BABOOSIC LAKE
1988-1989
LAKES LAY MONITORING PROGRAM

by

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edited by

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NEW HAMPSHIRE LAKES LAY MONITORING PROGRAM

NH LLMP

FRESHWATER BIOLOGY GROUP
University of New Hampshire
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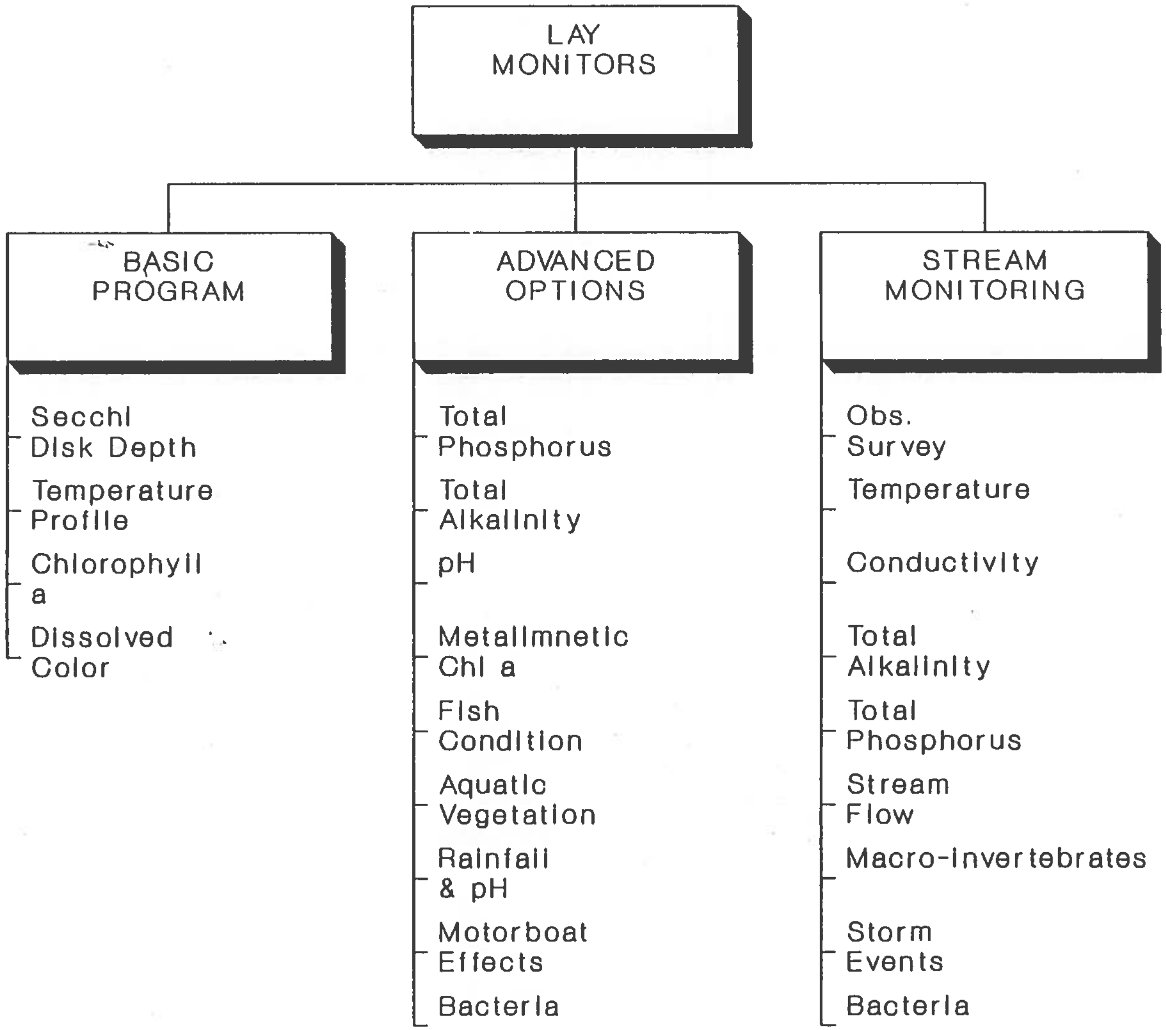

FBG Team corraborate tests above and sample plankton

PREFACE

This report contains the findings of a water quality survey of Baboosic Lake, New Hampshire, conducted in the summers of 1988 and 1989 by the Freshwater Biology Group (**FBG**) of the University of New Hampshire and the Baboosic Lake Association.

The report is written with the concerned lake resident in mind and contains a brief, non-technical summary of 1988 and 1989 results as well as more detailed "Introduction" and "Results and Discussion" sections. The description of methods and materials used by the Lay Monitors and the Freshwater Biology Group has been included in an appendix. While it is common practice to exclude this type of section from a "general" writing such as this, it is our goal to provide program participants with a complete report which can stand on its own for comparison to past as well as future lake studies.

Graphic display of data is included, in addition to listings of data in appendices, to aid visual perspective. Other appendices contain various supporting materials including a glossary of terms commonly used in this and other reports on water quality. The more adventurous reader is referred to these last sections, as well as the materials cited in the references section, if there is interest in learning more about the dynamics of fresh water systems.

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ACKNOWLEDGEMENTS

This was the seventh year of participation in the Lakes Lay Monitoring Program (**LLMP**) for the Baboosic Lake monitors. The Lay Monitors were: Bernard A. Arseneau, Gersha Bayer, Chris Gower, Harry B. Harden, Josephine Plant, Janet Carpenter, Autumn Harden, Delia P. Medrick, Diane Pawluk, and Jack Plant. Harry Harden was again coordinator of the program for the association and Josephine Plant acted as liaison between the monitors and the FBG. The Freshwater Biology Group (**FBG**) congratulates the monitors on the quality of their work, and the time and effort put forth. We encourage the Baboosic Lake Association to continue monitoring during the 1990 season. Funding for the program was provided by the Towns of Merrimack (through the Conservation Commission), Amherst and the Baboosic Lake Association. Most important was the contribution by the two towns, which is a welcome demonstration of the continued support the monitoring program has received from the Town Officers. Sampling in 1989 was facilitated by an upgrade of lay monitor equipment funded by a one-time assistance award from the state. This funding was the direct result of the efforts of Clifton Chandler, of Alton Bay, in requesting assistance from the Governor's Office.

The Freshwater Biology Group is a not-for-profit research program co-supervised by Dr. Alan Baker and Dr. James Haney and coordinated by Jeffrey Schloss. Members of the **FBG** summer field team included Jeffrey Schloss, Katherine Maroney, Beth Ferrari, Barent Rice, Maura Callahan, Elizabeth LaPointe and David Cederholm. Other **FBG** staff assisting in the fall were: Bonnie Bruce, Roger Caron, Robert Craycraft and John Ferraro.

The **FBG** acknowledges the University of New Hampshire Cooperative Extension for funding and furnishing office, laboratory and storage space. The Department of Plant Biology provided accounting support and the UNH Office of Computer Services provided computer time and data storage allocations.

Participating groups in the **LLMP** include: The New Hampshire Audubon Society, Derry Conservation Commission, Dublin Garden Club, 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 Pemaquid Watershed Study Group, the associations of Baboosic Lake, Beaver Lake, Berry Bay, Big Island Pond, Bow Lake Camp Owners, Lake Chocorua, Crystal Lake, Dublin Lake, Goose Pond, Great East Lake, Lake Kanasatka Watershed, Langdon Cove, Long Island Landowners, Lovell Lake, Mascoma Lake, Mendum's Pond, Merrymeeting Lake, Moultonbouro Bay, Lake Winnipesaukee, Naticook Lake, Newfound Lake, Nippo Lake, Perkins Pond, Pleasant Lake, Silver Lake (Hollis), Silver Lake (Harrisville), Silver Lake (Madison), Squam Lakes, Lake Sunapee, Sunset Lake, Swains Pond, Lake Winona, and Wentworth Lake and the towns of Alton, Amherst, Hollis, Madison, Merrimack, Strafford, Tuftonboro and Wolfeboro.

BABOOSIC LAKE 1988-1989 NON-TECHNICAL SUMMARY

Weekly monitoring was undertaken at Baboosic Lake by the volunteer monitors. An in-depth analysis of Baboosic Lake was conducted in mid-August 1989 and late July 1988 by the FBG.

1) Water transparency at Baboosic Lake was intermediate, the sign of a moderately productive (moderate algal and aquatic plant levels) lake. The secchi disk was visible as far down as 4.9 meters (16 feet) in 1989 and as far down as 5.7 meters (18.7 feet) in 1988. The average secchi disk depths were 3.6 meters in 1989 and 4.3 meters in 1988. This indicates the deepwater sites on the lake have moderate levels of dissolved color and suspended matter such as algae and particulates. Secchi disk depth averages in 1989 are lower (i.e. the lake is less clear) than the 1988 averages which were lower than previous years. Moderate to high chlorophyll levels (see below) suggest algal blooms are responsible for the reduction in transparency.

2) Chlorophyll a concentrations for the surface waters of Baboosic Lake were generally at moderate levels, with sites 1 and 3 reaching high levels in late June and early July. Chlorophyll levels indicate the extent of algae growth in the water. Concentrations in the mixed layer of water averaged 6.0 milligrams per cubic meter (mg m^{-3}, equivalent to about 6.0 parts chlorophyll per billion parts water) in 1989 and 3.6 mg m^{-3} in 1988 (1988 results are slightly biased to lower levels due to atypically low chlorophyll levels at site 1, see text). Generally, concentrations below 3 mg m^{-3} are common to less productive, clear lakes and values above 7 mg m^{-3} are common in productive lakes. The very high chlorophyll concentrations in the early part of the 1989 sampling season were at significant bloom levels.

3) Dissolved lakewater color levels for Baboosic Lake in 1989 and 1988 were high with an average between 39 and 43 color units (ptu) and considerably more than the average level of 28 ptu (platinate color units) in other program lakes. Small increases in

water color from the natural breakdown of plant materials in and around a lake are not considered to be detrimental to water quality. However, increased color can lower water transparency, and hence, change the public perception of water quality. High color levels can actually mask the ability of secchi disk transparency to predict chlorophyll levels.

4) Total phosphorus (nutrient) levels were low at the deep lake sites but were very high early (spring) and late (fall) at most tributaries. In-lake summer samples were about 4 ppb while tributary samples ranged from less than 1 ppb to 440 ppb. A concentration of the 15 parts per billion (ppb) is commonly thought of as the boundary between less productive and more productive lakes.

5) The pH of the surface waters of the lake, measured by the FBG, remains within the optimum range for most aquatic organisms. The alkalinity of the lake; the lakes ability to buffer acid input, is low , but about 2 to 2.5 units above the average for LLMP program lakes. The pH and alkalinity data indicate that Baboosic Lake seems to have a sufficient buffering capacity at this time to resist fluctuations in pH due to acid loadings.

6) The specific conductivity of the deep sites on Baboosic Lake was low to moderate. High conductivity values can indicate the presence of septic leachate or de-icing salt runoff.

7) In-depth analysis at the deep sites disclosed the typical temperature stratification patterns for northern temperate lakes. Oxygen content of the bottom waters was low; bottom water oxygen concentration remained above 5 milligrams per liter (the minimum concentration required for successful reproduction and growth of most fish) down to about 3 meters in 1989 and 4 meters in 1988. Carbon dioxide in the bottom waters was high indicating the accumulation of organic matter.

8) For all measurements considered and averaged for the season, Baboosic Lake would be classified as having moderate productivity, a mesotrophic lake. However, algal

blooms, aquatic plant growth and low oxygen in the bottom waters suggest that Baboosic Lake is approaching more eutrophic conditions.

9) Comparisons between lay monitor and FBG data indicate that the volunteer monitors of Baboosic Lake are doing an excellent job of measuring water quality at all stations.

COMMENTS AND RECOMMENDATIONS

1) We recommend that each association, including the Baboosic 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 phosphorus testing to be done during early spring, during times of heavy use (ie: 4 July, Labor Day) and late in the season when septic systems have been put through a full seasons use. Deep sites as well as shore samples should be included.

3) We recommend lake limited testing starting in May or earlier, if possible, to monitor the lakes reaction to the nutrients and acid loading that typically occur after ice- melt and during heavy spring rains. (Nutrients, pH and alkalinity).

4) Since the Baboosic monitors have a high level of experience, we invite them to participate in our preliminary investigation of the effect of boat traffic on lakes. All that would be required is sampling in the morning and then the same day late in the afternoon on a "quiet day" followed by the same sampling approach on a day of heavy boat traffic. Transparency readings are all that are necessary but a discount for sample processing will be offered to try to minimize costs of additional testing. Contact the LLMP coordinator for further information.

5) A joint program between NH Fish and Game and the Freshwater Biology Group is currently providing the staffing to analyze fish condition data collected by volunteer monitors. We recommend that Baboosic Lake participate in this Fish Condition Program while federal funding is available to underwrite the costs for this program.

INTRODUCTION

The New Hampshire Lakes Lay Monitoring Program

During the past decade the NH Lakes Lay Monitoring Program has grown from a university class project on Chocorua Lake to a comprehensive state-wide program with over 500 volunteer monitors and more than 75 lakes participating. Originally developed to establish a data-base for determining long-term trends of lake water quality for science and management, the program has expanded by taking advantage of the many resources that citizen monitors can provide. Current projects include: use of volunteer generated data for non-point pollution studies using a geographic based information system (GIS) in conjunction with the NH Office of State Planning, intensive watershed monitoring for the development of lake nutrient budgets, investigations of water quality and indicator organisms (fish condition, and stream invertebrates), and ground-truthing for remote sensing studies. Key ingredients responsible for the success of the program include innovative funding and cost reduction, assurance of credibility of data, practical sampling protocols and, most importantly, the interest and motivation of our volunteer monitors.

Importance of Long-term Monitoring

A major goal of a monitoring program is to identify any short or long-term changes in the water quality of the lake. Of major concern is the detection of cultural eutrophication: increases in the productivity of the lake, the amount of algae and plant growth, 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, as New Hampshire receives large amounts of acid precipitation, yet most of our lakes contain little mineral content to neutralize this type of pollution.

