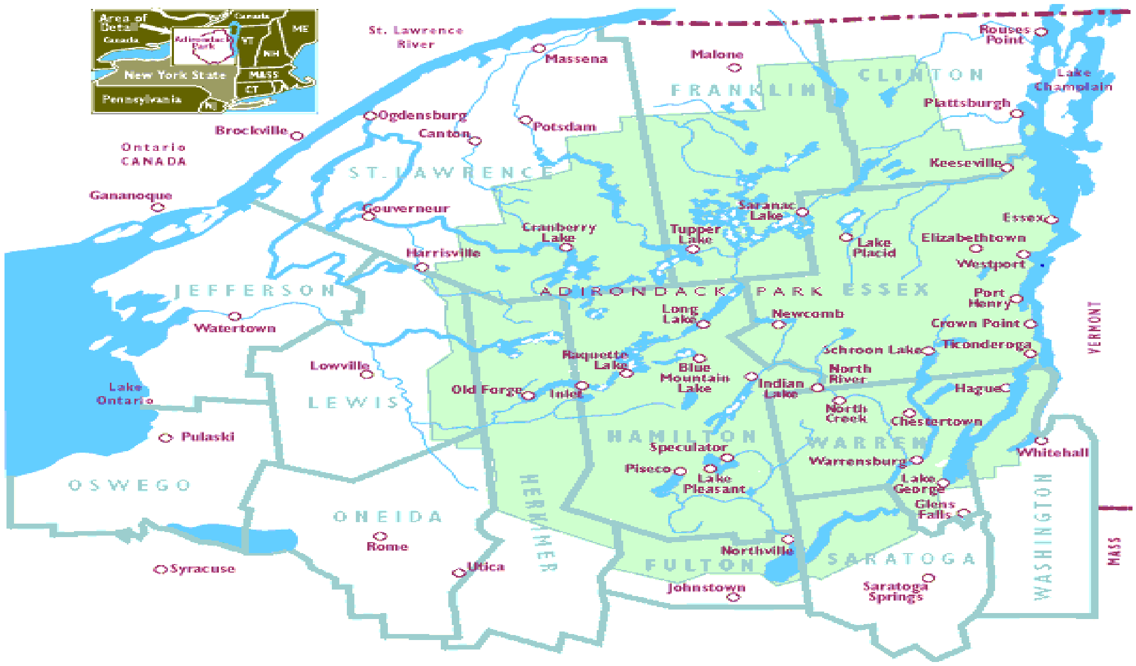
Adirondack Lake Assessment Program
2010



<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

Garnet 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

Garnet Lake was sampled three times by volunteers in 2009. Samples were collected on the following dates: 6/07/09, 7/15/09 and 8/22/09. Results for 2009 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 Lakes Assessment program, the acidity status of Garnet Lake is considered satisfactory. 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 Lakes Assessment Program, Garnet 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 waters of Garnet Lake ranged from 6.51 to 6.76. The average pH was 6.65. Based solely on pH, Garnet 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 waters of Garnet Lake ranged from 9.0 ppm to 18.0 ppm. The average alkalinity was 14.3 ppm. These values indicate a low sensitivity to acidification.

Calcium

Calcium is one of the buffering materials that occurs 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 waters of Garnet Lake was measured and found to range from 2.61 to 3.84 ppm. The average calcium concentration was found to be 3.35 ppm. This shows us a lake that is not sensitive to acidification at this time.

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 in the upper waters of Garnet Lake was calculated and found to be 2.85. This shows a lake that has a very 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 waters of Garnet Lake ranged from 12 ppb to 15 ppb. The average concentration was 13.7 ppb. This is indicative of mesotrophic conditions in the upper waters.

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 waters of Garnet Lake ranged from 2.79 ppb to 4.61 ppb. The average concentration was 3.61 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 Garnet Lake ranged from 3.7 meters to 4.7 meters. The average transparency was 4.2 meters. These values are 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 waters of Garnet Lake ranged from 0.113 to 0.175 ppm. The average nitrate concentration was 0.150 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. Chlorides levels 10 ppm and higher are 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 waters of Garnet Lake was measured and found to range from 1.35 to 1.72 ppm. The average chloride concentration was found to be a very low 1.58 ppm.

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 waters of Garnet Lake ranged from 17.5 μohms/cm to 26.6 μohms/cm. The average conductivity was 23.4 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 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 waters of Garnet Lake ranged from 9 Pt-Co to 33 Pt-Co. The average color was 24.0 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 waters of Garnet Lake was measured and found to range from 0.000 to 0.012 ppm. The average aluminum concentration was found to be a very low 0.008 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 Garnet Lake for 2002 through 2004 and 2008 are presented in Appendix A. The dissolved oxygen remained quite stable from the surface to about the fifth meter, when it started gradually declining until it reached about 2.0 ppm at the bottom of Garnet Lake. The oxygen level is insufficient for cold-water fish survival and it is too warm in Garnet Lake for the cold water fish to thrive. The dissolved oxygen and temperature profiles for Garnet Lake in 2008 were later in the season when oxygen deficits in lakes usually begin to show themselves.

Summary

Garnet Lake was a moderately productive mesotrophic lake during 2010. Based on the results of the 2010 Adirondack Lakes Assessment program, the acidity status of Garnet Lake is considered satisfactory. The pH values are satisfactory, and the alkalinity, calcium and CSI values indicate low sensitivity to acidification. The oxygen level is insufficient for cold-water fish survival and it is too warm in Garnet Lake for the cold water fish to thrive. The dissolved oxygen and temperature profiles for Garnet Lake in 2008 were later in the season when oxygen deficits in lakes usually begin to show themselves.

Nine years worth of data collection is enough to be able to predict trends or changes in Garnet Lakes' water quality; we can also compare 2002 through 2009 with 2010. The alkalinity, conductivity, total phosphorous, and calcium levels were slightly lower in 2010 when compared to 2009. The pH, color, Secchi disk transparency, nitrate, chloride and aluminum were slightly higher in 2010 when compared to 2009. Over the last nine years, there have only been slight year to year variations in Garnet Lakes' water quality and no real large changes or fluctuations.

