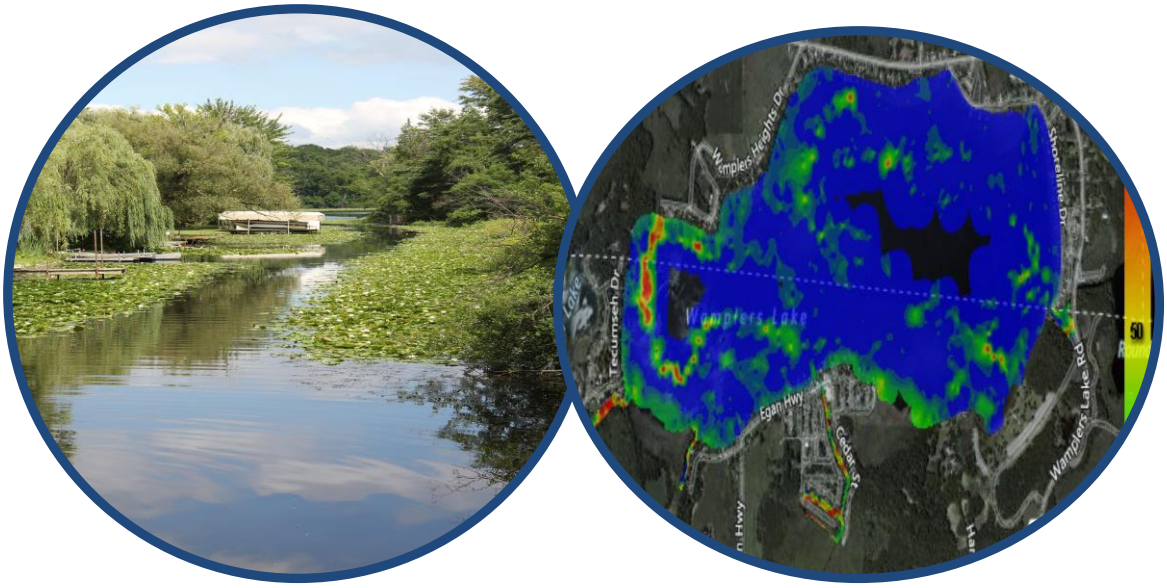
Restorative Lake Sciences™

Wamplers Lake 2016 Aquatic Vegetation & Water Quality Report & 2017 Management Recommendations



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Wamplers Lake 2016 Aquatic Vegetation & Water Quality Report & 2017 Management Recommendations

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Section 1

Wamplers Lake 2016 Aquatic Vegetation & Water Quality Report & 2017 Management Recommendations

The following information is a summary of key lake findings collected during 2016.

The overall condition of Wamplers Lake is ranked in the top 25% of developed lakes of similar size in the state of Michigan. The lake has good water clarity which may be attributed due to filtration of the water by Zebra Mussels and due to coarser bottom sediment that does not create silty, turbid conditions when high wave or boat activity agitates the lake water. Additionally, the lake has enough nutrients (phosphorus and nitrogen) to support some algae and submersed aquatic plant growth, but the nutrient levels are considered moderate. Invasive species such as Eurasian Watermilfoil (EWM), Curly-leaf Pondweed (CLP), and Starry Stonewort are able to grow in moderate nutrient waters and thus are a challenge to the Wamplers Lake ecosystem. In 2016, all of the invasives were treated with aquatic herbicides with significant reductions in all of them.

Protection of the 26 native aquatic plant species is paramount for the health of the lake fishery and these plants should not be managed unless they are a nuisance to lakefront property owners and possess navigational and recreational hazards (i.e. lily pads or nuisance growth in the canals). The plan for 2017 will include whole-lake aquatic vegetation sampling and scanning and spot-treatment of remaining invasives (milfoil, Curly-leaf Pondweed, and Starry Stonewort) as needed.

