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Hard-shelled seaweed survives by its loose knees | Life

Stringy joints between calcified algae's segments don't break easily under repeated stresses

By Susan Milius

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To survive the thrashing of several million waves a year, a hard-bodied Pacific seaweed relies on special joints that work like loose bundles of strings.

WHAT LIES BETWEEN

A close-up of a Pacific seaweed shows the hard segments that survive in surf thanks to the fracture-resistant tissue connecting them.

Credit: Patrick Martone

The purply red *Calliarthron cheilosporioides* isn't a soft, floppy seaweed. One of what biologists call coralline algae, it grows as branching strands of calcium-hardened segments. "If you didn't know better, it would look like coral," says biomechanist Mark Denny of Stanford University's Hopkins Marine Station in Pacific Grove, Calif.

Between the hard segments lie joints of flexible connecting tissue made of long, soft, skinny cells running side by side. The joints bend as the surf whips the algae back and forth, and they can deform thousands or even millions of times before they fracture, Denny and his colleagues report September 25 in the *Journal of Experimental Biology*.

C. cheilosporioides thrives in the zone exposed by extremes of receding tides, and the algae get pounded by waves. Such repeated stresses exacerbate tiny flaws in just about any material, until microscopic weak spots flare into huge, fatal cracks.

To measure how well algal joints withstand repeated stress, the researchers first determined how much force would snap a joint with one yank. Then Denny and a computer specialist devised a machine that tugged 10 times a second, using less than catastrophic force on a piece of alga. The machine ran continually for about a year testing 25 samples.

When stressed with 80 percent of the force that would snap them at once, algal joints withstood more than 1,000 repetitions before breaking. At 60 percent, joints lasted more than 10 million rounds, and at 50 percent, the researchers stopped the machine at 51 million cycles with one extreme sample still unbroken.

Such resistance to fracturing comes from the structure of the joints, Denny says. The individual cells running from one calcified segment to the next are only loosely connected to each other, the researchers found. As a result, one cell can snap without rupturing its neighbors. A breaking cell can "just go 'twang,'" Denny says. "The cell next door is just as safe as it was before."

Mechanisms like this for preventing cracks show up all over the natural world as well as in human designs, says Robert O. Ritchie of the University of California, Berkeley. The number of stresses the algae withstood "are obviously impressive but they're nothing different than what you would see for most metals." Some seashells, though, resist cracks with remarkable forms and have inspired his lab to devise new materials.

Citations

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