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William Partridge Burpee: *Shore View, Swampscott*, **c. 1888**

Curlyleaf Pondweed and Eurasian Watermilfoil Growth Potential Based on Lake Soil Fertility for Big Round Lake, Polk County, Wisconsin

[Lake Sediment Survey Conducted: October 14, 2004]

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Prepared for: Big Round Lake District, Polk County, Wisconsin
Prepared by: Steve McComas (Blue Water Science)

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Summary

The objectives of this lake sediment study were two fold: first, the idea was to gage the potential for curlyleaf pondweed, which is present in Big Round Lake, to attain nuisance growth conditions and secondly, to determine to what extent Eurasian watermilfoil would colonize the Big Round Lake, if it were to invade the lake. As of 2004 Eurasian watermilfoil is not present in Big Round Lake.

Lake sediments at 26 sites were collected in 4 to 8 feet of water depth from Big Round Lake on October 14, 2004. The lake "soils" were analyzed for 16 parameters including nitrogen, phosphorus, and potassium.

Research has found that several lake sediment parameters are highly correlated with nuisance growth conditions of curlyleaf pondweed. These parameters include a low sediment bulk density, high organic matter, high pH, and low iron. Other research results have found that different sediment parameters effect the nuisance growth of Eurasian watermilfoil. The critical parameter for nuisance growth is nitrogen. There is a strong correlation of high sediment nitrogen, as exchangeable ammonium-nitrogen, with nuisance growth of Eurasian watermilfoil (EWM). At lower nitrogen values, EWM will still grow, but not necessarily to nuisance conditions. In these cases, removal is typically unnecessary.

Sediment results indicated that Big Round Lake will support the growth of both curlyleaf pondweed (it is already present) and Eurasian watermilfoil (not present). Light nuisance growth of both species is expected.

Examples of matting, nuisance curlyleaf pondweed are shown on the left, and matting nuisance Eurasian watermilfoil is shown on the right. Both have a density of a "5" and are classified as a heavy nuisance growth. These conditions are not expected in Big Round Lake based on lake sediment analyses.

The Potential for Curlyleaf Pondweed Nuisance Growth: For curlyleaf pondweed, four sediment parameters are correlated with various types of curlyleaf pondweed growth. For heavy nuisance curlyleaf growth to occur in a lake, four parameters from a sediment site need to be within range of the reference nuisance category. The four parameters are: sediment bulk density, pH, organic matter and iron. For Big Round Lake, none of the sediments tested had all four sediment characteristics that apparently are necessary to produce heavy nuisance growth of curlyleaf pondweed.. However, lake areas within Big Round Lake can still support light nuisance growth. For these areas, management by herbicide or mechanical harvesting are options. Aquatic plant surveys will continue to help characterize the curlyleaf status and check the predicted growth conditions.

