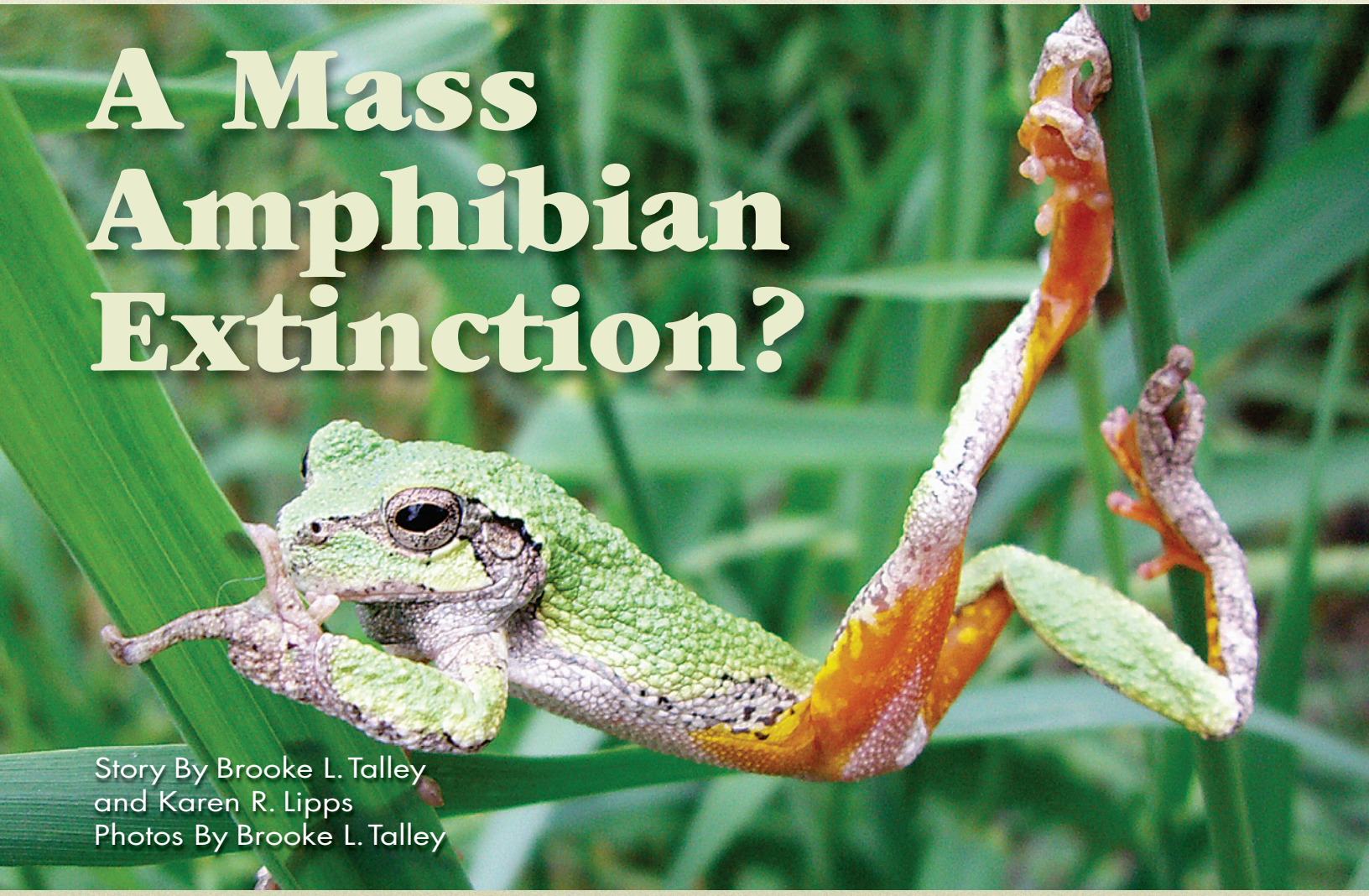
Microscopic, free-swimming spores called chytrids (kit-rids) are blamed for amphibian extinctions in Panama and elsewhere. Are the same spores about to devastate Illinois amphibians?

A Mass Amphibian Extinction?



Story By Brooke L. Talley
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Photos By Brooke L. Talley

On a geologic timescale, Panama and Illinois developed independent of one another, like twins separated at birth. They do not share similar habitats, weather patterns or most species, but these two geographically separated areas share a fungal disease that is driving amphibian species to extinction. The disease, Chytridiomycosis, is caused by a fungus (*Batrachochytrium dendrobatidis* or *Bd*) that infects amphibian skin and can lead to death. *Bd* is thought to kill amphibians by preventing them from getting enough water and oxygen across their skin.

Bd is causing what has been called the Sixth Mass Extinction because of its global distribution and wide range of host species, resulting in deaths of hundreds of amphibian species. In Panama, a massive die-off began in the 1990s, leaving only a small portion of the native amphibian fauna intact. This epizootic is expected to spread through the remainder of Central America in the next few years, killing many frogs in its path.

In 1994, *Bd* was first reported from Illinois, although no subsequent massive die-off occurred from this disease. We suspect that because Panama and Illinois are so different in their geographic locations, and different in the environmental pressures that drive disease dynamics, the death sentence that most *Bd* infected Panamanian frogs receive may translate only to life-without-parole in most Illinois frogs.

A gray tree frog (*Hyla chrysoscelis/versicolor*) from Jubilee College State Park in Peoria County demonstrates the acrobatic skill tree frogs have, and the orange coloration that is not visible when the tree frog is in a compact, sitting position.

Many frog species in the temperate United States are susceptible to infection with *Bd*, but do not always succumb to the lethal effects of Chytridiomycosis. This means that they may be infected with the disease but that they can typically live with it.

