Some species’ rely for survival on their sperm successfully navigating through open water towards a single egg. But how tiny sperm locate their own species’ eggs was largely a mystery, until Richard Zimmer’s lab began analysing the essential essence released by abalone eggs. After purifying litres of egg-enhanced seawater, Patrick Krug and Jeffrey Riffell found that the eggs were secreting nothing more exotic than tryptophan to lure the sperm in their direction (p. 1439).

More is known about how birds navigate the heavens than how a single sperm cell locates its target. Creatures that release their gametes into the ocean must have developed some way of attracting sperm from their own species, otherwise evolution would have consigned them to the wastebasket. Krug explains that ‘there had to be some chemoattractant’ to direct the sperm.

Riffell and Krug decided to see if abalone sperm knew which way to go when tempted with a fresh egg, and if they could find the molecule that lured the sperm in the right direction. They placed an egg in a container of seawater and watched to see how the sperm reacted. The moment the sperm picked up the scent, they instantly doubled their speed and aimed directly at the egg. That’s when the really hard work started. Zimmer’s team had no idea what sort of compound they were searching for.

They flushed egg-conditioned seawater through chromatography columns and tested how the separated chemicals affected the sperm’s speed and sense of direction. Krug explains that they had an early stroke of luck when the compound that the sperm responded to stuck to the first column they tried! It took several more purification steps before they had isolated a component that attracted the sperm, but they still didn’t know what the mysterious compound was.

Nuclear magnetic resonance spectroscopy revealed the molecule’s identity; the chemoattractant was simply tryptophan! Krug admits that he’d been secretly hoping that it might be something more glamorous, but after recovering from his initial disappointment, the advantages became clear. Krug and Riffell could test the sperm’s response to a host of readily available tryptophan derivatives and really get to the bottom of the chemical’s attraction.

First they discovered that the sperm were sensitive to L-tryptophan, and completely disinterested in D-tryptophan. They also tested how the sperm reacted to a uniform distribution of L-tryptophan versus a gradient of the chemical. When presented with a gradient, the sperm raced along it towards the egg, but when the sperm just had a uniformly high concentration of tryptophan, the gametes went wild, swimming all over the place, without locating the egg. Sperm that were presented with an egg that had lost its tryptophan gradient were completely disinterested in it, and failed to reach their goal.

Of course, this is still far from the sperm’s real world, where they locate their target egg through swirling currents, but Krug and Riffell have gone a long way to solving the mystery of the identity of the chemical that lies at the heart of sperm navigation.

In this issue

**Bugs do it, Birds do it. Even Tiny Little Sperm do it!**

Whatever size you are, you’ll have to navigate your way around your world at some time or another. Bugs orientate towards decomposing food, and migrating birds aim towards remote destinations.
How Algae Weather the Waves

Mark Denny has spent most of his research career puzzling over life on the seashore. And when he describes the pounding that these organisms get almost every moment of their lives, you begin to understand why. If you were constantly battered by hurricane force winds, you’d want armour too, just like the limpets that cling to rocky shorelines. But some organisms have developed a more flexible approach for surviving one of the planet’s harshest environments. In their review: The mechanics of wave-swept algae (p. 1355), Denny and his colleague Brian Gaylord, describe the successful pact that the algae have made with their turbulent environment to ensure their survival.

All sea algae grow along the same body plan. Each has a pad-like-anchor that tethers them to the rock with thousands of tiny finger like projections that grip on to tiny fissures in the rock’s surface. A slender flexible stem, called a stipe, grows out of the ‘holdfast’ structure and frilly ‘blades’ grow from the stipe.

At first sight, kelp doesn’t look as if it could survive a sharp tug, let-alone a constant assault from the sea. Denny explains that if you told an engineer that you could build a 30m long elastic band that could survive hurricane forces, he wouldn’t believe you. But just a few metres off the coast, giant kelp wave in the sea, and that’s exactly what they are. He says that even though algae are relatively flimsy ‘they do a remarkable job of coping’.

One of the algae’s strategies for survival is to use their flexibility to ‘go with the flow’ in strong currents. They align with the prevailing flow to reduce the damaging drag on the algae’s delicate fronds. But this relaxed approach comes at a price. Algae that drift with the prevailing current eventually reach a point when they can’t extend any further, and have effectively reached the end of their tether. At the last moment, as the algae reaches its limit, the algae’s own weight can be enough to wrench the stipe away from its holdfast.

The review also describes the forces the algae experience as a result of the ocean’s constant movement. Algae that live in relatively deep water experience weak forces from unbroken rolling waves, so they have a relatively quiet life. But it’s a different matter altogether in the surf zone, where water velocities suddenly double as the wave breaks. Denny and Gaylord point out that the next major question is understanding how exposed algae at the sea’s edge survive the huge forces produced by breaking waves; these are the strongest forces that the plants will ever encounter.

Understanding the algae’s intriguing resilience is an important step along the way to conserving this economically significant crop. Kelp forests are the preferred spawning grounds for many major fish stocks, and the algae are also harvested to supply alginates to the food and cosmetics industry. Recent fluctuations in the planet’s climate have caused an increase in the frequency of El Niño events that warm the southern oceans and increase the number of storms the algae have to contend with. Understanding how these plants weather today’s storms could help us design marine reserves if climate change threatens to take the algae beyond their elastic limit.

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