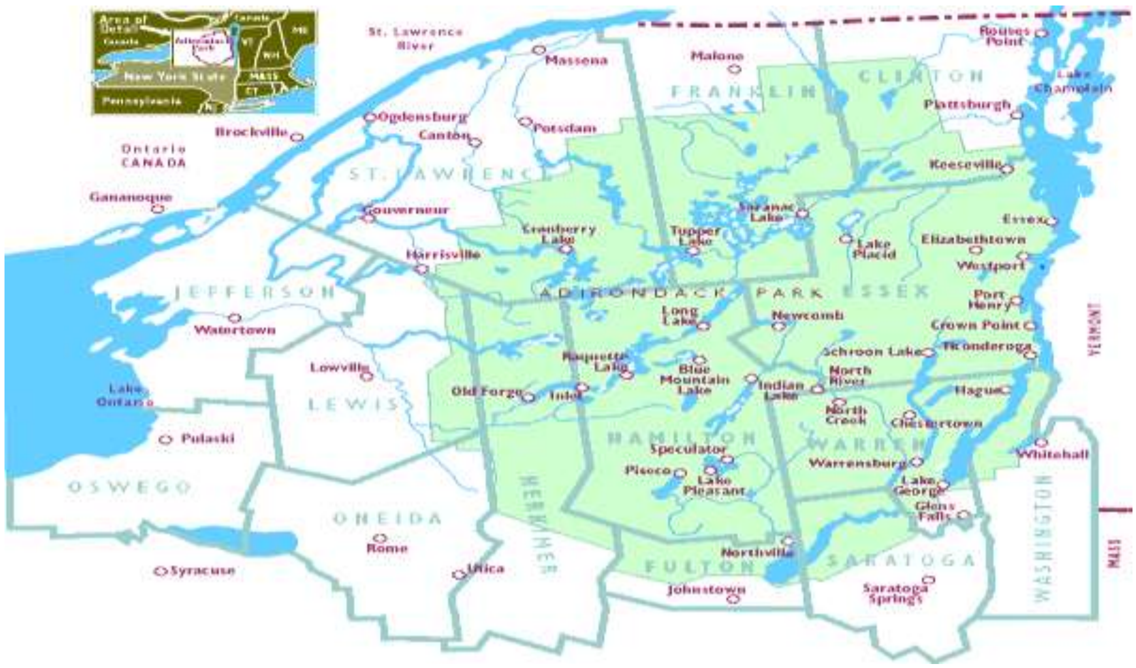
Adirondack Lake Assessment Program 2012



<u>**Fifteen Years in the program**</u>
Cranberry Lake, Loon Lake, Oven Mountain Pond, Blue Mountain Lake, Silver Lake, Eagle Lake
<u>**Fourteen Years in the program**</u>
Little Long Lake, Gull Pond, Stony Creek Ponds, Thirteenth Lake, Eli Pond
<u>**Thirteen Years in the program**</u>
Austin Pond, Osgood Pond, Middle Saranac Lake, White Lake, Brandreth Lake, Trout Lake
<u>**Twelve Years in the program**</u>
Hoel Pond, 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>**Eleven 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, Balfour Lake
<u>**Ten Years in the program**</u>
Raquette Lake, Lake Colby, Kiwassa Lake, Canada Lake
<u>**Nine Years in the program**</u>
Indian Lake, Big Moose Lake
<u>**Eight Years in the program**</u>
Dug Mountain Pond, Abanakee Lake, Moss Lake, Mountain View Lake, Indian Lake, Tupper Lake
<u>**Seven Years in the program**</u>
Sylvia Lake, Fern Lake, Hewitt Lake
<u>**Six Years in the program**</u>
Adirondack Lake, Lower Chateaugay Lake, Upper Chateaugay Lake, Lake Easka, Lake Tekeni
<u>**Five Years in the program**</u>
Simon Pond
<u>**Four Years in the program**</u>
Amber Lake, Jordan Lake, Otter Pond
<u>**Three Years in the program**</u>
Auger Lake, Lake Titus, Star Lake
<u>**Two Years in the program**</u>
Chapel Pond, Lake Durant, Upper Cascade Lake

Adirondack Lake
Assessment Program

Lake Tekeni

Summer 2012

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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' fifteenth year. The program was established to help develop a current database of water quality in Adirondack lakes and ponds. There were 69 participating lakes in the program in year 2012.

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.

