

# Restoring our underwater forests: can native revegetation enhance invasion resistance in lakes?

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Binational GLAIS Forum  
Nov 19, 2025



UNIVERSITY OF MINNESOTA



07/30/2024 12:29:08

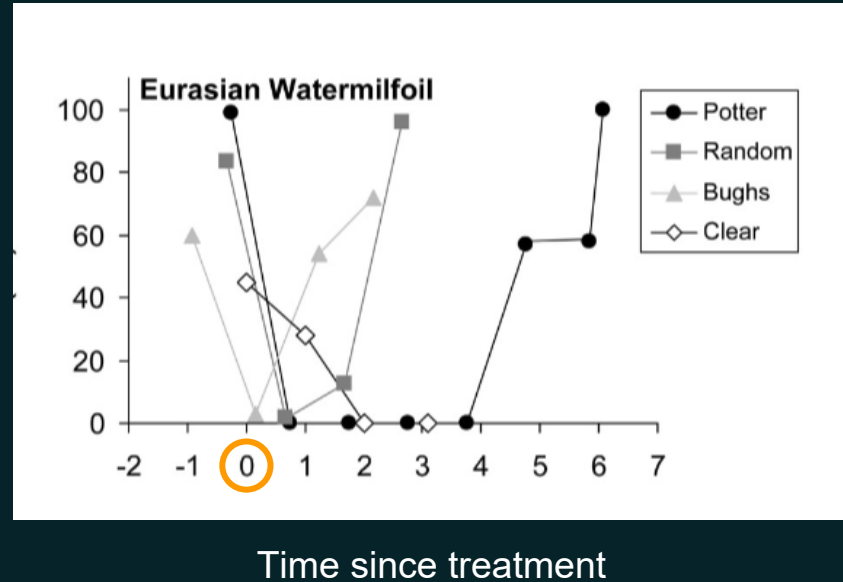
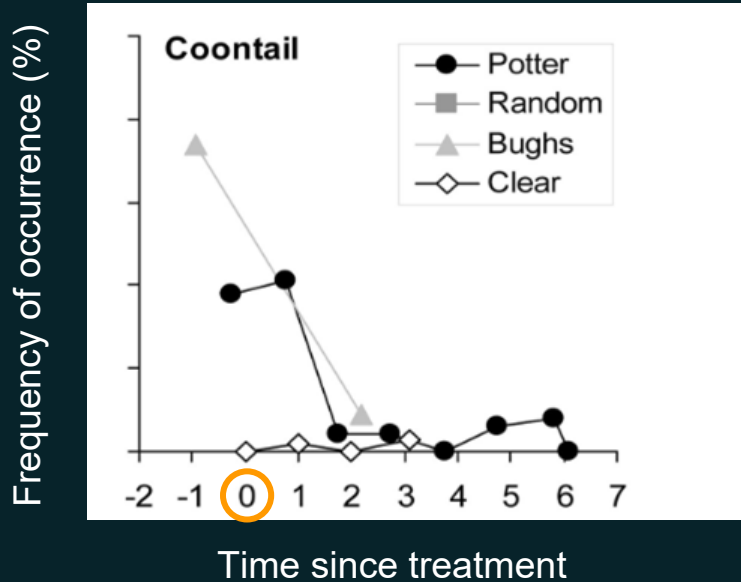




# Only one problem!

Often the native plants don't come back...

...and the invaders do!



These two shortcomings  
– **lack of native plant recovery and reinvasion**  
– may be linked.

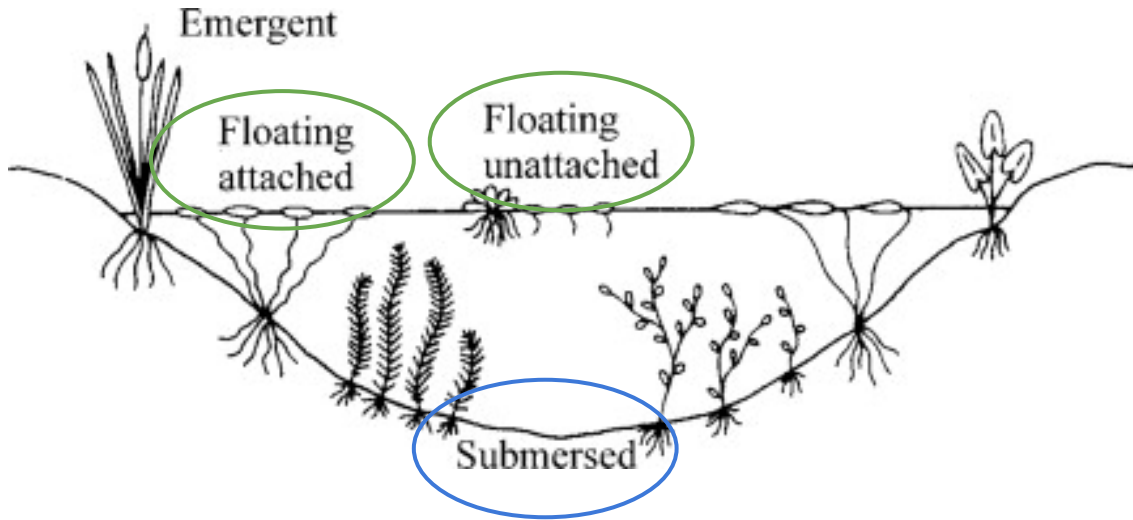
**BIOTIC RESISTANCE (Elton, 1958)**

The hypothesis that having more biologically diverse communities can lower invasion risk



Could **revegetation** of aquatic plants be used to prevent re-invasion and enhance lake resilience?

# Types of aquatic plants



138 species recorded in Minnesota lakes!  
(PI Charter, 2024)



Curlyleaf pondweed  
(*Potamogeton crispus*)



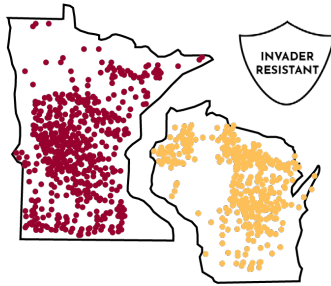
Starry stonewort  
(*Nitellopsis obtusa*)



Eurasian watermilfoil  
(*Myriophyllum spicatum*)

