



Protecting your
environment today
for tomorrow.

Green & Duck Lakes Association Program Update and Review

Casey Shoaff- Environmental Biologist
North- Regional Manager
caseys@plmcorp.net
800-382-4434 ext.2202



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PLM Lake & Land Management Corp.

- Casey Shoaff, Environmental Biologist
- Studied at Cornerstone University
- Regional Manager- Evart, 10 years
- Focus on community outreach/education and working with municipalities, POAs, and individuals to form comprehensive programs with an ecological focus





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PLM Lake & Land Management Corp.

- 4 offices in Michigan to better serve our clients
- Largest Aquatic Management Company in the State of Michigan.
- Full service firm with services to meet your needs:

Vegetation Assessment/Mapping
Water Quality Monitoring
Aquatic Invasive Plant and Algae Control
Fisheries Evaluation
Lake Depth and volume mapping
Fountain Installation and Maintenance
Phosphorus Mitigation
Plant Harvesting
Aeration
Shoreline Restoration





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Lake Facts

- Putting it in perspective
 - Michigan has ~11,037 lakes over 5 acres in size
 - Largest lake is Houghton, over 20,000 acres
 - 36,000 miles of streams, rivers and creeks
 - Never more than 6 miles from an inland lake or stream and never more than 85 miles from a Great Lake
 - Provides critical habitat for 154 freshwater fish species
 - Inland lakes generate ~15 billion dollars in direct and indirect economic activity annually



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The fight against Invasive Species

- ~\$24 Million spent per year to control aquatic plants in Michigan
- ~\$200 million lost per year in the Great Lakes Region due to the effects of ship-born invasive species on sport fishing, commercial fishing, wildlife watching and raw water usage
- ~\$5.7 billion per year of Total Impact of AIS in the Great Lakes Region
- How many non-native aquatic organisms have colonized the Great Lakes since the 1800's?
 - 180+



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Agenda

- Why share the above figures?
 - Lakes are connected and the work done to protect our inland lakes is vital to ensuring our lakes are healthy and functioning.
 - Important to keep in mind that the BMP's for EWM and various other nonnative plants are well established, peer reviewed and used as part of your annual management plan
- Lake Management
 - Integrated Pest Management Approach (IPM)
 - Riparian BMP's & Natural Shoreline/Nutrient abatement
 - Prevention
 - Monitoring- Planning/Evaluation
 - Management
 - Native Plant Diversity
 - Nonnative submersed Plants
 - Eurasian watermilfoil
 - Terrestrial Plants
 - Phragmites
 - Algae Management
 - Starry stonewort
- Lake Management Approaches
 - Phosphorus Mitigation
- Green & Duck Lake Program and treatment data
 - Herbicides
- Eutrophication



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An Overall Plant Management Program

At PLM, our Plant Management Programs focus on preserving and protecting desirable plant life while controlling unwanted “weed” species through remediation services. In addition, these preventative programs strive to keep your site free from unwelcome plants that are known to be pests elsewhere in the region.

Under PLM’s Plant Management Program, we first evaluate and record your site goals. Next, we prescribe an individually developed management plan to control unwanted plant growth. After consultation with you, we then implement the agreed upon plan. Later, we assess the results and use the information to modify and improve our priorities, processes and plans- starting the cycle again.

The key to our success is our Plant Management program, which minimizes the total long-term impact of noxious aquatic and terrestrial vegetation. Our priorities include prevention of new infestations and management of existing plant growth, which provide the most value for your money while protecting our environment.





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Integrated Pest Management (IPM)

- Emphasize spending more effort evaluating the problem, so that exactly the right control can be applied at just the right time to control the pest.
- Minimize management costs and minimizes the use of chemicals.
- Essential for long term success.
- Multi-faceted approach to review numerous control avenues.
- Allows for cost-benefit analysis as well as checks and balances over program.





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What can you do to help protect Green & Duck Lakes?

- Do not rake leaves into the lake. Decomposing leaves produces more muck.
- Do not feed the ducks and geese.
- Remove dog, geese and duck droppings from lawns, docks, etc. Excess feces will increase nutrients within the lake.
- If you do fertilize make sure you are using Phosphorus free fertilizer. One pound of phosphorous may produce over 775 pounds of algae-“The slimy green stuff”.
- Perforate lawn periodically and seed and mulch exposed soil (to prevent erosion).
- Remove aquatic plants, leaves/branches and other debris that washes up along the lakeshore so less decomposition occurs in or near the lake.
- Always use silt fences when building a new home or doing any yard-work that would cause erosion.
- Keep all burn piles and debris piles away from lake. Do not burn near the water. The ash is concentrated nutrients!
- Encourage the use of stone, brick and similar porous materials when building a landscape to minimize urban water collection.
- Create a natural buffer close to the water’s edge.
 - A natural setting will filter excess nutrients from entering the water
 - Decreases erosion.
 - Deters geese from making a stop on your beach front. Geese do not like areas where they cannot see the predators coming towards them.





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Natural Shoreline & Nutrient Abatement

- Lakeshore residents should also be encouraged to manage their waterside landscapes according to the recommendations outlined in publications on this topic available from the MSU Extension.
- Rooted plants derive most of their key nutrients from the sediments; thus, they respond slowly, if at all, to reductions in nutrient loading. In fact, if reductions in nutrient loading lead to improved water clarity, the growth of rooted plants will probably increase.
- If organic material (muck) accumulates to undesirable levels in shoreline areas, bacterial treatments should be considered as a way to alleviate the buildup.
- Shoreline development has led to habitat degradation and as lakes continue to become more and more developed, the impacts continue to be damaging to the lake ecosystem.
 - From mowed grass and sandy beaches, to seawalls and riprap and fertilizer, development has negatively impacted a lake in all ecological aspects.
 - Working to reduce the human footprint around the lake, the health of the lake will be improved.
 - Natural shoreline restoration is helpful from reducing nutrient loading and runoff to providing habitat for frogs and fish to naturally defending against Canadian geese congregating in your yard, it is important that action is taken to minimize development impact and restore natural features.
 - Maintaining a natural shoreline can greatly aid in the overall health of the lake.

- Converting seawall shorelines back to natural vegetation; plants, trees and shrubs along the water's edge has many benefits for the lake.
 - Benefits include erosion control, nutrient and pollution absorption, increase in wildlife and fish habitat and reduction of nuisance geese on lawns.
 - If seawall removal is not feasible there are other options residents can do to improve and protect the lake.
 - Placing rip rap in front of a seawall will help reduce wave action thus reducing lake scour. Rip rap can also create a suitable shoreline for animals to access the land and provide places for aquatic insects and plants to grow.
 - Native vegetation can be planted within the rip rap, creating a more natural shoreline. Adding rip rap is an easy, affordable and effective way to help the lake.





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Prevention

- Early detection and rapid response is key to a successful program.
- Community education and outreach is key to preventing introductions.
- More often than not, nonnative aquatic plants (exotic species) were possibly introduced by boats and/or boat trailers.
- Preventing their inadvertent introduction to your lake can significantly lower the cost of future lake management.
- Education can be an effective preventative measure.
 - Newsletter articles should alert lake residents to the threat from exotic nuisance plants and animals.
 - Warning signs should be erected at any public boat access sites, if applicable, that encourage boaters to clean boats and trailers when launching or removing watercraft from the lake.



**STOP AQUATIC
HITCHHIKERS!™**

Be A Good Steward.
Clean. Drain. Dry.

