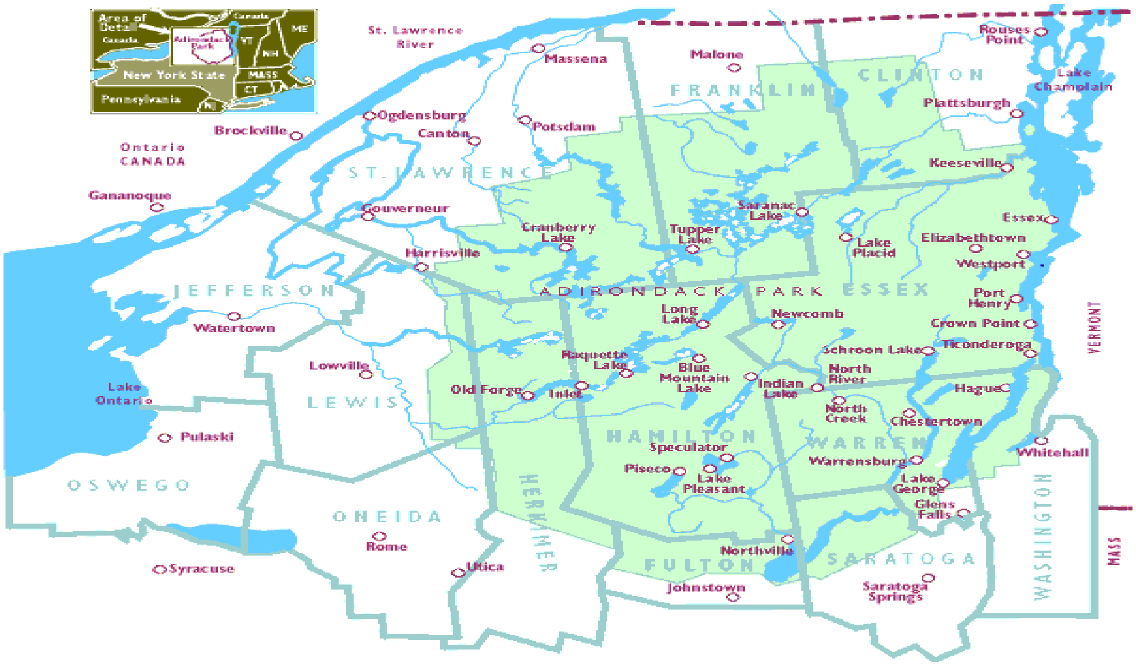
Adirondack Lake Assessment Program
2010



<u>**Thirteen Years in the program**</u>
Cranberry Lake, Loon Lake, Oven Mountain Pond, Blue Mountain Lake, Silver Lake, Eagle Lake
<u>**Twelve Years in the program**</u>
Little Long Lake, Gull Pond, Stony Creek Ponds, Thirteenth Lake, Eli Pond
<u>**Eleven Years in the program**</u>
Austin Pond, Osgood Pond, Middle Saranac Lake, White Lake, Brandreth Lake, Trout Lake
<u>**Ten Years in the program**</u>
Hoel Pond, Great Sacandaga Lake, Tripp Lake, Sherman Lake, Wolf Lake, Twitchell Lake, Deer Lake, Arbutus Pond, Rich Lake, Catlin Lake, Pine Lake, Lake of the Pines, Pleasant Lake
<u>**Nine Years in the program**</u>
Spitfire Lake, Upper St. Regis, Lower St. Regis, Garnet Lake, Lens Lake, Snowshoe Pond, Lake Ozonia, Long Pond, Lower Saranac Lake
<u>**Eight Years in the program**</u>
Raquette Lake, Lake Colby, Kiwassa Lake, Canada Lake
<u>**Seven Years in the program**</u>
Indian Lake, Schroon Lake, Lake Eaton, Chazy Lake, Big Moose Lake
<u>**Six Years in the program**</u>
Dug Mountain Pond, Seventh Lake, Abanakee Lake, Moss Lake, Mountain View Lake, Indian Lake, Tupper Lake
<u>**Five Years in the program**</u>
Sylvia Lake, Fern Lake
<u>**Four Years in the program**</u>
Adirondack Lake, Lower Chateaugay Lake, Upper Chateaugay Lake, Lake Easka, Lake Tekeni
<u>**Three Years in the program**</u>
Simon Pond
<u>**Two Years in the program**</u>
Amber Lake, Jordan Lake, Otter Pond, Rondaxe Lake
<u>**One Year in the program**</u>
Auger Lake, Lake Titus, Star Lake

Adirondack Lake

Assessment Program

Loon Lake

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Introduction

The Adirondack Lake Assessment Program is a volunteer monitoring program established by the Residents' Committee to Protect the Adirondacks (RCPA) and the Adirondack Watershed Institute (AWI). The program is now in its' thirteenth year. The program was established to help develop a current database of water quality in Adirondack lakes and ponds. There were 70 participating lakes in the program in 2010.

Methodology

Each month participants (trained by AWI staff) measured transparency with a secchi disk and collected a 2-meter composite of lake water for chlorophyll-a analysis and a separate 2-meter composite for total phosphorus and other chemical analyses. The participants filtered the chlorophyll-a sample prior to storage. Both the chlorophyll-a filter and water chemistry samples were frozen for transport to the laboratory at Paul Smith's College.

In addition to the volunteer samples, AWI staff sampled water quality parameters in most of the participating lakes as time and weather allowed. In most instances, a 2-meter composite of lake water was collected for chlorophyll-a analysis. Samples were also collected at depths of 1.5 meters from the surface (epilimnion) and within 1.5 meters of the bottom (hypolimnion) for chemical analysis. Once collected, samples were stored in a cooler and transported to the laboratory at Paul Smith's College.

All samples were analyzed AWI staff in the Paul Smith's College laboratory using the methods detailed in *Standard Methods for the Examination of Water and Wastewater, 21st edition* (Greenberg, *et al*, 2005). Volunteer samples were analyzed for pH, alkalinity, conductivity, color, nitrate, chlorophyll a and total phosphorus concentrations. Samples taken by AWI staff were analyzed for the same parameters, as well as for calcium, chloride, and aluminum concentrations.

Results Summary

Loon Lake was sampled three times by volunteers in the North Basin in 2010. Samples were collected on the following dates: 6/12/10, 7/24/10, and 9/02/10. Loon Lake was sampled three times by volunteers in the South Basin in 2010. Samples were collected on the following dates: 6/12/10, 7/24/10, and 9/02/10. Results for 2010 are presented in Appendix A and will be discussed in the following sections. Results are presented as concentrations in milligrams per liter (mg/L) or its equivalent of parts per million (ppm) and micrograms per liter (μg/L) or its equivalent of parts per billion (ppb).

1 mg/L = 1 ppm; 1 μg/L = 1 ppb; 1 ppm = 1000 ppb.

Adirondack lakes are subject to the effects of acidic precipitation (i.e., snow, rain). A waterbody's susceptibility to acid producing ions is assessed by measuring pH, alkalinity, calcium concentrations, and the Calcite Saturation Index (CSI). These parameters define both the acidity of the water and its buffering capacity. Based on the results of the 2010 Adirondack

Lake Assessment program, Loon Lake's acidity status is considered to be satisfactory, with a low sensitivity to further acidic inputs.

Limnologists, the scientists who study bodies of fresh water, classify lake health (trophic status) into three main categories: oligotrophic, mesotrophic, and eutrophic. The trophic status of a lake is determined by measuring the level of three basic water quality parameters: total phosphorus, chlorophyll-a, and secchi disk transparency. These parameters will be defined in the sections that follow. Oligotrophic lakes are characterized as having low levels of total phosphorus, and, as a consequence, low levels of chlorophyll-a and high transparencies. Eutrophic lakes have high levels of total phosphorus and chlorophyll-a, and, as a consequence, low transparencies. Mesotrophic lakes have moderate levels of all three of these water quality parameters. Based upon the results of the 2010 Adirondack Lake Assessment Program, Loon Lake is considered to be late oligotrophic.

PH

The pH level is a measure of acidity (concentration of hydrogen ions in water), reported in standard units on a logarithmic scale that ranges from 1 to 14. On the pH scale, 7 is neutral, lower values are more acidic, and higher numbers are more basic. In general, pH values between 6.0 and 8.0 are considered optimal for the maintenance of a healthy lake ecosystem. Many species of fish and amphibians have difficulty with growth and reproduction when pH levels fall below 5.5 standard units. Lake acidification status can be assessed from pH as follows:

pH less than 5.0	Critical or Impaired
pH between 5.0 and 6.0	Endangered or Threatened
pH greater than 6.0	Satisfactory or Acceptable

The pH in the upper water of Loon Lake ranged from 6.97 to 7.11. The average pH was 7.07 in the North Basin. The average pH in the South basin was very similar at 7.04. Based solely on pH, Loon Lake's acidity levels should be considered satisfactory.

