FOREST LAKE FACTS

This article has been commissioned by the Forest Lake Preservation Foundation. One of the legal requirements of the Foundation is to give information to the riparian owners of Forest Lake. We would hope that some of this information will be both new and interesting, and lead to even increased appreciation of our lake. We would also encourage you to share this info with your guests as well. This article summarizes the key facts and findings from our last Lake Management Plan. Hopefully a trimmed down 6 page format instead of 80 pages will be helpful to our riparian owners. Our last Lake Management Plan was done in 2016. The next one is coming up soon. If you read our synopsis of the 2016 plan, you will have all the key concepts and info. Our intention is to summarize changes in the new Lake Management Plan soon after completion and we will send the synopsis to you as well as the whole plan.The synopsis should be quite a bit shorter than 6 pages, assuming that people read the 2016 summary here to get the basic concepts. Lake management plans are important for several reasons. The 2016 plan is intended to be a scientific snapshot of the lake's health. The followup plan is very important so we can compare snapshots to make sure our lake is not deteriorating in ways we haven't noticed yet (plants, fish, water quality etc). In addition, the new plan will provide further information and advice abut the milfoil so we are using all the tools available in 2023 and on in our milfoil battle. Likewise, we will have a better idea of how our milfoil approaches have worked over the last 7 years so we can make future modifications if needed. The plan also will include parameters that may trigger different milfoil treatments or strategies in the future. In addition, without an updated lake management plan we will not be DNR grant eligible.

Forest Lake (FL) is known as a 470 acre deep seepage lake. A seepage lake being defined as no above ground inlet where water enters, and no outlet as well. It is 60 feet deep at its maximum. There are only 35 deep seepage lakes in Wisconsin, 21 of which are in the Northern Lakes and Forests ecosystem. This ecosystem encompasses approximately the northern 1/3 of the state. The watershed is the area around the lake that contributes rainfall water into the lake through runoff and groundwater. The watershed surrounding FL is relatively small and consists of about another 600 acres. In other words about 1 acre of surrounding land drains into 1 acre of FL. The water flows out of the lake slowly, and 1 estimate is that the water is completely replaced once every 12 years. Walter Bates from Black Oak Lake did a very thorough water flow study of Black Oak Lake which is very similar to FL. He determined that the above ground topography could not predict where water seeped into or out of Black Oak. It was felt that the nature of the substrate below the lake bottom was the determining factor for inflow and outflow.The watershed surrounding FL is about 75% forest, 20% wetlands, and 5% grass. This watershed is a fairly small area in relation to the size of the lake compared to most other lakes. This has advantages and disadvantages. The advantage is that the riparian owners own much of this land and therefore have very good control over it. The disadvantage is that when some of the watershed is degraded (as in grass planted and trees cut down) this will have a larger relative bad effect on the health of the lake.

FL is at about 1720 feet of elevation which is quite high. In comparison, the Cisco Chain is about 65 feet lower in elevation. The high elevation is related to the fact that we are basically on the Sub Continental Divide. Water that slowly seeps out of Forest Lake will eventually enter Spring Lake, and then into the Ontonagon River and further north to Lake Superior. The Cisco Chain also drains north to Lake Superior. In contrast, the majority of Black Oak Lake drains to the Mississippi River. The bottom of Forest Lake is composed of 60% sand, 25% rock, and 15% gravel according to Google. Personally I think that analysis is not completely correct as I think it did not consider some softer sediments in some of our bays. Nevertheless, the lake bottom is largely harder substrate such as rock and sand.

Water levels in Forest Lake have varied widely over the years. Current lake levels are approximately 5 feet higher than the levels in 2013. Please see the chart which I have shamelessly copied from the Black Oak Lake Management Plan which shows the swings in water levels in several similar seepage lakes. (See last page) The data has been synthesized to provide a long term picture of local water levels. Note the wild fluctuations, and lack of predictability. The big picture seems to be that the extremes of water level seem to only last for 2-3 years.

