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NORTHERN TWO LINED AND NORTHERN RED SALAMANDER LARVAE DISPERSION COMPARED WITH STREAM QUALITIES

Joshua Samuels, Tim Sullivan and Jude Smith

ABSTRACT

Salamanders are a common amphibian found across the globe, and many studies have been conducted on their habitat and stream choice. We wanted to find out how salamander larvaes were dispersed, and what stream qualities influenced salamander larvae dispersion. Previous research on other species of salamander has indicated a preference for close proximity to the origin of the stream (Connette, Grant & Osbourn, Michael & Peterman, William 2016*)*. We studied two springs located in Central Pennsylvania, Cold Spring and Warm Spring. We divided the two streams into three sections each and collected data on stream quality as well as the salamanders we found. There were two types of salamander that were found in both springs. These were the Northern Two-Lined Salamander and the Red Salamander. We found that Warm Springs had a Two-lined Salamander majority, while Cold Springs was dominated by the Red Salamanders. Our data also indicated a preference for higher alkalinity, hardness, and lower dissolved oxygen. Both salamanders preferred to reside in vegetation, the vast bulk being watercress. Our data on Warm Spring also seemed to support Connette, Osbourn, and Petermans's study, but less so Cold Spring. Overall, Warm Spring had more salamanders, indicating a strong preference for higher temperatures.

Key words: Salamander, Physiochemical, Springs, Population, Dispersion

INTRODUCTION

The first point of conducting this study was to get an accurate assessment of what species of salamander larvae were found in two different springs, determining the main species found in both springs were the Northern Two-Lined Salamander (*Eurycea bislineata*) and the Red Salamander (*Pseudotriton ruber ruber*). Each species was identified through a visual identification that looked at primarily coloration, color patterns, and body size. Any specimens whose ID could not be confirmed on scene were photographed and cross-referenced with photos of local species. The next question to answer was how are they dispersed and why are they dispersed this way. Northern Two-Lined Salamanders prefer habitats such as springs and creeks that have a sandy to small gravel substrate. They also prefer warmer water temperatures but are resilient in their ability to tolerate

cold water. Red Salamanders are more cold tolerant and actually prefer colder springs and creeks, especially those with larger gravel substrates and numerous stones or other hiding places as they are a very shy species. *P. ruber* also tends to prefer softer water than the *E. bislineata*. *Pseudotriton ruber* are a larger species than the *E. bislineata* and their larvae are no different, with Red Salamander larvae being consistently larger than the Two-Lined Salamander larvae. This means that Red Salamanders need higher concentrations of dissolved oxygen due to their larger size. Because of these differences in habitat needs it was hypothesized that more Northern Two-Lined Salamanders would be found in Warm Springs and not in Cold Springs due to its preference for warm water and sandy substrates. It was also Hypothesized that the Red Salamander would be found predominantly in Cold Springs and in the later sections of Warm Springs due to the higher dissolved oxygen and the higher amounts of gravel substrates. Testing these hypotheses is worthwhile in understanding the population dynamics of each spring and understanding how the seemingly small differences in physiochemicals can have great impact on which species are found there.

FIELD SITES

We had two field sites for this study. One was at Warm Spring and the other was at Cold Spring. Both springs were divided into three sections, labeled Section A, Section B, and Section C. Both springs were shallow and located in deciduous forested areas. Warm springs had a muddy bank and a rocky, wooded bank. Warm Springs Section A had many medium to large sized rocks and some foliage, being watercress. There were also several downed trees in and over the water. Section B contained more medium sized rocks, and lots of sand sized sediments covering the floor of the Mud Bank side. Section B also had lots of watercress covering about 70% of the section, with only parts of the Mud side not covered. Section C was a longer section, with the first 60-70% having many small to medium and large rocks covering the right side and the left side being more open. The last 30-40% was foliage, with the end of the section being covered with watercress. At Cold Springs, the water was much shallower, and the stream was far thinner. There was a bank that led to the woods and a bank covered with flowers that became muddy at Section C. Section A contained many medium to large rocks and larger grain sediment covering the floor. The stream flowed down the hill and contained a small waterfall. Section B had some medium to large rocks in the first 30-40% with the rest being covered with watercress. Section C was almost entirely covered with watercress, likely ~ 90%. There were many large and medium sized rocks concealed under the watercress.

