Courtship in the cricket world

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Everyone wants to present themselves in the best light - especially when it comes to finding a partner. Some rely on supplying honest information about their attributes while others exaggerate for good effect. A new study by researchers at the University of Bristol, published in *PNAS*, has discovered how male crickets could use similar tactics to attract a mate.

Male crickets advertise for mates by singing loud repetitive songs at night. They rub their wings together, setting them into resonant vibration, making a loud and intense sound, which enables the female crickets to locate them. The females also use this sound to establish which males are the most desirable. There are many cues they can use to gauge desirability, but there is one that everyone thought could never be faked, size.

Female crickets tend to prefer large males; the speculation is that they are somehow better at finding and using resources, and hence their size reflects their advantageous genes. Males that are larger make lower pitched sounds, and smaller ones have a higher pitch. Females can simply listen and gauge the size of the male. The males, it was thought, could do nothing about it and always sang at only one frequency, because of the inflexible mechanics of singing. It was then discovered that tree crickets — tiny, nearly transparent and highly unusual creatures — change the pitch of their song with temperature.

One species *Oecanthus henryi* sings at a squeaky high pitch of 3.6 kHz when it's a balmy 27 degrees C and a deep bass 2.3 kHz when it's 18 degrees C. However, no one really knew how they managed this or even

why they did it - until now.

In a collaborative study, scientists from the University of Bristol and the Indian Institute of Science began to investigate these curious biomechanics. They used a sophisticated technique called microscanning laser Doppler vibrometry, which can pick up tiny vibrations. The technique is so sensitive that it can detect motion that is smaller than atomic bond lengths. While the tree cricket's wings vibrated more than that; the researchers found that the pattern of vibration was unusual. The whole wing vibrated instead of just a small part and instead of having a single sharp vibratory peak near song frequency, there were two fused peaks.

Dr Natasha Mhatre, lead author on the study and an expert in the biomechanics of singing and hearing in insects at Bristol's School of Biological Sciences, said: "The unusual long shape of their wings has always intrigued us. Using a method called finite element modelling, borrowed from engineering; we were able to show that geometry is key. As wings go from short to long, different vibratory modes start coming closer in frequency and amplitude and start merging with each other. "

When a tree cricket is singing, its wings cannot be locked into a single vibrational mode or frequency and it vibrates at a range of frequencies. Because they are cold-blooded, the activity of insects is highly influenced by temperature. Hence, when the temperature rises, tree crickets are more energetic and call faster and engage a higher frequency mode. What this means is that their size is no longer related to their song frequency but to how fast the tree cricket is able to move its wings. This opens up many possibilities for these unique crickets including using song to disguise their true size. Whether they do, however, remains to be seen.

The analysis shows a turn in the story at this point. The researchers

found that the most probable reason for changing the geometry of their wings by making them bigger is to increase the amount of sound they can make.

Dr Mhatre added: "Sometimes understanding how something works is crucial to understanding why it works that way. Understanding mechanics lead the way to understanding the evolution of tree cricket song. By studying the mechanics, we have shown that variable frequency song is a by-product of increasing sound power and not a desired feature in itself."

Now, the mystery of what exactly is coded in the pitch of the tree cricket song remains to be unravelled and many intriguing candidates offer themselves. But there is no doubt that the rules of cricket courtship have been rewritten.

Provided by University of Bristol