Lakeshore Habitat Restoration in the Northern Highlands Ecological Landscape

WAL Conference
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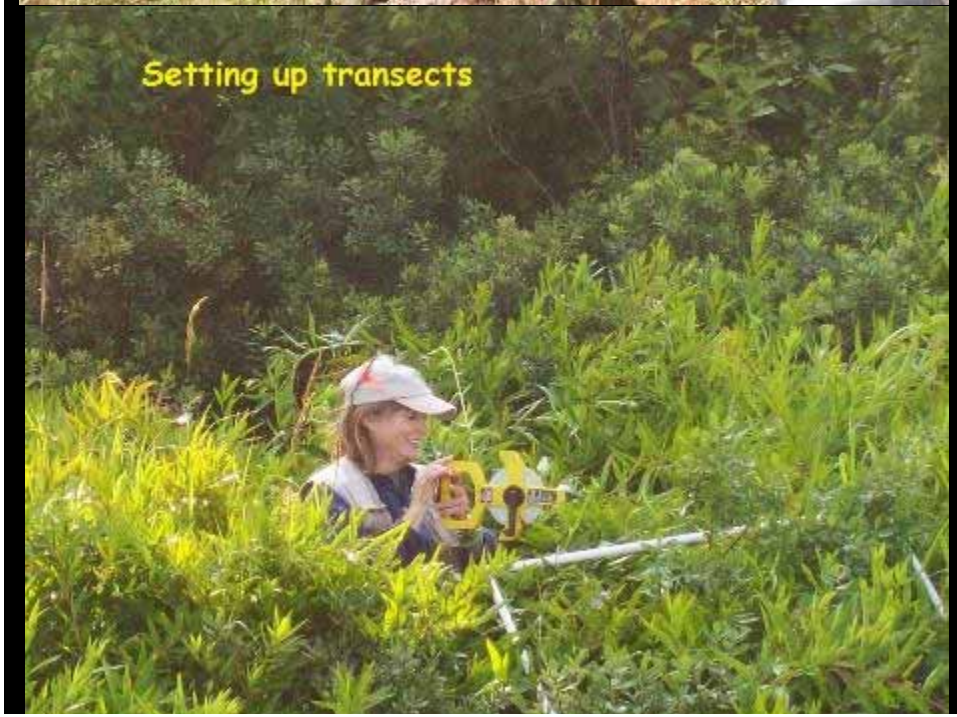
Setting up transects

SILENCE OF THE LOONS

Summer is here and the car is loaded: swimsuit, sunblock, junk fiction, fishing tackle. Forget the map – you already know where you're going: All Points North.

To ask why seems needless. Tell a friend you're headed North and they'll understand. We all seek refuge, solace, recreation. To feel the sun after a refreshing dip in any one of 12,400 lakes. To wonder at flowers and eagles and not a few fish. Many of us are reenacting treasured recollections of youthful summers, pungent memories that linger like the sweet aroma of pine. We seek a primal tonic to offset our urbane existence, a calling loon at sunset to remind us what wild is and what wild does and why wild is good.

This is not merely a road trip; it is a pilgrimage.

Problem is, it's also a mass migration. Some Fridays, it seems like every car in the upper Midwest is bolting for some secret North Woods Shangri-la. If you haven't noticed the bumper-to-bumper traffic, the "FOR SALE" signs and the boomtown persona permeating the North, you really need a vacation. For the last three years, virtually every northern county has watched its tax base soar annually by double digits, a veritable pace car for statewide economic growth. A billion tourist dollars grease hands here every year.

Driving north on Highway 51, the first billboard comes 15 miles south of Stevens Point. Two-foot high blue letters announce: WATERFRONT PARCELS. That's all, plus a small logo and a toll-free number: 1-800-868-[illegible].

John Eavlis, a Mequon native, answers the phone. "Business is fantastic," he confides. As well it should be: Four Seasons Realty specializes in buildable waterfront lots, a seller's market. "It is unbelievable right now. Within the last five years, the price has just skyrocketed."

PAUL BUNYAN AND HIS MIGHTY AXMEN MERELY RAVAGED THE NORTH WOODS. WILL RECREATIONAL SPRAWL KILL IT? BY ERIK NESS

PHOTOGRAPHED BY RICHARD BEAUCHAMP

Erik Ness writes frequently about environmental issues for Milwaukee Magazine.

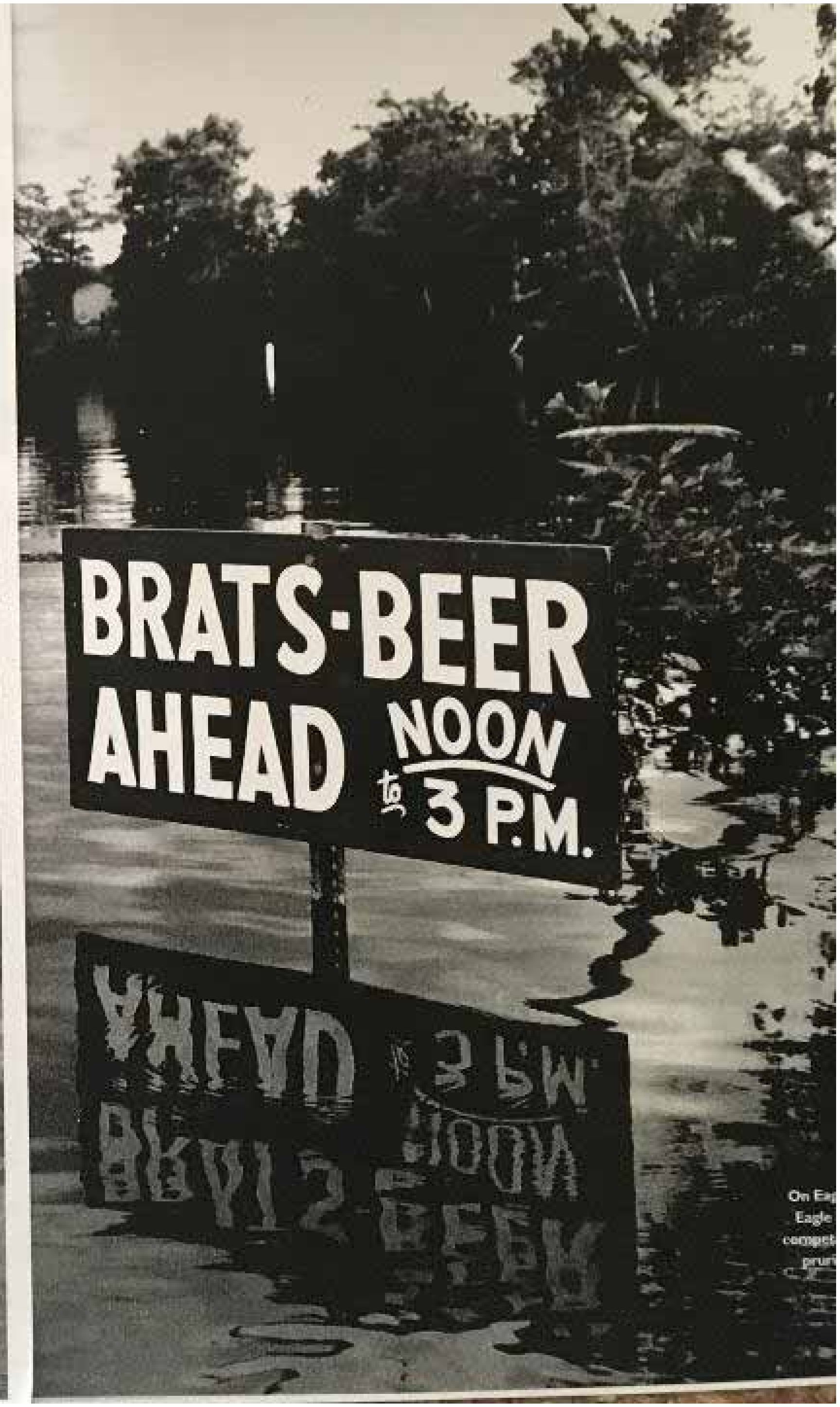

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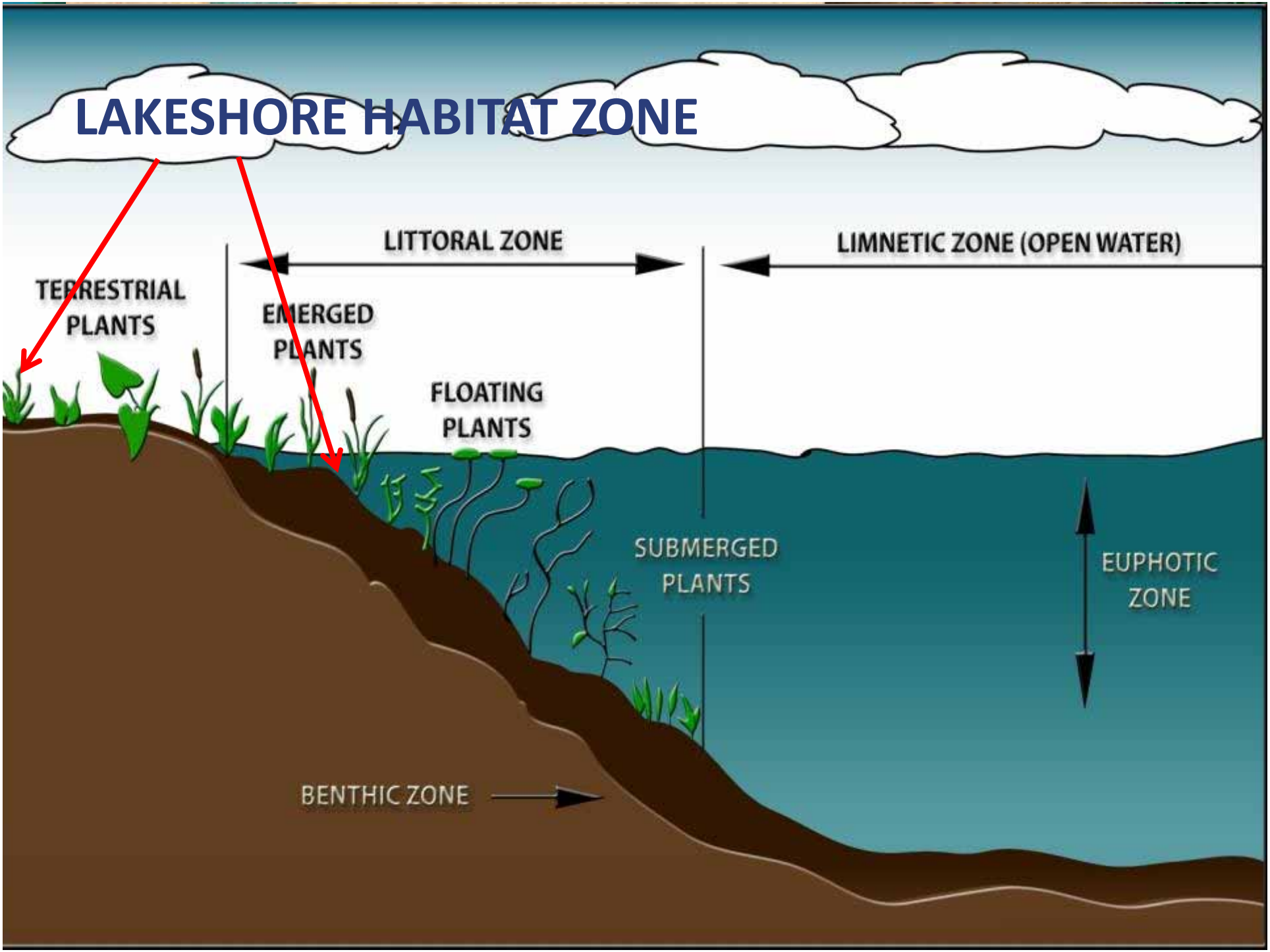
Photo by: D. Haskell


