Contrasting photoacclimation costs in ecotypes of the marine eukaryotic picoplankter Ostreococcus

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ABSTRACT: *Ostreococcus*, the smallest known marine picoeukaryote, includes low- and high-light ecotypes. To determine the basis for niche partitioning between *Ostreococcus* sp. RCC809, isolated from the bottom of the tropical Atlantic euphotic zone, and the lagoon strain *Ostreococcus tauri*, we studied their photophysiologies under growth irradiances from 15 µmol photons m^{-2} s^{-1} to 800 µmol photons m^{-2} s^{-1} with a common nutrient replete regime. With increasing growth irradiance, both strains down-regulated cellular chlorophyll *a* and chlorophyll *b* (Chl *a* and Chl *b*) content, increased xanthophyll de-epoxidation correlated with nonphotochemical excitation quenching, and accumulated lutein. Ribulose-1,5-bisphosphate carboxylase/oxygenase content remained fairly stable. Under low-growth irradiances of 15-80 µmol photons m^{-2} s^{-1}, *O.* sp. RCC809 had equivalent or slightly higher growth rates, lower Chl *a*, a higher Chl *b* : Chl *a* ratio, and a larger photosystem II (PSII) antenna than *O. tauri*. *O. tauri* was more phenotypically plastic in response to growth irradiance, with a larger dynamic range in growth rate, Chl *a*, photosystem cell content, and cellular absorption cross-section of PSII. Estimating the amino acid and nitrogen costs for photoacclimation showed that the deep-sea oceanic *O.* sp. RCC809 relies largely on lower nitrogen cost changes in PSII antenna size to achieve a limited range of σ-type light acclimation. *O.* sp. RCC809, however, suffers photoinhibition under higher light. This limited capacity for photoacclimation is compatible with the stable low-light and nutrient conditions at the base of the euphotic layer of the tropical Atlantic Ocean. In the more variable, high-nutrient, lagoon environment, *O. tauri* can afford to use a higher cost n-type acclimation of photosystem contents to exploit a wider range of light.