Alkalinity

Alkalinity (acid neutralizing capacity) is a measure of the buffering capacity of water, and in lake ecosystems refers to the ability of a lake to absorb or withstand acidic inputs. In the northeast, most lakes have low alkalinities, which mean they are sensitive to the effects of acidic precipitation. This is a particular concern during the spring when large amounts of low pH snowmelt runs into lakes with little to no contact with the soil's natural buffering agents. Alkalinity is reported in milligrams per liter (mg/L) or microequivelents per liter (μeq/L). Typical summer concentrations of alkalinity in northeastern lakes are around 10 mg/l (200 μeq/L).

Lake acidification status can be assessed from alkalinity as follows:

Alkalinity less than 0 ppm	Acidified
Alkalinity between 0 and 2 ppm	Extremely sensitive
Alkalinity between 2 and 10 ppm	Moderately sensitive

Alkalinity between 10 and 25 ppm	Low sensitivity
Alkalinity greater than 25 ppm	Not sensitive

The alkalinity of the upper water of Loon Lake ranged from 20.8 ppm to 22.8 ppm. The average alkalinity was 21.7 ppm in the North Basin. The average alkalinity for the South Basin was a similar 21.5 ppm. These values indicate that Loon Lake has a low sensitivity to acidification.

Calcium

Calcium is one of the buffering materials that occur naturally in the environment. However, it is often in short supply in Adirondack lakes and ponds, making these bodies of water susceptible to acidification by acid precipitation. Calcium concentrations provide information on the buffering capacity of that lake, and can assist in determining the timing and dosage for acid mitigation (liming) activities. Adirondack lakes containing less than 2.5 ppm of calcium are considered to be sensitive to acidification.

The calcium in the upper water of Loon Lake averaged 4.21 ppm in 2010 in the North Basin and a similar 4.21 in the South Basin. This suggests that Loon Lake may currently not be sensitive to acidification.

Calcite Saturation Index

The Calcite Saturation Index (CSI) is another method that is used to determine the sensitivity of a lake to acidification. High CSI values are indicative of increasing sensitivity to acidic inputs. CSI is calculated using the following formula:

$$CSI = -\log_{10}\frac{Ca}{40000} - \log_{10}\frac{Alk}{50000} - pH + 2$$

Where *Ca* = Calcium level of water sample in ppm or mg/L
Alk = Alkalinity of the water sample in ppm or mg/L
pH = pH of the water sample in standard units

Lake sensitivity to acidic inputs is assessed from CSI as follows:

CSI greater than 4	Very vulnerable to acidic inputs
CSI between 3 & 4	Moderately vulnerable to acidic inputs
CSI less than 3	Low vulnerability to acidic inputs

CSI values for Loon Lake were found to be 2.60 in the sample taken from the upper water in the North Basin, and 2.60 in the sample taken from the upper water in the South Basin in 2010. These values classify Loon Lake as having low vulnerability to further acidic inputs.

Total Phosphorus

Phosphorus is one of the three essential nutrients for life, and in northeastern lakes, it is often the controlling, or limiting, nutrient in lake productivity. Total phosphorus is a measure of all forms of phosphorus, both organic and inorganic. Total phosphorus concentrations are directly related to the trophic status (water quality conditions) of a lake. Excessive amounts of phosphorus can lead to algae blooms and a loss of dissolved oxygen within the lake. Surface water (epilimnion) concentrations of total phosphorus less than 10 ppb are associated with oligotrophic (clean, clear water) conditions. Concentrations greater than 25 ppb are associated with eutrophic (nutrient-rich) conditions.

The total phosphorus in the upper water of Loon Lake ranged from 6 ppb to 10 ppb. The average concentration was 7.0 ppb in the North Basin. The average concentration was a little higher 9.0 ppb in the South Basin. This total phosphorous average value would classify Loon Lake as an oligotrophic lake.

Chlorophyll-a

Chlorophyll-a is the green pigment in plants used for photosynthesis, and measuring it provides information on the amount of algae (microscopic plants) in lakes. Chlorophyll-a concentrations are also used to classify a lakes trophic status. Concentrations less than 2 ppb are associated with oligotrophic conditions and those greater than 8 ppb are associated with eutrophic conditions.

The chlorophyll-a concentrations in the upper water of Loon Lake ranged from 1.18 ppb to 2.12 ppb. The average concentration was 1.32 ppb in the North Basin. The average concentration was a little higher 1.77 ppb in the South Basin. This is indicative of oligotrophic conditions in the North and South Basin.

Secchi Disk Transparency

Transparency is a measure of water clarity in lakes and ponds. It is determined by lowering a 20 cm black and white disk (Secchi) into a lake to the depth where it is no longer visible from the surface. This depth is then recorded in meters. Since algae are the main determinant of water clarity in non-stained, low turbidity (suspended silt) lakes, transparency is also used as an indicator of the trophic status of a body of water. Secchi disk transparencies greater than 4.6 meters (15.1 feet) are associated with oligotrophic conditions, while values less than 2 meters (6.6 feet) are associated with eutrophic conditions (DEC & FOLA, 1990).

Secchi disk transparency in Loon Lake in the North Basin ranged from 6.0 to 6.8 meters and averaged 6.50 meters. Secchi disk transparency in Loon Lake in the South Basin averaged a little lower 5.50 meters. These values would classify Loon Lake in both basins as an oligotrophic lake.

Nitrate

Nitrogen is another essential nutrient for life. Nitrate is an inorganic form of nitrogen that is naturally occurring in the environment. It is also a component of atmospheric pollution. Nitrogen concentrations are usually less than 1 ppm in most lakes. Elevated levels of nitrate concentration may be indicative of lake acidification or wastewater pollution.

The average nitrate in the upper water of Loon Lake in the North Basin was found to be 0.210 ppm. The average nitrate concentration was 0.150 ppm in the South Basin.

Chloride

Chloride is an anion that occurs naturally in surface waters, though typically in low concentrations. Background concentrations of chloride in Adirondack Lakes are usually less than 1 ppm. Chloride levels 10 ppm and higher is usually indicative of pollution and, if sustained, can alter the distribution and abundance of aquatic plant and animal species. The primary sources of additional chloride in Adirondack lakes are road salt (from winter road de-icing) and wastewater (usually from faulty septic systems). The most salt impacted waters in the Adirondacks usually have chloride concentrations of 100 ppm or less.

The chloride in the upper water of Loon Lake was a slightly elevated 6.09 ppm in 2010 in the North Basin and a similar 6.09 ppm chloride in the South Basin.

Conductivity

Conductivity is a measure of the ability of water to conduct electric current, and will increase as dissolved minerals build up within a body of water. As a result, conductivity is also an indirect measure of the number of ions in solution, mostly as inorganic substances. High conductivity values (greater than 50 μohms/cm) may be indicative of pollution by road salt runoff or faulty septic systems. Conductivities may be naturally high in water that drains from bogs or marshes. Eutrophic lakes often have conductivities near 100 μohms/cm, but may not be characterized by pollution inputs. Clean, clear-water lakes in our region typically have conductivities up to 30 μohms/cm, but values less than 50 μohms/cm are considered normal.

The conductivity in the upper water of Loon Lake ranged from 30.5 μohms/cm to 35.5 μohms/cm. The average conductivity was 34.6 μohms/cm in the North Basin. The average conductivity was a similar 32.2 μohms/cm in the South Basin.

Color

The color of water is affected by both dissolved (e.g., metallic ions, organic acids) and suspended (e.g., silt and plant pigments) materials. Water samples are collected and compared to a set of standardized chloroplatinate solutions in order to assess the degree of coloration. The measurement of color is usually used in lake classification to describe the degree to which the water body is stained due to the accumulation of organic acids. The standard for drinking water color, as set by the United States Environmental Protection Agency (US EPA) using the platinum-cobalt method, is 15 Pt-Co. However, dystrophic lakes (heavily stained, often the color of tea) are common in this part of the country, and are usually found in areas with poorly drained soils and large amounts of coniferous vegetation (i.e., pines, spruce, hemlock). Dystrophic lakes usually have color values upwards of 75 Pt-Co.

Color can often be used as a possible index of organic acid content since higher amounts of total organic carbon (TOC) are usually found in colored waters. TOC is important because it can bond with aluminum in water, locking it up within the aquatic system and resulting in possible toxicity to fish (see Aluminum).

The color in the upper water of Loon Lake ranged from 15 Pt-Co to 37 Pt-Co. The average color was 27.7 Pt-Co in the North Basin. The average color was a little higher 28.0 Pt-Co in the South Basin.

Aluminum

Aluminum is one of the most abundant elements found within the earth's crust. Acidic runoff (from rainwater and snowmelt) can leach aluminum out of the soil as it flows into streams and lakes. If a lake is acidic enough, aluminum may also be leached from the sediment at the bottom of it. Low concentrations of aluminum can be toxic to aquatic fauna in acidified water bodies, depending on the type of aluminum available, the amount of dissolved organic carbon available to bond with the aluminum, and the pH of the water. Aluminum can form thick mucus that has been shown to cause gill destruction in aquatic fauna (i.e., fish, insects) and, in cases of prolonged exposure, can cause mortality in native fish populations (Potter, 1982). Aluminum concentrations are reported as mg/L of total dissolved aluminum.

