SUNSET LAKE

LAKES LAY MONITORING PROGRAM

1986

Freshwater Biology Group (FBG)

University of New Hampshire

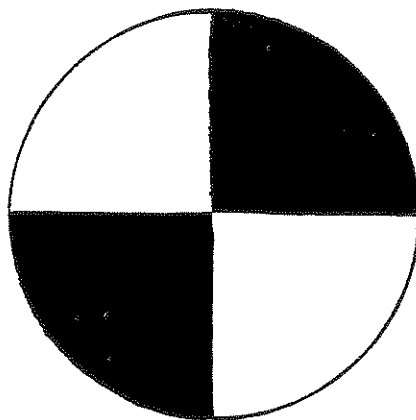Durham

by

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LAKES LAY MONITORING PROGRAM

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ACKNOWLEDGEMENTS

Participating groups in the **LLMP** for 1986 included: The New Hampshire Audubon Society, Derry Conservation Commission, Nashua Regional Planning Commission, Center Harbor Bay Conservation Commission, Governor's Island Club Inc., Little Island Pond Rod and Gun Club, Walker's Pond Conservation Society, United Associations of Alton, the associations of Baboosic Lake, Beaver Lake, Berry Bay, Bow Lake Camp Owners, Lake Chocorua, Flint Pond, Lake Kanasatka Watershed, Langdon Cove, Long Island Landowners, Moultonbouro Bay, Lake Winnipesaukee, Naticook Lake, Newfound Lake, Nippo Lake, Scruton Pond, Silver Lake (Hollis), Silver Lake (Madison), Squam Lake, Sunset Lake, Lake Winona, and Lake Wentworth and the towns of Alton, Hollis and Stratham.

PROGRAM DESCRIPTION

The Lakes Lay Monitoring Program

The New Hampshire Lakes Lay Monitoring Program (**LLMP**) is a research and educational function of the Freshwater Biology Group (**FBG**) at the University of New Hampshire co-directed by Professors Alan Baker, Department of Botany and Plant Pathology, and James Haney, Department of Zoology and coordinated by Jeffrey Schloss. The program involves the cooperative participation of lake residents, lake associations, conservation and planning commissions and local governments with University faculty and students. Developed in 1978 around Squam Lake, the program has grown to include more than 30 lakes throughout New Hampshire.

As a **research** project, the LLMP has investigated the extent of lake degradation caused by perturbations such as acid rain, septic and agricultural runoff, and lakeshore development. Essentially the monitors in the program collect data once each week. The data are stored on a computer, the results are analyzed periodically, and interpretive reports are written that include graphics and statistical analyses. A major goal is to detect any short or long-term changes in the water quality of the lakes. To that end a long-term data base has been established.

As an **educational** tool, several students are trained each year to collect and analyze lakewater samples for physical, chemical and biological parameters, and to interpret water quality data. In addition, more than 200 "lay" monitors have been trained to monitor their own lakes and educated about lake water quality.

As a **service** to the state and to local communities, the reports of the **LLMP** are available at cost, and should prove useful to lake residents, conservationists, developers and land-use planners. Also, **LLMP** staff members conduct workshops, lectures and informal talks on various lake related topics and hold advisory positions on many municipal and private conservation and planning boards. The **LLMP** is a not-for-profit organization with funding derived primarily from the participating groups.

COMMENTS AND RECOMMENDATIONS

1) We recommend that each association, including the Sunset Lake Association continue to develop their data base on lake water quality through continuation of the long term monitoring program. The data base will provide information on the short and long-term cyclic variability that occurs in the lake and eventually will enable more reliable predictions of water quality trends.

2) We recommend the initiation of total phosphorus testing as early as possible after spring melt. This should be combined with sampling of the lake during a time of heavy use (ie: 4 July, Labor Day). Early spring phosphorus data combined with summer sampling can provide information on the amount and sources of phosphorus loading into the lake. Samples might also be taken at sites around the perimeter of the lake to try to determine if nutrient loading is occurring from a particular area or source.

