Please note that study methods and explanations of analyses for Harris Lake can be found within the Town of Winchester Town-wide Management Plan document.

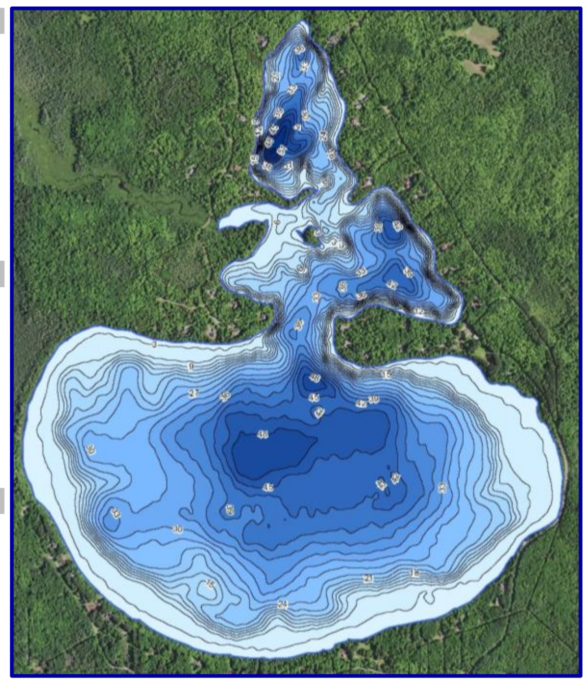
8.1 Harris Lake

An Introduction to Harris Lake

Harris Lake, Vilas County, is a deep, headwater oligo-mesotrophic drainage lake with a maximum depth of 57 feet, a mean depth of 24 feet, and a surface area of approximately 536 acres (Harris Lake – Map 1). Its surficial watershed encompasses approximately 2,348 acres comprised mainly of intact forests and wetlands. Water from Harris Lake flows out through Harris Creek to the Presque Isle River and ultimately Lake Superior. In 2015, 55 native aquatic plant species were located within the lake, of which muskgrasses (*Chara* spp.) were the most common. A small population of the non-native aquatic plant curly-leaf pondweed (*Potamogeton crispus*) was discovered in the lake in 2008; however, control strategies including herbicide applications and manual hand-removal have significantly reduced this population.

Lake at a Glance - Harris Lake

Morphology	
LakeType	Deep, Headwater Drainage
Surface Area (Acres)	536
Max Depth (feet)	57
Mean Depth (feet)	24
Perimeter (Miles)	5.8
Shoreline Complexity	3.2
Watershed Area (Acres)	2,348
Watershed to Lake Area Ratio	3:1
Water Quality	
Trophic State	Oligo-mesotrophic
Limiting Nutrient	Phosphorus
Avg Summer P (µg/L)	12.2
Avg Summer Chl-α (µg/L)	2.4
Avg Summer Secchi Depth (ft)	16.1
Summer pH	8.1
Alkalinity (mg/L as $CaCO_3$)	38.7
Vegetation	
Number of Native Species	56
NHI-Listed Species	Northeastern bladderwort (*Utricularia resupinata*)
Exotic Species	Curly-leaf pondweed (*Potamogeton crispus*)
Average Conservatism	7.0
Floristic Quality	44.3
Simpson's Diversity (1-D)	0.91



Descriptions of these parameters can be found within the town-wide portion of themanagement plan

8.1.1 Harris Lake Water Quality

It is often difficult to determine the status of a lake's water quality purely through observation. Anecdotal accounts of a lake "getting better" or "getting worse" can be difficult to judge because a) a lake's water quality may fluctuate from year to year based upon environmental conditions such as precipitation, and b) differences in observation and perception of water quality can differ greatly from person to person. It is best to analyze the water quality of a lake through scientific data as this gives a concrete indication as to the health of the lake, and whether its health has deteriorated or improved. Further, by looking at data for similar lakes regionally and statewide, the status of a lake's water quality can be made by comparison.

In 2015, a stakeholder survey was sent to 79 Harris Lake riparian property owners. Approximately 43%, or 34 surveys, were completed. Given the relatively low response rate, the results of the stakeholder survey cannot be interpreted as being statistically representative of the population sampled. At best, the results may indicate possible trends and opinions about stakeholder perceptions of Harris Lake, but cannot be stated with statistical confidence. The full survey and results can be found in Appendix B. When asked about Harris Lake's current water quality, the majority of respondents (91%) described the current water quality of Harris Lake as *excellent* or *good*, 3% described it as *poor*, and 2% were *unsure* (Figure 8.1.1-1). When asked how water quality has changed in Harris Lake since they first visited the lake, approximately 61% of respondents indicated water quality has *remained the same*, 3% indicated it has *somewhat improved*, 24% indicated it has *somewhat* or *severely degraded*, and 12% were *unsure* (Figure 8.1.1-1).

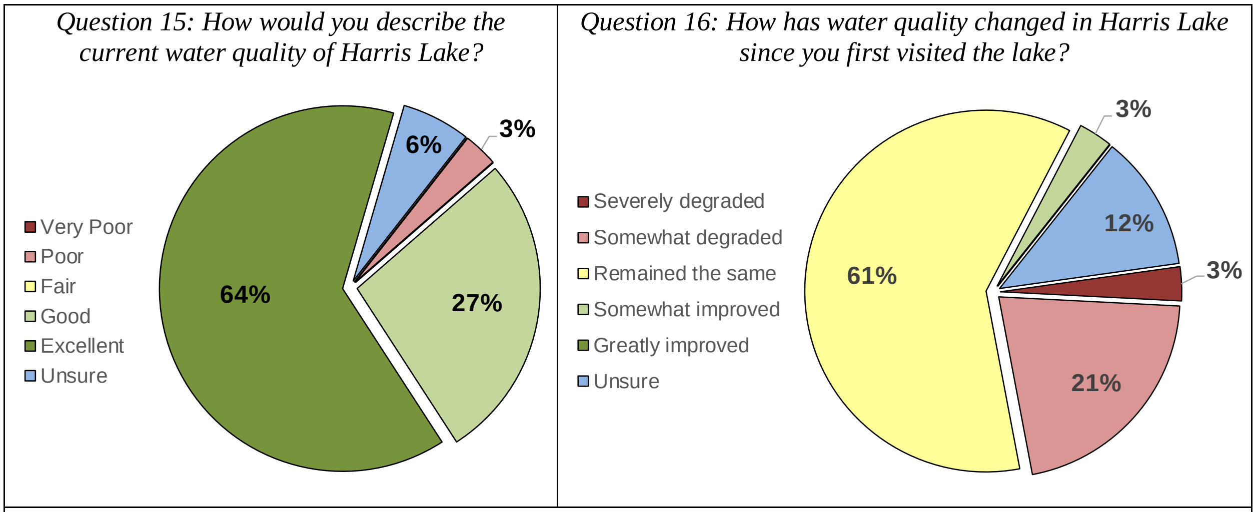


Figure 8.1.1-1. Harris Lake stakeholder survey responses regarding the lake's current and historical water quality. Created using responses from 33 (43%) respondents of 79 surveys distributed.

Near-surface total phosphorus data for Harris Lake are available from 1979, 1992-1996, 1999, 2000, and 2002-2015 (Figure 8.1.1-2). All historical near-surface total phosphorus concentrations and the data collected as part of the lake management planning project in 2015 fall within the *excellent* category for deep, headwater drainage lakes in Wisconsin. The weighted average of summer near-surface total phosphorus concentrations using all data that are available is 12.2 µg/L, and falls below the median concentration for other deep, headwater drainage lakes in Wisconsin (17.0 µg/L) and the median concentration for all lake types within the Northern Lakes and Forests (NLF) ecoregion (21.0 µg/L).

Trends analysis indicates that near-surface total phosphorus concentrations have remained stable over the time period for which data are available, and no trends (positive or negative) are occurring over time. As is discussed further in Harris Lake Watershed Section, measured near-surface total phosphorus concentrations align with predicted concentrations based on watershed modeling. The mid-summer total nitrogen to total phosphorus ratio measured from Harris Lake in 2015 was 27:1, indicating that phosphorus is the limiting nutrient, or the nutrient controlling phytoplankton growth in Harris Lake.

Chlorophyll-*a* concentrations, a measure of phytoplankton abundance, are available for Harris Lake from 1979, 1993-1996, 1999-2000, and 2002-2015 (Figure 8.1.1-3). With the exception of 1979, all historical data and the data collected in 2015 fall into the *excellent* category for deep, headwater drainage lakes. The average weighted summer chlorophyll-*a* concentration for Harris Lake is 2.4 µg/L, significantly lower than the median chlorophyll-*a* concentration for other deep, headwater drainage lakes in Wisconsin (5.0 µg/L) and the median concentration for all lake types within the NLF ecoregion (5.6 µg/L). The low level of phytoplankton production in Harris Lake is a result of the low concentrations of phosphorus, the nutrient regulating phytoplankton production. Trends analysis indicates that like total phosphorus, chlorophyll-*a* concentrations have remained stable over the time period for which data are available, and no trends (positive or negative) are occurring over time.

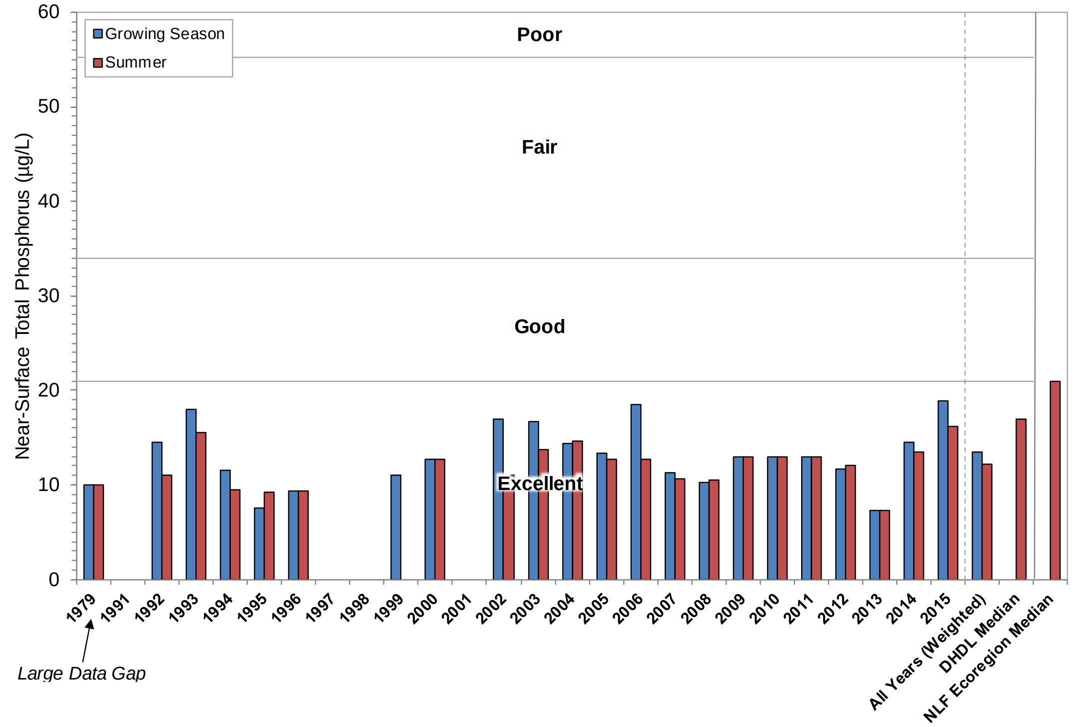


Figure 8.1.1-2. Harris Lake average annual near-surface total phosphorus concentrations and median near-surface total phosphorus concentrations for state-wide deep, headwater drainage lakes (DHDL) and Northern Lakes and Forests (NLF) ecoregion lakes. Water Quality Index values adapted from WDNR PUB WT-913.

Secchi disk transparency data from Harris Lake are available from 1979, 1991-1996, 1999-2000, 2002-2004, and 2006-2015 (Figure 8.1.1-4). Average annual growing season and summer Secchi disk transparency data fall within the *excellent* category for deep, headwater drainage lakes for all years that have available data. The weighted average summer Secchi disk transparency in Harris Lake is 16.1 feet, exceeding the median value for other deep, headwater drainage lakes in Wisconsin (10.8 feet) and the median value for all lake types within the NLF ecoregion (8.9 feet).

Unlike total phosphorus and chlorophyll-*a* which have remained relatively stable in Harris Lake, Secchi disk transparency data indicate that water clarity is more variable from year to year. Trends analysis indicates that Secchi disk transparency in Harris Lake has been approximately 4.0 feet lower in 2013, 2014, and 2015 when compared to averages prior to 2013 (Figure 8.1.1-4). Given that water clarity in most Wisconsin lakes is governed by phytoplankton abundance, when water clarity begins to decline in a lake, ecologists look to see if there is a corresponding increase in chlorophyll-*a* concentrations. However, in Harris Lake, chlorophyll-*a* concentrations in 2013, 2014, and 2015 are not statistically different from those measured prior to 2013 indicating that another factor is driving the reductions in water clarity observed in these years.

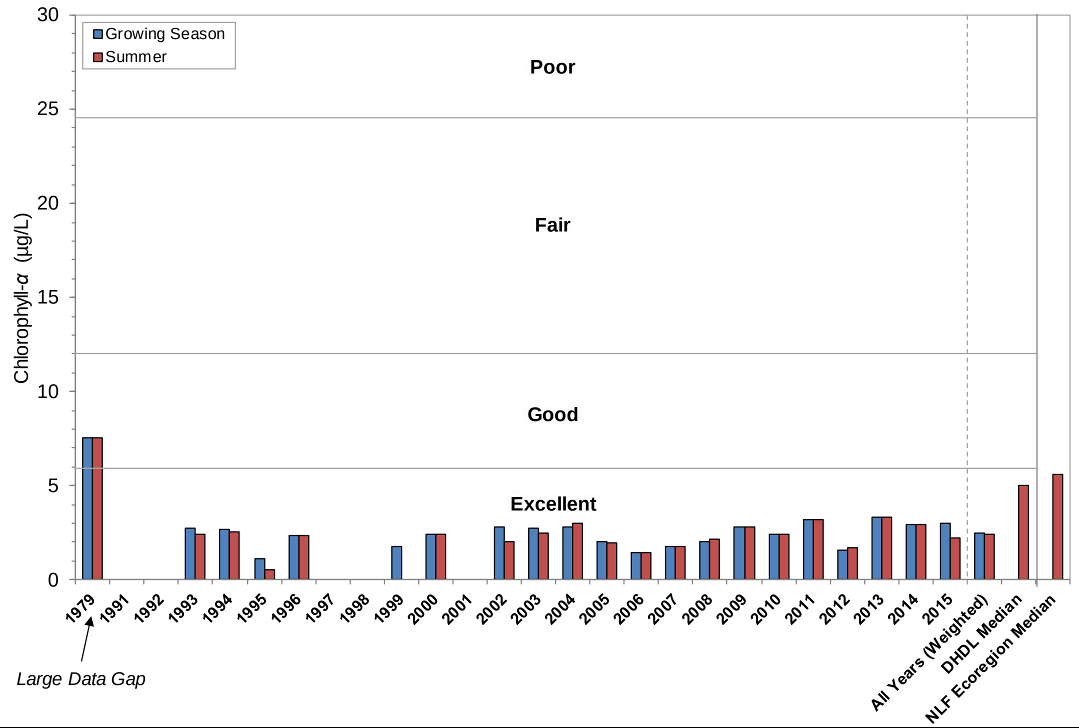


Figure 8.1.1-3. Harris Lake average annual chlorophyll-α concentrations and median chlorophyll-α concentrations for state-wide deep, headwater drainage lakes (DHDL) and Northern Lakes and Forests (NLF) ecoregion lakes. Water Quality Index values adapted from WDNR PUB WT-913.

Increases in abiotic suspended particulates, such as sediment, can cause a reduction in water clarity. However, *total suspended solids*, a measure of both biotic and abiotic suspended particles within the water, were below the limit of detection in Harris Lake in 2015 indicating minimal amounts of suspended material within the water. While suspended particles are minimal in Harris Lake, water clarity can also be influenced by dissolved compounds within the water. Many lakes in the northern region of Wisconsin contain higher concentrations of natural dissolved organic acids that originate from decomposing plant material within wetlands in the lake's watershed. In higher concentrations, these dissolved organic compounds give the water a tea-like color or staining and decrease water clarity.

A measure of water clarity once all of the suspended material (i.e. phytoplankton and sediments) have been removed, is termed *true color*, and indicates the level of dissolved material within the water. True color values measured from Harris Lake in 2015 averaged 30 SU (standard units), indicating the lake's water is *lightly tea-colored*. The true color of Harris Lake's water was also measured in 2003 with a value of 15 SU, indicating *clear* water. It is believed that the concentration of dissolved organic compounds in Harris Lake increased in 2013 (and likely 2014 and 2015) as the result of increases in annual precipitation.

