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SHORT NOTES

Residing at low pH matters, resilience of the egg jelly coat of sea urchins living at a CO_2 vent site

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Abstract

The sea urchin egg jelly coat is important in fertilisation as a source of sperm activating compounds, in species-specific gamete recognition and in increasing egg target size for sperm. The impact of ocean acidification (− 0.3 to 0.5 pH_T units) on the egg jelly coat of *Arbacia lixula* was investigated comparing populations resident in a control (pH_T 8.00) and a CO_2 vent site (mean pH_T 7.69) in Ischia. Measurements of egg and jelly coat size showed no significant differences between sea urchins from the different sites; however, sensitivity of the jelly coat to decreased pH differed depending on the origin of the population. Acidification to pH_T 7.7 and 7.5 significantly decreased egg jelly coat size of control urchins by 27 and 23%, respectively. In contrast, the jelly coat of the vent urchins was not affected by acidification. For the vent urchins, there was a significant positive relationship between egg and jelly coat size, a relationship not seen for the eggs of females from the control site. As egg and jelly coat size was similar between both populations, vent *A. lixula* jelly coats are likely to be chemically fine-tuned for the low pH environment. That the egg jelly coat of sea urchins from the vent site was robust to low pH shows intraspecific variation in this trait, and that this difference may be a maternal adaptive strategy or plastic response. If this is a common response in sea urchins, this would facilitate the maintenance of gamete function, facilitating fertilisation success in a low pH ocean.

Introduction

Due to increased atmospheric CO_2, the ocean is expected to decrease in surface ocean pH by approximately 0.3–0.5 pH units by the end of the century (IPCC 2014). It is becoming evident that some marine invertebrates show adaptive potential to near future changes in pH through epigenetic, transgenerational plasticity and natural selection (Foo and Byrne 2016; Calosi et al. 2016). Due to logistical constraints and long developmental times, however, it is not easy to incorporate the plastic and evolutionary responses of a species into laboratory experiments, thus identification of natural proxies, such as CO_2 vent systems, are of great importance (Foo et al. 2018a).

CO_2 vents are used as proxies for future OA to assess potential outcomes for marine species. Of the vent systems that have been explored as proxies of a future ocean, the volcanic vent areas of the Castello Aragonese in the island of Ischia, Italy in the Mediterranean Sea are the best characterised (Foo et al. 2018a). These systems provide insights into the animals and plants that can adapt and survive in a lower pH ocean (Hall-Spencer et al. 2008). The vents incorporate a range of environmental factors, such as nutrients, currents and species interactions that cannot be replicated in the laboratory (Barry et al. 2010; Garrard et al. 2012) and are especially important to identify the species that have occupied these areas for years and decades.

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