

# Seagrasses of India- an account on diversity

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Ramya Abhijith and Shilta M.T

Calicut Regionall Station, ICAR – Central Marine Fisheries Research Institute

Seagrasses are marine angiosperms, basically monocotyledons, found submerged fully in coastal and estuarine waters. It is the world's only flowering plant which can sustain in seawater and withstand an incredible ally in the war against climate change.

## Adaptations in seagrasses

It is believed to have evolved from land plants with terrestrial like leaves, flowers, seeds, roots and is pioneers in making their food. Unlike terrestrial plants, however, they lack strong stems to hold themselves; instead they are well supported by the buoyancy of the water. Seagrasses are well developed to sustain completely submerged underwater life with internal gas transport and well developed epidermal chloroplasts. Water-borne filamentous pollen grains and ribbon-like leaves of seagrasses which are devoid of stomata are some of the adaptations that help in thriving in aquatic or saline environments. These adaptations help the plants disperse their pollen and survive in challenging conditions.

## Distribution of seagrasses

Globally, the seagrass comprises six families encompassing 14 genera of Angiosperms with seven tropical and temperate genera each. The seagrasses are quite evident in all coastal waters except the northern Arctic Circle and Antarctica. The diversity of seagrass flora of Indian context is represented by six genera and 14 species. In India, various seagrass species such as *Enhalus acoroides*, *Halophila ovalis*, *Halophila ovata*, *Halophila stipulacea*, *Halophila beccarii*, *Halophila decipiens*, *Thalassia hemprichii*, *Cymodocea rotundata*, *Cymodocea serrulata*, *Halodule uninervis*, *Halodule pinifolia*, *Halodule wrightii*, *Syringodium isoetifolium* and *Ruppia maritima* have been recorded. The maximum species are recorded from Gulf of Mannar and Palk Bay, Andaman and Nicobar Islands, Lakshadweep, Gulf of Kutch and in patches from all along other coastal and estuarine regions of India.

## Classification of seagrasses

Seagrasses are indeed not considered as true grasses. While they share some similarities with terrestrial grasses, they belong to a different

taxonomic group within the angiosperms (flowering plants). Seagrasses are a functional group because they have adapted to live in marine environments, particularly in shallow coastal waters. They provide important habitats for various marine organisms and play a crucial role in coastal ecosystems.

## Taxonomic Classification

Kingdom	Plantae
Division	Magnoliophyta
Class	Liliopsida
Subclass	Alismatidae
Order	Alismatales
Family	Hydrocharitaceae Cymodoceae Posidoniaceae Zosteraceae

Hydrocharitaceae Hydrocharitaceae is a flowering plant family broadly called the 'tape-grasses'. The family has 18 freshwater species and 3 marine species. The marine genera are *Enhalus*, *Halophila* and *Thalassia* whereas *Cymodoceaceae* family is called as 'manatee-grass family', the only marine species family with five genera comprising 16 species, mostly occurring in tropical coastal regions. The noted genera under *Cymodoceaceae* are the *Cymodocea*, *Halodule*, *Amphibolis*, *Syringodium* and *Thalassodendron*. *Posidoniaceae* family has a sole genus *Posidonia* which contains 9 species of seagrasses mostly seen in the Mediterranean Sea and southern part of Australia. *Zosteraceae* family is found in the temperate region as well as subtropical waters with two genera, *Zostera* and *Phyllospadix*.

## Taxonomic identification of Seagrasses

Globally the seagrass species are called as Eel grass, turtle grass, spoon grass, tape grass and shoal grass etc. The term seagrass arise due to the grassy leaf appearances though some are not like grass at all. The size ranges from few centimeters to 6 meters. Morphologically the seagrass differs with seaweeds in terms of advanced leaves, stem, roots, rhizome, fruits,

flowers and seeds. In actual there is quite differences between different seagrass species. For example, the leaves of seagrasses may appear to be oval shape or fern like in *Halophila*, elongated spaghetti like in *Syringodium* or ribbon like in *Cymodocea*, *Thalassia*, and *Halodule*. The leaves are well protected by leaf base called sheath whereas the round or pointed leaf tip helps in identification of species. In many seagrass varieties, the leaves arise directly from the vertical stem except in *Halophila* species where prominent petioles are observed. The leaves scars are very prominent in seagrasses. The horizontal stem, running parallel to ground are called as Rhizomes of which the Roots arise vertically. The segmentation is very prominent in rhizomes which are called as Nodes/Scars from which vertical stems or directly leaves arise. The distance between two adjacent nodes is known as internodes. Both rhizome and roots (simple or branching) are often found buried in sediment, helping in anchorage, absorbing nutrients as well as stores carbohydrates. In asexual reproduction, the rhizomic extension plays a vital role as it can lead to vast meadow in short lifespan.