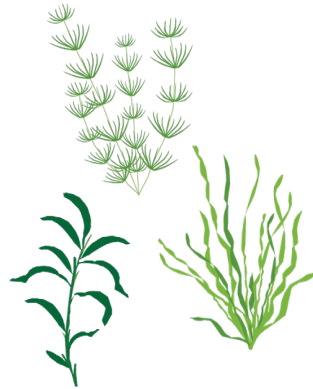
# Project overview

STEP 1



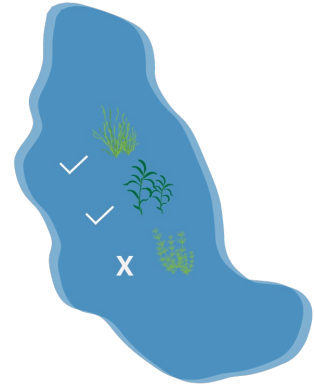
Analysis of monitoring  
data

STEP 2



Identifying and  
propagating focal  
species

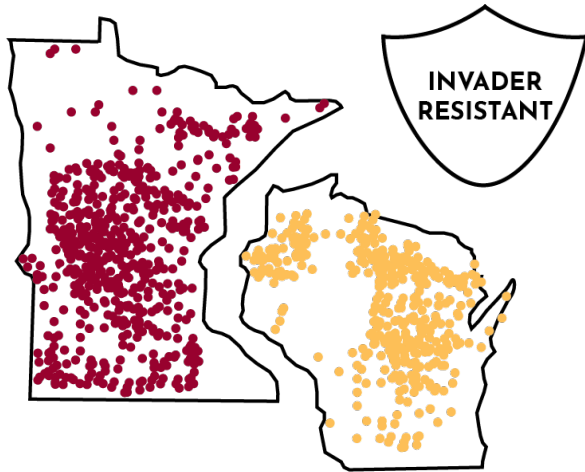
STEP 3



In-lake,  
revegetation trials

# Project overview

STEP 1

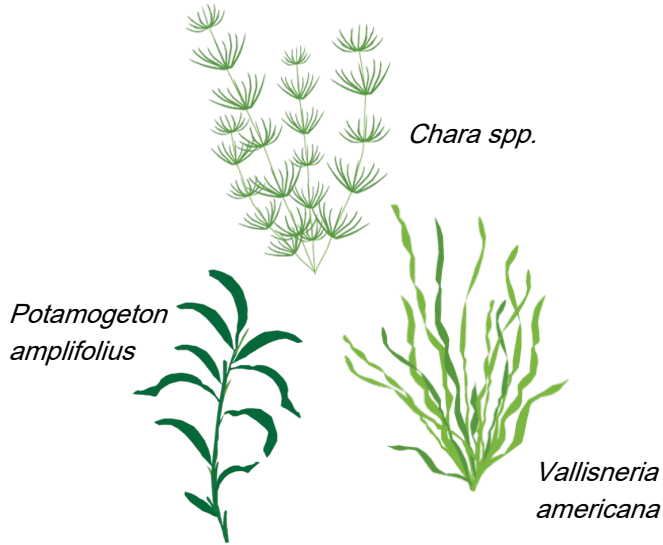


Analysis of monitoring  
data

- Minnesota & Wisconsin
- Monitoring data
  - More than 6,000 point-intercept surveys
  - 20+ years
- **Which characteristics of native plant communities might enhance invasion resistance?**

# Project overview

## STEP 2

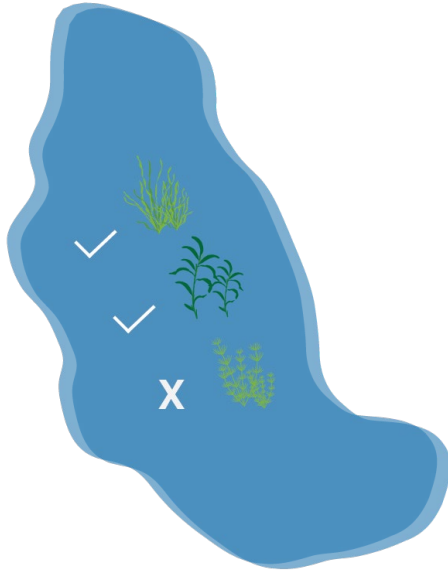


Identifying and propagating focal species

- Figure out seed storage, germination, and transplanting protocols for revegetation
- Select focal species
- Propagate species under various environmental conditions

# Project overview

STEP 3

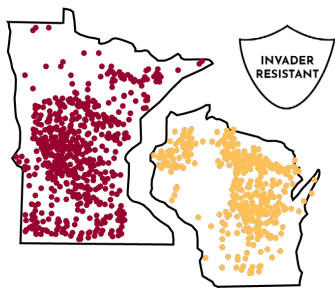


In-lake,  
revegetation trials

- Testing reveg framework (species, methods, environmental conditions)
- Looking at past revegetation data
- Adaptive management

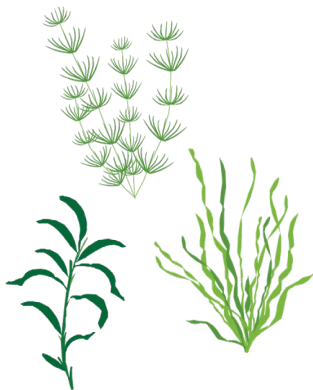
# Project updates

STEP 1



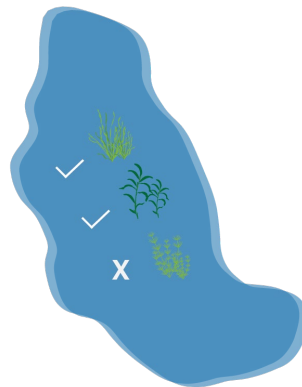
Analysis of monitoring  
data

STEP 2



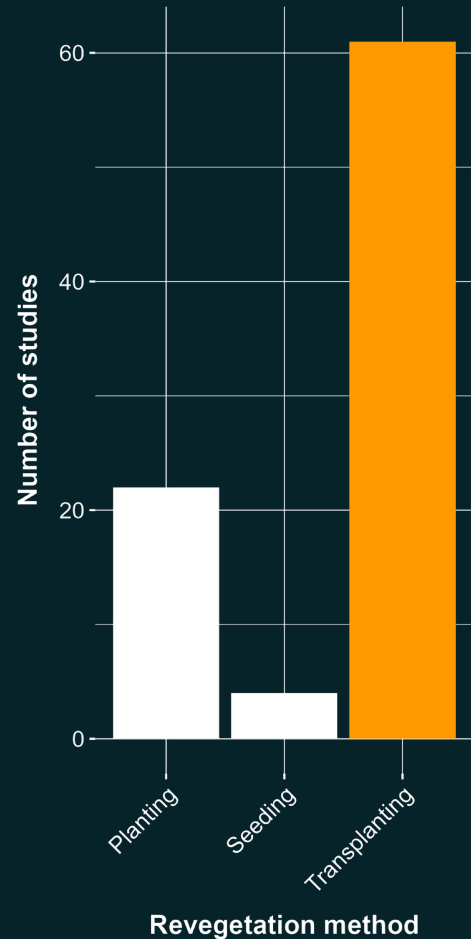
Identifying and  
propagating focal  
species

STEP 3



In-lake,  
revegetation trials

Current revegetation methods rely highly on **transplanting** mature plants from **donor** sites



# Large gaps in knowledge for growing submerged plants from **seed**

Z<sub>z</sub>

Dormancy?  
Seeds can  
“sleep” for  
decades



Germination cues?  
Light, temp,  
chemical



Standardized  
protocols for seed  
harvesting and  
storage?