We do not know why some amphibians decline while others do not, where *Bd* came from, or how to cure infected frogs in the wild. Researchers are left

(Photo by Erin Tucker.)

To test for *Bd*, scientists run a swab over the frog's feet, thighs and abdomen to collect a DNA sample. Once taken, the sample is stored for analysis and the frog is released. Because of their limited distribution throughout the state, Strecker's chorus frog (right, *Pseudacris streckeri*) and bird-voiced tree frog (left, *Hyla avivoca*) populations are important to survey for *Bd*.

with more questions than answers when it comes to understanding *Bd*.

Bd is a parasite that requires a host for survival and reproduction. Parasites do not usually cause extinction of their hosts, or they, too, would go extinct. In the case of *Bd*, it is killing frog hosts at an unexpectedly high rate.

The fact that *Bd* is an invasive species probably gives it the ability to kill numerous native populations of amphibians where it has been introduced. This is similar to what the Native Americans may have experienced when Europeans brought infectious disease to the Americas.

Researchers are testing whether environmental factors or amphibian behaviors can reduce amphibian mortality, and are hoping to find cures from the natural defenses of amphibian skin. This means that frog species which survive with *Bd* may hold the key to answering *how* they are able to do so. Geneticists have already discovered that there are multiple strains of *Bd*, with some strains being more virulent than others.

Bd is an emerging infectious disease, and has been found on all continents where amphibians occur. Because massive die-offs occur mostly at high-altitude sites, researchers suspected that *Bd*'s growth and survival may be dependent on temperature. Like many common fungi, researchers suspected that *Bd* grew only in cool, damp conditions. They found that *Bd* grew best in laboratory experiments between 17°C (62.6°F) and 25°C (77°F); this temperature range coincides with that of many upland neotropical areas, and montane areas of the U.S. So, although Illinois does not have the mountainous geography or neotropical climate associated with widespread mortality of a *Bd* epizootic, spring and summer temperatures fall within this thermal range.

Bd has been present in the United States since at least the 1960s, and is widespread today throughout most of the United States and Canada.

Today, some Illinois species, such as hellbenders and mudpuppys, are missing or rarely encountered, and while habitat loss is likely involved, factors such as disease also may be involved. Crayfish frogs have shown some losses in the central parts of the state, but the cause is not known.

Cricket frogs are the only widespread frog species in Illinois currently declining. They have declined in the northern portion of their range in Illinois, but are one of the most common frogs in the southern parts of the state. Cricket frogs have been documented with *Bd* in Illinois and elsewhere; while scientists have not yet implicated *Bd* as the agent in the decline, it is a possibility.

With interest from wildlife managers and biologists, the Department of Nat-

(Photo by Edmund Tucker.)

Scott Ballard (DNR) shows the authors the physical traits that make Strecker's chorus frogs good fossorial frogs—strong arms that help them dig into the sandy substrate for over-wintering.

ural Resources provided a State Wildlife Grant to fund research into these basic, statewide questions of *Bd* patterns in Illinois. Jody Shimp, administrator for the DNR Division of Natural Heritage, was instrumental in getting this project off the ground. Efforts to identify important sites and species were aided by DNR Natural Heritage biologists throughout the state, including Scott Ballard, Terry Esker, Mark Guetersloh and Bob Lindsay. Site and species selection in northern Illinois was aided by Mike Redmer, a biologist with the U.S. Fish and Wildlife Service.

With this sort of collaboration, the first statewide survey for *Bd* was initiated. We are determining where *Bd* is geographically located in Illinois, in which species *Bd* is found, what percentage of amphibian species have *Bd* (prevalence), how extensive the *Bd* infections are in individuals (intensity), etc. Without this basic understanding of *Bd* assessment in the Midwest, wildlife managers are in the dark with regard to how they can handle an emerging infectious disease that has driven amphibians species to extinction elsewhere.

Although Illinois amphibian communities have not had a massive die-off from *Bd*, as experienced in Panama, these communities are under intense pressure from other sources including urbanization, agriculture, pollution and climate change. How these other factors interact with a disease like *Bd* is unknown. What we do know is that the natural landscape of Illinois is continuously changing, and that the amphibian fauna found in our parks and protected areas may need active management in the face of this emerging infectious disease.

The plight of Panamanian amphibians is fairly well-understood compared with populations in our own backyard. Whether *Bd* is widespread, or absent, in our landscape is unknown. Currently, we are analyzing results from approximately 4,000 Illinois frogs and toads. Preliminary data show that Illinois frogs may be in trouble; the percent of amphibians carrying this fungus is surprisingly high, as are the intensities of infection.

While some Illinois frogs are easily found in roadside ditches and other non-natural habitats, the frogs at Kickapoo State Park were found in a number of scenic wetlands and shallow ponds. This wetland was bustling with gray tree frogs and cricket frogs perched on emergent vegetation during nighttime hours.

While cricket frog (*Acris crepitans*) populations are booming in most of Illinois, distinct declines have occurred in the northern portion of the state. The reasons are unclear.

Yet, these populations persist. Once the dataset is analyzed, the lessons learned from Panama will be used to better understand how Illinois frog and toad populations will fare in the face of this emerging infectious disease.

While surveying in Illinois, we've heard on numerous occasions of historic "raucous calling" in rural ponds during the spring that kept nearby people awake throughout the night in the 1960s and 70s. Now, these same people do not hear the frogs like they used to. It's unknown whether these muted ponds are a result of habitat change or whether *Bd* played a part.

Frog calls tell us a story from which we can learn. There are still ponds that sing through the twilight hours in Illinois, where frogs happily chirp, groan, clink and hum alongside turtles, snakes, cattails and lily pads.

The question is why other ponds teeming with frogs no longer sing, and are swallowed into the silent night.

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