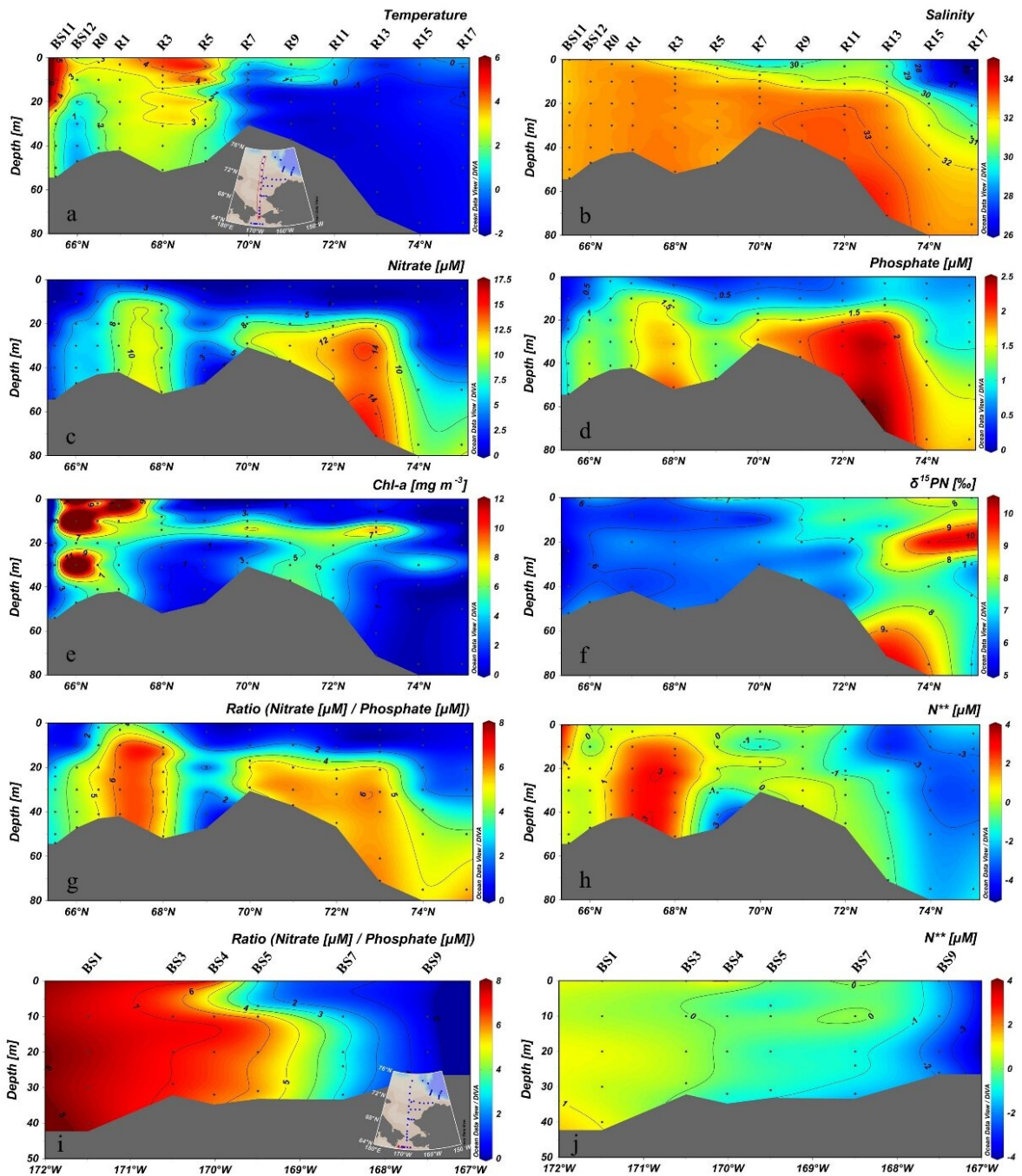


# Overlooked contribution of the biological pump to the Pacific Arctic nitrogen deficit

August 30 2022

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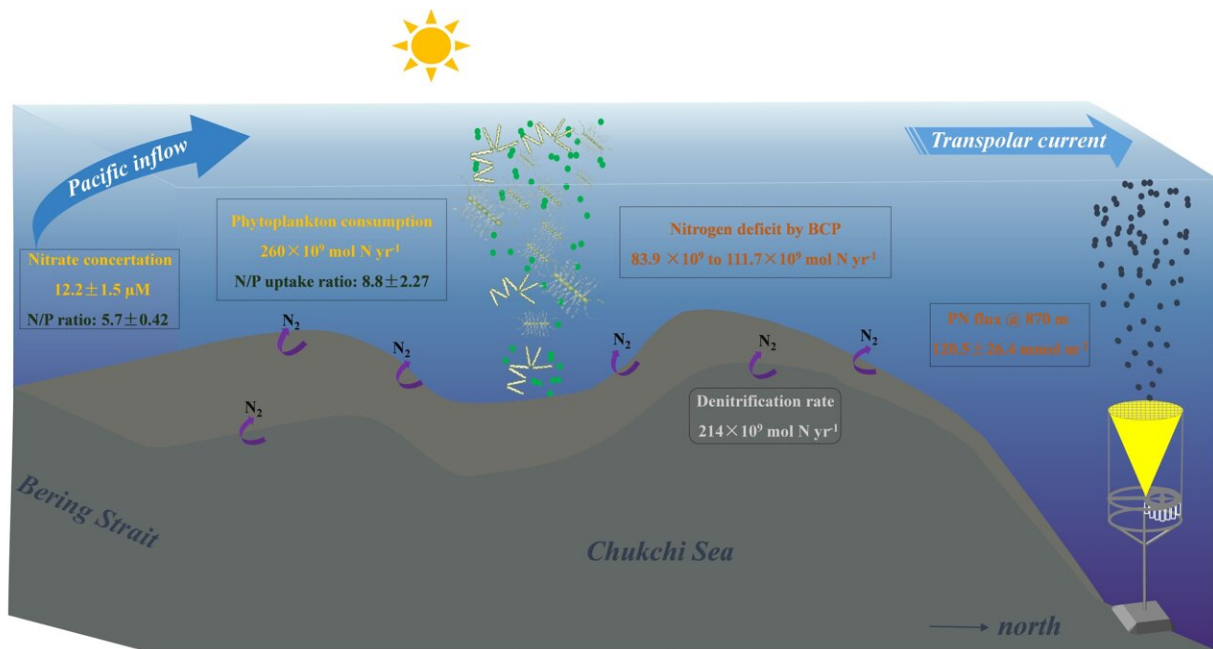


Vertical sections of water column properties along meridional transect on the Bering-Chukchi shelf and zonal transect just south of the Bering Strait. Credit: Science China Press

This study is led by Dr. Chen Jianfang and Dr. Li Hongliang from the Second Institute of Oceanography, Ministry of Natural Resources. Based on the field observation through two Chinese National Arctic Research Expedition (CHINARE) cruises in 2003 and 2008, the team focused the N/P uptake ratio by phytoplankton, seasonal consumption of nutrients, and export of particulate nitrogen in the Chukchi shelf and slope. Accordingly, they highlighted the overlooked contribution of the biological pump to the Pacific Arctic nitrogen deficit.

The role of nitrogen availability in the Pacific Arctic is a subject of much interest and speculation, which is believed to be regulated by the sedimentary denitrification in the Bering Strait-Chukchi Sea. This study demonstrated that the nitrate concentrations of the Pacific inflow gradually decrease northward in association with notable biological utilization. The phytoplankton N/P uptake ratio was higher than the N/P ratio of Pacific inflow water. This uptake ratio, in combination with efficient vertical nitrogen export, serves to preferentially remove nitrogen (relative to phosphorus) from upper waters, thereby further intensifying the Arctic nitrogen deficit.