The Secchi disk transparency has been very stable staying between three and four meters, and even increasing in the last few years, keeping Garnet Lake solidly in the mesotrophic or normal middle aged lake classification. The total phosphorous has also varied little between 11 and 15 ppb. The only real shift in the last few years has been a rise in pH and alkalinity but these were lower during the very wet Adirondack Summer of 2009.

Literature Cited

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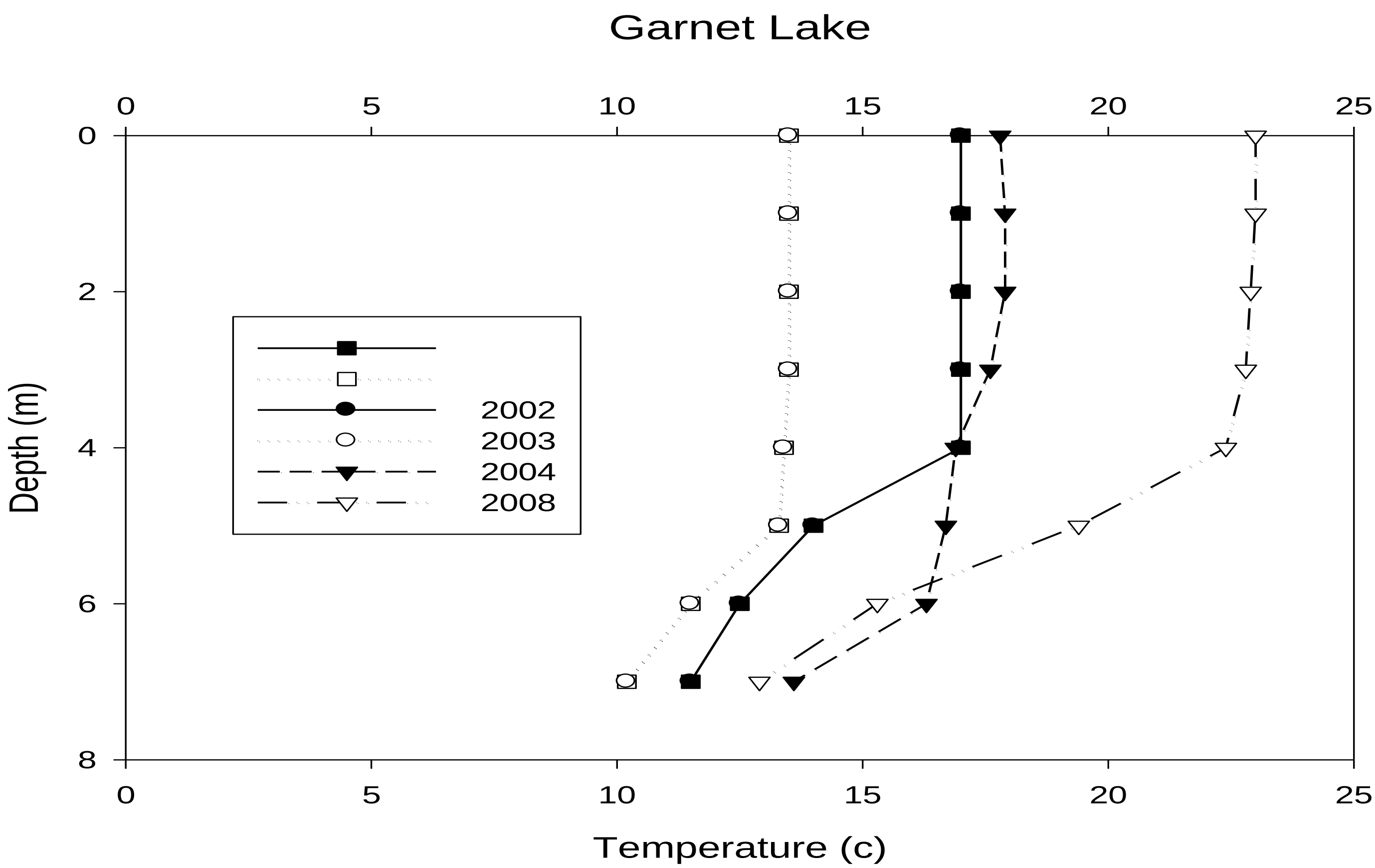
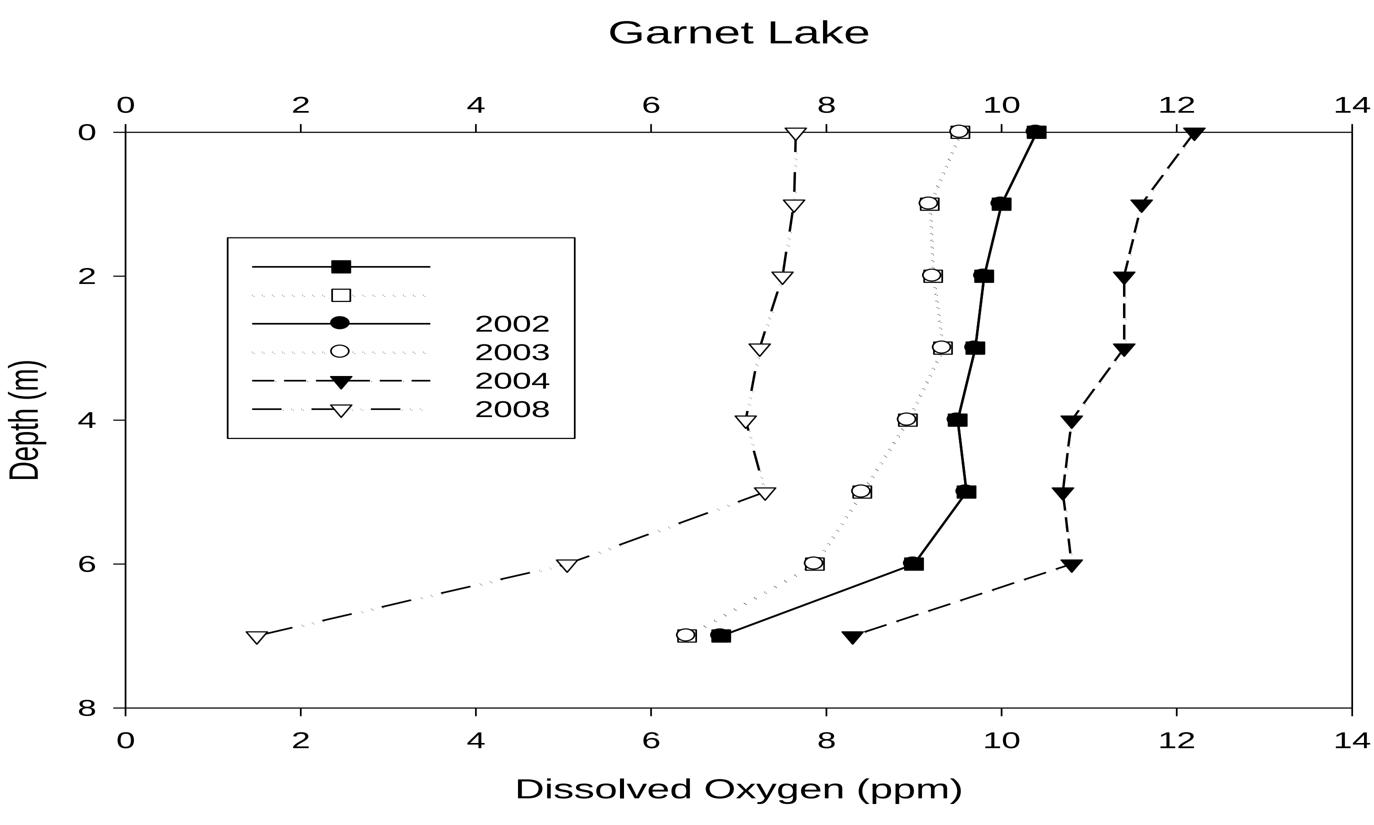
Greenberg, A.E., Eaton, A.D., and Leseri, L.A. (editors). (2005). Standard Methods for the Examination of Water and Wastewater, 21st Edition. American Public Health Association: Washington, D.C.