The water quality of Forest Lake is excellent. There are several ways to measure water quality and they are all interrelated. Secchi discs are lowered into the water and the depth at which it disappears is recorded. This measures water clarity directly. Working with the Wisconsin Citizen Lake Monitoring Network, water samples and Secchi disk readings have been taken and recorded regularly on FL at least 3 times each year since 1996. Chlorophyll levels are another important measurement. The water clarity is largely dependent on chlorophyll levels produced by algae. Other metrics of water quality include phosphorus levels and oxygen levels. Higher phosphorous levels will lead to more algae, which in turn lead to more chlorophyll in the water which in turn leads to decreased water clarity. According to Onterra (see lake management plan), FL has the clearest water in the entire Northern Lakes and Forest ecosystem.

As mentioned phosphorous is the key to water quality and clarity in FL. The limiting ingredient to weed or algae growth is the amount of phosphorous in the water. The more phosphorous, the more weeds and algae, and the murkier the water. In FL the phosphorous comes from 2 sources: the watershed, and what is called internal phosphorus loading. We will discuss each separately.

The watershed adds phosphorous to the lake in 2 ways: through seepage and through runoff directly into the lake from the shore land. Non porous surfaces such as roofs and asphalt can lead to increased runoff if not directed away from the shoreline. Grass lawns allow more runoff into the lake than forested land, and consequently more phosphorous into the lake. In addition grass lawns lead to 3-4 times the amount of phosphorous seeping into the lake from groundwater compared to forested land. According to our Lake Management Plan, if 25% of the forest in our watershed was converted to agriculture the result to water clarity would be average Secchi disk readings dropping from 17 feet to 10 feet. I am not a real estate person, but I suspect that a change in water clarity of that magnitude would significantly affect property values on FL. (Opinion only).

To understand internal phosphorous loading we have to discuss the fact that the lake “turns over” twice a year. This means that FL is a 2 story lake, with warmer water in the upper layer, and colder water in the lower layer. This happens here because Forest lake is deep enough to support 2 layers that don’t mix. To understand why these layers don’t mix we have to appreciate the nature of water. Warmer water is less dense than colder water, and so warm water will tend to stay near the surface, and colder water will sink. This leads to 2 layers that do not mix during the summer. While the colder layer is on the bottom, there is not enough light for algae to grow and produce oxygen, so this layer becomes oxygen depleted. (There is not enough depletion in Forest to lead to fish kills under normal circumstances, but most fish stay in the upper levels with sufficient oxygen). When there is not enough oxygen in the lower levels, a chemical reaction occurs and phosphorous is released from the sediments on the bottom. When the weather turns cold in the fall, the water in the upper layer of the lake become cooler and begins mixing with the lower layer which transports phosphorous to the upper layer and feeds the algae. This lake “turnover” leads to more food for the algae, and we then typically have decreased water clarity in the fall. This is called internal loading. Although internal loading

occurs in Forest, the amount is not enough to significantly affect water quality. This could change however if more phosphorous is loaded into the lake from the watershed.

During winter the lake is again a 2 layer lake with the coldest water again at the bottom, with even lower oxygen levels. This leads to increased phosphorous release at the bottom. When spring starts to melt the ice on top, that colder ice melt sinks, and the lake mixes or "turns over" again. There is often some increased phosphorous transported to the upper layer, leading to increased algae and some decreased water clarity in the early summer. Again it is not a severe decrease in clarity. Because the water clarity of lakes that turn over varies over time, it is important to look at the time of the year water clarity is measured. To get around this, most people look at "weighted averages" of Secchi disk readings.

Although the chemical properties of water are not the subject of this paper, I would like to amplify on the amazing nature of H20! Cold water is denser than warm water, but when water freezes, it becomes LESS dense than cold or even warm water. This is what allows ice to form on the top of a lake in the winter rather than the bottom. If water did not behave in this unusual fashion, lakes would eventually fill up with ice from the bottom to the top during the winter, and there would likely be no significant life in any lakes in temperate climates. How peculiar, and how fortunate! Sorry, but I had to bring this up.

