A Survey of Riparian Buffers Along the Schuylkill River

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Abstract

Four Schuylkill River tributaries and their riparian buffers were surveyed. The percentage of native species and invasive species, diversity, and disturbance were measured with this study. It was found that most of the sites were dominated by invasives. There was an observed relationship between disturbance and a prominence in invasive species.. Erosion by flooding was the most prominent disturbance overall.

Introduction

The Schuylkill River and its tributaries span throughout southeastern Pennsylvania and are important watersheds for the area. They provide habitats for the native aquatic species and drinking water for the residents of Philadelphia and its neighboring counties (Philadelphia Water Department, 2020). The Schuylkill River also contributes to its surrounding ecosystem by providing a source of water and prey for terrestrial species and supplying plants with habitats. In return, some of these plants help to protect the river itself by forming riparian buffers. Riparian buffers are areas of natural vegetation along rivers, streams, lakes, and other waterways. These natural barriers prevent sedimentary and organic pollutants from entering waterways (Brogna et al, 2018). Riparian buffers also prevents eutrophication of waterways and large algae blooms to occur.(Álvarez et al, 2017). For these reasons, the presence of riparian buffers has been linked to improved water quality (Brogna et al, 2018; Jencso et al, 2010). The improvement of water quality by riparian buffers provides a more biodiverse ecosystem (Stewart, 2011; Chivian et al, 2008). With greater biodiversity, the ecosystem is more stable and less likely to crumble (Tu et al, 2019). Across the United States, many native plants in riparian buffers have been overrun by invasive species. These invasive species have manifested themselves as mostly woody plants. The change from native plants to woody, invasive species has caused the collapse of the natural ecosystem and limited the dispersal of natural riparian buffers (Macfarlane et al, 2017). This has caused a problem because native plants are more tailored to and better for their natural ecosystems than invasive species. The purpose of this study was to quantify disturbance and diversity and calculate the percentage of native vs invasives.

Methods

Four sites were surveyed: Indian Creek, Valley Creek, Trout Creek, and Perkiomen Creek. At each site, the point intercept method was used. Three transects from a point were laid 45º apart from each other. Each transect was 13m long with the first 3m ignored to prevent overlap. From there, plants were counted and identified using the PictureThis app and field guides. All trees greater than 5 feet tall, shrubs, vines, and herbaceous plants 1m on either side of the transect tape were included in the count. This process was repeated at least three times at each site. From here, the data was analyzed including Shannon's Diversity Index and the disturbance level equation from Sunil et al, 2010.

$$\text{Disturbance level} = \sum_{i=1} \text{score } i \times \frac{\text{total number of incidents of activity } i}{\text{observer effort}}$$

i = various type of disturbances in each site, score i = sum of the score given to each site based on the intensity of disturbances

Results

Figure 1:

- Trout Creek is the most diverse although it is not significantly different from Indian Creek or Valley Creek.
- Perkiomen Creek is the least diverse.

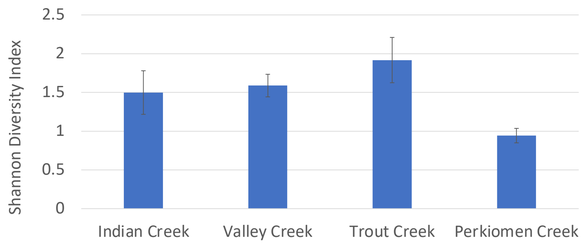

Figure 1: Graph of Shannon's Diversity Index of the four tributaries described in this survey. Standard error bars indicate if there is a significant difference between two variables.

Figure 2:

•Valley Creek was the only site with more natives than invasives.

•Valley Creek has more natives than Indian Creek and Perkiomen Creek although it is not significantly different than Trout Creek.

•Valley Creek has the least amount of invasives.

