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Characterising the short-term sensitivity of Californian intertidal community calcification to ocean acidification

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Anthropogenic emissions of CO_2 and invasion of part of this CO_2 into the oceans results in a decrease in seawater pH and a lowering of the calcium carbonate saturation state. The historic and projected decrease of the calcium carbonate saturation state of seawater has the potential to compromise the ability of many marine calcifying organisms to form their calcium carbonate shells or skeletons and is likely to have significant ocean ecosystem impacts over the 21st Century. In laboratory manipulations temperate calcifying organisms have been shown to exhibit reduced calcification as a result of CO_2 addition. However, very few experiments have observed how calcification in temperate systems responds to natural variations in seawater carbonate chemistry. We assess the community level sensitivity of Californian tidal pool calcification rates to variability in the calcium carbonate saturation state. Our tidal pool study sites at Bodega Bay in Northern California experience extreme variation in low tide carbonate saturation state due to photosynthetic activity and the time at which the pools are isolated from the open ocean. During our study period, we observed aragonite saturation levels ranging from 0.5 to 9. Photosynthetic activity is largely dependent on temperature and photosynthetic active radiation which vary on a diurnal timescale whereas the time at which pools are isolated from open seawater, and thus the amount by which tide pool carbonate chemistry differs from that of open ocean waters, is largely a consequence of tidal period which varies on a lunar cycle. Because there are substantial uncorrelated components of light, temperature, and seawater carbonate chemistry in our data, one can separate the influence of carbonate saturation state on calcification from the influence of temperature and PAR. This provides an opportunity to characterise the short-timescale sensitivity of tidal pool calcification rates to changes in carbonate saturation state. We show that on such timescales community level rates of daytime calcification are not strongly influenced by variability in carbonate saturation state. This suggests that these intertidal communities may be more resilient to projected ocean acidification than previously thought, although extending this work to consider longer timescales would be required to more firmly support this hypothesis.