**Tim Greene 5/5/24**

**Summary of What Might Cause Increased Weed Growth**

Dear Wrighter Lake Homeowners.

**Introduction**

In the fall of 2023, Tom Novitsky, the then president of the Wrighter Lake Homeowners Association (WLHA) appointed an ad hoc committee of Tim Greene (chair), Bob Lissner, Cate DeGraw, Carl Arabia, and Tom Novitsky to investigate the possible causes of increased weed growth in a community lake like Wrighter Lake. This document is a summary of what we learned about mitigating the causes of lake weed growth. We were not tasked with the question of how to remove weeds from the lake, only as to what the possible causes of increased weed growth are. The sections below are what we learned. The members of this committee are not professionals in lake weed management and hence are presenting only what we have learned. The information we present here are from multiple sources including the Penn State Extension Office; Pennsylvania Lake Management Association; and magazine, journal, and conference papers.

We begin with a list of recommendations that each homeowner can do to help limit weed growth. We then follow the recommendations with background information that will help you better understand the causes of lake weed growth. Posted on the WLA website are several articles if you want to learn more.

**Recommended Actions That Individual Homeowners Can Take To Mitigate Lake Weed Growth**

There are many things we as individual property owners can do to mitigate weed growth. Some are easier than others. But each of us can contribute to mitigating the causes of lake weeds. Here are some recommendations:

* Minimize or eliminate any fertilization of your yard or flower beds especially near the lakeshore. This will reduce nutrients especially nitrogen and phosphorous which promote weed growth.
* Minimize or eliminate the use of soaps and detergents that contain phosphorous. Even if these soaps and detergents go into your sewer system, there is a potential for leakage into the lake through the underground aquifer.
* Monitor your septic systems. Make sure your sewer system is not leaking into the lake. Our annual water quality checks may not detect phosphorous leaking into the lake. Check for increased vegetation growth between your system and the lake and check for any inflows, even very slight on your lake shore. For those people with older steel septic and holding tanks, be aware that overtime they corrode, develop small pin holes in them and can leak slightly. It is hard to know if they are leaking. Consider replacing an older steel tank.
* Clean and reduce the frequency of watercraft that enter the lake that have been in other bodies of water. If watercraft are to enter the lake, make sure they have been thoroughly cleaned. Cleaning must also include the trailer that enters the water when the watercraft is launched. Uncleaned equipment can introduce additional unwanted invasive vegetation into the lake. The invasive weed material may be so small that the untrained eye will not see it on the watercraft or trailer.
* Build berms (areas of un-mowed natural grasses and flowers) between your yard and the lake. Berms of five to twenty feet wide reduce sediment runoff into the lake, absorb nutrients before they reach the lake, and deter geese from entering your yard to feed and hence live at the lake. While homeowners with limited lake shore may have limited opportunity to build berms, any berm is better than none.
* Use only washed or semi-washed gravel on your road or parking area. Gravel that has been washed contains much less sediment that can ultimately wash into the lake.
* Do not blow autumn leaves into the lake in the fall as they decompose and increase the sediment level at the lakeshore as well as increase the nutrient level.
* Do not deposit grass clippings near the lakeshore as they contain nutrients that can leach into the lake.
* Reduce the wild geese population. Geese eat on the shore and then defecate in the water adding nutrients. Berms discourage geese living at the lake, But also pin wheels, fox or owl decoys, and string and glitter ribbons are all means to discourage geese from having their nests on the lakeshore, feeding on the lakeshore, living at the lake for the summer or year-round, and hopefully moving to another lake. The WL Homeowners Association will also investigate humane ways to relocate the geese.
* Eliminate the use of bubblers. A lake that is ice covered longer means less early season weed growth. Because most weeds grow in the shallow water near the shore, bubblers that keep the shallow, near-shore areas free of ice may promote an earlier and longer weed growing season. (Note there is a lack of information on the effect of bubblers on weed growth that the committee could find.) In addition, bubblers provide open water throughout the winter promoting geese to winter at the lake and promote otters and muskrat to live year-round at the lake.
* Create holding areas where large amounts of water flow into the lake to allow sediment to settle and not enter the lake. We have two streams that naturally flow into the lake, one under Wrighter Lake Road on the south side of the lake and a smaller one at the northern most corner of the lake. Is it possible to build sediment holding areas at these points of inflow? In addition, we have several sluices/ditches that direct the water from the back of homeowner properties into the lake. Can all these areas support individual holding areas to collect sediment before it enters the lake? This will require property owner cooperation, obtaining any needed state permitting and probably a major cost to the WLHA to construct them and help maintain them.
* Property owner seasonal raking of weeds. While weed raking may not initially be thought of as a mitigation strategy, eliminating the weeds before they decompose, add to the sediment, and add to the nutrient load is a mitigation strategy. Homeowners are encouraged to rake their shoreline several times a season to remove any weeds. The removed weeds should be moved well away from the shoreline, so their nutrients do not leach back into the lake.

