Seagrass: The Lungs of Ocean

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ABSTRACT

Seagrass ecosystems, often overshadowed by more conspicuous marine habitats, play a vital role in marine ecology and coastal resilience. Seagrasses, the sole marine representatives of Angiospermae, are widely distributed across shallow coastal areas, salt marshes, and estuaries globally. They serve as essential habitats and nursery grounds for diverse marine species, supporting intricate food webs and providing refuge from predators. Seagrass meadows act as filters, stabilizing sediments, improving water quality, and mitigating the impacts of waves and storms on coastlines. Economically, seagrasses contribute significantly to commercial fisheries and nature-based tourism industries. Despite their importance, seagrass habitats face threats from human activities such as trawling, dredging, and pollution. Restoration efforts, including replanting and reseeding techniques, are underway to conserve and restore seagrass ecosystems. Overall, seagrasses emerge as critical "ecosystem engineers" essential for maintaining coastal biodiversity and resilience in the face of climate change and anthropogenic pressures.

INTRODUCTION

Seagrass ecosystem is one of the most productive habitats in sea, has received less attention compared to most charismatic or conspicuous marine ecosystems such as coral reefs or mangroves. With unique adaptation to survive under saline environments, seagrasses have colonized near shore coastal beds of all continents in the world except Antarctica. They undergo aquatic pollination with the seeds being dispersed in

water to colonize new habitats. Seagrass meadows act as filters to the benthic habitats, stabilizing sediments, checking nutrient run – off, extracting pollutants from water and sequestering carbon from the atmosphere. Their ability to sequester carbon from the atmosphere and store it in oceanic sediments as "blue carbon" also makes them critical in tackling climate change. Due to their immense role in the benthic marine ecosystems, seagrass meadows are globally regarded as "ecosystem engineers". Seagrass meadows serve as refuge, nursery and feeding grounds for a range of marine vertebrates and invertebrates (Jackson *et al*., 2001).

Distribution

Seagrasses are the sole marine representatives of the **Angiospermae.** They all belong to the order **Helobiae.** There are currently some 60 species recognized, in 12 genera. The origins of the seagrasses appear to have been around the ancient Tethys Sea, bounded by Africa, Gondwana and Asia, around 100 million years ago. Seagrasses are commonly found in shallow coastal marine locations, salt-marshes and estuaries; in the tropics they are often found associated with mangroves. They are widely distributed in both tropical and temperate coastal waters creating one of the most productive aquatic ecosystems on earth. Due to the high primary production and a complex habitat structure, seagrass beds support a variety of benthic, demersal and pelagic organisms. The global distribution of seagrass genera is remarkably consistent north and south of the equator. The northern and southern hemispheres share ten seagrass genera and only have one unique genus each. Some genera are much more speciose than others, with the genus Halophila having the most seagrass species. They are mainly found in bays, estuaries and coastal waters from the mid-intertidal (shallow) region. Most species are found in shallow inshore areas. Seagrasses inhabit all types of ground (substrates), from mud to rock.

Major Seagrass habitats of India

S.No	Region	Estimated area (ha)	Number of species reported
1.	Gulf of Mannar and Palk Bay, Tamil Nadu (Bay of Bengal)	6911	14
2.	Andaman and Nicobar Islands (Bay of Bengal)	881	12
3.	Lakshadweep Islands (Arabian Sea)	72	10
4.	Gulf of Kutch, Gujarat (Arabian Sea)	1700	8
5.	Chilka lake, Odisha (Bay of Bengal)	8547	8

(Pande *et al*., 2021)

Reproduction

Seagrass can reproduce sexually or asexually. Pollen is carried through the water to fertilize female flowers. Male seagrass flowers release pollen from stamens into the water. This pollen often collects into stringy clumps. Then the clumps are moved by currents until they land on the pistil of a female flower and fertilization takes place. Seagrasses can also send out rhizome roots that can sprout new growth, so a single plant is capable of producing an entire underwater meadow (Green and Short, 2003).

