Darrin Fresh Water Institute

AT LAKE GEORGE

THE 2001 LAKE GEORGE LAY MONITORING PROGRAM

by

Jeffrey S. Bartkowski, Laboratory Technician
Lawrence W. Eichler, Research Scientist
Shannon M. Shaver, Laboratory Technician
Charles W. Boylen, Associate Director

Darrin Fresh Water Institute
5060 Lakeshore Dr.
Bolton Landing, NY 12814

Rensselaer Polytechnic Institute
Troy, New York 12180-3590

March, 2002

DFWI #2002-2

INTRODUCTION

The year 2001 was the twenty-first sampling season for the Lake George Lay Monitoring program. 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 123 Secchi depth and surface water temperature readings from Lake George. In this report, 73 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

There were a few changes in the layout of the monitoring program this year. We ended up with a total of six volunteers monitoring 12 locations across the lake. With these changes in monitors, the Lake George Lay Monitoring Program had a loss of two monitors and six sites for the sampling season. 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 2001.

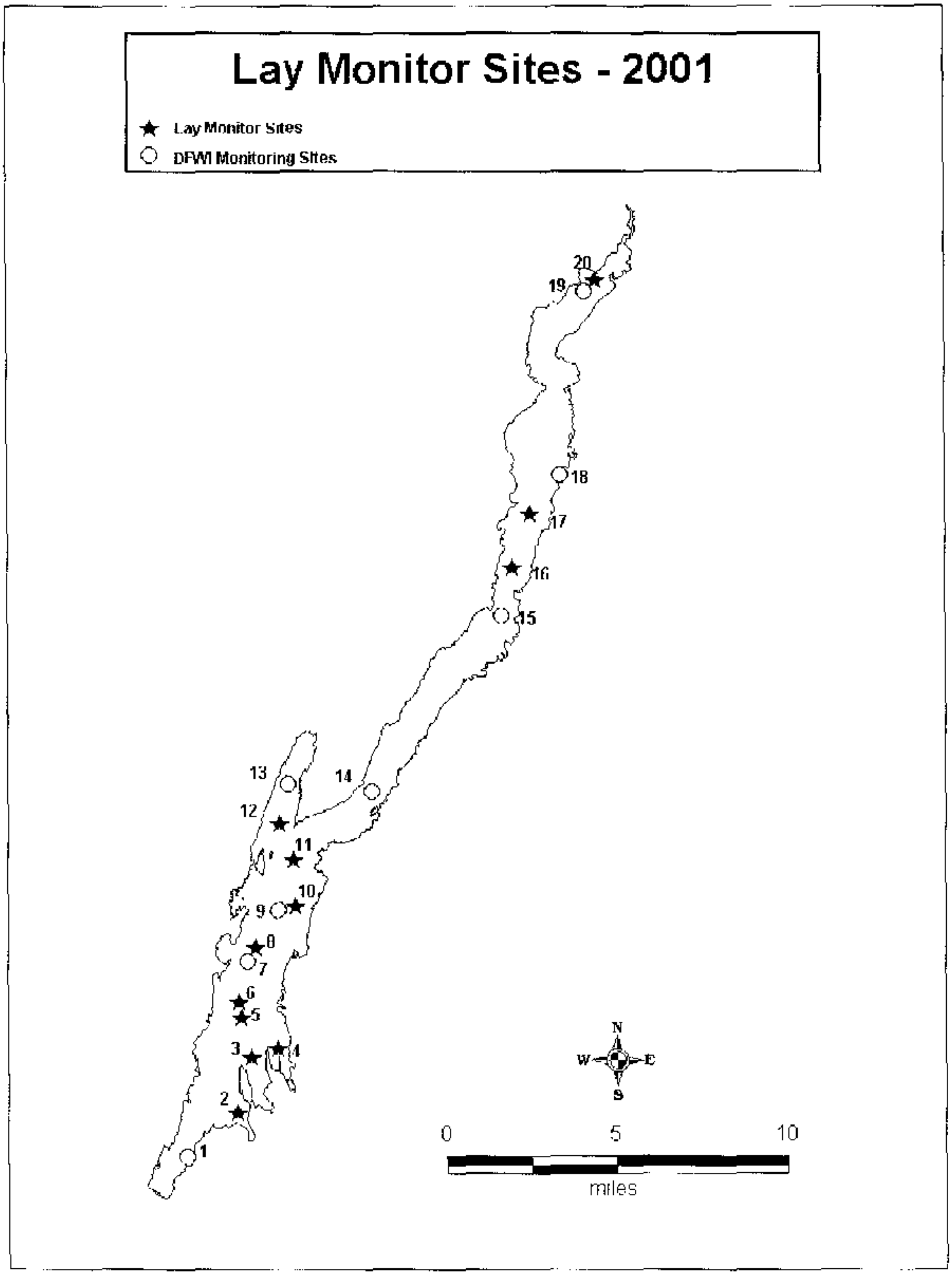


Table 1. Volunteer Lay Monitors and the sites where they obtained Secchi depth and surface temperature measurements.

Monitor	Site No.	Site Name	Miles from LG Village	Average Secchi (m)
DWFI	1	East of Tea Island	1.5	7.6
Wrigley	2	Dunham's Bay - midlake	3.3	9.8
Wrigley	3	Assembly Pt.:Ripley Pt.	4.9	9.7
Sebold	4	Kattskill Bay	5.8	8.5
Wrigley	5	Middleworth Bay midlake	5.8	11.4
Sebold	6	Long Isl.: Cotton Pt.	6.0	10.1
DFWI	7	Basin Bay	7.2	8.9
Desantis	8	Fish Pt.:Pilot Knob	7.7	6.0