The average aluminum concentration in the upper water of Loon Lake in the North Basin was a very low 0.017 ppm and the same 0.017 ppm in the South Basin in 2010.

Dissolved Oxygen

The dissolved oxygen in a lake is an extremely important parameter to measure. If dissolved oxygen decreases as we approach the bottom of a lake we know that there is a great amount of bacterial decay that is going on. This usually means that there is an abundance of nutrients, like phosphorous that have collected on the lake bottom. Oligotrophic lakes tend to have the same amount of dissolved oxygen from the surface waters to the lake bottom, thus showing very little bacterial decay. Eutrophic lakes tend to have so much decay that their bottom waters will have very little dissolved oxygen. Cold-water fish need 6.0 ppm dissolved oxygen to thrive and reproduce. Warm water fish need 4.0-ppm oxygen.

The dissolved oxygen and temperature profiles for Loon Lake for 2000 - 2004 and 2008 are presented in Appendix A. The dissolved oxygen gradually decreases from the surface to the bottom in Loon Lake. This decrease in dissolved oxygen with depth in Loon Lake is much more pronounced when the readings were taken when the lake was warmer as shown in 2001 and 2008. During both of these years, the water was warmest as shown on the temperature profile and the dissolved oxygen decreased rapidly at a depth between 8 and 10 meters. The oxygen level is sufficient for cold and warm-water fish survival in the surface waters but cold water fish may become stressed in the lower levels of the lake during the warm summer months.

Summary

Loon Lake was a slightly productive oligotrophic lake during 2010. Based on the results of the 2010 Adirondack Lake Assessment program, the acidity status of Loon Lake is considered to be satisfactory, with a low sensitivity to further acidic inputs.

The trend graphs found in the Appendix only reflect data collected from the North basin or usual sampling location. The South Basin has only been sampled for three seasons. Thirteen years of data are sufficient to detect water quality trends; and it is possible to compare the current data with the data collected in 1998 through 2009. This year, the conductivity, total phosphorous, chlorophyll-a, Secchi disk transparency and calcium levels were slightly lower than in 2009. In 2010, the pH, alkalinity, color, nitrate, aluminum and chloride levels were slightly higher than in 2009. The total phosphorous has been at very low levels the past six years. This low total phosphorous level led to fewer nutrients in the lake available for algal growth. This was reflected by lower chlorophyll-a levels the past six summers and, because there was less algal growth, the Secchi disk transparency readings were higher the last seven years. Over the entire thirteen years of this study, the water quality of Loon Lake has improved greatly. Total phosphorous and chlorophyll-a levels have declined almost every year and this has led to an increase in Secchi disk levels since 2002.

The sampling of the lake was switched from five months and one station in the North to three months and two stations one in the North and one in the South. We recommend that this change to two stations continue in 2011. Loon Lake is a long narrow lake with two separate basins and each should be sampled and their water quality compared to see if there are any differences between the two basins. After 2011, the fourth year of two basin sampling it will be more statistically significant to begin to compare the water quality for the North and South Basins of Loon Lake. So far it does look like the water quality is very good for both basins of Loon Lake with the North basin slightly better than the South basin.

Literature Cited

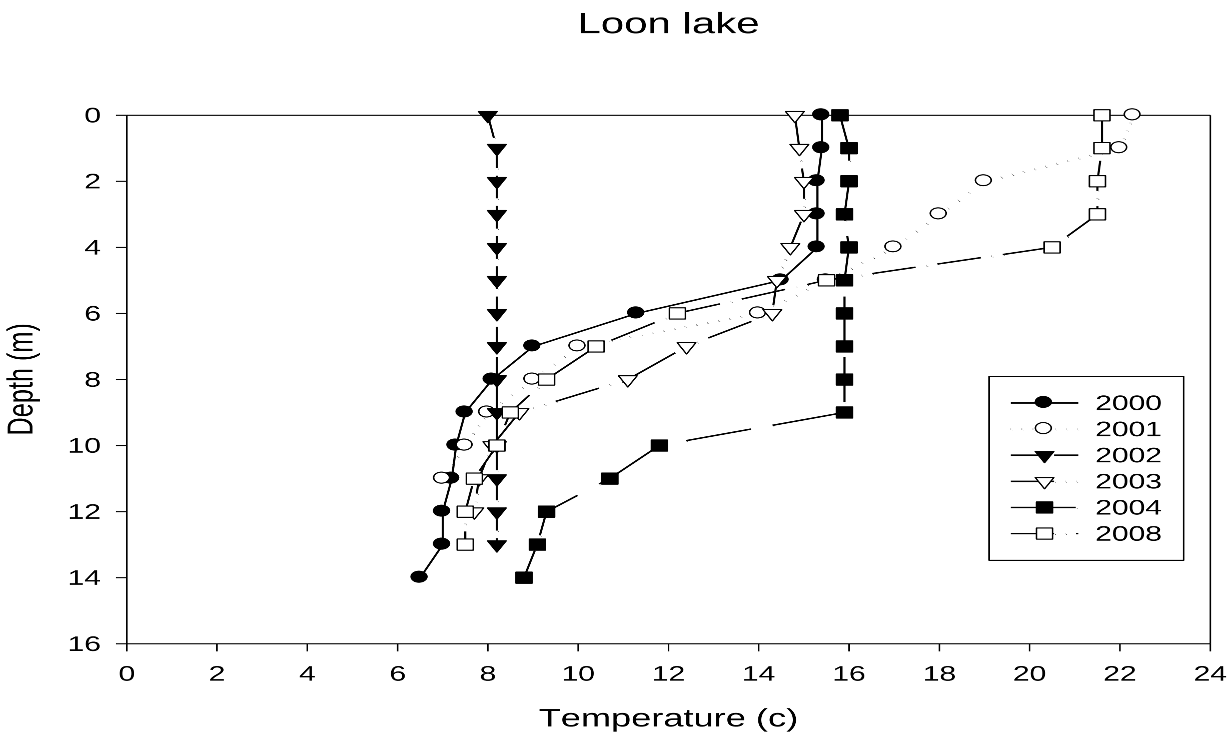
DEC & FOLA. (1990). Diet for a Small Lake: A New Yorker's Guide to Lake Management. New York State Department of Environmental Conservation & The Federation of Lake Associations, Inc.: Albany, New York.

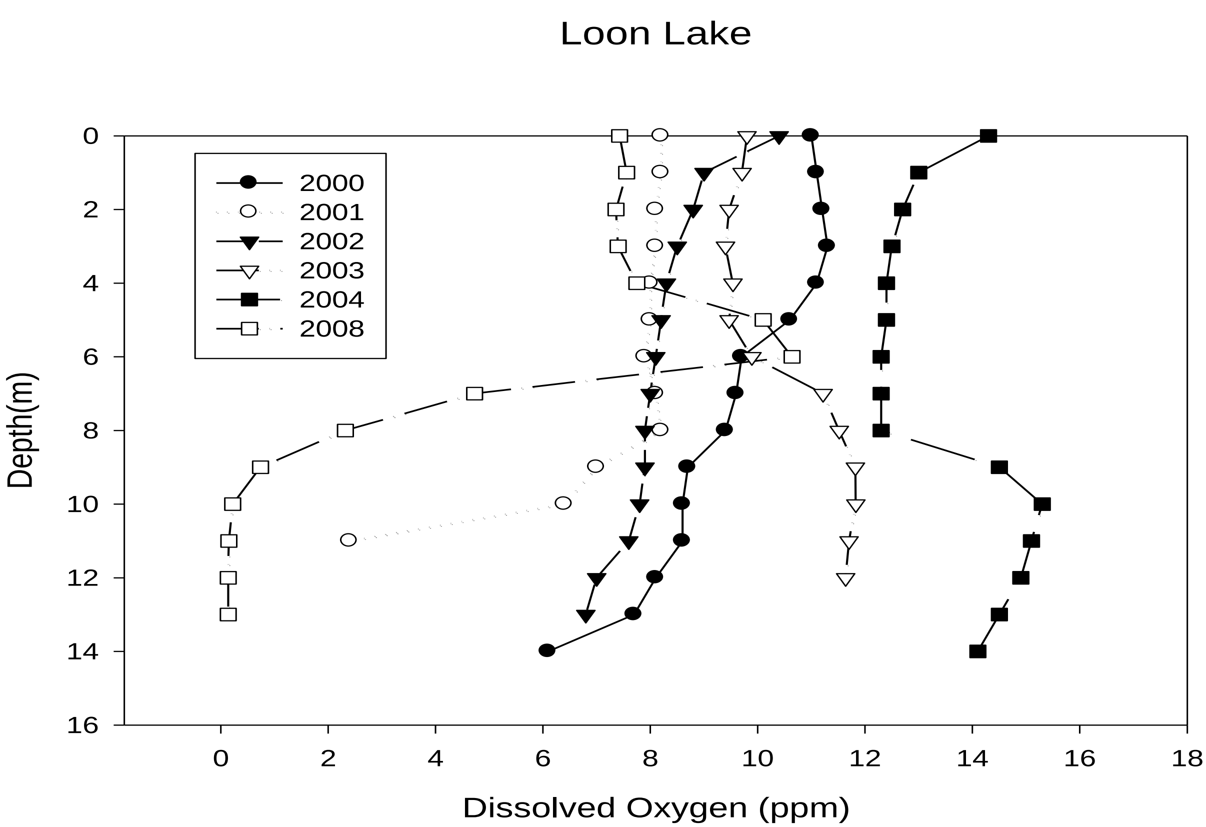
Greenberg, A.E., Eaton, A.D., and Leseri, L.A. (editors). (2005). Standard Methods for the Examination of Water and Wastewater, 21st Edition. American Public Health Association: Washington, D.C.

