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Interaction of high seawater temperature and light intensity on photosynthetic electron transport of eelgrass (*Zostera marina* L.)

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1 **Interaction of high seawater temperature and light intensity on photosynthetic electron transport of**  
2 **eelgrass (*Zostera marina* L.)**

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9 **Abstract** The interaction of widely recognized causes of eelgrass decline (high seawater temperature and limited  
10 light intensity) on photosynthetic electron transport was investigated via chlorophyll fluorescence technique.  
11 High seawater temperature combined light intensity significantly increasing the relative maximum electron  
12 transport rate ( $rETR_{max}$ ); at critical temperature of 30 °C, the  $rETR_{max}$  increased with the enhancement of light  
13 intensity, indicating the elevation of overall photosynthetic performance. Based on the magnitude of effect size  
14 ( $\eta^2$ ), light intensity was the predominant factor affecting the performance index ( $PI_{ABS}$ ), indicating that  
15 photosystem II (PSII) was sensitive to light intensity. Moreover, the donor side was severely damaged as  
16 evidenced by the higher decrease amplitude of fast component and its subsequent incomplete recovery. The  
17 reaction center exhibited limited flexibility due to the slight decrease amplitude in maximum photochemical  
18 quantum yield. In contrast with PSII, photosystem I (PSI) was more sensitive to high seawater temperature,  
19 based on the magnitude of  $\eta^2$  derived from the maximal decrease in slope. High seawater temperature  
20 significantly increased PSI activity, plastoquinol reoxidation capacity, and probability for electron transfer to  
21 final PSI electron acceptors. Moreover, it combined elevated light intensity significantly stimulated the activity  
22 of cyclic electron flow (CEF) around PSI. Higher activity of both PSI and CEF contributed to balancing the  
23 linear electron transport via alleviating the over-reduction of the plastoquinone pool, exhibiting flexible  
24 regulation of photosynthetic electron transport at critical temperature. Therefore, limited light intensity decreased  
25 the tolerance of eelgrass to critical temperature, which might be a factor contributing factor in the observed  
26 decline.

27

28 **Keywords:** Chlorophyll a fluorescence; Eelgrass; High seawater temperature; Light intensity; Photosynthetic  
29 electron transport

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