2005 INTERPRETIVE SUMMARY

NEW YORK
CITIZENS STATEWIDE
LAKE ASSESSMENT PROGRAM
(CSLAP)

EAGLE LAKE

NY Federation of Lake Associations
NYS Department of Environmental Conservation

July, 2006

BACKGROUND AND ACKNOWLEDGMENT

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 more than 200 lakes, ponds, and reservoirs and 1000 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 fifteen-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. This report summarizes the 2005 sampling results for **Eagle Lake**.

Eagle Lake is a 422 acre, class B lake found in the Town of Ticonderoga in Essex County, within the Eastern Adirondack region of New York State. Eagle Lake was first sampled as part of CSLAP in 2000. The following volunteers have participated in CSLAP, and deserve most of the credit for the success of this program at **Eagle Lake**: **Paul and Mary Lloyd Burroughs.**

In addition, the authors wish to acknowledge the following individuals, without whom this project and report would never have been completed:

From the Department of Environmental Conservation, N.G. Kaul, Sal Pagano, Dan Barolo, Italo Carcich, Phil DeGaetano, Dick Draper, and Jeff Myers for supporting CSLAP for the past twenty years; Jay Bloomfield and James Sutherland, for their work in developing and implementing the program; and the technical staff from the Lake Services Section, for continued technical review of program design.

From the Federation of Lake Associations, Anne Saltman, Dr. John Colgan, Don Keppel, Bob Rosati, Nancy Mueller and the Board of Directors, for their continued strong support of CSLAP.

The New York State Department of Health (prior to 2002), particularly Jean White, and Upstate Freshwater Institute (since 2002), particularly Carol Matthews, Doug Gillard, and Jennifer Aicher provided laboratory materials and all analytical services, reviewed the raw data, and implemented the quality assurance/quality control program.

Finally, but most importantly, the authors would like to thank the more than 1000 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.

EAGLE LAKE
FINDINGS AND EXECUTIVE SUMMARY

Eagle Lake was sampled as part of the New York Citizens Statewide Lake Assessment Program in 2005. For all program waters, water quality conditions and public perception of the lake each year and historically have been evaluated within annual reports issued after each sampling season. This report attempts to summarize both the 2005 CSLAP data and an historical comparison of the data collected within the 2005 sampling season and data collected at Eagle Lake prior to 2005.

The majority of the short- and long-term analyses of the water quality conditions in Eagle Lake are summarized in Table 2, divided into assessments of eutrophication indicators, other water quality indicators, and lake perception indicators. The CSLAP data indicate that the lake can be classified as oligotrophic, or highly unproductive. Eagle Lake was about as productive (lower water clarity and lower algae levels, but phosphorus levels were similar) as in the typical CSLAP sampling season. The drop in water clarity in the last five years has not been mirrored by an increase in algae levels, and it is likely that the small changes were probably within the normal variability for this lake. CSLAP data suggest that water clarity is probably closely influenced by both algae and nutrients (based on the similar trophic classification generated from each of the trophic indicators), and the nitrogen to phosphorus ratios indicate that algae levels in Eagle Lake are probably controlled by phosphorus. Lake productivity decreases slightly but not significantly over the course of a typical sampling season, due in large part to deepwater nutrient levels that are nearly identical to those at the lake surface (and thus do not “enrich” the surface waters during destratification, despite slight deepwater oxygen deficits dating back at least to the 1930s). Phosphorus levels in the lake fall well below the state phosphorus guidance value, resulting in water transparency readings that significantly exceed the minimum recommended water clarity for swimming beaches.

The lake is weakly colored (low levels of dissolved organic matter); however, the recent (slight) rise in these readings was coincident with the slight drop in water transparency. As with most CSLAP lakes, it is likely that the recent rise in color is in response to wetter weather. Eagle Lake has moderately softwater, slightly alkaline (above neutral) pH readings, and mostly undetectable nitrate and ammonia readings. Conductivity readings have increased slightly, though not in 2005, but it is not suspected that this has otherwise impacted the lake. pH readings consistently fall between the NYS water quality standards (=6.5 to 8.5), and should be adequate to support most organisms found in the lake. Neither nitrate nor ammonia levels in surface or bottom waters are high enough to represent a threat to the lake. Calcium levels are probably high enough to support zebra mussels, although these exotic animals have not been found in the lake.

The recreational suitability of Eagle Lake has been stable the last several years. Recreational conditions were most often described as “slightly impaired” for most uses, and mostly “not quite crystal clear”, the latter is slightly less favorable than expected given the water quality conditions in the lake. The recreational assessments are atypical (less favorable) than in other lakes with similar water quality characteristics, but indicative of lakes with similar plant densities (aquatic plants regularly grow to, but not densely at, the lake surface, according to the sampling volunteers, and “excessive weed growth” is regularly reported as impacting lake use). The recreational assessments are seasonally stable, consistent with seasonally stable aquatic plant and water quality conditions.

The 1996 NYSDEC Priority Waterbody Listings (PWL) for the Upper Hudson River drainage basin do not include Eagle Lake. The CSLAP datasets suggest that recreation may be *stressed* by excessive weed growth. The next PWL review for the Upper Hudson River drainage basin will likely occur in 2006.

General Comments and Questions:

- ***What is the condition of Eagle Lake?***

Water quality conditions in Eagle Lake are more than adequate to support most recreational uses of the lake during the summer, and can be best described as oligotrophic, or highly unproductive, with nutrient levels low enough to indicate that water quality changes are unlikely in at least the near future. These recreational assessments, however, indicate "slightly impaired" conditions, but continue to most strongly influenced by excessive weed growth (or poor weather).

- ***What about the dark and murky bottom waters of the lake?***

Although Eagle Lake is thermally stratified, deepwater nutrient (phosphorus and nitrogen) levels are nearly identical to those measured at the lake surface. This suggests that nutrient release from bottom sediments are probably negligible, and that deepwater oxygen levels probably remain high during the summer (although there probably remains some oxygen deficits at the lake bottom, based on data collected in the 1932 Biological Survey and 1999 LCI survey of the lake).

- ***How does this condition change from spring showers thru changing of the leaves?***

The productivity of Eagle Lake (clarity, nutrient and algae levels) decreases slightly during the summer, though in a manner that is not statistically significant, and recreational assessments are seasonally stable, coincident with seasonal stability in weed coverage and densities.

- ***How has the condition changed since CSLAP sampling began on the lake and/or relative to historical values?***

Color readings have increased slightly since 2000, a pattern common to many CSLAP lakes, perhaps in response to wetter weather or the 2002 shift in laboratories, although color readings remain fairly low. None of the other measured water quality indicators have exhibited significant change over this period, and the small changes in each of these indicators are probably within the normal and expected range of variability for this lake.

- ***How does Eagle Lake compare to other similar lakes (nearby lakes,….)?***

Eagle Lake is less productive than other nearby (Upper Hudson River basin) lakes, other lakes classified for swimming and other contact recreation (Class B), and other NYS lakes. However, recreational assessments have consistently been less favorable than in these other lakes, due to the influence of excessive weed growth (and/or poor weather conditions).

- ***Based on these data, what should be done to improve or maintain Eagle Lake?***

Given the low lake productivity, and little evidence of water quality threats, management of water quality conditions in Eagle Lake should focus on reducing nutrient loading to the lake, through maintaining septic systems, shoreline buffer zones, limited use of lawn fertilizers, minimizing land disturbances in the near-lake watershed, and localized stormwater management. The lake association is also advised to minimize introductions of exotic plants and animals from public and private launch areas into the lake, particularly given the strong connection between weeds and recreational assessments of the lake, as well as the increasing presence of zebra mussels in nearby lakes.

Context and Qualifiers

The NY Citizens Statewide Lake Assessment Program (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.

I. INTRODUCTION: CSLAP DATA AND YOUR LAKE

Lakes are dynamic and complex ecosystems. They contain a variety of aquatic plants and animals that interact and live with each other in their aquatic setting. As water quality changes, so too will the plants and animals that live there, and these changes in the food web also may affect water quality. Water quality monitoring provides a window into the numerous and complex interactions of lakes. Even the most extensive and expensive monitoring program **cannot completely assess** the water quality of a lake. However, by looking at some basic chemical, physical, and biological properties, it is possible to gain a greater understanding of the general condition of lakes. CSLAP monitoring is a basic step in overall water quality monitoring.

Understanding Trophic States

All lakes and ponds undergo **eutrophication,** an aging process, which involves stages of succession in biological productivity and water quality (see Figure 1). **Limnologists** (scientists who study fresh water systems) divide these stages into **trophic** states. Each trophic state can represent a wide range of biological, physical, and chemical characteristics and any lake may "naturally" be categorized within any of these trophic states. In general, the increase in productivity and decrease in clarity corresponds to an enrichment of nutrients, plant and animal life. Lakes with low biological productivity and high clarity are considered **oligotrophic**. Highly productive lakes with low clarity are considered **eutrophic**. Lakes that are **mesotrophic** have intermediate or moderate productivity and clarity. It is important to remember that eutrophication is a natural process, and is not necessarily indicative of man-made pollution.

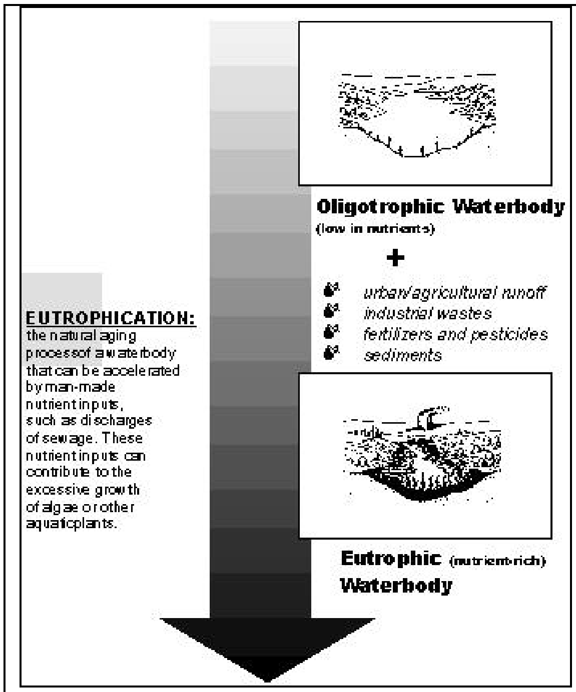


Figure 1. Trophic States

In fact, some lakes are thought to be "naturally" productive. Trophic classifications are not interchangeable with assessments of water quality. Water quality degradation from the perspective of one user may contrast with the perception of favorable conditions by a different lake user. For example, a eutrophic lake may support an excellent warm-water fishery because it is nutrient rich, but a swimmer may describe that same lake as polluted. A lake's trophic state is still important because it provides lake managers with a reference point to view changes in a lake's water quality and begin to understand how these changes may cause **use impairments** (threaten the use of a lake or swimming, drinking water or fishing)**.**

When human activities accelerate lake eutrophication, it is referred to as **cultural eutrophication**. Cultural eutrophication may result from shoreline erosion, agricultural and urban runoff, wastewater discharges or septic seepage, and other nonpoint source pollution sources. These can greatly accelerate the natural aging process of lakes, cause successional changes in the plant and animal life within the lake, shoreline and surrounding watershed, and impair the water quality and value of a lake. They may ultimately extend aquatic plants and emergent vegetation throughout the lake, resulting in the transformation of the lake into a marsh, prairie, and forest. The extent of cultural eutrophication, and the corresponding pollution problems, can be signaled by significant changes in the trophic state over a short period of time.

II. CSLAP PARAMETERS

CSLAP monitors several parameters related to the trophic state of a lake, including the clarity of the water, the amount of nutrients in the water, and the amount of algae resulting from those nutrients. Three parameters are the most important measures of eutrophication in most New York lakes: **total phosphorus, chlorophyll *a*** (estimating the amount of algae), and **Secchi disk transparency**. Because these parameters are closely linked to the growth of weeds and algae, they provide insight into "how the lake looks" and its suitability for recreation and aesthetics. Other CSLAP parameters help characterize water quality at the lake. In addition, CSLAP also uses the responses on the **Field Observation Forms** to gauge volunteer perceptions of lake water quality. Most water quality "problems" arise from impairment of accepted or desired lake uses, or the perception that such uses are somehow degraded. As such, any water quality monitoring program should attempt to understand the link between perception and measurable quality.

The parameters analyzed in CSLAP provide valuable information for characterizing lakes. By adhering to a consistent sampling protocol provided in the CSLAP Sampling Protocol, sampling volunteers collect and use data to assess both seasonal and yearly fluctuations in these parameters, and to evaluate the water quality conditions in their lake. By comparing a specific year's data to historical water quality information, lake managers can pinpoint trends and determine if water quality is improving, degrading or remaining stable. Such a determination answers a first critical question posed in the lake management process.

Ranges for Parameters Assessing Trophic Status and Eagle Lake

The relationship between phosphorus, chlorophyll *a*, and Secchi disk transparency has been explored by many researchers, to assess the trophic status (the degree of eutrophication) of lakes. Figure 2 shows ranges for phosphorus, chlorophyll a, and Secchi disk transparency (summer median) are representative for the major trophic classifications:

These classifications are valid for clear-water lakes only (with less than 30 platinum color units). Some humic or "tea color" lakes, for example, naturally have high levels of dissolved organic material, resulting in color readings that exceed 30 color units. This will cause the water transparency to be lower than expected given low phosphorus and chlorophyll *a* levels in the lake. Water transparency can also be unexpectedly lower in shallow lakes, due to influences from the bottom (or the inability to measure the maximum water clarity due to the visibility of the Secchi disk on the lake bottom). Even shallow lakes with high water clarity, low nutrient concentrations, and little algal growth may also have significant weed growth due to shallow water conditions. While such a lake may be considered unproductive by most water quality standards, that same lake may experience severe aesthetic problems and recreational impairment related to weeds, not trophic state. Generally, however, the trophic relationships described above can be used as an accurate "first" gauge of productivity and overall water quality.

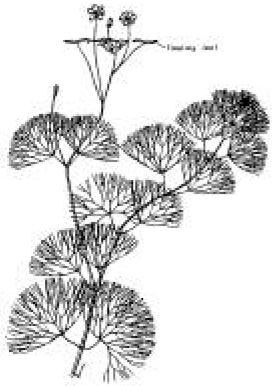
Figure 2. Trophic Status Indicators

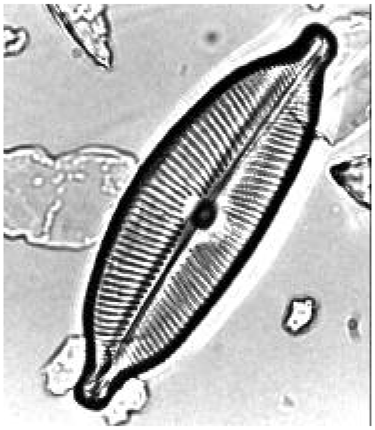
Parameter	Eutrophic	Mesotrophic	Oligotrophic	Eagle Lake
Phosphorus (mg/l)	> 0.020	0.010 - 0.020	< 0.010	**0.008**
Chlorophyll a (µg/l)	> 8	2- 8	< 2	**1.2**
Secchi Disk Clarity (m)	< 2	2- 5	> 5	**6.4**

Figure 3. CSLAP Parameters

PARAMETER	**SIGNIFICANCE**
Water Temperature (°C)	Water temperature affects many lake activities, including the rate of biological growth and the amount of dissolved oxygen. It also affects the length of the recreational season
Secchi Disk Transparency (m)	Determined by measuring the depth at which a black and white disk disappears from sight, the Secchi disk transparency estimates the clarity of the water. In lakes with low color and rooted macrophyte ("weed") levels, it is related to algal productivity
Conductivity (µmho/cm)	Specific conductance measures the electrical current that passes through water, and is used to estimate the number of ions (charged particles). 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. Generally, lakes with conductivity less than 100 µmho/cm are considered softwater, while conductivity readings above 300 µmho/cm are found in hardwater lakes.
pH	pH is a measure of the (free) hydrogen ion concentration in solution. Most clearwater lakes must maintain a pH between 6 and 9 to support most types of plant and animal life. Low pH waters (<7) are acidic, while high pH waters (>7) are basic
Color (true) (platinum color units)	The color of dissolved materials in water usually consists of organic matter, such as decaying macrophytes or other vegetation. It is not necessarily indicative of water quality, but may significantly influence water transparency or algae growth. Color in excess of 30 ptu indicate sufficient quantities of dissolved organic matter to affect clarity by imparting a tannic color to the water.
Phosphorus (total, mg/l)	Phosphorus is one of the major nutrients needed for plant growth. It is often considered the "limiting" nutrient in NYS lakes, for biological productivity is often limited if phosphorus inputs are limited. Nitrogen to phosphorus ratios of >10 generally indicate phosphorus limitation. Many lake management plans are centered around phosphorus controls. It is measured as total phosphorus (TP)
Nitrogen (nitrate, ammonia, and total (dissolved), mg/l)	Nitrogen is another nutrient necessary for plant growth, and can act as a limiting nutrient in some lakes, particularly in the spring and early summer. Nitrogen to phosphorus ratios <10 generally indicate nitrogen limitation (for algae growth). For much of the sampling season, many CSLAP lakes have very low or undetectable levels of one or more forms of nitrogen. It is measured in CSLAP in three forms- nitrate/nitrite (NO_x) ammonia ($NH_{3/4}$), and total nitrogen (TN or TDN).
Chlorophyll *a* (µg/l)	The measurement of chlorophyll *a*, the primary photosynthetic pigment found in green plants, provides an estimate of phytoplankton (algal) productivity, which may be strongly influenced by phosphorus
Calcium (mg/l)	Calcium is a required nutrient for most aquatic fauna, and is required for the shell growth for zebra mussels (at least 8-10 mg/l) and other aquatic organisms. It is naturally contributed to lakes from limestone deposits and is often strongly correlated with lake buffering capacity and conductivity.

By each of the trophic standards described above, Eagle Lake would be considered to be an **oligotrophic, or highly unproductive, lake. This has been a consistent assessment for each of the six CSLAP sampling seasons at the lake**.





III. AQUATIC PLANTS

Macrophytes:

Aquatic plants should be recognized for their contributions to lake beauty as well as for providing food and shelter for other life in the lake. Emergent and floating plants such as water lilies floating on the lake surface may provide aesthetic appeal with their colorful flowers; sedges and cattails help to prevent shoreline erosion, and may provide food and cover for birds. Submergent plants like pondweeds and leafy waterweed harbor insects, provide nurseries for amphibians and fish, and provide food for birds and other animals. Those who enjoy fishing at the lake appreciate a diverse plant population. Aquatic plants can be found throughout the *littoral zone*, the near-shore areas in which sufficient light reaches the lake bottom to promote photosynthesis. Plant growth in any particular part of the lake is a function of available light, nutrition and space, bottom substrate, wave action, and other factors, and extensive plant growth can occur in both "clean" and "polluted" lakes. A large portion of aquatic vegetation consists of the microscopic algae referred to as phytoplankton; the other portion consists of the larger rooted plants called **macrophytes.**

Of particular concern to many lakefront residents and recreational users are the *non-indigenous macrophytes* that can frequently dominate a native aquatic plant community and crowd out more beneficial plant species. The invasive plant species may be introduced to a lake by waterfowl, but in most cases they are introduced by fragments or seedlings that remain on watercraft from already-infested lakes. Once introduced, these species have tenacious survival skills, crowding out, dominating and eventually aggressively overtaking the indigenous (native) plant communities in a variety of water quality conditions. When this occurs, they interfere with recreational activities such as fishing, swimming or water-skiing. **These species need to be properly identified to be effectively managed.**

Non-native Invasive Macrophyte Species

Examples of **the common non-native invasive species found** in New York are:

- **Eurasian watermilfoil** *(Myriophyllum spicatum)*
- **Curly-leaf pondweed** *(Potamogeton crispus)*
- **Eurasian water chestnut** *(Trapa natans)*
- **Fanwort** *(Cabomba caroliniana).*

If these plants are not present, efforts should be made to continue protecting the lake from the introduction of these species.

Whether the role of the lake manager is to better understand the lake ecosystem or better manage the aquatic plant community, knowledge of plant distribution is paramount to the management process. There are many procedures available for assessing and monitoring aquatic vegetation. The <u>CSLAP Sampling Protocol</u> contains procedures for a "semi-quantitative" plant monitoring program. Volunteers collect plant specimens and provide field information and qualitative abundance estimates for an assessment of the macrophyte communities within critical areas of the lake. While these techniques are no substitute for professional plant surveys, they can help provide better information for lake managers. Lake associations planning to devote significant time and expenditures toward a plant management program are advised to pursue more extensive plant surveying activities.

Aquatic plant surveys have not been conducted through CSLAP at Eagle Lake, although the presence of Eurasian watermilfoil (*Myriophyllum spicatum*) has been verified by other sources.

The Other Kind of Aquatic Vegetation

Microscopic algae referred to as phytoplankton make up much of aquatic vegetation found in lakes. For this reason, and since phytoplankton are the primary producers of food (through photosynthesis) in lakes, they are the most important component of the complex food web that governs ecological interactions in lakes.

In a lake, phytoplankton communities are usually very diverse, and are comprised of hundreds of species having different requirements for nutrients, temperature and light. In many lakes, including those of New York, diatom populations are greatest in the spring, due to a competitive advantage in cooler water and relatively high levels of silica. In most lakes, however, diatom densities rarely reach nuisance portions in the spring. By the summer, green algae take advantage of warmer temperatures and greater amounts of nutrients (particularly nitrogen) in the warm water and often increase in density. These alga often grow in higher densities than do diatoms or most other species, although they are often not the types of algae most frequently implicated in noxious algae blooms. Later in the summer and in the early fall, blue green algae, which possess the ability to utilize atmospheric nitrogen to provide this required nutrient, increase in response to higher phosphorus concentrations. This often happens right before turnover, or destratification in the fall. These alga are most often associated with taste and odor problems, bloom conditions, and the "spilled paint" slick that prompts the most complaints about algae. Each lake possesses a unique blend of algal communities, often varying in population size from year to year, and with differing species proportional in the entire population. The most common types range from the mentioned diatoms, green, and blue-green algae, to golden-brown algae to dinoflagellates and many others, dominating each lake community.

So how can this be evaluated through CSLAP? CSLAP does assess algal biomass through the chlorophyll *a* measurement. While algal differentiation is important, many CSLAP lake associations are primarily interested in "how much?", not "what kind?", and this is assessed through the chlorophyll *a* measurement. Phytoplankton communities have not been regularly identified and monitored through CSLAP, in part due to the cost and difficulty in analyzing samples, and in part due to the difficulty in using a one-time sample to assess long-term variability in lake conditions. A phytoplankton analysis may reflect a temporary, highly unstable and dynamic water quality condition.

In previous CSLAP sampling seasons, nearly all lakes were sampled once for phytoplankton identification, and since then some lakes have been sampled on one or more occasions. For these lakes, a summary of the most abundant phytoplankton species is included below. Algal species frequently associated with taste and odor problems are specifically noted in this table, although it should be mentioned that these samples, like all other water samples collected through CSLAP, come from near the center of the lake, a location not usually near water intakes or swimming beaches. Since algal communities can also be spatially quite variable, even a preponderance of taste and odor-causing species in the water samples might not necessarily translate to potable water intake or aesthetic impairments, although the threat of such an impairment might be duly noted in the "Considerations" section below.

Phytoplankton surveys have not been conducted through CSLAP at Eagle Lake.

Historical Information for Eagle Lake

Eagle Lake was sampled by the NYSDEC in 1999 as part of the Lake Classification and Inventory (LCI) survey, the Division of Water ambient lake monitoring program. It was also sampled by the New York State Conservation Department (the predecessor to the NYSDEC) as part of the Biological Survey of the Upper Hudson River basin in 1932. The results from both of these surveys, at least as they pertain to water quality indicators measured through CSLAP, are reported in Table 1. The LCI results from 1999 indicate that water transparency was slightly higher than in the contemporary CSLAP study of the lake, although nutrient and algae levels were comparable. These indicators suggest that water quality conditions from 1999 were similar to those measured in recent years through CSLAP.

The Biological Survey was intended to evaluate water quality conditions as they relate to fisheries management, so much of the information collected cannot be easily compared to the CSLAP dataset. The lake was described as follows:

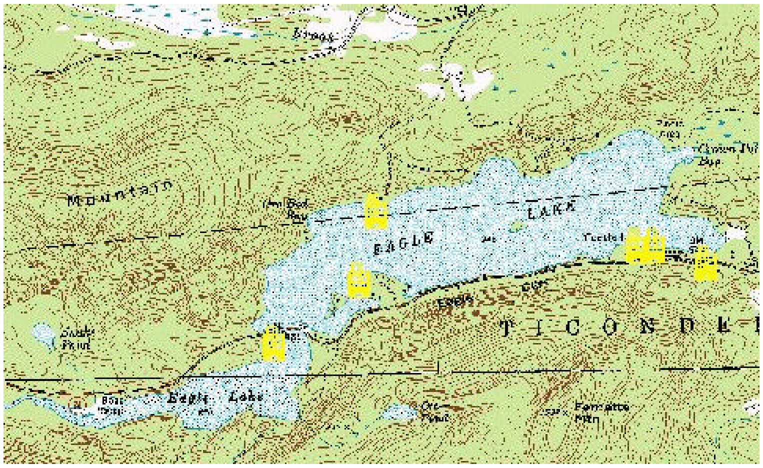
> *"Eagle Lake comprises an area of 409 acres with little shallow water and few weed beds. The rocky bottom slopes rapidly away from the shores. Eighty to ninety percent of the lake is over twenty feet deep and temperature and oxygen relationships are satisfactory for fish everywhere….. ...few weed beds…This is a rather narrow lake with rocky shores. The weed areas are limited mostly to a long narrow bay which includes the part of the lake west of the highway crossing. This bay gradually merges with Paragon Creek. This whole area, for a distance of over one mile, supports a very luxuriant growth of plants"*

Detailed aquatic plant survey information indicated the following relative abundances, although overall there were "few weeds"

Abundant	Common	Frequent	Rare
Potamogeton robbinsii	*Potamogeton dimorphus*	*Sparganium fluctuans*	*Sparganium eurycarpum*
Najas flexilis	*Potamogeton epihydrus*	*Potamogeton amplifolius*	*Potamogeton americanus*
	Elodea canadensis	*Potamogeton compressus*	*Sagittaria latifolia*
	Scirpus subterminalis	*Potamogeton gramineus*	*Eleocharis palustris*
	Eriocaulon septangulaire	*Potamogeton natans*	*Dulichium arundinaceum*
	Brasenia schreberi	*Potamogeton praelongus*	*Lobelia dortmanna*
	Isoetes echinospora	*Potamogeton pusillus*	*Bidens beckii*
		Vallisneria americana	
		Eleocharis acicularis	
		Pontederia cordata	
		Nymphaea odorata	
		Nymphozanthus advena	
		Utricularia vulgaris	

It is likely that many of these aquatic plants continue to be found in the lake, although Eurasian watermilfoil, probably the most dominant plant in the lake at this time, was not present in the lake in the 1930s (nor was it found in at least most, if not all, NYS lakes at this time).

The water quality data suggests that water clarity and pH readings were probably similar to those in the present studies, suggesting water quality changes may not have been significant. Oxygen levels were somewhat depleted very near the lake bottom, a phenomenon found on occasion in recent studies.



Regulated Facilities Associated with Eagle Lake

There appear to be a few facilities or activities on Eagle Lake that requires permits or is otherwise regulated by the NYSDEC; the map below shows facilities on or near the lake (represented by “derricks”). These corresponds to a shoreline improvement projects.

IV. NYS AND CSLAP WATER QUALITY DATA: 1986-2004

Overall Summary:

Although water quality conditions at each CSLAP lake have varied each year since 1986, and although detailed statistical analyses of the entire CSLAP dataset has not yet been conducted, general water quality trends can be evaluated after 5-20 years worth of CSLAP data from these lakes. Overall (regional and statewide) water quality conditions and trends can be evaluated by a variety of different means. Each of the tested parameters ("analytes") can be evaluated by looking at the how the analyte varies from year to year from the long-term average ("normal") condition for each lake, and by comparing these parameters across a variety of categories, such across regions of the state, across seasons (or months within a few seasons), and across designated best uses for these lakes. Such evaluations are provided in the second part of this summary, via Figures 4 through 14. The annual variability is expressed as the difference in the annual average (mean) from both the long-term average and the normal variability expected from this long-term average. The latter can be presented as the "standard error" (SE- calculated here within the 95% confidence interval) - one standard error away from the long-term average can be considered a "moderate" change from "normal", with a deviation of two or more standard errors considered to be a "significant" change. For each of these parameters, the percentage of lakes with annual data falling within one standard error from the long-term average are considered to exhibit "no change", with the percentage of lakes demonstrating moderate to significant changes also displayed on these graphs (Figures 5a through 14a). Annual changes in these lakes can also be evaluated by standard linear regressions- annual means over time, with moderate correlation defined as $R^2 > 0.33$, and significant correlation defined as $R^2 > 0.5$. These methods are described in greater detail in Appendix D. Assessments of weather patterns- whether a given year was wetter or drier than usual- accounts for broad statewide patterns, not weather conditions at any particular CSLAP lake. As such, weather may have very different at some (but not most) CSLAP lakes in some of these years.

Long-term trends can also be evaluated by looking at the summary findings of individual lakes, and attempting to extrapolate consistent findings to the rest of the lakes. Given the (non-Gaussian) distribution of many of the water quality parameters evaluated in this report, non-parametric tools may be the most effective means for assessing the presence of a water quality trend. However, these tools do not indicate the magnitude of the trend. As such, a combination of parametric and non-parametric tools are employed here to evaluate trends. The Kendall tau ranking coefficient has been utilized by several researchers and state water quality agencies to evaluate water quality trends via non-parametric analyses, and is utilized here. For parametric analyses, best-fit analysis of summer (June 15 through September 15) averages for each of the eutrophication indicators can be evaluated, with trends attributable to instances in which deviations in annual means exceed the deviations found in the calculation of any single annual mean. "Moderate" change is defined as $t > 0.33$, and "significant" change is defined as $t > 0.5$. It has been demonstrated in many of these programs that long-term trend analyses cannot be utilized to evaluate lake datasets until at least five years worth of data have been collected.

