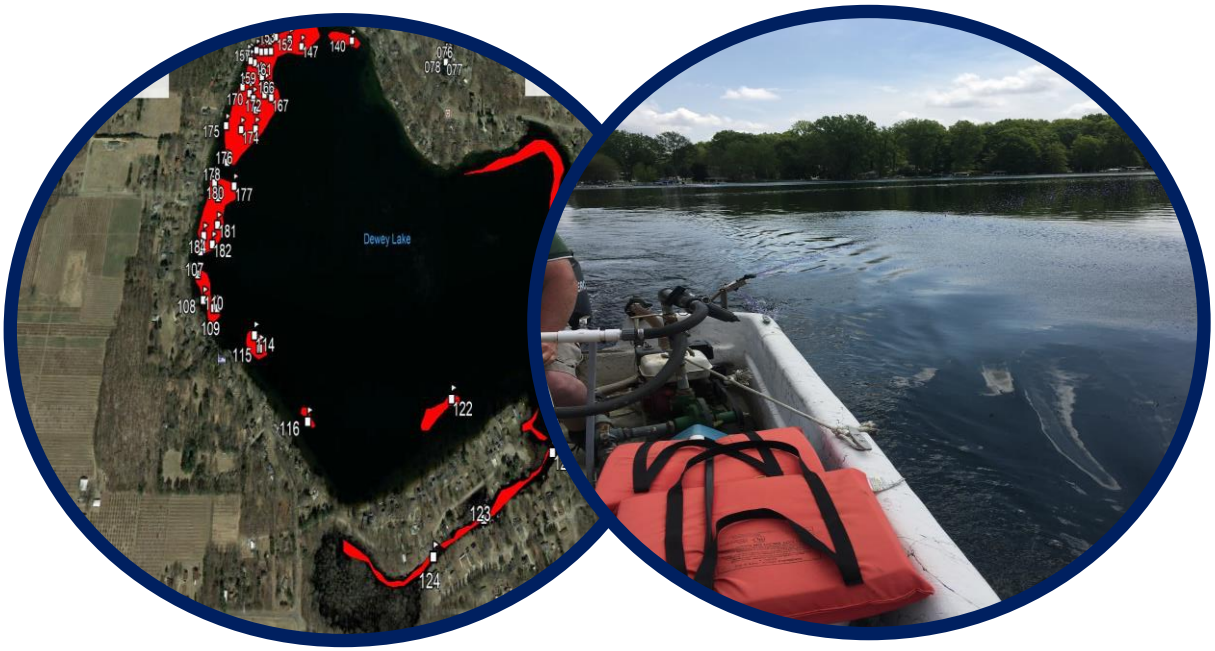
Dewey Lake 2020 Aquatic Vegetation, Water Quality, and 2021 Management Recommendations Report



October, 2020

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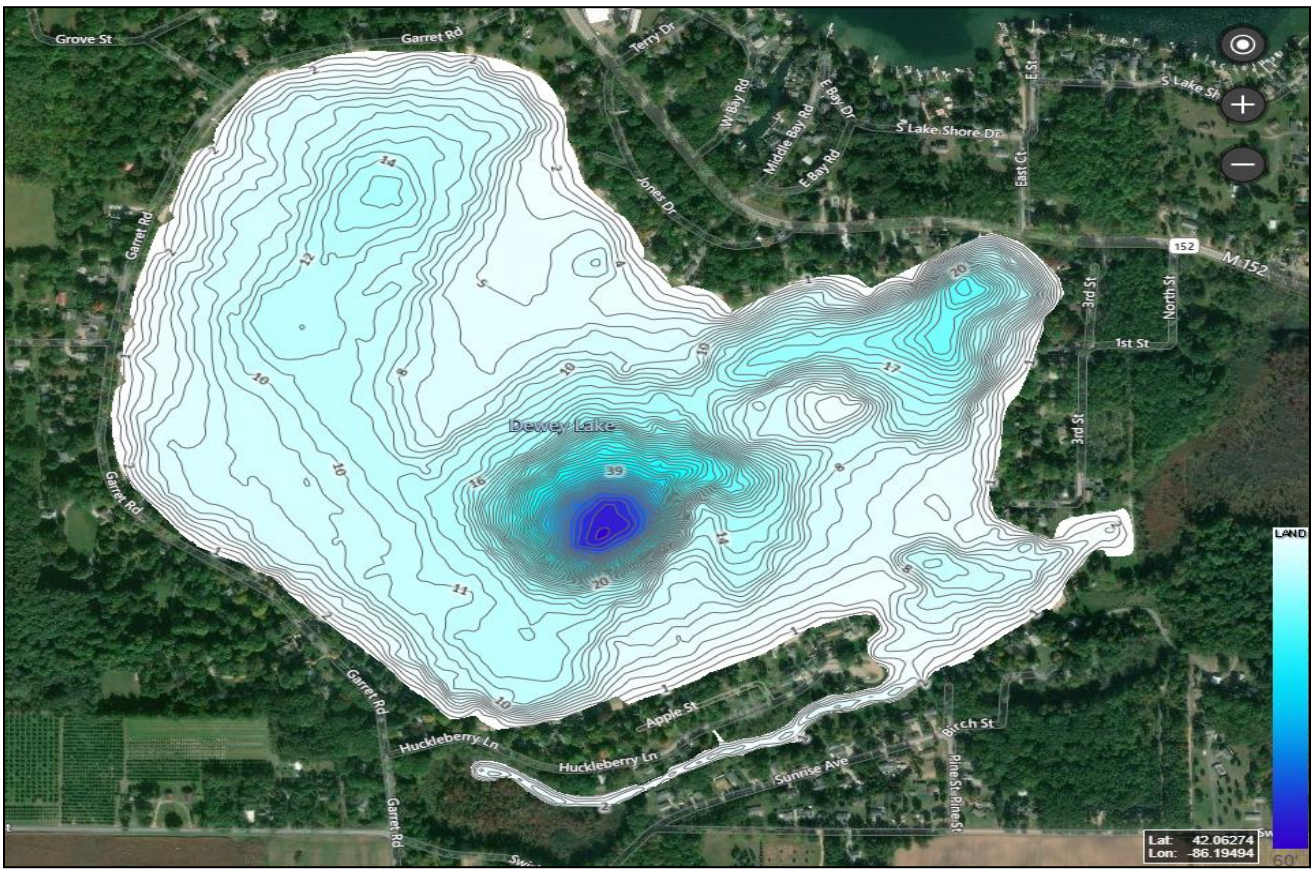

