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# POTENTIAL FOR ACIDIFICATION OF SIX REMOTE PONDS IN THE WHITE MOUNTAINS OF NEW HAMPSHIRE

Donald C. Buso  
*New York Botanical Garden*

C. Wayne Martin  
*University of New Hampshire*

James W. Hornbeck  
*University of New Hampshire*

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# POTENTIAL FOR ACIDIFICATION OF SIX REMOTE PONDS IN THE WHITE MOUNTAINS OF NEW HAMPSHIRE



**Donald C. Buso**

**C. Wayne Martin**

**James W. Hornbeck**

Water Resource Research Center  
University of New Hampshire  
Durham, New Hampshire

February, 1984

POTENTIAL FOR ACIDIFICATION OF SIX REMOTE  
PONDS IN THE WHITE MOUNTAINS OF NEW HAMPSHIRE

Donald C. Buso

C. Wayne Martin

James W. Hornbeck

Northeastern Forest Experiment Station

USDA Forest Service, Durham, NH 03824

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The COVER PHOTO shows Cone Pond, one of the six remote ponds discussed in this report. Cone Pond is widely publicized as one of the most acidic ponds in New Hampshire.

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Contents of this publication do not necessarily reflect the views and policies of the United States Department of the Interior, nor does mention of trade names or commercial products constitute their endorsement or recommendation for use by the United States Government.

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## ABSTRACT

Six remote ponds and their watersheds in the White Mountains of New Hampshire were mapped, and chemical characteristics of the ponds and inlet streams were measured to estimate susceptibility to acid precipitation. The methods used and data collected during 1980-82 are included for possible comparisons with future studies or for alternative analyses and interpretations. Although the ponds are within a 20-km radius of each other and seemingly have similar watershed characteristics and precipitation chemistry, the volume-weighted pH between ponds ranged from 4.5 to 6.4. Volume weighted alkalinity ranged from 0 to 144 ueq/l. Alkalinity was related to pH, basin morphology, production of hypolimnetic alkalinity, and chemistry of inlet streams. Historic pH and alkalinity data from these ponds are inadequate for determining if they are acidifying.

Volume-weighted  $\text{SO}_4^{2-}$  ranged from 70 to 170 ueq/l among the ponds. The ratios of divalent cations countering  $\text{SO}_4^{2-}$  suggest that weathering within the watersheds of the various ponds is an important factor in buffering acid precipitation and pond acidity. Volume-weighted total aluminum ranged from 0.10 to 0.60 mg/l. The most acidic ponds had the most total aluminum. The less acidic ponds appear to produce enough alkalinity and dissolved organic carbon to allow complexing of inorganic, toxic forms aluminum.

All ponds experienced short-term acidification in the upper water as a result of snowmelt events. Four models for predicting the susceptibility of the 6 study ponds to acidification worked poorly.

Each of the 6 ponds is unique and a broad approach at grouping them based on only one or two parameters is inadequate.



## INTRODUCTION

New Hampshire has more than 1,300 lakes and ponds, the majority of which are < 10 ha in surface area (NH State Planning Board, 1934). In the past few years, many of these lakes and ponds, especially those that are small, remote, and at higher elevations, have become susceptible to acid rain.

Anglers and backpackers have long been attracted to the more remote ponds because they provide unique esthetic and recreational experiences. The New Hampshire Fish and Game Department annually makes a substantial investment in stocking these ponds to meet the demand for an attractive fisheries resource. But this resource may be endangered by acid rain.

For New Hampshire towns that use ponds as a municipal water supply, there are concerns about the health effects from acidified water. Future projects of statewide importance may be impaired. For example, accelerated acidification of upland watersheds and ponds could be detrimental to efforts to reestablish a viable Atlantic salmon fishery in the upper Merrimack River Basin (Stolte, 1982).

These concerns point out a need to more clearly define current and potential effects of acid rain on New Hampshire's aquatic resources. We studied the susceptibility to acid rain of 6 remote ponds in the White Mountains. The chemical variability between these 6 ponds, and within each pond over time, was investigated. This approach has not been used in past studies of New Hampshire ponds.

Each of the 6 study ponds was less than 5 ha in area and had a watershed area less than 200 ha. Pond volumes ranged from  $85 \times 10^3 \text{ m}^3$  to  $111 \times 10^3 \text{ m}^3$ . Inlets were either first- or second-order streams. All ponds were remote, with no paved roads, or permanent human inhabitants within

their catchments. Volume-weighted alkalinity ranged from 0 to 144 ueq/l; volume-weighted pH ranged from 4.5 to 6.4.

Each pond had a viable fish population within recent history. More than 200,000 fish have been stocked in the study ponds since 1946,<sup>1/</sup> and more than 20 miles of trails and forest roads have been constructed and maintained in part to afford the public access to these remote recreational areas.<sup>2/</sup> Appendix A includes descriptions and maps of each pond and watershed.

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<sup>1/</sup> New Hampshire Fish and Game Commission, Concord, unpublished reports.

<sup>2/</sup> USDA Forest Service, Laconia, N.H., unpublished reports.

## OBJECTIVES

Precipitation in New Hampshire is acidic (Likens et al., 1977). Many ponds in the state are poorly buffered, and may be sensitive to acid precipitation. How seriously have these ponds been affected to date? How seriously are they likely to be affected in the future? This study has attempted to answer these questions by:

- 1) establishing a reliable and comprehensive record of limnological baseline data for future reference.
- 2) assessing the degree of acidification or potential for acidification of the 6 ponds by using the following indicators:
  - a) pH or  $H^+$
  - b) alkalinity
  - c) comparisons of historic and current data
  - d) specific conductance
  - e) sulfate loading
  - f) total aluminum concentrations
  - g) dissolved organic carbon
- 3) describing and quantifying the temporal and spatial changes in whole-pond chemistries associated with snowmelt events.

## METHODS

### Site Selection

In early 1980, reconnaissance was made of 14 ponds in the White Mountains using aerial photography and site visits. Analyses of water samples and field investigations indicated that 6 of the ponds covered a range of chemical, limnologic, hydrologic, and physiographic characteristics that would facilitate comparative studies, and be representative of ponds in the region. The 6 ponds -- Black, Black Mountain, Cone, East, Kiah, and Peaked Hill -- were clustered within a 20-km radius of the Hubbard Brook Experimental Forest in north-central New Hampshire (Fig. 1). Hubbard Brook served as the base of operations, and as the collection site of important supplemental information such as volume and chemical content of precipitation.

### Mapping

A perimeter map of each pond was developed from aerial photographs taken for the USDA Forest Service in 1978. Map scales were determined from on-site measurements of distances between objects obvious in the photographs. Color and color-infrared aerial photographs, from 2 sorties flown in 1982 for this project, were used to compile all recent changes in water level, aquatic vegetation, and water color. Final maps were composed with commercial photo layout equipment that includes unlimited scale-adjustment capacity.

The bathymetry of each pond was derived from multiple transects with a portable depth sounder (Lowrance LFP-300D).<sup>3/</sup> Frequent readjustment of gain and noise-suppression controls, repeated line soundings, and occasional sampling of bottom substrate provided an accuracy of  $\pm 0.5$  m in

UPPER PEMIGEWASSET RIVER WATERSHED

WHITE MOUNTAIN NATIONAL FOREST

NEW HAMPSHIRE

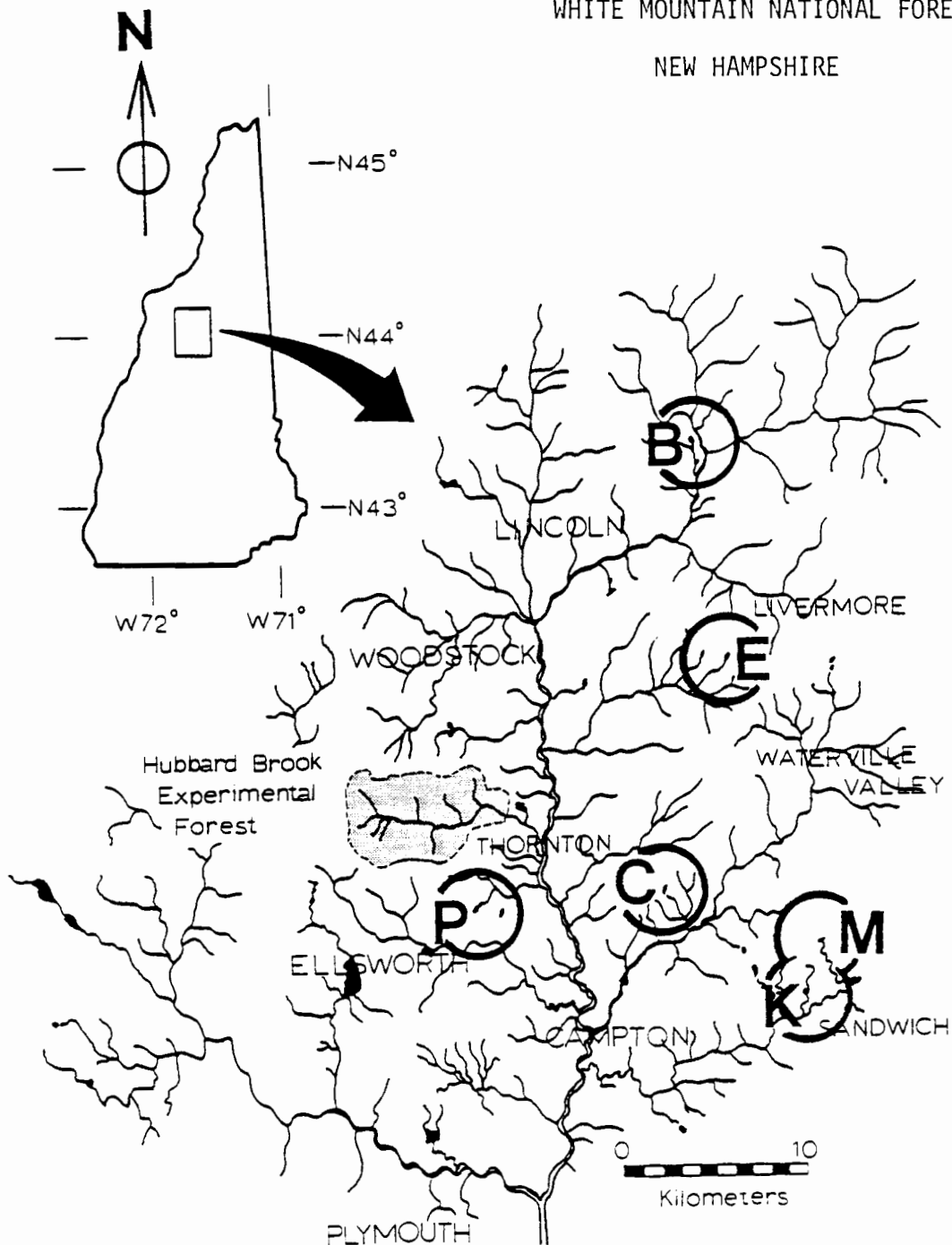


Fig. 1 Location of study ponds: Black Pond (B), Black Mountain Pond (M), Cone Pond (C), East Pond (E), Kiah Pond (K), and Peaked Hill Pond (P).

water between 1 and 15 m deep. Transects were approximately parallel and used landmarks identifiable on the detailed base maps for position triangulation. Depth contour maps were constructed from interpolation of the bathymetric data (Wetzel and Likens, 1979).

Color photos from 1978 and 1982 showed light extinction gradients from shallow to deep water in all but the most humic ponds. The observed photographic gradients agreed well with the bathymetry and were used to enhance the details of the depth contour maps.

From a mathematical model based on surface area, computed area of the strata, the number and size of the contour intervals, shoreline complexity, hypsographic form, and the distance between sounding tracks, the calculated "correct identification value" for the 6 ponds ranged from 0.906 to 0.991, or between 9 and 1% "area error" (Hakanson, 1978). This translates to a volume estimation error of no more than  $\pm 10\%$  for any of the ponds.

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<sup>3/</sup> The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an endorsement or approval of any product or service to the exclusion of others that may be suitable.



### Sampling Methods

Water samples were collected from 1 vertical profile in each pond, from selected streams and spring inlets, and from the outlets. The vertical sampling intervals for each pond were established by the bathymetric survey. Three to five samples were collected down each profile depending on pond depth (Appendix B). Pond samples were collected with a 4-liter Van Dorn bottle made of polyvinylchloride-polyethylene. The midpoint of the 50-cm-long Van Dorn sampler was used to establish the actual sampling point. The deepest samples were collected 50 cm above the bottom to prevent sample contamination by sediments.

Inlet, spring, and outlet samples were collected at riffles, waterfalls, and other sites of moving water, as close to the pond as practical. Each sample was collected in a 1-liter, acid-washed, polyethylene bottle. Upon return to the laboratory, a 500-ml aliquot was removed and frozen for later analyses. The remainder of the water sample was allowed to come to room temperature for analyses that were performed immediately.

During each visit, a temperature profile was developed and the Secchi disc transparency was measured. Temperature profiles were measured with a thermistor probe (Whitney, Yellow Springs, or Hydro-Lab instruments).<sup>3/</sup> A mercury-in-glass thermometer graduated in increments of 0.2°C was used to calibrate the probe, and for temperature measurements in the inlets and outlets. Transparency was measured with a 20-cm-diameter, plain white Secchi disc (Welch, 1948). A water scope was not used to reduce surface reflection. Morphometric and hydrologic characteristics for each pond and watershed are listed in Appendix A.

Volume-weighted average values were calculated for pH,  $H^+$ ,  $SO_4^{2-}$ , alkalinity, and total aluminum. To obtain these values, the bathymetric data for each pond were used to calculate volumes of water in the pond by a series of strata that were either 0.5 or 1.0 m deep. Concentration of chemical constituents for each stratum was obtained from profiles constructed by depth. If no sample was collected within a stratum, linear interpolations were made from the concentration profile. Volume-weighted values (mg) for each stratum were obtained by multiplying estimated concentrations (mg/l) from the interpolations times the water volume of the stratum. Volume-weighted average concentrations for the pond were calculated by dividing the sum of the volume-weighted values from each stratum by total volume of the pond.

#### Analytical Methods

The following analyses were performed at the Hubbard Brook Experimental Forest Laboratory in West Thornton, New Hampshire: pH, specific conductance, alkalinity, total dissolved aluminum, total dissolved iron, dissolved organic carbon, total organic carbon, dissolved inorganic carbon, dissolved oxygen, and oxygen saturation.

The following analyses were performed at the Forestry Sciences Laboratory, Durham, New Hampshire:  $Ca^{2+}$ ,  $Mg^{2+}$ ,  $K^+$ ,  $Na^+$ ,  $Cl^-$ ,  $NO_3^-$ ,  $NH_4^+$ , and  $SO_4^{2-}$ .

pH

All pH determinations were made in the laboratory. Field measurements were impractical, especially during extreme winter conditions. Measurements were made potentiometrically with an Orion Research Model 407A

meter and glass pH and reference electrodes (Orion Research, 1977). The unit was calibrated for each sample set with commercially prepared buffers of pH 7.0 and 4.0. The stability of the electrodes was tested weekly with a sample of de-ionized water brought to equilibrium with CO<sub>2</sub> by aeration (a theoretical pH of 5.6), and against a prepared dilute solution of H<sub>2</sub>SO<sub>4</sub> and HNO<sub>3</sub> with a theoretical pH of 4.3 (Galloway et al, 1979; NADP, 1982a).

Samples were allowed to come to room temperature for measurements of pH and alkalinity. If the determination could not be made within a few hours of return to the laboratory, samples were refrigerated at 4°C until the analysis could be performed, usually within 16 hours. Samples were swirled gently as the electrodes were immersed, but were not stirred thereafter. Readings were taken after about 5 minutes. Samples were neither purged with nor measured under an inert gas. Thus, CO<sub>2</sub> loss may have elevated pH slightly.

Conversion of pH to H<sup>+</sup> concentration for use in the ion balances was assumed to be  $H^+_{ueq/l} = 10^{-pH} \times 10^6$ .

Since the pH meter readings had a reproducibility of better than ± 0.05 units, the accuracy of the H<sup>+</sup> estimation probably was no worse than ± 10% over the range 0.1 to 100 ueq/l (pH 7 to pH 4) (Weber and Stumm, 1963).

#### Specific Conductance

Specific conductance was measured with a Beckman conductivity bridge (Model No. RC 15B2), and a Beckman platinum conductivity cell with a constant of 0.1. The unit was checked weekly with a prepared KCl solution of known conductance (NADP, 1982a). All readings were corrected to 25°C. Reproducibility was ± 1% between 10 and 50 uS/cm.

## Alkalinity

Alkalinity was determined by potentiometric titration; the equipment was the same as for the pH analysis. Each 50-ml sample was titrated with 0.010 N H<sub>2</sub>SO<sub>4</sub>, dispensed from a micropipette in 0.025-ml aliquots. End points were picked from the plot of the change in pH divided by the change in titrant, against the total titrant (Barnes, 1964). The following equation was used to calculate alkalinity (Barnes, 1964):

$$\text{ueq/l Alkalinity} = \frac{\text{volume Titrant} \times \underline{N} \text{ Acid} \times 50,000 \times 20}{\text{volume sample}}$$

All initial pH readings were < 7, so alkalinity was assumed to be equal to the HCO<sub>3</sub><sup>-</sup> concentration. No attempt was made to estimate the acid neutralizing capacity of any species other than those of the carbonate system (Weber and Stumm, 1963).

Analysis of fresh and stored samples showed essentially no change in end point pH or alkalinity. Reproducibility was about  $\pm 5$  ueq/l in the range 0 to 100 ueq/l, and about  $\pm 10$  ueq/l in the range 100 to 300 ueq/l alkalinity.

## Calcium, Magnesium, Potassium, Sodium

Ca<sup>2+</sup>, Mg<sup>2+</sup>, K<sup>+</sup>, and Na<sup>+</sup> were determined using flame atomic absorption spectrophotometry on a Perkin-Elmer Model 603. Methods and standards are detailed in the manufacturers handbook (Perkin-Elmer, 1974). A 2% solution of LaO<sub>2</sub> in HCl was used on a split aspirator, with constant feed, to reduce interference with Ca<sup>2+</sup>. Reproducibility in the range 0 to 100 ueq/l was about  $\pm 5\%$  for Mg<sup>2+</sup>, K<sup>+</sup>, and Na<sup>+</sup>, and about 10% for Ca<sup>2+</sup> in the range 0 to 300 ueq/l.

#### Ammonium

$\text{NH}_4^+$  was determined on a Technicon AutoAnalyzer II; the formation of indophenol blue from the Berthelot Reaction was used to detect the presence of an  $\text{NH}_4^+$  salt (Technicon Instruments, 1973). Reproducibility was about  $\pm 5\%$  for the range 0 to 50 ueq/l. Samples often were frozen for extended periods before analysis. The delayed determination of  $\text{NH}_4^+$  from highly stratified pond waters may result in an underestimate because of gradual oxidation (APHA, 1976).

#### Chloride

$\text{Cl}^-$  was determined on a Technicon AutoAnalyzer II; the production of ferric thiocyanate was used as an indirect measure of the formation of mercuric chloride in the presence of ferric nitrate and mercuric thiocyanate (Technicon Instruments, 1973). Reproducibility was about  $\pm 10\%$  in the range 0 to 50 ueq/l.

#### Nitrate

$\text{NO}_3^-$  was determined on a Technicon AutoAnalyzer II with copper-cadmium column reduction of  $\text{NO}_3^-$  to  $\text{NO}_2^-$ , and the eventual measurement of azo dye production by colorimetry (Technicon Instruments, 1973). Samples were kept frozen until the analysis was performed. Reproducibility was about  $\pm 10\%$  in the range 0 to 50 ueq/l.

#### Sulfate

$\text{SO}_4^{2-}$  was determined by colorimetric analysis on a Technicon AutoAnalyzer II. Several modifications of the standard methylthymol blue color reduction method were used to prevent calibration curve shifting, and

to improve the stability of the light sensitive reagents (McSwain et al., 1974). Reproducibility was about  $\pm 5\%$  in the range 0 to 200 ueq/l.

#### Total Aluminum

Total aluminum was determined on a Spectronic 20 spectrophotometer (Bausch and Lomb, 1964) by measuring the absorbance of an aluminum-quinoline sulfonic acid complex (Ferron) at a wavelength of 370-nm (Rainwater and Thatcher, 1960). Orthophenanthroline was added to reduce the interference from, and to analyze for, dissolved iron. An iron interference curve at 370-nm was developed to prepare a correction factor for the total aluminum absorption values.

In general, the iron correction value was no more than 5% of the total aluminum value. However, samples from waters low in dissolved oxygen often had an iron correction that amounted to nearly 50% of the calculated aluminum concentration. In the presence of more than 1.0 mg/l iron, the value for the true total aluminum concentration should be regarded as approximate. Color corrections were necessary and often very significant in waters with a humic appearance because humic compounds absorb light at the 370-nm wavelength (Wetzel, 1975).

Because determinations could not be performed immediately, each sample was acidified with ultrapure 15 N HNO<sub>3</sub> to approximately pH 3.0, about 12 hours before analysis. Adding more HNO<sub>3</sub> to a pH of 2.0 increased the aluminum yield in all cases. However, the procedure resulted in instability of the sodium acetate buffer. At a minimum, the analysis probably represents the total monomeric aluminum present (both organic and inorganic), but is not a measure of all the aluminum forms, including the slowly reactive colloidal and particulate fractions (Driscoll, 1982). The



data are reported as total aluminum, in mg/l, because accurate determination of the charged aluminum species was not possible. The lower detection limit of the analysis was 0.01 mg/l, with reproducibility of  $\pm 5\%$  in the range 0 to 1.0 mg/l.

#### Total Iron

Total iron was determined on a spectrophotometer (Bausch and Lomb, 1964) by measuring the absorbance of an iron-orthophenanthroline complex at a wavelength of 520-nm (Rainwater and Thatcher, 1960). The analysis was run simultaneously with the aluminum determination. Color corrections at 520 nm were negligible. Samples were acidified to approximately pH 3.0 with ultrapure 15 N HNO<sub>3</sub>. Except for samples from anoxic waters, the analysis values should be regarded as total iron. The ferrous iron present under anoxic conditions would have precipitated as Fe(OH)<sub>3</sub> during storage. Acidification to pH 3.0 did not bring all of the Fe(OH)<sub>3</sub> back into solution, so total iron values for samples from reducing environments are underestimates (APHA, 1976).

The detection limit was 0.01 mg/l, with reproducibility of  $\pm 5\%$  in the range 0 to 2.0 mg/l.

#### Dissolved Organic Carbon

Samples for dissolved organic carbon (DOC) were filtered through ashed Whatman GF/F filters (minimum retention size is 0.7 um) immediately upon return to the laboratory, and sealed in precombusted ampoules with persulfate, for digestion in an autoclave (Menzel and Vaccaro, 1964). After persulfate digestion, the sample was extracted by syringe and stripped with helium gas; the carbon fraction (as CO<sub>2</sub>) was measured on a

gas chromatograph (Stainton, 1973). Standards were made from anhydrous D-glucose. Reproducibility for the analysis was about  $\pm 10\%$  in a range 0 to 20 mg/l. The lower detection limit was 0.05 mg/l carbon.

#### Total Organic Carbon

Procedures for total organic carbon (TOC) were the same as for DOC except that the samples were not filtered. Reproducibility was large, about  $\pm 20\%$  in the range 0 to 20 mg/l carbon, because it included digested fine particulate carbon and living seston.

#### Dissolved Inorganic Carbon

For the range of pH encountered in this study, dissolved inorganic carbon (DIC) is defined as the sum of the  $\text{CO}_2$  (or  $\text{H}_2\text{CO}_3$ ) and the  $\text{HCO}_3^-$  present (Weber and Stumm, 1963). Samples were collected in ground glass-stoppered bottles; the physical procedures used were the same as for dissolved oxygen. The bottles were kept sealed and refrigerated at  $4^\circ\text{C}$  upon return to the laboratory. The analyses were performed within 16 hours. Aliquots were extracted by syringe, acidified, and stripped with helium carrier gas; the carbon (as  $\text{CO}_2$ ) was measured on a gas chromatograph (Stainton, 1973). Standards were made from a  $\text{NaHCO}_3$  stock solution, and  $\text{CO}_2$  free water (less than 5  $\mu\text{M}/\text{l}$  DIC); DIC is expressed as mg/l in the data tables to make comparisons with DOC easier, though it is conventionally expressed as  $\mu\text{M}/\text{l}$  ( $\text{mg}/\text{l} = \mu\text{M}/\text{l} \times .012$ ). Reproducibility was  $\pm 5\%$  in the range 0 to 1000  $\mu\text{M}/\text{l}$ . The lower detection limit was 5  $\mu\text{M}/\text{l}$  DIC.

## Dissolved Oxygen

The Winkler method with the azide modification (APHA, 1976) was used to determine dissolved oxygen ( $\text{DO}_2$ ). Samples were collected with a Van Dorn sampler, in ground glass-stoppered bottles, following standard field procedure (Welch, 1948). The samples were acidified with  $\text{H}_2\text{SO}_4$  upon return from the pond and titrated immediately with a standardized solution of thiosulfate. The accuracy of the analysis was about  $\pm 0.1$  mg/l  $\text{DO}_2$ . The azide method is recommended for waters with less than 1 mg/l ferrous iron unless fluoride is added to prevent the liberation of free iodine due to the formation of iron oxide. Under near anoxic conditions, based on the figures for total iron, some of the  $\text{DO}_2$  data for the hypolimnion of Black Pond may be spuriously high (Appendix B).

## Dissolved Oxygen Saturation

Estimation of the percent saturation of the dissolved oxygen was based on a temperature-altitude-concentration nomograph (Wetzel, 1975). Accuracy was about  $\pm 1\%$ ; saturations below 10% were approximations.

## RESULTS AND DISCUSSION

### Baseline Data Collection

One objective of this study was to establish well-documented, reproducible limnological records from several remote ponds to serve as baseline data. Such data are necessary for at least 3 reasons. First, there are little comprehensive data from which to determine the seriousness of lake acidification in New Hampshire. Second, standardization of data collection, analyses, and reporting is needed to provide compatibility with other regional studies. Third, published, reproducible data are necessary for time-trend analyses in long-term studies of acidification.

### Indicators of Acidification

Each of the 6 study ponds is unique and complex. Attempts to lump them into a pattern of regional susceptibility to acidification (for example, Omernik and Powers, 1982) may be of little use to local managers. Instead, ponds must be viewed individually in their ability to buffer acid inputs. We illustrate this by examining 7 parameters that might serve as indicators of acidification.

pH or  $H^+$

pH and its conversion to  $H^+$  probably are the most used and recognized indicators of acidification. Determination of pH is relatively easy, though accuracy can be a problem depending on methods (APHA, 1976; Galloway et al., 1979). To characterize the pH or  $H^+$  of a pond accurately, determinations must be made throughout the vertical profile, and over time to encompass seasonal and annual variability. In the following section we

report volume-weighted values that take into account the variability in pH with depth.

pH varied considerably between ponds, and within each pond over time and with depth. The volume-weighted pH of Black Pond ranged from 5.3 to 6.4; the range for East Pond was 5.3 to 6.3, for Peaked Hill 5.1 to 6.1, for Black Mountain Pond 5.1 to 6.0, for Kiah Pond 4.5 to 6.2, and for Cone Pond 4.5 to 4.8 (Figs. 2-7). All ponds showed seasonal cycles, generally being most acidic during late winter and early spring and least acidic during late summer and autumn. Even the most acidic Cone Pond clearly demonstrated this trend. The seasonal trend seemed to be caused by inputs of acidic snowmelt in the spring (see section on acidic snowmelt episodes). The depression in pH for Black Pond, Peaked Hill Pond, and Kiah Pond in April 1982, are extreme examples of snowmelt effects (Figs. 2, 6, 7).

Since the pH scale is logarithmic, large differences in pH may not indicate large differences in  $H^+$ . For example, Black, Black Mountain, East, and Peaked Hill Ponds had volume-weighted pH ranges of approximately 1 pH unit. However, because the pH values were relatively high ( $> 5.0$ ),  $H^+$  was always less than 10 ueq/l and relatively uniform over time. At the other extreme, the range in volume-weighted pH for Cone Pond was only 4.5 to 4.8, but this represents  $H^+$  of 16 to 32 ueq/l, or a much greater range in acidity. Figures 8 and 9 illustrate this concept for Black and Cone Ponds.

There were important variations in pH with depth (Appendix B). In late winter and early spring, the water immediately under the ice was more acidic than lower in the water column. Acidification near the surface likely resulted from additions of acid snowmelt to the pond. The bottom

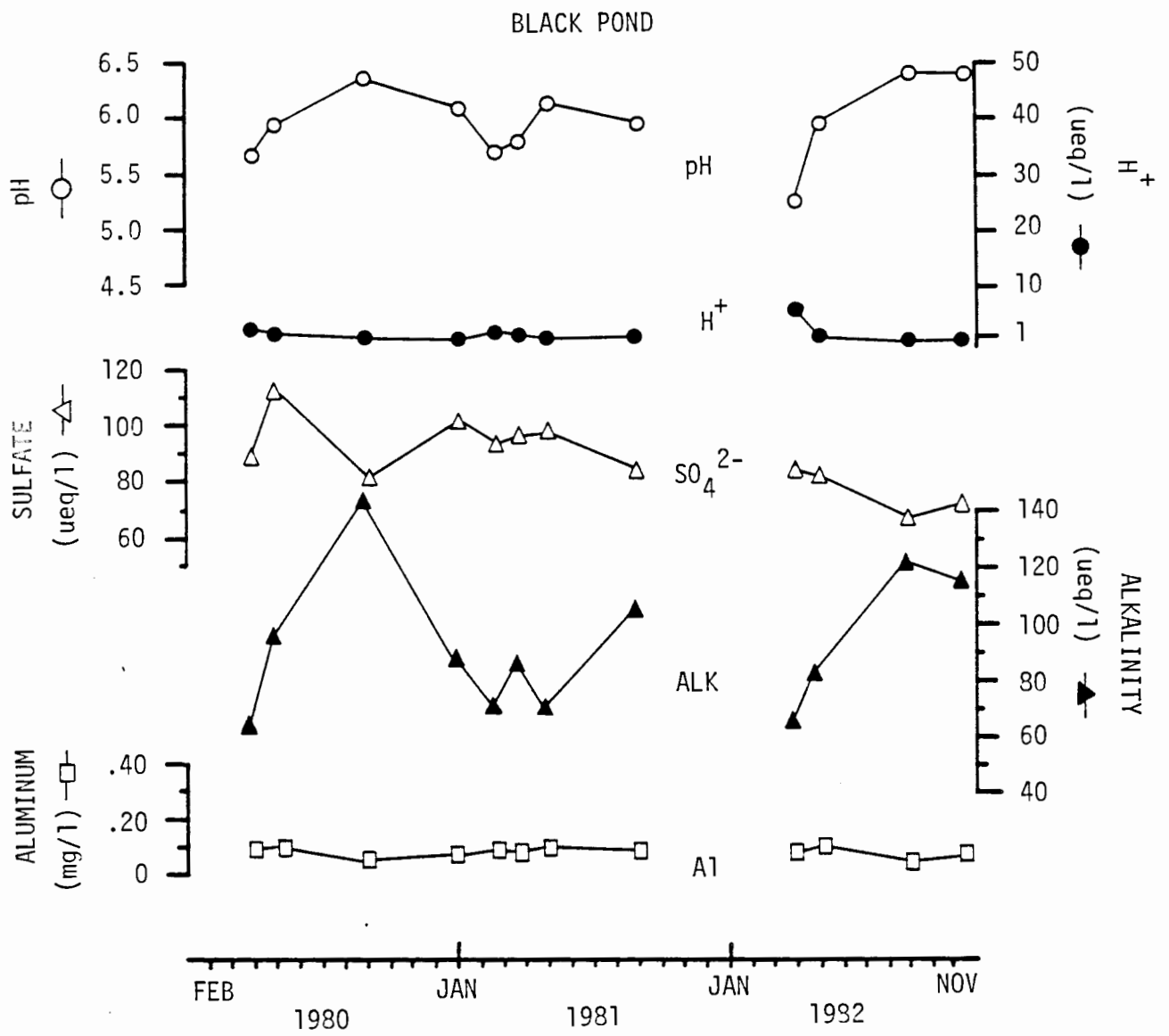


Fig. 2 Volume-weighted average pH, hydrogen ion, sulfate, alkalinity, and aluminum in Black Pond.



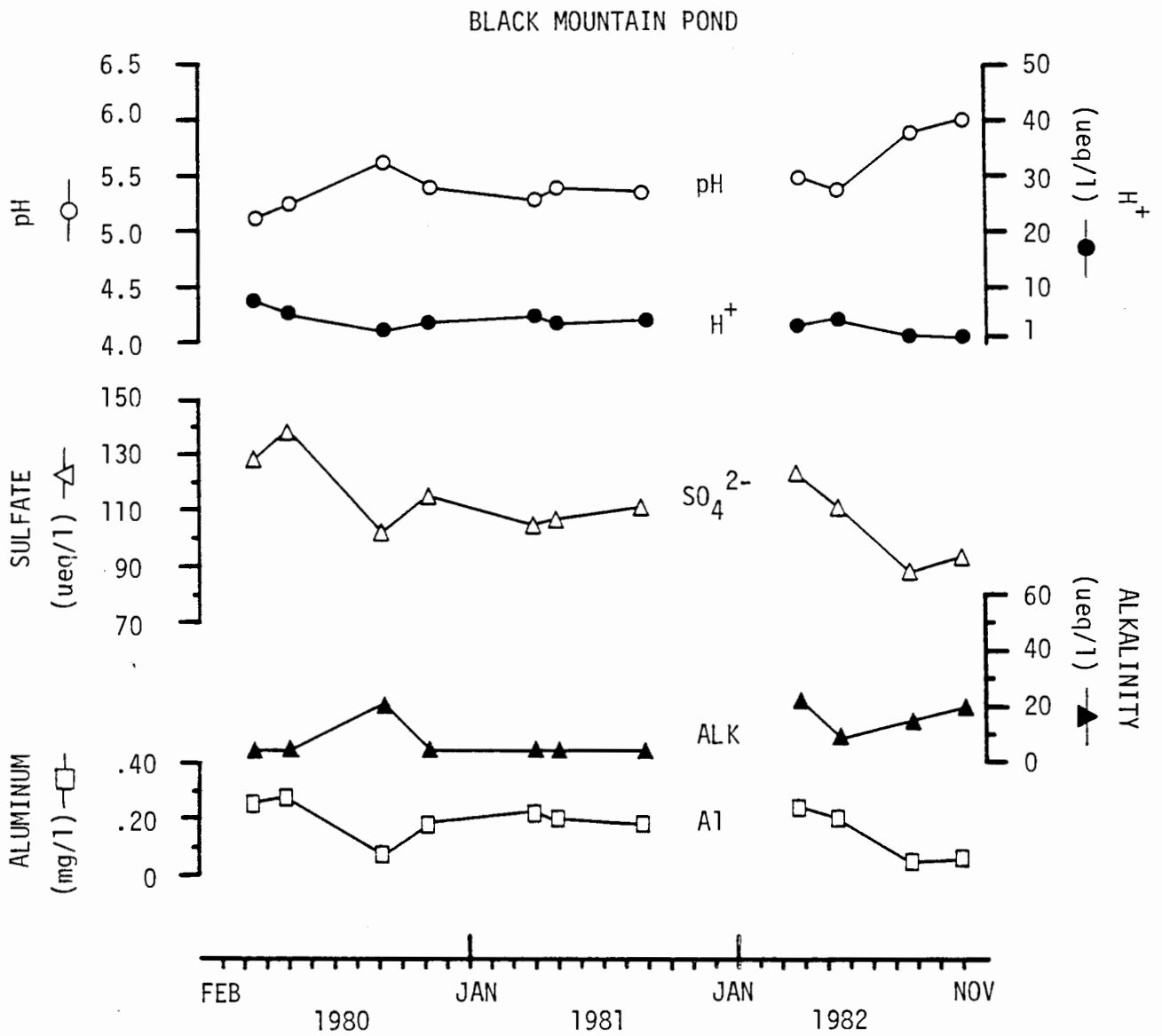


Fig. 3 Volume-weighted average pH, hydrogen ion, sulfate, alkalinity, and aluminum in Black Mountain Pond.

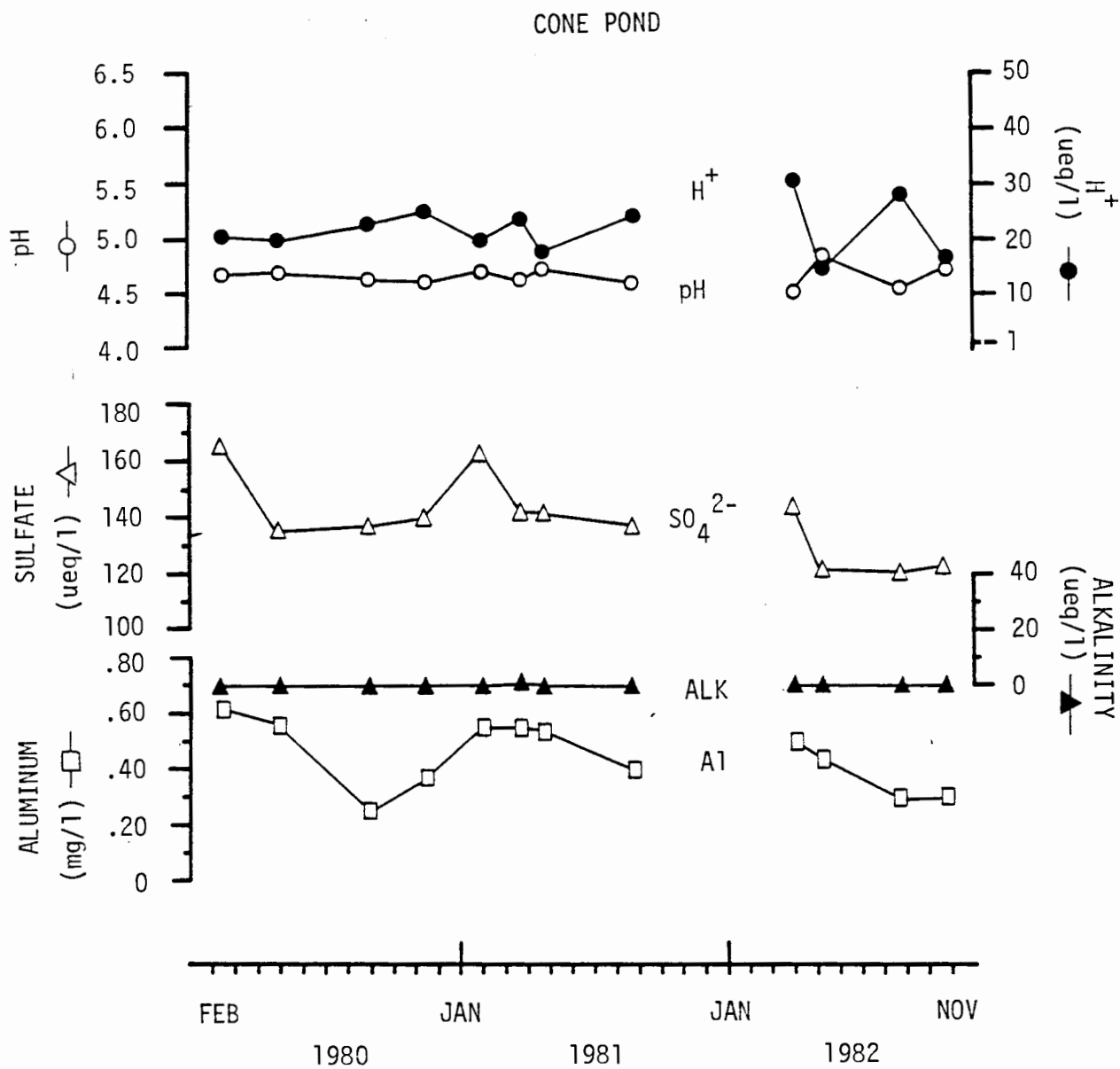


Fig. 4 Volume-weighted average pH, hydrogen ion, sulfate, alkalinity, and aluminum in Cone Pond.

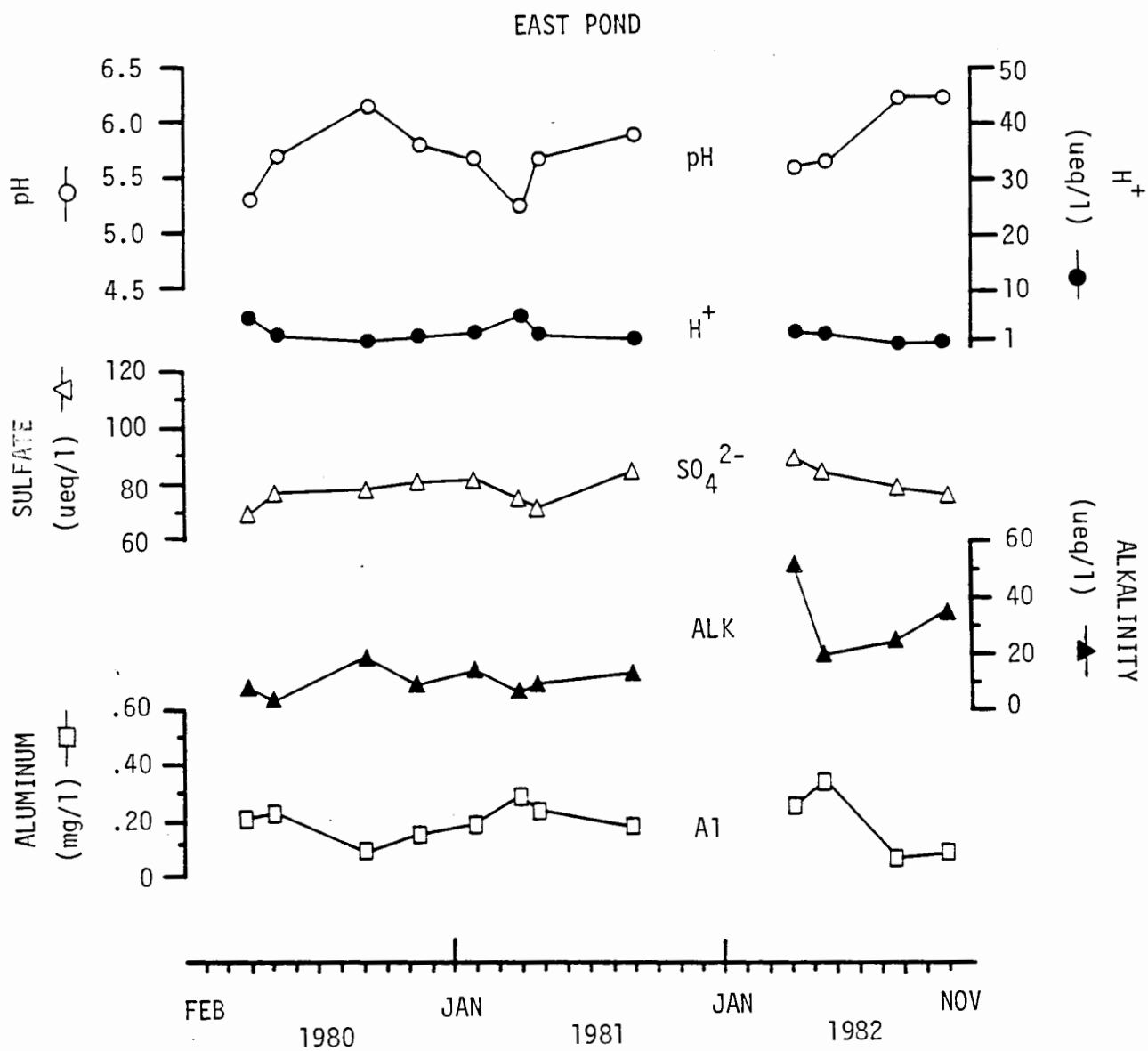


Fig. 5 Volume-weighted average pH, hydrogen ion, sulfate, alkalinity, and aluminum in East Pond.

