Marine and Coastal Ecosystems – Seagrasses, Mangroves and Corals

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Seagrasses

Introduction

Seagrasses are underwater plants that evolved from land plants. Unlike terrestrial plants, however, they do not have strong stems to hold themselves up—instead they're supported by the buoyancy of the water that surrounds them. Seagrasses are the only flowering plants which grow in marine environments**.** Seagrasses are a very important food source and habitat for wildlife, supporting a diverse community of organisms including fish, octopuses, sea turtles, shrimp, blue crabs, oysters, sponges, sea urchins, anemones, clams, and squid. Seagrasses have been called "the lungs of the sea" because they release oxygen into the water through the process of photosynthesis. There are about 60 species of fully marine seagrasses which belong to four families Seagrasses can reproduce sexually or asexually. They are flowering plants that produce seeds. Pollen is carried through the water to fertilize female flowers. Seagrasses can also send out rhizome roots that can sprout new growth, so a single plant is capable of producing an entire underwater meadow. The grasses help lessen the effects of strong currents, and also provide concealment and a place for eggs and larvae to attach.

Global Biodiversity of Seagrasses

Distribution and Genera

Seagrasses are distributed across various bioregions, with the highest diversity found in the Tropical Indo-Pacific, where up to 14 species can coexist in a single area [1]. The global distribution of seagrass genera is quite consistent, with both hemispheres sharing 10 genera, while each hemisphere has one unique genus. The following table summarizes the number of genera:

Family	Number of genera
Zosteraceae	2
Hydrocharitaceae	7
Posidoniaceae	3

Biodiversity of Seagrasses in India

In India, seagrass meadows are predominantly found along the coasts of the Arabian Sea and the Bay of Bengal. The country hosts around 10 species of seagrasses from various genera. These species contribute significantly to local biodiversity and play crucial roles in coastal protection, carbon sequestration, and as nursery habitats for fish.

Conservation Status

Despite their ecological importance, seagrass habitats face threats from coastal development, pollution, and climate change. Conservation efforts are essential to protect these ecosystems, which support not only marine biodiversity but also the livelihoods of coastal communities [2].

In summary, while global seagrass diversity is relatively low with about 72 species across 12 genera and 3 families, regions like the Tropical Indo-Pacific exhibit remarkable richness. In India, approximately 10 species contribute to coastal biodiversity, underscoring the need for conservation initiatives to safeguard these vital ecosystems. Some important species of sea-grasses are:

1) ***Thalassia testudinum*:** commonly known as Turtlegrass, is a species of marine seagrass. It forms meadows in shallow sandy or muddy locations in the Caribbean.
2) ***Posidonia oceanica*:** commonly known as Neptune grass or Mediterranean tapeweed, is a seagrass species that is endemic to the Mediterranean Sea.
3) ***Zostera marina*:** commonly known as Common eelgrass. It lives in cooler ocean waters in the North Atlantic.
4) ***Zostera noltii*:** is a species of seagrass commonly known as Dwarf eelgrass. It is found in shallow coastal waters in north western Europe.
5) ***Halophila ovalis*:** commonly known as paddle weed, spoon grass or dugong grass. It is a small herbaceous plant that occurs in sea beds and other saltwater environments in the Indo-Pacific.

Mangroves

Introduction

Mangroves are a group of trees and shrubs that live in the coastal intertidal zone. There are about 80 different species of mangrove trees. All of these trees grow in areas with low-oxygen soil, where slow-moving waters allow fine sediments to accumulate. Many mangrove forests can be recognized by their dense tangle of prop roots that make the trees appear to be standing on stilts above the water. Mangrove forests are vital ecosystems found in tropical and subtropical regions, primarily between latitudes 25° North and 25° South. They cover approximately 15.2 million hectares globally, distributed across 123 countries and territories, with the highest diversity observed in Southeast Asia. The largest areas of mangrove forests are located in Indonesia, Brazil, Nigeria, and Mexico [3].

Genera and Families

Globally, there are about 70 species of true mangroves, which belong to approximately 20 genera within 12 families. The most prominent families include:

- Rhizophoraceae (e.g., Rhizophora)
- Avicenniaceae (e.g., Avicennia)
- Sonneratiaceae (e.g., Sonneratia)
- Combretaceae (e.g., Laguncularia)

These species exhibit adaptations that allow them to thrive in saline coastal environments, contributing to their unique ecological roles.

Mangrove Biodiversity in India

India's mangrove cover is approximately 4,975 square kilometers, accounting for about 3.3% of the world's total mangrove area. In India, mangroves are found on the east and west coasts of the mainland and on the Islands of Andaman and Nicobar and Lakshadweep. Indian mangroves represent 3.3% of global mangroves and about 56% of global mangrove species. The Sundarbans mangrove forest, one of the largest such forests in the world (140,000 ha), lies on the delta of the Ganges, Brahmaputra and Meghna rivers on the Bay of Bengal. The area is known for its wide range of fauna.This coverage represents 0.15% of India's total geographical area. The Sundarbans in West Bengal is the largest mangrove region in India and also one of the largest in the world [4].

Genera and Families

In India, there are about 69 species of mangroves identified across various states, with a significant concentration along the eastern coast. The distribution includes:

- 63 species on the eastern coast
- 37 species on the western coast
- 44 species in the Andaman and Nicobar Islands

Key genera found in Indian mangroves include:

- Avicennia
- Rhizophora
- Bruguiera
- Sonneratia

These genera contribute to the complex intertidal ecosystems that provide habitat for numerous marine and terrestrial species.

