

## Floral survey of wet coastal and associated ecosystems of Maharashtra

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Received 1 December 2009; revised 3 December 2010

Maharashtra coast is 720 km long stretch interrupted with about 45 estuaries. There is formation of different types of habitat on this coastline. Each one is ecologically unique and inhabits some specific floral components. Present paper reports occurrence of different plant species in the habitat like sandy beach, sand dune, encroached mangrove land, areas along the mangroves and mangrove swamps. Mangrove species are well documented and therefore excluded. There are 33 trees, 118 herbs, shrubs, climbers and 12 species with restricted distribution on the coast of Maharashtra.

[**Keywords:** Mangrove, Sand dune, Wet coastal ecosystems, Floral survey, Beach.]

### Introduction:

The mangrove vegetation of India is relatively well known and well documented<sup>1</sup>. However, number of new additions have been made by Bhosale<sup>2</sup> and Bhosale *et. al.*<sup>3</sup> in case of mangroves and mangrove associates of Maharashtra. Kothari<sup>4</sup> has taken a review of mangrove floristic of North West coast of India. He has mentioned the work right from Blatter<sup>5</sup> to Kothari and Singh<sup>6,7</sup>. Recently, some of the new mangrove associates are reported by Gokhale and Chavan<sup>8</sup>.

But, there is a gap in floristic work on mangrove associates and other plant species growing in the mangrove associated ecosystems of Maharashtra. As far as east coast is concerned, considerable attention on this aspect has been paid by Naskar and Guhabakshi<sup>9</sup>, Dagar and Singh<sup>10</sup>.

While dealing with mangrove associates and other species growing in associated ecosystems, there are two approaches; one is screening for salt tolerant species and another is screening for floristic. Number of estuaries of Maharashtra are suffering from encroachment by bund construction<sup>11</sup>. Encroached land can not support the agriculture. As a result of this, there is formation of different micro-geographic areas supporting the growth of different plant species. Some plants are economically important while some are ecologically important. Therefore, during present work an attempt has been made to screen number of

micro-geographic areas along the estuaries and coast of Maharashtra. For this purpose five different types of habitats were considered *viz.* Sand dune, sandy beaches, encroached mangrove lands, areas along the mangroves and mangrove swamps.

### Material and Methods:

Maharashtra has a coastline of 720 Km, 45 estuaries and mangrove area of more than 138 Sq. Km. The coast is either sandy or rocky. Generally the rocky coast harbors algal growth. Sandy beaches and sand dunes show presence of some characteristic species. As a result of encroachment, there is formation of encroached land. It is supporting the growth of some typical plant species. Areas along the mangroves are inundated periodically and show presence of some peculiar plant species. Some of the associates are directly growing on mangrove swamps.

Estuaries in Maharashtra were visited frequently from June 1999 to October 2009 to document plant species growing in all types of habitats. Their ecological status is recorded. For identification purpose authentic literature is used<sup>1,12,13,14, 15,16,17</sup>. Salt tolerance of the species was examined<sup>10,18</sup>.

### Results and Discussion:

Mangroves of Maharashtra are well documented and well studied even for IUCN status<sup>2</sup>. Therefore, these are excluded. Other species are categorized into

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two classes i. e. woody species and herbaceous, climbers as well as shrubby species.

A list of woody species is given in Table 1. Ecological status, habitat distribution, salinity tolerance and regeneration capacity in these ecosystem is also mentioned. It is to be noted here that the trees which are rare in occurrence showing rare regeneration in these ecosystems. While, generally the common and frequent species are having salt tolerance and show regeneration in these areas. Therefore, a group of woody trees occurring rarely may possibly salt sensitive and can be considered as indicators of human encroachment. As fully grown trees can tolerate the saline environment and survive

but they can not leave potential descendents behind. It is indicative of the sensitivity of seeds and seedlings to the salts. Another group exhibits the salt tolerance and inhabits wide micro-geographic areas and most of the species in this group are able to regenerate in these ecosystems. Among the woody trees recorded *Syzygium*, *Catunaregam*, *Morinda*, *Alstonia* are medicinally important. *Zanthoxylum*, *Colubrina*, *Calophyllum* yield essential oils and oils. While species like *Barringtonia*, *Gmelina* provides good quality timber. Therefore, all these are minor plant resources of coastal Maharashtra.

