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THREATS TO THE MANGROVES OF THANE CREEK AND ULHAS RIVER ESTUARY, INDIA.

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ABSTRACT

The mangroves have adapted themselves best in the shallow sea coast, sheltered estuaries and deltaic zones of the tropics and subtropics with characteristic environmental conditions viz. temperature ranges between 20^0 C to 30^0 C, moderate to high monsoon precipitation i.e. 1000 – 3000 mm/ annum, high humidity but with coastal aridity. On the sea-land interface in global mangrove systems, there are gradual, slow or quickly changing ecological or geomorphological conditions to which mangroves have to adapt. The human thrust or pressure, other biotic factors and interactions also cause changes in mangrove ecosystems. Due to this the mangroves are now very dynamic but have become fragile through out the globe.Mangroves have various adaptations to cope with the stress to which they are subjected and for these adaptations they have to expend a lot of energy. Increased salinity has brought about floristic changes in the mangroves, particularly in growth, form and structure of plant parts such as pneumatophores, thickening of leaves, salt extruding glands, viviparity, stunted tree growth of some species and changes in plant communities.The mangrove forests stand as a barrier between the land and the sea and are feeding and breeding grounds for different fishery organisms. The mangroves of the world, especially of the Indian continent are threatened and are on the verge of losing their identity. The study on the distribution of mangroves and the associate plants along Ulhas river estuary and the Thane creek during the period September 2001 to August 2002 showed presence of 8 genera and 14 species of mangroves and 11 genera and 12 species of mangrove associates. The dominant mangrove type was Avicennia marina where as Acanthus ilicifolius was the major associate type. When compared with the earlier data it was apparent that the mangrove cover was significantly reduced. The main threat to mangroves was due to anthropogenic activities, like cutting for fuel; reclamation for various purposes such as industry, agriculture, sand landing (reti-bunder), solid waste dumping, aquaculture ponds, construction of housing colonies, roads and bridges violating the CRZ regulation. There is an urgent need to conserve the mangroves of this region; which can be achieved through education, motivation of local people and strict supervision by administrative bodies and non-government organizations

Kaywards : Threats to Mangroves, anthropogenic activities, Thane creek, Ulhas river estuary, India.

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INTRODUCTION

Mangrove ecosystems exist along the tropical and subtropical seashores. They are found on flat land between the high and low water marks (Mandura, 1997). Arroyo

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(1977) defined mangroves as "A small group of true mangrove plants and associated species belonging to systematically unrelated families, possessing similar physiological characteristics and structural adaptations with common preference to the intertidal habitat." The special adaptation of these plants is that they are tolerant to fluctuating water salinity. The prop roots and the stilt roots form a firm anchorage in the sinking substratum, also trap the fine suspended particles in water leading to accumulation of sediment and formation of the mudflats. The mudflats enhance the settlement and growth of different mangrove species and their associate plants there by developing mangrove forest or "mangrove ecosystem". The mangrove forests grow by taking nutrients from the tidal waters and in turn provide natural food to the mangrove dwelling fauna (Odum *et al.*, 1982).

They have enormous value, as habitats, as food sources and shelter for various organisms and fishery species. Mangrove plants have a number of highly specialized adaptations to survive in regular tidal inundation by saline waters, such as, breathing roots that allow them to survive in anaerobic sediments, supporting structures such as buttresses and columnar roots which enable them to grow in unstable substrate, low water holding potentials and high intracellular salt concentrations to maintain favorable water relations in saline environments, foliage salt-excretion to remove excess salt from the sap, xerophytic (water conserving) leaves to cope with periods of high salinity stress and buoyant viviparous propagules for dispersal and establishment in new areas (Sasekumar, 2000). According to Henckel (1963) and Adriani (1958), all mangroves are evolved from glycophytes; as such, their seeds need fresh water conditions for germination.

Depending upon the mode of seed germination Bhosle *et al.* (1983), have considered four groups of mangroves .

1) **Mangroves showing vivipary:** Plants of family Rhizophoraceae show viviparous germination in which the germinated seed grows further and the seedling remains on the mother plant for about a year (Mulik and Bhosale, 1989)
2) **Mangroves showing cryptovivipary:** Exhibited by plants belonging to family Avicenniaceae. In cryptovivipary (hidden germination, i.e. within the fruit which is not visible from outside) embryo inside the fruit wall does not enlarge sufficiently to rupture the fruit wall. In genus *Avicennia* the seed inside the fruit germinates before the fruit attains its maximum size. Growth of the embryo and enlargement of fruit wall continues simultaneously till the embryo is mature. Therefore, the fruit wall does not get a crack through which radicle can protrude. Dehiscence of the fruit takes place whereupon the embryo inside the seed is released on the ground (Gill, 1982).
3) **Germination of seed on soil** - This is exhibited by plants belonging to family Sonneratiaceae. These plants do not possess vivipary or cryptovivipary. Most of the species of this category are salt accumulating type of mangroves. Therefore the seeds already have higher level of salt contents. Seeds directly germinate in the soil. (Anjal and Bhosale, 1986).
4) **Vegetative propagation** - This is seen in the plants belonging to family Acanthaceae. These plants spread by vegetative propagation. It forms roots at the nodal regions. The plants thus have a tufted appearance (Mulik and Bhosale, 1986).

