The relationship between salamander size and depth of occurrence in a mountain stream in North Carolina

By Tom Vosburgh

Summer Ventures in Science and Mathematics
Field Biology and Ecology
Dr. Michael J. Baranski, instructor
Katie Bender, assistant
16 July, 2010

Abstract

Salamanders, members of the order Caudata *and the only vertabrates that can regenerate missing limbs, are very common, if elusive, North Carolinia amphibians. As part of the 2010 Summer Ventures Field Biology and Ecology program at the University of North Carolina at Charlotte, students searched for salamanders in Lower Creek, located in Mount Mitchell State Park in Yancey County, North Carolina. Data were collected on the salamander. This paper examined the correlation between a salamander's size, both length and weight, and the depth of the water in which it was found. There was no significant correlation between the two variables; the null hypothesis was accepted.*

Introduction

There are about 500 species of salamanders in the world, and, contrary to myth, none are created by fire. They can, however, regenerate limbs that have been bitten off by predators. (Conger, 2008) Other than this ability, which has attracted the attention of numerous scientists, salamanders are rather mundane amphibians, living in terrestrial or aquatic environments and laying their eggs in fresh water.

Salamanders, which make up the order *Caudata*, are amphibians. They are "creatures that lead double lives… typically inhabiting freshwater early on and then changing into forms that can live on land" (Wernert, 1982). Of course, some species spend their entire lives on land or in water, and have the respiratory organs necessary for life in their home environment.

While their habitats certainly vary greatly, caudates cover a wide spectrum of sizes as well. From the Chinese Giant Salamander (*Andrias davidianus*), which can grow to a length

of almost two meters, to those of the genus *Thorius*, which can measure less than two centimeters, salamanders come in all sizes.

While freakishly large and incredibly small salamanders do exist, most measure approximately 10 to 20 centimeters long. In North Carolina, the largest salamander, the Hellbender (C*ryptobranchus alleganiensis*), grows up to 29 inches (Wernert, 1982). While large, the Hellbender is not particularly common in North Carolina. The Blackbellied, Spring and Two-lined salamanders, however, are common.

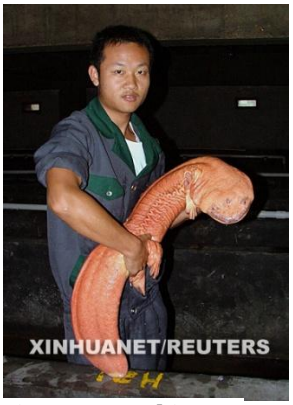

Figure 1: A Chinese Giant Salamander

The Two-lined Salamander (*Eurycea bislineata*) usually measures about 2.25-4.75 inches long and is easily identifiable by its "back with yellow, greenish or bronze stripe, bordered by [a] dark stripe from eye to tail" (Wernert, 1982). It lives in moist mountain forests and in brooks. The Spring Salamander (*Gyrinophilus porphyiticrus*) grows to a length of 4-1.5 inches and is often a brownish-pink color. Lastly, the Blackbellied Salamander (*Desmognathus quadramaculatus*) grows about 5.5 inches long and has a unique method of respiration; they breathe directly through their skins, which requires a gooey substance to coat them at all times.

This study was undertaken to determine if a correlation exists between a salamander's size –both length and weight– and the depth of the water in which it is captured. Large salamanders are expected to be found in deeper water, while smaller salamanders are expected to live in shallower water.

Methods

The study was conducted by the Summer Ventures Field Biology class of the University of North Carolina at Charlotte on July 7, 2010, at Lower Creek in Mount Mitchell State Park, located in Yancey County, North Carolina. Collection began at approximately 3:15 p.m. and ended at 4:25 p.m. Before collection began, several vital statistics were taken. It was recorded that Lower Creek had no turbidity, a pH factor of 6.6, making it very close to neutral, a water temperature of 13°C, and was located at an elevation of 5,700 feet above sea level. The composition of the creek's bed can be seen in Figure 1. The air was 30°C and the relative humidity was 38%.

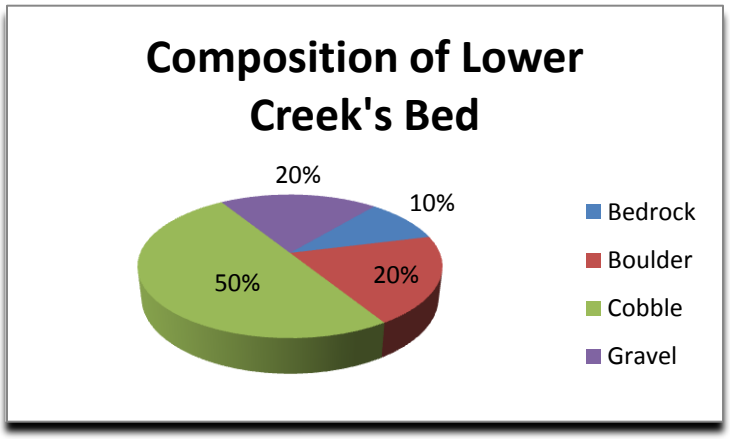

Figure 1: Composition of Lower Creek's riverbed.