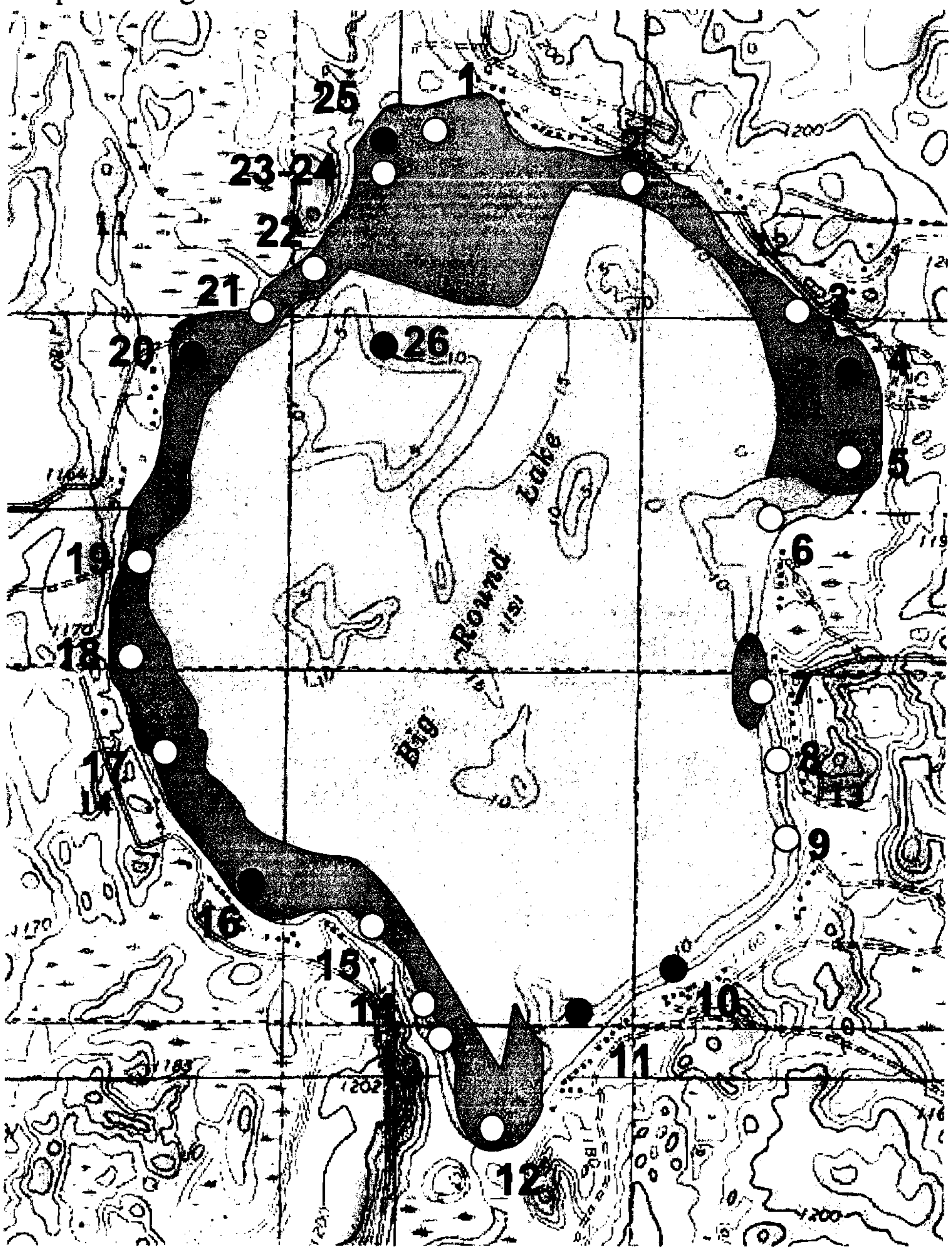

Figure 1. Map of areas where curlyleaf could grow to a light nuisance are shown in yellow. Dark green dots represent areas of predicted non-nuisance growth. The light green shading represents the existing coverage of curlyleaf pondweed in 2003 and 2004.

Potential for Eurasian Watermilfoil Nuisance Growth: Based on lake sediment analyses of Big Round Lake sediments, the areas that have the potential to support nuisance EWM are shown in Figure 2. Nitrogen levels were found to be low to moderate at most of the sample stations. However two stations had conditions that could support nuisance milfoil growth. Based on lake sediment results, if Eurasian watermilfoil was to invade Big Round Lake we would predict potential nuisance acreages to be less than 20 acres.

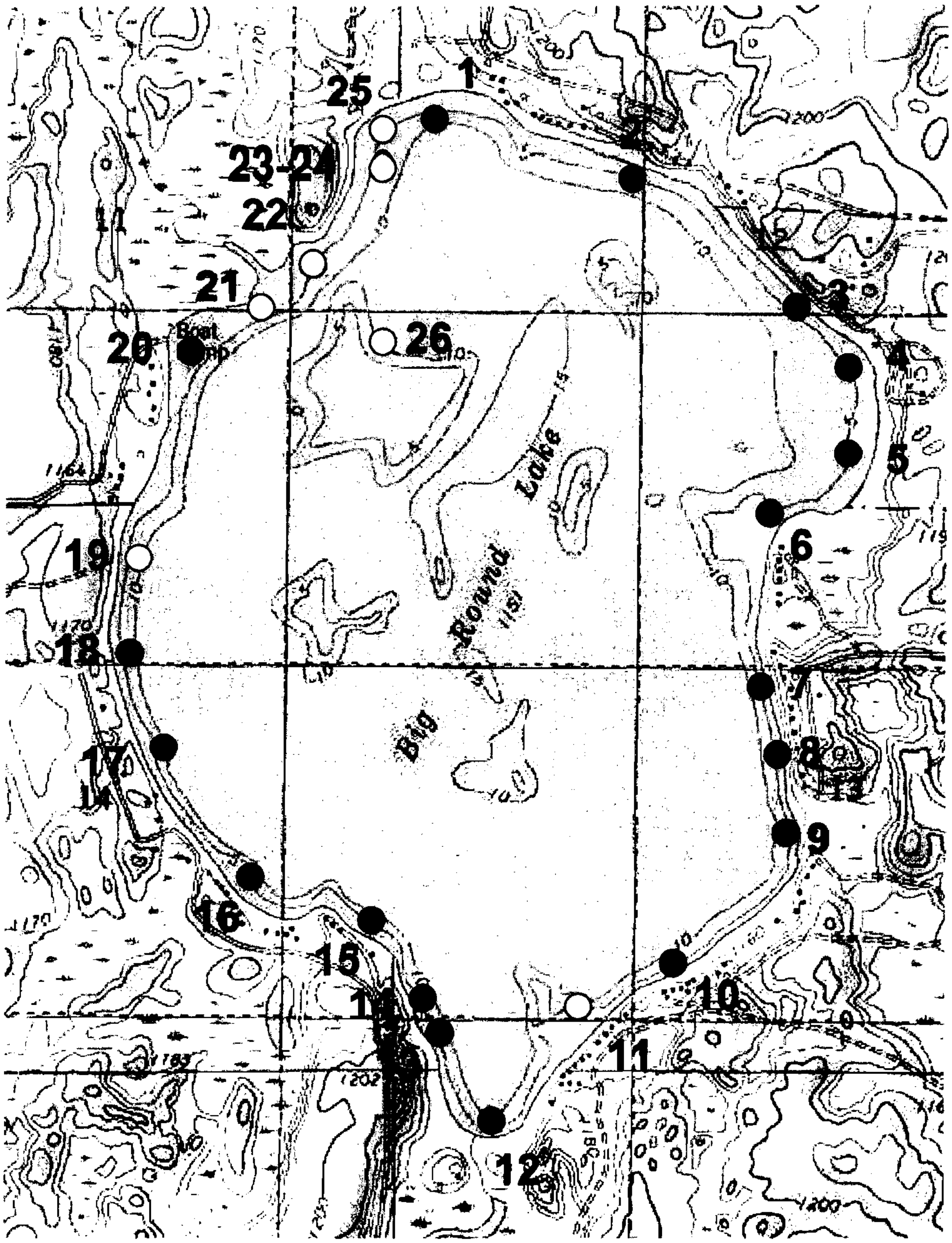

Figure 2. Map of areas where nuisance growth of Eurasian watermilfoil are predicted to top out if it invaded Big Round Lake are shown with red dots. Only two areas have the potential to support nuisance growth and are in the vicinity of Sites 1 and 12. Several other areas (shown with yellow dots) have elevated nitrogen, but are not considered to be sites of long term nuisance growth. The green dots indicate sites where milfoil could grow, but it is predicted it would not grow to nuisance conditions. At this time, Eurasian watermilfoil has not been found in Big Round Lake.