Warm Springs

Section A

Section B

Section C

Cold Springs

Section A

Section B

Section C

MATERIAL AND METHODS

The first methods we used were out at our two Field Sites. When gathering data on the Field Site, we measured width, depth, and dissolved oxygen. We used a tape measure, yard stick, and a dissolved oxygen probe to measure this. When gathering data on salamanders, we searched for 10 minutes in each section, using an iPhone to time. While in the water we used waders or sandals to protect our feet. We captured salamanders by wading in the springs, slowly lifting rocks and scanning the bed for them. When one was spotted we used a free hand to scoop the salamanders into a small handheld net. When one of us captured a salamander, the timer was stopped and we gathered data. The salamander was then transferred to a bin where its length would be measured using a 12 inch ruler. We then weighed the salamander using a digital scale, and the distance between where the salamander was measured using a yardstick or tape measure and the nearest bank, using a tape measure. This data, along with the type of salamander and the qualities of the rock it was found under (if it was found under one), was recorded using an iPhone. We then repeated these steps until time ran out, and then we continued to the next section.

RESULTS

We found that the Warm Springs salamander population was dominated by 81% of Two-Lined Salamander Species in the area (Fig. 3). The remainder of the salamander population in Warm Springs was 19% and it consisted of Red Salamanders (Fig. 3). The salamander population of Cold Springs was dominated by the Red Salamanders who took up 90% of the recorded population (Fig. 5). The rest of the recorded population of salamanders consisted of an equal number of Dusty Salamanders and Two-Lined Salamanders (Fig. 5). Salamanders that came out of Warm Springs tended to be larger in length (in) and weight (g) then those in Cold Springs (Fig. 1). We found that the salamanders found in both springs enjoyed residing under a variety of rock sizes and they seemed to prefer vegetation in the area (Fig. 1). Based on our water physicochemical data on Warm Springs and Cold Springs (Fig. 2) undeveloped salamanders prefer warmer water with a higher level of hardness and alkalinity in it, however it seems a lower level of dissolved oxygen is preferable for the salamanders. As we looked for salamanders farther away from the source of the springs we found less salamanders compared to the amount found upstream (Fig. 4, Fig. 6). We were not able to form a T-Test or probability test due to the limited amount of sections per spring.

Conclusion			
Warm Springs			
Total Number of Salamanders			
32	26	6	0
Avg Length (cm)			
	5.494326	6.841667	0
Avg Weight (g)			
	0.833441	2.515	0
Most Common shelter			
	Large Moss	Medium Mossy Rock	
Cold Springs			
Total Number of Salamanders			
19	1	17	1
Avg Length (cm)			
	1.333333	6.3625	1.216667
Avg Weight (g)			
	0.151667	1.414028	0.466667
Most Common Shelter			
	Large Moss	Large Plain	Open water

Fig. 1

Water Phiso						
Warm Spri	pH	Nitrate(ppı	Nitrite(ppn	Water Harc	Alkalinaty	Dissolved o2
Section A						
	7.01	0	0	75	60	3.74
Section B						
	7.08	0	0	75	80	4.19
Section C						
	7.2	0	0	75	80	4.45
Cold Spprings						
Section A						
	6.6	0	0	40	20	6.07
Section B						
	6.39	0	0	30	10	5.93
Section C						
	6.44	0	0	25	10	6.03