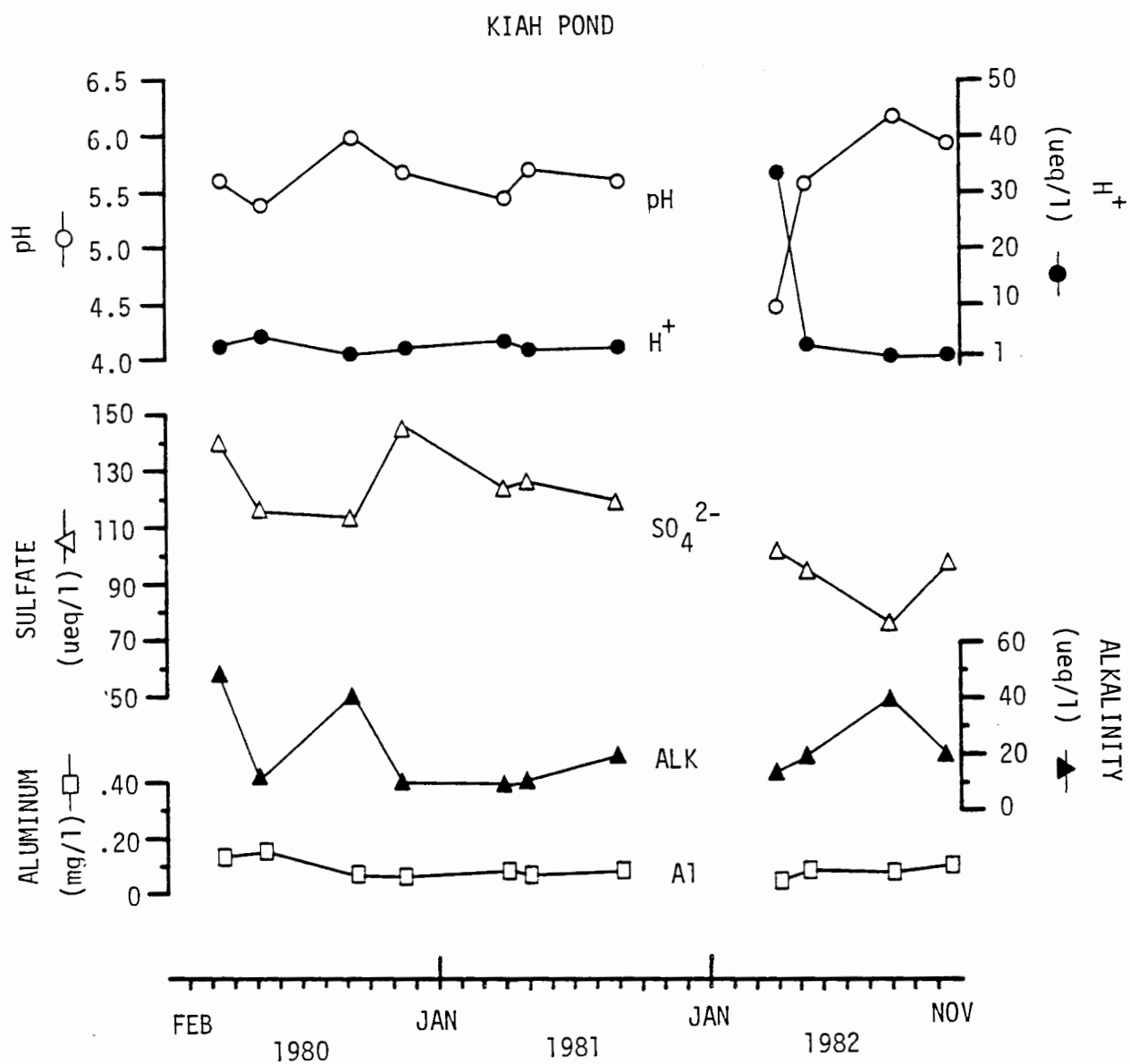


Fig. 6 Volume-weighted average pH, hydrogen ion, sulfate, alkalinity, and aluminum in Kiah Pond.

PEAKED HILL POND

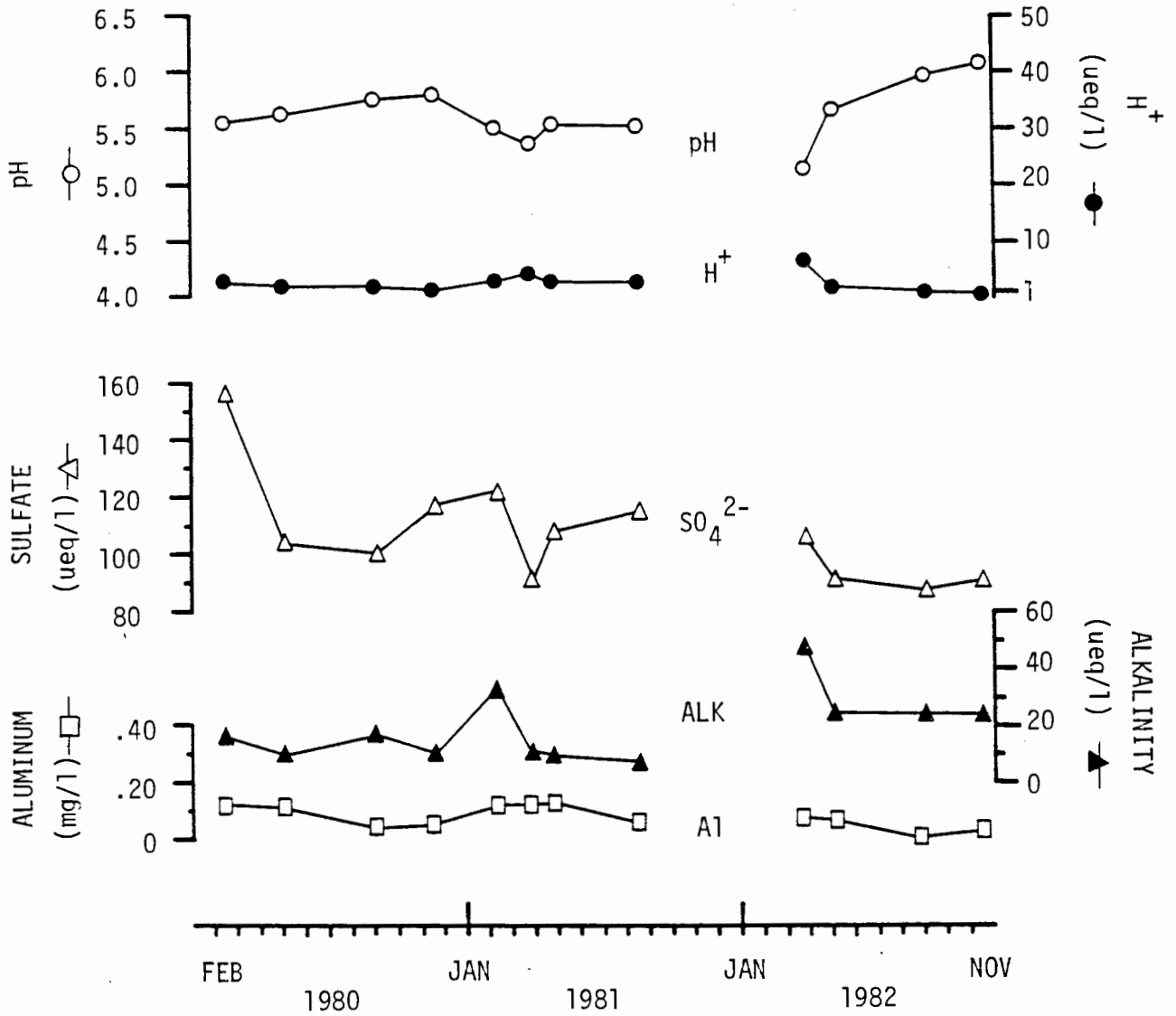


Fig. 7 Volume-weighted average pH, hydrogen ion, sulfate, alkalinity, and aluminum in Peaked Hill Pond.

waters were less acidic under stratification, and with anoxic conditions, during late spring and early summer. This was apparent in Black and Cone Ponds (Figs. 8-9). The neutralization of  $H^+$  in deeper waters may result from the production of hypolimnetic alkalinity in Black Pond, and even in acidic Cone Pond.

The ranges in pH and  $H^+$  have important biological implications. For example, the species present in Cone Pond must be able to tolerate changes in  $H^+$  concentrations of 10 to 20 ueq/l while those in Black Pond encounter a range of 1 to 5 ueq/l. Although pH and  $H^+$  do not indicate which ponds are likely to be acidified by precipitation, they do define the wide range of conditions in these ponds, which are in close proximity and seemingly have similar watershed characteristics.

#### Alkalinity

Alkalinity and its sources are of particular importance in the ability of a pond to buffer acid inputs such as in precipitation. The composition and amount of alkalinity are affected by pH, so it was not surprising to find a wide range of alkalinity values, correlating roughly with pH, in the study ponds. For example, the volume-weighted alkalinity (in ueq/l) was 63 to 144 for Black Pond, 8 to 49 for Peaked Hill Pond, 5 to 52 for East Pond, 9 to 48 for Kiah Pond, 5 to 22 for Black Mountain Pond, and 0 to < 1 for Cone Pond (Figs. 2-7). For all but acidic Cone Pond, volume-weighted alkalinity tended to be maximum under the most stratified conditions, either in late winter or late summer.

Other factors that may affect pond alkalinity include basin morphology, primary productivity, production of hypolimnetic alkalinity, and additions of alkalinity in inlet streams and springs. To illustrate

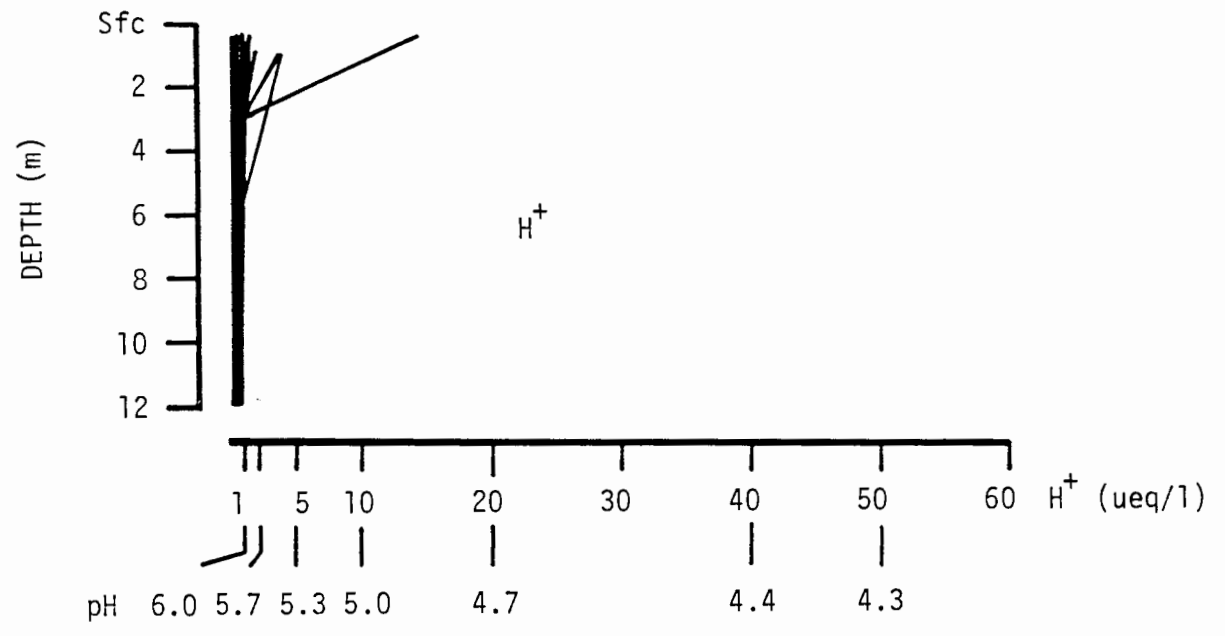
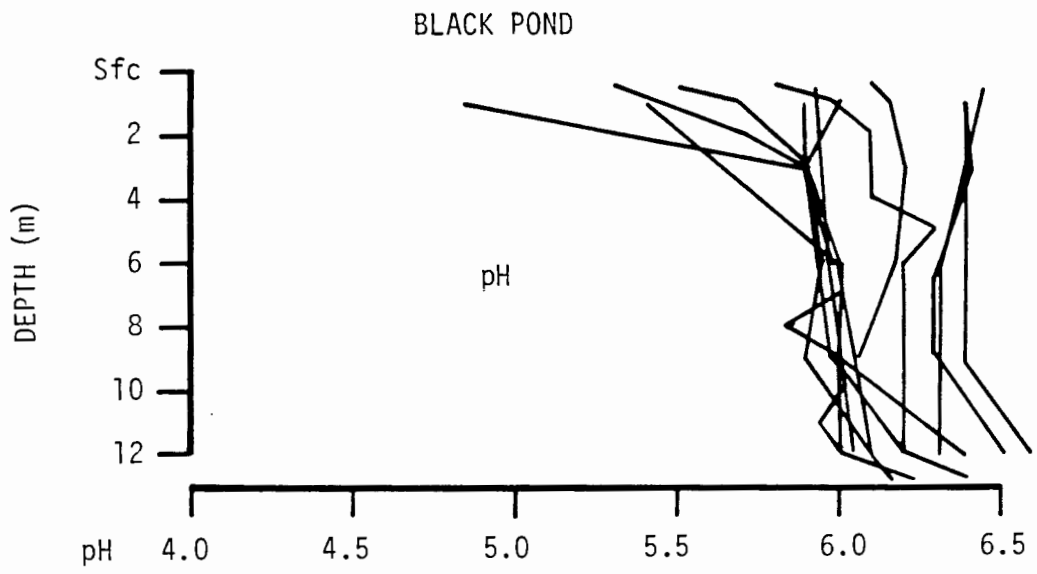


Fig. 8 Seasonal profiles of pH and  $H^+$  in Black Pond.

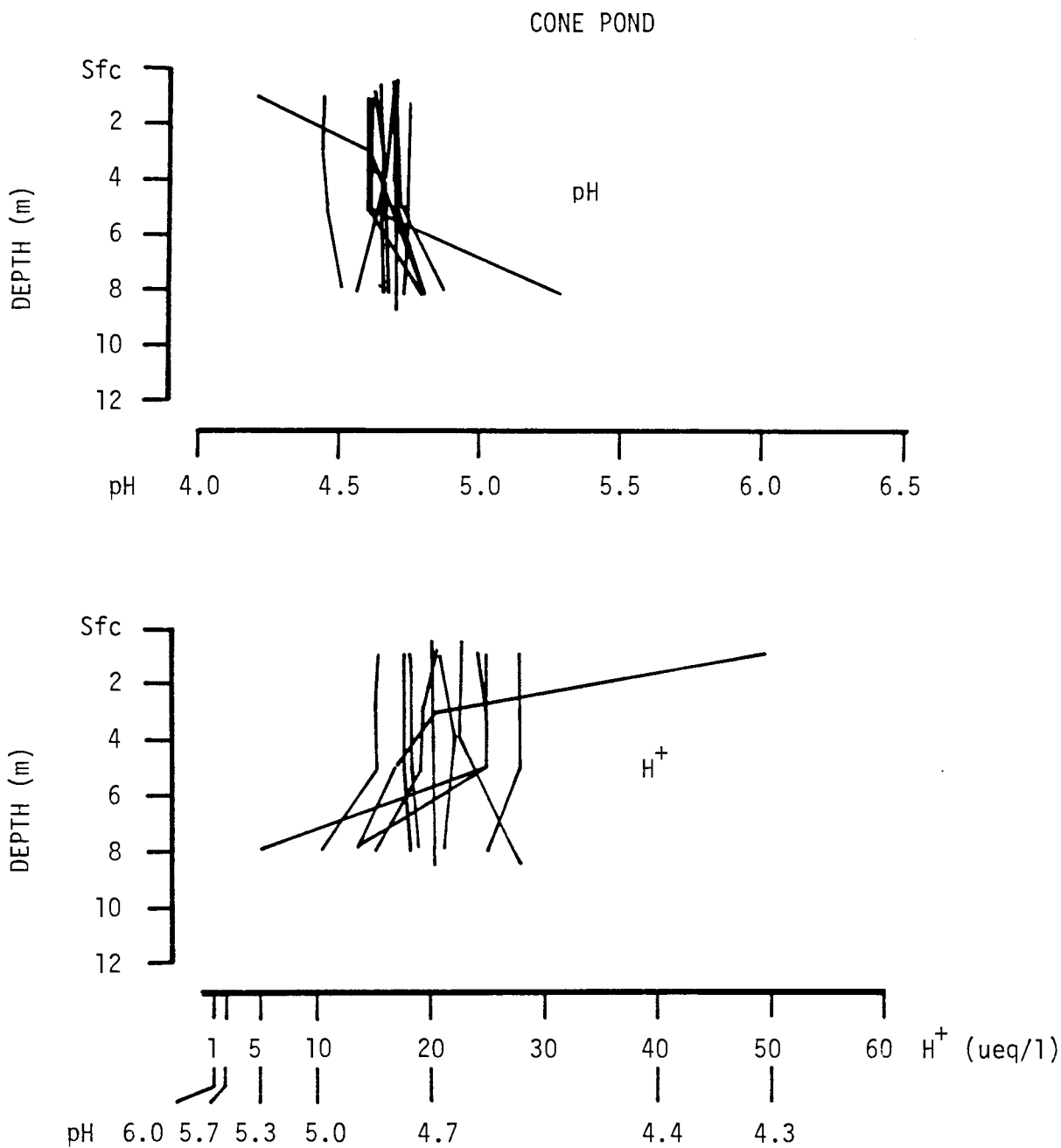


Fig. 9 Seasonal profiles of pH and H<sup>+</sup> in Cone Pond.



the potential effects of basin morphology, Black Pond had considerably greater alkalinity than Peaked Hill Pond (Fig. 10). These 2 ponds represent the hypsometric extremes for the 6 ponds; Black Pond had the maximum amount of deep water and Peaked Hill Pond had the minimum (Fig. 10). Because of its depth, Black Pond had a more stable stratification (Appendix B) and less flushing action, and thus appeared to store alkalinity much more effectively through the year than Peaked Hill Pond.

Pond depth and stratification are important to the generation of hypolimnetic alkalinity. For all ponds except Cone, alkalinity increased with depth during seasonal stratification. Black and Peaked Hill Ponds had maximum concentrations of alkalinity in the hypolimnion during winter stratification 1982 (Fig. 10 and Appendix B).

Increases in hypolimnetic alkalinity may be a result of the reduction of  $\text{SO}_4^{2-}$  and  $\text{NO}_3^-$ . This process may occur where sediment pore waters are anoxic, including the shallow sediments. A byproduct of this reduction is DIC (Schindler et al., 1980). Our study ponds clearly demonstrate the large increase in DIC under low  $\text{DO}_2$  (Fig. 11). Depending on the ambient pH, and on the availability of mobilized Fe to trap S, DIC may accumulate as  $\text{HCO}_3^-$  and increase the alkalinity (Schindler et al., 1980). Increases in total iron were found in most of the samples from low  $\text{DO}_2$  waters, and in conjunction with increases in alkalinity (Appendix B).

The accumulation of alkalinity is only possible in a well developed hypolimnion. This alkalinity is usually seasonal and is lost during the turnover of pond water. Peaked Hill Pond mixed completely and lost its winter buildup of alkalinity. Black Pond mixed poorly and continued to develop alkalinity from winter into summer (Fig. 10). Black Pond is the only one of the study ponds with potential for persistent alkalinity

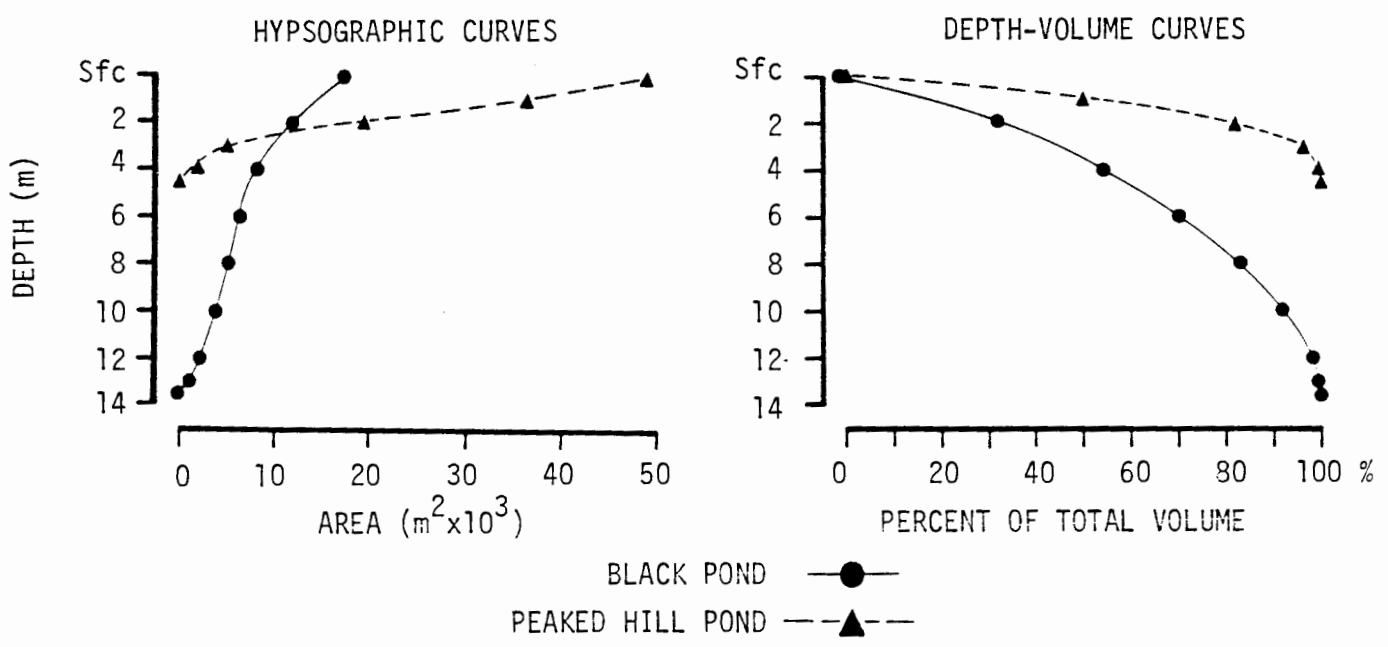
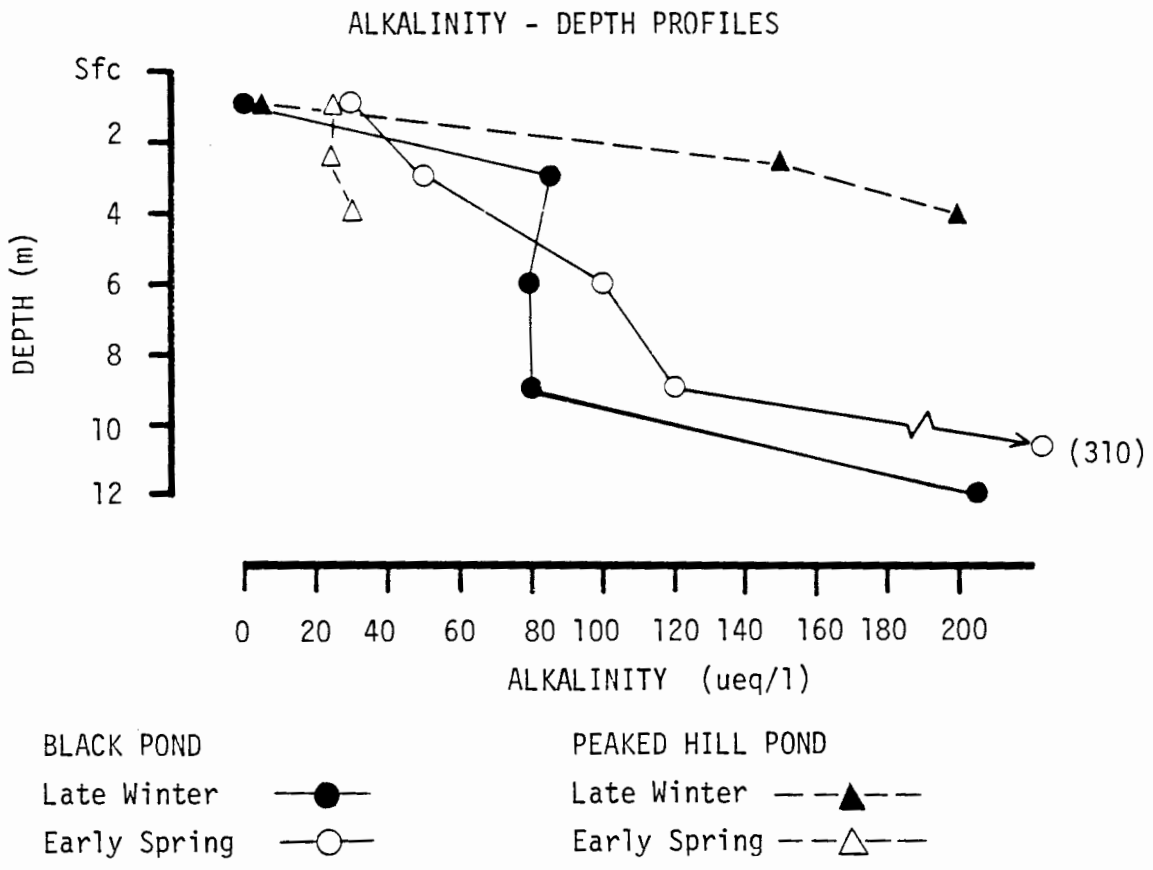


Fig. 10 Depth vs alkalinity, depth vs area, and depth vs volume of Black and Peaked Hill Ponds.

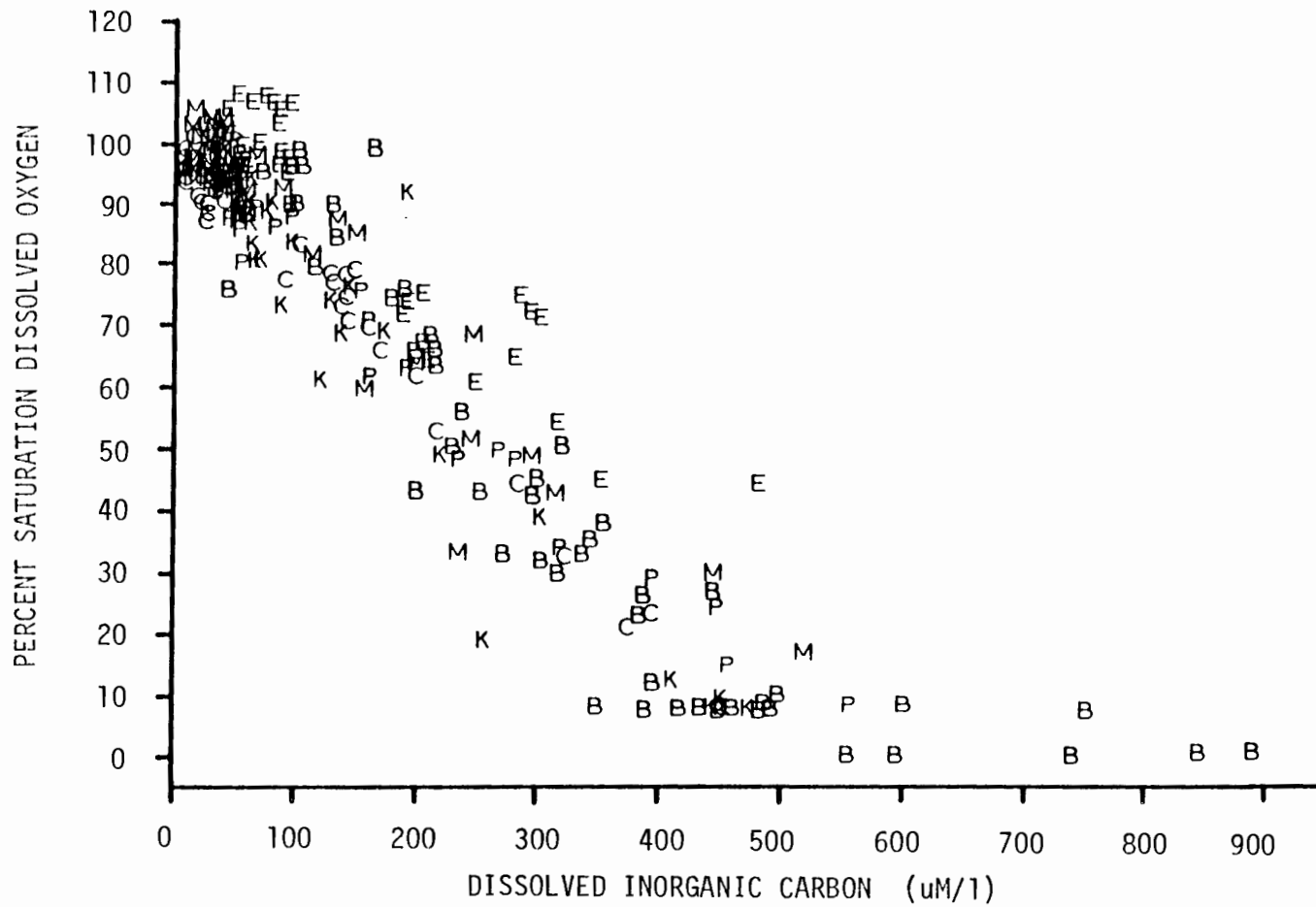


Fig. 11 Percent saturation of dissolved oxygen vs DIC. Percent saturation of  $DO_2$  below 10% is approximate. Abbreviations for ponds are same as for Figure 1.

production. The hypolimnetic samples from Black Pond often showed large increases in DIC and alkalinity, and  $DO_2$  was seldom above 10% saturation. This reducing condition encompassed up to 36% of the total sediment surface in winter, spring, and summer 1982 (Appendix B). On the basis of alkalinity, Black Pond seems best suited of the study ponds to counter acid precipitation.

Inlet streams may contribute important amounts of alkalinity to ponds. The inlet stream to Kiah Pond had summer alkalinity values ranging from 50 to 80 ueq/l. The surface springs of East Pond carried as much as 20 to 65 ueq/l alkalinity, even during snowmelt, when the concentrations in inlet streams were negligible. Inlet alkalinity to Black and Peaked Hill Ponds varied widely, ranging from 5 to 95 ueq/l. The inlet alkalinity to Black Mountain Pond ranged from 0 to 10 ueq/l while the inlet to Cone Pond had no detectable alkalinity. There is a need to quantify the volume of alkalinity being added by inlets, and to understand the disparity in alkalinity among inlet streams.

#### Comparison of Historic and Current Data

A logical possibility for identifying ponds susceptible to acid precipitation is to compare historic and current chemical data. If there is an increase in acidity, or a decline in alkalinity over several years, a pond may be showing effects of acid precipitation. Such comparisons and subsequent interpretations require caution.

Alkalinity and pH data are available for the study ponds from intermittent surveys conducted in New Hampshire since 1934. We plotted the historic data with some of our own (Figs. 12-17) to determine if there are discernible trends. We show only values for near-surface samples since they are the only consistently available sampling points.

Sample dates, time intervals, field crews, equipment, and analytical techniques varied greatly between most of the surveys. However, there is some documentation and it was possible to determine that before 1970 pH generally was determined colorimetrically with color comparator kits, while alkalinity was measured with a methyl orange titration (Davis, 1938; Newell, 1972).

Alkalinity Comparisons. Alkalinity titrations with methyl orange as an indicator of pH equivalence points are useful only in waters of high ionic strength, and moderate to high alkalinity (Weber and Stumm, 1963). In poorly buffered waters such as the study ponds, the analysis is prone to errors in end point detection because of variable light, natural water color, and operator bias. This technique also may result in gross over titration because the methyl orange color change takes place at pH of 4.6 or lower (APHA, 1976). The titration end points of dilute waters may be as high as pH 5.3 (Barnes, 1964).

The manuals used on early New Hampshire surveys state that field titrations were continued until the methyl orange turned a "faint pink" (Davis, 1938; Newell, 1972), possibly at pH 4.5 or less. This depressed end point would represent an overestimation of alkalinity of at least 32 ueq/l (Kramer and Tessier, 1982). Consequently, the historic alkalinity values in Figures 12-17 have been corrected by subtracting 32 ueq/l from

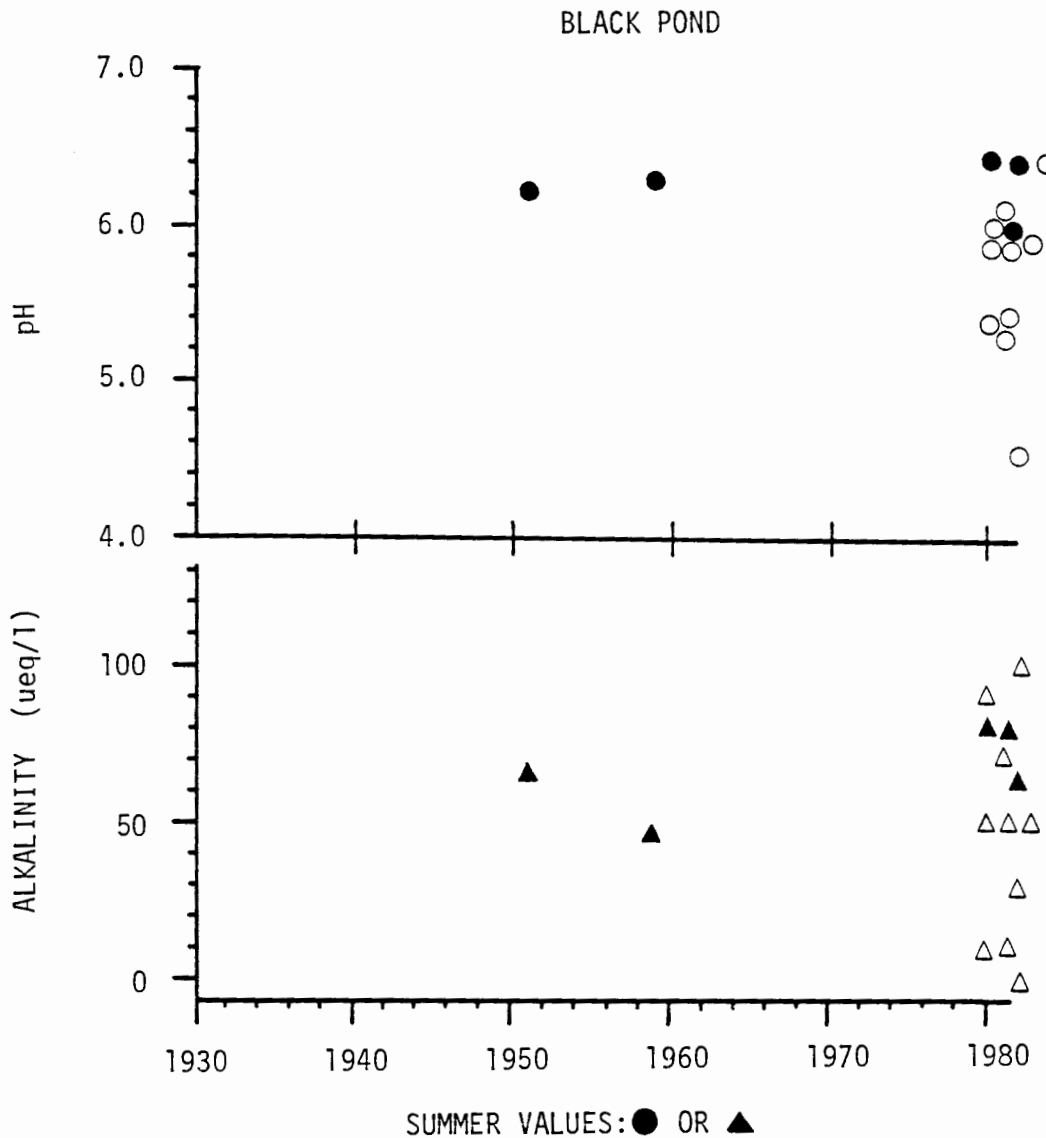


Fig. 12 Historical and current data for surface waters of Black Pond. Pre-1980 alkalinities have been corrected for methyl orange titration by subtracting 32 ueq/l from all data. Sources: 1951 data from New Hampshire Fish and Game Department files; 1959 data from USDI Fish and Wildlife Service files; 1980-82 data from this study.

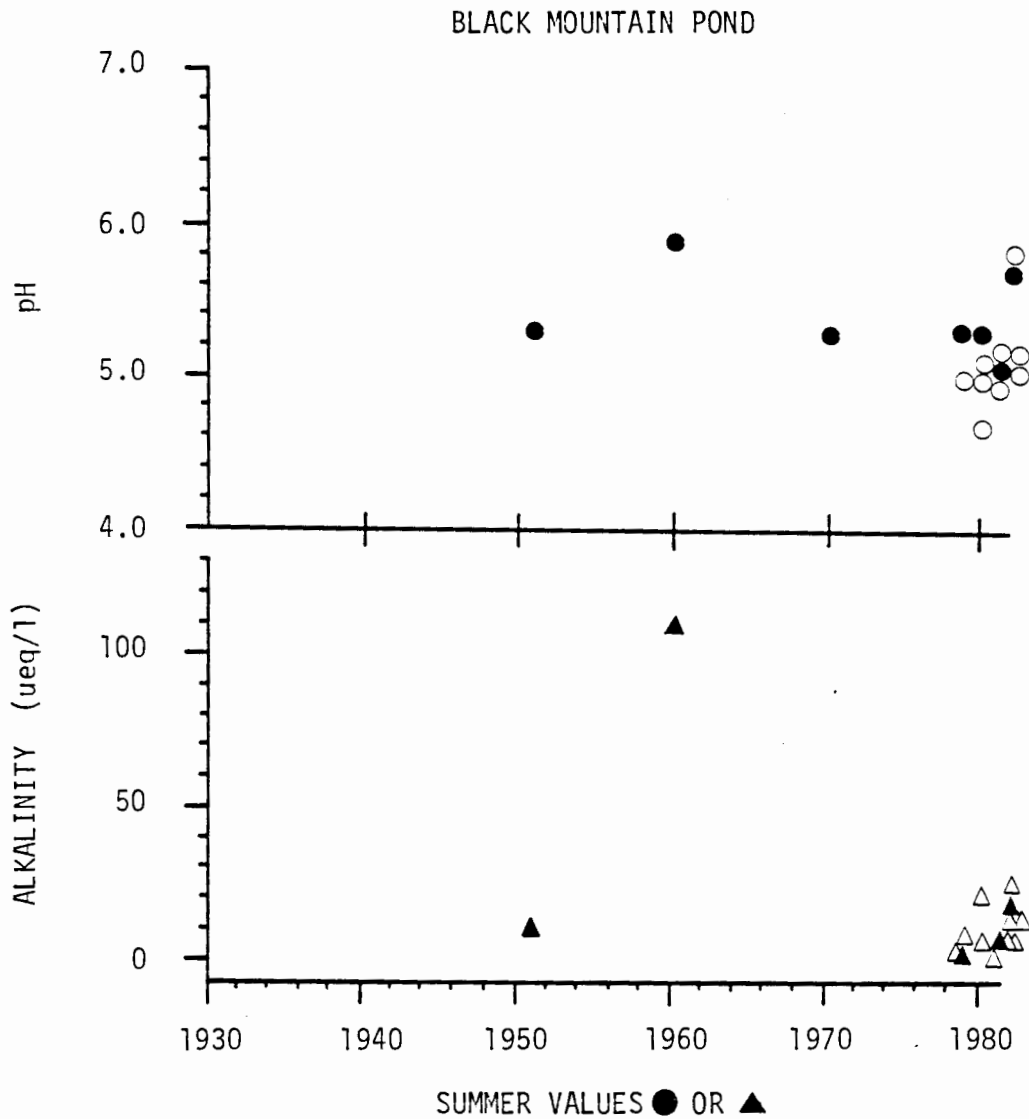


Fig. 13 Historical and current data for surface waters of Black Mountain Pond. Pre-1979 alkalinities have been corrected for methyl orange titration by subtracting 32 ueq/l from all data. Sources: 1951 and 1979 data from New Hampshire Fish and Game Department files; 1960 and 1970 data from USDI Fish and Wildlife Service files; 1979 data from Norton et al (1981); 1980-82 data from this project.

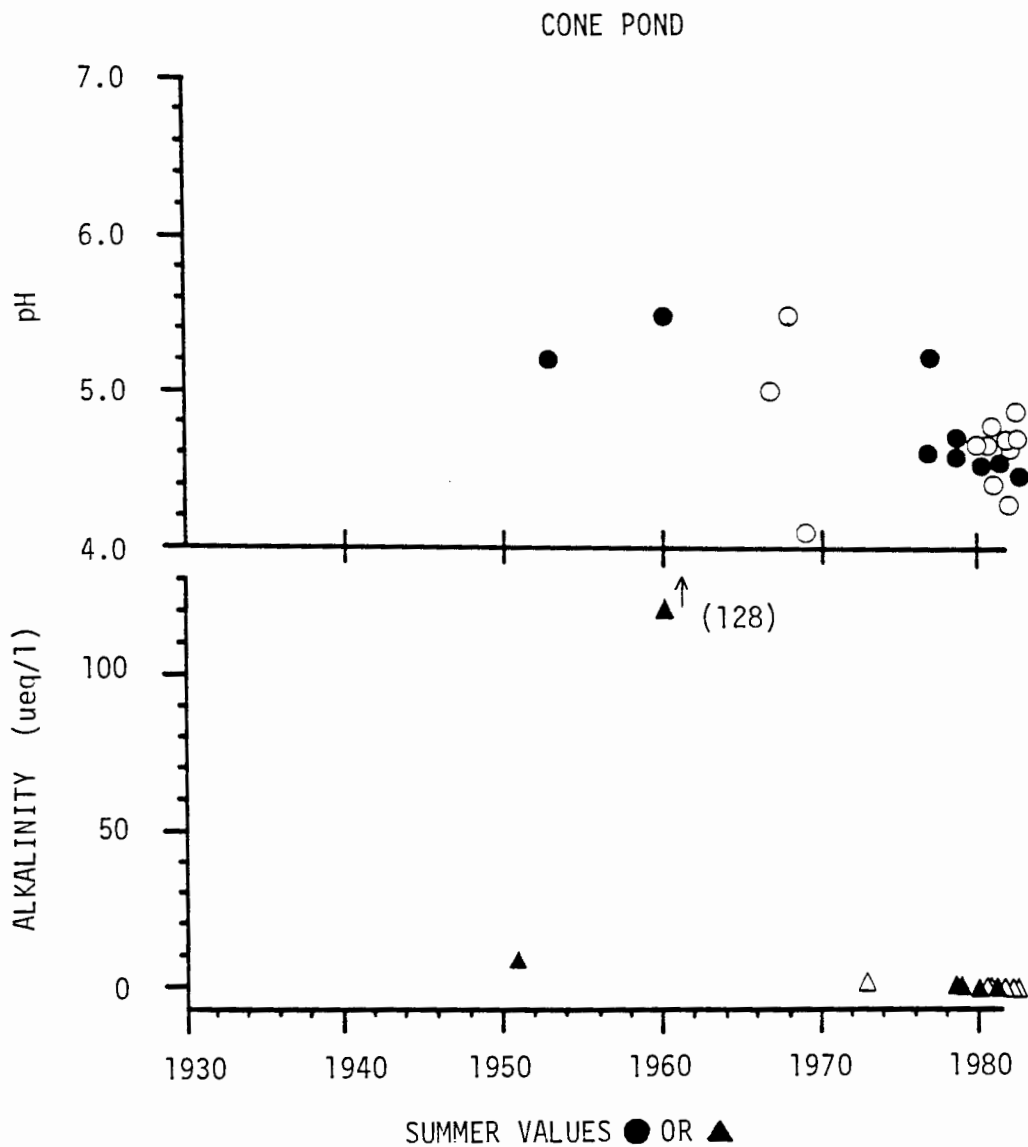


Fig. 14 Historical and current data for surface waters of Cone Pond. Pre-1973 alkalinities have been corrected for methyl orange titration by subtracting 32 ueq/l from all data. Sources: 1951 and 1981 data from New Hampshire Fish and Game Department files; 1960, 1968, 1969, and 1977 data from USDI Fish and Wildlife Service files; 1973 and 1977 data from USDA Forest Service files; 1979 data from Norton et al (1981); 1980-82 data from this project.



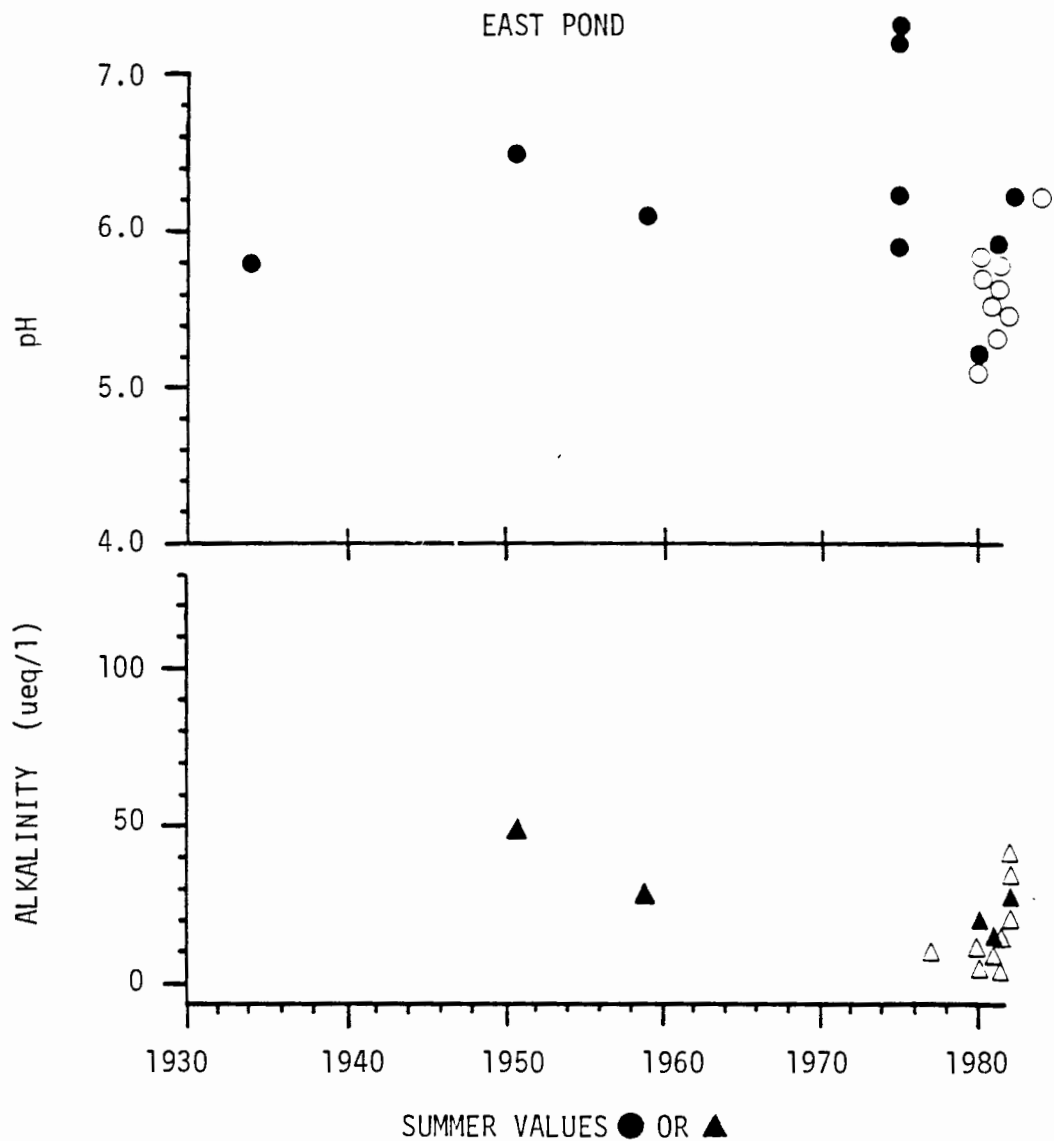


Fig. 15 Historical and current data for surface waters of East Pond. Pre-1980 alkalinities have been corrected for methyl orange titration by subtracting 32 ueq/l from all data. Sources: 1934 datum from USDC Bureau of Fisheries files; 1951 data from New Hampshire Fish and Game Department files; 1959 data from USDI Fish and Wildlife Service files; 1975 data from USDA Forest Service files; 1980-82 data from this study.

