Species of rock ant doesn't just walk randomly, they 'meander' systematically

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If you've ever watched an ant searching for food, you probably assumed that they were just covering ground in a random fashion. But a study by researchers reporting in the journal *iScience* on January 30 now finds that

at least one species of rock ant doesn't walk randomly at all. Instead, their search combines systematic meandering with random walks interspersed.

"Previously, researchers in the field assumed that ants move in a pure random walk when searching for targets of which they don't know their location," said Stefan Popp of the University of Arizona, Tucson. "We found that rock ants, Temnothorax rugatulus, show a striking, regular meandering pattern when exploring the area around their nests. This means that the ants smoothly alternate left and right turns on a relatively regular length scale of roughly three body lengths."

He explains that he and colleagues refer to the behavior as "meandering" because it reminds them of the pattern formed by a meandering river. What's more, their study finds that the ants' meandering may make their search more efficient than a pure random search would. That's because ants tend to cross their own paths less frequently while meandering than random walk tracks, so that they less often search the same area twice.

Popp's team set out to learn how ants react to nestmates and surface structure on a colony scale. Because it's difficult to track ants in their natural environment, they moved a whole colony into the lab, where they could easily track all ants automatically and under constant conditions.

They soon noticed the meandering pattern of the ants as they walked around. It raised an immediate question: could the patterns they were seeing arise from random squiggles, without any systematic rules? Or were the ants moving in a more systematic, non-random way? To find out, they compared the ant tracks with computer-simulated random walk patterns.

"We wanted to make sure that we are not just seeing patterns where there is none," Popp said. "We then used a simple statistical method of

detecting regularity in movement tracks to get a simple answer."

They report that their studies found 78% of ants showed significant negative autocorrelation around 10 mm, or about 3 body lengths. That means that turns in one direction usually were followed by turns in the opposite direction after a roughly constant distance. They say it likely makes the ants' search more efficient, as the insects can stay close to the nest without repeatedly searching the same areas. Popp says he was most intrigued by the extreme forms the ants' patterns could take from these simple principles.

"Parts of some tracks look like the curled threads one can pull out of a piece of clothing, and in some it looks like the meandering path meanders itself," he said, "creating a seemingly fractal structure. It reminds me of some space-filling curves we know from math."

The new study is the first to find evidence for efficient search through regular meandering in a freely searching animal, they report. It also adds another complex behavior for ants, suggesting that there's still more to learn.

Popp says he's most fascinated in questions about the rules in an ant's mind that allow such complex search patterns to emerge. He notes also that the ants have solved a problem of collective search over the course of evolution in a way that might find application for designing autonomous swarms of search robots or drones for use in disaster areas or unexplored landscapes.

More information: Stefan Popp et al, Ants combine systematic meandering and correlated random walks when searching for unknown resources, *iScience* (2023). DOI: 10.1016/j.isci.2022.105916. www.cell.com/iscience/fulltext … 2589-0042(22)02189-7

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