Circadian cycles in growth and feeding rates of heterotrophic protist plankton

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ABSTRACT: Growth and feeding rates of four species of planktonic marine heterotrophic protists showed pronounced diel cycles. In most cases, rates were higher during the day and lower at night. However, for the ciliate *Strobilidium* sp., growth was highest at night. In another ciliate species, *Balanion comatum*, no day-night difference in growth and feeding rates was found. Maintenance of day-night rate differences during 24-h exposures to continuous darkness demonstrated that most of these protists had circadian cycles. The heterotrophic dinoflagellate *Oxyrrhis* marina exhibited a clear irradiance threshold for maintenance of the circadian cycle: day-night differences in growth and feeding rates were observed at irradiances as low as 2.6×10^{-3} µmol photons m^{-2} s^{-1} but not at 3.1×10^{-4} µmol photons m^{-2} s^{-1}. We also studied growth and feeding in transition from complete darkness to culturing in a day : night light cycle in *O. marina* and found that resetting the circadian cycle in this dinoflagellate temporarily arrested growth and feeding. We suggest that protists use a time-integrated light threshold rather than an instantaneous irradiance to maintain the circadian cell cycle. This allows them to avoid temporary arrests in growth and feeding when they are mixed over depth across the 3.1×10^{-4} µmol photons m^{-2} s^{-1} irradiance threshold. Overall, higher rates of feeding and growth during the light period, when phytoplankton are photosynthetically active, may strongly influence predator-prey cycles in the euphotic zone.