SILVER LAKE OF MADISON

LAKES LAY MONITORING PROGRAM

1985

Freshwater Biology Group (FBG)

University of New Hampshire

Durham

by

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LAKES LAY MONITORING PROGRAM

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This is a LEVEL I report. (See last page for definition.)

All data in this report are available to any person or organization upon request and payment of costs involved.

PREFACE

Importance of long-term monitoring

Lake monitoring carried out weekly over the course of several consecutive summers benefits the lake in a number of ways. The resulting data not only indicate the lake's condition for a particular summer, but they also suggest what it was like in the past, and make it possible to predict its condition in the future.

For this reason, it is important to distinguish between short-term and long-term results. As an example, a 30 year time-span may provide evidence for a long-term trend towards eutrophy (Fig. 1). Yet, if one looks at data over a 1-5 year time-span, one sees only short-term fluctuations; there are no apparent trends nor is it possible to separate the "signal" from "noise". Chlorophyll, water transparency, and phosphorus may fluctuate from year to year in response to annual variations in climate and activity on the lake, and may be unrelated to long-term trends. The more such "noise" in the data, whether due to real or analytical variations, the longer a monitoring program must continue to demonstrate long-term trends.

Use of long-term trends

Long-term trends serve several important functions. From them, past deterioration of the lake can be recognized. They can also be used to forecast the future condition of

They can also be used to forecast the future condition of the lake, and if necessary, management techniques can be implemented to keep potential problems from becoming worse. Finally, long-term trends provide a basis for evaluation of existing management programs so that necessary changes may be brought about.

It takes a great deal of motivation, perseverance, and a love for one's lake to be a lay monitor. Sometimes it may seem to be an inconvenience, or to be discouraging when it's unclear just what a year's worth of hard work means with respect to the "big picture" of the lake. Yet, each observation by a lay monitor is a significant contribution.

Thus, continuation of data collection is important. The LLMP data base is becoming more comprehensive and valuable each year. We are pleased with the interest and commitment of lakeshore volunteers. Keep up the great work!

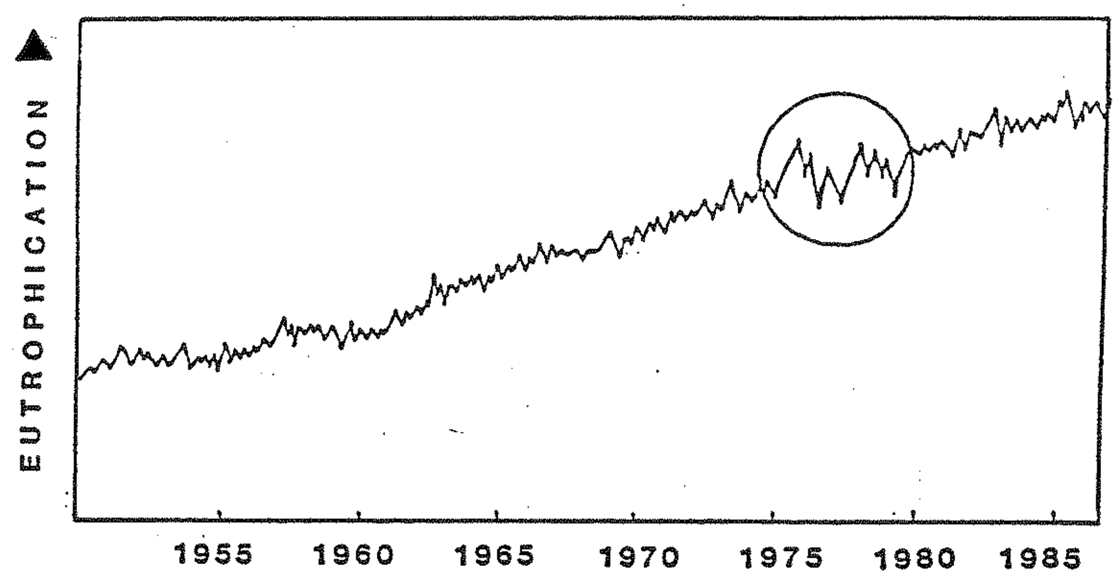

Figure 1. Long-term vs. short-term trends in a hypothetical lake approaching eutrophication.

ACKNOWLEDGEMENTS

Silver Lake has participated in the Lakes Lay Monitoring Program since 1983. The program continued strongly in 1985 through the direction of Dr. Lawrence Slanetz and with the help of several dedicated monitors. Six sites on the lake were monitored weekly from April through October. Lay monitors for 1985 were: Barbara and Carl Beck, Robert Benford, Robert Hewton, Percy Hill, and William Jones.

The Freshwater Biology Group congratulates the monitors on the quality of their work and the time and effort put forth. We encourage them and other interested members of the Silver Lake Association to continue monitoring during the 1986 season. We would also like to thank Dr. Slanetz for his continued dedication to the maintenance and organization of the LLMP for the lake.

