Geography, UG, 4th Semester, Generic
GEO-GE-03-TH: Environmental Geography

Topic: Mangrove Biome

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Mangrove Biome

A **mangrove** is a shrub or small tree that grows in coastal saline or brackish water (tidal areas). The term is also used for tropical coastal vegetation consisting of such species.

The word mangrove can describe a single plant or it can refer to a whole community of plants.

Mangroves are often a huge community of trees & shrubs of different species.

They are halophytes (Salt loving). Most plant cannot survive in salty conditions; mangroves have to adaptations to thrive here.

Mangroves form highly productive ecosystems, providing habit for marine and terrestrial species.

Mangrove lives in two worlds at once, acting as the interface between land and sea.

Geographical regions

Mangroves occur worldwide in the tropics and subtropics, mainly between latitudes

Mangroves can be found in over 118 countries and territories in the tropical and subtropical regions of the world. The largest percentage of mangroves is found between the 5° N and 5° S latitudes. Approximately 75% of world's mangroves are found in just 15 countries. Asia has the largest amount (42%) of the world's mangroves, followed by Africa (21%), North/Central America (15%), Oceania (12%) and South America (11%).

Mangrove in India

Mangrove forests are found in the coastal areas of India. The two largest concentrations are at Sunderban in Bengal and Pichavaram in T.N. The Sundarbans is the largest mangrove forest in the world, located in the Ganges River delta in Bangladesh and West Bengal. The Pichavaram mangroves in Tamil Nadu is also India's one of the largest mangrove forests.
Mangroves are found in coastal areas.

Characteristics of Mangrove Biome

The mangrove biome, or mangal, is a distinct saline woodland or shrubland habitat characterized by

- Depositional coastal environments, where fine sediments (often with high organic content) collect in areas protected from high-energy wave action.
- The saline conditions tolerated by various mangrove species range from brackish water, through pure seawater (3 to 4%), to water concentrated by evaporation to over twice the salinity of ocean seawater (up to 9%).
- Mangrove forests move carbon dioxide "from the atmosphere into long-term storage" in greater quantities than other forests, making them "among the planet's best carbon scrubbers".

Mangal Ecology

Above and below water view at the edge of the mangal.

- Mangrove swamps (mangals) are found in tropical and subtropical tidal areas. Areas where mangroves occur include estuaries and marine shorelines.
- These are growing in intertidal region. High tide brings in salt water, and when the tide recedes, solar evaporation of the seawater in the soil leads to further increases in salinity.
- The return of tide can flush out these soils, bringing them back to salinity levels comparable to that of seawater.
- At low tide, organisms are also exposed to increases in temperature and reduced moisture before being then cooled and flooded by the tide. Thus, for a plant to survive in this environment it must tolerate broad ranges of salinity, temperature, and moisture, as well as a number of other key environmental factors.
- Mangrove plants require a number of physiological adaptations to overcome the problems of low environmental oxygen levels, high salinity and frequent tidal flooding. Each species has its own solutions to these problems; this may be the primary reason why, on some shorelines, mangrove tree species show distinct zonation.
- Once established, mangrove roots provide an oyster habitat and slow water flow, thereby enhancing sediment deposition in areas.
- The fine, anoxic sediments under mangroves act as sinks for a variety of heavy (trace) metals which colloidal particles in the sediments have scavenged from the water.
- Mangrove swamps protect coastal areas from erosion, storm surge (especially during hurricanes), and tsunamis.
- The mangroves' massive root systems are efficient at dissipating wave energy. They slow down tidal water so sediment is deposited as the tide comes in, leaving all except fine particles when the tide ebbs. In this way, mangroves build their own environments.

Mangrove swamps' effectiveness in terms of erosion control. Wave energy is low in areas where mangroves grow, so their effect on erosion is measured over long periods. Their capacity to limit high-energy wave erosion is in relation to events such as storm surges and tsunamis.

The unique ecosystem found in the mesh of mangrove roots offers a quiet marine region for young organisms. In areas where roots are permanently submerged, the organisms they host include algae, barnacles, oysters, sponges, and bryozoans, which all require a hard surface for anchoring while they filter feed. Shrimps and mud lobsters use the muddy bottoms as their home. Mangrove crabs munch on the mangrove leaves, adding nutrients to the mangal mud for other bottom feeders. Mangrove plantations in Vietnam, Thailand, Philippines and India host several commercially important species of fishes and crustaceans.

Mangrove forests are an important part of the cycling and storage of carbon in tropical coastal ecosystems.

Adaptations of Mangrove

1. Adaptations to low oxygen

A red mangrove, *Rhizophora mangle*.

Red mangroves, which can survive in the most inundated areas, prop themselves above the water level with stilt roots and can then absorb air through pores in their bark (lenticels).

Black mangroves live on higher ground and make many pneumatophores (specialised root-like structures which stick up out of the soil like straws for breathing) which are also covered in lenticels.

These "breathing tubes" typically reach heights of up to 30 cm, and in some species, over 3 m.

The four types of pneumatophores are stilt or prop type, snorkel or peg type, knee type, and ribbon or plank type.

2.Nutrient uptake

Because the soil is waterlogged, little free oxygen is available. Anaerobic bacteria liberate nitrogen gas, soluble ferrum (iron), inorganic phosphates, sulfides and methane, which make the soil much less nutritious.

