Mycologist says our close relatives break the bounds of biology

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The European Amanita phalloides ("death cap") mushroom. Credit: Archenzo/Creative Commons

The mushroom nicknamed "death cap" made headlines this summer when it poisoned Syrian refugees fleeing through Eastern Europe.

But it was cooperation, not toxicity, that attracted Anne Pringle to Amanita phalloides. The fungus consumes carbon compounds released by tree roots, says the UW-Madison associate professor of botany and bacteriology, and in return helps the roots absorb soil nutrients. "I was interested in the evolution of cooperation," she says, "and fungi and plants are models for understanding how symbiotic species interact—how the relationship is policed and maintained."

Long before the Syrian refugees were poisoned, Pringle says, immigrants in California were dying as the death cap expanded its range along the West Coast. "A. phalloides poisoning is a really unpleasant way to go," she says. "There's intestinal distress, diarrhea. Then you feel fine during a 'honeymoon' that lasts several hours or more. Death can come through liver and kidney failure."

In large swaths of California, she says, "the mushrooms are so abundant, it's hard to believe they're simply a neutral addition to the landscape."

Fungi are essential recyclers of material and members of ecosystems, but they are "a cryptic part of biodiversity, largely hidden in the soil," Pringle says. "We don't have a fungicide that is species specific, and if you drenched its habitat with fungicide, would that be effective and safe for the environment?"

The hallucinogenic toadstool Amanita muscaria is also invading new terrain.
Credit: Rytas Vilgalys

Fungi as a group are poorly known, says Pringle, who was an associate professor of organismic and evolutionary biology at Harvard University before coming to Wisconsin. "The fungi are basically a jungle of species. There are an estimated one to 10 million species, and we have names for 100,000, which suggests how little we know. You can go outside and pick up some soil, put it in a gene sequencer, and you will see a heck of a lot of species that do not match anything seen before."

Pringle's studies of spore dispersal show that fungi actually have some mobility. "Typically, people think fungi just release spores passively to the wind or water," she says, "but it seems that they have evolved a mechanism to make sure the spores are released when they are most likely to spread."

Pringle, along with Damon Smith and Mehdi Kabbage, two UW-Madison assistant professors of plant pathology, is studying the spring-like mechanism that parasitic soybean fungi use to catapult their spores into the wind. Such a mechanism, she says, "challenges the idea of fungi as passive entities."

Pringle says fungi are puzzling. "If there is a rule in biology, I can think about how it does not apply to fungi. They challenge our preconceptions of how biology works."

The overall oddness of fungi appears in the genes. In almost all organisms, every cell contains identical genes—it is a difference in gene activation that distinguishes a blood cell from a nerve cell. "But in fungi, one part looks very different genetically from another," Pringle says, "so the entity you call an individual from a physical perspective encompasses many different genetic individuals. What is going on?"

Cooperation, not competition, is the archetypal relationship between fungi and many of their hosts, especially plants, Pringle says. "How you think about biology is shaped by the organisms you work with. If you think about fungi, you start with symbiosis."

The goal of her ecological studies, she says, "is to slowly chip away at this overwhelming amount of not-knowledge. How does the pattern of fungal biodiversity vary across regions, and across the planet? How are species being moved? What does extinction look like in the fungal kingdom?"

Many people are surprised to find that the genomes of fungi and people are so closely related, Pringle observes. "If biology is to be true, we have to build rules that work for the whole of life. Maybe there are no general rules, and if that's true, that's also interesting. Understanding these issues is a critical part of our job, and it gets me up every day. If we are going to search for life on other planets, we need to think about how the entire spectrum of life works."

Provided by University of Wisconsin-Madison

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