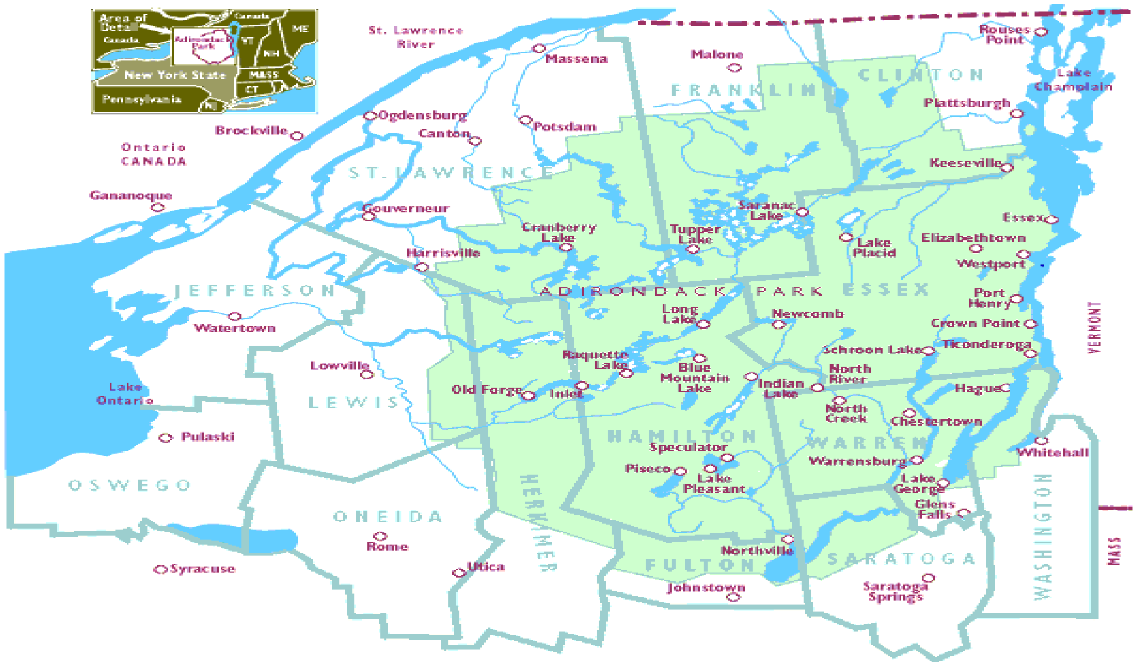
Adirondack Lake Assessment Program
2010



<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

Spitfire Lake

Summer 2010

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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 by 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

Spitfire Lake was sampled three times by a volunteer and once with AWI staff in 2010. Samples were collected on the following dates: 7/15/10, 8/09/10 and 9/20/10. 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, the acidity status of Spitfire Lake is considered satisfactory, with only a slight sensitivity to acidification. The pH values are satisfactory and the alkalinity, calcium and CSI values indicate low sensitivity to acidification.

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, Spitfire Lake is considered to be mesotrophic.

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 Spitfire Lake ranged from 6.80 to 7.03. The average pH was 6.94. Based solely on pH, Spitfire 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 Spitfire Lake ranged from 19.6 ppm to 24.4 ppm. The average alkalinity was 22.1 ppm. These values indicate 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 Spitfire Lake was measured in 2010 and it ranged from 3.82 to 4.13 ppm. The average calcium concentration was found to be 3.96 ppm. This value shows us a lake that is not sensitive to further 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

The CSI value for Spitfire Lake was calculated and it was found to be 2.50. This value shows us a lake that has a low vulnerability to 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 Spitfire Lake ranged from 10 to 23 ppb and the average concentration was 15.0 ppb. This is indicative of mesotrophic conditions.

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 Spitfire Lake ranged from 3.05 ppb to 7.72 ppb. The average concentration was 5.19 ppb. This is indicative of mesotrophic conditions.

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 Spitfire Lake ranged from 2.6 to 4.9 meters. The average value was 4.0 meters. This value is indicative of mesotrophic conditions.

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 nitrate in the upper water of Spitfire Lake ranged from 0.029 to 0.192 ppm and the average value was found to be 0.120 ppm.

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 Spitfire Lake was measured in 2010 and it ranged from 8.31 to 20.90 ppm. The average chloride concentration was found to be an elevated 12.54 ppm. This high chloride reading is most likely due to road salt contamination.

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 Spitfire Lake ranged from 45.2μohms/cm to 53.4μohms/cm. The average conductivity was 48.7 μohms/cm.

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 water. 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 Spitfire Lake ranged from 12 Pt-Co to 15 Pt-Co. The average color was 13.3 Pt-Co.

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 aluminum in the upper water of Spitfire Lake was measured and found to range from 0.000 to 0.010 ppm. The average aluminum concentration was found to be a very low 0.003 ppm.

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 Spitfire Lake for 2002 – 2010 except 2005 and 2007 are presented in Appendix A. The dissolved oxygen remained relatively constant from the surface to around the fifth meter, after which it continually decreased to the bottom. The oxygen level is sufficient for cold-water fish survival near the top, but the water temperature there is not conducive to their survival. However, the lake does have sufficient dissolved oxygen for warm water fish survival.

Summary

Spitfire Lake was a moderately productive mesotrophic lake during 2010. Based on the results of the 2010 Adirondack Lake Assessment program, the acidity status of Spitfire Lake is considered satisfactory, with a low sensitivity to acidification. The pH values are satisfactory and the alkalinity, calcium and CSI values indicate low sensitivity to acidification.