Characteristics

Plants of mangroves grow in saline, waterlogged and anaerobic conditions. They have specialized above ground roots called breathing roots or pneumatophores. Mangrove forests are rich in biodiversity and acts as habitat for wildlife. The roots of the trees hold the soils together and thus do not allow it to erode. The mangroves' massive root systems are efficient at dissipating wave energy.

Some important species of mangroves are:

1. ***Rhizophora mangle*:** the red mangrove, is distributed in estuarine ecosystems throughout the tropics.
2. ***Avicennia marina*:** commonly known as grey mangrove or white mangrove, is a species of mangrove tree classified in the plant family Acanthaceae
3. ***Avicennia germinans*:** commonly known as black mangrove refers to the color of the trunk and heartwood. Black mangrove grows in coastal tidal areas throughout the tropics and subtropics of America and Africa.
4. ***Rhizophora mucronata*:** commomly known as loop-root mangrove, red mangrove or Asiatic mangrove, is a species of mangrove found on coasts and river banks in East Africa.
5. ***Excoecaria agallocha*:** a mangrove species, belongs to the genus Excoecaria of the family Euphorbiaceae. The species has many common

names, including: blinding tree, buta buta tree, milky mangrove, poison fish tree, and river poison tree.

Importance to fisheries

- Mangrove forests provide habitat and refuge to a wide array of wildlife such as birds, fish, invertebrates, mammals and plants.
- Estuarine habitats with coastal mangrove shorelines and tree roots are often important spawning and nursery territory for juvenile marine species including shrimp, crabs, and many sport and commercial fish species such as redfish, snook and tarpons.
- Endangered species such as the small tooth sawfish, manatee, hawksbill sea turtle, key Deer and the Florida panther rely on this habitat during some stage of their life cycle.

Corals

Introduction

Corals are marine invertebrates within the class Anthozoa of the phylum Cnidaria. Each individual coral animal is called a polyp, and most live in groups of hundreds to thousands of genetically identical polyps that form a 'colony'. The colony is formed by a process called budding, which is where the original polyp literally grows copies of itself. Coral species include the important reef builders that inhabit tropical oceans and secrete calcium carbonate to form a hard skeleton. There are about 799 species known of corals.

Each polyp is a sac-like animal typically only a few millimeters in diameter and a few centimeters in height characterized by a simple stomach with a single mouth opening surrounded by stinging tentacles. Although some corals are able to catch plankton and small fish using stinging cells on their tentacles, most corals obtain the majority of their energy and nutrients from photosynthetic unicellular dinoflagellates, zooxanthellae, that live within their tissues. During feeding, a coral polyp will extend its tentacles out from its body and wave them in the water current where they encounter small fish, plankton or other food particles. Corals breed sexually by spawning. The larva formed by fusion of egg and sperm is known as a planula. Coral is generally classified as either "hard coral" or "soft coral". There are around 800 known species of hard coral, also known as the 'reef building' corals.

Coral reefs are among the most diverse ecosystems on Earth, hosting a vast array of species, including corals themselves. The biodiversity of corals is measured in terms of the number of genera and families, which varies significantly across different regions, particularly in hotspots like the Coral Triangle and India.

Global Coral Biodiversity

The Coral Triangle, which includes parts of Indonesia, Malaysia, Papua New Guinea, the Philippines, the Solomon Islands, and Timor-Leste, is recognized as the global epicenter of marine biodiversity. This region is home to approximately 605 species of hard corals, accounting for 76% of the world's total coral species (798). The Bird's Head Peninsula in Indonesian Papua is particularly notable, hosting 574 species alone [5].

Taxonomic Diversity

- Number of Families: The Coral Triangle encompasses around 70 families of corals [5].
- Genera Count: There are approximately 200 genera of corals found within this region [5].

Comparison with Other Regions

In contrast to the Coral Triangle:

- The Great Barrier Reef in Australia has fewer than 500 coral species.
- The Caribbean Sea hosts only about 61 species [5].

Coral Biodiversity in India

India's coral reefs are primarily found along its eastern and western coastlines, particularly in the Andaman and Nicobar Islands and the Gulf of Mannar.

India is home to around 150 species of corals, which belong to approximately 50 genera and around 20 families [5]. While this number is significantly lower than that found in the Coral Triangle, India's coral reefs are crucial for local biodiversity and fisheries.

Notable Areas

- The Andaman and Nicobar Islands are recognized for their rich coral diversity, with various endemic species present.
- The Gulf of Mannar Marine National Park is another significant area where coral diversity can be observed.

Conservation Status

India's coral reefs face numerous threats from climate change, pollution, and overfishing, leading to a decline in coral health and biodiversity. Initiatives for conservation are crucial to protect these ecosystems, which support both marine life and human livelihoods.

Coral reefs are vital to marine biodiversity, with the Coral Triangle serving as a global hotspot. In contrast, India's coral diversity, while lower in comparison, remains significant within its ecological context. Conservation efforts are essential to maintain these diverse ecosystems against ongoing environmental threats.

Some important species of corals are:

1. ***Acropora palmata*:** Elkhorn coral is an important reef-building coral in the Caribbean. The species has a complex structure with many branches which resemble that of elk antlers; hence, the common name.
2. ***Acropora cervicornis*:** commonly known as Staghorn coral.
3. ***Dendrogyra cylindricus*:** Pillar coral is a hard coral found in the western Atlantic Ocean and the Caribbean Sea.
4. ***Orbicella annularis*:** commonly known as the boulder star coral, is a species of coral that lives in the western Atlantic Ocean.
5. ***Orbicella faveolata*:** commonly known as mountainous star coral, is a colonial stony coral in the family Merulinidae. It is native to the Caribbean Sea.

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