3) The **FBG** trip provided a more in-depth analysis of the lake during stratification conditions. It also indicated that the lay monitors of the lake are doing an excellent job. We recommend one or more **FBG** trips in 1987. The possible presence of an algal layering at the thermocline can then be investigated.

4)   As a general addition to our Lakes Lay Monitoring Program, we recommend that each lake in the Program begin monitoring the condition of the fish taken from the lake. The "Fish Monitoring" will require at least one lay monitor to 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. The required equipment, supplies and analytical costs will be approximately $100. Explanation of procedures and fish identification will be given to monitors who decide to measure this parameter.

Length-to-weight ratios give a measure of the nutritional condition of the fish. Age analysis of the fish scales (to be done at UNH) will tell how old each fish is. Together, these variables can help to track changes in the condition of the fish populations in the lake, and, of course, the "health" of the lake.

INTRODUCTION

Importance of long term monitoring

A major goal of this program is to identify any short or long-term changes in the water quality of the lakes. Of major concern, is the detection of cultural eutrophication; increases in the productivity of the lake due to the addition of nutrients from human activities. Changes in the natural buffering capacity of the lakes in the program is also a topic of great concern since New Hampshire receives large amounts of acid precipitation. Weekly sampling of a lake during a single summer provides information only on the variation that occurs. Short-term differences may be due to variations in weather or lake activity, or other chance events. The resulting short-term fluctuations may be unrelated to the actual long-term trend.

As an example, a 30 year study of a lake may indicate a long-term trend toward eutrophy (Fig. 1). Yet if only the data from a five year period (ie: Fig 1, years 1975-80) are examined, no apparent trends can be seen. If only two years are examined, the data suggest a decrease in eutrophy! Monitoring carried out weekly over the course of many summers can provide the information required to distinguish between short-term fluctuation ("noise") and long-term

trends ("signal"). To that end, each lake must establish a long-term data base.
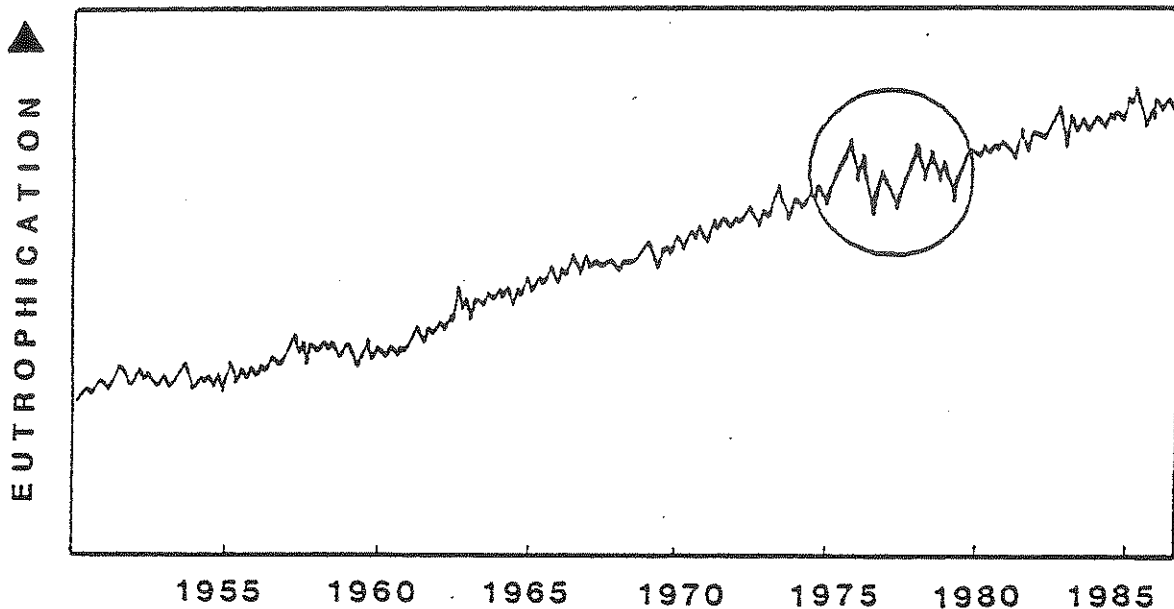
Figure 1. Eutrophication of a hypothetical lake over time. Circled area is enlarged for comparison between short and long-term trends.