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


Garnet Lake
0
5
10
15
20
25
0
2
4
6
8
Depth (m)
2002
2003
2004
2008
Temperature (c)


Garnet Lake
0
2
4
6
8
10
12
14
0
2
4
6
8
Depth (m)
2002
2003
2004
2008
Dissolved Oxygen (ppm)

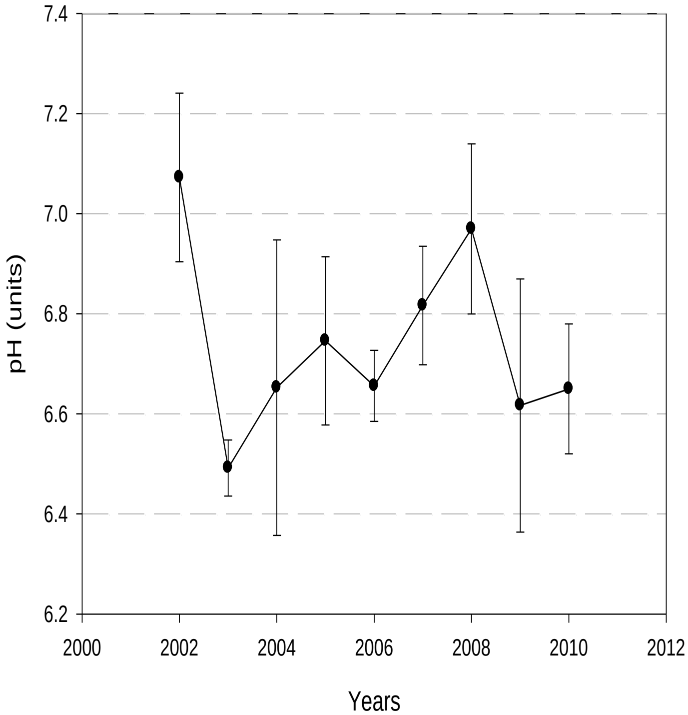
Source	Lake/Pond Name	Sampling Location	Sampling Date	pH (units)	Alkalinity (ppm)	Conductivity (μohms/cm)	Color (Pt-Co)	Total P (ppm)	Chl a (μg/l)
AWI	Garnet Lake	Epilimnion	6/3/2002	7.1600	15.2000	32.5000	16.0000	0.0120	2.1300
Vol	Garnet Lake	Deephole	6/3/2002	7.1600	15.2000	32.5000	27.0000	0.0120	0.0500
Vol	Garnet Lake	Deephole	7/3/2002	6.8200	16.8000	29.2000	16.0000	0.0140	3.9000
Vol	Garnet Lake	Deephole	8/3/2002	7.1500	22.8000	30.9000	13.0000		2.6500
			MEAN	7.0725	17.5000	31.2750	18.0000	0.0127	2.1825
			Std Dev	0.1684	3.6129	1.5756	6.1644	0.0012	1.6040
AWI	Garnet Lake	Hypolimnion	6/3/2002	7.0900	15.2000	32.7000	48.0000	0.0140	
AWI	Garnet Lake	Epilimnion	5/16/2003	6.4200	18.0000	17.0000	25.0000	0.0170	4.1800
Vol	Garnet Lake	Deephole	5/16/2003	6.5200	14.0000	24.0000	21.0000	0.0170	3.7400
Vol	Garnet Lake	Deephole	6/16/2003	6.4200	14.0000	30.9000	32.0000	0.0130	1.9900
Vol	Garnet Lake	Deephole	7/19/2003	6.5200	16.4000	32.6000	25.0000	0.0150	3.8200
Vol	Garnet Lake	Deephole	8/18/2003	6.5300	14.0000	21.0000	21.0000	0.0130	3.0100
Vol	Garnet Lake	Deephole	9/21/2003	6.5400	14.0000	23.0000	39.0000	0.0150	3.3800
			Mean	6.4917	15.0667	24.7500	27.1667	0.0150	3.3533
			Std Dev	0.0560	1.7282	5.9531	7.0545	0.0018	0.7782
AWI	Garnet Lake	Hypolimnion	5/16/2003	6.5000	10.0000	24.0000	23.0000	0.0170	4.1800
AWI	Garnet Lake	Epilimnion	5/27/2004	6.6800	14.0000	28.0000	11.0000	0.0170	4.2200
Vol	Garnet Lake	Deephole	5/27/2004	6.6800	14.2000	28.7000	13.0000	0.0160	
Vol	Garnet Lake	Deephole	6/29/2004	6.8300	16.2000	29.8000	19.0000	0.0160	4.9800
Vol	Garnet Lake	Deephole	7/20/2004	7.0600	18.4000	32.8000	36.0000	0.0220	5.2400
Vol	Garnet Lake	Deephole	8/24/2004	6.4500	6.0000	29.8000	0.0000	0.0090	5.0400
Vol	Garnet Lake	Deephole	9/22/2004	6.4200	14.0000	28.9000	0.0000	0.0080	8.1500
			Mean	6.6867	13.8000	29.6667	13.1667	0.0147	5.5260
			Std Dev	0.2396	4.1952	1.6825	13.4672	0.0053	1.5172
AWI	Garnet Lake	Hypolimnion	5/27/2004	6.6000	10.0000	27.0000	7.0000	0.0170	
Vol	Garnet Lake	Deephole	5/30/2005	6.8800	17.4000	21.0000	33.0000	0.0120	3.9300
Vol	Garnet Lake	Deephole	6/27/2005	6.8200	17.2000	27.2000	27.0000	0.0140	3.2300
Vol	Garnet Lake	Deephole	7/21/2005	6.8900	18.2000	29.0000	3.0000	0.0150	3.0900
Vol	Garnet Lake	Deephole	8/26/2005	6.6300	10.0000	43.2000	6.0000	0.0100	3.8900
Vol	Garnet Lake	Deephole	9/24/2005	6.5100	10.0000	28.1000	19.0000	0.0050	3.5900
			Mean	6.7460	14.5600	29.7000	17.6000	0.0112	3.5460
			Std Dev	0.1683	4.1795	8.1737	12.9923	0.0040	0.3793
Vol	Garnet Lake	Deep Hole	5/28/2006	6.6000	16.8000	28.6000	13.0000	0.0160	3.9400
Vol	Garnet Lake	Deep Hole	6/29/2006	6.6100	16.8000	26.3000	16.0000	0.0130	3.0700
Vol	Garnet Lake	Deep Hole	7/30/2006	6.7600	17.2000	26.5000	21.0000	0.0130	3.3300
Vol	Garnet Lake	Deep Hole	8/30/2006	6.6100	16.8000	25.2000	48.0000	0.0120	4.6100
Vol	Garnet Lake	Deep Hole	9/27/2006	6.7000	26.8000	26.6000	19.0000	0.0140	4.5500
			Mean	6.6560	18.8800	26.6400	23.4000	0.0136	3.9000
			Std Dev	0.0709	4.4308	1.2300	14.0819	0.0015	0.6968
Vol	Garnet Lake	Deephole	6/15/2007	6.8900	18.8000	28.2000	50.0000	0.0120	3.2700
Vol	Garnet Lake	Deephole	7/17/2007	6.8800	19.2000	28.8000	21.0000	0.0140	3.5500
Vol	Garnet Lake	Deephole	8/20/2007	6.6800	17.2000	26.5000	19.0000	0.0160	3.7800
			Mean	6.8167	18.4000	27.8333	30.0000	0.0140	3.5333
			Std Dev	0.1185	1.0583	1.1930	17.3494	0.0020	0.2554

