Collins Lake

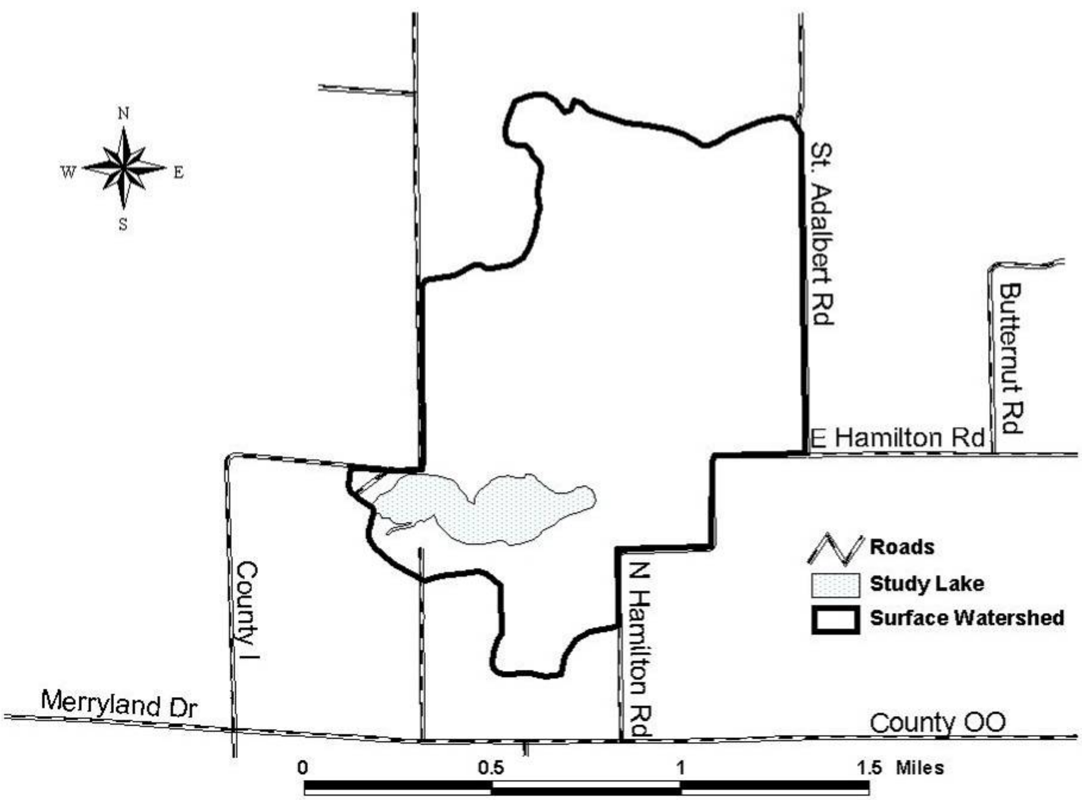
Introduction

Collins Lake is a 41 acre **soft water seepage lake** located in the towns of Alban and Sharon, three miles southwest of Rosholt. It is a deep lake with a maximum depth of 56 feet and an estimated volume of 1,036 acre-feet. Collins Lake has a light brown tint to the water and a thermocline that develops at approximately 11 feet. The estimated **retention time** is 2.1 years. The bottom material is diverse, including **marl**, sand, gravel, muck, rubble, and some boulders. The fishery of Collins Lake consists of panfish, largemouth bass, walleye, and northern pike. A large County park borders the northern shore with a beach, campground, picnic area, and a boat launch. The County also has land on the steep slopes of the south side. Currently, residential development is largely limited to the west end of the lake.

Land Use and Watershed

The surface **watershed** of Collins Lake is 1,015 acres (Figure 1). The major land use is split between forest (37%) and irrigated agriculture (32%) (Figure 2). From 1948 to 1968 non-irrigated agriculture and forest were the prominent land uses in the surface **watershed**. Sometime between 1968 and 1990, however, over half of the non-irrigated cropland was converted to irrigated cropland. Forestland has increased slightly since 1948. Shrub vegetation has fluctuated during this period with an overall decrease overall since 1948. Residential and transportation use has remained minimal over the years (Figure 3).

Figure 1. Collins Lake surface watershed boundary.



*Terms in bold, see glossary pp 16-21

Figure 2. Land Use in the Collins Lake surface watershed 2002.

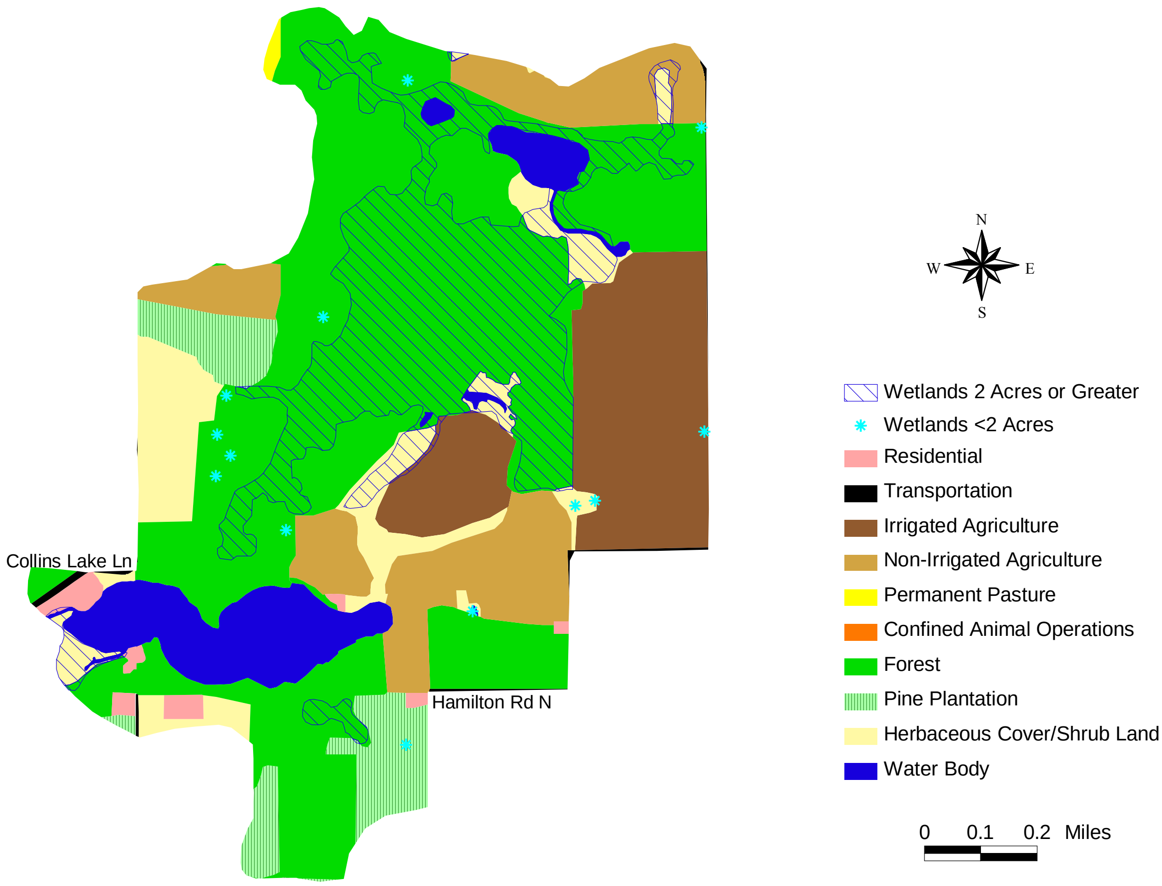
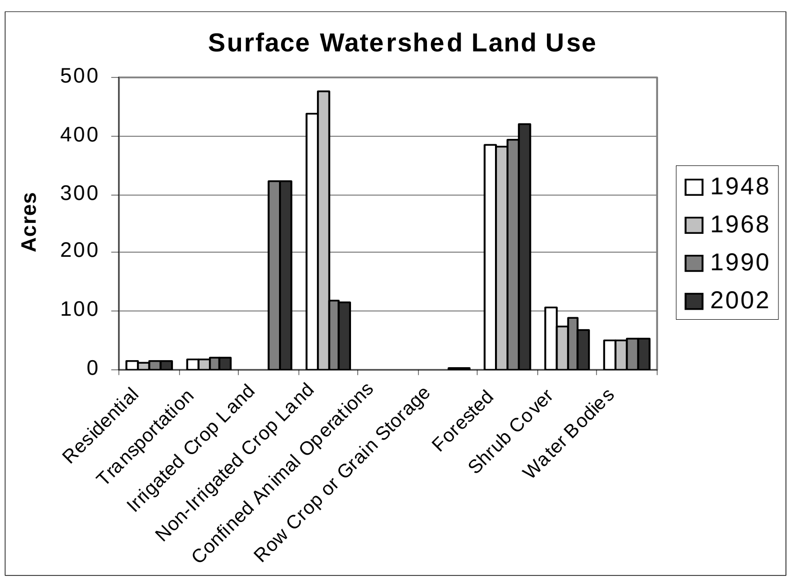


Figure 3. Land Use in the Collins Lake surface watershed 1948-2002.