As of 2005, there were 142 CSLAP lakes that have been sampled for at least five years- the change in these lakes is demonstrated in Figures 4 and 5; Figures 4a through 4j indicate "moderate" long-term change, while Figures 5a through 5j indicate "significant" long-term change**.** When these lakes are analyzed by this combination of parametric and non-parametric analyses, these data suggest that while most NYS lakes have not demonstrated a significant change (either t or $R^2 > 0.5$) or even a moderate changes (t or $R^2 > 0.33$).

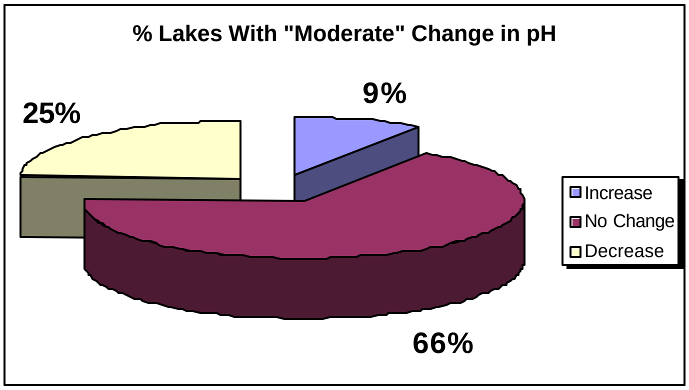


Figure 4a. %CSLAP Lakes Exhibiting Moderate Long-Term Change in pH

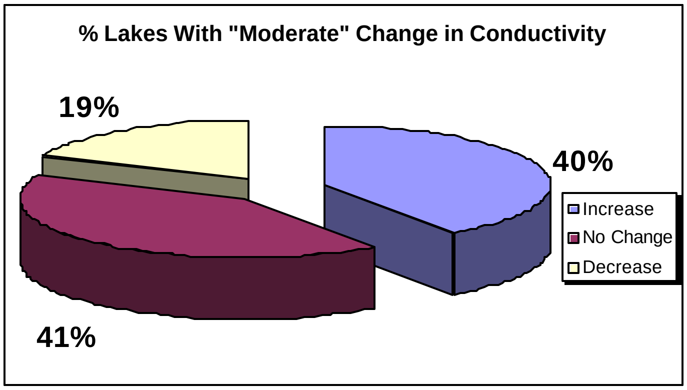


Figure 4b. %CSLAP Lakes Exhibiting Moderate Long-Term Change in Conductivity

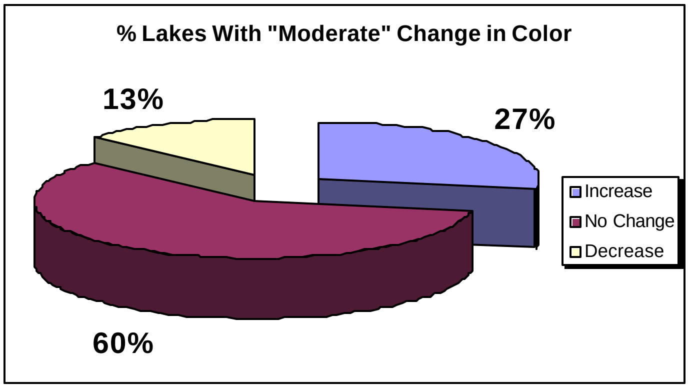


Figure 4c. %CSLAP Lakes Exhibiting Moderate Long-Term Change in Color

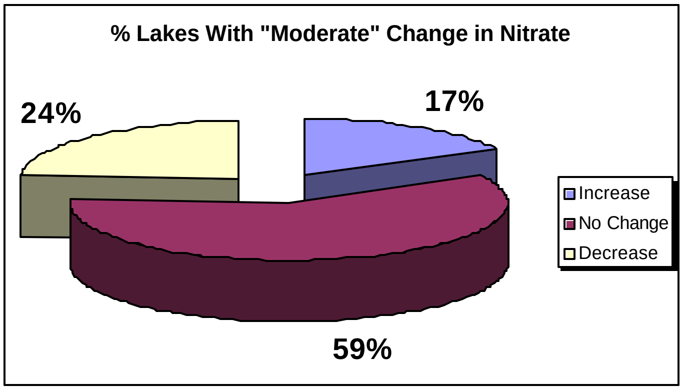


Figure 4d. %CSLAP Lakes Exhibiting Moderate Long-Term Change in Nitrate

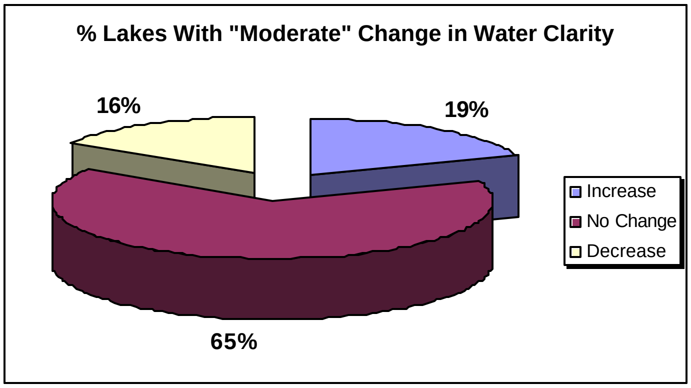


Figure 4e. %CSLAP Lakes Exhibiting Moderate Long-Term Change in Water Clarity

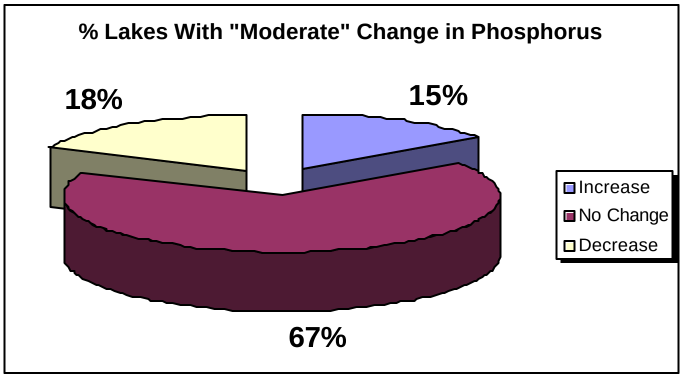


Figure 4f. %CSLAP Lakes Exhibiting Moderate Long-Term Changes in Phosphorus

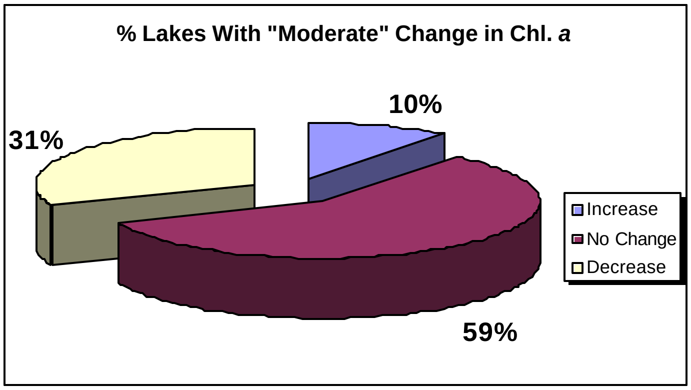


Figure 4g. %CSLAP Lakes Exhibiting Moderate Long-Term Change in Chlorophyll *a*

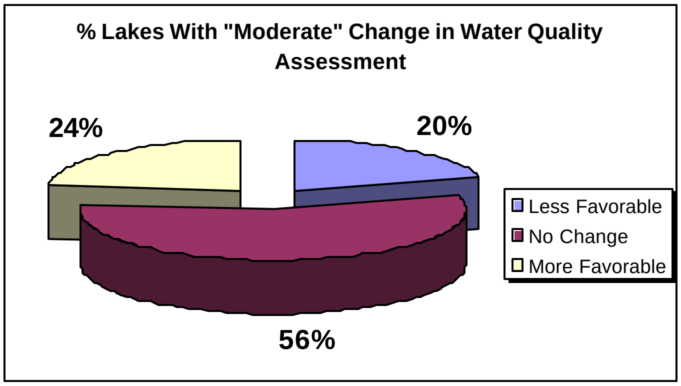


Figure 4h. %CSLAP Lakes Exhibiting Moderate Long-Term Change in Water Quality Assessment

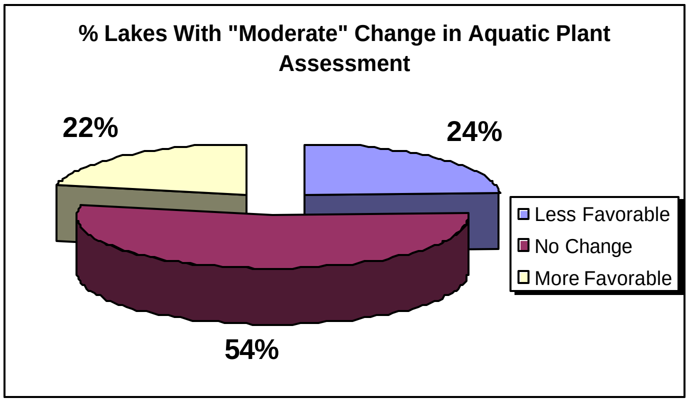


Figure 4i. %CSLAP Lakes Exhibiting Moderate Long-Term Change in Aquatic Plant Assessment

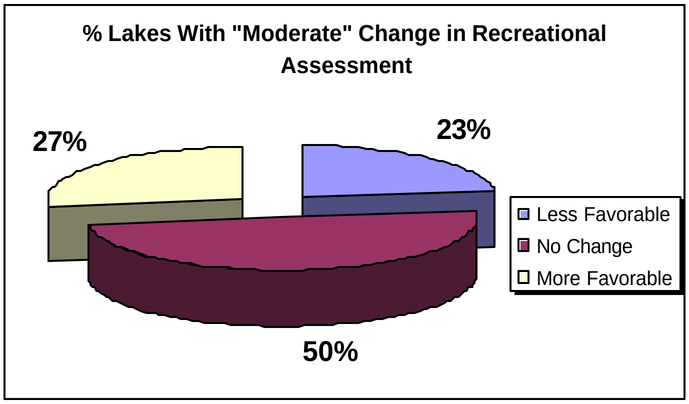


Figure 4j. %CSLAP Lakes Exhibiting Moderate Long-Term Change in Recreational Assessment

Some of the lakes sampling through CSLAP have demonstrated a moderate change since CSLAP sampling began in 1986, at least for some of the sampling parameters measured through CSLAP. In general, between 50% and 65% of the CSLAP lakes have not exhibited even moderate changes. Some of the parameters that have exhibited moderate changes may not reflect actual water quality change. For example, it appears that the increase in color (Figure 4c) and decrease in nitrate (Figure 4d) and chlorophyll *a* (Figure 4g) is probably due to the shift in laboratories, even though the analytical methods are comparable. The increase in conductivity (Figure 4b) and decrease in pH (Figure 4a) are probably real phenomena- both changes were evident to some degree prior to the shift in laboratories, and both are largely predictable. The difference between the increase and decrease in the other sampling parameter (or between more favorable and less favorable conditions) does not appear to be important, and probably indicates random variability.

Figures 5a through 5j indicate that, not surprisingly, “substantial” change is less common. Substantial change follows the same patterns as discussed above with the evaluation of “moderate” change in CSLAP lakes, except that the percentage of CSLAP lakes not exhibiting significant change is much higher, rising to about 65-80% of these lakes. For those CSLAP lakes exhibiting substantial change, it is most apparent in the same parameters described above. About 30% of the CSLAP lakes have exhibited a substantial increase in conductivity, consistent with a broad (and expected) successional pattern, in which lakes generally concentrate materials washed in from the surrounding watershed (and as the runoff itself concentrates materials as these watersheds move from forested to more heavily used, whether via residential development or other uses. The comparison between Figures 5b and 5e through 5g indicate that this has not (yet) translated into higher nutrient loading into lakes.

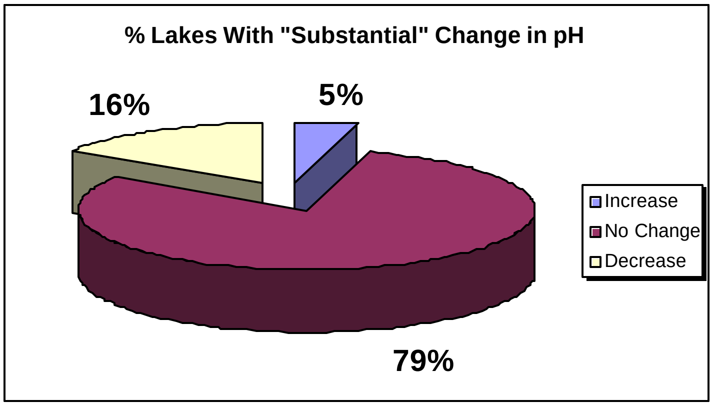


Figure 5a. %CSLAP Lakes Exhibiting Substantial Long-Term Change in pH

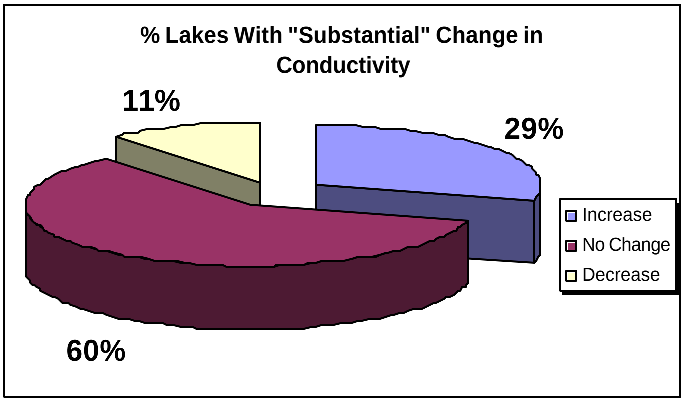


Figure 5b. %CSLAP Lakes Exhibiting Substantial Long-Term Change in Conductivity

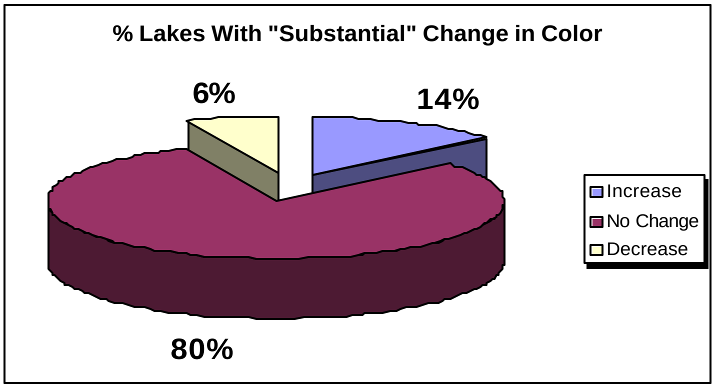


Figure 5c. %CSLAP Lakes Exhibiting Substantial Long-Term Change in Color

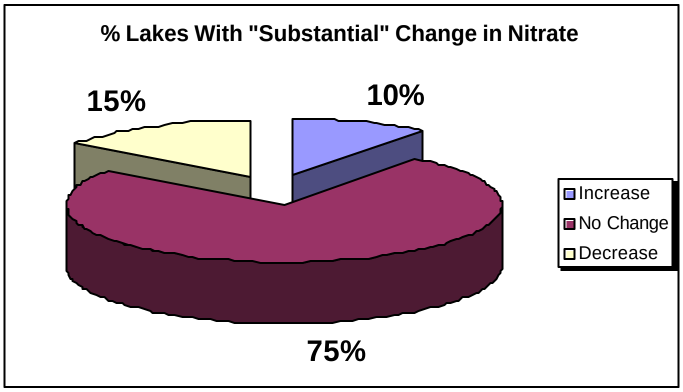


Figure 5d. %CSLAP Lakes Exhibiting Substantial Long-Term Change in Nitrate

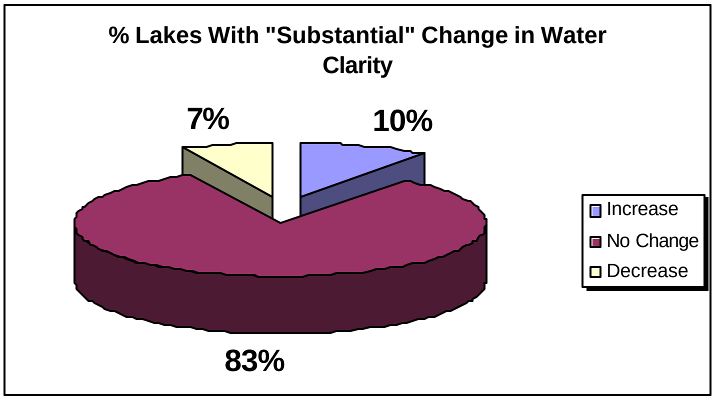


Figure 5e. %CSLAP Lakes Exhibiting Substantial Long-Term Change in Water Clarity

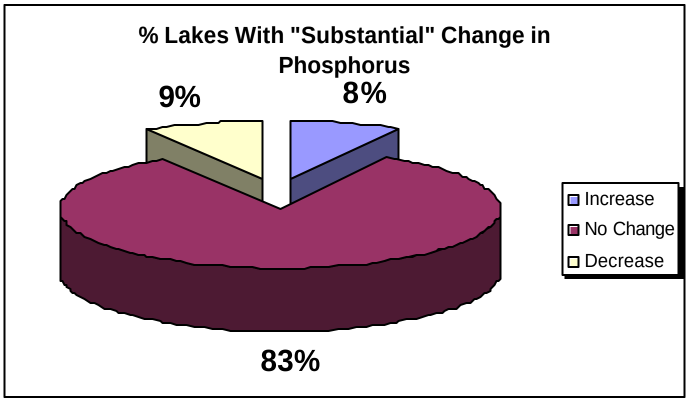


Figure 5f. %CSLAP Lakes Exhibiting Substantial Long-Term Change in Phosphorus

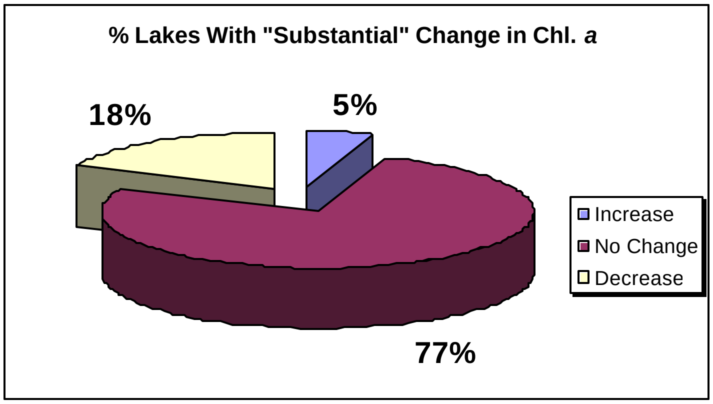


Figure 5g. %CSLAP Lakes Exhibiting Substantial Long-Term Change in Chlorophyll *a*

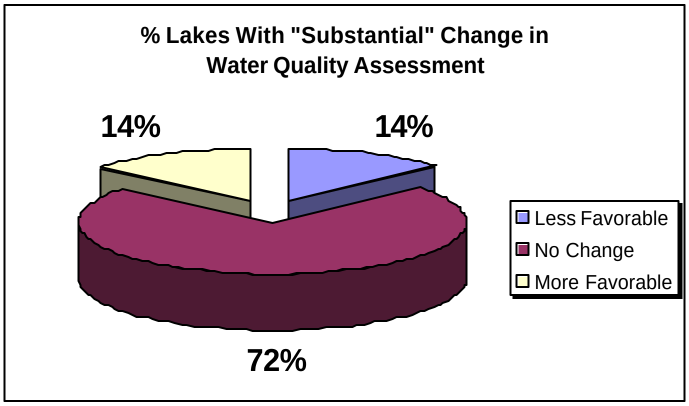


Figure 5h. %CSLAP Lakes Exhibiting Substantial Long-Term Changes in Water Quality Assessment

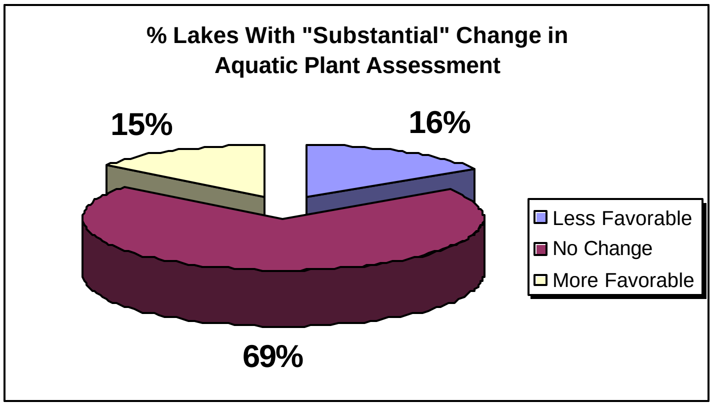


Figure 5i. %CSLAP Lakes Exhibiting Substantial Long-Term Change in Aquatic Plant Assessment

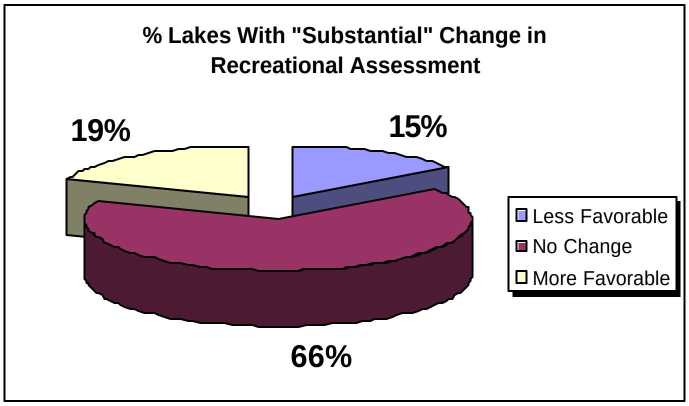


Figure 5j. %CSLAP Lakes Exhibiting Substantial Long-Term Change in Recreational Assessment

As noted above, there does not appear to be any clear pattern between weather and water quality changes, although some connection between changes in precipitation and changes in some water quality indicators is at least alluded to in some cases. However, all of these lakes may be the long-term beneficiaries of the ban on phosphorus in detergents in the early 1970's, which with other local circumstances (perhaps locally more "favorable" weather, local stormwater or septic management, etc.) has resulted in less productive conditions. Without these circumstances, water quality conditions in many of these lakes might otherwise be more productive, in the creeping march toward aging, eutrophication, and succession (as suggested from the steady rise in conductivity). In other words, the higher materials loading into these lakes may be largely balanced by a reduction in nutrients within the corresponding runoff

The drop in pH in NYS lakes has been studied at length within the Adirondacks and may continue to be attributable on a statewide basis to acid rain, since acidic rain continues to fall throughout the state. The CSLAP dataset is not adequate to evaluate any ecological changes associated higher lake acidity, and it is certainly worth noting that the slight drop in pH in most CSLAP lakes does not bring these lakes into an acidic status (these lakes have, at worse, become slightly less basic). In addition, for lakes most susceptible to acidification, laboratory pH is only an approximation of actual pH. Fully accurate pH readings require field measurements using very specialized equipment, although for most lakes with even modest buffering capacity, laboratory pH is a good estimate of *in situ* pH readings. So while the decrease in pH in some CSLAP lakes should continue to be watched, it does not appear to be a cause for concern, at least relative to the low pH in small, undeveloped, high elevation lakes within the Adirondack Park.

Lake perception has changed more significantly than water quality (except conductivity), due in part to the shorter timeframe for evaluation and thus a lower statistical hurdle for quantifying change (14 years versus up to 20 years for some lakes), but perhaps due to the multiple influences of these phenomena. None of these indicators- water quality perception, weeds perception, or recreational perception- have varied in a consistent manner, although variability is more common in each of these indicators. The largest change is in recreational assessments, with about 1/3 of all lakes exhibiting substantial change and nearly half have demonstrated moderate change. A more detailed analysis of these assessments (not presented here) indicate that the Adirondacks have demonstrated more "positive" change than other regions of the state, due to the perception that aquatic weed densities have not increased as significantly (and water quality conditions have improved in some cases). However, the rapid spread of *Myriophyllum spicatum* into the interior Adirondacks will likely reverse this "trend" in coming years, and it is not clear if these "findings" can be extrapolated to other lakes within the Adirondack Park.

Larger trends and observations about each of the CSLAP sampling parameters are presented below in Figures 6 through 15. As noted in the nitrate discussion, there is still an insufficient database for ammonia or total nitrogen to evaluate annual, geographic, seasonal, or lake use variability in these sampling parameters. However, these parameters are discussed in the specific discussions for Eagle Lake later in this document.

pH

Annual Variability

The pH of most CSLAP lakes has consistently been well within acceptable ranges for most aquatic organisms during each sampling season. The average pH has not varied significantly from one sampling season to the next. There does not appear to be a strong connection between pH and weather; some of the years with the relatively highest pH, 1988 and 1992, and the lowest pH, 1987, correspond to years with relatively normal precipitation, although some of the other years with relatively low pH corresponded to wetter years (1996, 2000, and 2004). There does not appear to be any significant annual pH trends in the CSLAP dataset. 90% of all samples had pH between 6.5 and 8.5 (the state water quality standards); 6% of samples have pH > 8.5 and 4% have pH < 6.5.

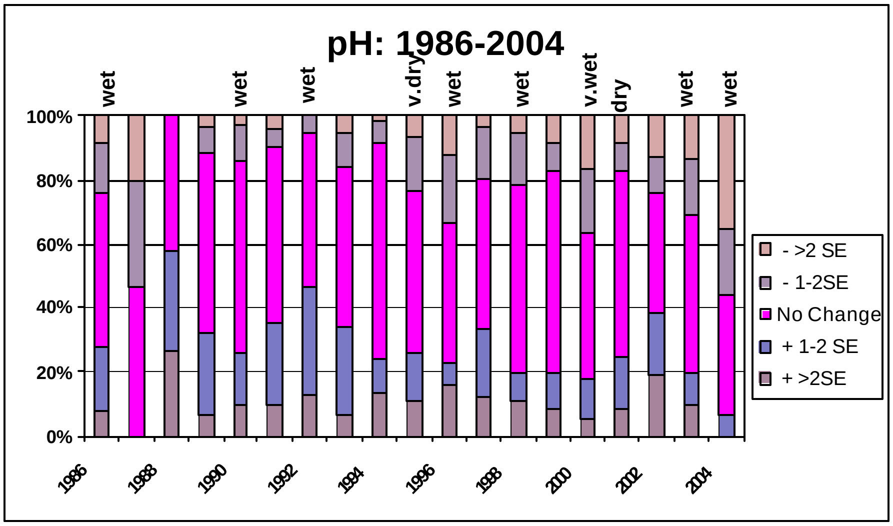


Figure 6a. *Annual Change from "Normal" pH in CSLAP Lakes (SE = Standard Error)*

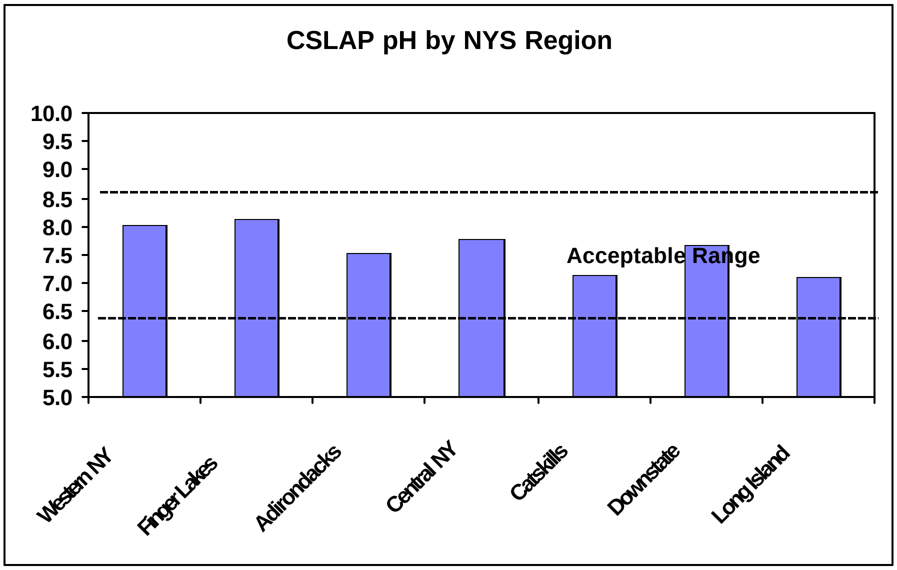


Figure 6b. *pH in CSLAP Lakes by NYS Region*

What Was Expected in 2005?

2005 was a relatively wet year, at least in most of the state during much of the summer sampling season. While there is not a strong correlation between weather and pH during at least most of the CSLAP sampling seasons, pH readings have generally been lower during wet years, most likely to due the input of acidic rain. Therefore, it is anticipated that pH readings may be slightly lower than usual, at least in some CSLAP lakes.

And What Happened at Eagle Lake in 2005?

pH readings in Eagle Lake were slightly higher in 2005 than in the typical CSLAP sampling season, although these readings were only slightly higher than in most previous sampling seasons. This occurred despite no significant changes in conductivity, but there did not appear to be a strong correlation between changes in pH and changes in weather or any of the measured water quality indicators.

Statewide Variability:

As expected, pH readings are lowest in the high elevation regions (Adirondacks and Catskills) or Long Island, which has primarily shallow and slightly colored lakes, and highest in regions with relatively high conductivity (Western NY and the Finger Lakes region). All of these readings are consistently within the acceptable range for most aquatic organisms. However, the CSLAP dataset does not reflect the low pH found in many high elevation NYS lakes overlying granite and poorly buffered soils, since the typical CSLAP lake resides in geological settings (primarily limestone) that allow for residential development. In other words, pH is one of the few CSLAP sampling parameters that does not yield comparable results when comparing CSLAP results to overall NYS results, since CSLAP lakes are not really representative of the typical NYS lake as related to pH.