Members of the Freshwater Biology Group (FBG) included Kim Babbitt, Henry Burke, Tracy Kenealy, Sandra Lord, Elizabeth Trieff, Celia Acacia, and Deb Thunburg. Kim was the LLMP Coordinator, and was responsible for arranging the field trips and supervising the research team. Liz and Sandy were responsible for phosphorus, Henry for equipment production and upkeep, Celia for phytoplankton, and Deb for zooplankton. Tracy was responsible for data entry and analysis, and for writing the reports in the fall. All members of the FBG participated in the field work and lab analyses.

We would also like to recognize the UNH Office of Computer Services for their provision of computer time and data storage space. The final text is available on an IBM-compatible diskette.

COMMENTS AND RECOMMENDATIONS

1) We recommend that the Silver Lake Association continue its long-term monitoring program in 1986. The association has established a three-year data base which can be strengthened through further monitoring. A data base resulting from several years of monitoring will be a valuable resource in the future as trends in the chemistry and biology of the lake become evident.

2) We strongly recommend the continuation of alkalinity and pH testing in 1986. Because both the pH and alkalinity on Silver Lake in 1985 were low, we are concerned with the problem of acidification. Alkalinity measurements provide a reliable way to detect changes in buffering capacity and to predict changes in acidity and pH.

3) As a general addition to our Lakes Lay Monitoring Program, we are suggesting that each lake in the Program begin monitoring the condition of the fish taken from the lake. The "Fish Monitoring" will require that at least one lay monitor record the species, length and weight and collect a sample of fish scales for each fish examined. In most lakes this will involve periodic creel census of sport fishermen on the lake. Equipment required will cost

approximately $100. Special instruction will be given to the lay monitors who chose to measure this parameter.

Length-to-weight ratios give a measure of the nutritional condition of the fish. Analysis of the fish scales (to be done at UNH) will tell how old each fish is. Together, these data will be extremely useful indicators of the health of the fish populations in the lake, and, of course, the "health" of the lake.

METHODS OF LAY MONITORS

This year data were collected on seven parameters: thermal stratification, water clarity (secchi disk depth), chlorophyll a concentration, total phosphorus, dissolved water color, pH, and alkalinity. Whenever possible, testing was done weekly between the hours of 9 am and 3 pm, the period of maximum sunlight penetration into the water. All samples and data were mailed to the FBG at UNH for analysis.

Thermal (temperature) profiles were obtained by collecting lakewater samples at several successive depths using a modified Meyer bottle (Lind, 1979). A weighted, empty bottle with a stopper was lowered to a specific depth. At that depth, the stopper was pulled, allowing the bottle to be filled with water. The bottle was quickly pulled back up to the surface where the temperature of the sample was taken with a Taylor pocket thermometer, and recorded in degrees Celsius. This procedure was repeated at one meter intervals through the epilimnion and hypolimnion, and at one-half meter intervals throughout the metalimnion.

Water clarity was measured by lowering a secchi disk (approximately 20 cm. or 8 inches) through the water off the shady side of the boat, and noting the average depth at which it disappeared upon lowering and reappeared when being raised (the cord attached to the secchi disk was marked in one-half meters). This process was done while holding a view-scope just below the surface to eliminate effects of surface reflection and wave action. This was repeated two or three times, and an average to the nearest one-tenth of a meter was recorded.

Chlorophyll a concentration was used as an index of algal biomass that is useful in determining the trophic state of the lake. A weighted plastic tube (10 meters in length) was lowered through the epilimnion, or "upper lake" to the top of the metalimnion, or "middle lake" (the depths of the epilimnion and metalinmion are determined from the temperature profile). The end of the tube above water is folded to shut off the water flow into or out of the tube. The weighted end of the tube is pulled up out of the water with an attached cord, trapping an integrated sample of water representing the "upper lake" in the tube. This sample is poured into a plastic 2.5 liter bottle and stored for chlorophyll filtration and alkalinity determination.

Water samples for chlorophyll a filtration were filtered through a 0.45 micron membrane filter. Damp filters, containing chlorophyll-bearing algae, were air-dried for at least 15 minutes, out of the sun, to prevent decomposition or bleaching of the chlorophyll on the filter. These filters were sent to UNH where members of the FBG analyzed them for chlorophyll a (see Methods of the Freshwater Biology Group).

Dissolved water color was determined by saving the filtrate from the the chlorophyll filtration and storing it frozen in a 50 ml plastic bottle. The bottles were sent to UNH and the color was analyzed by reading the absorbance of the samples at two different wavelengths (440 and 493).

Samples for total phosphorus analysis were collected in two ways. For determination of epilimnetic phosphorus, water was taken from the integrated sample collected with the tube-sampler. On parts of the lake where it was suspected that phosphorus might be high, (eg. sites along the shoreline, inlets or outlets), surface samples were taken by dipping a bottle into the water and letting it fill. All samples were collected in acid-washed 250 ml bottles, fixed with 1.0 ml of concentrated sulfuric acid, and stored frozen until analysis by the FBG team. (See Methods by the Freshwater Biology Group.)

To determine the alkalinity, a two-endpoint titration was done with 0.002 N sulfuric acid to a pH of 4.5 and 5.1. The endpoint indicator was methyl red/bromocresol green. The amount of titrant used (dilute sulfuric acid) was recorded to the nearest 0.1 ml, representing the equivalent milligrams of calcium carbonate per liter.