The number of seasons it takes to discern between the noise and the signal is not the same for each lake. Evaluation and interpretation of a long term data base will indicate that the water quality of the lake has worsened, improved, or remained the same. As more data is collected prediction of current and future trends can be made. No matter what the outcome, this information is essential for the intelligent management of the lake.

There are also short-term uses for lay monitoring data. The examination of different stations in a lake can disclose specific problems and corrective action can be initiated to handle the situation before it becomes more serious. On a lighter note, some associations post their weekly data for use in determining the best depths for finding fish!

It takes a considerable amount of effort as well as a deep concern for one's lake to be a lay monitor. Many times a monitor has to brave inclement weather or heavy boat traffic to collect samples. Sometimes it even may seem that one week's data is just the same as the next. Yet every sampling provides important information on the variability of the lake.

Every data sheet the **LLMP** receives is significant to further the understanding of the lakes in the program. We are pleased with the interest and commitment of our lay monitors and are proud that their work is what makes the **LLMP** the most extensive, and we believe, the best volunteer program of its kind.

METHODS OF LAY MONITORS

Lay monitors receive their initial training either on-site or on campus from a member of the FBG. Workshops covering new techniques are usually offered on a yearly basis and updates may be held on-site during an FBG sampling trip.

This year data were collected on six parameters: thermal stratification, water clarity (secchi disk depth), chlorophyll a concentration, dissolved color, total phosphorus and total 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 or hand delivered 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, stoppered, empty bottle 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 C. This procedure was repeated at one meter intervals through the epilimnion (upper water column), at one-half meter

intervals throughout the metalimnion (depths at which the temperature change is greater than 1 degree C per meter) and at one meter intervals through the hypolimnion (depths below the metalimnion).

Water clarity was measured by lowering a secchi disk (approximately 20 cm. or 8 inches) through the water off the shaded side of the boat, and noting the average of the depths at which it disappeared upon lowering and reappeared when being raised (the cord attached to the secchi disk is marked in one tenth of a meter for the first half meter and in one-half meters thereafter). Water clarity was determined 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 to the top of the metalimnion (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

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the tube. This sample is poured into a blue plastic 2.5 liter bottle and stored in the shade until chlorophyll filtration could be done.

Water samples for chlorophyll _a_ filtration were filtered through a 0.45 micron membrane filter under low vacuum. Damp filters, containing chlorophyll-bearing algae, were air-dried for at least 30 minutes, in the dark, 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 the **FBG** team (see Methods of the Freshwater Biology Group).

To determine the alkalinity, lake water samples were titrated with 0.002 N sulphuric acid in the presence of the indicator methyl red/bromocresol green to a pH of 5.1 (grey endpoint) and 4.6 (pink endpoint). The amount of titrant used (dilute sulphuric acid) was recorded to the nearest 0.1 ml, equivalent to milligrams of calcium carbonate per liter. Values reported can be converted to microequivalents of calcium carbonate using a multiplication factor of 20.

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 (ie: sites along the
shoreline, inlets or outlets), sub-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 of the Freshwater Biology Group).

