New York State
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Water

New York
Citizens Statewide Lake Assessment Program

(CSLAP)

2009 Adirondack Region Report

New York State
Department of Environmental Conservation

2009
ADIRONDACK REGION REPORT

NEW YORK
CITIZENS STATEWIDE
LAKE ASSESSMENT PROGRAM
(CSLAP)

Scott A. Kishbaugh, PE

NYS Department of Environmental Conservation
NY Federation of Lake Associations

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Acknowledgments

The Citizens Statewide Lake Assessment Program (CSLAP) is a volunteer lake monitoring program conducted by the NYS Department of Environmental Conservation (NYSDEC) and the NYS Federation of Lake Associations (FOLA). Founded in 1986 with 25 pilot lakes, the program has involved nearly 230 lakes, ponds, and reservoirs and 1,500 volunteers from eastern Long Island to the northern Adirondacks to the western-most lake in New York, and from 10-acre ponds to several Finger Lakes, Lake Ontario, Lake George, and lakes within state parks. In this program, lay volunteers trained by the NYSDEC and FOLA collect water samples, observations, and perception data every other week in a 15 week interval between May and October. Water samples are analyzed by certified laboratories. Analytical results are interpreted by the NYSDEC and FOLA and utilized for a variety of purposes by the State of New York, local governments, researchers, and, most importantly, participating lake associations.

The author wishes to acknowledge the following individuals, without whom this project and report would never have been completed:

From the Department of Environmental Conservation, Margaret Novak and Glenn Milstrey for on-going support of the program; Jay Bloomfield and James Sutherland, for their work in developing and implementing the program, and the technical staff from the Inland Lakes and Freshwater Section, and the Statewide Waters Monitoring Section, for continued technical review of program design.

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Finally, but most importantly, the authors would like to thank the more than 1,500 volunteers who have made CSLAP a model for lay monitoring programs throughout the country and the recipient of a national environmental achievement award. Their time and effort have served to greatly expand the efforts of the state and the public to protect and enhance the magnificent water resources of New York State.

Chapter 1- Background

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There is a long history of water quality monitoring programs in New York state, starting with the State Conservation Department (predecessor to the New York State Department of Environmental Conservation, or NYSDEC) biological surveys from the 1920s and 1930s, The Adirondack Lake Survey Corporation (ALSC) involved a study of more than 1500 lakes in the Adirondacks, Catskills and surrounding areas primarily for evaluation of lake acidification in the 1980s. The NYSDEC Lake Classification and Inventory (LCI) survey has sampled more than 200 lakes 1-4x since the early 1980s. There have also been several academic and private studies of lakes throughout the state.

However, none of these programs conducted multi-year sampling at a frequency or duration capable of evaluating changes imposed by weather, by season, or by trends, and none of these programs looked at the rest of the more than 7500 lakes in the state. Perhaps most importantly, most of these programs were not directed toward the large number of lakes used daily by active lake communities, and none of these programs took advantage of the local knowledge and experience gained by lake residents observing first-hand the daily and generational changes in their lakes. These datasets were vitally important to gaining an understanding of what makes New York lakes tick, but they weren't enough.

In 1985, NYSDEC staff proposed the development of a volunteer monitoring program, referred to as CSLAP—the Citizens Statewide Lake Assessment Program. NYSDEC Commissioner Henry Williams committed full support for CSLAP, but efforts to secure funding for implementation were unsuccessful. In his 1986 State of the State address, New York State Governor Mario M. Cuomo provided his endorsement:

> " .. I propose creating a program within the Department of Environmental Conservation to use trained volunteers to collect information on the State's water bodies. With this information, the Department can more effectively manage and protect our invaluable water resources."

With this endorsement and the support of several organizations, New York State developed a volunteer-based monitoring program, adapted from models successfully developed in Vermont, Maine, Minnesota and Illinois. The New York State Citizens Statewide Lake Assessment Program (CSLAP) was established in 1985 by Jim Sutherland and Jay Bloomfield from the NYSDEC as a cooperative program between the DEC and the NY Federation of Lake Associations (NYSFOLA), a non-profit coalition of lake associations, individual citizens, park districts, lake managers, and consultants dedicated to the preservation and restoration of lakes and their watersheds throughout the state. CSLAP was founded with three primary objectives:

- collect high quality lake data
- identify lake problems and water quality trends
- educate the public about lake stewardship

The pilot began with a small ($80,000) grant awarded to NYSFOLA to fund the purchase of sampling equipment, sample analysis, and the hiring of a CSLAP Program Coordinator in late

1985. NYSFOLA, via then President Jack Colgan, were instrumental in securing the grant and generating an interested pool of lake associations and volunteers for the program. The NYSDEC Program Coordinator was charged with identifying pilot candidate lakes (in concert with NYSFOLA), developing the sampling protocol, ordering equipment and supplies, establishing on-site training schedules, creating sampling kits, and setting up contracts with the New York State Department of Health (NYSDOH) inorganics laboratory to receive and analyze samples, and with the U.S. Postal Service to ship samples. The 25 lakes included in the pilot program were solicited from the NYSFOLA membership pool, and intentionally included a mixture of private and public lakes; lake associations, fish and game clubs, and park districts; small ponds and large lakes; and lakes from downstate to the western boundary of the state.

In the last 24 years, nearly 230 lakes, ponds, and reservoirs have been sampled through CSLAP, some continuously since 1986 and most for a much shorter duration. The following report summarizes the water quality data from the 110 lakes sampled through CSLAP in 2009, and broadly summarizing the 2009 data in the context of data collected through CSLAP from 1986 to 2009. A much more detailed summary of the CSLAP data for the first twenty five years of the program will be included in a 25 Year Summary report expected to be completed in 2011, after the 25th year of CSLAP sampling in 2010.

Chapter 2- CSLAP Statewide and Regional Reports

Chapter 2.1 Introduction to Regional Summaries

Chapter 2.2 CSLAP Lakes in the Adirondack Region Sampled in 2009

Chapter 2- CSLAP Statewide and Regional Reports

CSLAP data and interpretive summaries have been provided to CSLAP lake associations—the sampling volunteers and other lake residents, NYSDEC staff, sponsoring organizations—county planning departments and park districts—and other interested parties as annual reports after each year of sampling. From 1986 to 1995, these annual reports were constructed in a format roughly equivalent to the format outlined here—a general compendium summary of water quality conditions and special study results across the state, with a short and abbreviated synopsis of results from each sampled lake. Regional and trend analyses were limited in part by the relative lack of data, although some trend analysis was conducted on individual lakes with multiple years of data. In 1991, the NYSDEC began developing Five Year Reports for a select number of CSLAP lakes, in anticipation of more detailed lake and watershed analysis of CSLAP data, but these were curtailed after only a few reports had been completed, largely because these were deemed unsustainable.

Starting in 1996, the report format changed from a statewide report to more detailed summaries of individual program lakes, with more limited discussion of statewide conditions. In the reports prior to 1996 and in subsequent years, most statewide summaries consisted of compendia of individual lake results and trends. The typical individual lake report ranged from 50 pages (in the mid 1990s) to 100 pages (in the mid 2000s). Although the general format stayed the same from 1996 to 2008, additional lake background information was added every year or two to supplement the CSLAP database, particularly in the last several years. This included information about regulated activities in the area around the lake and a compendium of other state water quality data for the lake in 2005, information about fish stocking, fisheries regulations, and fish consumption advisory information, site location maps, information about rare, threatened, or endangered plant species in lake, and detailed discussions about lake use impacts and their implications for the state Priority Waterbody List in 2006. The 2007 report included RIBS water quality monitoring data, more detailed discussions about weather patterns and the implications of these patterns for water quality conditions in NYS lakes, historical aquatic plant identifications, more detailed discussions of nitrogen trends, and expanded exotic plant distribution maps. The 2008 CSLAP report included more detailed discussions about the connection between precipitation and water quality in CSLAP, and greater discussion about changes in water temperature and the potential connection between these findings and larger global climate change, an expanded discussion of most of the CSLAP sampling parameters, focusing on an "outstanding" question associated with each (usually in response to findings within the last few years), and a more detailed "So What Have We Learned Through CSLAP" section. By the time of the 2008 reports, the breadth of discussion and analysis far exceeded the information conveyed in the original Five Year Summary reports, although one of the key components of the Five Year reports—desktop nutrient budgets—had not yet been incorporated into the individual CSLAP lake reports by 2008.

Most of these reports were provided in paper format to the primary CSLAP sampling volunteer prior to the mid 2000s, but in the last several years have been issued primarily in electronic (PDF) format. In addition, the last several PDF reports are posted on the NYSFOLA website at www.nysfola.org, under the New York State Lake Association List directory. Reports have also been provided, primarily in electronic format, to DEC Regional staff and select county agencies.

Chapter 2.1- Introduction to Regional Summaries

The 2009 CSLAP Annual Report is divided into a single statewide report and four regional reports. These broad geographic categories are a modification of the statewide regional breakouts summarized in extensive detail in the 2nd Edition of *Diet for a Small Lake: The Expanded Guide to New York State Lake and Watershed Management*, but can be summarized here as follows:

1. **Downstate Region**- covers the two Long Island counties, the five counties constituting the boroughs of New York City, and the area on both sides of the Hudson River between New York City and the Central region, defined by the northern border of Sullivan, Ulster, and Dutchess Counties.

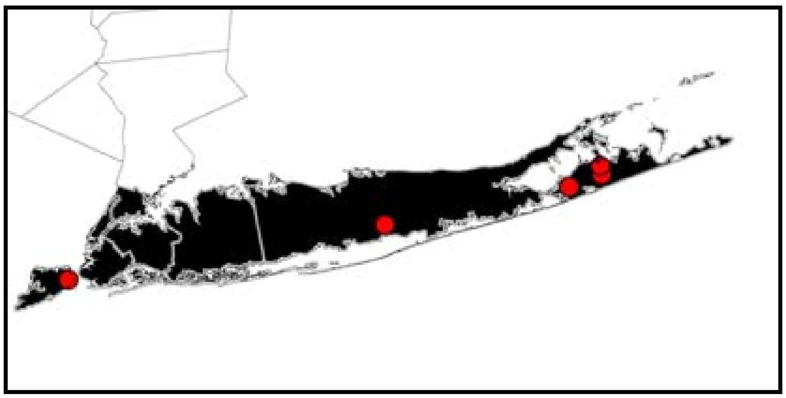


Figure 2.1.1 – Location of CSLAP Lakes in the Long Island/NYC portion of the "Downstate" region

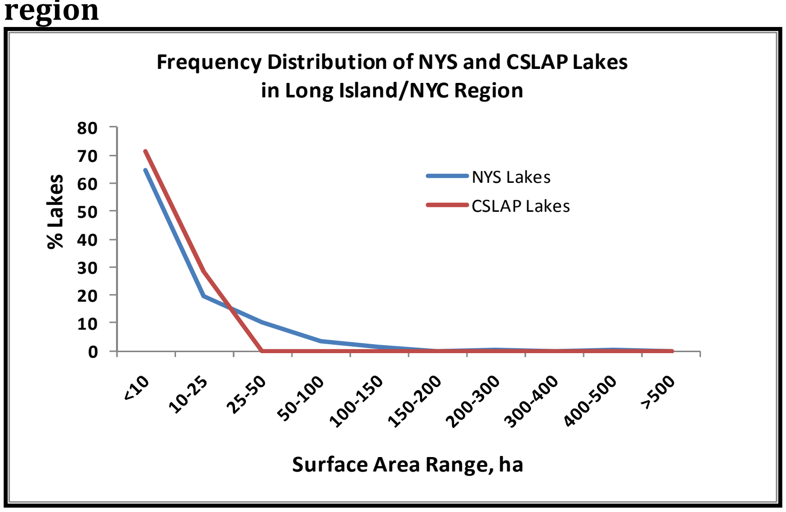


Figure 2.1.2 - Distribution of NYS and CSLAP Lakes in the Long Island/NYC portion of the "Downstate" region

Within the Long Island "sub" region, all but the eastern portion of this region is highly urbanized, and most (but not all) of the lakes are shallow, small and primarily support aquatic life, angling, and aesthetics. Most of these urban lakes do not support contact recreation or potable water use. 5 CSLAP lakes have been sampled among the approximately 150-200 lakes in Long Island (the named waterbodies greater than 2.6 hectares in surface area), or about 3% of the lakes. Within the New York City region, only one lake (from Staten Island) is sampled through CSLAP; this represents about 8% of the lakes in the five county region.

The geographic boundaries and CSLAP lake distribution in the Long Island and New York City region are shown in Figure 2.1.1 and 2.1.2. Although there are a small number of CSLAP lakes in this region, the size distribution of these lakes is similar to the overall size distribution of lakes in the region. However, the CSLAP lakes in this region, like most of those in other regions, are represented by lake associations and do not closely resemble the sociological profile of the typical Long Island or New York City region lake (which include a large number of lakes in state, county, or town parks). Both the Long Island and New York City regions are underrepresented in CSLAP, although this is almost entirely due to the very small number of lake associations found in this area.

The “Downstate” portion of this region is highly suburbanized, particularly southeast of the Hudson, and becomes increasingly rural (with some agriculture) and forested in the northern stretches of the region. The southeastern portion is dominated by the New York City drinking water reservoirs, which comprise the majority of the largest waterbodies, but the entire region is very lake rich and includes a large number of lake associations and park districts.

The geographic boundaries and CSLAP lake distribution in this “Downstate” portion of the region are shown in Figure 2.1.3 and 2.1.4. The highest percentage of CSLAP lakes in this region are found in the southeastern portion of the region—Westchester and Putnam Counties. The large number of Westchester County lakes in CSLAP originates in the active CSLAP sponsorship by the Westchester County Planning Department and the large number of lakes in this area. However, the large number of lakes in Orange and Sullivan Counties (are not well represented in CSLAP, again

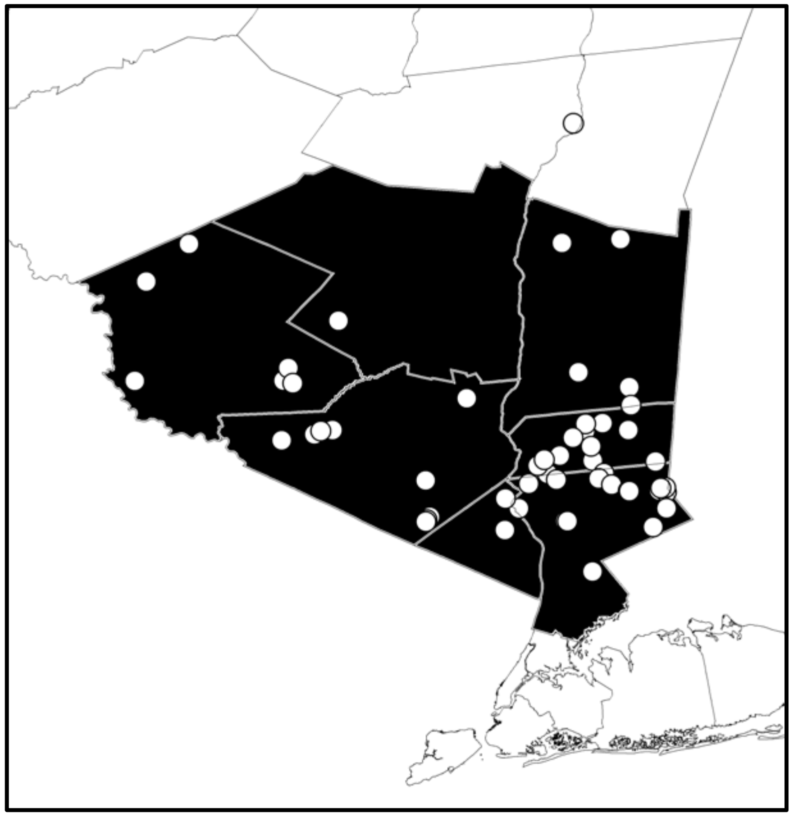


Figure 2.1.3 – Location of CSLAP Lakes in the northern portion of the “Downstate” Region

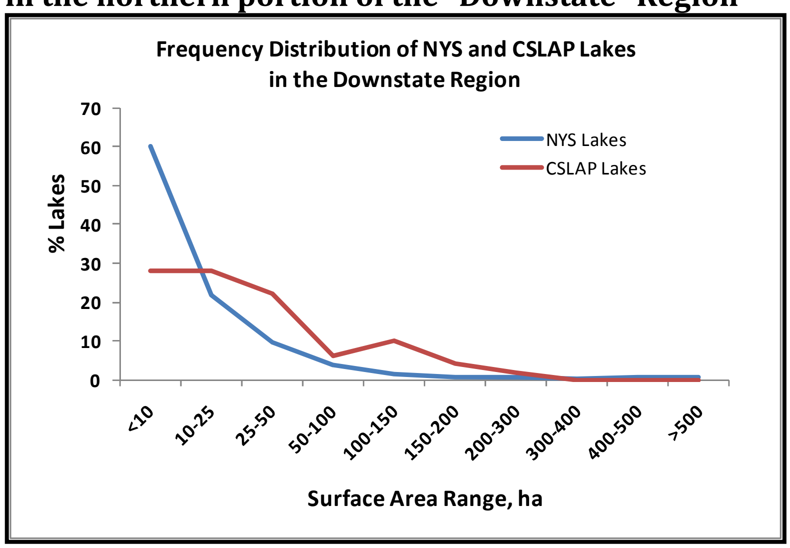


Figure 2.1.4 - Distribution of NYS and CSLAP Lakes in the northern portion of the “Downstate” Region

due in part to the small number of lake associations found in the NYSFOLA membership rolls).

None of the New York City reservoirs are sampled through CSLAP—these reservoirs are extensively sampled by the New York City Department of Environmental Protection, and none of the power generating reservoirs in the western areas are sampled, but many lakes within the watershed of these reservoirs (and thus subject to NYCDEP regulations) are sampled through CSLAP. A total of 54 CSLAP lakes have been sampled out of the approximately 800 lakes in this region, or about 7% of the lakes in the region. The CSLAP dataset includes a larger percentage of lakes between 10 and 300 hectares, particularly in the 10-50 hectare range, and a smaller percentage of lakes < 10 hectares in size. The latter range is generally underrepresented by lake associations and therefore in CSLAP.

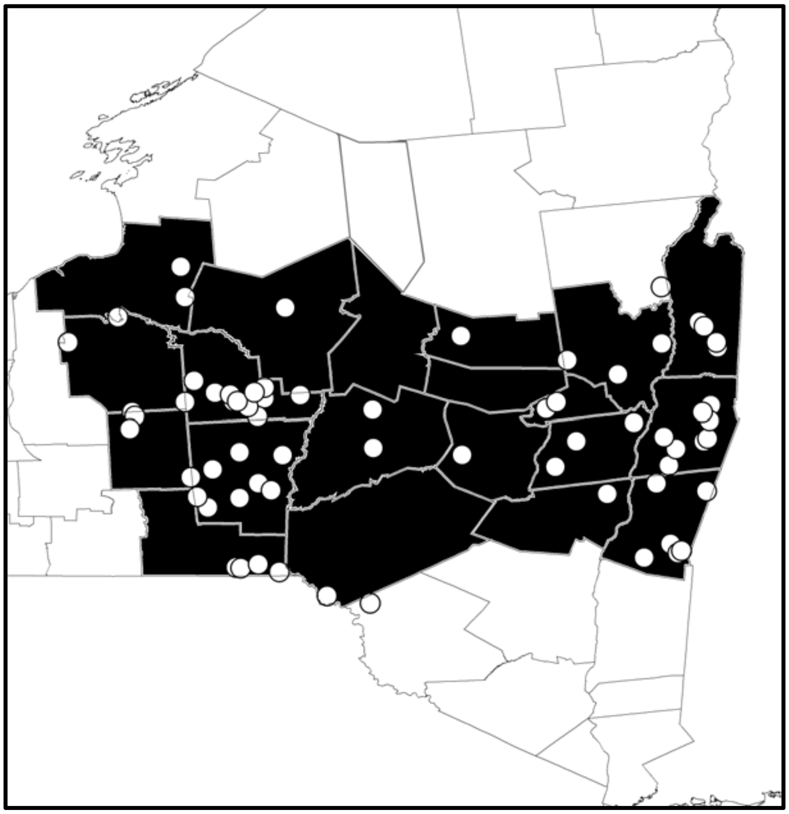


Figure 2.1.5 – Location of CSLAP Lakes in the Central Region

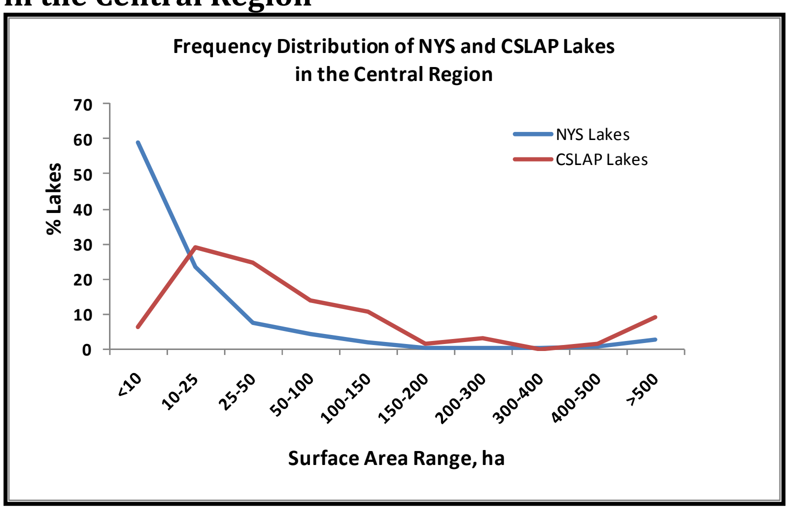


Figure 2.1.6 - Distribution of NYS and CSLAP Lakes in the Central Region

2. **Central Region-** this comprises the area between the Downstate, Adirondack, and Finger Lakes region, the latter two of which are well defined geographic areas. It is bounded on the south by the southern border of Delaware, Greene, and Columbia Counties, on the north by the southern edge of the Adirondack Park Boundary (the Blue Line), and to the west by the western border of Broome, Cortland, Onondaga, and Oswego Counties. The region includes a mixture of large and small, and shallow and deep lakes, although most of the lakes are in rural, forested areas, though mostly close to travel corridors and metropolitan areas. This region covers a large geographic area, but is not particularly lake rich, owing to the drainage areas dominated by the Hudson,

Mohawk, and Susquehanna Rivers. The highest density of lakes is generally found along the eastern and western portions of the region.

The geographic boundaries and CSLAP lake distribution in this region are shown in Figure 2.1.5 and 2.1.6. CSLAP lakes in the Capital District and along the eastern edge of the region—Columbia, Rensselaer and Washington Counties. There are relatively few CSLAP lakes in the interior portion of this region, an area also poorly represented by lakes and lake associations. This is also an area in which few invasive species have been reported—it is not known if the relative absence of lake associations is due to reduced impacts from exotic plants, or if the lack of invasive plant confirmations results from little surveillance from lake associations. As in most other New York state regions, there are a relatively small number of small (< 10 hectare) CSLAP lakes in the Central region, at least relative to non-CSLAP lakes in the region. This region also includes a slightly higher percentage of larger lakes, although these still comprise a small number of lakes in the region.

Approximately 600 lakes are found in this region; 66 of them have been sampled through CSLAP, approximately 11% of the lakes in the region.

3. **Adirondack Region-** this includes both the Adirondack Park region (defined by the Adirondack Blue Line, a geopolitical boundary codified in the state constitution) and the surrounding areas, particularly north to the U.S./Canadian border and west to the St. Lawrence River and the Indian River lakes region. This is among the most distinct of the New York state regions. The Adirondack region is as defined by lakes as any other geographic feature, and includes deep alpine and shallow wetland lakes, crystal clear lakes and dark tea colored ponds, and dammed rivers and power generating reservoirs to the west and south, and kettle ponds throughout the region. The diversity of lakes is enormous, but most tend to be highly rural and forested, with limited access. However, a large number of the larger lakes along the edge of region are heavily used by the public, due to state launch sites. There is a high density of lakes throughout the region, and many of the lakes are used for a variety of recreational purposes and serve as local water supplies.

The geographic boundaries and CSLAP lake distribution in this region are shown in Figure 2.1.7 and 2.1.8. This region also hosts a number of other volunteer monitoring programs, including the Adirondack Park Invasive Plant Program conducted by the Nature Conservancy of the Adirondacks, and the Adirondack Lake Assessment Program run by the Adirondack Watershed Institute of Paul Smiths College. These programs may draw some lakes out of CSLAP, particularly in the northern Adirondacks, although the APIPP program works closely with many CSLAP volunteers. Otherwise there is a wide distribution of CSLAP lakes throughout this region, with a particularly heavy concentration in the lake-rich areas of Warren, Franklin, and Fulton Counties, and large participation from the mix of deep and shallow lakes in the Indian River lakes region of northern Jefferson and southern St. Lawrence Counties.

The interior Adirondacks are not well represented in CSLAP. Many of these lakes are regularly sampled by the Hamilton County SWCD, and a large number of other lakes in this area do not support large populations or are otherwise not represented by lake associations. These lakes have also generally not suffered the water quality or invasive weed problems seen in much of the rest of the state, although this appears to be changing.

Figure 2.1.8 shows a very large number of small lakes not sampled through CSLAP—many of these are colored, acidic lakes sampled through the Adirondack Lake Survey Corporation study of >1500 high elevation lakes in the Adirondack and Catskill regions. Many of the larger, high profile, public access lakes within the Adirondack Park and Indian River Lakes region, particularly those in the 100-400 hectare range, are sampled through CSLAP. Of the approximately 2000 lakes in this region (named and larger than 2.6 hectares), 76 have been sampled through CSLAP, representing about 4% of the total number of lakes in the region.

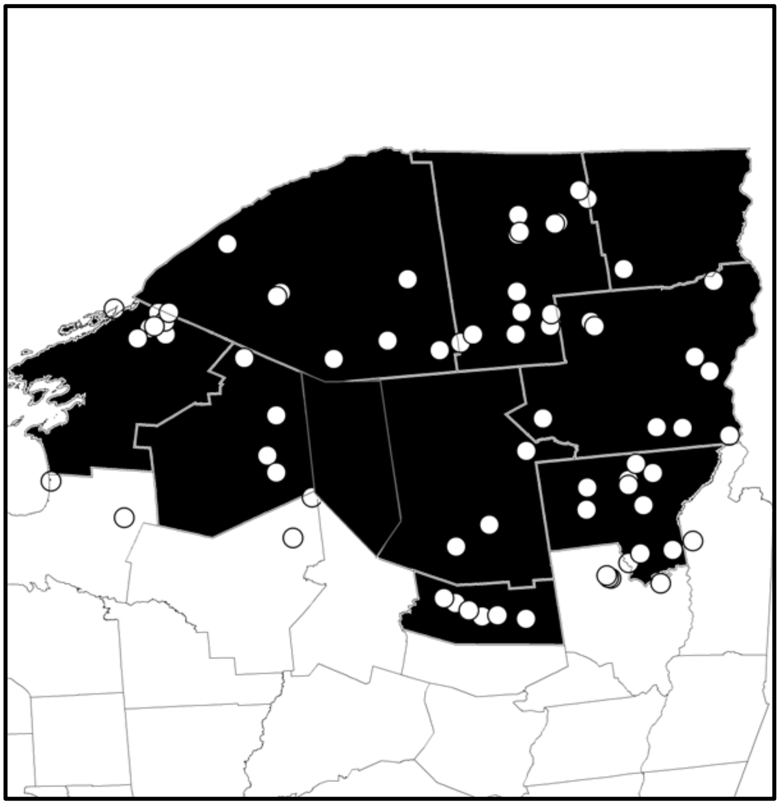


Figure 2.1.7 – Location of CSLAP Lakes in the Adirondack Region

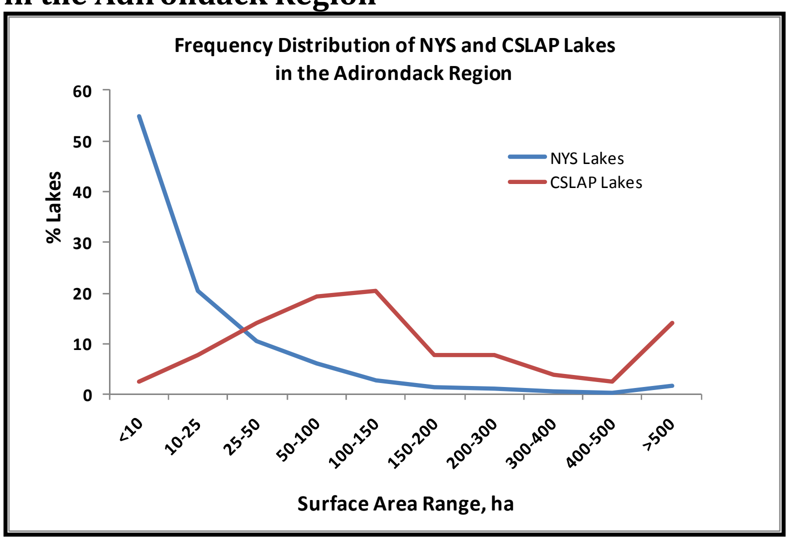


Figure 2.1.8 - Distribution of NYS and CSLAP Lakes in the Adirondack Region

4. **Finger Lakes and Western region**- this is comprised of the region bounded to the north by Lake Ontario, to the south and west by the Pennsylvania border, and to the east by "Central" region. This region can be subdivided into the Finger Lakes region, dominated by 11 very large north-south oriented very deep Finger Lakes, and the Western region, dominated by four very large lakes (Lake Erie, Lake Ontario, Allegheny Reservoir, and Chautauqua Lake). Most of the other waterbodies in the region are small and shallow, although there are also many enclosed embayments to Lake Ontario that otherwise are typical of many inland lakes. However, both the large and small lakes share many common problems and issues. Perhaps owing to the dominance of the Finger Lakes and the Great Lakes, this is not otherwise a very rich lake area.

The geographic boundaries and CSLAP lake distribution in Finger Lakes region are shown in Figure 2.1.9 and 2.1.10. Six of the eleven Finger Lakes have been sampled through CSLAP, including all but three of the Finger Lakes (Keuka, Canandaigua, and Otisco Lakes) which are multi-use waterbodies. In addition, five of the largest embayments to Lake Ontario have also been sampled through CSLAP, four of them in this region (North Sandy Pond in Oswego County is also a CSLAP lake). However, only a small number of other lakes in this region have been sampled through CSLAP. Of the 170 lakes and protected

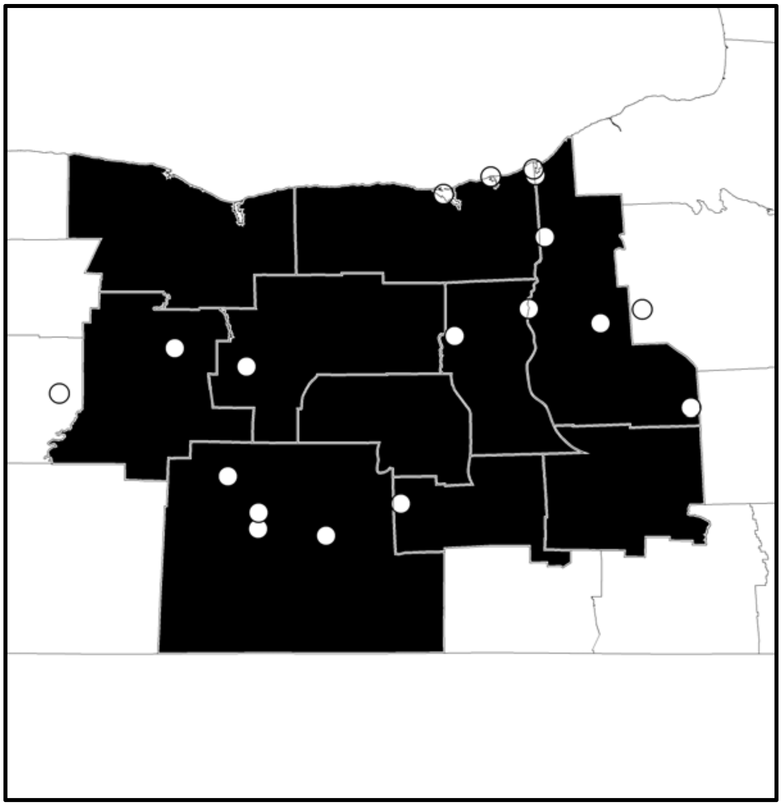


Figure 2.1.9 – Location of CSLAP Lakes in the Finger Lakes portion of the Western Region

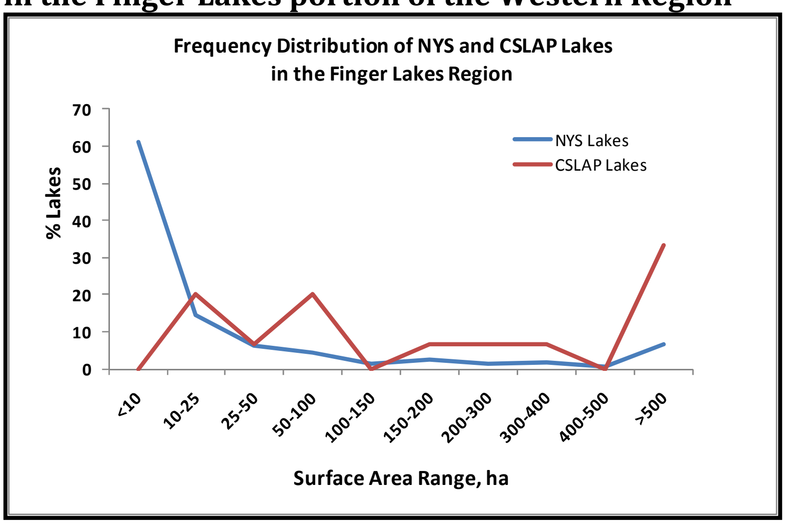


Figure 2.1.10 - Distribution of NYS and CSLAP Lakes in the Finger Lakes portion of the Western Region

embayments (to Lake Ontario) in this region, 14 have been sampled through CSLAP. While this represents about 8% of the lakes in the region, a percentage typical of the rest of the state, less than 3% of the lakes not classified as Finger Lakes or Lake Ontario embayments in this region have been sampled through CSLAP.

Figure 2.1.10 shows a fairly even distribution of lake sizes represented in CSLAP, from the largest lakes (generally the Finger Lakes) to small ponds. As in most other regions of the state, most of the lakes in this region are less than 10 hectares in area, and the smaller size range is particularly underrepresented in the CSLAP pool, at least relative to most other regions of the state. This is due in large part to the paucity of small lake associations (as members of NYSFOLA or otherwise) represented in this region. It is not known if this is in response to the historical lack of problems frequently spawning the establishment of a lake association (issues related to water quality, invasive species, dam management, and fishing, for example) or the dominating presence of the larger associations and organizations connected to the Finger Lakes.

The geographic boundaries and CSLAP lake distribution in the Western portion of the region are shown in Figure 2.1.11 and 2.1.12. Multiple sites on both Lake Ontario (corresponding to beaches administered by the NYS Office of Parks and Recreation) and Chautauqua Lake have been sampled through CSLAP. Most of the other

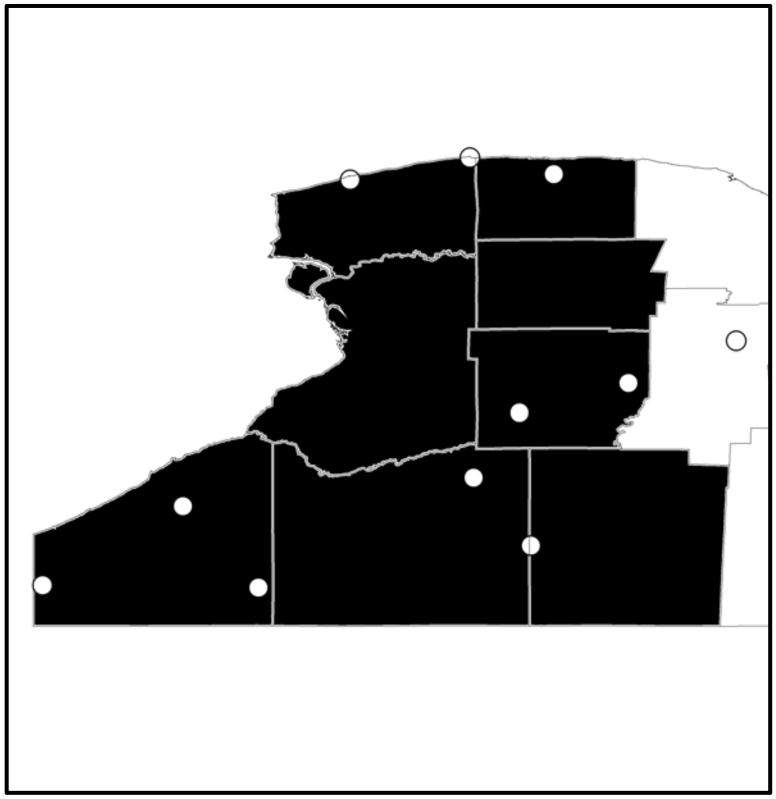


Figure 2.1.11 – Location of CSLAP Lakes in the western portion of the "Western" Region

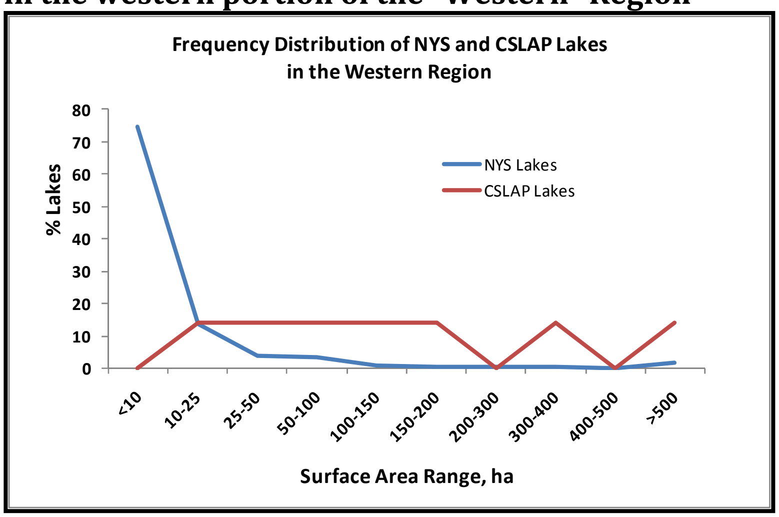


Figure 2.1.12 - Distribution of NYS and CSLAP Lakes in the western portion of the "Western" Region

CSLAP lakes in the region are on reservoirs or small ponds that support contact recreation and aquatic life, but not potable water usage. These lakes are scattered throughout the region, but except for the Lake Ontario sites at Golden Hill and Wilson-Tuscarora State Parks, the northwestern portion of this region has not been well represented in CSLAP (due largely to the small number of lakes and lake associations). There are, however, a number of lakes in the Buffalo area that have not been sampled through CSLAP, although most of these are in city or town parks and are not heavily populated by residences.

Figure 2.1.12 shows an even distribution of small and large lakes in this region, although the majority of lakes in the region have a surface area less than 10 hectares. As in the Finger Lakes portion of the region, lakes in the smaller size range are poorly represented in CSLAP. Of the approximately 180 lakes in this region, 13 have been sampled through CSLAP, representing about 7% of these lakes.

Table 2.1.1 summarizes the number of CSLAP lakes in each region, the percentage of lakes that this represents, and the areas within each region that have been most and least represented by CSLAP lakes (taking into consideration the actual distribution of lakes in the region). The areas or waterbody types listed as "over-represented" does not indicate a call to conduct less sampling; this merely reflects a higher percentage of these lakes relative to their representation in the regional distribution of lakes.

Table 2.1.1: CSLAP Lakes by Region, 1986-2009

Region	# CSLAP Lakes	% Lakes in Region	Under-Represented	Over-Represented
Downstate	60	6%	Urban lakes, Large reservoirs, Sullivan/ Orange Co lakes	Suburban lakes in Westchester/Putnam Co
Central	66	11%	Delaware and Schoharie Co. lakes	Rural lakes in Rensselaer and Washington Co
Adirondacks	76	4%	Colored and interior Adirondack lakes	Mid sized public access lakes on edges of region
Western	27	8%	Small urban and suburban lakes, Northwestern lakes	Finger Lakes?
CSLAP Statewide	**229**	**6%**		

% Lakes in region represents the percentage of CSLAP lakes among the named lakes > 2.6ha in surface area within the region

Regional Reports and the 2009 Dataset

The regional CSLAP reports cover the following region(s):

1. **"Downstate" region**- represents the Long Island/NYC and Downstate areas, as seen in Figures 2.1.1 and 2.1.3. These two "sub" regions are the most ecologically similar among the regions delineated above, and 32 CSLAP lakes in the Downstate region were sampled in 2009 (and 60 lakes in this region have been sampled since CSLAP began in 1986).
2. **"Central" region**- the Central region defined in Figure 2.1.5 and Diet for a Small Lake is sufficiently large (36 CSLAP lakes in 2009 and 66 CSLAP lakes sometime during the period from 1986-2009) to warrant a regionally-specific report.
3. **"Adirondack" region-** the Adirondack region defined in Figure 2.1.7 and Diet for a Small Lake is also sufficiently large (33 CSLAP lakes in 2009 and 76 CSLAP lakes in the period from 1986-2009) to warrant a regionally specific report.
4. **"Western" region**- represents the Finger Lakes and Western areas, as seen in Figures 2.1.9 and 2.1.11. These two "sub" regions are ecologically similar, and include 9 lakes sampled in 2009 and 27 lakes sampled at least one year in the period from 1986 to 2009.

Figure 2.1.13: CSLAP Lakes Sampled in 2009

CSLAP Lakes Sampled in 2009

Figure 2.1.13 shows the distribution of the 110 CSLAP lakes sampled in 2009. The list and distribution of lakes within each of the four regions listed above is provided in the regional summaries. The distribution of lakes is heaviest in the eastern and northwestern Adirondack region, along the Hudson corridor and in Madison and Chenango Counties in the Central Region, and in the southern portion of the Downstate region. The Western, Finger Lakes, and Long Island/NYC regions were not well represented in CSLAP in 2009, although these regions also generally have a smaller population of lakes.

Table 2.1.2 shows the regional summary of lakes sampled in CSLAP in 2009. The Long Island/NYC and Downstate regions include a disproportionate number of relatively new CSLAP lakes. The Long Island region includes three lakes associated with the Long Pond Greenbelt region, all of which became involved in CSLAP in recent years. The Downstate region includes a number of lakes sponsored by the Westchester County Planning Department and others introduced to CSLAP through the frequency regional NYSFOLA conferences in Putnam and Westchester Counties. The CSLAP lakes in the Central, Finger Lakes, and Western regions on average have been sampled longer than those lakes in other parts of the state, although the regional averages are no doubt influenced by the small number of lakes in the western regions of the state.

Table 2.1.2: Regional Summary of CSLAP Lakes Sampled in 2009

Region	#2009 Lakes*	Avg #Years in CSLAP	Avg #2009 Samples
Downstate	32	6.4	7.0
Central	35	13.5	7.8
Adirondacks	43	10.1	7.6
Western	10	14.0	8.0
CSLAP Statewide	**120**	**10.5**	**7.5**

*includes multiple sites sampled on three Adirondack region lakes and one Western region lake

Table 2.1.2 also suggests that the lakes sampled for the shortest period of time were also more likely to conduct less sampling in 2009. This may be due to a greater reliability associated with volunteers at longer-duration CSLAP lakes, indicating an "institutional" dedication to long-term monitoring.

Chapter 2.2- CSLAP Lakes in the Adirondack Region Sampled in 2009

33 lakes from the Adirondack region were sampled through CSLAP in 2009, including two sites each at Schroon Lake and Paradox Lake, and seven sites at Lake George. This includes several lakes—Glen Lake, Goodnow Flow, Butterfield Lake, and Fulton Second Lake—that were sampled in the CSLAP pilot project in 1986, and only two lakes—Eagle Pond and Upper Saranac Lake—sampled fewer than five years (several of the Lake George sites have been sampled since 2004). Since the criteria for evaluating water quality trends in CSLAP lakes is five years of data, nearly all of these lakes have been included in the full suite of analyses in the Adirondack region report. The 2009 Adirondack region database included very small (Eagle Pond, Lorton Lake, Lake Forest) and very large (Lake George, Upper Saranac Lake, Lake Placid) lakes, although the typical CSLAP lake in the region sampled in 2009 was larger than the typical Adirondack region lake. The interior Adirondacks were represented by Fulton Second Lake and Sacandaga Lake, although these areas were also not as strongly represented as were lakes along the outer boundaries of the region. Most of these lakes were *oligotrophic* to *mesoligotrophic*, as discussed in Chapter 3, although some more productive lakes were also sampled, and many of these lakes suffer from invasive plants.

Each of the Adirondack region lakes sampled through CSLAP at one time since 1986 is listed in the statewide report, in the discussion of CSLAP activities associated with the timeframe in which the lake was first sampled. Table 2.2.3 below identifies the Adirondack region lakes sampled through CSLAP in 2009. Chapters 3 through 9 summarize the Adirondack region sampling results from 1986 to 2009, with a special emphasis on the results from 2009.

Table 2.2.3: CSLAP Adirondack Region Lakes Sampled in 2009

Lake Name	Years	#Years	#Samples	#2009 Samples	County[1]	Town[1]	Contact
Augur Lake	1997-2009	12	87	8	Essex	Chesterfield	Paul Knott
Black Lake	1988-2009	22	159	8	St. Lawrence	Hammond	Jim Jackson
Brantingham Lake	2001-2009	9	64	7	Lewis	Greig	Donald Schneider
Butterfield Lake	1986-2009	24	187	8	Jefferson	Redwood	
Canada Lake	2001-2009	9	70	8	Fulton	Caroga	Merryn Byrnes
Eagle Lake	2000-2009	10	80	9	Essex	Ticonderoga	Paul and Mary Lloyd Burroughs
Eagle Pond	2008-2009	2	16	8	Franklin	Duane	Gerry Gould
East Caroga Lake	1990-2009	15	113	7	Fulton	Caroga	Gail Girvin
Effley Falls Lake	1997-2009	11	82	8	Lewis	Croghan	John and Kathy Bast
Friends Lake	1991-2009	14	104	8	Warren	Chester	Wendell Lorang
Fulton Second Lake	1986-2009	19	161	8	Herkimer	Old Forge	Steve Pitela
Glen Lake	1986-2009	21	112	7	Warren	Glens Falls	Paul Derby
Goodnow Flow	1986-2009	13	106	7	Essex	Newcomb	Bill James
Grass Lake	2004-2009	6	46	8	St. Lawrence	Rossie	Paul Gentile
Horseshoe Pond	2000-2009	10	75	8	Franklin	Duane	James Reh
Hunt Lake	1994-2009	13	92	8	Saratoga	Corinth	Bob Cady
Hyde Lake	1999-2009	7	41	8	Jefferson	Theresa	Tim Aiken
Lake Bonaparte	1988-2009	12	101	8	Lewis	Harrisville	Lynn Jinks
Lake Clear	1998-2009	12	97	8	Franklin	Harrietstown	Bob Callaghan
Lake Forest	2001-2009	9	54	6	Warren	Lake Luzerne	Rosealba O'Boyle
Lake George-Basin Bay	2004-2009	6	48	8	Warren	Bolton	Emily DeBolt
Lake George-Crown Island	2004-2009	6	33	8	Warren	Bolton	Emily DeBolt
Lake George-Diamond Island	2004-2009	6	41	8	Warren	Lake George	Emily DeBolt
Lake George-Gull Bay	2007-2009	3	24	8	Warren	Hague	Emily DeBolt

Lake Name	Years	#Years	#Samples	#2009 Samples	County[1]	Town[1]	Contact
Lake George-Harris Bay	2007-2009	3	24	8	Warren	Queensbury	Emily DeBolt
Lake George-Hearts Bay	2005-2009	5	27	4	Warren	Hague	Emily DeBolt
Lake George-Huletts Landing	2004-2009	6	29	8	Warren	Hague	Emily DeBolt
Lake Placid	1991-2009	19	109	8	Essex	North Elba	Mark Wilson
Lincoln Pond	1997-2009	8	62	5	Essex	Elizabethtown	Wayne Johnson
Lorton Lake	1990-2009	15	120	8	Oswego	Orwell	Barbara Sherman
Millsite Lake	1997-2009	13	100	8	Jefferson	Theresa	Janice Douglass
Mirror Lake	1998-2009	11	68	7	Essex	Lake Placid	Mark Wilcox
Otter Lake	1992-2009	8	100	8	Oneida	Forestport	Scott Lincoln
Paradox Lake-West	2003-2009	7	56	8	Essex	Schroon	Helen Wildman, Jane Jenks
Paradox Lake-East	2004-2009	6	47	8	Essex	Schroon	Helen Wildman, Jane Jenks
Peck Lake	1992-2009	7	57	8	Fulton	Bleeker	James Oare
Pleasant Lake	2000-2009	9	64	2	Fulton	Stratford	Bob Vaniglia
Sacandaga Lake	1987-2009	11	94	8	Hamilton	Lake Pleasant	Peter Tobiessen
Schroon Lake-North	1987-2009	11	109	8	Essex	Schroon	Helen Wildman
Schroon Lake-South	2003-2009	6	47	8	Warren	Horicon	Helen Wildman
Silver Lake	1996-2009	13	86	8	St. Lawrence	Clifton	Roger Johnson c/o Robb Kimmes
Upper Saranac Lake-North	2006-2009	3	25	8	Franklin	Santa Clara	Corey Laxson
Upper Saranac Lake-South	2006-2009	3	25	8	Franklin	Harrietstown	Corey Laxson

[1]Locational information corresponds to the coordinates of the mouth of the outlet, except for the multiple site lakes—these town and county locations correspond to the approximate location of the sampling site

Chapter 3- Evaluation of Eutrophication Indicators

Phosphorus Fact Sheet

Description:	total phosphorus represents a measure of both suspended and soluble (dissolved) forms of phosphorus, reported in milligrams per liter (parts per million) as phosphorus.
Importance:	phosphorus is one of the major nutrients needed for plant growth. It is often considered the "limiting" nutrient in NYS lakes, for biological productivity (as defined by algae) is often limited if phosphorus inputs are limited. Since excessive algae growth often leads to reduced water clarity and degraded water quality perception, many lake management plans are centered on phosphorus controls. Phosphorus limitation is assumed when phosphorus to nitrogen ratios exceed 25 (on a molar basis), although this simplified assessment should be accompanied by other analyses to determine factors that most affect algae growth.
How Measured:	total phosphorus is analyzed from the surface (1.5 meter grab) sample collected in CSLAP with the use of a Kemmerer bottle and transferred to a collapsible container and labeled sample aliquot bottles. Sample bottles were pre-acidified prior to 2004, but subsequent analyses showed that this was unnecessary if samples were kept cold (39ºC) shortly after collection and continuously until analysis within 28 days. Hypolimnetic (deepwater) samples are collected at a depth of 1.5 meters from the lake bottom in thermally stratified lakes. Phosphorus is analyzed using a spectrophotometer with a 10cm cuvette.
Detection Limit:	0.0007 mg/l (prior to 2002, detection limit = 0.002 mg/l)
Range in NYS:	undetectable (< 0.0007 mg/l) to 2.0 mg/l; 93% of readings fall between 0.005 mg/l and 0.075 mg/l (5-75 ppb).
WQ Standards:	the existing state guidance value for total phosphorus is 0.020 mg/l to protect contact recreation in Class B and higher lakes; this will likely be modified as part of the nutrient criteria development process. New guidance values will probably reflect differences in both regional water quality characteristics and lake uses.
Trophic Assessment:	New York State's trophic assessments differ slightly from the standard Carlson assessment criteria. Total phosphorus readings exceeding 0.020 mg/l in New York State and 0.024 mg/l using the Carlson indices, are considered *eutrophic*, or highly productive. Readings below 0.010 mg/l in New York State, and 0.012 mg/l using the Carlson indices, are considered *oligotrophic*, or highly unproductive. Lakes in the intermediate range are considered *mesotrophic*. The differences between the New York State and Carlson criteria are discussed in Chapter 3.4.

Chapter 3- Evaluation of Eutrophication Indicators

Chapter 3.1- Evaluation of Adirondack Region Total Phosphorus

Summary of CSLAP Total Phosphorus Findings in Adirondack Region Lakes, 1986-2009

1. CSLAP lakes within the Adirondack region have lower phosphorus readings than those in other parts of the state, with the majority of lakes having typical total phosphorus levels below 10 ppb, corresponding to *oligotrophic* conditions.
2. CSLAP lakes within the Adirondack region have slightly lower phosphorus readings than non-CSLAP lakes in the same region, although CSLAP and non-CSLAP lakes in the same depth and size are comparable.
3. CSLAP lakes within the Adirondack region are more likely to have lower phosphorus readings in drier years, although this difference is much less likely to occur in wetter years.
4. No long-term trends in total phosphorus readings have been apparent in CSLAP lakes within the Adirondack region, although recent increases in phosphorus levels in Schroon Lake and Paradox Lake have been measured.
5. Total phosphorus readings are highest within the northwest portion of the Adirondack region lakes, particularly outside the Adirondack Park boundary (blue line). These are the only *mesotrophic* to *eutrophic* lakes within this region
6. Deepwater (hypolimnetic) phosphorus readings are highest, overall and relative to surface readings, in thermally stratified *mesotrophic* lakes, particularly those outside the Adirondack Park blue line.
7. Total phosphorus readings in Adirondack region lakes were similar in 2009 to those reported in the typical CSLAP sampling season from 1986 to 2008.
8. Changes in the Adirondack region lakes with both higher and lower than normal total phosphorus readings in 2009 were probably not indicative of any long-term trends, and may have been mediated by weather patterns (most likely wetter weather and higher water levels).

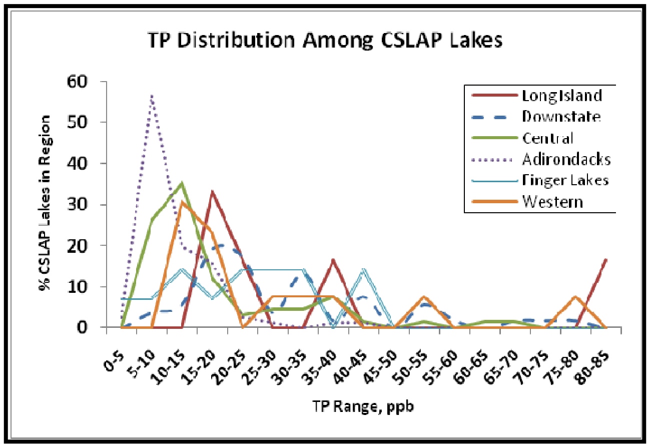
Adirondack Region Data Compared to NYS Data

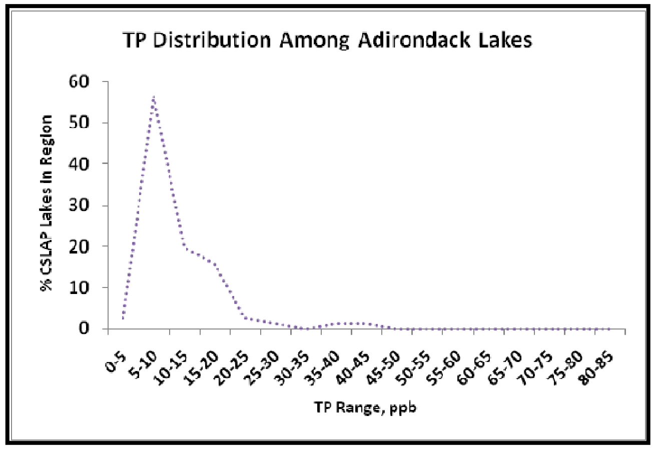
CSLAP lakes in the Adirondack region are less productive than in any other region of the state, as measured by lower phosphorus readings and as demonstrated in Figure 3.1.1. The most common range of TP readings in CSLAP Adirondack region lakes is in the 5-10 ppb range, with decreasing frequency as TP readings increase. Very few Adirondack region lakes have TP readings above 30 ppb, as seen in Figure 3.1.2.

Comparison of CSLAP to NYS Lakes in the Adirondack Region

There are more Adirondack region lakes with total phosphorus readings in the 5-10 ppb range in CSLAP than was found in other New York state monitoring programs, as seen in Figure 3.1.3. The majority of the lake water quality data outside of CSLAP comes from the Adirondack Lake Survey Corporation (ALSC) study of more than 1500 mostly small, high elevation lakes within the Adirondacks, Catskills and nearby regions. The typical ALSC lake is small and colored, a combination that leads to slightly higher phosphorus readings than seen in the typical

CSLAP lake in the Adirondack region, although ALSC lakes generally have lower phosphorus readings than were found in most other regions in the state. The water quality differences between the ALSC and CSLAP datasets can also be seen in other trophic indicators (water clarity and chlorophyll *a*), conductivity, and color.





Figures 3.1.1 and 3.1.2: Distribution of Phosphorus Ranges in CSLAP and Adirondack Region Lakes

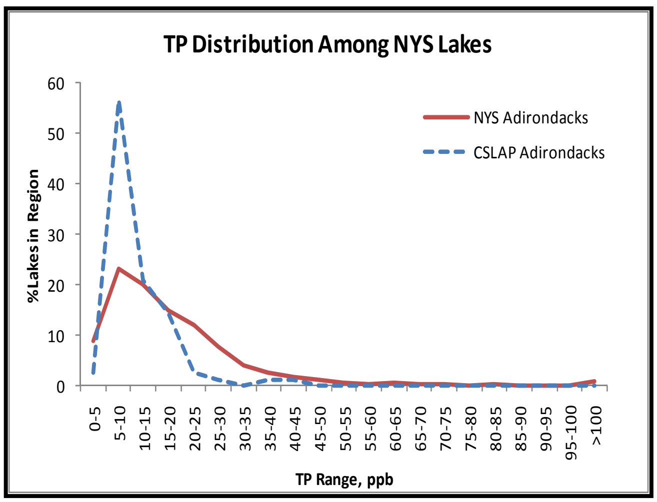


Figure 3.1.3: Average Distribution of Phosphorus Readings in New York State and CSLAP Lakes in the Adirondack Region

Annual Variability:

Total phosphorus has varied annually in Adirondack lakes, although less so than in most other regions of the state. The highest phosphorus readings measured through CSLAP occurred during 1991, 2003, 2000, 1996, 1993 and 1986. The last four of these years were wetter than normal. The lowest phosphorus readings occurred in 2002, 1997, 1993, 1994 and 1989; none of these occurred in drier than normal years. Table 3.1.1 looks at the percentage of CSLAP lakes with high phosphorus (greater than 1 standard error above normal) and low phosphorus (greater than 1 standard error below normal) readings in wet and dry years. These data show that high phosphorus readings are more likely to occur in wetter years and low phosphorus readings occur in drier years, although the disparity appeared to be greater in dry years. This suggests that although the years with the lowest phosphorus readings were neither dry nor wet, in general drier conditions bring a decrease in phosphorus readings.

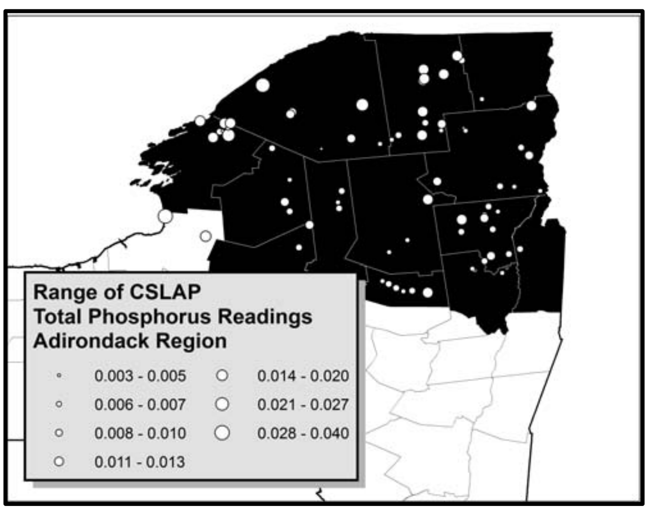
Table 3.1.1- % of CSLAP Lakes with Higher or Lower (than Normal) TP Readings During Dry and Wet Years in the Adirondack Region

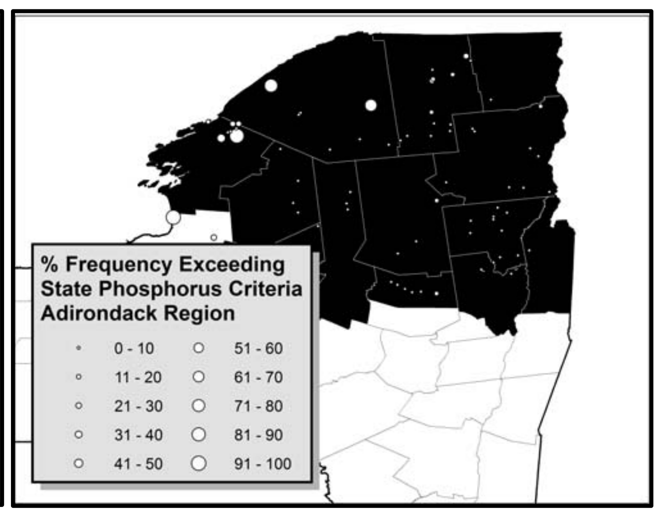
	Dry Years	Wet Years
Higher Phosphorus	18%	24%
Lower Phosphorus	26%	22%

Dry Years: 1988, 1995, 2004, 2005
Wet Years: 1990, 1998, 2000, 2002, 2008
"Higher" and "Lower" defined as >1 SE higher than and lower than normal, respectively

Long Term Trends:

The evaluation of long-term trends since 1986 in the Adirondack region lakes is adversely affected by the small number of lakes sampled during some sampling seasons, particularly in the earliest years of CSLAP (from 1986 to 1990). The CSLAP data show that since 1986, the frequency of both significantly higher than normal and significantly lower than normal TP readings has increased, although these trends appear to be statistically weak, as with the statewide database. The frequency of moderately lower TP levels has increased while the frequency of moderately higher TP levels has decreased, although neither trend is statistically significant. These data indicate that no clear long-term trends in phosphorus readings have been apparent, or at least that long-term changes in phosphorus readings are more likely to be related to year to year changes in weather patterns than any true long-term trends.





Figures 3.1.4 and 3.1.5: Range of Phosphorus Readings and Frequency of Exceeding the State TP Guidance Value in the Adirondack Region

Regional Distribution:

Total phosphorus readings with the Adirondack region are highest in the northwestern lakes, although most of the highest readings are in the lakes outside the Adirondack Blue Line, particularly those in the Indian River Lakes area in northeastern Jefferson and southwestern St. Lawrence counties. The lowest phosphorus readings are found in the southern and southeastern corner of the Adirondack Park, as seen in Figure 3.1.4. Likewise the greatest frequency of exceeding the state phosphorus guidance value is found in the northwestern part of the region, as seen in Figure 3.1.5. Several of these lakes are in the *mesotrophic* to *eutrophic* range, while *oligotrophic* is the most common assessment in nearly all other lakes within this region. Most lakes found in the Adirondack region, and most lakes within the Adirondack Park (within the Blue Line), do not exceed this guidance value at any time.

Table 3.1.2 shows the number of phosphorus samples, the minimum, average, and maximum phosphorus readings, the most common trophic assessment for the lake, the frequency of exceeding the state phosphorus criteria, the last year in which the lake was sampled through CSLAP, and whether phosphorus readings have changed since CSLAP sampling began in the lake (through 2008). The latter was only evaluated for those lakes sampled through CSLAP in 2009.

Table 3.1.2: Surface Total Phosphorus Summary in CSLAP Adirondack Region Lakes, 1986-2009

Lake Name	Years	Num	Min	Avg	Max	Trophic Category	%Violating TP Criteria	Change?
Adirondack Lake	1986-1989	36	0.005	0.015	0.028	*Mesotrophic*	11	
Augur Lake	1997-2009	83	0.006	0.016	0.043	*Mesotrophic*	12	No
Augur Lake	2009	8	0.013	0.016	0.023	*Mesotrophic*	13	No
Bartlett Pond	1997-2000	20	0.005	0.010	0.026	*Mesotrophic*	5	
Black Lake	1988-2009	154	0.007	0.040	0.099	*Eutrophic*	86	No
Black Lake	2009	8	0.029	0.039	0.047	*Eutrophic*	100	No
Brant Lake	1987-2003	80	0.001	0.006	0.019	*Oligotrophic*	0	No
Brantingham Lake	2001-2009	71	0.000	0.009	0.036	*Oligotrophic*	7	No
Brantingham Lake	2009	7	0.002	0.007	0.013	*Oligotrophic*	0	No
Butterfield Lake	1986-2009	171	0.004	0.017	0.034	*Mesotrophic*	25	No
Butterfield Lake	2009	8	0.006	0.017	0.027	*Mesotrophic*	13	No
Canada Lake	2001-2009	67	0.003	0.007	0.019	*Oligotrophic*	0	No
Canada Lake	2009	8	0.005	0.007	0.009	*Oligotrophic*	0	No
Chase Lake	1990-1997	40	0.006	0.010	0.021	*Mesotrophic*	3	No
Eagle Crag Lake	1986-2005	103	0.000	0.007	0.021	*Oligotrophic*	1	No
Eagle Lake	2000-2009	79	0.002	0.006	0.023	*Oligotrophic*	1	No
Eagle Lake	2009	9	0.005	0.006	0.009	*Oligotrophic*	0	No
Eagle Pond	2008-2009	15	0.006	0.014	0.035	*Mesotrophic*	13	
Eagle Pond	2009	8	0.006	0.016	0.035	*Mesotrophic*	25	No
East Caroga Lake	1990-2009	112	0.000	0.009	0.018	*Oligotrophic*	0	No
East Caroga Lake	2009	7	0.000	0.007	0.012	*Oligotrophic*	0	No
Effley Falls Lake	1997-2009	80	0.001	0.007	0.032	*Oligotrophic*	1	No
Effley Falls Lake	2009	8	0.004	0.007	0.010	*Oligotrophic*	0	No
Efner Lake	1997-2001	33	0.002	0.006	0.013	*Oligotrophic*	0	No
Friends Lake	1991-2009	102	0.001	0.010	0.034	*Mesotrophic*	7	No
Friends Lake	2009	8	0.005	0.007	0.008	*Oligotrophic*	0	Lower
Fulton Second Lake	1986-2009	153	0.003	0.009	0.029	*Oligotrophic*	3	No
Fulton Second Lake	2009	8	0.005	0.009	0.017	*Oligotrophic*	0	No
Garnet Lake	1989-2001	35	0.000	0.009	0.025	*Oligotrophic*	3	No
Glen Lake	1986-2009	109	0.002	0.008	0.017	*Oligotrophic*	0	No
Glen Lake	2009	7	0.006	0.008	0.010	*Oligotrophic*	0	No
Goodnow Flow	1986-2009	110	0.002	0.011	0.020	*Mesotrophic*	0	No
Goodnow Flow	2009	7	0.003	0.011	0.018	*Mesotrophic*	0	No
Grass Lake	2004-2009	45	0.002	0.016	0.063	*Mesotrophic*	22	No
Grass Lake	2009	8	0.011	0.016	0.020	*Mesotrophic*	0	No
Gull Pond	1994-1998	34	0.003	0.006	0.030	*Oligotrophic*	3	No
Hadlock Pond	1997-2001	19	0.004	0.008	0.013	*Oligotrophic*	0	No
Horseshoe Pond	2000-2009	75	0.009	0.018	0.045	*Mesotrophic*	21	No
Horseshoe Pond	2009	8	0.017	0.020	0.027	*Eutrophic*	50	No
Hunt Lake	1994-2009	87	0.003	0.006	0.013	*Oligotrophic*	0	No
Hunt Lake	2009	8	0.005	0.005	0.007	*Oligotrophic*	0	No

Lake Name	Years	Num	Min	Avg	Max	Trophic Category	%Violating TP Criteria	Change?
Hyde Lake	1999-2009	41	0.004	0.020	0.059	*Eutrophic*	41	No
Hyde Lake	2009	8	0.008	0.016	0.025	*Mesotrophic*	38	Lower
Indian Lake	1986-1997	52	0.006	0.013	0.020	*Mesotrophic*	0	No
Jenny Lake	1994-2007	59	0.001	0.007	0.015	*Oligotrophic*	0	No
Joe Indian Lake	1986-1990	54	0.012	0.024	0.050	*Eutrophic*	80	No
Kayuta Lake	1997-2001	33	0.000	0.010	0.021	*Oligotrophic*	3	No
Kellum Lake	1997-2001	34	0.005	0.009	0.028	*Oligotrophic*	3	No
Lake Bonaparte	1988-2009	97	0.000	0.008	0.016	*Oligotrophic*	0	No
Lake Bonaparte	2009	8	0.007	0.009	0.016	*Oligotrophic*	0	No
Lake Clear	1998-2009	89	0.002	0.008	0.024	*Oligotrophic*	1	No
Lake Clear	2009	8	0.006	0.010	0.014	*Oligotrophic*	0	No
Lake Colby	1999-2001	24	0.007	0.012	0.024	*Mesotrophic*	8	
Lake Forest	2001-2009	50	0.007	0.012	0.024	*Mesotrophic*	4	No
Lake Forest	2009	6	0.009	0.014	0.024	*Mesotrophic*	17	No
Lake George	2004-2009	48	0.002	0.006	0.023	*Oligotrophic*	4	No
Lake George	2009	8	0.005	0.006	0.007	*Oligotrophic*	0	No
Lake Kiwassa	1990-1995	40	0.005	0.007	0.012	*Oligotrophic*	0	No
Lake Luzerne	1999-2004	42	0.005	0.009	0.019	*Oligotrophic*	0	No
Lake of the Isles	2000-2001	16	0.010	0.016	0.035	*Mesotrophic*	13	
Lake of the Woods	1994-2008	58	0.001	0.006	0.011	*Oligotrophic*	0	No
Lake Placid	1991-2009	111	0.000	0.004	0.014	*Oligotrophic*	0	No
Lake Placid	2009	4	0.000	0.002	0.004	*Oligotrophic*	0	Lower
Lake Titus	1999-2001	20	0.008	0.014	0.022	*Mesotrophic*	10	
Lincoln Pond	1997-2009	58	0.003	0.009	0.024	*Oligotrophic*	2	No
Lincoln Pond	2009	5	0.005	0.006	0.006	*Oligotrophic*	0	Lower
Little Wolf Lake	1998-2000	13	0.006	0.010	0.017	*Oligotrophic*	0	
Loon Lake	1986-1997	45	0.003	0.010	0.023	*Oligotrophic*	4	No
Lorton Lake	1990-2009	118	0.002	0.018	0.064	*Mesotrophic*	26	No
Lorton Lake	2009	8	0.006	0.015	0.026	*Mesotrophic*	13	No
Lower Chateaugay Lake	1991-1995	34	0.006	0.017	0.033	*Mesotrophic*	24	No
Lower St. Regis Lake	2000-2002	16	0.009	0.015	0.041	*Mesotrophic*	13	
Mayfield Lake	2000-2004	28	0.003	0.014	0.025	*Mesotrophic*	11	No
Millsite Lake	1997-2009	96	0.002	0.008	0.020	*Oligotrophic*	0	No
Millsite Lake	2009	8	0.002	0.010	0.020	*Mesotrophic*	0	Higher
Mirror Lake	1998-2009	66	0.002	0.007	0.016	*Oligotrophic*	0	No
Mirror Lake	2009	7	0.006	0.009	0.013	*Oligotrophic*	0	Higher
Moon Lake	1992-1996	38	0.013	0.027	0.041	*Eutrophic*	95	No
Moreau Lake	1994-2002	59	0.002	0.006	0.011	*Oligotrophic*	0	No
Mountain Lake	1998-2001	25	0.005	0.009	0.013	*Oligotrophic*	0	
Mountain View Lake	1991-1997	37	0.011	0.017	0.027	*Mesotrophic*	19	No
North Sandy Pond	1986-1990	52	0.013	0.040	0.130	*Eutrophic*	94	No
Otter Lake	1992-2009	98	0.004	0.012	0.031	*Mesotrophic*	9	No
Otter Lake	2009	8	0.010	0.013	0.017	*Mesotrophic*	0	No
Paradox Lake	2003-2009	56	0.004	0.009	0.023	*Oligotrophic*	4	No
Paradox Lake	2009	8	0.005	0.012	0.022	*Mesotrophic*	13	Higher
Peck Lake	1992-2009	42	0.003	0.006	0.011	*Oligotrophic*	0	No
Peck Lake	2009	8	0.004	0.007	0.011	*Oligotrophic*	0	No
Piseco Lake	1999-2003	37	0.003	0.007	0.037	*Oligotrophic*	3	No
Pleasant Lake	2000-2009	62	0.003	0.007	0.057	*Oligotrophic*	2	No
Pleasant Lake	2009	2	0.008	0.008	0.008	*Oligotrophic*	0	No
Rondaxe Lake	1998-2001	27	0.003	0.006	0.014	*Oligotrophic*	0	
Sacandaga Lake	1987-2009	91	0.001	0.006	0.019	*Oligotrophic*	0	No
Sacandaga Lake	2009	8	0.005	0.006	0.008	*Oligotrophic*	0	No
Schroon Lake	1987-2009	107	0.001	0.008	0.038	*Oligotrophic*	6	Increasing
Schroon Lake	2009	8	0.006	0.012	0.024	*Mesotrophic*	25	Higher

Lake Name	Years	Num	Min	Avg	Max	Trophic Category	%Violating TP Criteria	Change?
Silver Lake-Clinton Co	1989-1993	24	0.002	0.006	0.013	*Oligotrophic*	0	No
Silver Lake- St. Law Co	1996-2009	79	0.005	0.011	0.025	*Mesotrophic*	5	No
Silver Lake- St.L Co	2009	8	0.009	0.012	0.019	*Mesotrophic*	0	No
Sixberry Lake	2001-2004	30	0.001	0.005	0.009	*Oligotrophic*	0	
Spitfire Lake	1996-2002	39	0.006	0.011	0.029	*Mesotrophic*	3	No
Star Lake	1994-1998	32	0.002	0.005	0.010	*Oligotrophic*	0	No
Stewarts Landing	1997-2001	36	0.000	0.008	0.014	*Oligotrophic*	0	No
Twitchell Lake	1986-1996	36	0.004	0.008	0.014	*Oligotrophic*	0	No
Upper Chateaugay Lake	1990-1994	31	0.006	0.009	0.018	*Oligotrophic*	0	No
Upper Saranac Lake	2006-2009	27	0.008	0.015	0.029	*Mesotrophic*	7	
Upper Saranac Lake	2009	8	0.008	0.012	0.026	*Mesotrophic*	13	No
Upper St. Regis Lake	1997-2002	41	0.005	0.010	0.019	*Mesotrophic*	0	No
West Caroga Lake	1997-2007	27	0.002	0.008	0.024	*Oligotrophic*	7	No
Windover Lake	1999-2003	38	0.007	0.015	0.030	*Mesotrophic*	8	No

Num = number of samples
Min, Avg, Max = minimum, average, and maximum total phosphorus readings, in mg/l
% Violating TP Criteria = % of samples at each lake with TP > 0.020 mg/l, corresponding to the existing NYS TP guidance value
Change? = exhibiting significant change in TP readings (best fit line of annual means with $R^2 > 0.5$ and seasonal Kendall-Tau rank correlation coefficient > 0.5); 2009 change based on TP readings >25% higher or lower than normal

The only lake in this region exhibiting long-term change is Schroon Lake, in the southeastern corner of the Adirondack Park. Phosphorus readings from 2005 to 2008 were higher (average readings 0.007-0.014 mg/l) than in the period from 1987 through 2004 (average readings 0.005-0.006 mg/l). This trend continued into 2009, as noted below. None of the other lakes within the Adirondack region has exhibited significant long-term trends.