Table 2 indicates herbaceous and climbing as well as shrubby species growing in mangroves and

Table 1—List of trees (other than mangroves) occurring in different habitats in and around the estuaries of Maharashtra.

Sr. No.	1	2	3	4	5	6
1	<i>Acacia auriculiformis</i> A. Cunn.	Cu	2,3	+	Occasional	Fuel
2	<i>Alstonia scholaris</i> (L.) R.Br.	R	4	-	-	Medicine
3	<i>Anacardium occidentale</i> L.	O	1,2		Occasional	Fruit
4	<i>Barringtonia acutangula</i> (L.) Garetn.	R	3	-	Frequent	Fuel
5	<i>Calophyllum inophyllum</i> L.	C	1,2,3	+	Common	Fuel, medicine
6	<i>Casuarina equisetifolia</i> J.R.& G. Forst.	Cu	1,2	+	Rare	Fuel, sand binder
7	<i>Catunaregam spinosa</i> (Thunb.) Tirveng.	R	4	-	-	Medicine
8	<i>Cerbera odollum</i> Gaerth.	R	4,5	-	Rare	Fuel
9	<i>Colubrina asiatica</i> (L.) Brongn.	O	2,3,4	+	Rare	-
10	<i>Dolichandrone spathacea</i> Sch.	R	3	+	-	Fuel
11	<i>Erythrina indica</i> Lamk.	R	3,4	-	Rare	-
12	<i>Ficus arnottina</i> Miq.	R	2, 4	-	Rare	-
13	<i>Ficus benghalensis</i> L.	O	2,4	-	-	Timber
14	<i>Ficus glomerata</i> Roxb.	R	4	-	-	Medicine
15	<i>Ficus religiosa</i> L.	R	4	-	-	Religious
16	<i>Gmelina arborea</i> Roxb.	R	4	-	-	Timber
17	<i>Gliricidia sepium</i> (Jacq.) Kunth. ex Steud.	Cu	1,2	-	Occasional	-
18	<i>Glochidion zeylanicum</i> var. <i>nitidum</i> Hook. F.	R	3,4	-	-	-
19	<i>Hibiscus tiliaceus</i> L.	C	2,3,4	+	Rare	Fuel
20	<i>Macaranga peltata</i> (Roxb.) Muell. Arg.	R	3	-	Rare	-
21	<i>Morinda citrifolia</i> L.	O	2,3,4	+	Rare	Medicine
22	<i>Morinda pubescens</i> Sm.	R	4	-	-	Medicine
23	<i>Pongamia pinnata</i> (L.) Pierre.	C	1,2,3,4	+	Frequent	Oil, fuel
24	<i>Salvadora persica</i> L.	F	4,5	+	Occasional	Medicine
25	<i>Sapindus laurifolius</i> Vahl	R	4	-	-	Saponins
26	<i>Strychnos nux-vomica</i> L.	O	2,3,4	-	Occasional	Medicine
27	<i>Syzygium caryophyllatum</i> (L.) Alst.	C	3,4	-	Occasional	Fruits, fuel
28	<i>Syzygium cumini</i> (L.) Skeels	R	3,4	+	Rare	Fruits
29	<i>Tamarix gallica</i> L.	R	3,4,5	+	Rare	-
30	<i>Terminalia catappa</i> L.	R	2	+	Rare	Fuel
31	<i>Thespesia populnea</i> (L.) Soland. Ex Corr.	C	1,2,3,4	+	Occasional	Fuel, fibers
32	<i>Zanthoxylum rhetsa</i> DC	R	4	-	-	Spice, medicine
33	<i>Ziziphus mauritiana</i> Lamk.	R	3,4	+	Rare	Fruit, fuel