Section

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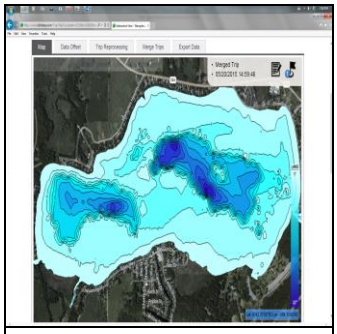
Wamplers Lake Water Quality Data (2016)

Water Quality Parameters Measured



Did You Know? Wamplers Lake has a maximum depth of 37 feet

There are hundreds of water quality parameters one can measure on an inland lake but several are the most critical indicators of lake health. These parameters include water temperature (measured in °F), dissolved oxygen (measured in mg/L), pH (measured in standard units-SU), conductivity (measured in micro-Siemens per centimeter-µS/cm), total dissolved solids (mg/L), Secchi transparency (feet), total phosphorus and total nitrate nitrogen (both in µg/L), chlorophyll-*a* (in µg/L), and algal species composition. **Water quality was measured in the deep basin of Wamplers Lake in June of 2016.**

Table 1 below demonstrates how lakes are classified based on key parameters. Wamplers Lake would be considered mesotrophic (relatively productive) since it does contain ample phosphorus, nitrogen, and aquatic vegetation growth but has excellent water clarity and moderate algal growth. **2016 water quality data for Wamplers Lake is shown below in Table 2.**

Table 1. Lake trophic classification (MDNR).

Lake Trophic Status	*Total Phosphorus ($\mu g\ L^{-1}$)*	*Chlorophyll-a ($\mu g\ L^{-1}$)*	*Secchi Transparency (feet)*
Oligotrophic	**< 10.0**	**< 2.2**	**> 15.0**
Mesotrophic	**10.0 – 20.0**	**2.2 – 6.0**	**7.5 – 15.0**
Eutrophic	**> 20.0**	**> 6.0**	**< 7.5**

Table 2. Wamplers Lake water quality parameter data collected in the deep basin (June 16, 2016).

Depth ft.	*Water Temp °F*	*DO mg L^{-1}*	*pH S.U.*	*Cond. µS cm^{-1}*	*Turb. NTU*	*Total Kjeldahl Nitrogen mg L^{-1}*	*Chl-a µgL^{-1}*	*Total Phos. mg L^{-1}*
0	75.1	8.5	8.5	390	0.5	< 0.50	1.0	<0.020
18	72.6	8.0	8.6	399	0.9	< 0.50	3.0	0.025
36	64.8	4.1	8.5	412	2.3	1.7	3.0	0.067

Water Clarity (Transparency) Data

Secchi transparency is a measure of water clarity using a weighted disk with black and white markings. The depth is recorded as a mean of the depth at which the disk disappears and reappears. Elevated Secchi transparency readings allow for more aquatic plant and algae growth. **The transparency throughout Wamplers Lake was adequate (12.5-16 feet) to allow abundant growth of algae and aquatic plants in the majority of the littoral zone of the lake.** Secchi transparency depends on the amount of suspended particles in the water (often due to windy conditions of lake water mixing) and the amount of sunlight present at the time of measurement. Other parameters such as turbidity (measured in NTU's) are correlated with water clarity and show an increase as clarity decreases. **The turbidity and total dissolved solids in Wamplers Lake have been quite low at ≤ 2.3 NTU's and 98 mg/L, respectively during the 2016 sampling event.**

Total Phosphorus

Total phosphorus (TP) is a measure of the amount of phosphorus (P) present in the water column. Phosphorus is the primary nutrient necessary for abundant algae and aquatic plant growth. TP concentrations are usually higher at increased depths due to higher release rates of P from lake sediments under low oxygen (anoxic) conditions and due to mineralization. Phosphorus may also be released from sediments as pH increases. In summer, the dissolved oxygen levels are lower at the bottom and likely cause release of phosphorus from the bottom. **TP concentrations from <0.020-0.067 mg L^{-1} from top to bottom during the 2016 sampling event. These TP concentrations are moderate for a lake the size and depth of Wamplers Lake and are ample to promote aquatic vegetation and algae growth.**

pH

Most Michigan lakes have pH values that range from 6.5 to 9.5 with typical being slightly basic (pH>7.0). Acidic lakes (pH < 7) are rare in Michigan and are most sensitive to inputs of acidic substances due to a low acid neutralizing capacity (ANC). Wamplers Lake is considered "slightly basic" on the pH scale. **The pH of Wamplers Lake ranged from 8.5-8.6 S.U. during the 2016 sampling event, which is ideal for an inland lake.** pH is usually lower at the lake bottom and can increase when aquatic vegetation is actively growing due to photosynthesis.