Limited studies with  
varying success,  
rarely applied in field  
contexts

(Muenscher 1936,  
Verhoeven et al. 2024,  
Rohal et al. 2022,  
Ailstock et al. 2010)

HARVESTING



CLEANING



STORING



**Illinois pondweed**  
(*Potamogeton illinoiensis*)



Photo credit:  
Naomi Blinick

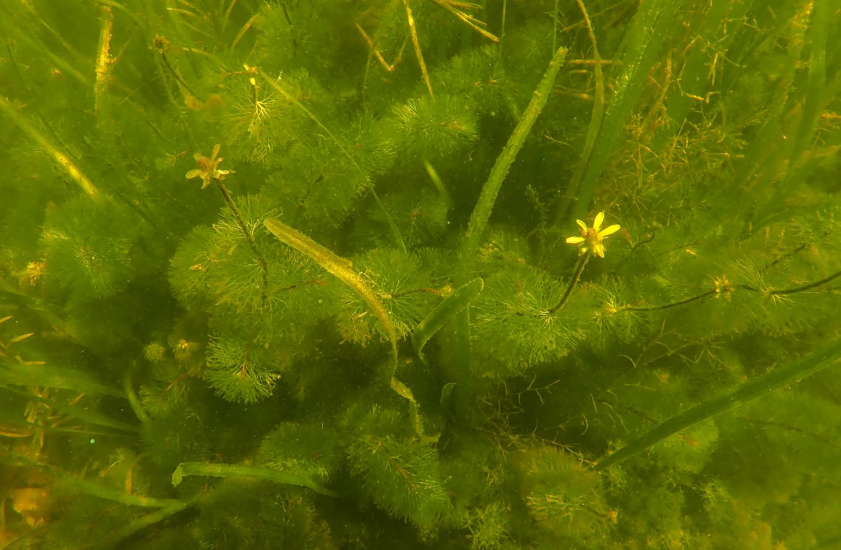
Water celery  
(*Vallisneria americana*)



2017 © Peter M. Dzuk

Thousands of  
seeds in here!





# Preliminary storage trials

Moisture	Temperature	Aeration	Water type
Wet	Cold	Sealed	Distilled
Dry	Ambient	Unsealed	Tap

11,000+ seeds, 7 species

*P. illinoensis*      *P. richardsonii*  
*P. amplifolius*    *P. foliosus*  
*P. natans*          *N. flexilis*  
*V. americana*



# Success!

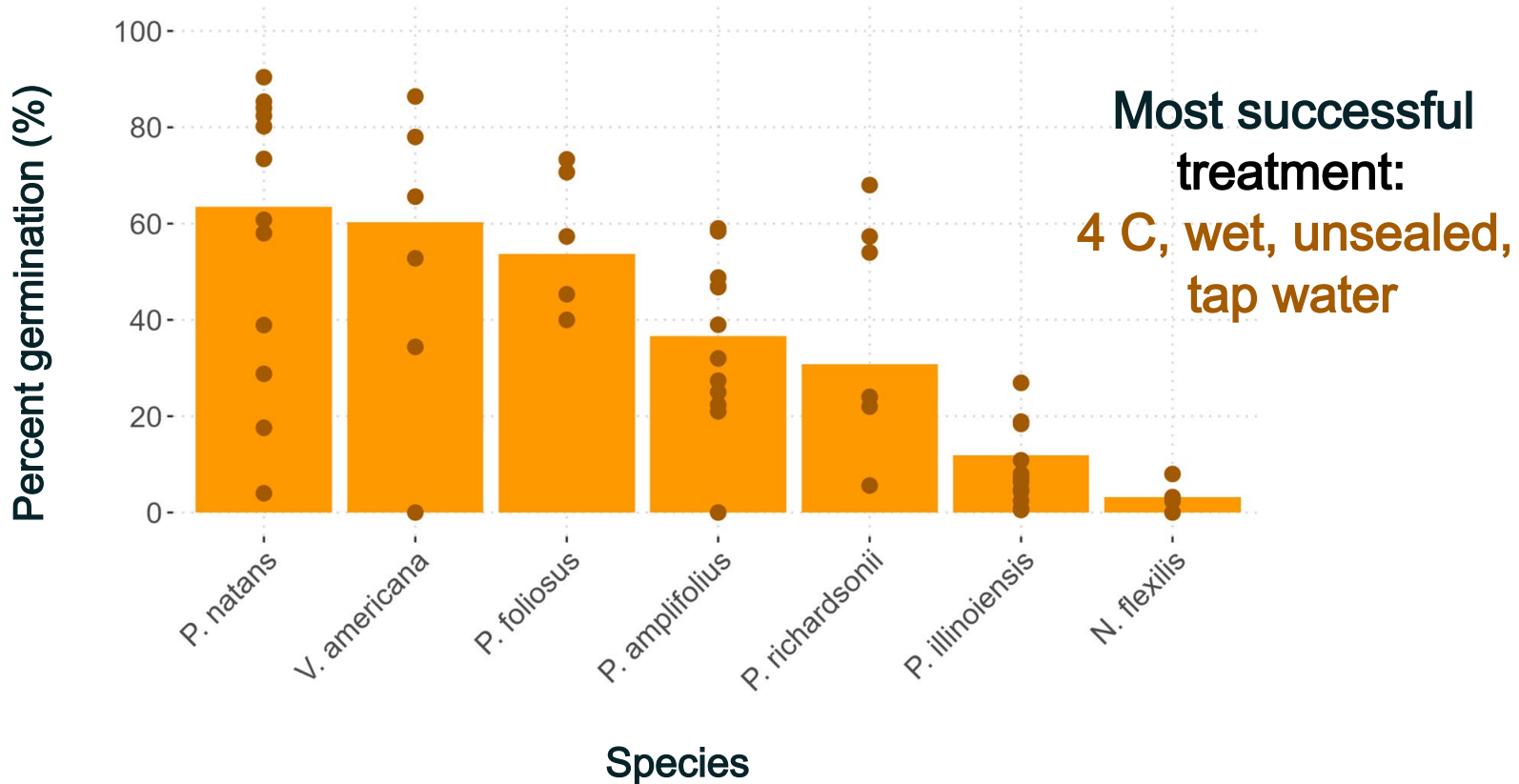
All species germinated with clear differences in treatment combinations

