STUDENT SHEET 5a

Sensitivity to ocean acidification parallels natural pCO_2 gradients experienced by Arctic copepods under winter sea ice

The science team on the Catlin Arctic Survey submitted their findings for publication to share with the wider science community. To do this they wrote an analysis of their findings which was published in a science journal, the Proceedings of the Natural Academy of Sciences.

Significance

The Arctic Ocean is a bellwether for ocean acidification, yet few direct Arctic studies have been carried out and limited observations exist, especially in winter. We present unique under-ice physicochemical data [and] empirical data demonstrating that these copepods show sensitivity to pCO_2 that parallels the range of natural pCO_2 they experience through their daily vertical migration behavior. Our data, collected as part of the Catlin Arctic Survey, provide unique insight into the link between environmental variability, behavior, and an organism's physiological tolerance to CO_2 in key Arctic biota.

The scientists described the significance of their work. This data is important because the Arctic Ocean is a 'bellwether', i.e. it is changing faster than other oceans and can help to warn what might happen in other ocean regions. It is also rare to have data from this time of year, because very few scientists have been to this remote region in the cold of winter.

Abstract

The Arctic Ocean already experiences areas of low pH and high CO_2, and it is expected to be most rapidly affected by future ocean acidification (OA). Copepods comprise the dominant Arctic zooplankton; hence, their responses to OA have important implications for Arctic ecosystems, yet there is little data on their current under-ice winter ecology on which to base future monitoring or make predictions about climate-induced change. Here, we report results from Arctic […] late-winter carbonate chemistry environmental data and their response to manipulated pCO_2 conditions (OA exposures). Our data reveal that species and life stage sensitivities to manipulated OA conditions were correlated with their vertical migration behavior and with their natural exposures to different pCO_2 ranges. Vertically migrating adult Calanus crossed a [larger] pCO_2 range of <140 μatm daily and showed only minor responses to manipulated high CO_2. [Nauplii] which remained in the surface waters and experienced a lower pCO_2 range of <75 μatm, showed significantly survival in high CO_2 experiments. These results support the relatively untested hypothesis that the natural range of pCO_2 experienced by an organism determines its sensitivity to future OA and highlight that the [copepod nauplii] may be more sensitive to future high pCO_2 conditions compared with the more widely studied larger copepods.

Studying copepods is important because they are the most abundant primary consumer in the Arctic.

Adult Calanus (a type of copepod) have a different vertical migration than the copepod nauplii.

Because the pH changes with depth, adult Calanus experience a larger range of pH in their daily lives compared to nauplii.

The conclusion is that organisms that experience larger changes in pH conditions ordinarily are less sensitive to future predicted changes in ocean acidification.

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