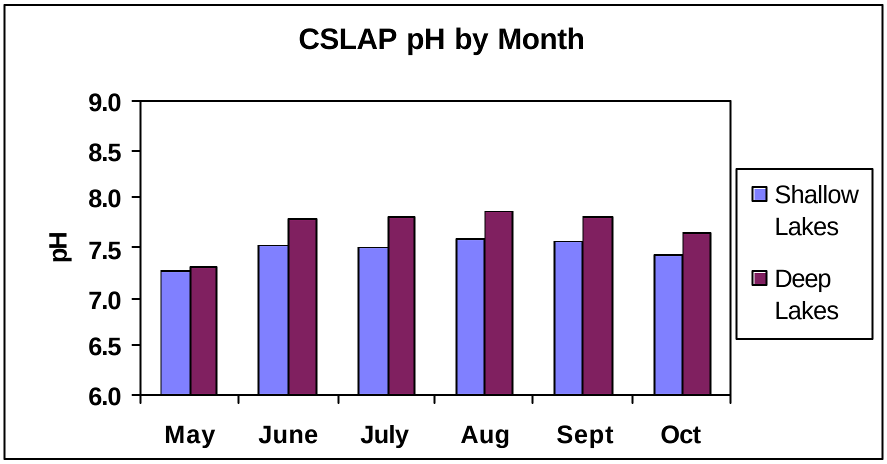


Figure 6c. *pH in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

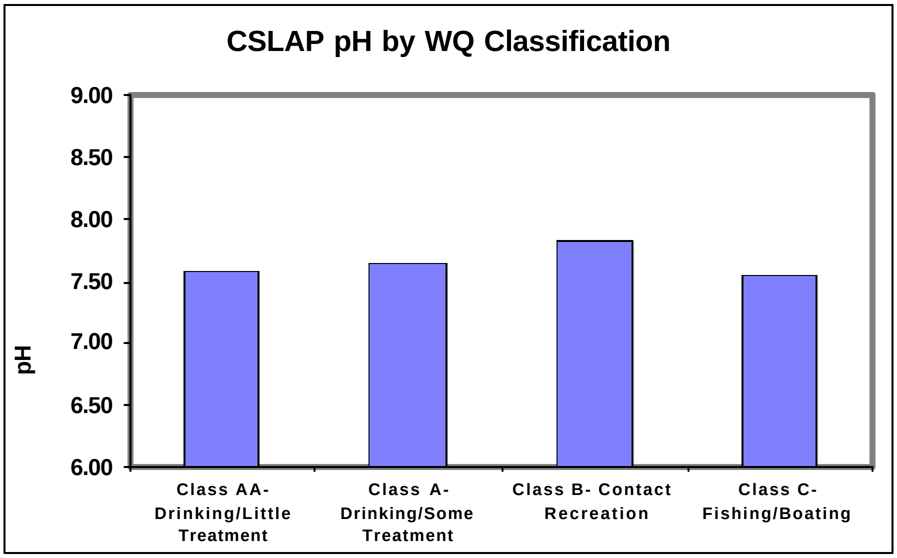


Figure 6d. *pH in CSLAP Lakes by Lake Use*

Seasonal Variability:

pH readings tend to increase slightly over the course of the summer, due largely to increasing algal photosynthesis (which consumes CO_2 and drives pH upward), although these seasonal changes are probably not significant. Low pH depressions are most common early in the sampling season (due to lingering effects from snowpack runoff) and high pH spikes occur mostly in mid to late summer.

Lake Use Variability

pH does not vary significant from one lake use to another, although in general pH readings are slightly higher for lakes used primarily for contact recreation (Class B). However, this is probably more reflective of geographical differences (there are relatively more Class B CSLAP lakes in higher pH regions, and more Class A lakes in lower pH regions) than any inherent link between pH and lake usage.

Conductivity

Annual Variability

The conductivity of most CSLAP lakes has varied somewhat from year to year, and has been (slightly) increasing overall and in specific lakes since 1986. This is apparent from Figure 6a, which shows that more lakes have exhibited higher readings in recent years that in the first several years of CSLAP sampling at the lake (although lower conductivity was apparent in 2004). Readings are generally higher in dry weather and lower in wetter weather, although the overall annual trend appears to be stronger than weather-impacted changes.

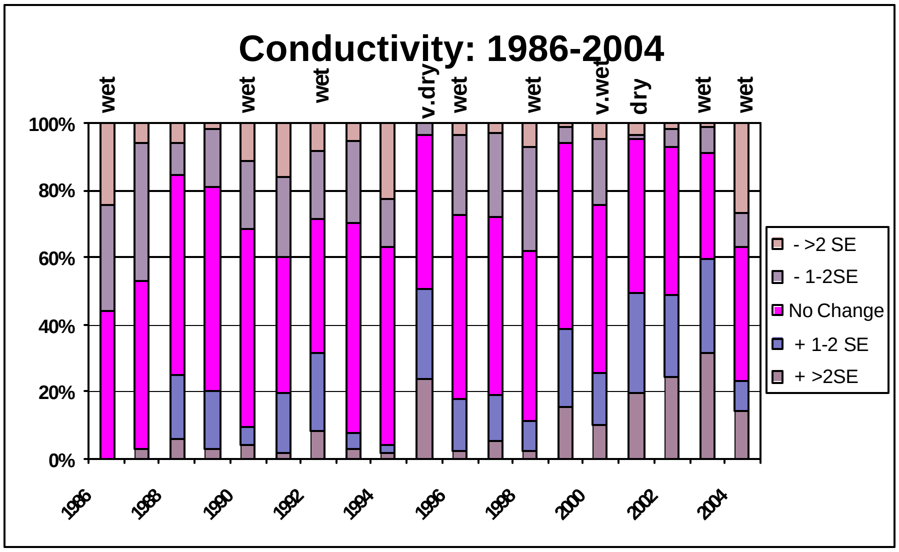


Figure 7a. *Annual Change from "Normal" Conductivity in CSLAP Lakes (SE = Standard Error)*

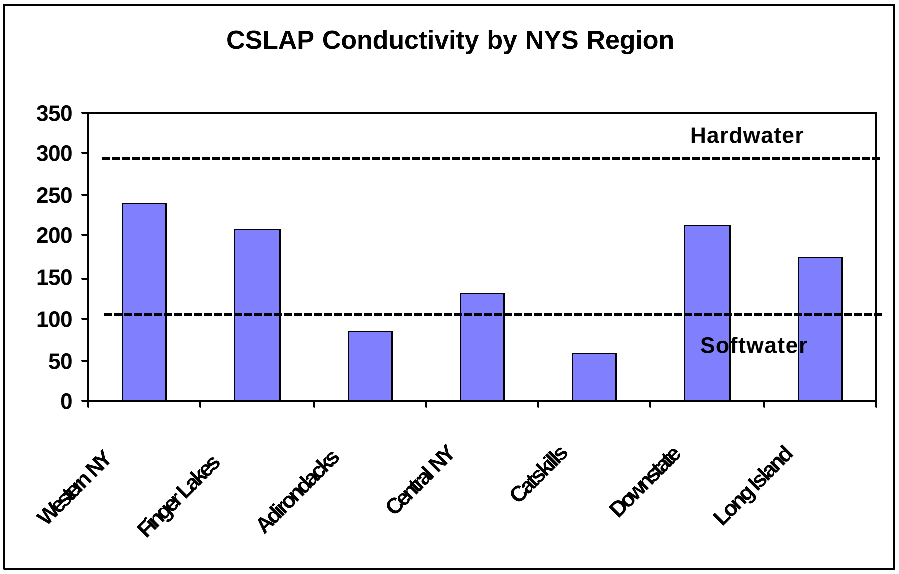


Figure 7b. *Conductivity in CSLAP Lakes by NYS Region*

What Was Expected in 2005?

2005 was a relatively wet year, at least in most of the state during much of the summer sampling season. Conductivity readings have generally been lower during wet years, although this rather weak pattern "competes" with a more significant trend toward increasing conductivity readings over time. Therefore, it is anticipated that conductivity readings may be within the normal range for most CSLAP lakes, although higher conductivity readings may be more likely that lower conductivity.

And What Happened at Eagle Lake in 2005?

Conductivity readings at Eagle Lake in 2005 were comparable to those measured in previous CSLAP sampling seasons. Nearly all conductivity readings in the lake have been representative of lakes with moderately soft water.

Statewide Variability:

Although “hardwater” and “softwater” is not consistently defined by conductivity, in general lakes in the Adirondacks and Catskills have lower conductivity (softer water), and lakes downstate, in Western NY, and in the Finger Lakes region have higher conductivity (harder water). These regional differences are due primary to surficial geology and “natural” conditions in these areas. However, within each of these broad geographical areas, there are usually some lakes with higher conductivity and some lakes with lower conductivity readings.

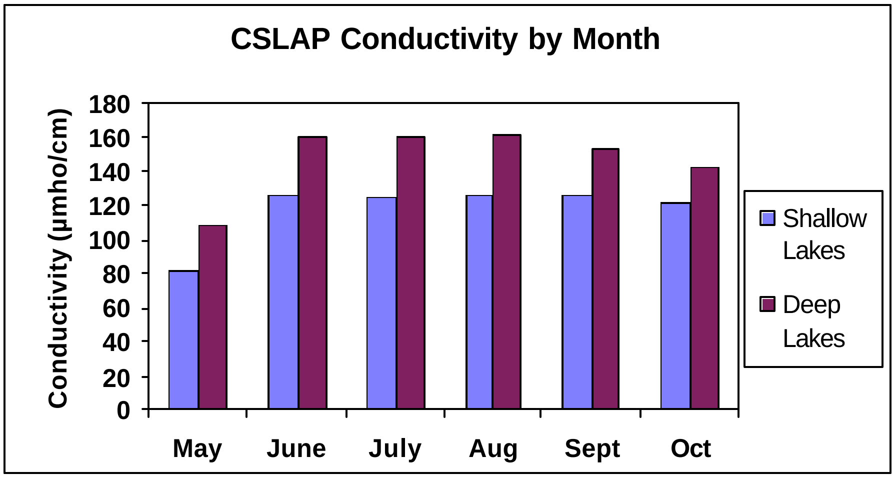


Figure 7c. *Conductivity in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

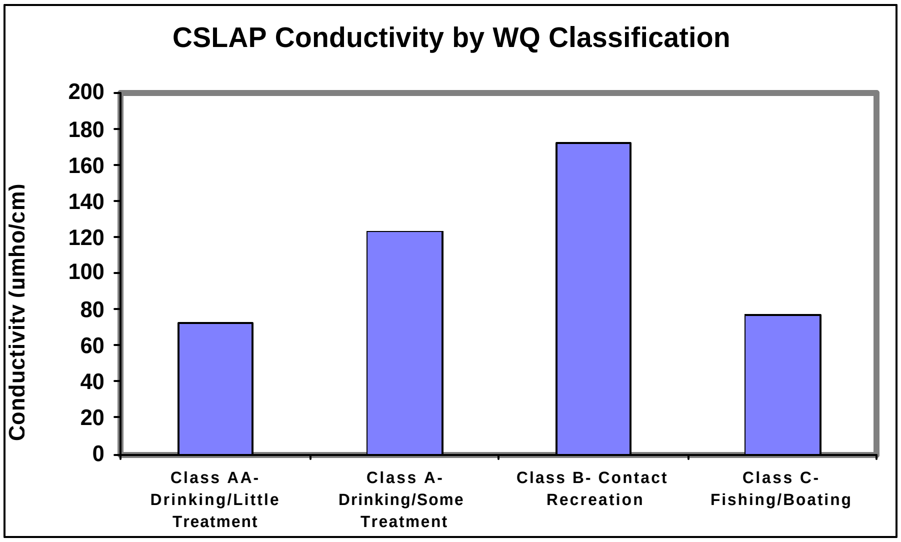


Figure 7d. *Conductivity in CSLAP Lakes by Lake Use*

Seasonal Variability:

Conductivity readings are much higher in the summer than in the late spring in many CSLAP lakes. These readings decreased in deep lakes in the summer and fall, but remained fairly steady in shallow lakes over this period (actual readings within specific lakes, however, may often vary significantly from week to week). Although lake destratification (turnover) brings bottom waters with higher conductivity to the lake surface in deeper lakes, conductivity readings dropped in the fall. It is possible that fully mixed conditions may be missed in some NYS lakes by discontinuing sampling after the end of October. Conductivity readings overall were higher in deep lakes, although this is may be an artifact of the sampling set (there are more CSLAP deep lakes in areas that “naturally” have harder water)

Lake Use Variability

Conductivity readings are substantially higher for lakes used primarily for contact recreation (Class B), and somewhat higher for lakes used for drinking water with some treatment (Class A). However, this is probably more reflective of geographical differences (there are relatively more softwater CSLAP lakes in the Adirondacks, which tend to have more Class A or Class AA lakes, at least in CSLAP, and more Class B lakes are found in hardwater regions) than any *de facto* connection between conductivity and lake usage.

Color

Annual Variability

The color of most CSLAP lakes has varied from year to year. The year with the lowest color readings, 1993, had "normal" levels of precipitation, although three of the years with the highest color readings (1992, and 2002 through 2004) were wet, and the least colored waters generally occurred during dry conditions. Most lake samples (92%) correspond to water color readings too low (< 30 ptu) to significantly influence water clarity. Color readings were much higher in 2004 than in any other CSLAP sampling season. Given that color readings were also higher in 2002 and 2003, the increase in color may be attributable in part to the shift in laboratories, which occurred prior to the 2003 sampling season.

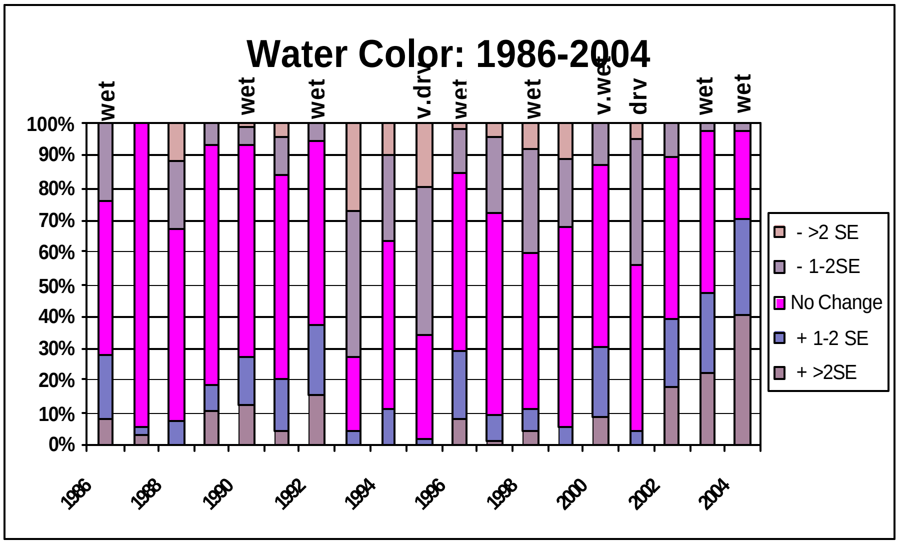


Figure 8a. *Annual Change from "Normal" Color in CSLAP Lakes (SE = Standard Error)*

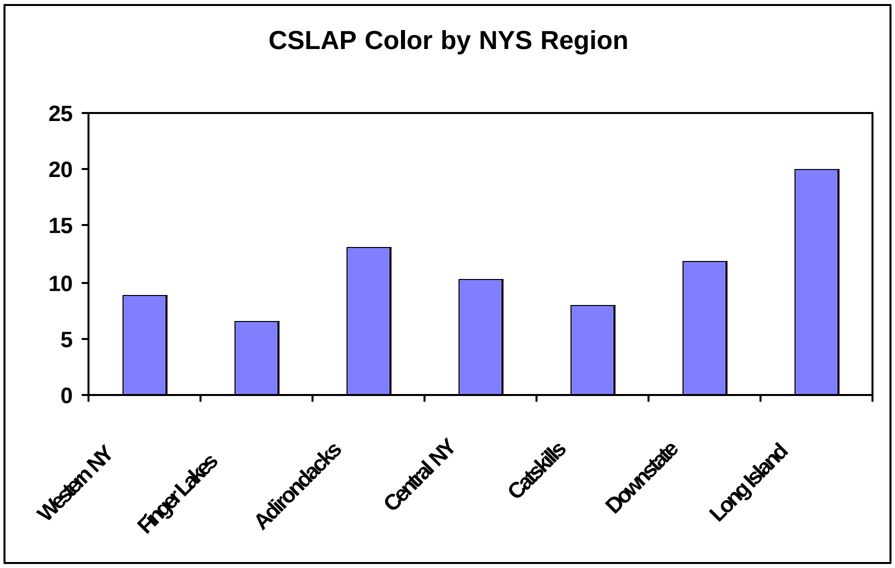


Figure 8b. *Color in CSLAP Lakes by NYS Region*

What Was Expected in 2005?

As noted above, color readings have generally been higher during wet years, and readings have been higher in the last three years, perhaps due to slightly different analytical methodology. Since 2005 generally corresponded to a wet year, it is likely that color readings in 2005 will at least be higher than the long-term average, although readings may not be higher than in 2004, which was also generally a wet year.

And What Happened at Eagle Lake in 2005?

Color readings in Eagle Lake have steadily increased over the last five years, but all readings continue to be fairly low. This long term pattern has been consistent with the pattern found in many CSLAP lakes, and may reflect both wetter weather and the shift in laboratories in 2002.

Statewide Variability:

Water color is highest in Long Island and the Adirondacks, and lowest in the Finger Lakes, Catskill and Western NY regions. This is mostly coincident with the statewide conductivity distribution (with softwater lakes more likely to be colored), and both seem to be largely consistent with the distribution of these lakes within New York State (in other words, the CSLAP dataset may be a representative cross-section of NYS lakes as related to color).

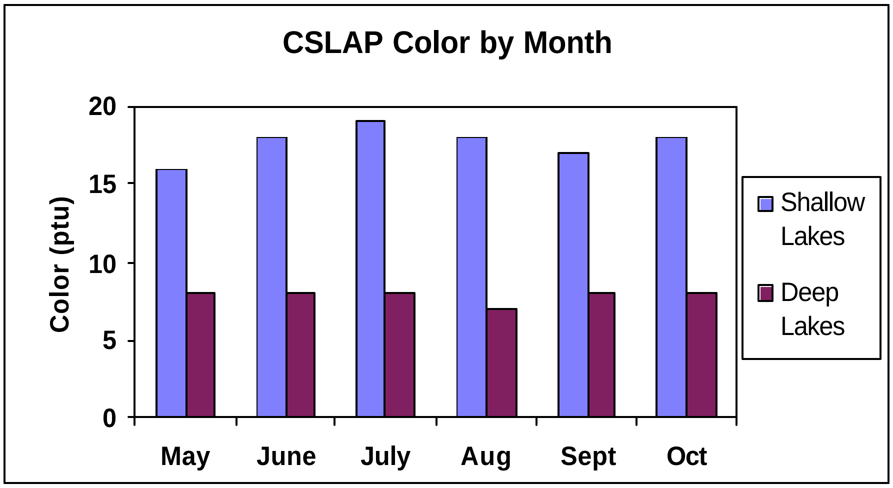


Figure 8c. *Color in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

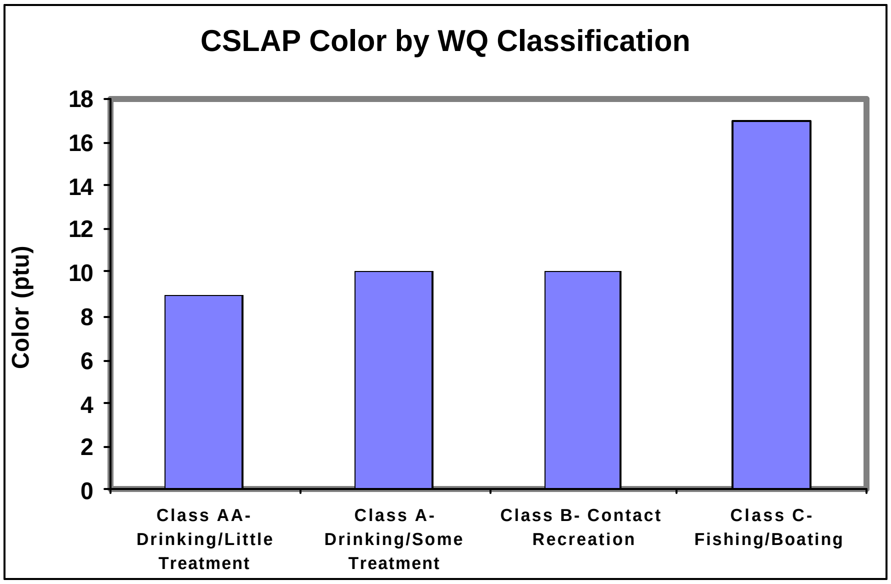


Figure 8d. *Color in CSLAP Lakes by Lake Use*

Seasonal Variability:

Color readings are significantly higher in shallow lakes than in deepwater lakes; these readings increase from spring to summer in these shallower lakes (perhaps due to dissolution of organic material, including algae, and wind-induced mixing during the summer) and then drop off again in late summer into the fall. Color generally follows the opposite trend in deeper lakes, with slightly decreasing levels perhaps due to more particle setting in the summer and remixing in the fall, although the seasonal trend in the deeper lakes is not as pronounced as in shallow lakes.

Lake Use Variability

Color readings are substantially higher for lakes used primarily for non-contact recreation (Class C), but this is probably more reflective of morphometric differences, for Class C lakes tend to be shallow lakes (mean depth = 4 meters), while the other classes tend to be deeper lakes (mean depth = 9 meters). However, the elevated color readings correspond to elevated levels of dissolved organic matter, and may also reflect impediments (via economically viable water treatment, aesthetics, and potential formation of hazardous compounds during chlorination) to the use of these waters for potable water.

Nitrate

Annual Variability

Evaluating nitrate in CSLAP lakes is confounded by the relative lack of nitrate data for many sampling seasons (it was analyzed in water samples at a lower frequency, or not at all, in many years), the high number of undetectable nitrate readings, and some changes in detection levels. The limited data indicated that nitrate was highest in 1986 and 1989, two early CSLAP years in which nitrate was analyzed more frequently (including a relatively large number of early season samples), and in 2004, which corresponded to the use of a new analytical tool. Readings were lowest in 1995, 2002 and 2003. Although nitrate levels are probably closely related to winter and spring precipitation levels (due to the higher nitrate readings in snowpacks), this is not apparent from Figure 9a. No readings have approached the state water quality standard (= 10 mg/l) in any CSLAP sample.

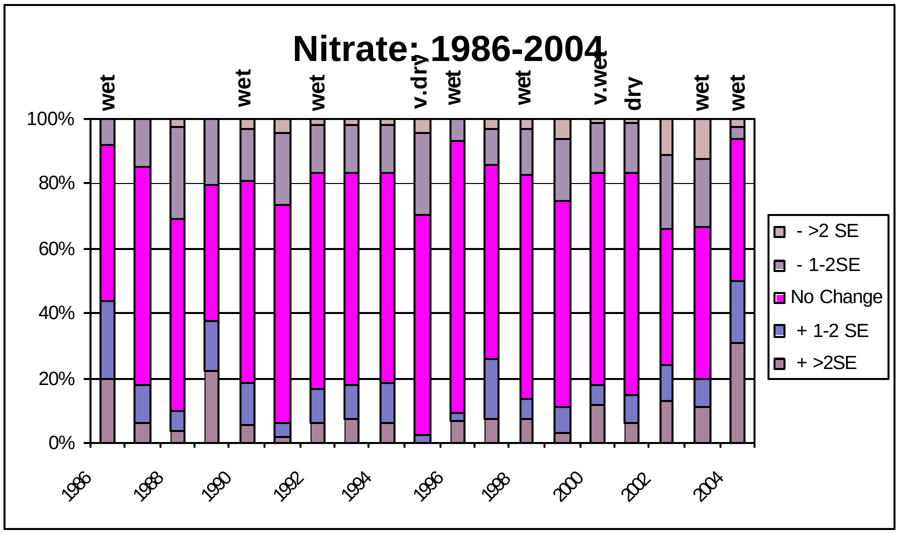


Figure 9a. *Annual Change from "Normal" Nitrate in CSLAP Lakes (SE = Standard Error)*

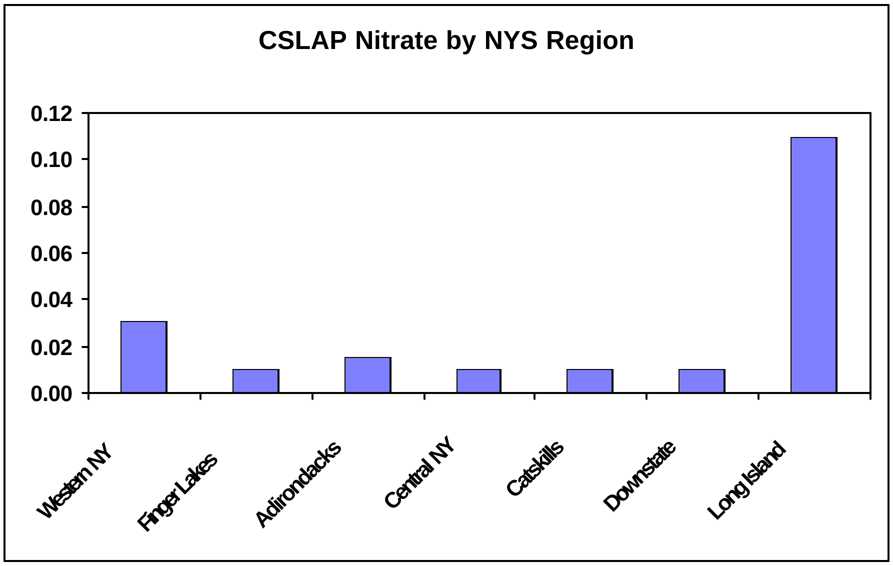


Figure 9b. *Nitrate in CSLAP Lakes by NYS Region*

What Was Expected in 2005?

Nitrate readings have been very unpredictable, although at nearly all times, all nitrate readings are small. Given the higher readings found in 2004, it is presumed that nitrate readings may also be slightly higher in 2005.

And What Happened at Eagle Lake in 2005?

Nearly all nitrate readings in Eagle Lake have been near the analytical detection limit, and there does not appear to be a strong correlation between changing weather patterns (at least precipitation) and changes in nitrate readings in Eagle Lake.

Statewide Variability:

Nitrate levels are highest in Long Island, Western NY, and the Adirondacks, and lowest in the other NYS regions. However, none of these regions demonstrate readings that are particularly high. Readings from individual lakes in the Long Island, Madison County, and the Adirondacks (spring only) are often elevated, although still well below water quality standards.

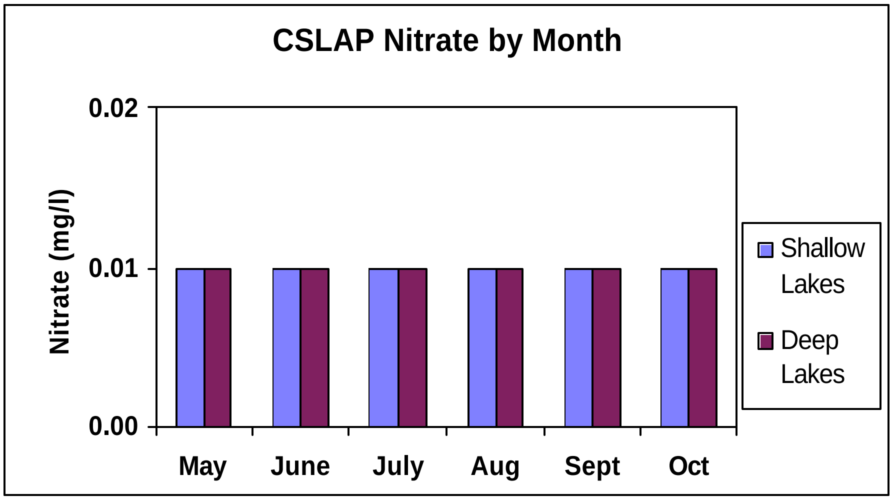


Figure 9c. *Nitrate in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

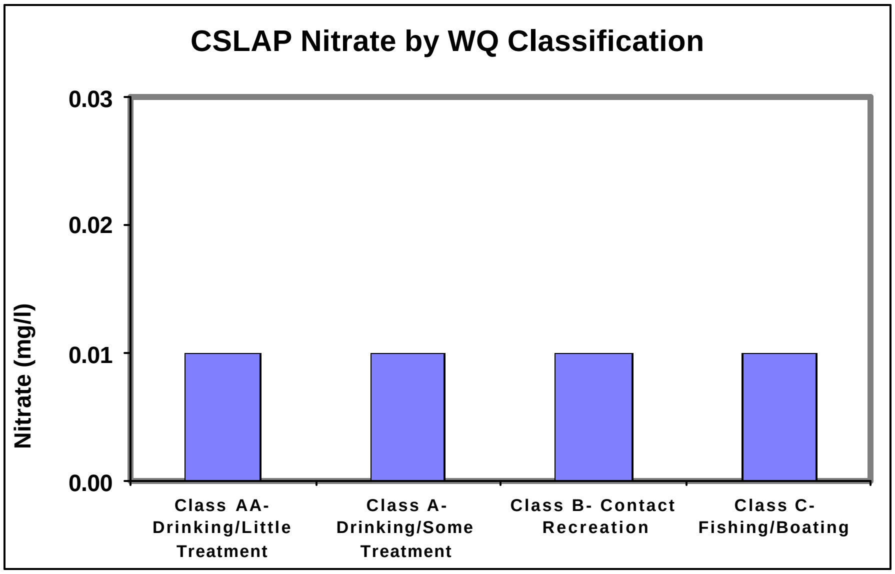


Figure 9d. *Nitrate in CSLAP Lakes by Lake Use*

Seasonal Variability:

Nitrate readings are not seasonally variable, as indicated in Figure 8c. However, in some individual lakes, in the regions listed above, nitrate is often detectable until early summer, and then undetectable through the rest of the sampling season (the large number of lakes with undetectable nitrate levels throughout the year overwhelm the statistics in Figure 9c).

