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DEPT. OF NATURAL RESOURCES

March 1, 2019

Dear to whom it may concern:

This past field season Lilly Lake in Brown County was part of the DNR Directed Lakes Monitoring Program. Through this program, Lilly Lake was sampled three times using methods to help determine overall lake health. The largest of these sampling methods was the aquatic plant index survey. This report details the plant survey and water chemistry monitoring results and how these results can be interpreted.

Plant Index Survey

Importance of Aquatic Plants

Aquatic plants form the foundation of healthy lake ecosystems. They not only protect water quality, but also produce life-giving oxygen. Aquatic plants are a lake's own filtering system, helping to clarify the water by absorbing nutrients like phosphorus and nitrogen that could stimulate algal blooms. Plant beds stabilize soft lake bottoms and prevent shoreline erosion by reducing the effect of waves and currents. Healthy native aquatic plant communities help prevent the establishment of invasive non-native plants such as Eurasian water milfoil and curly-leaf pondweed. Native aquatic plants also provide important reproductive, food, and cover habitat for fish, invertebrates, and wildlife. By leaving or restoring a natural buffer area of emergent vegetation along the shoreline, property owners can reduce erosion, help maintain water quality, and provide habitat and travel corridors for wildlife.

Invasive Aquatic Plant Species

Invasive aquatic species are a huge threat to Wisconsin lakes both ecologically and economically. Ecological impacts of introduced invasive species can range in severity depending on differing ecosystem variables. Specific impacts are difficult to predict. Invasive plants are problematic because they can grow to nuisance levels. These dense populations of non-native plants often have a negative impact on native plant communities because they are able to out-compete them for available resources needed for survival. Changes in the native plant community have far-reaching effects on fish, birds and invertebrates that need native plants to survive. Nuisance levels of non-native aquatic plants may also inhibit recreational activities (such as fishing, swimming, boating, etc.), decrease aesthetic value, and negatively affect water quality. Some industries such as sport and commercial fishing and raw water users (power companies and utilities), are also negatively affected by invasive species. It is important that everyone utilizing Wisconsin's lake resources do their part to help prevent and stop the spread of aquatic invasive species.

Point-Intercept Sampling Method

Based on area and depth specific to Lilly Lake, we mapped a 155-point sampling grid over the entire lake surface. Using a GPS, we navigated by boat to each of the pre-determined grid points. At each point we used a two-sided rake to sample approximately 1 foot along the bottom. After pulling the plants to the surface, the overall rake as well as individual species on the rake were assigned a fullness rating of 1, 2 or 3 to estimate density of plant growth (figure 1). We also recorded visual sightings of species within six feet of the sample point, as well as any additional species seen in the lake during a general boat survey. For more detailed information on the point-intercept sampling method and how data were collected please visit: http://www.uwsp.edu/cnr-ap/UWEXLakes/Documents/ecology/Aquatic%20Plants/PI-Protocol-2010.pdf

Species frequencies of occurrence reflect the percentage of times a species was found out of the total number of points sampled. Littoral frequency of occurrence (given in Table 1) indicates how often a species was found considering only areas of the lake that are capable of supporting plant growth (known as the "littoral area or zone"). The maximum depth of plant growth is the deepest depth at which plants were found in the lake. Species richness is a count of the total number of different plant species found in a lake. The Floristic Quality Index (FQI) is a metric that evaluates the closeness of the flora in a lake to that of an undisturbed condition. The higher a FQI value, the closer that plant community is to an undisturbed ecosystem. Statewide and ecoregion averages are calculated from a subset of approximately 250 lakes across Wisconsin.

Table 1: Species Present

% Frequency of Occurrence (Littoral): This estimation of frequency of occurrence is calculated by taking the total number of times a species is detected in a lake divided by the total number of points in a lake at which the growth of plants is possible. Voucher specimens have been sent to the UW-Stevens Point Herbarium, therefore all species identifications are subject to change pending verification.

Common Name	Scientific Name	Growth Form (Floating, free floating, submerged, emergent)	% frequency of Occurrence
Common Waterweed	Elodea canadensis	Submerged	25.2
Coontail	Ceratophyllum demersum	Submerged	20.9
Fern Pondweed	Potamogeton robinsii	Submerged	12.8
Southern Naiad	Najas guadalupensis	Submerged	9.9
Wild Celery	Vallisneria americana	Submerged	6.7
Muskgrass	Chara asp.	Free Floating	6.0
White Water Lily	Nympheae odorata	Submerged	5.0
Sago Pondweed	Stuckenia pectinata	Submerged	3.2
Common Bladderwort	Utricularia vulgaris	Submerged	2.8
Largeleaf Pondweed	Potamogeton amplifolius	Submerged	2.5
Flat-stem Pondweed	Potamogeton zosteriformis	Submerged	2.1
Northern Water Milfoil	Myriophyllum sibiricum	Submerged	1.4
Longleaf Pondweed	Potamogeton natans	Submerged	0.4
Small Duckweed	Lemna minor	Floating	0.4
Water Smartweed	Polygonum amphibium	Submerged	0.4
Fries' Pondweed	Potamogeton Friesii	Submerged	0.4

