Darrin Fresh Water Institute

AT LAKE GEORGE

THE 1999 LAKE GEORGE LAY MONITORING PROGRAM

by

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INTRODUCTION

October brought the second full decade of the Lake George Lay Monitoring Program to a close. There were a few changes made in the location and number of sites measured due to the addition and loss of volunteers. Overall, lay monitors collected 125 Secchi depth and surface water temperature readings from Lake George. In this report, 62 data measurements for Secchi and surface temperatures taken by the Darrin Fresh Water Institute (DFWI) during the FUND for Lake George sponsored offshore chemical monitoring survey will be used to supplement the data set.

The goal of the Lay Monitoring Program continues to be the collection of a large amount of physical lake data over a long period of time through the voluntary efforts of Lake George basin residents. This allows for long-term monitoring of changes in physical characteristics of the lake. A beneficial side-effect of the Lay Monitoring Program has always been the opportunity to educate basin residents with hands-on experience about lake water quality and techniques used to study freshwater ecology.

The basic water quality parameters measured by all lay monitors included water temperature and transparency (Secchi depth). The lay monitors provided a great service by sampling the lake basin weekly, and supplying information that would not otherwise have been collected by the Darrin Fresh Water Institute.

SAMPLING SITES AND COLLECTION METHODS

Several factors affected the sampling scheme this year. Two new monitors were added to the program this year, covering the southern part of the Narrows and an additional site in Hague. We lost one monitor in the north basin who covered three different sites, resulting in a gap in the Silver Bay area. We also had one monitor return from a one year hiatus, filling a vacancy in the northern section of the Narrows. With these changes in monitors, the Lake George Lay Monitoring Program had a net gain of two monitors for the sampling season. An additional factor, Hurricane Floyd, put many of the lay monitors out of business, cutting the sampling season short by a few weeks. Overall, nineteen separate areas of the lake were observed, with monitored sites spread throughout the lake. Ten lay monitor sites from Diamond Island to the Narrows and one DFWI site at Tea Island covered the southern basin of Lake George. Seven lay monitor sites and one DFWI site from French Point in the Narrows to Windmill Point in the north covered the northern section of the lake. Figure 1 is a map of site locations and Table 1 is a list of lay monitors with their respective sites.

Figure 1. Location of the sampling sites on Lake George for 1999.