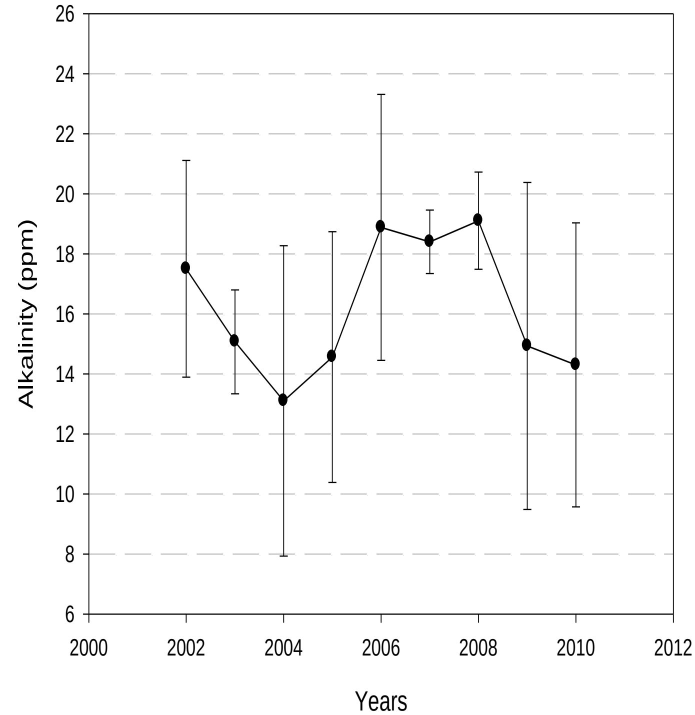
Source	Lake/Pond Name	Sampling Location	Sampling Date	pH (units)	Alkalinity (ppm)	Conductivity (mohms/cm)	Color (Pt-Co)	Total P (ppm)	Chl a (mg/l)
AWI	Garnet Lake	Epilimnion	6/30/2008	7.1400	20.2000	32.9000	3.0000	0.0170	4.4400
Vol	Garnet Lake	Deephole	6/30/2008	7.0700	19.8000	35.5000	11.0000	0.0160	
Vol	Garnet Lake	Deephole	7/30/2008	7.0700	20.2000	28.3000	11.0000	0.0150	3.8800
Vol	Garnet Lake	Deephole	8/28/2008	6.7800	17.2000	33.4000	42.0000	0.0100	2.2700
			Mean	6.9733	19.0667	32.4000	21.3333	0.0137	3.0750
			Std Dev	0.1674	1.6289	3.7027	17.8979	0.0032	1.1384
AWI	Garnet Lake	Hypolimnion	6/30/2008	7.0200	18.9000	33.9000	3.0000	0.0180	x
Vol	Garnet Lake	Deephole	6/7/2009	6.7100	16.8000	30.1000	2.0000	0.0150	3.8200
Vol	Garnet Lake	Deephole	7/15/2009	6.8100	19.2000	35.5000	9.0000	0.0150	3.6800
Vol	Garnet Lake	Deephole	8/22/2009	6.3300	8.8000	10.7000	38.0000	0.0130	3.3400
			Mean	6.6167	14.9333	25.4333	16.3333	0.0143	3.6133
			Std Dev	0.2532	5.4455	13.0420	19.0875	0.0012	0.2468
Vol	Garnet Lake	Deephole	7/5/2010	6.6800	16.0000	26.0000	33.0000	0.0120	2.7900
Vol	Garnet Lake	Deephole	8/11/2010	6.7600	18.0000	26.6000	30.0000	0.0150	3.4200
Vol	Garnet Lake	Deephole	9/11/2010	6.5100	9.0000	17.5000	9.0000	0.0140	4.6100
			Mean	6.6500	14.3333	23.3667	24.0000	0.0137	3.6067
			Std Dev	0.1277	4.7258	5.0895	13.0767	0.0015	0.9242

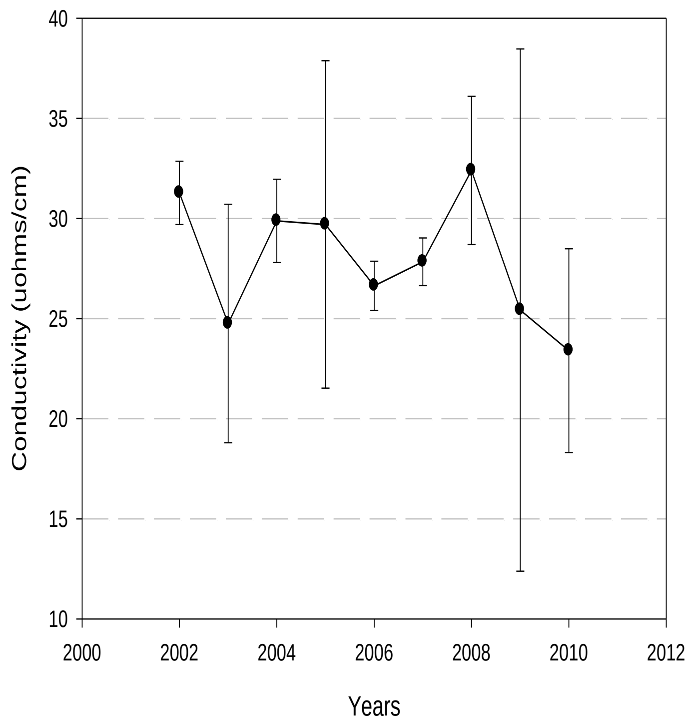
Source	Lake/Pond Name	Sampling Location	Sampling Date	Secchi (meters)	Nitrate (ppm)	Calcium (ppm)	Chloride (ppm)	Aluminum (ppm)	CSI
AWI	Garnet Lake	Epilimnion	6/3/2002	4.7000	0.1000	4.3900	0.0000	0.0020	2.3167
Vol	Garnet Lake	Deephole	6/3/2002	4.0000	0.1000				
Vol	Garnet Lake	Deephole	7/3/2002	4.0000	0.1000				
Vol	Garnet Lake	Deephole	8/3/2002	4.0000	0.1000				
			MEAN	4.1750	0.1000				
			Std Dev	0.3500	0.0000				
AWI	Garnet Lake	Hypolimnion	6/3/2002		0.2000	4.3700	0.0000	0.0020	2.3887
AWI	Garnet Lake	Epilimnion	5/16/2003	3.0000	0.5000	4.4700	0.0000	0.0080	2.9700
Vol	Garnet Lake	Deephole	5/16/2003	3.0000	0.4000				
Vol	Garnet Lake	Deephole	6/16/2003	4.0000	0.0000				
Vol	Garnet Lake	Deephole	7/19/2003	3.5000	0.0000				
Vol	Garnet Lake	Deephole	8/18/2003	4.0000	0.4000				
Vol	Garnet Lake	Deephole	9/21/2003	3.5000	0.7000				
			Mean	3.5000	0.3333				
			Std Dev	0.4472	0.2805				
AWI	Garnet Lake	Hypolimnion	5/16/2003	3.0000	0.5000	3.8300	0.0000	0.0100	3.2200
AWI	Garnet Lake	Epilimnion	5/27/2004	3.1000	0.5000	4.4900	0.0000	0.0020	#REF!
Vol	Garnet Lake	Deephole	5/27/2004	2.7500	0.3000				
Vol	Garnet Lake	Deephole	6/29/2004	3.0000	0.1000				
Vol	Garnet Lake	Deephole	7/20/2004	2.5000	0.1000				
Vol	Garnet Lake	Deephole	8/24/2004	4.0000	0.0000				
Vol	Garnet Lake	Deephole	9/22/2004	4.0000	0.2000				
			Mean	3.2250	0.2000				
			Std Dev	0.6354	0.1789				
AWI	Garnet Lake	Hypolimnion	5/27/2004		0.6000	3.8900	0.0000	0.0120	#REF!