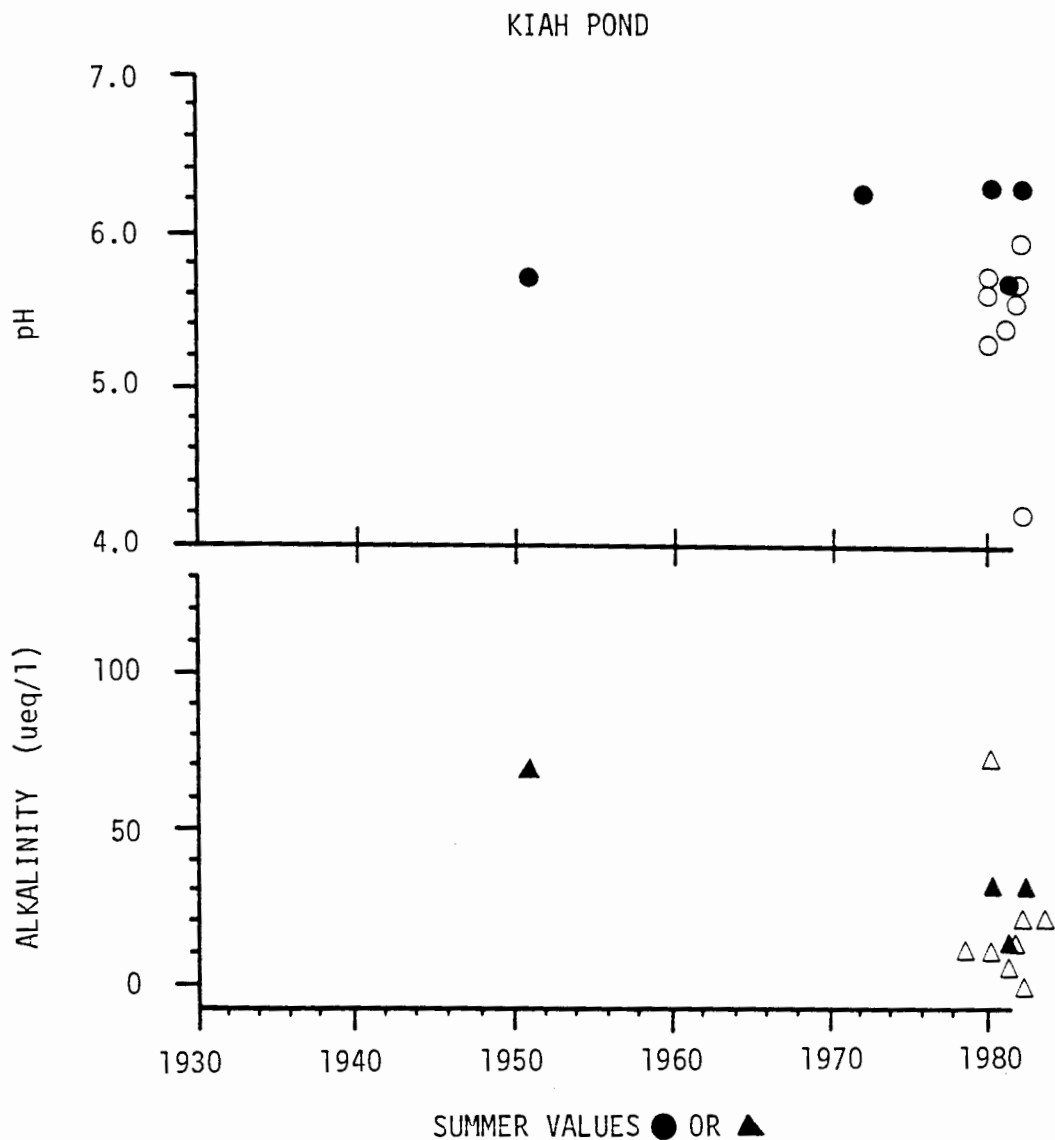


Fig. 16 Historical and current data for surface waters of Kiah Pond. Pre-1980 alkalinity has been corrected for methyl orange titration by subtracting 32 ueq/l from the datum. Sources: 1951 and 1972 data from New Hampshire Fish and Game Department files; 1980-82 data from this project.

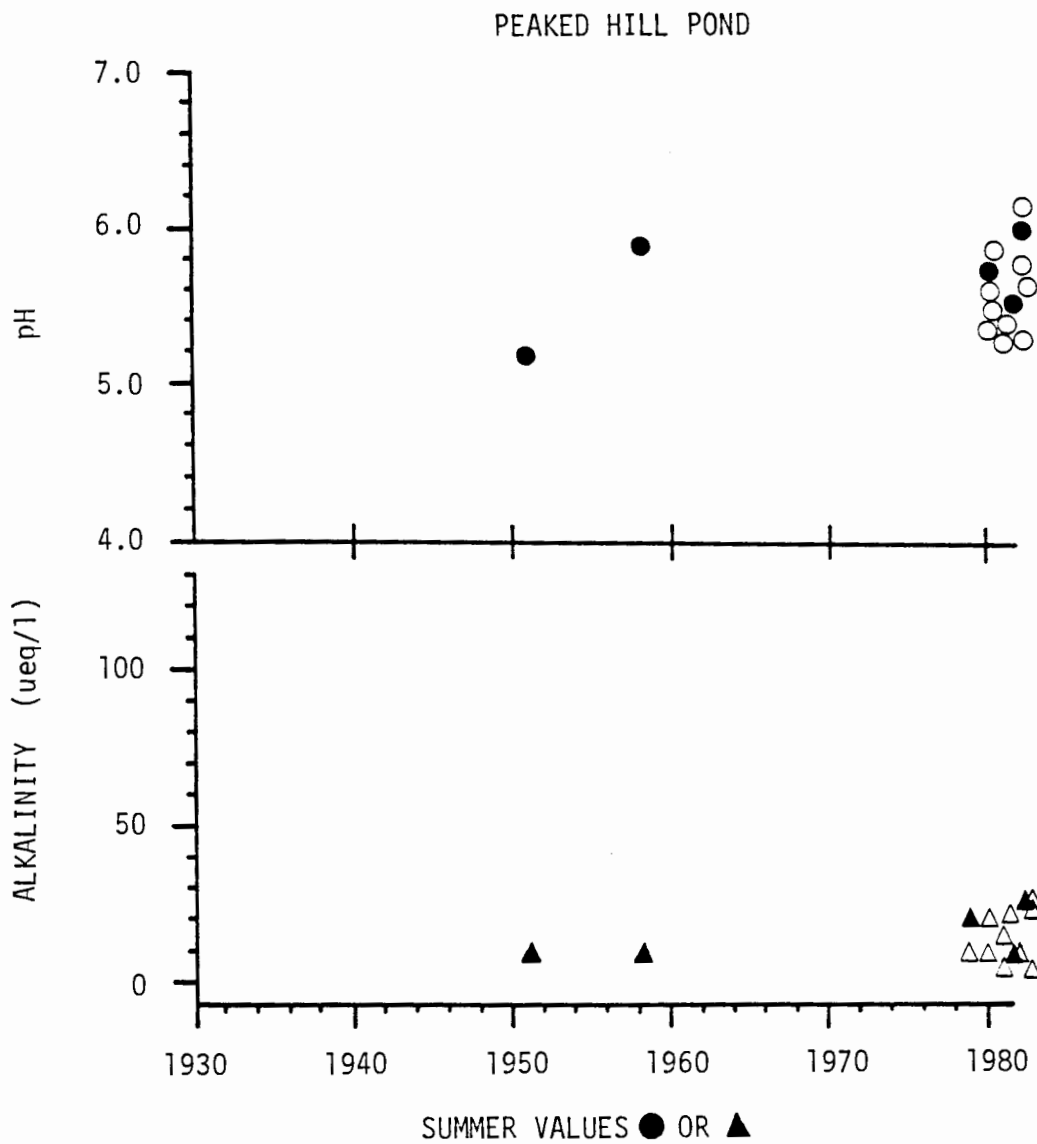


Fig. 17 Historical and current data for surface waters of Peaked Hill Pond. Pre-1980 alkalinities have been corrected for methyl orange titration by subtracting 32 ueq/l from all data. Sources: 1951 data from New Hampshire Fish and Game Department files; 1958 data from USDI Fish and Wildlife Service files; 1980-82 data from this project.

the original values as found in files of state and federal agencies. At least 2 of the early values for alkalinity are questionable. Black Mountain and Cone Ponds, sampled within 3 days of each other in July 1960, had a surface-water alkalinity of 108 and 128 ueq/l, respectively. These values seem greatly in excess of what would be expected from the listed pH values of 6.1 and 5.5 (Figs. 13-14), and from unstratified waters.

Comparison of the corrected historic and current alkalinity data (Figs. 12-17) shows no obvious trends over the 30 years for which data are available. The scarcity of data before our study and differences in methods make conclusions highly speculative.

pH Comparisons. Published pH values for the ponds before our study were determined in the field, mostly with a Hellige colorimetric kit. The method requires adding a color indicator to the sample and matching it with a color disc that spans a range of pH values. Normally, there are several indicator discs, including a bromcresol-green wheel spanning pH 4.0 to 5.6, and a chlorophenol-red wheel spanning pH 5.2 to 6.8.

Use of the Hellige kit on New Hampshire ponds raises 2 major questions. First, were the kits equipped with the correct color disc if pH was below 5.2? We found indications in the records that only the chlorophenol red disc spanning pH 5.2 to 6.8 was used. If this is true, ponds with a pH of < 5.2, such as Cone Pond, may have been recorded as having a pH value of about 5.2.

Second, how well does pH determined with a Hellige kit compare with pH determined potentiometrically? To answer this question we purchased a Hellige kit with bromcresol-green and chlorophenol-red color discs and compared it with potentiometric readings; pH was determined by both

methods on the same pond sample within 1 day of collection. Samples with a potentiometric pH of  $< 5.2$  were not used in the test of the chlorphenol-red, and no samples with a meter pH  $> 5.6$  were tested with bromcresol green.

The scatter between pH meter readings and the chlorophenol-red indicator was considerably greater than scatter between the pH meter and the lower range bromcresol-green indicator (Fig. 18). The chlorophenol-red has an obvious bias in the lower part of its pH range. The bromcresol-green values more closely approximated meter reading, being no more than 0.2 to 0.4 units high. Comparisons of the potentiometric and colorimetric values after conversion of pH to  $H^+$  are shown in Figures 19 and 20. The bromcresol-green indicator disc is a more suitable colorimetric indicator in the pH range 5.2 to 5.6 for the variety of natural waters represented by the 6 study ponds. The use of the chlorphenol-red disc in early surveys probably caused errors.

The other concern about the Hellige kit is that the ionic strength of the chlorphenol-red indicator apparently is enough to modify the dilute natural waters to which it is added. Tests using 2 ml of indicator added to 20 ml of pond water show that the chlorphenol-red consistently raised the pH of the sample by several tenths (Fig. 21). The resulting pH of the solution seems a reasonable representation of only the modified sample.

These problems raise serious concerns about comparing historic with current pH data. Historic measurements for Black, East, and Kiah Ponds could be adequate as they fell within the midrange of the chlorophenol-red indicator probably used at the time. Historic data for Black Mountain and Peaked Hill Ponds lie in the chlorphenol-red indicator range that could have biased the pH values slightly upward. Based on current values for

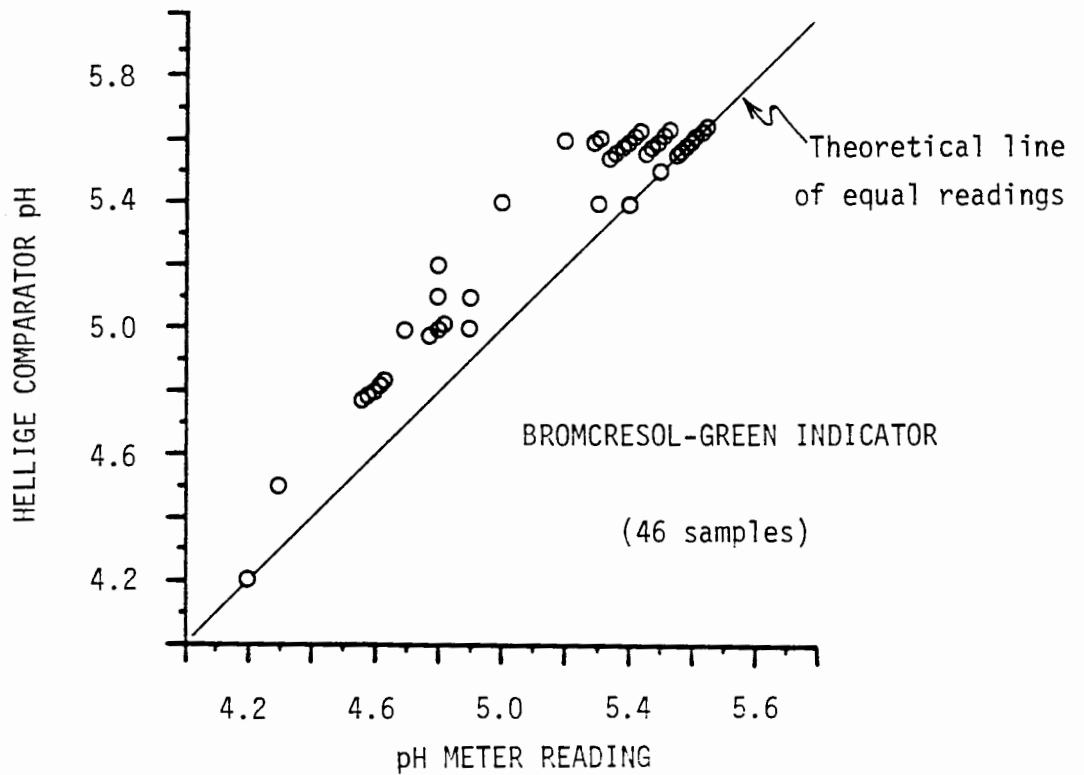
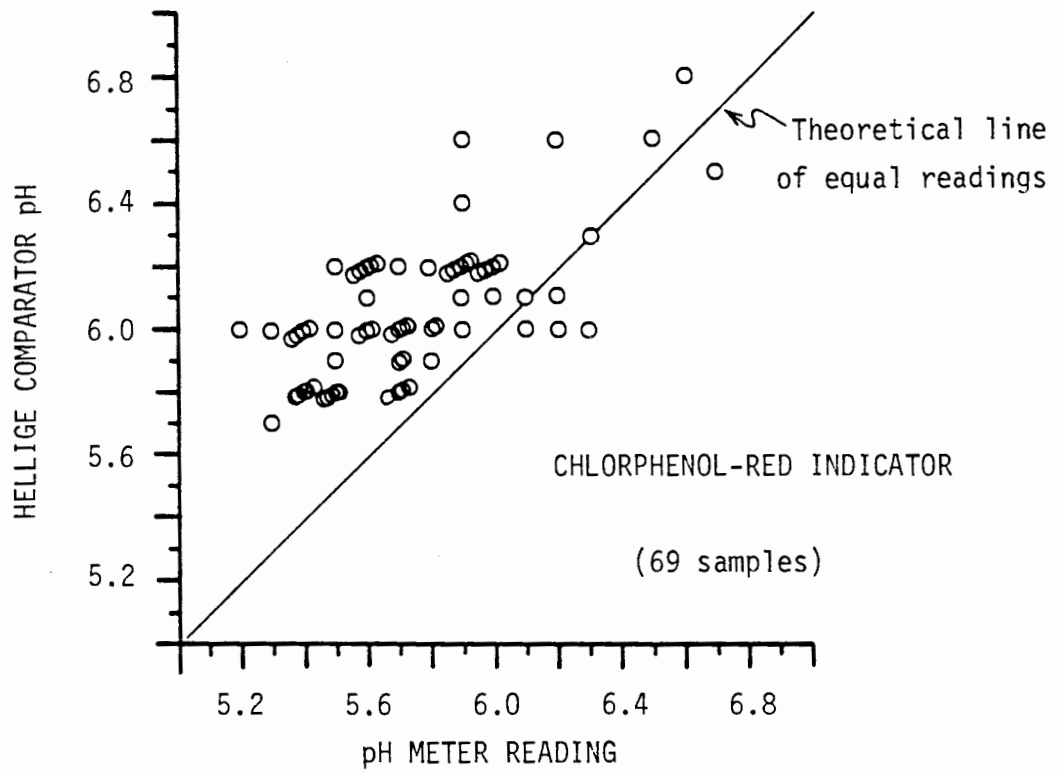


Fig. 18 Comparison of laboratory pH meter readings with Hellige kit readings on aliquots from the same pond samples, tested concurrently.

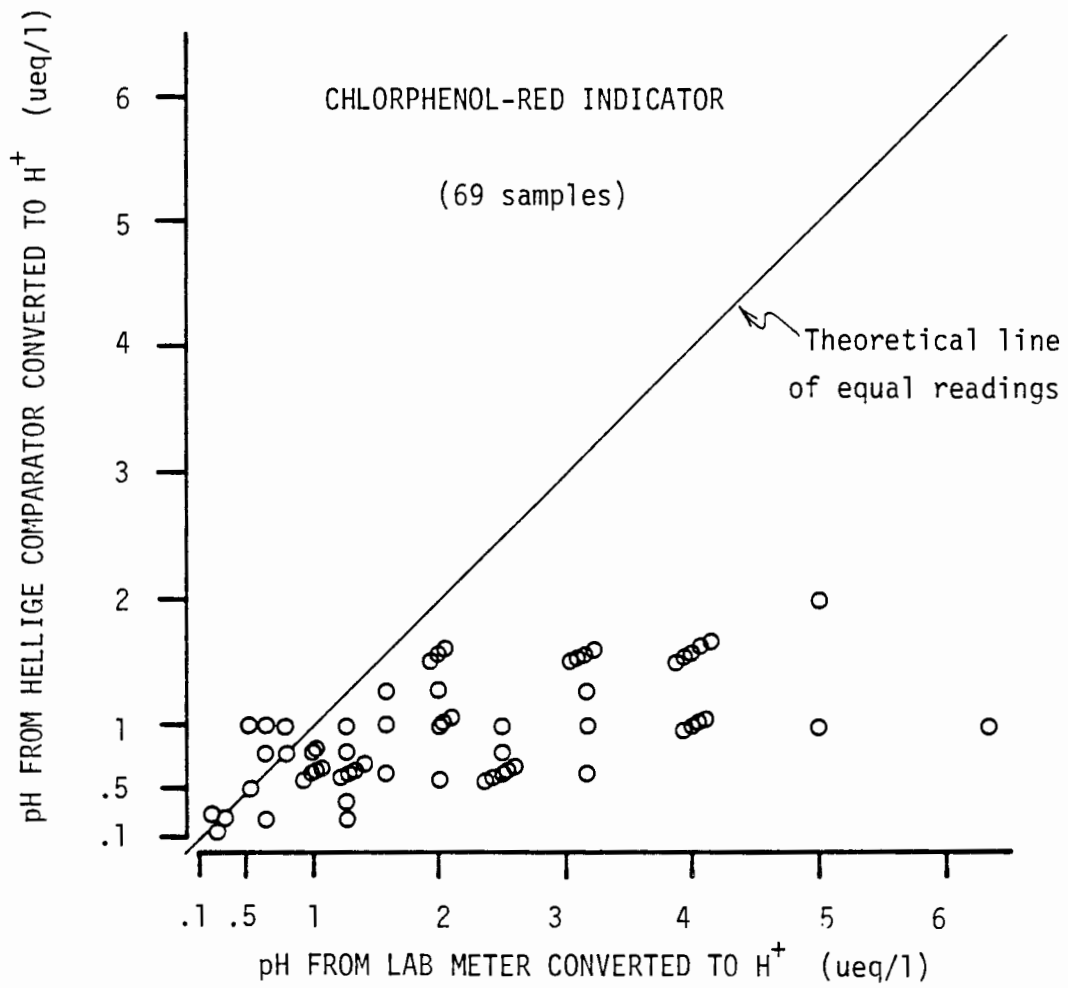


Fig. 19 Comparison of potentiometric pH data with Hellige Color Comparator data using the chlorphenol-red indicator.

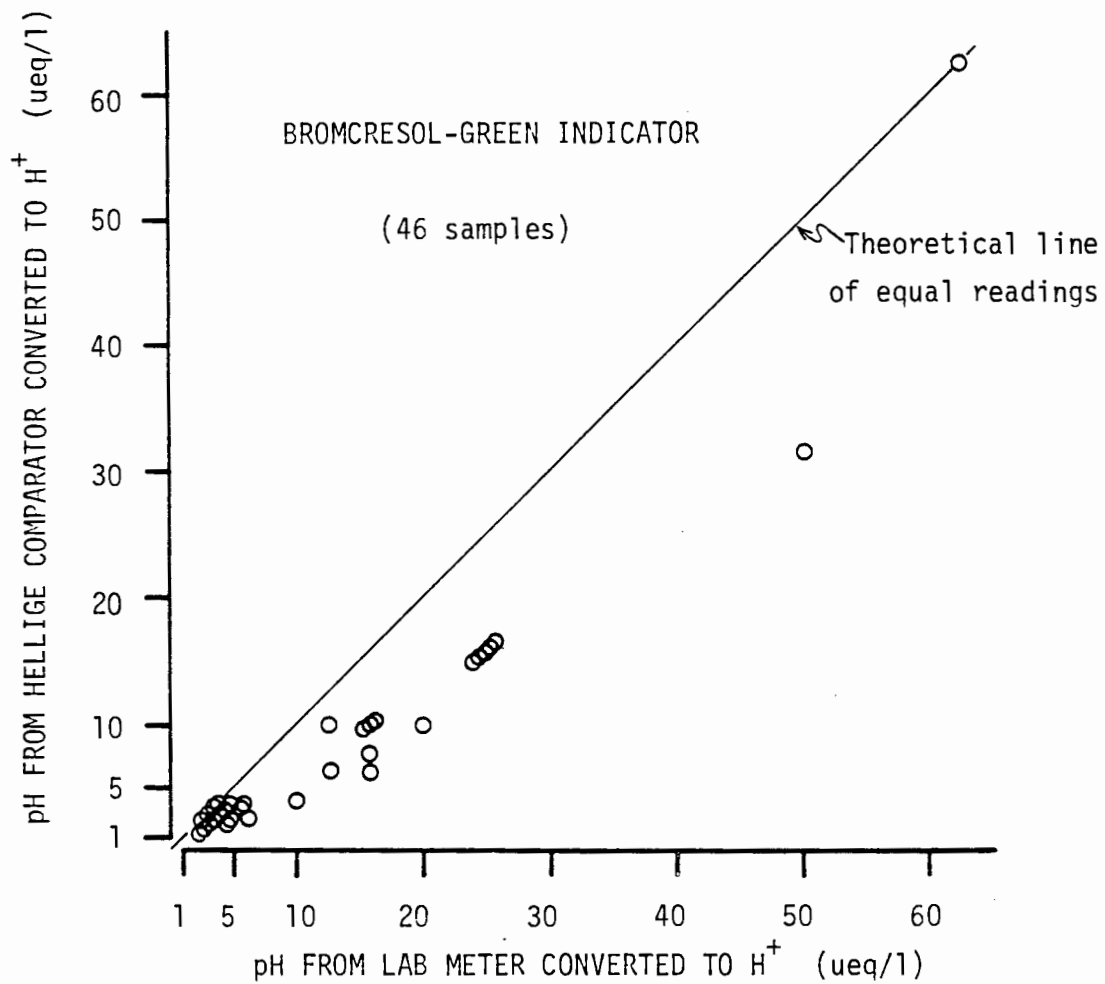


Fig. 20 Comparison of potentiometric pH data with Hellige Color Comparator data using the bromocresol-green indicator.



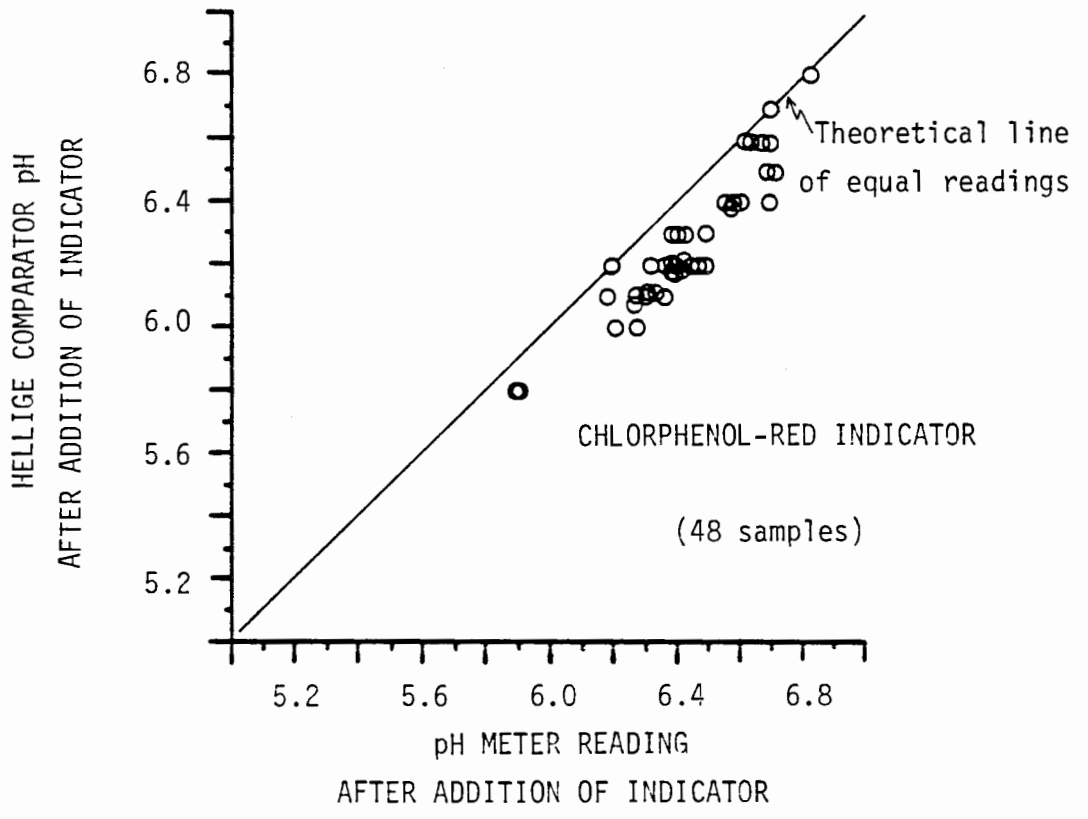
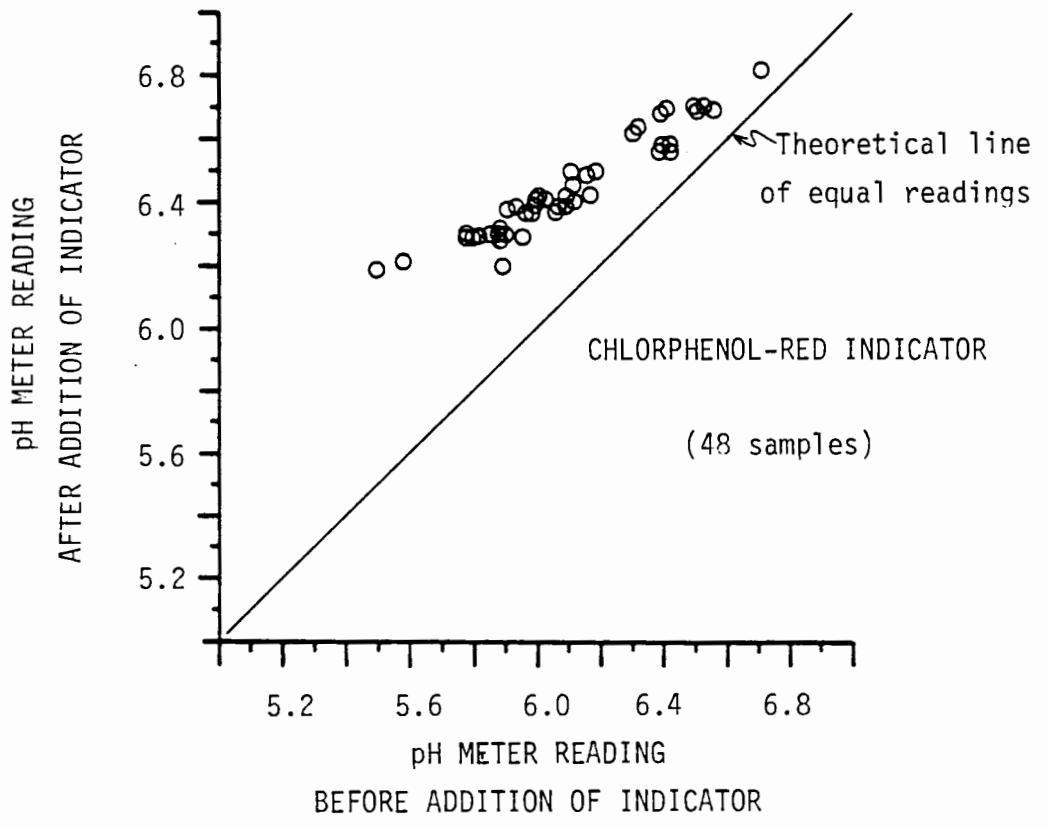


Fig. 21 Tests of the effect of the chlorophenol-red indicator on the pH of samples from the study ponds (excluding acidic Cone Pond).

Cone Pond, the pH at the time of the earlier surveys could have been below the range of the chlorphenol-red indicator disc.

We believe that questions about methodology used in the early surveys, coupled with the small number of determinations, prevent meaningful comparison of historic and current pH data.

#### Specific Conductance

The specific conductance of pond water is a function of the concentration of ions and their individual charge. Specific conductance in combination with pH can be used as an indicator of pond acidification. For example, in dilute, acidic ponds, increasing conductance usually indicates increasing  $H^+$ . In more dilute, neutral ponds, increasing conductivity generally indicates increasing amounts of all ions, including both basic cations and associated anions (APHA, 1976).

This relationship forms a parabola as indicated in Figure 22. Cone Pond, a dilute, acidic pond, has low pH values and relatively high conductivities, forming the lower limb of the parabola. Black Pond, with higher pH values and higher total ion concentrations, forms the upper limb. The remaining ponds fall in between these extremes of pH and ion content.

When ponds have similar pH values, the differences in specific conductance can be a useful indicator of differences in buffer capacity. For example, in the summer of 1982, samples of deep water (5 to 6 m) from Black and East Ponds were both in the pH range 6.2 to 6.3, while specific conductances were about 30 and 20  $\mu S/cm$  respectively (Appendix B). This difference in specific conductance at essentially the same pH reflects large differences in the concentrations of  $Ca^{2+}$ ,  $Mg^{2+}$ , and  $HCO_3^-$ . The Black Pond sample has 170  $\mu eq/l$  of  $Ca^{2+}$  plus  $Mg^{2+}$ , and 150  $\mu eq/l$  of  $HCO_3^-$ .

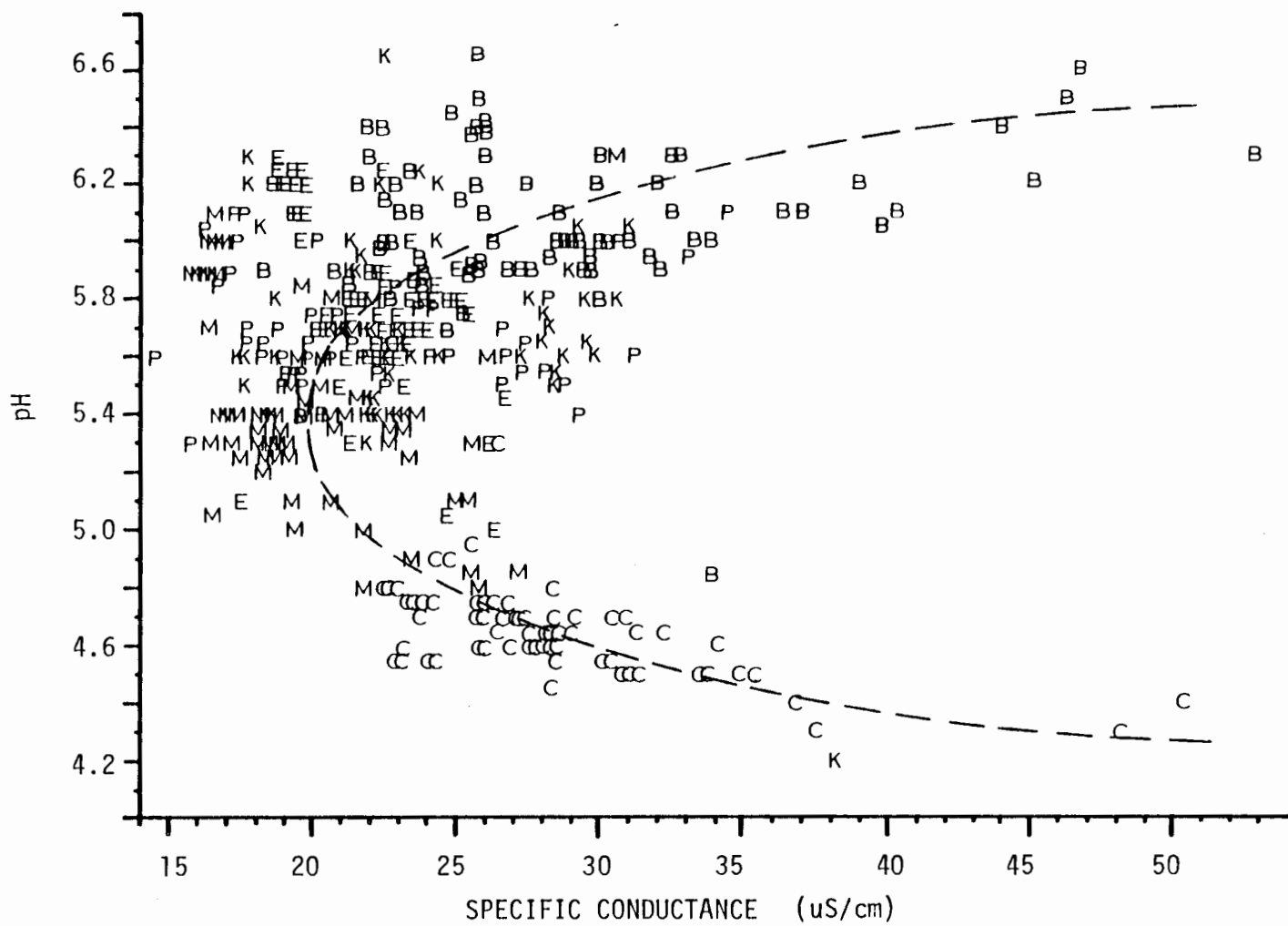


Fig. 22 Specific conductance vs pH for samples from all of the ponds, including inlets and outlets.

The East Pond  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ion sum was 74 ueq/l, along with only 25 ueq/l of  $\text{HCO}_3^-$ . Both pond samples had similar concentrations of  $\text{SO}_4^{2-}$  (75 to 79 ueq/l). Total ion content (cations plus anions) was about 500 ueq/l for Black Pond and about 280 ueq/l for East Pond. Thus, although the pH of these two ponds was similar, the higher specific conductances for Black Pond serves as an indicator of a significantly greater buffer capacity.

#### Sulfate Loading

Sulfate concentrations in pond waters could be indicators of acidification since  $\text{SO}_4^{2-}$  is the dominant anion in precipitation falling on central New Hampshire (Likens et al., 1977).

Volume-weighted  $\text{SO}_4^{2-}$  concentrations ranged from 70 to 90 ueq/l in East Pond, 68 to 115 in Black Pond, 75 to 140 in Kiah Pond, 89 to 140 in Black Mountain Pond, 87 to 157 in Peaked Hill Pond, and 119 to 165 in Cone Pond (Figs. 2-7). The wide ranges of  $\text{SO}_4^{2-}$  concentrations resulted from seasonal variation. Except for East Pond, where concentrations remained relatively stable,  $\text{SO}_4^{2-}$  concentrations of all ponds were highest during the late winter and spring and lowest during the summer. Sulfate released from melting snowpacks, or meltwater flushing of  $\text{SO}_4^{2-}$  in soils, may explain this seasonal variation.

Variations in  $\text{SO}_4^{2-}$  concentrations with depth usually were small (Appendix B). An exception was strongly stratified Black Pond, where  $\text{SO}_4^{2-}$  levels decreased substantially in the deepest waters, perhaps because of  $\text{SO}_4^{2-}$  reduction during long periods of anoxia.

The  $\text{SO}_4^{2-}$  levels of the inlet streams typically were slightly higher than those in the water columns of each pond (Appendix B). On several occasions, the inlet to Cone Pond contributed more than 200 ueq/l of  $\text{SO}_4^{2-}$ . The Cone Pond watershed may include some sulfide bearing rocks which weather slowly, resulting in  $\text{SO}_4^{2-}$  leaching during storm events.

Concentrations of  $\text{SO}_4^{2-}$  in the streams of the 6 ponds agree well with predictions from the literature (Johnson et al., 1972). Since  $\text{SO}_4^{2-}$  is the dominant anion in both precipitation and pond waters, it seems of questionable use as an indicator of acidification unless the values are extremely high. Also, higher  $\text{SO}_4^{2-}$  concentrations in pond waters do not always imply lower pH values since  $\text{SO}_4^{2-}$  is such a prominent part of the ion assemblages of all 6 ponds (Fig. 23). For example, Kiah and Cone Ponds have roughly equivalent  $\text{SO}_4^{2-}$  levels (100-140 ueq/l), but have very different pH values.

The ratio of  $\text{SO}_4^{2-}$  to the divalent cations mobilized to meet the anion charge may be a more suitable indicator of acidity (Henriksen, 1980). The entire set of study ponds is relatively rich in  $\text{SO}_4^{2-}$ , but the more acidic ponds have low levels of  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  (Fig. 24). This implies that  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  weathering in the watersheds of each pond are different, or that some ponds have a capacity to store these basic cations, or even to remove  $\text{SO}_4^{2-}$ .

Given the present  $\text{SO}_4^{2-}$  content of the rain in this region, ponds with additional mineral sources of oxidizable S, or severe deficiencies in weatherable  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$ , such as Cone and Black Mountain Ponds, would tend to be more susceptible to acidification (Fig. 24).

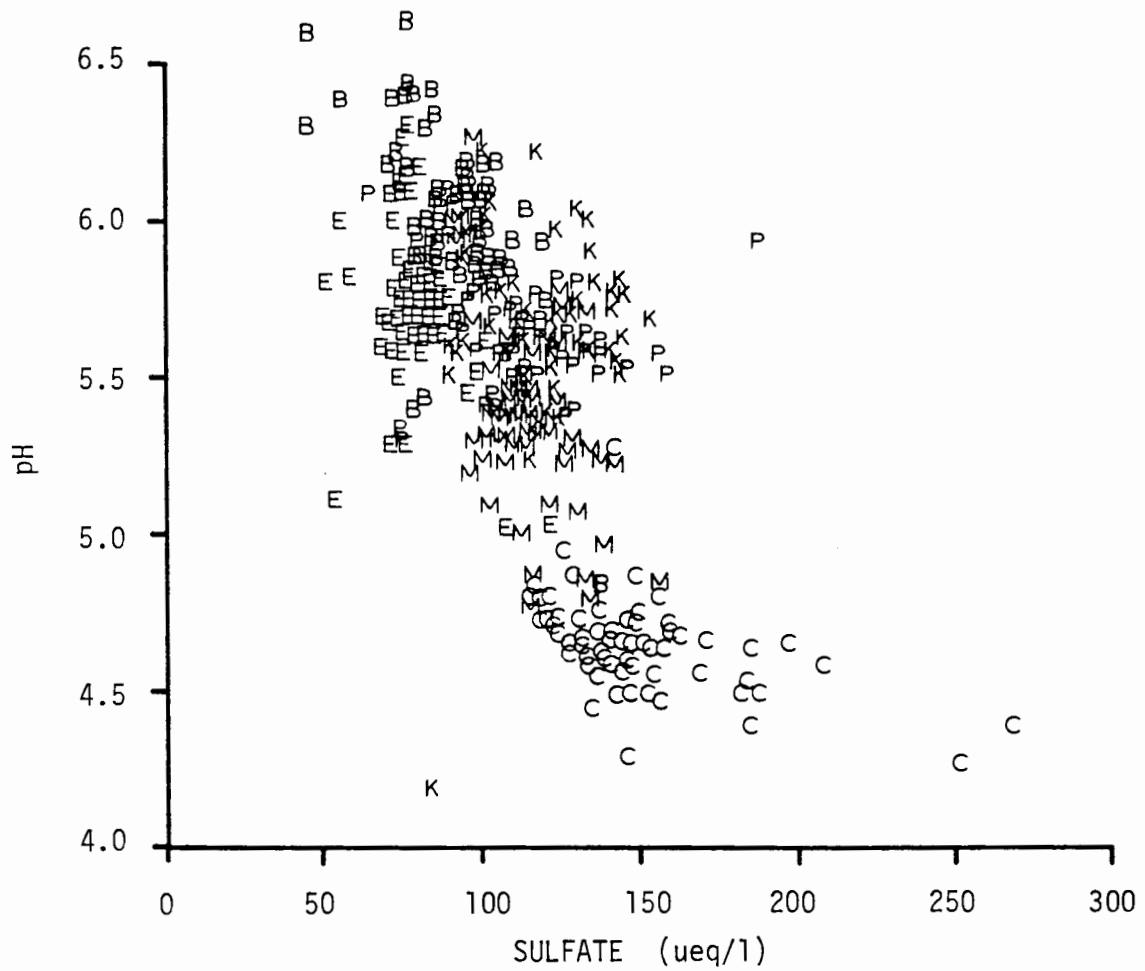


Fig. 23 Sulfate vs pH for all the samples from the study ponds, including inlets and outlets. The lowest  $\text{SO}_4^{2-}$  values are from East Pond spring water and from Black Pond hypolimnetic samples. The highest values are from Cone Pond inlet stream samples.

