Brief Communication

# Seagrass diversity along the southern coast of India and experimental restoration of seagrass meadows

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Human activities have significantly altered and degraded ecosystems, and ecological restoration is the process of repairing the damages by attempting to return these ecosystems back to their natural state. This differs from conservation which focuses on preventing further degradation of existing ecosystems. Restoring an ecosystem requires a comprehensive assessment of its current state of degradation, identifying the causes of damage and recognizing the potential threats. Effective restoration efforts must involve the active participation from local communities along with the involvement of government institutions in the planning,

implementation and monitoring phases. For projects that involve active restoration such as soil rehabilitation and land stabilization, adequate funding, technical expertise and material support are essential. The ultimate goal of restoration should be to bring back the site to its natural physical, chemical and biological characteristics, ensuring long-term ecological balance and resilience. Seagrasses, seaweeds, mangroves, marshes and other tidal wetlands play vital roles in sequestering and storing significant amounts of carbon, protecting shorelines, and preserving ecosystem quality. Among these, seagrasses remain the least understood due the dynamic ecosystems they inhabit. Seagrasses evolved around 100 million years ago belong to four major groups. Being rooted plants, these marine autotrophs are highly influenced by the unique interactions between the water column and sediment. Consequently, their diversity varies significantly along the Indian coastline

In India, seagrasses belong to two families, with around 14 species reported. In this study, the seagrass beds located off Lakshadweep, Mandapam and Kozhikode along the southern coast of India were monitored during the period 2020-2024. The seagrass species display a range of forms, like the *Enhalus acoroides* which is endemic to Gulf of Mannar and has long strap-like leaves that can grow up to a length of 150 cm, while *Halophila ovalis* is much smaller with leaves measuring only 2-3 cm in length. *Halodule pinifolia* leaf blade length varies based on water column depth, with shorter lengths observed in shallow regions due to tidal exposure. Further, presence of rubbles hinders the growth of this species.

Presence of rubbles preventing the growth of *Halodule pinifolia*

In the present study, the maximum seagrass diversity was observed in the Gulf of Mannar, with 11 species recorded. *Cymodocea serrulata* was the most abundant species, forming 25-30% of the seagrass cover. *Thalassia hemprichii* was found to be restricted to areas with coralline debris. In the Kadulundy Estuary in Kozhikode, *Halophila beccarii* was the only species observed. The Lakshadweep islands are home to 6 species of seagrasses, but large-scale habitat loss has been reported from the region.

Fabrication of cage for seagrass restoration

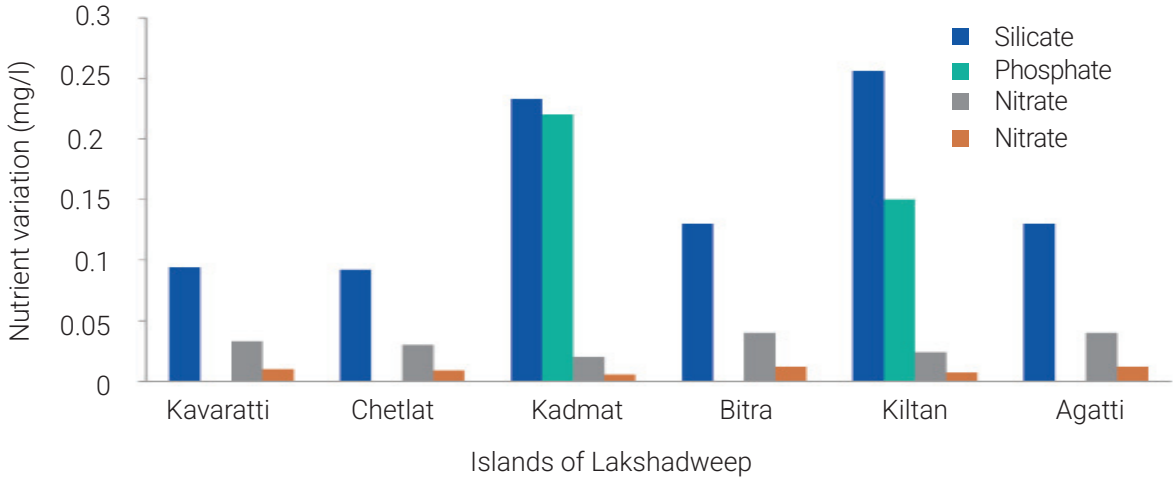
Seagrass restoration efforts on an experimental scale for two species viz., *Cymodocea rotundata* and *Thalassia hemprichii* were initiated on 13$^{th}$ October 2022, in the three islands Kavaratti, Kadmat and Chetlat of Lakshadweep, an archipelago of 36 islands.

