Alternative Species for Restoration of Black Ash Ecosystems Under Threat from Emerald Ash Borer

MI Upper Peninsula and northern WI study sites

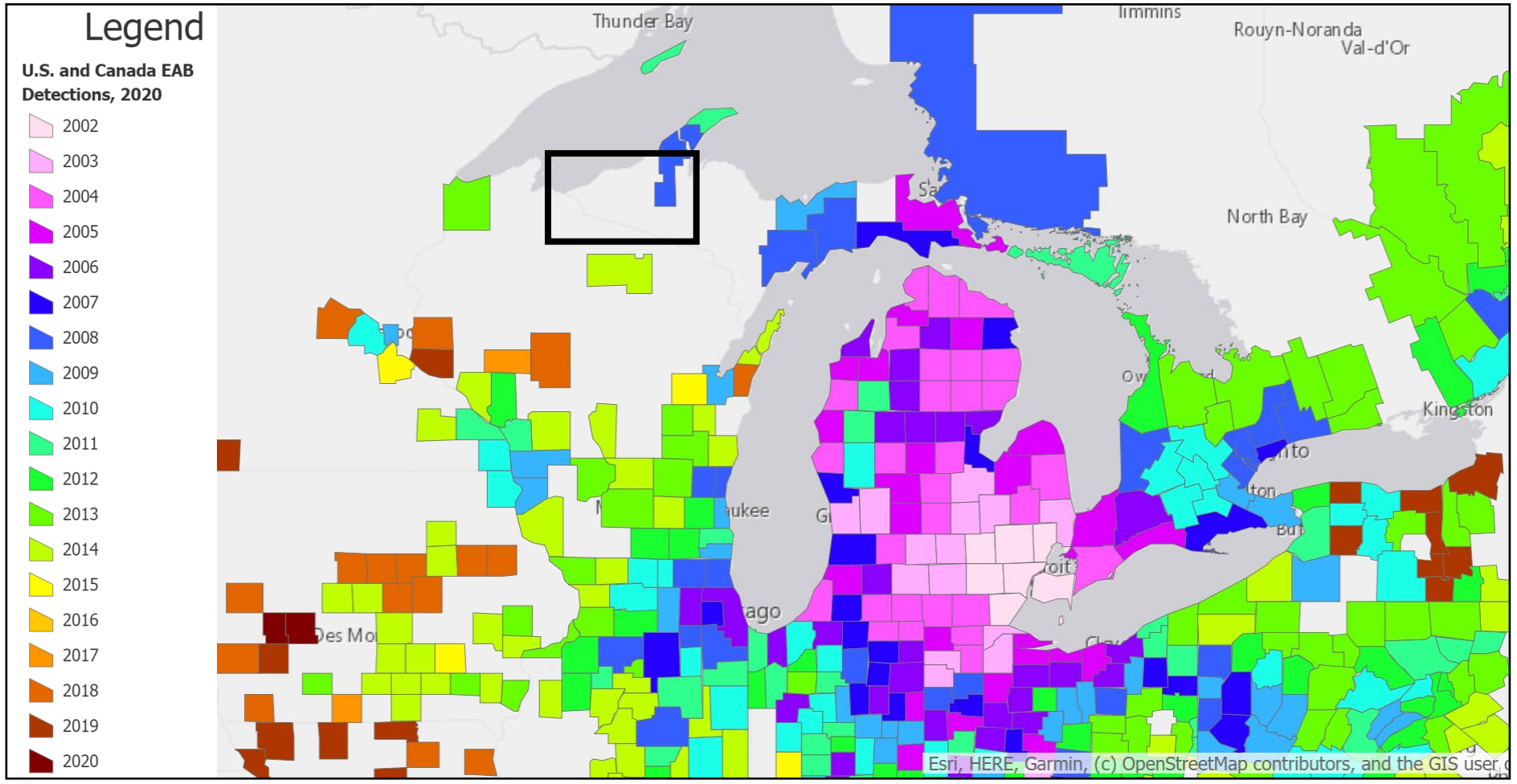
Kathryn Hofmeister, University of Wisconsin-Oshkosh