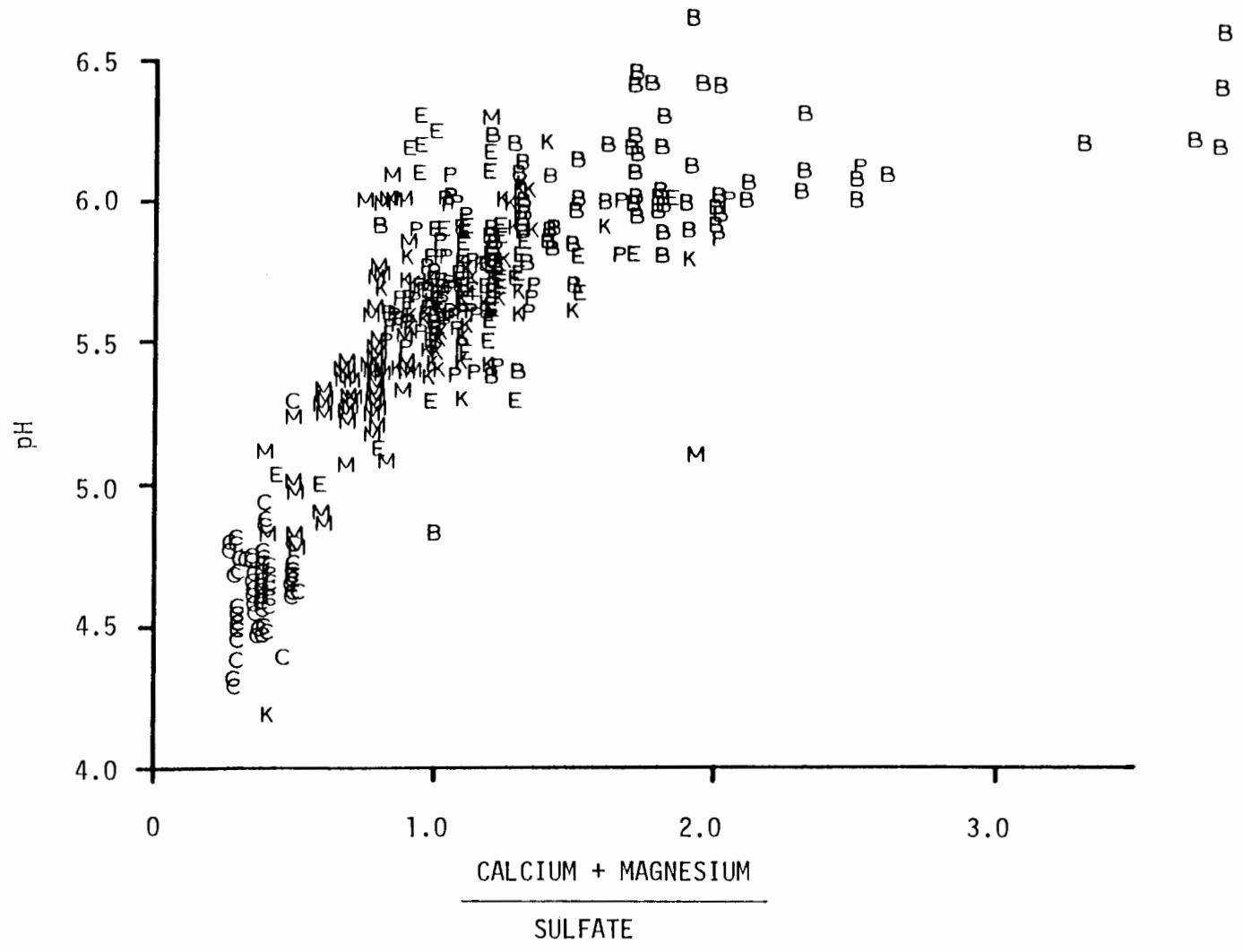


Fig. 24 pH vs ratio of the sum of the concentrations (ueq/l) of calcium and magnesium, to the concentration (ueq/l) of sulfate in samples from the study ponds, including inlets and outlets.

## Total Aluminum Concentrations

High concentrations of total aluminum can indicate acidification of a pond and the inlet streams. However, only certain species of aluminum are biologically damaging, and organic carbon in the ponds may ameliorate the hazards by complexing these species.

Volume-weighted concentrations of total aluminum ranged from less than 0.10 mg/l to about 0.60 mg/l. Black, Kiah, and Peaked Hill Ponds averaged 0.10 mg/l with little variation (Figs. 2, 6, 7). The inlet streams of these ponds have a higher pH and contain less aluminum than the other ponds. Also, their watersheds were the largest or were thought to contain deeper soils. Thus, the soil water pathways may have been longer with greater opportunity for neutralization by cation exchange (Johnson et al., 1981).

Temporal variations in aluminum concentrations were evident only in Black Mountain, Cone, and East Ponds (Figs. 3-5). Volume-weighted aluminum was highest in the late winter and early spring, and lowest in the late summer. The aluminum concentrations were inversely related to pH of these ponds. Snowmelt in late winter may have provided more free hydrogen to mobilize aluminum in the watersheds.

Aluminum concentrations usually were highest in the epilimnion of Black Mountain and Cone Ponds. Both ponds received much more aluminum from their inlets than was contained within the water columns or was lost through the outlets (Fig. 25). Thus, these 2 ponds may be sinks for aluminum. Their watersheds have thin soils with extensive areas of bare bedrock, which may provide short soil-water pathways and little chance for neutralization of acidity. This may explain the high concentrations of aluminum in the inlets.



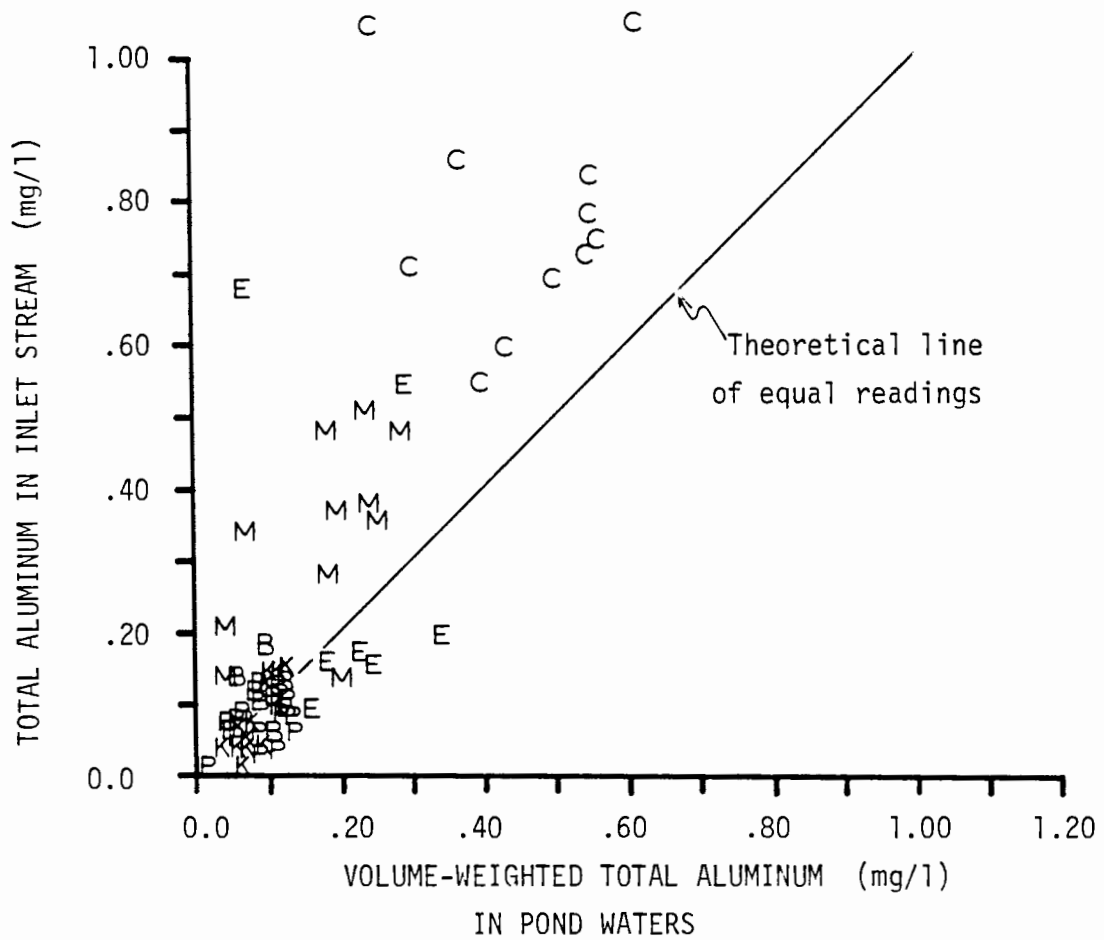


Fig. 25 Aluminum concentrations in inlet water vs volume-weighted average concentration in the pond, sampled on the same date. Cone Pond (C) and Black Mountain Pond (M) have relatively acidic watersheds. East Pond (E) has both acidic temporary inlets (streams) and less acidic springs.

The calculations of ion balances, for Black Mountain, Cone, and East Ponds revealed an excess of anions. This discrepancy seems to be balanced by the total aluminum, assuming a valence of  $3^+$  (Fig. 26). These ponds contain low concentrations of DOC (Appendix B). Black, Kiah, and Peaked Hill Ponds, with higher DOC, generally had ion balances with excess cations. Unmeasured organic anions may have balanced the charges in these humic waters. In these humic ponds, aluminum concentrations were not well correlated with pH (Fig. 27). In the 3 clearwater ponds, Black Mountain, Cone, and East, higher aluminum was correlated with pH.

There is no way to relate high aluminum levels in the clearwater ponds to measurement of potential fisheries damage without additional analyses. Both Black Mountain and East Ponds evidently have populations of holdover trout (Appendix A). It seems reasonable to assume that aluminum toxicity to adult fish is not an acute problem in these 2 ponds, or in the 3 humic-water ponds. Identifying chronic problems, like reproductive failure or low fitness in any of the ponds, would require an extensive sampling effort.

Aqueous aluminum is a ubiquitous part of the water chemistry of the White Mountains. The presence of high concentrations in ponds depends on the weathering of neutralizing cations in individual watersheds. Increased pond aluminum implies increased acidification at some point in the soil-water flow path, but does not necessarily mean that there are biological problems. The toxic effects of high concentrations of aluminum depend on the particular form of aluminum present, on the ambient pH, and on the amount of DOC available to chelate inorganic aluminum.

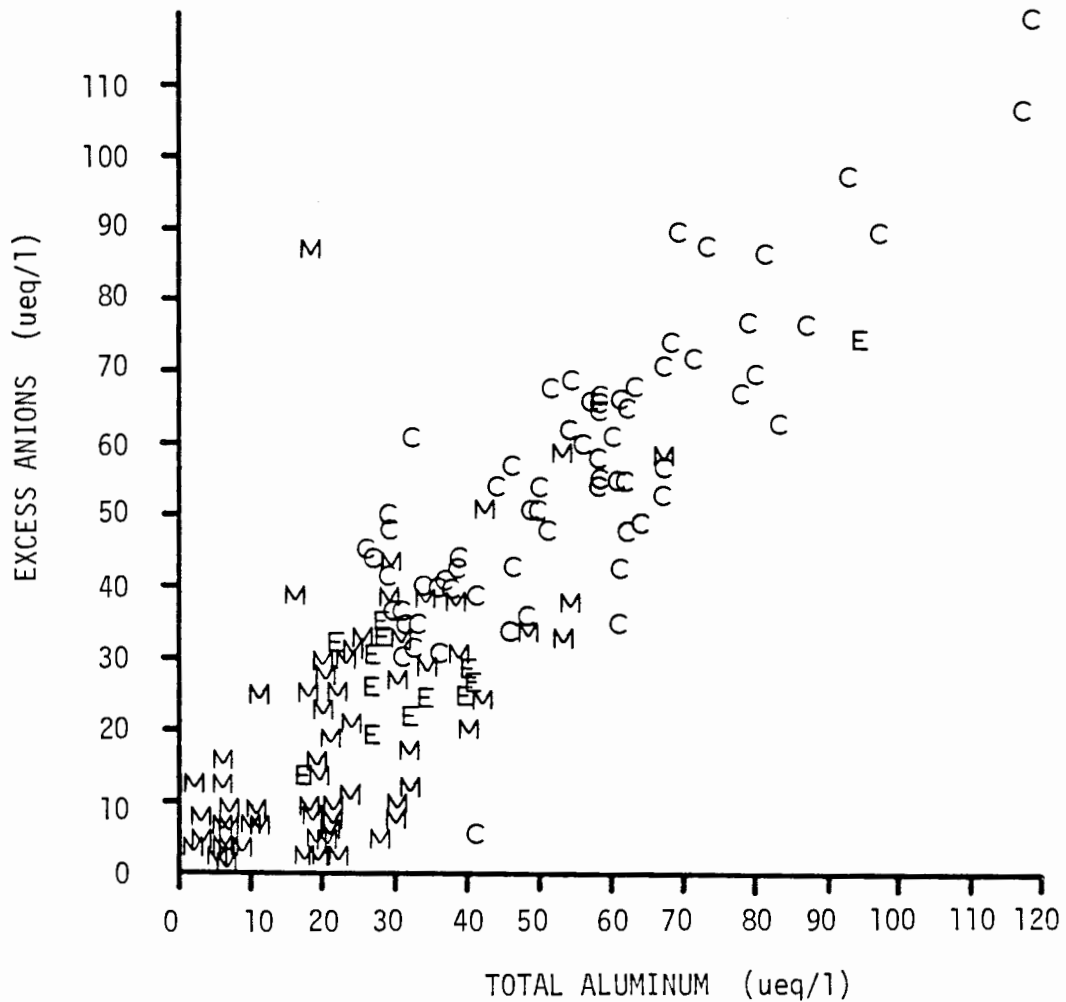


Fig. 26 Excess anions in the ion balances of water samples from Black Mountain, Cone, and East Ponds plotted against the measured aluminum concentrations (assuming a valence state for aluminum of +3). These are low-DOC waters. Spurious Black Mountain Pond sample (M) had very high total iron.

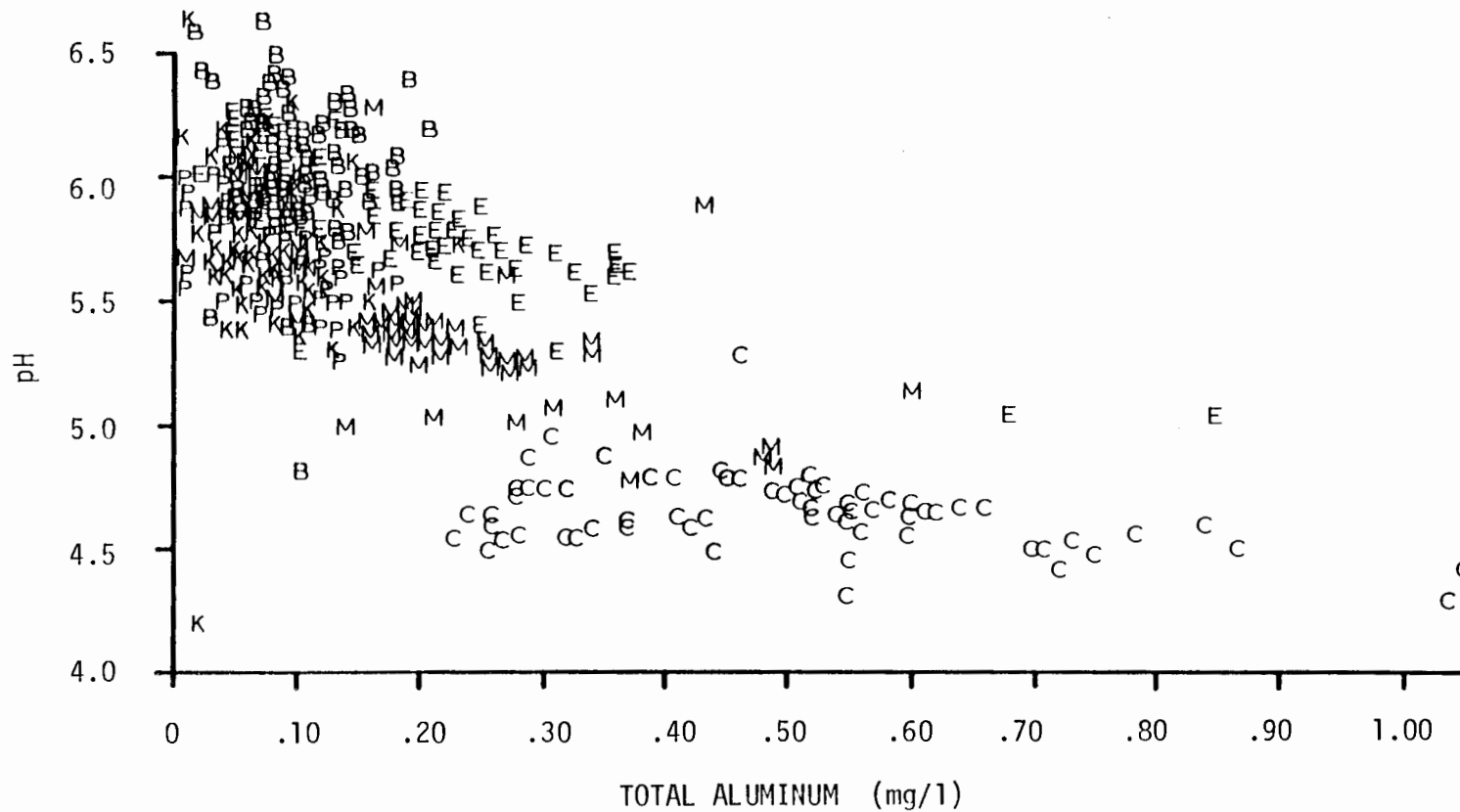


Fig. 27 pH vs aluminum for all of the study ponds, including inlets and outlets. Spurious Kiah Pond sample (K) was dilute, epilimnetic snowmelt sample.

## Dissolved Organic Carbon

Pondwaters low in DOC may not be able to complex reactive toxic aluminum, provide organic anion buffering capacity, or support production of hypolimnetic alkalinity. Most DOC compounds found in pond waters are slowly degradable, humic substances of high molecular weight that are derived from live or decaying plant tissue or from soil compounds (Wetzel, 1975).

Black, Kiah, and Peaked Hill Ponds contain 3 to 12 mg/l of DOC, while Black Mountain, Cone, and East Ponds contain only 0.1 to 4 mg/l (Appendix B). The highest levels of DOC tended to occur during the summer, probably the result of greater organic productivity in the pond or watersheds. The DOC usually was between 80 and 100% of the TOC in the humic ponds, and between 60 and 100% in the clearwater ponds (Appendix B). A DOC to TOC ratio of 85 to 90% is typical for most aquatic ecosystems (Wetzel, 1975).

As a weak organic acid, DOC may buffer dilute, slightly acidic waters (Driscoll and Bisogni, 1982). A pond with low alkalinity and low ionic strength might be buffered by large concentrations of organic anions (Hemond, 1980); DOC buffering may occur in Black, Peaked Hill, and Kiah Ponds. The end points of the alkalinity titrations were 0.1 to 0.3 pH units lower than predicted for dilute waters (Barnes, 1964) in these 3 ponds, possibly because of buffering by the high concentrations of DOC.

DOC compounds complex strongly with aluminum. These complexes are highly soluble at a pH < 5 (Lind and Hem, 1975). Aluminum complexed with DOC is less toxic than unbound, labile aluminum (Driscoll et al., 1980), and changes in chemical equilibria can cause precipitation of DOC-aluminum compounds at low pH (Driscoll, 1982). Black, Kiah, and Peaked Hill Ponds, with low aluminum to DOC ratios (0.05 or less), may have much total

aluminum, but little in toxic form. The aluminum in DOC-poor Cone and East Ponds with aluminum to DOC ratios  $> 1.0$  may be more labile and toxic.

The DOC in Cone Pond plummeted after turnover in late summer 1980 and 1982 (Appendix B). In 1981, when the pond remained stratified, DOC and aluminum concentrations remained high. Apparently, the organic-aluminum complex equilibrium was disrupted by the mixing of less acidic water from the hypolimnion in 1980 and 1982.

Sufficient DOC to lessen toxic affects of free aluminum is important to a successful fishery. The extent to which aluminum is complexed with DOC in less acidic water such as in Black Mountain Pond is not clear. However, labile aluminum in the inlets may be chelated in the several humic wetlands and beaver ponds that line the perimeter of Black Mountain Pond.

#### Acidic Snowmelt Episodes

Volume-weighted pH for all ponds always was lowest in the late winter, under the ice, or in the early spring, just after turnover. This pH depression apparently is due to export of  $H^+$  from the snowpack and soils during snowmelt (Figs. 2-7). The majority of the snowpack melted in late March and April during each year of our study. Since spring snowmelt usually provides 30 to 50% of the annual streamflow in this region (Likens et al., 1977), large volumes of acidic waters can be added to the ponds in short periods of time.

Usually snowmelt acidified only the upper 2 m of the water column (Figs. 28-30). Peaked Hill Pond, with extensive shoal areas less than 2 m deep, was more susceptible to whole-pond acidification than the others. Meltwater at  $1^{\circ}C$  or less will lie just under the ice on top of the remainder of the pond water, which is slightly more dense at  $4^{\circ}C$  (Hultberg,

BLACK POND

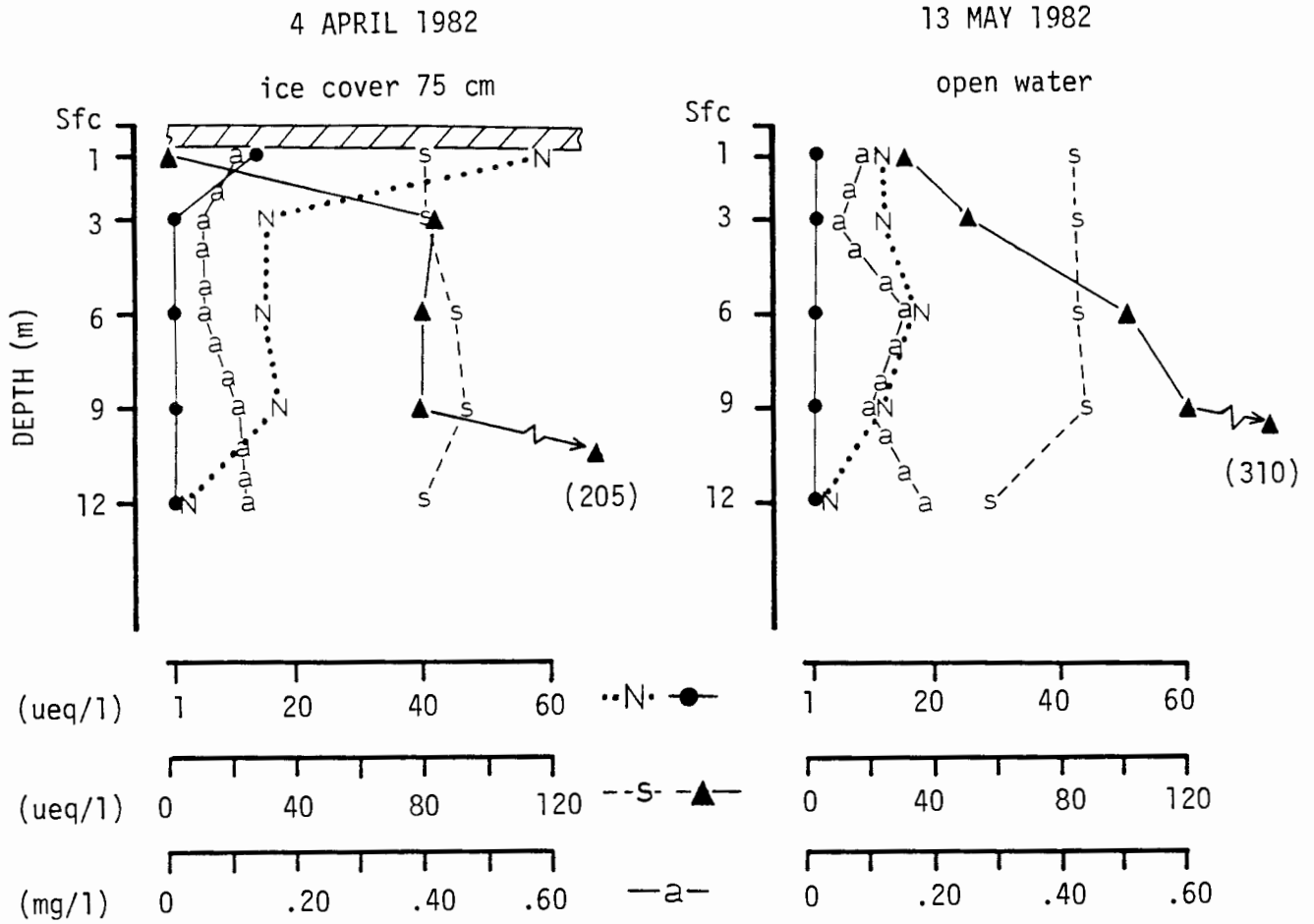


Fig. 28 Concentrations of hydrogen ion (●), alkalinity (▲), nitrate (·N·), sulfate (—S—), and aluminum (—a—) compared in water-column profiles for Black Pond, taken on 2 visits in 1982. Profile samples were from 1, 3, 6, 9, and 12 m.

CONE POND

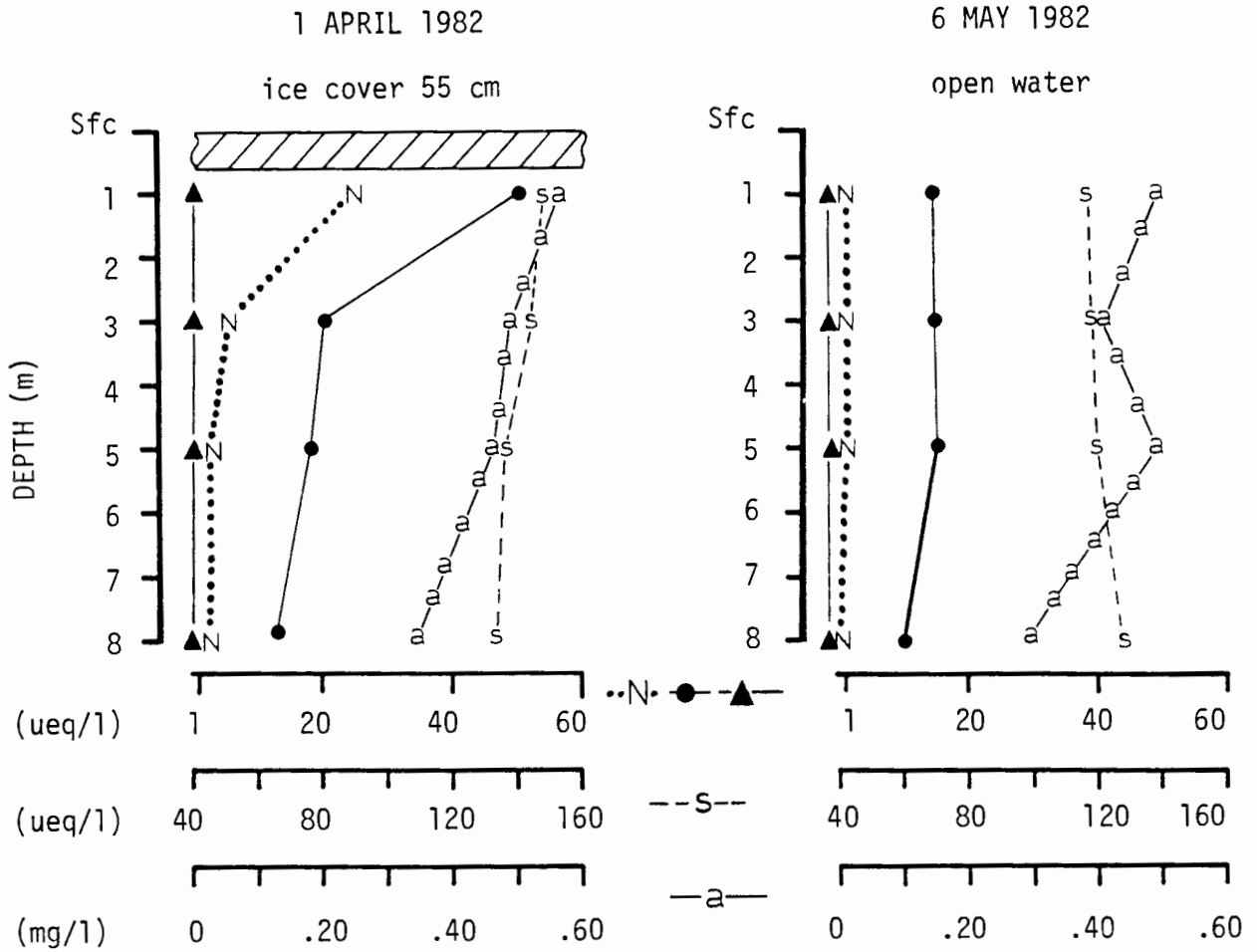


Fig. 29 Concentrations of hydrogen ion (●—), alkalinity (▲—), nitrate (··N··), sulfate (—S—), and aluminum (—a—) compared in water-column profiles for acidic Cone Pond, taken on 2 visits in 1982. Profile samples were from 1, 3, 5, and 8 m.



KIAH POND

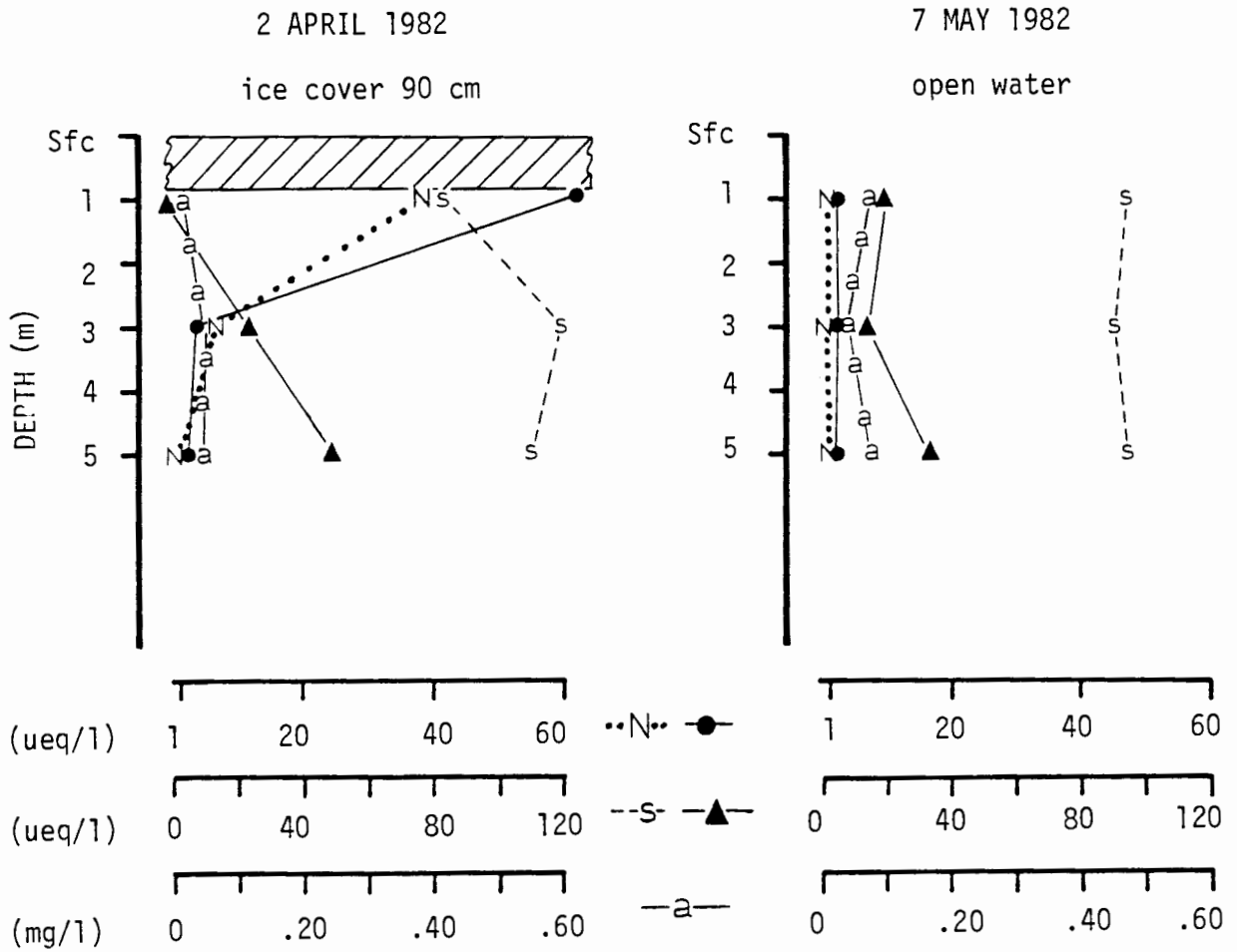


Fig. 30 Concentrations of hydrogen ion (—●—), alkalinity (—▲—), nitrate (••N••), sulfate (—S—), and aluminum (—a—) compared in water-column profiles for Kiah Pond, taken on 2 visits in 1982. Profile samples were from 1, 3, and 5 m.

1976; Hendrey et al., 1980). Meltwater may move into the pond from the ice cover, inlets, or leaching along the entire perimeter of the pond. It may then flow just beneath the ice or accumulate if there is no current.

Seasonal sampling may miss many important snowmelt episodes. The apparent acid event that occurred in April 1982 (Figs. 28-33) is a good example of a fortuitous sampling visit. Sampling a few days earlier or later probably would have missed the drastic changes in pond chemistry.

Snowmelt episodes also increased  $\text{NO}_3^-$  in the ponds (Figs. 28-30). Biological activity within the watershed normally would assimilate about 80% of the incoming nitrate (Driscoll and Likens, 1982). But in the cold conditions of late winter,  $\text{HNO}_3$  entering the lake from inlet streams may be a major source of increased acidity in the ponds. After ice out, biological activity may remove  $\text{NO}_3^-$ . The associated increase in productivity, in turn, may increase alkalinity. The increased acidity of the ponds during snowmelt seems to result solely from  $\text{HNO}_3$  since  $\text{NO}_3^-$  increased and  $\text{SO}_4^{2-}$  either did not change or decreased in the upper 2 m of the ponds during snowmelt (Figs. 28-30). Accompanying the increase in acidity in the epilimnion was a decrease in  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  (Figs. 31-33). This dilution of nonprotolytic cations intensifies the effect of the increase in  $\text{HNO}_3$  (Galloway et al., 1983). Because of greater quantities of water entering during snowmelt, weighted-average concentrations of aluminum increased in Black Mountain, Cone, and East Ponds (Figs. 2-4). Aluminum in the epilimnia of these ponds tended to respond to higher aluminum in the inlet streams (Appendix B).

Concentrations of DOC usually declined because of dilution during snowmelt (Fig. 33 and Appendix B). Since pH declined and aluminum concentrations remained nearly static, the aluminum in the ponds where DOC

BLACK POND

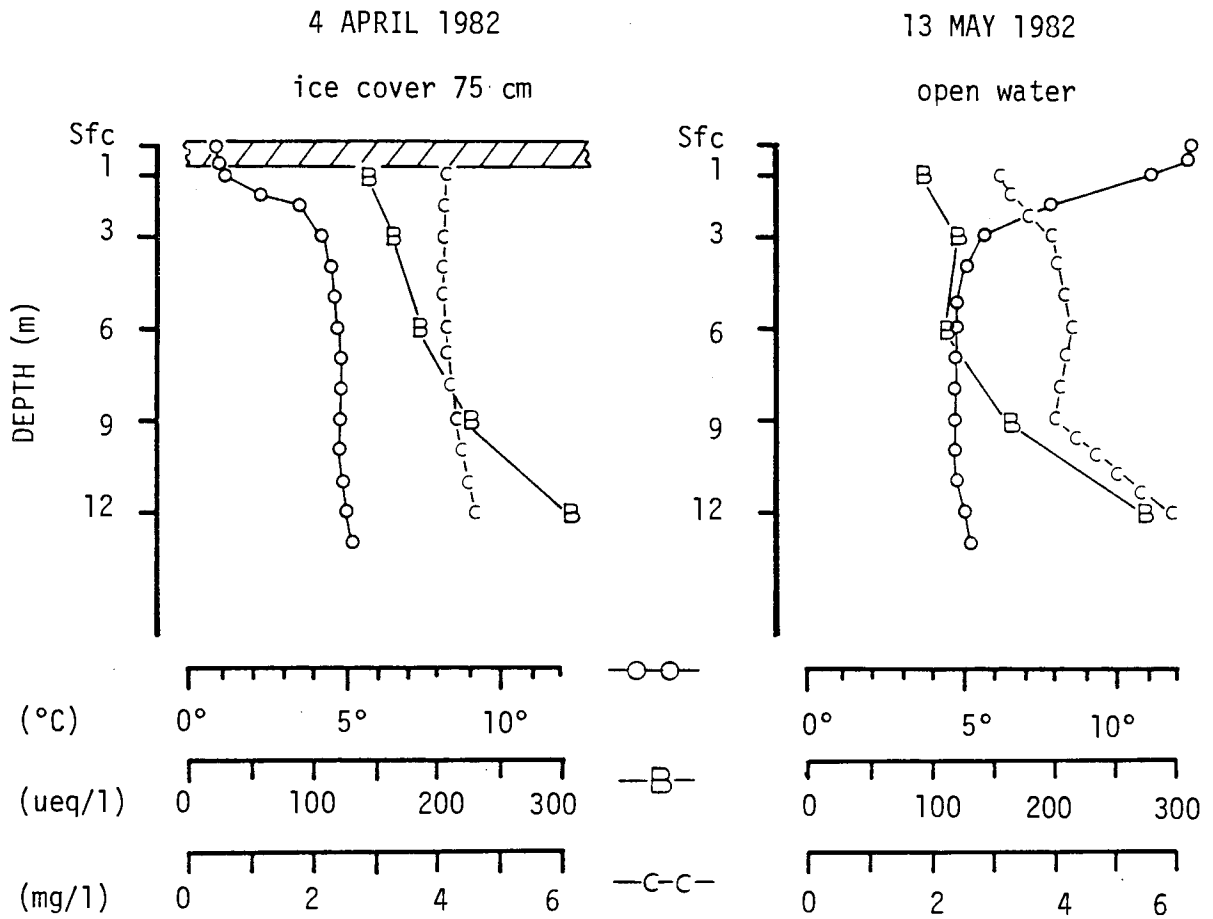


Fig. 31 Concentrations of DOC (-C-) and the sum of calcium and magnesium ions (-B-), as well as the temperature (-○-), compared in water-column profiles for Black Pond, taken on 2 visits in 1982. Profile samples were from 1, 3, 6, 9, and 12 m. Temperature profiles were determined at intervals of 0.5 to 1.0 m.

CONE POND

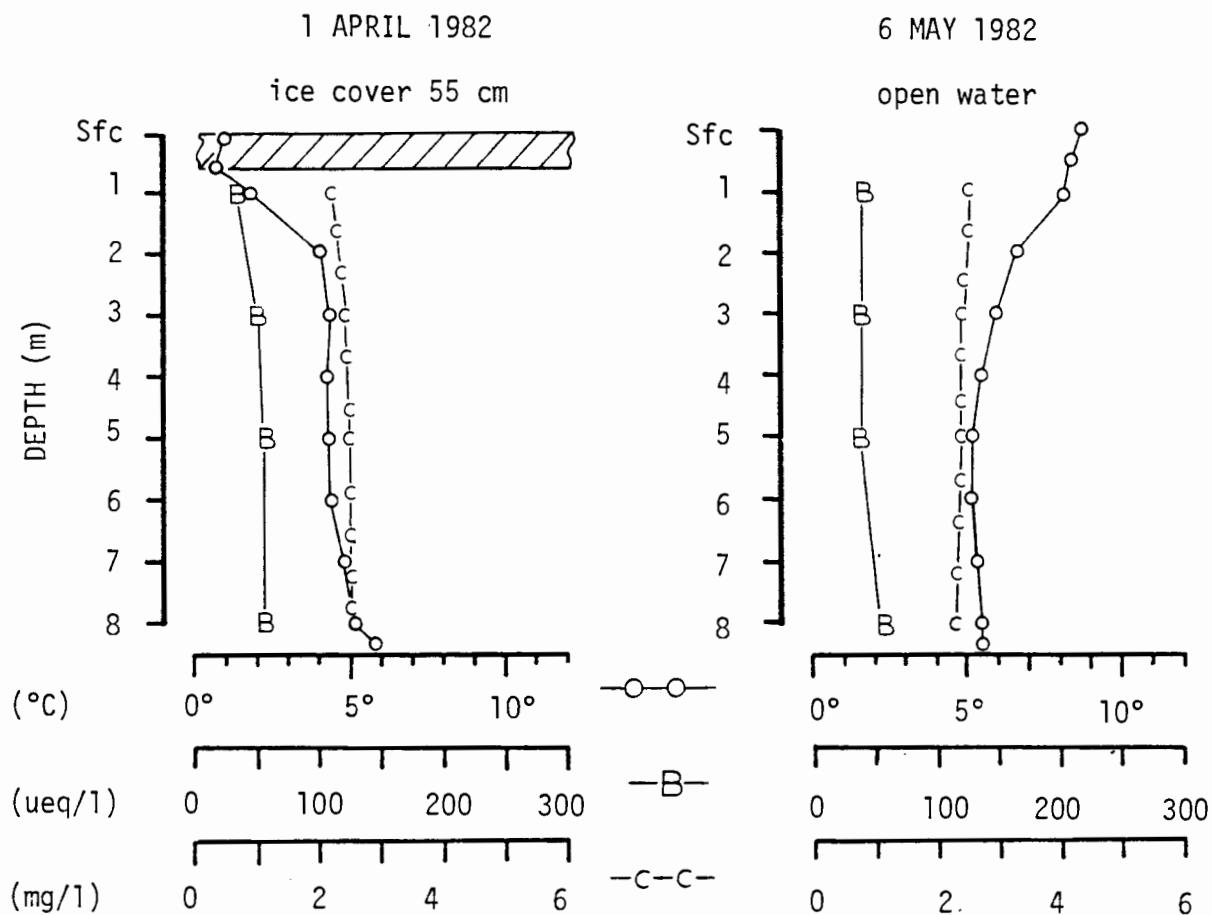


Fig. 32 Concentrations of DOC (-C-) and the sum of calcium and magnesium ions (-B-), as well as the temperature (-O-), compared in water-column profiles for acidic Cone Pond, taken on 2 visits in 1982. Water samples were from 1, 3, 5, and 8 m. Temperature profiles were determined at intervals of 0.5 to 1.0 m.

KIAH POND

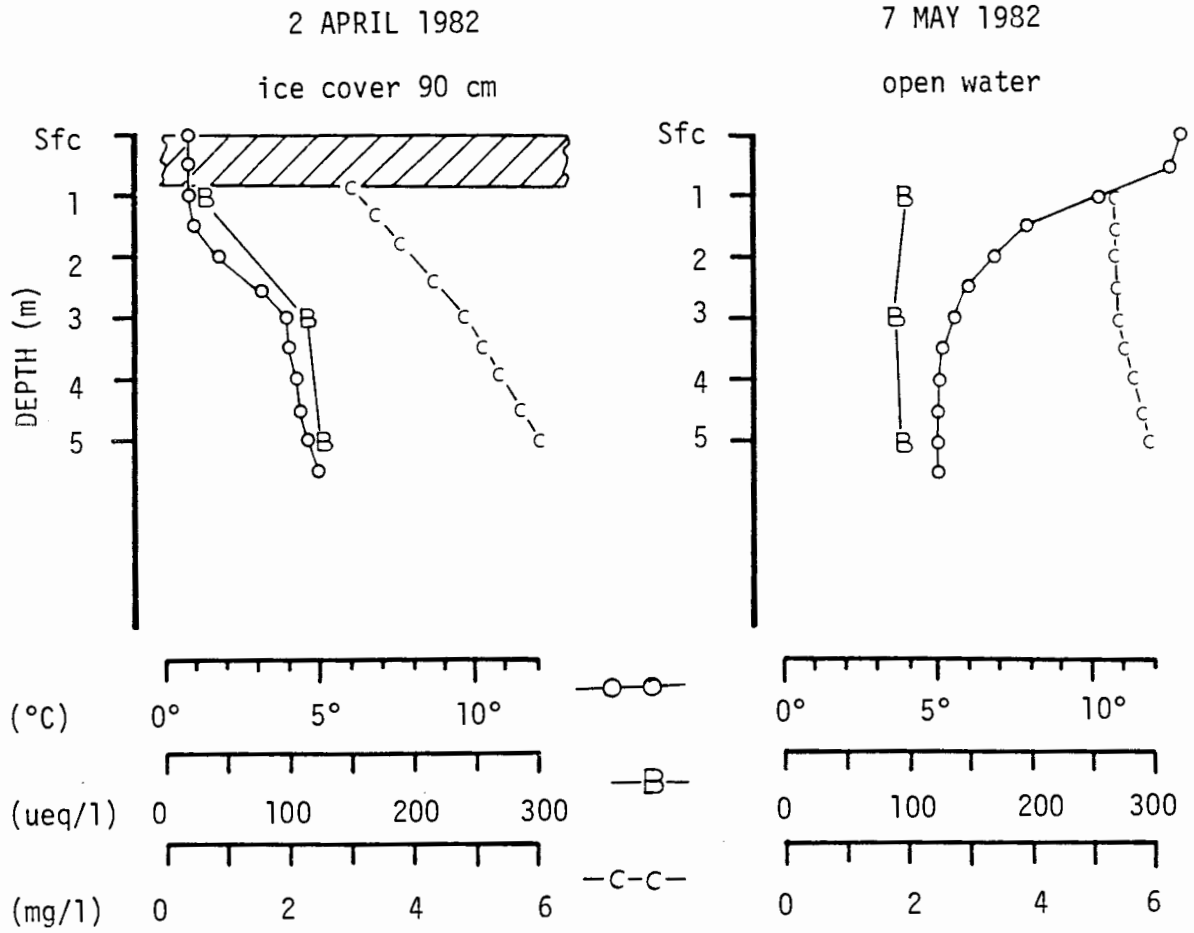


Fig. 33 Concentrations of DOC (-C-) and the sum of calcium and magnesium ions (-B-), as well as the temperature (-O-), compared in water-column profiles for Kiah Pond, taken on 2 visits in 1982. Water samples were from 1, 3, and 5 m. Temperature profiles were determined at intervals of 0.5 m.

was diluted by snowmelt may have changed forms, leading to possible toxic conditions.

The processes and spatial variation in near-surface water acidification need to be investigated more thoroughly. On the basis of 3 years of observations on the 6 study ponds, it seems clear that the snowpack tends to melt before the ponds turn over. This means that one must consider not only watershed size but the degree of density stratification and the morphology of the pond basin when modeling the effects of episodic acidic snowmelt water.

The volume-weighted data from this study show that late winter/early spring inputs do have a marked effect on overall pond chemistry. The study ponds may or may not have become more acidic in the past decades, but all have experienced some short-term, temporary acidification in the upper water as a result of snowmelt events.