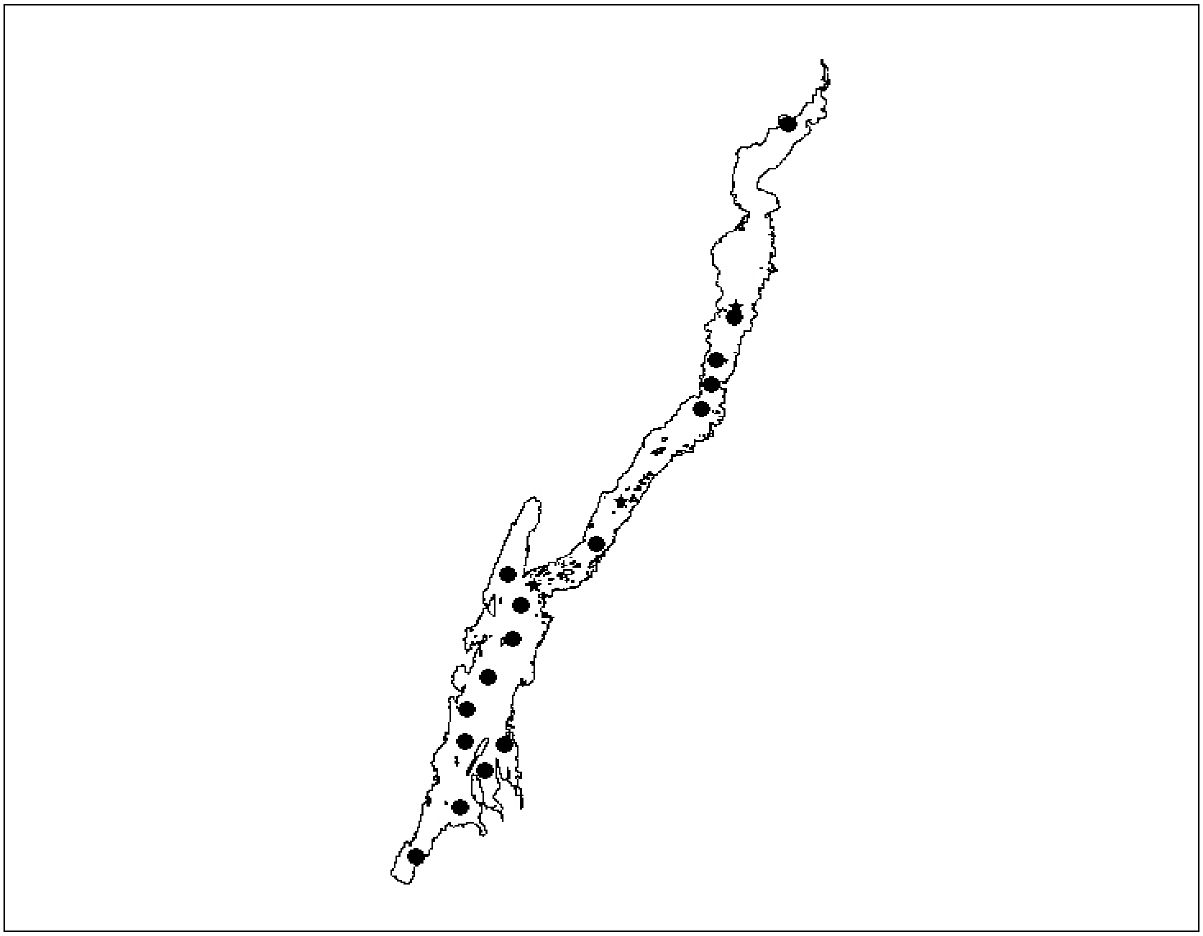


Table 1. Volunteer Lay Monitors and the sites where they obtained Secchi depth and surface temperature measurements.

Monitor	Site No.	Site Name	Miles from LG Village	Average Secchi (m)
DWFI	1	East of Tea Island	1.45	8.4
Douglas A. Wrigley	2	Dunham's Bay - midlake	3.25	9.9
Douglas A. Wrigley	3	Assembly Pt.:Ripley Pt.	4.25	9.4
Grendon & Beverly Sebold	4	Kattskill Bay	5.75	8.7
Douglas A. Wrigley	5	Middleworth Bay midlake	5.80	10.9
Grendon & Beverly Sebold	6	Long Isl.: Cotton Pt.	6.25	9.3
Carl DeSantis, Sr.	7	Fish Pt.:Pilot Knob	7.75	5.9
Roger R. Summerhayes	8	Dome Is.:Watch Pt.	9.25	10.4
Roger R. Summerhayes	9	Crown Is:Shelving Rock	10.50	10.4
Mary Dreyer	10	Turtle:Ship Islands	11.60	8.9
Roger R. Summerhayes	11	Northwest Bay mouth	11.75	10.2
Mary Dreyer	12	Floating Battery Island	15.80	9.6
DFWI	13	French Point	18.25	10.3
James Neal	14	Agnes Island	19.75	9.9
James Neal	15	Bluff Head	20.75	9.6
Stuart Harmon	16	Odell Island	21.50	10.6
Stuart Harmon	17	Skipper Island	23.00	10.5
Sandra Dwenger	18	Stark Point	24.00	11.5
Stanley Vickers	19	North Rogers Rock (Windmill Pt)	30.75	8.1

All lay monitors were equipped with a calibrated thermometer, Secchi disk, and data sheets. They were asked to record their observations and measurements of surface water temperature, Secchi depth and weather conditions -- wind, lighting, air temperature and precipitation – on a weekly or biweekly basis during the months of June through September. Secchi depth is a measurement of water clarity determined by lowering an eight inch diameter, black and white Secchi disk into the water until the viewer can no longer see it and recording the depth. Data were to be collected between 10 A.M. and 2 P.M. when the sun was as nearly directly overhead as possible. When convenient, measurements were to be limited to days with calm, clear weather in order to reduce the influence of waves and wind on the Secchi depth readings. Realistically, ideal conditions rarely occur, thereby affecting the results of the measurements.