Potter, W. (1982). *The Effects of Air Pollution and Acid Rain on Fish, Wildlife and Their Habitats – Lakes*. Technical Report FWS/OBS – 80/50.4. United States Fish and Wildlife Service, Biological Services Program: Washington, D.C.

Appendix A

Water Quality Data


Loon lake
Depth (m)
Temperature (c)
2000
2001
2002
2003
2004
2008


Loon Lake
Depth(m)
Dissolved Oxygen (ppm)
2000
2001
2002
2003
2004
2008

Source	Lake/Pond Name	Sampling Location	Sampling Date	pH (units)	Alkalinity (ppm)	Conductivity (μohms/cm)	Color (Pt-Co)	Total P (ppm)	Chl a (μg/l)
Vol	Loon Lake		07/30/98	6.9000	12.0000	38.8000	20.0000	0.0140	3.6200
AAI	Loon Lake	Epi	08/12/98	6.8600	11.0000	40.5000	14.0000	0.0130	3.3400
Vol	Loon Lake		08/25/98	7.1200	15.0000	39.3000	24.0000	0.0140	3.8800
Vol	Loon Lake		09/17/98	6.8400	12.6000	39.6000	20.0000	0.0170	3.7800
Vol	Loon Lake		10/31/98	6.6700	14.8000	34.1000	12.0000	0.0110	3.2600
			MEAN	6.8780	13.0800	38.4600	18.0000	0.0138	3.5760
			Std Dev	0.1613	1.7584	2.5146	4.8990	0.0022	0.2700
AAI	Loon Lake	Hypo	08/12/98	6.2600	12.0000	40.2000	34.0000	0.0280	
Vol	Loon Lake		06/10/99	7.0300	17.4000	42.9000	29.0000	0.0260	8.8700
Vol	Loon Lake		07/12/99	6.8700	12.8000	44.7000	30.0000	0.0180	7.3000
AAI	Loon Lake	epi	08/23/99	7.1300	17.6000	42.2000	15.0000	0.0130	6.1900
Vol	Loon Lake		08/23/99	7.0200	17.6000	38.4000	23.0000	0.0140	5.7300
Vol	Loon Lake		09/12/99	6.5800	11.4000	41.8000	10.0000	0.0090	2.0400
Vol	Loon Lake		10/16/99	6.4500	11.1000	41.3000	11.0000	0.0130	7.0700
			MEAN	6.8467	14.6500	41.8833	19.6667	0.0155	6.2000
			Std Dev	0.2731	3.2111	2.0760	8.8919	0.0059	2.3075
AAI	Loon Lake	hypo	08/23/99	6.8700	18.4000	42.2000	20.0000	0.0220	
Vol	Loon Lake	Vol	10/14/2000	6.4600	24.8000	42.1000	20.0000	0.0130	2.1700
Vol	Loon Lake	Vol	8/7/2000	6.6800	22.2000	40.9000	7.0000	0.0120	1.9800
Vol	Loon Lake	Vol	9/13/2000	6.7200	22.8000	41.7000	18.0000	0.0120	1.9500
Vol	Loon Lake	Vol	7/12/2000	6.7200	22.8000	40.5000	14.0000	0.0150	2.3700
AAI	Loon Lake	Epilimnion	6/8/2000	7.2800	16.8000	40.0000	27.0000	0.0130	3.1600
AAI	Loon Lake	Deephole	6/5/2000	7.2800	15.8000	34.2000	25.0000	0.0140	4.3900
			MEAN	6.8567	20.8667	39.9000	18.5000	0.0132	2.6700
			Std Dev	0.3419	3.6588	2.8962	7.3417	0.0012	0.9522
AAI	Loon Lake	Hypolimnion	6/8/2000	6.8000	18.4000	41.3000	28.0000	0.0130	
AAI	Loon Lake	Epilimnion	6/15/2001	7.1600	21.2000	42.8000	21.0000	0.0130	1.7200
Vol	Loon Lake	Deephole	6/15/2001	7.0800	21.2000	37.5000	15.0000	0.0130	1.7300
Vol	Loon Lake	Deephole	8/14/2001	7.7800	20.0000	42.1000	10.0000	0.0080	1.7400
Vol	Loon Lake	Deephole	9/15/2001	7.6200	19.6000	41.9000	23.0000	0.0090	1.9100
Vol	Loon Lake	Deephole	10/10/2001	7.2600	18.0000	40.4000	20.0000	0.0110	3.5400
Vol	Loon Lake	Deephole	7/21/2001	7.5300	18.4000	44.2000	32.0000	0.0100	2.7800
AAI	Loon Lake	Hypolimnion	6/15/2001	6.9900	21.8000	41.2000	21.0000	0.0150	
			MEAN	7.4050	19.7333	41.4833	20.1667	0.0107	2.2367
			Std Dev	0.2790	1.3545	2.3112	7.4677	0.0021	0.7578
AWI	Loon Lake	Epilimnion	5/20/2002	7.1200	22.4000	40.6000	33.0000	0.0180	6.3900
Vol	Loon Lake	Deephole	5/20/2002	7.0600	21.6000	40.8000	45.0000	0.0180	6.2700
Vol	Loon Lake	Deephole	6/25/2002	7.4800	22.0000	39.3000	26.0000	0.0300	6.2300
Vol	Loon Lake	Deephole	7/24/2002	7.2200	22.8000	40.4000	39.0000	0.0300	1.3500
Vol	Loon Lake	Deephole	8/25/2002	7.3500	22.8000	40.2000	19.0000	0.0400	1.9900
Vol	Loon Lake	Deephole	9/18/2002	7.6600	20.4000	40.4000	23.0000	0.0500	10.5000
Vol	Loon Lake	Deephole	10/20/2002	7.0700	26.0000	42.6000	27.0000	0.0300	2.8500
			MEAN	7.2800	22.5714	40.6143	30.2857	0.0309	5.0829
			Std Dev	0.2277	1.7260	0.9974	9.2144	0.0114	3.2214
AWI	Loon Lake	Hypolimnion	5/20/2002	7.1600	22.4000	43.5000	25.0000	0.0200	