Nine years of data are sufficient to detect water quality trends, and it is possible to compare the current data with the data collected in 2002 through 2010. In 2010, the conductivity, color, total phosphorous, chlorophyll-a, nitrate, and calcium were lower than in 2009. In 2010, the pH, alkalinity, Secchi disk transparency, aluminum and chloride were higher than levels in 2009. Over the last nine years the pH, alkalinity, color, nitrate, calcium and aluminum levels have changed very little with only slight year to year changes. There has been an alarming increase in conductivity and chloride levels. This is most likely due to road salt entering the lake through runoff from State Route 30. This rise in these parameters has been seen in many lakes near state highways throughout the Adirondack Park. The total phosphorous and chlorophyll a levels decreased in the last year and this has led to a increase in Secchi disk transparency.

Literature Cited

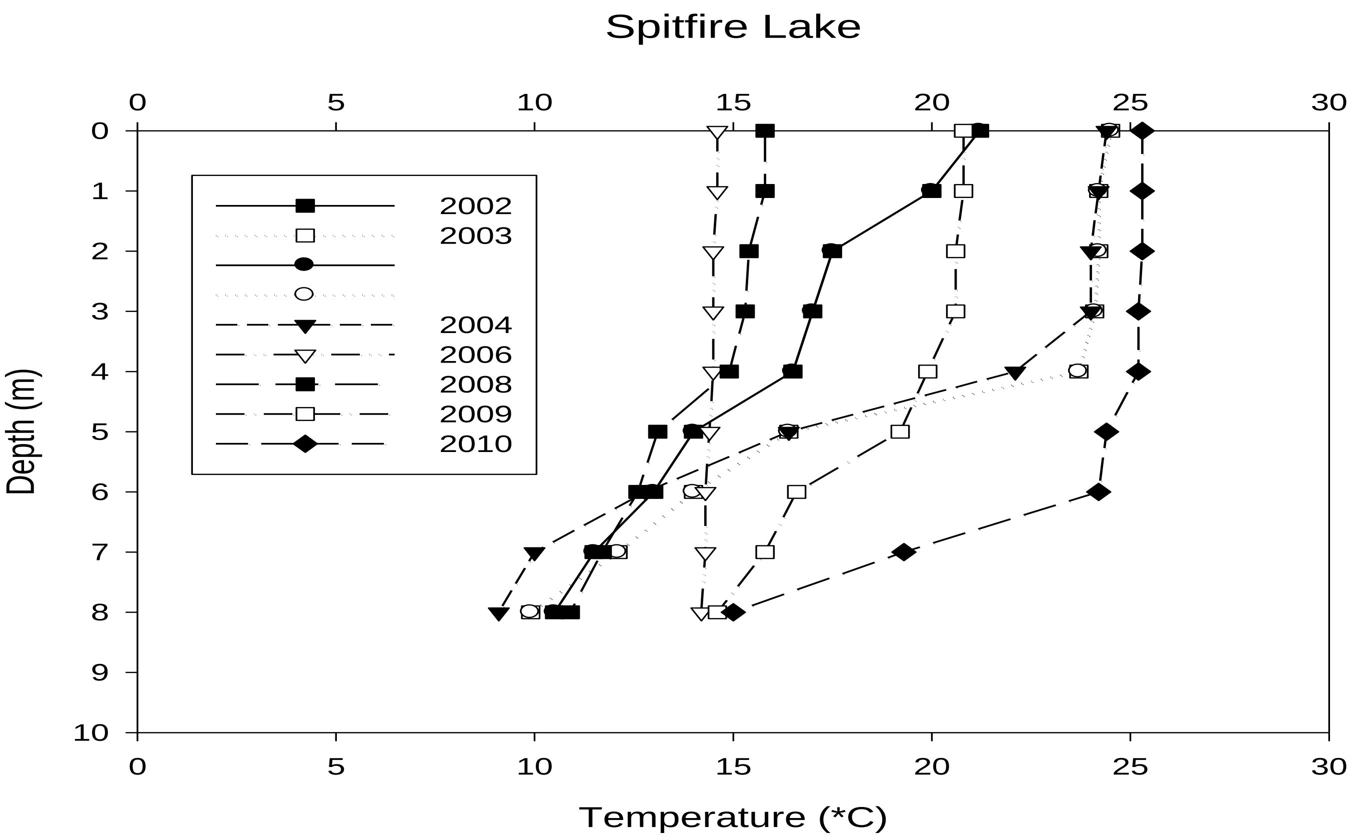
DEC & FOLA. (1990). Diet for a Small Lake: A New Yorker's Guide to Lake Management. New York State Department of Environmental Conservation & The Federation of Lake Associations, Inc.: Albany, New York.

