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WATER RESOURCE BASELINE DATA
AND ASSESSMENT OF IMPACTS FROM
ACIDIC PRECIPITATION

Acadia National Park

June 1985

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AN EVALUATION OF THE TECHNICAL
REPORT FOR MANAGEMENT

Water Resource Baseline Data and Assessment of Impacts from
Acidic Precipitation, Acadia National Park, Maine

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Water Resources Program
North Atlantic Region

Technical Report #16

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June, 1985

This Evaluation for Management Summarizes the
Findings of the Technical Report

Water Resource Baseline Data and Assessment of Impacts from
Acidic Precipitation, Acadia National Park, Maine

Principal Investigators: J.S. Kahl, J.L. Andersen, and S.A. Norton

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EXECUTIVE SUMMARY

The aquatic chemistries of 18 lakes and ponds, and 23 first- and second-order streams at Acadia National Park (ANP) were studied during 1982-1984 to ascertain present chemical status and to estimate potential impacts of acidic deposition. ANP is situated primarily on biotite and hornblende granites. Topography is steep to moderate, and the soils are thin and poorly buffered, or non-existent, except on the valley floors. The mean weighted pH of precipitation is about 4.4, with wet sulfate (SO_4) deposition of 15-20 kg/ha/year. This deposition of both hydrogen ion and SO_4 is in excess of the amount thought to produce effects in other regions of the world receiving acidic precipitation. The lakes are poorly buffered, have low specific conductance, and are very clear waters; these three factors generally indicate that a lake is sensitive to the effects of acidic precipitation.

Surveys performed during baseflow yielded mean pH of 6.39, 6.48, and 5.93, for the lakes, second-order streams (SOS), and first-order brooks (FOB), respectively; alkalinities were 61, 140, and 56 $\mu\text{eq/l}$. The only previous data was for seven of the largest lakes at ANP, which show no significant change in pH since the 1940's. Currently, the only 'acidic' site is the smallest, highest elevation pond on the island, Sargent Mountain Pond (SMP; mean pH 4.58). During snow-melt in mid-March of both 1983 and 1984, mean pH was depressed to 5.78, 6.01, and 5.43 in the lakes, SOS, and FOB, respectively; corresponding alkalinity values were 20, 32, and 10 $\mu\text{eq/l}$. Several independent calculations estimate that 40 to 76 percent of the spring decline in alkalinity is due to acidification, presumably by strong acids related to acidic precipitation. Dilution, rather than acidification, is estimated to account for 24 to 60 percent of the decrease in alkalinity during snow-melt. After correction for sea salts, 60 percent of the sites sampled are sulfate-dominated ($\text{SO}_4 > \text{HCO}_3$). All but two of the bicarbonate waters are in the relatively thick till found on the valley floors or at relatively low elevation, in soils formed in part from marine sediments deposited during deglaciation. Similarly, all of the sulfate-dominated waters are at higher elevation, except for 5 low elevation, clearwater lakes. Two-thirds of the lakes are sulfate-dominated, including all of the very clear water lakes. Sulfate concentrations range from values less than, to over three times that currently found in wet deposition.

Total aluminum concentrations are generally low (< 100 ppb) although some low elevation or humic sites have total Al concentrations greater than 100 ppb. At these sites, ion-exchangeable (labile) Al concentrations are less than 65 ppb. SMP and some of the FOB have higher total and labile Al, especially during depressed pH in the spring, but labile Al concentrations are generally less than 100 ppb, except in SMP (130-230 ppb labile Al). Total zinc and manganese concentrations are generally low (≤ 10 and ≤ 20 ppb) and show only slight seasonal pH dependent changes. The highest values for both trace metals were observed during low baseflow conditions in the summer and fall.

The sensitivity of ANP surface waters to acidification is indicated by low alkalinities, and by high calcite saturation indices (CSI) which are all in the 'sensitive' range ($\text{CSI} > 3$). Based on both parameters, and on data from other surveys, ANP waters are more

sensitive than the New England regional norm. Application of empirical models adapted from Henriksen indicate that alkalinity loss at some upland, first-order sites may have been as great as 50 percent, although these sites are predicted to have had very low alkalinities. If these changes in alkalinity are due to acidic precipitation, they have occurred since the onset of acidic precipitation over the past century. Alternatively, these inferred declines may be artifacts of normal soil processes occurring in thin, naturally acidic soils. Several surface waters have modern alkalinity values equal to or greater than the reconstructed historical alkalinity. These sites are all in terrain with thick overburden, or at low elevation. Except for the FOB, which may have had pH declines of up to 0.8 pH units, and SMP (up to 1.2 pH unit decline), pH has apparently not changed significantly, based on inferred past water chemistry. The apparent pH depressions may be due to natural processes or to acidic deposition. There is no relationship between pH and sulfate, although the ratio of SO_4 to the sum of anions indicates that the sulfate concentration is a factor in the pH and alkalinity status of each site. High relative sulfate concentrations, presumably related to acidic deposition, are found in low pH and low alkalinity waters.

The sediment chemistry records from SMP, The Bowl, and Long Pond (Isle au Haut) indicate that anthropogenic trace metals (Pb, Zn, Cu) have been deposited into ANP lake sediments for at least 100 years. These data suggest that the inferred effects of acidic deposition have occurred at least over this time span. Calcium accumulation rates in sediments began declining in SMP and The Bowl in the mid- to late 1800's, possibly indicative of the sensitivity and response of these sites to acidic precipitation. In contrast, Ca deposition remained nearly constant at Long Pond until approximately 20 years ago, when the rate began to decline.

This study indicates the existence of surface waters at ANP that are very sensitive to acidic precipitation. Sargent Mountain Pond is the only acidic site, although indirect evidence suggests that it has been acidic for over 200 years. A number of small brooks have lower modern pH and alkalinity than chemical modelling predicts should have existed previously. Compared to the results of other surveys in New England and the Adirondacks, the pH and alkalinity distribution of ANP waters are typical of the region, with acidic waters generally restricted to small, high elevation sites. The rate of change of chemical parameters at ANP, if any, is unknown. Current trends cannot be determined unequivocally until future work is compared to this baseline data.

PROBLEM STATEMENT

Acadia National Park is largely situated on granitic bedrock that is resistant to chemical weathering. Except in places at elevations below approximately 40 meters, and in some of the valley floors, the soils are thin, and low in acid neutralizing capacity. The topography is generally moderate to steep, resulting in short residence times for soil- and groundwaters. These factors cause the surface waters at ANP to be poorly buffered and very sensitive to acidic precipitation.

Although the National Atmospheric Deposition Program (NADP) station at ANP has recorded an average annual precipitation pH of less than 4.5 since its inception in 1980, the chemical status of the aquatic resources was largely unknown prior to 1982. This study determined the present status of ANP surface waters, thus establishing a baseline data set to which future studies can be compared. We also estimated the current impact of acidic precipitation using a modification of an existing chemical model, and evaluated the sediment chemistry profiles for three ponds as an aid in the interpretation of historical trends.

PROBLEM BACKGROUND

Although much uncertainty exists regarding the historical, as well as the 'normal', pH of precipitation, observations worldwide suggest that aquatic resources are degraded by acidification when the pH of precipitation is less than 4.7. Although there is little unequivocal evidence linking fish loss or forest decline to acidic precipitation in North America, circumstantial indications are that gradual, long-term acidification may be occurring in some sensitive systems. The pH 4.4 precipitation at ANP represents a concentration of hydrogen ion twice that in precipitation of pH 4.7. Consequently, a priori expectations were that at least some of the waters would show evidence of acidification.

Two previous studies had examined the aquatic chemistries of several lakes at ANP. A survey in the 1940's measured the pH of 7 lakes. The second study during 1978-1979 determined pH and cation concentrations in 6 lakes. The modern pH data do not show evidence of acidification relative to the historical data. However, these studies were performed as part of larger surveys, and represent single samplings for each site. Furthermore, the data are from the largest lakes in the park, lakes least likely to show effects of acidification. With acidic precipitation being cited as a major environmental threat, a need existed to conduct a comprehensive spatial and temporal chemical survey of the major lakes and streams, as well as to estimate the status of the many small, upland first-order brooks.

In this study, we included all lakes and ponds located completely within park boundaries, or accessible on park land, and most of the larger streams in or adjacent to the park. Additionally, we chose The Bowl and Sargent Mountain Pond, and the Canon Brook, Upper Hadlock Pond, and Eagle Lake watersheds for more intensive study. The first-order brooks in these systems were expected to exhibit the greatest acidification, if any were evident, and therefore to be of importance in the estimation of overall vulnerability. Using the modern water chemistry, application of empirical chemical models developed in Norway was used to extrapolate the past chemical condition of these waters, in lieu of extensive historical data.

RESEARCH RESULTS

The surface waters of ANP are generally clear and oligotrophic. A few smaller ponds and low elevation second-order streams are associated with wetlands, and are moderately more humic (Pt-Co color units 20-100), although the maximum mean color for any site was 60 Pt-Co units. Specific conductances are low (mean 38 μ mhos), in spite of the input of marine aerosols from seawater.

Figures 1 and 2 present the pH and alkalinity distributions during baseflow (summer and fall) conditions for the brooks, streams and lakes of ANP. While pH and alkalinity are temporally relatively constant for the lakes during baseflow, the chemistries of the flowages respond more to precipitation events. In the spring, the pH and alkalinity are depressed at all sites, in part in response to acidic inputs from melting snow (Table 1). In general, the lowest recorded pH and alkalinities occurred in mid-March of both years. However, freeze-thaw cycles occur repeatedly during the winters at ANP, making the complete documentation of chemical excursions very difficult. Recovery to baseflow alkalinity was complete in 10 to 16 weeks, although heavy rains resulted in substantial pH and alkalinity depressions several times during the study, especially in the first-order brooks. The responses of the first-order brooks at Upper Hadlock Pond are typical of those found at other sites during the study (Figure 3).

In addition to low pH and/or alkalinity, the calcite saturation index (CSI) is an indicator of sensitivity to acidification. The CSI is the negative logarithm of the degree of saturation of a water with respect to CaCO_3 . Sensitive waters are defined as having a CSI greater than 3.0: the larger the CSI, the greater the sensitivity. When applied to ANP waters, only 11 of the 536 analyses for the 41 sites yielded a CSI less than 3. All of the mean CSI values were above 3: 5.5, 4.9, and 4.6 for the brooks, lakes, and streams respectively, with the lowest mean CSI being 3.32 (Stanley Brook). Based on alkalinity and CSI from other studies, ANP waters are more sensitive than the New England regional norm. In the most comprehensive synoptic survey of New England to date, 41 percent of the waters sampled had alkalinities less than 100 μ eq/l, compared to 68 percent in this study. Similarly, approximately 70 percent of the samples had CSI values less than 3.0 (non-sensitive), whereas all of the ANP mean values were greater than 3.0.

The pH and alkalinity depressions observed during different flow regimes are a combination of 'titration' by strong acids and simple dilution by increased volume of water. Using several methods of estimating the relative influences of acidification and dilution, we estimate that spring loss of alkalinity due to reaction with strong acids is equal to or greater than dilution effects also occurring during spring snow-melt. The maximum estimated dilution effect was 52 percent in the second-order streams, during spring 1983. In contrast, loss of alkalinity apparently due to reaction with strong acids represented more than 70 percent of the decline in alkalinity in the first-order brooks during both spring 1983 and 1984.

Many of the waters at ANP are no longer bicarbonate waters (HCO_3

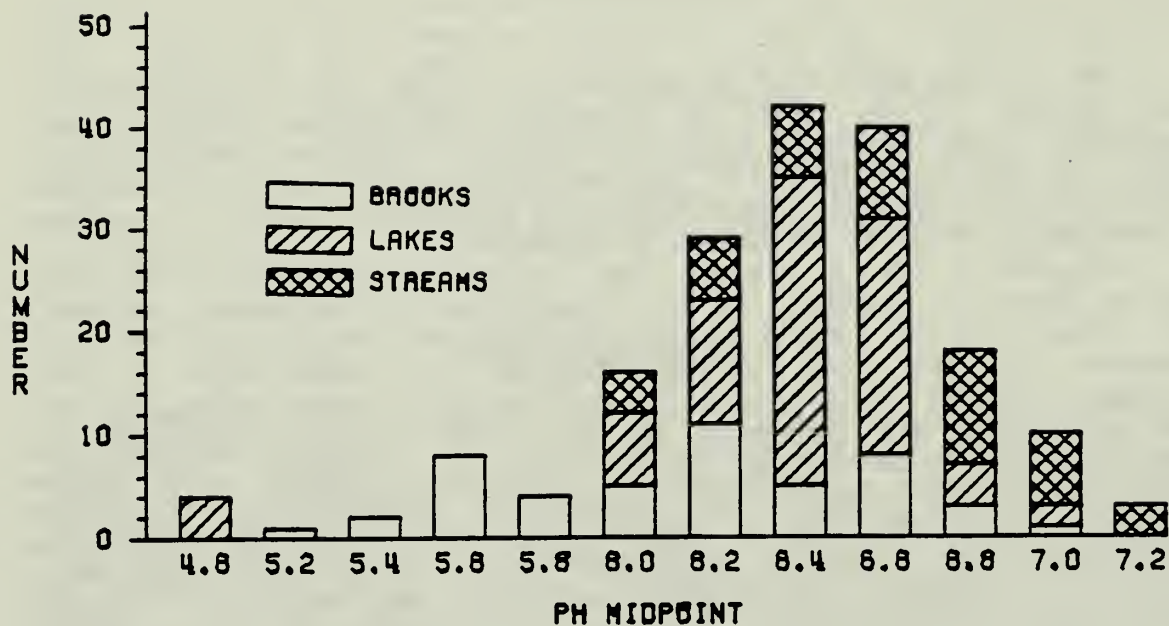


Figure 1. Baseflow pH distribution, 1982-1984.

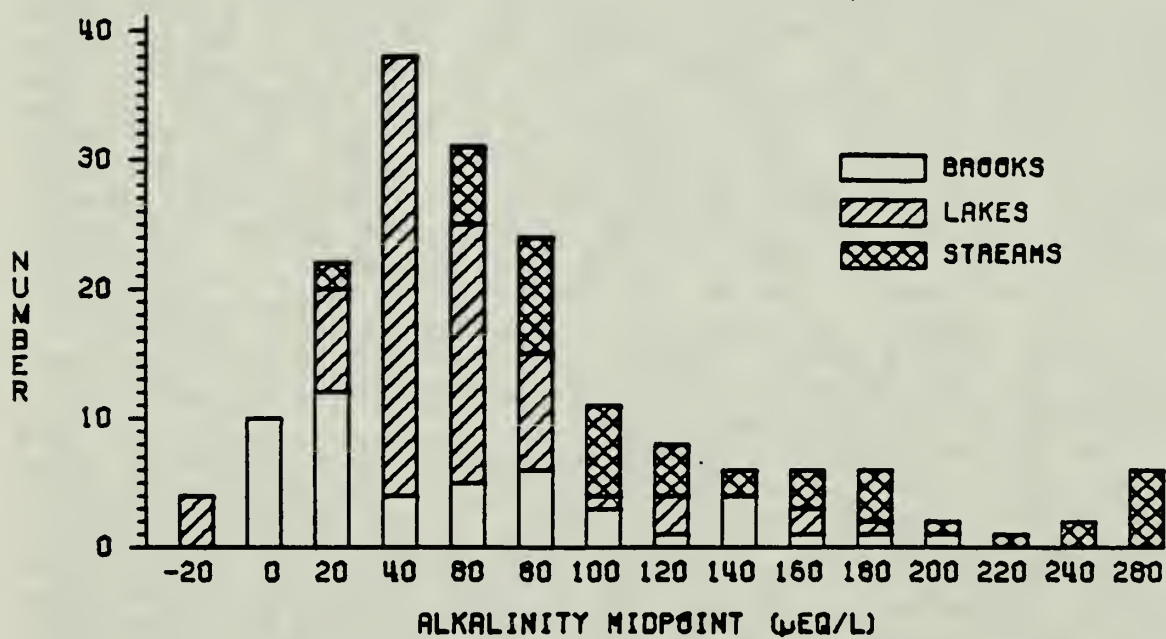
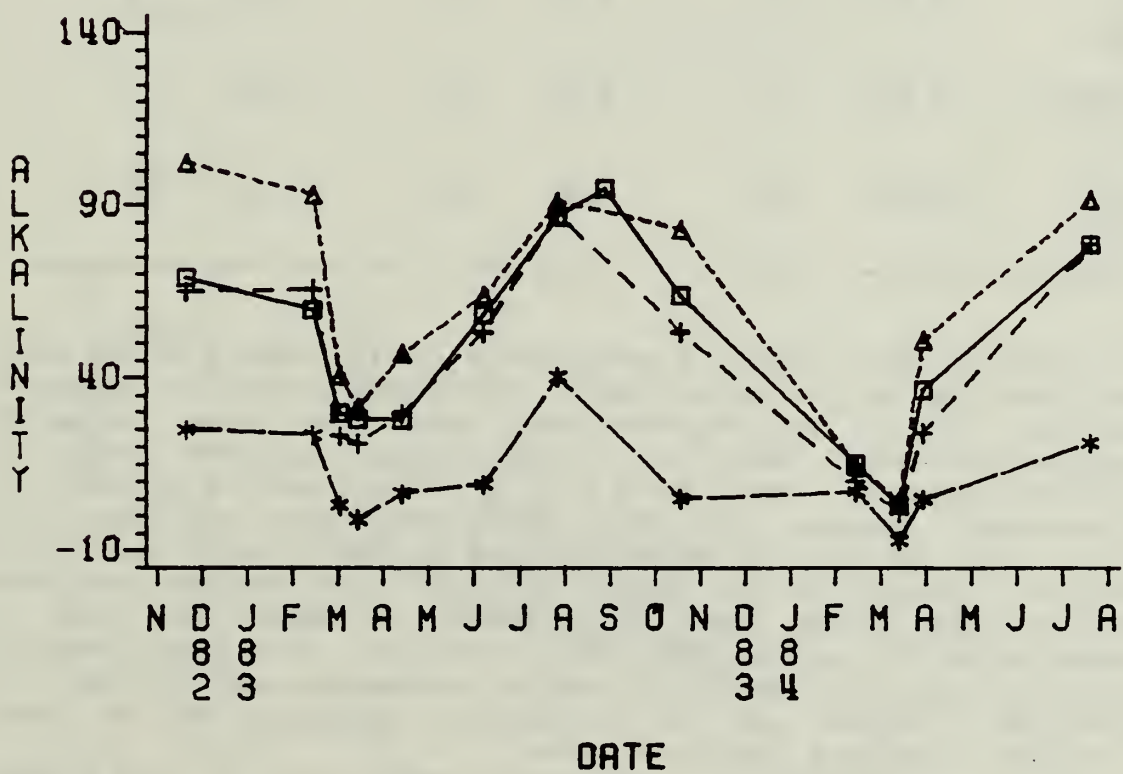
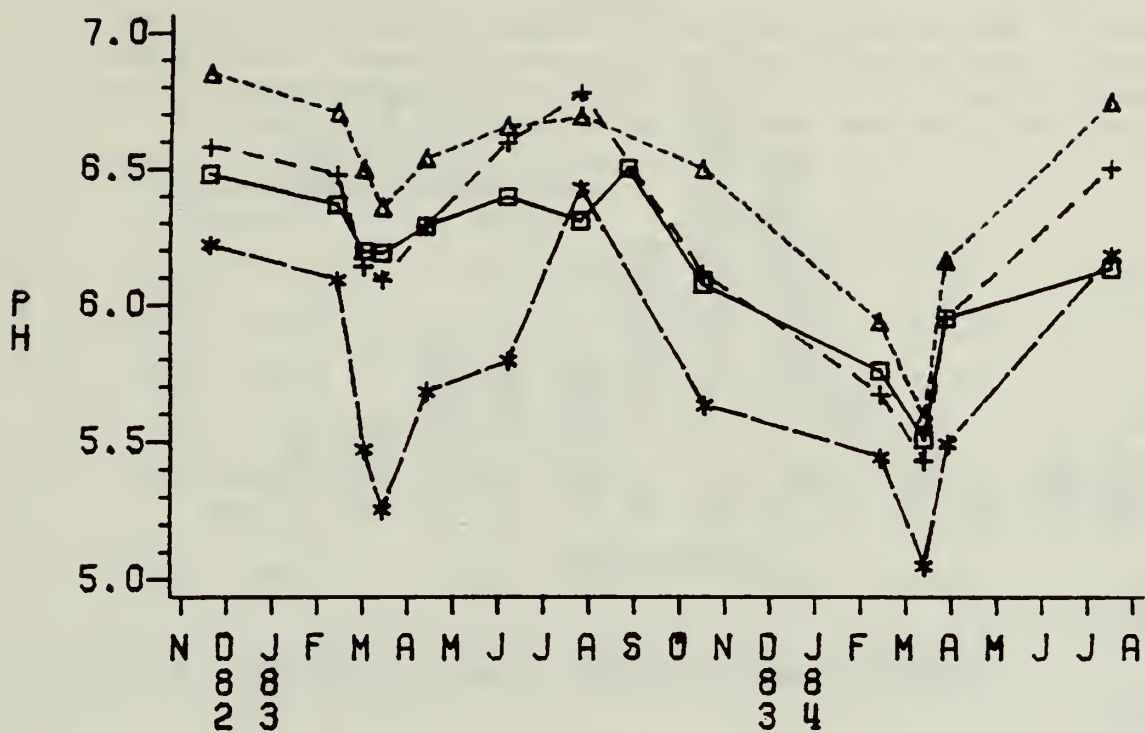


Figure 2. Baseflow alkalinity distribution, 1982-1984.



Δ Gilmore + Parkman □ Hadlock * Penobscot

Figure 3. pH and alkalinity in the first-order brooks in the Upper Hadlock Pond watershed, 1982-1984. Alkalinity data in $\mu\text{eq/l}$.

Table 1. Mean pH and alkalinity of lakes, streams and brooks for selected sampling dates for the three sample types. Lake data for several dates are for monitored lakes only. Sargent Mountain Pond is excluded from lake means. Alkalinity data are in $\mu\text{eq/l}$.

Date	Lakes (surface)		Second-order streams		First-order brooks	
	pH	Alk	pH	Alk	pH	Alk
Nov. 1982	6.35	58	6.41	84	5.90	48
Mid-Mar. 1983	5.69	18	6.12	35	5.66	15
July 1983	6.44	63	6.41	185	6.09	75
Oct. 1983	6.39	65	6.42	198	5.74	41
Feb. 1984	5.69	13	5.98	26	5.48	8
Mid-Mar. 1984	5.86	21	5.96	28	5.28	6
July 1984	6.40	52	6.45	102	6.06	63

is less than SO_4); waters in geologically similar regions of the world not receiving acidic precipitation have bicarbonate in excess of sulfate. All of the SO_4 -dominated waters are above the marine transgression limit, except for 5 low elevation clearwater lakes. All of the clearwater lakes (Pt-Co color ≤ 15) have sulfate in excess of bicarbonate. However, this SO_4 predominance does not result in a relationship between pH and sulfate, due to the different sources and pathways followed by the waters at each site. Non-marine sulfate concentrations range from less than, to three times that in precipitation (≤ 50 to $150 \mu\text{eq/l}$; Figure 4). This distribution is controlled by a number of poorly understood soil-related and biological factors on the terrestrial landscape, and by redox processes in wetlands and in sediments.

The concentrations of the trace metals Mn, Zn, and Al were generally very low, although seasonal variations exist for all three. Zinc and Mn are generally highest during baseflow, whereas Al concentrations increased in the spring, in response to depressed pH, although much of this Al was present in a non-labile, probably organically-bound form. Figure 5 represents the total Al-labile Al relationship in the first-order brooks.

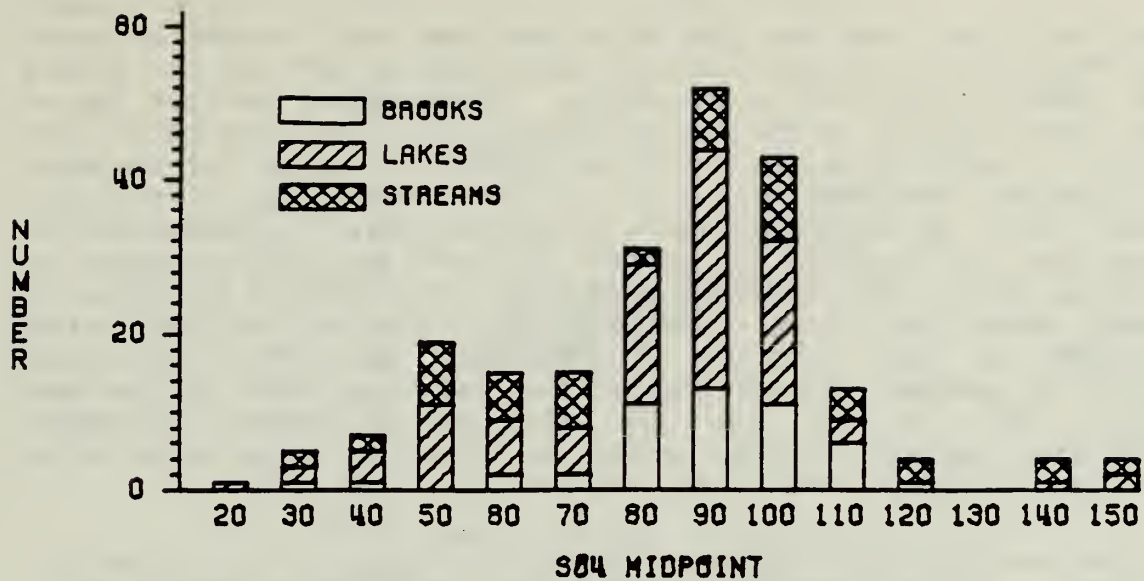


Figure 4. Distribution of SO_4 concentrations, 1982-1984. Data in $\mu\text{eq/l}$.

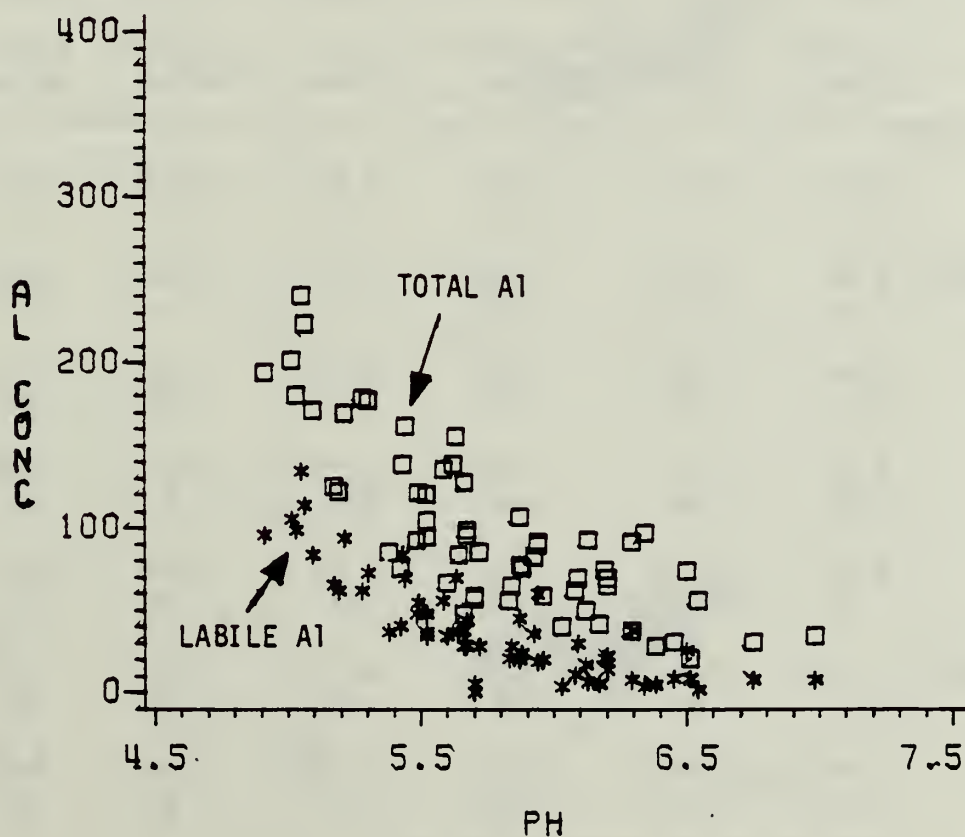


Figure 5. The relationship between pH and total and ion-exchangeable Al in the first-order brooks. Data in ppb.

In lieu of extensive historical data, we applied chemical models modified from those developed by A. Henriksen and R. Wright in Norway to reconstruct the past aquatic chemistries of ANP, and to estimate the impacts from acidic precipitation. These methods indicate that pH may have declined in the smallest brooks, and in SMP (Figure 6); some loss of alkalinity has apparently occurred at all sites that are above the marine transgression limit, but not those found in relatively thick tills or marine sediments (Figure 7; Table 2). Some sites may have lost as much as 50 percent of their alkalinity, compared to inferred historical chemistry, although the absolute magnitudes of these losses are generally not great due to the very low alkalinities inherent in these waters. An independent estimate of pH changes utilizing sediment diatom populations indicates that SMP has been acidic ($\text{pH} \leq 5$) for over 200 years due to natural processes. Similarly, natural acidity cannot be ruled out as a factor in the chemistry of some of the first-order brooks.

Table 2. The relationship between current and inferred past pH and alkalinity for the major sample types by date, based on a modification of the Henriksen model. Sargent Mountain Pond is not included in the lake means. Alkalinity data are in $\mu\text{eq/l}$.

Date	Lakes (surface)		Second-order streams		First-order brooks	
	Current pH/alk	past pH/alk	Current pH/alk	past pH/alk	Current pH/alk	past pH/alk
Nov. 1982	6.35 58	6.38 74	6.41 84	6.51 102	5.90 48	6.43 84
Mid-March 1983	5.69 18	6.36 60	6.12 35	6.41 73	5.66 14	6.34 60
July 1983	6.44 63	6.36 87	6.41 185	6.59 143	6.09 75	6.42 100
Oct. 1983	6.39 65	6.50 88	6.42 198	6.70 208	5.74 41	6.48 94
Feb. 1984	5.69 13	6.36 54	5.98 26	6.30 63	5.48 8	6.30 45
Mid-March 1984	5.86 21	6.41 61	5.96 28	6.48 80	5.28 6	6.32 50
July 1984	6.40 52	6.45 75	6.45 102	6.58 115	6.06 63	6.42 79

The sediment records from Sargent Mountain Pond, The Bowl, and Long Pond (Isle au Haut) indicate the beginning of measurable air

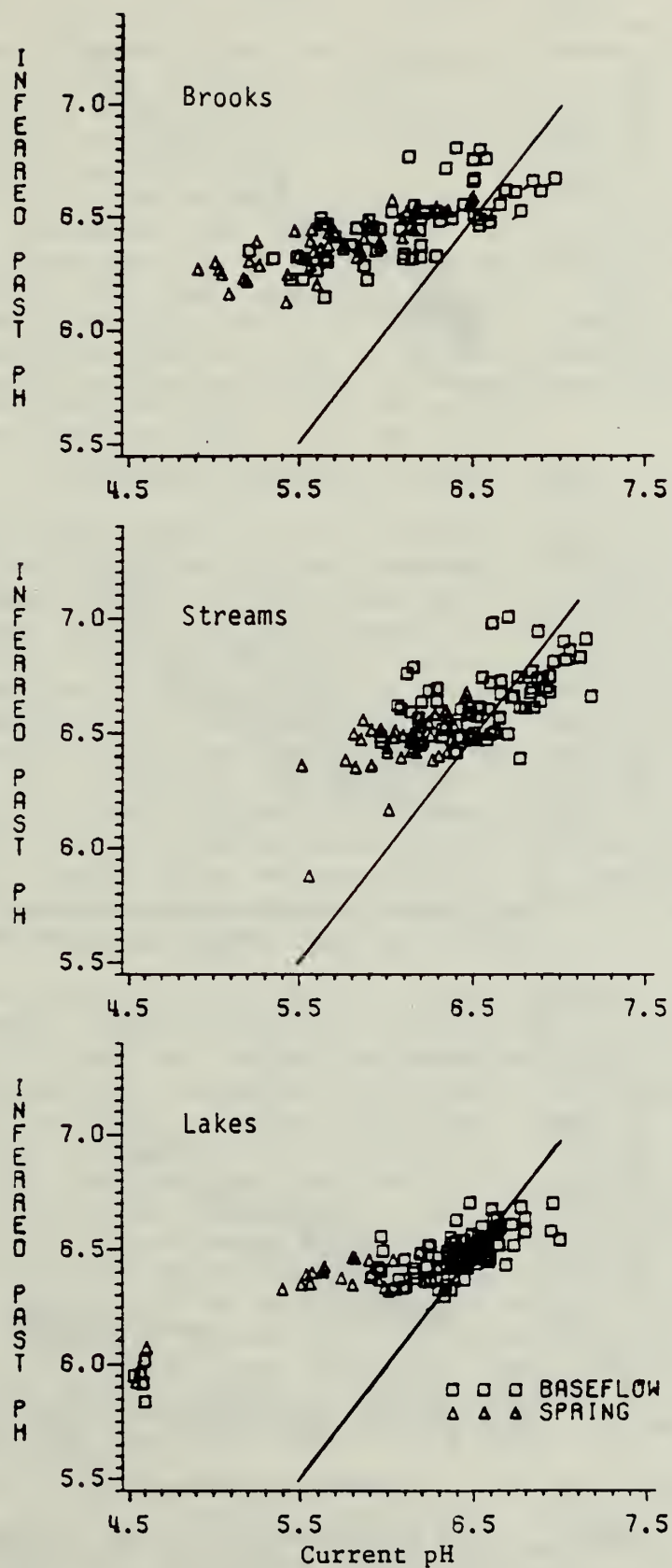


Figure 6. The relationship of inferred past pH to current pH.

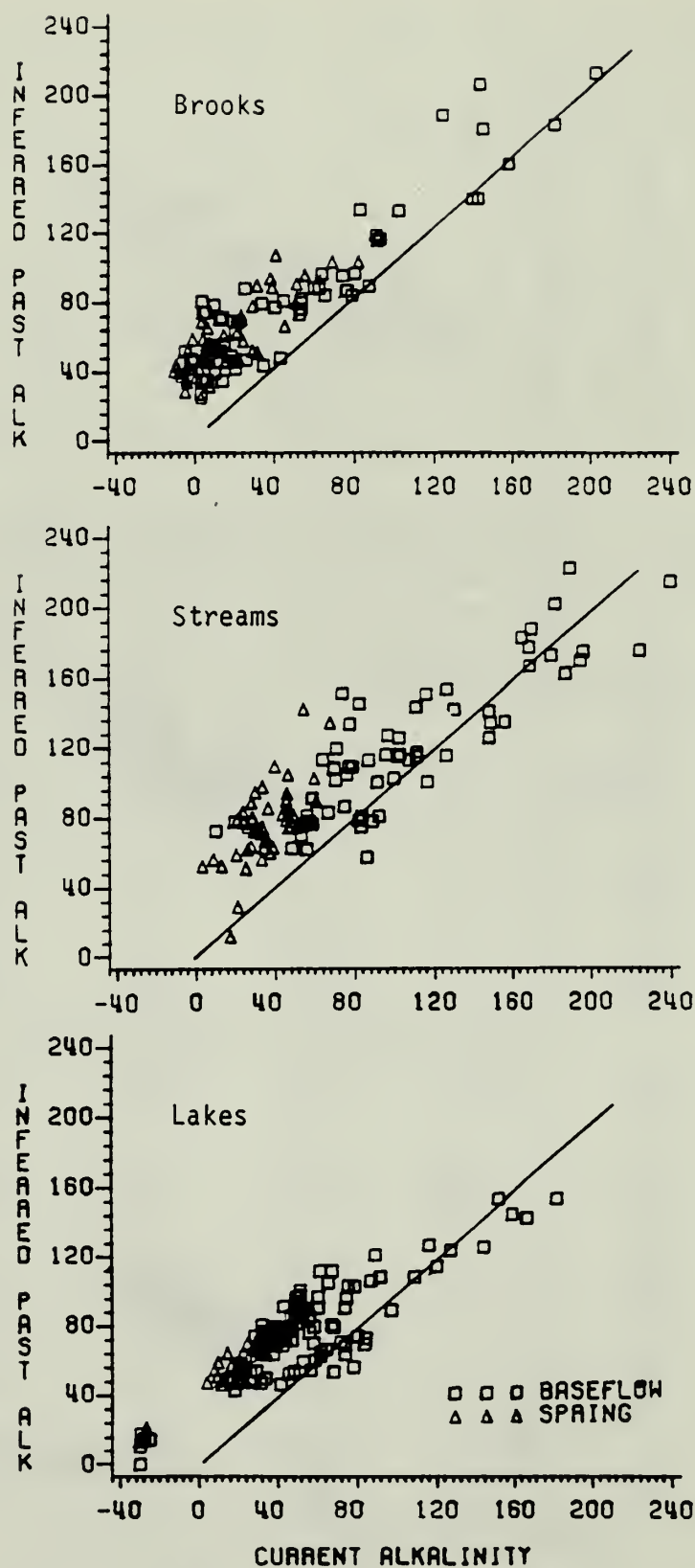


Figure 7. The relationship of inferred past alkalinity to current alkalinity. Data in $\mu\text{eq/l}$.

pollution in the form of increased Pb, Zn, and Cu by the mid- to late 1800's (Figure 8). Thus, chemical changes due to acidic precipitation, if any, are inferred to have occurred during this time frame. Maximum trace metal enrichment factors (maximum concentration divided by background) in the sediments are nearly 20X for lead and generally 2 to 4X for Zn and Cu. At SMP, Zn is enriched by a factor of 11; the 1100 ppm total is the highest concentration reported for any oligotrophic 'unpolluted' lake in the U.S. or Scandinavia.

