In nature, the littlest things can have the biggest impact

By Sarah Kaplan July 10

Springtime in the Maine woods. Melting snow soaks the forest floor. Rain spills off pale new leaves into growing puddles. Tiny egg cases that endured the winter hidden in the leaf litter begin to thaw out in the water and sun. They hatch, releasing tiny translucent crustaceans known as fairy shrimp. Larger creatures — wood frogs, blue-spotted salamanders — lay their eggs in the secluded pools, where no predatory fish might make a meal of them. Mammals come to the pools for a drink of water. Birds swoop down to snack on larvae.

For a few brief months, these “vernal pools,” so named because they form in the spring and evaporate beneath the summer sun, are wellsprings of life. Though they represent a relatively tiny proportion of the landscape — usually a fraction of a percent — in some ecosystems they can support up to 35 percent of rare species.

To the world, they may be mere puddles. But to their inhabitants, they are the whole world.

Once you take a look at them, “you have to be impressed,” said Aram Calhoun, a conservation biologist at the University of Maine. Yet few people bother looking. Vernal pools are so small they fall through the cracks in environmental regulations, and so modest that few conservation campaigns would chose them as a poster child.

“They're definitely the underdogs,” Calhoun said.

In the latest issue of the journal Biological Conservation, Calhoun and her colleagues go to bat for vernal pools and other neglected parts of nature. The entire issue is devoted to small natural features — rocky outcrops, cramped caves, single trees, even the patches of vegetation that flourish along the sides of roads and the edges of fields — that have outsized impacts on their landscapes. It's an ode to the odd, the ephemeral and the easily overlooked.

“I'm a small natural feature myself,” said Calhoun, who's 5 feet tall, “so it resonates with me. … I like to speak out for the things that don’t have a lot of people speaking out for them.”

The special issue was organized by Malcolm Hunter, Calhoun's husband and fellow University of Maine scientist. He calls the biological significance of small natural features the “Frodo effect,” for the unassuming hobbit who becomes the hero of the Lord of the Rings.

Like Frodo, these features are unlikely saviors of the system (or the shire). But their size belies their strength. Just as the members of the Fellowship of the Ring had to trust Frodo to save the day, Hunter said scientists must invest in small natural features if they want to protect much of the world's biodiversity.

Wood frogs spend the majority of the year in the forest, but they depend on vernal pools to make it possible for them to lay their eggs. (Aram Calhoun)

Take, for example, a “snag” — a dead or dying tree often found in old-growth forests. To the untrained eye, it may appear to be just a decaying log, a symbol of death, not life. But snags are actually host to complex communities of decomposers — fungi, bacteria, bugs. Birds, bats and mammals feed on these organisms and, in turn, become prey to larger predators. A single snag can support a hundred species.

“Here's a kind of nerdy statistic,” Hunter said. “There are two families of beetles, metallic wood borers and longhorn beetles, that are uniquely associated with dead wood. And there are more species in those two families of beetles than all the birds and all the reptiles and all the amphibians put together.”

He paused to let the concept sink in, then said, “We tend to focus on birds and mammals, and I love them, too, of course, but really the mother lode of diversity are all these little things. And things like a big old snag are incredibly important to these little creatures.”

Another contributor to the issue, Australia National University's David Lindenmayer, makes the case for protecting single large old trees — aging individuals whose high-up canopies and gnarled trunks provide vital habitat and resources not found in younger specimens. In southeastern Australia, where Lindenmayer works, there are 39 species that depend on the hollows formed in the trunks of older mountain ash trees. Among them is Leadbeater's possum, a critically endangered species that lives nowhere else.

“They are really quite extraordinary micro hot spots,” Lindenmayer said. And it only takes a few to make “a massive difference in the ecosystem,” providing enough resources “to make that place that would otherwise be uninhabited,” he said.

But large old trees, like other small natural features, are vulnerable. Industrial logging and increasing rates of forest fire have depleted the number of mountain ash older than 150 years. And though they grow quickly — as much as a meter a year — it still takes more than a century for them to reach the size at which the “Frodo effect” starts to take hold.

“Poor decisions made today or yesterday will have implications for centuries to come,” Lindenmayer said.

Traditionally, environmental regulations are not designed to protect a single tree or a fleeting vernal pool. But they can be. Calhoun and her colleagues recently worked with the Environmental Protection Agency to develop a program for managing temporary wetlands: Developers can pay a fee to build over pools in inhabited areas (where the ecosystem is likely stressed anyway). That money then goes to local homeowners to fund conservation of ecologically important pools on their land.

“It's not a top-down approach,” Calhoun said. It suggests a way that humans and conservation can coexist.

Lindenmayer said this kind of “micromanagement” of small natural features may well be the best way for scientists to get the biggest biological bang for their buck, especially as the world's human population continues to grow. Large swaths of protected land are vital for many species, he said, but realistically, most of the world is not going to be set aside as a wildlife preserve. The “human footprint” is seen on 83 percent of the Earth's surface, he said, citing a 2002 study by Columbia University scientists.

“That 83 percent has an enormous amount [of] biodiversity,” he said. “If we don’t think carefully about how we do conservation in those non-reserved lands, we’re going to lose a lot.”