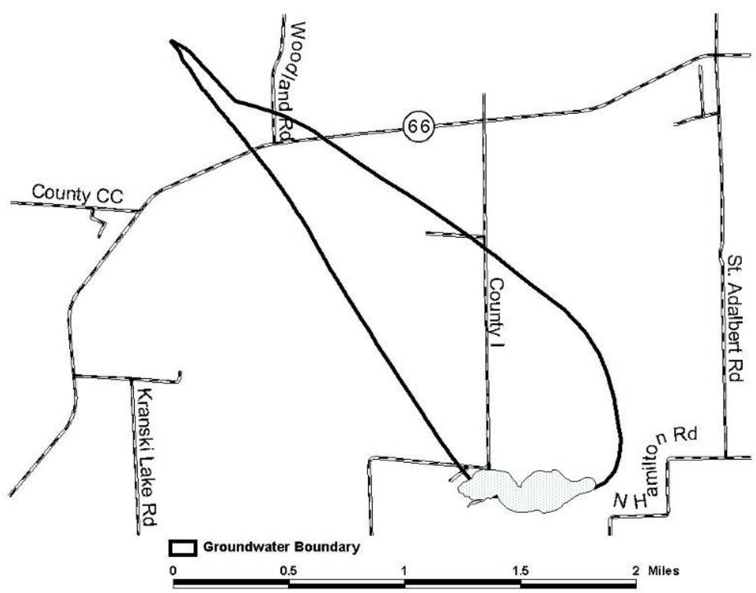


*Terms in bold, see glossary pp 16-21

The **groundwater watershed** for Collins Lake is 758 acres (Figure 4). The dominant land use is forest (50%), followed by non-irrigated cropland (22%) and shrub cover (19%) (Figure 5). Between 1948 and 1968 it appears as though a portion of forest was harvested and the land use converted to shrub cover. Since 1968, however, forestland has been increasing slightly. Shrub vegetation has increased considerably since 1948. Irrigated cropland entered the **watershed** sometime between 1968 and 1990 but remains less than 3% of the land usage in the **groundwater watershed** (Figure 6).

According to Portage County records there are six potentially failing septic systems in the surface **watershed**, one in the **groundwater watershed**, and two within both **watersheds**. There is no indication of any former landfill sites within either of these **watersheds**.

Figure 4. Collins Lake groundwater watershed boundary.



*Terms in bold, see glossary pp 16-21

Figure 5. Land use in the Collins Lake groundwater watershed 2002.

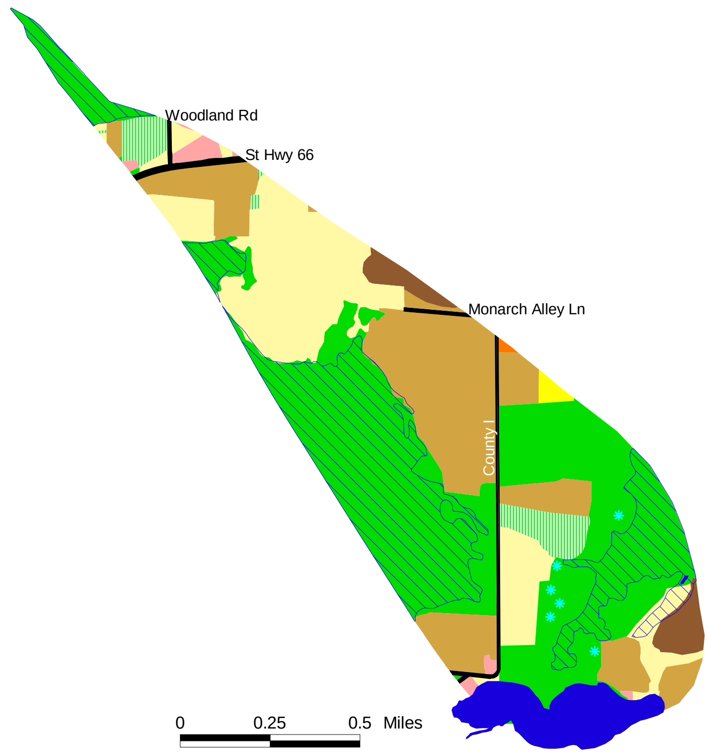
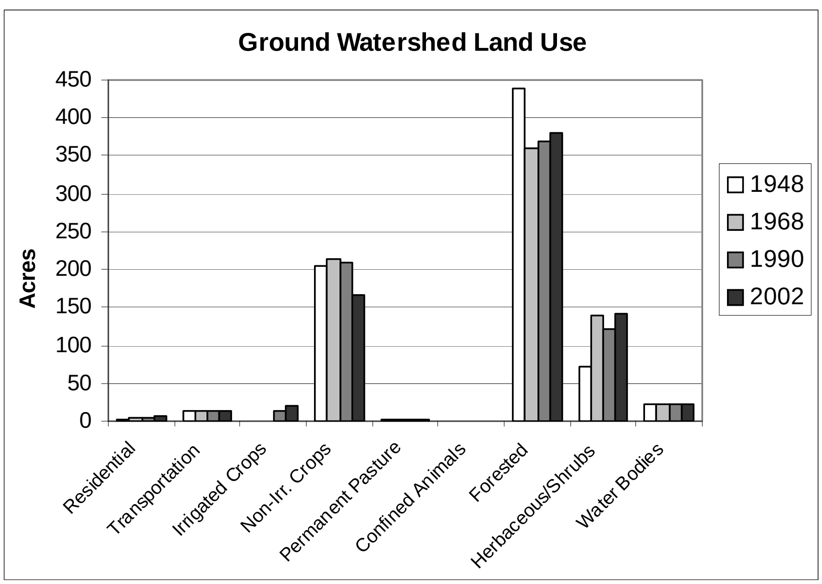


Figure 6. Land use in the Collins Lake groundwater watershed 1948-2002.