Lake Use Variability

Nitrate readings appeared to be identical for all classes of lake uses, as indicated in Figure 8d. Higher early season nitrate readings are found in some lakes influenced by the melting of large winter snowpacks, such as some Class AA and A lakes in the Adirondacks, but these statistics cannot be easily teased from datasets strongly influenced by the large number of lakes with undetectable nitrate readings).

Note- there is still insufficient ammonia and total dissolved nitrogen data (only three years) to include in these parameter-specific evaluations.

Trophic Indicators: Water Clarity

Annual Variability

Water clarity (transparency) has varied annually in most CSLAP lakes. There appears to be at least a weak correlation between clarity and precipitation- the highest clarity occurred during the driest year (1995), and the lowest clarity during the two wettest years (1996 and 2000). There are no significant broad statewide water clarity trends, although (as described in other portions of this report), clear trends do exist on some lakes. The majority of water clarity readings in CSLAP lakes (56%) correspond to *mesotrophic* conditions (clarity between 2 and 5 meters), with 27% corresponding to *eutrophic* conditions (Zsd < 2) and 17% corresponding to *oligotrophic* conditions (Zsd > 5).

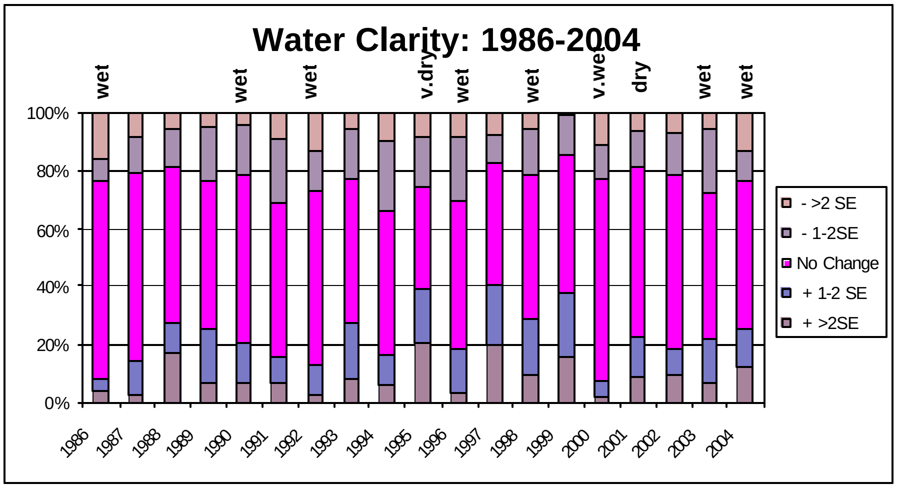


Figure 10a. *Change from “Normal” Water Clarity in CSLAP Lakes (SE = Standard Error)*

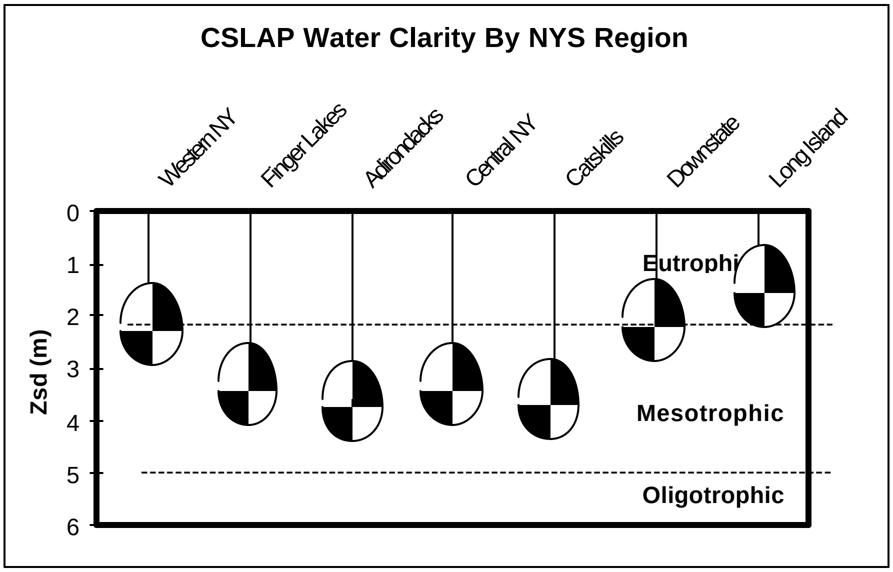


Figure 10b. *Water Clarity in CSLAP Lakes by NYS Region*

What Was Expected in 2005?

While there is a correlation between weather and water transparency readings, this only appears to occur with the extremes- very dry or very wet conditions. Since in general 2005 did not exhibit consistently strong weather patterns- it was very wet in the summer upstate, but dry downstate, and dry in the spring throughout most of the state- it is difficult to identify expected conditions. However, since water clarity seems to be lowest during wet years, it is likely that more lakes would exhibit slightly lower water transparency readings in 2005.

And What Happened at Eagle Lake in 2005?

Water clarity readings in Eagle Lake have generally decreased over the last six years, but algae and nutrient levels have been very consistent over this period. This suggests that the changes observed in water clarity may be within the normal range of variability for Eagle Lake, and may be driven by wetter weather in recent years.

Statewide Variability:

As expected, water clarity is highest in the Adirondacks, Catskills, and Finger Lakes regions, and lowest in Long Island, Downstate, and Western NY. The differences are more pronounced (at least for the Adirondacks) when "naturally" colored lakes are not considered. However, except for Long Island (for which water clarity is at least partially limited by the shallow water depth), the "typical" lake in each of these regions would be classified as *mesotrophic*.

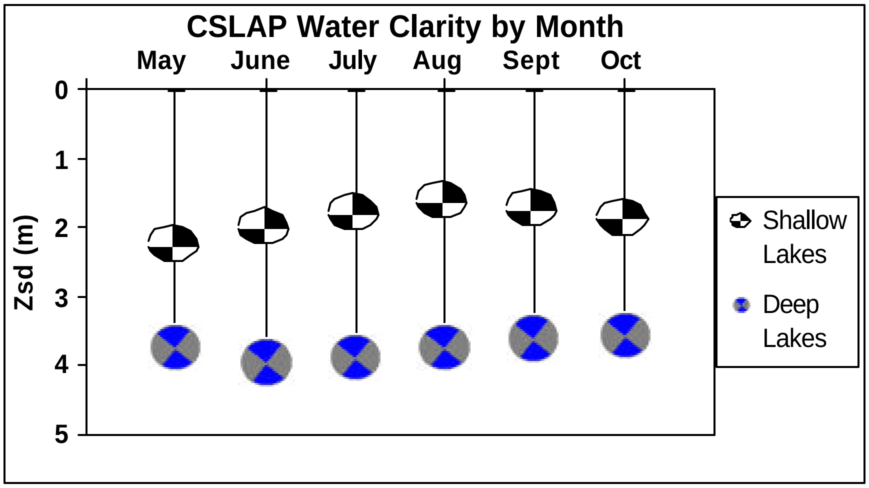


Figure 10c. *Water Clarity in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

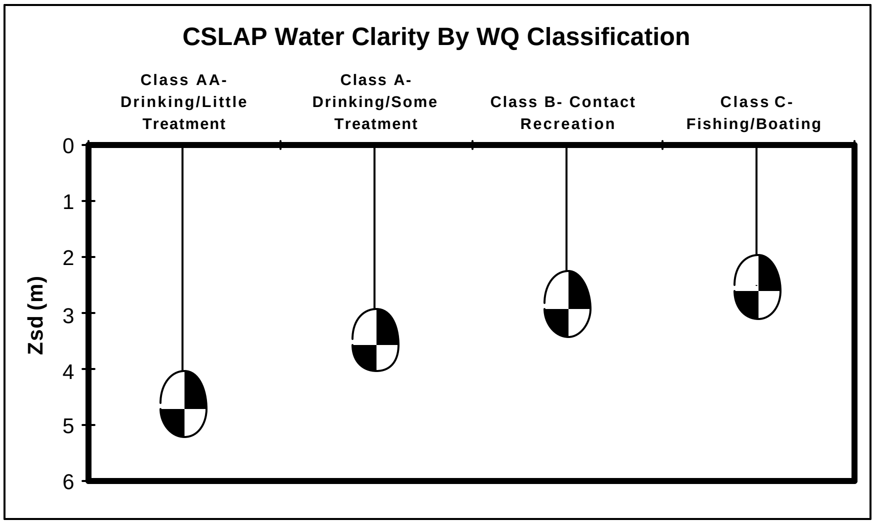


Figure 10d. *Water Clarity in CSLAP Lakes by Lake Use*

Seasonal Variability:

Water clarity readings are lower, as expected, in shallow lakes, even when water depth does not physically limit a water clarity measurement. Transparency decreases in both shallow and deep lakes over the course of the sampling season (the drop in clarity in shallower lakes is somewhat more significant), although clarity readings increase from spring to early summer in deeper CSLAP lakes. Water transparency rebounds slightly in shallower lakes in the fall, probably due to a drop in nutrient levels. The lack of "rebound" in deeper lakes may be due to occasional fall algal blooms in response to surface nutrient enrichment after lake turnover (see below)

Lake Use Variability

Water transparency decreases as the "sensitivity" of the lake use decreases, with higher clarity found in lakes used for potable water (Class AA), and lower clarity found in lakes used primarily for contact and non-contact (fishing and boating) recreation. As with many of the other water quality indicators, this is due to both geographical and morphometric (depth) differences, although the original designation of these uses may also reflect these measurable and visually apparent water quality differences.

Trophic Indicators: Phosphorus (TP)

Annual Variability

Total phosphorus (TP) has varied annually in most CSLAP lakes. As with clarity, there appears to be at least a weak correlation between phosphorus and precipitation-the highest phosphorus concentrations occurred during 1991, 1996, 1998, 2000, and 2003, the latter four of which corresponded to wet years. However, the lowest readings, from 1989, 1997, and 2002, did not correspond to unusually dry years, and 2004 was a fairly wet year. The majority of phosphorus readings in CSLAP lakes (39%) correspond to *mesotrophic* conditions (clarity of 2 to 5m), with 27% corresponding to *eutrophic* conditions (< 2m clarity) and 34% corresponding to *oligotrophic* conditions (> 5m clarity); the latter is a much higher percentage than the trophic designation for water clarity.

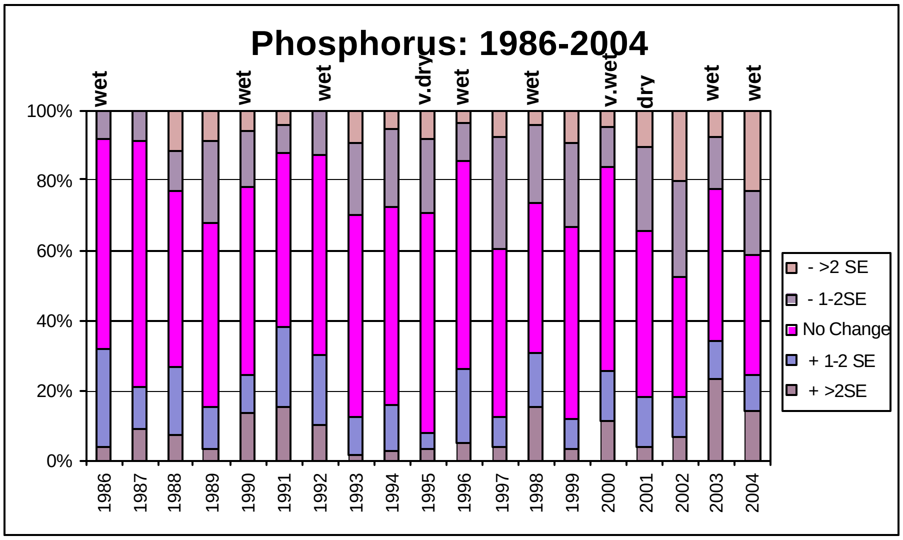


Figure 11a. *Annual Change from "Normal" TP in CSLAP Lakes (SE = Standard Error)*

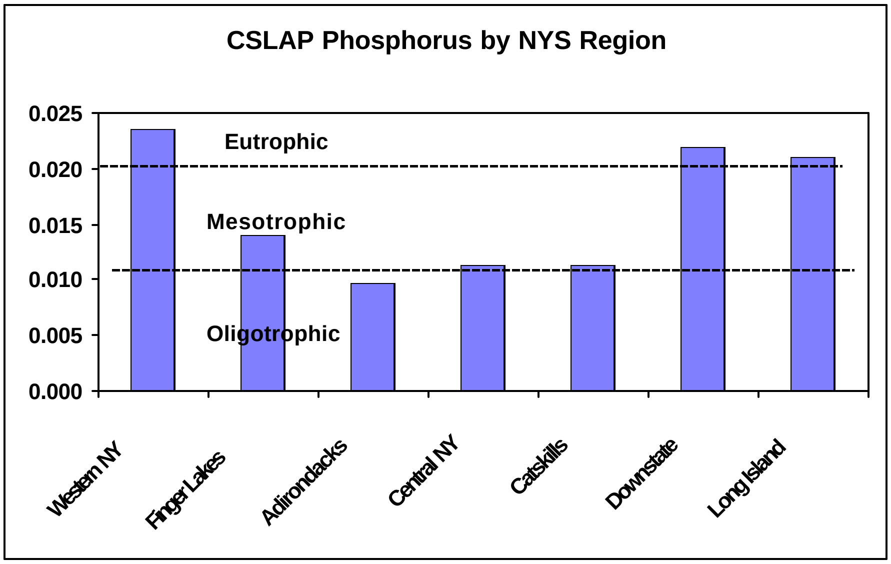


Figure 11b. *TP in CSLAP Lakes by NYS Region*

What Was Expected in 2005?

As noted above, there is not a strong correlation between weather and total phosphorus, and there does not appear to be a consistent long-term pattern in the total phosphorus data. The data also does not appear to be significantly laboratory-dependent, at least as apparent in Figure 10a. As such, it is difficult to predict whether phosphorus levels might be expected to be higher or lower in most CSLAP lakes in 2005.

And What Happened at Eagle Lake in 2005?

Phosphorus readings in Eagle Lake have been very stable over the last six years, including 2005, and it is very clear that any change from sample to sample and year to year has been within the normal range of variability for Eagle Lake.

Statewide Variability:

As expected, nutrient levels are lowest in the Adirondacks, Catskills, and Central New York (where clarity is highest) and highest in Long Island, Downstate, and Western NY, where clarity is lowest. In the latter three regions, the "typical" lake in each of these regions would be classified as *eutrophic*, while only in the Adirondacks could most lakes be described as *oligotrophic*, based on nutrients.

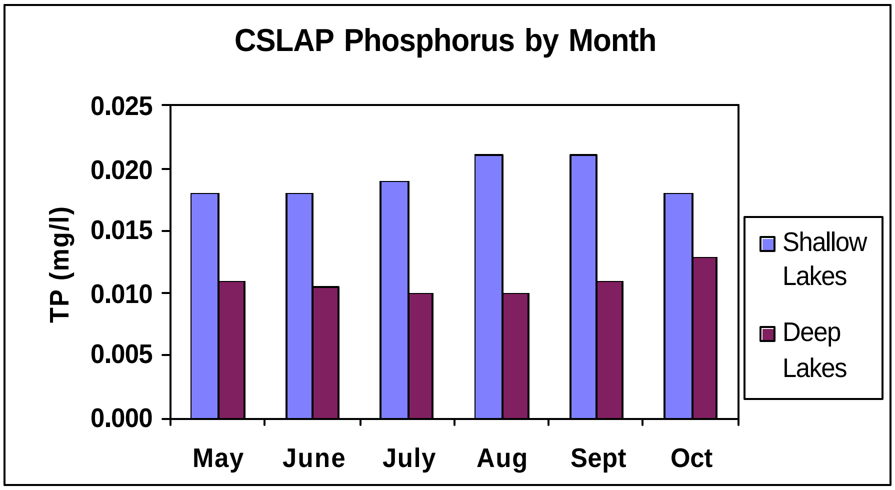


Figure 11c. *TP in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

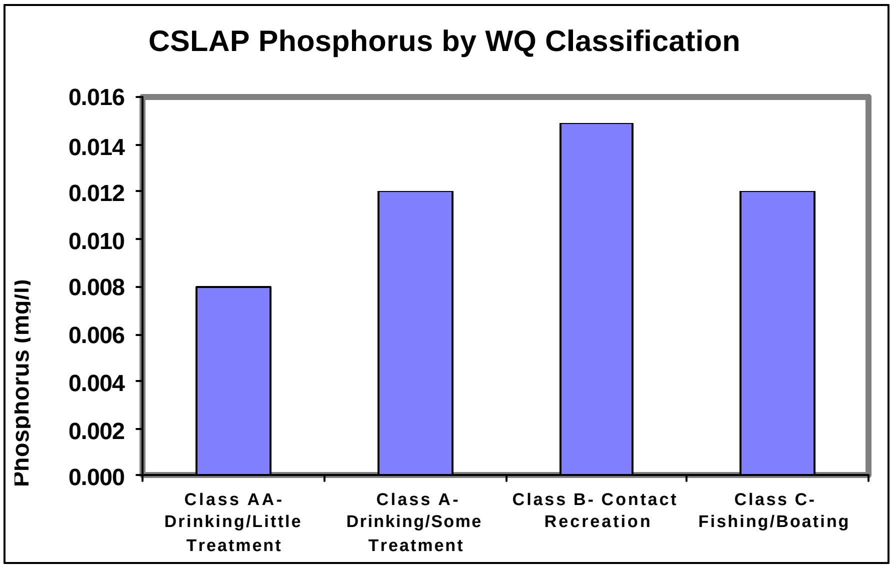


Figure 11d. *TP in CSLAP Lakes by Lake Use*

Seasonal Variability:

Nutrient levels are higher, as expected, in shallow lakes, and phosphorus levels increase in shallow lakes over the course of the sampling season, until dropping in the fall. However, phosphorus levels in deeper lakes are lower and decrease slightly through July, then increase into the fall. The latter phenomenon is due to surface nutrient enrichment after lake turnover (high nutrient water from the lake bottom, due to release of nutrients from poorly oxygenated lake sediments in the summer, migrates to the lake surface when the lake destratifies).

Lake Use Variability

Phosphorus readings are lower in lakes used for minimally treated potable water intakes (Class AA), and are higher for other lake uses. Although Class B waters are utilized for a "higher" lake use than Class C lakes (contact recreation versus non-contact recreation), these lakes actually have higher nutrient levels, perhaps reflecting the influence of deepwater nutrient enrichments (these lakes are typically deeper) and the "unofficial" use of Class C waters for bathing and contact recreation.

Trophic Indicators: Chlorophyll *a* (Chl.a)

Annual Variability

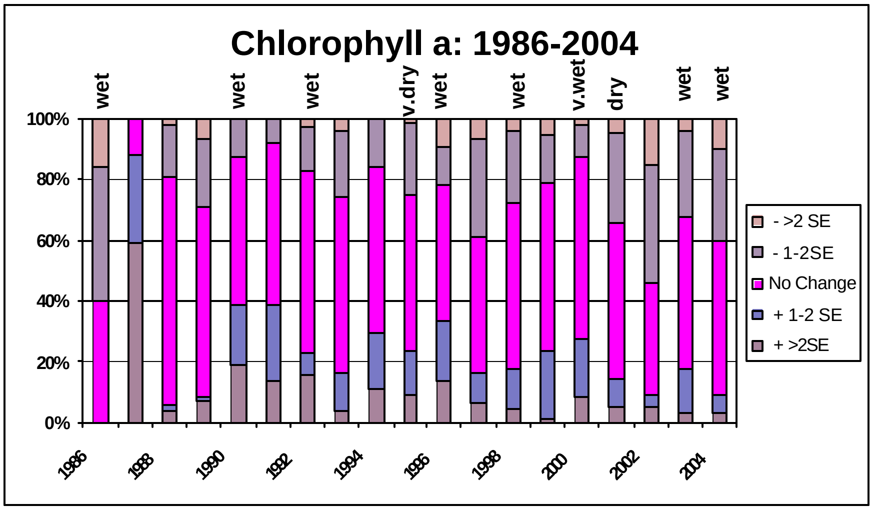


Figure 12a. *Annual Change from "Normal" Chlorophyll a in CSLAP Lakes (SE = Standard Error)*

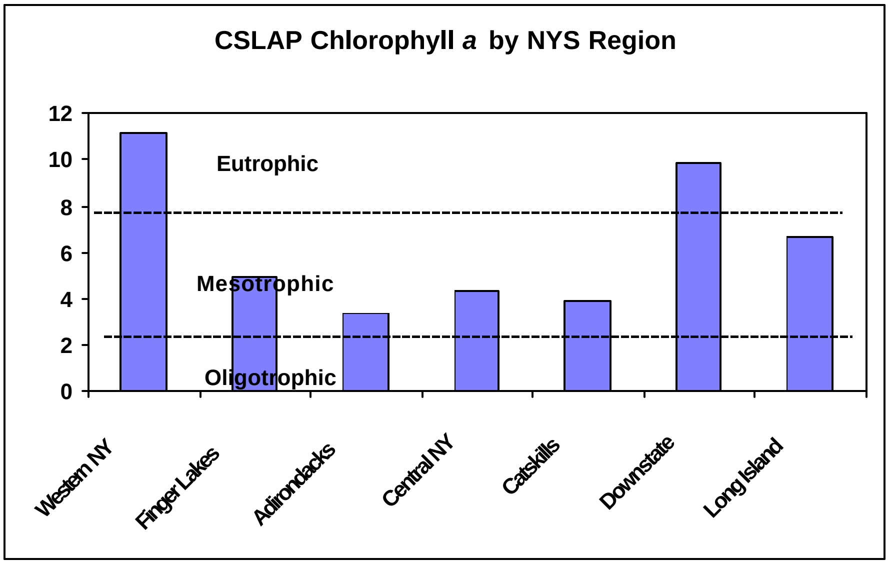


Figure 12b. *Chlorophyll a in CSLAP Lakes by NYS Region*

Chlorophyll *a* (Chl.a) has varied in most CSLAP lakes more significantly that the other trophic indicators, as is typical of biological indicators (which tend to grow "patchy"). With the exception of the very high readings in 1987 (probably due to a lab "problem"), the highest phosphorus levels occurred during 1990, 1996, and 2000, corresponded to wet years. However, the lowest readings, from 1989, 1997, and 2001, 2002, 2003, and 2004 did not correspond to unusually dry years (except in 2001). The consistently lower chlorophyll readings in the last three years may also correspond to the shift in laboratories, although both labs use the same analytical methodology. The near majority of chlorophyll readings in CSLAP lakes (49%) correspond to *mesotrophic* conditions (clarity between 2 and 5 meters), with 33% corresponding to *eutrophic* conditions (Zsd < 2) and 18% corresponding to *oligotrophic* conditions (Zsd > 5); these percentages are more like those for water clarity rather than those for phosphorus.

What Was Expected in 2005?

It is likely that chlorophyll readings would be lower than the long-term average for most CSLAP lakes in 2005, due to consistently lower readings coming from the same laboratory in the last several years. However, the shift to a higher sampling and analytical volume in 2005 may remove the "artificially" low readings that came from inaccurate volumetric measurements. Since 2005 was also generally a hotter and "stickier" year than is typical at most NYS lakes, it would not be surprising to see higher-than-usual chlorophyll readings, at least relative to the last several years. However, this did not consistently occur in previously hot/humid years.

And What Happened at Eagle Lake in 2005?

Algae readings in Eagle Lake have been essentially identical for the last five years, and all readings have been indicative of lakes with very low algal productivity.

Statewide Variability:

As with phosphorus, chlorophyll levels are lowest in the Adirondacks, Central New York, and the Catskills (where clarity is highest) and highest in Long Island, Downstate, and Western NY, where clarity is lowest. In the latter two regions, the “typical” lake in each of these regions would be classified as *eutrophic*, while lakes in the other regions would be described as *mesotrophic*.

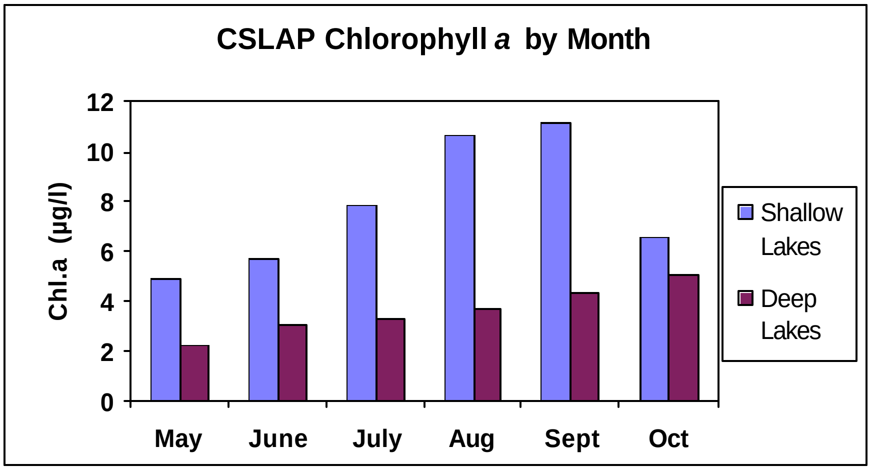


Figure 12c. *Chlorophyll a in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

Seasonal Variability:

Chlorophyll levels are higher, as expected, in shallow lakes, and increase in both shallow and deep lakes over the course of the sampling season, with chlorophyll readings dropping in shallow lakes in the fall. The steady increase in chlorophyll in both shallow and (to a lesser extent) deep lakes is consistent with the change in phosphorus over the same period, due to steady migration of nutrients released from poorly oxygenated lake sediments during the summer and especially in the fall (as well as drier weather, increased lake use, and other factors).

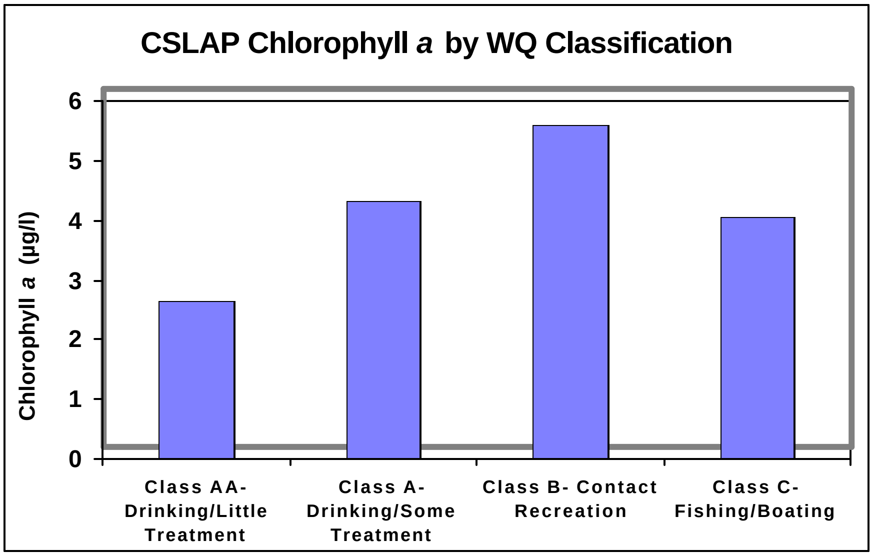


Figure 12d. *Chlorophyll a in CSLAP Lakes by Lake Use*

Lake Use Variability

Chlorophyll readings are lower in lakes used for minimally treated potable water intakes (Class AA), and are higher for other lake uses. Although Class B waters are utilized for a “higher” lake use than Class C lakes (contact recreation versus non-contact recreation), these lakes actually have similar levels, perhaps reflecting the influence of deepwater nutrient enrichments (these lakes are typically deeper) and the “unofficial” use of Class C waters for bathing and contact recreation. This is similar to the use pattern for phosphorus.

Water Quality Assessment (QA on the Perception Form)

Annual Variability

Water quality assessments (the perceived physical condition of the lake, or QA on the use impairment surveys) were least favorable in the very wet (2000) and very dry (1995) years, suggesting the lack of correlation between weather and perceived water quality (although 1995 was also the year with the most "improved" conditions). The general perception of CSLAP lakes in 2004 indicated no strong changes in perceived water quality, whether favorable or unfavorable. Although there is a strong connection between measured and perceived water clarity in most CSLAP lakes, this is not closely reflected in the comparison of Figures 10a and 13a.

