SEAGRASS DISTRIBUTION AND ITS VULNERABILITY IN INDIA.

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Introduction

The coastal vegetation is of specialized nature, which grows under different conditions with one ecosystem linked to the other including the coral reefs. The vegetation can be classified into four groups 1. Marine algae or seaweeds 2. Seagrasses, 3. Mangroves and 4. Sanddune vegetation,which grows on a sandy shore beyond the highest high tide level.

Seagrasses are submerged angiospermic monocotyledon plants. They are adapted to the marine environment and complete their life cycle under water. In contrast to other submerged marine plants (e.g. seaweeds), sea grasses flower, fruit and produce seeds. They also have true roots and internal system for the transport of gases and nutrient. They generally grow in shallow coastal water from the inter-tidal zone to depths up to 10m. In turbid estuarine environment, such as the Indian coast, where there is an enormous deposition of silt into the sea by major rivers, sea grasses are rarely encountered at depths below 10m. In less turbid areas, such as the Caribbean sea and Australian coast, sea grasses can be found at depths of 50m or more.

Seagrass ecosystem distribution

Seagrass beds can be found along all of the world's continents except Antartica. But unlike other taxonomic groups with worldwide distribution, they exhibit low taxonomic diversity (approximately 60 species worldwide, compared with approximately 250,000 terrestrial angiosperms). The three independent lineages of seagrass (Hydrocharitaceae, Potamogetonaceae, and Zosteraceae) evolved from a single lineage of monocotyledonous flowering plants between 70 million and 100 million years ago. This is in stark contrast to other plant groups that have colonized the marine environment, such as salt marsh plants, mangroves, and marine algae, which are descended from multiple and diverse evolutionary lineages. Seagrasses have evolved into 12 genera spreading to the pacific and Atlantic as continents drifted during Eocene period. In India, seagrass meadows can be found on the eastern and western coast, in Lakshadweep islands as well as in the Andaman and Nicobar Islands. They belong to two families

Hydrocharitacae and Potamogetonaceae. They take a variety of form like the *Enhalus acoroides* has long strap like leaf which grows to a length of 30-150 cm while the *Halophilla ovalis* is 2-3 cm long. The eel grass *Zostera caulescens* also grows to 4m long. Large seagrass beds are present in Palk Bay and Gulf of Mannar. The Gulf of Mannar harbours the highest concentration (11 no:s) of seagrass species in India and six of the world's twelve genera (Fig 1). Around fourteen species are found around the Indian coast, of which nine can be found in the Andaman and Nicobar Islands. In Andaman coast three mangrove associated seagrass are *Thalassia hemprichii*, *Enhalus acoroides* and *Halophila ovalis* producing a biomass up to 1941 g wet wt/m^2. In Lakshadweep islands 5 genera were recorded in the 9 islands. Out of 7 species, *Cymodocea serrulata* was found to be dominant in the Lakshadweep islands whereas *Halophila decipiens* was found only in Kalpeni island. Higher seagrass diversity was found in Agathi island (6 species).

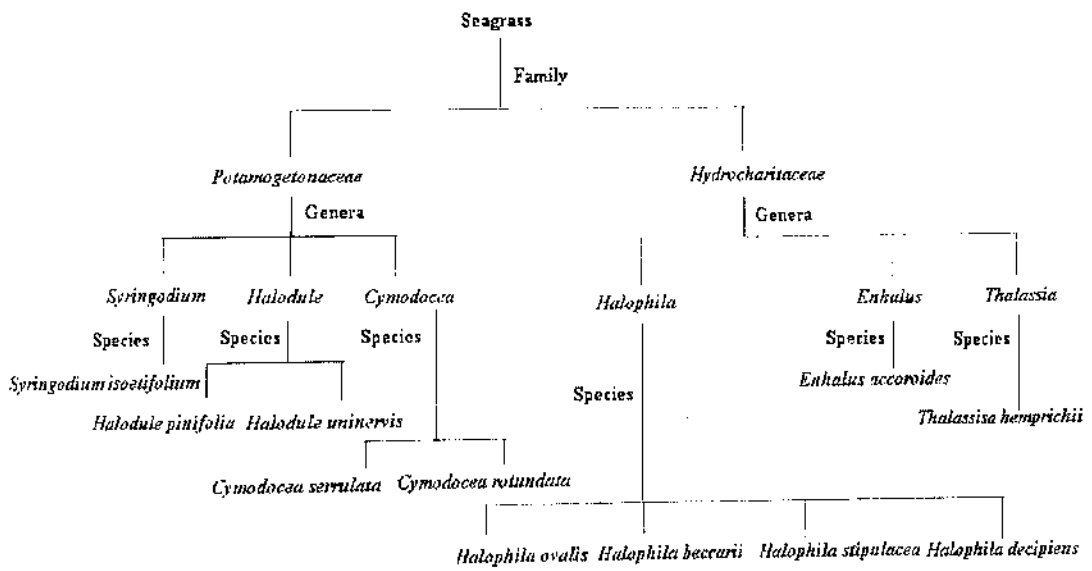

Fig.1 Seagrass species of Gulf of Mannar and Palk Bay

Importance of seagrass ecosystem

Seagrass meadows play a significant role in the processes and resources of near shore coastal ecosystems, as they have physical, chemical and biological effects on habitats. Although corals and mangroves receive much more publicity, seagrass meadows are thought to be among the most threatened ecosystems on earth. A recent study by a group of seagrass experts supported by the National Center for Ecological Analysis and Synthesis found that seagrass meadows have been disappearing by about seven percent per year since 1990.