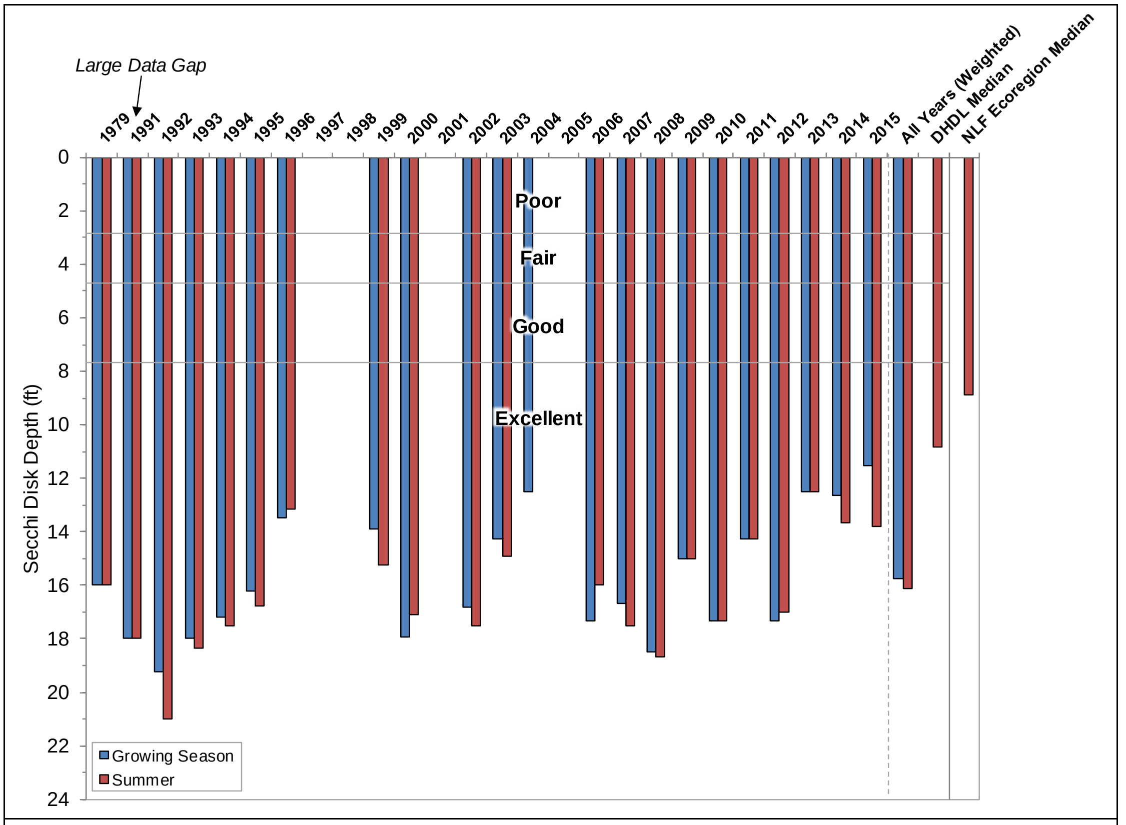


Figure 8.1.1-4. Harris Lake average annual Secchi disk depths and median Secchi disk depths for state-wide deep headwater drainage lakes (DHDL) and Northern Lakes and Forests (NLF) ecoregion lakes. Water Quality Index values adapted from WDNR PUB WT-913.

Precipitation data obtained from nearby Hurley, WI indicate that precipitation in 2013 and 2014 was approximately 21 and 6 inches above average, respectively (Figure 8.1.1-5). This increase in precipitation likely flushed a greater amount of these dissolved organic compounds from coniferous wetlands in Harris Lake's watershed into the lake, resulting in reduced water clarity. While precipitation in 2015 was average, the dissolved compounds delivered to the lake in 2013 and 2014 likely persisted given the lake's water residence time of over five years. While these compounds contributed to a reduction in Harris Lake's water clarity, it is important to note that these compounds are natural and do not indicate degraded water quality. Given the large areas of coniferous wetlands in Harris Lake's watershed, it is to be expected that larger amounts of these dissolved compounds will be delivered to the lake during years with higher precipitation. Because chlorophyll-*a* concentrations have not increased over this same time period, the decline in water clarity in Harris Lake since 2013 is not of concern.

To determine if internal nutrient loading (discussed in town-wide section of management plan) occurs in Harris Lake, near-bottom phosphorus concentrations are compared against those collected from the near-surface. Near-bottom total phosphorus concentrations were measured on three occasions from Harris Lake in 2015 and once in 2016, and historical near-bottom total phosphorus concentrations are available from 1979 and 1992-1996 (Figure 8.1.1-6). As illustrated, on some occasions near-bottom total phosphorus concentrations are similar to those measured near the surface, while on other occasions near-bottom concentrations are significantly higher than near-surface concentrations. The higher concentrations of phosphorus near the bottom occurred when Harris Lake was stratified and the cold, bottom layer of water (hypolimnion) was anoxic. These higher concentrations near the bottom are an indication that phosphorus is being released from bottom sediments into the overlying water during periods of anoxia, or that internal nutrient loading is occurring.

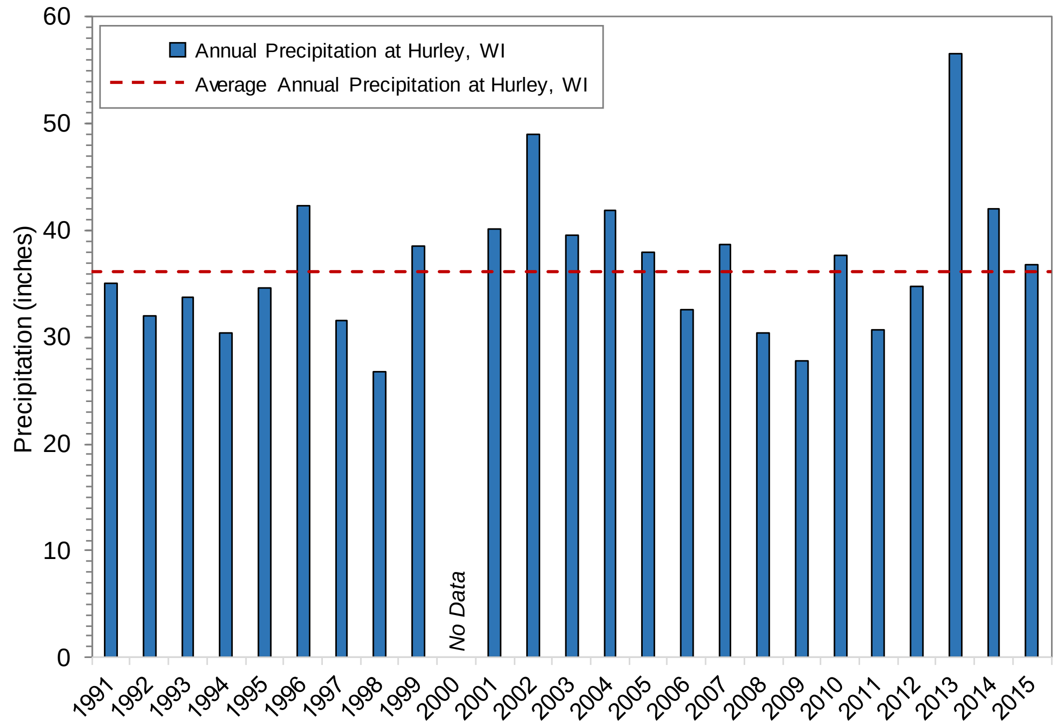


Figure 8.1.1-5. Total annual precipitation measured in Hurley, WI. Data obtained from National Oceanic and Atmospheric Administration website (https://www.ncdc.noaa.gov/cdo-web/).

While phosphorus is likely being released from bottom sediments into the hypolimnion during periods of stratification and anoxia in the summer, near-surface concentrations indicate that this sediment-released phosphorus is not being mixed into surface waters. Harris Lake is *dimictic*, meaning the lake completely mixes or turns over two times per year; once in spring and again in fall. While phosphorus is released from bottom sediments into the hypolimnion during periods of anoxia in the summer, this phosphorus remains 'trapped' near the bottom as the hypolimnion is unable to mix with the warmer epilimnion above due to large differences in density. In fall when the epilimnion cools and its density becomes similar to the hypolimnion below, the lake turns over and the phosphorus released into the hypolimnion is mixed throughout the water column.

Figure 8.1.1-7 displays the average monthly near-surface total phosphorus concentrations, chlorophyll-*a* concentrations, and Secchi disk transparency in Harris Lake calculated from all available growing season data. Near-surface total phosphorus concentrations are higher in the spring, likely a result of higher runoff from snowmelt and increased precipitation. As the summer progresses, near-surface total phosphorus concentrations decline as precipitation declines and phytoplankton incorporate the phosphorus into their tissues, die, and sink to the bottom. In fall, phosphorus concentrations quickly increase as the phosphorus that was released from bottom sediments into the hypolimnion is mixed throughout the water column during fall turnover. However, because this delivery of phosphorus from the near-bottom to the surface occurs in fall when water temperatures are cooler, an increase in phytoplankton growth is not observed. While internal nutrient loading occurs to some extent in Harris Lake, this phosphorus remains unavailable to phytoplankton at the surface in summer and does not appear to have a detectable impact to the lake's water quality.

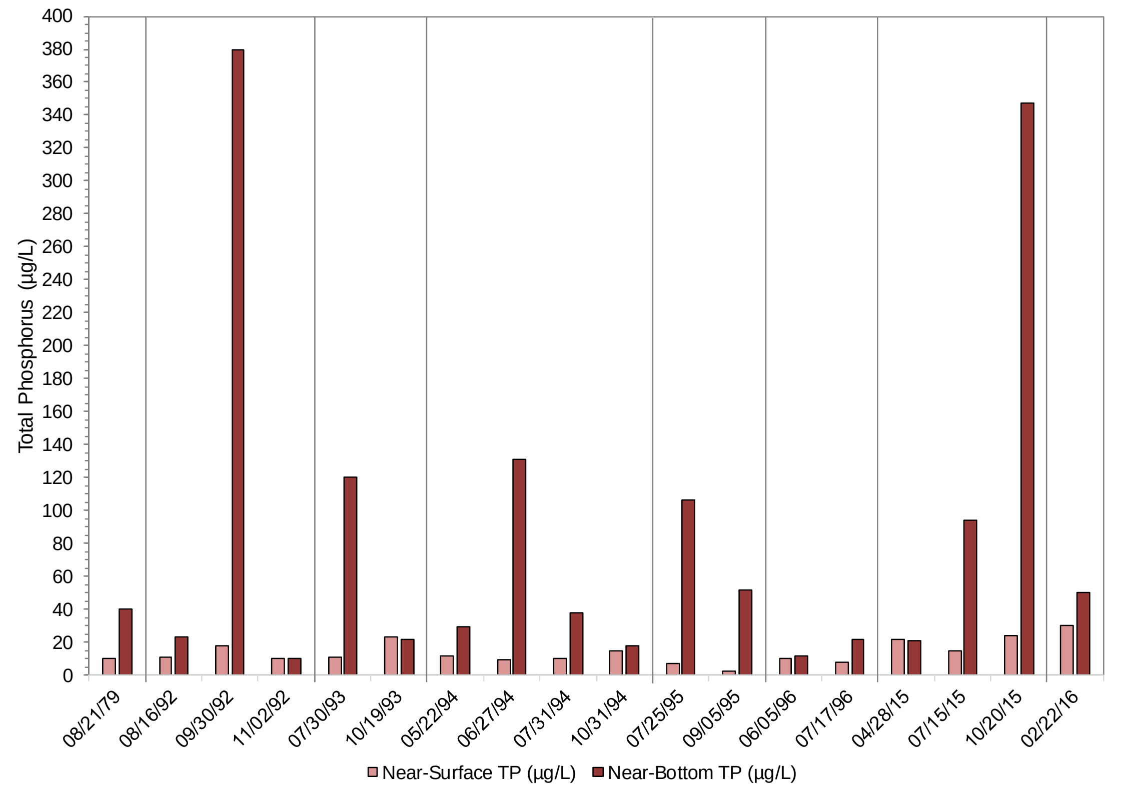


Figure 8.1.1-6. Harris Lake available near-bottom total phosphorus concentrations and corresponding near-surface total phosphorus concentrations.

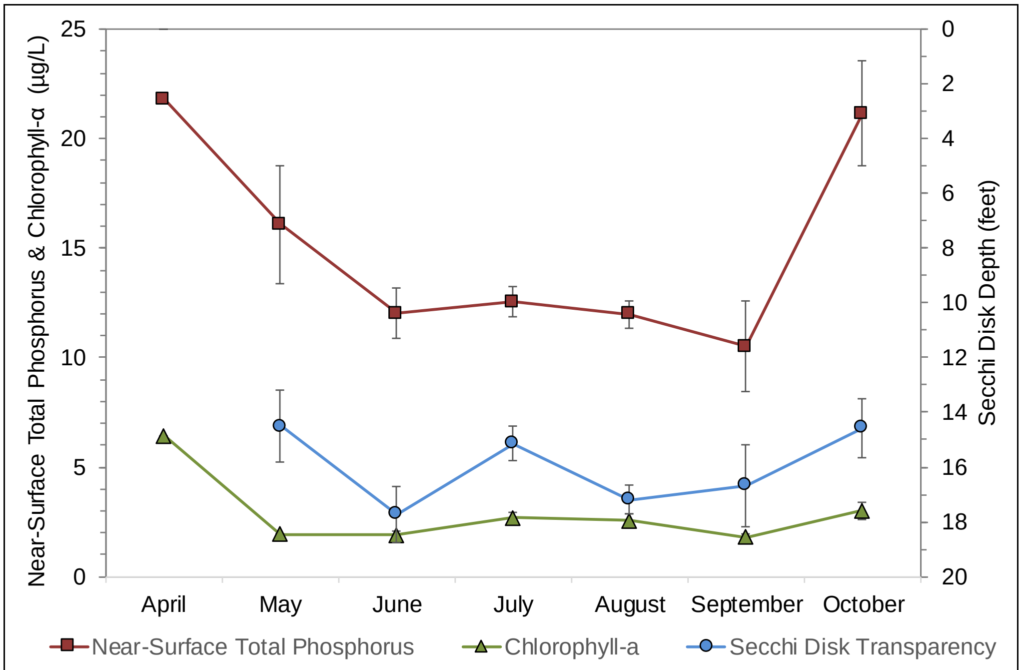


Figure 8.1.1-7. Harris Lake average monthly near-surface total phosphorus, chlorophyll-α, and Secchi disk transparency.

Harris Lake Trophic State

Figure 8.1.1-8 contains the weighted average Trophic State Index (TSI) values for Harris Lake. These TSI values are calculated using summer near-surface total phosphorus, chlorophyll-*a*, and Secchi disk transparency data collected as part of this project along with available historical data. In general, the best values to use in assessing a lake's trophic state are chlorophyll-*a* and total phosphorus, as water clarity can be influenced by other factors other than phytoplankton such as dissolved organic compounds. The closer the calculated TSI values for these three parameters are to one another indicates a higher degree of correlation.

The weighted TSI values for total phosphorus and chlorophyll-*a* in Harris Lake straddle the threshold between oligotrophic and mesotrophic, and the lake can be classified as currently being in a oligo-mesotrophic state. Harris Lake's TSI values are all relatively similar, indicating phosphorus regulates phytoplankton growth and phytoplankton growth regulates water clarity. Harris Lake is in a lower productivity state than the majority of other deep, headwater drainage lakes in Wisconsin and the majority of lakes within the NLF ecoregion.

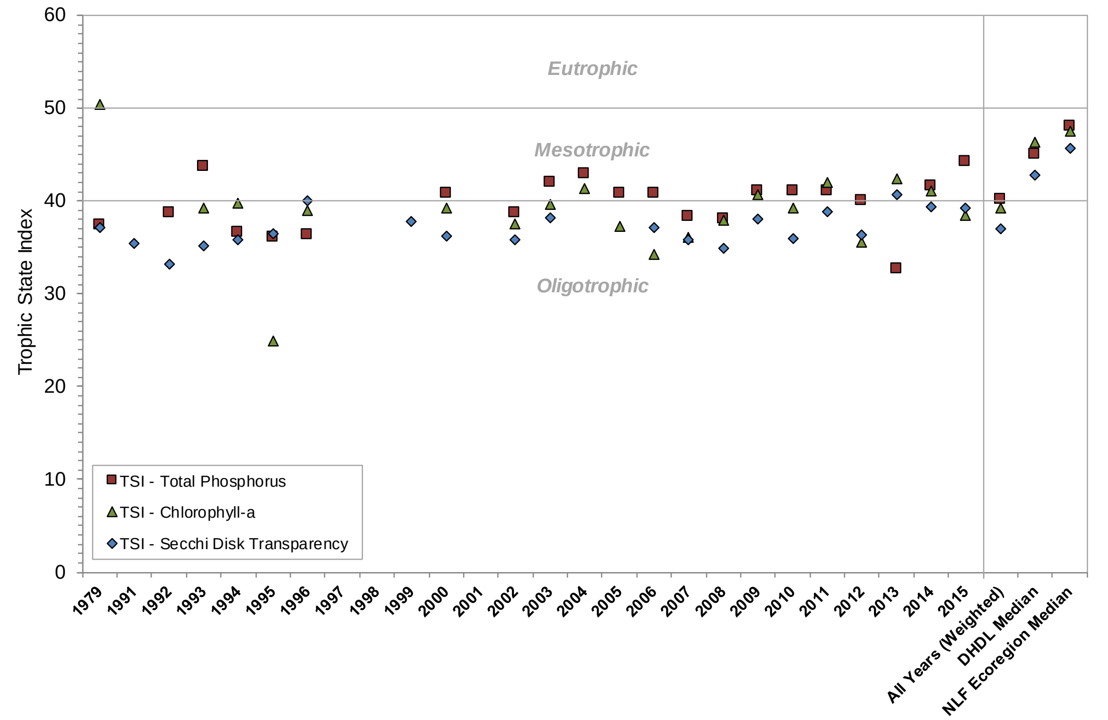


Figure 8.1.1-8. Harris Lake, statewide deep, headwater drainage lakes (DHDL), and Northern Lakes and Forests (NLF) ecoregion lakes Trophic State Index values. Values calculated with summer month surface sample data using WDNR PUB-WT-193.

Dissolved Oxygen and Temperature in Harris Lake

Dissolved oxygen and temperature profile data were collected during each water quality sampling event conducted by Onterra ecologists. These data are displayed in Figure 8.1.1-9. As mentioned previously, Harris Lake is dimictic, meaning the lake remains stratified during the summer (and winter) and completely mixes, or turns over, once in spring and once in fall. During the summer, the surface of the lake warms and becomes less dense than the cold layer below, and the lake thermally stratifies. Given Harris Lake's deeper nature, wind and water movement are not sufficient during the summer to mix these layers together, only the warmer, upper layer will mix. As a result, the bottom layer of water no longer receives atmospheric diffusion of oxygen, and decomposition of organic matter within this layer depletes available oxygen. Once anoxia sets in, phosphorus (and other nutrients) are released from bottom sediments into the overlying hypolimnion.

