**'Unless we allow animals to expand and contract their ranges, as they have done for millennia, we are going to reduce the vitality of these animals, and ultimately of ourselves.'**

*— Michael Klemens, director of the Metropolitan Conservation Alliance in Rye, N.Y.*



Photo by Paul Fusco

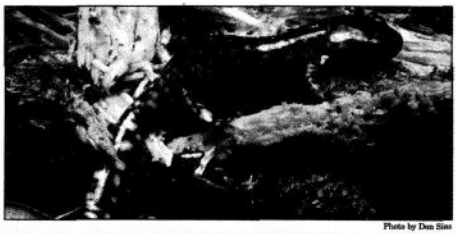

Photo by Dan Sies

**The Jefferson salamander, left, is declining in population and interbreeding with the blue-spotted salamander, right, though in a pristine environment the two species never cross paths.**

# 'The First to Disappear'

## Little salamanders are the red flag of habitat harm when humans move in

By Madeline Bodin

JEFFERSON salamander No. 309 headed north-northwest when she was released near her breeding pool on May 22 last year — and she kept going.

With a ground-hugging bearing and body just 3½ inches long, not including her tail, No. 309 inched across the landscape through the summer and fall. Fallen branches loomed like fortress walls. Rock ledges towered like mountain ranges.

Being eaten by a snake, attacked by a shrew or dried out by the summer sun were constant dangers. Traveling only on rainy nights, she found refuge in the root system of a beech tree, in a rotten hemlock log and in a tunnel system under some fallen tree limbs as she made her way across the forest floor.

She completed the trek in October. No. 309 spent the winter in a tunnel system on the slope of a small ravine. She is one lucky Jefferson salamander.

According to scientists and conservationists, Jefferson salamander populations are declining, mostly from human-created causes. Salamander 309 is safe from most of these threats because she lives in the Marsh-Billings-Rockefeller National Historical Park in Woodstock, Vt. Her movements were traced by Steven Faccio, a conservation biologist with the Vermont Institute of Natural Science, in a study designed to find out just how much room to roam the park's salamanders need.

Jefferson salamanders are mole salamanders that live underground unseen for 11 months of the year, appearing only in early spring to breed in wetlands of various kinds. They are relatively common near wetlands, but because they go above ground only on rainy nights, few people ever see them.

Human development in the Northeast is putting the squeeze on many species of mole salamander, and indeed, on many species of amphibian, but for Jefferson salamanders the situation is particularly treacherous.

"Jefferson salamanders are analogous to forest-interior birds. They are the first species to disappear when a region moves from rural to developed," says Michael Klemens, director of the Metropolitan Conservation Alliance in Rye, N.Y. The alliance is a program of the Bronx-based Wildlife Conservation Society, which also runs what used to be known as the Bronx Zoo.

The states of New York, Connecticut, New Jersey, Massachusetts and Vermont have listed the Jefferson salamander among their animals of special concern. State classification as a threatened or endangered species — a status that packs legal clout — is unlikely for the Jefferson salamander.

"Here is the problem with Jeffersons: Nobody has a handle on their real population status," says Sam Droege, a U.S. Geological Survey wildlife biologist and salamander expert. "There are no overarching surveys designed for this group of salamanders. All you have to go on is local experience and herpetological common sense."

Both of these signposts point toward trouble for the Jefferson salamander. Klemens has seen many local populations that have declined or disappeared. One in Foxon, Conn., had been studied by Yale University researchers for decades. Specimens from the location were part of collections both at Yale and at the Field Museum in Chicago. When Klemens accompanied Yale researchers to the spot in the 1980s, however, there was not a single Jefferson salamander left.

The Jefferson salamander faces some problems unique to its species, some common to other amphibians and some that plague most living things in developed areas.

The Jefferson salamander interbreeds readily with the blue-spotted salamander. In a pristine environment, however, these two species never cross paths.

The Jefferson salamander breeds in temporary forest wetlands called vernal pools. After breeding, it spends the rest of the year in small-mammal tunnels in the forested uplands surrounding the vernal pool. The blue-spotted salamander breeds and lives in swamps. When their habitats are disturbed or destroyed, the salamanders travel in search of new habitat, sometimes settling for a second-best choice.

After these moves, Jefferson salamanders sometimes find themselves among blue-spotted salamanders, and vice versa. The resulting hybrids were once called the silvery salamander and Tremblay's salamander. But scientists have learned that these are not separate species, and that even the hybrid situation is much more complicated than they thought.

Photo by Dennis DeMelle

**Jefferson salamanders lay their eggs in a forest pool that forms in spring and then roam to forest uplands. Roads are a big hazard, and these vernal pools are not protected by law.**

Jefferson salamanders, blue-spotted salamanders and their hybrids are prone to polyploidy — having more than two sets of chromosomes.

Jefferson and blue-spotted salamander hybrids have been found with two, three and even four sets of chromosomes. But no matter how many sets of chromosomes the hybrid has, when the two species of salamander mix, the genome of the less-hardy Jefferson salamander ultimately loses out.

"The hybrid forms are a good indication of changes in the population's genetic structure," says Klemens. "The change is often fueled by habitat disturbance."

Between hybridization and polyploidy, pure populations with just two sets of chromosomes in either species of salamander are relatively rare, Klemens says. One such population of blue-spotted salamander exists on Montauk. (Jefferson salamanders are not native to Long Island, although they are found in New Jersey, Connecticut and Westchester County.)