DFWI	9	Dome Island	8.9	10.7
Summerhayes	10	Dome Is : Watch Point	9.3	10.4
Summerhayes	11	Crown Is : Shelving Rock	10.5	8.1
Summerhayes	12	Northwest Bay mouth	11.3	10.5
DFWI	13	Northwest Bay - Mid Bay	12.4	9.3
DFWI	14	French Point	13.4	9.4
DFWI	15	Sabbath Day Point	19.8	10.2
Harmon	16	Odell Islands	21.3	10.6
Harmon	17	Skippers Jib	22.9	10.2
DFWI	18	Smith Bay	24.3	9.9
DFWI	19	Roger's Rock	30.4	9.1
Vickers	20	Rogers Rock north(Windmill Pt)	30.8	7.8

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 monitoring between the 2001 and 2000 seasons, more observations were recorded in 2001. Lay monitors recorded 123 Secchi depths and corresponding surface water temperatures in 2001, 8 more observations then 2000. DFWI personnel, starting May 1st and ending October 19th, 2001 provided an additional 73 readings, an increase over the 55 readings of the previous year.

Surface water temperatures ranged from a spring low of 7°C (45°F) on May 1st to a high of 27°C (81.0°F) on August 15th. A late autumn low of 14°C (57.0°F) was reported on several occasions in October. The average surface water temperature for Lake George during the sampling season of 2001 was 19.7°C (67.6°F), only a 0.1° C increase from the mean temperature for 2000 (19.6°C, 67.6°F). Similar climactic conditions between the relative years are most likely responsible for the negligible change in mean surface temperatures. Figures 2 and 3 demonstrate the changes in lake surface water temperature in 2001 for both basins in Lake George.

Figure 2. Water temperature records for the South Basin in 2001.