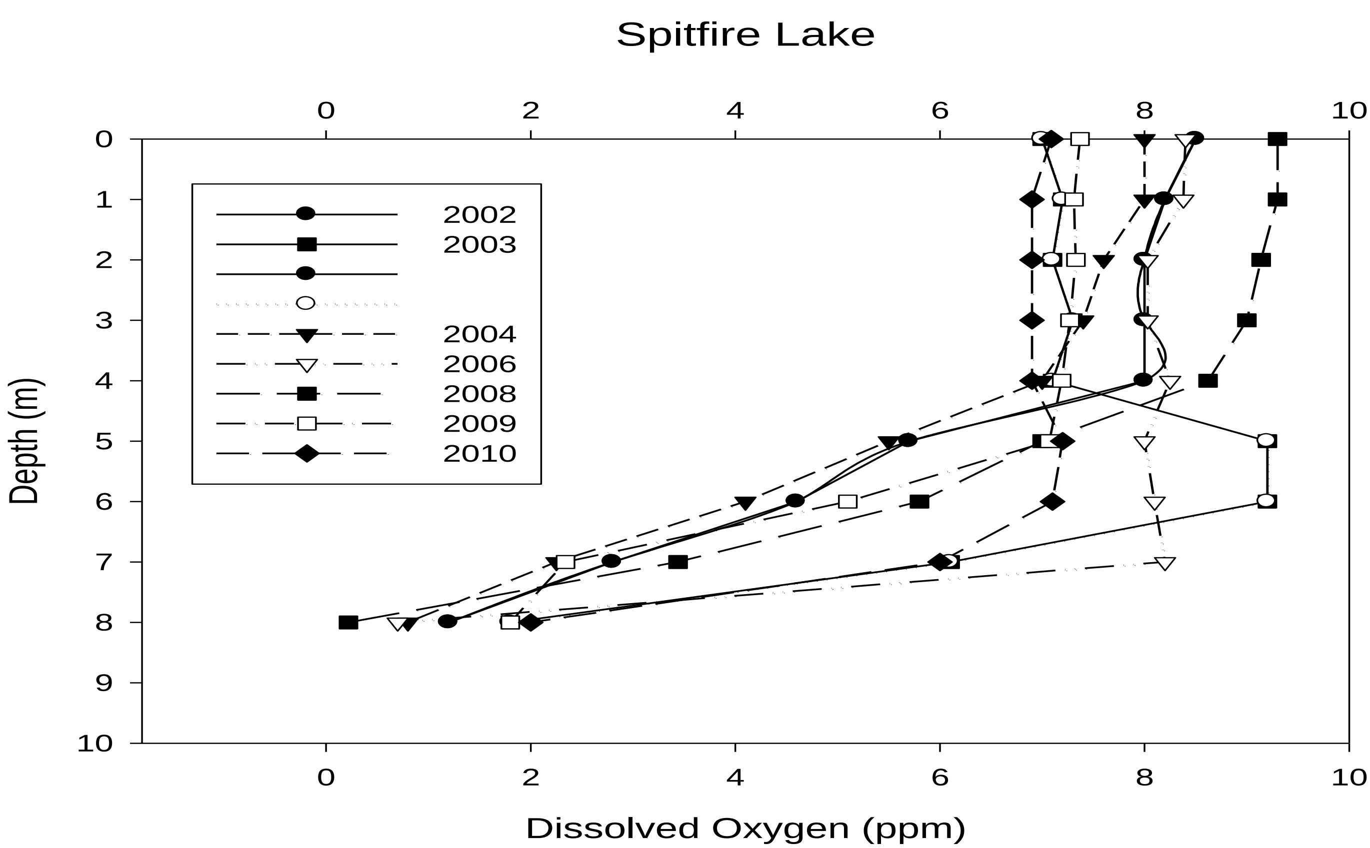
Greenberg, A.E., Eaton, A.D., and Leseri, L.A. (editors). (2005). Standard Methods for the Examination of Water and Wastewater, 21st Edition. American Public Health Association: Washington, D.C.

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


Spitfire Lake
0
5
10
15
20
25
30
Depth (m)
2002
2003
2004
2006
2008
2009
2010
Temperature (*C)

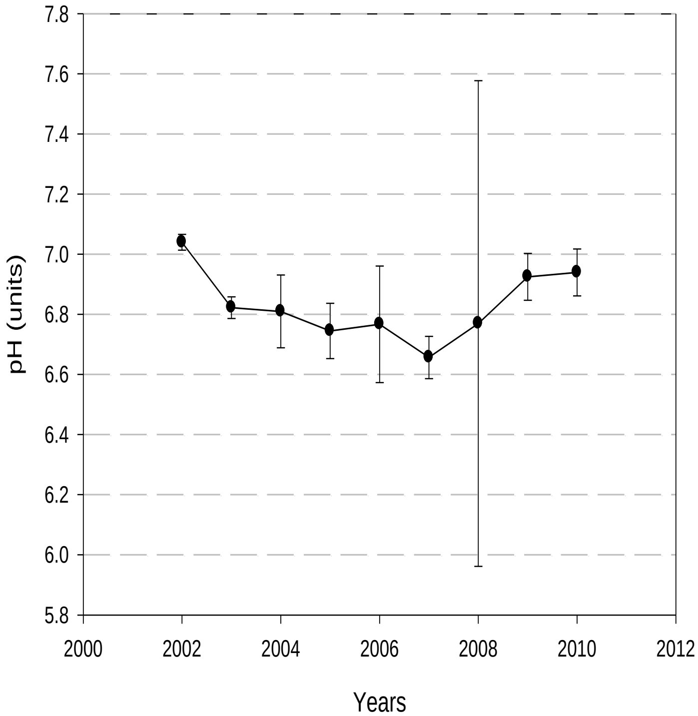

Spitfire Lake
Depth (m)
2002
2003
2004
2006
2008
2009
2010
Dissolved Oxygen (ppm)