For over a decade, data collected weekly from lakes participating in the **New Hampshire Lakes Lay Monitoring Program** have indicated there is quite a variation in water quality indicators through the open water season on the majority of lakes. Short-term differences may be due to variations in weather, lake use, or other chance events. Monthly sampling of a lake during a single summer provides some useful information, but there is a greater chance that important short-term events such as algal blooms or the lake response to storm run-off will be missed. These short-term fluctuations may be unrelated to the actual long-term trend of a lake or they may be indicative of the changing status or "health" of a lake.

To determine if a change in water quality is occurring, a lake must be sampled on a frequent basis over a substantial amount of time. A poorly designed sampling program may even mislead the investigator away from the actual trend: Consider the hypothetical lake in Figure 1. Sampling only once a year during August from 1982 to 1986 would produce a plot (Figure 2) suggesting a decrease in eutrophication. The actual long-term trend of the lake, increasing eutrophy, can only be clearly discerned by sampling additional times a year for a ten year period (Figure 1). Frequent monitoring carried out 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, the lake must establish a long-term data base.

The number of seasons it takes to distinguish 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. In addition, different areas of a lake may show a different response. 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 the location of 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 in the NH Lakes Lay Monitoring Program. 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.

We are pleased with the interest and commitment of our lay monitors and are proud that their work is what makes the **NH LLMP** the most extensive, and we believe, the best volunteer program of its kind.

Purpose and Scope of This Study

This was the seventh year that monitoring of Baboosic Lake was undertaken by the Freshwater Biology Group and the Baboosic Lake Association. The program of sampling was designed to establish a long-term data base. Sampling emphasis was placed on two open water deep stations.

The primary purpose of this report is to discuss results of the 1989 monitoring with emphasis on current conditions of Baboosic Lake including the extent of eutrophication and the lake's susceptibility to increasing acid precipitation. This information is part of a large data base of historical and more recent data compiled and entered onto computer files for New Hampshire lakes that include New Hampshire Fish and Game surveys of the 1930's and 1970's, the surveys by the New Hampshire Water Supply and Pollution Control Commission and the FBG surveys. Care must be taken when comparing current results with early studies. Many complications arise due to methodological differences of the various testing facilities and technological improvements in testing.

RESULTS AND DISCUSSION OF LAY MONITOR DATA

Monitoring of Baboosic Lake was done at three locations. In 1988 and 1989, sampling for temperature, secchi disk depth, chlorophyll a, dissolved color, alkalinity and total phosphorus took place weekly or biweekly June through September. See figure 3 for the sampling site locations and 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.

In the shallow areas of many lakes, the secchi disk will hit bottom before it is able to disappear from view (what is referred to as a "Bottom Out" condition). Thus, Secchi disk measurements are generally taken over the deepest sites of a lake. Transparency values of greater than 4 meters are typical of clear, less productive lakes. Values less than 2.5 meters are generally an indication of a very productive lake. In 1989 the average transparency for lakes participating in the NH LLMP was 6.2 meters with a range of 1.4 to 12.5 meters.

Average secchi disk transparency was 3.1 and 3.1 meters for site 1 CLARKS, 4.7 and 3.8 meters for site 2 CENTER, and 4.5 and 3.9 meters for site 3 SHARKS in 1988 and 1989 respectively.

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 concentrations of algae and aquatic plants due to nutrient enrichment. Characteristics include accumulated organic matter in the lake basin and lower dissolved oxygen in the bottom waters. Summer chlorophyll a concentrations average above 7 mg m^{-3} (7 milligrams per cubic meter; 7 parts per billion). **Oligotrophic** lakes have low productivity and low nutrient levels and average summer chlorophyll a concentrations are generally less than 3 mg m^{-3}. These lakes generally have cleaner bottoms and high dissolved oxygen levels throughout. **Mesotrophic** lakes are intermediate in productivity with concentrations of chlorophyll a generally between 3 mg m^{-3} and 7 mg m^{-3}. In 1989 the average chlorophyll for lakes participating in the NH LLMP was 2.8 mg m^{-3} with a range of 0.1 to 54.4 mg m^{-3}.

Testing is sometimes done to check for **metalimnetic algal populations**, algae that layer out at the thermocline and generally go undetected if only epilimnetic (point or integrated) sampling is undertaken. Chlorophyll concentrations of a water sample collected in the thermocline is compared to the integrated epilimnetic sample. Greater chlorophyll levels of the point sample, in conjunction with microscopic examination of the samples (see Phytoplankton section below), confirm the presence of such a population of algae. These populations should be monitored as they may be an indication of increased nutrient loading into the lake.

Chlorophyll of the upper mixed water layer (epilimnion) was sampled by the volunteer monitors. Average chlorophyll concentrations were 1.4 (range 0.9 to 2.1 mg m^{-3}) and 6.9 mg m^{-3} (range 3.8 to 14.3 mg m^{-3}) for site 1 CLARKS, 5.5 (range 0.9 to 11.4 mg m^{-3}) and 4.9 mg m^{-3} (range 3.4 to 6.5 mg m^{-3}) for site 2 CENTER, 3.8 (range 0.8 to 7.4 mg m^{-3}) and 5.8 mg m^{-3} (range 3.7 to 10.6 mg m^{-3}) for site 3 SHARKS in 1988 and 1989 respectively. Average chlorophyll a concentrations for the sites from previous years were in the range of 0.1 to 13.6 mg m^{-3}. Thus, the 14.3 mg m^{-3} chlorophyll level for site 1 in 1989 is the highest reading obtained for the lake by the monitors. NOTE: 1988 values for site 1 were atypically low and most likely underestimate the productivity of this site. Secchi disk readings suggest the chlorophyll levels at site 1 were greater. Monitor samples only included the surface (upper 2 meters) of the lake while other sites were sampled down to about 4 meters.

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. Increases in dissolved watercolor can be an indication of increased development within the watershed as many land clearing activities (construction, deforestation, and the resulting increased run-off) add additional organic material to lakes. Natural fluctuations of dissolved color occur when storm events increase drainage from wetlands areas within the watershed. As suspended sediment is a difficult and expensive test to undertake, both dissolved color and chlorophyll information is important when interpreting the secchi disk transparency.

Dissolved color is measured on a comparative scale that uses standard chloroplatinate dyes and is designated as a color unit or ptu. Lakes with color below 10 ptu are very clear, 10 to 20 ptu are slightly colored, 20 to 40 ptu are lightly tea colored, 40 to 80 ptu are tea colored and greater than 80 ptu indicates highly colored waters. Generally the majority of New Hampshire lakes have color between 20 to 30 ptu.

Average dissolved color concentration was 39 units in 1988 and 43 units in 1989. The range of color was 12 to 56 ptu in 1988 and 30 to 66 ptu in 1989. Baboosic Lake color was high compared to most NH LLMP lakes in 1988 and 1989.

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 arise primarily through human related 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. As little as 15 parts per billion of phosphorus in a lake can cause an algal bloom.

Generally, in the more pristine lakes, phosphorus values are higher after spring melt when the lake receives the majority of runoff from its surrounding watershed. The nutrient is used by the algae and plants which in turn die and sink to the lake bottom causing phosphorus to decrease as the summer progresses. Lakes with nutrient loading from human activities and sources (Agriculture, Sediment Erosion, Septic Systems, etc) will show greater concentrations of nutrients as the summer progresses or after major storm events. Circulation of nutrients from the bottom waters of more productive lakes in late fall can result in algal blooms.

Total phosphorus samples were taken early spring and late fall at selected tributary sites. Phosphorus concentrations were in the range less than 1 to 441 ppb. In 1988, the greatest concentrations occurred in October the time of year that the water table is high (thus greater chance of septic system leachate entering lake) and run-off is greatest. Early spring sampling, mid-summer sampling and late fall sampling of the deep sites is suggested for 1990.

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 and soils of lake watersheds.

Decreasing alkalinity over a period of a few years can have serious effects on the lake ecosystem. In a study on an experimental acidified lake in Canada by Schindler, gradual lowering of the pH from 6.8 to 5.0 in an 8-year period resulted in the disappearance of some aquatic species, an increase in nuisance species of algae and a decline in the condition and reproduction rate of fish. During the first year of Schindler's study the pH remained unchanged while the alkalinity declined to 20 percent of the pre-treatment value. The decline in alkalinity was sufficient to trigger the disappearance of zooplankton species, which in turn caused a decline in the "condition" of fish species that fed on the zooplankton.

The analysis of alkalinity employed by the **Freshwater Biology Group** includes use of a dilute titrant allowing an order of magnitude greater sensitivity and precision than the standard method. Two endpoints are recorded during each analysis. The first endpoint (grey color of dye; pH endpoint of 5.1) approximates low level alkalinity values, while the second endpoint (pink dye color; pH endpoint of 4.6) approximates the alkalinity values recorded historically, such as NH Fish and Game data, with the methyl-orange endpoint method.

The average alkalinity of lakes throughout New Hampshire is low, approximately 9 mg per liter (calcium carbonate alkalinity), while the average alkalinity of the lakes studied by the **Freshwater Biology Group** in the NH LLMP is approximately 6.0 mg per liter. When alkalinity falls below 2 mg per liter the pH of waters can greatly fluctuate. Alkalinity levels are most critical in the spring when acid loadings from snowmelt and run-off are high, and many aquatic species are in their early, and most susceptible, stages of their life cycle. Average alkalinity at Baboosic Lake was 7.8 units for 1988 and was 8.4 units in 1989 was 5.9 mg per liter, which is low but greater than the average for **NH LLMP** program lakes.

Comparisons to Previous Years

Figure 10 compares 1988 and 1989 individual site results to the mean values and ranges of a five year base-line (1983 to 1987). This is one way in which data is analyzed to detect changing trends. The mean is marked by the intersection of the two patterns of the horizontal bar. The minimum and maximum values are indicated by the ends of the bar (as indicated in the key at the top of each figure).

Secchi disk transparency comparisons: All averages for all sites except site 2 CENTER in 1988 were less than the five year average indicating the lake is less clear than in previous years. Site 1 CLARKS had a minimum secchi disk reading of 2 meters in 1988 which is a new low for this site. At all site the 1989 means were less than 1988 means.

Chlorophyll concentration comparisons (site 1 1988 results are not considered due to possible sampling shortcomings): Chlorophyll concentration continues to increase at most sites. New chlorophyll maxima were measured at site 1 in 1988 and site 3 in 1989. Most chlorophyll levels represent a significant increase over the previous 5 year levels. This could be due to increased algal levels throughout the water column or a rise in the metalimnetic algal layer (see below) towards the surface or a combination of the two phenomena. site 22 and 24 in 1988 and 1989 with concentrations reaching greater than 4 $mg\ m^{-3}$ at site 24. All 1988 and 1989 means still fall within the range for less productive, healthy lakes.

As dissolved color was high in 1988 and 1989 secchi disk transparency was not a good indicator of the chlorophyll levels at the sites; Increases in algae did not necessarily cause a resulting decrease in transparency.

RESULTS AND DISCUSSION OF FBG DATA

The Freshwater Biology Group (FBG) visited Baboosic Lake on 26 July 1988, and 10 August 1989. The lake was sampled for several chemical, physical and biological parameters at one deep sites: 3 Sharks. Chlorophyll a, secchi disk transparency, alkalinity and dissolved color measured during the **FBG** field team visits were not significantly different from readings obtained by the monitors at this site on the same dates, indicating good corroboration between lay monitor and FBG data.

Water Transparency

The secchi disk depth measured by the FBG at site 3 SHARKS was 4.5 meters in 1988 and 4.6 meters in 1989.

Chlorophyll a

The mixed layer chlorophyll concentrations measured by the FBG at site 3 SHARKS in both 1988 and 1989 was 3.5 mg m^{-3}. Chlorophyll levels at the thermocline were 4.3 and 5.2 mg m^{-3}, only slightly greater than mixed layer concentrations suggesting that the algae was more dispersed throughout the water column than in previous years.

Dissolved Color

Dissolved color was in about 32 ptu in both 1988 and 1989.

Total Phosphorus

Total phosphorus concentrations were low, at about 4 ppb in the upper waters. Bottom water concentrations were higher and more indicative of productive lakes with internal loading : 15.7 ppb in 1988 and 24.5 ppb in 1989.

Thermal Stratification in the Deep Water Sites

Lakes in New Hampshire display distinct patterns of temperature stratification, that develop as the summer months progress, 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**. Some shallow lakes may be continually mixed by wind action and will never stratify. Other lakes may only contain a developed epilimnion and metalimnion. The Baboosic Lake sites were generally shallow and thus, did not have a developed hypolimnion (see FIGURES and APPENDIX C).

Dissolved Oxygen and Free Carbon Dioxide *

Oxygen is an essential component for the survival of aquatic life. Submergent plants and algae take in free carbon dioxide and create oxygen through **photosynthesis** by day. **Respiration** by both animals and plants uses up oxygen continually and creates **carbon dioxide**. Dissolved oxygen profiles determine the extent of declining oxygen concentrations in the lower waters. High carbon dioxide values are indicative of low oxygen conditions and accumulating organic matter. For both gases, as the temperature of the water decreases, more gas can be dissolved in the water.

The typical pattern of clear, unproductive lakes is a slight decline in hypolimnetic oxygen as the summer progresses. Oxygen in the lower waters is important for maintaining a fit, reproducing, cold water fishery. Trout and salmon generally require oxygen concentrations above 5 mg per liter (parts per million) in the cool deep waters. On the other hand, carp and catfish can survive very low oxygen conditions. Oxygen above the lake bottom is important in limiting the release of nutrients from the sediments and minimizing the collection of undecomposed organic matter.

Bacteria, fungi and other **decomposers** in the bottom waters break down organic matter originating from the watershed or generated by the lake. This process uses up oxygen and produces carbon dioxide. In lakes where organic matter accumulation is high, oxygen depletion can occur. In highly stratified eutrophic lakes the entire hypolimnion can remain unoxygenated or **anaerobic** until fall mixing occurs.