LAKESHORE HABITAT ZONE
LITTORAL ZONE
LIMNETIC ZONE (OPEN WATER)
TERRESTRIAL PLANTS
EMERGED PLANTS
FLOATING PLANTS
SUBMERGED PLANTS
EUPHOTIC ZONE
BENTHIC ZONE

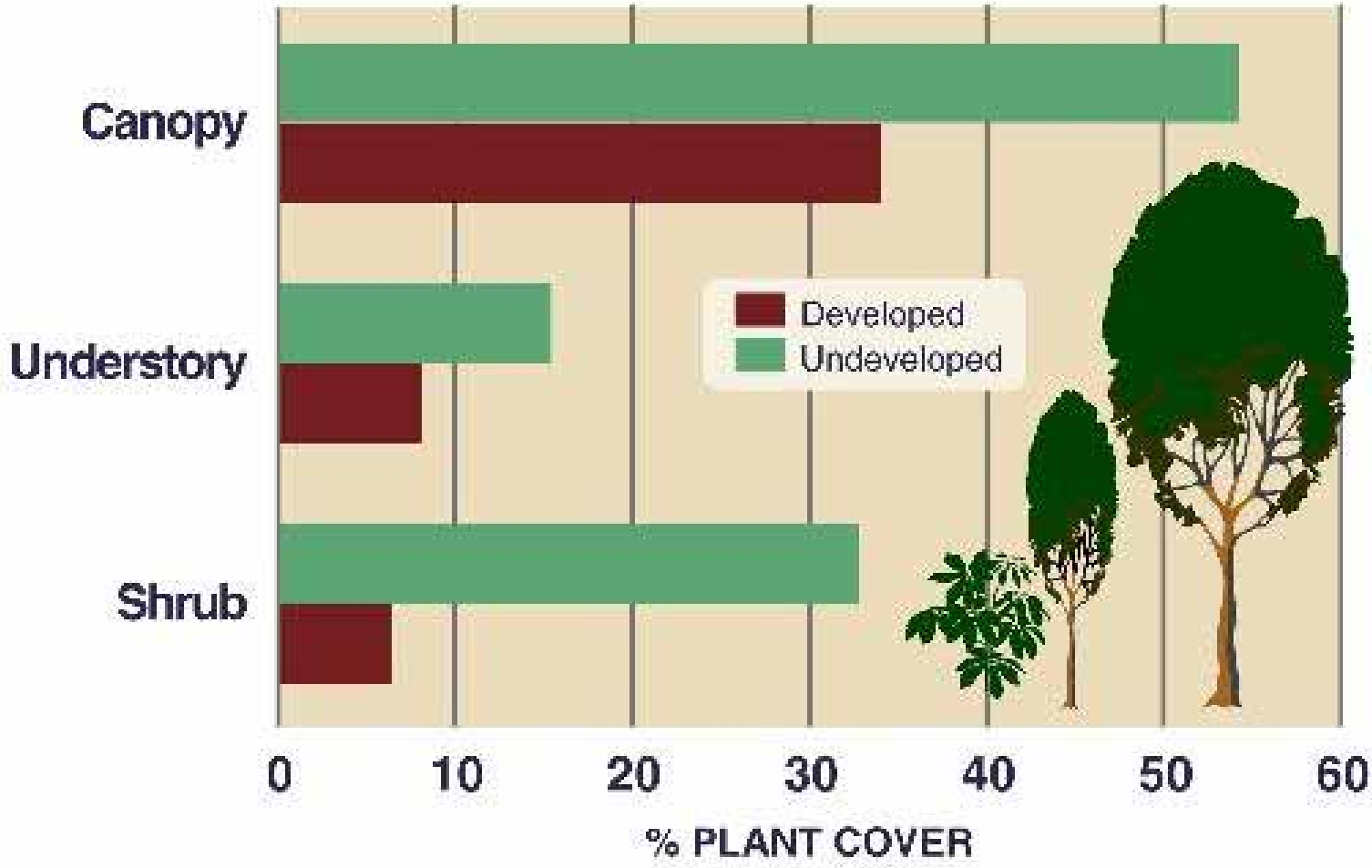
Research Findings (1990s)
Current Wisconsin Shoreland Management Rules (NR 115)
do not protect critical fish and wildlife habitat –

Shoreline development densities (52 homes/mile) are too high!

Shoreland plants trends

From: Elias, JE and Meyer, MW (2003) Wetlands 23: 800-816.

What has Happened to Shoreland Plants?

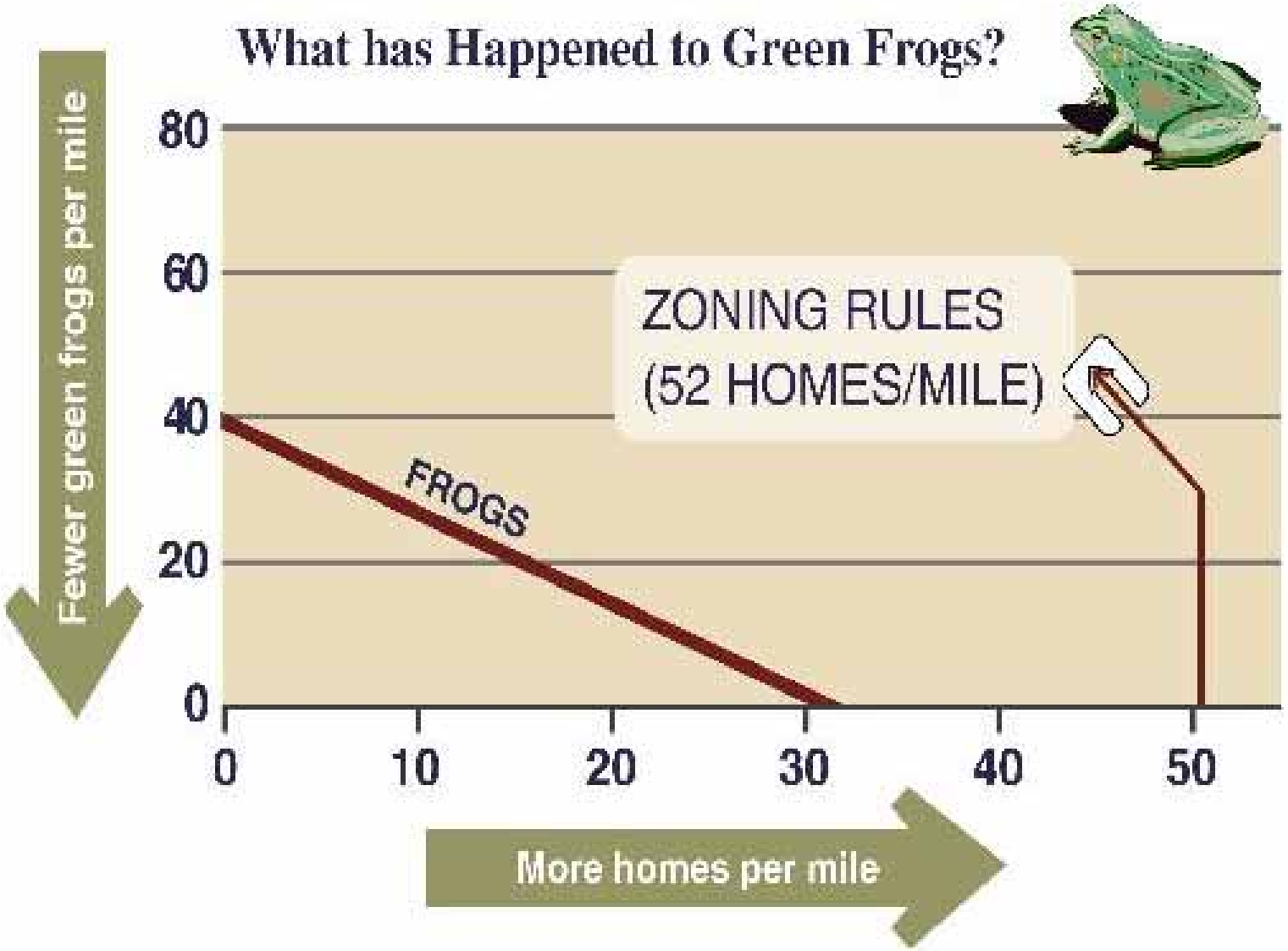


Source: Wisconsin Dept. of Natural Resources

The Wisconsin Lakes Partnership

Shoreland green frog trends

From: Woodford, JE and Meyer, MW (2002) Biological Conservation. 110(2):277-284.

