

## Short-Term Variability of Phytoplankton Functional Traits in a Mediterranean Coastal Lagoon: Lake Fusaro

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Mediterranean coastal lagoons are biodiversity-rich transitional ecosystems that provide essential ecological services but are highly vulnerable to climate change and anthropogenic pressure. Their shallow morphology, restricted water exchange, and strong coupling with atmospheric and terrestrial forcing make them natural sentinels of environmental change. Phytoplankton, as primary producers with rapid turnover rates, represent an ideal biological component for monitoring functional responses to such variability.

This work investigates the potential of a trait-based approach to describe phytoplankton community dynamics and ecosystem functioning in Mediterranean coastal lagoons, with a particular focus on the Fusaro Lagoon (Southern Italy). The study integrates functional traits, cell size structure, pigment composition, and photo-physiological indicators with key environmental drivers, including temperature, salinity, light availability, and nutrient dynamics. Phytoplankton biomass and functional composition were quantified through size-fractionated chlorophyll-a analyses and high-performance liquid chromatography (HPLC) of diagnostic pigments, supported by a high-frequency temporal sampling strategy. Results highlight strong seasonal and environmental control on phytoplankton functional organization. Small-sized phytoplankton dominated during cool, nutrient-poor, and moderately mixed conditions, reflecting high nutrient-use efficiency and adaptability to resource limitation. In contrast, warmer periods characterized by intense stratification, high salinity, and enhanced internal nutrient recycling favored stress-tolerant and opportunistic taxa, including nanophytoplankton and episodic microphytoplankton pulses. Pigment-based functional markers effectively tracked rapid community reorganization associated with thermal extremes, evaporation-driven salinity increases, and short-lived nutrient enrichment events. Multivariate analyses confirmed that seasonal variability was the dominant driver of functional structure, while diel variability played a secondary role. Overall, the results demonstrate that trait-based phytoplankton metrics provide a sensitive, mechanistic, and scalable framework for monitoring biodiversity and ecosystem functioning in Mediterranean coastal lagoons. This approach offers valuable tools for early detection of climate-driven changes and supports the development of functional indicators for lagoon management and conservation.