-exploredness in these localities [8], he made a short trip to Jambu, Hukitola and False Point of Mahanadi delta in June 1949 and added 12 mangrove taxa to the previous compendium. Out of these, 10 species were turned out to be new records for the state of Odisha. However, intensive botanization of the rich mangrove forests of Bhitarkanika has remained untouched. Several studies have provided some information about the coastal vegetation in Odisha coast [9-12]. Further contribution to the mangrove diversity of Mahanadi delta highlighting the conservational aspect has been discussed [13]. Recently, the enumeration of some potential economic plants and medicinal weeds from Mahanadi delta has been made [6, 14]. A comparative account of mangroves of Bhitarkanika and Mahanadi delta has been provided [15]. It is quite evident that no extensive floristic survey

in Mahanadi delta has been carried out till today, except for the publication of a few stray reports. Realising the importance, a detailed floristic survey was made during 2012-2015. The species namely *Polyalthia korintii*, *Taveniera cuneifolia*, *Heritiera kanikensis*, *Colubrina asiatica*, *Dalbergia candenatens* as reported earlier from Mahanadi delta [8] could not be traced out during the present investigation. Habitat destruction might be the sole cause for the disappearance of these species.

Vegetation

In Mahanadi delta, the mangrove formation occurs along the tidal inundated creeks, channels and islets. The sea fronted beaches and dunes are under the spell of the ocean's physical forces. The sandy fore-shore is inhospitable and devoid of higher plant life. However, the back shore supports some herbaceous flora. The sand bars and sand dunes along the littoral track of Agarnasi, Hukitola and Nadiakhia sea shore are mostly covered by some strand runners and herbs like *Canavalia maritima*, *Ipomoea pescaprae*, *Spinifex littoreus*, *Cyperus arenarius*, *Launaea sarmentosa*, *Hydrophylax maritima*, *Sesuvium portulacastrum*, *Pedaliium murex*, *Gisekia pharnaceoides*, *Rothia indica*, *Borreria articularis*, *Indigofera glabra*, *Portulaca pilosa* and others which act as sand binders and sand stabilizers.

Along the narrow and defunct creeks *Acanthus ilicifolius* and *Acrostichum aureum* occur in close association. The ground flora is very poor and only represented by pure formation of *Myriostachya wightiana* and *Porteresia coarctata* in muddy flats. Notable herbaceous elements such as *Suaeda maritima*, *Suaeda nudiflora*, *Salicornia brachiata*, *Tylophora tenuissima*, *Heliotropium curassavicum*, *Fimbristylis ferruginea*, *Pentatropis capensis* are found in dry, open and elevated areas especially in Kansaridia, Hetamundia and Sanatubi forest blocks. During the present investigation, few members of *Solanum trilobatum* could be observed inside the *Casuarina equisetifolia* plantation along the sea shore of Saralikuda and Hetamundia forest blocks.

Usually the mangroves in this area occur in two storey systems. The representative elements constituting the top canopy are *Sonneratia apetela*, *Avicennia officinalis*, *A. alba*, *Excoecaria agallocha*, *Xylocarpus granatum*, *X. mekongensis*, *Heritiera fomes* etc. These are luxuriant along the river banks and creeks. The population of *Heritiera fomes* and *Xylocarpus mekongensis* is very low in Mahanadi delta in comparison to Bhitarkanika, where mostly are located in Kharinasi and Kansaridia forest blocks. The second storey is composed of shrubby and small trees such as *Rhizophora apiculata*, *R. mucronata*, *Kandelia candel*, *Ceriops decandra*, *Aegiceras corniculatum*, *Sonneratia alba*, *Bruguiera cylindrica*, *B. gymnorrhiza*, *Avicennia marina*, *Hibiscus tiliaceus*, *Aegialitis rotundifolia*, *Brownlowia tersa* etc. (Fig. 2).