RESULTS

Due to the changes in volunteer lay monitor between the 1998 and 1999 seasons and Hurricane Floyd, approximately the same number of observations were made on Lake George in 1999 as were made in 1998. Although there were some changes in volunteer participation, the same number of observations were made by lay monitors on Lake George throughout the course of the summer. Lay monitors recorded 125 Secchi depths and corresponding surface water temperatures. DFWI personnel, starting May 11th and ending October 6th, 1999 provided an additional 62 readings.

Surface water temperatures ranged from a spring low of 9.9°C (49.8.°F) on May 26th to a high of 26°C (78.8°F) on July 23rd. A late autumn low of 16°C (60.8°F) was reported on several occasions in October. The average surface water temperature for Lake George during the sampling season of 1999 was 21.7°C (71.1°F), exactly one degree centigrade increase from the mean temperature for 1998. This change is most likely due to the unusually dry summer months of 1999. The limited influx of water from streams and rainfall allowed the upper layers of the water column to absorb significant amounts of energy from the sun. During the summer months, very little mixing occurs between the upper and lower layers of water in the open lake, allowing the upper layer to reach much warmer temperatures. Figures 2 and 3 demonstrate the changes in lake surface water temperature in 1999 for both basins in Lake George.

Figure 2. Water temperature records for the south basin in 1999.