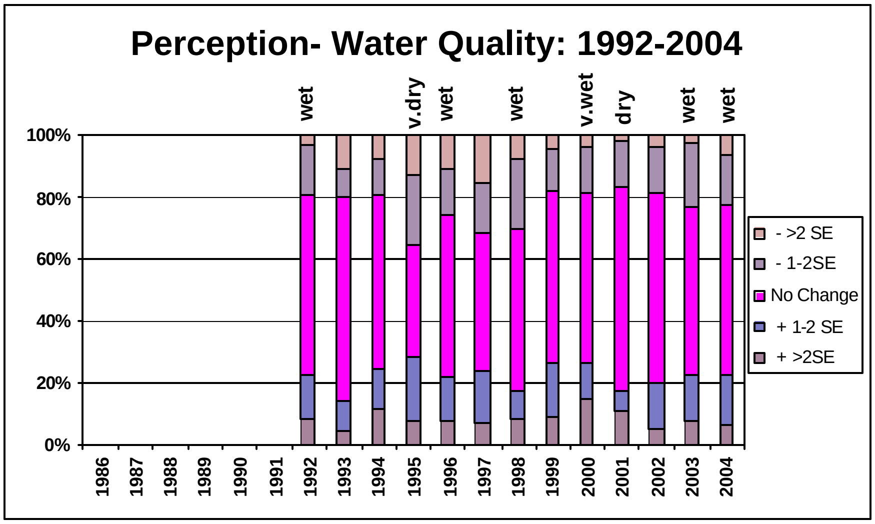


Figure 13a. *Annual Change from "Normal" Water Quality Assessment in CSLAP Lakes (SE = Standard Error)*

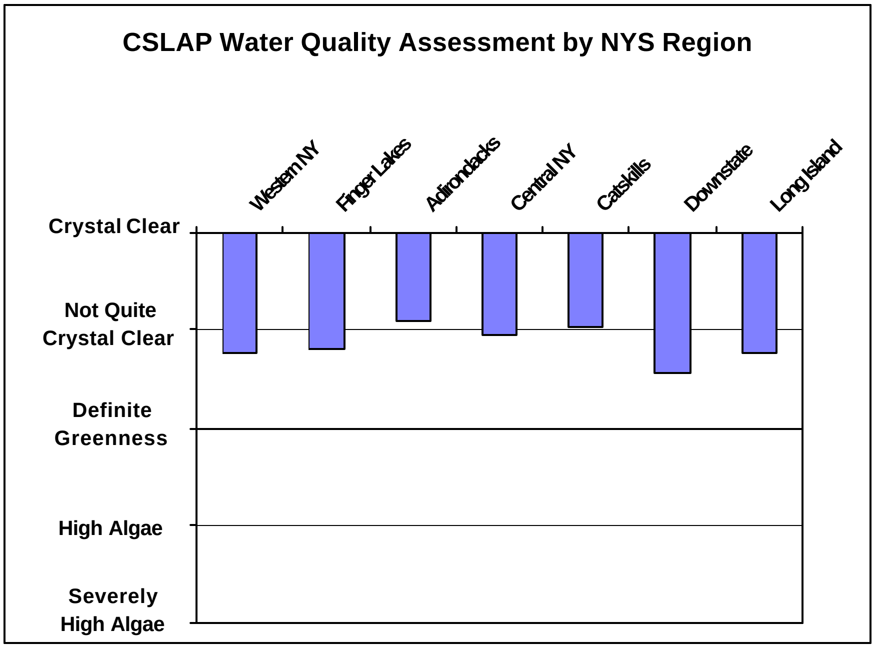


Figure 13b. *Water Quality Assessment in CSLAP Lakes by NYS Region*

What Was Expected in 2005?

There was not a strong connection between precipitation (within mostly normal weather patterns) and perceived water quality, or even between measured and perceived water quality conditions. As such, it is difficult to identify expected conditions in 2005, although since water clarity readings were mostly within normal ranges, it is reasonable to expect that perceived water quality conditions would also largely be unchanged.

And What Happened at Eagle Lake in 2005?

Water quality assessments in Eagle Lake have not changed in any sample since 2000, and the lake has been consistently described as "not quite crystal clear" during each CSLAP sampling session. This is consistent with the stable water clarity readings, but these assessments continue to be slightly less favorable than in other CSLAP lakes with similar water transparency readings.

Statewide Variability:

The most favorable water quality assessments (at least in support of contact recreation) occurred in the Adirondacks, Catskills, and Central New York, as expected, and water quality assessments were slightly less favorable in Downstate, Western NY, and Long Island. This is mostly consistent with the water clarity readings in these regions. However, since the difference between the most favorable (Adirondacks) and least favorable (Downstate) assessments is smaller that the measured water transparency differences, this suggests that the relatively low water clarity in the latter regions may be considered "normal" by lake residents.

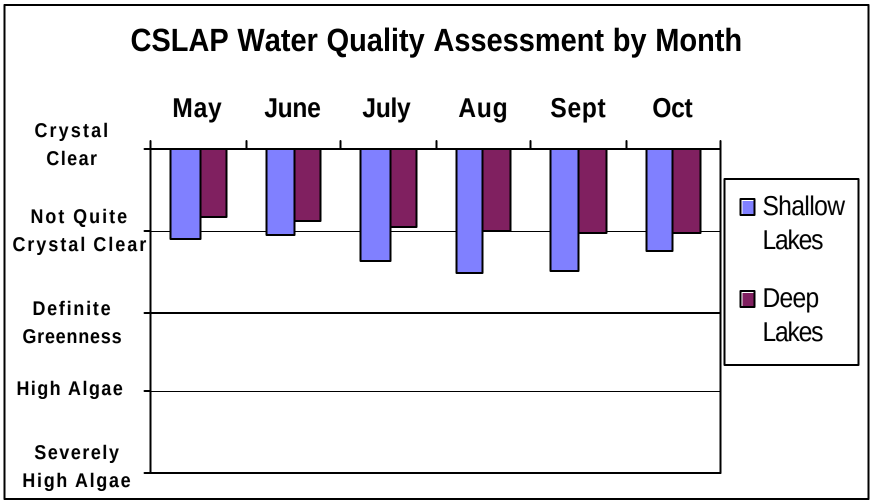


Figure 13c. *Water Quality Assessment in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

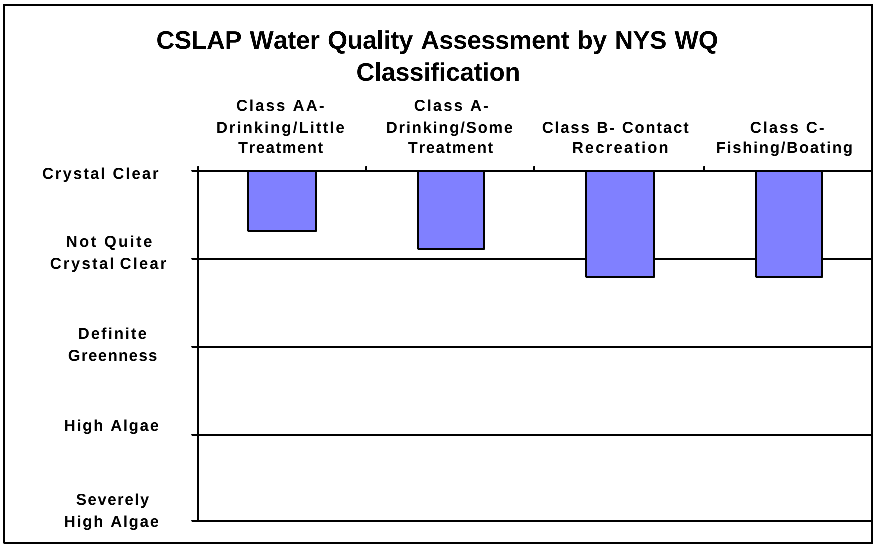


Figure 13d. *Water Quality Assessment in CSLAP Lakes by Lake Use*

Seasonal Variability:

Water quality assessments become less favorable as the summer progresses in both deep and (especially) shallow lakes, coincident with similar patterns for the trophic indicators. However, the seasonal changes in these assessments are not very large. These assessments become slightly more favorable in shallow lakes in the fall, consistent with the improved (measured) water clarity, although overall water quality assessments are less favorable all year in shallow lakes.

Lake Use Variability

Water quality assessments are more favorable in lakes used for potable water intakes (Class AA and Class A), and less favorable for other lake uses. Although Class B waters are utilized for a "higher" lake use than Class C lakes (contact recreation versus non-contact recreation), these lakes actually have similar water quality assessments, perhaps reflecting the influence of deepwater nutrient enrichments (these lakes are typically deeper) and the "unofficial" use of Class C waters for bathing and contact recreation. This is similar to the pattern seen for the trophic indicators.

Aquatic Plant (Weed) Assessment (QB)

Annual Variability

Aquatic plant assessments (the perceived extent of weed growth in the lake, or QB on the use impairment surveys) indicated that weeds grew most significantly in 1995 (very dry conditions) and 2000 (very wet conditions), and weed growth was less extensive in 1994 and 1999, suggesting the lack of correlation between weather and weed densities. The highest weed growth occurred when the perceived physical condition (clarity) of the lake was also least favorable- these conditions may offer a selective advantage to invasive or exotic weeds (such as *Myriophyllum spicatum*).

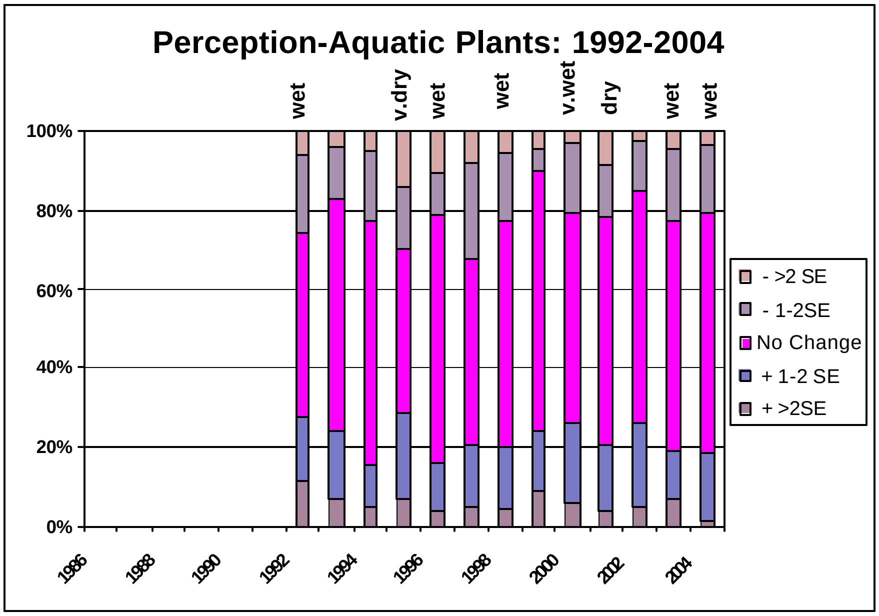


Figure 14a. *Annual Change from "Normal" Weed Assessment in CSLAP Lakes (SE = Standard Error)*

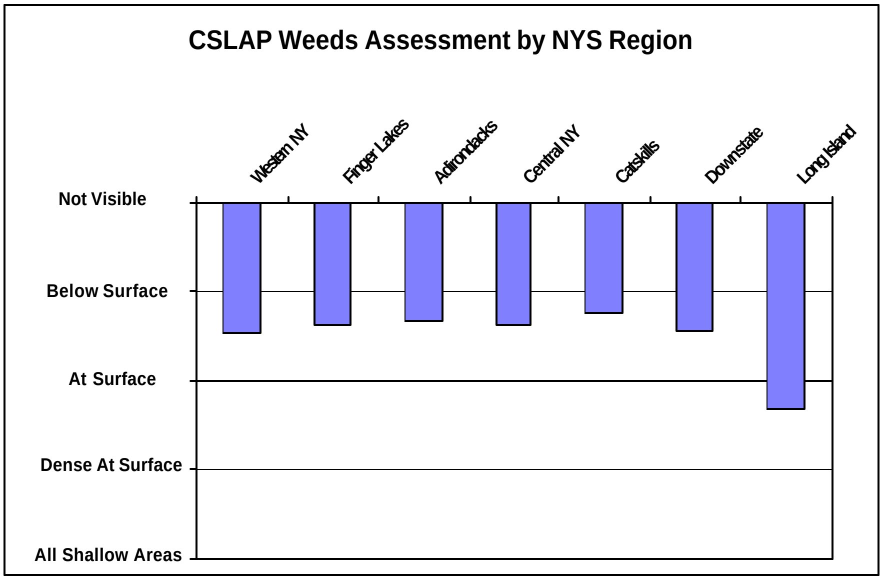


Figure 14d. *Weed Assessment in CSLAP Lakes by Lake Use*

What Was Expected in 2005?

There was not a strong connection between precipitation and extent of weed growth, at least as measurable through CSLAP. This makes it difficult to identify expected conditions in 2005. As is always the case, it is likely that the extent of weed growth in any particular CSLAP lake in 2005 is unrelated to the extent of weed growth in most other NYS lakes, and is not readily predictable given historical patterns of aquatic plant growth in that lake.

And What Happened at Eagle Lake in 2005?

Aquatic plants densities and coverage in Eagle Lake in the last several years have been fairly stable, or at least submergent plant communities could consistently be described as growing to the lake surface throughout the sampling season during each of these years. It is not known if actual plant communities have varied over this period, although it is assumed that invasive plant growth continues to be associated with Eurasian watermilfoil.

Statewide Variability:

Aquatic plant growth was most significant in Long Island (and to a lesser extent Downstate and Western NY) and least significant in the Catskills and Adirondacks area. The former may have a larger concentration of shallow lakes (Long Island) or preponderance of exotic weeds (Downstate and Western NY), while the latter may correspond to deeper lakes or fewer instances of these invasive weeds, although it is also likely that invasive weed growth may be increasing in many lakes within these “less impacted” areas.

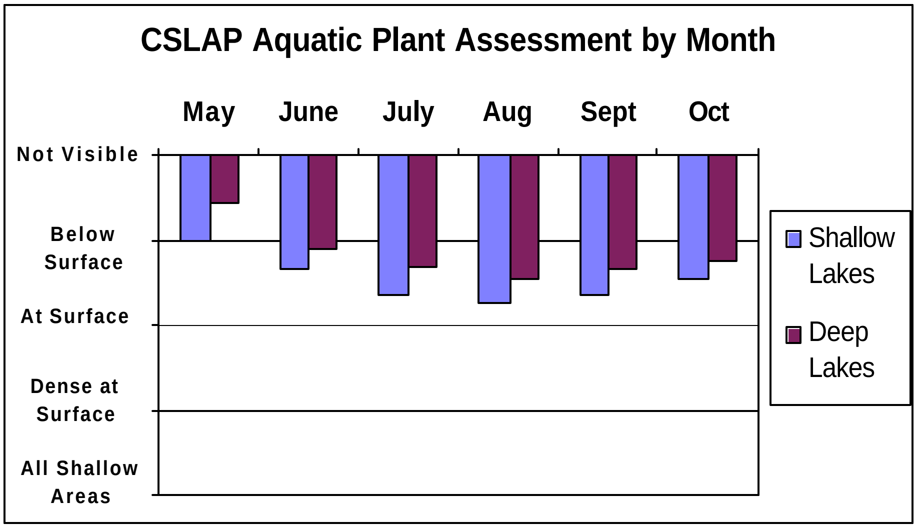


Figure 14c. *Weed Assessment in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

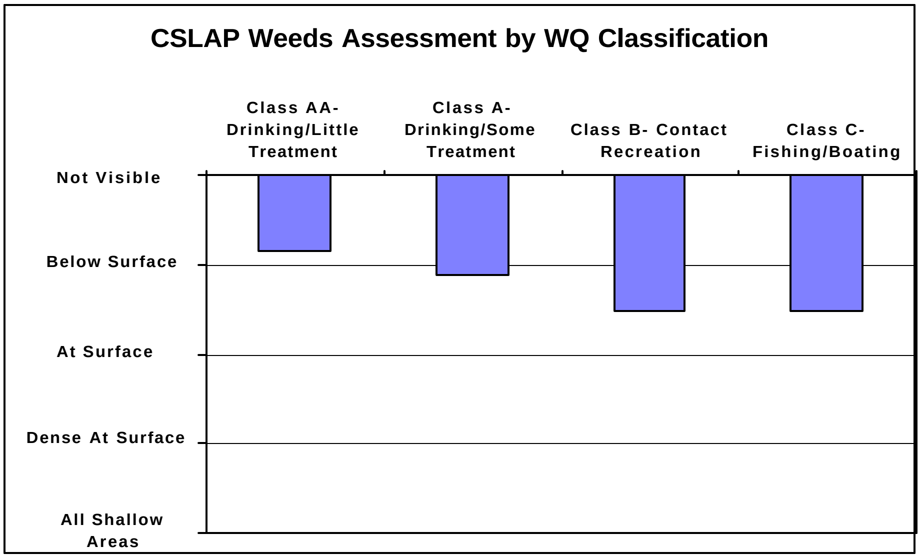


Figure 14d. *Weed Assessment in CSLAP Lakes by Lake Use*

Seasonal Variability:

As expected, aquatic plant densities and coverage increase seasonally (through late summer) in both shallow and deep lakes, with greater aquatic plant coverage and densities found in shallow lakes. Peak aquatic plant densities tend to occur in late summer. The variability from one lake to another (from very little growth to dense growth at the lake surface) is more pronounced later in the summer. Despite higher clarity in shallow lakes in the fall, aquatic plant coverage decreases, while the drop in fall plant coverage in deeper lakes is less pronounced.

Lake Use Variability

Aquatic plant coverage was more significant in Class B and Class C lakes than in other lakes, but this (again) is probably a greater reflection of geography or lake size and depth (Class B lakes tend to be found outside the high elevation areas in the Catskills and Adirondacks, and Class C lakes tend to be shallower than Class AA or Class A lakes).

Recreational Assessment (QC)

Annual Variability

Recreational assessments (the perceived recreational suitability of the lake, or QC on the use impairment surveys) have varied from year to year, with no clear long-term pattern. The most favorable assessments were in 1997, corresponding to the year with the lowest aquatic plant (weed) coverage. This was also among the years with the most favorable water quality assessments. The years with the most favorable water quality assessments (1995 and 1998) were among the years with the most favorable recreational assessments, despite higher than usual weed densities. This suggests that recreational assessments are influenced by both water quality conditions and aquatic plant densities. The extent of "normal" conditions (the middle bar in Figure 15a) has generally not changed significantly since perception surveys were first conducted in 1992.

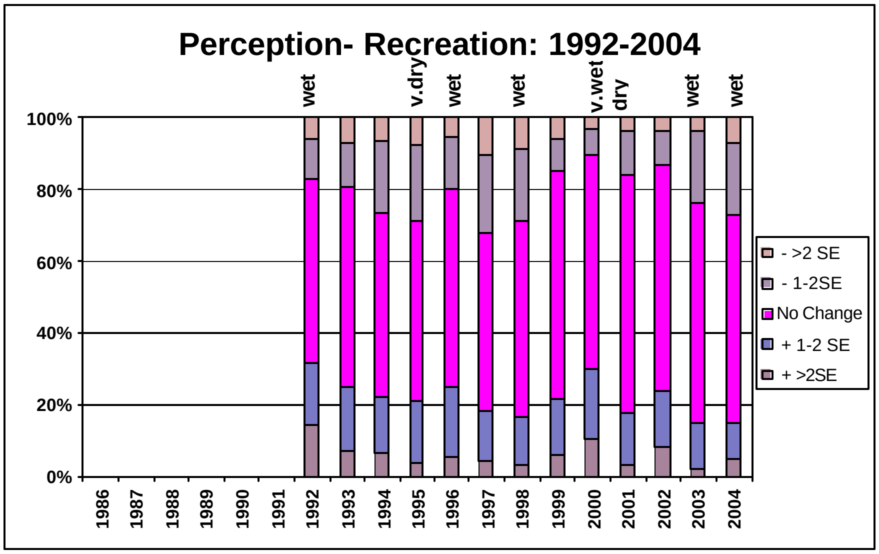


Figure 15a. *Annual Change from "Normal" Recreational Assessment in CSLAP Lakes (SE = Standard Error)*

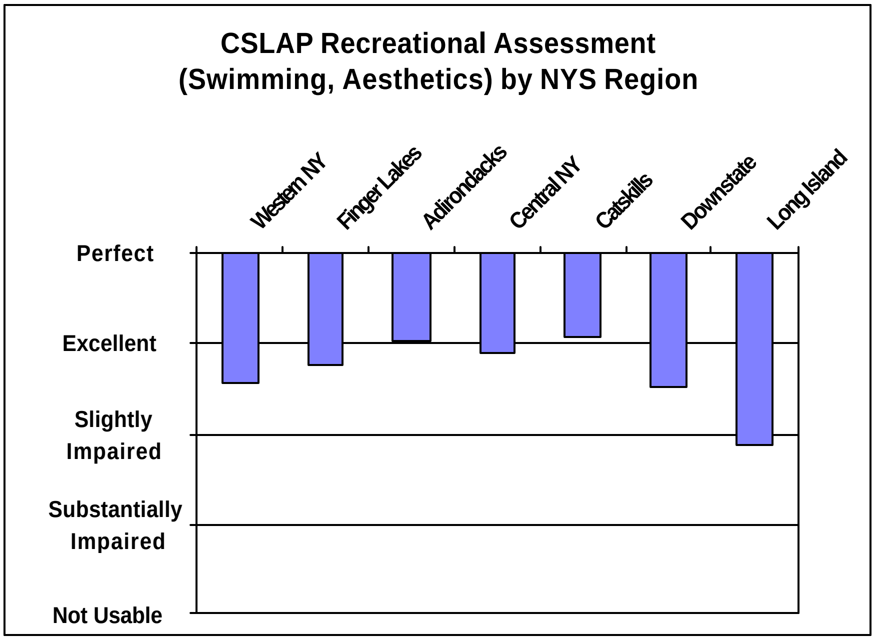


Figure 15b. *Recreational Assessment in CSLAP Lakes by NYS Region*

What Was Expected in 2005?

There was not a strong connection between precipitation (within mostly normal weather patterns) and perceived water quality, or even between measured and perceived water quality conditions. As such, it is difficult to identify expected conditions in 2005, although since water clarity readings were mostly within normal ranges, it is reasonable to expect that perceived water quality conditions would also largely be unchanged.

And What Happened at Eagle Lake in 2005?

Lake recreational assessments in Eagle Lake have been very stable over the last six years, with most recreational use impacts associated with invasive weed growth (probably Eurasian watermilfoil) or poor weather.

Statewide Variability:

Recreational assessments are most favorable in the Adirondacks and Catskills, and less favorable in Long Island and (to a lesser extent) Downstate and in Western New York. This appears to be in response to less favorable assessments of water quality and aquatic plant growth, respectively. Except for (the assessments in the small number of CSLAP lakes in) Long Island, overall recreational assessments in all regions are, in general, highly favorable.

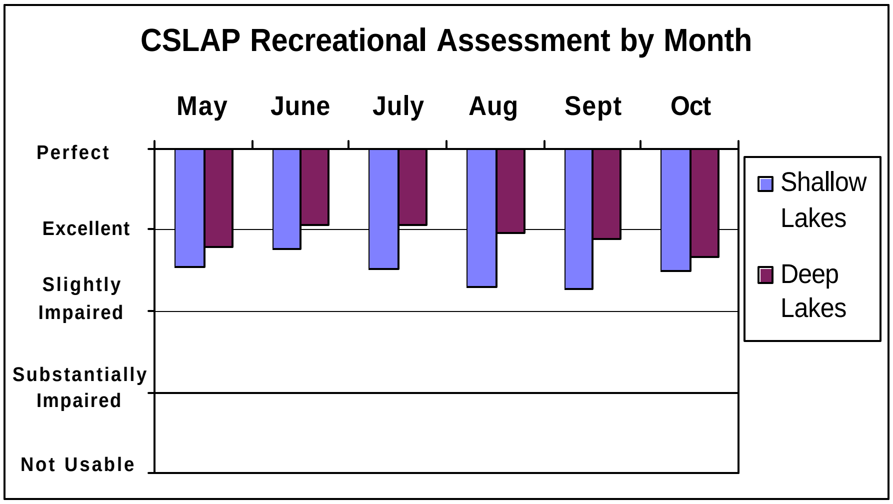


Figure 15c. *Recreational Assessment in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

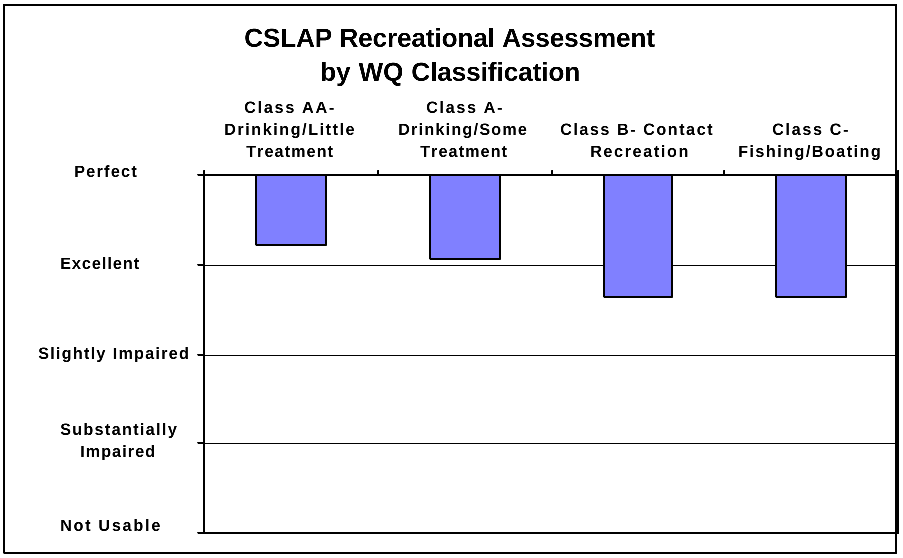


Figure 15d. *Recreational Assessment in CSLAP Lakes by Lake Use*

Seasonal Variability:

Recreational assessment in both shallow and deep lakes tends to improve from spring to early summer, and then degrade through the summer, improving in shallow lakes in the fall. As expected, this generally corresponds to seasonal increases in aquatic plant coverage in deep lakes, and also to seasonally degrading water quality in shallow lakes. Overall recreational assessments are more favorable in deep lakes every month of the sampling season, although the differences are less pronounced in late spring and early fall (and winter, when every lake looks nice!)

Lake Use Variability

Recreational assessment becomes less favorable as the designated lake use becomes less sensitive (drinking water to contact recreation), although recreational assessments of Class C lakes are only slightly less favorable than in Class AA and A lakes. This may be considered a validation of these classifications (recognizing, again, that many Class C lakes continue to fully support contact recreation and perhaps even potable water use).

V. EAGLE LAKE CSLAP WATER QUALITY DATA

CSLAP is intended to provide the strong database, which will help lake associations understand lake conditions and foster sound lake protection and pollution prevention decisions. This individual lake summary for **2005** contains two forms of information. The **raw data** and **graphs** present a <u>snapshot</u> or glimpse of water quality conditions at each lake. They are based on (at most) eight or nine sampling events during the summer. As lakes are sampled through CSLAP for a number of years, the database for each lake will expand, and assessments of lake conditions and water quality data become more accurate. For this reason, lakes new to CSLAP for only one year will not have information about annual trends.

Raw Data

Two **"data sets"** are provided below. The data presented in Table 1 include an annual summary of the minimum, maximum, and average for each of the CSLAP sampling parameters, including data from other sources for which sufficient quality assurance/quality control documentation is available for assessing the validity of the results. This data may be useful for comparing a particular data point for the current sampling year with historical data information. Table 2 includes more detailed summaries of the 2005 and historical data sets, including some evaluation of water quality trends, comparison against existing water quality standards, and whether 2005 represented a typical year.

Graphs

The second form of data analysis for your lake is presented in the form of **graphs**. These graphs are based on the raw data sets to represent a <u>snapshot</u> of water quality conditions at your lake. The more sampling that has been done on a particular lake, the more information that can be presented on the graph, and the more information you have to identify annual trends for your lake. For example, a lake that has been doing CSLAP monitoring consistently for five years will have a graph depicting five years worth of data, whereas a lake that has been doing CSLAP sampling for only one year will only have one. Therefore, it is important to consider the number of sampling years of information in addition to where the data points fall on a graph when trying to draw conclusions about annual trends. There are certain factors not accounted for in this report that lake managers should consider:

- **Local weather conditions** (high or low temperatures, rainfall, droughts or hurricanes). Due to delays in receiving meteorological data from NOAA stations within NYS, weather data from individual weather stations or the present sampling season are not included in these reports. Some of the variability reported below can be attributed more to weather patterns than to a "real" water trend or change. However, it is presumed that much of the sampling "noise" associated with weather is dampened over multiple years of data collection, and thus should not significantly influence the limited trend analyses provided for CSLAP lakes with longer and larger databases.