Declining Ca concentrations during at least the past two centuries in the sediments from The Bowl and SMP are indicative of the sensitivity of these ponds to acidification, suggesting that long-term acidification may have been occurring slowly. The low modern Ca accumulation rate at SMP, and the declining concentration trend evident for more than 200 years may be further evidence of a tendency toward natural acidity prior to inputs of anthropogenic acids.

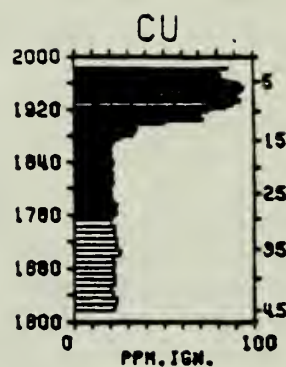
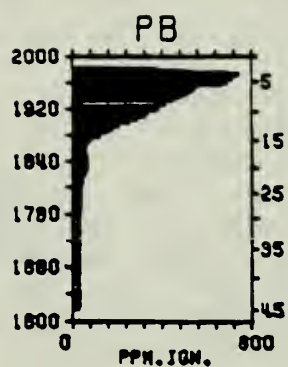
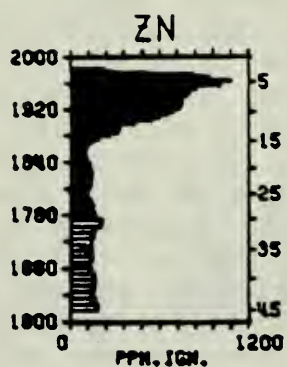
RECOMMENDED MANAGEMENT ALTERNATIVES

We believe that there is no immediate concern, or practical course of action, regarding the chemical status of the waters at ANP. Except for Sargent Mountain Pond and periodically in the smallest headwater brooks, waters of ANP generally have pH greater than 6. Seasonal pH and Al concentration excursions in the lakes and streams are not severe, or of long duration, although the first-order brooks are more vulnerable to chemical fluctuations (see Figure 3). No active management techniques are practical or seem necessary at this time, because it is not possible to project the rate or magnitude of future changes, if any. However, the current chemical status of SMP and the small brooks indicate that chronic acidification or loss of alkalinity are possibilities at some sites. This conclusion raises questions that should be addressed. We suggest that the following research be considered by the National Park Service:

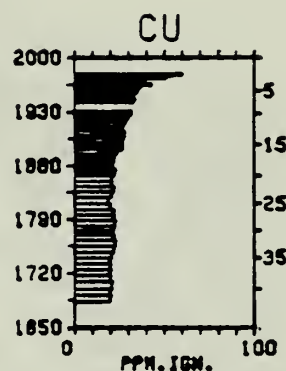
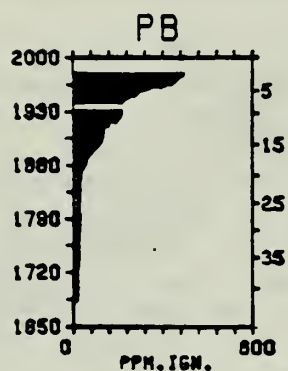
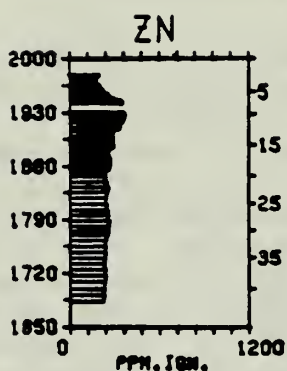
A) A follow-up survey to this one, using the same methods and the same sample sites should be performed in 5 to 10 years, depending in part on deposition trends during that time. Some recent studies have suggested that significant changes in pH and alkalinity occurred in some Adirondack lakes in the 1950's. Although the data from this study and our other recent work suggest that precipitation has been polluted in New England for at least 100 years, the possibility exists that rapid changes in pH and alkalinity may occur, especially in first-order brooks. It would be important to document such changes in brook chemistry as an early warning of a more widespread chronic acidification. With the results of this survey as a baseline, a new study could sample all 41 sites less frequently than done in this survey (perhaps one baseflow sample in succeeding years) but the streams and brooks should be examined for two years, including at least two spring snow-melts.

B) An in-depth soil geochemistry study could relate aquatic chemistry to soil chemical parameters. The major determining factors appear to be the presence or absence of glacio-marine sediments and till (outwash versus groundmoraine), the soil type (spodosols versus inceptisols), marine aerosol deposition

Sargent
Mountain
Pond



The Bowl



Long Pond
(Isle au Haut)

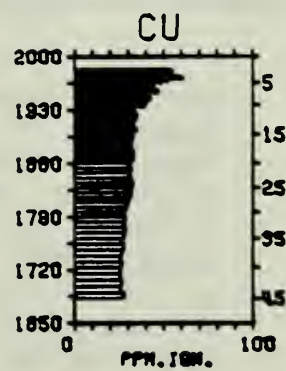
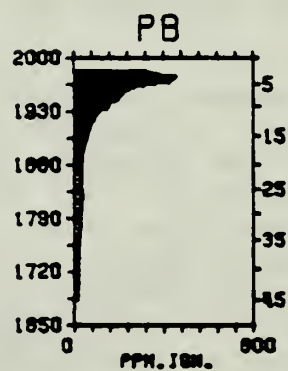
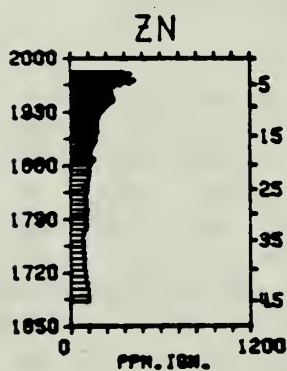


Figure 8. Concentration versus year and depth (cm) for Zn, Pb, and Cu from sediment cores from the three cored study lakes.

gradients, the local topographic relief, and the extent of the 1947 fire. Parameters that may be influenced by these factors include soil cation exchange capacity, acid neutralizing capacity, sulfate adsorption capacity, and soil-water retention time, all of which may have been influenced by mineralization of basic oxides as a result of the fire. Representative watersheds could be chosen from those in this study. Such studies would result in an improved understanding of the vulnerability of these sites, and of the potential for future acidification.

C) A paleolimnologic tool not utilized in this study is the reconstruction of past pH regimes based on down-core studies of diatoms and/or chrysophytes. Analysis of distributions should provide information on acidification trends, if any, in SMP and The Bowl, and might provide insight into the significance of the declining Ca accumulation rate in recent sediments in Long Pond.

D) A recent scientific and political issue is the possibility of forest die-back in northeastern North America. Such a die-back would have an obvious detrimental effect on a national park. This alleged die-back has been attributed to acidic precipitation by some researchers. An effort should be made to differentiate air pollution from acidic precipitation stress, and both of these from other stresses. The soils research proposed above in B could be designed to provide baseline data for future biogeochemical studies relating to soil nutrient status and forest growth. Such a data base would be especially useful if forest stress becomes a widespread problem at ANP. Elevational transects of fog and precipitation chemistry would also be informative in conjunction with a forest inventory of the park. Significant gradients in chemistry may exist due to marine aerosols or sea fogs.

TECHNICAL REPORT

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Acidic Precipitation, Acadia National Park, Maine

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ABSTRACT

The aquatic chemistries of 18 lakes and ponds, and 23 first- and second-order streams in Acadia National Park (ANP) were studied during 1982-84 to ascertain chemical status and to estimate potential impacts of acidic deposition. ANP is situated primarily on biotite and hornblende granites, and is receiving precipitation with mean weighted pH of 4.4. Topography is severe to moderate, and the soils are thin and poorly buffered, or non-existent, except on the valley floors. These factors result in oligotrophic waters with low specific conductance (mean 38 μmhos), low color (mean 15 Pt-Co color), which are generally sensitive to the effects of acidic precipitation.

Mean baseflow pH during the study period was 6.39, 6.48, and 5.93, for the lakes, second-order streams (SOS), and first-order brooks (FOB), respectively. Alkalinities were 61, 140, and 56 $\mu\text{eq/l}$. The only 'acidic' site is the smallest, highest elevation pond on the island, Sargent Mountain Pond (SMP), which had a mean pH of 4.58. During spring snow-melt in 1983 and 1984, mean pH was depressed to 5.78, 6.01, and 5.43 in the lakes, SOS, and FOB. Corresponding alkalinity values were 20, 32, and 10 $\mu\text{eq/l}$. Several independent calculations estimate that 40 to 76 percent of the spring decline in alkalinity is due to acidification, presumably by strong acids related to acidic precipitation. Dilution, rather than acidification, is estimated to account for 24 to 60 percent of the loss of alkalinity for some sites during spring snow-melt.

Sixty percent of the sites sampled are sulfate dominated ($\text{SO}_4 > \text{HCO}_3$). All but two of the bicarbonate waters are below the marine transgression limit (MTL) in the relatively thick till and marine sediments found on the valley floors. Similarly, all of the SO_4 -dominated waters are above the MTL, except for 5 low elevation clearwater lakes. Two-thirds of the lakes are SO_4 -dominated, including all of the very clear water (Pt-Co ≤ 15) lakes. Sulfate concentrations range from values less than currently found in wet deposition ($\leq 40 \mu\text{eq/l}$) to three times that found in precipitation (150 $\mu\text{eq/l}$).

Total Al concentrations are generally low ($< 100 \text{ ppb}$) although some sites below the MTL or with high color ($\geq 60 \text{ Pt-Co}$) have total Al concentrations greater than 100 ppb. At these sites, labile Al concentrations are less than 65 ppb. SMP and some of the FOB have higher total and labile Al, especially in response to depressed pH in the spring. At these sites, labile Al concentrations are generally less than 100 ppb, except in SMP (130-230 ppb labile Al). For all sites, total Zn and Mn concentrations are low (≤ 10 and $\leq 20 \text{ ppb}$, respectively) and show only slight seasonal pH dependent changes in concentration. The highest values for both trace metals were observed during baseflow conditions in the summer and fall.

The sensitivity of ANP surface waters is indicated by low alkalinities, and by high mean calcite saturation indices (CSI) which are all in the 'sensitive' range (CSI > 3). Based on both parameters, and on data from other surveys, these waters are more sensitive than the New England regional norm. Application of predictor models adapted from Henriksen indicate that alkalinity loss at some sites may have been as great as 50 percent (up to 60 $\mu\text{eq/l}$). These declines may have occurred since the onset of acidic precipitation, or they may be artifacts of normal soil processes occurring in the thin, naturally

acidic spodosols on upland sites. However, a number of sites have modern alkalinity values equal to or greater than reconstructed historical alkalinity. These sites are all in thick overburden and/or below the MTL. Except for the FOB, which may have had pH declines of up to 0.8 pH units, and SMP (up to 1.2 pH unit decline), pH has apparently not changed significantly, based on inferred past water chemistry, and on sparse historical data. Indirect evidence from sediment core diatom populations indicates that the pH of SMP has been less than 5.0 for at least 200 years. There is no relationship between pH and sulfate concentrations at ANP, although the ratio of sulfate to the sum of non-marine anions indicates that sulfate is a factor in the pH and alkalinity status of each site. High relative sulfate concentrations, presumably related to acidic deposition, are found in lower pH and alkalinity waters.

The sediment chemistry records from SMP, The Bowl, and Long Pond (on Isle au Haut) indicate that anthropogenic trace metals (Pb, Zn, Cu) have been deposited into lake sediments in increasing amounts for at least 100 years, suggesting that acidic deposition has occurred over this time span. Calcium accumulation rates in sediments, which are indicative of the sensitivity and perhaps the actual acidification of these waters, began declining relative to other major constituents in SMP and The Bowl at least by the late 1800's. Calcium deposition remained nearly constant at Long Pond until approximately 20 years ago, when the relative rate of accumulation began to decline.

Water Resource Baseline Data and Assessment of Impacts from
Acidic Precipitation, Acadia National Park, Maine

Principal Investigators: J.S. Kahl, J.L. Andersen, and S.A. Norton

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INTRODUCTION

The phenomenon called 'acidic precipitation' has received increasingly widespread attention since the 1950's (Cowling, 1982). Concern regarding potential damage to forests and natural waters has created a major political and scientific issue. There is no question that precipitation that is acidic is falling on much of eastern North America, and in other areas of the continent as well. While there are no indications that the acidity of precipitation has increased recently (Likens et al., 1984; Stenslund and Semonin, 1982; Likens et al., 1977), the geographic extent of the area receiving 'acidic' deposition may be expanding (Hinds, 1983; Wisniewski and Keitz, 1983; Logan et al., 1982; McColl et al., 1982). Unfortunately, there is little agreement on what the pH of 'normal' rain should be. Rain has never been only distilled water in equilibrium with atmospheric carbon dioxide, and thus the often quoted pH 5.65 for unpolluted precipitation is merely a convenient reference point. A variety of natural and anthropogenic materials found in rainwater may raise or lower pH values. A reasonable pH for rain in regions similar to the northeastern U.S. may be as low as 5.0 (Charlson and Rodhe, 1982). Readings below pH 5.0 have commonly been observed in remote, 'unpolluted' regions of the world (Galloway et al., 1984; Harte, 1983; Marsh, 1978).

Although there is little unequivocal evidence linking fish loss or forest decline to acidic precipitation in North America, circumstantial indications are that some gradual acidification may have occurred over the past 50 to 100 years in sensitive systems where the pH of local precipitation is less than 4.7. Acadia National Park (ANP) is an area sensitive to the effects of acidic precipitation due to its geologic and pedologic setting (Norton et al., 1982; McFee, 1976; Chapman, 1970). This two year study was designed to ascertain the current chemical status of waters at ANP and to estimate the potential vulnerability of these waters to continued inputs of acids. The data base established will provide a valuable reference for future studies. We examined in detail the aquatic chemistries of 18 lakes and ponds, and 23 streams and brooks (Figure 1) during 1982-84. Additionally, we applied existing chemical models to estimate the past chemical condition of these waters, and used dated sediment chemistry profiles from 3 ponds to estimate historical trends in aquatic and precipitation chemistries.

STUDY AREA

Physical Setting

Acadia National Park (ANP) covers approximately 12,200 hectares (30,000 acres) on Mount Desert Island (MDI) in east-central coastal Maine (Figure 1). Nearly the entire park is located on medium- to coarse-grained biotite (Somesville Pluton) or hornblende (Cadillac Mountain) granites (Tables 1 and 2; (Carl et al., 1984; Chapman, 1970). Watersheds are characterized by thin, patchy soils, and steep slopes with abundant exposed bedrock. The composition of the soils is influenced strongly by Pleistocene glacial and post-glacial events including marine submergence during deglaciation. Up to an elevation

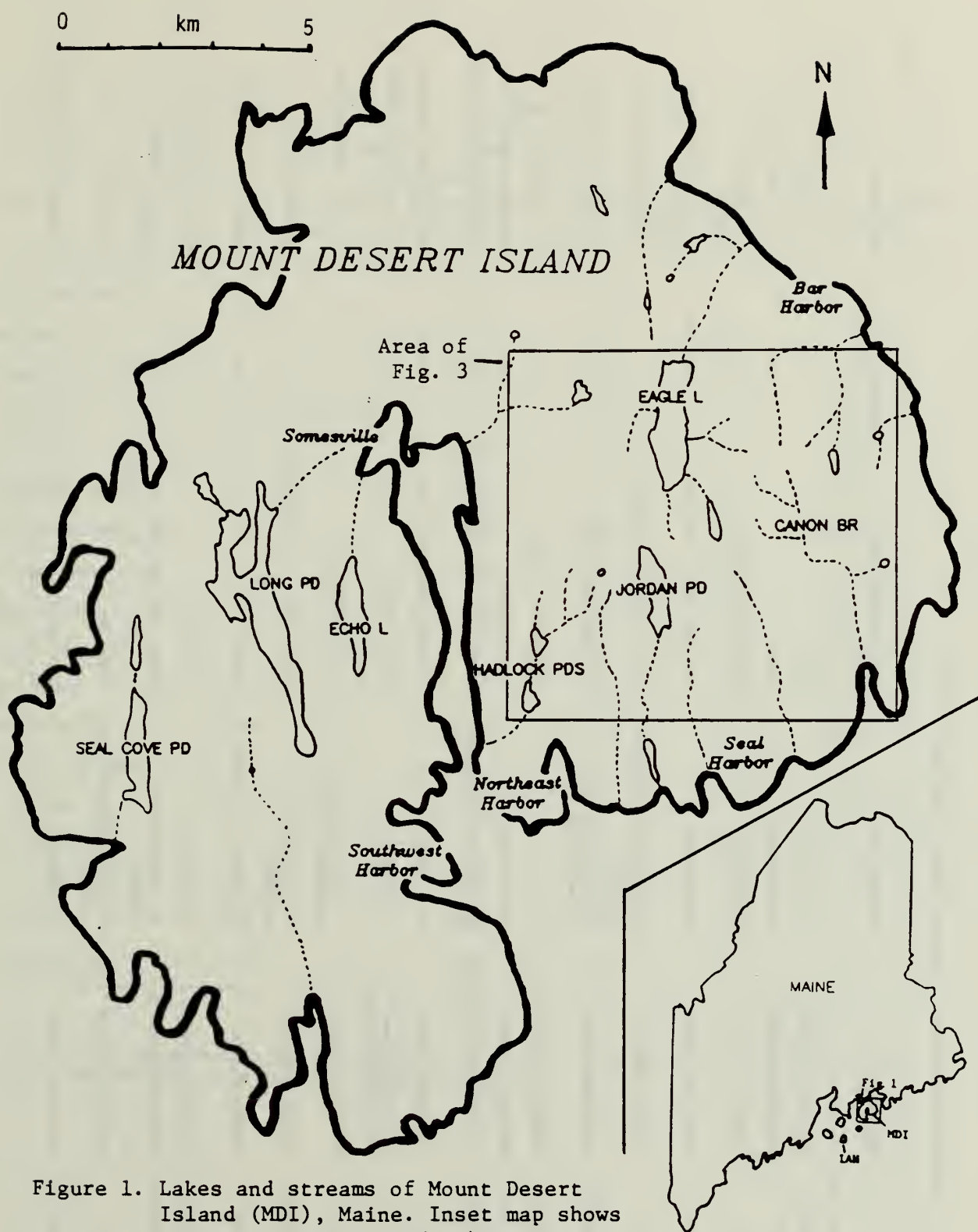


Figure 1. Lakes and streams of Mount Desert Island (MDI), Maine. Inset map shows the main study area (MDI), and Isle au Haut (IAH), the location of one of the lake coring sites (Long Pond).

Table 1A. Selected characteristics of lakes and ponds in Acadia National Park.

Name	Bedrock Geology	Surficial Geology	Development/Access	Watershed Burned in 1947	Vegetation
Bear Brook Pd	Hornblende Granite	till/outcrop	road	yes	Birch/Aspen
The Bowl	Hornblende Granite	till/outcrop	trails	yes	Birch/Aspen/Bog plants
Bubble Pd	Hornblende Granite	till/outcrop	road, carriage path	no	White Cedar/Northern Hardwood
Eagle Lake	Hornblende Granite	till/outcrop	carriage path, trails, dam	partial	Northern Hardwood/mixed conifers
Echo Lake	Horn/Biot Granite	till/outcrop/glaciomarine sediments	camp, road, public beach	no	Birch-Aspen/Spruce-fir
U. Hadlock Pd	Hornblende Granite	till/glaciomarine sediments/outcrop	carriage path, road	no	Spruce-fir/N. Hardwood
L. Hadlock Pd	Hornblende Granite	till	dam, house, trails	no	Spruce-fir/White Cedar
Halfmoon Pond	Hornblende Granite	till/outcrop	carriage path	yes	Sphagnum-Sedge/W. Pine
Hodgdon Pond	Diorite/Biotite Granite	glaciomarine sediments/ till	camp	no	Spruce-fir/Sphagnum-Sedge
Jordan Pond	Hornblende Granite	outcrop/till	carriage path, road, dam	partial	Spruce-fir/N. Hardwood
Lake Wood	Diorite/Hornblende Granite/Metasediments(?)	till/outcrop	public beach	yes	N. Hardwood/Birch-Aspen
Long Pond	Horn/Biot Granite	till/glaciomarine sediments/outcrop	camp, roads, dam	no	Mixed conifer/Hardwood
Little Long Pd	Hornblende Granite	till/glaciomarine sediments	road, houses, carriage path	no	Hardwood/Spruce-fir
Round Pond	Biotite Granite	glaciomarine sediments/ till	camp	no	Spruce-fir/N. Hardwood
Sargent Mtn. Pd	Hornblende Granite	till/outcrop	trails	no	Spruce-fir/Bog plants
Seal Cove Pond	Diorite/Horn Granite	till/glaciomarine sediments	camp, carriage path, road	no	Conifer/Hardwood/ Agriculture
The Tarn	Hornblende Granite	till/outcrop/glaciomarine sediments	road, dam	yes	Birch-Aspen
Witch Hole Pond	Hornblende Granite	till/outcrop	carriage path	yes	Sphagnum-Sedge/Birch-Aspen

Table 18. Physical parameters of lakes and ponds in Acadia National Park.

Name	Area (ha)	Max. Depth (m)	Approx. Watershed Area (ha)	Watershed/ Area Ratio	Elevation (m)	Residence Time* (months)
Bear Brook Pond	2	4	65	33:1	40	1
The Bowl	4	9	25	6:1	130	12
Bubble Pond	13	12	170	13:1	101	12
Eagle Lake	176	34	950	5:1	85	60
Echo Lake	96	20	680	7:1	26	30
U. Hadlock Pond	16	14	460	29:1	70	4
L. Hadlock Pond	14	12	780	56:1	57	3
Halfmoon Pond	1	6	20	20:1	73	4
Hodgdon Pond	11	7	300	28:1	12	3
Jordan Pd	75	46	440	6:1	85	100
Lake Wood	6	3	160	26:1	42	2
Long Pond	360	34	1600	4:1	18	60
Little Long Pond	12	2	320	26:1	2	1
Round Pond	15	6	110	7:1	22	11
Sargent Mtn. Pd	1	3	5	5:1	325	6
Seal Cove Pd	114	13	900	8:1	12	16
The Tarn	6	1	110	38:1	30	1
Witch Hole Pd	11	10	120	11:1	55	8

*calculated as approximate volume (= mean depth * area) divided by watershed area X 0.5 m rainfall per year (approximated after evapotranspiration)

Table 1C. Chemical and Mineralogical Composition
of MDI Granites from Carl et al. (1984).

I. Average chemical composition of the Somesville (biotite) and Cadillac Mountain (hornblende) granites. Data in weight percent.

	<u>Somesville</u>	<u>Cadillac Mountain</u>
SiO ₂	75.50	72.62
Al ₂ O ₃	13.48	12.85
Fe ₂ O	1.56	4.36
MgO	0.24	0.25
CaO	0.81	1.00
Na ₂ O	3.46	4.26
K ₂ O	4.71	3.88
TiO ₂	0.16	0.42
MnO	0.05	0.07

II. CIPW mineralogy.

	<u>Somesville</u>	<u>Cadillac Mountain</u>
quartz	35.0	29.9
orthoclase	27.8	22.8
albite	29.3	36.2
anorthite	3.9	4.5
other	4.0	5.9

Table 2. The second-order streams of Acadia National Park.

Name	Watershed Area (ha)	¹ Gradient (m/100m)	² Elevation (m)	Development/ Access	Watershed Burned in 1947 fire	Bedrock Geology	Surficial Geology	Vegetation
Breakneck Brook	380	3	6	dirt road	yes	Hornblende Granite	till/glacioluarine sediments	Birch-Aspen/ mixed conifer
Canon Brook	340	9	30	trail, beaver	partial	Hornblende Granite	till/glacioluarine sediments	Birch-Aspen/ White Cedar
Cromwell Brook	230	1	15	road	yes	Hornblende Granite	glacioluarine sediments	Sphagnum-Sedge/ grasses
Duck Brook	1200	2	60	road, dam, house	partial	Hornblende Granite	till/outcrop	Birch-Aspen/ White Pine
Heath Brook	950	2	6	houses, roads	partial	Blot./Horn. Granite	till/glacioluarine sediments	Sphagnum-Sedge/ Birch-Aspen
Hadlock Brook	150	11	70	trail	no	Hornblende Granite	till/outcrop	mixed
Hunters Brook (2 stations)	600/300	4/4	6/130	road, trail	no	Hornblende Granite	till/glacioluarine sediments/outcrop	Spruce-Fir/ mixed
Kebo Brook	170	12	75	trail, beaver	yes	Hornblende Granite	till/outcrop	Hemlock/Birch- Aspen
Little Harbor Brook	370	8	3	trail	no	Hornblende Granite	till/glacioluarine(?) sediments	Spruce-Fir
'Reservoir' (Western Mtn Brk)	78	16	58	trail	no	Blotite Granite	till/outcrop	Spruce-Fir
Stanley Brook	360	4	6	town, road	no	Hornblende Granite	till/glacioluarine sediments	Spruce/Maple

¹ above sampling site

² elevation of sampling site

of about 40 meters, glaciomarine sediments are found discontinuously in stream beds and in soils (Lowell, 1980; Borns, 1974). At lower elevations, and in some of the glacial valleys, these sediments overlie or are interbedded with till deposits. Locally, the marine transgression limit (MTL) reached an elevation of between 65 and 85 meters during deglaciation 10-13,200 years b.p. (Mayewski et al., 1981; Thompson and Crossen, 1981; Lowell, 1980; Schnitker, 1974).

A variety of different natural habitats occur within ANP providing the background for a diversity of natural resources (Tables 1-3; Appendix B). Mount Desert Island is the northernmost limit of many temperate plants and the southernmost limit for some arctic species. There is a mixture of coniferous forests, deciduous forests, mixed conifer and hardwood forests, meadows, and bog species found near many sample sites.

Except for roads, gravelled carriage paths, and trails, most of the sites chosen for study have been relatively undisturbed since at least the 1930's, although a large area of the east side of MDI burned in 1947. The park waters are generally exceptionally clear, oligotrophic, soft waters. In regions subjected to acidic precipitation, such catchments are considered vulnerable to acidification.

Precipitation Chemistry

Isopleth maps of precipitation pH locate the pH 4.4 or 4.5 isoline in central Maine (NADP, 1984; 1983; 1982; Wisniewski and Keltz, 1983;). The National Atmospheric Deposition Program (NADP) station at ANP has consistently recorded annual volume weighted laboratory pH values of 4.3 to 4.4 (Figure 2) since its inception in 1980 (NADP, 1984; 1983; 1982; N. Fletcher, pers. comm.). Such pH values are close to or lower than the pH recorded at the three inland Maine sites (NADP, 1984; 1983; 1982). Although precipitation pH is clearly linked to the concentrations of non-marine sulfate and nitrate (Figure 3), the NADP laboratory pH is consistently higher than that calculated from the concentrations of the acid anions, or the ANP field pH, which agree closely. The causes of these discrepancies are unknown.

METHODS

Site Selection

In this study, we included all lakes and ponds located within park boundaries, or accessible on park land (Table 1). This selection included all but three small ponds on MDI. We also sampled most of the 'major' streams in or adjacent to the park (Table 2), although we did not examine several flowages associated with wetlands. It was beyond the scope of this project to intensively monitor the large number of smaller streams and brooks. However, inasmuch as these upland, headwater catchments should respond most quickly to stresses, it was important to characterize their chemistries and responses. We chose the Canon Brook, Hadlock Ponds, and Eagle Lake watersheds for more intensive study, along with The Bowl and Sargent Mountain Pond (Figure 4 and Table 3). These sites will be referred to as

Table 3. Stream and lake monitoring sites. Numbers correspond to site locations on Figure 3. Bedrock geology is hornblende granite at all sites; surficial geology is till and/or outcrop at all sites except Canon Brook Rt. 3, which has marine clays in the immediate watershed.

Site	Elevation (m)	Gradient ¹ (m/100m)	Watershed area	Vegetation
<u>Canon Brook</u>				
1. Canon Brook - Rt. 3	34	.09	51	Birch-Aspen/Wh. Cedar
2. Canon Brook - West	77	.10	56	Wh. Cedar
3. Canon Brook - Cadillac	129	.26	85	Wh. Cedar
4. Canon Brook - Dorr	126	.13	339	Wh. Cedar
<u>Eagle Lake</u>				
5. Eagle Lake - (N basin)	85	—	951	N. Hardwood/mixed conifers
6. Eagle Lake - (S basin)	85	—	951	N. Hardwood/mixed conifers
7. Eagle - S Inlet	87	.04	102	Wh. Pine/mixed
8. Eagle - W Inlet	86	.05	43	mixed
9. Eagle - E Inlet	94	.22	100	N. Hardwood
10. Eagle - E Inlet (N)	154	.05	21	Wh. Cedar/Birch-Aspen
11. Eagle - E Inlet (S)	154	.23	36	Wh. Cedar/Birch-Aspen
12. Bubble Brook	88	—	173	Hardwood/Spruce-Hemlock
13. Bubble Pond	101	—	173	Wh. Cedar/N. Hardwood
<u>Hadlock Ponds</u>				
14. Upper Hadlock	70	—	465	Spruce-Fir/N. Hardwood
15. Lower Hadlock	58	—	787	Spruce-Fir/Wh. Cedar
16. Hadlock Brook	75	.11	148	mixed
17. Penobscot Brook	154	.14	43	Spruce-Fir/mixed
18. Gilmore Brook	154	.10	48	Spruce-Hemlock/Hardwood
19. Parkman Brook	83	.22	24	mixed
20. Sargent Mtn. Pond	325	—	5	Spruce-Fir
21. The Bowl	129	—	24	Birch/Aspen

¹ above sampling site

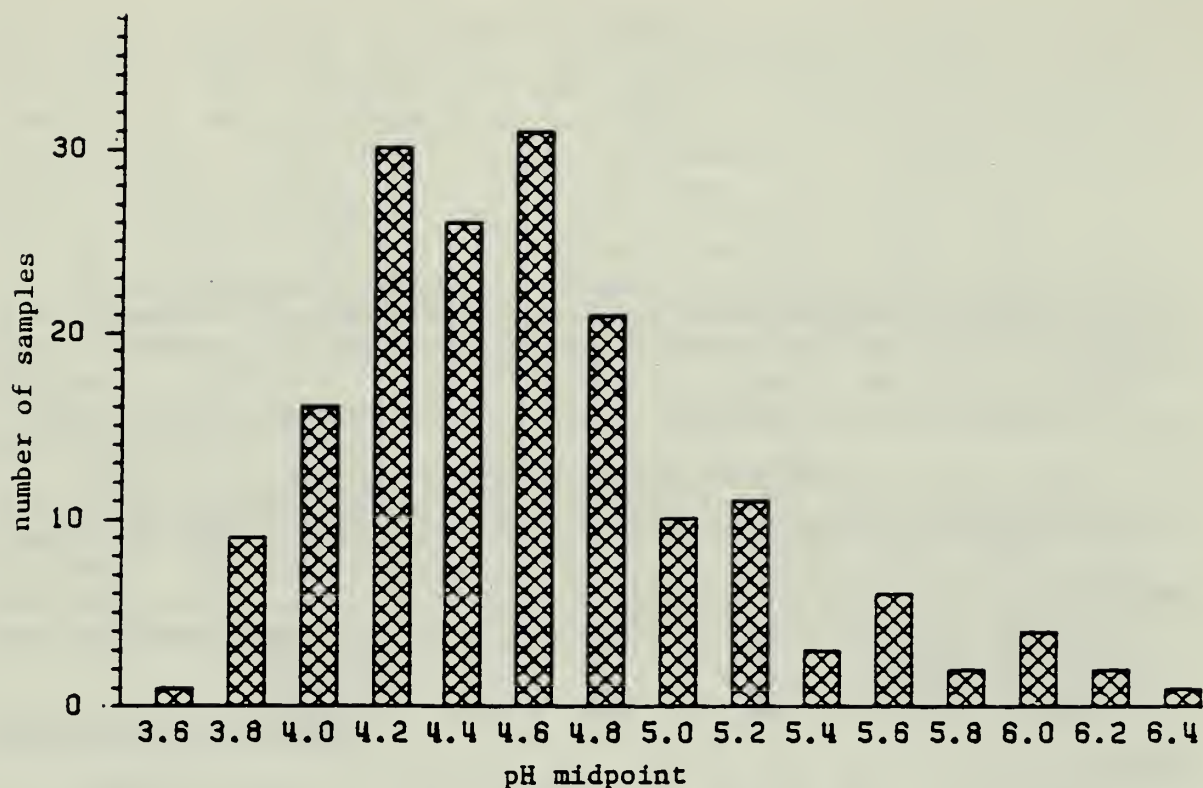


Figure 2. NADP precipitation pH at Acadia National Park, 1980-1984. Data are laboratory pH through October 18, 1983, and field pH from October 25, 1983 through August, 1984.

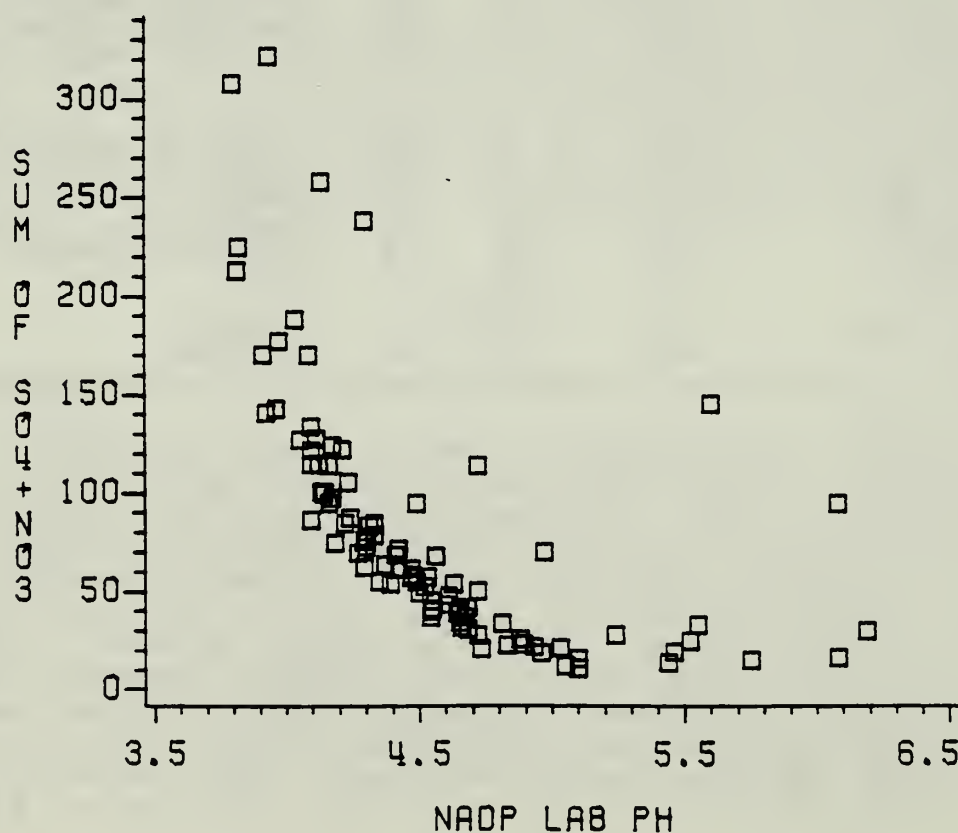


Figure 3. The relationship between the sum of NO₃ and SO₄ in precipitation and NADP precipitation pH. Data in $\mu\text{eq/l}$.