Tables 3.1.3a and 3.1.3b summarize the surface total phosphorus data collected through CSLAP in 2009, and compare these data to the data collected for each program lake in the region prior to 2009. Total phosphorus readings in the CSLAP lakes in the Adirondack region in 2009 were similar to those reported in previous years, whether evaluated by average TP reading or percent frequency of exceeding the state guidance value (10% in 2009 and 10% from 1986 to 2008). The percentage of lakes with higher than normal total phosphorus readings in 2009 was similar to the percentage of lakes with lower than normal readings, although a slightly higher percentage of lakes established new minimum readings than established new maximum readings in 2009. These data also suggest that, on a region-wide basis, total phosphorus readings in 2009 were comparable to those measured in previous CSLAP sampling seasons.

Table 3.1.3a: Surface Total Phosphorus Summary in CSLAP Lakes, 2009

	Number Lakes	Minimum	Average 2009	Average 1986-08	Maximum	Typical	%Violating TP Criteria
Downstate	32	0.004	0.037	0.043	0.344	*Eutrophic*	63
Central	36	0.001	0.016	0.018	0.050	*Mesotrophic*	24
Adirondacks	33	<0.001	0.011	0.011	0.047	*Mesotrophic*	10
Western	9	0.002	0.045	0.032	0.159	*Eutrophic*	73
CSLAP Statewide	**110**	**<0.001**	**0.023**	**0.024**	**0.344**	***Eutrophic***	**35**

Table 3.1.3b: Surface Total Phosphorus Summary in CSLAP Lakes, 2009

	Number Lakes	Average 2009	Average 1986-08	%Higher	%Lower	%Above Max	%Below Min
Downstate	32	0.037	0.043	22	13	25	16
Central	36	0.016	0.018	8	5	5	5
Adirondacks	33	0.011	0.011	13	16	9	16
Western	9	0.045	0.032	11	11	11	0
CSLAP Statewide	**110**	**0.023**	**0.024**	**14**	**11**	**11**	**11**

% Higher = percentage of lakes in region with TP readings in 2009 >25% higher than normal (before 2009)
% Lower = percentage of lakes in region with TP readings in 2009 <25% below normal (before 2009)
% Above Max = percentage of lakes in region with TP readings in 2009 above previous maximum (before 2009) for lake
% Below Min = percentage of lakes in region with TP readings in 2009 below previous minimum (before 2009) for lake

Adirondack Region Lakes With Higher Than Normal TP in 2009:
Millsite Lake, Mirror Lake, Paradox Lake, Schroon Lake

Discussion:

Four Adirondack-region lakes exhibited higher than normal phosphorus readings in 2009. Phosphorus readings in Mirror Lake have been higher than normal in the last three years, although this has not translated into higher than normal algae levels (as measured by chlorophyll *a*) or lower than normal water transparency readings. TP levels in Millsite Lake were similar in 2009 and 2002-2004; in all four years, annual averages were affected by single elevated TP readings that generally did not appear to be representative of normal conditions in the lake at that time, based on chlorophyll *a* and water clarity readings. Neither of these lakes has exhibited any long-term changes in total phosphorus. Therefore, it is likely that the higher readings in 2009 represent normal variability.

The higher TP readings in Paradox Lake in 2009 were associated with consistently higher water color and occurred at the beginning of the sampling season, at a time of wetter than normal weather conditions in much of the state. It is not known if this triggered the rise in phosphorus, particularly since this was not seen in most other NYS lakes also subject to wetter weather. As discussed earlier, phosphorus readings in nearby Schroon Lake have been consistently higher than normal since 2005. In all but 2008 (when phosphorus readings were closer to normal), the higher phosphorus readings have been associated with higher water color and lower water clarity, but no significant change in chlorophyll *a* readings. This suggests that the change in these indicators may be related to some common factor, such as heavier runoff from local rainstorms. Heavy rainfall and higher water level was reported in each of these years, particularly early in the sampling season. Although heavy rainfall was also reported in 2008, neither high water level nor intense rains were reported early in the summer.

Phosphorus readings in these two lakes should continue to be evaluated.

Adirondack Region Lakes With Lower Than Normal TP in 2009:
Friends Lake, Hyde Lake, Lake Placid, Lincoln Pond

Discussion:

Phosphorus readings in Lake Placid were slightly lower than normal in 2009, but well within the normal range and the difference between the long-term average and the 2009 readings may have been within the "rounding error" associated with environmental sampling and analysis. The readings in Friends Lake were also lower than normal in 2009, but close to the typical readings from the lake in the period from 1991 to 2002 and in 2008. TP readings from 2003 to 2007 were inexplicably higher than normal in Friends Lake, despite the lack of change in water clarity or algae levels over this period, and the 2008 and 2009 readings appear to indicate a return to normal conditions.

Hyde Lake exhibited similar total phosphorus readings in 2009, 2003 and 2001, and it is likely that readings in most years have represented normal variability in the lake. Phosphorus readings in Lincoln Pond in 2009 were, on average, lower than in any of the previous seven CSLAP sampling seasons, but chlorophyll *a* readings in 2009 were similar to those reported in previous years.

It is likely that the lower phosphorus readings in each of the four lakes listed above represent normal variability rather than a part of a longer-term trend.

Deepwater Total Phosphorus

Table 3.1.4 shows the number of samples, and minimum, average and maximum reading deepwater (*hypolimnetic*) phosphorus reading. These readings were generally collected from a depth of 1-2 meters from the lake bottom in thermally stratified lakes. This table also compares the average surface and hypolimnetic phosphorus reading in each thermally stratified lake in this region. The most significant difference between surface and hypolimnetic readings was recorded at Butterfield Lake, Grass Lake, Paradox Lake and Spitfire Lake. Butterfield, Grass and Spitfire are the only CSLAP *mesotrophic* lakes in the region that are deep enough to be thermally stratified throughout the summer. It is likely that the deepwater results from Paradox Lake are not representative of the lake. The other lakes in the region have similar surface and bottom phosphorus readings, suggesting the lack of anoxic (oxygen depleted) conditions in the lake bottom.

Table 3.1.4: Bottom Total Phosphorus Summary in CSLAP Adirondack Region Lakes, 1986-2009

Lake Name	Years	Num	Min	Avg	Avg Surface TP	Max
Augur Lake	1998-2009	19	0.012	0.023	0.016	0.092
Augur Lake	2009	8	0.018	0.031	0.016	0.092
Bartlett Pond	1998-1998	3	0.008	0.009	0.010	0.010
Brant Lake	2002-2002	6	0.004	0.005	0.006	0.007
Brantingham Lake	2002-2009	46	0.003	0.021	0.009	0.068
Brantingham Lake	2009	7	0.003	0.011	0.007	0.016
Butterfield Lake	1993-2009	46	0.011	0.084	0.017	0.782
Butterfield Lake	2009	8	0.011	0.250	0.017	0.782
Canada Lake	2002-2009	41	0.001	0.006	0.007	0.013
Canada Lake	2009	8	0.001	0.005	0.007	0.013
Chase Lake	1993-1994	8	0.008	0.016	0.010	0.033
Eagle Crag Lake	1986-2002	16	0.005	0.011	0.007	0.016
Eagle Lake	2002-2009	47	0.002	0.006	0.006	0.013
Eagle Lake	2009	8	0.004	0.006	0.006	0.008
East Caroga Lake	1993-2009	51	0.000	0.008	0.009	0.023
East Caroga Lake	2009	6	0.002	0.008	0.007	0.015
Effley Falls Lake	1998-1999	5	0.005	0.005	0.007	0.007

Lake Name	Years	Num	Min	Avg	Avg Surface TP	Max
Efner Lake	1998-1999	5	0.010	0.020	0.006	0.025
Friends Lake	1993-2009	48	0.005	0.011	0.010	0.028
Friends Lake	2009	8	0.005	0.009	0.007	0.014
Fulton Second Lake	1998-2009	32	0.004	0.011	0.009	0.079
Fulton Second Lake	2009	8	0.007	0.010	0.009	0.021
Glen Lake	1998-2009	38	0.006	0.036	0.008	0.145
Glen Lake	2009	7	0.016	0.042	0.008	0.145
Grass Lake	2005-2009	32	0.000	0.092	0.016	0.328
Grass Lake	2009	8	0.059	0.116	0.016	0.203
Gull Pond	1998-1998	2	0.010	0.013	0.006	0.015
Hadlock Pond	1998-1999	5	0.011	0.022	0.008	0.043
Horseshoe Pond	2005-2005	8	0.013	0.019	0.018	0.025
Hunt Lake	1998-2009	49	0.001	0.010	0.006	0.029
Hunt Lake	2009	8	0.007	0.008	0.005	0.011
Hyde Lake	2009-2009	7	0.018	0.033	0.020	0.049
Hyde Lake	2009	7	0.018	0.033	0.016	0.049
Jenny Lake	1995-2007	20	0.001	0.009	0.007	0.056
Kayuta Lake	1998-1998	1	0.013	0.013	0.010	0.013
Kellum Lake	1998-1999	4	0.006	0.014	0.009	0.025
Lake Bonaparte	1998-2009	24	0.000	0.084	0.008	1.568
Lake Bonaparte	2009	8	0.000	0.011	0.009	0.018
Lake Clear	2002-2009	46	0.002	0.026	0.008	0.112
Lake Clear	2009	7	0.004	0.028	0.010	0.049
Lake George	2005-2009	40	0.002	0.007	0.006	0.013
Lake George	2009	8	0.003	0.007	0.006	0.010
Lake Kiwassa	1993-1994	8	0.009	0.013	0.007	0.016
Lake Luzerne	2002-2002	8	0.005	0.009	0.009	0.025
Lake of the Woods	2002-2008	20	0.002	0.012	0.006	0.020
Lake Placid	1993-2009	42	0.001	0.005	0.004	0.032
Lake Placid	2009	4	0.005	0.007	0.002	0.009
Lincoln Pond	1999-2009	15	0.005	0.009	0.009	0.016
Lincoln Pond	2009	5	0.005	0.007	0.006	0.009
Lower St. Regis Lake	2002-2002	2	0.003	0.018	0.015	0.033
Millsite Lake	1998-2009	50	0.005	0.032	0.008	0.094
Millsite Lake	2009	8	0.005	0.030	0.010	0.054
Mirror Lake	2005-2009	39	0.004	0.010	0.007	0.048
Mirror Lake	2009	7	0.005	0.010	0.009	0.017
Paradox Lake	2005-2009	40	0.000	0.085	0.009	1.736
Paradox Lake	2009	8	0.000	0.007	0.012	0.012
Peck Lake	1993-1994	7	0.007	0.014	0.006	0.023
Piseco Lake	2002-2002	7	0.005	0.005	0.007	0.007
Pleasant Lake	2005-2009	24	0.005	0.011	0.007	0.017
Pleasant Lake	2009	2	0.008	0.008	0.008	0.009
Rondaxe Lake	1999-1999	3	0.013	0.013	0.006	0.013
Sacandaga Lake	1998-2009	9	0.005	0.008	0.006	0.013
Sacandaga Lake	2009	8	0.005	0.008	0.006	0.013
Schroon Lake	2002-2008	30	0.000	0.008	0.008	0.059
Sixberry Lake	2002-2002	8	0.005	0.009	0.005	0.012
Spitfire Lake	1998-2002	9	0.009	0.064	0.011	0.267
Star Lake	1998-1998	1	0.005	0.005	0.005	0.005
Upper Saranac Lake	2006-2007	18	0.011	0.028	0.015	0.093
Upper St. Regis Lake	1998-2002	11	0.007	0.012	0.010	0.019
West Caroga Lake	1998-2007	8	0.006	0.011	0.008	0.021

Num = number of hypolimnetic phosphorus samples
Min, Avg, Max = minimum, average, and maximum hypolimnetic total phosphorus readings, in mg/l
Avg Surface TP = average surface total phosphorus readings, 1986-2009, in mg/l

Chlorophyll *a* Fact Sheet

Description:	Chlorophyll is the photosynthetic pigment found in green plants, and chlorophyll *a* is the primary pigment found in freshwater algae. It constitutes 0.1-3.4% of the phytoplankton (algal) biomass and is a measure of primary productivity. The chlorophyll *a* analysis is much less time consuming than counting algal cells under a microscope, the most accurate measure of planktonic phytoplankton biomass in a lake.
Importance:	chlorophyll *a* is a measure of primary planktonic lake productivity and is closely related to both phosphorus and water transparency. Therefore, it is both a response variable to changes in phosphorus and a stressor to changes in water transparency. This makes it a critical trophic indicator and a representation of the building blocks for the entire ecological community in lakes. Since it measures only planktonic algae, however, it is not a good indicator of floating algae scums, benthic (bottom dwelling) algae, or epiphytes (algae growing on plants).
How Measured: in CSLAP	chlorophyll *a* is analyzed from the surface (1.5 meter grab) sample collected with the use of a Kemmerer bottle and transferred to a collapsible container. 100ml are filtered through a 0.45 μ, 47 mm diameter mixed ester filter, placed in a labeled glass vial, and wrapped in aluminum foil. Once received by the laboratory, a chloroform-methanol extractant is added in anticipation of centrifugation and analysis with a spectrophotometer.
Range in CSLAP:	undetectable (< 0.01 μg/l) to 1020 μg/l; 88% of readings fall between 1 μg/l and 50 μg/l.
WQ Standards:	there are no water quality standards or guidance values for chlorophyll *a* in New York State. Guidance values will probably be implemented as part of the nutrient criteria development process; these values will probably reflect differences in both regional water quality characteristics and lake uses.
Trophic Assessment:	New York State's trophic assessments differ slightly from the standard Carlson assessment criteria. Chlorophyll *a* readings exceeded 8 μg/l in NYS and 6.4 μg/l using the Carlson indices, are considered *eutrophic*, or highly productive. Readings below 2 μg/l in New York State, and 2.6 μg/l using the Carlson indices, are considered *oligotrophic*, or highly unproductive. Lakes in the intermediate range are considered *mesotrophic.* The differences between the New York State and Carlson criteria are discussed in Chapter 3.4.

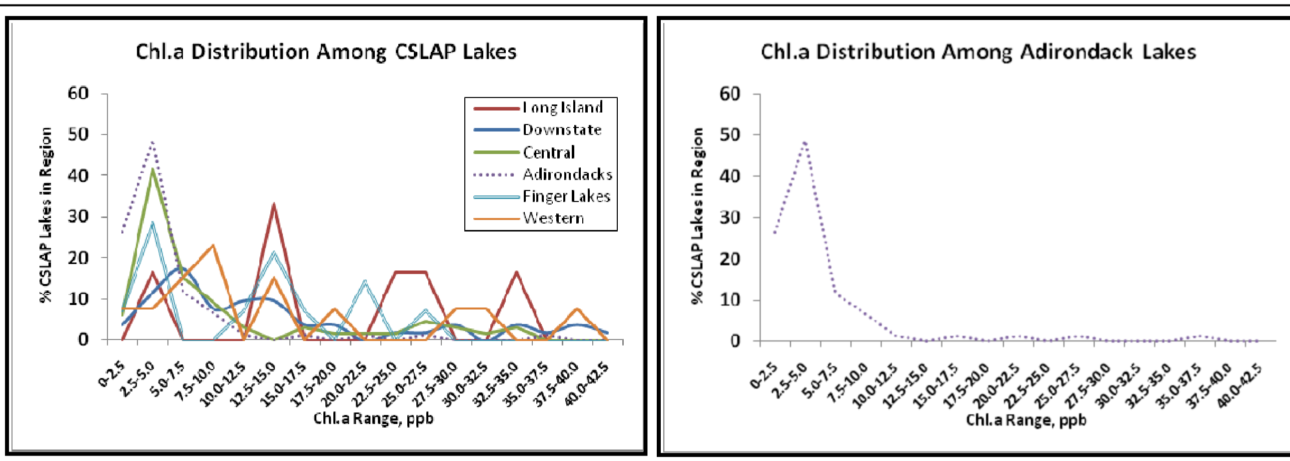
Chapter 3.2- Evaluation of Adirondack Region Chlorophyll *a*: 1986-2009

Summary of CSLAP Chlorophyll a Findings in Adirondack Region Lakes, 1986-2009

1. CSLAP lakes within the Adirondack region have lower chlorophyll *a* readings than those in other parts of the state, with the majority of lakes having typical chlorophyll *a* levels between 2.5 and 5 µg/l, corresponding to *mesoligotrophic* conditions.
2. CSLAP lakes within the Adirondack region have slightly lower chlorophyll *a* readings than non-CSLAP lakes in the same region, although CSLAP and non-CSLAP lakes in the same depth and size are probably comparable.
3. CSLAP lakes within the Adirondack region are more likely to have lower algae levels readings in drier years. No clear difference is apparent in wetter years.
4. No long-term trends in chlorophyll *a* readings have been apparent in CSLAP lakes within the Adirondack region.
5. More Adirondack region lakes exhibited lower algae levels in 2009 than exhibited higher algae levels, although the majority of lakes in the region exhibited chlorophyll *a* readings in 2009 that were close to normal. No clear sub-regional or morphometric patterns were apparent in this trend, although some of the lakes exhibiting changes in phosphorus readings exhibited like changes in chlorophyll *a* readings.
6. Chlorophyll *a* readings are highest within the northwest portion of the Adirondack region lakes, particularly outside the Adirondack Park boundary (blue line). These are the only *eutrophic* lakes within this region, at least as defined by chlorophyll *a* readings.

Adirondack Region Data Compared to NYS Data

CSLAP lakes in the Adirondack region are slightly less productive than in any other region of the state, as measured by lower chlorophyll *a* readings and as demonstrated in Figure 3.2.1., due to a higher percentage of readings in the lowest chlorophyll *a* ranges. The most common range of chlorophyll *a* readings in CSLAP Adirondack region lakes is in the 2.5-5 ppb range, with decreasing frequency as chlorophyll *a* readings decrease, although a large percentage of lakes are also in the 0-2.5 ppb range (corresponding to *oligotrophic* conditions). Very few Adirondack region lakes have chlorophyll *a* readings above 12 ppb, as seen in Figure 3.2.2.



Figures 3.2.1 and 3.2.2: Distribution of Chlorophyll *a* Ranges in CSLAP and Adirondack Region Lakes

Comparison of CSLAP to NYS Lakes in the Adirondack Region

There are slightly more Adirondack region lakes with chlorophyll *a* readings in the 2.5-5 ppb range in CSLAP than was found in other New York state monitoring programs, as seen in Figure 3.2.3. As discussed in the phosphorus section, the majority of the lake water quality data outside of CSLAP comes from the ALSC study of more than 1500 mostly small, high elevation lakes within the Adirondacks, Catskills and nearby regions. However, the ALSC dataset does not include chlorophyll *a* data, and most of the other state monitoring programs have not sampled the majority of the lakes in the Adirondack region (in part due to the extensive reach of the ALSC sampling program for most lake water quality indicators). The Adirondack region lakes sampled in the non-CSLAP monitoring programs in New York State appear to exhibit water quality conditions comparable to those lakes sampled through CSLAP. The slightly lower algae levels in CSLAP lakes probably reflect the slightly larger and deeper lakes sampled through CSLAP.

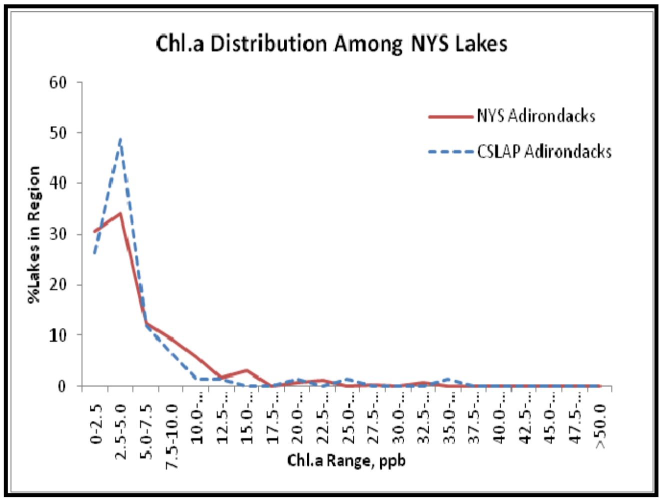


Figure 3.2.3: Average Distribution of Chlorophyll *a* Readings in New York State and CSLAP Lakes in the Adirondack Region

Annual Variability:

Chlorophyll *a* has varied annually in Adirondack lakes, although less so than in most other regions of the state. The highest chlorophyll *a* readings measured through CSLAP occurred during 1987, 1991, 1996, 1990, and 1992. These generally did not occur in wet or dry years. The lowest chlorophyll *a* readings occurred in 1986, 2002, 2005, 2007, and 2004; some of these occurred in drier than normal years. Table 3.2.1 looks at the percentage of CSLAP lakes with high chlorophyll *a* (greater than 1 standard error above normal) and low chlorophyll *a* (greater than 1 standard error below normal) readings in wet and dry years. These data show that lower chlorophyll *a* readings occur in drier years, and chlorophyll readings do not change significantly in wet years.

Table 3.2.1- % of CSLAP Lakes with Higher or Lower (than Normal) Chlorophyll *a* Readings During Dry and Wet Years in the Adirondack Region

	Dry Yea	Wet Yea
Higher Chlorophyll *a*	14%	23%
Lower Chlorophyll *a*	28%	22%

Dry Years: 1988, 1995, 2004, 2005
Wet Years: 1990, 1998, 2000, 2002, 2008
"Higher" and "Lower" defined as >1 SE higher than and lower than normal, respectively

Long Term Trends:

The evaluation of long-term trends since 1986 in the Adirondack region lakes is adversely affected by the small number of lakes sampled during some sampling seasons, particularly in the earliest years of CSLAP (from 1986 to 1990). The frequency of higher chlorophyll *a* readings has decreased, although these trends appear to be statistically weak, as with the statewide database. These trends are essentially non-existent when the elevated chlorophyll readings from 1987 are removed from the database, since these 1987 chlorophyll data may be erroneously high. These figures also show that the frequency of lower chlorophyll *a* levels has increased over the last 25 years, although this trend is also not statistically strong.

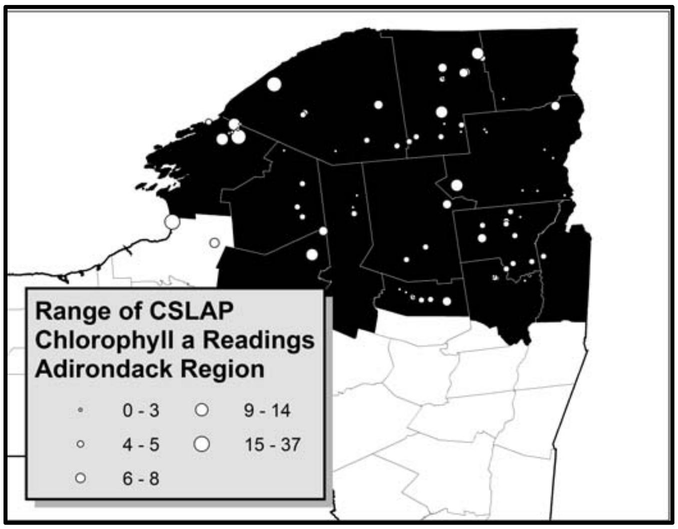


Figure 3.2.4: Range of Chlorophyll Readings in the Adirondack Region

Regional Distribution:

Chlorophyll *a* readings with the Adirondack region are highest in the northwestern lakes, although most of the highest readings are in the lakes outside the Adirondack Blue Line, particularly those in the Indian River Lakes area in northeastern Jefferson and southwestern St. Lawrence counties. Many of these lakes can be classified as *eutrophic*, or highly productive. Lower chlorophyll *a* readings were found throughout the Adirondack Park, as seen in Figure 3.2.4. The lowest readings in this region were found in the deeper lakes within the Adirondack Park, and these lakes can be classified as *oligotrophic* to *mesoligotrophic*, or highly to moderately unproductive. The trophic assessments of these lakes are discussed in the Trophic State Indicators section later in this report.

Table 3.2.2 shows the number of phosphorus samples, the minimum, average, and maximum chlorophyll *a* readings, the most common trophic assessment for the lake, the last year in which the lake was sampled through CSLAP, and whether phosphorus readings have changed since CSLAP sampling began in the lake. This long-term assessment was limited to lakes sampled for at least five years through 2009.

Table 3.2.2: Surface Chlorophyll *a* Summary in CSLAP Adirondack Region Lakes, 1986-2009

Lake Name	Years	Num	Min	Avg	Max	Trophic Category	Change?
Adirondack Lake	1986-1989	34	0.3	5.7	18.9	*Mesotrophic*	
Augur Lake	1997-2009	85	0.4	7.6	35.2	*Mesotrophic*	No
Augur Lake	2009	8	1.5	7.1	12.2	*Mesotrophic*	No
Bartlett Pond	1997-2000	25	0.8	2.5	5.9	*Mesotrophic*	
Black Lake	1988-2009	158	0.1	26.0	91.4	*Eutrophic*	No
Black Lake	2009	8	0.8	10.8	26.2	*Eutrophic*	Lower

Lake Name	Years	Num	Min	Avg	Max	Trophic Category	Change?
Brant Lake	1987-2003	76	0.2	2.2	7.1	*Mesotrophic*	No
Brantingham Lake	2001-2009	68	0.4	3.6	13.8	*Mesotrophic*	No
Brantingham Lake	2009	7	2.8	4.6	6.5	*Mesotrophic*	No
Butterfield Lake	1986-2009	174	0.1	11.1	48.8	*Eutrophic*	No
Butterfield Lake	2009	8	1.7	7.3	12.0	*Mesotrophic*	Lower
Canada Lake	2001-2009	68	0.3	1.5	4.5	*Oligotrophic*	No
Canada Lake	2009	8	1.3	2.6	4.5	*Mesotrophic*	Higher
Chase Lake	1990-1997	40	1.0	3.5	23.2	*Mesotrophic*	No
Eagle Crag Lake	1986-2005	103	0.1	2.9	12.5	*Mesotrophic*	No
Eagle Lake	2000-2009	72	0.1	1.0	8.2	*Oligotrophic*	No
Eagle Lake	2009	9	0.4	0.9	2.0	*Oligotrophic*	No
Eagle Pond	2008-2009	15	0.4	1.9	5.9	*Oligotrophic*	
Eagle Pond	2009	8	0.4	2.3	5.9	*Mesotrophic*	
East Caroga Lake	1990-2009	108	0.4	3.9	44.4	*Mesotrophic*	No
East Caroga Lake	2009	6	0.9	3.6	9.1	*Mesotrophic*	No
Effley Falls Lake	1997-2009	83	0.1	3.6	23.2	*Mesotrophic*	No
Effley Falls Lake	2009	8	1.3	2.9	6.1	*Mesotrophic*	No
Efner Lake	1997-2001	38	0.4	1.9	5.5	*Oligotrophic*	No
Friends Lake	1991-2009	99	0.2	3.5	32.6	*Mesotrophic*	No
Friends Lake	2009	8	1.4	2.5	4.2	*Mesotrophic*	Lower
Fulton Second Lake	1986-2009	155	0.5	3.8	19.0	*Mesotrophic*	No
Fulton Second Lake	2009	8	2.1	3.2	4.5	*Mesotrophic*	No
Garnet Lake	1989-2001	34	1.0	5.7	20.4	*Mesotrophic*	No
Glen Lake	1986-2009	108	0.1	3.2	43.3	*Mesotrophic*	No
Glen Lake	2009	7	0.2	2.7	9.1	*Mesotrophic*	No
Goodnow Flow	1986-2009	108	1.6	8.3	29.6	*Eutrophic*	No
Goodnow Flow	2009	7	5.0	12.4	24.0	*Eutrophic*	Higher
Grass Lake	2004-2009	46	0.1	2.8	17.3	*Mesotrophic*	No
Grass Lake	2009	8	0.4	3.0	8.2	*Mesotrophic*	No
Gull Pond	1994-1998	40	0.5	2.9	27.3	*Mesotrophic*	No
Hadlock Pond	1997-2001	18	1.2	4.0	23.6	*Mesotrophic*	No
Horseshoe Pond	2000-2009	74	0.3	3.6	13.0	*Mesotrophic*	No
Horseshoe Pond	2009	8	1.7	5.1	10.6	*Mesotrophic*	Higher
Hunt Lake	1994-2009	92	0.8	4.2	21.1	*Mesotrophic*	No
Hunt Lake	2009	8	1.8	2.6	4.1	*Mesotrophic*	Lower
Hyde Lake	1999-2009	41	0.4	14.2	57.4	*Eutrophic*	No
Hyde Lake	2009	8	3.6	10.8	23.9	*Eutrophic*	Lower
Indian Lake	1986-1997	48	0.1	5.0	16.0	*Mesotrophic*	No
Jenny Lake	1994-2007	64	0.2	4.0	22.9	*Mesotrophic*	No
Joe Indian Lake	1986-1990	48	0.2	5.4	16.8	*Mesotrophic*	No
Kayuta Lake	1997-2001	39	1.5	8.9	29.4	*Eutrophic*	No
Kellum Lake	1997-2001	35	0.6	4.1	20.6	*Mesotrophic*	No
Lake Bonaparte	1988-2009	99	0.6	2.2	5.2	*Mesotrophic*	No
Lake Bonaparte	2009	8	0.9	2.8	4.9	*Mesotrophic*	Higher
Lake Clear	1998-2009	92	0.4	2.8	6.7	*Mesotrophic*	No
Lake Clear	2009	8	1.4	2.9	5.6	*Mesotrophic*	No
Lake Colby	1999-2001	17	0.3	3.8	15.3	*Mesotrophic*	
Lake Forest	2001-2009	53	0.7	4.1	10.2	*Mesotrophic*	No
Lake Forest	2009	6	1.8	5.3	7.4	*Mesotrophic*	Higher
Lake George	2004-2009	44	0.2	0.9	2.6	*Oligotrophic*	No
Lake George	2009	8	0.6	0.8	1.3	*Oligotrophic*	No
Lake Kiwassa	1990-1995	40	0.4	2.6	6.2	*Mesotrophic*	No
Lake Luzerne	1999-2004	38	1.0	3.1	13.2	*Mesotrophic*	No
Lake of the Isles	2000-2001	16	1.1	3.6	5.3	*Mesotrophic*	
Lake of the Woods	1994-2008	54	0.2	1.4	4.1	*Oligotrophic*	No

Lake Name	Years	Num	Min	Avg	Max	Trophic Category	Change?
Lake Placid	1991-2009	112	0.1	1.8	7.5	*Oligotrophic*	No
Lake Placid	2009	4	1.2	1.6	2.5	*Oligotrophic*	No
Lake Titus	1999-2001	19	2.6	7.4	17.1	*Mesotrophic*	
Lincoln Pond	1997-2009	60	0.2	2.1	7.8	*Mesotrophic*	No
Lincoln Pond	2009	5	1.0	1.3	1.6	*Oligotrophic*	Lower
Little Wolf Lake	1998-2000	18	0.9	4.2	11.3	*Mesotrophic*	
Loon Lake	1986-1997	44	0.4	4.4	12.7	*Mesotrophic*	No
Lorton Lake	1990-2009	119	0.3	6.3	80.6	*Mesotrophic*	No
Lorton Lake	2009	8	1.5	2.4	4.6	*Mesotrophic*	Lower
Lower Chateaugay Lake	1991-1995	33	1.8	8.9	24.8	*Eutrophic*	No
Lower St. Regis Lake	2000-2002	14	2.3	8.6	23.9	*Eutrophic*	
Mayfield Lake	2000-2004	27	0.4	5.5	18.7	*Mesotrophic*	No
Millsite Lake	1997-2009	99	0.1	1.9	12.3	*Oligotrophic*	No
Millsite Lake	2009	8	0.6	1.8	3.3	*Oligotrophic*	No
Mirror Lake	1998-2009	69	0.1	1.3	4.9	*Oligotrophic*	No
Mirror Lake	2009	7	0.3	1.1	2.3	*Oligotrophic*	No
Moon Lake	1992-1996	38	3.5	21.1	62.8	*Eutrophic*	No
Moreau Lake	1994-2002	61	0.4	1.7	9.7	*Oligotrophic*	No
Mountain Lake	1998-2001	29	0.4	2.9	7.6	*Mesotrophic*	
Mountain View Lake	1991-1997	38	0.3	6.8	31.9	*Mesotrophic*	No
North Sandy Pond	1986-1990	45	1.7	37.1	134.0	*Eutrophic*	No
Otter Lake	1992-2009	90	0.1	5.6	25.7	*Mesotrophic*	No
Otter Lake	2009	8	0.1	1.9	4.8	*Oligotrophic*	Lower
Paradox Lake	2003-2009	55	0.1	2.3	8.9	*Mesotrophic*	No
Paradox Lake	2009	8	1.3	3.1	8.9	*Mesotrophic*	Higher
Peck Lake	1992-2009	46	0.1	4.2	17.7	*Mesotrophic*	No
Peck Lake	2009	8	1.1	4.2	11.8	*Mesotrophic*	No
Piseco Lake	1999-2003	31	1.5	3.3	7.1	*Mesotrophic*	No
Pleasant Lake	2000-2009	60	0.7	2.7	9.8	*Mesotrophic*	No
Pleasant Lake	2009	2	4.2	4.5	4.8	*Mesotrophic*	Higher
Rondaxe Lake	1998-2001	31	0.8	2.4	7.8	*Mesotrophic*	
Sacandaga Lake	1987-2009	92	0.5	4.2	13.7	*Mesotrophic*	No
Sacandaga Lake	2009	8	2.7	2.8	3.0	*Mesotrophic*	Lower
Schroon Lake	1987-2009	106	0.1	3.2	12.4	*Mesotrophic*	No
Schroon Lake	2009	7	0.1	2.9	12.4	*Mesotrophic*	No
Silver Lake-Clinton Co	1989-1993	25	0.8	2.2	3.9	*Mesotrophic*	No
Silver Lake- St. Law Co	1996-2009	84	0.1	3.8	10.6	*Mesotrophic*	No
Silver Lake- St.L Co	2009	7	0.6	1.0	1.5	*Oligotrophic*	Lower
Sixberry Lake	2001-2004	25	0.2	1.2	2.9	*Oligotrophic*	
Spitfire Lake	1996-2002	42	0.2	3.5	10.7	*Mesotrophic*	No
Star Lake	1994-1998	40	0.4	2.6	5.0	*Mesotrophic*	No
Stewarts Landing	1997-2001	40	0.2	2.4	12.5	*Mesotrophic*	No
Twitchell Lake	1986-1996	33	0.2	2.2	19.2	*Mesotrophic*	No
Upper Chateaugay Lake	1990-1994	31	1.0	3.2	8.2	*Mesotrophic*	No
Upper Saranac Lake	2006-2009	27	0.8	4.8	10.1	*Mesotrophic*	
Upper Saranac Lake	2009	8	2.4	5.6	7.7	*Mesotrophic*	
Upper St. Regis Lake	1997-2002	47	0.2	4.1	15.8	*Mesotrophic*	No
West Caroga Lake	1997-2007	28	0.0	1.8	4.2	*Oligotrophic*	No
Windover Lake	1999-2003	37	0.9	4.2	19.6	*Mesotrophic*	No

Num = number of samples
Min, Avg, Max = minimum, average, and maximum chlorophyll *a* readings, in ug/l
Change? = exhibiting significant change in chlorophyll *a* readings (best fit line of annual means with $R^2 > 0.5$ and seasonal Kendall-Tau rank correlation coefficient > 0.5); 2009 change based on chlorophyll *a* readings >25% higher or lower than normal

None of the lakes within the Adirondack region has exhibited significant long-term trends in chlorophyll *a* readings, including Schroon Lake (the only lake in the region with increasing phosphorus readings). The lack of long-term change is due in part to the lack of statistical change from year to year due to high variability in chlorophyll *a* readings in lake surface samples, owing to the patchy growth of algae within the water column and throughout the surface waters or lakes.

Tables 3.2.3a and 3.2.3b summarize the surface chlorophyll *a* data collected through CSLAP in 2009, and compare these data to the data collected for each program lake in the region prior to 2009. Chlorophyll *a* readings in the CSLAP lakes in the Adirondack region in 2009 were slightly lower than those reported in previous years. The percentage of lakes with lower than normal chlorophyll *a* readings in 2009 was slightly higher than the percentage of lakes with higher than normal readings, and a slightly higher percentage of lakes established new minimum readings rather than new maximum readings in 2009. This occurred despite phosphorus readings in the Adirondack region that were close to normal in 2009.

Table 3.2.3a: Surface Chlorophyll *a* Summary in CSLAP Lakes, 2009

	Number Lakes	Minimum	Average 2009	Average 1986-08	Maximum	Typical
Downstate	32	0.1	15.7	19.5	363	*Eutrophic*
Central	36	0.1	5.8	11.5	87.8	*Mesotrophic*
Adirondacks	33	0.1	3.9	4.9	26.2	*Mesotrophic*
Western	9	0.1	19.8	14.8	160	*Eutrophic*
CSLAP Statewide	**110**	**0.1**	**9.2**	**11.8**	**363**	***Eutrophic***

Table 3.2.3b: Surface Chlorophyll *a* Summary in CSLAP Lakes, 2009

	Number Lakes	Average 2009	Average 1986-08	%Higher	%Lower	%Above Max	%Below Min
Downstate	32	15.7	19.5	9	32	26	29
Central	36	5.8	11.5	6	64	6	18
Adirondacks	33	3.9	4.9	21	30	9	9
Western	9	19.8	14.8	33	44	22	33
CSLAP Statewide	**110**	**9.2**	**11.8**	**14**	**43**	**14**	**19**

% Higher = percentage of lakes in region with Chl.a readings in 2009 >25% higher than normal (before 2009)
% Lower = percentage of lakes in region with Chl.a readings in 2009 <25% below normal (before 2009)
% Above Max = percentage of lakes in region with Chl.a readings in 2009 above previous maximum (before 2009) for lake
% Below Min = percentage of lakes in region with Chl.a readings in 2009 below previous minimum (before 2009) for lake

Adirondack Region Lakes With Higher Than Normal Chlorophyll a in 2009:
Canada Lake, Goodnow Flow, Horseshoe Pond, Lake Bonaparte, Lake Forest, Paradox Lake, Pleasant Lake

Discussion:
Seven Adirondack-region lakes exhibited higher than normal chlorophyll *a* readings in 2009. Only one of these lakes—Paradox Lake—exhibited higher phosphorus readings in 2009, suggesting that the higher chlorophyll *a* readings in at least the other lakes does not represent a long-term trend. These six lakes constituted a mix of small (Horseshoe Pond and Lake Forest) and large (Lake Bonaparte and Paradox Lake) lakes, shallow (Goodnow Flow and Horseshoe Pond) and deep (Pleasant Lake and Lake Bonaparte) lakes, and those found in the northwestern

(Lake Bonaparte), southeastern (Lake Forest), southern (Canada Lake) and northeastern (Horseshoe Pond) areas of the region. This indicates that the higher chlorophyll *a* readings in 2009 did not fall into a clear pattern.

Chlorophyll *a* readings in Goodnow Flow, Lake Bonaparte and Lake Forest were consistently higher than normal in 2009, and the sampling volunteers' reported that wet weather was common, if not persistent. Algae levels in Canada Lake were higher than normal in the last three sampling sessions, also after heavy rains and a large rise in water level (> 1.5 feet). It is assumed that algae levels will return to normal when drier conditions return, particularly given the lack of increase in phosphorus readings over this period, although algae levels should be watched in these lakes.

The higher 2009 chlorophyll readings in Horseshoe Pond and Pleasant Lake shown in Table 3.2.2 were associated with either single elevated readings (increasing the average well above normal) or insufficient data to determine if these 2009 data were representative of normal (higher) conditions in the lake. It is unlikely that the higher readings in 2009 are part of a longer trend.

Adirondack Region Lakes With Lower Than Normal Chlorophyll a in 2009:
Black Lake, Butterfield Lake, Friends Lake, Hunt Lake, Hyde Lake, Lincoln Pond, Lorton Lake, Otter Lake, Sacandaga Lake, Silver Lake

Discussion:
Phosphorus readings in 2009 were lower than normal in 10 Adirondack region lakes, including three lakes (Friends Lake, Hyde Lake and Lincoln Pond) were lower than normal phosphorus readings. None of these 10 lakes has exhibited any long-term decrease in algae levels.

Black Lake exhibited much lower than normal chlorophyll *a* readings than normal in 2009, particularly after midsummer. This was coincident with reports of very heavy rains and high water level throughout the summer, and contrary to the usual summer increase in algae levels. Nearby Butterfield Lake and Hyde Lake demonstrated increasing chlorophyll readings during the summer, as in the typical CSLAP sampling season, but most readings were lower than normal throughout the year.

Chlorophyll *a* readings were lower than normal in Lorton Lake and Otter Lake in 2009 throughout the summer and did not exhibit any clear seasonal trend, consistent with the lack of a clear seasonal pattern during most sampling seasons. The sampling volunteers in Lorton Lake reported heavy rainfall and high water levels during the summer, particularly early in the sampling season.

Algae levels in Friends Lake and Lincoln Pond were only slightly lower than normal, consistent with the lower than normal phosphorus readings. Chlorophyll *a* readings in Hunt Lake, Sacandaga Lake and Silver Lake (St. Lawrence County) in 2009 were very stable, and the lower readings did not appear to be linked to changes in any other water quality indicators.

Water Clarity

Description:	a measure of the transparency of the water, as measured by the depth of disappearance of a 20cm black and white disk, using a method developed in the mid 1860s by Pietro Angelo Secchi and standardized through nearly all lake monitoring programs.
Importance:	in lakes with low color and rooted macrophyte ("weed") levels, water clarity is related to algal productivity and the greenness of water. Water clarity is closely related to public perception of lake conditions, and is a trigger for the development of lake restoration and protection plans. Water transparency also influences the depth of macrophyte growth, the depth of the thermocline (the zone separating the surface warm water and deeper cold waters), and in turn is influenced by dissolved organic matter (natural water color), and suspended inorganic turbidity, primarily sediment and silt.
How Measured: in CSLAP	Secchi disk transparency is computed as the average of the depth at which the Secchi disk disappears from sight from the lake surface and the depth at which the disk reappears, both measured to the nearest 0.1 meter. Samplers are instructed to take readings from the shady side of the boat (if available) and not to use viewscopes or polarized lenses.
Detection Limit:	limited only by size of disk. Larger disks are used in very (>20m) clear water—not needed in NYS.
Range in NYS:	0.1 meters to 16 meters; 93% of readings fall between 1 meter and 8 meters.
WQ Standards:	none in New York State, although numeric water clarity guidance values will likely be developed as part of the nutrient criteria development process. The state Department of Health requires 4 feet (=1.2 meters) of water clarity in three locations to site a new swimming beach, although this is not a DOH requirement for maintaining the beach.
Trophic Assessment:	New York State’s trophic assessments differ slightly from the standard Carlson assessment criteria. Water clarity readings less than 2 meters, both within NYS and using the Carlson indices, are considered *eutrophic*, or highly productive. Readings exceeding 5 meters in New York State, and 4 meters using the Carlson indices, are considered *oligotrophic*, or highly unproductive. Lakes in the intermediate range are considered *mesotrophic*. The differences between the New York State and Carlson criteria are discussed in Chapter 3.4
Nomenclature:	The terms *water clarity* and *water transparency* (or *Secchi disk transparency*) are used interchangeably throughout this report.

Chapter 3.3- Evaluation of Adirondack Region Water Clarity: 1986-2009

Summary of CSLAP Water Clarity Findings in Adirondack Region Lakes, 1986-2009

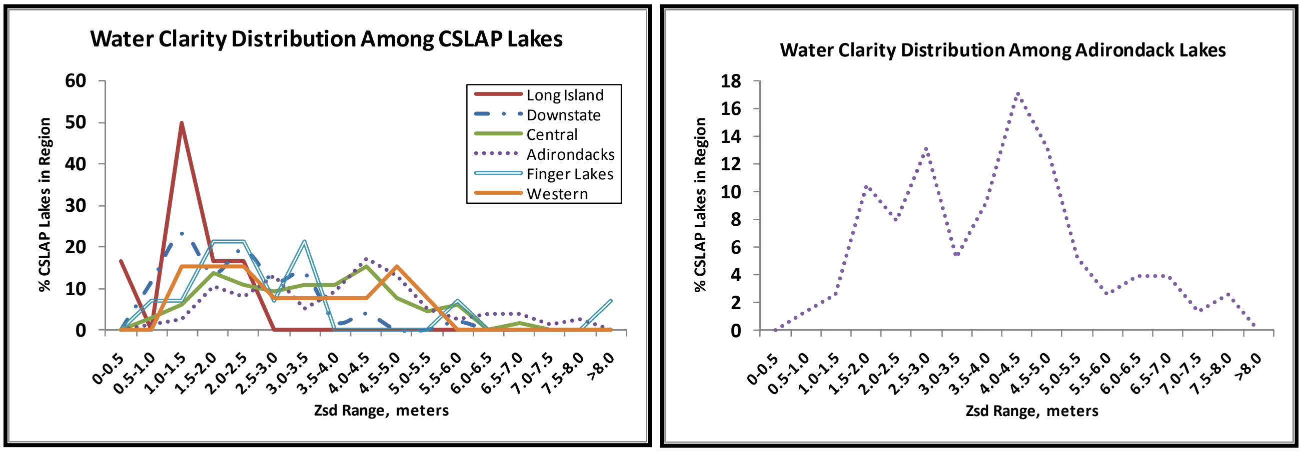
1. CSLAP lakes within the Adirondack region have higher water clarity readings than those in other parts of the state, with the majority of lakes having typical water clarity readings in the 4-5 meter range, corresponding to *mesoligotrophic* conditions.
2. CSLAP lakes within the Adirondack region have higher water clarity readings than non-CSLAP lakes in the same region, although CSLAP and non-CSLAP lakes in the same depth and size are comparable.
3. CSLAP lakes within the Adirondack region are more likely to have higher water clarity readings in drier years, and lower water clarity in wetter years, and this difference is greater in wetter years.
4. No long-term trends in water clarity readings have been apparent in CSLAP lakes within the Adirondack region.
5. Water clarity readings are highest in the eastern part of the region, particularly in deeper lakes, and lowest within the northern and southwestern portion of the Adirondack region lakes. The only lakes regularly exhibiting water clarity readings lower than the NYSDOH guidance for siting new swimming beaches are very shallow, highly colored lakes.
6. Water clarity readings in Adirondack region lakes were similar in 2009 to those reported in the typical CSLAP sampling season from 1986 to 2008.
7. Only a small percentage of Adirondack region lakes exhibited either higher or lower than normal water clarity readings in 2009. For most of these lakes, small differences in water clarity from year to year are probably mediated weather patterns (most likely wetter weather and higher water levels) rather than any real changes in the lake.

Adirondack Region Data Compared to NYS Data

CSLAP lakes in the Adirondack region are less productive than in any other region of the state, as measured by higher water clarity readings and as demonstrated in Figure 3.3.1. The most common range of water clarity readings in CSLAP Adirondack region lakes is in the 4-5 meter range, although water transparency in the 2-3 meter range is also very common. A low percentage of Adirondack region lakes have water clarity readings below 1.5 meters or above 7 meters, as seen in Figure 3.3.2. However, the percentage of lakes with water transparency greater than 5 meter is much larger than in other regions of New York state.

Comparison of CSLAP to NYS Lakes in the Adirondack Region

There are fewer Adirondack region lakes with total phosphorus readings in the 1-2 meter range in CSLAP than was found in other New York state monitoring programs, as seen in Figure 3.3.3. The majority of the lake water quality data outside of CSLAP comes from the Adirondack Lake Survey Corporation (ALSC) study of more than 1500 mostly small, high elevation lakes within the Adirondacks, Catskills and nearby regions. The typical ALSC lake is small and colored, a combination that leads to slightly lower water clarity readings than seen in the typical CSLAP lake in the Adirondack region, although ALSC lakes generally have higher water clarity readings than were found in most other regions in the state. The water quality differences between the ALSC and CSLAP datasets can also be seen in phosphorus, conductivity, and color.



Figures 3.3.1 and 3.3.2: Distribution of Water Clarity Ranges in CSLAP and Adirondack Region Lakes

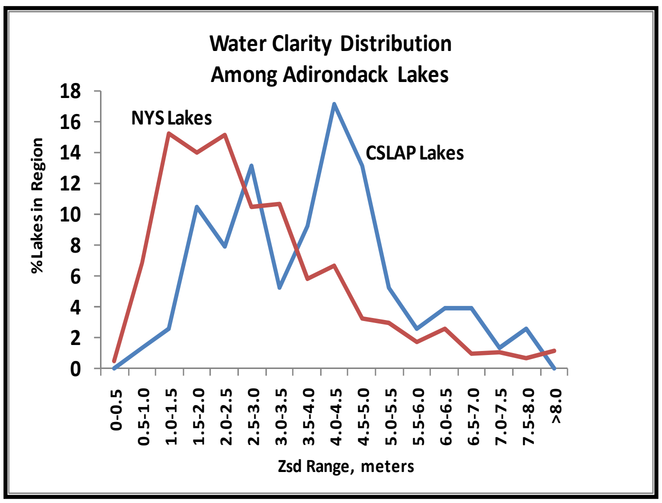


Figure 3.3.3: Average Distribution of Water Clarity Readings in New York State and CSLAP Lakes in the Adirondack Region

Annual Variability:

Water clarity has varied annually in Adirondack lakes, although less so than in most other regions of the state, whether evaluated across the region or in specific lakes. Far fewer lakes exhibit high water clarity at one time of the year and low water clarity at other times, a characteristic of *mesotrophic* lakes. The lowest water clarity readings measured through CSLAP occurred during 1994, 2006 and 1986. The highest water clarity readings occurred in 1999, 1997 and 1995. High water clarity readings are more likely to occur in dry years and low water clarity occurs in wetter years, although the shift in weather conditions appears to be much more likely to result in higher water clarity. It should be noted that neither the years with the highest water clarity nor the years with the lowest water clarity were associated with unusually wet or dry conditions. As discussed above, on a statewide basis, higher water clarity usually occurred in the driest years, and lower clarity was associated with the wettest years.

Table 3.3.1- % of CSLAP Lakes with Higher or Lower (than Normal) Water Clarity Readings During Dry and Wet Years in the Adirondack Region

	Dry Years	Wet Years
Higher Water Clarity	36%	18%
Lower Water Clarity	27%	30%

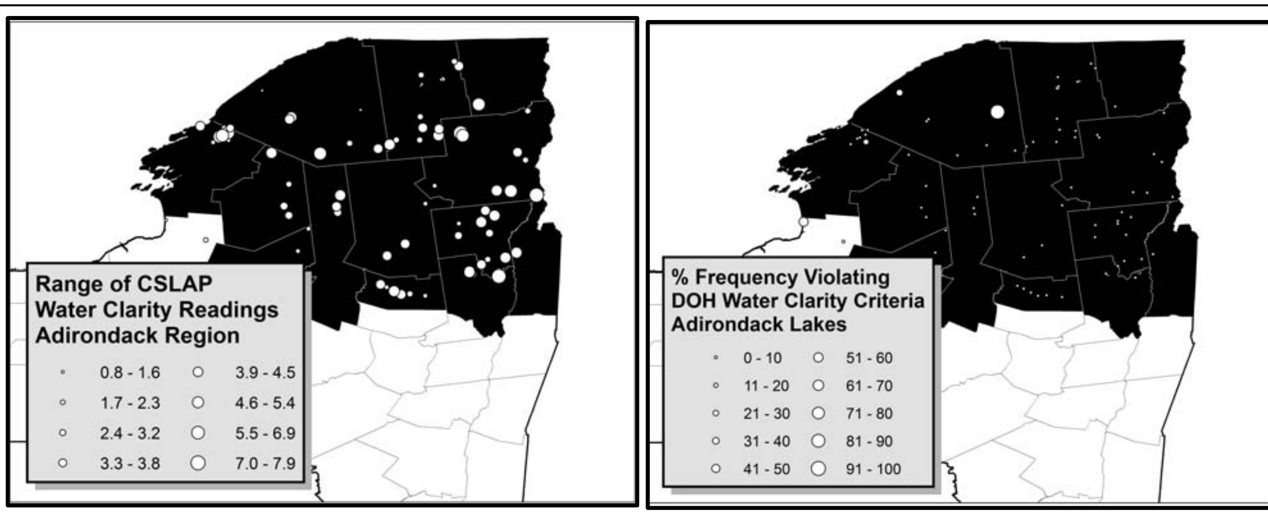
Dry Years: 1988, 1995, 2004, 2005
Wet Years: 1990, 1998, 2000, 2002, 2008
"Higher" and "Lower" defined as >1 SE higher than and lower than normal, respectively

Long Term Trends:

The evaluation of long-term trends since 1986 in any specific region of the state, including Adirondack region lakes, is adversely affected by the small number of lakes sampled during some sampling seasons, particularly in the earliest years of CSLAP (from 1986 to 1990). The frequency of both significantly higher than normal and significantly lower than normal water transparency readings has not changed over time. Neither slightly higher nor slightly lower water clarity has been apparent over this period. These data indicate that no clear long-term trends in water clarity readings have been apparent, or at least that long-term changes in water transparency is more likely to be related to year to year changes in weather patterns than any true long-term trends.

Regional Distribution:

Water clarity readings within the Adirondack region are generally highest in the eastern region of the Adirondack Park, although high water clarity is apparent in many lakes throughout this region. The lowest phosphorus readings are found in the northern and southwestern corner of the Adirondack Park, as seen in Figure 3.3.4. Very few lakes within this region fail to reach the state water clarity criteria (to protect swimming safety), with only very highly colored lakes (Joe Indian Lake), some of the more productive lakes in the Indian River region (Black Lake, Moon Lake), and isolated shallow lakes (North Sandy Pond, Otter Lake, Horseshoe Pond) exhibiting low water clarity readings. Most of the latter lakes are in the *mesotrophic* to *eutrophic* range, while *oligotrophic* is the most common assessment in nearly all other lakes within this region.



Figures 3.3.4 and 3.3.5: Range of Water Clarity Readings and Frequency of Violating the DOH Water Clarity Criteria in the Adirondack Region

Table 3.3.2 shows the number of water clarity readings, the minimum, average, and maximum water clarity readings, the most common trophic assessment for the lake, the frequency of violating the state water clarity criteria, the last year in which the lake was sampled through CSLAP, and whether water transparency readings have changed since CSLAP sampling began in the lake (through 2008).

Table 3.3.2: Water Clarity Summary in CSLAP Adirondack Region Lakes, 1986-2009

Lake Name	Years	Num	Min	Avg	Max	Trophic Category	%Violating Zsd Criteria	Change?
Adirondack Lake	1986-1989	35	1.0	2.1	3.5	*Mesotrophic*	3	
Augur Lake	1997-2009	87	1.4	2.9	5.5	*Mesotrophic*	0	No
Augur Lake	2009	8	2.5	3.1	4.3	*Mesotrophic*	0	No
Bartlett Pond	1997-2000	23	1.6	2.7	4.5	*Mesotrophic*	0	
Black Lake	1988-2009	159	0.5	1.5	3.7	*Eutrophic*	37	No
Black Lake	2009	8	1.0	1.8	3.0	*Eutrophic*	13	No
Brant Lake	1987-2003	79	1.9	5.4	7.7	*Oligotrophic*	0	No
Brantingham Lake	2001-2009	64	3.0	3.8	4.9	*Mesotrophic*	0	No
Brantingham Lake	2009	6	3.0	3.7	4.2	*Mesotrophic*	0	No
Butterfield Lake	1986-2009	187	1.3	2.7	6.0	*Mesotrophic*	0	No
Butterfield Lake	2009	7	1.5	2.3	3.9	*Mesotrophic*	0	No
Canada Lake	2001-2009	70	2.5	4.8	9.4	*Mesotrophic*	0	No
Canada Lake	2009	8	4.0	4.7	6.3	*Mesotrophic*	0	No
Chase Lake	1990-1997	42	2.9	3.5	4.5	*Mesotrophic*	0	No
Eagle Crag Lake	1986-2005	109	2.5	4.2	7.4	*Mesotrophic*	0	No
Eagle Lake	2000-2009	80	4.5	6.3	8.2	*Oligotrophic*	0	No
Eagle Lake	2009	9	5.8	6.3	7.3	*Oligotrophic*	0	No
Eagle Pond	2008-2009	16	1.3	1.5	1.7	*Eutrophic*	0	
Eagle Pond	2009	8	1.4	1.5	1.6	*Eutrophic*	0	No
East Caroga Lake	1990-2009	113	0.8	3.6	9.8	*Mesotrophic*	1	No
East Caroga Lake	2009	7	3.6	4.9	9.8	*Mesotrophic*	0	Higher
Effley Falls Lake	1997-2009	82	1.9	2.7	3.9	*Mesotrophic*	0	No
Effley Falls Lake	2009	8	2.4	2.7	3.1	*Mesotrophic*	0	No
Efner Lake	1997-2001	40	3.4	5.1	7.1	*Oligotrophic*	0	No
Friends Lake	1991-2009	104	2.7	4.8	7.0	*Mesotrophic*	0	No
Friends Lake	2009	8	3.7	4.2	5.3	*Mesotrophic*	0	No
Fulton Second Lake	1986-2009	161	2.5	3.6	5.8	*Mesotrophic*	0	No
Fulton Second Lake	2009	8	3.4	3.9	4.7	*Mesotrophic*	0	No
Garnet Lake	1989-2001	35	2.5	3.6	5.3	*Mesotrophic*	0	No
Glen Lake	1986-2009	112	2.1	4.9	7.4	*Mesotrophic*	0	No
Glen Lake	2009	7	2.6	3.7	4.9	*Mesotrophic*	0	Lower
Goodnow Flow	1986-2009	106	1.3	2.2	3.5	*Mesotrophic*	0	No
Goodnow Flow	2009	6	1.7	2.2	2.7	*Mesotrophic*	0	No
Grass Lake	2004-2009	46	1.8	3.4	7.5	*Mesotrophic*	0	No
Grass Lake	2009	8	1.8	3.2	5.1	*Mesotrophic*	0	No
Gull Pond	1994-1998	41	3.6	5.3	7.3	*Oligotrophic*	0	No
Hadlock Pond	1997-2001	18	3.8	5.3	7.6	*Oligotrophic*	0	No
Horseshoe Pond	2000-2009	75	0.9	1.5	2.7	*Eutrophic*	13	No
Horseshoe Pond	2009	8	1.2	1.6	2.1	*Eutrophic*	25	No
Hunt Lake	1994-2009	92	2.0	4.0	6.0	*Mesotrophic*	0	No
Hunt Lake	2009	8	3.3	3.6	4.5	*Mesotrophic*	0	No
Hyde Lake	1999-2009	41	1.0	2.2	4.8	*Mesotrophic*	5	No
Hyde Lake	2009	8	1.3	2.7	4.8	*Mesotrophic*	0	No
Indian Lake	1986-1997	55	1.0	2.3	3.6	*Mesotrophic*	2	No
Jenny Lake	1994-2007	72	2.3	4.4	7.1	*Mesotrophic*	0	No
Joe Indian Lake	1986-1990	54	0.6	0.8	2.0	*Eutrophic*	98	No
Kayuta Lake	1997-2001	37	1.1	1.8	2.6	*Eutrophic*	3	No
Kellum Lake	1997-2001	39	1.5	3.5	7.6	*Mesotrophic*	0	No
Lake Bonaparte	1988-2009	101	3.1	4.9	9.0	*Mesotrophic*	0	No
Lake Bonaparte	2009	8	3.7	4.2	5.3	*Mesotrophic*	0	No
Lake Clear	1998-2009	97	2.5	4.4	6.9	*Mesotrophic*	0	No
Lake Clear	2009	8	3.5	4.0	4.5	*Mesotrophic*	0	No

Lake Name	Years	Num	Min	Avg	Max	Trophic Category	%Violating Zsd Criteria	Change?
Lake Colby	1999-2001	23	2.4	4.5	7.4	*Mesotrophic*	0	
Lake Forest	2001-2009	54	1.8	2.6	3.3	*Mesotrophic*	0	No
Lake Forest	2009	6	2.1	2.7	3.1	*Mesotrophic*	0	No
Lake George	2004-2009	48	5.8	7.9	10.8	*Oligotrophic*	0	No
Lake George	2009	8	6.8	8.2	9.7	*Oligotrophic*	0	No
Lake George-N	2001-2001	5	7.5	7.9	8.3	*Oligotrophic*	0	
Lake Kiwassa	1990-1995	40	3.5	5.0	6.6	*Mesotrophic*	0	No
Lake Luzerne	1999-2004	43	3.0	4.0	5.6	*Mesotrophic*	0	No
Lake of the Isles	2000-2001	16	2.3	4.0	6.1	*Mesotrophic*	0	
Lake of the Woods	1994-2008	67	4.2	6.4	10.2	*Oligotrophic*	0	No
Lake Placid	1991-2009	109	4.9	7.9	12.1	*Oligotrophic*	0	No
Lake Placid	2009	4	7.1	7.9	8.9	*Oligotrophic*	0	No
Lake Titus	1999-2001	20	2.6	3.0	3.6	*Mesotrophic*	0	
Lincoln Pond	1997-2009	62	2.9	4.5	6.6	*Mesotrophic*	0	No
Lincoln Pond	2009	5	3.9	4.5	5.5	*Mesotrophic*	0	No
Little Wolf Lake	1998-2000	20	1.4	2.9	4.9	*Mesotrophic*	0	
Loon Lake	1986-1997	47	2.6	3.7	5.3	*Mesotrophic*	0	No
Lorton Lake	1990-2009	120	0.6	2.0	3.0	*Mesotrophic*	4	No
Lorton Lake	2009	8	2.0	2.6	3.0	*Mesotrophic*	0	Higher
Lower Chateaugay Lake	1991-1995	34	1.3	2.9	5.1	*Mesotrophic*	0	No
Lower St. Regis Lake	2000-2002	16	2.1	3.0	3.9	*Mesotrophic*	0	
Mayfield Lake	2000-2004	30	1.1	1.9	2.9	*Eutrophic*	7	No
Millsite Lake	1997-2009	100	3.5	6.9	9.0	*Oligotrophic*	0	No
Millsite Lake	2009	8	4.8	7.0	8.4	*Oligotrophic*	0	No
Mirror Lake	1998-2009	68	3.7	5.9	8.6	*Oligotrophic*	0	No
Mirror Lake	2009	7	5.5	6.5	7.5	*Oligotrophic*	0	No
Moon Lake	1992-1996	37	0.9	1.7	4.8	*Eutrophic*	27	No
Moreau Lake	1994-2002	62	4.5	7.4	11.0	*Oligotrophic*	0	No
Mountain Lake	1998-2001	30	2.0	2.9	3.9	*Mesotrophic*	0	
Mountain View Lake	1991-1997	39	1.0	1.6	2.5	*Eutrophic*	8	No
North Sandy Pond	1986-1990	52	0.8	1.3	3.0	*Eutrophic*	54	No
Otter Lake	1992-2009	100	1.1	2.0	3.3	*Mesotrophic*	3	No
Otter Lake	2009	8	1.1	1.2	1.6	*Eutrophic*	38	Lower
Paradox Lake	2003-2009	56	2.6	4.8	7.7	*Mesotrophic*	0	No
Paradox Lake	2009	8	3.3	4.5	5.3	*Mesotrophic*	0	No
Peck Lake	1992-2009	57	2.4	4.1	5.6	*Mesotrophic*	0	No
Peck Lake	2009	8	2.8	3.1	3.5	*Mesotrophic*	0	Lower
Piseco Lake	1999-2003	36	2.7	4.4	6.4	*Mesotrophic*	0	No
Pleasant Lake	2000-2009	64	3.1	4.3	5.9	*Mesotrophic*	0	No
Pleasant Lake	2009	2	4.1	4.5	4.9	*Mesotrophic*	0	No
Rondaxe Lake	1998-2001	32	3.1	4.3	5.6	*Mesotrophic*	0	
Sacandaga Lake	1987-2009	94	2.9	4.4	7.1	*Mesotrophic*	0	No
Sacandaga Lake	2009	8	3.3	4.0	5.0	*Mesotrophic*	0	No
Schroon Lake	1987-2009	109	2.0	4.0	10.0	*Mesotrophic*	0	No
Schroon Lake	2009	8	2.8	3.2	3.9	*Mesotrophic*	0	Lower
Silver Lake-Clinton Co	1989-1993	25	3.9	5.7	8.4	*Oligotrophic*	0	No
Silver Lake- St. Law Co	1996-2009	86	1.4	3.2	4.6	*Mesotrophic*	0	No
Silver Lake- St.L Co	2009	8	2.2	3.3	4.5	*Mesotrophic*	0	No
Sixberry Lake	2001-2004	30	3.8	6.0	8.3	*Oligotrophic*	0	
Spitfire Lake	1996-2002	44	2.6	4.7	6.6	*Mesotrophic*	0	No
Star Lake	1994-1998	40	4.2	6.5	11.5	*Oligotrophic*	0	No
Stewarts Landing	1997-2001	41	1.5	2.1	2.8	*Mesotrophic*	0	No
Twitchell Lake	1986-1996	35	3.4	4.7	8.0	*Mesotrophic*	0	No
Upper Chateaugay Lake	1990-1994	31	3.1	4.3	6.3	*Mesotrophic*	0	No
Upper Saranac Lake	2006-2009	25	2.3	3.0	4.1	*Mesotrophic*	0	

Lake Name	Years	Num	Min	Avg	Max	Trophic Category	%Violating Zsd Criteria	Change?
Upper Saranac Lake	2009	7	2.3	2.7	3.0	*Mesotrophic*	0	No
Upper St. Regis Lake	1997-2002	47	2.7	4.2	6.1	*Mesotrophic*	0	No
West Caroga Lake	1997-2007	29	2.6	4.7	8.6	*Mesotrophic*	0	No
Windover Lake	1999-2003	40	1.0	1.8	2.6	*Eutrophic*	5	No

Num = number of samples
Min, Avg, Max = minimum, average, and maximum water clarity readings, in meters
% Violating Zsd Criteria = % of samples at each lake with water clarity < 1.2m, corresponding to the existing NYSDOH water clarity criteria for siting new swimming beaches
Change? = exhibiting significant change in water clarity readings (best fit line of annual means with $R^2 > 0.5$ and seasonal Kendall-Tau rank correlation coefficient > 0.5); 2009 change based on water clarity readings >25% higher or lower than normal

None of the lakes in this region has exhibited any long-term change in water transparency readings.

Tables 3.3.3a and 3.3.3b summarize the surface water clarity data collected through CSLAP in 2009, and compare these data to the data collected for each program lake in the region prior to 2009. Water clarity readings in the CSLAP lakes in the Adirondack region in 2009 were similar to those reported in previous years, whether evaluated by average water transparency readings or percent frequency of failing to reach the state water clarity criteria value (2% in 2009 and 4% from 1986 to 2008). The percentage of lakes with higher than normal water clarity readings in 2009 was lower than the percentage of lakes with lower than normal readings, although a slightly higher percentage of lakes established new maximum readings than established new maximum readings in 2009. These data also suggest that, on a region-wide basis, water transparency readings in 2009 were comparable to those measured in previous CSLAP sampling seasons.