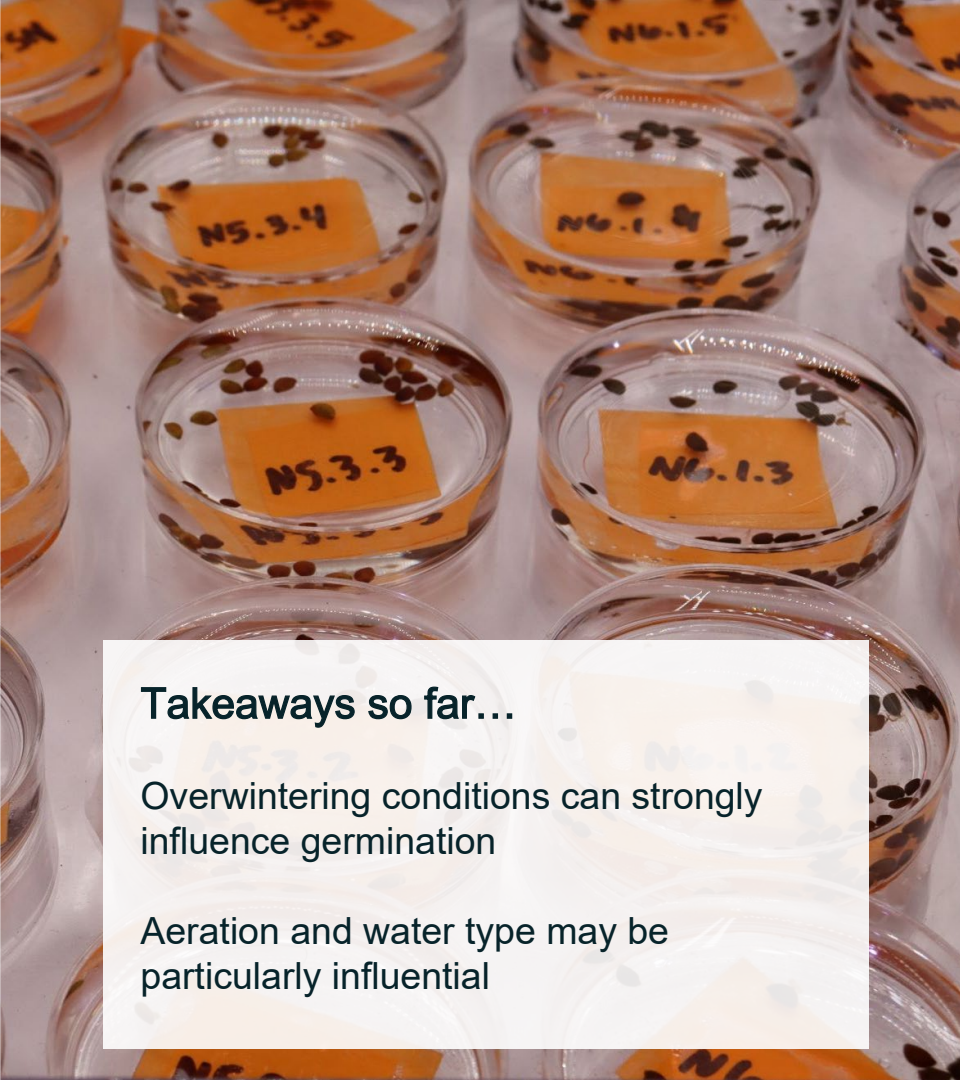
**MAX: 90% germination**  
**AVG: 40% (4,600 seedlings)**

Photo credits: Ethan O'Brien, Abha Panda



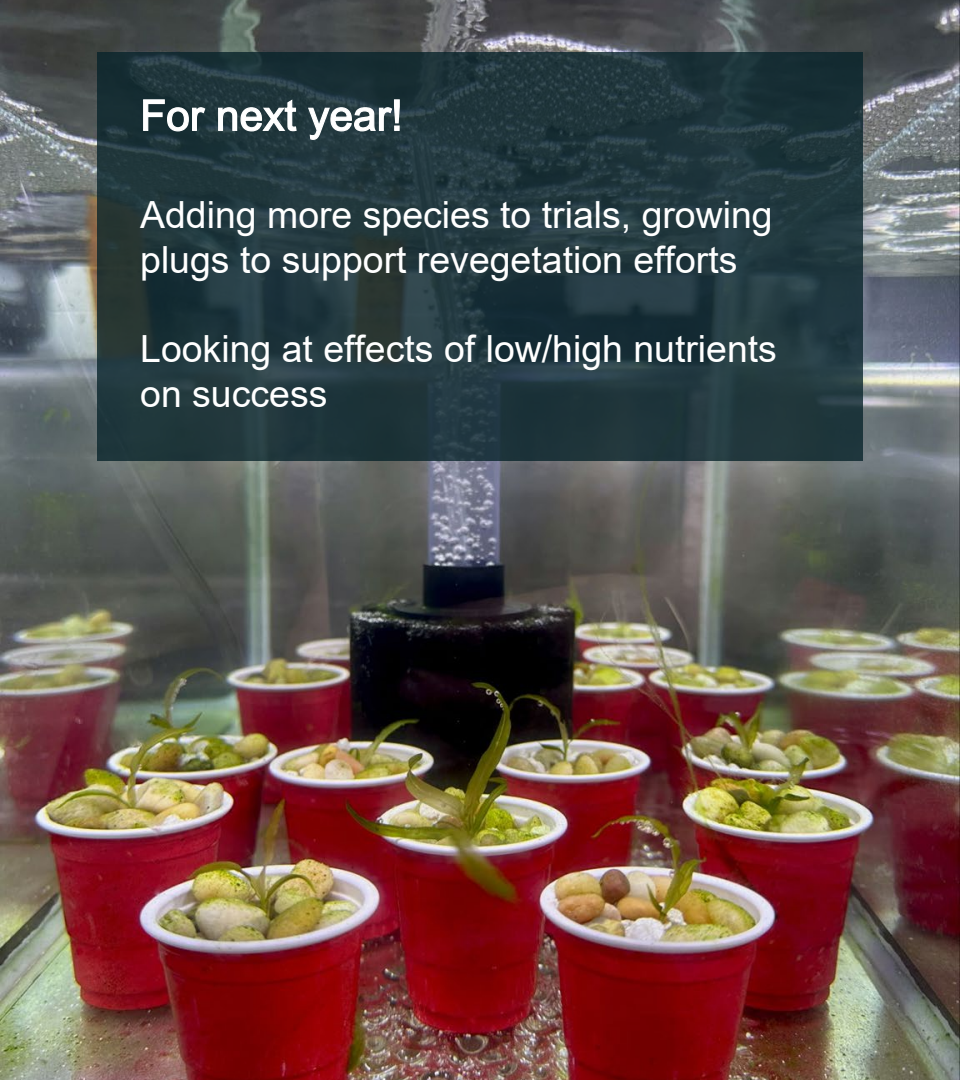
# Floating leaf pondweed (*P. natans*) had most germination across species





**For next year!**

- Adding more species to trials, growing plugs to support revegetation efforts
- Looking at effects of low/high nutrients on success

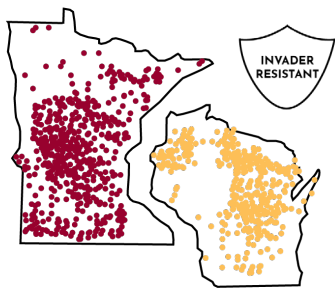


**Takeaways so far...**

- Overwintering conditions can strongly influence germination
- Aeration and water type may be particularly influential

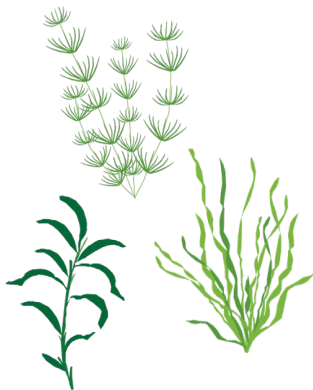
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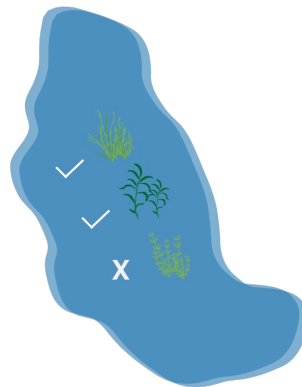
Analysis of monitoring  
data

