A Step in the Right Direction: Streambank Restoration Efforts at the Botanical Garden of the Ozarks

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Project Overview

The Botanical Garden of the Ozarks (BGO) is a unique destination in Northwest Arkansas that draws more than 80,000 visitors a year (BGO, 2015). According to the BGO, the site includes over 40 acres, 12 themed gardens, and borders Hilton Creek, which flows directly into Lake Fayetteville. While the BGO manages low-input practices, run-off from synthetic fertilizers containing phosphorus and nitrogen are of concern to water quality and overall ecological interactions of the site.

Streambank restoration efforts will serve as a riparian buffer for the Hilton Creek that aim to reduce pollutant deposition from nutrient amendments applied, while enhancing ecological and social interactions at the BGO.

Objectives and Methods

Established and completed objectives for this project are: 1) perform pre- and post-restoration streambank assessments, 2) obtain and implement native vegetative material promoting ecological diversity, 3) create an area for educational purposes focusing on streambank restoration and riparian buffers, and 4) use this research as a demonstration project highlighting collaboration between the UofA and the BGO.

Methodologies for streambank assessment are adapted from EPA's Rapid bioassessment protocols for use in streams and wadeable rivers (Barbour et al., 1999), a QBR index (Munne´ et al., 2003), and a Shannon–Wiener Index of diversity (Krebs, 1989).

Streambank restoration efforts were divided into three zones: Zone A (1.3x10.7 meters (m)), Zone B (2.7x10.7 m) and Zone C (1.3x10.7 m). Soil test kits, provided by UofA faculty, were used for pre-restoration soil sampling test for nitrate, phosphate, and pH (7 Feb. 2016). Native vegetation was purchased from White River Nursey, Fayetteville, AR (4 Apr.) and planted at the site (5 Apr.). Water quality measurements of dissolved oxygen, specific conductance, pH, and temperature (˚C) were taken three times during the project, (7 Feb., 18 Mar., and 16 Apr.) using a Sonde (YSI 600XLM®, USA). A QBR index comparison was conducted pre- and post-restoration (18 Mar. and 16 Apr.). On-site plant species inventory were recorded (18 Mar. and 5 Apr.) and used for Shannon–Wiener Index of diversity calculations. All data were analyzed using Microsoft® Excel (2013).

Figure 1. Hilton Creek streambank pre-restoration, 7 Feb., 2016.

Figure 2. Hilton Creek streambank post-restoration, 16 Mar., 2016.

Figure 3. Three-dimensional streambank restoration planting design using Rhinoceros® 5 and Adobe® Illustrator.

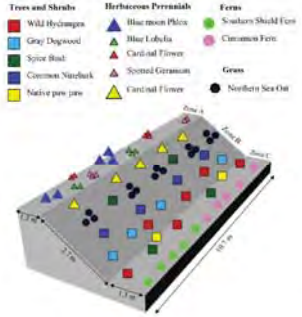
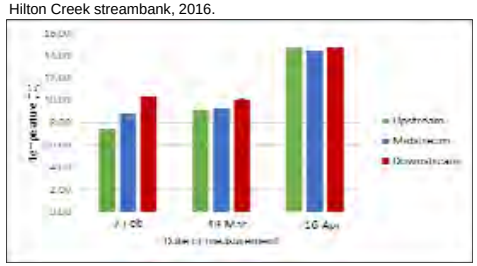


Figure 4. Pre- and post-restoration plant species inventory recorded 18 Mar. and 5 Apr., 2016.

