Biogeosciences Discuss., 6, C95–C102, 2009
www.biogeosciences-discuss.net/6/C95/2009/

Biogeosciences Discussions

Interactive comment on "Impact of CO_2-driven ocean acidification on invertebrates early life-history – What we know, what we need to know and what we can do" *by* S. Dupont and M. C. Thorndyke

Anonymous Referee #1

Received and published: 7 April 2009

In their manuscript entitled "Impact of CO2-driven ocean acidification on invertebrates' early life-history – what we know, what we need to now, and what we can do," Dupont and Thorndyke review the current body of published (and unpublished) research that investigates the effects of CO2-induced reductions in pH and carbonate saturation state on larval development for a range of marine invertebrates. In their review, the authors also discuss various strategies that may improve the field of ocean acidification research, including standardizing experimental protocols, focusing on more sensitive species, populations, and habitats, and improving the communication of scientific re-

sults to politicians, the media, and the general public.

The impact of CO2-induced ocean acidification on invertebrate larvae is a particularly important aspect of ocean acidification research because of the likely sensitivity of the larval developmental stage. In this regard, the authors address a very topical issue that is well-deserving of a focused review article. However, the effectiveness of this review article is diminished by several key shortcomings, which are summarized below. The authors will need to make substantial revisions to their current manuscript to fully address these shortcomings.

General comments: I. Presentation of non-peer reviewed results One of the greatest strengths of this review article is the inclusion of a table summarizing the various experiments that have addressed the effects of CO2-induced ocean acidification on invertebrates' early life history. However, of the 24 species that are included in the summary table, 13 (over half) are cited as "personal communications" that have not been peer reviewed. This is not acceptable. The purpose of a review article is to discuss the implications of previously published, peer-reviewed work. If the authors wish to include the many non-peer reviewed studies in their summary table and corresponding discussion, then they need to provide the experimental methods, actual results, and the appropriate statistical analysis that will allow reviewers (and readers) of this manuscript to duly evaluate this work. As the authors themselves note in their review article, the current field of ocean acidification research is confounded by differing modes of acidification, differing modes of quantifying calcification and other responses, non-realistic growth conditions, etc. By not providing the methods, actual results (vs. summary), and appropriate statistical treatments, the authors are contributing to the very confusion that they admonish against in their manuscript. Again, these non-peer reviewed results should only be included in this review article if (1) they are accompanied by the necessary qualifying information and (2) after reviewing this qualifying information, reviewers of the manuscript deem these studies worthy of publication. This is a very critical issue.

BGD

6, C95–C102, 2009

II. Discussion of the various responses listed in Table 1 The manuscript would benefit from a more thorough discussion of the various patterns identified amongst the various taxa listed in Table 1. For example, there is only very limited discussion of the role that calcification plays in larval development. And there is also no discussion of polymorph mineralogy utilized by the various taxa, which is surely an important aspect of the various responses. It would be interesting, for example, to discuss the well-known phenomenon that many low-Mg calcite molluscs start out secreting the more soluble aragonite phase in the larval stage and only switch to producing low-Mg calcite later on in development. The authors should also consider discussing the mechanisms of calcification in the larval stage, and how it differs from later, potentially less-sensitive stages. It is in these areas that the authors could make substantial contributions to and provide important direction for the field of ocean acidification research.

III. Discussion of adaptation potential In their manuscript, the authors offer only a limited discussion of the potential for and mechanisms of adaptation to ocean acidification. This section should be substantiated with a more thorough discussion of previous studies investigating how selective forces (in this case, ocean acidification) cause disproportionately rapid changes in genotype when focused on the larval stage of development. They should also discuss the fact that most of the invertebrates they cover in their reviews are r-selected taxa, which produce very large numbers of offspring of which only a few survive to adulthood. R-selected taxa, because of the intrinsically elevated genetic variation of their offspring (due to sheer number of offspring) will be more likely to produce genetic variants that are more tolerant of extreme conditions (in this case, CO2-induced ocean acidification). Naturally, this suggests that such organisms may exhibit a more rapid evolutionary response to OA. The next question is whether the rate of ocean acidification will be too rapid to permit an evolutionary response. The current body of literature on these subjects permits a quick comparison of these rates and may be worthy of inclusion in the review paper.

IV. Focus and concision of the manuscript While the manuscript has a clear focus at

BGD

6, C95–C102, 2009

the onset, the focus within sections is not well maintained. For example, the main paragraph on p. 3117 begins by stating that OA researchers should not extrapolate from single species. Several sentences later there is a vague discussion of Knoll et al's discussion of the end-Permian extinction. Then the paragraph is concluded with several statements that assert that we need to focus more attention on the "winners" of OA. Unfortunately, such lack of focus is prevalent throughout the manuscript. The authors need to rewrite many portions of this manuscript so that the sentences in each paragraph follow a logical progression. Redundancies are also prevalent, both within sentences and throughout paragraphs. This distracts from the main points the authors raise in the manuscript. I have attempted to address many – but not all – of these stylistic problems in the "Specific comments" section below.