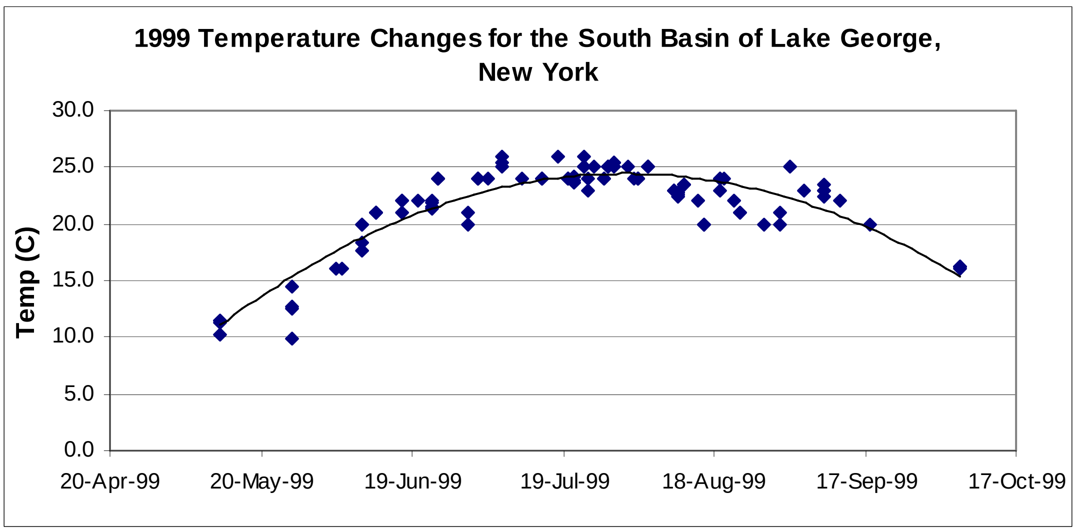
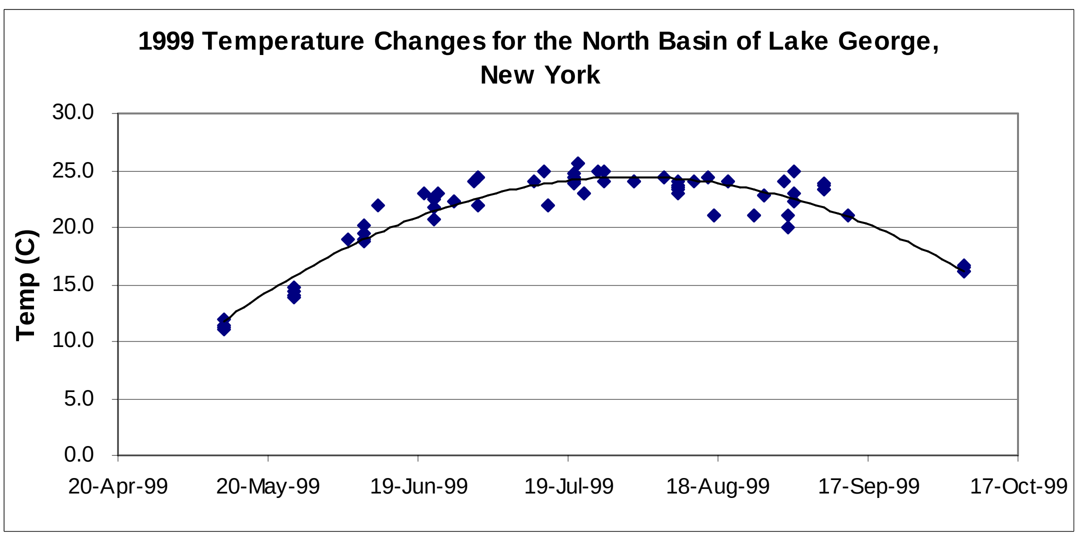
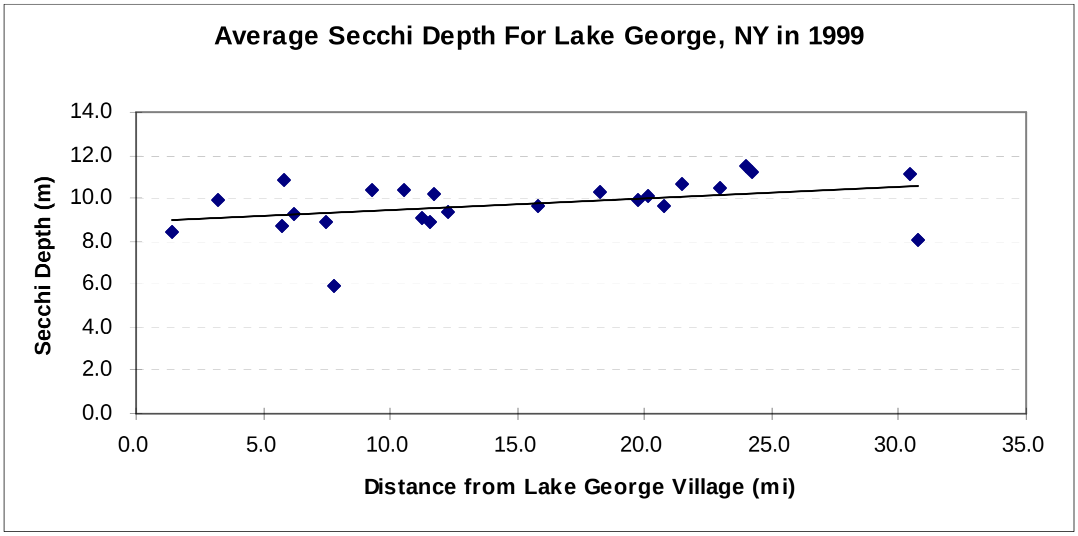


Figure 3. Water temperature records for the north basin in 1999.



