

Subject: Weed overgrowth on Muskellunge Lake, Vilas County
Jeff Rappold, 1/22/14

On an all too regular basis comments are made by Muskellunge Lake property owners that they would desire the lake to be something different than what it currently is. Specifically this usually relates to comments of too many weeds or too much algae in the mid-summer and its negative impact on the way that people want to enjoy the lake. This topic regularly is a part of MLA annual meetings, MLA board meetings and personal requests to board members. The call for "We need to do something about these weeds..." has been one constant request as long as I can remember.

Having done significant research on this matter, I felt I would summarize what I have discovered and share it with others. My primary purpose here is to inform and educate lake property owners on this topic. The following comments are the personal opinions of Jeff Rappold on this subject. I realize some lake property owners may have opinions that differ and I respect that. I have attached web links in this document where appropriate information may be obtained that provides some of the supportive science I have discovered. My observations and opinions offered here are based on;

- My own observations as being a lake property owner on this lake for 40+ years.
- While gathering information for our web site, I have read nearly every science based article ever published about Muskellunge Lake. Most of this is linked on our MLA web site.
<http://www.muskellungelake.org/>
- I have personal interest in lake biology and invasive species control. This interest has connected me to many other documents about lakes in our area with similar lake chemistry and biology.
- I've had a long time interest in Limnology and I am a follower of the UW/EX Lakes organization. I have followed most of their writings on these topics over the years.
<http://www4.uwsp.edu/cnr/uwexlakes/>
- The information here is based solely on what I have learned about our water chemistry and plant biology. I don't make connections here to aquatic or land based animal species though there is assuredly significant interplay in the overall lake biology.

Personal Observations

- Our family property is located in the NE area of the lake with a South facing shoreline. Bulrushes are growing out in front of most of our property in a sand/gravel base that is silted over with up to a foot of silt. At about 4 feet in depth the aquatic plants turn to various submergent varieties. In the 42 years of being on this lake I have used the lake for a number of uses. From water skiing and power boating years ago to fishing, pontoon rides and wildlife viewing in more recent years. The bay we are in has always had submerged weeds that come nearly to the surface in late summer. How far out into deeper water the weeds grow seems to vary year to year. I offer an opinion that I believe there are more weeds and silt near our shoreline than ever. This opinion is without fact or substance though.
- Lake filling in. Our lake is clearly leaning to becoming a more eutrophic type lake. This has been reconfirmed over the years based on the water quality reports. It seems lately that the sandy shorelines are being covered with more silt. This becomes the ideal growing conditions for new submergent weeds. Lower water levels in the last several years are perhaps are part of this for consideration.
- Floating weed fragments. Every one of us has experienced times when masses of cut off weeds float into our shorelines. Heavy boat traffic, fishing tournaments, inconsiderate boating practices and even wildlife and natural die offs create this material and the wind then blows it to

an unlucky lake owners shoreline. Left to decompose this material will turn to silt and muck in the near shore areas.

- Density and diversity of weeds. As a fisherman, it seems the weeds are getting thicker as time goes on. Lily pads now grow out further into the bays than historically I can remember. Northern Milfoil (not an invasive) grows to the surface and its runners easily tangle on the surface that mat together late in the summer. Coontail and various pondweeds seem to be growing further out in the bays than in the past. All of these conditions could be a function of our lower water levels the last several years.
- Water depth. The last several drought years have lowered the average water level in mid-summer. In areas of clear shoreline, the increased impact of wave action cleaned out some of the sandy shorelines. In other areas, low water exposed sediment. This then allowed shoreline land vegetation to take root and prosper. Water level in the lake is now electronically monitored by USGS at our outlet dam. Various data can be selected and graphed. Note- Not active.
http://waterdata.usgs.gov/wi/nwis/uv/?site_no=05390680&PARAMeter_cd=00065,00060