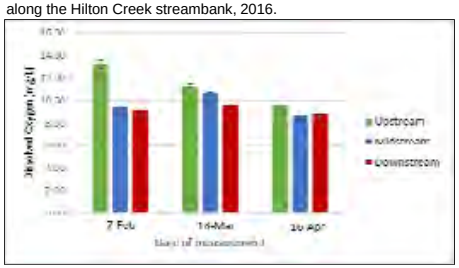
Pre-restoration existing vegetation	*Scientific name*	# of individuals	Post-restoration added vegetation	*Scientific name*	# of individuals
Sedge grass	*Carex spp.*	5	Wild hydrangea	*Hydrangea arborescens*	6
Wild carrot	*Daucus carota*	2	Common ninebark	*Physocarpus opulifolius*	4
Chick weed	*Stellaria media*	3	Gray dogwood	*Cornus foemina*	4
Wild onion	*Allium spp.*	1	Spicebush	*Lindera bencoin*	4
Wild violet	*Viola spp.*	3	Native paw paw	*Asimina triloba*	2
Elderberry	*Sambucus spp.*	1	Blue lobelia	*Lobelia siphilitica*	5
Native paw paw	*Asimina triloba*	3	Blue phlox	*Phlox divaricata*	5
Horn beam	*Carpinus spp.*	1	Spotted geranium	*Geranium maculatum*	5
Red buckeye	*Aesculus pavia*	1	Red columbine	*Aquilegia Canadensis*	5
Silky dogwood	*Cornus amomum*	1	Cardinal flower	*Lobelia cardinalis*	8
Pre-restoration: Species Total = 10 Total Individuals = 21 Shannon–Wiener Index of diversity value = 2.13			Southern shield fern	*Dryopteris ludoviciana*	5
Post-restoration: Species Total = 26 Total Individuals = 94 Shannon–Wiener Index of diversity value = 2.91			Cinnamon fern	*Osmunda cinnamomea*	5
			Northern sea oat	*Chasmanthium latifolium*	15

Figure 5. Temperature (˚C) measured at three different dates along the Hilton Creek streambank, 2016.



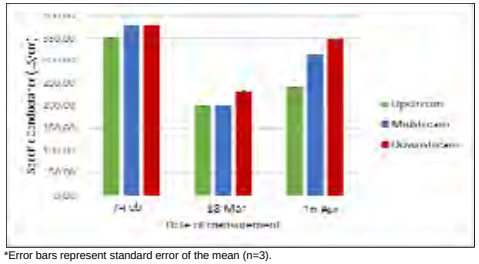
*Error bars represent standard error of the mean (n=3).

Figure 6. Dissolved oxygen (mg/L) measured at three different dates along the Hilton Creek streambank, 2016.



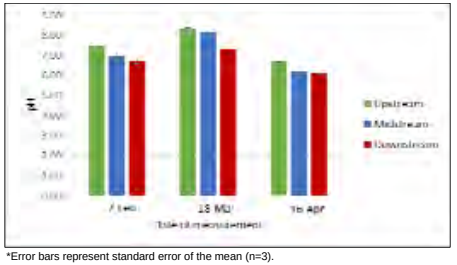
*Error bars represent standard error of the mean (n=3).

Figure 7. Specific conductance (µS/cm) measured at three different dates along the Hilton Creek streambank, 2016.



*Error bars represent standard error of the mean (n=3).

Figure 8. pH measured at three different dates along the Hilton Creek streambank, 2016.



*Error bars represent standard error of the mean (n=3).

Results

The Hilton Creek streambank pre-restoration site was bare with exposed soil, lacking vegetation (Figure 1). Post-restoration holds a diversity of native vegetation covering the soil (Figure 2). Soil test kits indicated the Hilton Creek streambank pre-restoration soil contained 81.82 and 84.07 (kg/ha) of nitrate and phosphorus respectively, and had a pH of 6.9 (Figure 1). Soil test values confirmed the site was suitable for the desired planting design of native trees, shrubs, herbaceous perennials, ferns, and grasses (Figure 3). Cataloged plant species equated to a pre-restoration Shannon–Wiener Index of diversity value of 2.13, while the post-restoration Shannon–Wiener Index of diversity equaled 2.91 (Figure 4). Results for water quality (Figures 5-8) are displayed with green bars representing 35 m upstream from the middle of the restoration site, blue bars representing the middle of the restoration site, and red bars being 35 m downstream from the middle of the restoration site. Pre-restoration QBR index value was calculated as 40 out of 100 and post-restoration QBR index value was calculated as 70 out of 100. Results show quantitative and visual differences post-restoration through increased plant diversity.

Sustainability

This project directly contributed to the sustainability of the natural and social systems. Water is essential to human life and reducing pollutants from human activities is fundamental to protecting our water resources. Vegetation implemented in this project is expected to serve as a natural filtration system between the BGO and Hilton Creek. Enhancing greenspace and plant diversity not only promotes ecological sustainability, but social sustainability as well. This project promotes social sustainability from the addition of aesthetically pleasing vegetation and space for community education. While this project aimed to enrich the community, it also greatly enriched the author's UofA experience. It directly impacted the author's values related to water security and ecological diversity with respect to sustainability.

References

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