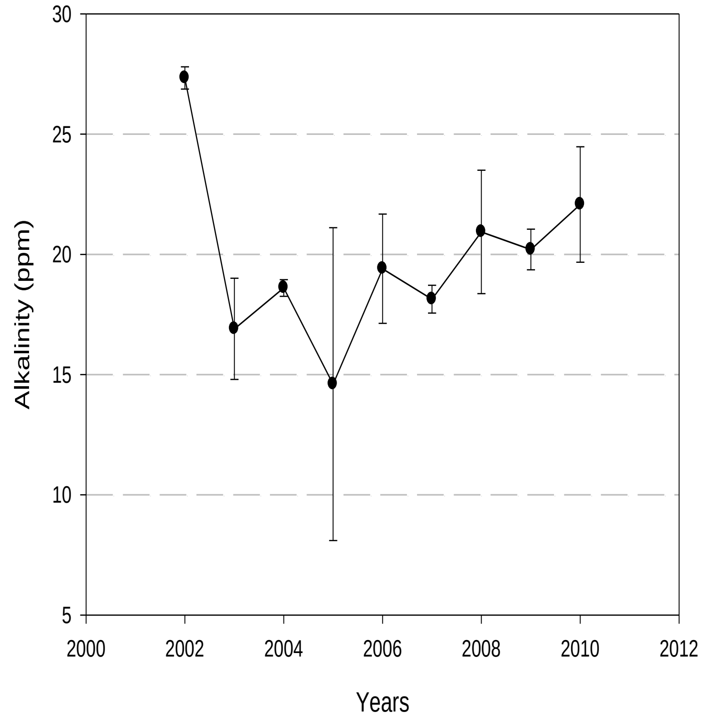
Source	Lake/Pond Name	Sampling Location	Sampling Date	pH (units)	Alkalinity (ppm)	Conductivity (µohms/cm)	Color (Pt-Co)	Total P (ppm)	Chl a (µg/l)
AWI	Spitfire Lake	Epilimnion	6/20/2002	7.0200	27.6000	42.7000	33.0000	0.0150	4.4200
Vol	Spitfire Lake	Deephole	7/9/2002	7.0700	27.6000	42.9000	26.0000	0.0140	4.1700
Vol	Spitfire Lake	Deephole	8/21/2002	7.0300	26.8000	43.6000	6.0000	0.0300	3.8800
			MEAN	7.0400	27.3333	43.0667	21.6667	0.0197	4.1567
			Std Dev	0.0265	0.4619	0.4726	14.0119	0.0090	0.2702
AWI	Spitfire Lake	Hypolimnion	6/20/2002	6.7200	15.8000	42.7000	42.0000	0.0180	
AWI	Spitfire Lake	Epilimnion	6/27/2003	6.7700	18.0000	43.0000	12.0000	0.0180	3.6100
Vol	Spitfire Lake	Deephole	7/18/2003	6.8400	18.8000	40.2000	19.0000	0.0130	3.6600
Vol	Spitfire Lake	Deephole	8/15/2003	6.8500	16.8000	38.2000	15.0000	0.0130	2.8800
Vol	Spitfire Lake	Deephole	9/27/2003	6.8300	14.0000	43.0000	12.0000	0.0150	3.7000
			Mean	6.8225	16.9000	41.1000	14.5000	0.0148	3.4625
			Std Dev	0.0359	2.1008	2.3409	3.3166	0.0024	0.3901
AWI	Spitfire Lake	Hypolimnion	6/27/2003	6.2000	10.0000	37.0000	23.0000	0.0210	
AWI	Spitfire Lake	Epilimnion	6/28/2004	6.7400	18.8000	44.9000	10.0000	0.0200	4.5800
Vol	Spitfire Lake	Deephole	7/30/2004	6.9500	18.8000	44.7000	30.0000	0.0100	3.0000
Vol	Spitfire Lake	Deephole	8/28/2003	6.7400	18.2000	44.5000	37.0000	0.0120	1.8200
			Mean	6.8100	18.6000	44.7000	25.6667	0.0140	3.1333
			Std Dev	0.1212	0.3464	0.2000	14.0119	0.0053	1.3848
AWI	Spitfire Lake	Hypolimnion	6/28/2004	6.7100	24.2000	45.1000	28.0000	0.0230	
Vol	Spitfire Lake	Deephole	6/13/2005	6.8100	19.2000	44.5000	45.0000	0.0170	5.7200
Vol	Spitfire Lake	Deephole	8/21/2005	6.6800	10.0000	51.4000	27.0000	0.0170	4.5600
			Mean	6.7450	14.6000	47.9500	36.0000	0.0170	5.1400
			Std Dev	0.0919	6.5054	4.8790	12.7279	0.0000	0.8202
Vol	Spitfire Lake	Deephole	6/28/2006	6.6400	18.4000	42.2000	17.0000	0.0180	5.2700
Vol	Spitfire Lake	Deephole	7/29/2006	6.9900	22.0000	48.6000	26.0000	0.0120	6.4200
Vol	Spitfire Lake	Deephole	8/31/2006	6.6700	17.8000	39.3000	10.0000	0.0120	3.5400
			Mean	6.7667	19.4000	43.3667	17.6667	0.0140	5.0767
			Std Dev	0.1940	2.2716	4.7585	8.0208	0.0035	1.4497
Vol	Spitfire Lake	Deephole	6/13/2007	6.7300	17.8000	51.9000	35.0000	0.0160	4.0200
Vol	Spitfire Lake	Deephole	7/11/2007	6.6500	18.8000	48.8000	21.0000	0.0180	7.7900
Vol	Spitfire Lake	Deephole	8/1/2007	6.5900	17.8000	53.4000	17.0000	0.0140	4.2800
			Mean	6.6567	18.1333	51.3667	24.3333	0.0160	5.3633
			Std Dev	0.0702	0.5774	2.3459	9.4516	0.0020	2.1056
AWI	Spitfire Lake	Epi	6/5/2008	6.7400	20.2000	51.7000	35.0000	0.0190	7.4800
Vol	Spitfire Lake	Deephole	6/5/2008	6.8400	22.8000	53.6000	22.0000	0.0210	7.7800
Vol	Spitfire Lake	Deephole	7/10/2008	6.6800	18.0000	61.9000	14.0000	0.0190	6.0800
Vol	Spitfire Lake	Deephole	8/7/2008	6.7800	22.0000	48.6000	13.0000	0.0180	5.0500
			Mean	6.7667	20.9333	54.7000	16.3333	0.0193	6.3033
			Std Dev	0.0808	2.5716	6.7179	4.9329	0.0015	1.3786
AWI	Spitfire Lake	Hypo	6/5/2008	6.7100	18.8000	55.5000	24.0000	0.0170	x
Vol	Spitfire Lake	Deephole	7/17/2009	6.9800	20.8000	53.4000	34.0000	0.0210	6.8800
Vol	Spitfire Lake	Deephole	8/14/2009	6.8700	19.6000	51.8000	36.0000	0.0140	3.8900
			Mean	6.9250	20.2000	52.6000	35.0000	0.0175	5.3850
			Std Dev	0.0778	0.8485	1.1314	1.4142	0.0049	2.1142