Conductivity

Conductivity is a measure of the amount of mineral ions present in the water, especially those of salts and other dissolved inorganic substances. Conductivity generally increases as the amount of dissolved minerals and salts in a lake increases, and also increases as water temperature increases. **The conductivity values for Wamplers Lake was moderate during the June, 2016 sampling event and ranged from 390-412 µS/cm.** Severe water quality impairments in freshwater lakes do not occur until values exceed 800 µS/cm and are toxic to aquatic life around 1,000 µS/cm.

Chlorophyll-*a* and Algal Species Composition

Chlorophyll-a is the primary photosynthetic pigment found in all plants and algae. Chlorophyll-*a* is a measure of the amount of green plant pigment present in the water, often in the form of planktonic algae. High chlorophyll-*a* concentrations are indicative of nutrient-enriched lakes. Chlorophyll-*a* concentrations greater than 6 µg L^{-1} are found in eutrophic or nutrient-enriched aquatic systems, whereas chlorophyll-*a* concentrations less than 2.2 µg/L are found in nutrient-poor or oligotrophic lakes**. The mean chlorophyll-*a* concentrations during the 2016 sampling event in Wamplers Lake was around 4.2 µg/L which is moderate for an inland Michigan lake yet favorable given the unprecedented high air and water temperatures in 2016.**

The algal genera were determined from composite water samples collected over the deep basin of Wamplers Lake in 2016 were analyzed with a compound bright field microscope. **The genera present included the Chlorophyta (green algae; Figure 1): *Scenedesmus* sp., *Chlorella* sp., *Cladophora* sp., *Euglena* sp., *Pediastrum* sp., *Gleocystis* sp., and *Pandorina* sp. The Cyanophyta (blue-green algae; Figure 2): G*leocapsa* sp., the Bascillariophyta (diatoms; Figure 3)*: Synedra* sp., *Navicula* sp., *Fragilaria* sp., *Cymbella* sp., *Nitzschia* sp., and *Tabellaria* sp.** The aforementioned species indicate a diverse algal flora and represent a good diversity of alga with an abundance of diatoms that are indicative of great water quality. Photos of the general algae types are shown below.

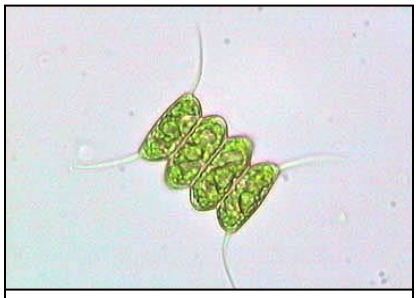


Figure 1. A Green Alga

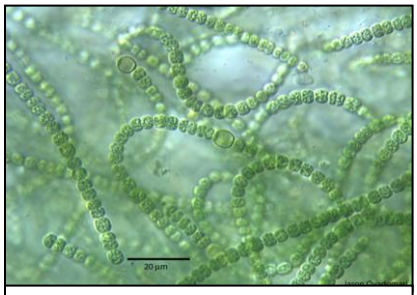


Figure 2. A Blue-Green Alga

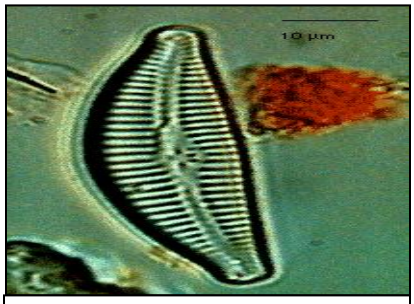


Figure 3. A Diatom Alga

Section

3

Aquatic Vegetation Data (2016)

Emergent islands that are normal and break off from the shoreline due to loose soils
Photo courtesy of Sylvia Kay

