Shorelines on Forest Lake

While we have been trying to minimize and control the invasive Eurasian Milfoil on the lake with multiple strategies such as hand harvesting, diver assisted suction harvesting and selective herbicide application, there are other considerations. Several people have expressed to me that while we are trying to destroy the milfoil, our activities on the land may be feeding the milfoil at the same time. I believe this may be a valid point, and I have researched this aspect of milfoil control.

We have all been taught in school how lakes gradually evolve over hundreds or thousands of years. Initially a lake in Northern Wisconsin starts out cold, and clear, and not very fertile. The bottoms tend to be sandy and gravel. This means that there is a minimal amount of nourishment for plants and animals in the lake. In other words, weed growth is hampered by the lack of key nutrients. Forest Lake is what is called an oligotrophic lake. The DNR has a scale for measuring this, and Forest Lake is rated on their index as 50-60. Under 30 is the least fertile. Oligotrophic lakes tend to be populated by walleyes, and other cold water fish like trout and whitefish. The water quality of oligotrophic lakes is rated as excellent, and fish kills are rare.

When enough nutrients flow into a lake, it becomes a mesomorphic lake. These nutrients include phosphorous and nitrates. This process will normally take centuries without the intervention of humans. Typically when a lake becomes more populated by humans, there will be a significant increase in the nutrient flow into the lake, and the lake speeds up in its cycle toward the mesomorphic stage. When a lake is in this stage, the water quality is lower, and water is noticeably less clear. Muck and mud will gradually begin accumulating on the bottom, and vegetation increases significantly due to the increase in nutrients. The types of vegetation, including algae, change to different species of plants and algae. The state of Wisconsin has recognized the harmful effects of phosphate inflow and has banned phosphate in fertilizers for a considerable period of time now. In addition, phosphates in laundry detergents have been banned in the US. Wisconsin has also banned phosphates in dishwasher detergent. See photo #1.

When the nutrient content of a lake increases even more, it becomes the last stage in a lake's life, a eutrophic lake. The water is more murky, the bottom accumulates extensive mud and muck, and the weed biomass is much greater. The water quality is considerably lower than the mesomorphic lake. The fish species change to more bass and more "rough fish" like carp. These are the lakes that are most likely to have algae blooms that cause "fish kills". In addition, these lakes are more commonly the source of blue green algae blooms that are toxic to dogs and moderately toxic to humans. As the lakes in Wisconsin gradually warm due to climate change more bodies of water will become susceptible to these blooms as well. When they occur, people can't swim in the lakes without the risk of fairly severe symptoms afterward. I have actually treated a number of patients in the past who were swimming in relatively warm Wisconsin ponds, and the side effects were sometimes very severe. Side effects include severe rashes, headache, eye irritation, dizziness, respiratory irritation or wheezing, vomiting, confusion, and diarrhea. Dogs can become comatose from drinking the water. These poisonings can occur with water ingestion, or even skin contact with water or inhalation of water vapor. I personally believe that Forest Lake is not very susceptible to blue green algae outbreaks, but with increased nutrient inflow and gradual lake warming more lakes will become susceptible in the future. See photo #2

Basically, the evolution of a lake from oligotrophic to mesomorphic to eutrophic is the life story of a lake from beginning to death. The key to the process is the amount of nutrients flowing into the lake. The main nutrients in this process are phosphorous and nitrates, coming from the land. Lake weeds need both of these nutrients in the right proportion in order to grow, and the more nutrients the faster the growth. When humans begin to settle along a lake there is naturally more nutrient flowing into the lake. The more homes around a lake the faster the eutrophication process. The nutrient sources include nitrates from septic systems, phosphorous from leaking septic systems, fertilizer application on properties, and changes to the lakeshore and the property in general. Changes to the lakeshore such as removing native plants leads to increased water runoff of nutrients directly into the lake with rain and snow melt, and increased nutrients into the groundwater directly below the property and subsequently into the lake.

A completely natural lakeshore is very healthy for both the lake and the lake ecosystem. For example, loons need undeveloped lake frontage for nesting purposes. A study done by the Wisconsin DNR found that, when the density of houses on a lake reaches a certain threshold, the loons disappear. This is likely partially due to lack of adequate nesting sites. Loons were native to the lakes as far south as mid-Illinois, but due to lake development, their natural territory has shrunk considerably. Frogs, turtles, and even the weevil, that eats Eurasian Milfoil, need natural lakeshore to survive throughout their life cycle. Once there is too much property development frogs disappear from a lake. See photo #3

In short, just by being present on the lake, we are decreasing the lifespan of our lake, as well as the quality of the ecosystem and water. None of us are heroes of this story. This article is not meant to blame any person or property, but to suggest ways that every one of us can become a better steward of the lake. Let us look at each of the ways that we can decrease our nutrient flow into the lake. See photos #4,5.

Because most or all of our human waste goes through septic systems, this is a key source of nutrients. In a healthy septic, microbes inside degrade the waste. As far as I can tell from my research, a healthy septic does not contribute significant phosphorous to a lake, but does contribute nitrates. However, if a septic is too full or leaking, there is a significant increase of both phosphorous and nitrates to the lake. This is why septic laws are being tightened with regular inspections, and why holding tanks are now required for new septic systems. I realize that I now need to change my habits and no longer dump uneaten or spoiled food through my garbage disposal which leads to the septic and puts more nutrients into the lake. Instead, I will put it in the garbage for the dump. I will admit that I am going to have to change my behavior drastically in this regard.