In fall as surface temperatures cool, the entire water column is again able to mix which re-oxygenates the hypolimnion and delivers sediment-released nutrients to the surface. During the winter, the coldest temperatures are found just under the overlying ice, while oxygen gradually declines once again towards the bottom of the lake. In February of 2016, oxygen concentrations remained above 2.0 mg/L throughout the majority of the water column, indicating that fishkills as a result of winter anoxia are likely not a concern in Harris Lake.

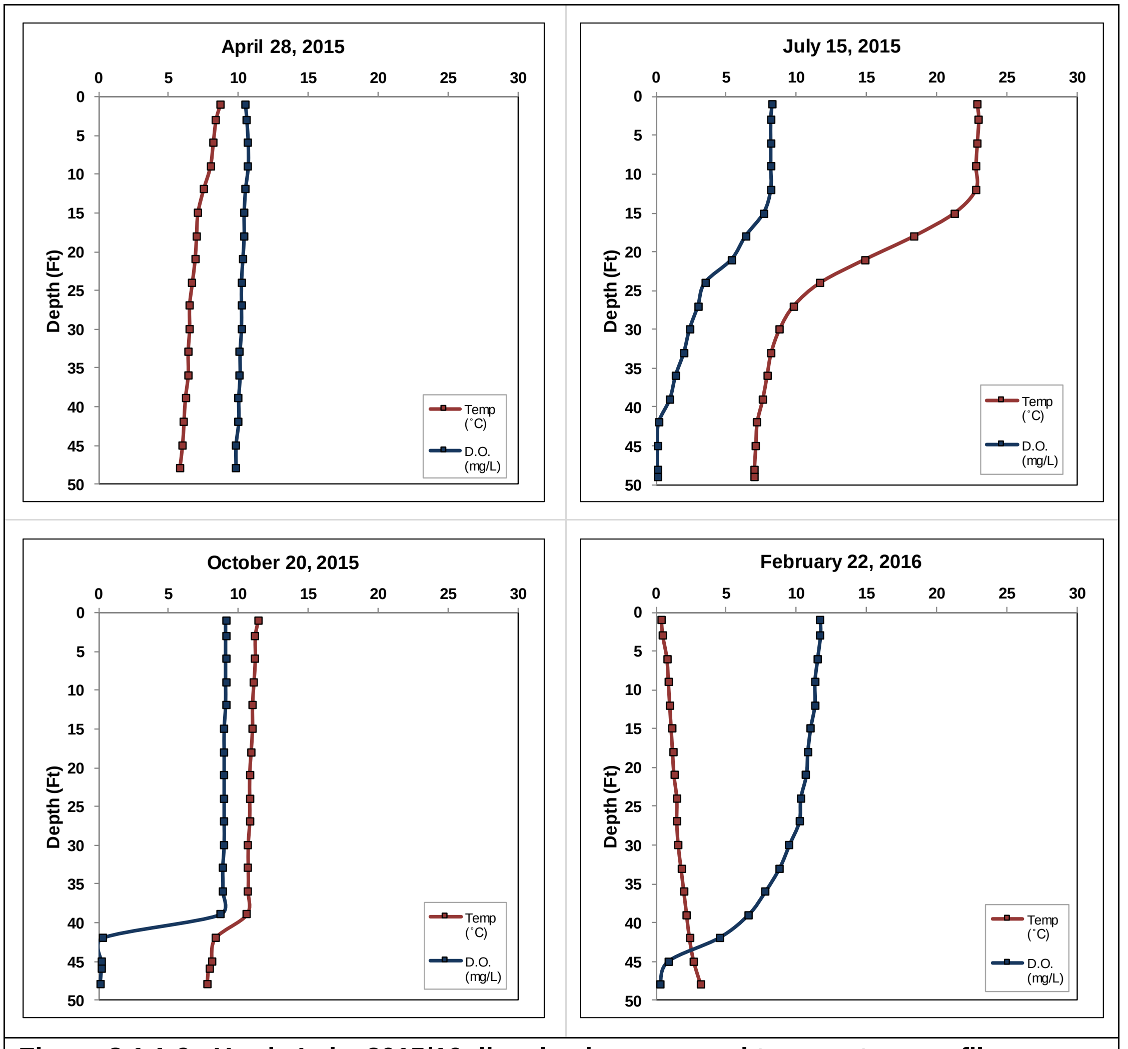


Figure 8.1.1-9. Harris Lake 2015/16 dissolved oxygen and temperature profiles.

Additional Water Quality Data Collected from Harris Lake

The previous section is centered on lake eutrophication. However, parameters other than water clarity, nutrients, and chlorophyll-*a* were collected as part of the project. These other parameters were collected to increase the understanding of Harris Lake's water quality and are recommended as a part of the WDNR long-term lake trends monitoring protocol. These parameters include pH, alkalinity, and calcium.

As the Town-wide Section explains, the pH scale ranges from 0 to 14 and indicates the concentration of hydrogen ions (H^+) within the lake's water and is thus an index of the lake's acidity. Harris Lake's mid-summer surface water pH was measured at roughly 8.1 in 2015. This value indicates Harris Lake's water is alkaline and falls within the normal range for Wisconsin lakes. Fluctuations in pH with respect to seasonality are common; in-lake processes such as photosynthesis by plants act to reduce acidity by carbon dioxide removal while decomposition of organic matter adds carbon dioxide to water, thereby increasing acidity. A lake's pH is primarily determined by the water's alkalinity, or a lake's capacity to resist fluctuations in pH by neutralizing or buffering against inputs such as acid rain. Harris Lake's average alkalinity measured in 2015 was 38.7 mg/L as $CaCO_3$. This value falls within the expected range for northern Wisconsin lakes, and indicates that Harris Lake is not sensitive to fluctuations in pH from acid rain.

Water quality samples collected from Harris Lake in 2015 were also analyzed for calcium. Calcium concentrations, along with pH, are currently being used to determine if a waterbody is suitable to support the invasive zebra mussel, as these animals require calcium for the construction of their shells. Zebra mussels typically require higher calcium concentrations than Wisconsin's native mussels, and lakes with calcium concentrations of less than 12 mg/L are considered to have very low susceptibility to zebra mussel establishment. The accepted suitable pH range for zebra mussels is 7.0 – 9.0, and Harris Lake's pH falls within this range. Harris Lake's calcium concentration in 2015 was 12.2 mg/L, indicating the lake has *low susceptibility* to zebra mussel establishment. Plankton tows were completed by Onterra ecologists at three locations in Harris Lake in 2015 that underwent analysis for the presence of zebra mussel veligers, their planktonic larval stage. Analysis of these samples were negative for zebra mussel veliger and for the invasive spiny water flea.

8.1.2 Harris Lake Watershed Assessment

Harris Lake's surficial watershed encompasses approximately 2,348 acres (Figure 8.1.2-1 and Harris Lake – Map 2). The watershed is comprised mainly of natural land cover types including forests (51%), wetlands (26%), and the lake surface itself (23%) (Figure 8.1.2-1). Less than 1% is comprised of rural residential areas and pasture/grass. Wisconsin Lakes Modeling Suite (WiLMS) modeling indicates that Harris Lake's residence time is approximately 5.2 years, or the water within the lake is completely replaced once every 5.2 years.

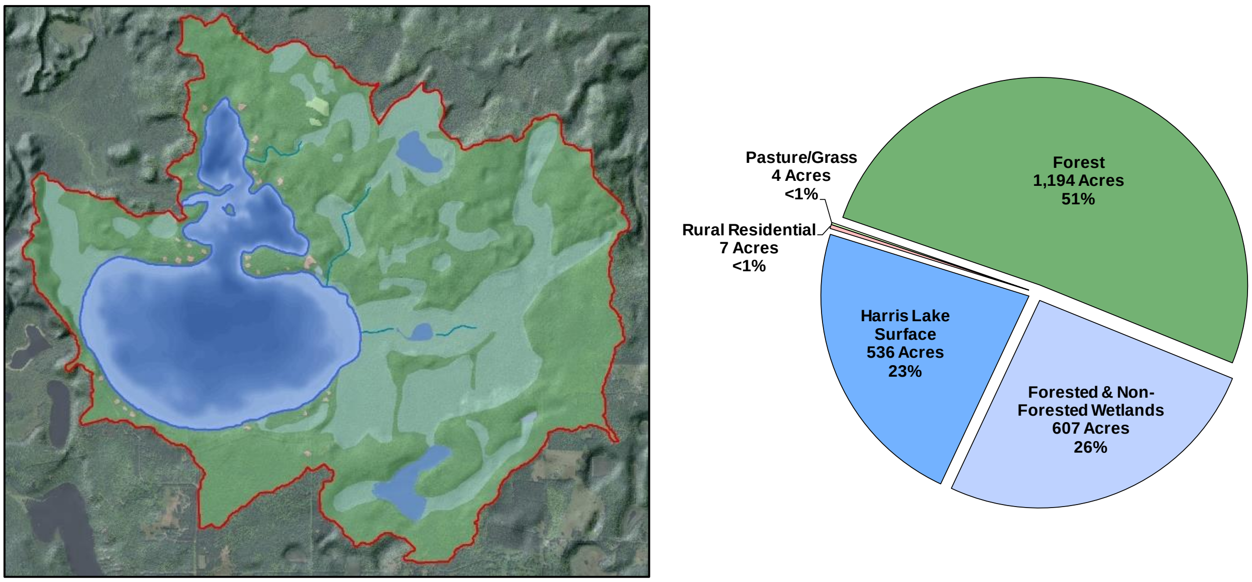


Figure 8.1.2-1. Harris Lake watershed boundary (red line) and proportion of land cover types. Based upon National Land Cover Database (NLCD – Fry et. al 2011).

Using the land cover types and their acreages within Harris Lake's watershed, WiLMS was utilized to estimate the annual potential phosphorus load delivered to Harris Lake from its watershed. In addition, data obtained from a stakeholder survey sent to Harris Lake riparian property owners in 2015 was also used to estimate the amount of phosphorus loading to the lake from riparian septic systems. The model estimated that a total of approximately 299 pounds of phosphorus are delivered to Harris Lake from its watershed on an annual basis (Figure 8.1.2-2).

Of the estimated 299 pounds of phosphorus being delivered to Harris Lake on an annual basis, the majority (143 pounds - 8%) originates from atmospheric deposition directly onto the lake's surface (Figure 8.1.2-2). Forests account for approximately 95 pounds (32%), wetlands account for 55 pounds (18%), and riparian septic systems were estimated to account for approximately 5 pounds (2%). The phosphorus delivered from rural residential areas and pasture/grass were negligible. Using the estimated annual potential phosphorus load, WiLMS predicted an in-lake growing season average total phosphorus concentration of 14 µg/L, which is essentially identical to the measured growing season average total phosphorus concentration of 13.5 µg/L. The similarity between the predicted and measured total phosphorus concentrations in Harris Lake is an indication that this is an accurate model of the lake's watershed and that there are no significant, unaccounted sources of phosphorus entering the lake.

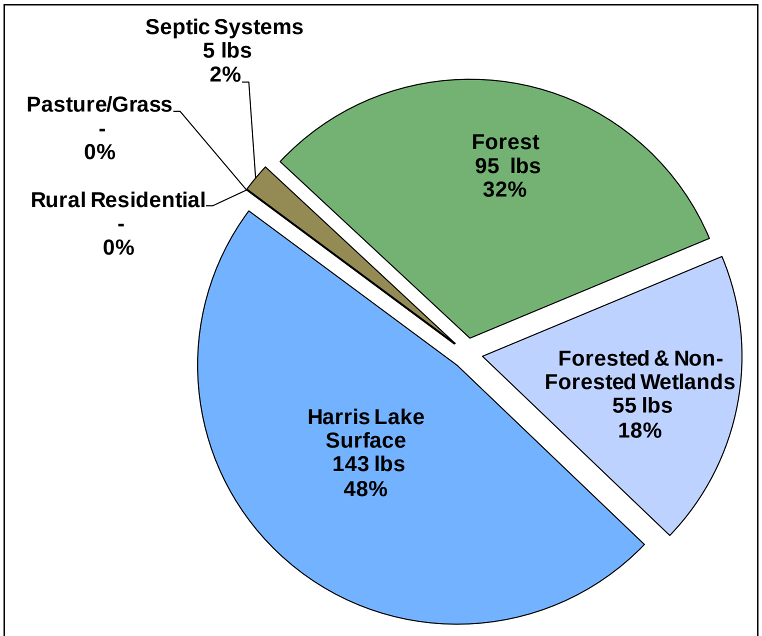


Figure 8.1.2-2. Harris Lake estimated potential annual phosphorus loading. Based upon Wisconsin Lake Modeling Suite (WiLMS) estimates.

Using the WiLMS model for Harris Lake's watershed, scenarios can be run to determine how Harris Lake's water quality would change given alterations to its watershed. For example, if 25% of the forests within Harris Lake's watershed were converted to pasture/grass, phosphorus concentrations are predicted to increase from the current growing season concentration of 13.5 µg/L to 16.0 µg/L. This increase in total phosphorus would result in chlorophyll-*a* concentrations increasing from the current growing season average of 2.5 µg/L to 4.8 µg/L, and Secchi disk transparency is predicted to decline from the current growing season average of 15.8 feet to 10.4 feet. In another scenario, if 25% of the forests in Harris Lake's watershed were converted to row crop agriculture, phosphorus concentrations are predicted to increase to 21 µg/L, chlorophyll-*a* concentrations would increase to 7.2 µg/L, and Secchi disk transparency would decline to 8.0 feet. This modeling illustrates the importance of the natural land cover types within Harris Lake's watershed in maintaining the lake's excellent water quality.

8.1.3 Harris Lake Shoreland Condition

Shoreland Development

As is discussed within the Town-wide Section, one of the most sensitive areas of a lake's watershed is the immediate shoreland zone. This transition zone between the aquatic and terrestrial environment is the last source of protection for the lake against pollutants originating from roads, driveways, and yards above, and is also a critical area for wildlife habitat and overall lake ecology. In the late-summer of 2015, the immediate shoreland of Harris Lake was assessed in terms of its development, and the shoreland zone was characterized with one of five shoreland development categories ranging from urbanized to completely undeveloped.

The 2015 survey revealed that Harris Lake has stretches of shoreland that fit all of the five shoreland assessment categories (Figure 8.1.3-1). In total, 5.0 miles (88%) of the 5.8-mile shoreland zone were categorized as natural/undeveloped or developed-natural, or shoreland types that provide the most benefit to the lake and should be left in their natural state if possible. Approximately 0.2 miles (4%) of the shoreland was categorized as developed-unnatural or urbanized, shorelands which provide little benefit to and may actually adversely impact the lake. If restoration of Harris Lake's shoreland is to occur, primary focus should be placed on these shoreland areas. Harris Lake – Map 3 displays the locations of these shoreland categories around the entire lake.

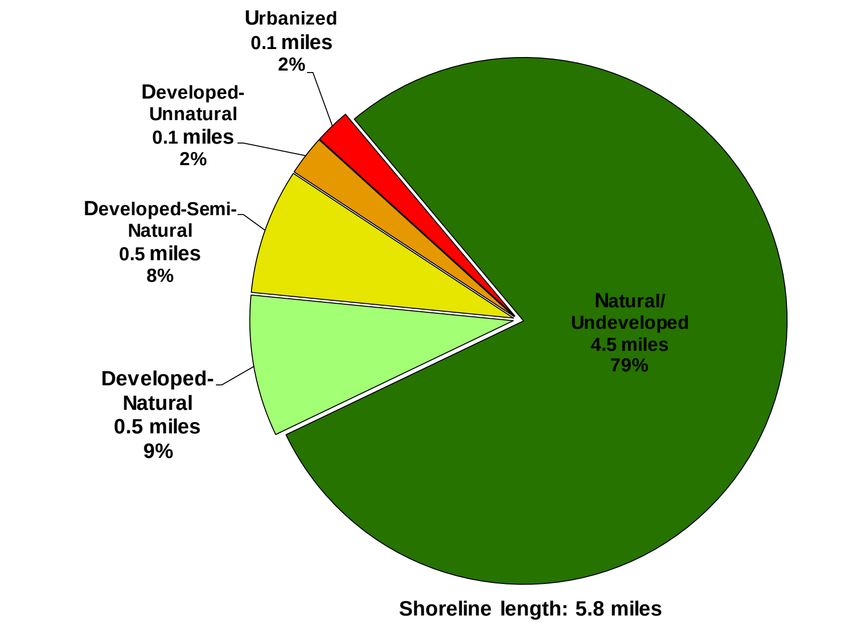


Figure 8.1.3-1. Harris Lake shoreland categories and total lengths. Based upon a late-summer 2015 survey. Locations of these categorized shorelands can be found on Harris Lake - Map 3.

Coarse Woody Habitat

A survey for coarse woody habitat was conducted in conjunction with the shoreland assessment (development) survey on Harris Lake in 2015. Coarse woody habitat was identified, and classified in several size categories (2-8 inches diameter, >8 inches diameter and cluster) as well as four branching categories: no branches, minimal branches, moderate branches, and full canopy. As discussed in the Town-wide Section, research indicates that fish species prefer some branching as opposed to no branching on coarse woody habitat, and increasing complexity is positively correlated with higher fish species richness, diversity and abundance (Newbrey et al. 2005).