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1

Dewey Lake 2020 Aquatic Vegetation, Water Quality, and 2021 Management Recommendations Report

The following information is a summary of key lake findings collected in 2020.

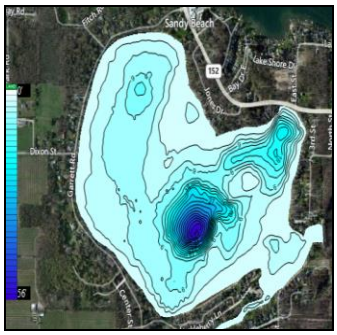
The overall condition of Dewey Lake is ranked in the top 25% of developed lakes of similar size in the state of Michigan. The water clarity in late spring of 2020 was around 18.0 feet which was favorable due to the high water temperatures and prolonged season that increased chlorophyll-a concentrations and weed growth in most lakes. 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) and Curly-leaf Pondweed (CLP) are able to grow in moderate nutrient waters and thus are a challenge to the Dewey Lake ecosystem. Protection of the 22 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, White-stem Pondweed).

The lake experienced depletion of dissolved oxygen with depth in late August in the deepest basin but not in the shallower deep basin. Other parameters such as pH and alkalinity were consistent with previous years. Dewey Lake is a well-balanced lake that has excellent water quality.

Section

2

Dewey Lake Water Quality Data (2020)



Water Quality Parameters Measured

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 alkalinity or hardness (measured in mg of calcium carbonate per liter-mg $CaCO_3$/L), 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 basins of Dewey Lake on June 4, 2020 prior to lake treatment. Table 1 below demonstrates how lakes are classified based on key parameters. Dewey 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. 2020 water quality data for Dewey Lake is shown below in Tables 2-3.

Table 1. Lake trophic classification (MDNR).

Lake Trophic Status	*Total Phosphorus (µg L^{-1})*	*Chlorophyll-a (µg 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. Dewey Lake water quality parameter data collected in deep basin 1 (June 4, 2020).

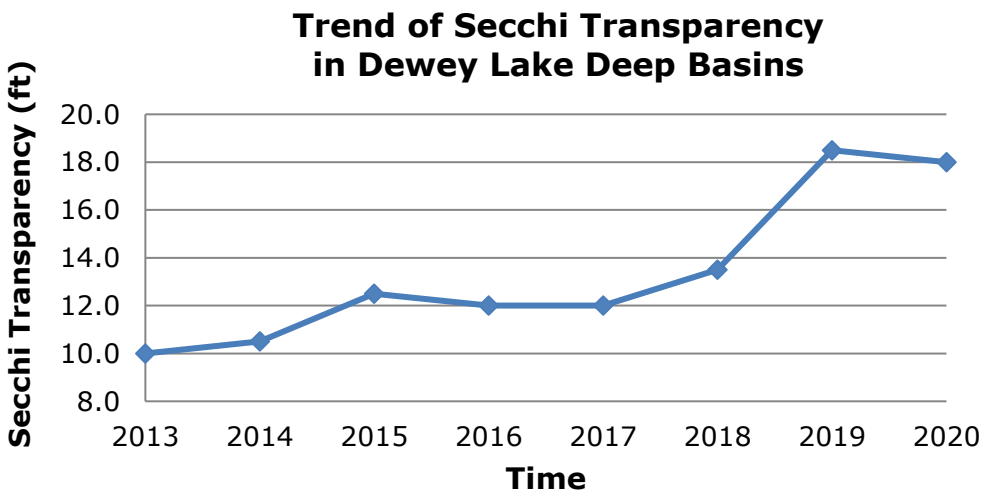
Depth ft.	*Water Temp ºF*	*DO mg L^{-1}*	*pH S.U.*	*Cond. µS cm^{-1}*	*Turb. NTU*	*ORP mV*	*Total Kjeldahl Nitrogen mg L^{-1}*	*Total Alk. mgL^{-1} $CaCO_3$*	*Total Phos. mg L^{-1}*
0	72.8	9.0	7.7	76	0.6	135.2	0.5	37	<0.010
25	66.8	8.1	7.7	76	0.6	130.6	0.5	37	0.010
50	57.8	6.9	7.5	71	0.9	120.8	1.0	35	0.030

Table 3. Dewey Lake water quality parameter data collected in deep basin 2 (June 4, 2020).