D. Beyer, N. Bolton, G. Boyle, D. Bronson, S. Davenport, J. Davis, R. Kolka, F. Liu J. Shannon, M. Van Grinsven

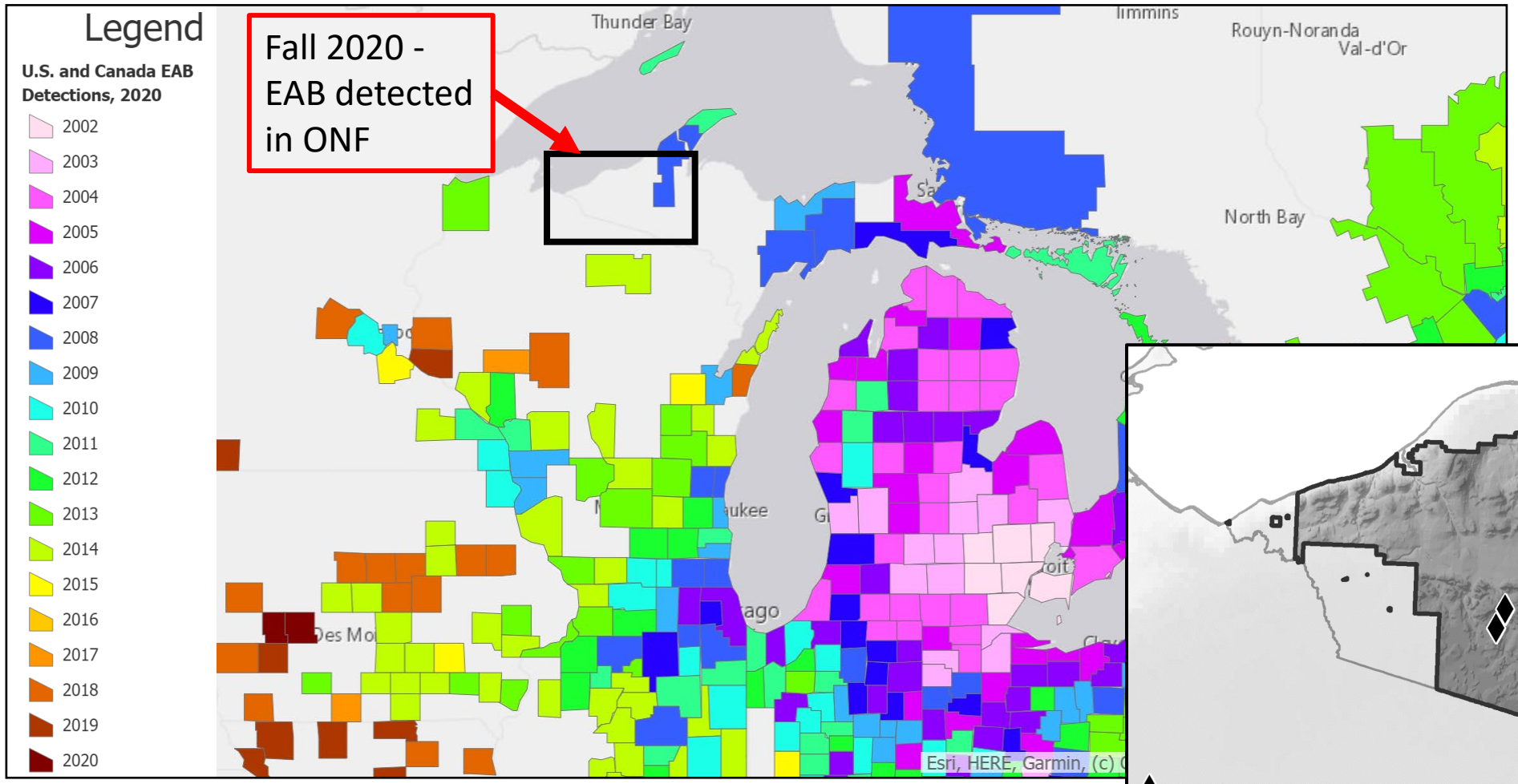
A big thanks to everyone involved in these projects!

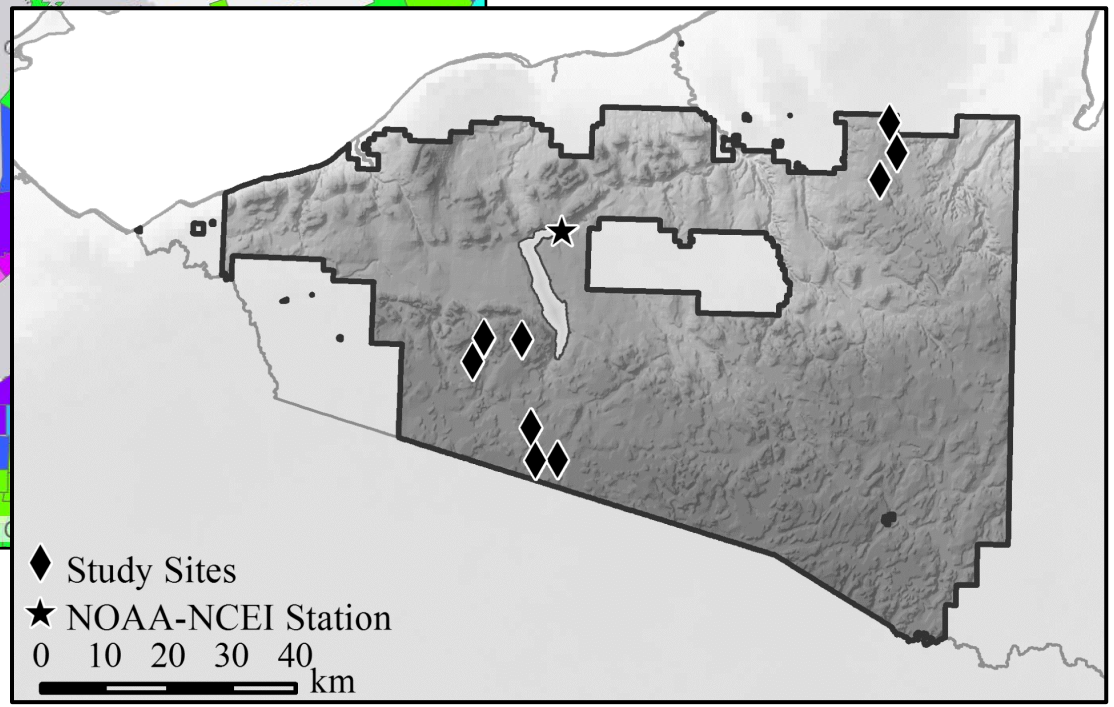
- M. Albrechtsen, A. Amman, B. Bergman, J. Bontrager, W. Capello, G. Carothers, J. Den Uyl, C. Flower, R. Frose, L. Harrison, S. Harttung, D. Hutchinson, N. Jin Noh, E. Jones, S. Kuczmarski, A. Lehner, A. Mayer, T. McDade, L. Nave, J. Nelson, A. Perram, V. Porter, B. Propson, K. Schneider, N. Schreiner, S. Sebestyen, E. Stimmel, S. Trull, 2022 YCC Students
- Ottawa National Forest, Chequamegon-Nicolet national Forest, Lake Superior National Estuarine Research reserve, Michigan Tech University, University of Michigan Biological Station
- Any questions, please contact me – **Kathryn Hofmeister, hofmeisterk@uwosh.edu**

Ottawa National Forest Study Sites



Ottawa National Forest Study Sites





12 Black Ash Wetlands

- 0.23-1.19 ha
- High percentage ash
  - 66% of basal area
- Deep muck soils

Experimental Design – Ecosystem Disturbance

- 3 treatments applied winter 2012-2013
  - *Control:* no EAB infestation
  - *Girdle:* short-term stand mortality, 3-4 years after infestation
  - *Ash Cut:* long-term ecosystem disturbance, widespread ash mortality

