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# Drivers of the Low Metabolic Rates of Seagrass Meadows in the Red Sea

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**Abstract:**

Tropical seagrass meadows are highly productive ecosystems that thrive in oligotrophic environments. The Red Sea is characterized by strong N-S latitudinal nutrient and temperature gradients, which constrain pelagic productivity. To date, the influence of these natural gradients have not been assessed in metabolic rates for local seagrass communities. Here we report metabolic rates [gross primary production (GPP), respiration (R), and net community production (NPC)] in four common species of seagrass (*Halodule uninervis*, *Halophila ovalis*, *Halophila stipulacea*, and *Thalassia hemprichii*) along latitudinal and thermal gradients in the Red Sea. In addition, we quantified leaf nutrient concentration (nitrogen, phosphorous, and iron), and correlated this with latitude. Our results show that average metabolic rates and aboveground biomass of seagrass meadows in the Red Sea were generally in the lower range when compared to global values reported for the same species elsewhere. The optimum temperature of Red Sea seagrass meadows varied among species with increases along the sequence: *H. stipulacea* < *T. hemprichii* <*H. uninervis* ~ *H. ovalis*. GPP for *H. uninervis* – a seagrass thermophile – was lowest in higher latitudes and increased towards lower latitudes during the summer months. While temperature was identified as a strong driver of metabolic rates across seagrass meadows, leaf concentration of phosphorous and iron (but not nitrogen) was below nutrient sufficiency thresholds, indicating these two elements might be limiting for seagrass meadows in the Red Sea.

Keywords: iron, gross primary production, metabolic rates, nitrogen, nutrient limitation, phosphorous, thermal optima, thermal performance