The Lilly ARBOR Project: An Experiment in Urban Riparian Restoration

Tedesco L.P.[1], Hernly, F.V.[2], Hall, B.E.[2], Salazar, K.A.[2], Lindsey, G.[3], and Minger, T.[3]
(1) Director, Center for Earth and Environmental Science (CEES), IUPUI, 723 W. Michigan St. Indianapolis, IN 46202, 317.274.7154, ltedesco@iupui.edu; (2) Research Scientist, CEES and Department of Geology, IUPUI; (3) Center for Urban Policy and the Environment, IUPUI.

The Lilly ARBOR Project is an experimental riparian restoration project along the White River in downtown Indianapolis, IN. The site has been undergoing ecological restoration since 1999 through the reforestation of eight acres of the riparian corridor along a one kilometer reach of a highly engineered urban stream. The experiment is designed to test the relative success of three commonly utilized reforestation strategies: a) three gallon containerized stock planted in a grid; b) bare-root stock planted along random tracks; and c) bare-root stock planted in rows with weed control strategies (3'X3' geotextile mats and Canada wild rye (*Elymus canadensis*) planted as a cover crop). A total of 1332 trees were planted with two acres planted in each style. Two additional acres are unplanted control plots. Tree species selected for planting were derived from historical floodplain composition studies (Lee, 1945; Lindsey et al., 1961; GLO, 1799-1834) and included those native species whose geographic range occurs within the riparian forests of the Tipton Till Plain Natural Region of central Indiana. We chose to exclude planting extremely rare or habitat restricted species (ie. Rock Elm {*Ulmus thomasi*} and Blue Ash {*Fraxinus quadrangulata*}) or American Elm (*Ulmus americana*) due to Dutch elm disease. We planted Hawthorn (*Crataegus spp.*), Honey Locust (*Gleditsia tricanthos*), Swamp White Oak (*Quercus bicolor*), Red Maple (*Acer rubrum*), Hackberry (*Celtis occidentalis*), Chinquapin Oak (*Quercus muhlenbergii*), Buckeye spp. (*Aesculus sp.* – both native Ohio and non-native Red – which were erroneously included in the planting stock), Silver Maple (*Acer saccharinum*), Sycamore (*Platanus occidentalis*), Cottonwood (*Populus deltiodes*), Green Ash (*Fraxinus pennsylvanica*), and Black Willow (*Salix nigra*). Site preparation included treating mowed turf grass with glyphosate (Rodeo™). All plantings utilized the same species composition, 12' spacings, similar numbers of each species, and between 204 and 240 trees per plot. We were interested in determining if hydroperiod had a differential affect on either species or planting style so we distributed species randomly throughout plots. Tree plantings and monitoring are conducted by volunteers and students participating in service learning programs at IUPUI. Every tree is tagged and located with GPS.

Our results show containerized plots had significantly higher survival compared to both types of bare-root methods (Table 1). There also is no statistically significant difference in survival rates between the two bare-root strategies. Important differences in survivorship are apparent between different species; Honey Locust and Green Ash have the highest survival rates, while Black Willow, Sycamore, Buckeye and Cottonwood suffered significantly higher mortality than all other species. Reed Canary Grass (*Phalaris arundinacea*) has begun to encroach into the restoration area and is causing detrimental effects in terms of both survivability and natural recruitment.

The cost of different restoration strategies is often an important factor in determining approach. We assessed the costs associated with initial planting and the cost

per surviving tree for each strategy (Table 1). The total cost was calculated by aggregating labor and material cost for each style. Material costs include only costs incurred for tree acquisition and installation. Labor costs were calculated using hourly rates plus fringe benefits for undergraduate interns ($7.00/hour), staff ($22.72/hour) and hourly employees ($10.71/hour). We did not include cost estimates for volunteer hours because the project was designed to utilize high numbers of volunteers for educational and stewardship purposes and does not reflect actual cost to the project.

Table 1 shows that the bare-root random method of planting was the cheapest method; however, survival of these trees was significantly lower than the survival of trees in the containerized plots. An increase in expenditures of 60% per surviving tree for containerized stock increased the survivability by 15% compared to bare-root random trees. Thus containerized plantings cost more per surviving tree but the survivability is significantly higher. Results also show that surviving trees planted in the bare-root, weed inhibitor plots cost 58% more than surviving bare-root random trees with no statistically significant difference in survivability. Therefore, the results of the analysis suggest that the added costs of weed inhibitor strategies were not cost effective.

Table 1: Summary of Tree Survival vs. Cost for Each Planting Method

Planting Style/ # Planted	# Surviving/ % Survival	Material Cost	Labor Cost	Total Cost	Cost per Tree Planted	Cost per Surviving Tree
Containerized Stock, N = 420	256/61%	$5,442.75	$3,310.89	$8,753.64	$20.84	$34.19
Bare-root Random, N = 480	221/46%	$2,198.35	$2,343.76	$4,542.11	$9.46	$20.55
Bare-root, Weed-inhibitor, N = 432	187/43%	$3,459.56	$3,160.54	$6,620.10	$15.32	$35.40

Our experience at ARBOR suggests that the advantage of utilizing containerized stock is that it provides taller trees quickly. The increase in survivability relative to cost for containerized stock can be made up by planting higher numbers of bare-root stock for lower cost. Restoration managers may choose to use containerized stock planting methods if the look of the restoration is important or bare-root random planting methods if cost is the overriding factor when choosing a restoration strategy.

REFERENCES

Lee, M.B. 1945. "An Ecological Study of the Floodplain Forest Along the White River System of Indiana." *Butler University Botanical Studies,* Volume 7: 1-21.

Lindsey, A.A., Petty, R.O., Sterling, D.K., Van Asdall, W. 1961. "Vegetation and Environment along the Wabash and Tippecanoe Rivers." *Ecological Monographs,* vol. 31 is. 2: 105-156.

General Land Office Survey Records for Indiana. 1799-1834, Volumes 1-8. Archives, Indiana State Library, Indianapolis.

ACKNOWLEDGEMENTS

Funding for this study was provided by a Five Star Restoration Challenge Grant, Eli Lilly Foundation, Rotary Club of Indianapolis, and IUPUI. The US Geological Survey, Indiana Department of Environmental Management, Indy Parks, and the City of Indianapolis have all provided invaluable support to the project. J.F. New and Company, Spence Restoration Nursery, and Berg-Warner Nursery provided staff, equipment and oversight. Numerous students, and corporate and community volunteers have been the backbone of this program throughout the years.