These elements remain under the action of tide and ebb regularly. Reduced numbers of *Lumnitzera racemosa* and *Cynometra iripa* could be observed in sandy clayey soil of Hukitola and Kansaridia forest blocks. In the terrestrial and swampy areas the mangrove associates like *Caesalpinia crista*, *C. bonduc*, *Clerodendrum inerme*, *Thespesia populnea*, *Pongamia pinnata*, *Azadirachta indica*, *Salvadora persica* and *Phoenix paludosa* are quite conspicuous. Climbers such as *Derris scandens*, *D. trifoliata*, *Finlaysonia obovata*, *Ipomoea tuba* etc. are well represented in this area. It is noteworthy to mention that the population of *Bruguiera parviflora* now only confined to small areas of Kansaridia forest block of Mahanadi delta and Kalibhanjadian Island of Bhitarkanika National Park. The list of extant mangroves and associates in Mahanadi delta is provided in Table 3.



Fig. 2. Species from Mahanadi Delta: a - *Bruguiera parviflora* - a rare mangrove species in Mahanadi Delta; b - *Bruguiera gymnorrhiza* in blooming; c - *Xylocarpus granatum* fruit used for medicinal purpose; d - *Kandelia candel* - A common mangrove species in Mahanadi Delta; e - *Avicennia alba* in fruiting during August-October; f - Flower of *Rhizophora mucronata* having caducous petals

Table 3. Systematic enumeration of mangroves and associates of Mahanadi delta

Sl. No.	Species	Family	Habit	Local name in Odia	IUCN Status
1	<i>Acanthus ilicifolius</i>	Acanthaceae	Shrub	Harakancha	EN
2	<i>Acrostichum aureum</i>	Acrostichaceae	Shrub	Kharkhari	L Rlc
3	<i>Aegialitis rotundifolia</i>	Plumbaginaceae	Tree	Banarua	EN
4	<i>Aegiceras corniculatum</i>	Myrsinaceae	Tree	Kharsi	EN
5	<i>Avicennia alba</i>	Avicenniaceae	Tree	Dhala Bani	CR
6	<i>Avicennia marina</i>	Avicenniaceae	Tree	Singala Bani	EN
7	<i>Avicennia officinalis</i>	Avicenniaceae	Tree	Bada Bani	EN
8	<i>Azadirachta indica</i>	Meliaceae	Tree	Nimba	-
9	<i>Brownlowia tersa</i>	Tiliaceae	Shrub	Lati Sundari	EN
10	<i>Bruguiera cylindrica</i>	Rhizophoraceae	Tree	Kaliachua	EN
11	<i>Bruguiera gymnorrhiza</i>	Rhizophoraceae	Tree	Bandari	CR
12	<i>Bruguiera parviflora</i>	Rhizophoraceae	Tree	Dot	CR
13	<i>Caesalpinia bonduc</i>	Caesalpinaceae	Climber	Gilo	-
14	<i>Caesalpinia crista</i>	Caesalpinaceae	Climber	Nentei	-
15	<i>Canavalia maritima</i>	Fabaceae	Climber	Luni Sima	-
16	<i>Ceriops decandra</i>	Rhizophoraceae	Tree	Garani	EN
17	<i>Clerodendrum inerme</i>	Verbenaceae	Shrub	Chiani	EN
18	<i>Crinum defixum</i>	Amaryllidaceae	Herb	Pani Kenduli	-
19	<i>Cynometra iripa</i>	Caesalpinaceae	Shrub	Singada	-