Ecosystem Responses to Disturbance

Biota

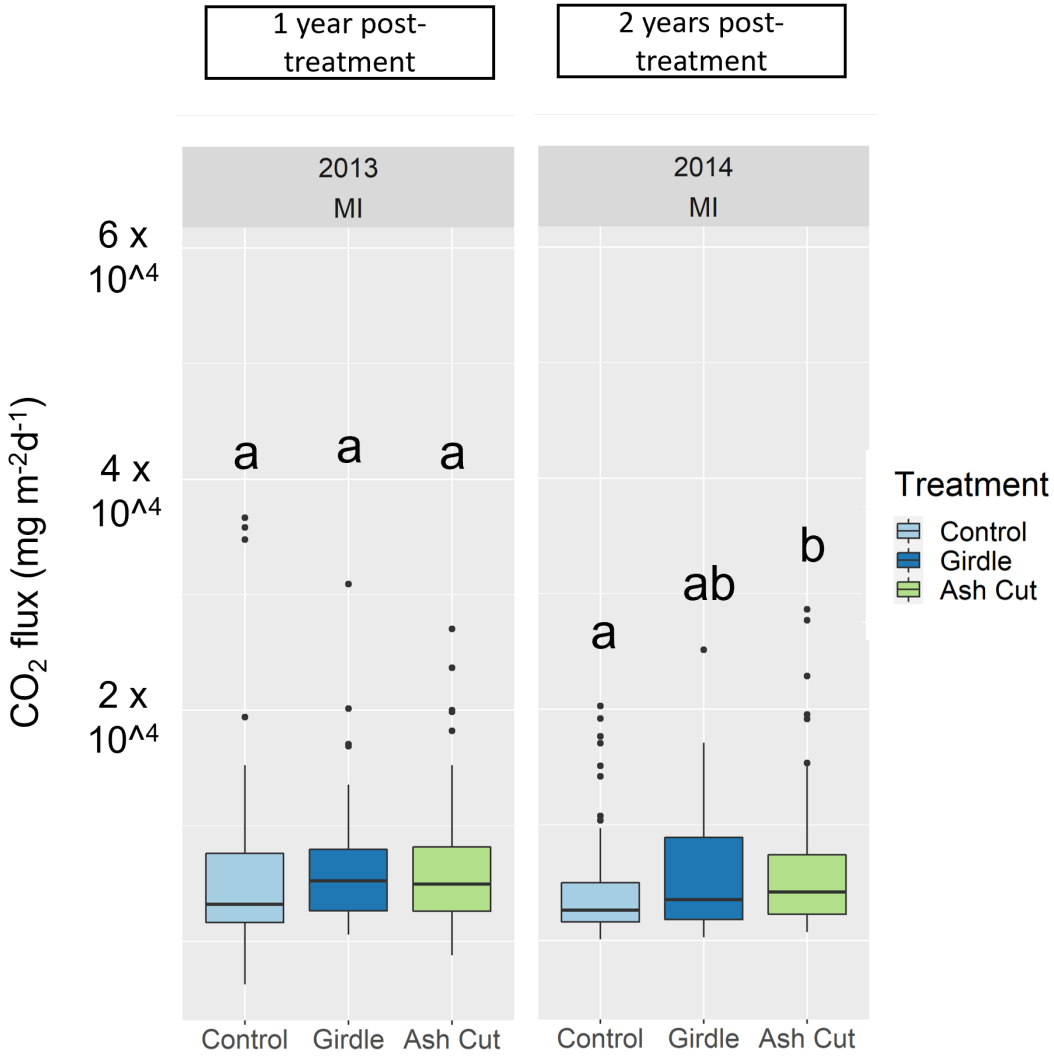
- Decrease in total basal area due to ash loss
- Increase in herbaceous MI cover
- Poor outlook for co-occurring woody species

Water level

- Elevated water table levels and delayed drawdown

Biogeochemistry

- Soil C, N pool sizes and concentrations don't change but gas fluxes and indices of cycling do respond

