

Bio-Sentinels of Coastal Maharashtra

Compilation & Photography :
Raman Kulkarni
Hon. Wildlife Warden, Kolhapur

Mangrove Cell
Forest Department
Maharashtra



Bio-Sentinels of Coastal Maharashtra

Concept by
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APCCF, Mangrove Cell and
Executive Director, Mangrove Foundation

Under the guidance of
Nitin Kakodkar IFS
Principal Chief Conservator of Forests (Wildlife)
Maharashtra State

Mangrove Cell
Forest Department
Maharashtra



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Acharya Mangroves, Sindhudurg

© Pranav Mangurkar



Sonneratia alba
(Sweet-Scented Apple)
State Mangrove tree of Maharashtra

© Raman Kulkarni



Speaking about the coast of Maharashtra, one of my most treasured memories is the spectacular aerial view of the region. Coastal Maharashtra has always been very fascinating because of its pristine beaches, thick mangrove forests, coral reefs and more, which are home to several species of flora & fauna apart from the various communities that reside there. The rich marine biodiversity of the State includes the coral reefs of Malvan, various species of dolphins and whales, many species of fish and other marine invertebrates, migratory birds, sea turtles, etc.

Owing to this rich biodiversity, coastal Maharashtra also has a very high potential for eco-tourism which is best illustrated by the 'Turtle Festival' in Velas and Anjarle in Ratnagiri district where tourists from all over, come to experience the journey of tiny turtle hatchlings from the beach to the sea.

The local communities in the coastal region have always played an important role in the conservation of this biodiversity and inclusion of these communities in the biodiversity conservation programmes is the only way forward. The Government of Maharashtra has therefore started many programmes which encourage the participation of the locals in various sustainable livelihood activities along the coast of Maharashtra which serves a dual purpose of involving the locals in the conservation of this biodiversity and providing them with alternate sources of income.

All these aspects have been aptly covered in this coffee table book and I sincerely hope that this beautiful book will go a long way in sensitising the common people about the wonders of coastal Maharashtra and the conservation efforts of the State Government for the same.

Uddhav Balasaheb Thackeray
Chief Minister of Maharashtra





Sunrise at Achara, Sindhudurg district



GOVERNMENT OF MAHARASHTRA



Maharashtra is a bio-diverse state with a rich assemblage of flora and fauna, especially when it comes to coastal and marine biodiversity. The amazing Olive Ridley sea turtles which come to nest on various beaches in the State and the magnificent Indian Ocean Humpback Dolphins seen along the entire coastline of Maharashtra certainly are the flagship species of the coastal and marine biodiversity of our State. Having said that, there are many other small and large marine animals such as sea slugs, marine worms, crabs, various fish etc. which may be lesser known but are equally beautiful and captivating in their own right.

I am extremely delighted that this Coffee Table book has managed to capture the myriad aspects of the coastal and marine biodiversity of Maharashtra with some outstanding photographs and I sincerely hope that this book will contribute to the growing awareness regarding the conservation of marine biodiversity in the State. Last but not the least, I congratulate Shri. Raman Kulkarni and the entire team of Mangrove Foundation for their hard work.

Aaditya Uddhav Thackeray
Minister (Tourism, Environment and
Climate Change, Protocol)
Maharashtra



Moray Eel
Malvan Marine Sanctuary



© Satyajit Mane



GOVERNMENT OF MAHARASHTRA



Maharashtra is extremely rich in terms of biodiversity, we have many amphibians, reptiles, birds, mammals, insects and fishes; some of them are endemic to Maharashtra as well. But usually, when we speak about biodiversity, the very first thing that comes to our mind are the mighty Western Ghats but the mangroves are seldom spoken off. Mangroves provide a safe haven to a number of species and act as a biodiversity hotspot in itself. Mangrove has its own food chain viz. detritus food chain which is responsible for nutrient recycling.

Apart from mangroves, the marine biodiversity of Maharashtra is also lesser-known. It is home to colourful and splendid corals, marine mammals, fishes, sea turtles and many more. Maharashtra also has the largest marine mammal i.e. Blue Whale and the largest fish i.e. Whale Shark and recently Leatherback Turtle which is the largest sea turtle in the world has also been recorded off the coast of Maharashtra.

It makes me really happy to see that all the aspects of coastal and marine biodiversity have been covered in this splendid coffee table book and my compliments to the author and the Mangrove Cell for bringing out such an amazing coffee table book in such a short span of time.

DB

Dattatray Bharane
Minister of State for Public Works
(Excluding Public Undertakings), Soil and
Water Conservation, Forests,
Animal Husbandry, Dairy Development
and Fisheries, General Administration
Maharashtra





GOVERNMENT OF MAHARASHTRA



Mangroves are very specialized group of plants that are found only in the transitional zone between land and the sea. They thrive in a hostile environment battling adverse ecological conditions, such as saline water, lack of oxygen in the soil, alternate exposure and submergence due to tidal action and much more. Despite these adverse conditions India has 46 species of mangroves of which 20 are found in Maharashtra.

I am very glad that this coffee table book has covered most of the mangrove species found in the State with vibrant photographs. These colourful pictures will surely help in sensitizing people about the mangrove diversity of Maharashtra. Furthermore, the coffee table book has some spectacular images, especially about marine invertebrate animals which are generally not seen by the common people. This book will go a long way in bringing this amazing intertidal and marine biodiversity into the limelight.

To conclude I wish all the best to the authors and the Mangrove Cell and Mangrove Foundation staff who have worked passionately on this coffee table book.

Milind Mhaiskar IAS
Principal Secretary (Forests)
Maharashtra



GOVERNMENT OF MAHARASHTRA



Coastal Maharashtra is a treasure trove of rich biodiversity and the sea turtles, dolphins and whales are the flagship species of Maharashtra's coastal and marine biodiversity. Maharashtra is also home to 215 species of freshwater fishes, and 653 species of marine and estuarine fishes too, a fact which is lesser known. As we move towards the landward side from the sea the vast mudflats and serene beaches harbour a very rich avifaunal diversity.

Some of the migratory birds found along coastal regions of Maharashtra are sandpipers, plovers, dunlins, sanderlings, gulls, terns etc. and it is fascinating to see how such small birds make arduous journeys from their breeding grounds in northern countries like Russia, Mongolia, European countries etc. to Maharashtra i.e. their wintering grounds.

Maharashtra has a remarkable variety of marine invertebrates which includes 160 species of molluscs, 162 species of marine bivalves, 450 species of marine gastropods, 37 species of prawns, 104 species of crabs and so on. Thanks to marine researchers these number are ever increasing.

My posting as Deputy Conservator of Forests, Roha forest division, Raigad district, between 1991-1996 exposed me to mangroves for the first time. I was fortunate enough to have had taken up initial works of raising mangrove nursery and plantations on lands taken up as Compensatory Afforestation lands under the provisions of the Forest Conservation Act, 1980. There was a striking need for such a compilation since then.

I am glad the authors have covered these aspects in this coffee table book and have managed to get some spectacular snap-shots of these beautiful animals. This coffee table book will be of great help to let people know about the coastal & marine biodiversity of Maharashtra and I wish the author, Mangrove Cell and the Mangrove Foundation of Maharashtra all the success.

G. Saiprakash IFS
Principal Chief Conservator of Forests
(Head of Forest Force)
Maharashtra State, Nagpur





GOVERNMENT OF MAHARASHTRA



Maharashtra has been endowed with a long coastline of 720 km which features varied habitats like sandy beaches, rocky beaches, estuaries, creeks, mangrove forests, coral reefs, etc. Coastal Maharashtra is extremely scenic and it is no wonder that it has many places which are sought after tourist destinations. In recent years though, there are a lot of eco-tourism destinations which have come up along coastal Maharashtra which offer various exciting activities such as Olive Ridley turtle festivals, Mangrove safaris, Mangrove trails, Dolphin safaris, SCUBA diving for corals etc.

Apart from the charismatic marine fauna such as sea turtles, dolphins, corals, there are a myriad of small and large marine animals which are found in the marine realm such as zoanthids, sponges, various marine invertebrates, octopuses, squids, many varieties of colourful fishes, etc. All these marine creatures are part of the huge marine ecosystem and they all need to be conserved for posterity.

Involvement of local communities whose livelihood is dependant on this resource is of paramount importance in the protection and conservation of these coastal and marine ecosystems and the Maharashtra Forest Dept. has taken steps in providing alternative sustainable livelihoods which acts as an incentive to the local communities & promotes conservation.

It gives me great pleasure to see this coffee table book which has covered all the above mentioned aspects with some amazing photographs. I am sure that this book will serve as a visual treat which will showcase the coastal biodiversity richness of the State and the measures taken up by the Maharashtra Forest Department for its conservation.

Nitin Kakodkar IFS
Principal Chief Conservator of Forests (Wildlife)
& Chief Wildlife Warden
Maharashtra State, Nagpur



GOVERNMENT OF MAHARASHTRA



One of the major components of coastal biodiversity in Maharashtra are the various mangrove species found in the State. Mangrove forest is a unique and highly evolved ecosystem that grows in brackish water where the river meets the sea. They adapt well in a variety of saltwater depths and are the most productive and biodiverse ecosystem on the planet. Mangroves are home to a large number of fishes, crabs, sea snails, shellfish, algae. The leaves and shoots are food for a variety of organisms.

Mangroves protect coastal areas from erosion by stabilizing the shoreline with their specialized root system. They also protect coasts from storms, hurricane and tsunamis. It provides a habitat for hundreds of species of birds, mammals, turtles, fishes, etc. They play an important role in sequestering atmospheric carbon called as 'Blue carbon', resulting in a significant percentage of global carbon storage.

Importance of mangroves and interrelated ecosystem is broadly classified in this coffee table book that will play a vital role in generating awareness about mangroves and the related biodiversity. Apart from coastal biodiversity, this book also highlights the sustainable livelihood activities such as Seabass Cage culture, Ornamental Fish culture, Mussel farming, Oyster farming, Crab farming which are run under the Mangrove Conservation and Livelihood Generation scheme by the Mangrove Cell, Forest Department of Maharashtra and Mangrove Foundation.

The beautiful and vibrant photos used in this book are from the Maharashtra coast and I hope that the readers will be amazed by the rich coastal and marine biodiversity of Maharashtra which is displayed in this book.

