Tree ant family tree reveals ant swimming evolution

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Life in the forest canopy is precarious: lose your footing and you could rule yourself out of the evolutionary arms race. Yet this hazard has not deterred many tropical ants from making their homes amongst the branches. In response to the danger of taking a tumble, many have developed the ability to glide to safety, although not all are lucky enough to land safely on another tree.

Steve Yanoviak, from the University of Louisville, USA, explains that many plummet into water when the rivers below flood. However, when Yanoviak tried dropping tropical ants into water to find out what happened, he was amazed to see some species scuttle across the surface with ease. Intrigued, Yanoviak suggested that his Master's student, Dana Frederick, find out how widespread this swimming ability is and which swimming techniques, if any, the ants favour. They publish their discovery that over 50% of tropical tree ant species can swim and that swimming must be so important that this evolved on four different occasions in the ant family tree in *The Journal of Experimental Biology*.

Fortunately, both Yanoviak and Frederick had heads for heights and were unfazed dangling from climbing ropes in the forest canopy as they collected ants from the branches. 'Some individual trees may have 20 or more ant species, so collecting workers of several species was not a major obstacle', recalls Yanoviak, who was also adept at distinguishing between harmless species and ants that could give a painful sting.

Having collected 35 species – ranging from minute *Wasmannia rochai* to

gargantuan *Paraponera clavata* – the duo returned to the ground and tried gently dropping the ants from a bridge over a flooded region of the forest to see how they fared. 'Over half (57%) of the tested species exhibited some swimming ability', says Yanoviak, adding that the rest fell helplessly into the water. Of the swimmers, 10 proved to be elite athletes – with *Gigantiops destructor* notching up top speeds of over 16cm/s – while the weakest 10 species eventually lumbered to safety after slow starts. The duo also analysed the ants' swimming prowess in terms of an ant family tree, discovering that the insects have evolved the ability to swim on four different occasions. And when the duo compared the ants' swimming abilities against their ability to glide, they found that the best gliders tended to be the weakest swimmers.

Next the duo focused on the swimming techniques of three of the larger species (*Odontomachus bauri*, *Pachychondyla foetida* and *P. villosa*), filming the insects with a high-speed camera at 240frames/s as they zipped across water in a shallow rectangular pan. 'Recording high-speed videos of swimming ants in the lab was technically the most challenging part of the work', recalls Yanoviak, adding that the ants would invariably stop performing when the filming conditions were perfect. However, after painstaking analysis, Frederick could see that the swimmers were alternately moving one and then the other tripod of legs; pulling the front two legs from each tripod through the water to propel themselves forward, while using the rear leg from each tripod to provide stability.

Yanoviak and Frederick also wondered whether the immersed insects could locate and swim toward dark objects, such as trees that they could climb to escape. Placing a 3.8cm diameter black tube at one of the four compass bearings around a child's play pool, Frederick then dropped O. bauri ants into the water and waited to see which direction they aimed for. Amazingly, 87% of the ants successfully escaped the water by scaling the dark pipe, while only 23% of the ants successfully located a white pipe. Yanoviak admits that he was surprised by the strength of the

ants' attraction to the dark object, known as skototaxis, and adds that he is now keen to understand how predatory fish respond to swimmers and non-swimmers that land in the water.

More information: Yanoviak, S. P. and Frederick, D. N. (2014). Water surface locomotion in tropical canopy ants. *J. Exp. Biol.* 217, 2163-2170. jeb.biologists.org/content/217/12/2163.abstract

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