StopAquaticHitchhikers.org



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Planning & Evaluation

- Survey Program
 - Surveys of the lake should be conducted frequently throughout the summer months (Duck- 6/17, 7/14, 8/7) (Green 8/7)
 - Management evaluation
 - Vegetation surveys determine the locations of target and non-target plant species.
 - Vegetation surveys also document the success of the prescribed management program.
- Mapping Program
- Water Quality Testing



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Fishery

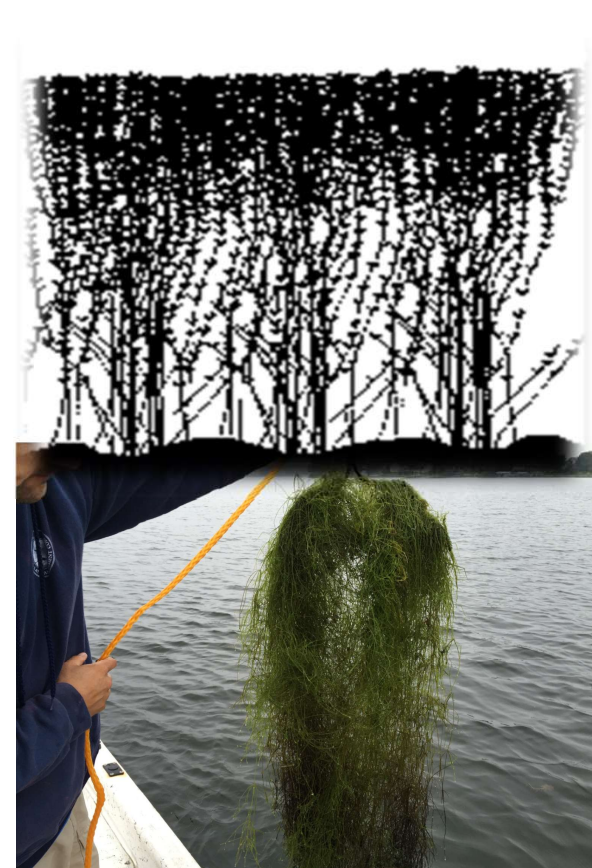
- Green & Duck Lakes has a diverse fishery including both cool and warm water species.
- Overall health of the lake's fishery is directly tied to many factors including:
 - Plant coverage
 - Water quality
 - Algae densities
- Managing nonnative plants, while maintaining native plants will promote a healthy fish community.
- Through proper management, a fishery impacted by nonnative plant infestations, can be restored.



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Plant Management

- Submersed nonnative plant management
 - On Duck Lake- EWM
 - On Green Lake – None
 - On the look out for Starry stonewort
- Emergent nonnative plant management
 - On Green & Duck Lakes
 - Phragmites (Phrag), Purple Loosestrife & Buckthorn
- Native plant & Algae management
 - Not part of Green & Duck Lakes Plan currently



Aquatic plants are part of a healthy lake. They produce oxygen, provide food and habitat for fish, and help to stabilize shoreline and bottom sediments.

Insects and other invertebrates live on or near aquatic plants, and become food for fish, birds, amphibians and other wildlife.

Plants and algae are the base of the food chain. Lakes with a healthy fishery have a moderate density of aquatic plants.

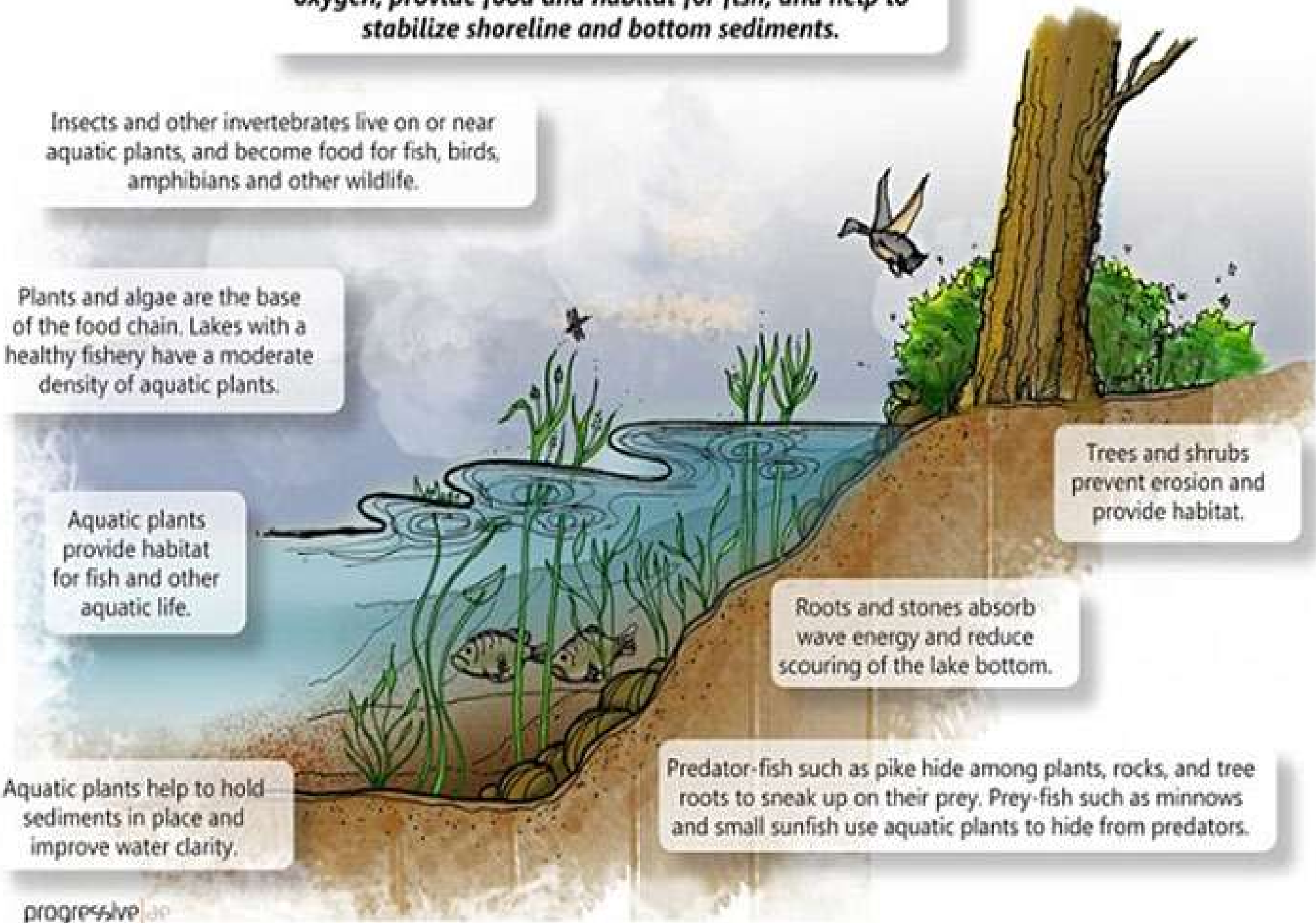
Aquatic plants provide habitat for fish and other aquatic life.

Aquatic plants help to hold sediments in place and improve water clarity.

Trees and shrubs prevent erosion and provide habitat.

Roots and stones absorb wave energy and reduce scouring of the lake bottom.

Predator-fish such as pike hide among plants, rocks, and tree roots to sneak up on their prey. Prey-fish such as minnows and small sunfish use aquatic plants to hide from predators.