Virendra Tiwari IFS
Additional Principal Chief Conservator of Forests
(Mangrove Cell)
Maharashtra State





Lesser flamingo *Phoeniconaias minor*
Thane Creek Flamingo Sanctuary

© Amol Lokhande



Since last 23 years, I have been exploring forests of the Western Ghats especially, from the Maharashtra region. Simultaneously through study of biodiversity and photographic documentation I am also concerned with the wildlife conservation and awareness programs. But till now I had not got an opportunity to stretch my vision towards the 720 Kilometres long coastal region in the state of Maharashtra. Now I have got this opportunity to travel 720 KM coastal area from the Mumbai to the Sindhudurg to study Mangroves and livelihood along this coastal area for the proposed Coffee Table Book by Mangrove Foundation. I owe my sincere gratitude towards Mr. Virendra Tiwari IFS, APCCF, Mangrove Cell and Executive Director, Mangrove Foundation for giving me such a great opportunity.

The coastal region of Maharashtra has 20 species of Mangroves while more than 150 species of associated floral diversity. Many lives like crabs, prawns, fishes and much more invertebrates depending upon these Mangrove forests are found here. Crocodiles, birds, honey bees inhabit these Mangrove ecosystems. The people residing in the coastal region are dependent on the fishing and rice farming. Mangrove ecosystem is not only important due to environment and ecological aspect but also socio-economic aspect. Hence this Mangrove Ecosystem is called as lifeline of coastal region.

Mainly for the coffee table book, information and photographs of mangrove, their flowers, roots and fruits with diversity of animals, birds and reptiles have been collected. Along with this, photographic documentation of estuarine diversity has been made. Due to the specificity in habitat selection of some animals, I had to visit few specific sites for the photography viz. *Sonneratia caseolaris*, *Cynometra iripa*, Marsh Crocodile are found at Songaon and Lesser Flamingo at Thane Creek Flamingo

Sanctuary. Many times we had to travel 20-30 km away from the main roads to collect information and photographic documentation. For exploring this we had planned according to high tide, low tide, types of beaches like sandy, rocky, and muddy.

Mangrove Cell, Maharashtra Forest Department and Mangrove Foundation are taking efforts to conserve these mangrove ecosystems for suitable and sustainable development and this Coffee Table Book is a part of it. The Coffee Table Book also includes projects which are implemented by Mangrove Foundation. Unless and until local people's involvement is ensured, conservation of Oceanic biodiversity and Mangrove ecosystem is not possible. Hence, to strengthen local people's social-economic status Sea Bass and Pearl spot cage Culture, Oyster farming, Crab culture, mussel culture, Marine Ornamental fish culture and Ecotourism have been introduced.

Except the people from coastal region of Maharashtra, no other common people from Maharashtra have awareness about the conservation of Mangrove Ecosystem and the biodiversity which relies on it. Through the effort made by the Mangrove Foundation and Maharashtra Government to publish this coffee table book people will be able to know a lot of hidden things regarding Mangrove Ecosystem and biodiversity. I am very much happy that I have got a crucial opportunity to work on it. I have a sincere view that after the publication of this book people of Maharashtra, India as well as the World will come to know about the Mangrove Ecosystem and its importance.

Raman Kulkarni
Hon. Wildlife Warden, Kolhapur





Flock of Little Stints, Thane Creek

© Amol Lokhande

ACKNOWLEDGEMENT

The study of Mangrove ecosystem extended over 720 Kms is not possible by a single person within a stipulated time. Due to the cooperation of Mangrove Foundation this Coffee Table Book was at its final stage.

I am very much grateful to the Mangrove Cell and their team, especially, Mr. Virendra Tiwari, IFS, APCCF, Mangrove Cell and Executive Director, Mangrove Foundation, Ms. Neenu Somaraj, DCF, Mangrove Cell and Joint Director, Mangrove Foundation, Mr. Adarsh Reddy, DFO, MMCU, Dr. Manas Manjrekar, Deputy Director, Research and Capacity Building, Dr. Sushant Sanaye, Deputy Director, Livelihood Development, Mr. Padmanabh Vaidya, Deputy Director, Finance, Dr. Sheetal Pachpande, Deputy Director Projects, for their support and fruitful production of this coffee-table book.

I also extend my sincere thanks to my support team during this photographic expedition. I would like to thank Abhishek Narvekar, Pranav Mangurkar and Rupesh Sawant for their continuous and restless efforts put into this project.

I also acknowledge all RFO's of Mangrove

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I am also grateful to my friend Mr. Pawan Mane for supporting in designing, compiling and editing of the coffee table book.

Finally, I would like to thank my children Vedhant and Shidhant, My wife Mrs. Asmita Kulkarni and My Mother Swarupa Kulkarni for their endurance without any complain for more than two months of on-field study. I thank one and all for their kind cooperation without whom this Coffee Table Book would have not seen the light of reader.



HISTORY & ORIGIN

Mangrove Cell
Maharashtra Forest Department

Maharashtra has a long coastline of about 720 kilometres, which is home to a diverse range of coastal ecosystems such as mangroves, corals, rocky shores, sandy shores, mudflats, etc. The coastal and marine environment not only supports an astounding variety of flora and fauna but also provides a number of ecosystem services, which are crucial to the sustenance of life and renders livelihood security to coastal communities.

Taking this into consideration, for the protection and conservation of mangrove ecosystem, research programmes on endangered species in coastal and marine habitat and to undertake pilot projects for improving the livelihood of coastal communities through sustainable livelihood activities, The Mangrove Cell was established in 2012 by the Government of Maharashtra under the Maharashtra Forest Department.

Mangrove Cell is headed by Additional Principal Chief Conservator of Forests (APCCF). In addition, Deputy Conservator of Forests (DCF) was appointed to boost the efforts of mangrove protection in the State.

Considering the increased pressures of development, waste dumping, pollution and encroachment in the Mumbai Metropolitan Region, a specialized unit called Mumbai Mangrove Conservation Unit (MMCUC) has been formed under the Mangrove Cell. MMCUC was created by the Government of Maharashtra on May 17, 2013, and is headed by a Divisional Forest Officer (DFO).

The establishment of the Mangrove Cell initiated a series of measures for the conservation of mangroves in Maharashtra. Mangrove Cell has taken a block by block approach towards mangrove conservation from raising mangrove nurseries to large-scale plantations in degraded areas to conducting 'Clean Mangrove Campaigns' to various awareness programmes.



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ABOUT THE FOUNDATION

Mangrove and Marine Biodiversity Conservation Foundation of Maharashtra (Mangrove Foundation)

Villagers harvesting cultured seabass fish from fish cages.

© Pranav Mangurkar

'Working towards conservation of coastal & marine biodiversity & improving the livelihood of the coastal communities through conservation-linked and eco-friendly interventions.'

Mangrove and Marine Biodiversity Conservation Foundation of Maharashtra (Mangrove Foundation), an Autonomous Body under the Revenue & Forests Department, Government of Maharashtra, was set up for recruiting necessary skill sets and operational flexibility to implement conservation programmes across the coastal regions of Maharashtra. Mangrove Foundation is a registered society under the Societies Registration Act, 1860 and it was set up by the Government of Maharashtra vide Government Resolution No. S-30 / 2015/CR 219/F-3 dated 23rd September 2015. The Foundation was launched with a corpus of Rs.115 Crore through which, the Foundation is able to fulfill its mandate of conservation of coastal and marine biodiversity, research and implementation of sustainable livelihood programmes.

Mangrove Foundation works towards the conservation and monitoring of mangroves and coastal biodiversity. The Foundation also supports the implementation of various livelihood activities under the 'Mangrove Conservation and Livelihood Generation Scheme' of Government of Maharashtra. In addition, the Foundation conducts capacity-building programmes for various stakeholders.



Fisherwomen harvesting cultured edible oysters.

© Ramon Kulkarni

INTRODUCTION



India is a country that is surrounded by the sea on three of its sides. The coastal plains in India are along the west and east of the country. The coastline of India extends up to 7516.6 km including the island groups Andaman and Lakshadweep.

Coastal plains in India are of two types :

1. Eastern Coastal Plains of India
2. Western Coastal Plains of India

Western Coastal plains stretches from Kerala in the South to Gujarat in the north passing through Karnataka, Goa and Maharashtra. The western coastal plains stretch for 1500 km north to south and its width ranges from 10 to 25 km.

Maharashtra has a long coastline of about 720 km, which is home to a diverse range of coastal ecosystems such as sandy shores, rocky shores, mudflats, mangroves etc. The coastal region of the Maharashtra state has 7 districts viz. Palghar, Thane, Mumbai City, Mumbai Suburban, Raigad, Ratnagiri and Sindhudurg popularly known as Konkan region.

The coast, also known as the coastline or seashore, is defined as the area where land meets the sea or ocean.



DIFFERENT TYPES OF COASTS IN MAHARASHTRA.

- Sandy beach
- Rocky shores
- Mangroves and mudflats
- Creeks



SANDY BEACH

Sandy shores are covered in sand. Sand is made up of fine grains of rocks, coral and shells. The intertidal beach zone is covered part of the day by water and part of the day it is exposed to air. Sandy shores constitute dynamic environments and unstable substrates, exposing plants and animals to varying and potentially harsh conditions. Tides, waves and swash supply nutrients and food. Maharashtra coast has mainly coarse gravel sandy beaches. Some beaches have high clay content that makes the beaches dark and tightly packed. Several groups of vertebrates make use of sandy beaches for foraging, nesting and breeding. Turtles nest on the backshore of sandy beaches. Birds use the beach for foraging, nesting and roosting.



© Raman Kulkarni



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Horned Ghost Crab *Ocypode ceratophthalmus*

This crab is nocturnal and it has stalked eyes. With a box-shaped body and long legs, these crabs are swift runners on sandy beaches. It is mainly beach scavenger. On being alarmed, the crab quickly disappears into its burrow or plunge into the sea.

◀ **Pearly Sea Anemone** *Paracondylactis sinensis*

Sea anemones are flower like, brightly coloured animals, classified under the phylum Cnidaria. They are distributed in intertidal to deep oceans and live attached with rocks, sea floor, shells and some forms burrow in the mud or sand. They are radially symmetric with columnar body and they have a single body opening-mouth which is surrounded by tentacles.



ROCKY SHORES

Rocky shores are made up of eroded cliffs; wave cut platforms and vertical cliffs. There are about 32 rocky shores along coastal Maharashtra, and they are mainly of laterite or basalt rock formation. Rocky shore habitat is a biologically rich environment and can include many different habitat types such as steep rocky cliffs, platforms, rock pools and boulder fields. Some of the common animal groups inhabiting rocky shores are algae, lichens, sponges, sea anemones, marine worms, molluscs and some fishes.



Sea Anemone

© Hishikesh Rane

Rock Pools or Tidal Pools :
When the tide goes out on a rocky seashore, pools of water are left behind in holes and trenches in the rocks. Tidal pools, are miniature habitats, home to a large range of animals and plants.

© Raman Kulkarni

© Vandana Jhaveri



Spiral Melongena *Volegalea cochlidium*
Volegalea cochlidium, commonly known as a spiral melongena, is a sea snail (gastropod) belonging to the family of conches. The spiral melongena, among others of its kind, is known for laying eggs as capsules in rows on hard surfaces like rocks and each capsule contains many eggs within.