Baboosic Lake had low concentrations of bottom water dissolved oxygen in 1988 and 1989, the sign of a more productive lake. Moderate to high amounts of carbon dioxide at the bottom waters during both years suggest organic matter generated from within the lake or running in from the surrounding watershed is accumulating substantially.

Oxygen peaks occurring at surface and mid-lake depths during the day are quite common in many lakes. These characteristic **heterograde oxygen curves** are the result of the large amounts of oxygen, the by-product of photosynthesis, collecting in regions of high algal concentrations. If the peak occurs in the thermocline of the lake, metalimnetic algal populations (discussed above) may be present.

No significant increase in oxygen at the metalimnion (thermocline) was found at Site 3 in 1988 but in 1989 a peak occurred at about 5 meters just below the thermocline. Future monitoring by both the FBG and the lay monitors will determine the extent of any possible algal layering in future years and if this is a sign of increasing productivity in the area.

Specific Conductivity

The specific conductance of a water sample indicates concentrations of dissolved salts. Leaking septic systems and deicing salt runoff from highways can cause high conductivity values. Fertilizers and other pollutants can also increase the conductivity of the water. Conductivity is measured in micro**mhos** (the opposite of the measurement of resistance **ohms**) per centimeter, or more commonly, as micro-Siemans per centimeter. Conductivity of Baboosic Lake deep site samples were moderate for New Hampshire lakes and in 1989 showed a marked increase towards the bottom waters suggesting some salt pollution is accumulating in the deep waters of the lake.

pH

The pH is a way of expressing the acidic level of lake water, and is generally 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 a ten times 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.

pH was in the range of 6.6 to 7.1 in 1988 and 6.2 to 6.7 in 1989 at the one site sampled. This indicates that although alkalinity of the lake is low the pH remains in the optimum range for most aquatic organisms. The range of surface water pH for all **LLMP** lakes was 5.2 to 7.2. The pH slightly decreased with depth during both dates at site 3 SHARKS. This is due to the higher carbon dioxide levels in the bottom waters.

Alkalinity

Surface alkalinities at both sites sampled were low; These results are comparable to lay monitor readings.

Underwater Light

Underwater light available to photosynthetic organisms is measured with an **underwater photometer** which is much like the light meter of a camera (only waterproofed !). The **photic zone** of a lake is the volume of water capable of supporting photosynthesis. It is generally considered to be delineated by the water's surface and the level where light is reduced, by the absorption and scattering properties of the lake water, to one percent of the surface intensity. The one percent depth is sometimes termed the **compensation depth.** Knowledge of light penetration is important when considering lake productivity and in studies of submerged vegetation. Discontinuity (abrupt changes in the slope) of the profiles could be due to metalimnetic layering of algae or other particulates (discussed above). The underwater photometer allows the investigator to measure light at depths below the Secchi disk depth to supplement the transparency information. The compensation depth for Baboosic Lake area at the time of FBG sampling was between 6.5 and 5.2 meters. In past years the compensation depths ranged from 3.7 to 8.8 meters. In 1989 the range of compensation depths for NH LLMP lakes was 2.6 meters (Flint Pond) to 19.3 meters (Lake Winnipesaukee).

Indicator Bacteria

Coliform bacteria in water indicate the possibility of fecal contamination. Although they are usually considered harmless to humans, they are much easier to test for than harmful pathogenic enteric bacteria (**Salmonella, Shigella** etc.) and viruses that may be present in fecal material. **Total coliform** includes all coliform bacteria which arise from the gut of animals or from vegetative materials. **Fecal coliform** are those specific organisms that inhabit the gut of warm blooded animals. Another indicator organism **Fecal streptococcus** (sometimes referred to as **enterococcus**) also can be monitored. The ratio of fecal coliform to fecal strep may be useful in suggesting the type of animal source responsible for the contamination. Desirable levels for a Class A water body is less than 50 total coliform organisms per 100 milliliters. If the coliform level rises above 150 organisms per 100ml swimming should be prohibited. Fecal

Coliform testing for Baboosic Lake was done by a commercial laboratory. Concentrations ranged from less than 1 organism per 100 ml to 46 per 100 ml. High values occurred at most sites tested in October suggesting septic runoff around the lake.

Ducks and geese are often a common cause of high concentrations of coliform at specific lake sites. While waterfowl are important components to the natural and aesthetic qualities of lakes that we all enjoy, it is poor management practice to encourage these birds by feeding them. The lake and surrounding area provides enough healthy and natural food for the birds and feeding them stale bread or crackers does nothing more than import additional nutrients into the lake and allows for increased plant growth. As birds also are a host to the parasite that causes "swimmers itch" waterfowl roosting areas offer a greater chance for infestation to occur. Thus while leaving offerings for our feathered friends is enticing, the results can prove to be detrimental to the lake system and to human health.

Phytoplankton *

The planktonic community includes microbial organisms that represent diverse life forms, containing photosynthetic as well as non-photosynthetic types, and including bacteria, algae, crustaceans and insect larvae (the zooplankton are discussed below in a separate section). Because planktonic algae or "phytoplankton" tend to undergo rapid seasonal cycles on a time scale of days and weeks, the levels of populations found should be considered to be most representative of the time of collection and not necessarily of other times during the ice-free season, especially the early spring and late fall periods.

The composition and concentration of phytoplankton can be indicative of the trophic status of a lake. Seasonal patterns do occur and must be considered. For example **diatoms**, tend to be most abundant in April-June and October-November, in the surface or epilimnetic layers of New Hampshire lakes. As the summer progresses, the dominant types might shift to **green algae** or **golden algae.** By late season **Blue-green bacteria** generally dominate. In nutrient rich lakes, nuisance green algae and/or bluegreen bacteria might dominate continually. After fall mixing diatoms might again be found to bloom.

Concentration of phytoplankton at site 3 was moderate in 1989, 645 organisms per milliliter. The dominant organism was the green algae (Chlorophyceae) Gleocystis, generally common in clean lakes (but at found in lower concentrations). Future FBG sampling will continue to monitor the phytoplankton population of the lake sites to see if 1989 was an atypical year or a change in the phytoplankton community is occurring.

Zooplankton

There are three groups of zooplankton that are generally prevalent in lakes: the **protozoa, rotifers** and **crustaceans.** Most research has been devoted to the last two groups although protozoa may be found in substantial amounts. Of the rotifers and the crustaceans, time and budgetary constraints usually make it necessary to sample only the larger zooplankton (macrozooplankton; larger than 80 or 150 microns; 1 million microns make up a meter). Thus, zooplankton analysis is generally restricted only to the larger crustaceans. Crustacean zooplankton are very sensitive to pollutants and are commonly used to indicate the presence of toxic substances in water. The crustaceans can be divided into two groups, the **cladocerans** (which include the "water fleas") and the **copepods.**

Macrozooplankton are an important component in the lake system. The filter feeding of the herbivorous ("grazing") species may control the population size of selected species of phytoplankton. The larger zooplankton can be an important food source for juvenile and adult planktivorous fish. All zooplankton play a part in the recycling of nutrients within the lake.

As discussed above for phytoplankton, zooplankton undergo seasonal population cycles and the results discussed below are most representative of the collection dates and not necessarily of other times during the ice-free season, especially during the early spring and late fall.

Macrozooplankton were high, 19.1 and 24 animals per liter for 1988 and 1989 respectively. Samples in both years were dominated by predatory cyclopoid copepods with the predominantly herbivorous ("phytoplankton eating") calanoid copepods as sub-dominants.

While populations do cycle throughout the season, the substantial dominance (greater than 50%) of one species of phytoplankton or zooplankton is indicative of a more productive system.

Fish Condition

As with the plankton discussed above, the health of the fish species of a lake will be indicative of the overall water quality. Condition is determined by comparing the length of the fish to its weight. As would be expected, the heavier the fish for its length, the better its condition will be. By also examining a scale collected from the fish under a microscope, the approximate age and growth history can also be determined.

To assess the lake's health through the use of a **bio-indicator** such as fish, a substantial number of fish samples are required. Thus, it is important for **NH LLMP** participants interested in monitoring fish populations to provide at least 50 fish readings per species of fish. Many lakes have designated a separate coordinator for the fish condition program and have received participatory support from fishing clubs and bait and tackle shops.

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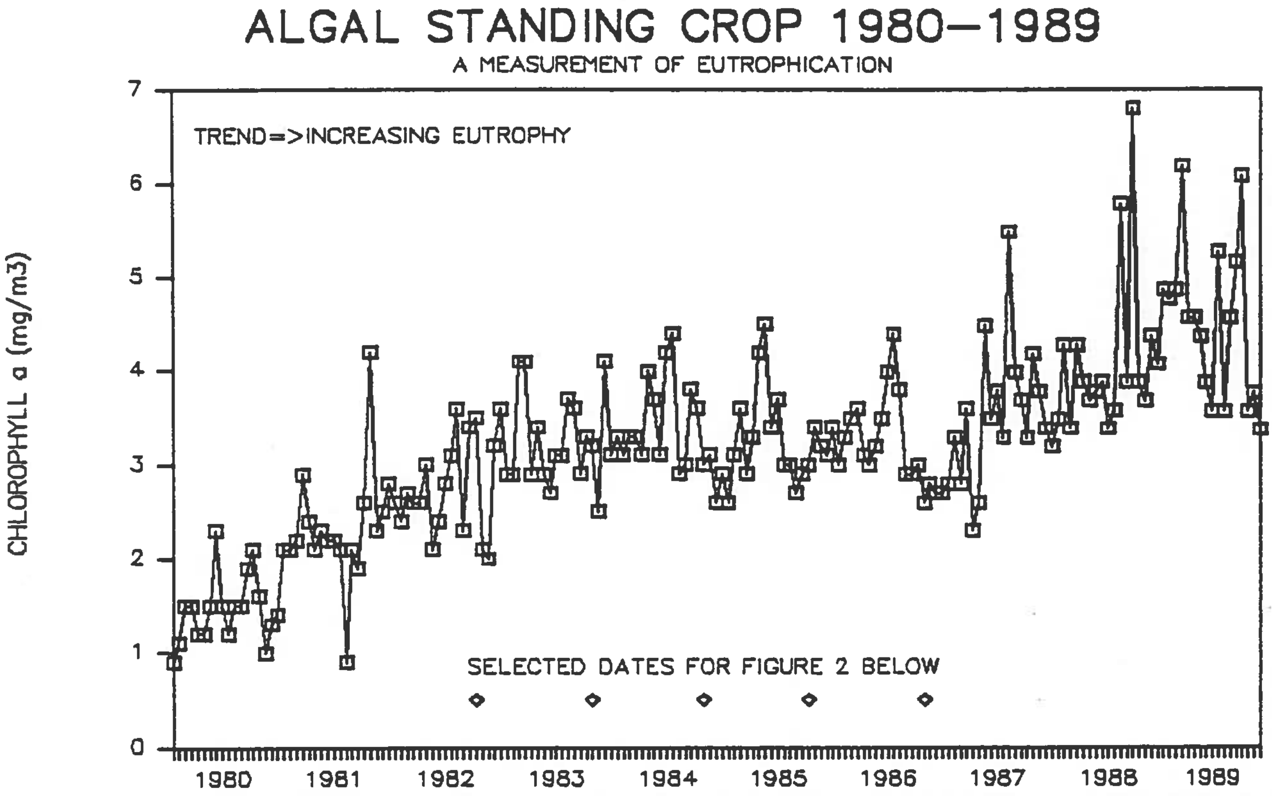
REPORT FIGURES



.Figure 1. The upper graph depicts weekly chlorophyll concentrations of a model lake measured weekly during ice-free conditions. The long-term trend is that of increased eutrophication (lake has become "greener"). Diamonds below the curve represent late summer (August) dates the data set was subsampled to create Figure 2.