Native plants and trees along the lakeshore absorb water and nutrients at both ground level and below ground level. By removing the plants and trees, we increase the level of nutrients coming into the lake. You might ask whether grass will be a good substitute for native plants or trees. There is a webinar from Michigan State University which addressed this. When grass is your vegetation leading up to the lakeshore, it is up to 10 times less effective at reducing runoff from the surface. When looking at the amount of nutrients reaching the groundwater directly under the grass, there is 3-4 times the amount of nitrates and phosphorous. To summarize, land is the main source of nutrient flow into a lake, and native plants and trees drastically reduce the amount of nutrients reaching Forest Lake. This makes sense if we look at the difference between grass lawns and native plants including grasses. Native plants have evolved to withstand fires, and therefore have extensive root systems, extending up to 10 feet into the ground. In contrast, grasses used for lawns have root systems from 1/2 foot to 1 foot deep. When you compare the biomass of a native plant area to the biomass of a woods, they are equal because the roots of the native plants are so deep and dense. This is the explanation for why woods and native plantings are so much more effective than grass at absorbing and filtering runoff and groundwater. See photos #6,7,8.

Some things we can do to decrease runoff into the lake involve the storm water that comes off our roofs. We can look at where our gutters empty, and if possible, extend them to areas of woods or native plants, or into rain gardens (using water loving plants such as iris and marsh marigold, etc.). I have noticed that some of the water running off our property follows our path down to the lake, and have graded these paths differently to keep our walking path from becoming a spillway during rain storms.

Although this isn't really within the scope of this article, the significant biomass of native plantings or native woods are a much better tool for carbon capture (to decrease warming). In addition, it has been shown that a woods around a house keeps the temperature significantly cooler during a warm summer day.

It's not appropriate to tell lake owners what to do with their properties. However, it's important to understand the implications of our property decisions on the health of Forest Lake. For example, lawns on Wisconsin lakes are a great attractant to geese. Up to 50% of Wisconsin lakes have resident geese populations. The more grass, the more likely a lake is to have geese. Unfortunately, geese are a direct competitor to loons, particularly when it comes to nesting sites. Both geese and loons arrive shortly after the lakes start opening. Geese, however, lay their eggs and start brooding their eggs 2 weeks earlier than loons. Both geese and loons prefer nesting sites along the edge of the water, away from predators like raccoons. According to Loon Watch, an active goose nest discourages loons from locating their nests nearby, and often the loons will then choose a nesting site suboptimal for incubating eggs. Forest Lake remains a good site for resident loons, but we shouldn't take their presence for granted. Steve Bablitch has reminded me that Forest Lake used to be named Goose Lake. Goose populations not only compete with loons but additionally deposit an enormous amount of poop on lawns. A single goose can poop up to two pounds per day.

It is understandable that some people on the lake may strongly prefer to have a lawn between their house and the lake. I would ask those people who love their lawn to consider a hybrid approach to protecting the lake. This would be a buffer strip directly along the lake, leaving the majority of the lawn intact. One could just plant a small area of buffer strip on a corner of the property or several small test areas to see how they look and function. Even small amounts of native plantings would help reduce the nutrient runoff into the lake. My prediction is that you might prefer this over lawn adjacent to the lake, as it would increase the biodiversity on your shoreline (frogs, hummingbirds, butterflies etc.), and act as a superior barrier to erosion. We have a tentative arrangement for someone from Paths to Nature to tour the lake with us in early summer. He is an expert on lakeshore restoration and an expert on erosion control. He will give us some suggestions which we can pass on, but even better, if you ask us specifically to look at your property, we will take notes on his suggestions and put you in contact with him for further discussion.

During my research on lake eutrophication, I have learned a small amount about erosion control, that I would like to share with you. Given the high lake levels recently you may find this information helpful. I will admit that I was wrong about the best method to control shoreline erosion.

I had always focused on the high water mark on our lake, and when we bought our property we had a landscaper put down some rip rap (medium to large stones) reinforcing the shoreline. I now understand that there may be better long term solutions to rock walls as an erosion barrier. To understand the mechanism of erosion there are 2 areas to consider: the water or “littoral zone”, and the land adjacent to the lakeshore.

The mechanism of lakeshore erosion is the result of energy from waves. The energy of the wave that reaches the shoreline causes the impact on the shoreline and leads to erosion. The water or littoral zone is not commonly recognized as a significant way to decrease the energy of waves but it turns out to be very important. Vegetation, logs (downed wood), and stones and gravel beneath the surface all take energy away from the wave and reduce the impact on the surface. This energy reduction is very important at preventing erosion. An added bonus to downed wood in the lake is that a DNR study showed that lakes with significant downed wood in the water have fish growth 3 times more rapid than lakes with little wood. See photos #9.10.

I had initially thought that a simple rock wall would provide good erosion control, but according to water scientists a vertical wall simply directs the energy of the wave to the bottom of the wall, gradually eroding under the lowest rock, ultimately leading to fragmentation and collapse of the wall. A superior rock wall is one which gradually slopes upward the closer it gets to the shoreline. This wall would begin with smaller rocks in the littoral zone, and end with the largest rocks along the shoreline. This allows much better absorption of wave energy. A rock wall usually needs to have an underlayment of landscape fabric as an additional protection against erosion under the rocks. Please be aware that many rock walls need DNR approval. (See DNR website.) A vertical rock wall is also detrimental to the lake ecosystem as it does not allow easy access to land for lake animals that are important to the overall lake. For example, the more homes along a lake the fewer frogs exist on a lake. Not only are frogs an amazing animal, but frogs are a “canary in a coal mine” to detect lake degradation. This highlights the importance of preserving natural shoreline. The best littoral zone erosion control is a combination of plants and wood, with a graduated gravel/rock shoreline. See photo #11 demonstrating how a vertical rock wall directs wave energy to the base of the wall, eroding it from underneath.

When we get to the actual shoreline itself, the presence of trees and native plantings have deep roots and are a significant force preventing erosion, whereas grass has little value in preventing erosion due to its shallow roots.