© Raman Kulkarni



Barnacles
Barnacles are arthropod and houses, a set of four to six interlocking calcium carbonate plates with a small hatch door on the top. During the low tide, the barnacle closes up tight to keep moisture inside, but at high tide, the door opens and the barnacle's cirri (feathery feet) emerges out which are specially adapted with tufts and hairs to filter the water to catch small particles of food.



Mangroves at Achara, Sindhudurg

© Pranav Mangurkar



© Ramon Kulkarni

Marsh Crocodiles in the mangrove habitat at Songaon, Ratnagiri district.

MANGROVES & MUDFLATS

Mangroves are trees and shrubs found along the coast or brackish water areas in tropical regions within the intertidal area. During evolution, they have developed special adaptations such as leaves that are capable of excreting excess salts, stilts like supporting roots, or breathing roots that come out of the soil for air intake, seeds that germinate while still attached to the parent plant. All these adaptations enable mangroves to survive in salty, oxygen-poor soil, which is hostile to other trees.



Scan to know more about mangroves



Mudflats are formed mainly by siltation and are a highly productive ecosystem.

© Raman Kulkarni



© Raman Kulkarni

Mangrove habitat forms a very important part of the marine food chain. The dense network of mangrove roots serves as an important breeding ground for many marine organisms, and also provide food and shelter to them. Mangroves prevent coastal erosion by stabilising sediments with their tangled root systems. The mangroves are guardians of the coast, acting as barriers against extreme weather events like storm waves and tsunamis.



Karli River, Sindhudurg

© Pranav Mangurkar



© Ramon Kulkarni

Karli River Creek, Malvan-Vengurla road, Sindhudurg

CREEKS

Creeks are inland brackish water wetlands seen along the coast. Along Maharashtra coast there are about 15 rivers, five major creeks, and 30 backwater regions. All these creeks and estuaries together form the drainage in east-west direction, flowing into the Arabian Sea. The mouths of these rivers and creeks are wide-open and funnel-shaped.

MANGROVE DIVERSITY



Sweet-Scented Apple

Sonneratia alba

Family : Lythraceae

Sonneratia alba, also known as white chippi or sweet-scented apple mangrove is the state mangrove tree of Maharashtra.

Maharashtra is the first state in the country to designate a state mangrove tree which will act as a symbol of mangrove conservation for Maharashtra.

Found in all coastal districts of Maharashtra. Grows 3-15 m tall. Oval to round leaves. Flowers white. Fruit green, edible and large 5 cm, shaped like an apple.



Red Mangrove Apple

Sonneratia caseolaris

Family : Lythraceae

One of the rarest species reported only from Sindhudurg district in Maharashtra. It is an evergreen tree, that grows up to 8m tall. Leaves are rounded, 7cm long and are arranged opposite each other on the branches.

Sonneratia alba has white flowers while *Sonneratia caseolaris* has red flowers.

The fruit is large, about 4 cm across, green leathery berries with a star-shaped base. Fruits are edible.



© Raman Kulkarni



© Raman Kulkarni



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Mangrove Apple
Sonneratia apetala

Family : Sonneratiaceae

Small to medium size columnar tree that can grow up to 20 m tall. The tree occurs on newly accreted soil in moderately to strongly saline areas and is considered as a pioneer species in ecological succession. Leaves simple, opposite, and leathery. Found in Thane, Mumbai and Raigad Districts but rarely found in southern districts of Ratnagiri and Sindhudurg (south of Alibaug). Flowers apetalous, cream coloured, arranged in axillary 3-flowered or 7 flowered dichasial cyme. The flowers have no petals, but 4-5 prominent green sepals.

The most interesting part of the flower is the style, which consists of a white, 2-3 cm long, curved, stigma, flattened like umbrella or mushroom. Fruit is small, 2 cm diameter.



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© Stock Photo - Mangrove Foundation



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River Mangrove
Aegiceras corniculatum

Family : Myrsinaceae

One of the most common mangrove plants. Found in all coastal districts of Maharashtra. Bushy shrub or small tree, grows 1 to 3 m tall. It has no obvious aboveground roots. Leaves alternate and shiny. Small, white, fragrant flowers are seen in clusters. Considered to be a good source for honey. Fruit 5-7 cm long, curved resembling chillies.



Unique habitat of *Avicennia marina* mangrove at Kalinge island.

Grey Mangrove

Avicennia marina

Family : Avicenniaceae

Most common species in Maharashtra. Evergreen tree grows 3 to 14 m tall. Tree base surrounded by pneumatophores upto 30 cm in height. Flowers white or golden yellow, in clusters of 3-5, small, almost 1 cm across. Fruit more or less heart shaped, hairy and smooth, green in colour. Salt crystals usually seen on the leaves.





© Niranjana Chavan



© Raman Kulkarni

White Burma Mangrove

Bruguiera cylindrica

Family : Rhizophoraceae

Evergreen tree growing up to 20 m tall with grey, smooth bark. Oppositely arranged leaves are light green. Cream colour flowers are small in clusters. Propagule 4-15 cm long. Reported from Mumbai, Thane, Raigad and Sindhudurg District. Rare in Ratnagiri District.



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Broad-leaf Orange Mangrove

Bruguiera gymnorhiza

Family : Rhizophoraceae

Evergreen small tree grows up to 10 m high. Flowers red to yellowish or cream-colored, with red to pink-red bell-shaped sepal cup. Petals have bristles at the tip. Fruit germinates on parent plant to form propagule, this propagule when drops down becomes embedded in the mud in an upright position, where they rapidly develop roots. Sparse distribution throughout the coastline of Maharashtra.



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© Ramon Kulkarni

Wrinkled Pod Mangrove
Cynometra iripa

Family : Fabaceae

Very rare species found only in Sindhudurg District. Evergreen tree up to 8-10 m tall. Leaves are compound. Dense inflorescence with white small flowers. Fruits are ellipsoid, compressed, 2-3 cm, full of wrinkles, with lateral beak extending to about 6 mm long, single seeded.

Tall-stilt Mangrove
Rhizophora apiculata

Rhizophoraceae

This mangrove prefers the intermediate estuarine zone in the mid-intertidal region. Mostly found in Ratnagiri and Sindhudurg District. Can grow 20-30 m tall. Leaves are narrowly-elliptic. Flowers small, in pairs on very short stalks. Petals yellow or white, but soon fall after blooming. Propagule smaller, 30 cm long.



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Cannonball Mangrove
Xylocarpus granatum

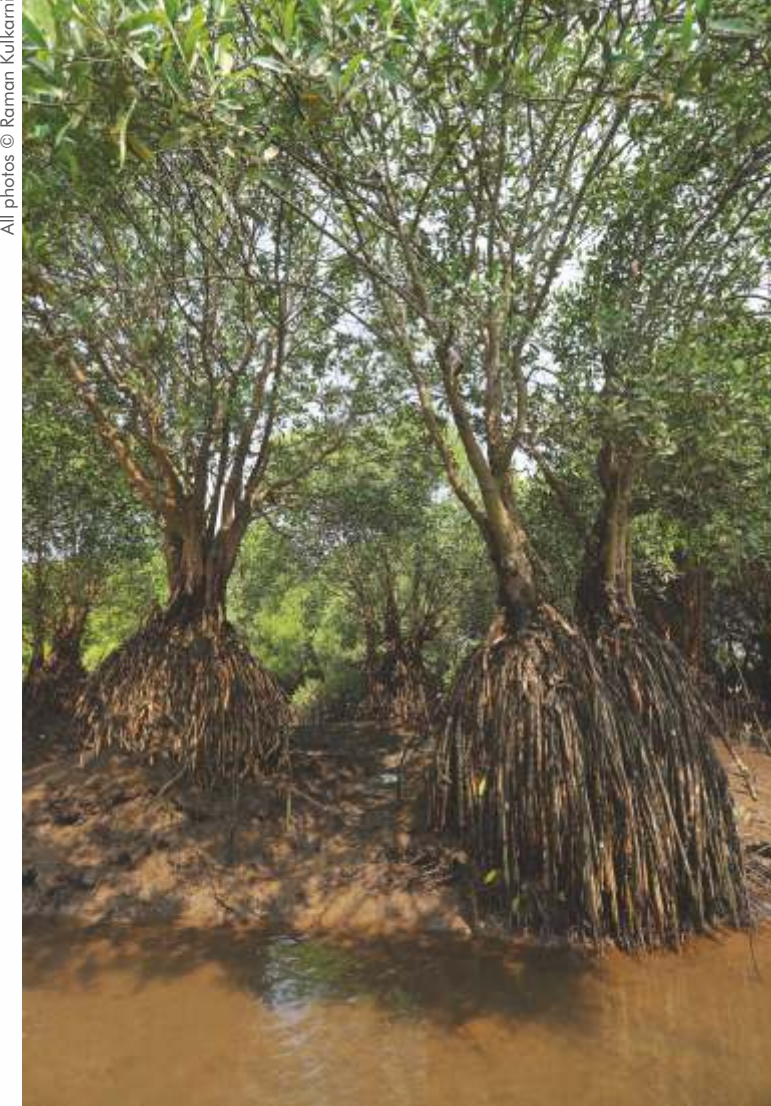
Family : Meliaceae

Medium size mangrove tree growing 3-12 m high. Leaves are abruptly pinnate, with pairs of leaflets which are elliptic or obovate, 8-18 cm long, 4-8 cm wide, with a pointed base and rounded tip. Flowers are small, white, 4-parted, borne on short terminal or axillary panicles. Fruit is very large, spherical, 15-25 cm in diameter, with 8 to 10 seeds. Fruit is known to be consumed by locals for its medicinal properties.



Red Mangrove
Rhizophora mucronata

Family : Rhizophoraceae
Mainly seen along sheltered estuaries and creeks throughout Maharashtra. Large evergreen tree grows up to 15-20 m height. It has well developed aerial stilt roots, which allow easy recognition of this species. Elliptical leaves are usually about 12 cm long and 6 cm wide. Flowers occur as axillary inflorescences and open within the leafy crown hanging downwards from a long peduncle. Fruits develop into long propagules, dull green brown reaching up to 60 cm length.



Narrow-leaved Kandelia

Kandelia candel

Family : Rhizophoraceae

Kandelia is a small tree up to 7 m tall. The stem is thickened but it is without buttresses and pneumatophores. Flowers are whitish, with numerous protruding stamens. Seeds are viviparous, form propagules up to 40 cm long at maturity, capped by the persistent sepals whose tips bend backwards to the fruit stalk.