Accordingly, as large as about  $111.7 \times 10^9$  mol N yr<sup>-1</sup> of nitrate was extra consumed, according to the real N/P uptake ratio rather than the ratio of the Pacific inflow, which may be as great as half the nitrogen loss ascribed to sedimentary denitrification. This findings suggest that besides sedimentary denitrification, biological disproportionate utilization of nutrients in the Chukchi Sea upper water is another important contributor to the nitrogen limitation and excess phosphorus in the upper Arctic Ocean. Furthermore, the modified Pacific inflow transported from the Arctic Ocean to the North Atlantic, which played an important role on the marine biogeochemical cycling by fueling nitrogen fixation.



Conceptual scheme of the nitrogen deficit induced by the biological carbon pump in the Chukchi Sea. Credit: Science China Press

Based on the study findings, in the rapid Arctic change era, the predicted reinforced biological pump could further impact the nutrient dynamics and biogeochemical process of the Arctic Ocean. The biological uptake and export significantly enhance N removal from the upper Arctic water column every summer, which should also be considered when preoccupied opinions regard sedimentary denitrification as the major reason for [nitrogen](#) deficit in the Pacific Arctic.

The research was published in *Science China Earth Sciences*.

**More information:** Li H et al, Overlooked contribution of the biological pump to the Pacific Arctic nitrogen deficit, *Science China Earth Sciences* (2022). [DOI: 10.1007/s11430-021-9916-1](https://doi.org/10.1007/s11430-021-9916-1)

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