METHODS OF THE FRESHWATER BIOLOGY GROUP

The Freshwater Biology Group (FBG) research team took one trip to the lake and conducted several tests which included measurements of sunlight penetration into the water, dissolved oxygen, alkalinity, free (unbound) carbon dioxide, pH, specific conductivity, chlorophyll a, total phosphorus, and a survey of the microscopic plants (phytoplankton) and animals (zooplankton) present. The FBG was also responsible for chlorophyll a and phosphorus analysis of lay monitor samples, as well as filing and analyzing 1985 data, performing statistical tests, and determining possible trends based on past data.

Field and Laboratory Methods

On the lake, a dissolved oxygen and temperature profile was taken using a Yellow Springs Instruments Model 54A Oxygen/Temperature meter with a submersible probe. Readings were taken at one-meter intervals throughout the epilimnion and hypolimnion, and at one-half meter intervals through the metalimnion.

Sunlight and skylight penetration into the water was measured with a Whitney submersible photometer model LMA-8A, off the sunny side of the boat. From the relative light intensities which were recorded, the coefficient of light extinction was later determined.

Samples for water chemistry (dissolved oxygen, alkalinity, free (unbound) carbon dioxide, pH, and specific conductivity) were collected with a 3-liter Van Dorn bottle at depths which represented the surface, mid-epilimnion, metalimnion, and hypolimnion. Alkalinity, free carbon dioxide, and pH samples were stored on ice in 250 milliliter polyethylene bottles and were analyzed in the field within 1 to 2 hours of sampling. Specific conductivity samples were analyzed in the FBG lab at room temperature.

In addition to the oxygen profile taken, the dissolved oxygen (DO) concentration of specific lakewater samples (epilimnetic and hypolimnetic) was determined chemically using the Winkler method for dissolved oxygen. The precision of the method allows us to to check the accuracy of the electronic probe, so that adjustments could be made in the probe readings if necessary. In the Winkler method, water is collected in Biological Oxygen Demand (BOD) bottles and fixed with manganese sulfate and alkali-iodine-azide. A loose precipitate (floc) of manganous hydroxide is formed that will absorb any dissolved oxygen present. The sample is then acidified with concentrated sulfuric acid in the presence of of iodide, and iodine is released in a quantity equal to the amount of dissolved oxygen present.

To determine the alkalinity, a two-endpoint titration was done with 0.002 N sulfuric acid to a pH of 4.5 and 5.1. The endpoint indicator used was methyl red/bromocresol green. The amount of titrant used (dilute sulfuric acid) was recorded to the nearest 0.1 ml, representing the equivalent milligrams of calcium carbonate per liter.

Free carbon dioxide concentration was determined by titrating the fresh lakewater samples with 0.0027 N Sodium Hydroxide to a final pH of 8.3, using the dye phenolphthalein as the end-point indicator.

Lakewater pH was measured with a digital pH meter (Orion model 231) equipped with a combination probe (Orion Co.)

Specific conductivity was measured with a Barnstead Conductivity Bridge Model PM-70CB , with a model B-10 probe (cell constant = 1.0). Corrections were made for sample temperatures with a standard curve.

Samples to be analyzed for chlorophyll a, total phosphorus, phytoplankton, and zooplankton were collected with a vertical tube sampler into a 2.5 liter plastic bottle. Chlorophyll samples were filtered through a 0.45 micron membrane filter and air-dried until analysis. The chlorophyll a content was analyzed by extracting the chlorophyll with a 95% acetone solution saturated with magnesium carbonate. The samples were then centrifuged and their light absorbance read at two standard wavelengths (663 and 750 nanometers).

Phosphorus samples were fixed with 1.0 milliliter of concentrated sulfuric acid and stored refrigerated until analysis. Also, phosphorus samples from lay monitors were received by the FBG in a refrigerated or frozen state, and stored cold until analysis. To determine the total phosphorus content, ammonium persulfate and 11 N sulfuric acid was added to digest the total phosphorus, and the samples were autoclaved for one hour. A single-reagent method was employed using potassium antimony tartrate, ammonium molybdate, and a fresh solution of ascorbic acid (E.P.A. 1979). Absorbance of the blue phosphorus complex was measured with a spectrophotometer at 650 nm. Each sample was analyzed twice and an average of the two values taken as the phosphorus content in parts per billion.

Phytoplankton samples were fixed with iodine (Lugol's solution) immediately after collection. The preserved samples were later counted with an inverted microscope after settling for 24 hours in counting chambers. At least 200 individual algal "units" were counted with a modified scan technique (Baker, 1973).

Zooplankton samples were collected by taking a plankton tow through the oxygenated portion of the water (>0.5 ppm oxygen) using a 30 cm diameter, 150 micron porosity plankton net. Samples were immediately preserved in a 4% formalin-sucrose solution (Haney and Hall, 1973) and subsampled with a 1-milliliter Hensen-Stemple pipet. Sufficient subsamples were taken to insure that at least 100 zooplankters were counted.

How the data are analyzed

Incoming data are received through the mail during the sampling season and are first filed in an "incoming data" book. This provides temporary storage until the corresponding chlorophyll and/or phosphorus sample for each data sheet is analyzed. All data, including date, lake, site, secchi disk depth, chlorophyll a and phosphorus content, alkalinity, and color measurements, are filed and stored on a computerized data-management system of the University of New Hampshire. Data can be easily retrieved by lake, sampling station or date, and used for individual reports and for each year.