Results Summary

Lake Tekeni was sampled three times by a volunteer in 2012. Samples were collected on the following dates: 6/10/12, 7/15/12, and 8/25/12. Results for 2012 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 water body'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 2012 Adirondack Lakes Assessment program, the acidity status of Lake

Tekeni is considered to have a satisfactory pH and an alkalinity, calcium and CSI values that shows little to no 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 2012 Adirondack Lakes Assessment Program, Lake Tekeni is considered to be a late oligotrophic to early mesotrophic water body.

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 Lake Tekeni ranged from 7.49 to 7.57. The average pH was 7.52. Based solely on pH, Lake Tekeni's acidity level 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 mg/L	Acidified

Alkalinity between 0 and 2 mg/L	Extremely sensitive
Alkalinity between 2 and 10 mg/L	Moderately sensitive
Alkalinity between 10 and 25 mg/L	Low sensitivity
Alkalinity greater than 25 mg/L	Not sensitive

The alkalinity of the upper waters of Lake Tekeni ranged from 9.7 mg/l to 39.9 mg/L. The average alkalinity was 21.1 mg/L. 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 mg/L of calcium are considered to be sensitive to acidification.

The calcium in Lake Tekeni was measured in 2012 and ranged from 6.50 mg/L to 7.04 mg/L. The average calcium concentration was found to be 6.82 mg/L. These values show a lake that is not sensitive to acidification in the near future.

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

A CSI value for Lake Tekeni was calculated to be 1.60. This value 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 0.010 mg/L are associated with oligotrophic (clean, clear water) conditions. Concentrations greater than 0.025 mg/l are associated with eutrophic (nutrient-rich) conditions.

The total phosphorus in the upper waters of Lake Tekeni ranged from 0.006 mg/L to 0.007 mg/L and averaged 0.0063 mg/L. This is indicative of oligotrophic 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 ug/L is associated with oligotrophic conditions and those greater than 8 ug/L are associated with eutrophic conditions.

The chlorophyll-a concentrations in the upper waters of Lake Tekeni ranged from 1.92 ug/L to 2.77 ug/L. The average concentration was 2.28 ug/L. This is indicative of early 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 Lake Tekeni ranged from 4.5 to 5.0 meters and the average was 4.83 meters. These values are indicative of late oligotrophic to early 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 mg/L in most lakes. Elevated levels of nitrate concentration may be indicative of lake acidification or wastewater pollution.

The nitrate concentrations in Lake Tekeni for 2012 ranged from 0.032 mg/l to 0.157 mg/l and averaged 0.087 mg/l. These values are typical for an Adirondack Lake.

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 mg/l. Chloride levels 10 mg/L 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 mg/l or less.

The chloride in the upper waters of Lake Tekeni ranged from 29.4 mg/l to 34.3 mg/l. The average chloride concentration was found to be 32.0 mg/l. This value is very high and usually indicative of 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 waters of Lake Tekeni ranged from 127.7 μohms/cm to 144.9 μohms/cm. The average conductivity was 136.7 μohms/cm. This is also very high and usually indicative of road salt contamination.

Color

The color of water is affected by both dissolved materials (e.g., metallic ions, organic acids) and suspended materials (e.g., silt and plant pigments). 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 Lake Tekeni ranged from 1 Pt-Co to 49 Pt-Co. The average color was 22 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 Lake Tekeni ranged from 0.099 mg/L to 0.127 mg/l. The average aluminum concentration was found to be a very low 0.116 mg/L.

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 profile for Lake Tekeni for 2012 was not measured due to the lack of a site visit by AWI staff. The dissolved oxygen and temperature profile for Lake Tekeni for 2008 is in Appendix A. The dissolved oxygen stays steady from the surface to about four meters and then slightly decreases to the bottom. The oxygen level is sufficient for cold and warm-water fish survival, although the temperature is probably too warm for cold-water fish.

Summary

Lake Tekeni was a slightly productive late oligotrophic to early mesotrophic lake during 2007 - 2012. Based on the results of the 2007-2012 Adirondack Lakes Assessment program, the acidity status of Lake Tekeni is considered to be satisfactory with little to no threat from further acidic inputs. The pH values were found to be satisfactory and the alkalinity, calcium and CSI values showed a lake that has a low vulnerability to acid rain and further acidic inputs. The chloride and conductivity values were much higher than typical Adirondack Lakes and this is most likely due to road salt contamination. The oxygen level is sufficient for cold and warm-water fish survival, although the temperature is probably too warm for cold-water fish.

If we look at the yearly averages for precipitation in the Adirondacks, the amount of total precipitation last year was normal. We had a very dry spring and early summer followed by a very wet late summer and fall. The average total precipitation for 2012 was normal, following 2011, in which we broke all records for total precipitation. Some of the changes to water quality on Lake Tekeni could have been weather related.

