Researcher weighs in on fairy circles of Namibia

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A fairy ring in Namibia. Credit: School of Science

A study conducted by researchers at Indiana University-Purdue University Indianapolis adds new insights into one of nature's great mysteries: the fairy circles of Namibia.

Numbering in the millions, the so-called fairy circles are in the eastern, interior margin of the coastal Namib Desert, stretching from southern Angola to northern South Africa. They range in size from about 12 feet to about 114 feet, consisting of bare patches of soil surrounded by rings of grass. The origins of the circles have long been debated by researchers.

There is more than solving a mystery at stake. Analysis on the formation, structure and growth of vegetation patterns and their interactions with Earth's water cycle can improve our understanding of important processes underlying the dynamics of water-limited ecosystems, said IUPUI researcher Lixin Wang.

Wang, an ecohydrologist in the School of Science at IUPUI, along with IUPUI Ph.D. student Kudzai Farai Kaseke, Sujith Ravi and Ilya Buynevich of Temple University, and Eugene Marais of the National Museum of Namibia, reports new findings in an article titled "Ecohydrological interactions within 'fairy circles' in the Namib Desert: Revisiting the self-organization hypothesis." The paper was published March 10 in the *Journal of Geophysical Research: Biogeosciences*.

The team's results provide support to the self-organization hypothesis of fairy circle formation.

Self-organization theory says that the circular vegetation pattern is created by competition for scarce water. It's believed that the bare patches percolate more rainfall and act as water reservoirs, which the grass along the edges of the circle can access.

A second major theory is that fairy circles are created and maintained by sand termites that clear vegetation in the area of their nests. By making the soil porous, it's believed, the termites establish permanent reservoirs of rainwater below the surface that sustain them and the surrounding plants.

The research team brought new equipment and research specialties to bear on the question of fairy circle formation as it conducted extensive measurements of infiltration rate, soil moisture, grass biometric and sediment grain-size distribution from multiple circles and spaces between the circles.

Water infiltration flow rates were measured inside and outside the circles, with very fast infiltration rates recorded within the inner portion of the circles. The faster infiltration rates were facilitated by coarser particle size inside the circles. The team also found the roots of grass around the circles were much larger on the inside of the grass ring compared to the outside.

"That means the grass puts its roots on the inner side of the ring, competing for water," Wang said. "When it does rain, water flows to the edge of the circles, where the grass's roots can take the water for their use.

"Our investigation provides new insights and experimental data on the ecohydrological processes associated with fairy circles."

With evidence in hand concerning the self-supporting theory, the team reached out to a termite expert to search for evidence of termites in and among the fairy circles where the study was conducted.

"There was no sign of sand termite activity at all," Wang said. "Our results seem to provide support to the self-organization theory of fairy circle formation attributed to scale-dependent biomass-water feedback loops," the researchers wrote in their paper.

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