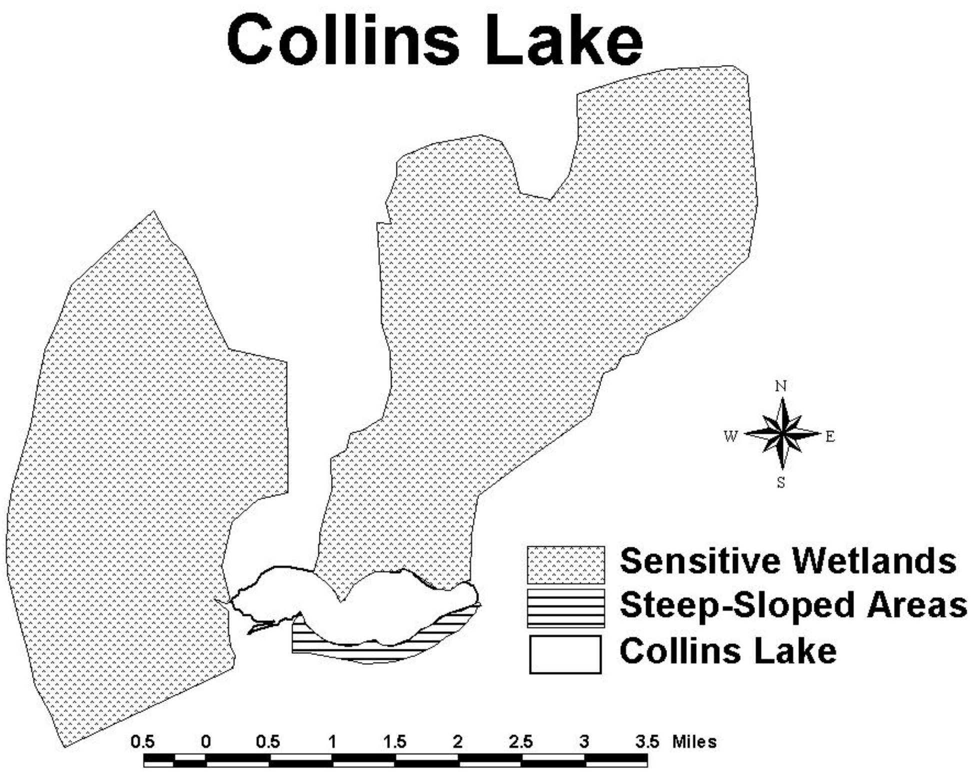


*Terms in bold, see glossary pp 16-21

Upland Sensitive Areas

The survey of upland sensitive areas was conducted to note areas immediately around the lakeshore that are particularly valuable, or sensitive to disruption. Collins Lake has two large wetlands nearby, one to the west of the lake and the other extending from the northern shore. There is also an area of steep banks lining part of the south shore (Figure 7).

Figure 7. Upland sensitive areas near Collins Lake.



Shoreline Vegetation, Reptiles, and Amphibians

Amphibians (frogs and toads) were included in this survey because with their permeable skin and biphasic lifecycle (meaning that the young live in water while adults can survive on land) they are considered excellent indicators of overall ecosystem health. Furthermore, both turtles and amphibians utilize both aquatic and terrestrial habitats and especially the shoreline interface between these two habitats, and thus are of particular relevance.

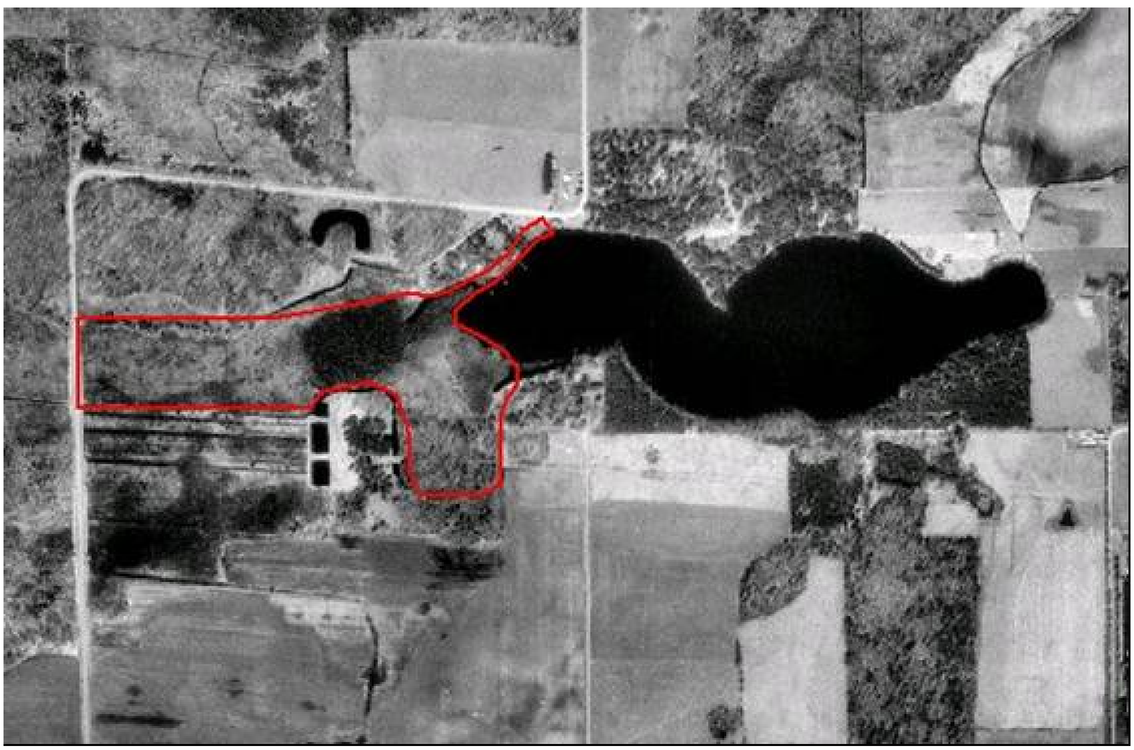
Large sections of continuous natural shoreline on lakes are ideal habitats for many frog species. Natural areas with large amounts of submergent, emergent, and floating-leaf vegetation provide protection and a place for attachment of eggs during the breeding season. The upland areas surrounding these lakes also provide important habitat as many frog species migrate to lakes and other bodies of water in the spring or fall to breed and spend the summer months foraging in the uplands. Several species also use the surrounding uplands for overwintering. The turtle species found associated with lakes are predominantly aquatic, usually departing from the water only to

*Terms in bold, see glossary pp 16-21

deposit eggs in a nest. Nests are usually on south facing slopes above the shoreline where there is open vegetation and sandy soil. The newly hatched young then find their way to the water. Thus, both turtles and anurans are intimately associated with lakes and the associated habitats of a **watershed**.

Five frog species were observed during the amphibian survey of Collins Lake (wood frog [*Rana sylvatica*], spring peeper [*Pseudacris crucifer*], northern leopard frog [*Rana pipiens*], American toad [*Bufo americanus*], and green frog [*Rana clamitans*]). The primary amphibian habitat is located on the southwest side of the lake (Figure 8). Some of the key features of this habitat include areas of marsh with large amounts of submergent, emergent, and floating-leaf vegetation. During the survey of reptiles Collins Lake was found to contain two species of turtles (painted turtle [*Chrysemys picta*] and snapping turtle [*Chelydra serpentina*]). The good news is that several frog species are present and large sections of undisturbed natural shoreline exist. However, the bad news is that several sections of shoreline are disturbed by development.

Figure 8. Regions of primary amphibian habitat around Collins Lake.