Fig. 2

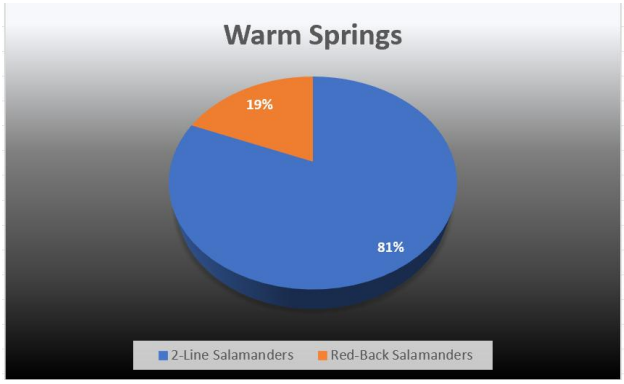

Fig. 3

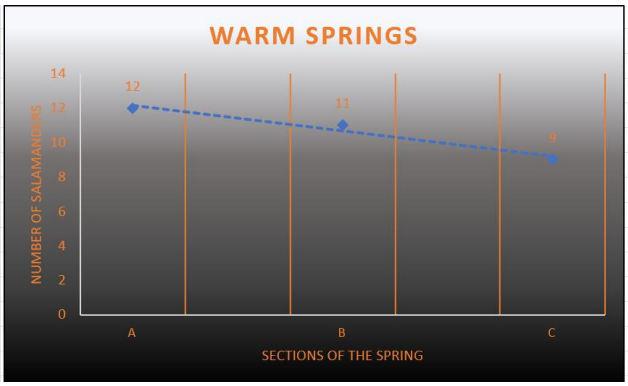

Fig. 4

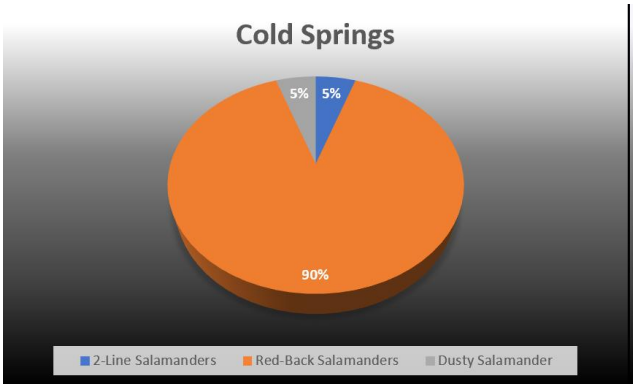

Fig. 5

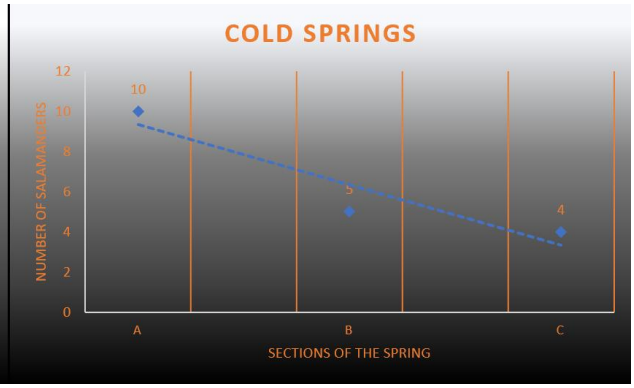

Fig. 6

DISCUSSION

The results confirm and prove the hypotheses, *P. ruber* was the most common and abundant species in Cold Springs while also being found somewhat readily in the later two sections of Warm Springs. *Eurycea bislineata* was, conversely, the most common species found in Warm Springs. Data from Cold Springs showed that very few salamanders were found in the spring itself, especially the last two sections, yet when we flipped rocks near the spring out of curiosity after packing up our equipment, we found an abundant number of salamanders. What is interesting is that we found more adult Northern Two-Lined Salamanders than Red Salamanders. Data was not recorded for the adults however, I believe we found upwards of ten Two-Lined Salamanders and five Red Salamanders. This is odd since we only found two larval *E. bislineata* in the spring itself. Further research could be done to look into why there are so few larval salamanders in Cold Springs but lots of adults. It would also be worthwhile to conduct research that looked into why there are so few larval *E. bislineata* even though there were enough adults in the surrounding area for there to be an established breeding community. Research could also be done to explore if water temperature and changes of it explains any of this interesting data since we did not account for temperature play a serious role in species dispersion since the temperature in these springs remains relatively constant year round. It is also worth mentioning that our data does not include salamanders that escaped/evaded capture. About 50% of the salamanders we found managed to escape across all sections and springs so while the trends in the data likely would remain the same, a large amount of data was not able to be recorded. In Warm Springs, our data also shows that the salamander population decreases as we get further from the stream origin. This lines up with the study mentioned in the abstract. "95% of Ocoee Salamanders are distributed within 79 m of their stream of origin and that relative abundance should decline exponentially with distance into terrestrial habitat" (Connette, Grant & Osbourn, Michael & Peterman, William 2016*).* While this study was on the Ocoee Salamander, the two salamander species we studied, there is overlap and they have similar breeding habits and habitat choice. As stated earlier, the data from Warm Spring supports their conclusions, but Cold Springs was not the same. However, we had a small sample size and more research would have to be done to be conclusive.

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