Ocean acidification impacting population demography and hindering adaptation potential

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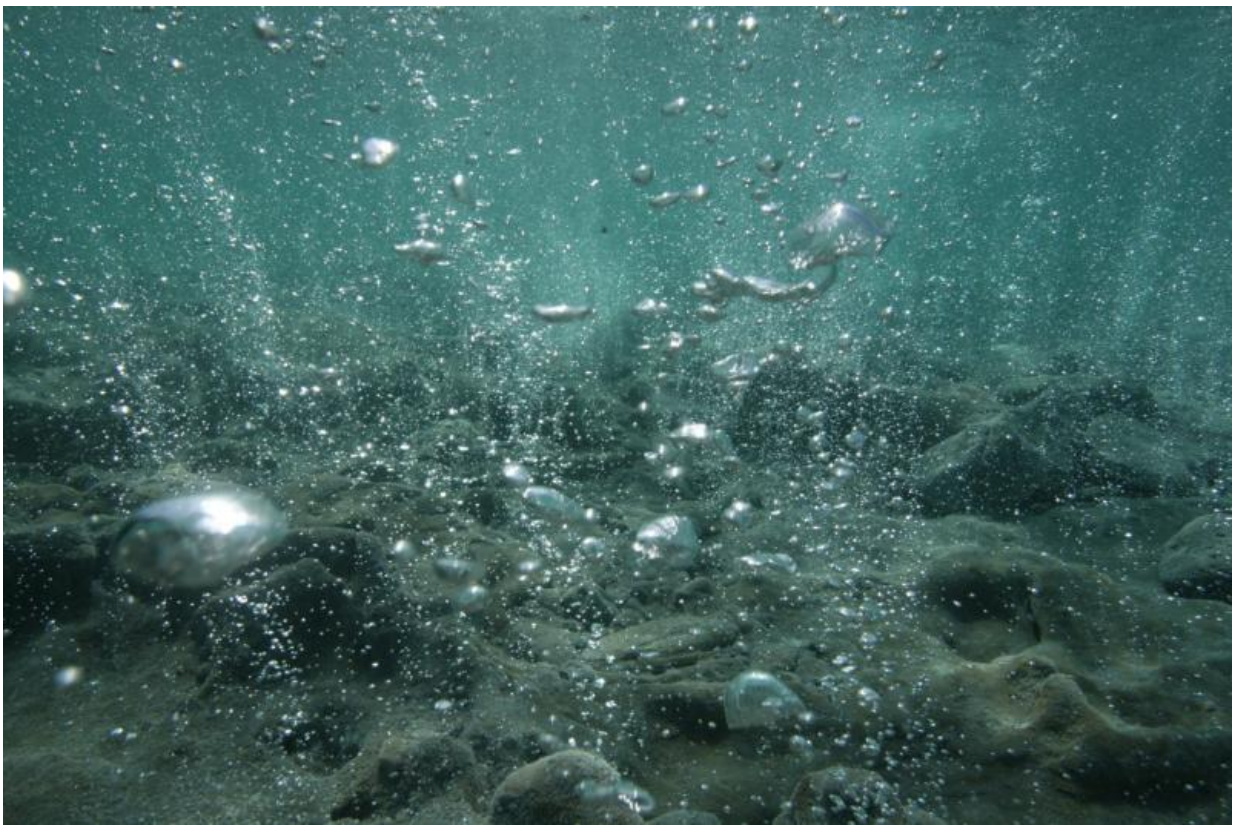

Carbon dioxide bubbles at the volcanic vent in the Mediterranean. Credit: Demetris Kletou, Plymouth University

Ocean acidification may be impacting upon the population dynamics of

marine species and hindering their ability to genetically adapt to future climate change.

These are the findings of a team of scientists, whose report is published in the journal *Scientific Reports*, following an investigation into how the gastropod *Hexaplex trunculus* has responded to ocean acidification over multiple generations.

The project, led by Aberystwyth University, in conjunction with a number of European partners, including the Institute of Marine Research, Bergen, Norway; Plymouth University; and the University of Palermo, found evidence that individuals have to trade-off maintaining their shells in order to compensate for a higher cost of living in acidified conditions.

But going further, they discovered that that these changes to the energy budget may not be the same for males and females, and at a population-level, those individuals contributing to reproduction change year-on-year, resulting in a genetic drift that could hinder the potential for genetic adaptation to ocean acidification.

Ben Harvey, of the Institute of Biological, Environmental, and Rural Sciences, at Aberystwyth, said: "Despite growing evidence for direct impacts on specific species, few studies have simultaneously considered the effects of ocean acidification on individuals and population level demographic processes. By using carbon dioxide vents as natural laboratories, we have found that ocean acidification may hamper normal breeding habits and reduce the potential for species to adapt."

A specimien of *Hexaplex trunculus* found at one of the research sites. Credit: Demetris Kletou, Plymouth University

H. trunculus, which grows to nearly 10cm, is a commercially valuable species of mollusc, one widely consumed in African countries that border the Mediterranean. In the course of the project, the scientists looked at communities clustered at three sites off the coast of Isola Vulcano in Sicily characterised by different levels of CO_2.

Those at the CO_2-rich site were found to have a significantly lower mean shell length, and smaller, thinner shells than those at the two neutral sites. They also found significantly fewer females present in the Low pH site (32.26%), while the sex ratio in the control pH sites was around 50%.

As part of the research, the team relocated some specimens from one site to another and after a 14-day period of exposure, extracted them to the laboratory to analyse the physiological response through its metabolic rate. They found notably higher metabolic rates for those that had been exposed to acidic waters, pointing to evidence of acclimatisation.

"Acclimatisation can buffer populations against the immediate impacts of ocean acidification, and even provide time for adaptation," said Samuel Rastrick, of the Institute of Marine Research. "However, it can also result in stress-induced energetic trade-offs, and unless organisms can compensate for the extra costs caused by ocean acidification, then they may suffer negative consequences in the form of reduced growth, development and reproduction."

Pippa Moore, also of Aberystwyth University, added: "Should organisms be unable to maintain their energy budgets, then they may lack the necessary energy to contribute to future generations."

Professor Jason Hall Spencer, of Plymouth University, concludes: "Overall, this study demonstrates that ocean acidification is driving individual and population level changes that will impact eco-evolutionary trajectories, and highlights the need for deeper understanding of the links between individual effects and (often unknown) population demographics in order to predict and manage the consequences of climate change."

More information: Ben P. Harvey et al. Individual and population-level responses to ocean acidification, *Scientific Reports* (2016). DOI: 10.1038/srep20194

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