- **Sampling season and parameter limitations**. Because sampling is generally confined to June-September, this report does not look at CSLAP parameters during the winter and other seasons. Winter conditions can impact the usability and water quality of a lake conditions. In addition, there are other sampling parameters (fecal coliform, dissolved oxygen, etc.) that may be responsible for chemical and biological processes and changes in physical measurements (such as water clarity) and the perceived conditions in the lake. **The 2005 CSLAP report attempts to standardize some comparisons by limiting the evaluation to the summer recreational season and the most common sampling periods (mid-June through mid-September), in the event that samples are collected at other times of the year (such as May or October) during only some sampling seasons.**

TABLE 1: CSLAP Data Summary for Eagle Lake

Year	Min	Avg	Max	N	Parameter
2000-05	**4.50**	**6.38**	**8.20**	**47**	**CSLAP Zsd**
2005	4.50	5.92	7.35	8	CSLAP Zsd
2004	5.60	6.23	6.80	8	CSLAP Zsd
2003	4.75	6.09	8.20	8	CSLAP Zsd
2002	5.50	6.39	7.05	8	CSLAP Zsd
2001	6.95	7.24	7.60	7	CSLAP Zsd
2000	5.00	6.51	7.95	8	CSLAP Zsd
1999	6.40	7.90	9.50	3	LCI Zsd
1932	7.01	7.01	7.01	1	DEC Zsd
Year	Min	Avg	Max	N	Parameter
2000-05	**0.002**	**0.006**	**0.013**	**45**	**CSLAP Tot.P**
2005	0.004	0.006	0.010	8	CSLAP Tot.P
2005	0.005	0.007	0.010	7	CSLAP HypoTP
2004	0.003	0.006	0.013	7	CSLAP Tot.P
2004	0.003	0.005	0.009	8	CSLAP HypoTP
2003	0.002	0.006	0.008	7	CSLAP Tot.P
2003	0.003	0.007	0.013	8	CSLAP HypoTP
2002	0.002	0.006	0.009	8	CSLAP Tot.P
2002	0.002	0.007	0.013	8	CSLAP HypoTP
2001	0.004	0.006	0.012	7	CSLAP Tot.P
2000	0.004	0.007	0.010	8	CSLAP Tot.P
1999	0.006	0.007	0.008	2	LCI Tot.P
1999	0.008	0.010	0.011	2	LCI Hypo Tot.P
Year	**Min**	**Avg**	**Max**	**N**	**Parameter**
2000-05	**0.00**	**0.01**	**0.03**	**46**	**CSLAP NO3**
2005	0.01	0.01	0.03	8	CSLAP NO3
2004	0.01	0.01	0.03	8	CSLAP NO3
2004	0.01	0.01	0.02	8	CSLAP HyNO3
2003	0.00	0.01	0.02	8	CSLAP NO3
2003	0.00	0.01	0.02	8	CSLAP HyNO3
2002	0.00	0.00	0.01	8	CSLAP NO3
2002	0.00	0.00	0.01	8	CSLAP HyNO3
2001	0.01	0.01	0.01	7	CSLAP NO3
2000	0.01	0.01	0.01	7	CSLAP NO3
1999	0.01	0.01	0.01	2	LCI NO3
Year	**Min**	**Avg**	**Max**	**N**	**Parameter**
2002-05	**0.00**	**0.01**	**0.05**	**32**	**CSLAP NH4**
2005	0.01	0.01	0.04	8	CSLAP NH4
2004	0.01	0.01	0.02	8	CSLAP NH4
2004	0.01	0.02	0.09	8	CSLAP HyNH4
2003	0.00	0.01	0.02	8	CSLAP NH4
2003	0.00	0.01	0.02	8	CSLAP HyNH4
2002	0.01	0.03	0.05	8	CSLAP NH4
2002	0.01	0.02	0.04	8	CSLAP HyNH4

DATA SOURCE KEY

CSLAP	New York Citizens Statewide Lake Assessment Program
LCI	the NYSDEC Lake Classification and Inventory Survey conducted during the 1980s and again beginning in 1996 on select sets of lakes, typically 1 to 4x per year
DEC	other water quality data collected by the NYSDEC Divisions of Water and Fish and Wildlife, typically 1 to 2x in any give year
ALSC	the NYSDEC (and other partners) Adirondack Lake Survey Corporation study of more than 1500 Adirondack and Catskill lakes during the mid 1980s, typically 1 to 2x
ELS	USEPA's Eastern Lakes Survey, conducted in the fall of 1982, 1x
NES	USEPA's National Eutrophication Survey, conducted in 1972, 2 to 10x
EMAP	USEPA and US Dept. of Interior's Environmental Monitoring and Assessment Program conducted from 1990 to present, 1 to 2x in four year cycles

Additional data source codes are provided in the individual lake reports

CSLAP DATA KEY:

The following key defines column headings and parameter results for each sampling season:

L Name	Lake name
Date	Date of sampling
Zbot	Depth of the lake at the sampling site, meters
Zsd	Secchi disk transparency, meters
Zsp	Depth of the sample, meters
TAir	Temp of Air, °C
TH2O	Temp of Water Sample, °C
TotP	Total Phosphorus as P, in mg/l (Hypo = bottom sample)
NO3	Nitrate + Nitrite nitrogen as N, in mg/l
NH$_{3/4}$	Ammonia as N, in mg/l
TN-TDN	Total Nitrogen = NO$_x$ + NH$_{3/4}$ + organic nitrogen, as N, in mg/l
TP/TN	Phosphorus/Nitrogen ratios
Ca	Calcium, in mg/l
Tcolor	True color, as platinum color units
pH	(negative logarithm of hydrogen ion concentration), standard pH
Cond25	Specific conductance corrected to 25°C, in µmho/cm
Chl.a	Chlorophyll *a*, in µg/l
QA	Survey question re: physical condition of lake: (1) crystal clear; (2) not quite crystal clear; (3) definite algae greenness; (4) high algae levels; and (5) severely high algae levels
QB	Survey question re: aquatic plant populations of lake: (1) none visible; (2) visible underwater; (3) visible at lake surface; (4) dense growth at lake surface; (5) dense growth completely covering the nearshore lake surface
QC	Survey question re: recreational suitability of lake: (1) couldn't be nicer; (2) very minor aesthetic problems but excellent for overall use; (3) slightly impaired; (4) substantially impaired, although lake can be used; (5) recreation impossible
QD	Survey question re: factors affecting answer QC: (1) poor water clarity; (2) excessive weeds; (3) too much algae/odor; (4) lake looks bad; (5) poor weather; (6) litter, surface debris, beached/floating material; (7) too many lake users (boats, jetskis, etc); (8) other

TABLE 1: CSLAP Data Summary for Eagle Lake (cont)

Year	**Min**	**Avg**	**Max**	**N**	**Parameter**
2002-05	**0.10**	**0.32**	**0.74**	**31**	**CSLAP TDN**
2005	0.10	0.22	0.61	8	CSLAP TDN
2004	0.15	0.28	0.57	7	CSLAP TDN
2004	0.20	0.39	1.05	7	CSLAP HyTDN
2003	0.11	0.28	0.41	8	CSLAP TDN
2003	0.03	0.26	0.38	7	CSLAP HyTDN
2002	0.33	0.48	0.74	8	CSLAP TDN
2002	0.31	0.43	0.58	8	CSLAP HyTDN
Year	**Min**	**Avg**	**Max**	**N**	**Parameter**
2002-05	**9.98**	**63.08**	**172.97**	**30**	**CSLAP TN/TP**
2005	12.30	46.21	140.48	8	CSLAP TN/TP
2004	15.95	67.39	135.61	6	CSLAP TN/TP
2004	21.80	96.21	328.55	7	CSLAP HyTN/TP
2003	9.98	53.52	133.67	8	CSLAP TN/TP
2003	1.87	52.61	124.40	7	CSLAP HyTN/TP
2002	46.00	86.29	172.97	8	CSLAP TN/TP
2002	34.03	83.93	214.16	8	CSLAP HyTN/TP
Year	Min	Avg	Max	N	Parameter
2000-05	**2**	**9**	**46**	**45**	**CSLAP TColor**
2005	6	13	46	8	CSLAP TColor
2004	4	12	19	8	CSLAP TColor
2003	2	8	15	7	CSLAP TColor
2002	2	7	16	8	CSLAP TColor
2001	3	5	8	7	CSLAP TColor
2000	3	5	8	7	CSLAP TColor
Year	Min	Avg	Max	N	Parameter
2000-05	**6.31**	**7.52**	**8.80**	**45**	**CSLAP pH**
2005	7.30	7.90	8.80	8	CSLAP pH
2004	6.31	7.34	8.04	8	CSLAP pH
2003	6.33	7.31	7.72	7	CSLAP pH
2002	6.71	7.58	7.95	8	CSLAP pH
2001	6.80	7.48	7.94	7	CSLAP pH
2000	6.75	7.46	8.15	7	CSLAP pH
1999	7.30	7.50	7.70	2	LCI pH
1932	7.20	7.20	7.20	1	DEC pH
Year	Min	Avg	Max	N	Parameter
2000-05	**115**	**140**	**168**	**45**	**CSLAP Cond25**
2005	129	138	147	8	CSLAP Cond25
2004	115	137	168	8	CSLAP Cond25
2003	146	150	157	7	CSLAP Cond25
2002	140	142	147	8	CSLAP Cond25
2001	117	139	153	7	CSLAP Cond25
2000	129	136	139	7	CSLAP Cond25
1999	140	140	140	2	LCI Cond25

TABLE 1: CSLAP Data Summary for Eagle Lake (cont)

Year	**Min**	**Avg**	**Max**	**N**	**Parameter**
2002-05	**11.8**	**12.2**	**13.0**	**5**	**CSLAP Ca**
2005	11.8	12.0	12.3	2	CSLAP Ca
2004	11.8	11.8	11.8	1	CSLAP Ca
2003	12.0	12.5	13.0	2	CSLAP Ca
2002	0	#DIV/0!	0	0	CSLAP Ca
Year	**Min**	**Avg**	**Max**	**N**	**Parameter**
2000-05	**0.16**	**1.19**	**8.20**	**39**	**CSLAP Chl.a**
2005	0.70	0.94	1.11	7	CSLAP Chl.a
2004	0.16	1.08	2.50	7	CSLAP Chl.a
2003	0.44	0.87	1.47	8	CSLAP Chl.a
2002	0.75	1.03	1.23	6	CSLAP Chl.a
2001	0.77	1.01	1.51	4	CSLAP Chl.a
2000	0.42	2.13	8.20	7	CSLAP Chl.a
1999	1.07	1.43	2.29	4	LCI Chl.a
Year	Min	Avg	Max	N	Parameter
2000-05	**2**	**2.0**	**2**	**42**	**QA**
2005	2	2.0	2	8	QA
2004	2	2.0	2	8	QA
2003	2	2.0	2	7	QA
2002	2	2.0	2	8	QA
2001	2	2.0	2	3	QA
2000	2	2.0	2	8	QA
Year	Min	Avg	Max	N	Parameter
2000-05	**1**	**2.8**	**3**	**42**	**QB**
2005	3	3.0	3	8	QB
2004	3	3.0	3	8	QB
2003	2	2.7	3	7	QB
2002	2	2.8	3	8	QB
2001	3	3.0	3	3	QB
2000	1	2.6	3	8	QB
Year	Min	Avg	Max	N	Parameter
2000-05	**2**	**3.0**	**3**	**42**	**QC**
2005	3	3.0	3	8	QC
2004	3	3.0	3	8	QC
2003	3	3.0	3	7	QC
2002	2	2.9	3	8	QC
2001	3	3.0	3	3	QC
2000	3	3.0	3	8	QC

- **Statistical analyses**. True assessments of water quality trends and comparison to other lakes involve rigid statistical analyses. Such analyses are generally beyond the scope of this program, in part due to limitations on the time available to summarize data from nearly 100 lakes in the five months from data receipt to next sampling season. This may be due in part to the inevitable inter-lake inconsistencies in sampling dates from year to year, and in part to the limited scope of monitoring. Where appropriate, some statistical summaries, utilizing both parametric and non-parametric statistics, have been provided within the report (primarily in Table 2).

- **Mean versus Median-** Much of the water quality summary data presented in this report is reported as the **mean**, or the average of all of the readings in the period in question (summer, annual, year to year). However, while mean remains one of the most useful, and often most powerful, ways to estimate the most typical reading for many of the measured water quality indicators, it is a less useful and perhaps misleading estimate when the data are not "normally" distributed (most common readings in the middle of the range of all readings, with readings less common toward the end of the range).

  In particular, comparisons of one lake to another, such as comparisons within a particular basin, can be greatly affected by the spread of the data across the range of all readings. For example, the average phosphorus level of nine lakes with very low readings (say 10 µg/l) and one lake with very high readings (say 110 µg/l) could be much higher (in this case, 20 µg/l) than in the "typical lake" in this set of lakes (much closer to 10 µg/l). In this case, **median**, or the middle reading in the range, is probably the most accurate representation of "typical". **This report will include the use of both mean and median to evaluate "central tendency", or the most typical reading, for the indicator in question. In most cases, "mean" is used most often to estimate central tendency. However, where noted, "median" may also be used.**

TABLE 2- Present Year and Historical Data Summaries for Eagle Lake *Eutrophication Indicators*

Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Zsd	2005	4.50	5.92	7.35
(meters)	All Years	4.50	6.38	8.20
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Phosphorus	2005	0.004	0.006	0.010
(mg/l)	All Years	0.002	0.006	0.013
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Chl.a	2005	0.70	0.94	1.11
(µg/l)	All Years	0.16	1.20	8.20

Parameter	**Year**	**Was 2005 Clarity the Highest or Lowest on Record?**	**Was 2005 a Typical Year?**	**Trophic Category**	**Zsd Changing?**	**% Samples Violating DOH Beach Std?+**
Zsd	2005	Lowest at Times	Yes	Oligotrophic	No	0
(meters)	All Years			Oligotrophic		0
Parameter	**Year**	**Was 2005 TP the Highest or Lowest on Record?**	**Was 2005 a Typical Year?**	**Trophic Category**	**TP Changing?**	**% Samples Exceeding TP Guidance Value+**
Phosphorus	2005	Within Normal Range	Yes	Oligotrophic	No	0
(mg/l)	All Years			Oligotrophic		0
Parameter	**Year**	**Was 2005 Algae the Highest or Lowest on Record?**	**Was 2005 a Typical Year?**	**Trophic Category**	**Chl.a Changing?**	
Chl.a	2005	Within Normal Range	Yes	Oligotrophic	No	
(µg/l)	All Years			Oligotrophic		

+- Minimum allowable water clarity for siting a new NYS swimming beach = 1.2 meters
+- NYS Total Phosphorus Guidance Value for Class B and Higher Lakes = 0.020 mg/l

-The 2005 CSLAP dataset indicates that Eagle Lake was probably about as productive in 2005 as in previous CSLAP sampling seasons. Water transparency readings were lower than usual, following a trend toward decreasing water clarity in recent years. However, chlorophyll *a* (algae) levels were also slightly lower than usual, and phosphorus readings have changed little since 2000. This suggests that none of these trophic indicators, including water transparency, have changed significantly since CSLAP sampling began at the lake. There continues to be only a weak correlation between changes in phosphorus and algae, and between changes in algae and water transparency, but this is typical of lakes with little algal productivity. It is likely that phosphorus readings ultimately control algae levels, which in turn exert the strongest influence on water transparency readings. Lake productivity generally varies little or even decreases over the course of the typical CSLAP sampling season, consistent with deepwater phosphorus levels that are nearly identical to those at the lake surface. Phosphorus levels in Eagle Lake fall well below the state guidance value for lakes used for contact recreation (swimming), and Secchi disk transparency readings are consistently well above the recommended water clarity for swimming beaches (= 1.2 meters). In short, Eagle Lake was about as productive in 2005 as in the typical sampling season, and it is likely that none of the changes in water clarity or other trophic indicators (chlorophyll *a*, and total phosphorus) are statistically significant.

TABLE 2- Present Year and Historical Data Summaries for Eagle Lake (cont)

Other Water Quality Indicators

Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Nitrate	2005	0.01	0.01	0.03
(mg/l)	All Years	0.00	0.01	0.03
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
NH4	2005	0.01	0.01	0.04
(mg/l)	All Years	0.00	0.01	0.05
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
TDN	2005	0.10	0.22	0.61
(mg/l)	All Years	0.10	0.32	0.74
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
True Color	2005	6	13	46
(ptu)	All Years	2	9	46
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
pH	2005	7.30	7.90	8.80
(std units)	All Years	6.31	7.53	8.80
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Conductivity	2005	129	138	147
(µmho/cm)	All Years	115	140	168
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Calcium	2005	11.8	12.0	12.3
(mg/l)	All Years	11.8	12.2	13.0

***- These data indicate Eagle Lake is a weakly colored, alkaline (above neutral pH) lake with low to undetectable nitrate and ammonia levels and moderately softwater. Water color readings have increased in recent years, probably due to wetter weather, and may have contributed to the drop in water clarity readings in recent years. These data indicate that phosphorus controls algae growth (actual nitrogen to phosphorus ratios probably exceed 15-25), although overall nitrogen levels are low. Nitrate and ammonia do not appear to represent a threat to water quality in surface or bottom waters. pH readings are usually within the state water quality standards (=6.5 to 8.5), and these readings are probably adequate to support most aquatic organisms. Conductivity readings increased slightly until 2005, but nearly all readings continue to be indicative of moderately softwater lakes. Calcium levels are above the threshold found to support zebra mussels, but it is not believed that these exotic animals have been found in Eagle Lake. The slight variation in most of these water quality indicators is probably due to normal variation in the lake, or due to unusual weather conditions.**

TABLE 2- Present Year and Historical Data Summaries for Eagle Lake (cont)

Other Water Quality Indicators (cont)

Parameter	Year	Was 2005 Nitrate the Highest or Lowest on Record?	Was 2005 a Typical Year?	Nitrate High?	Nitrate Changing?	% Samples Exceeding NO3 Standard	
Nitrate	2005	Highest at Times	Yes	No	No	0	
(mg/l)	All Years			No		0	
Parameter	**Year**	**Was 2005 Ammonia the Highest or Lowest on Record?**	**Was 2005 a Typical Year?**	**Ammonia High?**	**Ammonia Changing?**	**% Samples Exceeding NH4 Standard+**	
NH4	2005	Within Normal Range	Yes	No	No	0	
(mg/l)	All Years			No		0	
Parameter	**Year**	**Was 2005 TDN the Highest or Lowest on Record?**	**Was 2005 a Typical Year?**	**TDN High?**	**TDN Changing?**	**Ratios of TN/TP Indicate P or N Limitation?**	
TDN	2005	Lowest at Times	Yes	No	Probably not	P Limitation	
(mg/l)	All Years			No		P Limitation	
Parameter	**Year**	**Was 2005 Color the Highest or Lowest on Record?**	**Was 2005 a Typical Year?**	**Colored Lake?**	**Color Changing?**		
True Color	2005	Highest at Times	Yes	No	Increasing?		
(ptu)	All Years			No			
Parameter	**Year**	**Was 2005 pH the Highest or Lowest on Record?**	**Was 2005 a Typical Year?**	**Acceptable Range?**	**pH Changing?**	**% Samples > Upper pH Standard+**	**% Samples < Lower pH Standard+**
pH	2005	Highest at Times	Yes	Yes	No	13	0
(std units)	All Years			Yes		2	5
Parameter	**Year**	**Was 2005 Conductivity Highest or Lowest on Record?**	**Was 2005 a Typical Year?**	**Relative Hardness**	**Conduct. Changing?**		
Conductivity	2005	Within Normal Range	Yes	Intermediate	No		
(µmho/cm)	All Years						
Parameter	**Year**	**Was 2005 Calcium Highest or Lowest on Record?**	**Was 2005 a Typical Year?**	**Support Zebra Mussels?**	**Calcium Changing?**		
Calcium	2005	Within Normal Range	Yes	Yes	No		
(mg/l)	All Years			Yes			

+- NYS Nitrate standard = 10 mg/l

+- NYS Ammonia standard = 2 mg/l (as NH_3-NH_4)

+- NYS pH standard- 6.5 < acceptable pH < 8.5

TABLE 2- Present Year and Historical Data Summaries for Eagle Lake

Lake Perception Indicators (1= most favorable, 5= least favorable)

Parameter	**Year**	**Minimum**	**Average**	**Maximum**
QA	2005	2	2.0	2
(Clarity)	All Years	2	2.0	2
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
QB	2005	3	3.0	3
(Plants)	All Years	1	2.8	3
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
QC	2005	3	3.0	3
(Recreation)	All Years	2	3.0	3

Parameter	**Year**	**Was 2005 Clarity the Highest or Lowest on Record?**	**Was 2005 a Typical Year?**	**Clarity Changed?**	**%Frequency 'Definite Algae Greenness'**	**%Frequency 'Severe Algae Levels'**	**%Frequency 'Slightly Impaired' Due to Algae**	**%Frequency 'Substantially Impaired' Due to Algae**
QA	2005	Highest and Lowest	Yes	No	0	0	13	0
(Clarity)	All Years				0	0	9	0
Parameter	**Year**	**Was 2005 Weed Growth the Heaviest on Record?**	**Was 2005 a Typical Year?**	**Weeds Changed?**	**%Frequency Surface Weeds**	**%Frequency Dense Weeds**	**%Frequency 'Slightly Impaired' Due to Weeds**	**%Frequency 'Substantially Impaired' Due to Weeds**
QB	2005	Heaviest at Times	Yes	No	100	0	100	0
(Plants)	All Years				86	0	79	0
Parameter	**Year**	**Was 2005 Recreation the Best or Worst on Record?**	**Was 2005 a Typical Year?**	**Recreation Changed?**	**%Frequency Slightly Impaired**	**%Frequency Substantially Impaired**		
QC	2005	Worst at Times	Yes	No	100	0		
(Recreation)	All Years				98	0		

Recreational, water quality, and aquatic plant assessments of Eagle Lake have varied little since CSLAP sampling began in 2000, perhaps as expected given the stability in water quality conditions. Eagle Lake has consistently been described as “not quite crystal clear”, an assessment slightly less favorable than in other lakes with similar water clarity readings. However, this also suggests that recent drops in water clarity may not be apparent to most lake users. Aquatic plants regularly grow to the lake surface, and have frequently been cited as impacting recreational uses of the lake. As a result, the lake has consistently been described as “slightly impaired” for some recreational uses, although these assessments are sometimes impacted by poor weather. These assessments vary little during the sampling season, consistent with seasonally stable water quality and aquatic plant coverage.

Eagle Lake has been described by the CSLAP sampling volunteers as “slightly impaired” during 98% of the CSLAP sampling sessions, but never “substantially” impaired. These recreational use impacts were more frequently associated with excessive weed growth or poor weather than with poor water clarity or other water quality factors.

How Do the 2005 Data Compare to Historical Data from Eagle Lake?

Seasonal Comparison of Eutrophication, Other Water Quality, and Lake Perception Indicators–2005 Sampling Season and in the Typical or Previous Sampling Seasons at Eagle Lake

Figures 16 and 17 compare data for the measured eutrophication parameters for Eagle Lake in 2005 and since CSLAP sampling began at Eagle Lake. Figures 18 and 19 compare nitrogen to phosphorus ratios, Figures 20 through 27 compare other sampling indicators, and Figures 28 and 29 compare volunteer perception responses over the same time periods.

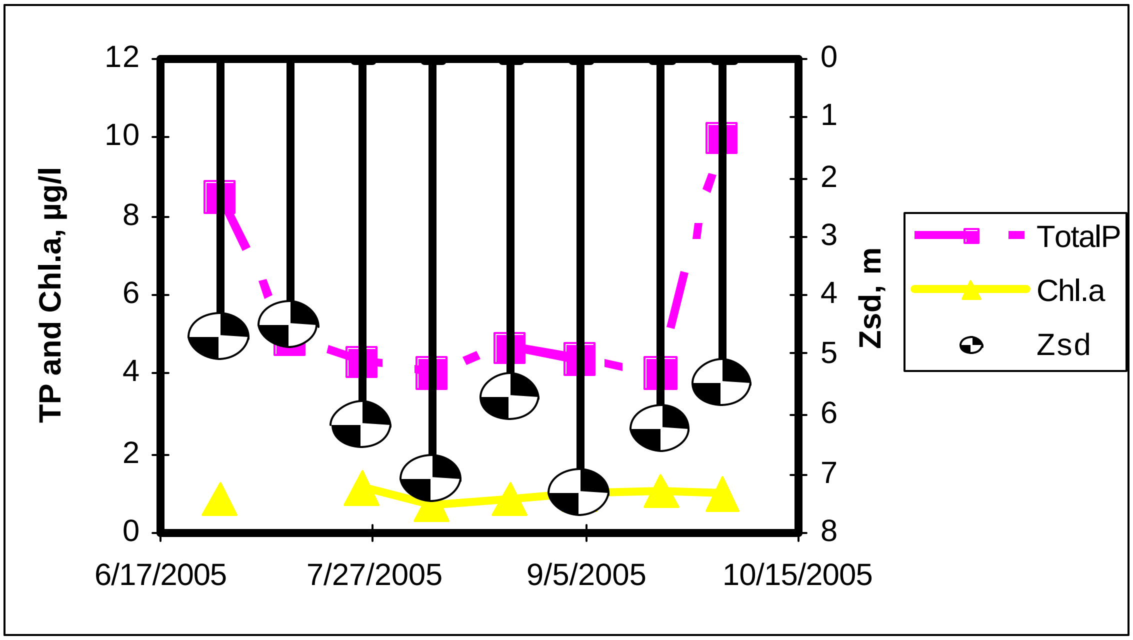


Figure 16. 2005 Eutrophication Data for Eagle Lake

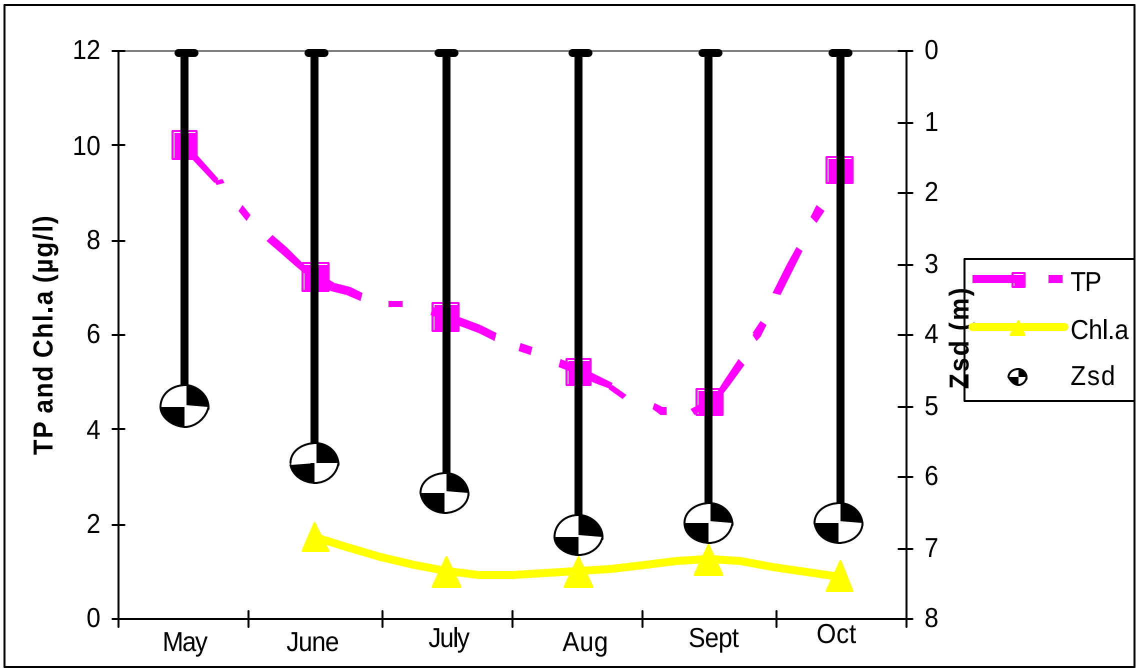


Figure 17- Eutrophication Data in a Typical (Monthly Mean) Year for Eagle Lake

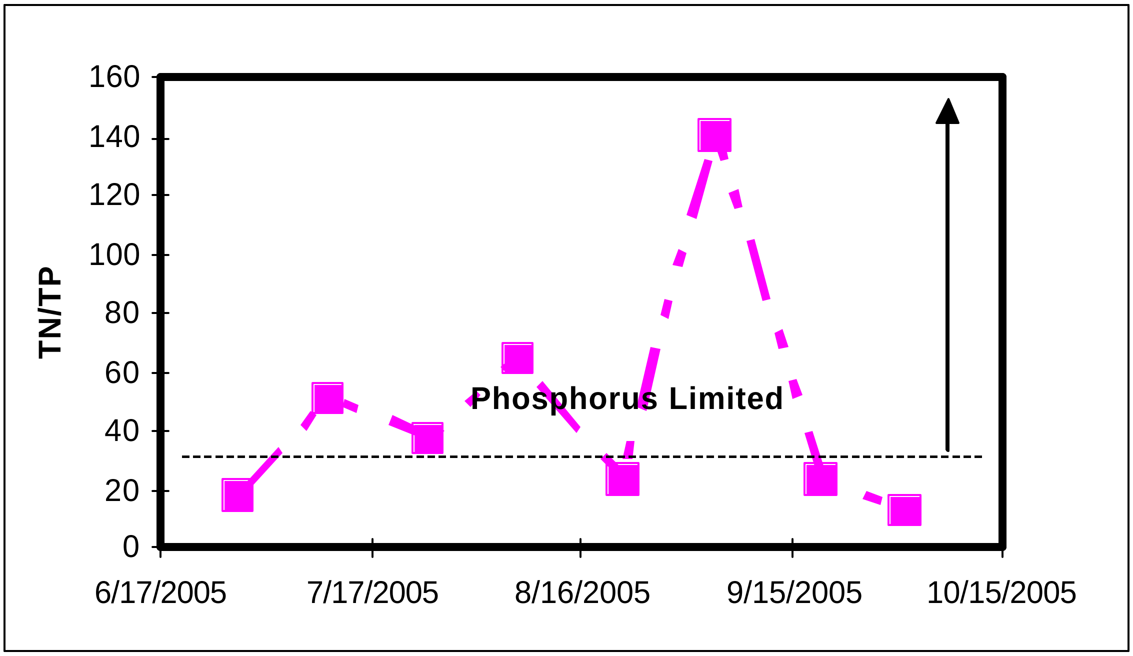


Figure 18. 2005 Nitrogen to Phosphorus Ratios for Eagle Lake

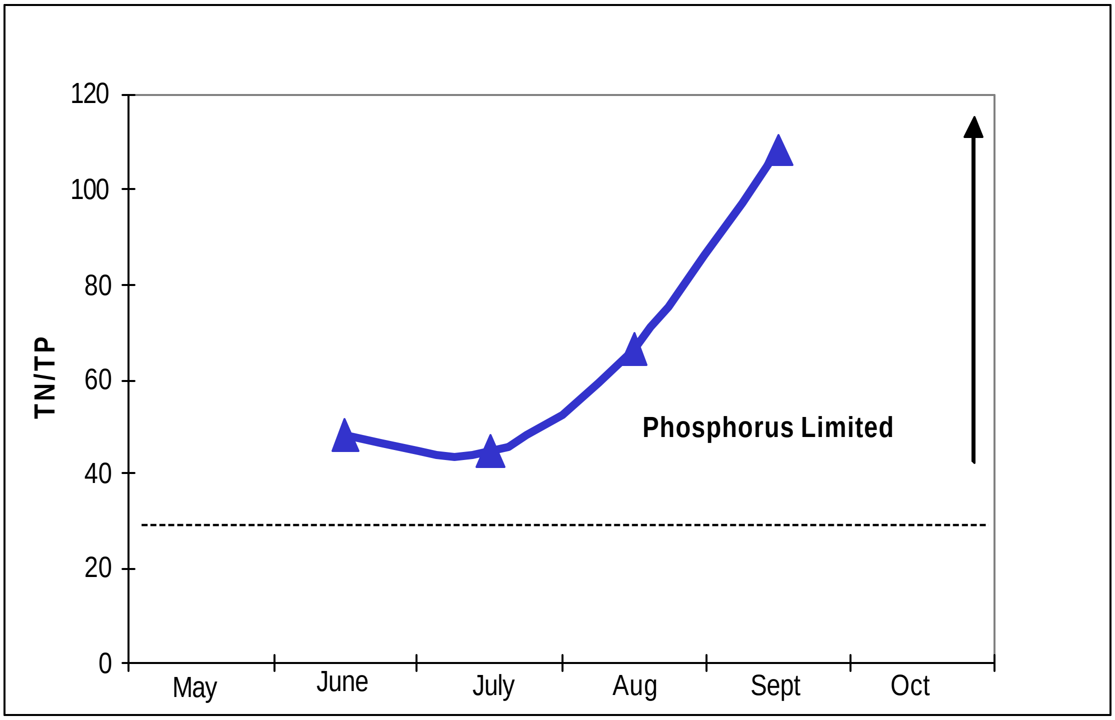


Figure 19- Nitrogen to Phosphorus Ratios in a Typical (Monthly Mean) Year for Eagle Lake