In summary the presence of houses by their very nature increase the eutrophication of a lake. Native plants and native woods are the most healthy options for both preventing eutrophication and weed growth. I think that the people who suggest that we need to minimize our feeding of the Eurasian Milfoil are 100% correct. As I mentioned I think every property owner has the opportunity to make changes to their lake footprint that will both slow weed growth, and enhance the health of our lake for future generations. A welcome side effect of these efforts should also help us with erosion control.

If I have offended some of our lake residents, I am no expert in this area and I have relied on the experts and the available science. I want to repeat the overriding theme of this article. They are no innocents living along the lakes of the North Woods. We all contribute to the deterioration of our lakes. My hope is to suggest ways that we all can diminish our impact on the lake. The bottom line is that it is crucial to keep the shoreline as natural as possible, and to decrease the flow of nutrients into the lake. I would be happy to answer any questions, and I would be happy to provide contacts who could help you with “test strips”, replantings, or supplemental plantings. An alternative to replanting, etc., is simply to stop mowing a strip of grass. Within 1-2 years multiple new plants will start to grow, many of them native. Once you are not mowing an area, you could supplement the area in the early fall with a mix of native wildflower and native grass seeds. After about 2 years you would have a much better barrier to nutrient flow into the lake, as well as multiple blooming wildflowers.

Photo 1:

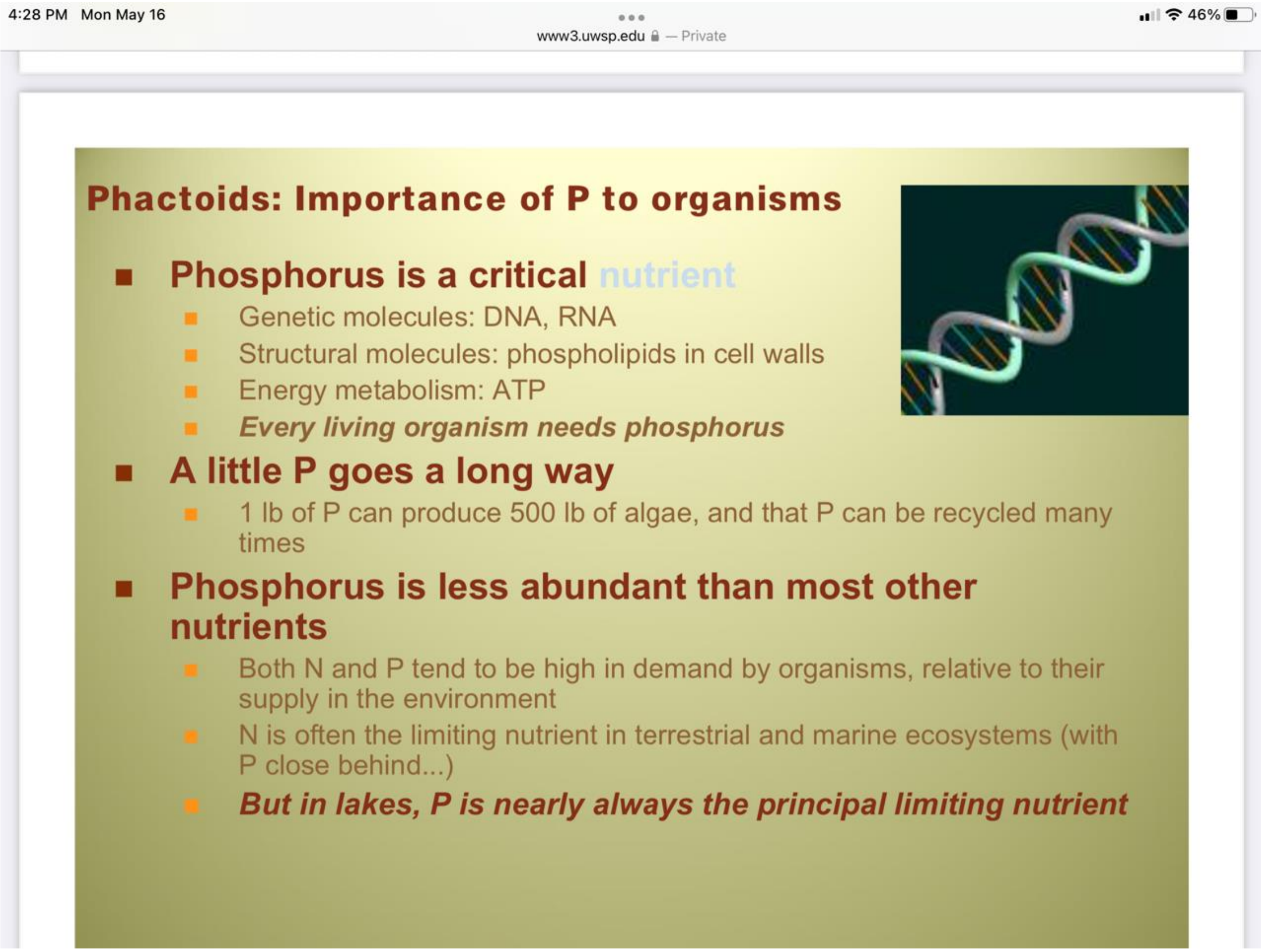


Photo 2:

4:29 PM Mon May 16

www3.uwsp.edu — Private

46%

Common *human* symptoms associated with blue-green algae exposure include:		
Respiratory	**Dermatologic**	**Other**
Sore throat Congestion Cough Wheezing Difficulty breathing Eye irritation	Itchy skin Red skin Blistering Hives Other Rash	Earache Agitation Headache Abdominal pain Diarrhea Vomiting Vertigo

Common *animal* symptoms associated with blue-green algae exposure:
Lethargy Vomiting Diarrhea Convulsions Difficulty breathing General weakness

