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Investigation of the simultaneous effects of ocean acidification and warming on coral reef Foraminifera

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Ocean acidification and warming are two of the major environmental threats today. This work focuses on two coral reef Foraminifera, important calcium carbonate producers in the oceans, from the central Great Barrier Reef. Interactive effects of the two stressors are often understudied. In order to reduce uncertainties this research explores the interaction between pCO_2 and warming. Specimens have been exposed to increasing levels of pCO¬2 (equivalent to a pH of 7.9 and 8.1) and warming (28 and 31°C) for up to six weeks in flow-through aquaria. The results indicate that in both species the photo-physiology of the symbionts, pigment concentration in the host and respiration are all negatively affected by temperature. Of these parameters, acidification affected only the photo-physiology. In Heterostegina depressa, both temperature and acidification affected growth rate and mortality. In both species, significant additive effects between the two stressors are observed. What is more, although the stressors alone had no effect on growth in Marginopora vertebralis, they had a significant interactive effect on this variable. These results indicate that the inhibition of photosymbiosis, respiration and growth in symbiont-bearing coral reef Foraminifera is likely to be stronger under simultaneous scenarios of acidification and temperature rise than what would be expected from the effect of each of the stressors individually.

Simulating the combined effects of pCO_2 and warming at levels that are predicted to occur by the end of the century put uncertainties on this study. Climate models and changes in ocean chemistry can only be predicted by models and always possess a certain level of uncertainty. Furthermore, specimen's adaptation potential to long-term (over several years) changes in temperatures and ocean pH are not possible or at least very difficult to study in manipulative experiments. In summary, uncertainties in models might alter the amount of time at which effects become visible or alter the scope of the presented results. If specimens are not able to adapt to rapid changes these organisms might experience extinction events as seen several times through earth history.