During the coarse woody habitat survey on Harris Lake, a total of 624 pieces were observed along 5.8 miles of shoreline, yielding a coarse woody habitat to shoreline mile ratio of 108:1 (Figure 8.1.3-2). Onterra ecologists have been completing these surveys on Wisconsin's lakes for five years, and Harris Lake has one the highest coarse woody habitat pieces per shoreline recorded on any Onterra project to date. Refraining from removing these woody habitats from the

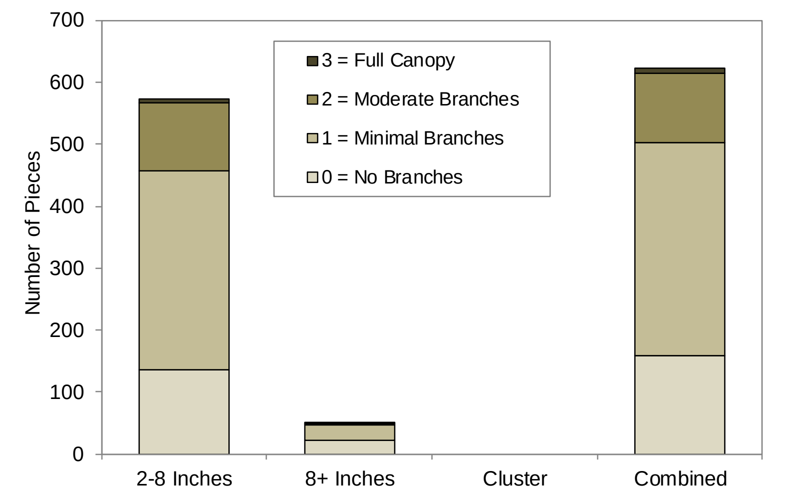


Figure 8.1.3-2. Harris Lake coarse woody habitat survey results. Based upon a late-summer 2015 survey. Locations of Harris Lake coarse woody habitat can be found on Harris Lake – Map 4.

shoreland area will ensure this high-quality habitat remains in these lakes. The locations of these coarse woody habitat pieces are displayed on Harris Lake – Map 4.

8.1.4 Harris Lake Aquatic Vegetation

An Early-Season Aquatic Invasive Species (ESAIS) Survey was conducted by Onterra ecologists on Harris Lake on June 30, 2015. While the intent of this survey is to locate any potential non-native species within the lake, the primary focus is to locate occurrences of the non-native curly-leaf pondweed, which should be at or near its peak growth at this time. Curly-leaf pondweed was discovered by Harris Lake Association members in 2008, and efforts to manage the population of this invasive plant are discussed in the subsequent Harris Lake Non-Native Plants section. However, no curly-leaf pondweed could be located in Harris Lake during the 2015 meander-based ESAIS survey.

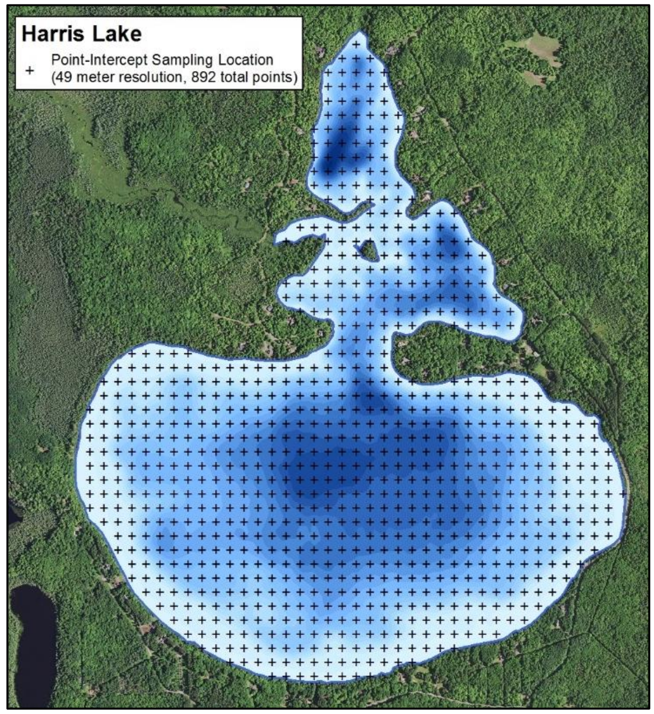


Figure 8.1.4-1. Harris Lake whole-lake point-intercept survey sampling locations.

The whole-lake aquatic plant point-intercept survey and emergent and floating-leaf aquatic plant community mapping survey were conducted on Harris Lake by Onterra ecologists on August 4, 2015 (Figure 8.1.4-1). During these surveys, a total of 57 aquatic plant species were located, one of which is considered to be a non-native, invasive species: curly-leaf pondweed (Table 8.1.4-1). As mentioned previously, curly-leaf pondweed was not observed in 2015 following a number of years of control efforts; however, because it has been documented in previous surveys it is included here. One native aquatic plant species present in Harris Lake, northeastern bladderwort, is listed by the Wisconsin Natural Heritage Inventory Program as a species of 'special concern' because it is rare or uncommon in Wisconsin and there is uncertainty regarding its abundance and distribution within the state. The WDNR completed a whole-lake point-intercept survey on Harris Lake in 2009 following the discovery of curly-leaf pondweed, and the species located during that survey are also included in Table 8.1.4-1.

Lakes in Wisconsin vary in their morphometry, water chemistry, and substrate composition, and all of these factors influence aquatic plant community composition. In early August of 2015, Onterra ecologists completed an acoustic survey on Harris Lake (bathymetric results shown in introduction). The sonar-based technology records aquatic plant bio-volume, or the percentage of the water column that is occupied by aquatic plants at a given location. Data pertaining to Harris Lake's substrate composition were also recorded during this survey. The sonar records substrate hardness, ranging from the hardest substrates (i.e. rock and sand) to the more flocculent, softer organic sediments.

Table 8.1.4-1. List of aquatic plant species located in Harris Lake during Onterra 2015 and WDNR 2009 aquatic plant surveys.

Growth Form	Scientific Name	Common Name	Coefficient of Conservatism (C)	2009 (WDNR)	2015 (Onterra)
Emergent	*Calla palustris*	Water arum	9		I
	Carex lasiocarpa	Narrow-leaved woolly sedge	9		I
	Carex pseudocyperus	Cypress-like sedge	8		I
	Carex utriculata	Common yellow lake sedge	7		I
	Cladium mariscoides	Smooth sawgrass	10		I
	Dulichium arundinaceum	Three-way sedge	9	X	X
	Eleocharis palustris	Creeping spikerush	6	X	X
	Equisetum fluviatile	Water horsetail	7	X	X
	Juncus effusus	Soft rush	4		I
	Phragmites australis subsp. *americanus*	Common reed	5		I
	Pontederia cordata	Pickerelweed	9		X
	Sagittaria latifolia	Common arrowhead	3		I
	Sagittaria rigida	Stiff arrowhead	8		I
	Schoenoplectus acutus	Hardstem bulrush	5	X	X
	Schoenoplectus pungens	Three-square rush	5	X	I
	Schoenoplectus tabernaemontani	Softstem bulrush	4		X
	Scirpus cyperinus	Wool grass	4		I
	Typha latifolia	Broad-leaf cattail	1		I
FL/E	*Sparganium emersum*	Short-stemmed bur-reed	8		I
FL	*Brasenia schreberi*	Watershield	7		X
	Nuphar variegata	Spatterdock	6	X	X
	Nymphaea odorata	White water lily	6	X	X
	Persicaria amphibia	Water smartweed	5	X	X
	Sparganium angustifolium	Narrow-leaf bur-reed	9		I
	Sparganium fluctuans	Floating-leaf bur-reed	10		I
Submergent	*Bidens beckii*	Water marigold	8	X	X
	Chara spp.	Muskgrasses	7	X	X
	Elodea canadensis	Common waterweed	3	X	X
	Eriocaulon aquaticum	Pipewort	9	X	X
	Heteranthera dubia	Water stargrass	6	X	X
	Isoetes spp.	Quillwort spp.	8	X	X
	Littorella uniflora	American shoreweed	10	X	
	Lobelia dortmanna	Water lobelia	10	X	X
	Myriophyllum alterniflorum	Alternate-flowered water milfoil	10		X
	Myriophyllum sibiricum	Northern water milfoil	7	X	X
	Myriophyllum tenellum	Dwarf water milfoil	10	X	X
	Najas flexilis	Slender naiad	6	X	X
	Nitella spp.	Stoneworts	8	X	
	Potamogeton amplifolius	Large-leaf pondweed	7	X	X
	Potamogeton crispus °	Curly-leaf pondweed	Exotic	X	I
	Potamogeton epihydrus	Ribbon-leaf pondweed	8		X
	Potamogeton foliosus	Leafy pondweed	6	X	
	Potamogeton friesii	Fries' pondweed	8		X
	Potamogeton gramineus	Variable-leaf pondweed	7	X	X
	Potamogeton illinoensis	Illinois pondweed	6		X
	Potamogeton praelongus	White-stem pondweed	8	X	X
	Potamogeton pusillus	Small pondweed	7	X	X
	Potamogeton richardsonii	Clasping-leaf pondweed	5	X	X
	Potamogeton robbinsii	Fern-leaf pondweed	8	X	X
	Potamogeton strictifolius	Stiff pondweed	8		X
	Potamogeton zosteriformis	Flat-stem pondweed	6	X	X
	Ranunculus flammula	Creeping spearwort	9	X	X
	Stuckenia pectinata	Sago pondweed	3	X	X
	Utricularia intermedia	Flat-leaf bladderwort	9	X	X
	*Utricularia resupinata**	Northeastern bladderwort	9	X	X
	Utricularia vulgaris	Common bladderwort	7		I
	Vallisneria americana	Wild celery	6	X	X
S/E	*Eleocharis acicularis*	Needle spikerush	5	X	X
	Juncus pelocarpus	Brown-fruited rush	8	X	X
	Sagittaria cristata	Crested arrowhead	9	X	I

FL/E = Floating Leaf and Emergent; FL = Floating Leaf; S/E = Submergent and Emergent
X = Located on rake during point-intercept survey; I = Incidental Species
** = Species listed as special concern by WI Natural Heritage Inventory*
° = CLP documented in past surveys, but not observed in 2015

Data regarding substrate hardness collected during the 2015 acoustic survey reveals that Harris Lake's average substrate hardness ranges from hard to moderately hard with deeper areas containing softer, more flocculent sediments (Figure 8.1.4-2 and Harris Lake – Map 5). Substrate hardness is highest within the shallowest areas of Harris Lake, and between one and ten feet, hardness declines relatively rapidly with depth. From ten and deeper, substrate hardness remains relatively constant. Figure 8.1.4-3 illustrates the spatial distribution of substrate hardness in Harris Lake. Like terrestrial plants, different aquatic plant species are adapted to grow in certain substrate types; some species are only found growing in soft substrates, others only in sandy areas, and some can be found growing in either. Lakes that have varying substrate types generally support a higher number of plant species because of the different habitat types that are available.

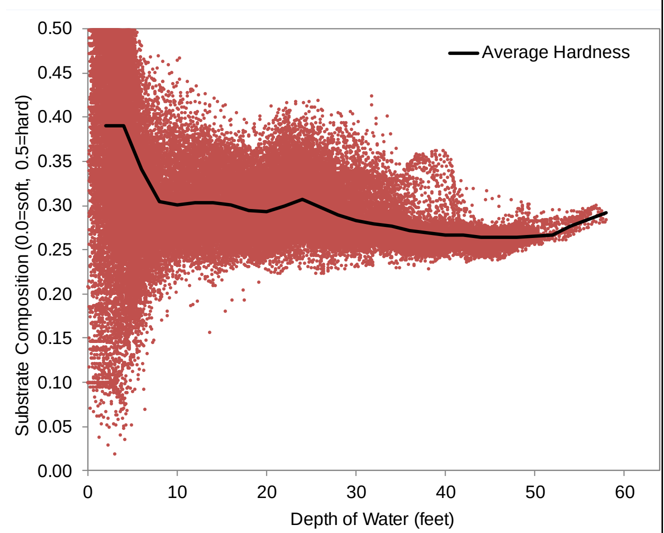


Figure 8.1.4-2. Harris Lake substrate hardness across water depth. Individual data points are displayed in red. Creating using data from August 2015 acoustic survey.

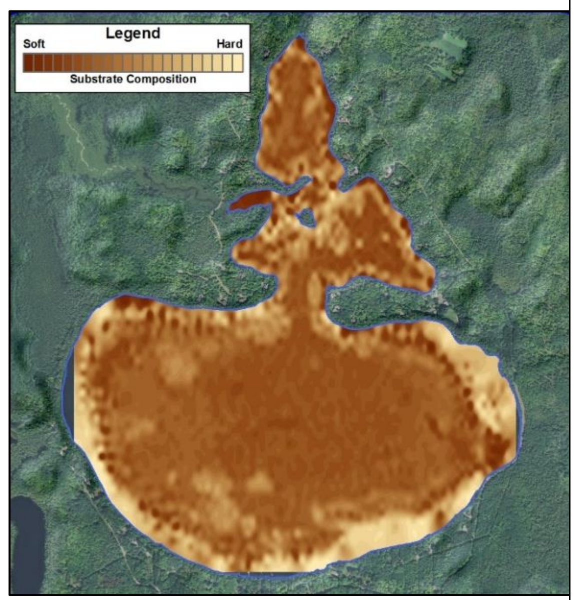


Figure 8.1.4-3. Harris Lake substrate hardness. Created using data from August 2015 acoustic survey.

The acoustic survey also recorded aquatic plant bio-volume throughout the entire lake. As mentioned earlier, aquatic plant bio-volume is the percentage of the water column that is occupied by aquatic plants. The 2015 aquatic plant bio-volume data are displayed in Figure 8.1.4-4 and Harris Lake – Map 6. Areas where aquatic plants occupy most or all of the water column are indicated in red while areas of little to no aquatic plant growth are displayed in blue. The 2015 whole-lake point-intercept survey found aquatic plants growing to a maximum depth of 28 feet, and the acoustic data indicate some growth at around 30 feet within the northern portion of the lake. However, the majority of aquatic plant growth occurs within the first 14 feet of water, and the presence of aquatic plants quickly diminished beyond 14 feet. Overall, the 2015 acoustic survey indicates that approximately 22% of Harris Lake contains aquatic vegetation (Figure 8.1.4-4). The remaining area of the lake is too deep to support aquatic plant growth.

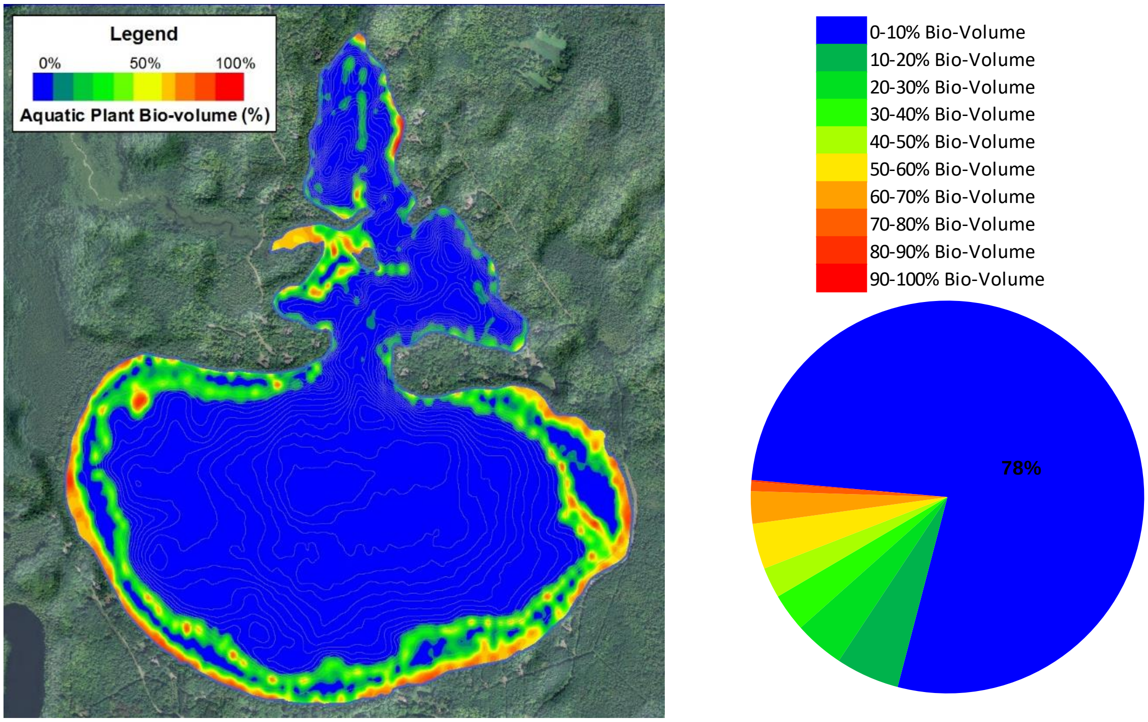


Figure 8.1.4-4. Harris Lake 2015 aquatic plant bio-volume. Created using data from August 2015 acoustic survey data. Contour lines represent three-foot increments.

While the acoustic mapping is an excellent survey for understanding the distribution and levels of aquatic plant growth throughout the lake, this survey does not determine what aquatic plant species are present. Whole-lake point-intercept surveys are used to quantify the abundance of individual species within the lake. During the 2015 aquatic plant point-intercept survey, the maximum depth recorded with aquatic plants was 28 feet; however, this represented just one sampling location, and the majority of the plant growth was found in 14 feet of water or less. Of the 456 point-intercept sampling locations that fell at or shallower than the maximum depth of plant growth (the littoral zone), approximately 49% contained aquatic vegetation. Aquatic plant rake fullness data collected in 2015 indicates that 30% of the 456 sampling locations contained vegetation with a total rake fullness rating (TRF) of 1, 13% had a TRF rating of 2, and 6% had a TRF rating of 3 (Figure 8.1.4-5).

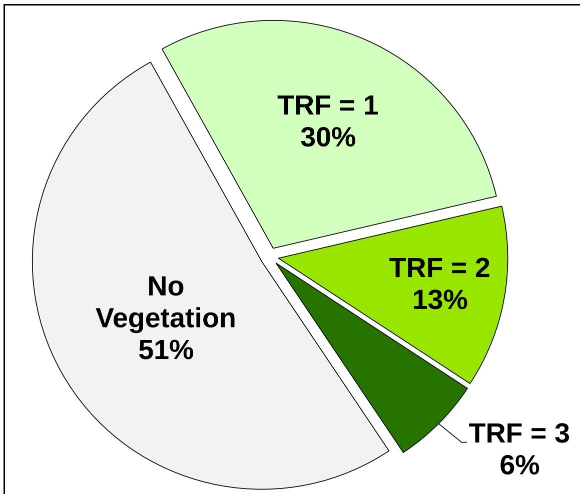


Figure 8.1.4-5. Harris Lake 2015 aquatic vegetation total rake fullness ratings (TRF). Created from data collected during the 2015 whole-lake point-intercept survey (N = 456).