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Goals of Aquatic Plant Management

Control Exotic Species

Promote a Balanced and Diverse
Native Plant Community

Improve Fisheries

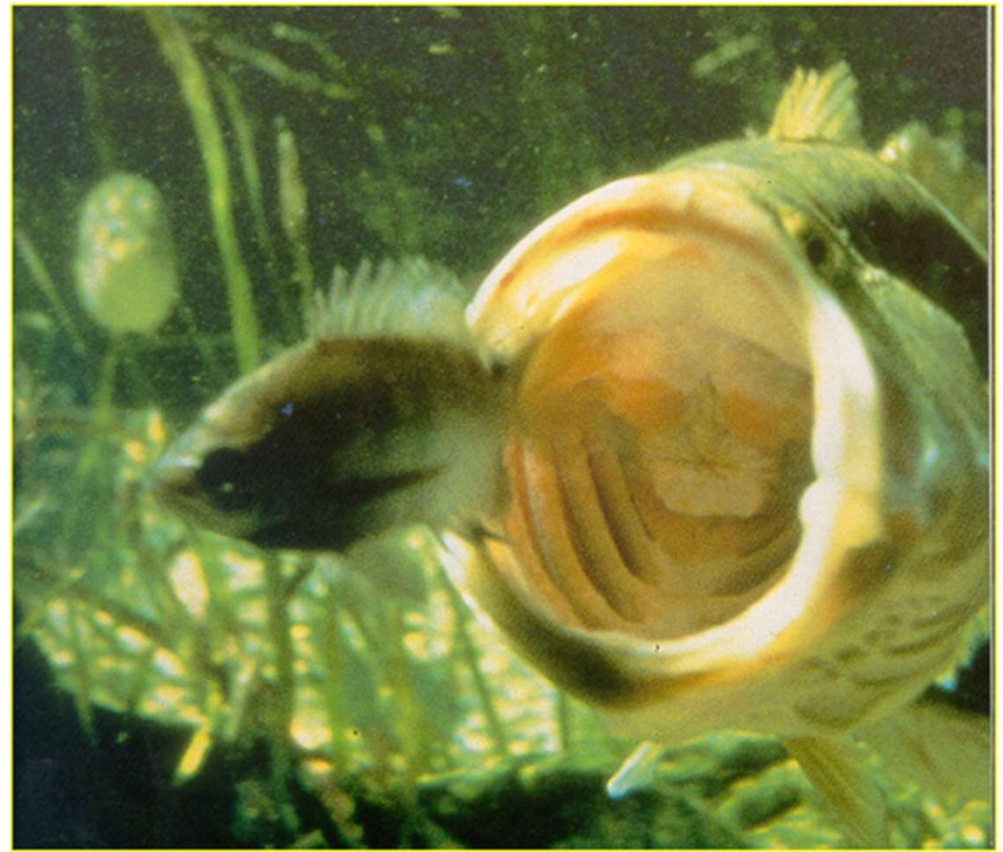
Maintain Property and
Recreational Values

Native Plant Species

Fundamental component of
aquatic ecosystems

Perform important functions

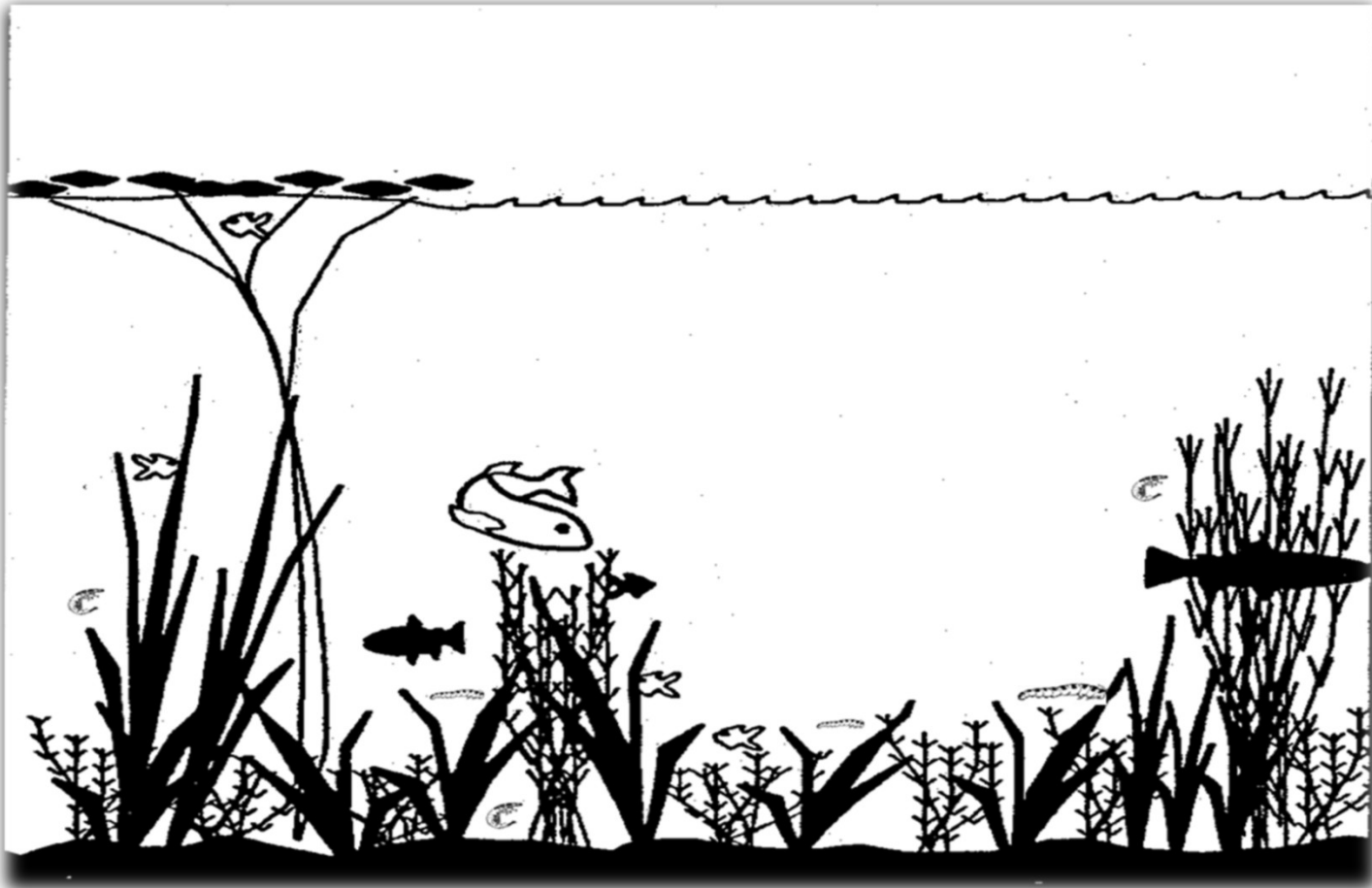
- Stabilizing sediments
- Support aquatic insects
- Maintaining Oxygen
- Provide forage and refuge areas for fish





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Diverse, Native Plant Community



The goal of Aquatic Plant Control: A healthy & diverse plant community.



