INSIDE JEB

Nessus sphinx hawkmoth caterpillars whistle like kettles

A Nessus sphinx hawkmoth caterpillar eating a wild grape leaf. Photo credit: Jayne Yack.

Most caterpillars are silent herbivores, munching on their vegetation of choice; but members of the hawkmoth and sphinx moth superfamily (Bombycoidea) are much rowdier. When a hungry bird shows too much interest and pecks at one of these delicious caterpillars, the insect lets out a startling cry. 'This is really remarkable, considering that caterpillars are not considered to be "acoustic" insects', says Jayne Yack from Carleton University, Canada. Intrigued by the noisy caterpillars, Yack and her laboratory have spent much of the last 10 years discovering which members of the superfamily are capable of shooing away unwanted attention. 'We have discovered four completely different ways that they make sounds', she says, describing how various members of the superfamily produce clicks and whistles, while others rub structures on their bodies to warn off attackers. In addition, a small group of closely related family members appear to expel air out of their mouths to generate a kissing sound. As this is an unconventional strategy for an animal that does not inhale air through its mouth to breathe, Yack and Conrado Rosi-Denadai embarked on pinning down the mechanism that allows Nessus sphinx hawkmoths to project their voices.

Having lured wild female moths into ultraviolet traps, Yack raised their young from eggs in the lab, 'Which was no menial task', she says, recalling how she fed the caterpillars on wild grape foliage from her own garden. Once the caterpillars were fully grown, Yack and Rosi-Denadai simulated bird attacks to get them going. 'You just have to pretend that you are a bird pecking at the caterpillar, so you take blunt forceps and give them a quick pinch to the body', chuckles Yack. Meanwhile Rosi-Denadai set up microphones, moving them to different locations around the insect's body to record its indignant response, until he eventually closed in on the mouth as the source of the sound. Yack adds, 'We videotaped the mouth parts using a macrolens and found that the mandibles [chewing parts of the caterpillar] were held open during sound production'. So the caterpillars were definitely producing sounds out of their mouths, but how?

'The hardest part was figuring out what is going on inside the animal without having X-ray vision', says Yack, who recalls how Melanie Scallion painstakingly dissected the throat of the insects in search of structures that might be responsible for their cry, 'Which takes very fine motor skills', says Yack. However, when Scallion found none, Yack resorted to looking for alternative mechanisms. Analysing the sound waves produced by the perturbed caterpillars, Craig Merrett from Clarkson University, USA, realised that the kissing sound was produced in much the same way that jet engines generate their roar and kettles whistle. He suspects that the caterpillars force air through a constriction between the crop and oesophagus, generating a whistling sound that is then amplified by the oesophagus similar to the way in which sounds are produced when you blow across the mouth of a bottle. However, Yack admits that it is still not clear how the feisty caterpillars draw air into the top portion of their guts.

Having developed a theory for how the raucous insects startle would-be assassins, Yack is now keen to figure out a way of observing the muscle movements inside the caterpillar's throats that generate the sound. 'With synchrotron X-ray visualization, we may be able to do this at higher speeds in the near future', she says optimistically, adding that she also hopes to learn more about how the insects inhale air.

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