Ecological Assessment and Education for Conservation of Mangrove Community in Ratnagiri District Of Maharashtra

MFF (INDIA) SMALL GRANT PROJECT

FINAL REPORT

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Project Summary

The project represents conservation issues of mangroves in the Ratnagiri District of Maharashtra. The area is well known for its dense mangroves yet not studied in detail till present. During the last 25 years, about 40% reduction in the mangrove cover of Maharashtra has been due to human interference. Recently, various industries including power project are set to be developed in this region. In light of these developments, it is needed to undertake a comprehensive assessment of mangrove habitats of this region along with awareness for conservation and improvement of degraded mangrove ecosystems along these coasts.

The project aimed towards detailed documentation of existing ecological status, as well as potential threats of mangrove plant community in Ratnagiri District of Maharashtra. It also attempts the empowerment of local community for conservation of mangroves through awareness generation and education programmes.

Surveys were conducted in the selected sites to analyse parameters such as species richness, community structure, and species distribution pattern across biotic and abiotic factors. Based on these data the maps will be produced. The reports thus produced will be circulated in relevant circles.

The other objective is to generate awareness among various target groups regarding status and conservation of mangroves. Target group – specific education programmes will be conducted. Similarly, meetings with stake holders and Village Governing Bodies will be conducted to create platform for sharing their experiences and problems encountered in conservation of mangroves.

As part of this objective a demonstration plot will be developed with people's participation for restoration of mangrove areas. Around 10,000 saplings will be raised in nursery. It is expected that at least four acres of suitable land will be restored with mangrove plantation. The volunteers will be involved in monitoring of these plantations.

This programme is an effort to reduce the ignorance about mangroves in Maharashtra in scientific circles as well as local communities. It is a short term activity to make a visible difference towards conservation, however will certainly empower people to value the importance of mangroves and try to reduce incidental destructions at least under their control.

1. Introduction

Background:

Majority of the mangrove forests of Maharashtra have vanished due to anthropogenic pressures in the recent years. During the last 25 years, about 40% reduction in the mangrove cover of Maharashtra has been due to human interference. Wood felling and habitat conversion under tremendous pressure of urbanization and industrialization are the two major threats observed for the mangroves of Maharashtra. Pollution of the rivers and creek water due to the industrial and sewerage discharge is another serious factor along the coastal belt of Maharashtra.

At least fifteen proposed coal-fired power projects equaling 25 GW of power are set to be built on a narrow strip of coastal land 50 to 90 km wide and 200 km long. Power plants require their own captive ports for the transport of raw material. Thus there are number of minor ports proposed to come up in this area. Needless to say that ancillary development bound to take place which is not necessarily envisaged in the proposed project impacts. Besides, thermal power plants and minor ports and jetties, the coastal areas are dotted with numerous aquaculture farms which have come up at the cost of mangroves and most probably without any legal clearances. Unfortunately, lot of coastal mangrove areas in Konkan are privately owned thus it is not surprising to find many of these areas are easily available for sale. Western Ghat areas of Konkan are now witnessing mining activities as well. There are already few operational mines. Number of new mines are proposed in these areas.

Coastal tourism is catching up very fast in the coastal Konkan. Number of coastal resorts have come up in this region of which one or two resorts are in total violation of Coastal Regulation Zone. It is evident from the baseline survey carried out by BNHS (Apte & Bhave 2010), that if

looked in totality, there is not a single sq km area free of impact in the stretch of about 200 km of coastal Konkan from Dabhol to Sindhudurg.

In light of these developments, it is needed to undertake a comprehensive assessment of mangrove habitats of this region. The most crucial problem in future years will be not simply the protection of mangrove vegetation but creation of a potential habitat for their conservation. Thus awareness for conservation and Improvement of degraded mangrove ecosystems along these coasts are necessary not only because of its environmental concern but its contribution in the health of the coastal communities.

To address some of these issues, the project was designed on following objectives:

1. Documentation of ecological status of mangrove plant community in Ratnagiri District of Maharashtra.
2. Awareness generation and education for conservation of mangroves.

Outputs	**Key Activities**	**Deliverables/Responsibility**
Objective # 1 - Documentation of ecological status of mangrove plant community in Ratnagiri District of Maharashtra.		
(a) Detailed reports on the ecological assessment of mangrove plant community.	(i) Pilot surveys to select sites to conduct systematic ecological studies.	➢ Suitable sample size selected to represent the mangroves of entire district.
	(ii) Surveys conducted to the selected sites to analyse parameters such as species richness, community structure, and species distribution pattern across biotic and abiotic factors.	➢ Maps of all mangrove areas and plant species therein. ➢ Dissemination of results in scientific as well as local communities.
Objective # 2 – Awareness generation and education for conservation of mangroves.		
(a) Raised levels of awareness among	(i) Development of education resource materials	➢ Dissemination of locale-specific information on

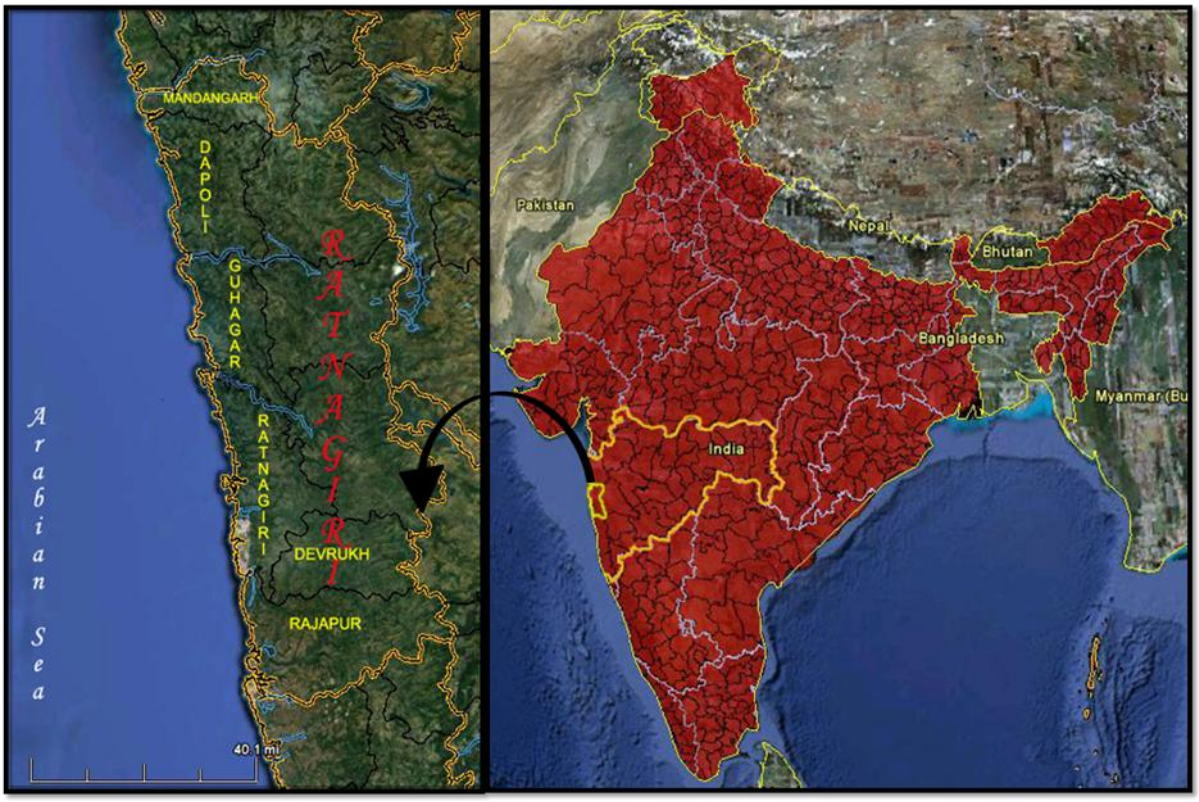
the local people about their mangrove resources and present threats.		mangroves based on first hand data from ecological surveys conducted.
	(ii) Education programmes for school children and teachers	➢ Students and teachers from at least 15 schools benefitted ➢ Integration mangrove related activities and education materials into curriculum
	(iii) Awareness programmes for villagers	➢ At least 15 villages benefitted
	(iv) Meetings with village governing bodies	➢ Assured cooperation and participation from VGB
(c) Development of demonstration plot for restoration of mangrove areas with people's participation.	(i) Development of mangrove nursery	➢ Around 10,000 saplings raised
	(ii) Plantation on the selected degraded mangrove areas	➢ Around 4 acres of land restored
	(iii) Maintenance and monitoring of plantations	➢ Monitoring reports