The other characteristics of the water on Forest Lake are pH, alkalinity, and calcium levels which are important. The pH which is a measure of the acidity of the water is 8. Normal pH for a lake is 6-8. Some fish, such as walleyes, will have difficulty spawning at a pH of 6.5 or lower (relatively acid water).The alkalinity of a lake is related to minerals such as calcite or dolomite, and the alkalinity of FL is good. Rainwater in Northern Wisconsin is slightly acidic (pH 5) due to CO2 in the atmosphere, and the good alkalinity in FL allows it to resist acidification from acid rain. The calcium concentration in FL is measured at 8.3 and this is good news as lakes with calcium levels below 12 are felt to have very low susceptibility to zebra mussels. Most people have a good appreciation for the drawbacks of zebra mussel infestation, which is likely impossible to eradicate, so, this is very good news indeed. There are zebra mussels in some of the lakes in southern Wisconsin, and they have the ability to spread rapidly. For example, zebra mussels can survive for up to 5 days when taken out of the water.

The plant community in a lake can also be a good barometer of lake health. The plant community is evaluated for every management plan, using acoustic surveys, raking, and visualization. The majority of the plant growth in a lake occurs in the first 8 feet of water. Conversely, there are few plants in greater than 15 feet of water. Our surveys show water plants as deep as 21 feet which is a testament to our excellent water clarity! The 2016 acoustic survey of FL revealed that 30% of the lake contains aquatic vegetation. The remainder of the lake is too deep to receive adequate light to support plant growth.

Fern-leaf pondweed is the most common plant (I think it is a mistake to refer to beneficial water plants as weeds), and represents 31% of the aquatic plants. It is generally found growing in thick beds over soft substrates. It stabilizes bottom sediments and forms a dense habitat for aquatic wildlife. Common waterweed occurs with a frequency of 16%. It is found throughout North America, and tolerates low light conditions and obtains the majority of its nutrients directly from the water. It absorbs nutrients that otherwise would be available to algae. In FL it is mainly in 11-17 feet of water. Muskgrasses occured with a 12% frequency. They require lakes with good water clarity and their large beds also stabilize bottom sediments. They also absorb phosphorous in calcium carbonate incrustations on the plant which makes the phosphorous unavailable to algae. Slender naiad comes in at 11% and is an annual plant. It produces numerous seeds which are an important source of food for migratory waterfowl. They are most prevalent in 2-8 feet of water, and provide excellent habitat for small aquatic creatures.

A total of 48 different species of aquatic plants were identified in the 2016 survey. Lakes with diverse aquatic plant communities "have higher resilience to environmental disturbances and greater resistance to invasion by non-native plants." FL is in the upper 25% for "species richness" in the Northern Lakes ecoregion. The plant community in Forest is dynamic and continually changing. I personally have seen whole "weed beds" disappear or appear in Forest Lake in a matter of one year. It is felt that some of the dynamic changes are related to changes in water depth over time.

FL has 1 invasive plant, Eurasian Milfoil. This plant has 2 advantages over our native species. It begins growth much sooner in the growing season and gets a "head start" on other species. In addition, it does not stop growing when it reaches the surface, but instead forms dense mats at the surface that block the light from reaching the natives below it. It does not spread in northern climates with seeding but it fragments and the fragments then root themselves. It was first found in 2001 in FL. We initially hand harvested it using snorkeling and free diving, and then treated it in late August 2001 with 2-4 D, a herbicide. The results were excellent, and many of the lake residents have participated in hand harvesting every year with what appeared to be excellent control of the milfoil. The milfoil however began outcompeting our amateur harvesting abilities by 2013, and professional harvesting commenced. An 8 acre treatment with 2-4 D was applied in 2015. The followup survey only detected 1 milfoil plant, and surveillance as well as volunteer hand harvesting continued the following year. Since that time the milfoil has become somewhat more prevalent, and professional harvesting has been the main method of control. In 2021, the North Bay was treated with the herbicide ProcellaCOR because of the density of the milfoil, and the results of this treatment are still being evaluated. The milfoil was clearly decreased but not eliminated and the final results are still not determined. It is clear that the Eurasian Milfoil like other invasives in North America will not be completely eliminated, but our goal has evolved to be containment rather than elimination. Complete elimination seems to be unnecessary. Rather, preventing "matting" and eliminating dense stands of milfoil that interfere with access and recreation on the lake may be the best approach both for the lake and its residents. This is one of the reasons that a lake management plan has to be regularly updated to incorporate previous experience as well as new science. We have looked at other methods of control, such as the milfoil weevil. The weevil feeds on milfoil. In Wisconsin lakes there are already milfoil weevils, but perhaps some strains of weevil will be found to be more voracious and a better natural control of the milfoil. The weevils are not currently recommended or grant eligible from the DNR. While the Eurasian Milfoil consumes a significant amount of time and funding on FL, the total levels of milfoil are still relatively low.