AWI	Loon Lake	Epilimnion	5/30/2003	6.7200	12.0000	51.0000	8.0000	0.0160	4.2500
Vol	Loon Lake	Deephole	5/30/2003	6.6400	12.0000	39.0000	22.0000	0.0150	4.4900
Vol	Loon Lake	Deephole	6/29/2003	6.9100	18.8000	51.0000	10.0000	0.0120	2.1900
Vol	Loon Lake	Deephole	7/26/2003	6.9600	19.6000	53.7000	18.0000	0.0100	1.9400
Vol	Loon Lake	Deephole	8/10/2003	7.0400	21.6000	51.9000	19.0000	0.0080	1.6800
Source	Lake/Pond Name	Sampling Location	Sampling Date	pH (units)	Alkalinity (ppm)	Conductivity (μohms/cm)	Color (Pt-Co)	Total P (ppm)	Chl a (μg/l)
Vol	Loon Lake	Deephole	9/8/2003	6.4200	12.0000	43.0000	18.0000	0.0100	2.5700
			Mean	6.7817	16.0000	48.2667	15.8333	0.0118	2.8533
			Std Dev	0.2322	4.4757	5.8527	5.5287	0.0031	1.2133
AWI	Loon Lake	Hypolimnion	5/30/2003	6.6000	18.0000	44.0000	42.0000	0.0250	
AWI	Loon Lake	Epilimnion	5/28/2004	6.3800	10.0000	39.0000	18.0000	0.0110	3.8800
Vol	Loon Lake	Deephole	5/28/2004	6.4600	14.0000	40.0000	20.0000	0.0110	3.2800
Vol	Loon Lake	Deephole	6/30/2004	7.4800	14.0000	45.8000	50.0000	0.0080	1.8400
Vol	Loon Lake	Deephole	7/25/2004	6.9000	14.0000	43.1000	7.0000	0.0100	2.2700
Vol	Loon Lake	Deephole	8/28/2004	6.4400	10.0000	43.8000	10.0000	0.0120	0.0000
Vol	Loon Lake	Deephole	9/18/2004	6.5500	6.0000	45.4000	22.0000	0.0110	5.7300
			Mean	6.7017	11.3333	42.8500	21.1667	0.0105	2.8333
			Std Dev	0.4239	3.2660	2.7970	15.2894	0.0014	1.9503
AWI	Loon Lake	Hypolimnion	5/28/2004	6.6400	10.0000	41.0000	23.0000	0.0130	
AWI	Loon Lake	Epilimnion	5/30/2005	6.7300	20.0000	40.5000	40.0000	0.0090	1.6600
Vol	Loon Lake	Deephole	5/30/2005	6.8100	18.0000	45.6000	16.0000	0.0090	2.0100
Vol	Loon Lake	Deephole	7/2/2005	6.5200	10.0000	41.6000	14.0000	0.0070	3.7700
Vol	Loon Lake	Deephole	7/30/2005	6.3900	10.0000	42.3000	10.0000	0.0060	2.8300
Vol	Loon Lake	Deephole	9/5/2005	6.4800	10.0000	39.9000	10.0000	0.0070	1.5200
Vol	Loon Lake	Deephole	10/15/2005	6.2200	6.0000	44.3000	3.0000	0.0110	1.2100
			Mean	6.5250	12.3333	42.3667	15.5000	0.0082	2.1667
			Std Dev	0.2175	5.4283	2.2070	12.8023	0.0018	0.9618
AWI	Loon Lake	Hypolimnion	5/30/2005	6.6400	22.0000	41.9000	40.0000	0.0100	
Vol	Loon Lake	Deephole	6/24/2006	6.8200	18.2000	41.4000	12.0000	0.0100	1.8700
Vol	Loon Lake	Deephole	7/16/2006	7.0500	20.4000	43.9000	7.0000	0.0080	1.7900
Vol	Loon Lake	Deephole	8/14/2006	6.6400	16.0000	41.4000	14.0000	0.0080	1.7700
Vol	Loon Lake	Deephole	9/17/2006	6.9000	18.4000	41.4000	10.0000	0.0070	1.6700
Vol	Loon Lake	Deephole	9/30/2006	6.4700	14.2000	43.5000	22.0000	0.0090	1.8000
			Mean	6.7760	17.4400	42.3200	13.0000	0.0084	1.7800
			Std Dev	0.2261	2.3891	1.2677	5.6569	0.0011	0.0721
Vol	Loon Lake	Deephole	5/26/2007	6.8900	19.2000	39.1000	8.0000	0.0090	1.9500
Vol	Loon Lake	Deephole	6/30/2007	7.0100	20.8000	41.1000	39.0000	0.0080	1.8300
Vol	Loon Lake	Deephole	7/22/2007	7.0300	21.2000	38.7000	13.0000	0.0060	1.6700
Vol	Loon Lake	Deephole	8/12/2007	6.9800	19.8000	44.8000	22.0000	0.0080	1.7100
Vol	Loon Lake	Deephole	9/28/2007	7.0200	20.6000	42.0000	14.0000	0.0070	1.6700
			Mean	6.9860	20.3200	41.1400	19.2000	0.0076	1.7660
			Std Dev	0.0568	0.8075	2.4623	12.1532	0.0011	0.1220
AWI	Loon Lake	Epilimnion	8/5/2008	6.8100	18.4000	42.0000	19.0000	0.0090	1.9400
	Loon Lake	North	6/8/2008	6.8800	20.2000	41.7000	18.0000	0.0100	1.9800
	Loon Lake	North	7/6/2008	6.7000	19.4000	42.3000	14.0000	0.0100	1.9500

	Loon Lake	North	8/31/2008	7.1200	28.6000	43.1000	21.0000	0.0100	1.8200
			Mean	6.9000	22.7333	42.3667	17.6667	0.0100	1.9167
			Std Dev	0.2107	5.0964	0.7024	3.5119	0.0000	0.0850
	Loon Lake	South	6/8/2008	6.7500	20.8000	39.5000	24.0000	0.0100	x
	Loon Lake	South	7/6/2008	6.6900	19.4000	41.5000	18.0000	0.0100	2.0600
	Loon Lake	South	8/31/2008	7.2600	30.8000	38.4000	23.0000	0.0100	2.7700
			Mean	6.9000	23.6667	39.8000	21.6667	0.0100	2.4150
			Std Dev	0.3132	6.2172	1.5716	3.2146	0.0000	0.5020
AWI	Loon Lake	Hypolimnion	8/5/2008	6.7000	22.6000	41.0000	20.0000	0.0100	X

Source	Lake/Pond Name	Sampling Location	Sampling Date	pH (units)	Alkalinity (ppm)	Conductivity (μohms/cm)	Color (Pt-Co)	Total P (ppm)	Chl a (μg/l)
	Loon Lake	North	6/14/2009	7.0400	21.4000	45.8000	16.0000	0.0070	1.0900
	Loon Lake	North	7/31/2009	7.0100	21.0000	41.1000	19.0000	0.0080	1.6200
	Loon Lake	North	9/6/2009	6.9000	20.2000	46.4000	8.0000	0.0080	1.3400
			Mean	6.9833	20.8667	44.4333	14.3333	0.0077	1.3500
			Std Dev	0.0737	0.6110	2.9023	5.6862	0.0006	0.2651
	Loon Lake	South	6/14/2009	6.8200	19.8000	38.2000	37.0000	0.0080	1.6400
	Loon Lake	South	7/31/2009	6.9700	21.0000	44.4000	14.0000	0.0100	1.8800
	Loon Lake	South	9/6/2009	6.8600	19.8000	41.8000	14.0000	0.0080	1.7100
			Mean	6.8833	20.2000	41.4667	21.6667	0.0087	1.7433
			Std Dev	0.0777	0.6928	3.1134	13.2791	0.0012	0.1234
	Loon Lake	North	6/12/2010	7.0400	21.2000	33.6000	27.0000	0.0080	1.5100
	Loon Lake	North	7/24/2010	7.0600	21.2000	35.5000	25.0000	0.0070	1.1800
	Loon Lake	North	9/2/2010	7.1100	22.8000	34.7000	31.0000	0.0060	1.2700
			Mean	7.0700	21.7333	34.6000	27.6667	0.0070	1.3200
			Std Dev	0.0361	0.9238	0.9539	3.0551	0.0010	0.1706
	Loon Lake	South	6/12/2010	6.9700	20.8000	34.1000	37.0000	0.0090	1.8100
	Loon Lake	South	7/24/2010	7.0700	21.6000	31.9000	15.0000	0.0080	1.3800
	Loon Lake	South	9/2/2010	7.0900	22.0000	30.5000	32.0000	0.0100	2.1200
			Mean	7.0433	21.4667	32.1667	28.0000	0.0090	1.7700
			Std Dev	0.0643	0.6110	1.8148	11.5326	0.0010	0.3716

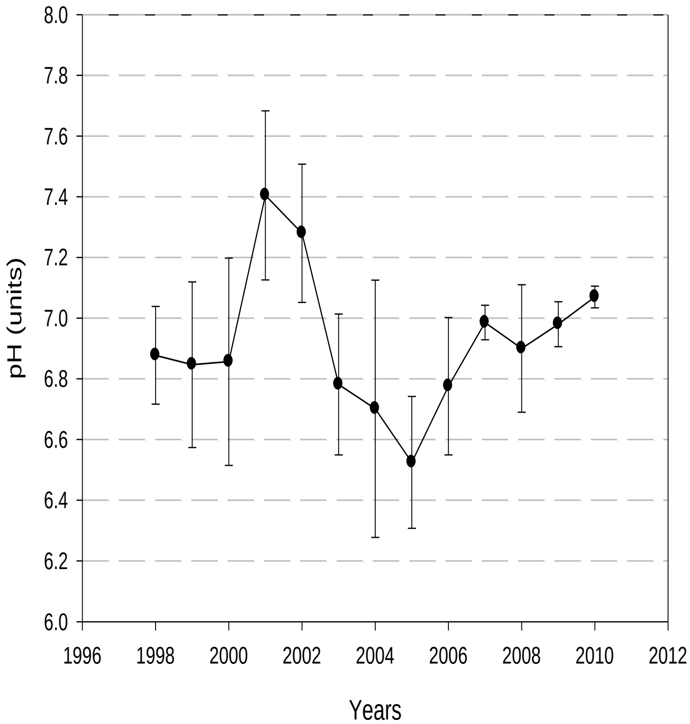
Source	Lake/Pond Name	Sampling Location	Sampling Date	Secchi (meters)	Nitrate (ppm)	Calcium (ppm)	Chloride (ppm)	Aluminum (ppm)	CSI
Vol	Loon Lake		07/30/98	4.9000	0.1000				
AAI	Loon Lake	Epi	08/12/98	6.0000	0.1000	3.1700	1.2500	0.0010	2.8986
Vol	Loon Lake		08/25/98	4.6000					
Vol	Loon Lake		09/17/98	4.7500					
Vol	Loon Lake		10/31/98		0.1000				
			MEAN	5.0625	0.1000				
			Std Dev	0.6369	0.0000				
AAI	Loon Lake	Hypo	08/12/98		0.1000	3.3100	1.1900	0.0000	3.4420
Vol	Loon Lake		06/10/99	4.9500	0.3000				
Vol	Loon Lake		07/12/99	4.9000	0.2000				
AAI	Loon Lake	epi	08/23/99	7.2000	0.1000	4.1800	1.0500	0.0000	2.3043
Vol	Loon Lake		08/23/99	6.2000	0.2000				
Vol	Loon Lake		09/12/99	7.0000	0.1000				
Vol	Loon Lake		10/16/99	4.9000	0.1000				
			MEAN	5.8583	0.1667				
			Std Dev	1.0846	0.0816				
AAI	Loon Lake	hypo	08/23/99		0.1000	4.3400	1.1400	0.0010	

