

# High CO<sub>2</sub> spurs wetlands to absorb more carbon

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The Smithsonian Environmental Research Center's Bert Drake holds up a cluster of *Spartina patens*, a marsh grass that absorbed more CO<sub>2</sub> than his team expected. Drake's team looks into the future by filling marsh chambers with extra CO<sub>2</sub>, tracking how plants will grow over the next century.

(Phys.org) —Under elevated carbon dioxide levels, wetland plants can absorb up to 32 percent more carbon than they do at current levels, according to a 19-year study published in *Global Change Biology* from the Smithsonian Environmental Research Center in Edgewater, Md.

With atmospheric CO<sub>2</sub> passing the 400 parts-per-million milestone this year, the findings offer hope that wetlands could help soften the blow of climate change.

Plant physiologist Bert Drake created the Smithsonian's Global Change Ecological Research Wetland in 1987 at Edgewater. Back then, most scientists thought plants would gradually stop responding to rising CO<sub>2</sub>. Whether or not [terrestrial ecosystems](#) could assimilate additional carbon—and act as powerful carbon sinks—was not known. This study tracked not only how much CO<sub>2</sub> wetlands absorb, but also the impact of rising temperature and sea level, changing rainfall and plant type.

To simulate a high-CO<sub>2</sub> world, Drake's team surrounded marsh plots with open-top Mylar chambers. For this study they left half of the chambers exposed to today's atmosphere. In the other half they added CO<sub>2</sub> and raised the level to 700 ppm, roughly doubling the CO<sub>2</sub> concentration as it was in 1987. Other plots of land were left without chambers. They compared the levels of CO<sub>2</sub> going in and CO<sub>2</sub> going out to determine the carbon exchange between the wetland and the atmosphere.

Two types of plants populate most of the world, and the experiment tested both. C<sub>3</sub> plants—which include more than 95 percent of the [plant species](#) on earth, including trees—form molecules of three carbon atoms during photosynthesis, and they tend to photosynthesize more as atmospheric CO<sub>2</sub> rises. C<sub>4</sub> plants form molecules of four [carbon atoms](#). But for C<sub>4</sub> plants, photosynthesis is saturated with CO<sub>2</sub> at present levels. For that reason the team expected photosynthesis to increase in the C<sub>3</sub> plants but not the C<sub>4</sub> plants as they raised CO<sub>2</sub>. In this study, half the plots were dominated by the C<sub>3</sub> sedge *Scirpus olneyi* and half by the C<sub>4</sub> grass *Spartina patens*.

The C<sub>3</sub> plants saw the largest increases. Over the 19-year study, they

absorbed on average 32 percent more carbon under higher CO<sub>2</sub> than under normal CO<sub>2</sub>. Most of the increase took place during the day, as the plants absorbed extra CO<sub>2</sub> through photosynthesis. But the team was surprised to find that elevated CO<sub>2</sub> also decreased the amount of carbon the plants lost at night through respiration. That reduction was due in part to a decrease in the amount of nitrogen in both types of plants when they grew in the high-atmospheric CO<sub>2</sub>. Also contrary to their expectations, the C<sub>4</sub> plants saw a 13 percent increase under elevated CO<sub>2</sub>, also predominantly during the day but partially at night.

"We expected that more carbon would be assimilated during the day due to stimulation of photosynthesis," Drake said. "We did not expect that loss of carbon at night would also be affected by the elevated CO<sub>2</sub>."

However, climate also affected how much carbon the plants absorbed. For example, droughts crippled the C<sub>3</sub> plants' ability to take up carbon. During three dry years (1995, 1999 and 2002), they absorbed a mere 4 percent more CO<sub>2</sub> on average under elevated versus normal conditions. Those three years also saw the lowest CO<sub>2</sub> absorption overall. Other environmental factors related to [climate change](#), such as sea-level rise and increasing temperature, also affected carbon assimilation.

Ecologists are still working out where all the extra absorbed carbon is going. According to their data, it does not all go into creating plant biomass. However, the plants do not show any sign of slowing their carbon absorption. "The results of this study suggest that wetland ecosystems will assimilate more carbon as atmospheric CO<sub>2</sub> levels continue to rise beyond the level of 400 ppm reached in May 2013," said Drake.

The accepted manuscript is available [online](#).

Provided by Smithsonian

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