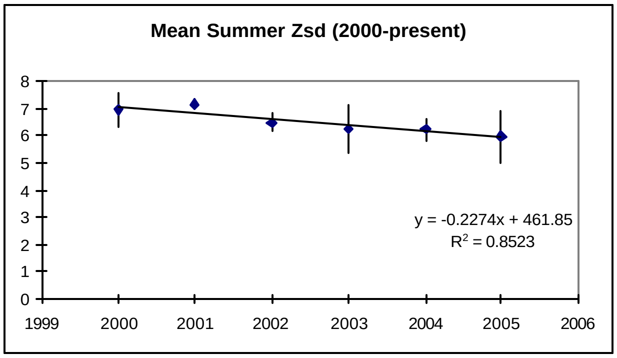


Figure 20. Annual Average Summer Water Clarity for Eagle Lake

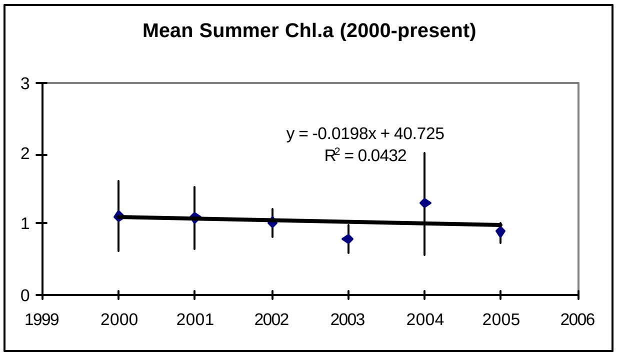


Figure 21. Annual Average Summer Chlorophyll a for Eagle Lake

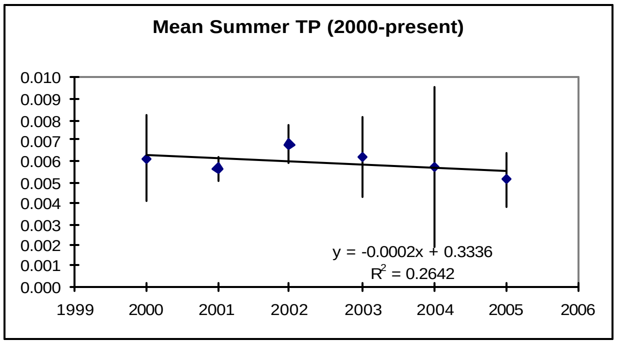


Figure 22. Annual Average Summer Total Phosphorus for Eagle Lake

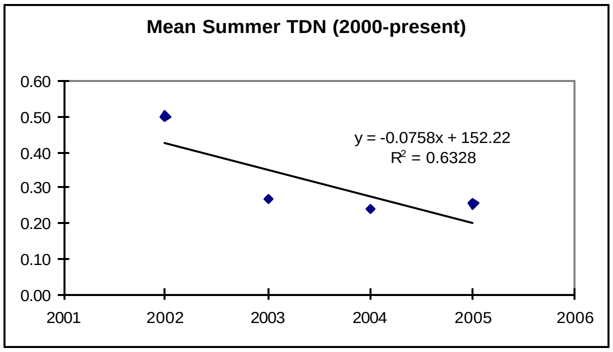


Figure 23. Annual Average Summer Total Nitrogen for Eagle Lake

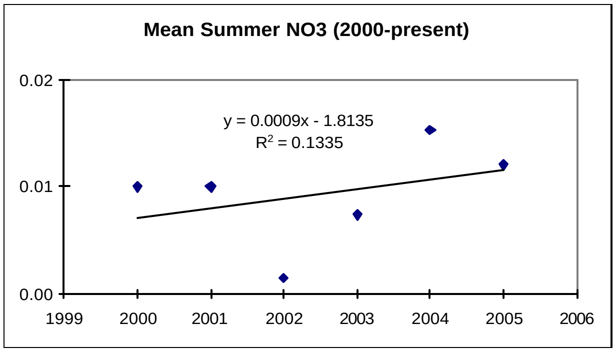


Figure 24. Annual Average Summer Nitrate for Eagle Lake

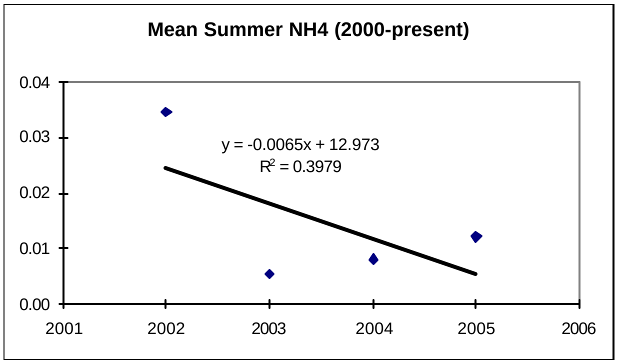


Figure 25. Annual Average Summer Ammonia for Eagle Lake

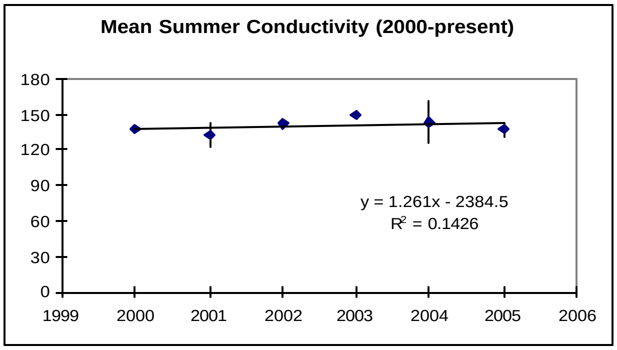


Figure 26. Annual Average Summer Conductivity for Eagle Lake

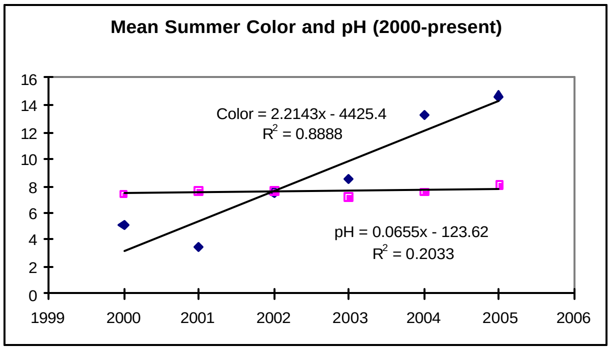


Figure 27. Annual Average Summer pH and Color for Eagle Lake

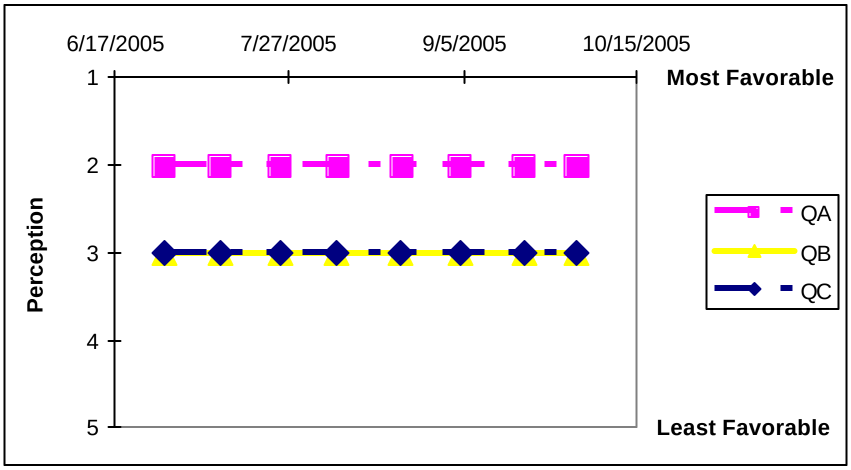


Figure 28. 2005 Lake Perception Data for Eagle Lake

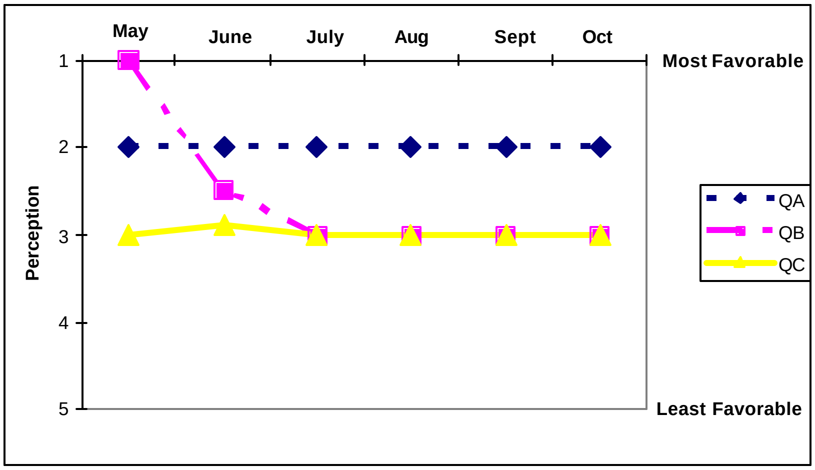


Figure 29- Lake Perception Data in a Typical (Monthly Mean) Year for Eagle Lake

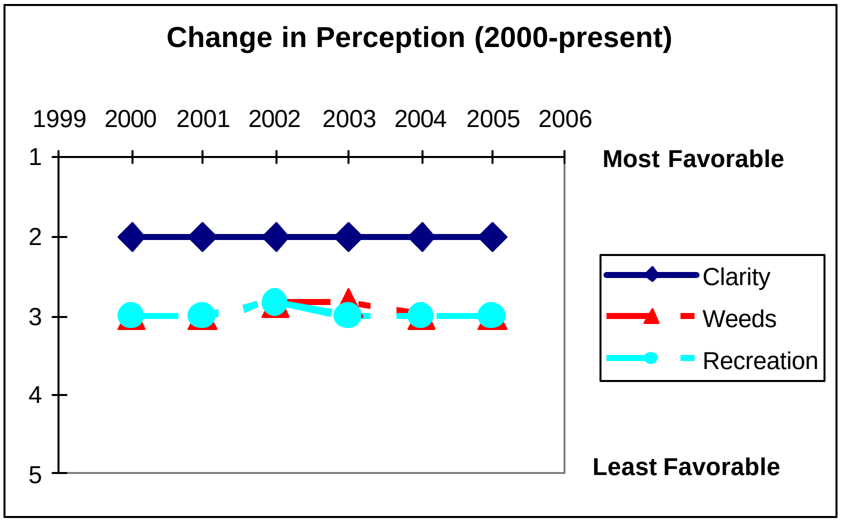


Figure 30- Annual Average Lake Assessments for Eagle Lake

(QA = clarity, ranging from (1) crystal clear to (3) definite algae greenness to (5) severely high algae levels
QB = weeds, ranging from (1) not visible to (3) growing to the surface to (5) dense growth covers lake;
QC = recreation, ranging from (1) could not be nicer to (3) slightly impaired to (5) lake not usable)

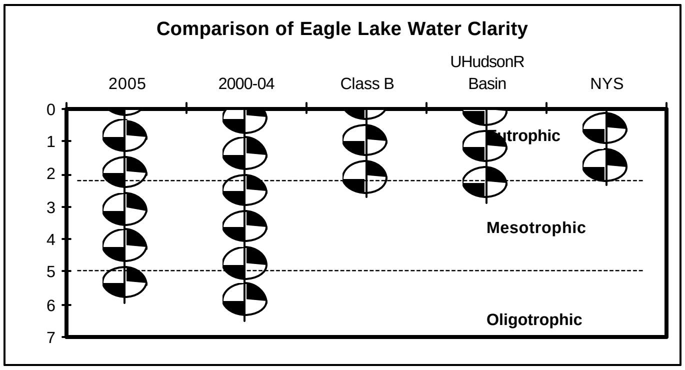


Figure 31. *Comparison of 2005 Secchi Disk Transparency to Lakes With the Same Water Quality Classification, Neighboring Lakes, and Other CSLAP Lakes in 2005*

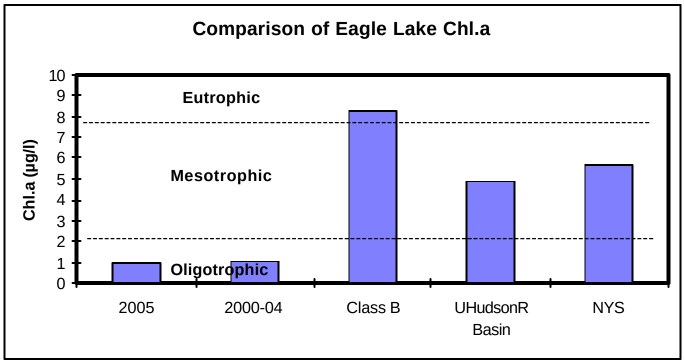


Figure 32. *Comparison of 2005 Chlorophyll a to Lakes with the Same Water Quality Classification, Neighboring Lakes, and Other CSLAP Lakes in 2005*

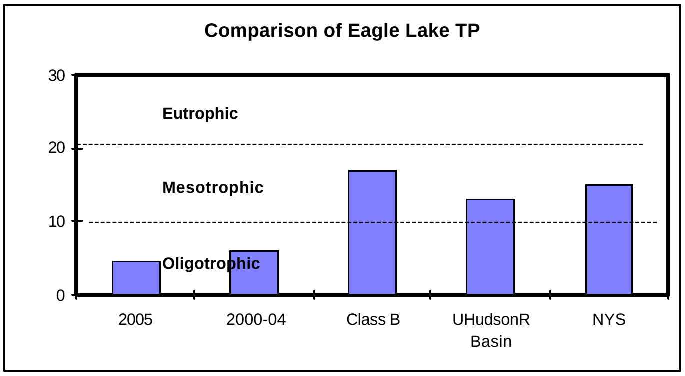


Figure 33. *Comparison of 2005 Total Phosphorus to Lakes With the Same Water Quality Classification, Neighboring Lakes, and Other CSLAP Lakes in 2005*

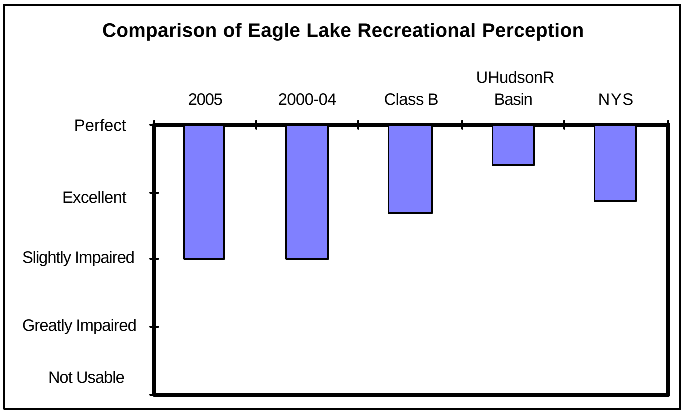


Figure 34. *Comparison of 2005 Recreational Perception*

How does Eagle Lake compare to other lakes?

Annual Comparison of Median Readings for Eutrophication Parameters and Recreational Assessment For Eagle Lake in 2005 to Historical Data for Eagle Lake, Neighboring Lakes, Lakes with the Same Lake Classification, and Other CSLAP Lakes

The graphs to the left illustrate comparisons of each eutrophication parameter and recreational perception at Eagle Lake in 2005, other lakes in the same drainage basin, lakes with the same water quality classification (each classification is summarized in Appendix B), and all of CSLAP. Readers should note that differences in watershed types, activities, lake history and other factors may result in differing water quality conditions at your lake relative to other nearby lakes. In addition, the limited data base for some regions of the state preclude a comprehensive comparison to neighboring lakes.

Based on these graphs, the following conclusions can be made about Eagle Lake in 2005:

a) Using water clarity as an indicator, Eagle Lake is less productive than Class B lakes, other Upper Hudson River basin lakes, and other NYS lakes.

b) Using chlorophyll *a* concentrations as an indicator, Eagle Lake is less productive than other NYS lakes, other Class B, and other Upper Hudson River basin lakes

c) Using total phosphorus concentrations as an indicator, Eagle Lake is less productive than other Upper Hudson River Lakes, other Class B lakes, and other NYS lakes.

d) Using QC on the field observations form as an indicator, Eagle Lake is less suitable for recreation than other Upper Hudson River basin lakes, other Class B lakes, and other NYS lakes.

VI: PRIORITY WATERBODY AND IMPAIRED WATERS LIST

The Priority Waterbody List (PWL) is presently 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 of which are threatened by potential impairment. However, the PWL is slowly evolving into an inventory of all waterbodies for which sufficient information is available to assess 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 and agencies to evaluate lakes for inclusion on the PWL, and the process for incorporating lakes data has become more standardized.

Specific numeric criteria have recently been developed to characterize sampled lakes in the available use-based PWL categories (*precluded*, *impaired*, *stressed*, or *threatened*). 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 the listing. 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 five years. In general, waterbodies that violate pertinent water quality standards (such as those listed in Table 3) at a frequency of greater than 25% are identified as *impaired*, 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. 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.

TABLE 3- Water Quality Standards Associated With Class B and Higher Lakes

Parameter	Acceptable Level	To Protect…..
Secchi Disk Transparency	> 1.2 meters*	Swimming
Total Phosphorus	< 0.020 mg/L and Narrative*	Swimming
Chlorophyll a	none	NA
Nitrate Nitrogen	< 10 mg/L and Narrative*	Drinking Water
Ammonia Nitrogen	2 mg/L*	Drinking Water
True Color	Narrative*	Swimming
pH	< 8.5 and > 6.5*	Aquatic Life
Conductivity	None	NA

*- Narrative Standards and Notes:

Secchi Disk Transparency: The 1.2 meter (4 feet) guidance is applied for safety reasons (to see submerged swimmers or bottom debris), and strictly applies only to citing new swimming beaches, but may be appropriate for all waterbodies used for contact recreation (swimming)

Phosphorus and Nitrogen: “None in amounts that will result in the growths of algae, weeds and slimes that will impair the waters for their best usages” (Class B= swimming)

-The 0.020 mg/l threshold for TP corresponds to a guidance value, not a standard; it strictly applies to Class B and higher waters, but may be appropriate for other waterbodies used for contact recreation (swimming). NYS (and other states) are in the process of identifying numerical nutrient (phosphorus, and perhaps Secchi disk transparency, chlorophyll *a*, and nitrogen) standards, but this is unlikely to be finalized within the next several years.

-The 10 mg/L Nitrate standard strictly applies to only Class A or higher waters, but is included here since some Class B lakes are informally used for potable water intake.

-For the form of ammonia (NH3+NH4) analyzed, a 2 mg/l human health standard applies to Class A or higher waters; while lower un-ionized ammonia standards apply to all classes of NYS lakes, this form is not analyzed through CSLAP

Color: “None in amounts that will adversely affect the color or impair the waters for their best usages” (for Class B waters, this is swimming)

pH: The standard applies to all classes of waterbodies

pH readings were within the NYS water quality standards (=6.5 to 8.5) during more than 90% of the CSLAP sampling sessions at Eagle Lake. Phosphorus levels at Eagle Lake have been well below the phosphorus guidance value for NYS lakes (=0.020 mg/l) during each of the CSLAP sampling sessions, and as a result, water transparency readings have at all times been well above the minimum recommended water clarity for swimming beaches (= 1.2 meters). It is not known if any of the narrative water quality standards listed in Table 3 have been violated at Eagle Lake.

Eagle Lake is not presently among the lakes listed on the Upper Hudson River drainage basin PWL (1996). The CSLAP dataset, including water chemistry data, physical measurements, and volunteer samplers’ perception data, indicate that *recreation* may be *stressed* by excessive weeds. The next PWL listing review for the Upper Hudson River drainage basin will likely occur in 2006.

GENERAL CONSIDERATIONS FOR ALL CSLAP LAKES

Nutrient controls can take several forms, depending on the original source of the nutrients:

- Septic systems can be regularly pumped or upgraded to reduce the stress on the leach fields which can be replaced with new soil or moving the discharge from the septic tank to a new field). Pumpout programs are usually quite inexpensive, particularly when lakefront residents negotiate a bulk rate discount with local pumping companies. Upgrading systems can be expensive, but may be necessary to handle the increased loading from camp expansion or conversion to year-round residency. Replacing leach fields alone can be expensive and limited by local soil or slope conditions, but may be the only way to reduce actual nutrient loading from septic systems to the lake. It should be noted that upgrading or replacing the leach field may do little to change any bacterial loading to the lake, since bacteria are controlled primarily within the septic tank, not the leach field.
- Stormwater runoff control plans include street cleaning, artificial marshes, sedimentation basins, runoff conveyance systems, and other strategies aimed at minimizing or intercepting pollutant discharge from impervious surfaces. The NYSDEC has developed a guide called Reducing the Impacts of Stormwater Runoff to provide more detailed information about developing a stormwater management plan. This is a strategy that cannot generally be tackled by an individual homeowner, but rather requires the effort and cooperation of lake residents and municipal officials.
- There are numerous agriculture management practices such as fertilizer controls, soil erosion practices, and control of animal wastes, which either reduce nutrient export or retain particles lost from agricultural fields. These practices are frequently employed in cooperation with county Soil and Water Conservation District offices, and are described in greater detail in the NYSDEC's Controlling Agricultural Nonpoint Source Water Pollution in New York State. Like stormwater controls, these require the cooperation of many watershed partners, including farmers.
- Streambank erosion can be caused by increased flow due to poorly managed urban areas, agricultural fields, construction sites, and deforested areas, or it may simply come from repetitive flow over disturbed streambanks. Control strategies may involve streambank stabilization, detention basins, revegetation, and water diversion.

Land use restrictions development and zoning tools such as floodplain management, master planning to allow for development clusters in more tolerant areas in the watershed and protection of more sensitive areas; deed or contracts which limit access to the lake, and cutting restrictions can be used to reduce pollutant loading to lakes. This approach varies greatly from one community to the next and frequently involves balancing lake use protection with land use restrictions. State law gives great latitude to local government in developing land use plans.

Lawn fertilizers frequently contain phosphorus, even though nitrogen is more likely to be the limiting nutrient for grasses and other terrestrial plants. By using lawn fertilizers with little or no phosphorus, eliminating lawn fertilizers or using lake water as a "fertilizer" at shoreline properties, fewer nutrients may enter the lake. Retaining the original flora as much as possible, or planting a buffer strip (trees, bushes, shrubs) along the shoreline, can reduce the nutrient load leaving a residential lawn.

Waterfowl introduce nutrients, plant fragments, and bacteria to the lake water through their feces. Feeding the waterfowl encourages congregation which in turn concentrates and increases this nutrient source, and will increase the likelihood that plant fragments, particularly from Eurasian watermilfoil and other plants that easily fragment and reproduce through small fragments, can be introduced to a previously uncolonized lake.

Although not really a "watershed control strategy", establishing **no-wake zones** can reduce shoreline erosion and local turbidity. Wave action, which can disturb flocculent bottom sediments and unconsolidated shoreline terrain is ultimately reduced, minimizing the spread of fertile soils to susceptible portions of the lake.

Do not discard or introduce plants from one water source to another, or deliberately introduce a "new" species from catalogue or vendor. For example, do not empty bilge or bait bucket water from another lake upon arrival at another lake, for this may contain traces of exotic plants or animals. Do not empty aquaria wastewater or plants to the lake.

Boat propellers are a major mode of transport to uncolonized lakes. Propellers, hitches, and trailers frequently get entangled by weeds and weed fragments. Boats not cleaned of fragments after leaving a colonized lake may introduce plant fragments to another location. New introductions of plants are often found near public access sites.

SPECIFIC CONSIDERATIONS FOR EAGLE LAKE

Management Focus: **Water Clarity/Algae/Physical Condition/Recreational Condition**

Issue	Through	By?
Maintain water clarity	Maintaining or reducing algae levels	Maintaining or reducing nutrient Inputs to the lake

Discussion:

User perception and water quality data indicate a favorable physical condition and water clarity of the lake. This places the focus of water clarity management on maintaining present conditions, an enviable position for many other lake associations. Although some increase in nutrient loading is inevitable, the lake association should devote efforts to minimize the input of nutrients to the lake, or change activities that otherwise influence water clarity.

Management Focus: **The Impact of Weeds on Recreational Condition**

Problem	Probable Cause	Probable Source
Moderate to Excessive weed growth	Shallow water depth, excessive nutrients and sediment	Excessive pollutant loading from watershed runoff (stormwater, construction sites, agriculture, etc.), septics, bottom disturbance,...

Discussion:

Perception data indicate that aquatic weed growth is perceived to inhibit recreational use of this lake, at least in some parts of the lake or during certain times of the year. Nuisance weed growth in lakes is influenced by a variety of factors- water clarity, sediment characteristics, wave action, competition between individual plant species, sediment nutrient levels, etc. In most cases, excessive weed growth is associated with the presence of exotic, (non-native) submergent plant species such as Eurasian watermilfoil (*Myriophyllum spicatum*), although some lakes are inhibited by dense growth of native species. Some of these factors cannot be controlled by lake association activities, while others can only be addressed peripherally. For example, sediment characteristics can be influenced by the solids loading to the lake. With the exception of some hand harvesting activities, aquatic plant management should only be undertaken when lake uses (recreational, municipal, economic, etc.) are significantly and regularly threatened or impaired. Management strategies can be costly and controversial, and a variety of factors should be weighed. Aquatic plant management most efficiently involves a mix of immediate, in-lake controls, and long-term measures to address the causes and sources of this excessive weed growth.

THE EAGLE LAKE ASSOCIATION HAS BEEN HEAVILY INVOLVED IN LOCAL AND STATEWIDE AQUATIC PLANT MANAGEMENT PLANNING, AND HAS ATTEMPTED TO DIRECT LOCAL EFFORTS TO CONTROL INVASIVE EURASIAN WATERMILFOIL GROWTH WITH THE USE OF AQUATIC HERBICIDES (SPECIFICALLY, FLURIDONE). HOWEVER, THE ENTIRE RANGE OF AQUATIC PLANT MANAGEMENT TECHNIQUES ARE PRESENTED HERE FOR THE SAKE OF COMPLETENESS.

IN –LAKE CONTROL TECHNIQUES

The following strategies primarily address the cause, but not the ultimate source, of problems related to nuisance aquatic plant growth. As such, their effectiveness is necessarily short-term, but perhaps more immediately realized, than strategies that control the source of the problem. Until the sources of the problem are addressed, however, it is likely that these strategies will need to be continuously employed. Some of these are listed in the **Watershed Controls**, since many of the same pollutants contribute to excessive algae growth as well as nuisance weed growth. Except where noted, most of these in-lake techniques do not require permits in most parts of the state, but, as always, the NYDEC Region 5 Offices and the Adirondack Park Agency should be consulted before undertaking these strategies. These techniques are presented within the context of potential management for the conditions (types of nuisance plants, extent of problem) reported through CSLAP. In-lake control methods include*: physical/mechanical plant management techniques, chemical plant management techniques, and biological plant management techniques*

Physical/mechanical control techniques utilize several modes of operation to remove or reduce the growth of nuisance plants. The most commonly employed procedures are the following:

- *Mechanical harvesters* physically remove rooted aquatic plants by using a mechanical machine to cut and transport plants to the shore for proper storage. Mechanical harvesters are probably the most common "formal" plant management strategy in New York State. While it is essentially akin to "mowing the (lake) lawn", it usually provides access to the lake surface and may remove some lake nutrients if the cut plants are disposed out of the watershed. However, if some shallow areas of the lake are not infested with weeds, they will likely become infested after mechanical harvesting, since fragments frequently wander from cut areas to barren sediment and colonize new plant communities. Harvesters are very expensive, but can be rented or leased. *Rotovators* are rotovating mechanical harvesters, dislodging and removing plants and roots. *Mechanical cutters* cut, but don't remove, vegetation or fragments. Box springs, sickles, cutting bars, boat props, and anchors often serve as mechanical cutters.

