

Interactive comment on “Ocean acidification reduces growth and grazing of Antarctic heterotrophic nanoflagellates” by Stacy Deppeler et al.

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Reviewer 1:

General comments

This work is part of a minicosm investigation of the effects of increasing fCO₂ levels on a natural planktonic microbial community of Prydz Bay, East Antarctica, and deals with the response of heterotrophic flagellates (HNF), nano- and picophytoplankton, and prokaryotes. The design of the experiments was similar to that of previous studies in East Antarctica, but with an initial CO₂ acclimation period. The publications (one of

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them, at least, in Biogeosciences) on the same minicosm experiment, and will have benefitted from the reviews of the previous works.

Overall, the manipulations appear to have been competently carried out and the text is well written. Concerning the discussion, I appreciated, in particular, the consideration given to potential community shifts, in addition to physiological changes. Some comments on aspects that could be improved are given below.

Specific comments

The main results of these accompanying works tend to appear late in the text; they should rather be presented up front in the introduction, so that the reader can better appreciate what is the context for and the contribution of the present study.

Response: We agree that presenting the previously published results of this minicosm study in the Introduction will provide greater context for the results presented. We will update the Introduction to include a summary of the previously published findings of this minicosm study.

Some conclusions go further than supported by the presented results. For example, the statement (whether correct or not): “Therefore, it is likely that increasing CO₂ will cause the phytoplankton community to shift from a summer community that is currently dominated by large diatoms to one composed of smaller species or morphotypes of nano- and picophytoplankton.” (lines 27-29 of page 13) does not derive from the work shown in the present manuscript (or if the authors believe so, it should be much better discussed).

Response: This is true, we did not analyse the phytoplankton community >50 μm

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in size so cannot solely base this conclusion on the results of this manuscript. This conclusion took into account the additional data provided by microscopic analysis of the microphytoplankton community in Hancock *et. al* (2018). We will reconsider this conclusion in its current location and will update this section of text to be more specific to the work in the present manuscript. We will provide further discussion of the combined published results of the greater minicosm study in the Conclusion.

Other comments

It would be helpful for the readers to give more details on the statistical analyses (for example, explain “1” in tables S2-S5, number of time points and of pseudoreplicates).

Response: We regret not having provided sufficient information regarding the statistical analysis. A number of changes will be made to the presentation and interpretation of statistical analyses (see also other referee comments below) and more clarification will be provided regarding pseudoreplicate numbers and abbreviations displayed in statistical tables.

It would be helpful to repeat somewhere that the prokaryote group here is supposed to include few or no cyanobacteria.

Response: The referee is entirely correct, the prokaryote analysis is of the heterotrophic prokaryote community only. This is because autotrophic prokaryotes (ie, cyanobacteria) were not detected in our study. We did mention in the Introduction that cyanobacteria are very rare in coastal Antarctic waters but we will reiterate this information in the Methods to make it abundantly clear that they were not detected in our flow cytometry results and were not part of the prokaryote analysis.

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Line 3 of page 9. Eliminate “treatments”.

Response: We will fix this sentence to remove the extra word.

Lines 6-7 of page 10. “acclimating cells over the years to decades . . . is unachievable in most experimental designs”. It is also doubtful to expect that the same cells/taxa would be acclimating for years or decades in natural settings.

Response: This is true and we will amend the wording of this sentence to acknowledge this.

Lines 7-8 of page 13. “dominated by large diatoms and ...” Which were the main “large diatom taxa”?

*Response: Previous observational studies of East Antarctic waters, of which the study site is located, identified a diverse range of large diatom taxa (e.g. Davidson *et. al*, 2010). The most abundant during summer were generally *Fragilariopsis* sp., *Chaetoceros* sp., *Thalassiosira* sp., *Navicula* sp., and *Pseudo-nitzschia* sp. In our minicosm study, the dominant species were large centric and pennate diatoms such as *Thalassiosira* sp. and *Fragilariopsis* sp. (see Hancock *et. al*, 2018). We will update this sentence to specify that we are discussing East Antarctic phytoplankton communities and provide examples of the dominant large diatom genera in early summer in this region.*

Lines 28-29 of page 13. “a summer community that is currently dominated by large

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diatoms”. This would not apply to many Antarctic areas.

Response: We disagree with this statement. Summer blooms of large diatoms have been observed frequently across East Antarctic coastal regions and the Antarctic Peninsula (e.g. Ducklow et. al, 2007, Davidson et. al, 2010). The Ross Sea is one region where this is not necessarily the case and where large blooms of Phaeocystis antarctica are observed during the summer months (Arrigo et. al, 2000). That said, we do acknowledge that the driving factors for community composition differ around Antarctica. Our experiment was performed in East Antarctic waters and we did not intend our statement to encompass all Antarctic waters. We will update our conclusions to make this clearer.

Line 31 of page 13. “Increases of prokaryote ..”

Response: We will fix this.

Explanation of Fig. 7: “prokaryotes” instead of “prokryotes”.

Response: We will fix this.

Explanation of Fig. 9: Add indication that the abscissa shows the picophytoplankton and prokaryote abundances on the day before decline. For example: “Heterotrophic nanoflagellate abundance (y axis) on the day before (a) picophytoplankton and (b) prokaryote abundance (shown in x axis) declined in each ... “

Response: We will revise the figure explanation to clarify the identity of the axes.

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References:

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Hancock, A.M., Davidson, A.T., McKinlay, J., McMinn, A., Schulz, K.G., van den Enden, R.L., 2018. Ocean acidification changes the structure of an Antarctic coastal protistan community. *Biogeosciences* 15, 2393–2410. <https://doi.org/10.5194/bg-15-2393-2018>

Interactive comment on *Biogeosciences Discuss.*, <https://doi.org/10.5194/bg-2019-224>, 2019.

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