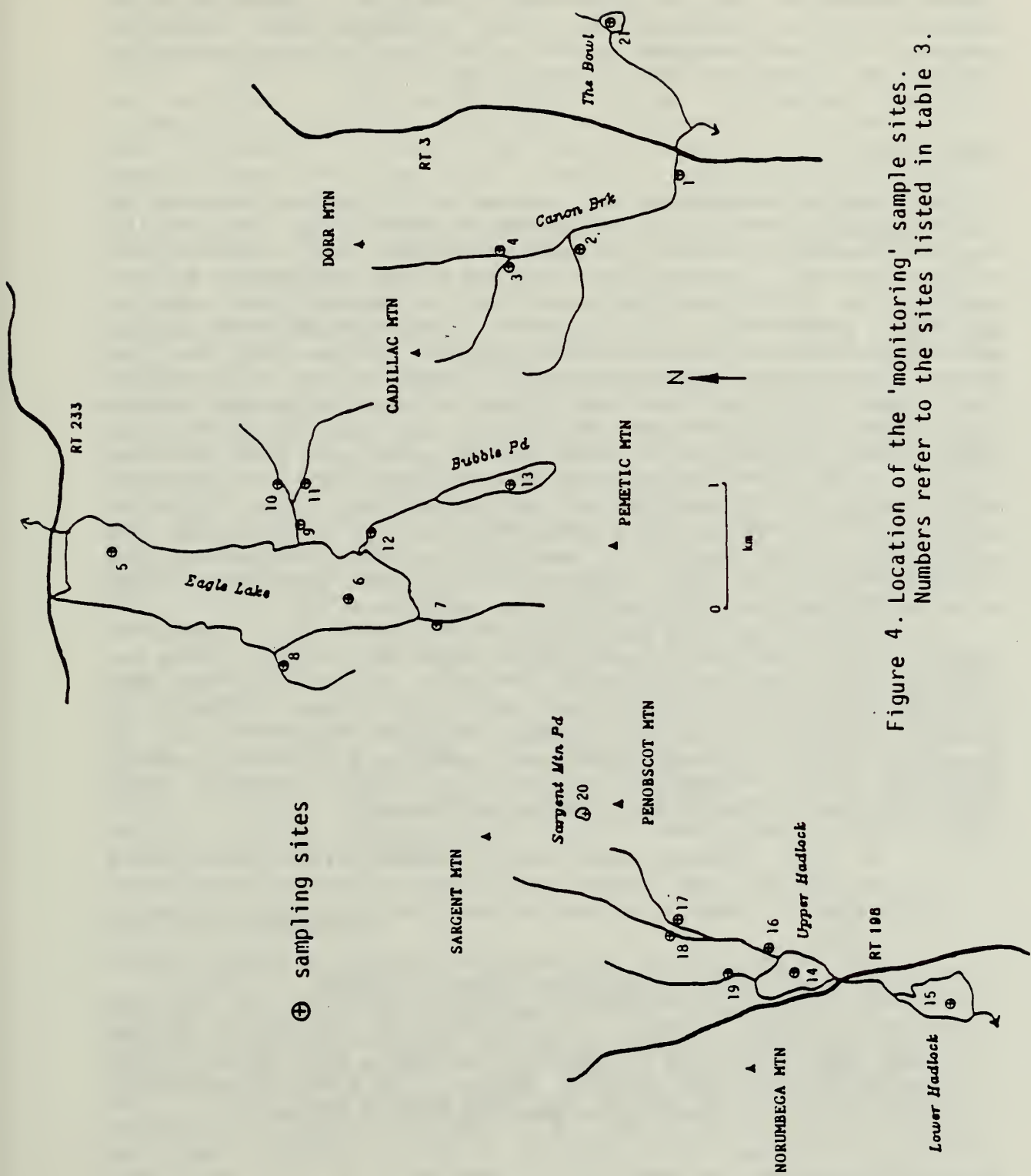


Figure 4. Location of the 'monitoring' sample sites.
Numbers refer to the sites listed in table 3.

'monitoring' sites, and include 12 first-order, headwater brooks. The sites sampled less frequently are referred to as 'survey' sites. We classified first-order flowages as 'brooks', and higher-order flowages as 'streams' for purposes of reference. In general, the streams are larger, perennial, and at lower elevation than the brooks. The only exception is the ephemeral east Inlet to Eagle Lake, which is considered a brook because of its size and intermittent nature, although it is a second-order flowage by definition.

Water Chemistry

All sample containers were soaked in 10 percent (v/v) HCl at least overnight, triple distilled-water rinsed, and dried in an inverted position. Linear polyethylene (LPE) sample bottles were re-filled with distilled water as an extra precaution against contamination. The distilled water was discarded just prior to sampling. After triple rinsing with lake or stream-water, samples were taken at midstream, in the region of greatest flow, near the center of the lake at approximately 0.5 m depth, or near the bottom at the deepest point of the lake or basin. Hypolimnion samples were taken with Kemmerer water samplers and then transferred to sample-rinsed LPE bottles. Samples for cation analyses were acidified to $\text{pH} < 2$ in the field and stored at room temperature upon return to the laboratory. Subsamples for pH, alkalinity, color, specific conductance, and anions were transported on ice. Anion samples were analyzed within 48 hours, or were frozen; other parameters were determined within 24 hours. Alkalinity and pH were determined the day of collection on aliquots warmed to room temperature.

During 1984, Al was speciated into 'labile' (largely monomeric, inorganic Al) and 'non-labile' (largely organically bound) by the ion exchange method of Driscoll (1984). Samples for anion analyses were routinely filtered through Whatman 44 filter paper (1982-83) or through Nucleopore 1.0 μm membrane filters (1983-84) prior to analysis. Cation samples from some dates were filtered through Nucleopore 0.4 μm membrane filters, prior to acidification. This practice was not followed on a routine basis because:

- 1) Our previous experience with clear, oligotrophic waters in New England has shown that filtering generally makes little difference in measured concentrations of major cations (Haines et al., 1985).
- 2) It was not cost effective or practical to devote a major effort to an expensive and labor intensive process.
- 3) Analyses of filtered samples unpredictably show spurious results, especially for potassium, sodium, chloride, and some trace metals, making it necessary to analyze parallel unfiltered samples along with filtered samples. As a routine procedure, this practice was beyond the resources of this project.

Sediment Chemistry

Sediment cores (about 0.5 m long) were taken from the approximate deepest point of Sargent Mountain Pond and Long Pond (Isle Au Haut) in

1983, and from The Bowl in 1979 (by R.B. Davis, Department of Botany and Plant Pathology and T.V. Lowell, Department of Geological Sciences) using a modified Davis and Doyle (1969) piston corer. The core barrel was a lucite tube approximately one meter long with an inside diameter of 6.35 cm. The cores had undisturbed sediment/water interfaces and presumably intact stratigraphies. These cores were sectioned in the field at 0.5 cm intervals for the upper 20 cm, and in 1.0 cm intervals below 20 cm, except for Sargent Mountain Pond, which was sectioned in 0.5 cm intervals to 30 cm. The sediment from each increment was placed in a Whirl-pak bag and stored in the dark at 5 °C until processed. Storage times were less than one month for Sargent Mountain Pond and Long Pond. Sediment from The Bowl was dried in 1979, and stored in glass vials. Sample preparation prior to metal analyses was by standard HF-aqua regia-boric acid sediment digestion (Norton et al., 1978, as adapted from Buckley and Cranston, 1971).

The chemistries of the sediment cores from each lake were used to estimate watershed and atmospheric loading histories using chronologies established by Pb-210 dating. Pb-210 is a daughter product in the U-238 decay series. One of the U-238 daughters, Ra-226, decays to Rn-222, which is released to the atmosphere from rocks, soils, and emergent groundwater. The Rn-222 decays through a series of rapid steps to Pb-210, which is scavenged by precipitation (atmospheric residence time is less than one week (Poet, 1972)) and incorporated into soils or onto particulates in aqueous media (Farmer, 1978). Terrestrial lead is very immobile; thus most Pb deposited in sediments must have fallen directly on the lake (Dillon and Evans, 1982; Farmer, 1978). A steady state delivery of Pb-210 to the sediment (pCi Pb-210/g sediment) should produce an exponential decay (concentration) curve with depth, which decreases nearly to background in approximately 100 years (the half life of Pb-210 is 22.2 years).

Pb-210 activities were determined for selected intervals in the cores from each lake. Sediment chronology was calculated from the Pb-210 activity profiles, using the CRS model of Appleby and Oldfield (1978). Dates were applied using a modified version of the methods of Eakins and Morrison (1978), as adapted by Davis et al., (1984). A Tracor Northern (TN-1710) Alpha Spectrometer was used to measure Po-210 activity in the samples. Counting times were 15,000 to 20,000 seconds. Pb-210 activity was calculated assuming secular equilibrium with the polonium granddaughter.

Analytical Procedures

Analytical standards were made by combining single metal solutions to yield an artificial sediment or water of composition similar to the actual samples. All chemical analyses for metals except silica were performed on a Perkin-Elmer model 703 Atomic Absorption Spectrophotometer using standard techniques (Perkin-Elmer, 1981; 1976). Flame methods were used for Ca, Mg, K, Na, Fe, and Zn in sediments and water, and for Ti, Al, and Mn in sediments. Flameless techniques (HGA-2200 Graphite Furnace) were used for Al and Mn in water, and for Pb in sediments. Silica was analyzed on a Jarrel-Ash Inductively Coupled Spectrophotometer (ICP) in the Plant and Soil Sciences Analytical Laboratory. Anions were analyzed on a Dionex model 16 double channel ion chromatograph (1982 and early 1983) or on

a Dionex model 2010i single channel ion chromatograph (1983 and 1984). Blanks, spiked samples, and EPA Quality Assurance Samples were run routinely as checks on analytical procedures (Appendix A).

Laboratory pH was done on an Orion 701A digital pH meter, equipped with Ross re-fillable glass electrodes. Two buffers were used for calibration, which was then checked using standardized acids and air-equilibrated distilled water (theoretical pH = 5.65). Re-standardization was performed if the standard acids or the distilled water were in error by more than 0.05 pH units. Field pH was performed with a Digi-sense LCD or LED pH meter, using Fisher non-refillable KCl-gel glass/polymer electrodes. Other parameters determined were: alkalinity by the Gran plot method (Butler, 1982; Stumm and Morgan, 1981), color with an Ecolab Pt-Co test kit, and specific conductance with a Yellow Springs Model 33 Salinity-Temperature-Conductance Meter.

RESULTS

Surface Water Chemistry

Baseflow Conditions

The surface waters of ANP are generally clear and oligotrophic. The large lakes and the small first-order brooks tend to be exceptionally clear (Pt-Co color ≤ 15 ; secchi transparencies 6-18 m (Figure 5)). A few smaller ponds and low elevation second-order streams associated with wetlands are moderately more humic (Pt-Co color 20-100), although the maximum mean color for any site was 60 Pt-Co units. Specific conductances are low (Figure 6; mean 38 μmhos), in spite of the input of marine aerosols from sea water.

Figures 7 and 8 present the pH and alkalinity distributions during baseflow (summer and fall) conditions for the brooks, streams, and lakes of ANP. While pH and alkalinity are relatively constant for the lakes between dates, the chemistries of the flowages respond more to meteorologic events. For example, 1983 was an unusual hydrologic year in that the summer was very dry, yet record precipitation in the spring and fall resulted in near-record total yearly precipitation (N. Fletcher, pers. comm.). Thus, summer pH and alkalinity were elevated in the streams (the brooks were often dry), but fall pH and alkalinity were depressed, especially in the small brooks sampled after heavy rains. Similarly, brief pH (a few weeks) and more prolonged alkalinity (2 to 4 months) depressions occurred during spring snow-melt each year.

Table 4 shows mean baseflow compositions for ANP waters. Sargent Mountain Pond (pH 4.58; alkalinity -28 $\mu\text{eq/l}$) is the only 'acidic' pond on the island, and is treated as a statistical outlier when group means are calculated for pH and alkalinity. While the major streams and lakes generally have relatively high pH for such low specific conductance waters in sensitive terrain, many are no longer bicarbonate waters (i.e. HCO_3 is not in excess of SO_4 ; Figure 9). Generally, in waters not in sulfide bearing bedrock and not receiving acidic deposition, HCO_3 concentrations are much greater than SO_4 . This SO_4 predominance at ANP does not result in a relationship between pH

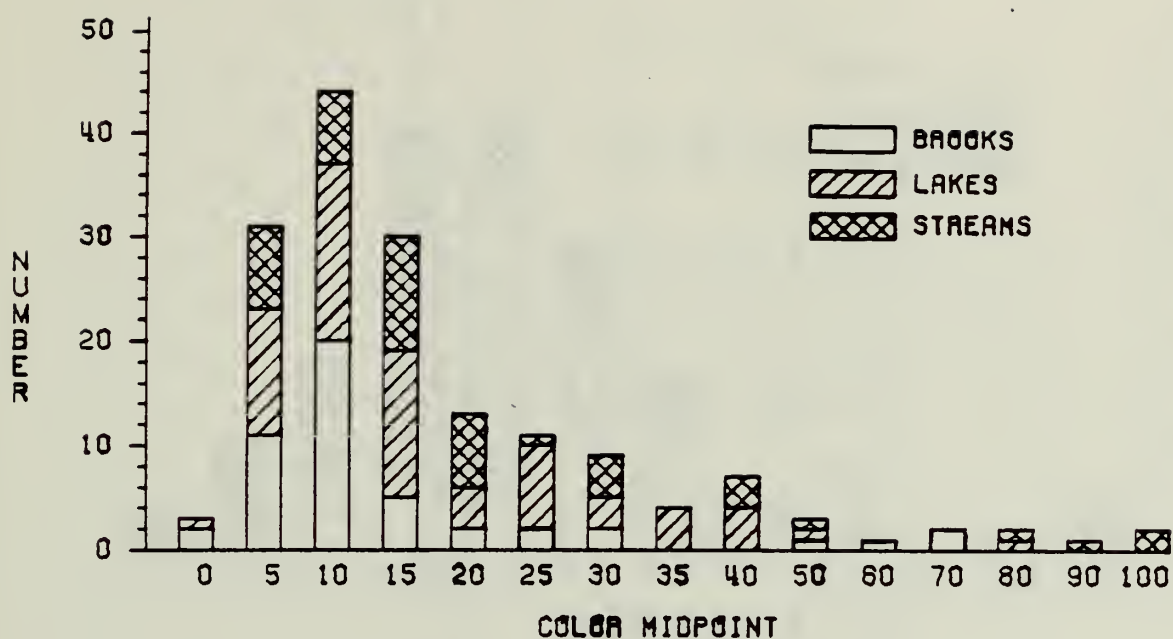


Figure 5. Baseflow water color distribution, 1982-1984 (Pt-Co units).

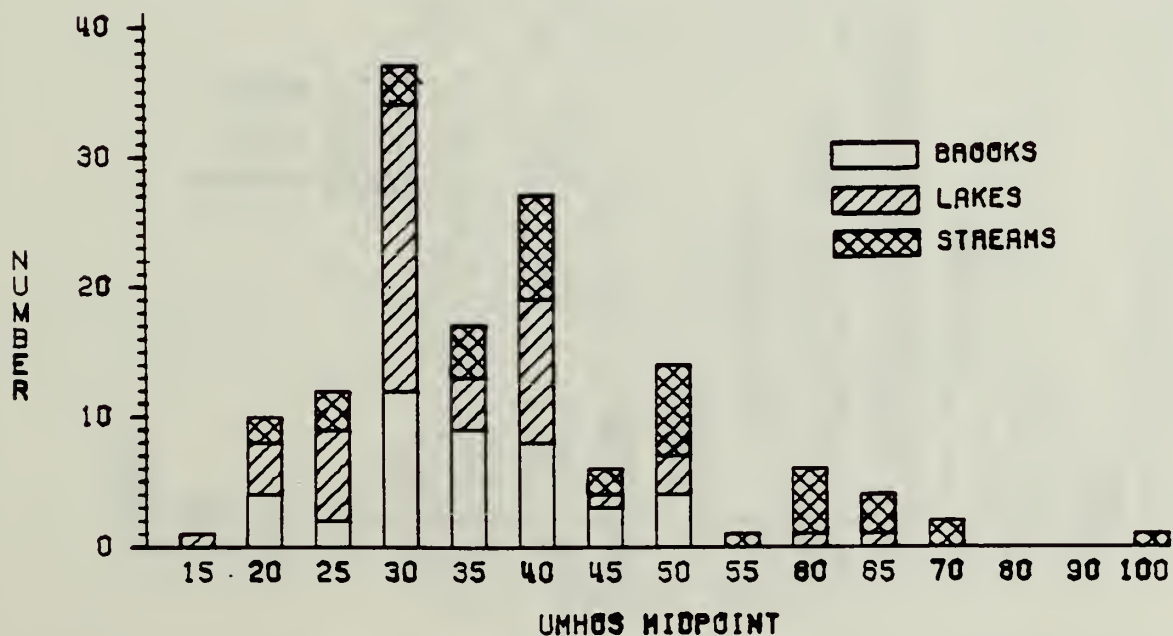


Figure 6. Baseflow specific conductance distribution, 1982-1984.

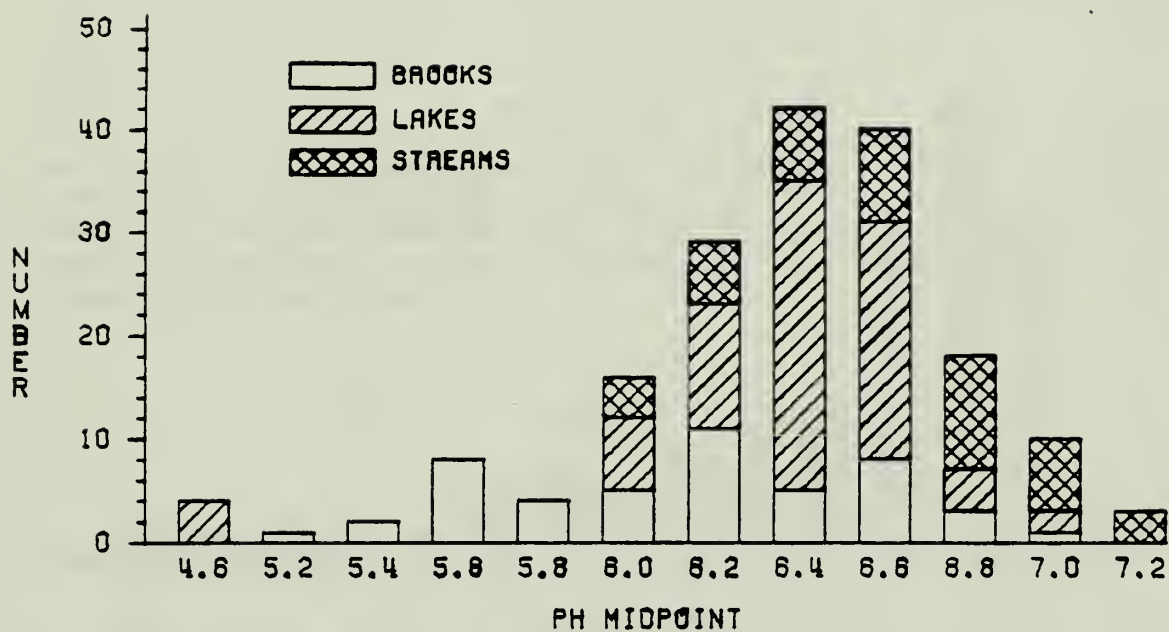


Figure 7. Baseflow pH distribution, 1982-1984.

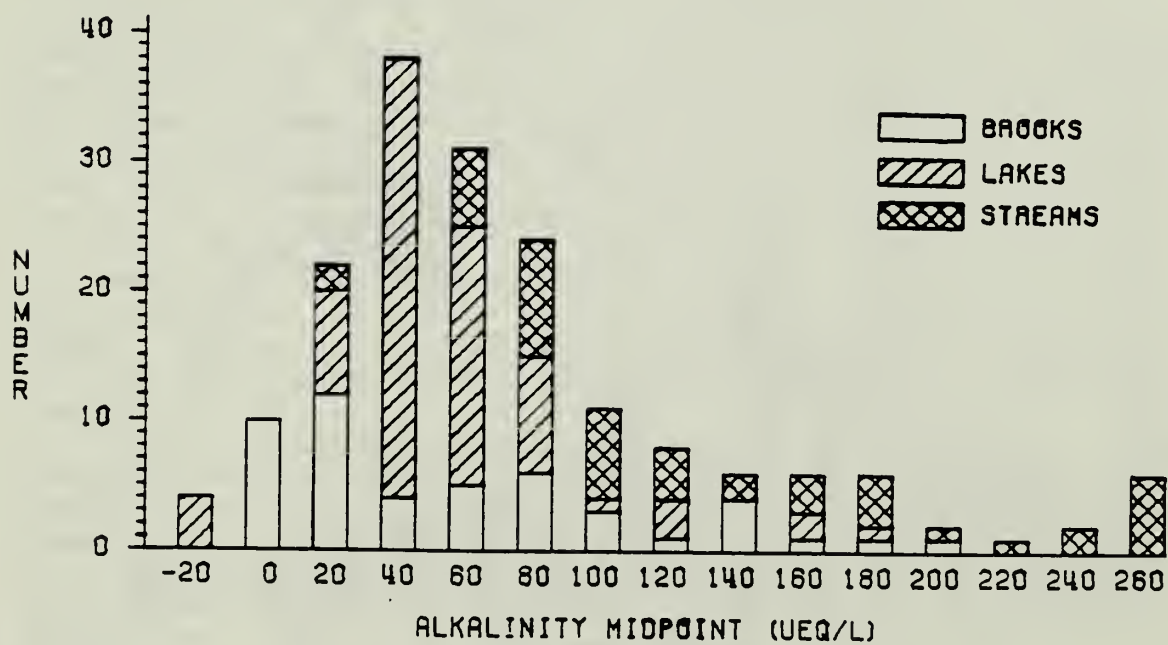


Figure 8. Baseflow alkalinity distribution, 1982-1984.

Table 4. Mean baseflow chemical compositions of ANP surface waters. Sargent Mountain Pond (SMP) is treated as an outlier. Data in $\mu\text{eq/l}$ and ppm (in parentheses) unless otherwise indicated. pH is the mean of H⁺, converted to pH. Lake means do not include Little Long Pond, which is flooded by seawater and is thus grossly typical of ANP lakes.

Type	pH	Alk. ($\mu\text{eq/l}$)	Color (Pt/Co)	Sp. Cond (μS)	Ca	Mg	K	Na	SO ₄	Cl	NO ₃
Brook	5.82	39	15	30	88.8 (1.78)	43.6 (0.53)	3.8 (0.15)	144.9 (3.33)	88.3 (4.24)	137.4 (4.87)	4.4 (0.27)
Stream	6.33	103	25	40	109.3 (2.19)	56.8 (0.69)	6.9 (0.27)	184.9 (4.25)	85.8 (4.12)	171.2 (6.07)	3.7 (0.23)
Lake (Surface)	6.35	52	20	44	89.9 (1.80)	68.3 (0.83)	8.4 (0.33)	170.5 (3.92)	91.6 (4.40)	178.9 (6.34)	2.9 (0.81)
SMP	4.58	-28	15	28	29.4 (0.59)	28.8 (0.35)	6.4 (0.25)	124.0 (2.85)	98.9 (4.75)	123.0 (4.336)	0.8 (0.05)

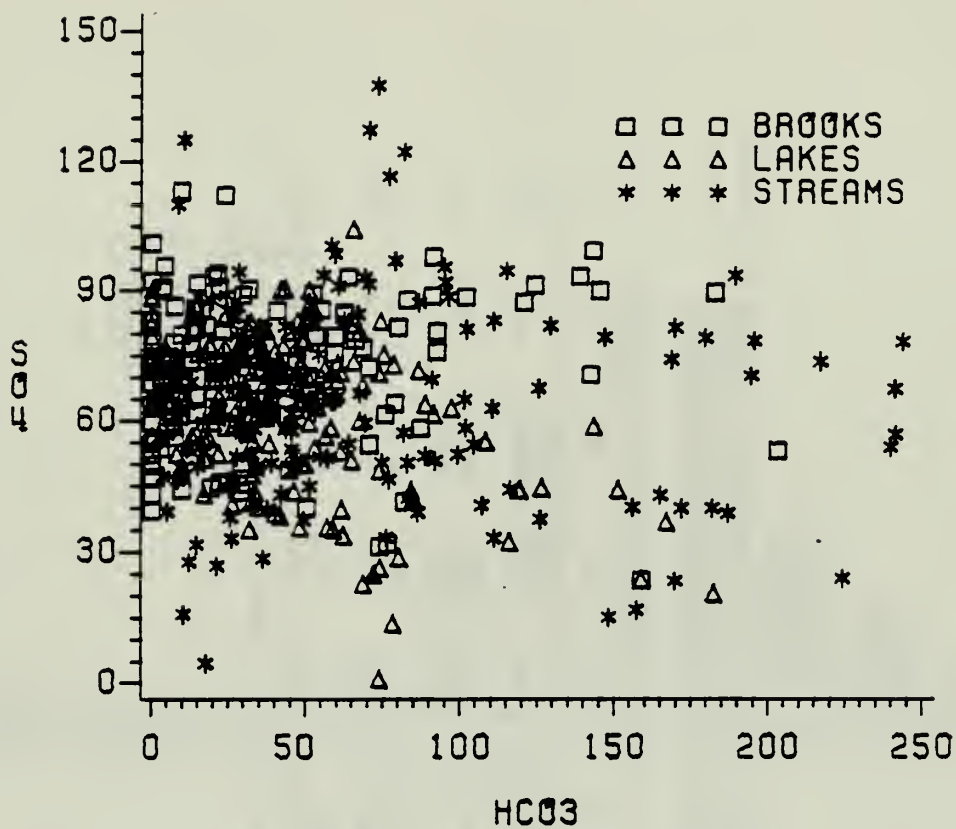


Figure 9. The relationship between SO_4 and HCO_3 (in $\mu\text{eq/l}$).

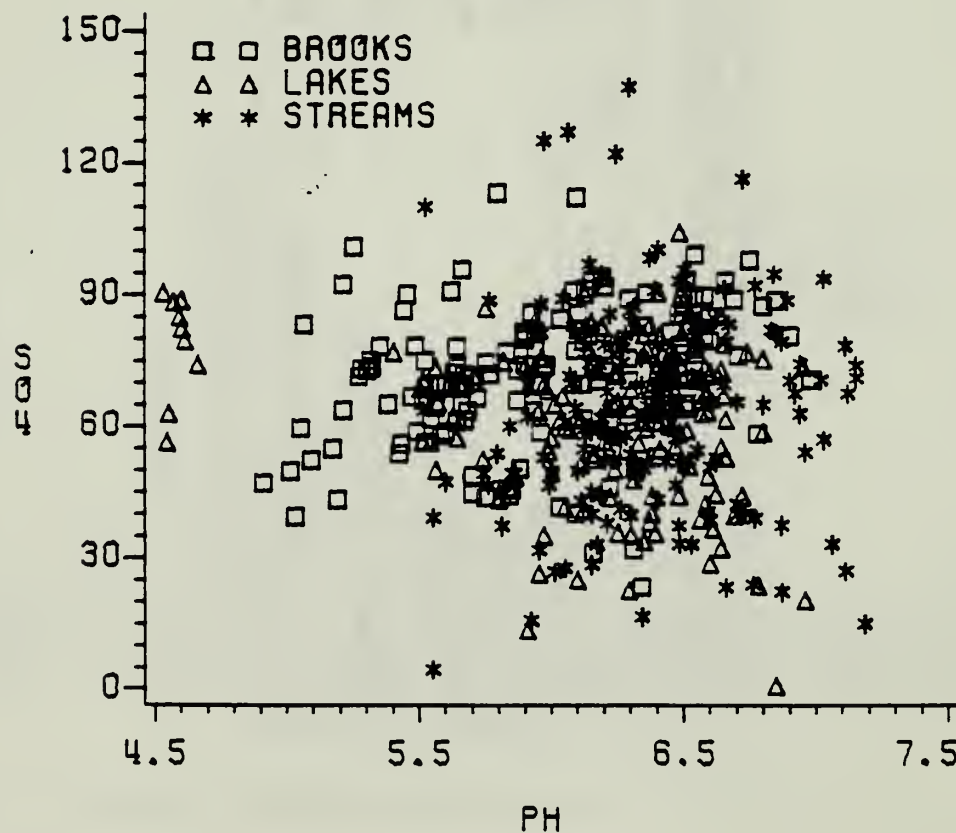


Figure 10. The relationship between SO_4 and pH. SO_4 data in $\mu\text{eq/l}$.

and SO₄ (Figure 10), due to the different sources and pathways of the waters in each lake or stream. Elevational transect studies in the Upper Hadlock, Canon Brook, and Eagle Lake watersheds indicate that sulfate concentrations are constant or increase as pH rises downstream.

Seasonal Variations

Table 5 lists the means by sampling date for pH and alkalinity for the three sample types. In general, pH and alkalinity are much less variable in the lakes than in the streams and brooks. During spring snow-melt, mean pH was depressed by as much as 0.7 pH units in the monitored lakes; the depression was evident only in the upper 1-2 meters. Mean hypolimnion pH for the monitored lakes was 6.1 and 6.2 in March of the respective years. This slight pH depression was due largely to incomplete CO₂ de-gassing at the time of pH measurement. Surface alkalinities declined to one-third of their baseflow values during maximum depression, although spring alkalinities for deep samples from the monitored lakes were greater than, or equal to, the baseflow mean. However, early summer hypolimnion alkalinity values were ubiquitously lower than those measured in the spring. This observation suggests that much of the rapid late-spring pH and alkalinity recovery was due to mixing of the alkalinity-poor surface layer with the relatively alkalinity-rich deeper waters. Complete alkalinity recovery throughout the water column did not occur until mid-summer.

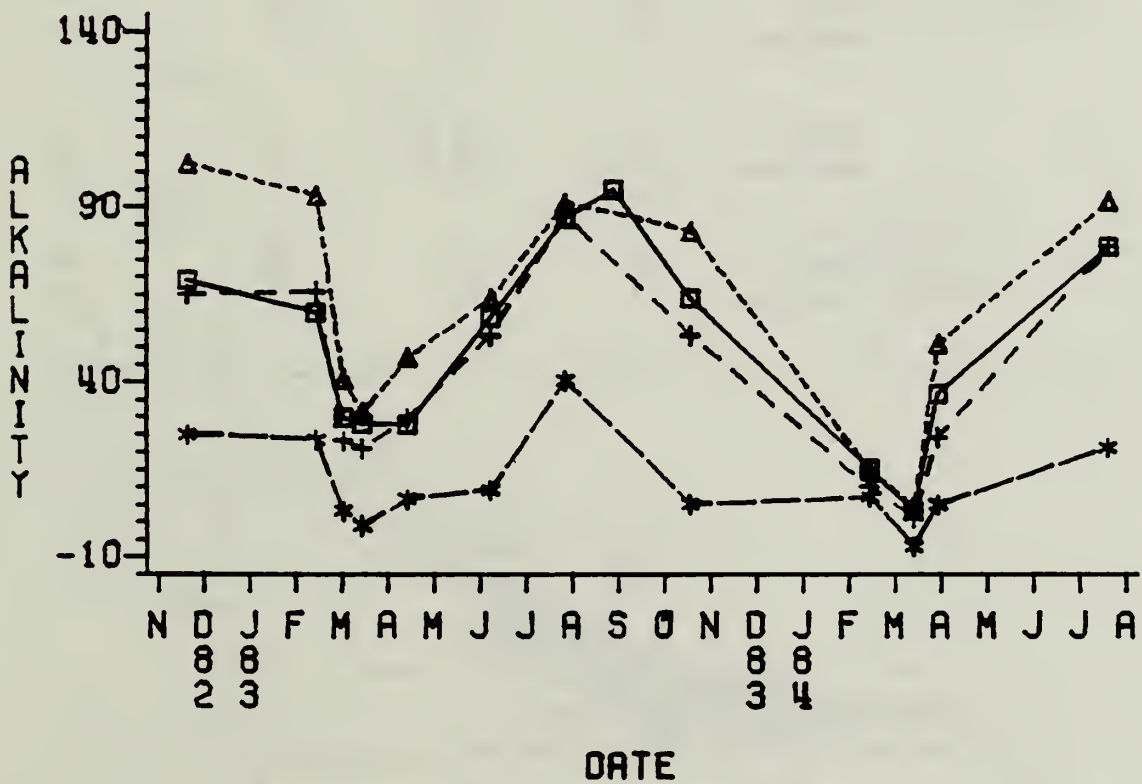
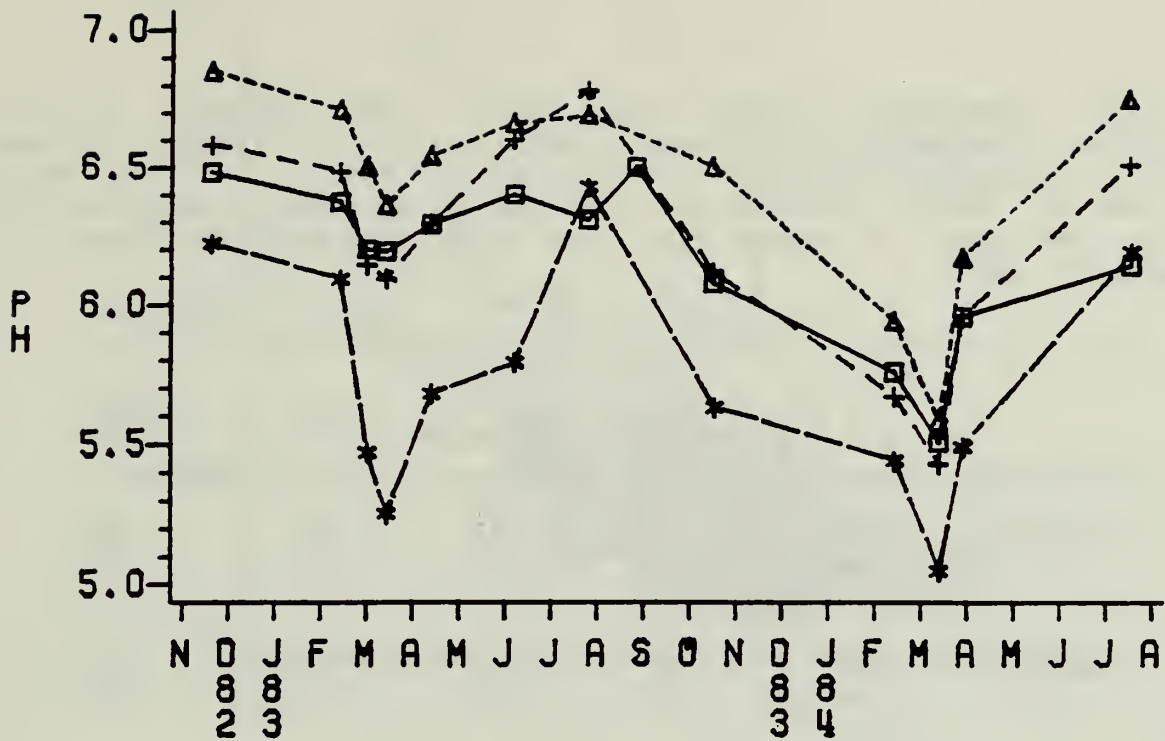
Spring pH and alkalinity depressions in the brooks and streams were more pronounced than in the lakes. For example in the Hadlock Brook system, pH declined from the mid to high 6's to the mid to low 5's in each spring (Figure 11). Alkalinity reached values below zero in two brooks (Figure 11), in spite of winter precipitation pH values of 4.55 and 4.63 in 1983 and 1984 (mean volume-weighted NADP laboratory pH from January 1 until mid-March of each year (calculated from data supplied by N. Fletcher, pers. comm.)). We recorded only one pH less than 5 (4.91 in the east inlet to Eagle Lake) in any stream or brook during the study.

Aluminum and Other Trace Metals

Manganese, Zn, and Al concentrations were generally low (Table 6), although seasonal variations exist for all three. Zinc and Mn were generally highest during baseflow or during extremely low flow, whereas Al concentrations increased in the spring, when pH was depressed (Appendix C). Aluminum mobility is apparently responding in part to pH dependent reactions, whereas Mn and Zn are probably mobilized largely in chelated or fine particulate form. Figure 12a shows the relationship between total aluminum and pH during the study period. Relatively high total Al concentrations in the major streams during baseflow may be related to the glaciomarine clays found commonly below 40 meters elevation, or to complexation by organics (Johnson et al. 1981; Cronan and Schofield, 1979; Johnson, 1979). However, the highest Al concentrations are generally associated with the lowest pH values in the spring. A majority of waters had total Al

Table 5. Mean pH and alkalinity by date for the three sample types.
Lake data for several dates are for monitored lakes only. Sargent
Mountain Pond is excluded from lake means.

Date	Lakes (surface)			Streams			Brooks		
	(n)	pH	Alk	(n)	pH	Alk	(n)	pH	Alk
<u>1982</u>									
Oct.	(21)	6.42	68	(11)	6.41	123		----	---
Nov.	(21)	6.35	58	(12)	6.41	84	(11)	5.90	48
<u>1983</u>									
Feb.	(6)	6.08	29	(12)	6.39	65	(11)	5.92	48
Early Mar.		----	--	(12)	6.18	37	(11)	5.70	21
Mid-Mar.	(6)	5.69	18	(12)	6.12	35	(11)	5.66	15
April	(21)	6.34	40	(12)	6.20	41	(11)	5.80	24
June	(5)	6.36	37	(12)	6.52	74	(11)	6.04	38
July	(21)	6.44	63	(12)	6.41	185	(11)	6.09	75
Oct.	(22)	6.39	65	(12)	6.42	198	(11)	5.74	41
<u>1984</u>									
Feb.	(5)	5.69	13	(11)	5.98	26	(11)	5.48	8
Mid-Mar.	(5)	5.86	21	(11)	5.96	28	(11)	5.28	6
Late Mar.	(12)	5.86	23	(12)	5.97	41	(11)	5.58	23
July	(22)	6.40	52	(12)	6.45	102	(11)	6.06	63



Δ Gilmore + Parkman □ Hadlock * Penobscot

Figure 11. pH and alkalinity in the first-order brooks in the Upper Hadlock Pond watershed, 1982-1984. Alkalinity data in $\mu\text{eq/l}$.