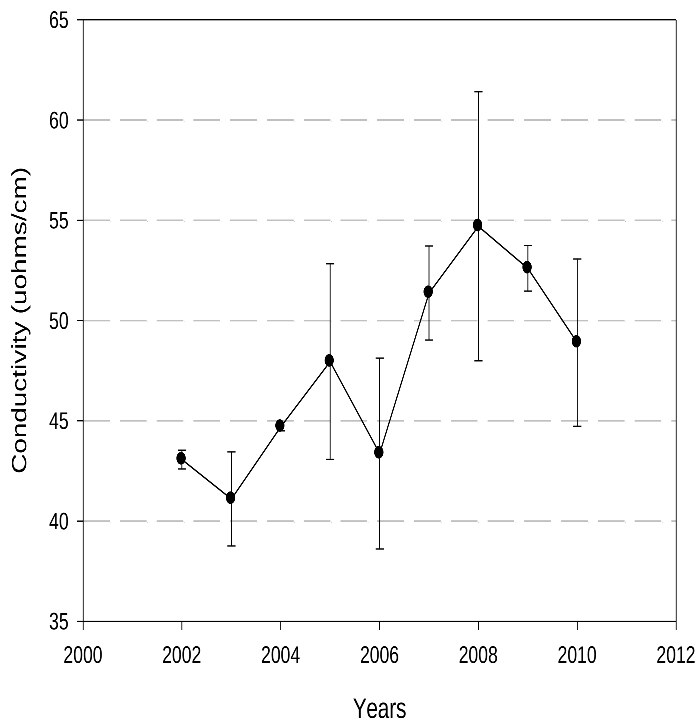
AWI	Spitfire Lake	Epi	7/15/2010	6.8800	19.6000	45.2000	15.0000	0.0100	3.0500
AWI	Spitfire Lake	Deephole	8/9/2010	7.0300	24.4000	48.0000	12.0000	0.0120	4.8100
AWI	Spitfire Lake	Epi	9/20/2010	6.9200	22.2000	53.4000	13.0000	0.0230	7.7200
			Mean	6.9433	22.0667	48.8667	13.3333	0.0150	5.1933
			Std Dev	0.0777	2.4028	4.1681	1.5275	0.0070	2.3585
AWI	Spitfire Lake	Hypo	7/15/2010	6.2000	12.8000	47.1000	74.0000	0.0160	x
AWI	Spitfire Lake	Hypo	8/9/2010	6.3600	14.4000	58.8000	27.0000	0.0880	x