20	<i>Dalbergia spinosa</i>	Fabaceae	Climber	Gohirakanta	-
21	<i>Derris scandens</i>	Fabaceae	Climber	Dhala Katiranai	-
22	<i>Derris trifoliata</i>	Fabaceae	Climber	Kala Katiranai	EN
23	<i>Dolichandrone spathacea</i>	Bignoniaceae	Tree	Gosinga	-
24	<i>Excoecaria agallocha</i>	Euphorbiaceae	Tree	Guan	VU
25	<i>Fimbristylis ferruginea</i>	Cyperaceae	Herb	Luni Ghasa	-
26	<i>Finlaysonia obovata</i>	Asclepiadaceae	Climber	Khasai Lata	CR
27	<i>Heliotropium curassavicum</i>	Boraginaceae	Herb	Luni Hatisundhia	-
28	<i>Heritiera fomes</i>	Sterculiaceae	Tree	Sundari	EN
29	<i>Hibiscus tiliaceus</i>	Malvaceae	Shrub	Bania	-
30	<i>Hydrophylax maritima</i>	Rubiaceae	Herb	-	-
31	<i>Ipomoea tuba</i>	Convolvulaceae	Climber	-	-
32	<i>Kandelia candel</i>	Rhizophoraceae	Tree	Sindhuka	EN
33	<i>Lumnitzera racemosa</i>	Combretaceae	Tree	Churunda	EN
34	<i>Merope angulata</i>	Rutaceae	Shrub	Bana Lembu	-
35	<i>Myriostachya wightiana</i>	Poaceae	Herb	Nalia Ghasa	EN
36	<i>Pandanus fascicularis</i>	Pandanaceae	Shrub	Ketaki Kia	-
37	<i>Pandanus foetidus</i>	Pandanaceae	Shrub	Luni Kia	-
38	<i>Pentatropis capensis</i>	Asclepiadaceae	Twiner	Raigidi	-
39	<i>Phoenix paludosa</i>	Arecaceae	Shrub	Hental	EN
40	<i>Phragmites karka</i>	Poaceae	Shrub	Nala	-
41	<i>Pongamia pinnata</i>	Fabaceae	Tree	Karanja	-
42	<i>Porteresia coarctata</i>	Poaceae	Herb	Dhani Dhana	VU
43	<i>Rhizophora apiculata</i>	Rhizophoraceae	Tree	Rai	EN
44	<i>Rhizophora mucronata</i>	Rhizophoraceae	Tree	Rai	VU
45	<i>Salicornia brachiata</i>	Chenopodiaceae	Herb	Batula	L Rnt
46	<i>Salvadora persica</i>	Salvadoraceae	Tree	Miriga	-
47	<i>Sarcolobus carinatus</i>	Asclepiadaceae	Climber	Lata Rai	-
48	<i>Sesuvium portulacastrum</i>	Aizoaceae	Herb	Goda Bani	EN
49	<i>Solanum trilobatum</i>	Solanaceae	Climber	-	-
50	<i>Sonneratia alba</i>	Sonneratiaceae	Tree	Orua	EN
51	<i>Sonneratia apetela</i>	Sonneratiaceae	Tree	Keruan	EN
52	<i>Sonneratia caseolaris</i>	Sonneratiaceae	Tree	Orua	EN
53	<i>Sonneratia griffithii</i>	Sonneratiaceae	Tree	Orua	CR
54	<i>Suaeda maritima</i>	Chenopodiaceae	Herb	Giria	EN
55	<i>Suaeda nudiflora</i>	Chenopodiaceae	Herb	Giria	EN
56	<i>Tamarix troupii</i>	Tamaricaceae	Shrub	Jagula	EN
57	<i>Thespesia populnea</i>	Malvaceae	Tree	Habali	-
58	<i>Tylophora indica</i>	Asclepiadaceae	Twiner	Anantamula	-
59	<i>Tylophora tenuis</i>	Asclepiadaceae	Twiner	Anantamula	-
60	<i>Xylocarpus granatum</i>	Meliaceae	Tree	Sisumar	EN
61	<i>Xylocarpus mekongensis</i>	Meliaceae	Tree	Pitamari	EN

Abbreviations: EN=Endangered CR=Critically Endangered VU=Vulnerable

L Rnt=Lower Risk-near threatened L Rlc=Lower Risk-least concern

Socio-Economic Importance

Mangroves are considered “Land builders” as they help in soil formation in coastal environment. The network of mangrove stilt roots effectively arrests the river bank and coastal erosion and ultimately helps in controlling flood damages. They also provide protection to coastal land masses against cyclonic wind and tidal surges. The sheltered waters of mangroves provide nursery grounds for fishes and other organisms too. Apart from these, mangroves cater immediate need to the local inhabitants in many ways. They are the source of food, fuel, timber, medicine and fodder.