Depth ft.	*Water Temp ºF*	*DO mg L^{-1}*	*pH S.U.*	*Cond. µS cm^{-1}*	*Turb. NTU*	*ORP mV*	*Total Kjeldahl Nitrogen mg L^{-1}*	*Total Alk. mgL^{-1} $CaCO_3$*	*Total Phos. mg L^{-1}*
0	72.4	9.1	7.7	78	0.7	133.6	0.5	36	0.010
8	72.0	8.2	7.7	78	0.7	125.1	0.5	36	0.020
17	68.4	7.9	7.6	72	1.1	114.1	0.5	37	0.030

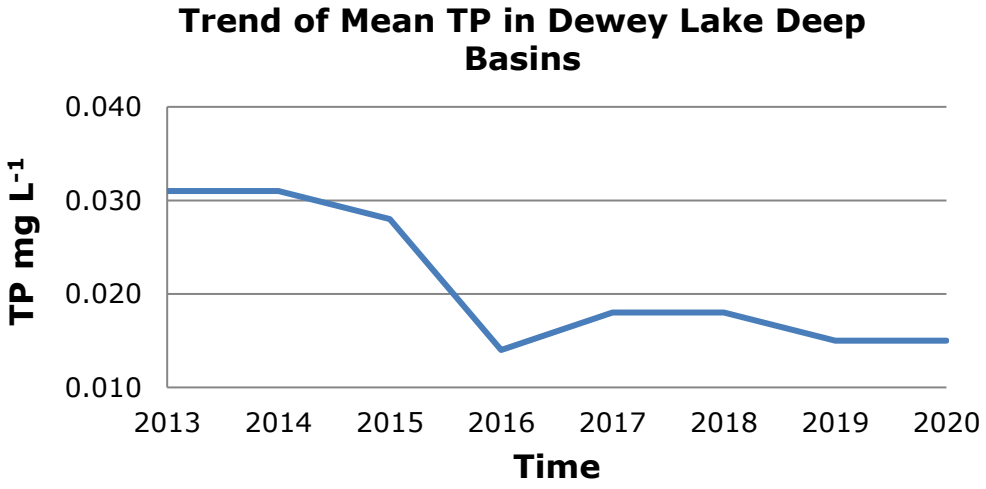
Water Clarity (Transparency) Data

Elevated Secchi transparency readings allow for more aquatic plant and algae growth. The transparency throughout Dewey Lake in spring of 2018 was adequate (13.5 feet) to allow abundant growth of algae and aquatic plants in the majority of the littoral zone of the lake. Secchi transparency is variable and 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) and Total Dissolved Solids (measured in mg/L) are correlated with water clarity and show an increase as clarity decreases. The turbidity and total dissolved solids in Dewey Lake in spring were quite low at ≤1.1 NTU's and ≤47 mg/L, respectively. The graph below shows the trend in Secchi transparency with time in Dewey Lake.



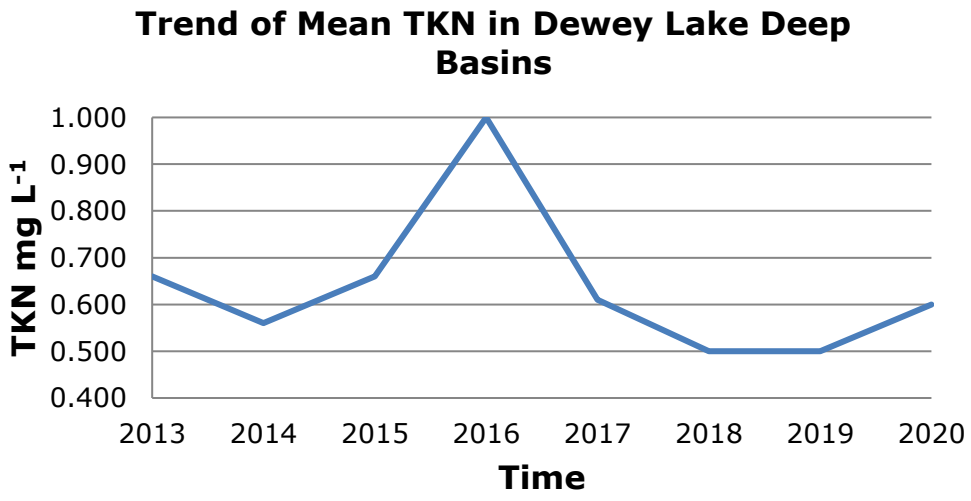
Total Phosphorus

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. Phosphorus may also be released from sediments as pH increases. Fortunately, even though the TP levels in Dewey Lake are moderate, the dissolved oxygen levels are good enough at the bottom until later summer to not cause release of phosphorus from the bottom. TP concentrations ranged between <0.010-0.030 mg L^{-1} in spring of 2020. The graph below shows the trend in TP with time in Dewey Lake.