Status of Native Aquatic Vegetation in Wamplers Lake

A whole-lake grid survey (n=437 sampling points) and bottom scanning survey of Wamplers Lake was conducted on May 23, 2016 by RLS scientists. The native aquatic vegetation present in Wamplers Lake is essential for the overall health of the lake and the support of the lake fishery. The most recent survey in August of 2016 determined that there were a total of 26 native aquatic plant species in Wamplers Lake. These included 18 submersed species, 3 floating-leaved species, and 5 emergent species. This indicates a very high biodiversity of aquatic vegetation in Wamplers Lake. The overall % cover of the lake by native aquatic plants is low relative to the lake size and thus these plants should be protected unless growing near swim areas at nuisance levels. The most dominant native aquatic plants were: 1) the macro alga, Chara (Figure 4) which lies close to the lake bottom and serves as excellent fish spawning habitat. In addition, Chara also helps to keep the small sediment particles from being suspended in the water column. The plant has a distinctive musky odor which smells skunk-like; 2) Whorled Watermilfoil (Figure 5) which is a native watermilfoil that has densely-leaved olive-green whorls and the plant resembles a tall pipe cleaner, and 3) Wild Celery (Figure 6), which has long, green, ribbon-shaped leaves that emerge from the lake bottom in late May and fertilize later in July and produce a prominent spiral stalk on the fertilized plants.

A list of all native aquatic plant species found in Wamplers Lake in 2016 is shown in Table 3 below. Additionally, a biovolume scan map is shown in Figure 7 below.

