Adaptive Silviculture in an Urban Environment: Initial Survival and Design Setup

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Overview:

- The floodplain forests of the Upper Mississippi River located in Crosby Farm Regional Park are an urban forest ecosystem where managers are facing impacts from climate change, invasive species, and aging overstory trees; natural regeneration is not occurring.
- Utilizing the framework developed by the Adaptive Silviculture for Climate Change (ASCC) network, we installed the first urban site within the network during the spring of 2020.
- Survival during the 2020 growing season across all three treatments (resistance, resilience, and transition) was high; however, mortality was highest in the transition treatment likely due to poor nursery stock quality.

Summary:

The Crosby Farms ASCC site sits in a Saint Paul Park and Recreation Area, owned and managed by the City of Saint Paul, that is embedded within the Mississippi National River and Recreation Area (MNRRA), a national park. Within the 736-acre park, there has been significant mortality of overstory green ash (*Fraxinus pennsylvanica*) due to the invasive emerald ash borer. Utilizing these already established mortality centers, three areas (or blocks) were identified. Prior to the removal of the mostly dead overstory, pretreatment conditions were measured. Overstory trees were removed during the 2019–2020 winter season. Twenty-four 1/10th acre permanent plots were established and fenced and included an unplanted control (3 blocks x 2 replicates x 4 treatments = 24 plots). We planted each plot with 3- to 6-ft bare root stock at a 10-ft spacing within the resistance, resilience, and transition treatments. Species that constitute each treatment include the following:

(1) Resistance: silver maple (*Acer saccharinum*), American elm (*Ulmus americana*), cottonwood (*Populus deltoides*), hackberry (*Celtis occidentalis*), and river birch (*Betula nigra*) from nurseries in USDA plant hardiness zone 4.

(2) Resilience: silver maple, American elm, cottonwood, black willow (*Salix nigra*), river birch, bur oak, American sycamore (*Platanus occidentalis*), and swamp white oak (*Quercus bicolor*) from nurseries in USDA plant hardiness zone 5, plus silver maple from zone 4.

(3) Transition: silver maple, red maple (*Acer rubrum*), American sycamore, river birch, sweetgum (*Nyssa sylvatica*), southern pin oak (*Quercus palustris*), and tulip poplar *(Liriodendron tulipifera*) from USDA plant hardiness zone 6 nurseries, plus silver maple from zone 4.

First year survival was generally high (86.5%) across all planted treatments; the transition treatment had the lowest survival (68% S.E. 2.8%), with red maple, river birch, and tulip poplar suffering the greatest mortality. Annual monitoring will continue into the future and provide critical information to mangers.

Silvicultural Concepts:

- Large bareroot stock (3 to 6 ft) was planted by volunteers and survival was high.
- Red maple, river birch, and tulip poplar from zone 6 had the greatest mortality. Mortality was likely due to issues with the stock and was related to greater transportation time.
- Competition control was completed during the growing season on herbaceous understory species.
- Long-term monitoring is critical to assess both short-term and long-term survival and growth of this understudied ecosystem and the planting of novel species.

Management Applications:

- The Adaptive Silviculture for Climate Change (ASCC) framework was successfully applied in an urban floodplain ecosystem and highlighted the ASCC's ability to be used in multiple ecosystems and at multiple scales. The initial planning meeting brought individuals from multiple disciplines and organizations together to discuss climate adaptive management within the Upper Mississippi River. This has spurred additional conservation and ideas related to adaptive management outside of the formal experiment at Crosby Farms Regional Park. Additionally, by partnering across multiple organizations, including organizations with extremely active and engaged volunteers, this project can engage citizens within maintenance (upkeep on fences) and data

collection, providing opportunity for greater connections among silviculture, climate adaptive management, and future forests.

Figure 1—Example of a transition plot post planting in spring 2020.