Table 3.3.3a: Water Clarity Summary in CSLAP Lakes, 2009

	Number Lakes	Minimum	Average 2009	Average 1986-08	Maximum	Typical	%Violating DOH Criteria
Downstate	32	0.3	2.0	2.0	6.6	*Mesotrophic*	27
Central	36	0.8	3.6	3.3	10.4	*Mesotrophic*	4
Adirondacks	33	1.0	3.8	3.9	9.8	*Mesotrophic*	2
Western	9	0.5	2.0	3.0	5.6	*Mesotrophic*	30
CSLAP Statewide	**110**	**0.3**	**3.1**	**3.1**	**10.4**	***Mesotrophic***	**12**

Table 3.3.3b: Water Clarity Summary in CSLAP Lakes, 2009

	Number Lakes	Average 2009	Average 1986-08	%Higher	%Lower	%Above Max	%Below Min
Downstate	32	2.0	2.0	4	21	21	25
Central	36	3.6	3.3	17	3	22	3
Adirondacks	33	3.8	3.9	6	12	9	6
Western	9	2.0	3.0	11	50	0	0
CSLAP Statewide	**110**	**3.1**	**3.1**	**9**	**15**	**17**	**10**

% Higher = percentage of lakes in region with water clarity (Zsd) readings in 2009 >25% higher than normal (before 2009)
% Lower = percentage of lakes in region with water clarity (Zsd) readings in 2009 <25% below normal (before 2009)
% Above Max = percentage of lakes in region with Zsd readings in 2009 above previous maximum (before 2009) for lake
% Below Min = percentage of lakes in region with Zsd readings in 2009 below previous minimum (before 2009) for lake

Adirondack Region Lakes With Higher Than Normal Water Clarity in 2009:
East Caroga Lake, Lorton Lake

Discussion:

Two Adirondack-region lakes exhibited higher than normal phosphorus readings in 2009. The higher-than-normal annual average on East Caroga Lake in 2009 was strongly affected by a single very high water clarity reading—in fact, the highest reading ever seen at the lake and the highest reading in the entire region in 2009. It is not known if this reading accurately represents the water transparency in the lake at this time. Absent this reading, the 2009 results in East Caroga Lake were mostly comparable to those recorded in previous years.

The higher water clarity in Lorton Lake was attributed to a combination of a late filling of the lake (due to spillway repair) and heavy rain until late summer. Water transparency readings in the lake were much more stable and, on average, consistently higher than normal.

It is likely that the water clarity readings in both of these lakes will revert to normal conditions in future years of CSLAP.

Adirondack Region Lakes With Lower Than Normal Water Clarity in 2009:
Glen Lake, Otter Lake, Peck Lake, Schroon Lake

Discussion:

Water transparency readings were lower than normal in 4 Adirondack region lakes in 2009. Water clarity is Glen Lake was lowest in early summer, and was thought to be associated with heavy rains. These readings reverted back to (close to) normal when the heavy rainfall ended later in the summer. Heavy rainfall also influenced water clarity readings in Otter Lake throughout the summer; these readings were consistently lower all year. Volunteers' comments did not inform an evaluation of the lower water clarity in Peck Lake; it is not known if the "rainy" conditions reported in about half of the sampling sessions contributed to the lower clarity. None of these lakes exhibited higher than normal phosphorus or chlorophyll *a* readings—in fact, algae levels were much lower than normal in Otter Lake. It is likely that the lower water clarity readings in each of the three lakes discussed above represent normal or weather induced variability rather than a part of a longer-term trend.

The lower water clarity in Schroon Lake was consistent with higher phosphorus readings and a long-term (though small) increase in both phosphorus and chlorophyll *a*. As noted in the phosphorus discussion, this bears further investigation. It should be noted that this lower clarity (and higher nutrient and algae levels) was much more apparent in the north site than in the south site, suggesting a potential localized input of nutrients.

Chapter 3.4- Evaluation of Adirondack Region Trophic State Indicator (TSI) Evaluation

Summary of Trophic State Findings in CSLAP Lakes

1. The percentage of CSLAP samples that are typical of *eutrophic* lakes, based on total phosphorus readings, is very similar to the percentage of samples characterized as *eutrophic* based on chlorophyll *a* and Secchi disk transparency readings
2. The strong correlation among the trophic indicators at the *mesotrophic-eutrophic* transition has significant implications for large scale water clarity monitoring to evaluate violations of the state phosphorus criteria, for reconciling differences between trophic category definitions in other regions of the country, and for evaluating similarities and differences among the trophic indicators.
3. Total phosphorus, chlorophyll *a*, and Secchi disk transparency readings yield similar trophic assessments in all regions of the state, although in the Long Island/NYC region, water clarity readings are lower than expected given the phosphorus and chlorophyll *a* readings in these lakes, due to the influence of water depth, turbidity, and rooted plants.
4. The Carlson Trophic State Index (TSI) calculations in New York state lakes have limited utility in determining trophic status, since trophic categories (*eutrophic, mesotrophic*, and *oligotrophic*) are defined differently in New York that in other states.
5. The most common trophic assessments in CSLAP lakes are between *mesoeutrophic* and *mesoligotrophic*.
6. The Adirondack region lakes have the lowest algal productivity, based on water clarity, phosphorus and chlorophyll *a* readings. This leads to lower TSI values than in the other regions.
7. The Downstate (Long Island/NYC) region has the highest algal productivity and the highest TSI values.
8. TSI-Phosphorus readings in the Adirondack region are lower than expected given the TSI values for water clarity and chlorophyll *a*. Water clarity may be reduced due to other factors (such as elevated color), and algae levels may be higher than expected in the Adirondack, Central and Western (Finger Lakes) regions due to efficiencies in converting nutrients to algae (relatively high soluble phosphorus)
9. Water clarity readings are slightly higher than expected in the Western region, perhaps due to the influence of zebra mussels.

What Is Trophic State?

The term *trophic* refers to nutrition, and originates from the Greek word *trophikos*, or food. In an ecological setting, it refers to the relationships among different organisms in the food chain. In a lake setting, the food chain, or more properly the food web, is based on phytoplankton, or algae. The amount of algae produced in a lake dictates the production of other organisms; hence, algae are referred to as the primary producers. Lakes with large amounts of algae (and other plants and animals) are called *eutrophic*, literally "well-nourished", and lakes with little biological production are called *oligotrophic*, or "scant(ly) nourished." Lakes with intermediate nourishment are called *mesotrophic*. *Eutrophication* is the process in which lakes become overly nourished, whether naturally or induced by human activities (*cultural eutrophication*). These definitions are not synonymous with water quality conditions or an indication of supporting lake use—many *eutrophic* lakes are highly productive sports fisheries, and many *oligotrophic* lakes do not support aquatic life, often due to high lake acidity imparted by acid rain. However, most ecologists and lake users will agree that either extreme conditions or a significant change in the *trophic state* of a lake represents a problem.

The trophic state of lakes can be defined both functionally—by measuring the actual biological production (*biomass*) in the system—and operationally—by measuring a few key indicators related to lake biomass. The former approach can be logistically difficult and costly. The latter approach can exploit a simple measure of algae biomass—chlorophyll *a*—and the relationship between algae and both the nutrients that drive algae growth—primarily phosphorus—and the lake changes observed by high algae production—changes in water transparency. Each of these water quality indicators—total phosphorus, chlorophyll *a*, and Secchi disk transparency—are measured through CSLAP in each water sampling session and can be used to quantitatively define the trophic state of the lake. Chapters 3.1, 3.2 and 3.3 in this report summarize the trophic condition of CSLAP lakes based on these indicators. Table 3.4.1 shows the trophic state ranges adopted in New York state and commonly used in other states (Carlson—see below). The small difference between these stems from the desire in New York state to use simple intervals, the recognition that trophic categories represent a continuum rather than clear delineations, and the fact that the New York state boundary between *mesotrophic* and *eutrophic* lakes are closely matched, as discussed later in this chapter.

Table 3.4.1: Trophic Ranges For Water Quality Indicators

	Oligotrophic		*Mesotrophic*		*Eutrophic*	
	Carlson	**NYS**	**Carlson**	**NYS**	**Carlson**	**NYS**
Phosphorus	<12 µg/l	<10 µg/l	12-24 µg/l	10-20 µg/l	>24 µg/l	>20 µg/l
Secchi Disk Transparency	>4 m	>5 m	2-4 m	2-5 m	<2 m	<2 m
Chlorophyll *a*	<2.6 µg/l	<2 µg/l	2.6-7.3 µg/l	2-8 µg/l	>7.3 µg/l	>8 µg/l

The relationship among these indicators has been explored by limnologists—lake scientists—for many years. Dr. Robert Carlson from Kent State University developed an index that places each of these trophic indicators on the same (logarithmic) scale. This allows each of these indicators to be used to define the trophic state of any lake, and to compare these indicators in a way that might provide some additional insights about the algal dynamics in lakes. The equations used by Dr. Carlson to define the *Trophic State Index (TSI)* for a set of midwestern US lakes in the mid 1970s are as follows (ln = natural logarithm in all equations):

TSI (water clarity) = 60 – 14.41 x ln(Zsd), where Zsd = Secchi disk transparency in meters
TSI (phosphorus) = 14.42 x ln(TP) + 4.15, where TP = total phosphorus in µg/l
TSI (chlorophyll *a*) = 9.81 x ln(Chl.a) + 30.6, where Chl.a = chlorophyll *a* in µg/l

Dr. Carlson developed these trophic state indices so that TSI values in a range between 40 and 50 would correspond to *mesotrophic* conditions for each of these trophic indicators, with higher TSI values corresponding to *eutrophic* conditions, and lower TSI values attributed to *oligotrophic* conditions. The same TSI values can be compared to the trophic categories defined in New York state and shown in Table 3.4.1; these TSI ranges are exhibited in Table 3.4.2.

Table 3.4.2: TSI Ranges For Trophic Categories

	Oligotrophic		***Mesotrophic***		***Eutrophic***	
	Carlson	**NYS**	**Carlson**	**NYS**	**Carlson**	**NYS**
Phosphorus	<40	<37	40-50	37-47	>50	>47
Secchi Disk Transparency	<40	<37	40-50	37-50	>50	>50
Chlorophyll *a*	<40	<37	40-50	37-51	>50	>51

A comparison of the TSI ranges in New York state (based on the trophic categories listed in Table 3.4.1) and the Carlson TSI ranges show that the transition from *oligotrophic* and *mesotrophic* consistently occurs at a TSI of 37, compared to a TSI of 40 for the Carlson trophic categories.

The transition from *mesotrophic* to *eutrophic* is somewhat more variable in the New York state TSI ranges, falling between a TSI of 47 (using phosphorus as the trophic status indicator) and a TSI of 51 (using chlorophyll *a* as the trophic status indicator). However, although the transitional TSI values for the New York state trophic categories may not be easy to remember—this was one of the reasons that 40 and 50 were chosen by Carlson for transitional values—the corresponding values for each of these water quality indicators are easily remembered integers (10 and 20 µg/l for phosphorus, 2 and 5 meters for water clarity, and 2 and 8 µg/l for chlorophyll *a*). More importantly, the transitional water quality values between mesotrophy and eutrophy are closely aligned in New York state lakes, and at least at present correspond to the state phosphorus guidance value.

Table 3.4.3 shows the regional frequency of CSLAP samples in which the *eutrophic* conditions are first reached (total phosphorus > 20 µg/l, chlorophyll *a* > 8 µg/l, and Secchi disk transparency < 2 meters). There are some regional differences—for example, the frequency of high algae levels is slightly lower in the Long Island/NYC region than expected given the phosphorus readings in these lakes. This is probably due to high turbidity in shallow lakes reducing light availability for algae growth, and due to the influence of excessive weeds that reduce algae growth without influencing the amount of phosphorus in the water (since most of these rooted plants either draw most of their nutrition from the water or pump sediment-bound nutrients into the water). Water clarity is also lower than expected, due in part to shallow water and wind-induced turbidity in these shallow lakes. But in every other region of the state, there is a very strong connection among these trophic indicators and the transitional values used in New York state to define the boundary between *mesotrophic* and *eutrophic* lakes. On a statewide basis, 33% of the CSLAP total phosphorus samples exceeded 20 µg/l, 32% of the chlorophyll *a* readings exceeded 8 µg/l, and 32% of the water clarity readings fell below 2 meters.

Table 3.4.3- Frequency of CSLAP Samples at the *Mesotrophic-Eutrophic* Boundary

	Number Lakes	% TP >20 µg/l	% Zsd <2 m	% Chl.a > 8 µg/l
Downstate	57	56	52	48
Central	68	30	29	33
Adirondacks	77	11	16	14
Western	27	49	40	48
CSLAP Statewide	**229**	**33**	**32**	**32**

%TP, Zsd, Chl.a = % of CSLAP samples in region in which total phosphorus (TP) and chlorophyll *a* (Chl.a) values exceed the *mesotrophic-eutrophic* transitional value, and water clarity (Zsd) readings fall below this transitional value

These findings have several important implications. First, there is a close connection between water clarity readings of 2 meters and total phosphorus readings of 20 µg/l, the latter of which corresponds to the present state phosphorus guidance value. This indicates that water clarity readings, which are simple and inexpensive to collect, can serve as a surrogate for the most critical range of phosphorus readings and provide an indication of eutrophication. Second, these data indicate that the present trophic designations used in New York state- water clarity less than 2 meters, chlorophyll *a* exceeding 8 µg/l, and total phosphorus exceeding 20 µg/l- are both mostly consistent with national definitions of trophic categories and internally consistent. Finally, the TSI for each of these indicators are close enough to allow a comparison of TSI values to gain greater information about the dynamics of these lakes.

Table 3.4.4 shows the trophic characterization for lakes in each of the six major geographic regions of the state. The trophic status of each lake is evaluated based on the trophic assessment of the total phosphorus, chlorophyll *a*, and Secchi disk transparency readings (Tables 3.1.4, 3.2.4 and 3.3.4, respectively, in the regional summaries). The "*mesoligotrophic*" and "*mesoeutrophic*" categories are for those lakes for which different trophic assessments for different trophic indicators preclude a single trophic state assessment for the lake. This table shows that the vast majority of CSLAP lakes can be characterized between *mesoeutrophic* and *mesoligotrophic*.

Table 3.4.4: Trophic Assessments in CSLAP Lakes

	Number Lakes	% Lakes *Oligotrophic*	% Lakes *Mesoligotrophic*	% Lakes *Mesotrophic*	%Lakes *Mesoeutrophic*	%Lakes *Eutrophic*
Downstate	54	0	4	20	31	45
Central	66	0	30	35	12	21
Adirondacks	76	12	46	25	13	4
Western	13	4	14	14	37	30
CSLAP Statewide	**229**	**4**	**27**	**25**	**21**	**23**

The trophic assessments vary somewhat from region to region. The Adirondack region has the highest percentage (58%) of *mesoligotrophic* to *oligotrophic* lakes, befitting a region in which the typical lake has the lowest algae and nutrient levels, and highest water clarity. The Downstate and Western regions have more than 50% of their CSLAP lakes characterized as *mesoeutrophic* to *eutrophic*, with the highest percentage of *eutrophic* lakes found in the Downstate (Long Island/NYC) region. However, although there are a small number of CSLAP lakes in this region, the CSLAP data are typical of those collected in other monitoring programs.

Table 3.4.5a shows the TSI calculations for each of the trophic indicators measured through CSLAP by major New York state region, as determined by the average of the TSI values for the CSLAP lakes in the region. This table also shows the percentage of CSLAP lakes in each region for which each of the TSI calculations are within 10 points ("consistent TSI"), and the trophic indicator(s) in each lake that deviates from the other TSI indicators, referred to here as the "outliers". Overall TSI values are lowest for the Adirondack and Central regions, corresponding to lower lake productivity, while the highest TSIs are associated with the Downstate regions. The average TSI values for each of the trophic indicators are similar in each region—meaning that TSI calculations for water clarity (Zsd), total phosphorus (TP) and chlorophyll *a* (Chl.a) are similar—and the percentage of lakes in which the TSI values for each indicator are within 10 points ranges from 63% (Western region) to 89% (Central region).

Table 3.4.5a: TSI Assessments in CSLAP Lakes

	Number Lakes	Avg TSI-Zsd	Avg TSI-TP	Avg TSI-Chl.a	%Consistent TSI	%Zsd Outlier	%TP Outlier	%Chl.a Outlier
Downstate	60	51	54	55	77	11	11	13
Central	66	44	44	49	89	6	5	11
Adirondacks	76	42	37	43	82	4	14	9
Western	27	47	49	53	63	30	7	30
CSLAP Statewide	**229**	**46**	**45**	**49**	**80**	**10**	**10**	**13**

Table 3.4.5b breaks out the TSI outliers into the whether the outlier—water clarity, total phosphorus, or chlorophyll *a*—is higher or lower than expected, summarized by the frequency of lakes within the region exhibiting the outlier. The sum of the percentages for each region often exceeds the regional average cited in Table 3.4.5a, since more than one TSI indicator may be an outlier. For example, for a lake with a TSI-Zsd of 40, and TSI-Chl.a of 50 and a TSI-TP of 60, both the Secchi disk transparency TSI and the total phosphorus TSI are outliers.

Table 3.4.5b: TSI Assessments in CSLAP Lakes

	Number Lakes	%Zsd Higher	%Zsd Lower	%TP Higher	%TP Lower	%Chl.a Higher	%Chl.a Lower
Downstate	60	10	2	7	5	12	2
Central	66	6	0	0	5	11	0
Adirondacks	76	0	4	0	14	9	0
Western	27	30	0	7	0	30	0
CSLAP Statewide	**229**	**8**	**2**	**2**	**8**	**13**	**<1**

An evaluation of the TSI outliers in each region can be instructive. For those waterbodies in which one of the trophic indicators (water clarity, total phosphorus, or chlorophyll *a*) is significantly different than expected given the magnitude of the readings for the other indicators, some other factor may be affecting the "production" of that indicator. This may have important management implications. Each of the six outlier categories—water clarity, total phosphorus or chlorophyll *a* higher than expected, or water clarity, total phosphorus, or chlorophyll *a* lower than expected—is explored below.

a. Water clarity higher than expected

In this scenario, water clarity readings are higher than expected (predicted) given the phosphorus and chlorophyll *a* readings in the lake. The most likely reason for this scenario is extreme patchiness in algae growth, where phosphorus readings are sufficiently high to create extensive growth of algae, but this algae growth is limited to isolated patches included in the water sample, but not representative of the open water of the lake, or suspended particles in the water that do not significantly affect water clarity (at least relative to the chlorophyll *a* and total phosphorus measurements in the lake). The latter may be associated with an epilimnetic band (strata) of water that only has a limited impact on water clarity, since the Secchi disk may still be visible below this strata of algae. Higher than expected water clarity, at least relative to phosphorus readings, may also reflect in the influence of zebra mussels.

b. Water clarity lower than expected

Lower than expected water transparency can be associated with a number of phenomena. The trophic assessments discussed above explore the relationship between water clarity and algae, the primary influence on water transparency on most New York State lakes. However, water clarity is also influenced by dissolved organic matter, as manifested in water color (brownness), non-algal turbidity (typically from suspended sediment), or whiting (light refraction from suspended calcium carbonate). Measured water clarity may also be limited by water depth, either by the inability to record an accurate water transparency reading if the Secchi disk is visible on the bottom, or due to sediment suspension in very shallow water.

c. *Total phosphorus higher than expected*

Phosphorus readings are very similar to chlorophyll *a* readings in many lakes, since all phosphorus is bound within algal cells. This is particularly common in lakes with relatively low total phosphorus readings and all phosphorus (initially) available for algae growth, usually in a dissolved form. In other lakes, algae growth is limited by nitrogen or temperature (in cold water) or other factors, rather than phosphorus, so increasing phosphorus inputs may not result in an increase in algae levels. This may also occur in some lakes with very short retention time (high flushing rate), since algae may not be able to grow with only limited exposure time to the needed nutrients. On the other hand, lakes with high flushing rates and limited nutrient inputs may exhibit lower phosphorus readings due to a rapid movement of water out of the lake. Higher phosphorus readings may also be associated with large amounts of dissolved organic matter, which may bind phosphorus and render it unavailable for algae growth (although these lakes tend not to have phosphorus identified as an outlier, since water clarity readings are usually low).

d. Total phosphorus lower than expected

Several CSLAP lakes exhibit lower than expected phosphorus readings, at least relative to the algae levels and water clarity readings in the lake. As discussed above, phosphorus readings in many of these lakes are comprised almost entirely of soluble phosphorus, so that the algae are highly efficient in utilizing any new phosphorus entering the lake. Higher flushing rates may also rapidly move small inputs out of the lake.

e. Chlorophyll a higher than expected

Many of the reasons for higher than normal chlorophyll *a* readings are similar to those for higher than normal water clarity. Patchy or isolated suspended planktonic algae, whether found in a specific depth strata or as individual algal colonies dotted throughout the water column, would result in higher chlorophyll *a* readings if associated with the water sampling depth and location, but might not be significant enough to control water transparency. Higher algae levels may also be associated with a few samples strongly influencing the average chlorophyll *a* value for a lake, since chlorophyll *a* has much higher variance (and therefore a tendency to unusually high algae readings that strongly influence average readings). Poor zooplankton crazing, perhaps due to an overabundance of planktivorous fish (plankton-eating fish), such as most young fish and alewives, can result in higher than expected algae levels.

f. Chlorophyll a lower than expected

Algae growth in a lake requires sufficient light for the algae to photosynthesize. Reduced algae growth may be associated with high water color, changing the wavelengths of light entering the water or restricting algae growth to the uppermost layers of the lake. Lower chlorophyll *a* readings may also be associated with lakes with high flushing rates, although these lakes may also have higher than expected phosphorus readings. Algae levels are also strongly influenced by intentional and natural biocontrol measures and biomanipulation, such as through the addition of algacides (copper compounds) to explicitly reduce algae concentrations, or through the presence of voracious piscivores (fish-eating fish), such as perch and pike, that may result in a loss of planktivorous fish that control zooplankton levels. These factors can be complex and dynamic, and changes in chlorophyll *a* readings can be difficult to predict even with a working knowledge of the fish and zooplankton communities in a lake.

Although a detailed regional or statewide evaluation suffers from small sample sizes—the limited number of lakes in each category seen in Table 3.4.5b—a few patterns are apparent. Higher than expected water clarity readings are more common than lower than expected water clarity readings in all but the Adirondack region. In the rest of the state, higher than expected water clarity is probably associated with algae cells dotting the upper waters of the lake without turning the water green, allowing the Secchi disk to be visible somewhat deeper in the water column. More detailed analysis of the phytoplankton community—perhaps through the DOH HAB study—may provide some insights about the algae "factors" leading to these conditions. In the Finger Lakes and Western regions, higher water clarity may also be associated with zebra mussels. Conversely, within the Adirondack region, the small number of lower than expected water clarity readings is associated with shallow, colored lakes.

Lower than expected phosphorus readings are more common than higher than expected phosphorus readings, particularly within the Adirondack region. This latter group of lakes has very high flushing rates, suggesting that any nutrient inputs move quickly out of the lake. A consistent pattern across the state appears to be higher than expected chlorophyll *a* readings.

There do not appear to be any clear reasons for this phenomenon, except that the average chlorophyll *a* readings in these lakes may be adversely influenced by a small number of much higher than normal samples. It is likely that much of this pattern would disappear if the trophic state indices (TSI) were calculated from median rather than mean values.

CSLAP Trophic State Indicator (TSI) Evaluation in the Adirondack Region

Trophic state indices (TSI) calculations in the Adirondack region can be used to identify factors that influence lake productivity outside of the normal interrelationship between total phosphorus, chlorophyll *a,* and Secchi disk transparency. These factors include water depth, flushing rate, dissolved organic matter (natural brownness), and even the challenges in identifying the most representative (average? median?) measure of these trophic indicators, particularly chlorophyll *a.*

The six major categories of TSI outliers—higher than expected water clarity, total phosphorus or chlorophyll *a* readings, or lower than expected readings for the same three indicators—can be evaluated with the Adirondack region dataset to identify additional factors influencing lake productivity. It should be noted that a very high percentage of Adirondack region lakes—82% of the lakes—exhibit water clarity, total phosphorus, and chlorophyll readings that are "internally" consistent, leading to TSI values that are similar and lead to consistent trophic assessments.

a. Adirondack Region lakes with water clarity higher than expected -
None

Discussion:
As discussed above, the most common reasons for lakes to exhibit higher than expected water clarity readings, based on evaluation of TSI values, is either the presence of algae that grows patchy or as green "dots" throughout the upper portions of the water column, or the presence of zebra mussels. Chapter 3.2 shows that algal densities are lower in the Adirondack region than in other regions of the state, so the likelihood of lakes exhibiting heavy algae growth is slight. Chapter 4.16 shows that lakes in most of the Adirondack region do not possess sufficient calcium to grow extensive colonies of zebra mussels, and the few CSLAP lakes in the region with zebra mussels do not exhibit signs of significant algal stripping by zebra mussels.

b. Water clarity lower than expected in Adirondack Region-
Eagle Pond, Horseshoe Pond, Joe Indian Pond

Discussion:
Each of the three Adirondack region lakes with lower than expected water clarity is very shallow, and is slightly to highly colored. Both phenomena—water depth limiting measured (and perhaps actual) water transparency and water color reducing the depth at which a Secchi disk may be visible—are common to lakes in the Adirondack region, particularly in the western and northern regions of the Adirondack Park, and are the likely cause of lower than expected water clarity readings.

c. Total phosphorus higher than expected in Adirondack Region-
None

Discussion:

Although there are a number of lakes in the Adirondack region with high flushing rates (low retention time), there appears to be sufficient contact time in these lakes for phosphorus readings to be consistent with chlorophyll *a* and water clarity readings.

d. Total phosphorus lower than expected in Adirondack Region-
Effley Falls Lake, Goodnow Flow, Kayuta Lake, Stewarts Landing, Peck Lake

(with higher than expected chlorophyll a*)- Garnet Lake, Gull Pond, Hunt Lake, Jenny Lake, Sacandaga Lake, Star Lake*

Discussion:

Lower than expected phosphorus readings (relative to expected phosphorus readings based on chlorophyll *a* and Secchi disk transparency TSIs) are fairly common in the Adirondack region, and can be summarized in two categories. One group of lakes does not exhibit relatively high chlorophyll *a* readings—these tend to have relatively high flushing rates and moderately high water color readings. The second group of lakes also has higher than expected chlorophyll *a* readings. The CSLAP lakes in the latter group are concentrated in the southeastern and western Adirondacks. It is not known if these lakes share any other limnological characteristics, or at least characteristics that distinguish them from other Adirondack region lakes.

e. Chlorophyll a higher than expected in Adirondack Region-
(with lower than expected total phosphorus)- Garnet Lake, Gull Pond, Hunt Lake, Jenny Lake, Sacandaga Lake, Star Lake

Discussion:

All of the Adirondack region lakes with higher than expected chlorophyll *a* readings also have lower than expected phosphorus readings (multiple outliers). These lakes have not exhibited any evidence of patchy or excessive algae, so it is likely that the higher average chlorophyll *a* readings are a statistical anomaly due to a few slightly elevated chlorophyll readings strongly influencing the average for the lake.

Fisheries data, particularly related to relative abundance of fish, are not available on these lakes—it is also possible that these lakes are dominated by planktivorous fish that are depressing the zooplankton populations, resulting in higher than expected algae levels in these lakes.

f. Chlorophyll a lower than expected in Adirondack Region-
None

Discussion:

Although there are a few Adirondack region lakes sampled through CSLAP with elevated color readings, these lakes have not had lower than expected chlorophyll *a* TSIs. It is likely that many highly colored lakes within the region do not produce much algae relative to the phosphorus readings in the lake, but although a large number of these lakes have been sampled through the ALSC program, the chlorophyll *a* levels in these lakes were not measured.

Table 3.4.6 shows the trophic state indices and outliers for each of the CSLAP lakes sampled in the Adirondack region.

Table 3.4.6: TSI Assessments in Adirondack Region CSLAP Lakes

Lake Name	Trophic Assessment	TSI-Zsd	TSI-TP	TSI-Chl.a	Outlier	Zsd Trophic Assessment	TP Trophic Assessment	Chl *a* Trophic Assessment
Adirondack Lake	*Mesotrophic*	49	44	48	None	*Mesotrophic*	*Mesotrophic*	*Mesotrophic*
Augur Lake	*Mesotrophic*	45	44	51	None	*Mesotrophic*	*Mesotrophic*	*Mesotrophic*
Bartlett Pond	*Mesotrophic*	46	38	40	None	*Mesotrophic*	*Mesotrophic*	*Mesotrophic*
Black Lake	*Eutrophic*	54	57	63	None	*Eutrophic*	*Eutrophic*	*Eutrophic*
Brant Lake	Meso*ligotrophic*	36	31	38	None	*Oligotrophic*	*Oligotrophic*	*Mesotrophic*
Brantingham Lake	Meso*ligotrophic*	41	35	43	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Butterfield Lake	Meso*eutrophic*	46	45	54	None	*Mesotrophic*	*Mesotrophic*	*Eutrophic*
Canada Lake	Meso*ligotrophic*	37	32	35	None	*Mesotrophic*	*Oligotrophic*	*Oligotrophic*
Chase Lake	*Mesotrophic*	42	38	43	None	*Mesotrophic*	*Mesotrophic*	*Mesotrophic*
Eagle Crag Lake	Meso*ligotrophic*	39	32	41	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Eagle Lake	*Oligotrophic*	33	30	31	None	*Oligotrophic*	*Oligotrophic*	*Oligotrophic*
Eagle Pond	Mesoligo*eutrophic*	54	42	37	Zsd	*Eutrophic*	*Mesotrophic*	*Oligotrophic*
East Caroga Lake	Meso*ligotrophic*	42	35	44	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Effley Falls Lake	Meso*ligotrophic*	46	31	43	TP	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Efner Lake	*Oligotrophic*	37	30	37	None	*Oligotrophic*	*Oligotrophic*	*Oligotrophic*
Friends Lake	*Mesotrophic*	37	38	43	None	*Mesotrophic*	*Mesotrophic*	*Mesotrophic*
Fulton Second Lake	Meso*ligotrophic*	42	35	44	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Garnet Lake	Meso*ligotrophic*	42	35	48	TP,Chl.a	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Glen Lake	Meso*ligotrophic*	37	35	42	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Goodnow Flow	Meso*eutrophic*	49	39	51	TP	*Mesotrophic*	*Mesotrophic*	*Eutrophic*
Grass Lake	*Mesotrophic*	42	44	41	None	*Mesotrophic*	*Mesotrophic*	*Mesotrophic*
Gull Pond	Meso*ligotrophic*	36	30	41	TP,Chl.a	*Oligotrophic*	*Oligotrophic*	*Mesotrophic*
Hadlock Pond	Meso*ligotrophic*	36	35	44	None	*Oligotrophic*	*Oligotrophic*	*Mesotrophic*
Horseshoe Pond	Meso*eutrophic*	54	46	43	Zsd,Chl.a	*Eutrophic*	*Mesotrophic*	*Mesotrophic*
Hunt Lake	Meso*ligotrophic*	40	31	45	TP,Chl.a	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Hyde Lake	Meso*eutrophic*	48	48	57	None	*Mesotrophic*	*Eutrophic*	*Eutrophic*
Indian Lake	*Mesotrophic*	48	41	46	None	*Mesotrophic*	*Mesotrophic*	*Mesotrophic*
Jenny Lake	Meso*ligotrophic*	39	31	44	TP,Chl.a	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Joe Indian Lake	Meso*eutrophic*	63	50	47	Zsd	*Eutrophic*	*Eutrophic*	*Mesotrophic*
Kayuta Lake	Oligo*eutrophic*	52	37	52	TP	*Eutrophic*	*Oligotrophic*	*Eutrophic*
Kellum Lake	Meso*ligotrophic*	42	36	44	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Lake Bonaparte	Meso*ligotrophic*	37	34	38	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Lake Clear	Meso*ligotrophic*	39	35	41	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Lake Colby	*Mesotrophic*	38	40	44	None	*Mesotrophic*	*Mesotrophic*	*Mesotrophic*
Lake Forest	*Mesotrophic*	46	41	44	None	*Mesotrophic*	*Mesotrophic*	*Mesotrophic*
Lake George	*Oligotrophic*	30	31	30	None	*Oligotrophic*	*Oligotrophic*	*Oligotrophic*
Lake Kiwassa	Meso*ligotrophic*	37	33	40	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Lake Luzerne	Meso*ligotrophic*	40	35	42	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*

Lake Name	Trophic Assessment	TSI-Zsd	TSI-TP	TSI-Chl.a	Outlier	Zsd Trophic Assessment	TP Trophic Assessment	Chl *a* Trophic Assessment
Lake of the Isles	*Mesotrophic*	40	44	43	None	*Mesotrophic*	*Mesotrophic*	*Mesotrophic*
Lake of the Woods	*Oligotrophic*	33	30	34	None	*Oligotrophic*	*Oligotrophic*	*Oligotrophic*
Lake Placid	*Oligotrophic*	30	25	36	None	*Oligotrophic*	*Oligotrophic*	*Oligotrophic*
Lake Titus	*Mesotrophic*	44	42	50	None	*Mesotrophic*	*Mesotrophic*	*Mesotrophic*
Lincoln Pond	Meso*ligotrophic*	38	35	38	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Little Wolf Lake	Meso*ligotrophic*	45	37	45	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Loon Lake	Meso*ligotrophic*	41	37	45	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Lorton Lake	*Mesotrophic*	50	46	49	None	*Mesotrophic*	*Mesotrophic*	*Mesotrophic*
Lower Chateaugay Lake	Meso*eutrophic*	44	45	52	None	*Mesotrophic*	*Mesotrophic*	*Eutrophic*
Lower St. Regis Lake	Meso*eutrophic*	44	44	52	None	*Mesotrophic*	*Mesotrophic*	*Eutrophic*
Mayfield Lake	Meso*eutrophic*	51	42	47	None	*Eutrophic*	*Mesotrophic*	*Mesotrophic*
Millsite Lake	Meso*ligotrophic*	32	34	37	None	*Oligotrophic*	*Oligotrophic*	*Oligotrophic*
Mirror Lake	*Oligotrophic*	34	31	33	None	*Oligotrophic*	*Oligotrophic*	*Oligotrophic*
Moon Lake	*Eutrophic*	52	52	61	None	*Eutrophic*	*Eutrophic*	*Eutrophic*
Moreau Lake	*Oligotrophic*	31	30	36	None	*Oligotrophic*	*Oligotrophic*	*Oligotrophic*
Mountain Lake	Meso*ligotrophic*	45	36	41	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Mountain View Lake	Meso*eutrophic*	53	45	49	None	*Eutrophic*	*Mesotrophic*	*Mesotrophic*
North Sandy Pond	*Eutrophic*	56	57	66	None	*Eutrophic*	*Eutrophic*	*Eutrophic*
Otter Lake	*Mesotrophic*	50	41	48	None	*Mesotrophic*	*Mesotrophic*	*Mesotrophic*
Paradox Lake	Meso*ligotrophic*	37	36	39	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Peck Lake	Meso*ligotrophic*	40	29	45	TP	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Piseco Lake	Meso*ligotrophic*	38	33	42	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Pleasant Lake	Meso*ligotrophic*	39	32	40	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Rondaxe Lake	Meso*ligotrophic*	39	30	39	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Sacandaga Lake	Meso*ligotrophic*	39	31	45	TP,Chl.a	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Schroon Lake	Meso*ligotrophic*	40	35	42	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Silver Lake-Clinton	Meso*ligotrophic*	35	30	39	None	*Oligotrophic*	*Oligotrophic*	*Mesotrophic*
Silver Lake-St.Lawrence	*Mesotrophic*	43	39	44	None	*Mesotrophic*	*Mesotrophic*	*Mesotrophic*
Sixberry Lake	*Oligotrophic*	34	27	32	None	*Oligotrophic*	*Oligotrophic*	*Oligotrophic*
Spitfire Lake	*Mesotrophic*	38	38	43	None	*Mesotrophic*	*Mesotrophic*	*Mesotrophic*
Star Lake	Meso*ligotrophic*	33	28	40	TP,Chl.a	*Oligotrophic*	*Oligotrophic*	*Mesotrophic*
Stewarts Landing	Meso*ligotrophic*	49	35	39	TP	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Twitchell Lake	Meso*ligotrophic*	38	35	38	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Upper Chateaugay Lake	Meso*ligotrophic*	39	36	42	None	*Mesotrophic*	*Oligotrophic*	*Mesotrophic*
Upper Saranac Lake	*Mesotrophic*	44	43	46	None	*Mesotrophic*	*Mesotrophic*	*Mesotrophic*
Upper St. Regis Lake	*Mesotrophic*	39	38	44	None	*Mesotrophic*	*Mesotrophic*	*Mesotrophic*
West Caroga Lake	Meso*ligotrophic*	38	34	36	None	*Mesotrophic*	*Oligotrophic*	*Oligotrophic*
Windover Lake	Meso*eutrophic*	51	43	45	None	*Eutrophic*	*Mesotrophic*	*Mesotrophic*

Zsd = Secchi disk transparency; TP = total phosphorus; Chl.a = chlorophyll *a*
Outlier – trophic indicator(s) for which the calculated TSI is more than 10 points different than the other TSIs
Trophic assessments based on NYS TSI calculations

An evaluation of the TSI outliers for individual waterbodies is included in the regional summaries.

Chapter 4: Evaluation of Limnological Indicators

NO_x Fact Sheet
Chapter 4.1: Evaluation of Adirondack Region NO_x

Ammonia Fact Sheet
Chapter 4.2: Evaluation of Adirondack Region Ammonia

Total Nitrogen Fact Sheet
Chapter 4.3: Evaluation of Adirondack Region Total Nitrogen

True Color Fact Sheet
Chapter 4.4: Evaluation of Adirondack Region True Color

pH Fact Sheet
Chapter 4.5: Evaluation of Adirondack Region pH

Conductivity Fact Sheet
Chapter 4.6: Evaluation of Adirondack Region Conductivity

Calcium Fact Sheet
Chapter 4.7: Evaluation of Adirondack Region Calcium

NO_x (Nitrate + Nitrite) Fact Sheet

Description:	Nitrogen is a nutrient necessary for plant growth and can act as a limiting nutrient in some lakes, particularly in the spring and early summer. Nitrate (NO_3) is the form of nitrogen most readily available for biological uptake, including uptake by algae. It is more easily detected as NO_x, or nitrate + nitrite. Nitrite (NO_2) is rarely found in surface waters, and can be created as an intermediate step in denitrification, the conversion of nitrate into nitrogen gas in the absence of oxygen.
Importance:	nitrate can be a limiting nutrient for some forms of green algae and may be an important nutrient in some regions of the state, such as Long Island. Nitrate can be an important component of wastewater, stormwater, fertilizers, and soil erosion. Therefore, it can be an indirect surrogate for pollutant loading to lakes, although elevated nitrate readings may be natural in some parts of the state. Nitrite can be toxic to aquatic life, though it readily converts to nitrate (or other forms of nitrogen) in the presence of oxygen.
How Measured: in CSLAP	NO_x is analyzed from the surface (1.5 meter grab) sample collected with the use of a Kemmerer bottle and transferred to a collapsible container and pre-labeled sample aliquot bottles. Deepwater NO_x samples were only collected during the 2002 CSLAP sampling season. NO_x is analyzed using a spectrophotometer.
Detection Limit:	0.005 mg/l NO_x, 0.003 mg/l NO_2 (prior to 1988, NO_x detection limit = 0.05 mg/l; from 1988 to 2002, NO_x detection limit = 0.02 mg/l)
Range in CSLAP:	undetectable (< 0.005 mg/l) to 3.9 g/l; 87% of readings are less than 0.1 mg/l.
WQ Standards:	the narrative standard for nitrogen is "none in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages." No water quality standard exists for NO_x. The state water quality standard for nitrate is 10 mg/l, to protect babies from methamoglobonemia. The state water quality standard for nitrite is 20 µg/l to protect trout (in waterbodies classified for trout survival or spawning), 100 µg/l to protect (other) aquatic life, and 1 mg/l to protect human health (potable water).
Trophic Assessment:	New York State does not use NO_x (or the components NO_3 or NO_2) in its trophic assessments. Samples are evaluated only against the state water quality standards.

Chapter 4- Evaluation of Limnological Indicators

Chapter 4.1- Evaluation of Adirondack Region NO_x: 1986-2009

Summary of CSLAP NOx Findings in Adirondack Region Lakes, 1986-2009

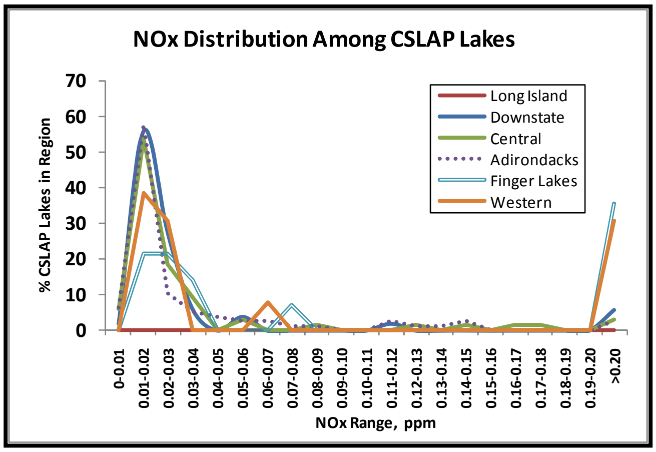
1. CSLAP lakes within the Adirondack region have NO_x readings that are close to the analytical detection limit and similar to those in other parts of the state.
2. CSLAP lakes within the Adirondack region have slightly lower NO_x readings than non-CSLAP lakes in the same region, although CSLAP and non-CSLAP lakes in the same depth and size are probably comparable.
3. Lower NO_x readings have been apparent in drier years in CSLAP lakes, although higher readings have not been apparent in wetter years.
4. NO_x readings in CSLAP lakes in the Adirondack region may have decreased slightly over the last twenty five years, perhaps due in part to reduced atmospheric NO_x emissions, although this change may be masked by several changes in analytical detection limits over this period.
5. There does not appear to be a strong sub-regional distribution of NO_x readings within the CSLAP dataset in the Adirondack region, although readings are generally highest in the southern portions of the region and lowest in the eastern to northeastern part of the region.
6. Only a small number of CSLAP lakes in the Adirondack region have exhibited a long-term change in NO_x readings, and only in one lake (Effley Falls Lake) does this change appear to be statistically significant.
7. NO_x readings were lower than normal in the Adirondack region in 2009, based on the high percentage of lakes with lower than normal readings. This may also be a consequence of Clean Air Act emission reductions, although annual weather variability probably plays a stronger role in changes in NO_x readings during any particular sampling season.

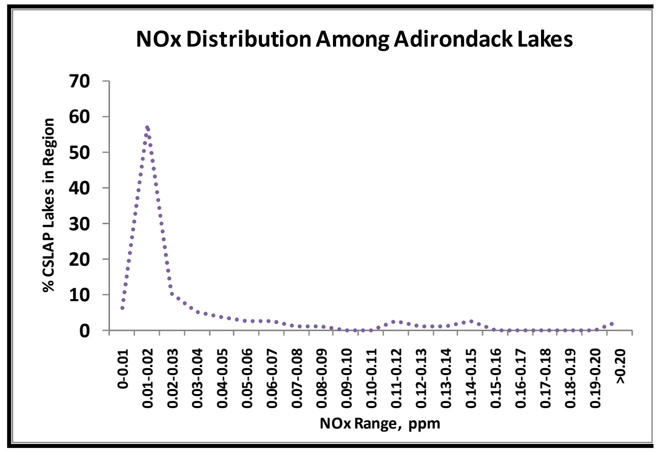
Adirondack Region Data Compared to NYS Data

CSLAP lakes in the Adirondack region have NO_x readings similar to these measured in other regions of the state, as demonstrated in Figure 4.1.1. The most common range of NO_x readings in CSLAP Adirondack region lakes is in the 0.01 to 0.02 mg/l range, very close to the analytical detection limit during most CSLAP sampling seasons. Very few Adirondack region lakes have NO_x readings above 0.01 mg/l, as seen in Figure 4.1.2.

Comparison of CSLAP to NYS Lakes in the Adirondack Region

There are slightly more Adirondack region lakes with NO_x readings in the 0.01-0.02 mg/l range in CSLAP than was found in other New York state monitoring programs, as seen in Figure 4.1.3. As discussed in the phosphorus section, the majority of the lake water quality data outside of CSLAP comes from the ALSC study of more than 1500 mostly small, high elevation lakes within the Adirondacks, Catskills and nearby regions. It is likely that the ALSC dataset includes a large number of shallow, highly colored lakes with slightly higher NO_x readings than seen in the rest of the CSLAP dataset. For the larger, deeper lakes within this region, the CSLAP and NYS dataset appears to be comparable.





Figures 4.1.1 and 4.1.2: Distribution of NO_x Ranges in CSLAP and Adirondack Region Lakes

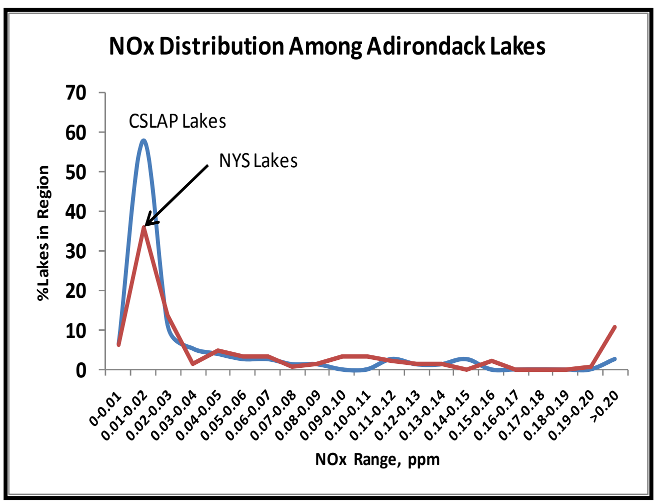


Figure 4.1.3: Average Distribution of NO_x Readings in New York State and CSLAP Lakes in the Adirondack Region

Annual Variability:

NO_x has varied from year to year in Adirondack lakes, although the differences have been relatively small. The highest NO_x readings measured through CSLAP occurred during 1986, 2004, 1990 and 2005. These occurred in both very wet and very dry years. The lowest NO_x readings occurred in 2002, 2003, 1991, and 1988; these also occurred in wetter and drier than normal years. Table 4.1.1 looks at the percentage of CSLAP lakes with high NO_x (greater than 1 standard error above normal) and low NO_x (greater than 1 standard error below normal) readings in wet and dry years. These data show that lower NO_x readings occur in wetter years, and dry years bring neither higher nor lower NO_x readings.

Table 4.1.1- % of CSLAP Lakes with Higher or Lower (than Normal) NO_x Readings During Dry and Wet Years in the Adirondack Region

	Dry Years	Wet Years
Higher NO_x	27%	19%
Lower NO_x	25%	33%

Dry Years: 1988, 1995, 2004, 2005
Wet Years: 1990, 1998, 2000, 2002, 2008
"Higher" and "Lower" defined as >1 SE higher than and lower than normal, respectively

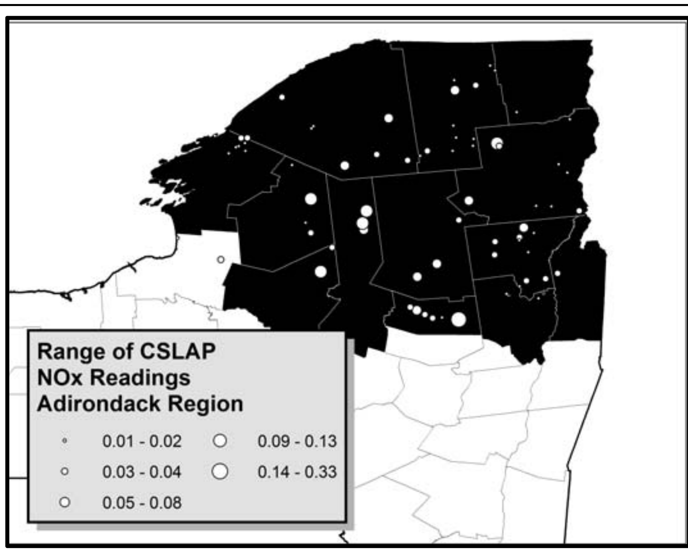
Long Term Trends:

The evaluation of long-term trends since 1986 in the Adirondack region lakes is adversely affected by the small number of lakes sampled during some sampling seasons, particularly in the earliest years of CSLAP (from 1986 to 1990). Since 1986, the frequency of lower than normal NO_x readings has increased, although these trends are no doubt strongly influenced by the shift in analytical detection limits over the last 25 years. However, this may also partially be a consequence of federal Clean Air legislation reducing NO_x emissions in the last two decades. The frequency of higher than normal NOx readings has not changed in any significant way since 1986.

Regional Distribution:

NO_x readings with the Adirondack region are highest in the south to southwestern portion of the region, although high NO_x readings are not found in any lakes within this region. The lowest readings are generally found in the northeastern and eastern portions of the region, although low NO_x readings are also commonly found in the Indian River lakes area in western St. Lawrence and northern Jefferson Counties. This is seen in Figure 4.1.4.

Table 4.1.2 shows the number of NO_x samples, the minimum, average, and maximum NO_x readings, and whether NO_x readings have changed since CSLAP sampling began in the lake. This long-term assessment was limited to lakes sampled for at least five years through 2009.



Figures 4.1.4: Range of NO_x Readings in the Adirondack Region

Several lakes within the Adirondack region have exhibited long-term trends in NO_x readings. NO_x readings increased in Star Lake during the CSLAP sampling duration at the lake. This lake has not been sampled through CSLAP since 1998, so it is not known if this apparent NO_x trend has continued or if it represented normal variability.

Eagle Lake, Effley Falls Lake, Grass Lake, Lincoln Pond, and North Sandy Pond have each exhibited decreasing NO_x readings. The decrease in Eagle Lake, Grass Lake and Lincoln Pond has been small, and may be within the normal variability for these lakes. Grass Lake NO_x readings at times exhibit a strong seasonal decrease, with peak readings in response to spring snowpack runoff. The decrease in recent years may be due in part to changes in snowpack melt rate and fewer early season sampling sessions. NO_x readings in Effley Falls Lake were substantially higher in the late 1990s than in recent years, and this decrease may be statistically significant. North Sandy Pond has not been sampled through CSLAP since 1990, so it is not known if this apparent NO_x trend has continued or if it represented normal variability.

Table 4.1.2: Surface NO_x Summary in CSLAP Adirondack Region Lakes, 1986-2009

Lake Name	Years	Num	Min	Avg	Max	Change?
Adirondack Lake	1986-1989	34	0.01	0.02	0.03	
Augur Lake	1997-2009	85	0.00	0.01	0.06	No
Augur Lake	2009	8	0.01	0.01	0.02	No
Bartlett Pond	1997-2000	25	0.01	0.01	0.01	
Black Lake	1988-2009	158	0.00	0.02	0.14	No
Black Lake	2009	8	0.00	0.01	0.02	Lower
Brant Lake	1987-2003	76	0.00	0.01	0.10	No
Brantingham Lake	2001-2009	68	0.00	0.02	0.14	No
Brantingham Lake	2009	7	0.01	0.02	0.04	Lower
Butterfield Lake	1986-2009	174	0.00	0.02	0.81	No
Butterfield Lake	2009	8	0.01	0.11	0.81	Higher
Canada Lake	2001-2009	68	0.01	0.14	0.48	No
Canada Lake	2009	8	0.03	0.07	0.14	Lower
Chase Lake	1990-1997	40	0.01	0.01	0.06	No
Eagle Crag Lake	1986-2005	103	0.00	0.02	0.20	No
Eagle Lake	2000-2009	72	0.00	0.02	0.24	Decreasing
Eagle Lake	2009	9	0.01	0.05	0.24	Higher
Eagle Pond	2008-2009	15	0.01	0.04	0.13	
Eagle Pond	2009	8	0.01	0.03	0.07	Lower
East Caroga Lake	1990-2009	108	0.00	0.01	0.12	No
East Caroga Lake	2009	6	0.01	0.02	0.07	Higher
Effley Falls Lake	1997-2009	83	0.01	0.13	0.36	Decreasing
Effley Falls Lake	2009	8	0.05	0.09	0.13	Lower
Efner Lake	1997-2001	38	0.01	0.01	0.06	No
Friends Lake	1991-2009	99	0.00	0.01	0.07	No
Friends Lake	2009	8	0.00	0.01	0.01	Lower
Fulton Second Lake	1986-2009	155	0.00	0.08	0.59	No
Fulton Second Lake	2009	8	0.00	0.03	0.06	Lower
Garnet Lake	1989-2001	34	0.01	0.02	0.16	No
Glen Lake	1986-2009	108	0.00	0.02	0.13	No
Glen Lake	2009	7	0.00	0.01	0.04	Lower
Goodnow Flow	1986-2009	108	0.00	0.04	0.31	No
Goodnow Flow	2009	7	0.01	0.01	0.02	Lower
Grass Lake	2004-2009	46	0.00	0.03	0.25	Decreasing
Grass Lake	2009	8	0.01	0.03	0.05	No
Gull Pond	1994-1998	40	0.01	0.01	0.02	No
Hadlock Pond	1997-2001	18	0.01	0.02	0.16	No
Horseshoe Pond	2000-2009	74	0.00	0.04	0.15	No
Horseshoe Pond	2009	8	0.01	0.05	0.08	Higher
Hunt Lake	1994-2009	92	0.00	0.02	0.19	No
Hunt Lake	2009	8	0.00	0.01	0.03	Lower
Hyde Lake	1999-2009	41	0.00	0.02	0.10	No
Hyde Lake	2009	8	0.01	0.01	0.03	No
Indian Lake	1986-1997	48	0.01	0.02	0.03	No
Jenny Lake	1994-2007	64	0.00	0.02	0.25	No

Lake Name	Years	Num	Min	Avg	Max	Change?
Joe Indian Lake	1986-1990	48	0.01	0.06	0.12	No
Kayuta Lake	1997-2001	39	0.01	0.11	0.26	No
Kellum Lake	1997-2001	35	0.01	0.01	0.04	No
Lake Bonaparte	1988-2009	99	0.00	0.01	0.15	No
Lake Bonaparte	2009	8	0.00	0.02	0.04	Higher
Lake Clear	1998-2009	92	0.00	0.01	0.18	No
Lake Clear	2009	8	0.00	0.02	0.04	No
Lake Colby	1999-2001	17	0.01	0.01	0.01	
Lake Forest	2001-2009	53	0.00	0.02	0.28	No
Lake Forest	2009	6	0.01	0.02	0.04	No
Lake George	2004-2008	21	0.00	0.02	0.09	No
Lake George	2009	8	0.01	0.01	0.01	
Lake Kiwassa	1990-1995	40	0.01	0.01	0.02	No
Lake Luzerne	1999-2004	38	0.00	0.01	0.04	No
Lake of the Isles	2000-2001	16	0.01	0.01	0.04	
Lake of the Woods	1994-2008	54	0.00	0.01	0.13	No
Lake Placid	1991-2009	112	0.00	0.13	2.29	No
Lake Placid	2009	4	0.01	0.06	0.10	Lower
Lake Titus	1999-2001	19	0.01	0.01	0.02	
Lincoln Pond	1997-2009	60	0.00	0.01	0.10	Decreasing
Lincoln Pond	2009	5	0.01	0.01	0.01	Lower
Little Wolf Lake	1998-2000	18	0.01	0.02	0.14	
Loon Lake	1986-1997	44	0.01	0.02	0.06	No
Lorton Lake	1990-2009	119	0.00	0.02	0.57	No
Lorton Lake	2009	8	0.01	0.05	0.18	Higher
Lower Chateaugay Lake	1991-1995	33	0.01	0.01	0.03	No
Lower St. Regis Lake	2000-2002	14	0.00	0.01	0.01	
Mayfield Lake	2000-2004	27	0.01	0.33	0.75	No
Millsite Lake	1997-2009	99	0.00	0.01	0.22	No
Millsite Lake	2009	8	0.01	0.01	0.02	Lower
Mirror Lake	1998-2009	69	0.00	0.02	0.11	No
Mirror Lake	2009	7	0.01	0.01	0.03	Lower
Moon Lake	1992-1996	38	0.01	0.01	0.02	No
Moreau Lake	1994-2002	61	0.01	0.01	0.03	No
Mountain Lake	1998-2001	29	0.01	0.01	0.03	
Mountain View Lake	1991-1997	38	0.01	0.02	0.08	No
North Sandy Pond	1986-1990	45	0.01	0.02	0.03	Decreasing
Otter Lake	1992-2009	90	0.00	0.02	0.44	No
Otter Lake	2009	8	0.00	0.01	0.03	Lower
Paradox Lake	2003-2009	55	0.00	0.01	0.08	No
Paradox Lake	2009	8	0.00	0.01	0.03	Lower
Peck Lake	1992-2009	46	0.00	0.03	0.13	No
Peck Lake	2009	8	0.01	0.02	0.05	Lower
Piseco Lake	1999-2003	31	0.01	0.07	0.15	No
Pleasant Lake	2000-2009	60	0.00	0.03	0.18	No
Pleasant Lake	2009	2	0.02	0.02	0.03	Lower
Rondaxe Lake	1998-2001	31	0.01	0.12	0.64	
Sacandaga Lake	1987-2009	92	0.00	0.04	0.25	No
Sacandaga Lake	2009	8	0.00	0.01	0.01	Lower
Schroon Lake	1987-2009	106	0.00	0.04	0.15	No
Schroon Lake	2009	7	0.01	0.03	0.06	Lower
Silver Lake	1989-1993	25	0.01	0.01	0.03	No
Silver Lake	1996-2009	84	0.00	0.02	0.25	No
Silver Lake	2009	7	0.01	0.02	0.04	No
Sixberry Lake	2001-2004	25	0.00	0.01	0.04	
Spitfire Lake	1996-2002	42	0.00	0.01	0.02	No

Lake Name	Years	Num	Min	Avg	Max	Change?
Star Lake	1994-1998	40	0.01	0.06	0.22	Increasing
Stewarts Landing	1997-2001	40	0.01	0.06	0.21	No
Twitchell Lake	1986-1996	33	0.01	0.12	0.30	No
Upper Chateaugay Lake	1990-1994	31	0.01	0.02	0.06	No
Upper Saranac Lake	2006-2009	27	0.00	0.01	0.06	
Upper Saranac Lake	2009	8	0.00	0.01	0.06	No
Upper St. Regis Lake	1997-2002	47	0.00	0.01	0.02	No
West Caroga Lake	1997-2007	28	0.01	0.03	0.13	No
Windover Lake	1999-2003	37	0.00	0.03	0.65	No

Num = number of samples
Min, Avg, Max = minimum, average, and maximum NO_x, in mg/l
Change? = exhibiting significant change in NO_x readings (best fit line of annual means with $R^2 > 0.5$ and seasonal Kendall-Tau rank correlation coefficient > 0.5); 2009 change based on NO_x readings >25% higher or lower than normal

Tables 4.1.3a and 4.1.3b summarize the NO_x data collected through CSLAP in 2009, and compare these data to the data collected for each program lake in the region prior to 2009. NO_x readings in the CSLAP lakes in the Adirondack region in 2009 were similar to those reported in previous years. The percentage of lakes with lower than normal NO_x readings in 2009 was much higher than the percentage of lakes with higher than normal readings, although a similar percentage of lakes established new minimum and new maximum readings in 2009. These data indicate that NO_x readings were largely unchanged in 2009.

Table 4.1.3a: Surface NOx Summary in CSLAP Lakes, 2009

Region	Number Lakes	Minimum	Average 2009	Average 1986-08	Maximum
Downstate	32	<0.01	0.04	0.09	0.86
Central	36	<0.01	0.07	0.05	2.50
Adirondacks	33	<0.01	0.03	0.03	0.81
Western	9	<0.01	0.04	0.17	0.39
CSLAP Statewide	**110**	**0.00**	**0.05**	**0.07**	**2.50**

Table 4.1.3b: Surface NOx Summary in CSLAP Lakes, 2009

Region	Number Lakes	Average 2009	Average 1986-08	%Higher	%Lower	%Above Max	%Below Min
Downstate	32	0.04	0.09	37	27	43	14
Central	36	0.07	0.05	28	42	11	3
Adirondacks	33	0.03	0.03	19	65	10	6
Western	9	0.04	0.17	0	57	0	0
CSLAP Statewide	**110**	**0.05**	**0.07**	**25**	**44**	**18**	**6**

% Higher = percentage of lakes in region with NOx readings in 2009 >25% higher than normal (before 2009)
% Lower = percentage of lakes in region with NOx readings in 2009 <25% below normal (before 2009)
% Above Max = percentage of lakes in region with NOx readings in 2009 above previous maximum (before 2009) for lake
% Below Min = percentage of lakes in region with NOx readings in 2009 below previous minimum (before 2009) for lake

Adirondack Region Lakes With Higher Than Normal NOx in 2009:
Butterfield Lake, Eagle Lake, East Caroga Lake, Horseshoe Pond, Lake Bonaparte, Lorton Lake

Discussion:

Six Adirondack-region lakes exhibited higher than normal NO_x readings in 2009. The 2009 NO_x average for Butterfield Lake, Eagle Lake, and Lorton Lake were strongly influenced by a single (or two) elevated NO_x reading(s) not associated with changes in any other water quality indicators. For these lakes, it is unlikely that this 2009 “increase” is part of a longer-term trend. For East Caroga Lake and Lake Bonaparte, the higher 2009 averages were only slightly higher than those measured in previous years and no doubt represents normal variability. NO_x readings in Horseshoe Pond were consistently higher than normal in 2009, but the sampling volunteers did not report if this may have been in response to wetter (or drier) than normal conditions. Additional data will help to determine if the higher NO_x readings in Horseshoe Pond are the start of rising NO_x readings in the lake.

Adirondack Region Lakes With Lower Than Normal NOx in 2009:

Black Lake, Brantingham Lake, Canada Lake, Eagle Pond, Effley Falls Lake, Friends Lake, Fulton Second Lake, Glen Lake, Goodnow Flow, Hunt Lake, Lake Placid, Lincoln Pond, Millsite Lake, Mirror Lake, Otter Lake, Paradox Lake, Peck Lake, Pleasant Lake, Sacandaga Lake, Schroon Lake

Discussion:

NO_x readings in 2009 were lower than normal in 20 Adirondack region lakes. Effley Falls Lake is the only one of these 19 lakes that has exhibited a long-term decrease in NO_x readings. This 2009 decrease may be part of a longer-term trend, but does not appear to have influenced changes in any other water quality indicators measured through CSLAP.

Black Lake, Brantingham Lake, Eagle Pond, Friends Lake, Glen Lake, Hunt Lake, Lincoln Pond, Millsite Lake, Mirror Lake, Otter Lake, Paradox Lake, Peck Lake, Pleasant Lake, and Schroon Lake all exhibited slightly lower than normal NO_x readings than normal in 2009, and it is clear that each of these readings were within the normal range of variability for these lakes. The decrease in Canada Lake, Fulton Second Lake, Goodnow Flow, Lake Placid, and Sacandaga Lake were slightly larger, although in all of these lakes, the long-term average NO_x readings for these lakes has been consistently low. For these lakes, the lower NO_x readings may have been in response to lake dilution from heavier rainfall during the year; however, only in Canada Lake, Fulton Second Lake and Goodnow Flow were high flow and heavy rain conditions reported by the sampling volunteers.

As noted above, federal Clean Air Act legislation has reduced the atmospheric NO_x emissions entering the northeast, and the decrease in stream and lake NO_x readings have been documented in some New York state lakes. It is possible that the NO_x decrease seen in these CSLAP lakes may be part of a longer-term trend, although significant long-term decreases in NO_x readings have not (yet) been apparent in most CSLAP lakes.

Ammonia Fact Sheet

Description:	Ammonia is a micronutrient and a form of nitrogen (and hydrogen) represented by the formula NH_3. It is produced from nitrogen gas by nitrogen fixation and through the degradation of organic matter, found in wastewater, and generated through several biological processes.
Importance:	ammonia is toxic to aquatic organisms and (to a much lesser extent) humans at concentrations occasionally found in lake water, particularly at high pH or in the absence of oxygen (such as occasionally found in the bottom waters of productive lakes). High ammonia readings may also be a sign of other forms of pollution and indicate persistent problems with anoxia (lack of oxygen).
How Measured: in CSLAP	total NH_3 is analyzed from the surface (1.5 meter grab) sample collected with the use of a Kemmerer bottle and transferred to a collapsible container and pre-labeled sample aliquot bottles. Deepwater NH3 samples were collected during the 2002 and 2009 CSLAP sampling seasons. NH_3 is analyzed using a spectrophotometer.
Detection Limit:	0.004 mg/l tNH_3 (total ammonia)
Range in NYS:	undetectable (< 0.004 mg/l) to 4.1 mg/l; 70% of surface readings are between 0.01 mg/l and 0.1 mg/l, and 24% of samples are less than 0.01 mg/l.
WQ Standards:	the narrative standard for nitrogen is "none in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages." The state water quality standard for total NH_3 is 2.0 mg/l for potable water supplies. The standard for unionized ammonia is a function of pH and temperature, and is quantified within a matrix found in the published state water quality standards. It is as low as 0.7 µg/l at 0ºC at a pH of 6.5.
Trophic Assessment:	New York State does not use NH_3 in its trophic assessments. Samples are evaluated only against the state water quality standards.

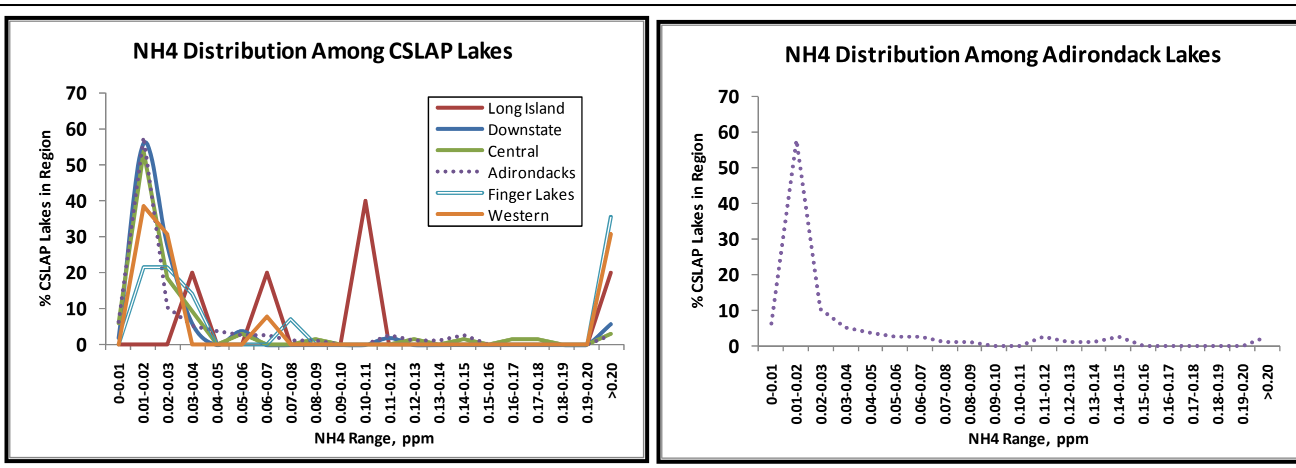
Chapter 4.2- Evaluation of Adirondack Region Ammonia: 1986-2009

Summary of CSLAP Ammonia Findings in Adirondack Region Lakes, 1986-2009

1. CSLAP lakes within the Adirondack region have low ammonia readings
2. There does not appear to be a clear relationship between ammonia and precipitation in the Adirondack region lakes.
3. Given the shore timeframe in which ammonia data have been collected, it is premature to evaluate any long-term trends (and no trends have been apparent over the last eight years).
4. Ammonia readings are highest in the western and southern portions of the Adirondack region, and lowest in the central and eastern portion of the regions, although low readings have been found in most lakes.
5. No CSLAP lakes in the Adirondack region have exhibited a long-term change in ammonia readings.
6. More Adirondack region CSLAP lakes had lower than normal ammonia readings in 2009 than had higher readings, but the differences in ammonia readings between 2009 and the typical CSLAP sampling season was small in nearly all of these lakes.
7. Deepwater ammonia readings were higher than those measured at the lake surface in a small number of moderately productive Adirondack region lakes, but none of these lakes had ammonia readings above the state water quality standard. None of the Adirondack region lakes used as a potable water supply had high hypolimnetic ammonia levels.

Adirondack Region Data Compared to NYS Data

CSLAP lakes in the Adirondack region have slightly less ammonia than in the Downstate (Long Island) and Western (Finger Lakes) regions of the state, as demonstrated in Figure 4.2.1. The most common range of ammonia readings in CSLAP Adirondack region lakes is in the 0.01 to 0.03 mg/l (ppm) range, with decreasing frequency as ammonia levels increase, although a few lakes also have ammonia readings between 0.10 and 0.15 mg/l. Very few Adirondack region lakes have ammonia readings above 0.2 mg/l, as seen in Figure 4.2.2.



Figures 4.2.1 and 4.2.2: Distribution of Ammonia Ranges in CSLAP and Adirondack Region Lakes

Comparison of CSLAP to NYS Lakes in the Adirondack Region

Ammonia has not been collected in or evaluated through most of the non-CSLAP monitoring programs conducted within the Adirondack region, including the ALSC study. Therefore, a comparison of ammonia readings between CSLAP and non-CSLAP lakes within the Adirondack region is not possible.

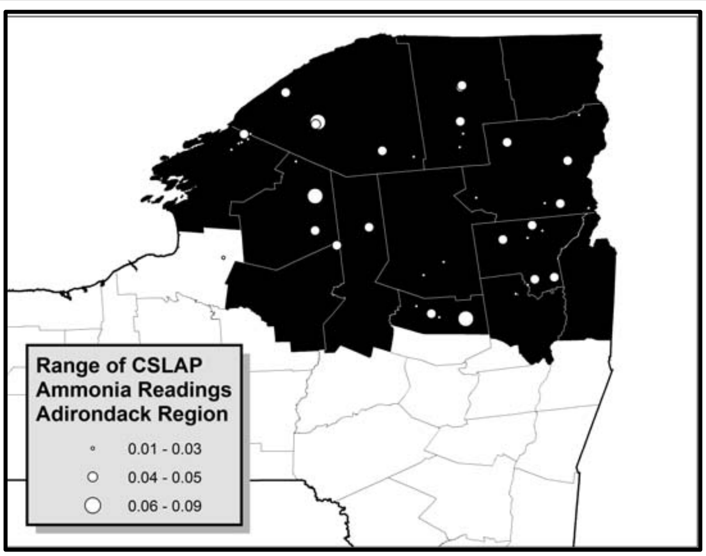
Annual Variability:

The highest ammonia readings within the Adirondack region measured through CSLAP occurred during 2002 and 2006, the two years with the wettest spring. The lowest ammonia readings occurred in 2005, 2004 and 2003, a mix of wet and dry years. Table 4.2.1 looks at the percentage of CSLAP lakes with high ammonia (greater than 1 standard error above normal) and low ammonia (greater than 1 standard error below normal) readings in wet and dry years. These data show that lower ammonia readings occur in drier years, and higher ammonia readings are found in wet years. Additional years of ammonia data (and broad ranges of precipitation data) may be needed to verify the relationship between ammonia and both wet and dry years.

Table 4.2.1- % of CSLAP Lakes with Higher or Lower (than Normal) Ammonia Readings During Dry and Wet Years in the Adirondack Region

	Dry Years	Wet Years
Higher Ammonia	10%	31%
Lower Ammonia	38%	2%

Dry Years: 1988, 1995, 2004, 2005
Wet Years: 1990, 1998, 2000, 2002, 2008
"Higher" and "Lower" defined as >1 SE higher than and lower than normal, respectively



Figures 4.2.3: Range of Ammonia Readings in the Adirondack Region

Long Term Trends:

The evaluation of long-term trends since 1986 in the Adirondack region lakes is adversely affected by the small number of lakes sampled during some sampling seasons, particularly in the earliest years of CSLAP (from 1986 to 1990). This is less of an issue for evaluation of ammonia, total nitrogen, and calcium trends, since these data were first collected in 2002, but evaluation of trends with these indicators is affected by the short timeframe of data collection. Since 2002, the frequency of higher ammonia readings has decreased, although these trends appear to be statistically weak. These trends are essentially non-existent when the elevated ammonia readings from 2002 (the first year of ammonia analysis, at a subcontractor laboratory) are removed from the database. These data indicate no long-term trends in ammonia readings since 2002.