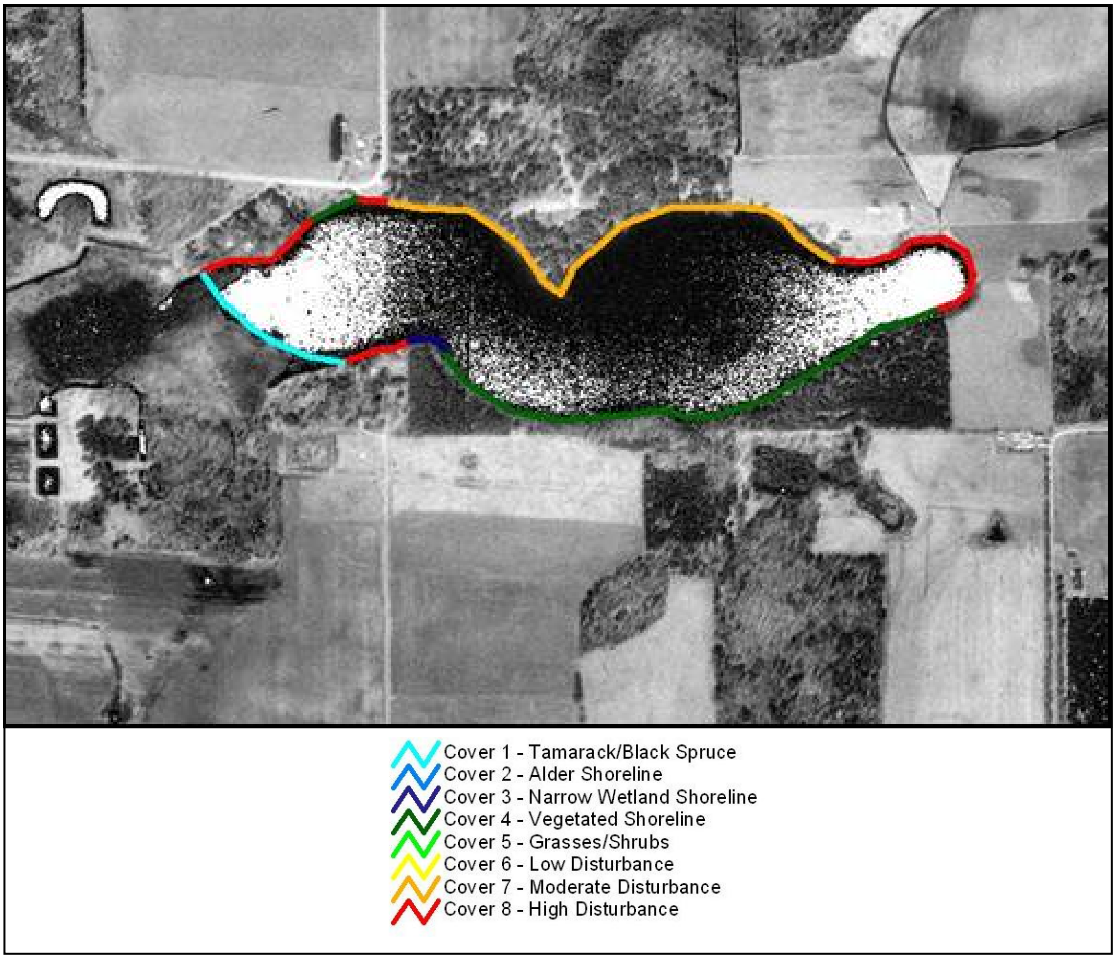


Slightly more that 34% of the Collins Lake shoreline is categorized as vegetated. Vegetated shoreline is characterized as being upland areas with dense vegetation comprised of tall grasses or shrubs that lacks a rocky component (Figure 9). Eleven percent of the shoreline is classified as black spruce/tamarack wetland. Tamarack/black spruce wetlands are characterized as wetland shore zone with a sweet gale or leatherleaf understory and a black spruce or tamarack canopy. Another 2.8 percent of the shoreline is composed of narrow wetland shore. Narrow wetlands are characterized as being wetland areas that extend less than 5 meters onto the shore and have an adjacent undeveloped upland area.

*Terms in bold, see glossary pp 16-21

Around Collins Lake, 52% of the shoreline is considered disturbed; 32% of the shoreline vegetation is classified as moderately disturbed developed areas and 19.8% is considered to be highly disturbed developed area. An area that has moderate vegetation disturbance is an area of shore that may contain a mowed lawn but has an intact overstory. An area that exhibits high vegetation disturbance is defined as a beach, **rip rap**, or sea wall, or where the shore is mowed to the water line.

Figure 9. Shoreline vegetation around Collins Lake.



Aquatic Plants

There are **93** species of aquatic **macrophytes** (90 species of **vascular plants**, 3 species of non-vascular plants) that have been found at Collins Lake. This is significantly above average for Portage County lakes. The average **coefficient of conservatism (c-value)** of the 90 species of **vascular plants** is **5.5** which is above average when compared to the other Portage County lakes. The **floristic quality index** is **52.2** which is also above average for Portage County lakes.

*Terms in bold, see glossary pp 16-21

Collins Lake holds the largest flora of aquatic and wetland species recorded for Portage County. It is one of the most thoroughly studied lakes in central Wisconsin, with herbarium records back to 1964 and notes on the aquatic flora beginning in 1968.

Although no endangered, threatened, or special concern species have been found in the lake, several plants which occur here are quite rare in this part of Wisconsin, including stiff (or spiny-spored) quillwort (*Isoetes echinospora*) and creeping spearwort (*Ranunculus flammula*). However, many of the notable or relatively rare plants, such as the quillwort, are now difficult to find, and others, such as the spearwort, have not been found in recent years. Species which are more aggressive or indicative of lakes with lower floristic quality are increasing. Unlike 30 - 35 years ago, submersed plants are now covered with filamentous **algae** and **marl**; submersed plants no longer grow at the greater depths where we could find them years ago. Reed canary-grass (*Phalaris arundinacea*) arrived about 35 years ago and is spreading along some of the shore. The quality and diversity of the aquatic flora of Collins Lake will probably continue to decline unless nutrients, run-off, and **turbidity** are reduced. Furthermore, the establishment of major invasive plants, such as Eurasian water-milfoil (*Myriophyllum spicatum*), curlyleaf pondweed (*Potamogeton crispus*), and purple loosestrife (*Lythrum salicaria*) would likely result in a drastic change in the character of the lake.

Current Water Quality Conditions

Water quality in lakes is assessed by measuring different characteristics including temperature, dissolved oxygen, water **clarity**, **chlorophyll *a***, water chemistry, and the algal community. Temperature was measured in Collins Lake during each sampling event. Collins Lake is typical of many Wisconsin lakes in that it is **stratified** during the summer and winter and water mixes from top to bottom in spring and summer (Figure 10). Profiles of dissolved oxygen show that during much of the summer in water deeper than 9 feet the dissolved oxygen is below the 5 **mg/L** needed to support most aquatic biota (Figure 11). This is of significant concern because much of the cool deeper water in the lake is not available for use during the warm summer.

*Terms in bold, see glossary pp 16-21

Figure 10. Profile of temperature in Collins Lake 2002-2004.

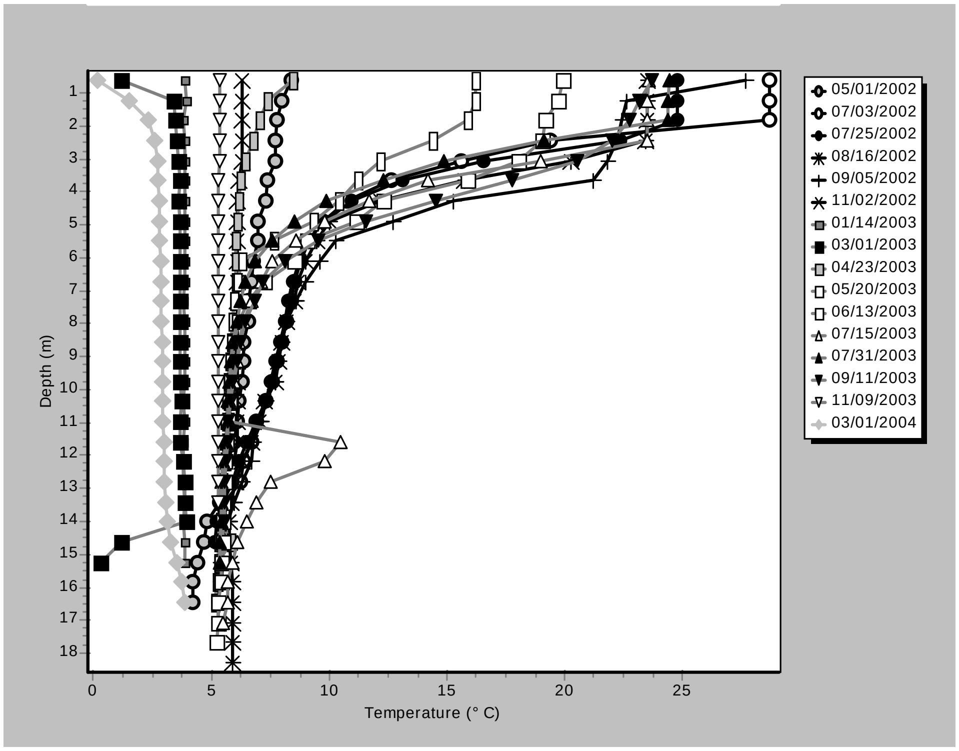
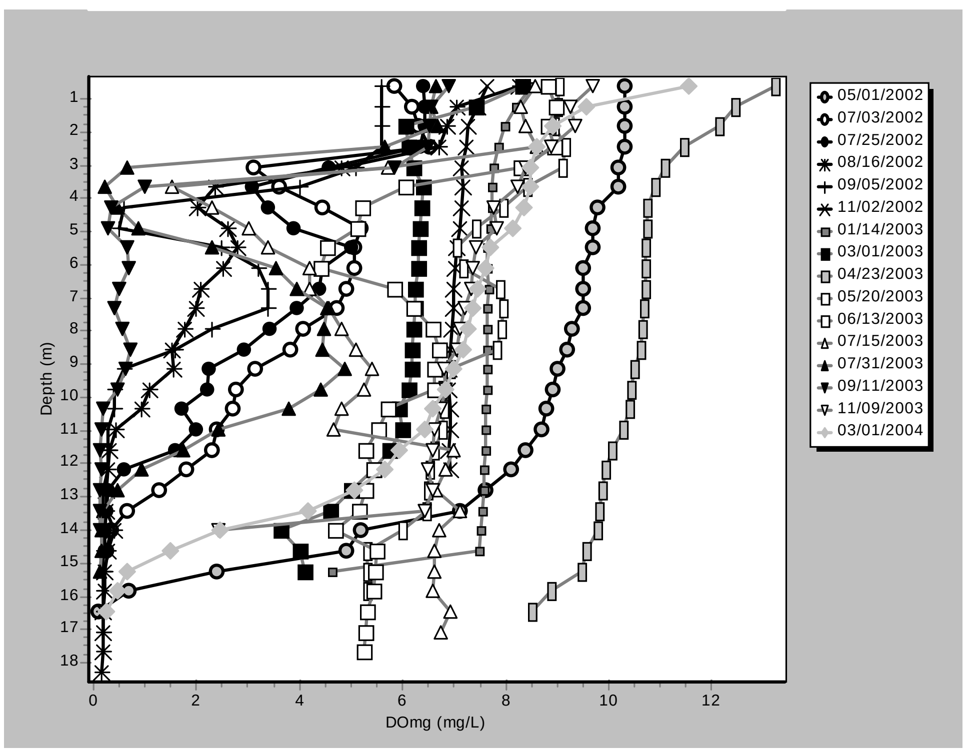