1. Name of the species

2. Ecological status ( R –rare, O-occasional, F- frequent, C- common Cu - cultivated)

3. Habitat ( 1-sand dune, 2- sandy beach, 3-encroached mangrove land, 4-along the mangroves, 5- on mangrove land)

4. Salt tolerance ( + : reported, - : not reported)

5. Regeneration in wet coastal ecosystems under study.

6. Economic use by local inhabitants.

Table 2—List of herbs, shrubs and climbers occurring in coastal ecosystems.

Sr. No.	Name of the species	Ecological status	Habitat	Salt tolerance
1	<i>Acheranthes aspera</i> L.	R	2	+
2	<i>Achroscopicum aureum</i> L.	F	3	+
3	<i>Aegeratum conyzoides</i> L.	O	2,3	+
4	<i>Alternanthera tentela</i> Colla.	R	2,3	-
5	<i>Alysicarpus bupleurifolius</i> (L.) DC	O	3	-
6	<i>Bacopa floribunda</i> (R. Br.) Wettst.	R	3	+
7	<i>Blyxa aubertii</i> L. Rich.	R	3	+
8	<i>Boerhavia diffusa</i> L.	O	1,2,3	+
9	<i>Brennia retusa</i> (Dennst.) Alston.	O	4	+
10	<i>Caesalpinia bonducella</i> (L.) Fleming	O	2	+
11	<i>Caesalpinia crista</i> L.	C	3,4,5	+
12	<i>Calotropis gigantea</i> (L.) R. Br.	O	1,2,3,4	+
13	<i>Calotropis procera</i> (Ait.) R. Br.	O	1,2,3,4	+
14	<i>Calycopteris floribunda</i> (Roxb.) Poir	R	3,4	-
15	<i>Canavalia maritima</i> (Aubl.) Thou.	O	2,3,4	+
16	<i>Carissa carandas</i> Grah.	R	4	+
17	<i>Cassia obtusifolia</i> L.	O	2,3	-
18	<i>Cassia tora</i> L.	O	2,3	+
19	<i>Cayratia trifolia</i> L.	C	1,2,3,4	-
20	<i>Centella asiatica</i> (L.) Urb.	O	3	+
21	<i>Centranthera indica</i> (L.) Gamble.	R	3	-
22	<i>Ceratopteris thalictroides</i> (L.) Brong.	F	3	-
23	<i>Cleome viscosa</i> L.	O	3	-
24	<i>Clerodendrum inerme</i> (L.) Gaertn.	C	2,3,4,5	+
25	<i>Clitoria ternatea</i> var. <i>ternatea</i> L.	R	3	-
26	<i>Crinum defixum</i> Ker-Gawl.	R	3,4	+
27	<i>Crotalaria striata</i> DC	O	3,4	-
28	<i>Crotalaria verrucosa</i> L.	C	2,3,4	-
29	<i>Cryptolepis buchananii</i> Roem. And Schult	F	2,3	-
30	<i>Cucumis melo</i> var. <i>agrestis</i>	R	2,3	-
31	<i>Pergularia daemia</i> (Forssk.) Choiv.	F	1,2	+
32	<i>Datura alba</i> Nees	R	1,2,3	-
33	<i>Derris heterophylla</i> Willd.	C	3,4,5	-
34	<i>Derris scandens</i> (Roxb.) Benth.	O	3,4	-
35	<i>Derris trifoliata</i> Lour.	C	3,4,5	+
36	<i>Dioscorea bulbifera</i> L.	R	3,4	-
37	<i>Drimia indica</i> (Roxb.) Jessop	F	1,2	-
38	<i>Drosera indica</i> L.	F	3	-
39	<i>Eclipta alba</i> (L.) Hassk	O	3	+
40	<i>Emilia sonchifolia</i> (L.) DC	O	3	-
41	<i>Epaltes divaricata</i> (L.) Cass.	O	2,3	-
42	<i>Eupatorium odoratum</i> Roxb.	O	1,2,3	-
43	<i>Euphorbia hirta</i> L.	O	3	+
44	<i>Geissaspis cristata</i> Wight & Arn	O	1,2,3,4	-
45	<i>Gloriosa superba</i> L.	F	3,4	+
46	<i>Halophila beccarii</i> Aschers.	O	5	+
47	<i>Helicteres isora</i> L.	R	3	-
48	<i>Heliotropium indicum</i> L.	O	2	+
49	<i>Hemidesmus indicus</i> (L.) R. Br.	F	2,3	+
50	<i>Holarrhena antidysenterica</i> (Roth.) A. DC.	R	3	+
51	<i>Hygrophila schulli</i> (Buch.-Ham.) M. R. and S. M. Almeida	F	3,4	-
52	<i>Ipomoea aquatica</i> Forssk.	R	3	+
53	<i>Ipomoea fistulosa</i> Mart. ex Choisy	O	2,3	-
54	<i>Ipomoea pes-caprae</i> (L.) Sweet	C	1,2,3,4	+