METHODS OF THE FRESHWATER BIOLOGY GROUP

The Freshwater Biology Group (FBG) research team took one trip to Sunset Lake and conducted several tests which included measurements of sunlight penetration into the water, dissolved oxygen, temperature, alkalinity, free (unbound) carbon dioxide, pH, specific conductivity, chlorophyll a, dissolved color, total phosphorus, and a survey of the microscopic plants (phytoplankton) and animals (zooplankton). The **FBG** also processed chlorophyll a, dissolved color, and phosphorus samples provided by the lay monitors. The input, storage and analysis of all **LLMP** data is also the responsibility of the **FBG**.

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. The coefficient of light extinction was calculated from the relative light intensities measured.

Samples of lake water chemistry to be analyzed for 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) were determined chemically with the azide modification of the Winkler method (EPA 1979). The precision of the method provides a standard for the electronic probe. Water is collected in 350 ml biological oxygen demand (BOD) bottles and fixed with two reagents, manganese sulfate and alkali-iodine-azide. A loose precipitate (floc) of manganic hydroxide that is equivalent to all dissolved oxygen originally present in the sample. Concentrated sulphuric acid is added to the bottle which causes a stoichiometric release of dissolved iodine equal to the original amount of dissolved oxygen present. A known quantity of sample is then titrated to an equivalence point using .0250N phenylarsine oxide titrant (similar to, but more stable than, sodium thiosulphate which may also be used) and a starch indicator solution. The end-point is

reached when the purple colored iodine-starch complex is reduced and the solution becomes colorless. The amount of titrant added is recorded to the nearest 0.1 ml and concentrations are reported to the nearest 0.2 milligrams dissolved oxygen per liter.

To determine the alkalinity, lake water samples were titrated with 0.002 N sulphuric acid in the presence of the indicator methyl red/bromocresol green to a pH of 5.1 (grey endpoint) and 4.6 (pink endpoint). The amount of titrant used (dilute sulphuric acid) was recorded to the nearest 0.1 ml, equivalent to milligrams of calcium carbonate per liter. Values reported can be converted to microequivalents of calcium carbonate using a multiplication factor of 20.

"Free" carbon dioxide concentration was determined by titrating the fresh lakewater samples with 0.0027 N sodium hydroxide to a final endpoint pH of 8.3, in the presence of the indicator dye phenolphthalein.

Lakewater pH was measured with a digital pH meter (Beckman model phi 44) equipped with a combination probe (Orion Co.) and an automatic temperature compensating probe. The meter was calibrated with pH 4 and pH 7 buffer solutions and then the probe was allowed to equilibrate in the lake water for at least thirty minutes prior to sample analysis.

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 of potassium chloride solution conductivity versus temperature. Results are reported as micro-Siemens (uS; where uS equals umho cm^{-2}) standardized to 18° C.

Samples to be analyzed for chlorophyll a, total phosphorus, and phytoplankton were collected with a vertical tube sampler into a 2.5 liter dark plastic bottle. Chlorophyll samples were filtered through a 0.45 micron membrane filter and air-dried in the dark 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) with a Baush and Lomb model 710 spectrophotometer equipped with 50mm cuvettes. An absorptivity value of 84 gm $liter^{-1}$ cm^{-1} (Vollenweider 1969) was used for calculating the concentrations.

Dissolved color samples of the filtrate from **FBG** chlorophyll filtrations was determined by reading the absorbance of the samples at two different wavelengths (440 and 493 nanometers) in a 50mm light path. The two readings were converted to the more widely used platinum cobalt color

values (ptu) using standard curves of the absorbance of chloroplatinate.

Phosphorus samples were preserved with 1.0 milliliter of concentrated sulphuric acid and 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 thirty minutes at 250 to 260 degrees C. Reagents included potassium antimony tartrate, ammonium molybdate, and a solution of ascorbic acid mixed fresh before each sample run (E.P.A. 1979). Absorbance of the blue phosphorus complex was measured with a spectrophotometer at 650 nanometers. A standard curve of the absorbance of a potassium phosphate (monobasic) solution to convert the readings to total phosphorus concentrations. Each sample was analyzed twice and an average of the two values taken as the phosphorus content in parts per billion (ppb).