STEP 2



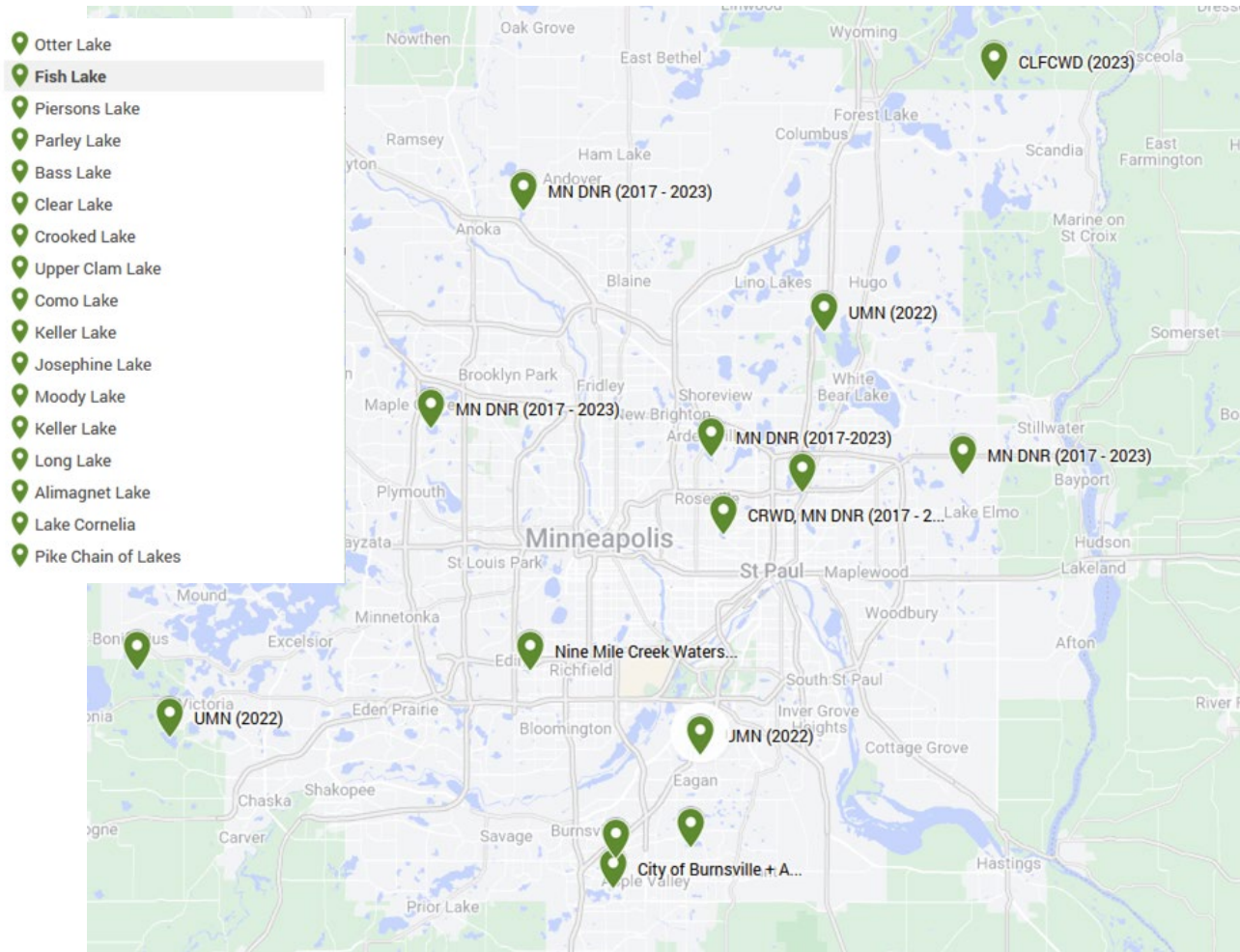
Identifying and  
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STEP 3



In-lake,  
revegetation trials

# Twin Cities revegetation projects (current / ongoing)



# Working Group Meeting (April, 24)

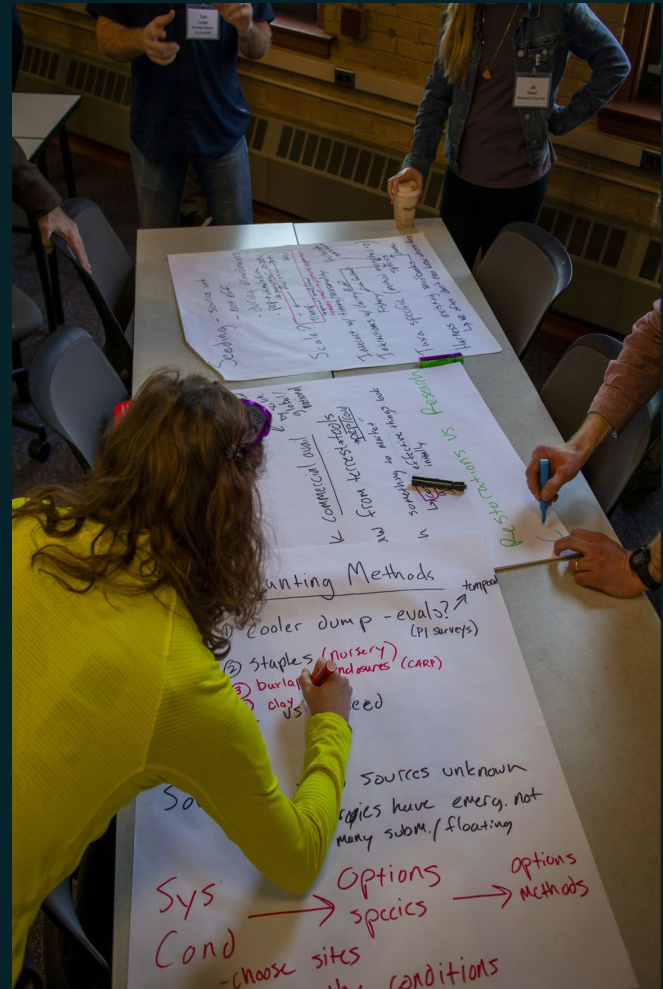


- ❖ Watershed districts
- ❖ State/federal agencies
- ❖ Local government groups
- ❖ Consulting firms

# What are the **biggest barriers** for engaging in revegetation efforts currently?

- Lack of “best management practices”
- Scalability
- Plant selection
- Sourcing/donor lake challenges
- Monitoring and maintenance
- Social buy-in + funding challenges

→ “knowing -doing gap”



# Establishing standardized trials across the Metro

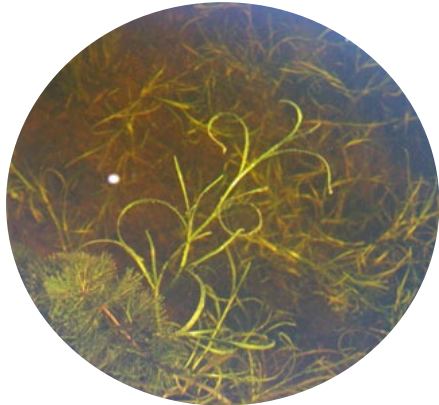
## Example: Centerville Lake, Anoka County



# Species selection

- Monitoring data post-invasion (which species persist after invasion?)
  - Growth forms (carpet growing vs large leaf)
  - Reproductive structures (rhizomes vs seeding)