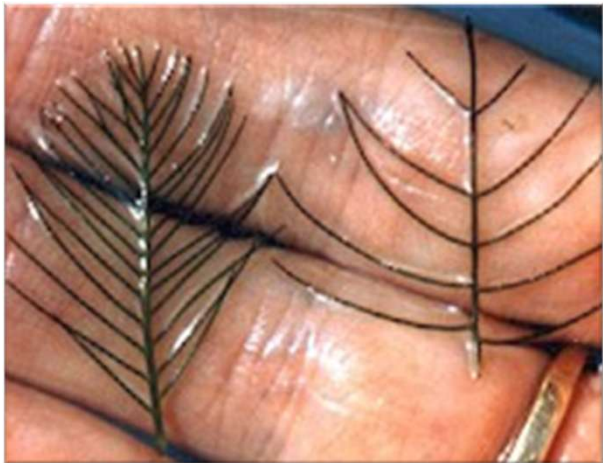
Impacts of Exotic Species



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Eurasian Watermilfoil (EWM)

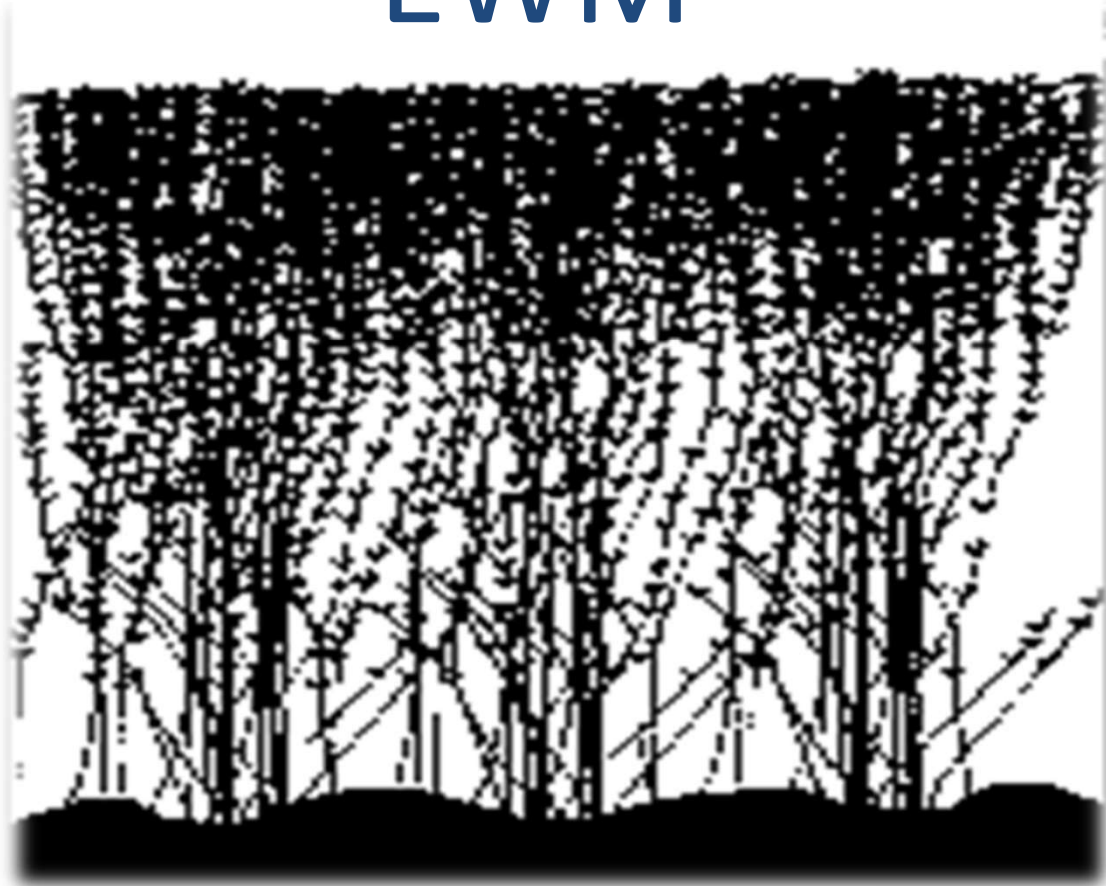
- Not native to North America
- Highly invasive, forms a canopy & monoculture
- Spreads from root system, seed, and **fragmentation** (cutting, raking increases spread)
- Over winters (lives under the ice).
- Outcompetes other native plants
- Negatively impacts fisheries
- A single plant can produce millions new plants in a single year!



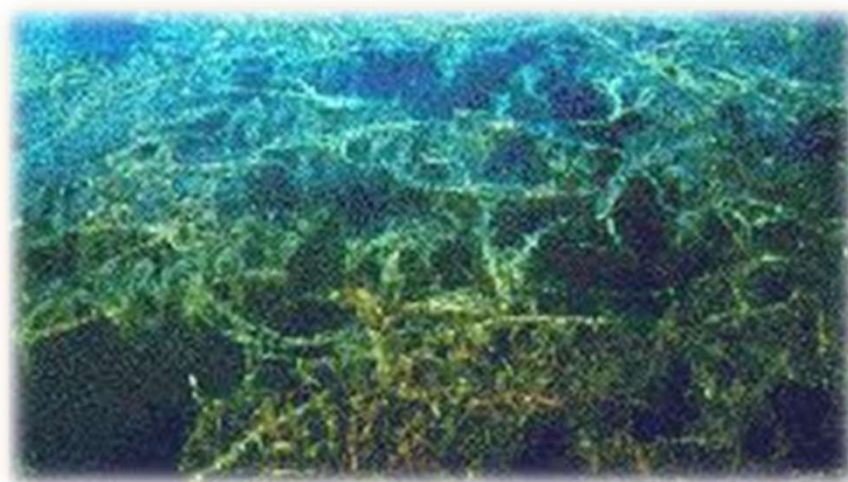


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EWM



CANOPY





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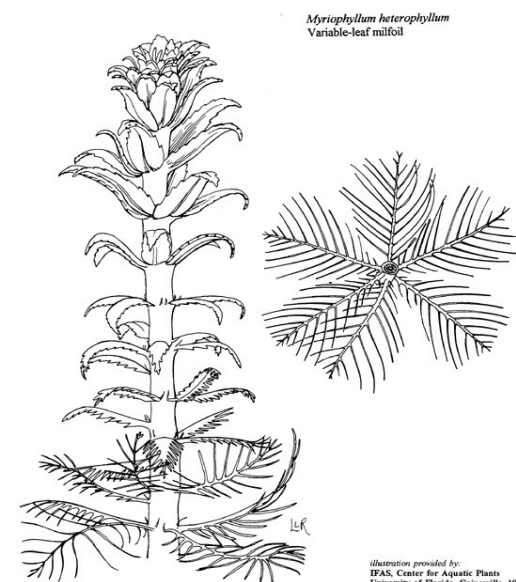
Hybrid milfoil

- Genetic research has found that Eurasian watermilfoil has bred with Northern watermilfoil and has produced different genetic plants—referred to as hybrid milfoil.
- Identification of hybrid over EWM is VERY difficult—typically requires lab analysis.
- Growing characteristics generally take after aggressive EWM but with the hardier growth ability of Northern (cold water, resistance to herbicides)
- For management purposes, EWM and hybrids are generally classified as non-native milfoil for control/management purposes



Variable Leaf Milfoil

- Seven species of milfoil in this region that have similar characteristics
- Most of the “native” milfoils looks very similar and often referred to as “Northern” or “Native Milfoil”
- Spreads by fragmentation, similar to that of Eurasian watermilfoil
- Can become an “invasive” plant in some cases, evidence of that in many Michigan lakes, as it has taken over many areas.