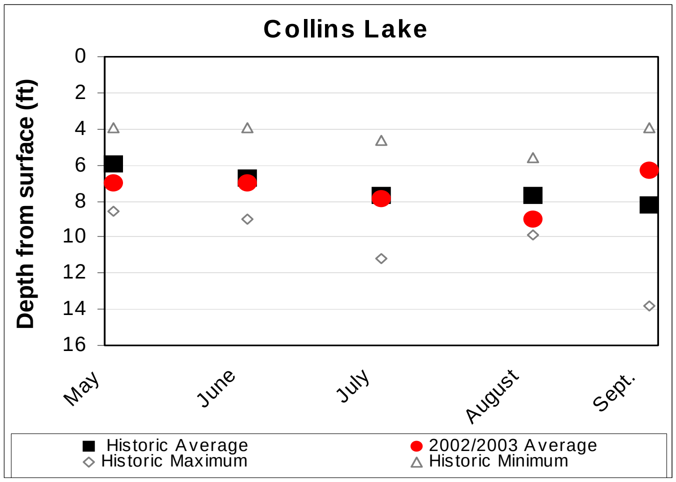
Figure 11. Profile of dissolved oxygen in Collins Lake 2002-2004.



*Terms in bold, see glossary pp 16-21

Water **clarity** is a measure of how deep light can penetrate. It is an aesthetic measure and is related to how deep **rooted aquatic plants** can grow. Water **clarity** is affected by water **color** and suspended materials in the water (**turbidity**). **Turbidity** consists of **suspended solids**, such as suspended sediments and **algae** (**chlorophyll *a***). The water **clarity** in Collins Lake is considered fair. The average **Secchi disc** depth reading for **drainage lakes** in Portage County is 10 feet; Collins Lake appears to have poorer **clarity** than this (Figure 12). The natural brown stained water was responsible for a relatively high measure of **color** which reduces light penetration; however, **chlorophyll *a*** measures were also high. Concentrations of **chlorophyll *a*** ranged from 0.01 to 17 **mg/L** with an average of 8.6 **mg/L**. **Turbidity** measures were low (Table 1). The water **clarity** in Collins Lake during the 2002-03 growing seasons was similar to the historical growing season average. The month of August shows the best water **clarity** and the month of September the poorest. These fluctuations throughout the summer are normal as **algae** populations and **sedimentation** increase and decrease. The higher than average phosphorous concentration and water **color** from wetland vegetation account for the lower **Secchi disc** readings.

Figure 12. Monthly average water clarity measurements in Collins Lake 2002-2003 and historic average, maximum and minimums.



Nutrients (**phosphorus** and **nitrogen**) are important measures of water quality in lakes because they are used for growth by **algae** and aquatic plants (similar to houseplants and crops). Total **phosphorus** concentrations were high in most of the samples, ranging from 12 to 70 ug/L. Averages for most seasons are sufficient for significant and frequent **algae** blooms and aquatic plant growth. Organic **nitrogen** is the most abundant form of **nitrogen**; some of this is available for aquatic plant uptake and some of it is not.

Chloride levels, and to a lesser degree **sodium** and **potassium** levels, are commonly used as an indicator of how strongly a lake is being impacted by human activity. Most of these elements had low measures, but **chloride** concentrations were moderately elevated and may be a result of inputs from road salt, animal waste, fertilizers, and/or septic systems. **Atrazine** was found in low concentrations in the lake water (0.26 and 0.13 μg/L), however some toxicity studies have

*Terms in bold, see glossary pp 16-21

indicated that reproductive system abnormalities can occur in frogs at these levels. The presence of **atrazine** indicates that other agri-chemicals may also be entering Collins Lake.

Table 1. 2002-2003 water quality seasonal averages in Collins Lake.

Collins Lake	TP (ug/L)	RP (ug/L)	TN (mg/L)	NO2+NO3 (mg/L)	NH4 (mg/L)	Alkalinity (mg/L)	Total Hardness (mg/L)	Calcium Hardness (mg/L)	Color (CU)	Turbidity (NTU)	Chlorophyll a (ppm)
Spring Averages	36.0	5.5	1.22	0.25	0.05	69.9	83.0	46.5	62	1.3	9.6
Summer Averages	27.5	9.2	1.06	0.11	0.02	69.7	84.0	46.4	67	1.3	7.6
Fall Averages	47.0	18.5	1.18	0.11	0.11	69.0	86.0	48.0	61	1.7	
Winter Averages	41.5	13.0	1.19	0.35	0.05						
2002-2004 Averages	32.7	11.3	1.14	0.19	0.05	69.5	84.3	46.9	64	1.4	7.9

TP=total **phosphorus**; RP=reactive or soluble **phosphorus**; TN=total **nitrogen**; NO2+NO3=**nitrite** and **nitrate nitrogen**; NH4=**ammonia nitrogen**

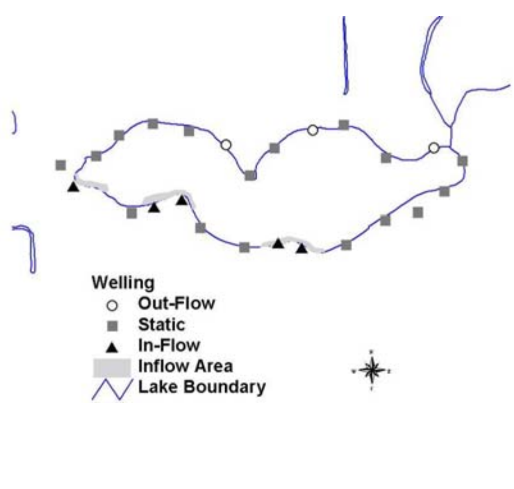
Table 2. 2002-2003 Collins Lake average water chemistry and reference value

Collins Lake	Low	Medium	High	Reference Values	Low	Medium	High
Sulfate	7.32			Sulfate	<10	10-20	>20
Chloride		4.28		Chloride	<3	3-10	>10
Potassium	1.82			Potassium*	<2.16	2.16-4.30	>4.30
Sodium	2.03			Sodium*	<2.28	2.28-5.09	>5.09

**Ranges of low, medium, high defined by taking the median values from the lake study and dividing into thirds.*

Twenty-five mini wells were installed into the **substrate** of Collins Lake to determine **groundwater** inflow/outflow to/from the lake (Figure 13). Most of the shallow **groundwater** inflow occurred on the south and west regions of the lake, however due to the variability in **substrate** (and hence connection between **groundwater** and lake water) **groundwater** may be moving into areas of Collins Lake that were not tested. Samples could not be collected for water quality analysis.