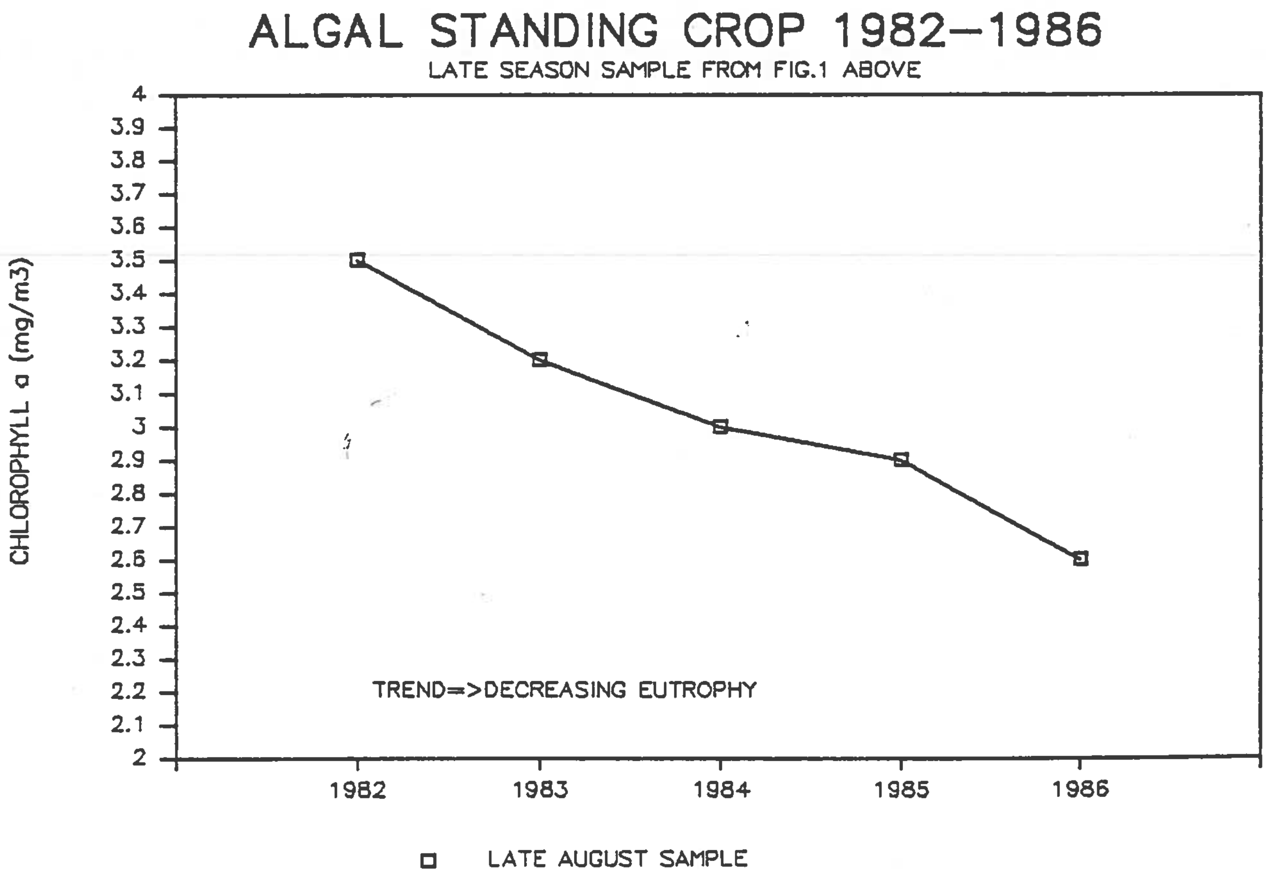
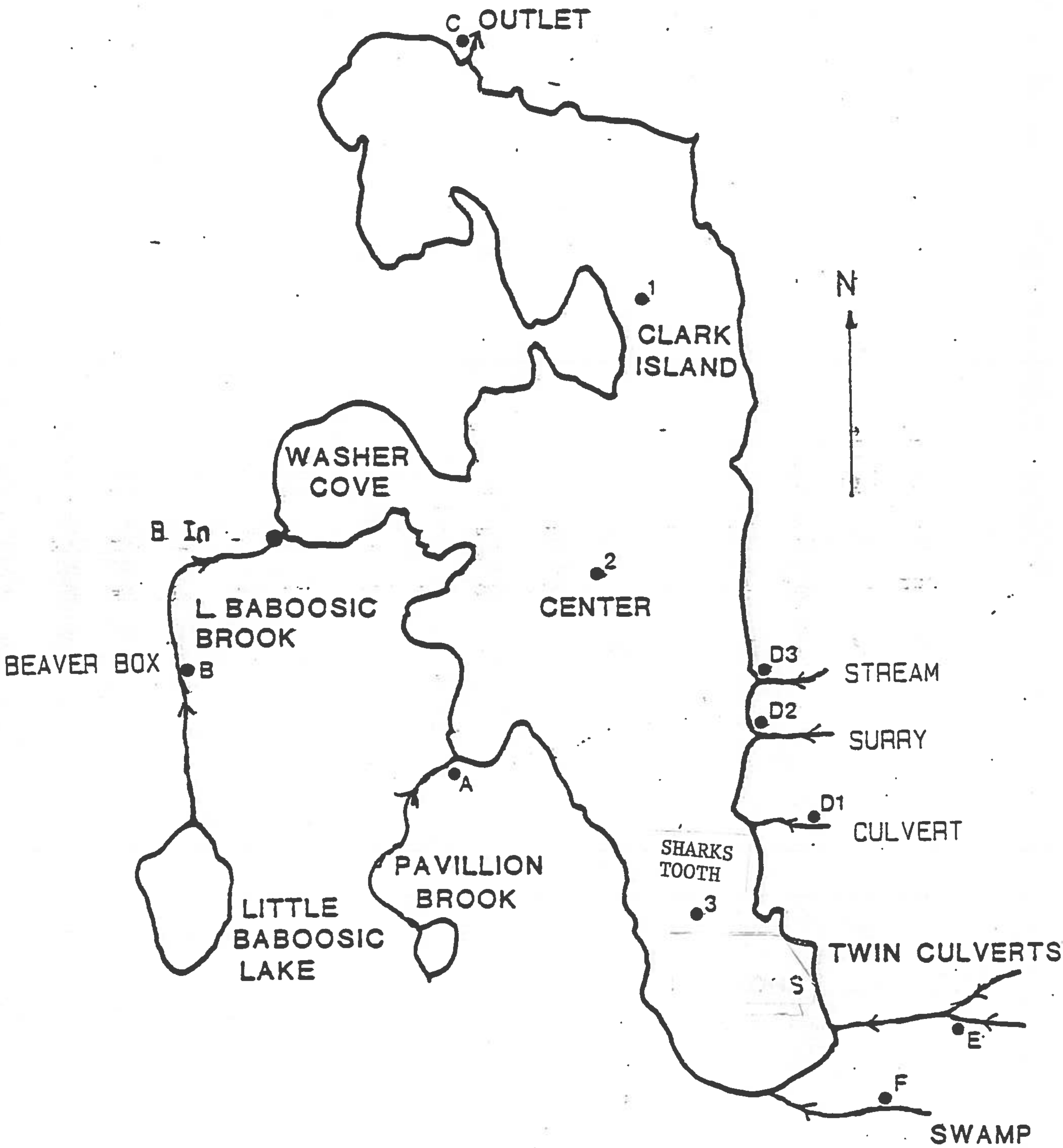
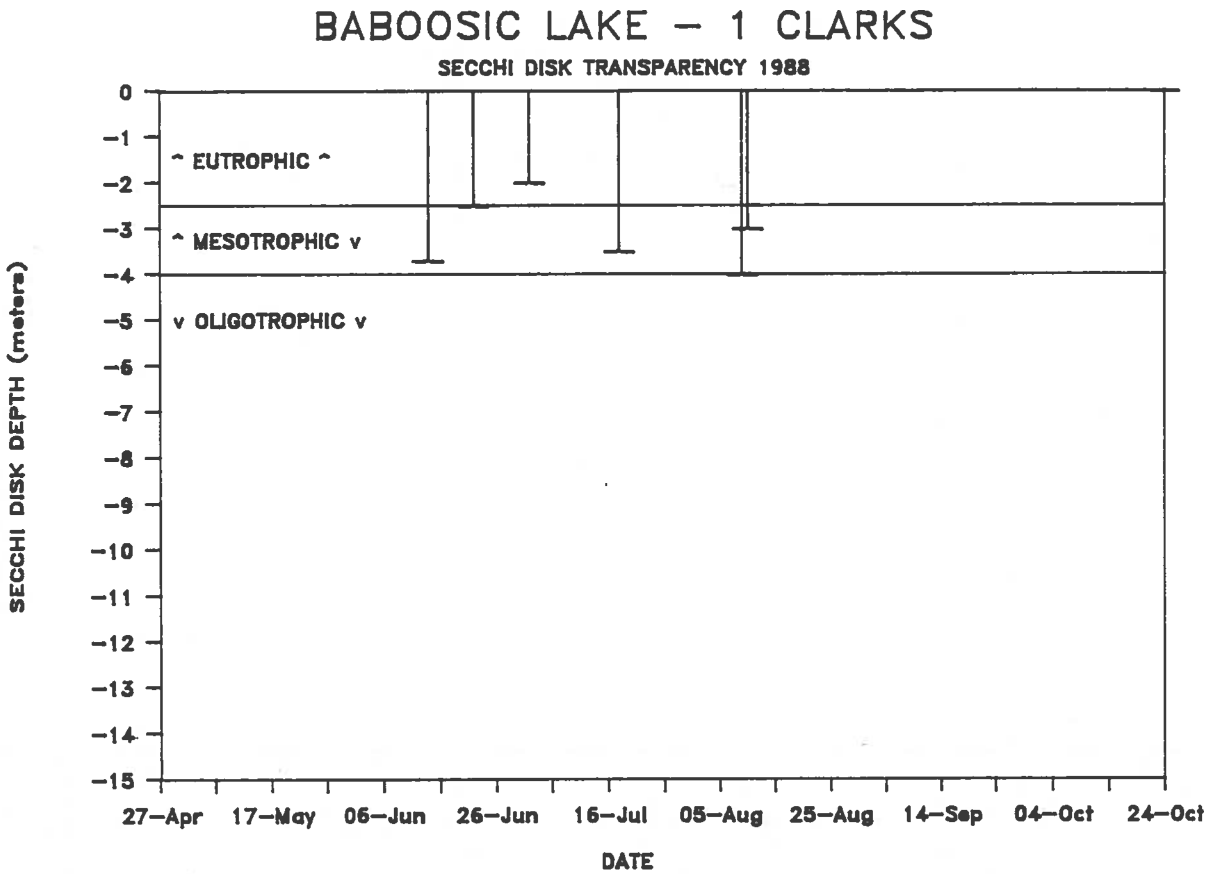


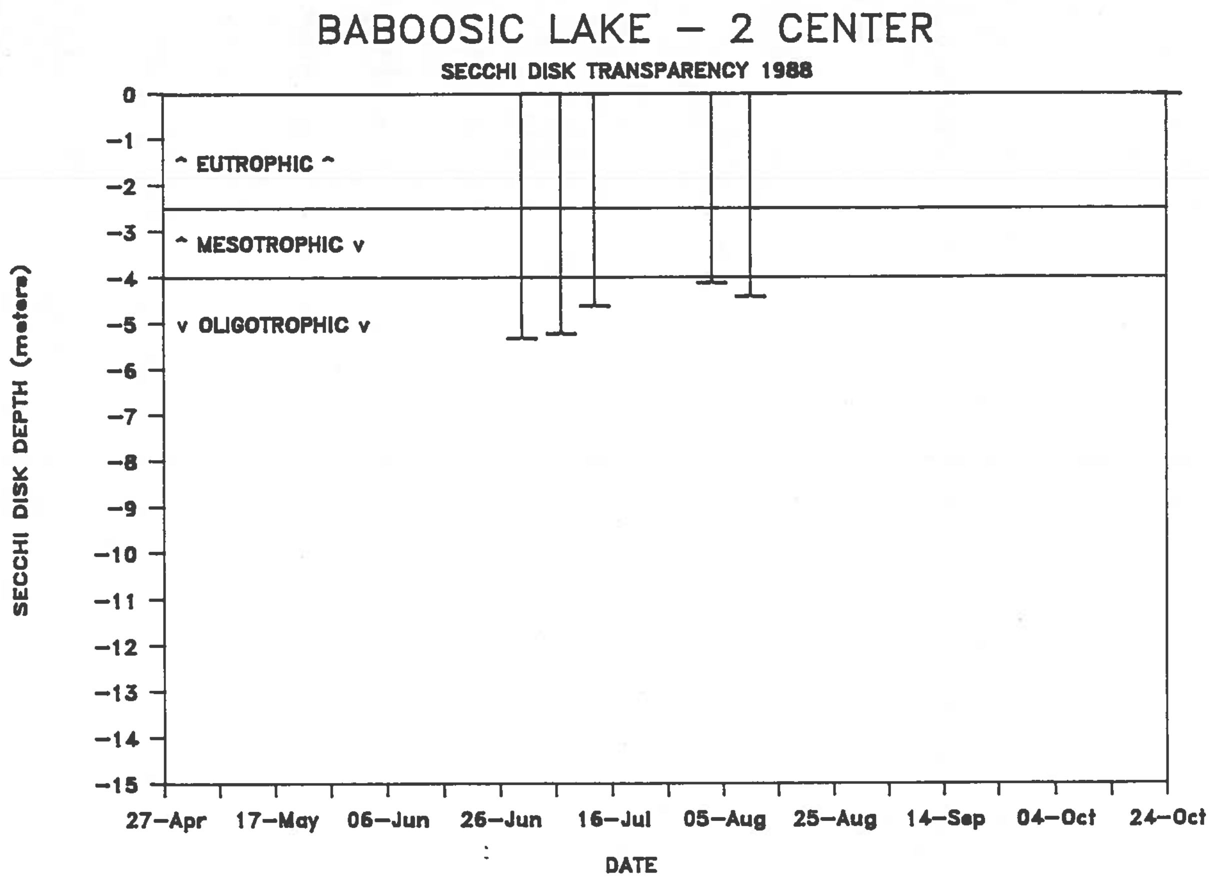
Figure 2. The lower graph depicts late summer chlorophyll data of the model lake in Figure 1. Note how limited sampling over a five year period suggests a much different trend, that of decreasing eutrophy. Thus, limited sampling can mislead the investigator of long-term trends.

Figure 3. Location of sampling sites on Baboosic Lake, New Hampshire.