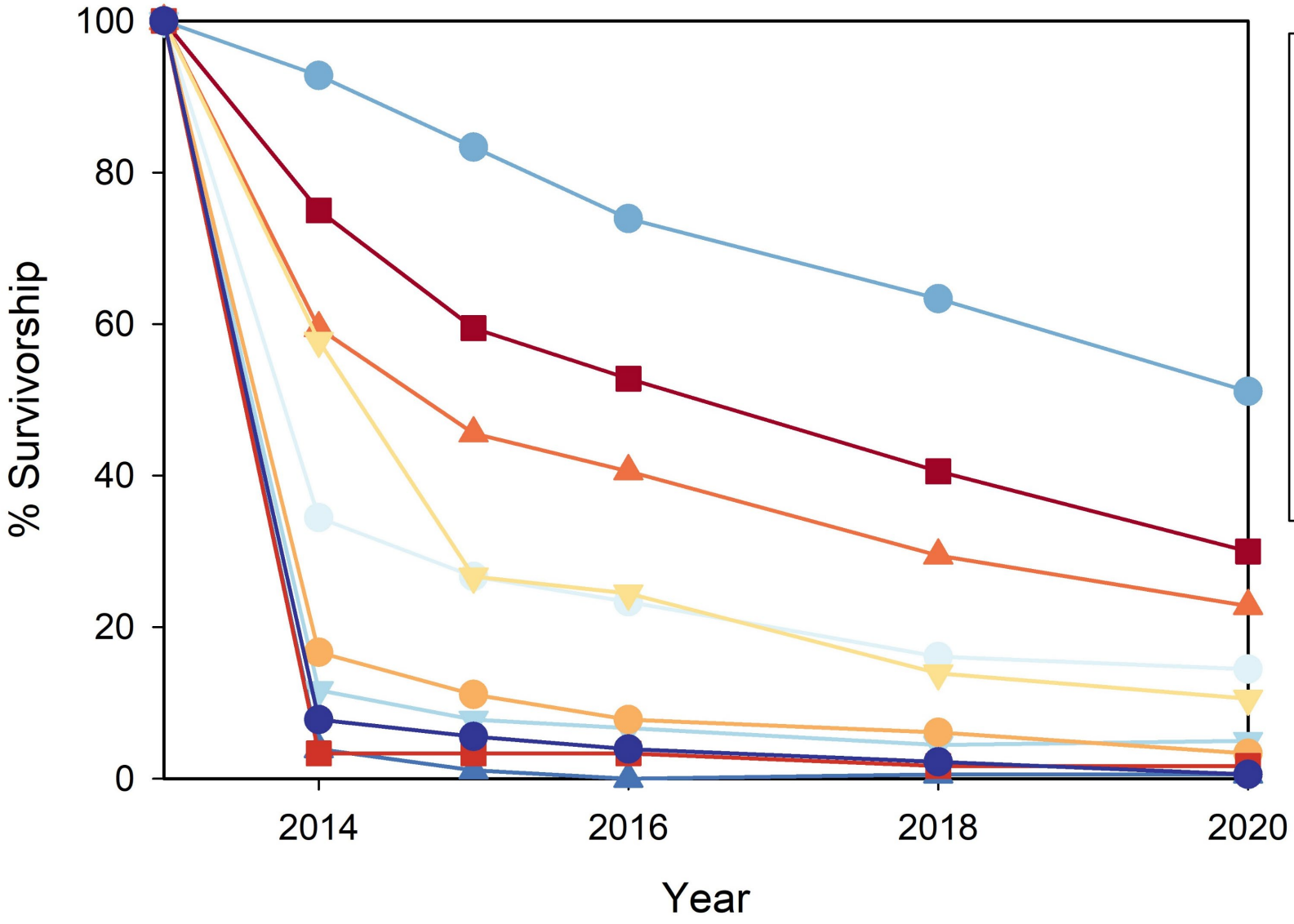


Potential restoration of black ash wetlands with alternative species

- 10 alternative species planted in 2013 in all treatments
- Seedlings planted in pairs in high (hummock) and low (hollow) microsites

Common Name	Scientific Name	Currently in Wetland Overstory?
American elm	*Ulmus Americana*	Yes
balsam fir	*Abies balsamea*	Yes
basswood	*Tilia americana*	Yes
black spruce	*Picea marina*	No, within habitat range
bur oak	*Quercus macrocarpa*	**No, outside habitat range**
northern white cedar	*Thuja occidentalis*	Yes
red maple	*Acer rubrum*	Yes
silver maple	*Acer saccharinum*	No, within habitat range
tamarack	*Larix larcinia*	No, within habitat range
yellow birch	*Betula alleghaniensis*	yes

Species Survivorship

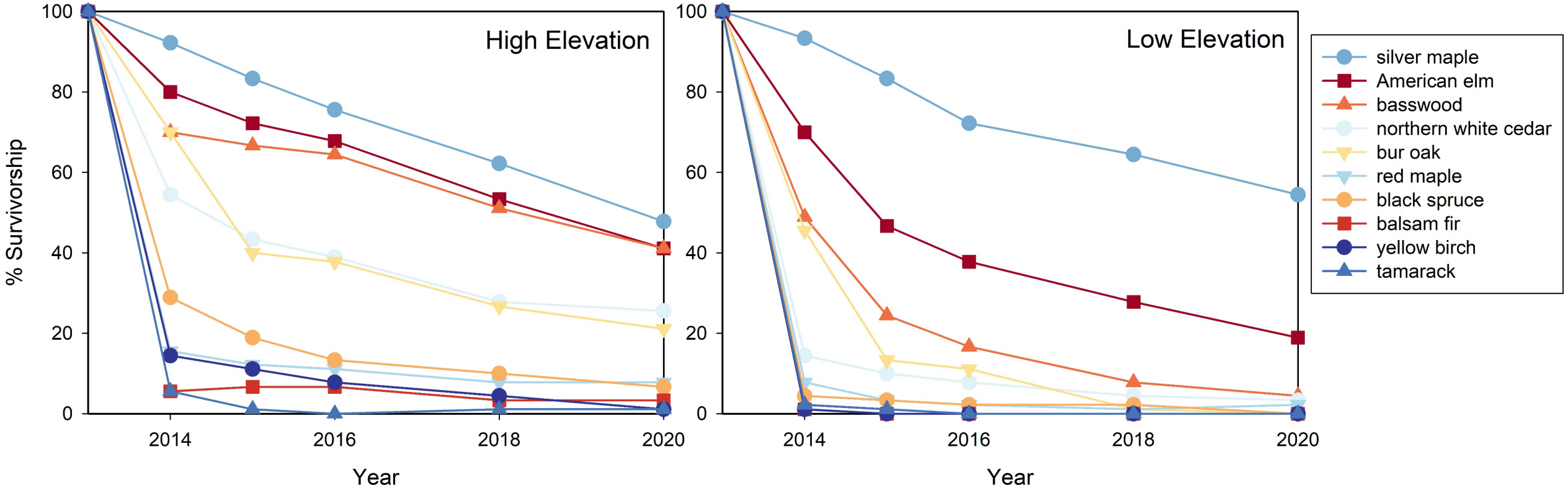


- silver maple
- American elm
- basswood
- northern white cedar
- bur oak
- red maple
- black spruce
- balsam fir
- yellow birch
- tamarack