The only other invasive species in FL are banded mystery snails. These are bottom dwellers and feed on algae, small diatoms, and organic and inorganic bottom sediments. They are native to the SE United States. There is not a lot of data on harmful effects of this snail, but they have been invasive in parts of the US for a long time and no serious problems seem to have been reported. They are larger than our native snails. They have thick shells, so they are harder to eat for native fish. We do not have rusty crayfish (present on Black Oak Lake). We do not have spiny water fleas (present on Star Lake). We do not have curly leaf pondweed (present on Mamie Lake) although curly leaf is more difficult to detect due to an unusual growing season. (Surveys have to be done in early spring).

Another important aspect of lake health is shore land habitat. This includes floating plant communities which decrease wave energy and lessen erosion. FL has 9 acres (2%) of area that contain floating leaf or emergent plants. In a 2007 report the National Lakes Association stated "of the stressors examined, poor lakeshore habitat is the biggest problem in the nations lakes: over one third exhibit poor shoreline habitat condition. Poor biological health is three times more likely in lakes with poor lakeshore habitat." In 2016 Onterra assessed our 7 miles of shoreline. We had .9 miles of urbanized or developed-unnatural shore land. Their report stated

“These shore land areas provide little benefit and actually may harm the lake ecosystem.” “While producing a completely natural shore land is ideal for a lake ecosystem, it is not always practical from a human’s perspective…However, riparian property owners can take small steps in ensuring their property’s impact on a lake is minimal. Placing lawns on flat, un-sloped areas or in areas that do not terminate at the lakes edge is one way to reduce the amount of runoff a lake receives from a developed site.” A buffer zone of native vegetation between grass and the lake is often an easy and practical approach to preventing lake degradation.

Allowing tree falls and other natural habitat features to remain along a shoreline is beneficial to the lake and riparian owner. It may result in reducing shoreline erosion and creating wildlife habitat. In 2016 our shoreline was evaluated for “coarse woody habitat” and they found 22 woody pieces per mile of shoreline. On completely undeveloped lakes there are an average of 345 coarse woody pieces per mile. In addition to erosion control, woody habitat is also very important for certain fish. For example, the Northern Pike spawns and does not provide parental care to their eggs. To prevent their eggs from being covered with silt and suffocating, they spawn over downed wood. Lakes with little submerged wood will have poor reproduction of pike.

A Minnesota study on 3 lakes found that only 74 of 852 crappie nests were found near shorelines that had any type of dwelling on it. The remaining nests were all located along undeveloped shore land. What we do to the shore land as riparian owners on Forest Lake has a significant impact on the fish of FL. Common loons used to be native as far south as mid-Illinois, but now there are none in Illinois or southern Wisconsin, largely due to shore land development. Concern has been raised that warming temperatures may further negatively impact loons as well as cold water species of fish like walleye.

The fishery of FL is good at this time, I have fished FL for the last 30 years and I have seen it evolve from primarily walleye and yellow perch, to more bluegills and bass. In addition to perch, walleye, bluegills, smallmouth and largemouth bass, other gamefish include northern pike, rock bass, and cisco. In addition FL has one of the largest white sucker populations in Vilas County. The only time I have seen white suckers was during spawning in early spring. They spawn on rocky points extending out from the mainland. I have seen the bald eagles perched on trees above the spawning sites and taking fish, and I have seen loons consuming the spawn. In the past the DNR has set up nets and milked the females for roe to feed Muskie fingerlings, but I am not sure if they are still doing that. Personally I hope that they are not. FL has been stocked as early as the 1930’s with variable species of fish, but as of 2006 there has been sustainable natural reproduction and no need for stocking. Initially perch and bluegill were stocked in1936 and1938,1937 to 1952 intermittently for largemouth bass, and 1965 to 1977 for walleye. Apparently not all of the gamefish in Forest Lake are original natives, but I can’t find further info. The cisco is another rarely seen fish in FL, partially because of its natural habitat. They are also known as lake herring but biologists prefer to call them cisco so they don’t get confused with ocean herring. They are referred to as lake whitefish on Lake Superior. They are part of the fish family that includes trout and salmon. They are a cold water fish preferring deeper water, but spawn in shallow areas in the fall. They are a good forage fish for other game fish. They are referred to as “the canaries of cold water” as they are very sensitive to too much phosphorous leading to decreased oxygen levels. I have never caught one on FL, but I have talked to fishing guides who have.