Pneumatophores (aerial roots) allow mangroves to absorb gases directly from the atmosphere, and other nutrients such as iron, from the inhospitable soil. Mangroves store gases directly inside the roots, processing them even when the roots are submerged during high tide.

3.Limiting salt intake

Salt crystals formed on grey mangrove leaf.

Red mangroves exclude salt by having significantly impermeable roots which are highly suberised (impregnated with suberin), acting as an ultra-filtration mechanism to exclude sodium salts from the rest of the plant.

Analysis of water inside mangroves has shown 90% to 97% of salt has been excluded at the roots. In a frequently cited concept that has become known as the "sacrificial leaf".Mangroves can also store salt

in cell vacuoles. White and grey mangroves can secrete salts directly; they have two salt glands at each leaf base (correlating with their name—they are covered in white salt crystals).

4. Limiting water loss

Because of the limited fresh water available in salty intertidal soils, mangroves limit the amount of water they lose through their leaves. They can restrict the opening of their stomata (pores on the leaf surfaces, which exchange carbon dioxide gas and water vapour during photosynthesis). They also vary the orientation of their leaves to avoid the harsh midday sun and so reduce evaporation from the leaves.

5. Increasing survival of offspring

Red mangrove seeds germinate while still on the parent tree.

In this harsh environment, mangroves have evolved a special mechanism to help their offspring survive. Mangrove seeds are buoyant and are therefore suited to water dispersal. Unlike most plants, whose seeds germinate in soil, many mangroves (e.g. red mangrove) are viviparous, meaning their seeds germinate while still attached to the parent tree. Once germinated, the seedling grows either within the fruit (e.g. *Aegialitis*, *Avicennia* and *Aegiceras*), or out through the fruit (e.g. *Rhizophora*, *Ceriops*, *Bruguiera* and *Nypa*) to form a propagule (a ready-to-go seedling) which can produce its own food via photosynthesis.

The mature propagule then drops into the water, which can transport it great distances. Propagules can survive desiccation and remain dormant for over a year before arriving in a suitable environment. Once a propagule is ready to root, its density changes so the elongated shape now floats vertically rather than horizontally. In this position, it is more likely to lodge in the mud and root. If it does not root, it can alter its density and drift again in search of more favorable conditions.

Plants Found in this Habitat

There is not a lot of plant diversity (number of species) in mangrove swamps. There are three kinds of mangroves: black, red and white.

The most common species of mangrove found in the inland swamps is the

Black mangrove. Black mangroves have roots that stick straight out of the water to reach the air. This is important for the plant, which is rooted in underwater soil where gas exchange is poor. These roots are called ***pneumatophores.***

Red mangroves are the most common coastal mangroves. They are the mangroves that have the strange, arching roots – called ***prop roots*** – that most people think of when they hear of mangroves. Prop roots grow down on the trunk of the mangrove until they reach the surface of the water where they will branch over and over forming a thick web of roots. These roots do the plant's gas exchange when out of the water. They also provide shelter for many animal species. The red mangroves located on the ocean side of their habitat are vitally important because they trap sand. This slows coastal erosion and builds a foundation for other plants to grow like sea grape, buttonwood, pines, ferns, black

and white mangroves. Red mangroves also protect the coast from storm damage by slowing storm surges and tidal waves.

White mangroves grow further inland out of the water, so do not need arching roots or special structures for reaching the air.

Animals Found in This Habitat

Mangrove swamps are rich habitats full of animals like the snowy egret, white ibis, **brown pelican**, frigate birds, cormorants, mangrove cuckoos, **herons**, **manatees**, monkeys, turtles, lizards like **anoles**, **red-tailed hawks**, eagles, **sea turtles**, **American alligators** and **crocodiles**. The mangrove roots house smaller animals like the **mangrove tree crab**, spotted mangrove crab, **snails**, **barnacles**, oysters, mussels, **anemones**, and sponges. Because they have thick vegetation for hiding and are rich in organic matter (dropped leaves, buds, seeds, bark, etc.) which provides food, they act as a nursery habitat for many species of larval shrimps and crabs. Many species of fish also feed there including: bonefish, tarpon, sheepshead, jacks, snappers, gar, mullet and moles. Other invertebrates (no backbone) are also found there like worms, protozoa, bacteria. The bacteria in mangroves are very important, acting as decomposers and breaking down organic matter making it is available to the food web.

Functions of Mangrove

Direct Productive Functions

- High quality construction timber and Fuel wood (high calorific value), Pulp wood
- Fodder for domestic animals
- Non timber forest products (tannin, medicines,)

Ecological functions

- Spawning and nursery grounds for fish and
- Maintaining delta building process (land forming)
- Soil conservation (along river and creek banks)
- Habitat for wildlife (birds, crocodile, etc)

Protecctive functions

- Storm protection (hydraulic resistance against storm surge)
- Shelter
- Shoreline protection.

Threats to Mangroves

- Mangrove forests are fading into disappearance all over the world.
- They were estimated to cover 18.1 milion sq. Kn worldwide but a more recent study estimates it around 15 million sq. Km.
- The world mangrove experts opine that the mangroves may be totally lost within 100 years.
- In the selected tropical coastlines such as delta areas of Ganges-Brahmaputra, Irrawaddy and Niger as well in the coastlines of the Malacca Straits, Borneo and Madagascar, mangrove areas are under heavy human pressure.