Graphs showing trends in Lake Tekeni over the last six years are included in Appendix A. When comparing the results for 2007 – 2012, we see a large change in water quality for 2011 most likely related to the record rainfall. Adirondack precipitation is acidic with no buffers and is commonly referred to as acid rain. This rain led to the changes in 2011 found in many Adirondack lakes. Lake Tekeni for 2011 had a low pH and a much lower alkalinity, conductivity, and color. The chloride concentrations have decreased all six years but are still elevated for an Adirondack lake. Total phosphorous has decreased most years with a slight increase during 2012. Chlorophyll-a concentrations have stayed fairly steady over the last six years. This has led to an increase in the Secchi disk transparency most years except 2012. The other measured parameters nitrate and aluminum were very stable with very little change over the six years of study.

Literature Cited

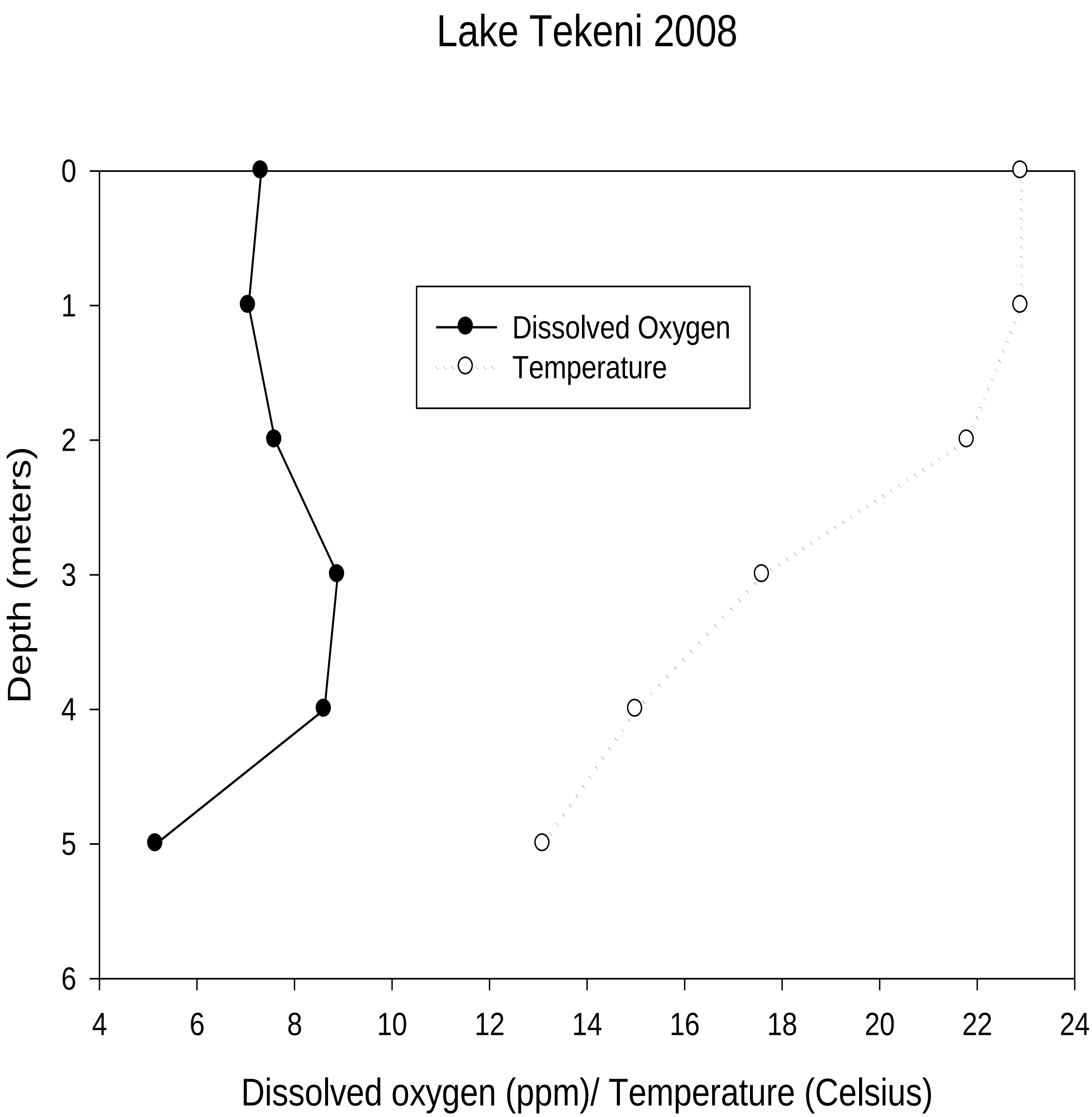
DEC & FOLA. (1990). Diet for a Small Lake: A New Yorker's Guide to Lake Management. New York State Department of Environmental Conservation & The Federation of Lake Associations, Inc.: Albany, New York.

