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RESEARCH ARTICLE

Chlorophyll fluorescence measures of seagrasses *Halophila ovalis* and *Zostera capricorni* reveal differences in response to experimental shading

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Abstract In coastal waters and estuaries, seagrass meadows are often subject to light deprivation over short time scales (days to weeks) in response to increased turbidity from anthropogenic disturbances. Seagrasses may exhibit negative physiological responses to light deprivation and suffer stress, or tolerate such stresses through photo-adaptation of physiological processes allowing more efficient use of low light. Pulse Amplitude Modulated (PAM) fluorometery has been used to rapidly assess changes in photosynthetic responses along in situ gradients in light. In this study, however, light is experimentally manipulated in the field to examine the photosynthesis of *Halophila ovalis* and *Zostera capricorni*. We aimed to evaluate the tolerance of these seagrasses to short-term light reductions. The seagrasses were subject to four light treatments, 0, 5, 60, and 90% shading, for a period of 14 days. In both species, as shading increased the photosynthetic variables significantly ($P < 0.05$) decreased by up to 40% for maximum electron transport rates (ETR_{max}) and 70% for saturating irradiances (E_k). Photosynthetic efficiencies (α) and effective quantum yields ($\Delta F/Fm'$) increased significantly ($P < 0.05$), in both species, for 90% shaded plants compared with 0% shaded plants. *H. ovalis* was more sensitive to 90% shading than *Z. capricorni*, showing greater reductions in ETR_{max}, indicative of a reduced photosynthetic capacity. An increase in E_k, Fm' and $\Delta F/Fm'$ for *H. ovalis* and *Z. capricorni* under 90% shading suggested an increase in photochemical efficiency and a more efficient use of low-photon flux, consistent with photo-acclimation to shading. Similar responses were found along a depth gradient from 0 to10 m, where depth related changes in ETR_{max} and E_k in *H. ovalis* implied a strong difference of irradiance history between depths of 0 and 5–10 m. The results suggest that *H. ovalis* is more vulnerable to light deprivation than *Z. capricorni* and that *H. ovalis*, at depths of 5–10 m, would be more vulnerable to light deprivation than intertidal populations. Both species showed a strong degree of photo-adaptation to light manipulation that may enable them to tolerate and adapt to short-term reductions in light. These consistent responses to changes in light suggest that photosynthetic variables can be used to rapidly assess the status of seagrasses when subjected to sudden and prolonged periods of reduced light.

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Introduction

Coastal waters and estuaries are highly productive and ecologically valuable ecosystems. These systems are under increasing stress from anthropogenic disturbances due to sediment dredging, catchment runoff and urbanisation. These disturbances and the increasing frequencies of natural disturbances (e.g. flooding and cyclones) (Preen et al. 1995; Campbell and McKenzie 2004) directly reduce the distribution of ecologically important primary producers