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INSIDE JEB

Light fine-tunes electric fish pulses to keep them in the shade

The electric pulse fish *Gymnotus omarorum*. Photo credit: Marcelo Casacuberta.

Many creatures perceive their surroundings with senses at which we can only marvel. One of the most elusive is electrical perception. Weakly electric fish in muddy South American rivers continually produce electric chirrups, speeding up and slowing down their pulses of electricity to detect nearby objects and communicate with members of their own species in the gloom under the mats of floating plants beneath which they shelter. But hunters that prey on these enigmatic creatures are on the lookout; they hunt by light. Knowing that the fish's electronic click rates vary throughout the day – speeding up at dusk and slowing at dawn – Angel Caputi, Ana Caramago and Pedro Aguilera from the Instituto de Investigaciones Biológicas Clemente Estable (IIBCE), Uruguay, wondered whether light might fine-tune the timing of *Gymnotus omarorum* electric chirrups.

Camargo went dip netting in the Laguna del Cisne, Uruguay, and collected 30 fish before transferring them to an aquarium at IIBCE, where she began adjusting the light levels. Initially, Camargo kept the fish in almost darkness (1 lx, the equivalent of the gloom beneath a mat of vegetation during the day) over night, recording the electric pulses emitted by the fish, before switching on the light (420 lx) in the morning, to simulate the fish emerging from beneath their shady mats. After recording the daylight chirrups, Camargo left the light on and waited until early evening to rerecord the fish's electronic calls before switching off the light and listening to their electric chatter again.

The light levels altered the fish's electrical chirrup patterns. The fish continually produced intermittent electronic pulses at night when the light was low, occasionally making short rapid bursts of clicks. However, when the light was on at night, the fish lost the rapid click bursts. The team also compared the fish's electric pulse patterns under the different light conditions during the day. After compensating for the fish's natural body rhythms – which accelerate the clicks in the evening and slow them in the morning – they saw that the continual clicks were longer when it was dark than when the lights were on. Light naturally fine-tunes the fish's electrical chirrups. But how do sudden changes in light affect the fish's electric discharges when a beam of light penetrates a gap in the vegetation or a mat drifts, leaving them exposed?

This time, Camargo painstakingly recorded the fish's electrical pulses as she flashed the light on and off, increasing the intensity from 1 to 30 to 150 lx (half the natural level in the fish's water) up to dazzlingly bright 75,000 lx flashes. As the intensity of the flashes increased, the fish produced stronger electrical discharges, as though they were scanning their surroundings more strongly when exposed.

Finally, Camargo checked whether the fish prefer to hang out in the light or shelter in shade. First, she determined whether the fish prefer to head into the left or right arm of a Y-shaped maze – some fish are left- and right-handed like people – and once she knew which maze arm a fish preferred, Carmago illuminated that arm, to see whether she could persuade the fish to override their usual preference for one side and head into the shady arm. Sure enough, they did. The fish prefer avoiding light.

The team concludes that light naturally modifies *G. omarorum*'s electrical pulses, in combination with the fish's natural biorhythms, enabling them to fine-tune their electrical clicks throughout the day to evade beams of light penetrating the mats of vegetation under which they shelter and allowing them to track their plant hides to remain safe from predators on the prowl.

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