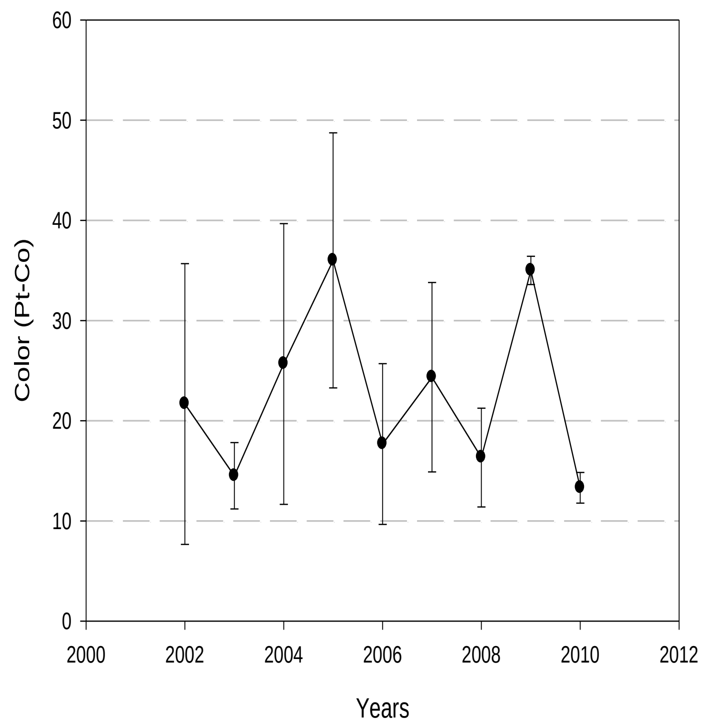
Source	Lake/Pond Name	Sampling Location	Sampling Date	Secchi (meters)	Nitrate (ppm)	Calcium (ppm)	Chloride (ppm)	Aluminum (ppm)	CSI
AWI	Spitfire Lake	Epilimnion	6/20/2002	3.1000	0.0000	10.5000	5.4000	0.0010	1.8200
Vol	Spitfire Lake	Deephole	7/9/2002	3.5000	0.1000				
Vol	Spitfire Lake	Deephole	8/21/2002	4.4000	0.0000				
			MEAN	3.6667	0.0333				
			Std Dev	0.6658	0.0577				
AWI	Spitfire Lake	Hypolimnion	6/20/2002		0.0000	6.5100	5.4000	0.0080	2.5700
AWI	Spitfire Lake	Epilimnion	6/27/2003	3.6000	0.4000	4.0800	7.0000	0.0000	2.6600
Vol	Spitfire Lake	Deephole	7/18/2003	4.4000	0.1000				
Vol	Spitfire Lake	Deephole	8/15/2003	5.6000	0.0000				
Vol	Spitfire Lake	Deephole	9/27/2003	3.5000	0.4000				
			Mean	4.2750	0.2250				
			Std Dev	0.9708	0.2062				
AWI	Spitfire Lake	Hypolimnion	6/27/2003		0.4000	3.6600	5.0000	0.0000	3.5400
AWI	Spitfire Lake	Epilimnion	6/28/2004	1.4000	0.1000	4.1600	5.0000	0.0000	#REF!
Vol	Spitfire Lake	Deephole	7/30/2004	6.0000	0.0000				
Vol	Spitfire Lake	Deephole	8/28/2003	5.2000	0.1000				
			Mean	4.2000	0.0667				
			Std Dev	2.4576	0.0577				
AWI	Spitfire Lake	Hypolimnion	6/28/2004		0.0000	4.5600	5.0000	0.0000	#REF!
Vol	Spitfire Lake	Deephole	6/13/2005	3.0000	0.0000				
Vol	Spitfire Lake	Deephole	8/21/2005	3.0000	0.1000				
			Mean	3.0000	0.0500				
			Std Dev	0.0000	0.0707				
Vol	Spitfire Lake	Deephole	6/28/2006	2.9000	0.0000				
Vol	Spitfire Lake	Deephole	7/29/2006	2.3000	0.1000				
Vol	Spitfire Lake	Deephole	8/31/2006	4.0000	0.1000				
			Mean	3.0667	0.0667				
			Std Dev	0.8622	0.0577				
Vol	Spitfire Lake	Deephole	6/13/2007	4.0000	0.5000				
Vol	Spitfire Lake	Deephole	7/11/2007		0.1000				
Vol	Spitfire Lake	Deephole	8/1/2007		0.1000				
			Mean	4.0000	0.2333				
			Std Dev	#DIV/0!	0.2309				

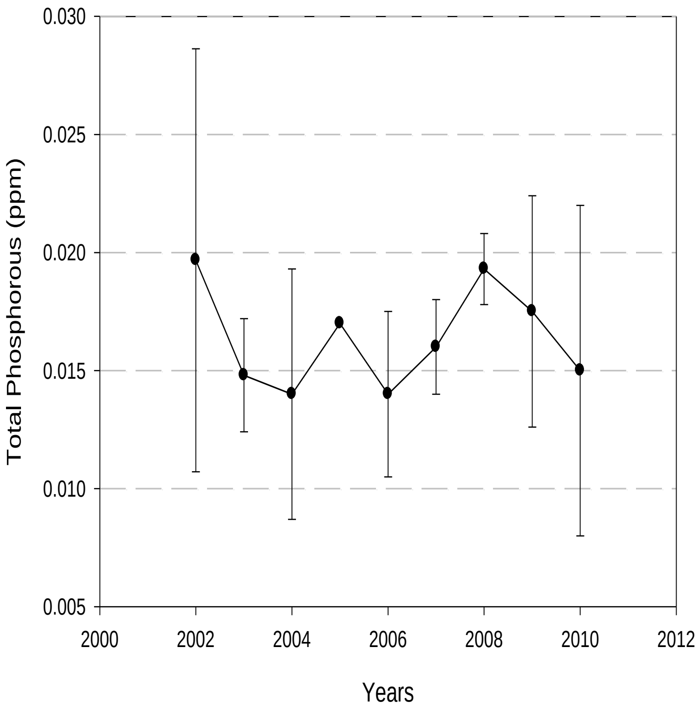
Source	Lake/Pond Name	Sampling Location	Sampling Date	Secchi (meters)	Nitrate (ppm)	Calcium (ppm)	Chloride (ppm)	Aluminum (ppm)	CSI
	Spitfire Lake	Epi	6/5/2008	2.4000	0.0000	4.4400	8.0000	0.0000	2.6000
Vol	Spitfire Lake	Deephole	6/5/2008	2.0000	0.2000				
Vol	Spitfire Lake	Deephole	7/10/2008	3.0000	0.0000				
Vol	Spitfire Lake	Deephole	8/7/2008	3.5000	0.1000				
			Mean	2.8333	0.1000				
			Std Dev	0.7638	0.1000				
AWI	Spitfire Lake	Hypo	6/5/2008	x	0.1000	4.3700	9.5000	0.0000	2.7000
Vol	Spitfire Lake	Deephole	7/17/2009	2.6000	0.2000	4.4800	9.0000	0.0000	2.4000
Vol	Spitfire Lake	Deephole	8/14/2009	4.1000	0.1000				
			Mean	3.3500	0.1500				
			Std Dev	1.0607	0.0707				
AWI	Spitfire Lake	Epi	7/15/2010	4.9000	0.0290	3.8200	8.4000	0.0000	
AWI	Spitfire Lake	Deephole	8/9/2010	4.5000	0.1400	4.1300	20.9000	0.0100	
AWI	Spitfire Lake	Epi	9/20/2010	2.6000	0.1920	3.9400	8.3100	0.0000	
			Mean	4.0000	0.1203	3.9633	12.5367	0.0033	
			Std Dev	1.2288	0.0833	0.1563	7.2430	0.0058	
AWI	Spitfire Lake	Hypo	7/15/2010	x	0.0290	4.3200	8.0000	0.0000	
AWI	Spitfire Lake	Hypo	8/9/2010	x	0.1890	3.9200	10.2000	0.0000	