Figure 13. Locations in Collins Lake showing groundwater inflow/no flow/outflow from mini-piezometer measurements and winter observations.



*Terms in bold, see glossary pp 16-21

Algal Community

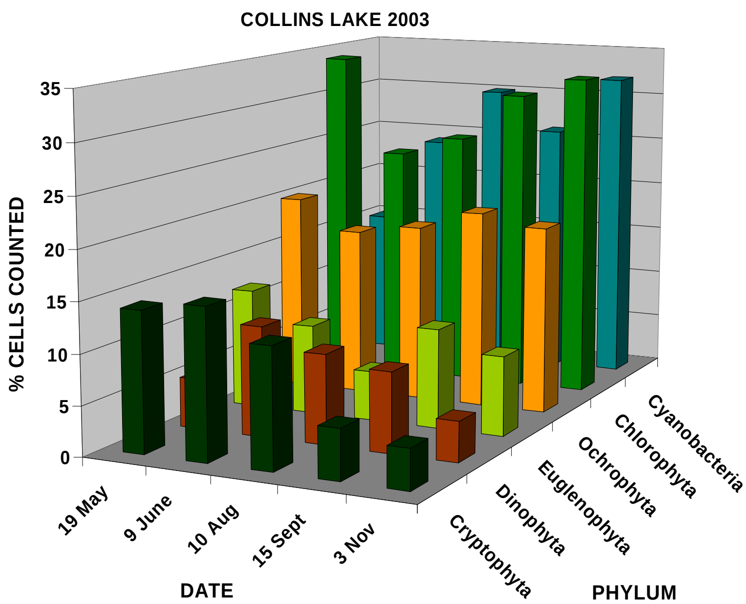
The algal community in Collins Lake was dominated by green algae (Chlorophyta) and blue-green algae (Cyanobacteria) (Table 3). In the 2200+ cells counted during this period there were 16 genera of Cyanobacteria, 19 genera of Chlorophyta, 15 genera of Ochrophyta (including 13 diatom genera), 3 genera of Euglenophyta, 2 general of Dinophyta, and 1 genus of Cryptophyta identified. The green algae represented between 24-34% (mean = 30%) of all cells counted and the blue-green algae represented between 15-32% (25%) of all cells counted. The green algae were the dominant group in May, June, September, and November while the blue-green algae were the dominant group in August (Figure 14). The ochrophytes (Ochrophyta), mostly diatoms, were the third most abundant phylum, by cells counted, representing between 17-20% (mean = 19%). This group was also the second most abundant group in the May sample.

Table 3. Algal phyla and mean seasonal composition in Collins Lake from May to November 2003.

COLLINS LAKE

PHYLUM	% CELLS COUNTED BY PHYLUM AND DATE					**MEAN**
	19 May	9 June	10 Aug	15 Sept	3 Nov	
Cyanobacteria	15	24	30	26	32	25
Chlorophyta	34	24	26	31	33	30
Ochrophyta	20	17	18	20	19	19
Euglenophyta	12	9	5	10	8	9
Dinophyta	5	11	9	8	4	7
Cryptophyta	14	15	12	5	4	10

Figure 14. Algal community composition by date in Collins Lake from May to November 2003 (total phylum cells counted divided by total cells counted).



*Terms in bold, see glossary pp 16-21

The green algal genus *Scenedesmus* dominated the May and November sample periods (Figure 15). It was also second or third most common in the other three sampling periods. This very common phytoplankter has high intrinsic growth rates and can numerically dominate a sample without contributing overwhelming amounts of biomass. The only other green **alga** in the top three positions was *Chlamydomonas* in November. The colonial blue-green algal genus *Woronichinia* dominated the June and August samples. *Anabaena*, a filamentous cyanobacterium, dominated the September sample. Blue-greens generally start slow and develop large populations over the course of the growing season. The size of the ending populations often depends on starting inoculum and nutrient dynamics in the **watershed** and lake. Several genera of euglenophytes (*Phacus*) and cryptophytes (*Cryptomonas*) were common and often the second or third most abundant taxa. These six genera were the top three dominants in all cases (Table 4).

The algal community, when considered relative to the **chlorophyll**, **phosphorus**, and **nitrogen** values for Collins Lake, indicates a very **mesotrophic** lake. The 56 genera identified during the sample periods are all relatively common in the region and the muted dynamics of the algal community during the growing season (dominated by a few taxa of greens and blue-greens) are typical of a fairly **mesotrophic** lake like Collins Lake. Also typical of very **mesotrophic** lakes is the strong presence of facultative heterotrophic genera like the euglenoids and cryptophytes. These organisms are an indication of substantial organic matter being present at times in the lake. These motile heterotrophs (like *Cryptomonas* and *Phacus*) can use organic materials for food in place of or in supplement to **photosynthesis**. Water **clarity** during the early season (dominated by the green **algae**) was fair. This **clarity** dropped substantially during the mid-late growing season when the **blue-green algae** began to dominate.

Figure 15. Algal community composition by phylum in Collins Lake from May to November 2003.

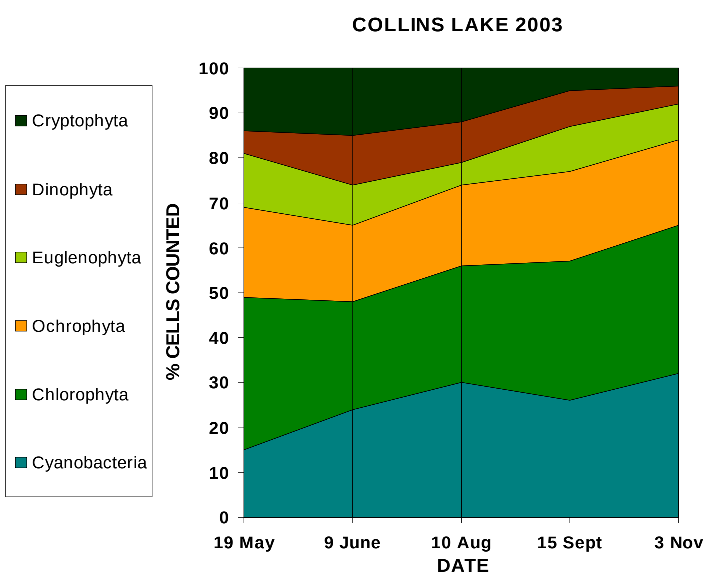


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Table 4. Most common algal genera by date in Collins Lake from May to November 2003.