Phytoplankton samples were preserved with iodine (Lugol's solution) immediately after collection. Algae were later identified and counted with an inverted microscope after settling for 24 hours in 5 or 10 ml counting chambers. At least 200 individual algal "units" were counted with a

modified scan technique (Baker, 1973). Phytoplankton are reported to species level whenever possible.

Zooplankton samples were collected with a plankton net (30 centimeter diameter, 150 micron porosity) towed vertically through the oxygenated portion of the water (>0.5 ppm oxygen). Samples were immediately preserved in a 4% formalin-sucrose solution (Haney and Hall, 1973). Organisms were identified to species whenever possible. Subsampling, whenever necessary, was done with a 1 ml Hensen-Stemple pipette. Repeated subsamples were analyzed until at least 100 organisms were counted.

Data analysis

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 concentrations, alkalinity, and color measurements, are filed and stored on the FBG computerized data-management system that utilizes a mainframe DEC VAX-8650 computer and an IBM compatible microcomputer (Zenith Data Systems 158). With full use of relational data bases, such as S1032 and Dbase III+ data can be easily retrieved by lake, date,

station or by parameter and used for individual reports and program summaries for each year.

Statistical treatment of the data from each lake, produced for level III reports, 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 are made on a yearly basis if the lake has been in the program for two years or more. Where sufficient data are available from several years, regression analyses and other statistical tests can be performed. Such analyses may identify trends and help explain variations in the data (eg. secchi disk depth, chlorophyll a, color). In addition, data from a lake may be compared with other lakes in the program, other computerized data bases, and to published water quality classifications.

Trophic boundaries of Forsberg and Ryding (1980) of transparency, chlorophyll a, and total phosphorus are used as criteria in discussions of the trophic state of the program lakes. Crustacean zooplankton were classified into one of four categories depending on their size (large or small) and their feeding preferences (herbivore or predator) with a modified version of criteria from Sprules (1980). The differences in abundance between the different groups allow for a more complete description of the zooplankton community and the trophic classification of lakes.

SUMMARY OF LAY MONITOR DATA

Monitoring of Sunset Lake was done at one location site 5 Center with a maximum depth of 9 meters . This year, sampling for temperature, secchi disk depth, chlorophyll a, dissolved color and alkalinity took place monthly in February, April, May, June, October and November, and weekly July through September. See Appendix A for the lay monitor data.

Water Transparency

Secchi Disk depth is a measure of the water transparency. The deeper the depth of secchi disk disappearance, the more transparent the lake water; light penetrates deeper if there is little dissolved and/or particulate matter (which includes both living and non-living particles) to absorb and scatter it.

Secchi disk transparency was in the range of 4.1 to 7.6 meters at 5 Center. Lowest transparency occurred in August and the greatest transparency during June. Transparency values greater than 4.0 meters are characteristic of clear lakes with low productivity. Water transparency in 1986 was slightly higher than in previous years but limited sampling restricts any trend analysis at this time.

Chlorophyll a

The chlorophyll a concentration is a measurement of the standing crop of phytoplankton and is often used to classify lakes into categories of productivity called trophic states. **Eutrophic** lakes are highly productive with large amounts of algae and aquatic plants due to nutrient enrichment. **Oligotrophic** lakes have low productivity and low nutrient levels and **mesotrophic** lakes are intermediate in productivity.

Chlorophyll a concentrations were in the oligotrophic range, 1.0 to 2.5 mg m^{-3} at 5 Center. Concentrations in 1986 were comparable to 1984 values and lower than 1985 values.

Dissolved Color

The dissolved color of lakes is generally due to dissolved organic matter from humic substances, which are naturally-occurring polyphenolic compounds leached from decayed vegetation. Highly colored or "stained" lakes have a "tea" color. Such substances generally do not threaten water quality except as they diminish sunlight penetration into deep waters.

