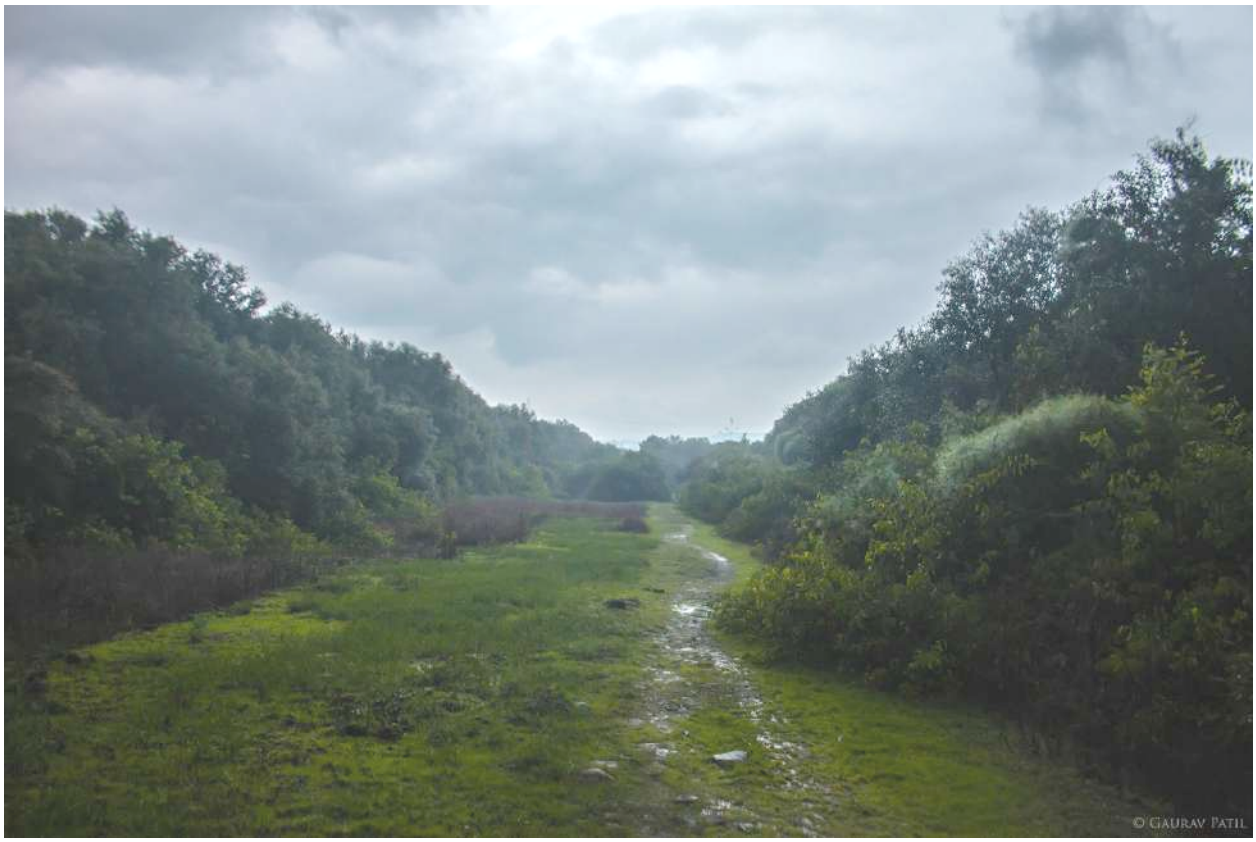
June 2017

The Essence of Mangroves

-by Sayee Girdhari



Pic 1: Mangroves in the monsoon. Photo credit: Gaurav Patil

Things that fascinate me about Mumbai are the movie stars, the local trains and the Mangroves!

Just imagine a coastal swamp. Marshy, beaten up by the waves continuously, flooded by water sometimes and completely dry at others, all in the same day! Nothing stays constant here. The hot, humid air and salty waters make it impossible to live here for anyone. Who would want to stay here and even if someone does, how?! That's what the Kingdom Plantae was busy thinking while some opportunist brave souls among them thought, 'why not!' and thus began their evolutionary journey to this impossible habitat.

What are Mangroves?

'Mangroves' are essentially woodlands or shrub lands inhabiting the coastal areas in many part of the world, including countries like United States, Australia, Brazil,

Papua New Guinea, Mexico, Nigeria, Indonesia, Bangladesh, and of course, India.