C OUTLET
1
CLARK ISLAND
N
WASHER COVE
B. In
2
CENTER
L. BABOOSIC BROOK
BEAVER BOX
B
D3
STREAM
D2
SURRY
A
D1
CULVERT
SHARKS TOOTH
PAVILLION BROOK
LITTLE BABOOSIC LAKE
3
TWIN CULVERTS
S
E
F
SWAMP



BABOOSIC LAKE – 1 CLARKS
SECCHI DISK TRANSPARENCY 1988
SECCHI DISK DEPTH (meters)
^ EUTROPHIC ^
^ MESOTROPHIC v
v OLIGOTROPHIC v
0
–1
–2
–3
–4
–5
–6
–7
–8
–9
–10
–11
–12
–13
–14
–15
27–Apr
17–May
06–Jun
26–Jun
16–Jul
05–Aug
25–Aug
14–Sep
04–Oct
24–Oct
DATE



BABOOSIC LAKE – 2 CENTER
SECCHI DISK TRANSPARENCY 1988
SECCHI DISK DEPTH (meters)
^ EUTROPHIC ^
^ MESOTROPHIC v
v OLIGOTROPHIC v
0
–1
–2
–3
–4
–5
–6
–7
–8
–9
–10
–11
–12
–13
–14
–15
27–Apr
17–May
06–Jun
26–Jun
16–Jul
05–Aug
25–Aug
14–Sep
04–Oct
24–Oct
DATE

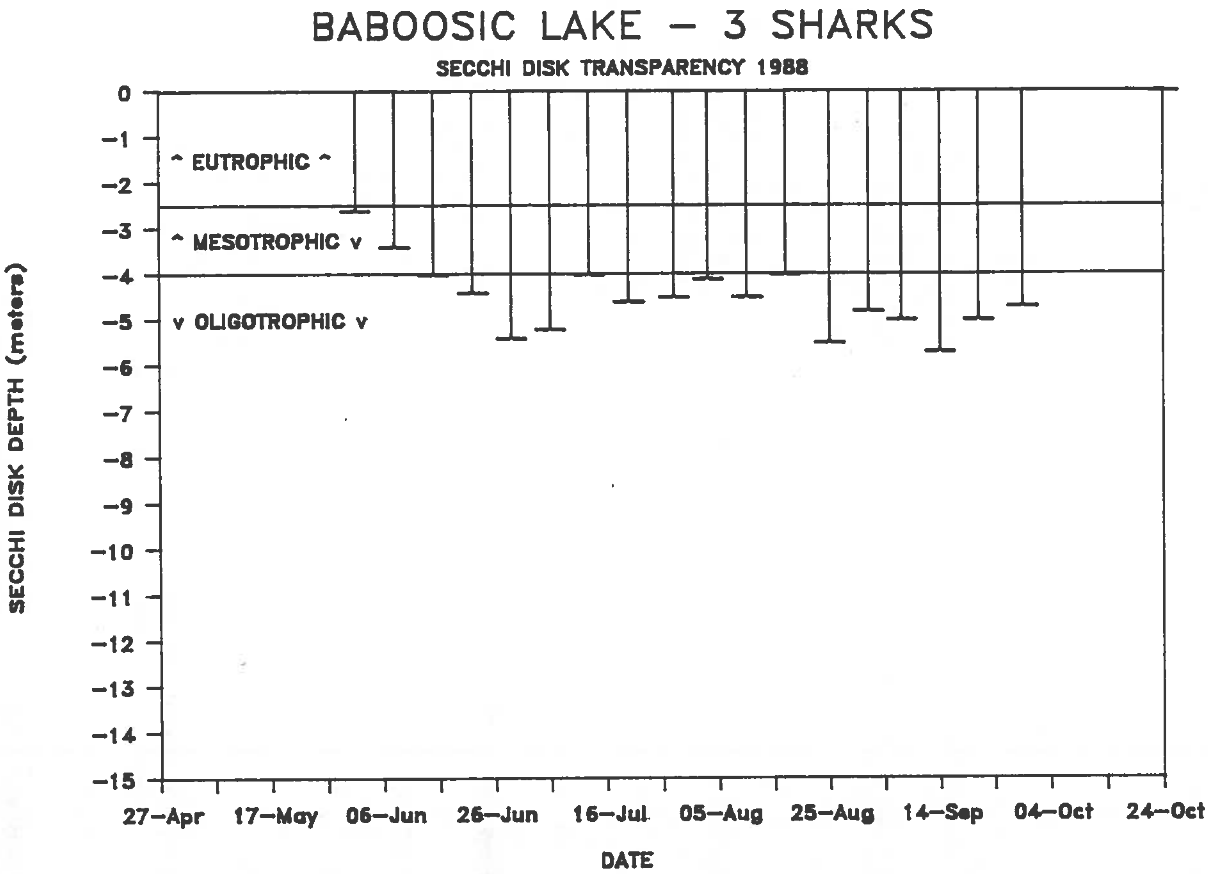
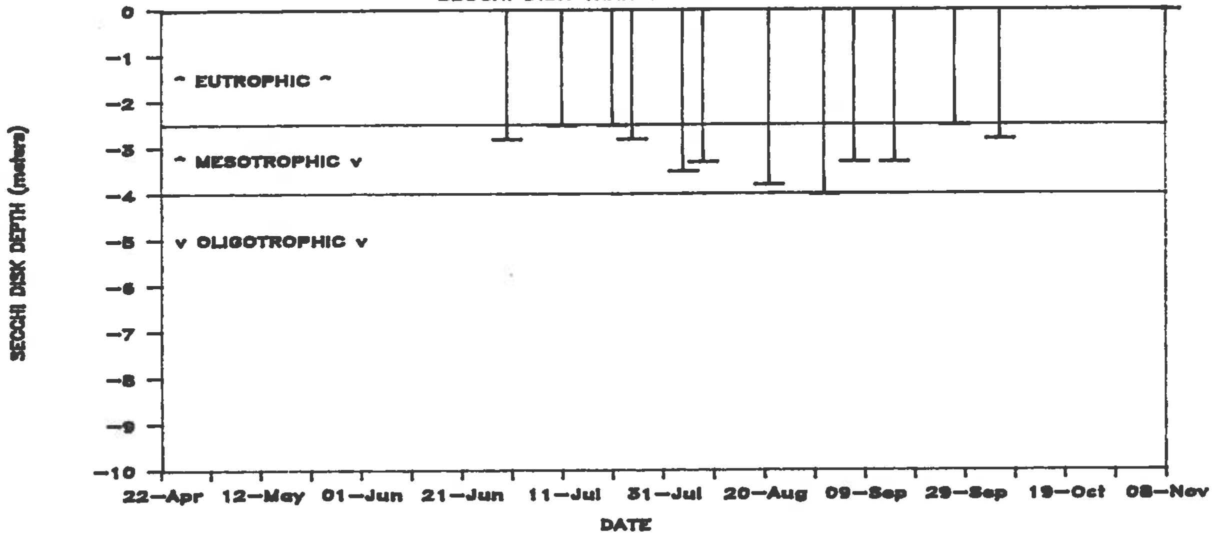


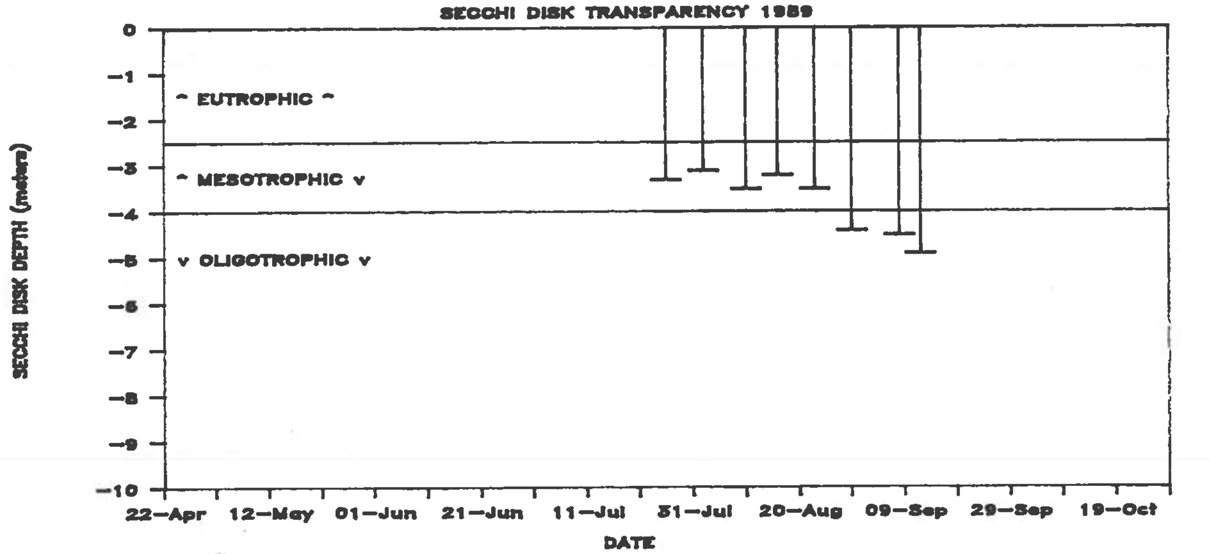
Figure 4. - Seasonal trends for secchi disk depth (water transparency) 1988 (A) Site 1 CLARKS (B) 2 CENTER, (C) 3 SHARKS . Solid lines on the plots border the ranges common to oligotrophic, mesotrophic and eutrophic lakes.

Figure 5. - Seasonal trends for secchi disk depth (water transparency) 1989 (A) Site 1 CLARKS (B) 2 CENTER, (C) 3 SHARKS. Solid lines on the plots border the ranges common to oligotrophic, mesotrophic and eutrophic lakes.

BABOOSIC SITE 1 CLARKS
SECCHI DISK TRANSPARENCY 1989



BABOOSIC LAKE 2 CENTER
SECCHI DISK TRANSPARENCY 1989



BABOOSIC LAKE 3 SHARKS
SECCHI DISK TRANSPARENCY 1989

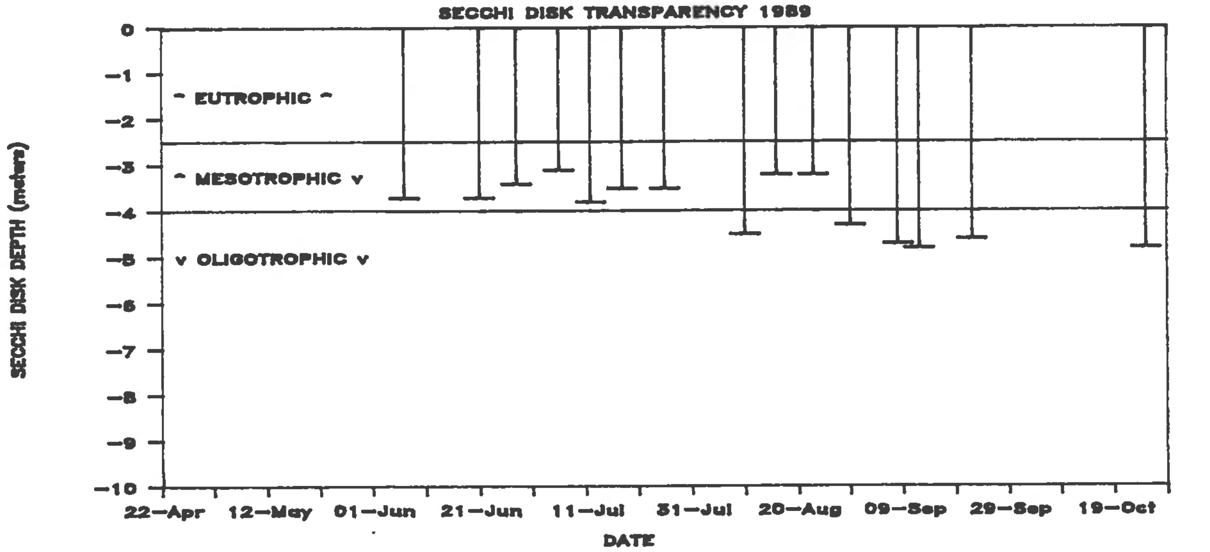
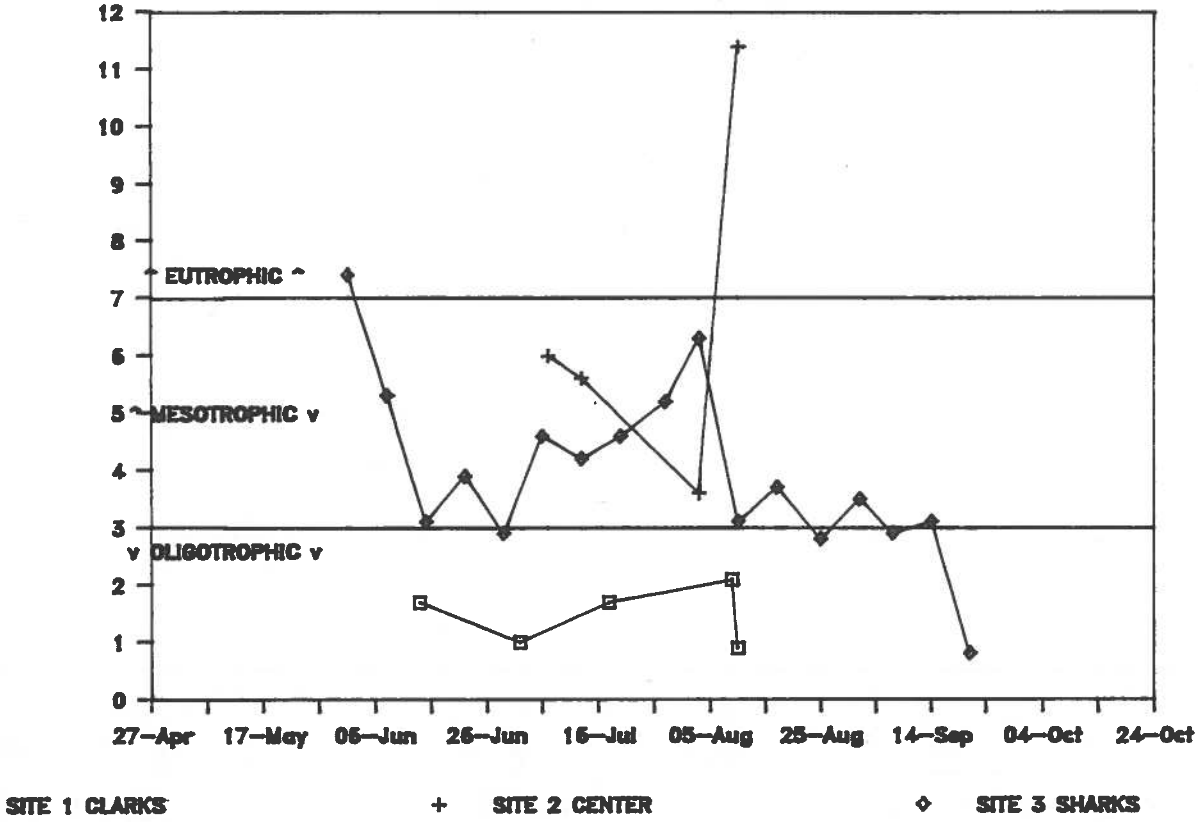


Figure 6 - Baboosic Lake 1988. Seasonal trends for chlorophyll a concentration of lay monitor sites 1 (squares), 2 (crosses), 3 (diamonds), 26 (triangles) and 27 (X's). Chlorophyll a concentrations in mg per m^3 of chlorophyll a.

Figure 7 - Baboosic Lake 1988. Seasonal trends for dissolved color concentration of lay monitor sites 1 (squares), 2 (crosses), 3 (diamonds), 26 (triangles) and 27 (X's). Color expressed as platinum-cobalt units (ptu).