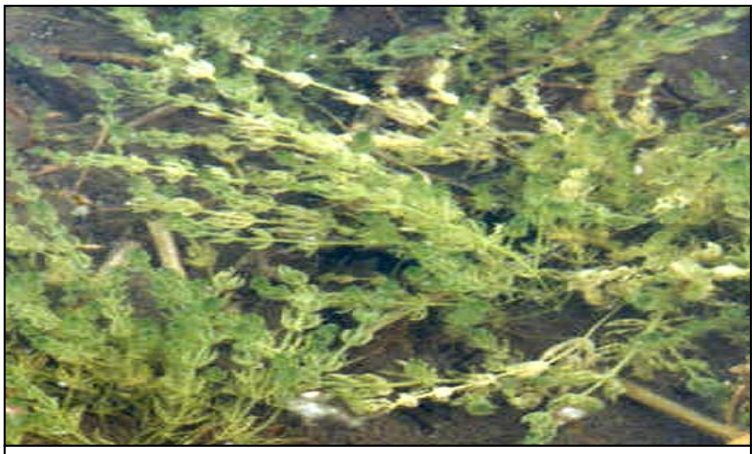


Figure 4. Chara

Figure 5. Whorled Watermilfoil

Figure 6. Wild Celery

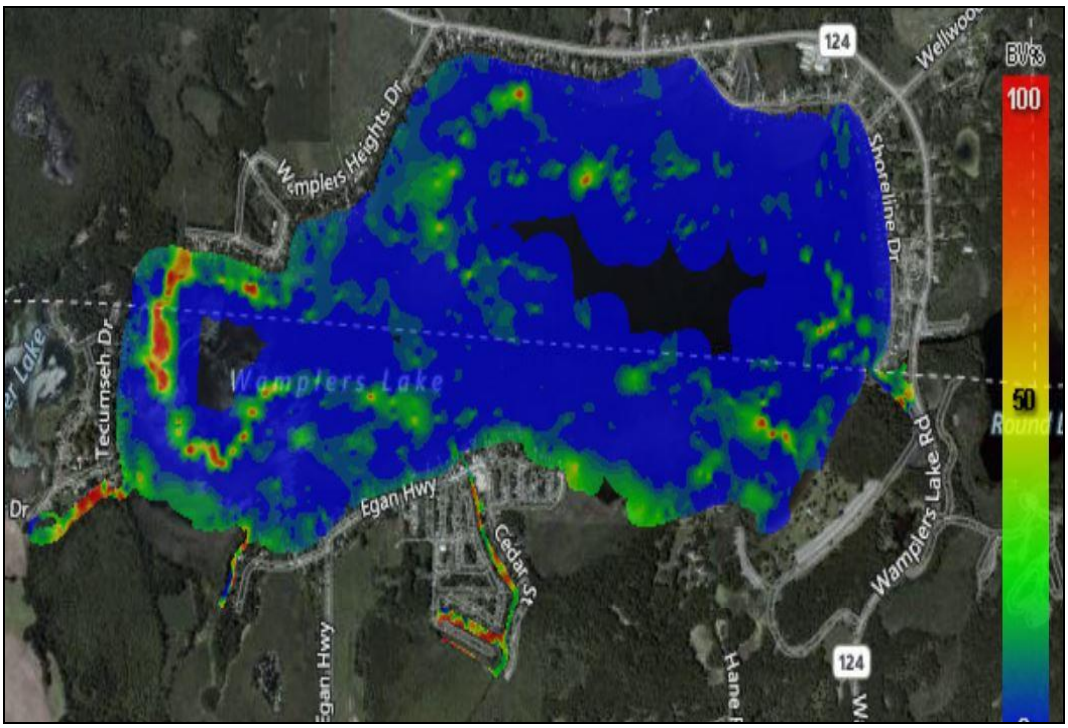


Figure 7. Aquatic Biovolume map of all aquatic vegetation in Wamplers Lake (May 23, 2016). Note: Blue colors denote a lack of aquatic plants; Red colors denote a high density of aquatic plants that are growing high in the water column; Orange or Yellow colors denote moderately low-growing aquatic plants.

Table 1. Wamplers Lake Native Aquatic Plant Species (May 23, 2016).

Aquatic Plant Species	Common Name	Growth Form	Frequency (%)
Chara vulgaris	Muskgrass	Submersed	19.5
Potamogeton zosteriformis	Flat-stem Pondweed	Submersed	0.5
Potamogeton robbinsii	Fern-leaf Pondweed	Submersed	0.6
Potamogeton richardsonii	Richardson's Pondweed	Submersed	0.5
Potamogeton gramineus	Variable-leaf Pondweed	Submersed	0.8
Potamogeton praelongus	White-stem Pondweed	Submersed	1.1
Potamogeton illinoensis	Illinois Pondweed	Submersed	0.9
Potamogeton amplifolius	Large-leaf Pondweed	Submersed	0.9
Potamogeton natans	Floating-leaf Pondweed	Submersed	1.2
Vallisneria americana	Wild Celery	Submersed	3.5
Sagittaria sp.	Submersed Sagittaria	Submersed	0.5
Myriophyllum verticillatum	Whorled Watermilfoil	Submersed	5.5
Myriophyllum sibiricum	Northern Watermilfoil	Submersed	0.4
Ceratophyllum demersum	Coontail	Submersed	0.4
Elodea canadensis	Common Waterweed	Submersed	0.9
Utricularia vulgaris	Bladderwort	Submersed	0.4
Najas guadalupensis	Southern Naiad	Submersed	0.5
Scirpus subterminalis	Submersed Bulrush	Submersed	0.7
Nymphaea odorata	White Water lily	Floating-Leaved	0.4
Nuphar sp.	Yellow Water lily	Floating-Leaved	0.9
Brasenia schreberi	Water shield	Floating-Leaved	0.7
Sagittaria sp.	Arrowhead	Emergent	0.4
Pontedaria cordata	Pickerelweed	Emergent	0.5
Typha latifolia	Cattails	Emergent	0.7
Scirpus sp.	Bulrushes	Emergent	0.5
Decodon verticillata	Swamp Loosestrife	Emergent	0.4

Status of Invasive (Exotic) Aquatic Plant Species in Wamplers Lake

The amount of Eurasian Watermilfoil (Figure 8) present in Wamplers Lake varies each year and is dependent upon climatic conditions, especially runoff-associated nutrients. This year was amongst the hottest years on record and many lakes experienced nuisance milfoil and algal outbreaks. **The May 23, 2016 survey revealed that approximately 53.4 acres of hybrid milfoil was found throughout the entire lake. On June 16, 2016, the milfoil was treated with high dose granular triclopyr (Renovate OTF).** RLS was present to oversee the treatments conducted by Aqua-Weed Control, Inc. A late summer whole-lake aquatic plant survey revealed that the treatment was very successful and much less acreage of EWM is expected in 2017.

In addition to the milfoil, there were approximately 13 acres of Curly-leaf Pondweed (Figure 9) treated on June 16, 2016 with the contact herbicide Aquathol-K®.

In addition to these invasives, there were approximately 3.3 acres of Starry Stonewort (Figure 10), an invasive macro alga that was treated with flumioxazin (Clipper®) in the south canal that was successfully controlled. Treatment maps for each of these invasive species are shown in the maps below (Figures 11-13).

