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Sensitivity of four tropical seagrass species to long-term pulsed eutrophication and implications for the nitrogen filter function as an ecosystem service

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Abstract

Eutrophication is a main driver for global seagrass loss. Together with the severe decline in diversity and abundance of seagrasses comes a loss of important ecosystem services like, for example, the filter function for land-derived substances. In NE Hainan, China, seagrass biomass decreased by 87 % between 2008 and 2017 as a result of eutrophication from aquaculture effluent input into coastal waters. At sites directly affected by aquaculture effluents with frequently high dissolved inorganic nitrogen concentrations > 8 µM, seagrass was lost almost completely. A multi-species seagrass meadow, which was remotely affected by aquaculture effluents, showed a less severe decline, but species were affected differently.

In an *in situ* nutrient enrichment experiment, we investigated the response of four seagrass species in the already chronically eutrophied environment to further nutrient enrichment. We tested the effect of nutrient availability and seasonality on morphological traits and the inorganic nitrogen (N_i) uptake of *Thalassia hemprichii, Cymodocea serrulata*, *Cymodocea rotundata* and *Halodule uninervis* in two four-week experiments using artificial NPK-fertilizer. Exposure to severe eutrophication events caused by typhoon-induced heavy rainfall resulted in a reduction of seagrass aboveground biomass. This loss acts as a positive feedback loop by reducing the overall filtering capacity of seagrass beds, which aggravates eutrophication with negative consequences for the entire coastal system. *T. hemprichii* was more resilient to eutrophication, as it could adapt morphologically. However, this species covers less of its leaf nitrogen demand though N_i-leaf uptake than the other species. This implies that the N_i filter function of a multi-species seagrass meadow decreases along with the loss of eutrophication-sensitive seagrass species under eutrophic conditions.

Keywords

Seagrass, Thalassia hemprichii, Eutrophication, Ecosystem services