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Lavish blue-green algae: Surprising supply of amino acids for zooplankton

In the international journal Limnology and Oceanography, marine biologist Natalie Loick-Wilde from Rostock reports about a study in the central Baltic Sea in which she and her colleagues from the Leibniz Institute for Baltic Sea Research Warnemünde (IOW) and the US-American Georgia Institute of Technology succeeded in proving that blue-green algae produce an excess of amino acids at a late stage of their bloom. In a typically nutrient-poor season, this leads to a surprising food supply for marine microorganisms and thus for the entire food web.

Our seas are not everywhere fertile and full of colourful, diverse life. Wide areas of the world's oceans are naturally poor in nutrients. The fact that marine life nevertheless develops, is to a large extent the work of cyanobacteria (colloquially: blue-green algae). Thanks to their unique ability to harness atmospheric nitrogen – a process known in the scientific community as nitrogen fixation – the small amounts of phosphorus that a nutrient-poor ocean has to offer are sufficient for them to form massive blooms. However, these relatively large and often toxic organisms are unsuitable for direct use in the food web. Rather, it is the amino acids produced by the blue-green algae that supply the food web, so that zooplankton and fish can also be fed. However, it has so far been largely unclear how high the amino acid synthesis is during nitrogen fixation and what influence the stage of the bloom has.

Natalie Loick-Wilde from IOW and her colleagues used a research cruise to the central Baltic Sea in summer 2015 to take a closer look at the supply of amino acids at the peak as well as at the beginning and advanced decay of a blue-green algae bloom. The Baltic Sea in general is not a nutrient-poor sea, but in midsummer, its nitrogen and phosphorus reserves are largely depleted. Then, even in the Baltic Sea, which is suffering from over-fertilization, it is "blue-green algae time". At four stations in the western and central Baltic Sea, the team sampled blue-green algae blooms in different stages, incubated the samples on deck already during the cruise and later determined the total nitrogen as well as the amino acid-specific nitrogen content. Using stable nitrogen isotopes in the amino acids, they developed for the first time an approach to investigate the synthesis of 13 amino acids during nitrogen fixation.

"We are one of the few laboratories in the world that can apply compound-specific nitrogen isotope analysis in amino acids (CSIA-AA for short)," Natalie Loick-Wilde reports. "It is this method that allowed us to develop the approach to see how much essential nutrients are being produced for a food web." It turned out that at a time when the blue-green algae themselves already largely stop their activity, so much amino acids are still produced in the bloom that this inevitably must have consequences for the food web. In anticipation of a proposed global increase of cyanobacteria blooms this excessive supply of nutrients before winter is a relevant parameter for the seasonal growth cycle of zooplankton – but also for fish-stocks. Its development and consequences should be further pursued.

Reference:

Loick-Wilde, N., S.C. Weber, E. Eglite, I. Liskow, D. Schulz-Bull, N. Wasmund, D. Wodarg, and J. P. Montoya. 2017. *De novo* amino acid synthesis and turnover during N₂ fixation. *Limnology & Oceanography*, doi: 10.1002/lno.10755

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