

Study shows some aquatic plants depend on the landscape for photosynthesis

November 14 2019



In aquatic environments, plants fight for light and carbon to maintain photosynthetic activity. Since CO_2 is often limited in freshwaters, many species have developed alternative carbon resources. Many plants have partial terrestrial life forms, such as floating leaves or above water growth, and thereby have access to atmospheric CO_2 . Others, like these green Stoneworts, are able to use bicarbonate HCO_3^- as a carbon-source. Credit: Lars Iversen

ASU researchers found that not only are freshwater aquatic plants affected by climate, they are also shaped by the surrounding landscape. When in an environment where CO_2 is limited, aquatic plants use strategies to extract carbon from bicarbonate. Scientists identified patterns across ecoregions around the globe and discovered a direct link between the availability of catchment bicarbonate and the ability of aquatic plants to extract carbon from that bicarbonate.

All [plants](#) need carbon dioxide, or CO_2 to live. They extract it from the air and use it during the photosynthesis process to feed themselves.

But what happens to [aquatic plants](#)? How do they get carbon dioxide?

Some have partial terrestrial forms, such as floating leaves or above water growth, which allows them to use carbon dioxide from the atmosphere. But for plants that live completely submerged in water, CO_2 is limited and many of these plants have developed a mechanism to tap into other carbon sources. In this case, they extract it from [bicarbonate](#)—a naturally occurring mineral that comes from the weathering of soils and rocks and the runoff reaches the plants.

In a paper published today in *Science*, researchers from Arizona State University School of Life Sciences found that not only are freshwater aquatic plants affected by climate, they are also shaped by the surrounding landscape.

"In this study, we're able to show that yes, when in an environment where carbon dioxide is limited, then plants use strategies to extract carbon from bicarbonate," said Lars Iversen, principal investigator for the study and a research fellow at the School of Life Sciences. "We see this in local rivers and lakes, but we also see this across the globe. We have identified patterns across ecoregions and there's a direct link between the availability of catchment bicarbonate and the ability of

aquatic plants to extract carbon from that bicarbonate."

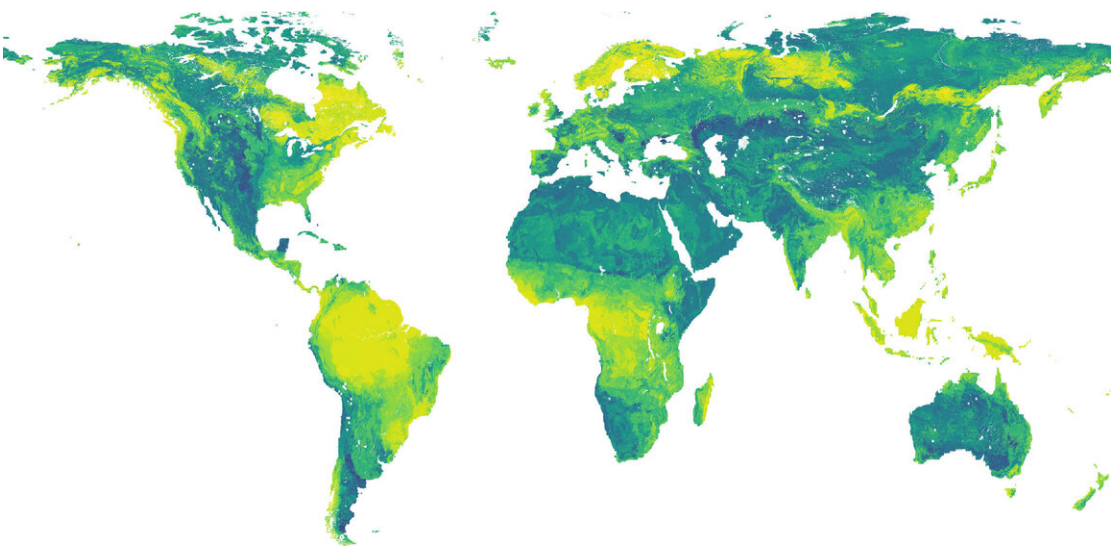


Photosynthesis activity and growth of aquatic plants in lakes and ponds are restricted by limited CO₂ concentrations in these habitats. In order to maintain growth via photosynthesis, many species in standing waters have developed alternative carbon uptake strategies by using bicarbonate. Credit: Lars Iversen

The study, which focused specifically on aquatic plants that live completely submerged, also showed that when plants have easier access to [carbon dioxide](#), they will use that as their [carbon](#) source, even if

bicarbonate is available.

"One of the main points of this study is that aquatic plants are different. We cannot use our extensive knowledge about terrestrial plants in the same way as aquatic plants," said Iversen, a researcher in Assistant Professor Ben Blonder's ecology lab. "This is really important because on a global scale, at least one-third of the human population is very closely linked to freshwater systems. So things like deltas, drinking water, and fishing grounds are critical to human survival. If we are to understand how these systems will persist and change within the next 100 years, then we really need to know how some of the main components and structures in freshwater systems are working."



One of the main products of the study is a statistically derived map of local bicarbonate concentrations in aquatic environments (dark blue = high bicarbonate values, light yellow = low bicarbonate concentrations). The ability of aquatic plants to use bicarbonate as a carbon source is positively correlated with bicarbonate concentrations. The map shows interesting patterns with low concentrations in major outwash zones (big river catchments and postglacial melt zones). Credit: Lars Iversen

Environmental changes caused by human activity, such as deforestation, land cultivation, and the use of fertilizers, are causing large increases in bicarbonate concentrations in many freshwater bodies around the world. Iversen said the insight from this study will help researchers evaluate how ecosystem functions change if concentrations of bicarbonate increase.

More information: [DOI: 10.1126/science.aay5945](https://doi.org/10.1126/science.aay5945) L.L. Iversen et al., "Catchment properties and the photosynthetic trait composition of freshwater plant communities," *Science* (2019). [science.sciencemag.org/cgi/doi ... 1126/science.aay5945](https://science.sciencemag.org/cgi/doi/10.1126/science.aay5945)

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Provided by Arizona State University

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