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DISTRIBUTION OF *RHINICHTHYS ATRATULUS* IN WARM SPRING

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ABSTRACT

We investigated the dispersion of *Rhinichthys atratulus* in Warm Spring (Huntingdon PA) and how it may be affected by water chemistry factors such as temperature, pH, conductivity, and dissolved oxygen. We went out to Warm Spring on three different days and divided the stream up into 4 sections in 10-meter increments. In each section we recorded the physical measurements and counted how many of the fish we would observe. Our hypothesis about the dispersion was proven wrong using a one-way ANOVA analysis and variance-to-mean ratio. We concluded that the dispersion of *Rhinichthys atratulus* had a uniform distribution as opposed to the clumped distribution that we predicted.

Keywords, conductivity, dispersion, dissolved oxygen, Rhinichthys atratulus, *species distribution*

INTRODUCTION

Aspects of water chemistry like dissolved oxygen, pH levels, conductivity, and water temperature have been shown to influence the spatial distribution and abundance of freshwater species. Lower dissolved oxygen levels can lead to hypoxic conditions, stressing aquatic life, altering the abundance of fish populations (Nado et al. 2023). Different species have different pH tolerance levels and a change in pH levels can alter the distribution and abundance of species. Many freshwater species are not adapted to survive in high salinity conditions, so a high conductivity level alters the distribution and abundance of fish populations. Warmer water temperatures can cause range shifts either expanding or shrinking a species range, altering their distribution and abundance.

The Eastern Blacknose Dace *Rhinichthys atratulus* is a small robust minnow with a dark lateral stripe from its snout to its tail. This species is commonly found in streams and rivers of eastern North America; they tend to inhabit headwaters or slower moving portions of their habitats (Trial et al. 1983). This study focuses on the aspects of water chemistry mentioned above and how that affects the distribution and abundance of the species. We hypothesized that the Eastern Blacknose Dace would show a clumped dispersion pattern concentrated in the headwaters of the stream. Our null hypothesis was that there is no significant difference in the distribution and abundance of the species throughout the field site.

FIELD SITE

This study was conducted April 21st, 28th and May 6th of 2025 in Warm Spring of Oneida Township, Pennsylvania. This small stream known for its warmer water temperatures holds many macroinvertebrates and other small vertebrates near a farmhouse. The weather on the days we completed the study on was partly cloudy and relatively warm with some rainy days prior, but the stream remained clear. As the days became warmer, there was substantial growth of duckweed in the stream that provided dense cover over much of the stream.

METHODS AND MATERIALS

We took samples of the water for physical measurements in all four sections in the stream ten

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meters apart using meter sticks and a tape measurer. At the start of each section, we used a pH meter, dissolved oxygen meter, and a conductivity meter from the lab to collect measurements. Starting at the most downstream section of the stream, we measured the pH, conductivity, dissolved oxygen, and temperature. We started downstream going up each section to not scare the fish. Carefully, we would count observations of fish after collecting the physical measurements of each section. After completing a section with all observations, we would take a photo to see the progressive growth and change to the stream over our three field studies. On April 28th when we went out, the dissolved oxygen meter was not available, resulting in a missing value.

RESULTS

The Eastern Blacknose Dace of Warm Spring were found to have a dispersion index of .405, by using our total variance divided by the mean of the average number of fish seen. The variance-to-mean ratio of .405 < 1, so it can be inferred that *Rhinichthys atratulus* has an approximately uniform distribution across the four sections of the stream. As shown in our one-way ANOVA (Figure 1), our p-value of .093 shows that our data was not statistically significant as it is >.05. This shows no correlation between the section of stream and the number of *Rhinichthys atratulus* observed.

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Section 1	3	7	2.33333333	2.33333333
Section 2	3	14	4.66666667	8.33333333
Section 3	3	23	7.66666667	4.33333333
Section 4	3	7	2.33333333	10.3333333

ANOVA

urce of Variati	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Gro	57.5833333	3	19.1944444	3.03070175	0.09324837	4.06618055
Within Group	50.6666667	8	6.33333333			
Total	108.25	11				

Figure. 1. One-way ANOVA analyzing species distribution of Rhinichthys atratulus *across the four sections of Warm Spring*

DISCUSSION

Our alternative hypothesis of a clumped dispersion pattern of Eastern Blacknose Dace towards the headwater of the stream was refuted. The one-way ANOVA showed a p-value of .093, which is greater than the threshold of .05 for statistical significance. Although section 3 had a visibly higher average fish count compared to other sections, its difference was not statistically significant. This led us to reject our alternative hypothesis, suggesting that the distribution of *Rhinichthys atratulus* was not influenced by the environmental characteristics of each section.

We could not reject our null hypothesis of no difference in species abundance in each section. The variance-to-mean ratio of .405 shows a uniform dispersion pattern of the Eastern Blacknose Dace in Warm Spring rather than a clumped pattern. This result suggests that the *Rhinichthys atratulus* were evenly distributed throughout the stream, in accordance with our consistent measurements in pH, temperature, and conductivity (Table 1). This can also be explained by the large amount of vegetation growing in the stream, with the fish becoming extremely limited in their ability to swim up or downstream due to physical barriers (Figures 2 and 3).

Our suggestion for further research is to focus on the environmental characteristics of Warm Spring, especially during the spring to summer transition. What we observed was that the fish were prone to be found in specific portions of the stream, where they were able to have cover, move up and downstream, and congregate with other Eastern Blacknose Dace. Every time we went to the field site to collect data, there was an increase in vegetation growth (Figures 2 and 3) which most likely had a large factor on the distribution of the *Rhinichthys atratulus*. By only focusing our study on the physical measurements of the stream, we were limited in our ability to analyze the effects of different environmental characteristics on the distribution of the eastern blacknose dace population in warm springs.

Table 1. Table of water chemistry data and fish count of each stream section over each trip to the field site.

[redacted]	4/21/25	Section 1	Section 2	Section 3	Section 4	4/28/25	Section 1	Section 2	Section 3	Section 4	5/6/25	Section 1	Section 2	Section 3	Section 4
pH	pH	7.1	7.16	6.96	6.5	pH	6.72	6.2	6.15	6.34	pH	6.77	7.13	7.32	7.02
Number of Fish	#	1	3	6	0	#	4	3	10	6	#	2	8	7	1
Dissolved Oxygen (mg/L)	D.O	7.8	6.94	6.9	6.2	D.O.	X	X	X	X	D.O.	6.94	6.98	6.32	5.7
Temperature (Celsius)	Temp	17.5	17.3	17.4	16.9	Temp	17.8	18.3	17.5	18	Temp	16.8	16.9	16.8	16.8
Conductivity (S/cm)	CNDTIV	142.1	141	138	139.3	CNDTV	138	145.6	139.4	141.5	Cndtv	136	140.5	141.5	139.6

Figure 3. Section 4 of the stream farthest upstream first time at the field site 4/21/2025.

Figure 4. Section 4 of the stream, farthest upstream on 5/6/2025 covered in shrubs and duckweed.

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