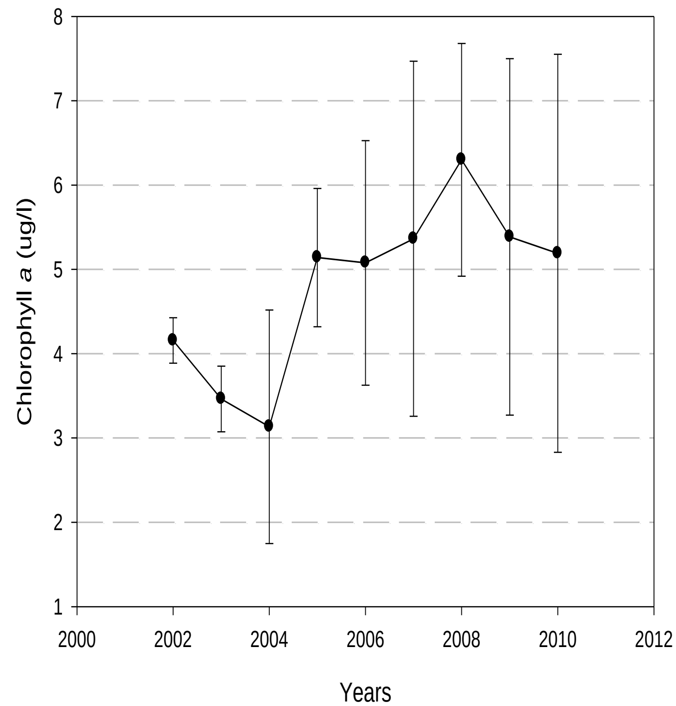

pH (units)
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
5.8
2000 2002 2004 2006 2008 2010 2012
Years

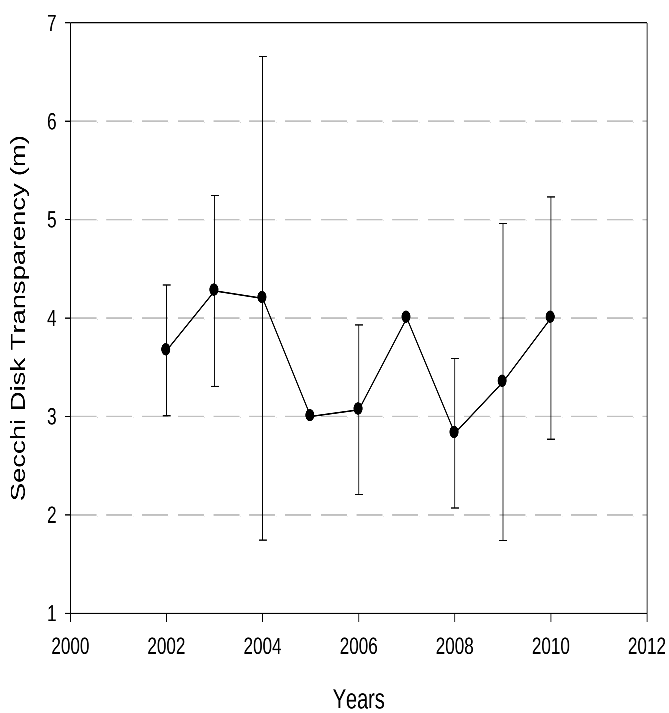

Alkalinity (ppm)
30
25
20
15
10
5
2000 2002 2004 2006 2008 2010 2012
Years

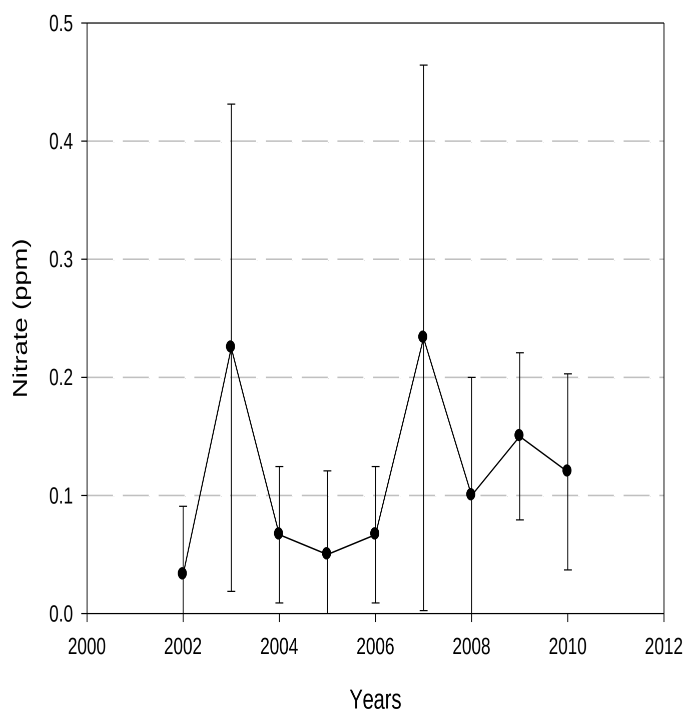

Conductivity (uohms/cm)
65
60
55
50
45
40
35
2000 2002 2004 2006 2008 2010 2012
Years