Spatterdock	Nuphar variegata	Submerged	0.4
Curly-leaf Pondweed*	Potamogeton crispus*	Submerged	Visual

* = species non-native and potentially invasive in WI

Table 2: Overall Survey Summary

	Lilly Lake	**Statewide Average**	**SWTP Ecoregion Average**
Littoral Frequency of Occurrence (%)	90.99%	73.3%	79%
Maximum Depth of Plant Growth (ft)	18	15.3	15.4
Species Richness	16	16.8	15
Floristic Quality Index (FQI)	23.25	24.1	20

Plant survey Results

As you can see from the overall plant index survey summary, Lilly Lake has a very high frequency of occurrence in the littoral zone when compared to other lakes throughout the state and ecoregion. This can partly be contributed to the lake's bathymetry. The two most common species in Lilly Lake are Common Waterweed and Coontail. The species richness is slightly above the ecoregion average. The FQI values show a good aquatic plant community overall.

Water Chemistry

The following information is taken from the Lilly Lake webpage provided by the DNR.
https://dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=82900

Lilly Lake - Deepest Part was sampled 3 different days during the 2018 season. Parameters sampled included:

- water clarity
- temperature
- dissolved oxygen
- total phosphorus
- chlorophyll

The average summer (July-Aug) secchi disk reading for Lilly Lake - Deepest Part (Brown County, WBIC: 82900) was 8 feet. The average for the Southeast Georegion was 7.4 feet. Typically, the summer (July-Aug) water was reported as CLEAR and GREEN. The green normally suggests a lake impacted by algae. However, since recent summer chlorophyll readings average less than 9 ug/l, this lake may have been impacted by another factor, such as suspended marl. An example of this is Clark Lake in Door County. Chemistry data was collected on Lilly Lake - Deepest Part. The average summer Chlorophyll was 4.1 μg/l (compared to a Southeast Georegion summer average of 31.6 μg/l). The summer Total Phosphorus average was 18.9 μg/l. Lakes that have more than 20 μg/l and impoundments that have more than 30 μg/l of total phosphorus may experience noticeable algae blooms.

The overall Trophic State Index (based on chlorophyll) for Lilly Lake - Deepest Part was 46. The TSI suggests that Lilly Lake - Deepest Part was mesotrophic. Mesotrophic lakes are characterized by moderately clear water but have an increasing chance of low dissolved oxygen in deep water during the summer.

Lake Water Quality 2018 Annual Report

Lilly Lake
Brown County
Waterbody Number: 82900

Lake Type: SEEPAGE
DNR Region: NE
GEO Region:SE

Site Name	Storet #
Lily Lake - Deepest Part	053228

Date	SD (ft)	SD (m)	Hit Bottom	CHL	TP	TSI (SD)	TSI (CHL)	TSI (TP)	Lake Level	Clarity	Color	Perception
07/17/2018	8.5	2.6	NO	3.87	19.5	46	45	51		CLEAR	YELLOW	
08/13/2018	7.5	2.3	NO	4.41	18.2	48	46	51			GREEN	
09/06/2018	7	2.1	NO	6.53	26	49	49	53				

07/17/2018		
Depth METERS	Temp. DEGREES C	D.O. MG/L
1	27.4	9.6
2	26.8	6.7
3	22.3	4.9
4	17.6	3.4
5	12.8	1.1

08/13/2018		
Depth METERS	Temp. DEGREES C	D.O. MG/L
1	26.6	10.5
2	26.3	9.9
3	23.2	6.8
4	19.7	2
5	16.6	.3

09/06/2018		
Depth METERS	Temp. DEGREES C	D.O. MG/L
1	23.7	8
2	23	7.4
3	22.2	7.4
4	20.9	.8
5	17.6	.2

Date	Data Collectors	Project
07/17/2018	Mary K Gansberg- HOLLY A STEGEMANN	Directed Lakes 2018 Gansberg
08/13/2018	Mary Gansberg	Directed Lakes 2018 Gansberg
09/06/2018	Mary K Gansberg- Faith Murray	Directed Lakes 2018 Gansberg

SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter(ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD), TSI(CHL), TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet.