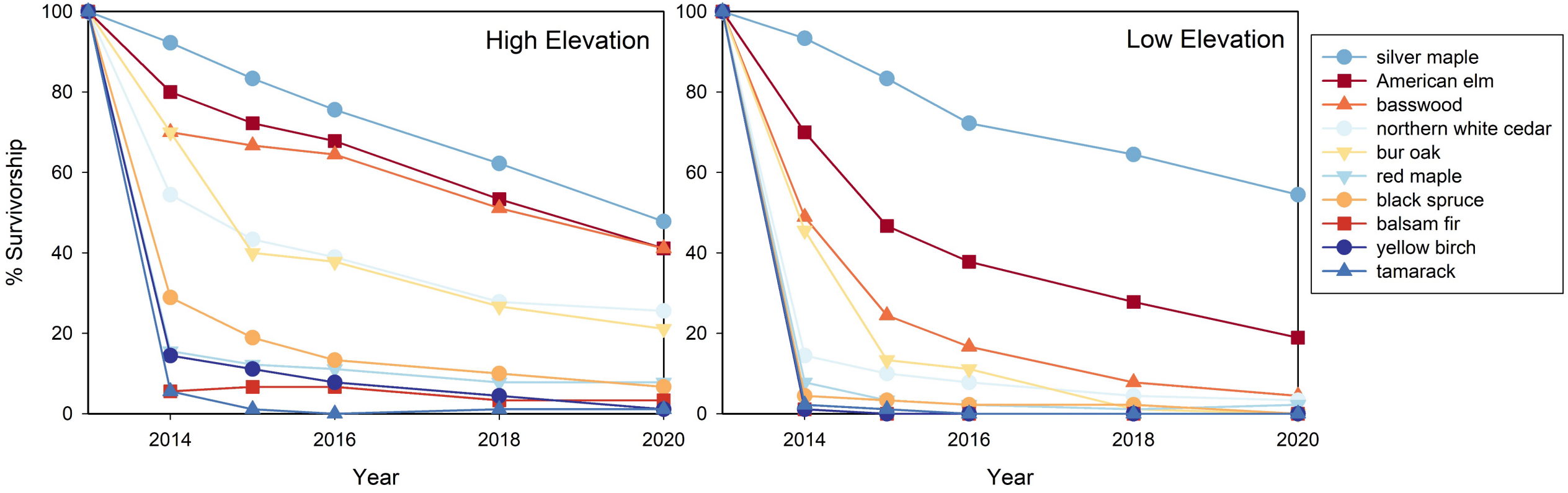
Top Surviving Species in 2020:

1. Silver maple (48%)
2. American elm (28%)
3. Basswood (22%)
4. Northern white cedar (14%)
5. Bur oak (9%)

Take away: Better seedling survival on higher elevation points (hummocks)

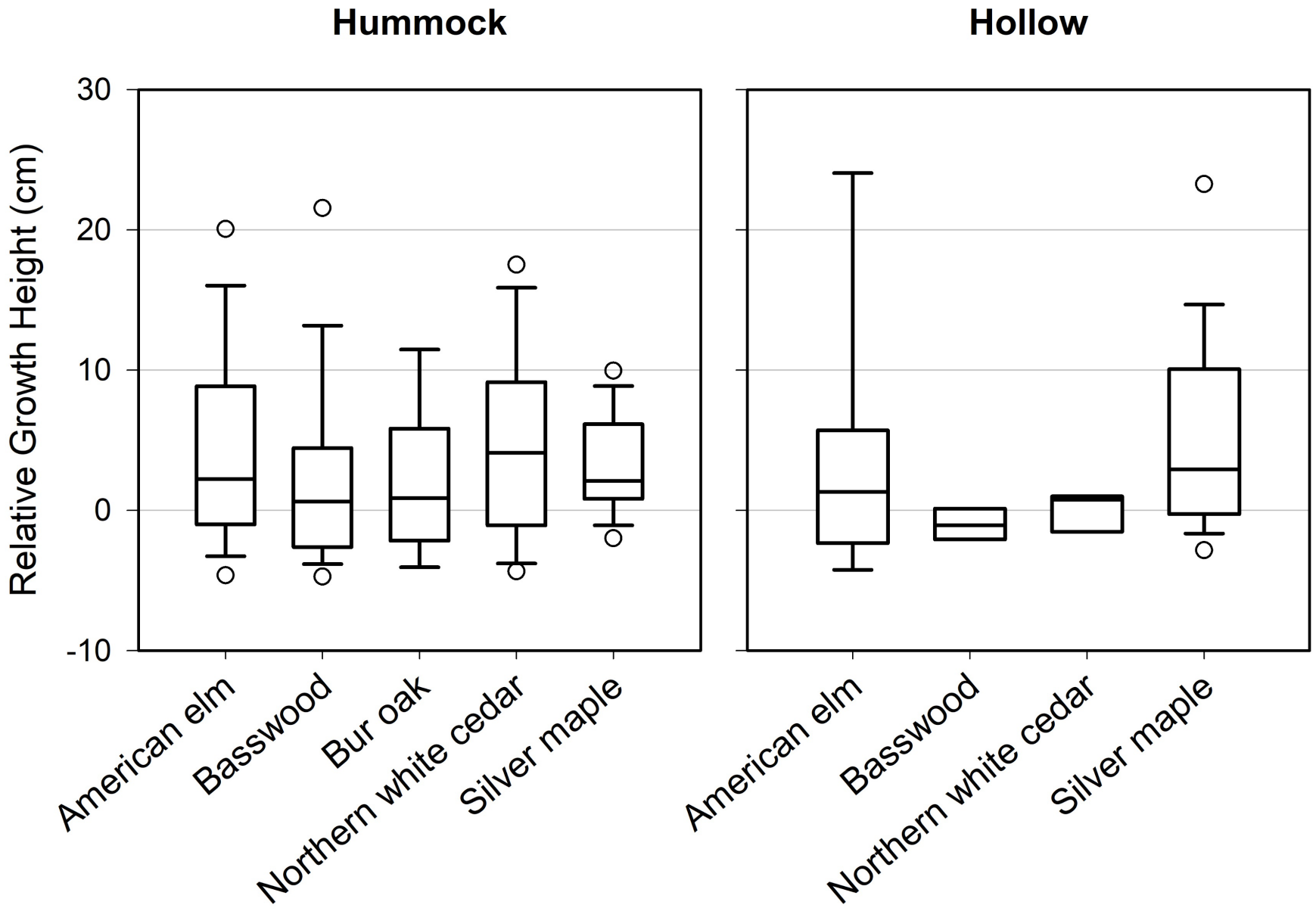


Take away: Better seedling survival on higher elevation points (hummocks)