Statistical treatment of the data for each lake includes a comparison of seasonal tendencies found throughout the year, monthly means for the different parameters tested, and confidence levels for each site. The same comparisons mentioned above are made on a yearly basis if the lake has been in the program for two years or more. If sufficient data are available from several years, regression analyses and other statistical tests are performed. Such analyses may identify trends and help explain variations in the data (eg. secchi disk depth, chlorophyll a, color). In addition, data is compared with other lakes in the program and to published water quality classifications. Trophic boundaries of Forsberg and Ryding (1980) are used to classify each lake.

SUMMARY OF LAY MONITOR DATA

Results from the lay monitors are presented separately from those of the Freshwater Biology Group, as the two groups conducted separate research. Conway Lake was sampled weekly at sites "1 South", "2 Deep", "3 Center", "4 East", and "5 North" from April 9 through October 16, 1985. A sixth site, "6 Big Island", was added in August. See Figure 2 for 1985 sampling sites and Appendixes A and B for lay monitor data from 1983-1985.

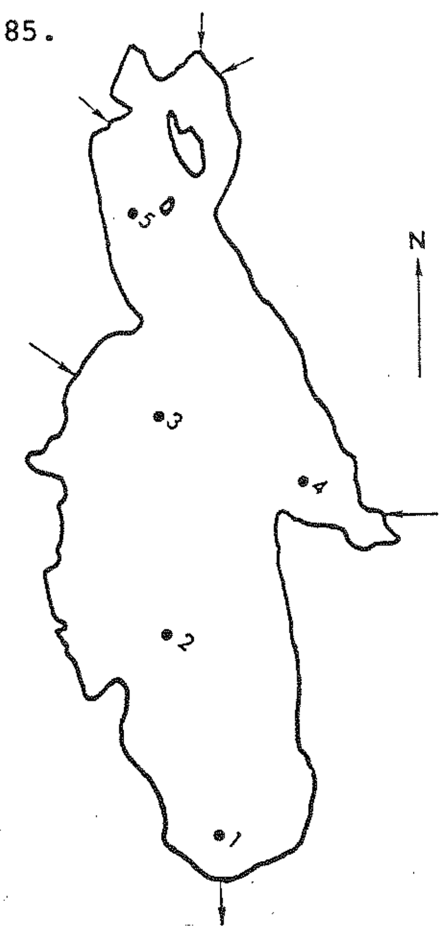

Figure 2. Silver Lake, Town of Madison, New Hampshire. Outline map and location of 1985 sampling sites.

Water Transparency

Water transparency (secchi disk depth) was in the range from 5.0 to 9.8 meters (m), with an average of 7.4 m for the lake. Water transparency was highest at site 3 (average 7.7 m) and lowest at site 4 (average 5.5 m). This range of secchi disk depths would classify Silver Lake as oligotrophic.

Chlorophyll a

Chlorophyll *a* concentrations were in the range from 0.1 to 1.8 milligrams per cubic meter (mg/cubic m) with an average of 0.7 mg/cubic m for the lake. The highest average chlorophyll concentration was found at site 5 (average 0.8 mg/cubic m) and the lowest average concentration was found at site 3 (average 0.6 mg/cubic m). These average values correspond to the sites where the water transparency was lowest and highest, respectively, suggesting that there may be an inverse relationship between the secchi disk depth and chlorophyll a concentration.

Dissolved Water Color

Samples for dissolved water color were taken from sites 1 through 5. Dissolved water color is the brown coloring of lakewater due primarily to dissolved humic substances, and was in the range from .01 to .03 for the 5 sites. Water color was slightly higher at sites 4 and 5 than at sites 1, 2, and 3. The range of values on Silver Lake was comparable to the majority of lakes in the LLMP.

Total Phosphorus

Samples for total phosphorus were taken from sites 1 through 5 and from two inlets to the lake (Figure 2). Phosphorus concentrations were in the range from 1.8 to 6.1 micrograms per liter (parts per billion, or ppb). Concentrations were in the same general range at all sites (Appendix B). Based on total phosphorus, Silver Lake would be classified as oligotrophic.

Alkalinity

Lay monitor alkalinity testing was carried out from July 24 through September 17, 1985. Alkalinities were in the range from 3.5 to 8.3 milligrams calcium carbonate per liter, with an average of 5.5 mg/l for the lake. Alkalinity values in this range indicate low buffering capacity.

pH

The pH on Silver Lake were in the range from 4.4 to 6.4. Samples were taken from both the surface and and deep spots. The pH values in the lower range may be critical, as some species of fish and crustaceans fail to reproduce at a pH as high as 5.9.

SUMMARY OF FRESHWATER BIOLOGY GROUP DATA

The Freshwater Biology Group (FBG) visited Silver Lake and sampled in on several parameters at sites "2 Deep" and "5 North" (Figure 2) on August 15, 1985.

Temperature and Dissolved Oxygen

Silver Lake was thermally stratified at both sites on August 15. Oxygen was abundant throughout the water column (greater than 5 parts per million). At both sites, an oxygen maximum was present at approximately 9 meters; as oxygen maximums are usually characteristic of lakes approaching eutrophy, their position in the water column should be monitored each year.