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.

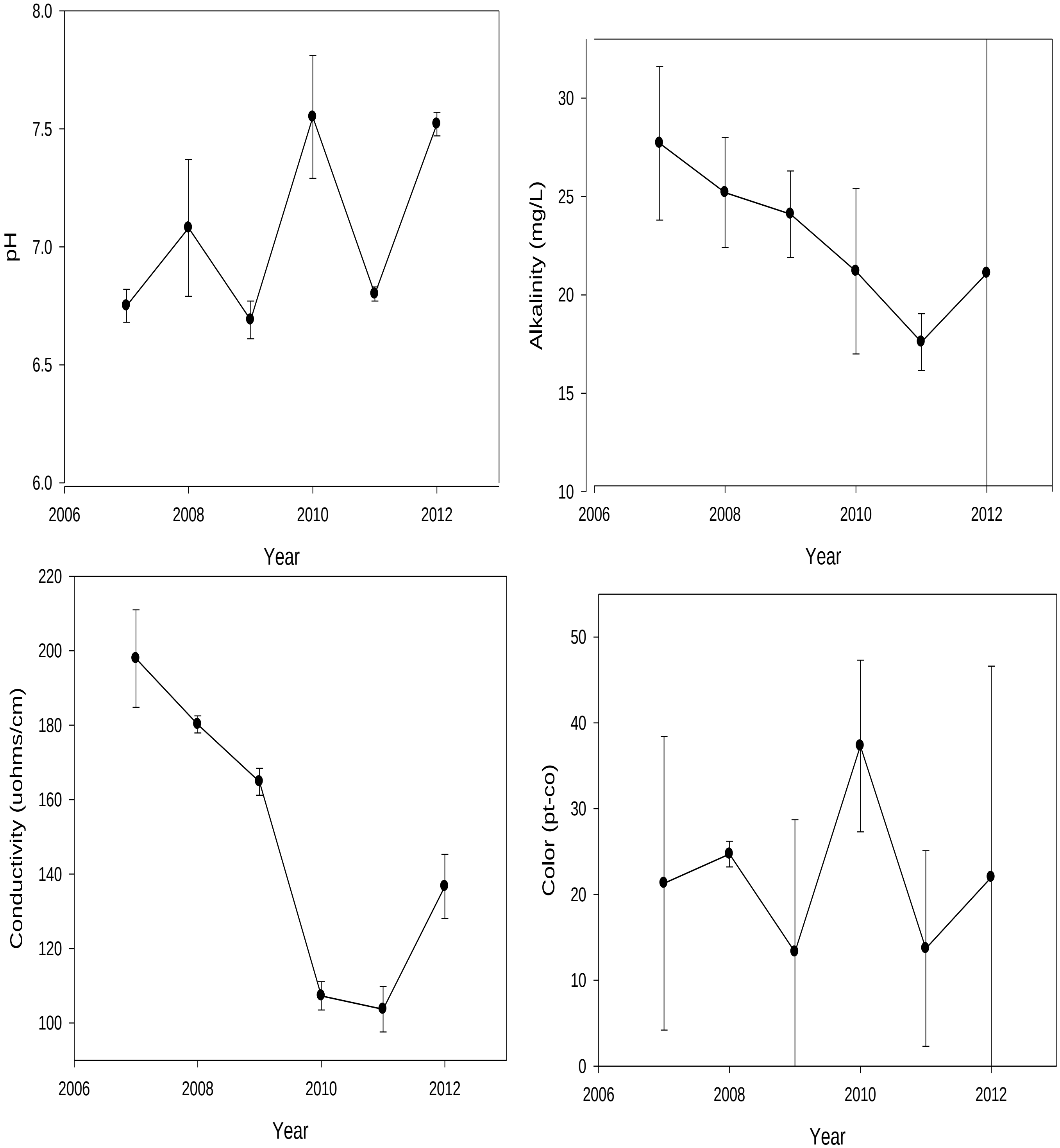
Appendix A

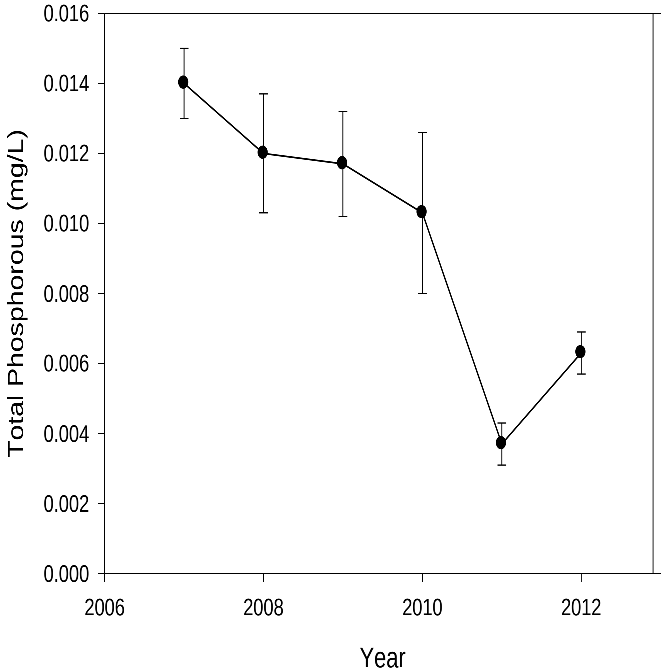
Water Quality Data