2. Study Area

Geography

Konkan constitutes a narrow coastal belt between the western mountain range, the Western Ghats, and the Arabian Sea. It stretches about 720 km from the River Tapi in the north up to the River Terekhol in the south and encompasses six districts *viz.* Thane, Greater Mumbai, Mumbai, Raigad (former Kolaba), Ratnagiri and Sindhudurg. The coastal zone of Maharashtra extends from 15°43'N and 20°10'N and longitude between 72°39'E and 73°30'E. The coastline is indented by numerous river mouths, creeks, small bays, headlands, sandy and rocky beaches, promontories, cliffs etc. (Mahabale, 1987). In the north of Mumbai it is wide up to 100 km, which gradually decreases towards south and near Vengurla, it is hardly 40 km. The coast is indented with number of beaches, 15 rivers, 5 major estuaries and over 30 backwater regions (Jagtap *et al.*, 1994). The total area of all the coastal districts is 30645.5 Km^2 comprising built up land (1.58%), agricultural (44.14%), forests (19.48%), wastelands (28.72%), water bodies (4.13%) and land under grasslands, mining areas and saltpans (1.95%) (Khire, 1996).

Administratively, it consists of 9 sub-divisional (Taluka) out of which five, namely, Mandangad, Dapoli, Guhagar, Ratnagiri and Rajapur are the coastal Talukas (Map 1). The boundaries of these Talukas are embossed with creeks and rivers most of them running parallel to each other in East – West direction (Map 1). Rising from the Sahyadrian scarp these streams drain the waters to the Arabian Sea through a region that is hilly and mostly bare. Their basins, accordingly, are narrow and rocky. Only the estuarine portions have comparatively good soils, and they indeed form agriculturally the best lands of the district, for example, the Vasishthi and the Shastri estuaries. Each of these creeks is fringed with mangrove patches which in some cases are extended even up to the off shore Talukas. A satellite imagery study carried out (Maharashtra Remote Sensing Authority report) depicts that Ratnagiri district has app. 40 sq. km of its area under mangrove cover.



Map 1 Location and coastal Tehsils of Ratnagiri District.

To the west of Sahyadrian and sub-Sahyadrian region of the Ratnagiri district, the hilly landscape opens out to form an undulating aspect which is called plateau surface deeply notched by the parallel flowing streams and their tributaries. Practically most of this surface belongs to the low level laterite that offers a bare and bleak appearance due to the destruction of earlier vegetation. This monotony in landscape is relieved only along the deeply entrenched stream courses where meandering sweeps create alluvial patches. On these, intensive rice cultivation and cocoanut and betel-nut gardening are practised and that gives the landscape a verdant appearance. The majority of the villages dot along these courses and most of them consist of strings of homesteads succeeding in one field and another. Population is essentially agricultural.

The chief hills of the district are the Sahyadris. Most of the hilly area is located at eastern part of the study area. The hilly terrain having typical northern Western Ghat appearance

characterized by tall forest at foothills, thick patches of vegetation around streams and rivers and more stunted and scrubby forest at peaks (Maharashtra State Gazetteers 1962).

Geology

The geology of the entire district consists of dark-coloured volcanic lava flows and laterites. These are spread out in the form of horizontal sheets or beds and constitute the innumerable spurs, hills and hill ranges; bold, flat topped ridges; lofty peaks and plateaus with impressive cliffs. The basalts are usually dark grey to grey and bluish grey in colour and are hard, compact and tough and fine to medium grained in texture. They generally form the hill tops, plateau and cliffs and show well-developed characteristic columnar and prismatic jointing.

Beds of laterite, usually formed by the mechanical and chemical disintegration brought about by the atmospheric agencies on the underlying trap. They are also found at places in the lower regions. The rocks are soft and show bright colours when freshly cut but become very hard and dull on exposure to atmosphere. The outer surface of the beds present a dark to dirty brown colour and a very rugged and pitted appearance. The traps on weathering give rise to a greyish to dirty green, friable murum which on decomposition and decay yield a rich and fertile reddish-brown to coffee brown and black soil, it is primarily found on northern part of district. The laterite on disintegration gives rise to a dusty, reddish to reddish-brown soil; this kind of soil is predominant in southern part of district (Maharashtra State Gazetteers 1962).

Soil

The soils of Konkan are mainly of alluvial and residual types. The residual soil occurs on the hilltops or slopes while alluvial is seen along the river valleys. Lateritic soil is formed in the hilly upland where the rainfall is more than 200 cm, which is rich in Fe, Al, Ti. Nevertheless, it is devoid of lime and poor in organic matter. Soil is lateritic in the south Sindhudurg and Ratnagiri districts.

Drainage

The major estuaries and rivers traversing through the district are:

Vasishti.

The Vasishthi running parallel to the Savitri has an course of about 30 miles and is the most important river of the district from the point of view of length and navigational facilities. Its source Waters rise in the Tivra section of the Sahyadris. In its mountainous course, it develops a narrow and steep profile. On reaching the plain tract, it develops a meandering course. Here the river becomes tidal. It is at this point that the commercial town of Chiplun is situated. Below the island of Govalkot, the river widens in sweeping meanders and after a course of 25 miles through low mud banks and mangrove, it reaches the sea in the shape of a shallow estuary that is arked by promontories on either side. As with the Savitri the estuarine mouth on the Vasishthi has a sandbar that reduces the navigational advantage of the river. On the southern headland of the estuary stands the old fort of Anjanwel, and on the north, the once famous port of Dabhol. Situated on a narrow strip .of low ground between the creek and the neighbouring steep hill, the present appearance of Dabhol hardly suggests its former greatness. During stormy weather condition, Dabhol offers a better anchorage, to the small sailing craft than Anjanwel, but all the same both these ports are essentially fair weather ports with a limited advantage.

Jagbudi.

The Jagbudi, the principal tributary of the Vasishthi on the north, rises near the Hatlot pass of the Sahyadris. In its first 12 miles, the, stream runs almost from north to south, and there develops a sharp bend to flow westwards for the next 12 miles and again resumes its southward trend till it joins the Vasishthi. These sharp, almost right angled, bends of the river are suggestive of drainage intricacies of the Konkan coastlands. Where the river becomes tidal about 12 miles upstream-is situated the local commercial and administrative centre of Khed. Several smaller tributaries are received by the Vasishthi on either bank, only some of the larger

ones I being tidal are useful for navigation. The passage in the smaller stream is obstructed by mud-banks and mangroves.

Shastri

South of the Vasishthi River, the Shastri flows from the east to the west. And drains a part of the district. It takes its source waters in the Sahyadris near the Prachitgad fort and has a total length of about 40 miles when, it meets the sea in an estuary, the adjoining 8 promontory of which supports the Jayagad fart. The first 16 miles of the river belong to a steep mountainous tract. Where the river i. leaves this tract to enter the coastland is situated the taluka towns of Sangameshwar. Below this town the river is joined by the tributary stream of Bav, and has a generally northwesterly trend right up to the sea. The river is tidal up to Sangameshwar. Of the several small tributary streams, the Bav is the more important. Rising in the Sahyadris near the

Amba pass the Bav develops a fertile valley and joins the Shastri an the left bank about 20 miles upstream the main river. On the Right Bank of the Shastri, the Gandhi is the main tributary. The estuary of the Shastri has a broad but shallow aspect. Though Jayagad is a good port for the smaller craft, the sandbar across the Shastri mouth presents difficulties.

The river is tidal up to Sangameshwar, but its navigability. is severely limited by the shallow waters, and silted reaches. Similarly the Gandhi and the Bav have a very limited navigational advantage. The Shastri can be forded at four important places between Tavasal and Laiegan, between Jambhari and Kudli, between Phangas and Dingne; and between Sangameshwar and Asurda. The Bav is usually fordable at Vandri and Parchuri.

Ratangiri

Twenty-five miles south of the. Shastri lies the Ratnagiri River. Rising in the Amba pass, it has a course of about 40 miles. At its mouth this stream is narrow and has a sandbar. On the north, lies the promontory on which stands the old fort of Ratnagiri. The mouth offers anchorage only to small craft, which can go upstream up to about 12 miles with the tide. The river is crossed by ferries at two points.