Table 6. Aluminum and other trace metals. Data in ppb. Aluminum speciation done by the cation exchange method of Driscoll (1984). For each analysis the sum of (labile Al + non-labile Al) = total Al. In this table, the sum of labile plus non-labile Al does not necessarily equal total Al because the data are means from many dates, and speciated Al was only measured in 1984.

		Lakes	Streams	Brooks	Sargent Mtn Pond
Total Al	Mean	55	83	104	285
	Maximum	211	511	270	401
Labile Al	Mean	16	15	39	170
	Maximum	58	70	135	237
Non-labile Al	Mean	38	52	59	77
	Maximum	126	165	117	97
Zn	Mean	4	5	8	11
	Maximum	29	22	24	16
Mn	Mean	16	20	13	17
	Maximum	63	174	57	22

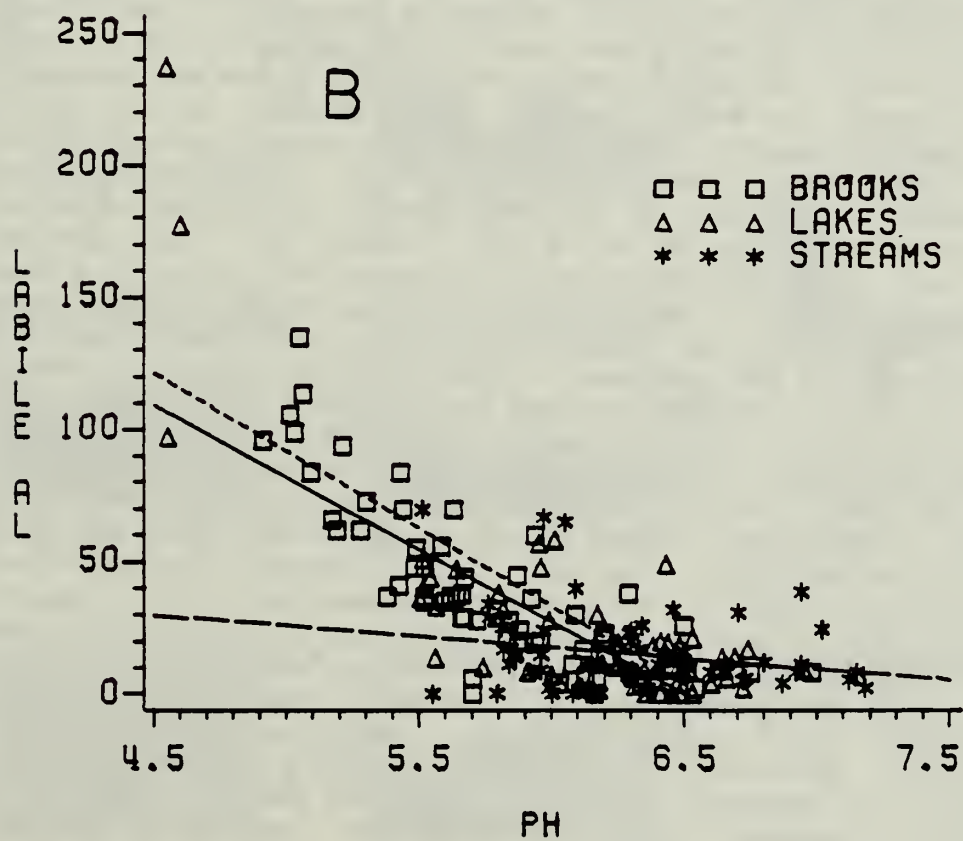
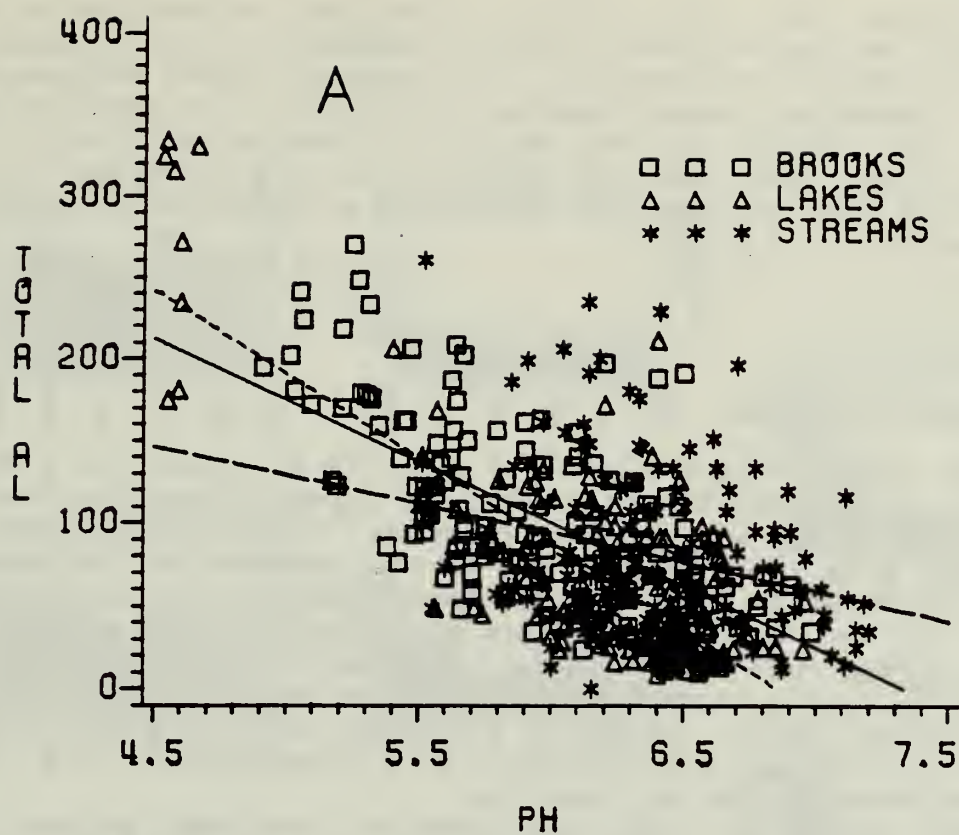


Figure 12. Relationship between total Al and labile Al, and pH. Aluminum data are in ppb.

concentrations less than 100 ppb. During 1984, we speciated Al into non-labile and labile forms. Labile Al represents 17 to 60 percent of total Al (Figure 12 and Table 6). This range is largely pH dependent, with a increasingly larger fraction of the total Al in complexed form at high pH. Similarly, the labile Al fraction of total Al is relatively low above pH 5.5 (Figure 12b). This relationship is in contrast to total Al versus pH, which shows an indistinct pH-dependent relationship in this study.

Sediment Chemistry

Major Element Chemistry

Lake sediments are deposits of a portion of a watershed's eroded detritus, with autochthonous organic and inorganic fractions (Wetzel, 1983; MacKereth, 1966). As such, sediments integrate and preserve, to an unknown extent, a history of the natural processes and disturbances in the watershed. Cores from the deepest point within the lake must be used for any interpretations, due to disturbances that may occur in shallow sites, such as slumping, re-suspension, basal freezing to surface ice, or bioturbation (which is generally greater in littoral than in hypolimnetic sediments). An undisturbed core may provide a record of watershed disturbance, but a disturbed core is of little value for sediment chemistry analysis.

Under stable watershed and chemical conditions, concentration profiles for the more lithogenous metals should remain constant. For example, TiO_2 is a chemically non-mobile component of the lithogenous fraction of sediments. Other rock-forming oxides should co-vary with TiO_2 regardless of sedimentation rate if the source and processing of sediment remain the same. However, if new sediment is more organic or more heavily leached, then element and oxide concentrations in sediment may vary. This latter situation will probably be indicative of changing conditions in the watershed. A disturbance which causes accelerated sedimentation of either leached or fresh material may change the relative proportions of elements, and non-uniform chemical profiles may result. For example, if allochthonous organic matter is input to sediments, then elements associated with these organics (such as heavy metals) may increase in concentration. Likewise, changes in water or organic content indicate that sediment characteristics, lake productivity, or biological community structure have changed. However, concentration plots (such as Figures 13 to 15) can be misleading in at least two ways. First, concentration parameters are not variables that are independent of one another. Variation in one may be due to or cause variation in another. Second, constant concentration with depth profiles do not necessarily represent undisturbed conditions. Co-varying or offsetting parameters may mask disturbances as recorded in chemical profiles. Accumulation rate plots provide an alternative method of interpretation for sediment chemistry, plotting net accumulation rates against calendar year. Accumulation rates are independent variables, unlike concentration parameters, allowing estimation of absolute rather than relative changes in sedimentation processes. Selected accumulation rates are presented in the discussion section of this text.

The chemical stratigraphies of the cores removed from the deep

SARGENT MOUNTAIN POND

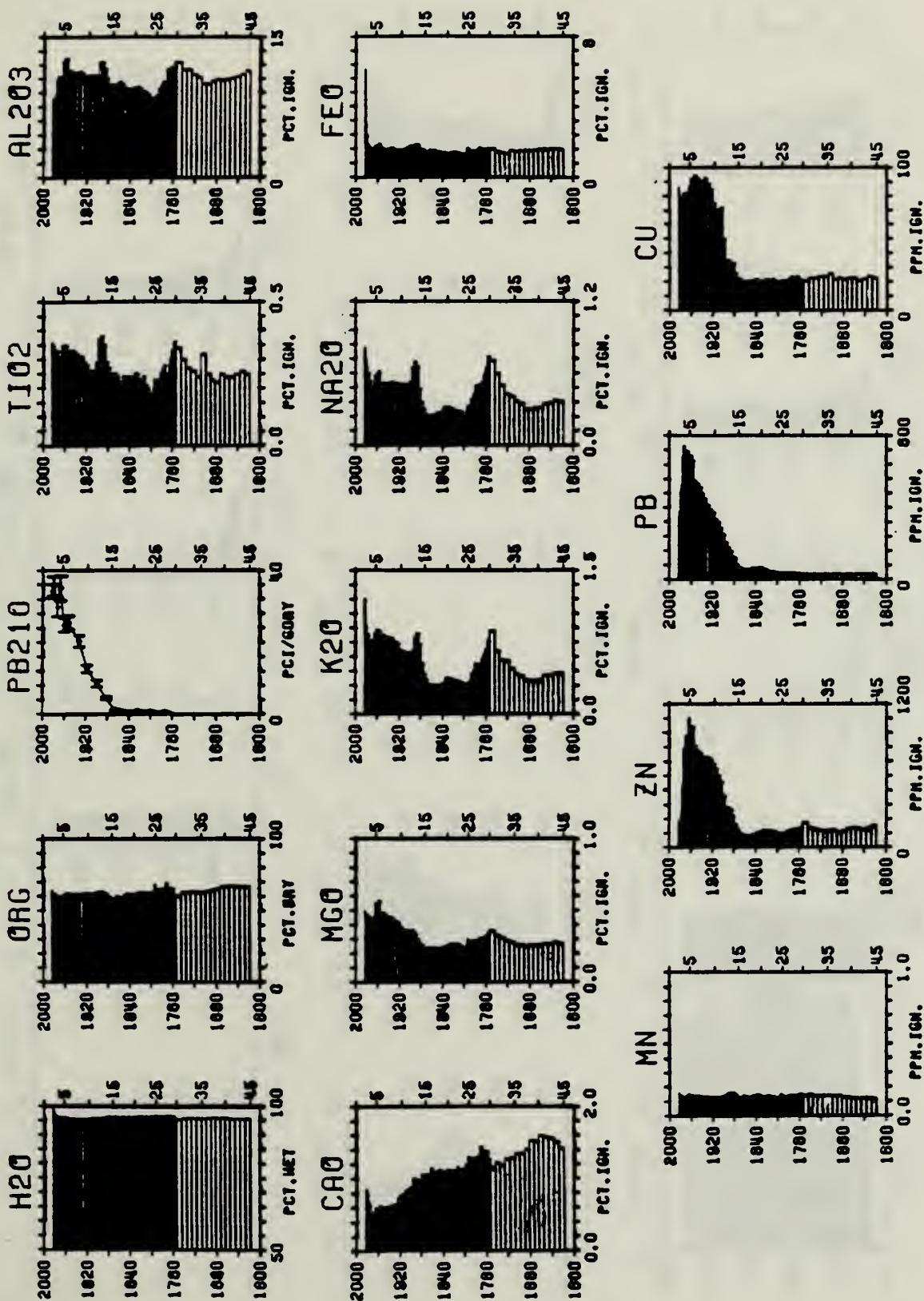


Figure 13. Sediment chemistry profiles for Sargent Mountain Pond. Data are concentration versus date (year) and depth (cm).

THE BOWL

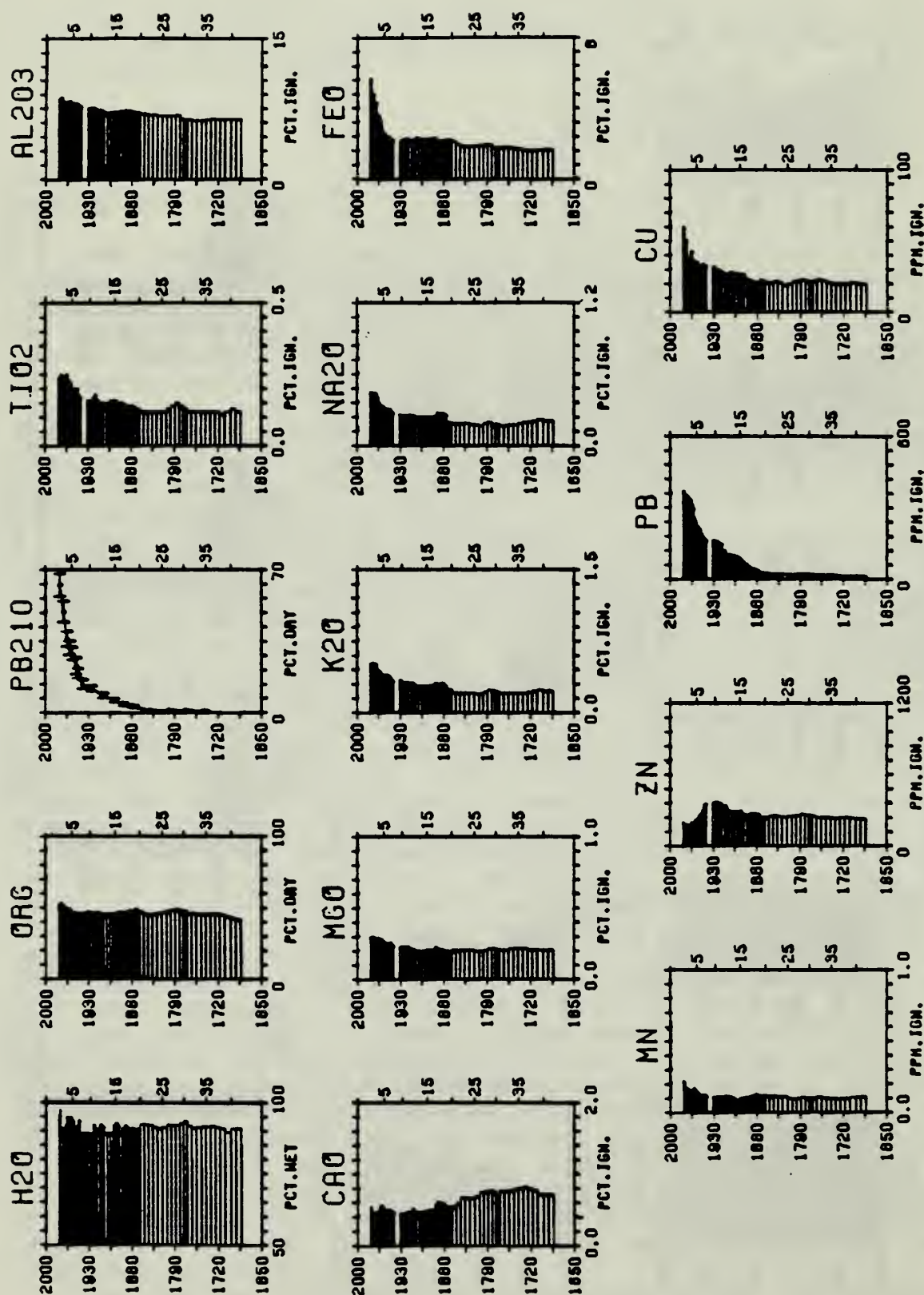


Figure 14. Sediment chemistry profiles for The Bowl. Data are concentration versus date (year) and depth (cm).

LONG POND - ISLE AU HAUT

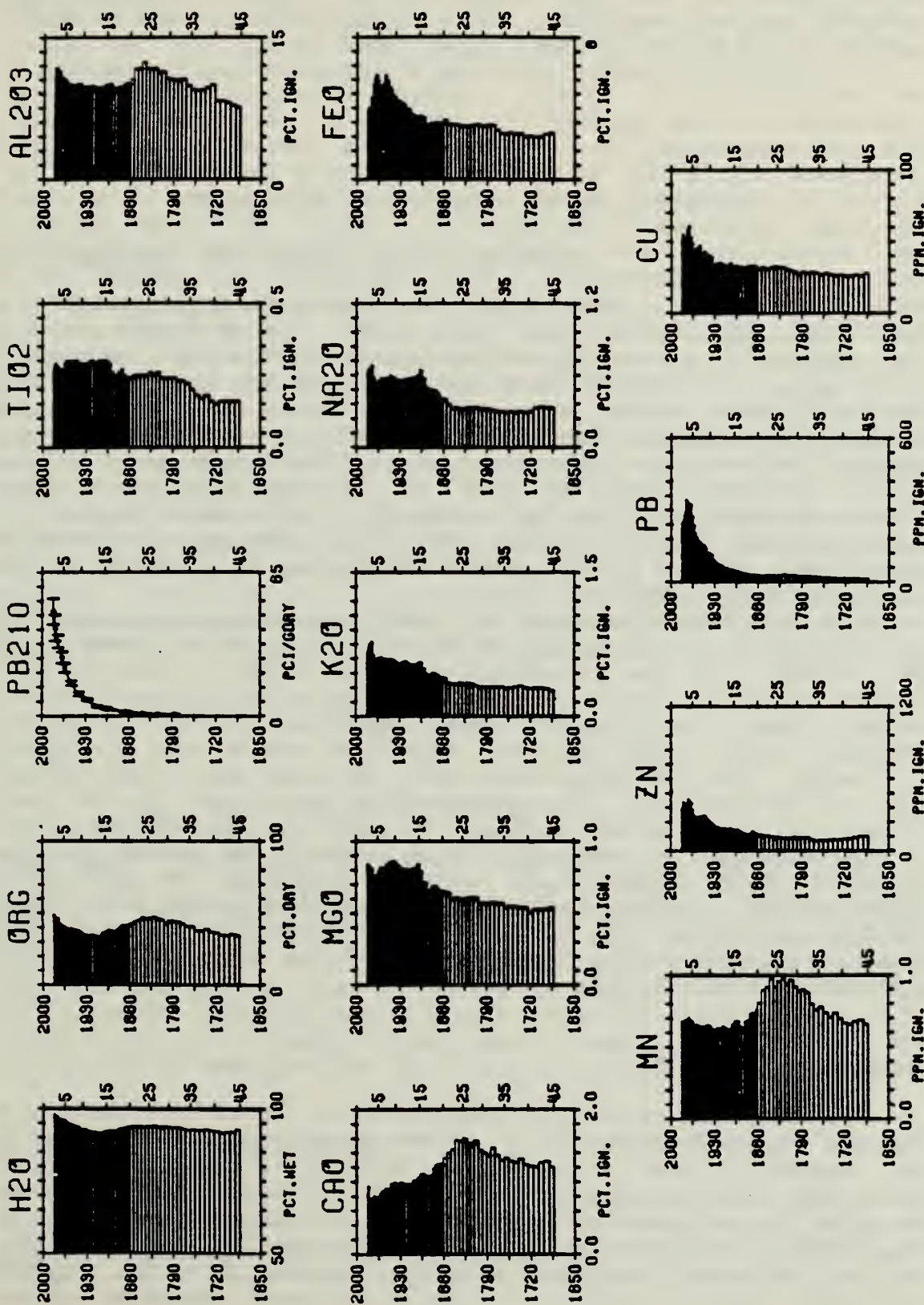


Figure 15. Sediment chemistry profiles for Long Pond-Isle au Haut. Data are concentration versus date (year) and depth (cm).

points of Sargent Mountain Pond (SMP), The Bowl, and Long Pond, were used to 1) evaluate the approximate watershed disturbance and water chemistry histories over the time period represented by the cores; and to 2) estimate anthropogenic heavy metal loading histories based on Pb-210 chronology for each core. For a measure of steady-state sedimentation and conditions, we evaluated activity plots of Pb-210 relative to the theoretical exponential decay curves.

The interpretation of Pb-210 profiles focuses on two aspects of the activity plot. First, changes in sedimentation rate or disturbance of the sediment in situ may be indicated by deviations from an exponential decay curve in the sediment. Second, the convergence of Pb-210 activity to background values determines our ability to accurately assign ages to particular strata in the core. The Pb-210 profiles of the cores from Long Pond and The Bowl approach the exponential form expected from steady-state sedimentation (corrected for compaction), and background is reached at a well-defined point. These cores are interpreted to be relatively undisturbed, and can be accurately dated. The SMP Pb-210 activity plot approaches a well defined background, and therefore the overall chronology is believed to be accurate, although the age uncertainties in the uppermost levels are probably greater in this core. We utilized the Constant Rate of Supply (CRS) model of Pb-210 accumulation for each core (Davis et al., 1984; Appleby and Oldfield, 1978). Accurately assigned dates are indicated by a charcoal peak correlated with the 1947 Bar Harbor fire in the sediments from The Bowl (Backman, 1984), which was dated at 1951, and the appearances of agricultural pollen in all cores in intervals dated just prior to the nineteenth century (Backman, 1984).

For information relating to watershed disturbance, we examined concentration profiles and net deposition rates of major elements. In SMP (Figure 13), the concentrations of the oxides of the major rock forming metals (Ti, Al, K, Na) vary tremendously but in phase with one another over time (depth). These variations probably represent erosional events associated with disturbances such as fire, blowdowns, or storms. The SMP watershed is small, exposed, and subject to this kind of perturbation. The concentration variations in The Bowl (Figure 14) are much more subdued. By contrast, long term variations in concentrations of the rock forming oxides of the sediment profile of Long Pond (Figure 15) occur throughout the core. One interpretation is that human disturbance on Isle au Haut has altered watershed processes and thus altered sedimentation processes. For these three ponds, the concentration profiles suggest at least some disturbance in each drainage.

Heavy Metal Deposition

The sediment records in lakes in much of the northern hemisphere indicate Pb and Zn deposition in amounts above background beginning in the mid-1800's (Kahl et al., 1984; Davis et al., 1980; Shirahata et al., 1980; Iskander and Keeney, 1974). This phenomenon has been noted at sites in eastern Maine as well (Kahl and Norton, 1983; Norton et al., 1978). All three ponds in this study show increases in Pb, Zn, and Cu, beginning in the mid-1800's (Figures 13 to 15). Maximum enrichment factors (maximum divided by background concentration) are

nearly 20X for lead and generally 2-4X for Zn and Cu (Table 7). At SMP, Zn is enriched by a factor of 11; the 1100 ppm total is the highest concentration we have seen from the sediment from any oligotrophic lake in North America. This Zn concentration peak is a function of a slow sedimentation rate and a low background concentration in the sediment. The Zn accumulation rate at SMP is similar to that at the other sites in this study, and at other sites in the region (Kahl and Norton, 1983; Kahl, 1982).

DISCUSSION

Sensitivity of ANP Waters to Acidification

pH, Alkalinity, and Calcite Saturation Index

The geologic setting of ANP should result in waters sensitive to acidic precipitation. Typically, 'sensitive' waters have been considered those with low specific conductances, alkalinities less than 100 $\mu\text{eq/l}$, and pH values less than 7.0. With the exception of several streams which seasonally have greater than 100 $\mu\text{eq/l}$ alkalinity, and Little Long Pond which has high specific conductance due to occasional flooding by seawater, every site at ANP fits these criteria for sensitivity.

Kramer (1981) has suggested using the calcite saturation index (CSI) as a measure of sensitivity instead of pH or alkalinity alone. CSI eliminates the comparison between a log function and a linear function, and may be used in place of pH and/or alkalinity, which have an imprecise relationship. The CSI is the negative logarithm of the degree of saturation of a water with respect of CaCO_3 :

$$\text{CSI} = -\log \frac{[\text{Ca}][\text{HCO}_3]}{[\text{H}] K}$$

or

$$\text{CSI} = \log K - \log[\text{Ca}] - \log[\text{HCO}_3] - \text{pH}$$

where $\log K = 2.582 - 0.024T$, and T is temperature in degrees celcius. A CSI of 1.0 represents a water saturated with respect to CaCO_3 . Sensitive waters are defined as having a CSI greater than 3.0 (Kramer, 1981): the larger the CSI, the greater the sensitivity. When applied to ANP waters, only 11 of the 536 analyses for the 41 sites yielded a CSI less than 3.0; all mean CSI values for each site were greater than 3.0 (minimum 3.32 for Stanley Brook). Mean CSI values are 5.5, 4.9, and 4.6 for the brooks, lakes, and streams, respectively. The distribution of mean baseflow CSI values is shown in Figure 16.

Dilution versus Acidification

A natural water's susceptibility to temporary acidification is critical in biological stress for many species. While chemical changes observed during spring snow-melt are often considerable (Cadle et al., 1984; Jeffries et al., 1979), some effects are due simply to

Table 7. Sediment deposition rates for study sites. Maximum sediment enrichment is the ratio of greatest concentration to background concentration. Total anthropogenic metal is the sum (in μg) of a given metal in excess of the pre-1850 background. Total anthropogenic metal load is estimated for The Bowl, based on interpolated values for the missing intervals.

	Average Sedimentation rate (last 100 years, cm/year)	Current sediment deposition rate $\mu\text{g}/\text{cm}/\text{yr}$ (ave. last 10 years)			Maximum deposition rate to sediments $(\mu\text{g}/\text{cm}/\text{yr})(\text{year})$			Maximum sediment enrichment			Total anthropo- genic metal $(\mu\text{g}/\text{cm})$		
		Pb	Zn	Cu	Pb	Zn	Cu	Pb	Zn	Cu	Pb	Zn	Cu
Long Pond (Isle Au Haut)	0.16	1.28	1.76	0.24	1.8 (1968)	2.3 (1970)	0.33 (1970)	17X	4X	2X	90	225	40
The Bowl	0.15	2.30	1.19	0.31	2.5 (1964)	3.6 (1944)	0.35 (1964)	18X	2X	3X	125	205	22
Sargent Mountain Pond	0.11	0.90	0.71	0.20	1.4 (1968)	2.6 (1961)	0.20 (1968)	19X	11X	4X	78	141	16

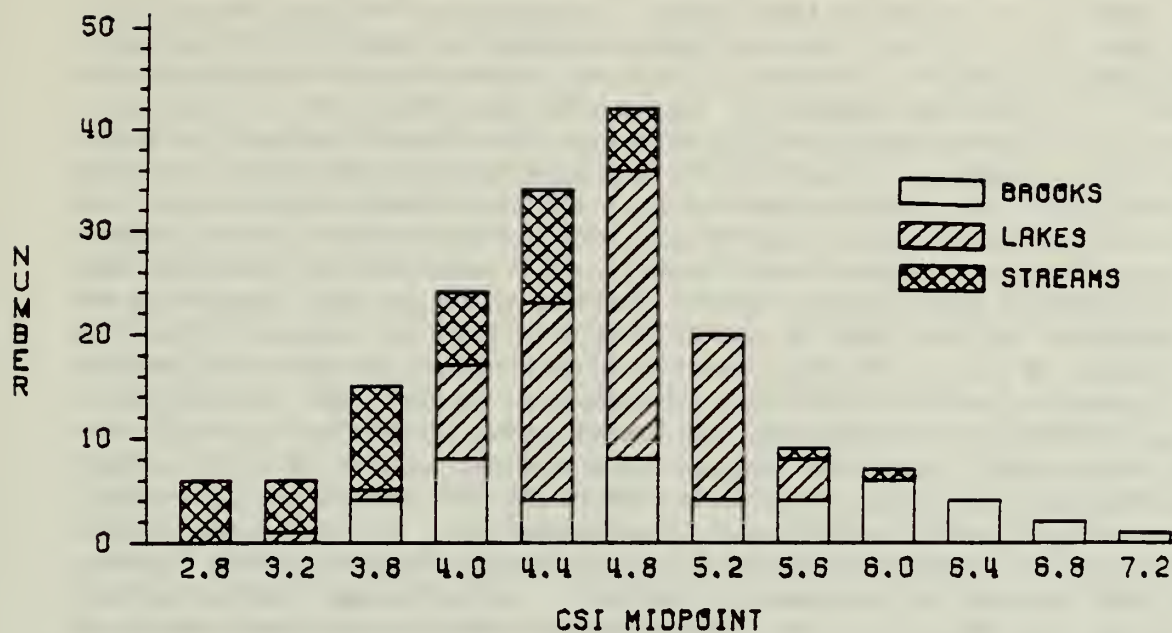


Figure 16. Baseflow calcite saturation index distribution, 1982-1984.

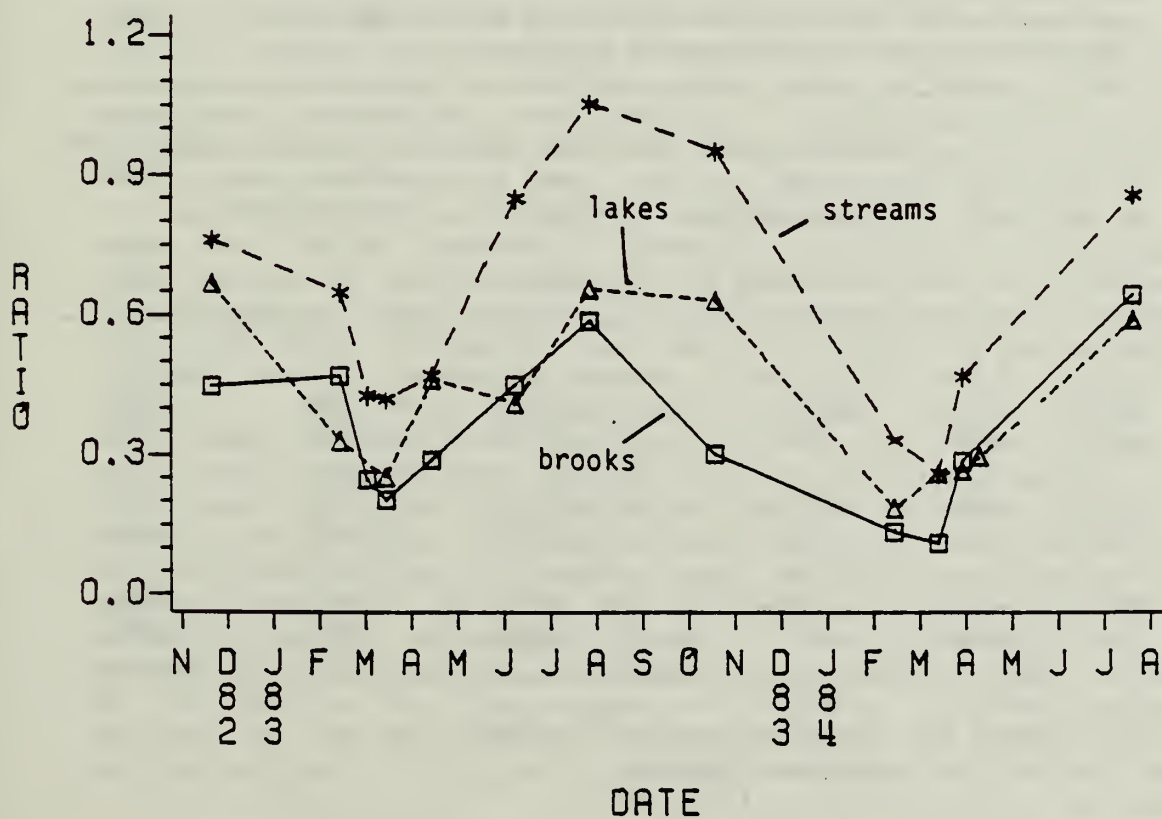


Figure 17. The relationship between HCO₃ and Ca versus time, as an indicator of dilution. The 'ratio' is HCO₃/Ca in non-marine µeq/l.

dilution rather than acidification by strong acids (Bjarnberg, 1983). The observed changes in stream and brook alkalinity during snow-melt at ANP could occur if flow increased by a factor of three, due only to the addition of distilled water (zero alkalinity). The ionic strengths (I) of all sample types declined during spring snow-melt, indicating dilution. However, dilution alone is not sufficient to explain the spring alkalinity depression in either year. A dilution factor (DF) can be estimated from changes in chemical composition with time. For example, if ionic strength declines by 25 percent due to the addition of distilled water, then all constituents should decline by 25 percent, with very minor deviations due to changes in speciation (eg. carbonates or aluminum). However, if alkalinity declines instead by 50 percent while other factors decline by 25 percent, then half of the alkalinity loss must be attributable to factors such as titration by strong acids. The approach is to estimate dilution using an ion not present in precipitation. Potassium is the best, although not ideal, choice because it has the lowest seawater concentration of any major ion, and thus the lowest atmospheric input. The very low K concentrations in natural fresh waters at ANP (less than 10 $\mu\text{eq/l}$), also reflect small amounts of weatherable K in rocks and soils. Changes in K concentrations (ΔK), corrected for atmospheric inputs, yield DF up to 43 percent (Table 8). Percentage estimates of alkalinity 'lost' only to titration can therefore be calculated as $[100-\text{DF}]$, and range up to 76 percent.

Table 8. An estimate of the relative contributions of dilution and acidification toward declines in alkalinity during spring melt. See text for further explanation of methods.

		(1) ΔK	(2) net loss of alkalinity $\mu\text{eq/l}$	(3) loss due to dilution $\mu\text{eq/l}$	(4) loss due to 'titration' (A)	(5) loss to (B)
'titration'						
Brooks	1983	-19%	32	9 (28%)	72%	67%
	1984	-20%	34	8 (24%)	76%	83%
Lakes	1983	-20%	33	10 (30%)	70%	64%
	1984	-16%	19	6 (31%)	69%	64%
Streams	1983	-43%	88	53 (60%)	40%	59%
	1984	-36%	171	71 (42%)	58%	73%

(1) $\Delta K\% = [(\text{fall } K - \text{spring } K)/(\text{fall } K)] \times 100$

(2) net loss = (fall alk - spring alk)

(3) loss to dilution = $[(1) \times (\text{fall alk})]$

(4) loss to 'titration' = $[(\text{fall alk}) - (\text{loss to dilution})]$

(5) loss to 'titration', calculated from alk/Ca ratios. See text

An alternative estimate of dilution effects can be made from seasonal variation in bicarbonate to Ca ratios. This ratio should be a function of the process of alkalinity production (largely HCO_3), and thus should be site specific. If the system in question is simply diluted by distilled water, the absolute amounts of both alkalinity and Ca will decrease, but the ratio will remain essentially constant. Deviations from baseflow norms should correspond to acidification. For example, mean baseflow alkalinity/Ca ratios are approximately 0.6, 0.7 and 1.0 for the brooks, lakes and streams, respectively. The ratios were reduced by 59 to 83 percent during spring-melt, indicating loss of bicarbonate to 'titration' (Figure 17). This estimate of 'titration' agrees well with our other estimate (Table 8). The loss of alkalinity is greatest in the first-order brooks (Table 5).

The strong acid responsible for decreases in alkalinity is not necessarily sulfuric, as one might expect. Sulfate did not change in concentration during spring 1983 and actually decreased during spring 1984 (Appendix C). Conversely, Cl concentrations were constant in spring 1983, but increased sharply (a mean increase of 44 percent) in spring 1984 (Figure 18), while not being matched stoichiometrically by increases in Na. This apparent anomaly was observed again in November, 1984, during heavy rains which followed prolonged dry weather. We suggest that these events represent an acidification by HCl, especially in the first-order brooks, as has been reported in coastal areas in western Norway (R. Wright and A. Henriksen, pers. comm.). The reaction is a displacement of H^+ by Na on exchange sites. The 44 percent increase in Cl corresponds to the projected 58 percent loss of alkalinity to factors other than dilution. The pH and alkalinity depressions were greatest in 1984 (Table 5), in spite of decreased SO_4 . Additional evidence for an acidification by HCl during 1984 comes from measured Na:Cl ratios. The ratio of Na to Cl expressed in $\mu\text{eq/l}$ should be just slightly less than 1.0 if all of the Na and Cl come from marine aerosols. Normally, the ratio is slightly greater than 1.0 due to weathering of Na from soils and bedrock. However, for the mid-March, 1984, sampling, 19 of 26 samples had Na:Cl ratios less than 1.0 after correction for sea salts ($\text{Cl} = 0$ after correction), whereas only 3 percent of samples in spring 83, and 4 percent of all samples in the entire project had similar Na:Cl ratios. These ratios imply that another cation (hydrogen ion?) is associated with the Cl. A simplistic scenario would have H^+ , SO_4 , Na, and Cl accumulate in soils from both wet precipitation and dry fall during summer and fall. In certain soil types, SO_4 may be adsorbed by the soil, while H^+ (from either precipitation or natural soil acidity) displaces cations on exchange sites. As the soil becomes saturated with NaCl-rich percolate during spring-melt, some H^+ are displaced by Na, and Cl becomes the mobile anion. The result is an export of HCl, rather than or in addition to, the export of sulfuric acid that occurs when sulfate is the mobile anion. The magnitude of this phenomenon either was not as great in 1983, or it was not detected.