Once the analysis of the creek and its surrounding environment was over, a quadrat was staked out. Only salamanders found in this quadrat would be used in the study. The quadrat was 950 centimeters long, and had a width ranging from 220 to 410 cm, with an average width of 332 cm. Therefore, the area of the quadrat surveyed was 31.54 square meters. The stream's depth was also randomly measured; depths ranged from 1.5 to 13 cm, with an average depth of 6.2 cm.

Pairs of researchers waded upstream in an orderly fashion, overturning rocks and searching in the water for salamanders. Any salamanders spotted were then caught by nets placed in plastic bags containing water and moved to a central location near the stream. While one student carried the salamander back to land, the other observed the size of the rock the salamander was under, the distance from the banks to the cover, and the depth of the water in which the salamander was found.

At the "weigh station," each salamander was measured in centimeters, weighed in grams identified and then kept in a plastic tub with the other captured salamanders until the study was completed. Once the collection process was over, the salamanders were returned to the stream from which they came and the rocks were moved back to their original positions.

The data in this report were graphed using Microsoft Excel. Regression analysis was applied using the computer software program *Quantitative Analysis in Ecology* (Brower, et. al) with a 95% confidence value. Significances of the t-values were determined via the paper *Data Presentation and Analysis* (Brower, et al., 1998).

Results

Table 1 is a comprehensive list of every non-juvenile salamander collected during the study. Juvenile salamanders were excluded from the data due to difficulty with identification. A total of 27 adult salamanders were found, representing three species common in the Appalachian Mountains.

The average Blackbelly Salamander weighed 8.2 grams, measured 11.2 centimeters long, and was found in water at an average depth of 3.9 centimeters. On the other hand, the average Spring Salamander was much smaller, weighing 2.9 grams, measuring 7.9 inches long, and living in 4.1 centimeters of water.

Table 1: A comprehensive list of all non-juvenile salamanders captured

Species	Water depth (cm)	Salamander length (cm)	Weight (g)
S	4.5	9.5	4.7
B	2.1	11.4	5.9
S	***2***	***7.7***	***2.4***
B	6.5	13.3	9.8
S	***4.2***	***3.7***	***1***
B	4	14.5	13.4
B	4	12.2	8.7
B	1	13.7	13.1
B	3.3	9.5	4.5
2	7	7.9	0.6
S	4.7	9.4	4.1
B	***2***	***7.6***	***5.2***
B	4	6.7	1.1
B	3	14.8	18.7
B	1	11.3	8.2
B	6	7.4	2.3
B	3.7	13	9.4
S	0.6	6.3	1.3
B	2.9	14.8	14.4
S	10	9.2	4.3
S	4	7.8	2.1
B	4	7.9	3
S	2	9	3.4
B	4	11.2	6.1
S	***5***	***8.2***	***3***
B	11.5	6.3	1.8
B	4	14.3	13.8

Within the chart, the letter "S" indicates a Spring Salamander (*Gyrinophilus porpyriticus*). The letter "B" indicates a Blackbelly Salamander (*Desmognathus quadramaculatus*). The numeral "2" represents the Two-lined Salamander (*Eurycea bislineata*). Finally, a bolded and italicized row indicates that the salamander had lost its tail.

Figure 2 compares the depth of the water and the length of the Blackbelly Salamanders found there. A plurality of salamanders was caught at a depth of around four inches, but plenty were caught in shallower and deeper waters. With an r-value, or correlation coefficient, of -0.4, the data are loosely correlated; depth of water does not affect the size of salamanders found there. Also, the data have a t-value of 1.68, which was insignificant at p=0.05.

