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Comparison of Freshwater Mussel Communities from 1988 to 2015 in the Cedar Creek Watershed, Indiana

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Figure 1: Photo of agricultural ditch BLG by A.D. Taylor.



Figure 4: *Lampsilis siliquoidea* photo by A.D. Taylor.

Abstract

Out of the 300 genera of freshwater mussels represented in North America, most species have exhibited declines in abundance and distribution largely due to anthropogenic impacts. Mussels are ecologically important organisms and often associated with clean streams.¹ Agricultural practices degrade riparian buffers contributing to the channelization of headwater streams, which directly influences mussel distribution.² The abundance of live mussels within four Cedar Creek main stem sites exhibited a progressive decline from 168 individuals in 1998 to 110 in 2005 to 56 in 2015. Additionally, since 1988, no live mussels have been recorded in Cedar Creek between Waterloo and Auburn, Indiana.

Objectives

1. Compare community composition and abundance of mussels in Cedar Creek, Indiana in 2015 with those in 1988 and 2005
2. Determine which independent variables best explain current mussel distribution

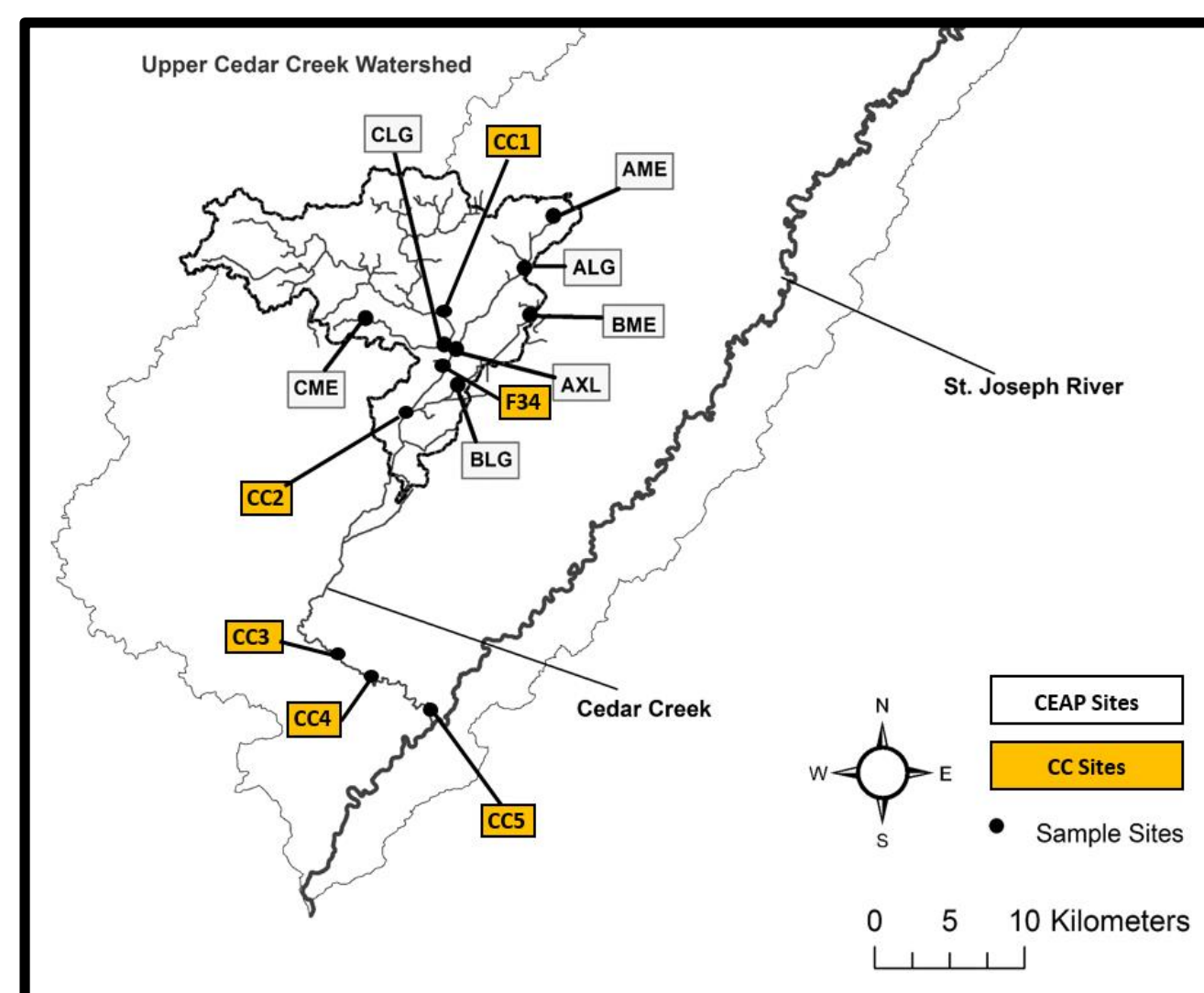
Methods

At each site: Single Collection Date		Weekly (Apr. through Oct.)
Mussel Sampling (16 quadrats and 200 m visual search)	Instream Habitat (i.e. depth, velocity, wet width, qualitative substrate, dominant cover)	Physicochemical (i.e. temp. pH, dissolved oxygen, etc.)
Fish Hosts	Riparian Habitat (i.e. % canopy cover, erosion, riparian type)	Pesticides/Herbicides (i.e. atrazine, alachlor)
Substrate Sieve Analysis		Nutrients (i.e. NH ₃ , Total phosphorus)

Statistical Analysis:

- Pearson correlation and multiple linear regression to eliminate multicollinearity
- Generalized linear models to evaluate correlations between mussel responses & independent variables

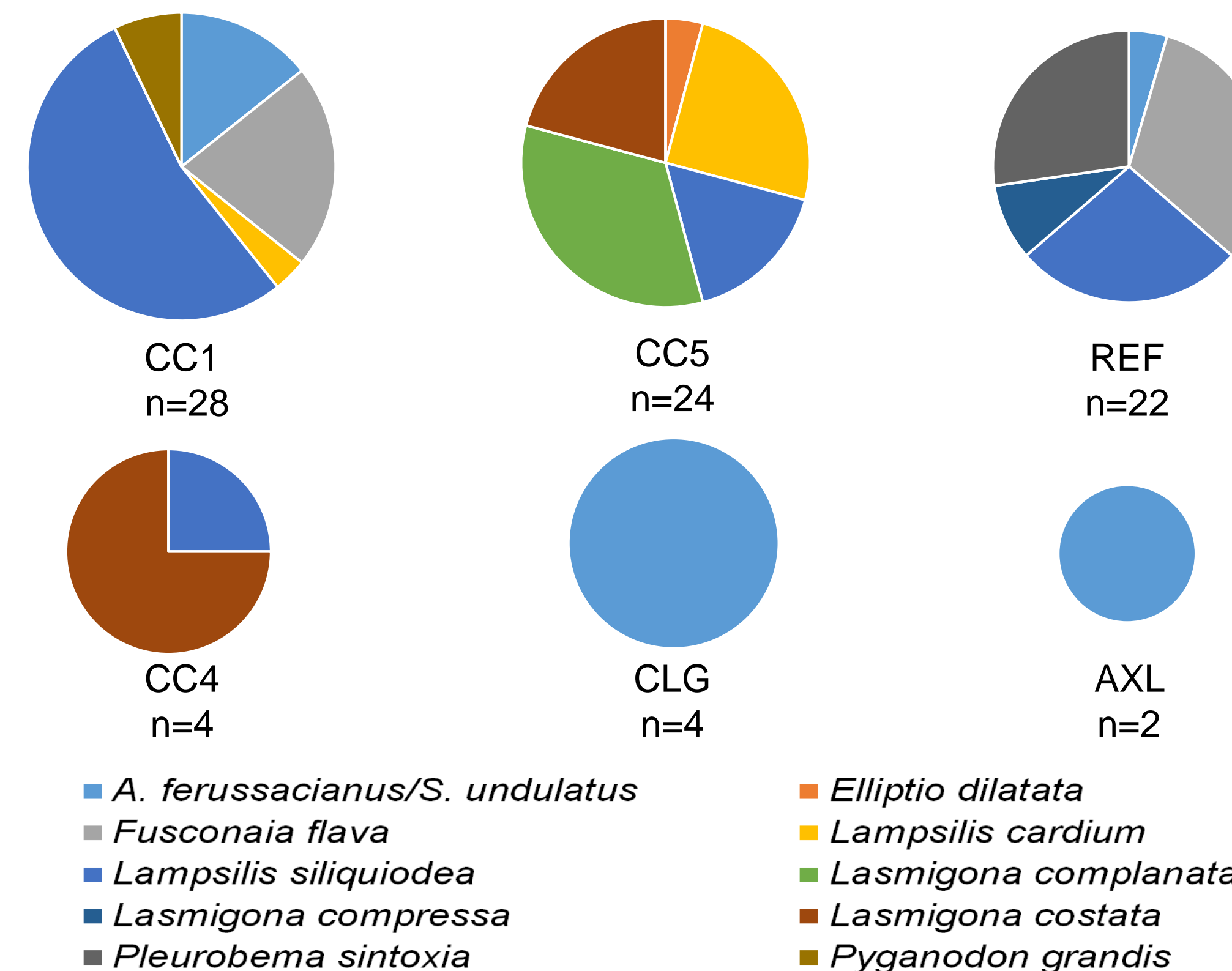
Figure 2: Map of sites sampled in 2015 excluding reference site.



