



# Effects of Urbanization on Spotted Salamanders



The Clifton Institute



Land managers and developers can take action to help combat the impact of urbanization on salamander habitat.



# Table of Contents

<b>Introduction.....</b>	<b>2</b>
<b>How Urbanization Is Affecting Salamanders.....</b>	<b>2</b>
<b>Testing the Effects of Urbanization on Salamander Habitat .....</b>	<b>3</b>
<b>Key Findings .....</b>	<b>4</b>
<b>Land Management Solutions to Protect Spotted Salamanders.....</b>	<b>5</b>
<b>Infographic.....</b>	<b>6</b>
<b>Acknowledgements.....</b>	<b>7</b>
<b>About Clifton Institute .....</b>	<b>7</b>

COVER IMAGE: SPOTTED SALAMANDER -  
AMBYSTOMA MACULATUM BY FYN KYND  
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The Spotted Salamander, *Ambystoma maculatum*, is an amphibian native to the eastern and midwestern United States. This species has a lifespan of about 20 years, during which time they live in deciduous forests, spending most of the year in burrows under woody debris and leaf litter. In early spring, Spotted Salamanders migrate up to 250 meters from their burrows to breed in vernal pools — small, shallow bodies of water that exist only seasonally because they lack surface connection with a permanent water source. Because they are temporary, they usually do not host fish, which makes them safe habitat for many amphibians, insects and other animals that could become prey to fish.

Unfortunately, recent studies show that Spotted Salamander populations are declining due to human activity and that increasing urbanization is threatening Spotted Salamanders and the vernal pools they live in.

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Clifton Institute researchers conduct a study on Spotted Salamanders at a vernal pool in Virginia.

## How Urbanization Is Affecting Salamanders

- **Deforestation** — The removal of forests to create room for developments decreases the amount of habitat available to Spotted Salamanders.
- **Forest fragmentation** — When forests are split into smaller sections, salamander habitats degrade and populations become cut off from each other, leading to inbreeding.
- **Roads and vehicle traffic** — When salamanders are forced to migrate over roads, they become vulnerable to vehicle traffic. This is especially problematic for Spotted Salamanders because they are long-lived animals that must reproduce several times throughout their lifetimes for a population to remain stable.
- **Pollution** — Salamanders absorb chemicals through their skin more easily than other animals, so they are especially vulnerable to pollutants and changes in water acidity.







Clifton Institute researchers used the presence of Spotted Salamander egg masses at vernal pools in Northern Virginia to assess whether salamanders were present at the locations studied.

SPOTTED SAL EGGS BY RICHARD BONNETT | CC BY-NC-ND 2.0  
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## Testing the Effects of Urbanization on Salamander Habitat

At the Clifton Institute property there are 12 vernal pools which serve as homes not only to Spotted Salamanders, but also to several other species of salamanders, including Jefferson Salamanders, Northern Two-Lined Salamanders, Eastern Newts, Eastern Red-Backed Salamanders, and Northern Red Salamanders. These vernal pools, in addition to 22 others from Washington, D.C. in the east to west of Front Royal, Virginia, served as the testing sites for the effects of urbanization on Spotted Salamander populations and habitat.

Clifton Institute researchers visited these 34 vernal pools between April 1, 2019 and April 30, 2019 to determine whether Spotted Salamanders were present at each of the locations. Presence of the salamanders was determined based on the presence of their egg masses — previous surveys of the species have shown that during the month of April, if salamanders were present there was likely to be at least one egg mass laid but not yet

hatched. The researchers only recorded presence or absence of egg masses, rather than the number of egg masses, because they were not able to visit all of the vernal pool locations during one day, and the number of egg masses was likely to vary over the course of the month as the eggs were laid and then hatched.

The researchers also measured characteristics of each of the pools to determine which habitat attributes make a vernal pool suitable for Spotted Salamanders. The characteristics studied included: the area of the vernal pools, their distance to the nearest open area (i.e., free of tree cover), the presence of impervious surfaces (e.g., paved areas) within 30 meters of the vernal pools, the amount of woody debris around the pool, and the water quality. In addition, geographic information system (GIS) data allowed researchers to measure the amount of land cover within 250 meters of the pond — a distance that correlates with the maximum distance Spotted Salamanders are known to migrate — and within 1 kilometer, which correlates with metapopulation (a regional group of connected populations of a species) dispersal.