Of the 57 aquatic plant species located in Harris Lake in 2015, 40 were encountered directly on the rake during the whole-lake point-intercept survey (Figure 8.1.4-6). The remaining 17 plants were located incidentally, meaning they were observed by Onterra ecologists while on the lake but they were not directly sampled on the rake at any of the point-intercept sampling locations. Incidental species typically include emergent and floating-leaf species that are often found growing on the fringes of the lake and submersed species that are relatively rare within the plant community. Of the 40 species directly sampled with the rake during the point-intercept survey, muskgrasses, hardstem bulrush, slender naiad, variable-leaf pondweed, and wild celery were the five-most frequently encountered plants, respectively (Figure 8.1.4-6).

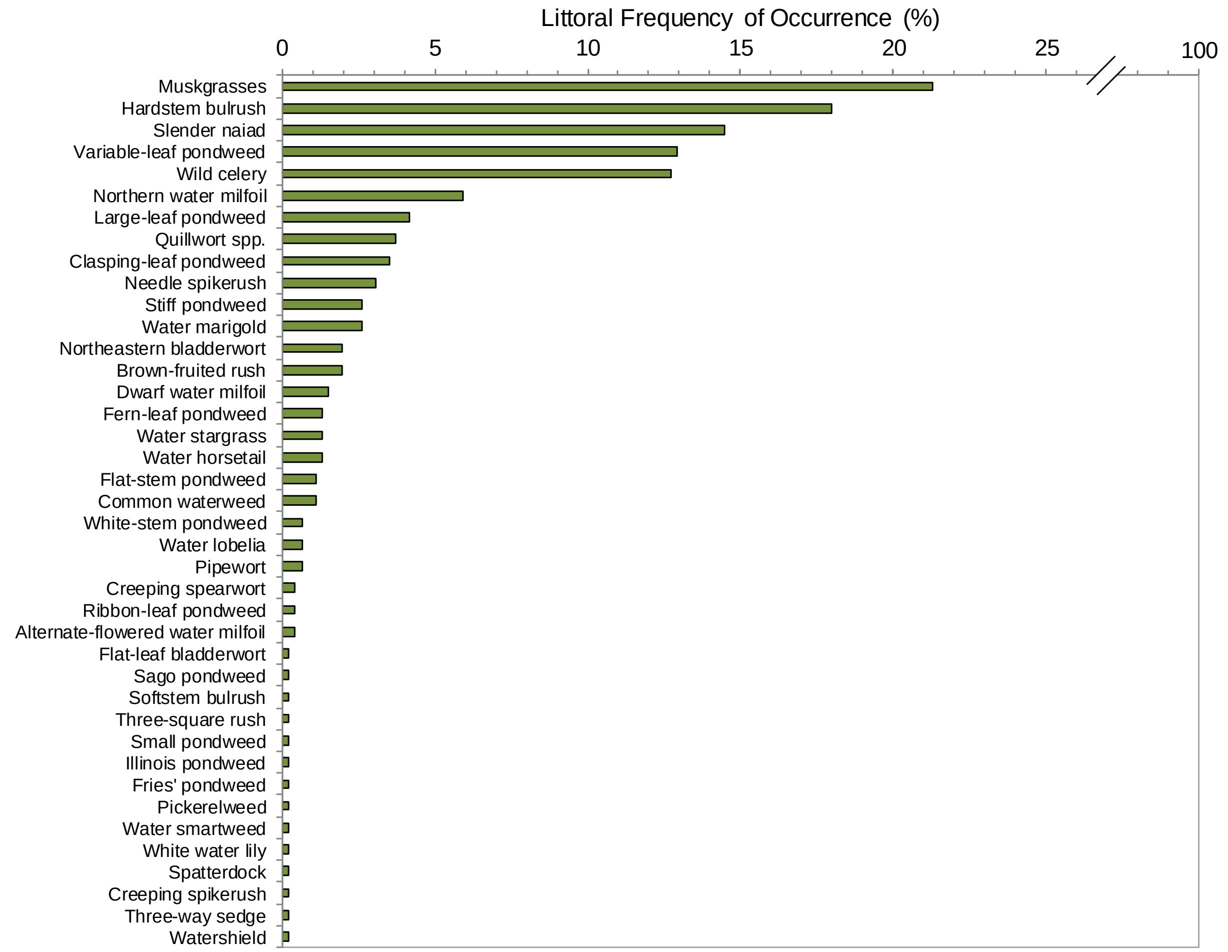


Figure 8.1.4-6. Harris Lake 2015 littoral frequency of occurrence of aquatic plant species. Created using data from 2015 whole-lake point-intercept survey.

Muskgrasses, the most abundant aquatic plants in Harris Lake with a littoral frequency of occurrence of approximately 21%, are a group of macroalgae of which there are several species in Wisconsin. While they are not vascular plants, muskgrasses still grow to a considerable size and form large, dense beds along the lake bottom where the supply oxygen to deeper waters and provide structural habitat for aquatic invertebrates and fish. Studies have also shown that these plants stabilize bottom sediments and improve water quality by removing nutrients to the water that would otherwise be available to algae.

Hardstem bulrush was the second-most frequently encountered aquatic plant in Harris Lake in 2015 with a littoral frequency of occurrence of approximately 18%. Contrary to its name, hardstem bulrush is not a rush (family *Juncaceae*) but is actually a tall, giant sedge in the family *Cyperaceae*. Harris Lake possesses large colonies of hardstem bulrush in shallow waters around the lake, and these communities are important habitat and food sources for wildlife and the stabilization of bottom and shoreline sediments.

Photo 8.1.4-1. Flower of northeastern bladderwort (*U. resupinata*). Photo credit: Onterra.

One aquatic plant species located in 2015, northeastern bladderwort (*Utricularia resupinata* – Photo 8.1.4-1), is listed as special concern in Wisconsin by the Natural Heritage Inventory due to uncertainty regarding its population and rarity in the state (WDNR PUBL-ER-001 2014). Northeastern bladderwort is one of nine bladderwort species found in Wisconsin, and one of three species found in Harris Lake. Bladderworts are *insectivorous*, meaning they supplement their nutrient demand by trapping and digesting small insects and crustaceans. These plants possess small sac-like bladders containing small hairs, which when touched by unsuspecting prey trigger a door on the trap to open rapidly drawing in water and the insect. Trapped within the bladder, the insect is slowly digested. Northeastern bladderwort is often difficult to locate, as the majority of the plant is buried within the substrate. In Harris Lake, this plant was found in shallow areas of sand near shore.

Submersed aquatic plants can be grouped into one of two general categories based upon their morphological growth form and habitat preferences. These two groups include species of the *isoetid* growth form and those of the *elodeid* growth form. Plants of the isoetid growth form are small, slow-growing, inconspicuous submerged plants (Photo 8.1.4-2). These species often have evergreen, succulent-like leaves and are usually found growing in sandy/rocky soils within near-shore areas of a lake (Boston and Adams 1987, Vestergaard and Sand-Jensen 2000).

In contrast, aquatic plant species of the elodeid growth form have leaves on tall, erect stems which grow up into the water column, and are the plants that lake users are likely more familiar with (Photo 8.1.4-2). It is important to note that the definition of these two groups is based solely on morphology and physiology and not on species' relationships. For example, dwarf-water milfoil (*Myriophyllum tenellum*) found in Harris Lake is classified as an isoetid, while all of the other milfoil species in Wisconsin such as northern water milfoil (*Myriophyllum sibiricum*), also found in Harris Lake, are classified as elodeids.

Alkalinity, as it relates to the amount of bicarbonate within the water, is the primary water chemistry factor for determining a lake's aquatic plant community composition in terms of isoetid versus elodeid growth forms (Vestergaard and Sand-Jensen 2000). Most aquatic plant species of the elodeid growth form cannot inhabit lakes with little or no alkalinity because their carbon demand for photosynthesis cannot be met solely from the dissolved carbon dioxide within the water and must be supplemented from dissolved bicarbonate.

On the other hand, aquatic plant species of the isoetid growth form can thrive in lakes with little or no alkalinity because they have the ability to derive carbon dioxide directly from the sediment, and many also have a modified form of photosynthesis to maximize their carbon storage (Madsen et al. 2002). While isoetids are able to grow in lakes with higher alkalinity, their short stature makes them poor competitors for space and light against the taller elodeid species. Thus, isoetids are most prevalent in lakes with little to no alkalinity where they can avoid competition from elodeids. However, in lakes with moderate alkalinity, like Harris Lake, the aquatic plant community can be comprised of isoetids growing beneath a scattered canopy of the larger elodeids. Isoetid communities are vulnerable to sedimentation and eutrophication (Smolders et al. 2002), and a number are listed as special concern (e.g. northeastern bladderwort) or threatened in Wisconsin due to their rarity and susceptibility to environmental degradation.

Photo 8.1.4-2. Lake quillwort (*Isoetes lacustris*) of the isoetid growth form (left) and variable pondweed (*Potamogeton gramineus*) and fern pondweed (*P. robbinsii*) of the elodeid growth form (right).

In the summer of 2009, the WDNR conducted a whole-lake point-intercept survey on Harris Lake following the discovery of curly-leaf pondweed. The methodology and sampling locations were the same as the survey completed in 2015, and therefore, the data collected from these two surveys can be statistically compared to determine if any significant changes in Harris Lake's aquatic plant community have occurred over this time period. Figure 8.1.4-7 displays the littoral frequency of occurrence of aquatic plant species from the 2009 and 2015 point-intercept surveys. Only the species that had a littoral frequency of occurrence of at least 5% are applicable for analysis. Because of their morphological similarity and often difficulty in differentiating between them, the occurrences of muskgrasses and stoneworts were combined for this analysis.

Fern-leaf pondweed, small pondweed, dwarf water milfoil, and common waterweed exhibited statistically valid reductions in their occurrence between the 2009 and 2015 point-intercept surveys (Figure 8.1.4-7). Slender naiad, wild celery, and hardstem bulrush exhibited statistically valid increases in their littoral occurrence between the 2009 and 2015 point-intercept surveys. However, the apparent increase in hardstem bulrush is a result of surveyors in 2009 recording its presence at a number of sampling locations as a 'visual occurrence' and they did not record it as present on the rake. If the visual occurrences are included, there is not statistical difference in the occurrence of hardstem bulrush between these two surveys. The littoral occurrences of muskgrasses and stoneworts, variable-leaf pondweed, large-leaf pondweed, needle spikerush, and northern water milfoil were not statistically different.

Aquatic plant communities are dynamic and the abundance of certain species from year to year can fluctuate depending on climatic conditions, herbivory, competition, and disease among other factors. Native aquatic plants can also decline following the implementation of herbicide applications to control non-native aquatic plants; however, as is discussed in detail within the Non-Native Aquatic Plant Section, the reductions in occurrence of the previously-mentioned aquatic plants in Harris Lake are not believed to be a result of the herbicide applications from 2010-2013 to control curly-leaf pondweed. Rather, these observed reductions and increases in occurrence of certain species are believed to be due to varying interannual environmental conditions, including the reduction in water clarity observed since 2013 as is discussed in the Harris Lake Water Quality Section.

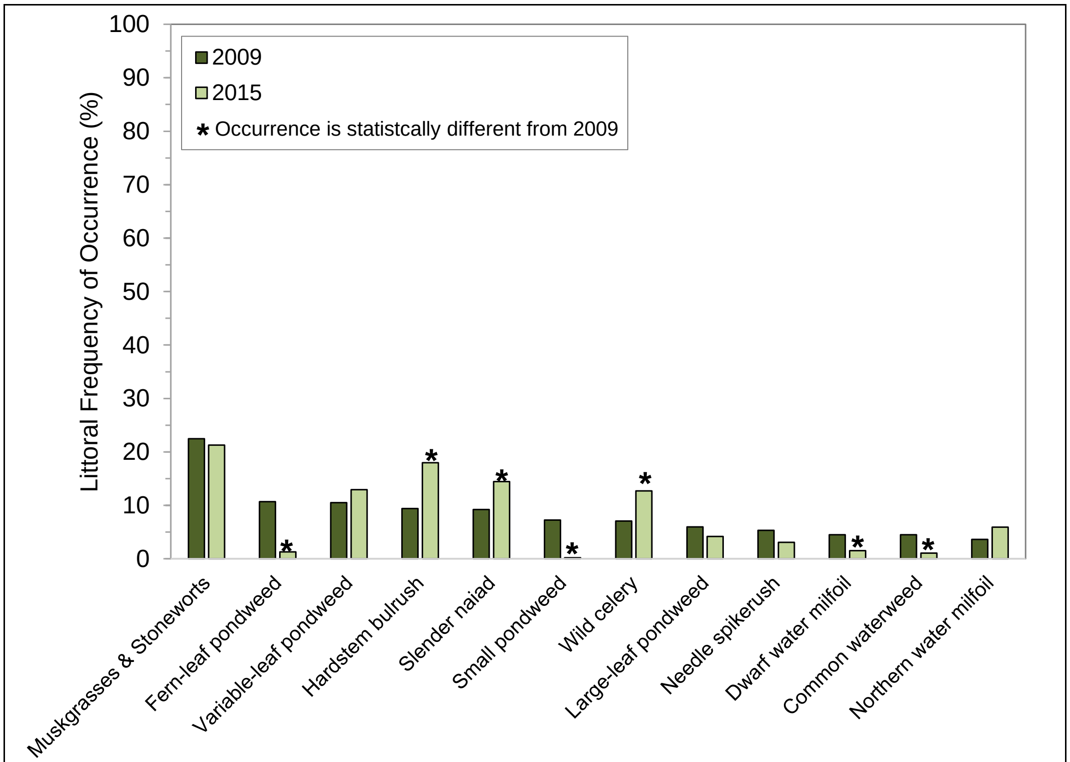


Figure 8.1.4-7. Harris Lake 2009 and 2015 aquatic plant littoral frequency of occurrence comparison. Please note that only the species with a littoral occurrence of at least 5% in one of the two surveys are displayed. Statistical significance determined using Chi-square analysis ($\alpha = 0.05$). Created using data collected during WDNR 2009 and Onterra 2015 whole-lake point-intercept surveys.

As discussed in the Town-wide section, the calculations used to create the Floristic Quality Index (FQI) for a lake's aquatic plant community are based on the aquatic plant species that were encountered on the rake during the point-intercept survey and do not include incidental species. The native species encountered on the rake during the 2009 and 2015 point-intercept surveys and their conservatism values were used to calculate the FQI of Harris Lake's aquatic plant community (equation shown below).

$$\text{FQI} = \text{Average Coefficient of Conservatism} * \sqrt{\text{Number of Native Species}}$$

Figure 8.1.4-8 compares the 2009 and 2015 FQI components of Harris Lake to median values of lakes within the Northern Lakes and Forests (NLF) ecoregion and lakes throughout Wisconsin. The number of native aquatic plant species encountered on the rake, or native species richness, was similar between the 2009 and 2015 surveys at 38 and 40, respectively. Harris Lake's species richness greatly exceeds the upper quartile value for lakes within the ecoregion and the state. The lake's excellent water quality and diversity of habitat types result in this high species richness.

Like native plant species richness, Harris Lake's average conservatism in 2009 and 2015 was also similar with values of 6.9 and 7.0, respectively (Figure 8.1.4-8). Harris Lake's average conservatism exceeds the median values for lakes in the ecoregion and throughout Wisconsin, and indicates Harris Lake's aquatic plant community contains a higher number of aquatic plants that are considered to be sensitive to environmental degradation and require high-quality habitats. Given Harris Lake's high native species richness and average conservatism values from 2009 and 2015, Harris Lake has high Floristic Quality Index values in both years of 42.5 and 44.3, respectively. These FQI values exceed the upper quartile values for lakes in the ecoregion and the state, and indicate that Harris Lake's aquatic plant community is of higher quality than the majority of lakes in the region and throughout Wisconsin.

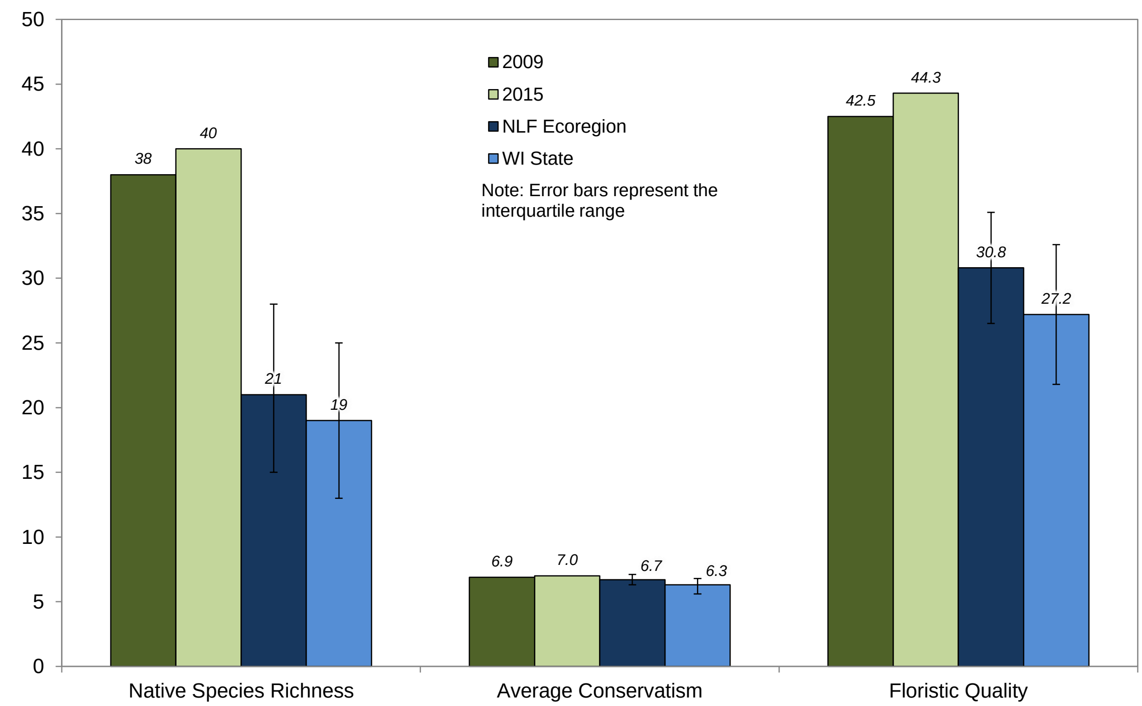


Figure 8.1.4-8. Harris Lake Floristic Quality Assessment. Created using data from WDNR 2009 and Onterra 2015 whole-lake point-intercept surveys. Analysis follows Nichols (1999).