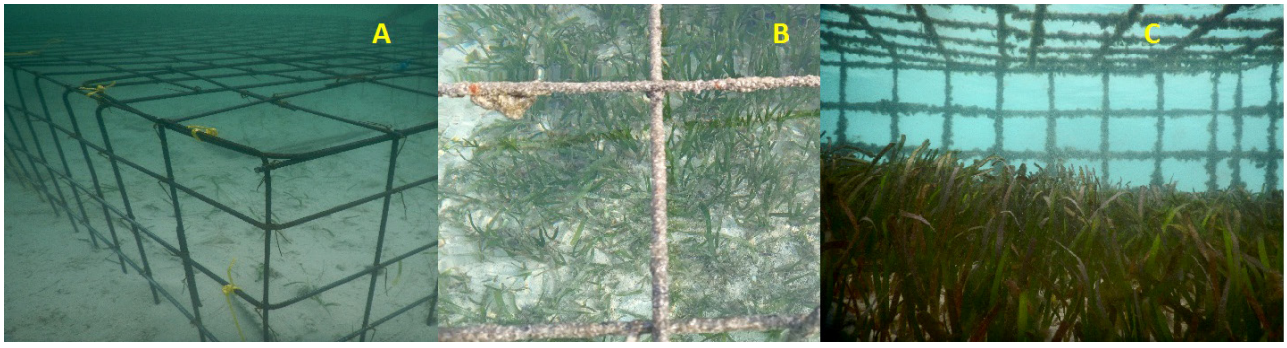
Securing seagrass plants to jute fabric for transplantation

Site for transplantation of seagrass was selected based on prior knowledge of the habitat and hydrography of the region. To protect the transplanted seagrass from predators and wave action, cages of size 400 × 200 × 70 cm fabricated using iron rods of 8 mm diameter with 15 cm spacing were deployed. Healthy seagrass plants with intact rhizomes and roots having an average leaf blade length of 6.5 cm for *Thalassia hemprichii* and 11.5 cm for

*Cymodocea rotundata* selected from a natural habitat were used for transplantation. Initially, the plants were secured to jute fabric. The seagrass plants were inserted, positioning the rhizomes and roots below the fabric and the leaves, sheaths, and stems above. The planted jute fabric was then tied to the legs of the iron cage, covering only half of the cage area and ensuring contact with the sand below. After securing it tightly, a small amount of sand was spread over the fabric. In the remaining half portion of the cage, seagrass plants were directly planted into the soil bed. Two such cages (each planted with *Cymodocea rotundata* and *Thalassia hemprichii*) were installed in lagoon of Kavaratti Island and one each in Chetlat and Kadmat.

The transplanted seagrasses established in all the four cages installed in the different islands. The well-protected transplanted plants successfully grew and began to colonize the adjacent area. The plants directly planted in the soil exhibited better growth than those planted using the jute fabric. During the period of observation, the surface water parameters such as temperature, pH, salinity and dissolved oxygen ranged between 27 to 28.2°C; 7.70 to 8.10; 33.0 to 36.0 ppt and 5.8 to 8.14 mg/l, respectively. Nutrient levels in seawater were recorded from the transplanted sites and those directly planted in the soil exhibited better growth than those planted using the jute fabric. During the period of observation, the surface water parameters such as temperature, pH, salinity and dissolved oxygen ranged between 27 to 28.2°C; 7.70 to 8.10; 33.0 to 36.0 ppt and 5.8 to 8.14 mg/l, respectively. Nutrient levels in seawater were recorded from the transplanted sites and other islands (Fig. 1). The growth of seagrass was unaffected by the onset of monsoon currents and from the impact of the Cyclone Biparjoy in the Arabian Sea in June 2023. Unlike conservation efforts, restoration initiatives are more labour-intensive and expensive, but definitely a way forward as coastal areas are physically vulnerable to increasing flooding, accelerated erosion, and seawater intrusion; issues that are expected to be exacerbated by climate change. The authors express their gratitude to ICAR-KVK Lakshadweep for extending all support in undertaking this work.




(A) Transplanted seagrass in cage 2022 (B) 2023 and (C) Seagrass growth observed presently at the transplanted sites