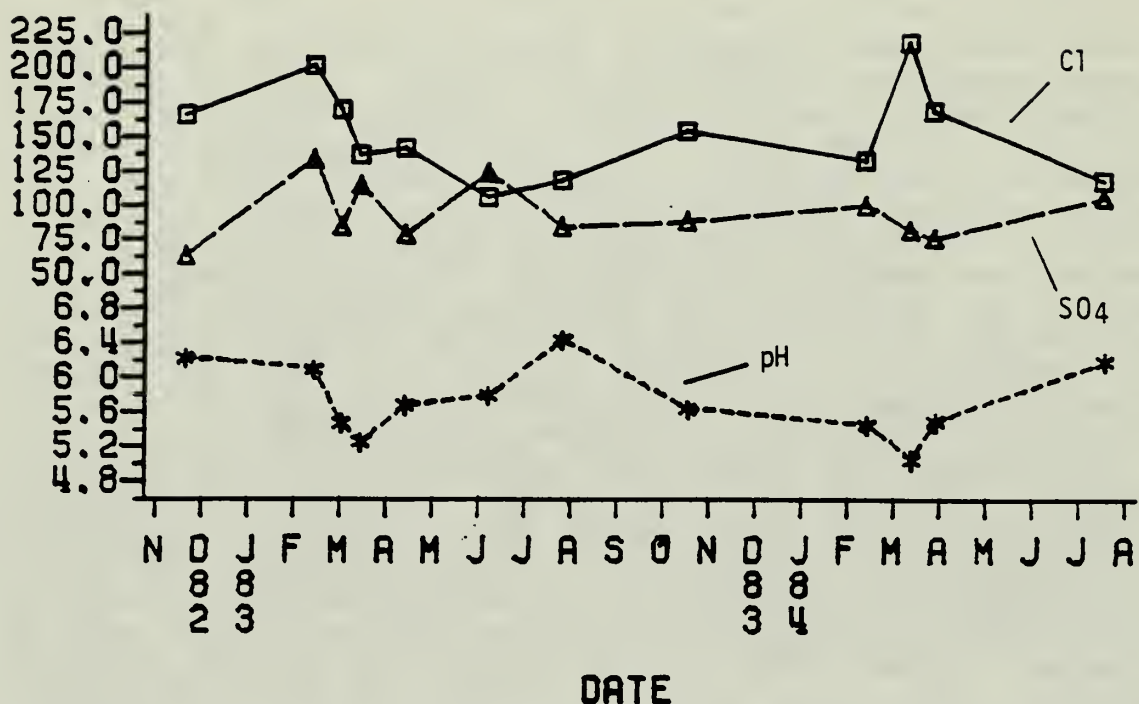


Figure 18. The relationship between pH, SO₄, and Cl versus time in Penobscot Brook. Cl and SO₄ data are in µeq/l.

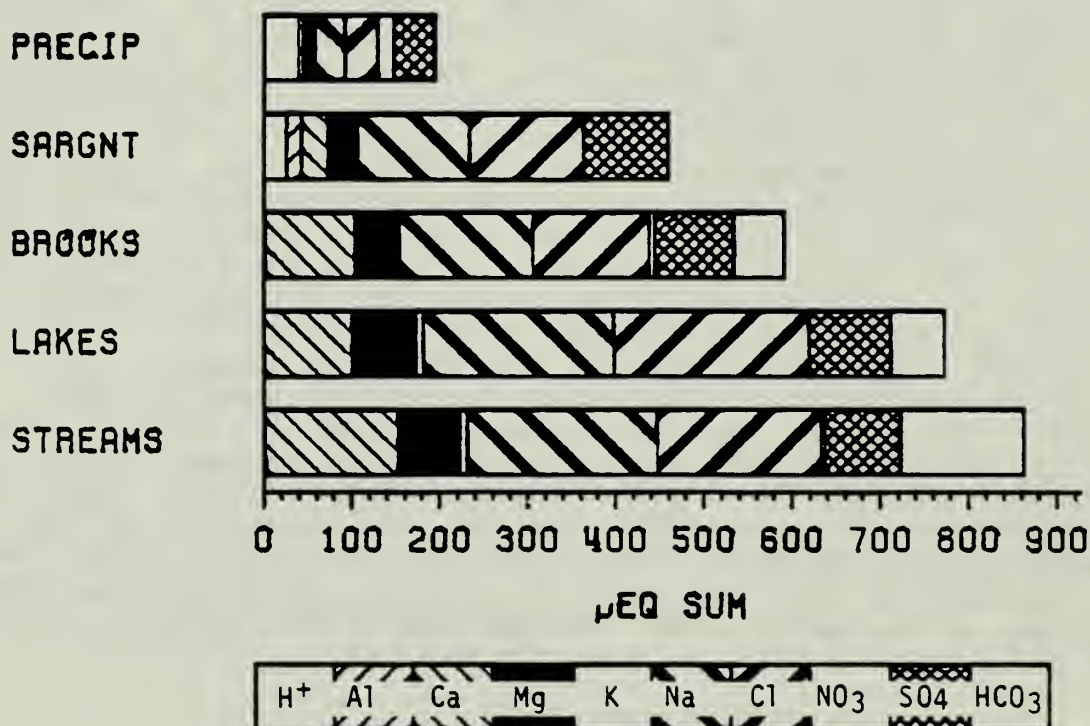


Figure 19. Mean compositions of precipitation and surface waters.

Comparisons of modern water quality to that of the past generally suffer from either a lack of historical data, or from uncertainties introduced as results from different methods are compared. For ANP some pH data exist from the 1940's (Fuller and Cooper, 1946), and pH and cation data exist from 1978-79 (Norton et al., 1981) (Table 9). There was no discernable change in the pH of the ponds sampled by Norton et al. (1981) in the intervening 6 years and no substantial change since the 1940's, given that the colorimetric data from the 1940's probably overestimated pH (Haines et al., 1983; Kramer and Tessier, 1982). For each site, the pH range observed in this study brackets that reported by Norton et al. (1981) and is often close to that reported by Fuller and Cooper (1946).

Although the pH values are higher in ANP waters compared to other recent New England surveys, alkalinities tend to be lower (Table 10). Sixty-eight percent of the waters at ANP have alkalinity values less than 100 $\mu\text{eq/l}$, indicating the sensitivity of these waters to acidic precipitation, and suggesting that as a group, they are more sensitive than the regional average. Haines and Akellazslek (1983) report that 70 percent of the New England waters surveyed have CSI values greater than 3.0 (sensitive to acidic precipitation). Based on CSI, all of the waters of ANP are considered sensitive (minimum CSI = 3.32).

Surface Water Chemistry

General Chemical Relationships

Aquatic chemistry at ANP is influenced by factors including marine aerosols, glaciomarine sediments, fire history, young, thin soils, and very chemically-resistant bedrock. The last two factors result in the waters being sensitive to acidification, whereas the former factors may be resisting acidification effects by supplying alkalinity. Once precipitation has been 'processed' by the terrestrial environment, the net effect is increased pH, decreased NO_3 concentrations, and increased Ca and HCO_3 (Figure 19). Other ions increase due to weathering, evapotranspiration, and dryfall. There is a 'transitional' stage represented by Sargent Mountain Pond, where only partial neutralization of acids has occurred. This neutralization occurs below the bicarbonate equivalence point (Norton and Kahl, 1982; Stumm and Morgan, 1981) and results in partial replacement of hydrogen ion by exchangeable Al or soluble Al phases (Johnson et al., 1981). The hydrogen ion concentration is 40 $\mu\text{eq/l}$ in precipitation, but only 25 in SMP, whereas Al has increased from 0 to 15-20 $\mu\text{eq/l}$. Waters in the remaining lakes and streams have essentially no Al or free hydrogen ion. In sensitive terrain, the first neutralization of acidic precipitation is by dissolution of Al minerals in soils (Johnson et al., 1981), and probably by cation exchange reactions. As the pH is raised by these processes to a value greater than the bicarbonate equivalence point, bicarbonate alkalinity production occurs. Therefore, HCO_3 and base cations from weathering above the equivalence point have replaced H and Al. This relationship is shown by the strong correlations between Ca, Mg, and HCO_3 in this study

Table 9. Comparative pH for several Acadia National Park lakes. Data from Fuller and Cooper (1946) are based on colorimetric determinations and may not be strictly comparable to the recent data.

	Fuller and Cooper, 1946	Norton et al., 1981	this study (baseflow conditions)
Bubble Pond	6.8	6.40	6.37 - 6.54
Eagle Lake	6.8	--	6.38 - 6.60
Echo Lake	6.8	6.79	6.64 - 6.91
Jordan Pond	6.8	6.50	6.49 - 6.74
Long Pond	6.7	6.50	6.24 - 6.53
Seal Cove Pond	6.7	6.50	6.45 - 6.58
Upper Hadlock Pd.	6.7	6.35	6.17 - 6.49

Table 10. pH and alkalinity distributions from synoptic surveys of water chemistry in New England. Data in percent.

n	pH distributions			alkalinity distributions				
	< 5	5-6	>6	<20	21-100	101-200	>200 $\mu\text{eq/l}$	
226	8	21	71	23	18	12	47	Haines and Ak- ellazsiek, 1983
91	12	15	73	not reported				Norton et al., 1981
41	2	10	88	12	56	20	7	this study

(Table 11). If pH is greater than 5.3, then pH is largely a function of bicarbonate (Figure 20).

There are significant differences in the relationships between chemical parameters in the lakes, streams, and brooks (Table 11). For example, there are strong correlations between pH and alkalinity, and the four major cations in the brooks and streams, but this relationship only exists between Ca and pH in the lakes. Silica concentrations, which should parallel major cation concentrations and represent a measure of weathering rates, are correlated with pH and alkalinity in the brooks (Figure 21), but not in the lakes or streams. Uptake and sedimentation of silica by diatoms confounds chemical relationships in lakes and perhaps downstream in second-order streams, resulting in low silica concentrations (Figure 22).

Many waters at ANP are no longer predominantly bicarbonate systems (Figure 9), as similar waters tend to be in geologically similar regions not receiving deposition of strong acids. However, there is no relationship between non-marine sulfate and pH (Figure 10; Table 11), and some waters have SO_4 concentrations that are below those in precipitation (Figure 23). These observations contradict a simple 'titration' model of water chemistry, in which strong acid is added to a lake causing alkalinity to decrease and pH to drop. The actual response of watersheds in the processing of precipitation is much more complex. However, the ratio of SO_4 to the sum of non-marine anions shows a strong relationship to alkalinity (Figure 24), indicating an influence by acidic deposition. Non-marine sulfate concentrations are correlated with ionic strength ($r^2 = 0.95$) in the lakes, due to a combination of degree of evapotranspiration and retention of SO_4 in the watershed. Sulfate is unrelated to other parameters, especially in the brooks and streams (Table 11). Sulfate decreases in relative importance downstream from precipitation (Figure 19). Chloride increases in concentration by a factor of six in surface waters compared to precipitation concentrations, whereas SO_4 increases by a factor of three. Evapotranspiration should concentrate both equally: therefore approximately 50 percent of the sulfate is retained in the system, presumably in soils, organic matter, or in the sediments.

Controls on Aquatic Chemistry

Broad physiographic influences on aquatic chemistry are generally difficult to ascertain in a small geographic area. For example, pH and alkalinity are often correlated with elevation in synoptic surveys. At ANP, lake elevation correlates with pH ($r^2 = -0.68$), total Al ($r^2 = 0.66$), and Cl ($r^2 = -0.42$), but these relationships are largely due to SMP, which is a chemical outlier, and the highest elevation site in the study.

Some relationships for the streams and brooks are clear. Alkalinity during baseflow is inversely related to both elevation ($r^2 = -0.55$; $p > 0.01$) and stream gradient ($r^2 = -0.62$; $p > 0.01$). These correlations are likely due to high relative soil-water retention times and the presence of glacio-marine sediments in the watersheds of low gradient and/or low elevation flowages. Similarly, the ratio of HCO_3 to SO_4 also decreases at higher elevation ($r^2 = -0.60$; $p > 0.01$).

A confounding factor in determining controls on chemistry at ANP

Table 11A. Relationships between sea-salt corrected chemical parameters during baseflow conditions (1982-84). Pearson Product-Moment correlation coefficients, $n = 239$ samples. Probabilities are very highly significant ($p > .001$) unless noted. Parameters not listed showed no significant correlations with other parameters. ns = no significant relationship.

Lakes														
	I	SO ₄	labile Al	total Al	SiO ₂	Mn	Zn	Fe	Na	K	Mg	Ca	color	alk
pH	ns	ns	-.77	-.77	.45*	ns	.28*	ns	ns	ns	ns	.57	ns	.64
alk	.42	ns	ns	-.25*	.53	ns	ns	.46	ns	.29*	.29*	.70	.45	
color	ns	ns	ns	ns	ns	.35	ns	.61	ns	ns	ns	ns		
Ca	.84	.70	ns	ns	.59	ns	ns	ns	.63	.75	.75			
Mg	.98	.97	ns	ns	ns	ns	ns	ns	-.81	.99				
K	.97	.96	ns	ns	ns	ns	ns	ns	-.82					
Na	-.77	-.80	ns	ns	ns	ns	ns	ns						
Fe	ns	ns	ns	ns	ns	.56	ns	ns						
Zn	ns	ns	ns	.36	ns	ns	ns							
Mn	ns	ns	ns	ns	ns									
SiO ₂	.50	ns	ns	ns										
total Al	ns	ns	ns	.83										
labile Al	ns	ns												
SO ₄	.95													

*($p > 0.01$)

Table 11B. Relationships between sea-salt corrected chemical parameters during baseflow conditions (1982-84). Pearson Product-Moment correlation coefficients, n = 239 samples. Probabilities are very highly significant (p > .001) unless noted. Parameters not listed showed no significant correlations with other parameters. ns = no significant relationship.

Streams

	I	SO ₄	labile Total		SiO ₂	Mn	Zn	Fe	Na	K	Mg	Ca	color	alk
			Al	Al										
pH	.41*	ns	ns	ns	ns	ns	-.43	ns	.46	.37*	.45	.48	ns	.55
alk	.38	ns	ns	ns	ns	ns	-.44	ns	.69	.61	.81	.93	ns	
color	ns	-.42	ns	.47	ns	.34*	ns	ns	ns	ns	ns	ns		
Ca	.93	ns	ns	ns	ns	ns	-.45	ns	.63	.67	.30			
Mg	.87	ns	ns	ns	.45	ns	ns	ns	.68	.76				
K	.71	ns	ns	ns	.53	ns	ns	.48	.35*					
Na	.71	ns	ns	ns	ns	ns	ns	ns						
Fe	ns	ns	ns	ns	ns	.46	ns							
Zn	ns	ns	ns	.35*	ns	ns								
Mn	ns	ns	ns	ns	ns									
SiO ₂	.38*	.42*	ns	ns										
total Al	ns	ns	.74											
labile Al	ns	ns												
SO ₄	ns													

*(p > 0.01)

Table 11C. Relationships between sea-salt corrected chemical parameters during baseflow conditions (1982-84). Pearson Product-Moment correlation coefficients, n = 239 samples. Probabilities are very highly significant (p > .001) unless noted. Parameters not listed showed no significant correlations with other parameters. ns = no significant relationship.

Brooks

	I	SO ₄	labile total		SiO ₂	Mn	Zn	Fe	Na	K	Mg	Ca	color	alk
			Al	Al										
pH	.63	ns	-.81	-.48	.49	ns	-.54	ns	.54	.36	.50	.65	ns	.75
alk	.90	ns	-.71	ns	.58	ns	-.53	.44*	.65	.39*	.84	.88	.54	
color	.56	ns	ns	.50	ns	.40*	ns	.70	ns	ns	.57	.51		
Ca	.95	ns	ns	ns	.61	ns	-.43*	.38*	.49	.47	.81			
Mg	.91	ns	ns	ns	.71	ns	-.39*	.40*	.66	.63				
K	.59	.39*	ns	ns	.56	ns	ns	ns	.51					
Na	.68	ns	.54*	ns	.41*	ns	-.49	ns						
Fe	.40*	.50	ns	ns	ns	.39*	ns							
Zn	-.46	ns	ns	ns	ns	ns								
Mn	ns	ns	ns	ns	ns									
SiO ₂	.65	ns	ns	ns										
total Al	ns	ns	.80											
labile Al	ns	ns												
SO ₄	ns													

*(p > 0.01)

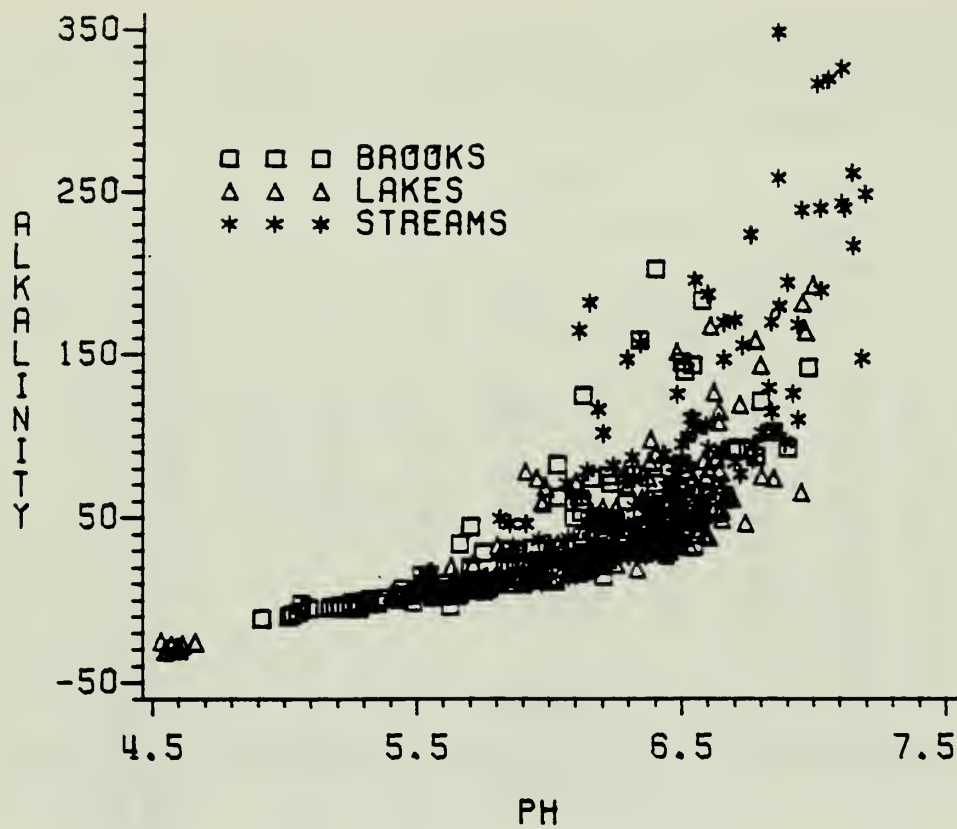


Figure 20. The relationship between alkalinity and pH.

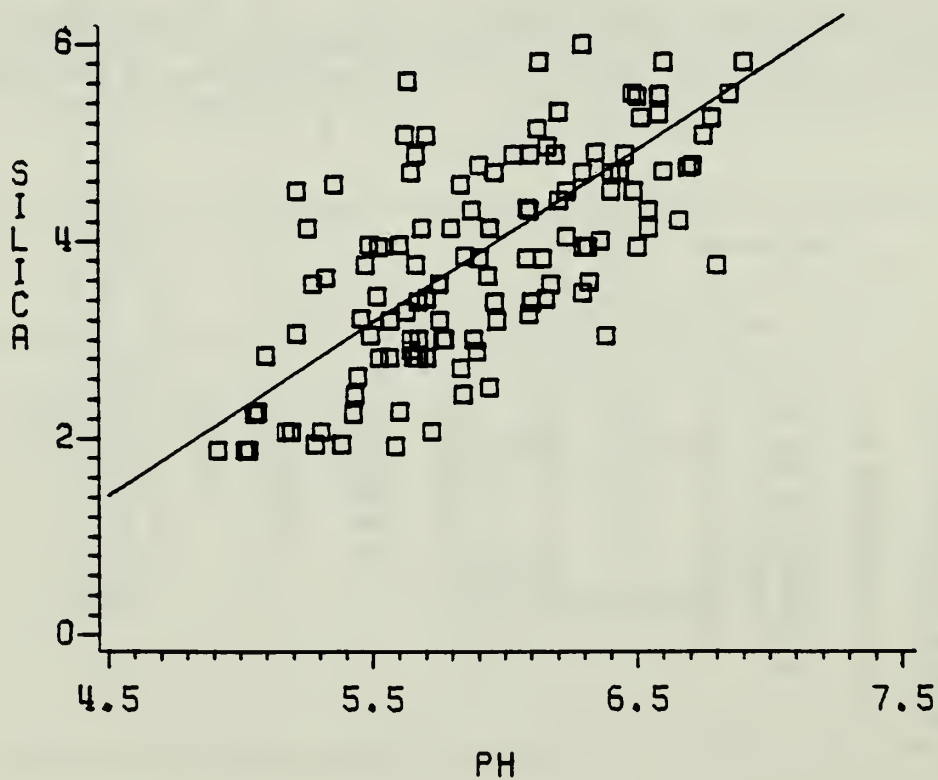


Figure 21. The relationship between silica and pH in the first-order brooks. Silica data are in ppm.

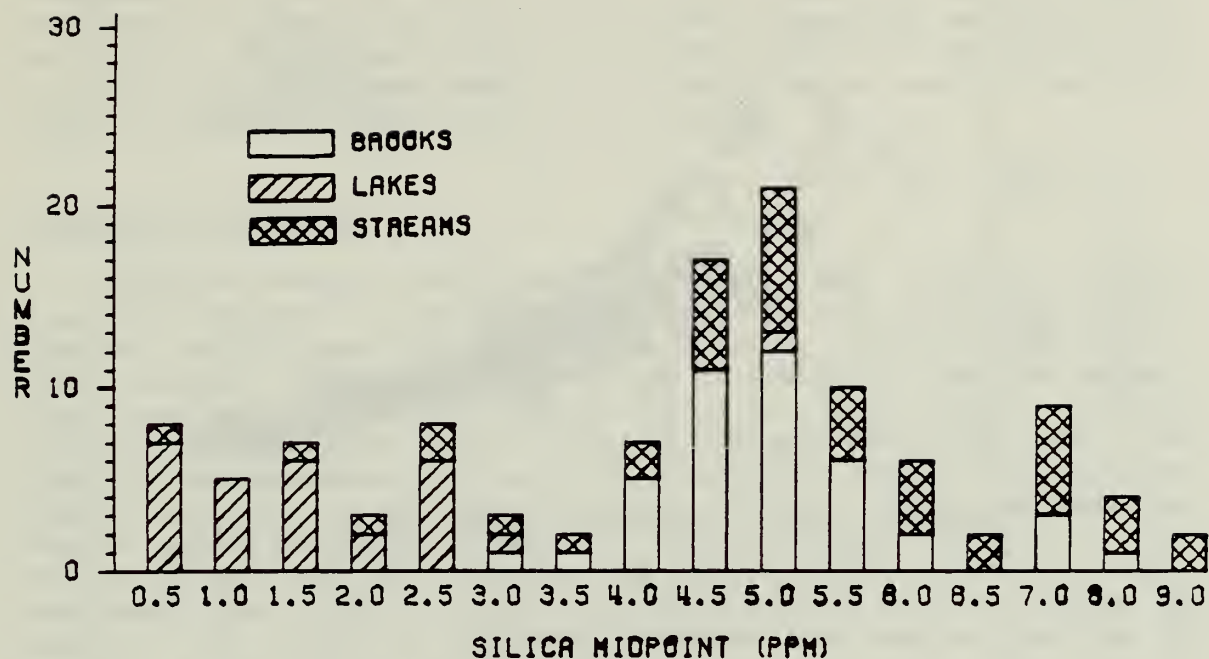


Figure 22. Distribution of silica concentrations, 1982-1984.

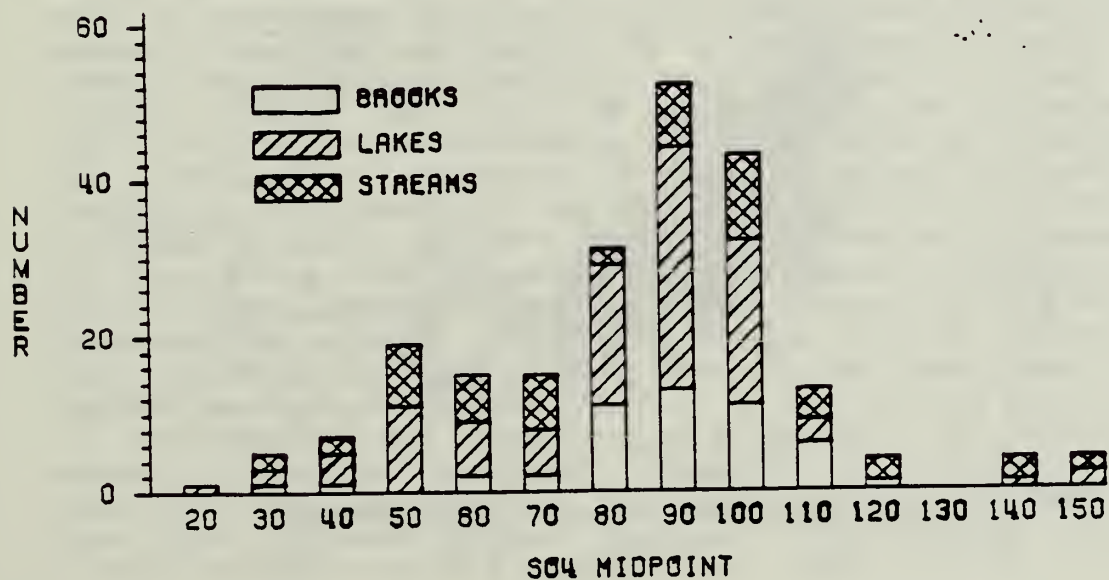


Figure 23. Distribution of sulfate concentrations in µeq/l, 1982-1984.

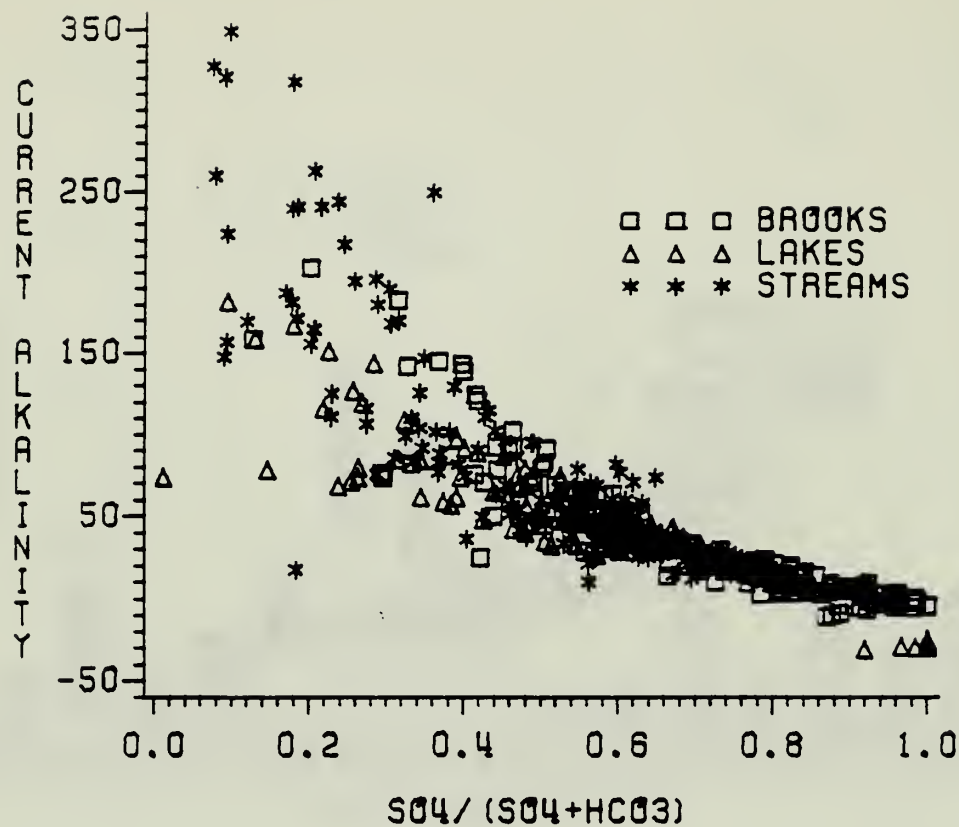


Figure 24. The relationship between alkalinity and the ratio of SO_4 to the sum of non-marine SO_4 and HCO_3 .

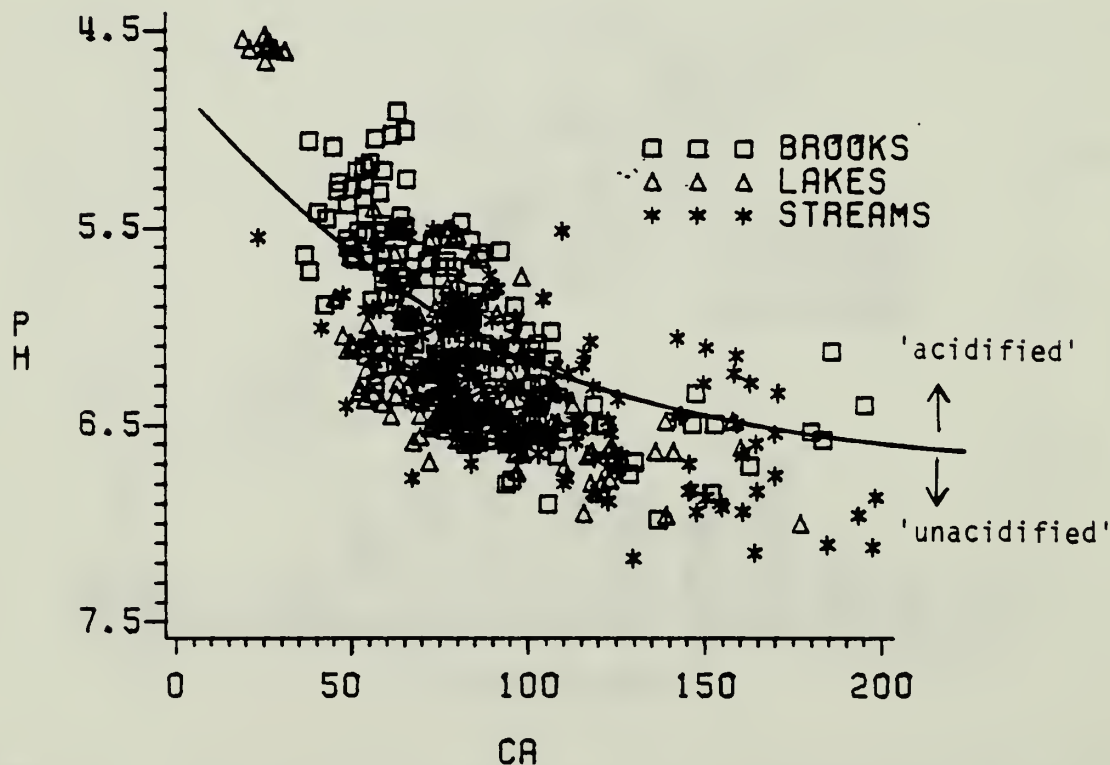


Figure 25. Henriksen's predictor graph of pH versus non-marine Ca for ANP study sites. Data in $\mu\text{eq/l}$.

is the abundance of beavers. At some sites such as Bear Brook Pond, Canon Brook, and Kebo Brook, flooding caused by beaver dams has apparently increased terrestrial-water interactions, with possible increases in pH and alkalinity. Conversely, a small beaver impoundment below the outlet from Bubble Pond has caused periodic declines in stream pH of up to 0.5 pH units, perhaps due to flooding of acidic organic soils. The influence of this factor on the chemistry of The Bowl, which has had its water level raised by at least one meter by beaver activity, is unknown.

Aluminum Geochemistry

Numerous workers have noted the importance of Al in the geochemical response of soils and natural waters to acidic precipitation (Wright and Skogheim, 1984; Kramer, 1983; Johnson et al., 1981; Cronan, 1980; Norton, 1976) and to biological response as well (Henriksen and Skogheim, 1984; Dillon et al., 1984; Schofield, 1981; Cronan, 1980; Driscoll et al., 1980; Haines and Schofield, 1980). The toxicity of non-chelated Al at low pH has become increasingly apparent (Baker and Schofield, 1982; Driscoll et al., 1980). We measured labile versus non-labile forms of Al (Driscoll, 1980) in 1984 in order to help interpret the Al data from 1982 and 1983. The 1982-83 data indicated that total Al was relatively high in some of the high pH waters. The speciation studies confirmed that much of the total Al was in a non-labile form (Figure 12 and Table 12). The ratio of labile Al to total Al decreases as water color increases ($r^2 = 0.60$; $p > 0.001$), suggesting that Al is increasingly bound to organics as organic carbon concentrations increase. There was also a positive correlation between total Al and Pt-Co color in both the first-order brooks ($r^2 = 0.50$) and in the second-order streams ($r^2 = 0.47$; Table 11). This result is to be expected if organic ligands are complexing reactive Al species; thus we expect that much of the total dissolved Al is complexed with organics. However, the sites with high pH and high Al are below the limit of Pleistocene marine submergence, and generally have glaciomarine clays in their catchments, commonly in the stream beds. This high pH-high Al relationship is in contrast to the typical situation when high Al is correlated with low pH. We suggest that the presence of weatherable clay sized particles, combined with the influence of increasing Al-organic complexation downstream, results in high total Al at high pH, low elevation sites. The influence of marine sediments in soils and streambeds is corroborated by observations from above and below the marine transgressive limit (MTL) in both Hunters Brook and Canon Brook. At high flow, Al concentrations decrease downstream. During baseflow, samples taken below the MTL have higher Al concentrations than those taken the same day in the same stream above the MTL. In the lakes and brooks, total Al concentrations are more strongly a function of pH, controlled by normal pH-dependent pedogenic processes with organic ligands relatively less important in the very clear waters of many of the lakes and first-order brooks. The result is the expected low pH-high Al relationship, especially for labile Al.

Table 12. Speciated Al at sites with anomalously high total Al (mean baseflow pH > 6.0 with total Al > 100 ppb or maximum Al > 200 ppb). Data are ppb.

Site	Mean Baseflow pH	Minimum pH	Mean Baseflow Total Al	Maximum Total Al	Mean Baseflow Labile Al	Maximum Labile Al
Canon Brook*	6.31	5.76	85	145	15	34
Eagle east Inlet	5.83	4.91	117	135	29	96
Eagle west Inlet	6.25	5.70	128	188	6	30
Cromwell Brook*	6.29	5.81	124	199	15	31
Upper Hadlock Pd	6.37	5.40	69	206	20	58
Heath Brook*	6.54	5.55	98	120	6	11
Penobscot Brook	6.01	5.05	118	270	45	135
Hunters Brook(S)*	6.82	6.05	92	235	8	65
Hunters Brook(N)	6.71	6.04	44	206	25	40
Sargent Mtn Pd	4.57	4.54	237	401	133	237
Stanley Brook*	6.94	6.28	64	283	9	32

*Glacio-marine clays observed or mapped (Borns, 1974) in the watershed.

Chemical Models

In spite of possible problems with colorimetric methods, the 1940's pH data (Fuller and Cooper, 1946) agree reasonably well with the results of this study, and the data of Norton et al. (1981) (Table 9). If we accept the historical data as valid--a risky assumption, then we would conclude that little or no change in pH has occurred in these lakes in the past 40 years. However, 1) the 1940's data are for the larger lakes on the island, which are the least likely to undergo discernable chemical changes, and 2) pH, by itself, is a poor indicator of a lake's vulnerability.

