Scientists find climate change to have paradoxical effects in coastal wetlands

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Rising atmospheric carbon dioxide is largely responsible for recent global warming and the rise in sea levels. However, a team of scientists, including two Smithsonian ecologists, have found that this same increase in CO_2 may ironically counterbalance some of its negative effects on one of the planet's most valuable ecosystems—wetlands. The team's findings are being published in the *Proceedings of the National Academy of Sciences* the week of March 23.

The team conducted their study for two years (2006 - 2007), during which they focused on the role that organic matter, both growing and decaying, plays on soil elevation in wetlands and the effect CO_2 has on this process. Coastal wetlands must build upward through the accumulation of mineral and organic matter to maintain a constant elevation relative to water levels; otherwise, they will drown and disappear.

Climate change, however, is causing acceleration in the rise of sea level, which would seemingly put wetlands at risk of excessive flooding. "Our findings show that elevated CO_2 stimulates plant productivity, particularly below ground, thereby boosting marsh surface elevation," said Adam Langley, the paper's lead author. Patrick Megonigal, the paper's corresponding author, added "We found that by stimulating root growth, thus raising a marsh's soil elevation, elevated CO_2 may also increase the capacity for coastal wetlands to tolerate relative rises in sea level." Both scientists are ecologists at the Smithsonian Environmental Research Center in Edgewater, Md.

These findings bear particular importance given the threat of accelerating sea-level rise to coastal wetlands worldwide. Some evidence suggests that only a two-millimeter increase in the rate of sea-level rise will threaten and possibly eliminate large portions of mid-Atlantic marshes. And the loss of these wetlands threatens critical services that the ecosystems provide, such as supporting commercially important fisheries, providing wildlife habitat, improving water quality and buffering human populations from oceanic forces.

Determining soil-surface elevation change is important for two reasons. First, the loss in soil elevation relative to local sea level may provide an early indication of the collapse of a tidal wetland. Second, tracking elevation changes in marsh soils through time, along with measurements of plant productivity and other environmental variables, allow scientists to identify specific mechanisms critical to the persistence of tidal wetlands under accelerating sea-level rise. To examine how CO_2 may interact with other factors that will accompany sea-level rise, the authors also manipulated CO_2, salinity and flooding in a companion greenhouse study.

The team of scientists from the Smithsonian Institution and the U.S. Geological Survey added CO_2 gas to a tidal marsh at the Smithsonian Environmental Research Center. The gas flowed continuously from the bottom upward through the top of large (two-meter diameter) cylinders surrounding marsh plots. Half of the plots also received added soil nitrogen, simulating increasing water pollution, which tended to diminish the positive effects of elevated CO_2 on marsh surface elevation. Changes in elevation were measured with an instrument developed by the U.S. Geological Survey that can detect changes in elevation as little as one millimeter. According to Langley, "Elevated CO_2 doubled the short-term rate of elevation gain in our marsh. Our next step is to determine whether this will continue in the long-term and in the face of actual sea-level rise and other climatic changes."

Though marshes appear to benefit from CO_2 in the short-term, the scientists stress that increasing CO_2 levels will continue to warm the Earth, melt glaciers and expand ocean water, thus accelerating sea-level rise. Ultimately, rapidly rising seas could outstrip the positive effects of CO_2 on the marshes that they have observed.

"Wetlands are some of the most specialized and valuable ecosystems in the world, not only to wildlife but humans as well," Megonigal said. "The sooner we can understand the effect global warming is having on them, the better we will be equipped to save them."

Source: Smithsonian (news : web)