

Seasonal dynamics of plankton community respiration in the Dongsha Atoll

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This study examines the seasonal and spatial variability of plankton community respiration (CR) and ecosystem metabolic balance within the Dongsha Atoll lagoon in the northern South China Sea. By integrating measurements of primary production (PP) and plankton CR, we evaluate the balance between organic carbon production and consumption across seasons and hydrographic settings. Field surveys were conducted in May, July, and September 2010, and February 2011, representing spring, summer, autumn, and winter, respectively. Physical hydrographic conditions exhibited pronounced temporal and spatial heterogeneity. Persistently lower water temperatures were observed in the northern and southern navigation channels and in the eastern interior of the atoll, indicating these regions as major pathways for water exchange between the lagoon and the surrounding oligotrophic South China Sea. Despite the oligotrophic nature of adjacent waters, plankton CR within the atoll were consistently elevated and displayed substantial spatial variability, frequently reaching levels characteristic of mesotrophic systems. When evaluated together with PP, the resulting P/R ratios revealed marked seasonal shifts in metabolic balance, indicating periods of enhanced heterotrophy as well as intervals approaching metabolic equilibrium. We propose that the semi-enclosed morphology of the Dongsha Atoll promotes efficient retention and recycling of externally supplied inorganic nutrients, thereby stimulating biological production and sustaining high organic carbon consumption within the lagoon. Weak and spatially heterogeneous internal circulation further amplifies the patchy distribution of plankton CR and P/R ratios. Collectively, these findings highlight the critical role of plankton CR in regulating carbon cycling and metabolic state in coral atoll lagoons influenced by episodic external nutrient inputs.

Keywords: Atoll, Plankton Community Respiration, Primary Production, Dissolved Inorganic Nutrient, Bacterioplankton, Chlorophyll a