#### Identification keys to Indian Seagrasses

1. A) Leaves cylindrical, round, terete or sphagetti like.....*Syringodium isoetifolium*  
 B) Leaves ribbon like or flat.....**2**
  
2. A) Leaves elliptic in shape, oval, lanceolate or linear-oblong .....*Halophila*  
 B) Leaves in whorl like arrangement, black patches, no cross veining.....*H. beccarii*  
 C) Leaves with presence of cross veining.....**3**
  
3. A) Leaves with 12-20 cross-veins.....*H. ovalis*  
 B) Leave of 6-8 pairs of cross-veins, hair on both sides, serrated margin.....*H. decipiens*  
 C) Leaves have 4-7 pairs of cross veining..... **4**
  
4. A) Leaves 2- 6 cm, petioles present, serrated tip, single root at each node....*H. stipulacea*

- B) Leaves in pairs, 8 to 12 cross veins, less than 5mm width.....*H. minor*  
 C) Leaves are linear with 5-10cm length.....**5**
  
5. A) Leaves appear to be ligulate.....**6**  
 B) Leaves are not ligulated.....**8**
  
6. A) Leaf veins are not more than 3.....*Halodule*  
 i) Leaf tip have irregular serrations, rounded, tip of midrib furcated.....*H. pinifolia*  
 ii) Leaf tip appears tridentate, tip of midrib not furcated.....*H. uninervis*  
 iii) Leaves flattened with blunt or forked tips.....*H. wightii*  
 B) Leaf Veins more than 3.....**7**
  
7. A) Leaves appear flat, strap like shaped.....*Cymodocea*  
 i) Leaf tip is smooth or slightly serrulated, leaf blades are linear .....*C. rotundata*  
 ii) Leaf tip is serrated and leaf blades are linear.....*C. serrulata*
  
8. A) Rhizome are 2-4 mm in diameter, densely organized with filiform laterals; linear falcate leaves, no basal black coloured fibers .....*Thalassia hemprichii*  
 B) Rhizome is more than one cm dia, naked roots, linear leaf and basal black fibers present ..... *Enhalus acoroides*

#### Detailed characteristics of seagrass varieties

1. *Cymodocea rotundata*
  - Leaves appear as plane, strap liked shaped with 2 to 4 mm width
  - Leaf apex is rounded with smooth edged
  - Leaf sheath fibrous, Smooth rhizome
  - Scars appear as a continuous ring pattern in the stem
  - These are very prominent in shallow reefs.
  
2. *Cymodocea serrulata*
  - Linear shaped leaves, appears as straps,

- with 5-9 mm wide
  - Serrated leaf tip
  - Leaf sheath non fibrous, broadly triangular shaped with a narrow base
  - Leaf Scars are non continuous
  - They are found on shallow sub tidal reefy areas and sand banks
- 3. *Enhalus acoroides***
- The leaves are ribbon like of 30 to 150cm in length
  - Thickness more than 1 cm
  - Leaf edges appears as inrolled
  - Rhizomes are thick, black with thread like roots
  - These are found on shallow, intertidal sand and mud banks
- 4. *Halodule pinifolia***
- Leaf tip rounded, small with a length of 20cm
  - one central vein and two parallel marginal veins
  - central vein get splited into two at leaf tip
  - Rhizome is pale with black fibres at nodes
  - These are found in intertidal sand banks.
- 5. *Halodule uninervis***
- These are larger than *H. pinifolia*
  - Leaf tip is tridentated, pointed not rounded
  - 3 parallel veins with central prominent
  - Rhizome colour is pale with presence of black fibres at nodes
  - Highly preferred by Dugong
  - These are found in shallow or intertidal sand or mud banks
- 6. *Halodule wightii***
- Flat leaves with serrated or forked apex
  - Shoots arises from nodes of rhizome
  - Grows in coastal/marine shallow waters
- 7. *Halophila decipiens***
- Small oval shaped, leaf blade of 1-2.5cm long
  - Leaves have petioles in pairs, leaves have 6 to 8 crossveins
  - Leaf hairs are present on both sides, leaf margins serrated
  - Leaves are longer than its width
  - These are found in more than 10 metres depth

- 8. *Halophila ovalis***
- Leaves are oval shaped, appear in pairs with the petioles
  - Eight or more cross veins are present, margins very smooth
  - Leaf surface have no hairs, length 5 to 20mm
  - These are the one of the early colonizing species
  - These are found in the intertidal – subtidal depths