Introduction

The use of lake soil fertility sampling to predict exotic aquatic plant growth in lakes or aquatic plant growth in general is an evolving area.

The objective of this lake soil fertility survey was to characterize Big Round Lake soils in the littoral zone in order to better predict where nuisance areas of curlyleaf and milfoil growth could occur in the future.

Based on other lake research, it appears that the potential nuisance growth of the exotic plant, curlyleaf pondweed, can be predicted in a lake based on several key sediment parameters. These parameters were analyzed in this Big Round study. Although this curlyleaf evaluation method is still experimental, it has correctly predicted heavy nuisance growth for several lakes in the Central Hardwood Forest Ecoregion (McComas, unpublished).

It is well established that nitrogen is often the limiting nutrient for terrestrial plants (Wedin and Tilman 1996; Stevens et al 2004). Based on results from other lakes, it appears sediment nitrogen (as exchangeable ammonium) is important for producing heavy growth of Eurasian watermilfoil (Anderson and Kalff 1986; Barko, pers comm). There appears to be a nitrogen threshold for nuisance milfoil growth (Wakeman and Les 1994). When sediment nitrogen concentrations (as exchangeable ammonia) are greater than about 10 ppm, nuisance milfoil conditions are found in these areas in many lakes (McComas, unpublished).

Organic matter is another leading indicator for potential nuisance milfoil growth and this is probably because organic matter and nitrogen are related so when there is also high organic matter there is also high nitrogen. However, at high levels of organic matter, and 20% or greater seems to be the threshold, Eurasian watermilfoil does not exhibit nuisance growth (Barko and Smart 1986; Barko et al 1991).

Based on results from other lakes it is predicted that the combination of organic matter and high nitrogen values (as exchangeable ammonium) will sustain nuisance milfoil growth in shallow water on an annual basis unless some other factor limits growth. Limiting factors include things such as herbicide use, milfoil weevils, light penetration, sediment composition, and even lake bottom slopes. When lake bottoms have moderate fertility (less than 10 ppm of exchangeable nitrogen), it is predicted that potential nuisance growth could occur in some years, but not on a continuous basis.

Methods

Lake Soil Collection: A total of 26 lake sediment samples were collected from depths ranging from 2 to 9 feet on October 14, 2004 by Dan Bergeron, Big Round Lake Improvement District and Steve McComas, Blue Water Science. Samples were collected using a modified soil auger, 5.2 inches in diameter (Figure 1). Soils were sampled to a depth of 6 inches. The lake soil from the sampler was transferred to 1-gallon zip-lock bags and delivered to a soil testing laboratory. Sample locations are shown in Figure 1.

Lake sediment samples were collected in the littoral zone. At each sample location, within about a 5-foot radius we noted all aquatic plant species and rated their density on a scale from 1 to 5 with one representing a low density.

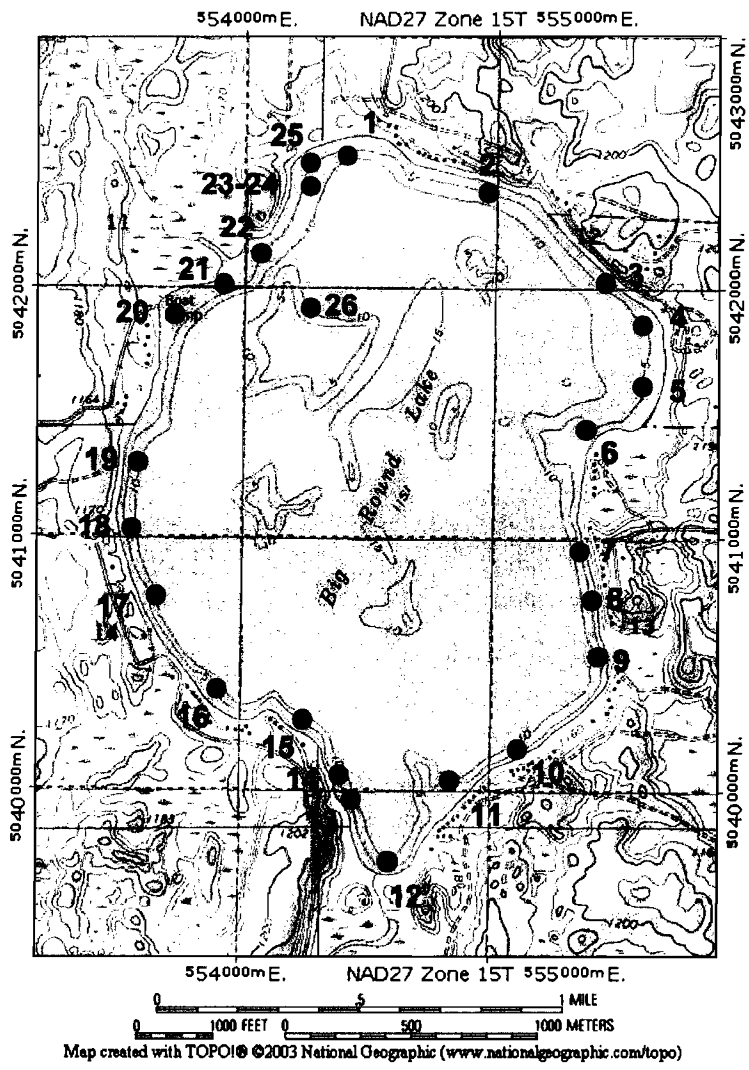

Figure 1. Lake sediment sample locations for the October 14, 2004 sediment survey.

