

## ***Interactive comment on “No observed effect of ocean acidification on nitrogen biogeochemistry in a summer Baltic Sea plankton community” by A. J. Paul et al.***

**D. Campbell (Referee)**

dcampbell@mta.ca

Received and published: 10 November 2015

This manuscript presents N<sub>2</sub> fixation and related data from a Baltic Sea mesocosm CO<sub>2</sub> enrichment study which has been previously covered in the companion paper Paul et al. 2015, also in BioGeoSciences. The study is well designed but suffered from contamination of a key stock of labelled N<sub>2</sub> late in the study, which overlapped with the period when diazotrophic cyanobacteria abundances were highest (albeit at a low total level). Thus measured rates of N<sub>2</sub> fixation were mostly below detection, until the period when contaminated N<sub>2</sub> was used. The authors present reasonable constraints up N<sub>2</sub> fixation, based upon P uptake rates, assumed N:P ratios and average N exudation and

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fixation rates, during the problematic period, but the problem remains that a key metric was not directly determined.

Paul et al. 2015 found higher phytoplankton biomass and lower [P] under elevated fCO<sub>2</sub> in these mesocosms. But the present study, subject to the limitations noted, does not support increased N<sub>2</sub> fixation under elevated fCO<sub>2</sub>, contrary to some lab studies (Levitan et al.; the authors cite a list of other studies on this issue) on effects of elevated fCO<sub>2</sub> upon N<sub>2</sub> fixation in cyanobacteria.

The diazotrophic cyanobacterial community was low in the mesocosms compared to some other Baltic sea studies, so any putative fCO<sub>2</sub> influence would be acting upon a small nitrogen fixation capacity.

The mesocosms were closed at the bottom. Would this alter their response by cutting off upwelling supplies of NH<sub>4</sub><sup>+</sup>?

This paper presents additional evidence that in natural communities elevated fCO<sub>2</sub> does not drive an increase in N<sub>2</sub> fixation, even though culture experiments suggest it should.

Given the importance of the topic, and the difficulty of mesocosm studies, and the reasonable discussion, I support publication of the manuscript despite the noted limitations.

Abstract: "(average treatment fCO<sub>2</sub>: 365–1231 μatm)" This statement needs to be clarified; I think: (average treatments fCO<sub>2</sub>: 365, 1232 uatm). Line 12 in the Materials & Methods has a different range of fCO<sub>2</sub>.

line 22: nor, not or. Nor follows a negative.

Materials & Methods: line 26, "KOSMOS,"??? Undefined acronym/abbreviation?

Table 1: I do not understand why this table is organized into 10 columns. It looks to me like it should be 5 columns, twice as many rows.

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Figure 1. Would it be worth showing DIC? Is there any change?

Figure 1: insert legends are very small; I cannot read them at printed page size. I am getting weird colour changes (artefacts) in the roman numerals for the experiment stage labelling I, II, III. This is probably a .pdf generation issue, but it is distracting.

Again, the listed fCO<sub>2</sub> levels differ from the materials and methods, and from the abstract.

Figure 3: It would be good to have the colour/symbol legend for each figure, to stand on its own without reference back to Figure 1.

Figure 6: Data points with uncontaminated gas are below detection, all detected rates are from the contaminated period. Should this data be presented? I am reading page 17519 but am not clear on the origin of the data in Figure 6.

Results: P.17521 The extrapolations in the absence of actual N<sub>2</sub> fixation rates seem reasonable, but are based upon multiple assumptions on N<sub>2</sub> rates, N:P ratios and N exudation rates.

P.17521, the N contamination issue is serious given the patchy cyanobacterial data.

Discussion: "In fact, nitrate concentrations continually increased throughout the experiment at an average 10 net rate of 1 nmolNL<sup>-1</sup> day<sup>-1</sup> (Fig. 1c)"

Summary: "Thus N uptake rates were well balanced with supply or any net differences were too small to be detected in N 10 pool sizes across the range of simulated ocean acidification scenarios"

These statements appear contradictory. I think the summary needs to be clarified that fCO<sub>2</sub> did not provoke changes in N pool sizes?

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Interactive comment on Biogeosciences Discuss., 12, 17507, 2015.