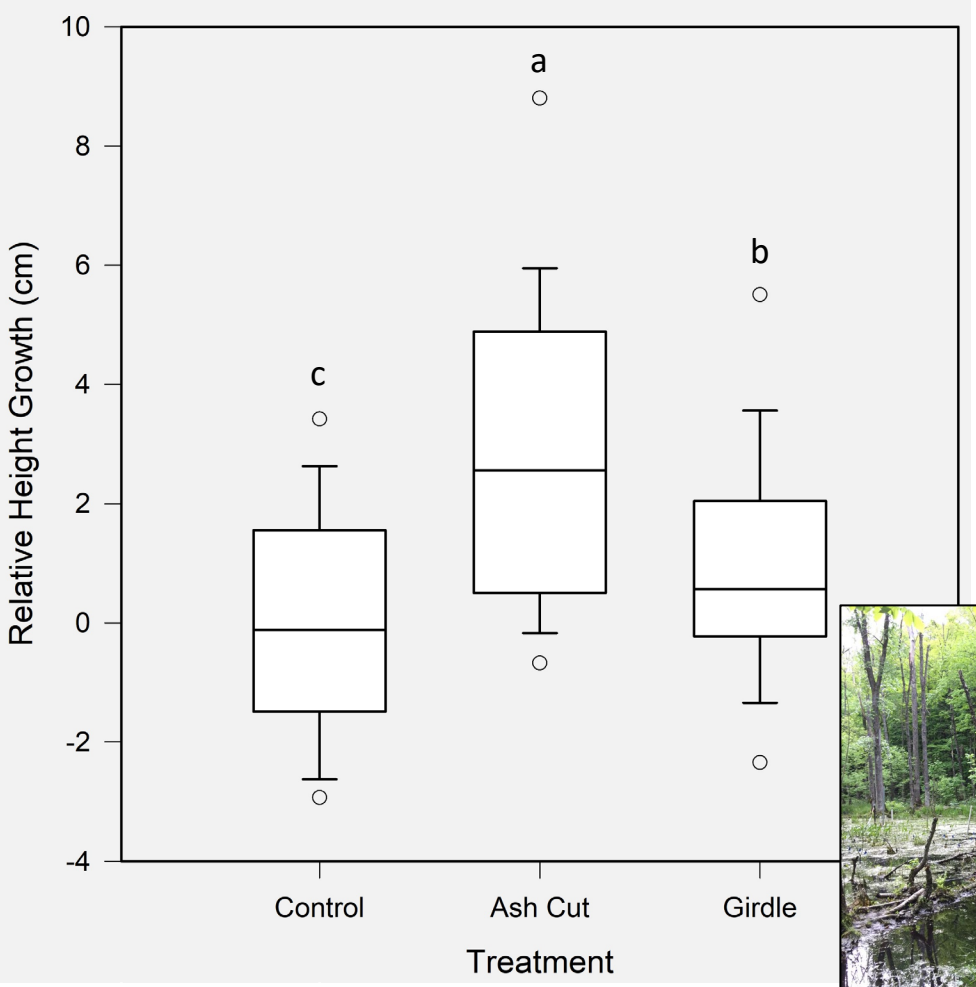


But… Species selection matters more for survival than planting position

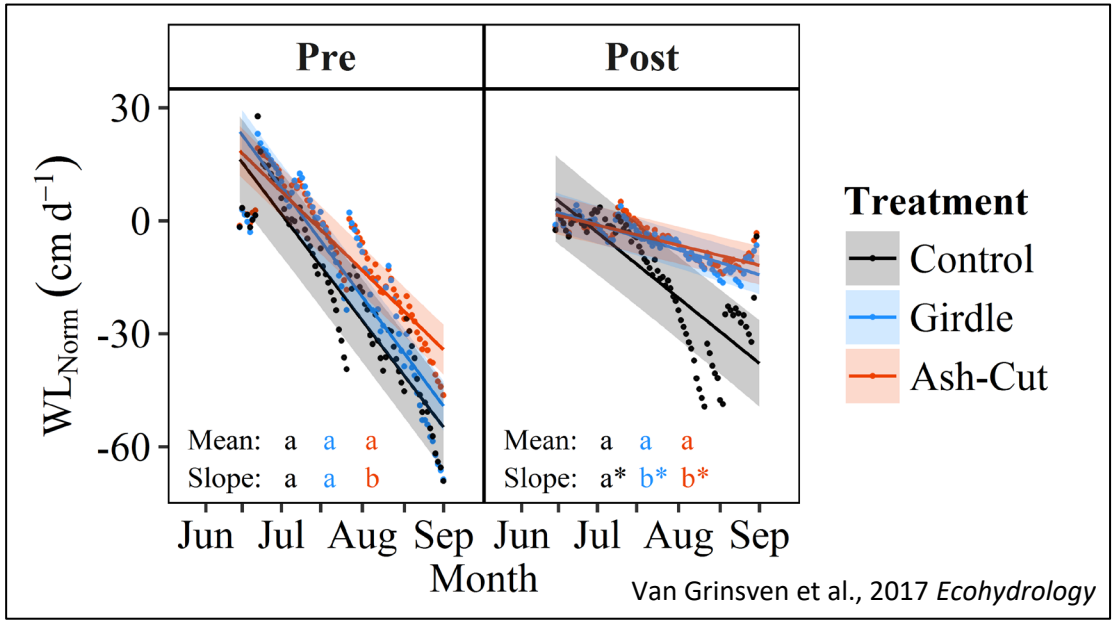
- Growth from 2013-2020
- Better growth rates at higher elevation points for most top surviving species



Importance of light availability for seedling growth



- Seedling growth was greatest at *ash cut* > *girdle* > *control* sites
- Increased **canopy openness** and **light availability** likely fueling increased seedling growth at treatment sites
- Elevated water levels at ash cut and girdled sites **do not** appear to reduce seedling growth