Sea Holly

Acanthus ilicifolius

Family : Acanthaceae

These plants often cover large areas to form thickets, particularly in degraded patches. Low growing gregarious shrub, up to 1.5 m tall. Leaves look like the spiny holly leaves. Sometimes, the salt can be seen as a white crystalline layer on the upper surface of the leaves. Flowers have a single large petal, showy and light violet. Found throughout Maharashtra.



Mangrove Fern

Acrostichum aureum

Family : Pteridaceae

It is a mangrove fern, growing up to 3 m tall. Rounded leaf tips. Young leaves are reddish. Grows along the estuaries and tidal creeks, often on higher landward ground.



Goat's Foot Glory

Ipomoea pes-caprae

Family : Convolvulaceae

A spreading ground creeper, it can cover 100 ft as it races along the beach, but it never gets more than a few inches high. Alternate leaves are notched at the tip such that they resemble the shape of a Goat's foot. The flowers are very showy, pink to lavender purple funnels about 5 cm long.



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Fragrant Screw Pine, Kevada
Pandanus odoratissimus

Family : Pandanaceae

Commonly known as Fragrant Screw Pine, it is a small branched tree or shrub with fragrant flowers found near beaches of Raigad, Ratnagiri and Sindhudurg. It is a small, slender, branching tree with a flexuous trunk supported by brace roots. With rosettes of long-pointed, stiffly leathery, spiny, bluish-green, fragrant leaves, it bears in summer very fragrant flowers. It is used to make perfume and thus helps generate income for the local community.

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Suicide Tree
Cerbera odollam

Family : Apocynaceae

Highly toxic plant. It grows preferentially in coastal salt swamps and in marshy areas. Flowers are white, showy, star-shaped, 5-7 cm, with a small yellow center. Leaves are 12-30 cm long, oval, dark green and glossy, held in dense spirals at the tips of the twigs. The fruit, when still green, looks like a small mango. On exposure to air, the white kernel turns violet, then dark grey, and ultimately brown or black. The plant as a whole yields a milky, white latex.

FAUNAL DIVERSITY

Crocodyles, birds, fish, crabs and mammals are present in the mangrove ecosystem. Out of the total 4,060 species living in India's mangroves, 969 are floral species, accounting for 40% of the biodiversity and the rest 3,091 are faunal species.

BIRDS

Coastal wetlands in Maharashtra are important habitats for water-birds migrating along the Central Asian Flyway, an umbrella term that comprises multiple migratory routes spanning 30 countries between Siberia (in the north), west and south Asia and the British Indian Ocean Territory. A two-year study by researchers at BNHS has recorded a total 70 species of waterfowl, including nine threatened species, at 99 monitoring sites, spread over Maharashtra's 720 km coastline.



Immature Greater Flamingo at NRI Residency

© Amol Lokhande

Greater Sand Plover *Charadrius leschenaultii*

Size : 22-25 cm

Winter visitor to coasts. Photo taken at Akshi beach, Alibaug in Photography expedition 28 Feb 2021-Tag inscription : X49. This bird was ringed at the same site on 26th September 2019 as a first-year juvenile bird. Since tagging , it has been resighted at the same site in November 2019 and January 2020 in the same season. In the current migratory season, it was recorded from Akshi in November and December 2020 and once in January 2021.

Source : Tuhina Katti, Scientist-B, Wetlands Programme, Bombay Natural History Society (BNHS), India.



© Raman Kulkarni

© Raman Kulkarni



Little Ringed Plover *Charadrius dubius*

Size : 14-17 cm

Widespread resident. Keeps in singly or small flocks on intertidal mudflats, tidal creeks.



Terek Sandpiper *Xenus cinereus*

Size : 22-25 cm

Winter visitor, mainly to coasts. Longish, upturned bill and short yellowish legs. It often forms communal roosts in the branches of mangroves.

© Raman Kulkarni

Kentish Plover *Charadrius alexandrinus*

Size : 15-17 cm

Widespread winter visitor. Small size, pale plover with broken black collar, sandy upperparts, greyish legs, and rather fine black bill.



© Raman Kulkarni



© Raman Kulkarni

Common Redshank *Tringa totanus*

Size : 27 - 29 cm

Common winter visitor. Breeds from NW Himalayas and above and from European countries in West till Japan in East. Orange-red at base of bill, orange-red legs, and broad white trailing edge to wing.



© Raman Kulkarni

Common Sandpiper *Actitis hypoleucos* Size : 19-21 cm
Breeds above NW Himalayas; widespread winter visitor.



© Raman Kulkarni

Ruddy Turnstone *Arenaria interpres* Size : 23 cm
During winter it is seen on rocky and sandy beaches. Short bill and orange legs. Dark brown and white upper side, with rump and tail-coverts white, dark brown crossbar on the tail-coverts.



© Raman Kulkarni

Black-tailed Godwit *Limosa limosa* Size : 36-44 cm
Winter visitor. White wing-bars and white rump with black tail band. Bill slender, straight and slightly upcurved.



© Raman Kulkarni

Black-winged Stilt *Himantopus himantopus*
Size : 35-40 cm
Local migrant and Winter visitor. Slender appearance, with long pinkish legs and a fine straight bill. Black upper wing strongly contrasts with white back in flight.



© Raman Kulkarni

Eurasian Curlew *Numenius arquata*
(Near Threatened)
Size : 50-60 cm
Widespread winter visitor, mainly to coasts. Long-legged bird with a very long and curved bill. Seen singly or in a small flock on mudflats near mangroves.



© Raman Kulkarni



© Ramon Kulkarni

Dark grey morph



© Ramon Kulkarni

White morph

Western Reef-egret *Egretta gularis*

Size : 55-65 cm

Resident. Mainly W and SE coast. Occurs in dark grey, intermediate and white colour morphs. Usually solitary or seen foraging with other egrets.



© Ramon Kulkarni

Grey Heron *Ardea cinerea*

Size : 90-98 cm

Resident. Long legged, long-necked bird of open marshes, mangroves and coastal mudflats. Usually feeds singly.



© Ramon Kulkarni

Black-headed Ibis *Threskiornis melanocephalus*

(Near Threatened)

Size : 75 cm

Common resident bird. Stocky, mainly white with stout downcurved black bill. Seen in small groups on mudflats, aquatic grasses, creeks, mangroves and coastal lagoons.



Lesser Flamingo *Phoeniconaias minor*
(Near Threatened)
Size : 80-90 cm

Local migrant. Shorter and darker rose-pink than Greater Flamingo, with dark red or maroon coloured bill, tipped with black. Male slightly taller than female. Juvenile has brown feather and dark grey beak. Their main diet consists of crustaceans like brine shrimp, phytoplankton and blue-green algae. Lesser flamingos are one of the unique visitors that habitat the mudflats of Mumbai in huge numbers (more than 1,00,000 individuals).



© Raman Kulkarni



© Raman Kulkarni

Greater Flamingo *Phoenicopterus roseus*

Size : 120-145 cm

Local migrant. Easily recognisable bird with long, thin curved neck, long pink legs. Breeds in Kutch in Gujarat. Flamingo occurs in flocks. They feed by filtering particles through tiny platelets in the bill. Feeds with head immersed; often rests on one leg, neck coiled and head tucked in feathers. A census in October 2018 recorded a little over 25,000 individuals of Greater Flamingo in Mumbai.



© Raman Kulkarni

Painted Stork *Mycteria leucocephala*

(Near Threatened)

Size : 93-100 cm

Common , resident. Fabulously coloured with long neck and striking wing pattern. Adult has downcurved yellow bill, bare orange head, and pinkish legs. Seen singly or in small groups foraging in wetlands.

© Raman Kulkarni



Asian Openbill *Anastomus oscitans*

Size : 68 cm

Forages singly or in small or medium-sized flocks. Usually seeks food by submerging its head and opened bill into shallow water and probing bottom mud; the bill is quickly closed on any prey.



© Raman Kulkarni

Lesser black-backed Gull (Heuglin's) *Larus fuscus heuglini*

Size : 58-65 cm

Winter visitor, mainly to coasts. Darkest large gull of region. Adult has darker grey upperparts; head more heavily streaked in non-breeding plumage.



Pallas's Gull *Larus ichthyaetus*

Size : 69 cm

Uncommon Winter visitor. Largest among gulls, with yellow bill having a red patch. In winter, head is white with brown streaks, turns black by February.





© Raman Kulkarni

Brown-headed Gull *Larus brunnicephalus*

Size : 41-45 cm

Common winter visitor. Head greyish white as seen in winter, head becomes brown by March. Prominent white patch near the black wing tips. Large flocks of 200-250 birds seen along the coast. Breeds in Ladakh in June-July.



© Anil Lakhonde

Mixed flock of Common Gull-billed Terns *Gelochelidon nilotica* and Caspian Terns *Hydroprogne caspia* at Panje Wetland, Navi Mumbai



© Raman Kulkarni

Lesser Crested Tern *Thalasseus bengalensis*

Size : 35-37 cm

Found over the entire Indian sea coast in winter. Breeds in Pakistan. Jet-black forehead; white in winter, upper wings, rump and central tail feathers grey, underparts white. Legs black and long sharp bill orange.



© Raman Kulkarni

Whiskered Tern *Chlidonias hybrida*

Size : 23-25 cm

Breeds in Kashmir, winter visitor. In breeding plumage, white cheeks contrast with black cap and grey underparts.



White-bellied Sea-eagle *Haliaeetus leucogaster*

Size : 66-71 cm

Resident. Mainly coasts and offshore islands. Ash-brown large bird with pure white head, neck and short white tail. Wingspan of female up to 2.2 m. Rather sluggish, perching for long periods close to water. Mainly lakes, tidal creeks and mangroves. They usually choose tall trees along the coast to nest, and often renovate their old nests and use them year after year. They feed on fish, turtles and sea snakes.

© Raman Kulkarni



© Anil Lakhande

Osprey *Pandion haliaetus*

Size : 55-58 cm

A dark brownish bird, head is white and brown. The lower part of the body is white. It is a large raptor, diurnal, fish-eating bird of prey with a cosmopolitan range.



© Raman Kulkarni

Black Kite (Black-eared) *Milvus migrans lineatus/formosanus*

Size : 47-60 cm

Overall dark brown kite with variable whitish crescent at primary base on underwing. Juvenile has whitish or buffish streaking on head and underparts.



Brahminy Kite *Haliastur indus*

Size : 45-51 cm

Common resident bird. Adult mainly chestnut, with white head, neck and breast. Frequently perches on tall tree overlooking water.

