

Interactive comment on “Sequential Nutrient Uptake by Phytoplankton Maintains High Primary Productivity and Balanced Nutrient Stoichiometry” by Kedong Yin and Paul J. Harrison

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Reviewer #3

Yin and Harrison have attempted to prove that there is preferential biological uptake of the most limiting nutrient as soon as the nutrient is added into the system. They provide high resolution nutrient data set and very interesting schematics (conceptual Fig. 1) to prove their claims. I enjoyed reading this manuscript but I still have the following suggestions that can improve the manuscript. General comments: 1. Research in this manuscript roams around the nutrient uptake ratios. We know that the nutrient uptake

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and stoichiometry are phytoplankton composition dependent (see Singh et al. 2015; Mills and Arrigo 2010). Authors have not provided any cell abundance microscopic data. I understand this research was conducted long time back but it would still improve the manuscript if authors could provide something on this aspect. They have mentioned a sentence on this in the discussion section (line 317-319) but I suggest them to add some more discussion on this.

#Reply: Thank you. We have added more discussion on phytoplankton assemblage there.

–Reviewer 3

Specific comments: Line 38: ‘3’ in ‘nitrate’ should be made subscript. Line 103: Fig. 1 in the heading looks a bit odd Line 111: Give space after full stop Line 111: N:P ratio of what? of nutrients?

#Reply: Line 38 NO_3^- is corrected to NO_3^- Line 103, removed Fig. 1 Line 111, added space Line 111, corrected as N:P ratio of nutrients

–Reviewer 3 Line 118: Just average nutrient ratio is not 16N:1P, it is rather when averaged for all the communities together

#Reply: You are right.

–Reviewer 3 Line 121-122: “The remaining. . . .phosphate.” Which species can take phosphate without taking any nitrate? Diazotrophs? Do they occur in the study area?

#Reply: The idea in this manuscript is to demonstrate that uptake of non-limiting nutrients can be decoupled from the most limiting nutrient. Here it is phytoplankton assemblages that can continue to take up phosphate after nitrate in the ambient water has disappeared.

–Reviewer 3 Line 175-177: “The incubation flasks. . . .16m).” Mention the light

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intensity at 16 m, at least with compared to the surface value in terms of %. What was the euphotic depth?

#Reply: 4 layers neutral screening is about 12.5% light reduction. The euphotic zone could reach down to 20 m.

–Reviewer 3 Line 184: What is T7? It is not described in the conceptual model.

#Reply: T7 here refers to the field vertical profile, not to the conceptual model. We have changed T0, T1, ... T6 to C0, C1, ... C6 in the conceptual model in Fig. 1 to avoid the confusion.

–Reviewer 3 Line 186: “due to an increase in NO₃- in the deep water”, what was the source of this high nitrate? What was the station depth?

#Reply: In the Strait of Georgia, deep water has high concentrations of nutrients and is the source of high nitrate. The station depth is over 300 m

–Reviewer 3 Line 187: How do the authors know that the silicate is from Fraser River? What is the silicate concentration in the river? #Reply: The dotted line for SiO₄ in the manuscript was very dim on my Apple computer, and you may not see it clearly. SiO₄ was minimal at 10 m with higher SiO₄ at the surface and at the 20 m. This higher SiO₄ is from the Fraser River as the River contains higher SiO₄ than the seawater in the Strait of Georgia deep water.

–Reviewer 3 Line 188: “top of the nutriclines” or “top of the nutriclines at T7” Line 192: “A strong wind”, provide wind speed. Line 220: ‘3’ in ‘nitrate’ should be made subscript.

#Reply: All are corrected.

–Reviewer 3 Line 235 “both.....undetectable”. What could be the reason for this? In nature, who could still utilize phosphate and silicate without nitrate?

#Reply: Phytoplankton uptake of nutrients can deplete these nutrients to undetectable

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levels. You are right, phytoplankton can not utilize phosphate and silicate without nitrate, but there is a time lag between their uptake, ie, uptake of 3 nutrients can be decoupled in time. The idea of this paper is to say sequential uptake of these nutrients.

–Reviewer 3 Line 249: How was the uptake ratio estimated?

#Reply: The uptake ratio was directly calculated from the decreasing concentrations over time during the incubation of seawater samples, e.g., using (day 2- day 1 nitrate concentration) / (day 2-day1 phosphate concentration) to get N:P ratio on day 1.

–Reviewer 3 Line 359: ‘this’ should be followed by ‘study’

#Reply: revised

–Reviewer 3 Line 356-363: Conclusion seems to be a bit misplaced. A lot of processes have been discussed and presented in the results but the authors have concluded only sequential uptake (which is not very convincing since there are neither any uptake measurements nor any information on community composition) #Reply: The conclusion has been revised

–Reviewer 3 References:

Mills, Matthew M, and Kevin R Arrigo (2010) Magnitude of Oceanic Nitrogen Fixation Influenced by the Nutrient Uptake Ratio of Phytoplankton. *Nature Geoscience* 3(6): 412–416.

Singh, Arvind, SE Baer, Ulf Riebesell, AC Martiny, and MW Lomas (2015) C: N: P Stoichiometry at the Bermuda Atlantic Time-Series Study Station in the North Atlantic Ocean. *Biogeosciences* 12(21): 6389–6403.

Please also note the supplement to this comment: <http://www.biogeosciences-discuss.net/bg-2016-426/bg-2016-426-RC3-supplement.pdf>

#Reply: These papers have been cited. Thank you.

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End of reply to referee #3

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