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Discussions

Interactive comment on "The Arctic picoeukaryote *Micromonas pusilla* benefits from Ocean Acidification under constant and dynamic light" *by* Emily White et al.

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White et al., investigate the response of Micromonas pusilla to ocean acidification (1000 μatm) and different types of light supply. The experiments are carefully designed and performed well. This study is very useful as it investigates the response of an important phytoplankton species to OA and different light conditions that has so far not been investigated physiologically in that much detail. I therefore only have minor/moderate comments.

Line 14: Climate change or global warming? I would say the latter although not 100 % sure.

Line 18 (and several times throughout the text): The authors claim that the dynamic light regime resembles a "natural light field". I have doubts that this claim is justified. The underlying assumption is that the organism is repeatedly and regularly moved up and down through the mixed layer. Is this really representative for what is happening in nature? How can chlorophyll a peaks form in the mixed layer if this scenario was true? I am certainly not an expert on this but would assume that the dynamic light regime is also unnatural but differentially unnatural than the constant light. I would therefore suggest rephrasing this claim throughout the text or provide evidence that this scenario is what the cells are typically experiencing.

Line 28: I find the term "physiologically plastic" somewhat cryptic and not necessary in this context.

Line 37ff: This statement is only true for the physiological level. In nature, positive or negative effects can also be induced indirectly e.g. through altered trophic cascades. Please add "on the physiological level" or something like this.

Line 40f: Do you have a reference for this?

Line 65: Two things: 1) According to convention picoplankton is generally considered to be the size class 0.2 – 2 μm. 2) I find it hard to believe that this size class "dominates primary productivity" in the oceans. I mean, when diatoms (larger than the picos) already contribute 40 – 50 % to marine PP than picos would have to contribute the other half (which leaves no room for other important groups such as dinoflagellates). They are without doubt important but I would be very careful with the term "dominant".

Line 120: Was pH measured at incubation temperature or did you correct that somehow after the measurement?

Line 133: Why did you use TA and pH and not TA and DIC? Isn't the DIC measurement more reliable than an NBS based pH measurement.

Line 144: Have you checked if the "slow" flow rate of the Accuri is correct? I calibrated

the flow rates of the Accuri with a balance (measuring sample weight before and after a long measurement test run) and found that the medium and fast flow rates were correct but the slow flow rates were off twofold (I don't remember out of my head if it was over- or underestimating the flow rate and the data is at the computer at my previous affiliation). I think this is important to clarify as it may significantly alter your growth and production rates, although it probably won't influence your overall interpretation.

Line 148: Please provide molarity of the HCl.

Line 151f: What is the rationale to calculate production rates by multiplying quotas with μ/LN(2)? I am aware that the usual calculation (i.e. quota * μ) is probably not so good but what is the advantage of μ * k? This very interesting and a sentence explaining this operation would be very helpful.

Lines 264 – 284: Your explanation sounds very plausible but I wonder why is the growth rate so much lower under dynamic light when the cells found a good compromise between low and high light periods. If the cells were as "plastic" as you describe them here, I would expect less of a reduction given that the overall amount of quanta provided to them is the same as in the constant light regime. So, aren't you a bit too optimistic about the performance of the cells or are there examples of other species which "suffered" much more under dynamic light relative to the constant light control setup? In other words, I wonder how you came to the conclusion that M. pusilla was "effectively acclimated" to varying light because I am missing a comparison to a species that is not.

Line 285: This paragraph says that the photoacclimation was costly which makes me wonder if it can be considered "effective" (see previous comment).

Line 294f: Not sure if it is necessary to emphasize this controversy here because there are probably many Micromonas genotypes with different light sensitivities. Prochlorococcus, for example, are known to occur in different water depths (presumably different genotype populations) with different fluorescence signatures. Could also be the case

for Micromonas.

Line 300: The phrasing of "enhancing OA" is kind of weird. Consider rephrasing this sentence.

Line 313: I find this final conclusion a bit too centered on the carbon metabolism. It could also be that the improved "performance" under OA is linked to a pH dependency of nutrient acquisition. We have speculated quite intensely about "why Picoeukaryotes are almost always winning" under simulated OA in natural communities and came up with quite some plausible explanations (I think). Perhaps check out the discussion in this paper (Bach et al., 2017 Plos One, . . .winners and Loosers in coastal phytoplankton). I am not urging you to cite this paper (!) but just think some speculations therein could enrich this part of the discussion.

Line 317: Do you mean in "our" study? Not sure which study you mean here.

Line 370: I do not understand what kind of generalizations you are talking about. Please clarify.

Line 375: This statement is plausible but how useful is it because you could say exactly the same thing about pretty much every other parameter (trace metal concentration, vitamins temperature etc.) So why is dynamic light a more important variable than any other parameter?

Line 378: see previous comment.

Line 388 and 389: The way you use the term "plasticity" it can basically mean everything. I think it would be better to say precisely what you mean here. Do you mean they benefitted?

Line 389: It seems like the message implied in this sentence is that we would better understand the fate of Micromonas if we combine OA, warming, and dynamic light. I doubt it. Maybe it is not the right place to start this discussion but I think this "multiple stressor" approach without a clear underlying mechanistic framework is leading

nowhere.

Table 1: Are the start and end values mixed up? E.g. DIC is lower at the start than at the end. If this is really the case, why is this so?

Table 2: The calculated pCO2 values are lower than the idealized 400 and 1000 μatm. Why don't you use measured values for your treatment nomenclature in the text and figures?

Table 2. It is unclear to me what the difference between the growth rate and the division rate constant is. Why do you show both and what does each one mean? The division rate constant is not discussed.

I hope my suggestions help the authors to improve their manuscript.

Kind regards

Lennart Bach

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