BABOOSIC LAKE

CHLOROPHYL CONCENTRATION 1988



BABOOSIC LAKE

DISSOLVED WATER COLOR 1988

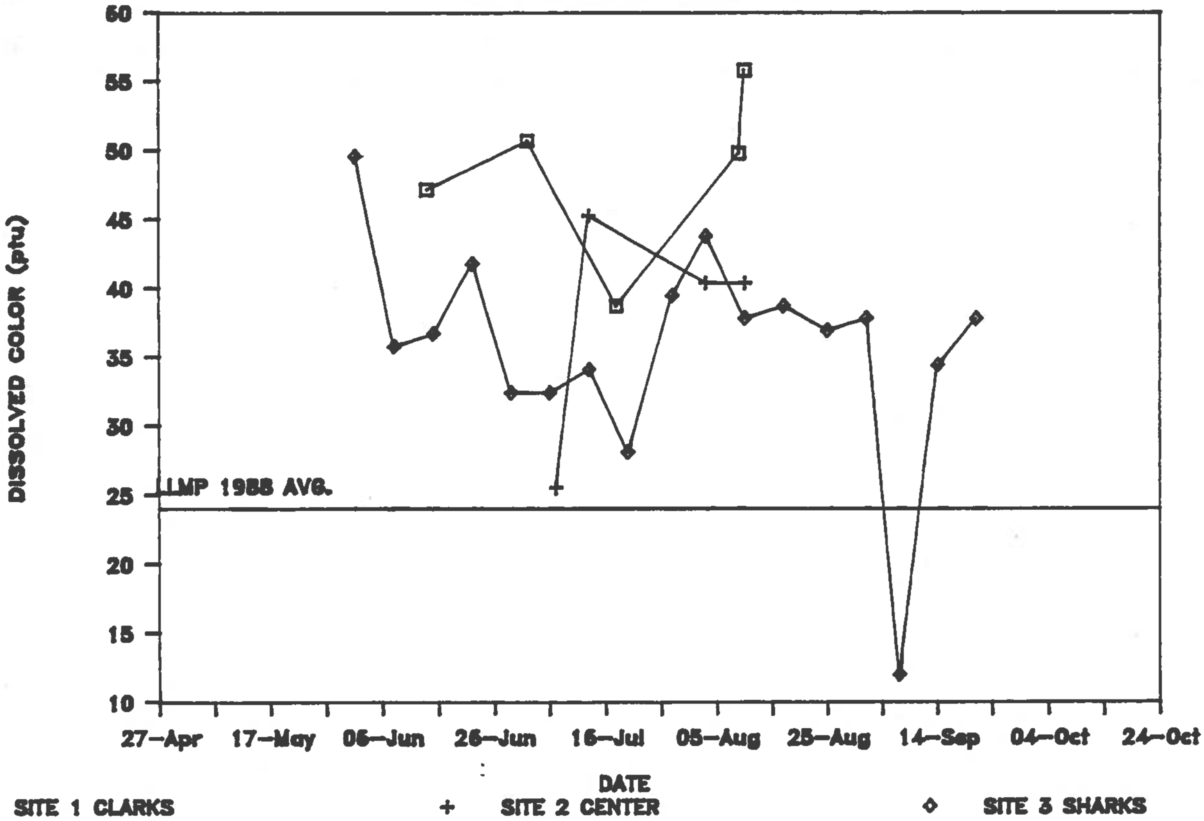
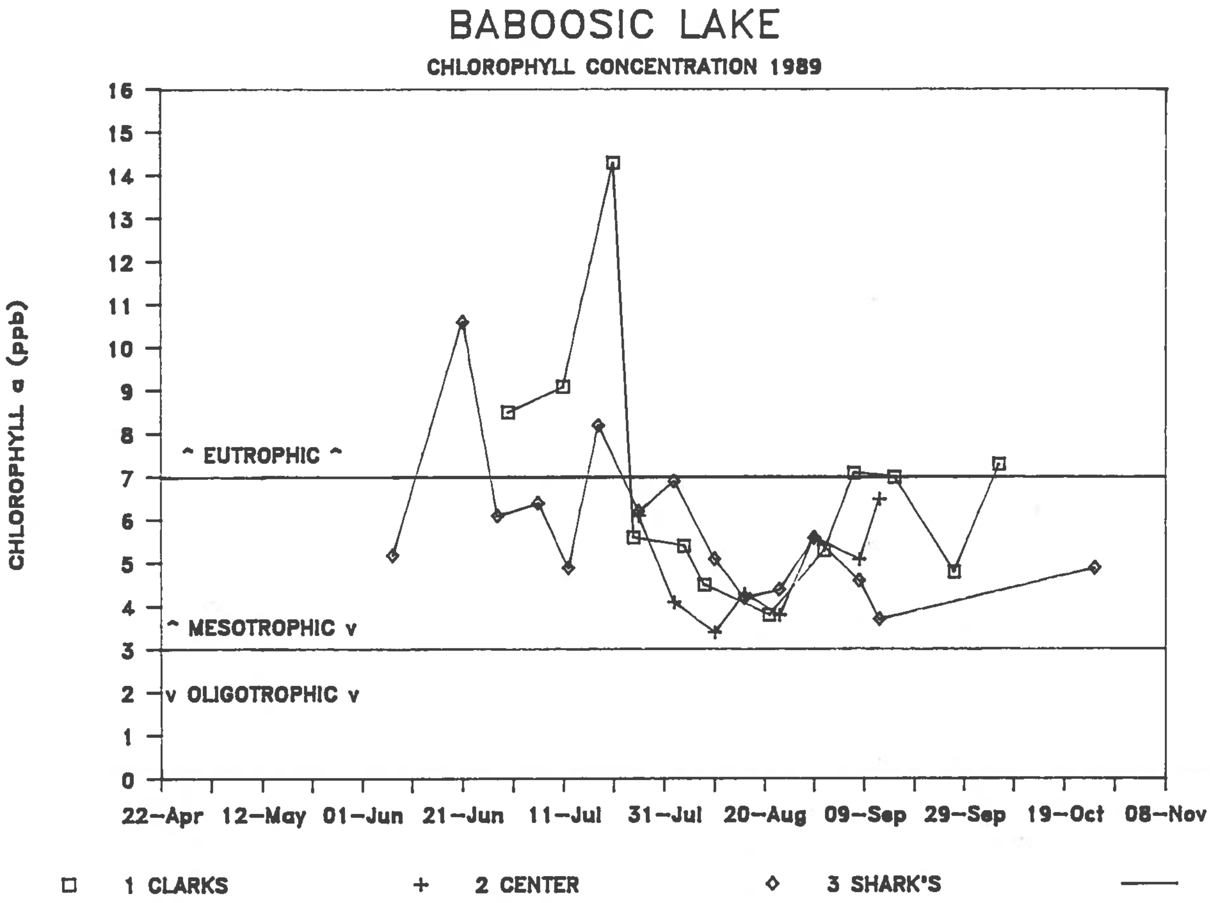
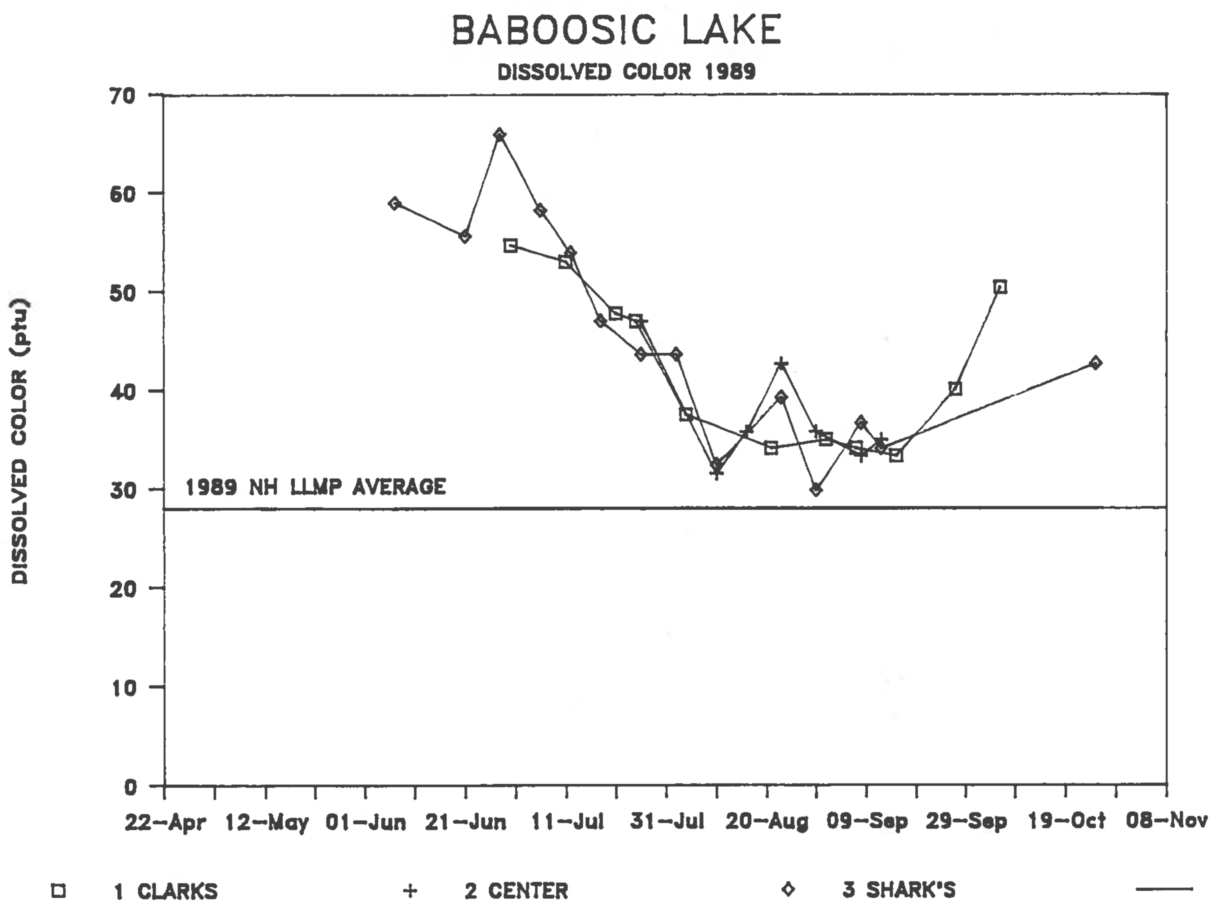


Figure 8 - Baboosic Lake 1989. Seasonal trends for chlorophyll a concentration of lay monitor sites 1 (squares), 2 (crosses), 3 (diamonds), 26 (triangles) and 27 (X's). Chlorophyll a concentrations in mg per m^3 of chlorophyll a.

Figure 9 - Baboosic Lake 1989. Seasonal trends for dissolved color concentration of lay monitor sites 1 (squares), 2 (crosses), 3 (diamonds), 26 (triangles) and 27 (X's). Color expressed as platinum-cobalt units (ptu).


BABOOSIC LAKE
CHLOROPHYLL CONCENTRATION 1989
CHLOROPHYLL a (ppb)
^ EUTROPHIC ^
^ MESOTROPHIC v
v OLIGOTROPHIC v
22-Apr 12-May 01-Jun 21-Jun 11-Jul 31-Jul 20-Aug 09-Sep 29-Sep 19-Oct 08-Nov
1 CLARKS
2 CENTER
3 SHARK'S

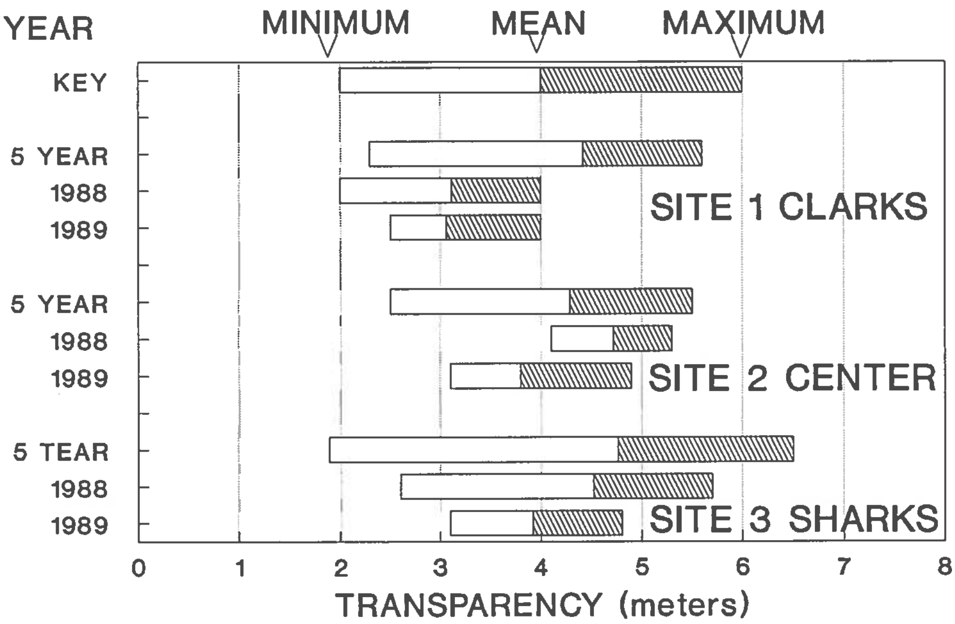

BABOOSIC LAKE
DISSOLVED COLOR 1989
DISSOLVED COLOR (ptu)
1989 NH LLMP AVERAGE
22-Apr 12-May 01-Jun 21-Jun 11-Jul 31-Jul 20-Aug 09-Sep 29-Sep 19-Oct 08-Nov
1 CLARKS
2 CENTER
3 SHARK'S

The figures on the facing page compare 1988 and 1989 individual site results to the mean values and ranges of a five year base-line (1983 to 1987). This is one way in which data is analyzed to detect changing trends. The mean is marked by the intersection of the two patterns of the horizontal bar. The minimum and maximum are indicated by the ends of the bar (as indicated in the key at the top of each figure).