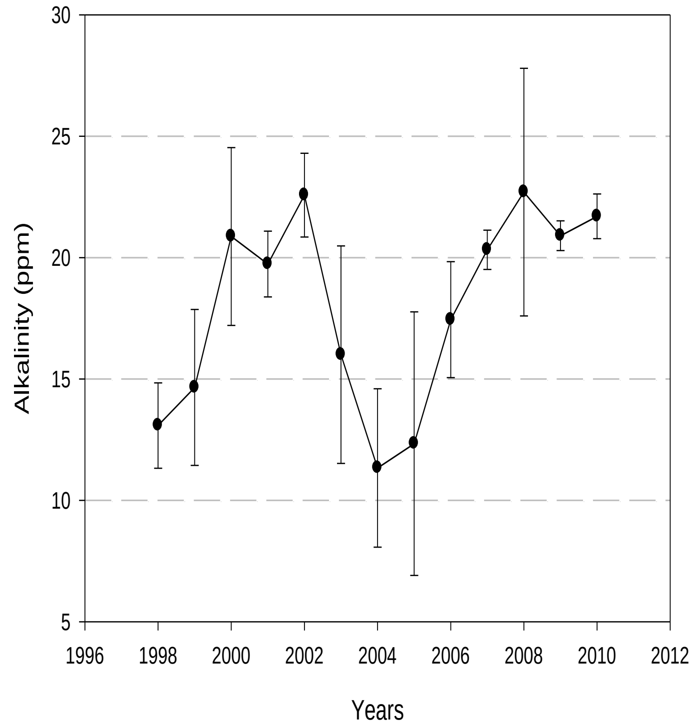
Vol	Loon Lake	Vol	10/14/2000	5.1000	0.0000				
Vol	Loon Lake	Vol	8/7/2000	5.3000	0.0000				
Vol	Loon Lake	Vol	9/13/2000	6.2500	0.0000				
Vol	Loon Lake	Vol	7/12/2000	5.0000	0.0000				
AAI	Loon Lake	Epilimnion	6/8/2000		0.1000	4.2100	1.2700	0.0010	2.1714
AAI	Loon Lake	Deephole	6/5/2000	4.5000	0.1000				
			MEAN	5.2300	0.0333				
			Std Dev	0.6419	0.0516				
AAI	Loon Lake	Hypolimnion	6/8/2000		0.1000	4.2700	1.3600	0.0030	2.6058
AAI	Loon Lake	Epilimnion	6/15/2001	6.7900	0.2000	4.4400	1.3600	0.0000	2.1700
Vol	Loon Lake	Deephole	6/15/2001	6.7900	0.1000				
Vol	Loon Lake	Deephole	8/14/2001	6.9000	0.0000				
Vol	Loon Lake	Deephole	9/15/2001	6.0000	0.1000				
Vol	Loon Lake	Deephole	10/10/2001	4.9500	0.1000				
Vol	Loon Lake	Deephole	7/21/2001	5.1000	0.1000				
AAI	Loon Lake	Hypolimnion	6/15/2001		0.2000	4.1800	1.2900	0.0000	2.3500
			MEAN	6.0883	0.1000				
			Std Dev	0.8859	0.0632				
AWI	Loon Lake	Epilimnion	5/20/2002	2.6000	0.1000	4.4800	1.5000	0.0000	2.1800
Vol	Loon Lake	Deephole	5/20/2002	2.6000	0.1000				
Vol	Loon Lake	Deephole	6/25/2002	4.5000	0.0000				
Vol	Loon Lake	Deephole	7/24/2002	5.1000	0.1000				
Vol	Loon Lake	Deephole	8/25/2002	6.0000	0.0000				
Vol	Loon Lake	Deephole	9/18/2002	6.0000	0.1000				
Vol	Loon Lake	Deephole	10/20/2002	4.1000	0.0000				
			MEAN	4.4143	0.0571				
			Std Dev	1.4253	0.0535				
AWI	Loon Lake	Hypolimnion	5/20/2002		0.0000	4.4800	1.5000	0.0010	2.1400
AWI	Loon Lake	Epilimnion	5/30/2003	3.6000	0.4000	3.6600	5.0000	0.0020	2.9400
Vol	Loon Lake	Deephole	5/30/2003	3.6000	0.5000				
Vol	Loon Lake	Deephole	6/29/2003	4.5000	0.1000				
Vol	Loon Lake	Deephole	7/26/2003	6.1000	0.1000				
Vol	Loon Lake	Deephole	8/10/2003	6.5000	0.0000				
Source	Lake/Pond Name	Sampling Location	Sampling Date	Secchi (meters)	Nitrate (ppm)	Calcium (ppm)	Chloride (ppm)	Aluminum (ppm)	CSI
Vol	Loon Lake	Deephole	9/8/2003	5.5000	0.5000				
			Mean	4.9667	0.2667				
			Std Dev	1.2549	0.2251				
AWI	Loon Lake	Hypolimnion	5/30/2003	3.6000	0.5000	3.8700	5.0000	0.0000	2.8500
AWI	Loon Lake	Epilimnion	5/28/2004	5.2000	0.5000	3.5200	5.0000	0.0000	3.3700
Vol	Loon Lake	Deephole	5/28/2004	5.0000	0.6000				
Vol	Loon Lake	Deephole	6/30/2004	4.5000	0.0000				
Vol	Loon Lake	Deephole	7/25/2004	5.1000	0.0000				
Vol	Loon Lake	Deephole	8/28/2004	7.0000	0.0000				
Vol	Loon Lake	Deephole	9/18/2004	6.5000	0.2000				
			Mean	5.5500	0.2167				
			Std Dev	0.9731	0.2714				
AWI	Loon Lake	Hypolimnion	5/28/2004		0.5000	3.7700	3.0000	0.0000	3.0900

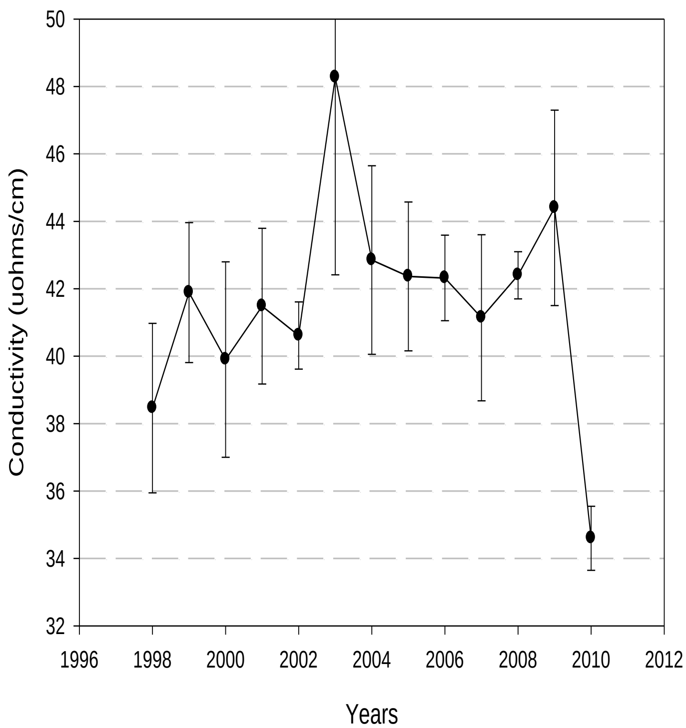
AWI	Loon Lake	Epilimnion	5/30/2005	5.5000	0.1000	4.2900	10.0000	0.0000	#REF!
Vol	Loon Lake	Deephole	5/30/2005	5.5000	0.1000				
Vol	Loon Lake	Deephole	7/2/2005	6.5000	0.0000				
Vol	Loon Lake	Deephole	7/30/2005	6.8000	0.1000				
Vol	Loon Lake	Deephole	9/5/2005	6.8000	0.2000				
Vol	Loon Lake	Deephole	10/15/2005	5.0000	0.1000				
			Mean	6.0167	0.1000				
			Std Dev	0.7782	0.0632				
AWI	Loon Lake	Hypolimnion	5/30/2005		0.1000	4.2700	8.0000	0.0030	#REF!
Vol	Loon Lake	Deephole	6/24/2006	5.4000	0.1100				
Vol	Loon Lake	Deephole	7/16/2006	6.1000	0.0900				
Vol	Loon Lake	Deephole	8/14/2006	6.2000	0.1000				
Vol	Loon Lake	Deephole	9/17/2006	6.4000	0.0800				
Vol	Loon Lake	Deephole	9/30/2006	5.8000	0.0800				
			Mean	5.9800	0.0920				
			Std Dev	0.3899	0.0130				
Vol	Loon Lake	Deephole	5/26/2007	5.2000	0.0000				
Vol	Loon Lake	Deephole	6/30/2007	6.5000	0.1000				
Vol	Loon Lake	Deephole	7/22/2007	6.7000	0.0000				
Vol	Loon Lake	Deephole	8/12/2007	6.4000	0.1000				
Vol	Loon Lake	Deephole	9/28/2007	6.6000	0.0000				
			Mean	6.2800	0.0400				
			Std Dev	0.6140	0.0548				
AWI	Loon Lake	Epilimnion	8/5/2008	5.5000	0.0000	4.3100	4.8000	0.0090	2.6000
	Loon Lake	North	6/8/2008	5.2000	0.0000				
	Loon Lake	North	7/6/2008	6.1000	0.1000				
	Loon Lake	North	8/31/2008	5.3000	0.0000				
			Mean	5.5333	0.0333				
			Std Dev	0.4933	0.0577				
	Loon Lake	South	6/8/2008	4.5000	0.0000				
	Loon Lake	South	7/6/2008	5.4000	0.1000				
	Loon Lake	South	8/31/2008	6.7000	0.0000				
			Mean	5.5333	0.0333				
			Std Dev	1.1060	0.0577				
AWI	Loon Lake	Hypolimnion	8/5/2008	X	0.3000	4.4600	4.8000	0.0070	

