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INSIDE JEB

Dull jewel beetles given warm boost by sun's infrared rays

A *Temognatha chalcodera* jewel beetle in a gum tree (*Eucalyptus* sp.). Photo credit: Amanda Franklin.

Many creatures love to bask; there's nothing quite like the sensation of warmth seeping into your bones. But for insects that dwell in the tropics, too much sun can be fatal; for example, Saharan silver ants are covered in a soft down of fine hair that helps them to emit heat and reflect sunlight to avoid baking in the desert. Knowing that, Lu-Yi Wang, Amanda Franklin and Devi Stuart-Fox from the University of Melbourne, Australia, wondered how other insects deal with the challenge of absorbing the right amount of sunlight to maintain a comfortable body temperature without frying. 'Body surface area and the thickness of body shell are two important factors animals have to juggle to optimise body temperature', says Wang. In addition, shiny insect exoskeletons might absorb and reflect different light colours to different extents, especially the infrared frequencies that carry almost half of the energy of the sun's rays. As jewel beetles range in length from large (38.68 mm) *Julodimorpha bakewelli* to small (12.63 mm) *Melobasis cuprifera*, with wing covers that vary between shimmering scarlet and iridescent blue, Wang measured how much heat the insects absorb from different portions of the sun's spectrum to find out which features of their shells are essential for the insects to maintain a healthy temperature.

'We used museum specimens to have broad colour diversity among the beetles we studied. Especially, we aimed for single-coloured beetles to accurately relate colouration to heating rate', says Wang, who visited the Australian National Insect Collection in Canberra to select 17 species of jewel beetle. After setting up a solar simulator – which reproduces a large range of the sun's full spectrum, carrying 98.9% of the sun's strength from 300 nm in the UV to 1700 nm in the infrared – Wang measured how portions of the beetles' wing cases heated up when warmed by the solar simulator's full wavelength range, the lower UV and visual end of the spectrum (300–700 nm) and the near infrared portion (700–1700 nm), in addition to calculating how much of the light rays the wing cases reflected. Comparing how quickly the area beneath the wing cases warmed up, it was clear to the team that the insects with the dullest (least reflective) shells absorbed heat fastest, while the shinier insects reflected more of the sun's rays and warmed slowly. And, when Wang compared the heating rates across the different portions of the sun's spectrum, it was clear that most of the warmth picked up by the insects was provided by the infrared rays, which are invisible to us. However, when Wang compared the insect's relative heating rates when illuminated by the full range of the sun's rays, the smaller insects warmed faster than their larger cousins, probably because of their more diminutive size. In addition, Jay Black (University of Melbourne) CT scanned the insects' wing casings to find out whether the roughness of the insects' wing casings impacted how fast they warmed, although it did not, with smooth beetles warming as fast as the beetles with rougher shells.

But why do some jewel beetles have shells that warm up quickly, absorbing more of the sun's infrared rays, while others are better tuned to warm more slowly? Wang suspects that the insects with duller shells may have an advantage earlier in the day when air temperatures are lower, and basking provides the opportunity to warm faster in order to get on the go more quickly. However, species whose shells reflect more of the infrared end of the spectrum may be able to remain active for longer at the peak of the day when others could overheat.

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Kathryn Knight
kathryn.knight@biologists.com

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