Regional Distribution:

Ammonia readings within the Adirondack region are highest in the western and southern portions of the region, although these lakes are interspersed with lakes with low ammonia readings. Each of the lakes within this region has surface ammonia readings that are more than 200x lower than the state water quality standard, although some deepwater ammonia readings approach these standards. The lowest ammonia readings are generally found in the central and eastern portion of the region, although many low (surface) ammonia lakes are found in the Indian River lakes region.

Table 4.2.2 shows the number of ammonia samples, the minimum, average, and maximum ammonia readings, and whether ammonia readings have changed since CSLAP sampling began in the lake. This long-term assessment was limited to lakes sampled for at least five years through 2009.

Table 4.2.2: Surface Ammonia Summary in CSLAP Adirondack Region Lakes, 1986-2009

Lake Name	Years	Num	Min	Avg	Max	Change?
Augur Lake	1997-2009	53	0.00	0.02	0.08	No
Augur Lake	2009	8	0.02	0.03	0.04	Higher
Black Lake	1988-2009	47	0.00	0.03	0.12	No
Black Lake	2009	8	0.01	0.04	0.12	No
Brant Lake	1987-2003	14	0.00	0.03	0.05	
Brantingham Lake	2001-2009	61	0.01	0.04	0.65	No
Brantingham Lake	2009	7	0.01	0.01	0.02	Lower
Butterfield Lake	1986-2009	58	0.00	0.04	0.36	No
Butterfield Lake	2009	8	0.01	0.07	0.36	Higher
Canada Lake	2001-2009	60	0.00	0.03	0.17	No
Canada Lake	2009	8	0.01	0.02	0.04	Lower
Eagle Crag Lake	1986-2005	32	0.00	0.02	0.31	
Eagle Lake	2000-2009	60	0.00	0.05	0.50	No
Eagle Lake	2009	9	0.14	0.27	0.50	Higher
Eagle Pond	2008-2009	15	0.00	0.03	0.12	
Eagle Pond	2009	8	0.01	0.03	0.04	No
East Caroga Lake	1990-2009	54	0.00	0.02	0.19	No
East Caroga Lake	2009	6	0.01	0.03	0.06	No
Effley Falls Lake	1997-2009	45	0.01	0.07	0.61	No
Effley Falls Lake	2009	8	0.01	0.18	0.61	Higher
Friends Lake	1991-2009	54	0.00	0.02	0.08	No
Friends Lake	2009	8	0.00	0.01	0.03	Lower
Fulton Second Lake	1986-2009	63	0.00	0.03	0.35	No
Fulton Second Lake	2009	8	0.01	0.08	0.35	Higher
Glen Lake	1986-2009	42	0.00	0.03	0.25	No
Glen Lake	2009	7	0.02	0.02	0.02	Lower
Goodnow Flow	1986-2009	21	0.01	0.02	0.05	
Goodnow Flow	2009	7	0.01	0.01	0.03	Lower
Grass Lake	2004-2009	45	0.00	0.04	0.38	No
Grass Lake	2009	8	0.01	0.12	0.38	Higher
Horseshoe Pond	2000-2009	56	0.00	0.04	0.12	No
Horseshoe Pond	2009	8	0.02	0.05	0.12	Higher
Hunt Lake	1994-2009	64	0.00	0.03	0.15	No
Hunt Lake	2009	8	0.01	0.02	0.04	Lower
Hyde Lake	1999-2009	25	0.00	0.02	0.06	
Hyde Lake	2009	8	0.00	0.02	0.05	Lower
Jenny Lake	1994-2007	25	0.00	0.03	0.10	No
Lake Bonaparte	1988-2009	24	0.00	0.02	0.05	

Lake Name	Years	Num	Min	Avg	Max	Change?
Lake Bonaparte	2009	8	0.00	0.01	0.02	Lower
Lake Clear	1998-2009	60	0.00	0.02	0.25	No
Lake Clear	2009	8	0.01	0.02	0.04	Lower
Lake Forest	2001-2009	46	0.01	0.03	0.12	No
Lake Forest	2009	6	0.01	0.02	0.03	Lower
Lake George	2004-2008	19	0.00	0.01	0.02	No
Lake Luzerne	1999-2004	22	0.00	0.02	0.11	
Lake of the Woods	1994-2008	31	0.00	0.03	0.24	No
Lake Placid	1991-2009	47	0.00	0.03	0.11	No
Lake Placid	2009	4	0.00	0.01	0.01	Lower
Lincoln Pond	1997-2009	20	0.01	0.03	0.16	
Lincoln Pond	2009	5	0.01	0.01	0.02	Lower
Lorton Lake	1990-2009	62	0.01	0.02	0.10	No
Lorton Lake	2009	8	0.01	0.02	0.03	No
Lower St. Regis Lake	2000-2002	3	0.01	0.04	0.06	
Mayfield Lake	2000-2004	14	0.00	0.09	0.30	
Millsite Lake	1997-2009	60	0.00	0.02	0.16	No
Millsite Lake	2009	8	0.01	0.02	0.08	No
Mirror Lake	1998-2009	45	0.01	0.03	0.27	No
Mirror Lake	2009	7	0.01	0.03	0.05	No
Otter Lake	1992-2009	51	0.01	0.04	0.14	No
Otter Lake	2009	8	0.02	0.04	0.08	No
Paradox Lake	2003-2009	53	0.00	0.02	0.14	No
Paradox Lake	2009	8	0.01	0.01	0.01	Lower
Peck Lake	1992-2009	16	0.00	0.02	0.07	
Peck Lake	2009	8	0.00	0.01	0.03	Lower
Piseco Lake	1999-2003	9	0.01	0.02	0.05	
Pleasant Lake	2000-2009	47	0.00	0.02	0.09	No
Pleasant Lake	2009	2	0.01	0.02	0.03	No
Sacandaga Lake	1987-2009	8	0.01	0.02	0.04	
Sacandaga Lake	2009	8	0.01	0.02	0.04	No
Schroon Lake	1987-2009	58	0.00	0.03	0.20	No
Schroon Lake	2009	7	0.01	0.02	0.04	Lower
Silver Lake	1996-2009	44	0.00	0.03	0.25	No
Silver Lake	2009	7	0.01	0.02	0.03	Lower
Sixberry Lake	2001-2004	19	0.00	0.02	0.07	
Spitfire Lake	1996-2002	6	0.03	0.08	0.24	
Upper Saranac Lake	2006-2009	26	0.01	0.02	0.10	
Upper Saranac Lake	2009	8	0.01	0.03	0.10	Higher
Upper St. Regis Lake	1997-2002	7	0.01	0.03	0.05	
West Caroga Lake	1997-2007	5	0.02	0.03	0.04	
Windover Lake	1999-2003	16	0.00	0.03	0.10	

Num = number of samples
Min, Avg, Max = minimum, average, and maximum NH_4 readings, in mg/l
Change? = exhibiting significant change in NH_4 readings (best fit line of annual means with $R^2 > 0.5$ and seasonal Kendall-Tau rank correlation coefficient > 0.5); 2009 change based on NH_4 readings >25% higher or lower than normal

None of the lakes within the Adirondack region has exhibited significant long-term trends in ammonia readings, although few lakes have been sampled long enough to evaluate these trends.

Tables 4.2.3a and 4.2.3b summarize the surface ammonia data collected through CSLAP in 2009, and compare these data to the data collected for each program lake in the region prior to 2009. Ammonia readings in the CSLAP lakes in the Adirondack region in 2009 were slightly higher than those reported in previous years. However, a greater percentage of Adirondack region lakes exhibited lower than normal ammonia readings in 2009, and the difference from 2009 from previous years was probably negligible. A similar percentage of Adirondack region lakes established new maximum and new minimum ammonia readings in 2009.

Table 4.2.3a: Surface Ammonia Summary in CSLAP Lakes, 2009

Region	Number Lakes	Minimum	Average 2009	Average 1986-08	Maximum
Downstate	32	0.00	0.07	0.07	1.57
Central	36	0.00	0.04	0.03	0.53
Adirondacks	33	0.00	0.04	0.03	0.61
Western	9	0.01	0.07	0.07	0.56
CSLAP Statewide	**110**	**0.00**	**0.05**	**0.04**	**1.57**

Table 4.2.3b: Surface Ammonia Summary in CSLAP Lakes, 2009

Region	Number Lakes	Average 2009	Average 1986-08	%Higher	%Lower	%Above Max	%Below Min
Downstate	32	0.07	0.07	31	47	31	31
Central	36	0.04	0.03	25	36	28	19
Adirondacks	33	0.04	0.03	25	47	28	22
Western	9	0.07	0.07	22	22	33	11
CSLAP Statewide	**110**	**0.05**	**0.04**	**27**	**41**	**29**	**23**

% Higher = percentage of lakes in region with NH_4 readings in 2009 >25% higher than normal (before 2009)
% Lower = percentage of lakes in region with NH_4 readings in 2009 <25% below normal (before 2009)
% Above Max = percentage of lakes in region with NH_4 readings in 2009 above previous maximum (before 2009) for lake
% Below Min = percentage of lakes in region with NH_4 readings in 2009 below previous minimum (before 2009) for lake

Adirondack Region Lakes With Higher Than Normal Ammonia in 2009:

Augur Lake, Butterfield Lake, Eagle Lake, Effley Falls Lake, Fulton Second Lake, Grass Lake, Horseshoe Pond, Upper Saranac Lake

Discussion:

Eight Adirondack-region lakes exhibited higher than normal ammonia readings in 2009. It is not known if the 2009 readings exceed the true normal range of ammonia readings in these lakes, since each of these lakes has a limited ammonia dataset.

Ammonia readings in Augur Lake, Horseshoe Pond, and Upper Saranac Lake were only slightly higher than those measured in previous years, and it is likely that the slight rise in ammonia readings in these lakes was within the normal range of variability.

The higher 2009 ammonia readings in Butterfield Lake, shown in Table 4.2.2 were associated with a single elevated reading not matched by similar changes in any other water quality indicators or explainable by other lake observations related to weather or other phenomena. It is unlikely that the higher readings in 2009 are part of a longer trend.

Ammonia readings in Fulton Second Lake were high early in the summer, coincident with surface scums and heavy rainfall. These readings reverted to normal later in the year, and there was no evidence that these temporarily (and slightly) elevated ammonia readings otherwise influenced lake conditions.

Eagle Lake ammonia readings were consistently higher than normal, though still well below the state water quality standards. Ammonia levels in Effley Falls Lake were much higher later in the summer (though still relatively low), but none of the field observations or other water quality indicators provide insights as to this change. Additional data will help to determine if these higher readings are part of a more permanent increase in ammonia readings or if they represent normal variability.

Adirondack Region Lakes With Lower Than Normal Ammonia in 2009:

Brantingham Lake, Canada Lake, Friends Lake, Glen Lake, Goodnow Flow, Hunt Lake, Hyde Lake. Lake Bonaparte, Lake Clear, Lake Forest, Lake Placid, Lincoln Pond, Paradox Lake, Peck Lake, Schroon Lake, Silver Lake

Discussion:

Ammonia readings in 2009 were lower than normal in 16 Adirondack region lakes, assuming that the 5-8 year average computed for each of these lakes prior to 2009 represents normal conditions for each lake.

Ammonia readings in Canada Lake, Friends Lake, Glen Lake, Goodnow Flow, Hunt Lake, Hyde Lake, Lake Bonaparte, Lake Clear, Lake Forest, Lake Placid, Lincoln Pond, Paradox Lake, Peck Lake, Schroon Lake and Silver Lake were only slightly lower than those measured in previous years, and it is likely that the slight drop in ammonia readings in these lakes was within the normal range of variability. The ammonia levels in each of these lakes continue to be very low.

The lower 2009 ammonia readings in Brantingham Lake, shown in Table 4.2.2 were very close to the analytical detection limit throughout the summer, consistently lower than normal. The sampling volunteers reported wetter and windy weather during much of the summer, but it is not known if these phenomena are related. It is likely that ammonia readings were return to their (slightly higher) long-term average in 2010.

Deepwater Ammonia

Table 4.2.4 shows the number of samples, and minimum, average and maximum reading deepwater (*hypolimnetic*) ammonia reading. These readings were generally collected from a depth of 1-2 meters from the lake bottom in thermally stratified lakes. This table also compares the average surface and hypolimnetic ammonia reading in each thermally stratified lake in this region sampled for deepwater ammonia. The most significant difference between surface and hypolimnetic readings was recorded at Butterfield Lake, Eagle Crag Lake, East Caroga Lake, Glen Lake, and Grass Lake. Butterfield Lake and Grass Lake also exhibited highly elevated hypolimnetic phosphorus readings, and can be classified as *mesotrophic* to *mesoeutrophic* lakes. Eagle Crag Lake, East Caroga Lake, and Glen Lake are *oligotrophic* to *mesoligotrophic*, and although these lakes likely exhibit significant hypolimnetic oxygen deficits, the elevated deepwater ammonia does not appear to migrate to the lake surface or otherwise affect surface waters.

The maximum hypolimnetic ammonia readings exceed 1 mg/l in Butterfield Lake and Grass Lake. Neither of these lakes is classified for potable water use, and none of the ammonia readings in these lakes exceed 2 mg/l, the state potable water quality standard for total ammonia. However, lake residents using bottom waters in these lakes are advised not to use this water for drinking purposes, given the risk of these intake waters creating health and aesthetic problems.

Table 4.2.4: Bottom Ammonia Summary in CSLAP Adirondack Region Lakes, 1986-2009

Lake Name	Years	Num	Min	Avg	Avg Surface NH4	Max
Augur Lake	1998-2009	4	0.03	0.08	0.02	0.21
Augur Lake	2009	8	0.03	0.08	0.02	0.21
Brant Lake	2002-2002	6	0.01	0.05	0.03	0.10
Brantingham Lake	2002-2009	12	0.01	0.11	0.04	0.50
Brantingham Lake	2009	7	0.01	0.04	0.01	0.10
Butterfield Lake	1993-2009	13	0.01	0.37	0.04	1.44
Butterfield Lake	2009	8	0.01	0.46	0.02	1.44
Canada Lake	2002-2009	12	0.03	0.09	0.03	0.30
Canada Lake	2009	8	0.04	0.12	0.01	0.30
Eagle Crag Lake	1986-2002	6	0.10	0.29	0.02	0.42
Eagle Lake	2002-2009	12	0.01	0.08	0.05	0.38
Eagle Lake	2009	8	0.08	0.21	0.01	0.38
East Caroga Lake	1993-2009	11	0.06	0.25	0.02	0.45
East Caroga Lake	2009	6	0.06	0.25	0.01	0.41
Friends Lake	1993-2009	9	0.01	0.03	0.02	0.09
Friends Lake	2009	8	0.01	0.01	0.01	0.02
Fulton Second Lake	1998-2009	4	0.05	0.08	0.03	0.11
Fulton Second Lake	2009	8	0.05	0.08	0.01	0.11
Glen Lake	1998-2009	8	0.01	0.20	0.03	0.35
Glen Lake	2009	7	0.11	0.23	0.01	0.35
Grass Lake	2005-2009	10	0.04	0.44	0.04	1.30
Grass Lake	2009	8	0.06	0.54	0.02	1.30
Hunt Lake	1998-2009	12	0.01	0.08	0.03	0.50
Hunt Lake	2009	8	0.01	0.13	0.01	0.50
Hyde Lake	2009-2009	4	0.00	0.01	0.02	0.02
Hyde Lake	2009	7	0.00	0.01	0.02	0.02
Jenny Lake	1995-2007	4	0.01	0.04	0.03	0.08
Lake Bonaparte	1998-2009	4	0.02	0.03	0.02	0.06
Lake Bonaparte	2009	8	0.02	0.03	0.01	0.06
Lake Clear	2002-2009	9	0.01	0.15	0.02	0.41
Lake Clear	2009	7	0.01	0.08	0.01	0.12
Lake George	2009	8	0.01	0.01	0.01	0.02
Lake Luzerne	2002-2002	7	0.02	0.04	0.02	0.07
Lake of the Woods	2002-2008	8	0.01	0.06	0.03	0.19
Lake Placid	1993-2009	3	0.02	0.03	0.03	0.06
Lake Placid	2009	4	0.02	0.02	0.00	0.03
Lincoln Pond	1999-2009	3	0.01	0.01	0.03	0.02
Lincoln Pond	2009	5	0.01	0.01	0.01	0.02
Lower St. Regis Lake	2002-2002	1	0.03	0.34	0.04	0.53
Millsite Lake	1998-2009	10	0.01	0.03	0.02	0.06
Millsite Lake	2009	8	0.01	0.03	0.01	0.06
Mirror Lake	2005-2009	4	0.01	0.02	0.03	0.03
Mirror Lake	2009	7	0.01	0.02	0.01	0.03
Piseco Lake	2002-2002	7	0.02	0.06	0.02	0.10
Pleasant Lake	2005-2009	1	0.08	0.08	0.02	0.08
Pleasant Lake	2009	2	0.08	0.08	0.01	0.08
Sacandaga Lake	1998-2009	4	0.02	0.06	0.02	0.09
Sacandaga Lake	2009	8	0.02	0.06	0.01	0.09
Schroon Lake	2002-2008	8	0.01	0.04	0.03	0.09
Sixberry Lake	2002-2002	8	0.01	0.04	0.02	0.07

Lake Name	Years	Num	Min	Avg	Avg Surface NH4	Max
Spitfire Lake	1998-2002	6	0.01	0.19	0.08	0.44
Upper Saranac Lake	2006-2007	3	0.03	0.05	0.02	0.07
Upper St. Regis Lake	1998-2002	5	0.01	0.09	0.03	0.28

Num = number of samples; Min, Avg, Max = minimum, average, and maximum NH_4 readings, in mg/l
Avg Surface NH_4 = average NH_4 readings in surface samples, 2002-2009

Total Nitrogen Fact Sheet

Description:	total nitrogen is the sum of all component forms of nitrogen—NOx (= NO_3 + NO_2) + total Kjeldahl nitrogen (or TKN, = tNH_3 + organic nitrogen). It can also be computed as an independent laboratory analysis, without first analyzing the nitrogen components. It is often a construct to compute nitrogen to phosphorus ratios, and is essentially equivalent to total dissolved nitrogen (= TDN) in most freshwater lake systems.
Importance:	total nitrogen can be compared directly to total phosphorus to evaluate which nutrient may be limiting algae growth. Comparing variations in total nitrogen and the component forms may also provide insights as to the potential sources of nitrogen.
How Measured: in CSLAP	total nitrogen is analyzed from the surface (1.5 meter grab) sample collected with the use of a Kemmerer bottle and transferred to a collapsible container and pre-labeled sample aliquot bottles. Samples were analyzed for TDN prior to 2008, but split samples on several CSLAP lakes in 2008 demonstrated that TDN and TN results were comparable. TN samples were analyzed in 2008 and 2009, and will be the primary means for evaluating total nitrogen after 2009. Deepwater total dissolved nitrogen samples were collected during the 2002 sampling season. Total nitrogen is analyzed using a spectrophotometer.
Detection Limit:	0.05 mg/l TN or 0.04 mg/l TDN
Range in CSLAP:	undetectable (< 0.05 mg/l) to 5.2 mg/l; 92% of surface readings are between 0.1 mg/l and 1.0 mg/l.
WQ Standards:	the narrative standard for nitrogen is "none in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages." There are no state numeric water quality standards or "translator" guidance value for total nitrogen.
Trophic Assessment:	New York State does not use total nitrogen in its trophic assessments. Some other states include total nitrogen in their trophic classifications. One such assessment considered by some researchers to be applicable in a variety of lake systems, using National Eutrophication Survey data in Florida, indicated that readings exceeded 0.75 mg/l are typical of *eutrophic*, or highly productive lakes, while readings below 0.35 mg/l are typical of *oligotrophic*, or highly unproductive lakes. Lakes in the intermediate range would be considered *mesotrophic*, or moderately productive. However, as noted above, New York State does not use total nitrogen to assess lakes for trophic condition, mostly because algae growth in nearly all New York state lakes is not nitrogen limited.

Chapter 4.3- Evaluation of Adirondack Region Total Nitrogen: 2002-2009

Summary of CSLAP Total Nitrogen Findings in Adirondack Region Lakes, 2002-2009

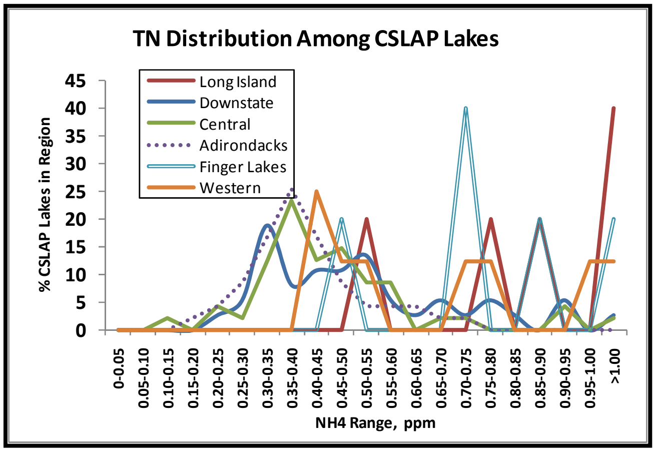
1. CSLAP lakes within the Adirondack region have lower total nitrogen readings than those in other parts of the state, with the majority of lakes having typical chlorophyll *a* levels between 0.25 and 0.55 ppm. This generally corresponds to *mesoligotrophic* conditions.
2. The total nitrogen readings in CSLAP lakes within the Adirondack region cannot be compared to non-CSLAP lakes, since the data for the latter have not yet been compiled.
3. CSLAP lakes within the Adirondack region are more likely to have lower total nitrogen levels readings in both wetter and drier years (lower TN during years with more variable weather).
4. No long-term trends in TN readings have been apparent in CSLAP lakes within the Adirondack region over the last eight years, as expected given the short timeframe.
5. More Adirondack region lakes exhibited lower TN in 2009 than exhibited higher TN levels. No clear sub-regional or morphometric patterns were apparent in this trend, although the greatest decrease in TN seemed to be associated with lakes in the northern and eastern portion of the region. This is almost certainly due to different weather patterns in these subregions in 2009.
6. TN readings are highest within the western and southern portion of the Adirondack region, particularly outside the Adirondack Park boundary (blue line). These are the only *eutrophic* lakes within this region, at least as defined by lake productivity.

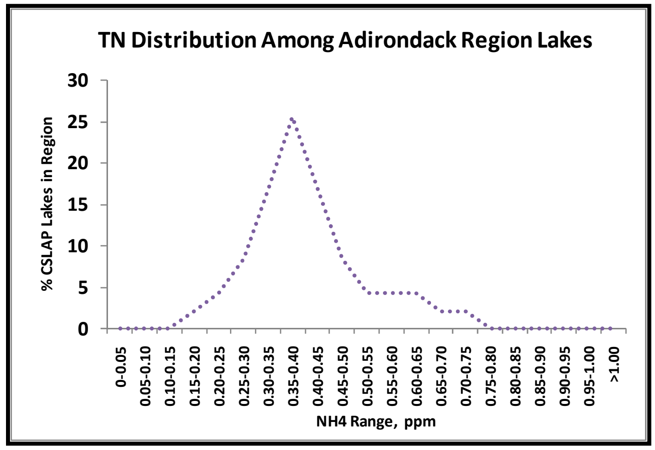
Adirondack Region Data Compared to NYS Data

CSLAP lakes in the Adirondack region have slightly less total nitrogen than in other regions of the state, particularly the Long Island and Finger Lakes regions, as demonstrated in Figure 4.3.1. The most common range of total nitrogen readings in CSLAP Adirondack region lakes is in the 0.25 to 0.55 mg/l (parts per million) range, with decreasing frequency above and below this range. Although total nitrogen data are not used for trophic evaluation, TN readings in this range are typical of *mesoligotrophic* lakes, the most common assessment in the Adirondack region. Very few Adirondack region lakes have total nitrogen readings above 0.7 mg/l, as seen in Figure 4.3.2.

Comparison of CSLAP to NYS Lakes in the Adirondack Region

Total nitrogen has not been collected in or evaluated through most of the non-CSLAP monitoring programs conducted within the Adirondack region, including the ALSC study. Therefore, a comparison of total nitrogen readings between CSLAP and non-CSLAP lakes within the Adirondack region is not (yet) possible.





Figures 4.3.1 and 4.3.2: Distribution of Total Nitrogen Ranges in CSLAP and Adirondack Region Lakes

Annual Variability:

The highest total nitrogen readings within the Adirondack region measured through CSLAP occurred during 2006 and 2007. The lowest total nitrogen readings occurred in 2005, 2003 and 2008. Table 4.3.1 looks at the percentage of CSLAP lakes with high total nitrogen (greater than 1 standard error above normal) and low nitrogen (greater than 1 standard error below normal) readings in wet and dry years. These data show that lower nitrogen readings occur in both much wetter and much drier years. Additional years of total nitrogen data (and broad ranges of precipitation data) may be needed to verify the relationship between total nitrogen and weather.

Table 4.3.1- % of CSLAP Lakes with Higher or Lower (than Normal) Total Nitrogen Readings During Dry and Wet Years in the Adirondack Region

	Dry Years	Wet Years
Higher Total Nitrogen	9%	19%
Lower Total Nitrogen	39%	22%

Dry Years: 1988, 1995, 2004, 2005
Wet Years: 1990, 1998, 2000, 2002, 2008
“Higher” and “Lower” defined as >1 SE higher than and lower than normal, respectively

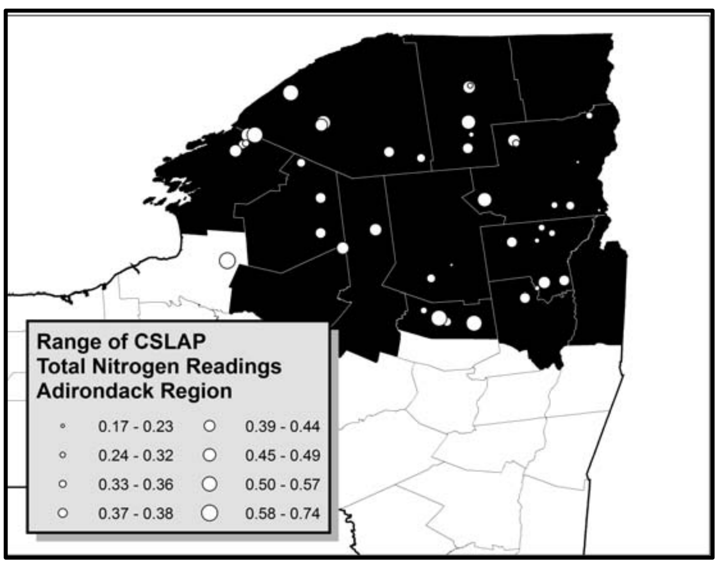
Long Term Trends:

The evaluation of long-term trends since 1986 in the Adirondack region lakes is adversely affected by the small number of lakes sampled during some sampling seasons, particularly in the earliest years of CSLAP (from 1986 to 1990). This is less of an issue for evaluation of ammonia, total nitrogen, and calcium trends, since these data were first collected in 2002, but evaluation of trends with these indicators is affected by the short timeframe of data collection. Since 2002, the frequency of higher and lower total nitrogen readings has increased slightly, although these trends appear to be statistically weak. This is mostly similar to the pattern observed across the state. These data indicate no long-term trends in total nitrogen readings have been apparent since CSLAP sampling began for this water quality indicator in 2002.

Regional Distribution:

Total nitrogen readings with the Adirondack region are highest in the western and southern portions of the region, although these lakes are interspersed with lakes with low total nitrogen readings (and some slightly elevated TN readings are found in other parts of the region). However, nearly all of the lakes within this region have fairly low total nitrogen readings, mostly typical of lakes with low algal productivity. The lowest TN readings are generally found in the eastern, central, and southwestern portions of the region, although TN data are not available for many "older" CSLAP lakes—those last sampled prior to 2002. This is seen in Figure 4.3.3

Table 4.3.2 shows the number of total nitrogen samples, the minimum, average, and maximum TN readings, the typical (average) total nitrogen to total phosphorus (TN:TP) ratios, whether nitrogen or phosphorus is more likely to be the limiting nutrient for algae growth, and whether TN readings have changed since CSLAP sampling began in the lake. This long-term assessment was limited to lakes sampled for at least five years through 2009. CSLAP lakes are considered to be phosphorus limited if the TN:TP ratios exceed 25, and are considered to be nitrogen limited if these ratios are less than 10. The limiting nutrient is less clear for ratios between 10 and 25. Although these ratios are not a definitive means for evaluating nutrient limitation—other factors can influence nutrient limitation and these ratios should be used with some caution—these data suggest that algae growth in Adirondack region lakes is far more likely to be limited by phosphorus than by nitrogen.



Figures 4.3.3: Range of Total Nitrogen Readings in the Adirondack Region

None of the lakes within the Adirondack region has exhibited significant long-term trends in total nitrogen readings, although few lakes have been sampled long enough to evaluate these trends.

Tables 4.3.3a and 4.3.3b summarize the total nitrogen data collected through CSLAP in 2009, and compare these data to the data collected for each program lake in the region prior to 2009. Total nitrogen readings in the CSLAP lakes in the Adirondack region in 2009 were lower than those reported in previous years. Moreover, a much greater percentage of Adirondack region lakes exhibited lower than normal total nitrogen readings in 2009, and established new minimum TN readings in 2009. Lower TN readings in 2009 were also measured in most CSLAP lakes across the state in 2009, although it is not known if this is a consequence of wetter weather (particularly early in the summer), normal variability, or the start of a longer-term trend.

Table 4.3.2: Total Nitrogen Summary in CSLAP Adirondack Region Lakes, 1986-2009

Lake Name	Years	Num	Min	Avg	Max	TN/TP	Limiting Nutrient?	Change?
Augur Lake	1997-2009	53	0.01	0.35	0.86	56	Phosphorus Limited	No
Augur Lake	2009	8	0.26	0.34	0.45	47	Phosphorus Limited	No
Black Lake	1988-2009	44	0.22	0.59	1.08	46	Phosphorus Limited	No
Black Lake	2009	8	0.46	0.51	0.63	29	Phosphorus Limited	No
Brant Lake	1987-2003	13	0.20	0.35	0.54	139	Phosphorus Limited	No
Brantingham Lake	2001-2009	59	0.07	0.38	0.83	179	Phosphorus Limited	No
Brantingham Lake	2009	7	0.17	0.22	0.29	65	Phosphorus Limited	Lower
Butterfield Lake	1986-2009	56	0.17	0.54	1.17	79	Phosphorus Limited	No
Butterfield Lake	2009	8	0.37	0.50	1.01	67	Phosphorus Limited	No
Canada Lake	2001-2009	59	0.10	0.41	0.99	155	Phosphorus Limited	No
Canada Lake	2009	8	0.15	0.21	0.25	66	Phosphorus Limited	Lower
Eagle Crag Lake	1986-2005	30	0.12	0.37	0.91	297	Phosphorus Limited	No
Eagle Lake	2000-2009	59	0.10	0.39	1.13	171	Phosphorus Limited	No
Eagle Lake	2009	9	0.30	0.49	0.89	179	Phosphorus Limited	Higher
Eagle Pond	2008-2009	15	0.19	0.30	0.50	53	Phosphorus Limited	No
Eagle Pond	2009	8	0.19	0.30	0.46	41	Phosphorus Limited	No
East Caroga Lake	1990-2009	54	0.09	0.37	0.75	121	Phosphorus Limited	No
East Caroga Lake	2009	6	0.21	0.27	0.34	81	Phosphorus Limited	Lower
Effley Falls Lake	1997-2009	44	0.18	0.45	0.97	194	Phosphorus Limited	No
Effley Falls Lake	2009	8	0.27	0.50	0.97	155	Phosphorus Limited	No
Friends Lake	1991-2009	53	0.05	0.28	0.56	68	Phosphorus Limited	No
Friends Lake	2009	8	0.16	0.18	0.20	60	Phosphorus Limited	Lower
Fulton Second Lake	1986-2009	64	0.01	0.43	1.88	127	Phosphorus Limited	No
Fulton Second Lake	2009	8	0.21	0.27	0.43	68	Phosphorus Limited	Lower
Glen Lake	1986-2009	42	0.13	0.38	0.98	112	Phosphorus Limited	No
Glen Lake	2009	7	0.20	0.27	0.34	79	Phosphorus Limited	Lower
Goodnow Flow	1986-2009	26	0.25	0.46	0.86	109	Phosphorus Limited	No
Goodnow Flow	2009	7	0.25	0.31	0.41	59	Phosphorus Limited	Lower
Grass Lake	2004-2009	45	0.19	0.67	2.58	155	Phosphorus Limited	No
Grass Lake	2009	8	0.33	0.53	0.75	73	Phosphorus Limited	Lower
Horseshoe Pond	2000-2009	55	0.14	0.46	0.89	61	Phosphorus Limited	No
Horseshoe Pond	2009	8	0.23	0.41	0.58	45	Phosphorus Limited	No
Hunt Lake	1994-2009	63	0.04	0.32	1.31	120	Phosphorus Limited	No
Hunt Lake	2009	8	0.11	0.16	0.24	62	Phosphorus Limited	Lower
Hyde Lake	1999-2009	25	0.20	0.42	1.13	66	Phosphorus Limited	No
Hyde Lake	2009	8	0.20	0.32	0.58	44	Phosphorus Limited	Lower
Jenny Lake	1994-2007	25	0.01	0.41	0.96	172	Phosphorus Limited	No
Lake Bonaparte	1988-2009	24	0.19	0.35	0.63	150	Phosphorus Limited	No
Lake Bonaparte	2009	8	0.19	0.24	0.32	57	Phosphorus Limited	Lower
Lake Clear	1998-2009	59	0.02	0.30	0.93	91	Phosphorus Limited	No
Lake Clear	2009	8	0.14	0.21	0.28	48	Phosphorus Limited	Lower
Lake Forest	2001-2009	44	0.15	0.42	2.60	76	Phosphorus Limited	No
Lake Forest	2009	6	0.19	0.24	0.27	38	Phosphorus Limited	Lower
Lake George	2004-2009	27	0.06	0.23	0.85	72	Phosphorus Limited	No
Lake George	2009	8	0.09	0.13	0.17	48	Phosphorus Limited	Lower
Lake Luzerne	1999-2004	22	0.01	0.31	0.55	93	Phosphorus Limited	No
Lake of the Woods	1994-2008	31	0.11	0.32	0.65	164	Phosphorus Limited	No
Lake Placid	1991-2009	47	0.12	0.44	3.03	439	Phosphorus Limited	No
Lake Placid	2009	4	0.20	0.24	0.33	256	Phosphorus Limited	Lower
Lincoln Pond	1997-2009	16	0.01	0.21	0.38	70	Phosphorus Limited	No
Lincoln Pond	2009	5	0.13	0.18	0.21	72	Phosphorus Limited	No
Lorton Lake	1990-2009	61	0.09	0.62	1.16	101	Phosphorus Limited	No
Lorton Lake	2009	8	0.48	0.61	1.01	89	Phosphorus Limited	No
Lower St. Regis Lake	2000-2002	3	0.41	0.51	0.63	67	Phosphorus Limited	No
Mayfield Lake	2000-2004	13	0.39	0.74	1.36	117	Phosphorus Limited	No

Lake Name	Years	Num	Min	Avg	Max	TN/TP	Limiting Nutrient?	Change?
Millsite Lake	1997-2009	58	0.03	0.35	0.81	115	Phosphorus Limited	No
Millsite Lake	2009	8	0.03	0.21	0.35	46	Phosphorus Limited	Lower
Mirror Lake	1998-2009	43	0.09	0.32	0.62	114	Phosphorus Limited	No
Mirror Lake	2009	7	0.16	0.25	0.44	62	Phosphorus Limited	Lower
Otter Lake	1992-2009	50	0.10	0.47	0.99	83	Phosphorus Limited	No
Otter Lake	2009	8	0.27	0.35	0.46	58	Phosphorus Limited	Lower
Paradox Lake	2003-2009	52	0.00	0.33	1.07	90	Phosphorus Limited	No
Paradox Lake	2009	8	0.10	0.17	0.22	33	Phosphorus Limited	Lower
Peck Lake	1992-2009	16	0.16	0.30	0.54	85	Phosphorus Limited	No
Peck Lake	2009	8	0.16	0.21	0.30	70	Phosphorus Limited	Lower
Piseco Lake	1999-2003	8	0.14	0.38	0.61	149	Phosphorus Limited	No
Pleasant Lake	2000-2009	45	0.10	0.35	1.30	123	Phosphorus Limited	No
Pleasant Lake	2009	2	0.19	0.23	0.26	62	Phosphorus Limited	Lower
Sacandaga Lake	1987-2009	8	0.07	0.16	0.20	59	Phosphorus Limited	No
Sacandaga Lake	2009	8	0.07	0.16	0.20	57	Phosphorus Limited	No
Schroon Lake	1987-2009	60	0.07	0.32	1.34	101	Phosphorus Limited	No
Schroon Lake	2009	7	0.12	0.17	0.32	31	Phosphorus Limited	Lower
Silver Lake	1996-2009	42	0.07	0.38	0.88	79	Phosphorus Limited	No
Silver Lake	2009	7	0.19	0.24	0.29	43	Phosphorus Limited	Lower
Sixberry Lake	2001-2004	19	0.11	0.35	0.74	177	Phosphorus Limited	No
Spitfire Lake	1996-2002	6	0.51	0.57	0.63	146	Phosphorus Limited	No
Upper Saranac Lake	2006-2009	26	0.15	0.36	0.54	57	Phosphorus Limited	No
Upper Saranac Lake	2009	8	0.15	0.23	0.32	40	Phosphorus Limited	Lower
Upper St. Regis Lake	1997-2002	8	0.06	0.46	0.82	106	Phosphorus Limited	No
West Caroga Lake	1997-2007	5	0.44	0.61	0.77	97	Phosphorus Limited	No
Windover Lake	1999-2003	15	0.18	0.44	0.72	82	Phosphorus Limited	No

Num = number of samples
Min, Avg, Max = minimum, average, and maximum TN readings, in mg/l
TN/TP = ratio of total nitrogen to total phosphorus, unitless (both nitrogen and phosphorus in molar concentrations)
Limiting Nutrient = phosphorus if TN/TP > 25; = nitrogen if TN/TP < 10; = uncertain if 10 < TN/TP < 25
Change? = exhibiting significant change in TN readings (best fit line of annual means with $R^2 > 0.5$ and seasonal Kendall-Tau rank correlation coefficient > 0.5); 2009 change based on TN readings >25% higher or lower than normal

Table 4.3.3a: Total Nitrogen Summary in CSLAP Lakes, 2009

Region	Number Lakes	Minimum	Average 2009	Average 1986-08	Maximum
Downstate	32	0.17	0.54	0.63	1.95
Central	36	0.05	0.41	0.45	1.31
Adirondacks	33	0.03	0.29	0.40	1.01
Western	9	0.24	0.65	0.74	1.75
CSLAP Statewide	**110**	**0.03**	**0.42**	**0.51**	**1.95**

Table 4.3.3b: Surface Total Nitrogen Summary in CSLAP Lakes, 2009

Region	Number Lakes	Average 2009	Average 1986-08	% TP Limited	%Higher	%Lower	%Above Max	%Below Min
Downstate	32	0.54	0.63	73	7	40	27	23
Central	36	0.41	0.45	100	0	51	11	16
Adirondacks	33	0.29	0.40	100	3	68	3	24
Western	9	0.65	0.74	89	0	33	11	11
CSLAP Statewide	**110**	**0.42**	**0.51**	**92**	**3**	**52**	**13**	**20**

% TP Limited = percentage of lakes in region with TN:TP ratios exceeding 25
% Higher = percentage of lakes in region with TN readings in 2009 >25% higher than normal (before 2009)
% Lower = percentage of lakes in region with TN readings in 2009 <25% below normal (before 2009)
% Above Max = percentage of lakes in region with TN readings in 2009 above previous maximum (before 2009) for lake
% Below Min = percentage of lakes in region with TN readings in 2009 below previous minimum (before 2009) for lake

Adirondack Region Lakes With Higher Than Normal Total Nitrogen in 2009:
Eagle Lake

Discussion:

One Adirondack-region lake—Eagle Lake—exhibited higher than normal total nitrogen readings in 2009. It is not known if the 2009 readings exceed the true normal range of total nitrogen readings in Eagle Lake, since all of the CSLAP lakes have a limited TN dataset. However, these data indicate that the increase in 2009 was small, and not part of a larger trend. Moreover, the lake continues to be phosphorus limited, so it is likely that this small change in 2009 was part of normal variability in the lake.

Adirondack Region Lakes With Lower Than Normal Total Nitrogen in 2009:
Brantingham Lake, Canada Lake, East Caroga Lake, Friends Lake, Fulton Second Lake, Glen Lake, Goodnow Flow, Grass Lake, Hunt Lake, Hyde Lake. Lake Bonaparte, Lake Clear, Lake Forest, Lake George, Lake Placid, Millsite Lake, Mirror Lake, Paradox Lake, Peck Lake, Pleasant Lake, Schroon Lake, Silver Lake, Upper Saranac Lake

Discussion:

Total nitrogen readings in 2009 were lower than normal in 23 Adirondack region lakes, assuming that the 5-8 year average computed for each of these lakes prior to 2009 represents normal conditions for each lake. This subset of lakes largely overlaps with the subset of lakes for which ammonia readings in 2009 were slightly lower than normal, an expected occurrence since ammonia is a component of total nitrogen.

TN readings in East Caroga Lake, Glen Lake, Goodnow Flow, Grass Lake, Hyde Lake, Lake Bonaparte, Lake Clear, Millsite Lake, Mirror Lake, Pleasant Lake, and Upper Saranac Lake were only slightly lower than those measured in previous years, and it is likely that the slight drop in total nitrogen readings in these lakes was within the normal range of variability. Most of these lakes tend to be found in northern to northwestern part of the region, suggesting a regional weather pattern. The TN levels in most of these lakes continue to be very low.

The lower TN readings in Brantingham Lake, Canada Lake, Friends Lake, Fulton Second Lake, Hunt Lake, Lake Forest, Lake George, Lake Placid, and Schroon Lake were more significant. Most of these lakes, with some exceptions, are found in the northern and eastern portion of the region, also suggesting a weather pattern. It is not likely that the low total nitrogen found in these lakes resulted in any ecological problems, and none of these lakes has exhibited any long-term trend toward decreasing TN readings. This suggests that the 2009 drop was mediated by (wetter) weather and that TN readings will likely return to their normal (still low) levels in future drier years.

True Color Fact Sheet

Description:	true color is a laboratory analysis used as a simple surrogate for dissolved organic carbon, since primary constituents of dissolved organic carbon—tannic and fulvic acids—impart a brownish color to water in direct proportion to their concentration in water. It involves either filtering or centrifuging a water sample and analyzing the filtrate. True color differs from apparent color, which includes suspended components, including algae and sediment, and dissolved components, including dissolved organic and inorganic matter.
Importance:	dissolved color can strongly influence water transparency, particularly in the absence of algal or inorganic turbidity (and color can significantly alter the light transmission in water, further limiting algae growth). However, this component of water clarity is not strongly linked to public water quality perception, since dissolved color is often "natural" in many lakes, particularly softwater, high elevation lakes in the northwestern Adirondacks, Catskills and other regions in the state overlying organic soils. Thus it is associated with *dystrophic* rather than *eutrophic* lake systems. Changes in color can also indicate changes in runoff patterns to lakes, but can be negatively correlated to conductivity, since dissolved organic matter is often comprised of neutrally charged particles that do not carry current.
How Measured: in CSLAP	true color is analyzed from the surface (1.5 meter grab) sample collected with the use of a Kemmerer bottle and transferred to a collapsible container. Approximately 100ml of lake water is filtered through a 0.45µ mixed ester filter, and the filtrate is transferred to pre-labeled sample aliquot bottles. Color samples are visually compared to a scaled set of standards created from a platinum-cobalt solution.
Detection Limit:	1 platinum color units (ptu) prior to 2002; 2 ptu since 2002
Range in CSLAP:	undetectable (< 1 ptu) to 289 ptu. 75% of surface readings are between 5 ptu and 30 ptu, and 40% of surface samples have true color less than 10 ptu.
WQ Standards:	there are no state water quality standards for true color. The state narrative water quality standard for color of 15 platinum color units applies to only potable groundwater.
Trophic Assessment:	New York State exempts any lake with color greater than 30 ptu from a strict application of the trophic criteria due to the strong influence of high water color on water transparency. Lakes with less than 30 ptu true color are considered "clearwater" lakes and can be characterized by the traditional trophic indicators (water clarity, True color, and total phosphorus). Color readings less than 10 ptu are probably not visible to the casual observer.

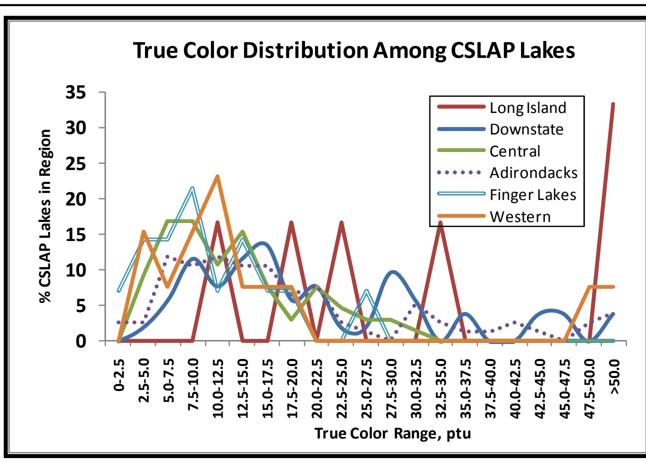
Chapter 4.4- Evaluation of Adirondack Region True Color: 1986-2009

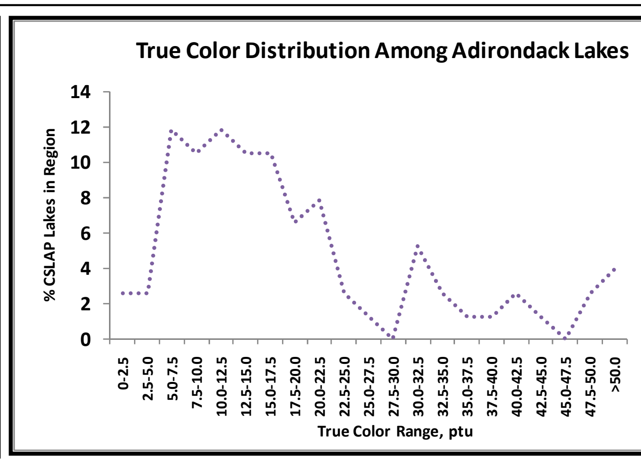
Summary of CSLAP True Color Findings in Adirondack Region Lakes, 1986-2009

1. CSLAP lakes within the Adirondack region have water color readings higher than in the western regions of the state, but lower than in southern regions of the state.
2. CSLAP lakes within the Adirondack region have much lower water color readings than non-CSLAP lakes in the same region. The non-CSLAP lakes in the Adirondacks region dataset are comprised of a large number of shallow Adirondack lakes sampled through the ALSC project.
3. CSLAP lakes within the Adirondack region are more likely to have lower water color readings in drier years, and higher water color in wetter years.
4. Several lakes in the Adirondack region have exhibited increasing water color readings. These lakes do not share any clear geographic, morphometric, or trophic similarities. The rise in color in these lakes may be due to the change in laboratories in 2002 or wetter weather in recent years.
5. True color readings in Adirondack region lakes were much higher in 2009 than in the period from 1986 to 2008, an increase observed in other regions of the state. This is coincident with much wetter weather in most of the region, although this may also be, at least in part, a laboratory artifact.
6. The much higher water color in most lakes in the region was not accompanied by similar changes in water clarity or other measured water quality indicators.

Adirondack Region Data Compared to NYS Data

CSLAP lakes in the Adirondack region are more colored than lakes in the Western region of the state, but less colored than Downstate region lakes, as seen in Figure 4.4.1. The most common range of color readings in CSLAP Adirondack region lakes is in the 5-20 ptu range, with decreasing frequency as color readings increase (although there is a small spike in the 30-33 ptu range). A small percentage of CSLAP Adirondack region lakes have color readings above 50 ppb, as seen in Figure 4.4.2.





Figures 4.4.1 and 4.4.2: Distribution of True Color Ranges in CSLAP and Adirondack Region Lakes

Comparison of CSLAP to NYS Lakes in the Adirondack Region

There are far more highly colored (> 50 ptu) Adirondack region lakes in other New York state monitoring programs than in CSLAP, as seen in Figure 4.4.3. As discussed above, this reflects the large number of lakes sampled through the Adirondack Lake Survey Corporation (ALSC) study of more than 1500 mostly small, high elevation lakes within the Adirondacks, Catskills and nearby regions. The typical ALSC lake is small and colored (and found at high elevation). The water quality differences between the ALSC and CSLAP datasets can also be seen in other trophic indicators (water clarity and phosphorus) and conductivity.

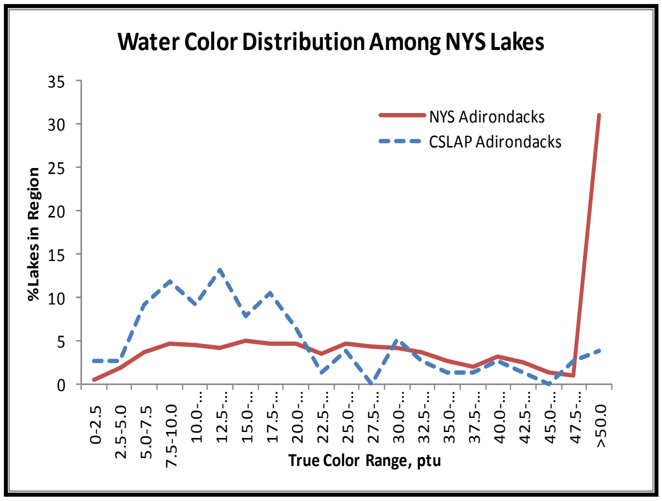


Figure 4.4.3: Average Distribution of True Color Readings in New York State and CSLAP Lakes in the Adirondack Region

Annual Variability:

True color readings are highly variable from lake to lake in each region of the state, including the Adirondack region. The highest color readings measured through CSLAP occurred during 2006, 2004, 2008, 2003, 1992 and especially 2009. Some of these years, particularly 2006 and perhaps 2009, were very wet. The lowest color readings occurred in 1995, 1993, 2001, 1999, 1988, and 1989; most of these were dry years. Table 4.4.1 looks at the percentage of CSLAP lakes with high water color (greater than 1 standard error above normal) and low water color (greater than 1 standard error below normal) readings in wet and dry years. These data show that high color readings are somewhat more likely to occur in wetter years, but low color was strongly associated with drier years.

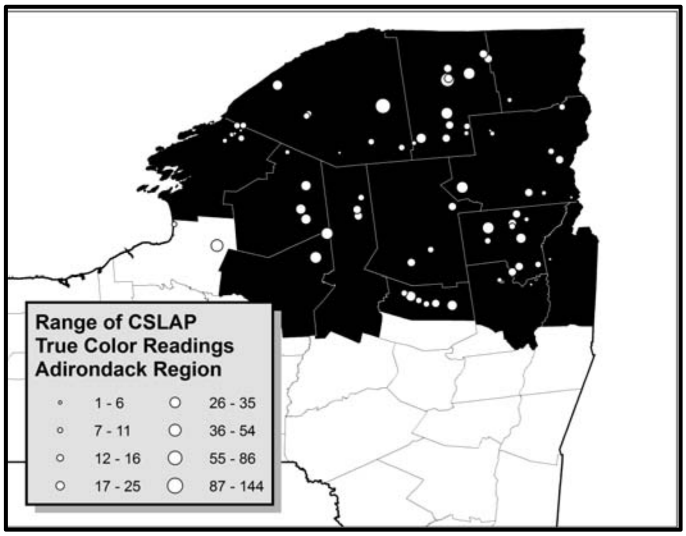
Table 4.4.1- % of CSLAP Lakes with Higher or Lower (than Normal) True Color Readings During Dry and Wet Years in the Adirondack Region

	Dry Years	Wet Years
Higher Color Readings	20%	27%
Lower Color Readings	48%	13%

Dry Years: 1988, 1995, 2004, 2005
Wet Years: 1990, 1998, 2000, 2002, 2008
"Higher" and "Lower" defined as >1 SE higher than and lower than normal, respectively

Long Term Trends:

The evaluation of long-term trends since 1986 in any region, including the lakes within the Adirondack region, is adversely affected by the small number of lakes sampled during some sampling seasons, particularly in the earliest years of CSLAP (from 1986 to 1990). Since 1986, the frequency of higher than normal (moderately and significantly) color readings have increased, as with the statewide database. As discussed earlier, this may be due to some combination of wetter weather, the change in labs, and normal variability. These Figures show that the frequency of lower color readings has decreased, although these trends are weaker. These data indicate that water color has increased in the Adirondack region lakes, although this has not translated into a significant change in water clarity.



Figures 4.4.4: Range of True Color Readings in the Adirondack Region

Regional Distribution:

True color readings with the Adirondack region are highest in the northern and southwestern portion of the region, although the ALSC and CSLAP dataset shows high readings throughout the park in small lakes near wetlands or in areas surrounded by highly organic soils. The lowest color readings are found in the region west of the Adirondack Park and in larger lakes throughout the Park, as seen in Figure 4.4.4. In many of these lakes, water color readings are sufficiently high to adversely affect water clarity, although they are not high enough to adversely affect water quality assessments or perceived recreational conditions in the lake.

Table 4.4.2 shows the number of water color samples, the minimum, average, and maximum water color readings in the entirety of the CSLAP dataset and in 2009, and whether water color readings have changed since CSLAP sampling began in the lake (through 2008).

Table 4.4.2: True Color Summary in CSLAP Adirondack Region Lakes, 1986-2009

Lake Name	Years	Num	Min	Avg	Max	Change?
Adirondack Lake	1986-1989	34	12	17	30	
Augur Lake	1997-2009	85	1	13	27	No
Augur Lake	2009	8	11	16	22	No
Bartlett Pond	1997-2000	25	11	24	45	
Black Lake	1988-2009	158	15	32	78	No
Black Lake	2009	8	39	59	78	Higher
Brant Lake	1987-2003	76	2	9	18	No
Brantingham Lake	2001-2009	68	7	34	73	No
Brantingham Lake	2009	7	36	46	57	Higher
Butterfield Lake	1986-2009	174	2	14	73	No
Butterfield Lake	2009	8	13	22	35	Higher

Lake Name	Years	Num	Min	Avg	Max	Change?
Canada Lake	2001-2009	68	2	16	40	No
Canada Lake	2009	8	12	25	34	Higher
Chase Lake	1990-1997	40	28	35	48	No
Eagle Crag Lake	1986-2005	103	5	13	56	No
Eagle Lake	2000-2009	72	2	9	46	No
Eagle Lake	2009	9	8	13	22	Higher
Eagle Pond	2008-2009	15	7	18	26	
Eagle Pond	2009	8	13	20	26	No
East Caroga Lake	1990-2009	108	3	13	30	No
East Caroga Lake	2009	6	16	19	22	Higher
Effley Falls Lake	1997-2009	83	3	32	75	No
Effley Falls Lake	2009	8	31	44	69	Higher
Efner Lake	1997-2001	38	3	9	16	No
Friends Lake	1991-2009	99	1	11	45	No
Friends Lake	2009	8	13	18	45	Higher
Fulton Second Lake	1986-2009	155	6	19	37	No
Fulton Second Lake	2009	8	24	30	35	Higher
Garnet Lake	1989-2001	34	7	15	23	No
Glen Lake	1986-2009	108	1	13	49	No
Glen Lake	2009	7	15	35	49	Higher
Goodnow Flow	1986-2009	108	20	42	83	No
Goodnow Flow	2009	7	43	58	73	Higher
Grass Lake	2004-2009	46	1	18	36	No
Grass Lake	2009	8	21	27	36	Higher
Gull Pond	1994-1998	40	1	9	20	No
Hadlock Pond	1997-2001	18	3	6	10	No
Horseshoe Pond	2000-2009	74	12	86	289	No
Horseshoe Pond	2009	8	62	78	97	No
Hunt Lake	1994-2009	92	1	8	22	Increasing
Hunt Lake	2009	8	10	16	22	Higher
Hyde Lake	1999-2009	41	3	10	26	No
Hyde Lake	2009	8	9	14	26	Higher
Indian Lake	1986-1997	48	10	21	35	No
Jenny Lake	1994-2007	64	1	9	66	No
Joe Indian Lake	1986-1990	48	30	144	250	No
Kayuta Lake	1997-2001	39	7	42	70	No
Kellum Lake	1997-2001	35	14	31	60	No
Lake Bonaparte	1988-2009	99	1	10	27	No
Lake Bonaparte	2009	8	11	20	27	Higher
Lake Clear	1998-2009	92	5	17	43	No
Lake Clear	2009	8	18	25	30	Higher
Lake Colby	1999-2001	17	8	12	22	
Lake Forest	2001-2009	53	9	25	66	No
Lake Forest	2009	6	37	48	66	Higher
Lake George	2004-2009	21	0	6	34	No
Lake George	2009	8	6	11	17	Higher
Lake Kiwassa	1990-1995	40	3	11	18	No
Lake Luzerne	1999-2004	38	10	19	49	No
Lake of the Isles	2000-2001	16	3	5	8	
Lake of the Woods	1994-2008	54	0	4	15	Increasing
Lake Placid	1991-2009	112	1	5	22	No
Lake Placid	2009	4	8	11	12	Higher
Lake Titus	1999-2001	19	17	21	29	
Lincoln Pond	1997-2009	60	5	12	26	No
Lincoln Pond	2009	5	13	17	26	Higher
Little Wolf Lake	1998-2000	18	18	35	64	

Lake Name	Years	Num	Min	Avg	Max	Change?
Loon Lake	1986-1997	44	11	18	25	No
Lorton Lake	1990-2009	119	20	54	160	No
Lorton Lake	2009	8	47	60	87	No
Lower Chateaugay Lake	1991-1995	33	10	18	24	No
Lower St. Regis Lake	2000-2002	14	26	44	86	
Mayfield Lake	2000-2004	27	13	27	63	Increasing
Millsite Lake	1997-2009	99	0	7	39	No
Millsite Lake	2009	8	6	17	39	Higher
Mirror Lake	1998-2009	69	1	8	31	No
Mirror Lake	2009	7	8	14	18	Higher
Moon Lake	1992-1996	38	5	11	20	No
Moreau Lake	1994-2002	61	1	2	6	
Mountain Lake	1998-2001	29	13	22	40	
Mountain View Lake	1991-1997	38	28	49	100	No
North Sandy Pond	1986-1990	45	1	10	35	No
Otter Lake	1992-2009	90	1	50	145	Increasing
Otter Lake	2009	8	44	70	80	Higher
Paradox Lake	2003-2009	55	10	22	68	No
Paradox Lake	2009	8	17	27	32	No
Peck Lake	1992-2009	46	3	12	29	No
Peck Lake	2009	8	12	20	29	Higher
Piseco Lake	1999-2003	31	9	18	26	Increasing
Pleasant Lake	2000-2009	60	3	16	41	No
Pleasant Lake	2009	2	18	20	21	No
Rondaxe Lake	1998-2001	31	8	17	80	
Sacandaga Lake	1987-2009	92	6	15	36	No
Sacandaga Lake	2009	8	20	26	36	Higher
Schroon Lake	1987-2009	106	3	18	52	Increasing
Schroon Lake	2009	7	28	40	52	Higher
Silver Lake	1989-1993	25	2	7	11	No
Silver Lake	1996-2009	84	1	13	116	No
Silver Lake	2009	7	13	19	33	Higher
Sixberry Lake	2001-2004	25	0	6	19	
Spitfire Lake	1996-2002	42	0	14	44	No
Star Lake	1994-1998	40	1	3	10	No
Stewarts Landing	1997-2001	40	18	32	65	Increasing
Twitchell Lake	1986-1996	33	5	15	27	No
Upper Chateaugay Lake	1990-1994	31	18	21	24	No
Upper Saranac Lake	2006-2009	27	2	25	65	
Upper Saranac Lake	2009	8	14	36	65	Higher
Upper St. Regis Lake	1997-2002	47	7	13	21	No
West Caroga Lake	1997-2007	28	7	13	25	No
Windover Lake	1999-2003	37	14	40	62	No

Num = number of samples
Min, Avg, Max = minimum, average, and maximum color readings, in ptu
Change? = exhibiting significant change in color readings (best fit line of annual means with $R^2 > 0.5$ and seasonal Kendall-Tau rank correlation coefficient > 0.5); 2009 change based on color readings >25% higher or lower than normal

There are several lakes in this region exhibiting long-term change in water color readings. Hunt Lake, Lake of the Woods, Mayfield Lake, Otter Lake, Piseco Lake, Schroon Lake, Stewarts Landing all exhibited increasing water color readings over the duration of their CSLAP sampling. These lakes comprise a wide variety of sizes—large (Schroon Lake, Piseco Lake) and small (Hunt Lake, Mayfield Lake), unproductive (Lake of the Woods, Piseco Lake) and more productive (Otter Lake), and are found throughout the region. Most of these lakes normally have moderate to low water color, and the higher water color readings found in the last several years of CSLAP sampling were not high enough to impart a strong brown color to the water. Most of these lakes were also sampled after the change in laboratories, and the apparent rise in color may reflect a shift in "normal" color readings driven by any differences in the lab analyses. None of these lakes exhibited a strong change in water color over the period of CSLAP sampling.

Tables 4.4.3a and 4.4.3b summarize the surface true color data collected through CSLAP in 2009, and compare these data to the data collected for each program lake in the region prior to 2009. True color readings in the CSLAP lakes in the Adirondack region in 2009 (and all other NYS regions) were much higher than those reported in previous years, at least as evaluated by average water color readings. It is likely that this reflects the very wet weather recorded throughout the state in at least the beginning of the summer. Unfortunately, at the time of this reporting, the majority of the 2009 meteorological data are not yet available. A high percentage (78%) of Adirondack region lakes exhibited higher than normal water color in 2009, and nearly half of the sampled lakes established a new maximum water color reading in 2009.

Table 4.4.3a: True Color Summary in CSLAP Lakes, 2009

	Number Lakes	Minimum	Average 2009	Average 1986-08	Maximum	Typical
Downstate	32	3	43	27	194	Highly Colored
Central	36	1	30	14	109	Highly Colored
Adirondacks	33	6	31	21	97	Highly Colored
Western	9	5	46	16	407	Highly Colored
CSLAP Statewide	**110**	**1**	**35**	**20**	**407**	**Highly Colored**

Table 4.4.3b: True Color Summary in CSLAP Lakes, 2009

	Number Lakes	Average 2009	Average 1986-08	%Higher	%Lower	%Above Max	%Below Min
Downstate	32	43	27	36	0	52	12
Central	36	30	14	84	0	27	5
Adirondacks	33	31	21	78	0	44	0
Western	9	46	16	100	0	44	0
CSLAP Statewide	**110**	**35**	**20**	**75**	**0**	**40**	**6**

% Higher = percentage of lakes in region with true color readings in 2009 >25% higher than normal (before 2009)
% Lower = percentage of lakes in region with true color readings in 2009 <25% below normal (before 2009)
% Above Max = percentage of lakes in region with color readings in 2009 above previous maximum (before 2009) for lake
% Below Min = percentage of lakes in region with color readings in 2009 below previous minimum (before 2009) for lake

Adirondack Region Lakes With Higher Than Normal Water Color in 2009:

Black Lake, Brantingham Lake, Butterfield Lake, Canada Lake, Eagle Lake, East Caroga Lake, Effley Falls Lake, Friends Lake, Fulton Second Lake, Glen Lake, Goodnow Flow, Grass Lake, Hunt Lake, Hyde Lake, Lake Bonaparte, Lake Clear, Lake Forest, Lake George, Lake Placid, Lincoln Pond, Millsite Lake, Mirror Lake, Otter Lake, Peck Lake, Sacandaga Lake, Schroon Lake, Silver Lake, Upper Saranac Lake

Discussion:

Most Adirondack-region lakes exhibited higher than normal water color readings in 2009. The vast majority of these lakes reported higher than normal precipitation in 2009; only Eagle Pond, Lake Clear, Millsite Lake, Otter Lake, Peck Lake, Sacandaga Lake, and Schroon Lake volunteers did not report wetter weather in 2009. Of these lakes, only Otter Lake and Schroon

Lake have exhibited a long-term increase in water color. In most of these lakes, water color readings were consistently higher in 2009 than in previous sampling seasons. However, water clarity did not decrease in most of these lakes, and lower water clarity readings were not apparent at the times when water color readings were very high. This suggests that either the increase in water color is still within the normal range of variability for the lake, or that these color readings are not accurate.

Adirondack Region Lakes With Lower Than Normal Water Color in 2009:
None

Discussion:
None of the Adirondack region lakes exhibited lower than normal water color readings in 2009.

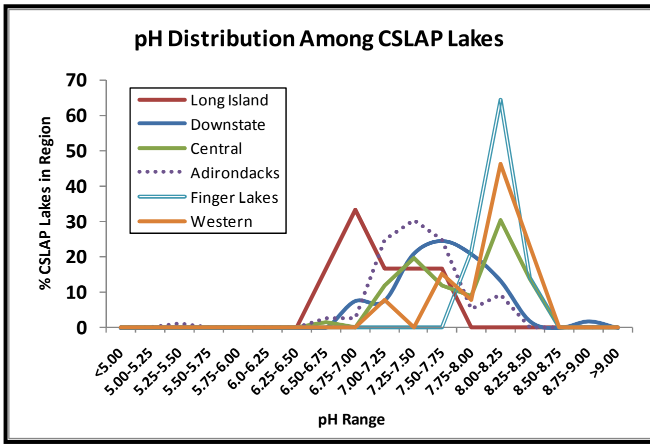
pH Fact Sheet

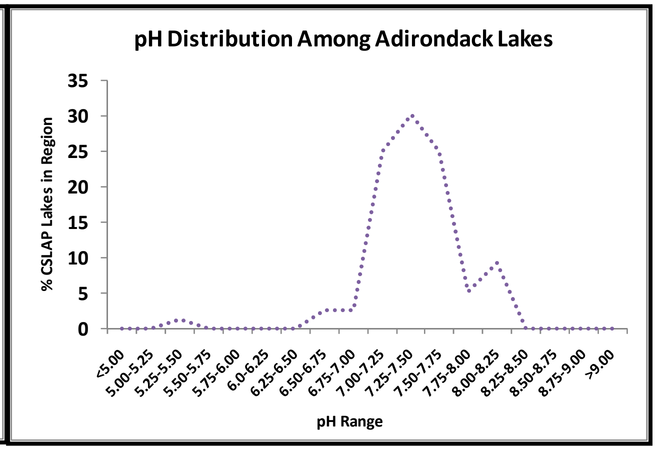
Description:	pH is the abbreviation for "powers of hydrogen", and is a mathematical construct that characterizes the acidity of water on a simple scale. It is the negative logarithm of the hydrogen ion concentration, and is measured on a 14 point scale, from 0 (very highly acidic) to 14 (nearly highly basic). The effective scale for most waterbodies is 4 to 10, with 7 considered neutral (equal concentrations of hydrogen and hydroxide ions).
Importance:	the survival of most aquatic organisms is strongly dependent on pH. Many aquatic organisms do not properly function in water with pH below 6.5 or above 8.5, although impacts in low pH are better understood. This sensitivity of aquatic organisms to pH also reflects the sensitivity of some chemical compounds to pH—the sensitivity of fish to low pH water is a function of aluminum compounds, which can clog gills once certain forms of aluminum predominate at lower pH values. Other compounds, such as ammonia, are more highly toxic at elevated pH.
How Measured: in CSLAP	pH is analyzed from the surface (1.5 meter grab) sample collected with the use of a Kemmerer bottle and transferred to a collapsible container and labeled sample aliquot bottles. pH is more accurately measured directly in the field, since a number of factors (such as headspace in a sample bottle) introduce "contaminants" that change pH between collection and analysis. Laboratory pH is usually fairly accurate for most lakes with moderate to high buffering capacity, and is measured with a benchtop pH meter with buffer standards bracketing the expected range.
Detection Limit:	not applicable
Range in CSLAP:	4.40 to 9.85; 89% of readings fall between pH 6.5 and 8.5, corresponding to the state water quality standards.
WQ Standards:	the state water quality standards require pH to be above 6.5 and below 8.5.
Water Quality Assessment:	pH readings are evaluated against the state water quality standards. In addition, lakes are classified by acidity status. Lakes with pH less than 6 are considered strongly acidic, and lakes with pH readings between 6 and 6.5 are considered weakly acidic. Lakes with pH greater than 8 are considered alkaline, and lakes with pH between 7.5 and 8 are considered weakly alkaline. Lakes with pH between 6.5 and 7.5 can be considered circumneutral.

Chapter 4.5- Evaluation of Adirondack Region pH: 1986-2009

Summary of CSLAP pH Findings in Adirondack Region Lakes, 1986-2009

1. CSLAP lakes within the Adirondack region have lower pH readings than those in most other parts of the state, with the majority of lakes having pH levels between 7 and 8, corresponding to circumneutral to weakly alkaline conditions.
2. CSLAP lakes within the Adirondack region have higher pH readings than non-CSLAP lakes in the same region, due to the large number of small, remote, softwater, acidic lakes sampled through the ALSC study. CSLAP and non-CSLAP lakes in the same depth and size range have similar pH readings.
3. CSLAP lakes within the Adirondack region are more likely to have higher pH readings in drier years, and lower readings in wetter years.
4. pH readings may have increased slightly in CSLAP lakes within the Adirondack region, based on an increasing percentage of lakes with higher than normal readings, although this change has probably been small. This may reflect the positive influence of Clean Air Act atmospheric pollutant reduction, and may be consistent with a slight decrease in NO_x levels.
5. The typical Adirondack region lake exhibited neither higher nor lower pH readings in 2009, and most lakes in the region have not exhibited any clear long-term trends.
6. pH readings with the Adirondack region are highest in the northeastern and northwestern portions of the region, particularly outside the Adirondack Park boundary (blue line), and lowest readings are found in the interior of this region.





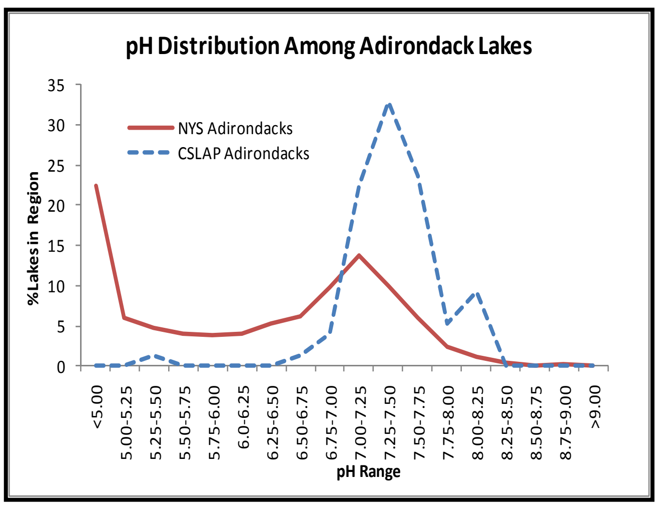
Figures 4.5.1 and 4.5.2: Distribution of pH Ranges in CSLAP and Adirondack Region CSLAP Lakes

Adirondack Region Data Compared to NYS Data

CSLAP lakes in the Adirondack region have lower pH readings than in any other region of the state except the Downstate (Long Island/NYC) region, as demonstrated in Figure 4.5.1. These pH readings, however, are higher than in the "typical" small, softwater, high elevation Adirondack lake. Most of the Adirondack region CSLAP lakes have pH readings between 7 and 8, and can be characterized as circumneutral to weakly alkaline. Very few CSLAP Adirondack region lakes have pH readings below 6.8 or above 8.3, as seen in Figure 4.5.2. This is close to the low end of the pH range in many other regions of the state, such as the Western (Finger Lakes) region, but the high end of the range of most non-CSLAP lakes in the Adirondack region, which frequently exhibit acidic water with pH readings below 5.0. Other water quality studies, such as the continuation of the ALSC study in recent years, are better designed than CSLAP to evaluate whether the low pH conditions seen from the 1950s to the 1990s in these lakes have persisted, given the federal Clean Air Act legislation designed to reduce acidic inputs to lakes.

