

Researchers find unique fore wing folding among Sub-Saharan African ensign wasps

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Researchers discovered several possibly threatened new species of ensign wasps from Sub-Saharan Africa. These wasps are the first known insects to exhibit transverse folding of the fore wing. Credit: István Mikó/Penn State

(Phys.org) —Researchers discovered several possibly threatened new species of ensign wasps from Sub-Saharan Africa—the first known insects to exhibit transverse folding of the fore wing. The scientists made this discovery, in part, using a technique they developed that provides broadly accessible anatomy descriptions.

"Ensign wasps are predators of cockroach eggs, and the transverse folding exhibited by these species may enable them to protect their wings while developing inside the cramped environment of cockroach egg cases," said Andy Deans, associate professor of entomology, Penn State. "It also may be useful while they are active in their cockroach prey's leaf-litter environment."

According to Deans, only a few other insects—mainly some earwigs, cockroaches and

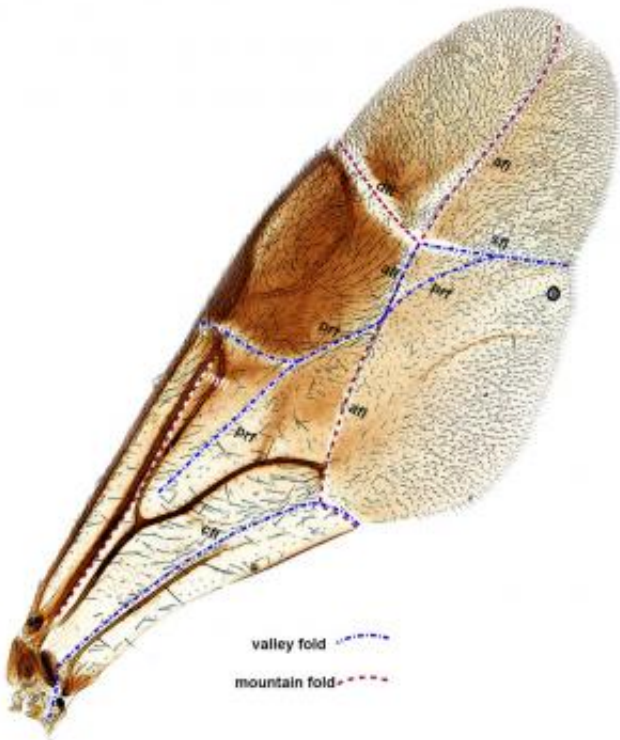
beetles—are capable of folding their hind wings transversely, along a line between the front and back wing margin, as opposed to longitudinal folding, which occurs along a line from the wing base to the wing tip.

"These other insects fold their wings transversely so that the wings can be shortened and tucked under a modified, shell-like fore wing," he said. "This, however, is the first time anyone has observed an insect that folds its fore wings transversely."

The researchers examined wasps belonging to the family Evaniidae from Sub-Saharan Africa. They named five new species—one of them, *Trissevania slideri* is named after their colleague David "Slider" Love, coordinator of farm and greenhouse operations, Penn State. The scientists also created an identification key for the new tribe, *Trissevaniini*.

"We didn't know these new species existed until now, and at least two of them—*Trissevania heatherae* and *T. mrimaensis*—are found only in a small patch of forest in Kenya that is threatened by mining activity," Deans said.

According to Deans, to officially give a [new species](#) a name one must, among other things, provide a diagnosis that describes how this species differs from others.



The researchers used principles of origami paper folding to physically visualize the transverse folding of the wings. In their paper, they included a print, cut and fold template to help readers comprehend the wing fold system. Credit: István Mikó/Penn State

"In most cases, the diagnosis lists certain phenotypic aspects of the wasps, such as having a black head or fuzzy hind legs," he said. "Diagnoses are typically written in natural language and using one's own custom lexicon. There is no standard syntax to describe the way an organism looks, which makes these data difficult to extract in any large-scale way."

To get around this problem, the researchers developed a technique that provides broadly accessible descriptions.

"The gist is that one could actually query across existing anatomy data using computers," he said. "For example, one could search for all the species that have fuzzy heads, or all the species that have a patch of hairs on the ventral surfaces of their abdomens. One could then cross-reference the result with information about the surrounding

environment, the cockroach host, or the evolutionary history of the wasp. The more we test and refine this approach the better we'll understand its capabilities and utility."

In addition to photographing the wasps' wings, the team used principles of origami paper folding to physically visualize the transverse folding of the wings.

"We used origami, one of the most ancient and simple art forms to understand the wing folding, which, based on our observations through microscopes was otherwise impossible to understand," said István Mikó, research associate in entomology. "In our paper, we included a print, cut and fold template for the readers that helps them and us to comprehend the simple, yet enigmatic, wing fold system of the new tribe,"

According to Mikó, insect wings are common subjects of researchers who investigate bio-inspired technologies.

"The relatively simple wing-folding mechanism of the new tribe can be utilized in advance technologies, such as applying morphing systems in aerospace vehicle research or expandable structural systems in space missions," Mikó said.

The team's results appeared in the May 1 issue of *PLOS ONE*.

The researchers said that by characterizing the phenotypes of these species of wasps, they are one step closer to understanding the evolutionary history of the family Evaniidae.

"Understanding the [evolutionary history](#) of this family of wasps is important because this knowledge will inform our attempts to reclassify the wasps in a way that is robust and predictive," Deans said.

In the future, the team plans to use the same methods it developed to investigate other groups of wasps in the family Evaniidae as well as those in the lineage Ceraphronoidea, small [wasps](#) that parasitize many other groups of insects and for which very little is known about their diversity and

morphology.

Provided by Pennsylvania State University

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