Total Kjeldahl Nitrogen

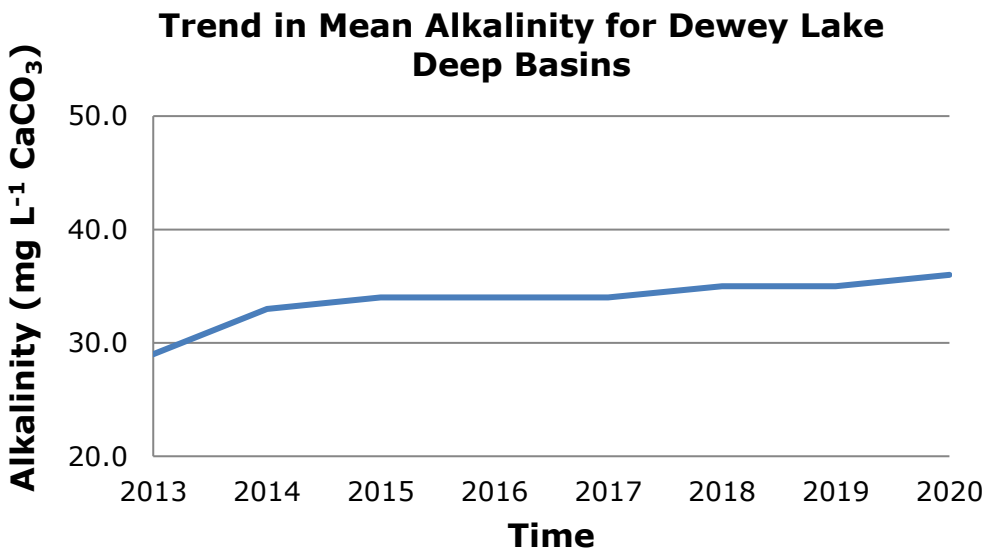
Total Kjeldahl Nitrogen (TKN) is the sum of nitrate (NO_3^-), nitrite (NO_2^-), ammonia (NH_4^+), and organic nitrogen forms in freshwater systems. Much nitrogen (amino acids and proteins) also comprises the bulk of living organisms in an aquatic ecosystem. Nitrogen originates from atmospheric inputs (i.e. burning of fossil fuels), wastewater sources from developed areas (i.e. runoff from fertilized lawns), agricultural lands, septic systems, and from waterfowl droppings. It also enters lakes through groundwater or surface drainage, drainage from marshes and wetlands, or from precipitation (Wetzel, 2001). In lakes with an abundance of nitrogen (N: P > 15), phosphorus may be the limiting nutrient for phytoplankton and aquatic macrophyte growth. Alternatively, in lakes with low nitrogen concentrations (and relatively high phosphorus), the blue-green algae populations may increase due to the ability to fix nitrogen gas from atmospheric inputs. Lakes with a mean TKN value of 0.66 mg L^{-1} may be classified as oligotrophic, those with a mean TKN value of 0.75 mg L^{-1} may be classified as mesotrophic, and those with a mean TKN value greater than 1.88 mg L^{-1} may be classified as eutrophic. The mean TKN concentration in Dewey Lake during the spring 2020 sampling event averaged 0.6 mg L^{-1}. These values are moderately low for an inland lake. The graph below shows the trend in TKN with time in Dewey Lake.



Total Alkalinity

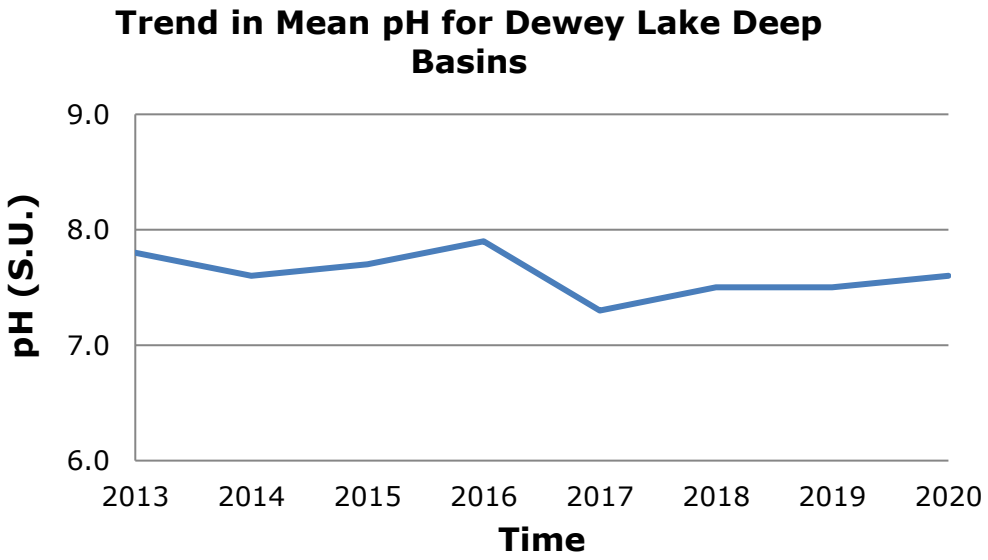
Lakes with high alkalinity (>150 mg L^{-1} of $CaCO_3$) are able to tolerate larger acid inputs with less change in water column pH. Many Michigan lakes contain high concentrations of $CaCO_3$ and are categorized as having "hard" water. Total alkalinity may change on a daily basis due to the re-suspension of sedimentary deposits in the water and respond to seasonal changes due

to the cyclic turnover of the lake water. The alkalinity of Dewey Lake has been very low and indicates a soft water lake system. The low alkalinity is one of the reasons why aquatic herbicides have worked so well on the nuisance aquatic plants in Dewey Lake as they are more effective in softer waters. The graph below shows the trend in total alkalinity with time in Dewey Lake.