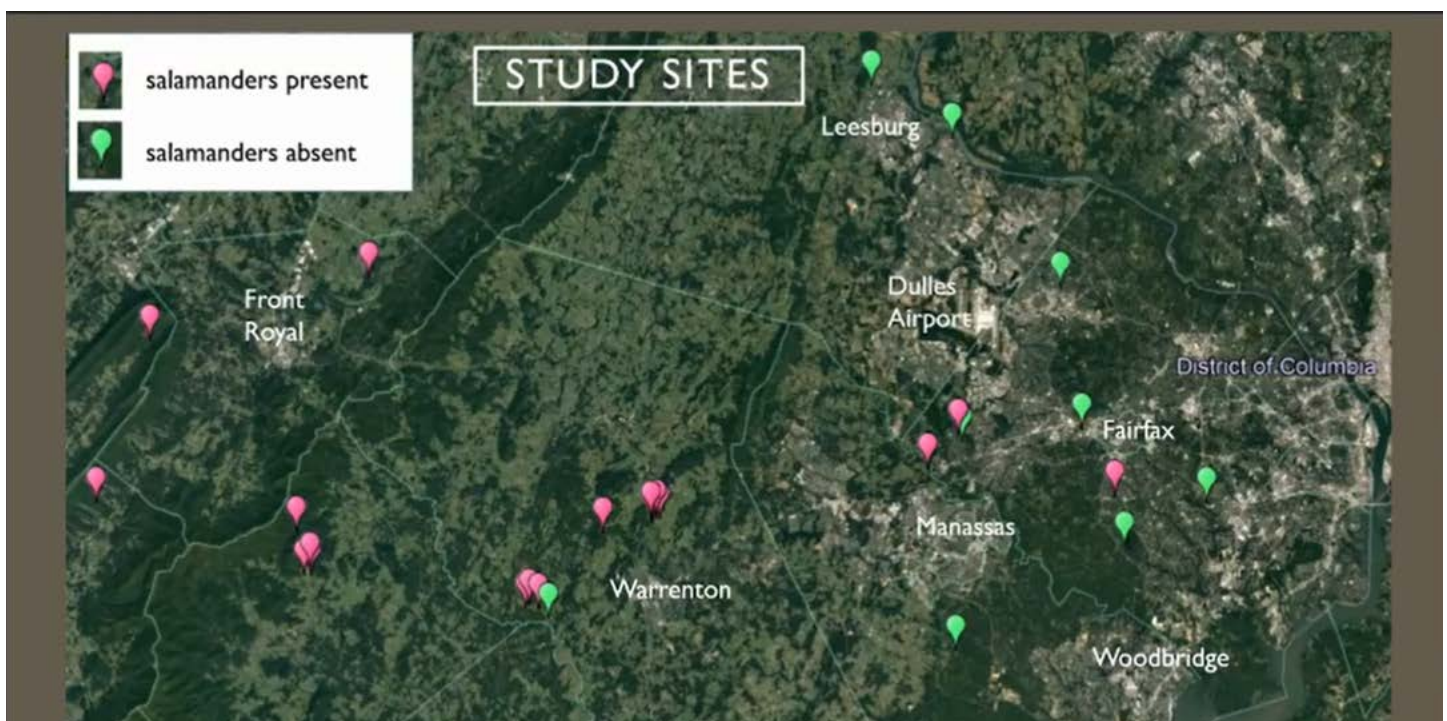
## Key Findings

At the beginning of the study, the researchers hypothesized that Spotted Salamanders would be more likely to lay their eggs in pools that were surrounded by less impervious surface, were larger, had more tree cover, and had minimally polluted water. The results of the study support two of these hypotheses. **Spotted Salamander eggs were not found in vernal pools that had more than about 30 percent developed land within 250 meters.** Developed land within 1 kilometer of a vernal pool somewhat negatively impacted Spotted Salamanders. In addition, the salamanders tended to prefer to lay their eggs in larger pools. Neither forest cover nor water quality strongly affected whether Spotted Salamanders would breed in a pool.

Overall, the findings from the study provide us with one very important piece of information: **maintaining viable populations of amphibians, such as Spotted Salamanders, will require the protection of vernal pool habitats and adjacent forested habitat.** Currently, human activity is negatively impacting populations of this species — but it doesn't have to. There are a number of steps land managers and urban planners can take to help protect Spotted Salamander habitat, and in turn, the populations of these and other amphibians.

# Spotted Salamander eggs were not found in vernal pools that had more than about 30 percent developed land within 250 meters.

A map depicts the sites of a 2019 Clifton Institute study on Spotted Salamanders.



