

High CO₂ 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 CO₂ than his team expected. Drake's team looks into the future by filling marsh chambers with extra CO₂, 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 CO₂ 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 CO₂. 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 CO₂ wetlands absorb, but also the impact of rising temperature and sea level, changing rainfall and plant type.

To simulate a high-CO₂ 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 CO₂ and raised the level to 700 ppm, roughly doubling the CO₂ concentration as it was in 1987. Other plots of land were left without chambers. They compared the levels of CO₂ going in and CO₂ 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. C₃ 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 CO₂ rises. C₄ plants form molecules of four [carbon atoms](#). But for C₄ plants, photosynthesis is saturated with CO₂ at present levels. For that reason the team expected photosynthesis to increase in the C₃ plants but not the C₄ plants as they raised CO₂. In this study, half the plots were dominated by the C₃ sedge *Scirpus olneyi* and half by the C₄ grass *Spartina patens*.

The C₃ plants saw the largest increases. Over the 19-year study, they

absorbed on average 32 percent more carbon under higher CO₂ than under normal CO₂. Most of the increase took place during the day, as the plants absorbed extra CO₂ through photosynthesis. But the team was surprised to find that elevated CO₂ 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 CO₂. Also contrary to their expectations, the C₄ plants saw a 13 percent increase under elevated CO₂, 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 CO₂."

However, climate also affected how much carbon the plants absorbed. For example, droughts crippled the C₃ plants' ability to take up carbon. During three dry years (1995, 1999 and 2002), they absorbed a mere 4 percent more CO₂ on average under elevated versus normal conditions. Those three years also saw the lowest CO₂ 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 CO₂ 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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