Ocean acidification makes ecologically important seaweed species fragile

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Ocean acidification will likely almost triple by the end of the century—a drastic environmental change that could impact important marine species like fleshy seaweeds, algae that grow vertically and promote biodiversity in more than a third of the world's coastline. To get a better idea of how seaweeds might fare in a rapidly acidifying ocean, a team of Swedish marine scientists subjected a common fleshy seaweed species to the acidification levels expected by the end of the century.

In a study published in the journal *Current Biology*, they report that increased acidification impacted the seaweed's chemical balance, made both its structure and its tissues weaker, and reduced its overall chances of survival.

"Climate change is resulting in unprecedented changes in terrestrial and aquatic ecosystems through the emission of greenhouse gases, including carbon dioxide," write the authors, who are based at the University of Gothenburg and the KTH Royal Institute of Technology. "Almost a third of that CO_2 is taken up by the ocean, which has profound effects on seaweeds."

To test how future ocean acidification conditions will impact fleshy seaweeds, the team grew Fucus vesiculosus, a common brown fleshy algae, in water treated with dissolved CO_2 for 90 days. They dissolved enough carbon dioxide to mimic the amount of acidification that we expect will be present in 2100, which is almost three times the acidification in today's oceans.

Throughout the experiment, the team observed the seaweed both on a visible level, by measuring how much it grew, and on a microscopic level , by observing tiny changes to its structure.

The team also calculated how well the seaweed performed photosynthesis, analyzed its chemical composition, tested its thallus strength (the leaves and stems that make up the core of the seaweed's structure), and watched how the seaweed moved or broke in response to mechanical stress designed to simulate waves (a metric called "drag") in order to see whether it would be at higher risk of damage or detachment in the ocean.

After comparing these metrics with measurements taken from F. vesiculosus grown in non-acidified seawater, the team found that the

acidification had mixed results.

The seaweed grown in acidified water actually grew more, photosynthesized more effectively, and showed no significant increase in drag. However, they also observed that the acidified seaweed had reduced thallus strength, less dense tissues, a more porous structure overall, and lower levels of calcium and magnesium—important nutrients that contribute to the strength and flexibility of a plant's structure. In general, the acidified seaweed broke more easily and died more often.

"Negative effects of ocean acidification on the tissue structure and breaking strength of seaweeds like F. vesiculosus could have drastic effects on coastal ecosystems," write the researchers. "Such changes could lead to an overall decrease in seaweed coverage, with corresponding negative effects on organisms that depend on these habitats for food and shelter."

The team calls for more research to test whether the impacts of ocean acidification are similar for all fleshy seaweeds. "If this proves to be a general mechanism affecting fleshy seaweeds, the expectation is that ocean acidification will have critical structuring effects on rocky-shore ecosystems given how widely distributed and fundamental brown seaweeds are across one-third of the coastlines of the world."

More information: Alexandra Kinnby & colleagus, Ocean acidification reduces tissue strength in a non-calcifying foundation seaweed, *Current Biology* (2023). DOI: 10.1016/j.cub.2023.07.056. www.cell.com/current-biology/f … 0960-9822(23)00995-8

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