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Inside JEB

CORALLINE ALGA STANDS THE TEST OF TIME ON SHORELINE

No one likes getting bashed about, but with waves constantly crashing into the shoreline, seaweeds have little choice; they just have to go with the flow, and bend over to become streamlined. It is therefore surprising to find a group of seaweeds, the coralline algae, which have calcified most of their cells and essentially turned themselves into living rocks. However, Mark Denny, from Hopkins Marine Station of Stanford University, USA, explains that despite their rocky appearances, the presence of specialised joints, made up of decalcified cells, actually makes them very flexible. Nonetheless, Denny points out: ‘Whether it’s a bit of rubber or one of these seaweeds, you can’t make a flawless material, and if you pull on them in one direction it stretches that flaw and creates a crack. Every time you pull on the crack it can grow a little bit, and the more it grows, the weaker the material gets and it will eventually break – it fatigues.’ With the bending, and thus most of force, occurring at the small joints (they make up just 15% of the alga), Denny wondered how resistant coralline algae are to fatigue (p. 3772).

Denny admits that at the onset of his experiments, he suspected that the alga had specialised joints that would minimise cracks spreading from cell to cell. He explains that under the microscope, the joint cells don’t seem to be attached to each other. Instead, they look like individual cables, which are attached at each end to the fragments of calcified alga either side of the joint, but not to the neighbouring cable. ‘The best way we could show that was by a torsional, twisting test’, says Denny. ‘If they were hooked [attached] to each other, the joints would be pretty stiff.’ So, after collecting some algae from the shorelines near the marine station, he twisted the algal joints and found they weren’t very stiff in torsion – a sure sign that the individual cells weren’t attached to each other.

Despite the algae’s fatigue-resistant design, which would prevent a crack in one cell spreading to its neighbour, Denny still didn’t know how resistant they were, so he moved on to his second experiment: ‘This test was blissfully simple – we just put them into an apparatus that pulls on a segment of the seaweed at a set force per area. So, you’re always applying the same amount of stress to the material and you keep doing it and doing it until the thing breaks and you count how many cycles it takes to break it.’ As a force of 25.9 MPa is enough to tear the alga in one single blow, Denny chose to reduce that by 50% for his fatigue test: 58 days and 51 million cycles later, to his surprise, the first sample still hadn’t broken.

It was time to change tactics, recalls Denny: ‘I was thinking: well, I’ve got to have 25 or 30 more of these samples to get a good sample size to write a paper, and if it’s taking a month or two per sample, I’m going to be here forever! So, I ended up loading most of them to 70–80% of their breaking stress, and still they would take a week to break.’ Even using weaker forces of up to 20.1 MPa, the seaweed stood up to at least a million cycles. However, Denny points out that even these levels of force are very rare on the shoreline, and it’s likely that only once or twice a year a wave will come along with that level of force. So, it seems that these seaweeds are indefatigable, at least when it comes to withstanding waves.

10.1242/jeb.095489

Denny, M., Mach, K., Tepler, S. and Martone, P. (2013). Indefatigable: an erect coralline alga is highly resistant to fatigue. *J. Exp. Biol.* **216**, 3772-3780.

Nicola Stead

CRAB SPIDERS’ TRICKS FOR YELLOW CAMOUFLAGE

Chameleons and octopuses may be famed for their extraordinary camouflage skills, but this ability is not unique and many animals, big and small, can match their surroundings. Perhaps one of the smallest is the tiny crab spider, *Thomisus onustus*, which measure between 1 and 10 mm. These tiny arachnids match the vibrant yellows, pinks and whites of their flowery hosts, where they lie in wait for their pollinator prey. Little is known about the reason behind the crab spiders’ camouflage (pollinators visit flowers regardless of a spider’s colour and these spiders have few predators themselves) or even what controls the reversible colour changes. During her PhD, Ana L. Llandres studied the benefits of camouflage; however, when it came to her post-doc at the IRIB, France, she wanted to turn her attention to the regulation of camouflage: ‘What are the factors that makes spiders change colour?’ With the help of her post-doctoral advisor,