DATE	TOP THREE TAXA (MOST ABUNDANT, LEFT TO RIGHT)		
19 May	*Scenedesmus*	*Cryptomonas*	*Phacus 1*
9 June	*Woronichinia*	*Cryptomonas*	*Scenedesmus*
10 August	*Woronichinia*	*Cryptomonas*	*Scenedesmus*
15 September	*Anabaena*	*Scenedesmus*	*Phacus 1*
3 November	*Scenedesmus*	*Anabaena*	*Chlamydomonas*

Collins Lake Study Highlights

- Collins Lake has two large wetlands nearby, one to the west of the lake and the other extending from the northern shore. There is also an area of steep banks lining part of the south shore.
- Five frog species were observed during the amphibian survey of Collins Lake (wood frog, spring peeper, northern leopard frog, American toad, and green frog). The primary amphibian habitat is located on the southwest side of the lake.
- Slightly more that 34% of the Collins Lake shoreline is categorized as vegetated, 11% is classified as black spruce/tamarack wetland, and 2.8% is narrow wetland shore. Around Collins Lake, 52% of the shoreline is considered disturbed.
- Collins Lake holds the largest flora of aquatic and wetland species recorded for Portage County.
- Although no endangered, threatened, or special concern species have been found in the lake, several plants which occur here are quite rare in this part of Wisconsin, including stiff (or spiny-spored) quillwort and creeping spearwort. However, many of the notable or relatively rare plants, such as the quillwort, are now difficult to find, and others, such as the spearwort, have not been found in recent years. Species which are more aggressive or indicative of lakes with lower floristic quality are increasing. Unlike 30 - 35 years ago, submersed plants are now covered with filamentous **algae** and **marl**; submersed plants no longer grow at the greater depths where we could find them years ago.
- Reed canary-grass arrived about 35 years ago and is spreading along some of the shore. The quality and diversity of the aquatic flora of Collins Lake will probably continue to decline unless nutrients, run-off, and **turbidity** are reduced. Furthermore, the establishment of major invasive plants, such as Eurasian water-milfoil, curlyleaf pondweed, and purple loosestrife, would likely result in a drastic change in the character of the lake.
- Total **phosphorus** concentrations were high in most of the samples at levels that are sufficient for significant and frequent **algae** blooms and aquatic plant growth. Organic **nitrogen** is the most abundant form of **nitrogen**; some of this is available for aquatic plant uptake and some of it is not.
- **Chloride** concentrations were moderately elevated and may be a result of inputs from road salt, animal waste, fertilizers, and/or septic systems. **Atrazine** was found in low concentrations in the lake water, however some toxicity studies have indicated that reproductive system abnormalities can occur in frogs at these levels. The presence of **atrazine** indicates that other agri-chemicals may also be entering Collins Lake.

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- The algal community, when considered relative to the **chlorophyll**, **phosphorus**, and **nitrogen** values for Collins Lake, indicates a very **mesotrophic** lake. The **algae** species identified are all relatively common in the region and the muted dynamics of the algal community during the growing season are typical of a fairly **mesotrophic** lake like Collins Lake. Also typical of very **mesotrophic** lakes in the strong presence of facultative heterotrophic genera like the euglenoids and cryptophytes. These organisms are an indication of substantial organic matter being present at times in the lake. Water **clarity** during the early season (dominated by the green **algae**) was fair. This **clarity** dropped substantially during the mid-late growing season when the **blue-green algae** began to dominate.

Glossary

Algae:

One-celled (phytoplankton) or multicellular plants either suspended in water (plankton) or attached to rocks and other substrates (periphyton). Their abundance, as measured by the amount of chlorophyll a (green pigment) in an open water sample, is commonly used to classify the trophic status of a lake. Numerous species occur. Algae are an essential part of the lake ecosystem and provides the food base for most lake organisms, including fish. Phytoplankton populations vary widely from day to day, as life cycles are short.

Alkalinity:

A measure of the amount of carbonates, bicarbonates, and hydroxide present in water. Low alkalinity is the main indicator of susceptibility to acid rain. Increasing alkalinity is often related to increased algae productivity. Expressed as milligrams per liter (mg/L) of calcium carbonate (CaCO3), or as microequivalents per liter (ueq/l). 20 ueq/l = 1 mg/L of $CaCO_3$.

Ammonia, Ammonium:

A form of nitrogen found in organic materials and many fertilizers. It is the first form of nitrogen released when organic matter decays. It can be used by most aquatic plants and is therefore an important nutrient. It converts rapidly to nitrate (NO_3) if oxygen is present. The conversion rate is related to water temperature. Ammonia is toxic to fish at relatively low concentrations in pH-neutral or alkaline water. Under acid conditions, non-toxic ammonium ions (NH_4^+) form, but at high pH values the toxic ammonium hydroxide (NH_4OH) occurs. The water quality standard for fish and aquatic life is 0.02 mg/L of NH_4OH. At a pH of 7 and a temperature of 68^o F (20^o C), the ratio of ammonium ions to ammonium hydroxide is 250:1; at pH 8, the ratio is 26:1.

Atrazine:

The nation’s most widely used weedkiller for both grassy and broadleaf weeds.

Blue-Green Algae:

Algae that are often associated with problem blooms in lakes. Some produce chemicals toxic to other organisms, including humans. They often form floating scum as they die. Many can fix nitrogen (N_2) from the air to provide their own nutrient.

Chloride (Cl-):

Chlorine in the chloride ion (Cl^-) form has very different properties from chlorine gas (Cl_2), which is used for disinfecting. The chloride ion (Cl^-) in lake water is commonly considered an indicator of human activity. Agricultural chemicals, human and animal wastes, and road salt are the major sources of chloride in lake water.

*Terms in bold, see glossary pp 16-21

Chlorophyll *a*:

Green pigment present in all plant life and necessary for photosynthesis. The amount present in lake water depends on the amount of algae and is therefore used as a common indicator of water quality.

Clarity:

see "Secchi disc."

Coefficient of Conservatism (c-value):

Indicates on a scale of 0 to 10 the degree to which a species can tolerate disturbance to a native plant community; a species with a c value of 10 is found only in relatively undisturbed areas of native plant community, whereas a species with a c value of 0 never grows in undisturbed areas of native plant communities. Plants with low numbers tend to occur in a wide range of more-or-less disturbed plant communities. Alien species are also assigned a c value of 0. The c values are used in this report in calculating the Floristic Quality Index for each lake.

Color:

Measured in color units that relate to a standard. A yellow-brown natural color is associated with lakes or rivers receiving wetland drainage. The average color value for Wisconsin lakes is 39 units, with the color of state lakes ranging from zero to 320 units. Color also affects light penetration and therefore the depth at which plants can grow.

Concentration Units:

Express the amount of a chemical dissolved in water. The most common ways chemical data is expressed is in milligrams per liter (mg/L) and micrograms per liter (ug/L). One milligram per liter is equal to one part per million (ppm). To convert micrograms per liter (ug/L) to milligrams per liter (mg/L), divide by 1000 (e.g. 30 ug/l = 0.03 mg/L). To convert milligrams per liter (mg/L) to micrograms per liter (ug/L), multiply by 1000 (e.g. 0.5 mg/L = 500 ug/L). Microequivalents per liter (ueq/L) is also sometimes used, especially for alkalinity; it is calculated by dividing the weight of the compound by 1000 and then dividing that number into the mg/L.

Diatoms:

A major group of eukaryotic algae, which are one of the most common types of phytoplankton. Diatom communities are a popular tool for monitoring environmental conditions, past and present, and are commonly used in studies of water quality; often the brown stuff attached to rock surfaces.

Drainage Basin:

The total land area that drains toward the lake.

Drainage Lakes:

Lakes fed primarily by streams and with outlets into streams or rivers. They are more subject to surface runoff problems but generally have shorter retention times than seepage lakes. Watershed protection is usually needed to manage lake water quality.

Erosion:

The lowering of the land surface by weathering, corrosion, and transportation, under the influence of gravity, wind, and running water.

Eutrophic:

Eutrophic lakes are high in nutrients and support a large biomass (all the plants and animals living in a lake). They are usually either weedy or subject to frequent algae blooms, or both. Eutrophic lakes often support large fish populations, but are also susceptible to oxygen depletion. Small, shallow, eutrophic lakes are especially vulnerable to winterkill which can reduce the number and variety of fish. Rough fish are commonly found in eutrophic lakes.

*Terms in bold, see glossary pp 16-21

Eutrophication:

The process by which lakes and streams are enriched by nutrients, and the resulting increase in plants and algae. The extent to which this process has occurred is reflected in a lake's trophic classification: oligotrophic (nutrient poor), mesotrophic (moderately productive), and eutrophic (very productive and fertile).

Fen:

A fen is a type of wetland fed by surface and/or groundwater. Fens are characterized by their water chemistry, which is neutral or alkaline, unlike bogs, which are generally acid.