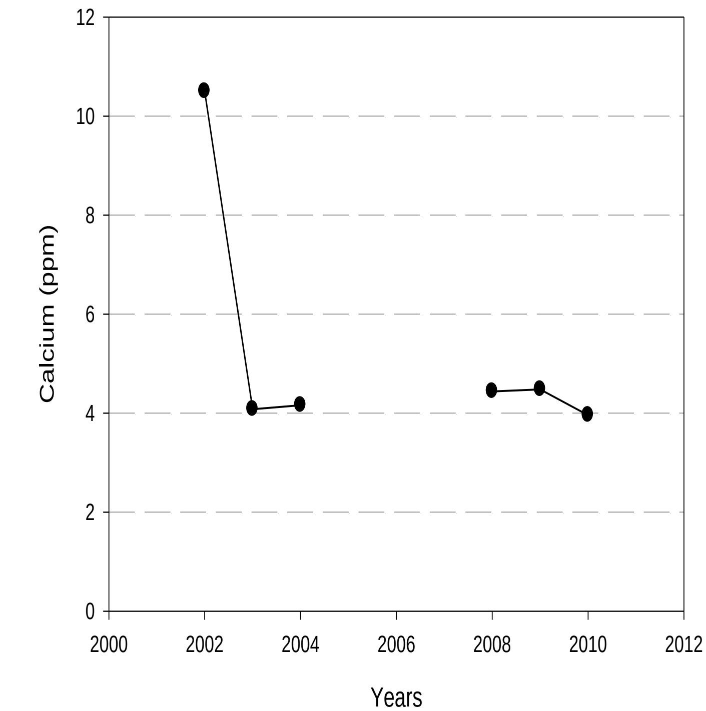

Color (Pt-Co)
60
50
40
30
20
10
0
2000 2002 2004 2006 2008 2010 2012
Years

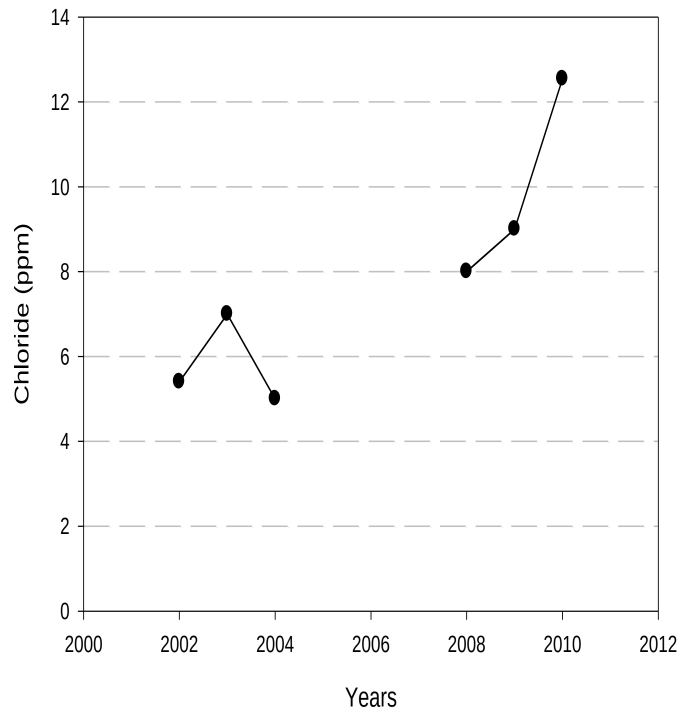

Total Phosphorous (ppm)
0.030
0.025
0.020
0.015
0.010
0.005
2000
2002
2004
2006
2008
2010
2012
Years

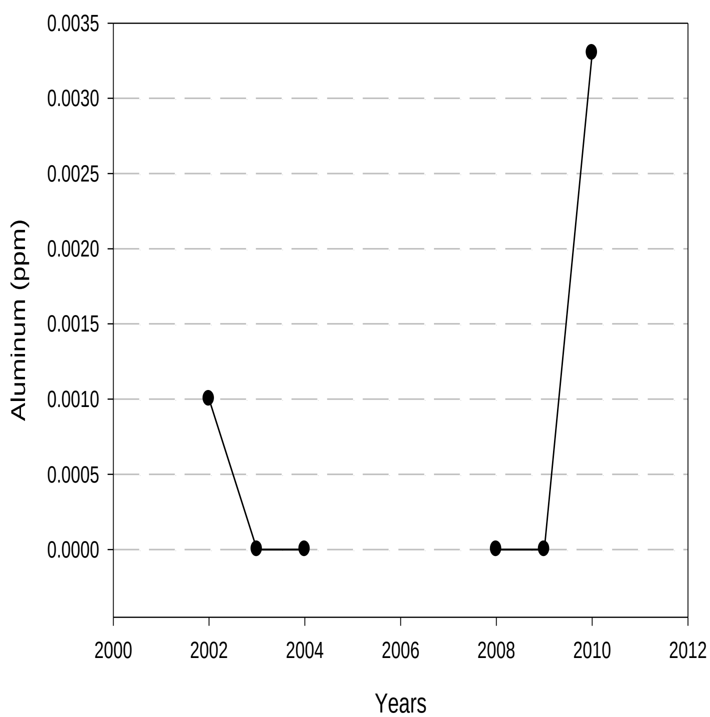

Chlorophyll a (ug/l)
8
7
6
5
4
3
2
1
2000
2002
2004
2006
2008
2010
2012
Years


Secchi Disk Transparency (m)
7
6
5
4
3
2
1
2000
2002
2004
2006
2008
2010
2012
Years


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


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


Chloride (ppm)
0
2
4
6
8
10
12
14
2000
2002
2004
2006
2008
2010
2012
Years


Aluminum (ppm)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
2000
2002
2004
2006
2008
2010
2012
Years