Water Transparency

The water transparency measured by the FBG was 9.2 meters (m) at site 2 and 6.0 m at site 5. Both values fall in the oligotrophic range.

Chlorophyll a and Dissolved Water Color

Chlorophyll *a* concentrations were 0.1 milligrams per cubic meter at site 2 and 0.3 at site 5. These concentrations are low and indicate oligotrophic conditions.

The dissolved water color was also low. The absorbance at 440 nanometers was 0.02 at both sites, which is the same as the average dissolved water color found by the lay monitors.

Total Phosphorus

Total phosphorus concentrations measured by the FBG were 2.3 micrograms per liter at site 2 and 1.5 micrograms per liter at site 5. Based on total phosphorus, Silver Lake would be classified as oligotrophic.

Alkalinity, pH, and Free Carbon Dioxide

The alkalinity was in the range from 3.4 to 4.0 milligrams calcium carbonate per liter. Values were relatively constant throughout the water column, and similar at both sites. Alkalinities in this range are low (the average alkalinity for New Hampshire lakes is approximately 9 mg/l), indicating low buffering capacity. A critical point occurs at alkalinity values of about 2 when there is little or no resistance of a lake to acidification. With little buffering capacity, the pH of the lake is unstable and will decrease rapidly if further acid is added.

The pH of Silver Lake measured by the FBG was in the range from 6 to 7, which is a higher range than that found by the lay monitors. The low alkalinities measured in 1985 and the low pH measured by the lay monitors may be cause for concern. Results from recent scientific literature have shown alkalinity to be a more reliable early indicator of acidification than pH. Therefore, both the pH and alkalinity of the lake should be carefully monitored in the future, and a decrease in either parameter should prompt an investigation of possible effects of acidification on the lake.

Levels of free (unbound) carbon dioxide were low, with a range of 0.4 to 2.6 milligrams per liter at both sites.

Specific Conductivity

The specific conductivity measured by the FBG was in the range from 19.9 to 31.8 micromhos at site 2, and from 46.0 to 52.3 at site 5. Specific conductivities in both ranges are low, indicating low levels of road salt and/or raw sewage entering the lake.

Phytoplankton

The phytoplankton density on Silver Lake was low, with 1428 cells per milliliter at site 2 and 2724 cells per milliliter at site 5. The Chrysophyceae (golden algae) were dominant at both sites, and the Cyanophyceae (bluegreens) and Prymnesiophyceae (*Chrysochromulina*) were also abundant.

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APPENDIX A

LLMP -- Lay Monitor Data: Silver (Madison)   Feb-22-86

13:35.10

Date	Lake		Site	SDD	Chl
Jul-28-83	Silver	(Madison	1 South	6.50	.76
Aug-02-83	Silver	(Madison	1 South	7.30	.62
Aug-09-83	Silver	(Madison	1 South	6.50	.52
Aug-19-83	Silver	(Madison	1 South	6.70	.62
Aug-23-83	Silver	(Madison	1 South	6.30	.95
Aug-30-83	Silver	(Madison	1 South	6.70	1.09
Sep-07-83	Silver	(Madison	1 South	7.30	.29
Sep-21-83	Silver	(Madison	1 South	8.20	.62
Oct-05-83	Silver	(Madison	1 South	8.90	.52
Oct-19-83	Silver	(Madison	1 South	7.80	1.05
Jun-07-84	Silver	(Madison	1 South	5.50	1.33
Jun-16-84	Silver	(Madison	1 South	5.50	1.43
Jun-21-84	Silver	(Madison	1 South	5.00	1.21
Jun-28-84	Silver	(Madison	1 South	5.70	1.57
Jul-05-84	Silver	(Madison	1 South	5.70	1.28
Jul-13-84	Silver	(Madison	1 South	4.50	1.57
Jul-19-84	Silver	(Madison	1 South	6.30	1.14
Jul-26-84	Silver	(Madison	1 South	4.25	.71
Aug-02-84	Silver	(Madison	1 South	6.80	1.07
Aug-08-84	Silver	(Madison	1 South	5.70	.64
Aug-15-84	Silver	(Madison	1 South	5.70	.71
Aug-24-84	Silver	(Madison	1 South	5.20	1.07
Aug-30-84	Silver	(Madison	1 South	6.30	.86
Sep-05-84	Silver	(Madison	1 South	6.00	.93
Sep-22-84	Silver	(Madison	1 South	6.50	.71
Oct-12-84	Silver	(Madison	1 South	6.50	---
May-09-85	Silver	(Madison	1 South	7.20	.86
May-17-85	Silver	(Madison	1 South	7.00	1.71
May-23-85	Silver	(Madison	1 South	7.60	.78
May-30-85	Silver	(Madison	1 South	6.20	.36
Jun-06-85	Silver	(Madison	1 South	7.20	---
Jun-15-85	Silver	(Madison	1 South	6.50	.86
Jun-20-85	Silver	(Madison	1 South	7.00	1.07
Jun-29-85	Silver	(Madison	1 South	5.50	1.64
Jul-11-85	Silver	(Madison	1 South	8.00	.29
Jul-24-85	Silver	(Madison	1 South	7.00	.36
Aug-08-85	Silver	(Madison	1 South	9.00	.78