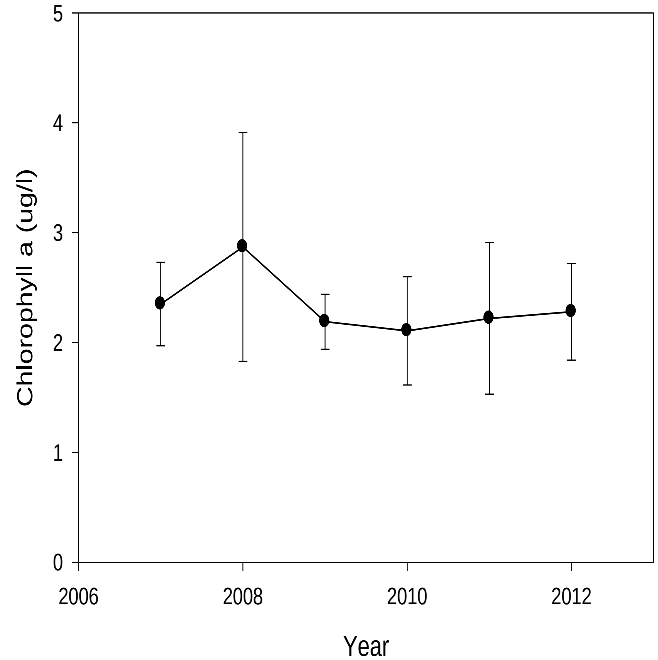

Lake Tekeni 2008
Dissolved Oxygen
Temperature
Depth (meters)
0
1
2
3
4
5
6
4
6
8
10
12
14
16
18
20
22
24
Dissolved oxygen (ppm)/ Temperature (Celsius)