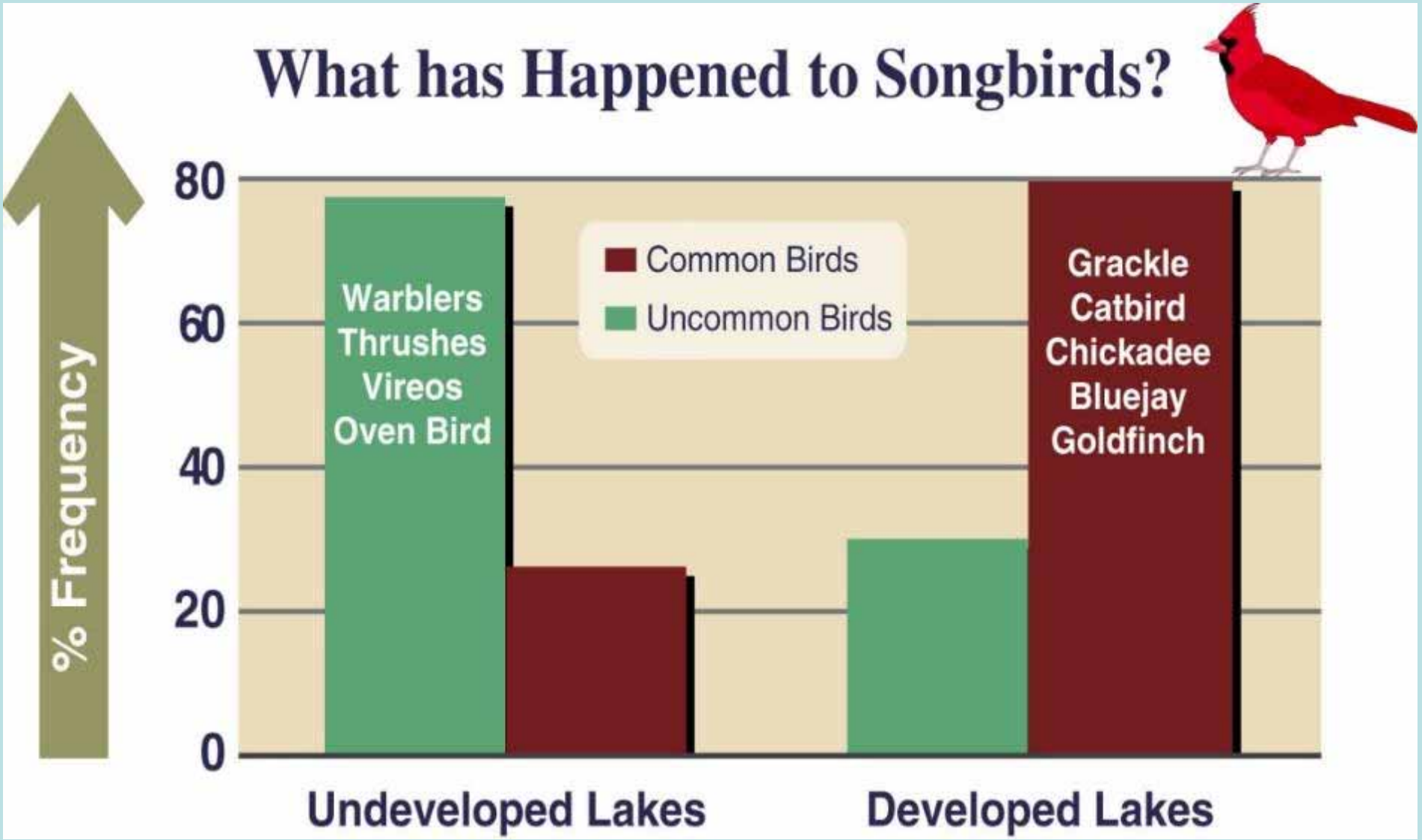


Source: Wisconsin Dept. of Natural Resources

The Wisconsin Lakes Partnership

Shoreland bird trends

From: Lindsay, AR et al. (2002) Biological Conservation 107: 1-11.



Source: Wisconsin Dept. of Natural Resources

The Wisconsin Lakes Partnership

Furbearer Abundance and Diversity Lower on Developed Lakes

From: Relationship between Carnivore Distribution and Landscape Features in the Northern Highlands Ecological Landscape of Wisconsin. *Haskell et al. 2012. American Midland Naturalist.*

Lakeshore Habitat Restoration uses native trees, shrubs, and groundcover, along with natural and biodegradable materials (biologs, delta-lock bags, sediment logs, soil lifts, woody material), to mitigate development impacts by reducing lakeshore erosion and improving aquatic and wildlife habitat quality from OHWM to >10 meters inland.

Lakeshore habitat restorations (>2000 meters of shoreland) occurred on 5 developed lakes in Vilas County at which long-term wildlife and habitat monitoring was implemented.

Measures of Success

Lakeshore Habitat Restoration will be considered a successful management practice if 10-year post-planting survey results demonstrate:

- Increased native plant abundance and diversity
- Improved wildlife habitat quality
- Increased wildlife abundance and diversity
- Reduced surface water and nutrient run-off

Best Management Practices - Survival and growth of restored native vegetation and erosion control effectiveness is also monitored to develop cost/effective management recommendations in the Northern Highlands

Five Lakeshores restored and matched with reference lakeshores

High-Development:

- Found
- Moon
- Lost
- LSG
- Crystal

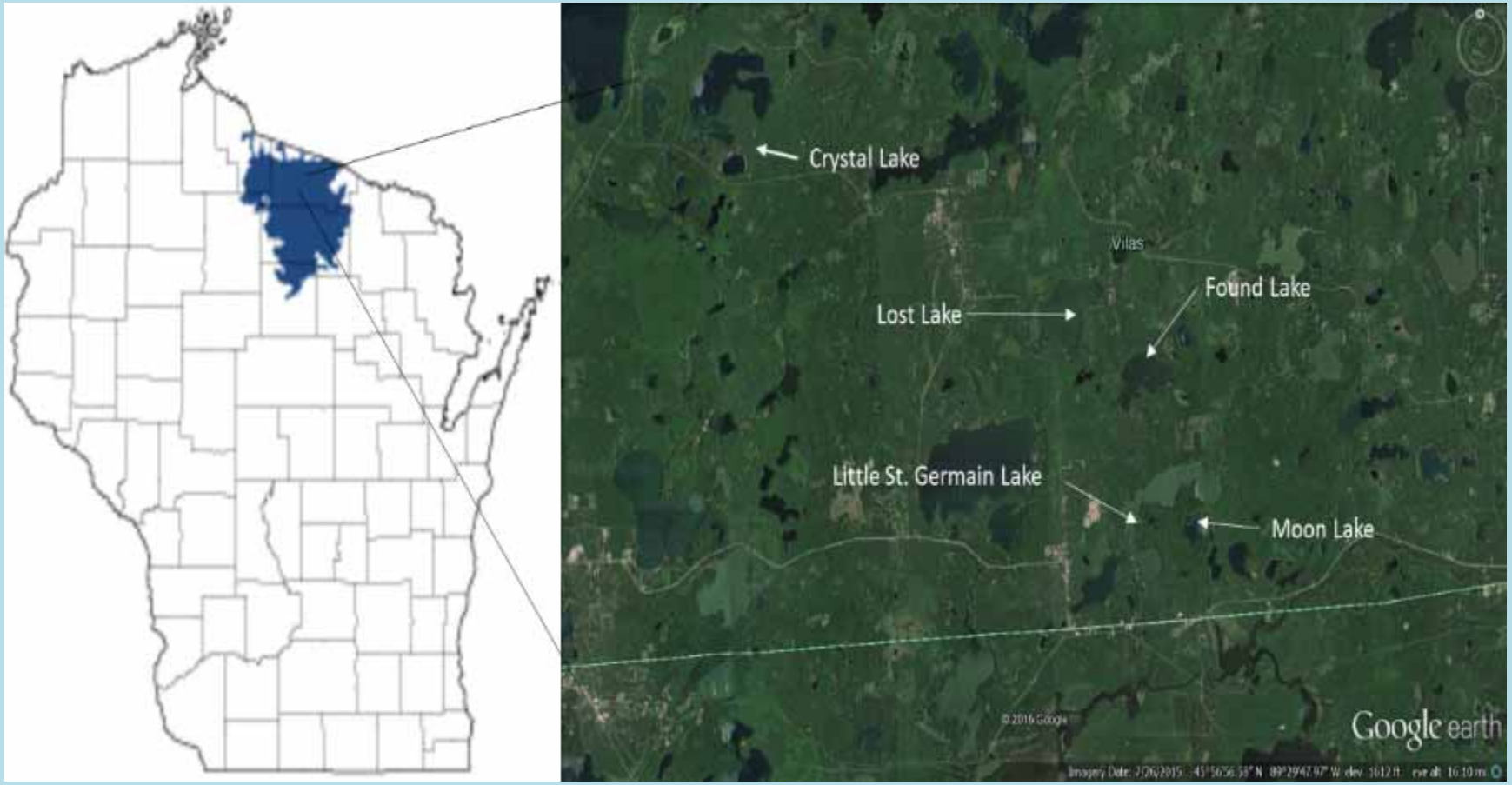
Low-Development:

- Escanaba
- Jag
- White Sand
- Star
- Starrett

Lakes were paired by:

- Surface size
- Water Chemistry
- Lake Type (drainage, seepage, spring)
- Substrate

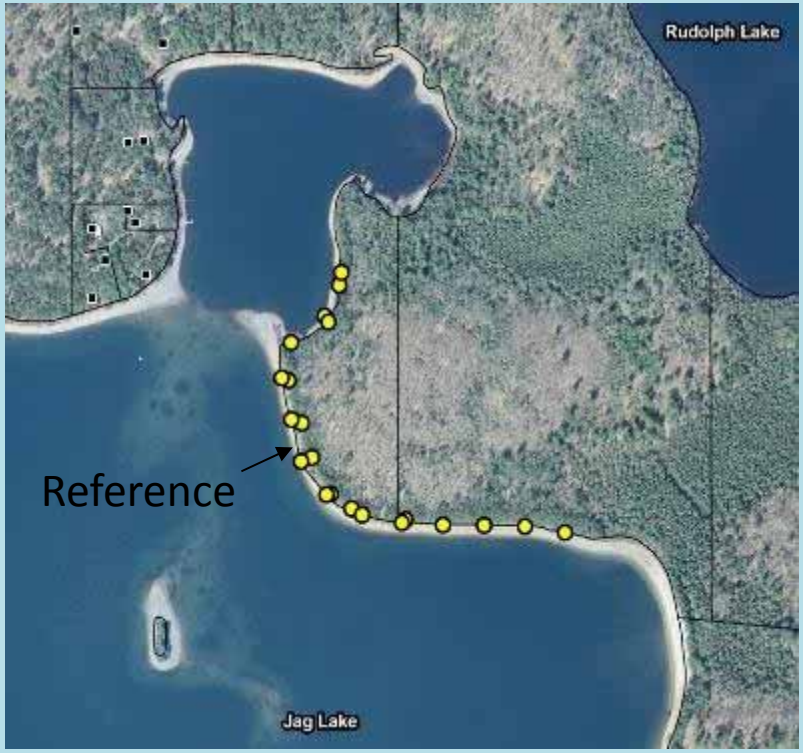
Targeted lakeshores for restoration within NHEL



Vegetation plot location using GIS

Moon Lake
Control & Restored

Jag Lake
Reference



Maps created by B. Fevold

Establishing habitat plots

- Landowners contacted for permission
- 10 x 10 m plots set up adjacent to shoreline for long term monitoring
- Plots approx. 50 m apart
- Data collected concurrently on matched sites

Restoration Efforts

- 26 private properties on Found, Moon, Lost, LSG Lakes & Crystal (public)
- ≈40,000 ground cover plants (100 spp.)
- ≈8,000 shrubs (30 spp.)
- ≈800 trees (20 spp.)
- ≈15,000 m of fence (deer exclosure)
- Plant density based on WI-BioTech Note 1