- *Hand harvesting* is the fancy term for lake weeding- pulling out weeds and the root structure by hand. It is very labor intensive, but very plant selective (pull the "weeds", leave the "plants"); and can be effective if the entire plant is pulled and if the growth area is small enough to be fully cleared of the plant. *Diver dredging* is like hand harvesting with a vacuum cleaner- in this strategy, scuba divers hand-pull plants and place them into a suction hose for removal into a basket in a floating barge. It is also labor intensive and can be quite expensive, but it can be used in water deeper than about 5ft (the rough limit for hand harvesting). It works best where plant beds are dense, but is not very efficient when plant beds or stems are scattered.
- *Water level manipulation* is the same thing as *drawdown*, in which the lake surface is lowered, usually over the winter, to expose vegetation and sediments to freezing and drying conditions. Over time this affects the growing characteristics of the plants, and in many cases selectively eliminates susceptible plants. This is obviously limited to lakes that have a mechanism (dam structure, controlled culvert, etc.) for manipulating water level. It is usually very inexpensive, but doesn't work on all plants and there is a risk of insufficient lake refill the following spring (causing docks to be orphaned from the waterfront). **It is not believed by the report authors that Eagle Lake can be sufficiently drawn down to utilize this technique.**
- *Bottom barriers* are screens or mats that are placed directly on the lake bottom to prevent the growth of weeds by eliminating sunlight needed for plant survival. The mats are held in place by anchors or stakes, and must be periodically cleaned or removed to detach any surface sediment that may serve as a medium for new growth. The mats, if installed properly, are almost always effective, with relatively few environmental side-effects, but are expensive and do not select for plant control under the mats. It is best used when plant communities are dense but small in area, and is not very efficient for lake-wide control.
- *Sediment removal*, also referred to as dredging, controls aquatic plants by physically removing vegetation and by increasing the depth of the lake so that plant growth is limited by light availability. Dredging projects are usually very successful at increasing depth and controlling vegetation, but they are very expensive, may result in significant side effects (turbidity, algal blooms, potential suspension of toxic materials), and may require significant area for disposal. This procedure usually triggers an extensive permitting process, **particularly in the Adirondack Park**.

Chemical control techniques involve the use of aquatic herbicides to kill undesired aquatic vegetation and prevent future nuisance weed growth. These herbicides come in granular or liquid formulations, and can be applied in spot- or whole-lake treatments. Some herbicides provide plant control by disrupting part of the plants life cycle or ability to produce food, while others have more toxicological effects. Aquatic herbicides are usually effective at controlling plants, but other factors in considering this option include the long term control (longevity), efficiency, and plant selectivity. Effectiveness may also depend on dosage rate, extent of non-target (usually native) plant growth, flushing rate, and other factors. The use of herbicides is often a highly controversial matter frequently influenced by personal philosophies about introducing chemicals to lakes. Some of the more recently registered herbicides appear to be more selective and have fewer side effects than some of the previously utilized chemicals. Chemical control of nuisance plants can be quite expensive, and, with only few exceptions, require permits and licensed applicators. **As discussed above, herbicides appear to be the control strategy of choice, at least among the active lake association members, at Eagle Lake.**

Biological control techniques presently involve the stocking of sterile grass carp, which are herbivorous fish that feed exclusively on macrophytes (and macroalgae). Grass carp, when stocked at the appropriate rate, have been effective at controlling nuisance weeds in many southern states, although their track record in NYS is relatively short, particularly in lakes with shallow or adjacent wetlands or in larger (>100 acre) lakes. These carp may not prefer the nuisance plant species desired for control (in particular Eurasian watermilfoil), and they are quite efficient at converting macrophyte biomass into nutrients that become available for algae growth. This is, however, one of the less expensive means of plant control. **The permitting process for grass carp in the Adirondacks is extensive.**

Naturally occurring biological controls may include native species of *aquatic weevils and moths* which burrow into and ultimately destroy some weeds. These organisms feed on Eurasian watermilfoil, and control nuisance plants in some Finger Lakes and throughout the Northeast. However, they also inhabit other lakes with varied or undocumented effectiveness for the long term. Because these organisms live in the canopy of weed beds and feed primarily on the top of the plants, harvesting may have a severe negative impact on the population. Research continues about their natural occurrence, and their effectiveness both as a natural or deliberately- introduced control mechanism for Eurasian watermilfoil. **The impact of herbivorous insects on Eurasian watermilfoil in Eagle Lake continues to be evaluated.**

Appendix A. Raw Data for Eagle Lake

LNum	PName	Date	Zbot	Zsd	Zsamp	Tot.P	NO3	NH4	TDN	TN/TP	TColor	pH	Cond25	Ca	Chl.a
169	Eagle L	5/30/2000	11.8	5.00	1.5	0.010	0.01				8	7.87	133		1.79
169	Eagle L	6/12/2000	12.4	5.55	1.5	0.006	0.01				7	7.57	129		8.20
169	Eagle L	6/26/2000	11.5	7.95	1.5	0.010	0.01				8	7.94	137		0.56
169	Eagle L	7/10/2000	11.6	5.95	1.5	0.004	0.01				3	7.49	139		1.08
169	Eagle L	7/24/2000	11.5	7.00	1.5	0.004	0.01				7	7.47	136		1.15
169	Eagle L	8/7/2000	11.5	7.40	1.5	0.005	0.01				4	6.82	137		2.08
169	Eagle L	8/22/2000	11.7	7.00	1.5	0.008	0.01				3	8.15	134		0.42
169	Eagle L	9/4/2000	11.5	6.25	1.5	0.006	0.01				6	6.75	138		1.41
169	Eagle L	7/8/2001	11.5	7.00	1.5	0.006	0.01				3	7.91	136		1.51
169	Eagle L	7/22/2001	11.5	7.25	1.5	0.005	0.01				4	7.94	138		0.77
169	Eagle L	8/5/2001	11.5	7.35	1.5	0.005	0.01				3	7.19	117		0.99
169	Eagle L	9/3/2001	11.5	6.95	1.5	0.006	0.01				4	7.64	139		
169	Eagle L	9/30/2001	11.5	7.60	1.5	0.004	0.01				6	6.80	142		
169	Eagle L	10/10/2001	11.5	7.35	1.5	0.012	0.01				5	7.57	145		
169	Eagle L	10/23/2001	11.5	7.20	1.5	0.007	0.01				8	7.31	153		0.78
169	Eagle L	06/10/02	11.5	5.50	1.5	0.009	0.01	0.02	0.56	64.65	9	7.04	142		1.04
169	Eagle L	06/23/02	11.5	6.50	1.5	0.009	0.00	0.03	0.40	46.00	2	7.70	140		
169	Eagle L	07/07/02	11.5	5.90	1.5	0.007	0.00	0.02	0.38	52.77	11	7.93	141		1.23
169	Eagle L	07/19/02	11.5	6.10	1.5	0.007	0.00	0.05	0.54	76.15	16	6.71	147		0.75
169	Eagle L	07/21/02	11.5	6.95	1.5	0.006	0.00	0.03	0.37	66.32	8	7.63	143		
169	Eagle L	08/04/02	11.5	6.30	1.5	0.006	0.00	0.04	0.74	128.35	6	7.95	144		0.99
169	Eagle L	09/01/02	11.5	7.05	1.5	0.007	0.00	0.04	0.55	83.09	2	7.74	141		1.11
169	Eagle L	09/21/02	11.5	6.85	1.5	0.002	0.00	0.01	0.33	172.97	5	7.94	142		1.04
169	Eagle L	6/9/2003	11.5	5.10	1.5	0.005	0.00	0.01	0.36	70.59	7	7.72	147	12.0	1.47
169	Eagle L	6/24/2003	11.5	5.60	1.5	0.008	0.01	0.00	0.32	39.70	5	7.70	148		0.71
169	Eagle L	6/29/2003	11.5	5.10	1.5	0.005	0.01	0.00	0.35	69.03	11	6.74	153		0.92
169	Eagle L	7/13/2003	11.5	6.50	1.5		0.01	0.02	0.23	9.98	9	6.33	157		1.22
169	Eagle L	7/27/2003	11.5	4.75	1.5	0.008	0.00	0.01	0.11	13.12				13.0	0.56
169	Eagle L	8/10/2003	11.5	8.20	1.5	0.005	0.02	0.00	0.41	75.85	9	7.62	149		0.81
169	Eagle L	8/24/2003	11.5	6.35	1.5	0.008	0.00	0.00	0.13	16.23	15	7.60	146		0.44
169	Eagle L	9/8/2003	11.5	7.10		0.002	0.00	0.00	0.32	133.67	2	7.43	147		0.87
169	Eagle L	6/12/2004	11.5	6.80	1.5	0.007	0.01	0.01			9	6.31	120		0.16
169	Eagle L	6/26/2004	11.5	5.60	1.5	0.005	0.03	0.01	0.15	29.44	19	6.69	161		
169	Eagle L	7/10/2004	11.5	6.80	1.5		0.03	0.01	0.32		4	6.94	140		0.20
169	Eagle L	7/24/2004	11.5	6.45	1.5	0.013	0.01	0.01	0.21	15.95	16	8.04	117		1.20
169	Eagle L	8/9/2004	11.5	6.35	1.5	0.004	0.01	0.02	0.19	52.62	15	7.78	157	11.8	1.30
169	Eagle L	8/24/2004	11.5	6.50	1.5	0.003	0.02	0.01	0.29	102.47	17	7.89	168		1.30
169	Eagle L	9/6/2004	11.5	5.60	1.5	0.004	0.01	0.01	0.26	68.24	8	7.88	121		2.50
169	Eagle L	9/18/2004	11.5	5.75	1.5	0.004	0.01	0.01	0.57	135.61	9	7.22	115		0.93
169	Eagle L	6/28/2005	11.5	4.70	1.5	0.008	0.01	0.01	0.15	17.33	11	8.80	147	12.3	0.82
169	Eagle L	7/11/2005	11.5	4.50	1.5	0.005	0.02	0.04	0.24	50.44	9	7.50	134		
169	Eagle L	7/25/2005	11.5	6.20	1.5	0.004	0.03	0.01	0.16	37.53	7	7.59	133		1.11
169	Eagle L	8/7/2005	11.5	7.10	1.5	0.004	0.01	0.01	0.26	64.05	9	8.28	144		0.70
169	Eagle L	8/22/2005	11.5	5.75	1.5	0.005	0.01	0.01	0.11	23.69	46	7.78	138	11.8	0.87
169	Eagle L	9/4/2005	11.5	7.35	1.5	0.004	0.01	0.01	0.61	140.48	6	8.35	129		0.99
169	Eagle L	9/19/2005	11.5	6.25	1.5	0.004	0.01	0.01	0.10	23.88	10	7.63	147		1.08
169	Eagle L	10/1/2005	11.5	5.50	1.5	0.010	0.01	0.01	0.12	12.30	6	7.30	131		0.97
169	Eagle L	06/10/02	11.5			0.009	0.01	0.03	0.58	67.04					
169	Eagle L	06/23/02	11.5			0.009	0.00	0.01	0.31	34.03					
169	Eagle L	07/07/02	11.5			0.007	0.00	0.01	0.45	68.53					
169	Eagle L	07/19/02	11.5			0.004	0.00	0.03	0.51	121.37					
169	Eagle L	07/21/02	11.5			0.007	0.00	0.01	0.34	48.04					
169	Eagle L	08/04/02	11.5			0.006	0.00	0.04	0.51	83.32					
169	Eagle L	09/01/02	11.5			0.013	0.00	0.02	0.44	34.96					
169	Eagle L	09/21/02	11.5			0.002	0.00	0.01	0.33	214.16					
169	Eagle L	6/9/2003				0.011	0.00	0.01	0.18	15.80					
169	Eagle L	6/24/2003				0.006	0.01	0.02	0.29	50.61					
169	Eagle L	6/29/2003				0.005	0.01	0.01	0.30	63.42					
169	Eagle L	7/13/2003				0.008	0.00	0.02	0.34	40.48					
169	Eagle L	7/27/2003				0.013	0.00	0.00	0.03	1.87					
169	Eagle L	8/10/2003				0.006	0.02	0.02							

LNum	PName	Date	Zbot	Zsd	Zsamp	Tot.P	NO3	NH4	TDN	TN/TP	TColor	pH	Cond25	Ca	Chl.a
169	Eagle L	8/24/2003				0.004	0.00	0.00	0.29	71.68					
169	Eagle L	9/8/2003			1.5	0.003	0.00	0.00	0.38	124.40					
169	Eagle L	6/12/2004	11.5			0.006	0.01	0.01							
169	Eagle L	6/26/2004	11.5			0.009	0.01	0.01	0.20	21.80					
169	Eagle L	7/10/2004	11.5			0.006	0.02	0.01	0.38	67.34					
169	Eagle L	7/24/2004	11.5			0.004	0.01	0.01	0.27	61.95					
169	Eagle L	8/9/2004	11.5			0.007	0.01	0.01	0.21	31.95					
169	Eagle L	8/24/2004	11.5			0.003	0.02	0.09	1.05	328.55					
169	Eagle L	9/6/2004	11.5			0.004	0.01	0.01	0.25	65.60					
169	Eagle L	9/18/2004	11.5			0.004	0.01	0.01	0.40	96.28					
169	Eagle L	6/28/2005	11.5			0.007									
169	Eagle L	7/11/2005	11.5			0.005									
169	Eagle L	7/25/2005	11.5			0.010									
169	Eagle L	8/7/2005	11.5												
169	Eagle L	8/22/2005	11.5			0.006									
169	Eagle L	9/4/2005	11.5			0.005									
169	Eagle L	9/19/2005	11.5			0.006									
169	Eagle L	10/1/2005	11.5			0.008									

LNum	PName	Date	Zbot	Zsd	Zsamp	QaQc	TAir	TH20	QA	QB	QC	QD
169	Eagle L	5/30/2000	11.8	5.00	1.5	1	20	15	2	1	3	
169	Eagle L	6/12/2000	12.4	5.55	1.5	1	17	16	2	2	3	25
169	Eagle L	6/26/2000	11.5	7.95	1.5	1	30	24	2	3	3	2
169	Eagle L	7/10/2000	11.6	5.95	1.5	1	22	22	2	3	3	56
169	Eagle L	7/24/2000	11.5	7.00	1.5	1	25	22	2	3	3	2
169	Eagle L	8/7/2000	11.5	7.40	1.5	1	21	23	2	3	3	125
169	Eagle L	8/22/2000	11.7	7.00	1.5	1	26	24	2	3	3	2
169	Eagle L	9/4/2000	11.5	6.25	1.5	1	11	21	2	3	3	25
169	Eagle L	7/8/2001	11.5	7.00	1.5	1	24	21	2	3	3	5
169	Eagle L	7/22/2001	11.5	7.25	1.5	1	24	24				
169	Eagle L	8/5/2001	11.5	7.35	1.5	1	29	25				
169	Eagle L	9/3/2001	11.5	6.95	1.5	1	27	24	2	3	3	2
169	Eagle L	9/30/2001	11.5	7.60	1.5	1	20	18				
169	Eagle L	10/10/2001	11.5	7.35	1.5	1	11	15				
169	Eagle L	10/23/2001	11.5	7.20	1.5	1	13	14	2	3	3	5
169	Eagle L	06/10/02	11.5	5.50	1.5	1	22	16	2	2	3	2
169	Eagle L	06/23/02	11.5	6.50	1.5	1	24	20	2	2	2	5
169	Eagle L	07/07/02	11.5	5.90	1.5	1	22	24	2	3	3	2
169	Eagle L	07/19/02	11.5	6.10	1.5	1	21	25	2	3	3	2
169	Eagle L	07/21/02	11.5	6.95	1.5	1	29	25	2	3	3	2
169	Eagle L	08/04/02	11.5	6.30	1.5	1	26	24	2	3	3	2
169	Eagle L	09/01/02	11.5	7.05	1.5	1	20	22	2	3	3	258
169	Eagle L	09/21/02	11.5	6.85	1.5	1	25	21	2	3	3	2
169	Eagle L	6/9/2003	11.5	5.10	1.5	1	20	16	2	2	3	25
169	Eagle L	6/24/2003	11.5	5.60	1.5	1	30	24	2	2	3	2
169	Eagle L	6/29/2003	11.5	5.10	1.5	1	25	24	2	3	3	25
169	Eagle L	7/13/2003	11.5	6.50	1.5	1	22	24	2	3	3	25
169	Eagle L	7/27/2003	11.5	4.75	1.5	1	24	24	2	3	3	25
169	Eagle L	8/10/2003	11.5	8.20	1.5	1	22	25				
169	Eagle L	8/24/2003	11.5	6.35	1.5	1	18	24	2	3	3	2
169	Eagle L	9/8/2003	11.5	7.10		1	19	21	2	3	3	28
169	Eagle L	6/12/2004	11.5	6.80	1.5	1	20	20	2	3	3	256
169	Eagle L	6/26/2004	11.5	5.60	1.5	1	21	21	2	3	3	25
169	Eagle L	7/10/2004	11.5	6.80	1.5	1	23	22	2	3	3	2
169	Eagle L	7/24/2004	11.5	6.45	1.5	1	22	23	2	3	3	25
169	Eagle L	8/9/2004	11.5	6.35	1.5	1	20	22	2	3	3	2
169	Eagle L	8/24/2004	11.5	6.50	1.5	1	21	22	2	3	3	2
169	Eagle L	9/6/2004	11.5	5.60	1.5	1	21	22	2	3	3	125
169	Eagle L	9/18/2004	11.5	5.75	1.5	1	19	20	2	3	3	125
169	Eagle L	6/28/2005	11.5	4.70	1.5	1	27	26	2	3	3	125

LNum	PName	Date	Zbot	Zsd	Zsamp	QaQc	TAir	TH20	QA	QB	QC	QD
169	Eagle L	7/11/2005	11.5	4.50	1.5	1	29	26	2	3	3	2
169	Eagle L	7/25/2005	11.5	6.20	1.5	1	22	26	2	3	3	25
169	Eagle L	8/7/2005	11.5	7.10	1.5	1	27	28	2	3	3	2
169	Eagle L	8/22/2005	11.5	5.75	1.5	1	20	25	2	3	3	25
169	Eagle L	9/4/2005	11.5	7.35	1.5	1	21	21	2	3	3	2
169	Eagle L	9/19/2005	11.5	6.25	1.5	1	21	21	2	3	3	2
169	Eagle L	10/1/2005	11.5	5.50	1.5	1	19	18	2	3	3	28
169	Eagle L	06/10/02	11.5			2						
169	Eagle L	06/23/02	11.5			2						
169	Eagle L	07/07/02	11.5			2						
169	Eagle L	07/19/02	11.5			2						
169	Eagle L	07/21/02	11.5			2						
169	Eagle L	08/04/02	11.5			2						
169	Eagle L	09/01/02	11.5			2						
169	Eagle L	09/21/02	11.5			2						
169	Eagle L	6/9/2003				2						
169	Eagle L	6/24/2003				2						
169	Eagle L	6/29/2003				2						
169	Eagle L	7/13/2003				2						
169	Eagle L	7/27/2003				2						
169	Eagle L	8/10/2003				2						
169	Eagle L	8/24/2003				2						
169	Eagle L	9/8/2003			1.5	2						
169	Eagle L	6/12/2004	11.5			2						
169	Eagle L	6/26/2004	11.5			2						
169	Eagle L	7/10/2004	11.5			2						
169	Eagle L	7/24/2004	11.5			2						
169	Eagle L	8/9/2004	11.5			2						
169	Eagle L	8/24/2004	11.5			2						
169	Eagle L	9/6/2004	11.5			2						
169	Eagle L	9/18/2004	11.5			2						
169	Eagle L	6/28/2005	11.5			2						
169	Eagle L	7/11/2005	11.5			2						
169	Eagle L	7/25/2005	11.5			2						
169	Eagle L	8/7/2005	11.5			2						
169	Eagle L	8/22/2005	11.5			2						
169	Eagle L	9/4/2005	11.5			2						
169	Eagle L	9/19/2005	11.5			2						
169	Eagle L	10/1/2005	11.5			2						

Appendix B. New York State Water Quality Classifications

Class N: Enjoyment of water in its natural condition and where compatible, as source of water for drinking or culinary purposes, bathing, fishing and fish propagation, recreation and any other usages except for the discharge of sewage, industrial wastes or other wastes or any sewage or waste effluent not having filtration resulting from at least 200 feet of lateral travel through unconsolidated earth. These waters should contain no deleterious substances, hydrocarbons or substances that would contribute to eutrophication, nor shall they receive surface runoff containing any such substance.

Class AA$_{\text{special}}$: Source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation; and fishing. These waters shall be suitable for fish propagation and survival, and shall contain no floating solids, settleable solids, oils, sludge deposits, toxic wastes, deleterious substances, colored or other wastes or heated liquids attributable to sewage, industrial wastes or other wastes. There shall be no discharge or disposal of sewage, industrial wastes or other wastes into these waters. These waters shall contain no phosphorus and nitrogen in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages.

Class A$_{\text{special}}$: Source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation; and fishing. These waters shall be suitable for fish propagation and survival. These international boundary waters, if subjected to approved treatment equal to coagulation, sedimentation, filtration and disinfection, with additional treatment if necessary to remove naturally present impurities, will meet New York State Department of Health drinking water standards and will be considered safe and satisfactory for drinking water purposes

Class AA: Source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation; and fishing. These waters shall be suitable for fish propagation and survival. These waters, if subjected to approved disinfection treatment, with additional treatment if necessary to remove naturally present impurities, will meet New York State Department of Health drinking water standards and will be considered safe and satisfactory for drinking water purposes

Class A: Source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation; and fishing. These waters shall be suitable for fish propagation and survival. These waters, if subjected to approved treatment equal to coagulation, sedimentation, filtration and disinfection, with additional treatment if necessary to remove naturally

	present impurities, will meet New York State Department of Health drinking water standards and will be considered safe and satisfactory for drinking water purposes
Class B	Suitable for primary and secondary contact recreation and fishing. These waters shall be suitable for fish propagation and survival
Class C:	Suitable for fishing, and fish propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.
Class D:	Suitable for fishing. Due to such natural conditions as intermittency of flow, water conditions not conducive to propagation of game fishery, or stream bed conditions, the waters will not support fish propagation. These waters shall be suitable for fish survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.
Class (T):	Designated for trout survival, defined by the Environmental Conservation Law Article 11 (NYS, 1984b) as brook trout, brown trout, red throat trout, rainbow trout, and splake

APPENDIX C:
SUMMARY OF STATISTICAL METHODS USED TO EVALUATE TRENDS

1. Non-Parametric Analyses

Kendall tau ranking orders paired observations by one of the variables (say arranging water clarity readings by date). Starting with the left-hand (say earliest date) pair, the number of times that the variable not ordered (in this case clarity readings) is exceeded by the same variable in subsequent pairs is computed as P, and the number of times in which the unordered variable is not exceeded is computed as Q. This computation is completed for each ordered pair, with N= total number of pairs (samples), and the sum of the differences $S = \Sigma(P-Q)$. The Kendall tau rank correlation coefficient **t** is computed as:

$$t = 2S/(N*(N-1))$$

Values for t range from –1 (complete negative correlation) to +1 (complete positive correlation). As above, strong correlations (or simply "significance") may be associated with values for t greater than 0.5 (or less than –0.5), and moderate correlations may be associated with values for t between 0.3 and 0.5 (or between –0.3 and –0.5), but the "significance" of this correlation must be further computed. Standard charts for computing the probabilities for testing the significance of S are provided in most statistics text books, and for values of N greater than 10, a standard normal deviate D can be computed by calculating the quotient

$$D= S\sqrt{18} /\sqrt{[(N(N-1)(2N+5)]}$$

and attributing the following significance:

$D > 3.29$ = 0.05% significance
$2.58 < D < 3.29$ = 0.5% significance
$1.96 < D < 2.58$ = 2.5% significance
$D < 1.96$ = > 2.5% significance

For the purpose of this exercise, 2.5% significance or less is necessary to assign validity (or, using the vernacular above, "significance") to the trend determined by the Kendall tau correlation. It should be noted again that this evaluation does not determine the magnitude of the trend, but only if a trend is likely to occur.

Parametric trends can be defined by standard best-fit linear regression lines, with the significance of these data customarily defined by the magnitude of the best fit regression coefficient ® or R^2). This can be conducted using raw or individual data points, or seasonal summaries (using some indicator of central tendency, such as mean or median). Since the former can be adversely influenced by seasonal variability and/or imprecision in the length and breadth of the sampling season during any given year, seasonal summaries may provide more realistic measures for long-term trend analyses. However, since the summaries may not adequately reflect variability within any given sampling season, it may be appropriate to compare deviations from seasonal means or medians with the "modeled" change in the mean/median resulting from the regression analyses.

When similar parametric and non-parametric tools are utilized to evaluate long-term trends in NYS lakes, a few assumptions must be adopted:

- Using the non-parametric tools, trend “significance” (defined as no more than appx. 3% “likelihood” that a trend is calculated when none exists) can only be achieved with at least four years of averaged water quality data. When looking at all summer data points (as opposed to data averaging), a minimum of forty data points is required to achieve some confidence in data significance. This corresponds to at least five years of CSLAP data. The “lesson” in these assumptions is that data trends assigned to data sets collected over fewer than five years assume only marginal significance.

As noted above, summer data only are utilized (as in the previous analyses) to minimize seasonal effects and different sampling schedules around the fringes (primarily May and September) of the sampling season. This reduces the number of data points used to compile averages or whole data sets, but is considered necessary to best evaluate the CSLAP datasets.

2. Parametric Analyses

Parametric analyses are conducted by comparing annual changes in summer mean values for each of the analyzed sampling parameters. Summer is defined as the period from June 15 thru September 15, and roughly corresponds to the window between the end of spring runoff (after ice out) and start of thermal stratification, and the onset of thermal destratification. This period also corresponds to the peak summer recreational season and (for most lakes) the most critical period for water quality impacts. It also bounds the most frequent range of sampling dates for the majority of both the primarily seasonal volunteers and full time residents of CSLAP lakes.

Trends in the parametric analyses are determined by the least squares method, in which “significance” requires both a high correlation coefficient ($R^2>0.5$) and intra-seasonal variance to be lower than the predicted change (trend) over the period of sampling (roughly corresponding to ?y). Changes in water quality indicators are also evaluated by the two-sided t-test, in which the change (z statistic) in the mean summer value for each of the indicators by decade of sampling (1980s, 1990s, 2000s) is compared to the t statistic distribution within the 95% confidence interval, with the null hypothesis corresponding to no significant change.

APPENDIX D: BACKGROUND INFO FOR EAGLE LAKE

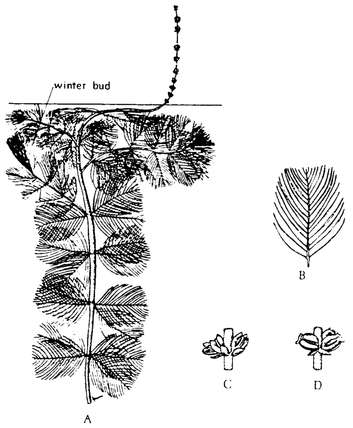
CSLAP Number	169
Lake Name	Eagle L
First CSLAP Year	2000
Sampled in 2004?	yes
Latitude	435218
Longitude	733702
Elevation (m)	288
Area (ha)	170.9
Volume Code	5
Volume Code Name	Upper Hudson River
Pond Number	438
Qualifier	none
Water Quality Classification	B
County	Essex
Town	Ticonderoga
Watershed Area (ha)	996.5
Retention Time (years)	Not yet determined
Mean Depth (m)	Not yet determined
Runoff (m/yr)	0.5
Watershed Number	11
Watershed Name	Upper Hudson River
NOAA Section	3
Closest NOAA Station	North Creek
Closest USGS Gaging Station-Number	4276842
Closest USGS Gaging Station-Name	Putnam Point East of Crown Point Center
CSLAP Lakes in Watershed	Adirondack L, Babcock L, Ballston L, Brant L, Cossayuna L, Eagle L, Efner L, Friends L, Garnet L, Goodnow F, Hedges L, Hunt L, Kellum L, L Forest, L Lauderdale, L Luzerne, Loon L-W, Mayfield L, Moreau L, Paradox L, Piseco L, Sacandaga L, Saratoga L, Schroon L, Summit L-W, Taconic P, Windover L

APPENDIX E: SUBMERGENT AND FLOATING AQUATIC PLANTS IDENTIFIED THROUGH CSLAP AT EAGLE LAKE

SPECIES NAME: *Myriophyllum spicatum*

COMMON NAME: Eurasian water milfoil

ECOLOGICAL VALUE: like most submergents, *Myriophyllum* harbors aquatic insects, provides hiding, nurseries, and spawning areas for amphibians and fish, and provides some food for waterfowl. However, *Myriophyllum spicatum* may dominate a water system, restricting boat traffic, recreational activities and water movement. While infestations of milfoil create favorable shelter for small fishes and invertebrates, they also commonly crowds out more desirable waterfowl plants



Myriophyllum spicatum: A. habit of submersed form with emergent inflorescence, × ½. B. leaf, × 1. C. flowers, × 2. D. fruits, × 2.

DISTRIBUTION IN UNITED STATES: locally abundant and aggressive from Quebec and New England west to Ontario, Michigan, Wisconsin, and British Columbia, south to Florida, Oklahoma, Texas, Washington, California, and Mexico (the range of this plant continues to increase each year)

DISTRIBUTION IN NEW YORK: found in increasing amounts throughout the State, except in the interior Adirondacks and the Long Island area (although it has recently been discovered in both locations)

DEGREE OF NUISANCE: like most exotics, *M. spicatum* establishes easily, and once established, often becomes the dominant plant in the macrophyte community, growing abundantly to nuisance levels

COMMENTS: while some species of *Myriophyllum* have earned a reputation for aggressive and opportunistic growth, most of the species in this genus are not nearly so robust, and often peacefully coexist with other submergent plants. The individual species within the *Myriophyllum* genus are superficially similar, so complete plants, including flowers (often pink) and fruits, are often needed for positive identification. The leaf structures and patterns of the milfoil closely resemble those of the *Ceratophyllum* (coontail) and *Utricularia* (bladderwort), and as a result, these plants are often confused for each other, particularly when viewed from a slight distance. Peak growth for most species is in mid-summer. *M. spicatum* is distinguished from other milfoils by having smaller flower-leaf structures on the emergent spike, flat-topped ends on the upper most submerged leaves, and red tips during the peak growing season and white to slightly pinkish stems. *Myriophyllum* spreads and reproduces vegetatively. This is one of the most discussed and well-known plants in the state, due to its propensity to form dense canopies that overwhelm the underlying native plant populations. Improved surveillance has greatly expanded the known range of this species within the state, though the range may have concurrently extended due to spread from boat traffic, waterfowl, and water transport from infected to uncontaminated lakes. Appropriate control strategies avoid excessive fragmentation.

Line drawing- Crowe, G.E. and C.B. Hellquist. Aquatic and wetlands plants of northeastern North America. 2000