Personal Experiences to Control the Plant Growth

- Localized weed cutting. I have used for a number of years a Weed Razor brand of manual weed cutter. It works quite well around the pier and wading areas to cut and clean out weeds. It is attached to a rope and can be tossed out and snapped back thereby cutting the weeds near their base. The device must be kept very sharp to be effective. Towing it behind a boat is not very effective. You then need to rake into the shore the remnants that now float to the surface and remove them. This whole process is a lot of work for a small area. The cutting, even to the base of the weeds, is never long lasting. Within weeks they return. This is a good short term solution to improving aesthetics around the pier or improving access for boats near the pier.
<http://www.weedrazers.com/>
- Use of chemicals. I have used in the past a pellet weed killer product called Aquicide. While very effective, it was also very expensive. A one gallon pail about 10 pounds would cover one treatment around one pier and now costs about \$80. It would last the whole summer but all the weeds return the next season. WDNR permitting is now necessary when using chemicals in public waters. <http://www.killlakeweeds.com/index.cfm>
- Uprooting weeds. I have used various rakes and devices over the years to try to remove the weeds manually near our frontage. Just like working the soil in a garden the newly exposed fresh bottom soil is a prime spot for new weeds to take root. In some cases what would take root and prosper was worse than what was there before.
- Buildup of sediment. Weeds that have been cut off will then float into shore and will quickly decay if not removed. This will make new silt and mud that packs up against the shoreline areas.
- Professional weed cutting. The experiment on our lake in this venture was successful in proving that it is not likely a good viable option for our lake. While the cutting of paths created better boat access for some, it was short lived. In some cases the areas cut grew back to the surface in a matter of weeks. The cutter only removed the tops of the weeds. Much like most plants, the trimming caused the plant to respond with new and even thicker growth. The weeds were cut in mid-summer when they were the thickest but it also meant the weeds were in their seeding stage. The spoils floating way from the mass mechanical cutting actually spread weed seeds and filament fragments. This then encouraged new and thicker growth nearby the cut areas. As not all of the weeds cut are recovered by the harvester, the floating masses of cut weeds messed up shorelines and sunk to create more silt. Research into other lake associations have shown that the only lakes where this kind of cutting is deemed to be successful by the lake owners is when weeds canopy into thick matted masses and the cutting is regular and permanent. Aquatic Plant

Lake biology and chemistry

- Phosphorus. This is the leading nutrient feeding the aquatic plants in our lake. It contributes to the algae and water clarity as well as the fertile growing conditions for the weeds. A number of scientific studies define this nutrient load and its interplay quite well.

USGS 2003 - http://pubs.usgs.gov/wri/wri034011/pdf/03-4011_Musky_Lake.pdf

2005 Blue Water Science - <http://www.muskellungelake.org/wp-content/uploads/2011/11/Report-Summ-2005001.pdf>

2011 Onterra studies - <http://www.muskellungelake.org/wp-content/uploads/2011/11/Muskelluge-Report-Final.pdf>

These reports all indicate the majority of the phosphorous is coming from natural sources. Much like fertilizer the phosphorus is taken up by the plants and thus accelerates their growth. Later, some of the phosphorus settles into the sediment of the lake as some of the biomass dies off each year. As this biomass decomposes it uses oxygen. The lake stratifies in late summer and the deeper areas become oxygen depleted. This creates an anaerobic condition that actually seals in the phosphorous near the bottom. Unfortunately, this is a short lived situation. When the water column cools in the fall, the surface water becomes heavier than the water below it and it sinks. This fall turnover as we know it remixes the phosphorus that has settled into the bottom. This same stratification condition occurs over winter and then another remixing at spring turnover that occurs near ice out. Because our lake is shallow, this phosphorous load never permanently settles out of the water column. Our lake also has relatively low outflow thus it doesn't flush out the nutrients like some lakes. When we had a number of years with significant rainfall it seemed to also be the years of less weed growth. A certain amount for flushing out likely was occurring. Drought years then meant little flushing and the phosphorous load increases. Wet spring conditions also add new phosphorous loads from out of the drainage areas around the lake. This again adds new nutrients. Total phosphorous index has been measured via our water monitoring since 1973. This information posted by the WDNR indicates that it has historically always been near 50 +/- 3 for this entire time. We can conclude from this that the overall nutrient load over time is not significantly increasing. An excellent article on understanding lake data is here - <http://www4.uwsp.edu/cnr/uwexplakes/understandingLakeData.pdf>.