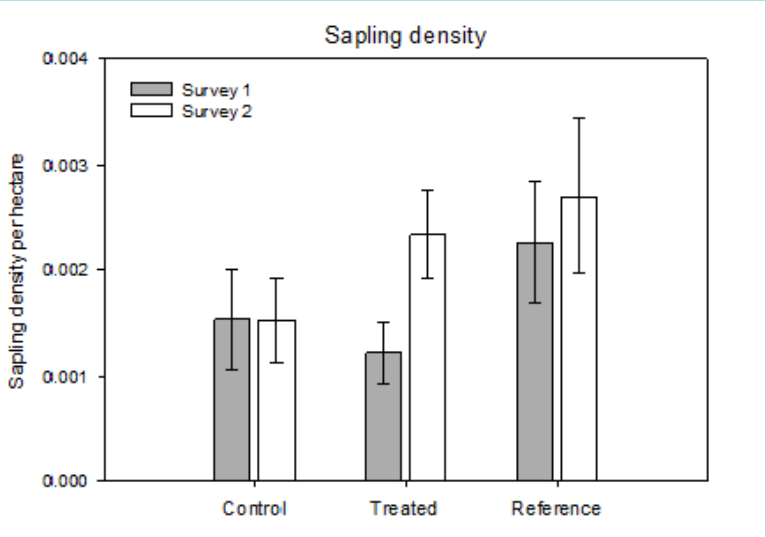
Photos by D. Haskell

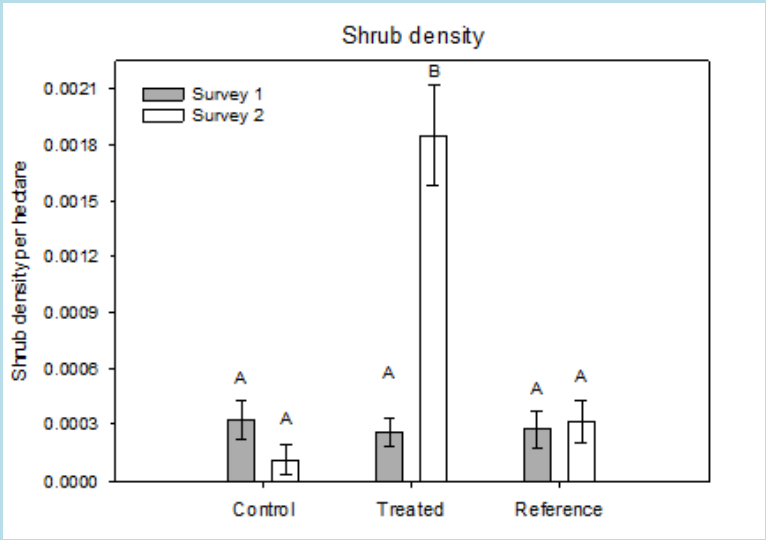
Methods:
Habitat measurements made prior & post restoration activities

- Live saplings and shrub ≥ 30 cm in height but having ≤ 5 cm DBH
- Visional Obstruction Density (VOD) to estimate the percent cover at four different height categories (0-0.3 m, 0.3-1 m, 1-2 m, 2-3 m)
- Woody Habitat (logs & snags)

Photos: D. Haskell

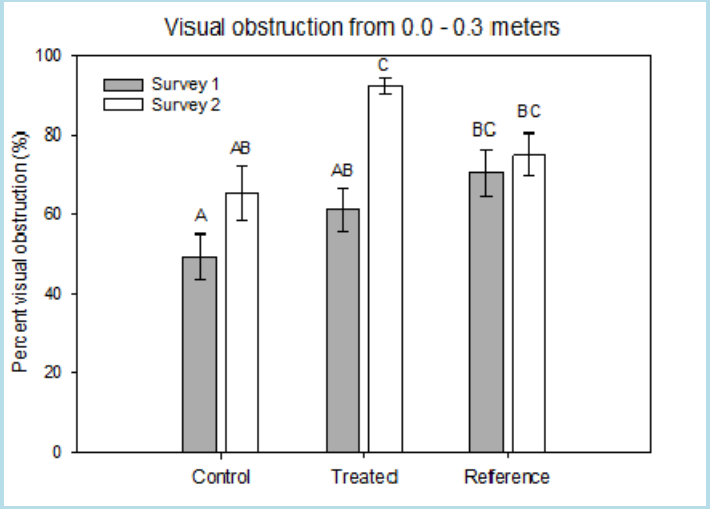
Results:
sapling and shrub stem density increased

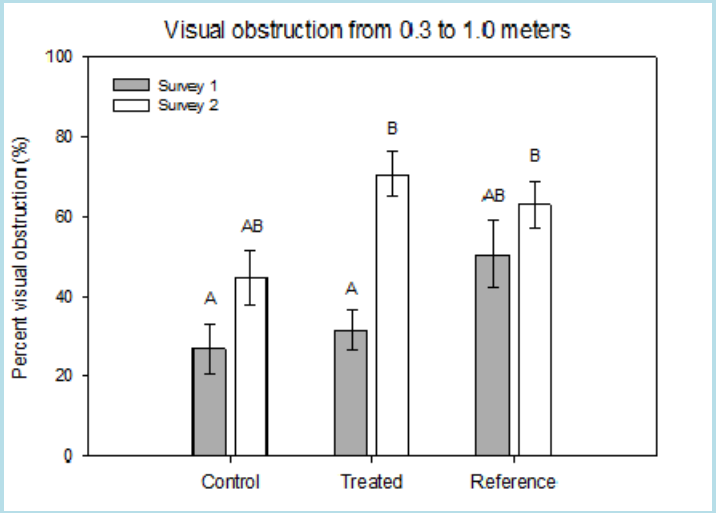




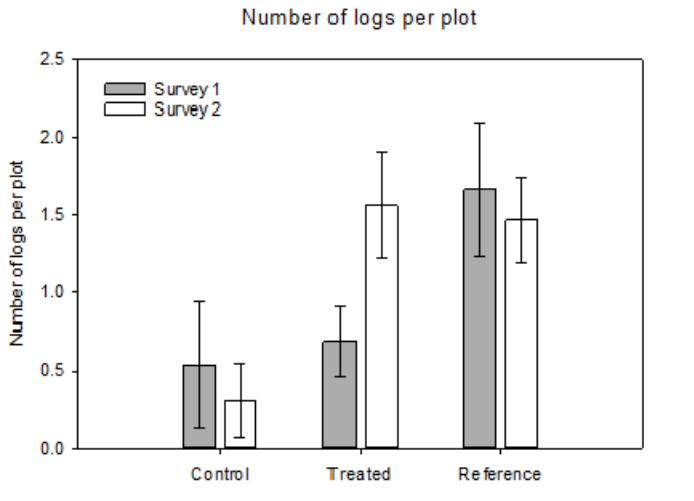
Photos: D. Haskell

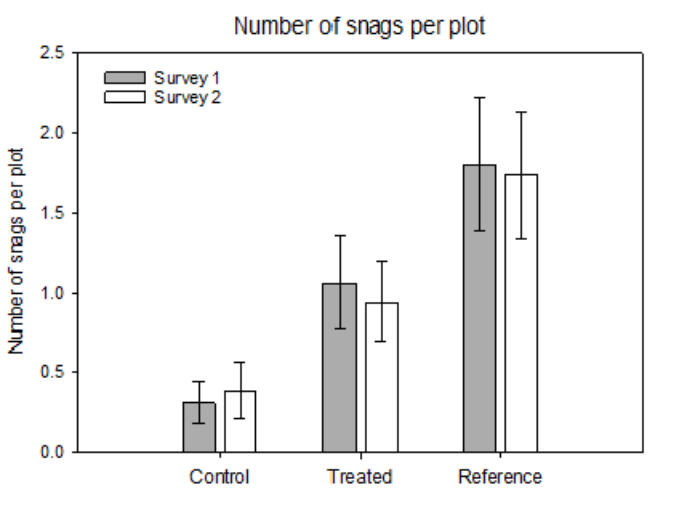
Results:
VOD (0-1m) increased significantly at restored sites



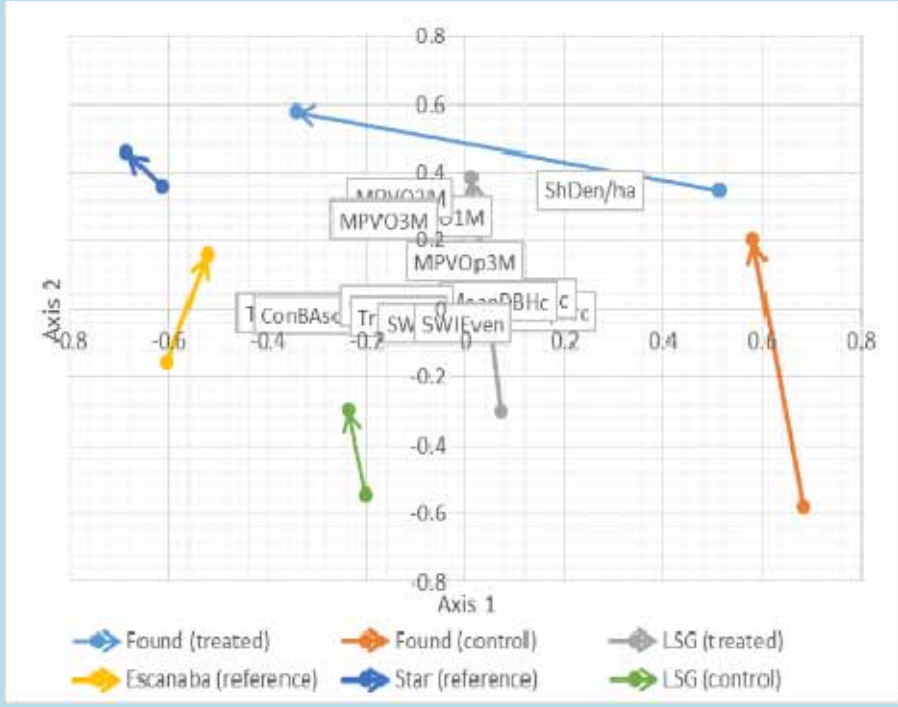


Results:
Logs increased on restored sites





Nonmetric Multi-Dimensional Scaling Ordination shows restored plots becoming more like reference plots over time



- Reference lakes showed little change in habitat features
- Restored lakeshores displayed longer vectors & movement towards reference conditions
- This increase in similarity was associated with increasing similarity in visual obstruction and shrub and sapling density among treatments and reference lakes

Summary

- These results suggest that changes in understory habitat conditions associated with restoration treatments may increase the similarity of habitat features for understory dwelling wildlife.
- Large structural changes (tree density, size, and diversity) will require more time, but improving understory conditions and diversity are a requisite first step.

Recommendations for habitat restoration

- Future restoration consider increasing sapling densities comparable to references sites
- Augmentation of woody habitat
- Long term monitoring of restoration should be part of the restoration plan and strategies to further this goal should be tested.