Dissolved color at Sunset lake was again at low levels, with an average of 11 ptu. This is greater than the 1985 average color of 5 ptu. Highest levels occurred in August and September. To put the dissolved color level in perspective, dissolved color concentrations of all lakes

participating in the LLMP in 1986 were in the range <1 to 117 ptu with an average of 18.5. Thus, Sunset Lake color was slightly below average compared to all lakes in the program.

Both dissolved color and chlorophyll concentration are major influences on the secchi disk transparency at Sunset Lake as minimum transparency occurred at times of higher levels of these two parameters.

Boating Effect Experiments

A preliminary investigation was undertaken by Ralph Green concerning the effect of heavy boat traffic on the lake during Labor Day Weekend from 29 August to 2 September. Sampling was done in the morning on all days except the first. The data suggests that chlorophyll is not immediately affected, transparency slightly decreases (the 29 August secchi disk transparency was taken too late in the day for comparisons to be made) and dissolved color increases. The only slight secchi disk effect may be due to sampling the next day after the boats were prevalent. Perhaps tests this year could include a sample taken at 9 am and one taken at 3:30 pm or so on the same day so any sediment mixed up into the water column does not have time to settle back down to the bottom. Since color is due to dissolved substances, settling is slow and levels were still high the next morning. This initial survey has raised some interesting questions on boating effects on a lake and we praise Mr.

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Green on his initiative. We hope we can try a more formalized testing in 1987.

Total Phosphorus

Of the two "nutrients" most important to the growth of aquatic plants, nitrogen and phosphorus, it is generally observed that phosphorus is the more limiting to plant growth, and therefore the more important to monitor and control. Phosphorus is generally present in lower concentrations, and its sources include primarily anthropogenic activity in a watershed. Nitrogen can be fixed from the atmosphere by many bloom-forming blue-green bacteria, and thus it is difficult to control. The total phosphorus includes all dissolved phosphorus as well as phosphorus contained in or adhered to suspended particulates such as sediment and plankton.

Phosphorus concentration measured from July through September had a range of 1.4 to 17 ppb. Concentrations were bordering on the range of moderately productive (mesotrophic) lakes in August while oligotrophic concentrations were common in July and September.

Alkalinity

Alkalinity is a measure of the buffering capacity of the lake water. The higher the value the more acid that can be neutralized. Typically lakes in New Hampshire have low alkalinities due to the absence of carbonates and other

natural buffering minerals in the bedrock of lake watersheds.

Sunset lake had an alkalinity range of 10.3 to 13.5 mg $CaCO_3$ liter^{-1}. This is high for New Hampshire lakes which average about 9 mg $CaCO_3$ liter^{-1}. Average alkalinity for lakes in the LLMP in 1986 was 6.0 mg $CaCO_3$ liter^{-1}.

SUMMARY OF FBG DATA

Comparison of FBG and Lay Monitor Data

Chlorophyll a measured during the FBG field team visit
on 18 July, 1.6 and 1.5 mg m^{-3} for sites 5 and a shore site
respectively, fall close to the ranges found by the lay
monitors throughout the sampling season. Water transparency
by the FBG, 6.1 meters compared well to the 6.4 meters
measured by the lay monitors on 14 July. Alkalinity values
were equivalent. Dissolved color measured by the FBG was
slightly lower than monitor measurements taken before and
after the FBG trip but are well within the range measured by
the monitors. Thus the lay monitor data corroborates well
with the FBG data.

Specific Conductivity

The specific conductance of a water sample indicates
concentrations of dissolved salts. Leaking septic systems
and de-icing salt runoff from highways can cause high
conductivity values. Conductivity was high in Sunset Lake
waters; values had a range of 158 to 163 uS suggesting that
the lake may be receiving inputs of road salts and/or
sewage.