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Phragmites

Phragmites

- Native and Non Native Forms
- Emergent Plant
- Creates a wall of thick vegetation
- Taking over Lake Michigan Shoreline, wetlands, ditches, roadsides, forms a wall around the lake
- Can grow 15'+
- Outcompetes native terrestrial plants

Identification

Native

Red stems

Green leaves

Smooth under sheath

Short growing season
season

Non-native

dull tan

bluish green leaves

ridged under sheath

long growing
season





Photo Credit: PLM



Photo Credit: PLM



Photo Credit: PLM



Msue.anr.msu.edu



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Algae Management

- **Why monitor Algae?**
- An over abundance of algae is an indicator that there is an excess amount of nutrients within the water column/lake, causing the waterbody to become overly productive.
- Algae are very beneficial in a lake ecosystem and can be thought of as the base of the food chain. Therefore, some algae is required.
- However, when an algae reaches the point of hindering the use of the lake, control measures are available:
 - Actions should be taken within the watershed to promote a healthy lake ecosystem and decrease nutrient loading, etc. However, no immediate change will be seen with these actions but play a critical role in protecting the lake for future generations.
 - Phosphorus Mitigation Options
 - Direct control options – again not part of the Green & Duck Lakes Plan
- 3 types of algae to be familiar with:
 - **Filamentous, Planktonic, Macroalgae**
- **Macroalgae** includes three types, Chara, Starry stonewort and Nitella.
 - Chara
 - Grows like a plant on the bottom (carpet), is a natural water filter and is excellent for fish bedding
 - This is a #1 species in Green & Duck Lakes and should continue to be protected!
 - Chara is the most dominate “plant” in Green & Duck Lakes 36% (found in 119/130 sections!)
 - Starry stonewort- the enemy of Chara and Green & Duck Lakes



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Algae

- **Planktonic algae**
 - Microscopic, often referred to as "water bloom". Typically Blue-green algae species
 - In large number, the algae can cause water to appear green, brown, yellow, or even red.
 - Can form toxins (not always)
 - Dealing with the source is often preferred over treatment.
- **Filamentous algae**, commonly called "pond scum"
 - Typically green algae or diatoms
 - Form raft-like masses over the water surface.
 - Vulnerable to winds and currents
 - Filamentous algae can grow attached to the lake bottom, weeds and docks. Frequently detach from the lake bottom and form floating mats.





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Starry stonewort

- Rooted macro algae
 - Takes all nutrients from water column, not roots
- Originated in Europe
- First found in St. Clair River/ Detroit Area
- Can grow in 20' of water
- Preferred by Zebra Mussels
- Forms a dense mat
- Rated as one of the more detrimental species to infest our waterways





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Starry stonewort



- Photo credit: Bre Grabill, PLM



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Lake Management Approaches

Main highlights listed (expanded points in LMP)

Aeration

- Adding oxygen into lake
- Permits almost impossible to get, many misused systems
- Not appropriate for Green & Duck Lakes

Bacteria Augmentation

- Optional for lake frontages with high organic content
- Not appropriate for lake wide management on Green & Duck Lakes

Benthic barriers

- One of oldest technologies in aquatics
- Mats placed to prevent light penetration
- Not selective, can impact spawning, securing issues, potential navigational hazard
- Requires permit and if used, avoid areas with mixed beds for less impact on native plants

Biological control

- Purple loosestrife beetles have been used successfully, access to new beetles was limited with covid but has started back up.
- EWM weevils or beetles are no longer being produced, very expensive with irregular results
 - Control was typically limited to top few inches, overwintering issues, fish impacts



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Lake Management Approaches

Main highlights listed

Chemical control

- Highly regulated by State of Michigan, EPA (Requires state and federal permits)
- Can be selective, expensive, requires professional contractor
- “Negative” view point of chemicals

DASH

- Suction hoses by diver to vacuum out plants (native and/or nonnative)
- Impacted by bottom sediments, easily stirred up, small areas, very expensive
- Fragmentation can occur
- Permits, deposal sites

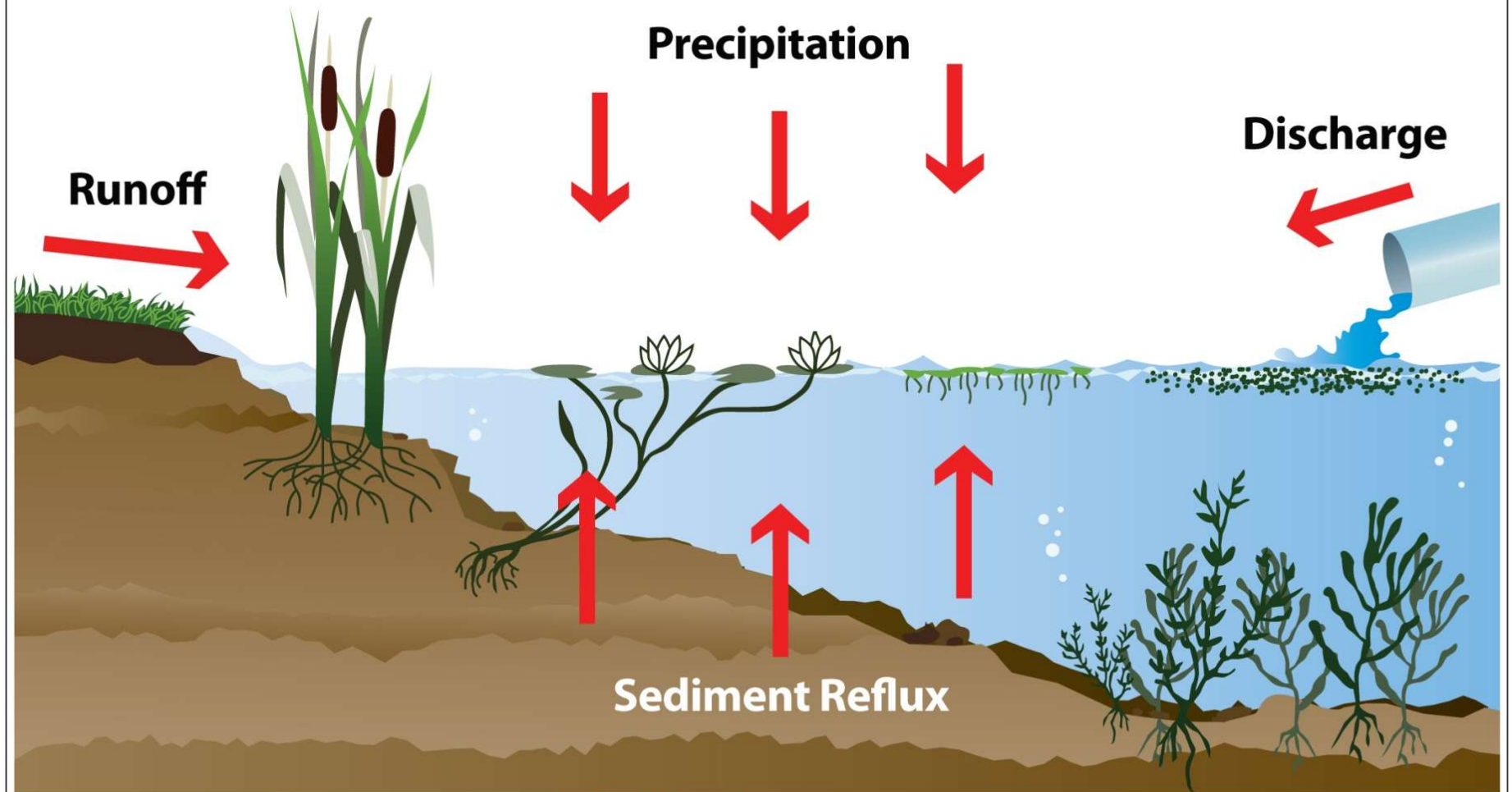
Harvesting

- Fragments plants
- Should be used for only non fragmenting plants and typically for native plant control
- Expensive, per hour rate, slow, dump site

Phosphorus mitigation

- New technology to help prevent/repair lakes from impairment and phosphorus pollution
- Becoming an interest to many lake residents to manage long term, not a band aid approach

Sources of Phosphorus Loading



- Lake and pond bottoms are a sink for sediments and ultimately phosphorus
- Sediments are a significant annual source of available P to lake water column