Adding Downed Woody Material (DWM) to Lakeshore Restorations

Removal of DWM on Sandy Soils

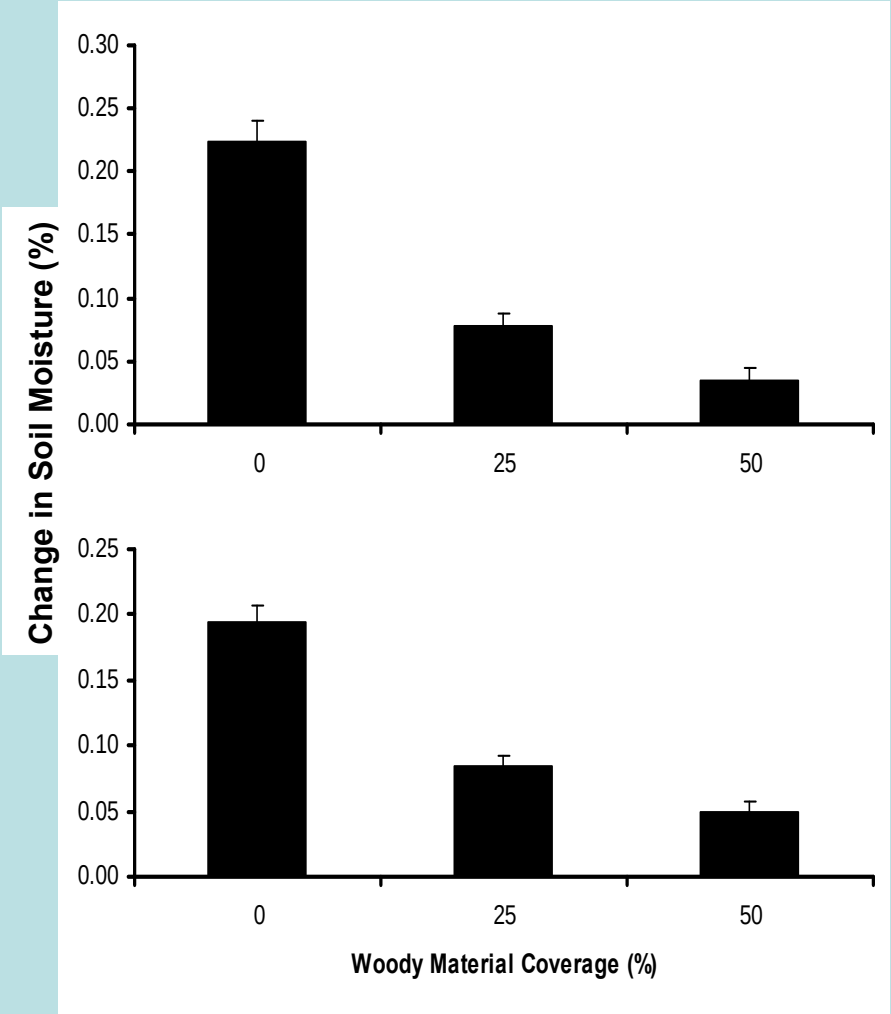
Woody Material Test Plots

Photos by Dan Haskell

Soil Moisture Results

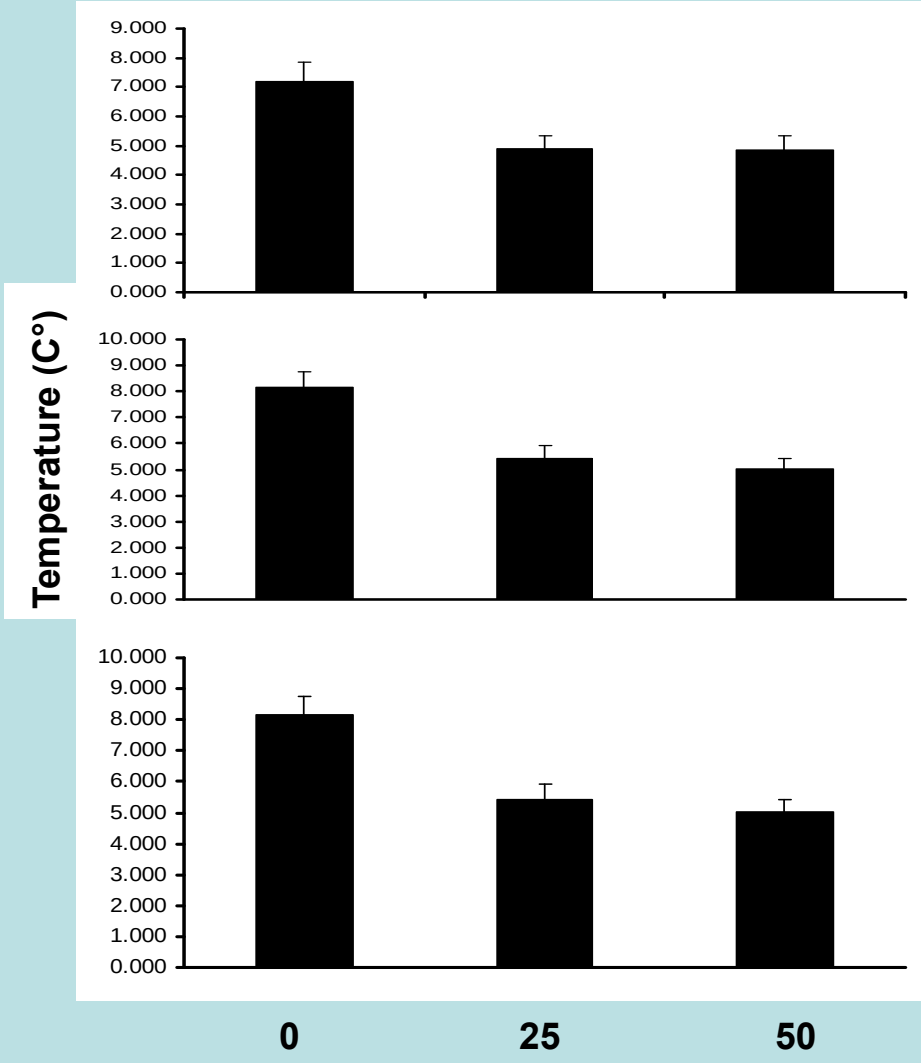
- **July:** *n* = 25/treatment
- 0% DWM plots had higher % change in moisture.
- (P = **<0.001**)

- **August:** *n* = 34/treatment
- 0% DWM plots had higher % change in moisture.
- (P = **<0.001**)



Difference Between High & Low Soil Temp

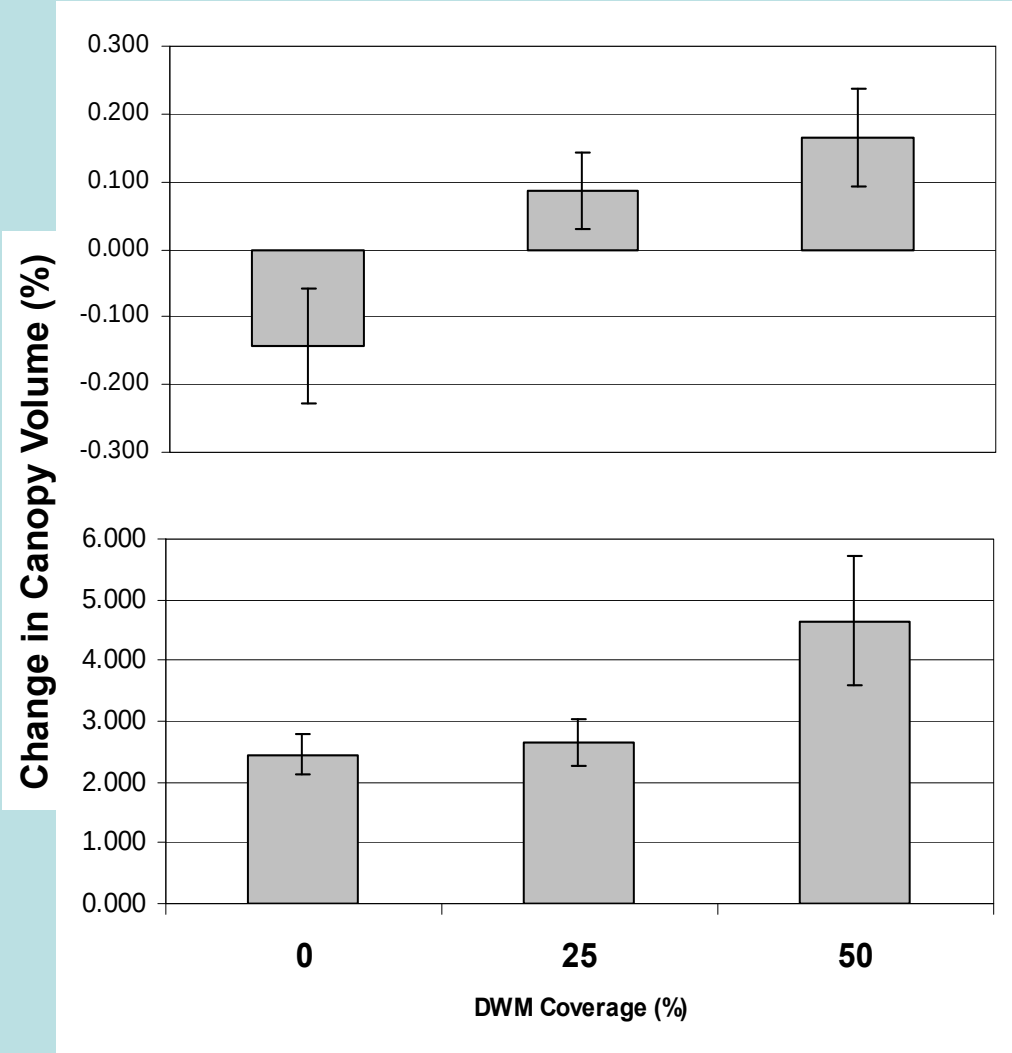
- **June:** 0% DWM plots had a greater difference in temp. (*P* = **0.005**)
- **July:** 0% DWM plots had a greater difference in temp. (*P* = **<0.001**)
- **August:** 0% DWM plots had a greater difference in temp. (*P* = **<0.001**)



Shrub Change in Canopy Volume (%)

- **Snowberry** (*Symphoricarpos albus):*
- negative growth in 0% DWM (*P* = **0.015**)

- **Sweet Fern** (*Comptonia peregrine*):
- no significant difference (*P* = 0.264)



Discussion DWM

- DWM lessened daily variation in soil temp and moisture
- DWM can improve growth of plants
- The addition of DWM should be considered in restoration project
- May take decades for DWM to occur naturally on human altered sites
- **WOOD IS GOOD**

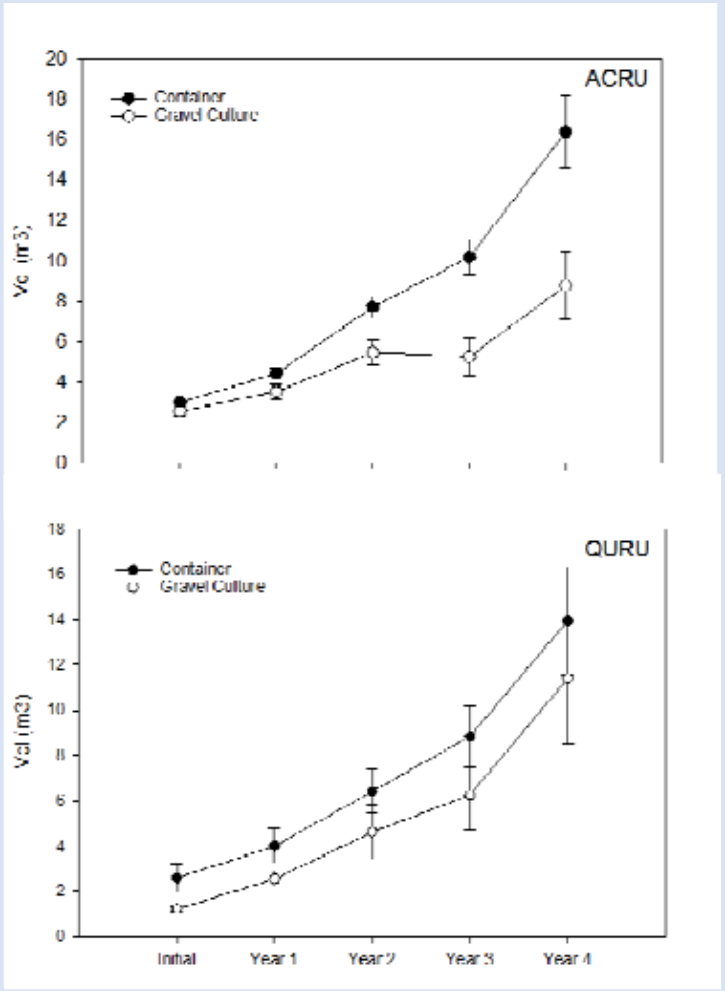
Tree and Shrub comparison study > bare root gravel culture plants versus 3-5 gallon containers

- Bare root is grown in an experimental gravel culture medium that is well-watered
- Paired with container stock of same species
- Planted in same shoreland area
- Marked/tagged for long-term monitoring
- Pairs were followed 4-5 years for growth rates and survival
- Will gravel culture materials be a more cost effective source for plantings with similar results as containerized plants?