Lake Soil Analysis: At the lab, sediment samples were air dried at room temperature, crushed and sieved through a 2 mm mesh sieve. Sediment samples were analyzed using standard agricultural soil testing methods. Sixteen parameters were tested for each soil sample. A summary of extractants and procedures is shown in Table 1. Routine soil test results are given on a weight per volume basis.

Table 1. Soil testing extractants used by University of Minnesota Crop Research Laboratory. These are standard extractants used for routine soil tests by most Midwestern soil testing laboratories (reference: Western States Laboratory Proficiency Testing Program: Soil and Plant Analytical Methods, 1996-Version 3).

Parameter	Extractant
P-Bray	0.025M HCL in 0.03M NH_4F
P-Olsen	0.5M $NaHCO_3$
NH_4-N	2N KCL
K, Ca, Mg	1N NH_4OA_c (ammonium acetate)
Fe, Mn, Zn, Cu	DTPA (diethylenetriamine pentaacetic acid)
B	Hot water
SO_4-S	$Ca(H_2PO_4)_2$
pH	water
Organic matter	Loss on ignition at 360°C

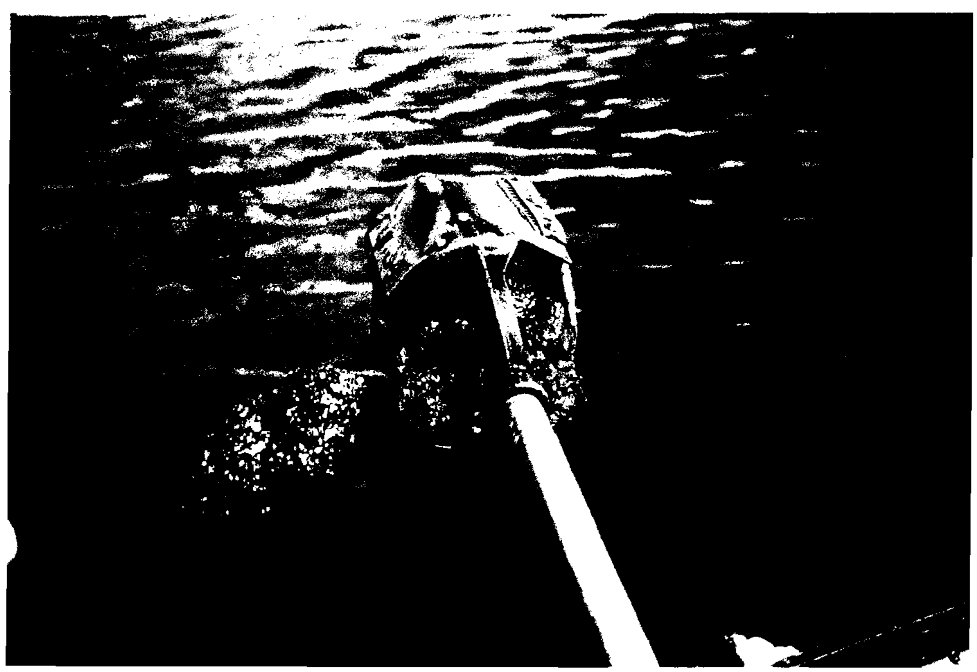

Figure 2. Soil auger used to collect lake sediments.

Reporting Lake Soil Analysis Results: Lake soils and terrestrial soils are similar from the standpoint that both provide a medium for rooting and supply nutrients to the plant.

However, lake soils are also different from terrestrial soils. Lake soils (or sediments) are water logged, generally anaerobic and their bulk density ranges from being very light to very dense compared to terrestrial soils.

There has been discussion for a long time on how to express analytical results from soil sampling. Lake sediment research results are often expressed as grams of a substance per kilogram of lake sediment, commonly referred to as a weight basis (mg/kg). However, in the terrestrial sector, to relate plant production and potential fertilizer applications to better crop yields, soil results typically are expressed as grams of a substance per cubic foot of soil, commonly referred to as a weight per volume basis. Because plants grow in a volume of soil and not a weight of soil, farmers and producers typically work with results on a weight per volume basis.

That is the approach used here for lake sediment results: they are reported on a weight per volume basis or $\mu g/cm^3$.

A bulk density adjustment was applied to lake sediment results as well. For agricultural purposes, in order to standardize soil test results throughout the Midwest, a standard scoop volume of soil has been used. The standard scoop is approximately a 10-gram soil sample. Assuming an average bulk density for an agricultural soil, a standard volume of a scoop has been a quick way to prepare soils for analysis, which is convenient when a farmer is waiting for results to prepare for a fertilizer program. It is assumed a typical silt loam and clay texture soil has a bulk density of 1.18 grams per cm^3. Therefore a scoop size of 8.51 cm^3 has been used to generate a 10-gram sample. It is assumed a sandy soil has a bulk density of 1.25 grams per cm^3 and therefore a 8.00 cm^3 scoop has been used to generate a 10-gram sample. Using this type of standard weight-volume measurement, the lab can use standard volumes of extractants and results are reported in ppm which is close to $\mu g/cm^3$. For all sediment results reported here a scoop volume of 8.51 cm^3 was used.