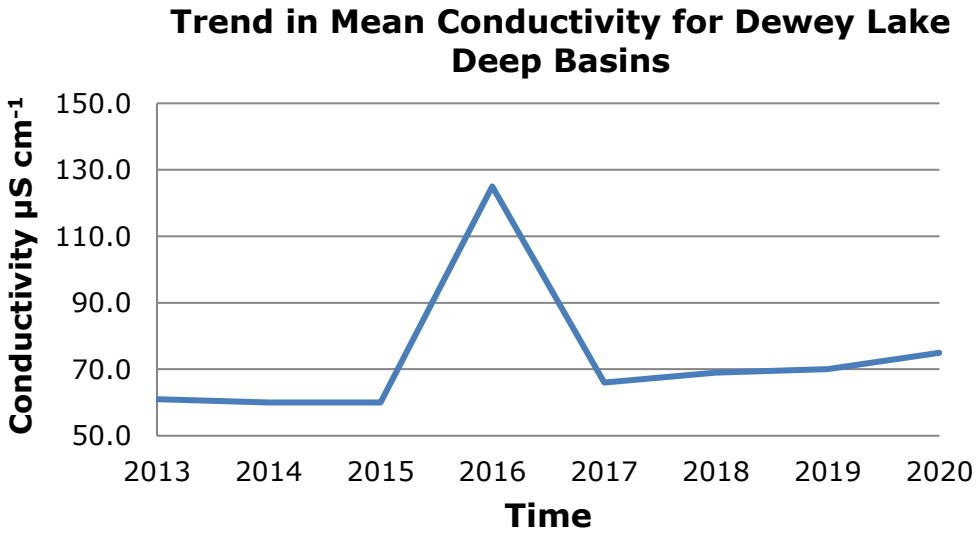
pH

Most Michigan lakes have pH values that range from 6.5 to 9.5. 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). Dewey Lake is considered “slightly basic” on the pH scale. The mean pH of Dewey Lake in spring of 2020 was 7.5 S.U. which is ideal for an inland lake but slightly on the acidic side. The graph below shows the trend in pH with time in Dewey Lake.



Conductivity

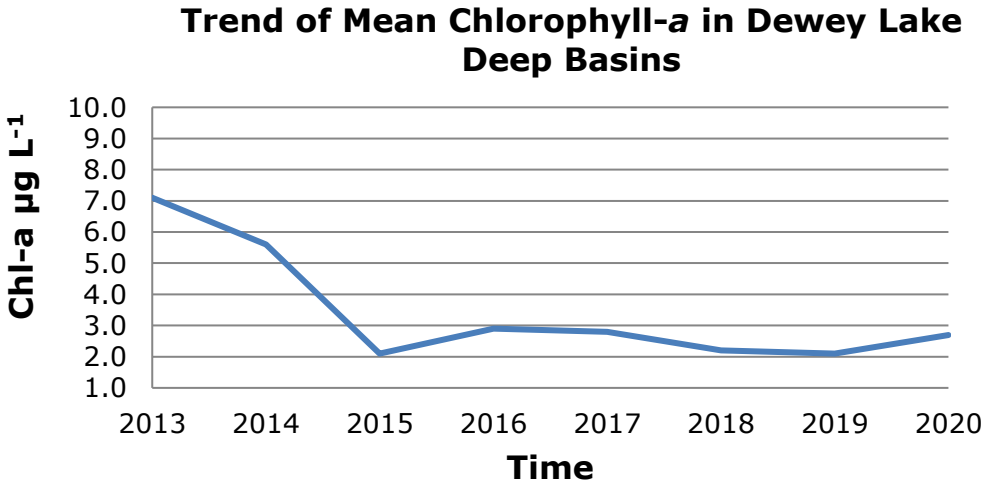
Conductivity is a measure of the amount of mineral ions present in the water, especially those of salts and other dissolved inorganic substances. Conductivity generally increases as the amount of dissolved minerals and salts in a lake increases, and also increases as water temperature increases. The conductivity values in spring of 2020 for Dewey Lake were quite low and ranged from 71-78 µS/cm. These numbers are higher than in recent years due to heavy spring runoff events. Severe water quality impairments do not occur until values exceed 800 µS/cm and are toxic to aquatic life around 1,000 µS/cm. The graph below shows the trend in conductivity with time in Dewey Lake.



Chlorophyll-*a* and Algal Species Composition

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* concentration in late spring of 2020 in Dewey Lake was 2.7 µg/L which is quite low for an inland Michigan lake but higher than in recent years due to increased spring rain and runoff.

