VERMONT CENTER FOR ECOSTUDIES
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Research Notes
Number 3

Pictured from top to bottom: Spotted Salamander (*Ambystoma maculatum*), Jefferson's Salamander (*Ambystoma jeffersonianum*) and vernal pool. All images © Bryan Pfeiffer / Wings Photography or © Steve Faccio / Vermont Center for Ecostudies.

Salamander Strategies

VCE Biologist Tracks Salamanders Beyond Their Vernal Pools

It is one of springtime's great events – the explosion of life in temporary woodland ponds known as vernal pools. Among the most intriguing members of these ecosystems are salamanders that spend most of their lives under ground, only to emerge with spring rains and migrate to the pools for courtship and breeding. This annual movement of salamanders has spawned a parallel movement of scientists, citizens and policy makers united in the protection of vernal pools and their unique assemblages of life. Yet research by Vermont Center for Ecostudies biologist Steve Faccio reveals that salamanders require habitat far beyond the water's edge of a vernal pool: a surrounding forested "life zone" that, until recently, had been largely unrecognized and poorly protected.

Background: Tracking A Mole Salamander

Faccio's research, published in the *Journal of Herpetology*[1], featured two salamander species: the widespread and relatively common spotted salamander (*Ambystoma maculatum*) and the Jefferson's salamander (*Ambystoma jeffersonianum*), a species of regional conservation concern in the Northeastern U.S. Both belong to a group, the mole salamanders, whose members dwell most of the year underground in forests some distance from vernal pools. While there, the salamanders eat, grow, prepare for breeding, avoid predators and escape dehydration and freezing. With the warming rains of early spring they emerge at night to crawl through the woods and slip into vernal pools for breeding. Although pools are crucial to the viability of salamander populations, the surrounding forest is similarly essential in the animal's life cycle and, as a result, warrants considerations in any conservation strategies.

Critical to protecting the forested life zone on which these salamanders depend is understanding the distance and direction individuals move, or emigrate, from vernal pools after the spring breeding season. Moreover, after they leave the pools, do these two salamander species prefer specific micro-habitat locations when they "go underground?" This was the focus of Faccio's research. Yet following around a subterranean salamander is anything but easy. So Faccio employed radio telemetry to track the animals' movements around two breeding pools at the Marsh-Billings-Rockefeller National Historical Park in Woodstock, Vermont. After their spring breeding season, he captured 16 adult salamanders (eight of each species) and fit each with a tiny radio transmitter. With each transmitter broadcasting at a unique frequency, Faccio would be able to identify individual salamanders and track their movements. He returned his 16 research subjects to their point of capture and began to monitor their whereabouts.

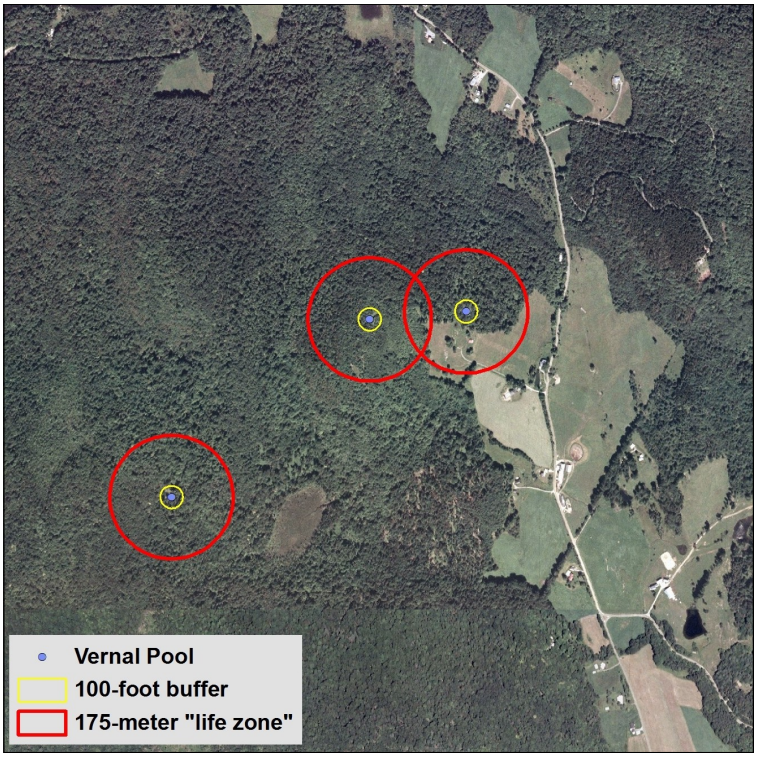
Various other studies have identified the habitat features that provide salamanders with the necessary forest floor microclimate and subterranean refuges. These include deep, uncompacted leaf litter; coarse woody debris; stumps and roots; dense understory vegetation; a closed forest canopy; and presence of small-mammal runways. Yet small-scale habitat disturbances that affect the forest floor environment, including logging, can damage these micro-habitats and threaten local salamander populations. Many state and federal guidelines, designed to minimize ecological impacts, may be inadequate to conserve amphibian populations. Faccio's research offers critical new insights on the habitat requirements of these two species beyond their vernal pools.