Comparison of CSLAP to NYS Lakes in the Adirondack Region

A large percentage of the Adirondack region lakes have pH readings below 5, as seen in Figure 4.5.3. As discussed in the phosphorus section, the majority of the lake water quality data outside of CSLAP comes from the ALSC study of more than 1500 mostly small, high elevation, remote, softwater, acidic lakes within the Adirondacks, Catskills and nearby regions. The Adirondack region lakes sampled in the non-CSLAP monitoring programs in New York State in the same size and elevation range as CSLAP lakes appear to exhibit pH readings comparable to those in lakes sampled through CSLAP. Although the CSLAP lakes exhibit higher pH readings than those more remote lakes sampled through the ALSC, the typical lake in this region is circumneutral.



Figures 4.5.3: Average Distribution of pH Readings in New York State and CSLAP Lakes in the Adirondack Region

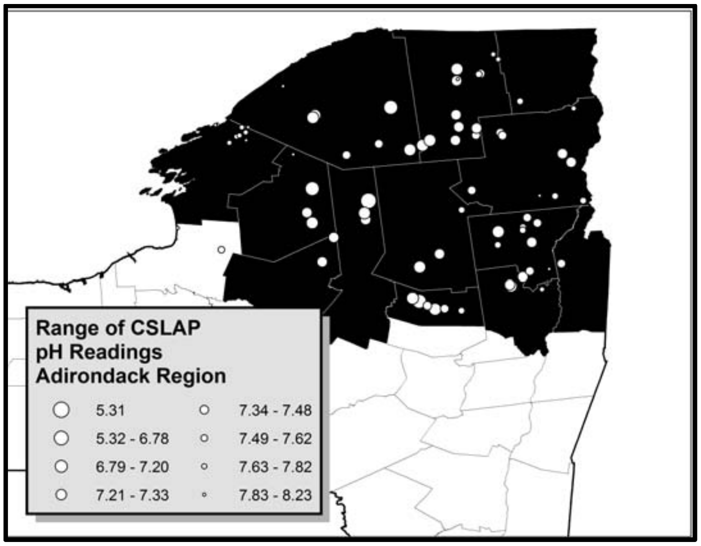
Annual Variability:

pH readings have stayed within a fairly tight range in most Adirondack region lakes—generally between 7 and 8—but have varied from year to year within this range. The highest pH readings measured through CSLAP occurred during 1988, 2007, 1992, 1989 and 1991, the same as in most of the rest of the state. The first of these years was very dry in the Adirondack region, but the other years were neither wet nor dry. The lowest pH readings occurred in 1987, 2004, and 2000, a combination of normal, dry, and wet years, respectively. However, Table 4.5.1 looks at the percentage of CSLAP lakes with high pH (greater than 1 standard error above normal) and low pH (greater than 1 standard error below normal) readings in wet and dry years. These data show that higher pH readings occur in drier years, and lower pH occurs in wet years, similar to the regional conductivity trend. This suggests that heavy acidic precipitation may still be influencing pH readings in the lakes in the region, even though the buffering capacity in the watersheds of many of these lakes is moderate to high.

Table 4.5.1- % of CSLAP Lakes with Higher or Lower (than Normal) pH Readings During Dry and Wet Years in the Adirondack Region

	Dry Years	Wet Years
Higher pH Readings	34%	17%
Lower pH Readings	20%	28%

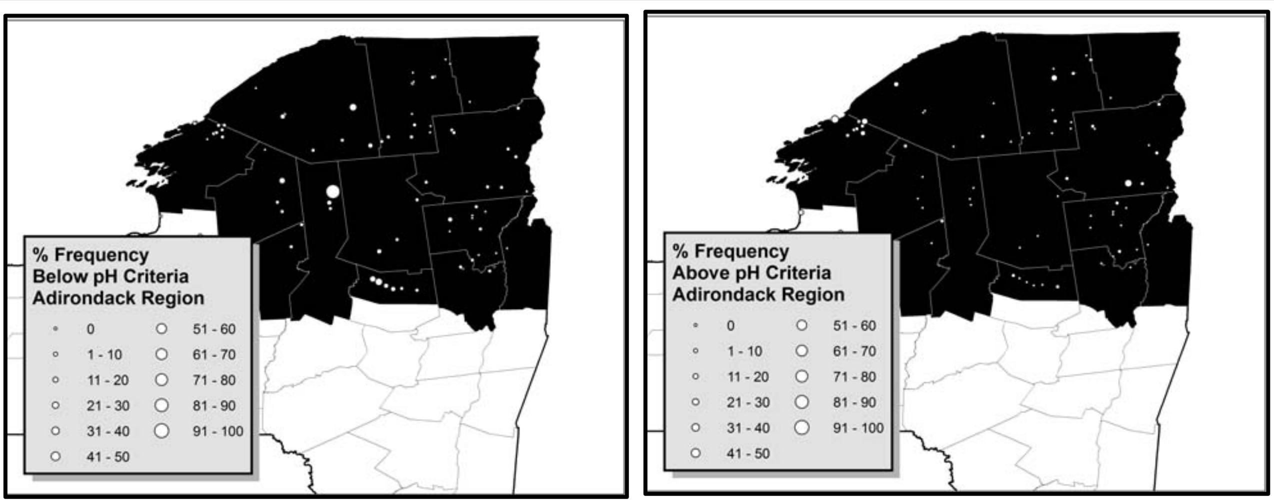
Dry Years: 1988, 1995, 2004, 2005
Wet Years: 1990, 1998, 2000, 2002, 2008
"Higher" and "Lower" defined as >1 SE higher than and lower than normal, respectively



Figures 4.5.4: Range of pH Readings in the Adirondack Region

Long Term Trends:

The evaluation of long-term trends since 1986 in the Adirondack region lakes is adversely affected by the small number of lakes sampled during some sampling seasons, particularly in the earliest years of CSLAP (from 1986 to 1990). Since 1986, the frequency of higher pH readings has increased, a trend observed on a statewide basis, although this is also not a strong trend. However, the frequency of low pH readings has also increased over the same period, a trend also observed statewide, and perhaps indicative of the influence of more variable weather patterns on pH readings in the lakes in this region.



Figures 4.5.5 and 4.5.6: Frequency of Low and High pH Readings in the Adirondack Region

Regional Distribution:

pH readings with the Adirondack region are highest in the northeastern and northwestern portions of the region, although most of the highest readings are in the lakes outside the Adirondack Blue Line, particularly those in the Indian River Lakes area in northeastern Jefferson and southwestern St. Lawrence counties. These lakes are consistently alkaline and very infrequency exhibit pH excursions below the state water quality standards (Figure 4.5.5). Lakes in this part of the region also have occasionally elevated pH readings (Figure 4.5.6), particularly those in the Indian River lakes region, although the frequency of lakes with pH readings above the state water quality standards is low throughout the region. Lower pH readings are found in the interior of this region, corresponding to the interior of the Adirondack Park and most lakes within the Adirondack Blue Line, as seen in Figure 5.5.7. Most of the lakes can be classified as circumneutral to weakly alkaline, although few of these lakes exhibit pH readings below the state water quality standards. The CSLAP lake with the lowest pH, Twitchell Lake in Herkimer County, is nestled among a large number of medium to large acidic lakes, although few of these have residences or have been sampled through CSLAP.

Table 4.5.2 shows the number of pH samples, the minimum, average, and maximum pH readings, the most appropriate pH category for the lake, the frequency of pH readings below and above the state water quality standards (=6.5 and 8.5, respectively), and whether pH readings have changed since CSLAP sampling began in the lake. This long-term assessment was limited to lakes sampled for at least five years through 2009

Table 4.5.2: pH Summary in CSLAP Adirondack Region Lakes, 1986-2009

Lake Name	Years	Num	Min	Avg	Max	Category	% Samples <6.5	% Samples > 8.5	Change?
Adirondack Lake	1986-1989	34	6.11	7.52	8.32	Alkaline	3	0	
Augur Lake	1997-2009	85	6.37	7.73	9.04	Alkaline	1	7	No
Augur Lake	2009	8	6.93	8.03	8.74	Alkaline	0	14	Higher
Bartlett Pond	1997-2000	25	6.35	7.29	8.86	Circumneutral	5	5	
Black Lake	1988-2009	158	6.53	8.03	9.61	Alkaline	0	14	No
Black Lake	2009	8	7.65	7.95	8.19	Alkaline	0	0	No
Brant Lake	1987-2003	76	6.53	7.43	8.14	Circumneutral	0	0	No
Brantingham Lake	2001-2009	68	5.74	7.20	8.38	Circumneutral	7	0	No
Brantingham Lake	2009	7	5.74	6.91	7.85	Circumneutral	29	0	No
Butterfield Lake	1986-2009	174	6.43	7.82	8.90	Alkaline	1	5	No
Butterfield Lake	2009	8	7.08	7.82	8.55	Alkaline	0	13	No
Canada Lake	2001-2009	68	5.99	7.11	9.35	Circumneutral	10	1	Increasing
Canada Lake	2009	8	6.69	7.49	8.05	Circumneutral	0	0	Higher
Chase Lake	1990-1997	40	6.40	7.22	7.69	Circumneutral	3	0	No
Eagle Crag Lake	1986-2005	103	5.61	6.99	8.07	Circumneutral	16	0	No
Eagle Lake	2000-2009	72	6.29	7.60	8.80	Alkaline	4	1	No
Eagle Lake	2009	9	6.29	7.44	8.23	Circumneutral	13	0	No
Eagle Pond	2008-2009	15	7.20	8.23	9.06	Alkaline	0	25	
Eagle Pond	2009	8	7.68	8.23	8.98	Alkaline	0	25	No
East Caroga Lake	1990-2009	108	6.17	7.48	8.36	Circumneutral	2	0	No
East Caroga Lake	2009	6	6.17	7.14	7.87	Circumneutral	29	0	Lower
Effley Falls Lake	1997-2009	83	4.50	6.78	8.24	Circumneutral	30	0	No
Effley Falls Lake	2009	8	7.08	7.39	7.63	Circumneutral	0	0	Higher
Efner Lake	1997-2001	38	6.02	7.23	8.22	Circumneutral	8	0	No
Friends Lake	1991-2009	99	6.60	7.52	8.29	Alkaline	0	0	No
Friends Lake	2009	8	6.77	7.27	8.02	Circumneutral	0	0	No

Lake Name	Years	Num	Min	Avg	Max	Category	% Samples <6.5	% Samples > 8.5	Change?
Fulton Second Lake	1986-2009	155	5.25	7.26	8.30	Circumneutral	8	0	No
Fulton Second Lake	2009	8	6.49	7.60	8.29	Alkaline	17	0	Higher
Garnet Lake	1989-2001	34	6.63	7.50	8.11	Alkaline	0	0	Decreasing?
Glen Lake	1986-2009	108	6.66	7.91	8.41	Alkaline	0	0	No
Glen Lake	2009	7	7.03	7.56	7.98	Alkaline	0	0	Lower
Goodnow Flow	1986-2009	108	6.04	7.38	8.74	Circumneutral	2	2	No
Goodnow Flow	2009	7	6.62	7.55	8.74	Alkaline	0	14	No
Grass Lake	2004-2009	46	6.03	7.93	9.10	Alkaline	11	20	No
Grass Lake	2009	8	6.03	7.41	8.29	Circumneutral	25	0	Lower
Gull Pond	1994-1998	40	5.50	7.11	7.85	Circumneutral	5	0	No
Hadlock Pond	1997-2001	18	6.50	7.45	7.98	Circumneutral	0	0	No
Horseshoe Pond	2000-2009	74	6.22	7.29	8.55	Circumneutral	1	1	No
Horseshoe Pond	2009	8	6.22	7.20	8.55	Circumneutral	13	13	No
Hunt Lake	1994-2009	92	6.28	7.24	8.40	Circumneutral	3	0	No
Hunt Lake	2009	8	6.90	7.55	8.40	Alkaline	0	0	No
Hyde Lake	1999-2009	41	6.51	7.74	8.65	Alkaline	0	7	Increasing?
Hyde Lake	2009	8	6.58	7.86	8.37	Alkaline	0	0	No
Indian Lake	1986-1997	48	6.49	7.38	7.97	Circumneutral	2	0	No
Jenny Lake	1994-2007	64	5.38	7.14	8.13	Circumneutral	6	0	No
Joe Indian Lake	1986-1990	48	5.68	6.78	7.76	Circumneutral	31	0	Increasing?
Kayuta Lake	1997-2001	39	6.34	7.32	7.98	Circumneutral	3	0	No
Kellum Lake	1997-2001	35	6.03	7.22	8.11	Circumneutral	8	0	No
Lake Bonaparte	1988-2009	99	7.00	8.10	8.60	Alkaline	0	3	No
Lake Bonaparte	2009	8	7.23	7.57	8.14	Alkaline	0	0	Lower
Lake Clear	1998-2009	92	5.98	7.30	8.81	Circumneutral	10	1	No
Lake Clear	2009	8	5.98	7.00	7.95	Circumneutral	29	0	No
Lake Colby	1999-2001	17	6.51	7.33	7.96	Circumneutral	0	0	
Lake Forest	2001-2009	53	6.51	7.45	8.59	Circumneutral	0	7	No
Lake Forest	2009	6	7.11	7.61	8.38	Alkaline	0	0	No
Lake George	2004-2008	21	6.54	7.59	8.27	Alkaline	0	0	No
Lake George	2009	8	7.23	7.95	8.66	Alkaline	0	0	Higher
Lake Kiwassa	1990-1995	40	6.69	7.41	7.88	Circumneutral	0	0	No
Lake Luzerne	1999-2004	38	6.45	7.22	8.24	Circumneutral	2	0	No
Lake of the Isles	2000-2001	16	5.95	8.03	8.73	Alkaline	6	31	
Lake of the Woods	1994-2008	54	6.23	7.64	8.71	Alkaline	5	2	No
Lake Placid	1991-2009	112	6.18	7.40	9.13	Circumneutral	3	2	No
Lake Placid	2009	4	7.08	7.48	7.77	Circumneutral	0	0	No
Lake Titus	1999-2001	19	6.50	7.18	7.91	Circumneutral	0	0	
Lincoln Pond	1997-2009	60	6.16	7.28	8.32	Circumneutral	8	0	No
Lincoln Pond	2009	5	6.93	7.76	8.23	Alkaline	0	0	Higher
Little Wolf Lake	1998-2000	18	5.99	7.16	7.97	Circumneutral	6	0	
Loon Lake	1986-1997	44	6.85	7.53	8.00	Alkaline	0	0	No
Lorton Lake	1990-2009	119	5.49	7.59	9.22	Alkaline	3	8	No
Lorton Lake	2009	8	6.74	7.83	8.87	Alkaline	0	13	No
Lower Chateaugay Lake	1991-1995	33	7.04	7.64	7.96	Alkaline	0	0	Decreasing?
Lower St. Regis Lake	2000-2002	14	6.55	7.29	7.95	Circumneutral	0	0	
Mayfield Lake	2000-2004	27	5.48	7.62	8.52	Alkaline	3	3	No
Millsite Lake	1997-2009	99	5.21	7.74	9.13	Alkaline	3	9	No
Millsite Lake	2009	8	7.26	7.74	8.20	Alkaline	0	0	No
Mirror Lake	1998-2009	69	6.27	7.40	8.31	Circumneutral	7	0	No
Mirror Lake	2009	7	6.53	7.44	7.89	Circumneutral	0	0	No
Moon Lake	1992-1996	38	5.34	8.12	9.32	Alkaline	3	11	No
Moreau Lake	1994-2002	61	6.38	7.65	8.12	Alkaline	2	0	No
Mountain Lake	1998-2001	29	5.36	7.40	7.92	Circumneutral	3	0	
Mountain View Lake	1991-1997	38	5.20	7.51	8.85	Alkaline	6	3	No

Lake Name	Years	Num	Min	Avg	Max	Category	% Samples <6.5	% Samples > 8.5	Change?
North Sandy Pond	1986-1990	45	6.63	8.06	9.30	Alkaline	0	13	No
Otter Lake	1992-2009	90	6.19	7.26	8.58	Circumneutral	3	1	No
Otter Lake	2009	8	6.34	7.09	7.65	Circumneutral	13	0	No
Paradox Lake	2003-2009	55	5.72	8.03	9.39	Alkaline	2	35	No
Paradox Lake	2009	8	6.78	8.29	8.88	Alkaline	0	50	No
Peck Lake	1992-2009	46	5.79	7.17	8.64	Circumneutral	12	2	No
Peck Lake	2009	8	6.48	7.22	8.64	Circumneutral	13	13	No
Piseco Lake	1999-2003	31	5.41	7.10	7.94	Circumneutral	14	0	No
Pleasant Lake	2000-2009	60	5.82	7.13	8.93	Circumneutral	21	2	Increasing
Pleasant Lake	2009	2	7.25	7.67	8.09	Alkaline	0	0	Higher
Rondaxe Lake	1998-2001	31	6.20	7.17	7.99	Circumneutral	13	0	
Sacandaga Lake	1987-2009	92	5.84	7.25	8.04	Circumneutral	6	0	No
Sacandaga Lake	2009	8	6.23	7.04	7.80	Circumneutral	25	0	No
Schroon Lake	1987-2009	106	6.19	7.40	9.07	Circumneutral	5	1	No
Schroon Lake	2009	7	6.19	7.09	7.58	Circumneutral	25	0	Lower
Silver Lake	1989-1993	25	6.67	7.52	8.01	Alkaline	0	0	No
Silver Lake	1996-2009	84	5.94	7.43	8.81	Circumneutral	4	2	No
Silver Lake	2009	7	5.94	7.23	8.14	Circumneutral	13	0	No
Sixberry Lake	2001-2004	25	5.27	7.75	8.98	Alkaline	3	3	
Spitfire Lake	1996-2002	42	6.19	7.20	7.92	Circumneutral	7	0	No
Star Lake	1994-1998	40	6.40	7.36	7.91	Circumneutral	3	0	No
Stewarts Landing	1997-2001	40	5.82	6.74	7.75	Circumneutral	32	0	No
Twitchell Lake	1986-1996	33	4.40	5.31	6.32	Acidic	100	0	No
Upper Chateaugay Lake	1990-1994	31	6.88	7.67	8.74	Alkaline	0	3	No
Upper Saranac Lake	2006-2009	27	6.36	7.32	8.16	Circumneutral	4	0	
Upper Saranac Lake	2009	8	6.36	7.24	8.10	Circumneutral	14	0	No
Upper St. Regis Lake	1997-2002	47	6.20	7.16	7.92	Circumneutral	13	0	No
West Caroga Lake	1997-2007	28	6.37	7.35	7.91	Circumneutral	10	0	No
Windover Lake	1999-2003	37	6.26	7.19	8.02	Circumneutral	10	0	No

Num = number of samples
Min, Avg, Max = minimum, average, and maximum conductivity readings, in µmho/cm
Category= acidic if pH < 6.5; = circumneutral if 6.5 < pH < 7.5; = alkaline if pH > 7.5
Change? = exhibiting significant change in pH readings (best fit line of annual means with $R^2 > 0.5$ and seasonal Kendall-Tau rank correlation coefficient > 0.5); 2009 change based on pH readings >25% higher or lower than normal

Several of the lakes within the Adirondack region have exhibited significant long-term trends in pH readings. pH readings in Canada Lake, Hyde Lake, Joe Indian Lake, and Pleasant Lake have increased during the duration of the CSLAP sampling at the lake. Joe Indian Lake is the most highly colored of all CSLAP lakes, and has not been sampled through CSLAP since 1990. It is not known if the increasing pH noted by the end of the sampling at the lake has continued into the present day, and it is unlikely that this rise in pH is in response to Clean Air Act atmospheric sulfate and nitrate reductions, since these mostly took place in the last ten years. The increasing pH in Canada Lake, Hyde Lake and Pleasant Lake was also apparent in 2009, and in Canada Lake and Pleasant Lake this did represent significantly higher pH relative to normal conditions. Canada Lake and Hyde Lake reported wetter weather and lower conductivity in 2009, but it is unlikely that these were related to the rise in pH in 2009. It is more likely that the higher pH exhibited in both Hyde Lake and Pleasant Lake represents normal variability rather than a long-term trend, although these should continue to be watched.

Garnet Lake and Lower Chateaugay Lake have exhibited decreasing pH readings. Neither lake has been sampled through CSLAP for several years, and it is not known if the decreasing pH recorded during the last several years of sampling at each lake has continued to the present day.

Tables 4.5.3a and 4.5.3b summarize the pH data collected through CSLAP in 2009, and compare these data to the data collected for each program lake in the region prior to 2009. pH readings in the CSLAP lakes in the Adirondack region in 2009 were slightly higher than the long-term average for this region, despite a different subset of lakes sampled within the region each year. However, the percentage of lakes with higher than normal pH readings in 2009 was higher than the percentage of lakes with lower than normal readings, but a higher percentage of lakes established new maximum readings rather than new minimum readings in 2009. This suggests that the variability in pH in the Adirondack region lakes in 2009 was normal, and does not represent a long-term trend.

Table 4.5.3a: pH Summary in CSLAP Lakes, 2009

	Number Lakes	Minimum	Average 2009	Average 1986-08	Maximum	Typical
Downstate	32	5.50	7.38	7.54	8.86	Circumneutral
Central	36	4.68	7.45	7.76	9.41	Circumneutral
Adirondacks	33	5.74	7.52	7.41	8.98	Alkaline
Western	9	6.74	7.75	8.02	8.95	Alkaline
CSLAP Statewide	**110**	**4.68**	**7.48**	**7.63**	**9.41**	**Circumneutral**

Table 4.5.3b: pH Summary in CSLAP Lakes, 2009

	Number Lakes	Average 2009	Average 1986-08	%Higher	%Lower	%Above Max	%Below Min
Downstate	32	7.38	7.54	15	53	20	57
Central	36	7.45	7.76	14	27	19	32
Adirondacks	33	7.52	7.41	13	26	12	26
Western	9	7.75	8.02	0	22	0	22
CSLAP Statewide	**110**	**7.48**	**7.63**	**13**	**34**	**15**	**36**

% Higher = percentage of lakes in region with pH readings in 2009 >25% higher than normal (before 2009)
% Lower = percentage of lakes in region with pH readings in 2009 <25% below normal (before 2009)
% Above Max = percentage of lakes in region with pH readings in 2009 above previous maximum (before 2009) for lake
% Below Min = percentage of lakes in region with pH readings in 2009 below previous minimum (before 2009) for lake

Adirondack Region Lakes With Higher Than Normal pH in 2009:

Augur Lake, Canada Lake, Effley Falls Lake, Fulton Second Lake, Lake George, Lincoln Pond, and Pleasant Lake

Discussion:

Six Adirondack-region lakes exhibited higher than normal pH readings in 2009. Only two of these lakes—Canada Lake and Pleasant Lake—have exhibited a long-term increase in pH over the duration of the sampling at the lake. The rise in pH in Augur Lake, Fulton Second Lake, Lake George, and Lincoln Pond was less than half a pH unit, and was almost certainly within the normal range of variability for the lake. The higher pH in Canada Lake, Effley Falls Lake and Pleasant Lake was slightly more substantial, although it is not suspected that this resulted in any ecological impact, since these pH readings were well within the state water quality standards. The increasing pH in Canada Lake and Pleasant Lake should continue to be evaluated.

Adirondack Region Lakes With Lower Than Normal pH in 2009:
East Caroga Lake, Glen Lake, Grass Lake, Lake Bonaparte, and Schroon Lake

Discussion:
pH readings in 2009 were lower than normal in 5 Adirondack region lakes. The drop in pH in East Caroga Lake, Glen Lake, and Schroon Lake was less than 0.5 pH units, and these readings were within the long-term normal range for the lake. It is likely that this represents normal variability.

Conductivity Fact Sheet

Description:	Specific conductance is the temperature-corrected analysis of conductivity, with measures the electrical current that passes through water, and is used to estimate the number of ions (charged particles). Current is carried by ions, so specific conductance is an indirect measure of the presence of dissolved solids such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron.
Importance:	Conductivity is not a measure of pollution per se—some lakes naturally have high conductivity—and conductivity is not directly related to eutrophication or other indicators of water quality problems. However, changes (increases) in conductivity can be an indication of changing runoff to a lake, either through changing flow rates or increases in erodible material in the flow. Since these materials can often bring pollutants or change biological habitat, changes in conductivity can be an indication of pollution problems. It is somewhat related to both the hardness and alkalinity (acid-buffering capacity) of the water and may influence the degree to which nutrients remain in the water.
How Measured: in CSLAP	Specific conductance is analyzed from the surface (1.5 meter grab) sample collected with the use of a Kemmerer bottle and transferred to a collapsible container and labeled sample aliquot bottles. It is measured in the laboratory using a conductivity meter comparing a sample to the conductivity of a known solution of potassium chloride (KCl) and corrected to 25ºC. Specific conductance is more accurately measured directly in the field using a conductivity bridge, although conductivity in many lakes is fairly stable.
Detection Limit:	1 µmho/cm
Range in CSLAP:	undetectable (<1 µmho/cm) to 2540 µmho/cm; 93% of readings fall between 26 µmho/cm and 400 µmho/cm.
WQ Standards:	there are no specific conductance (or conductivity) standards in New York State.
Water Quality Assessment:	conductivity readings are not evaluated against any state water quality standards. Conductivity is related to hardness, since many of the same cations (calcium, magnesium, etc.) that contribute to hardness also contribute to conductivity (and are found in similar proportions to other metals that also contribute to conductivity). Lakes with conductivity below 100 µmho/cm can be considered softwater lakes, and lakes with conductivity above 300 µmho/cm have hard water.

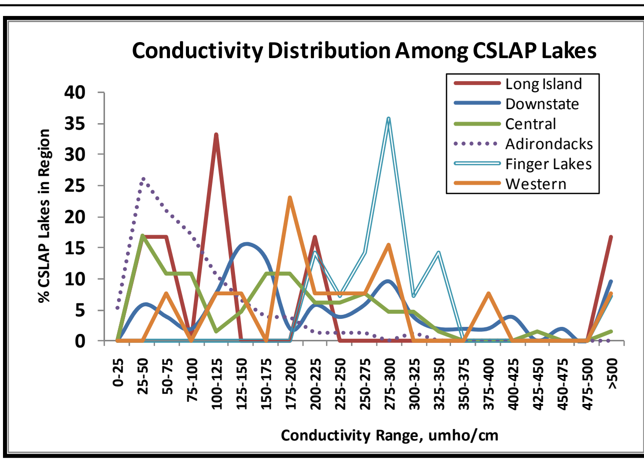
Chapter 4.6- Evaluation of Adirondack Region Conductivity: 1986-2009

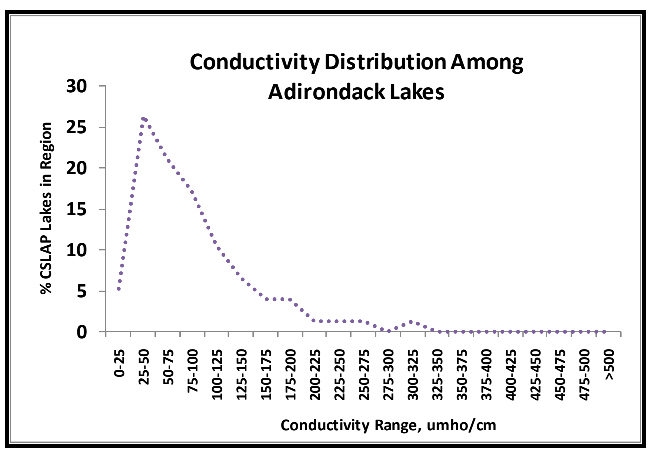
Summary of CSLAP Conductivity Findings in Adirondack Region Lakes, 1986-2009

1. CSLAP lakes within the Adirondack region have lower conductivity readings than those in other parts of the state, with the majority of lakes having typical conductivity levels between 25 and 75 µmho/cm, corresponding to softwater conditions.
2. CSLAP lakes within the Adirondack region have slightly higher conductivity readings than non-CSLAP lakes in the same region, due to the large number of small, remote, softwater lakes sampled through the ALSC study. CSLAP and non-CSLAP lakes in the same depth and size range have similar conductivity readings.
3. CSLAP lakes within the Adirondack region are more likely to have higher conductivity readings in drier years, and lower readings in wetter years.
4. Conductivity readings have increased slightly in CSLAP lakes within the Adirondack region over the last twenty five years, whether evaluated by the increased frequency of lakes with higher than normal conductivity readings in recent years or the number of lakes with increasing conductivity readings.
5. However, more Adirondack region lakes exhibited lower conductivity levels in 2009, perhaps in response to wetter weather.
6. Conductivity readings with the Adirondack region are highest in a horseshoe running from the southern edge through the eastern, northern and northwestern lakes, and are lowest in the interior of this region.

Adirondack Region Data Compared to NYS Data

CSLAP lakes in the Adirondack region have lower conductivity than in any other region of the state, as demonstrated in Figure 4.6.1, with most readings below 50-75 µmho/cm, corresponding to softwater lakes. The most common range of conductivity readings in CSLAP Adirondack region lakes is in the 25-75 µmho/cm range, with decreasing frequency as conductivity readings increase. Very few Adirondack region lakes have conductivity readings above 200 µmho/cm, as seen in Figure 4.6.2. This is close to the low end of the conductivity range in many other regions of the state, such as the Finger Lakes region.





Figures 4.6.1 and 4.6.2: Distribution of Conductivity Ranges in CSLAP and Adirondack Region Lakes

Comparison of CSLAP to NYS Lakes in the Adirondack Region

Most of the Adirondack region lakes have conductivity readings below 50 µmho/cm, as seen in Figure 4.6.3. As discussed in the phosphorus section, the majority of the lake water quality data outside of CSLAP comes from the ALSC study of more than 1500 mostly small, high elevation, remote, softwater lakes within the Adirondacks, Catskills and nearby regions. The Adirondack region lakes sampled in the non-CSLAP monitoring programs in New York State in the same size and elevation range as CSLAP lakes appear to exhibit conductivity readings comparable to those in lakes sampled through CSLAP. Although the CSLAP lakes exhibit higher conductivity readings than those more remote lakes sampled through the ALSC, the typical lake in this region exhibits low conductivity, typical of soft water lakes.

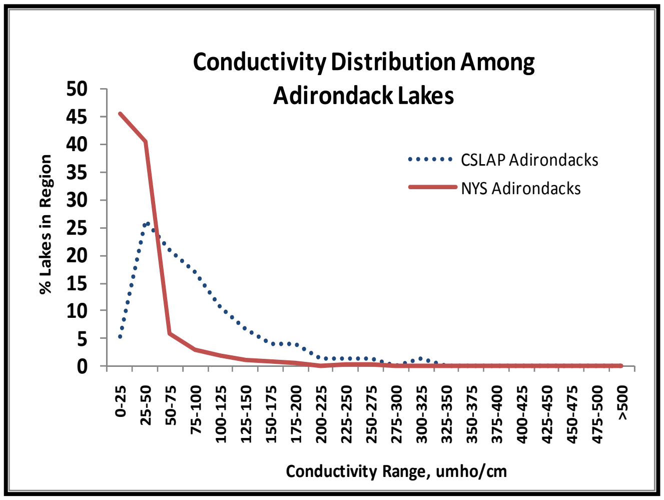


Figure 4.6.3: Average Distribution of Conductivity Readings in New York State and CSLAP Lakes in the Adirondack Region

Annual Variability:

Conductivity readings have been fairly stable in most Adirondack region lakes, although variability within the region is common. The highest conductivity readings measured through CSLAP occurred during 1995, 2003, 2002, 2001 and 1999. This corresponds to a mixture of wet and dry years. The lowest conductivity readings occurred in 1986, 2006, 1987, 2008, and 1994. Table 4.6.1 looks at the percentage of CSLAP lakes with high conductivity (greater than 1 standard error above normal) and low conductivity (greater than 1 standard error below normal) readings in wet and dry years. These data show that higher conductivity readings occur in drier years, and lower conductivity occurs in wet years, similar to the statewide trend.

Table 4.6.1- % of CSLAP Lakes with Higher or Lower (than Normal) Conductivity Readings During Dry and Wet Years in the Adirondack Region

	Dry Years	Wet Years
Higher Conductivity Readings	35%	19%
Lower Conductivity Readings	12%	30%

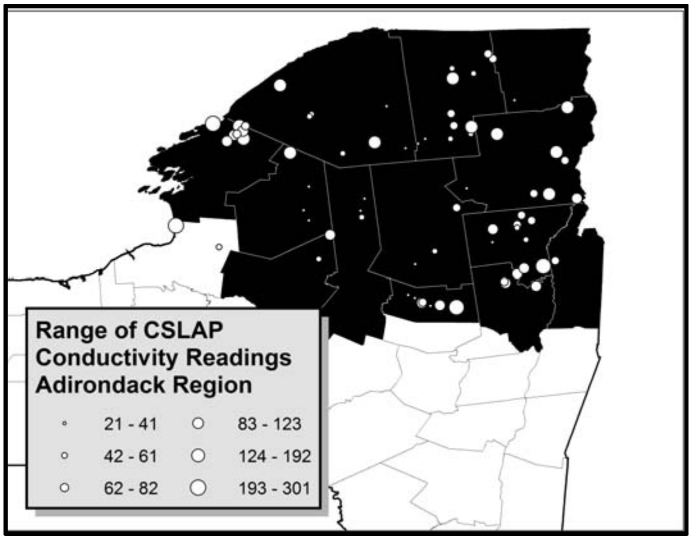
Dry Years: 1988, 1995, 2004, 2005
Wet Years: 1990, 1998, 2000, 2002, 2008
"Higher" and "Lower" defined as >1 SE higher than and lower than normal, respectively

Long Term Trends:

The evaluation of long-term trends since 1986 in the Adirondack region lakes is adversely affected by the small number of lakes sampled during some sampling seasons, particularly in the earliest years of CSLAP (from 1986 to 1990). The frequency of higher conductivity readings has increased. Although these trends do not appear to be statistically strong, they are stronger than any statewide trends and suggest that conductivity may be increasing slightly. These figures also show that the frequency of lower conductivity levels has decreased over the last 25 years, although this trend is statistically much weaker.

Regional Distribution:

Conductivity readings with the Adirondack region are highest in a horseshoe running from the southern edge through the eastern, northern and northwestern lakes, although some of the highest readings are in the lakes outside the Adirondack Blue Line, particularly those in the Indian River Lakes area in northeastern Jefferson and southwestern St. Lawrence counties. Many of these lakes can be classified as having water of intermediate hardness, although these regions are more likely to be comprised of softwater (low conductivity) than hardwater (high conductivity) lakes. Lower conductivity readings were found in the interior of this region, corresponding to the interior of the Adirondack Park, as seen in Figure 4.6.4. All of these lakes can be classified as softwater lakes, corresponding to lakes with very low conductivity.



Figures 4.6.4: Range of Conductivity Readings in the Adirondack Region

Table 4.6.2 shows the number of conductivity samples, the minimum, average, and maximum conductivity readings, the most common conductivity category for the lake, and whether conductivity readings have changed since CSLAP sampling began in the lake. This long-term assessment was limited to lakes sampled for at least five years through 2009.

Table 4.6.2: Conductivity Summary in CSLAP Adirondack Region Lakes, 1986-2009

Lake Name	Years	Num	Min	Avg	Max	Category	Change?
Adirondack Lake	1986-1989	34	73	82	92	Softwater	
Augur Lake	1997-2009	85	124	192	270	Intermediate	No
Augur Lake	2009	8	133	174	211	Intermediate	No
Bartlett Pond	1997-2000	25	45	63	179	Softwater	
Black Lake	1988-2009	158	81	154	216	Intermediate	No
Black Lake	2009	8	116	148	177	Intermediate	No
Brant Lake	1987-2003	76	68	78	91	Softwater	No
Brantingham Lake	2001-2009	68	20	32	246	Softwater	No
Brantingham Lake	2009	7	20	23	29	Softwater	Lower
Butterfield Lake	1986-2009	174	11	137	200	Intermediate	No
Butterfield Lake	2009	8	99	119	151	Softwater	No
Canada Lake	2001-2009	68	25	39	53	Softwater	No
Canada Lake	2009	8	27	33	49	Softwater	No
Chase Lake	1990-1997	40	21	26	30	Softwater	Decreasing
Eagle Crag Lake	1986-2005	103	15	23	139	Softwater	Decreasing
Eagle Lake	2000-2009	72	88	135	191	Intermediate	No
Eagle Lake	2009	9	88	119	143	Softwater	No
Eagle Pond	2008-2009	15	81	157	197	Intermediate	

Lake Name	Years	Num	Min	Avg	Max	Category	Change?
Eagle Pond	2009	8	81	141	182	Intermediate	No
East Caroga Lake	1990-2009	108	60	98	129	Softwater	Increasing
East Caroga Lake	2009	6	75	91	102	Softwater	No
Effley Falls Lake	1997-2009	83	5	21	109	Softwater	No
Effley Falls Lake	2009	8	9	15	21	Softwater	Lower
Efner Lake	1997-2001	38	58	68	76	Softwater	Increasing
Friends Lake	1991-2009	99	38	58	81	Softwater	No
Friends Lake	2009	8	46	52	61	Softwater	No
Fulton Second Lake	1986-2009	155	29	56	70	Softwater	No
Fulton Second Lake	2009	8	34	49	70	Softwater	No
Garnet Lake	1989-2001	34	32	35	57	Softwater	Decreasing
Glen Lake	1986-2009	108	153	301	379	Hardwater	No
Glen Lake	2009	7	153	286	346	Hardwater	No
Goodnow Flow	1986-2009	108	12	34	59	Softwater	No
Goodnow Flow	2009	7	20	25	30	Softwater	Lower
Grass Lake	2004-2009	46	52	73	90	Softwater	No
Grass Lake	2009	8	54	66	74	Softwater	No
Gull Pond	1994-1998	40	22	26	30	Softwater	No
Hadlock Pond	1997-2001	18	72	81	93	Softwater	No
Horseshoe Pond	2000-2009	74	57	113	206	Softwater	Increasing
Horseshoe Pond	2009	8	85	134	179	Intermediate	No
Hunt Lake	1994-2009	92	28	54	71	Softwater	Increasing
Hunt Lake	2009	8	47	53	62	Softwater	No
Hyde Lake	1999-2009	41	63	111	132	Softwater	No
Hyde Lake	2009	8	63	81	109	Softwater	Lower
Indian Lake	1986-1997	48	33	38	55	Softwater	No
Jenny Lake	1994-2007	64	51	98	121	Softwater	No
Joe Indian Lake	1986-1990	48	24	31	42	Softwater	No
Kayuta Lake	1997-2001	39	25	49	64	Softwater	No
Kellum Lake	1997-2001	35	22	54	146	Softwater	Decreasing
Lake Bonaparte	1988-2009	99	104	172	203	Intermediate	No
Lake Bonaparte	2009	8	130	151	172	Intermediate	No
Lake Clear	1998-2009	92	20	73	144	Softwater	Increasing
Lake Clear	2009	8	38	76	130	Softwater	No
Lake Colby	1999-2001	17	164	176	189	Intermediate	
Lake Forest	2001-2009	53	34	106	363	Softwater	No
Lake Forest	2009	6	48	73	92	Softwater	Lower
Lake George	2004-2009	44	31	106	135	Softwater	No
Lake George	2009	8	31	93	121	Softwater	No
Lake Kiwassa	1990-1995	40	38	51	54	Softwater	No
Lake Luzerne	1999-2004	38	62	94	313	Softwater	No
Lake of the Isles	2000-2001	16	242	258	296	Hardwater	
Lake of the Woods	1994-2008	54	58	92	98	Softwater	No
Lake Placid	1991-2009	112	18	32	80	Softwater	Decreasing
Lake Placid	2009	4	20	23	25	Softwater	Lower
Lake Titus	1999-2001	19	52	59	64	Softwater	
Lincoln Pond	1997-2009	60	18	133	182	Intermediate	No
Lincoln Pond	2009	5	71	99	118	Softwater	Lower
Little Wolf Lake	1998-2000	18	12	31	41	Softwater	
Loon Lake	1986-1997	44	72	80	93	Softwater	No
Lorton Lake	1990-2009	119	21	47	65	Softwater	No
Lorton Lake	2009	8	35	41	49	Softwater	No
Lower Chateaugay Lake	1991-1995	33	63	78	86	Softwater	No
Lower St. Regis Lake	2000-2002	14	58	69	81	Softwater	
Mayfield Lake	2000-2004	27	3	217	299	Intermediate	Increasing
Millsite Lake	1997-2009	99	46	91	238	Softwater	Decreasing

Lake Name	Years	Num	Min	Avg	Max	Category	Change?
Millsite Lake	2009	8	69	78	92	Softwater	No
Mirror Lake	1998-2009	69	3	173	241	Intermediate	No
Mirror Lake	2009	7	122	154	207	Intermediate	No
Moon Lake	1992-1996	38	127	134	143	Intermediate	Decreasing
Moreau Lake	1994-2002	61	109	123	169	Softwater	No
Mountain Lake	1998-2001	29	92	106	208	Softwater	
Mountain View Lake	1991-1997	38	38	61	78	Softwater	Decreasing
North Sandy Pond	1986-1990	45	207	240	417	Intermediate	No
Otter Lake	1992-2009	90	45	108	171	Softwater	No
Otter Lake	2009	8	45	91	141	Softwater	No
Paradox Lake	2003-2009	55	17	67	88	Softwater	No
Paradox Lake	2009	8	32	50	62	Softwater	Lower
Peck Lake	1992-2009	46	19	41	59	Softwater	No
Peck Lake	2009	8	19	32	37	Softwater	Lower
Piseco Lake	1999-2003	31	34	37	45	Softwater	Increasing
Pleasant Lake	2000-2009	60	18	34	56	Softwater	No
Pleasant Lake	2009	2	27	28	28	Softwater	No
Rondaxe Lake	1998-2001	31	19	22	31	Softwater	
Sacandaga Lake	1987-2009	92	33	45	61	Softwater	No
Sacandaga Lake	2009	8	33	39	44	Softwater	No
Schroon Lake	1987-2009	106	26	69	104	Softwater	No
Schroon Lake	2009	7	26	45	62	Softwater	Lower
Silver Lake	1989-1993	25	26	40	42	Softwater	No
Silver Lake	1996-2009	84	96	138	196	Intermediate	No
Silver Lake	2009	7	112	141	164	Intermediate	No
Sixberry Lake	2001-2004	25	48	75	83	Softwater	
Spitfire Lake	1996-2002	42	40	43	56	Softwater	No
Star Lake	1994-1998	40	40	47	52	Softwater	Increasing
Stewarts Landing	1997-2001	40	28	34	40	Softwater	Increasing
Twitchell Lake	1986-1996	33	17	21	41	Softwater	No
Upper Chateaugay Lake	1990-1994	31	58	67	77	Softwater	No
Upper Saranac Lake	2006-2009	27	28	59	283	Softwater	
Upper Saranac Lake	2009	8	28	47	65	Softwater	Lower
Upper St. Regis Lake	1997-2002	47	40	45	62	Softwater	No
West Caroga Lake	1997-2007	28	68	78	114	Softwater	No
Windover Lake	1999-2003	37	64	94	124	Softwater	No

Num = number of samples
Min, Avg, Max = minimum, average, and maximum conductivity readings, in µmho/cm
Category = softwater if conductivity < 125; = moderate if 125 < conductivity < 250; = hardwater if conductivity > 7.5
Change? = exhibiting significant change in conductivity readings (best fit line of annual means with $R^2 > 0.5$ and seasonal Kendall-Tau rank correlation coefficient > 0.5); 2009 change based on conductivity readings >25% higher or lower than normal

Several of the lakes within the Adirondack region have exhibited significant long-term trends in specific conductance readings. This sampling parameter has been much more variable than any other water quality indicator measured through CSLAP.

Conductivity readings in East Caroga Lake, Efner Lake, Horseshoe Pond, Hunt Lake, Lake Clear, Mayfield Lake, Piseco Lake, Star Lake, and Stewarts Landing have increased during the duration of the CSLAP sampling at the lake. All of these except Horseshoe Pond and Mayfield Lake are softwater lakes, and despite the rise in conductivity, these lakes still possess softwater. This group of lakes includes large lakes and small lakes, high clarity lakes and those with greater lake productivity, deep and shallow lakes, and lakes and ponds found throughout the Adirondack region. Efner Lake, Mayfield Lake, Piseco Lake, Star Lake and Stewarts Landing have not been sampled through CSLAP for more than five years, and it is not known if the increasing conductivity noted by the end of the sampling at the lake has continued into the present day. The increasing conductivity in Lake Clear has not been accompanied by long-term changes in any other CSLAP water quality indicators. The rise in conductivity in Efner Lake and Horseshoe Pond has been accompanied by a rise in pH, an increase in phosphorus readings in Star Lake, and a decrease in phosphorus in Stewarts Landing. Most of these lakes were sampled for only a short period of time—usually five years—and the small rise in conductivity in these lakes is probably within the normal range of variability.

East Caroga Lake, Hunt Lake, and Lake Clear have been sampled over a much longer period, and the rise in conductivity in these lakes may represent a real phenomenon. Water color readings in both East Caroga Lake and Hunt Lake increased over this period, and it is not known if the rise in conductivity and color are related (these indicators are not closely related in most lakes).

Chase Lake, Eagle Crag Lake, Garnet Lake, Kellum Lake, Lake Placid, Millsite Lake, Moon Lake, and Mountain View Lake have exhibited decreasing conductivity readings. Moon Lake and Millsite Lake have intermediate hardness, typical of other lakes in the Indian River lake region, while the other lakes listed above are softwater lakes. As with the lakes exhibiting increasing conductivity readings, the lakes with decreasing conductivity readings comprise a mix of small and large, shallow and deep, and clear and turbid lakes from throughout the Adirondack region. All but Lake Placid and Millsite Lake have not been sampled through CSLAP for several years, and it is not known if the decreasing conductivity recorded during the last several years of sampling at each lake has continued to the present day.

Lake Placid and Millsite Lake have been sampled recently and for several years. Only four samples were collected through CSLAP in Lake Placid in 2009, although this trend was also apparent in other recent years. It appears that the decrease in conductivity in both lakes may be statistically significant, although this decrease was not accompanied by a change in any other water quality indicators measured through CSLAP in either lake. It is not known if this decrease in conductivity in either lake has led to any ecological impacts.

Tables 4.6.3a and 4.6.3b summarize the conductivity data collected through CSLAP in 2009, and compare these data to the data collected for each program lake in the region prior to 2009. Conductivity readings in the CSLAP lakes in the Adirondack region in 2009 nearly identical to the long-term average for this region, despite a different subset of lakes sampled within the region each year. The percentage of lakes with lower than normal conductivity readings in 2009 was much higher than the percentage of lakes with higher than normal readings, and a higher percentage of lakes established new minimum readings rather than new maximum readings in 2009. This is consistent with what was likely a much wetter than normal year in the region in 2009 (the complete 2009 regional and statewide precipitation dataset was not available at the time of this writing).

Table 4.6.3a: Conductivity Summary in CSLAP Lakes, 2009

	Number Lakes	Minimum	Average 2009	Average 1986-08	Maximum	Typical
Downstate	32	15	190	244	680	Intermediate
Central	36	20	119	168	353	Softwater
Adirondacks	33	9	86	86	346	Softwater
Western	9	80	164	257	327	Intermediate
CSLAP Statewide	**110**	**9**	**134**	**173**	**680**	**Intermediate**

Table 4.6.3b: Conductivity Summary in CSLAP Lakes, 2009

	Number Lakes	Average 2009	Average 1986-08	%Higher	%Lower	%Above Max	%Below Min
Downstate	32	190	244	0	10	32	40
Central	36	119	168	0	42	8	26
Adirondacks	33	86	86	0	35	3	32
Western	9	164	257	0	44	0	33
CSLAP Statewide	**110**	**134**	**173**	**0**	**31**	**12**	**32**

% Higher = percentage of lakes in region with conductivity readings in 2009 >25% higher than normal (before 2009)
% Lower = percentage of lakes in region with conductivity readings in 2009 <25% below normal (before 2009)
% Above Max = percentage of lakes in region with conductivity readings in 2009 above previous maximum (before 2009) for lake
% Below Min = percentage of lakes in region with conductivity readings in 2009 below previous minimum (before 2009) for lake

Adirondack Region Lakes With Higher Than Normal Conductivity in 2009:
None

Discussion:
No Adirondack-region lakes exhibited higher than normal conductivity readings in 2009, even though the overall average conductivity for lakes in the Adirondack region was identical to the long-term average. This is probably due to slightly lower than normal readings for a group of lakes within this region that otherwise have slightly higher conductivity than many of the lakes sampled through CSLAP from 1986 to 2008.

Adirondack Region Lakes With Lower Than Normal Conductivity in 2009:
Brantingham Lake, Effley Falls Lake, Goodnow Flow, Hyde Lake, Lake Forest, Lake Placid, Lincoln Pond, Paradox Lake, Peck Lake, Schroon Lake, Upper Saranac Lake

Discussion:
Conductivity readings in 2009 were lower than normal in 11 Adirondack region lakes. Lake Placid was the only lake with lower conductivity readings in 2009 exhibiting a long-term decrease in conductivity. Schroon Lake was the only lake in this group with lower than normal pH in 2009. The sampling volunteers at Brantingham Lake, Effley Falls Lake, Goodnow Flow, Hyde Lake, Lake Placid, Lincoln Pond, Paradox Lake and Schroon Lake all reported much wetter conditions in 2009, particularly during the early part of the sampling season. This may have triggered the decrease in conductivity readings in these lakes, particularly given the relationship between precipitation and conductivity in the Adirondack region, as shown in Table 5.6.1. It is likely that the lower conductivity readings in the other three lakes (Lake Forest, Peck Lake, and Upper Saranac Lake) were also in response to wetter than normal weather, particularly in the early part of the 2009 CSLAP sampling season, but wetter weather was not explicitly cited by the CSLAP sampling volunteers at these lakes.

Calcium Fact Sheet

Description:	calcium is a trace metal closely associated with limestone geology and strongly buffered, alkaline lakes.
Importance:	calcium can be considered a surrogate for alkalinity, or buffering capacity—lakes with high calcium levels are generally immune to swings in pH due to acid rain or other acidic inputs to lakes. Calcium is also a micronutrient required by freshwater mussels to grow their shells, and calcium may be one of the most significant limiting factors to colonization by zebra mussels. It is temporally stable in most lake systems, so it is analyzed in only two samples per year, although calcium levels may vary significantly spatially within a lake, due to inputs from concrete or limestone leaching. Open water calcium levels may be significantly lower than those measured near developed shorelines, thus underestimating the potential for "microhabitats" for zebra mussels.
How Measured: in CSLAP	calcium is analyzed from the surface (1.5 meter grab) sample collected with the use of a Kemmerer bottle and transferred to a collapsible container. Once received in the laboratory, it is immediately acidified with nitric acid. Calcium is analyzed using the atomic absorption spectrophotometric method.
Detection Limit:	0.3 mg/l. Calcium was not analyzed through CSLAP prior to 2002.
Range in CSLAP:	undetectable (< 0.3 mg/l) to 56.1 mg/l. 68% of surface readings are between 5 mg/l and 30 mg/l, and 20% of surface samples have calcium readings in excess of 25 mg/l.
WQ Standards:	there are no state water quality standards for calcium.
Water Quality Assessment:	calcium readings in CSLAP are evaluated for susceptibility for zebra mussel infestation. The calcium levels required to support zebra mussel shell growth is approximately 25 mg/l. However, open water sampling (as conducted through CSLAP) may indicate calcium levels lower than those measured along developed shorelines—some CSLAP lakes with open water calcium levels as low as 12 mg/l have been found to support zebra mussels, due to higher localized calcium readings. It is assumed that lakes with calcium levels above 20 mg/l, or those with known localized presence of zebra mussels or mussel veligers are susceptible to zebra mussel colonization.

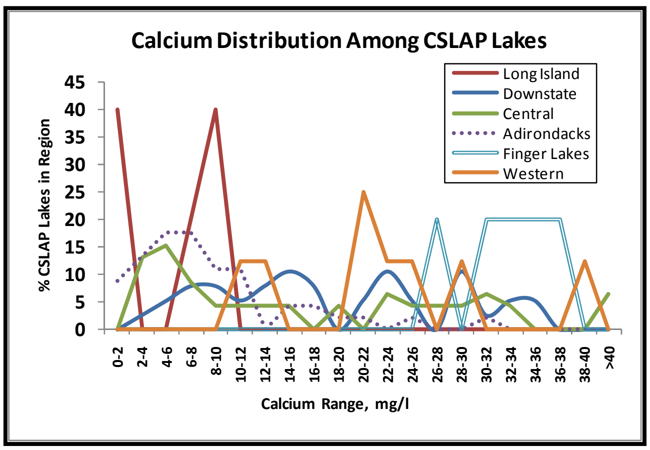
Chapter 4.7- Evaluation of Adirondack Region Calcium: 2002-2009

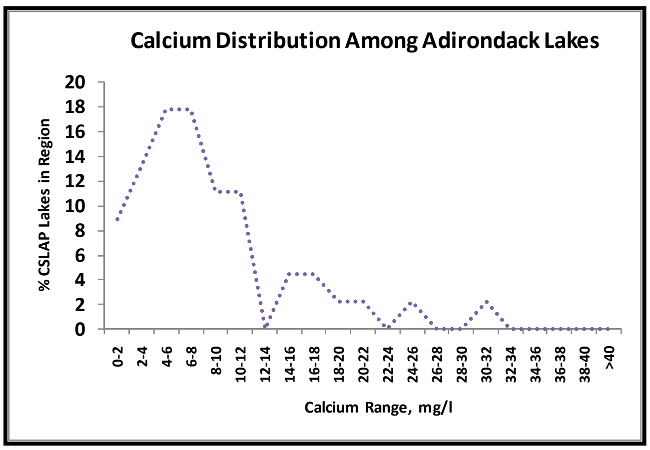
Summary of CSLAP Calcium Findings in Adirondack Region Lakes, 2002-2009

1. CSLAP lakes within the Adirondack region have calcium readings that are lower than in all but the Long Island region.
2. Calcium readings in CSLAP lakes within the Adirondack region are higher in the drier years and lower in the wetter years.
3. It is premature to evaluate long-term trends in calcium data, given the short timeframe in which data were collected and the small number of samples analyzed each year.
4. Few CSLAP lakes in the Adirondack region have exhibited any long-term changes in calcium levels, and calcium readings in most of these lakes were close to normal in 2009.
5. Calcium readings with the Adirondack region are highest in the western and southeastern portions of this region, and lowest in the interior and south to southwestern part of this region.
6. Most lakes in the Adirondack region do not appear to be susceptible to zebra mussel infestations, based on calcium levels in the lake.

Adirondack Region Data Compared to NYS Data

Figure 4.7.1 indicates that CSLAP lakes in the Adirondack region have lower calcium levels than lakes in all other regions of the state except the Downstate (Long Island) region. The most common range of calcium readings in CSLAP Adirondack region lakes is in the 4-8 mg/l range, with most lakes having calcium readings below 20 mg/l, as seen in Figure 4.7.2. This indicates that only a small percentage of lakes in the Adirondack region are susceptible to infestation by zebra mussels.





Figures 4.7.1 and 4.7.2: Distribution of Calcium Ranges in CSLAP and Adirondack Region Lakes

Comparison of CSLAP to NYS Lakes in the Adirondack Region

Calcium has not been collected in or evaluated through most of the non-CSLAP monitoring programs conducted within the Adirondack region, including the ALSC study. Therefore, a comparison of calcium readings between CSLAP and non-CSLAP lakes within the Adirondack region is not possible.

Annual Variability:

The highest calcium readings measured through CSLAP in the Adirondack region occurred during 2004 and 2003. The lowest calcium readings occurred in 2008 and 2009. Table 4.7.1 looks at the percentage of CSLAP lakes with high water calcium (greater than 1 standard error above normal) and low calcium (greater than 1 standard error below normal) readings in wet and dry years. These data show that high calcium readings are somewhat more likely to occur in dry years, and low calcium was associated with wet years.

Table 4.7.1- % of CSLAP Lakes with Higher or Lower (than Normal) Calcium Readings During Dry and Wet Years in the Adirondack Region

	Dry Years	Wet Years
Higher Calcium Readings	30%	2%
Lower Calcium Readings	6%	40%

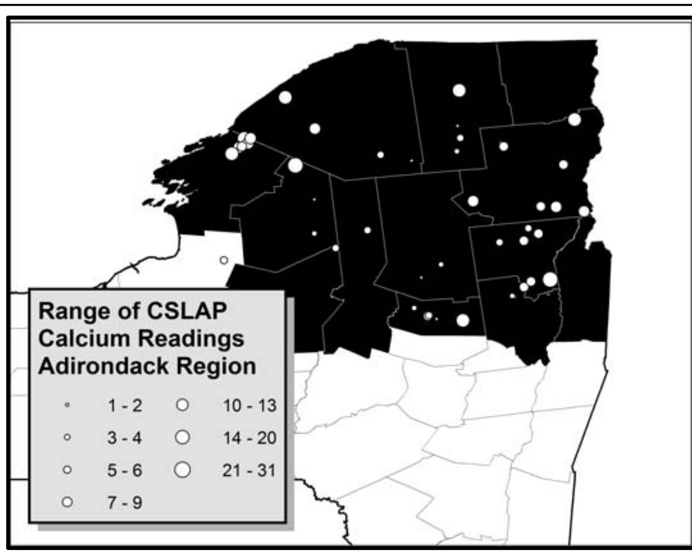
Dry Years: 1988, 1995, 2004, 2005
Wet Years: 1990, 1998, 2000, 2002, 2008
"Higher" and "Lower" defined as >1 SE higher than and lower than normal, respectively

Long Term Trends:

The evaluation of long-term trends for ammonia, total nitrogen, and calcium is affected by the short timeframe of data collection. Since 2002, the frequency of lower than normal (moderately and significantly) calcium readings has decreased. However, this trend disappears when the very low 2002 readings (subcontracted to a different laboratory) are removed from the dataset. These data indicate that no long-term trends in calcium data are apparent, although additional years of data may be needed before any trends become apparent.

Regional Distribution:

Calcium readings with the Adirondack region are highest in the western and southeastern portions of this region, similar to the regional conductivity and pH patterns, as apparent in Figure 4.7.3. Some of these lakes have high enough calcium levels to support zebra mussel colonization, although these exotic bivalves have not been found in some of these lakes. The lowest calcium readings are found in interior and south to southwestern part of this region. None of these lakes are likely to be able to support zebra mussel colonization.



Figures 4.7.3: Range of Calcium Readings in the Adirondack Region

Table 4.7.2 shows the number of calcium samples, the minimum, average, and maximum calcium readings in the entirety of the CSLAP dataset and in 2009, whether the average calcium readings are high enough to support colonization by zebra mussels, and whether calcium readings have changed since CSLAP sampling began in the lake (through 2008).

Table 4.7.2: Calcium Summary in CSLAP Adirondack Region Lakes, 1986-2009

Lake Name	Years	Num	Min	Avg	Max	Susceptible to Zebra Mussels?	Change?
Augur Lake	1997-2009	13	12.7	16.4	20.2	No	No
Augur Lake	2009	2	14.5	15.4	16.3	No	No
Black Lake	1988-2009	13	17.3	19.5	24.0	Borderline	No
Black Lake	2009	2	20.0	22.0	24.0	Yes	No
Brant Lake	1987-2003	3	3.9	7.2	9.2	No	
Brantingham Lake	2001-2009	15	1.8	4.0	11.7	No	No
Brantingham Lake	2009	2	2.7	3.0	3.2	No	Lower
Butterfield Lake	1986-2009	13	6.0	16.8	20.7	Borderline	No
Butterfield Lake	2009	2	18.3	19.5	20.7	No	No
Canada Lake	2001-2009	14	1.7	2.3	2.7	No	No
Canada Lake	2009	2	1.7	1.8	2.0	No	No
Eagle Crag Lake	1986-2005	6	0.8	1.8	2.3	No	No
Eagle Lake	2000-2009	13	5.1	11.5	13.9	No	No
Eagle Lake	2009	2	12.6	13.3	13.9	No	No
Eagle Pond	2008-2009	4	13.7	14.3	15.5	No	
Eagle Pond	2009	2	13.7	14.6	15.5	No	No
East Caroga Lake	1990-2009	13	3.4	8.5	12.2	No	No
East Caroga Lake	2009	2	6.9	7.9	8.9	No	No
Effley Falls Lake	1997-2009	11	0.9	2.0	4.2	No	No
Effley Falls Lake	2009	2	2.2	3.2	4.2	No	Higher
Friends Lake	1991-2009	13	3.7	6.8	7.9	No	No
Friends Lake	2009	1	7.4	7.4	7.4	No	No
Fulton Second Lake	1986-2009	13	0.9	4.7	5.9	No	No
Fulton Second Lake	2009	2	4.5	4.6	4.7	No	No
Glen Lake	1986-2009	13	10.9	30.8	34.6	Yes	No
Glen Lake	2009	2	34.2	34.4	34.6	Yes	No
Goodnow Flow	1986-2009	6	3.1	9.1	33.0	No	No
Goodnow Flow	2009	2	3.1	3.7	4.3	No	Lower
Grass Lake	2004-2009	12	9.8	11.3	13.3	No	No
Grass Lake	2009	2	11.5	12.4	13.3	No	No
Horseshoe Pond	2000-2009	15	3.9	9.0	13.9	No	No
Horseshoe Pond	2009	2	10.1	10.9	11.7	No	No
Hunt Lake	1994-2009	15	0.7	3.7	4.9	No	No
Hunt Lake	2009	2	3.6	4.3	4.9	No	No
Hyde Lake	1999-2009	6	11.3	14.8	17.0	No	
Hyde Lake	2009	2	13.0	14.6	16.2	No	No
Jenny Lake	1994-2007	8	1.4	4.3	5.7	No	No
Lake Bonaparte	1988-2009	6	23.6	25.6	27.4	Yes	No
Lake Bonaparte	2009	2	24.7	26.1	27.4	Yes	No
Lake Clear	1998-2009	15	1.1	4.9	7.4	No	No
Lake Clear	2009	2	5.2	5.6	6.1	No	No
Lake Forest	2001-2009	14	1.5	7.4	9.7	No	No
Lake Forest	2009	2	7.4	8.4	9.3	No	No
Lake George	2004-2009	11	9.4	11.7	14.8	Borderline	No
Lake George	2009	2	11.9	13.3	14.8	No	No
Lake Luzerne	1999-2004	4	3.2	7.0	8.8	No	
Lake of the Woods	1994-2008	6	2.8	11.1	15.8	No	No
Lake Placid	1991-2009	13	1.3	3.4	6.4	No	No
Lake Placid	2009	1	2.7	2.7	2.7	No	Lower
Lincoln Pond	1997-2009	5	6.2	7.6	10.8	No	
Lorton Lake	1990-2009	15	1.6	5.5	7.0	No	No
Lorton Lake	2009	2	6.9	7.0	7.0	No	Higher
Mayfield Lake	2000-2004	2	5.8	20.0	29.3	Yes	
Millsite Lake	1997-2009	13	1.3	11.6	16.8	No	No

Lake Name	Years	Num	Min	Avg	Max	Susceptible to Zebra Mussels?	Change?
Millsite Lake	2009	2	13.2	15.0	16.8	No	Higher
Mirror Lake	1998-2009	12	7.1	8.5	9.1	No	No
Otter Lake	1992-2009	11	2.1	6.3	8.8	No	No
Otter Lake	2009	2	5.1	5.9	6.7	No	No
Paradox Lake	2003-2009	12	7.1	8.3	9.7	No	Decreasing?
Paradox Lake	2009	2	8.0	8.2	8.4	No	No
Peck Lake	1992-2009	4	1.9	2.7	3.4	No	No
Peck Lake	2009	2	2.5	3.0	3.4	No	No
Piseco Lake	1999-2003	3	0.6	2.0	3.4	No	
Pleasant Lake	2000-2009	13	1.8	2.8	4.2	No	No
Pleasant Lake	2009	2	3.0	3.0	3.0	No	No
Sacandaga Lake	1987-2009	2	3.8	4.0	4.1	No	
Sacandaga Lake	2009	2	3.8	4.0	4.1	No	No
Schroon Lake	1987-2009	14	2.9	5.4	9.1	No	No
Schroon Lake	2009	2	5.1	5.6	6.1	No	No
Silver Lake	1996-2009	11	2.7	5.4	7.0	No	No
Silver Lake	2009	2	5.6	6.3	6.9	No	No
Sixberry Lake	2001-2004	4	3.5	9.0	16.4	No	
Spitfire Lake	1996-2002	2	1.1	1.3	1.6	No	
Upper Saranac Lake	2006-2009	6	4.0	4.3	4.7	No	
Upper Saranac Lake	2009	2	4.0	4.1	4.2	No	No
Upper St. Regis Lake	1997-2002	2	1.6	10.5	19.3	No	
West Caroga Lake	1997-2007	1	6.1	6.1	6.1	No	
Windover Lake	1999-2003	3	1.8	4.7	7.4	No	

Only one lake in this region may be exhibiting long-term change in calcium readings. Calcium levels in Paradox Lake have generally decreased over the last six years, though not in 2009. This is coincident with decreasing conductivity readings over the same period, although pH readings in the lake did not decrease over the same period. It is not likely that the slight drop in calcium levels over this period led to any other measurable ecological impacts, although these cannot be well evaluated through CSLAP.

Tables 4.7.3a and 4.7.3b summarize the calcium data collected through CSLAP in 2009, and compare these data to the data collected for each program lake in the region prior to 2009. Calcium readings in the CSLAP lakes in 2009 were higher than normal in all regions, including the Adirondack region, except the Downstate (Long Island/NYC) region. This occurred despite the very wet weather experienced in most of the state in the beginning of 2009 (the majority of the 2009 meteorological data are not yet available at the time of this writing). Although a much higher percentage of Adirondack region lakes exhibited new maximum calcium readings in 2009, about an equal number (10%) of sampled lakes exhibited calcium readings that were much higher and much lower than normal in 2009. It is likely that the higher calcium readings in the Adirondack region lakes were still within the normal range of variability for these lakes.

Table 4.7.3a: Calcium Summary in CSLAP Lakes, 2009

	Number Lakes	Minimum	Average 2009	Average 1986-08	Maximum	% Susceptible to Zebra Mussels
Downstate	29	0.1	17.7	16.7	43.4	31
Central	33	1.5	17.6	16.6	54.3	39
Adirondacks	32	1.7	9.7	8.8	34.6	9
Western	9	9.6	26.8	26.1	39.8	78
CSLAP Statewide	**103**	**0.1**	**16.0**	**15.2**	**54.3**	**32**

Table 4.7.3b: Calcium Summary in CSLAP Lakes, 2009

	Number Lakes	Average 2009	Average 1986-08	%Higher	%Lower	%Above Max	%Below Min
Downstate	29	17.7	16.7	0	3	62	38
Central	33	17.6	16.6	9	3	35	26
Adirondacks	32	9.7	8.8	10	10	45	13
Western	9	27.1	26.1	11	0	33	11
CSLAP Statewide	**103**	**16.0**	**15.2**	**7**	**6**	**46**	**24**

% Higher = percentage of lakes in region with calcium readings in 2009 >25% higher than normal (before 2009)
% Lower = percentage of lakes in region with calcium readings in 2009 <25% below normal (before 2009)
% Above Max = percentage of lakes in region with calcium readings in 2009 above previous maximum (before 2009) for lake
% Below Min = percentage of lakes in region with calcium readings in 2009 below previous minimum (before 2009) for lake

Adirondack Region Lakes With Higher Than Normal Calcium Readings in 2009:
Effley Falls Lake, Lorton Lake, Millsite Lake

Discussion:

Three Adirondack-region lakes exhibited higher than normal calcium readings in 2009. Calcium readings in Effley Falls Lake, Lorton Lake, and Millsite Lake were only slightly higher than normal, and none of these lakes exhibited higher than normal conductivity readings (conductivity in Effley Falls Lake was lower than normal). It is likely that the change in calcium readings in 2009 was within the normal range of variability for these lakes.

Adirondack Region Lakes With Lower Than Normal Calcium in 2009:
Brantingham Lake, Goodnow Flow, Lake Placid

Discussion:

Three Adirondack-region lakes exhibited lower than normal calcium readings in 2009. Each of these lakes—Brantingham Lake, Goodnow Flow, and Lake Placid—exhibited lower than normal conductivity in 2009. These findings suggest that the decrease in calcium and conductivity may have influenced other water quality indicators in the lake.

Chapter 5- Evaluation of Biological Condition

Chapter 5- Evaluation of Biological Condition

Summary of Biological Condition Adirondack Region Findings

1. Biological condition can only be evaluated to a limited extent in CSLAP lakes, in large part because CSLAP is intended primarily as a water quality monitoring program. This is offset somewhat in the Adirondack region by the extensive ALSC dataset.
2. Primary productivity can be evaluated by phytoplankton and macrophytes—algae and rooted aquatic plants.
3. The primary means for evaluating phytoplankton is chlorophyll *a*, as discussed in detail in section 4.2, phytoplankton identification, paleolimnology, and an analysis of harmful algal blooms (HAB).
4. CSLAP phytoplankton identification was conducted only as a special study in 1992, and the 2008 paleolimnology portion of the NYSDEC biomonitoring study on a small subset of CSLAP lakes has not yet been completed.
5. The 1992 algal enumeration found high percentages (but low total counts) of dinoflagellates, diatoms, and bacteria in many of the sampled 14 Adirondack region lakes. Higher cyanobacteria levels were generally limited to lakes outside the Adirondack Park.
6. A five year HAB study conducted by DOH and DEC on about 65 CSLAP lakes began in 2009, but the initial results from this study are not yet available. This is discussed in the statewide report.
7. Macrophyte data are available for 68 Adirondack region lakes, much of it collected through ALSC or Adirondack Park Invasive Plant Program (APIPP) monitoring.
8. Very high aquatic plant diversity was apparent in the ALSC and CSLAP sampled lakes in the region, although occurrences of exotic plants are increasing.
9. The CSLAP data indicate that the presence of exotic plants appears to trigger more extensive surface plant growth and more recreational use impacts.
10. There are insufficient lake zooplankton data for Adirondack region lakes to warrant a "local" assessment
11. There are insufficient lake benthic macroinvertebrate studies for Adirondack region lakes to warrant a "local" assessment, although this will no doubt change in the future. The statewide report presents the limited and preliminary statewide benthic findings.
12. Zebra mussels are limited to the perimetry of the Adirondack region lakes, no doubt due to both limited exposure and poor habitat (low calcium levels)
13. Fisheries surveys on CSLAP lakes indicate a high percentage of coolwater and coldwater fish species in the Adirondack region, particularly in those lakes within the Adirondack Park.