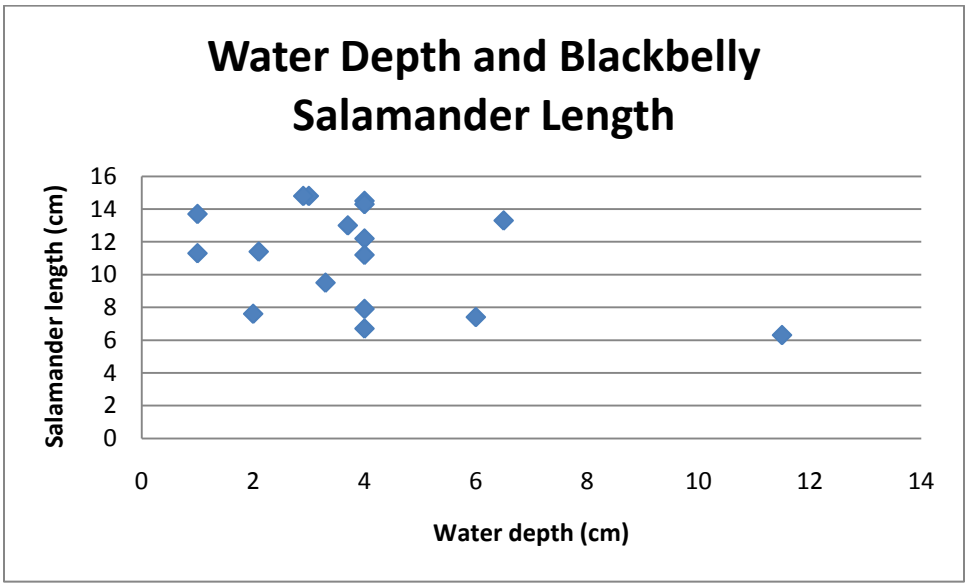

Figure 2: Water depth and length of Blackbelly Salamanders.

Figure 3 compares the depth of the water to the length of the Spring Salamanders. Fewer Spring Salamanders were found, which may have led to slightly skewed data, as each individual salamander had more weight on the calculations performed. Most Spring Salamanders were found in 4-5 centimeter deep water and were about 8-10 centimeters long. With a slope of .22 and an r-value of 1.38, the two variables had a slight positive correlation. Due to the data's t-value of .89, however, the correlation cannot be considered significant.

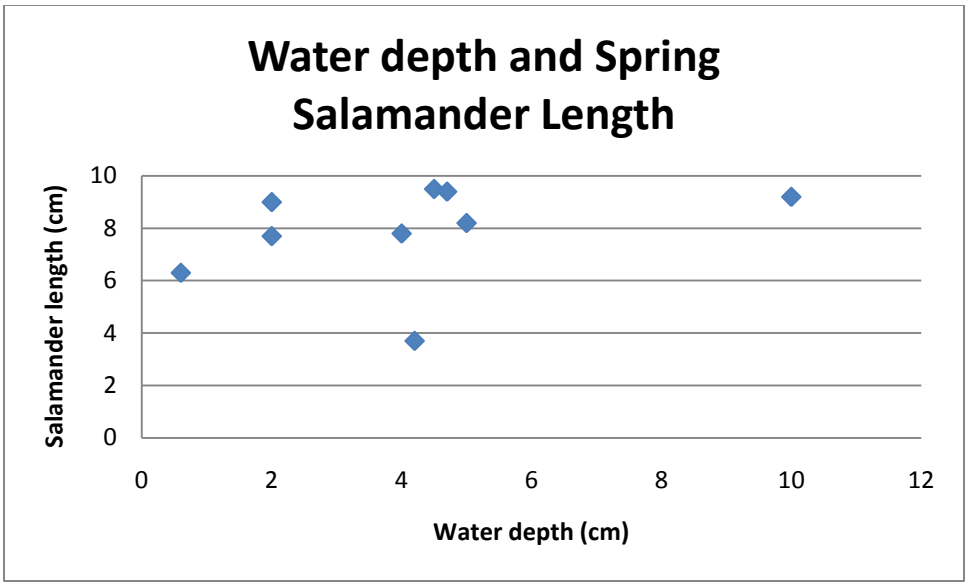

Figure 3: Water depth and length of Spring Salamanders.

Blackbelly Salamanders' weight and the depth of the water in which they are found are compared in Figure 4. Many Blackbelly Salamanders were found at a water depth of about 3-4 centimeters. While the depths at which they were found were fairly consistent, Blackbelly weights varied dramatically, though. The data have a slope of -.79 and an r-value of .38; heavier Blackbellies tend to live in shallower water. The data are not significant, though, as the t-value is only 1.57 and a value of 2.13 is necessary for significance at p=0.05.

