



If healthy vernal pools can come back, so can frogs

Many frogs rely on ephemeral ponds, known as vernal pools, to feed and reproduce. Not only are the spring-to-summer pools important to the frogs, but the frogs eat plant-eating insects and lay eggs, which hatch into tadpoles reliant upon plants to oxygenate the water. It's a remarkable showcase of how plants and animals work together to maintain a healthy ecosystem.

But the equilibrium of this ecosystem is under threat. The invasive shrub buckthorn has degraded vernal pools, sabotaging native wetland plants and inhibiting the growth and development of chorus frogs, tree frogs, and other environmentally threatened amphibians.

That's why land stewards and research ecologists at several Forest Preserves of Cook County sites are closely tracking a new pilot study being led by Matt Evans, a 27-year-old graduate student in the joint graduate program in plant biology and conservation through Northwestern University and the Chicago Botanic Garden. Their hope is that the study will corroborate what Evans suspects: by removing invasive buckthorn from seasonal forest ponds, dormant seeds of native wetland plants will be able to re-emerge on their own and help attract insects and the frogs that feed on them.

"One metric of success would be to see higher numbers of chorus frogs," Evans says. He cites research from the International Union for Conservation of Nature, showing that more than 2,000 species of frogs, toads, and salamanders—more than 31 percent of

the world's amphibians—are at risk of dying out as a result of climate change, habitat loss, and other anthropogenic effects.

Begun in spring 2018 in partnership with the Shedd Aquarium, the study is focused on nine buckthorn-invaded ponds and two healthy pools at Possum Hollow Woods and La Grange Park Woods, Forest Preserves sites targeted for volunteer restoration as part of the broader Great Lakes Action Days program.

Evans and his thesis adviser, Chicago Botanic Garden conservation scientist Andrea Kramer, Ph.D., who became the Garden's director of restoration ecology in March, recovered 18 soil samples at a depth of 5 centimeters using simple tools—trowels, rulers, and plastic bags. Seeds culled from these samples were germinated in cold frames at the Garden's nursery. The



Far left: Vernal pool. Left: spring peeper.
Center: Western chorus frog tadpole ©Mike Redmer. Right: Matt Evans and REU intern Paola Ramirez.

highest quality plants will be replanted at area sites.

“The plants are there, and they come back,” Evans says. “We have been able to demonstrate that there is a seed bank, and it is very diverse. I think the most exciting thing is that these results could be extrapolated throughout the forest preserves of northern Illinois, and we could potentially see this vernal pool story turn from a sad story to a very happy story.”

According to a 2017 U.S. Forest Service report, 28 percent of the Chicago Wilderness Region’s urban tree population is made up of buckthorn. But Evans’s preliminary findings show that the plant community looks much more diverse below ground, where seeds of blue flag iris (*Iris virginica schreivi*), hop sedge (*Carex lupulina*), buttonbush (*Cephalanthus occidentalis*), and other native plants are lying in wait for the right conditions to emerge; namely, soil free of invasive buckthorn. “This project could show an efficient, cost-effective way for land managers to re-establish native vegetation without the need for reseeding,” Evans says.

Dr. Kramer points out that healthy vernal pools, found locally at restored forests, such as Somme Woods in Northbrook and the Garden’s McDonald Woods, are only inundated with water from spring to midsummer, drying out after a crucial period in the frogs’ life

cycles when they lay eggs that become tadpoles. Warmer seasonal temperatures and drier conditions resulting from climate change are likely to disturb the timing and abundance of these pools and heighten the need for interventions to ensure that frogs have the habitat they need to reproduce. “Frogs couldn’t reproduce successfully without these ponds. In a lake or a river, where there are fish, the tadpoles would get eaten,” Kramer says.

Ecologists generally agree that forest preserves with more plant species are better at cleaning air, siphoning water from flood-prone residential communities, and recovering after disturbances, but how plant diversity in and around vernal pools directly impacts frog populations is an understudied area, particularly in the Midwest.

A partnership with the Garden, Forest Preserves of Cook County, and Shedd Aquarium targets threatened ecosystems.

Evans’s work has begun to shed light on the ecological conditions under which seeds survive and germinate in the face of exotic invasion—a process that varies widely by soil conditions. Previous Garden research found few native seeds remaining in buckthorn-invaded soils in drier habitat, but Evans’s research shows an exception for wetland plants. “Wetland seeds have developed the ability to persist a long time in wet soil

with an impregnable seed coat layer that prevents rot from occurring,” Evans says.

In a subsequent experimental study, Evans will delve deeper into vernal pool ecology, drawing soil samples from deeper underground and using the nursery’s aquatic tanks to grow seeds. Paolo Ramirez, a student in the Research Experiences for Undergraduate students program (REU), will help analyze the soil seed bank at three depths.

If all goes as predicted, Evans expects upper levels of the soil to contain high levels of invasive species but deeper levels to reveal evidence of a diverse seed reservoir preserved from a time before buckthorn invasion and European settlement, when the planet was friendlier to frogs. He plans to present his results in his thesis defense in May 2020.

“I think this is a great example of what we’re trying to do more of—closing the loop,” Kramer says. “Not only doing the research, but collaborating with land managers in Cook County to identify priority questions and finding ways to answer them, and then using those projects to give graduate students opportunities to build their skill sets and present their results to the communities that will use them.”

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