According to Bhosle *et al.* (1991), the fact is that viviparous seedlings need almost a year on the mother plant for adaptation to salination. However same is achieved in a couple of months in cryptoviviparous seedlings, whereas plant shedding seeds directly on the ground do not need much time for this. Thus the direct

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seed germination is more advanced than cryptovivipary, which is more advanced than vivipary, vegetative propagation is still more advanced than all these. Thus change in habitat and salinity causes damage to the growth of mangroves

India has 5700 km. long coastline, which can be divided into west coast, east coast and island chains. Mangrove area of India is about 6740 sq. km., which is about 7% of the mangrove area of the world (Gupta and Sastry, 1991). The present satellite based estimate of mangrove area is 4460 sq. km. which indicates a loss of 2280 sq. km. mangrove cover (Nayak *et al.*, 1996). According to Kothari and Singh (1998), in the area wise ranking, Indonesia ranks first followed by Australia, Malaysia, Bangladesh and India.

The mangrove diversity in coastal regions of India is studied by a number of workers. After the pioneering work by Cooke (1901- 1908) the work was continued by a number of other scientists. To mention a few Shah (1962), Rao and Sastry (1974, 1977), Blasco, (1975) and Banerjee *et al.* (1989), etc. worked out the coastal ecology of India in general. While the mangroves particularly of the Western region including the North West coast were known through the works of Blatter (1905), Navalkar (1951) and Kulkarni (1988) from BSI who studied flora of Sindhudurga. Vartak (1966) published a list of 1512 species based on literature and exploration from Gomantak, North Kanara, Ratnagiri etc., which included mangroves. Thane creek mangroves were studied by Billore (1972), Dwivedi *et al.* (1974), Untawale (1982). Kothari and Rao (1990,91a, 1991b, 1994,1995,1996) explored the Thane creek and creeks of Raigad district. Untawale *et al.*(1980) have mentioned 47 mangrove species and 37 types of mangrove associated flora from the Indian deltaic mangals. These Indian mangrove species are especially restricted to the deltaic regions within the major Indian estuaries viz. the Hooghly river between the Baratala and the Haribhang (West Bengal), Mahanadi river between the Devi and the Dharma (Orissa), the Krishna and the Godavari rivers (Andhra Pradesh), the Cauvery river (Tamilnadu) and the Narmada river (the Runn of Kutch) etc. Most of these major deltaic areas are confined to the east coast, covering about 70% of the total Indian mangals; while the minor estuaries of the west coast have no such deltaic mangals (Untawale and Jagtap, 1980).

Growing industrialization, urbanization and various human activities along the coastal ecosystem are causing significant damage to mangroves. The present paper presents the diversity of the mangroves, mangrove associate plants and non mangrove halophytes (Kothari and Singh1998) along the Thane creek and Ulhas river estuary and reviews the threats to them.

MATERIALS AND METHODS

The study was conducted from March 2001 to February 2002 in three zones of both Thane creek and Ulhas river estuary, namely riverine zone of low salinity, middle zone of intermediate salinity and seaward zone of high salinity. Ulhas river opens in the Arabian Sea while the Thane creek coming from the Arabian sea meets the Ulhas river. Thus, both, the creek and the estuary show the above mentioned three zones of salinity.

Two methods were used

1) *Quadrant method:*
   This was employed at every study station (1-12 Ulhas river estuary and 13-24 in Thane creek.) A 10mx 10m quadrant was drawn and the proportion of the plants in the quadrant was decided. Such 5 quadrants were studied to calculate average proportion.
2) *Visual estimation*:
   This was done from the boat while going from one station to another. The mangroves were observed through

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binoculars to get a rough estimate of the width of the mangroves belt, types of mangroves, damaging factors etc.

While presenting the data was consolidated zone wise Zone 1-riverine end, Zone 2- middle zone, and Zone 3- Seaward; each zone consisting of four study stations.