In lieu of either extensive or complete historical data, we can apply predictive models based on empirical data from other regions of the world to estimate the extent of surface water acidification. Such an approach allows us to reconstruct historical conditions for any water whenever modern chemical analyses exist. Henriksen (1979) has proposed that a qualitative estimate of acidification can be made by plotting pH against non-marine Ca (Figure 25). The line on Figure 25, which is based on empirical observations, separates acidified (above the line) from non-acidified waters. Henriksen (1979) suggested that this plot could serve as an 'acidification indicator', identifying waters that had lost alkalinity and were prone to further acidification. The Henriksen relationship as applied to ANP indicates that as a group, the waters of ANP have not undergone any significant acidification. Most of the points above the line are spring snow-melt stream or brook samples.

Henriksen (1984; 1982) proposed a more specific model, derived from empirical relationships between pH, alkalinity, and base cation concentrations. Wright (1983) and Henriksen (1982; 1980) have noted that in oligotrophic waters not receiving acidic precipitation, the sum of non-marine Ca and Mg ($\text{Ca}^* + \text{Mg}^*$) is approximately equal to alkalinity. Although the rationale for the use of ($\text{Ca}^* + \text{Mg}^*$) instead of the sum of all non-marine cations (as suggested by Kramer and Tessier (1982)) is not necessarily obvious, empirical relationships between alkalinity and the four major cations are clear: alkalinity concentrations are much more closely correlated with non-marine Ca and Mg than with Na and K (Table 13; Figure 26). However, the geochemical reasons for these relationships are somewhat unresolved. Expectations from the chemistry of the K and Na-rich granites at ANP (Table 1C) do not support the generation of alkalinity largely from the weathering of only Ca- and Mg-rich minerals.

Henriksen's (1982) empirical relationship for waters in regions not receiving acidic precipitation is:

$$\text{Alk} = [0.93 (\text{Ca}^* + \text{Mg}^*) - 14] \quad (1)$$

However, the quantity ($\text{Ca}^* + \text{Mg}^*$) represents modern (measured) concentrations which will be higher than pre-acidic precipitation values if deposition of acids has increased chemical weathering. Henriksen (1984; 1982) assumes that the quantity ($\text{Ca}^* + \text{Mg}^*$) has increased; thus a correction factor must be subtracted from modern ($\text{Ca}^* + \text{Mg}^*$) to get pre-acidification ($\text{Ca}^* + \text{Mg}^*$).

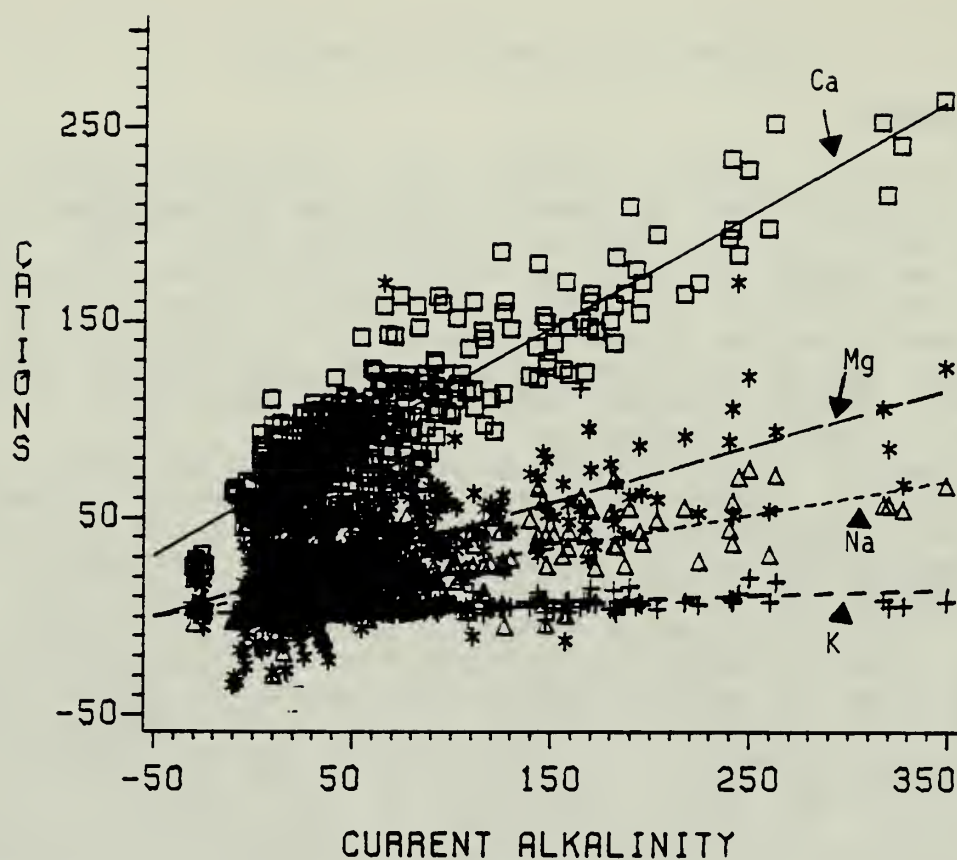


Figure 26. The relationship of non-marine major cation concentrations to alkalinity. Data in $\mu\text{eq/l}$.

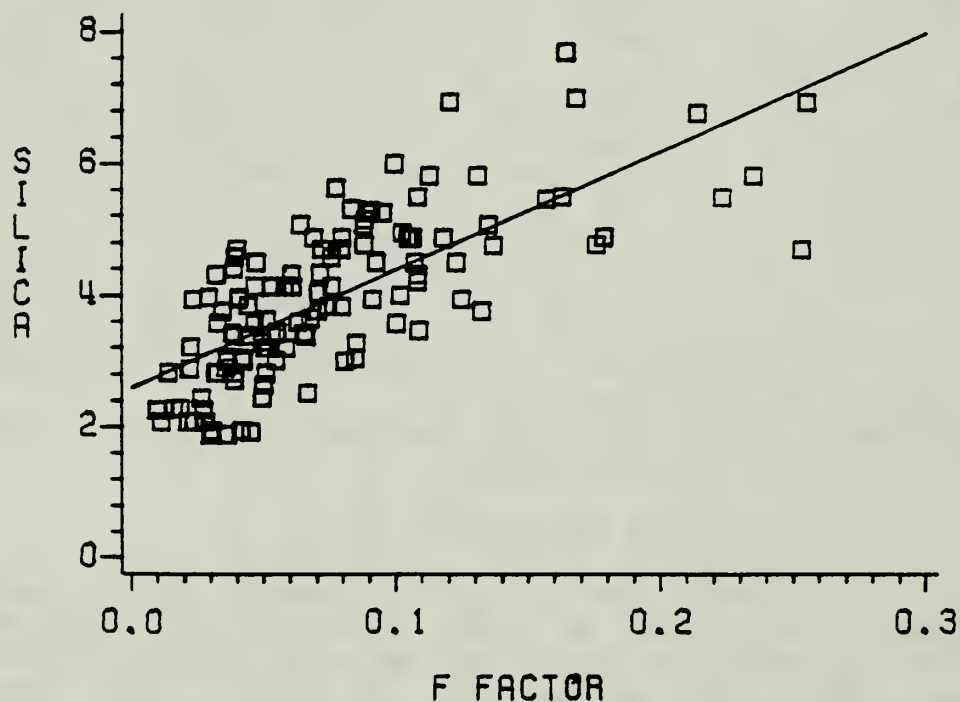


Figure 27. The relationship of silica concentrations to the F factor in the first-order brooks.

Table 13. Relationship of alkalinity to the non-marine concentrations of major cations. Pearson product-moment correlation coefficients (from Table 11). ns = no significant correlation; all probabilities are $p > .001$ unless noted with * ($p > .01$).

type -----	Ca -----	Mg -----	Na -----	K -----
Brooks	0.88	0.84	0.65	0.43
Streams	0.93	0.81	0.69	0.61
Lakes	0.70	ns	ns	ns

The following rationale leads to a modified version of Henriksen's model for calculating past chemistry:

1) Prior to acidic precipitation, clear water lakes in terrain such as that in Norway and ANP were bicarbonate lakes. Non-marine sulfate was very low.

2) Non-marine sulfate in excess of background is due to deposition of anthropogenic sulfate, which has replaced some or all of the HCO_3^- in the ion balance.

3) Increases in cation concentrations are proportional to increases in sulfate, the acid anion which presumably caused the increases in cation concentrations.

4) Estimates of increases in $(\text{Ca}^* + \text{Mg}^*)$ range from zero to 40 percent (Henriksen, 1984; 1982), depending on the evidence and assumptions used. Henriksen assumes 20 percent in his calculations ($F = 0.2$). However, a constant increase factor ignores the complexities of individual system responses to acid inputs. We suggest that the increase factor will be proportional to the modern weathering rate, for which we use $(\text{Ca}^* + \text{Mg}^*)$ as a surrogate. For example $(\text{Ca}^* + \text{Mg}^*)$ is approximately 30 $\mu\text{eq/l}$ in Sargent Mountain Pond (SMP), but is 210 $\mu\text{eq/l}$ in Stanley Brook. The level in SMP is so low that it could not have changed significantly through time. These low concentrations represent very low weathering rates, due to a combination of thin or non-existent soils, rapid soil-water flushing, a more severe microclimate, or other factors. Conversely, the relatively high $(\text{Ca}^* + \text{Mg}^*)$ in Stanley Brook reflects higher weathering rates, and thus indicates terrain that is more susceptible to increases in weathering than are others. We assume an increase factor (F) of 0.2 for the mean $(\text{Ca}^* + \text{Mg}^*)$ for Stanley Brook, the site with the highest mean $(\text{Ca}^* + \text{Mg}^*)$, and an F of 0 for SMP, the site with the lowest mean $(\text{Ca}^* + \text{Mg}^*)$, and use the resulting empirical equation for each analysis in our data:

$$F = .0012 (\text{Ca}^* + \text{Mg}^*) - .0454 \quad (2)$$

This relationship provides each analysis for each site with its

own increase factor (range 0 to 0.48, mean 0.10; reflecting the sensitive nature of ANP waters). This F factor should be proportional to the weathering rate at each site, if our assumption is valid that $(Ca^* + Mg^*)$ is proportional to weathering rate. The F factor should therefore be proportional to dissolved silica concentrations which are largely derived from primary weathering of rock and soil minerals. The relationship is not good for lake samples, where diatoms are utilizing silica, but is quite good for the streams and especially for the first-order brooks (figure 27). The brooks should represent the best application of SiO_2 as an indicator of primary weathering, due to the thinness of soils and to the general lack of erratic (non-granitic) glacial debris at the higher elevation, high relief sites.

With the addition of the variable 'F', our modification of Henriksen's equation is

$$\text{Past Alk} = [0.93 (Ca^* + Mg^*) - 14] - F [(SO_4^*) - b(SO_4^*)] \quad (3)$$

where: $(Ca^* + Mg^*)$ is the modern non-marine sum of Ca + Mg, F is the site specific weathering increase factor proportional to $(Ca^* + Mg^*)$, SO_4^* is the modern non-marine sulfate concentration, and $b(SO_4^*)$ is the estimate of background sulfate $[0.09(Ca^* + Mg^*) + Na^* + K^*]$; Wright, 1983). Finally, we can estimate past pH, based on the theoretical relationship between pH and bicarbonate in water equilibrated with atmospheric CO_2 :

$$pH = 11.3 + \log [HCO_3^-] \quad (4)$$

In practice, the equation is somewhat different from theoretical (Table 14) due to measurement errors, organic acids, and different methods of degassing excess CO_2 .

Our ability to predict current pH (figure 28) and the closeness of fit of Henriksen's equation to our own (Table 14), leads us to believe that Henriksen's model is applicable at ANP. This study is the first that we know of that has applied Henriksen's model to streams or brooks. However, there is no significant difference between the relationships for pH and alkalinity for the streams, brooks, or lakes. Use of stream and brook data in the model may actually be more appropriate than lake data, due to lessened biological alteration of water chemistry in flowing waters, compared to biological action in lakes. Furthermore, moderate changes in our estimates of F, or in background sulfate do not markedly alter the estimates of historical pH or alkalinity, and do not change the apparent trends. For example, empirical data support F values between zero and 0.4 (Henriksen, 1984; 1982; Johnson et al., 1981). Our variable F factor for the MDI granites averages 0.1, compared to the 0.2 chosen by Henriksen (1982; 1983) for Scandinavia. This F factor is in fact, a 'conservative' estimate of F, resulting in an estimate of past alkalinity that is higher than would be obtained with a higher F value (see equation 3). However, calculations using our variable F, and F values of zero and 0.40 yield results that are not significantly different (figure 29). One study (Turk and Peters, 1977) estimated the increase in weathering

Table 14. Empirical relationships for pH and bicarbonate in lakes from various regions of the world. Based on data compiled by Wright (1983) plus this study.

region	regression equation	n	r ²
Adirondack Mtns.	pH = 10.82 + 0.86 log HCO ₃	94	0.87
Rocky Mtns.	pH = 11.25 + 0.86 log HCO ₃	29	0.83
New England	pH = 10.71 + 0.92 log HCO ₃	145	0.87
Quebec	pH = 9.08 + 0.78 log HCO ₃	23	0.84
Norway	pH = 9.57 + 0.77 log HCO ₃	834	0.86
Labrador	pH = 9.75 + 0.79 log HCO ₃	167	0.73
this study	pH = 9.52 + 0.74 log HCO ₃	422	0.81

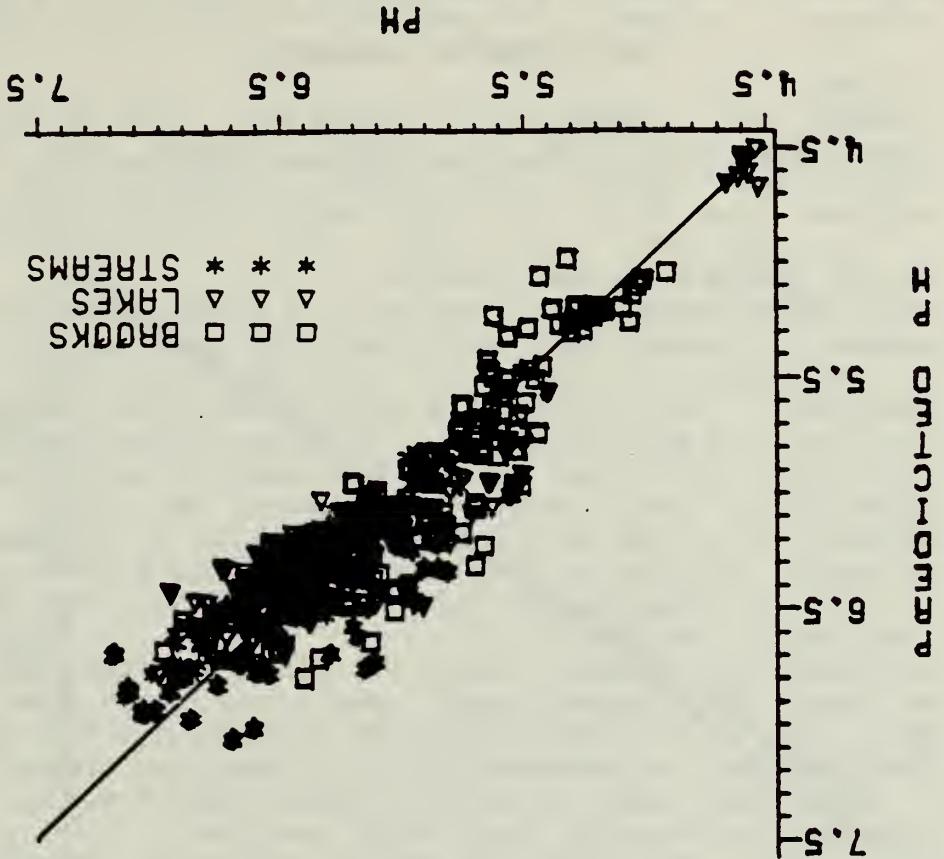
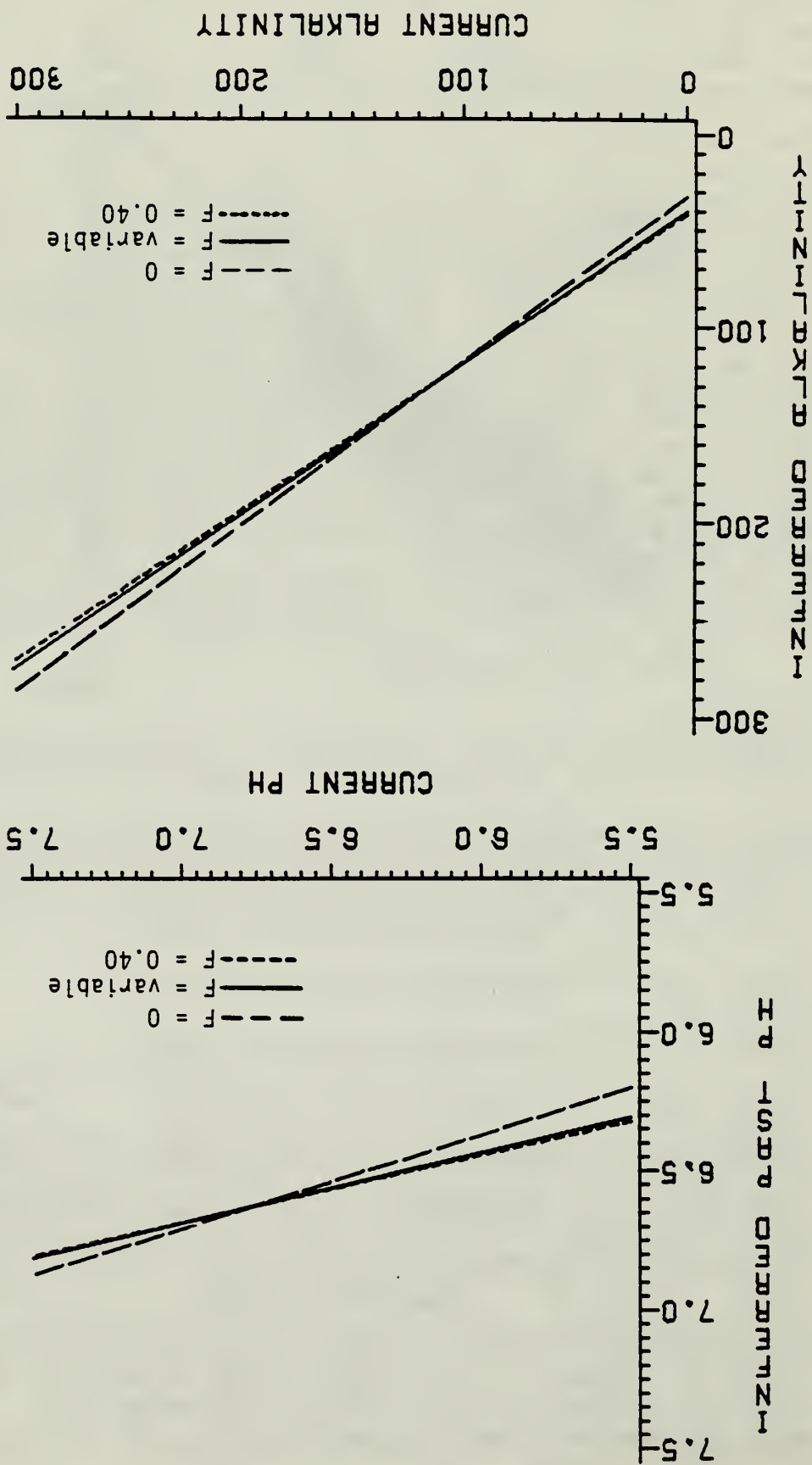


Figure 28. The relationship of predicted pH to current pH, based on the Henriksen model.

Figure 29. The effect of different F factors on inferred past pH and alkalinity, calculated from the modified Henriksen model.



rates to have been 75 percent ($F = 0.75$) in a metasedimentary rock basin in New York. While we consider 0.75 to be on unreasonable F value for granites such as those at MDI, use of this F in the equation results in predicted past alkalinities which are only 16 percent (range 7 to 34 percent) lower than with our variable F. However, if such a high F factor is realistic, the potential impact of acidic deposition is much less than we indicate. Differences between present and inferred alkalinities become smaller, especially in the first-order brooks.

A second inferred variable in the equation is background sulfate. Henriksen (1983; 1982;) assumed a value of 20 $\mu\text{eq/l}$ for Norway. Wright (1983) calculated background SO_4 using the remainder of the ion balance equation not used in the calculation of past alkalinity: $[\text{Ca}^* + \text{Mg}^* + \text{Na}^* + \text{K}^*]$. Wright's estimates of background SO_4 from 14 data sets in northeastern North America range from 24 to 70 $\mu\text{eq/l}$. The estimate of background at ANP using the same equation ranges from 0 to 88 $\mu\text{eq/l}$ (mean of 39). However, if we bracket the range calculated by Wright with a fixed background of 0 and of 70 $\mu\text{eq/l}$ in the modified Henriksen equation, the predicted past pH and alkalinity are again only slightly altered, and the trends are unchanged (Figure 30).

Table 15 and Figures 31 and 32 summarize our inferred past pH and alkalinity data for all sample dates. A complete tabulation of mean predicted pH and alkalinity for individual sites during basaltic conditions is given in Appendix E. There are several conclusions to be drawn from this data:

- 1) In general, modern pH and alkalinity are commonly slightly lower than pre-pollution reconstructed values, although sites with the highest pH and/or alkalinity have apparently remained unaffected, at least during basaltic flow.
- 2) Past lake pH is very close to modern lake pH. Sargent Mountain Pond is the exception with a predicted historical pH of about 5.8, and a modern pH of 4.6, although this decline may not be real, as discussed later. Many of the points above the line in Figure 31 (lower present pH than in the past) were samples taken during the spring.
- 3) In contrast to pH, lake alkalinity has apparently decreased by a mean 22 percent (27 $\mu\text{eq/l}$) with a range of 0 to 50 percent (0 to 56 $\mu\text{eq/l}$). This observation is in agreement with expectations that acidification occurs by initial loss of alkalinity with little change in pH above the equivalence point, followed by a more rapid drop in pH as alkalinity approaches zero (Henriksen, 1980). A possible implication is that some sites may be candidates to experience a pH drop in the future (years to decades). These sites include the ponds above the marine limit, with thin, rocky soils or with very low alkalinities: Bubble Pond and The Bowl are the best examples.
- 4) The small brooks show the only apparent basaltic pH declines (mean 0.48 pH units; range 0 to 0.89) and alkalinity losses (mean = 38%; 32 $\mu\text{eq/l}$; range 14 to 90%; 21 to 52 $\mu\text{eq/l}$). This relationship was anticipated, because small headwater systems should be more vulnerable than lakes or higher-order streams.
- 5) The larger streams are not affected except during spring snow-melt. Perhaps the streams are not particularly impacted by

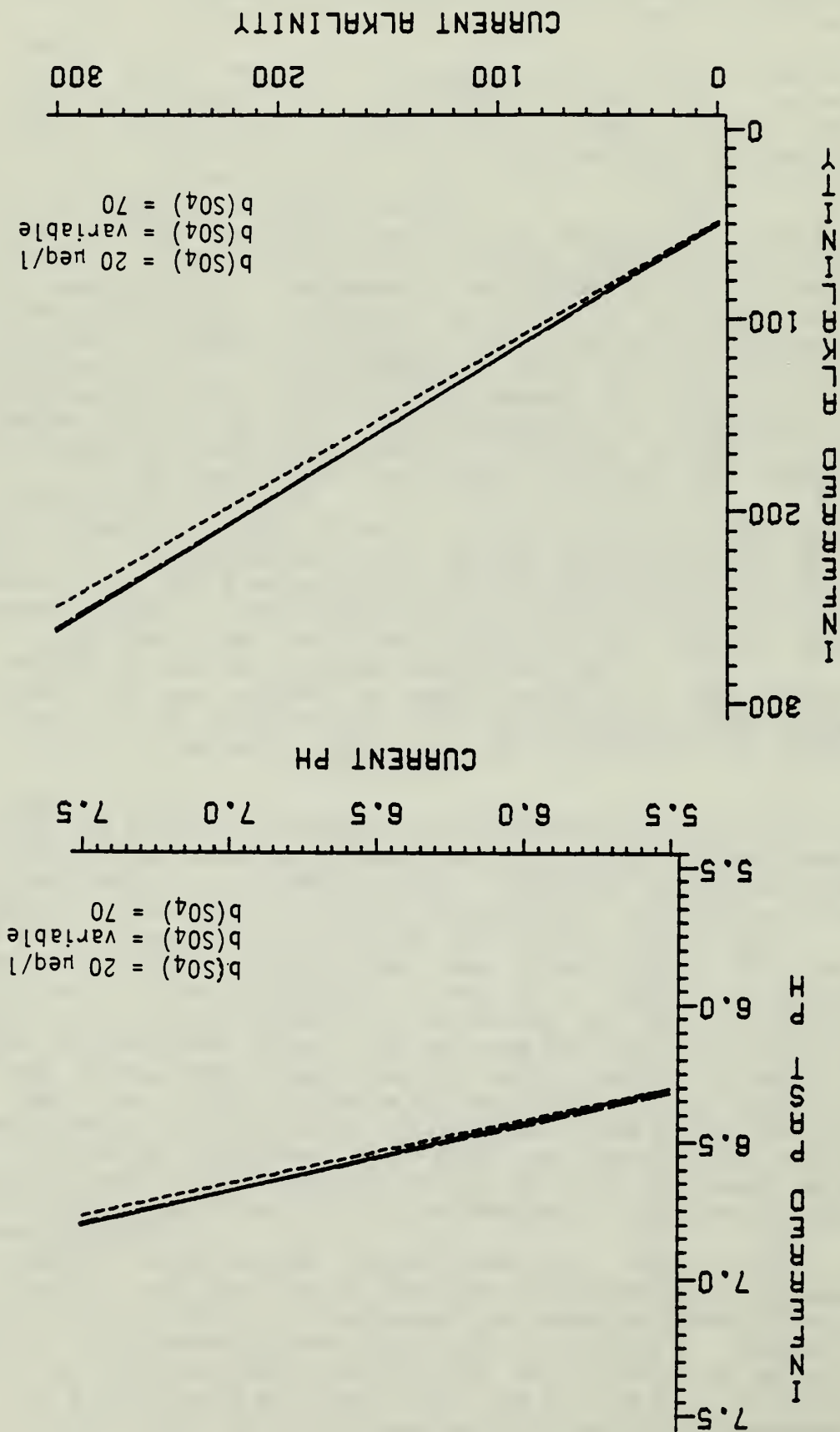


Table 15. The relationship between current and inferred past pH and alkalinity for the major sample types by date, based on a modification of the Henriksen model (1982). Sargent Mountain Pond is not included in the lake means.

Date	(n)	Lakes pH/alk	Past pH/alk	Streams (n=12) pH/alk	Past pH/alk	Brooks (n=11) pH/alk	Past pH/alk
<u>1982</u>							
Oct.	(21)	6.42	6.41	6.47	6.61	-	-
Nov.	(21)	6.35	6.38	6.41	6.51	5.90	48
<u>1983</u>							
Feb.	(5)	6.08	6.43	6.39	6.51	5.92	48
Early March		-	-	6.18	6.43	5.70	21
Mid-March	(5)	5.69	6.36	6.12	6.41	5.66	14
April	(21)	6.34	6.34	6.20	6.43	5.80	24
June	(5)	6.36	6.28	6.52	6.43	6.04	38
July	(22)	6.44	6.36	6.41	6.59	6.09	75
Oct.	(22)	6.39	6.50	6.42	6.70	5.74	41
<u>1984</u>							
Feb. 84	(5)	5.69	6.36	5.98	6.30	5.48	8
Mid-March 84	(5)	5.86	6.41	5.96	6.48	5.28	6
Late March	(5)	5.86	6.40	5.97	6.35	5.58	23
July	(22)	6.40	6.45	6.45	6.58	6.06	63
<u>1985</u>							
Feb. 85	(5)	5.69	6.36	5.98	6.30	5.48	8
Mid-March 85	(5)	5.86	6.41	5.96	6.48	5.28	6
Late March	(5)	5.86	6.40	5.97	6.35	5.58	6
July	(22)	6.40	6.45	6.45	6.58	6.06	63

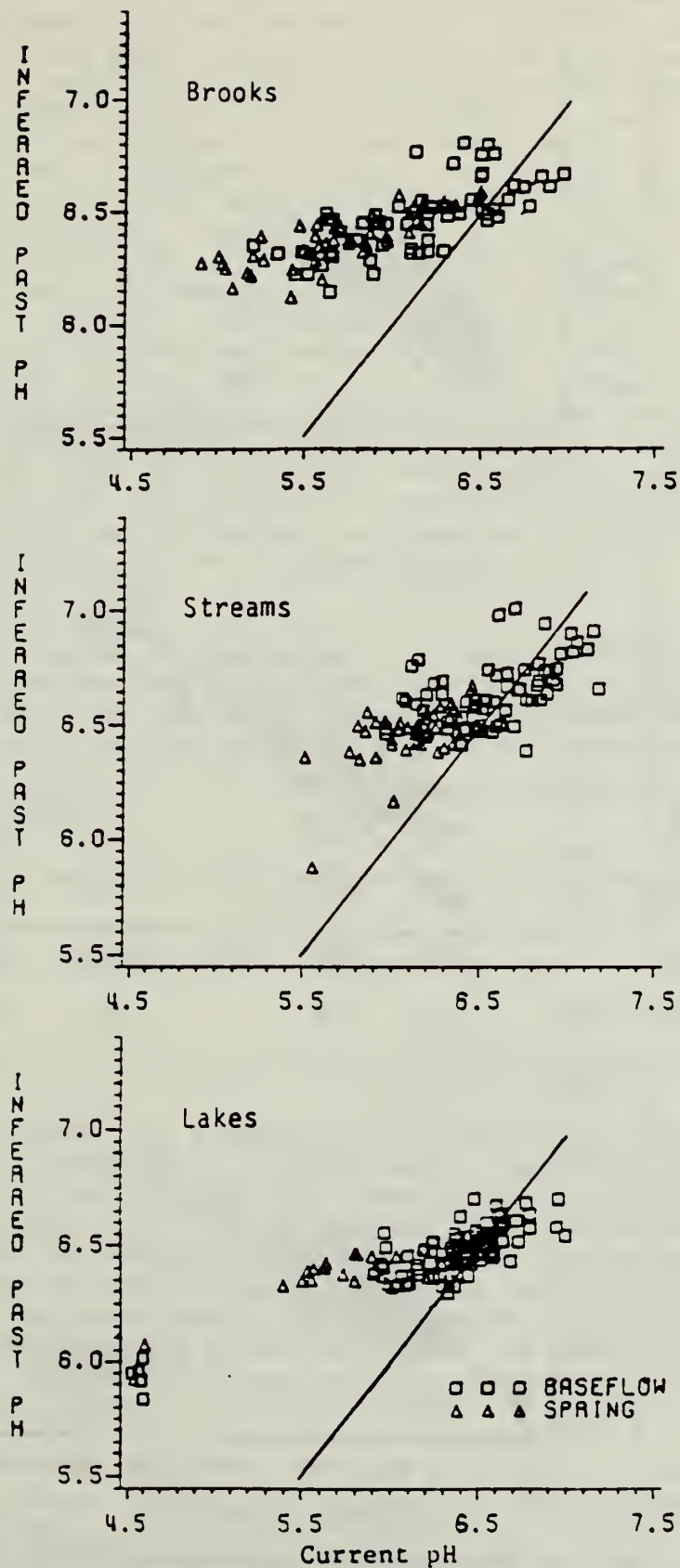


Figure 31. Relationship between inferred past pH, based on the modified Henriksen model, and current pH.

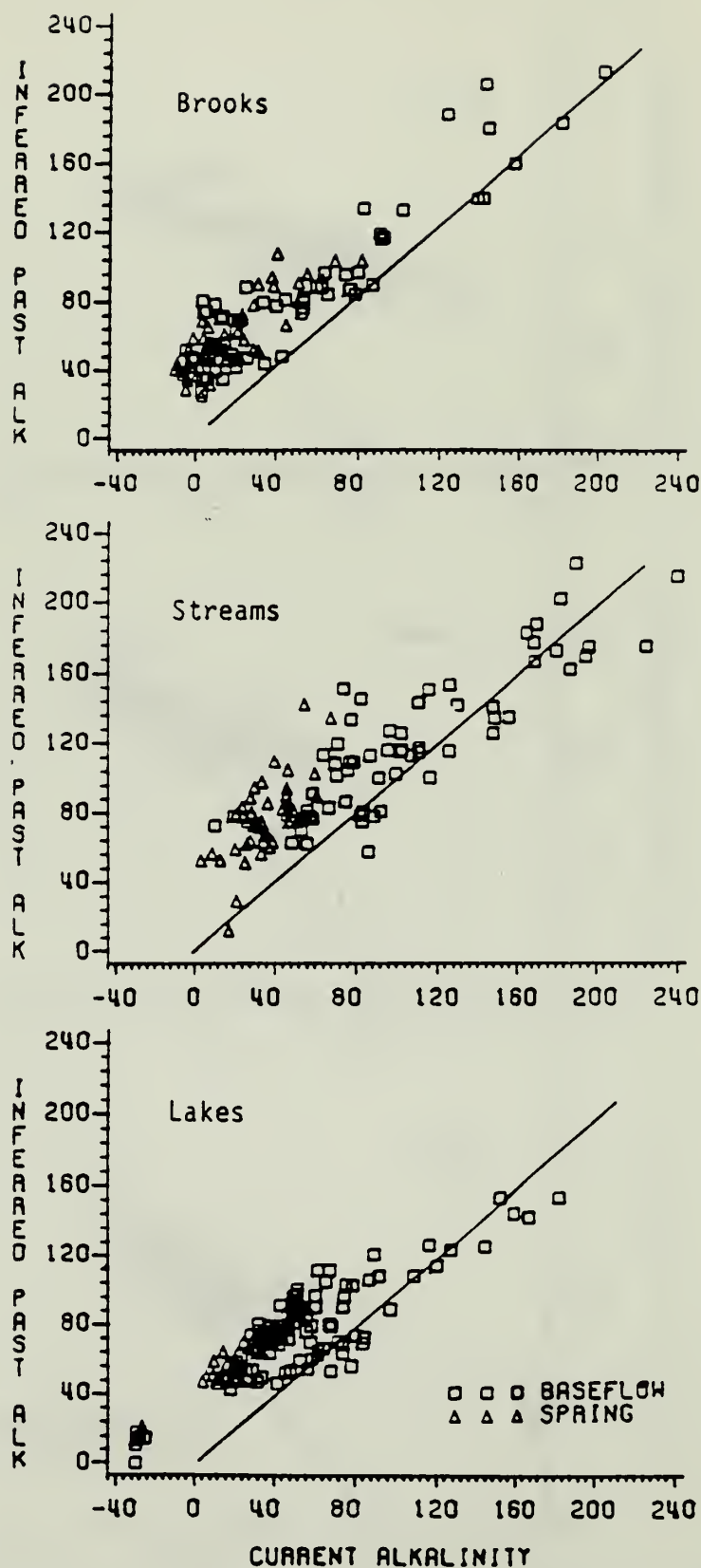


Figure 32. Relationship between inferred past alkalinity, based on the modified Henriksen model, to current alkalinity. Data are in $\mu\text{eq/l}$.

acidic deposition due to a buffering influence of marine sediments at low elevation. Seven of the 12 sampling sites are at less than 30 m elevation and six of these have marine clays in their stream beds, or glacio-marine deposits mapped as the surficial material. During spring snow-melt, when flushing is rapid, these materials may be unable to exert a significant influence on water flowing from upstream sites.

6) An independent estimate of spring snow-melt dilution versus acidification can be calculated from the differences between predicted alkalinities and actual alkalinities during spring-melt (Figure 33). The difference between predicted and actual alkalinity should correspond to 'titration' of HCO_3 if the model is correct. These estimates (Table 16) agree very closely with our previous estimates (Table 8). For example, the alkalinities during 1983 in the lakes, streams, and brooks are 31, 48, and 24 percent, respectively, of their predicted values. These data correspond to 69, 52, and 76 percent loss of alkalinity lost to 'titration'. The analogous values from Table 8 are 70, 40, and 72 percent. These estimates also suggest that acidification by titration was greater in 1984 than in 1983, possibly due to HCl, as discussed previously.

Table 16. Estimates of 'titration' of bicarbonate alkalinity from the Henriksen's model (predicted alk-measured alk = alk lost to titration (ΔH) and from the ΔK (dilution) method (Table 8). Data in percent.

	<u>Lakes</u>		<u>Brooks</u>		<u>Streams</u>	
	1983	1984	1983	1984	1983	1984
ΔK	70%	69%	72%	76%	40%	58%
ΔH	69%	66%	76%	84%	52%	65%
alk/Ca	64%	64%	67%	83%	59%	73%

7) There is a weak direct relationship between calculated loss of alkalinity (Inferred past alkalinity minus present alkalinity) and present day non-marine sulfate ($r^2 = 0.40$; $p > .001$) (Figure 34). This observation supports the possibility that loss of alkalinity has occurred with concurrent increase in SO_4 . The relationship was strongest in the lakes ($r^2 = 0.64$; $p > 0.001$). The relationship between excess sulfate and calculated loss of alkalinity (both estimated variables) seems to be stronger (Figure 34) especially in the streams ($r^2 = 0.68$; $p > 0.001$) and lakes ($r^2 = 0.58$; $p > 0.001$).

