Vegetation and Hydrology of Two Black Ash (*Fraxinus nigra*) Swamps in Western Wisconsin

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Background

Black ash (*Fraxinus nigra*) is an important overstory dominant in northern hardwood swamps but is declining due to invasive emerald ash-borer (EAB, *Agrilus planipennis*).

Questions

This study: How do the plant communities and hydroperiods of black ash swamps on different soils differ from each other?

Long term: How will these swamps change differently with ash death?

Study Sites

Sites had few dead ash and intact canopies, indicating beginning stages of infestation.

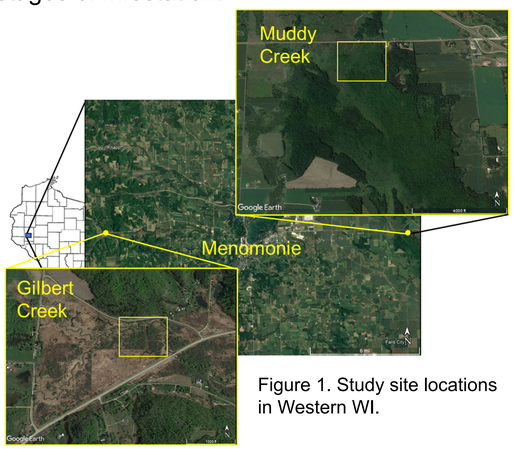

Figure 1. Study site locations in Western WI.

Muddy Creek State Wildlife Area (Muddy)

- Large wetland complex with Markey much soil
- Longer history as a forested wetland

Gilbert Creek State Fisheries Area (Gilbert)

- Smaller, isolated area with Orion silt loam soil (hydric)
- Shorter history as a forested wetland.

Methods

- Nested piezometers (water-table, deep piezometer and shallow piezometer wells) at each site with water-level data loggers.
- 8-10 permanent plots were installed at each site. Plots had a 10 m radius for trees (≥ 3 cm DBH) and 3 m radius for shrubs. There were 5 understory 1 m^2 sub-plots per plot (Figure 2).
- Signs of EAB infestation included bark flaking, canopy thinning and epicormic sprouting (Figure 3). Few D-shaped holes were observed.

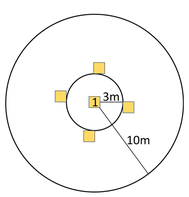

Figure 2. Plot design

Figure 3. Signs of EAB infestation

Overstory

10% of Gilbert Creek ash trees had signs of EAB, while 51% of Muddy Creek ash trees did. Very few trees had D-shaped holes. Canopy cover was significantly higher ($P < 0.001$) at Gilbert Creek (94%, SE= 1%) than Muddy Creek (86%, SE = 1%)

Muddy Creek

- More even abundance of important tree species (Figure 4A).
- More even distribution of black ash size classes (Figure 4B).

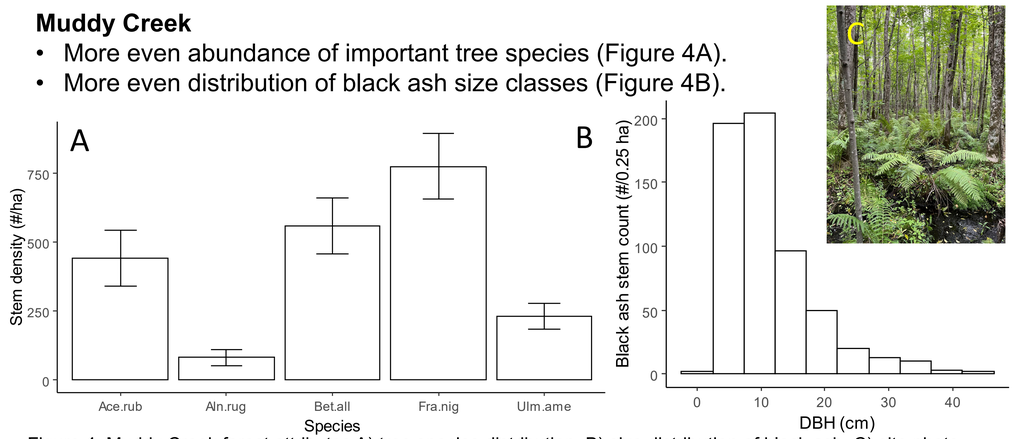

Figure 4. Muddy Creek forest attributes A) tree species distribution, B) size distribution of black ash, C) site photo.

Gilbert Creek

- Less even abundance of important tree species (Figure 5A).
- Black ash size distribution skewed toward smaller trees (Figure 5B).

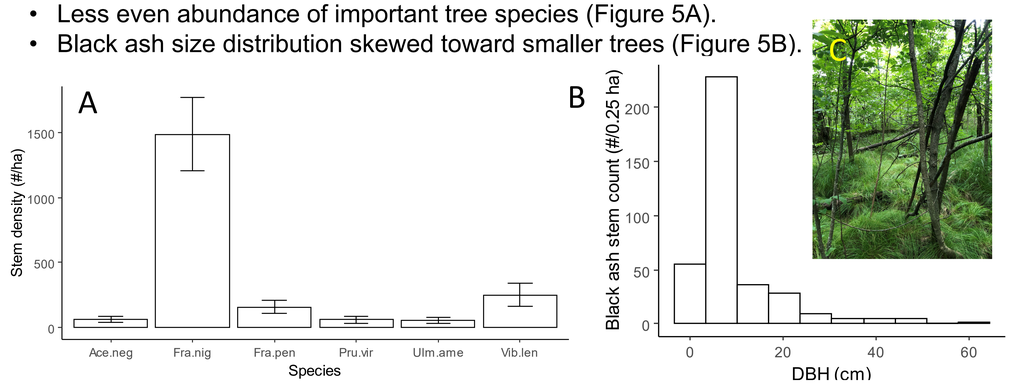

Figure 5. Gilbert Creek forest attributes A) tree species distribution, B) size distribution of black ash, C) site photo.

