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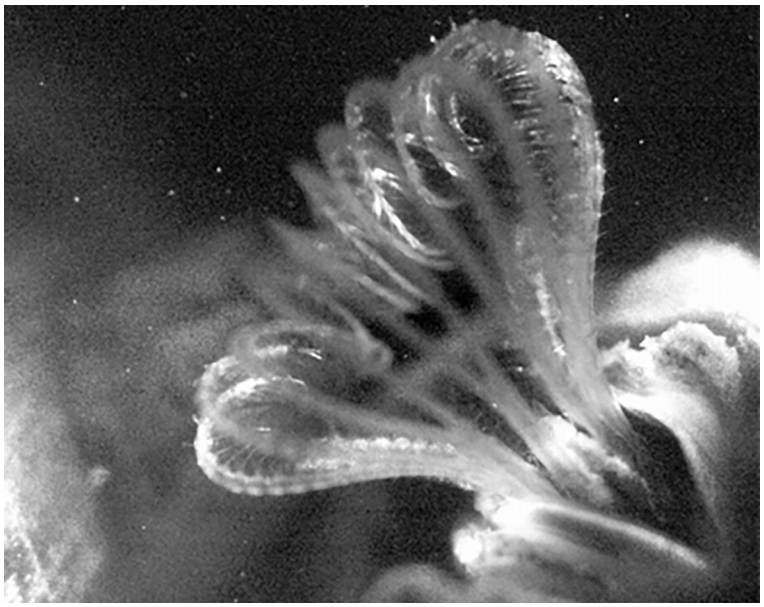
INSIDE JEB

Dining on crude oil at the bottom of the food chain



The feeding apparatus of *Balanus crenatus* retracting back into the shell.

Filter feeders come in all sizes, from massive blue whales lunging through the water with their colossal mouths wide open to tiny barnacles wafting feathery feeding appendages through the top of their shells to entrap minute morsels. Yet, all of these creatures are at risk of ingesting other unwanted contamination, including dispersed droplets of crude oil. And inadvertent ingestion of oil by the smallest feeders, such as *Daphnia*, places animals further up the food chain at risk from the pollution. But no one knew how small filter feeders pick up miniscule droplets of oil carried in water, so Francis Letendre and Christopher Cameron from the University of Montreal, Canada, filmed two members of the acorn barnacle family (the relatively large *Balanus glandula* and smaller *B. crenatus*) and *Daphnia magna* water fleas to find out how they harvest crude oil droplets from water flowing past.

Securing the barnacles in a tank with water flowing at speeds from 1.4 to 24 cm s^{-1}, Letendre filmed the animals as they extended their feathery feeding tentacles, sometimes allowing the tentacles to waft gently in the flow while on other occasions the structures seemed to reach out and grasp the water before being rapidly withdrawn back into the shell. However, when the scientists calculated the stickiness of the water flowing past the feathery structures wafting in the slower streams (less than 10 cm s^{-1}), they realised that the water was essentially coating each fine hair so that the gaps between the hairs were effectively clogged, transforming each filagree feeding structure into a solid paddle, intercepting droplets of oil in the static layer of water coating the structure. However, as the water speeded up, it became more slippery, flowing through the structures lodging droplets of oil against the hairs, ready for the barnacle to scrape them free with its mouth after retracting the tentacles back within its shell.

In contrast, the tiny *Daphnia* wafted water carrying droplets of crude oil into their mouths by pulsating all four pairs of thoracic legs in a rippling Mexican wave. However, the hairs coating the lower two pairs of rippling legs also became clogged with oil. And when the team left water fleas swimming freely for 48 h in fine mists of crude oil droplets – less than 10 µm in diameter – all the *Daphnia* ingested some of the toxic oil ready to pass on to any creature that chose to dine on them. In addition, the duo calculated the stickiness of water around the fine hairs coating the antennae and they too became coated in the relatively thick water, transforming the filamentous structures into paddles ideal for propelling the animals through the water while leaving the antennae oil free.

Having begun to discover how animals at the bottom of the food chain might ingest droplets of crude oil, the team would like to learn more about how these filter feeders cope when bathed in the larger oil droplets generated by oil tanker spills and rig disasters. And they are curious to learn how different shapes of shell affect how barnacles entrap the oil globules that drift their way.

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