

# Seasonal Changes in the Fish Community of a Headwater Stream Plunge Pool

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## Introduction

Fish community composition and diversity may change seasonally in response to fluctuations in abiotic and biotic factors (Huang et. al, 2016). Seasonal shifts in species diversity may be a result of a response to temperature or other environmental cues that trigger the movement of species throughout communities (González-Bergonzoni et. al, 2016). The high gradients of headwater streams result in greater incidence of waterfalls and, therefore, plunge pool habitat. Plunge pools serve as valuable components in headwater streams and are productive habitats for coolwater fishes (Krocher et. al, 2008). Pools provide refuge for fishes and may serve as protection from biotic and abiotic elements. Because of their large sizes in comparison to adjacent pools, plunge pools of headwater streams may be critical to sustaining local fish communities.

This study investigated the seasonal shifts of a fish community over three months (September-November) in a single plunge pool. **We hypothesized that there would be a significant change in fish community structure in the waterfall plunge pool over sampling period.**

## Objective

**To determine if the fish community changes in diversity and community composition over a three-month period in a headwater stream plunge pool.**

## Methods

**Study Site:** Sampling was conducted in Corn Creek, a small (~4 m wide) stream located in Young Harris, GA in the Southern Appalachian Mountains and consisted of a plunge pool that occurred 0.5 km east of the Young Harris College campus. The plunge pool contained mostly cobble and gravel substrates and had an average depth of 1.2-1.5 m.



**Data Collection:** Fishes were sampled from the plunge pool using a 10' x 6' seine for nine weeks from late August – early November. Three seine hauls were conducted. Captured fish from each seine haul were placed into separate holding tanks that contained stream water. Captured fish were identified to species and counted from each seine haul. Precipitation levels were recorded from weather.gov. Water quality was measured using Oakton handheld meters.

**Data Analysis:** The percent community composition of each species was calculated by dividing the number of individuals caught for a species by the total number of individuals caught for all species. Species richness, evenness, and Shannon diversity index was calculated for each sampling data. Correlation analysis was conducted to compare changes in fish diversity to water temperature and rainfall.



The most abundant to least abundant species were *Clinostomus* sp., Hiwassee Smoky Dace (n = 567), *Luxilus coccogenis*, Warpaint Shiner (n = 217), *Notropis leuciodus*, Tennessee Shiner (n = 202), *Campostoma anomalam*, Central Stoneroller (n = 178), *Semotilus atromaculatus*, Creek Chub (n = 131), *Etheostoma blennioides*, Greenside Darter (n = 3), *Cottus bairdi*, Mottled Sculpin (n = 1), *Etheostoma rufilineatum*, Redline Darter (n = 1), and *Ambloplites rupestris*, Rock Bass (n = 1). From Aug 21-Sept 25, *C. funduloides* (~58%) was the most abundant species but became less prevalent (~26%) through Nov 4. Comparatively, *L. coccogenis* (~15 - ~31%) increased throughout the same period and *N. leuciodus* (~18 - ~34%) also increased, peaking in the 7th and 8th week of sampling. *C. anomalam* was rare (2%) during the first 9 weeks of sampling but most abundant (42%) during the 9th and 10th week of sampling beginning on Oct 14. The biodiversity of the plunge pool changed throughout the sampling period with SDI values ranging from 0.60 to 1.45, peaking in week 6 of sampling.