(Contd.)

Table 2—List of herbs, shrubs and climbers occurring in coastal ecosystems.(Contd.)

Sr. No.	Name of the species	Ecological status	Habitat	Salt tolerance
55	<i>Ixora coccinia</i> L.	O	3	-
56	<i>Jatropha curcas</i> L.	O	2,3	+
57	<i>Jatropha gossipifolia</i> L.	R	1,2,3	+
58	<i>Justicia simplex</i> D. Don.	O	3	+
59	<i>Lantana camara</i> L.	O	2,3	+
60	<i>Launaea sarmentosa</i> (Willd.) Sch. Bip.	C	1,2	+
61	<i>Leea indica</i> (Burm. f.) Merr.	C	1,2,3	-
62	<i>Leucas aspera</i> (Willd.) Link.	F	3	+
63	<i>Lindernia anagallis</i> (Burm. f.) Pennell.	F	3	-
64	<i>Lindernia antipoda</i> (L.) Alst.	R	4,5	+
65	<i>Ludwigia perennis</i> L.	F	2,3	+
66	<i>Luffa acutangula</i> var. <i>amara</i> (Roxb.) Clarke.	F	4	-
67	<i>Lygodium flexuosum</i> (L.) Sw.	R	4	-
68	<i>Marselia minuta</i> L.	R	3	+
69	<i>Mazus rugosus</i> Lour.	F	3	-
70	<i>Mukia maderaspatana</i> (L.) Roem.	O	1,2,3	+
71	<i>Mimosa pudica</i> L.	O	1,2,3	-
72	<i>Mollugo oppositifolia</i> L.	O	3	-
73	<i>Monochoria vaginalis</i> (Burm. f.) Presl	R	3	+
74	<i>Mucuna pruriens</i> (L.) DC.	O	2,3,4	-
75	<i>Murdania nudiflora</i> (L.) Brenan.	O	1,2,3	-
76	<i>Murdania spirata</i> (L.) Brueckn.	O	3	-
77	<i>Murdania vaginata</i> (L.) Brueckn.	O	3	-
78	<i>Najas</i> L.	R	3	+
79	<i>Nesaea lanceolata</i> (Heyne ex Clarke) Koehne.	R	2,3	-
80	<i>Nymphaea nouchali</i> Burm. f.	O	3	+
81	<i>Ocimum gratissimum</i> L.	R	2	-
82	<i>Odina wodier</i> Roxb.	F	3	-
83	<i>Hedyotis herbacea</i> L.	F	2,3	-
84	<i>Oxalis corniculata</i> L.	O	2,3	+
85	<i>Pandanus fascicularis</i> Lam.	F	2,3,4	+
86	<i>Passiflora foetida</i> L.	O	3,4	-
87	<i>Pedaliium murex</i> L.	F	1,2	-
88	<i>Phyllanthus amarus</i> Schum and Thonn.	R	2,3	-
89	<i>Portulaca oleracea</i> L.	R	3	+
90	<i>Premna obtusifolia</i> R. Br.	F	2,3,4	-
91	<i>Rhamphicarpa longiflora</i> (Arn.) Bth.	O	3	-
92	<i>Ricinus communis</i> L.	O	1,2,3	+
93	<i>Rostellularia japonica</i> (Thunb.) Ellis.	O	2,3	-
94	<i>Ruppia aritime</i> L.	O	3	+
95	<i>Sapium insigne</i> (Royle) Benth.	F	3	-
96	<i>Sesamum mulayanum</i> Nair.	R	2	-
97	<i>Sesbania bispinosa</i> (Jacq.) Wight	R	2,3	+
98	<i>Sesuvium portulacastrum</i> L.	R	3	+
99	<i>Sida acuta</i> Burm. F.	O	2,3	-
100	<i>Smilax zeylanica</i> L.	R	2,3	-
101	<i>Sopubia delphinifolia</i> (L.) G. Don	O	3	-
102	<i>Spermacoce ocymoides</i> Burm. F.	R	3	-
103	<i>Spermacoce pusilla</i> Wall.	R	3	-
104	<i>Spermacoce articularis</i> (L. f.) F. N. Williams	R	3	-
105	<i>Sphenoclea zeylanica</i> Gaertn. Fruct.	R	3	-
106	<i>Spinifex littoralis</i> (Burm. F.) Merr.	C	1,2	-
107	<i>Suaeda aritime</i> Dumort.	R	2,3	+
108	<i>Tephrosia purpurea</i> (L.) Pers.	O	3	-
109	<i>Tricholepis amplexicaulis</i> C. B. Cl.	O	2,3	-