Figure 10 A- Secchi disk transparency comparisons: All averages for all sites except site 2 CENTER in 1988 were less than the five year average indicating the lake is less clear than in previous years. Site 1 CLARKS had a minimum secchi disk reading of 2 meters in 1988 which is a new low for this site. At all site the 1989 means were less than 1988 means.

Figure 10 B- Chlorophyll concentration comparisons (site 1 1988 results are not considered due to possible sampling shortcomings): Chlorophyll concentration continues to increase at most sites. New chlorophyll maxima were measured at site 1 in 1988 and site 3 in 1989. Most chlorophyll levels represent a significant increase over the previous 5 year levels. This could be due to increased algal levels throughout the water column or a rise in the metalimnetic algal layer (see below) towards the surface or a combination of the two phenomena. site 22 and 24 in 1988 and 1989 with concentrations reaching greater than 4 $mg\ m^{-3}$ at site 24. All 1988 and 1989 means still fall within the range for less productive, healthy lakes.

BABOOSIC LAKE
SECCHI DISK TRANSPARENCY



BABOOSIC LAKE
CHLOROPHYLL CONCENTRATION

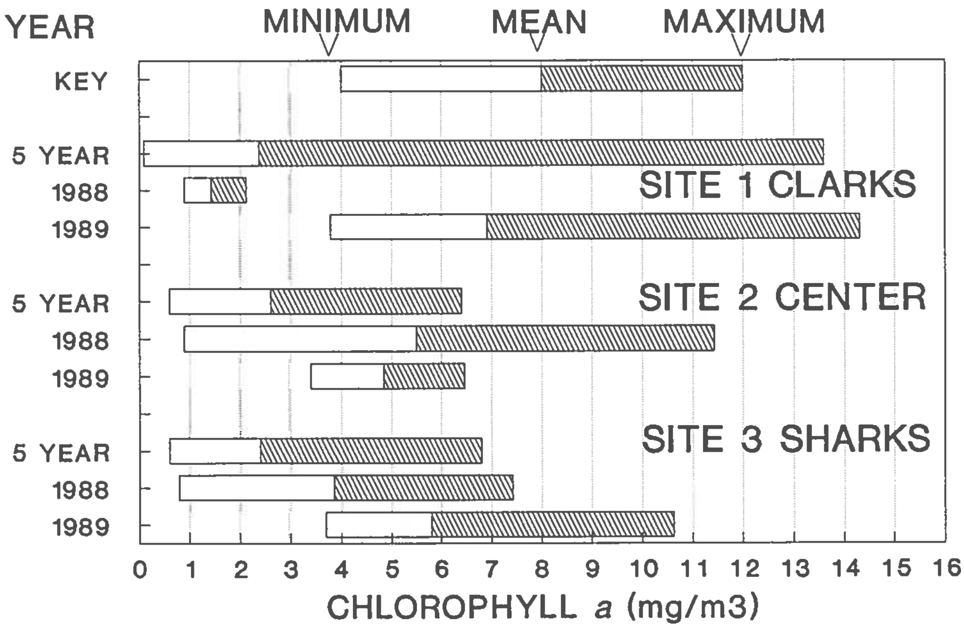
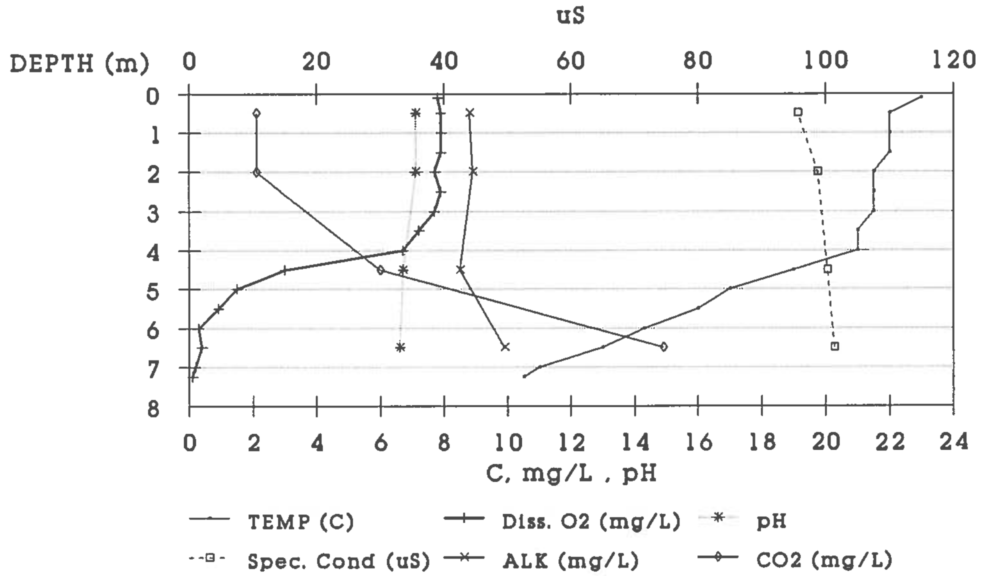


Figure 11 - Profiles of temperature (temp.), dissolved oxygen (O2), "free" carbon dioxide (CO2), pH, and total alkalinity on 26 July 1988 (A) and 10 August 1989 at Baboosic Lake site 3 SHARKS. Units of measurement are as indicated. Oxygen and temperature were measured at one-half meter intervals, other parameters were sampled at the discrete depths indicated by the x's, asterisks, boxes and crosses.

BABOOSIC LAKE
3 Sharks Tooth 26 JULY 1988



BABOOSIC LAKE
3 Sharks Tooth 10 AUGUST 1989

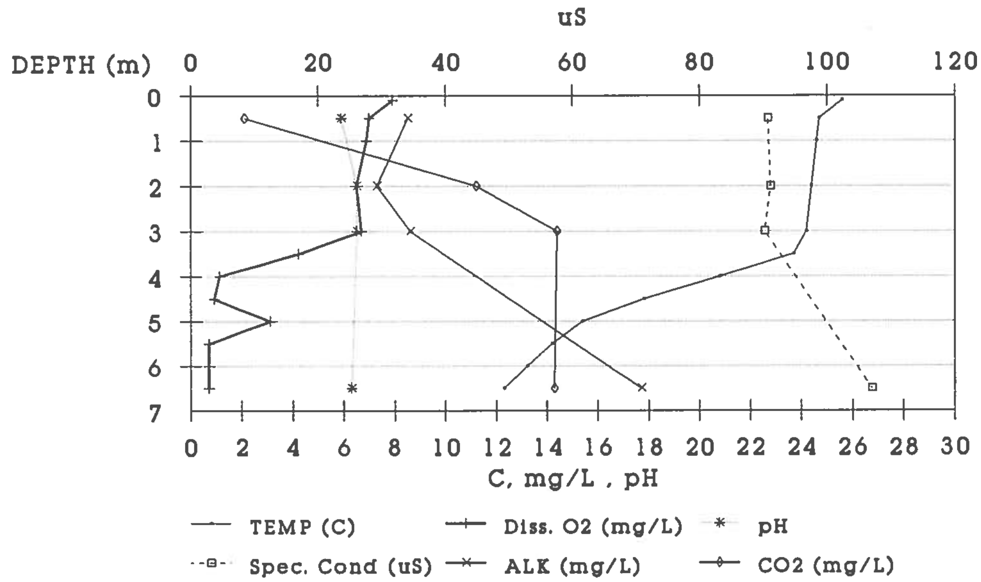


Figure 12 - Pie diagram of Phytoplankton Diversity at Baboosic Lake by Algal Class for site 3 Sharks, 10 August 1989.

BABOOSIC 1 DEEP 8/10/89
0-3.0 METERS

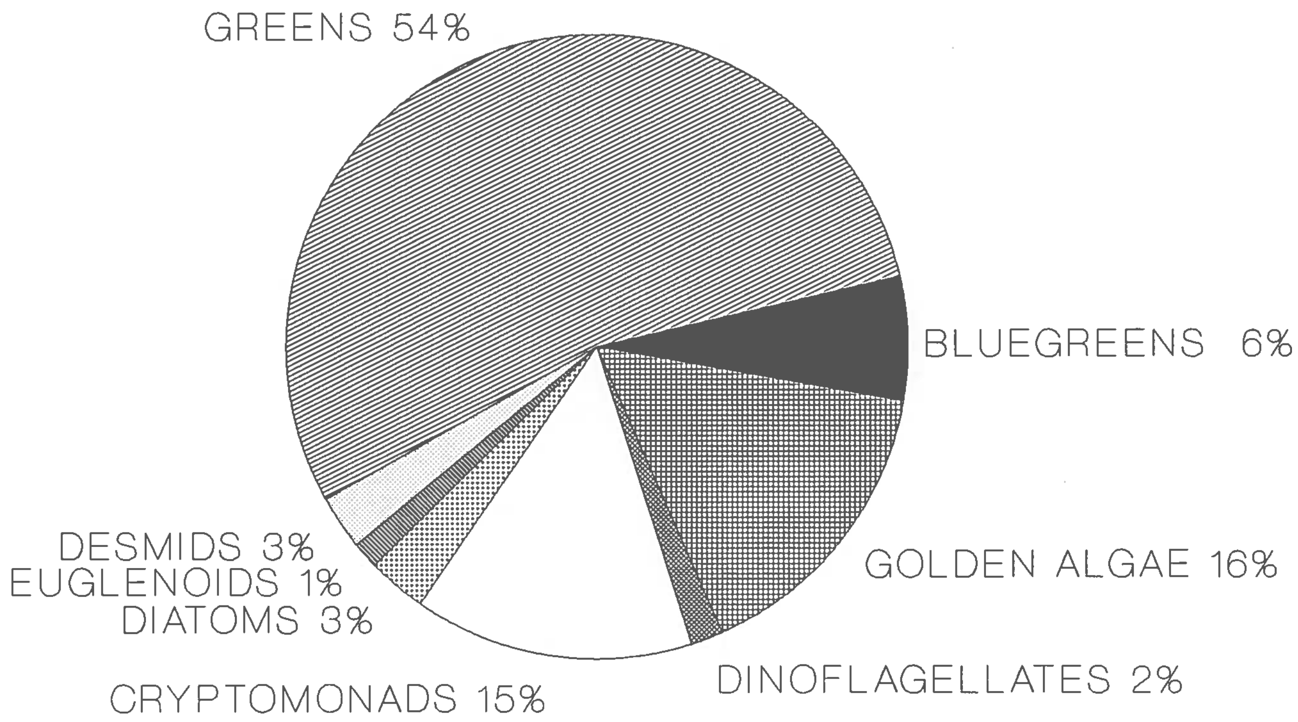


Figure 13 - Pie diagram of Macro-Zooplankton Diversity by organism for Baboosic Lake site 3 SHARKS 26 July 1988.