Photo 3:

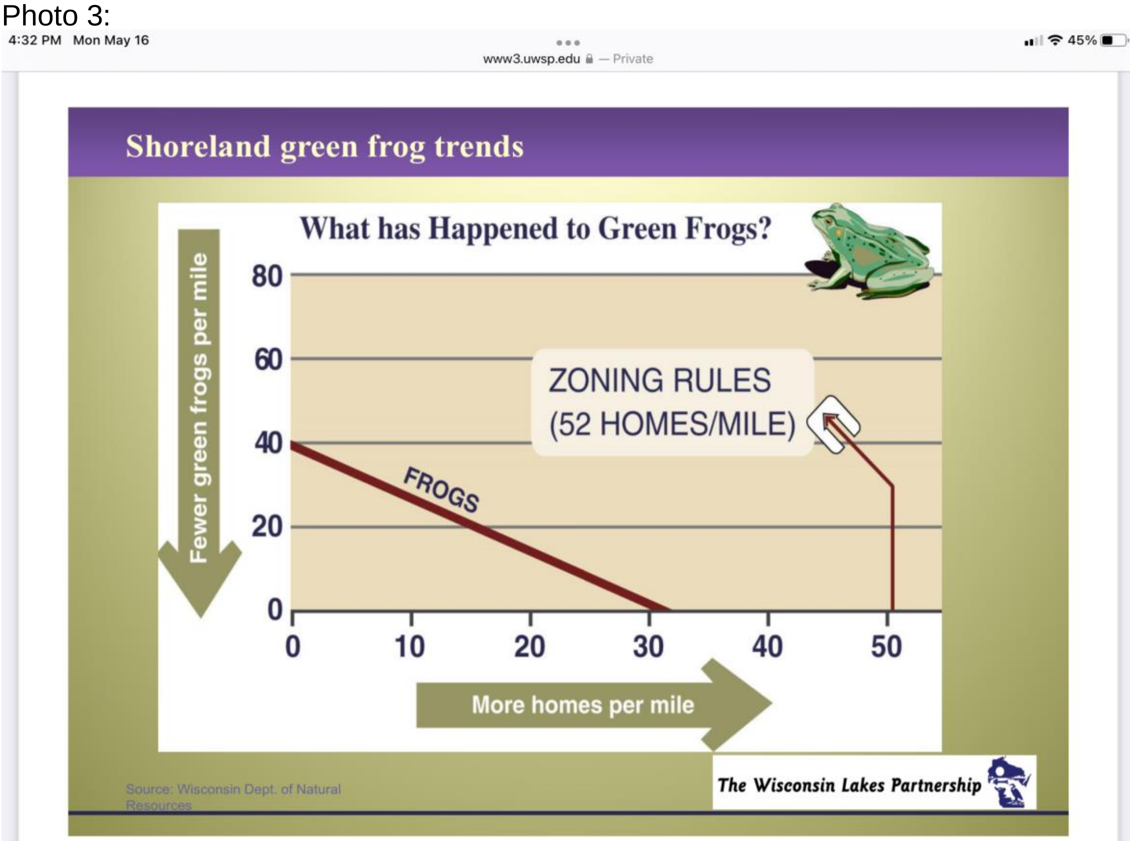


Photo 4:

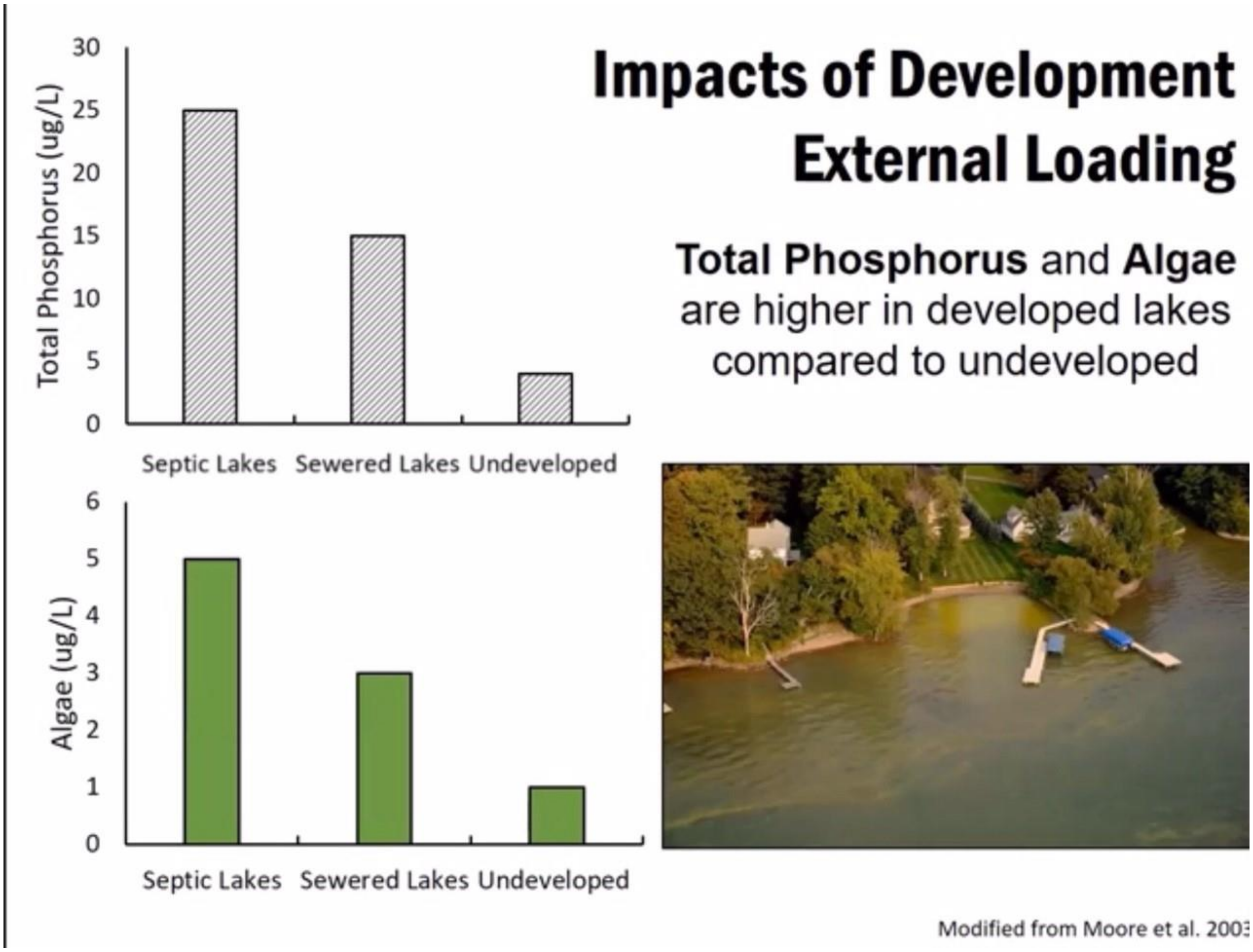

Impacts of Development
External Loading
Total Phosphorus and Algae
are higher in developed lakes
compared to undeveloped
Total Phosphorus (ug/L)
30
25
20
15
10
5
0
Septic Lakes
Sewered Lakes
Undeveloped
Algae (ug/L)
6
5
4
3
2
1
0
Septic Lakes
Sewered Lakes
Undeveloped
Modified from Moore et al. 2003

Photo 5:

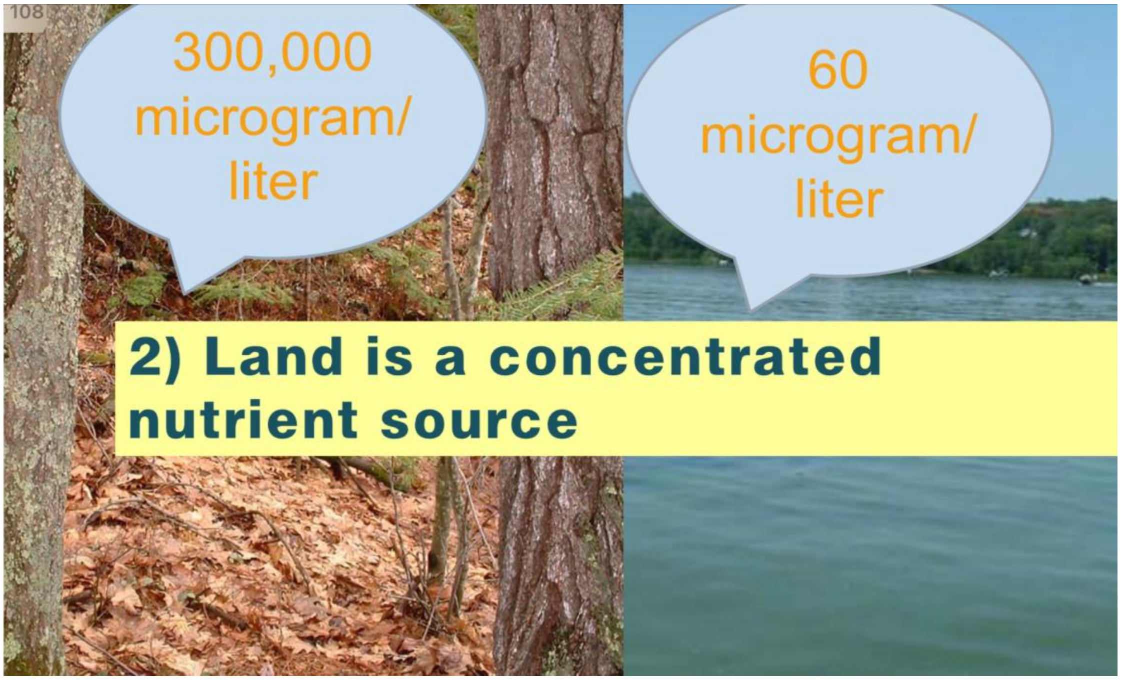


Photo 6:

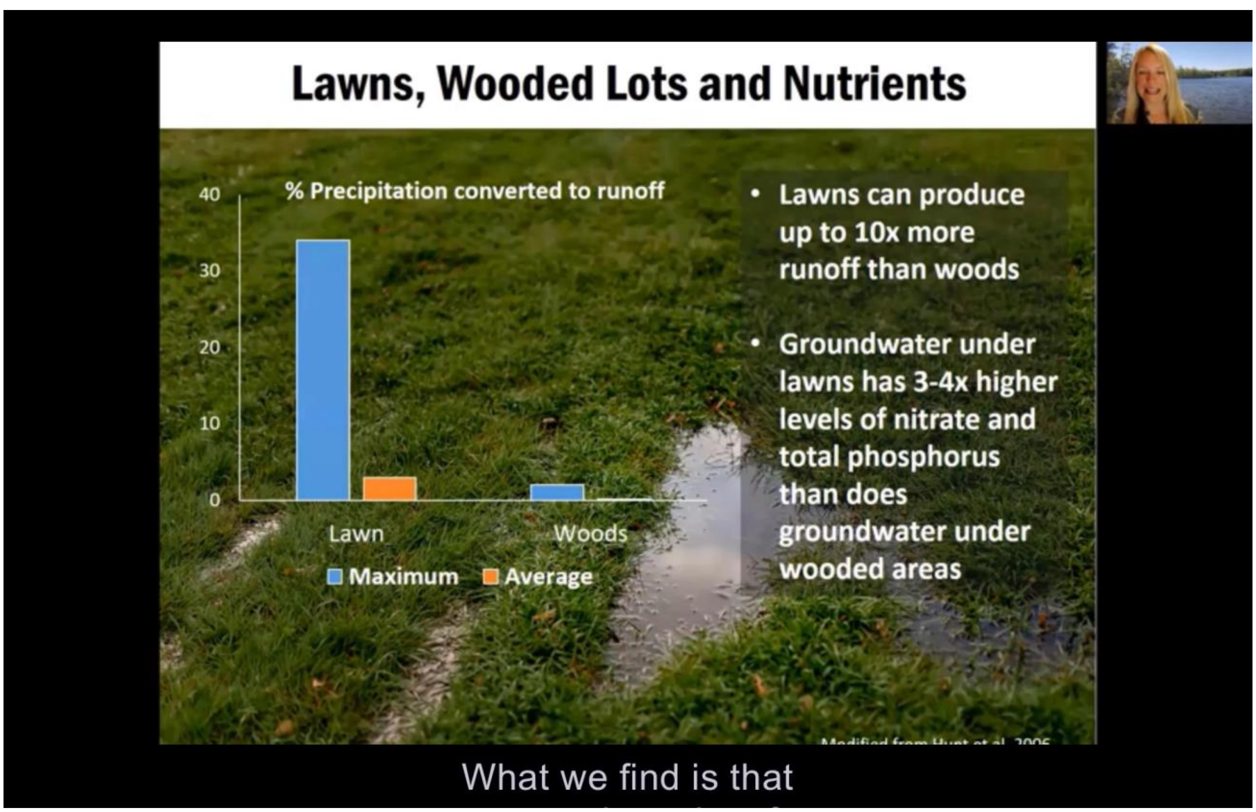
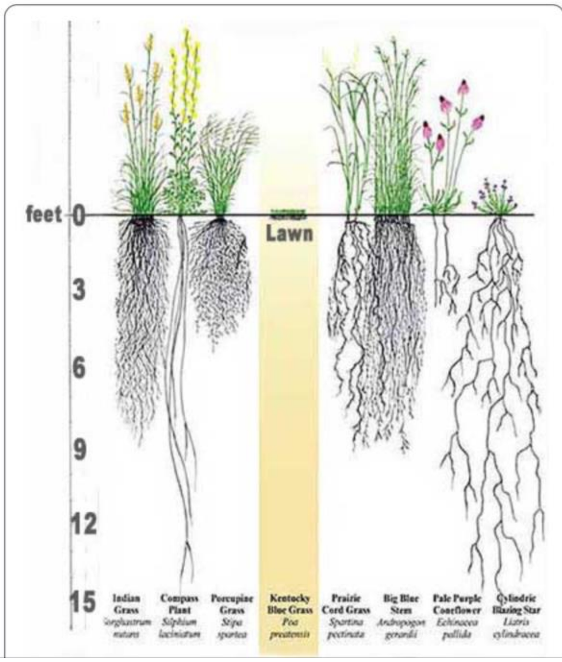


Photo 7:

The deep root systems of many Wisconsin native plants increase the soil's capacity to stabilize soils, reduce water usage, control water runoff and, consequently, reduce flooding.



The roots of a plant play an important role to help the plant grow and thrive. They anchor the plant in the soil; absorb water and minerals; and store excess food for future needs underground. We are all familiar with eatable roots like carrots, beets parsnips and potatoes. What about the roots of native and wild plants? What are their attributes? Do they provide food and medicine?

The bulk of a prairie grass plant, it turns out, exists out of sight, with anywhere from 8 to 14 feet of roots extending down into the earth. Why should we care? Besides being impressively large, these hidden root balls accomplish a lot:

- Nourishing soil
- Increasing bioproductivity
- Preventing erosion

One of the really nice things about bringing native plants back into our environments is that they are already acclimated to our local soils, rainfall and nutrient loads. Garden soils need little work for native plants to flourish.