## Results

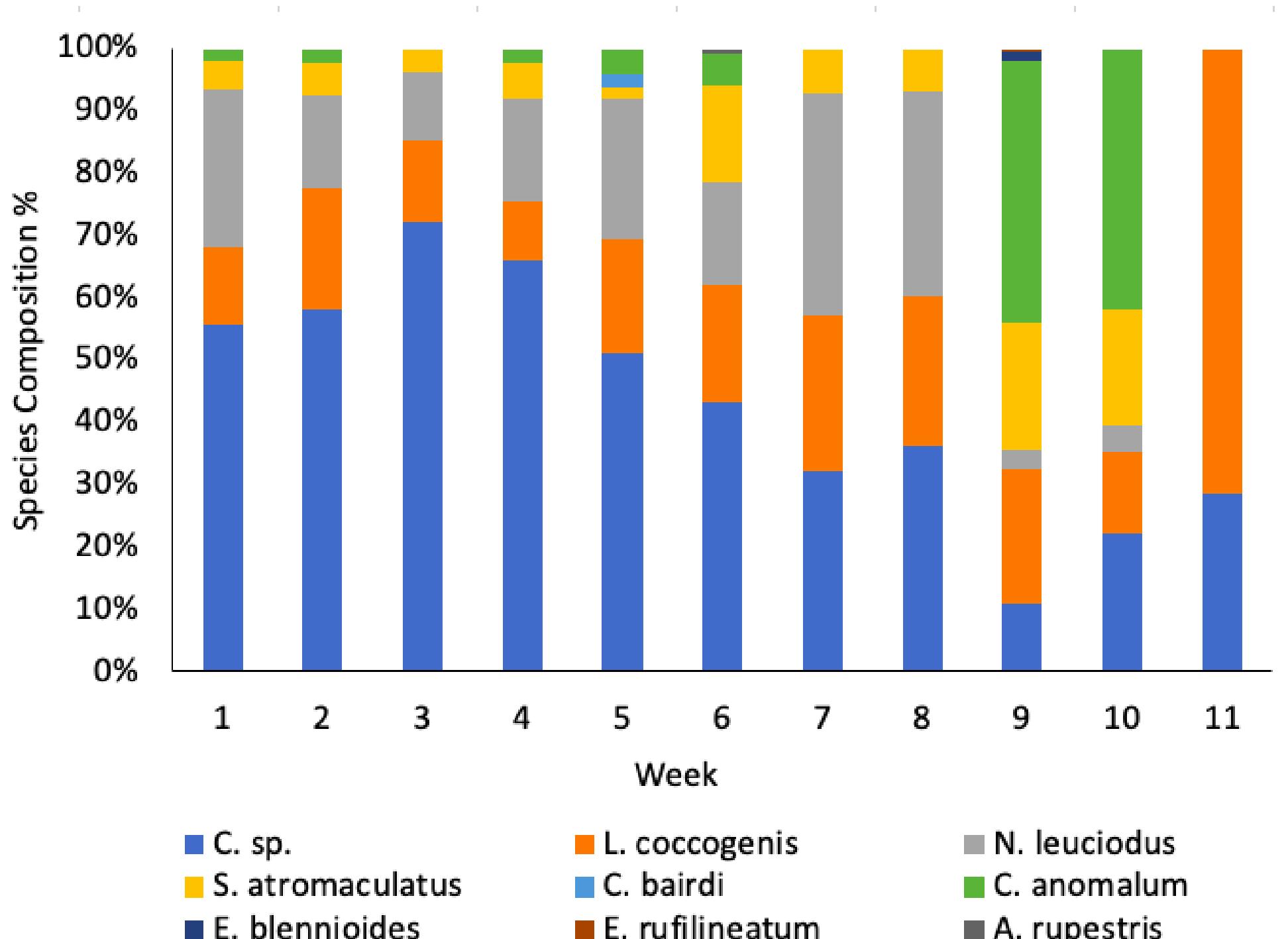


Figure 1. Change in percentage species composition in the Cupid Falls Plunge Pool by week sampled. Each bar contains 100% of the sample collected during that sampling event.

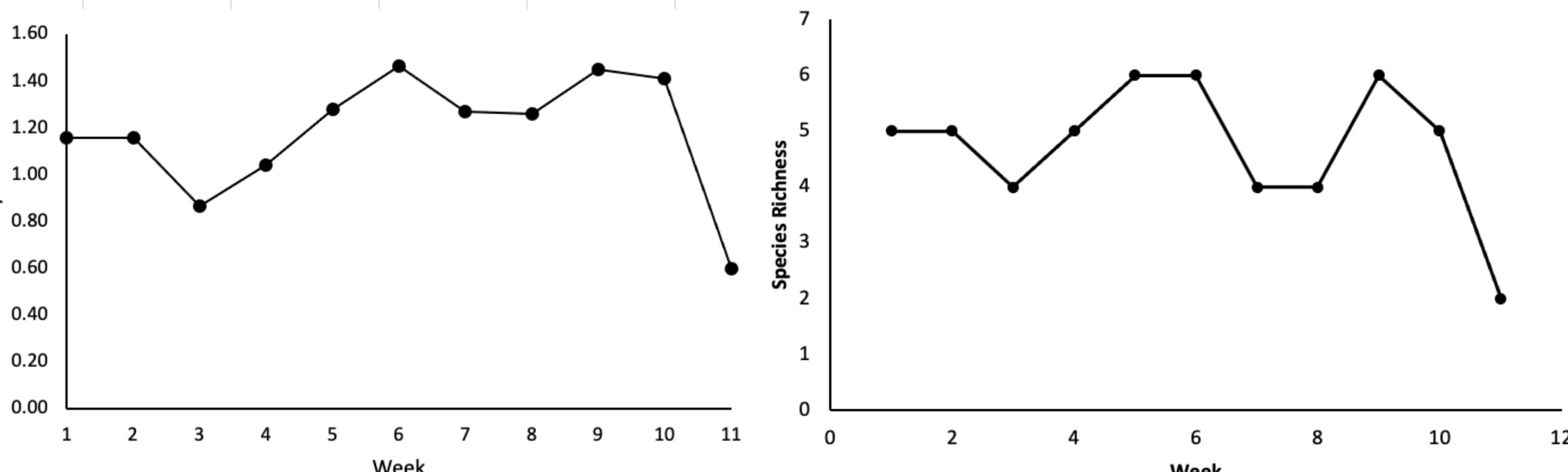


Figure 2. Shannon Diversity Index values during sampling.