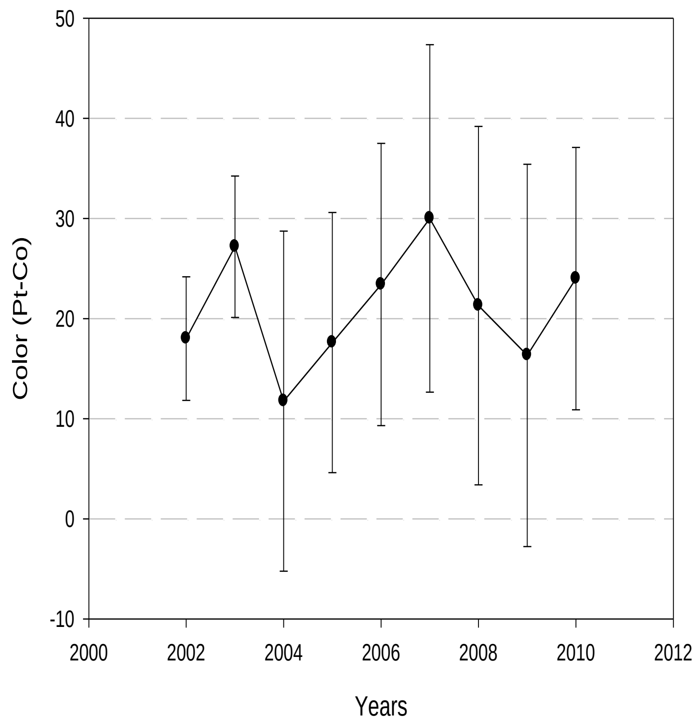
Source	Lake/Pond Name	Sampling Location	Sampling Date	pH (units)	Alkalinity (ppm)	Conductivity (mohms/cm)	Color (Pt-Co)	Total P (ppm)	Chl a (mg/l)
	Garnet Lake	Deephole	5/30/2005	4.0000	0.1000				
Vol	Garnet Lake	Deephole	6/27/2005	4.0000	0.1000				
Vol	Garnet Lake	Deephole	7/21/2005	3.8000	0.1000				
Vol	Garnet Lake	Deephole	8/26/2005	4.1000	0.2000				
Vol	Garnet Lake	Deephole	9/24/2005	4.2000	0.1000				
			Mean	4.0200	0.1200				
			Std Dev	0.1483	0.0447				
Vol	Garnet Lake	Deep Hole	5/28/2006	3.5000	0.1000				
Vol	Garnet Lake	Deep Hole	6/29/2006	4.0000	0.3000				
Vol	Garnet Lake	Deep Hole	7/30/2006	4.0000	0.2000				
Vol	Garnet Lake	Deep Hole	8/30/2006	3.9000	0.2000				
Vol	Garnet Lake	Deep Hole	9/27/2006	3.9000	0.0800				
			Mean	3.8600	0.1760				
			Std Dev	0.2074	0.0888				
Vol	Garnet Lake	Deephole	6/15/2007	4.1000	0.3000				
Vol	Garnet Lake	Deephole	7/17/2007	3.9000	0.1000				
Vol	Garnet Lake	Deephole	8/20/2007	3.8000	0.2000				
			Mean	3.9333	0.2000				
			Std Dev	0.1528	0.1000				

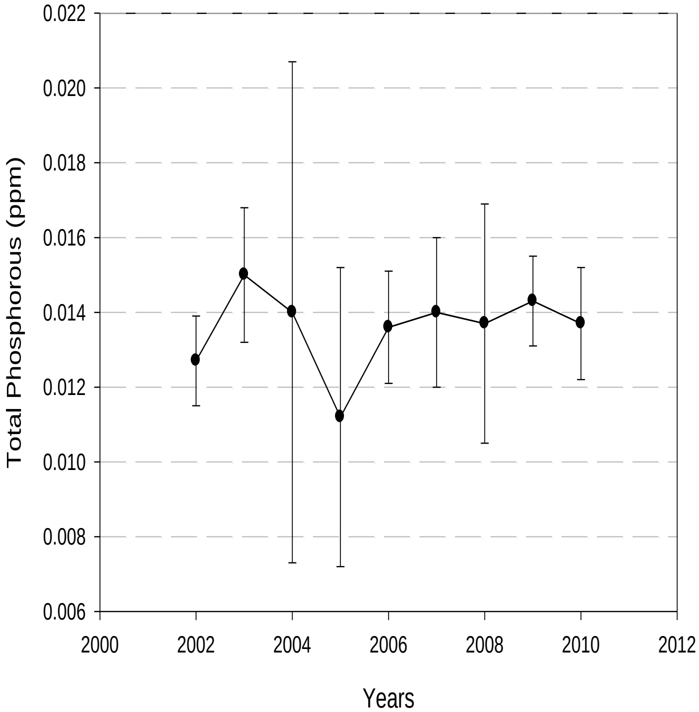
Source	Lake/Pond Name	Sampling Location	Sampling Date	Secchi (meters)	Nitrate (ppm)	Calcium (ppm)	Chloride (ppm)	Aluminum (ppm)	CSI
AWI	Garnet Lake	Epilimnion	6/30/2008	3.6000	0.1000	4.8700	1.0000	0.0020	2.4000
Vol	Garnet Lake	Deephole	6/30/2008		0.0000				
Vol	Garnet Lake	Deephole	7/30/2008	4.1000	0.3000				
Vol	Garnet Lake	Deephole	8/28/2008	5.0000	0.1000				
			Mean	4.5500	0.1333				
			Std Dev	0.6364	0.1528				
AWI	Garnet Lake	Hypolimnion	6/30/2008	x	0.0000	4.6800	1.0000	0.0080	
Vol	Garnet Lake	Deephole	6/7/2009	4.0000	0.0000	4.4100	1.0000	0.0030	2.7000
Vol	Garnet Lake	Deephole	7/15/2009	4.1000	0.1000				
Vol	Garnet Lake	Deephole	8/22/2009	4.2000	0.3000				
			Mean	4.1000	0.1333				
			Std Dev	0.1000	0.1528				
Vol	Garnet Lake	Deephole	7/5/2010	4.7000	0.1750	3.8400	1.6700	0.0110	
Vol	Garnet Lake	Deephole	8/11/2010	4.2000	0.1610	3.6000	1.7200	0.0120	
Vol	Garnet Lake	Deephole	9/11/2010	3.7000	0.1130	2.6100	1.3500	0.0000	
			Mean	4.2000	0.1497	3.3500	1.5800	0.0077	
			Std Dev	0.5000	0.0325	0.6520	0.2007	0.0067	

