Researchers gain insight into the biology of a deadly fungus

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Research associate Sarah Prostak initially wrote what later became the Current Biology paper for her undergraduate honors biology thesis at the University of Massachusetts Amherst. Credit: UMass Amherst

Researchers at the University of Massachusetts Amherst have gained new insight into the biological processes of a chytrid fungus responsible

for a deadly skin infection devastating frog populations worldwide.

Led by cell biologist Lillian Fritz-Laylin, the team describes in a paper published Feb. 8 in *Current Biology* how the actin networks of Batrachochytrium dendrobatidis (Bd) also serve as an "evolutionary Rosetta Stone," revealing the loss of cytoskeletal complexity in the fungal kingdom.

"Fungi and animals seem so different, but they are actually pretty closely related," says Fritz-Laylin, whose lab studies how cells move, which is a central activity in the progression and prevention of many human diseases. "This project, the work of Sarah Prostak in my lab, shows that during early fungal evolution, fungi probably had cells that looked something like our cells, and which could crawl around like our cells do."

Chytrids including Bd encompass more than 1,000 species of fungi deep on the phylogenetic, or evolutionary, tree. The researchers used chytrids, which share features of animal cells that have been lost in yeast and other fungi, to explore the evolution of actin cytoskeleton, which helps cells keep their shape and organization and carry out movement, division and other crucial functions.

Prostak, a research associate in Fritz-Laylin's lab, is the lead author of the paper, which she initially wrote as her undergraduate honors biology thesis, the expanded and finished the research after graduation. Other authors are Margaret Titus, professor of genetics, cell biology and development at the University of Minnesota, and Kristyn Robinson, a UMass Amherst Ph.D. candidate in Fritz-Laylin's lab.

"Bd is more closely related to animal cells than more typically studied fungi so it can tell us a lot about the animal lineage and the fungal lineage and can also provide a lot of insight into human actin networks,"

Prostak says. "We can use it to study animal-like regulation in a similar system rather than actually studying it in animal cells, which is very complicated because animal cells have so many actin regulators."

The research team used a combination of genomics and fluorescence microscopy to show that chytrids' actin cytoskeleton has features of both animal cells and yeast. "How these complex actin regulatory networks evolved and diversified remain key questions in both evolutionary and cell biology," the paper states.

The biologists explored the two developmental stages in Bd's life cycle. In the first stage, Bd zoospores swim with a flagellum and build actin structures similar to those of animal cells, including pseudopods that propel the organisms forward. In the reproductive stage, Bd sporangia assemble actin shells, as well as actin patches, which are similar to those of yeast.

The disease chytridiomycosis, caused by Bd, ravages the skin of frogs, toads and other amphibians, eventually leading to heart failure after throwing off fluid regulation. This disease has been attributed to huge losses of biodiversity, including dozens of presumed population declines and extinctions over the past 50 years, though exactly how many species have been affected by this disease has been subject to debate.

The UMass Amherst biologists say Bd's actin structures they observed likely play important roles in causing the disease. "This model suggests that actin networks underlie the motility and rapid growth that are key to the pathology and pathogenicity of Bd," the paper concludes.

Prostak, an animal lover drawn to Fritz-Laylin's lab because of its focus on pathogens, hopes their research advancing the knowledge about Bd will lead to measures that slow the deadly damage of chytridiomycosis.

"Figuring out the basic biology of Bd will hopefully give insight into disease mitigation in the future," Prostak says.

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