- 9. *Halophila minor***
- Up to 8 pairs of cross veins or sometimes less than 8
  - Less than 5mm wide leaves
  - The leaves are small, oval and appears in pairs
  - Leaf sheath is wedge shaped, no leaf hairs present
  - Leaf margin is smooth
  - These are found in shallow or intertidal sand areas

- 10. *Halophila stipulacea***
- Leaves elliptical, leaf margin serrated
  - Pair of blades extend from each rhizome node on petioles
  - Internodes reported a length of 7-50 mm
  - Rhizomes are 0.5 to 2cm in diameter

- 11. *Halophila beccarii***
- Leaves arranged as whorls or clusters of 5 to 10 at a node
  - Leaf clusters do not lie flat, finely serrated leaf margin
  - Leaves are elongate, midrib present, no cross veins
  - Short vertical stems seen

- 12. *Syringodium isoetifolium***
- Leaves are noodle or spaghetti shaped with pointed tips
  - Leaves contain air cavities
  - Leaves are 7 to 30 cm in length, inflorescence a cyme
  - These are found in shallow subtidal reef area as well as in sand banks

- 13. *Thalassia hemprichii***
- Tannin cells appear as short black bars in leaf blades
  - Rhizome is thick with scars
  - Leaf shapes as hooks or are curved
  - Leaves range of 10-40 cm long
  - These are common in shallow reef areas

- 14. *Ruppia maritima***

- Leavea are thread like in appearance
- Leaf tips are pointed with serrations
- Inflorescence on a long bunch like stalk
- Fragile rhizome

#### Reproduction in seagrasses

Seagrasses are capable of reproducing sexually as well as asexually. These flowering plants produce seeds and the water born pollen grains are carried through the water to the female flowers for fertilization. The asexual reproduction occurs via extension of rhizome / roots through new growth thereby the single plant is capable of producing an entire meadow. This asexuality in seagrass leads to quick recovery after being grazed extensively by turtles, dugongs or even disturbed by storms.

#### Ecosystem Services provided by Seagrass ecosystem

Seagrass ecosystems are considered as highly productive coastal marine environments, boasting coastal productivity. It is the feeding-breeding grounds for fin-fishes, shellfishes, other major invertebrate communities, sea turtles, dugong, coastal and migratory birds etc. Many herbivorous/ detritivorous based food chains do depend on seagrass ecosystems and hence these can be considered as productive pastures of the sea.

Seagrass meadows sequester the atmospheric and dissolved CO<sub>2</sub> as a result of photosynthesis and the carbon will get deposited / stored in the sediment which helps enrichment and conditioning of the coastal waters.

Seagrasses are known as “the lungs of the sea” because of their oxygen releasing into the adjoining water through the process of photosynthesis.

Seagrasses modify the current-wave patterns, traps and stores the sediments and hence effectively filter and leach out the nutrients to the coast and to the deep sea. Thus these seagrasses can be called as biological sentinels or the canaries of coastal areas.

Seagrasses trap fine sediments, thus helping in maintenance of water quality and the suspended solids in the water which increases water clarity. This is due to the highly complex arrangement of roots which stabilizes the bottom substratum as that of land grasses, preventing soil erosion.

Seagrasses are breeding, feeding and nursery grounds of commercially important fin-fishes and shellfishes. The higher productivity of seagrass meadow impacts a positive remark on the coastal fisheries too.

It is also believed that the carbon storage within the seagrasses can affect the pH and increase calcification of coral reefs which mitigates the effects of ocean acidification.

#### Blue Carbon

Seagrass ecosystem stores carbon in the sediments, known as "blue carbon". It is believed that only 0.1 percent of the sea floor is occupied by the seagrasses, but are capable of sequestering 11 per cent of the carbon which is buried in the seabed and thus are able to absorb 83 million tonnes of carbon (83 gC/m<sup>2</sup> /yr translating to global storage rates between 27 and 40 TgC/yr) from the atmosphere annually which is 35 times faster than tropical rainforests. On a mathematical fact, it is estimated that One acre of seagrass meadow sequester 740 pounds of carbon per annum (83 grams of carbon per sq.m per year) which is equal to the amount emitted by a fuel driven car travelling around 6,212 kilometers.

#### Threats to seagrasses

Globally, research on seagrasses indicated that meadows are vanishing at an alarming rate from the coastal areas at the rate of 110 sq km per year due to the impact of anthropogenic activity. The main reasons for declining of seagrass are urban/port development, agriculture activities, urbanization in coastal areas, dredging, berthing and anchoring of boat, Netting/Trawling, pollution, sedimentation, excessive nutrients, storms, disease outbreak, and overgrazing by herbivores.