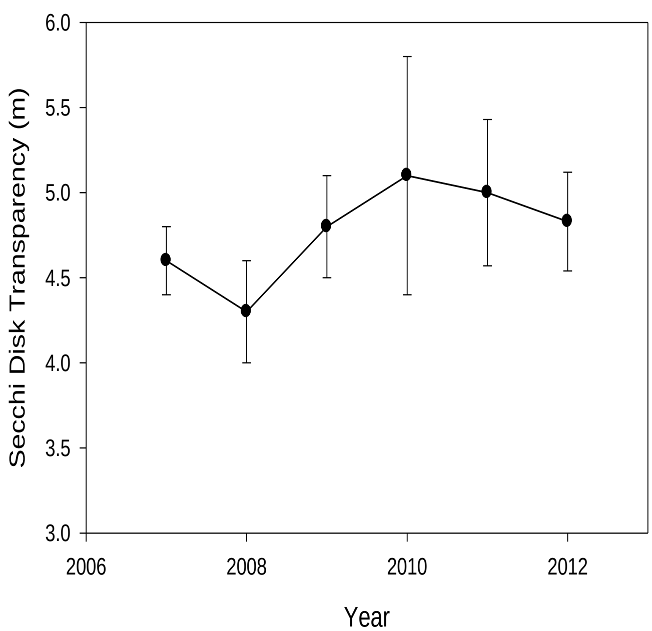
Source	Lake Name	Sampling Location	Sampling Date	pH (units)	Alkalinity (mg/L)	Conductivity (μohms/cm)	Color (Pt-Co)	Total P (mg/L)	Chl a (μg/l)	Secchi (meters)	Nitrate (mg/L)
Vol	Lake Tekeni	Deephole	7/15/2007	6.81	32.20	191.0	10.0	0.0150	2.040	nr	0.20
Vol	Lake Tekeni	Deephole	8/18/2007	6.77	26.20	189.6	41.0	0.0130	2.240	4.75	0.00
Vol	Lake Tekeni	Deephole	9/16/2007	6.68	24.80	213.0	13.0	0.0140	2.780	4.50	0.10
			MEAN	6.75	27.73	197.9	21.3	0.0140	2.353	4.63	0.10
			Std Dev	0.07	3.93	13.1	17.1	0.0010	0.383	0.18	0.10
AWI	Lake Tekeni	Epi	6/16/2008	7.42	28.20	181.5	17.0	0.0120	2.270	4.60	0.10
Vol	Lake Tekeni	Deephole	6/16/2008	7.38	28.20	178.6	26.0	0.0110	2.210	4.50	0.10
Vol	Lake Tekeni	Deephole	7/25/2008	6.80	24.80	182.8	25.0	0.0110	2.340	4.50	0.10
Vol	Lake Tekeni	Deephole	8/20/2008	7.06	22.60	179.2	23.0	0.0140	4.080	4.00	0.10
			MEAN	7.08	25.20	180.2	24.7	0.0120	2.877	4.33	0.10
			Std Dev	0.29	2.82	2.3	1.5	0.0017	1.044	0.29	0.00
AWI	Lake Tekeni	Hypo	6/16/2008	5.42	4.80	182.6	25.0	0.0160	x	x	0.20
Vol	Lake Tekeni	Deephole	6/25/2009	6.66	24.20	163.8	3.0	0.0100	1.920	5.00	0.20
Vol	Lake Tekeni	Deephole	7/16/2009	6.62	21.80	168.8	6.0	0.0130	2.410	4.50	0.40
Vol	Lake Tekeni	Deephole	8/16/2009	6.78	26.20	161.9	31.0	0.0120	2.230	4.75	0.10
			MEAN	6.69	24.07	164.8	13.3	0.0117	2.187	4.75	0.23
			Std Dev	0.08	2.20	3.6	15.4	0.0015	0.248	0.25	0.15
Vol	Lake Tekeni	Deephole	6/15/2010	7.62	18.80	104.9	41.0	0.0090	1.760	5.50	0.21
Vol	Lake Tekeni	Deephole	7/17/2010	7.26	18.80	105.5	26.0	0.0090	1.890	5.50	0.20
Vol	Lake Tekeni	Deephole	8/13/2010	7.76	26.00	111.4	45.0	0.0130	2.670	4.25	0.17
			MEAN	7.55	21.20	107.3	37.3	0.0103	2.107	5.08	0.19
			Std Dev	0.26	4.16	3.6	10.0	0.0023	0.492	0.72	0.02
Vol	Lake Tekeni	Deephole	6/15/2011	6.78	16.4	98.5	23.0	0.0040	3.020	4.50	0.172
Vol	Lake Tekeni	Deephole	7/13/2011	6.84	17.2	102.3	17.0	0.0040	1.860	5.25	0.146
Vol	Lake Tekeni	Deephole	8/21/2011	6.79	19.2	110.4	1.0	0.0030	1.780	5.25	0.093
			MEAN	6.80	17.60	103.7	13.7	0.0037	2.220	5.00	0.137
			Std Dev	0.03	1.44	6.1	11.4	0.0006	0.694	0.43	0.040
Vol	Lake Tekeni	Deephole	6/10/2012	7.49	39.9	127.7	49.0	0.0060	1.920	5.00	0.157
Vol	Lake Tekeni	Deephole	7/15/2012	7.57	9.7	137.4	1.0	0.0060	2.770	4.50	0.087
Vol	Lake Tekeni	Deephole	8/25/2012	7.49	13.7	144.9	16.0	0.0070	2.150	5.00	0.032
			MEAN	7.52	21.10	136.7	22.0	0.0063	2.280	4.83	0.092
			Std Dev	0.05	16.40	8.6	24.6	0.0006	0.440	0.29	0.063