Results

2015

- *Lampsilis siliquoidea* occurred at 4 sites & comprised 31% of individuals



Compared to 2005³ & 1988⁴

- Since 1988, no live mussels have been recorded between Waterloo and Auburn, IN (CC2)

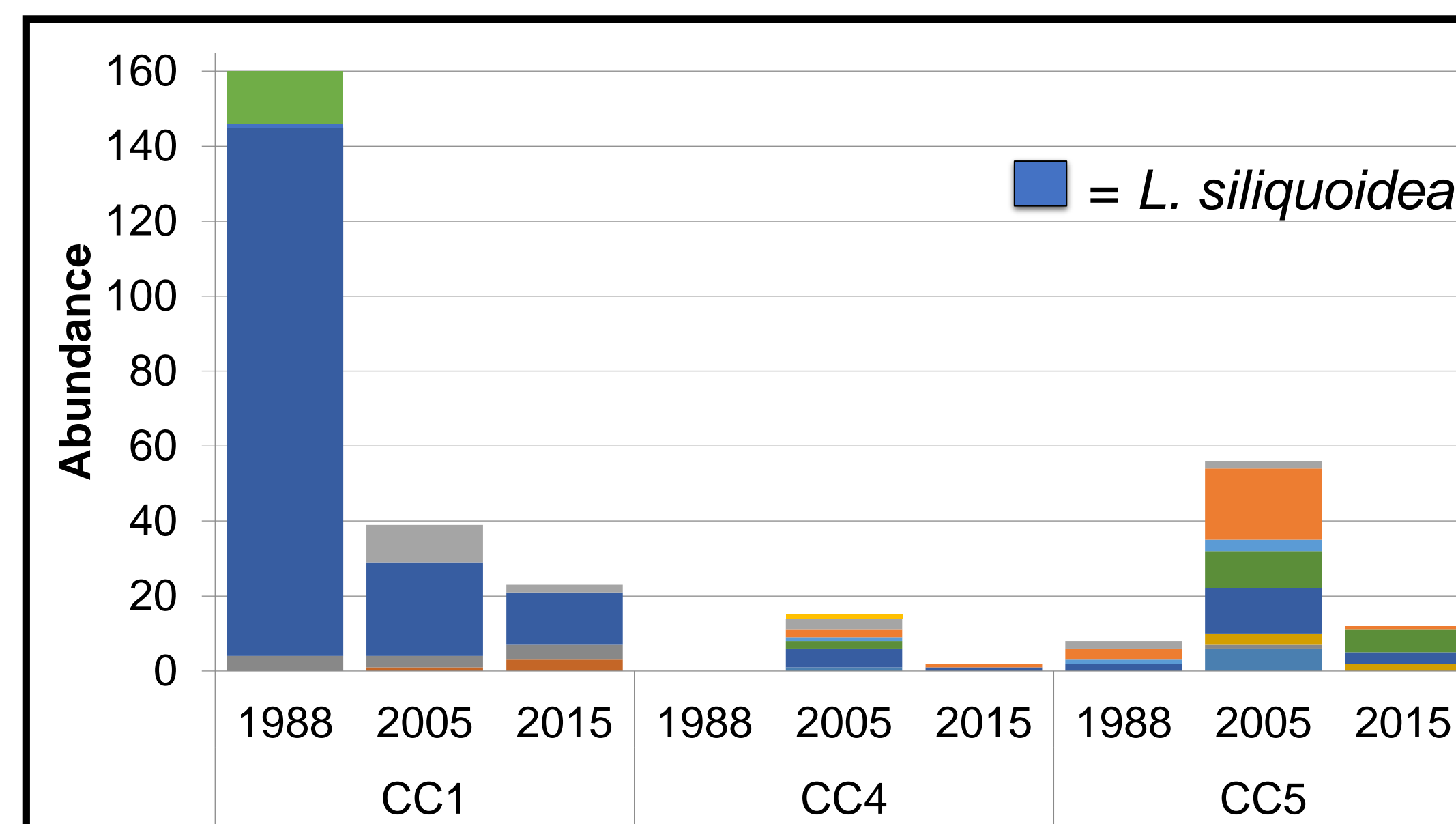


Figure 3: Mussel Abundance comparison among study years. Individual species represented by the various colors.

Results (cont.)

Table 1: Generalized linear model correlations between response & independent variables.

Mussel Response Variables	pH	Riparian	Temperature (°C)	Host Fish Abundance
Presence	0.093 (+)	n/a	n/a	n/a
Richness	0.093 (+)	0.007 (+)	n/a	n/a
Abundance	n/a	0.000 (+)	0.002 (+)	0.049 (-)

Discussion

Our results suggest that higher amounts of woody vegetation (riparian) and temperature were significant in explaining mussel abundance observed in 2015. It is important to note that agrichemicals were not included in this analysis. However, using 2010-2014 data from ditch sites, ammonia ($p < 0.000$) and total phosphorous ($p < 0.000$) best explained mussel abundance in 2015. These variables also strongly influenced mussel richness ($p = 0.02$). *Anodontoidea ferussacianus/ Strophitus undulatus*, the only species collected in agricultural ditches, are commonly found in headwater streams in all sediment types.⁵

Temporal declines in live adult mussels is likely caused by one of three factors: 1) decreases in juvenile recruitment, 2) intolerance to water quality, or 3) heavy predation pressures. Since mussels require a fish host for their larval stage, we also identified fish hosts. Fish hosts were found at all sites and therefore, unlikely to explain the decreases in mussel abundances alone. In addition, the long lived nature of mussels could mean a slow recovery from past conditions. Few studies have evaluated success rates of larval life stages in agricultural watersheds. Therefore, surveys of the presence of juvenile mussels throughout Cedar Creek would lend support to a better understanding of the decreases in adult mussels.

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