The algal genera were determined from composite water samples collected over the deep basins of Dewey Lake in 2020 were analyzed with the following occurring in order of abundance: The green algae *Chlorella* sp., *Haematococcus* sp., *Cosmarium* sp., *Rhizoclonium* sp., *Scenedesmus* sp., *Radiococcus* sp., and *Mougeotia* sp.; The Blue-green algae *Oscillatoria* sp.; The diatoms *Navicula* sp., *Synedra* sp., *Cymbella* sp., and *Asterionella* 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. The graph below shows the trend in chlorophyll-*a* with time in Dewey Lake.


Trend of Mean Chlorophyll-*a* in Dewey Lake Deep Basins
Chl-a µg L-1
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
2013
2014
2015
2016
2017
2018
2019
2020
Time

Section

3

Aquatic Vegetation Data (2020)

Status of Native Aquatic Vegetation in Dewey Lake

The native aquatic vegetation present in Dewey Lake is essential for the overall health of the lake and the support of the lake fishery. The whole-lake survey on May 29, 2020 determined that there were a total of 22 native aquatic plant species in Dewey Lake. These include 14 submersed species, 4 floating-leaved species, and 4 emergent species. This indicates a high biodiversity of aquatic vegetation in Dewey 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. All of the native aquatic plant species found in Dewey Lake during the survey are shown below in Table 4.

The most common native aquatic plant species included: 1) Fern-leaf Pondweed (Figure 1) which has leaves that resemble small ferns that lie close to the lake bottom, 2) White-stem Pondweed (Figure 2), which has long, bright green leaves and may top out of the lake surface, and 3) Large-leaf Pondweed (Figure 3), which has large, brown leaves and may refer to it as “cabbage weed”. This plant has leaves that resemble small ferns that lie close to the lake bottom. The lily pads can become a nuisance in the channel, whereas pondweeds are problematic in the main portion of the lake for recreational activities.

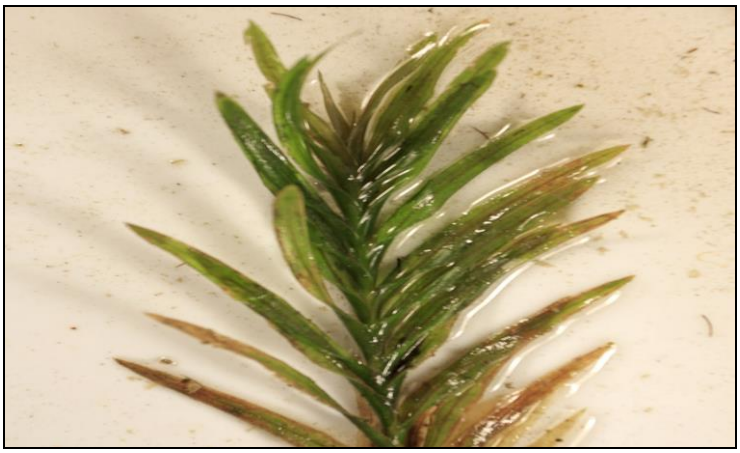


Figure 1. Fern-leaf Pondweed

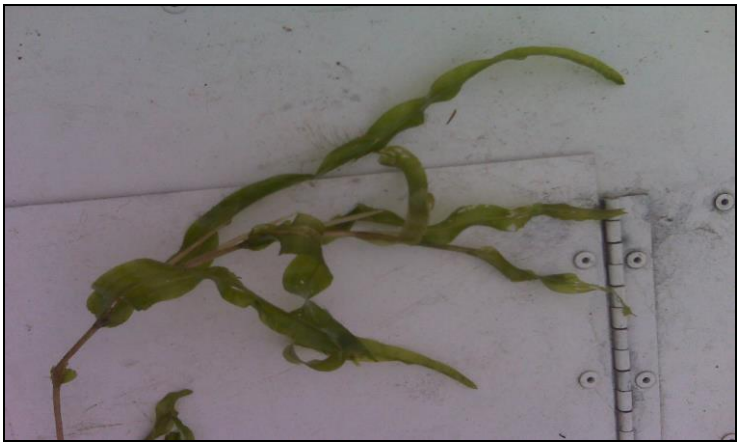


Figure 2. White-stem Pondweed

Figure 3. Large-leaf Pondweed

Table 4. Dewey Lake Native Aquatic Plant Species (May 29, 2020).

Native Aquatic Plant Species Name	***Aquatic Plant Common Name***	***Abundance in/around Dewey Lake***	***Aquatic Plant Growth Habit***
Chara vulgaris	Muskgrass	6.3	Submersed, Rooted
Potamogeton pectinatus	Thin-leaf Pondweed	6.8	Submersed, Rooted
Potamogeton zosteriformis	Flat-stem Pondweed	1.0	Submersed, Rooted
Potamogeton robbinsii	Fern-leaf Pondweed	12.5	Submersed, Rooted
Potamogeton amplifolius	Large-leaf Pondweed	10.0	Submersed, Rooted
Potamogeton praelongus	White-stem Pondweed	12.5	Submersed, Rooted
Potamogeton pusillus	Small-leaf Pondweed	1.0	Submersed, Rooted
Vallisneria americana	Wild Celery	7.2	Submersed, Rooted
Utricularia vulgaris	Bladderwort	5.2	Submersed, Non-Rooted
Ceratophyllum demersum	Coontail	0.2	Submersed, Non-Rooted
Najas guadalupensis	Southern Naiad	1.9	Submersed, Rooted
Nymphaea odorata	White Waterlily	9.9	Floating-Leaved, Rooted
Nuphar variegata	Yellow Waterlily	1.6	Floating-Leaved, Rooted
Brasenia schreberi	Watershield	0.7	Floating-Leaved, Rooted
Lemna minor	Duckweed	0.2	Floating-Leaved, Non-Rooted
Typha latifolia	Cattails	0.4	Emergent
Scirpus acutus	Bulrushes	0.4	Emergent
Pontedaria cordata	Pickerelweed	0.4	Emergent
Decodon verticillatus	Swamp Loosestrife	0.5	Emergent