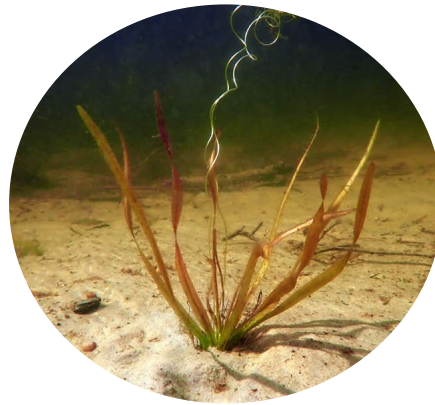
**Water stargrass**  
(*H. dubia*)



**Illinois pondweed**  
(*P. illinoensis*)



**Water celery**  
(*V. americana*)

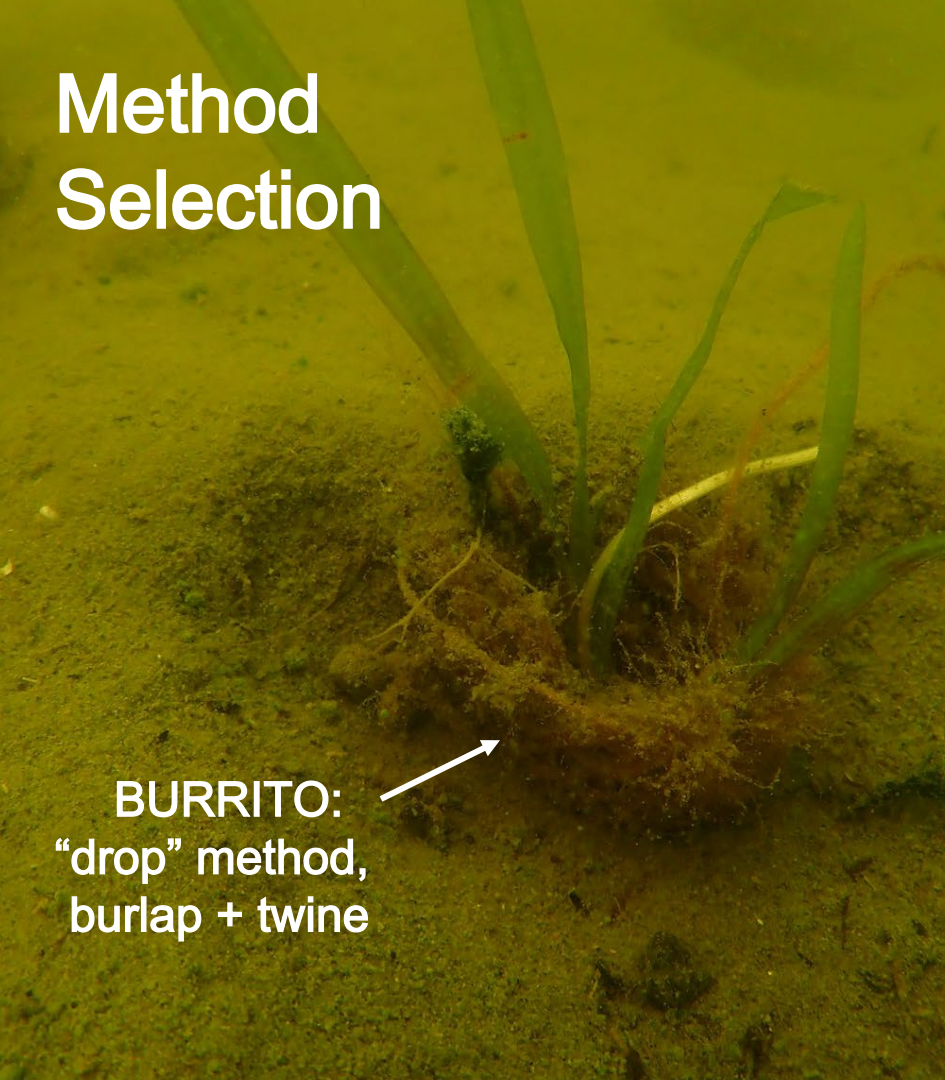


**Muskgrass**  
(*Chara*)



# Method Selection

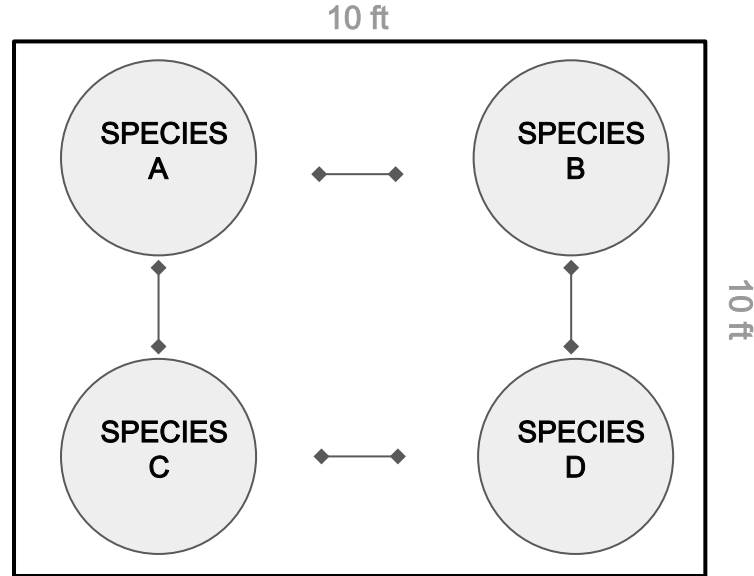
**BURRITO:**  
“drop” method,  
burlap + twine

An underwater photograph showing a plant with long, green, blade-like leaves. The root system is exposed and is held together by a thick, brown, fibrous material, likely burlap, which is secured with several strands of light-colored twine. A white arrow points from the text 'BURRITO' to the root system.

**STAPLE:**  
“plant” method,  
metal landscaping  
staples

An underwater photograph showing a plant with long, green, blade-like leaves. The root system is exposed and is held together by several metal landscaping staples. A white arrow points from the text 'STAPLE' to the root system.

# Study design with chicken wire enclosures



+ Control Areas  
(with and without enclosure)



# Monitoring and expected results

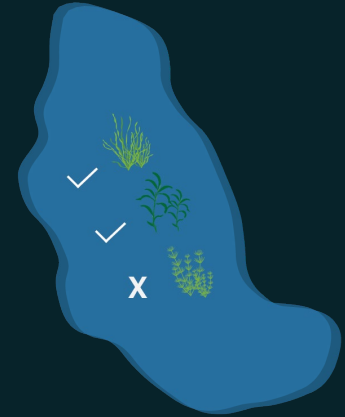
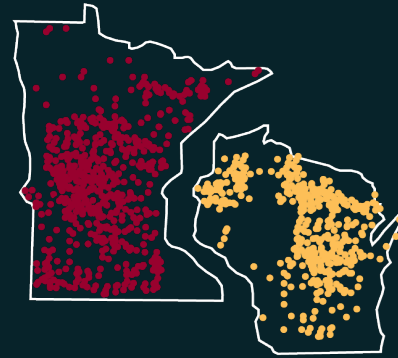
4+ metro lakes

Year 1 & 2 survival

- Less re-invasion in planted exclosures compared to control areas
- Environmental conditions will likely play a large role
  - Differences in method x species combinations in establishment success



Can revegetation  
of aquatic plants  
be used to  
enhance lake  
resilience and  
prevent invasion?