However lake sediment bulk density has wide variations but only a single scoop volume of 8.51 cm^3 was used for all lake sediment samples. This would not necessarily produce a consistent 10-gram sample. Therefore, for our reporting, we have used corrected weight volume measurements and results have been adjusted based on the actual lake sediment bulk density. We used a standard scoop volume of 8.51 cm^3, but sediment samples were weighed. Because test results are based on the premise of a 10 gram sample, if our sediment sample was less than 10 grams, then the reported concentrations were adjusted down to account for the less dense bulk density. If a scoop volume weighed greater than 10.0 grams than the reported concentrations were adjusted up. For example, if a 10-gram scoop of lake sediment weighed 4.0 grams, then the correction factor is 4.00 g/ 10.00 g = 0.40. If the analytical result was 10 ppm based on 10 grams, then it should be 0.40 x 10 ppm = 4 ppm based on 4 grams. The results could be written as 4 ppm or 4 $\mu g/cm^3$. Likewise, if a 10-gram scoop of lake sediment weighed 12 grams, then the correction factor is 12.00 g / 10.00 g = 1.20. If the analytical result was 10 ppm based on a 10 gram scoop, then it should be 1.20 x 10 ppm = 12 ppm based on 12 grams. The result could be written as 12 ppm or 12 $\mu g/cm^3$. These are all dry weight determinations.

Delineating Areas of Potential Nuisance Curlyleaf and Milfoil Growth: Delineating an area of potential nuisance plant growth is based on conventional soil survey methods. When a sediment sample analysis has a nitrogen reading over 10 ppm and has an organic matter content of less than 20%, it has a high potential for nuisance milfoil growth. For sediment results with a high growth potential collected in a cove, typically, the water depths in the cove from 5 to 7 feet would be designated as having a potential for nuisance growth. If high potential samples are found along a stretch of shoreline, a designated high potential area would be delineated until there was a shoreline break or change in sediment texture. In other cases, if the next site down the shoreline records a low potential reading, then the designated nuisance area would extend midway between a high and low potential sample sites.

Figure 3. Matting, nuisance Eurasian watermilfoil is shown above. This is a density of a "5" and this is the kind of nuisance growth predicted by high sediment nitrogen values and a sediment organic matter content less than 20%.

Big Round Lake Results

A total of 26 locations were sampled around the Big Round Lake in water depths from 2 to 9 feet. At each location the types of plants were identified as well (Table 2).

Based on research reports, it appears curlyleaf pondweed and Eurasian watermilfoil growth potential can be predicted based on lake sediment analysis for selected parameters.

It appears sediment bulk density, pH, organic matter, and iron influence curlyleaf pondweed growth. Exchangeable ammonia and organic matter appear to be the best predictors of nuisance Eurasian watermilfoil growth. However, in addition to these parameters other parameters were analyzed for each sediment sample collected in this study. Results are listed in Table 3.

In Big Round Lake, lake sediment phosphorus levels are generally low and another plant nutrient, potassium (shown as K in Table 3), is also low. One reason for the low concentrations may be that the lake sediments are dominated by sand in the nearshore areas.

Soil analyses indicate the overall fertility of Big Round Lake sediments is low. Big Round Lake soils are not polluted with excessive zinc or copper and the lake sediments are representative of typical lake sediments.

Table 2. Aquatic plants found at the time of sediment sample collection, October 14, 2004.

Sample Number	Water Depth at Sample Location (ft)	Bottom Char.	Aquatic Plant Species Found at Sediment Sample Sites												
			bul-rush	chara	clasping-leaf	coontail	floating-leaf	northern milfoil	quill-wort	sage	stringy	water celery	water star-grass	[illegible]	[illegible]
1	7													1	1
2	2	sand							1			1			2
3	5.5	sand brown													0
4	5.5	sand-fine-silt										1	2	1	3
5	5.5	sandy marl				1		1			1				3
6	3	sand	4				1								2
7	4	sand										1			1
8	5	sand			1			1							2
9	5	sand						1				2			2
10	7					2		2							2
11	4	sandy with organics		1	1			1							3
12	6					1		1					1		3
13	6							4.5							1
14	5	clay, sand						3.5							1
15	5														0
16	5	sand						1							1
17	6	sand & gravel						4							1
18	5	brown sand	1		1			4							3
19	9							2						1	2
20	3	sand grain-fine	1			1		1							3
21	5	peaty muck						2		1				1	3
22	4.5				1	1		1						1	4
23	7							2		1				2	3
24	7							2		1				2	3
25	4	brown sand				1		2				1			3
26	7	sand						1							1

Table 3. Big Round Lake sediment results from October 8, 2003. Results are in ug/cm³ (which is similar to ppm) except for bulk density (g/cm³), OM (organic matter in %), and pH (standard units).

