A SURVEY OF SOIL PREFERENCE FOR SALAMANDERS IN THE HUNTINGDON PENNSYLVANIA AREA

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ABSTRACT

Steady declines in amphibian populations have prompted an emphasis on habitat research. We conducted a survey in the Huntingdon County region of Pennsylvania to assess the preferred soil conditions of our local salamander species: Spotted, Marbled, Four-toed, and Valley and Ridge. Our studies showed that these salamanders have a clear preference for soil at an average pH of 5.1 and an average moisture content of 27.13%. Our results agreed with previous research carried out in other amphibian habitats, emphasizing the consistency of habitat selection in these salamanders.

Keywords: Forest, salamanders, soil preference, vernal pools

INTRODUCTION

It is well-known that amphibian populations have faced decreasing numbers worldwide for the past 100 years. Probable causes for this trend include (but are not limited to) habitat loss, disease, ozone depletion, introduced species, and climate change (Beebee and Griffiths, 2005). In light of this impending crisis, it is important to study the habitat preferences of our local amphibians. Without these essential links in the food web, many insect populations could become unmanageable and the entire ecosystem could be thrown into disarray.

Salamanders need varying degrees of moisture in their environment, depending on the species. The Plethodontidae do not have lungs, but instead breathe directly through their skin, so their skin must always be kept moist to facilitate the absorption of oxygen. In addition, Ambystoma and Hemidactylium species have to be near a pond in order to breed.

Considering the fact that these salamanders spend the majority of their lives in a terrestrial environment, the condition of the soil is an important factor for habitat selection. Therefore, it is likely that they will have a specific preference for moisture content, temperature, and pH of soil. It is also likely that each species of salamander will have its own distinct preferences, but none of them will be far removed from the others.

MATERIALS AND METHODS

Upon arriving at each site, we measured soil temperature. Then, we systematically lifted each piece of debris to check for salamanders. If a salamander was present, a soil sample was collected and the species was noted. When salamanders were not present, we collected soil from several random pieces of debris. Soil samples were stored in small plastic bags, and then weighed in those bags upon returning to the lab facility. A triple beam balance
was used to measure weights. We then dried out the samples with a desiccator and weighed them a second time to measure the percentage of water in the soil. Following this, samples were mixed with distilled water and tested for pH level. Weather conditions, air temperature, and time of day were also recorded as they could be possible factors influencing salamander dispersion.

Moisture content was determined by dividing water weight by soil weight. A one-way ANOVA was performed on the data to determine whether there was a difference between the salamander and no salamander conditions. We then plotted all data, pH versus moisture content to look for correlations.

FIELD SITE

Soil samples were collected from two locations in the vicinity of vernal pools located on Petersburg Pike near Huntingdon, Pennsylvania. Each location was divided into several sites based on large clusters of natural debris that could be used as shelter.

Sites from the first location were along the edge of a Game Commission service road that accessed the vernal pools. Overhead cover was very limited due to the clearing of trees to provide access to the road. However, ground cover was still substantial. Most of the debris was woody. Spotted and marbled salamanders (*Ambystoma maculatum* and *A. opacum*, respectively) were found at this location.

The second location was just down the road from location one, and was also along a Game Commission service road and vernal pool. There was a much larger amount of overhead cover for these sites, and even more ground cover. It was also closer to the pool and contained more rocky debris. Spotted, four-toed and Valley and Ridge salamanders (*A. maculatum, Hemidactylium scutatum* and *Plethodon hoffmani*, respectively) were found at this location.

RESULTS

From the two locations, containing 12 different sites, 153 soil samples were collected. Thirty one of these samples were taken in the presence of salamanders. All samples were tested for moisture content, but only 138

![Figure 1](image-url). Locations surveyed according to soil moisture, pH, and presence of salamanders.
samples were tested for pH. These samples were plotted in respect to our two variables, giving us Figure 1. According to this chart, the majority of salamander sightings occurred between the pH values of 4.5 and 5.5, and between the soil moisture values of 20 and 30 percent. On the whole, the samples ranged approximately from pH values of 4 to 7, and from moisture values of 10 to 65 percent. Significance of the data was assessed and included in Table 1.

Table 1. Averages and standard deviations of locations where salamanders were present (positive) and not present (negative).

<table>
<thead>
<tr>
<th></th>
<th>MOISTURE</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>0.2713</td>
<td>5.1034</td>
</tr>
<tr>
<td>Standard</td>
<td>0.1040</td>
<td>0.4708</td>
</tr>
<tr>
<td>Average</td>
<td>0.3231</td>
<td>4.9240</td>
</tr>
<tr>
<td>Standard</td>
<td>0.1082</td>
<td>0.3899</td>
</tr>
<tr>
<td>P Value</td>
<td>0.0180</td>
<td>0.0370</td>
</tr>
</tbody>
</table>

A one-way ANOVA test was performed on the soil moisture content yielding the values $F(1,151) = 5.74$ and $P = 0.018$, as well as on the pH values yielding $F(1,136) = 4.43$ and $P = 0.037$. Both $P$-values obtained were below the significance level of 0.05. The average percentage of soil moisture was higher and the pH was lower in soil samples where no salamanders were present.

**DISCUSSION**

Based on the data we collected, it can be assumed that salamanders have a preference for specific soil moisture and pH levels. Salamanders were most abundant at an average moisture content of 27.13% and an average pH of 5.1. Varying too far beyond these values in either direction caused the frequency of salamander sightings to rapidly decline. In the case of soil moisture, our results show a significant difference between areas that were chosen and areas that were not. Contrary to what we expected, salamanders chose soil that was on average 5% drier than uninhabited areas. However, this is most likely due to the weather conditions on days that we surveyed our locations, which were more often than not rainy, or the day following rain. It is likely that the preferred moisture content would not change, but it’s relation to the surrounding soil would vary. We can conclude from this that while salamanders need water to moisten their skin, too much water is not ideal. We suspect that this is because lungless salamanders exchange oxygen through their skin, and an oversaturation of water in the soil can suffocate them.

When looking at soil pH, the results were likewise significant. Overall, salamanders preferred a higher pH than locations that were uninhabited, but the soil was still relatively acidic. Previous research has suggested that salamanders prefer a pH range between 4.5 and 6, but this can vary between species (Sugalski and Claussen, 1997). Our samples appear to favor the lower end of that spectrum, but this could simply be due to the habitats available. It is common knowledge that the Huntingdon County area of Pennsylvania is subjected to periods of acid rain, so very few of our soil samples even reached a pH of 6.

We noted, but did not collect data regarding the type of debris that salamanders preferred. However, we did see a difference in the material used as shelter by the two different families. The Marbled and Spotted salamanders (Ambystomatidae) were more frequently found beneath logs and other woody debris. In contrast, the Four-toed and Valley and Ridge salamanders (Plethodontidae) were often found under rocky debris.

A suggested follow-up study would include emphasis on specific salamander species, rather than salamanders as a whole. Also, a survey of a study site that contained a wider range of pH values would provide a better understanding of salamander habitat preferences.
ACKNOWLEDGEMENTS

We thank Dr. Doug Glazier, professor of ecology at Juniata College, for his guidance and use of his laboratory equipment. Dr. John Matter should also be thanked for providing information about local salamander habitats. We also thank Mike Anderson and Jon Fetzer, students at Juniata, for assisting with data collection.

LITERATURE CITED
