THE DAYLIGHT AWARD

DAYLIGHT ACADEMY

The Daylight Award 2026 Jury reasoning

Category: Daylight Research

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Summary

The work of Zepernick, Wilhelm and McKay provides key insights on the role of daylight in photosynthetic algae. Their body of work and important discoveries allow for a greater understanding of the impact of climate change on aquatic ecosystems with major implications for planetary health and biodiversity.

Background

Using daylight, photosynthetic algae sustain most life on Earth. Through photosynthesis these algae use sunlight, water, and carbon dioxide to create chemical energy (glucose) and release oxygen as a byproduct. As a result, algae are fundamental to most ecosystems, generating vast amounts of atmospheric oxygen, contributing at least half, and perhaps as much as 70-80% of global oxygen. Oxygen is required for efficient respiration and complex multicellular life. Oxygen also forms the ozone layer shielding the Earth from high-energy ultraviolet (UV) photons, eliminating 90% of the UV-B and all of the UV-C radiation which would otherwise destroy much of the life on our planet. In addition, algae such as diatoms act as primary producers sitting at the base of aquatic food chains, supporting marine and freshwater life from zooplankton to fish, while also controlling nutrient cycles, sequestering carbon dioxide, providing essential habitats, and influencing water quality. As a result, algae are vital for planetary health and biodiversity. Understanding how climate change impacts the photosynthetic capacity of different species of algae is fundamental to understanding the future of the biosphere, and ultimately the survival of countless species, including ourselves.

Research

Zepernick, Wilhelm and McKay are utilising their complementary skills to address the critical question of how different communities of light-harvesting algae are being affected by climate change. One area of research has shown that warmer water temperatures favour cyanobacteria (blue-green algae), which can be toxic, over other, more beneficial types of algae (e.g. diatoms). This leads to more frequent, severe, and longer-lasting cyanobacterial harmful algal blooms (CyanoHABs). Such blooms have multiple impacts including oxygen depletion in aquatic environments resulting from the decomposition of CyanoHABs, creating "dead zones" just below the water's surface, which blocks sunlight from reaching submerged plants and algae crucial for the food web. In addition, the toxins in CyanoHABs are directly harmful to humans, pets and livestock. When such toxins enter the food chain, they harm whole ecosystems, affecting invertebrates, fish and birds.

Most recently the team have used cutting-edge methods to understand how the loss of ice cover has led to a decline in diatom populations due to the diminished capacity to undertake photosynthesis. Normally, diatoms stick to the underside of ice, fixing their location within the light environment to optimize photosynthesis. Climate change has led to a widespread decline in ice across the Great Lakes. In the absence of ice, water currents move the diatoms away from the surface and make the water more turbid. In response to this loss of daylight, diatoms have increased their expression of various photosynthetic genes and iron transporters, suggesting that the diatoms are attempting to increase their capacity for photosynthesis. In addition, these researchers found an upregulation of proton-pumping rhodopsins in the diatoms which act to augment photosynthesis and light-driven primary production.

With large-scale climatic changes already underway, the observations by these researchers provide novel mechanistic insights into how diatoms powered by daylight respond to ice loss and thus help to elucidate how they will fare in a climatically altered tomorrow, with major implications for planetary health and biodiversity.