Sample ID	Bulk density g/cm³	NH_4-N corrected	P_Bray corrected	P_Olsen corrected	K corrected	OM %	Ca corrected	Mg corrected	SO_4S corrected	Zn corrected	Cu corrected	Mn corrected	Fe corrected	B corrected	pH su	Mn:Fe
1	0.6	5.2	6.1	2	10.2	13.2	574	66	53.8	4.7	1.5	9.8	365	0.6	5.6	0.03
2	1.47	2.4	6.3	3.8	31.3	0.4	276	51.3	5.0	0.4	0.5	26.4	17.0	0.1	7.1	1.55
3	1.53	2.1	11.7	2.6	15.7	0.4	643	70.5	5.2	0.1	0.3	0.9	9.1	0.3	8.0	0.1
4	1.41	2.2	12.0	2.4	20.4	0.9	492	43.3	28.8	0.6	0.2	2.2	24.8	0.6	7.4	0.09
5	1.23	1.6	1.0	3.1	20.9	0.8	3177	108	8.4	0.5	0.8	1.1	8.2	0.2	8.1	0.14
6	1.44	1.8	6.1	2.4	18.3	0.7	379	34.2	12.2	0.1	0.1	2.6	10.3	0.5	7.7	0.25
7	1.49	2.0	5.1	2.5	34.1	0.3	479	60.7	12.6	0.3	0.1	2.7	23.0	0.3	7.7	0.12
8	1.46	2.1	5.0	3.7	34.9	0.4	457	47.3	19.9	0.2	0.1	3.1	15.6	0.4	7.7	0.20
9	1.49	1.9	5.1	2.5	31.6	0.3	827	30.3	20.2	0.1	0.3	3.2	18.5	0.3	7.8	0.17
10	1.13	4.2	5.8	1.9	18.3	3.3	603	51.9	31.7	0.8	0.6	11.3	77.6	0.7	7.0	0.15
11	0.87	3.5	1.5	1.5	11.9	10.7	1397	96.5	13.4	0.3	0.2	45.0	234	0.4	7.0	0.19
12	0.67	8.1	12.0	2.3	5.7	6.7	442	25.1	25.1	1.1	0.5	16.0	117	0.5	6.7	0.14
13	1.5	4.7	9	3.8	16.6	0.5	1086	67.8	52.4	0.3	0.8	5.2	37.1	0.3	7.5	0.14
14	1.31	4.7	11.2	2.2	81.6	1.0	1763	177	17.9	0.2	1.6	8.7	74.0	0.2	7.7	0.12
15	1.01	3.9	10.3	2.6	66.2	1.7	1151	202	7.7	0.2	3.7	17.1	79.1	0.2	7.7	0.22
16	1.37	2.3	5.8	2.3	28.0	1.0	802	43.2	50.2	0.5	0.7	11.9	84.5	0.4	7.4	0.14
17	1.44	3.2	13.4	3.7	30.6	0.6	956	55.0	18.3	0.2	0.9	11.0	62.7	0.2	7.7	0.18
18	1.51	2.2	12.9	2.6	21.9	0.5	949	41.2	21.9	0.1	0.3	4.6	30.8	0.4	7.7	0.15
19	0.77	4.0	0.7	5.3	15.8	2.6	2308	87.6	61.9	1.3	2.9	33.9	92.7	0.2	7.7	0.37
20	1.26	3.8	6.4	3.2	19.3	1.8	601	47.2	10.7	0.2	0.4	9.5	47.9	0.4	7.5	0.20
21	0.41	3.4	1.4	1.0	5.9	51.5	1231	152	11.8	3.2	2.3	21.6	348	1.1	6.7	0.06
22	0.74	2.4	1.9	4.4	11.9	8.4	1875	138	21.3	1.1	0.9	22.3	20.1	0.4	7.5	1.11
23	0.4	3.8	2.7	3.4	11.9	37.7	945	77.7	22.8	2.7	1.6	58.3	516	0.8	6.7	0.11
24	0.42	3.4	2.9	2.5	10.4	35.9	942	75.4	28.4	2.7	1.6	51.0	499	0.7	6.8	0.10
25	1.24	4.7	14.8	2.1	13.7	1.6	943	57.1	24.3	0.6	0.3	7.7	77.3	0.3	7.3	0.1
26	1.03	5.4	0.9	5.3	24.6	2.3	2382	66.8	27.2	0.9	0.5	14.9	96.3	0.7	7.3	0.16

Predicting Areas of Nuisance Curlyleaf Pondweed Growth in Big Round

For curlyleaf pondweed, four sediment parameters are correlated with various types of curlyleaf pondweed growth. The means of the sediment determinations as they correlate to three potential growth categories (low, medium, and high) are shown in Table 4. For heavy nuisance curlyleaf growth to occur in a lake, like Big Round, four parameters from a sediment site need to be within range of the reference nuisance category. For Big Round, none of the sediments tested had all four sediment characteristics that apparently are necessary to produce heavy nuisance growth of curlyleaf pondweed on an annual basis (McComas, unpublished). However, about half of the shallow water areas of the lake could support light nuisance growth. Light nuisance growth can still hinder navigation and contribute phosphorus to algae blooms, but it is not as severe as the heavy nuisance conditions. Aquatic plant surveys will help to characterize the curlyleaf status and check the predicted growth patterns in the future.

Table 4. Big Round sediment data and ratings for potential nuisance curlyleaf pondweed growth.

Sample ID	Bulk density (g/cm^3)	Organic Matter (%)	pH (su)	Mn:Fe Ratio	Potential for Nuisance Curlyleaf Pondweed Growth
non-nuisance	1.04	5	6.8	0.22	Low
light nuisance	0.94	11	6.2	0.17	Med
heavy nuisance	<0.51	>20	>7.7	>0.64	[illegible]
1	0.6	13.2	5.6	0.03	Medium
2	1.47	0.4	7.1	[illegible]	Medium
3	1.53	0.4	[illegible]	0.1	Medium
4	1.41	0.8	7.4	0.09	Low
5	1.23	0.8	[illegible]	0.14	Medium
6	1.44	0.7	[illegible]	0.25	Medium
7	1.49	0.3	[illegible]	0.12	Medium
8	1.46	0.4	[illegible]	0.2	Medium
9	1.42	0.3	[illegible]	0.17	Medium
10	1.13	3.3	7	0.15	Low
11	0.87	10.7	7	0.19	Low
12	0.67	6.7	6.7	0.14	Medium
13	1.5	0.5	[illegible]	0.14	Medium
14	1.31	1	[illegible]	0.12	Medium
15	1.01	1.7	[illegible]	0.22	Medium
16	1.37	1	7.4	0.14	Low
17	1.44	0.8	[illegible]	0.18	Medium
18	1.51	0.5	[illegible]	0.15	Medium
19	0.77	2.5	[illegible]	0.37	Medium
20	1.26	1.5	7.5	0.2	Low
21	[illegible]	[illegible]	6.7	0.08	Medium
22	0.74	8.4	7.5	[illegible]	Medium
23	[illegible]	[illegible]	6.7	0.11	Medium
24	[illegible]	[illegible]	6.8	0.1	Medium
25	1.24	1.6	7.3	0.1	Low
26	1.08	2.3	7.3	0.16	Low