[1] Faccio, S.D. 2003. Post-breeding emigration and habitat use by Jefferson and spotted salamanders in Vermont. Journal of Herpetology 37:479-489.

To read the full paper visit: http://www.vtecostudies.org/PDF/Faccio_JHerp_2003.pdf

Results

Faccio was able to track the salamanders between May 17 and November 15 of a single field season, accumulating a total of 466 distinct telemetry fixes, or encounters with the radio frequencies, of his 16 subjects. Each salamander was tracked for an average of 164 days (with a range from 119 to 182 days). So how far did they move in this period? In some cases, much farther than earlier research had reported.



For both species combined, salamanders moved an average of 112 meters from their release points. Most emigrated from pools during overnight rains, but the timing, direction and distance traveled varied widely among individuals (from as close as 11 meters to as far as 405 meters). On average, Jefferson salamanders in the study went farther (123 meters) from their vernal pools than did spotted salamanders (101 meters), and females moved nearly twice as far (155 meters) as males (78 meters). This latter result may have important conservation implications if buffer zones around vernal pools are not large enough to include females. Habitat loss that disproportionately affects females could increase the risks of local extinctions.

By combining his results with data from other studies, Faccio determined that salamanders use an area extending 175 meters from a vernal pool's edge. This salamander "life zone," as Faccio defines it, would include not only salamanders emigrating an average distance (112 meters in this case) but also salamanders that venture even farther away. Overall this zone can be expected to include 95 percent of the population breeding in a given vernal pool. The 175-meter life zone would encompass roughly 10 hectares (25 acres) of forested habitat.

In addition to documenting the distance that salamanders travel from a vernal pool, Faccio identified their habitat preferences. In general, Jefferson and spotted salamanders preferred well-shaded, deciduous forest stands with abundant logs, stumps, and other coarse woody debris. There, unable to excavate their own tunnels, they almost exclusively used two types of small-mammal burrows as their terrestrial refuges: deep vertical tunnels and highly branched horizontal tunnels. This finding suggests that an important ecological relationship exists between mole salamanders and small mammals that excavate and/or maintain tunnel systems. Populations of these small-mammal species may be key to maintaining viable salamander populations by providing both summer and winter refuges. In areas with few small-mammal burrows, it is possible that competition between salamanders could limit their population densities.

Faccio's most noteworthy conclusion is that the forested areas surrounding vernal pools need greater protection than they currently receive. Many states adopt "Best Management Practices" for forestry operations. These BMPs, for example, typically recommend small buffer zones ranging from 15 to 30 meters in which logging around vernal pools is limited. These small buffer zones are designed to protect water quality and maintain proper forest floor conditions immediately surrounding a pool, but in most cases they fall well short of the 175-meter radius suggested in this study.

"This 'salamander life zone' should be identified as critical wildlife habitat and included in forest management plans," Faccio wrote in the publication, "Although more research is needed to better understand the short- and long-term effects of forest management in uplands surrounding temporary breeding pools, a variety of habitat characteristics have been identified as important to mole salamander populations in this and other studies .... Forest managers who strive to maintain these habitat features within the salamander life zone will help preserve the ecological integrity of temporary breeding pools and their associated amphibian breeding populations."

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The Vermont Center for Ecostudies (VCE) is an independent group with a mission to advance wildlife conservation through research, monitoring and citizen engagement. VCE brings more than 20 years of experience to its goal of promoting conservation practices that benefit biodiversity. With a reach extending from northern New England through the Caribbean to South America, VCE's work unites people and science for conservation.