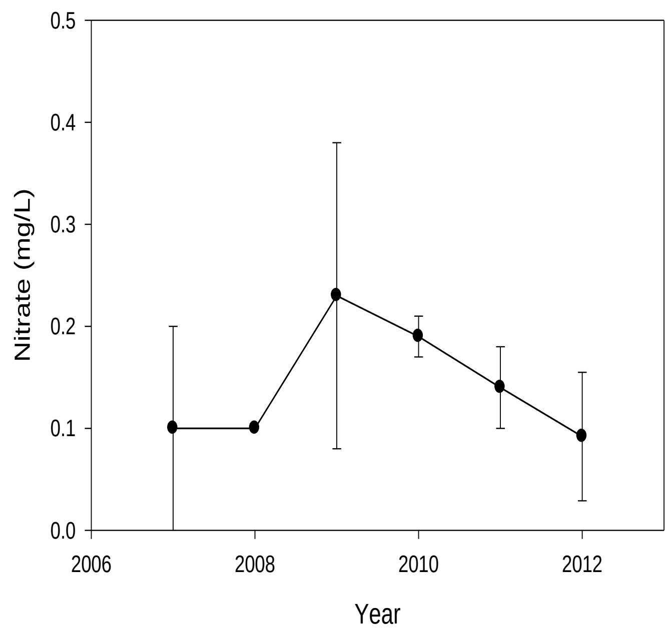
Source	Lake Name	Sampling Location	Sampling Date	Calcium (mg/L)	Chloride (mg/L)	Aluminum (mg/L)	CSI	Acid Vulnerability
AWI	Lake Tekeni	Epi	6/16/2008	6.47	53.00	0.001	1.6000	low
AWI	Lake Tekeni	Hypo	6/16/2008	1.66	54.00	0.032	5.0000	
Vol	Lake Tekeni	Deephole	6/25/2009	6.14	48.00	0.001	2.4000	low
Vol	Lake Tekeni	Deephole	6/15/2010	6.76	33.80	0.050		
Vol	Lake Tekeni	Deephole	7/17/2010	6.70	32.80	0.060		
Vol	Lake Tekeni	Deephole	8/13/2010	6.81	44.10	0.050		
			MEAN	6.76	36.90	0.053		
			Std Dev	0.06	6.26	0.006		
Vol	Lake Tekeni	Deephole	6/15/2011	6.19	31.70	0.050		
Vol	Lake Tekeni	Deephole	7/13/2011	6.68	37.60	0.040		
Vol	Lake Tekeni	Deephole	8/21/2011	7.06	40.60	0.010		
			MEAN	6.64	36.63	0.033		
			Std Dev	0.44	4.53	0.021		
Vol	Lake Tekeni	Deephole	6/10/2012	6.51	29.40	0.127		
Vol	Lake Tekeni	Deephole	7/15/2012	6.91	32.20	0.121		
Vol	Lake Tekeni	Deephole	8/25/2012	7.04	34.30	0.099		
			MEAN	6.82	31.97	0.116	1.6000	
			Std Dev	0.28	2.46	0.015		

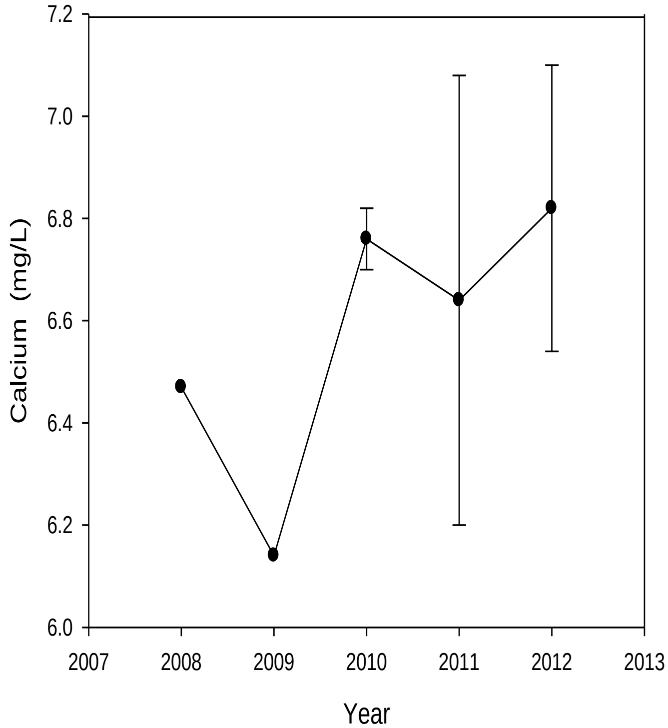

8.0
7.5
7.0
6.5
6.0
pH
2006
2008
2010
2012
Year
30
25
20
15
10
Alkalinity (mg/L)
2006
2008
2010
2012
Year
220
200
180
160
140
120
100
Conductivity (uohms/cm)
2006
2008
2010
2012
Year
50
40
30
20
10
0
Color (pt-co)
2006
2008
2010
2012
Year

