

# Evaluation of Planted Seedling Survival and Growth in Forested Mitigation Wetlands in Marquette Michigan, USA

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# Mitigation Wetland Project & Site History

## Purpose and Background

Mitigation project to fulfill a Michigan Department of Environment, Great Lakes, and Energy permit to restore 2.1 acres of forested palustrine wetlands.

## Study Area Description

Some of the historically present seasonally saturated palustrine persistent emergent and shrub/scrub broad-leaved deciduous wetlands remain intact.

- Several feet of sandy-gravel fill was placed on top of a portion of the pre-existing wetland area circa 1920.
- It is possible this area should actually be classified as a coastal swamp due to its proximity to and possible hydrological connection with Lake Superior.

(See K. Robinson "Examining Hydrologic Connectivity of Mitigated Forested Wetlands in Marquette Michigan, USA" poster)



**Figure 1.** Study area location relative to the Great Lakes region and the City of Marquette (right), and the mitigation wetland study site boundaries (above).



# Objectives and Methods

The purpose of this study was to evaluate the relative growth rates and survivorship of planted seedlings within two forested mitigation wetlands.



## Planted Seedling Monitoring

A few hundred tree seedlings, including balsam fir, red maple, silver maple, tamarack, white spruce and white cedar were planted in sites B and C in 2015 and 2016.

- 253 seedlings were tagged with unique IDs in 2017, and baseline height measurements were recorded.
- Seedling height and survivorship were monitored in 2018 and 2019, respectively.

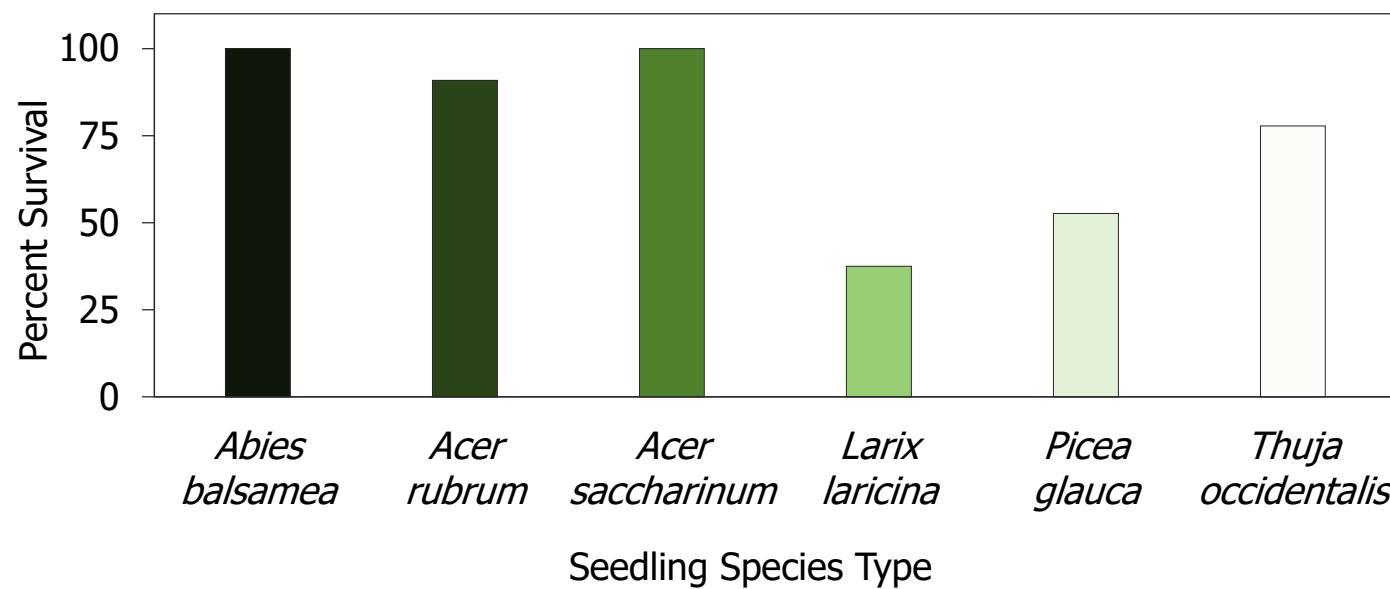
Relative height growth was calculated according to equation 1 where RH = relative height (cm), H = height (cm) and t = time (year)

### Equation 1

$$RH = \frac{(H_2 - H_1)}{\frac{H_1}{t_2 - t_1}}$$

# Results: Planted Seedling Survival

Common Name	Scientific Name	n	Survival (%)
Balsam fir	<i>Abies balsamea</i> (L.) Mill	30	100
Red Maple	<i>Acer rubrum</i> L.	33	90.9
Silver maple	<i>Acer saccharinum</i> L.	5	100
Tamarack	<i>Larix laricina</i> K. Koch	40	37.5
White spruce	<i>Picea glauca</i> (Moench) Voss	19	52.6
White cedar	<i>Thuja occidentalis</i> L.	54	77.8