Water temperature was positively correlated to total fish abundances ( $r=0.97$ ). The effect of water temperature on abundance varied by species and included strong correlations for Smoky dace ( $r=0.42$ ), Warpaint shiners ( $r=0.94$ ), Creek chubs ( $r=0.91$ ), and Central stonerollers ( $r=0.91$ ). Precipitation was weakly positively correlated to total fish abundance ( $r=0.47$ ). The effect of precipitation on abundance varied by species and included stronger correlations for Warpaint shiners ( $r=0.53$ ), Creek chubs ( $r=0.61$ ), and Central stonerollers ( $r=0.61$ ).

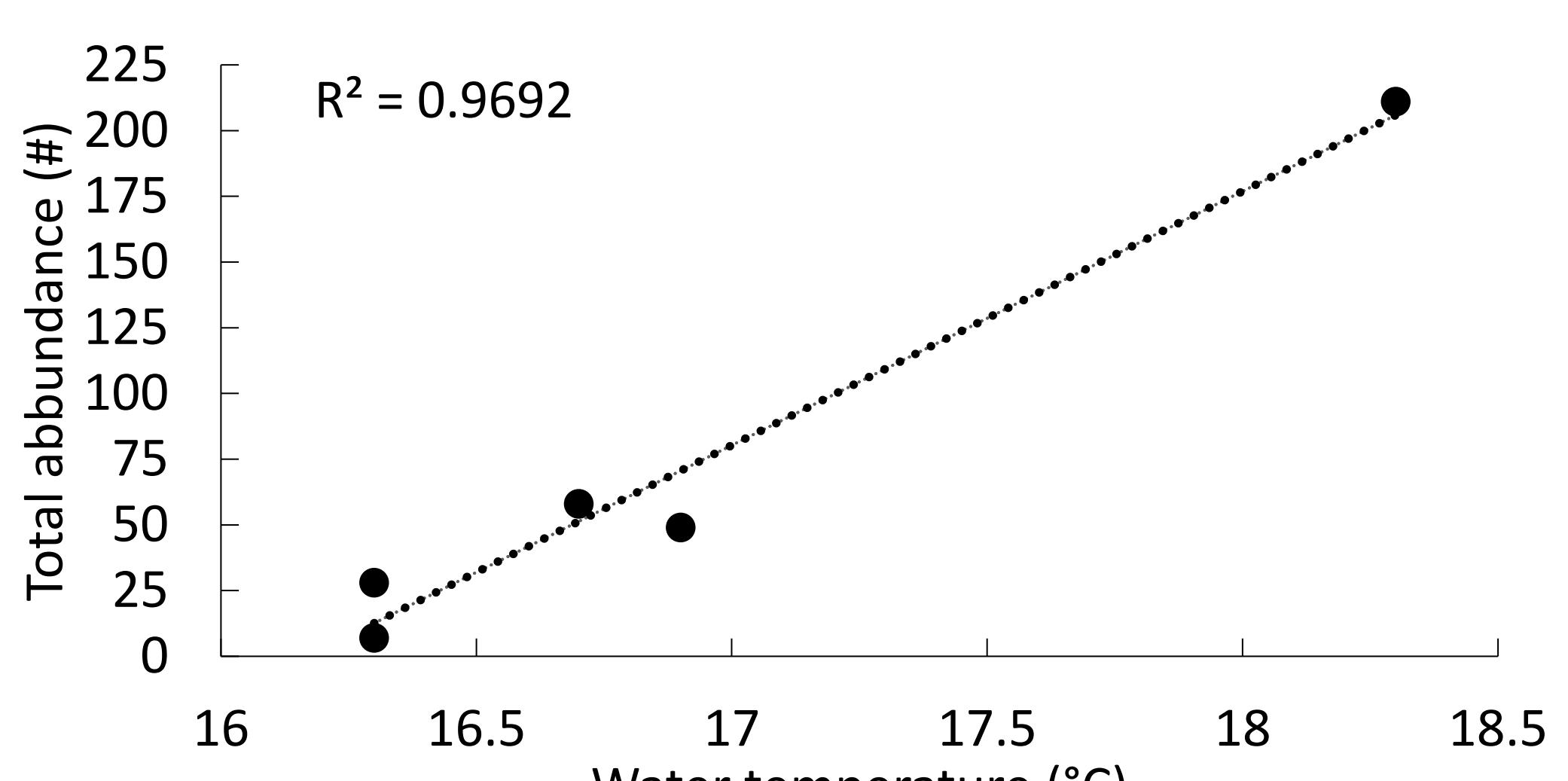


Figure 4. Correlation of water temperature with total fish abundance within the Corn Creek plunge pool located in Towns County, Ga between early September to late October of 2020.