The Secchi disc data collected in 1999 by the lay monitors shows water transparency ranging from 4.5 meters (14.3 feet) off Pilot Knob on September 18 to a maximum of 13.6 meters (43.2 feet) at French Point. The 1999 whole lake Secchi average increased slightly to 9.6 meters from 9.0 meters in 1998. This is not a significant change, and in fact the lake Secchi average for 1997 was also 9.6 meters. This demonstrates the variability of Secchi measurements that must be recognized when analyzing transparency data.

Figure 4. Average water transparency in miles from Lake George Village for 1999.



Average Secchi depths for each site are plotted against distance from Lake George Village in Figure 4. From the graph, it is apparent that the water transparency increases as the distance from Lake George Village increases, with greatest clarity found in the north basin. The average Secchi depth in the south basin was 9.1 meters and the average in the north basin was 10.2 meters for a difference between the two basins of nearly one meter. This change is demonstrated by the increasing trendline with distance from Lake George Village in Figure 4.

The trend of increasing light transparency from the southern margin of Lake George to the outlet in Ticonderoga has been well documented by lay monitors over the duration of the program. Storm water runoff deposits both nutrients and particulate matter into the lake, which increase the productivity of the algae and phytoplankton thereby reducing the water clarity. Accurate statistical analyses on the lay monitors' data are difficult due to the amount of variability in sampling conditions and differing number of volunteers and sites sampled each year.

Figure 5. Comparison of historical Secchi readings at Dome Island.

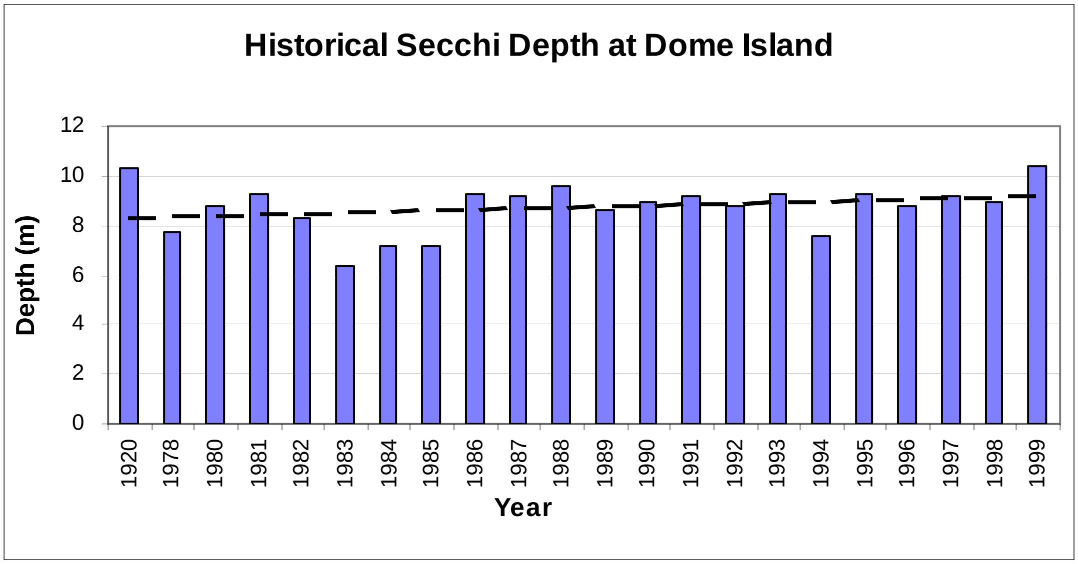


Figure 5 is a representation of the average annual Secchi readings on record for the Dome Island area. As depicted by the chart, Needham et al. (1922) took the highest value on record at Dome Island in 1920 for a biological survey (10.3 m). This however represents a single measurement. All other measurements are summer averages from data collected by lay monitors or DFWI. The data for the last 20 years indicates the variable nature of Secchi transparency. The variability is attributable to varying climatic conditions such as wind, cloud cover, and rainfall. The dashed line in Figure 5 is a trendline that demonstrates a slight increase in the average Secchi measurements at Dome Island over the course of this program. The 1999 season average was the first in the history of the Lay Monitoring program to match the Secchi measurement recorded in 1920.

