INSIDE JEB

Corals' throbbing tentacles keep water flowing to flush away oxygen

Heteroxenia coral polyps. Photo credit: Laura Miller.

Pulsing rhythmically in sluggish water, tiny *Heteroxenia* corals appear to draw water toward their mouths as their feathered tentacles grasp repeatedly. However, first appearances can be deceptive. 'Food particles are rarely found in their guts', says Laura Miller, from the University of North Carolina at Chapel Hill (UNC-Chapel Hill), USA, adding that they have even been seen effectively spitting out food. Even though the coral's pulsing manoeuvres do not appear essential for feeding, when Uri Shavit and colleagues from the Inter-University Institute for Marine Sciences (IUI) in Eilat, Israel, checked how well the corals thrived when motionless, the movements were clearly crucial for the coral's wellbeing. The symbiotic algae that live and photosynthesise within immobile corals were only able to produce one-fifth of the sugars generated by the algae in the flailing corals. The throbbing motion was somehow essential for disposing of oxygen, which disrupts photosynthesis when it mounts up in sluggish water around polyps; it just wasn't clear how.

After diving in the shallow Red Sea to collect *Heteroxenia* corals, which thrive in the warm, sunny water, Julia Samson – also from UNC-Chapel Hill – returned with the animals to the IUI. Once the corals were content in their new laboratory home, Samson, Uri Shavit (Technion Israel Institute of Technology), Roi Holzman (Tel Aviv University, Israel) and Shilpa Khatri (University of California, Merced, USA) filmed the animals' delicate fanning motions. At first, the tentacles lifted up, folding together like the petals of a tulip, before the tips of each tentacle pulled down toward the coral's mouth and then unfurled, spreading wide ready to initiate the cycle again. However, when Samson and Khatri added microscopic shiny beads to the water – to trace the motion of the fluid around the continually clasping coral – and analysed the motions with UNC-Chapel Hill's Dylan Ray, they saw a 0.25 cm s^{-1} jet of water squirting away from the polyp's mouth as fresh water was pulled in between the tentacles when they unfurled. And when Miller and Khatri built a computer simulation of the water flowing around the pulsing coral polyp, it revealed fresh water being pulled over and between the tentacles, prior to mixing with stale water trapped above the tentacles as they relaxed slowly. Also, when the simulated tentacles contracted, pulling the coronet down toward the mouth, the fluid was propelled away from the body at a rate of 0.71 cm^3 s^{-1}.

Miller explains that the jet produced by the coral's wafting tentacles is essential for the animal's health as it carries away oxygen that would otherwise accumulate around the polyp, slowing photosynthesis. In addition, when the team analysed how the tentacles' bristles contributed to the flowing currents, they realised that the fine hairs form a solid surface as the tentacles gently unfurl, trapping water and allowing oxygen to leave the coral's body in exchange for nutrients brought in by the fresh water. However, as the tentacles contract and pull down slowly toward the body, the bristles release the water and behave like a leaky rake as the plume of water jets out.

So the coral's hypnotic gyrations generate a jet of water that continually pulls in fresh water while expelling waste oxygen to enhance photosynthesis, and the team points out that the coral's fluid flows are similar to those produced by some cruising jellyfish, which must also keep algal lodgers happy.

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