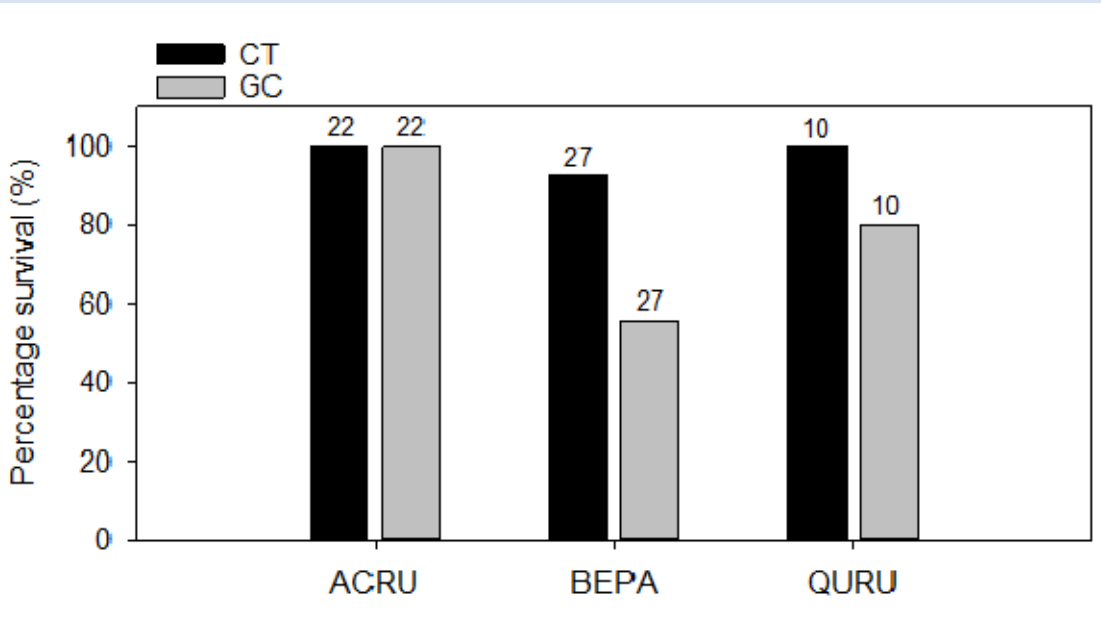
Results: Hardwood GC vs CT Growth Rates

Haskell et al. In press. Restoring hardwood trees to lake riparian areas using three planting treatments. Restoration Ecology (accepted Feb.21, 2017)

Photos by D. Haskell



Results: Hardwood GC vs CT Survival



Survival of GC Hardwoods after four years

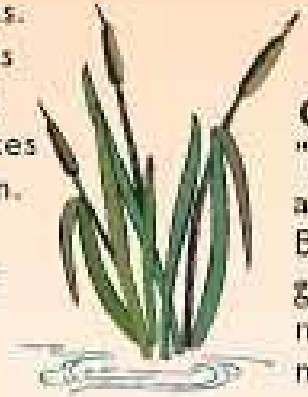
Evaluation of Active vs. Passive Lakeshore Habitat Restoration: Crystal Lake Campground

Forest Resources & Environmental Science
MichiganTech

Why Mow? Let it Grow!

A "no-mow" approach can be a great way to restore the shoreland. "No-mow" saves time, effort, and money. Native plants often grow in wet or shady areas. When mowing stops, native habitat returns.

Non-native plants can invade disturbed areas. They rob native plants of nutrients and light. Planting natives reduces the chance of invasion. "No-mow" areas should be monitored for invasive plants.



Other options:

"No-mow" is just one way to restore the shoreland. Some areas, such as thick lawns, require a little more preparation. Black plastic can act like an oven, burning out the existing grass. In some cases, an aquatic-safe herbicide is needed. Seeding or planting native species may quicken your results.

Did you know...

80% of the plants and animals on the Endangered Species List live all or part of their lives near the shore. (WDNR)

Protect and Restore
Our Living Shore

“Passive Restoration” With Fence and Irrigation

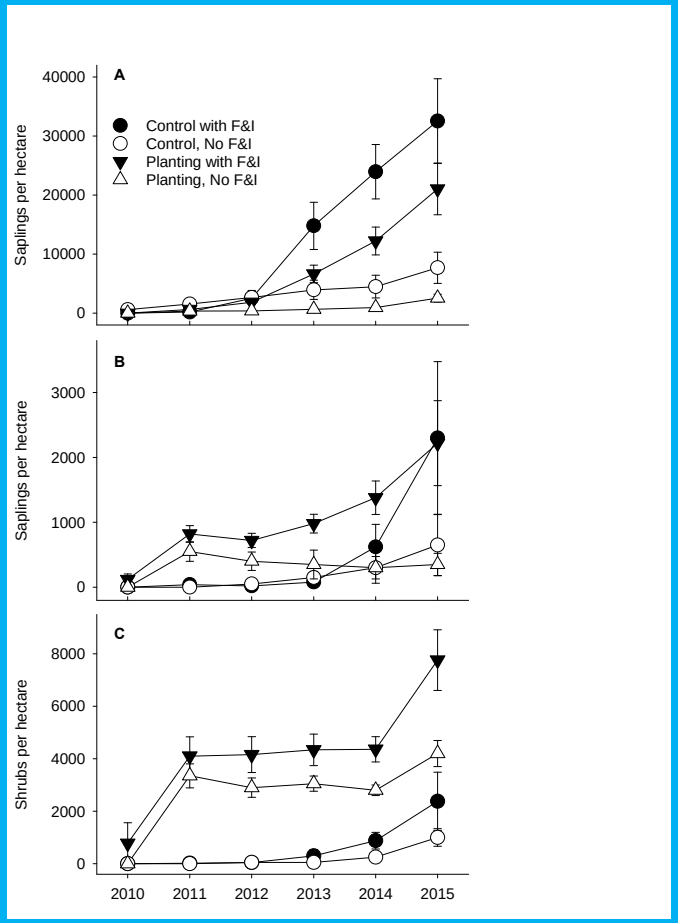
Before

After

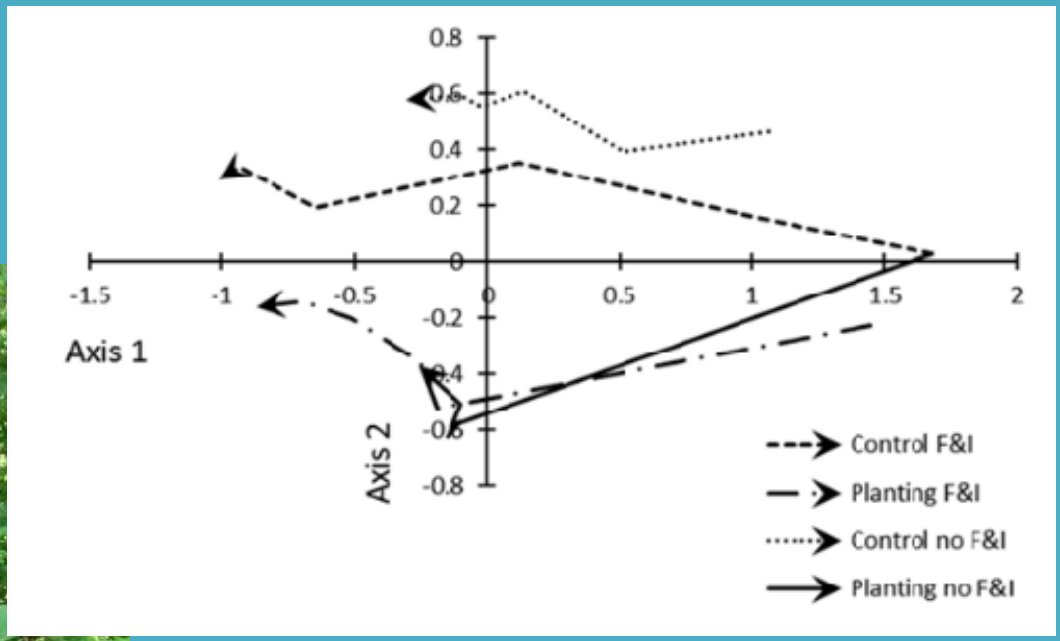
“Active Restoration” with Fence & Irrigation

Crystal Lake Results

- If Seed Bank present a “natural recovery” can be efficient
- If a shrub component is desired than “active restoration” may be needed
- Irrigation & Fence should be used



Preliminary ordination analysis shows both passive and active restoration result in similar lakeshore habitat improvement over time - provided presence of a viable seed bank, deer fencing, and irrigation.



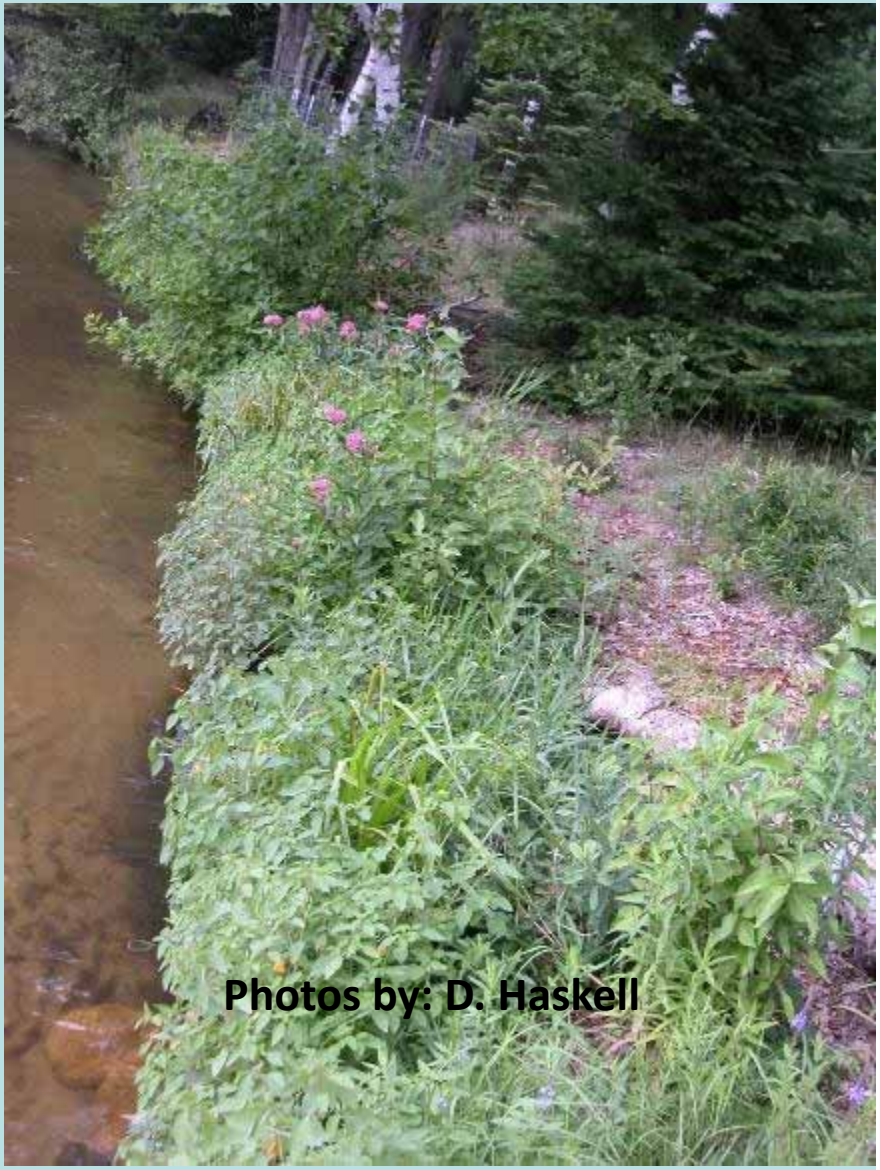
Bioengineering Techniques For Erosion Control