- Secchi history. The Secchi disk reading is a means to check water clarity and has a direct relationship to Chlorophyll and algae. Shallow Secchi readings mean less sunlight penetrates thus the weed growth doesn't go as deep or perhaps as thick. Secchi readings have been done on our lake since 1991. July and Aug averages that entire time have been between 3.5 and 4.5 feet. We can conclude from this that while at some times of the year the clarity of the water is better and thus more appealing to water sport activities. Inevitably water temps and sunlight create nearly the same chlorophyll and algae situation every year.

<https://dnrx.wisconsin.gov/swims/public/reporting.do?type=11&action=post&format=html&stationNo=643137>

1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
4.1	4.4	4.2	3.7	7.1	3.8	3.6	3.7	2.3	3.6	3.5	4.5	4.5	3.8	5	3.5	2.7	3.3	4	4.1	3

- Trophic state. The various chemistry data collected is entered into a mathematical formula thus creating what is called TSI or Trophic State Index. This is a comparative measure that can be

applied to any lake. Fundamentally every lake is aging over the eons of time and its Trophic state index will increase. Our lake has its TSI calculated to be in the mid 50's since 1991 placing us in the early stages of becoming Eutrophic. The history over those 20 years does not indicate a significant change or statistical trend.

- <https://dnrx.wisconsin.gov/swims/public/reporting.do?type=33&action=post&format=html&stationNo=643137> This table indicates the definitions applicable.

TSI 40- 50	Water moderately clear, but increasing chance of low dissolved oxygen in deep water during the summer.
TSI 50- 60	Lakes becoming eutrophic: decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, plant overgrowth evident, warm-water fisheries (pike, perch, bass, etc.) only.
TSI 60- 70	Blue-green algae become dominant and algal scums are possible, extensive plant overgrowth problems possible.

- Weed biomass - Winter. The weeds themselves that we are all concerned about also have an impact on the year to year variability we see. In the winter when there is much snow cover many of the weeds die due to lack of sun light. When these weeds die they settle to the bottom and decompose. As the plants break down it frees up the phosphorus that was captured in the plant. This decomposition process also consumes oxygen which is the reason we run an aerator during the winter. As noted before, spring turnover now remixes this new load of nutrient. Thus in heavy snow years or long winters we will get an accelerated shot of fertilizer that will be available for the growing plants that spring. Conversely, when the plants can keep growing all winter, the phosphorus remains locked in the plants. Thus a new extra shot of nutrient in the spring does not occur but the weeds may also be naturally higher and denser as they have been growing all winter.
- Weed biomass – Summer. Similarly to winter, some unique things can occur in the summer with the weed growth. Our lake naturally stratifies in the summer. The areas deeper than 12-15 feet generally become oxygen depleted in mid-summer. Due to the water chemistry, when this occurs the phosphorous in the sediment is effectively capped off and can no longer act as a nutrient. When this occurs early in the summer or if there is less sunlight penetration, the weeds will grow less vigorously. We will recognize this condition by observing fewer weeds that year. If we add to the summer biomass by leaving additional dead plants in the lake thru our boating or weed cutting we are in effect adding more nutrients to the lake. An early weed die off in summer can also naturally occur through lack of sunlight or heavy algae content. This new phosphorous is likely too late to effect that growing season. All if it is returned to the water column with the next seasonal turnover. This is why commercial weed cutting can actually be adding undesirable nutrients to the lake. A healthy and stable weed bed that stays growing all year is the best of all circumstances. Our weed beds are a good thing.