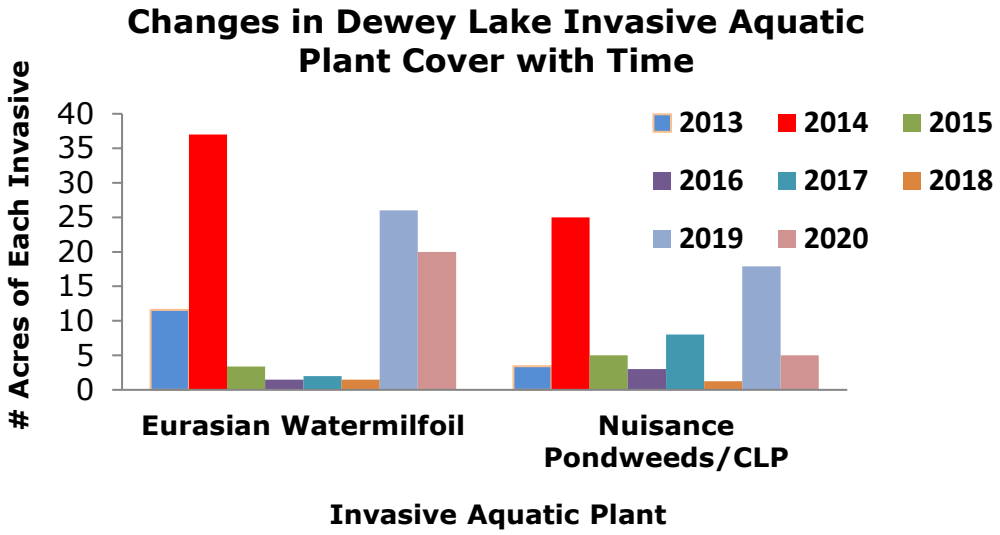
Status of Invasive (Exotic) Aquatic Vegetation in Dewey Lake

The amount of Eurasian Watermilfoil (Figure 4) present in Dewey Lake varies each year and is dependent upon climatic conditions, especially runoff-associated nutrients. 2020 was a year of intense rainfall events and some lakes had more aquatic plant growth this year due to this and the prolonged season. The May 29, 2020 survey revealed an abundance of EWM found throughout the entire lake. On June 4, 2020, the milfoil was treated with the contact herbicide diquat. The treatment was very successful with no milfoil remaining at the end of the 2020 season. RLS staff was present to oversee the treatment.

In addition to the milfoil, there were sparse beds of nuisance Curly-leaf Pondweed (CLP; Figure 5) which is an invasive submersed aquatic plant that can form dense canopies if not treated. These areas were successfully treated with the contact herbicide Aquathol-K®. Figure 6 shows the changes in the invasive aquatic plants in Dewey Lake with time. Treatment maps for each of these invasive species are shown in the maps below (Figures 7-8). RLS did not recommend treatment of the Spatterdock as treatments are not quite effective on emergent leaves. Figure 9 displays the aquatic vegetation biovolume.