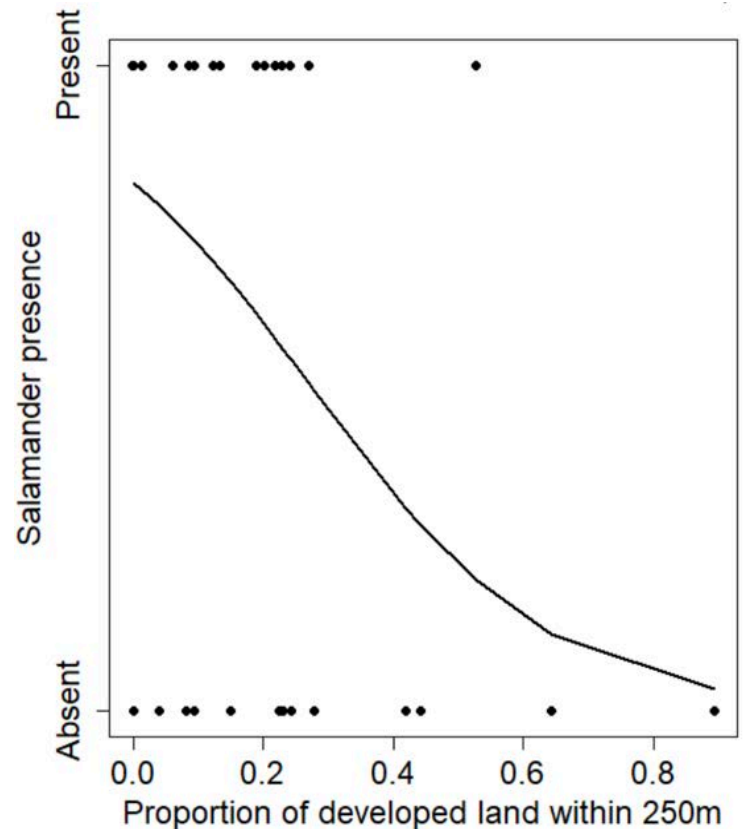
## Land Management Solutions to Protect Spotted Salamanders

Here are some of the actions land managers, developers and others can take to help protect Spotted Salamanders and their habitat.

**1** | To combat habitat loss due to deforestation, we can **protect land through conservation easements**.

**2** | When salamanders are forced to migrate over roads, they can easily be run over. This is particularly problematic populations of long-lived species like Spotted Salamanders. During the spring season, we can get together to **direct traffic in key areas to help salamanders cross roads safely**. (Bonus Tip: Some areas have had success with creating tunnels beneath roads to aid wildlife migration.)

**Maintaining viable populations of amphibians, such as Spotted Salamanders, will require the protection of vernal pool habitats and adjacent forested habitat.**



A chart from a 2019 Clifton Institute study of Spotted Salamanders illustrates the correlation between the increase in development and decline in salamanders.

**3** | Developers and landowners alike can set aside dedicated land for vernal pools. You can even **construct a vernal pool of your own!** You can find guidance online about how to build one that will collect water in the spring but will dry out in the summer. Even ornamental ponds can play a roll in fostering healthy salamander habitat.

**4** | Landowners can **promote healthy Spotted Salamander habitat** by leaving woody debris, such as dead logs and leaves, that salamanders can live under. If there are no logs, you can set out cover boards to serve as salamander homes.



# Land Management Solutions to Protect Spotted Salamanders

**Deforestation, forest fragmentation, vehicle traffic and pollution from urbanization** are negatively affecting Spotted Salamander Habitat.

Once **30 percent** of land within 250 meters of salamander habitat is **developed**, populations **decline**.

Leaving leaf litter and woody debris, such as dead logs, **promotes healthy Spotted Salamander habitat**

**Constructing vernal pools** can provide Spotted Salamanders with a place to breed

**Directing traffic** in key areas during salamander breeding season can help salamanders cross roads safely

**Protecting land through conservation easements** can preserve critical Spotted Salamander habitat

 **Undeveloped**  
 **Developed**





Spotted Salamanders have a lifespan of about 20 years, during which they spend the majority of the time living in burrows under woody debris and leaf litter.

## Acknowledgements

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## About the Clifton Institute

The Clifton Institute is a nonprofit dedicated to inspiring the next generation of environmental stewards, learning about the ecology of the northern Virginia Piedmont, and conserving native biodiversity. We accomplish this mission by providing environmental education to people of all ages, carrying out ecological research, and restoring habitat for native plants and animals. Our 900-acre property in central Fauquier County, which is permanently protected under a conservation easement, provides a beautiful and easily accessible environment for our programs. For more information, visit [cliftoninstitute.org](https://cliftoninstitute.org), like us on Facebook ([facebook.com/clifton.institute](https://facebook.com/clifton.institute)) and follow us on Instagram ([instagram.com/clifton.institute](https://instagram.com/clifton.institute)). To see a video of Clifton Institute Co-Director Bert Harris presenting this research at the 2020 Virginia Herpetological Society (VHS) Virtual Fall Symposium, visit the VHS Facebook page ([tinyurl.com/y6h8l7er](https://tinyurl.com/y6h8l7er)).



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