#### Current Indexes of Acidification

Each pond is a complex system of biologic, geologic, and atmospheric interactions which vary seasonally and with depth. Thus, the best application of conceptual models may be to predict the susceptibility of ponds to acidification rather than attempt to predict levels of acidification. We have attempted to test susceptibility models for our study ponds.

#### Calcium vs pH Model

Henriksen (1979) plotted  $\text{Ca}^{2+}$  concentrations vs pH for lakes in southern Norway where precipitation pH is  $< 4.6$ , and for lakes in northern Norway where precipitation pH is  $> 4.6$ . An empirical curve was drawn

between the 2 data sets. Ponds that fell above and right of the line were acidified; ponds below and left of the line were not;  $\text{Ca}^{2+}$  vs pH data from our 6 ponds and their inlets and outlets were plotted on Henriksen's curve (Fig. 34). Data from 5 of the 6 ponds fell on both sides of the line. Only acidic Cone Pond fell completely on the acidified side. The model does not have much applicability in our area since all 6 ponds probably receive precipitation with similar chemical content.

#### Calcium vs Alkalinity Model

Henriksen (1979) developed a linear regression model comparing  $\text{Ca}^{2+}$  with alkalinity, assuming that all  $\text{Ca}^{2+}$  is complexed with  $\text{HCO}_3^-$ . His data were from 98 lakes in the Experimental Lakes Area (ELA) of northwestern Ontario, Canada. These lakes receive precipitation with a pH > 5.0 (Schindler et al., 1980). He corrected the alkalinity data by subtracting 32 ueq/l because the samples were overtitrated to pH 4.5.

Data on  $\text{Ca}^{2+}$  vs those on alkalinity from our ponds and their inlets and outlets were plotted against Henriksen's regression line (Fig. 35). The data points that fell above and left of the line were from highly stratified ponds and indicated excess alkalinity. The remainder of the samples fell below the line, indicating a deficiency of alkalinity. It appears that the 6 ponds contain 20 to 100 ueq/l less alkalinity than the ELA lakes. However, the precipitation in New Hampshire is 10 times more acidic than in the ELA.

This model implies that our 6 ponds may have lost alkalinity in the past and may be susceptible to future acidification. However it may not be valid to compare data from the ELA located on Precambrian Canadian gneisses and granites with those from lakes in New Hampshire underlain with

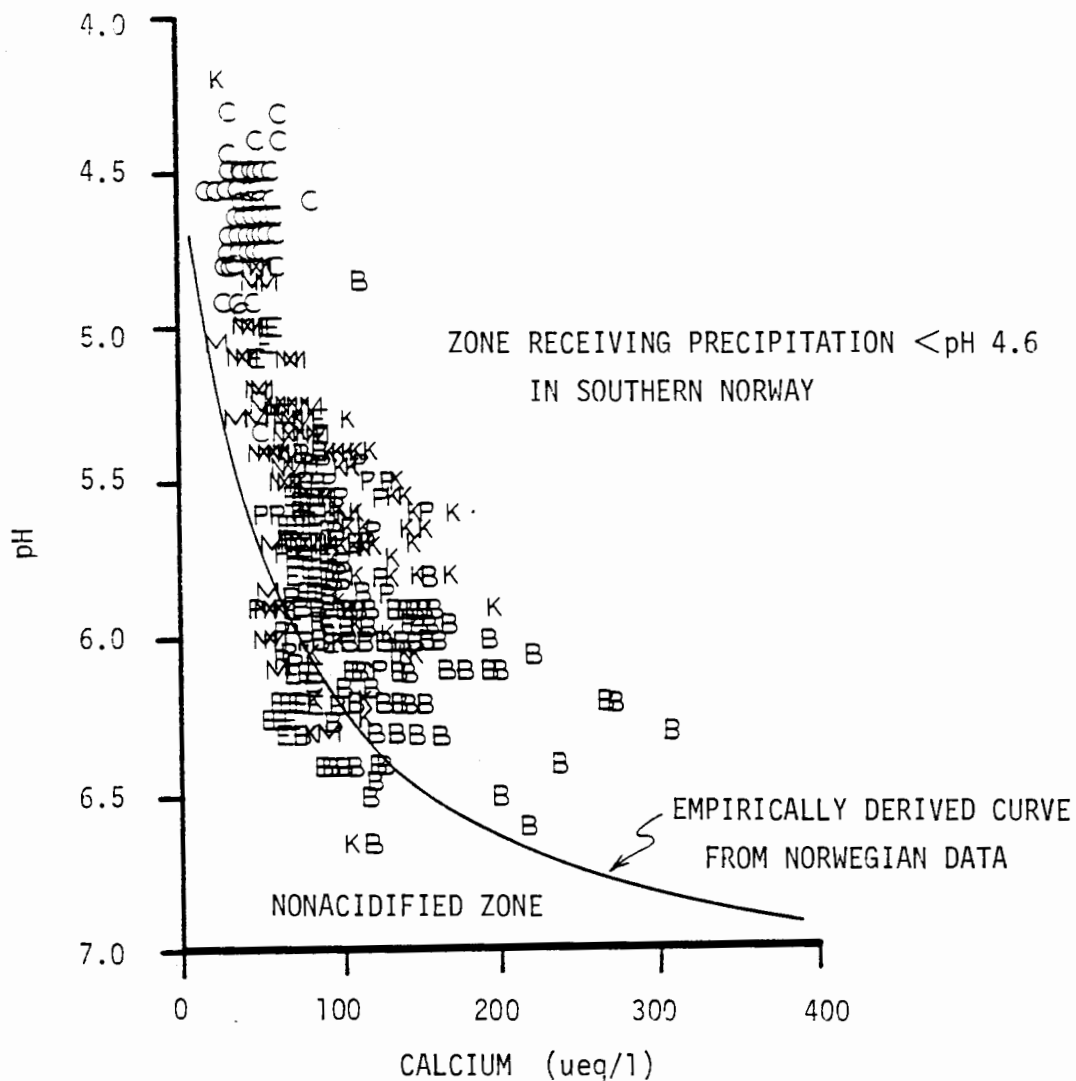


Fig. 34 pH plotted against calcium concentration applied to an empirically derived curve (Henriksen, 1979) that separates acidified from nonacidified regions in Norway. Data are from all of the New Hampshire study ponds, including inlets and outlets. Correction for seasalt contribution to  $Ca^{2+}$  is  $-1$  ueq/l based on average  $Cl^-$  of 18 ueq/l for all pond inlets.



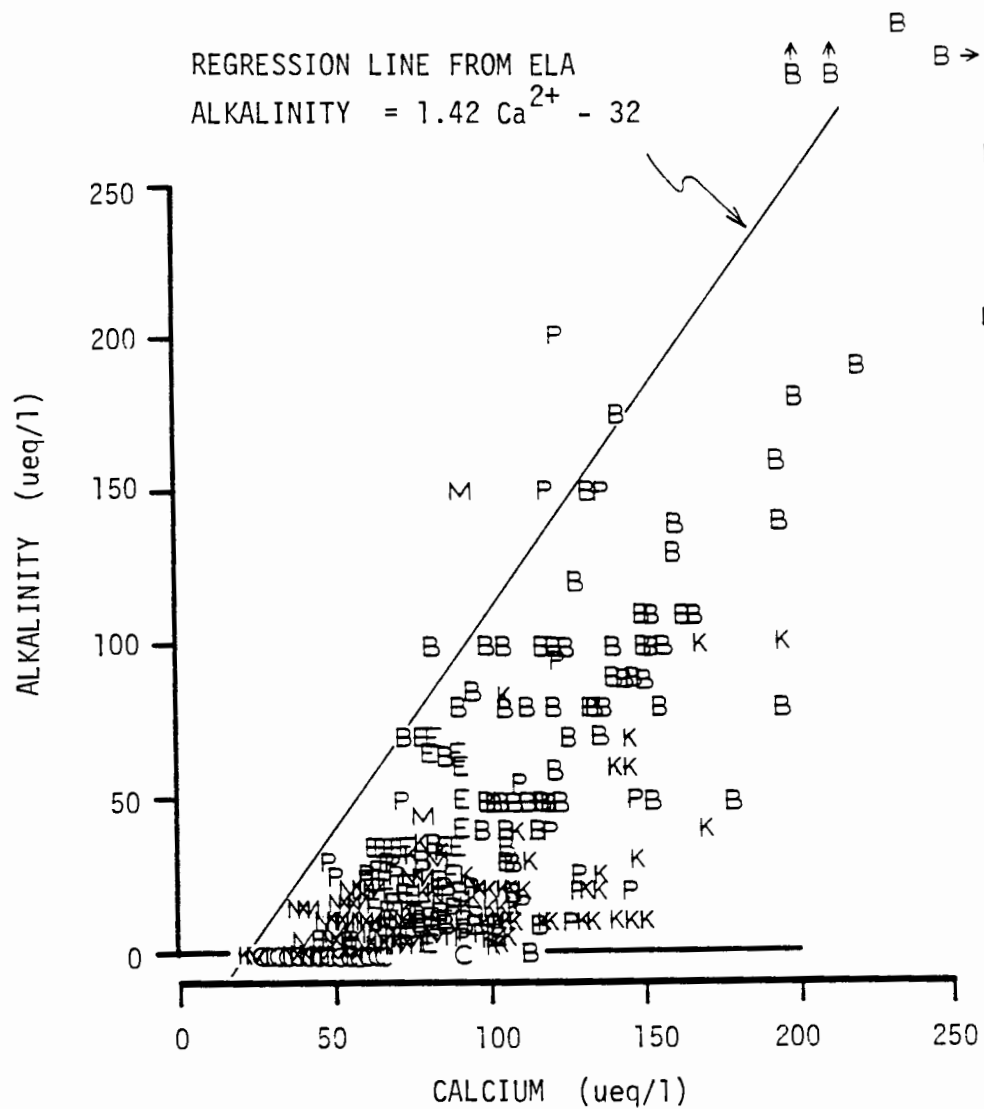


Fig. 35 Alkalinity plotted against calcium concentrations from all study ponds, including inlets and outlets. Regression line developed from Experimental Lakes Area (Ontario, Canada), where average precipitation pH is about 5.

Paleozoic granites and schists. Calcium weathering rates in these two regions may be different. Also, there may be significant amounts of calcium bound to organic ligands in the 6 study ponds, particularly in the more humic ones.

#### Sulfate vs Calcium Plus Magnesium Model

As a further refinement, Henriksen (1980) developed relationships that are used to predict the acidity of lakes and ponds. Data from lakes in southern Norway receiving incident precipitation of pH 4.6 or less were used to develop regression lines of  $\text{Ca}^{2+}$  plus  $\text{Mg}^{2+}$  with  $\text{SO}_4^{2-}$ . Samples from 58 lakes in this region, with a pH range from 5.2 to 5.4, were used to develop a regression line that defined the lower boundary of lakes still dominated by  $\text{HCO}_3^-$ . In the same region data from 207 lakes, with a pH range of 4.6 to 4.8 were used to develop a line that defined the upper boundary of those lakes now dominated by strong mineral acids. Lakes above the upper line are considered resistant to acidification; those between the lines are susceptible; those below the lower line are acidic.

Pond data from our study were applied to the Norwegian regression lines because there are not enough data from New Hampshire's small headwater ponds to construct a similar nomograph (Fig. 36). The ranges of ion concentrations in each of the 6 study ponds tend to span all 3 acidity classes on the nomograph. Again, this model simplifies the effects of spatial and temporal variability, and ignores the presence of dissolved organic material.

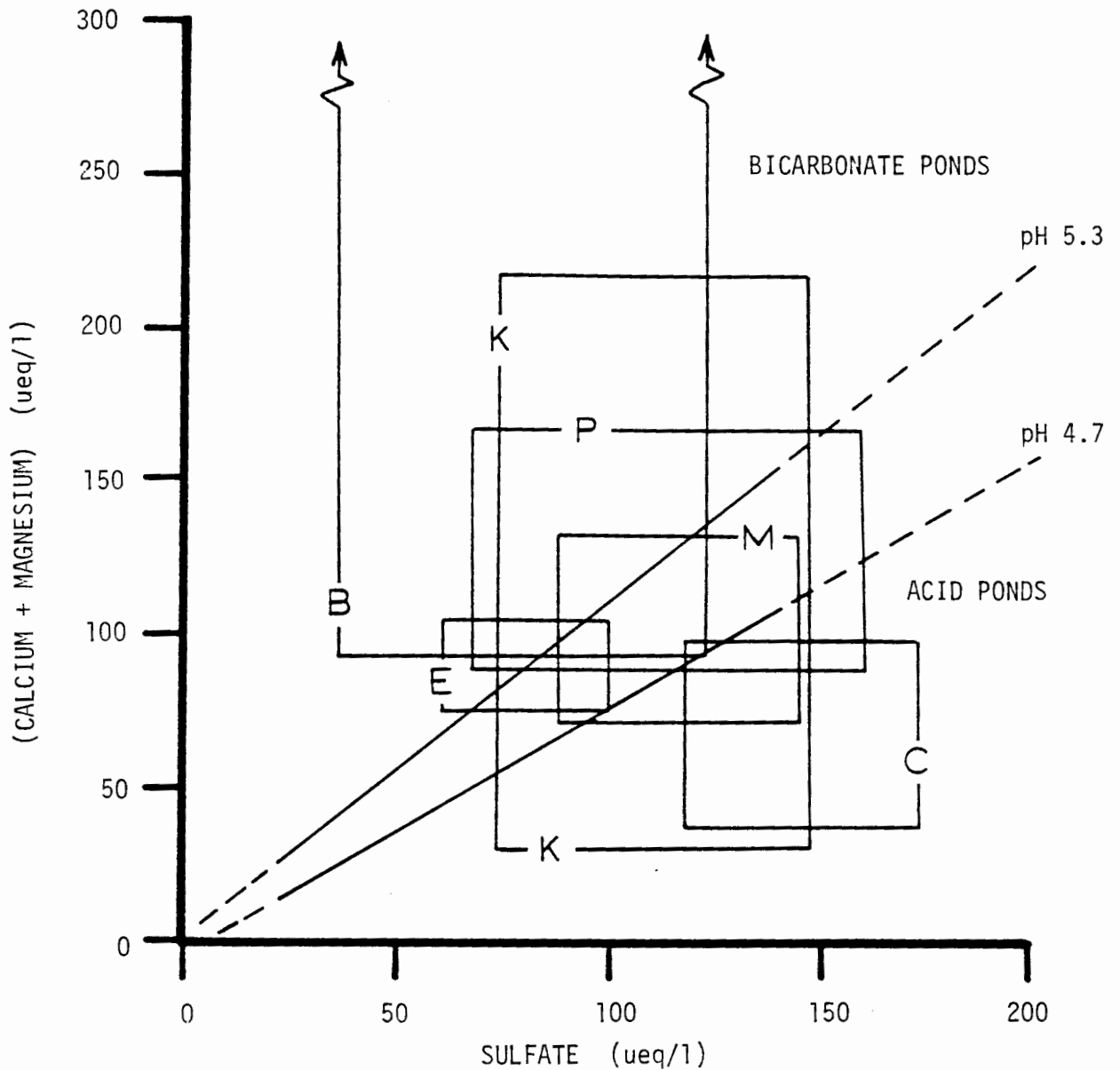


Fig. 36 Regression lines from Henriksen (1980) applied to data from study ponds. Regressions are based on sum of nonmarine  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  plotted against  $\text{SO}_4^{2-}$  in samples from lakes of known pH in southern (acidified) Norway. The pH boundaries for the Norwegian lakes were:

$$\text{pH } 5.3 \text{ line: } \text{Ca}^{2+} + \text{Mg}^{2+} = 1.13 \text{ SO}_4^{2-} - 5$$

$$\text{pH } 4.7 \text{ line: } \text{Ca}^{2+} + \text{Mg}^{2+} = 0.75 \text{ SO}_4^{2-} - 11$$

For New Hampshire data, corrections for seasalt are: -4 ueq/l for the sum of  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$ , and -2 ueq/l for  $\text{SO}_4^{2-}$ .

## Geologic Model

Norton has produced a map of New Hampshire that shows sensitivity to acid deposition. The map is based on the acid neutralizing capacity (ANC) of bedrock geology (NADP, 1982b). The criteria for the acid sensitivity indexes were very broad.

According to the map, Black and East Ponds lie on bedrock with low to no ANC (map type 1), and Black Mountain, Cone, Kiah, and Peaked Hill Ponds are underlain by geologic formations with medium to low ANC (map type 2). On the basis of our data, the chemistries for all 6 ponds seem to span the pH, alkalinity, and total calcium means and ranges used as criteria for map type 1 terrain. Yet, there are obvious and large differences in the chemistries of the ponds.

The sensitivity map is useful since it indicates that New Hampshire has extensive areas of terrain that are low in ANC. However, our data demonstrate that the map is not detailed enough to indicate the sensitivity of individual ponds.

## SUMMARY AND RECOMMENDATIONS

### Summary of Pond Susceptibility

#### Black Pond

Data on pH and alkalinity collected since 1951 are inadequate for determining if this pond is acidifying. Acidification by short-term snowmelt episodes are restricted to the dilute upper waters. The small watershed size, protected perimeter, basin morphology, and high concentrations of DOC may result in persistent stratification. The lower layers may be too well stratified, because of temperature and ionic strength gradients, to respond to episodic inputs. Under these lengthy anoxic conditions, the reduction and sequestering of  $\text{SO}_4^{2-}$  could produce significant amounts of persistent alkalinity. Storage of hypolimnetic alkalinity maintains relatively high whole-pond acid buffering capacity throughout the year. Levels of aluminum are low; most probably is complexed with abundant DOC, and is not biologically interactive. Both the internal cycles of the pond and the watershed appear to have the capacity to effectively ameliorate acid inputs.

#### Black Mountain Pond

As with Black Pond, pH and alkalinity data collected since 1951 are inadequate for determining if this pond is acidifying. However, it does appear to be susceptible to accelerated acidification and to short-term episodic acidity. Water clarity, exposure to winds, and cooler temperatures due to elevation prevent strong stratification. The watershed is steep and large in area relative to the pond, and soils are shallow.

Inlet waters are dominated by  $H^+$ ,  $SO_4^{2-}$ , and aluminum. While the pondwater evidently neutralizes these inputs slightly, ionic strength is very low, and DOC only moderate. Some hypolimnetic alkalinity is produced. Since stratification is relatively weak, this alkalinity is only seasonal, so the pond should be susceptible to acidification from precipitation and inlet waters. Beaver impoundments along the periphery seem to act as organic carbon sources, which could complex reactive aluminum in the inlets and delay flow to the ponds, which, in turn, may mitigate snowmelt episodes. The presence of the beaver flowage is critical to the neutralization of atmospheric inputs, and assures the continued viability of the fishery in this pond.

#### Cone Pond

Cone Pond already is acidic, and evidence for a change in that acidity since 1951 is unclear. Examination of a sediment core revealed that the acidobiontic diatom species had not increased within recent history (Ford, 1980). Also, there was a viable fish population until its removal in 1963 (see Appendix A). Lack of buffering and elevated aluminum and sulfate in the watershed may be related to a forest fire that denuded the catchment in the 19th century, and/or to the weathering of acidic materials exposed on the extensive rock outcrops. In some years, weak stratification may produce enough hypolimnetic alkalinity to influence the cycles of aluminum and DOC after mixing. Currently, the major influences in the pond are the exceptionally large  $H^+$ ,  $SO_4^{2-}$ , and aluminum inputs from its watershed. Even this acidic pond responds to even stronger episodic acidity in the upper waters during snowmelt.

### East Pond

Data for East Pond date to 1934. However, the recovery of this pond from a diatomite mining operation may be masking the effects of acid deposition. Inputs from the relatively large and aluminum-rich watershed may be channeled into the pond by subsurface flow. The chemistry suggests this in that values for many ions, especially  $\text{SO}_4^{2-}$  and  $\text{Cl}^-$ , tend to be uniform, spatially and temporally. Late-winter, near-surface acidification can take place, but this hydrogen ion input usually is balanced by temporary alkalinity produced in the hypolimnion, which is stratified only during that period. Because ionic strength and DOC are very low, and aluminum values moderately high, it would seem that the chemical and physical stability of the groundwater entering the pond is very important to the biota of this pond.

### Kiah Pond

Data on pH and alkalinity collected since 1951 are inadequate for determining if this pond is acidifying. Kiah Pond may be acutely susceptible to dramatic short-term acidic events. During high-volume snowmelt episodes, the magnitude of late-winter stratification evidently is not great enough to prevent mixing of acidified inlet waters with much of the pond. DOC produced in the inlet beaver swamp has a strong influence on light penetration and hypolimnetic alkalinity produced during stratification. This alkalinity seems to be lost during each mixing cycle, but is augmented by substantial inputs from the watershed. Aluminum concentrations are relatively low, probably chelated by organic ligands, and not available to influence biological activity. Stream-water chemistry

may regulate the pondwater chemistry in this case. The large watershed and beaver swamps apparently neutralize most acidic atmospheric inputs before they reach the pond, except during snowmelt. Acidic snowmelt potentially mixes more deeply into Kiah Pond because of the large size of the inlet stream.

#### Peaked Hill Pond

No long-term acidification can be justified for Peaked Hill Pond since 1951, though short-term acidification does occur, with possible consequences for the biota. The pond is strongly stratified under the late winter ice, and the production of temporary alkalinity effectively blocks substantial mixing of episodic inputs. But the low volume of deep water, coupled with anoxia, leaves little room for aerobic life to exist without stress. High levels of DOC, enhanced by beaver activity in the watershed swamps and littoral zone of the pond, probably eliminates inorganic, toxic aluminum.



## Recommendations

1. For reasons of practicality and economy, past sampling for chemical content of remote, headwater ponds in New Hampshire has been largely limited to annual, surface-water, grab samples. Our study showed that the ponds are too dynamic and complex to be characterized by such infrequent sampling. To fully characterize pond susceptibility to acid precipitation, samples must be taken at seasonal intervals over several years. Moreover, samples must be collected at several depths in the water column, and in pond inlets and outlets.

2. pH and alkalinity are easily obtained indicators of acidity, but more information is needed to understand the susceptibility of a pond to acidification. At a minimum, specific conductance,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{SO}_4^{2-}$ , aluminum, and DOC should be measured. Low specific conductance is related to low buffering capacity at a  $\text{pH} > 5$ . High  $\text{SO}_4^{2-}$  indicates acidification, but only when  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  are low. Aluminum concentrations will increase in acidified waters, but any toxic effects may not if sufficient DOC is present to chelate the aluminum. The variability of any of these indicators is critical to the assessment of acidification.

3. Care should be taken in the use of historic pH and alkalinity data for comparative purposes. The methods used by the original investigators should be researched and tested thoroughly. Conclusions regarding the possibility of changes must be considered with potential natural variability in mind.

4. Generation of hypolimnetic alkalinity may be greater in ponds that have higher rates of productivity, are more strongly stratified, and can support an anoxic metabolism for long periods. Whether this alkalinity is persistent or is lost during turnover is a function of the degree of mixing in the spring and fall. An understanding of pond trophic condition and morphology is needed to assess this potential acid-neutralizing capacity for each pond considered.

5. Strong acidity from snowmelt usually affects only the upper waters of ponds under the winter ice cover. It is not clear how much or when these stratified acid inputs mix into the water column. However, brief incidents of turbulent mixing can appreciably lower the pH of the whole pond. Short-term pond acidification from snowmelt is more obvious than long-term, cumulative, whole-pond acidification. Pond acidification during snowmelt can be studied adequately only with an intensive sampling design.

6. The characteristics of the watershed, including geologic materials, soils, vegetation, soil-water residence time, and runoff pathways, all contribute to the chemistry of a pond. They may neutralize acidic inputs in a variety of ways, or even contribute to acidity. Apparent similarities, used to classify pond susceptibility on a regional basis, often fade in importance when examined closely. Pond-watershed interactions must be an integral part of any studies of pond acidification.

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APPENDIX A: POND AND WATERSHED DESCRIPTIONS

## DEFINITIONS AND EXPLANATIONS OF TERMS

### Pond Maps

All elevations were interpolated from the most recent U. S. Geological Survey maps. Pond area and the area of each depth stratum were measured by dot-grid enumeration on base maps drawn from air photos (Avery, 1966). Bathymetry was determined by depth-sounder transects. A weighted line was used to check the maximum depth found during sonar transects.

The 2-m depth contour was chosen as the delineation of shoal area. The combination of emergent, floating-leaved, and shallow submersed aquatic macrophytes tends to make the 0- to 2-m depth the most productive (Collins and Likens, 1969; Moeller, 1975; Wetzel, 1975).

The theoretical mean depth is the volume divided by the area of the pond; the relative depth is the ratio of the maximum depth to the theoretical mean diameter (Wetzel and Likens, 1979). Large, shallow lakes have relative depths of much less than 1%, while small, deep lakes can exceed 10% (Wetzel, 1975).

The volume of each stratum was estimated by using the areas of the upper and lower surfaces of that stratum, and by assuming that it was a regular, truncated cone 0.5 m or 1 m deep (Wetzel and Likens, 1979). The volume of the pond was taken to be the sum of all the strata. Accuracy is probably about  $\pm 10\%$  (see Methods section in body of report).

Maximum length of the pond is associated with a directional vector because the orientation of the basin relative to prevalent winds is an important factor when considering stratification (Wetzel, 1975). Shoreline length was measured by planimetry on the base maps.

Shoreline complexity (or development) is the ratio of the pond shoreline length to the circumference of a theoretical circle with the same area as the pond surface (Wetzel and Likens, 1979). A round pond would have a value of 1; ponds with dendritic basins might approach 10 in extreme cases (Hakanson, 1978).

#### Watershed Maps

Watershed area and the areas of any inlet catchments were determined by dot-grid enumeration (Avery, 1966) on maps prepared from U. S. Geological Survey 7.5' Series topographic sheets. Boundary delineations were checked with aerial photography and field observations.

The area of the pond divided by the land catchment around it, is the pond/watershed area ratio (expressed in percent). In simple lake-mixing models, ponds with ratio values of less than 10% often have an equilibrium chemistry that more closely reflects the concentrations found in their watershed streams (Dingman and Johnson, 1971).

The mean slope of the drainage basin was estimated by multiplying the total length of contours on the map by the contour interval and dividing by the basin area (Wisler and Brater, 1949).

Springs are defined as points of water issuance, with no evident channel for surface flow. Subsurface flow is defined as a situation where flowing surface water disappears into the substrate. Evidence for the likelihood of overland flow includes: unchanneled gravel or sand alluvium; redistribution of debris on the forest floor; disturbance of the layer of soil litter.

## Pond and Watershed Summaries

Areas of exposed bedrock or wetlands, vegetation coverage, and individual stand sizes were measured by dot-grid enumeration on scaled aerial photography (Avery, 1966).

Personal observations by the senior author on the presence of fish species are based on fishing experiences, sightings in shallow water, or collection of dead specimens. The scientific names for those species reported are:

Brook trout	<u>Salvelinus fontinalis</u> (Mitchill)
Brown bullhead	<u>Ictalurus nebulosus</u> (Lesueur)
Blacknose dace	<u>Rhinichthys atratulus</u> (Hermann)
Chain pickerel	<u>Esox niger</u> (Lesueur)
Golden shiner	<u>Notemigonus crysoleucas</u> (Mitchill)
Lake chub	<u>Couesius plumbeus</u> (Agassiz)
Pumpkinseed sunfish	<u>Lepomis gibbosus</u> (Linnaeus)
Yellow perch	<u>Perca flavescens</u> (Mitchill)

Estimations of recreational pressure are only descriptive. They are based on the number of people encountered, and on any obvious disturbance or abuse of the area seen during the 15 or more visits to each pond.

Data from this study or from state, federal, university, and private files (primarily DO<sub>2</sub> and temperature profiles) were examined before generalizations on the strength and timing of pond stratification were formulated.

Shoreline composition was either mineral (rocks, gravel, sand) or organic (muck, littoral vegetation, swamp), measured in meters, and expressed as percent of total shoreline length. It was determined by aerial photography and field checked during the bathymetric surveys.

Comments on the distribution and abundance of aquatic macrophytes are purely subjective and designed only to familiarize the reader with the overall appearance of the pond. On-site observations and color 35-mm aerial photography from late summer are the basis for the descriptions.

The level of beaver activity was noted during each visit. A check was made for the presence of new materials on dams and lodges, and the perimeter of the pond was checked for fresh cuttings.

The bedrock of all of the watersheds is noncalcareous and composed largely of silica oxides and aluminum oxides (Billings and Wilson, 1965). The descriptions of the surficial geology were derived from personal observations and from the Ecological Land Types of the White Mountain National Forest Ecosystem inventory report (USDA, 1978). The predominant soils of all of the watersheds are rocky or stoney, fine sandy, loamy spodosols. The soil descriptions were taken from soil surveys conducted by the USDA Soil Conservation Service (SCS, 1977 and personal communications), by the USDA Forest Service (USDA, 1978), and by personal observations. The vegetation descriptions were compiled from personal observations and from the compartment files of the Pemigewasset Ranger District, USDA Forest Service, Plymouth, New Hampshire.

## BLACK POND

### Bedrock Geology

The bedrock is a coarse grained granite (Mt. Osceola Granite), composed chiefly of K-feldspar and quartz, with minor amounts of olivine, pyroxene, and amphibole (Billings and Williams, 1935). These minor mineral constituents impart a dark color to fresh material, but often are altered hydrothermally to light-colored secondary minerals (Billings, 1956).

### Surficial Geology

The watershed is underlain by deep till, with rounded boulders and cobbles deposited from glacial ice sheet ablation, probably derived from a variety of nearby igneous and metasedimentary bedrocks. Little bedrock is exposed in the watershed.

### Soils

A deep, well-drained, bouldery or cobbly spodosol is predominant. Siltier spodosols on the lower slopes tend to have a pan layer. There is a small inclusion of a histosol in the inlet stream swamp.

### Vegetation

A stand of mixed softwoods and hardwoods, dominated by white pine and red spruce, surrounds the pond. The bulk of watershed cover consists of a second growth forest of sugar maple, beech, and yellow birch, with scattered aspen and softwood. In the swamp on the inlet stream is a deteriorating spruce and fir stand. Forest cover is 100% of watershed.

### Fisheries

Fish species present include brook trout, brown bullhead, and lake chub (Kuzmeskus et al., 1981). It has been stocked with fingerling brook trout since 1949 (about 33,000 fish) (N. H. Fish and Game Department, open files). No spawning was observed, but subfingerling trout were seen in the inlet stream during the study.

### Landuse History

The watershed apparently was uncut until about 1895 when the East Branch and Lincoln railroad was extended up the Pemigewasset River from Lincoln (Belcher, 1980). A dugway road leads directly to the outlet of the pond from an old logging camp along the railbed. The extensive fires of 1907 burned nearby Owl's Head and Bond Cliff, but apparently stopped short of the cutover catchment. The USDA Forest Service purchased the land from the Parker-Young Company in 1936 (USDA Forest Service files, Laconia, New Hampshire).

The perimeter of the pond is now a Restricted Use Area of the White Mountain National Forest. Recreational use is heavy year round. Access is by foot, from the Kancamagus Highway over 6 km of the Pemigewasset Wilderness Trail.

### Pond Synopsis

This is a softwater pond, strongly humic in appearance. The volume-weighted pH ranges from 5.3 to 6.4. It is perennially stratified, with a severely clinograde oxygen curve (often with an anoxic hypolimnion), an orthograde salinity curve, and a strong seasonal temperature gradient. It does not turn over in some years, probably due to a combination of the



small watershed, small surface area, great depth, sheltered position, and lack of transparency.

The shoreline is about 10% mineral and 90% organic in composition. Ericaceous shrubs and drowned woodland skirt the perimeter of the littoral zone. Floating-leaved, aquatic macrophytes are scattered about the shoal areas; few emergent or submersed macrophytes are obvious.

Beavers play an important role in maintaining the present high pool level. The colony has begun cutting and building in the wooded swamp on the inlet stream. This stream develops a humic color while passing through the swamp.



# BLACK POND

1983



depth contours  
in meters

LOCATION: N 44<sup>o</sup> 06' 30" W 71<sup>o</sup> 35' 00"

MT. OSCEOLA 5.7' SERIES QUADRANGLE (1967)

TOWN OF LINCOLN, GRAFTON COUNTY, NEW HAMPSHIRE

ELEVATION: 480 m

SURFACE AREA: 1.7 ha

SHOAL AREA: 33%

MAXIMUM DEPTH: 13.5 m

MEAN DEPTH: 5.3 m

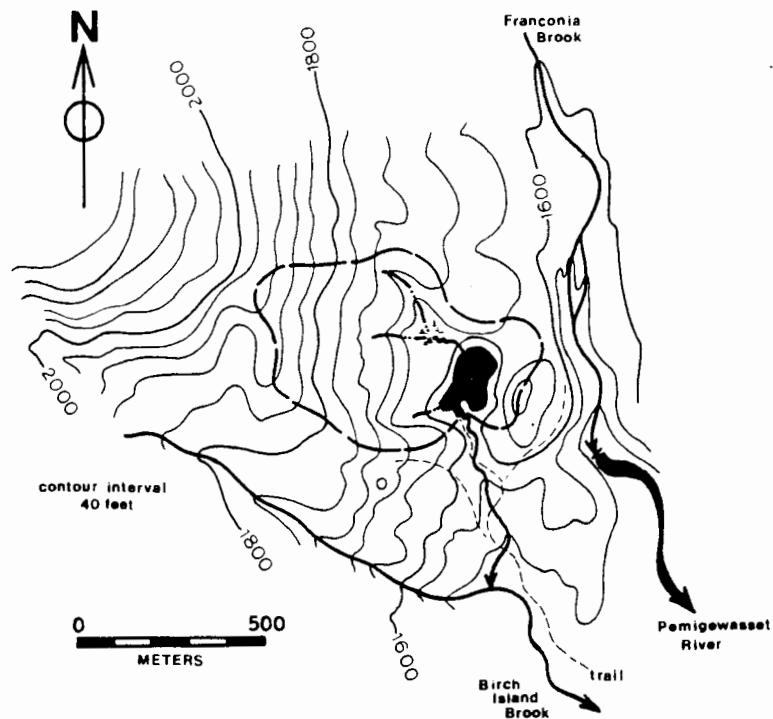
RELATIVE DEPTH: 9.2%

VOLUME:  $92 \times 10^3 \text{ m}^3$

MAXIMUM LENGTH: 210 m at N 45<sup>o</sup> E

SHORELINE LENGTH: 680 m

SHORELINE COMPLEXITY: 1.4



### BLACK POND

WATERSHED AREA: 25 ha (not including pond)

POND AREA: 1.7 ha

POND/WATERSHED AREA RATIO: 6.8%

HIGHEST ELEVATION: 590 m

MEAN SLOPE: 23%

ASPECT: FACING ESE

INLETS: One perennial stream with 18-ha drainage enters at NW edge;  
ephemeral stream with 4-ha basin a SW corner.

SPRINGS: None Obvious.

SUBSURFACE FLOW: None obvious.

OVERLAND FLOW: No evidence of significant amounts.

WETLANDS: 0.5-ha wooded swamp on perennial inlet, 100 m upstream of pond;  
perimeter of pond flooded by beaver dam at outlet.

OUTLET: Brook flows S, a tributary of Birch Island Brook, and the E Branch  
of the Pemigewasset River.

CONTROLLING STRUCTURES: Two sequential beaver dams at outlet have raised  
the pool level about 0.5 m above outlet streambed.

## BLACK MOUNTAIN POND

### Bedrock Geology

The bedrock is a highly variable, quartz-mica schist, or mica-schist (Littleton Formation) composed of biotite and quartz, with accessory amounts of plagioclase feldspar, sillimanite, and occasional garnet. Fractured surfaces often are stained with iron. A coarse, porphyritic granite lobe (Kinsman Quartz Monzonite), lying along the SE shoreline, is composed of quartz, K-feldspar, plagioclase feldspar, and biotite (Moke, 1945).

### Surficial Geology

The till grades from thin to deep bouldery colluvium accumulated around the pond. About 24% of the watershed is barren rock ledge, with pockets of bouldery debris and numerous fractured surfaces and rock slides. Deposited drift probably is from local bedrock.

### Soils

A shallow, well-drained, rocky spodosol grades from the sparsely covered ridge (Rock outcrop-Lyman association), through a steep slope (Lyman-Rock outcrop-Berkshire association), to a deeper, colluvial spodosol in the pond perimeter (Lyman-Berkshire association). An area of deep histosol is located in the drainageway entering at the NW corner of the pond (Chocorua-Mucky Peat).

### Vegetation

The forest is mainly an association of red spruce, balsam fir, and paper birch of mixed ages and conditions. A distinct stand of paper birch, yellow birch, mountain maple, and red maple occupies a 20-ha area NE of the pond. Vegetation coverage is only about 75% of the watershed, with the remainder barren bedrock ledge.

### Fisheries

The only fish species present is the brook trout (Kuzmeskus et al., 1981). An introduced population of golden shiners apparently was eradicated by rotenone poisoning in 1952 (N. H. Fish and Game Department, open files). It has been stocked with fingerling brook trout since 1946 (about 60,000 fish) (N. H. Fish and Game Department, open files). Spawning of trout was observed in the gravel shoals along the NE shoreline in October 1982, but no subfingerlings were noted during the study.

### Landuse History

There is no clear record of logging activity in the watershed. The forest may have been passed over in the 19th century because of its remote location and poor grade of timber. Black Mountain was described in 1903 as being barren along the ridge top, and as having a low volume of mixed softwoods along the lower slopes (Chittenden, 1903). Four logging companies owned the property from 1904 to 1943 (USDA Forest Service files, Laconia, N. H.). The only nearby areas cut by these companies were stands just below the pond, and the next valley E of the watershed (USDA Forest Service files, Plymouth, N. H.).

The predominance of larger paper birch in the NE part of the watershed suggests a history of major disturbance, either in a single, catastrophic event (landslide, fire) or continuous instability (soil creep). Cores from selected large individuals show that the stand originated between 1830 and 1860.

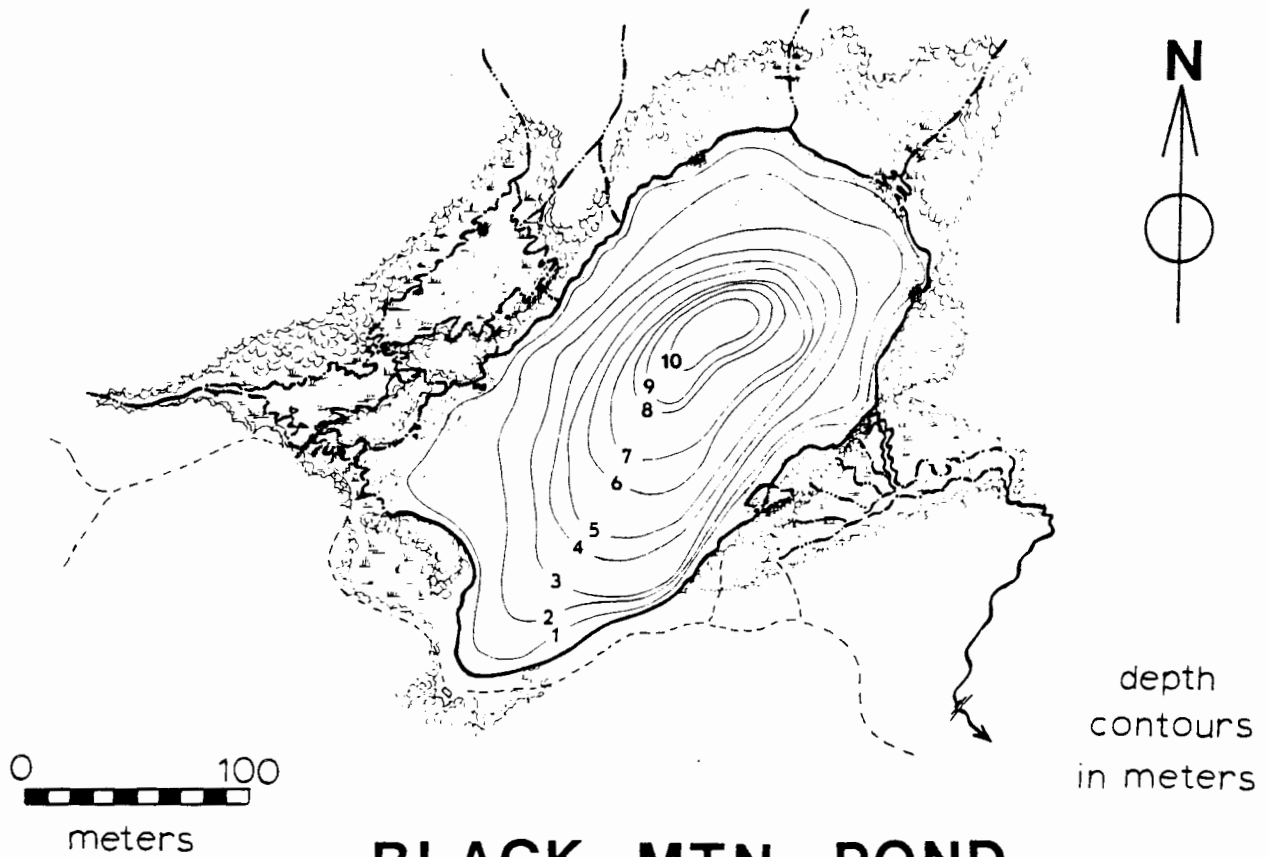
The land was donated to the USDA Forest Service in 1950 by the estate of G. J. Meade (USDA Forest Service files, Laconia, N. H.). A lean-to shelter along the W shore of the pond serves as a focal point for recreation. Summer use is heavy; winter use is light. Access is by foot, from the Sandwich Notch Road over 4 km of the Algonquin Trail and from numerous old logging roads.

#### Pond Synopsis

This is a softwater pond with mild humic coloration. The volume-weighted pH ranges from 5.1 to 6.0. It is weakly stratified and dimictic, with a clinograde oxygen curve usually during the late winter or summer stagnation. Stratification during the ice-free season can be ephemeral. The pond is prone to destratification during high winds due to its exposed position on a relatively high-elevation mountain bench.

The shoreline is about 80% mineral and 20% organic in composition. Emergent and floating-leaved aquatic macrophytes are scattered about the shoal areas, but are not obviously abundant. Patches of submersed macrophytes cover the sediments in waters less than about 5 m deep.

Beavers have had a significant impact on this pond. The large colony maintains the lengthy outlet dam, has built several dams between the N shoreline and 2 shallow, humic impoundments, and has constructed smaller structures on virtually all of the ephemeral inlets.



# BLACK MTN POND

1983

LOCATION: N 43° 53' 00" W 71° 30' 30"

WATERVILLE VALLEY 7.5' SERIES ADVANCE SHEET (1979)

TOWN OF SANDWICH, CARROLL COUNTY, NEW HAMPSHIRE

ELEVATION: 675 m

SURFACE AREA: 3.1 ha

SHOAL AREA: 31%

MAXIMUM DEPTH: 11.0 m

MEAN DEPTH: 3.6 m

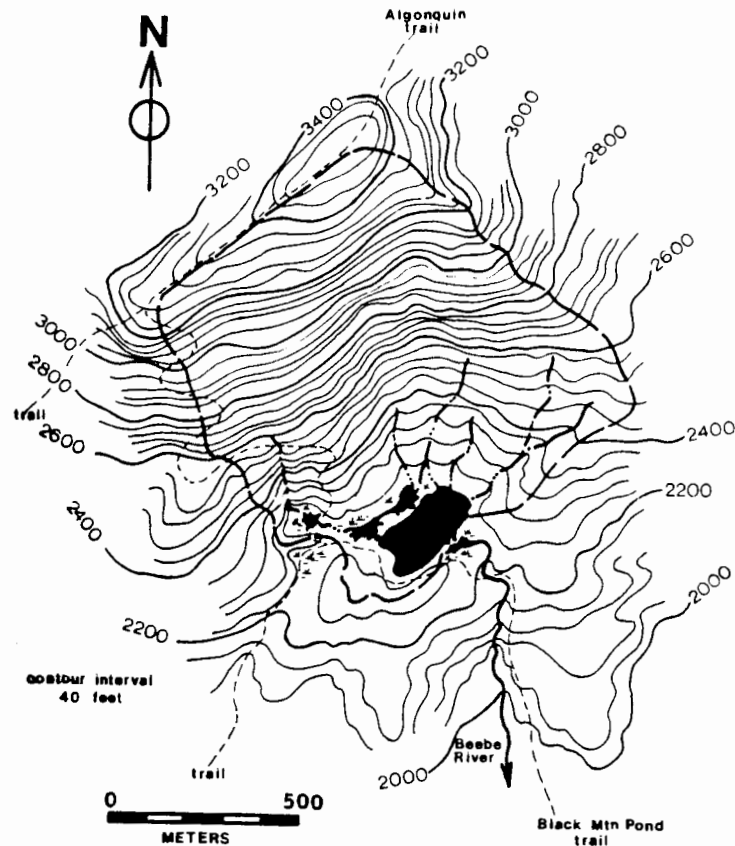
RELATIVE DEPTH: 5.6%

VOLUME:  $111 \times 10^3 \text{ m}^3$

MAXIMUM LENGTH: 280 m at N 28° E

SHORELINE LENGTH: 870 m

SHORELINE COMPLEXITY: 1.4



### BLACK MTN. POND

WATERSHED AREA: 85 ha (not including pond)      POND AREA: 3.1 ha

POND/WATERSHED AREA RATIO: 3.6%

HIGHEST ELEVATION: 1065 m      MEAN SLOPE: 45%      ASPECT: FACING S

INLETS: All inlets ephemeral; N and NW streams coalesce in beaver flowage to form perennial inlet at NW corner of pond; drainage areas indistinct due to the many vertical ledges.