Table 4. Socio-economic potential of Mangroves

Species	Family	Habit	Parts used	Purpose
<i>Acanthus ilicifolius</i>	Acanthaceae	Shrub	Leaf, Root& Seeds	Medicine
<i>Aegialitis rotundifolia</i>	Plumbaginaceae	Tree	Pole	House construction
<i>Avicennia alba</i>	Avicenniaceae	Tree	Bark	Medicine
<i>Avicennia marina</i>	Avicenniaceae	Tree	Bark	Medicine
<i>Avicennia officinalis</i>	Avicenniaceae	Tree	Bark, Trunk, Tender twig	Medicine, Timber, Fuel, Fodder
<i>Brownlowia tersa</i>	Tiliaceae	Shrub	Fruit	Medicine
<i>Bruguiera cylindrica</i>	Rhizophoraceae	Tree	Pole	House construction, Fencing
<i>Caesalpinia crista</i>	Caesalpinaceae	Climber	Root	Medicine
<i>Ceriops decandra</i>	Rhizophoraceae	Tree	Root	Medicine
<i>Cynometra iripa</i>	Caesalpinaceae	Shrub	Fruit kernel	Food
<i>Excoecaria agallocha</i>	Euphorbiaceae	Tree	Leaf, Dried wood	Medicine
<i>Finlaysonia obovata</i>	Asclepiadaceae	Climber	Leaf	Medicine
<i>Heritiera fomes</i>	Sterculiaceae	Tree	Trunk, Seeds	Agricultural implements, Medicine
<i>Hibiscus tiliaceus</i>	Malvaceae	Shrub	Root	Medicine
<i>Kandelia candel</i>	Rhizophoraceae	Tree	Bark	Medicine
<i>Lumnitzera racemosa</i>	Combretaceae	Tree	Bark	Medicine
<i>Merope angulata</i>	Rutaceae	Shrub	Fruit	Medicine
<i>Myriostachya wightiana</i>	Poaceae	Herb	Matured culm, Stolon	Thatching, Basket making
<i>Pentatropis capensis</i>	Asclepiadaceae	Twiner	Root, Fruit	Medicine, Food
<i>Phoenix paludosa</i>	Arecaceae	Shrub	Culm, Leaf, Fruit	House construction, Thatching, Food
<i>Porteresia coarctata</i>	Poaceae	Herb	Tender culm,	Fodder
<i>Rhizophora mucronata</i>	Rhizophoraceae	Tree	Bark	Medicine
<i>Salicornia brachiata</i>	Chenopodiaceae	Herb	Leaf	Medicine
<i>Salvadora persica</i>	Salvadoraceae	Tree	Tender leaf, Fruit	Fodder, Medicine
<i>Sarcobolus carinatus</i>	Asclepiadaceae	Climber	Leaf, Root	Medicine
<i>Sonneratia alba</i>	Sonneratiaceae	Tree	Fruit	Medicine
<i>Sonneratia apetela</i>	Sonneratiaceae	Tree	Leaf, Unripe fruit pericarp	Medicine, Food
<i>Suaeda maritima</i>	Chenopodiaceae	Herb	Tender leaf	Food
<i>Thespesia populnea</i>	Malvaceae	Tree	Root, Fruit	Medicine
<i>Tylophora indica</i>	Asclepiadaceae	Twiner	Leaf	Medicine
<i>Xylocarpus granatum</i>	Meliaceae	Tree	Fruit	Medicine

Mangroves play a pivotal role in curing various types of ailments. The traditional methods of using different parts of mangroves are still practiced in fringe villages. Considering the potential medicinal values, a 200ha patch of mangrove cover in Kansaridia PRF under Mahakalapada Wildlife Range has been designated as Medicinal Plants Conservation Area (MPCA) in 2008-09. Medicinal properties and other uses of some species have been ascertained at field level and with the help of standard treaties [16-19]. The list of mangroves used for various purposes are cited (Table 4).