As explained in the Town-wide section, lakes with diverse aquatic plant communities have higher resilience to environmental disturbances and greater resistance to invasion by non-native plants. In addition, a plant community with a mosaic of species with differing morphological attributes provides zooplankton, macroinvertebrates, fish, and other wildlife with diverse structural habitat and various sources of food. Because Harris Lake contains a high number of native aquatic plant species, one may assume the aquatic plant community has high species diversity. However, species diversity is also influenced by how evenly the plant species are distributed within the community.

While a method for characterizing diversity values of fair, poor, etc. does not exist, lakes within the same ecoregion may be compared to provide an idea of how Harris Lake's diversity value ranks. Using data collected by Onterra and WDNR Science Services, quartiles were calculated for 212 lakes within the NLF ecoregion (Figure 8.1.4-9). Using the data collected from the 2009 and 2015 point-intercept surveys, Harris Lake's aquatic plant is shown to have high species diversity with Simpson's Diversity Index values of 0.94 and 0.91, respectively. In other words, if two individual aquatic plants were randomly sampled from Harris Lake in 2015, there would be a 91% probability that they would be different species. These diversity values fall above the upper quartile value for lakes in the ecoregion and the state.

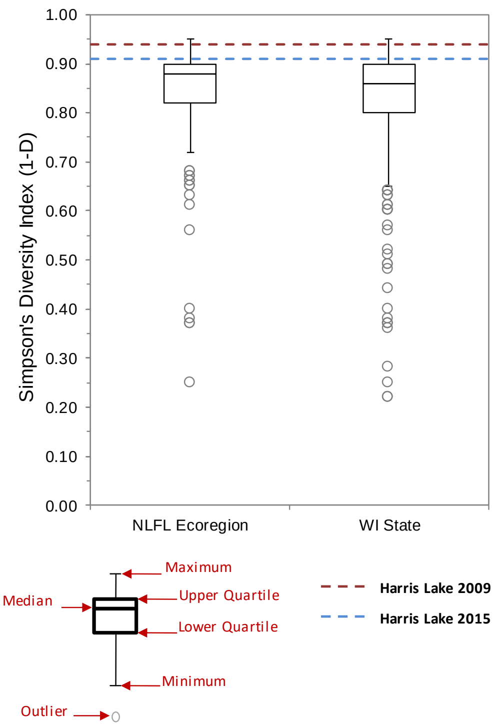


Figure 8.1.4-9. Harris Lake species diversity index. Created using data from WDNR 2009 and Onterra 2015 point-intercept surveys.

One way to visualize Harris Lake's high species diversity is to look at the relative occurrence of aquatic plant species. Figure 8.1.4-10 displays the relative frequency of occurrence of aquatic plant species created from the 2015 whole-lake point-intercept survey and illustrates the relatively even distribution of aquatic plant species within the community. A plant community that is dominated by just a few species yields lower species diversity. Because each sampling location may contain numerous plant species, relative frequency of occurrence is one tool to evaluate how often each plant species is found in relation to all other species found (composition of population). For instance, while muskgrasses were found at 21% of the littoral sampling locations in Harris Lake in 2015, their relative frequency of occurrence is 17%. Explained another way, if 100 plants were randomly sampled from Harris Lake in 2015, 17 of them would be muskgrasses.

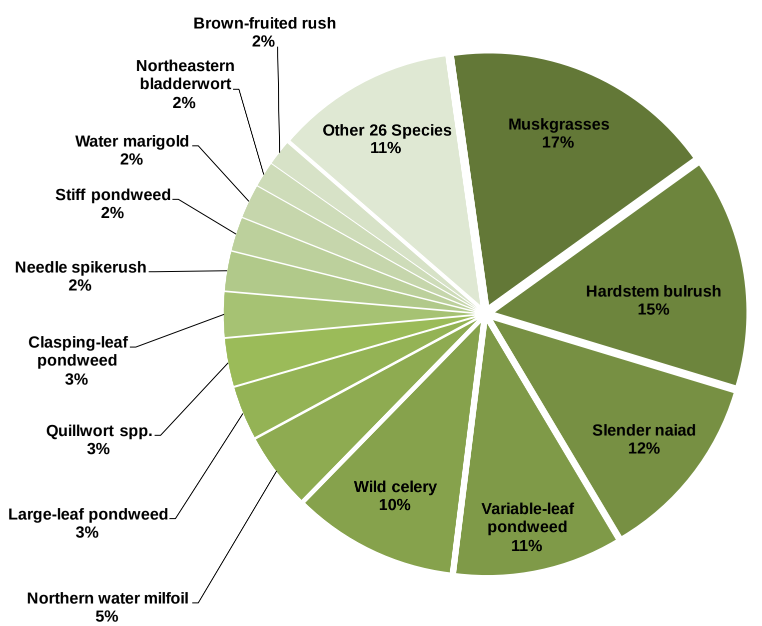


Figure 8.1.4-10. Harris Lake 2015 relative frequency of occurrence of aquatic plant species. Created using data from 2015 point-intercept survey.

In 2015, Onterra ecologists also conducted a survey aimed at mapping emergent and floating-leaf aquatic plant communities in Harris Lake. This survey revealed Harris Lake contains approximately 92 acres of these communities comprised of 24 different aquatic plant species (Harris Lake – Map 7 and Table 8.1.4-2). The majority of these communities are comprised of emergent species, primarily hardstem bulrush and three-square rush. These native emergent and floating-leaf plant communities provide valuable fish and wildlife habitat that is important to the ecosystem of the lake. These areas are particularly important during times of fluctuating water levels, since structural habitat of fallen trees and other forms of course-woody habitat can be quite sparse along the shores of receding water lines.

Table 8.1.4-2. Harris Lake 2015 acres of emergent and floating-leaf aquatic plant communities. Created using data from 2015 aquatic plant community mapping survey.

Harris Lake	
Plant Community	**Acres**
Emergent	88.8
Floating-leaf	0.1
Mixed Emergent & Floating-leaf	2.9
Total	**91.9**

The community map represents a ‘snapshot’ of the important emergent and floating-leaf plant communities, and a replication of this survey in the future will provide a valuable understanding of the dynamics of these communities within Harris Lake. This is important, because these communities are often negatively affected by recreational use and shoreland development.

Non-native Aquatic Plants in Harris Lake

Curly-leaf pondweed (CLP)

Curly-leaf pondweed

Curly-leaf pondweed (*Potamogeton crispus*; CLP; Photo 3.4-3) is a non-native aquatic plant that has invaded over 530 waterbodies in Wisconsin. The plant may outcompete other native aquatic vegetation with its dominating, aggressive growth and reach the point where its populations form dense mats on the surface of a lake’s littoral zone. These dense mats impact recreation as well as the ecology of the lake. Further, a natural, mid-summer senescence (die-back) of large populations of CLP may contribute to an increase of water column phosphorus with larger populations.

Photo 8.1.4-3. The non-native, invasive aquatic plant curly-leaf pondweed.

Of the two lakes studied to date under Phase I, CLP in Harris Lake has been the only non-native aquatic plant located thus far. Curly-leaf pondweed was first discovered in Harris Lake in 2008 by members of the Harris Lake Association, Inc. (HLA), and was later verified by the WDNR. Following its discovery, the HLA was advised to seek professional assistance to survey the lake for additional occurrences of CLP and develop an appropriate management strategy for controlling and monitoring the population.

In the fall of 2008, the HLA contracted with Onterra aid in the development of a CLP management strategy. With Onterra's assistance, the HLA was awarded a WDNR Aquatic Invasive Species (AIS)-Early Detection and Response (EDR) Grant to aid in the funding of the CLP surveys in 2009 and 2010 and associated treatment development and monitoring. Onterra ecologists completed the first whole-lake meander-based mapping of CLP in Harris Lake in June of 2009. This survey revealed a number of isolated colonies of CLP comprised mainly of single plants spread around the lake (Figure 8.1.4-11). The first herbicide application of approximately 10.4 acres using endothall to control CLP occurred in the spring of 2011.

Traditionally, CLP control strategies involve the annual application of herbicide in May/June with a goal of causing plant mortality before they are able to produce asexual reproductive structures called turions. Studies have indicated that viable CLP turions can remain dormant within the sediment for at least seven years, and is the reason a number of consecutive annual treatments are needed to prevent the formation of new turions and to kill plants that sprout from dormant turions deposited in years past. After multiple years of treatment (generally three to five), the turion bank within the sediment is exhausted and the CLP population declines.

Post-treatment assessments of the 2011 treatment were deemed successful as little to no CLP could be observed within the herbicide application areas. Subsequent endothall applications occurred during the springs of 2012 (4.1 acres) and 2013 (2.0 acres). These treatments were followed-up by volunteer monitoring and hand-removal by HLA volunteers. The HLA volunteers also implemented monitoring and hand-removal of CLP in smaller areas that were no applied with herbicide. All of these treatments were deemed successful, and following the mapping of CLP in 2013, it was determined that the CLP had declined to a level that did not warrant herbicide treatment in 2014 and that manual hand-removal by HLA volunteers would be the most appropriate method for control.

In the early summer of 2014, Onterra ecologists completed a mapping survey aimed at locating occurrences of CLP. These locations would then be provided to the HLA volunteers for their use in hand-removal. However, Onterra ecologists were unable to locate any of the CLP that had been mapped in 2013 nor was any CLP observed in any of areas previously applied with herbicide. While volunteer hand-removal of CLP did not occur in 2014, the HLA volunteers monitored the lake for potential occurrences of CLP; however, no additional CLP was located.

On June 30, 2015, Onterra ecologists completed the Early-Season AIS Survey on Harris Lake as part of the Town of Winchester Lake Management Planning Project – Phase I. During this survey, Onterra ecologists were unable to locate any occurrences of CLP. Onterra ecologists returned to Harris Lake on June 29, 2016 to complete another Early-Season AIS Survey as part of the Town of Winchester Lake Management Planning Project – Phase II. During this survey, three plants were located in close proximity to one another in the northwestern portion of the lake (Figure 8.1.4-12). These plants were hand-removed with a rake during this survey. Professional monitoring of CLP in Harris Lake is scheduled to occur in 2017 and 2018 under Phase III and IV of the lake management planning project, and monitoring of CLP beyond 2018 in Harris Lake is discussed within Harris Lake's Implementation Plan.

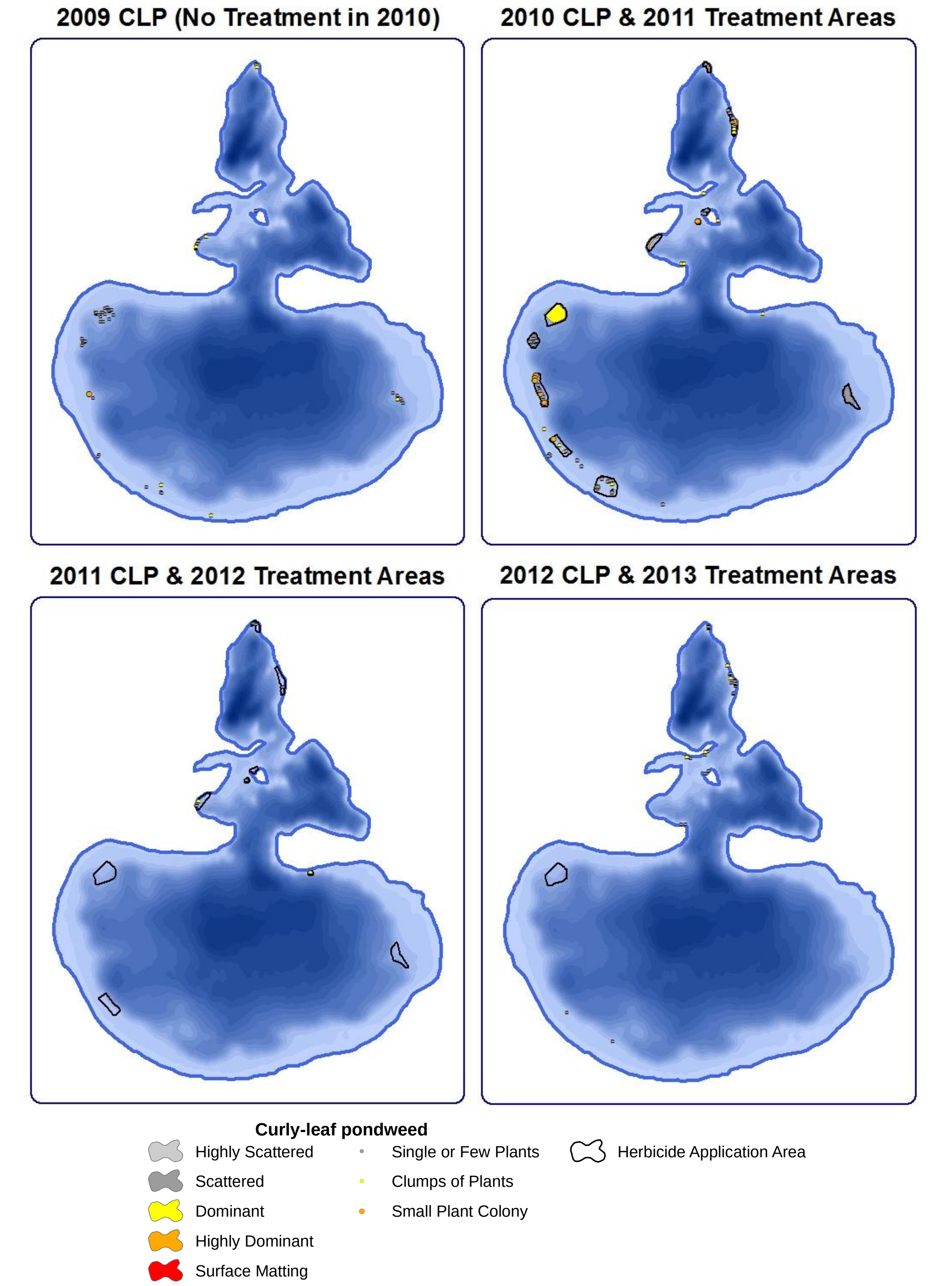


Figure 8.1.4-11. Locations of CLP and herbicide application areas in Harris Lake from 2009-2012.

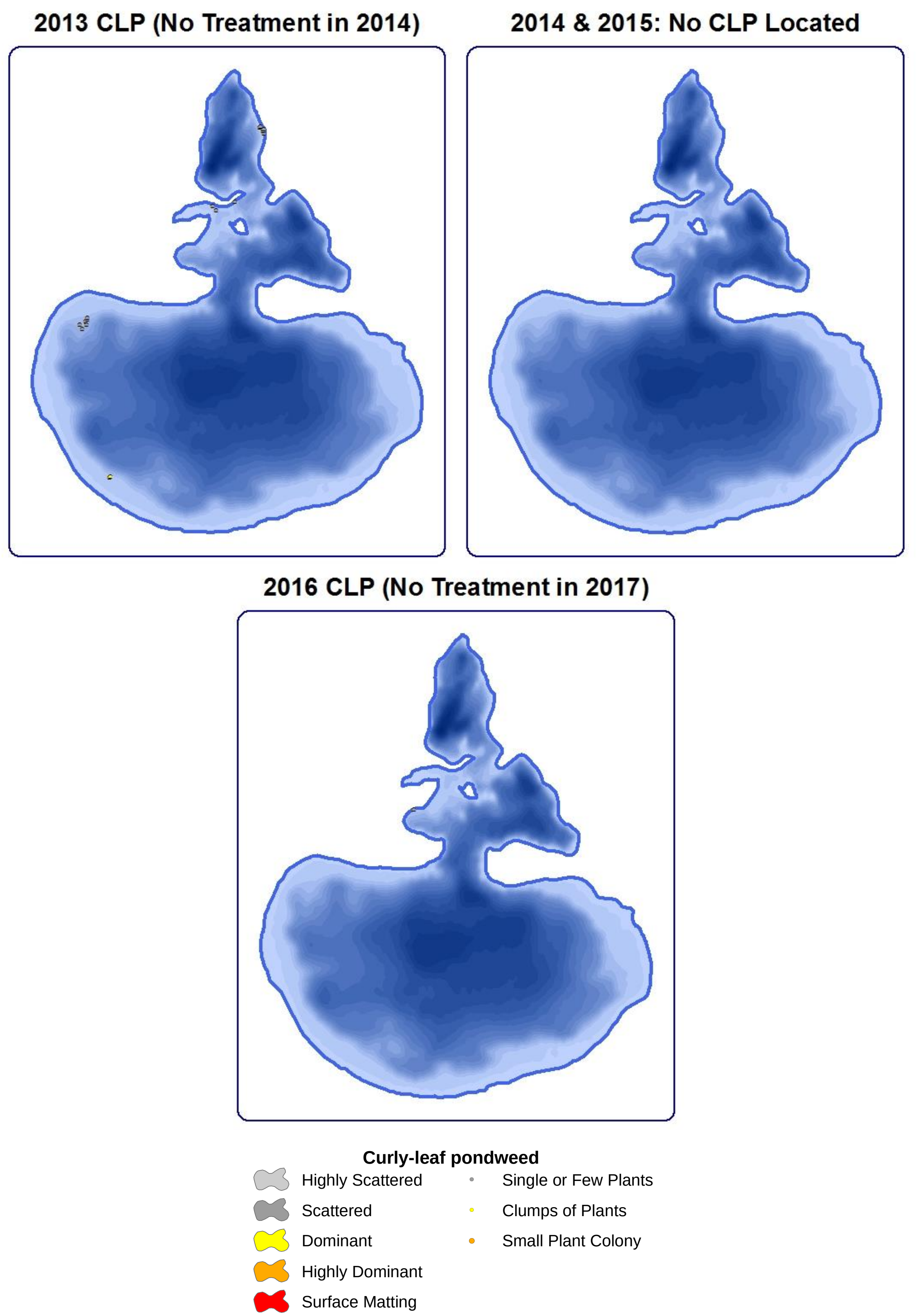


Figure 8.1.4-12. Locations of CLP in Harris Lake from 2013-2016.