- Biologs
- EnviroLok Bags™
- Coconut Erosion Mat
- Sediment Logs
- Tree Drops
- Water Retention Ponds (Rain Gardens)

Installation of Bio-Logs

Photos by: D. Haskell

Bio-logs One Year Later



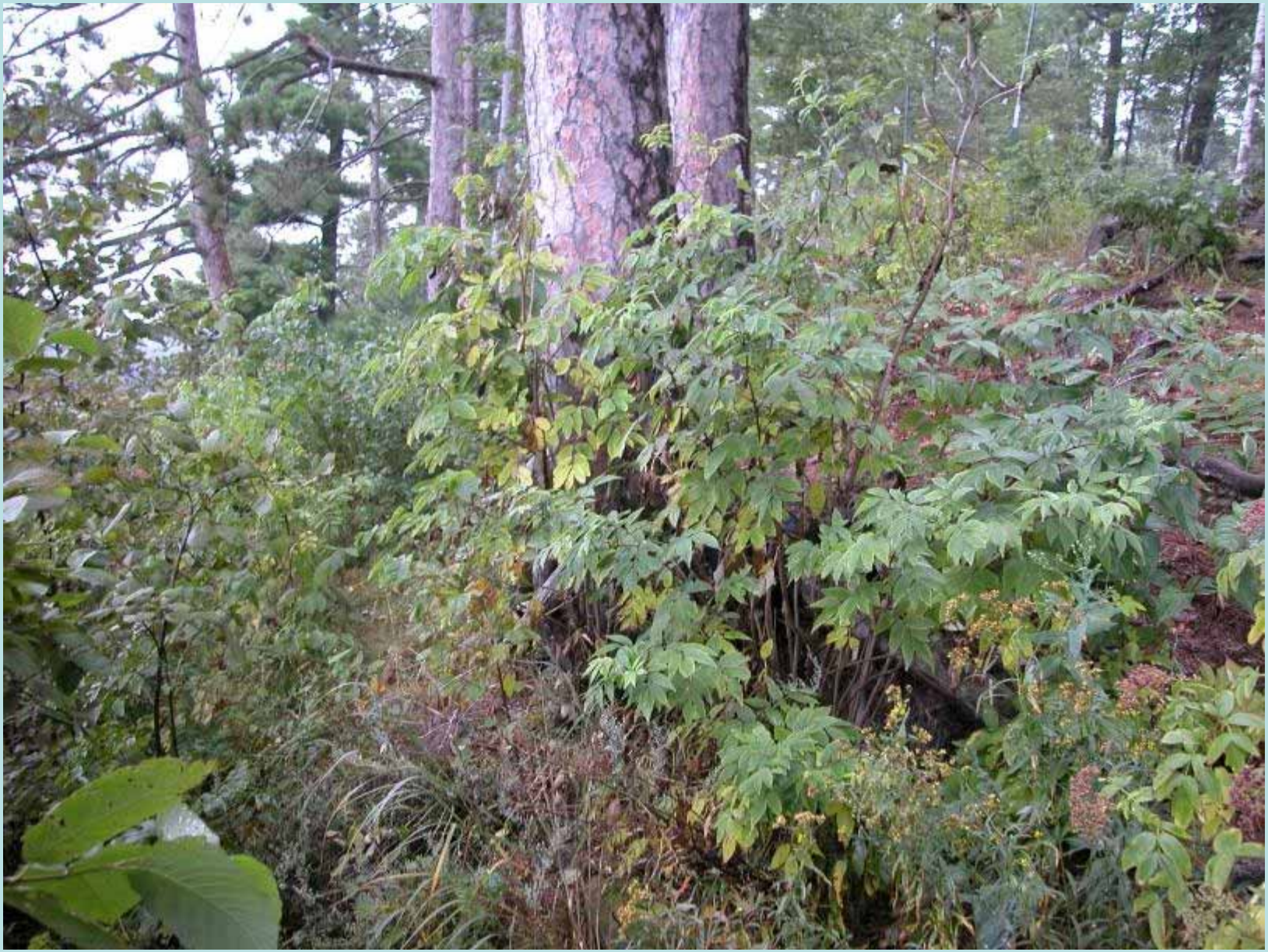
Photos by: D. Haskell

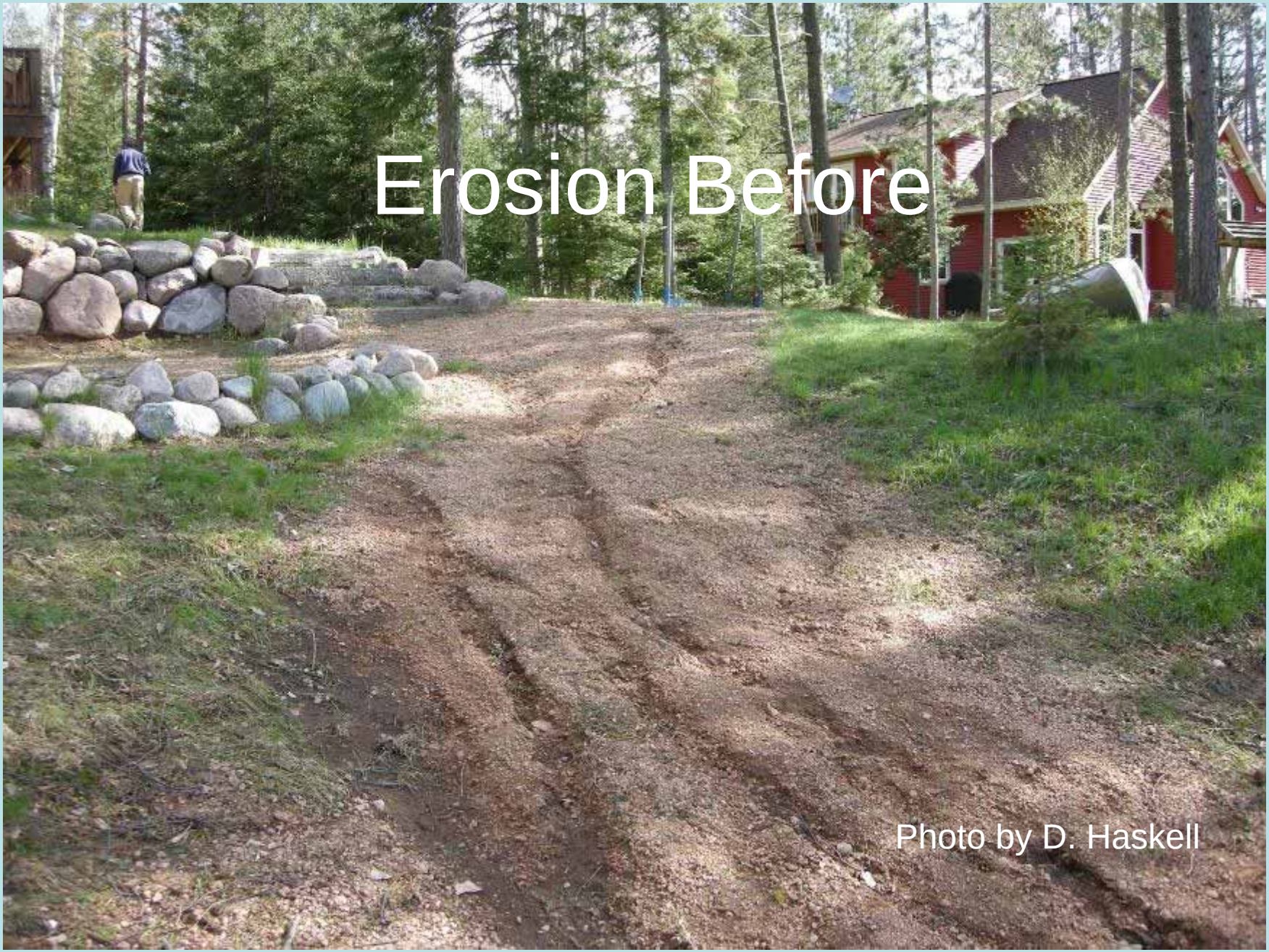
Erosion control method > biologs / Enviro-lok® bags

EnviroLok™ Bags

Photos A & B: before EnviroLok™ bags were installed.
Photos C & D: after EnviroLok™ were installed on Moon Beach during the spring and summer of 2009.

EnviroLok™ Bags 2011




Erosion Before
Photo by D. Haskell


Erosion After

Erosion control method > soil lifts

Wisconsin Lakeshore Restoration Project Conclusion

- Restoration increases habitat structure
- The addition of DWM positively influence plants
- Gravel Culture plants can be used in restoration projects
- Natural recovery can be a cost effective alternative
- Bioengineering reduces erosion
- Bridges gap between property owners and agency personnel
- Provides ecological and aesthetic value