Figure 6 is a plot of trophic state indices comparing the two basins. The Carlson trophic state index (TSI) relates to the amount of nutrients available for consumption by various organisms in the lake. A lake with a high level of nutrients is generally known as eutrophic; conversely, a lake with low levels of nutrients and aquatic biota is called oligotrophic. The term mesotrophic is used to describe all lakes that fall between the two extremes. The index describes all shades of the trophic process on a scale ranging from 0 to 100 (0 being highly oligotrophic). A decrease of 10 points on the TSI scale (e.g., from 30 to 20) represents a doubling of Secchi depth in meters (e.g., from 9 to 18 meters). Chlorophyll and total phosphorus values can also be applied to the TSI model. Figure 7 is a chart relating the Carlson trophic state index values to the classic definitions of trophic states.

Figure 6. Trophic state indices for Lake George in 1999.

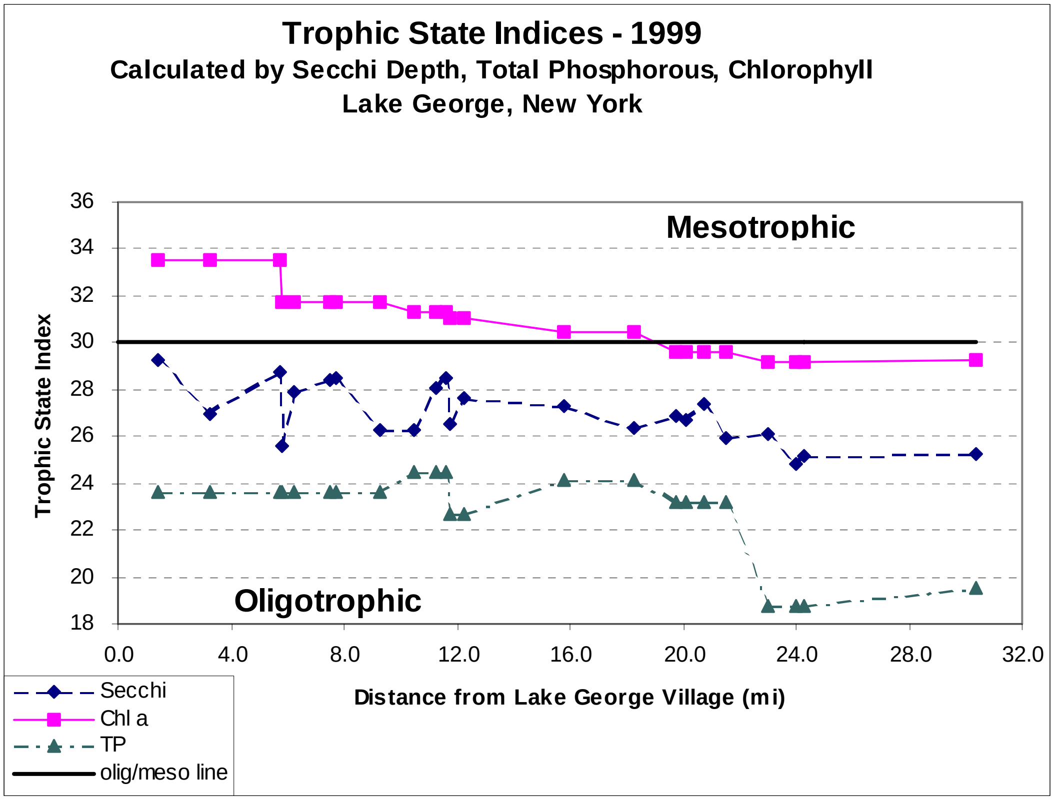
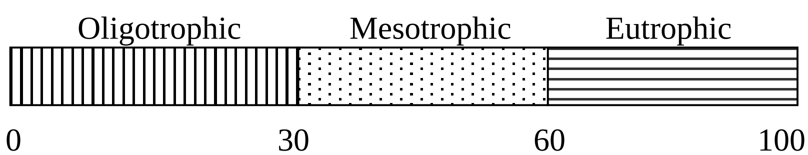


Figure 7. Carlson's trophic state definition chart.