Overall, there apparently has been some loss of alkalinity in ANP waters with little change in pH except in SMP and some first-order brooks. However, an important observation is that the pH and alkalinity of some waters seem to be unaffected by acidic deposition. These sites include low elevation streams and ponds in thick glacial

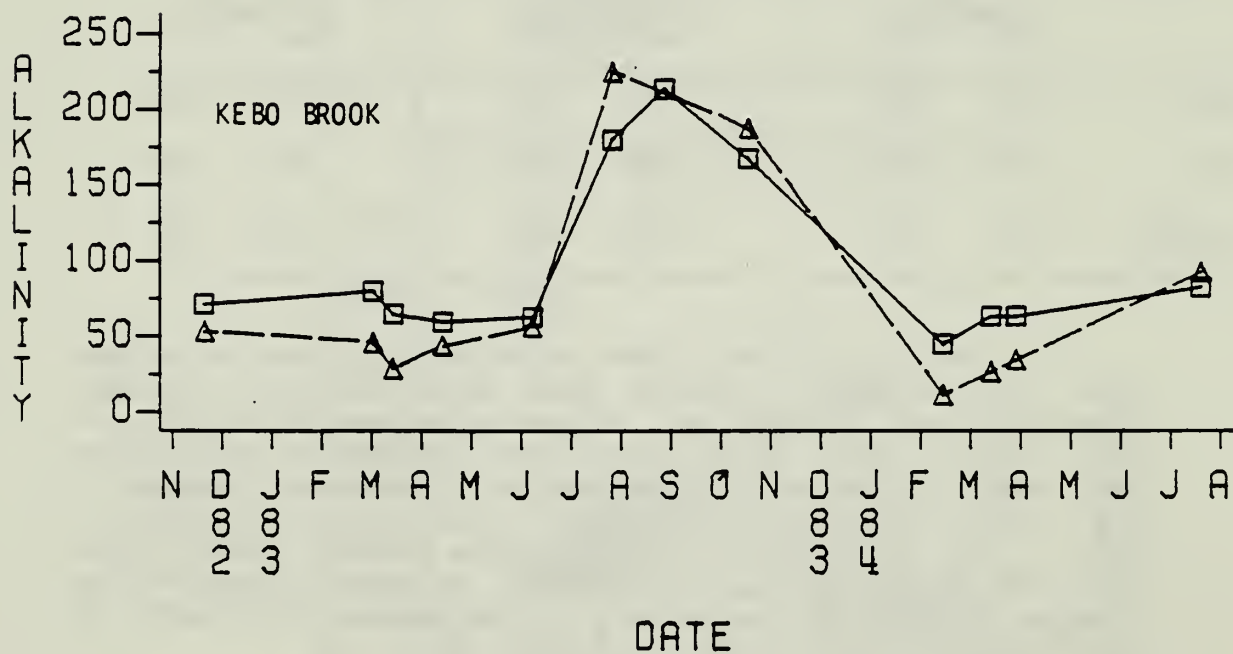
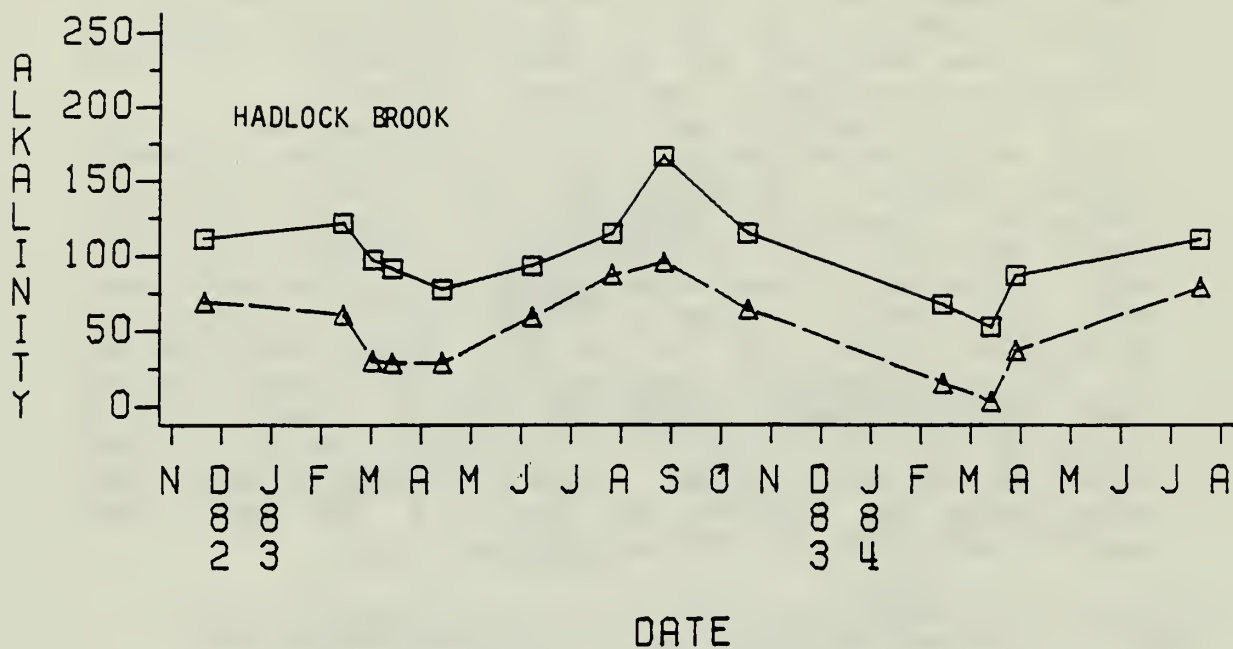


Figure 33. The relationship between current alkalinity (triangles) to predicted alkalinity (squares) on the same dates, based on the modified Henriksen model.

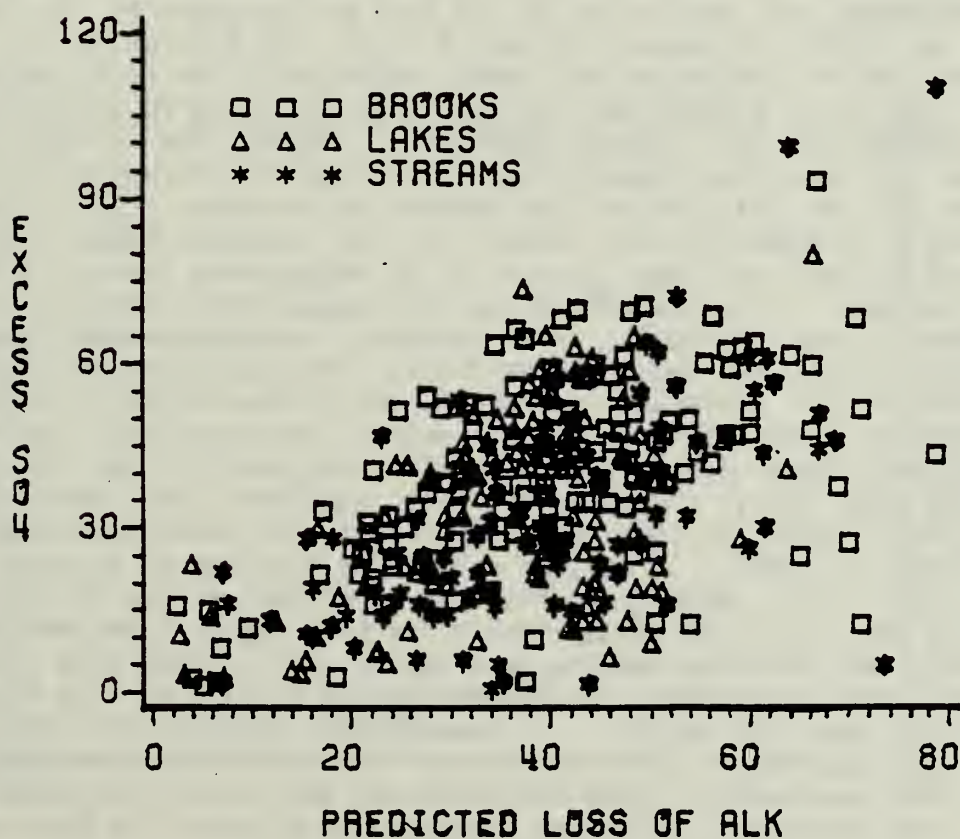
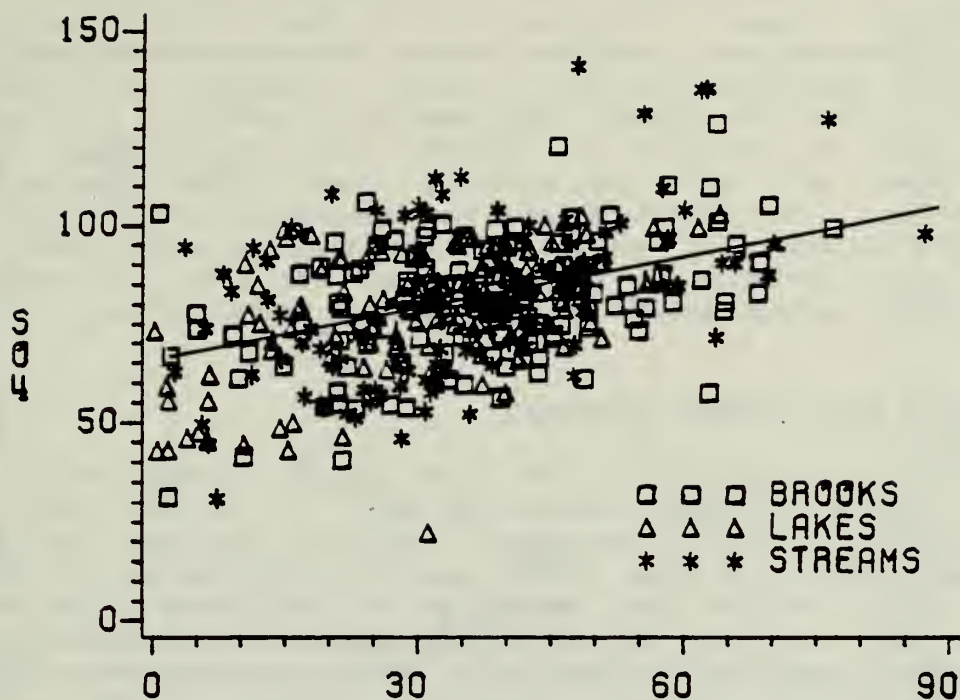


Figure 34. The relationship between current non-marine SO₄ and excess SO₄ concentrations to inferred loss of alkalinity, based on the modified Henriksen model. Data are in $\mu\text{eq/l}$.

cover, or in marine sediments, in terrain that is generally flat. They have large, poorly defined watersheds, resulting in long contact times for soil and groundwaters. We do not believe that the results for these sites represent a failure of the model. Many sites in many geologic terrains will exhibit little or no acidification, even with atmospheric deposition similar to that in eastern North America. Conversely, the few colored waters sampled in this study tend to have lower modern pH relative to inferred past pH, although current alkalinities are not substantially lower than inferred past alkalinities. Interpretation of a Henriksen-type relationship for pH for these waters will overestimate the impact of acidic deposition, due to the influence of organic acids, in spite of reasonable relationships between modern and inferred past alkalinities.

Indications from Sediment Chemistry

The TiO_2 accumulation rate plots for all 3 ponds indicate relatively stable watershed conditions until 70 to 100 years b.p. (Figures 35, 37, 39). Increased TiO_2 flux occurs earliest in Long Pond (ca. 1880), and later in SMP (ca. 1915) and The Bowl (ca. 1910). These results reflect the habitation of Isle au Haut in the 1800's, whereas The Bowl and SMP were less accessible to habitations or development. Logging in the early 1900's, the 1947 fire, and ANP trail development probably account for more recent watershed disturbance indicated by TiO_2 flux in SMP and The Bowl.

The sediment records from all three ponds indicate the beginning of measurable air pollution in the form of increased Pb, Zn, and Cu fluxes by 1870 ± 10 years (Figures 13 to 15, and Figures 36, 38, 40). Increases in Pb accumulation rates occur until the 1960's or early 1970's (Table 7; Figures 36, 38, 40), when declining Pb emissions due to decreased use of leaded gasoline (Lindberg and Turner, 1983) resulted in declining deposition. Although the concentration plots (Figures 13 to 15) reflect the general depositional trends, factors such as a diagenetic iron crust at the sediment-water interface (Figures 13 and 14) may result in an exaggerated decline in metal concentrations. Zinc concentrations and accumulation rates decline at all three sites, although this reflects the pH-dependent chemical mobility of Zn, not declining emissions. The magnitude and depth of the zone of Zn depletion is probably controlled largely by lake pH, sedimentation rate, and to a lesser extent, sediment type. Declining accumulation rates for Zn began in 1970, 1961 and 1944 for Long Pond, SMP, and The Bowl, respectively. The magnitude and depth of the decline are small in Long Pond, consistent with known lake chemistry (pH 6.3-6.4 in 1983). In SMP, Zn deposition declines by a factor of 5 since 1961. This marked decline is consistent with a low lake pH. However, declines in Zn deposition in The Bowl begin in sediment dated at 1944, and the rates decline by a factor of 3. These data from The Bowl are not consistent with modern lake pH (6.33), or with inferred historical lake pH (6.36). A speculation is that the 1947 fire altered Zn cycling in soils or altered the flora, which decreased the input into sediments. Some birch species are known to accumulate Zn (Young and Carpenter, 1967). The abundance of birch at The Bowl may be partly responsible for the sediment profile.

Declining concentrations of Ca relative to other constituents

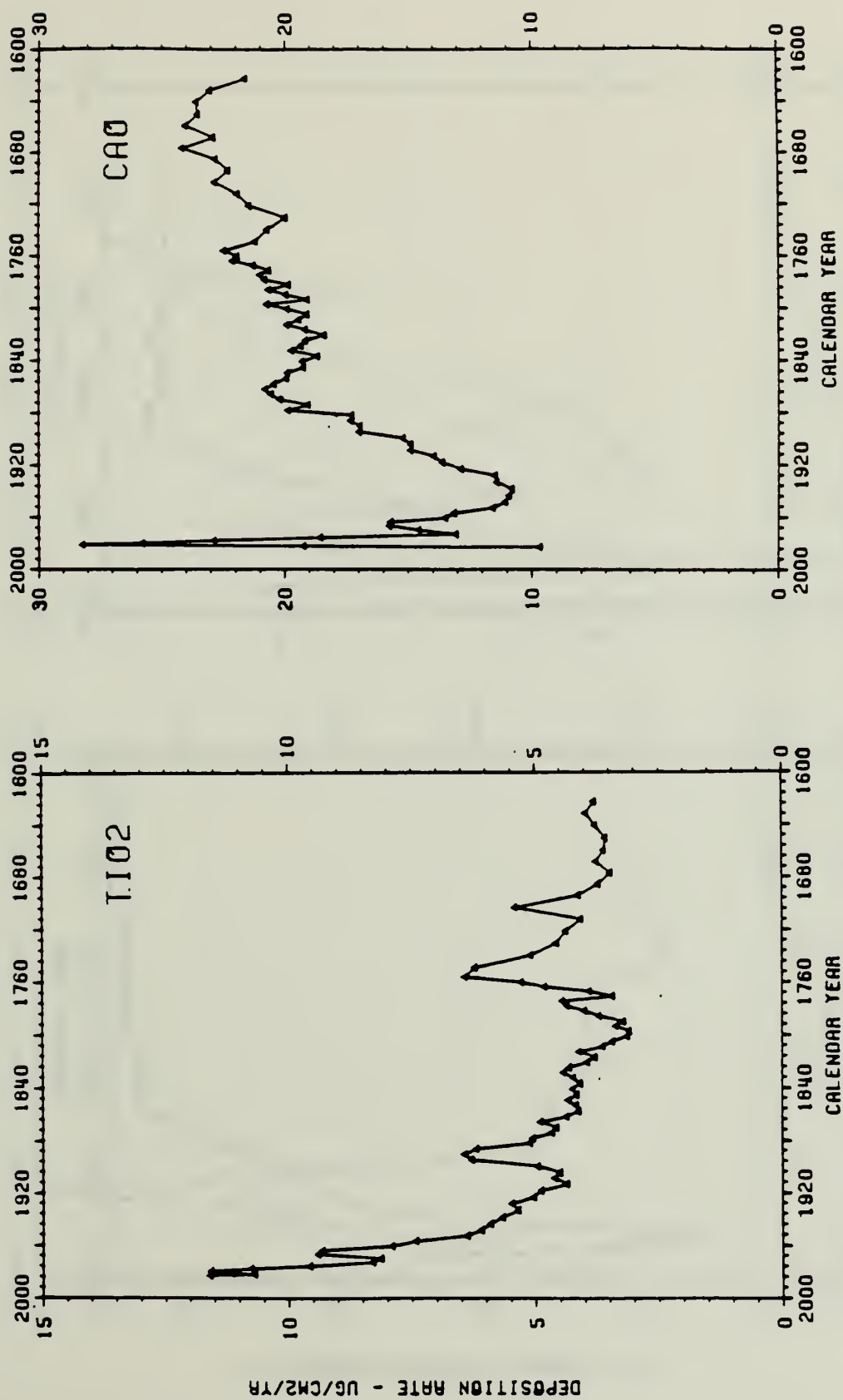


Figure 35. Net accumulation rates of TiO_2 and CaO in the sediments of Sargent Mountain Pond.

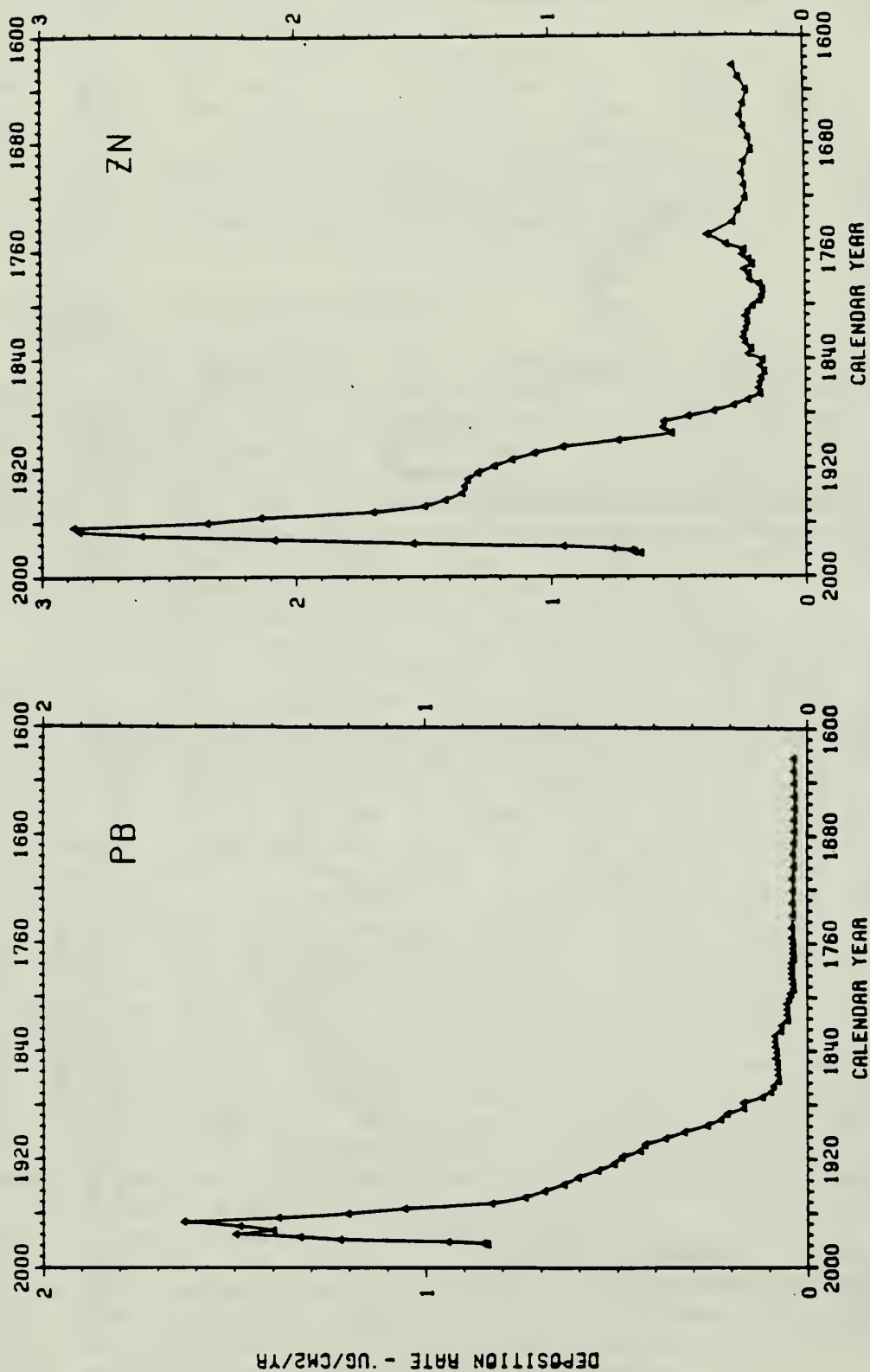


Figure 36. Net accumulation rates of Pb and Zn in the sediments of Sargent Mountain Pond.

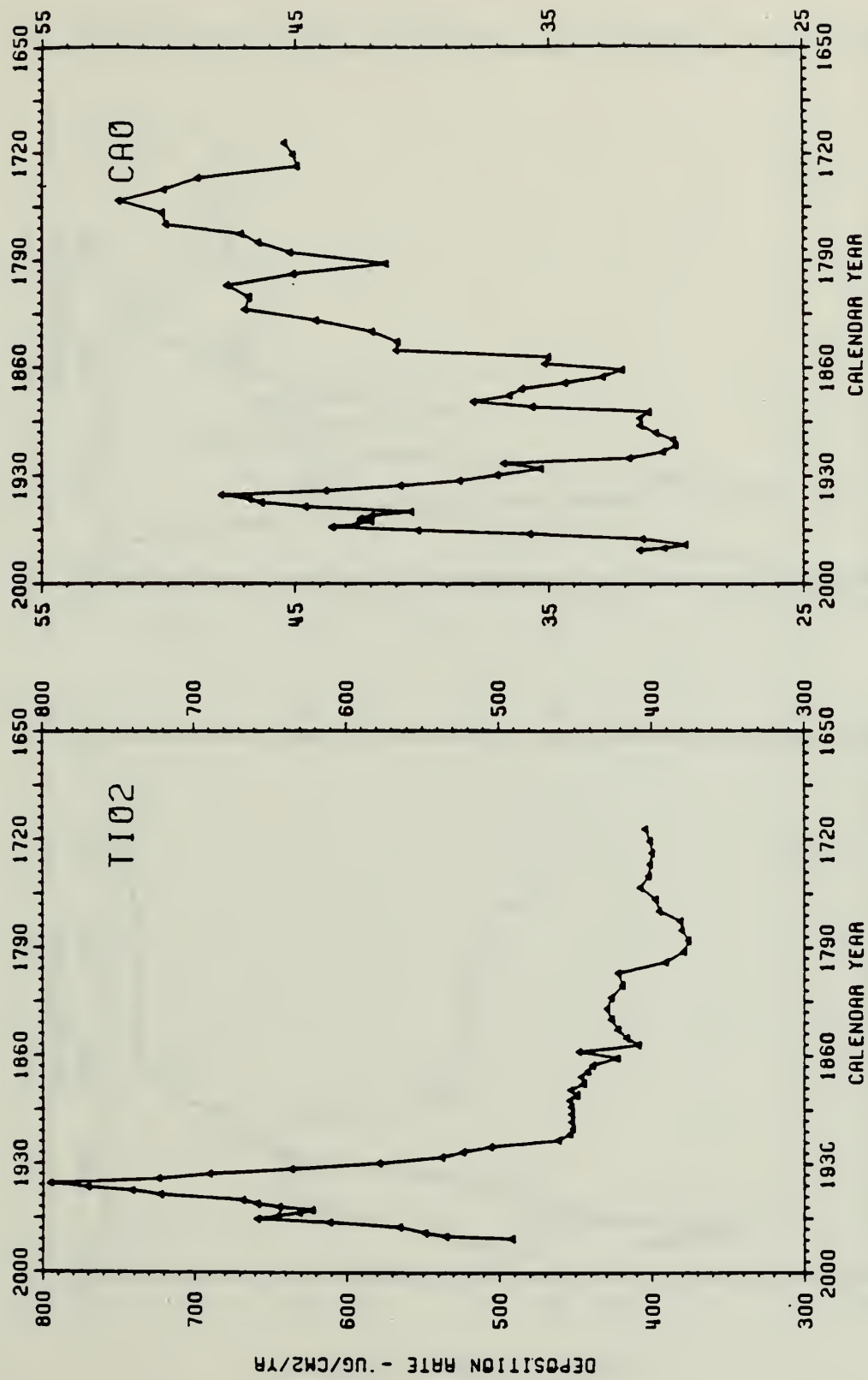


Figure 37. Net accumulation rates of TiO_2 and CaO in the sediments of The Bowl.

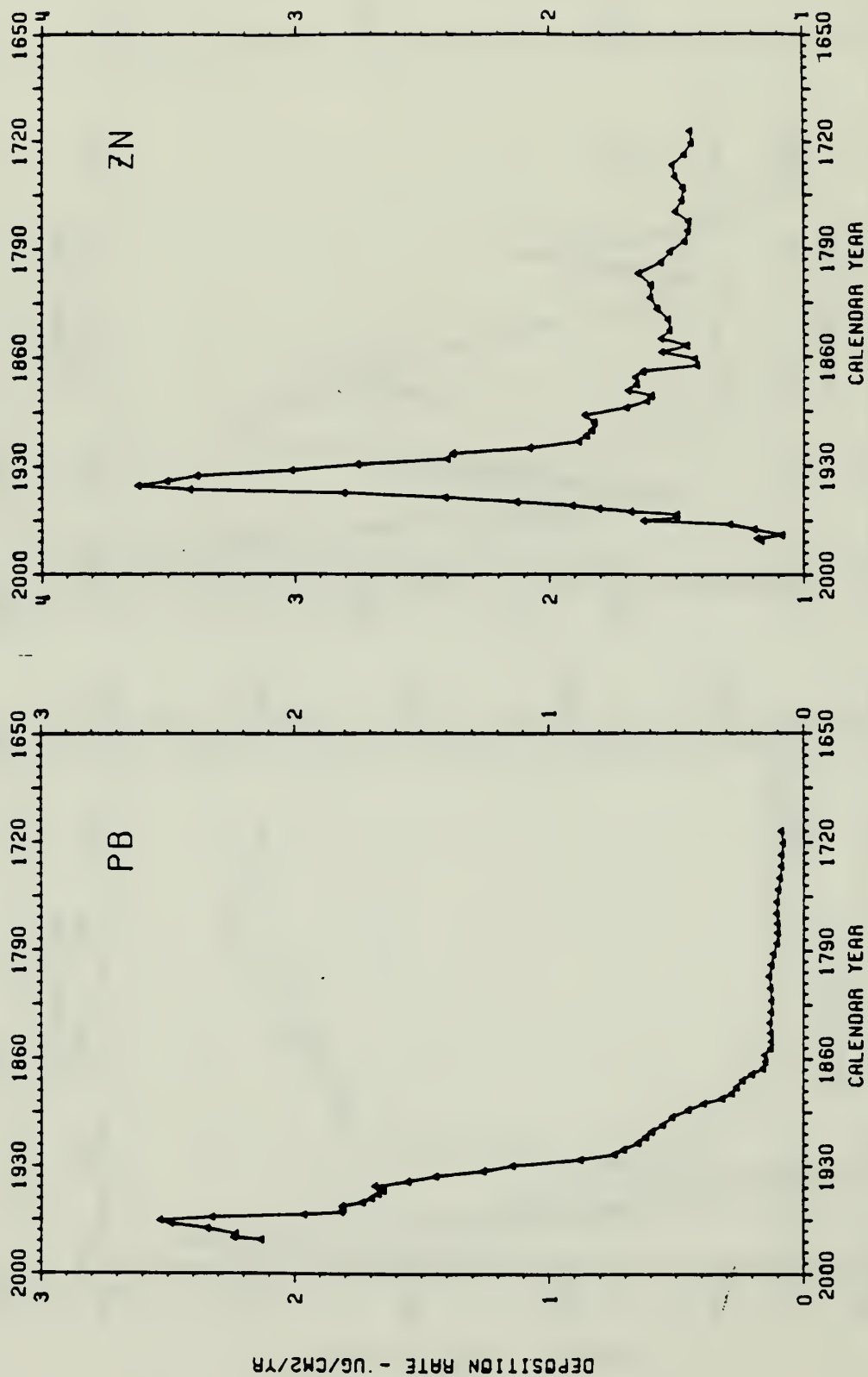


Figure 38. Net accumulation rates of Pb and Zn in the sediments of The Bowl.

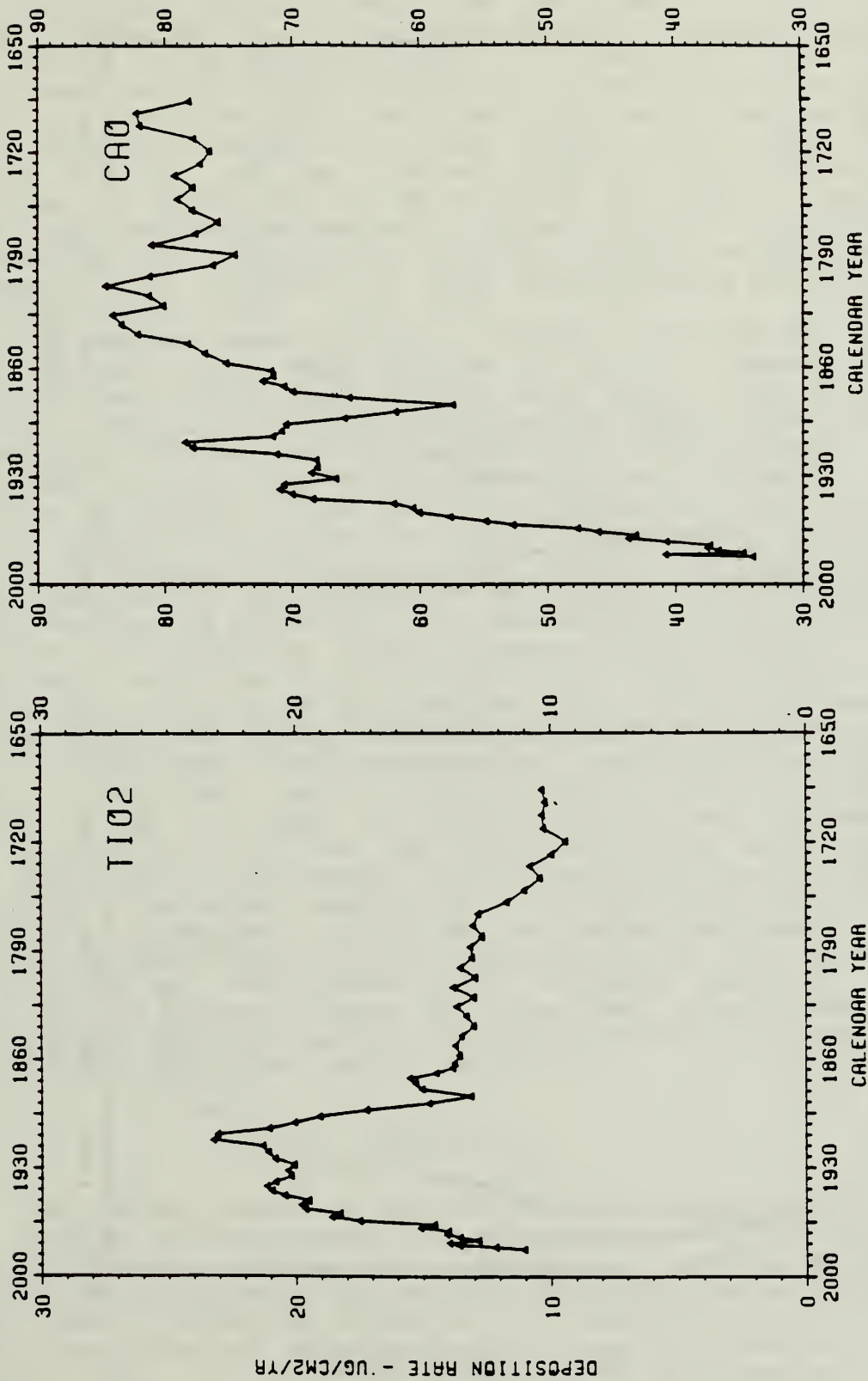


Figure 39. Net accumulation rates of TiO_2 and CaO in the sediments of Long Pond.

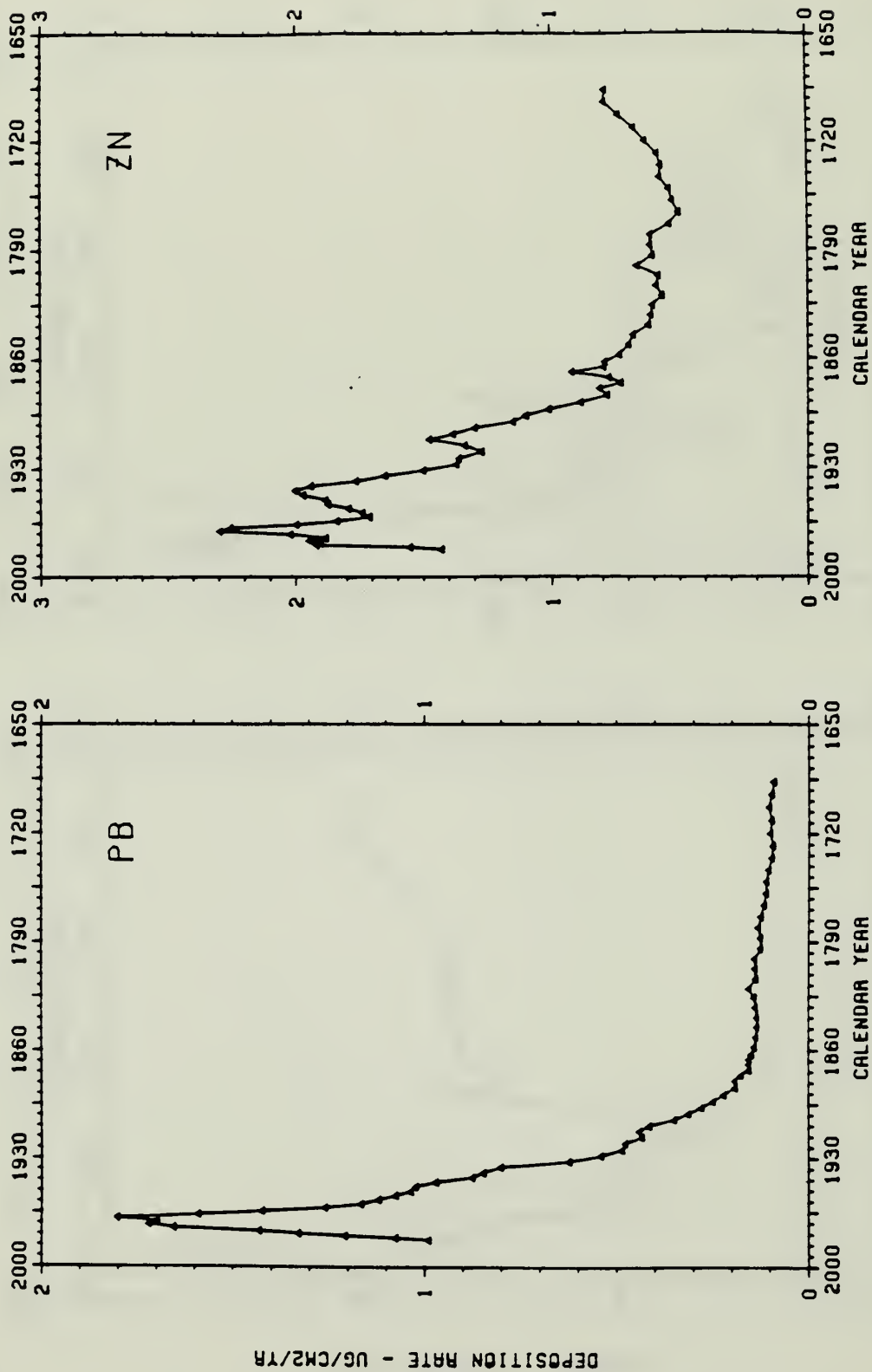


Figure 40. Net accumulation rates of Pb and Zn in the sediments of Long Pond.