While both Jefferson salamanders and blue-spotted salamanders share these genetic threats, the Jefferson salamander's habitat needs make it more vulnerable to other threats, such as roads.

"These salamanders need woodland pools to lay eggs in and big chunks of woodlands nearby to live in when they are not laying eggs," explains Droege. "The roads problem exists because the salamanders move slowly and tend to get crushed when traveling to their egg-laying sites. I call this annual event the honeymoon massacre, as it usually occurs on one or two warm rainy nights each spring when much of the population is roiling in salamander lust."

Other amphibians, including salamanders and frogs, that move from drier uplands to wetlands to breed suffer from their own honeymoon massacres.

A study by James Gibbs, a professor at the State University College of Environmental Science and Forestry at Syracuse, found that the farther a species migrates to breed, the bigger impact development — especially roads

See SALAMANDER on C8

# The First to Disappear: Salamanders

SALAMANDER from C3

— has on it.

In his research at the Yale Natural Preserves in New Haven, Conn., he found that the amphibian species most sensitive to forest fragmentation was the red-spotted newt, which has a whole life stage devoted to migration. Although he didn't study Jefferson salamanders, he found that other mole salamanders were also highly sensitive to forest fragmentation.

The red-backed salamander was the most hardy of the animals he studied. It survived even in urban areas.

Jefferson salamanders, if they make it across the road, face yet another threat: finding that the vernal pool that serves as their honeymoon suite and nursery has disappeared. Species that rely on rivers, lakes and even swamps have a little more security. Federal, state and local regulations protect wetlands, but the tiny vernal pools — sometimes just a few yards wide — are often exempt from this protection because of their size and the fact that they often dry up by late summer.

Klemens is intimate with the way wetland regulations affect various species. The Metropolitan Conservation Alliance works with municipalities and other groups in the metropolitan area to create procedures for permits that work for water quality, human needs and wildlife. He also is chairman of Rye's planning commission, which issues wetland permits for that city.

"Our wetland protection in this country is accomplished by permits," he says.

Wetland laws don't really protect wetlands in a straightforward way, he says. The laws govern what type of development is allowed or not allowed, and the laws themselves are subject to interpretation by local planning boards. In most places there is no law that says a vernal pool can't be turned into a storm-water overflow basin, which results in no net loss of wetlands but is devastating for the species that rely on the characteristics of the vernal pool.

A 100-foot-wide buffer around any wetland is a common regulation in many areas, Klemens says. It's used as a rule of thumb by well-intentioned people even where there are no wetland regulations. But this rule starves animals like the Jefferson salamander of the land they need.

"The 100-foot buffer is designed to protect the quality of the water," says Klemens. "It's not meant to protect wildlife and biodiversity. If the upland requirements of the animals are modest, they survive. That's why riverine and flood-plain species are doing much better. They stay near the wetland, and there is a wider recognition that the areas where they live even are wetlands."

The situation is bleak for animals that rely solely on vernal pools, such as the Jefferson salamander, the spotted salamander, the marbled salamander and the wood frog, Klemens says.

If 100 feet is not enough, how much is?

"Five hundred and thirty-four feet," says Raymond D. Semlitsch, a professor of ecology at the University of Missouri, Columbia.

A buffer of that size is large enough to contain the wanderings of 95 percent of the salamanders breeding in the average wetland. To protect just half the salamanders, a buffer of about 400 feet is needed.

Semlitsch arrived at these numbers through an exhaustive survey of the research done by directly tracking salamanders. The scientific papers he surveyed spanned 30 years and covered 265 individual salamanders. The idea, he says, was not to focus on the distance-record winners, but the average salamander under average circumstances.

"My purpose was to give land managers a number they can hang their hat on," says Semlitsch. "I've offered to go to court on this, and I will do it. I can defend it, based on biology."

Some land managers want even better numbers based on the particular salamander species found on their land and the particular habitat their land provides. These numbers can be compiled through a survey that tracks individual salamanders at the site, like the survey Vermont biologist Faccio conducted for the Marsh-Billings-Rockefeller National Historical Park.

The salamanders in Faccio's survey traveled an average of 412 feet from their breeding pools. It's a figure that fits well with Semlitsch's overview.

In spite of the general usefulness of Semlitsch's numbers and his confidence in them, the 100-foot wetland buffer remains the standard.

Most land managers find the 534 feet recommendation unpalatable, he says. It simply represents too large a change from the status quo. To Semlitsch, Klemens and other scientists who study wetland animals, these wetland protection issues are much more than quibbles over puddles in the forest.

"These vernal pool animals have a lesson that goes far beyond the vernal pool," says Klemens. Human development is slicing animals' habitat into pieces that meet the needs of only a few, he says. "Unless we allow animals to expand and contract their ranges, as they have done for millennia, we are going to reduce the vitality of these animals, and ultimately of ourselves."

The life that begins each spring in a vernal pool is carried into the forest by the wanderings of the insects, frogs and salamanders that were born there. Sometimes these wanderings carry the vitality of the vernal pool relatively far.

For example, salamander 309 is overwintered 1,414 feet from the pool where she bred last spring. That is just 29 yards short of the length of five football fields laid goalpost to goalpost. It's a distance that is far beyond the 100-foot buffer that can be a death sentence for some salamanders. It's even far beyond even the more generous 534-foot recommendation that marks the average wanderings of most of 309's kind.

Yes, that's one lucky salamander.

*Madeline Bodin is a freelance writer.*

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