Wisconsin Department of Natural Resources **Wisconsin Lakes Partnership**

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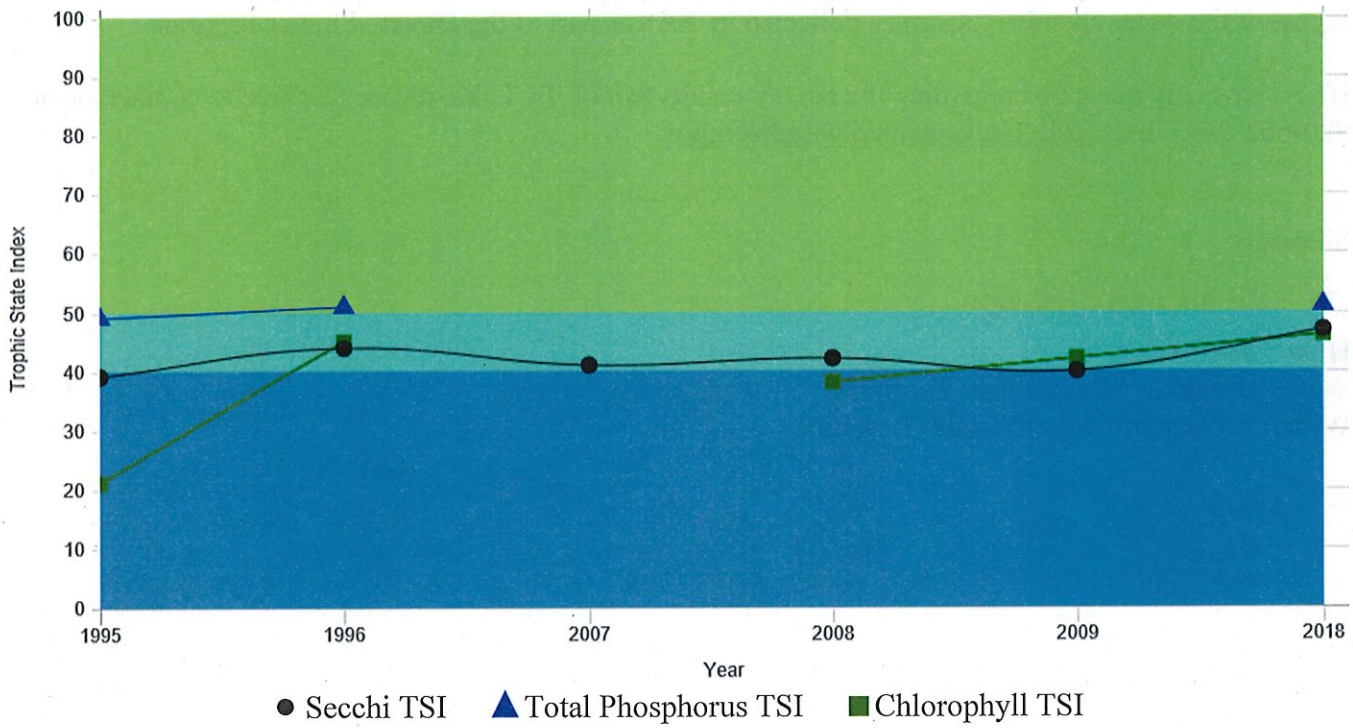
Trophic State Index Graph: Lily Lake - Deepest Part - Brown County



TSI	TSI Description
TSI < 30	Classical oligotrophy: clear water, many algal species, oxygen throughout the year in bottom water, cold water, oxygen-sensitive fish species in deep lakes. Excellent water quality.
TSI 30-40	Deeper lakes still oligotrophic, but bottom water of some shallower lakes will become oxygen-depleted during the summer.
TSI 40-50	Water moderately clear but increasing chance of low dissolved oxygen in deep water during the summer.
TSI 50-60	Lakes becoming eutrophic: decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, plant overgrowth evident, warm-water fisheries (pike, perch, bass, etc.) only.
TSI 60-70	Blue-green algae become dominant and algal scums are possible, extensive plant overgrowth problems possible.
TSI 70-80	Becoming very eutrophic. Heavy algal blooms possible throughout summer, dense plant beds, but extent limited by light penetration (blue-green algae block sunlight).
TSI > 80	Algal scums, summer fish kills, few plants, rough fish dominant. Very poor water quality.

This report summarizes the 2018 monitoring results. To add to this data set, I am planning to collect water chemistry samples in Lilly Lake again in the summer of 2019. This monitoring effort will be a repeat of the water chemistry samples collected in 2018 as part of the Directed Lakes Program.

If you have any questions regarding the survey results from Lilly Lake, please feel free to contact me at 920-662-5497 or at Holly.Stegemann@wisconsin.gov.

Sincerely,

Holly Stegemann

Holly Stegemann
Water Resources Management Specialist
Wisconsin Department of Natural Resources