SPRINGS: None obvious.

SUBSURFACE FLOW: Ephemeral stream flows from NE basin tend to disappear into gravel substrate 10 to 50 m from pond edge.

OVERLAND FLOW: Lower reaches of ephemeral watersheds have extensive deposits of gravel, fine sand, and woody debris, indicating flash flooding.

WETLANDS: A 0.25-ha beaver swamp 50 m up NW inlet, at base of cliff, joins with 0.75-ha flowage, filled to 0.5 m deep, connected to pond at NW corner over 1.5-m-high beaver dam.

OUTLETS: Leaks along SE edge of pond form a stream, which is the beginning of the Beebe River.

CONTROLLING STRUCTURES: 75 m of SE edge of pond dammed by beaver cuttings laid on top of a natural rock sill; beaver construction is ubiquitous.



## CONE POND

### Bedrock Geology

Primarily a highly variable, quartz-mica schist, or mica-schist (Littleton Formation; see Black Mountain Pond), with numerous, scattered intrusions of porphyritic granite (Kinsman Quartz Monzonite; see Black Mountain Pond), containing occasional pegmatite seams (Moke, 1945).

### Surficial Geology

Pockets of till, or a veneer of fractured, angular, bouldery colluvium cover the bases of steep slopes and small depressions. This material is derived from local bedrock types. About 13% of the watershed is barren bedrock ledge.

### Soils

A shallow, well-drained, rocky spodosol is scattered between the numerous ledges (Lyman-Berkshire-Rock outcrop association, or Lyman-Herman-Rock outcrop association). A layer of charcoal covering the bedrock or the mineral soil horizon can be found in many locations. The wooded bog on the inlet stream covers a deep histosol.

### Vegetation

The pond perimeter has an overstory forest of paper birch, yellow birch, red maple, and white pine, with an understory of red spruce, hemlock, and balsam fir. Among the many rocky ledges of the upper watershed, the spruce, hemlock, and fir association dominates. Ericaceous shrubs are notably abundant. Only 87% of the watershed is vegetated.

### Fisheries

The presence of brown bullhead, yellow perch, and chain pickerel was reported in 1938 (Hoover, 1938). The fish population, composed entirely of yellow perch, was eradicated by rotenone poisoning in 1963. Brook trout were stocked from 1964 through 1968 (about 2,500 fish). There was no observed survival; further stocking was cancelled in 1970. There are no fish in the pond (N. H. Fish and Game Department, open files, and USDI Fish and Wildlife Service, open files).

### Landuse History

In the lower watershed, loggers cut the easily accessible softwoods in the 19th century, cut the accessible hardwood in the early 20th century, and removed some of the second-growth softwood about 1933. The USDA Forest Service purchased this area from F. C. Tobey at that time. The upper watershed forest was of no commercial value due to an intense fire about 1820 that burned off much of the timber, leaving the mountain top barren of even organic soil. Charcoal fragments can be found scattered throughout the entire catchment. In 1920, the USDA Forest Service purchased the upper watershed area from the Publishers Paper Company (USDA Forest Service files, Laconia, N. H.).

Recreation use is slight; only tyros fish the pond. Access is by foot, from Sugar Run Estates over a 1.5 km trail (Red Trail), mostly on private land.

### Pond Synopsis

This is an acidic, clearwater pond. The volume-weighted pH ranges from 4.5 to 4.8. It is dimictic, moderately stratified, with a clinograde

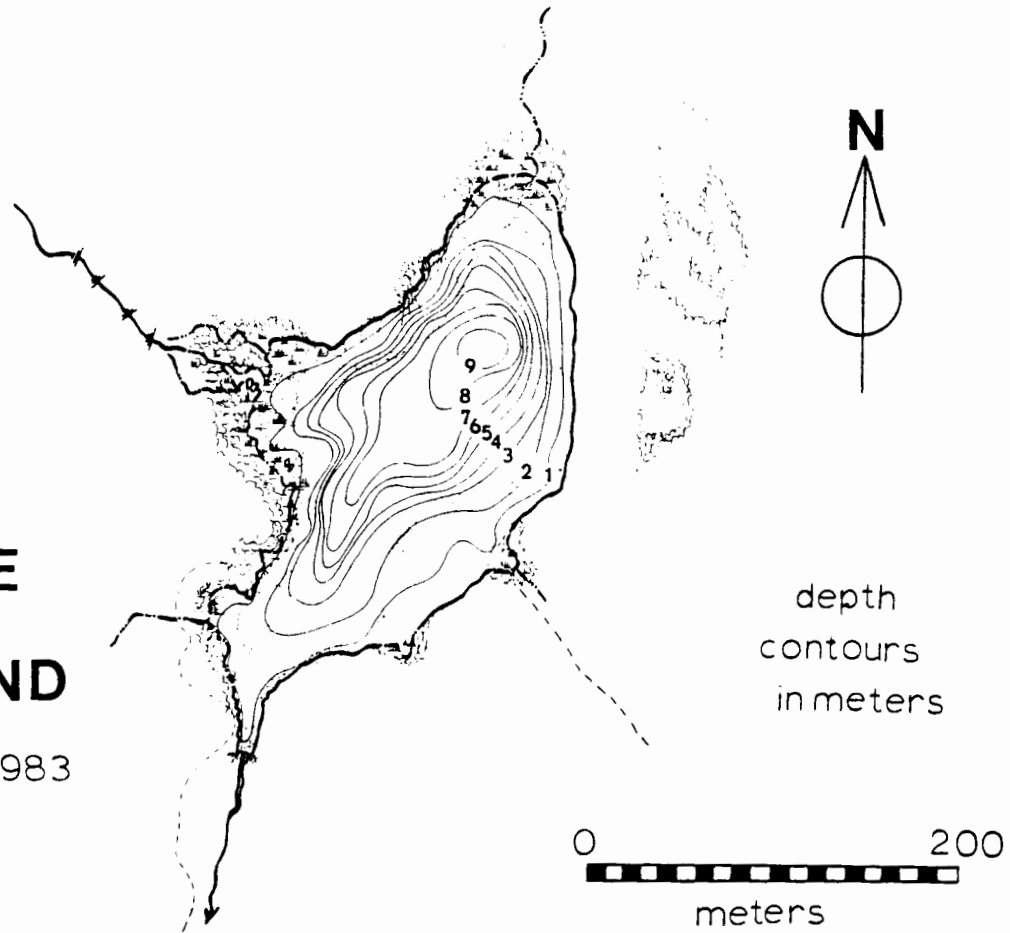
oxygen curve under the late-winter ice pack and during summer stagnation. Destratification seems to occur from mid to late summer.

The shoreline is about 25% mineral and 75% organic in composition. Ericaceous shrubs and sphagnum around the perimeter of the littoral zone grade into a uniform mat, dominated by a filamentous green alga (Mougeotia). There is little emergent or floating-leaved aquatic vegetation.

There is abundant evidence of earlier beaver colonies. The outlet dam is now in disrepair, and the pool level is down substantially. Unlike the pond, the inlet stream is humic in appearance, probably influenced by a wooded bog farther up in the watershed.

# CONE POND

1983



LOCATION: N  $43^{\circ} 54' 00''$  W  $71^{\circ} 36' 00''$

WATERVILLE VALLEY 7.5' SERIES ADVANCE SHEET (1979)

TOWN OF THORNTON, GRAFTON COUNTY, NEW HAMPSHIRE

ELEVATION: 480 m

SURFACE AREA: 3.1 ha

SHOAL AREA: 46%

MAXIMUM DEPTH: 9.0 m

MEAN DEPTH: 3.3 m

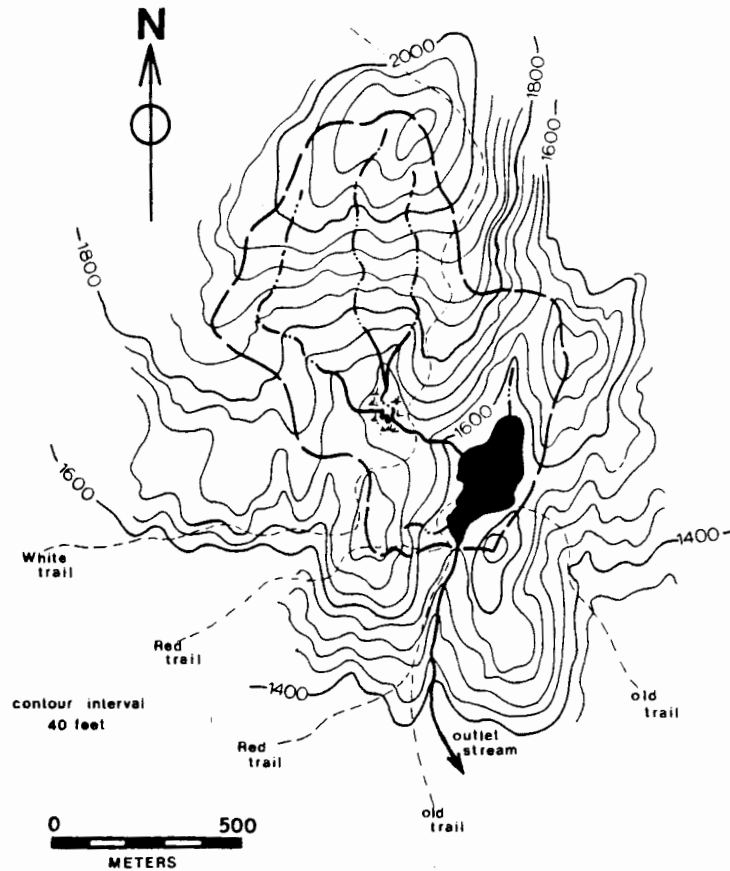
RELATIVE DEPTH: 4.5%

VOLUME:  $101 \times 10^3 \text{ m}^3$

MAXIMUM LENGTH: 340 m at N  $24^{\circ}$  E

SHORELINE LENGTH: 1060 m

SHORELINE COMPLEXITY: 1.7



### CONE POND

WATERSHED AREA: 60 ha (not including pond)

POND AREA: 3.1 ha

POND/WATERSHED AREA RATIO: 5.2%

HIGHEST ELEVATION: 645 m      MEAN SLOPE: 24%      ASPECT: FACING SSE

INLETS: Two ephemeral streams; N drains 12 ha, SW drains 5 ha; perennial stream, draining 41 ha, enters pond from waterfalls at W edge; inlet is a combination of ephemeral streams that meet in a bog at the top of waterfalls.

SPRINGS: None obvious.

SUBSURFACE FLOW: Ephemeral and perennial streams tend to disappear short of the pond water's edge during drought conditions.

OVERLAND FLOW: Upper watershed ledges show evidence of soil, leaf litter, and woody debris driven by movement of surface water.

WETLANDS: 0.5-ha wooded bog, 200 m upstream on inlet, and about 30 m higher than pond; organic sediments in bog up to 2.5 m thick, mostly sphagnum remains; much of pond periphery is swamp-like.

OUTLET: Flows S through a rocky gorge; a tributary of the Mad River.

CONTROLLING STRUCTURES: Beaver dam at narrow outlet gorge has raised the pond pool up to 1 m above outlet stream bed; dam is in disrepair and pond surface level is about 0.5 m below top of dam.

## EAST POND

### Bedrock Geology

A coarse-grained granite (Mt. Osceola Granite; see Black Pond), (Billings and Williams, 1935).

### Surficial Geology

Thin, bouldery till of angular drift, covering steep sidewalls, grades to deeper, bouldery, sandy colluvium accumulating along lower slopes and valley floor. Saprolitic, pale-colored, gravel-like substrate surrounding the pond appears to be highly weathered Mt. Osceola Granite. Little bedrock is exposed.

### Soils

A well-drained, bouldery spodosol grades from shallow along the ridgeline to deep along the lower slopes and pond perimeter.

### Vegetation

A dense, second-growth forest of red spruce, balsam fir, and paper birch predominates. A disjunct 25-ha stand of larger red spruce and paper birch occupies the steep slope E of the pond. Forest covers 100% of the watershed.

### Fisheries

The only fish species present is brook trout (Kusmeskus et al., 1981). A massive, introduced population of golden shiners was reported in 1959. It was stocked with fingerling brook trout from 1946 through 1957.

Stocking was resumed officially in 1981 (12,000 fish since 1946). Spawning trout were observed in gravel spring seeps along the N shoreline in October 1982. There was no evidence of subfingerling trout during the study (N. H. Fish and Game Department, open files, and the USDI Fish and Wildlife Service, open files).

### Landuse History

During the extensive logging of the watershed about 1910, the pond was found to have deep deposits of diatomaceous earth. Between 1910 and 1916, the Livermore Tripolite Company dredged the pond for diatomite. A concrete and rock dam was built across the natural outlet, and a wooden conduit was buried in the outlet stream to drain the pond. Problems encountered in separating impurities at the nearby incineration mill may have forced the closing of the operation in 1916 (USDA Forest Service, files, Laconia, N. H.). Sediment cores taken in a survey in 1940 indicated that the remaining deposits were 2 to 3.5-m thick (McNair, 1941). Publishers Paper Company sold the valley around the pond to the USDA Forest Service in 1926. Ownership of the pond perimeter and the mineral rights were retained by the heirs of the C. B. Henry family (J. E. Henry and Sons Timber Co.) (USDA Forest Service files, Laconia, N. H.).

Recreational use of the area is moderate to heavy in summer, light in winter. Access is by foot, from the Tripoli Road over a 2-km trail that follows the old wagon path from the mill ruins to the pond outlet.

### Pond Synopsis

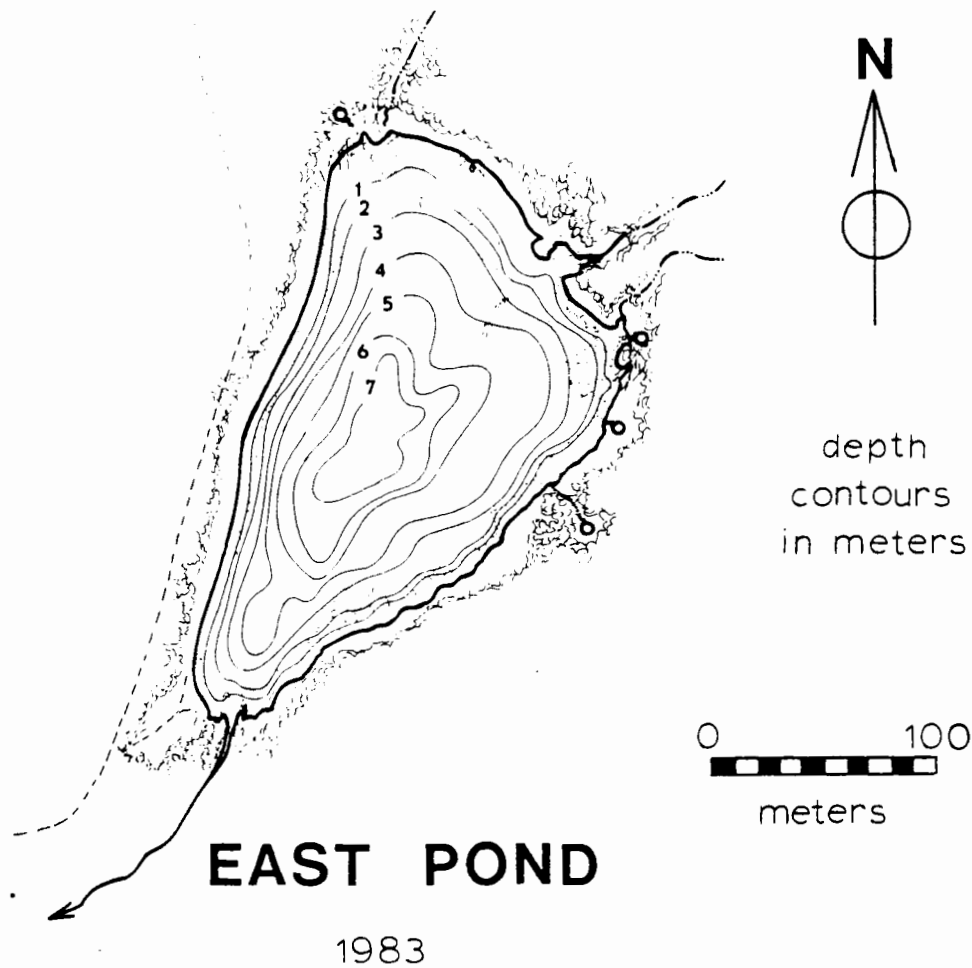
This is a softwater pond with nearly colorless water. The volume-weighted pH ranges from 5.3 to 6.2. It is weakly stratified; a clinograde oxygen curve is found only under the late-winter ice pack. The

pond is predominantly spring fed. The gravelly, decomposing granite surrounding the pond apparently offers a suitable matrix for subsurface flow. Surface flow is found only after heavy rains or during snowmelt. Because of its exposed, high elevation, the pond is prone to wind-induced mixing during the ice-free season.

The shoreline is entirely mineral in composition. There is little emergent or floating-leaved aquatic vegetation. Submersed benthic macrophytes cover much of the sediments.

In 1959, the water level was about 1 m higher than the present-day pool level due to the construction of a beaver dam across the remains of the manmade outlet ditch (USDI Fish and Wildlife Service, open files, Laconia, N. H.). That dam, and most signs of beaver activity, have disappeared.





LOCATION: N 44° 00' 30" W 71° 34' 00"

MT. OSCEOLA 7.5' SERIES QUADRANGLE (1967)

TOWN OF LIVERMORE, GRAFTON COUNTY, NEW HAMPSHIRE

ELEVATION: 785 m

SURFACE AREA: 2.7 ha

SHOAL AREA: 27%

MAXIMUM DEPTH: 7.5 m

MEAN DEPTH: 3.4 m

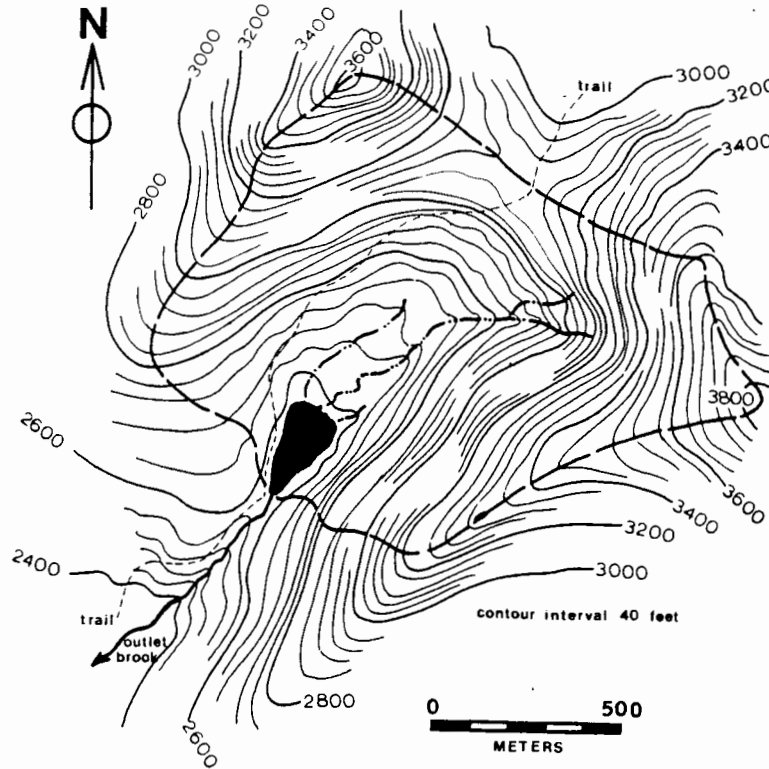
RELATIVE DEPTH: 4.0%

VOLUME:  $93 \times 10^3 \text{ m}^3$

MAXIMUM LENGTH: 280 m at N 26° E

SHORELINE LENGTH: 780 m

SHORELINE COMPLEXITY: 1.3



### EAST POND

- WATERSHED AREA: 111 ha (not including pond)      POND AREA: 2.7 ha  
 POND/WATERSHED AREA RATIO: 2.4%  
 HIGHEST ELEVATION: 1165 m      MEAN SLOPE: 45%      ASPECT: FACING SSW  
 INLETS: NE, CENTRAL, and N inlets drain about 83 ha, but flowing water disappears into stream bed 100 to 400 m before pond.  
 SPRINGS: Four indentifiable surface springs at N, NE, E, and SE edges; SE spring drains about 18 ha, has most substantial flow; evidence of submerged springs on bottom of pond at points of obvious substrate disturbance.  
 SUBSURFACE FLOW: Entire periphery of pond may have water flowing in or out through gravel-like substrate.  
 OVERLAND FLOW: Lower sections of NE basin and N shoreline contain debris and gravel associated with extensive, unchanneled water movement.  
 WETLANDS: None in watershed; edge of pond entirely mineral in composition.  
 OUTLET: Natural outlet no longer obvious; stream flows SW through manmade ditch, a tributary of Eastman Brook.  
 CONTROLLING STRUCTURES: Rock debris plug, piled at head of 30-m-long, 1-to 2-m-deep channel dug circa 1910 during diatomite mining operation; in past, beavers have used narrow ditch to build dam that flooded pond extensively; now gone; concrete and rock dam lies submerged.

## KIAH POND

### Bedrock Geology

Mostly a highly variable, quartz-mica schist, or mica-schist (Littleton Formation; see Black Mountain Pond) in a nearly indistinguishable matrix with an injected porphyritic granite (Kinsman Quartz Monzonite; see Black Mountain Pond). A pegmatite outcrop lies along the inlet stream (Moke, 1945).

### Surficial Geology

There is thin, bouldery till along the hilltops and a stoney, deep till along midslopes and valley floor, where the glaciofluvial-deposited sediments have undergone subglacial compaction. The till is derived from a variety of bedrock sources. Exposed bedrock areas make up less than 1% of the watershed.

### Soils

The spodosols grade from shallow, well-drained, and rocky on the steep slopes and ridgelines (Lyman-Rock outcrop-Berkshire association), to deep, moderately well drained, and very stoney on the midslopes with gentle relief (Marlow-Peru association; Waumbek-Skerry association; Herman association). The Marlow soils often have a pan layer, while the Waumbek series is poorly drained due to seasonal flooding along the inlet stream. The upper inlet beaver swamp has produced an area of drowned inceptisol (Leicester-Ridgebury association). A muck histosol underlies the marsh at the N end of the pond.

### Vegetation

The majority of the watershed forest cover is composed of second-growth sugar maple, beech, and yellow birch; also, red spruce is found on the ridges and wet areas. Northern red oak is a codominant in the hardwood stand on the south-facing slope of the mountain due N. Small stands of spruce, hemlock, and fir are located around the pond and the inlet stream. The watershed is 97% forested and 3% open wetlands.

### Fisheries

Fish species present include brook trout, brown bullhead, and blacknose dace (Kuzmeskus et al., 1981). It has been stocked with yearling and fingerling brook trout since 1945 (about 42,500 fish) (N. H. Fish and Game Department, open files). No spawning was observed though subfingerling trout were seen in the upper inlet stream during the study.

### Landuse History

The area of Sandwich Notch that surrounds the pond has had a relatively long history of human disturbance. The watershed probably was cutover in the early 19th century. There were several subsistence farms and a sawmill in the immediate vicinity between 1806 and 1890. Part of the watershed was cleared for pasture and then abandoned in 1860. A popular wagon path, the alternative to the current Notch Road, ran E to W across the center of the watershed. The proper name of the pond was Currier's Pond (circa 1790) before local pronunciation took precedence (Sandwich Historical Society, 1972; Walling, 1860).

From 1916 to 1981, the land was owned by 5 logging companies, each cutting timber intermittently until the 1970's. The USDA Forest Service

purchased the land from Yorkshire Timber Company in 1981 (USDA Forest Service, open files, Plymouth and Laconia, N. H.).

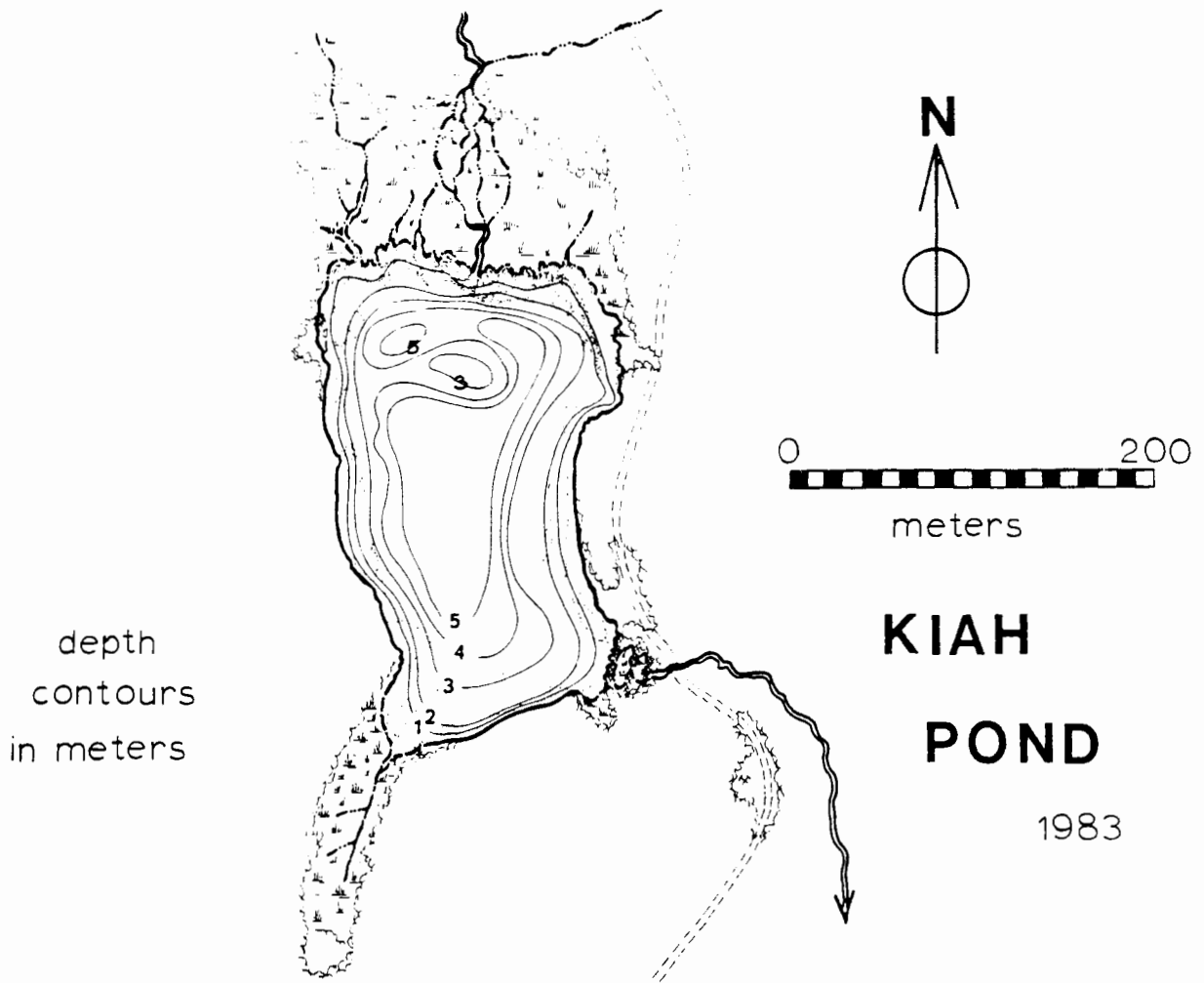
Recreational use is moderate to heavy in summer, light in winter. Access can be by vehicle, from Sandwich Notch Road over a 1-km gravel spur road that fords the outlet stream and passes close by the E shoreline of the pond.

#### Pond Synopsis

This is a softwater pond, strongly humic in appearance. The volume-weighted pH ranges from 5.4 to 6.2, with 1 incident of a weighted pond pH of 4.5. It is dimictic and strongly stratified, with a severely clinograde oxygen curve during the winter and summer stagnation.

The shoreline is about 30% mineral and 70% organic in composition. Emergent and floating leaved macrophytes are obvious in the shallow perimeter of the pond, especially along the marsh at the N end. Submersed macrophytes are not notably abundant.

Beavers have had a significant impact on this pond. The current colony maintains the outlet dam and has built numerous smaller dams around the inlet/marsh area. The inlet stream develops much of its strongly humic coloring in its upper reaches, where beavers have created a large, shallow, stagnant impoundment.



LOCATION: N 43° 51' 30" W 71° 31' 00"

SQUAM MTN. 7.5' SERIES ADVANCE SHEET (1975)

TOWN OF SANDWICH, CARROLL COUNTY, NEW HAMPSHIRE

ELEVATION 435 m

SURFACE AREA: 3.5 ha

SHOAL AREA: 31%

MAXIMUM DEPTH: 5.5 m

MEAN DEPTH: 3.0 m

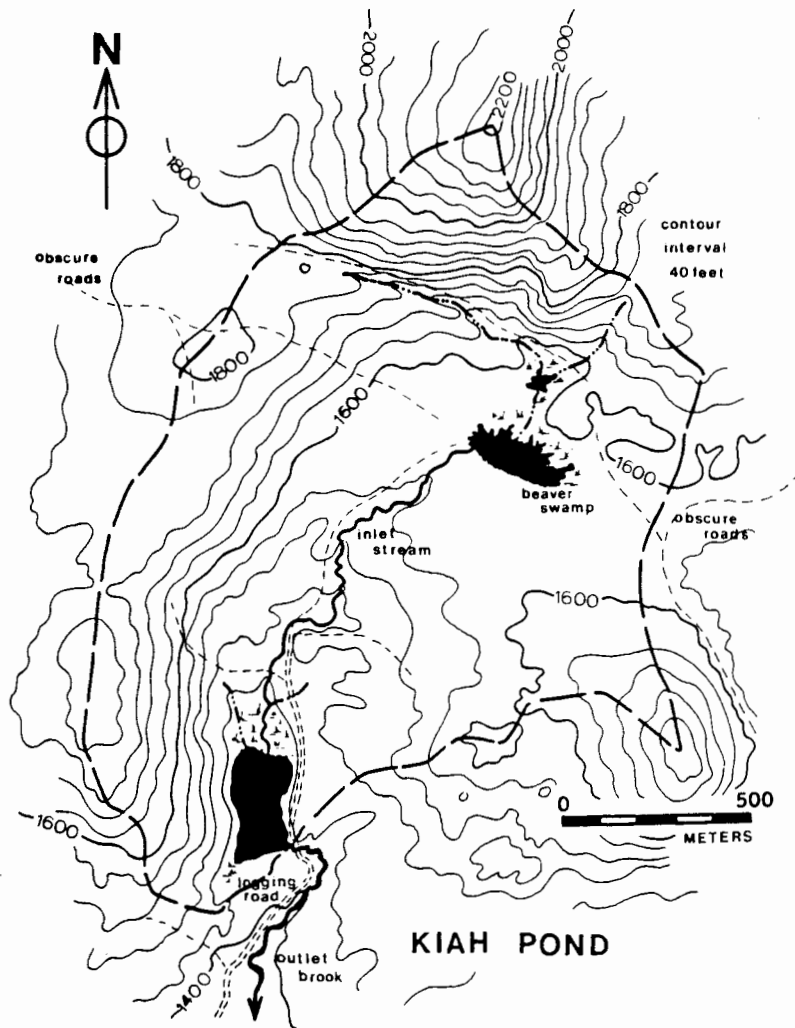
RELATIVE DEPTH: 2.6%

VOLUME:  $104 \times 10^3 \text{ m}^3$

MAXIMUM LENGTH: 280 m at N 02° W

SHORELINE LENGTH: 940 m

SHORELINE COMPLEXITY: 1.4



WATERSHED AREA: 194 ha (not including pond)

POND AREA: 3.5 ha

POND/WATERSHED AREA RATIO: 1.8%

HIGHEST ELEVATION: 675 m      MEAN SLOPE: 20%      ASPECT: FACING SSW

INLETS: One perennial stream enters N end, draining about 164 ha;  
ephemeral streams at NW and SW corners drain about 25 ha total.

SPRINGS: None obvious.

SUBSURFACE FLOW: None obvious.

OVERLAND FLOW: Lower inlet stream shows evidence of spreading out into woods during high flow.

WETLANDS: 2.5-ha beaver flowage, up to 1 m deep, 1 km upstream on inlet;  
perimeter of pond flooded; 0.25-ha swamp at SW corner and 2.5-ha wooded swamp along entire N shoreline, extending up inlet stream valley.

OUTLET: Flows SE, a tributary of the Beebe River.

CONTROLLING STRUCTURES: Ubiquitous beaver construction on inlet stream system; actively maintained beaver dam on outlet has raised pool level about 0.5 m above outlet streambed.

## PEAKED HILL POND

### Bedrock Geology

In part, an injected body of prophyritic granite (Kinsman Quartz Monzonite; see Black Mountain Pond) occurs along the W edge of the watershed and on Peaked Hill, with the remainder of the bedrock being a highly variable, quartz-mica schist or mica schist (Littleton Formation; see Black Mountain Pond) (Moke, 1945).

### Surficial Geology

The thin, bouldery till on Peaked Hill, derived from ice sheet scouring, grades into deep, bouldery, ice sheet ablatational till on the uplands on either side of the flat valley floor. Slackwater, glaciofluvial deposits around the pond are deep and subglacially compacted. Till is derived from local bedrock forms. Exposed bedrock areas make up less than 1% of the watershed.

### Soils

The shallow, well-drained, bouldery spodosol on the steep slopes and ledges of Peaked Hill grades into a deep, moderately well-drained, bouldery spodosol covering the midslopes and gentle lowland hills. The nearly level perimeter of the pond has a deep, stoney, siltier spodosol, with a pan layer that has produced areas of poor drainage.

### Vegetation

An association of red spruce, hemlock, and fir dominates the wet areas surrounding the pond. The adjacent low hills and the midslopes of Peaked



Hill have a complex cover of sugar maple, beech, yellow birch, red maple, and aspen. Stands of spruce and fir occupy the steepest slopes and top of Peaked Hill. Sizes, ages, and densities of tree stands are quite variable. About 97% of the watershed is forested; the remaining cover is primarily wetland vegetation.

### Fisheries

Fish species present include brook trout and brown bullhead (Kuzmeskus et al., 1981). It has been stocked with fingerling brook trout since 1952 (about 56,000 fish). The early stockings failed to produce a permanent trout population. Rotenone poisoning was used to remove chain pickerel and brown bullhead in 1956. There is an unverified report of the presence of poisoned yellow perch and pumpkinseed sunfish during the reclamation project (N. H. Fish and Game Department, open files). No spawning was observed, though subfingerling trout were found in the inlet stream during the study.

### Landuse History

The watershed of the pond has had a relatively long history of human disturbance. There were 2 subsistence farms along the outlet stream circa 1860. The NE edge of the watershed includes an area cleared for pasture from the mid-19th century (Walling, 1860). A partially breached, manmade, cobble and boulder dam lies across the pond outlet, covered with beaver cuttings and growing trees. The original use of the dam is unknown.

Forest cutting in the area began in the early 19th century. Logging by private owners and companies continued intermittently until the late 1960's. Overgrown roads from the last 2 decades of hardwood selective

cutting cross much of the pond catchment.

The N shoreline, the outlet area, and the top of Peaked Hill were purchased by the USDA Forest Service from the Publishers Paper Company in 1920. The remainder of the pond and its watershed is held by the receivers of the bankrupt Franconia Paper Company (USDA Forest Service files, Plymouth and Laconia, N. H.).

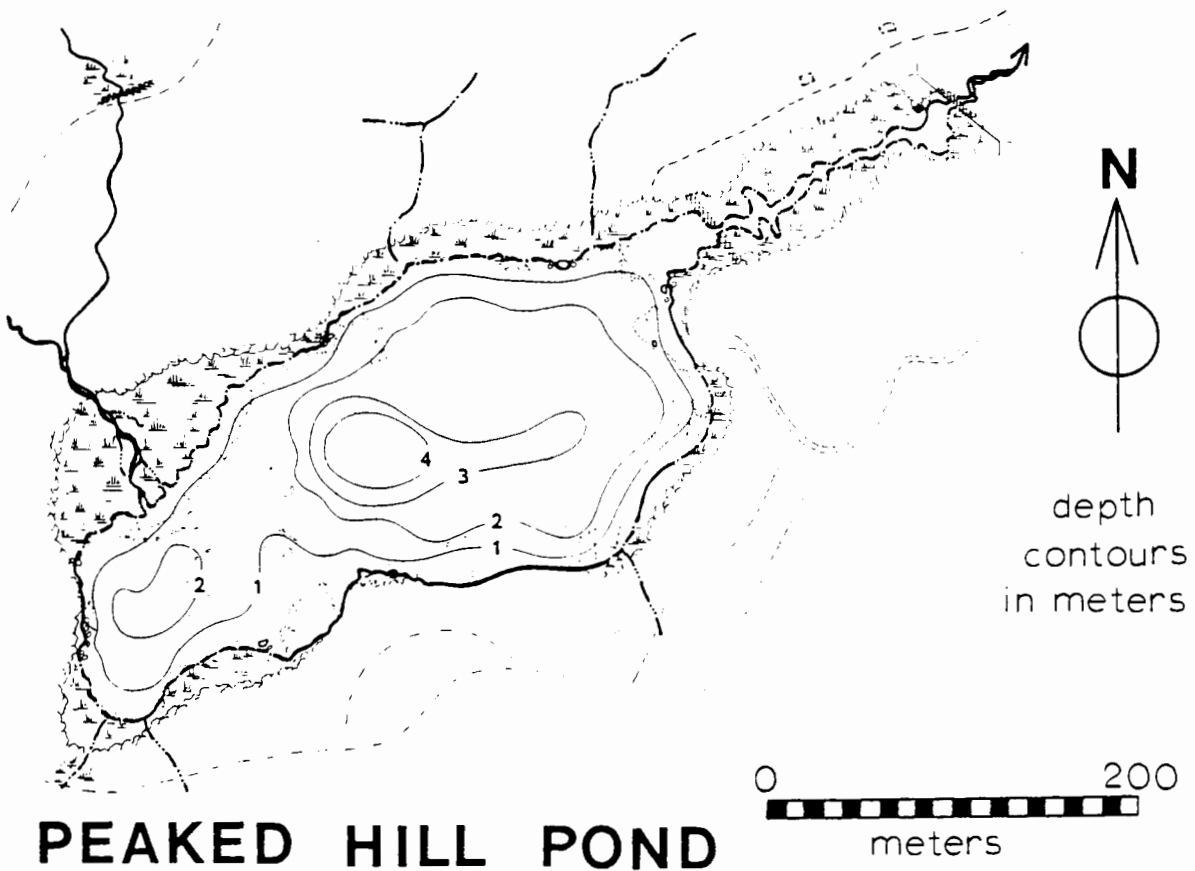
Recreational use is moderate to heavy in the summer, light in winter. Access is by foot, from NH Route 3 over 3 km of old logging and sugar orchard roads.

#### Pond Synopsis

This is a softwater pond, humic in appearance. The volume-weighted pH ranges from 5.1 to 6.1. Because of the preponderance of shallow water, summer stratification tends to be ephemeral. Depletion of dissolved oxygen can be severe under the late-winter ice pack, probably because of the input of high concentrations of organic matter from the littoral zone and inlet stream.

The shoreline is about 10% mineral and 90% organic in composition. The littoral zone grades from sedges and ericaceous shrubs, through a band of emergent vegetation, to thick patches of floating-leaved macrophytes. Submersed aquatic plants are obvious in waters less than 2 m deep.

Beaver activity is important at this pond. The current colony maintains the outlet dam and has raised the pool level significantly. Incoming streamwater picks up a humic appearance, or even floating foam, below a shallow beaver pond on the W fork of the inlet.



# PEAKED HILL POND

1983

LOCATION: N 43° 54' 00" W 71° 43' 00"

WOODSTOCK 7.5' SERIES ADVANCE SHEET (1974)

TOWN OF THORNTON, GRAFTON COUNTY, NEW HAMPSHIRE

ELEVATION: 360 m

SURFACE AREA: 4.9 ha

SHOAL AREA: 60%

MAXIMUM DEPTH: 4.5 m

MEAN DEPTH: 1.7 m

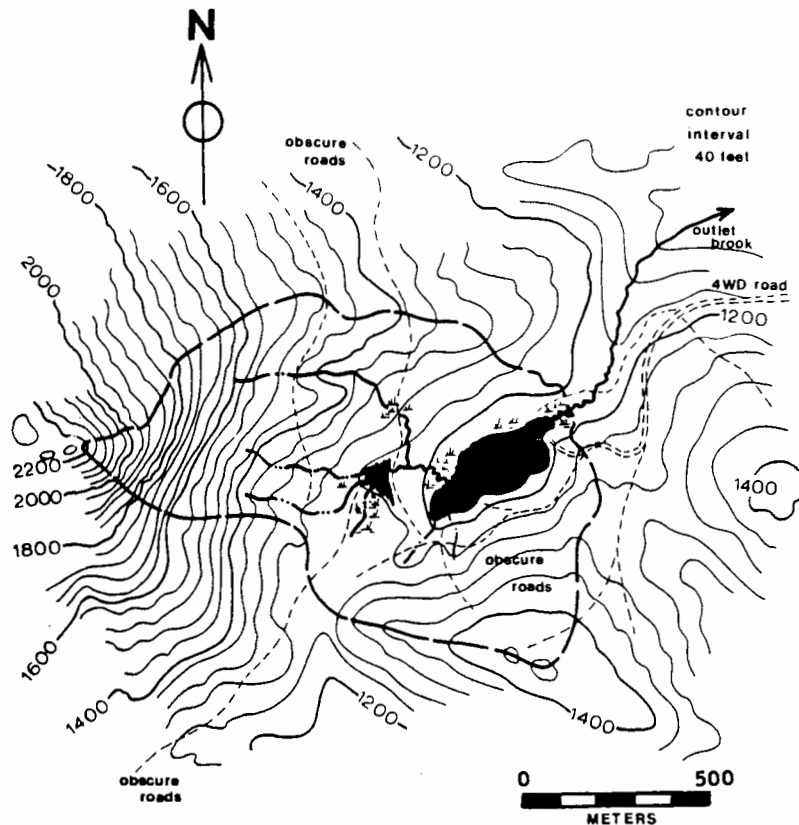
RELATIVE DEPTH: 1.8%

VOLUME:  $85 \times 10^3 \text{ m}^3$

MAXIMUM LENGTH: 420 m at N 52° E

SHORELINE LENGTH: 1280 m

SHORELINE COMPLEXITY: 1.6



### PEAKED HILL POND

WATERSHED AREA: 73 ha (not including pond) POND AREA: 4.9 ha

POND/WATERSHED AREA RATIO: 6.7%

HIGHEST ELEVATION: 680 m MEAN SLOPE: 25% ASPECT: FACING E

INLETS: Several ephemeral streams around perimeter of pond; perennial inlet enters along W shore, consisting of N fork (14-ha drainage), and W fork (25-ha drainage) that combine 80 m upstream from pond.

SPRINGS: None obvious.

SUBSURFACE FLOW: None obvious.

OVERLAND FLOW: W end of watershed, at base of mountain, shows evidence of debris driven by movement of surface water.

WETLANDS: 0.75-ha beaver pond on W fork of inlet, water up to 1 m deep; N fork has small beaver pool; edges of pond, inlet area, and outlet flowage are flooded, swamp-like.

OUTLET: Outlet stream flows NE, a tributary of Bagley Brook.

CONTROLLING STRUCTURES: Outlet dam is manmade structure of cobbles and larger boulders, 20 m long, augmented by beaver cuttings such that the pool level is about 2 m higher than the outlet streambed.

## APPENDIX B: SURVEY DATA

Data are listed by pond, in order of sampling date. Headings for the data tables are:

1-m, 4-m, etc., INLET, OUTLET: sample depth or location

ALK: Alkalinity or  $\text{HCO}_3^-$  concentration  
[ $\text{H}^+$ ]: Estimated hydrogen ion concentration  
DOC: Dissolved organic carbon  
TOC: Total organic carbon  
DIC: Dissolved inorganic carbon or  $[\text{CO}_2] + [\text{HCO}_3]$   
DO<sub>2</sub>: Dissolved oxygen  
O<sub>2</sub> %SAT: Estimated oxygen saturation  
TEMP °C: The temperature of the sample at the time it was taken

Notations for incomplete data are:

LD: Lost data (sample collected but never analyzed; notes missing; sample lost or destroyed)

NA: Not attempted (no sample collected; analysis method not available at this time; site not suitable for this type of analysis)

RJD: Rejected data (sample collected but had gross analytical error; obvious contamination; spurious numbers)

SITE: BLACK POND

DATE: 1 APRIL 1980

TIME: 0815 to 1130 EST

CONDITIONS: Frozen; ice 58 cm thick; Secchi depth 4 m; sunny; clear; slight W wind; 5° to 10°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub> %SAT	TEMP °C
	pH	COND											total	total						
		uS/cm													mg/l -----					
1 m	5.40	19.5	10	4.0	77	20	8	33	2	17	34	79	.09	.03	NA	NA	NA	11.5	94%	4.1°
6 m	6.00	31.0	100	1.0	150	RJD	RJD	RJD	RJD	20	RJD	100	.09	.01	NA	NA	NA	5.4	44%	4.5°
12 m	6.10	37.0	150	0.8	177	41	13	78	4	3	11	96	.14	.46	NA	NA	NA	0.7	<10%	4.9°
INLET	5.90	25.8	10	1.3	115	29	12	44	2	20	44	102	.14	.02	NA	NA	NA	NA	NA	LD
OUTLET	5.90	23.9	30	1.3	107	25	12	44	8	13	29	94	.16	.05	NA	NA	NA	NA	NA	LD

REMARKS: About 10 cm of pond ice was frozen slush; watershed snow pack starting to melt; data rejected because of contamination during storage.