© Raman Kulkarni



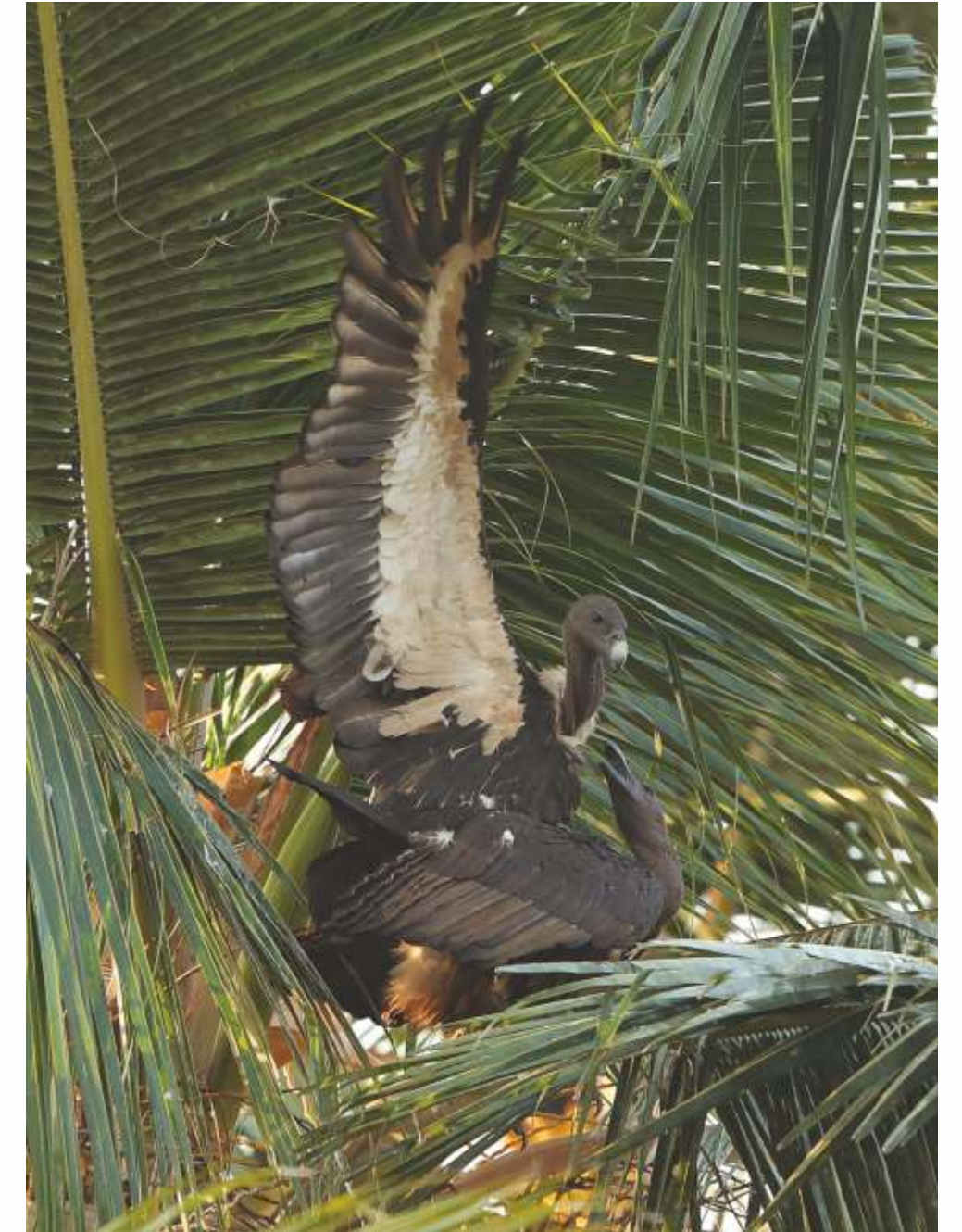
White-rumped Vulture *Gyps bengalensis*

(Critically Endangered)

Size : 75-85 cm

Globally threatened. Adult mainly blackish, with white neck-ruff, white rump and back, and white underwing-coverts. Sexes alike.

Natural efforts to conserve vultures near Mahad in Raigad district over the last 15 years have led to a rise in the bird's population. Vulture conservation efforts are being carried out along Shrivardhan coast in Raigad. 268 White-rumped Vulture have been counted in Shrivardhan and Mhasla. The vulture nests in Shrivardhan areas of Raigad district were extensively damaged due to Cyclone Nisarga that hit Konkan on 2nd June 2020.





© N. Vasudevan

MAMMALS

Marine Mammals

Marine mammals are some of the most interesting organisms on planet earth. In India around 29 species of marine mammals are known to be present out of close to 120 species reported from around the world. Marine mammals are a group of mammals that live in an aquatic environment. Most importantly, they get all or most of their food from the aquatic environment. Cetaceans are a group of marine mammals, which include whales, dolphins and porpoises. Blue Whale, Indo-pacific Finless Porpoise, Indian Ocean Humpback Dolphin, Bryde's Whale are found along the Maharashtra Coast.

Indian Ocean Humpback Dolphin *Sousa plumbea*

This dolphin can grow 1.8 m to 3 m and weigh 250 kg to 300 kg. It can be identified by its characteristic hump topped with a small dorsal fin. Coloured lead-grey with a pinkish tinge on the underside. Best seen at Bhogwe, Mhapan, Devbag, Tarkarli and Vijaydurg creek. Maharashtra government's Mangrove Cell has decided on an action plan to conserve oceanic dolphins along 720 km coastline in line with the Centre's Project Dolphin programme. This is the most common dolphin found in Sindhudurg. These occur close to the shore in shallow waters, mostly around estuaries and river mouths.

Land Mammals

Golden Jackal *Canis aureus indicus*

The Golden jackal has a scraggy, buff-grey coat. Found in forests, grasslands, mangrove, urban and semi-urban areas. In mangroves they are active from dusk till dawn. They feed on crabs, dead fish, rodents, reptiles and insects.



© Raman Kulkarni



Common Leopard *Panthera pardus*

They are found in all types of forests. Due to the reduced habitat of wild animals especially leopard, it has increased the instances of human leopard conflict.



Grey Mongoose *Herpestes edwardsii*

Its tawny grey fur is much more grizzled and coarser than that of other mongooses. Its small legs are darker than its body.



South-Western Langur *Semnopithecus hypoleucos*
The most widely spread langur in Maharashtra. Inhabits all habitats including mangroves and is also found near human settlements.



Indian Flying Fox *Pteropus giganteus*
The only mammal capable of true flight. Indian Flying Fox or Indian Fruit Bat has a chestnut-brown head with large black, pointed ears and huge black wings that it often folds over its tan or orange belly.



Smooth-coated Otter *Lutrogale perspicillata*
The smooth-coated Otter is easily identified by its well-groomed grey-brown coat. The lips, cheek, throat and chest are of this lighter colour. Its paws are brown but lighter than the body. Seen in mangroves, lakes, rivers and dams. They usually dig burrows near water. Otters are excellent swimmers and mainly feed on fish, but will catch crabs, snails, frogs, turtles and even birds. Otters are most active during the early part of the day or in the evening.

© Raman Kulkarni



Thalloid Red Algae
Amphiroa sp.

© Satyajeeet Mane



© Satyajeeet Mane

Scorpion Fish

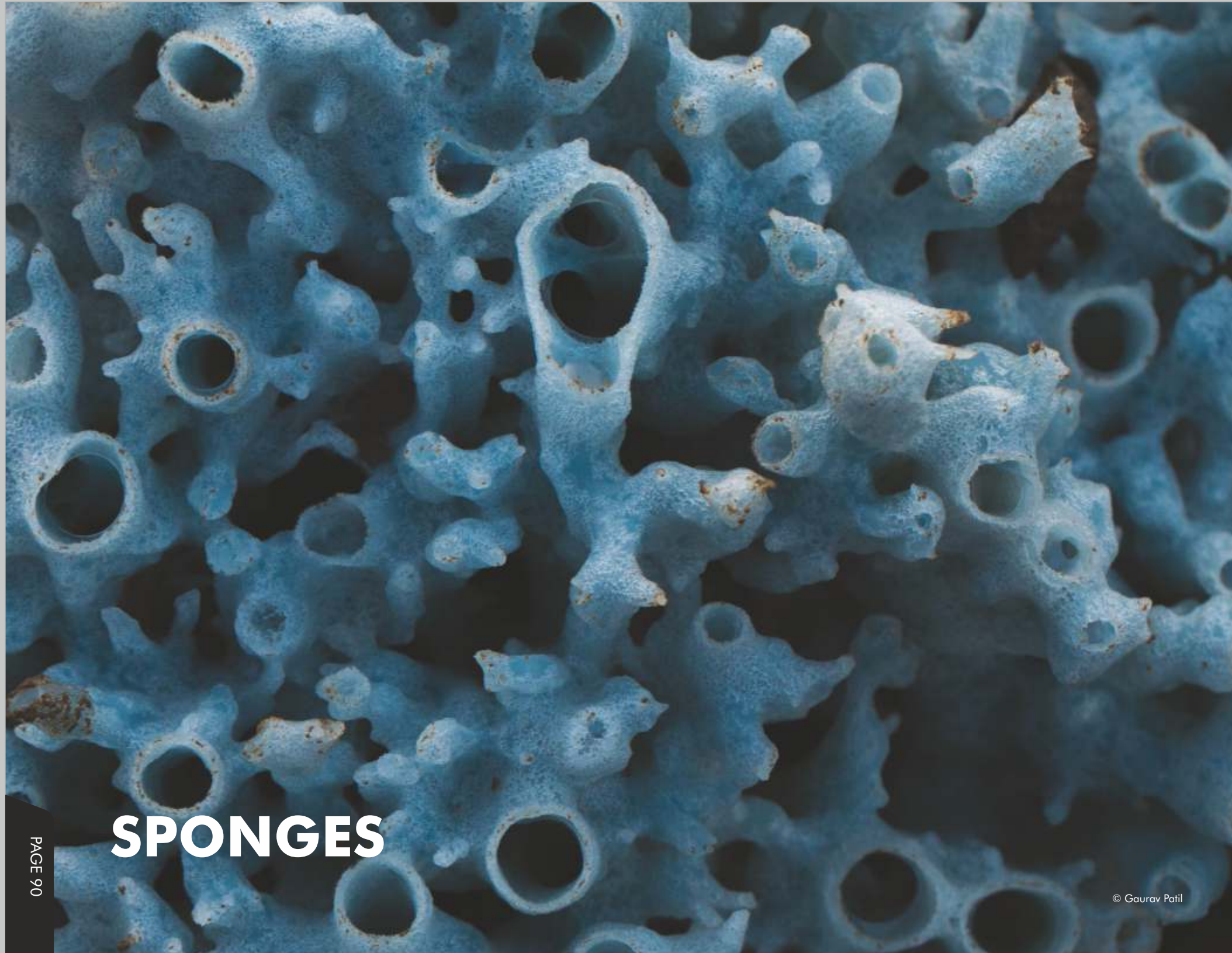


© Satyajeeet Mane

Red-tailed Butterflyfish *Chaetodon collare*

The coastal and marine habitat of Maharashtra is home to diverse life forms which include microscopic planktons to the largest marine mammal on the earth, the Blue Whale. Coral reef pockets along the coastline serve as important habitat for endangered fish, reef fish, sea snakes and a variety of marine invertebrates. Rocky intertidal shores and tide pools harbour a number of sea snails, sea slugs, crabs, sponges, algae and colourful animals such as zoantharians, feather duster worms etc. Sandy shores provide nesting grounds for Olive Ridley sea turtles and also many other animals such as sand bubbler crabs, moon crabs, polychaete worms, sea stars, seashells housed under the sand which are usually difficult to observe. Many marine and estuarine animals are adapted to life in the mangroves and mudflats. Air-breathing sea slugs and snails migrate to and fro with the tides. Fiddler crabs are often seen waving their large claw and mudskippers skipping around on the mudflats.