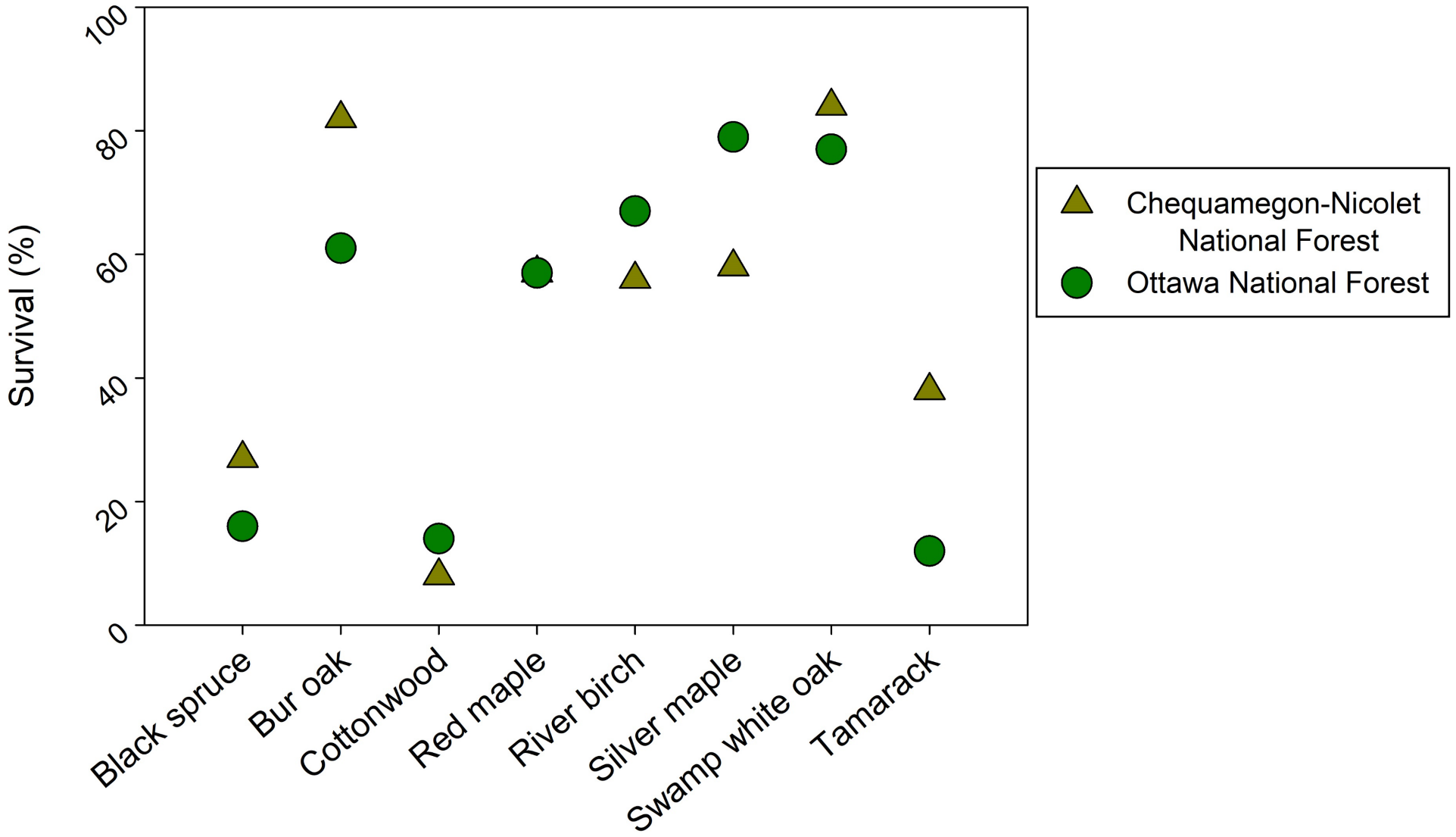
Summer 2022: Chequamegon-Nicolet and Ottawa National Forest Seedling Plantings

- 8 ash-alternative species planted in black-ash dominated lowland wetlands
  - Drainways and lowland wetlands

Common Name	Scientific Name	Currently in habitat range?
Black spruce	*Picea marina*	Within range
Bur oak	*Quercus macrocarpa*	**Outside range**
Cottonwood	*Populus deltoides*	Edge of range
Red maple	*Acer rubrum*	Within range
River birch	*Betula nigra*	**Outside range**
Northern white cedar	*Thuja occidentalis*	Within range
Silver maple	*Acer saccharinum*	Within range
Swamp white oak	*Quercus bicolor*	**Outside range**
Tamarack	*Larix larcinia*	Within range

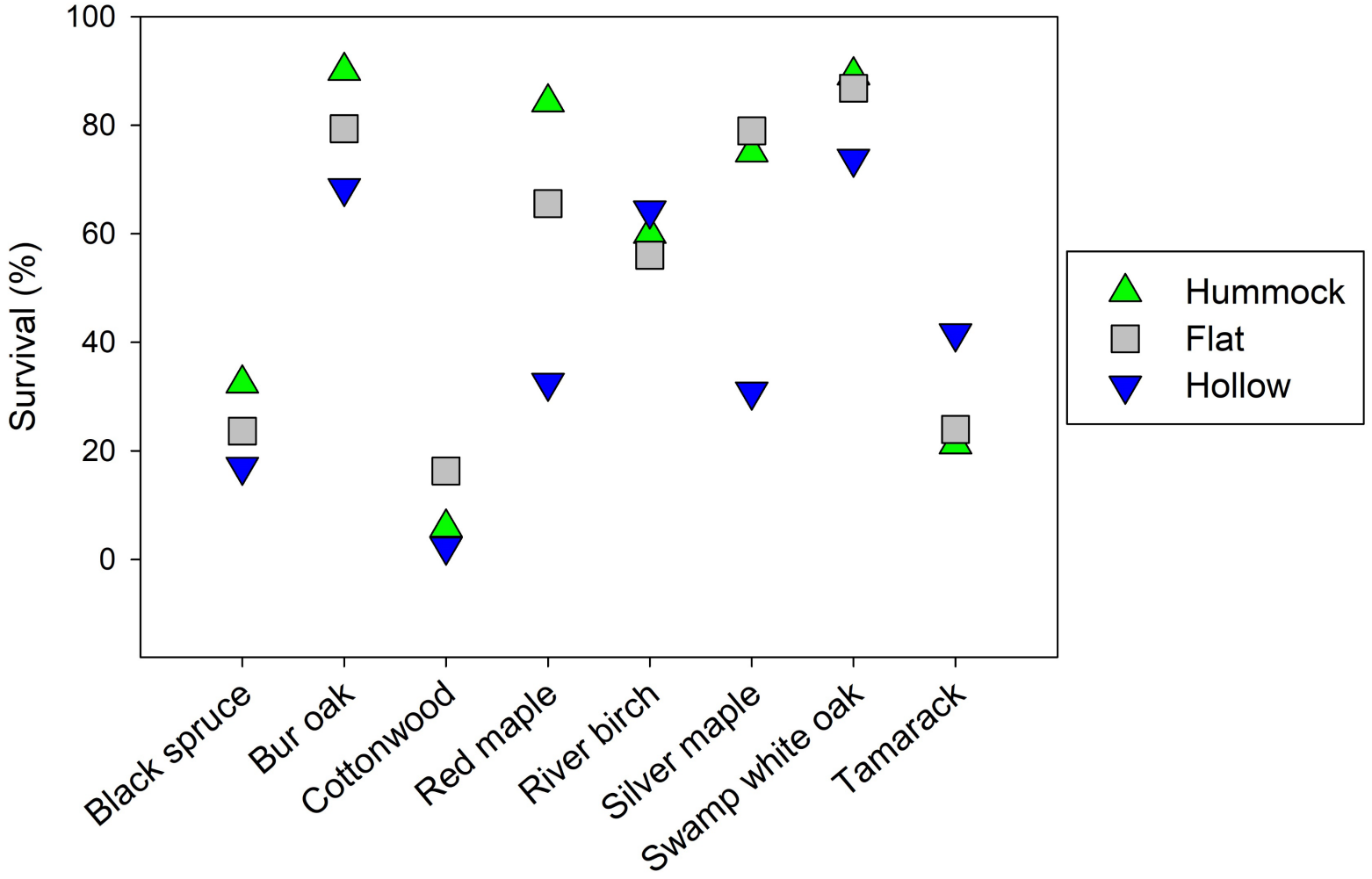
Seedling survival after 1 year: Same trends, different time, different place

