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Molecular Mechanisms behind the Physiological Resistance to Intense Transient Warming in an Iconic Marine Plant

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The endemic Mediterranean seagrass *Posidonia oceanica* is highly threatened by the increased frequency and intensity of heatwaves. Meadows of the species offer a unique opportunity to unravel mechanisms marine plants activate to cope transient warming, since their wide depth distribution impose divergent heat-tolerance. Understanding these mechanisms is imperative for their conservation. Shallow and deep genotypes within the same population were exposed to a simulated heatwave in mesocosms, to analyze their transcriptomic and photo-physiological responses during and after the exposure. Shallow plants, living in a more unstable thermal environment, optimized phenotype variation in response to warming. These plants showed a pre-adaptation of genes in anticipation of stress. Shallow plants also showed a stronger activation of heat-responsive genes and the exclusive activation of genes involved in epigenetic mechanisms and in molecular mechanisms that are behind their higher photosynthetic stability and respiratory acclimation. Deep plants experienced higher heat-induced damage and activated metabolic processes for obtaining extra energy from sugars and amino acids, likely to support the higher protein turnover induced by heat. In this study we identify transcriptomic mechanisms that may facilitate persistence of seagrasses to anomalous warming events and we discovered that *P. oceanica* plants from above and below the mean depth of the summer thermocline have differential resilience to heat.

Keywords: heat stress, RNA-seq, *Posidonia oceanica*, marine plants, comparative transcriptomics, thermal tolerance, transient warming, mesocosms

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INTRODUCTION

Seagrasses are a polyphyletic group of clonal plants of the order Alismatales that have colonized the sea at least on three different occasions along their evolutionary history (Les et al., 1997). In their adaptation to live completely submerged on the marine realm this group of plants converged on a series of structural and physiological modifications, that involved adjustments of their genetic repertoire in respect to terrestrial plants (Wissler et al., 2011; Olsen et al., 2016). Seagrasses lost several characters of the terrestrial counterparts (e.g., absence of stomata) but also gained others typical of macroalgae (e.g., cell wall composition), featuring now clear distinctive attributes and characteristics (Olsen et al., 2016).