8.1.5 Other Aquatic Invasive Species in Harris Lake

As of 2016, curly-leaf pondweed is the only aquatic invasive species listed as present in Harris Lake. As discussed in Harris Lake's Water Quality Section, plankton tows completed by Onterra ecologists in 2015 were negative for the presence of zebra mussel (*Dreissena polymorpha*) veligers and the spiny waterflea (*Bythrotrephes cederstroemi*). Nearby lakes within the Town of Winchester contain the non-native banded mystery snail (*Viviparus georgianus*), Chinese mystery snail (*Cipanogopaludina chinensis*), and freshwater jellyfish (*Craspedacusta sowerbyi*). Anne Lake, which flows into Harris Lake, contains the rusty crayfish (*Orconectes rusticus*). It is possible that Harris Lake contains one or more of these non-native invertebrates and that they have gone unreported.

Rusty crayfish were introduced to Wisconsin from the Ohio River Basin in the 1960's likely via anglers' discarded bait. In addition to displacing native crayfish (*O. virilis* and *O. propinquus*), rusty crayfish also degrade the aquatic habitat by reducing aquatic plant abundance and diversity and have also been shown to consume fish eggs. While there is currently no control method for eradicating rusty crayfish from a waterbody, aggressive trapping and removal has been shown to significantly reduce populations and minimize their ecological impact.

One study conducted in northern Wisconsin lakes found that the Chinese mystery snail did not have strong negative effects on native snail populations (Solomon et al. 2010). However, researchers did detect negative impacts to native snail communities when both Chinese mystery snails and the rusty crayfish were present (Johnson et al. 2009). The ecological impacts from freshwater jellyfish, which are believed to have been introduced from China, are not known. However, it is theorized that these jellyfish may have some impacts to zooplankton communities.

8.1.6 Harris Lake Fisheries Data Integration

Fishery management is an important aspect in the comprehensive management of a lake ecosystem; therefore, a brief summary of available data is included here as reference. The following section is not intended to be a comprehensive plan for the lake's fishery, as those aspects are currently being conducted by WDNR biologists overseeing the Town of Winchester Lakes. The goal of this section is to provide an overview of some of the data that exists. Although current fish data were not collected, the following information was compiled based upon data available from the WDNR and the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) (WDNR 2016B & GLIFWC 2016A and 2016B).

Harris Lake Fishing Activity

Based on data collected from the stakeholder survey (Appendix B), open water fishing was the highest ranked important or enjoyable activity on Harris Lake (Question #14). When examining the fishery of a lake, it is important to remember what "drives" that fishery, or what is responsible for determining its mass and composition. The gamefish in Harris Lake are supported by an underlying food chain. At the bottom of this food chain are the elements that fuel algae and plant growth – nutrients such as phosphorus and nitrogen, and sunlight. The next tier in the food chain belongs to zooplankton, which are tiny crustaceans that feed upon algae and plants, and insects. Smaller fish called planktivores feed upon zooplankton and insects, and in turn become food for larger fish species. The species at the top of the food chain are called piscivores, and are the larger gamefish that are often sought after by anglers, such as bass and walleye.

A concept called energy flow describes how the biomass of piscivores is determined within a lake. Because algae and plant matter are generally small in energy content, it takes an incredible amount of this food type to support a sufficient biomass of zooplankton and insects. In turn, it takes a large biomass of zooplankton and insects to support planktivorous fish species. And finally, there must be a large planktivorous fish community to support a modest piscivorous fish community. Studies have shown that in natural ecosystems, it is largely the amount of primary productivity (algae and plant matter) that drives the rest of the producers and consumers in the aquatic food chain. This relationship is illustrated in Figure 8.1.6-1.

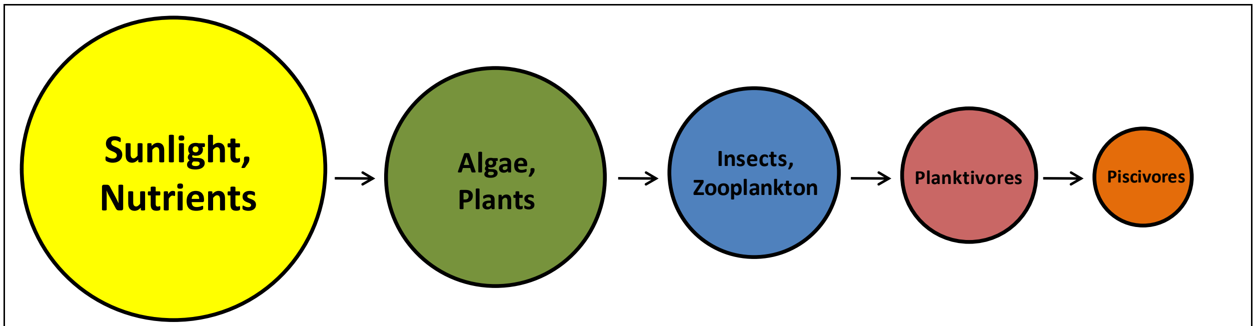


Figure 8.1.6-1. Aquatic food chain. Adapted from Carpenter et. al 1985.

As discussed in the Water Quality section, Harris Lake is an oligo-mesotrophic lake, meaning it has fairly low nutrient content and thus relatively low primary productivity. Simply put, this means Harris Lake may be limited in supporting sizable populations of predatory fish (piscivores) because the supporting food chain is relatively modest.

Table 8.5.1-1. Gamefish present in the Harris Lake with biological information (Becker, 1983)**.**

Common Name	Scientific Name	Max Age (yrs)	Spawning Period	Spawning Habitat Requirements	Food Source
Largemouth Bass	*Micropterus salmoides*	13	Late April - Early July	Shallow, quiet bays with emergent vegetation	Fish, amphipods, algae, crayfish and other invertebrates
Smallmouth Bass	*Micropterus dolomieu*	13	Mid May – June	Nests more common on shorelines over gravel	Small fish including other bass, crayfish, insects (aquatic and terrestrial)
Northern Pike	*Esox lucius*	25	Late March - Early April	Shallow, flooded marshes with emergent vegetation with fine leaves	Fish including other pike, crayfish, small mammals, water fowl, frogs
Muskellunge	*Esox masquinongy*	30	Mid April - Mid May	Shallow bays over muck bottom with dead vegetation, 6 - 30 in.	Fish including other muskies, small mammals, shore birds, frogs
Walleye	*Sander vitreus*	18	Mid April - Early May	Rocky, wave-washed shallows, inlet streams on gravel bottoms	Fish, fly and other insect larvae, crayfish

Harris Lake Tribal Spear Harvest Records

Approximately 22,400 square miles of northern Wisconsin was ceded to the United States by the Lake Superior Chippewa tribes in 1837 and 1842 (Figure 8.1.6-2). The Town of Winchester falls within the ceded territory based on the Treaty of 1842. This allows for a regulated open water spear fishery by Native Americans on specified systems. Determining how many fish are able to be taken from a lake, either by spear harvest or angler harvest, is a highly regimented and dictated process.

This highly structured procedure begins with an annual meeting between tribal and state management authorities. Reviews of population estimates are made for ceded territory lakes, and then a "total allowable catch" is established, based upon estimates of a sustainable harvest of the fishing stock (age 3 to age 5 fish). This figure is usually about 35% (walleye) or 27% (muskellunge) of the lake's known or modeled population, but may vary on an individual lake basis due to other circumstances. In lakes where population estimates are out of date by 3 years, a standard percentage is used. The total allowable catch number may be reduced by a percentage agreed upon by biologists that reflects the confidence they have in their population estimates for the particular lake. This number is called the "safe harvest level".

Often, the biologists overseeing a lake cannot make adjustments due to the regimented nature of this process, so the total allowable catch often equals the safe harvest level. The safe harvest is a conservative estimate of the number of fish that can be harvested by a combination of tribal spearing and state-licensed anglers. The safe harvest is then multiplied by the Indian communities claim percent. This result is called the declaration, and represents the maximum number of fish that can be taken by tribal spearers (Spangler, 2009). Daily bag limits for walleye are then reduced for hook-and-line anglers to accommodate the tribal declaration and prevent over-fishing. Bag limits reductions may be increased at the end of May on lakes that are lightly speared. The tribes have historically selected a percentage which allows for a 2-3 daily bag limit for hook-and-line anglers (USDI 2007).

Spearers are able to harvest muskellunge, walleye, northern pike, and bass during the open water season; however, in practice, walleye and muskellunge are the only species harvested in significant numbers, so conservative quotas are set for other species. The spear harvest is monitored through a nightly permit system and a complete monitoring of the harvest (GLIFWC 2015B). Creel clerks and tribal wardens are assigned to each lake at the designated boat landing. A catch report is completed for each boating party upon return to the boat landing. In addition to counting every fish harvested, the first 100 walleye (plus all those in the last boat) are measured and sexed. An updated nightly declaration is determined each morning by 9 a.m. based on the data collected from the successful spearers. Harvest of a particular species ends once the declaration is met or the season ends. In 2011, a

Figure 8.1.6-2. Location of the Town of Winchester within the Native American Ceded Territory (GLIFWC 2016A). This map was digitized by Onterra; therefore, it is a representation and not legally binding.

new reporting requirement went into effect on lakes with smaller declarations. Starting with the 2011 spear harvest season, on lakes with a harvestable declaration of 75 or fewer fish, reporting of harvests may take place at a location other than the landing of the speared lake.

Walleye open water spear harvest records are provided in Figure 8.1.6-3. One common misconception is that the spear harvest targets the large spawning females. Figure 8.1.6-3 shows that 7% (108 fish) of the total walleye harvest (1,550 fish) from 2000 to 2012 was comprised of female fish. Tribal spearers may only take two walleyes over twenty inches per nightly permit; one between 20 and 24 inches and one of any size over 20 inches (GLIWC 2015B). This regulation limits the harvest of the larger, spawning female walleye. Figure 8.1.6-4 displays the Native American open water muskellunge spear harvest since 1989. Since 1989, five muskellunge have been harvested on Harris Lake during the open water spear fishery and none have been harvested since 2009.

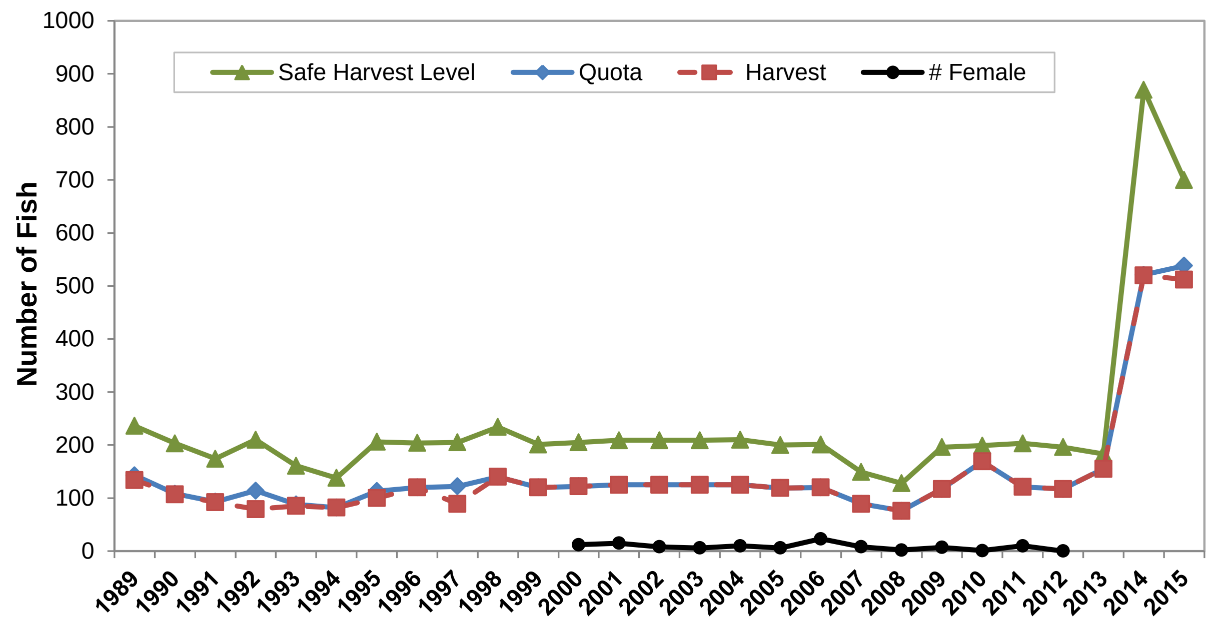


Figure 8.1.6-3. Harris Lake walleye spear harvest data. Annual total walleye harvest and female walleye harvest are displayed since 1989 from WDNR records.

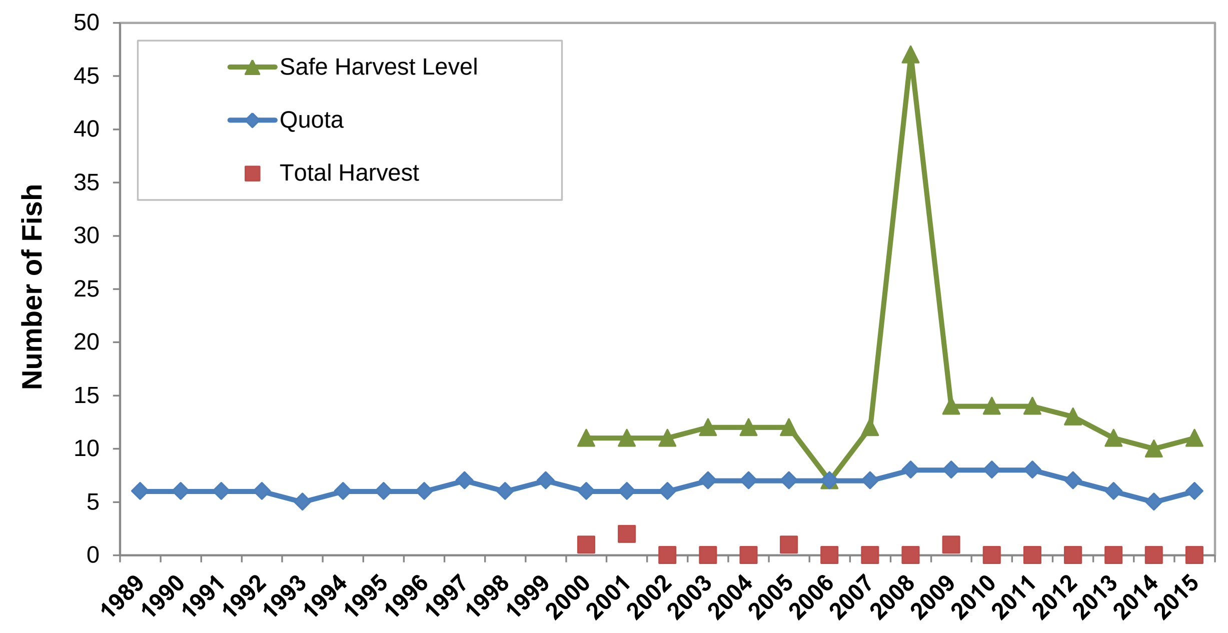


Figure 8.1.6-4. Harris Lake muskellunge spear harvest data. Annual total muskellunge harvests are displayed since 1989 from WDNR records.

Harris Lake Fishing Regulations

The Town of Winchester Lakes are within the northern bass zone in Wisconsin. From May 7 – June 17, smallmouth bass are catch and release only whereas largemouth bass have a daily bag limit of 5 fish and a minimum length of 14 inches. From June 18 to March 5, five largemouth or smallmouth bass in combination may be kept and must be at least 14 inches in length. The Town of Winchester Lakes are in the northern management zone for muskellunge and northern pike. No minimum length limit exists for northern pike and five pike may be kept in a single day. Statewide regulations apply for all other fish species. Wisconsin species regulations are provided in each annual WDNR fishing regulations publication. Anglers should visit the WDNR website (www. http://dnr.wi.gov/topic/fishing/regulations/hookline.html) for specific fishing regulations or visit their local bait and tackle shop to receive a free fishing pamphlet that would contain this information.

Harris Lake Fish Stocking

To assist in meeting fisheries management goals, the WDNR may stock fish in a waterbody that were raised in nearby permitted hatcheries. Stocking of a lake is sometimes done to assist the population of a species due to a lack of natural reproduction in the system, or to otherwise enhance angling opportunities. Fish can be stocked as fry, fingerlings or even as adults. A stocking summary for the Harris Lake is displayed in Table 8.1.6-2. Limited stocking of gamefish has occurred on Harris Lake due to the sustaining naturally reproducing populations within the lake.

Table 8.1.6-2. Available Stocking History on Harris Lake.

Harris Lake WDNR Stocking					
Year	**Species**	**Strain (Stock)**	**Age Class**	**# Fish Stocked**	**Avg Fish Length (in)**
1974	Walleye	Unspecified	Fingerling	10,000	3
1978	Muskellunge	Unspecified	Fingerling	1,020	10

Harris Lake Substrate Type

Substrate and habitat are critical to fish species that do not provide parental care to their eggs, in other words, the eggs are left after spawning and not tended to by the parent fish. Muskellunge is one species that does not provide parental care to its eggs (Becker 1983). Muskellunge broadcast their eggs over woody debris and detritus, which can be found above sand or muck. This organic material suspends the eggs above the substrate, so the eggs are not buried in sediment and suffocate as a result.