Abundance and types of mangroves, the associated plants and non halophytes were recorded by studying them in quadrants; various causes of damage were recorded and photographed during the visit.

RESULTS AND DISCUSSION

Results

Ong (1982) has commented, "The mangrove is nature's own aquaculture ecosystem with a number of advantages. The natural system is vastly more stable and less susceptible to diseases and epidemics". However, anthropogenic pressure from the rising population all over the tropics are seriously jeopardizing the coastal mangroves which provide the raw material for many purposes (Lenden and Jernelov, 1980). Nowadays the major cause of mangrove destruction is their clearing for agriculture & aquaculture and reclamation by solid waste dumping.

The present study was carried out along the Thane creek at four stations with different salinity conditions. Station 1 being upstream and close to the connection of the creek with Ulhas river estuary, experiences low average salinity. Station 4 on the seaward end has higher average salinity and the stations 2 and 3 have intermediate average salinity (Table Sl). For such environments three types of mangrove ecosystems are described 1) riverine mangroves (in river-dominated areas), 2) fringe mangroves (in tide-dominated areas) and 3) basin mangroves (in intermediate interior areas). Fringe mangroves receive the brunt of tidal action and basin mangroves have the greatest diversity in tree species.

Table1. 1 SL: Stationwise and seasonwise salinity (ppt.)

	stn1	stn2	stn3	stn4	Average
Premonsoon	31.2	17.62	13.67	31.98	23.61
Monsoon	16.09	20.76	18.25	30.8	**21.48**
Early post monsoon	17.89	25.7	29.7	31.26	**26.14**
Late post monsoon	23.63	27.22	10.08	33.42	23.59
Average	22.20	22.83	17.92	31.86	23.70
Minimum	16.09	17.62	**10.08**	30.8	
Maximum	31.2	27.22	29.7	**33.42**	
Std. Dev.	6.80	4.43	8.53	1.14	

According to Kothari and Singh (1998), there are true mangroves, mangrove associates, and non-mangrove halophytes that form the mangrove forest. The genus *Avecinnia* in the world is represented by eleven species (Chapman, 1970). While in India it is represented by three species *A. officinalis, A. alba, and A. marina* with its two varieties; *A marina var. marina, A. marina var. acutissina.* According to Macnae (1968), *Avicennia marina* is the only well known mangrove species, which can tolerate desert climate. During the period 1990-1995, Kothari and Rao (1990,91,95) reported 15 true mangroves, 2 semi- mangroves, 15 mangroves associates

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and 9 non-mangrove halophytes in Thane creek. Whereas later Kothari and Singh (1998) observed along the Thane creek the mangrove species *Avicennia marina var. acutissima,* as the most common and abundant species, *Avicennia officinalis, Bruguiera cylindrica, Rhizophora mucronata, Sonneratia apetala* and the mangrove associates *Acanthus ilicifolius, Aegiceras corniculatum, Cyperus spp., Aleuropus lagopoides, Derris trifoliate, Excoecaria agallocha.*

Discussion

In the present study of the mangroves 14 species of true mangroves, 12 species of mangrove associates, and 8 species of non-mangrove halophytes were recorded (Table 1).

In the Thane creek the mangrove *Avicennia spp.* are regularly denuded due to the infestation by larvae of moth *Hyblaea puera* .The pest preferred varieties of *A. marina* only. The infestation starts in the month of August/ September and lasts up to the month of October / November after which the moths disappear. The plants develop new foliage within a month. Apart from this, the mangroves of Thane creek are subjected to different other damage causing factors the main factor being the anthropogenic activity. The mangroves are regularly cut for fuel along the creek at all the selected stations or for acquiring land for aquaculture ponds along the Thane creek and the Ulhas river estuary at all the stations. In many places the damage has been caused by solid waste dumping which includes plastic polythene bags, foot wear, slippers, bulbs, tube lights, thermacol, plastic tins and cans. It gets entangled in the pneumatophores and becomes subjected to tidal fluctuations. All this material is non biodegradable that smothers the breathing roots harming the plants and damaging the mudflats. Reclamation of mudflat for road, bridge, building construction etc. is also another factor causing destruction. The damage is significant at places that are easily accessible either from the water front or the road side. All these factors have resulted in stunted growth or total absence of these mangroves from the mudflats.

The occurrence and diversity of mangroves recorded in the earlier studies was abundant, while in the present study it was clearly seen to be less in number with dwindling diversity.