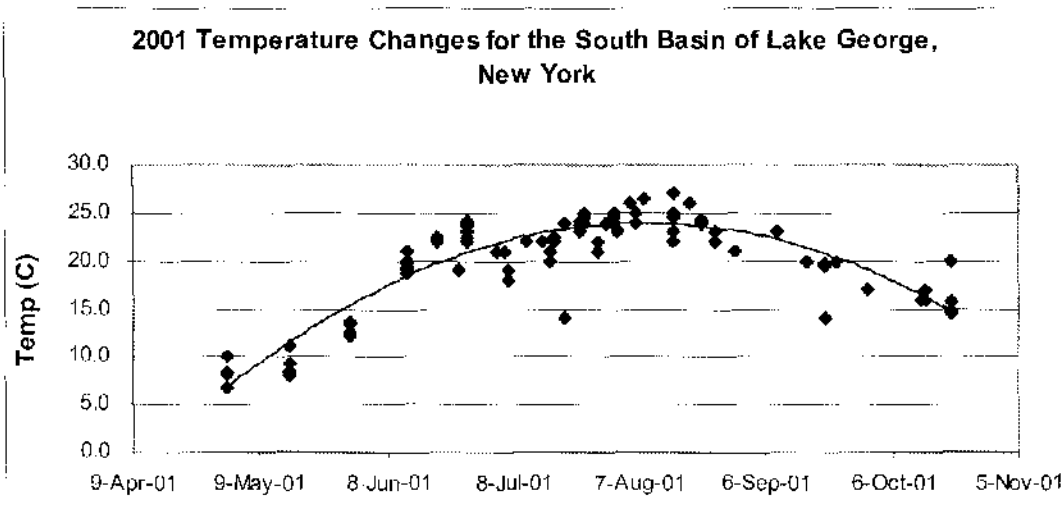
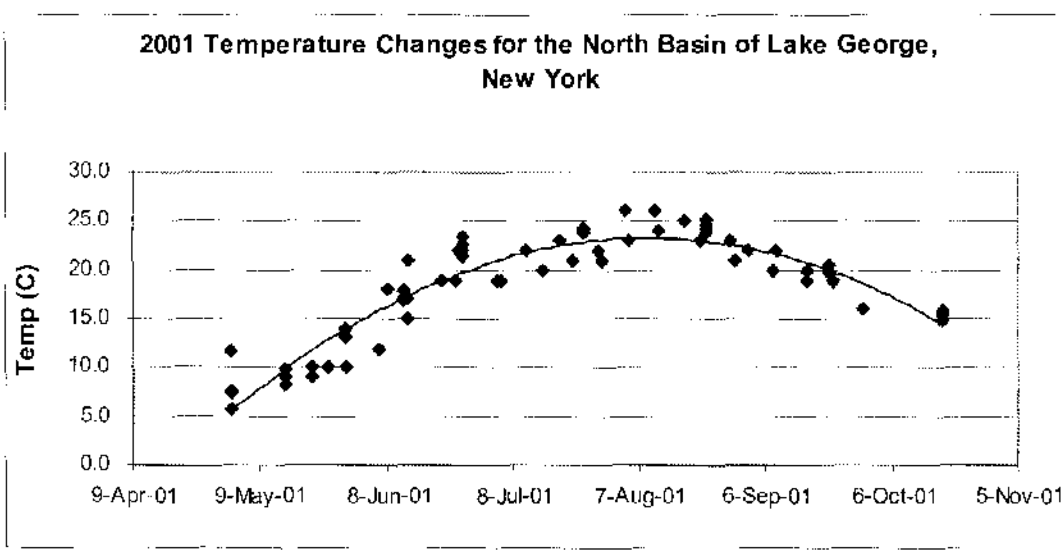
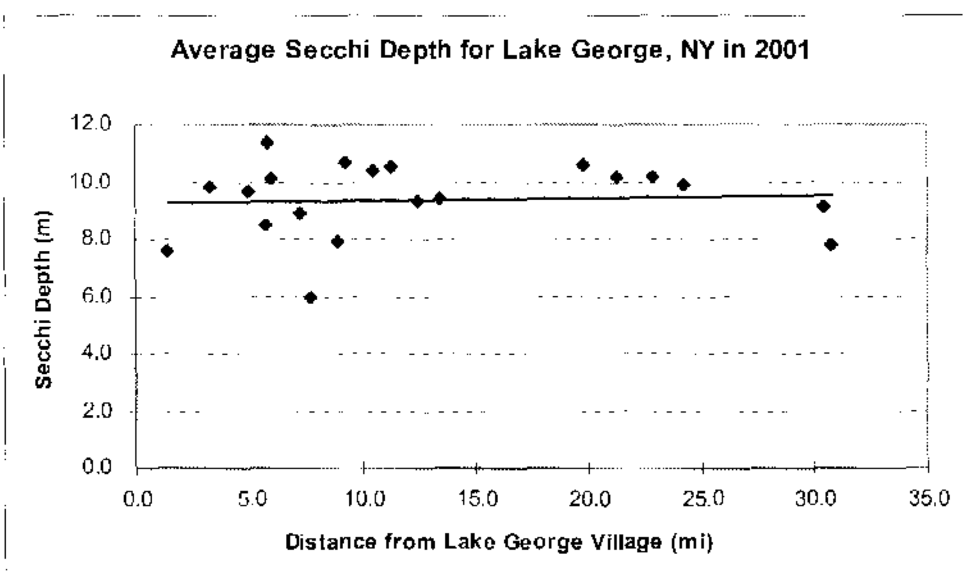


Figure 3. Water temperature records for the North Basin in 2001.