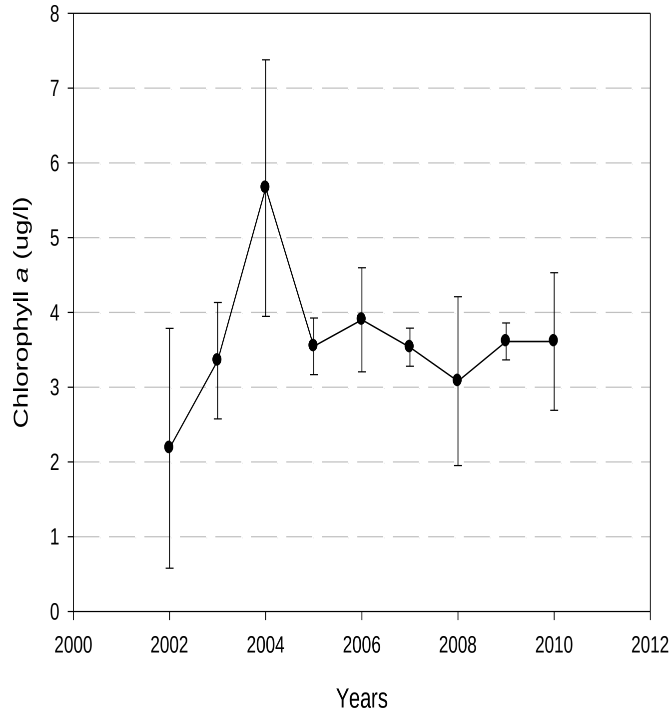

pH (units)
7.4
7.2
7.0
6.8
6.6
6.4
6.2
2000 2002 2004 2006 2008 2010 2012
Years

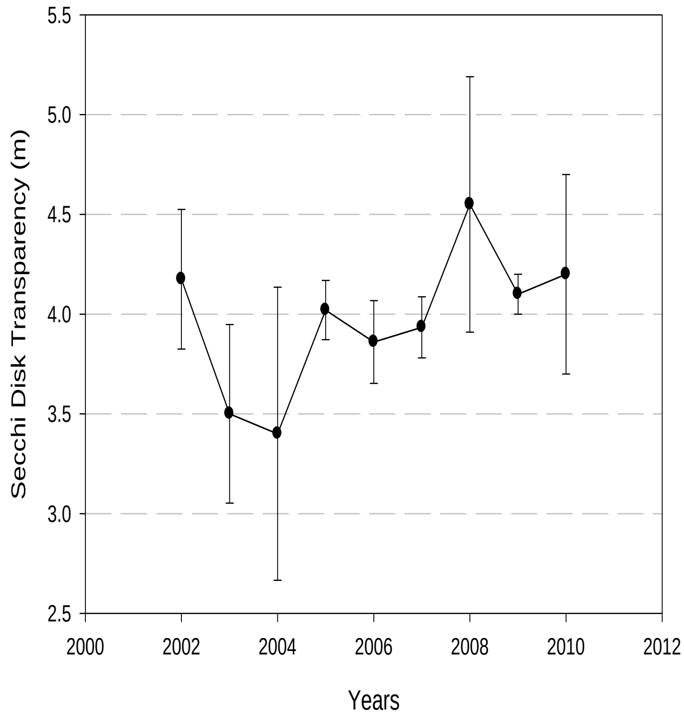

Alkalinity (ppm)
26
24
22
20
18
16
14
12
10
8
6
2000 2002 2004 2006 2008 2010 2012
Years

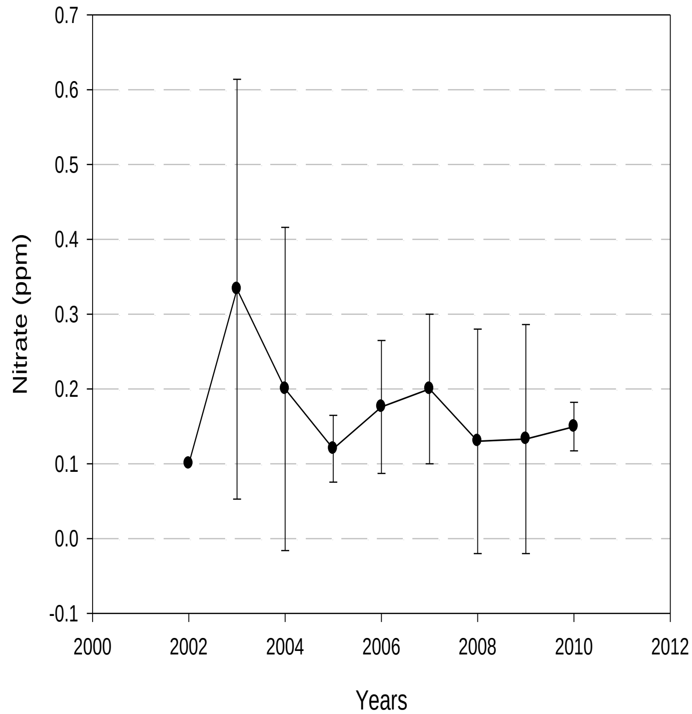

Conductivity (uohms/cm)
40
35
30
25
20
15
10
2000 2002 2004 2006 2008 2010 2012
Years