Aug-22-85	Silver	(Madison	1	South	7.50	.57
Sep-03-85	Silver	(Madison	1	South	8.80	.50
Sep-19-85	Silver	(Madison	1	South	8.00	.29
Oct-03-85	Silver	(Madison	1	South	9.80	.29
Oct-16-85	Silver	(Madison	1	South	8.70	.43
Jul-28-83	Silver	(Madison	2	Deep	7.20	1.00
Aug-02-83	Silver	(Madison	2	Deep	7.00	.57
Aug-09-83	Silver	(Madison	2	Deep	7.50	.48
Aug-19-83	Silver	(Madison	2	Deep	7.00	.67
Aug-23-83	Silver	(Madison	2	Deep	7.00	1.09
Aug-30-83	Silver	(Madison	2	Deep	6.50	1.00
Sep-07-83	Silver	(Madison	2	Deep	7.50	.33
Sep-21-83	Silver	(Madison	2	Deep	8.00	.38
Oct-05-83	Silver	(Madison	2	Deep	8.80	.48
Oct-19-83	Silver	(Madison	2	Deep	7.50	1.43
Jun-07-84	Silver	(Madison	2	Deep	5.90	---
Jun-16-84	Silver	(Madison	2	Deep	4.50	.93
Jun-21-84	Silver	(Madison	2	Deep	5.30	1.28
Jun-28-84	Silver	(Madison	2	Deep	6.30	1.14
Jul-05-84	Silver	(Madison	2	Deep	5.20	1.43
Jul-13-84	Silver	(Madison	2	Deep	4.00	1.86
Jul-19-84	Silver	(Madison	2	Deep	5.80	1.43
Jul-26-84	Silver	(Madison	2	Deep	4.50	1.00
Aug-02-84	Silver	(Madison	2	Deep	6.70	1.14
Aug-08-84	Silver	(Madison	2	Deep	5.60	.64
Aug-15-84	Silver	(Madison	2	Deep	5.00	.29
Aug-24-84	Silver	(Madison	2	Deep	4.80	.93
Aug-30-84	Silver	(Madison	2	Deep	6.40	.71
Sep-05-84	Silver	(Madison	2	Deep	6.40	.29
Sep-22-84	Silver	(Madison	2	Deep	6.60	.78
Oct-12-84	Silver	(Madison	2	Deep	6.20	---
May-09-85	Silver	(Madison	2	Deep	7.20	1.07
May-17-85	Silver	(Madison	2	Deep	7.30	1.21
May-23-85	Silver	(Madison	2	Deep	8.10	.64
May-30-85	Silver	(Madison	2	Deep	6.50	.36
Jun-06-85	Silver	(Madison	2	Deep	6.50	.86
Jun-15-85	Silver	(Madison	2	Deep	6.50	1.00
Jun-20-85	Silver	(Madison	2	Deep	7.00	1.00
Jun-29-85	Silver	(Madison	2	Deep	6.00	1.78
Jul-11-85	Silver	(Madison	2	Deep	7.30	.64
Jul-24-85	Silver	(Madison	2	Deep	7.50	.29
Aug-03-85	Silver	(Madison	2	Deep	---	---
Aug-08-85	Silver	(Madison	2	Deep	8.40	.71
Aug-22-85	Silver	(Madison	2	Deep	7.50	---
Sep-03-85	Silver	(Madison	2	Deep	8.80	.36
Sep-19-85	Silver	(Madison	2	Deep	7.40	.29
Oct-03-85	Silver	(Madison	2	Deep	9.80	.36
Oct-16-85	Silver	(Madison	2	Deep	8.50	.43
Jul-28-83	Silver	(Madison	3	Center	7.20	1.00
Aug-02-83	Silver	(Madison	3	Center	8.20	.90
Aug-09-83	Silver	(Madison	3	Center	7.10	.57