Walleye is another species that does not provide parental care to its eggs. Walleye preferentially spawn in areas with gravel or rock in places with moving water or wave action, which oxygenates the eggs and prevents them from getting buried in sediment. Fish that provide parental care are less selective of spawning substrates. Species such as bluegill tend to prefer a harder substrate such as rock, gravel or sandy areas if available, but have been found to spawn in muck as well. According to the point-intercept survey conducted by Onterra in 2015, the majority (76%) of the substrate in Harris Lake is composed of either sand or gravel, whereas 24% is composed of a soft, mucky or organic substrate.

8.1.7 Harris Lake Implementation Plan

The Implementation Plan presented below was created through the collaborative efforts of the Harris Lake Association (HLA) Planning Committee, Onterra ecologists, and North Lakeland Discovery Center (NLDC) and WDNR staff. It represents the path the HLA will follow in order to meet their lake management goals. The goals detailed within the plan are realistic and based upon the findings of the studies completed in conjunction with this planning project and the needs of the Harris Lake stakeholders as portrayed by the members of the Planning Committee and the numerous communications between Planning Committee members and the lake stakeholders. The Implementation Plan is a living document in that it will be under constant review and adjustment depending on the condition of the lake, the availability of funds, level of volunteer involvement, and the needs of the stakeholders.

Management Goal 1: Maintain current water quality conditions

Management Action:	Continue monitoring of Harris Lake's water quality through the WDNR Citizens Lake Monitoring Network (CLMN).
Timeframe:	Continuation of current effort
Facilitator:	HLA Board of Directors (suggested)
Description:	Monitoring water quality is an import aspect of every lake management planning activity. Collection of water quality data at regular intervals aids in the management of the lake by building a database that can be used for long-term trend analysis. As discussed in the Water Quality Section, Harris Lake's water quality is excellent, and early detection of potential negative trends may lead to the reason as of why the trend is developing. The Citizen Lake Monitoring Network (CLMN) is a WDNR program in which volunteers are trained to collect water quality information on their lake. Volunteers from the HLA have been collecting water quality data from Harris Lake since 1991. The HLA realizes the importance of continuing this effort, which will supply them with valuable data about their lake. Tim Nickels is currently the CLMN volunteer collecting water quality data from Harris Lake, and the HLA Board of Directors will appoint a water quality monitor at the annual meeting. When a change in the collection volunteer occurs, Sandy Wickman (715.365.8951) or the appropriate WDNR/UW-Extension staff will need to be contacted to ensure the proper training occurs and the necessary sampling materials are received by the new volunteer. It is also important to note that as a part of this program, the data collected are automatically added to the WDNR database and available through their Surface Water Integrated Monitoring System (SWIMS) by the volunteer.

Action Steps:

1. HLA Board of Directors appoints/recruits new volunteer(s) as needed at annual meeting.
2. New volunteer(s) contact Sandy Wickman (715.365.8951) as needed.
3. Volunteer(s) reports results to WDNR and to HLA members during annual meeting.

<u>Management Action:</u> Preserve natural and restore highly developed shoreland areas on Harris Lake.

Timeframe: Initiate 2017

Facilitator: HLA Board of Directors (suggested)

Description: The 2015 Shoreland Condition Assessment found that approximately 88% (5.0 miles) of Harris Lake's immediate shoreland zone contains little to no development, delineated as either *natural/undeveloped* or *developed-natural*, while approximately 4% (0.2 miles) contains a higher degree of development categorized as *developed-unnatural* or *urbanized*. It is important that the owners of properties with little development become educated on the benefits their shoreland is providing to Harris Lake in terms of maintaining the lake's water quality and habitat, and that these shorelands remain in a natural or semi-natural state. It is equally important that the owners of properties with developed shorelands become educated on the lack of benefits and possible harm their shoreland has to Harris Lake's water quality and contribution to habitat loss.

The HLA board of directors will work with appropriate entities such as the NLDC to research grant programs and other pertinent information that will aid the HLA in preserving and restoring Harris Lake's shoreland. This would be accomplished through education of property owners, or direct preservation of land through implementation of conservation easements or land trusts that the property owner would approve of.

Action Steps:

1. HLA Board of Directors gathers appropriate information from entities listed above.
2. The HLA provides Harris Lake property owners with the necessary informational resources to protect or restore their shoreland should they be interested. Interested property owners may contact the NLDC and Vilas County Land and Conservation office for more information on shoreland restoration plans, financial assistance, and benefits of implementation.

Management Goal 2: Assure and Enhance the Communication and Outreach of the Harris Lake Association with Harris Lake Stakeholders

Management Action:	Promote stakeholder involvement, inform stakeholders on various lake issues, as well as the quality of life on Harris Lake.
Timeframe:	Continuation of current effort
Facilitator:	HLA Board of Directors (suggested)

Description: Education represents an effective tool to address lake issues like shoreline development, invasive species, water quality, lawn fertilizers, as well as other concerns such as community involvement and boating safety. The HLA will continue its effort to promote lake preservation and enhancement through a variety of educational efforts.

Currently, the HLA regularly publishes and distributes a monthly hardcopy and electronic newsletter that provides association-related information including current association projects and updates, meeting times, and educational topics. This is an excellent source for communication to association members. In addition, the HLA maintains an association website and Facebook page.

The majority of Harris Lake stakeholder survey respondents indicated that the HLA keeps them either fairly well informed or highly well informed regarding issues with the lake and its management. The HLA would like to maintain its capacity to reach out to and educate association and non-association members regarding Harris Lake and its preservation. Education of lake stakeholders on all matters is important, and a list of educational topics that were discussed during the planning meetings can be found below. These topics can be included within the association's newsletter or distributed as separate educational materials. In addition, the HLA can invite professionals who work within these topics to come and speak at the association's annual meeting or hold workshops if available.

Example Educational Topics

- Shoreline restoration and protection
- Effect lawn fertilizers/herbicides have on the lake
- Importance of maintaining course woody habitat
- Fishing rules and regulations
- Catch-and-release fishing
- Boating regulations and safety
- Pier regulations and responsible placement to minimize habitat disturbance
- Importance of maintaining a healthy native aquatic plant community

- Respect to and maintaining a safe distance from wildlife (e.g. loons) within the lake
- Aquatic invasive species (AIS) prevention
- Water quality monitoring updates from Harris Lake
- Septic system maintenance
- Littering on the ice and year-round

Action Steps:

1. See description above.

Management Goal 3: Reduce Shoreland Erosion on Harris Lake Brought About by Beaver Activity

Management Action:	Investigate management strategies for beaver and beaver dam removal in Harris Creek to reduce shoreland erosion caused by high water.
Timeframe:	Initiate in 2017
Facilitator:	HLA Board of Directors (suggested)
Description:	During the two planning meetings with the HLA Planning Committee, one of the top concerns regarding Harris Lake was shoreland erosion caused by higher water levels maintained by a series of beaver dams in Harris Creek, the outlet to Harris Lake. Respondents to the Harris Lake stakeholder survey also indicated that high water caused by beaver dams were among their top concerns for the lake and that a number of lake property owners have observed significant erosion of their shorelands. During the second planning committee meeting, the WDNR's document *Beaver Dam Control* (http://dnr.wi.gov/topic/waterways/factsheets/beaverdamage.pdf) was presented to the committee members and beaver management options were discussed. As is discussed within this document, assistance from the WDNR relating to beavers is limited to providing the HLA with instructional materials, clarification of applicable laws, and referral to experienced trappers or wildlife control companies. The WDNR does not visit problem sites or aid in beaver removal. The HLA would like to take an active role in managing beavers at the outlet to Harris Lake to reduce shoreland erosion. This active management strategy will likely involve the trapping and removal of beavers along with removal of the dams. Removal of the dams without removal of the beavers would likely result in the dams being rebuilt shortly thereafter. Landowners may remove beaver dams causing property damage without any permit, permission, or authorization from the WDNR. However, if a dam is to be removed via blasting, the blaster must be licensed. Blasting cannot be used to kill beaver, and

may only be used on vacated lodges. And as mentioned previously, removal of the dam without the beavers will likely result in the dams being rebuilt.

The property along Harris Creek where the beaver dams occur is privately owned, and the HLA should contact these property owners before any beaver trapping and/or dam removal is conducted. The NLDC recommended the HLA consult with Zach Wilson (715.561.2234), a local trapper and conservation specialist with Iron County Land and Water Conservation Department regarding the removal of beaver from Harris Creek. The HLA needs to understand that beaver trapping and dam removal may be expensive, and may need to occur periodically as new beavers move in and construct new dams.

Action Steps:

1. HLA Board of Directors reviews WDNR's *Beaver Damage Control* (http://dnr.wi.gov/topic/waterways/factsheets/beaverdamage.pdf) to review legal beaver management options.
2. HLA Board of Directors contacts Zach Wilson (715.531.2234), a local trapper and conservation specialist with the Iron County Land and Water Conservation Department, for consultation on beaver trapping in Harris Creek.
3. HLA enacts beaver management strategy as needed.

Management Goal 4: Control Existing Aquatic Invasive Species and Prevent New Introductions to Harris Lake

Management Action: Continue curly-leaf pondweed monitoring and hand-removal strategy to manage curly-leaf pondweed population in Harris Lake.

Timeframe: Continuation of current effort

Facilitator: HLA Board of Directors with assistance from NLDC (suggested)

Description: As is discussed within the Harris Lake Aquatic Plant Section, curly-leaf pondweed (CLP) was first discovered in Harris Lake in 2008. Following a combination of herbicide spot treatments (2011, 2012, 2013) and HLA volunteer hand-removal, the CLP population has been greatly reduced and remains small. In 2016, only three CLP plants were located and all were hand-removed by Onterra ecologists. Continued monitoring of Harris Lake's CLP population will ensure that any larger colonies are detected early and that the population is managed at a level which is not having an ecological impact to the lake.

Since 2009, professional CLP monitoring surveys have been completed on an annual basis by Onterra ecologists on Harris Lake. Surveys from 2009-2014 were funded via WDNR AIS-Early Detection and Response Grants, while surveys in 2015 and 2016 were funded under the WDNR AIS-Education, Planning and Prevention

Grants received for the Town of Winchester Lakes Management Planning Project. Professional monitoring is scheduled to continue in Harris Lake in 2017 and 2018 corresponding to the Phase III and IV portion of the town-wide management project.

Given the current population of CLP in Harris Lake is very small, it is conducive to hand-removal by HLA volunteers. During the planning meetings, the HLA Planning Committee indicated they wanted to continue annual volunteer monitoring and hand-removal of CLP. While the level of CLP located in 2016 was able to be removed by Onterra ecologists, if higher amounts of CLP are located in the future, the location of the plants will be relayed to the HLA volunteers for removal.

The objective of this management action is not to eradicate CLP from Harris Lake, as that is impossible with current tools and techniques. The objective is to maintain a CLP population that exerts little to no detectable impact on the lake's native aquatic plant community and overall ecology, recreation, and aesthetics. Monitoring is a key aspect of any AIS control project, both to prioritize areas for control and to monitor the strategy's effectiveness. The monitoring also facilitates the "tuning" or refinement of the control strategy as the control project progresses. The ability to tune the control strategies is important because it allows for the best results to be achieved within the plan's lifespan. It must be noted that hand-removal methodology is still experimental, and success criteria for assessing the efficacy of hand-removal have not yet been defined. Because of this, the following series of steps to manage CLP via hand-removal in Harris Lake should remain flexible to allow for modifications as the project progresses. The series includes:

1. A professional lake-wide assessment of CLP (Early-Season AIS Survey) completed while the plant is at or near its peak growth (June). This meander-based survey of the lake's littoral zone is designed to locate all possible occurrences of CLP, and the findings would be compared to results from the previous year's Early-Season AIS Survey to assess the efficacy of the control strategy implemented (e.g. hand-harvesting or herbicide application).

2. Using CLP findings from the most recent survey, professional ecologists will work with the HLA to delineate defined CLP hand-harvesting sites (Site A, B, etc.). The hand-harvesters will then be able to record the number of hours (effort) spent within each site, allowing for a more accurate assessment of the level of effort spent within each area.

3. Hand-removal efforts begin as soon as possible following the Early-Season AIS Survey (before plants senesce) using the finalized strategy that resulted from the ESAIS survey.

4. Professional Early-Season AIS Survey completed the following year to determine hand-removal efficacy and create new hand-removal sites/strategy.

5. Report generated on hand-removal success and recommendation for following year's strategy.

Typically, AIS control programs (mainly with herbicides) incorporate both established qualitative (CLP mapping) and quantitative (sub-sample point-intercept survey) evaluation methodologies. However, quantitative monitoring of hand-removal areas using sub-sample point-intercept methodology is not applicable at this time in Harris Lake as there are no areas of CLP large enough to attain the number of sampling locations required to meet the assumptions of statistical analyses. Therefore, each potential hand-removal site would be monitoring using qualitative methods.

The qualitative monitoring would be completed by comparing pre-hand-harvesting (summer before hand-harvesting) with post-hand-harvesting (summer immediately following hand-harvesting) Early-Season AIS Survey results. A hand-removal site would be deemed successful if the level of CLP is maintained at the point-based mapping level; for example, a site would be considered unsuccessful if it contained *single or few plants* (point-based mapping) prior to hand-harvesting and expanded to contain colonized CLP (polygons) following hand-harvesting.

As discussed, professional monitoring of CLP is scheduled to occur in Harris Lake in 2017 and 2018 under the Town of Winchester management planning project. However, the HLA should continue to monitor the lake's CLP population beyond 2018, and the HLA will have to decide if they would like to move forward with monitoring (professional, volunteer, or a combination of both).

Action Steps:

1. Retain qualified professional assistance for monitoring and management strategy design utilizing the methods described in 2017 and 2018.
2. HLA volunteers continue AIS monitoring in Harris Lake and report findings to resource managers.
3. HLA volunteers attend periodic NLDC AIS identification and monitoring training.
4. CLP control and monitoring strategy developed for 2019 and beyond following 2018 professional monitoring survey.

Management Action:	Initiate aquatic invasive species rapid response plan upon discovery of new infestation.
Timeframe:	Initiate upon invasive species discovery.
Facilitator:	HLA Board of Directors (suggested)
Description:	In the event that another aquatic invasive species such as Eurasian watermilfoil is located by the trained volunteers, the areas would be marked using GPS and the HLA should contact resource managers (NLDC, WDNR, etc.) immediately. The areas marked by volunteers would serve as focus areas for professional ecologists, and these areas would be surveyed by professionals and the results would be used to develop potential control strategies.
Action Steps:	
1.	See description above.

Management Action:	Continue Clean Boats Clean Waters watercraft inspections at Harris Lake's public access location.
Timeframe:	Continuation of current effort
Facilitator:	HLA Board of Directors (suggested)
Description:	The HLA has been periodically conducting watercraft inspections at the public boat landing since 2007 through the Clean Boats Clean Waters (CBCW) program. In-kind time for watercraft inspections at Harris Lake is being provided through the WDNR grants as part of the four-year lake management planning project (2015-2018). However, the HLA would like to continue watercraft inspections beyond 2018. The intent of the boat inspections would not only be to prevent additional exotic species from entering the lake through the public access point, but also to prevent the infestation of other waterways with exotic species that originated in Harris Lake (e.g. CLP). The goal would be to monitor the during the busiest times (e.g. holiday weekends) in order to maximize contact with lake users, spreading the word about the negative impacts of AIS on our lakes and educating people about how they are the primary vector of their spread. The HLA would like to continue watercraft inspections using volunteers. Often, it is difficult for lake groups to recruit and maintain a volunteer base to oversee CBCW inspections throughout the summer months. Recruitment outside of the HLA may be necessary in order to have sufficient coverage of the Harris Lake public access. Education efforts outside of the lake community help to not only raise awareness about the threat of AIS, but also potentially recruit new volunteers to participate in activities such as CBCW. Members of the HLA, as well as other volunteers, will need to be trained on CBCW protocols in order to participate in public boat

landing inspections. Fully understanding the importance of CBCW inspections, paid watercraft inspectors may be sought to ensure monitoring occurs at the public boat landing. These paid inspectors may be purchased alone or in conjunction with volunteers through the HLA or in the community.

Action Steps:

1. Members of the HLA periodically attend CBCW training sessions through the WDNR to update their skills to current standards.
2. Training of additional volunteers completed by those previously trained.
3. Begin inspections during high-use weekends.
4. Report results to WDNR and HLA.
5. Promote enlistment and training of new volunteers to keep program fresh.

Management Goal 5: Enhance the fishery of Harris Lake

Management Action: Continue work with WDNR fisheries managers to enhance the fishery of Harris Lake.

Timeframe: Continuation of current effort

Facilitator: HLA Fisheries Committee (suggested)

Description: The majority of respondents to the Harris Lake stakeholder survey ranked fishing as their favorite recreational activity on the lake, and that walleye and smallmouth bass were the most sought-after fish. Harris Lake is listed as an Area of Special Natural Resource Interest (ASNRI) for harboring naturally reproducing populations of both walleye and muskellunge. The HLA understands that a multitude of factors such as changes in habitat, water levels, and fishing pressure affect fish communities, and the HLA would like to take an active role in maintaining a healthy fishery and ensuring Harris Lake remains a high-quality fishing lake for future generations.

Harris Lake is currently overseen by WDNR fisheries biologist Steve Gilbert (715.356.5211). In an effort to remain informed on studies pertaining to fisheries in Harris Lake, the HLA fisheries committee should contact Steve at least once per year (perhaps during the winter months when field work is not occurring) for a brief summary of activities. In addition, the HLA can discuss management options for maintaining and enhancing the lake's fishery, which may include changes in angling regulations and/or habitat enhancements.

Action Steps: See description above.