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Biogeosciences Discussions

Interactive comment on "Impact of anthropogenic ocean acidification on thermal tolerance of the spider crab *Hyas araneus*" *by* K. Walther et al.

K. Walther et al.

kathleen.walther@awi.de

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Author comment to Referee 2

We appreciate the constructive comments by this referee. In the following we answered the questions and tried to develop a hypothesis to explain the observed results.

General comments:

This paper shows the impact of ocean acidification on the Hyas araneus population from Helgoland. Our aim was to demonstrate the effects on a crab population from the southernmost border of its distribution range (warmest). We will emphasize this more in our manuscript. In future studies we will investigate these effects of ocean acidification on the population of the northest border (coldest).

We now tried to address the question what are the potential metabolic responses to the increment in CO2 levels: The additional decrement in heart rate at low temperatures may possibly involve an accumulation and effect of adenosine under CO2 exposure. Adenosine was found to accumulate under elevated CO2 levels and depress ventilation rate in Sipunculus nudus (Reipschläger et al., 1997). The role of pH in this effect is not clear (Pörtner, 2008). In crustaceans, adenosine also depresses spontaneous activity and the responsiveness of interneurons to electrical and chemical stimuli in the brain (Derby et al., 1987) and elicits bradycardia (Brevard et al., 2003). In contrast, adenosine can display a stimulatory effect on heart rate, haemolymph flow and scaphognathite frequency (Maurer et al., 2008; Stegen and Grieshaber, 2001). This apparent discrepancy resembles the contrasting CO2 effects at low and at high temperatures. A stimulatory effect might in fact be involved in the increase in heart rate with rising CO2 concentrations in the warmth (Fig. 5). Further experiments are required to test these hypotheses.

Methods: P 2841, L 4: We worked with male and female adults. We can't see any differences between both adult types at their PeO2 and heart rate values.

P 2841, L 7: We think that mussel tissues provide all nutritional requirements to the species, esp. considering the time course of the experiments.

P 2842, L 15: We continue CO2 equilibrations during temperature changes. Due to the water body being saturated with CO2 and the acute temperature changes we found no effect with respect to pH differences.

Results: Figure 3 is an important figure to show the regression lines of the arrhenius plots. We restricted the calculations of the Q10 values to well defined temperature ranges and eliminated the tables from the manuscript.

Discussion: We now calculated the Q10 values between 6 to 12°C, i.e. for the exponential phases of the heart rate changes. Then the Q10 values are more meaningful for the impact of different CO2 levels.

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P 2849-50: We think the comparison with the Petrolisthes species with Hyas araneus is most suitable. If CO2 has effects on the tolerance range of species depending on their latitudinal range such differences would be similar to those expected for species along clines in the intertidal zone.

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