The Secchi disc data collected in 2001 by the lay monitors shows water transparency ranging from 5.0 meters (16.4 feet) off Pilot Knob on August 5th to a maximum of 13.0 meters (42.7 feet) in Middleworth Bay on June 13th. In 2001 whole lake Secchi average increased to 9.4 meters from 8.5 meters reported in 2000. With similar rainfall amounts recorded for the 2000 and 2001 sampling season, differences in mean Secchi values is most likely due to other factors. According to lay monitors data, there was a decrease in the number of windy and cloudy days when compared to 2000. This would have created better viewing conditions and could lead to higher mean Secchi values. These factors demonstrate the variability of Secchi measurements must be recognized when analyzing transparency data.

Figure 4. Average water transparency in miles from Lake George Village for 2001.



Average Secchi depths for each site are plotted against distance from Lake George Village in Figure 4. From the graph, it appears that water transparency increases slightly 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 9.2 meters and the average in the north basin was 9.7 meters. 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.

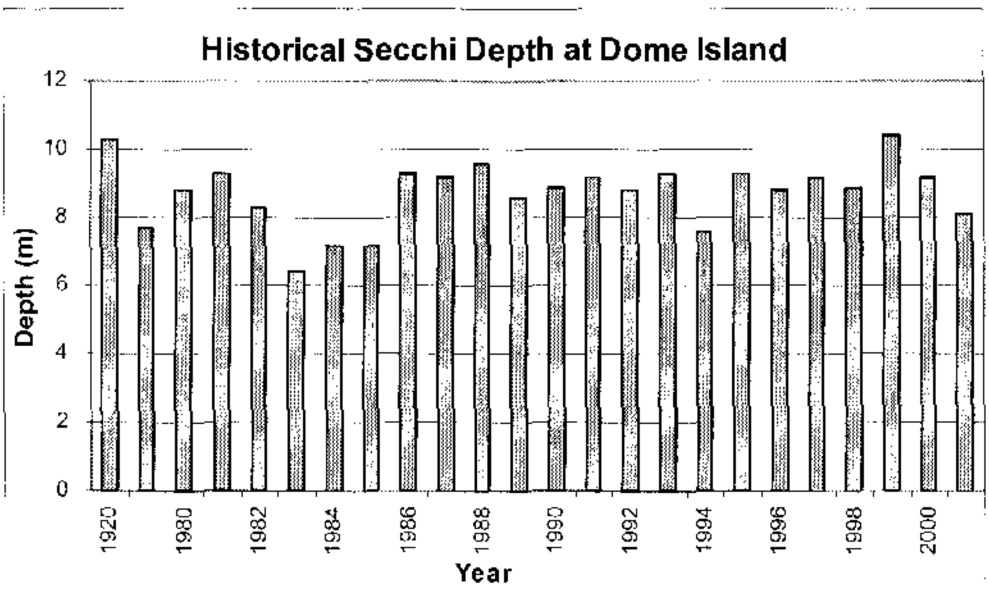


Figure 5 is a representation of the average annual Secchi readings on record for the Dome Island area. This data is compared to a single historical measurement taken by Needham et al. (1922) at Dome Island in 1920 for a biological survey (10.3 m). All other measurements are summer averages from data 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.

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 (Carlson, 1977).

Figure 6. Trophic state indices for Lake George in 2001.