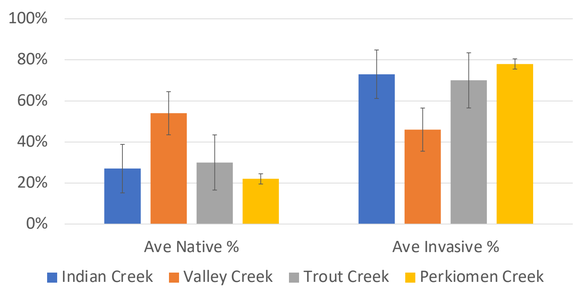

Figure 2: Graph compares the average percentage of native species and invasive species between sites. Note that only herbaceous plants, vines, shrubs, and trees over 5ft tall were included. Grasses and saplings did not qualify. Standard error bars indicate if there is a significant difference between two variables.

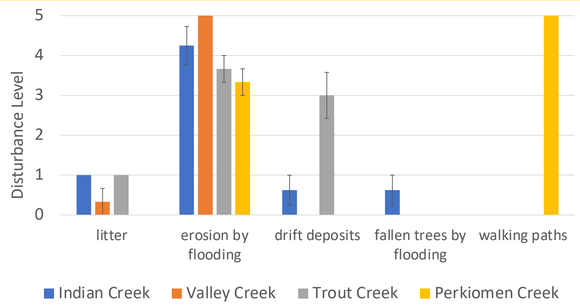

Figure 3: Graph shows average calculated disturbance level for different types of disturbance at each tributary. Note that each disturbance was given a rating of 1-5 and calculated using Kausalya (2005) disturbance equation.

Figure 3:

•Erosion by flooding is the most prominent disturbance.

•Indian Creek had the most types of disturbances.

•A walking path was only found at Perkiomen Creek.

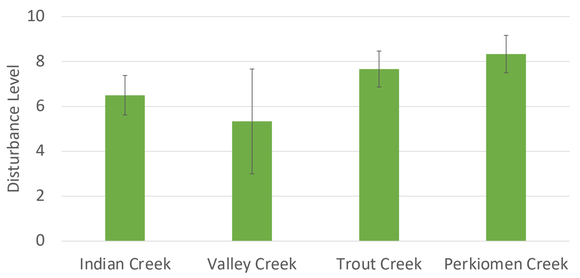

Figure 4: Graph shows overall average calculated disturbance level at each tributary. Standard error bars indicate if there is a significant difference between two variables.

Figure 4:

•Perkiomen Creek was the most disturbed although it was not significantly different than Trout Creek.

•Valley Creek was the least disturbed.

Discussion

While Trout Creek was the most diverse, this did not correlate to the function of the buffer. Part of the function of riparian buffers is to provide stability to the ecosystem (Tu et al, 2019). Because the buffer at Trout Creek was mostly invasive, this change has caused the collapse of the natural ecosystem and lost some function of the buffer. It was also concluded that the Perkiomen Creek was the least diverse and most disturbed due to the walking path through the middle of the site. This severely limited the number of plants that could be identified and counted. Another conclusion that was made was that anthropogenetic erosion by flooding was a key sign of habitat modification. It was present and common at all the sites. This shows that human influence in the surrounding areas has caused great damage to the surrounding buffers by allowing soil erosion on the banks of the tributaries (Li et al, 2021). This severely limits plants growth and the ability for the riparian buffer to thrive. Lastly, it was concluded that the height of the streambanks at Valley Creek caused limited flooding. This means that there was limited disturbance to most of the buffer, allowing native plants to keep control (Kuebbing et al, 2014; Yang et al, 2021). This conclusion also helps to draw a relationship between invasive succession and disturbance.

Conclusions

- The disturbance level was linked to the percentage of invasive vs. native species.
- Originally hypothesized that a site dominated by invasives would have less diversity. There was no correlation in our study sites.
- Disturbance intensity was highest when there was a purposeful human modification of the riparian buffer.

Future Directions

- Compare our data to water quality data to see if there is a link between disturbance and/or the presence and abundance of invasive/native species.

References & Acknowledgements

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