Background

The biological condition of lakes can be evaluated in many ways. Ideally, these evaluations include assessments of primary producers, such as phytoplankton (algae) and macrophytes (rooted aquatic plants), and primary, secondary and tertiary consumers, including zooplankton, macroinvertebrates, mussels, fish, and mammals, and decomposers such as bacteria, as well as the interactions among these components of the food web. These assessments are largely beyond the scope of CSLAP and most standard water quality monitoring programs. Although most of these components have been evaluated in at least some CSLAP lakes, few were measured in CSLAP in 2009. The biological condition evaluation from each CSLAP lake sampled in 2009 is discussed in the individual lake survey. The 25 Year CSLAP report will discuss in detail the findings from the 1992 phytoplankton and zooplankton surveys, the macroinvertebrate surveys, and the fisheries surveys conducted by the NYSDEC, ALSC, and other monitoring programs. Since macrophyte surveys have been conducted every year in many CSLAP lakes, from semi-quantitative surveys to assessments of aquatic plant coverage during the field perception surveys conducted during each CSLAP sampling session, aquatic plant assessments are summarized in the statewide and regional reports.

Evaluation of Primary Producers

Chapter 5.1- Evaluation of Phytoplankton

The algal communities in lakes can be evaluated by looking at algal species composition—the frequency of various classes of algae—and algal abundance associated with the water surface, suspended in the water, and growing on rooted plants, rocks and bottom substrate. Floating algae, whether associated with surface canopies of rooted plants or buoyant algal mats, are highly temporally and spatially variable in lakes and are difficult to measure and characterize in standard monitoring programs. Benthic algae—those associated with the lake bottom—are increasingly becoming more problematic in New York state lakes, particularly in those lakes with either increasing water clarity (due to removal of suspended algae by algacides or algal precipitants such as alum) or removal of bottom macrophytes by drawdown or herbicides. However, these have also not been monitored through CSLAP, although some sampling volunteers report changes in benthic algal communities.

There are a wide variety of suspended algae genera found in New York state lakes. In general, water quality problems tend to be associated with cyanobacteria (also known as blue green algae), although algal blooms are occasionally associated with green algae and diatoms. The healthiest lake environment tends to exhibit low levels of a large number of algae species from several genera. Suspended algal abundance can be evaluated by looking at chlorophyll *a*, a photosynthetic pigment found in all freshwater algae. The CSLAP chlorophyll *a* analyses are discussed in the "Evaluation of Eutrophication Indicators" portion of this report (section 4.2). This is the dominant segment of the phytoplankton community in most New York state lakes, although it does not distinguish between "good" and "bad" algae.

The composition of the suspended algae community can be evaluated by enumerating algae under a microscope. Algae identification and enumeration is conducted by a small number of algologists—scientists studying algae, including the NYS Department of Health (NYSDOH)—but is usually limited to special studies investigating algal blooms or threats to potable water use.

Except for a special study conducted in most CSLAP lakes in 1992 and for some lakes in later years, phytoplankton have not been analyzed through CSLAP. A summary of the 1992 phytoplankton surveys will be included in the 25 Year CSLAP report issued in 2011, and with chlorophyll *a* evaluations are included in the individual lake appendices.

In addition to the one-time algae identification conducted through CSLAP in 1992, the NYSDOH received a five year grant from the Centers for Disease Control (CDC) to study the frequency and dynamics of harmful algal blooms and algal toxins, starting in 2009. In the pilot year of the program, all CSLAP lakes with historical evidence of algal blooms, nutrient conditions that render the lake susceptible to blooms, and lakes serving as potable water supplies were provided bottles to conduct algal bloom monitoring. This constituted about 65 CSLAP lakes in 2009. In the event of an algal bloom, algal scum and open water samples (from the grab water sample) were submitted to the NYSDOH. Background (non-bloom) samples in late summer were also collected to provide a comparison with bloom conditions. All HAB study samples were analyzed for the presence of microcystin-LR, a toxin commonly produced by cyanobacteria (blue green algae). In addition, these samples, and all CSLAP water samples submitted after mid August were analyzed at the water chemistry laboratory (UFI) with a handheld phycocyanin detector for the potential presence of cyanobacteria (phycocyanins are pigments found in blue green algae). By comparing both phycocyanin and Microcystin-LR (a toxic variant most associated with bloom conditions) results to water chemistry sampling data at the time of sampling, the environmental conditions and causes associated with harmful algal blooms may become more apparent, providing important information that may lead to strategies for controlling and minimizing these blooms.

67% of the samples submitted during year 1 have been analyzed for the presence of microcystin. 74% of these contained detectable levels of microcystin, and 37% were above 0.1 ppb. As a reference point, the World Health Organization has established a provisional guideline of 1.0 ppb to protect potable water supplies, and has identified a "*low probability*" of acute health effects from swimming in water with 10-20 ppb of microcystin-LR. It should be noted that some of these samples were collected from non-CSLAP lakes, including other lakes monitored by the NYSDEC and the NYS Office of Parks and Recreation. While all water samples associated with HAB concerns at regulated beaches (or other locations with reported potentially HAB related illnesses) were analyzed immediately, the regular monitoring samples were preserved and held for later analysis. These results will be summarized once all of the samples have been analyzed and the data have been interpreted.

Chapter 5.2- Evaluation of Macrophytes

As with phytoplankton, aquatic plants can be evaluated by looking at the total amount of vegetation in the lake, using biomass counts or semi-quantitative measures of aquatic plant densities or coverage, conducted through rake toss surveys. These rake toss surveys have been conducted at several CSLAP lakes, mostly in response to aquatic plant monitoring requirements through the DEC aquatic pesticides permitting program. In the absence of rake toss survey results for a large number of CSLAP lakes, other methods for evaluating plant abundance can be utilized. During each CSLAP sampling session, sampling volunteers evaluate aquatic plant coverage through the standardized recreational use perception surveys. The results from these surveys are discussed in detail in the "Evaluation of Lake Perception" section.

The number and type of aquatic plant species in lakes provide additional information about the health and stability of macrophyte communities. Aquatic ecologists generally view native plants more favorably than exotic plants, and a high diversity of plants more favorably than monocultures, particularly when the monoculture consists of invasive, exotic plants like Eurasian watermilfoil. Aquatic botanists in several midwestern states have developed a Floristic Quality Index (FQI) to assess the quality of the flora (aquatic and terrestrial) of their state. An FQI is developed by assigning a Coefficient of Conservation for each plant species on a 10 point scale, "representing an estimated probability that a species is likely to occur in a landscape relatively unaltered from what is believed to be a pre-settlement condition." Thus, a 0-3 represents species highly tolerant of disturbance, 4-6 are moderately tolerant taxa, 7-8 are found in a narrow range but can tolerate minor disturbance, and 9-10 represents highly intolerant of disturbance. The FQI for a plant community, whether in a lake or field or larger geographic area, is calculated from a simple algorithm involving the C values and the total number of plants.

An FQI can serve to:

(1) identify high quality lakes warranting protection;
(2) identify susceptible waterbodies (by finding many low FQI lakes in the neighborhood);
(3) establish a standardized way to evaluate plant control efficacy;
(4) allow state permit reviewers to identify a trigger point for management (once an FQI falls below an "acceptable" level, active management may be needed, particularly for "nuisance" versus "invasive" conditions)

However, since there are more than 1000 plant species found in New York state, and aquatic and terrestrial botanists in other states have not reached a consensus on C values for most of these plants (and in fact C values often vary significantly from state to state), FQIs cannot be easily developed in New York state. Until C values are established for plants in New York state or within several northeastern states, modified C value categories can be established for aquatic plants. One such grouping of categories could be as follows (Table 5.2.1):

Table 5.2.1- Modified C Values for Aquatic Plants in New York State

Category	Proposed Modified C Value	Representative Plants
Protected Plants	5	Water marigold, Farwellii's milfoil, Northern pondweed, Lesser bladderwort
Beneficial Native Plants	3	Eelgrass, Common waterweed, Water shield, Whorled watermilfoil, Slender naiad
Nuisance Native Plants	1	Coontail, Largeleaf pondweed, Duckweed, Watermeal, Southern naiad
Innocuous or Regionally Problematic Exotic Plants	-1	Water shamrock, Pond water starwort, Brittle naiad, Swollen bladderwort
Problematic to Regionally Invasive Exotic Plants	-3	Variable watermilfoil, Brazilian elodea, Curlyleaf pondweed, Starry stonewort
Invasive Exotic Plants	-5	Eurasian watermilfoil, Water chestnut, Hydrilla

For any lake, the average modified C value (mC) can be calculated from all of the aquatic plants observed or collected in the lake and verified through CSLAP or other monitoring programs. The modified Floristic Quality Index (mFQI) can be calculated from the formula:

mFQI = mean mC x $\sqrt{N}$, where N = number of plant species identified.

A "good" Floristic Quality Index (or modified Index) has not been defined for either aquatic or terrestrial ecosystems, particularly in the northeast, since the FQI does not account for plant abundance or the nuisance growth of good plants in some lakes. However, aquatic botanists from the state of Florida have defined the following broad classifications of aquatic plant communities, shown in Table 5.2.2:

Table 5.2.2- Typical Aquatic Plant Community Designations

Aquatic Plant Community Designation	Description
Outstanding	67% "sensitive", 0% "tolerant", 90% "native", 0% "invasive"
Excellent	20% "sensitive", 20% "tolerant", 85% "native", 0% "invasive"
Fair	15% "sensitive", 35% "tolerant", 70% "native", 10% "invasive"
Poor	0% "sensitive", 50% "tolerant", 60% "native", 25% "invasive"
Very Poor	0% "sensitive", 40% "tolerant", 40% "native", 40% "invasive"

Some waterbodies may not fall cleanly within a plant community classification—for example, a lake may have a high percentage of both "sensitive" and 'invasive" plants—but these designations provide a reference point for characterizing the quality of aquatic plants in a lake. In addition, although the broad categories of modified C values in Table 5.2.1 doesn't exactly match the plant community descriptions in Table 5.2.2, these modified C values can be used to characterize the modified FQIs for each CSLAP lake based on the number of plants in each lake.

The volunteers from each CSLAP lake have been offered an opportunity to submit plants for identification, using the procedures outlined in the back of the CSLAP sampling protocol to collect, preserve and transport the samples. Aquatic plant sampling has not been included in the CSLAP training sessions, and thus only about half (49%) of the CSLAP lakes have any aquatic plant survey data collected through CSLAP. However, many other CSLAP lakes have been sampled by consultants, academic institutions, and other monitoring programs, with varying degrees of intensity (as is the case with CSLAP plant surveying as well). In addition, there is some inconsistency in plant identifications, particularly protected plant species, from program to program. The largest Adirondack region monitoring program, the Adirondack Lake Survey Corporation survey of 1500 lakes, identified aquatic plants down to species level, limiting the ability to distinguish protected, beneficial, and invasive plants within the same genera (such as *Potamogeton* and *Myriophyllum*). Thus any comparison of plant sampling results across monitoring programs or even within the CSLAP dataset has limited utility. Nonetheless, to try to encourage more detailed monitoring on these lakes, and to provide at least a rudimentary evaluation of aquatic plant communities in CSLAP lakes, the mFQIs and general plant survey result summaries for each of the Adirondack region CSLAP lakes with plant survey data are provided in Table 5.2.3.

The data from Table 5.2.3 suggest that high diversity is found in most Adirondack region lakes, even those with exotic plant species (columns C01, C03, and C05). The statewide CSLAP report indicates that this diversity is probably greater than in other regions of the state, and the relatively small number of lakes with invasive species indicates that the remoteness of much of the Adirondack Park, particularly the interior regions, has spared it from the onslaught of invasive species found in the rest of the state (although this is starting to change). Extremely high diversity is apparent in a number of lakes in the southeastern corner of the Adirondacks, including Lake George, Brant Lake, and Loon Lake, although this is due at least in part to the more extensive survey work conducted at those lakes (as seen with the Upper Saranac Lake results). Those lakes listed in Table 5.2.3 with relatively few aquatic plants no doubt reflects the lack of complete survey data, although some of these lakes may also not be as biologically diverse as other lakes in the region.

Table 5.2.3- Summary of Adirondack Region Macrophyte Survey Data for CSLAP Lakes

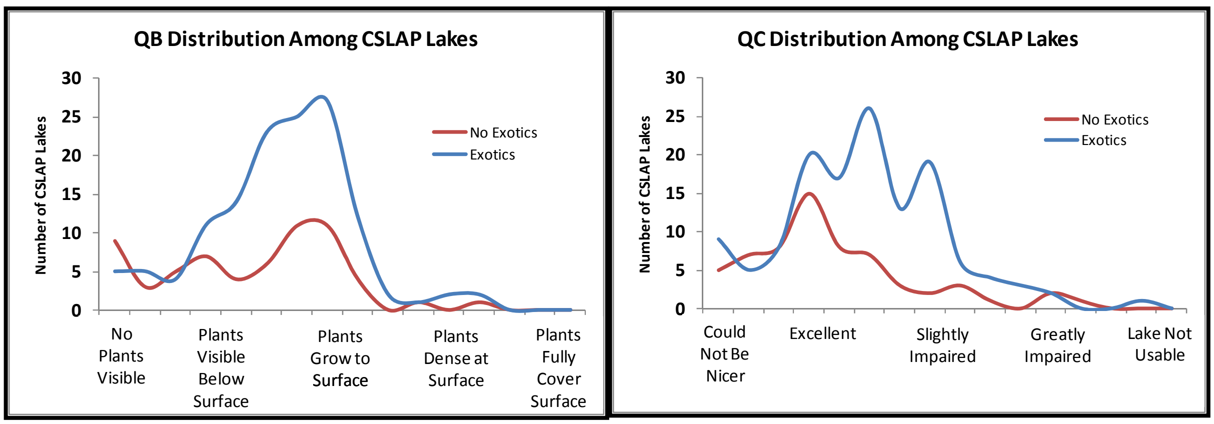
Lake Name	Macrophyte Surveys	Survey via?	N	C5	C3	C1	C01	C03	C05	MeanC	mFQI	FQI Rating
Adirondack Lake	2009	DEC	21		20	1				2.9	13.3	Excellent
Augur Lake	2007, 2008	CSLAP	11	2	6	2			1	2.3	7.5	Fair
Bartlett Pond	1997-2000	AE	1						1	-5.0	-5.0	no FQI
Black Lake	1990	CSLAP	16	1	10	3		1	1	1.9	7.5	Fair
Brant Lake	1990	CSLAP	20		15	2	1	1	1	1.9	8.5	Excellent
Brantingham Lake	1986, 1994	ALSC, DFWI	20		18	2				2.8	12.5	Excellent
Butterfield Lake	1991	CSLAP, Cedar Eden	3			2			1	-1.0	-1.7	no FQI
Chase Lake	1986, 1990	ALSC, CSLAP	18		18					3.0	12.7	Excellent
Eagle Crag Lake	1986, 1990	ALSC, CSLAP	11		11					3.0	9.9	Excellent
Eagle Lake	2000-2009	DFWI, NHP	38	2	33	2			1	2.8	17.2	Excellent
Eagle Pond	1987-2009	ALSC, CSLAP	16		16					3.0	12.0	Excellent
East Caroga Lake	1981-1983	?	11		8	2			1	1.9	6.3	Fair
Effley Falls Lake	1986-2008	CSLAP, ALSC	6	1	5					3.3	8.2	Excellent
Efner Lake	1995, 1998	DFWI, CSLAP	33	1	29	2	0	1	0	2.8	15.8	Excellent
Friends Lake	1991-2008	CSLAP	34	1	29	4				2.8	16.5	Excellent
Fulton Second Lake	1994-2000	CSLAP	14		13			1		2.6	9.6	Excellent
Garnet Lake	1990	CSLAP	8		7	1				2.8	7.8	Excellent
Glen Lake	1990	CSLAP	9		7	1			1	1.9	5.7	Fair
Goodnow Flow	1991	CSLAP	38	2	32	2		1	1	2.6	16.2	Excellent
Gull Pond	1986	ALSC	9		9					3.0	9.0	Excellent
Hadlock Pond	2009, 1986	DFWI, ALSC	28		22	3	1		2	2.1	11.0	Fair
Horseshoe Pond	2000-2009	CSLAP, ALSC	19		16	2			1	2.4	10.3	Fair
Hunt Lake	1995	DFWI	12		11			1		2.5	8.7	Excellent
Hyde Lake	2000	CSLAP	3		2				1	0.3	0.6	no FQI
Indian Lake	2003	Cornell	25	2	17	4	1		1	2.4	11.8	Fair
Jenny Lake	1995	DFWI	25		24			1		2.8	13.8	Excellent

Lake Name	Macrophyte Surveys	Survey via?	N	C5	C3	C1	C01	C03	C05	MeanC	mFQI	FQI Rating
Joe Indian Lake	1985	ALSC	14	1	13					3.1	11.8	Excellent
Kayuta Lake	1986, 2000	ALSC, SUNY Oneonta	18		14	3			1	2.2	9.4	Fair
Lake Bonaparte	1992	CSLAP	24	3	17	2	1		1	2.6	12.7	Excellent
Lake Clear	none	Cedar Eden	1		1					3.0	3.0	no FQI
Lake Colby	1986, 2001	ALSC, CSLAP	14	1	11	1			1	2.4	9.1	Excellent
Lake George	1988	DFWI	45	8	31	4		1	1	2.9	19.2	Excellent
Lake Kiwassa	1990-1995	CSLAP	11		9	1			1	2.1	6.9	Fair
Lake Luzerne	2009	ACT	40	3	31	4		1	1	2.6	16.4	Excellent
Lake of the Isles	not known		9		5	3			1	1.4	4.3	Fair
Lake of the Woods	1994-2008	CSLAP	5		3	1			1	1.0	2.2	Fair
Lake Placid	1991-2009	CSLAP, APIPP	11		10			1		2.5	8.1	Excellent
Lake Titus	1985	ALSC	6		5				1	1.7	4.1	Fair
Lincoln Pond	2001, 2006	Cornell, AE	32	1	24	5		1	1	2.3	13.1	Excellent
Little Wolf Lake	1985	ALSC	9		9					3.0	9.0	Excellent
Loon Lake	1990	CSLAP	34	4	27	3				3.1	17.8	Excellent
Lorton Lake	1990-2009	CSLAP	29	4	19	4	2			2.7	14.7	Excellent
Lower Chateaugay Lake	none	Cedar Eden	4		3				1	1.0	2.0	no FQI
Lower St. Regis Lake	1986	ALSC	16		14	1			1	2.4	9.5	Fair
Mayfield Lake	2000-2001	CSLAP	14		13				1	2.4	9.1	Excellent
Millsite Lake	1997-2009	CSLAP	9		5	1			3	0.1	0.3	Poor
Mirror Lake	2008	CSLAP	4		4					3.0	6.0	no FQI
Moon Lake	?		1						1	-5.0	-5.0	no FQI
Moreau Lake	1994-2002	CSLAP	1						1	-5.0	-5.0	no FQI
Mountain Lake	2000-2001	CSLAP	2		2					3.0	4.2	no FQI
Mountain View Lake	2003	Cornell	25	2	17	4	1		1	2.4	11.8	Fair
North Sandy Pond	1999	SUNY Oneonta	12		10	1			1	2.2	7.5	Fair
Otter Lake	1987-2009	ALSC, CSLAP	18		17	1				2.9	12.3	Excellent
Paradox Lake	1988	DFWI	20	2	15	1		1	1	2.4	10.7	Excellent
Piseco Lake	1999	CSLAP	4		4					3.0	6.0	Excellent
Pleasant Lake	2000-2009	CSLAP	2	1	1					4.0	5.7	no FQI
Rondaxe Lake	1986	ALSC	12		12					3.0	10.4	no FQI
Schroon Lake	1991, 1988	CSLAP, DFWI	23	2	19	1			1	2.7	13.1	Excellent
Silver Lake-Clinton	1990	CSLAP	9		9					3.0	9.0	Excellent
Silver Lake-St.Lawrence	1986-1997	CSLAP	19		17	2				2.8	12.2	Excellent
Spitfire Lake	1986	ALSC	10		10					3.0	9.5	Excellent
Stewarts Landing	1997	CSLAP	3		3					3.0	5.2	Excellent
Twitchell Lake	1988	DFWI	7	1	6					3.3	8.7	no FQI
Upper Chateaugay Lake	1990	CSLAP	10		7	2			1	1.8	5.7	Excellent
Upper Saranac Lake	1990	NYSDEC	40	2	33	4			1	2.7	17.1	Fair
West Caroga Lake	1987, 2001	ALSC, CSLAP	6		5				1	1.7	4.1	Excellent
Windover Lake	1999-2001	CSLAP	4		4					3.0	6.0	Fair

Surveyors- ACT = Aquatic Control Technology, AE = Aquatic Ecologists, ALSC = Adirondack Lake Survey Corporation, Cedar Eden = Cedar Eden Environmental Inc, Cornell = Cornell Experimental Ponds, DFWI = Darrin Freshwater Institute of RPI, SUNY Oneonta Biological Field Station
N = number of aquatic plant species (or genera for ALSC sampled lakes)
C5 = number of protected aquatic plant species
C3 = number of beneficial native aquatic plant species rarely associated with nuisance conditions
C1 = number of native aquatic plant species frequently associated with nuisance conditions
C01 = number of exotic aquatic plant species rarely associated with invasive conditions
C03 = number of exotic aquatic plant species occasionally or regionally associated with invasive conditions
C05 = number of exotic aquatic plant species frequently associated with invasive conditions in all regions
mean C = mean value for modified Coefficient of Conservation, scale from -5 (invasives) to +5 (protected)
mean FQI = mean modified Floristic Quality Index
FQI rating = scale based on number of plants and number of sensitive, tolerant, and invasive plants

The FQI rankings show a high percentage (49%) of lakes in the Adirondack region with "excellent" floristic quality, and very few lakes (1%) with poor to very poor floristic quality, although about 30% of the lakes in the region have no or incomplete plant survey information. Although these assessments will no doubt change with additional information on these 30% of lakes and the eventual development of a true floristic quality index for New York state lakes, the high percentage of lakes with apparently excellent floristic quality is consistent with observations and the relative lack of invasive plant species in the region, particularly in the non-acidic lakes in the interior of the Adirondack Park.

The number of lakes with protected plant species (column C5 in Table 5.2.3) is higher than expected given the statewide Natural Heritage Program (NHP) database, as noted in the statewide CSLAP report. This may be due in part to an incomplete NHP database for some of the smaller Adirondack region lakes, and in part due to uncertainty in the identification of some protected species, particularly the narrowleaf pondweeds and smaller bladderworts more common in this region than in other parts of the state.



Figures 5.2.1 and 5.2.2 –Typical Aquatic Plant Coverage and Recreational Assessments in CSLAP Lakes With and Without Exotic Plants

As expected, there is a strong connection between the presence of invasive plants and increased (overall) coverage of aquatic plants and recreational use impacts. Figure 5.2.1 shows that the extent of plant coverage is slightly greater for lakes with exotic plants than for lakes without exotics—lakes with exotic plants more consistently exhibit surface plant growth, and lakes without these invasive species exhibit a wider range of plant coverage conditions. Most of the lakes with surface weed growth in the absence of exotics are very shallow—often less than 10 feet deep.

Figure 5.2.2 indicates that lakes with exotic plants tend to have less favorable recreational assessments, with "slightly impaired" conditions much more common than in lakes without exotic plants. In lakes dominated by native plants, "excellent" recreational conditions are most frequently reported by the sampling volunteers.

Primary, Secondary and Tertiary Consumers

Chapter 5.3- Evaluation of Zooplankton

Zooplankton communities were studied in CSLAP lakes only in 1992, as part of graduate research conducted by Bruce Cady, a CSLAP training coordinator hired by NYSFOLA in 1992 and 1993. Vertical or horizontal plankton tows using a Wisconsin style net with a 12cm opening and 80µm mesh on 20 CSLAP lakes in mid-summer.

A summary of the 1992 zooplankton surveys will be included in the 25 Year CSLAP report issued in 2011, and in the individual lake appendices.

Chapter 5.4- Evaluation of Macroinvertebrates

The lake macroinvertebrate studies conducted in New York state in the last few years are discussed in the statewide CSLAP report. There are insufficient data in the Adirondack region to include a regional discussion, although it is anticipated that with the collection of additional lake macroinvertebrate data, and an incorporation of the ALSC macroinvertebrate dataset, future generations of this report will include detailed discussions about lake benthic communities.

Chapter 5.5- Evaluation of Zebra Mussels

The extent of zebra mussel infestations in this region are limited to the perimetry—Lake Champlain, Glen Lake, small portions of Lake George, and several sections of the St. Lawrence River. Most of the lakes in this region, particularly in the interior portions of the Adirondack Park, do not appear to be susceptible to zebra mussel colonization, although microclimates may exist in concrete breakwalls and docks, and at the receiving end of streams draining watersheds overlying limestone deposits or other sources of calcium. A detailed discussion of zebra mussel distribution in CSLAP and New York state lakes is provided in the statewide CSLAP report.

Chapter 5.6- Evaluation of Fish

Fish surveys are not conducted through CSLAP. However, many CSLAP lakes have been surveyed as part of fisheries stocking activities, to assess or report on sports fisheries, or as part of general biological assessments. These surveys have been conducted by the NYSDEC Division of Fish and Wildlife, the Adirondack Lake Survey Corporation, private lake associations, and academic studies. In addition, incomplete species lists for many New York state lakes can be found on various fishing web sites. Inventories have been developed for nearly 75% of the CSLAP lakes, including nearly 70 lakes in the Adirondack region. Since each of these surveys or limited inventories was developed to serve different purposes, some have been more comprehensive than others, and a detailed evaluation of the results from these inventories should be viewed with discretion. Nonetheless, a compilation of the survey and inventory results from CSLAP lakes can provide some useful insights.

A summary of the fisheries survey information available for CSLAP lakes will be included in the 25 Year CSLAP report issued in 2011, and in the individual lake appendices.

Chapter 6- Evaluation of Lake Perception

Lake Perception Fact Sheet

Chapter 6.1- Evaluation of Adirondack Region Water Quality Perception

Chapter 6.2- Evaluation of Adirondack Region Aquatic Plant Perception

Chapter 6.3- Evaluation of Adirondack Region Recreational Perception

Lake Perception Fact Sheet

Description:	lake perception can be evaluated semi-quantitatively (using a standardized scale) to assess how the lake looks, aquatic plant populations, and recreational suitability.
Importance:	public perception of lakes is a critical component of lake management. Public dissatisfaction with (or desire to protect) the condition of the lake is frequently a strong impetus for the development of management, protection, or restoration plans for a lake, and often informs the desire to fund and implement management actions. Lake perception is often closely linked to measurable water quality or lake indicators, affording the opportunity to gauge progress and success, and to conduct cost-benefit analyses of specific management activities. Standardized scales can provide opportunities for comparison from year to year and across regional and state boundaries, since most New England and Upper Midwestern states use the same standardized tool for assessing lake perception.
How Measured: in CSLAP	lake perception is evaluated via a 4 question survey. The first and third questions relate to the physical condition of the lake (how it looks) and the recreational condition of the lake, respectively. These are graded on a 5 point scale, ranging from most favorable (1) to least favorable (5). The second question relates to the aquatic plant coverage in the lake, ranging from not visible (1) to densely covering the entire lake surface (5). The last question asks survey respondents to identify which factor(s) adversely affect recreational assessments. The surveys are completed during each sampling session prior to data or sample collection, to minimize bias.
Detection Limit:	not applicable
Range in CSLAP:	1 to 5 for all survey questions. 76% of all respondents described their lake as “not quite crystal clear” or having “definite algal greenness”. 77% of all respondents said aquatic plants were visible from or grew to the lake surface, but not densely. 72% of survey respondents reported their lake as “excellent” or “slightly impaired” for recreational uses. However, these assessments varied widely regionally and from lake to lake.
WQ Standards:	no water quality standards or guidance values exist for lake perception. However, these data will likely be used to help determine the appropriate water clarity, chlorophyll *a* and total phosphorus readings to protect recreational uses of lakes, as part of the nutrient criteria development process.
Trophic Assessment:	the proposed guidance values for water clarity, chlorophyll *a*, and total phosphorus will likely be developed to prevent “impaired” conditions (as defined by the recreational perception survey data) at a frequency of greater than 10%-25% of the summer recreational season.

Chapter 6- Evaluation of Lake Perception

Chapter 6.1- Evaluation of Adirondack Region Water Quality Perception: 1992-2009

Summary of CSLAP Water Quality Perception Findings in Adirondack Region Lakes, 1992-2009

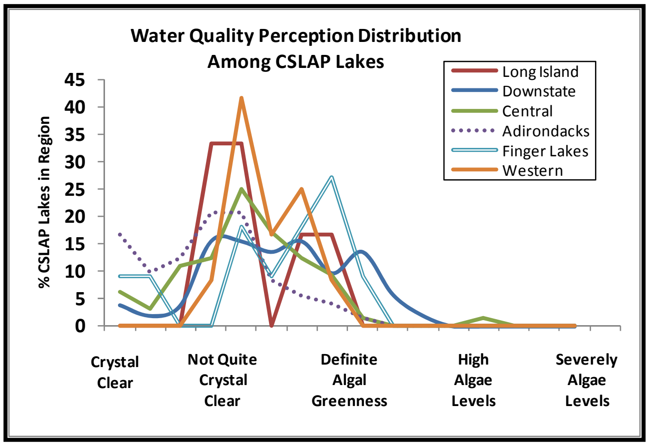
1. CSLAP lakes within the Adirondack region have more favorable water quality assessments than those in other regions of the state, consistent with the higher water transparency and lower chlorophyll *a* readings in these lakes.
2. The water quality assessments of CSLAP lakes cannot be compared to those from lakes evaluated in other monitoring programs, since the assessment tools used in CSLAP have not been used in other programs for a long enough duration.
3. Water quality assessments in CSLAP lakes in the Adirondack region are not strongly influenced by weather conditions.
4. Slightly more favorable water quality assessments have been apparent in recent years, although this long-term trend is not statistically significant.
5. Water quality assessments are highly favorable in most of the Adirondack region lakes, with the least favorable water quality assessments in the Indian River lakes region west of the Adirondack Park blue line.
6. It is likely that changes in water quality assessments in 2009 and in the long-term exhibited by the lakes within the Adirondack region are within the normal range of variability for these lakes.
7. Water quality assessments in Adirondack region lakes were similar in 2009 to those reported in the typical CSLAP sampling season from 1986 to 2008.
8. A larger percentage of Adirondack region lakes exhibited more favorable water quality assessments on average, and the most favorable assessments at any time, than exhibited less favorable assessments in 2009.

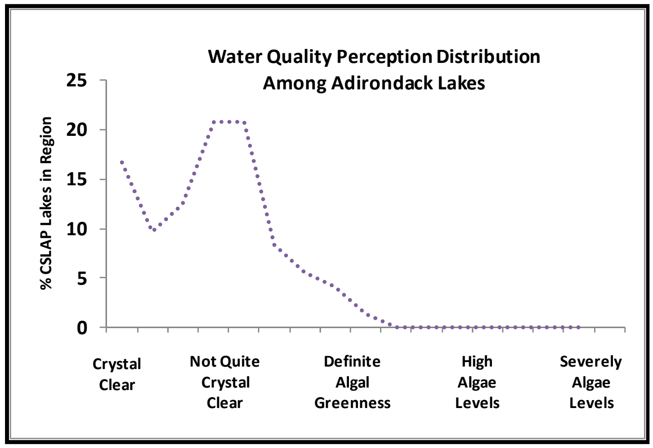
Adirondack Region Data Compared to NYS Data

Water quality assessments in CSLAP lakes in the Adirondack region are more favorable than those in other regions of the state. The most frequent water quality assessments in these lakes is "crystal clear" to "not quite crystal clear," assessments consistent with the high water transparency readings in these lakes. Very few lakes could be described as having "definite algal greenness," and no lakes were reported as having "high algae levels" or "severely high algae levels."

Comparison of CSLAP to NYS Lakes in the Adirondack Region

Lake perception surveys, modeled after the CSLAP user perception surveys, have been included in the Lake Classification and Inventory (LCI) survey work conducted in the Adirondacks. It is not known if similar perception surveys have been included in other monitoring programs, including volunteer programs, conducted with this region. Given the paucity of data—both water quality and lake perception data—collected in this program, a comparison of CSLAP and other NYS datasets within the Adirondack region is premature at this time. This is shown in Figures 6.1.1 and 6.1.2.





Figures 6.1.1 and 6.1.2: Distribution of Water Quality Perception in CSLAP and Adirondack Region Lakes

Annual Variability:

Lake water quality perception is fairly stable in most lakes, but varies significantly from lake to lake throughout the state, including the Adirondack region. The most favorable water quality assessments recorded through CSLAP occurred during 1998, 1995, 1997, and 1992. These comprised both dry and wet years. The least favorable water quality assessments occurred in 2006, 2000, 2008, and 1999; some of these were wet years. Table 6.1.1 looks at the percentage of CSLAP lakes with less favorable water quality (greater than 1 standard error above normal) and more favorable water quality (greater than 1 standard error below normal) assessments in wet and dry years. These data show that the more extreme conditions (more or less favorable water quality assessments) were more likely to occur in dry years than in wet years, but neither wet nor dry years were likely to trigger specific changes in water quality perceptions.

Table 6.1.1- % of CSLAP Lakes with Higher or Lower (than Normal) Water Quality Perception During Dry and Wet Years in the Adirondack Region

	Dry Years	Wet Years
More Favorable Water Quality Perception	27%	20%
Less Favorable Water Quality Perception	26%	22%

Dry Years: 1995, 2004, 2005
Wet Years: 1998, 2000, 2002, 2008
"More" and "Less" favorable defined as >1 SE higher than and lower than normal, respectively

Long Term Trends:

The evaluation of long-term trends since 1986 in any region, including the lakes within the Adirondack region, is adversely affected by the small number of lakes sampled during some sampling seasons, particularly in the earliest years of CSLAP (from 1986 to 1990). Since 1986, the frequency of more favorable water quality assessments has decreased, although this trend is not statistically significant. Less favorable assessments have also become less common in recent years, although this trend is also not statistically significant. These data indicate that shifts from normal water quality assessments (either more or less favorable) have decreased in the Adirondack region lakes in recent years, although trend has not been statistically significant.

Regional Distribution:

Water quality assessments within the Adirondack region are favorable in all areas, with the least favorable assessments mostly found in the Indian River lake region just west of the Adirondack Park blue line, in Jefferson and St. Lawrence Counties. Most of the less favorable assessments in other parts of the region are not in a common geographic area, but are more likely to be associated with shallow lakes. As noted in the True Color section of this report, high color readings in CSLAP lakes scattered throughout this region are not regularly associated with poor water quality assessments, due to the sense that these represent "natural" conditions. This is shown in Figure 6.1.3.

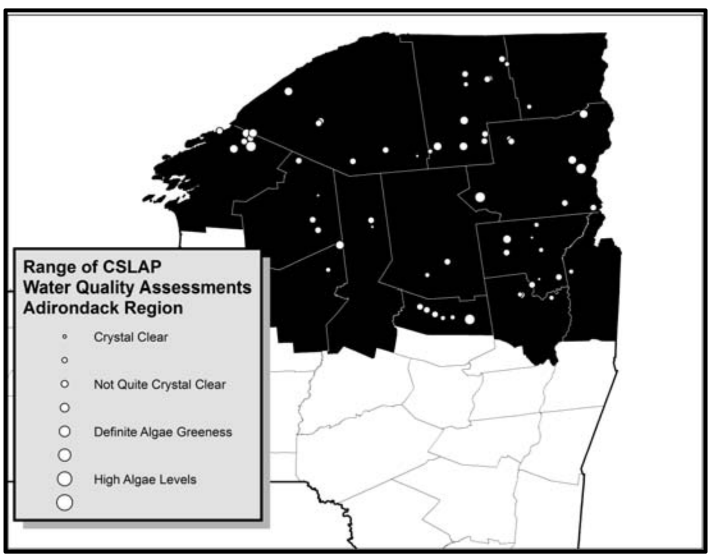


Figure 6.1.3: Range of Water Quality Assessments in the Adirondack Region

Table 6.1.2 shows the number of sampling sessions with water quality assessments, the minimum (most favorable), average, and maximum (least favorable) water quality assessments in the entirety of the CSLAP dataset (since 1993) and the frequency with which "definite algae greenness" and "high algae levels" are observed in each region, and whether these assessments have changed since CSLAP sampling began in the lake (through 2008).

Table 6.1.2: Water Quality Assessments in CSLAP Adirondack Region Lakes, 1992-2009

Lake Name	Years	Num	Min	Avg	Max	%Definite Algae Greenness	% High Algae Levels	Change?
Augur Lake	1997-2009	81	1	2.4	4	42	5	No
Augur Lake	2009	8	2	2.6	3	63	0	No
Bartlett Pond	1997-2000	22	2	2.8	3	82	0	
Black Lake	1988-2009	102	1	2.2	5	30	5	Improving
Black Lake	2009	8	1	1.9	2	0	0	No
Brant Lake	1987-2003	35	1	1.0	2	0	0	No
Brantingham Lake	2001-2009	66	1	1.8	2	0	0	Degrading
Brantingham Lake	2009	7	1	1.4	2	0	0	More Favorable
Butterfield Lake	1986-2009	113	1	2.5	4	41	8	No
Butterfield Lake	2009	8	2	2.0	2	0	0	No
Canada Lake	2001-2009	64	1	1.2	3	3	0	No
Canada Lake	2009	8	1	1.1	2	0	0	No
Chase Lake	1990-1997	23	1	1.9	3	8	0	No
Eagle Crag Lake	1986-2005	58	1	1.2	3	2	0	No
Eagle Lake	2000-2009	69	2	2.0	3	3	0	No
Eagle Lake	2009	9	2	2.2	3	22	0	No
Eagle Pond	2008-2009	15	1	1.5	2	0	0	
Eagle Pond	2009	8	1	1.6	2	0	0	No
East Caroga Lake	1990-2009	89	1	1.8	2	0	0	No
East Caroga Lake	2009	6	1	1.4	2	0	0	More Favorable
Effley Falls Lake	1997-2009	78	1	1.2	3	3	0	No
Effley Falls Lake	2009	8	1	1.4	2	0	0	No
Efner Lake	1997-2001	36	1	1.0	1	0	0	No
Friends Lake	1991-2009	83	1	1.2	2	0	0	Improving
Friends Lake	2009	8	1	1.0	1	0	0	No
Fulton Second Lake	1986-2009	109	1	1.3	3	2	0	No
Fulton Second Lake	2009	8	2	2.1	3	13	0	Less Favorable
Garnet Lake	1989-2001	19	1	1.8	2	0	0	
Glen Lake	1986-2009	65	1	2.2	4	23	3	No
Glen Lake	2009	7	2	2.7	3	71	0	No
Goodnow Flow	1986-2009	54	1	2.9	3	89	0	No
Goodnow Flow	2009	7	3	3.0	3	100	0	No
Grass Lake	2004-2009	44	1	2.5	4	45	2	No
Grass Lake	2009	8	2	2.4	3	43	0	No
Gull Pond	1994-1998	37	1	1.6	2	0	0	Degrading
Hadlock Pond	1997-2001	12	1	1.6	2	0	0	No
Horseshoe Pond	2000-2009	72	1	1.1	2	0	0	No
Horseshoe Pond	2009	8	1	1.1	2	0	0	No
Hunt Lake	1994-2009	90	1	1.9	3	9	0	No
Hunt Lake	2009	8	2	2.0	2	0	0	No
Hyde Lake	1999-2009	40	1	2.5	4	55	5	Degrading
Hyde Lake	2009	8	2	2.3	3	25	0	No
Indian Lake	1986-1997	7	2	2.0	2	0	0	
Jenny Lake	1994-2007	60	1	1.4	3	3	0	No
Kayuta Lake	1997-2001	35	1	1.3	3	6	0	No
Kellum Lake	1997-2001	34	1	1.7	3	11	0	Improving
Lake Bonaparte	1988-2009	58	1	1.8	2	0	0	No
Lake Bonaparte	2009	8	1	1.9	2	0	0	No
Lake Clear	1998-2009	92	1	1.1	2	0	0	No
Lake Clear	2009	8	1	1.6	2	0	0	Less Favorable
Lake Colby	1999-2001	17	1	2.0	4	25	4	No
Lake Forest	2001-2009	52	1	1.1	2	0	0	No
Lake Forest	2009	6	1	1.0	1	0	0	No

Lake Name	Years	Num	Min	Avg	Max	%Definite Algae Greenness	% High Algae Levels	Change?
Lake George	2004-2008	18	1	2.1	3	20	0	No
Lake George	2009	8	1	1.0	1	0	0	More Favorable
Lake Kiwassa	1990-1995	23	1	1.8	2	0	0	
Lake Luzerne	1999-2004	37	1	1.9	2	0	0	No
Lake of the Isles	2000-2001	16	2	2.1	3	6	0	
Lake of the Woods	1994-2008	50	1	2.0	3	8	0	No
Lake Placid	1991-2009	98	1	1.5	3	4	0	No
Lake Placid	2009	4	1	1.8	2	0	0	No
Lake Titus	1999-2001	18	2	2.1	3	11	0	
Lincoln Pond	1997-2009	57	1	2.5	3	64	0	No
Lincoln Pond	2009	5	1	1.2	2	0	0	More Favorable
Little Wolf Lake	1998-2000	15	2	2.6	4	56	6	
Lorton Lake	1990-2009	103	1	1.6	3	3	0	No
Lorton Lake	2009	8	1	1.4	2	0	0	No
Lower Chateaugay Lake	1991-1995	25	1	2.2	3	23	0	
Lower St. Regis Lake	2000-2002	14	2	2.7	3	69	0	
Mayfield Lake	2000-2004	26	2	3.0	4	94	3	No
Millsite Lake	1997-2009	97	1	1.1	2	0	0	No
Millsite Lake	2009	8	1	1.0	1	0	0	No
Mirror Lake	1998-2009	63	1	1.8	3	1	0	No
Mirror Lake	2009	7	1	1.9	2	0	0	No
Moon Lake	1992-1996	33	2	3.0	4	85	18	Degrading
Moreau Lake	1994-2002	53	1	1.5	3	4	0	No
Mountain Lake	1998-2001	25	1	1.5	2	0	0	
Mountain View Lake	1991-1997	31	1	2.2	4	19	3	No
Otter Lake	1992-2009	89	1	2.7	4	66	11	Degrading
Otter Lake	2009	8	2	2.4	3	38	0	No
Paradox Lake	2003-2009	53	1	1.1	3	2	0	No
Paradox Lake	2009	8	1	1.3	2	0	0	No
Peck Lake	1992-2009	42	1	1.5	3	2	0	No
Peck Lake	2009	8	1	1.0	1	0	0	More Favorable
Piseco Lake	1999-2003	31	1	1.4	2	0	0	Improving
Pleasant Lake	2000-2009	59	1	2.0	2	0	0	No
Pleasant Lake	2009	2	2	2.0	2	0	0	No
Rondaxe Lake	1998-2001	30	1	1.9	3	6	0	
Sacandaga Lake	1987-2009	41	1	1.8	2	0	0	No
Sacandaga Lake	2009	8	2	2.0	2	0	0	No
Schroon Lake	1987-2009	64	1	1.5	3	5	0	No
Schroon Lake	2009	7	1	1.0	1	0	0	More Favorable
Silver Lake	1989-1993	3	1	1.7	2	0	0	
Silver Lake	1996-2009	81	1	2.0	3	8	0	No
Silver Lake	2009	7	2	2.6	3	63	0	Less Favorable
Sixberry Lake	2001-2004	24	1	1.9	2	0	0	No
Spitfire Lake	1996-2002	37	1	2.1	3	21	0	No
Star Lake	1994-1998	38	1	2.0	3	16	0	No
Stewarts Landing	1997-2001	40	1	2.1	3	29	0	Degrading
Twitchell Lake	1986-1996	4	1	1.0	1	0	0	
Upper Chateaugay Lake	1990-1994	14	1	1.6	3	7	0	
Upper Saranac Lake	2006-2009	25	1	2.4	3	44	0	
Upper Saranac Lake	2009	8	2	2.3	3	29	0	No
Upper St. Regis Lake	1997-2002	46	1	2.0	3	7	0	No
West Caroga Lake	1997-2007	27	1	1.8	3	4	0	No
Windover Lake	1999-2003	36	1	2.4	3	49	0	No

Num = number of samples
Min, Avg, Max = minimum, average, and maximum water quality perception rating (QA on the perception survey), integer values 1-5

% Definite Algae Greenness = percentage of sampling session in which response to question QA was 3, 4, or 5
% High Algae Levels = percentage of sampling session in which response to question QA was 4 or 5
Change? = exhibiting significant change in QA readings (best fit line of annual means with $R^2 > 0.5$ and seasonal Kendall-Tau rank correlation coefficient > 0.5); 2009 change based on QA readings >25% higher or lower than normal

There are several lakes in this region exhibiting long-term change in water quality assessments. Black Lake, Friends Lake, Kellum Pond, and Piseco Lake have all exhibited improving water quality assessments over the duration of their CSLAP sampling, although only Black Lake and Friends Lake were sampled in recent years. None of these lakes has exhibited any long-term trends in water clarity or chlorophyll *a* readings, suggesting that the more favorable water quality assessments in each of these lakes are probably within the normal range of variability for these lakes.

Brantingham Lake, Gull Lake, Hyde Lake, Moon Lake, Otter Lake, and Stewarts Landing have all exhibited degrading water quality assessments. None of these lakes has exhibited any long-term changes in water clarity or chlorophyll *a*. As with the lake exhibiting improving water quality assessments, this suggests that the less favorable water quality assessments in these lakes represent normal variability.

Tables 6.1.3a and 6.1.3b summarize the water quality assessment data collected through CSLAP in 2009, and compare these data to the data collected for each program lake in the region prior to 2009. Water quality assessments in the CSLAP lakes in the Adirondack region in 2009 (and all other NYS regions except the western regions) were about as favorable as those reported in previous years, at least as evaluated by average water quality assessments. This is consistent with a lack of significant change in either water clarity or chlorophyll *a* readings in the Adirondack region. A higher percentage (18% versus 9%) of Adirondack region lakes exhibited more favorable than less favorable water quality assessments in 2009, and a larger percentage of lakes exhibited their most favorable assessments in 2009. It is likely that this still represent normal variability, although this may have contributed to slightly more favorable recreational assessments in this region in 2009.

As in previous years, a low percentage of lakes exhibit “definite algal greenness”, and “high algae levels” were not reported at all in 2009 in the Adirondack region. This region of the state continues to have the most favorable water quality conditions, consistent with the highest water clarity and lowest algae levels.

Table 6.1.3a: Water Quality Assessment Summary in CSLAP Lakes, 2009

	Number Lakes	Minimum	Average 2009	Average 1986-08	Maximum	%Frequency Definite Algal Greenness	% Frequency High Algae Levels
Downstate	32	1	2.3	2.4	4	40	6
Central	36	1	2.1	2.2	4	28	3
Adirondacks	33	1	1.8	1.9	3	14	0
Western	9	1	2.7	2.3	5	64	7
CSLAP Statewide	**110**	**1**	**2.1**	**2.1**	**5**	**30**	**3**

Table 6.1.3b: Water Quality Assessment Summary in CSLAP Lakes, 2009

	Number Lakes	Average 2009	Average 1986-08	%Less Favorable	%More Favorable	%Above Max	%Below Min
Downstate	32	2.3	2.4	0	9	46	75
Central	36	2.1	2.2	6	19	25	72
Adirondacks	33	1.8	1.9	9	18	45	67
Western	9	2.7	2.3	0	11	44	33
CSLAP Statewide	**110**	**2.1**	**2.1**	**5**	**15**	**39**	**68**

% Less Favorable = percentage of lakes in region with water quality assessments in 2009 >25% worse than normal (before 2009)
% More Favorable = percentage of lakes in region with water quality assessments in 2009 >25% better than normal (before 2009)
% Above Max = percentage of lakes in region with any water quality assessments in 2009 less favorable than normal (before 2009)
% Below Min = percentage of lakes in region with any water quality assessments in 2009 more favorable than normal (before 2009)

Adirondack Region Lakes With More Favorable Water Quality Assessments in 2009:
Brantingham Lake, East Caroga Lake, Lake George, Lincoln Pond, Peck Lake, Schroon Lake

Discussion:

Six Adirondack-region lakes exhibited more favorable water quality assessments in 2009. Only one of these lakes—East Caroga Lake—exhibited higher than normal water transparency readings in 2009, and only one of these lakes—Lincoln Pond—exhibited lower algae levels. In both of these lakes, the more favorable water quality assessments were consistent with the lower lake productivity.

One Adirondack region lake—Lorton Lake—exhibited both higher water clarity and lower algae levels but water quality assessments that were close to normal. In addition, phosphorus readings in Schroon Lake were higher than normal in 2009 (as part of an apparent longer-term trend), and water clarity readings in Schroon Lake and Peck Lake were lower than normal in 2009. This variability among each of the trophic indicators and the apparent disconnect between water quality assessments and these trophic indicators suggests that the more favorable water quality assessments in most of these lakes probably represents normal variability.

Adirondack Region Lakes With Less Favorable Water Quality Assessments in 2009:
Fulton Second Lake, Lake Clear, Silver Lake

Discussion:

Water quality assessments in three Adirondack region lakes were less favorable in 2009 than in previous years. In Fulton Second Lake and Lake Clear, water clarity and chlorophyll *a* readings in 2009 were close to normal, and in Silver Lake, chlorophyll *a* readings in 2009 were slightly lower than normal. This suggests that the less favorable water quality assessments in each of these lakes were within the normal range of variability for these lakes.

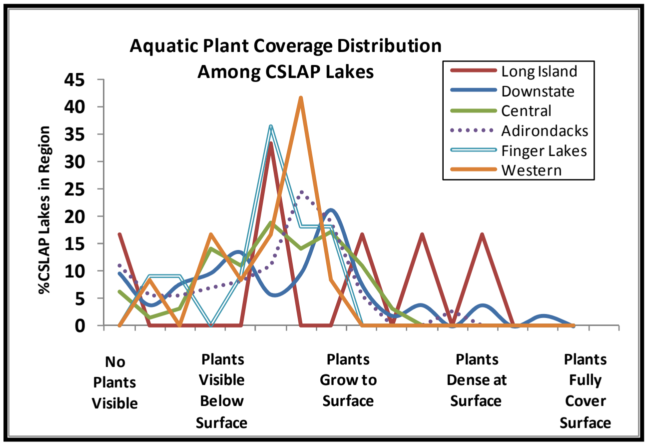
Chapter 6.2- Evaluation of Adirondack Region Aquatic Plant Perception: 1992-2009

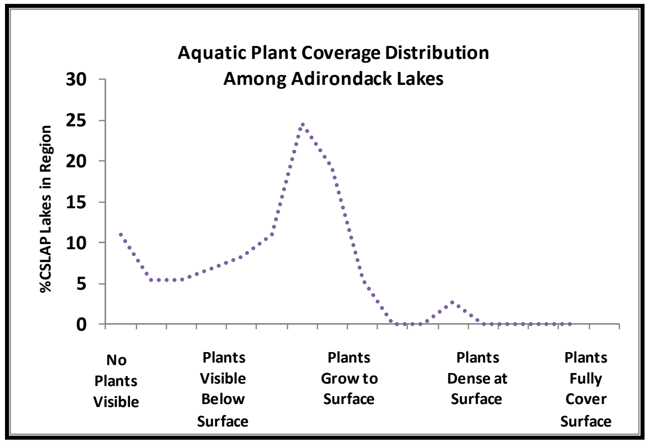
Summary of CSLAP Aquatic Plant Coverage in Adirondack Region Lakes, 1992-2009

1. CSLAP lakes within the Adirondack region have similar coverage of aquatic plants as seen in other parts of the state, although the extent of invasive, exotic plant growth is probably lower, particularly within the interior Adirondack region.
2. Aquatic plant coverage in CSLAP lakes within the Adirondack region cannot be compared to non-CSLAP lakes in the same region, since similar aquatic plant assessments have not been conducted in most lakes throughout this region through other monitoring programs.
3. CSLAP lakes within the Adirondack region do not exhibit significant changes in coverage of aquatic plants due to weather changes, although it is slightly less weedy in dry years.
4. No long-term trends in aquatic plant coverage have been apparent in CSLAP lakes within the Adirondack region, although plant growth has no doubt changed in some specific lakes over this period.
5. Aquatic plant coverage has been greatest in the eastern, northern and western portions of the region, although this is much more strongly a function of lake depth—the greatest plant coverage has been in highest in shallower lakes regardless of location.
6. A small number of lakes in the region have exhibited some long-term change in aquatic plant coverage. However, it is likely that most of these changes represent normal variability or the results of active lake management.
7. Aquatic plant coverage in Adirondack region lakes was similar in 2009 to that reported in the typical CSLAP sampling season from 1986 to 2008.
8. A large percentage of Adirondack region lakes exhibited both greater and less plant coverage on average at any time, and a very low percentage exhibited either greater or less plant coverage on average, in 2009 than in the typical CSLAP sampling season.

Adirondack Region Data Compared to NYS Data

Aquatic plant coverage in CSLAP lakes in the Adirondack region is comparable to plant coverage in other regions of the state (except for Long Island, which is dominated by weed-filled shallow lakes), although it is likely that most Adirondack region lakes possess fewer problems with invasive weeds. The data in Figure 6.2.1 indicates that CSLAP sampling volunteers report that aquatic plants are visible below the lake surface and regularly grow to the lake surface. Dense plant growth at the lake surface is not commonly reported in Adirondack region lakes, although surface plant growth is common. Figure 6.2.2 shows that there is a wide range of "normal" extent of plant growth in these lakes, owing to the large variety (shallow and deep, sandy and mucky shorelines, etc.) of lakes in the region.





Figures 6.2.1 and 6.2.2: Distribution of Aquatic Plant Assessments in CSLAP and Adirondack Region Lakes

Comparison of CSLAP to NYS Lakes in the Adirondack Region

Although aquatic plant surveys are increasingly conducted in lakes throughout New York State, including the Adirondack region, in support of plant management activities, the number of lakes throughout the state with extensive plant surveys is still small. Moreover, the CSLAP perception forms are generally not used in most Adirondack region monitoring programs. Therefore it is not possible to compare CSLAP data regarding the extent of aquatic plant coverage to data collected through other monitoring programs.

Annual Variability:

Aquatic plant coverage may be highly variable from lake to lake, but has been fairly stable on a statewide basis and within the Adirondack region lakes. The most significant aquatic plant coverage recorded through CSLAP occurred during 1993, 1992, 2002, and 2005. These comprised both dry and wet years. The lowest (least) plant coverage occurred in 1997, 1998, 1994, and 2004, a combination of wet and dry years. Table 6.2.1 looks at the percentage of CSLAP lakes with higher aquatic plant coverage (greater than 1 standard error above normal) and lower plant coverage (greater than 1 standard error below normal) assessments in wet and dry years. These data show that greater plant coverage generally occurs in wet years, and lower weed densities occur in dry years, although neither relationship is very strong.

Table 6.2.1- % of CSLAP Lakes with Higher or Lower (than Normal) Aquatic Plant Coverage During Dry and Wet Years in the Adirondack Region

	Dry Years	Wet Years
More Coverage of Aquatic Plants	26%	29%
Less Coverage of Aquatic Plants	33%	25%

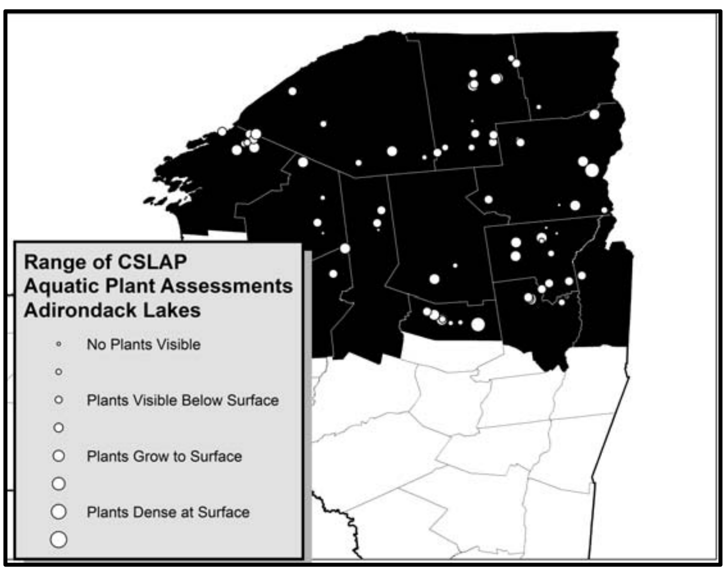
Dry Years: 1995, 2004, 2005
Wet Years: 1998, 2000, 2002, 2008
"More" and "Less" Coverage defined as >1 SE higher than and lower than normal, respectively

Long Term Trends:

The evaluation of long-term trends since 1986 in any region, including the lakes within the Adirondack region, is adversely affected by the small number of lakes sampled during some sampling seasons, particularly in the earliest years of CSLAP (from 1986 to 1990). Since 1986, the frequency of lower weed coverage has increased, and the frequency of higher aquatic plant coverage has decreased, although none of these trends are statistically significant. These data indicate that, despite the growing problem with invasive species in New York State lakes, occurrences of reduced weed coverage has increased, perhaps in response to active management of invasive weed problems. However, as noted above, none of these trends appear to be statistically significant.

Regional Distribution:

Aquatic plants assessments within the Adirondack region do not exhibit any clear regional patterns. Heavier weed coverage is found in some of the shallower lakes in the eastern, southern, and western portions of the Adirondack region. Lakes with relatively low weed coverage are scattered throughout the region, and are mostly found in relatively deep lakes. The distribution of "weedy" lakes does not appear to mirror the distribution of invasive species, particularly Eurasian watermilfoil. Many of the weedier lakes in the Adirondack region do not have exotic species, or these exotic plants are among many plants that grow to the lake surface. The distribution of exotic species in this region is discussed in the "Evaluation of Biological Condition" section of this report. The aquatic plant coverage distribution is shown in Figure 6.2.3.



Figures 6.2.3: Range of Aquatic Plant Coverage in the Adirondack Region

Table 6.2.2 shows the number of sampling sessions with aquatic plant assessments, the minimum (least extensive), average, and maximum (most extensive) aquatic plant coverage in the entirety of the CSLAP dataset (since 1992) and in 2009, the frequency with which "surface plant growth" and "dense surface growth" are observed in each region, and whether these assessments have changed since CSLAP sampling began in the lake (through 2008).

Table 6.2.2: Aquatic Plant Coverage in CSLAP Adirondack Region Lakes, 1992-2009

Lake Name	Years	Num	Min	Avg	Max	% Surface Weeds	% Dense Surface Weeds	Change?
Augur Lake	1997-2009	83	1	2.9	4	73	17	No
Augur Lake	2009	8	3	3.0	3	100	17	No
Bartlett Pond	1997-2000	22	3	3.8	5	100	68	
Black Lake	1988-2009	102	1	2.4	5	44	12	No
Black Lake	2009	8	1	1.6	2	0	12	Less Coverage
Brant Lake	1987-2003	35	1	1.1	3	3	0	No
Brantingham Lake	2001-2009	66	1	1.1	2	0	0	No
Brantingham Lake	2009	7	1	1.1	2	0	0	No
Butterfield Lake	1986-2009	113	1	2.5	5	51	8	No
Butterfield Lake	2009	8	2	2.9	4	57	8	No
Canada Lake	2001-2009	65	1	2.4	3	57	0	No
Canada Lake	2009	8	2	2.8	3	75	0	No
Chase Lake	1990-1997	23	1	2.7	3	76	0	
Eagle Crag Lake	1986-2005	59	1	1.3	3	13	0	No
Eagle Lake	2000-2009	69	1	2.9	4	88	3	No
Eagle Lake	2009	9	2	3.1	4	89	3	No
Eagle Pond	2008-2009	15	2	2.6	3	56	0	
Eagle Pond	2009	8	2	2.4	3	38	0	No
East Caroga Lake	1990-2009	91	1	2.9	3	90	0	No
East Caroga Lake	2009	6	3	3.0	3	100	0	No
Effley Falls Lake	1997-2009	79	1	1.6	3	17	0	No
Effley Falls Lake	2009	8	1	2.5	3	63	0	More Coverage
Efner Lake	1997-2001	36	1	2.7	3	76	0	Increasing Coverage
Friends Lake	1991-2009	91	1	1.3	3	10	0	No
Friends Lake	2009	8	1	1.0	1	0	0	Less Coverage
Fulton Second Lake	1986-2009	108	1	1.2	3	5	0	No
Fulton Second Lake	2009	8	2	2.4	3	38	0	More Coverage
Garnet Lake	1989-2001	19	1	2.9	3	90	0	
Glen Lake	1986-2009	65	1	2.6	4	55	9	No
Glen Lake	2009	7	2	2.7	3	71	9	No
Goodnow Flow	1986-2009	54	1	2.7	3	78	0	No
Goodnow Flow	2009	7	3	3.0	3	100	0	No
Grass Lake	2004-2009	44	2	2.8	3	84	0	No
Grass Lake	2009	8	2	2.7	3	71	0	No
Gull Pond	1994-1998	37	1	2.4	3	53	0	Decreasing Coverage
Hadlock Pond	1997-2001	11	1	2.3	3	50	0	No
Horseshoe Pond	2000-2009	73	1	2.9	4	80	8	No
Horseshoe Pond	2009	8	2	2.9	3	88	8	No
Hunt Lake	1994-2009	90	1	3.0	4	91	14	Increasing Coverage
Hunt Lake	2009	8	3	3.6	4	100	14	No
Hyde Lake	1999-2009	40	1	2.9	4	78	13	No
Hyde Lake	2009	8	2	2.9	3	88	13	No
Indian Lake	1986-1997	7	1	2.8	3	89	0	
Jenny Lake	1994-2007	61	1	2.6	3	74	0	No
Kayuta Lake	1997-2001	36	1	2.6	3	70	0	No
Kellum Lake	1997-2001	34	1	2.1	3	45	0	No
Lake Bonaparte	1988-2009	58	1	2.8	4	75	5	No
Lake Bonaparte	2009	8	2	2.5	3	50	5	No
Lake Clear	1998-2009	92	1	2.6	3	74	0	No
Lake Clear	2009	8	1	2.8	3	88	0	No
Lake Colby	1999-2001	17	1	2.6	3	75	0	
Lake Forest	2001-2009	52	1	2.7	4	70	4	No
Lake Forest	2009	6	3	3.0	3	100	4	No

Lake Name	Years	Num	Min	Avg	Max	% Surface Weeds	% Dense Surface Weeds	Change?
Lake George	2004-2008	18	1	2.0	3	5	0	No
Lake George	2009	8	1	1.0	1	0	0	Less Coverage
Lake Kiwassa	1990-1995	23	1	2.3	3	46	0	
Lake Luzerne	1999-2004	37	1	2.4	4	60	5	Decreasing Coverage
Lake of the Isles	2000-2001	16	1	2.5	4	50	13	
Lake of the Woods	1994-2008	49	1	2.5	3	54	0	No
Lake Placid	1991-2009	98	1	1.4	3	15	0	No
Lake Placid	2009	4	2	2.3	3	25	0	More Coverage
Lake Titus	1999-2001	17	2	2.5	3	50	0	
Lincoln Pond	1997-2009	56	1	2.7	4	67	14	No
Lincoln Pond	2009	5	1	1.8	3	20	14	Less Coverage
Little Wolf Lake	1998-2000	15	1	2.2	3	50	0	
Loon Lake	1986-1997	0	3	3.0	3	100	0	
Lorton Lake	1990-2009	103	1	2.5	4	49	4	No
Lorton Lake	2009	8	2	2.8	3	75	4	No
Lower Chateaugay Lake	1991-1995	25	1	2.2	3	27	0	
Lower St. Regis Lake	2000-2002	14	1	1.0	1	0	0	
Mayfield Lake	2000-2004	26	3	3.9	5	100	84	Decreasing Coverage
Millsite Lake	1997-2009	97	1	1.8	3	21	0	No
Millsite Lake	2009	8	1	1.8	2	0	0	No
Mirror Lake	1998-2009	63	1	2.3	3	46	0	No
Mirror Lake	2009	7	2	2.6	3	57	0	No
Moon Lake	1992-1996	33	2	3.2	4	97	27	No
Moreau Lake	1994-2002	53	1	1.8	3	26	0	No
Mountain Lake	1998-2001	25	1	1.7	3	23	0	
Mountain View Lake	1991-1997	31	1	3.1	4	94	22	No
Otter Lake	1992-2009	89	1	3.0	4	87	11	No
Otter Lake	2009	8	2	2.9	3	88	11	No
Paradox Lake	2003-2009	53	1	1.2	3	4	0	No
Paradox Lake	2009	8	1	1.3	2	0	0	No
Peck Lake	1992-2009	43	1	1.6	3	9	0	No
Peck Lake	2009	8	1	1.0	1	0	0	Less Coverage
Piseco Lake	1999-2003	31	1	2.9	4	92	5	No
Pleasant Lake	2000-2009	59	1	2.7	3	76	0	Increasing Coverage
Pleasant Lake	2009	2	3	3.0	3	100	0	No
Rondaxe Lake	1998-2001	30	1	2.6	3	77	0	
Sacandaga Lake	1987-2009	41	1	1.4	3	2	0	Decreasing Coverage?
Sacandaga Lake	2009	8	1	1.5	2	0	0	No
Schroon Lake	1987-2009	63	1	1.2	2	0	0	No
Schroon Lake	2009	7	1	1.1	2	0	0	No
Silver Lake	1989-1993	3	1	1.7	2	0	0	
Silver Lake	1996-2009	81	1	2.8	3	86	0	No
Silver Lake	2009	7	3	3.0	3	100	0	No
Sixberry Lake	2001-2004	24	1	2.0	3	10	0	
Spitfire Lake	1996-2002	37	1	1.1	2	0	0	No
Star Lake	1994-1998	36	1	1.8	3	31	0	No
Stewarts Landing	1997-2001	40	1	2.9	3	93	0	No
Twitchell Lake	1986-1996	4	2	2.5	3	50	0	
Upper Chateaugay Lake	1990-1994	14	2	2.6	3	57	0	
Upper Saranac Lake	2006-2009	25	1	1.8	3	28	0	
Upper Saranac Lake	2009	8	1	1.0	1	0	0	Less Coverage
Upper St. Regis Lake	1997-2002	47	1	2.0	3	13	0	No
West Caroga Lake	1997-2007	27	1	2.2	3	50	0	No
Windover Lake	1999-2003	36	1	2.4	3	49	0	No

Num = number of samples

Min, Avg, Max = minimum, average, and maximum aquatic plant coverage rating (QB on the perception survey), integer values 1-5
% Surface Weeds = percentage of sampling session in which response to question QB was 3, 4, or 5
% Dense Surface Weeds = percentage of sampling session in which response to question QB was 4 or 5
Change? = exhibiting significant change in QB readings (best fit line of annual means with $R^2 > 0.5$ and seasonal Kendall-Tau rank correlation coefficient > 0.5); 2009 change based on QB readings >25% higher or lower than normal

There are several lakes in this region exhibiting long-term change in aquatic plant coverage, at least in the portion(s) of the lake evaluated through the CSLAP perception surveys. Efner Lake, Hunt Lake, and Pleasant Lake (Fulton County) have all exhibited increasing coverage of aquatic plants over the duration of their CSLAP sampling. Efner Lake has not been sampled through CSLAP for several years, so it is not known if the increase in aquatic plant coverage observed in 2000 and 2001 has continued. Like Hunt Lake, Efner Lake possesses *Cabomba caroliniana* (fanwort), an exotic plant species generally thought to be limited to the Long Island and far downstate region until its discovery in Jenny Lake, Hunt Lake and Efner Lake. It is not believed, based on the CSLAP observations, that fanwort levels in Jenny Lake have increased. The increase in plant coverage in Pleasant Lake does not appear to have strongly influenced recreational assessments, and does not appear to be associated with exotic plants.

Gull Pond, Lake Luzerne, Mayfield Lake, and Sacandaga Lake have all exhibited decreasing coverage of aquatic plants during the years of CSLAP sampling at the lake. Mayfield Lake and Gull Pond have not been sampled through CSLAP since 2004 and 1998, respectively, so it is not known if plant coverage in the last several years has continued to be lower (though still regularly growing densely at the lake surface at Mayfield Lake). Lake Luzerne was last sampled through CSLAP in 2004, and the extent of Eurasian watermilfoil growth in the lake has increased enough in recent years to prompt the proposed use of triclopyr, an aquatic herbicide registered for use in New York State for the first time in 2007. Sacandaga Lake was sampled through CSLAP in 2009 for the first time since 2001, so it is not known if the reduced plant coverage up to that time still occurs.

Tables 6.2.3a and 6.2.3b summarize the aquatic plant coverage data collected through CSLAP in 2009, and compare these data to the data collected for each program lake in the region prior to 2009. Aquatic plant coverage in the CSLAP lakes in the Adirondack region in 2009 (and all other NYS regions except the western regions) was similar to that reported in previous years, based on “average” assessments of plant coverage and frequency of greater and less than normal coverage. It is not believed that any of the lakes in the Adirondack region reported any invasive aquatic plant species for the first time in 2009.

As in previous years, surface plant growth was reported during more than half of the CSLAP sampling sessions, a frequency close to the statewide average. The frequency of dense plant growth was again low in 2009. It is likely that the surface plant growth in many of these lakes, particularly in the interior Adirondack Park region, is associated with native, beneficial plants—in many of these lakes, the makeup of the aquatic plant community is not known. As discussed in the Recreational Perception section, despite the frequency of surface plant growth, the frequency of “slightly” and “substantially” impaired recreational conditions in this region is much lower than in the rest of the state. This may also provide evidence that the plant community is associated with native, rather than exotic, plants.

Table 6.2.3a: Aquatic Plant Assessment Summary in CSLAP Lakes, 2009

	Number Lakes	Minimum	Average 2009	Average 1986-08	Maximum	%Frequency Surface Plants	% Frequency Dense Surface Plants
Downstate	32	1	2.2	2.5	5	45	8
Central	36	1	2.6	2.4	5	62	5
Adirondacks	33	1	2.3	2.3	4	52	4
Western	9	1	2.6	2.3	4	61	6
CSLAP Statewide	**110**	**1**	**2.4**	**2.4**	**5**	**54**	**6**

Table 6.2.3b: Aquatic Plant Assessment Summary in CSLAP Lakes, 2009

	Number Lakes	Average 2009	Average 1986-08	%Less Favorable	%More Favorable	%Above Max	%Below Min
Downstate	32	2.2	2.5	3	11	42	61
Central	36	2.6	2.4	14	14	50	42
Adirondacks	33	2.3	2.3	4	8	45	45
Western	9	2.6	2.3	11	11	33	11
CSLAP Statewide	**110**	**2.4**	**2.4**	**9**	**15**	**45**	**46**

% Less Favorable = percentage of lakes in region with aquatic plant assessments in 2009 >25% greater than normal (before 2009)
% More Favorable = percentage of lakes in region with aquatic plant assessments in 2009 >25% less than normal (before 2009)
% Above Max = percentage of lakes in region with any aquatic plant assessments in 2009 less favorable than normal (before 2009)
% Below Min = percentage of lakes in region with any aquatic plant assessments in 2009 more favorable than normal (before 2009)

Adirondack Region Lakes With More Extensive Plant Coverage in 2009:
Effley Falls Lake, Fulton Second Lake, Lake Placid

Discussion:

Three Adirondack-region lakes exhibited more extensive aquatic plant coverage in 2009. Each of these three lakes have low densities of plants, at least relative to the typical Adirondack region lake, and the increase in plant coverage in 2009 may be within the “rounding error” of measuring plant coverage in these lakes. In each of these lakes, the typical aquatic plant assessments in the lake shifted from “not visible from the lake surface” to at least occasionally “growing to the lake surface.” It is not known if the slightly higher plant coverage in Lake Placid is in response to the recent finding of variable watermilfoil (*Myriophyllum heterophyllum*) near the state launch site. None of these lakes has exhibited any significant long-term trends in aquatic plant coverage.