# No singular answer: **context matters**

## **Biotic resistance to invasion is ubiquitous across ecosystems of the United States**

Evelyn M. Beaury ✉, John T. Finn, Jeffrey D. Corbin, Valerie Barr, Bethany A. Bradley

First published: 25 December 2019 | <https://doi.org/10.1111/ele.13446> | Citations: 122

## **Correlation of native and exotic species richness: a global meta-analysis finds no invasion paradox across scales**

Shijia Peng, Nicole L. Kinlock, Jessica Gurevitch ✉, Shaolin Peng

First published: 02 January 2019 | <https://doi.org/10.1002/ecy.2552> | Citations: 101

# Meta-analysis: a global perspective on revegetation

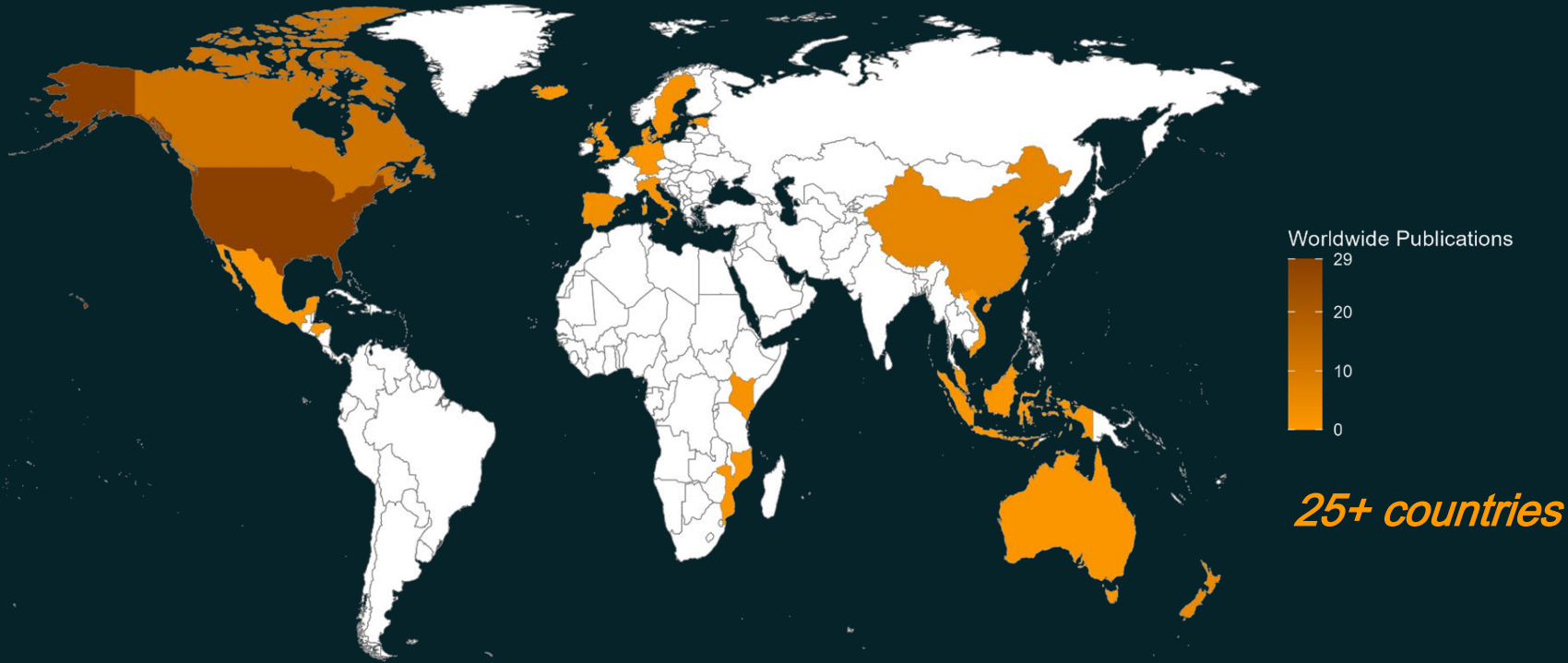
(aquatic OR wetland OR lake OR river OR marsh OR bog OR fen OR stream OR coastal OR marine OR sea)

AND

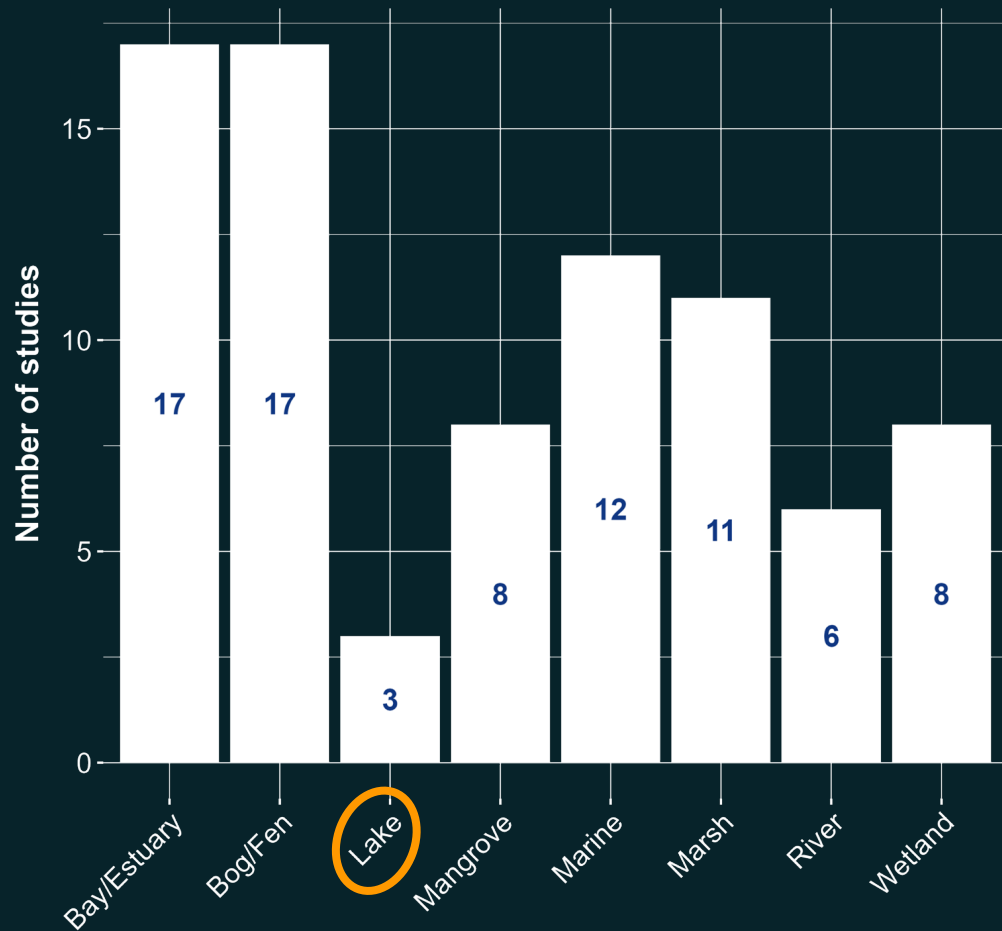
(revegetat\* OR revegetat\* OR reseed\* reseed\* OR replant\* re-plant\* OR transplanted)