- **Winners:** Bur oak, Red maple, River birch, Silver maple, Swamp white oak
- **Losers:** black spruce, cottonwood, tamarack
- Similar results to prior ONF planting study



Seedling survival after 1 year: Same trends, different time, different place

- Microsite does influence survival, but not as much as species
- Some new species seem promising (river birch) and some not so much (cottonwood)
- Similar growth rate trends
  - Indications that red maple, black spruce are slow growing in these wetlands too



Consider planting species to address goals at different timescales

	Survives well	Survives poorly
Grows fast	- Silver maple - American elm - River birch*	- Black spruce - Yellow birch
Grows slowly	- Northern white cedar - Bur oak* - Basswood	- Tamarack - Balsam fir

- **Survives well and grows fast** = 'hold the lines' species
  - Help maintain canopy, thermal cover, control water level responses
- **Survives well and grows slowly** = 'long game species'
  - Lends diversity as stand matures
- **Survives poorly and grows fast** = plant for some structural and species diversity
- **Survives poorly and grows slowly** = don't bother with these

Consider planting species to address goals at different timescales

	Survives well	Survives poorly
Grows fast	- Silver maple - American elm - River birch*	- Black spruce - Yellow birch
Grows slowly	- Northern white cedar - Bur oak* - Basswood	- Tamarack - Balsam fir

- **Survives well and grows fast** = 'hold the lines' species
  - Help maintain canopy, thermal cover, control water level responses
- **Survives well and grows slowly** = 'long game species'
  - Lends diversity as stand matures
- **Survives poorly and grows fast** = plant for some structural and species diversity
- **Survives poorly and grows slowly** = don't bother with these

Climate considerations: Some species from outside current habitat ranges appear to survive well

- river birch, bur oak, swamp white oak

Management Considerations

- Light availability drives seedling growth → Consider opening canopy with targeted removals
  - Shelterwood effect of girdled sites supports relatively high growth and survival for a variety of species

Management Considerations

- Light availability drives seedling growth → Consider opening canopy with targeted removals
  - Shelterwood effect of girdled sites supports relatively high growth and survival for a variety of species

- Manage as non-forest wetlands – view change as opportunity
  - Plant native shrubs and grasses, focus on invasive species removal

Management Considerations

- Light availability drives seedling growth → Consider opening canopy with targeted removals
  - Shelterwood effect of girdled sites supports relatively high growth and survival for a variety of species

- Manage as non-forest wetlands – view change as opportunity
  - Plant native shrubs and grasses, focus on invasive species removal

- Consider hydrologic connectivity between wetland hydrology and regional groundwater system
  - Target places where hydrology can be controlled by management or is more locally influenced
  - Coupled upland/wetland management strategies can help minimize wetland water level rise

Buffer of trees around seasonal pond

Thank you!

Thank you!

Project papers:

- Bolton et al., 2018. Methods to improve survival and growth of planted alternative species seedlings in black ash ecosystems threatened by emerald ash borer. *Forests* 9 doi:10.3390/f9030146

- Davis et al., 2017. Vegetation responses to simulated emerald ash borer infestation in Fraxinus nigra dominated wetlands in Upper Michigan, USA. *Canadian Journal of Forest Research* 47 doi:10/1139/cjfr-2016-0105

- Davis et al., 2019. Nitrogen cycling responses to simulated emerald ash borer infestation in Fraxinus nigra-dominated wetlands. *Biogeochemistry* 145 doi:10.1007/s10533-019-00604-2

- Noh et al., 2018. Temperature responses of carbon dioxide fluxes from coarse dead wood in a black ash wetland. *Wetlands Ecology and Management* 27 doi:10.1007/s11273-01809649-0

- Shannon et al., 2018. Water level controls on sap flux of canopy species in black ash wetlands. *Forests* 9 doi:10.3390/f9030147

- Van Grinsven et al., 2017. Source water contributions and hydrologic responses to simulated emerald ash borer infestations in depressional black ash wetlands. *Ecohydrology* 10 doi:10.1002/eco.1862

- Van Grinsven et al., 2018. Response of black ash wetland gaseous soil carbon fluxes to a simulated emerald ash borer infestation. *Forests* 9 doi:10.3390/f9060324