**WLA Assistance in Weed Cutting and Raking**

The WLA Board has decided to purchase a week knife that will be available for loan to any homeowner that wants to harvest their in-water shoreline weeds. Mackenzie Devite and Tom Novitsky have agreed to share responsibility to lend out the knife. Please contact one of them to schedule a time for you to borrow it.

**Summary of What Might Cause Increased Weed Growth**

Weed growth can be attributed to many factors, none of which is a dominate factor. Nor is it easy, if even possible to identify a single factor or even a set of factors. These are some of the factors that can affect weed growth:

* Nutrients – Primarily phosphorous and nitrogen:
	+ Wildlife defecation
	+ Fertilizers
	+ Previous season’s vegetation (weeds and leaves) decay
* Sediment:
	+ Erosion from the shoreline and via streams and sluices.
	+ Road sediment runoff
	+ Previous seasons’ weed growth that has decayed
* Water temperature:
	+ Overall climate change
	+ Annual variations in spring precipitation and earlier or warmer springs
	+ Annual variations in air and water temperature and water depth
	+ Bubblers mitigating ice coverage
* Weed growth cycles from year to year
* Incursion of new invasive weed species from:
	+ Uncleaned watercraft and their trailers entering the lake that can transport invasive species
	+ Seeds of invasive species from other areas brought to the lake by bird and geese defecation

Many of these factors are intertwined. Some factors may dominate one year’s growing season, but the same factor may be much less impactful the following seasons. Below is a general discussion of the factors.

**Nutrients – Phosphorous (P) and Nitrogen (N)**

All vegetation needs phosphorous and nitrogen to grow. The sources of these nutrients are many and may include run off from yard fertilization, leakage from sewer systems, wildlife defecation, inflows from other sources, and decay of previous year’s weeds.

Our annual water quality tests indicate we have very little free phosphorous in the water. But weeds are naturally hungry phosphorous consumers. This means that with a high weed load, the weeds quickly absorb all the available phosphorous entering the lake, and hence it will not register on our water tests.

Phosphorous and nitrogen can come from water runoff into the lake (point sources and general sources), such as a season with a wet spring with a lot of rain. They can also come from local fertilization using fertilizers with P and N in it. This fertilization can be from local homeowners or from farms far away through the water shed and underground aquifers.

P and N can come from increased use of point sources primarily septic sewer systems (more and more frequent use of toilets, showers, dishwashers, and washing machines using phosphorus rich detergents) but you cannot measure the P coming into the lake so you cannot determine the amount of P being leached into the lake.

P and N also come from increased animal waste including:

* Run off from fields where livestock have been housed or run off from fields where livestock manure has been spread. Note this runoff may come from miles away through underground aquifers.
* Increase animal habitat on the lake such as increased geese populations
* Open water in the winters can also result in increased animal habitat and hence increased P and N (seasonal bird migration, otters, muskrats, etc.) Open water may be caused by global warming as well as human intervention with bubblers.

One method of limiting P & N intrusion is berms. Berms are five to 20 feet of natural grasses and flowers along the lake’s edge that are allowed to grow all year around. Berms can catch P &N and use it before it enters the lake. Berms also reduce the areas for geese to come ashore, feed, nest and hence fertilize the lake with their defecations. Berms are a deterrent to geese living at the lake during the summer and during the winter. The downside of berms is that homeowners with limited shoreline and yard might not be willing to sacrifice their areas to natural berms.

**Sediment**

Sediment is fine sand and soil that accumulates at the bottom of the lake over many years. Increased sediment is a natural site for increased vegetation growth as it holds nutrients and seeds and promotes weed root growth. All lakes become shallower over many years. Shallower water means:

* The water warms earlier in the spring promoting earlier weed growth
* The water is in general warmer during the summer promoting better growing conditions, and
* The lake bottom is closer to the surface providing increase light to the weeds and increased photosynthesis.

Sediment can come from many sources including erosion of the lake shore, water flowing into the lake that carries fine particles of sediment, decomposition of vegetation (weeds) in the lake from previous growing seasons, and decomposition of leaves in the fall.

Annually as weeds decay, they create muck which is an excellent foundation for the following years weed growth. Sediment can capture nitrogen and phosphorous therefore causing a better weed growing the following seasons. Hence a weedy lake for years promotes a weedier lake in the future. If weeds are removed during their annual growth cycle, then they cannot die and decay. While the ad hoc committee was not charged with how to eliminate weeds, it is noted that individual homeowners can remove weeds from their shoreline with specially designed water weed rakes. If this is undertaken, it is important to remember to remove the raked weeds far from the shoreline, so they do not leach nutrients back into the lake, or they decay, erode, and add to the sediment level in the lake.

