Behavioral plasticity in a benthic bivalve enhances tolerance of microalgal grazers to ocean warming and acidification

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Anthropogenic carbon dioxide emissions are rapidly changing seawater pH and carbonate chemistry with vast repercussions on marine biodiversity. Direct effects of both phenomena on species populations are well documented, but how such effects cascade through communities and affect functioning remain mostly unknown. In this presentation we demonstrate how the interaction network between porewater nutrients, primary producers, benthic grazers, predators and large bioturbators in a soft-sediment community significantly restructures in response to experimental warming and acidification.

Under unmanipulated conditions microalgal freshness was influenced by top-down control of epifaunal grazers and the omnivorous ragworm *Hediste diversicolor*, while the peppery furrow shell *Scrobicularia plana* reduced porewater nutrient availability to primary producers. Under high pCO_2 conditions (+ 3°C, - 0.4 pH units) *S. plana* did not influence porewater nutrients, promoted microalgal freshness and inhibited population biomass of *H. diversicolor*. Juvenile bivalves and the mudsnail *Hydrobia ulvae* had lower survival under high pCO_2 conditions, particularly in the absence of *S. plana*.

Using porewater hydraulic signatures we furthermore demonstrate that such change in community interactions is linked to behavioral plasticity in *S. plana*. This key species shifted feeding behavior from predominant filter feeding under ambient conditions to almost exclusive deposit feeding under high pCO_2 conditions. Deposit feeding is associated with less intake of water and thus reduces physiological disruption related to hypercapnia. This behavioral shift is also associated with enhanced interference competition from bioturbation that might explain negative effects on *H. diversicolor*, while at the same time deposit feeding is known to stimulate primary production via gardening mechanisms.

Hydrobia ulvae and juvenile bivalves both rely on freshly produced microalgae for their diet and are prey for *H. diversicolor*. Release from predation pressure and the facilitation of food resources associated with behavioral plasticity in *S. plana* therefore seems to explain the alleviated mortality of these marine calcifiers to ocean acidification and warming in the presence of *S. plana*.
In summary, this study demonstrates that in addition to direct effects on species, populations and communities, non-lethal effects that alter ecosystem interactions will determine the resilience of soft sediment communities to climate change.

Keywords: Future oceans; Ecosystem interaction network; Benthic community; Ocean acidification; Ocean warming