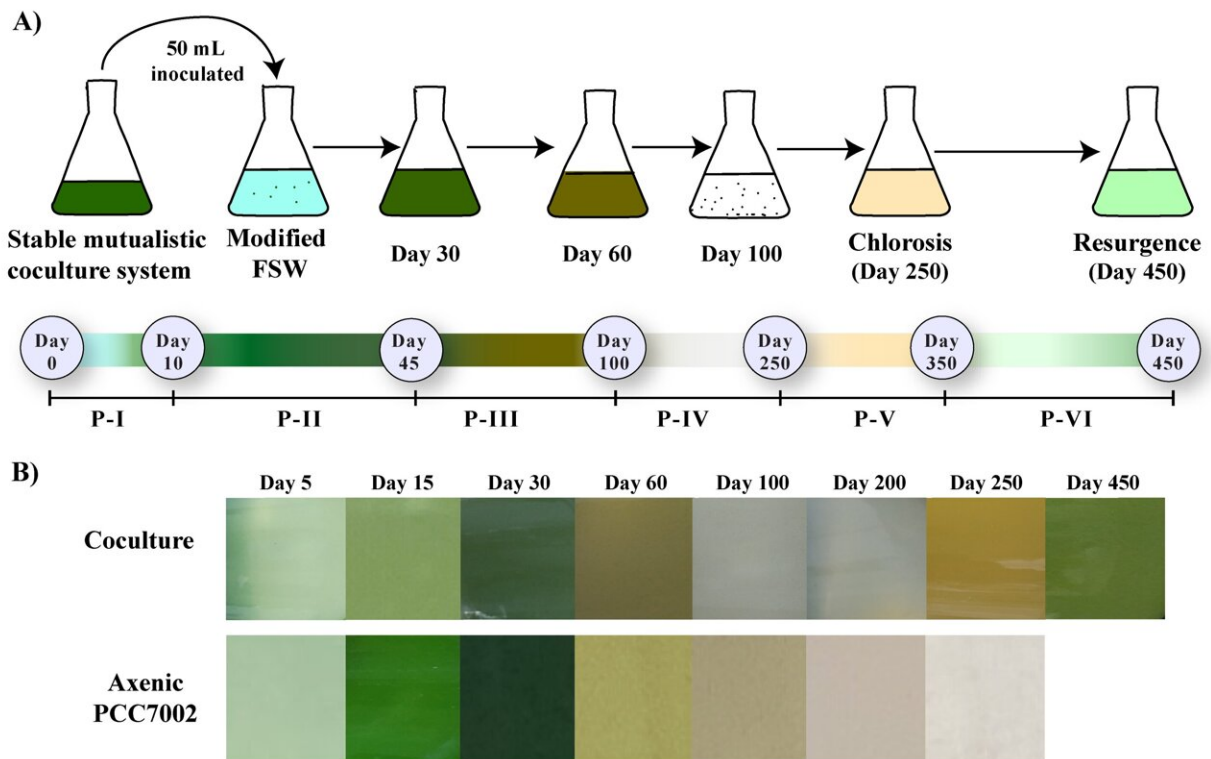


# Marine phytoplankton gets by with a little help from its bacteria friends

October 3 2022



(A) Illustration showing the experimental setup. Exogenous nutrients were added to an existing *Synechococcus*-heterotrophic bacterial mutualistic coculture system and *Synechococcus* growth was monitored for 450 days. The timescale below the culture flasks illustrates the start and end of each phase with their corresponding observed (visually) color change. (B) Real-time visual color change within the coculture system and in the axenic *Synechococcus* sp. PCC7002 culture. Credit: Shailesh Nair

A phytoplankton almost as old as Earth—about 3 billion years compared to the planet's 4.5 billion years—still holds secrets, including how it can survive starvation in the most nutrient-deficient oceans. *Synechococcus* is the most geographically diverse of three phytoplankton species, contributing to a quarter of the oceans' primary production and appearing in both frigid polar waters and warm tropical seas.

Now, researchers from the Qingdao Institute of Bioenergy and Bioprocess Technology (QIBEBT), Chinese Academy of Sciences (CAS), may have discovered who to thank for the phytoplankton's persistent existence: heterotrophic [bacteria](#).

In a series of multi-year experiments, the team found that *Synechococcus* and the bacteria that feed on them may have an inherent tendency toward mutualism and will undergo significant changes to encourage each other's survival. The marine algae *Synechococcus* and its associated heterotrophic bacterial community have an inseparably close relationship.

Their findings were published on Sept. 30 in *Science Advances*.

Previous studies include one in which the phytoplankton and its bacterial community thrived for more than two years without any external nutrient support. According to Prof. Zhang Yongyu from QIBEBT, these results hint at microbial interactions that may sustain long-term *Synechococcus* growth, but only in controlled and consistent experimental circumstances.

However, unlike laboratory culture systems, the ocean is not static and experiences changes in environmental factors, including nutrients. "This study was carried out to understand how changes in [environmental factors](#), such as the availability of external nutrients, will influence the mutualistic relationship between the *Synechococcus* and heterotrophic

bacterial community," said corresponding author Prof. Zhang.

Mimicking the change in [marine environment](#), the researchers supplied sterile inorganic nutrients to the established mutualistic coculture of *Synechococcus* and a diverse bacterial community from their previous study. The two-year-old stable and mutually beneficial relationship buckled but did not break.

"Our findings suggest that the availability of external nutrient sources disrupts the established mutualism, leading to the collapse of *Synechococcus* health," said co-first author Shailesh Nair, postdoctoral scholar at QIBEBT. "However, once the external nutrients were exhausted, over the next 450 days, *Synechococcus* and heterotrophic bacteria gradually re-established their metabolic mutualism under long-term coexistence that revived *Synechococcus* health."

Through [genetic analysis](#) and tracing the nitrogen in the system, the researchers determined that the bacteria facilitated [nitrogen fixation](#), converting nitrogen for use in buoying the phytoplankton, which triggered the re-established mutualism.

"During the process, [bacterial community](#) structure and functions underwent tremendous adjustments to achieve the driving effect, and the bacteria's cogeneration of nitrogen, phosphorus, iron and vitamin B12 sustained *Synechococcus*'s prolonged healthy growth," said co-first author Zhang Zenghu, associate professor at QIBEBT.

These findings suggest that *Synechococcus* and heterotrophic bacteria may have an inherent tendency towards mutualism, which can be re-established after environmental interference. This natural, recurrent trait of *Synechococcus* and heterotrophic bacteria may exhibit their co-evolutionary adaptations in nutrient-deficient environments for survival.

While the researchers said they believe this study answered the longstanding question about the tenacity of *Synechococcus*, they now have several more questions they plan to answer.

"Does this inherent mutualistic relationship apply to other algae as well?" Zhang Yongyu asked. "Can we boost algal growth by artificially constructing algal-friendly microbial communities? The potential regulation of algae-bacteria interactions may offer a novel way to increase algae-driven marine carbon sequestration."

**More information:** Shailesh Nair et al, Inherent tendency of *Synechococcus* and heterotrophic bacteria for mutualism on long-term coexistence despite environmental interference, *Science Advances* (2022). [DOI: 10.1126/sciadv.abf4792](https://doi.org/10.1126/sciadv.abf4792).  
[www.science.org/doi/10.1126/sciadv.abf4792](https://www.science.org/doi/10.1126/sciadv.abf4792)

Provided by Chinese Academy of Sciences

Citation: Marine phytoplankton gets by with a little help from its bacteria friends (2022, October 3) retrieved 26 April 2024 from <https://phys.org/news/2022-10-marine-phytoplankton-bacteria-friends.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.