Threat to Mangroves and Present Management Intervention

The entire mangrove forests of Mahanadi delta were under the erstwhile Burdhanwan Estate for a long time. During the Zamindari Regime, the reclamation of fringe mangroves for agriculture was encouraged for collection of land revenue. The Zamindar invited and encouraged people from bordering Bengal Province to reclaim the mangrove forests in maximum extent. Indiscriminate encroachment by clearing mangroves continued for a long period during the Zamindari system.

With the abolition of the Zamindari system, the mangrove forests came under the administrative control of Government of Orissa since 26 November 1951. The administration of the area was vested with the “Anchal Sasan” under the Revenue Department, Government of Orissa. The depletion of mangroves was hastened with the establishment of Paradeep Port,

ancillary industries, settlement of refugees and migrants and fish landing stations. From 15 November 1957 the mangrove forests of Bhitarkanika and Mahanadi delta came under the administrative control of Athgarh Forest Division. To improve the management of the Orissa mangroves, a separate Division, namely Mangrove Forest Division, was created at Rajnagar in November 1990. Since then, it became a great challenge for the administrators to restore mangroves in denuded locations. This could be achieved after the implementation of the Mangrove Afforestation Programme in the Division. Around 2149.50ha of denuded and evicted aquaculture farm were restored with mangroves since 2001. The mangrove cover as seen now has been saved from further degradation due to the implementation of the Mangrove Action Plan (MAP). Persistent efforts have been made time and time to remove unauthorized encroachment. But in many cases the eviction process is under logjam due to the lawsuits imposed by the encroachers. Constant patrolling by forest staff has saved the mangroves from further depletion. Eco-Development Committees (EDCs) have been constituted in the peripheral villages to reduce dependency on mangrove forests.

Conservation

Mangrove resources of Mahanadi delta have faced tangible shrinkage in the past due to biotic interferences. With the passage of time, many species are struggling for their survival due to changing environmental conditions and are becoming rare and threatened. For example, *Bruguiera parviflora*, *Xylocarpus mekongensis*, *X. granatum*, *Lumnitzera racemosa*, *Cynometra iripa*, *Merope angulata* etc. are restricted to certain localities which need urgent protection before further genetic erosion.

Mangrove ecosystem acts as an important buffer zone between the sea and the landmass which provides diverse ecosystem services to mankind. The loss of mangrove forests was greatly felt during the super cyclone that devastated the coastal districts of Odisha in October 1999. So, it is high time to conserve mangrove forests and adopt a large scale plantation in habitat specific degraded areas to withstand future hazards.

The species like *Porteresia coarctata* and *Merope angulata* are considered wild relatives of rice and citrus respectively. The salt tolerant genes may be introduced to develop relatives with desired vigor by increasing food security to people inhabiting near coast. Therefore, it is required to conserve these two species in their natural habitat (*in situ*).

For effective implementation of the management plan for mangrove conservation, the local communities need to be involved. Thus, mangrove awareness programs should be organized at regular intervals. Realizing this, the Mangrove Forest Division (Wildlife), Rajnagar under Forest and Environment Department, Government of Odisha has taken steps to conserve these fragile plant communities in their natural habitats. Large scale mangrove plantations are being taken up under various State as well as Central Government sponsored schemes including World Bank funded ICZM Project. Apart from this, mass awareness programs are also undertaken at divisional as well as field level.

Conclusions

Mahanadi delta supports an optimum habitat for useful mangrove species of *Rhizophora*, *Ceriops*, *Heritiera*, *Lumnitzera*, *Bruguiera*, *Sonneratia*, *Avicennia*, *Salvadora* etc. the source of food, fodder, medicine and timbers. It also provides an important habitat for sea turtles, estuarine crocodiles, birds, edible crabs and many fishes. However, these useful plant resources

are also facing some major ecological disturbances such as natural calamities, increase of human settlement, deforestation due to fire woods, house and boat building materials and construction of bridge and ports etc.

For conservation of this fragile ecosystem, scientific managements and local educational campaigns should be launched by the Government Departments and Non Government Organizations and the habitat should be declared as a Wildlife sanctuary.

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