Another possible source of sediment is from the unwashed gravel placed on our roads eroding away and passing through our sluices/ditches into the lake. For those people who live near the sluices, you probably have seen the plumes of sediment flowing into the lake after a heavy rain.

One method of limiting sediment intrusion is berms as mentioned above under P & N. The thick grass and flowers in berms can catch sediment before it enters the lake. A second method is to construct catch ponds at point source outlets that allow sediment to settle in the catch pond and not progress into the lake. But permits may be needed to create catch ponds, homeowner approval will be needed, they may be expensive to construct, and they need to be maintained (dredged) periodically. A third method that some lakes have resorted to is lake dredging. But dredging is a very expensive process.

**Water Temperature**

As climate change causes global warming, lake water also warms. With warmer water, the weed growing season is longer and weed growth starts earlier in the spring. In addition, with global warming, there are less days of ice coverage on the lake and therefore increased sun radiating down through the water promoting increased photosynthesis. But weather patterns vary year to year with some years having warmer summers and/or warmer springs so overall warming is not necessarily linear. These temperature variations may influence weed growth in any one year.

There is not much individual Wrighter Lake homeowners can do about global warming expect in the greater good of all humanity.

Water temperature is also affected by the amount of water running into the lake. A rainy spring or summer can have a warming or cooling effect on the lake water temperature and hence weed growth. Increased spring rains can also increase increased nutrient levels just as weeds are beginning their growing cycle increasing weed growth for that year.

As mentioned above, water also warms if it is not covered with ice in the winter. A warm winter means less time the lake is covered with ice in the spring, increased sun exposure for photosynthesis and possibly more weed growth. In addition, bubblers that keep the ice from forming may cause warmer lake water and greater early season weed growth.

**Weed Growth Cycles**

Many weeds have multi-year growth cycles that naturally cause changes in the amount of vegetation seen in an annual growing cycle. Also effecting growth cycles are variations in spring and summer temperatures, winter ice levels, and the amount of spring rains from year to year. Therefore, it is hard to immediately associate mitigation actions with decreased weed levels. Weed levels need to be considered over multiple years to determine long term effects of mitigation strategies.

**Incursion of New Invasive Weed Species**

While we already have many of the most irritating invasive weed species already in Wrighter Lake, there are other invasive weeds that we do not want arriving including Hydrilla and Watermeal. Ways new invasive weeds can enter the lake include watercraft being launched in the lake that have come from other lakes containing harmful weeds where the watercraft and the trailer have not been thoroughly cleaned. The clippings or seeds can be unseen to the casual observation but can then proliferate over time into a major issue.

Birds and geese can also bring seeds from other lakes miles away and deposit them in Wrighter lake through their defecations. Besides berms and devices intended to discourage geese from coming ashore, there is very little that can be done to minimize wildlife from bringing additional seeds to the lake.

**Lake Eutrophication**

The scientific study of how a lake ages and is impacted by external issues as discussed above is called lake eutrophication (u-**tro**-fi-ca-shun). Two good articles on lake eutrophication are by Anderson et al and Geletu. They write “Eutrophication is a consequence of the accumulation of nutrients in soil or water by natural or human activities. Natural eutrophication is considered to be a natural aging process of aquatic ecosystem in which nutrients accumulate gradually, with the water body becoming rich in plant and animal life. Human activities accelerate this slow process of natural eutrophication by increasing nutrient inputs, a process referred to as cultural eutrophication.” (Geletu, T.T ((2022) Lake eutrophication: Control of phytoplankton overgrowth and invasive aquatic weeds. Lakes and Reservoirs, DOI: 10.1111/lre.12425 and Anderson, D. M., Glibert, P. M., & Burkholder, J. (2002). Harmful algal blooms and dutrophication: Nutrient sources, composition, and consequences. Estuaries, *25*, 704–726).

To summarize the research on lake eutrophication in simple terms; lakes naturally age over time as sediment makes them shallower and nutrients increase leading to increased vegetation growth. Humans can increase the rate of lake eutrophication by improper actions, but humans can also slow lake eutrophication (but not stop it) by better actions.

**Sources**

There is considerable information and literature on lake water quality and lake weeds. Some of the literature focuses on small ponds (five acres or so) that are either near or not near farming operations. Some of the pond information pertains to larger, multi-homeowner lakes. Some literature speaks to lakes in much milder climates and maybe is not as applicable to Wrighter Lake. Some of the more useful information sources we found include:

* Penn State Extension - Penn State Extension Resources for Pond and Lake Owners
* Cornell Cooperative Extension
* The Lilly Center for Lakes and Streams at Grace College, Indiana
* Pennsylvania Lake Management Society
* Lakes & Reservoirswileyonlinelibrary.com
* New Mexico State University - College of Agricultural, Consumer, and Environmental Sciences
* Vermont Department of Environmental Conservation