Understory

There were very few species in common between the two black ash swamps (Table 1).

Gilbert Creek had a significantly higher *Fraxinus* seedling abundance ($P = 0.008$, Figure 6A). Muddy Creek had significantly higher species richness ($P = 0.038$, Figure 6B).

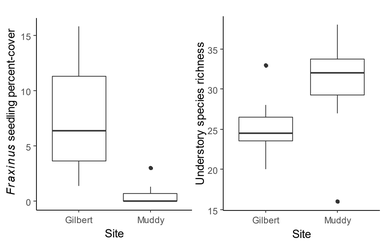

Figure 6. A) *Fraxinus* seedling cover and B) understory species richness by site.

Table 1. Mean cover of the 15 most frequent understory species at each site.

Muddy Creek		Gilbert Creek	
Species	Mean percent-cover (SE)	Species	Mean percent-cover (SE)
Osmundastrum cinnamomeum	46.3 (4.6)	*Carex bromoides*	42.5 (5.8)
Leersia oryzoides	17.8 (7.5)	*Geranium macrophyllum*	15.3 (3.8)
Maienthemum canadense	11.2 (2.4)	*Ranunculus hispidus*	13.6 (2.7)
Rubus pubescens	7.3 (1.5)	*Fraxinus pensylvanica*	11.3 (3.5)
Persicaria arifolia	6.7 (2.3)	*Fraxinus nigra*	9.9 (2.4)
Onoclea sensibilis	3.1 (0.9)	*Viburnum lentago*	8.3 (3.2)
Trientalis borealis	3.0 (0.9)	*Fraxinus* seedling	8.2 (1.7)
Symphyotrichum lateriflorum	2.9 (1.1)	*Ribes americanum*	4.5 (1.2)
Toxicodendron vernix	2.5 (0.9)	*Lysimachia ciliata*	2.5 (1.3)
Fraxinus seedling	2.0 (0.4)	*Micranthes pensylvanica*	2.5 (0.3)
Arisaema triphyllum	1.6 (0.4)	*Arisaema triphyllum*	1.8 (0.4)
Carex leptalea	1.4 (0.5)	*Symphyotrichum lateriflorum*	1.4 (0.7)
Acer rubrum	1.3 (0.7)	*Cornus racemosa*	1.3 (0.4)
Pilea pumila	1.0 (0.3)	*Geum canadense*	1.0 (0.3)
Impatiens capensis	1.0 (0.2)	*Caltha palustris*	0.4 (0.1)

Bartonia virginica at Muddy Creek

Toxicodendron vernix at Muddy Creek

Micranthes pensylvanica at Gilbert

Hydrographs

- Gilbert had a more variable hydroperiod than Muddy. At Muddy Creek, groundwater discharged into the wetland, stabilizing the hydroperiod. At Gilbert Creek, the wetland recharged the local groundwater (Figure 7).

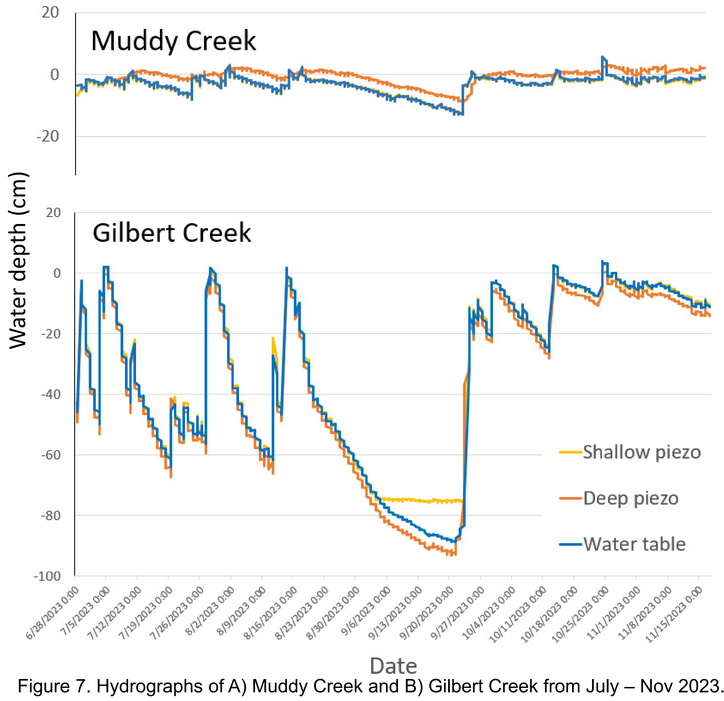

Figure 7. Hydrographs of A) Muddy Creek and B) Gilbert Creek from July – Nov 2023.

Monitoring well nest at Muddy Creek

Platanthera psycodes at Gilbert Creek

Conclusions

- Black ash swamp vegetation varies dramatically with soil type.
- The larger diversity of tree species at the Muddy Creek site may help the site be more resistant than Gilbert Creek to change over time.
- Ash decline may have greater impacts on the hydrology of groundwater recharge wetlands like Gilbert Creek.

Acknowledgements

Thank you to UW-Stout undergraduates An Nguyen, Ted Welch, Kal Breeden, Casie Kopischke, Ryder Simington and Oliver Cunningham for field assistance.

Funding for data analysis and ongoing research comes from the Freshwater Collaborative of Wisconsin.

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