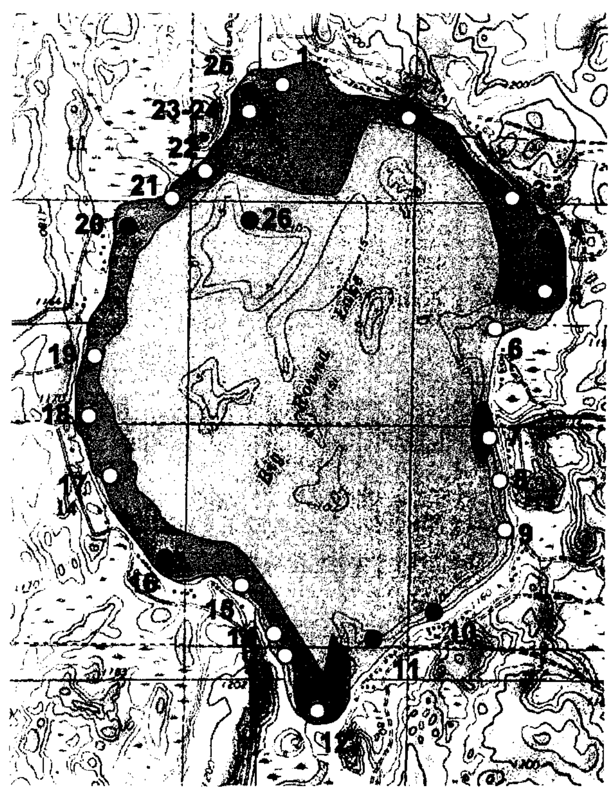

Figure 4. Sediment sample locations are shown with dots. The dot color indicates the potential for the growth characteristic of curlyleaf pondweed to grow at that site. Key: green dot = low; yellow dot = medium; red dot = high potential.

Figure 5a. Example of a light nuisance curlyleaf pondweed condition found in Alimagnet Lake, Burnsville, Minnesota. This is the condition most often observed in Big Round Lake.

Figure 5b. An example of a heavy growth of curlyleaf pondweed found in Crystal Lake, Burnsville, Minnesota. This heavy growth condition where curlyleaf tops out in a continuous canopy is rare in Big Round Lake.

Predicting Areas of Nuisance Eurasian Watermilfoil Growth in Big Round Lake

Based on results from other studies conducted by Blue Water Science, there has been a correlation of sediment exchangeable ammonia concentrations over 10 ppm and an organic matter content of less than 20% with nuisance growth of Eurasian watermilfoil. Using the 10 ppm nitrogen threshold and the 20% organic matter limit, as a basis for prediction, we have constructed a map showing the areas in Big Round Lake that have the potential to support nuisance milfoil growth (Figure 6). We predict that 2 areas (Sites 1 and 12) could exhibit nuisance growth covering a total of about 20 acres.

Table 5. Big Round Lake sediment data and ratings for potential nuisance EWM growth.

Sample Number	NH_4 ($\mu g/cm^3$)	Organic Matter (%)	Potential for Nuisance EWM Growth
non-nuisance or light nuisance	<10	>20	Low (green) to Medium (yellow)
heavy nuisance	>10	<20	High (red)
1	[illegible]	[illegible]	[illegible]
2	1.9	[illegible]	Low
3	1.6	[illegible]	Low
4	1.8	[illegible]	Low
5	1.5	[illegible]	Low
6	1.5	[illegible]	Low
7	1.6	[illegible]	Low
8	1.7	[illegible]	Low
9	1.5	[illegible]	Low
10	4.4	[illegible]	Low
11	4.7	[illegible]	Medium
12	[illegible]	[illegible]	[illegible]
13	3.7	[illegible]	Low
14	4.2	[illegible]	Low
15	4.5	[illegible]	Low
16	2	[illegible]	Low
17	2.6	[illegible]	Low
18	1.7	[illegible]	Low
19	6	[illegible]	Medium
20	3.5	[illegible]	Low
21	9.9	51.5	Medium
22	3.8	[illegible]	Medium
23	[illegible]	37.7	Medium
24	9.6	35.9	Medium
25	4.4	[illegible]	Medium
26	6.1	[illegible]	Medium

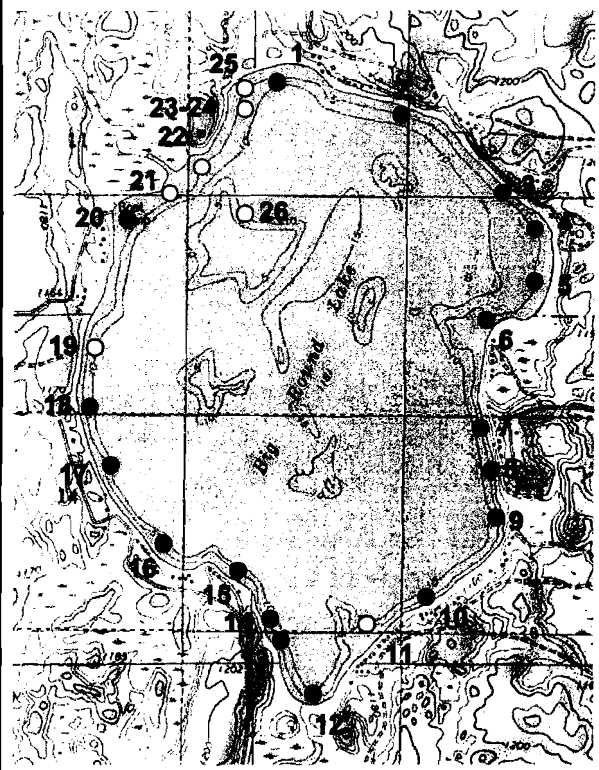

Figure 6. Sediment sample locations are shown with dots. The dot color indicates the potential for the growth characteristic of Eurasian watermilfoil to grow at that site. Key: green dot=low; yellow dot =medium; red dot=high potential.

