Lighting up heterotrophy: seasonality and environmental preferences of photoheterotrophic prokaryotes in the northern Mediterranean Sea

Vincenzo Manna[1,2], Elisa Banchi[1,2], Viviana Fonti[1], Mauro Celussi[1,2]

(1) Istituto Nazionale di Oceanografia e Geofisica Sperimentale – OGS, Trieste
(2) NBFC, National Biodiversity Future Center, Palermo

* email corresponding author: vmanna@ogs.it

ABSTRACT

The ability to supplement heterotrophic metabolism with light-driven energy production is widespread in microbial communities inhabiting the sunlit portion of the ocean. Besides facultative heterotrophs (i.e. cyanobacteria), photoheterotrophic microbes can use either bacteriochlorophyll (Bchl*a*)-driven light harvesting or proteorhodopsins (PRs), a photon-driven proton pump, to obtain energy from light. Despite the importance of these processes for organic matter biogeochemistry, their temporal patterns are seldom investigated. Leveraging on published data to identify Bchl*a*- and PRs-bearing prokaryotic taxa at fine taxonomic resolution, we investigated seasonal patterns and environmental preferences of photoheterotrophic prokaryotes in a 3-year time series of 16S rRNA amplicon sequencing in the northern Adriatic Sea. Bchl*a*-bearing genera (e.g. Planktomarina, HIMB11 and Luminiphilus) showed relative abundance peaks (~20%) in spring that were significantly associated with photoperiod lengthening and higher chlorophyll *a* concentrations. Taxa containing PRs (e.g., members of the SAR11 and SAR86 clades) reached peaks of ~12% relative abundance in fall and winter and preferred oligotrophic conditions. Among the Bchl*a*-bearing genera, we detected different abundance patterns in response to organic matter availability, suggesting the existence of a gradient in the contribution of light-driven energy production to their metabolic balance. Our results suggest that PRs- and Bchl*a*-driven photoheterotrophy occupies different temporal and ecological niches, shedding light on this widespread metabolic trait in temperate coastal environments.