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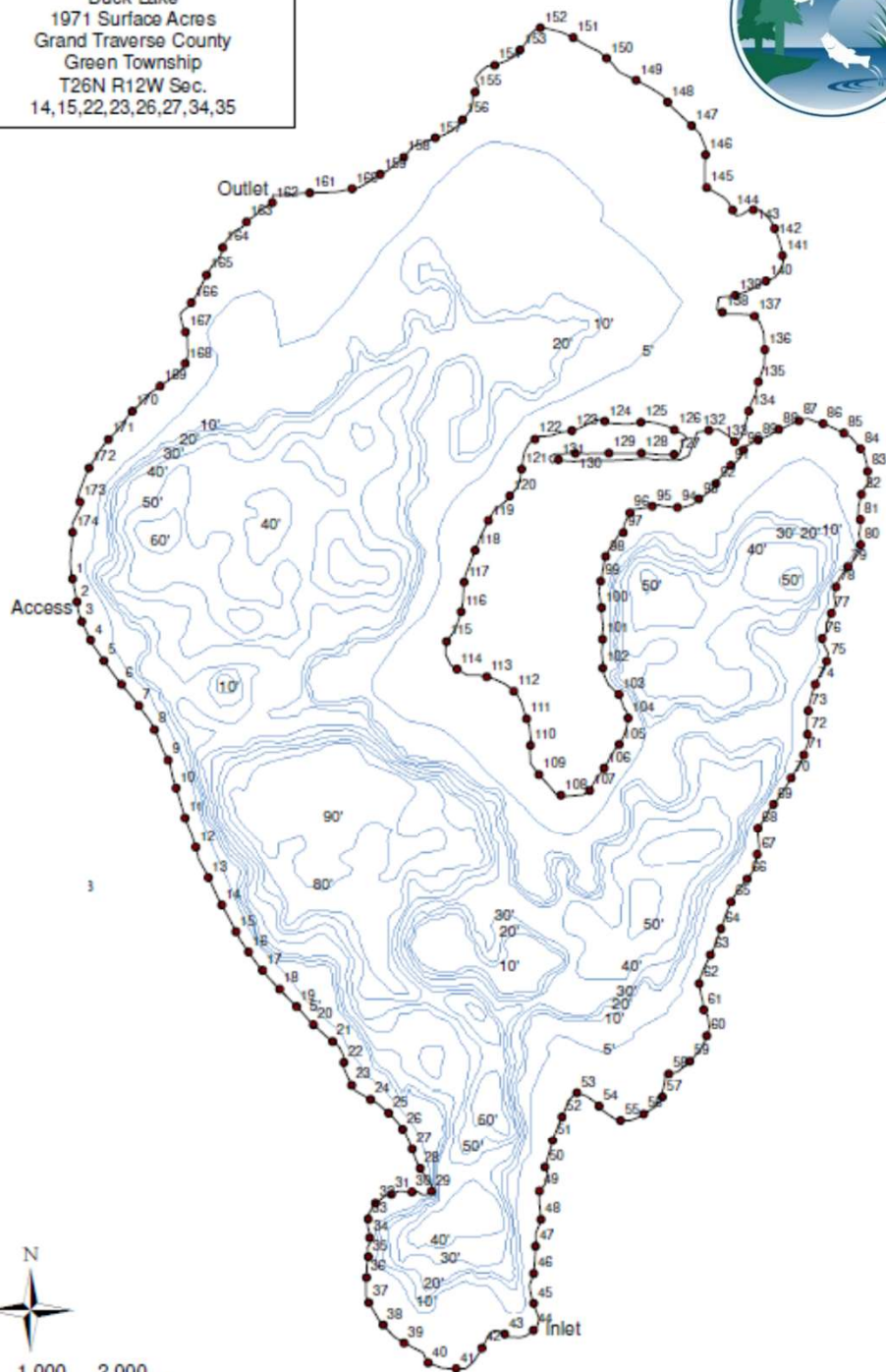
Green & Duck Lakes Survey Program

- Numerous surveys each summer including:
 - One end of year AVAS Surveys
 - GPS shoreline map, 174 segments on Duck, 157 segments on Green
 - State standard survey method
 - Pre/post treatment surveys
 - Includes GPS mapped areas for applicator
 - Independent genetic testing completed in the past, as well as other independent surveys to confirm results.
 - Collaboration is key!
- Score the shore – “consider as an association”
 - CLMP Survey program for overall lake health
 - Great for determining health of lake shoreline (erosion, % of natural shoreline, ID various plants, working with residents for improvement)
 - Citizen scientists

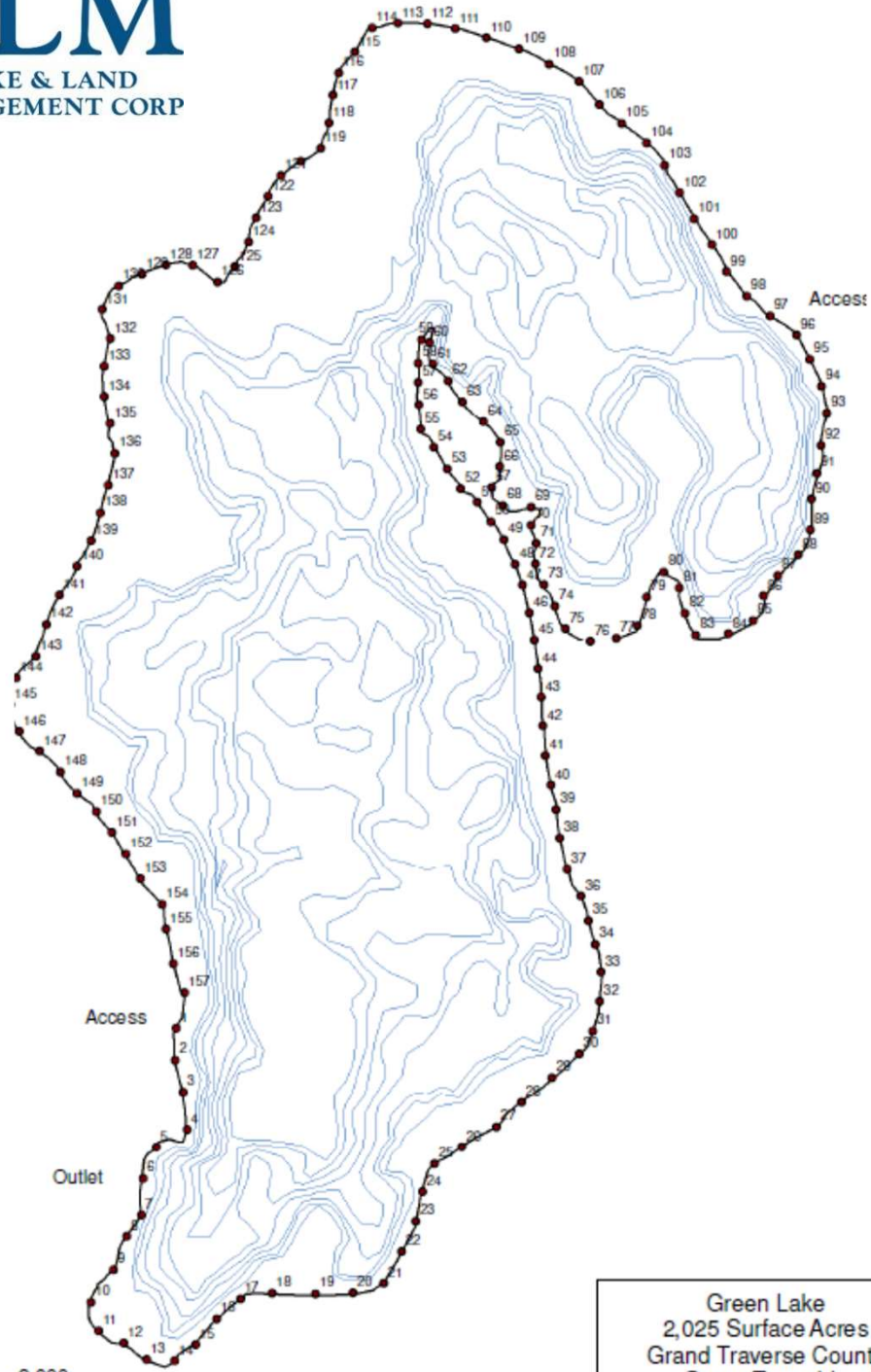
Duck Lake
1971 Surface Acres
Grand Traverse County
Green Township
T26N R12W Sec.
14, 15, 22, 23, 26, 27, 34, 35