What we can do

- Use of fertilizers. It is obvious we have plenty of natural nutrients in our lake. Most of the reports show that the phosphorus is largely naturally occurring but we can have an impact. We should be good stewards of our lake neighborhood by not using fertilizers around our yards and

gardens. It all inevitably ends up in the lake. Keeping our septic tanks in good working condition is essential. It will help minimize infiltration issues when working properly.

- Control run off. Nutrients and chemicals all naturally will run towards the lake. Keeping grasses and plants tall and natural along the shoreline will help slow and absorb the run off.
- Personal trimming of weeds. The weeds are a nuisance particularly around our piers and shorelines. The DNR allows manual weed removal for these reasons in front of your own property. Remember you will have to do this repeatedly to be effective. Chemical herbicide use is now restricted. Please be courteous to your neighbors by capturing and removing from the lake all the weeds you cut. Wait for a day when the wind is pushing into your shore and Mother Nature will make it easier for you to collect the cut weeds. Also remember that while some may like a manicured shoreline, your neighbors may not. We all share this wonderful resource so be respectful of others. Remember any aquatic plant we cut and don't remove from the lake just adds to the nutrient problem.
- Boats and watercraft. We all like our boats but we should be aware that the same thing that frustrates us while wrapped around the prop is now added to the nutrient load in the lake. Certainly we need access to our piers and shoreline but unnecessarily running in shallow waters and cutting weeds adds to the problems. Stirring up sediment is like opening a bag of fertilizer in the lake. Be mindful of your prop wash with your boats and watercraft when in shallow water and try to have fun in the deeper areas of the lake.
- Power loading. While a common practice for some it is a destructive for the lake. The prop wash is digging a deeper and deeper hole behind the concrete ramps making for maintenance issues that is expensive. All that sediment is now pushed out and is making a shallow area out in the lake. Next that sediment is suffocating the weeds and the prop wash is stirring up the nutrients in the lake. Lastly, with a freshly exposed lake bottom, it is a prime spot for new invasive species like Eurasian milfoil to take root. In every lake that has this invasive it was first found near these fresh lake bottom areas. Healthy natural weed growth will prevent many invasives from taking root. Back off on the throttle and use your winch please.
- Control new invasive species. If we are worried about the usability of our lake because of weeds we certainly won't like the prognosis if we get an invasion of Eurasian Milfoil or Curly Leaf Pond weed. Once entrenched these invasions have made shallow lakes like ours virtually unusable for recreation. Prevention is essential for us. The cost of eradication is huge and in some cases impossible. Practice good Clean Boat/Clean Waters protocols and share with all your visitors. Consider spending some volunteer time at the boat landing increasing awareness to prevent an invasion here. CBCW information - <http://www4.uwsp.edu/cnr/uwexplakes/CBCW/default.asp>
- 10 simple things we can do to protect our lake. <http://clean-water.uwex.edu/pubs/pdf/waterfront.pdf>
- Simple shoreline stewardship. <http://clean-water.uwex.edu/pubs/pdf/watersedge.pdf>
- Background information from Onterra Class project. http://www.muskellungelake.org/wp-content/uploads/2011/11/ClvndVilas_Muskellunge_April10_Draft_v1.pdf

What we should not do

- Phosphorus control. As mentioned in earlier studies that are published on our web site there was feasibility study to analyze the control the free phosphorous in our lake. The addition of Alum, a chemical agent, could be dumped on the lake to attempt to chemically bind and seal the phosphorous in the bottom sediment. This would take tens of thousands of pounds of alum in our lake over a number of years. While this treatment has worked on some small ponds and impoundments, it has not been done in this scale on a natural lake such as ours. DNR permitting would be necessary and an exhaustive process with little funding support. The result would for

the short term remove some nutrients from being recycled into the water column. As new phosphorus is entering the lake every day, the results would only be temporary. While feasible, this is not a reasonable solution.