Aug-18-83	Silver	(Madison	3	Center	6.20	.71
Aug-22-83	Silver	(Madison	3	Center	7.10	.86
Aug-30-83	Silver	(Madison	3	Center	7.50	1.19
Sep-07-83	Silver	(Madison	3	Center	7.70	.33
Sep-21-83	Silver	(Madison	3	Center	7.70	.29
Oct-05-83	Silver	(Madison	3	Center	8.50	.62
Oct-19-83	Silver	(Madison	3	Center	7.70	1.00
Jun-07-84	Silver	(Madison	3	Center	4.10	---
Jun-16-84	Silver	(Madison	3	Center	5.50	1.00
Jun-21-84	Silver	(Madison	3	Center	5.00	1.00
Jun-28-84	Silver	(Madison	3	Center	6.30	1.36
Jul-05-84	Silver	(Madison	3	Center	4.80	1.36
Jul-13-84	Silver	(Madison	3	Center	4.70	1.43
Jul-19-84	Silver	(Madison	3	Center	5.50	1.43
Jul-26-84	Silver	(Madison	3	Center	4.50	.78
Aug-02-84	Silver	(Madison	3	Center	6.30	1.86
Aug-08-84	Silver	(Madison	3	Center	5.50	.78
Aug-15-84	Silver	(Madison	3	Center	5.30	.86
Aug-24-84	Silver	(Madison	3	Center	5.50	.93
Aug-30-84	Silver	(Madison	3	Center	6.30	.57
Sep-05-84	Silver	(Madison	3	Center	6.80	.78
Sep-22-84	Silver	(Madison	3	Center	6.00	.57
Oct-12-84	Silver	(Madison	3	Center	6.60	---
May-09-85	Silver	(Madison	3	Center	7.00	.43
May-17-85	Silver	(Madison	3	Center	8.00	1.00
May-23-85	Silver	(Madison	3	Center	7.20	.64
May-30-85	Silver	(Madison	3	Center	6.30	.50
Jun-06-85	Silver	(Madison	3	Center	7.00	.71
Jun-15-85	Silver	(Madison	3	Center	6.00	.71
Jun-20-85	Silver	(Madison	3	Center	7.00	.71
Jun-29-85	Silver	(Madison	3	Center	6.00	1.64
Jul-11-85	Silver	(Madison	3	Center	7.30	.43
Jul-24-85	Silver	(Madison	3	Center	7.50	.29
Aug-08-85	Silver	(Madison	3	Center	8.80	.78
Aug-22-85	Silver	(Madison	3	Center	7.30	---
Sep-03-85	Silver	(Madison	3	Center	8.80	.43
Sep-19-85	Silver	(Madison	3	Center	9.00	.21
Oct-03-85	Silver	(Madison	3	Center	9.80	.21
Oct-16-85	Silver	(Madison	3	Center	9.50	.50
Jul-28-83	Silver	(Madison	4	East	---	1.00
Aug-02-83	Silver	(Madison	4	East	5.50	.71
Aug-09-83	Silver	(Madison	4	East	5.60	.86
Aug-18-83	Silver	(Madison	4	East	---	.62
Aug-22-83	Silver	(Madison	4	East	---	.71
Aug-30-83	Silver	(Madison	4	East	---	.95
Sep-07-83	Silver	(Madison	4	East	---	.29
Sep-21-83	Silver	(Madison	4	East	---	.43
Oct-05-83	Silver	(Madison	4	East	---	.81
Oct-19-83	Silver	(Madison	4	East	---	.62
Jun-07-84	Silver	(Madison	4	East	4.50	---
Jun-16-84	Silver	(Madison	4	East	5.00	1.12

Jun-21-84	Silver	(Madison	4 East	5.30	1.21
Jun-28-84	Silver	(Madison	4 East	4.80	1.71
Jul-05-84	Silver	(Madison	4 East	---	1.43
Jul-13-84	Silver	(Madison	4 East	4.20	2.36
Jul-19-84	Silver	(Madison	4 East	4.30	1.86
Jul-26-84	Silver	(Madison	4 East	5.00	1.21
Aug-02-84	Silver	(Madison	4 East	5.30	1.57
Aug-08-84	Silver	(Madison	4 East	5.30	1.14
Aug-15-84	Silver	(Madison	4 East	5.00	.64
Aug-24-84	Silver	(Madison	4 East	5.00	.86
Aug-30-84	Silver	(Madison	4 East	5.50	.50
Sep-05-84	Silver	(Madison	4 East	---	.93
Sep-22-84	Silver	(Madison	4 East	---	.71
Oct-12-84	Silver	(Madison	4 East	---	---
May-09-85	Silver	(Madison	4 East	---	.50
May-17-85	Silver	(Madison	4 East	---	1.14
May-23-85	Silver	(Madison	4 East	---	.71
May-30-85	Silver	(Madison	4 East	5.00	---
Jun-06-85	Silver	(Madison	4 East	---	.93
Jun-15-85	Silver	(Madison	4 East	---	1.00
Jun-20-85	Silver	(Madison	4 East	---	1.00
Jun-29-85	Silver	(Madison	4 East	---	1.64
Jul-11-85	Silver	(Madison	4 East	---	.64
Jul-24-85	Silver	(Madison	4 East	5.60	.36
Aug-03-85	Silver	(Madison	4 East	---	---
Aug-08-85	Silver	(Madison	4 East	---	.93
Aug-22-85	Silver	(Madison	4 East	---	---
Sep-03-85	Silver	(Madison	4 East	---	.14
Sep-19-85	Silver	(Madison	4 East	5.60	.36
Oct-03-85	Silver	(Madison	4 East	---	.43
Oct-16-85	Silver	(Madison	4 East	5.90	.86
Jul-28-83	Silver	(Madison	5 North	6.50	1.05
Aug-02-83	Silver	(Madison	5 North	6.90	.76
Aug-09-83	Silver	(Madison	5 North	6.00	.62
Aug-18-83	Silver	(Madison	5 North	5.90	.90
Aug-22-83	Silver	(Madison	5 North	6.20	.90
Aug-30-83	Silver	(Madison	5 North	6.00	.90
Sep-07-83	Silver	(Madison	5 North	6.30	.57
Sep-21-83	Silver	(Madison	5 North	7.40	.36
Oct-05-83	Silver	(Madison	5 North	8.30	1.09
Oct-19-83	Silver	(Madison	5 North	7.10	.71
Jun-07-84	Silver	(Madison	5 North	4.50	---
Jun-16-84	Silver	(Madison	5 North	6.00	1.21
Jun-21-84	Silver	(Madison	5 North	5.10	1.07
Jun-28-84	Silver	(Madison	5 North	5.30	1.14
Jul-05-84	Silver	(Madison	5 North	4.80	1.14
Jul-13-84	Silver	(Madison	5 North	4.20	2.14
Jul-19-84	Silver	(Madison	5 North	4.30	2.43
Jul-26-84	Silver	(Madison	5 North	4.50	1.64
Aug-02-84	Silver	(Madison	5 North	5.30	3.00
Aug-08-84	Silver	(Madison	5 North	4.50	.93
Aug-15-84	Silver	(Madison	5 North	5.20	.64