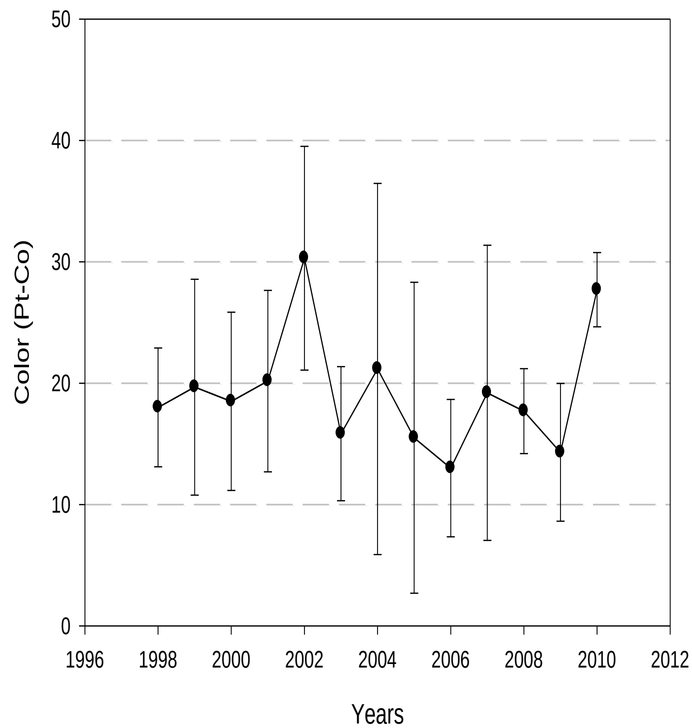
Source	Lake/Pond Name	Sampling Location	Sampling Date	Secchi (meters)	Nitrate (ppm)	Calcium (ppm)	Chloride (ppm)	Aluminum (ppm)	CSI
	Loon Lake	North	6/14/2009	7.8000	0.1000	4.5700	5.0000	0.0000	2.3000
	Loon Lake	North	7/31/2009	6.6000	0.1000				
	Loon Lake	North	9/6/2009	7.0000	0.1000				
			Mean	7.1333	0.1000				
			Std Dev	0.6110	0.0000				
	Loon Lake	South	6/14/2009	6.6000	0.1000	4.3900	4.0000	0.0000	2.5000
	Loon Lake	South	7/31/2009	5.4000	0.1000				
	Loon Lake	South	9/6/2009	6.4000	0.0000				
			Mean	6.1333	0.0667				
			Std Dev	0.6429	0.0577				

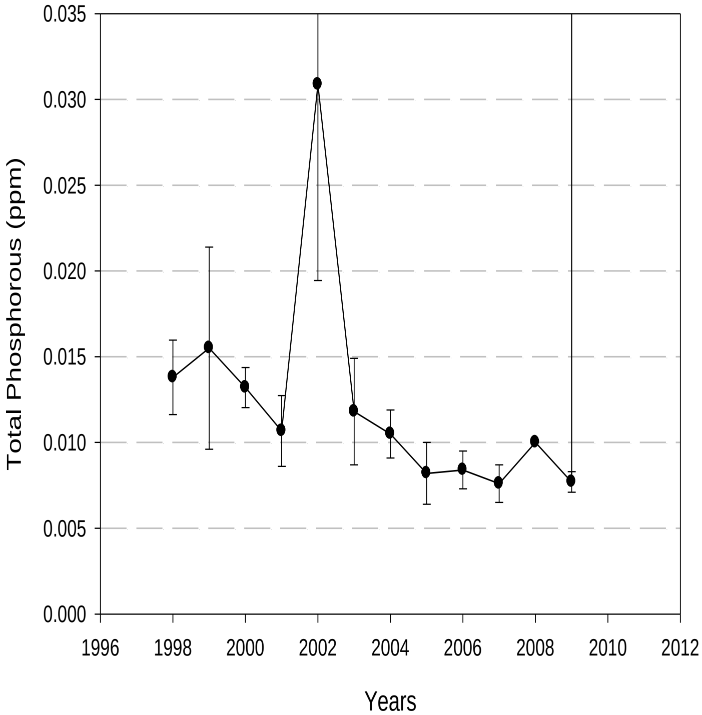
Source	Lake/Pond Name	Sampling Location	Sampling Date	Secchi (meters)	Nitrate (ppm)	Calcium (ppm)	Chloride (ppm)	Aluminum (ppm)	CSI
	Loon Lake	North	6/12/2010	6.0000	0.2000	4.2100	5.9100	0.0100	
	Loon Lake	North	7/24/2010	6.8000	0.2100	4.1400	6.2600	0.0200	
	Loon Lake	North	9/2/2010	6.6000	0.2100	4.2700	6.1000	0.0200	
			Mean	6.4667	0.2067	4.2067	6.0900	0.0167	
			Std Dev	0.4163	0.0058	0.0651	0.1752	0.0058	
	Loon Lake	South	6/12/2010	5.3000	0.2000	4.1100	4.8600	0.0200	
	Loon Lake	South	7/24/2010	6.2000	0.0400	4.1800	4.1800	0.0200	
	Loon Lake	South	9/2/2010	5.0000	0.2100	4.3100	5.8400	0.0200	
			Mean	5.5000	0.1500	4.2000	4.9600	0.0200	
			Std Dev	0.6245	0.0954	0.1015	0.8345	0.0000	

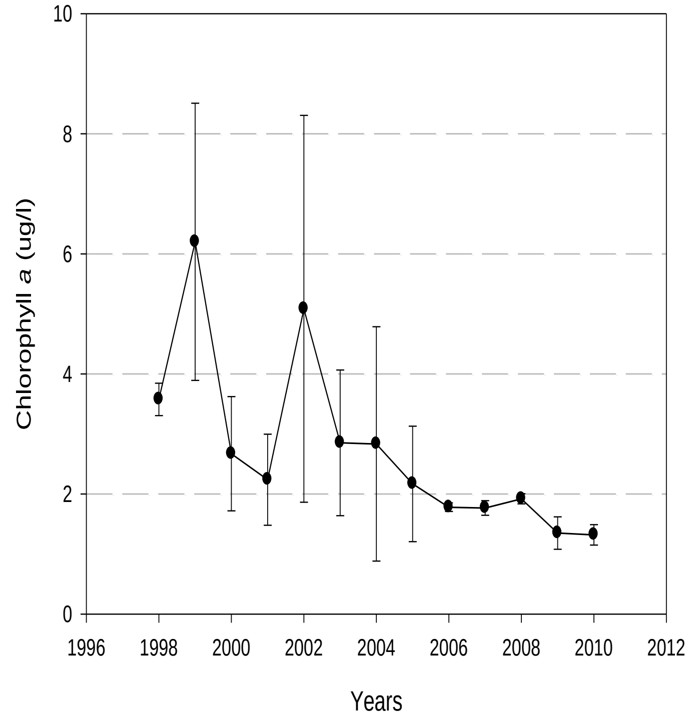

pH (units)
8.0
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
1996
1998
2000
2002
2004
2006
2008
2010
2012
Years