Muchkundi

The Muchkundi rises in the heights of Machal in the Sahyadrian range, near Prabhanavli, and flows parallel to the Ratnagiri, to its south, to empty its waters into the Purangad creek. It is navigable for about twelve miles upstream, and on its northern bank stands on a bluff the fort of Purangad.

Jaitapur

South of the Muchkundi, the land is drained by the Jaitapur river which taking its source waters from the Anaskura tract of the Sahyadris, develops first a south-westerly course far nearly two-third of its length, and then takes a due, westward turn to join the sea in the Jaitapur creek. Widway between the source and the mouth, stands on the north-bank the historical trading centre of Rajapur. The Jaitapur creek is protected by a promontory on its north. On this bluff stands the Yeshwantgad fort. The creek is narrow at the mouth but broadens out upstream. The ecosystem developed due to the mixing of fresh water (Arjuna River) and brackish water, sedimentation, humid climate and high rainfall in this creek facilitates the development of mangroves. Mangrove patches are found in the periphery of the creek and in the central portion. Several mangrove species are distributed in the periphery of the ecosystem. The landward side of the creek contained components of moist deciduous forests.

Vaghotan

Immediately south of the Jaitapur creek lies another parallel flowing river, which at its mouth is known as the Vijayadurg creek and upstream as the Vaghotan River. Rising in. the Kajorda region of the Sahyadris, the river flows south eastwards for about 15 miles, where it becomes tidal. At this point is situated the old trading RATNAGIRI DISTRICT centre of Kharepatan. Below Kharepatan, the river rapidly widens and joins the sea in a wide estuary that is protected from the south by the rocky height of the Vijayadurg fort. This promontory gives a good protection to craft from the southwest monsoon and the wide estuary gives spacious room. The estuary is comparatively free from sandbars, and so at the immediate entrance there is good depth for

vessels of large size, but inside, it rapidly shoals to offer a depth of about twelve feet to the sailing craft. After rounding Vijayadurg, the channel turns southeast for about four miles almost parallel to the coastline, and then gradually curves eastwards. At: the bend of the river, a large back waters runs south for about three miles to create the narrow peninsula of Bheria. The river is navigable for vessels of medium size up to the town of Vaghotan. and for smaller sized craft up to Kharepatan which is 20 miles inland.

Climate

The climate of this area is typical of that on the West Coast of India. The summer season from March to May is followed by the south-west monsoon season from June to September, with 3,028 mm average annual rainfall of the district as a whole. October and November form the post-monsoon or the retreating monsoon season. The period from December to February is the cold season. Because of coastal area the daily and seasonal variations of temperature are not large. May is the hottest month with a mean maximum temperature 31.7°C and the mean minimum temperature 26.4°C. The air is humid throughout the year. Relative humidity is on an average over 80% during the south-west monsoon season. In the rest of the year the relative humidity is between 65 - 75%. Winds are very strong and blow from west or south-west during monsoon season.

Vegetation

According to the botanical classification, coastal Maharashtra is a part of Malabar sub provenance of India. Konkan flora is a major subdivision in the vegetation of Maharashtra. It displays a distinct composition of vegetation from the other regions of Maharashtra *viz.* Desh (Western Maharashtra), Khandesh, Vidarbha and Marathwada. According to the forest classification by Champion and Seth (1968), the vegetation of Konkan comprises of,

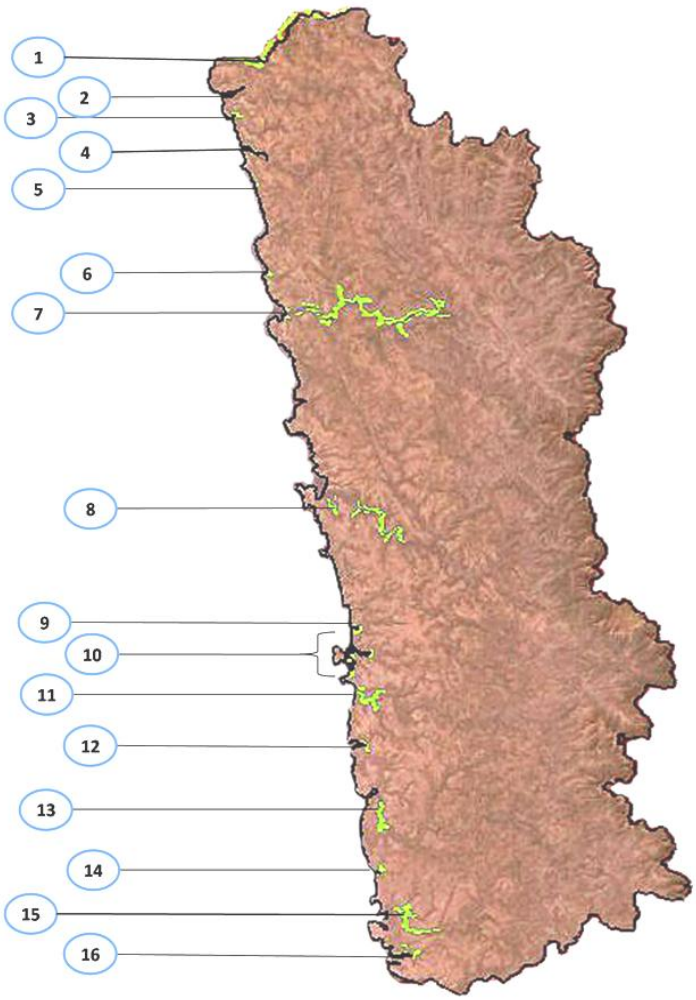
a) Intertidal swampy forests on the tidal saline sediments along the estuaries and creeks,

b) Plateau vegetation at lower elevations or plains representing moist to dry deciduous forests

c) Semi evergreen forests are interspersed with the patches of Montane subtropical evergreen forests and West coast semi-evergreen forests along the ghats.

Some of the coastal areas are also endowed with small grassland and scrublands (Almeida, 1996).

The distribution of mangrove patches along various estuaries, rivers and backwaters are depicted in the Map 2.



Map 2 Distribution of Mangrove habitats along Ratnagiri Coast: 1. Bankot, 2. Kelashi, 3. Aade, 4. Anjarle, 5. Saldure, 6. Kolathare, 7. Dabhol, 8. Jaigad, 9. Kajirbhati, Aare, 10. Shirgaon, 11. Bhatye, 12. Pawas, 13. Purnagad, 14. Vetye, 15. Rajapur, 16. Ansure.

Socio-economic profile

Main occupation of the people in this region is agriculture and fishing. Agricultural activities are chiefly carried out in low-lying planes while fishing is predominant in coastal and estuarine areas. The main food crops are rice, ragi, vari and cereals like green gram and black gram. Considerable area is occupied by orchards, which includes coconut, mango, areca nut, cashew, condiment and spices. Other minor occupation includes livestock, forestry, mining, house hold industry and trade and commerce. Konkan was known to have significant part of its population located in nearby cities like Mumbai, Kolhapur for earnings. Recent industrial growth such as power plants and other, shipyards, mining, commercialized fisheries and horticulture has caused a rapid urbanization in this region diverting significant population from agriculture to other occupations as well as attracting people from the neighbouring districts or even states in search of jobs.

In the present scenario, by and large the occupation and economy of Konakn belt is governed by Mumbai through business and employment opportunities. Fishery, agriculture (Paddy and Ragi) and horticulture (mango, coconut, cashew etc.) form the second major unit for the economy of Konkan. Tourism is mostly restricted to religious places and the sandy beaches. Developmental activities like Konkan Railway Project, several power projects, proposed Marine Highway, Cargo Ports are attracting more settlements and industries in this region. The state government is planning to form a separate body to develop tourism activity along the Konkan belt.

The recent pattern of development along the Maharashtra coast is unable to utilize the natural resources in sustainable manner as a result of increasing urban pressures and industrial growth. This situation demands the urgent need of the alternative strategies to protect and conserve the coastal resources of Maharashtra for better and efficient utilization. In this view, mangroves, one of the significant coastal ecosystems is analyzed to know its present and past status along the Konkan coast with the threats to their existing cover and conservation aspects.

Review of literature

Mangrove vegetation of the Konkan coast has been extensively reported since Blatter (1905). The account on floristic diversity and distribution is dealt in chapter 4. Fungal elements from the mangrove habitats have been studied by Borse (1984, 1985, 1987a-c, 1988a-b), Borse and Shrivastava (1988, 1994); Borse *et al.*, (1988); Shindikar and Borse (2002); Patil and Borse (1983a-b, 1985); Shrivastava (1994). A total of 83 marine fungi have been identified (62 Ascomycetes, 3 Basidomycetes and 18 Deuteromycetes) from the Maharashtra coast (Borse, 1988a-b**,** 2000). *Massarina velataspora* Hyde and Borse is found to be the most dominant species in the mangroves.

