

## Comment on bg-2022-44

Anonymous Referee #3

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Referee comment on "Upwelled plankton community modulates surface bloom succession and nutrient availability in a natural plankton assemblage" by Allanah Joy Paul et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2022-44-RC1>, 2022

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The manuscript shows a nice experiment planned to demonstrate the influence of the chemistry and biology of upwelled water on the development and later progress of phytoplankton blooms in coastal upwelling systems. In my opinion, the design of the experiment is correct, in which the simulation of the dilution caused by an upwelling episode stands out. However, upwelling most likely does not cause a full 1:1 mixing of upwelling water with surface water. Usually, upwelling pushes up, compresses the surface layer, and so supplies nutrients (and plankton) by diffusion and turbulent mixing at different intensities.

The conclusions are correct, although expected. The first conclusion is the best known. That is, nutrient supply to surface water with low nutrient concentrations induces phytoplankton blooms, mainly diatoms. The second is somewhat new, but not strange. It is reasonable to expect that plankton populations reaching the surface with upwelled waters modulate the bloom and its later evolution. This experiment clearly demonstrates that this happens. However, a better characterization of the species and/or genera of phytoplankton involved is lacking. The flow cytometer has only allowed the characterization of *Synechococcus*. For the rest of the community there was only a proxy of its size with very low detection of microphytoplankton. In addition, chlorophyll was not fractionated. This information is especially important in the post-bloom, when divergence between treatments and the variability within treatments is more evident. However, there is also variability among treatments during the bloom, as inferred from the differences in chlorophyll concentration on day 4 (Fig. 3A) and in the different abundances of nanoplankton (Fig. 5D, E, F). On the other hand, the results reporting significant silicate drawdown in the HN biology treatment point to the importance of diatoms, which could be different from those found in other treatments, including the LN biology treatment. Microphytoplankton (mainly diatoms) are likely causing the divergence observed in both bloom and post-bloom.

Although the introduction and the discussion read well, this is not the case for the results. In my opinion, this section, of great importance to support the conclusions, is written in a cumbersome way. It is necessary to read it several times and with enough attention to

catch the information. Figures are not always properly cited, nor is supplementary material. There are tables in the supplementary material that are not cited in the text.

In my opinion, this results section could be improved to remove weaknesses and make the manuscript more attractive to potential readers. The manuscript will probably improve by focusing the description of results on those relevant to the conclusions and ignoring those with low contribution to the two main conclusions.

Despite the lack of information on phytoplankton species composition, which in my opinion represents the greatest weakness of the manuscript, the design of the experiment and the difficulty of its execution, lead me to recommend the publication of the manuscript with major revisions.

Specific comments

Introduction

Line 29. ...is considered the most productive... from where? Maybe ...“the most productive upwelling region” or something similar

Lines 66-68. The Peruvian productivity paradox is a common paradox to all upwelling systems. With strong upwelling, chlorophyll concentration is low because surface water is recently upwelled water with high nutrient concentrations. Chlorophyll concentration increases when upwelling relaxes. This time lag also has translation into spatial heterogeneity. Chlorophyll concentration is low (few phytoplankton) in the upwelling center where there is deep water recently upwelled. High chlorophyll levels can be found in the surroundings.

Materials and methods

Line 105. According to Figure 1, the range of 15 m was only at station A, at station B it was 5 m.

Line 109. ...collected from the mesocosms (*M* in Fig.1)

Lines 129-131. The last sentence reads, “Both the surface (mesocosms) and treatment

water (deep water) were filtered... However, the deep water added to the two biology treatments was unfiltered.

Line 135 ...were set to the same *two levels* as in the organic...

Line 173. (picoeukaryotes, *nanophytoplankton*, small microphytoplankton, large microphytoplankton). It may be appropriate to add a few words here to inform that microphytoplankton is not well estimated by this technique, although it is recognized in the legend of figure S2.

## Results

### Initial conditions (Day 1)

Lines 256-257. If referring to all nutrients, Fig. 3B and C and Table S1 should be cited. If only nitrate is referred to, Fig. 3B should be cited.

Lines 262-265. Fig. 4E should be cited when discussing  $a_{254}$ . For E2:E3 it should be Fig 4F. Add Table S1 to Fig 3F when LAP activity is discussed; the slightly higher activity is better seen in the table than in the figure.

Lines 266-271. Table S1 should be mentioned when commenting about the phytoplankton community. The same table can be mentioned for Fv/Fm, Fig. 4D is the figure.

Line 274. ...between Day 3 and 5. Better between Day 3 and 6 (Fig. 3D).

It is difficult to follow the chlorophyll in this paragraph, it would be better to specify something else, for example: Peak Chl a concentrations of up to 12  $\mu\text{g L}^{-1}$  (HN organic) and  $\sim 6 \mu\text{g L}^{-1}$  (LN inorganic and biology). According to figure 4A, there are differences between various treatments on this day 4.

- It is difficult to follow this about the ratio DIN drawdown to maximum Chla accumulation. This ratio was higher in LN only for the case of organic treatment (Fig. 4A). I think the next paragraph about higher recycling of N or highest N utilization efficiency under low nitrate needs further explanation. How this higher N recycling or N utilization efficiency deduces from a lower DIN ratio drawdown to Chla accumulation? It seems too risky to attribute these differences in the ratio only to N. Variations in the ratio may also be due to different cell concentrations of chlorophyll. Mixotrophic behavior can also affect this ratio. The ratio changes through changes in N, changes in chlorophyll, or in both. Here phytoplankton composition could provide additional information.

Lines 291-292. The last sentence indicating that the initial concentration of DIN was 3 times higher in HN than in LN can be deleted. It was reported at the beginning of the results.

Line 322-323. I understand the association between higher silicate drawdown and higher chlorophyll concentration, but not with nanoplankton abundance. There is no information on the species that are in the nanoplankton fraction. On the other hand, the increase in chlorophyll could well occur in micro diatoms. Maybe the sentence could write like this:

The highest  $\text{Si(OH)}_4$  and phosphate drawdown, and consequently Chl a concentration was observed in one replicate. This replicate also showed highest nanophytoplankton abundances (Fig. 5B).

Fig. 5. I think the symbols on the panels do not correspond to the ones on the labels, where they are all circles.

## Discussion

Line 370-372. I think this sentence about bottom-up and grazing control is missing something.

Line 420-422. Silicic acid consumption could well have occurred by micro-sized diatoms. It is difficult to conceive that all or nearly all of the nanophytoplankton were diatoms. Usually, there are many flagellates in this fraction.

Lines 429-430. Diatoms were not analyzed and, therefore, it cannot be confirmed that the different behavior of the two treatments was due to the different response of the diatoms and the different seed population. What can be said is that the different behavior of the two treatments could be attributed to a different response of the diatoms and probably also to differences in the seed population.

Line 490-491. The highest silicate uptake only occurred in a biology treatment, in the HN biology. In the LN biology it did not occur (Fig. 3D).