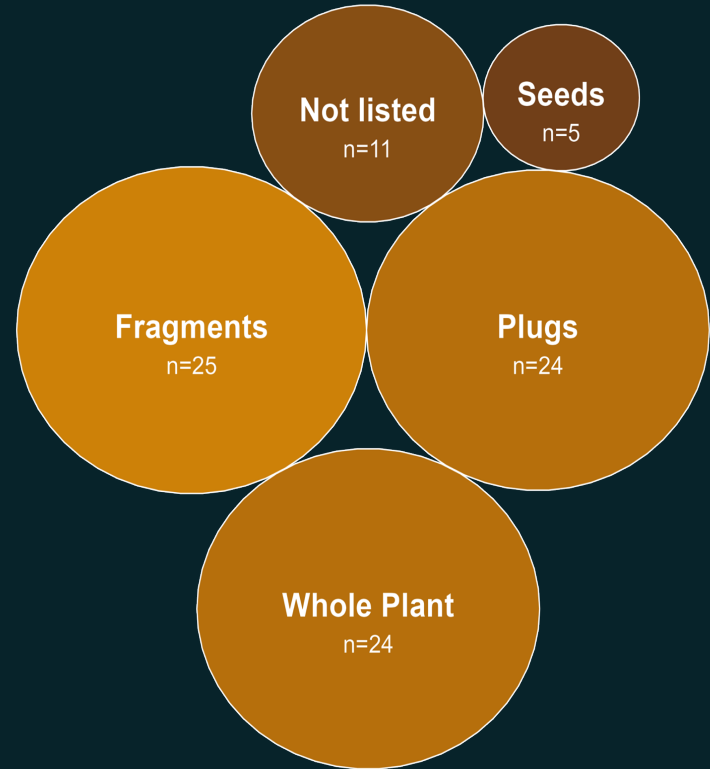
# Where are active revegetation projects happening?



**Lakes**  
**underrepresented**  
in global  
revegetation  
studies



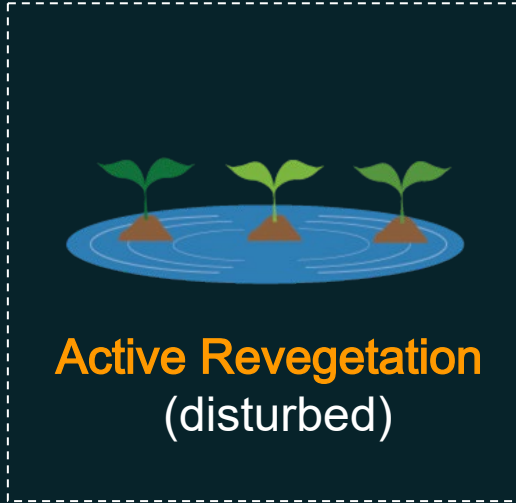
**Less seed based**  
methods were used,  
reliance on vegetative  
material



# Did active revegetation “succeed” across these studies?



**Reference**  
(undisturbed)



**Active Revegetation**  
(disturbed)

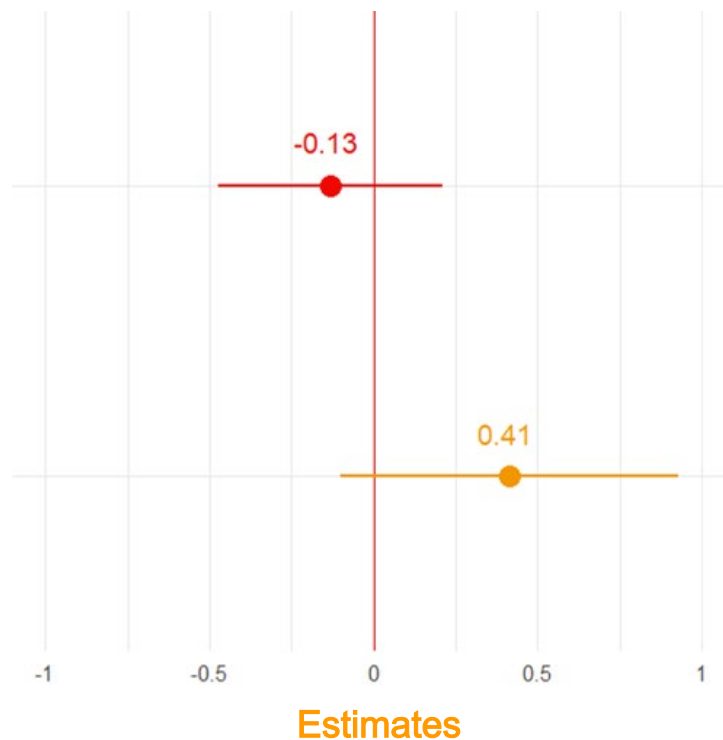
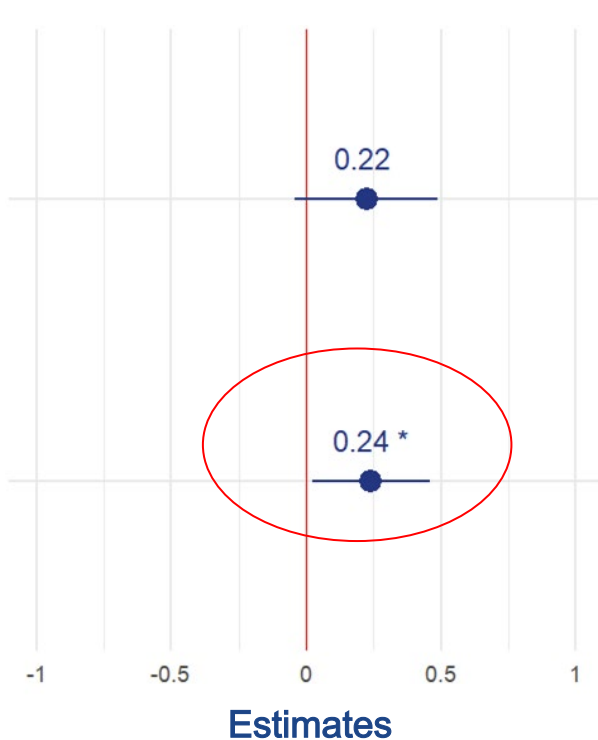


**Unplanted**  
(disturbed)

# DIVERSITY higher in revegetated sites; no difference in ABUNDANCE

DIVERSITY (n=21)

ABUNDANCE (n=60)



# Main takeaways

Revegetation can work! **Sometimes!**

Need for more scalable, seed based methods & field applications

Aquatic plants in lakes are often understudied compared to plants in other systems...**BUT**...this does not mean we should ignore them!

**Plants are foundational to our lake ecosystems. We need them (more) than they need us!**



# THANK YOU!

**Advisor:** Dr. Dan Larkin

**Research team members:** Naomi Blinick, Dr. Mike Verhoeven

**Research technicians:** Zoë Battle, Ava Schimnowski

**Collaborators for lake trials:** MN DNR, Rice Creek Watershed District, City of Apple Valley, City of Burnsville, Minneapolis Parks and Recreation Board

**Working group members and other partners!**



**ENVIRONMENT  
AND NATURAL RESOURCES  
TRUST FUND**



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Naomi Blinick