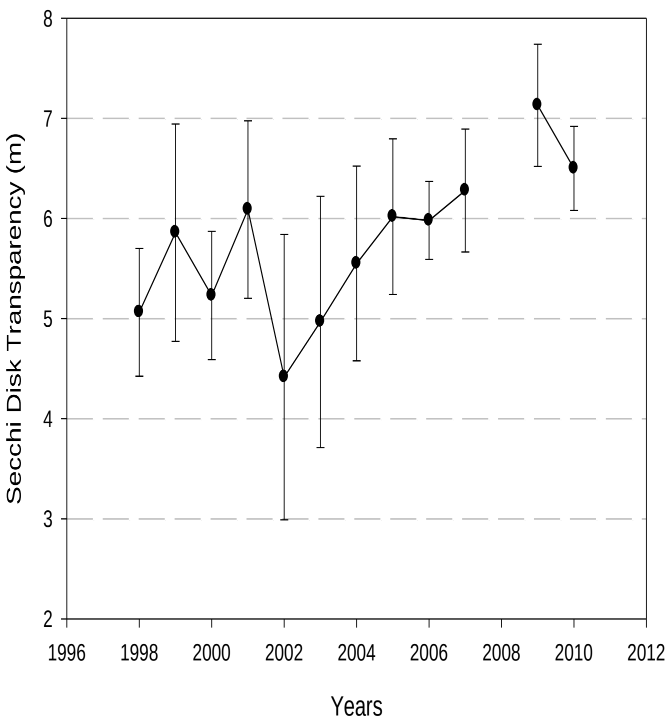

Alkalinity (ppm)
30
25
20
15
10
5
1996
1998
2000
2002
2004
2006
2008
2010
2012
Years

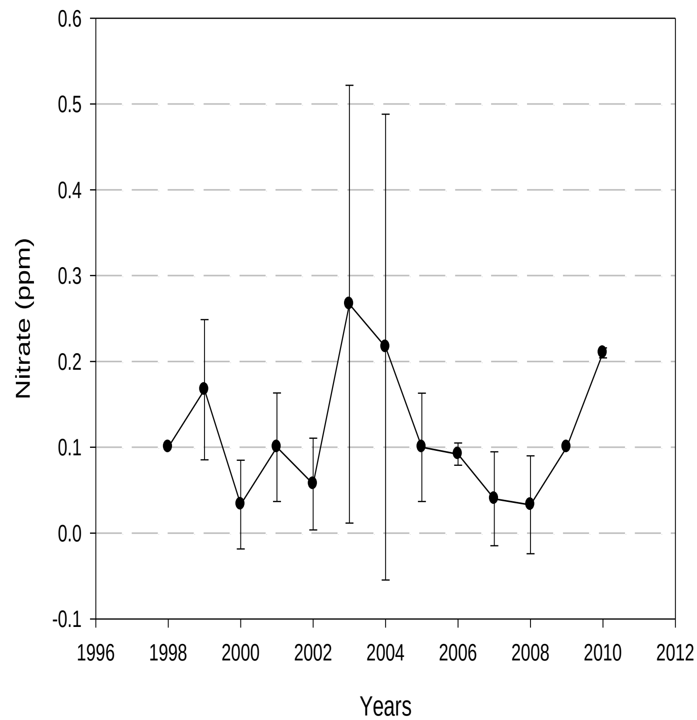

Conductivity (uohms/cm)
50
48
46
44
42
40
38
36
34
32
1996
1998
2000
2002
2004
2006
2008
2010
2012
Years

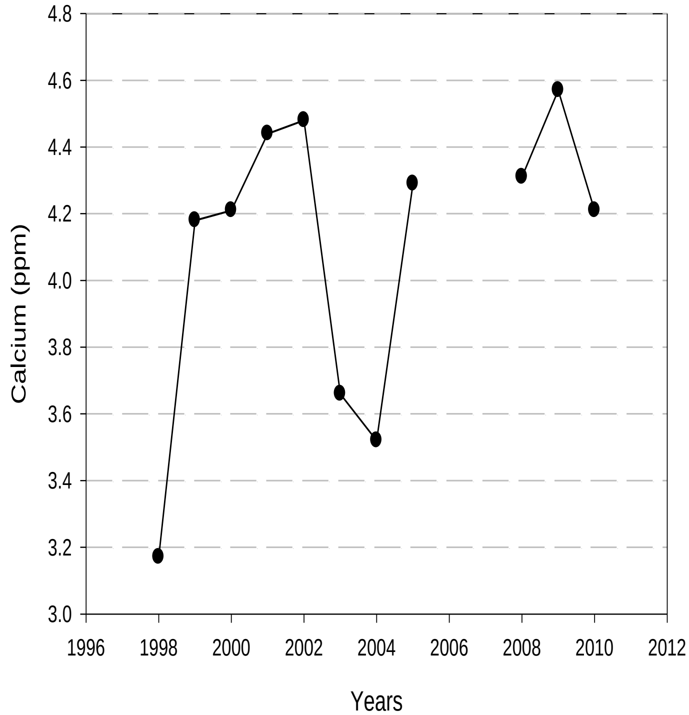

Color (Pt-Co)
50
40
30
20
10
0
1996
1998
2000
2002
2004
2006
2008
2010
2012
Years

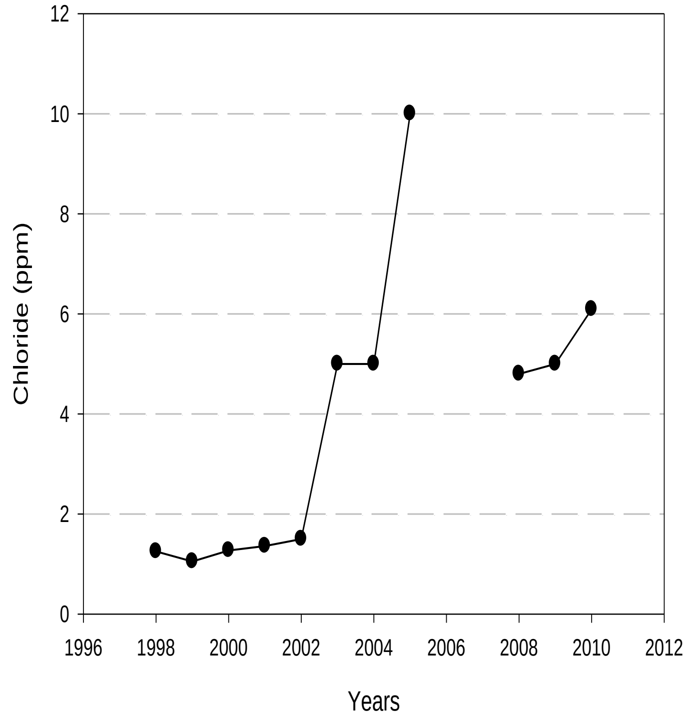

Total Phosphorous (ppm)
0.000 0.005 0.010 0.015 0.020 0.025 0.030 0.035
1996 1998 2000 2002 2004 2006 2008 2010 2012
Years

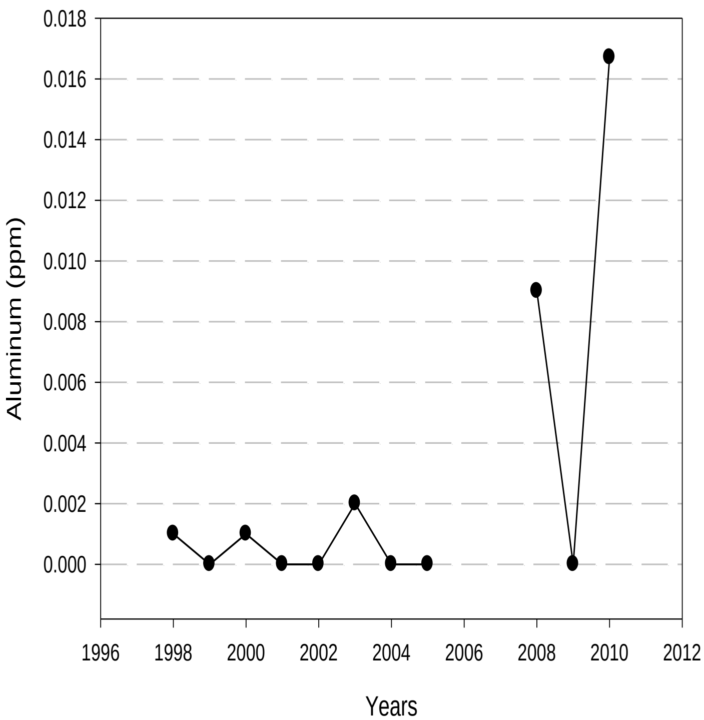

Chlorophyll a (ug/l)
0 2 4 6 8 10
1996 1998 2000 2002 2004 2006 2008 2010 2012
Years


Secchi Disk Transparency (m)
2 3 4 5 6 7 8
1996 1998 2000 2002 2004 2006 2008 2010 2012
Years


Nitrate (ppm)
-0.1 0.0 0.1 0.2 0.3 0.4 0.5 0.6
1996 1998 2000 2002 2004 2006 2008 2010 2012
Years


Calcium (ppm)
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
1996
1998
2000
2002
2004
2006
2008
2010
2012
Years


Chloride (ppm)
12
10
8
6
4
2
0
1996
1998
2000
2002
2004
2006
2008
2010
2012
Years


Aluminum (ppm)
0.018
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
1996
1998
2000
2002
2004
2006
2008
2010
2012
Years