The game fish in FL are subject to DNR suggested limits on consumption. These advisories relate to mercury in the fish. Mercury is toxic to developing human brains. Apparently in the past, FL was listed by the DNR as “impaired” because of mercury levels in the fish, but we were de-listed in 2006. In general, there are now no advisories for men or women over 50, but for children under 15 and women under 50 the suggested limits are 1 meal per week of the smaller fish such as perch, bluegills, and 1 meal per month for the larger fish such as bass,

walleye and northern pike, which are higher on the food chain. The human body will gradually eliminate mercury, but as mentioned it has negative effects on the development of the growing brain. Cleaning and cooking fish does not reduce mercury consumption because the mercury is in the fish meat (muscles) and it is not affected by cooking. The mercury largely comes from coal burning power plants putting dust into the atmosphere. According to researchers at the nearby Trout Lake DNR station, mercury levels in lakes go up when water levels are high.They hypothesize that when water levels go up, trees and bushes die, and the mercury stored in these plants from pollution over the years goes into the water supply. I am not certain about the significance of this data, but it suggests that mercury levels in our fish may vary with the climate.

Approximately 22,400 square miles of northern Wisconsin was ceded to the United States by the Lake Superior Chippewa tribes in 1837 and 1842. FL falls within the territory from 1842. The treaty allows for a regulated open water spear fishery by Native Americans. The tribe and DNR biologists agree on a "safe harvest" which is often 12% of the lakes walleye population. The safe harvest is the number of fish that can be harvested by spearing and state licensed anglers. The quota for spearing is adjusted to provide for a legal limit of 2-3 walleye for licensed anglers. In practice, walleyes are the main fish speared on Fl. The spear harvest is monitored by a nightly permit system during walleye spawning. DNR creel clerks and tribal wardens are assigned to each lake at the boat landing. Spearers are allowed only 2 walleye over 20 inches per night to limit the harvest of the larger spawning females. According to our lake management plan, the average quota speared is about 118 fish per year on FL. Newer numbers include 150 walleye in 2018 and 124 in 2019. This year's licensed angler limit is 3 walleye in FL. Two fish have to be under 14 inches, and one fish may be greater than 18 inches. Nothing between 14 and 18 inches is allowed.

To summarize directly from the lake management plan:

"Overall, Forest Lake is a very healthy lake. Nutrient levels are lower…than all lakes in the Northern Lakes and Forests Ecoregion. This leads to excellent water clarity as well. There is some evidence of internal nutrient loading, and there is no evidence that this is impacting the lakes water quality in a noticeable manner at present. The quality of the plants in Forest Lake is higher than most lakes in the state and ecoregion and is another indicator of the lakes good ecological health. Eurasian Watermilfoil was first documented in Forest in 2001 and remained at a very low occurrence through 2014, likely due to the diligent hand-harvesting efforts of the Forest Lake Association. Since then, it is apparent that EWM has increased in density and area in several locations around the lake. Still, on a lake-wide basis, the EWM population would be considered to be very low."

"While EWM may seem to be the biggest challenge facing the Lake Association in managing Forest Lake, it likely is not. When considering the overall health of Forest Lake the most daunting challenge is the impacts by human beings as they alter the landscape around the lake and recreate on the lake itself. Fortunately, those that first developed property around the lake created certain deed restrictions that ease some of those impacts to the lake's health. Further, the Lake Association membership is highly involved in the monitoring and management of the lake's health. The challenge facing the Association is to maintain that involvement and awareness in its members so in the long-run, the lake's overall health remains as high as it is now."

Lake Water Level Trends over Time

Buffalo Lake (BL) Crystal Lake (CR) Black Oak Lake (BOL)