- They are primary producers that contribute large quantities of fixed carbon (the basis of all food chains) to coastal ecosystems.

- They are important in stabilising bottom sediments as they slow water movement which promotes sedimentation of particulate matter. They prevent erosion, trap and bind sediment and organic detritus, provide a stable habitat for epiphytes and contributes to the detrital food chain.
- A 25cm^2 seagrass bed can support a highly diverse group of fauna (Fig. 1) as seen in Gulf of Mannar. Sensitivity of seagrass to external environmental change can cause wide fluctuations in the populations of marine fauna they support.

Fig. 2 Diverse benthic fauna associated with seagrass beds of *Cymodocea serrulata* in a patch of 25 cm^2 in Palk Bay

- One of the most important benefits of seagrasses for the world's oceans is carbon sequestration. The preservation of these ecosystems may prove essential in the global fight against climate change.
- Deforestation is considered one of the largest contributors to climate change, similary loss of seagrass meadows releases large amounts of carbon into the atmosphere. The disappearance of seagrass may lead to a more significant contribution to climate change than coral reef destruction, as seagrasses are more widely distributed across the oceans.
- The health of seagrass meadows is closely tied to that of mangrove and coral reef ecosystems, as many fish migrate between these habitats for food and shelter.

Threat to seagrass ecosystem

Although it is true that the global distribution and abundance of seagrasses have changed over evolutionary time in response to sea-level change, physical modification of coastlines and global changes in atmospheric carbon dioxide (CO_2) concentration and water temperature, the very gradual changes in environmental conditions over the history of seagrass evolution are overshadowed by current changes to the coastal zone resulting from increased human pressures.

- Physical alteration to aquatic ecosystem through such process as erosion, siltation and hydrologic modification are among the leading causes of water quality impairment and a key understanding avenue for restoration. Many physical disturbances are the result of specific actions (e.g. Channelization, shoreline hardening and dredging).While some others are the result of less specific non-point activities that result from land use. As ocean is the eventual receiving basin for all land runoff water it carriers, any uncontrolled development activity located anywhere near coastal area-in watersheds, floodplains, wetlands, tidelands or water basin has the potential for damage to the coastal ecosystem.
- Eutrophication caused by excess nutrients or sewage discharge in to coastal waters is an expanding problem. The initial effects are of altered species composition, both in water column and in benthic communities. More severe effects are low oxygen concentration and mass mortalities.
- Oil when spilled in large quantities can cause severe local effects especially on seagrass bed and associated flora and fauna
- The factors such as destructive fishing (Fig. 3), coastal development (ports, navigation channels, ship building yards, anchoring of boats etc), and invasive species (seaweeds over seagrass beds), many of which will be exacerbated by climate change.

Fig 3 Fishing on seagrass beds leads its destructions.

- Destruction of sand dunes and dune vegetation can destabilize the coast and in turn the cost becomes vulnerable to high energy storms resulting in sea grass ecosystem loss.
- Marine litter is also a growing problem to the destruction of ecosystems.
- The loss of seagrass beds may result from natural events (Fig. 4), such as high energy storms but most seagrass loss has resulted from human activities, such as eutrophication causing algal blooms and land use change. The apparent sensitivity of seagrass to external environmental change, often induced by man, can be

expected to cause wide fluctuations in the populations of marine fauna that they support.

- On a global scale, shorelines and shallow marine environment receive approximately 80% of their sediments from rivers and remaining 20% for biogenic production and transportation by a combination of ice, wind and volcanoes. Changes in sediment delivery, whether natural or anthropogenic produce effects which range from moderate to profound on the geomorphology of coastal environments. The impacts on humans, even from moderate geomorphological effects, are usually significant because 70% of the world's population lives within 60 km of the coast.

Problems of changes of sediment delivery

1. Higher water column turbidity and increased sediment trapping in estuaries.
2. Increased navigational hazards in tidal inlets, river entrances and seaports, resulting in frequent dredging.
3. Destruction of seagrass, mangroves, coral reefs and due to high concentration of suspended sediment.
4. Change in offshore profile and shelf transport processes.
5. A shift in current pattern may create condition of extremes in salinity and temperature than now prevalent.
6. Reduction of tidal channels and grass flats will reduce the area available as nursery and breeding ground of commercially important fishes.
7. Scouring and redistribution of bottom material will take place.
8. Recolonization of the affected area will depend upon the rapidity with which currents stabilize the bottom conditions.

Fig 4 High energy cyclonic storm eroding the coast near Dhanuskodi in Rameswaram island and resultant uprooted seagrass

Conservation

Coastal area include a wide variety of habitats with known high species diversity such as seagrass beds, coastal sedimentary habitat, mangrove and coral reefs . Often seagrass beds are an integral part of coral reef ecosystem. Thus it is linking systems that must be protected if complete protection of biodiversity is to be achieved. Not only the high diversity areas are in need of conservation often low diversity areas like upwelling areas are highly productive and humans exploit these system. Estuaries with low species number due to salinity stress are habitats that are under severe threat from urbanization and industrialization. We need a healthy environment that provides the essential services—a stable climate, fresh water, healthy soils and reliable food—upon which we all depend. The present model of global economic development has the potential to lift so many out of poverty, too often it destroys natural ecosystems and threatens biodiversity that we need to ensure for our future well-being. By managing our natural resources in a more sustainable way, we can create a development path that will lead us to future prosperity.