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0 1,000 2,000
Feet



2,000
Feet

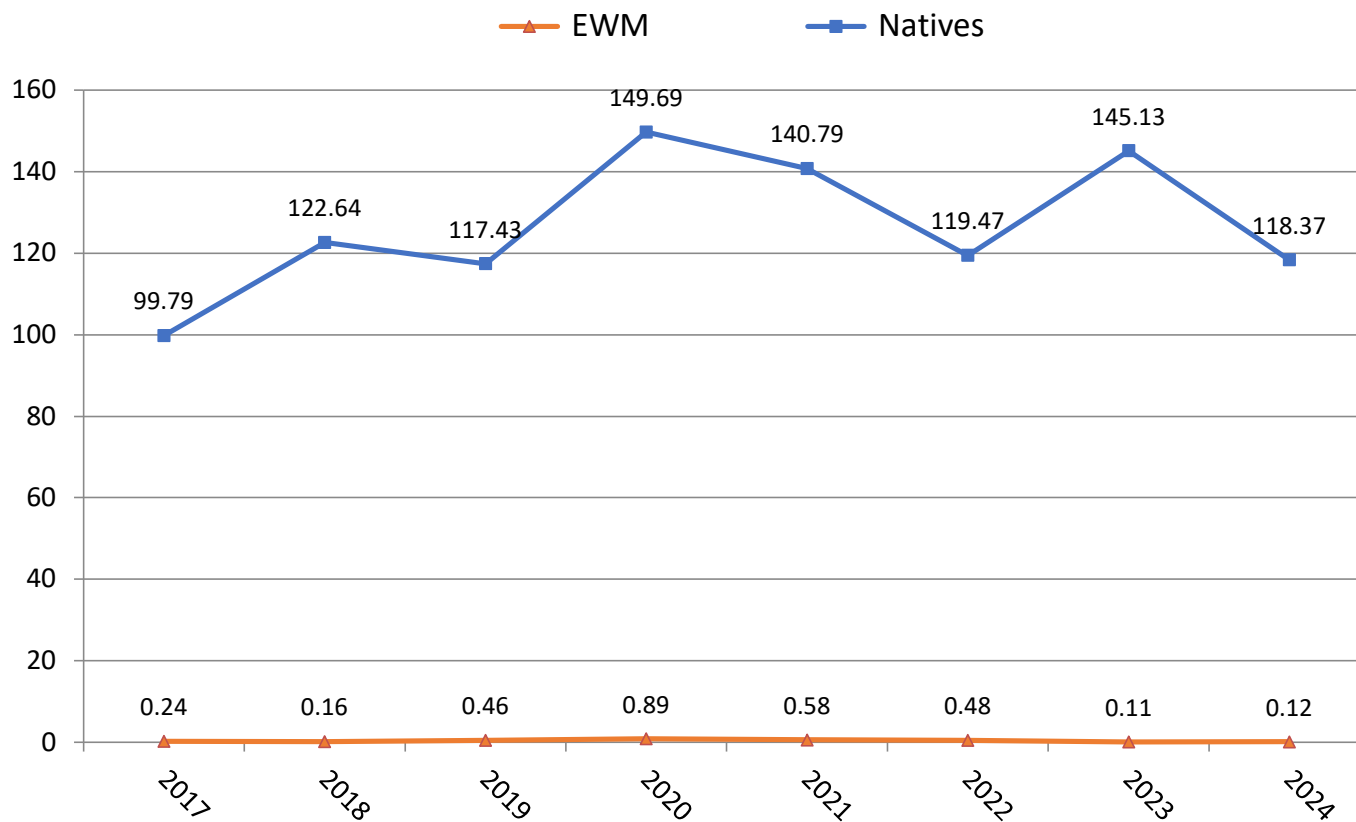
Green Lake
2,025 Surface Acres
Grand Traverse County
Green Township