Before / after photos > Found Lake

The Wisconsin Lakes Partnership

Before / after photos > North Lakeland Discovery Center 2009

The Wisconsin Lakes Partnership

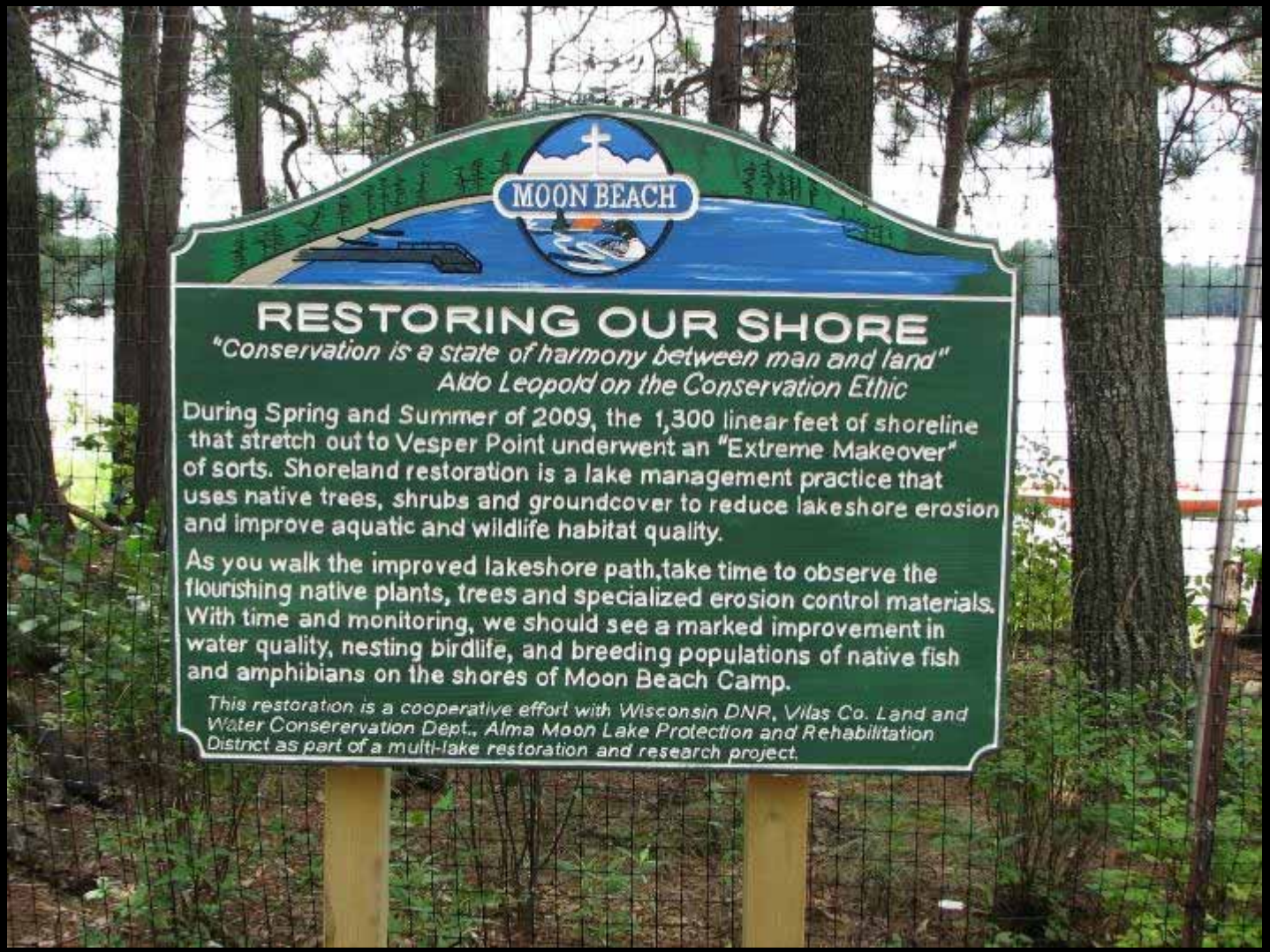
North Lakeland Discovery Center

Shoreland numbers for Wisconsin

- 47,162,014 meters of shoreline on our inland lakes
(data from WDNR Hydro IV database on 1:24,000 sources)
or over 29,304 miles

- Shoreland restoration needs to be an available option for any Wisconsin landowner willing to give it a try

Next Step – 2017 “Neighbor to Neighbor” Education and Outreach in Vilas County



Private sector partners are now ready to offer solutions to neighbors with lakeshore habitat restoration needs in the Northern Highlands.

Acknowledgements

Funding: WDNR, WDATCP, VCLWD, WSO, ESC, GSC
Moon Beach Campers
MTU Faculty, staff, and students
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Marshfield Clinic Research Foundation
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Questions?

Michigan Tech

NOVA Ecological Services

Wisconsin Lakes Partnership

Wisconsin Department of Agriculture, Trade and Consumer Protection

HANSON'S GARDEN VILLAGE

Forest Resources & Environmental Science Michigan Tech

ecosystem Science Center

Vilas COUNTY

WISCONSIN DEPT. OF NATURAL RESOURCES

Lessons learned > landowners

- Written agreements, photographs, and detailed property maps are a key tool for working with landowners undertaking restoration projects

- Landowner maintenance of projects are vital to restoration success over the long-term

- Finding willing landowners to participate in the lakeshore restoration process is a continuing issue

Lessons learned > plantings and watering

- Drought conditions through most of first season and part of the 2nd year as well
- Some difficulty with access to water—had to pump from lake which made it more costly and time intensive
- The amount of time and resources needed to have adequate watering take place was underestimated
- Difficult site conditions—harsh exposure, '*sugar*' sand soil, steep slopes (up to 45°)

Lessons learned > deer/rabbit browse protection - fencing & repellents

Protection of plants for 3-5 years with temporary fencing and repellents is essential to establishment of the native plantings

Lessons learned > costs

- Preliminary cost breakdowns are between ~$50 and $100 per linear foot of restored buffer back 35-feet

- Costs in part dependent on the amount of involvement from landowners, staff labor support, who does the design work, erosion control installation, plantings, fence building, and watering regime over time

- Fencing and erosion control techniques can be costly and logistically challenging

- County cost-share programs and WDNR Lake Grant Program (lake protection/Healthy Lakes) can assist

Lessons learned > working with nurseries & contractors

- Building local expertise with nurseries and contractors for effective shoreland buffer designs and installations will be a continued priority

Lessons learned > working with nurseries & contractors

- The importance of having enough native plant material available through local nurseries. Native, yet will tolerate tough conditions (hot, dry, sugar sand, shade, browsers)

2) Somewhere in presentation: acknowledgment of the amount of engineering expertise needed to design the installation some of the methods (bag walls, geogrid lifts, etc).

0780 photo is Hvam 2013.

Photo 0725 – 0727 Krum 2013

Lessons learned in the art and science of intelligent tinkering on lakeshores:

• Landowners are essential to any restoration strategy; without willing lakeshore property owners, opportunities for rehabilitating lakeshore habitat are minimal. Within
the Northern Highlands, we found interest low among lake property owners. Finding local, on-lake champions of lakeshore rehabilitation work like lake association officers
or master gardeners can make for effective peer-to-peer learning and project buy-in. Two lakes involved with this project had less success with securing landowners because no effective local lake champion could be found to make the case for recruiting suitable lakeshore property owners.

• Natural resource educators, contractors, planners, and other consultants to these landowners need to be hands-on with their assistance. They must openly communicate with landowners to understand their vision for their lakeshore properties on access points, view corridors, plant selection, storage needs, landscaping preferences, and other facets of the project. For example, we need to meet landowners where their landscape values are, whether they champion a “messy look” closer to a wild lakeshore or a “tidy” aesthetic that might accentuate drifts of plants, delineated edgings, and lower growing native vegetation.

• Incorporating ecological design principles of water infiltration, retention, reuse, and flow control into our strategies with landowners pays dividends. This includes low impact development (LID) approaches and practices that are targeted to reduce runoff of water and pollutants like rain gardens and barrels, permeable pavements, green roofs, living walls, infiltration planters, drain systems, water bars, brush bundles, gutters, and cisterns.

• Finding erosion control solutions for landowners to challenges from ice heave and wave action are critical to success. This fact often brings willing landowners to the table for doing shoreland rehabilitation so we need to make sure we address these concerns effectively. Innovative advances in erosion control materials that meet state standards and codes can be found by partnering with land and water conservation departments, consultants, and others.

• Shoreland zoning and other regulatory instruments alone are not enough to protect lakeshore habitat. Lakes with minimum frontage lake lots at 200 feet versus 100 feet (or less) withstand the stressors of human disturbance more positively.

• Holistic and inclusive lake community partnerships can support lakeshore restoration work of all kinds. Be open to possible project helpers like lake organizations, scouting groups, master gardeners, churches and other community organizations.

• Lakeshore rehabilitation projects are good for local economies and small business owners. Expenditures from these lake projects provide income to area contractors, nurseries, landscapers, erosion control specialists, and others employed in facets of the work.

• Select native plant species that are proven work horses, namely sedges, grasses, and rushes. These soil-holding plants are important to the goal of restoring ecological
functions to lakeshore areas and they can persist throughout the transition zone from upland areas to near-shore locations with wet feet.

• Upland species can be a challenge to get established without proper maintenance. The soil condition, aspect, and slopes should be considered when generating a plant
list.

• Maintenance is a vital part of the process (i.e., monitoring for ample watering regimes; invasive species control needs; browse protection systems like spray deterrents,
temporary fencing, or motion-sensory sprinkler plans; proper dock storage; etc.).

• Degradation of lakeshore habitat cover is the most important stressor of lakes.

• At present, voluntary restoration of lakeshore habitat will likely have only a modest influence on watershed health. Even mandatory mitigation requirements wrapped up in local shoreland rules may only marginally increase participation. But when politically possible, shoreland rules or zoning that require lakeshore habitat conservation and restoration can perhaps provide the greatest benefit in the long term. Understanding more deeply and clearly the barriers landowners confront in ultimately accepting the practice of lakeshore habitat restoration and devising marketing strategies that utilize this information may also pay dividends in the future.

• Few wildlife survey results illustrate clear relations to restoration activities two to five years post restoration. It could be that: (1) the scale of restoration is too small to affect
change; (2) it is too early to anticipate change given the lack of development of habitat on the restored sites; (3) our survey techniques to date are not sensitive to real changes that may have occurred for birds, frogs, and small mammals; and/or (4) new surveys need to be implemented to measure change that occurs at the scale of our lakeshore restorations.

• Additional surveys need to be implemented to measure change that more likely occurs at the scale of our lakeshore restorations (e.g., pollinators; soil microbes/arthropods;
soil chemistry; fine woody material; root growth and depth; etc.).

Lessons learned / emerging conclusions / transferability

- A holistic partnership involving a myriad of agencies, people and talents is crucial to our success;
- A formalized and significant watering regime during the first growing season initially took a lot of time and effort (I.E., portable pumps; drought conditions; sugar-sand soils; water sources; etc.)—increased emphasis has been put on watering systems, planning, and long-term maintenance;
- Preliminary cost breakdowns are ~$50 to $100 per linear foot of restored buffer back 35 feet depending on the involvement level of the landowners, staff support, planting labor, watering, etc.
- Biocontrol and erosion control techniques can be costly and logistically challenging;
- Landowners are vital to making this partnership work over the ten-year period of the study;
- Creating a reliable funding mechanism for the ten-year duration of the study between multiple agencies is an ongoing hurdle to overcome;
- Finding willing landowners to participate in the lakeshore restoration process is a continuing concern;
- We know that 200 ft. [or greater] lot sizes typically provide landowners with enough room to live on the lake comfortably while still maintaining adequate wildlife habitat and suitable water quality;
- Fencing native plantings is crucial to allowing the plants the opportunity to establish viable roots that can resist heavy browsing pressure from deer, rabbits, and other critters;
- Building local expertise with contractors and nurseries for effective shoreland buffer designs and installations will be a priority into the future;
- A higher diversity of mammals is being detected on low-development lakes when compared to high-development lakes--coyotes were the most numerous species detected with the majority encountered on low-development lakes--white-tailed deer and red fox were more abundant on high-development lakes--high-development lakes are having a negative effect on the mammal community in this area;
- Baseline data for bird and small mammal community diversity and abundance and on vegetation structure is being collected over the long-term study; and
- Peer-to-peer educational techniques and communication methods can be an effective strategy for fostering behavior change and achieving project buy-in by shoreland property owners engaged in the study.