Stratification in the Deep Water Sites

Profiles of temperature for the two deep sites studied
show distinct patterns of temperature stratification where a
layer of warmer water (the **epilimnion**) overlies a deeper
layer of cold water (**hypolimnion**). The layer that separates
the two regions characterized by a sharp drop in temperature
with depth is called the **thermocline** or **metalimnion**.

Oxygen concentrations were high in the upper waters and
decreased to lower values (below 1 mg per liter) in the
bottom waters at 5 Center. Carbon dioxide in the hypolimnion
was low to moderate. Thus the temperature and dissolved gas
profiles of Sunset Lake are similar to those of lakes with
low to moderate productivity. Slight increases in oxygen in
the metalimnion might indicate the presence of a layering of
algae. The **FBG** trip in 1987 should look into this
possibility.

pH

The pH is a way of expressing the acidic level of lake
water, and is measured with an electrical probe sensitive to
hydrogen ion activity. The pH scale has a range of 1 (very
acidic) to 14 (very "basic" or alkaline) and is logarithmic
(ie: changes in 1 pH unit reflect an order of magnitude
difference in hydrogen ion concentration). Most aquatic
organisms tolerate a limited range of pH and most fish
species require a pH of 5.5 or higher for successful growth

and reproduction. Surface pH was 6.9 well above the critical level for aquatic organisms. The range of surface water pH for all LLMP lakes was 5.2 to 7.2.

Phytoplankton and Zooplankton

Low to moderate phytoplankton concentrations, 1932 organisms per ml were found at site 5. The site was dominated by "golden" algae (Chrysophyceae) species common in oligotrophic lakes. Macrozooplankton (caught using a 150 micrometer mesh net) were at high concentrations, 28.3 organisms per liter. Calanoid copepods and two species of Daphnia (water fleas) were the dominant herbivores ("phytoplankton eaters"). Very few smaller cladoceran herbivores were present which sometimes is an indication of limited planktivorous fish populations.

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Sunset Lake Data on file as of 05/03/1987

Lakes Lay Monitoring Program, U.N.H.

[Lay Monitor Data]

Sunset Lake
    -- subset of trophic indicators, all sites, 1984

1984 SUMMARY
                 Average transparency: 4.1   (1984:   13 values)
                 Average chlorophyll: 1.5   (1984:   8 values)

SITE	DA	SDD	CHL	TP	ALKG	ALKP	COLOR
5 Center	05/21/1984	3.0	---	---	---	---	---
5 Center	06/08/1984	3.6	---	---	---	---	---
5 Center	06/22/1984	3.0	---	---	---	---	---
5 Center	07/02/1984	3.9	---	---	---	---	---
5 Center	07/10/1984	4.5	1.2	---	---	---	---
5 Center	07/20/1984	4.5	1.5	---	---	---	---
5 Center	08/03/1984	4.3	1.8	---	---	---	---
5 Center	08/10/1984	3.5	---	---	---	---	---
5 Center	08/17/1984	3.5	2.9	---	---	---	---
5 Center	08/26/1984	4.5	1.2	---	---	---	---
5 Center	09/08/1984	4.5	1.1	---	---	---	---
5 Center	09/18/1984	4.5	1.9	---	---	---	---
5 Center	09/30/1984	5.5	0.1	---	---	---	---

           << End of 1984 listing,   13   records >>

Lakes Lay Monitoring Program, U.N.H.