Importance of seagrass

Sea grass meadows are among productive aquatic ecosystems in biosphere. Seagrass provides food and shelter for many organisms, and are a nursery ground for commercially

important prawn and fish species. Seagrass supports numerous herbivores and detritivore-based food chains, and are considered very productive pastures of the sea. The associated economic values of seagrass meadows are very large, although is difficult to quantify. Feeding ground for both grazing on leaves or epiphytes and predation on other organisms, so, sea grass acts many levels of atrophic chain.

Ecosystem support:

Seagrasses provide food, shelter, and essential nursery areas to commercial and recreational fishery species and to countless invertebrates living in seagrass communities. Some fish such as seahorses and lizard fish, can be found in seagrasses throughout the year, while other fish remain in seagrass beds during certain life stages.

Food:

While some organisms, including the endangered dugong, manatee and green sea turtle, graze directly on seagrass leaves, others use seagrasses indirectly to provide nutrients. Bottlenose dolphins are often found feeding on organisms that live in seagrass areas. Detritus from bacterial decomposition of dead seagrass plants provides food for worms, sea cucumbers, crabs, and filter feeders such as anemones and ascidians. Further decomposition releases nutrients (such as nitrogen and phosphorus), which, when dissolved in water, are re-absorbed.

Nursery areas:

The relative safety of seagrass meadows provides an ideal environment for juvenile fish and invertebrates to conceal themselves from predators. Seagrass leaves are also ideal for the attachment of larvae and eggs, including those of the sea squirt and mollusk (Mathews *et al*., 2010).

Habitat:

While seagrasses are ideal for juvenile and small adult fish for escape from larger predators, many infaunal organisms (animals living in soft sea bottom sediments) also live within seagrass meadows. Species such as clams, worms, crabs, and echinoderms, like starfishes, sea cucumbers, and sea urchins, use the buffering capabilities of seagrasses to provide a refuge from strong currents. The dense network of roots established by seagrasses also helps deter predators from digging through the substratum to find infaunal prey organisms. Seagrass leaves provide a place of anchor for seaweeds and for filter-feeding animals like bryozoans, sponges, and foams. (Mathews *et al*., 2010)

Water Quality:

Seagrasses help trap fine sediments and particles that are suspended in the water column, which increases water clarity. When a sea floor area lacks seagrass communities, the sediments are more frequently stirred by wind and waves, decreasing water clarity, affecting marine animal behavior, and generally decreasing the recreational quality of coastal areas. Seagrasses also work to filter nutrients that come from land-based industrial discharge and stormwater runoff before these nutrients are washed out to sea and to other sensitive habitats such as coral reefs.

Stabilization:

Ocean bottom areas that are devoid of seagrass are vulnerable to intense wave action from currents and storms. The extensive root system in seagrasses, which extends both vertically and horizontally, helps stabilize the sea bottom in a manner similar to the way land grasses prevent soil erosion. With no seagrasses to diminish the force of the currents along the

bottom, beaches, businesses, and homes can be subject to greater damage from storms.

Economics:

Although seagrass is not a commodity that is directly cultivated, its economic value can be measured through other industries, such as commercial and recreational fisheries and nature and wildlife tourism, which rely on this habitat to survive. Since most of fishery species (approximately 70%) spend at least part of their life cycle within seagrass communities, seagrasses are vital to the survival of these fishing industries.

CONCLUSION

Seagrasses are "ecosystem engineers". Seagrasses naturally improve water quality. Seagrass meadows buffer coastal communities from the full impact of waves and protect coastlines from erosion. Healthy seagrass meadows are a nature-based solution to many threats facing coastal waters and communities, including climate change. Most management that protects seagrasses focuses on maintaining their biodiversity and the services these habitats provide for humans and ecosystems. There is no international legislation for seagrasses, and so protection typically occurs by local and regional agencies. Actions taken to help seagrasses include limiting damaging practices such as excessive trawling and dredging, runoff pollution and harmful fishing practices (such as dynamite or cyanide fishing). There are also attempts to rebuild and restore seagrass beds, often by planting seeds or seedlings grown in aquaria, or transplanting adult seagrasses from other healthy meadows. The main two seagrass restoration techniques that have already been developed and trialed - replanting of adult shoots and reseeding. Reseeding generally involves the collection and targeted redistribution (and sometimes processing) of wild seed. Meanwhile, replanting normally involves harvesting plants from an existing bed and transplanting them to the restoration site.

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