Adirondack Region Lakes With Less Extensive Plant Coverage in 2009:
Black Lake, Friends Lake, Lake George, Lincoln Pond, Peck Lake, Upper Saranac Lake

Discussion:

Aquatic plant coverage in six Adirondack region lakes was lower than normal in 2009. In several of these lakes—Upper Saranac Lake, Lake George—aquatic plants are actively managed, and the reduced coverage at the sites evaluated through CSLAP may be in response to local management actions. Plant populations in Black Lake and Lincoln Pond are often variable, in response to plant herbivory, water quality changes, and other factors, and it is likely that these changes represent normal variability. However, both of these lakes have extensive populations of Eurasian watermilfoil, and the reduced plant growth may also represent a recovery of native plant communities. Friends Lake and Peck Lake are dominated by native plants, and variability in the coverage of native aquatic plants is common from year to year.

Chapter 6.3- Evaluation of Adirondack Region Recreational Perception: 1992-2009

Summary of CSLAP Recreational Use Assessments in Adirondack Region Lakes, 1992-2009

1. CSLAP lakes within the Adirondack region have more favorable recreational assessments than those in other regions of the state, consistent with the lower productivity and nuisance weed growth, and more favorable water quality assessments in these lakes.
2. The recreational assessments of CSLAP lakes cannot be compared to those from lakes evaluated in other monitoring programs, since the assessment tools used in CSLAP have not been used in other programs for a long enough duration.
3. Recreational assessments in CSLAP lakes in the Adirondack region are more favorable in dry years and less favorable in wet years, although the connection between recreational conditions and precipitation is not strong.
4. Recreational assessments have become less favorable in recent years in Adirondack region lakes, based on the decreasing frequency of more favorable assessments.
5. Recreational assessments are highly favorable in most of the Adirondack region lakes, with the least favorable recreational assessments in the Indian River lakes region west of the Adirondack Park blue line.
6. It is likely that changes in recreational assessments in 2009 and in the long-term exhibited by the lakes within the Adirondack region are within the normal range of variability for these lakes, although these assessments were more favorable in 2009.
7. A larger percentage of Adirondack region lakes exhibited more favorable recreational assessments on average, and the most favorable assessments at any time, than exhibited less favorable assessments in 2009.

Adirondack Region Data Compared to NYS Data

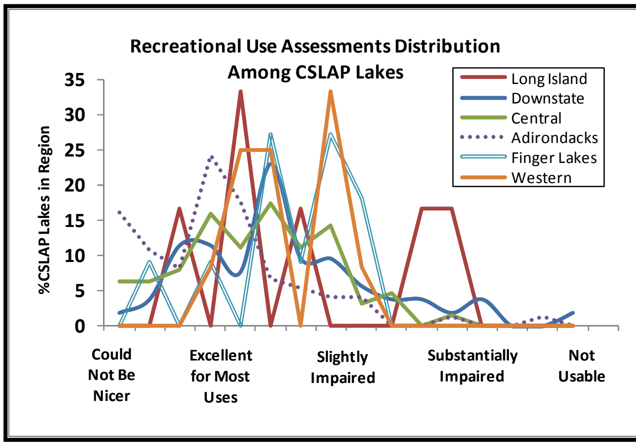
Recreational use assessments in CSLAP lakes in the Adirondack region are favorable than those in other regions of the state, consistent with higher water clarity readings, lower algae levels, and generally fewer problems with invasive weeds. The majority of the lakes in this region can most frequency be described as “could not be nicer” to “excellent” for most recreational uses. The few instances of “slightly” to “substantially” impaired conditions are more likely to be associated with excessive weeds than with poor water clarity or excessive algae, with very few lakes in the region suffering from both excessive algae and weeds.

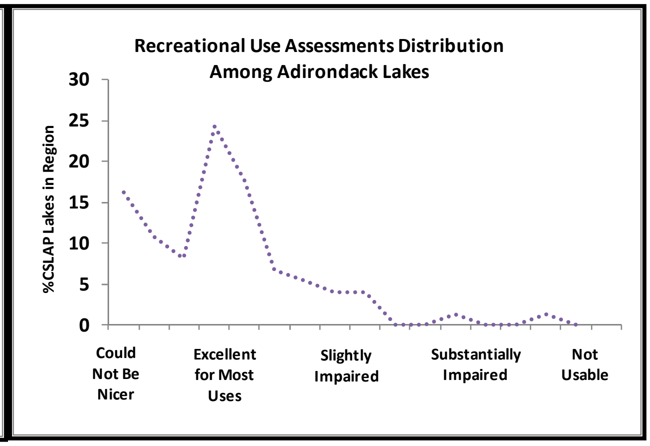
Comparison of CSLAP to NYS Lakes in the Adirondack Region

Although recreational perception surveys are included within a few monitoring programs, including the state’s ambient lake monitoring program (the Lake Classification and Inventory Survey, LCI), the number of lakes throughout the state with recreational perception data is still small. Therefore it is not possible to compare CSLAP data regarding the extent of recreational use impacts to data collected through other monitoring programs.

Annual Variability:

Recreational use assessments are fairly stable and highly favorable within most Adirondack region lakes. The most favorable recreational use assessments recorded through CSLAP occurred during 1997, 1998, 1995, 1994, and 2004, mostly dry years. The least favorable recreational assessments occurred in 1992, 2000, 2006, 2007 and 1996, most of which are neither wet nor dry years. Table 6.3.1 looks at the percentage of CSLAP lakes with less favorable recreational perception (greater than 1 standard error above normal) and more favorable recreational perceptions (greater than 1 standard error below normal) in wet and dry years. These data show that more favorable recreational perception generally occurs in dry years, and less favorable assessments occur in wet years, although neither relationship is very strong. The data in Table 6.3.1 appear to be consistent with the findings in Figure 6.3.3.





Figures 6.3.1 and 6.3.2: Distribution of Recreational Perception in CSLAP and Adirondack Region Lakes

Table 6.3.1- % of CSLAP Lakes with More or Less (than Normal) Favorable Recreational Perception During Dry and Wet Years in the Adirondack Region

	Dry Years	Wet Years
More Favorable Recreational Perception	28%	24%
Less Favorable Recreational Perception	17%	32%

Dry Years: 1995, 2004, 2005
Wet Years: 1998, 2000, 2002, 2008
"More" and "Less" Coverage defined as >1 SE higher than and lower than normal, respectively

Long Term Trends:

The evaluation of long-term trends since 1986 in any region, including the lakes within the Adirondack region, is adversely affected by the small number of lakes sampled during some sampling seasons, particularly in the earliest years of CSLAP (from 1986 to 1990). Since 1992, the frequency of less favorable recreational assessments has increased, and the frequency of more favorable assessments has decreased, although none of these trends are statistically significant. This appears to be contrary to the aquatic plant coverage data, which shows a weak trend toward more instances of decreasing plant coverage over this period. However, the patterns discussed above are consistent with those reported in Chapter 6.1, which shows that the frequency of less favorable water quality conditions has increased slightly since 1992.

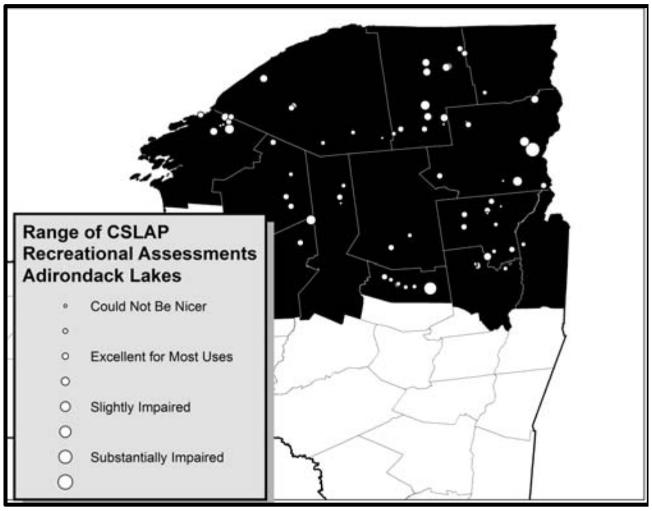
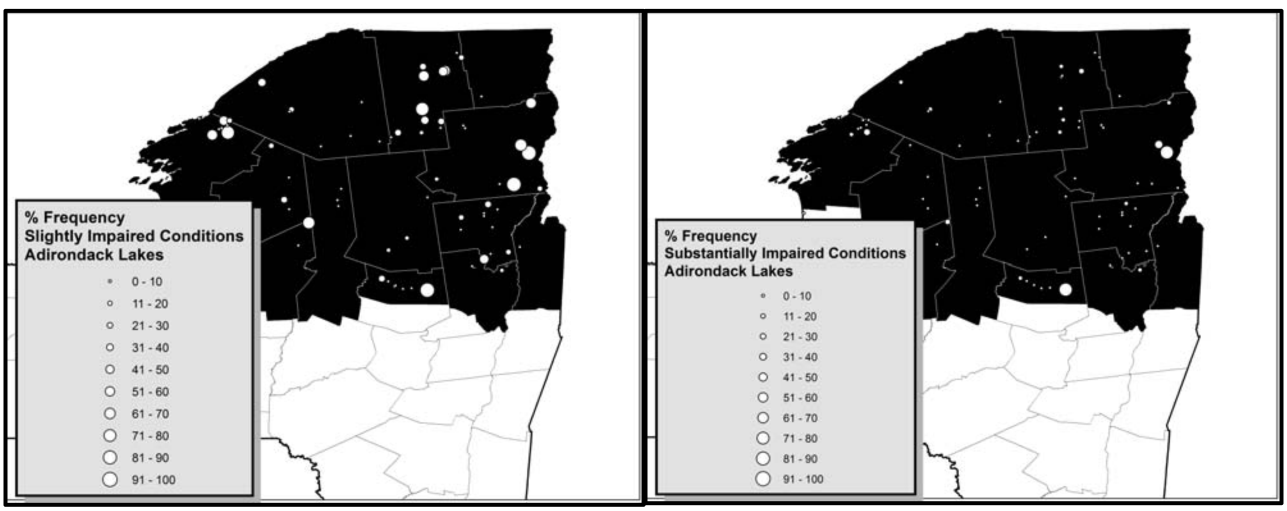


Figure 6.3.3: Range of Recreational Perception in the Adirondack Region

Regional Distribution:

Recreational assessments within the Adirondack region do not exhibit any clear regional patterns. In general, the most favorable recreational assessments are found in lakes in the interior of the Adirondacks, where neither invasive plant nor excessive algae problems commonly occur (Figure 6.3.3). This may be coincident with the high percentage of undeveloped (housing or road) areas in this part of the Adirondack Park. Increasing recreational impacts occur radiating out from the center of this region, with invasive weed problems common along the northeastern, northern, and northwestern portions of this region. Nuisance algae problems are not common anywhere in this region, but are more likely to be found in developed areas in the northeastern and northwestern regions, and in lakes with a maximum depth of less than 20-25 feet (6-8 meters).

"Slightly" impaired conditions are more common along the edges of this region, and "substantially" impaired conditions are uncommon throughout this region. The most significant recreational use impairments are more likely to be associated with excessive weeds than with nuisance algae.



Figures 6.3.4 and 6.3.5: Frequency of Slightly and Substantially Impaired Conditions in the Adirondack Region

Table 6.3.2 shows the number of sampling sessions with recreational use assessments, the minimum (most favorable), average, and maximum (least favorable) recreational conditions in the entirety of the CSLAP dataset (since 1992) and in 2009, the frequency with which "slightly" and "substantially" impaired conditions are observed in each region, whether impaired conditions are associated with excessive algae and poor water clarity, excessive weeds, or both, and whether these assessments have changed since CSLAP sampling began in the lake (through 2008).

Table 6.3.2: Recreational Use Perception in CSLAP Adirondack Region Lakes, 1986-2009

Lake Name	Years	Num	Min	Avg	Max	% Slightly Impaired	%Highly Impaired	%Impaired By Algae	%Impaired By Weeds	%Impaired Algae/Weeds	Change?
Augur Lake	1997-2009	83	1	2.7	4	69	15	33	65	31	No
Augur Lake	2009	8	3	3.0	3	100	0	50	100	50	No
Bartlett Pond	1997-2000	22	2	4.6	5	91	86	59	86	55	
Black Lake	1988-2009	102	1	2.3	4	39	17	17	13	6	No
Black Lake	2009	8	1	2.3	4	25	13	0	0	0	No
Brant Lake	1987-2003	35	1	1.1	2	0	0	0	0	0	No
Brantingham Lake	2001-2009	66	1	1.9	4	7	3	0	0	0	Degrading
Brantingham Lake	2009	7	1	2.0	4	29	14	0	0	0	No
Butterfield Lake	1986-2009	113	1	2.6	4	53	9	21	36	13	No
Butterfield Lake	2009	8	2	2.3	3	29	0	0	29	0	No
Canada Lake	2001-2009	65	1	1.4	5	7	3	3	0	0	No
Canada Lake	2009	8	1	1.0	1	0	0	0	0	0	More Favorable
Chase Lake	1990-1997	23	1	2.1	4	32	8	0	0	0	No
Eagle Crag Lake	1986-2005	59	1	1.2	4	5	5	0	0	0	No
Eagle Lake	2000-2009	69	2	3.0	4	97	7	4	81	4	No
Eagle Lake	2009	9	3	3.2	4	100	22	0	100	0	No
Eagle Pond	2008-2009	15	1	2.4	4	56	6	0	25	0	
Eagle Pond	2009	8	1	2.3	4	50	13	0	13	0	No
East Caroga Lake	1990-2009	91	1	1.9	4	18	6	1	4	1	No
East Caroga Lake	2009	6	1	1.3	2	0	0	0	0	0	More Favorable
Effley Falls Lake	1997-2009	79	1	1.4	4	7	1	0	0	0	No
Effley Falls Lake	2009	8	1	1.0	1	0	0	0	0	0	More Favorable
Efner Lake	1997-2001	36	1	1.0	2	0	0	0	0	0	No
Friends Lake	1991-2009	91	1	1.1	2	0	0	0	0	0	No
Friends Lake	2009	8	1	1.0	1	0	0	0	0	0	No
Fulton Second Lake	1986-2009	109	1	1.2	2	0	0	0	0	0	No
Fulton Second Lake	2009	8	2	2.0	2	0	0	0	0	0	Less Favorable
Garnet Lake	1989-2001	19	1	2.0	4	10	5	0	0	0	
Glen Lake	1986-2009	65	1	2.2	4	28	3	12	11	3	No
Glen Lake	2009	7	2	2.1	3	14	0	14	0	0	No
Goodnow Flow	1986-2009	54	1	2.1	3	13	0	13	0	0	No
Goodnow Flow	2009	7	2	2.1	3	14	0	14	0	0	No
Grass Lake	2004-2009	44	1	2.1	3	27	0	5	0	0	No
Grass Lake	2009	8	2	2.3	3	29	0	0	0	0	No
Gull Pond	1994-1998	37	1	1.4	2	0	0	0	0	0	Improving
Hadlock Pond	1997-2001	12	1	1.6	2	0	0	0	0	0	No
Horseshoe Pond	2000-2009	73	1	1.8	4	13	1	0	7	0	No
Horseshoe Pond	2009	8	1	1.8	2	0	0	0	0	0	No
Hunt Lake	1994-2009	90	1	1.8	2	0	0	0	0	0	No
Hunt Lake	2009	8	2	2.0	2	0	0	0	0	0	No
Hyde Lake	1999-2009	40	2	2.6	4	53	10	25	28	15	No
Hyde Lake	2009	8	2	2.1	3	13	0	0	13	0	No
Indian Lake	1986-1997	7	2	2.7	3	67	0	11	56	11	
Jenny Lake	1994-2007	61	1	1.2	3	1	0	1	0	0	No
Kayuta Lake	1997-2001	36	1	1.8	4	3	3	3	0	0	Degrading
Kellum Lake	1997-2001	34	1	1.4	2	0	0	0	0	0	No
Lake Bonaparte	1988-2009	58	1	2.1	3	26	0	0	18	0	No
Lake Bonaparte	2009	8	1	2.0	3	13	0	0	0	0	No
Lake Clear	1998-2009	92	1	2.2	4	39	16	0	1	0	No

Lake Name	Years	Num	Min	Avg	Max	% Slightly Impaired	%Highly Impaired	%Impaired By Algae	%Impaired By Weeds	%Impaired Algae/Weeds	Change?
Lake Clear	2009	8	1	1.8	2	0	0	0	0	0	More Favorable
Lake Colby	1999-2001	17	1	2.3	4	38	8	4	0	0	
Lake Forest	2001-2009	52	1	1.3	3	4	0	0	2	0	No
Lake Forest	2009	6	1	1.0	1	0	0	0	0	0	More Favorable
Lake George	2004-2008	18	1	2.0	3	25	0	0	0	0	No
Lake George	2009	8	1	1.0	1	0	0	0	0	0	More Favorable
Lake Kiwassa	1990-1995	23	1	1.2	4	4	4	0	0	0	
Lake Luzerne	1999-2004	37	1	2.5	4	60	2	0	60	0	No
Lake of the Isles	2000-2001	16	1	1.9	3	6	0	0	0	0	
Lake of the Woods	1994-2008	50	1	1.8	3	8	0	0	6	0	No
Lake Placid	1991-2009	97	1	1.2	4	1	1	0	0	0	No
Lake Placid	2009	4	1	1.8	2	0	0	0	0	0	Less Favorable
Lake Titus	1999-2001	17	1	2.3	4	39	11	0	0	0	
Lincoln Pond	1997-2009	56	1	2.9	4	71	40	0	66	0	Improving
Lincoln Pond	2009	5	1	1.6	2	0	0	0	0	0	More Favorable
Little Wolf Lake	1998-2000	15	1	2.2	4	31	6	19	0	0	
Loon Lake	1986-1997	0	2	2.0	2	0	0	0	0	0	
Lorton Lake	1990-2009	103	1	2.1	4	33	5	4	16	1	No
Lorton Lake	2009	8	2	2.5	3	50	0	0	38	0	No
Lower Chateaugay Lake	1991-1995	25	1	1.9	4	8	4	0	0	0	
Lower St. Regis Lake	2000-2002	14	2	3.0	4	88	13	63	0	0	
Mayfield Lake	2000-2004	26	3	3.9	4	100	87	45	97	45	No
Millsite Lake	1997-2009	97	1	1.2	4	4	2	0	0	0	No
Millsite Lake	2009	8	1	1.1	2	0	0	0	0	0	No
Mirror Lake	1998-2009	63	1	1.8	4	4	1	0	0	0	Degrading
Mirror Lake	2009	7	2	2.0	2	0	0	0	0	0	No
Moon Lake	1992-1996	33	2	3.2	4	88	33	58	76	45	No
Moreau Lake	1994-2002	53	1	1.7	5	18	18	0	0	0	No
Mountain Lake	1998-2001	25	1	1.5	2	0	0	0	0	0	
Mountain View Lake	1991-1997	31	1	2.8	4	59	22	44	44	34	
Otter Lake	1992-2009	89	1	2.9	4	68	26	54	44	40	No
Otter Lake	2009	8	2	2.3	3	25	0	25	13	13	More Favorable
Paradox Lake	2003-2009	53	1	1.1	3	2	0	0	0	0	No
Paradox Lake	2009	8	1	1.1	2	0	0	0	0	0	No
Peck Lake	1992-2009	43	1	1.5	5	8	6	2	0	0	No
Peck Lake	2009	8	1	1.0	1	0	0	0	0	0	More Favorable
Piseco Lake	1999-2003	31	1	1.8	4	19	5	0	0	0	Degrading
Pleasant Lake	2000-2009	59	1	2.1	5	30	17	0	0	0	No
Pleasant Lake	2009	2	1	1.0	1	0	0	0	0	0	More Favorable
Rondaxe Lake	1998-2001	30	1	1.9	4	10	3	0	0	0	
Sacandaga Lake	1987-2009	41	1	1.6	4	12	2	0	0	0	No
Sacandaga Lake	2009	8	1	1.3	2	0	0	0	0	0	More Favorable
Schroon Lake	1987-2009	64	1	2.0	5	29	11	0	0	0	No
Schroon Lake	2009	7	1	1.3	2	0	0	0	0	0	More Favorable
Silver Lake	1989-1993	3	1	1.7	2	0	0	0	0	0	
Silver Lake	1996-2009	81	1	1.8	4	6	1	6	0	0	No
Silver Lake	2009	7	2	2.5	3	50	0	50	0	0	Less Favorable
Sixberry Lake	2001-2004	24	1	1.2	2	0	0	0	0	0	
Spitfire Lake	1996-2002	37	1	2.0	4	21	10	15	0	0	No
Star Lake	1994-1998	38	1	1.7	4	8	3	3	0	0	No
Stewarts Landing	1997-2001	40	1	1.5	3	7	0	0	0	0	Degrading
Twitchell Lake	1986-1996	4	1	1.8	2	0	0	0	0	0	
Upper Chateaugay Lake	1990-1994	14	2	2.2	3	21	0	0	21	0	
Upper Saranac Lake	2006-2009	25	1	2.0	4	16	12	4	0	0	
Upper Saranac Lake	2009	8	1	1.9	3	14	0	14	0	0	No

Lake Name	Years	Num	Min	Avg	Max	% Slightly Impaired	%Highly Impaired	%Impaired By Algae	%Impaired By Weeds	%Impaired Algae/Weeds	Change?
Upper St. Regis Lake	1997-2002	47	1	2.0	4	4	2	2	0	0	No
West Caroga Lake	1997-2007	27	1	1.5	2	0	0	0	0	0	No
Windover Lake	1999-2003	37	1	2.2	4	30	3	8	15	8	No

Num = number of samples
Min, Avg, Max = minimum, average, and maximum recreational perception rating (QC on the perception survey), integer values 1-5
% "Slightly Impaired" = percentage of sampling sessions in which response to question QC was 3, 4, or 5
% "Highly Impaired" = percentage of sampling sessions in which response to question QC was 4 or 5
% Impaired by Algae = percentage of sampling sessions in which "slightly impaired" conditions were attributed to "poor water clarity" or "excessive algae"
% Impaired by Weeds = percentage of sampling sessions in which "slightly impaired" conditions were attributed to "excessive weeds"
% Impaired by Algae/Weeds = percentage of sampling sessions in which "slightly impaired" conditions were attributed to "excessive algae" and "excessive weeds"
Change? = exhibiting significant change in QC readings (best fit line of annual means with $R^2 > 0.5$ and seasonal Kendall-Tau rank correlation coefficient > 0.5); 2009 change based on QC readings >25% higher or lower than normal

There are several lakes in this region exhibiting long-term change in recreational conditions. Gull Pond and Lincoln Pond exhibited improved recreational assessments over the duration of CSLAP sampling at the lake. Gull Pond has not been sampled through CSLAP since 1998, and the small "improvement" in recreational assessments in the lake from 1994 to 1998 probably represents normal variability. The recreational assessments in Lincoln Pond have been much more favorable in the last two years, coincident with improved water quality assessments over the same period. However, water transparency and chlorophyll *a* readings were close to normal, and it is likely that this apparent improvement in recreational assessments actually represents normal variability.

Brantingham Lake, Kayuta Lake, Mirror Lake, Piseco Lake, and Stewarts Landing, have all exhibited degrading recreational assessments during the years of CSLAP sampling at the lake. Kayuta Lake and Stewarts Landing have not been sampled through CSLAP since 2001, and the last CSLAP sampling at Piseco Lake occurred in 2003. It is not known if recreational assessments in the last several years have continued to be less favorable, or if the lake conditions reverted to normal. Although recreational assessments in Brantingham Lake and Mirror Lake have degraded in the last several years, the less favorable assessments have been associated with poor weather, pollen, excessive boat traffic, and other conditions not associated with water quality degradation.

Tables 6.3.3a and 6.3.3b summarize the recreational perception data collected through CSLAP in 2009, and compare these data to the data collected for each program lake in the region prior to 2009. Recreational assessments in the CSLAP lakes in the Adirondack region in 2009 (and in the Downstate regions) were slightly more favorable than those reported in previous years, at least as evaluated by average recreational assessments and frequency of improved conditions. A slightly lower than normal percentage of lakes in 2009 was reported as impaired by algae or weeds. This is consistent with a higher percentage (18% versus 9%) of Adirondack region lakes that exhibited more favorable water quality assessments in 2009, and a larger percentage of lakes that exhibited their most favorable assessments in 2009. However, no water quality changes were evident in most of these lakes. There was also no clear change in aquatic plant coverage in the majority of lakes in this region in 2009. This suggests that the slight improvement in 2009 in water quality assessments, and the resulting improvement in recreational assessments, may have been within the normal range of variability.

As in previous years, a low percentage of lakes exhibit "slightly impaired" and "substantially impaired" conditions. Few lakes in the region are impaired by excessive weeds, even fewer were impaired by excessive algae, and instances of both excessive weeds and excessive algae are very uncommon (about 2% of the time) in the region.

Table 6.3.3a: Recreational Use Perception Summary in CSLAP Lakes, 2009

	Number Lakes	Min	Average 2009	Average 1986-08	Max	%Frequency Slightly Impaired	% Frequency Substantially Impaired	% Impaired by Algae	% Impaired by Weeds	% Impaired Algae + Weeds
Downstate	32	1	2.3	2.5	5	35	16	21	14	8
Central	36	1	2.3	2.2	5	35	10	11	18	4
Adirondacks	33	1	1.8	2.0	4	16	2	5	9	2
Western	9	1	2.8	2.5	4	67	16	38	35	30
CSLAP Statewide	**110**	**1**	**2.2**	**2.2**	**5**	**32**	**10**	**14**	**15**	**6**

Table 6.3.3b: Recreational Use Perception Summary in CSLAP Lakes, 2009

	Number Lakes	Average 2009	Average 1986-08	%Less Favorable	%More Favorable	%Above Max	%Below Min
Downstate	32	2.3	2.5	9	9	59	64
Central	36	2.3	2.2	14	17	28	58
Adirondacks	34	1.8	2.0	9	35	26	65
Western	9	2.8	2.5	0	0	33	11
CSLAP Statewide	**110**	**2.2**	**2.2**	**10**	**19**	**36**	**58**

% Less Favorable = percentage of lakes in region with recreational assessments in 2009 >25% less favorable than normal (before 2009)
% More Favorable = percentage of lakes in region with recreational assessments in 2009 >25% more favorable than normal (before 2009)
% Above Max = percentage of lakes in region with any recreational assessments in 2009 less favorable than normal (before 2009)
% Below Min = percentage of lakes in region with any recreational assessments in 2009 more favorable than normal (before 2009)

Adirondack Region Lakes With More Favorable Recreational Use Perception in 2009:
Canada Lake, East Caroga Lake, Effley Falls Lake, Lake Clear, Lake Forest, Lake George, Lincoln Pond, Otter Lake, Peck Lake, Pleasant Lake, Sacandaga Lake, Schroon Lake

Discussion:

Twelve Adirondack-region lakes exhibited more favorable recreational assessments in 2009. In Canada Lake, East Caroga Lake, Effley Falls Lake, Lake Forest, Lake George, Peck Lake, Pleasant Lake, Sacandaga Lake, and Schroon Lake, the most common recreational assessment in 2009 was "could not be nicer." In most of these lakes, this represented only a slight improvement, and most recreational use impacts prior to 2009 were associated with poor weather or other factors unrelated to water quality or nuisance weeds. Improved recreational conditions were reported in Lake Forest, Peck Lake, Otter Lake, Pleasant Lake, and Schroon Lake, despite lower water clarity readings or higher algae levels in the lake in 2009. In these lakes, it is likely that the small change in recreational conditions in 2009 represents normal variability. Otter Lake was less likely to be impaired by algae and weeds, despite similar overall coverage of aquatic plants. As a result, "slightly" and "substantially" impaired conditions were less frequent in 2009.

In Lake Clear, more favorable recreational assessments were not driven by reduced impairment from excessive algae or weeds, since recreational conditions are not influenced by either algae or weeds. More favorable assessments are associated with more favorable weather.

In Lincoln Pond, excessive weeds frequently influenced recreational conditions prior to 2009, but did not affect recreation in 2009, due to the lack of surface plant coverage throughout the summer. It is not known if the more favorable recreational conditions and reduced plant coverage in 2009 was due to active management (including natural milfoil moth predation) or normal variability.

Adirondack Region Lakes With Less Favorable Recreational Use Perception in 2009:
Fulton Second Lake, Lake Placid, Silver Lake (St. Lawrence County)

Discussion:
Recreational use conditions in three Adirondack region lakes were less favorable than normal in 2009. In Fulton Second Lake and Lake Placid, recreational assessments were still highly favorable in 2009, and except for the final sampling session in Lake Placid, less favorable recreational assessments were associated with poor weather. Although not explicitly cited in the perception surveys, the discovery of *Myriophyllum heterophyllum* in Lake Placid may have also contributed to less favorable recreational assessments. In Silver Lake, recreational assessments were less favorable than normal later in the summer, coincident with an apparent planktonic algal bloom manifested in patchy green dots in the water. However, none of these lakes has exhibited any long-term changes in recreational assessments, suggesting that "normal" conditions will return in 2010.

Chapter 7- Evaluation of Local Climate (Temperature) Change

Temperature Fact Sheet

Chapter 7.1- Evaluation of Statewide Air and Water Temperature

Chapter 7.2- Evaluation of Adirondack Region Air and Water Temperature

Water and Air Temperature Fact Sheet

Description:	a measure of the thermal properties of a lake (and the primary influence on these properties) at the time of sampling. Given the relative stability of water temperature readings, the CSLAP water temperature reading is assumed to be representative of thermal conditions in the surface waters of the lake.
Importance:	biological productivity is enhanced by rising temperature, at least in the range found in most freshwater systems. Algae production generally increases as air and water temperatures increase, leading to higher oxygen demands when these algae die and are broken down by bacteria. In turn, as water temperatures increase, the amount of oxygen that can dissolve in water decreases, accelerating the biological stress on lake biota susceptible to low oxygen and high temperature conditions. Rising air and water temperatures are also a response to global climate change.
How Measured: in CSLAP	from 1986 to 1998, glass pocket thermocolor thermometers were used to measure air and water temperatures—thermocolor is a substance that becomes transparent when it exceeds a critical temperature. Since 1998, a dial bimetal pocket thermometer has been used
Detection Limit:	-40ºC to 50ºC (= -40ºF to 122ºF)
Range in CSLAP:	Air temperature: -10ºC to 40ºC (14ºF to 104ºF) Water temperature: 1ºC to 31ºC (34ºF to 88ºF)
WQ Standards:	none in New York State, although thermal discharges are regulated: “All thermal discharges to the waters of the State shall assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water”
Water Quality Assessment:	water temperatures are not included in the standard water quality assessments of New York state lakes.

Chapter 7- Evaluation of Local Climate (Temperature) Change

Chapter 7.1- Evaluation of Water and Air Temperature

Summary of CSLAP Water and Air Temperature Findings in New York State Lakes

1. Air and water temperature readings in lakes are a function of sample timing—time of day, month, and year—and cannot be easily compared from one lake to another absent comparable temporal patterns in sampling programs. Comparisons are possible within the CSLAP sampling framework
2. Annual variations in water temperature in CSLAP lakes were generally, but not universally, related to annual variations in air temperature.
3. Changes in temperatures were somewhat related to changes in precipitation, with lower temperatures occurring in wetter years and higher temperatures occurring in drier years.
4. **Since 1986, the frequency of higher than normal air and water temperatures has increased, and the frequency of lower than normal temperatures has decreased. This may be the strongest signal in the CSLAP dataset that global climate change has affected New York State lakes.**
5. Temperatures were highest in the Downstate region lakes, and lower in upstate waterbodies.
6. Water and air temperatures increase through late July to early August, and then decrease into the fall. The seasonal increase in deep lakes is greater than in shallow lakes, although by midsummer, the temperature of surface waters of most deep lakes are similar to those in shallow lakes, due to the influence of summer stratification (which effectively turns deep lakes into a shallow upper zone and deeper cold zone).
7. There does not appear to be a correlation between water quality classification and water temperatures.
8. Although increased algae growth may be triggered by warmer water, average chlorophyll *a* readings are not well correlated with average summer air or water temperatures.
9. As expected, there is a strong correlation between water temperature and air temperature.

Comparison of CSLAP to NYS Lakes:

The water temperature of CSLAP lakes cannot be easily compared to those in other New York State lakes, due to the significant differences in sample collection schedules. Most other New York State lake monitoring programs do not involve biweekly samples, so water temperature comparisons would require comparing a small subset of CSLAP lake samples to other NYS lakes sampled at the same time). However, given the similarity in the sampling schedules, CSLAP lakes can be compared to each other, and over time.

Annual Variability:

Air and water temperatures have varied annually in most CSLAP lakes. This annual variability can be evaluated by looking at the long-term change in frequency of temperatures readings above and below normal variability, as defined by standard error calculations. Based on these criteria, the highest air and water temperatures measured through CSLAP occurred during

2005, 2002, 1999, and 2001. These were neither dry nor wet years. The lowest temperatures occurred in 1986 and 1992. 1990, 1995, 2000, 2003 and 2004 were also cooler than normal, although these did not translate into cooler air temperatures. Likewise, 1998, 1987, 1989, and 1990 had cooler water temperatures without cooler air temperatures, at least as measured through CSLAP. Tables 7.1.1 and 7.1.2 look at the percentage of CSLAP lakes with high temperatures (greater than 1 standard error above normal) and low temperatures (greater than 1 standard error below normal) readings in wet and dry years. These data show that low temperature readings are more likely to occur in wetter years, although higher temperatures were not as common in drier years.

Table 7.1.1- % of CSLAP Lakes with Higher or Lower (than Normal) Air Temperature Readings During Dry and Wet Years

	Dry Years	Wet Years
Higher Air Temperature	29%	17%
Lower Air Temperature	26%	34%

Dry Years: 1995, 2001
Wet Years: 1986, 1996, 2003, 2006
"Higher" and "Lower" defined as >1 SE higher than and lower than normal, respectively

Table 7.1.2- % of CSLAP Lakes with Higher or Lower (than Normal) Water Temperature Readings During Dry and Wet Years

	Dry Years	Wet Years
Higher Water Temperature	34%	13%
Lower Water Temperature	14%	30%

Dry Years: 1995, 2001
Wet Years: 1986, 1996, 2003, 2006
"Higher" and "Lower" defined as >1 SE higher than and lower than normal, respectively

Long Term Trends:

Long-term trends cannot be evaluated simply by looking at changes in annual (or median) temperatures in CSLAP lakes, since the lakes sampled through CSLAP have changed from year to year. These data show that since 1986, the frequency of higher than normal temperatures has increased, and that the frequency of lower than normal temperatures has decreased. These data suggest that air temperatures are increasing in the period (generally June through September) evaluated through CSLAP, triggering an increase in water temperatures over the same period.

Statewide Distribution:

As expected, air temperatures were highest at the time of sampling in the Downstate region, as seen in Table 7.1.3. Likewise, Table 7.1.4 shows that water temperatures are highest in the same parts of the state. Air temperatures were lowest in the Adirondack and Western (Finger Lakes) region, and water temperatures were lowest in these regions and the western lakes. The slightly higher-than-expected water temperature readings in the Adirondack region may be due to the influence of shallow lakes (which generally have higher water temperatures, as shown below.

Table 7.1.3- Regional Summary of Air Temperature Readings for CSLAP Lakes, 1986-2009

	Number Lakes	Min	Avg	Max	%Increasing Significantly	%Decreasing Significantly
Downstate	60	1	23.5	38	4	2
Central	66	-3	21.8	40	12	6
Adirondacks	76	2	21.0	36	4	3
Western	27	-10	21.1	40	8	4
CSLAP Statewide	**229**	**-10**	**21.9**	**40**	**7**	**3**

Min, avg and max air temperature in ºC
% Increasing and Decreasing Significantly = % CSLAP lakes in region exhibiting significant change in air temperature readings (annual average linear regression $R^2 > 0.50$ and T tests results)

Table 7.1.4- Regional Summary of Water Temperature Readings for CSLAP Lakes, 1986-2009

	Number Lakes	Min	Avg	Max	%Increasing Significantly	%Decreasing Significantly
Downstate	60	1	22.9	33	4	2
Central	66	1	21.4	34	15	8
Adirondacks	76	1	20.4	30	3	8
Western	27	1	20.2	36	8	4
CSLAP Statewide	**229**	**1**	**21.3**	**36**	**7**	**6**

Min, avg and max water temperature in ºC
% Increasing and Decreasing Significantly = % CSLAP lakes in region exhibiting significant change in water temperature readings (annual average linear regression $R^2 > 0.50$ and T tests results)

Tables 7.1.3 and 7.1.4 also show the percentage of lakes in each region of the state exhibiting a long-term change in air and water temperatures. The overall percentage of lakes exhibiting change in air and water temperatures is low on a statewide basis and in most regions of the state. However, the temperature differences associated with global climate change over a 5-25 year period—less than 2ºC—is smaller than the variability within each sampling season and probably less than the criteria established here to indicate change. Therefore, these data might be need to be evaluated using different criteria (than used to evaluate changes in the other CSLAP water quality indicators) to assess change. A less rigid criterion—defining change based on simple linear regressions—is applied in Table 7.1.5. This suggests that lakes in the Downstate and Central regions are more likely to exhibit increasing water temperatures, while the changes in the other regions do not appear to be statistically significant (due to the small difference between percentages of increasing and decreasing lakes, or small number of lakes in the region).

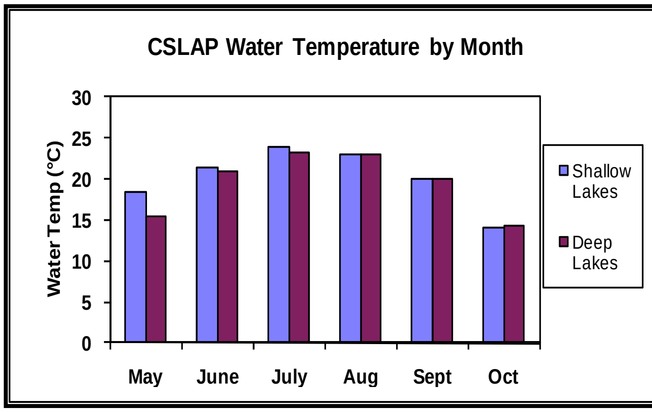
Table 7.1.5- Summary of Slight Changes in Water Temperature Readings for CSLAP Lakes

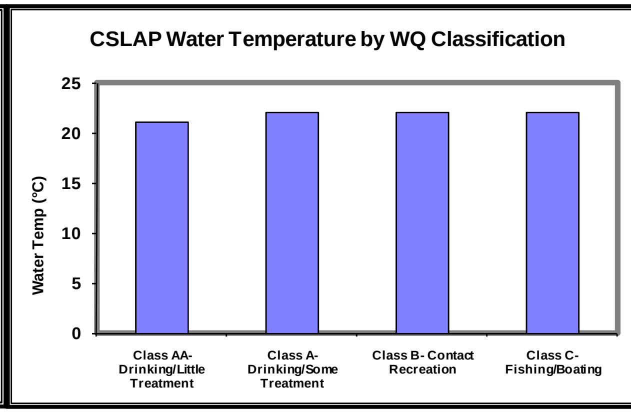
	Number Lakes	%Slightly Increasing Water Temp	%Slightly Decreasing Water Temp
Downstate	31	29	13
Central	57	23	12
Adirondacks	68	13	19
Western	21	15	25
CSLAP Statewide	**177**	**21**	**16**

% Change = % CSLAP lakes in region for which the change in mean water water temperature readings is statistically significant ($R^2 > 0.50$)

Seasonal Variability:

Water temperatures, as expected, are slightly higher in shallow lakes, since they possess a smaller volume of water to gain heat (Figure 7.1.1). The temperature of both deep and shallow lakes increase through late summer, peaking in late July or early August, and then decrease into the fall. By August, the temperature difference between deep and shallow lakes appears to disappear. This may be due to the stable thermocline in late summer, when temperature differences between the upper and lower layers of the lake become most pronounced. In effect, the upper layers of deeper lakes, where these temperature measurements are collected, act as shallow lakes distinct from the bottom waters. Recreational suitability in both deep and shallow lakes, at least as related to temperatures, cease in mid fall, corresponding (and in response) to colder air temperatures, effectively ending the (contact) recreational season.





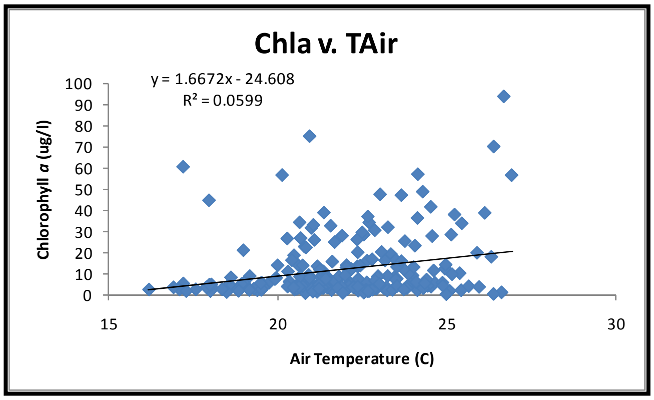
Figures 7.1.1 and 7.1.2: Water Temperature Readings by Month and Water Quality Classification

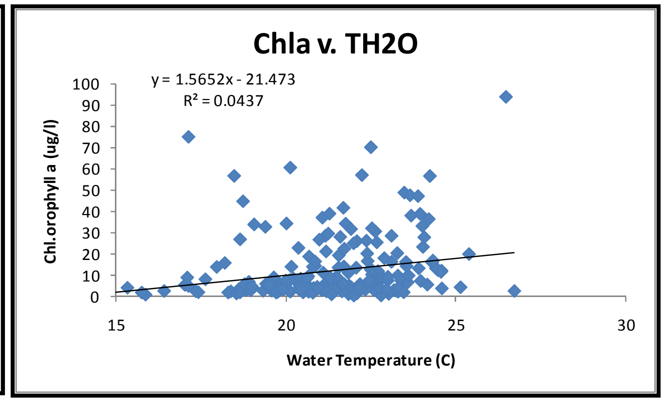
Lake-Use Variability:

Lakes in each of the classes of lake use—potable water, contact recreation, and non-contact recreation—do not exhibit differences in water temperature. This is to be expected, and the small differences in lakes from one classification to the next are more likely to be due to differences in lake depth or geography. This relationship is seen in Figure 7.1.2.

Relationship with Other Water Quality Indicators:

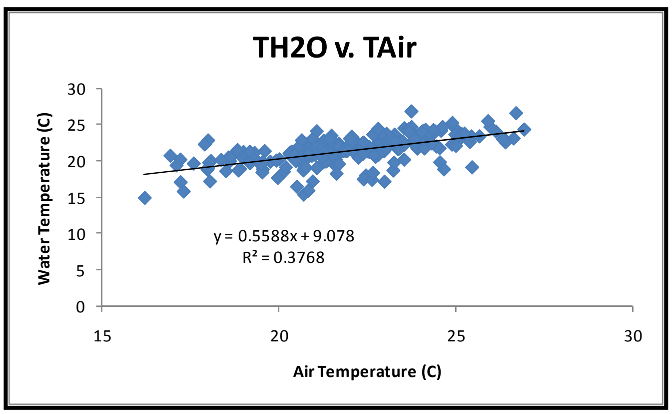
Water temperature may influence several water quality indicators. As discussed above, the maximum dissolved oxygen concentration in lakes is strongly influenced by water temperature—the maximum D.O. saturation in lakes, assuming no influence of photosynthesis, is more than 11 parts per million at 10ºC (at sea level) and less than 8 parts per million at 30ºC. However, in the typical range of summer water temperatures seen in New York state lakes, none of the CSLAP water quality indicators are strongly influenced by water temperature. For example, Figures 7.1.3 and 7.1.4 show that chlorophyll *a* readings are not strongly affected by lake average water temperatures, although for any given lake, algal productivity will increase if water temperatures increase.





Figures 7.1.3 and 7.1.4: Relationship Between Chlorophyll *a* and Air and Water Temperature

Figure 7.1.5 shows the stronger relationship between average air temperature and average water temperature in CSLAP lakes. The lakes experiencing the highest average air temperature—as seen in Table 7.1.1, these corresponds to the lakes in the southern part of the state—also exhibit the highest water temperatures. If local climate variations, as part of a global climate change, result in increases in air temperature, Figure 7.1.5 suggests that this will also lead to increasing water temperature readings.



Figures 7.1.5: Relationship Between Air and Water Temperature in CSLAP Lakes

Chapter 7.2- Evaluation of Adirondack Region Water Temperature: 1986-2009

Summary of CSLAP Water Temperature Findings in Adirondack Region Lakes, 1986-2009

1. Annual variations in water temperature in CSLAP lakes in the Adirondack region were generally related to annual variations in air temperature.
2. Changes in temperatures were related to changes in precipitation, with lower temperatures occurring in wetter years and higher temperatures occurring in drier years. This pattern is more apparent in Adirondack region lakes than from a statewide perspective, although this may reflect the closer connection between a single weather assessment (rainy or dry) in a regional setting than at a statewide scale.
3. **Since 1986, the frequency of higher than normal air and water temperatures has increased, and the frequency of lower than normal temperatures has decreased. This may be the strongest signal in the CSLAP dataset that global climate change has affected Adirondack region lakes, although these trends are not statistically strong.**
4. Consistent with the lack of statistical rigor in the statewide trends assessment, changes in water temperature have not been strongly apparent in individual lakes, and a slightly larger percentage of lakes have exhibited a decrease in water temperatures than have exhibited an increase in these readings over the duration of CSLAP sampling at that lake.

Annual Variability:

Water temperatures have varied annually in most CSLAP lakes. This annual variability can be evaluated by looking at the long-term change in frequency of temperatures readings above and below normal variability, as defined by standard error calculations. Based on these criteria, the highest water temperatures measured through CSLAP occurred during 2005, 2002, 1999, and 2001, consistent with statewide observations. These consisted of both dry and wet years. The lowest temperatures occurred in 1986, 1992, 1998 and 1990. Table 7.2.1 looks at the percentage of CSLAP lakes with high temperatures (greater than 1 standard error above normal) and low temperatures (greater than 1 standard error below normal) readings in wet and dry years. These data show that low temperature readings are more likely to occur in wetter years, and higher temperatures were found in drier years. This mirrored the statewide patterns identified in Table 7.1.1.

Table 7.2.1- % of CSLAP Lakes with Higher or Lower (than Normal) Water Temperature Readings During Dry and Wet Years

	Dry Years	Wet Years
Higher Water Temperature	40%	18%
Lower Water Temperature	13%	30%

Dry Years: 1995, 2004, 2005
Wet Years: 1998, 2000, 2002, 2008
"Higher" and "Lower" defined as >1 SE higher than and lower than normal, respectively

Long Term Trends:

Long-term trends cannot be evaluated simply by looking at changes in annual (or median) temperatures in CSLAP lakes, since the lakes sampled through CSLAP have changed from year to year. These data show that since 1986, the frequency of higher than normal temperatures has increased, and that the frequency of lower than normal temperatures has decreased. These data suggest that air temperatures are increasing in the period (generally June through September) evaluated through CSLAP, triggering an increase in water temperatures over the same period.

Regional Distribution:

Table 7.2.2 shows the long-term and 2009 water temperature readings in CSLAP lakes in the Adirondack region. The majority of these lakes have not exhibited any clear long-term trends, since the frequency of higher water temperatures has increased over the last 25 years. Only two lakes (Black Lake and Brant Lake) in the region have exhibited increasing water temperature readings over the period of their participation in CSLAP, and neither of these lakes had substantially higher than normal water temperature readings in 2009). Likewise, of the six lakes exhibiting decreasing water temperatures (Brantingham Lake, Effley Falls Reservoir, Horseshoe Pond, Lincoln Pond, Millsite Lake, and Pleasant Lake), none exhibited significantly lower water temperatures in 2009. Some of this apparent discrepancy may represent the difference between weather variability and climate change, but this dataset may not be sufficient for evaluating local climate change on individual waterbodies. It is not known if other, less stringent criteria for evaluating water quality changes would have resulted in a larger number of Adirondack region lakes exhibiting significant change in water temperatures over the last twenty-five years.

These data suggest that long-term changes in climate may be occurring in the Adirondack region, as manifested in an increasing frequency of higher than normal water temperatures and a decreasing frequency of lower than normal temperatures. However, these trends are not (yet) statistically robust, and are not readily apparent when inspecting the temperature data from individual lakes. Continued evaluation of these data may provide some additional insights about the impact of larger scale climate change on the water temperatures in New York State lakes, and whether any local changes have triggered any significant biological changes in these lakes.

Table 7.2.2- Regional Summary of Water Temperature Readings for Adirondack Region Lakes, 1986-2009

Lake Name	Years	Num	Min	Avg	Max	Change?
Adirondack Lake	1986-1989	34	8	19	27	No Change
Augur Lake	1997-2009	85	1	20	27	No Change
Augur Lake	2009	8	18	22	25	No
Bartlett Pond	1997-2000	25	1	16	26	No Change
Black Lake	1988-2009	158	16	22	27	Increasing
Black Lake	2009	8	18	23	25	No
Brant Lake	1987-2003	76	15	23	29	Increasing
Brantingham Lake	2001-2009	68	13	21	26	Decreasing
Brantingham Lake	2009	7	13	19	24	No
Butterfield Lake	1986-2009	174	12	22	28	No Change
Butterfield Lake	2009	8	20	22	26	No
Canada Lake	2001-2009	68	13	22	28	No Change
Canada Lake	2009	8	13	21	26	No

Lake Name	Years	Num	Min	Avg	Max	Change?
Chase Lake	1990-1997	40	10	20	27	No Change
Eagle Crag Lake	1986-2005	103	5	19	29	No Change
Eagle Lake	2000-2009	72	14	22	28	No Change
Eagle Lake	2009	9	18	21	23	No
Eagle Pond	2008-2009	15	10	19	22	No Change
Eagle Pond	2009	8	12	20	22	No
East Caroga Lake	1990-2009	108	9	22	27	No Change
East Caroga Lake	2009	6	17	21	25	No
Effley Falls Lake	1997-2009	83	2	19	27	Decreasing
Effley Falls Lake	2009	8	16	21	23	No
Efner Lake	1997-2001	38	2	17	28	No Change
Friends Lake	1991-2009	99	9	21	29	No Change
Friends Lake	2009	8	18	22	24	No
Fulton Second Lake	1986-2009	155	10	20	27	No Change
Fulton Second Lake	2009	8	17	20	24	No
Garnet Lake	1989-2001	34	6	20	28	No Change
Glen Lake	1986-2009	108	5	22	28	No Change
Glen Lake	2009	7	22	24	27	No
Goodnow Flow	1986-2009	108	11	20	27	No Change
Goodnow Flow	2009	7	17	21	25	No
Grass Lake	2004-2009	46	11	21	27	No Change
Grass Lake	2009	8	11	20	26	No
Gull Pond	1994-1998	40	10	20	26	No Change
Hadlock Pond	1997-2001	18	1	21	26	No Change
Horseshoe Pond	2000-2009	74	9	20	30	Decreasing
Horseshoe Pond	2009	8	11	20	26	No
Hunt Lake	1994-2009	92	15	23	28	No Change
Hunt Lake	2009	8	20	22	23	No
Hyde Lake	1999-2009	41	17	24	27	No Change
Hyde Lake	2009	8	19	22	27	No
Indian Lake	1986-1997	48	9	20	27	No Change
Jenny Lake	1994-2007	64	9	22	28	No Change
Joe Indian Lake	1986-1990	48	9	17	24	No Change
Kayuta Lake	1997-2001	39	2	17	26	No Change
Kellum Lake	1997-2001	35	2	15	26	No Change
Lake Bonaparte	1988-2009	99	11	21	26	No Change
Lake Bonaparte	2009	8	14	21	26	No
Lake Clear	1998-2009	92	12	19	25	No Change
Lake Clear	2009	8	15	17	20	No
Lake Colby	1999-2001	17	14	21	26	No Change
Lake Forest	2001-2009	53	12	23	28	No Change
Lake Forest	2009	6	16	23	26	No
Lake George	2004-2009	44	12	18	22	No Change
Lake George	2009	8	17	19	22	No
Lake Kiwassa	1990-1995	40	12	20	27	No Change
Lake Luzerne	1999-2004	38	5	22	29	No Change
Lake of the Isles	2000-2001	16	16	22	27	No Change
Lake of the Woods	1994-2008	54	16	22	26	No Change
Lake Placid	1991-2009	112	8	20	29	No Change
Lake Placid	2009	4	19	22	27	No
Lake Titus	1999-2001	19	13	20	25	No Change
Lincoln Pond	1997-2009	60	1	20	28	Decreasing
Lincoln Pond	2009	5	20	22	25	No
Little Wolf Lake	1998-2000	18	16	22	26	No Change
Loon Lake	1986-1997	44	13	20	26	No Change
Lorton Lake	1990-2009	119	8	21	28	No Change

Lake Name	Years	Num	Min	Avg	Max	Change?
Lorton Lake	2009	8	19	22	25	No
Lower Chateaugay Lake	1991-1995	33	10	20	26	No Change
Lower St. Regis Lake	2000-2002	14	11	21	26	No Change
Mayfield Lake	2000-2004	27	8	20	26	No Change
Millsite Lake	1997-2009	99	2	21	28	Decreasing
Millsite Lake	2009	8	14	20	23	No
Mirror Lake	1998-2009	69	4	19	26	No Change
Mirror Lake	2009	7	8	18	22	No
Moon Lake	1992-1996	38	14	21	27	No Change
Moreau Lake	1994-2002	61	4	21	28	No Change
Mountain Lake	1998-2001	29	12	22	27	No Change
Mountain View Lake	1991-1997	38	12	19	25	No Change
North Sandy Pond	1986-1990	45	14	21	29	No Change
Otter Lake	1992-2009	90	10	21	27	No Change
Otter Lake	2009	8	21	23	25	No
Paradox Lake	2003-2009	55	12	21	25	No Change
Paradox Lake	2009	8	12	19	22	No
Peck Lake	1992-2009	46	11	21	26	No Change
Peck Lake	2009	8	19	22	25	No
Piseco Lake	1999-2003	31	14	21	28	No Change
Pleasant Lake	2000-2009	60	11	20	25	Decreasing
Pleasant Lake	2009	2	20	21	21	No
Rondaxe Lake	1998-2001	31	11	21	26	No Change
Sacandaga Lake	1987-2009	92	4	20	25	No Change
Sacandaga Lake	2009	8	15	20	24	No
Schroon Lake	1987-2009	106	14	21	28	No Change
Schroon Lake	2009	7	17	21	23	No
Silver Lake	1989-1993	25	14	20	26	No Change
Silver Lake	1996-2009	84	8	21	26	No Change
Silver Lake	2009	7	8	18	22	No
Sixberry Lake	2001-2004	25	16	23	26	No Change
Spitfire Lake	1996-2002	42	11	20	26	No Change
Star Lake	1994-1998	40	7	19	24	No Change
Stewarts Landing	1997-2001	40	2	17	28	No Change
Twitchell Lake	1986-1996	33	13	20	25	No Change
Upper Chateaugay Lake	1990-1994	31	14	20	24	No Change
Upper Saranac Lake	2006-2009	27	11	19	25	No Change
Upper Saranac Lake	2009	8	19	21	22	No
Upper St. Regis Lake	1997-2002	47	2	19	25	No Change
West Caroga Lake	1997-2007	28	2	18	26	No Change
Windover Lake	1999-2003	37	15	22	29	No Change

Minimum, average and maximum air temperature in ºC
% Change = % CSLAP lakes in region exhibiting significant change in air temperature readings (annual average linear regression $R^2 > 0.50$ and T tests results)

Chapter 8- Evaluation of Impacts to Lake Usage

Chapter 8.7- Adirondack Region Assessments

Chapter 8- Evaluation of Impacts to Lake Usage

Summary of Lake Usage Impacts in CSLAP Lakes

1. Lakes are assessed by the NYSDEC to determine whether they support the designated use for the lake—*potable water, contact recreation* (swimming and bathing), *non-contact recreation* (boating and angling), *aquatic life, aesthetics* and *fish consumption*.
2. These assessments lead to a characterization of use support as *precluded, impaired, stressed, threatened,* or *fully supporting*; the first two categories also meet the federal definition of *impaired* waters and lead to required management actions.
3. CSLAP data can contribute to these assessments, although the overall assessment should include all possible sources of data and information.
4. CSLAP data have only limited utility in evaluating potable water supplies, although data not yet available for review for the 2009 CSLAP report improve these assessments. **The assessment criteria for evaluating potable water conditions have not yet been finalized.** The **limited and preliminary** potable water assessments are discussed in the regional reports and the individual lake appendices and are derived from the chlorophyll *a* data.
5. Contact recreation is evaluated with the trophic indicators—water clarity, chlorophyll *a*, and total phosphorus. **The assessment criteria for evaluating contact recreation have also not yet been finalized. The limited and preliminary contact recreation assessments** are discussed in the regional reports and the individual lake appendices.
6. Non-contact recreational assessments are limited to evaluation of lakes with excessive weeds and/or exotic plants. These impacts are most significant in the Central region; the large number of threatened lakes in the Downstate and Adirondack regions are associated with both the large number of sampled lakes and the persistence of invasive plants.
7. Aquatic life assessments are derived from pH and inferred oxygen data, and are most significant in the Downstate and Central region, mostly due to oxygen deficits. Acidic lake conditions are uncommon in CSLAP lakes due to the small number of "developed" lakes with depressed pH, although elevated pH (and resulting threats to aquatic life) are more common in the Western (Finger Lakes) region.
8. Aesthetics impacts are limited to CSLAP volunteer reports that the "lake looks bad". These impacts are scattered throughout the state, but are generally associated with lakes with both nuisance algae and excessive weeds
9. Fish consumption is not evaluated through CSLAP.

Background on Lake Assessments

CSLAP is intended to be a long-term, standardized, trophic-based, water-quality monitoring program to facilitate comparison of water-quality data from season to season, year to year, and from lake to lake. The data and information collected through CSLAP can be utilized to identify water-quality problems, detect seasonal and long-term patterns, and educate sampling volunteers and lake residents about water-quality conditions and stressors at their lakes. It is particularly useful in evaluating the over-enrichment of aquatic plant (algae and rooted plant) communities in a lake, and the response of the lake to these trophic stressors.

Shorefront residents, lake managers, and government agencies are increasingly tasked to better assess and evaluate water-quality conditions and lake uses in NYS lakes, including those sampled through CSLAP, whether to address localized problems, meet water-quality standards, satisfy state and federal environmental reporting requirements, or enhance and balance a suite of lake uses. CSLAP data should be a part of this process, but only a part. For some lakes, particularly small lakes and ponds with limited public access by those who don't reside on the lake shore, CSLAP may be the sole source of data used to assess lake conditions. In addition, studies conducted through CSLAP find strong similarities between sampling sites in many, but not all, large lakes, and generally find a strong convergence of perceptions about lake and recreational use conditions within most lakes, based on a local familiarity with "normal" conditions and factors that might affect lake use. For the purpose of broad water-quality evaluations and understanding the connection between measured water-quality indicators and the support of broadly based recreational uses of the lake, CSLAP can be a singularly effective tool for standardizing the lake-assessment process. CSLAP volunteers, lake associations, and others engaged in lake assessment and management should continue to utilize CSLAP in this context.

However, for large, multi-use lakes, or those lakes that are threatened by pollutants not captured in eutrophication-based monitoring programs, CSLAP becomes a less effective primary tool for assessing lake condition and use impairments. For example, CSLAP data have only limited utility in evaluating the following:

(a) contamination from bacteria or other biological toxins, particularly related to the safety of water use for potable intake or swimming
(b) contamination from inorganic (e.g., metals) and organic (e.g., PCBs, DDT) compounds
(c) portions of a lake not well mixed with the "open water" or otherwise distant from the primary sampling site(s), including the shoreline, bottom sediment and isolated coves
(d) rooted aquatic plant impacts in areas of the lake not evaluated by the sampling volunteers
(e) diverging perceptions of recreational-use impacts, particularly in lakes with shorelines or isolated coves exhibiting conditions very different from those sampled or evaluated by the sampling volunteers
(f) impacts to fish or other fauna due to factors unrelated to eutrophication
(g) PWL or 303(d) listings for other pollutants or portions of the lake not sampled through CSLAP

For these waterbodies, CSLAP can and should continue to be part of an extensive database used to comprehensively evaluate the entirety of the lake and its uses, but absent a more complete dataset, CSLAP data should be used with caution as a sole means for evaluating the lake. Water-quality evaluations, recommended PWL listings, and other extrapolations of the data and analyses should be utilized in this context and by no means should be considered “the last word” on the lake.

Priority Waterbody List

The Priority Waterbody List (PWL) is an inventory of all waters in New York State (lakes, ponds, reservoirs, rivers, streams, and estuaries) known to have designated water uses with some degree of impairment, or those threatened by potential impairment. These designated uses include:

- *potable water*—drinking—for class AA or class A waterbodies
- *contact recreation*—swimming and bathing—for class B waterbodies
- *non-contact recreation*—boating and angling—for class C waterbodies
- *aquatic life*—for all classes of waterbodies
- *aesthetics*—for all classes of waterbodies
- *fish consumption*—for all classes of waterbodies

However, an overarching goal of the federal Clean Water Act is for the protection and propagation of fish, shellfish, and wildlife and recreation in and on all waterbodies, broadly characterized as making all waterbodies “swimmable (and) fishable.” Therefore, any water quality criteria established for protecting swimming will apply to all waterbodies, unless explicitly precluded by natural conditions preventing swimming (or for water supply reservoirs on which contact recreational is restricted).

The PWL is a subset of the Waterbody Inventory, an inventory of all waterbodies in the state, which contains all available information on the condition and/or usability of the waterbody. PWL waterbodies are identified through a broad network of county and state agencies, with significant public outreach and input, and the list is maintained and compiled by the NYSDEC Division of Water. Monitoring data from a variety of sources, including CSLAP, have been utilized by state agencies to evaluate lakes for inclusion on the PWL, and the process for incorporating lakes data has become more standardized.

Specific numeric water quality criteria have been developed to characterize sampled lakes in the available use-based PWL categories. The following categories have been broadly defined as follows:

Precluded:	designated use cannot be conducted
Impaired:	designated use is strongly compromised but can still be conducted
Stressed:	designated use may be comprised during part of the summer or in part of the lake, but the designated use is still supported
Threatened:	designated use is supported but may become compromised by higher or more frequent occurrences of a pollutant
Fully Supporting: *(or No Uses Impaired)*	designated use is not compromised at any time or location

The latter category is a bridge to the equivalent federal (USEPA) assessment criteria, in which waterbodies are designated as *fully supporting, partially supporting* (the equivalent of the NYSDEC categories *threatened* or *stressed*), or *not supporting* designated uses.

Evaluations utilize the NYS phosphorus guidance value, water-quality standards, criteria utilized by other states, and the trophic ranges described earlier to supplement the other more antidotal inputs to these listings. The procedures by which waterbodies are evaluated are known as the Consolidated Assessment and Listing Methodology (CALM) process. This process is undertaken on an annual rotating basin, with waterbodies in several drainage basins evaluated each year. Each of the 17 drainage basins in the state is assessed within every 5 years. In general, waterbodies that violate pertinent water-quality standards at a frequency of greater than 25% are identified as *impaired* for the designated use intended to be protected by that standard, at a frequency of 10-25% are identified as *stressed*, and at a frequency of 0-10% are identified as *threatened*, although some evidence of use impairment (including through CSLAP lake-perception surveys) might also be required. Mean (average) phosphorus levels are evaluated against the state guidance value. Evidence of use prohibitions (via beach closures, etc.) is often required to identify a waterbody as *precluded*, while evidence of actual use restrictions or necessary management must accompany an *impaired* listing, at least for lakes evaluated in recent years.

Lakes that have been identified as *precluded* or *impaired* on the PWL are likely candidates for the federal 303(d) list, an “Impaired Waters” designation mandated by the federal Clean Water Act, under the federal designation of *not supporting* uses. Lakes on this list must be closely evaluated for the causes and sources of these problems. Remedial measures must be undertaken, under a defined schedule, to solve these water-quality problems. This entire evaluation and remediation process is known as the “TMDL” process, which refers to the Total Maximum Daily Load calculations necessary to determine how much (pollution that causes the water-quality problems) is too much.

Evaluation of Designated Uses in CSLAP Lakes

As noted above, the PWL assessment process involves a number of stakeholders and sources of information, from monitoring data to an inventory of management actions to recommendations and professional judgment from those familiar with each waterbody. The CSLAP dataset can play an important role in providing some of this assessment information, although it cannot be overemphasized that a comprehensive evaluation of these waterbodies should consider all sources of information. The following section of the report summarizes each of the designated uses in New York state lakes and a preliminary assessment of these uses in each CSLAP lake based solely on information collected through CSLAP (unless explicitly stated). These assessments should be considered preliminary in part because continued evolution of the program will provide better information and datasets to conduct this evaluation, in part because conditions change in these lakes, and in part because the dataset on many of these lakes is limited.

Comment on Preliminary Assessments-nutrient criteria development in New York state will likely not be completed until 2011. These numeric criteria for chlorophyll a, total phosphorus, and Secchi disk transparency data will identify conditions leading to impaired, stressed, and threatened conditions, and will be used to update the state Priority Waterbody List and federal Impaired Waters (303d) list. Until these criteria are established, any pertinent existing water quality standards, criteria, or guidance values will be used to identify use impairments.

Chapter 8.1- Evaluation of Impacts to Potable Water

The health and quality of potable surface waters can be influenced by a variety of factors. Most of these are not evaluated through CSLAP, a water quality monitoring program not intended to assess potable water supplies. However, some of the information collected through CSLAP has some utility in evaluating water quality conditions in lakes used for drinking water. The continuing evolution of the program involves collecting better information related to potable water quality, as demonstrated in the monitoring of harmful algal blooms and taste and odor compounds (iron and manganese) starting in 2009.

The CSLAP water quality indicators that can be used to assess potable water quality conditions include:

Assessment of Chlorophyll a Data

Discussion: High algae levels create a number of problems for surface water supplies, including additional treatment costs related to filtering and algae removal by copper compounds (or other algacides), reductions in dissolved oxygen concentrations from the bacterial breakdown of the organic remains of algal cells (leading to the production of taste and odor compounds and dangerous forms of some compounds, including hydrogen sulfide, ammonia, and arsenic), the production of algal toxins by some species of blue green algae, and the production of dangerous disinfection by-products (DBPs) that come from the chlorination of water with high organic content.

Evaluation Criteria: Research is on-going to evaluate the connection between excessive eutrophication and potable water impacts. It is anticipated that this research will lead to final assessment guidance criteria by 2011. Until this guidance works through public comment and the regulatory process, and promulgated into state water quality criteria, any evaluation is premature.

Availability: Extensive data; collected during every CSLAP sampling session

Assessment of Ammonia and Nitrite Data

Discussion: Ammonia and nitrite at high concentrations is toxic to both humans and aquatic life. The state water quality standard is 2 mg/l total ammonia and 1 mg/l nitrite. These levels are unlikely to be reached in the surface waters of most New York state waterbodies, at least those without direct wastewater inputs. However, deepwater ammonia and nitrite readings are elevated in some lakes with deepwater anoxia, due to the conversion of NO_x to ammonia or nitrite. This may adversely impact deepwater intakes in lakes serving as potable water supplies.

Evaluation Criteria: The depth of water intakes, and the extent of deepwater ammonia enrichment, is not readily available in New York state lakes. Absent this information, CSLAP lakes classified for potable water use (Class AA or Class A) are considered *threatened* if the state water quality standard for ammonia (= 2 mg/l) or nitrite (= 1 mg/l) is exceeded in more than 25% of the hypolimnetic samples, or if the average hypolimnetic ammonia or nitrite levels exceed 0.5 mg/l.

Availability: Limited data; only collected during some CSLAP sampling sessions in stratified CSLAP lakes in 2002 and in stratified potable water supplies in 2009. Nitrite data were only collected in 2009, and none of the results were close to the state standards.

Assessment of Algal Toxins Data

Discussion: Microcystin-LR is a toxin commonly produced by cyanobacteria (blue green algae), a form of algae commonly found in highly productive lakes. The World Health Organization (WHO) has recommended that microcystin-LR levels remain below 1 µg/l, based on their drinking water provisional guidelines to protect potable water supplies. The NYSDOH harmful algal bloom study on a number of CSLAP lakes is looking at microcystin-LR levels within blooms and in the open water of lakes.

Evaluation Criteria: The evaluation criteria for determining potable water impacts in CSLAP lakes as related to harmful algal blooms and the production of microcystin-LR has not yet been established. The most likely criteria will be to define any lake with microcystin-LR levels exceeding the WHO potable water criteria (= 1 µg/l) during more than 25% of the sampling sessions at the lake as *impaired*. Any lake violating this criteria at a frequency of 10-25% of the time will be identified as *stressed*, and any occurrence of microcystin-LR reading above this criteria will likely be identified as *threatened.*

Availability: HAB and microcysis-LR data were collected for the first time through CSLAP in 2009. Unfortunately, the data from the first year of studies on CSLAP lakes are not available at the time of this writing.

Assessment of Arsenic Data

Discussion: Arsenic is a carcinogenic metal found in low levels in many waterbodies, due to natural deposits in the earth or from agricultural and industrial practices. However, recent studies by the NYSDEC indicate that arsenic may migrate from bottom sediments and rise to dangerous levels in response to deepwater anoxia, particularly in lakes overlying arsenic-rich sediments, in a manner similar to anoxia-mediated changes in bottom phosphorus, ammonia, and arsenic lakes. This may adversely affect deep potable water intakes, and perhaps shallower intakes during and immediately after lake destratification.

Evaluation Criteria: There continues to be some debate about the most appropriate arsenic guidance needed to protect human health. The present maximum contamination limit (MCL), the highest level of a contaminant that is allowed in drinking water, is 10 µg/l. Evaluation criteria have not yet been established for evaluating CSLAP lakes. One possible criteria will be to define any lake with arsenic levels exceeding the MCL (= 10 µg/l) during more than 10% of the sampling sessions at the lake as *impaired*, any lake exceeding this MCL at any time will be identified as *stressed*, and lake with average arsenic levels at one half the MCL will likely be identified as *threatened.*

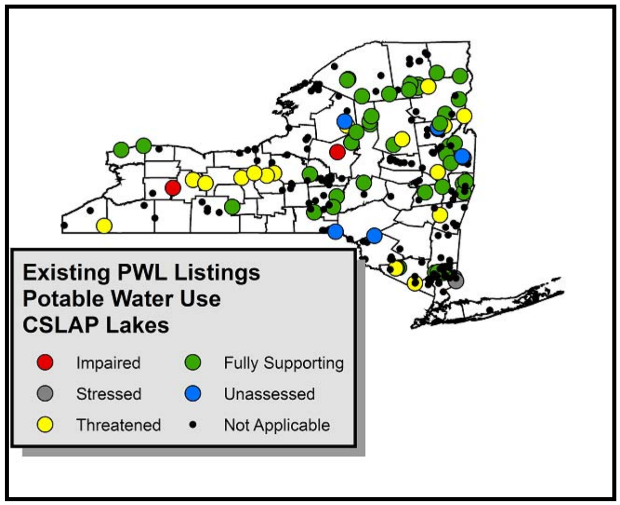


Figure 8.1- Existing PWL Potable Water Assessments in CSLAP Lakes

Availability: CSLAP data for arsenic were collected for the first time in 2009. Unfortunately, the data from the first year of studies on CSLAP lakes (2009) are not available at the time of this writing.

