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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.

Anonymous Referee #2

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General comments

The paper presents illustrative evidence of the potential synergistic effects of seawater acidification and warming on the spider crab Hyas araneus thermal tolerance. I want to accentuate the term "illustrative" because I think authors must be more careful in raising general conclusions regarding for example that the acidification-warming synergistic factors may changes the distributional range of the species. It must be clear that in the present study authors exposed individuals crabs (coming from the southern limit of the species) to an acute shift in water acidification (ïĄ¿2 and 8 fold from normocapnic CO2 concentration) and then to a temperature decrease (in 10 °C) and increase (in 15 °C) throughout ïĄ¿48 h. Thus the physiological effects they observed represent an acute response to these physical factors. As they mentioned in the introductory sec-

tion, the pH decrease in 0.2 and 0.7 units is expected to occur during the next 100 and 300 years, respectively. I'm aware that is not possible to test the effects of water acidification during such a long period, but I would like authors at least discuss the potential physiological mechanisms of acclimation and/or adaptation to a long-term change in the environmental pH scenario. Even I think the discussion section lacks of information regarding the effects of pH decrease on physiological function and the potential animals' metabolic responses or mechanisms of adaptations. Another general concern I have it is regarding the general conclusions the authors have raised for the H. araneus species from studying a single population. For example they stated that ". . .circulatory performance reached its limit beyond 10°C, which would reflect the upper pejus temperature of the species". I think authors should be more cautious regarding such conclusions at a species level. They studied only one H. araneus population acclimated to one single season. In fact, considering that physiological responses to temperature changes may differ significantly between individuals acclimated to contrasting seasons, I think this study could have greatly been enriched if authors had compared individuals acclimated to at least two contrasting seasons. Additionally, this study was done in a H. araneus population coming from the southern edge of the species. We know that according to the center hypothesis, populations in their limits of distribution might not represent the "normal" species pattern of responses to environmental factors. Even though this species do not respond according to the expectation of the center hypothesis, it is highly possible that the northern populations that are adapted to live in a lower and narrower temperature range would have respond completely different to the trials developed in this study. Thus, I insist that in the context of the present study general conclusions for the species is not possible.

Specific comments

Methods Page (P) 2841, Line (L) 4: Indicate if you worked with female or male adults. If you worked with females indicate if they were in the same reproductive stage and which one. Herein it is important to consider that metabolic demands increase signifi-

cantly during embryo incubation process. P 2841, L 7: Does a mussel base mono-diet cope with all the nutritional requirements of this species? A 4 weeks acclimation with an inadequate diet could change metabolic capacity trough for example changing mitochondria membrane composition. P 2842, L 15: Did you continue pumping CO2 during temperature changes? Or did you control CO2 levels during temperature increases or decreases? Consider the temperature effect on CO2 solubility Do a temperature increase in 15 °C and/or decrease in 10°C affect pH? Which would be the expected values under each trial temperatures?

Results Fig. 3. The information this figure gives is also present in figure 4. I suggest incorporating the regression information in figure 4. Table 2. I believe that authors do not take much advantage of this table. They only mention it once during the discussion, without mentioning or comparing their results with those described in the table. They only state that H. araneus heart rates were similar to other marine invertebrates. By contrast a long comparison and parallelism with Petrolisthes species is made in the discussion section and these species are not included in Table 2.

Discussion

Most of my concerns regarding this section are mentioned in the general comments. However there is another aspect that I would like authors try to explain, and it is regarding the very low heart rate Q10 observed for individuals under all temperature-CO2 combinations. It is true that they found an increase of the Q10 value associated with an increase in CO2, from 1.13 in normocapnia to 1.23 and 1.29 in 710 and 3000 ppm, respectively. But these values still very low and are indicative of thermal insensibility or acclimation to physical factor changes.

P 2849-50, L 27-28 and 1-6. The parallelism made with Petrolisthes species does not contribute much to problem that deals with the fact that a CO2 would induce narrowing of the thermal tolerance. I think this parallelism is rather confusing. I suggest eliminating this paragraph.

Interactive comment on Biogeosciences Discuss., 6, 2837, 2009.