Very little attention has been paid on mangrove-associated algae and as such their documentation is rare (Lewmanomont, 1983; Lambart *et al.*, 1987; Dhargalkar, 1994; Phillips, 1994). Borgesen (1935), Deodhar (1987), Chaugule and Gunale (1981) studied some species from the open coast and beaches of Maharashtra. Algal diversity exclusively from the mangrove swamps was studied by the Yeragi and Yeragi (2002) from the Mithbav creek and Shindikar (2002) from Thane creek. A total of 29 species from 24 genera (11 Chlorophyta, 5 Phaeophyta, 5 Rhodophyta and 8 Cyanophyta) were recorded from Mithbav creek. Ecological society reported dominance of Rhodophycean (24) algal members over Chlorophycean (16), Phaeophycean (7). The Forest Department recorded 46 algae belonging to Rhodophyta, 24 chlorophyta and 19 Phaeophyta. Phytoplankton are mostly studied as indicators of pollution from the creeks in and around Mumbai. In general, the diatom dominates the planktonic population in and around Mumbai (Ram, 1985, 1999; Ramaiah and Ramaiah, 1998). Based on the remotely sensed data, mangrove cover along the state was estimated to be *ca.* 210 km^2 that covers 28% of total estuarine area along the coast. About 79% of the mangrove cover of Maharashtra was recorded along 14 major creeks (Jagtap *et al.*, 1994).

The survey conducted by the Ecological Society, Pune has reported 7 marine animals, 21 fishes and 170 birds from the coastal and near-shore areas (Gole, 1997). The survey conducted for the

State Department of Forests reports 121 birds and 40 marine animals including corals, mud skipper and oysters (Anonymous, 1998). Mangroves and near shore areas are regarded for the avian diversity. The avifauna plays an important role in the food chain of coastal systems. Thane creek is identified as Important Bird Area (IBA) by the BNHS (2002) on the basis of occurrence of 295 species including nesting or resident, long distance and local migratory birds. Quadros and Athalye (2002) reported 55 species along the Thane and Ulhas creeks while the survey for Maharashtra Nature Park in Mumbai has recorded 84 birds in the coastal habitats. Mangroves and salt pan habitat along the Mahul creek supports 94 species of birds belonging to 13 orders and 28 families (Verma *et al.*, 2002).

Ecotonal communities have always attracted ecologists due to the inbuilt diversity of biological components and patterns observed in them. These communities represent a combined status of adjoining ecosystems and the changes occurring in the transition through functional interactions. Coastal ecosystems therefore extend a platform and facilitate several such communities to interact freely with the marine and terrestrial niches. Further, the coastal interface is continuously influenced by the climatic changes like global warming and resultant sea level fluctuations. In addition, the geological processes like plate movements or tectonics are more pronounced at the continental margins. The Tsunami that hit the coasts of South East Asian countries on December 26, 2004 has forced to think and design a strategy for scientific measures to face such hazards. As coasts are regarded as the places for civilization and transport since historic times and more than 60% of global population is estimated to settle in the narrow coastal belt, the near shore ecosystems are becoming highly significant. Increasing coastal population utilizes the resources unsustainably and invites urbanization and industrialization in the course of development. These processes have direct or indirect impact on the coastal ecosystems. In view of this, coastal vegetation especially mangroves are recognized as buffer systems or bio shields against the ferocity of natural calamities like storms, cyclones and Tsunami or even man made pollution.

The term ‘mangrove’ has been defined in various ways by many, but all of them in one way or the other, related it to a plant community associated with the near-shore marine habitat. In

fact, the mangroves constitute a niche for itself, as it occupies a transitional zone between the marine and terrestrial environments of the low-lying tropical coastlines. Although the mangrove vegetation consists of taxonomically unrelated plant species, they show distinct physiognomy, physiology and structural adaptations. All mangroves are adapted to high water salinity stress, exhibit mechanisms that allow water uptake against the physiological water gradient and show xerophytic adaptations. In response to a great variation in the environmental conditions, heterogeneity of mangrove ecosystem is globally acknowledged. These ecosystems are considered amongst the most complex because of a high degree of structural and functional diversity observed in the biological components.

Mangrove formations differ from other forest types in a way that they receive large inputs of matter and energy from both land and sea. Globally efforts are being made to understand the mangrove system as a functional unit along with its components and their interaction within and outside the system. Traditionally, the local inhabitants utilize mangrove forest resources. Mangroves play a very important role in prevention of soil erosion through land building and also protection of the coast from cyclones or storms. Mangrove swamps extend breeding and nursery grounds to a number of marine organisms. The forest resources are explored for timber and non-timber forest products, medicines or even scientific and aesthetic purposes. Considering the utility of mangroves in every aspect of human life and survival at the coast (Plate 1.1), there are increasing efforts to understand and conserve these forests. Accordingly, there is a need to address the changing scenario of the mangrove vegetation with respect to natural and anthropogenic impacts.

The mangroves of India constitute an interesting and probably unique case in South East Asia (Blasco *et al.*, 1986). It harbors a significant mangrove cover over a great range of variation in the bioclimatic and edaphic factors along the Indian coastline. The Indian mangroves comprise 43 genera belonging to 30 families and more than 68 species (Banerjee, 2003). Their distribution is uneven along the sheltered bays, estuaries and river mouths (Bahuguna and Nayak, 2002). Andaman and Nicobar Islands, Sunderbans (West Bengal), Bhitarkanika (Orissa),

Pichavaram (Tamil Nadu), Mandovi and Zuari complex (Goa) and coasts of Gujarat and Maharashtra are the areas with significant diversity and mangrove cover (Untawale, 1987).

Major deltas along the east coast facilitated better and well-developed mangroves as compared to that of west coast. According to the report of the Forest Survey of India, total area under mangrove cover is estimated to be 4,87,100 hector of which nearly 2,75,800 ha (56.7%) occurs along the east coast while 1,14,700 ha (23.5%) found along west coast and remaining 96,000 ha (19.8%) is present in the Andaman and Nicobar Islands (Anonymous, 2004).

In general, the presence and extent of mangrove vegetation is determined by coastal geography, geomorphology and tidal regime while physicochemical, edaphic and climatic factors determine the development, growth and productivity of the ecosystem. The diversity and distributional aspects of mangroves along the Indian coast are also determined by the environmental factors such as geomorphology, climate, tidal amplitude, duration and quantity of freshwater inflow (Blasco, 1975). The mangrove wetlands of India are classified as tide-dominated type (Sundarbans and Mahanadi), river dominated type (Godavari, Krishna and the Cauvery), drowned valley type (Gujarat and west coast) and low energy carbon platform (Andaman and Nicobar Islands) (Selvam, 2003). With this background, it is clear that habitat forms a basic unit for the analysis of mangrove ecosystem and is as such responsible for the formation and functional efficiency at the local level. Mangrove vegetation, the most visible tree component of ecosystem, can be analyzed on the basis of habitats. Such analysis helps us to correlate the intricate relations of various environmental factors for a given mangrove area. Identification and classification of the vegetation and its distribution across the habitats provides an idea about the environmental gradients existing and operating on the vegetation.

Mangroves are sensitive to the climatic fluctuation, monsoon patterns on one hand and tectonics or sea level fluctuation on the other. All these factors determine the extent and characters of intertidal habitat of mangroves and therefore study of mangrove environment provides valuable information about the changing pattern of these factors.

3. Methodology

Ecological surveys and analysis

Selection of sampling sites

The initial pilot surveys were exclusively utilized to map the location and extent of the mangroves of the entire study area. Each of these mangrove patches were visited and assessed thoroughly to by recording their GPS locations (Garmin GPSMAPs 78s). Data thus collected was plotted using Google Earth ™ and LandSAT (1999 & 2005) to develop habitat polygons with precision. The maps were generated using Quantum GIS with base layers (GADM data), contours (10 m interval data: SRTM-Shuttle Radar Topographic Mission, NASA), with EPGS4326 projection.

In the present study, habitat is considered as a unit to analyze the mangrove community along the Maharashtra coast. Accordingly, regular botanical field visits have been designed considering the vast coastline, diversity in habitats, available facilities and practical limitations of working in mangrove environment. Keeping this in mind, the following methodology was adopted to understand the present status of mangrove forests along the coast.