SITE: BLACK POND

DATE: 10 MAY 1980

TIME: 1115 to 1430 EDT

CONDITIONS: Open water; Secchi depth 3 m; partly cloudy; moderate W wind; light rain; 12°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub> %SAT	TEMP °C
	pH	COND											total	total						
		uS/cm													mg/l -----					
0.5 m	5.90	23.9	50	1.3	115	29	12	50	4	14	2	104	.11	.03	4.0	NA	0.9	10.2	96%	10.5°
6 m	5.95	31.7	110	1.1	165	37	12	85	3	17	0	121	.09	.07	4.3	NA	3.6	5.4	46%	5.5°
12 m	6.05	39.8	190	0.9	220	49	13	87	8	23	1	117	.18	.69	4.7	NA	5.9	0.4	<10%	4.5°
INLET	5.75	25.2	10	1.8	100	29	12	46	2	15	20	121	.13	.05	4.4	NA	NA	NA	NA	4.5°
OUTLET	5.85	23.9	50	1.4	112	29	12	48	1	15	9	94	.09	.02	4.1	NA	NA	NA	NA	11.5°

REMARKS: Watershed snow pack appears to be completely melted; observed fishermen catching several 10 cm Brook Trout; stream flows high.

SITE: BLACK POND

DATE: 7 SEPTEMBER 1980

TIME: 0900 to 1300 EDT

CONDITIONS: Open water; Secchi depth 3.5 m; partly sunny; slight NE wind; 14° to 16° air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
0.5 m	6.45	24.9	80	0.4	120	29	12	57	0	13	0	87	.03	.06	4.0	NA	1.2	8.4	99%	20.8°
6 m	6.30	32.5	140	0.5	160	33	12	70	2	17	1	87	.07	.06	3.4	NA	5.3	2.8	28%	13.0°
12 m	6.30	53.0	350	0.5	309	49	15	91	37	27	1	48	.14	2.2	5.2	NA	10.2	0.0	0%	8.0°
INLET	6.30	26.0	60	0.5	120	25	8	68	3	10	0	81	.14	.03	7.6	NA	NA	NA	NA	13.5°
OUTLET	6.10	26.0	80	0.8	135	29	12	59	2	13	1	87	.06	.07	4.3	NA	NA	NA	NA	16.2°

REMARKS: Obvious phytoplankton bloom in epilimnion; very dry weather; streams barely flowing.

SITE: BLACK POND

DATE: 21 NOVEMBER 1980

TIME: 1220 to 1550 EST

CONDITIONS: Frozen; ice thickness 1-2 cm; partly cloudy; calm; light snow; -2° to 0° air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
0.5 m	6.00	28.7	90	1.0	140	29	10	61	4	18	6	98	.08	.03	4.8	NA	0.6	10.1	77%	2.1°
INLET	5.80	23.9	<10	1.6	97	25	6	50	2	14	23	102	.13	.05	2.8	NA	NA	NA	NA	1.1°
OUTLET	5.80	30.0	50	1.6	152	29	12	63	4	18	6	104	.08	.06	4.9	NA	NA	NA	NA	1.7°

REMARKS: Ice too thin to risk deep water sample; took sample 3 m from shore; only 2 to 4 cm snow cover.

SITE: BLACK POND

DATE: 2 JANUARY 1981

TIME: 1220 to 1550 EST

CONDITIONS: Frozen; ice thickness 25 cm; Secchi depth 3 m; cloudy; slight N wind; snow falling; -4° to -8° air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		uS/cm																		
1 m	6.00	26.3	70	1.0	125	29	10	61	2	16	15	102	.08	.04	3.6	NA	2.0	LD	LD	3.2°
4 m	6.10	28.6	90	0.8	140	33	12	61	6	17	6	102	.09	.06	4.7	NA	2.4	8.3	68%	4.3°
8 m	6.20	29.9	100	0.6	140	33	12	61	2	17	8	102	.06	.03	4.6	NA	2.9	6.9	57%	4.5°
12 m	6.20	32.0	110	0.6	150	33	12	65	2	11	13	102	.14	.19	4.4	NA	4.6	3.2	27%	4.7°
INLET	5.90	25.8	30	1.3	105	25	8	52	0	13	28	106	.10	.03	2.5	NA	NA	NA	NA	0.2°
OUTLET	5.95	27.6	40	1.1	115	29	9	54	0	14	22	110	.14	.06	3.9	NA	NA	NA	NA	0.6°

REMARKS: 1 m DO<sub>2</sub> bottle cracked; 25 to 30 cm snow cover; streams had relatively high flows; open water at inlet and outlet areas.

SITE: BLACK POND

DATE: 26 FEBRUARY 1981

TIME: 1110 to 1515 EST

CONDITIONS: Frozen; ice thickness 25 to 35 cm; Secchi depth 3 m; cloudy; strong NW wind; sleet and snow; 3° to 0° air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		uS/cm																		
1 m	5.40	20.3	10	4.0	85	21	8	33	0	13	27	81	.11	.03	3.9	NA	1.2	11.5	90%	2.9°
3 m	5.90	29.4	90	1.3	145	37	12	61	0	16	10	100	.09	.05	4.3	NA	2.8	6.2	50%	4.2°
6 m	6.00	30.0	90	1.0	147	37	12	61	0	16	11	100	.07	.01	4.2	NA	3.0	5.3	43%	4.1°
9 m	6.00	30.2	100	1.0	150	33	12	67	0	17	14	100	.12	.06	4.0	NA	3.3	4.2	34%	4.2°
12 m	6.00	33.8	130	1.0	160	37	13	74	0	31	10	98	.15	.20	4.2	NA	4.6	0.6	<10%	4.4°
INLET	5.80	22.7	10	1.6	95	21	12	37	0	23	35	90	.13	.03	4.3	NA	NA	NA	NA	0.5°
OUTLET	5.85	21.2	20	1.4	90	21	9	37	0	14	26	88	.09	.01	4.1	NA	NA	NA	NA	1.1°

REMARKS: Sampled following partial snow pack melt due to warm rains; all stream flows very high; 5 to 10 cm of standing water on pond surface.



SITE: BLACK POND

DATE: 29 MARCH 1981

TIME: 1040 to 1415 EST

CONDITIONS: Frozen; ice thickness 30 cm; Secchi depth 3.5 m; sunny; scattered clouds; moderate W wind; 15° to 18°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm																		
1 m	5.70	24.7	50	2.0	110	25	9	48	0	13	26	92	.10	.05	2.7	NA	2.3	9.4	76%	3.9°
3 m	5.90	29.7	90	1.3	145	33	13	63	0	17	13	98	.07	.03	3.9	NA	3.5	5.5	43%	4.0°
6 m	5.95	29.7	90	1.1	145	33	10	65	0	17	12	100	.12	.06	3.9	NA	4.0	4.0	33%	4.0°
9 m	5.90	32.1	110	1.3	152	33	13	65	0	20	11	100	.04	.05	3.6	NA	4.7	1.6	13%	4.1°
12 m	6.10	40.3	180	0.8	200	41	13	76	0	21	15	94	.14	.41	4.0	NA	5.6	0.4	<10%	4.3°
INLET	5.95	23.7	30	1.1	105	25	12	44	0	14	26	98	.18	.03	3.9	NA	NA	NA	NA	0.8°
OUTLET	5.90	25.5	40	1.3	105	25	9	52	0	14	23	106	.11	.05	2.9	NA	NA	NA	NA	2.9°

REMARKS: Ice slushy, decaying; little left of winter snow pack; recent snow melt elevated stream flows; inlet and outlet areas thawed, as well as NE shoreline.

SITE: BLACK POND

DATE: 1 MAY 1981

TIME: 0910 to 1240 EDT

CONDITIONS: Open water; Secchi depth 3.5 m; partially sunny to cloudy; near calm; light rain; 10° to 12°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm																		
1 m	6.50	25.8	50	0.3	117	29	12	54	2	14	15	96	.11	.03	3.2	NA	1.2	10.4	97%	9.2°
3 m	6.20	25.7	50	0.6	122	29	12	54	2	16	14	98	.11	.06	3.3	NA	1.5	10.5	90%	6.0°
6 m	6.20	27.4	70	0.6	135	29	12	57	0	16	16	96	.08	.03	3.4	NA	2.2	9.0	75%	4.7°
9 m	6.10	32.5	110	0.8	165	33	12	67	2	18	11	98	.13	.13	3.5	NA	4.6	2.9	24%	4.4°
12 m	6.10	36.4	160	0.8	195	41	13	76	3	21	11	96	.18	1.3	3.5	NA	5.8	0.2	<10%	4.3°
INLET	6.10	23.6	20	0.8	107	25	9	46	2	14	23	100	.13	.05	2.9	NA	NA	NA	NA	5.7°
OUTLET	6.15	25.1	50	0.7	117	25	12	52	0	16	13	98	.07	.03	3.6	NA	NA	NA	NA	9.3°

REMARKS: Pockets of snow left in watershed; observed fishermen catching several 10 cm Brook Trout; 2 beavers splashing about on surface; zooplankton especially numerous in epilimnion.

SITE: BLACK POND

DATE: 3 SEPTEMBER 1981

TIME: 1045 to 1730 EDT

CONDITIONS: Open water; Secchi depth 3 m; cloudy; thin overcast; slight SW wind; light rain; 15° to 20°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
1 m	6.00	22.5	80	1.0	112	25	14	50	2	20	0	81	.08	.16	7.5	NA	1.4	7.0	80%	18.2°
3 m	5.90	25.3	80	1.3	132	29	13	54	2	17	0	81	.10	.30	5.9	NA	3.8	3.0	31%	13.8°
6 m	6.00	28.5	100	1.0	155	33	12	61	0	16	6	90	.08	.06	3.0	NA	4.2	4.4	39%	6.9°
9 m	6.00	33.2	140	1.0	195	37	13	68	3	18	2	94	.09	.05	3.4	NA	5.8	0.7	<10%	5.2°
12 m	6.20	45.1	260	0.6	270	41	14	80	25	24	0	89	.21	2.9	4.8	5.6	8.9	0.0	0%	5.0°
INLET	6.20	21.5	80	0.6	105	21	8	55	2	17	0	75	.07	.06	5.6	5.6	NA	NA	NA	13.7°
OUTLET	6.00	22.5	50	1.0	102	25	14	50	2	21	0	83	.05	.20	7.8	NA	NA	NA	NA	17.6°

REMARKS: Beaver dam improved; pond pool raised 25 cm; stream flows relatively high; observed otter fishing for and eating Brown Bullheads.

SITE: BLACK POND

DATE: 3 APRIL 1982

TIME: 0920 to 1215 EST

CONDITIONS: Frozen; ice thickness 75 cm; Secchi depth 3 m; partly sunny to cloudy; slight SE wind; 4° to 7°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
1 m	4.85	33.9	0	14	112	29	13	50	7	18	58	81	.11	.05	4.1	4.1	3.8	6.9	51%	1.0°
3 m	5.90	26.8	85	1.3	132	29	13	59	3	18	16	81	.06	.10	4.1	4.5	4.1	4.4	36%	4.2°
6 m	5.95	28.3	80	1.1	155	29	13	61	1	24	15	90	.07	.06	4.1	4.1	5.2	1.0	<10%	4.7°
9 m	6.00	29.3	80	1.0	195	29	13	61	1	20	17	94	.11	.28	3.9	4.9	5.8	0.2	<10%	4.8°
12 m	6.20	39.0	205	0.6	267	37	14	67	30	22	1	80	.12	.96	4.6	4.8	7.1	0.0	0%	5.0°
INLET	6.10	23.0	35	0.8	105	25	12	44	2	11	32	75	.11	.05	2.8	3.3	NA	NA	NA	0.4°
OUTLET	5.90	27.3	50	1.3	102	29	14	52	4	16	31	83	.08	.08	4.1	4.2	NA	NA	NA	0.8°

REMARKS: Recent rains had increased snow pack density; all streams unfrozen, but not swollen by snow melt; 2 deer stirred up water in inlet stream.

SITE: BLACK POND

DATE: 13 MAY 1982

TIME: 0905 to 1230 EDT

CONDITIONS: Open water; Secchi depth 3.5 m; cloudy to partly sunny; gusty NW wind; 15° to 20°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
1 m	5.90	18.3	30	1.3	77	16	9	37	2	13	11	83	.10	.05	3.1	3.2	1.1	9.3	90%	11.1°
3 m	5.90	22.0	50	1.3	97	21	10	42	2	18	12	85	.05	.03	3.9	4.2	3.6	3.7	32%	5.7°
6 m	6.00	22.8	100	1.0	82	29	12	61	2	18	15	85	.16	.15	4.2	4.3	5.0	1.0	<10%	4.8°
9 m	6.00	29.2	120	1.0	127	33	13	65	2	18	12	87	.11	.38	4.0	4.5	5.3	0.1	<10%	4.8°
12 m	6.40	44.1	310	0.4	235	37	14	76	30	23	3	58	.19	1.30	5.9	5.9	6.7	0.0	0%	5.1°
INLET	6.15	22.5	45	0.7	100	21	8	44	2	11	10	96	.10	.01	3.3	3.5	NA	NA	NA	8.3°
OUTLET	5.90	20.9	35	1.3	82	16	9	35	2	21	10	81	.13	.06	3.5	3.9	NA	NA	NA	11.9°

REMARKS: All obvious snow melted; pond pool level raised by increased beaver activity on dam.

SITE: BLACK POND

DATE: 6 SEPTEMBER 1982

TIME: 1030 to 1315 EDT

CONDITIONS: Open water; Secchi depth 3.5 m; sunny; clear; slight SW wind; 20° to 25°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
1 m	6.40	21.9	65	0.4	85	29	13	57	3	17	0	67	.03	.15	6.3	7.6	LD	8.7	97%	17.5°
3 m	6.40	22.4	80	0.4	90	29	13	59	4	17	0	65	.02	.10	6.4	7.2	1.6	8.1	85%	14.8°
6 m	6.30	30.0	150	0.5	133	37	14	70	2	18	0	81	.13	.56	4.0	5.4	6.0	1.1	10%	6.9°
9 m	6.30	32.8	175	0.5	143	41	14	72	3	20	0	75	.07	1.1	4.2	5.7	7.2	0.2	<10%	5.0°
12 m	6.50	46.2	340	0.3	200	49	15	89	37	24	0	35	.08	1.2	5.8	7.0	10.7	0.0	0%	5.0°
INLET	6.25	23.3	85	0.6	95	29	20	63	3	24	3	58	.09	.19	11.6	13.1	NA	NA	NA	12.0°
OUTLET	6.30	22.0	70	0.5	72	21	9	42	2	16	1	46	.06	.15	6.3	6.8	NA	NA	NA	14.1°

REMARKS: Very dry, inlet barely flowing; obvious plankton bloom; pond pool level up due to continued work by beavers on outlet dam; 1 m DIC bottle cracked.

SITE: BLACK POND

DATE: 17 NOVEMBER 1982

TIME: 1145 to 1500 EDT

CONDITIONS: Open water; edges frozen; Secchi depth 2 m; sunny; slight SW wind; 0° to 5°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub> %SAT	TEMP °C
	pH	COND											total	total						
		uS/cm													mg/l					
1 m	6.40	25.7	100	0.4	100	25	14	61	2	18	0	73	.09	.35	5.7	6.3	2.5	8.2	68%	4.8°
3 m	6.40	25.7	100	0.4	105	29	15	65	2	20	0	77	.08	.37	5.4	LD	2.5	8.1	67%	4.7°
6 m	6.40	25.9	100	0.4	120	29	15	65	2	20	1	77	.09	.37	5.3	6.3	2.5	8.0	66%	4.6°
9 m	6.40	25.9	100	0.4	125	29	15	65	2	18	0	77	.08	.39	5.2	6.4	2.5	8.0	66%	4.6°
12 m	6.60	46.8	350	0.3	215	41	17	91	39	25	0	46	.01	4.0	5.9	7.2	8.9	0.5	<10%	5.0°
INLET	6.20	22.9	40	0.6	97	25	13	50	2	17	9	96	.12	.11	5.1	5.2	NA	NA	NA	2.1°
OUTLET	6.65	25.7	100	0.2	117	29	15	65	2	20	1	77	.07	.26	5.5	6.8	NA	NA	NA	3.9°

REMARKS: Recent heavy rains; pond pool up 25 cm from spring level due to extensive refurbishing of outlet dam by beavers; obvious plankton bloom; TOC ampules exploded.

SITE: BLACK MOUNTAIN POND

DATE: 20 MARCH 1980

TIME: 1045 to 1445 EST

CONDITIONS: Frozen; ice thickness 50 cm; Secchi depth 5 m; sunny; hazy; slight SW wind; 2° to 8°C air temp.

DATA:	LAR	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP	
	pH	COND											total	total					%SAT	°C	
		μS/cm																			
2 m	5.10	25.4	<5	7.9	70	25	18	28	2	23	14	131	.31	.14	NA	NA	NA	11.1	92%	4.2°	
4 m	5.25	23.4	<5	5.6	75	16	8	24	2	20	2	129	.20	.07	NA	NA	NA	10.2	85%	4.3°	
8 m	5.35	23.2	<5	4.5	82	25	9	33	1	23	0	131	.25	.11	NA	NA	NA	9.7	81%	4.6°	
INLET	5.10	25.1	<5	7.9	68	25	18	26	8	27	16	125	.36	.11	NA	NA	NA	NA	NA	LD	
OUTLET	5.30	25.6	<5	5.0	80	25	26	26	2	24	18	129	.29	.12	NA	NA	NA	NA	NA	1.0°	

REMARKS: Inlet barely flowing; buried under deep snow and ice; snow pack starting to decay; inlet temp. misplaced; 2 otters swimming in inlet.

SITE: BLACK MOUNTAIN POND

DATE: 7 MAY 1980

TIME: 0950 to 1300 EST

CONDITIONS: Open water; Secchi depth 4.5 m; cloudy; foggy; light rain; 8°C air temp.

DATA:	LAR	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP	
	pH	COND											total	total					%SAT	°C	
		μS/cm																			
0.5 m	5.25	18.9	<5	5.6	62	21	13	24	1	21	0	144	.26	.11	2.5	NA	0.1	10.4	98%	9.0°	
5 m	5.30	18.7	<5	5.0	52	21	13	26	0	21	0	135	.31	.11	2.6	NA	0.2	11.1	103%	8.5°	
9.5 m	5.25	19.2	<5	5.6	57	21	13	26	0	20	1	140	.26	.13	2.5	NA	0.4	11.2	97%	5.7°	
INLET	4.85	25.6	0	14	47	21	17	24	0	24	0	158	.48	.17	2.5	NA	NA	NA	NA	9.2°	
OUTLET	5.30	19.0	<5	5.0	60	21	13	11	0	21	0	115	.22	.11	2.2	NA	NA	NA	NA	10.0°	

REMARKS: Patches of snow left in watershed; all inlets flowing well; including ephemeral ones.

SITE: BLACK MOUNTAIN POND

DATE: 5 SEPTEMBER 1980

TIME: 0945 to 1230 EDT

CONDITIONS: Open water; Secchi depth 5 m; cloudy, heavy overcast; calm; light rain; 15°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
0.5 m	5.50	19.3	20	3.2	70	25	14	30	2	23	1	104	.08	.09	2.5	NA	0.5	8.0	96%	20.0°
5 m	5.85	19.7	20	1.4	70	25	14	32	2	23	0	104	.05	.11	2.6	NA	0.6	7.7	93%	20.0°
10 m	5.70	21.4	45	2.0	77	25	15	32	8	23	0	98	.10	.13	2.4	NA	2.8	2.9	34%	18.7°
INLET	5.30	18.4	15	5.0	37	25	14	32	1	23	3	104	.34	.65	8.0	NA	NA	NA	NA	17.0°
OUTLET	5.60	19.7	15	2.5	70	12	18	30	21	34	2	110	.09	.11	2.1	NA	NA	NA	NA	19.5°

REMARKS: Considerable beaver construction on inlet and outlet dams; dry weather mitigated by recent rains.

SITE: BLACK MOUNTAIN POND

DATE: 8 NOVEMBER 1980

TIME: 1100 to 1430 EST

CONDITIONS: Open water; edges frozen; Secchi depth 5.5 m; cloudy; very strong NW wind; sleet/snow; 8° to -2°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
0.5 m	5.40	21.2	<5	4.0	70	25	13	33	4	25	2	112	.18	.11	2.4	NA	0.3	13.0	100%	1.7°
5 m	5.45	21.7	5	3.6	70	25	14	35	3	28	2	121	.19	.11	2.4	NA	LD	LD	LD	1.7°
10 m	5.30	22.9	<5	5.0	67	25	14	35	4	25	2	121	.18	.12	2.5	NA	LD	LD	LD	1.8°
INLET	4.85	27.2	0	14	55	25	5	33	4	30	2	137	.48	.15	2.0	NA	NA	NA	NA	3.3°
OUTLET	5.35	22.9	<5	4.8	72	25	14	33	3	24	2	123	.20	.16	2.3	NA	NA	NA	NA	1.7°

REMARKS: Raft swamped, lost 5 m and 10 m DO<sub>2</sub>/DIC bottles; 5 cm snow cover; white caps on pond; field crew hypothermic.

SITE: BLACK MOUNTAIN POND

DATE: 3 APRIL 1981

TIME: 1020 to 1345 EST

CONDITIONS: Frozen; ice thickness 35 cm; Secchi depth 5.75 m; sunny; clear; slight SW wind; 8° to 15°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm											mg/l							
1 m	5.20	18.3	0	6.3	52	21	8	26	0	23	2	98	.27	.08	1.6	NA	1.1	11.3	92%	3.3°
3 m	5.35	20.9	<5	4.5	70	25	13	32	0	25	1	110	.23	.11	2.0	NA	1.6	10.6	88%	4.0°
5 m	5.40	20.9	<5	4.0	70	25	12	30	0	27	0	112	.16	.05	2.0	NA	1.8	10.4	86%	4.0°
7 m	5.40	23.5	15	4.0	82	29	13	33	3	28	2	125	.10	.01	1.9	NA	2.9	8.3	69%	4.2°
10 m	5.60	26.1	50	2.5	102	29	14	37	11	28	2	119	.17	.27	1.7	NA	5.4	3.5	30%	5.1°
INLET	5.10	20.7	0	7.9	35	21	6	26	3	25	2	127	.60	.18	2.2	NA	NA	NA	NA	2.6°
N. INLET	4.90	23.5	0	13	42	21	4	26	1	24	1	116	.43	.07	1.0	NA	NA	NA	NA	3.3°
OUTLET	5.25	18.7	10	5.6	70	21	8	26	0	20	1	108	.27	.12	1.6	NA	NA	NA	NA	1.5°

REMARKS: Edge of ice sheet thawed, pulled back 1 to 5 m from shore; ice decaying; most of watershed snow pack melted; all stream flows elevated; evidence of very high water in streams during winter rains.

SITE: BLACK MOUNTAIN POND

DATE: 30 APRIL 1981

TIME: 1000 to 1400 EDT

CONDITIONS: Open water; Secchi depth 5.5 m; sunny; scattered clouds; strong NW wind; 8° to 10°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm											mg/l							
1 m	5.40	19.9	<5	4.0	70	25	8	28	0	21	1	106	.20	.11	1.4	NA	0.3	11.0	98%	7.0°
3 m	5.40	19.9	<5	4.0	67	21	9	28	0	21	1	110	.19	.11	1.5	NA	0.3	11.1	100%	7.0°
5 m	5.45	19.9	<5	3.6	67	25	8	28	0	21	1	110	.19	.11	1.4	NA	LD	11.0	99%	7.0°
7 m	5.50	19.9	<5	3.2	67	25	8	30	0	21	2	112	.19	.11	1.3	NA	0.3	11.1	99%	6.9°
10 m	5.50	20.2	<5	3.2	67	25	8	30	0	21	2	115	.19	.11	1.4	NA	0.3	11.0	98%	6.9°
INLET	4.80	25.8	0	16	50	21	5	28	0	21	2	135	.49	.13	1.5	NA	NA	NA	NA	9.6°
OUTLET	5.40	20.0	<5	4.0	70	21	8	28	0	23	2	112	.21	.09	1.6	NA	NA	NA	NA	7.7°

REMARKS: No snow left in watershed; all stream flows elevated due to overnight rain; beavers very active.

SITE: BLACK MOUNTAIN POND

DATE: 27 AUGUST 1981

TIME: 0945 to 1530 EDT

CONDITIONS: Open water; Secchi depth 5.5 m; partly sunny; broken overcast; slight W wind; rain showers; 15° to 20°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
1 m	5.35	18.2	<5	4.5	67	21	3	28	0	13	0	110	.18	.12	2.3	NA	0.5	9.1	104%	17.8°
3 m	5.40	18.2	<5	4.0	67	21	3	30	0	13	0	112	.19	.14	2.1	NA	0.5	9.1	102%	17.2°
5 m	5.30	18.3	<5	5.0	67	21	3	30	2	14	0	117	.16	.11	2.2	NA	0.6	9.1	101%	16.2°
7 m	5.40	19.0	<5	4.0	65	21	3	28	0	16	0	115	.19	.13	2.4	NA	0.7	8.3	91%	15.8°
10 m	5.40	19.0	5	4.0	67	21	3	28	2	14	0	115	.16	.39	2.5	3.2	1.8	5.6	60%	15.5°
INLET	5.00	19.5	<5	10	40	16	3	28	4	16	1	112	.28	.41	2.5	2.5	NA	NA	NA	17.0°
OUTLET	5.40	18.4	<5	4.0	60	21	3	30	2	14	1	115	.17	.11	2.2	2.9	NA	NA	NA	18.0°

REMARKS: Wet weather had kept flowing water in all inlets; beavers actively working on several sites; 3 beaver kits swimming on surface.

SITE: BLACK MOUNTAIN POND

DATE: 25 MARCH 1982

TIME: 1040 to 1345 EST

CONDITIONS: Frozen; ice thickness 90 cm; Secchi depth 5.5 m; sunny; clear; slight SW wind; 5° to 14°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
1 m	5.30	18.8	10	0.5	55	21	1	30	2	17	2	119	.34	.12	1.0	1.2	2.4	8.5	65%	1.2°
3 m	5.80	22.2	25	1.6	77	25	5	33	9	20	3	127	.16	.07	1.3	1.9	2.9	6.0	51%	4.2°
5 m	5.70	22.4	30	2.0	82	25	5	35	9	21	3	129	.10	.07	1.3	1.6	3.6	5.8	49%	4.3°
7 m	5.70	22.4	30	2.0	80	25	6	33	9	20	2	131	.18	.12	1.3	1.6	3.8	5.1	42%	4.5°
10 m	6.30	30.6	150	0.5	92	29	9	35	26	28	1	100	.16	2.9	1.6	2.7	6.3	2.0	17%	5.6°
INLET	5.00	21.8	0	10.0	45	21	1	26	4	15	3	140	.38	.17	1.2	1.3	NA	NA	NA	0.8°
OUTLET	5.60	20.4	25	2.5	75	25	3	30	4	14	3	125	.27	.12	1.3	1.6	NA	NA	NA	1.9°

REMARKS: Snow pack starting to soften, but no major melt water yet; beavers already cutting new material for outlet dam and lodge.



SITE: BLACK MOUNTAIN POND

DATE: 19 MAY 1982

TIME: 0900 to 1230EDT

CONDITIONS: Open water; Secchi depth 7 m; sunny; hazy; scattered clouds; slight S wind; 20° to 25°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		uS/cm																		
1 m	5.40	17.1	10	4.0	55	21	4	24	3	14	1	115	.18	.07	0.9	1.3	0.2	9.9	106%	15.2°
3 m	5.40	16.8	10	4.0	55	16	3	24	2	14	1	112	.23	.14	1.0	1.3	0.4	9.9	105%	14.2°
5 m	5.30	16.5	5	5.0	50	21	3	22	9	13	1	110	.19	.10	1.0	1.2	0.4	10.4	102%	10.5°
7 m	5.30	17.2	10	5.0	50	21	3	24	1	14	1	100	.22	.08	1.0	1.4	0.8	10.4	94%	7.2°
10 m	5.25	17.5	5	5.6	50	21	3	24	1	14	1	102	.29	.22	1.1	1.5	1.4	9.2	81%	6.3°
INLET	4.80	22.0	0	16	40	16	3	24	2	8	1	117	.37	.23	1.8	2.3	NA	NA	NA	17.2°
OUTLET	5.40	16.9	10	4.0	50	21	3	24	2	10	1	106	.18	.08	1.0	1.8	NA	NA	NA	15.2°

REMARKS: Patches of snow left in watershed; new beaver construction along S.E. edge; all streams running well; numerous (freshly stocked) Brook Trout cruising shallow water.

SITE: BLACK MOUNTAIN POND

DATE: 29 AUGUST 1982

TIME: 0945 to 1330 EDT

CONDITIONS: Open water ; Secchi depth 5.5 m; partly cloudy to partly sunny; strong NW wind; 15°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		uS/cm																		
1 m	5.90	16.1	15	1.3	55	21	5	26	4	10	1	87	.06	.13	2.6	2.7	0.5	8.9	97%	15.5°
3 m	5.90	16.7	15	1.3	55	21	5	26	4	11	1	90	.03	.17	2.5	3.0	0.5	8.9	97%	15.4°
5 m	5.85	16.1	15	1.4	55	21	5	26	1	10	1	90	.02	.10	2.4	2.8	0.5	8.8	97%	15.5°
7 m	5.90	16.2	15	1.3	55	21	5	26	6	10	1	92	.06	.17	2.4	LD	0.5	9.0	98%	15.5°
10 m	5.90	16.2	15	1.3	55	16	5	26	7	10	1	92	.03	.09	2.3	2.8	0.5	8.6	94%	15.6°
INLET	5.05	16.5	0	8.9	23	12	3	24	4	8	1	96	.21	.71	1.5	2.0	NA	NA	NA	13.3°
OUTLET	5.70	16.4	15	2.0	55	16	5	26	2	10	2	92	.01	.07	1.5	1.8	NA	NA	NA	14.7°

REMARKS: Pond pool level up 10-20 cm; obvious iron ppt. in inlet stream; near drought conditions; low flows.

SITE: BLACK MOUNTAIN POND

DATE: 28 OCTOBER 1982

TIME: 1200 to 1515 EST

CONDITIONS: Open water ; Secchi depth 6 m; sunny; scattered clouds; moderate N wind; 5°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
1 m	6.00	17.0	20	1.0	55	16	6	28	4	11	1	94	.05	.12	2.6	3.1	0.3	11.3	100%	6.6 <sup>o</sup>
3 m	6.00	16.8	20	1.0	62	16	6	28	4	11	2	96	.05	.10	2.9	2.9	0.3	11.1	98%	6.2 <sup>o</sup>
5 m	6.00	16.5	20	1.0	62	16	6	28	4	10	2	92	.05	.13	2.8	2.9	0.3	11.2	98%	6.2 <sup>o</sup>
7 m	6.00	16.5	20	1.0	62	21	6	28	4	13	2	94	.06	.12	2.9	3.2	0.3	11.2	99%	6.2 <sup>o</sup>
10 m	6.00	16.5	20	1.0	55	21	6	28	6	11	1	94	.06	.13	2.9	2.9	0.3	11.2	98%	6.1 <sup>o</sup>
INLET	5.10	19.3	15	7.9	40	16	3	28	6	17	0	108	.14	.26	3.2	4.3	NA	NA	NA	7.0 <sup>o</sup>
OUTLET	6.10	16.6	20	0.8	60	21	8	28	6	11	2	94	.05	.15	2.6	3.3	NA	NA	NA	6.6 <sup>o</sup>

REMARKS: Pool levels of pond and beaver swamps raised due to beaver construction; streams barely flowing; many Brook Trout, a few 25 to 35 cm in length, in breeding colors, concentrated along gravel shoreline at NE end.

SITE: CONE POND

DATE: 16 FEBRUARY 1980

TIME: 1145 to 1545 EST

CONDITIONS: Frozen; ice thickness 37 cm; cloudy, heavy overcast; calm; snowing; -4°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP	
	pH	COND											total	total					%SAT	°C	
		µS/cm																			
1 m	4.70	30.5	0	20	52	21	3	34	0	27	2	173	.64	.09	NA	NA	NA	11.3	92%	3.5 <sup>o</sup>	
4 m	4.65	28.7	0	22	45	16	3	26	0	24	2	160	.61	.08	NA	NA	NA	11.1	90%	4.0 <sup>o</sup>	
8 m	4.65	28.1	0	22	45	15	2	25	3	24	2	154	.57	.09	NA	NA	NA	9.6	78%	4.4 <sup>o</sup>	
INLET	4.40	50.5	0	40	62	25	2	45	17	42	0	269	1.1	.06	NA	NA	NA	NA	NA	LD	
OUTLET	4.65	31.3	0	22	55	17	3	28	1	27	2	187	.62	.11	NA	NA	NA	NA	NA	LD	

REMARKS: First significant snow of season; inlet stream flow very low; misplaced temp. data for inlet/outlet.

SITE: CONE POND

DATE: 4 MAY 1980

TIME: 1100 to 1500 EDT

CONDITIONS: Open water; Secchi depth 9 m; sunny; clear; strong NW wind; 18°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP	
	pH	COND											total	total					%SAT	°C	
		µS/cm																			
0.5 m	4.70	25.7	0	20	45	15	3	22	0	20	1	133	.58	.07	3.1	NA	0.2	10.1	100%	12.5 <sup>o</sup>	
4 m	4.70	26.8	0	20	45	15	3	22	0	21	2	137	.55	.11	3.0	NA	0.8	10.5	97%	9.5 <sup>o</sup>	
8.5 m	4.70	27.2	0	20	50	16	3	22	2	24	2	142	.55	.12	3.0	NA	0.3	10.4	88%	6.0 <sup>o</sup>	
INLET	4.50	33.8	0	32	45	16	2	25	0	25	0	158	.75	.07	4.8	NA	NA	NA	NA	5.3 <sup>o</sup>	
OUTLET	4.65	26.7	0	22	40	15	3	21	0	20	0	142	.54	.01	3.2	NA	NA	NA	NA	13.0 <sup>o</sup>	

REMARKS: Patches of snow left in watershed; pond pool level very high; edge vegetation drowned.

SITE: CONE POND

DATE: 4 SEPTEMBER 1980

TIME: 1210 to 1500 EDT

CONDITIONS: Open water; Secchi depth 8 m; sunny, scattered clouds; slight SW wind; 19°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm				µeq/l									mg/l					
0.5 m	4.65	28.2	0	22	45	15	3	23	2	18	1	135	.24	.09	0.1	NA	0.2	8.0	100%	23.0°
4 m	4.65	28.9	0	22	45	15	3	23	2	20	1	137	.26	.09	0.1	NA	0.2	8.0	100%	23.0°
8.5 m	4.55	28.6	0	28	45	14	3	22	2	18	1	140	.23	.13	0.1	NA	0.3	7.9	98%	22.5°
INLET	4.30	48.2	0	50	65	23	1	29	2	21	0	256	1.1	.03	6.2	NA	NA	NA	NA	14.0°
OUTLET	4.50	31.1	0	32	45	15	5	23	2	20	2	150	.26	.08	0.5	NA	NA	NA	NA	22.5°
LOWER OUTLET	4.50	31.0	0	32	42	16	1	24	0	20	0	146	.44	.02	0.1	NA	NA	NA	NA	17.0°

REMARKS: Very dry conditions; sheets of green algae in water column; 2 people swimming in pond; sampled outlet brook 300 m downstream of pond.

SITE: CONE POND

DATE: 15 NOVEMBER 1980

TIME: 1345 to 1500

CONDITIONS: Frozen; ice thickness 1 to 2 cm; sunny; clear; slight N wind; 3°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm				µeq/l									mg/l					
0.5 m	4.60	26.8	0	25	82	17	4	26	5	23	2	140	.37	.01	1.2	NA	0.2	13.5	100%	0.9°
INLET	4.50	35.5	0	32	50	18	0	35	1	35	1	190	.87	.05	4.3	NA	NA	NA	NA	2.6°
UPPER INLET	4.50	35.0	0	32	55	18	1	33	1	32	0	185	.71	.01	4.5	NA	NA	NA	NA	2.5°
OUTLET	4.65	28.0	0	22	55	11	3	27	4	4	2	150	.41	.03	1.5	NA	NA	NA	NA	0.5°

REMARKS: Ice too thin to risk deep water sample; no Secchi data; sampled 1 m from shore; sampled upper inlet 300 m upstream from pond above wooded swamp on W ephemeral inlet.

SITE: CONE POND

DATE: 31 JANUARY 1981

TIME: 1100 to 1500 EST

CONDITIONS: Frozen; ice thickness 30 cm; Secchi depth 6 m; sunny; clear; slight N wind; -5°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub> %SAT	TEMP °C
	pH	COND											total	total						
		µS/cm													mg/l					
1 m	4.70	31.0	0	20	60	19	5	30	4	28	2	165	.60	.09	2.1	NA	1.7	9.7	75%	2.3 <sup>0</sup>
3 m	4.70	28.5	0	20	55	16	3	26	5	25	2	162	.51	.06	2.1	NA	1.7	9.2	74%	3.9 <sup>0</sup>
5 m	4.70	29.1	0	20	55	17	5	27	5	27	2	160	.50	.09	2.1	NA	2.0	8.6	70%	4.0 <sup>0</sup>
8 m	4.80	28.4	0	16	60	18	6	27	6	31	2	158	.52	.13	1.9	NA	3.4	5.4	45%	4.9 <sup>0</sup>
INLET	4.60	34.1	0	25	55	19	2	35	2	25	1	210	.84	.05	3.6	NA	NA	NA	NA	0.1 <sup>0</sup>
OUTLET	4.65	32.2	0	22	60	21	5	31	4	30	3	198	.66	.08	2.6	NA	NA	NA	NA	0.4 <sup>0</sup>

REMARKS: Large amount of windthrown timber in watershed; very low flow in inlet stream.

SITE: CONE POND

DATE: 26 MARCH 1981

TIME: 1230 to 1505 EST

CONDITIONS: Frozen; ice thickness 30 cm; Secchi depth 3 m; sunny; clear; slight S wind; 12°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub> %SAT	TEMP °C
	pH	COND											total	total						
		µS/cm													mg/l					
1 m	4.60	27.6	0	25	55	16	5	25	3	28	3	133	.55	.09	2.6	NA	1.6	9.5	77%	4.0 <sup>0</sup>
3 m	4.60	27.6	0	25	50	17	5	25	3	28	2	148	.60	.07	2.7	NA	1.7	9.6	78%	4.0 <sup>0</sup>
5 m	4.60	28.1	0	25	50	16	5	25	3	27	2	150	.52	.08	2.7	NA	1.7	9.7	78%	4.0 <sup>0</sup>
8 m	5.30	26.6	<5	5.0	50	18	9	28	7	34	2	144	.46	.09	2.6	NA	3.9	4.0	33%	4.6 <sup>0</sup>
INLET	4.55	30.5	0	28	47	17	2	28	2	30	0	171	.78	.05	3.5	NA	NA	NA	NA	0.1 <sup>0</sup>
OUTLET	4.65	26.5	0	22	50	17	5	25	2	27	2	146	.52	.01	2.7	NA	NA	NA	NA	2.4 <sup>0</sup>

REMARKS: Pond ice decaying; snow only in patches under conifers; streams flowing well; but not high; Secchi transp. very low.

SITE: CONE POND

DATE: 23 APRIL 1981

TIME: 1351 to 1550 EST

CONDITIONS: Open water; Secchi depth 5 m; cloudy, heavy overcast; slight SW wind; light rain; 10° to 13°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		μS/cm																		
1 m	4.75	26.4	0	18	45	16	5	24	2	25	2	131	.56	.03	2.4	NA	0.5	10.8	92%	6.5°
3 m	4.75	26.4	0	18	47	16	5	24	2	27	2	148	.52	.05	2.4	NA	0.4	10.7	90%	5.9°
5 m	4.75	26.9	0	18	45	16	4	24	3	24	2	150	.52	.09	2.3	NA	0.6	10.8	91%	5.5°
8 m	4.70	26.1	0	20	45	16	4	24	2	25	2	150	.51	.07	2.4	NA	0.7	10.6	88%	5.3°
INLET	4.50	33.7	0	32	45	16	1	27	1	24	0	185	.73	.06	4.2	NA	NA	NA	NA	2.3°
OUTLET	4.70	27.3	0	20	45	16	5	23	2	24	2	154	.49	.05	2.3	NA	NA	NA	NA	6.9°

REMARKS: Pond pool level up, due to improvements to beaver dam; no snow left in watershed.

SITE: CONE POND

DATE: 26 AUGUST 1981

TIME: 0830 to 1430 EDT

CONDITIONS: Open water; Secchi depth 7 m; sunny; clear; calm; 8° to 20°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		μS/cm																		
1 m	4.60	26.1	0	25	45	13	2	23	1	13	1	131	.43	.15	3.4	NA	0.7	7.9	91%	19.4°
3 m	4.60	25.9	0	25	45	13	2	23	2	11	1	137	.37	.11	3.0	NA	0.7	7.8	89%	19.2°
5 m	4.60	27.0	0	25	45	13	3	23	2	13	1	140	.41	.13	3.3	NA	1.1	6.8	77%	18.2°
8 m	4.90	24.3	0	13	45	14	5	23	2	18	1	144	.29	.15	4.7	5.8	5.4	0.1	<10%	13.5°
INLET	4.45	28.4	0	36	32	9	1	25	2	16	1	131	.55	.08	5.9	6.0	NA	NA	NA	13.3°
OUTLET	4.60	27.5	0	25	45	14	2	23	5	13	1	140	.34	.08	3.1	NA	NA	NA	NA	20.8°

REMARKS: No new work on beaver dam, but pool level holding at 10-15 cm higher than last summer; all streams running well from recent rain; "saddle prominent" caterpillars have defoliated much of deciduous tree cover; thousands of caterpillars have drowned in outlet and inlet streams.

SITE: CONE POND

DATE: 1 APRIL 1982

TIME: 0945 to 1245 EST

CONDITIONS: Frozen; ice thickness 55 cm; Secchi depth 5.5 m; partly sunny to cloudy; strong W wind; snow flurries; 2° to 5°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		μS/cm																		
1 m	4.30	37.5	0	50	32	13	2	22	3	16	24	148	.55	.08	2.2	2.2	1.8	10.3	79%	1.8°
3 m	4.70	27.2	0	20	35	15	5	26	6	20	5	144	.49	.03	2.4	2.8	2.4	7.6	62%	4.2°
5 m	4.75	25.9	0	18	40	15	5	26	8	21	2	137	.46	.08	2.5	2.8	2.6	6.3	52%	4.3°
8 m	4.90	24.9	0	13	40	15	6	25	16	23	2	133	.35	.15	2.5	3.2	4.7	2.8	23%	5.2°
INLET	4.50	31.1	0	32	35	14	3	22	2	11	10	154	.70	.06	4.1	4.4	NA	NA	NA	0.5°
OUTLET	4.55	30.3	0	28	37	16	3	26	3	17	3	158	.56	.05	3.7	4.0	NA	NA	NA	0.5°

REMARKS: 2 to 5 cm standing water on ice; snow pack starting to melt; pond ice decaying; all streams open, with high flows; broke through ice in 1 m of water.

SITE: CONE POND

DATE: 6 MAY 1982

TIME: 0900 to 1200 EDT

CONDITIONS: Open water; Secchi depth 6.5 m; sunny; slight S wind; 15° to 25°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		μS/cm																		
1 m	4.80	22.5	0	16	27	12	3	18	4	13	2	119	.45	.08	2.5	2.6	1.2	9.3	84%	8.2°
3 m	4.80	22.8	0	16	27	12	3	18	4	14	2	121	.41	.03	2.4	2.6	1.7	8.4	71%	6.0°
5 m	4.80	23.0	0	16	27	12	3	19	8	13	2	121	.45	.11	2.4	2.7	2.1	7.8	66%	5.2°
8 m	4.95	25.6	0	11	40	16	6	24	16	23	1	129	.31	.61	2.3	4.0	4.5	2.6	22%	5.3°
INLET	4.60	27.5	0	25	30	12	1	18	1	10	0	148	.60	.06	4.1	4.5	NA	NA	NA	5.9°
OUTLET	4.80	22.8	0	16	30	12	2	19	3	13	2	121	.39	.02	2.3	2.8	NA	NA	NA	10.4°

REMARKS: No snow left in watershed; very high pond pool level; many wood frogs singing in shallow water.