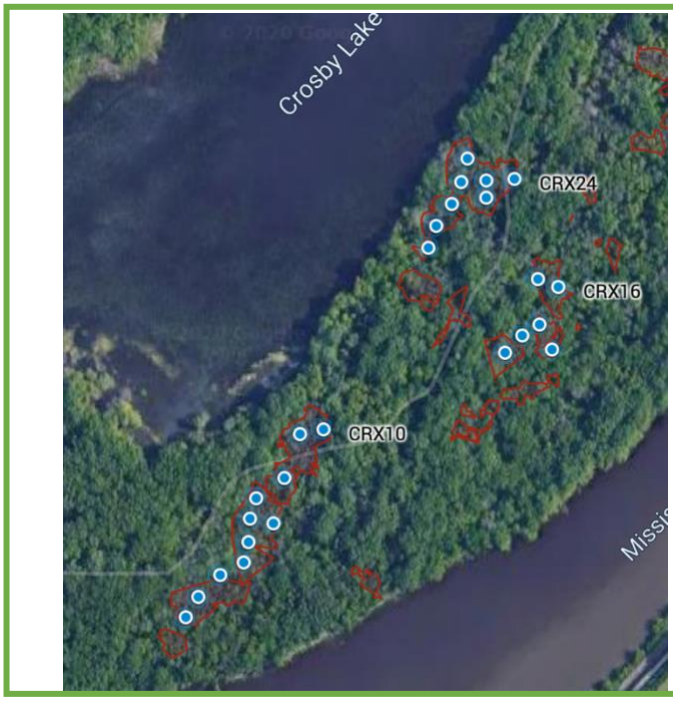

Figure 2—The associated mortality areas created by emerald ash borer (red) and location of the twenty-four 1/10th acre plots (blue dots) within Crosby Farms Regional Park.

Table 1—Example of the planting design within the 1/10th acre plot. Each tree species was individually marked and randomly assigned a planting location. Spacing was on a 10 x 10 ft grid. Seedlings were permanently marked after planting and nail polish was used to mark locations for measurements for basal diameter and diameter at breast height (d.b.h.) for repeated measurements. Species code include the first two letters of the genus and species, followed by the planting zone, and then the nursery.

TRANSITION								
Plot 1								
			BENI-Z6-WA	ACSA2-Z4-CR	LITU-Z6-WA			
		ACSA2-Z4-CR	PLOC-Z6-WA	BENI-Z6-WA	ACSA2-Z6-WA	ACRU-Z6-WA		
	ACSA2-Z4-CR	ACSA2-Z4-CR	PLOC-Z6-WA	QUPA-Z6-WA	ACSA2-Z6-WA	ACRU-Z6-WA	LIST-Z6-WA	
LIST-Z6-WA	QUPA-Z6-WA	ACSA2-Z6-WA	BENI-Z6-WA	ACRU-Z6-WA	BENI-Z6-WA	LIST-Z6-WA	LITU-Z6-WA	LIST-Z6-WA
ACSA2-Z4-CR	LITU-Z6-WA	ACSA2-Z4-CR	ACSA2-Z4-CR	ACSA2-Z6-WA	LITU-Z6-WA	PLOC-Z6-WA	ACRU-Z6-WA	ACSA2-Z6-WA
ACSA2-Z4-CR	PLOC-Z6-WA	CAIL-Z5-AL	PLOC-Z6-WA	CAIL-Z5-AL	CAIL-Z5-AL	PLOC-Z6-WA	QUPA-Z6-WA	ACRU-Z6-WA
	BENI-Z6-WA	ACSA2-Z6-WA	QUPA-Z6-WA	LIST-Z6-WA	BENI-Z6-WA	LITU-Z6-WA	LIST-Z6-WA	
		CAIL-Z5-AL	LITU-Z6-WA	CAIL-Z5-AL	ACRU-Z6-WA	CAIL-Z5-AL		
			QUPA-Z6-WA	QUPA-Z6-WA	ACSA2-Z4-CR			