INSIDE JEB

80-year-old Ander’s organ mystery solved


If you really want to learn about evolution, getting your hands on a living fossil is probably a great place to start. ‘Hump-winged grigs [a type of cricket] belong to a family with only eight living species, yet over 100 fossil species’, says Charlie Woodrow from the University of Lincoln, UK, who teamed up with PI Fernando Montealegre-Z (University of Lincoln) to unravel the mystery of how the insects’ hearing evolved. However, when investigating the ears of Cyphoderris monstrosa – flightless hump-winged grigs found in the northeast USA and Canada – Woodrow and Montealegre-Z noticed the creatures flexing their abdomen when startled, dragging the rear section of the thorax over a tiny ridged portion of the abdomen known as the Ander’s organ. Scouring the literature, they quickly realised that virtually nothing was known about the enigmatic acoustic structure, save Kjell Ander’s original 1938 description in German. After Thorin Jonsson and Barbara Sander (MacEwan University) translated the 80-year-old paper, Woodrow, Christian Pulver and Montealegre-Z resolved to pick up where Anders left off, to find out more about the insect’s unconventional mode of sound production.

‘Kevin Judge from MacEwan University, Canada, collected the insects during the breeding season when males were singing’, says Montealegre-Z, explaining that the noisy males were relatively easy to locate, as they rub their wings together to produce the familiar cricket sounds that woo females. However, locating the silent youngsters and females was more haphazard. Then Montealegre-Z, Woodrow and Pulver had to find a way to get the insects sufficiently riled up to begin strumming their thorax across the Ander’s organ. ‘Brushing across the face [using a soft paintbrush] elicited the most frequent response’, says Woodrow. However, it quickly became apparent that the otherwise strident adult males produced no sound at all from Ander’s ridged structure. In contrast, the team was astonished when they realised that the sounds produced by the female and juvenile Ander’s organs were extraordinarily high pitched. ‘In some recordings, we saw sound energy reaching over 100 kHz into the ultrasonic range’, exclaims Montealegre-Z. And, when Woodrow and Montealegre-Z eventually succeeded in recording the motion as the females compressed their bodies while rubbing the hind portion of the thorax across the ridges on the abdomen, they could see a row of plectrum-like files rasping across the Ander’s organs. In contrast, the horizontally oriented files on the male thorax completely failed to engage. ‘Capturing the motion of the organ was definitely the hardest part; it took us many attempts to properly record the motion synchronised with the sound data’, admits Montealegre-Z. CT scans of the insects’ bodies also revealed sound box-like cavities in the exoskeleton beneath the Ander’s organ, which probably amplify the ultrasonic blasts.

But who are these extraordinarily high-pitched squeals aimed at? ‘We know they cannot be for communication within the species, as the frequency far exceeds their hearing range’, says Montealegre-Z. The researchers think that the insects produce the sounds to ward off predators, but the warning may not be aimed at bats, which would have hunted the insect’s flying ancestors. ‘We suspect shrews or mice are the target’, says Woodrow. Looking back through the insect’s extensive family tree, he thinks it is possible that C. monstrosa’s ancestors may have had the ability to deter predators with their shrill alarms earlier than scientists previously thought. And Montealegre-Z is keen to find what effect the rasping organ has on creatures that intend to dine upon them. ‘It would be great fun to run some playback experiments of the sound, to see how potential predators react’, he says.

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