- Adding biological controls. This includes fish, crayfish, mussels, plants or insects to control our weeds. This has brought up in the past at a number of meetings. One doesn't have to listen to the news around our area very long until you hear a new problem being created by a non-native species that has gone out of control. Various carp, rusty crawfish, mussels and others have been brought to the north woods to help control weeds and algae. In every case the end result was something worse than the original problem. It is now illegal to introduce any non-native species to any public water. At this point we may not like the esthetics of our lake but it is 100% natural with all native biology. To think we can add non-native species will never be a viable solution.
- Chemical control. Mass chemical control of weeds is not a reasonable solution. The killing of large amounts of plants will decompose and consume oxygen in the process as well as releasing huge amounts of nutrients. Some waterways where this was done in the past also suffered massive fish kills as a result. Permits have occasionally been issued for this kind of treatment but it is usually in manmade impoundments and farmland type mill ponds where a dramatic drawdown of the water level followed to recondition the lake bottom. This has not been done in a natural lake. If we ever get invasive species in our lake we likely will have to deal with chemical control on limited basis. As documented in a number of area lakes this process even on a limited basis is very expensive for the lake association and owners.
- Commercial weed harvesting – A controversial solution. While those whose lake access is impeded by weeds will enjoy some relief for recreational use of the lake, others may not benefit at all and thus not be willing to support the activity. As stated earlier, the results of this kind of treatment is always temporary, is always expensive, and always disrupts the biology and chemistry of the lake.

Personal conclusions

- Real estate values. I wish we had greater ethics among local real estate agents. I know of a number of people who purchased property on this lake only to be 'surprised' later that what they got was not what they expected. If you read the web descriptions of any of the properties currently for sale on Muskellunge Lake you will see a lake described that anyone would love. Buyers beware. The reality is, God is not creating any new lake property. What we own is in limited supply and someone will always be willing to buy when we are ready to sell.
- Historical observations. People including myself have made comments and observations about the lake and how it was so much better in the past. Anecdotal memories are unfortunately very selective about the best years and also about the worst conditions. People have a tendency to measure the most current situation against all of the best of their past remembrances. The reality is the chemistry and biology of our lake as documented by real science is not changing that much. There is a natural year to year variability that we need to understand is normal.
- You can't fix Mother Nature. Our 272 acres of lake is not a swimming pool. We shouldn't consider using man made influences to make Muskellunge Lake into something it is not. Our lake is more eutrophic than some because of the area drainage and soil chemistry all shaped initially by the retreating glaciers. It is what it is.
- Every one of us has at one time or another wished that Muskellunge Lake was different than it is. Some days I wished it was clearer and better for swimming with nicer shorelines. Some days I wished it was bigger for boating and waterskiing. Some days I wished for deeper water structures and the associated walleye fishing opportunities. Some days I wished for better

musky fishing or duck hunting opportunities. The reality is we all forget we are located in the middle of an area resource that is not repeated anywhere in the world. In this 2 county area we have more lakes than land. We have a wider diversity of attributes in these lakes than anywhere. Shallow, deep, weeds, clear, sand, muck, fishing, boating, swimming, drainage, seepage, flowage, river and more are all in this smorgasbord of natural resources. A 30 mile radius will take you to an excellent example of every one of these kinds of lakes. I need to remind myself this the next time I am wishing for something different and go visit another neighborhood. After all as any sportsman will tell you, it is always better where you're not.
<http://clean-water.uwex.edu/pubs/pdf/waterfrontprop.pdf>

Summary comment. In seeking to understand why things are the way they are on our lake I sought out knowledge of the limnology, chemistry, geography and biology of our lake. The research continues to be rewarding in that I have a deeper understanding of the complexities involved. Muskellunge Lake is a place where I have learned to enjoy it just the way it is.

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