Floristic Quality Index (FQI):

The FQI is a standardized method for evaluating natural plant communities by multiplying the average coefficient of conservatism (c-value) for all species by the square root of the total number of species found at that lake; an additional point is added to the index for each state-listed special concern species, two points added for a threatened species, and three points added for an endangered species. A higher floristic quality index, such as FQI=60, indicates a higher floristic quality and biological integrity and a lower level of disturbance impacts. A lower floristic quality index, such as FQI=20, indicates a lower floristic quality and biological integrity and a higher level of disturbance impacts.

Groundwater:

Water found below the land surface in pore spaces between soil particles or in cracks in rock. It moves slowly from higher to lower areas on the landscape and may provide water to a lake.

Groundwater Drainage Lake:

Often referred to a spring-fed lake, has large amounts of groundwater as its source, and a surface outlet. Areas of high groundwater inflow may be visible as springs or sand boils. Groundwater drainage lakes often have intermediate retention times with water quality dependent on groundwater quality.

Hardness, Hard Water:

The quantity of multivalent cations (cations with more than one +), primarily calcium (Ca++) and magnesium (Mg++) in the water expressed as milligrams per liter of $CaCO_3$. Amount of hardness relates to the presence of soluble minerals, especially limestone, in the lake watershed. Moderately hard water has 61-120 mg/L $CaCO_3$, hard water has 121-180 mg/L $CaCO_3$, and very hard water has more than180 mg/L $CaCO_3$.

Impoundment:

Manmade lake or reservoir usually characterized by stream inflow and always by a stream outlet. Because of nutrient and soil loss from upstream land use practices, impoundments ordinarily have higher nutrient concentrations and faster sedimentation rates than natural lakes. Their retention times are relatively short.

Littoral:

The shallow water zone near the shoreline that is home to most aquatic plants.

Macrophytes:

see "Rooted aquatic plants."

Macrophytic Algae:

Algae that resemble true plants in that they appear to have stems and leaves, and are attached to the bottom.

Marl:

White to gray accumulation on lake bottoms caused by precipitation of calcium carbonate ($CaCO_3$) in hard water lakes. Marl may contain many snail and clam shells, which are also calcium carbonate. While it gradually fills in lakes, marl also precipitates phosphorus, resulting in low algae populations and good water clarity. In the past, marl was recovered and used to lime agricultural fields.

Mesotrophic:

Mesotrophic lakes lie between the oligotrophic and eutrophic trophic stages. In late summer, they lose oxygen at depth, limiting cold water fish and causing phosphorus release from sediments.

mg/L:

see "Concentration units"

Nitrate (NO_3^-):

An inorganic form of nitrogen important for plant growth. Nitrogen is in this stable form when oxygen is present. Nitrate often contaminates groundwater when water originates from manure pits, fertilized fields, lawns or septic systems. High levels of nitrate-nitrogen (over 10 mg/L) are dangerous to infants and expectant mothers. A concentration of nitrate-nitrogen (NO_3-N) plus ammonium-nitrogen (NH_4-N) of 0.3 mg/L in spring will support summer algae blooms if enough phosphorus is present.

Nitrite (NO_2^-):

A form of nitrogen that rapidly converts to nitrate (NO_3^-) and is usually included in the NO_3^- analysis.

Nitrogen:

A chemical element that is an essential plant nutrient and may occur in the form of nitrate, nitrite, ammonium, or organic nitrogen in lakes.

Oligotrophic:

A trophic state in which lakes are generally clear, deep and free of weeds or large algae blooms. Though beautiful, they are low in nutrients and do not support large fish populations. However, oligotrophic lakes often develop a food chain capable of sustaining a very desirable fishery of large game fish.

Phosphorus:

Key nutrient influencing plant growth in more than 80% of Wisconsin lakes. Soluble reactive phosphorus is the amount of phosphorus in solution that is available to plants. Total phosphorus includes the amount of phosphorus in solution (reactive) and in particulate form.

Photosynthesis:

The process by which green plants convert carbon dioxide (CO_2) dissolved in water to sugar and oxygen using sunlight for energy. Photosynthesis is essential in producing a lake's food base, and is an important source of oxygen for many lakes.

Potassium:

A chemical element that is an essential plant nutrient and may enter lakes from runoff of agricultural fertilizers and animal wastes.

Retention Time: (Turnover Rate or Flushing Rate)

The average length of time water resides in a lake, ranging from several days in small impoundments to many years in large seepage lakes. Retention time is important in determining the impact of nutrient inputs. Long retention times result in recycling and greater nutrient retention in most lakes. Calculate retention time by dividing the volume of water passing through the lake per year by the lake volume.

*Terms in bold, see glossary pp 16-21

Rip Rap (Rip-Rap):

Hard rock, commonly granite or concrete rubble recycled from construction sites, used inland on lakes, rivers, coastlines, and other waterways to prevent bank erosion. Generally rip rap is not considered good management in lakes, due to its inability to provide adequate habitat, and is no longer commonly used.

Rooted Aquatic Plants: (Macrophytes)

Refers to higher (multi-celled) plants growing in or near water. Macrophytes are beneficial to lakes because they produce oxygen and provide substrate for fish habitat and aquatic insects. Overabundance of such plants, especially problem species, is related to shallow water depth and high nutrient levels.

Secchi Disc (Secchi Disk):

An 8-inch diameter plate with alternating quadrants painted black and white that is used to measure water clarity (light penetration). The disc is lowered into water until it disappears from view. It is then raised until just visible. An average of the two depths, taken from the shaded side of the boat, is recorded as the Secchi disc reading. For best results, the readings should be taken on sunny, calm days.

Sedimentation:

Accumulated organic and inorganic matter on the lake bottom. Sediment includes decaying algae and weeds, marl, and soil and organic matter eroded from the lake's watershed.

Seepage Lakes:

Lakes without a significant inlet or outlet, fed by rainfall and groundwater. Seepage lakes lose water through evaporation and groundwater moving on a down gradient. Lakes with little groundwater inflow tend to be naturally acidic and most susceptible to the effects of acid rain. Seepage lakes often have long retention times, and lake levels fluctuate with local groundwater levels. Water quality is affected by groundwater quality and the use of land on the shoreline.

Sodium:

A chemical element that may enter lakes from runoff of road salt, fertilizers, and human and animal wastes.

Soft Water:

Water with less than 60 mg/L CaCO3 (see Hard water).

Stratification, Stratified:

The layering of water due to differences in density. Water's greatest density occurs at 39^{o}F (4^{o}C). As water warms during the summer, it remains near the surface while colder water remains near the bottom. Wind mixing determines the thickness of the warm surface water layer (epilimnion), which usually extends to a depth of about 20 ft. The narrow transition zone between the epilimnion and cold bottom water (hypolimnion) is called the metalimnion or thermocline.

Sulfate (SO_4^{--}):

The most common form of sulfur in natural waters. The amounts relate primarily to soil minerals in the watershed. Sulfate (SO_4^{--}) can be reduced to sulfide (S^{--}) and hydrogen sulfide (H_2S) under low or zero oxygen conditions. Hydrogen sulfide smells like rotten eggs and harms fish. Sulfate input from acid rain is a major indicator of sulfur dioxide (SO_2) air pollution. Sulfate concentration is used as a chemical fingerprint to distinguish acid lakes acidified by acid rain from those acidified by organic acids from bogs.

Substrate:

The material found at the bottom of a lake, such as silt, mud, sand, clay, marl, gravel, etc.

Suspended Solids:

A measure of the particulate matter in a water sample, expressed in milligrams per liter. When measured on inflowing streams, it can be used to estimate the sedimentation rate of lakes or impoundments.

*Terms in bold, see glossary pp 16-21

Turbidity:

The “cloudiness” or “murkiness” of water, caused by total suspended solids.

Vascular Plants:

Vascular plants are those plants that have tissues for conducting water, minerals, and food through the plant. Vascular plants include the ferns, clubmosses, flowering plants, and conifers.

Watershed:

The total land area that drains either surface water or groundwater toward a lake.

*Terms in bold, see glossary pp 16-21