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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<sup>-2</sup> s<sup>-1</sup> to 800 µmol photons m<sup>-2</sup> s<sup>-1</sup> 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<sup>-2</sup> s<sup>-1</sup>, 0, sp. RCC809 had equivalent or slightly higher growth rates, lower Chla, a higher Chl b : Chl a ratio, and a larger photosystem II (PSII) antenna than 0. tauri. 0. 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 o-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.

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