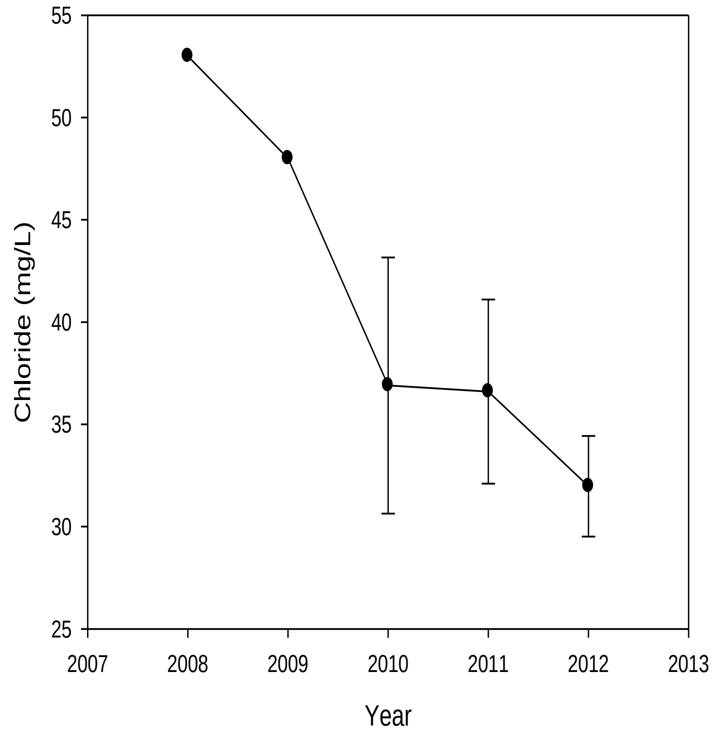

0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
Total Phosphorous (mg/L)
2006
2008
2010
2012
Year

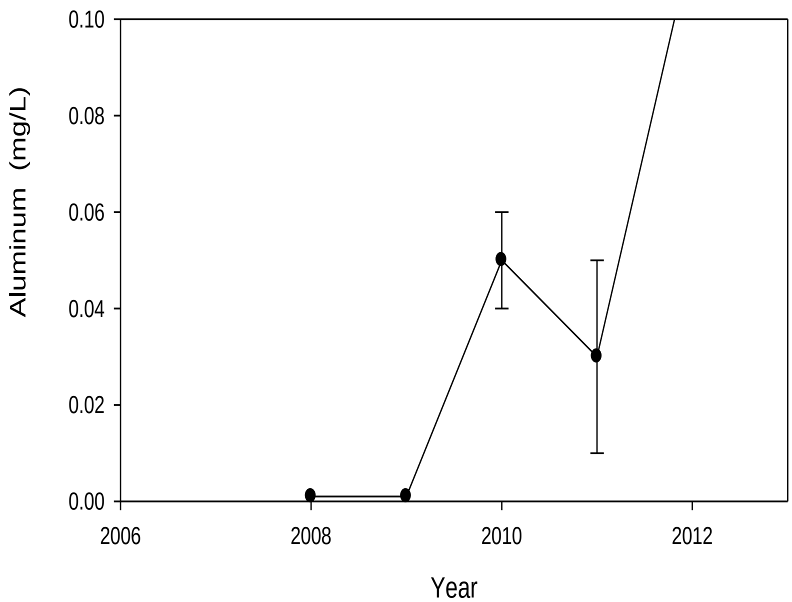

5
4
3
2
1
0
Chlorophyll a (ug/l)
2006
2008
2010
2012
Year


6.0
5.5
5.0
4.5
4.0
3.5
3.0
Secchi Disk Transparency (m)
2006
2008
2010
2012
Year


0.5
0.4
0.3
0.2
0.1
0.0
Nitrate (mg/L)
2006
2008
2010
2012
Year


7.2
7.0
6.8
6.6
6.4
6.2
6.0
Calcium (mg/L)
2007
2008
2009
2010
2011
2012
2013
Year


55
50
45
40
35
30
25
Chloride (mg/L)
2007
2008
2009
2010
2011
2012
2013
Year


0.10
0.08
0.06
0.04
0.02
0.00
Aluminum (mg/L)
2006
2008
2010
2012
Year