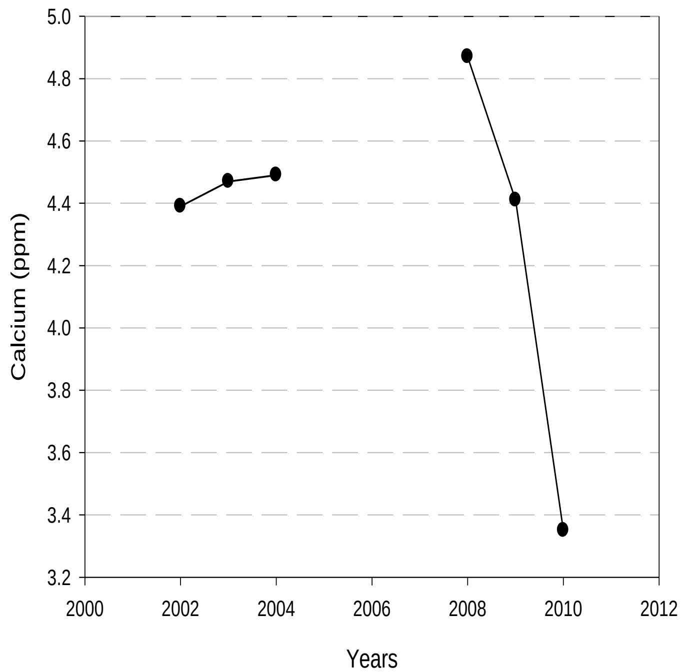

Color (Pt-Co)
50
40
30
20
10
0
-10
2000 2002 2004 2006 2008 2010 2012
Years

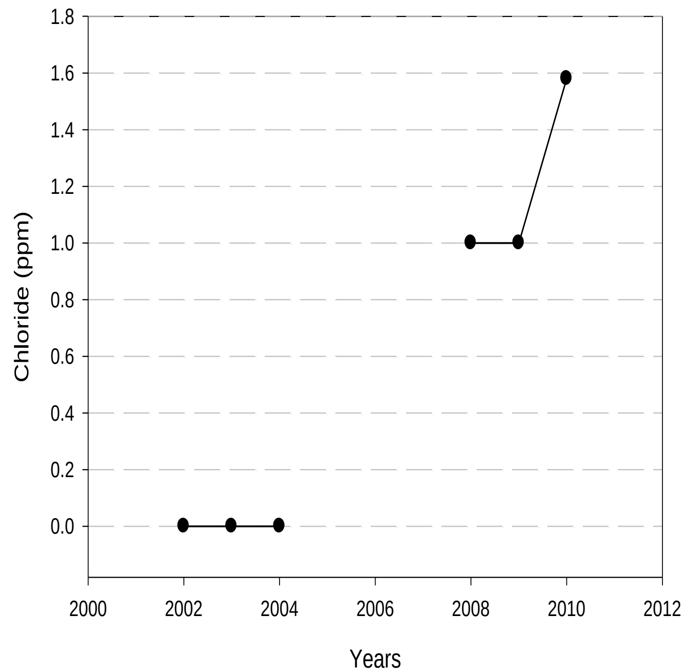

Total Phosphorous (ppm)
0.022
0.020
0.018
0.016
0.014
0.012
0.010
0.008
0.006
2000
2002
2004
2006
2008
2010
2012
Years

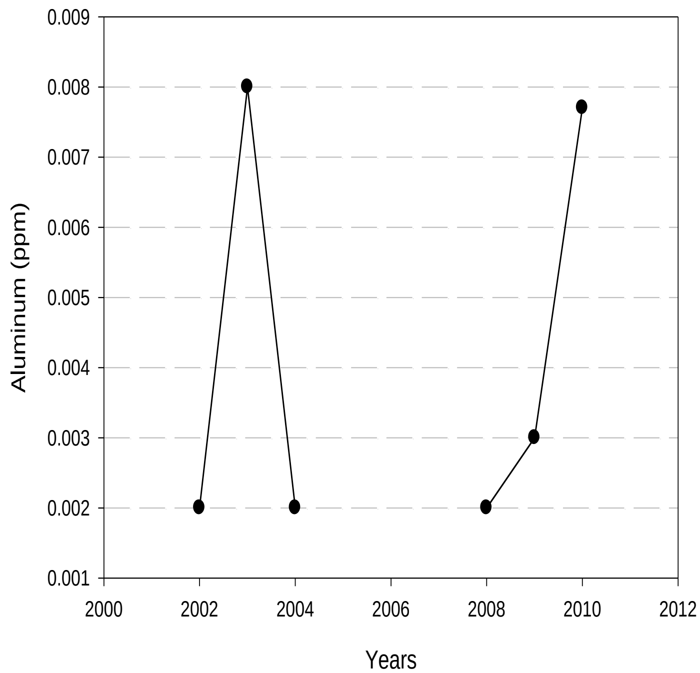

Chlorophyll *a* (ug/l)
8
7
6
5
4
3
2
1
0
2000
2002
2004
2006
2008
2010
2012
Years


Secchi Disk Transparency (m)
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2000
2002
2004
2006
2008
2010
2012
Years


Nitrate (ppm)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
2000
2002
2004
2006
2008
2010
2012
Years


Calcium (ppm)
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
2000
2002
2004
2006
2008
2010
2012
Years


Chloride (ppm)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2000
2002
2004
2006
2008
2010
2012
Years


Aluminum (ppm)
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
2000
2002
2004
2006
2008
2010
2012
Years