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Altered epiphyte community and sea urchin diet in *Posidonia oceanica* meadows in the vicinity of volcanic CO_2 vents

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ABSTRACT

Ocean acidification (OA) predicted for 2100 is expected to shift seagrass epiphyte communities towards the dominance of more tolerant non-calcifying taxa. However, little is known about the indirect effects of such changes on food provision to key seagrass consumers. We found that epiphyte communities of the seagrass *Posidonia oceanica* in two naturally acidified sites (i.e. north and south sides of a volcanic CO_2 vent) and in a control site away from the vent at the Ischia Island (NW Mediterranean Sea) significantly differed in composition and abundance. Such differences involved a higher abundance of non-calcareous crustose brown algae and a decline of calcifying polychaetes in both acidified sites. A lower epiphytic abundance of crustose coralline algae occurred only in the south side of the vents, thus suggesting that OA may alter epiphyte assemblages in different ways due to interaction with local factors such as differential fish herbivory or hydrodynamics. The OA effects on food items (seagrass, epiphytes, and algae) indirectly propagated into food provision to the sea urchin *Paracentrotus lividus*, as reflected by a reduced *P. oceanica* exploitation (i.e. less seagrass and calcareous epiphytes in the diet) in favour of non-calcareous green algae in both vent sites. In contrast, we detected no difference close and outside the vents neither in the composition of sea urchin diet nor in the total abundance of calcareous versus non-calcareous taxa. More research, under realistic scenarios of predicted pH reduction (i.e. $\leq$ 0.32 units of pH by 2100), is still necessary to better understand cascading effects of this altered urchin exploitation of food resources under acidified conditions on ecosystem diversity and function.

1. Introduction

The concentration of carbon dioxide (CO_2) in the atmosphere is increasing mainly due to fossil fuel combustion and industrial processes. Oceans absorb approximately 30% of the anthropogenic CO_2 released to the atmosphere, which has caused a pH decrease in surface waters of 0.1 units since pre-industrial times in a process commonly known as ocean acidification (OA). An additional decrease in pH of 0.06–0.32 units is expected by the end of the century according to the different scenarios of CO_2 emissions used for projections (IPCC, 2014). Together with reduced pH, changes in the relative proportion of total dissolved inorganic carbon forms co-occur, including a reduced concentration of carbonate ions (CO_3^{2-}). These changes may negatively affect the formation of carbonate structures, shells and skeletons by calcifying organisms, as well as their metabolism (e.g. acid-base regulation), survival or abundance (Pörtner, 2008; Kroeker et al., 2011, 2013a). At the same time, increased availability of photosynthesis substrates (CO_2 and/or HCO_3^-) may enhance the photosynthesis and growth of non-calcifying primary producers such as phytoplankton, cyanobacteria, fleshy algae and seagrasses (Doney et al., 2009; Kroeker et al., 2010).

The above-mentioned responses and sensitivities of species to OA have mostly been identified by means of CO_2 enrichment experiments in laboratory or mesocosms. More recently, *in situ* observations of submarine volcanic CO_2 vents have provided data on

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