(Contd.)

Table 2—List of herbs, shrubs and climbers occurring in coastal ecosystems.(Contd.)

Sr. No.	Name of the species	Ecological status	Habitat	Salt tolerance
110	<i>Trichosanthes cucumerina</i> L.	O	2,3	+
111	<i>Trichosanthes tricuspoidata</i> Lour.	R	4	-
112	<i>Tridax procumbans</i> L.	O	1,2,3	+
113	<i>Tylophora asthamatica</i> (L. f.)	F	3,4	+
114	<i>Utricularia reticulata</i> Sm.	O	3	+
115	<i>Utricularia stellaris</i> (L. f.) Taylor	R	3	+
116	<i>Vitex nigundo</i> L.	C	1,2,3,4	-
117	<i>Vitex trifolia</i> L.	C	1,2,3,4	-
118	<i>Zyzyphus rugosa</i> Lamk.	O	2,3,4	-

Ecological status (R –rare, O-occasional, F- frequent, C- common) Habitat (1-sand dune, 2- sandy beach, 3-encroached mangrove land, 4-area along the mangroves, 5- on mangrove land) Salt tolerance (+ : reported, - : not reported)

Table 3—List of plants having restricted distribution and their threats.

Sr. No.	Name of the Species	Occurrence	Threats
1	<i>Alstonia scholaris</i> (L.) R. Br.	Along the bunds	Construction and repairs of bunds, habitat destruction.
2	<i>Blyxa aubertii</i> A. Rich.	Shallow water in encroached mangrove land during rains	Encroachment of human and reclamation of land.
3	<i>Cerbera odollum</i> Gaerth.	Landward sites in fringing mangroves	Cutting and felling
4	<i>Halophilla beccarri</i> Aschers.	Basin type mangrove swamps mainly under <i>Sonneratia</i> and <i>Avicennia</i> .	Collection of bivalves, mollusks etc. in the habitat.
5	<i>Lindernia antipoda</i> (L.) Alst.	Elevated mangrove swamps during rains	Human interference on mangrove soils
6	<i>Monochoria vaginalis</i> (Burm.f.) Pers.	Shallow ditches in encroached land with fresh water input, generally in shade.	Encroachment of human and reclamation of land.
7	<i>Morinda pubescens</i> Sm.	Along the bunds	Construction and repairs of bunds, habitat destruction.
8	<i>Najas</i> L.	Deep water in encroached mangrove land near fresh water input.	Encroachment of human and reclamation of land.
9	<i>Ruppia maritima</i> L.	Deep water in encroached mangrove land during rains	Human encroachment.
10	<i>Sesuvium portulacastrum</i> L.	Open mangrove swamps	Habitat modification.
11	<i>Tamarix gallica</i> L.	On the open mangrove lands and canopy gaps	Habitat modification
12	<i>Utricularia stellaris</i> L. f.	Deep ditches in encroached mangrove land with continuous supply of freshwater, during rains	Cut off of freshwater input.

associated ecosystems. Among the species recorded for the coast of Maharashtra, some are having salt tolerance and included in the standard literature of salt tolerant plants<sup>10,18</sup>. Characteristically the species which are having salt tolerance are wide in distribution along the coast of Maharashtra. The species which occur only in encroached mangrove land and along the mangroves, typically distributed in most of the estuaries of Maharashtra having human interference. Therefore, these should be considered as indicator species of human encroachment. These species complete their life cycles during rainy season but the propagules or desseinules remain in the soil throughout the year. Therefore, there is sufficient ground to screen these species for salt tolerance.