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AVAS Data Graph

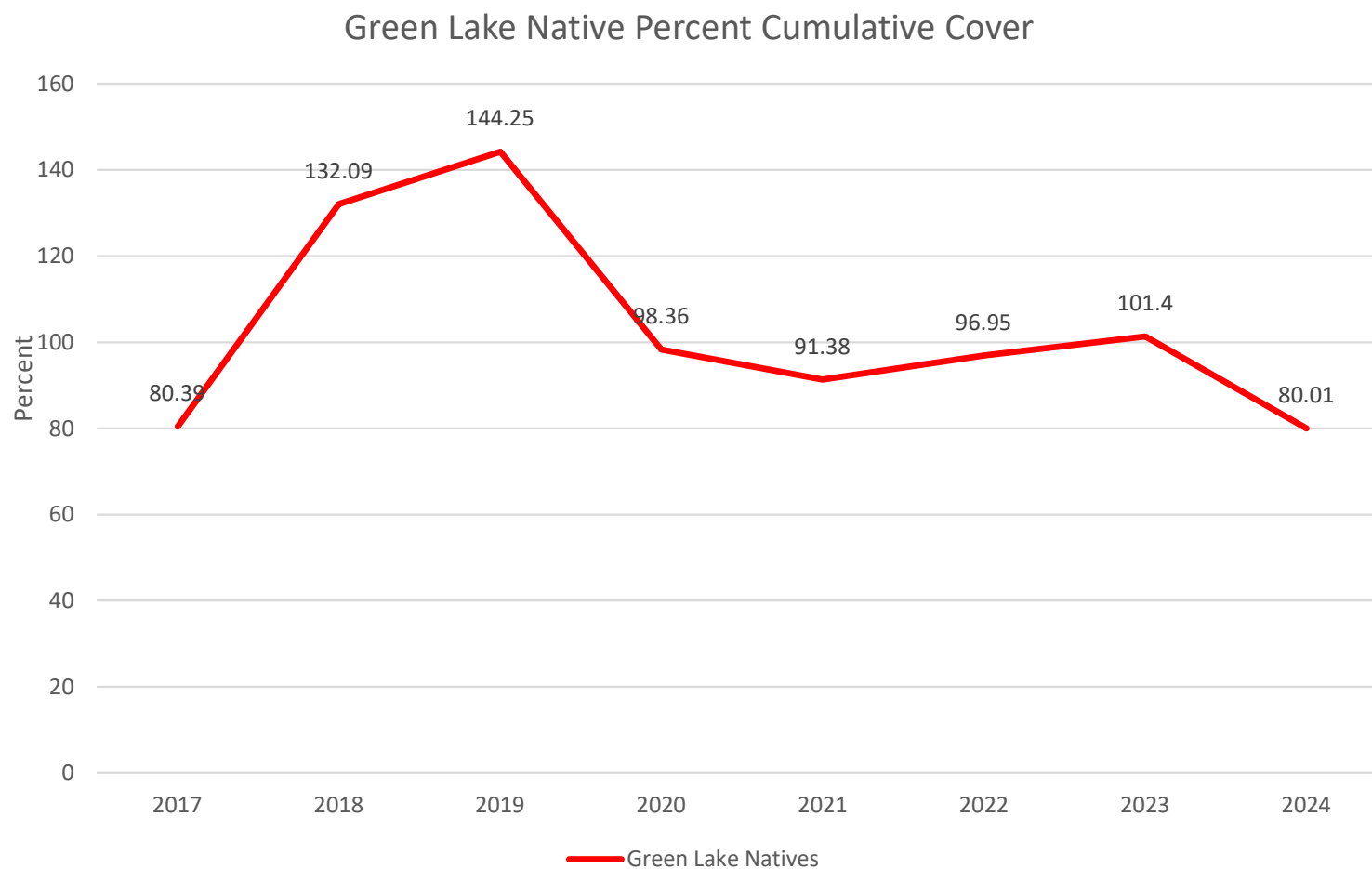
Duck Lake % Cumulative Cover





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AVAS Data Graph





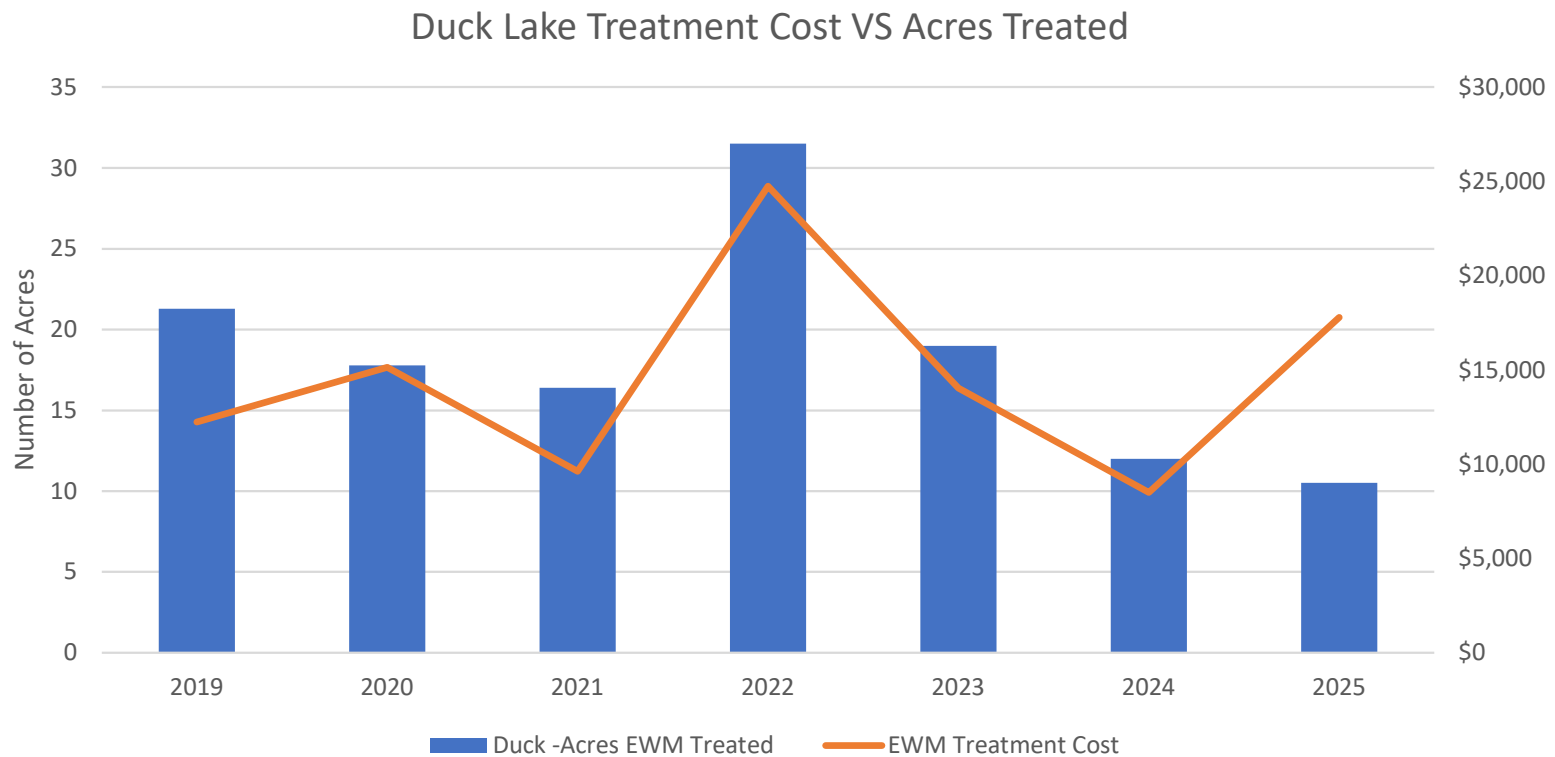
Duck Lake's Treatment - 2025

- Historical overview of treatment maps
- A few more areas of growth this season
 - Vital to stay on top of the growth!
 - Using various active ingredients to fight EWM resistance
- ~9 acres of EWM treated with ProcettaCOR and 1.5 acres with Flumioxazin
- Follow up survey found no EWM in treatment areas
- ~0.01% of the lake was treated in 2025



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Duck Lake Treatment Cost vs Acres Treated





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Understanding herbicides

- Ideally, herbicides would not be required
- Products are re-registered every 10 years, costing millions of dollars each time
- Aquatics has a very small market and very few products as compared to agriculture
- Michigan has its own approval process for each specific product, not just active ingredient, but each trade name (this procedure in itself can take months to years)
- MDARD oversees applicators in addition to EGLE Permits/oversight
- Herbicides are designed to attack the chlorophyll of the plant (the green part that makes it grow). Only plants have chlorophyll.



The Dose Makes the Poison

- Prescription drugs (antibiotics) are therapeutic if taken in small doses, but can be dangerous if abused or taken in overdose proportions.
- Pesticides, like antibiotics are effective when used in the right circumstances, but can become a threat to the environment or even human health if improperly used.

<i>Less Toxic</i>	LDC/50 mg/kg
Fluridone	10,000
Glyphosate	5,600
Table Salt	3,000
Triclopyr	2,574
Aspirin	1,000
2,4-D	300 – 1,000
Copper Sulfate	300
Diquat	230
Caffeine	192
Nicotine	53
Sodium Cyanide	6.4
<i>Most Toxic</i>	



STOP AQUATIC HITCHHIKERS!

Prevent the transport of nuisance species.
Clean all recreational equipment.

www.ProtectYourWaters.net

THANK YOU, QUESTIONS!

- Know your environment, what is around you
- Ask questions
- Communicate
- Prevention is key
- Early detection, rapid response
- We can all do our part!
- Let's work together to protect your Lake!

Casey Shoaff

caseys@plmcorp.net

800-382-4434 ext.2202



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HELP STOP AQUATIC HITCHHIKERS!

To avoid spreading aquatic invasive species

BEFORE launching ... BEFORE leaving:

- Remove aquatic plants and aquatic animals
- Drain lake or river water away from landing
- Dispose of unwanted live bait in the trash

It's the Law... Do not:

- Transport aquatic plants, zebra mussels, or other prohibited species on public roads
- Launch a watercraft or place a trailer in the water if it has aquatic plants, zebra mussels or other prohibited species attached
- Transport water from infested waters

Michigan Department of Natural Resources