Mountaineering ants use body heat to warm nests

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Labidus Praedator. Credit: Photo by Dinesh Rao/Drexel University

For their colonies to survive at high altitudes, army ants keep their underground nests as much as 13 degrees F warmer than surface temperatures, according to a new study by Drexel University scientists.

Although they're a nomadic species—which is relatively rare for ants—*Labidus praedator* create underground nests (called bivouacs) that harbor their eggs and young offspring (brood). How hot or cold that bivouac gets may be critical for the ability of the ants to stay mobile and raise their young.

"As is the case for most insects, army ant brood temperature is a key determiner of the time required for each hatched egg to reach adulthood," said Kaitlin Baudier, a graduate student in Drexel's College of Arts and Sciences, who teamed with Drexel professor Sean O'Donnell, PhD, to publish their findings in *Insectes Sociaux*.

L. praedator carefully time the lifecycle of their young. Efficiency is key. When their young are larvae (freshly hatched offspring), the colony can remain on the move. But when those larvae become pupae (similar to a chrysalis in butterflies, the stage just before the ants become adults), the colony is tied down to one bivouac for weeks.

Since there is an ideal temperature range that best facilitates offspring growth, it's important for the ants to keep their nest nice and toasty. And when those bivouacs occur at higher elevations that becomes especially vital.

"At high elevations, bivouac heating may be even more important than at low elevations because ambient air temperatures are further below optimum growth temperatures," Baudier explained.

Studying army ant colonies in Costa Rica, Baudier and O'Donnell tracked three different bivouacs, the lowest constructed at 950 meters above sea level and the highest at 1,565.

While Drexel's researchers measured surface and soil temperatures that frequently dropped too low for the ants' young, the bivouacs were

consistently kept warm enough to remain in their ideal temperature range. In fact, the warmest temperatures were recorded lower in the nest, about 40 centimeters down, where the youngest offspring resided.

Underground areas near the bivouac were only slightly warmer than above-ground—just about 1 degree F. Meanwhile, the bivouacs' mean temperature was 13 degrees F above the surface. Higher temperatures didn't just result from residual heat energy in the ground—the ants' bodies were warming it.

While previous research focused on above-ground army ants who make their bivouacs at lower (and warmer) elevations, Baudier and O'Donnell's research showed the resiliency of army ants when confronting colder mountain environments.

"This study lifts the roof on what we thought army ants were capable of in terms of warming their young in the face of the more extreme cold and wet conditions at high elevations," Baudier said.

Still, that doesn't mean that the ants are ready to climb Mount Everest. Army ants do a good job of warming their nests, but there might be a ceiling to their capabilities.

In the lower bivouac the researchers studied (constructed at 950 meters above sea level) even the coolest portions were consistently warmer than the highest temperatures recorded in the bivouac at 1,565 meters above sea level.

"The record high elevation for an army ant in Costa Rica was a specimen of Labidus coecus—a close relative, though more subterranean than L. praedator—that was found at 3,000 meters above sea level. However, in the case of L. praedator, the highest I'm aware of is about 1,750 meters above sea level," Baudier said. "I do suspect that cold temperatures are a

major factor in setting these upper elevational ranges. The highest bivouacs seem to struggle to keep warm in wet, cold soil."

"We suspect ants in the mountains have to expend a lot of energy to keep their nests warm," O'Donnell added.

More information: K. M. Baudier et al, Structure and thermal biology of subterranean army ant bivouacs in tropical montane forests, *Insectes Sociaux* (2016). DOI: 10.1007/s00040-016-0490-2

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