Aug-24-84	Silver	(Madison	5 North	4.80	1.64
Aug-30-84	Silver	(Madison	5 North	6.50	.64
Sep-05-84	Silver	(Madison	5 North	5.80	1.14
Sep-22-84	Silver	(Madison	5 North	6.00	.78
Oct-12-84	Silver	(Madison	5 North	6.60	---
May-09-85	Silver	(Madison	5 North	6.90	.57
May-17-85	Silver	(Madison	5 North	6.70	1.21
May-23-85	Silver	(Madison	5 North	7.00	.86
May-30-85	Silver	(Madison	5 North	5.00	.78
Jun-06-85	Silver	(Madison	5 North	6.40	1.50
Jun-15-85	Silver	(Madison	5 North	7.00	1.14
Jun-20-85	Silver	(Madison	5 North	6.50	1.00
Jun-29-85	Silver	(Madison	5 North	5.50	1.64
Jul-11-85	Silver	(Madison	5 North	7.00	.71
Jul-24-85	Silver	(Madison	5 North	7.00	.21
Aug-08-85	Silver	(Madison	5 North	7.90	.78
Aug-22-85	Silver	(Madison	5 North	6.30	.50
Sep-03-85	Silver	(Madison	5 North	8.30	.29
Sep-19-85	Silver	(Madison	5 North	7.60	.43
Oct-03-85	Silver	(Madison	5 North	8.50	.64
Oct-16-85	Silver	(Madison	5 North	8.00	.86
Aug-22-85	Silver	(Madison	6 Big Is	7.50	.43
Sep-03-85	Silver	(Madison	6 Big Is	8.80	.29
Sep-19-85	Silver	(Madison	6 Big Is	7.10	.43
Oct-03-85	Silver	(Madison	6 Big Is	8.90	.50
Oct-16-85	Silver	(Madison	6 Big Is	7.90	.57
Aug-02-85	Silver	(Madison	7 CooksI	---	---
Aug-02-85	Silver	(Madison	8 ForestI	---	---

>>> END OF LIST <<<

APPENDIX B

LLMP -- Lay Monitor Data: Silver (Madison) Feb-22-86
13:44.54

Date	Lake	Site	Alk (ppm)	Tot-P
Jun-29-85	Silver (Madison	1 South	---	6.1
Jul-24-85	Silver (Madison	1 South	---	6.1
Aug-22-85	Silver (Madison	1 South	---	1.8
Sep-03-85	Silver (Madison	1 South	---	1.8
Jun-29-85	Silver (Madison	2 Deep	---	5.1
Aug-03-85	Silver (Madison	2 Deep	---	3.5
Aug-22-85	Silver (Madison	2 Deep	---	2.3
Jun-29-85	Silver (Madison	3 Center	---	5.1
Jul-24-85	Silver (Madison	3 Center	---	4.9
Aug-22-85	Silver (Madison	3 Center	---	3.8
Sep-03-85	Silver (Madison	3 Center	---	2.3
Jun-29-85	Silver (Madison	4 East	---	4.9
Jul-24-85	Silver (Madison	4 East	---	5.1
Aug-03-85	Silver (Madison	4 East	---	3.8
Aug-22-85	Silver (Madison	4 East	---	3.3
Jun-29-85	Silver (Madison	5 North	---	2.0
Jul-24-85	Silver (Madison	5 North	---	5.1
Aug-22-85	Silver (Madison	5 North	---	3.5
Sep-03-85	Silver (Madison	5 North	---	1.8
Aug-02-85	Silver (Madison	7 Cooksl	---	4.9
Aug-02-85	Silver (Madison	8 Forestl	---	5.1

>>> END OF LIST <<<

NOTE

There are three levels of reports available to participating lake associations in the LLMP. They are differentiated as follows:

LEVEL I - This is a basic report that includes sections on the methods employed, comments and recommendations, and a brief summary of results. It also contains an appendix listing data from the present and past years.

LEVEL II - This is a mid-level report that includes methods employed, a non-technical summary of lay monitor and FBG data, comments and recommendations and an in-depth results and discussion section. It contains an appendix listing data from the present and past years.

LEVEL III - This is a full report which includes the following sections: methods employed, a non-technical summary, comments and recommendations, a technical summary, and a complete results and discussion section supplemented by computerized graphics. It also contains 3-4 appendixes: a listing of present-year and past data, limnological concepts and technical terms, and a glossary.