Regular field excursions were conducted along the coast in order to survey the mangroves, associated species and distribution. The phsio- chemical characteristics of the air, soil and water were also recorded at each site per season.

Representative mangrove habitats such as were selected for the quantitative vegetation analysis. Each sampling site was analyzed in terms of the species richness, diversity, and short term and long-term changes in vegetation. Further, direct and indirect threats to the existing mangroves were listed on the basis of enquiries made for landuse pattern in and around the mangrove forests.

Local understanding about the mangroves, was analysed by interviewing people about the community dependence on them.

For identification of plants the vegetative and floral characters were observed along with additional characters such as bark, modified root system, flowering twigs, fruits, seeds and appropriate publications.

Systematic enumeration of mangroves

Ecological notes

Distribution of each species at Global, National and State level is compiled based on the secondary data sources (Tomlinson, 1986; Banerjii, 2003; Deshmukh, 1990). Information about the pollinators, pollination and seed dispersal is given based on the field observations and also from the relevant references (Tomlinson, 1986). Species specific threats are listed based on the observation during field excursions which are significant in view of planning the conservation measures. Duke *et al.* (1984) and Coupland *et al.* (2005, 2006) provided additional notes on the pollination mechanism, seed dispersal and propagation based on the field observations.

Community structure analysis

Diversity is estimated and expressed in many ways. Variety of parameters and devices are used to quantify species diversity. In the present study, only higher plants are studied for their diversity at species level. After reviewing different sampling methods to study the mangrove vegetation, a random stratified sampling method was selected for present investigation. This method is also useful in analyzing habitat based diversity of plants. Number of quadrate and their size was determined by drawing minimal area curve and minimum number curve. For many of the locations, 10 x 10 m quadrates was found to be suitable to get the idea about the vegetation of sampling site. In few cases belt transects were employed keeping the area constant. At each sapling site, 10 such quadrats were taken and the observations are expressed per 100 m^2 area. Such quadrats were temporarily demarckated with the nylon ropes. Height and diameter for each individual (D130 - girth of the stem taken at 130 cm level) were

measured manually at each sampling location. The seedlings were measured in 1 x 1 m quadrate.

Quantitative analysis of vegetation profile from the representative locations mainly dealt with species richness (number of species and individuals), frequency, density, abundance and Importance Value Index (IVI). In addition to this the growth parameters such as height, girth were used to determined the above ground biomass. These readings were volunteered for the horizontal and vertical profile at the site. Growth of the pneumatophores and seedlings was also noticed at few locations. The calculations were carried out by using following formulae,

a) Frequency Frequency indicates distribution of particular species in a community. Frequency was calculated by using following formula, and expressed in percentage.

$$\text{Frequency} = \frac{\text{Total no. of quadrats in which sp. occurs}}{\text{Total number of quadrat sampled}} \times 100$$

b) Abundance and density These values represent numerical strength and distribution of species in a unit area. They were calculated by using following formulas.

$$\text{Density} = \frac{\text{Total no. of individuals of a species}}{\text{Total number of quadrat sampled}}$$

$$\text{Abundance} = \frac{\text{Total no. of individuals of a species}}{\text{Total number of quadrat in which sp. occurs}}$$

C) IVI indicates the dominance as well as ecological success of the species. As it is the summation of relative density, relative frequency and relative dominance it considers the number, occurrences and area occupied by that species (Curtis and Mclntosh, 1950)

I.V.I. = Relative Frequency + Relative Density + Relative Dominance where,

$$\text{Relative frequency} = \frac{\text{Frequency of a species}}{\text{Sum of frequencies of all the species}} \times 100$$

$$\text{Relative Density} = \frac{\text{Density of a species}}{\text{Sum of densities of all the species}} \times 100$$

$$\text{Relative basal area} = \frac{\text{Basal area of a species}}{\text{Sum of the basal areas of all the species}} \times 100$$

e) Diversity indices It is the statistical expression of diversity, which includes species richness and evenness within the community. It can be measured by using species richness model, species abundance model or proportional abundance model. In the present study alpha diversity of vascular mangrove plants was measured. Diversity for the vegetation was calculated by using Shannon's diversity index (H'). It measures the average degree of uncertainty for S number of species and N number of individuals of the species. The index comes to zero when there is only one species in the community and it is maximum when all the species are equal in number.

$H' = \Sigma (Pi \ln Pi)$ and $Pi = ni / N$ (log to the base n is used)

where, ni = Total number of individuals of a species

N = Total number of individuals of all the species

Threatened category

Species-wise threatened category (at global and national level) is assigned on the basis of Conservation Assessment and Management Plan (CAMP) report for mangroves (Rao *et al.,* 1998). For state level it is referred from the recent report by Bhosale (2002, 2006).

4. Results

Ecological status

Floristics

4.4.1 Floristic analysis

The floristic explorations are constantly subject to new discovery, addition and deletion of species from the mangrove database of Maharashtra. Due to the restricted contribution of plant taxonomists, the systematic enumeration of mangroves is seldom mentioned in the literature and the aspect of identification is generally taken for granted in most of the ecological works. Limitations to the field work, wide distribution and adaptation of the species are responsible for the taxonomic uncertainties despite their apperent familaritry. As the mangroves belong to different families, the phenological stages change according to the species and the researchers are unable to find a single season to study the characters of a species. Therefore, frequent field visits and laboratorical observations become necessary in the process of identification of mangroves. Some of the earlier publications have produced erroneous species list due to the mis-identification or nomenclatural changes. From the table it is clear that species *Bruguiera parviflora, Sonneratia acida, Acanthus ebracteatus, Acanthus volubilis, Lumnitzera coccinea, Xylocarpus moluccensis* and *Xylocarpus mekongensis* are not recorded afterwards or their occurrence in the study area is dubious. Surprisingly, *Sonneratia alba* which is very distinct species and common at the mouth of all major estuaries was not mentioned in any of the State Flora of BSI and Almeida..

The present floristic analysis of mangroves along the Maharashtra coast reveals 18 true mangrove species with one variety (Table 4.2a) and 15 frequent associates. The mangrove species belongs to 12 genera from 9 families. The family Rhizophoraceae dominates with 7 species representing 4 genus followed by Sonneratiaceae and Avicenniaceae with three species each. Myrsinaceae, Combretaceae, Acanthaceae, Euphorbiaceae, Meliaceae and Fabaceae represent single genus and

species. *Avicennia*, which is taxonomically most confusing genus, has two distinct species and a variety. An account of their occurrence is provided in following table.

Table @@ Mangroves of Maharashtra

No.	Botanical Name	Family
01	*Bruguiera cylindrica* (L.) Blume	Rhizophoraceae
02	*Bruguiera gymnorrhiza* (L.) Lam.	Rhizophoraceae
03	*Bruguiera parviflora* (Roxb.) Griff.	Rhizophoraceae
04	*Ceriops tagal* (Perr.) C.B. Rob.	Rhizophoraceae
05	*Kandelia candel* Druce	Rhizophoraceae
06	*Rhizophora apiculata* Blume	Rhizophoraceae
07	*Rhizophora mucronata* Lam.	Rhizophoraceae
08	*Avicennia marina* var. marina (Forssk.) Vierh.	Avicenniaceae
09	*Avicennia marina* var. accutissima Stapf. & Moldenke ex Moldenke	Avicenniaceae
10	*Avicennia officinalis* L.	Avicenniaceae
11	*Aegiceras corniculatum* (L.) Blanco	Myrsinaceae
12	*Sonneratia alba* Sm.	Sonneratiaceae
13	*Sonneratia apetala* Buch.-Ham.	Sonneratiaceae
14	*Sonneratia caseolaris* (L.) Engl.	Sonneratiaceae
15	*Excoecaria agallocha* L.	Euphorbiaceae

16	*Acanthus ilicifolius* L.	Acanthaceae
17	*Lumnitzera racemosa* Willd.	Combretaceae
18	*Xylocarpus granatum* K.D. Koenig	Meliaceae
19	*Cynometra iripa* Kostel.	Fabaceae

Table @@ Species and generic status of mangroves in Maharashtra

Sr.No.	Family	No. of Genus	No. of Species	Variety
1	Acanthaceae	1	1	0
2	Avicenniaceae	1	2	1
3	Combretaceae	1	1	0
4	Euphorbiaceae	1	1	0
5	Fabaceae	1	1	0
6	Meliaceae	1	1	0
7	Myrsinaceae	1	1	0
8	Rhizophoraceae	4	7	0
9	Sonneratiaceae	1	3	0
Total		12	18	1

Table @@ Frequent mangrove associates

Acrostichum aureum L.	*Premna obtusifolia* var. *pubescens f serratifolia* (L.) Moldenke
Aeluropus lagopoides Druce	*Salicornia brachiata* Roxb.
Caesalpinia crista L.	*Salvadora persica* L.
Clerodendrum inerme Gaertn.	*Sesuvium portulacastrum* (L.) L.
Cyperus rotundus L.	*Sphaeranthus africans* L.
Derris trifoliata Lour.	*Suaeda maritima* (L.) Dumort
Pongamia pinnata (L.) Pierre	*Thespesia populnea* (L.) Correa

Awareness Programmes

The awareness and education programmes included 17 schools and five villages in the Ratnagiri districts. The nature of the programmes was common for schools and villages or governing bodies.