Figure 8. Eurasian Watermilfoil

Figure 9. Curly-leaf Pondweed

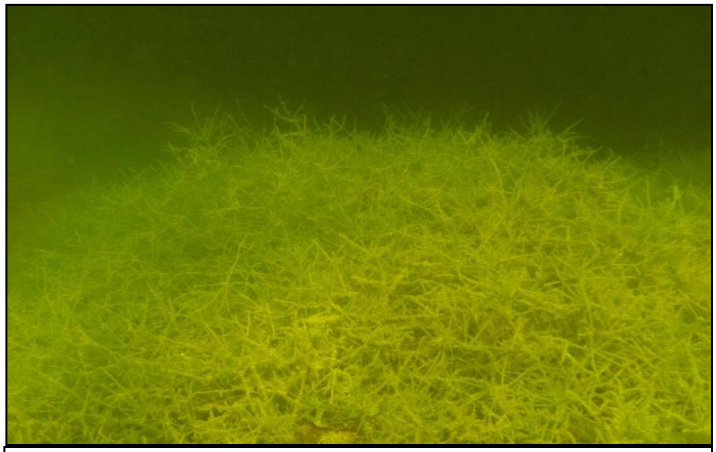


Figure 10. Starry Stonewort

Figure 11. Eurasian Watermilfoil distribution in Wamplers Lake (May, 2016).

Figure 12. Curly-leaf Pondweed distribution in Wamplers Lake (May, 2016).

Figure 13. Starry Stonewort and invasive emergent aquatic plant distribution in Wamplers Lake (May, 2016).

Section

3

Management Recommendations for 2017

Continuous aquatic vegetation surveys are needed to determine the precise locations of EWM, CLP, or Starry Stonewort (primarily found in the canals) or other problematic invasives in Wamplers Lake. These surveys should occur in mid to late-May to early-June and again post-treatment in 2017.

Due to the relative scarcity of native aquatic vegetation in Wamplers Lake, the treatment of these species with aquatic herbicides is not recommended (one exception is the overgrowth of nuisance weeds in the canals). The plan for 2017 includes the use of higher doses of systemic aquatic herbicides due to the genetically determined strains of hybrid milfoil that require such doses for effective treatment. Higher doses such as Sculpin G® at a dose of 250 lbs. per acre would be recommended offshore and a dose of 250 lbs. per acre for Renovate OTF® nearshore for effective control of the hybrid milfoil. The nuisance growth in the canals should not require such extensive treatment as in 2016 but would respond well to Clipper® at 400 ppb if needed. Curly-leaf Pondweed will respond well to Aquathol-K® at 1-2 gallons per acre. Starry Stonewort will respond well to a mixture of Clipper® at 200 ppb and chelated copper.

In conclusion, Wamplers Lake is a healthy lake with good aquatic plant biodiversity, good water clarity, moderate nutrients, and a healthy lake fishery. Management of the EWM, CLP, and Starry Stonewort are paramount for the long-term health of the lake. Thus far, the invasive species management efforts have been very successful with over 70% of the original milfoil infestation reduced.

Glossary of Scientific Terms used in this Report

1) Biodiversity- The relative abundance or amount of unique and different biological life forms found in a given aquatic ecosystem. A more diverse ecosystem will have many different life forms such as species.

2) CaCO3- The molecular acronym for calcium carbonate; also referred to as "marl" or mineral sediment content.

3) Eutrophic- Meaning "nutrient-rich" refers to a lake condition that consists of high nutrients in the water column, low water clarity, and an over-abundance of algae and aquatic plants.

4) Mesotrophic- Meaning "moderate nutrients" refers to a lake with a moderate quantity of nutrients that allows the lake to have some eutrophic qualities while still having some nutrient-poor characteristics

5) Oligotrophic- Meaning "low in nutrients or nutrient-poor" refers to a lake with minimal nutrients to allow for only scarce growth of aquatic plant and algae life. Also associated with very clear waters.

6) Sedimentary Deposits- refers to the type of lake bottom sediments that are present. In some lakes, gravel and sand are prevalent. In others, organic muck, peat, and silt are more common.