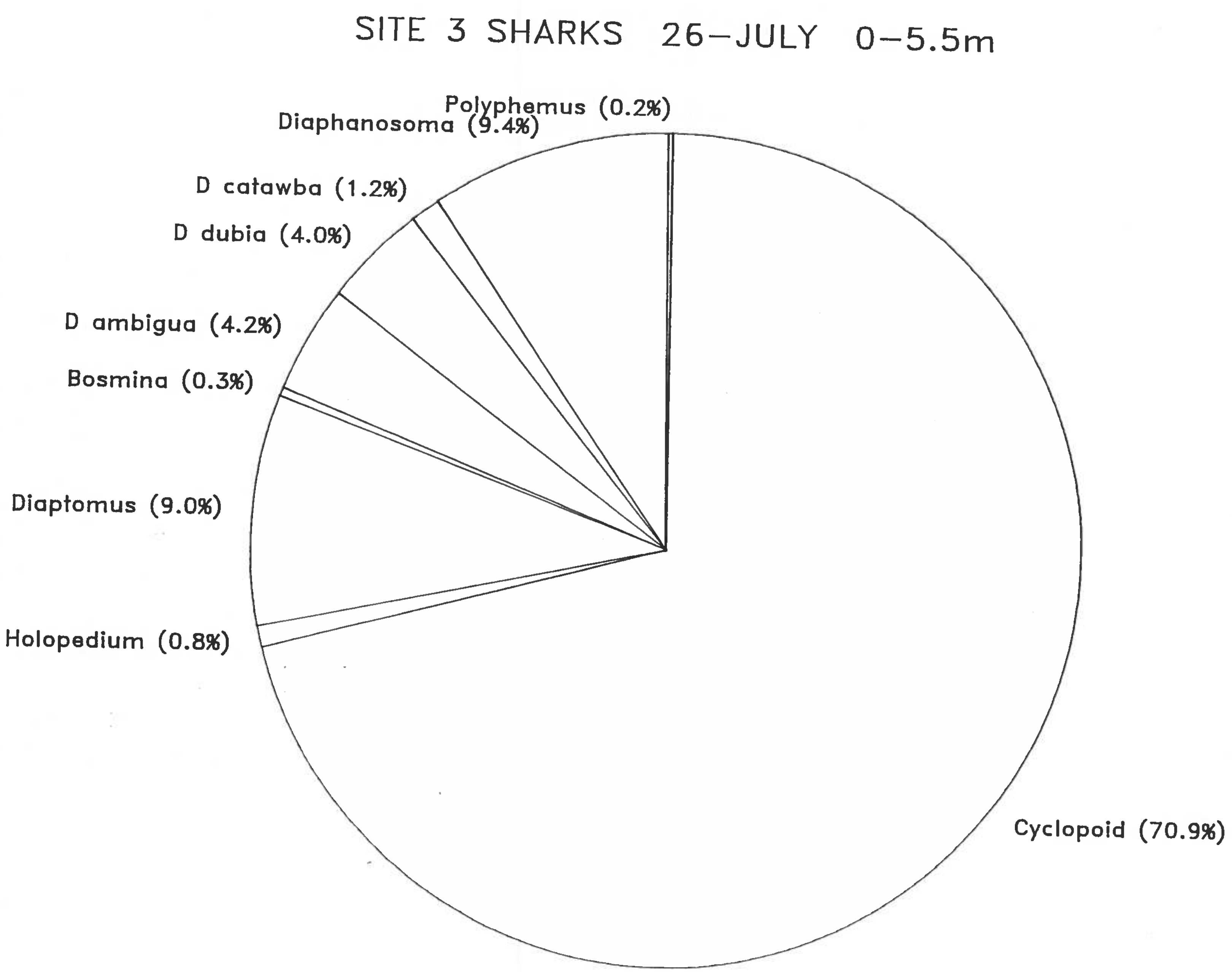
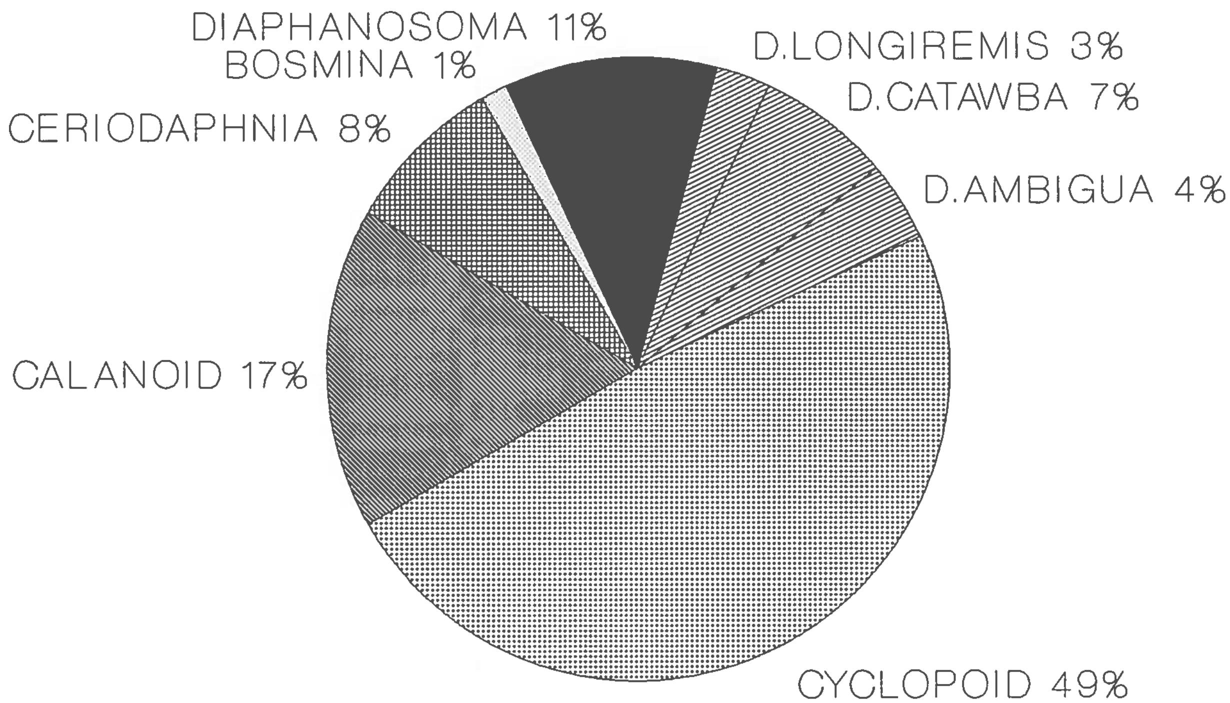

SITE 3 SHARKS 26-JULY 0-5.5m
Polyphemus (0.2%)
Diaphanosoma (9.4%)
D catawba (1.2%)
D dubia (4.0%)
D ambigua (4.2%)
Bosmina (0.3%)
Diaptomus (9.0%)
Holopedium (0.8%)
Cyclopoid (70.9%)

Figure 14 - Pie diagram of Macro-Zooplankton Diversity by organism for Baboosic Lake site 3 SHARKS 10 August 1989.

BABOOSIC 3 SHARKS 8/10/89
0-6 METERS



Baboosic Lake Data on file as of 04/17/1989

Lakes Lay Monitoring Program, U.N.H.

[Lay Monitor Data]

Baboosic Lake, New Hampshire
-- subset of trophic indicators, all sites, 1988

1988 SUMMARY

Average transparency:	4.3	(1988:	29	values;	2.0 -	5.7	range)
Average chlorophyll:	3.6	(1988:	29	values;	0.8 -	11.4	range)
Average phosphorus:	56.6	(1988:	13	values;	6.2 -	440.6	range)
Average alk (gray):	7.8	(1988:	17	values;	6.1 -	8.9	range)
Average alk (pink):	8.4	(1988:	17	values;	6.8 -	10.1	range)
Average color, 440:	38.5	(1988:	27	values;	12.0 -	55.8	range)

Site	Date	Trans-parency (m)	Chl a (ppb)	Total Phos (ppb)	Alk. (gray) ph 5.1	Alk. (pink) ph 4.6	Color Pt-Co units
1 Clarks	06/14/1988	3.7	1.7	---	---	---	47.2
1 Clarks	06/22/1988	2.5	1.2	---	---	---	---
1 Clarks	07/02/1988	2.0	1.0	---	---	---	50.7
1 Clarks	07/18/1988	3.5	1.7	---	---	---	38.7
1 Clarks	08/09/1988	4.0	2.1	---	---	---	49.8
1 Clarks	08/10/1988	3.0	0.9	---	---	---	55.8
2 Center	06/30/1988	5.3	0.9	---	---	---	---
2 Center	07/07/1988	5.2	6.0	---	---	---	25.5
2 Center	07/13/1988	4.6	5.6	---	---	---	45.3
2 Center	08/03/1988	4.1	3.6	---	---	---	40.4
2 Center	08/10/1988	4.4	11.4	---	---	---	40.4
3 Sharks	06/01/1988	2.6	7.4	---	6.1	6.8	49.6
3 Sharks	06/08/1988	3.4	5.3	---	6.9	7.2	35.8
3 Sharks	06/15/1988	4.0	3.1	---	6.4	7.2	36.7
3 Sharks	06/22/1988	4.4	3.9	---	6.8	7.3	41.8
3 Sharks	06/29/1988	5.4	2.9	---	7.0	7.4	32.4
3 Sharks	07/06/1988	5.2	4.6	---	7.1	7.6	32.4
3 Sharks	07/13/1988	4.0	4.2	---	7.4	8.4	34.1
3 Sharks	07/16/1988	---	---	15.7	---	---	---
3 Sharks	07/20/1988	4.6	4.6	---	7.5	8.1	28.1
3 Sharks	07/28/1988	4.5	5.2	---	8.2	9.2	39.5
3 Sharks	08/03/1988	4.1	6.3	---	7.9	8.4	43.8
3 Sharks	08/10/1988	4.5	3.1	---	8.5	8.3	37.8
3 Sharks	08/17/1988	4.0	3.7	---	8.5	9.0	38.7
3 Sharks	08/25/1988	5.5	2.8	---	8.5	9.3	36.9
3 Sharks	09/01/1988	4.8	3.5	---	8.5	9.2	37.8
3 Sharks	09/07/1988	5.0	2.9	---	8.8	9.6	12.0
3 Sharks	09/14/1988	5.7	3.1	---	8.9	10.1	34.4
3 Sharks	09/21/1988	5.0	0.8	---	8.8	9.6	37.8
3 Sharks	09/29/1988	4.7	1.6	---	---	---	36.1
6 Swamp	05/18/1988	---	---	13.9	---	---	---
6 Swamp	10/24/1988	---	---	68.8	---	---	---

Baboosic Lake Data on file as of 04/17/1989

Site	Date	Trans-parency (m)	Chl a (ppb)	Total Phos (ppb)	Alk. (gray) ph 5.1	Alk. (pink) ph 4.6	Color Pt-Co units
A Pavill	03/29/1988	---	---	30.6	---	---	---
A Pavill	05/18/1988	---	---	6.2	---	---	---
B BeavrBox	03/29/1988	---	---	9.7	---	---	---
C Outlet	10/24/1988	---	---	19.8	---	---	---
D1 Culvert	03/29/1988	---	---	7.7	---	---	---
D1 Culvert	05/18/1988	---	---	8.2	---	---	---
D1 Culvert	10/24/1988	---	---	91.9	---	---	---
D2 Surry	03/29/1988	---	---	9.0	---	---	---
D3 Stream	03/29/1988	---	---	440.6	---	---	---
E TwinCul	03/29/1988	---	---	13.5	---	---	---

<< End of 1988 listing, 42 records >>

BABOOSIC LAKE Data on file as of 02/05/1990

Lakes Lay Monitoring Program, U.N.H.

[Lay Monitor Data]

BABOOSIC LAKE, N.H. -- subset of trophic indicators, all sites, 1989

1989 SUMMARY

Average transparency:	3.6	(1989:	35	values;	2.5	-	4.9	range)
Average chlorophyll:	6.0	(1989:	35	values;	3.4	-	14.3	range)
Average phosphorus:	50.5	(1989:	23	values;	0.4	-	440.6	range)
Average alk (gray):	8.4	(1989:	15	values;	8.0	-	8.8	range)
Average alk (pink):	9.0	(1989:	15	values;	8.3	-	10.2	range)
Average color, 440:	42.8	(1989:	32	values;	29.8	-	65.9	range)

Site	Date	Trans-parency (m)	Chl a (ppb)	Total Phos (ppb)	Alk. (gray) ph 5.1	Alk. (pink) ph 4.6	Color Pt-Co units
1 Clarks	06/30/1989	2.8	8.5	---	---	---	54.7
1 Clarks	07/11/1989	2.5	9.1	---	---	---	53.0
1 Clarks	07/21/1989	2.5	14.3	---	---	---	47.8
1 Clarks	07/25/1989	2.8	5.6	---	---	---	47.0
1 Clarks	08/04/1989	3.5	5.4	---	---	---	37.5
1 Clarks	08/08/1989	3.3	4.5	---	---	---	---
1 Clarks	08/21/1989	3.8	3.8	---	---	---	34.1
1 Clarks	09/01/1989	4.0	5.3	---	---	---	35.0
1 Clarks	09/07/1989	3.3	7.1	---	---	---	34.1
1 Clarks	09/15/1989	3.3	7.0	---	---	---	33.3
1 Clarks	09/27/1989	2.5	4.8	---	---	---	40.1
1 Clarks	10/06/1989	2.8	7.3	---	---	---	50.4
2 Center	07/26/1989	3.3	6.1	---	---	---	47.0
2 Center	08/02/1989	3.1	4.1	---	---	---	---
2 Center	08/10/1989	3.5	3.4	---	---	---	31.5
2 Center	08/16/1989	3.2	4.3	---	---	---	35.8
2 Center	08/23/1989	3.5	3.8	---	---	---	42.7
2 Center	08/30/1989	4.4	5.6	---	---	---	35.8
2 Center	09/08/1989	4.5	5.1	---	---	---	33.3
2 Center	09/12/1989	4.9	6.5	---	---	---	35.0
3 Sharks	06/07/1989	3.7	5.2	---	8.8	10.2	59.0
3 Sharks	06/21/1989	3.7	10.6	---	8.6	9.6	55.6
3 Sharks	06/28/1989	3.4	6.1	---	8.5	9.0	65.9
3 Sharks	07/06/1989	3.1	6.4	---	8.0	8.3	58.2
3 Sharks	07/12/1989	3.8	4.9	---	8.0	8.6	53.9
3 Sharks	07/18/1989	3.5	8.2	---	8.8	8.9	47.0
3 Sharks	07/26/1989	3.5	6.2	---	8.6	9.3	43.6
3 Sharks	08/02/1989	---	6.9	---	8.1	8.8	43.6
3 Sharks	08/10/1989	4.5	5.1	---	8.0	8.5	32.4
3 Sharks	08/16/1989	3.2	4.2	---	8.1	8.6	---
3 Sharks	08/23/1989	3.2	4.4	---	8.0	8.5	39.3
3 Sharks	08/30/1989	4.3	5.6	---	8.5	9.1	29.8
3 Sharks	09/08/1989	4.7	4.6	---	8.6	9.2	36.7

BABOOSIC LAKE Data on bab89 as of 02/05/1990

Site	Date	Trans-parency (m)	Chl a (ppb)	Total Phos (ppb)	Alk. (gray) ph 5.1	Alk. (pink) ph 4.6	Color Pt-Co units
3 Sharks	09/12/1989	4.8	3.7	---	8.1	9.2	34.1
3 Sharks	09/22/1989	4.6	---	---	---	---	---
3 Sharks	10/25/1989	4.8	4.9	---	8.6	9.4	42.7
A	08/18/1989	---	---	8.4	---	---	---
A Pavill	03/29/1989	---	---	30.6	---	---	---
A Pavill	04/12/1989	---	---	5.3	---	---	---
A Pavill	10/27/1989	---	---	54.2	---	---	---
B	08/18/1989	---	---	11.0	---	---	---
B Beavrbox	10/27/1989	---	---	7.7	---	---	---
B Inlet	04/12/1989	---	---	10.8	---	---	---
B Inlet	05/18/1989	---	---	241.4	---	---	---
D1	08/18/1989	---	---	56.9	---	---	---
D1 Culvert	04/12/1989	---	---	1.8	---	---	---
D1 Culvert	10/27/1989	---	---	5.5	---	---	---
D2	08/18/1989	---	---	4.4	---	---	---
D2 Surry	03/29/1989	---	---	9.0	---	---	---
D2 Surry	04/12/1989	---	---	1.3	---	---	---
D2 Surry	10/27/1989	---	---	0.4	---	---	---
D3	08/18/1989	---	---	8.4	---	---	---
D3 stream	03/29/1989	---	---	440.6	---	---	---
D3 stream	04/12/1989	---	---	2.9	---	---	---
D3 stream	10/27/1989	---	---	13.2	---	---	---
E	03/29/1989	---	---	13.5	---	---	---
E	04/12/1989	---	---	34.8	---	---	---
E	08/18/1989	---	---	65.3	---	---	---
E	10/27/1989	---	---	133.6	---	---	---

<< End of 1989 listing, 59 records >>