MARINE DIVERSITY



SPONGES



Although they may appear like plants, sponges are the primitive and simplest of multi-cellular animals. They are very effective filter feeders, since they are able to capture and eat particles as small as bacteria as well as much larger particles. Sponges come in two basic types : encrusting or free-standing. Encrusting sponges typically cover the surface of a rock.



© Satyajeet Mane

Corals

CNIDARIANS

The Cnidarians include the hydroids, jellyfish, zoanthids, anemones and corals. All Cnidarians have tentacles with stinging cells in their tips which are used to capture and subdue prey. In fact, the phylum name "Cnidarian" literally means "stinging creature."



Corals

© Satyajeet Mane



© Harshid Kane

Coral Reef at Angria Bank

Angria Bank is a submerged bank in the Arabian Sea, situated about 100 km. off the coast of Maharashtra, but falling within the Exclusive Economic Zone (EEZ) of the Country. It is a marine biodiversity hotspot with stunning coral diversity and an assemblage of associated fauna. The Mangrove Cell, Maharashtra Forest Dept. has undertaken some exploratory surveys of this site in collaboration with other partner institutions and efforts are on-going to declare this site as a Protected Area.



Zoaanthids

© Satyaajeet Mane

Zoanthids
Zoanthus sansibaricus



© Raman Kulkarni

Sea cucumbers *Holothuria leucospilota*

ECHINODERMS

Gets its name from the Greek, literally meaning "spiny skin." Many echinoderms actually do have "spiny" skin. All echinoderms have a body structure that points outwards from the center of the body. Popularly known creatures from this group are starfish, sea urchins, feather stars, sea cucumbers and sand dollars.

Plain Sand Star *Astropecten indicus*



© Raman Kulkarni

© Harshal Karve



Christmas tree worm

© Raman Kulkarni



Feather duster worm

ANNELIDS

This is a large group of ringed worms including earthworms and their relatives, ragworms, leeches and a large number of mostly marine worms known as polychaetes.



Planaxis sulcatus

© Raman Kulkarni

Sea shells or Shelled gastropods are very common and abundant group of marine animals. The animal is protected by its shell. There are variety of sea shells which are commonly seen and further categorized into various groups based on their morphology and internal anatomy.

MOLLUSCS

Molluscs are most abundant and well known marine invertebrates. Sea snails, clams, mussels, squid and octopus are few examples. They are soft bodied animals and have well developed body organs but lack body segmentation.



Asiatic Hard Clam
Meretrix sp.

© Raman Kulkarni



© Raman Kulkarni

Indian Tibia *Tibia curta*



© Harshali Karve

Pirenella Horn Snail *Pirenella cingulata*



© Raman Kulkarni

Planaxis sulcatus



Gem Sea Slug *Goniobranchus geminus*

© Satyajeeet Mane

Sea Slugs (Nudibranchs)

The name "sea slug" is most often applied to nudibranchs, as well as to a paraphyletic set of other marine gastropods without obvious shells. Sea slugs have an enormous variation in body shape, colour and size.



Military Phidiana *Phidiana militaris*

© Raman Kulkarni



© Pranav Mangurkar
© Harshal Karve

Trapania sp.



© Harshal Karve

Ragged Seahare *Bursatella leachii*



Elegant Nudibranch *Cratena sp.*



© Raman Kulkarni

Indian Squid *Loligo duvauceli*

Indian Squid has reddish brown patches and spots on a pale white body. They are characterized by short life span, high human consumption and high market price. Occurs in reef associated habitats.

Octopus ▶

The octopus has a saccular body; the head is slightly demarcated from the body and has large complex eyes and eight contractile arms. Most octopuses move by crawling along the bottom with their arms and suckers, though when alarmed they may shoot swiftly backward by ejecting a jet of water from the siphon.



© Satyojeet Mane

SQUIDS, CUTTLFISH, OCTOPUS



Sand Bubbler Crab *Dotilla* sp.

© Raman Kulkarni

ARTHROPODS

CRABS & SHRIMPS

Arthropods means " joint-legged." In order to move such a rigid body, it has numerous joints in its exoskeleton.



© Raman Kulkarni



Three Spotted Swimmer Crab *Portunus sanguinolentus*



Red-spotted Box Crab *Calappa calappa*



Cross Crab *Charybdis feriatus*



Fiddler Crab *Austruca* sp.



Banded-leg Swimming Crab *Charybdis annulata*

All photos © Raman Kulkarni



Painted Rock Lobster *Panulirus versicolor*
Occur in rocky habitats and coral reefs up to a depth of 15 m. They are nocturnal, often hiding among rocky crevices during the day.

© Satyajeeet Mane



© Satyajeeet Mane

© Ramran Kulkarni



Indian White Prawn *Fenneropenaeus indicus*

Prawn catch at a fish market



Stingray *Neotrygon indica*

© Satyajeeet Mane

FISH CHORDATES

Fish : Two types of marine fish inhabit the sea : Cartilaginous fish (shark, rays, skates & chimaeras) and bony fish (all other fish).

Chordates : A Chordate is an animal that belongs to the *Phylum chordata*. Most chordates are vertebrates, though chordates includes some small marine invertebrate animals too.

Mudskipper



Shrimp Scad *Alepes djedaba*



Vermiculated Spinefoot *Siganus vermiculatus*



Tonguesole Fish *Cynoglossus* sp.



Mullet *Mugil* sp.



Cloudy Grouper *Epinephelus erythrurus*



Tigertooth Croaker *Otolithes ruber*



Mangrove Red Snapper *Lutjanus argentimaculatus*



Shaw's Sea Snake *Hydrophis curtus*

SEA SNAKES

Sea snakes are among the most venomous of the world's snakes and are completely adapted to life in the sea. A total of 26 species of sea snakes have been reported from India. Sea snakes can hold their breath for a long time. They have a special gland to remove salt water.



© Raman Kulkarni



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Fishing is one of the extractive occupations of mankind older than agriculture. Fish assumes greater significance for the people of Konkan in Maharashtra as it forms one of the most important items of their diet. Fishing also serves as a means of livelihood to a large number of people of Konkan. The fishing industry plays a vital role in socio-economic development.

LIVELIHOOD

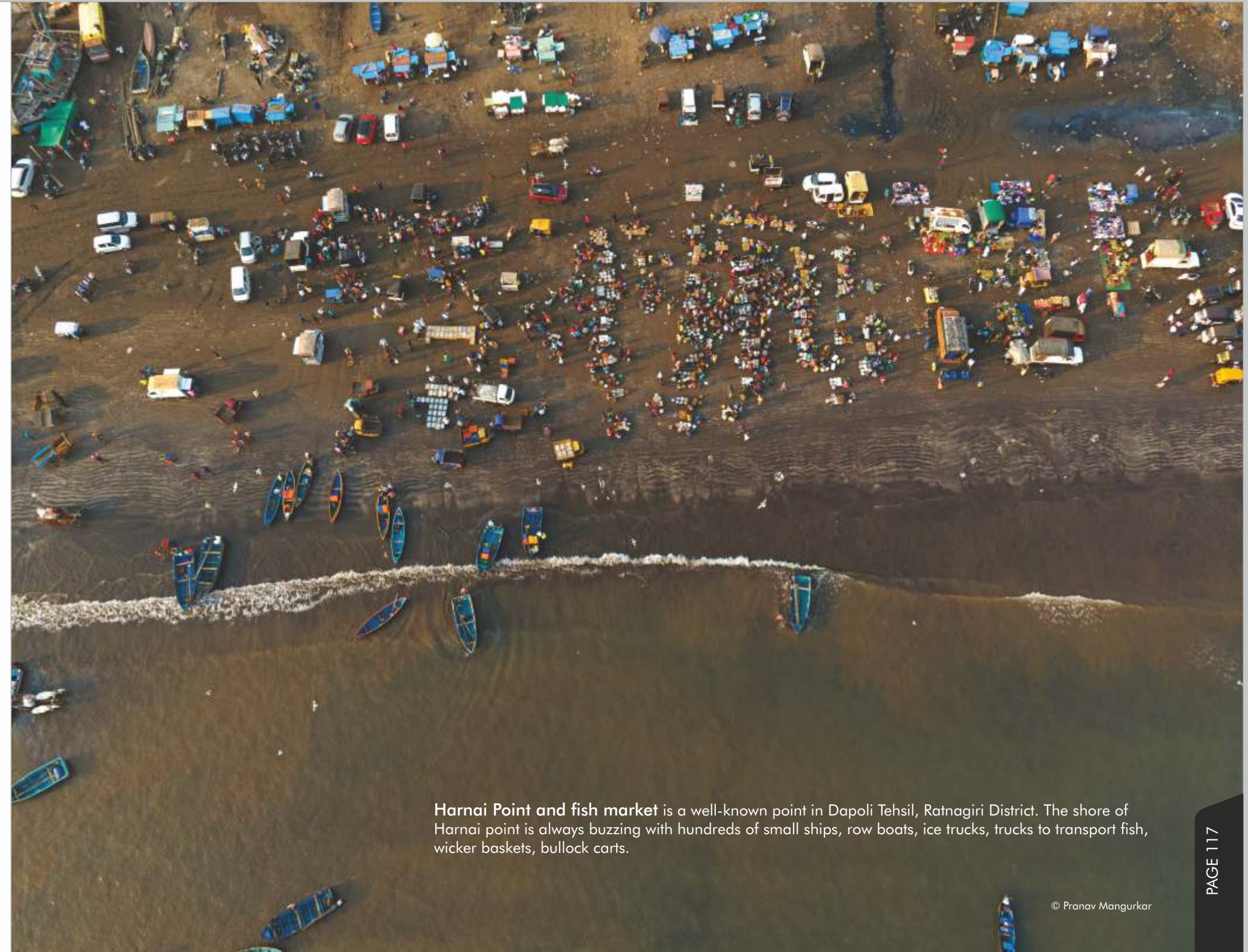
of the common people

◀ Fish auction in Harnai fish market, Dapoli Tehsil, Ratnagiri District.