The schools were open to readily participate in such programmes. Maharashtra State Education Board syllabus for secondary schools included lessons on mangrove ecosystem and their conservation in the Environmental Science which was taught as a separate subject till last academic year (2011-2012). However, the subject merely exists as three additional lessons in the text book of General Sciences which includes a paragraph on mangrove ecosystems. Most of the schools appreciated the programmes conducted by BNHS as students and even teachers got an opportunity of the subject exposure.

However, it was very difficult to approach and gather villagers together for any activity mostly due to their pre-occupations and partially due to lack of interest. On the other hand the villages which readily allowed to take the programmes in their villages were very proactive and eager to respond. The villages which participated in programmes were Umroli, Bhopan, Tiwre, Juve and Aade.

The details of the schools and villages participated in programmes are listed below.

Sr. No.	Village Name	School Name	Target Students	Students coming from villages	Girls	Boys	Total
1	Umroli	Umroli Panchakroshi Madhyamik Vidhyalay, Umroli	8th to 10th	Umroli, Gudeghar, Shipole, Kante, Kengwal, Ranawali, Katalkond, Bankot, Narayan Nagar, Velas, Walmiki Nagar	60	82	142
2	Umroli	J. P. Adarsha Kendra Shala, Umroli	5th to 7th	Umroli, Gudeghar, Shipole, Kante, Kengwal, Ranawali, Katalkond, Bankot, Narayan Nagar, Velas, Walmiki Nagar	55	64	119
3	Vesvi	K. V. Bhate Vidyamandir	8th to 10th	Umroli, Gudeghar, Shipole, Kante, Kengwal, Ranawali, Katalkond, Bankot, Narayan Nagar, Velas, Walmiki Nagar	54	58	112
4	Kelashi	Parashurambhau Dandekar Vidyalay, Kelashi	8th to 10th	Kelashi, Atgaon, Sakhari, Velas, Veswi, Shipole, Bankot, Aade, Padale, Anjarle, Umbarshet, Utambar, Rowale	148	162	310
5	Aade	Kai. Padmashri Annasaheb Behare Vidyalay, Aade	8th to 10th	Kelashi, Atgaon, Sakhari, Shipole, Aade, Padale, Anjarle,M uradi, Umbarshet, Utambar, Pandhari, Adkhal	40	64	104
6	Anjarle	Madhavraw Khambete Prashala, Anjarle	8th to 10th	Kelashi, Atgaon, Sakhari, Shipole, Aade, Padale, Anjarle,M uradi, Umbarshet, Utambar, Pandhari, Adkhal	75	88	163
7	Agarvaingani	Bahujan Hitay Vidyamandir, Agarvaingani	8th to 10th	Agarwayangani, Bhopan, Panderi, Pangari, Gudhage, Dabhol, Umbarghar, Oni	45	55	100
8	Dabhol	Lokmanya Tilak Highschool, Dabhol	7th to	Dabhol, Veldur, Dhopave,	176	174	350

			10th	Navase, Bhivbandar, Navoshi, Usgaon, Gudhage, Unavare, Agarwayangani			
9	Guhaghar	Shri. Dev Gopal Krushna Vidyamandir, Guhaghar	8th to 10th	Guhagar, Kondwadi, Kirtanwadi, Asgoli, Ranavi, waki, Anjanvel	95	119	214
10	Guhaghar	SSP Science & MJB Commerce Junior College, Guhagar	11th & 12th	Guhagar, Kondwadi, Kirtanwadi, Asgoli, Ranavi, waki, Anjanvel, Veldur, Dhopave, Are, Sakhari, Palshet, Nivoshi, Pomendi	40	50	90
11	Khandala	Madhyamik Vidyalay Varawade va Bhagshala Vatad, Khandala	7th to 10th	Khandala, Varavade, Vatad, Kasari, Chaferi, Satkondi, Sandelawgan	75	125	200
12	Varavade	Madhyamik Vidyalay, Varawade	8th to 10th	Malgund, Varavade, , Vatad, Kasari, Chaferi, Satkondi, Sandelawgan, Ganapati Pule, Undi, Khandala	42	53	95
13	Malgund	Baliram Parkar Vidyalay, Malgund	8th to 10th	Malgund, Varavade, Ganapati Pule, Undi, Khandala	65	77	142
14	Kasheli	Jilha Parishad Kendriya Vidyalay	8th to 10th	Kasheli, Adiware, Rajwadi, Mogare, Dhartale,	75	70	145
15	Adivare	Shri Mahakali English School and Junior College, Navedar	8th to 10th	Rajwadi, Mogare, Dhartale, Tiware, Kombhe, Kondsare, Benagi, Runde, Lonwi, Vetye	90	82	172
16	Janshi	Janshi Highschool	8th to 10th	Janashi, Sagave, Nive, Ansure, Tiware, Salkarkombe	90	109	199
17	Sakharkombe	Sakharkombe Highschool	8th to 10th	Janashi, Sagave, Nive, Ansure, Tiware, Salkarkombe	105	109	214
		Total			**1330**	**1541**	**2871**

School programmes at Aade

School programmes at Veswi

School programmes at Aadiware school

School programmes at Dabhol School

The Officers from Forest Department were recourse persons for a few programmes.

Awareness programmes for villagers:

Sr. No.	Village Name	Women	Men	Children	Total
1	Tiware	12	17	12	41
2	Juve	3	9	0	12
3	Aade	27	34	2	63
4	Vadad VGB	7	11	0	18
5	Umroli	5	8	0	13
6	Ansure VGB	1	5	0	6
	Total	**55**	**84**	**14**	**153**

Village programme for fishing community at Aade

Village Governing Body meeting at Juve

Education programme at Tiware

Handouts

खारफुटी म्हणजे नक्की काय?

- खारफुटी हि एक अशी परिसंस्था आहे जी सतत आपला एक पाय जमिनीत तर एक पाय समुद्रात रोऊन उभी असते.
- खारफुटीत समावेश होणाऱ्या अनेक झाडांमध्ये काही अगदी लहानशी झुडपं तर काही २०० फुट म्हणजेच तब्बल ६० मीटर जाड खोड असलेली झाडेही आहेत.
- संपूर्ण जगभरात खारफुटी झाडांच्या जवळजवळ ७० वेगवेगळ्या जाती अहेत.
- दलदलीतसुद्धा सहजपणे जिवंत राहण्यासाठी या झाडांच्या मुळांची गुंतागुंतीची रचना मदत करते.
- यातील काही झाडांची मुळे तर त्यांना पाणबुडयांच्या श्वास घेण्याच्या नळी सारखे वर येउन श्वास घ्यायला मदत करतात. त्यांना शल्यमुळे म्हणतात.
- यातील काही झाडांची मुळे पारंब्यांसारखी असतात (आधार मुळे) जी त्यांना गाळ असणाऱ्या जागीही उभं राहायला मदत करतात.
- काही झाडांना खोडाच्या तळाशी कंद आणि भक्कम मुळे असतात जी आधारासाठी टेकू म्हणून उपयोगी पडतात.