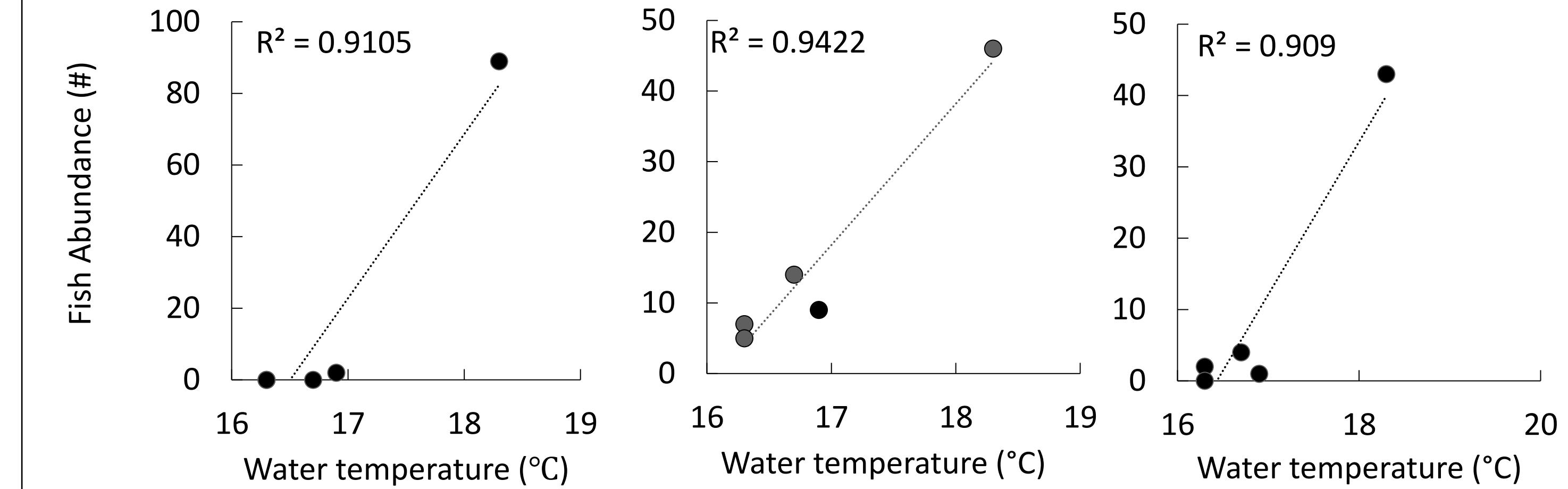


Figure 5. Correlation of water temperature to fish abundance for Central Stonerollers (A), Warpaint Shiners (B), and Creek Chubs (C) within the Corn Creek plunge pool located in Towns County, GA.

## Discussion

The composition of species in the fish community of the plunge pool exhibited recognizable changes from late summer to early fall. Much of the observed community changes in the plunge pool was driven by changes in the abundance of Cyprinids, such as *C. funduloides* sp., *N. leuciodus*, and *C. anomalam*. Cyprinids are more mobile than other families of fishes, and they have been found to have higher pool variances and more inter-pool movement than other groups of fishes (Matthews et. al, 1994). Freeman and Grossman (1993) studied 3 pools containing *C. funduloides*, from May to December and found that the distribution of *C. funduloides* was significantly different between months, but that neither changes in temperature, pool depth, water velocity, or suitable foraging conditions likely had any effect on distribution. *C. funduloides* abundance was not correlated to water temperature or recent precipitation in this study. *C. anomalam* is commonly found in pool or intermediate habitats (Schaefer, 2001) and has high dispersal abilities, selecting varying stream flows (Schaefer, 2001). *L. coccogenis* and *N. leuciodus* are two endemic highland fishes that frequently occur together in assemblages and the distribution and abundance resulting from the study can be considered typical (Scott and Helfman, 2001). Low captures of benthic fishes such as sculpins and darters is likely related to the capture method of seining. Visual observation with Aquascopes indicated a likely higher abundance of benthic fishes than reported.

Pools are essential habitat for many Southern Appalachian fishes providing them with feeding grounds (Matthews et. al, 1987), protection from desiccation in periods of drought (Hodges and Magoulick, 2011), and refuge from predators (Harvey and Stewart, 1991). Pools play an integral role in the life histories of many fishes and the importance of the Cupid Falls plunge pool to its resident fishes is recognized. Because of the rarity of pools (<14% in Corn Creek), large plunge pools can be important to fish community persistence and structure.

## Acknowledgements

We would like to thank the Young Harris College Department of Biology for funding and support and our research advisor, Dr. Johnathan Davis for assistance with this project.

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