© Pranav Mangurkar

All the fishing trawlers from Harnai, Dabhol, Veldur, Ratnagiri and even Bankot arrive at the port in the noon and dock there one by one. Sometimes, even the big fishing boats who stay at sea for 3-4 days come back to the port with their catch.



© Pranav Mangurkar

Harnai Point and fish market is a well-known point in Dapoli Tehsil, Ratnagiri District. The shore of Harnai point is always buzzing with hundreds of small ships, row boats, ice trucks, trucks to transport fish, wicker baskets, bullock carts.

Fishes kept on beach for drying.



Fisher women selling dry fish.



© Raman Kulkarni



© Raman Kulkarni

Shrimps have a high market value, special care is taken to preserve it. Tiger prawns and White prawns are the more costlier ones and the costliest of the prawn's family is the lobster.



A large section of fishermen depend on the sale of *Tisare*. Harvesting of *tisare* is done by hand, feet, hand-operated scoop net or with the aid of a digging stick from the beds during low tide by local people.



© Raman Kulkarni

Locally all clams are known as *Mule*, *Tisare* or *Shimpale*. Clams are a traditional staple food for the local population for its nutritional values especially high protein content.



© Raman Kulkarni



© Raman Kulkarni

The local women would work for long hours during low tide to collect the Oysters or Kalva by hand.



© Rupesh Sawant



© Raman Kulkarni



© Raman Kulkarni

Rock Oyster seen commonly on rocky shores in the intertidal zone, can be found at a depth around 15 m. It fixes itself by cementing to rocks or the roots of mangroves.



Coconut *Cocos nucifera* : *Cocos nucifera* or the coconut palm, is a monocot belonging to the family *Arecaceae*, and is a widespread plant in tropical coasts of the world. Coconut palm is also known as "Kalpavriksha" – the tree of heaven.



Practically every part of the plant is used. The fruit of coconut is a drupe and is used in the food, cosmetic, coir and other industries. Additionally the wood, leaves and sap also find commercial and traditional value. Coconut plays an important role in the social, economic and cultural activities of the people.



© Raman Kulkarni

The **Arecanut Palm** *Areca catechu* is the source of common chewing nut, popularly known as betel nut or *Supari*. It is a highly profitable commercial plantation crop in Maharashtra.

These palms have large, evergreen leaves that are either palmately ('fan-leaved') or pinnately ('feather-leaved') compound and spirally arranged at the top of the stem.



© Raman Kulkarni



© Roman Kulkarni



© Dhananjay Joshi

Salt Farming : Salt pans are man-made hypersaline ecosystems from which crude salt is extracted during summer. Salt produced through this natural evaporation process plays a vital role in the economy.



A villager with a Mud crab

© Raman Kulkarni



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Government of Maharashtra, on 20th September 2017, has initiated a scheme on 'Mangrove Conservation and Livelihood Generation' in the coastal districts of Maharashtra. The scheme is being implemented by the Mangrove Foundation through the village-based Mangrove Co-Management Committee (MCMC). Through this scheme, a group activity is entitled to 90% of subsidy while an individual (landowners with more than 1 acre of private mangroves) is entitled to 75% of subsidy for livelihood activities. 114 villages from Palghar, Mumbai Suburban, Thane, Raigad, Ratnagiri, and Sindhudurg have been selected for the implementation of the scheme activities during the year 2017-2021.

LIVELIHOOD ACTIVITIES

run by the Mangrove Foundation



MUD CRAB FARMING

© Stock photo - Mangrove Foundation



Mud Crab Farming

Mangrove provide healthy breeding grounds for crabs, the promotion of crab farming on mangrove lands instills the need for mangrove conservation among the communities. Furthermore, crab farming serves as a resilient livelihood option for the coastal communities over traditional fisheries which is declining day by day due to various factors including delayed rainfalls, sea level and temperature rise.

A programme in mangrove crab farming was initiated by Maharashtra's Mangrove Cell under the Gol-UNDP-GEF project, with the technical help of the Rajiv Gandhi Centre for Aquaculture (RGCA) a society under the Marine Products Export Development Authority (MPEDA). Self-help groups in Achara, Taramumbari, Shiroda among the villages took up this activity following a training programme on crab farming. The programme has given these groups an additional source of livelihood income, a new skill and - as many of them claim - a personal support group.

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OYSTER & MUSSEL CULTURE

Oyster and mussel culture can be taken up as an eco-friendly activity without adversely affecting the environment. Floating rafts made up with bamboo or GI pipes have been used for oyster and mussel farming in Sindhudurg and Ratnagiri districts.

© Raman Kulkarni

Green Mussel Farming

Green Mussel *Perna viridis*

Full-grown mussels are dark green to brown, young mussels are bright green. An adult can grow 150 mm (6 inches) long.

Mussel farming uses various techniques like rack, raft and longline which are robust, eco-friendly methods and there are no extraneous inputs like feed, fertilizer and other materials to the culture system. Thus, the maintenance of the culture system is also comparatively easy.

Raft culture is the most popular method in which seeded ropes are suspended from a raft set at a desirable site and depth in the inshore area. The ropes are set 0.5 to 1 m apart and care is taken to ensure that the end of the rope is about 2 m above the water bottom. Raft culture is more suited to the areas of dense phytoplankton and also to smaller operations, as there is less scope for mechanical harvesting.

The harvest is carried out after a period of six months. Each mussel is generally sold at a price of Rs.12/- to 15/- per piece in wholesale with an average weight of 30 g.



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Oyster Farming Using Floating Bamboo Raft method

© Raman Kulkarni

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Oyster Farming

Oyster farming (*Crassostrea* sp.) is a simple method, which involves setting up of a bamboo raft with substrates in the creeks. The women setup bamboo rack systems which contain strings of oyster shells for capturing oysters spats. The naturally available spat attaches itself to the substrates and in a span of twelve to fourteen months, the oysters achieve commercial size. The activity is eco-friendly and organic in nature. The bivalves being filter feeders, feed on the natural food from the marine environment and help clean the environment where they grow.

FISH CAGE CULTURE

Farmers rear small fishes (size 3-4 inches) in hapa nets in ponds. Once the fish attain a weight of 80-100 g., they are transferred in floating cages in creeks. The cage has two sections which allow the segregation of the fishes according to size. They are covered by nets on the top to avoid predation from birds.

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Floating cages of seabass & pearlspot cage culture

© Stock Photo - Mangrove Foundation



Asian Sea Bass *Lates calcarifer*

Fish Cage Culture

There is a high demand for Asian Sea Bass, Red snapper and Pearl spot fish in the coastal region of Maharashtra. Mangrove Foundation is implementing the activity of sea bass farming on a large scale across the coastal districts of Maharashtra in technical collaboration with ICAR-Central Institute of Brackishwater Aquaculture (CIBA), Tamil Nadu.

The Self-Help Groups formed under the project, undertook the cage farming of the Asian Seabass and Pearl Spot fish using the hatchery produced and nursery grown seeds and formulated feed in the customised cost-effective cages.

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Pearl spot *Etroplus suratensis*

ORNAMENTAL FISH FARMING



Amphiprion sp.

Marine Ornamental Fish Rearing Unit,
Saikrupa Bachat Gat, Gandhinagar,
Vengurla Tehsil, Sindhudurg.

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Ornamental Freshwater Fish Rearing Unit,
Taramumbari, Devgad Tehsil, Sindhudurg.



© Raman Kulkarni

Marine and Freshwater Ornamental Fish rearing :
A hatchery of ornamental fishes such as Clown-fishes has
been set up at Coastal and Marine Biodiversity Centre, Airoli.



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MANGROVE ECOTOURISM

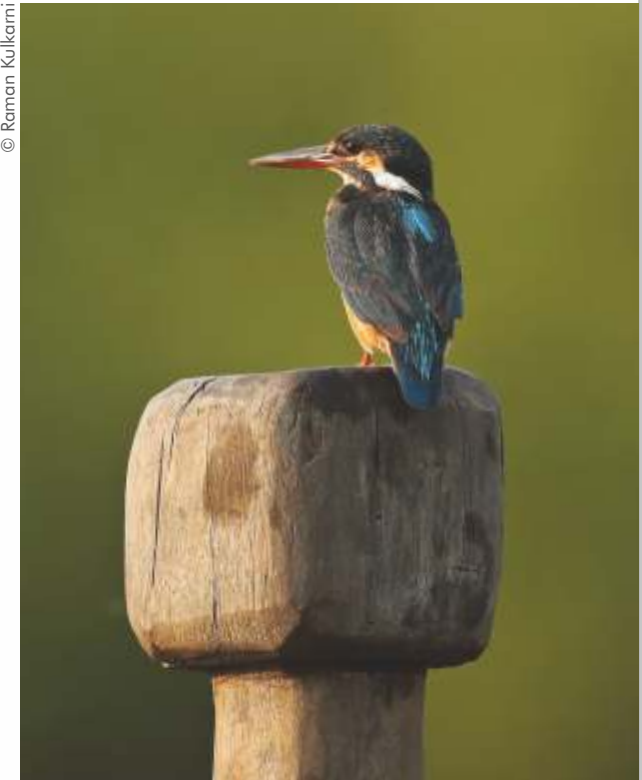
Worldwide, tourism is one of the most important and fast-growing economic sectors. It employs one in every ten people on Earth and provides livelihoods to many more indirectly.

The key players in the protection of mangroves and their habitat are local communities that have a symbiotic relationship with the ecosystem. Sustainable mangrove conservation by local communities can happen when they start deriving tangible benefits from protecting the mangrove ecosystem. Thus ecotourism provides a viable combination of tourism along with ecological and cultural protection, increases awareness about the value of preserving the natural and cultural environments, and also aids in the economic development of the local communities.

The Mangrove Foundation has identified many places having ecotourism potential along coastal Maharashtra and developing them as a Mangrove ecotourism destination, involving local communities, which would be low-impact and as far as possible a small scale alternative to standard mass commercial tourism. This initiative would also emerge as an ideal example of 'community-based conservation sites'.

Several activities like mangrove boat safaris, nature trails, birdwatching, kayaking, stargazing, shore walk and tidal rock pools exploration, snorkelling etc. are planned in coastal villages like Kalinje, Diveagar, Anjarle, Songaon, Taramumbri, Mithmumbri, Achara, Nivti and many more.