Summary of CSLAP Potable Water Assessment Data

Table 8.1 shows the existing statewide PWL summary of potable water assessments, and Figure 8.1 shows the statewide distribution of CSLAP lakes in relation to their PWL assessments for potable water supply. Some of the sampled lakes may have already been identified as impacted by some pollutant not measured through CSLAP, particularly bacteria, metals, or some organic compounds. As such, these data should only supplement the more extensive data collected by municipalities or other water purveyors for the purposes of assessing surface drinking water conditions as part of the PWL evaluation. However, it should be noted that PWL assessments are updated by basins (the 17 major drainage basins in the state) in approximately 5 year intervals. Assessments in some of these basins (and corresponding regions in Table 9.1) do not include recent CSLAP data, and CSLAP data related to potability have only been occasionally used in these assessments. An evaluation of the CSLAP data related to potable water impacts in these lakes is provided in the regional CSLAP reports.

The data from Table 8.1 suggest that potable water impacts are most frequently reported in the Downstate and Western (Finger Lakes) regions, consistent with the combination of a large number of Class AA and Class A lakes in this region. There are a few lakes in the Adirondack and Central regions reported to have potable water impacts, consistent with the larger number of CSLAP lakes classified for use as public water supplies in these regions.

A more detailed discussion of potable water impacts to individual CSLAP lakes is included in the regional CSLAP reports.

Table 8.1- Summary of Existing PWL Listings Based on Potable Water Impacts to CSLAP Lakes

Region	Number Lakes	Impaired	Stressed	Threatened	Fully Supporting	Not Applicable	Not Assessed
Downstate	57	0	1	3	5	48	1
Central	65	1	0	2	12	50	2
Adirondacks	75	0	0	6	23	46	2
Western	27	0	0	7	3	16	0
CSLAP Statewide	**224**	**2**	**1**	**18**	**43**	**160**	**5**

Chapter 8.2- Evaluation of Impacts to Contact Recreation

Swimming conditions are affected by a number of factors, some of which are evaluated through CSLAP. Some of these factors relate to swimming safety—the ability of swimmers to see bottom debris or lifeguards to see submerged swimmers, some relate to swimming health—the production of enough algae to greatly increase the likelihood of selecting for blue-green algae and the toxins they can produce, and other factors are related to aesthetic quality. The primary means for evaluating contact recreation—bacteria levels to assess whether swimming can be dangerous—cannot be evaluated through CSLAP, but the multiple “lines of evidence” evaluating these other factors provide useful information in identifying swimming and bathing impacts.

Assessment of Chlorophyll a Data

Discussion: Excessive algae leads to excessive greenness in the lake. As summarized in the “Evaluation of Eutrophication Indicators” section (Chapter 3), excessive algae greenness is strongly related to decreasing water clarity and in turn is triggered by increasing phosphorus concentrations in a lake. Moreover, there is a strong correlation between changes in these trophic indicators and recreational assessments, given the strong connection between measured and perceived water quality conditions. These data also show a strong depth and regional gradient in water quality and recreational assessments.

In addition, data collected by the NYSDEC and other researchers around the world suggest that elevated chlorophyll *a* readings increase the likelihood of the production of algal toxins, the frequency of unsafe swimming conditions (due to poor water clarity) and the frequency of intense algal blooms.

Evaluation Criteria: The NYS nutrient criteria development process is identifying the appropriate chlorophyll *a* readings necessary to protect recreational uses of lakes. "Reference conditions" (water quality conditions with minimal recreational use impacts) can be associated with lakes exhibiting less than 25% frequency of "slightly impaired conditions" in two distinct regional areas—the Adirondacks and rest of the state—and in deep (> 20 feet deep) and shallow lakes. The completion of the nutrient criteria development process will identify the chlorophyll *a* readings associated with *impaired* conditions. At present, there are no water quality standards, criteria, or guidance values associated with chlorophyll *a.*

Availability: Extensive data; collected during every CSLAP sampling session.

Assessment of Water Clarity Data

Discussion: Water clarity is strongly related to both recreational assessments and unsafe swimming conditions—the latter is associated with insufficient visibility for swimmers and lifeguards. These are discussed in the "Assessment of Chlorophyll *a* Data" above.

Evaluation Criteria: The background information for evaluating water clarity criteria to protect swimming quality in lakes is provided in the "Assessment of Chlorophyll *a* Data" section above. The completion of the nutrient criteria development process will identify the water clarity readings associated with *impaired* conditions. At present, the NYS Department of Health has established a guidance value of 1.2 meters (= 4 feet) for siting new swimming beaches, to allow swimmers to observe submerged debris and to allow lifeguards to view submerged swimmers. Lakes with water clarity readings failing to reach this criteria at a frequency of greater than 25% can, at present, be considered *impaired* for contact recreation. Lakes with water clarity readings below 1.2 meters at a frequency of 10-25% can be considered *stressed,* and lakes with any water clarity readings below this criteria can be considered *threatened.*

Availability: Extensive data; collected during every CSLAP sampling session.

Assessment of Total Phosphorus Data

Discussion: Total phosphorus is strongly related to both recreational assessments and unsafe swimming conditions, as the "stressor" that triggers these recreational use responses—high algae levels and low water clarity. These are discussed in the "Assessment of Chlorophyll *a* Data" above.

Evaluation Criteria: The background information for evaluating total phosphorus criteria to protect swimming quality in lakes is provided in the "Assessment of Chlorophyll *a* Data" section above. The completion of the nutrient criteria development process will identify the water clarity readings associated with *impaired* conditions. At present, the NYSDEC has established a guidance value of 0.020 mg/l (= 20 µg/l). Lakes with mean phosphorus readings exceeding this guidance value may be considered *impaired* for contact recreation. Lakes with phosphorus readings exceeding this criteria at a frequency of 25% can be considered *stressed,* and lakes with phosphorus readings exceeding this guidance value at a frequency of 10-25% can be considered *threatened***.**

Availability: Extensive data; collected during every CSLAP sampling session.

Assessment of Algal Toxins Data

Discussion: Microcystin-LR is a toxin commonly produced by cyanobacteria (blue green algae), a form of algae commonly found in highly productive lakes. The World Health Organization (WHO) has not yet established microcystin-LR levels above which recreational use impacts are likely to occur. The literature suggests that median chlorophyll a readings above 12 µg/l may be sufficient to render lakes unsafe for swimming during an unacceptable portion of the summer.

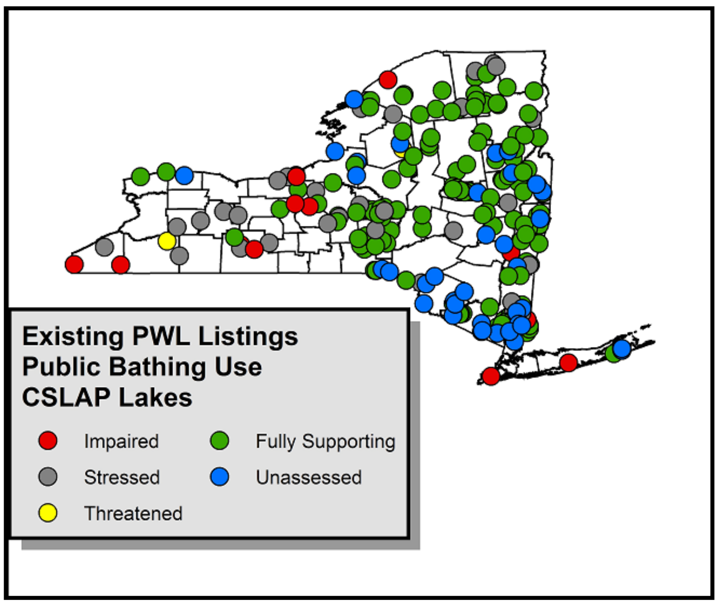


Figure 8.2- PWL "Public Bathing" Assessments in CSLAP Lakes

Evaluation Criteria: The evaluation criteria for determining contact recreational impacts in CSLAP lakes as related to harmful algal blooms and the production of microcystin-LR has not yet been established. It is anticipated that the NYSDOH harmful algal bloom study on a number of CSLAP lakes looking at microcystin-LR levels within blooms and in the open water of lakes will help to identify unacceptable microcystin-LR levels to protect swimming.

Availability: HAB and microcysis-LR data were collected for the first time through CSLAP in 2009. Unfortunately, the data from the first year of studies on CSLAP lakes are not available at the time of this writing.

Summary of CSLAP Contact Recreation Assessment Data

Table 8.2 shows the existing statewide PWL summary of contact recreational—swimming and bathing—assessments, and Figure 8.2 shows the statewide distribution of CSLAP lakes in relation to their PWL assessments for "public bathing". It should be noted that the existing PWL process identifies only those lakes with documented public health or safety impacts to swimming—such as elevated bacterial levels, unsafe water clarity, or wastewater discharges to the water—rather than aesthetic impacts. The latter category, including perceived poor conditions for swimming, and slightly (but persistently) elevated algae levels or reduced water clarity, is reflected in the PWL assessment of "recreation" cited in section 8.3. It is anticipated that, once nutrient criteria are finalized and adopted in New York state, "recreation" and "non-contact recreation" will be clearly distinguished within future generations of the PWL.

Some of the sampled lakes may have already been identified as impacted by some pollutant not measured through CSLAP. The most likely candidates for additional stressors of recreational uses in lakes are bacteria and nuisance weeds. The latter is assessed through CSLAP, but for the purposes of this assessment, it is assumed that recreational use impacts associated with nuisance weeds are associated with non-contact recreation rather than swimming or bathing. Although bacteria has been monitored on a number of CSLAP lakes, and will likely be included in future CSLAP reports (and has been discussed in previous reports), these data have not been consistently collected or reported to the NYSDEC.

The data from Table 8.2 suggest that the highest percentage of "public bathing" impacts are in the Western (Finger Lakes) region lakes, and the highest number of impacted lakes are in the Adirondack, Downstate and Central regions, the latter reflecting the larger number of CSLAP lakes sampled in these regions. The lowest percentage of lakes with impacted public bathing is in the Adirondacks, where the combination of high water clarity and low algae levels has resulted in fewer problems with poor swimming or bathing (notwithstanding the cold water during much of the summer).

However, it should be noted that PWL assessments are updated by basins (the 17 major drainage basins in the state) in approximately 5 year intervals. Assessments in some of these basins (and corresponding regions in Table 8.2) do not include recent CSLAP data, and CSLAP data related to potability have only been occasionally used in these assessments. An evaluation of the CSLAP data related to contact recreational impacts in these lakes is provided in the regional CSLAP reports.

Table 8.2- Summary of Existing PWL Listings Based on "Public Bathing" Impacts to CSLAP Lakes

Region	Number Lakes	Impacted	Stressed	Threatened	Fully Supporting	Unassessed
Downstate	43	4	3	5	31	20
Central	58	1	9	0	48	9
Adirondacks	69	1	8	1	59	8
Western	12	8	11	1	6	1
CSLAP Statewide	**196**	**14**	**31**	**7**	**144**	**38**

A more detailed discussion of swimming and bathing impacts to individual CSLAP lakes is included in the regional CSLAP reports and the individual lake appendices.

Chapter 8.3- Evaluation of Impacts to Non-Contact Recreation

Non-contact recreational conditions—boating and fishing—are strongly influenced by a number of factors not measured (or measurable) through CSLAP, from water depth and lake access to quantity and type of fish. Some of these factors, such as water quality effects on fish habitat, related to oxygen and pH, are discussed in the aquatic life section, and some of the factors contributing to CSLAP volunteers' assessments that "the lake looks bad" and discussed in the Aesthetics section are discussed below. However, the primary influence on boating and perhaps aesthetics is aquatic plant coverage and densities, and is discussed here.

Assessment of Aquatic Plant Coverage Data

Discussion: Boating and non-contact recreation, including fishing access, can be strongly influenced by the type and density of aquatic plants. Notwithstanding the plant survey and FQI information provided in the Biological Condition section (Chapter 6), the type of aquatic plants in many CSLAP lakes, or at least the type (species or invasiveness status) of the most dominant plants in the lake are not known. However, it is assumed that the presence of exotic submergent or floating leaf plant species—Eurasian watermilfoil, water chestnut, curly-leafed pondweed, etc.—represent at least a threat to non-contact recreation.

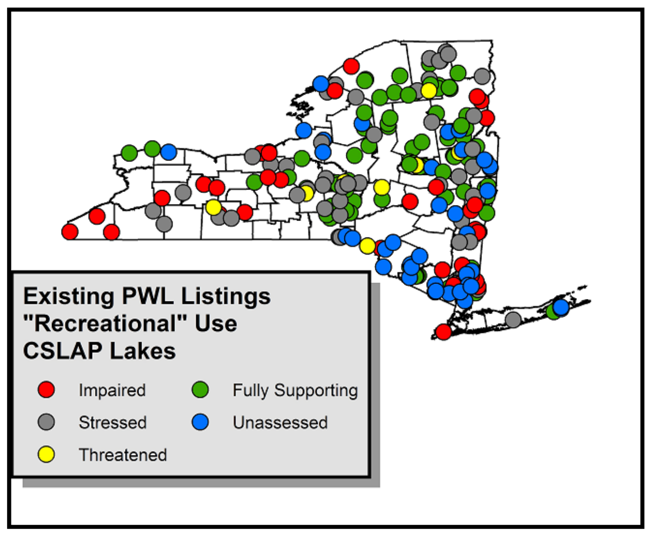


Figure 8.3- PWL "Recreation" Assessments in CSLAP Lakes

The more useful information comes from the CSLAP Field Observations form, which gauges volunteers' opinions about the extent of aquatic plant coverage and the impact of "excessive weeds" on recreational suitability. Matching recreational use impacts specifically to instances of excessive weed coverage (and limiting those matches to those times when volunteers explicitly cite "excessive weeds" as leading to poor recreational conditions) identifies the occurrence of non-contact recreational use impacts.

Evaluation Criteria: Standardized criteria have not been established for identifying non-contact recreational use impacts, but several approaches can be employed. These approaches must recognize that identifying lakes as *impaired* for boating and non-contact recreation may be problematic, since excessive weed growth is not necessarily associated with a known pollutant and therefore a management response may be limited to symptom management. This creates problems in matching New York state impairment assessments with federal criteria, as is often required, since the latter are usually linked to managing pollutant sources.

However, one such approach to assessing waterbodies used here is to identify lakes with "substantially impaired" conditions (response 4 on the recreational perception survey) at a frequency of > 25% as *impaired*, and lakes with "slightly impaired' conditions (response 3) at a frequency of > 25% as *stressed.* Lakes with "slightly impaired" conditions at a frequency of 10-25% or the presence of exotic plant species can be considered *threatened*.

Availability: Extensive data; collected during every CSLAP sampling session since 1992.

Summary of CSLAP Non-Contact Recreational Assessment Data

Table 8.3 shows the existing statewide PWL summary of "recreational" assessments—boating and swimming quality (as opposed to health), and Figure 8.3 shows the statewide distribution of CSLAP lakes in relation to their PWL assessments for "recreation." As discussed in Section 8.2, the existing PWL distinguishes between "public bathing", as measured by lake health, and "recreation", as measured by lake aesthetics. The latter includes both contact and non-contact recreation. It is anticipated that these will be clearly delineated in future generations of the PWL.

Additional information about some of these lakes regarding aquatic plant coverage or impacts to angling have been collected independent of CSLAP but are not included in this assessment. This information will likely appear in the PWL assessment for these waterbodies. The data in this table includes only the aquatic plant coverage collected through CSLAP and the invasive species inventory information identified in the Biological Condition section (Chapter 5). However, it is likely that future non-contact recreational assessments in CSLAP lakes will include information and assessments from outside sources.

The data from Table 8.3 suggest that non-contact recreational impacts are most likely in the Downstate and Central regions, although this also reflects the large number of CSLAP lakes sampled in these regions. A relative high percentage of contact recreational use impairments is found in all other regions of the state except the Adirondacks, although the increasing occurrence of exotic plant species in this region (though less so within the Adirondack Park itself) places a large number of lakes in the region in the *Threatened* category.

A more detailed discussion of non-contact recreational impacts to individual CSLAP lakes is included in the regional CSLAP reports and in the individual lake appendices.

Table 8.3- Summary of Existing PWL Listings Based on " Recreation" Impacts to CSLAP Lakes

	Number Lakes	Impaired	Stressed	Threatened	Fully Supporting	Unassessed
Downstate	38	13	12	0	13	20
Central	58	8	21	4	25	9
Adirondacks	69	6	15	3	45	8
Western	24	13	8	1	2	3
CSLAP Statewide	**189**	**40**	**56**	**8**	**85**	**40**

Chapter 8.4- Evaluation of Impacts to Aquatic Life

CSLAP is not well designed for assessing the health of the aquatic life in lakes. Although there are some biological indicators measured or evaluated through CSLAP—chlorophyll *a* and macrophytes—these assessments are directed toward identifying thresholds for "too much" algae or weeds. Although excessive algae and macrophyte growth can strongly influence aquatic life, particularly if either is associated with invasive species, these are not strong measures of aquatic life. The Biological Condition section (Chapter 5) of this report also identifies some other potential indicators of aquatic life, and some of these are discussed below, but the primary means for evaluating impacts to aquatic life is the direct measure of pH and the indirect (inferred) measure of dissolved oxygen.

Assessment of pH Data

Discussion: pH strongly influences aquatic life. Much of the attention in New York state has been directed to low pH—acid rain may be the most extensive stressor in New York state lakes, affecting hundreds of small, poorly buffered, high elevation Adirondack lakes. Acidic lakes are not well represented in the CSLAP dataset, since the lake habitats most susceptible to lake acidification—poorly buffered watersheds at high elevation—do not accommodate development, since these thin soils cannot support septic leach fields and are often associated with steep slopes. The specific stressor in many of these lakes—elevated aluminum and mercury readings "magnified" in clear, acidic waters—can occur in developed areas, but few CSLAP lakes suffer from consistently depressed pH. High pH can also create problems, since some organisms are susceptible to elevated ammonia and scaling associated with highly alkaline waters. Although the state water quality standard for pH is 8.5 (see below), there is some uncertainty about whether ecological impacts occur at pH levels above this threshold.

Evaluation Criteria: New York state lakes do not meet the state water quality standards when pH is below 6.5 or above 8.5. The interpretation of these standards, which were largely developed to protect receiving waters, usually rivers and streams, from industrial and municipal discharges, is subject to interpretation. As discussed above, the assessment of most water quality standards complies with the "10-25" rule; *impaired* conditions are associated with exceeding the standard 25% of the time, and *stressed* conditions are defined as exceeding the standard 10% of the time. However, given the uncertainty associated with laboratory pH measurements and ecological impacts from high pH, the evaluation criteria may more appropriately define lakes as *impaired* by low pH if more than 50% of the pH readings fall below 6.5, and *stressed* by low or high pH if 25% of the pH readings fall below 6.5 or exceed 8.5, respectively. *Threatened* conditions are associated with pH failing to meet these standards at a frequency of 10-25% of the sampling sessions.

Availability: Extensive data; collected during every CSLAP sampling session.

Assessment of Dissolved Oxygen "Information"

Discussion: Dissolved oxygen is one of the bedrock water quality standards, although like pH, it is subject to interpretation. Low dissolved oxygen will adversely affect most aquatic organisms, with some fish, like salmonids (trout and salmon) most susceptible to depressed oxygen, particularly in combination with high temperatures. Although a few dissolved oxygen meters and dissolved oxygen test kits were provided for loan to some CSLAP lake associations in the early years of CSLAP, dissolved oxygen data are not available, at least through CSLAP, for the majority of CSLAP lakes (although the 25 Year CSLAP report will likely update this section to include all available oxygen profile data).

However, absent dissolved oxygen data, the absence of oxygen can be inferred from "observations" or a number of other CSLAP tests. *Anoxia*, or the absence of oxygen, often triggers the conversion of sulfate (SO_4) to hydrogen sulfide (H_2S), which impacts a rotten egg odor to the water. This can often be detected in hypolimnetic samples collected in mid to late summer, but this has not been collected in a systematic way in CSLAP lakes. The same *redox* (oxidizing-reducing) reactions that trigger the production of hydrogen sulfide can also result in phosphorus release from bottom sediments and the conversion of NO_x to ammonia. Elevated readings of hypolimnetic phosphorus and ammonia may be an indication of *hypoxic* (low oxygen) to anoxic conditions.

Evaluation Criteria: The New York state water quality standard for dissolved oxygen ranges from 7 parts per million (ppm) for trout spawning lakes to 6 ppm daily average or never to fall below 5 ppm for trout survival to never to fall below 4 ppm for non-trout waters. This has not been interpreted as a standard to be achieved at all times throughout the water column, since fish may not be naturally found in the deepest waters of some lakes. However, the interpretation of this standard continues to evolve, and New York state may ultimately invoke more precise standards and interpretation of these standards to protect aquatic life (and the 25 Year CSLAP report may provide both available dissolved oxygen data and updated assessments of aquatic life impacts). In the absence of these data in most CSLAP lakes, and in the absence of evidence of impaired aquatic life (which is not "measured" in most monitoring programs), lakes are classified here as *stressed* if there is evidence of hypolimnetic anoxia, defined here as hypolimnetic TP levels are more than 10x greater than those measured at the lake surface or hypolimnetic ammonia levels exceed surface readings by a factor of 25. *Threatened* conditions are equated to hypolimnetic hypoxia, with TP levels 5x higher than those at the lake surface and ammonia readings exceeding surface readings by a factor of 10.

Availability: Hypolimnetic phosphorus data collected periodically through CSLAP in thermally stratified lakes, and hypolimnetic ammonia collected in thermally stratified lakes in 2002 and 2009. Deepwater odors are periodically reported by CSLAP volunteers.

Assessment of Benthic Macroinvertebrates, Floristic Quality Indices (FQIs), and Zebra Mussels

Discussion: The 2008 and 2009 NYSDEC Biomonitoring study involved sampling in 8-10 randomly chosen (but equally distributed) benthic macroinvertebrate samples collected in 10-12 lakes each year, covering a variety of lake depths, geographic locations, and baseline nutrient conditions. This study is described in the Biological Condition section (Chapter 5). These data were collected primarily to establish the connection between lake eutrophication and changes in benthic communities. This process involves identifying a representative subgroup of benthic organisms in each sample and determining which organisms are most sensitive to variations in these conditions (nutrients, depth, latitude, etc.) and each other. Although the metrics established in this study to characterize biological sensitivity to nutrient inputs, other (multiple) metrics may also be identified to successfully characterize the overall biological community structure and health.

The Floristic Quality Indices (FQIs) discussed in Chapter 5 are a modified surrogate for the FQIs that New York state and several New England states are in the process of developing. One of the goals of establishing FQIs is to evaluate biological condition in lakes as they relate to the health of the floristic (aquatic plant) communities in lakes. Although FQI values have been evaluated as part of this report, continuing development of FQIs in New York state and the application of those FQIs to assessments of lake health will be needed before they can be used to provide a PWL recommendation for aquatic life support in these lakes.

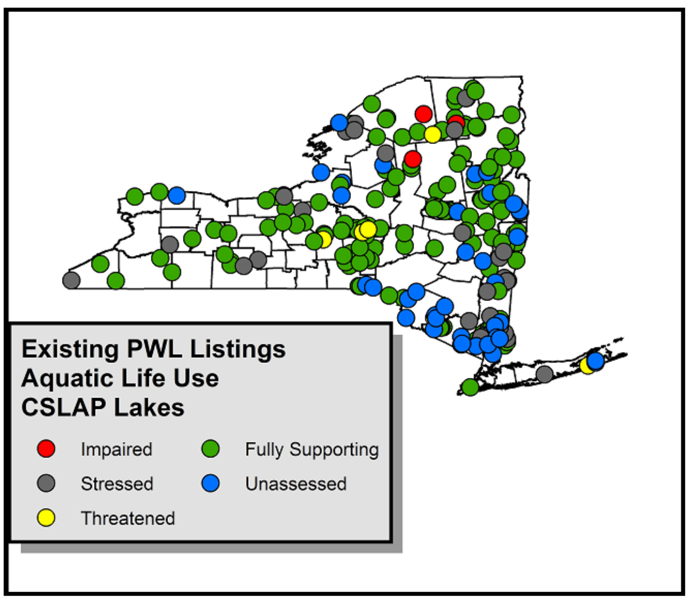


Figure 8.4- PWL Aquatic Life Assessments in CSLAP Lakes

Evaluation Criteria: The NYSDEC is in the process of evaluating the Biomonitoring Study data to establish multimetric indices to characterize biological health of a lake as defined by the benthic macroinvertebrate community. New York state, via the New York Nature Conservancy, will eventually establish FQIs that will be used to identify standard indicators of the biological health of a lake as defined by the aquatic plant community structure. At present, neither of these lake evaluation criteria are far enough along to summarize in this report.

Availability: not yet, but it is anticipated that at least preliminary assessments of biological health in CSLAP lakes will be discussed in the 2010 CSLAP annual report. .

Summary of CSLAP Aquatic Life Assessment Data

Table 8.4 shows the existing statewide PWL summary of aquatic life assessments, and Figure 8.4 shows the statewide distribution of CSLAP lakes in relation to their PWL assessments for aquatic life. Information in the Biological Condition section (Chapter 5) may also inform this discussion, and many lakes have information about impacts on lake fisheries due to other biological factors, such as plankton or spawning stress. As with most other sections of this report, it is likely that future aquatic life assessments in CSLAP lakes will include information and assessments from outside sources.

The data from Table 8.4 suggest that aquatic life impacts are most likely in the Downstate and Central regions. Most of the aquatic life impacts in this part of the state come from elevated hypolimnetic phosphorus and reduced oxygen levels, based on the CSLAP data, although these data largely did not inform these PWL listings.

A more detailed discussion of aquatic life impacts to individual CSLAP lakes is included in the regional CSLAP reports and individual lake appendices.

Table 8.4- Summary of Existing PWL Listings Based on Aquatic Life Impacts to CSLAP Lakes

	Number Lakes	Impaired	Stressed	Threatened	Fully Supporting	Unassessed
Downstate	38	0	15	2	21	20
Central	58	0	8	3	47	9
Adirondacks	69	3	7	1	58	8
Western	26	0	5	0	21	1
CSLAP Statewide	**191**	**3**	**35**	**6**	**147**	**38**

Chapter 8.5- Evaluation of Impacts to Aesthetics

Aesthetics are influenced by a large number of factors, several of which are measured through CSLAP. These include invasive weeds, whether growing up to the lake surface or forming surface canopies, and excessive algae growth, particularly when growing in bubbling mats on the lake surface. Aesthetics problems can be exacerbated when thick surface weeds serving as a platform for dense surface algal scums, and these conditions can lead to stagnant water, poor recreational conditions, and water quality problems. However, the CSLAP dataset cannot easily distinguish between these conditions and “excessive algae” or “excessive weeds.” The CSLAP Field Observations form does provide an opportunity for sampling volunteers to evaluate aesthetic problems, and while these assessments clearly undercount incidences of unfavorable lake aesthetics, these can serve as the backdrop for evaluating aesthetics impacts.

Assessment of "Aesthetics" Data

Discussion: The CSLAP Field Observations form queries sampling volunteers about the recreational suitability of the lake during each sampling session (Question C), and the following questions asks the sampler to identify the factors that influence recreational assessments. One of the options is response 4, which allows the sampler to report that "the lake looks bad." Although other responses give the sampler the opportunity to identify problems with excessive algae or excessive weeds, the "…looks bad" option has a direct linkage to lake aesthetics and is the only one considered here.

Evaluation Criteria: It is assumed for the purposes of these evaluations that aesthetics cannot be *precluded* or *impaired*, at least independent of the other indicators previously discussed. Using the same approach described above, lakes are considered *stressed* for aesthetics if "slightly impaired" recreational use conditions are associated with reports that "the lake looks bad" during at least 25% of the CSLAP sampling sessions. *Threatened* conditions occur when "slightly" impaired recreational conditions are due to reports that "the lake looks bad" during at least 10% of the sampling sessions.

Availability: CSLAP volunteers have been asked to assess recreational conditions during each CSLAP sampling session since 1992, and "the lake looks bad" has consistently been an option for evaluating recreational use impacts.

Summary of CSLAP Aesthetics Assessment Data

Table 8.5 shows the existing statewide PWL summary of aesthetics assessments, and Figure 8.5 shows the statewide distribution of CSLAP lakes in relation to their PWL assessments for aesthetics. As discussed above, this does not necessarily include recreational impacts "presumed" to come from excessive algae or weeds, so actual impacts to lake aesthetics may be more significant in these lakes.

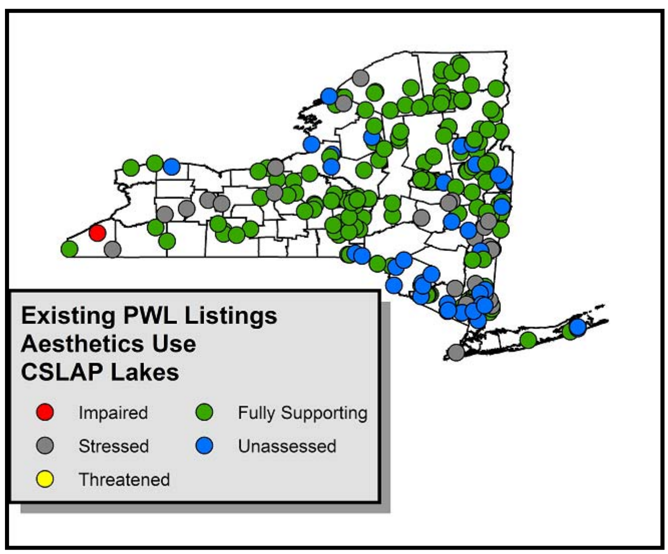


Figure 8.5- PWL Aesthetics Assessment in CSLAP Lakes

Figure 8.5 suggests that aesthetics impacts, as defined above, are not common in the state, although poor aesthetic conditions are no doubt more common in the state. For example, the sampling volunteers reporting that the lake "looks bad" are found at lakes scattered throughout the state, although nearly all of these lakes consistently exhibit problems with nuisance algae, and usually also exhibit problems with excessive weeds. It is likely that the statewide distribution of lakes with aesthetic impairments would look similar to the distribution of lakes with both contact recreational use impacts (Figure 8.2) and non-contact use impacts (Figure 8.3).

The data from Table 8.5 indicate a higher percentage of *stressed* lakes for aesthetics in the Downstate, Central and Western (Finger Lakes) regions, and a lower percentage of impacts in the Adirondacks regions. Although impacts to lakes aesthetics are no doubt underestimated in the existing PWL, the statewide distribution of impacted lakes is probably accurate.

A more detailed discussion of aesthetics impacts to individual CSLAP lakes is included in the regional CSLAP reports and individual lake summaries.

Table 8.5- Summary of Existing PWL Listings Based on Aesthetics Impacts to CSLAP Lakes

	Number Lakes	Impaired	Stressed	Threatened	Fully Supporting	Unassessed
Downstate	38	0	12	0	26	20
Central	58	0	8	0	50	9
Adirondacks	69	0	2	0	67	8
Western	26	1	7	0	18	1
CSLAP Statewide	**191**	**1**	**29**	**0**	**161**	**38**

Chapter 8.6- Summary of Fish Consumption Advisories

The lakes in New York state are used by many lake residents, anglers, and others for fish consumption. CSLAP does not collect any information to evaluate fish consumption. However, each year the NYS Department of Health issues fish consumption advisories for the waters (and fish) of the state. Several CSLAP lakes have been the subject of fish consumption advisories, usually due to the bioaccumulation of atmospheric pollutants such as mercury. Table 8.6a shows the regional summary of fish consumption advisories in CSLAP lakes. The distribution of CSLAP lakes with fish advisories suggests that these advisories are weighed heavily toward the Adirondack region. However, as seen in Table 8.6b, the statewide summary of fish consumption advisories for all New York state lakes shows that, while the largest number of advisories has been posted for Adirondack region lakes, the highest percentage of lakes with advisories is found in the Downstate (Long Island/NYC) region.

Table 8.6a- Summary of Fish Consumption Advisories in CSLAP Lakes

	Number Lakes	Precluded	Impaired	Stressed	Fully Supporting
Downstate	58	0	0	0	58
Central	67	1	1	0	65
Adirondacks	77	0	6	1	70
Western	27	0	2	4	21
CSLAP Statewide	**229**	**1**	**9**	**5**	**214**

Precluded = state advisory of "do not eat" one or more fish species in lake
Impaired = state advisory to "limit" consumption of one or more fish species in lake
Stressed = state advisories for Lake Ontario embayments for which migration from the main lake is likely
Fully Supporting = no state fish consumption advisories

Table 8.6b- Summary of Fish Consumption Advisories in New York State Lakes

	Number Lakes	Precluded	Impaired
Downstate	40	4	36
Central	28	4	24
Adirondacks	54	9	45
Western	13	2	11
Statewide	**135**	**19**	**116**

Precluded - state advisory = "do not eat" one or more fish species in lake
Impaired – state advisory = "limit" consumption of one or more fish species in lake

A more detailed discussion of fish consumption advisories to individual CSLAP lakes is included in the individual lake appendices.

Chapter 8.7- Adirondack Region Assessments

Background

PWL assessments can be provided for the majority of Adirondack region lakes for many of the designated lake uses in the region. A number of water quality indicators have been collected on many Class AA and Class A lakes in the region, including chlorophyll *a*, algal toxins, and deepwater ammonia, iron, manganese and arsenic. These data will eventually be used to improve the potable water and contact recreational assessments on these lakes, but for the purposes of this report, the trophic and hypolimnetic phosphorus and ammonia readings form the basis of preliminary CSLAP assessments. Some of these data are also used to evaluate aquatic life in the Adirondack region.

Table 8.7 summarizes the existing PWL listings for potable water, public bathing (swimming), "recreation" (swimming and non-contact recreation), aquatic life, aesthetics and fish consumption advisories for each of the CSLAP lakes sampled in the Adirondack region. The findings from these assessments for each category of lake use are discussed below:

Table 8.7- Summary of Existing PWL Listings for Adirondack Region CSLAP Lakes

Lake Name	Potable Water PWL Listing	Public Bathing PWL Listing	Recreation PWL Listing	Aquatic Life PWL Listing	Aesthetics PWL Listing	Fish Consumption PWL Listing
Adirondack Lake	Not applicable	Fully Supporting	Stressed	Fully Supporting	Fully Supporting	Fully Supporting?
Augur Lake	Fully supporting	Fully Supporting	Stressed	Fully Supporting	Fully Supporting	Fully Supporting?
Bartlett Pond	Fully supporting	Stressed	Impaired	Fully Supporting	Fully Supporting	Fully Supporting?
Black Lake	Not applicable	Impaired	Impaired	Fully Supporting	Stressed	Fully Supporting?
Brant Lake	Threatened	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Brantingham Lake	Threatened	Threatened	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Butterfield Lake	Not applicable	Stressed	Stressed	Fully Supporting	Fully Supporting	Fully Supporting?
Canada Lake	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Impaired
Chase Lake	Unassessed	Unassessed	Unassessed	Unassessed	Unassessed	Fully Supporting?
Eagle Crag Lake	Fully supporting	Fully Supporting	Fully Supporting	Threatened	Fully Supporting	Fully Supporting?
Eagle Lake	Not applicable	Fully Supporting	Stressed	Fully Supporting	Fully Supporting	Fully Supporting?

Lake Name	Potable Water PWL Listing	Public Bathing PWL Listing	Recreation PWL Listing	Aquatic Life PWL Listing	Aesthetics PWL Listing	Fish Consumption PWL Listing
Eagle Pond	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
East Caroga Lake	Not applicable	Fully Supporting	Threatened	Fully Supporting	Fully Supporting	Fully Supporting?
Effley Falls Lake	Not applicable	Fully Supporting	Fully Supporting	Stressed	Fully Supporting	Impaired
Efner Lake	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Friends Lake	Fully supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Fulton Second Lake	Fully supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Garnet Lake	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Glen Lake	Fully supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Goodnow Flow	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Grass Lake	Not applicable	Fully Supporting	Stressed	Stressed	Fully Supporting	Fully Supporting?
Gull Pond	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Hadlock Pond	Fully supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Horseshoe Pond	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Hunt Lake	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Hyde Lake	Not applicable	Stressed	Stressed	Stressed	Fully Supporting	Fully Supporting?
Indian Lake	Not applicable	Fully Supporting	Stressed	Stressed	Fully Supporting	Fully Supporting?
Jenny Lake	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Joe Indian Lake	Not applicable	Fully Supporting	Fully Supporting	Impaired	Fully Supporting	Fully Supporting?
Kayuta Lake	Fully supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Kellum Lake	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Lake Bonaparte	Not applicable	Stressed	Stressed	Fully Supporting	Fully Supporting	Fully Supporting?
Lake Clear	Fully supporting	Fully Supporting	Fully Supporting	Impaired	Fully Supporting	Fully Supporting?
Lake Colby	Fully supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Lake Forest	Not applicable	Unassessed	Unassessed	Unassessed	Unassessed	Fully Supporting?
Lake George	Threatened	Fully Supporting	Impaired	Fully Supporting	Fully Supporting	Fully Supporting?
Lake Kiwassa	Threatened	Fully Supporting	Impaired	Fully Supporting	Fully Supporting	Fully Supporting?
Lake Luzerne	Fully supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Lake of the Isles	Not applicable	Fully Supporting	Threatened	Fully Supporting	Fully Supporting	Fully Supporting?
Lake of the Woods	Not applicable	Unassessed	Unassessed	Unassessed	Unassessed	Fully Supporting?
Lake Placid	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Lake Titus	Threatened	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Lincoln Pond	Not applicable	Stressed	Stressed	Fully Supporting	Fully Supporting	Fully Supporting?
Little Wolf Lake	Not applicable	Fully Supporting	Impaired	Fully Supporting	Fully Supporting	Impaired
Loon Lake	Not applicable	Stressed	Stressed	Fully Supporting	Fully Supporting	Fully Supporting?
Lorton Lake	Unassessed	Unassessed	Unassessed	Unassessed	Unassessed	Fully Supporting?
Lower Chateaugay Lake	Not applicable	Unassessed	Unassessed	Unassessed	Unassessed	Fully Supporting?
Lower St. Regis Lake	Not applicable	Stressed	Stressed	Fully Supporting	Fully Supporting	Fully Supporting?
Mayfield Lake	Not applicable	Fully Supporting	Stressed	Fully Supporting	Fully Supporting	Fully Supporting?
Millsite Lake	Not applicable	Unassessed	Unassessed	Unassessed	Unassessed	Fully Supporting?
Mirror Lake	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Moon Lake	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Moreau Lake	Not applicable	Fully Supporting	Impaired	Stressed	Stressed	Fully Supporting?
Mountain Lake	Fully supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Mountain View Lake	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
North Sandy Pond	Not applicable	Fully Supporting	Stressed	Stressed	Fully Supporting	Fully Supporting?
Otter Lake	Not applicable	Unassessed	Unassessed	Unassessed	Unassessed	Stressed
Paradox Lake	Fully supporting	Fully Supporting	Stressed	Fully Supporting	Fully Supporting	Fully Supporting?
Peck Lake	Fully supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Piseco Lake	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Pleasant Lake	Fully supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Rondaxe Lake	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Sacandaga Lake	Fully supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Schroon Lake	Threatened	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Impaired
Silver Lake-Clinton	Fully supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Impaired
Silver Lake-St. Lawrence	Fully supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?

Lake Name	Potable Water PWL Listing	Public Bathing PWL Listing	Recreation PWL Listing	Aquatic Life PWL Listing	Aesthetics PWL Listing	Fish Consumption PWL Listing
Sixberry Lake	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Spitfire Lake	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Star Lake	Fully supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Stewarts Landing	Fully supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Twitchell Lake	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Upper Chateaugay Lake	Fully supporting	Fully Supporting	Fully Supporting	Impaired	Fully Supporting	Fully Supporting?
Upper Saranac Lake	Not applicable	Stressed	Stressed	Fully Supporting	Fully Supporting	Impaired
Upper St. Regis Lake	Fully supporting	Fully Supporting	Threatened	Stressed	Fully Supporting	Fully Supporting?
West Caroga Lake	Fully supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?
Windover Lake	Not applicable	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting	Fully Supporting?

Chapter 8.7.1- Evaluation of Impacts to Potable Water in Adirondack Region Lakes

48 of the 77 CSLAP lakes in the Adirondack region are classified for potable water use (Class AA or Class A) and can be assigned a preliminary assessment for potable water impacts based on the limited CSLAP dataset. Most (more than 75%) of these lakes appear to be supportive of potable water use, as evaluated by the chlorophyll *a* and deepwater ammonia readings collected through CSLAP. Those lakes identified as *potentially stressed* are found along the perimetry of the Adirondack Park, and most of these possess chlorophyll *a* levels that do not indicate likely problems with nuisance algae. It is not believed that these lakes have exhibited impacts from the production of disinfection-byproducts, algal toxins, or excessive turbidity, although a more detailed evaluation of potable water supplies may be available in the 2010 CSLAP report. It should again be emphasized that CSLAP does not focus on evaluation of drinking water assessments, and more extensive data (such as those collected in many of these lakes by municipal and private water purveyors and evaluated in local Consumer Confidence Reports, or CCRs) are needed for accurate evaluation of potable water uses in these lakes.

A discussion of the specific "citations" for impacts to potable water is provided below:

Preliminary Assessment- Potentially Impacted: Augur Lake

Discussion: Augur Lake exhibits chlorophyll *a* readings that may regularly be high enough to render the lake susceptible to taste and odor compounds or elevated DBP (disinfection by product) compounds that could affect the potability of the water, whether considering the long-term or 2009 CSLAP dataset. It is not known if Augur Lake waters are used for drinking purposes, if these waters are chlorinated, and if DBPs are produced in the chlorination process. This information, if available, will help to determine if this is the appropriate PWL listing for the lake. At present, potable water use in Augur Lake is not identified on the Lake Champlain PWL.

Preliminary Assessment- Potentially Stressed: Friends Lake, Garnet Lake, Hadlock Pond, Loon Lake, Otter Lake, Sacandaga Lake, Upper Saranac Lake, Upper St. Regis Lake, Windover Lake

Discussion: Each of these lakes has been identified here as *potentially stressed* due to average chlorophyll *a* readings that occasionally indicate elevated algae levels. Garnet Lake, Hadlock Pond, Loon Lake, Upper St. Regis Lake, and Windover Lake were not sampled in recent years, and it is not known if the average chlorophyll *a* readings triggering this proposed listing have changed, warranting a revisiting of this assessment. Chlorophyll *a* readings in Friends Lake, Otter Lake, and Sacandaga Lake in 2009 did not indicate elevated algae levels and may be more representative of present conditions in these lakes. However, chlorophyll *a* readings in Upper Saranac Lake were similar in 2009 as in previous CSLAP sampling seasons, and suggest that this listing may be appropriate.

Chapter 8.7.2- Evaluation of Impacts to Contact Recreation in Adirondack Region Lakes

Each of the 77 CSLAP lakes in the Adirondack region can be evaluated for their support of contact recreation—swimming and bathing. Although swimming and bathing are most accurately and assessed with bacteria data, the CSLAP dataset provides useful information for evaluating the aesthetic quality and safety of contact recreation in these lakes. 58 of these 77 lakes (75%) of the Adirondack region lakes have been identified as fully supporting contact recreation, based on the CSLAP dataset and the existing state phosphorus guidance value (= 0.020 mg/l).

A discussion of the specific "citations" for impacts to contact recreation is provided below:

Preliminary Assessment- Potentially Impacted: Augur Lake, Black Lake, Lake Titus, Lower St. Regis Lake, Mayfield Lake, Moon Lake, North Sandy Pond

Discussion: All of the Adirondack region lakes identified as *potentially impacted* for contact recreation based on CSLAP data are found along the perimetry of the region. These lakes have all been identified as *potentially impacted* due to low water clarity readings and elevated total phosphorus and chlorophyll *a* readings. Unfavorable recreational assessments reported in Augur Lake, Lower St. Regis Lake, Mayfield Lake and Moon Lake were linked to poor water clarity or excessive algae, and poor recreational assessments in Black Lake were linked to both poor clarity and excessive weeds. Poor assessments were not reported in Lake Titus, and recreational assessments are not available from North Sandy Pond.

Augur Lake and Black Lake were the only lakes listed above that were sampled through CSLAP in 2009. Although both lakes exhibited at least some indication of more favorable water quality conditions in 2009—chlorophyll *a* and Secchi disk transparency readings were more favorable in both lakes, and total phosphorus readings were lower in Black Lake—an assessment of *potentially impacted* conditions was still appropriate in both lakes in 2009. It is not known if trophic conditions were similar in the other Adirondack region lakes not sampled through CSLAP in 2009.

Black Lake is presently cited on the federal 303d list as *impaired* for contact recreation due to excessive algae and nutrients. None of the other lakes listed above as *potentially impacted* are presently cited on the federal 303d list as *impaired*.

Preliminary Assessment- Potentially Stressed: Kayuta Lake, Upper Saranac Lake, Windover Lake

Discussion: The three Adirondack region lakes cited here as *potentially stressed* indicate a potential problem with two of the three trophic indicators. Kayuta Lake has relatively low phosphorus levels, while Upper Saranac Lake and Windover Lake exhibit chlorophyll *a* readings that indicate minimal problems with excessive (planktonic) algae. Each of these lakes exhibited only limited recreational use impairments, according to the CSLAP sampling volunteers. Upper Saranac Lake was the only one of these three lakes sampled in 2009; phosphorus readings were lower than normal in 2009 but water clarity readings were also lower than normal. These data suggest that the *stressed* assessment may be appropriate for Upper Saranac Lake.

Preliminary Assessment- Potentially Threatened: Butterfield Lake, Eagle Pond, Effley Falls Reservoir, Garnet Lake, Horseshoe Pond, Hyde Lake, Joe Indian Lake, Little Wolf Lake, Mountain Lake

Discussion- The nine Adirondack region lakes cited here as *threatened* exhibited "problems" with one of the trophic criteria. Water clarity readings were low in Eagle Pond, Effley Falls Reservoir, Horseshoe Pond, Joe Indian Lake, Little Wolf Lake, and Mountain Lake. Most of these are shallow, slightly to highly colored lakes with short retention times. Little Wolf Lake is the only lake in this group regularly reporting recreational use impacts. Chlorophyll *a* readings were frequently elevated in Butterfield Lake, Garnet Lake, and Hyde Lake. Butterfield and Hyde Lakes are in the Indian River lakes region, and both regularly exhibit slightly impaired conditions in response to excessive algae or poor water clarity (based on recreational perception data provided by the CSLAP sampling volunteers).

Eagle Pond, Effley Falls Reservoir, Horseshoe Pond, Butterfield Lake, and Hyde Lake were sampled in 2009. Each of these lakes identified as *potentially threatened* due to low water clarity (Eagle Pond, Effley Falls Reservoir and Horseshoe Pond) had higher water transparency readings in 2009, but these readings were still below the proposed state criteria. The two lakes cited for high algae levels—Butterfield Lake and Hyde Lake—had lower than normal chlorophyll *a* readings in 2009, and the algae levels in Butterfield Lake in 2009 were low enough to indicate the lack of recreational problems. Additional data may help to determine if the 2009 chlorophyll *a* readings in Butterfield Lake indicate a change in "normal" conditions and an indication that no contact recreation PWL listings are apparent.

Chapter 8.7.3- Evaluation of Impacts to Non-Contact Recreation in Adirondack Region Lakes

75 of the 77 CSLAP lakes in the Adirondack region can be evaluated for their support of non-contact recreation—boating and angling. The CSLAP perception surveys query sampling volunteers about recreational conditions related to a variety of lake stressors, including water clarity, algae, and aquatic plants (perception surveys have not been conducted at two CSLAP

lakes—Adirondack Lake and Joe Indian Lake). 31 of these 75 lakes (41%) of the Adirondack region lakes have been identified as fully supporting contact recreation, based on the CSLAP dataset. This percentage is lower than for the other lake uses due to the "automatic" designation of *threatened* for any lake with one or more exotic plants, even if there is no evidence that this lake has (yet) suffered from recreational use impacts.

A discussion of the specific "citations" for impacts to non-contact recreation is provided below:

Preliminary Assessment-Potentially Impaired: Bartlett Pond, Lincoln Pond, Mayfield Lake, Moon Lake

Discussion: All of the Adirondack region lakes identified as *impaired* for non-contact recreation based on CSLAP data are found along the edge of the region. These lakes have all been identified as *impaired* due to excessive weeds (specifically cited as) triggering "substantially impaired" recreational conditions during more than 25% of the CSLAP sampling sessions. *Myriophyllum spicatum* (Eurasian watermilfoil) has been identified on each of these lakes, and it is presumed that this exotic plant causes the excessive weed growth in these lakes.

Lincoln Pond was the only lake in this group sampled through CSLAP in 2009. Substantially lower weed growth was reported in 2009; it is not known if this was due to effective herbivory by the aquatic moth (*Acentria ephemerella*) previously studied at the lake. It is not known if the plant populations have been managed in these lakes.

Preliminary Assessment- Potentially Stressed: Augur Lake, Butterfield Lake, Eagle Lake, Hyde Lake, Indian Lake, Lake Luzerne, Mountain Lake, Otter Lake

Discussion: The eight Adirondack region lakes cited here as *stressed* typically report "slightly impaired" recreational conditions as a result of excessive weeds during at least 25% of the CSLAP sampling sessions. All but Mountain Lake and Otter Lake are dominated by Eurasian watermilfoil. Mountain Lake is shallow and may suffer from extensive native plant growth—detailed aquatic plant surveys are not available for the lake. The plant community in Otter Lake has historically been dominated by *Utricularia* sp. (bladderwort), an acidophilic native plant genera that occasionally and cyclically exhibits explosive growth.

Augur Lake, Butterfield Lake, Eagle Lake, Hyde Lake, and Otter Lake were sampled in 2009. Plant coverage was greater than normal in Butterfield Lake and Eagle Lake, and close to normal in the other lakes. Many of the lake associations affiliated with these lakes have actively managed the plants in these lakes—grass carp were used in Augur Lake and proposed in Otter Lake, and hand harvesting and benthic barriers have been used in Eagle Lake (and aquatic herbicides have been proposed for use on the lake).

Preliminary Assessment-Potentially Threatened: Black Lake, Brant Lake, Eagle Pond, East Caroga Lake, Efner Lake, Fulton Second Lake, Glen Lake, Goodnow Flow, Hadlock Pond, Horseshoe Pond, Hunt Lake, Jenny Lake, Kayuta Lake, Lake Bonaparte, Lake Colby, Lake George, Lake Kiwassa, Lake of the Isles, Lake of the Woods, Lake Placid, Lake Titus, Lorton Lake, Lower Chateaugay Lake, Millsite Lake, Moreau Lake, North Sandy Pond, Paradox Lake, Schroon Lake, Upper Chateaugay Lake, Upper Saranac Lake, West Caroga Lake, Windover Lake

Discussion- Many Adirondack region lakes are cited here as *threatened.* These lakes can be divided into two overlapping categories—those with "slightly impaired" recreation due to excessive weeds at a frequency of 10-25%, and those with a documented presence of one or more exotic plant species.

The former group—the lakes with slightly impaired recreation due to excessive weeds—include Black Lake, Eagle Pond, Glen Lake, Lake Bonaparte, Lorton Lake, Upper Chateaugay Lake, and Windover Lake. Glen Lake, Lake Bonaparte, and Upper Chateaugay Lake are large lakes with extensive populations of Eurasian watermilfoil, prompting the need for local management. Black Lake, Eagle Pond, Lorton Lake, and Windover Lake are shallow lakes, and only Black Lake suffers from Eurasian watermilfoil. Black Lake, Eagle Pond, Glen Lake, Lake Bonaparte, and Lorton Lake were sampled in 2009; all of these lakes except Lorton Lake exhibited less weed growth and/or fewer recreational use impacts associated with nuisance weeds. Weed growth and recreational use problems from excessive weeds were more significant in Lorton Lake in 2009; it is not known if this was associated with variable watermilfoil (*Myriophyllum heterophyllum*) or native plant species.

The second group—lakes identified as *threatened* due to the presence of exotic plants—include Black Lake, Brant Lake, East Caroga Lake, Efner Lake, Fulton Second Lake, Glen Lake Goodnow Flow, Hadlock Pond, Horseshoe Pond, Hunt Lake, Jenny Lake, Kayuta Lake, Lake Bonaparte, Lake Colby, Lake George, Lake Kiwassa, Lake of the Isles, Lake of the Woods, Lake Placid, Lake Titus, Lorton Lake, Lower Chateaugay Lake, Mayfield Lake, Millsite Lake, Moreau Lake, North Sandy Pond, Paradox Lake, Schroon Lake, Stewarts Landing, Upper Chateaugay Lake, Upper Saranac Lake, and West Caroga Lake. The offending exotic plant in nearly all of these lakes is Eurasian watermilfoil. Fanwort (*Cabomba caroliniana*) is found in Efner Lake, Hunt Lake, and Jenny Lake; variable watermilfoil is found in Lake Placid, Lorton Lake, and North Sandy Pond, brittle naiad (*Najas minor*) is found in Goodnow Flow, Lorton Lake, Mayfield Lake, and Stewarts Landing, and curly leaf pondweed (*Potamogeton crispus*) is found in Lake George. Some of these plants, such as brittle naiad and variable watermilfoil, have not been found to grow explosively in some New York state lakes, and explosive growth of other plants, such as curly leafed pondweed, is limited to spring or early summer. But the presence of exotic plants in each of these lakes may trigger recreational use impacts in at least part of the lake during part of the summer recreational season.

Chapter 8.7.4- Evaluation of Impacts to Aquatic Life in Adirondack Region Lakes

Each of the 77 CSLAP lakes in the Adirondack region can be evaluated for their support of aquatic life. As discussed earlier in this report, the CSLAP dataset provides only limited utility in evaluating aquatic life in CSLAP lakes, although the development of and collection of additional data for applying macroinvertebrate metrics and the continued development of a floristic quality index will improve these assessments. The existing pH and inferred dissolved oxygen dataset can be used to assess aquatic life in the CSLAP lakes. 54 of these 77 lakes (70%) of the Adirondack region lakes have been identified as fully supporting aquatic life, based on the CSLAP dataset.

A discussion of the specific "citations" for impacts to aquatic life is provided below:

Preliminary Assessment- Potentially Impaired: Twitchell Lake

Discussion: Twitchell Lake is the only CSLAP lake exhibiting consistently acidic conditions. The low pH readings in the lake lead to significant ecological impacts and impaired conditions for fish. Twitchell Lake is presently among the New York State lakes cited on the federal 303d list as impaired due to lake acidification. It is not known if these conditions have persisted in Twitchell Lake, since this lake has not been sampled through CSLAP for many years.

Preliminary Assessment- Potentially Stressed: Effley Falls Reservoir?, Joe Indian Lake, Lake Bonaparte?, Lake of the Isles, Paradox Lake?, Stewarts Landing

Discussion: Four of the six Adirondack region lakes cited here as *stressed* exhibited either low pH (Effley Falls Reservoir, Joe Indian Lake and Stewarts Landing) or high pH (Lake of the Isles) outside the state water quality standards at a frequency of greater than 25%. Lake Bonaparte and Paradox Lake demonstrate evidence of low oxygen, based on hypolimnetic phosphorus or hypolimnetic ammonia readings that are significantly higher than those measured at the lake surface. It is not known if any of these lakes has exhibited actual aquatic life impacts, or simply pH or dissolved oxygen conditions that might lead to stressed conditions for aquatic life (particularly salmonids or other fish species).

Effley Falls Reservoir, Lake Bonaparte and Paradox Lake were sampled through CSLAP in 2009. The pH readings in Effley Falls Reservoir in 2009 were more typical of alkaline lakes, and suggest that aquatic life was not *stressed.* Hypolimnetic phosphorus and ammonia readings in Lake Bonaparte and Paradox Lake in 2009 were similar to those at the lake surface, also suggesting that aquatic life is not *stressed.* Additional data from these three lakes will help provide better information about aquatic life impacts.

Preliminary Assessment- Potentially Threatened: Black Lake, Butterfield Lake, Eagle Crag Lake, Eagle Pond, Glen Lake, Grass Lake?, Lake George, Moon Lake, North Sandy Pond, Peck Lake, Piseco Lake, Pleasant Lake?, Rondaxe Lake, Spitfire Lake, Upper St. Regis Lake, West Caroga Lake, Windover Lake.

Discussion: Aquatic life in a large number of Adirondack region lakes may be threatened by pH or dissolved oxygen. Depressed pH was occasionally (>10% of the time) measured in East Caroga Lake, Peck Lake, Piseco Lake, Pleasant Lake, Upper St. Regis Lake, West Caroga Lake, and Windover Lake, while elevated pH was occasionally measured in Black Lake, Grass Lake, Moon Lake, and North Sandy Pond. The low pH lakes are all found within the

Adirondack Park, and the high pH lakes were all found outside the Park in the Indian River lakes region. In addition, Butterfield Lake, Eagle Crag Lake, East Caroga Lake, Grass Lake and Spitfire Lake all exhibited signs of hypoxia, based primarily on nutrient-enriched hypolimnetic waters. It is not known if any of these "habitats" lead to actual aquatic life impacts.

Of the lakes that may be *threatened* by pH or oxygen, Black Lake, Butterfield Lake, Eagle Pond, Grass Lake, Peck Lake, and Pleasant Lake were sampled in 2009. pH readings in Grass Lake were lower than normal in 2009, and were higher than normal in Pleasant Lake, suggesting aquatic life impacts in these lakes may not occur. Hypolimnetic nutrient enrichment was again significant in Butterfield Lake and Grass Lake in 2009, suggesting that aquatic life *threats* may be real.

Aquatic life may also be threatened in Glen Lake and Lake George due to the presence of zebra mussels.

Chapter 8.7.5- Evaluation of Impacts to Aesthetics in Adirondack Region Lakes

Sampling volunteers from 75 of the 77 CSLAP lakes in the Adirondack region completed the Field Observations forms and were given the opportunity to evaluate impacts to aesthetics. As discussed earlier in this report, the CSLAP dataset provides multiple opportunities for evaluating aesthetics in CSLAP lakes, but the reports of "excessive weeds" or "excessive algae" cannot be assumed to represent impacts to lake aesthetics. Reports of these impacts are therefore limited to those instances in which sampling volunteers recorded that the lake "looks bad."

A discussion of the specific "citations" for impacts to aesthetics is provided below:

Preliminary Assessment- Potentially Stressed: Mayfield Lake, Otter Lake

Discussion: Mayfield Lake and Otter Lake were the only CSLAP lakes in the Adirondack region reporting that "the lake looks bad" during more than 25% of the CSLAP sampling sessions. Both lakes are extensively impacted by both algae and weeds during 45-95% of all CSLAP sampling sessions. The statewide report indicates that problems with both algae and weeds are a prerequisite for aesthetics problems in most CSLAP lakes.

Preliminary Assessment- Potentially Threatened: Hyde Lake, Moon Lake

Discussion: The sampling volunteers at Hyde Lake and Moon Lake reported problems with lake aesthetics, as defined by indications that the lake "looks bad," during 10-25% of the CSLAP sampling sessions. Both lakes also exhibit algae and weed problems, with Moon Lake reporting "slightly impaired" conditions associated with both algae and weeds during more than 50% of the CSLAP sampling sessions.

Chapter 8.7.6- Summary of Fish Consumption Advisories in Adirondack Region Lakes

Fish surveys—either creel surveys, fish netting, or fish flesh analysis—are not conducted through CSLAP. However, to provide at least limited assessments of each of the major designated uses in New York states, the New York State Department of Health fish consumption advisory inventory can be reported here for CSLAP lakes.

In the Adirondack region, fish consumption advisories have been established for six CSLAP lakes:

Canada Lake-	One meal per month of >15" smallmouth bass and chain pickerel due to mercury contamination
Effley Falls Reservoir-	One meal per month of smallmouth bass and chain pickerel due to mercury contamination
Lincoln Pond-	One meal per month of >15" largemouth bass due to mercury contamination
Sacandaga Lake-	One meal per month of smallmouth bass due to mercury contamination
Schroon Lake-	One meal per month of > 27" lake trout, >13" yellow perch, and smallmouth bass due to mercury and PCB contamination
Upper Chateaugay Lake-	One meal per month of >15" smallmouth bass due to mercury contamination

Each of these advisories constitutes an *impaired* assessment—*precluded* conditions are limited to prohibition of the consumption of a specific fish species.

Chapter 9- CSLAP 2010 and Beyond- Where We Are Going

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One of the (many) positive attributes of CSLAP is the consistent, unwavering collection of water quality data, at the same spot, at the same time, looking at the same indicators, year after year after year. It is this dependable, long-term database that provides insights about the condition of a lake, through the annual and weather-related variability—in essence, seeing both the trees and the forest. This stability provides an opportunity for assessing trends and responses to management actions that cannot be ascertained from single snapshots in time or even periodic peeks behind the curtains.

But while this monitoring program is first and foremost developed to gather the data and information needed to assess lake conditions over an expanded timeframe, there are other benefits that come from the samples collected by and long-term presence of volunteers on the water. Some of these—identification of individual lake problems and assessment of regional conditions, the development of nutrient criteria to protect recreational and aesthetic uses of lakes, a network of volunteers on the lookout for invasive species, to name a few—are already considered primary objectives of the program and are discussed within this report. This balance of steady data collection and application of specific assessment tools to evaluate individual waterbodies has served the CSLAP lake associations over the last twenty-five years, and will no doubt continue to direct the monitoring activities into at least the near future.

However, as CSLAP approaches the 25th year of sampling, the monitoring program needs to adapt to both the changing needs of the participating lake associations and the changing framework in which these samples are collected and analyzed. This has already been done several times over the last twenty five years, necessitated by emerging threats (invasive species, toxic algae), reduced sampling budgets, more rapid exchange of information through the internet, and the loss of the state Health Department laboratory for analyzing samples. These changing times provide both challenges and opportunities for CSLAP 2010 and beyond.

Some of the key changes to the program in the near and more distant future are as follows:

- **Moving from a one-size-fits-all program to a program tailored to individual lakes**

CSLAP has been slowing moving in this direction for the last twenty years. Starting in the early 1990s, phosphorus was analyzed in the hypolimnetic samples of thermally stratified lakes, and nitrogen (ammonia and NO_x) were occasionally analyzed in these samples. However, starting in 2009, CSLAP lakes were organized into five distinct groups for water sampling: shallow lakes, deep unproductive non-drinking water (Class B and C) and drinking water (Class AA and A) lakes, and deep productive non-drinking water and drinking water lakes. Water samples from each of these groups were analyzed for a different suite of water quality indicators, although all groups included the standard suite of CSLAP water quality parameters analyzed since at least 2002. The latter three groups, and the more productive shallow lakes, were also included in the NYSDOH harmful algal bloom (HAB)/algal toxins study conducted in cooperation with CSLAP (see below).

These "functional" groups within CSLAP will likely be continued into the future, and additional groupings may also be established to provide a program that addresses specific needs on each CSLAP lake. Although these groups will dictate a common platform of sampling indicators measured at each lake within the group, individual analytes may vary slightly from lake to lake depending on a more "real time" evaluation of water quality conditions during each sampling season.

- **"Near-real time" response to water quality problems**

Even within the confines of these functional monitoring groups, the present CSLAP program involves a pre-determined number of sampling sessions and suite of sampling parameters at each lake, based on expected water quality conditions and stressors and an even frequency and distribution (every other week) of sampling sessions. This is useful for evaluating general water quality conditions and comparing results from lake to lake and year to year, but is less useful in detecting unusual events, such as algal blooms. The NYSDOH HAB study provides the "tools" for assessing blooms that occur between sampling sessions, and for the laboratory to detect the potential for bloom conditions (via the phycocyanin analyses on all incoming water samples), but it does not provide a mechanism for collecting additional water chemistry samples or complementary water quality analytes that might provide insights to the cause of these problems, or providing some other response to these "findings." The former might include nutrient analyses at various depths in the water column, particularly for those lakes with water intakes that are not close to the lake surface or bottom, sampling closer to inlet streams to identify potential sources of pollutants triggering these blooms, or other specialized sampling. Appropriate responses may be advising lake residents to avoid swimming until the bloom dissipates or through a timetable outlined by the Health Department. Given the immediacy of the phycocyanin screening results and the ability to rapidly contact sampling volunteers, these "real time" responses may be best initiated with the HAB study.

At present, the CSLAP analytical services budget does not provide a buffer for additional analyses, but it is anticipated that such a buffer will be available starting in 2011. At that time, there may also be additional screening tools or a standardized "near-real time" reporting mechanism to direct additional monitoring resources in places to address specific and immediate problems.

- **Continuation of the NYSDOH HAB study through 2013**

The NYSDOH grant to study harmful algal blooms is slated to run for five years, through 2013. The CSLAP-NYSDOH partnership is beneficial to both parties—CSLAP lake associations receive information about the potential for harmful algal blooms (and the characteristics of the bloom conditions in the lake) and NYSDOH receives on-the-ground samples and information about blooms from throughout the state as they occur. There is a need for better communication and information exchange in this study, and a "near-real time" feedback about bloom conditions and the potential threat to swimmers, but it is anticipated that these problems will be resolved as the study continues. The evolution of the program will likely result in more targeted sampling of blooms, but this may be expanded to all CSLAP lakes, rather than just those “susceptible” lakes (those with histories of blooms, water quality conditions indicating a susceptibility to blooms, and potable water supplies). In the interim, a continuation of this partnership should continue through the duration of the study.

- **Expanded biological monitoring**

The summary of the biological condition in CSLAP lakes (Chapter 5) represents a first attempt at compiling information about the biological communities in CSLAP lakes. There is no doubt additional information on these lakes, particularly related to phytoplankton and zooplankton and fish populations, that will be accumulated and included in the 2010 CSLAP report, particularly since it is unlikely that there will be a mechanism for conducting plankton monitoring in at least the near future, and CSLAP is not devised to conduct creel surveys.

The lake macroinvertebrate study conducted by the NYSDEC starting in 2008 focuses on CSLAP lakes to take advantage of the extensive water quality database and local interest in these data. The 2008 and 2009 studies collected benthic samples at 18 CSLAP lakes, and it is anticipated that an additional 9-12 CSLAP lakes will be sampled for each of the next several years. The 2010 CSLAP report will likely include a more detailed evaluation of the existing dataset and more detailed characterization of the biological condition of these lakes.

The macrophyte summaries in Chapter 5 constitute a compilation of plant survey data from a variety of sources, including plant surveys conducted by CSLAP volunteers. The data summary includes a discussion of a modified floristic quality index (FQI) for these lakes, using a modified scale developed for easily classifying plants into one of six categories. The New York chapter of The Nature Conservancy is in the process of developing a plant specific FQI for both terrestrial and aquatic plants in the region. The utility of the FQI can be expanded by better inventories of aquatic plants throughout the state, and assessments of the relative composition (abundance) of plants within lakes throughout the state. Starting in 2010, CSLAP sampling volunteers will be strongly encouraged to participate in one or both of these activities—detailed inventories of all plants in their lake, and assessments of plant abundance in their lake. The quality of aquatic plant communities in individual lakes and throughout the state will be better understood with this expanded database.

- **Return to a Rotating Lake Schedule**

At several points during the last twenty five years, the CSLAP waiting list—the list of NYSFOLA lake associations interested in participating in CSLAP—has exceeded the capacity for expanding the program. In most cases, the waiting period has been less than a year, and in many years, the CSLAP waiting list has been fully emptied during the following sampling season.

To that end, the NYSDEC and NYSFOLA continue to seek resources to fully build out CSLAP, to include all interested lake associations and provided expanded monitoring at each program lake. Unfortunately, the additional funds for analytical services, equipment, sample transport, and staff to manage an expanded program are not available in 2010 and are unlikely to be available in at least the near future. As a result, a large number of lakes continue to languish on the 2010 CSLAP waiting list. In some previous years and in 2010, each of these "stalled" waiting list lakes will be offered an opportunity to participate in an updated version of "CSLAP Light"—Secchi disk transparency and water temperature measurements, lake perception surveys, aquatic plant identifications, and an opportunity to participate in the NYSDOH HAB study.

To keep moving lakes off the waiting list in light of a shortage of funds to support an expanded program, a rotational schedule for CSLAP participants will likely be resumed in 2011. This will differ in a few ways from the original "Five Year On-Five Year Off" plan:

a. CSLAP lakes will likely return to the active monitoring program after a recess of about 1-2 years, depending on funding availability.
b. All CSLAP lakes will be encouraged to retain their Secchi disk and thermometer to keep "low level" monitoring during the 1-2 year "off" period.
c. CSLAP lakes rotated out of the program cannot "buy in" to the program to continue sampling during the 1-2 year "off" period.
d. A subset of CSLAP lakes will not be rotated out of the program. These "index" lakes will be sampled each year, presuming that the corresponding lake association retains their NYSFOLA membership and pays the CSLAP participation fee.

- **Index Lakes**

The NYSDEC uses the CSLAP dataset to evaluate long-term statewide and regional trends, the former as part of the statewide water quality assessments required by the federal government. These statewide assessments are supported by other monitoring programs, including a rotating regional monitoring program conducted by the NYSDEC. However, a core group of sampling sites provides a consistency to these assessments. The statewide river monitoring program includes 19 large river sites that represent most of the major drainage basins in the state; these serve as "index" sites that are monitored multiple times every year. The statewide lake monitoring program does not have equivalent index sites. A subset of CSLAP lakes can serve that purpose.

The lake index sites cannot replicate the river sites, since very few lakes drain large swaths of the state (and thus would only be representative of the very large lakes in the state). Instead, the CSLAP index lakes should represent, as best as possible, a typical cross-section of lakes in the state. The choice of index lakes is somewhat limited due to the limited pool of lakes sampled through CSLAP. For example, as discussed in this report, there are few urban lakes, particularly in Long Island, and few acidic lakes sampled through CSLAP. However, these lakes can be included in other monitoring programs.

Four criteria are being established to identify CSLAP index lakes:

a. *Geography*- the state and CSLAP report can be divided into four regions—Downstate, Central, Adirondack, and Western regions. These should be represented in the subset of index lakes in roughly equivalent frequency to their distribution throughout the state, or at least as much as feasible given the distribution of CSLAP and NYSFOLA lakes.
b. *Lake Depth*- lakes can be characterized by broad categories of water depth. Shallow lakes—those less than 20 feet (= 6 meters) deep—behave differently than deep lakes—those more than 50 feet deep. Lakes in the intermediate depth range—from 20 to 50 feet deep—may be susceptible to anoxia-induced water quality problems. The subset of index lakes should be represented by lakes in each of these depth categories.
c. *Lake Size*- the CSLAP dataset includes lakes ranging in size from small ponds to Great Lakes. The index lake set should include small lakes—those less than 100 acres in surface area, intermediate sized lakes—those between 100 and 500 acres, and large lakes—those over 500 acres. These, however, should not be distributed in equal proportion to their distribution throughout the state, since the vast majority of New York state lakes are much less than 50 acres.
d. *Trophic State*- the CSLAP monitoring program focuses on eutrophication indicators. As discussed at length in this report, a wide range of trophic conditions occurs in New York state lakes. The subset of index lakes should include representation from the list of *eutrophic, mesoeutrophic, mesotrophic, mesoligotrophic*, and *oligotrophic* lakes.

It is anticipated that 40-50 CSLAP lakes will be chosen to represent these four categories as index lakes. These lakes will not be rotated out of the program, although it should again be noted that even rotational lakes will be in an "off" cycle for no more than 1-2 years. The specific composition of the index lake set will be identified during the summer of 2010.

- **CSLAP Reports**

The CSLAP reports presented here represent a significant departure from previous reports. The new reporting format is discussed in Chapter 2. It is anticipated that this reporting format will allow for the statewide and regional reports to be posted on the NYSDEC and NYSFOLA websites, and for better distribution of the individual lake appendices. This format will also allow for expanded discussion of regional and statewide findings, and individual lake impacts with continued data collection. Perhaps most importantly, this format will be used to report on the 25 years of CSLAP data results after the 2010 CSLAP sampling season.