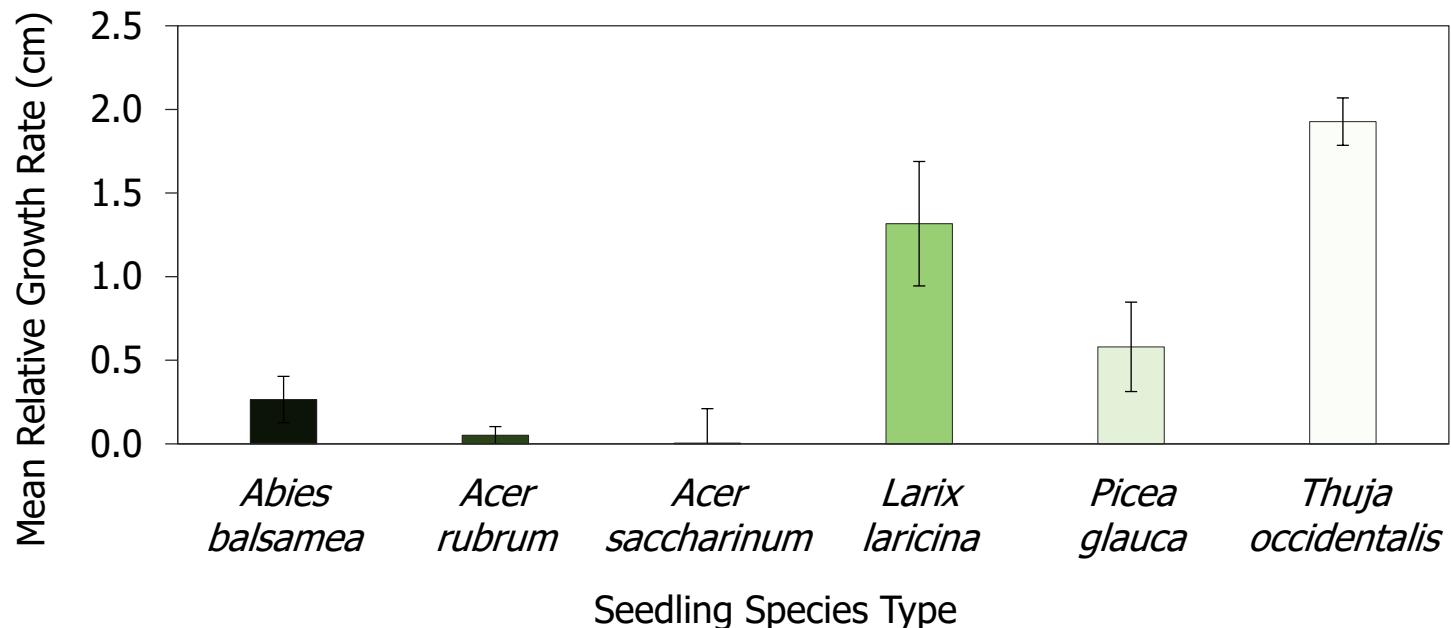
**Table 1.** Survival (%) of planted tree species in site B and site C mitigation wetlands between 2018 and 2019 where n is the number of observations.

**Figure 2** Percent survival (%) of planted tree species in site B and site C mitigation wetlands between 2018 and 2019.

- The 72.9% survivorship for all species between 2018-2019 was considerably greater than the 37.9% survivorship reported for the same sites between 2017-2018.

# Results: Mean Relative Height Growth

Common Name	Scientific Name	n	MRGR (cm $y^{-1}$ )	SE MRGR (cm $y^{-1}$ )
Balsam fir	<i>Abies balsamea</i> (L.) Mill	30	0.2652	0.1385
Red Maple	<i>Acer rubrum</i> L.	30	0.0514	0.0521
Silver maple	<i>Acer saccharinum</i> L.	5	0.0045	0.2061
Tamarack	<i>Larix laricina</i> K. Koch	15	1.3168	0.3723
White spruce	<i>Picea glauca</i> (Moench) Voss	10	0.5802	0.2674
White cedar	<i>Thuja occidentalis</i> L.	42	1.9270	0.1414

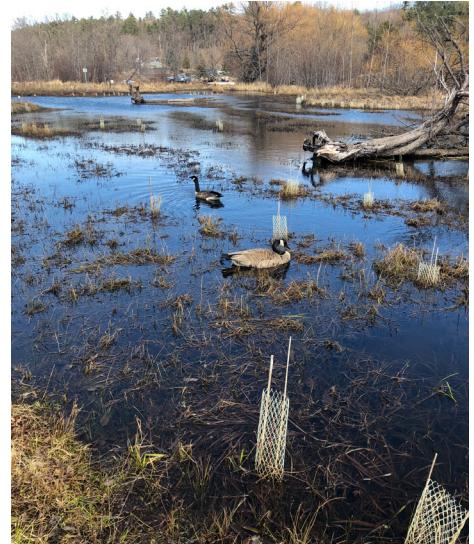


**Table 2.** Mean relative growth rate (MRGR;  $\text{cm } y^{-1}$ ) of planted tree species in site B and site C mitigation wetlands between 2018 and 2019 where n is the number of observations and SE is the standard error (cm).

**Figure 3** Mean relative growth rate (MRGR;  $\text{cm } y^{-1}$ ) of planted tree species in site B and site C mitigation wetlands between 2018 and 2019 where whiskers represent  $\pm 1$  standard error (cm).

- Tamarack demonstrated the second largest relative growth rate, however it conversely exhibited the lowest survivorship.

# Discussion & Conclusion



- Survivorship for all planted tree species was considerably greater between 2018 – 2019 when compared to 2017 – 2018
- Based upon both survivorship and mean relative height growth, white cedar was a top performing species with a  $1.9 \text{ (cm y}^{-1}\text{)}$  and 78% survivorship. Red maple and silver maple also demonstrated strong survivorship among species.
- These results will support future wetland mitigation efforts in the area by providing a targeted list of best and poorest performing tree species.