[Lay Monitor Data]

Sunset Lake
        -- subset of trophic indicators, all sites, 1985

   1985 SUMMARY
                Average transparency: 5.2   (1985:   15   values)
                Average chlorophyll: 2.2   (1985:   12   values)
                Average phosphorus: 5.0   (1985:   8   values)
                Average alk (gray):   12.6   (1985:   7   values)
                Average alk (pink):   13.4   (1985:   7   values)
                Average color, 440:   5.6   (1985:   7   values)

        SITE   DA   SDD   CHL   TP   ALKG   ALKP   COLOR
   ----------   ----------   ----- ----- -----   ------ ------ -----
   5 Center   07/01/1985   5.0   7.4   ---   ---   ---   ---
   5 Center   07/07/1985   5.0   4.4   ---   ---   ---   ---
   5 Center   07/13/1985   5.0   1.6   ---   ---   ---   ---
   5 Center   07/18/1985   5.0   1.6   2.2   ---   ---   ---
   5 Center   07/27/1985   4.5   1.2   ---   ---   ---   8.3
   5 Center   08/02/1985   4.8   1.9   5.3   ---   ---   8.3
   5 Center   08/08/1985   4.5   2.1   5.8   13.0   13.5   6.6
   5 Center   08/17/1985   4.6   2.5   7.1   12.2   12.6   2.3
   5 Center   08/23/1985   4.6   0.9   6.6   12.2   12.8   5.8
   5 Center   09/01/1985   4.8   1.1   4.1   12.8   13.4   6.6
   5 Center   09/08/1985   5.8   1.1   4.1   ---   ---   ---
   5 Center   09/13/1985   5.2   1.1   4.6   12.9   13.5   1.5
   5 Center   09/29/1985   6.0   ---   ---   ---   ---   ---
   5 Center   10/08/1985   6.5   ---   ---   12.8   14.1   ---
   5 Center   11/16/1985   7.0   ---   ---   12.5   13.7   ---

             << End of 1985 listing,   15   records >>

Sunset Lake Data on file as of 05/03/1987

Lakes Lay Monitoring Program, U.N.H.

[Lay Monitor Data]

Sunset Lake
-- subset of trophic indicators, all sites, 1986

1986 SUMMARY
Average transparency:	5.6	(1986:	17	values)
Average chlorophyll:	1.7	(1986:	15	values)
Average phosphorus:	6.7	(1986:	12	values)
Average alk (gray):	12.1	(1986:	19	values)
Average alk (pink):	12.8	(1986:	19	values)
Average color, 440:	11.6	(1986:	13	values)

SITE	DA	SDD	CHL	TP	ALKG	ALKP	COLOR
5 Center	02/17/1986	---	---	---	11.4	12.2	---
5 Center	04/19/1986	6.5	---	---	10.3	11.1	10.9
5 Center	05/11/1986	5.5	1.4	---	10.6	11.5	12.6
5 Center	06/17/1986	7.6	2.4	---	11.8	12.4	11.8
5 Center	07/07/1986	6.1	---	---	11.9	12.5	5.8
5 Center	07/14/1986	6.4	2.4	---	12.5	13.1	6.6
5 Center	07/18/1986	---	---	6.0	---	---	---
5 Center	07/24/1986	6.7	0.9	14.0	12.4	13.1	10.1
5 Center	08/02/1986	5.0	2.0	13.0	13.5	14.2	9.2
5 Center	08/08/1986	4.8	2.5	17.0	12.0	12.8	11.8
5 Center	08/17/1986	4.1	2.4	---	12.5	13.0	26.4
5 Center	08/29/1986	4.3	1.9	3.4	12.4	12.9	6.6
5 Center	08/30/1986	5.5	1.9	5.4	12.6	13.2	---
5 Center	08/31/1986	5.5	1.3	1.4	13.0	13.6	8.3
5 Center	09/01/1986	5.1	1.6	3.4	12.9	13.5	16.9
5 Center	09/02/1986	4.9	1.5	4.1	12.4	12.9	14.3
5 Center	09/27/1986	5.4	1.1	4.1	12.4	13.1	---
5 Center	10/22/1986	5.4	1.1	4.1	12.2	12.8	---
5 Center	11/22/1986	6.4	1.0	4.1	12.5	13.6	---
6 Winter	02/17/1986	---	---	---	11.4	12.2	---

<< End of 1986 listing,   20   records >>