The term 'Mangrove' is used to refer to the swamps, or the entire vegetation in swamps, or simply the species of genus Rhizophora, that dominates the mangrove population. Biologically, mangrove is a tree/ shrub that shows all the adaptations required to survive in the marshes. They may be found along the rivers or in the intertidal zones along the coasts or in the estuaries.

Pic 2: Flowers of the Rhizophora species

Know thy mangroves

There are core mangroves and 'mangrove associates', that grow along with mangroves but show few to no adaptations. They differ according to the local diversity.

The mangroves are broadly known by 3 types – red mangroves (family Rhizophoraceae), white or grey mangroves (family Combretaceae) and black mangroves (family Acanthaceae).

Mangroves in India exhibit great diversity represented by 59 species (inclusive of some mangrove associates) from 29 families. Of these, 34 species of 21 families are found along the West coast, while 48 species along the east coast, some species being common on both these coasts. About 15 species of are found in various parts of Mumbai, which includes Vasai creek, Thane creek, Malad, Mahim, Bandra, Versova, Siwari, Diva and more.

The most abundant mangrove in Mumbai is Avicennia marina, commonly called grey mangrove or 'Tiwar' in Marathi. Other species found are Rhizophora apiculata, R. mucronata, Avincennia officinalis, Acanthus ilicifolius, Salvadora persica, etc.

How do they choose their land?

Mangrove ecosystem is extremely rich, unique, fragile and irreplaceable. It starts like every other 'sere' in the environment. It starts with land and proceeds towards the water. Plants with high tolerance to salinity, like Porteresia coarctata (family Poaceae) or members of family Cyperaceae, which are eventually replaced by the next batch of plants. Finally, the mangrove shrubs take over, moving towards the sea. This ecosystem has now reached a climax. The submerged banks are occupied by stable vegetation, which provides shelter to millions of organisms, both aquatic and terrestrial, exhibiting the 'circle of life'.

How were they formed?

Formation of mangrove members takes place by one of the most interesting phenomenon, known as 'convergent evolution'.

Convergent evolution is independent evolution of different species to produce similar features. 'Analogous structures' is a characteristic of this kind of evolution. These structures may or may not have the same functions, but they were not present in the last common ancestor of those species. To understand it better, consider 'flight' in insects, birds, Pterosaur and bats, whose functionally similar structure – the wings – have developed through convergent evolution.

So, various trees developed a few similar features through convergent evolution to form a group that we call 'Mangrove'.

Salient features of mangroves

We know the mangroves live in conditions that are very different from a normal

plant habitat. They have practically no constant substratum as the silt keeps moving according to the river flow or tidal action, the water level changes drastically throughout the day, the swamps have extremely low oxygen levels and only water available is highly saline. Despite these harsh conditions, mangroves thrive so well, owing to the following adaptations.

1. Adaptations to swamp habitat

For standing in loose soil, the roots have taken up various forms in mangroves, like:

i) Stilt roots – they hold the mangrove canopy above water preventing complete submergence

ii) Knee roots – they literally look like a leg bent in the knee, which hoist the crown safely above water. The bent knee structure enhances the plant's stability in powerful tides.

2. Adaptations to low oxygen

Only 2 genera of mangroves, Avicennia and Sonneratia spp produce these roots called 'pneumatophores'. They are aerial branches of underground roots that grow vertically. They are seen poking out of the soil. They are green, porous and 30 cm. to 3 m. long. The pores, called lenticels, facilitate gaseous exchange. The pneumatophores also store air so that the plant is never deficient even if the breathing roots are submerged. How smart is that!

3. Adaptations to salt

It is a myth that mangroves need saline soil for growth. They grow very well in normal conditions, as well. They are just very well prepared to tackle the salts.

Red mangroves have highly suberised (suberin, a waxy substance) roots that block most of the sodium salts from entering the plant. If some salts still enter the system, they are stored in the vacuoles. The white or grey mangroves have specialized salt glands on their leaves, which exude excess of salts, giving them the white appearance.

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4. Adaptations to draught

The mangroves practically live in water but very little is suitable for survival and they have to work hard to filter out the salts. Hence, they also have mechanism to limit water loss, which is quite similar to those seen in Xerophytes (the desert-dwellers). They control opening of stomata to reduce evaporation, strategically position the leaves to avoid direct exposure to harsh sun and absorb moisture from the air. The leaves also store water and are hence thick and leathery.