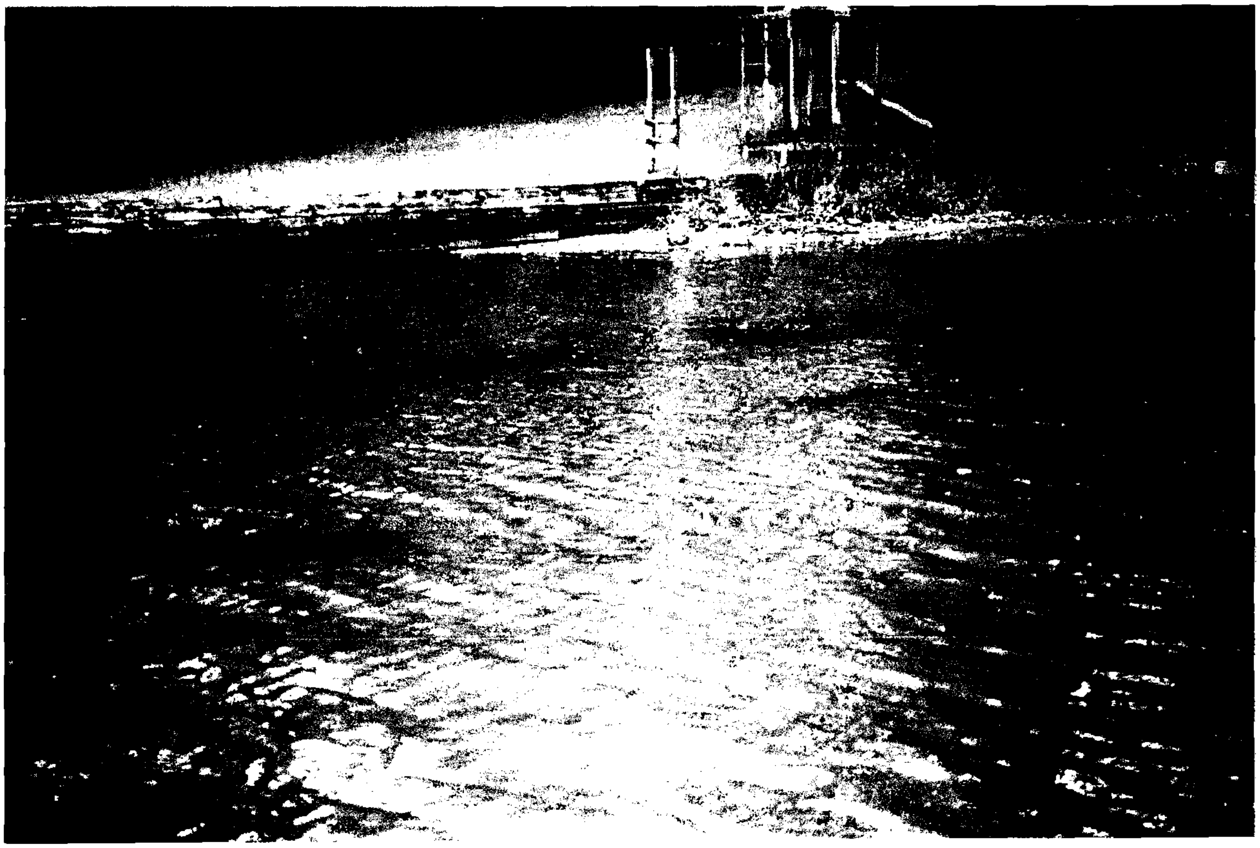

Figure 7a. Example of a light nuisance EWM condition in Upper Prior Lake, Dakota County, Minnesota.

Figure 7b. Example of a heavy nuisance EWM condition in White Bear Lake, Washington County, Minnesota.

Exotic Aquatic Plant Management Ideas for the Big Round

Curlyleaf pondweed: Curlyleaf pondweed was surveyed in Big Round Lake in 2003 and in 2004 by Blue Water Science and the Lake District. Early summer surveys are needed to characterize the distribution and abundance of this exotic plant. Sediment sample results indicate curlyleaf should not exhibit widespread heavy growth characteristics although light nuisance to non-nuisance growth could occur along a fairly widespread area.

Curlyleaf pondweed control is recommended which will improve recreational conditions and reduce a phosphorus source that originates with the curlyleaf dieback in early summer. The recommended option is an experimental sediment iron treatment. The second option for curlyleaf control is mechanical harvesting and the third control option is a herbicide treatment program.

After curlyleaf pondweed is brought under control, spot treatments with a herbicide may be needed to keep curlyleaf pondweed under control.

Eurasian watermilfoil: At the end of 2004, there was no observed Eurasian watermilfoil growth in Big Round Lake. It is recommended that in the future, lake residents monitor for milfoil. Training sessions should be organized by the Lake Improvement District.

Because milfoil is expected to present nuisance conditions in only a couple of small areas (less than 20 acres overall), spot herbicide use will probably address problems if milfoil ever invades Big Round Lake.

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