#### Conservation of seagrasses

Seagrasses are very sensitive ecosystem and are much susceptible to any natural or anthropogenic stresses. As these provide extreme levels of ecosystem services, the seagrasses can be considered as indicators of pollution. Loss of seagrass habitats leads to ultimate decline of associated flora and fauna thus results in the decline of overall ecosystem productivity. It is high time to take earnest measures to protect, conserve and manage these seagrass ecosystems so as to sustain these sensitive critical marine habitats for future generations.

#### References

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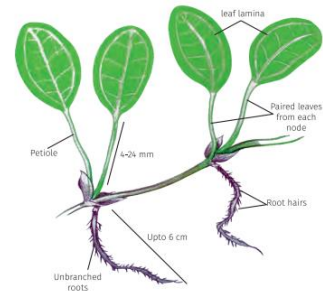
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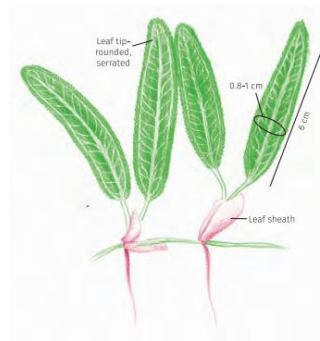
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<https://ocean.si.edu/ocean-life/plants-algae/seagrass-and-seagrass-beds>

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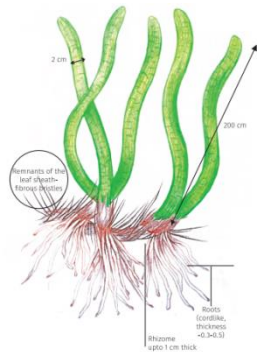
*Halophila ovata*



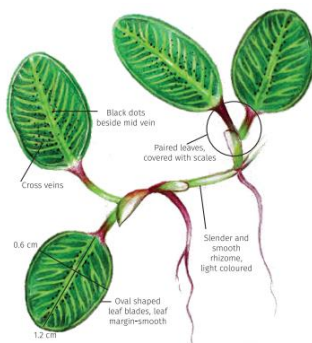
*Halophila stipulacea*

## Images of Seagrass Varieties of India

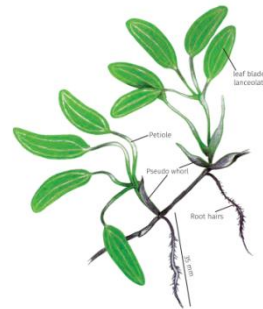
### Family- Hydrocharitaceae



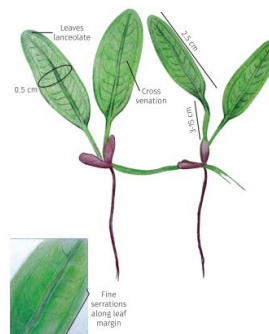
*Enhalus acoroides*



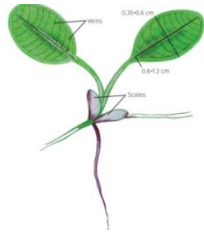
*Halophila ovalis*



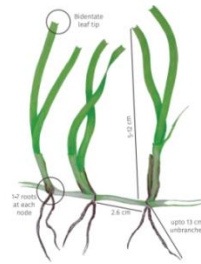
*Halophila beccarii*



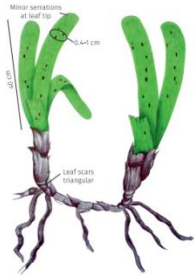
*Halophila decipiens*



*Halophila minor*



*Halodule wrightii*

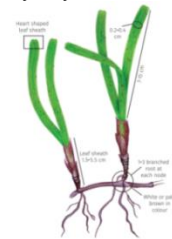


*Thalassia hemprichii*



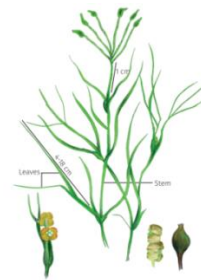
*Syringodium isoetifolium*

**Family Cymodoceaceae**

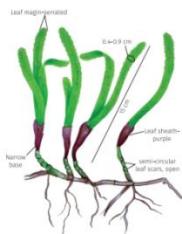


*Cymodocea rotundata*

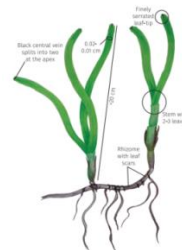
**Family Ruppiaceae**



*Ruppia maritima*



*Halodule uninervis*



*Halophila pinnifolia*

(Images from Pande et al, 2021)