To decide conservation strategies it is essential to regularly study the various ecological aspects of the mangrove ecosystems. Such studies have been undertaken in Vietnam (Hong, 1999), Thailand and Florida (Mangrove Action Plan, Quarto, 2000), and Australia where Australian Institute of Marine Sciences (AIMS) is engaged in regular documentation & studies on mangroves. These studies include assessment of the abiotic components like water, sediment and the biotic components like flora and fauna. Such studies reveal complex relationships between the different parameters and help in understanding health status of the ecosystem.

Studies on hydrological parameters provide us the first hand information about the metabolic events occurring in the water bodies (Quadros, 1995). They can also give us general idea regarding deterioration or improvement in the ecosystem, if the averages of long-term studies are compared with those in the past. Apart from the physical and chemical properties of water it is also important to study the life in water.

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Table2. List of True Mangroves and their zone wise occurrence

		Ulhas			Thane		
Genera	Family	Zone1	Zone2	Zone3	Zone1	Zone2	Zone3
Avicennia marina var. marina(Forsk)Vierh	Avicenniaceae	-	+	+++	+++	+++	+++
Avicennia marina var. acutissima (Forsk)Vierh		-	-	+++	+++	+++	+++
Avicennia officinalis (L)		-	+++	++	++	++	++
Aegiceras corniculatum (L)	Myrsinaceae	-	++	++	++	++	++
Bruguiera gymnorhiza (L)	Rhizophoraceae	-	+	+	-	+	-
Bruguiera caryophylloides (BL)		-	-	+	-	-	-
Ceriops decandra		-	-	++	-	-	-
Ceriops tagal (Perr.)Robin		-	-	-	-	+	-
Rhizophora apiculata		-	++	-	-	-	-
Rhizophora mucronata Lamk		-	++	-	-	-	-
Excoecaria agallocha (L)	Euphorbiaceae	-	-	++	++	++	++
Salvadora persica	Salvadoraceae	+++	+++	+++	+++	+++	+++
Sonneratia apetala Buch. Ham	Sonneretiaceae	++	+++	+++	+++	+++	+++
Sonneratia griffithi		+	++	-	++	++	-
Total number of species		3	8	8	7	8	5
Mangrove associates							
Acanthus ilicifolius	Acanthaceae	+++	+++	+++	+++	+++	+++
Calotropis gigantea	Asclepiadaceae	++	++	++	++	++	++
Clerodendrum inermae	Verbenaceae	++	++	++	++	++	++
Cressa critica	Scrophulariaceae	-	-	++	++	-	-
Derris trifoliate	Fabaceae	+++	+++	+++	+++	+++	+++
Derris uliginosa.		+++	+++	+++	+++	+++	+++
Fimbristylis feruiginea	Cyperaceae	+++	+++	++	+++	+++	++
Ipomoea spp.	Convolvulaceae	++	++	++	++	++	++
Pandanus odoratissimus	Pandanaceae	++	-	++	-	++	++
Porteresia coarctata (Roxh)	Poaceae	++	++	++	++	++	++
Thespesia populnea	Malvaceae	++	++	++	++	++	++
Urochondra setulosa	Poaceae	++	++	++	++	++	++
Total number of species		11	10	12	11	11	11
Non Mangrove Halophytes							
Aeluropus lagopoides	Poaceae	-	+++	+++	+++	+++	+++
Sesuvium portulacastrum	Aizoaceae	-	++	++	++	++	++
Suaeda maritime	Chenopodiaceae	-	-	++	-	++	-
Scirpus littoralis		++	++	++	++	++	++
Tamarix troupii	Tamaricaceae	-	+	-	+	+	-
Hibiscus spp.	Malvaceae	+	+	+	+	-	-
Cyperus spp.	Cyperaceae	++	++	++	+	--	-
Hygrophilla spinosa	Acanthaceae	+	+	+	+	+	-
Total number of species		4	7	7	7	6	3

+++ Abundant ++ Moderate + Few –Absent

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CONCLUSION

In general, the Ulhas river estuary, showed low mangrove diversity on the riverine and more diversity in zones 2 and 3.Thane creek has more diversity in the middle zone due to plantation efforts by Godrej. Cutting for fuel, solid waste dumping, reclamation for road or construction was the damaging factor common to both Thane creek and Ulhas river estuary. However, reclamation for agriculture and sand landing centers, cutting for fuel were predominant along Ulhas river estuary, while, reclamation for fish aquaculture, solid waste dumping were the significant factors for the Thane creek. In spite of favorable water conditions for mangrove growth in Ulhas river estuary, it had comparatively lesser mangrove cover along its banks (1.5 sq.km.) than the Thane creek (2.5 sq.km.). It was observed that the mangrove cover in both the ecosystems was rapidly declining due to various anthropogenic activities. Conservation of mangroves needs to be done on top priority basis.

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