Root Physiology

Photo 8

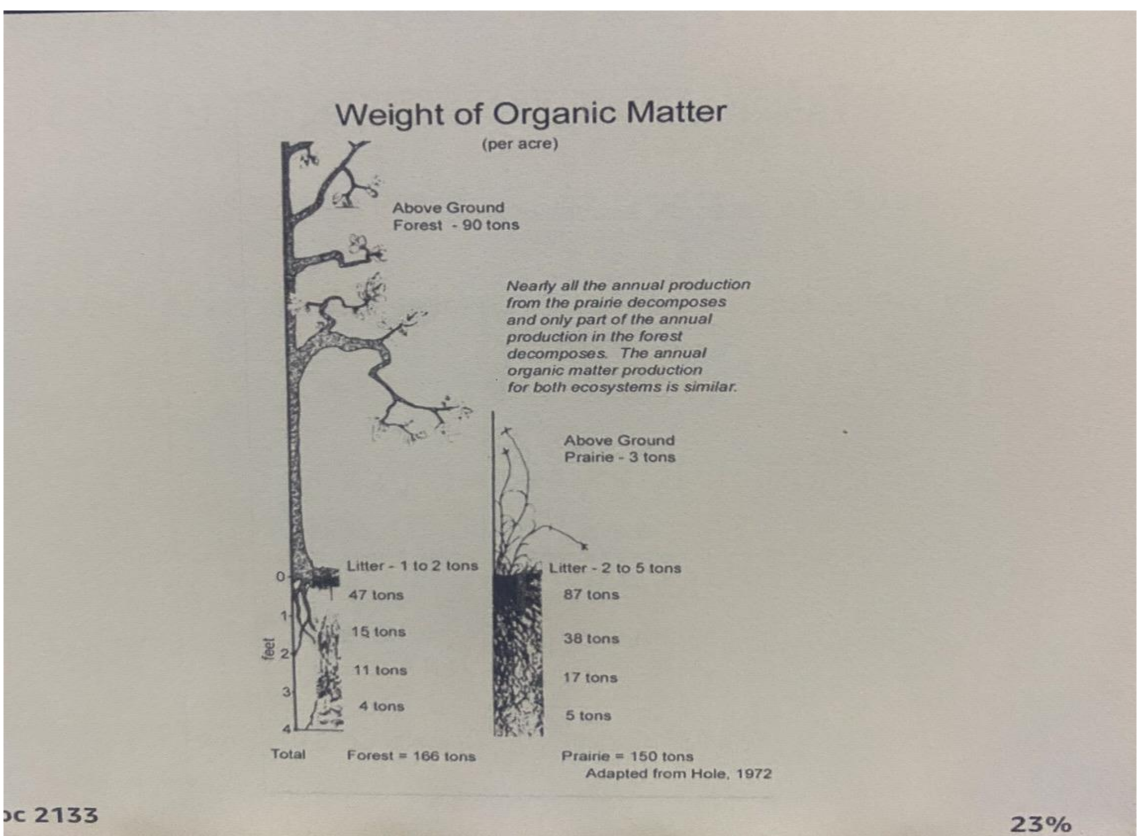


Photo 9:

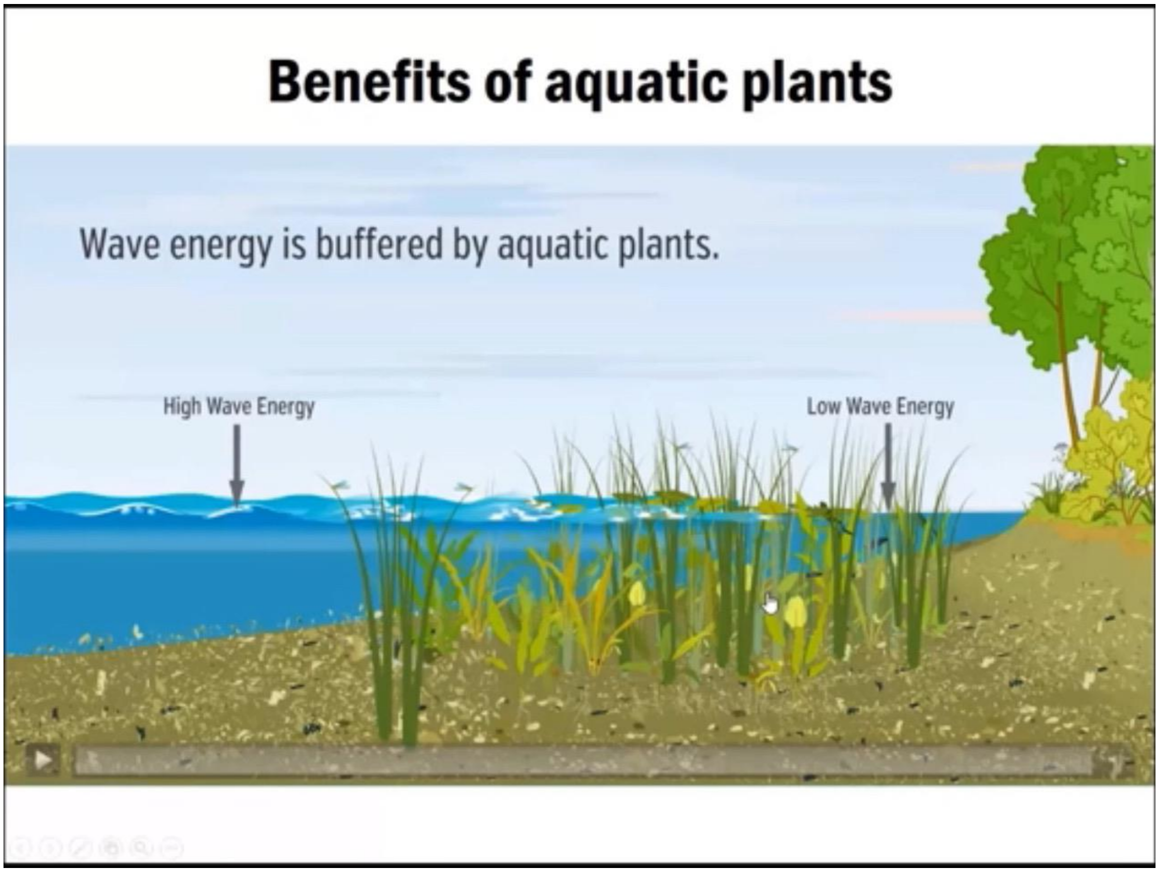


Photo 10:

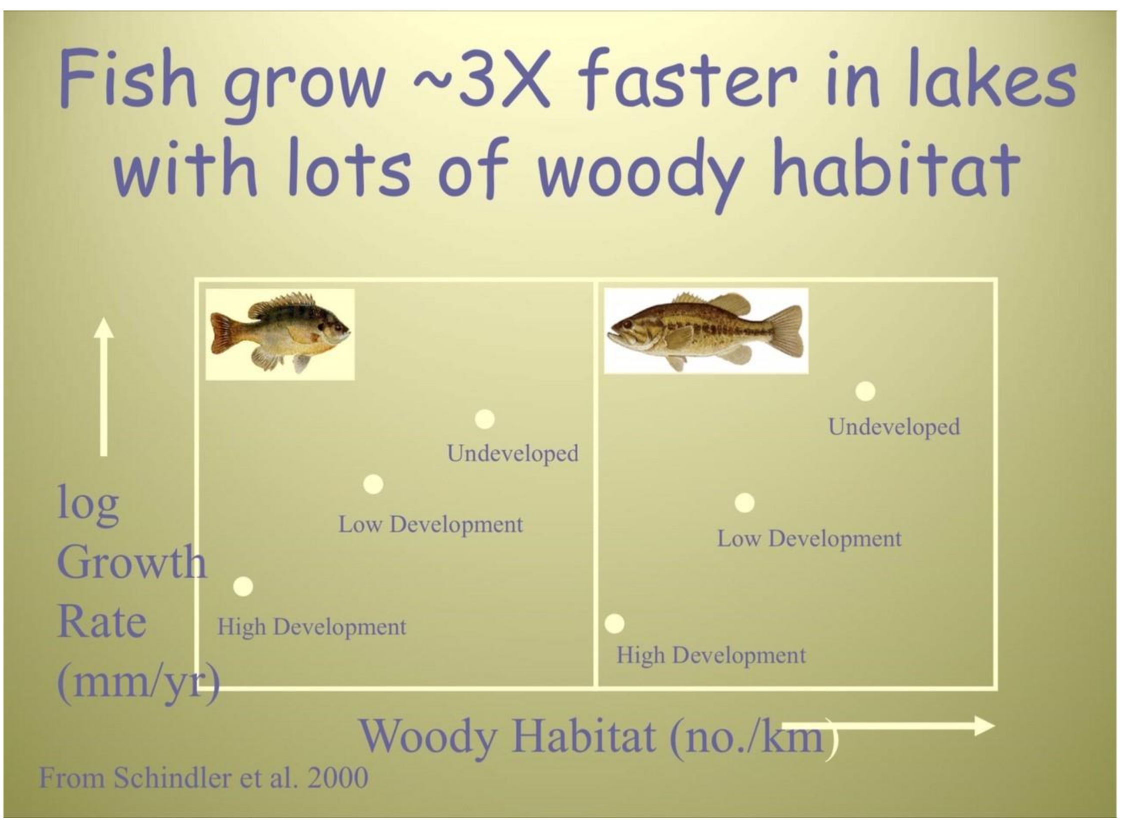
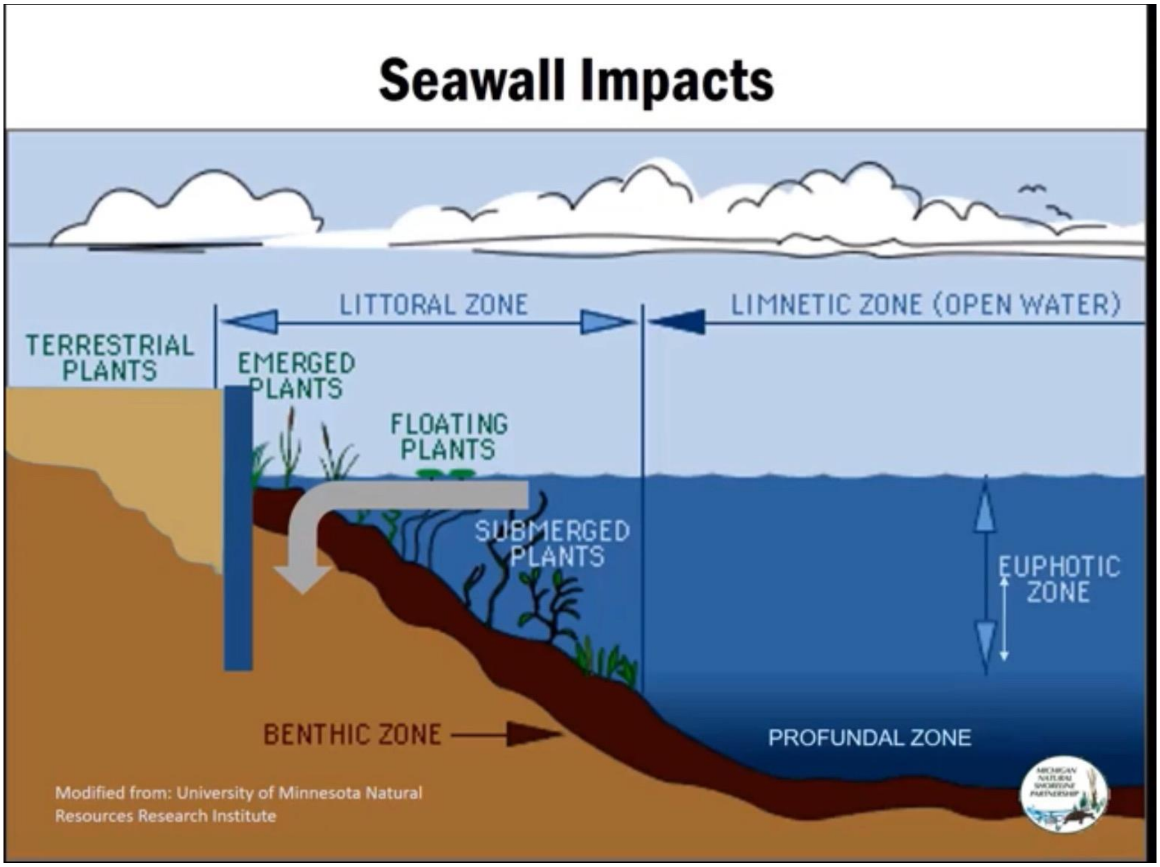


Photo 11:


Seawall Impacts
LITTORAL ZONE
LIMNETIC ZONE (OPEN WATER)
TERRESTRIAL PLANTS
EMERGED PLANTS
FLOATING PLANTS
SUBMERGED PLANTS
EUPHOTIC ZONE
BENTHIC ZONE
PROFUNDAL ZONE
Modified from: University of Minnesota Natural Resources Research Institute