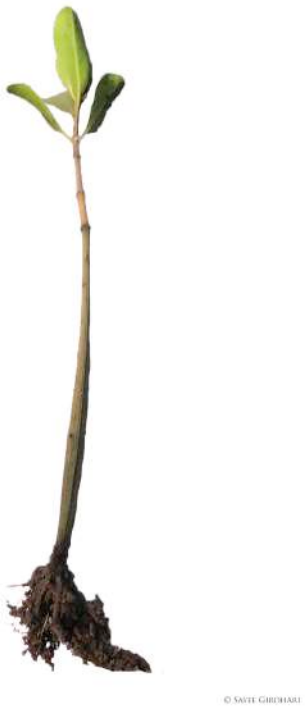
5. Adaptations for nutrient uptake

As if anoxic conditions weren't harsh enough, the anaerobic bacteria in swamps emit free nitrogen, inorganic phosphates, sulfides and methane, all of which are useless for the plants. Hence, they have to employ the pneumatophores for gas and nutrient uptake.

6. Adaptation for propagation

In harsh habitat, it is impossible to achieve seed germination, which is the first step in propagation of a plant. Mangroves, however, have devised a mind-blowing mechanism to ensure survival of their offspring. They exhibit 'Vivipary' i.e. the seeds germinate inside the fruit while it is still on the parent plant. Once germinated, the seedling stays inside the fruit or protrudes out of the fruit, forming a ready-to-go plantlet.

The propagule falls off due to weight and floats on water horizontally. Once the roots are produced, it becomes vertical and anchor in mud. If it does not find a suitable place, it changes its density, becomes horizontal again and travel great distance through water.



Pic 3: An example of a propagule. Photo credit: Sayee Girdhari

Mangroves the Saviors

Mangroves cover the entire coastal land, from soil to water. However, they are not a continuous patch of vegetation but show zonation.

1. Proximal zone/ Front mangroves

Very close to water, this area is very dynamic and inhabited by Rhizophora species that produce sturdy stilt roots. Sometimes, Avicennia and Sonneratia are also found on rocky or coral substrates.

2. Middle zone/ Mid mangroves

Right in the swamps grow the brave Bruguieria, Lumnitzera, Ceriops, Aegiceras, etc. that have strong knee roots supporting their trunks.

3. Distal zone/ Back mangroves

Some mangroves associates like Excoecarus agallocha, Heritiera littoralis, Xylocarnus spp occur in this zone, which is almost like regular land.

The zonation isn't strictly followed and is more distinct in creek regions. The zones are determined by water levels and salinity, which is well defined in an estuary, hence the prominent classification in its mangroves.

Mangroves grow very close to the coast. They act as buffer zone between land and sea. They not only reduce the force of the waves but also help humans maintain a safe distance from the waters. They play the guards that can save the land dwellers from impact of tsunamis. Their roots hold the soil tightly, forming lands in waters. Their vast root systems supports greatly diverse populations of mollusks, fishes, crabs and reptiles while dense canopies are home to many native and even migratory birds.

The flamingos that visit Mumbai every year take shelter only in the mangroves. Mammals like tigers, jackals, wolves (latest discovery!), crabs eating macaques, etc. have specially modified themselves to reside in the mangroves. They trap carbon and lock it in the swampland, filtering out even the heavy metals. They are natural sewage treatment plants that keep the trash we conveniently hurl in the creeks, from reaching the waters and people think mangroves are wastelands and simply ask for them to be destroyed!

Pic 4: Flamingoes, regular visitors to the mangroves. Photo credit: Gaurav Patil

Land reclamations for construction, agriculture and so-called 'development', dumping of waste, deforestation, fuelwood collection and over-harvesting in Mangroves is already doing the job quite efficiently. It is just a matter of time till we would no longer see them on Mumbai coasts.

The sad state of mangroves

There has been 40% reduction in mangrove cover of Mumbai in the past decade. It is alarming because they are the reason our fishermen get their fishes and they are reason Mumbai hasn't turned into Atlanta yet. We will have to face grave consequences if we are too late in saving the last unfortunates patches of this highly misunderstood, mysterious forest. All we need to save them is awareness and little compassion towards them.

About the author:

Sayee Girdhari is a Botany student who has recently completed her masters from Pune University. With a specialization in plant biotechnology she looks to further her work in plant taxonomy and aid her research for the conservation work in the future.