Technical note: Overuse of italics Italics, in scientific writing, should be reserved for scientific nomenclature, variables, and, in rare cases, to emphasize a very critical point in a manuscript. Here, the authors use italics on over 12 separate occasions to emphasis their point. Because of their overuse, they become virtually meaningless by mid-article. The emphasis that the authors are seeking to achieve with these italics should instead be rendered through diction, sentence structure, and overall manuscript organization.

Specific comments:

Title: change to "marine invertebrates" and add possessive apostrophe

page 1, line 2: change "increasingly fast" to "increasing"

8-9: is this true? why?

10-12: change to "the field is advancing rapidly"; remove "good data are still scarce".

12: remove "apparent paradoxes" (redundant); remove "will"

13: remove "work in progress"; see #1 above 15: remove "very" and "resources"

18: remove "and rescue"

BGD

6, C95–C102, 2009

22-23: remove 2nd sentence, superfluous

26: change “she” to “the author”

page 2, line 3: change “correcting carbonates and bicarbonates” to “correcting for dissolved inorganic carbon speciation”

4: “realistic” is overused here

7: limiting the experimental parameters to levels predicted for year 2100 is arbitrary; why not limit to levels predicted for 500 years out – this is still relatively near in the future; not a good criterion

10: change “fast” to “quickly”; “several” means “four,” is this what the authors intend to say? there are many more labs than this looking at this problem

11-15: preliminary and “personal communication” data should not be included unless methods and results have been peer-reviewed (see #1 above).

17: begin section with an explicit introduction of Table 1

17: change “accepted” to “expected”

24: delete “listed”

page 3, line 6: change “water chemistry” to something more specific (e.g., temperature, CO2 solubility, etc.)

13: change “dangerous” to “misleading”

20: change to “a more acid future ocean”

21: new sentence: “Therefore, profound changes ...”

24: begin paragraph with a more focused transition

27-29: sentence does not make sense

BGD

6, C95–C102, 2009

page 4, line 14: rewrite sentence for clarity

line 21: define “this” explicitly

page 5, line 1-2: change to “neither their gross morphology nor their fitness was affected.”

6-8: sentence does not make sense; rewrite for clarity

11-12: include citation re: maintenance of microenvironment adjacent to site of skeletogenic calcification.”

13: change “imply” to “suggest”

14: change “solved” to “answered”

18-20: change to: “Moreover, with the exception of cold water...”

26: change to “Calcification is only one of the many physiological parameters that is affected by OA.

page 6, line 4: “what is a “calcium transient”?

5: “exquisitely” is wrong word

6-7: rewrite sentence for clarity

23: “change artificial selection in” to “selective survival of”

page 7, line 3: change “specific or synergic” to “combined effects of OA and ...(delete “both”)

15: delete “on ‘what we need to know”’

20: again, what is so important about 2100? how about 2500?

20-22: delete sentence; a bit patronizing

page 8, 2-3: delete sentence; superfluous

BGD

6, C95–C102, 2009

10-11: remove sentence; redundant

13-17: sentence does not make sense

23: change to “For example, jellyfish may be suitable candidates for this.”

page 9, line 19-23: contradictory sentences

28: replace “on” with “do this over”

page 10, line 4: change “for” to “to”

23: change “those from” to “the effect of”

24: change “then” to “therefore”

page 11, line 9: change “ameliorate” to “mitigate the negative effects of”

10: add “impact of climate change through the natural selection of CO2-tolerant genotypes.”

15: change “provides” to “may provide”

16: New, revised sentence: “Early development stages are key to understanding the impact of OA on these organisms.

21-23: remove sentence; superfluous

25: change “by” to “through the award of”

page 12, lines 7-9: remove last sentence of this paragraph. Many scientists all around the world are already actively investigating ways to sequester carbon and mitigate the effects of ocean acidification.

11: delete “good quality information”

15: change “local extinction” to “extermination” (which means local extinction)

19: delete “some”; change to “investigating...understanding...identifying...isolating, etc”

BGD

6, C95–C102, 2009

Interactive Comment

25: change to “different”

26: delete “some” (two times)

28: change to “We should also...”

page 13, line 2: change to “Here, it will be essential....”

6-7: Delete first sentence and half of second; superfluous

8: Begin with “If humans do not reduce their emission of CO2...”

10-12: Delete sentence; redundant

13-15: use active voice: “We already know that...temperature impacts early development.”

16: change to “that the nature of these changes...”

19-20: change to “variability may lead to lead to natural selection of more CO2-tolerant genotypes.”

21-25: rewrite final sentences for clarity: “As scientists, we need to improve of understanding of predicted future changes, particularly to estimate the susceptibility of certain populations to climate change to inform conservation efforts. There is an urgent need to develop scientifically-based strategies to provide tractable and sustainable solutions to mitigate the negative impacts of CO2-induced ocean acidification.

Interactive comment on Biogeosciences Discuss., 6, 3109, 2009.