SITE: CONE POND

DATE: 28 AUGUST 1982

TIME: 1330 to 1610 EDT

CONDITIONS: Open water; Secchi depth 8.5 m; sunny; scattered clouds; moderate NW wind; 20<sup>o</sup> to 25<sup>o</sup>C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		μS/cm													mg/l					
1 m	4.55	23.1	0	28	25	11	1	23	2	8	0	119	.28	.11	0.6	0.8	0.3	8.2	94%	19.4 <sup>o</sup>
3 m	4.55	24.0	0	28	25	11	1	23	2	8	0	119	.27	.06	0.4	0.7	0.3	8.1	93%	19.1 <sup>o</sup>
5 m	4.55	23.2	0	28	25	11	1	23	2	10	0	121	.33	.09	0.5	0.7	0.3	7.9	91%	18.9 <sup>o</sup>
8 m	4.60	23.2	0	25	25	12	1	23	3	10	0	121	.26	.02	0.6	0.9	0.3	7.7	87%	18.7 <sup>o</sup>
OUTLET	4.55	24.3	0	28	27	12	1	23	2	10	2	121	.32	.07	0.6	0.6	NA	NA	NA	19.2 <sup>o</sup>

REMARKS: Drought conditions; inlet stream dry; pond pool level down 0.5 m; sheets of green algae floating in pond; outlet dam in poor condition.

SITE: CONE POND

DATE: 29 OCTOBER 1982

TIME: 1000 to 1400 EST

CONDITIONS: Open water; Secchi depth 8.5 m; partly sunny; slight SW wind; 10<sup>o</sup>C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		μS/cm													mg/l					
1 m	4.75	24.2	0	18	32	12	2	23	15	10	2	121	.32	.10	0.3	0.5	0.2	10.8	99%	8.7 <sup>o</sup>
3 m	4.75	23.3	0	18	32	12	2	23	17	10	2	123	.28	.10	0.4	0.5	0.2	10.8	98%	8.6 <sup>o</sup>
5 m	4.75	23.3	0	18	30	12	2	23	15	10	2	123	.30	.09	0.3	0.6	0.2	10.6	97%	8.4 <sup>o</sup>
8 m	4.75	23.6	0	18	32	12	2	23	16	10	2	123	.29	.11	0.4	0.6	0.2	10.6	96%	8.3 <sup>o</sup>
INLET	4.40	36.8	0	40	47	19	1	30	1	23	0	185	.72	.05	3.7	3.7	NA	NA	NA	7.1 <sup>o</sup>
OUTLET	4.70	23.8	0	20	32	12	1	23	15	10	2	125	.28	.10	LD	0.6	NA	NA	NA	8.4 <sup>o</sup>

REMARKS: Perimeter sediments of pond exposed by low water; inlet stream barely flowing; benthic algal mat extensively developed.



SITE: EAST POND

DATE: 29 MARCH 1980

TIME: 1015 to 1320 EST

CONDITIONS: Frozen; ice thickness 50 to 65 cm; cloudy; heavy overcast; moderate SW wind; 8° to 2°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm				µeq/l									mg/l					
1 m	5.10	17.5	5	8.0	45	RJD	RJD	RJD	RJD	RJD	RJD	60	RJD	RJD	NA	NA	NA	10.6	89%	4.1°
4 m	5.65	22.6	15	2.2	82	10	14	50	1	16	34	81	.21	.02	NA	NA	NA	9.8	83%	4.5°
7 m	5.70	23.6	15	2.0	82	7	9	40	1	21	40	85	.15	.0	NA	NA	NA	9.5	81%	4.5°
OUTLET	5.70	20.7	10	2.0	77	10	12	44	1	13	34	73	.21	.04	NA	NA	NA	NA	NA	LD

REMARKS: No flowing water in inlets; could not locate springs beneath 1 m snow; evidence of overland flow at N. end of pond; watershed snow pack just starting to decay; forgot Secchi disc.; 1 m sample contaminated during storage.

SITE: EAST POND

DATE: 11 MAY 1980

TIME: 1115 to 1430 EST

CONDITIONS: Open water ; Secchi depth 6 m; sunny to cloudy; strong SW wind, rain after 1400; 18° to 13°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm				µeq/l									mg/l					
0.5 m	5.70	20.3	5	2.0	72	9	13	41	1	13	34	73	.20	0	2.1	NA	0.5	10.3	98%	9.0°
3 m	5.70	20.4	5	2.0	70	10	13	42	1	13	35	79	.27	.01	2.4	NA	0.6	10.4	97%	8.5°
6 m	5.70	20.4	5	2.0	72	10	13	41	1	13	31	85	.22	.0	2.4	NA	0.8	10.8	100%	8.0°
N. SPRING	5.80	23.7	65	1.6	82	8	9	75	0	13	44	52	.07	.02	0.3	NA	NA	NA	NA	4.5°
N. INLET	5.80	24.8	10	1.6	82	11	13	72	1	14	48	60	.10	0	1.1	NA	NA	NA	NA	6.5°
S.E. SPRING	5.60	22.6	5	2.5	80	11	15	46	1	13	45	102	.33	.02	0.6	NA	NA	NA	NA	5.0°
OUTLET	5.75	20.6	5	1.8	80	11	13	43	0	13	35	87	.20	0	1.6	NA	NA	NA	NA	9.0°

REMARKS: Heavy flow from springs; N. inlet barely flowing; other inlets dry; observed fisherman catching Brook Trout 10 to 15 cm in length.

SITE: EAST POND

DATE: 6 SEPTEMBER 1980

TIME:

CONDITIONS: Open water ; Secchi depth 7.5 m; sunny, changing to cloudy; SW wind increasing to strong; rain storm approaching; 20° to 15°C air temp

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm																		
0.5 m	6.20	18.6	20	0.6	82	11	13	50	1	13	19	79	.10	.06	1.2	NA	0.5	7.9	96%	20.0°
4 m	6.10	19.7	20	0.8	82	11	13	50	1	14	20	77	.07	.01	1.1	NA	0.5	7.8	95%	19.8°
7 m	6.10	19.6	20	0.8	82	11	13	50	1	13	20	77	.12	.05	1.2	NA	0.5	7.9	96%	19.8°
OUTLET	6.00	19.7	20	1.0	82	11	13	51	1	13	20	75	.09	.02	1.0	NA	NA	NA	NA	19.5°

REMARKS: No flowing inlets or surface springs; many 10 cm Brook Trout feeding at surface; water appears to be crystal clear.

SITE: EAST POND

DATE: 16 NOVEMBER 1980

TIME: 1030 to 1300 EST

CONDITIONS: Frozen; ice thickness 2 to 4 cm; partly sunny, broken overcast; moderate N wind; snow flurries; -5°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm																		
0.5 m	5.80	21.5	10	1.6	87	12	13	56	2	16	31	81	.16	.03	1.2	NA	0.8	13.0	101%	1.1°
N. SPRING	6.00	23.5	65	1.0	90	10	10	81	1	15	44	56	.02	0	0.2	NA	NA	NA	NA	4.0°
S.E. SPRING	5.70	23.9	5	2.0	102	11	15	52	1	15	55	77	.18	.01	0.3	NA	2.3	NA	NA	3.9°
OUTLET	5.80	22.0	5	1.6	87	12	14	53	1	17	31	83	.12	.01	1.3	NA	NA	NA	NA	1.1°

REMARKS: Ice too thin to risk deep water samples; took sample 4 m from shore while standing on snowshoes; spring flows substantial; inlet streams dry; moose and bear tracks along shore.

SITE: EAST POND

DATE: 30 JANUARY 1981

TIME: 1115 to 1510 EST

CONDITIONS: Frozen; ice thickness 30 cm; Secchi depth 7 m; sunny; clear; strong NW wind; -5° to -15°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		uS/cm													mg/l					
1 m	5.65	23.2	15	2.2	82	12	16	54	2	15	41	82	.21	.03	0.8	NA	2.3	8.9	71%	2.1°
3 m	5.70	22.4	15	2.0	77	12	13	52	2	14	39	82	.15	0	0.8	NA	2.2	8.9	74%	3.9°
5 m	5.70	22.9	15	2.0	82	12	14	51	2	14	40	82	.20	.03	0.9	NA	2.5	7.9	66%	4.0°
7 m	5.70	22.7	10	2.0	87	13	14	54	2	14	39	82	.18	.02	0.9	NA	3.0	7.3	61%	4.2°
OUTLET	5.85	24.2	20	1.4	92	13	15	58	2	14	48	85	.20	.03	0.9	NA	NA	NA	NA	0.5°

REMARKS: Snow pack 10 to 15 cm deep; inlets and springs dry; had a touch of frost bite on fingers.

SITE: EAST POND

DATE: 2 APRIL 1981

TIME: 1115 to 1400 EST

CONDITIONS: Frozen; ice thickness 35 cm; Secchi depth 7.5 m; cloudy, heavy overcast; strong NW wind; sleet/rain; 1° to -3°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		uS/cm													mg/l					
1 m	5.30	21.3	<5	5.0	65	11	12	39	2	14	58	73	.31	0	0.9	NA	2.4	9.8	75%	0.3°
3 m	5.50	23.1	10	3.2	77	12	13	50	1	16	50	73	.28	.02	0.7	NA	3.5	8.8	75%	4.0°
5 m	5.60	22.4	10	2.5	77	12	14	50	2	16	48	77	.23	0	0.8	NA	3.6	8.6	72%	4.0°
7 m	5.60	22.8	10	2.5	77	12	14	51	1	14	49	75	.26	.03	0.6	NA	3.6	8.6	72%	4.0°
S.E. SPRING	5.70	22.2	5	2.0	80	11	16	45	0	16	49	87	.25	0	0.2	NA	NA	NA	NA	4.6°
CENTRAL																				
INLET	5.00	26.4	0	10	55	10	13	28	1	17	64	110	.85	.01	1.6	NA	NA	NA	NA	0.4°
OUTLET	5.50	21.0	<5	3.2	70	10	13	42	0	16	55	79	.34	0	1.2	NA	NA	NA	NA	1.6°

REMARKS: Watershed snow pack melting; stream flows high but dropping; pond ice decayed; partially thawed along edges.

SITE: EAST POND

DATE: 26 APRIL 1981

TIME:

CONDITIONS: Open water ; Secchi depth 7.5 m; partly cloudy; moderate W wind; 10° to 16°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
1 m	5.60	21.2	10	2.5	72	11	12	45	0	13	52	71	.27	.03	0.9	NA	1.0	11.6	97%	3.9°
3 m	5.70	21.5	10	2.0	70	12	13	48	0	14	51	73	.21	0	0.5	NA	1.0	11.7	97%	3.9°
5 m	5.75	21.4	10	1.8	72	12	14	48	1	14	52	75	.26	.03	0.4	NA	1.0	11.6	96%	3.9°
7 m	5.80	21.4	10	1.6	72	12	13	47	1	14	52	73	.23	0	0.5	NA	1.0	11.7	97%	3.9°
N. INLET	5.30	26.6	25	5.0	87	11	9	65	1	14	50	77	.11	.03	0.6	NA	NA	NA	NA	5.9°
S.E. SPRING	5.70	23.4	10	2.0	80	11	15	48	1	14	56	73	.21	0	0.2	NA	NA	NA	NA	4.9°
OUTLET	5.90	21.7	10	1.3	70	12	13	48	1	14	52	73	.25	.02	0.5	NA	NA	NA	NA	4.9°

REMARKS: Patches of snow left in watershed; S.E. spring flow was substantially greater than any other inlet or spring.

SITE: EAST POND

DATE: 30 AUGUST 1981

TIME: 1200 to 1700 EST

CONDITIONS: Open water ; Secchi depth 7.5 m; cloudy; broken overcast; slight SW wind; 12° to 18°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
1 m	5.90	21.9	15	1.3	82	11	13	49	1	13	50	83	.16	0	1.0	NA	0.6	10.3	113%	15.2°
3 m	5.90	22.0	15	1.3	82	11	13	49	1	14	41	85	.20	.03	1.0	NA	0.9	10.6	113%	14.6°
5 m	5.90	22.6	10	1.3	82	11	13	49	1	14	40	87	.18	.01	1.0	NA	1.0	10.5	112%	14.1°
7 m	5.85	22.6	10	1.4	82	11	13	50	1	13	42	87	.22	.03	1.0	1.2	1.1	10.4	110%	13.7°
N. INLET	5.90	25.1	35	1.3	87	10	9	71	1	14	43	79	.07	0	0.7	NA	NA	NA	NA	8.4°
S.E. SPRING	5.80	24.1	10	1.6	82	11	15	52	1	14	62	75	.22	.03	0.3	NA	NA	NA	NA	4.8°
OUTLET	5.90	21.9	5	1.3	80	11	13	48	1	13	40	87	.19	0	1.1	NA	NA	NA	NA	15.5°

REMARKS: Only S.E. spring had substantial flow; other inlets and springs barely flowing; Brook Trout feeding on insect hatch at surface.

SITE: EAST POND

DATE: 9 APRIL 1982

TIME: 0945 to 1200 EST

CONDITIONS: Frozen; ice thickness 110 cm; Secchi depth 5.5 m; sunny; clear; slight SE wind; 3°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		μS/cm																		
1 m	5.45	26.8	40	3.6	92	13	16	54	3	16	59	100	.25	.11	0.8	1.0	3.3	8.5	65%	1.0°
3 m	5.75	25.3	60	1.8	92	13	15	53	2	16	44	83	.24	.02	0.5	0.6	3.8	6.2	53%	4.3°
5 m	5.70	24.8	70	2.0	82	13	16	54	4	16	40	79	.25	.03	0.5	0.5	4.2	5.2	45%	4.5°
7 m	5.75	25.3	70	1.8	82	13	15	55	4	16	40	77	.20	0	0.4	0.5	4.6	5.2	45%	4.6°
OUTLET	5.80	25.1	50	1.6	92	13	14	52	2	17	52	.87	.23	.03	0.4	0.5	NA	NA	NA	0.6°

REMARKS: Watershed snow pack 1 to 2 m deep; could not locate flowing springs or inlets under ice and snow, no obvious snow melt, yet.

SITE: EAST POND

DATE: 19 MAY 1982

TIME: 1430 to 1700 EST

CONDITIONS: Open water ; Secchi depth 7.5 m; partly sunny, to cloudy; moderate SW wind; rain imminent; 20° to 25°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		μS/cm																		
1 m	5.70	22.8	20	2.0	75	11	13	44	2	13	53	85	.31	0	0.7	0.9	0.6	10.9	110%	12.0°
3 m	5.65	22.1	20	2.2	77	11	13	44	1	13	54	85	.36	.03	0.8	0.9	0.9	11.5	110%	9.2°
5 m	5.60	22.1	20	2.5	72	11	13	45	2	13	55	85	.37	0	0.8	0.8	0.9	11.6	108%	8.4°
7 m	5.60	22.1	20	2.5	70	12	13	45	2	14	56	83	.36	.03	0.9	0.9	1.1	11.7	109%	8.1°
S.E.																				
SPRING	5.80	22.4	30	1.6	77	10	15	45	2	13	49	79	.23	0	0.2	0.3	NA	NA	NA	4.9°
N. INLET	5.85	23.5	35	1.4	85	10	11	59	2	16	50	81	.16	.03	0.8	0.9	NA	NA	NA	7.3°
OUTLET	5.70	22.2	20	2.0	72	11	14	45	2	13	54	81	.29	0	0.7	0.9	NA	NA	NA	12.2°

REMARKS: Patches of snow in watershed; S.E. spring had substantial flow; 2 fishermen present, caught no fish; violent thunderstorm at 1700.

SITE: EAST POND

DATE: 26 AUGUST 1982

TIME: 1330 to 1600 EDT

CONDITIONS: Open water ; Secchi depth 7.5 m; sunny; scattered clouds; moderate NW wind; 20° to 25°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
1 m	6.20	19.8	25	0.6	65	9	10	54	1	11	24	81	.05	.03	1.2	1.2	0.4	8.5	97%	17.0°
3 m	6.25	20.6	25	0.6	65	9	11	54	1	11	25	79	.07	.07	1.2	1.2	0.4	8.6	98%	16.6°
5 m	6.25	19.7	25	0.6	65	9	10	54	1	11	25	79	.05	.03	1.1	1.3	0.4	8.7	98%	16.4°
7 m	6.25	19.7	25	0.6	62	9	10	54	1	11	25	75	.13	.09	1.2	1.3	0.4	8.7	98%	16.3°
OUTLET	6.20	19.7	25	0.6	65	10	10	54	0	11	24	77	.09	.03	1.2	1.4	NA	NA	NA	17.4°

REMARKS: Drought conditions; all inlet streams and surface springs dry; many trout feeding in shallow water, most about 15 cm long.

SITE: EAST POND

DATE: 27 OCTOBER 1982

TIME: 0945 to 1400 EDT

CONDITIONS: Open water ; edges frozen; Secchi depth 7 m; sunny; clear; slight SW wind; -5° to 5°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
1 m	6.20	18.6	35	0.6	65	9	12	54	1	13	16	79	.07	.05	0.9	1.1	0.4	11.1	98%	6.0°
3 m	6.25	18.9	35	0.6	65	10	11	54	1	13	17	75	.07	.08	0.9	1.1	0.4	11.1	98%	6.0°
5 m	6.30	18.9	35	0.5	65	9	11	54	0	13	17	77	.06	.10	0.9	1.1	0.4	11.1	98%	6.0°
7 m	6.20	19.1	35	0.6	72	9	11	54	1	13	17	77	.06	.09	0.9	1.1	0.3	11.1	98%	6.1°
CENTRAL INLET	5.05	24.8	10	8.9	55	9	12	39	0	11	35	123	.68	.02	1.3	1.3	NA	NA	NA	1.6°
OUTLET	6.10	19.7	50	0.8	67	9	11	54	1	13	12	79	.11	.07	0.3	0.4	NA	NA	NA	6.2°

REMARKS: Drought conditions; pond pool level down 0.5 m; sampled Cen. Inlet 300 m beyond pond at site of first flowing water; all surface springs dry; many Brook Trout spawning in gravel at N. end.

SITE: KIAH POND

DATE: 12 MARCH 1980

TIME: 1130 to 1500 EST

CONDITIONS: Frozen; ice thickness 55 cm; Secchi depth 3 m; sunny; scattered clouds; strong NW wind; -6° to -10°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		μS/cm													mg/l					
1 m	5.60	29.8	70	2.5	145	30	9	53	2	28	1	135	.12	.12	NA	NA	NA	6.6	50%	1.6°
3 m	5.55	28.5	25	2.8	135	27	8	45	2	30	1	144	.11	.09	NA	NA	NA	5.7	46%	4.0°
5 m	5.50	28.5	20	3.2	135	26	7	41	2	30	1	146	.16	.14	NA	NA	NA	4.3	35%	4.5°
INLET	6.05	31.0	60	0.9	145	23	5	42	2	18	7	133	.14	.04	NA	NA	NA	NA	NA	LD
OUTLET	5.80	30.6	30	1.6	147	26	6	44	2	30	6	146	.18	.11	NA	NA	NA	NA	NA	LD

REMARKS: Snow depth 50 to 75 cm; inlet stream ice-bound, difficult to locate under snow; temp. data misplaced.

SITE: KIAH POND

DATE: 8 MAY 1980

TIME: 0900 to 1200 EDT

CONDITIONS: Open water ; Secchi depth 3 m; cloudy to sunny, slight SW wind changing to N; 13° to 15°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		μS/cm													mg/l					
0.5 m	5.30	21.8	10	5.0	102	22	10	36	2	24	1	117	.13	.02	8.5	NA	LD	10.2	93%	9.5°
3 m	5.40	22.2	10	4.0	97	21	12	34	3	24	1	115	.16	.08	8.8	NA	0.7	10.6	95%	8.0°
5 m	5.45	22.0	15	3.6	102	21	9	33	3	24	0	117	.10	.03	9.3	NA	1.5	8.6	74%	6.0°
INLET	5.45	21.9	<5	3.6	100	19	9	31	2	23	0	125	.11	.06	8.6	NA	NA	NA	NA	7.5°
OUTLET	5.40	21.9	10	4.0	107	21	10	33	2	39	0	121	.08	.04	8.0	NA	NA	NA	NA	11.0°

REMARKS: Pockets of snow left in watershed; DIC bottle shattered; caught 5 Brook Trout, 15 to 20 cm; all streams still flowing relatively high; otter fishing in inlet brook.

SITE: KIAH POND

DATE: 5 SEPTEMBER 1980

TIME: 1430 to 1600 EDT

CONDITIONS: Open water ; Secchi depth 3 m; cloudy, heavy overcast; slight S wind; light rain; 18°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm				µeq/l									mg/l					
0.5 m	6.25	23.5	30	0.6	112	26	9	42	2	20	2	119	.07	.10	6.1	NA	0.9	7.3	88%	21.5 <sup>o</sup>
3 m	5.80	23.5	40	1.6	107	26	9	43	1	21	1	108	.02	.13	6.6	NA	1.5	5.3	58%	17.0 <sup>o</sup>
5 m	5.80	29.5	100	1.6	167	26	13	37	7	27	1	102	.12	.48	7.1	NA	5.3	0.8	<10%	12.0 <sup>o</sup>
INLET	6.05	29.3	60	0.9	140	30	11	66	1	16	2	133	.04	.13	7.4	NA	NA	NA	NA	15.0 <sup>o</sup>
OUTLET	6.00	24.3	20	1.0	132	26	9	44	2	18	2	123	.05	.10	6.8	NA	NA	NA	NA	20.5 <sup>o</sup>

REMARKS: Pond pool 10 to 15 cm below spring level; dry summer, low stream flows.

SITE: KIAH POND

DATE: 15 NOVEMBER 1980

TIME: 1030 to 1330 EST

CONDITIONS: Frozen; ice thickness 1 to 3 cm; Secchi depth 3.5 m; sunny; clear; slight N wind; 6°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm				µeq/l									mg/l					
0.5 m	5.65	28.0	10	2.2	150	30	12	46	3	27	5	146	.06	.09	8.5	NA	0.5	12.7	92%	0.5 <sup>o</sup>
3 m	5.70	28.2	10	2.0	145	27	10	44	4	27	5	144	.07	.14	8.1	NA	0.6	12.5	91%	0.6 <sup>o</sup>
5 m	5.80	27.5	10	1.6	132	27	10	43	2	27	5	146	.23	.21	9.3	NA	0.6	12.5	92%	0.9 <sup>o</sup>
INLET	5.65	29.6	10	2.2	140	30	7	49	2	31	4	152	.04	.12	9.0	NA	NA	NA	NA	0.9 <sup>o</sup>
OUTLET	5.75	28.0	10	1.8	132	27	10	43	3	28	5	146	.05	.06	9.4	NA	NA	NA	NA	1.0 <sup>o</sup>

REMARKS: No snow cover; smashed channel out through ice to deep water with canoe; stream flows relatively high.



SITE: KIAH POND

DATE: 28 MARCH 1981

TIME: 1030 to 1330 EST

CONDITIONS: Frozen; ice thickness 40 cm; Secchi depth 4 m; sunny; clear; slight wind; 10° to 15°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
1 m	5.40	23.1	5	4.0	100	20	6	30	2	31	5	119	.10	.11	6.2	NA	1.7	10.0	76%	2.1°
3 m	5.40	23.2	5	4.0	105	RJD	RJD	RJD	RJD	RJD	RJD	123	.05	.08	6.5	NA	2.1	8.9	69%	2.5°
5 m	5.60	27.3	40	2.5	170	23	7	35	2	31	4	135	.04	.20	6.9	NA	3.6	4.8	39%	4.0°
INLET	5.65	23.0	15	2.2	105	21	6	35	2	28	5	127	.08	.10	5.0	NA	NA	NA	NA	1.0°
OUTLET	5.60	23.4	10	2.5	105	22	6	35	1	28	5	125	.07	.05	4.8	NA	NA	NA	NA	1.6°

REMARKS: Snow pack was undergoing melting due to warm temp; streams rising; evidence of extremely high flows at inlet and pond outlet dam during the previous month; 3 m sample contaminated during storage.

SITE: KIAH POND

DATE: 25 APRIL 1981

TIME:

CONDITIONS: Open water ; Secchi depth 3 m; cloudy; foggy; slight N wind; light rain; 5°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
1 m	5.70	21.6	10	2.0	100	21	4	33	1	24	2	123	.06	.10	5.7	NA	0.7	10.9	92%	6.1°
3 m	5.70	22.2	10	2.0	100	19	5	32	1	24	1	127	.05	.05	5.3	NA	0.7	10.9	90%	5.7°
5 m	5.70	21.8	15	2.0	105	19	4	34	1	24	1	129	.09	.10	5.7	NA	0.8	10.4	87%	5.4°
INLET	5.60	22.6	<5	2.5	100	20	4	37	1	24	0	142	.07	.05	7.1	NA	NA	NA	NA	4.6°
OUTLET	5.70	21.8	15	2.0	100	20	4	33	1	24	2	129	.10	.10	6.0	NA	NA	NA	NA	6.4°

REMARKS: 4 boats on pond, 2 with motors, all people fishing; stream flows up due to recent rains; no obvious snow left in watershed; numerous zooplankton in epilimnion.

SITE: KIAH POND

DATE: 29 AUGUST 1981

TIME: 1130 to 1630 EST

CONDITIONS: Open water ; Secchi depth 2 m; sunny; scattered clouds; moderate S wind; 20° to 25°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		uS/cm													mg/l					
1 m	5.70	20.6	10	2.0	117	21	2	33	3	28	0	112	.03	.18	12.5	NA	0.9	8.1	90%	18.2°
3 m	5.40	22.7	10	4.0	117	22	3	33	3	24	1	121	.10	.34	11.2	NA	3.1	1.9	20%	14.8°
5 m	5.90	29.0	100	1.3	195	23	9	35	1	24	1	135	.13	.79	9.2	10.3	5.4	0.8	<10%	10.6°
INLET	6.20	22.2	50	0.6	115	22	4	42	1	20	3	102	.04	.12	7.8	NA	NA	NA	NA	15.0°
OUTLET	5.70	21.2	20	2.0	107	21	2	32	3	20	1	115	.03	.23	12.1	NA	NA	NA	NA	19.4°

REMARKS: Beaver dam being rebuilt; pond pool level up 10 to 20 cm; fisherman observed catching half-dozen Brook Trout, one trout measured 25 to 30 cm; 3 moose wading in inlet swamp.

SITE: KIAH POND

DATE: 2 APRIL 1982

TIME: 1400 to 1645 EST

CONDITIONS: Frozen; ice thickness 90 cm; Secchi depth 2.5 m; sunny; clear; strong NW wind; 2°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		uS/cm													mg/l					
1 m	4.20	38.1	0	63.0	22	7	1	14	7	11	39	85	.02	.07	3.0	3.1	0.8	12.7	92%	0.7°
3 m	5.40	22.9	25	4.0	92	19	5	35	4	21	6	121	.05	.26	4.8	5.0	2.3	9.0	72%	3.9°
5 m	5.60	24.4	50	2.5	97	21	6	40	6	25	1	112	.04	.30	6.0	6.4	4.9	1.5	13%	4.6°
INLET	5.70	20.9	15	2.0	90	16	3	30	2	16	4	125	.05	.10	4.7	5.2	NA	NA	NA	1.0°
OUTLET	5.55	22.6	15	2.8	90	17	3	30	2	17	7	125	.05	.08	4.9	5.2	NA	NA	NA	0.9°

REMARKS: Recent rains had created high flows in streams, now back to normal flow rates; snow pack looked unaffected, just ice coated.

SITE: KIAH POND

DATE: 7 MAY 1982

TIME: 0900 to 1200 EDT

CONDITIONS: Open water ; Secchi depth 2.5 m; partly sunny; slight S wind; 10° to 15°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub> %SAT	TEMP °C
	pH	COND											total	total						
		µS/cm													mg/l					
1 m	5.60	17.4	20	2.5	77	18	3	25	1	14	2	96	.08	.13	5.3	5.4	1.2	9.0	84%	10.2°
3 m	5.50	17.6	15	3.1	72	16	2	23	2	16	2	92	.05	.10	5.4	5.9	1.6	8.2	69%	5.7°
5 m	5.60	18.7	35	2.5	77	17	3	27	3	17	3	96	.08	.25	5.9	6.3	2.7	5.9	49%	5.0°
INLET	5.80	18.7	20	1.6	80	19	3	32	1	14	2	108	.06	.03	5.4	5.9	NA	NA	NA	10.1°
OUTLET	5.60	17.4	15	2.5	72	17	3	25	1	14	2	94	.09	.10	5.3	6.0	NA	NA	NA	12.2°

REMARKS: Pond pool level up about 25 cm; beavers continue to rebuild outlet dam; beaver splashing on surface; 2 fishermen caught nothing.

SITE: KIAH POND

DATE: 1 SEPTEMBER 1982

TIME: 1045 to 1300 EDT

CONDITIONS: Open water ; Secchi depth 3 m; cloudy, heavy overcast; light S wind; 15° to 20°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub> %SAT	TEMP °C
	pH	COND											total	total						
		µS/cm													mg/l					
1 m	6.30	17.6	30	0.5	75	17	3	38	1	17	0	73	.09	.18	9.5	10.2	0.9	7.9	88%	17.7°
3 m	6.05	18.1	35	0.9	80	18	3	36	2	17	0	75	.03	.31	8.1	9.2	1.4	5.9	61%	14.2°
5 m	6.20	24.4	100	0.6	117	19	8	33	16	35	29	79	.01	2.8	7.5	10.3	5.7	0.5	<10%	8.8°
INLET	6.65	22.5	80	0.2	105	23	7	53	1	16	5	65	.01	.09	6.6	7.3	NA	NA	NA	12.8°
OUTLET	6.20	17.7	35	0.6	80	19	3	37	2	17	0	73	.06	.32	8.5	9.6	NA	NA	NA	17.4°

REMARKS: Dry weather; low stream flows; beaver work continues to support high pool level; pack of bear dogs ran past pond, followed by hunters.

SITE: KIAH POND

DATE: 14 NOVEMBER 1982

TIME:

CONDITIONS: Open water ; only edges frozen; Secchi depth 2.5 m; sunny; clear; slight SW wind; 5°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
1 m	5.95	21.7	20	1.1	105	23	10	41	2	31	2	96	.10	.36	9.7	10.2	0.7	10.1	84%	5.2°
3 m	5.90	21.3	20	1.3	105	23	10	41	4	30	1	96	.08	.37	10.5	10.5	0.8	9.7	81%	5.1°
5 m	5.90	21.3	20	1.3	97	22	10	41	2	30	1	94	.08	.35	10.4	10.4	0.7	9.8	81%	5.0°
INLET	5.65	22.6	15	2.2	107	22	11	38	2	32	0	106	.10	.24	10.2	10.7	NA	NA	NA	3.8°
OUTLET	6.00	21.3	20	1.0	97	23	10	41	2	31	1	96	.09	.34	9.0	10.6	NA	NA	NA	5.6°

REMARKS: Recent rains produced typical stream flows, relieving the near drought conditions; new, elaborate beaver dams on outlet backed pond pool up into swamp at N end; pond water very darkly stained.

SITE: PEAKED HILL POND

DATE: 15 FEBRUARY 1980

TIME: 1400 to 1700 EST

CONDITIONS: Frozen; ice 35 cm thick; sunny; scattered clouds; strong N wind, then calm; -1° to -4°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
0.5 m	5.50	28.9	20	3.2	127	35	9	46	1	28	1	160	.10	.08	NA	NA	NA	LD	LD	1.6°
1.5 m	5.55	28.2	10	2.8	125	RJD	RJD	RJD	RJD	31	RJD	158	.18	.05	NA	NA	NA	LD	LD	3.8°
2.5 m	5.50	26.6	150	3.2	117	43	9	39	0	28	0	146	.08	.09	NA	NA	NA	LD	LD	3.9°
W. FORK INLET	5.60	31.2	50	2.5	147	39	14	33	2	21	1	140	.17	.10	NA	NA	NA	NA	NA	LD
N. FORK INLET	5.80	28.3	95	1.6	122	48	14	45	1	41	1	102	.06	.23	NA	NA	NA	NA	NA	LD

REMARKS: Snow-less winter as of this date; outlet frozen solid, no running water; DO<sub>2</sub> bottles broken in transit; water column full of decomposing aquatic plant pieces; Secchi disc not available; 1.5 m sample contaminated in storage.

SITE: PEAKED HILL POND

DATE: 3 MAY 1980

TIME: 0900 to 1600 EST

CONDITIONS: Open water ; Secchi depth 3 m; sunny; clear; calm; clouding up; late rain; 22° to 18°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm													mg/l					
1 m	5.60	18.9	10	2.5	75	30	8	25	1	20	0	104	.12	.03	6.0	NA	0.4	10.2	100%	13.0°
2.5 m	5.70	18.8	10	2.0	72	31	8	25	2	20	0	104	.09	.03	4.7	NA	0.4	10.9	102%	11.5°
W. FORK INLET	5.55	22.4	10	2.8	85	34	9	29	1	20	1	125	.01	.07	5.6	NA	0.3	NA	NA	12.2°
N. FORK INLET	5.70	21.9	10	2.0	85	35	8	27	0	18	2	125	.07	.04	3.4	NA	0.2	NA	NA	9.5°
OUTLET	5.55	19.1	10	2.8	70	25	9	20	2	17	1	108	.07	.05	5.3	NA	0.5	NA	NA	15.5°

REMARKS: Patches of snow left in watershed; all streams relatively high; beavers splashing, stirring up surface water.

SITE: PEAKED HILL POND

DATE: 4 SEPTEMBER 1980

TIME: 0815 to 1100 EDT

CONDITIONS: Open water ; Secchi depth 3 m; sunny; clear; calm; 13<sup>o</sup> to 15<sup>o</sup>C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		uS/cm													mg/l					
0.5 m	5.75	20.8	20	1.8	82	34	8	31	3	18	1	98	.03	.10	5.1	NA	0.9	7.1	86%	22.5 <sup>o</sup>
2.5 m	5.80	20.9	15	1.6	82	33	8	32	3	20	1	104	.05	.09	4.9	NA	1.1	7.2	88%	23.0 <sup>o</sup>
W. FORK INLET	5.85	22.8	25	1.4	127	39	17	36	6	34	6	83	.05	.50	13.6	NA	NA	NA	NA	17.0 <sup>o</sup>
N. FORK INLET	5.95	33.1	20	1.1	145	57	19	38	2	17	13	187	.08	.09	5.0	NA	NA	NA	NA	14.0 <sup>o</sup>
OUTLET	5.60	22.0	10	2.5	85	30	5	34	3	21	1	106	.08	.16	8.1	NA	NA	NA	NA	18.0 <sup>o</sup>

REMARKS: Outlet dam being worked on by beavers; pond pool level up 10 to 15 cm; outlet swamp flooded, inlets nearly dry; obvious organic foam in streams.

SITE: PEAKED HILL POND

DATE: 15 NOVEMBER 1980

TIME: 1600 to 1700 EST

CONDITIONS: Frozen; ice 1 to 2 m thick; sunny; clear; N winds decreasing to calm; -1<sup>o</sup> to -5<sup>o</sup>C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		uS/cm													mg/l					
0.5 m	5.80	22.0	10	1.6	87	35	9	34	3	21	4	117	.05	.09	4.8	NA	0.8	13.2	102%	2.1 <sup>o</sup>
INLET	5.70	24.5	10	2.0	95	44	6	33	0	21	4	140	.05	.08	3.7	NA	NA	NA	NA	2.1 <sup>o</sup>
OUTLET	5.70	22.2	10	2.0	87	35	10	34	3	23	3	119	.07	.13	6.0	NA	NA	NA	NA	2.0 <sup>o</sup>

REMARKS: Ice too thin to risk deep water sample; no Secchi depth; sampled 2 m from shore; sampled N and W Inlet forks at junction of both.

SITE: PEAKED HILL POND

DATE: 6 FEBRUARY 1981

TIME: 1240 to 1530 EST

CONDITIONS: Frozen; ice thickness 35 cm; Secchi depth 2.5 m; sunny, thin overcast; slight W wind; light flurries; -5° to -8°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP	
	pH	COND											total	total					%SAT	°C	
		µS/cm																			
0.5 m	5.40	29.3	20	4.0	107	49	12	37	5	27	19	127	.11	.10	4.2	NA	3.8	4.6	33%	0.2°	
1.5 m	5.65	27.4	40	2.2	115	45	10	37	6	25	8	121	.13	.15	4.7	NA	4.7	3.7	30%	3.8°	
2.5 m	5.70	26.6	55	2.0	110	41	0	33	8	24	0	112	.12	.24	4.7	NA	5.5	2.0	16%	4.2°	
INLET	5.60	26.8	10	2.5	100	49	9	35	5	27	20	133	.09	.10	4.1	NA	NA	NA	NA	0.1°	
OUTLET	5.55	27.3	10	2.8	97	45	12	37	4	30	16	131	.12	.14	6.0	NA	NA	NA	NA	0.1°	

REMARKS: Recent heavy rains created high flows in streams, now locked up in ice; pond surface ice stained brown; beavers continue to work on outlet dam in mid-winter.

SITE: PEAKED HILL POND

DATE: 26 MARCH 1981

TIME: 0745 to 1025 EST

CONDITIONS: Frozen, ice thickness 35 cm; Secchi depth 2 m; sunny; clear; calm; 5° to 10°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP	
	pH	COND											total	total					%SAT	°C	
		µS/cm																			
0.5 m	5.30	15.7	5	5.0	57	RJD	RJD	RJD	RJD	RJD	RJD	75	.13	.09	3.3	NA	2.8	6.2	48%	3.0°	
1.5 m	5.40	20.5	20	4.0	85	34	6	31	3	21	12	104	.13	.16	3.7	NA	3.2	6.2	50%	4.0°	
2.5 m	5.50	22.5	10	3.2	90	RJD	RJD	RJD	RJD	RJD	RJD	115	.13	.09	3.6	NA	3.4	6.0	48%	4.0°	
INLET	5.60	20.9	10	2.5	92	35	6	31	1	25	2	123	.09	.11	3.4	NA	NA	NA	NA	0.7°	
OUTLET	5.60	20.2	20	2.5	82	35	7	31	1	20	2	110	.13	.11	3.7	NA	NA	NA	NA	3.0°	

REMARKS: Very little snow left in watershed; all streams back down to normal flows; outlet dam being rebuilt by beavers; 2 sample bottles contaminated in storage.

SITE: PEAKED HILL POND

DATE: 23 APRIL 1981

TIME: 0845 to 1105 EDT

CONDITIONS: Open water ; Secchi depth 3 m; sunny; thin overcast; calm; 8° to 12°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm																		
0.5 m	5.40	19.5	10	4.0	80	33	6	30	0	18	0	106	.13	.12	3.3	NA	0.3	11.3	95%	6.8°
1.5 m	5.60	18.9	10	2.5	77	RJD	RJD	RJD	RJD	RJD	RJD	110	.13	.05	3.1	NA	0.4	11.1	94%	6.7°
2.5 m	5.75	20.0	10	1.8	77	33	6	28	0	18	0	112	.10	.08	3.1	NA	0.4	11.3	95%	6.5°
INLET	5.65	22.1	5	2.2	82	37	5	30	0	20	1	133	.07	.15	2.7	NA	NA	NA	NA	3.8°
OUTLET	5.65	19.8	5	2.2	72	33	6	28	0	18	0	112	.12	.06	3.7	NA	NA	NA	NA	6.5°

REMARKS: No obvious snow in watershed; stream flows relatively low; numerous zooplankton in epilimnion; Brook Trout feeding on surface; pond pool level raised about 15 cm by outlet beaver dam; sample bottle contaminated in storage.

SITE: PEAKED HILL POND

DATE: 19 AUGUST 1981

TIME: 0800 to 1500 EDT

CONDITIONS: Open water ; Secchi depth 3 m; sunny to partly sunny; calm; 10° to 25°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		µS/cm																		
0.5 m	5.50	19.5	10	3.2	80	23	2	28	3	14	0	112	.05	.07	5.6	NA	0.5	8.8	100%	19.6°
1.5 m	5.55	19.3	5	2.8	80	24	2	28	3	14	0	119	.06	.10	5.7	NA	0.6	8.8	98%	18.6°
2.5 m	5.60	19.3	5	2.5	77	23	2	27	2	14	0	117	.08	.10	5.6	NA	0.6	8.7	97%	18.2°
4.0 m	5.55	19.4	5	2.8	80	23	2	28	2	14	0	121	.07	.12	6.0	6.2	0.6	8.5	92%	17.5°
INLET	5.65	21.4	5	2.2	90	28	3	29	2	17	2	129	.08	.12	5.7	6.0	NA	NA	NA	15.6°
OUTLET	5.50	19.3	5	3.2	75	23	2	27	1	14	0	117	.04	.11	6.1	NA	NA	NA	NA	20.9°

REMARKS: Wet conditions; all streams running well; several dead Brown Bullheads in aquatic growth along shoreline; pond pool still high; found and sampled 4.5 m deep hole for first time.



SITE: PEAKED HILL POND

DATE: 27 MARCH 1982

TIME: 1050 to 1330 EST

CONDITIONS: Frozen; ice thickness 75 cm; cloudy, broken overcast; strong NW wind; snow flurries; -1° to -5°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		uS/cm																		
1 m	5.60	24.4	5	2.5	67	30	4	25	7	17	23	115	.09	.16	2.8	3.2	1.9	8.5	61%	0.6°
2.5 m	6.00	30.9	150	1.0	135	42	10	36	13	30	2	87	.07	.19	4.6	4.9	5.3	3.1	25%	4.4°
4 m	6.10	34.3	200	0.8	122	44	13	37	20	32	1	67	.09	.20	5.6	6.1	6.7	0.8	<10%	4.5°
INLET	5.80	24.1	10	1.6	90	39	5	30	0	16	19	125	.04	.08	2.9	3.2	NA	NA	NA	0.4°
OUTLET	5.60	24.7	20	2.5	95	37	7	35	3	20	12	131	.08	.11	3.4	3.6	NA	NA	NA	0.5°

REMARKS: Recent heavy rain; streams now refrozen at low flows; snow pack very dense, hard; 1 m sample clear, while others were stained; some thawing of pond ice in inlet swamp.

SITE: PEAKED HILL POND

DATE: 2 MAY 1982

TIME: 0815 to 1200 EDT

CONDITIONS: Open water ; Secchi depth 3 m; sunny; clear; calm; 10° to 15°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		uS/cm																		
1 m	5.70	17.7	25	2.0	62	30	5	23	4	17	4	92	.07	.13	3.3	4.0	1.8	9.0	76%	6.4°
2.5 m	5.65	18.3	25	2.2	62	28	5	22	4	16	3	90	.08	.17	4.0	4.0	2.0	8.6	71%	5.6°
4 m	5.60	18.4	30	2.5	67	28	5	22	4	17	3	90	.07	.13	3.6	4.8	2.3	7.9	64%	4.9°
INLET	5.55	19.2	15	2.8	70	30	2	22	2	11	6	110	.08	.07	3.3	3.5	NA	NA	NA	8.0°
OUTLET	5.65	17.7	25	2.2	65	28	5	22	3	16	3	90	.10	.12	3.5	3.8	NA	NA	NA	7.4°

REMARKS: Some snow patches left next to pond and in watershed; Mayfly hatch in progress, no fish seen taking on surface.

SITE: PEAKED HILL POND

DATE: 28 AUGUST 1982

TIME: 0930 to 1215 EDT

CONDITIONS: Open water ; Secchi depth 4 m; sunny; clear; moderate NE wind; 20° to 25°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		uS/cm				ueq/l									mg/l					
1 m	6.00	16.9	25	1.0	65	27	3	30	2	13	0	87	.01	.09	5.8	6.8	0.7	7.9	90%	19.3°
2.5 m	6.00	16.5	25	1.0	65	27	3	30	2	13	0	87	.04	.13	5.8	6.3	0.6	7.7	87%	18.6°
4 m	5.85	16.7	30	1.4	65	27	3	30	3	11	0	90	.01	.13	6.0	6.1	0.8	7.2	81%	18.1°
INLET	6.00	19.1	50	1.0	72	31	7	40	10	21	44	62	.01	.56	11.4	11.8	NA	NA	NA	13.4°
OUTLET	5.60	14.5	30	2.5	47	22	3	25	3	18	1	60	.01	.55	8.5	9.4	NA	NA	NA	16.5°

REMARKS: Pond pool level very high due to refurbishment of outlet dam by beavers; otherwise, inlets nearly dry; 6 fishermen worked pond over, caught nothing.

SITE: PEAKED HILL POND

DATE: 14 NOVEMBER 1982

TIME: 0845 to 1130 EST

CONDITIONS: Open water ; except frozen along edges; Secchi depth 4 m; sunny; clear; -5° to 5°C air temp.

DATA:	LAB	Sp	ALK	[H <sup>+</sup> ]	Ca	Mg	K	Na	NH <sub>4</sub>	Cl	NO <sub>3</sub>	SO <sub>4</sub>	Al	Fe	DOC	TOC	DIC	DO <sub>2</sub>	O <sub>2</sub>	TEMP
	pH	COND											total	total					%SAT	°C
		uS/cm				ueq/l									mg/l					
1 m	6.10	17.4	25	0.8	65	29	7	33	2	17	0	90	.04	.13	5.0	5.5	0.6	10.8	89%	5.3°
2.5 m	6.00	17.3	25	1.0	65	30	7	33	1	17	0	90	.03	.15	5.1	6.2	0.6	10.7	88%	5.3°
4 m	6.10	17.3	25	0.8	62	29	7	32	2	17	1	87	.06	.13	5.0	5.3	0.6	10.8	88%	5.1°
INLET	5.80	23.5	15	1.6	85	40	9	33	2	23	3	129	.08	.18	5.1	5.3	NA	NA	NA	4.0°
OUTLET	5.90	17.1	25	1.3	50	23	6	27	2	17	1	79	.05	.14	6.0	6.2	NA	NA	NA	4.3°

REMARKS: Pond pool level still high, but upstream inlet beaver ponds held very little water; numerous zooplankton in epilimnion; stream flows relatively high because of recent rains.