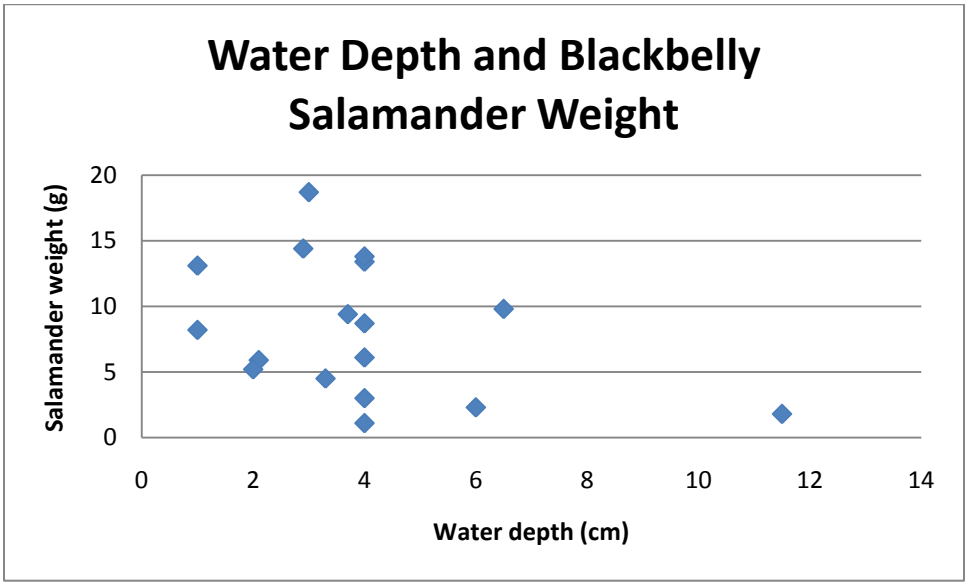

Figure 4: Water depth and weight of Blackbelly Salamanders.

Figure 5 shows the correlation between Spring Salamanders' size and the depth of the water in which they were caught. There was a slight positive correlation between the two factors; heavier Spring Salamanders were slightly more likely to live in deeper water. With a t-value of 1.7, however, this finding is not significant.

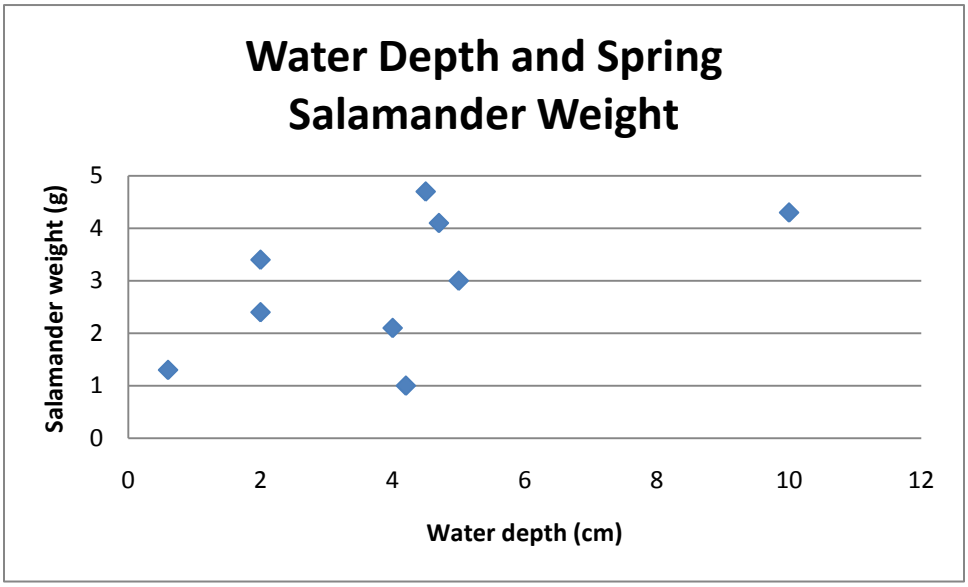

Figure 5: Water depth and weight of Spring Salamanders.

Discussion

The results of each data set each led to the same conclusion: there is no significant correlation between salamander size and water depth. While slight correlations, ranging from -.4 to 1.38, were present in the data, the correlations were deemed insignificant when regression analysis was performed. In other words, results would have varied if the experiment had been performed in another location or at a different time of year.

Conclusion

None of the four data sets provided any significance. The original hypothesis, that larger salamanders would live in deeper waters, was rejected and the null hypothesis was accepted.

Salamander size and water depth are in no way correlated. Further research could sample more salamanders in different locations. One could also sample the same location throughout the year to determine if air and water temperature affects where salamanders tend to congregate.

Literature Cited

Brower, J, Zar, J, von Ende, C. 1997. *Field and Laboratory Methods of General Ecology*. Dubuque, Iowa: William C. Brown Publishers. (software)

Conger, C. 2008. *How can salamanders regrow body parts?*. *Howstuffworks.com*. Retrieved (2010, July 13) from http://animals.howstuffworks.com/amphibians/salamander-regrow-body-parts.htm

Keim, B. 2009. Salamander discovery could lead to human limb regeneration. *Wired*. Retrieved (2010, July 13) from http://www.wired.com/wiredscience/2009/07/regeneration/

Wernert, S. (Ed.). 1982. *Reader's digest north american wildlife*. Pleasantville, NY: The Reader's Digest Association, Inc.