Figure 4. Eurasian Watermilfoil

Figure 5. Curly-leaf Pondweed



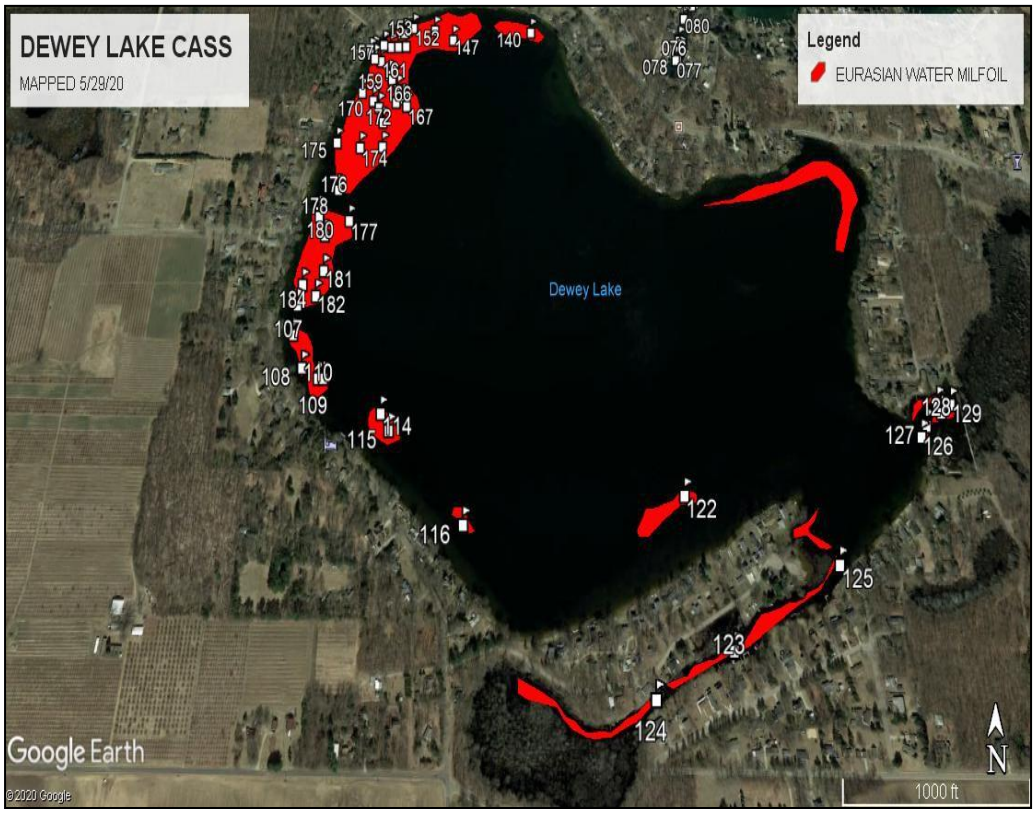


Figure 7. EWM distribution in Dewey Lake (May 29, 2020).

Figure 8. CLP Distribution in Dewey Lake (May 29, 2020).

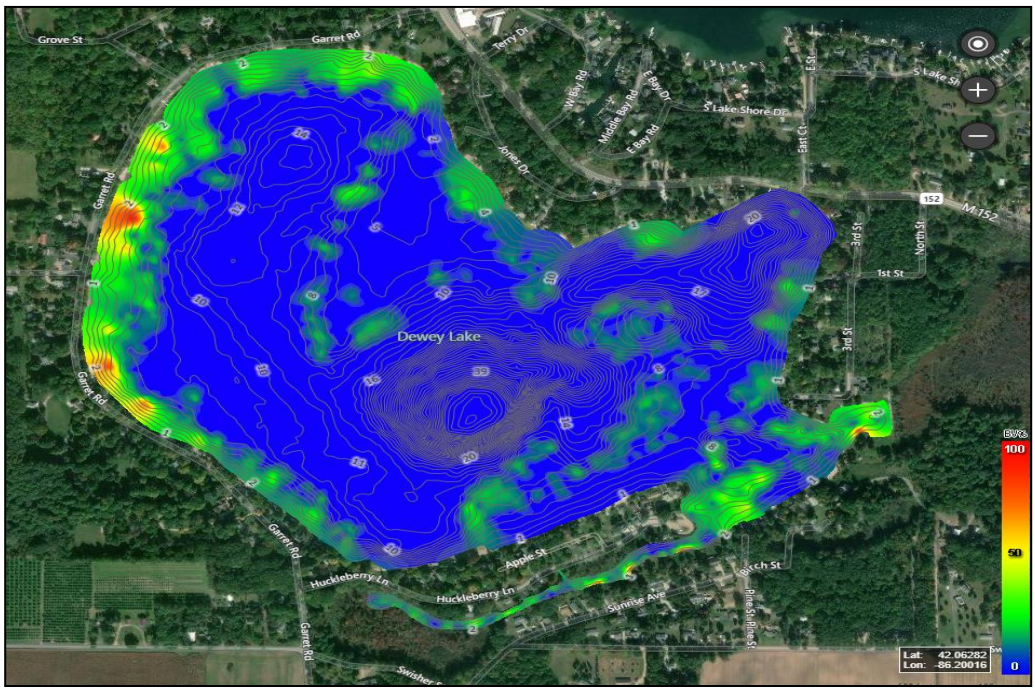


Figure 9. Aquatic Vegetation Biovolume in Dewey Lake (May 29, 2020).

Section

4

Management Recommendations for 2021

Continuous aquatic vegetation surveys are needed to determine the precise locations of EWM, CLP, or other problematic invasives in and around Dewey Lake. These surveys should occur in late-May to early-June and again post-treatment in 2021. Scientists from Restorative Lake Sciences will also be present to oversee the lake treatments.

Due to the relative scarcity of native aquatic vegetation in Dewey Lake, the treatment of these species with aquatic herbicides is only recommended for dense pondweeds and lily pads in a few select areas of the lake. The plan for 2021 includes the use of high dose systemic aquatic herbicides for spot-treatments of any new milfoil. Sculpin G® at a dose of 150 lbs. per acre would be recommended offshore and a dose of 120-150 lbs. per acre for Renovate OTF® nearshore for effective control of the milfoil. The lily pads should not require such extensive treatment as in previous years but would respond well to Clipper® at 400 ppb if treatment is needed. Curly-leaf Pondweed will respond well to Aquathol-K® at 1-2 gallons per acre.

Water quality parameters in the main lake will also be monitored in 2021 and graphed to show long-term data trends that can serve as measures of change in the Dewey Lake aquatic ecosystem.

In conclusion, Dewey Lake is a healthy lake with good aquatic plant biodiversity and water clarity, moderate nutrients, and a healthy lake fishery. Management of the EWM, CLP, and protection of the water quality are paramount for the long-term health of the lake.

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) $CaCO_3$- 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.