TSI values were generated using the lay monitors Secchi readings and DFWI chlorophyll and total phosphorus data. The area in the south known as the Caldwell basin, which runs from the steel pier in the village and northward a distance of four miles to Diamond Island, typically demonstrates the highest TSI readings in the lake basin. The higher TSI numbers generated by chlorophyll content suggest this area of the lake basin should be classified as mesotrophic or moderately enriched. Secchi transparency and total phosphorus content support a classification of oligotrophic or nutrient-poor for the entire lake. DFWI offshore data confirms this conclusion: high total phosphorus, chlorophyll and lower Secchi readings have historically been found in this area. Elevated nutrient levels and reduced transparency in Lake George have been attributed to urbanization and resultant storm water runoff and its associated pollutants (Eichler et al., 1993; Sutherland et al., 1983). This section of the lake basin also has the greatest amount of urbanization.

CONCLUSIONS

The results of the 1999 Lake George Lay Monitoring Program suggest a continuation of the trends presented in Secchi transparency findings of the past. These trends include:

- Greater Secchi transparency in the North basin than the South basin.
- Consistent differences in Secchi depths between basins.
- A slight increase in the whole lake light transparency between 1999 and 1998
- A slight increase in overall lake surface water temperatures

An analysis of south basin sites over the past few years demonstrates a consistent increase in Secchi transparency readings at a majority of the locations evaluated. Increasing Secchi readings and decreasing Trophic State Indices as the distance from Lake George Village increases are trends that have been observed over many years. These trends support conclusions reached in the 1998 Lake George Chemical Monitoring Program (Eichler et al., 1998) in that greater concentrations of nutrients (nitrogen and phosphorus) and greater overall productivity were found in the south basin when compared to the north basin. Higher concentrations of nutrients generally result in more phytoplankton and thus reduced transparency.

The source of the elevated levels of nutrients in the south basin has been the subject of a number of studies (Gibble, 1974; Ferris and Clesceri, 1975; Aulenbach, 1979; Wood and Fuhs, 1979; Sutherland et al., 1983; and Dillon, 1983). Although estimates differ on the precise amounts of nutrient loading from various sources, all investigators agree that atmospheric deposition (rain, snow, and dryfall), erosion, and urban runoff are the major sources of nitrogen and phosphorus to the lake. In addition to these plant nutrients, erosion and urban runoff are the leading causes of sedimentation in Lake George. Urban runoff includes rainwater that washes tons of road sand and salt into the lake. This is particularly evident at the deltas of English, Finkle, East, West and Hague Brooks. Erosion, both natural and instigated, occurs all around the basin where bare soil is exposed to the elements. Wind, rain and snowmelt all contribute to increased suspended solids, and therefore, decreased water transparency in Lake George.

Erosion and urban runoff may be mediated in a variety of ways, including: sediment traps, management of vegetation in shoreline and riparian zones, replacement of impermeable with permeable surfaces, reduction in the amount of road sanding, and a host of other methods dependent on the type and quantity of surface runoff. It should be the responsibility of all persons interested in the water quality of Lake George to press for more effective runoff controls.

ACKNOWLEDGMENTS

The staff of the Darrin Fresh Water Institute would like to thank all of this year's Lay Monitors for a job well done. The Lake George Lay Monitoring Program continues to provide an enormous amount of valuable data in a very cost-effective manner. Results of this program support conclusions generated through this and other DFWI research activities whose overall goal is protection of the water quality of Lake George. You should be justifiably proud of your efforts.

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