खारफुटी - एक महत्वाची परीसंस्था

- खारफुटी ही इतर कोणत्याही जंगलांपेक्षा सर्वात अधिक उत्पादक व जैवविविधता असलेली परिसंस्था आहे.
- खेकडे, मासे, शिंपल्या, कोलंबी अशा पाण्यात राहणाऱ्या अनेक पाण्यांसाठी खारफुटी त्यांचे घर आहे, जेथे ते आपले प्रजनन आणि पोषण करतात.
- खारफुटी ही प्राथमिक अन्नसाखळ्यांपैकी एक आहे. ती अनेक जलचर प्राण्यांना पोषणाची साधने उपलब्ध करून देते. पाणसाप व मगरीही काही वनांमध्ये आढळून येतात..
- अनेक पक्षांची घरटी या वनांमध्ये आढळून येतात.
- काही कासवांची पिल्ले या परीसंस्थेतच वाढतात आणि अन्नासाठी सुद्धा तिच्यावरच अवलंबून असतात.
- या झाडांच्या फुलांमधून मधमाश्या मध गोळा करतात.

उपयुक्त अशी खारफुटी

- खारफुटी वने वेगवान लाटांपासून किंवा भरती-ओहोटी आणि नैसर्गिक संकटांपासून समुद्र किनाऱ्यांचे रक्षण करतात.
- हिरव्या पानांनी गच्च सजलेल्या या घनदाट वनांमुळे हवेतील कार्बन डायऑक्साईड शोषला जाऊन वातावरण स्वच्छ होते.
- काही खारफुटीतील झाडांची फळे लोणची बनवण्यासाठी, लाकडे सरपणासाठी तर पाने गुरांना चारा म्हणून वापरली जातात.

- खारफुटीतील काही विशिष्ट जातीची झाडे औषधी म्हणून वापरली जातात. त्यांचा माशांचा डंख, मलेरिया, मधुमेह आणि काही त्वचारोगांवर उपचारासाठी वापर केला जातो.
- काहीं पासून डासांना व माशांना मारण्याचे औषध बनवले जाते.
- आपल्याला माहित असणारी, टुथपेस्ट मध्ये वापरली जाणारी मेसवाक ही वनस्पतीसुद्धा खारफुटी वनस्पतींपैकीच एक आहे.

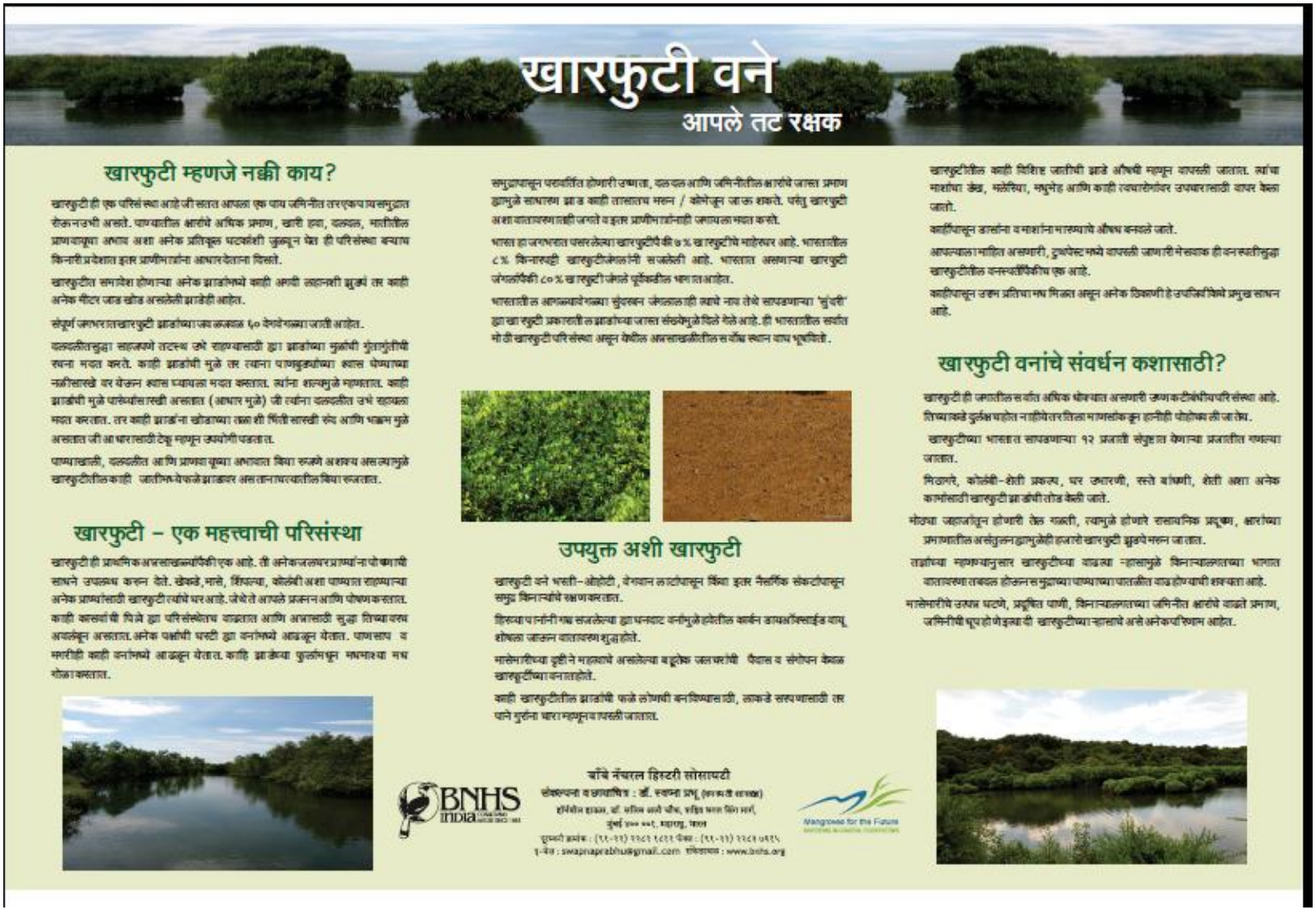
खारफूटी वनांचे संवर्धन कशासाठी ?

- खारफुटी ही एक महत्वाची परिसंस्था असतानाही तिच्याकडे दुर्लक्षच होत नाहीये तर तिला माणसांकडून हानीही पोहोचवली जातेय.
- खारफुटी ही जगातील सर्वात अधिक धोक्यात असणारी उष्ण कटिबंधीय परिसंस्था आहे.
- खारफुटीच्या भारतात सापडणाऱ्या १२ प्रजाती संपूष्टात येणाऱ्या प्रजातींत गणल्या जातात.
- मिठागरे, कोलंबी शेती प्रकल्प, घर उभारणी, रस्ते बांधणी, शेती अशा अनेक कामांसाठी खारफुटी झाडांची तोड केली जाते.
- मोठ्या मोठ्या जहाजांतून होणारी तेल गळती, त्यामुळे होणारे रासायनिक प्रदूषण, क्षारांच्या प्रमाणातील असंतुलन यामुळेही हजारो खारफुटी झुडपे मरून जातात.
- तज्ज्ञांच्या म्हणण्यानुसार, खारफुटीच्या वाढत्या ऱ्हासामुळे किनाऱ्यालगतच्या भागांत वातावरणात बदल होऊन समुद्राच्या पाण्याच्या पातळीत वाढ होण्याची शक्यता आहे.
- मासेमारीचे उत्पन्न घटणे, प्रदूषित पाणी, किनाऱ्या लगतच्या जमिनीत क्षारांचे वाढते प्रमाण, जमिनीची धूप होणे... खारफुटीच्या ऱ्हासाचे हे आणि असे अनेक परिणाम आहेत.

तुम्हाला हे माहित आहे का ?

- समुद्र पासून पराबर्तीत होणारी उष्णता, दलदल आणि जमिनीतील क्षारांचे जास्त प्रमाण यामुळे साधारण झाड काही तासांतच मारुन/कोमेजून जाऊ शकते. परंतु खारफुटी अशा वातावरणात हि जगते न इतर प्रतिमात्रांनाही जगायला मदत करते.
- भारत हा जगभरात पसरलेल्या खारफुटी पैकी ७% खारफुटीचे माहेरघर आहे.
- भारतातील ८% किनारपट्टी खारफुटी जंगलांनी सजलेली आहे.
- भारतात असणाऱ्या खारफुटी जंगलांपैकी ८०% खारफुटी जंगले पूर्वेकडील भागात आहेत.
- भारतातील आगळ्यावेगळ्या सुंदरबनजंगलालाही त्याचे नाव तेथे सापडणाऱ्या "सुंदरी" या खारफुटी प्रकारातील झाडांच्या जास्त संख्येमुळेच दिले गेले आहे

Poster



खारफुटी वने

आपले तट रक्षक

खारफुटी म्हणजे नक्की काय?

