Biogeosciences Discuss., 7, C1250–C1253, 2010
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Biogeosciences Discussions

Interactive comment on "Effect of ocean acidification on the early life stages of the blue mussel (*Mytilus edulis*)" *by* F. Gazeau et al.

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Received and published: 2 June 2010

We would like to thank the referees (Talmage and Gobler) for their comments and suggestions on our manuscript.

We agree with the referees that it could be useful for the reader to mention the pCO2 levels that corresponded to our pH levels. This has been included in the abstract and in the Material and Methods section. pCO2 levels were already mentioned in the Results section as well as saturation states with respect to aragonite.

Specific comments

Introduction

- Shellfish are an important food source for many organisms beyond birds

We agree and this was corrected in the Introduction section. It now reads as:

"Shellfish are ecosystem engineers governing energy and nutrient flows in coastal ecosystems, providing habitats for many benthic organisms and constitute an important food source for, for instance, birds, crabs, starfishes and fishes (Gutiérrez et al., 2003; Norling and Kautsky, 2007)."

- Natural variation in pH and CO2

We already refer to this variability on several occasions in the manuscript and thanks to the suggestions of the 3 referees we have extended our discussion on this aspect.

Material and Methods

P2932L8: the conditions at which the adult mussels are exposed to in the field are discussed in the Results section. Following Reviewer#1 recommendations, we added a paragraph on the relevance of our experiment with respect to natural conditions in the Discussion section.

Analytical precision of pH measurements: We suggest reporting the level of analytical precision and detection limit. Detection limits are not important/not relevant in this context and analytical errors in pH, pCO2, TA etc are much smaller than experimental errors (i.e. variance during incubation conditions).

P2933L12, sensitivity of larvae to acid washing. The vessels were indeed carefully rinsed after the acid cleaning procedure and before reintroducing the organisms in the tanks. This has been clarified in the text.

P2933L19: Sub-sampling of 500 μl for counting and size determinations. The 500 μl were not sampled in the 130 l tanks but in the 2 l jars where the organisms were concentrated. As we did triplicate samplings that did not show important variations, we believe the sampling procedure was appropriate.

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7, C1250–C1253, 2010

P2934L8: GFF filtration altering TA. By definition, TA is not modified by gas exchanges.

P2935: Use of the past tense for the paragraph on the natural variations in the Oosterschelde estuary: This has been modified.

P2938L7: Presence of amorphous calcium carbonate. The referee is right, we have added a small paragraph on that issue:

"Although the regulation of calcification by this mechanism is well documented for adults, few studies have focused on the mechanisms of larval calcification and on the capacity of bivalve larvae to regulate calcification rates by controlling the carbonate chemistry at the site of calcification. There is, however, some indication that biomineralization of Mytilus edulis larvae is physiologically controlled, as the activity of the carbonic anhydrase, an enzyme that catalyses the reversible hydration of CO2 to HCO3- and H+, reaches a maximum at the end of each developmental stage connected with biomineralization (Medakovic, 2000). This study also reported that these larvae, as showed for other molluscs and echinoderms larvae (Weiss et al., 2002), produce mainly amorphous calcium carbonate (ACC) during the first 2-3 days of development and aragonite in the following days. As the solubility of ACC is 30 greater than that of aragonite (Brecevic and Nielsen, 1989), early larval stages should be much more vulnerable than older larval stages and adults that precipitate aragonite and/or calcite. Again, the fact that 2-days old larvae were able to produce a shell under aragonite undersaturation highlights the strong regulation capacity of these organisms under sub-optimal growth conditions."

P2938L20: Including upwelling and changes in net metabolism in the pH variability in coastal zones. This has been included:

"Shellfish predominantly inhabit coastal regions, which usually exhibit lower pH values than the open ocean because of permanent or episodic low pH water inputs from rivers (Salisbury et al., 2008), from upwellings (Feely et al., 2008) and due to intense rates of organic matter degradation and/or nitrification (Hofmann et al., 2009)."

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7, C1250–C1253, 2010

Technical corrections:

P2929L13: to slight, corrected

P2931L15: Capital M in mollusks removed.

P2939L2 and 4: Reference corrected.

References

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Interactive comment on Biogeosciences Discuss., 7, 2927, 2010.