Pioneering Mangrove Ecotourism in Maharashtra Swamini, Vengurla

Swamini Self-Help Group in Vengurla, Sindhudurg has done pioneering work in the field of mangrove ecotourism in Maharashtra under the UNDP-GEF Project implemented by Mangrove Cell. It is also the first project of mangrove ecotourism in Maharashtra, run entirely by fisherwomen. The women row the boats themselves and help the tourists in identifying the various mangrove species and associated flora and fauna. The programme was launched on January 26th, 2017 and is running successfully till date.

With the help and support of experts in form of various workshops, capacity building programmes and provision of basic amenities during the project duration, the Swamini Self-Help Group successfully modelled a mangrove ecotourism programme around the Mandvi creek and has been recognised nationally as well as internationally.



© Vandana Jhaveri

Mangrove Safari / Mangrove Walk

While the main focus of ecotourism initiatives are mangrove conservation, protection and livelihood generation for local communities, they share their traditional knowledge and passion in a channelised manner wherein tourists can learn and appreciate the mangroves as an entire ecosystem and also understand the ecological benefits which the mangrove provides.



Marine walk at Anjarle

© Pranav Mangurkar

Rock Pools or Tidal Pools



© Raman Kulkarni

Sea Anemone



© Raman Kulkarni

Barnacles



© Raman Kulkarni



© Raman Kulkarni

A zoanthid colony in the intertidal region at Nepeansea Road, Mumbai

Shore Walk and Tidal Rock Pools Exploration

An entirely new concept in mainstream ecotourism that takes people to a different journey altogether. A guided walk on a sandy and rocky shore and tide pools of Anjarle can reveal many hidden marvels of marine life and gives you an opportunity to understand the fragile and often overlooked marine ecosystems. This visit will introduce you to a variety of seashells and bivalves, sea anemone, marine crabs, sea-star and much more.



Mangrove Kayaking

Kayaking is typically considered an adventure sport; however, a guided kayak ride in narrow mangrove channels can give you an opportunity to observe mangroves, how they have adapted to survive in unfavourable conditions and biodiversity which thrives in this environment which is hostile to most organisms.



© Raman Kulkarni

© Raman Kulkarni



Asian Openbill *Anastomus oscitans*



© Raman Kulkarni

Nature trail and Birdwatching

Mangroves and their surrounding habitat harbours a rich avian diversity, many wading birds such as sandpipers, spoonbills, storks, flamingos are particularly attracted to the mudflats



© Raman Kulkarni

Woolly-necked Stork *Ciconia episcopus*

Celebrating the journey of sea turtles

Out of seven, five species of sea turtles are known to inhabit Indian coastal waters and islands : Green, Hawksbill, Olive ridley, Loggerhead and Leatherback sea turtle have been recorded from coastal Maharashtra.

Raigad, Ratnagiri and Sindhudurg districts have sporadic nesting sites of Olive ridley sea turtles. Females come on the sandy beach to lay eggs, while males never come back on the land. At many nesting sites 'Turtle Festival' is organised by locals in collaboration with the Mangrove Cell, Maharashtra Forest Department to create awareness and to protect the nesting site of the sea turtles. Each year thousands of tourists visit these sites to witness the epic journey of the hatchlings of Olive Ridley Sea Turtle from the nest to the sea.



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Anjarle, Velas and Kelshi beaches are important nesting site for Olive Ridley Turtles in the Dapoli region. From this turtle conservation programme was born the Turtle Festival with the intention of increasing awareness of this species and linking conservancy with livelihood for the villagers who protect them. The Velas-Anjarle residents offer home-stay arrangement for tourists. The turtle conservation programme has an economic value for the villagers.

Crocodile safari and unique habitat of *Kandelia candel*

Songaon is a small village situated on the banks of River Vashishti in Ratnagiri district. Creeks and islands around Songaon are rich in biodiversity and harbour a large number of rare mangrove species *Kandelia candel*. A major attraction here is the Marsh crocodiles that inhabit the islands and riverbank of Vashishthi, tourists can take a boat ride to see these rare mangroves and Marsh Crocodiles.



© Raman Kulkarni



Visit Aquaculture sites, Mangrove plantation sites during trails/boat safari

Mangrove Cell and Mangrove Foundation are implementing various livelihood activities under the 'Mangrove conservation and livelihood generation scheme' of the Government of Maharashtra. Tourists can visit such sites under ecotourism where these projects are being implemented and understand more about these activities.



Suvarnadurg Fort

History and heritage

Konkan is known for its rich history and heritage, the coastal belt of Maharashtra has many forts, temples and other places of historical importance. Sindhudurg has the only known sacred grove dedicated to mangroves. Including such sites in the ecotourism circuit will result in a better visitor experience and create awareness about the rich history and heritage woven around the natural areas.



Stargazing

Many of these ecotourism sites offer dark and clear skies which are ideal for stargazing and visitors can immerse themselves in a starry night and explore worlds beyond.



Visitors can take a boat ride in the sanctuary to witness thousands of Flamingos and other migratory birds.

© Raman Kulkarni

© Suresh Varak



Thane Creek Flamingo Sanctuary (TCFS)

Thane Creek is Asia's largest creek with a length of 26 km. Large patches of mangroves border the Thane creek and protect the city of Mumbai, Thane and Navi Mumbai from natural calamities, such as storms and tsunamis. The mangrove ecosystem here acts as an important coastal biodiversity heritage site in the middle of a metropolitan region. Its vibrant avian diversity has earned it the distinction of being declared an Important Bird and Biodiversity Area (IBA) by BirdLife International. More than 200 species of birds have been reported from this place. Among these, the splendidly coloured flamingoes are the topmost attraction in addition to various other migratory birds and waders. The elusive Golden Jackal has also been reported multiple times from the sanctuary.

The Mangrove Cell has undertaken a major project for bird conservation in this mangrove-rich area. Coastal and Marine Biodiversity Centre has been set up to support conservation education, sensitise visitors about the coastal and marine biodiversity of Maharashtra, especially Thane Creek and the need to conserve this unique ecosystem.

Based on the 'International Climate Initiative' Agreement between the Government of India and the Federal Republic of Germany, a bilateral project towards improving the conservation of marine biodiversity called "Sustainable Management of Coastal and Marine Protected Areas" (SM-CMPA) was launched in Maharashtra with the help of the German agency called GIZ. The project led to the notification of the Thane Creek Flamingo Sanctuary. This is Maharashtra's second marine sanctuary, the first being the Malvan Marine Sanctuary in Sindhudurg.

© Raman Kulkarni



Coastal and Marine Biodiversity Centre (CMBC)

© Suresh Varak



Mangrove Boardwalk opens to a deck offering a panoramic view of Thane Creek Flamingo Sanctuary



Malvan Marine Wildlife Sanctuary

Malvan is known for its historical heritage and scenic beauty and hence has a good potential for tourism development. It is famous for the Sindhudurg Fort, standing in the open sea constructed by the Maratha King Chatrapati Shivaji in the 16th century. The fort is declared as a national monument and is under the control of the "Archaeological Survey of India". Several tourists visit this place every year.

Owing to the rich marine biodiversity in this region the Government of Maharashtra has declared a part of Malvan coastal waters as Marine Sanctuary in 1987. The total area of Marine Sanctuary is about 29.12 sq. km. The core zone of about 3.2 sq. km. includes the Sindhudurg Fort, Padmagad Fort and submerged rock patches and sandbanks.

Malvan Marine Sanctuary consists of a myriad of biodiversity comprising undisturbed coral reefs, several marine organisms comprising many scheduled and protected species like Dolphins, Fishes, Molluscs, Pearl Oysters, Sea Anemones, Polychaetes, Seagrass etc. The declaration of the Sanctuary ensured the conservation of this unique marine environment through preservation and regulations.



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Sindhudurg Fort



Scuba diving



© Satyajiit Mohe

Jellyfish



© Satyajiit Mohe

Coral



Corals

© Harshal Karve

THREATS

Decline in mangrove cover over the last few decades is reported from many areas worldwide. In the past few decades rapid urbanization and population growth has resulted in the reduction of mangrove forest. Mangroves in and around Mumbai have undergone massive destruction in the past.

Mumbai faces a huge risk from large amounts of solid waste and effluents that enter its natural ecosystem. It is believed that about 70 per cent of Mumbai's mangroves have been destroyed due to various developmental activities.

Mangroves act as a barrier against natural disasters but sometimes, disasters could in turn, affect mangroves. It is one of the most important issues that is universal in nature and cannot be attributed to just one state. Increase in temperatures, rise in sea levels, increasing frequencies of natural calamities are all repercussions of Global Climate change which in turn will have its own impact on mangroves.



MANGROVE CONSERVATION IN MAHARASHTRA

A watershed in mangrove conservation in the state was the order of the Hon'ble High Court of Bombay dated 6th October 2005 which contained several directions towards mangrove conservation in the State. The most important among these was the one that mandated the State to declare all mangroves on Government land as Protected Forests. By 2008, 5,469 hectares of mangroves in and around Mumbai were notified as 'Protected Forests'. In 2013, the State government decided to elevate the status of mangrove forests on government land from 'Protected Forests' to 'Reserved Forests'. Today, about 17,091 hectares of mangroves on government land, in seven coastal districts in Maharashtra, are notified as 'Reserved Forests'. On 5th January 2012, a dedicated unit called the "Mangrove Cell" was established for the protection of mangroves. As the country's first such unit, its creation has led to the unprecedented extension of the activities of Maharashtra Forest Department to the coastal areas. A series of measures for conservation of mangroves have been initiated by the Mangrove Cell.

ACTIONS BY THE MANGROVE CELL

Hundreds of thousands of mangrove saplings were raised in nurseries for establishing mangrove plantations in different coastal districts. Saplings of all 20 mangrove species, including Rare, Endangered and Threatened (RET) species, found in Maharashtra have been raised at the nurseries. In the first three years alone, plantation programmes were carried out in over 2 sq. km. (200 hectares) of degraded mangrove areas in the Greater Mumbai region. Patrolling was intensified in mangrove areas, leading to the booking of a large number of offence cases, seizure of vehicles and arrest of offenders. Thousands of illegal shanties, which had cropped up on mangrove lands in various parts of Mumbai have been given notices for evacuation and many removed through a sustained campaign, overcoming stiff resistance from powerful forces. In an effort to closely monitor the status of mangroves in Maharashtra, satellite mapping of mangrove areas was carried out, district by district, on a 1:5000 scale and the areas in the possession of Forest Department were demarcated on the ground with clear boundary markings.





Save Mangroves

Mangroves support biodiversity and fish nurseries, reduce erosion, protect coasts, regulate the climate and provide various ecosystem services.

International day for the
Conservation of the Mangrove Ecosystem

26 July



Mangrove Cell
Forest Department
Maharashtra



Mangrove Foundation
Mangrove and Marine Biodiversity
Conservation Foundation of Maharashtra

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