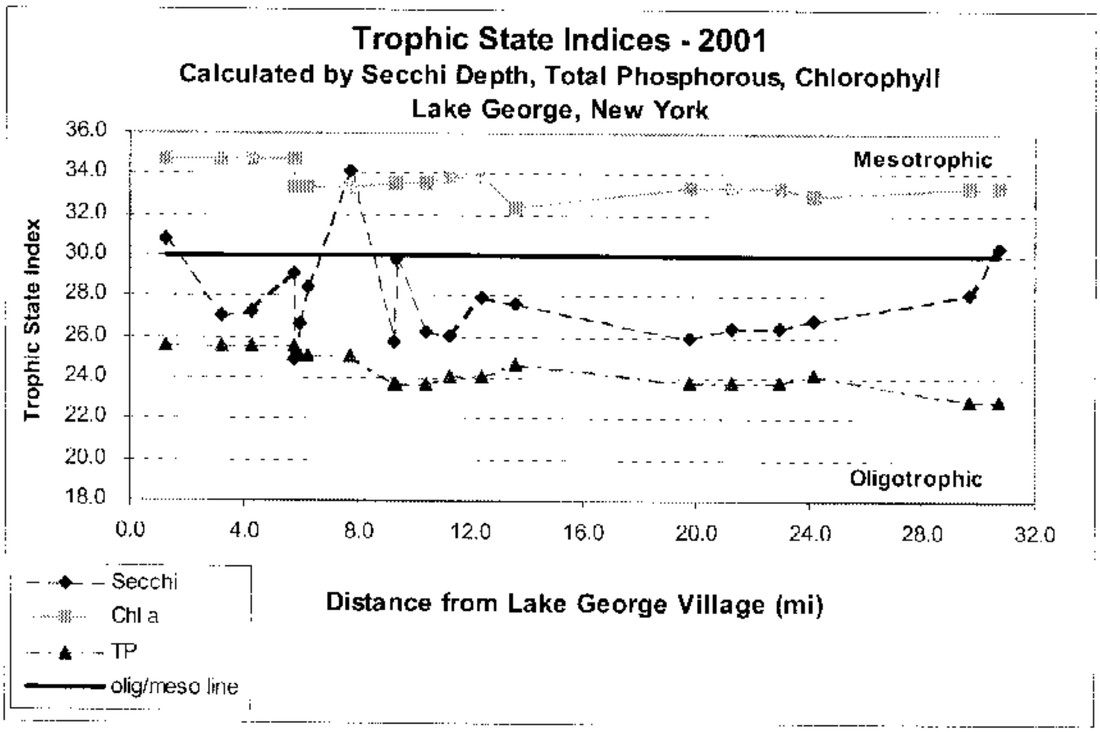
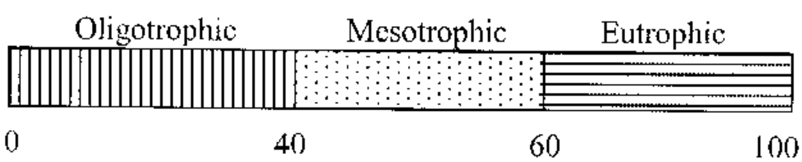


Figure 7. Carlson's trophic state definition chart.



TSI values were generated using the lay monitor Secchi readings and DFWI chlorophyll and total phosphorus data. The area in the south end of the lake, 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 Caldwell basin 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 2001 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.
- An increase in the whole lake light transparency between 2001 and 2000
- Relatively unchanged lake surface water temperatures

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 2001 Lake George Chemical Monitoring Program (Eichler et al., 2002) 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.

REFERENCES

Aulenbach, D.B. 1979. Nutrient budgets and the effects of development on trophic conditions in lakes. Fresh Water Institute Report No. 79-2, Darrin Fresh Water Institute, Rensselaer Polytechnic Institute, Troy, NY.

Dillon, P.J. 1983. Nutrient budgets for Lake George, New York. In: C.D. Collins (ed.) The Lake George Ecosystem, Volume III. The Lake George Association, Lake George, NY pp. 157-167.

Ferris, J.J. and N.L. Clesceri. 1975. A description of the trophic status and nutrient loading for Lake George, New York. In: North American Project - A Study of U.S. Water Bodies. EPA-600/3-77-086, USEPA, Corvallis, OR.

Eichler, L.W., J.S. Bartkowski, S.M. Shaver, and C.W. Boylen. 2002. The 2001 Lake George Offshore Chemical Monitoring Program. DFWI Technical Report 02-4. Darrin Fresh Water Institute, Bolton Landing, NY.

Gibble, E.B. 1974. Phosphorus and nitrogen loading and nutrient budget on Lake George, New York. Masters Thesis, Rensselaer Polytechnic Institute, Troy, NY.

Sutherland, J.W., J.A. Bloomfield, and J.M. Swart. 1983. Final report for the Lake George urban runoff study, nationwide urban runoff program. Bureau of Water Research, New York State Department of Environmental Conservation, Albany, NY.

Wood, L.W. and G.W. Fuhs. 1979. An evaluation of the eutrophication process in Lake George based on historical and 1978 limnological data. Environmental Health Report No. 5, Environmental Health Center, Division of Laboratories and Research, New York State Department of Health, Albany, NY. 73 pp.