खारफुटी ही एक परिसंस्था आहे जी सतत आपला एक पाय जमिनीत तर एक पाय समुद्रात रोवून उभी असते. पाण्यातील क्षारांचे अधिक प्रमाण, खारी हवा, दलदल, मातीतील प्राणवायूचा अभाव अशा अनेक प्रतिकूल घटकांशी जुळवून घेत ही परिसंस्था बेचाव किनारी प्रदेशात इतर प्राण्यांनाही आधार देताना दिसते.

खारफुटीत समावेश होणाऱ्या अनेक झाडांमध्ये काही अगदी लहानशी झुडपं तर काही अनेक मीटर जाड खोड असलेली झाडेही आहेत.

संपूर्ण जगभरात खारफुटी झाडांच्या जवळजवळ ६० वेगवेगळ्या जाती आहेत.

दलदलीतसुद्धा सहजपणे तटस्थ उभे राहण्यासाठी ह्या झाडांच्या मुळांची गुंतागुंतीची रचना मदत करते. काही झाडांची मुळे तर त्यांना पाणबुडव्यांच्या स्नॉर्केल घेण्याच्या नळीसारखे वर येऊन श्वास घ्यायला मदत करतात. त्यांना श्वसनमुळे म्हणतात. काही झाडांची मुळे पारंब्यांसारखी असतात (आधार मुळे) जी त्यांना दलदलीत उभे राहायला मदत करतात. तर काही झाडांना खोडाच्या तळाशी पिंपी सारखी रचना आणि भक्कम मुळे असतात जी आधारासाठी टेकू म्हणून उपयोगी पडतात.

पाण्याखाली, दलदलीत आणि प्राणवायूच्या अभावात बिया रुजणे अशक्य असल्यामुळे खारफुटीतील काही जातींच्या फळे झाडावर असतानाच पाण्यातील बिया रुजतात.

खारफुटी – एक महत्त्वाची परिसंस्था

खारफुटी ही प्राथमिक अन्नसाखळ्यांपैकी एक आहे. ती अनेक जलचर प्राण्यांना पोषणाची साधने उपलब्ध करून देते. खेकडे, मासे, शिंपल्या, कोलंबी अशा पाण्यात राहण्याऱ्या अनेक प्राण्यांसाठी खारफुटी त्यांचे घर आहे. जेथे ते आपले प्रजनन आणि पोषण करतात. काही कासवांची पिल्ले ह्या परिसंस्थेतच वाढतात आणि अन्नासाठी सुद्धा तिथ्या वरच अवलंबून असतात. अनेक पक्षीची घरटी ह्या वनांमध्ये आढळून येतात. पाणसाप व मगरीही काही वनांमध्ये आढळून येतात. काही झाडांच्या फुलांमधून मधमाश्या मध गोळा करतात.

समुद्रापासून परावर्तित होणारी उष्णता, दलदल आणि जमिनीतील क्षारांचे जास्त प्रमाण ह्यामुळे साधारण झाड काही तासातच मरून / कोमेजून जाऊ शकते. परंतु खारफुटी अशा वातावरणातही जगते व इतर प्राण्यांनाही जगायला मदत करते.

भारत हा जगभरात पसरलेल्या खारफुटीपैकी ७ % खारफुटीचे माहेरघर आहे. भारतातील ८% किनारपट्टी खारफुटीजंगलांनी सजलेली आहे. भारतात असणाऱ्या खारफुटी जंगलांपैकी ८० % खारफुटी जंगले पूर्वकडील भागात आहेत.

भारतातील आगळावेगळ्या सुंदरबन जंगलालाही त्याचे नाव तेथे सापडणाऱ्या 'सुंदरी' ह्या खारफुटी प्रकारातील झाडांच्या जास्त संख्येमुळे मिळे गेले आहे. ही भारतातील सर्वात मोठी खारफुटी परिसंस्था असून येथील अन्नसाखळीतील सर्वोच्च स्थान वाघ भूषवितो.

उपयुक्त अशी खारफुटी

खारफुटी वने भरती-ओहोटी, वेगवान लाटांपासून किंवा इतर नैसर्गिक संकटांपासून समुद्र किनाऱ्यांचे रक्षण करतात.

हिरव्या पानांनी गच्च सजलेल्या ह्या घनदाट वनांमुळे होतेाल कार्बन डायऑक्साईड वायू शोषला जाऊन वातावरण शुद्ध होते.

मासेमारीच्या दृष्टीने महत्वाचे असलेल्या बहुतेक जलचरांची पैदास व संगोपन केवळ खारफुटीच्या वनांतच होते.

काही खारफुटीतील झाडांची फळे लोणची बनविण्यासाठी, लाकडे सरपणासाठी तर पाने गुरांना चारा म्हणून वापरली जातात.

खारफुटीतील काही विशिष्ट जातींची झाडे औषधी म्हणून वापरली जातात. त्यांचा माशांचा डंख, मलेरिया, मधुमेह आणि काही त्वचारोगांवर उपचारासाठी वापर केला जातो.

काहींपासून डासांना व माशांना मारण्याचे औषध बनवले जाते.

आफ्रिकेला माहित असणारी, टुथपेस्ट मध्ये वापरली जाणारी मेसवाक ही वनस्पतीसुद्धा खारफुटीतील वनस्पतींपैकीच एक आहे.

काहीपासून उत्तम प्रतिचा मध मिळत असून अनेक ठिकाणी हे उपजिविकेचे प्रमुख साधन आहे.

खारफुटी वनांचे संवर्धन कशासाठी?

खारफुटी ही जगातील सर्वात अधिक धोक्यात असणारी उष्णकटिबंधीय परिसंस्था आहे. तिच्याकडे दुर्लक्ष होत राहीले तर तिला मानवासकट कुणा हानीही पोहोचवली जाऊ शके.

खारफुटीच्या भागात सापडणाऱ्या १२ प्रजाती संपुष्टात येण्याच्या प्रजातीत गणल्या जातात.

मिठागरे, कोळंबी-शेती प्रकल्प, घर उभारणी, रस्ते बांधणी, शेती अशा अनेक कामांसाठी खारफुटी झाडांची तोड केली जाते.

मोठ्या जहाजांतून होणारी तेल गळती, त्यामुळे होणारे रासायनिक प्रदूषण, क्षारांच्या प्रमाणातील असंतुलन ह्यामुळेही हजारो खारफुटी झुडपे मरून जातात.

ताज्यांच्या म्हणण्यानुसार खारफुटीच्या वाढत्या ऱ्हासामुळे किनाऱ्यालगतच्या भागात वातावरणात बदल होऊन समुद्राच्या पाण्याच्या पातळीत वाढ होण्याची शक्यता आहे.

मासेमारीचे उपद्रव घटणे, प्रदूषित पाणी, किनाऱ्यालगतच्या जमिनीत क्षारांचे वाढते प्रमाण, जमिनीची धूप होणे इत्यादी खारफुटीच्या ऱ्हासाचे असे अनेक परिणाम आहेत.

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Booklet

Nursery Development and Plantation Programme

BNHS set up a small nursery at Village Kasari for last three years, where we had decided to grow around 10,000 saplings as one of the objectives of the MFF SGP programme. The plot was a small part of an agricultural field close to the mangrove area occasionally flooded by tidal waters. The tidal water feeding this area is controlled by the dyke constructed about 30 years ago, with a few of its flood gates open. Unfortunately all these floodgates except two were closed last year by "Kharland Development Board" authorities, which resulted in stopping the tidal water from entering in the agricultural plots. Around 5000 saplings of three year age withered away due to stopped water supply.

Consequently we raised the fresh lot of 10000 mangrove saplings on the creek side of the mangrove patches. In the beginning of April all the flood gates were closed resulting in drying up of 100 ha mudflat surrounded by mangroves. The tidal water was confined to a shallow patch app. 200m from the nursery. Since there was no other source of water nearby, the only option was to dig trenches from subsided water level till nursery. This worked out well and the nursery was saved. However, it took a lot more time than scheduled for the establishment of the nursery.

Consequently plantation programme was carried out in the month of December (2013) with the help of villagers of Kasari village, especially, Women's Self – Help Group there.

App. 5000 saplings were planted along the bund constructed by Kharland Development Board.

Nursery Set up in April 2012

As a solution trenches were dig to train the subsided water till nursery.

Nursery set up at October 2013

Plantation

Mangrove plantation programme with the help of Women Self- help Groups and villagers at Kasari