Among the species recorded, some have restricted distribution on Maharashtra coast. The type of micro-habitat they inhabit is also unique. The list is depicted in Table 3. Among these species *Blyxa aubertii*, *Monochoria vaginalis*, *Morinda pubescens*, *Cerbera odollum*, *Utricularia stellaris* and *Tamarix gallica* are very rare and require typical ecological conditions as described in Table 3. Occurrence of *Suaeda maritima* is reported by Bhosale<sup>19</sup> and Kothari<sup>4</sup>. It is rare on the coast of Maharashtra, restricted mainly in the northern districts.

The plants including *Clerodendrum inerme*, *Caesalpinia crista*, *C. bonducella*, *Derris scandens*, *Lygodium flexuosum*, *Eclipta alba*, *Murdania nudiflora*, *Calotropis gigantia*, *C. procera*, *Ipomoea*

*fistulosa*, *Drimia indica*, *Gloriosa superba*, *Thespesia populnea*, *Morinda citrifolia*, *M. pubescens*, *Pongamia pinnata*, *Boerhavia diffusa*, *Mukia maderaspatana* have wide ecological amplitude. These plants can grow under varied ecological conditions as halophyte or glycophyte species. Therefore, these are potential species in restoration programme for coastal habitats.

*Eupatorium* is appearing on the coast from last four years. It is one of the well known invasive weed. Occurrence of *Sphenoclea zeylanica* is also recent at few sites.

The coastal population depends on these plant resources for a variety of food, honey, fodder, fuel-wood, medicine and some other needs. Some of the castes and tribes are solely depend for their survival on these ecosystems. Rather these are part and parcel of these ecosystems. With the scenario of ever-increasing population and the need for increased crop production, the salt dominated habitats have to be used for tree plantation and non-conventional crops of economic value. Many halophytes combine high biomass and high protein or mineral levels with outstanding ability to a wide range of environmental stresses. Stabilization of population and climate can be achieved by redesigning irrigated agriculture, restoration of ecology by judicious management of degraded natural ecosystems and biodiversity conservation.

#### Acknowledgement

Authors are grateful to Prof. G. B. Dixit, Head, Department of Botany, Shivaji University, and Kolhapur for providing necessary facilities and encouragement and Prof. S. R. Yadav, Department of Botany, Shivaji University, Kolhapur for his valuable help in identification as well as confirmation of species.

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