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Physiological responses of a population of *Sargassum vulgare* (Phaeophyceae) to high pCO_2/low pH: implications for its long-term distribution

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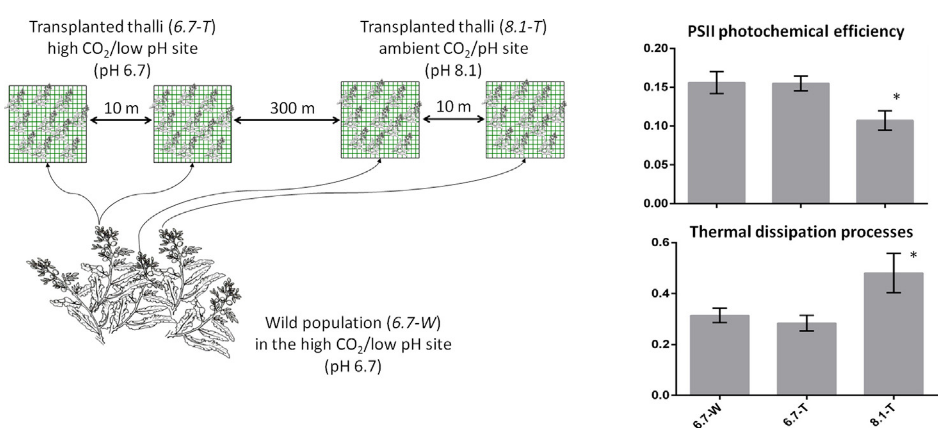
HIGHLIGHTS

- Long-term responses of species to ocean acidification are difficult to predict.
- CO_2 seeps may help to reveal adaptive strategies to cope with high CO_2/low pH.
- Photosynthetic performance and stress response were assessed on decadal exposure.
- Stress response and a decreased photochemistry was observed from pH 6.7 to 8.1.
- High pCO_2 allowed a rapid adaptation in a fast changing ocean pH.

GRAPHICAL ABSTRACT



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ABSTRACT

Ocean Acidification (OA) is likely to affect macroalgal diversity in the future with species-specific responses shaping macroalgal communities. In this framework, it is important to focus research on the photosynthetic response of habitat-forming species which have an important structural and functional role in coastal ecosystems. Most of the studies on the impacts of OA involve short-term laboratory or micro/mesocosm experiments. It is more challenging to assess the adaptive responses of macroalgal community to decreasing ocean pH over long-term periods, as they represent the basis of trophic dynamics in marine environments. This work aims to study the physiological traits of a population of *Sargassum vulgare* that lives naturally in the high pCO_2 vents system in Ischia (Italy), in order to predict the species behaviour in a possible OA future scenario. With this purpose, the photosynthetic performance of *S. vulgare* was studied in a wild, natural population living at low pH (6.7) as well as in a population transplanted from native (6.7) to ambient pH (8.1) for three weeks. The main results show that the photochemical activity and Rubisco expression decreased by 30% after transplanting, whereas the non-photochemical dissipation mechanisms and the photosynthetic pigment content increased by 50% and 40% respectively, in order to compensate for the decrease in photochemical efficiency at low pH. Our data indicated a stress condition for the *S. vulgare* population induced by pH variation, and therefore a reduced acclimation capability at different pH conditions. The decline of the PS_{II} maximum quantum yield (F_v/F_m) and the increase of PARP enzyme activity in transplanted thalli further supported this hypothesis. The absence of the species at ambient pH

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