(especially TiO_2) have been interpreted as an indicator of acidification (Norton et al., 1980; Kahl and Norton, 1983). However, this interpretation of the declining concentrations from all three ponds during the past 120-300 years may be misleading. In the Long Pond sediments, declines in deposition rates occur only in the past 20 years (Figure 39), and may be related to inputs of leached detritus. The decline in Ca deposition began in the late 1800's in SMP (Figure 35), consistent with a postulated gradual long-term acidification, and with modern lake chemistry. The Ca deposition record from The Bowl is much less clear. Deposition rates decline beginning in the mid-1800's (Figure 37), but increase in the early 1900's. A peak in deposition is dated at about 1947, and may be related to the fire. Since that time, the trend has been downward. The early decline in Ca deposition suggests an early sensitivity to acidification. Perhaps natural changes or the influences of fires have maintained the lake pH at elevated values.

The Henriksen model predicts a historical pH for SMP that is more than one unit higher than measured (5.8 vs 4.6). However, SMP had little buffering capacity (predicted alkalinity of about 10 $\mu\text{eq/l}$), and may have been acidified slowly over at least the past century. Alternately, SMP may have always been acidic. The vegetation in the watershed is largely softwoods growing in thin histosols, often directly on bedrock. Such soils are typically very acidic, with little capacity to generate alkalinity. Furthermore, the pond is partly surrounded by bog and other acidophilic vegetation. A comparison can be made between SMP and a small colored acid bog pond (Duck Pond) on the west side of MDI, representing the end of the color spectrum from clearwater lakes. The model predicts a pH of 6.22 for this pond, which has a pH of about 5.0. We think that this site represents a failure of the predictor model, due to the presence of organic acids and perhaps base-cation uptake by sphagnum. Although SMP is not dystrophic, the surrounding bog vegetation is comparable to that of Duck Pond. We feel that while SMP has probably become more acidic during the past 100 years, the pond had a pre-acidic precipitation pH less than the 5.8 predicted by the model, and thus the magnitude of acidification by acidic deposition is much less than indicated. Preliminary examination of diatom populations in the sediment core suggest that pH has not changed significantly in SMP during the approximately 300 years represented by the core (M. Whiting and D. Anderson, pers. comm.). An intriguing hypothesis is that pre-industrial organic acidity may have been replaced recently by strong acid acidity, resulting in the clarification of waters that were formerly humic (Davis et al., 1985).

CONCLUSIONS

The natural waters at Acadia National Park are all sensitive to the effects of acidic precipitation, due to generally thin soils and granitic bedrock. However, the presence of scattered thick till deposits and glaciomarine sediments has lessened the vulnerability for many sites. Whereas pH is generally well above 6.0, alkalinities are low. Alkalinity and pH measurements, and calcite saturation indices predict that all sites are vulnerable to acidification. This vulnerability is manifested seasonally during spring snow-melt, when

40 to 76 percent of alkalinity is lost to input of strong acids, rather than simply to dilution by increased run-off.

Indirect methods and incomplete historical data suggest that pH has not changed significantly during the past 50 years, except perhaps in the smaller headwater first-order brooks. Sargent Mountain Pond is currently acidic, but the site probably never had significant alkalinity, and it may have been acidic for more than 200 years. Alkalinity, for which historical data do not exist, may have decreased at some sites, with greater decreases in some lakes and in the first-order brooks, than in the lower elevation second-order streams. If the trend toward lower alkalinities is real, it is inferred to have begun as much as 120 years ago, based on the sedimentary record of air pollution, and on major element sediment chemistry, especially in SMP. However, we cannot predict whether the rate of change, if any, has been constant, making prediction of the timing of possible future trends impossible. There is no correlation between pH and modern sulfate concentrations, although the deposition of strong acids is presumed to be largely responsible for any changes. The relationships of 1) the sulfate-fraction of total non-marine anions to alkalinity; and 2) non-marine sulfate and excess sulfate to inferred loss of alkalinity, indicate that addition of sulfate to surface waters has resulted in loss of alkalinity.

Total Al concentrations are generally low (< 100 pPb) in a majority of waters at ANP. Sargent Mountain Pond, a few streams below the marine limit with $\text{pH} \geq 6$, and a few first-order brooks, have higher Al concentrations. Sargent Mountain Pond has a mean pH of 4.58 and Al concentrations of 200 to 400 pPb. The relatively high Al in the streams below the marine limit seems to be related to marine sediments in the watersheds. Aluminum speciation studies demonstrated that much of this Al is non-labile, probably bound as organic-Al complexes. At all sites except SMP, the labile Al concentrations are well below toxic limits for fish. Sargent Mountain Pond is fishless, but contains an abundance of zooplankton, aquatic insects, and other invertebrates. Due to its small size and location at the top of a Mountain, the pond may never have had a natural fish population.

Given our current understanding of geochemical processes, deposition of strong acids cannot continue unabated without deterioration of aquatic resources. However, the timing of effects may be on the order of years, or it may be centuries. Some soils at ANP seem to have large acid neutralizing capacity, whereas some sites are more sensitive. For example, some of the second-order streams have modern alkalinities equal to, or higher than, predicted historical alkalinities. The soils of these lower elevation sites are generally Inceptisols that have developed on thick overburden and/or in part in marine sediment soil precursors. However, higher elevation, steep gradient brooks have apparently undergone some loss of alkalinity during the past century, as have some lakes. The soils in these catchments are generally Histosols or Spodosols, which provide little acid neutralizing capacity, or possibly even contribute to surface water acidity. These sites, especially the first-order brooks, are the waters most vulnerable to the effects of acidic deposition.

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Appendix A. Quality Assurance

All water and sediment analyses were performed in the Geological Sciences laboratory at the University of Maine at Orono, except for silica and during 1982 and part of 1983, when anions were analyzed on a Dionex model 16 ion chromatograph in the Department of Botany. Silica was analyzed on a Jarrel-Ash Inductively Coupled Plasma Spectrophotometer in the analytical laboratory in the Department of Plant and Soil Sciences. Quality assurance results are listed in Table 1A. All procedures have been refined from manufacturer's methods, and are as follows:

pH: The pH of water samples was measured with an Orion 701A digital meter equipped with Ross, liquid-filled combination glass electrodes, or with a Digi-sense LCD meter with Fisher gel-filled electrodes (field pH). Room temperature samples were decanted into a 100 ml beaker and gently agitated. Gentle agitation and recording of pH continued until two readings spaced approximately 30 seconds apart were identical. Meters were calibrated with pH 7.00 and 4.01 NBS certified buffers before each set of measurements. Additionally, electrode performance in low ionic strength water was verified by analysis of pH 4.0, 4.7 and 5.3 standardized acids. The standardized acids are prepared from appropriate dilutions of 0.020 N titration acid.

Alkalinity: Alkalinity was determined by inflection point titration (Stumm and Morgan, 1981) with 0.0200 N acid which had been standardized with potassium phthalate. Typically, 10 to 12 titration points were determined between pH 5.0 and 3.9. Titrations were re-done if the correlation coefficient of the linear portion of the Gran plot was less than 0.998. Typically, more than 70 percent of our correlations were 1.000.

Specific Conductance: Specific conductance was measured with a YSI Salinity-Conductance-Temperature meter. The meter was calibrated daily with standardized KCl solution, and with the internal standard.

Color: Color was determined by comparison of unfiltered water samples with chloroplatinate color standard.

Cations: Sodium and K were determined with air-acetylene flame atomic absorption spectrophotometry (AAS). Calcium and Mg were determined by nitrous oxide-acetylene flame AAS. Samples are aspirated directly into the instrument. Aluminum (total and ion-exchanged fractions) was determined by graphite furnace AAS. Element standards are prepared in our laboratory from ACS reagent grade chemicals or from atomic absorption reference standards. The instrument is calibrated before analysis of each set of samples for each element. Standards are rechecked every 10-20 samples on flame and every 2 to 6 samples on furnace, and recalibration is performed as needed.

Anions: Sulfate, nitrate, and chloride were measured by ion chromatography (IC), using sodium bicarbonate/carbonate eluent. Standards are prepared from reagent grade chemicals. The instrument

is calibrated with 4-7 standards at the start of each run, and 1-2 standards are run every hour of machine time. At least 3 EPA reference standards are run each day.

The determination of analytical ion balance (the ratio of [sum of cations/sum of anions]) was used as a measure of the overall validity of a water analysis. While the true value of this ratio is always 1.0, accurate and precise analyses will yield ratios not equal to 1.0 for at least two major reasons. First, errors are introduced by a lack of knowledge of the speciation of an element. For example, Al will usually be complexed in part by hydroxide and organics, and the charge may range from +3 to -1. Second, organic anions are generally not quantified, and are generally ignored. Their presence also causes a decrease in the slope of the Gran plot titration curve, resulting in an unknown underestimation of the true alkalinity. These factors typically result in analyses that have slightly positive ion balances. The mean ratio of [sum of cations: sum of anions] was 1.05 for the 536 samples reported here (Figure A-1). We believe that a major part of this bias was due to the factors listed above, for the following rationale: The only chemical parameters that correlated with the ratio of cations to anions were total Al ($p > .05$) and water color ($p > .01$). The implication is that higher Al concentrations or greater color (high organic carbon concentration) resulted in a more positive ion balance, due to chelation of chemical species, while we report those species as though they have monomeric equivalent charges, or due to the existence of unmeasured negative charge as organic anions.

Table A1. Analytical procedures and quality assurance results.

Parameter (Method)	Precision	Mean Bias
<u>Water Samples</u>		
pH (Meter)	± 3%	± 3%
Specific Conductance (Meter)	± 5%	± 10%
Alkalinity (Gran Titration)	± 5%	± 4%
Color (Platinum/Cobalt Standard)	± 2%	± 2%
Aluminum (Graphite Furnace AAS)	± 8%	± 1%
Calcium (Flame AAS)	± 1%	± 1%
Magnesium (Flame AAS)	± 2%	± 2%
Potassium	± 2%	± 1%
Flame AAS)	± 1.66	± 1%
Sodium (Flame AAS)	± 1%	± 1%
Silica (ICP)		
Manganese (Graphite Furnace AAS)	± 6%	± 5%
Zinc (Flame AAS)	± 10%	± 10%
Chloride (Ion Chromatography)	± 3%	± 1%
Nitrate (Ion Chromatography)	± 6%	± 3%
Sulfate (Ion Chromatography)	± 5%	± 1%
<u>Sediment Samples</u>		
CaO	± 1	± 2
MgO	± 5	± 1
K ₂ O	± 5	± 4
Na ₂ O	± 1	± 4
Al ₂ O ₃	± 4	± 2
FeO	± 5	± 2
TiO ₂	± 4	± 1
Pb	± 4	± 8
Zn	± 1	NA
Cu	± 5	NA

$$\text{Precision} = \frac{2 \times \text{std dev}}{\text{Mean Value}} \times 100$$

$$\text{Bias} = \frac{(\text{Mean value}) - (\text{reference value})}{\text{Reference value}} \times 100$$

using EPA or USGS standards, or spike recoveries.

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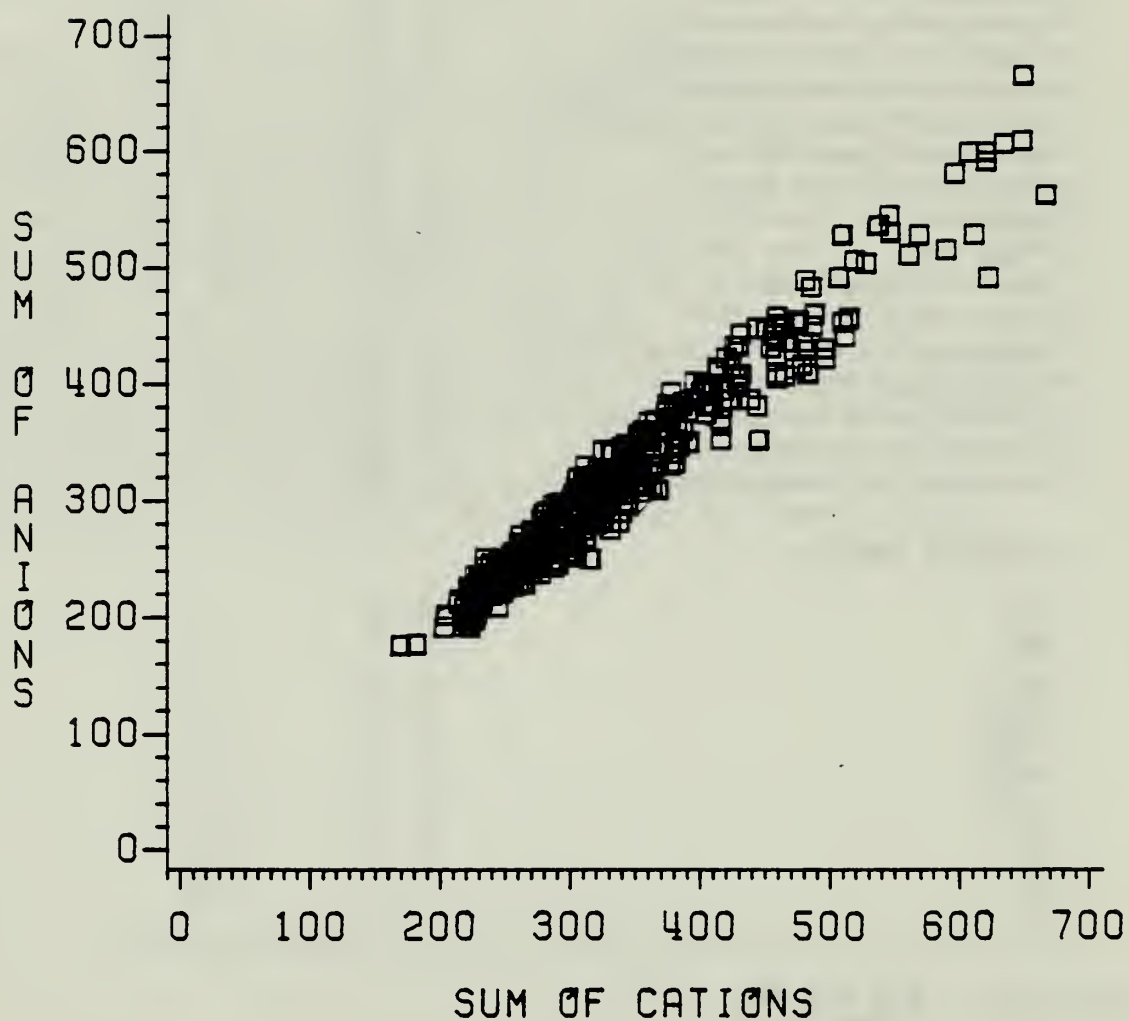


Table A-1. The relationship of the sum of anions to the sum of cations.

Appendix B. Vegetation types associated with sample sites

Site	Vegetation Type
Aunt Betty Pond	Northern hardwood with mixed conifers and large white pine.
Bear Brook Pond	Birch-aspen forest.
The Bowl	Birch-aspen forest with many bog and acid-loving plants, especially on the south and west side of the pond.
Breakneck Brook	Birch-aspen forest with conifers (pine, spruce, and cedar), ferns, and grasses on the bank.
Bubble Pond	East side predominately northern white cedar forest with bands of birch-aspen forest; west side predominately red oak forest with some mixed northern hardwood forest.
Bubble Brook	Predominately mixed hardwoods (birch, beech, and maple) on the west shore and spruce and hemlock on the east shore (ANP vegetation maps list as spruce-fir forest).
Canon Brook	
Canon Brook (Route 3)	Birch-aspen forest with red maple and spruce near the stream.
Canon Brook (Cadillac)	Northern white cedar forest with moss on rocks in the stream and on the bank.
Canon Brook (Dorr)	Northern white cedar forest with moss on the bank.
Canon Brook (West)	Northern white cedar forest.
Cromwell Brook	Sphagnum-sedge bog and a few woody bog plants.
Duck Brook	Birch-aspen forest with white pine and mixed hardwoods.
Eagle Lake	Predominately mixed northern hardwood forest and mixed conifer forest with areas of mixed hardwood-conifer forest.
Eagle South Inlet	Mixed conifer forest with moss on the bank.

Eagle East Inlet	Northern hardwood forest, predominately beech.
Eagle Inlet (North)	Northern white cedar forest and birch-aspen forest mixed with many conifer species.
Eagle Inlet (South)	Northern white cedar forest and birch-aspen forest mixed with many conifer species.
Echo Lake	Predominately birch-aspen and spruce-fir forests.
Hadlock Pond (Lower)	Two-thirds spruce-fir forest and one-third northern white cedar forest.
Hadlock Pond (Upper)	Predominately spruce-fir forest with more hardwoods at the northern end of the pond.
Hadlock Brook	Mixed hardwood-conifer forest; dense canopy with moss ferns, moss and other shade-loving ground covers.
Gilmore Brook	Predominately spruce and hemlock with a mixture of hardwood species (ANP vegetation map list as spruce-fir forest) and ferns and moss along the bank.
Parkman Brook	Mixed conifer forest with hardwoods.
Penobscot Brook	Spruce and mixed hardwood species (ANP vegetation maps list as spruce-fir forest); canopy more open than Gilmore with moss and ferns and many acid-loving species.
Heath Brook	Sphagnum-sedge bog into birch-aspen forest.
Hodgdon Pond	Predominately spruce-fir forest, but sphagnum-sedge bog habitat near sample site.
Hunters Brook	Spruce-fir forest with moss on the bank.
Jordon Pond	Predominately spruce-fir or northern hardwood forests.
Kebo Brook	Hemlock forest with birch-aspen forest upstream (ANP vegetation maps list as white pine forest) and moss on the bank.
Lake Wood	Predominately northern hardwood and birch-aspen forests.

Little Harbor Brook	Spruce-fir forest and moss on the bank.
Little Long Pond	Predominately hardwoods, especially oaks, with spruce-fir forest at the northern end of the pond.
Long Pond	Predominately mixed hardwood-conifer and birch-aspen forests with some spruce-fir forest.
'Reservoir' (Western Mtn. Brook)	Spruce-fir forest with greater than average hardwoods in open area near the water.
Round Pond	Predominately spruce-fir and mix hardwood-conifer forests with some bog areas.
Sargent Mt. Pond	Spruce-fir forest with many bog and acid-loving plants, especially on the west shore.
Seal Cove Pond	Mixture of several conifer and hardwood forest types and developed areas.
Stanley Brook	Predominately spruce and red maple (ANP vegetation maps list as mixed conifer and red oak forests) with moss on the bank.
The Tarn	Birch-aspen forest.
Witch Hole Pond	Sphagnum-sedge bog surrounded by birch-aspen forest.

Appendix C: Chemical parameters for monitored sampling sites and the monitored sampling sites and the major streams, from October, 1982 to July, 1984.

Abbreviations listed on graphics correspond to the following sites (see Table 3 and Figure 3):

Canon Brook: Cadl = Canon Brook-Cadillac branch
 Canon = Canon Brook-Route 3 site
 Dorr = Canon Brook-Dorr site
 West = Canon Brook-west branch

Upper Hadlock Pond: Gilm = Gilmore Brook
 Park = Parkman Brook
 Hadl = Hadlock Brook
 Pen = Penobscot Brook

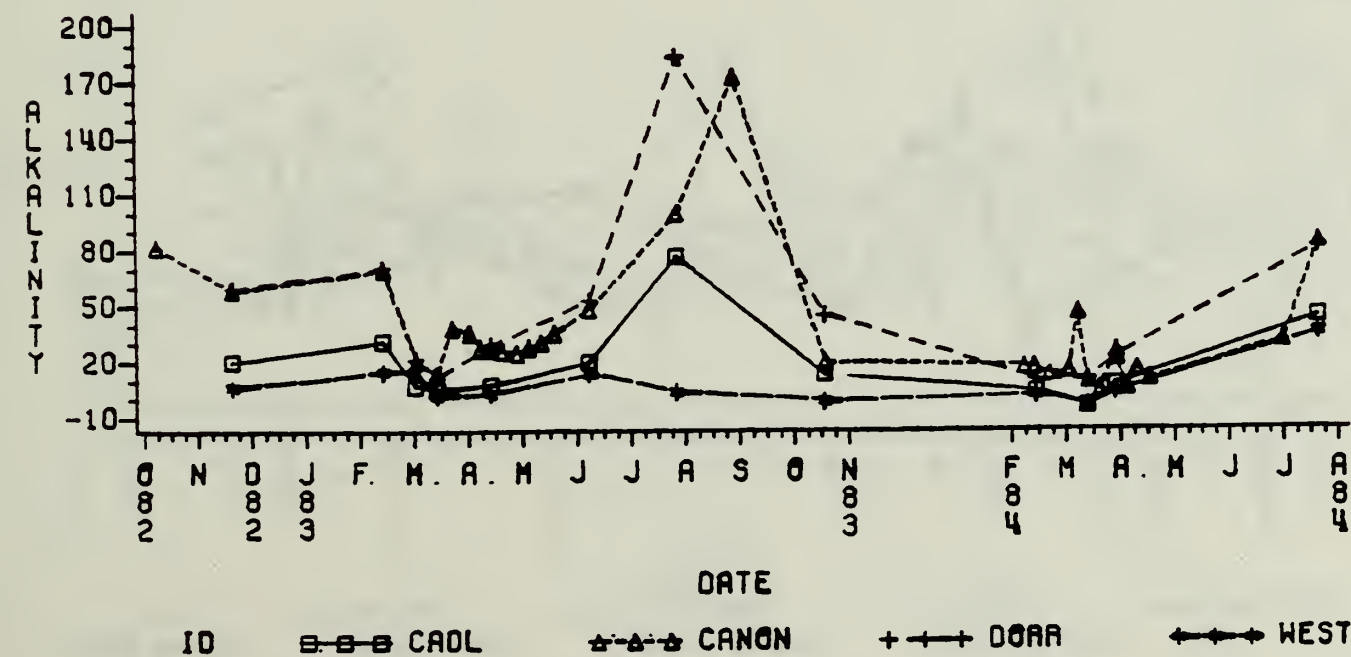
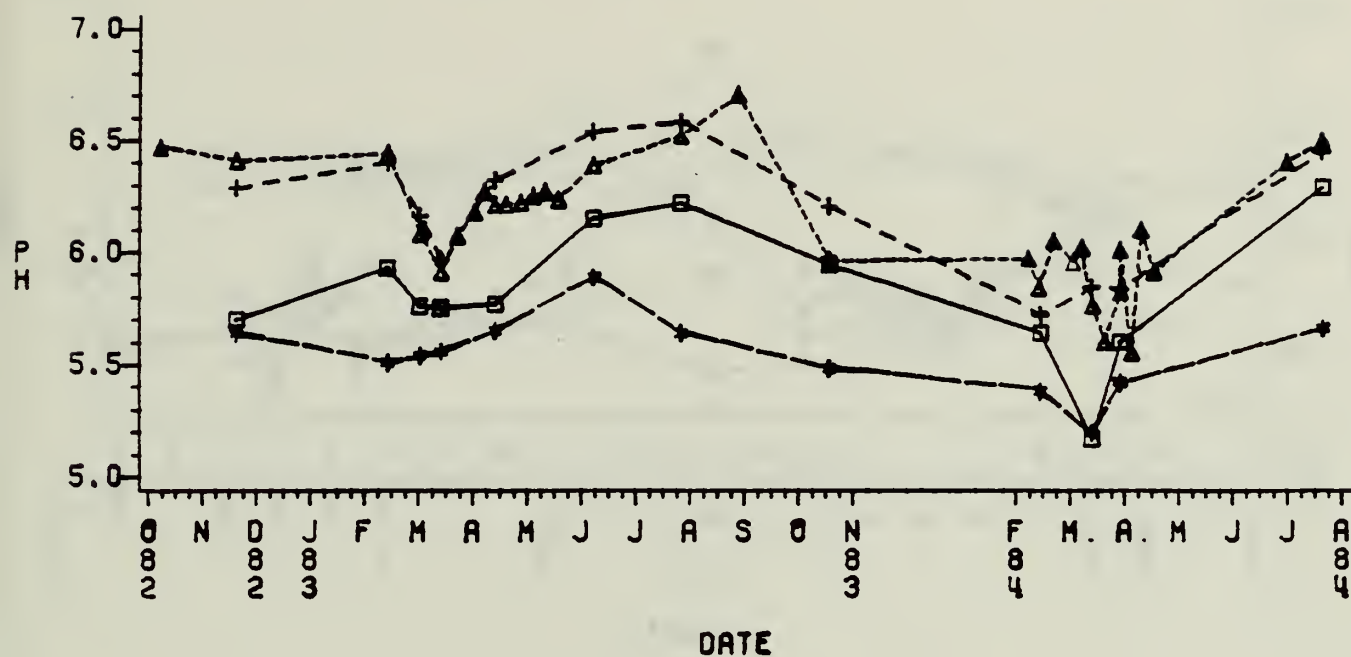
Eagle Lake: Bubble = Bubble Brook
 East = East Inlet
 E(N) = East Inlet, north branch
 E(S) = East Inlet, south branch
 South = South Inlet
 West = West Inlet

Monitored Lakes: Bowl = The Bowl
 Bubble = Bubble Pond
 Eagle = Eagle Lake (mean of 2 sites)
 L. Hadl = Lower Hadlock Pond
 Sarg M = Sargent Mountain Pond
 U. Hadl = Upper Hadlock Pond

Major Streams: Break = Breakneck Brook
 Canon = Canon Brook
 Crom = Cromwell Brook
 Duck = Duck Brook
 Hadl = Hadlock Brook
 Heath = Heath Brook
 Hntn = Hunters Brook (N site)
 Hnts = Hunters Brook (S site)
 Kebo = Kebo Brook
 Lhbr = Little Harbor Brook
 Res = Western Mountain Brook (Reservoir)
 Stan = Stanley Brook

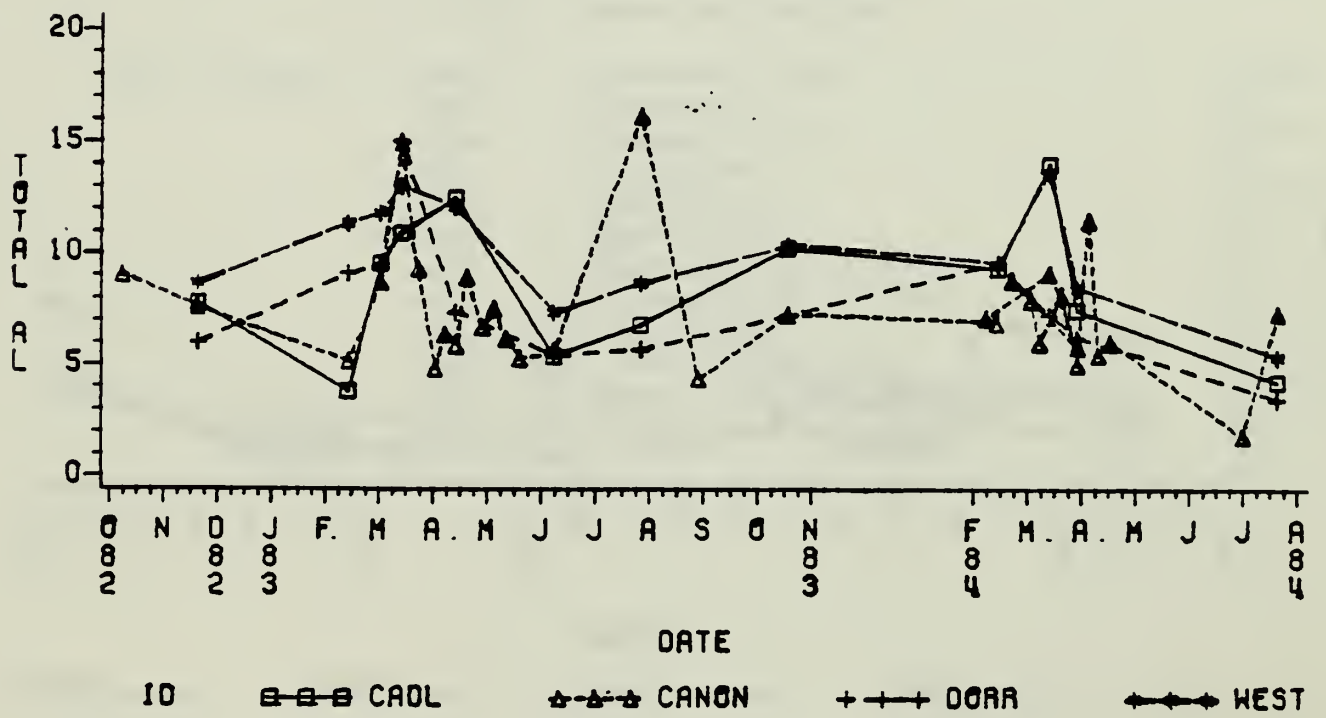
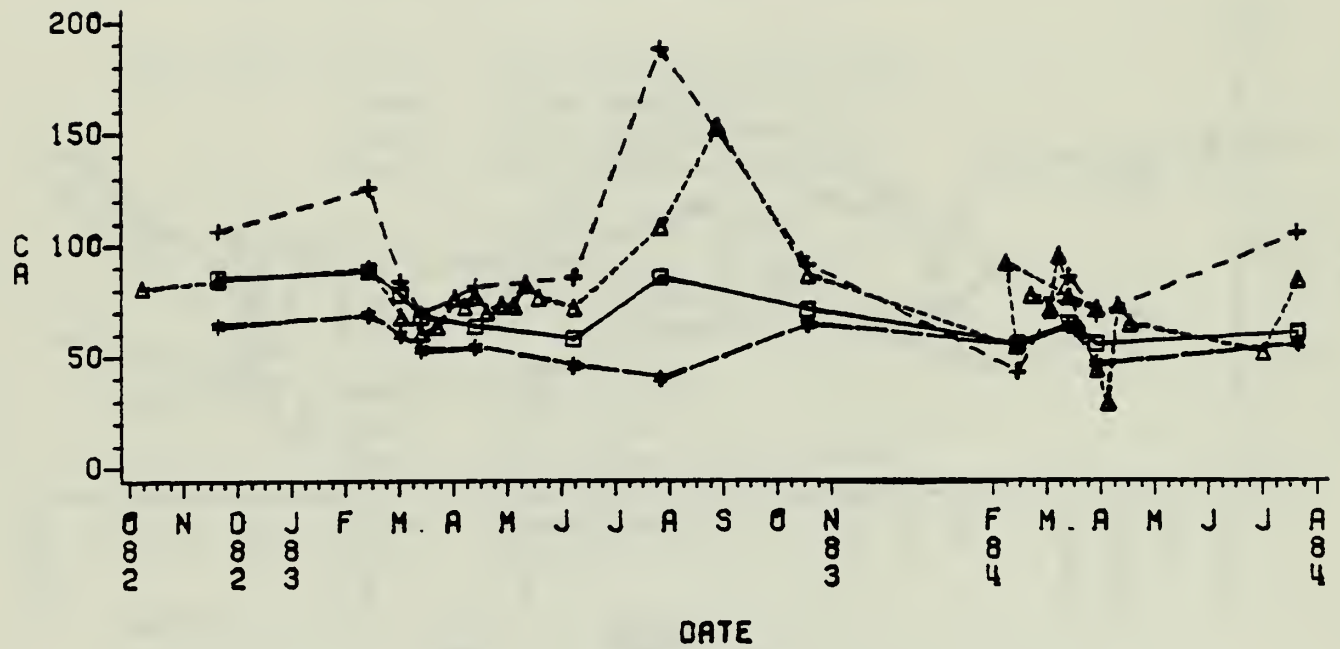
Appendix C (cont)

Canon Brook System



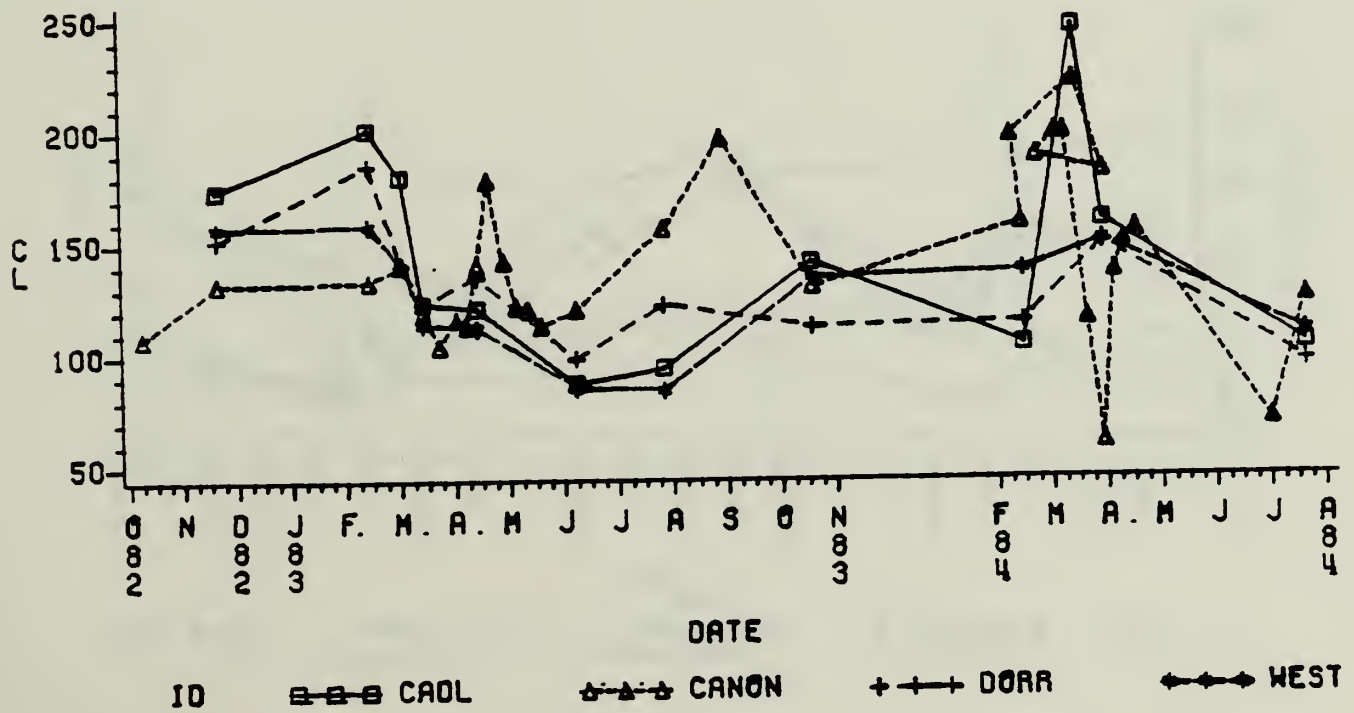
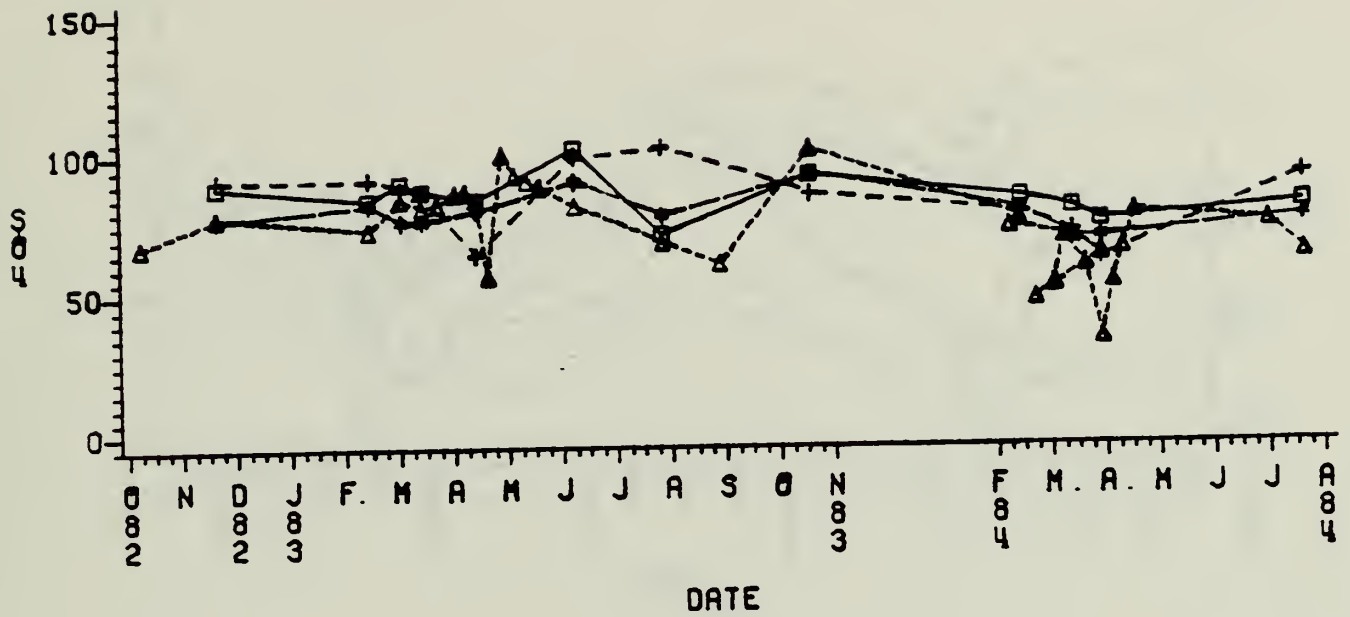
Appendix C (cont)

Canon Brook System



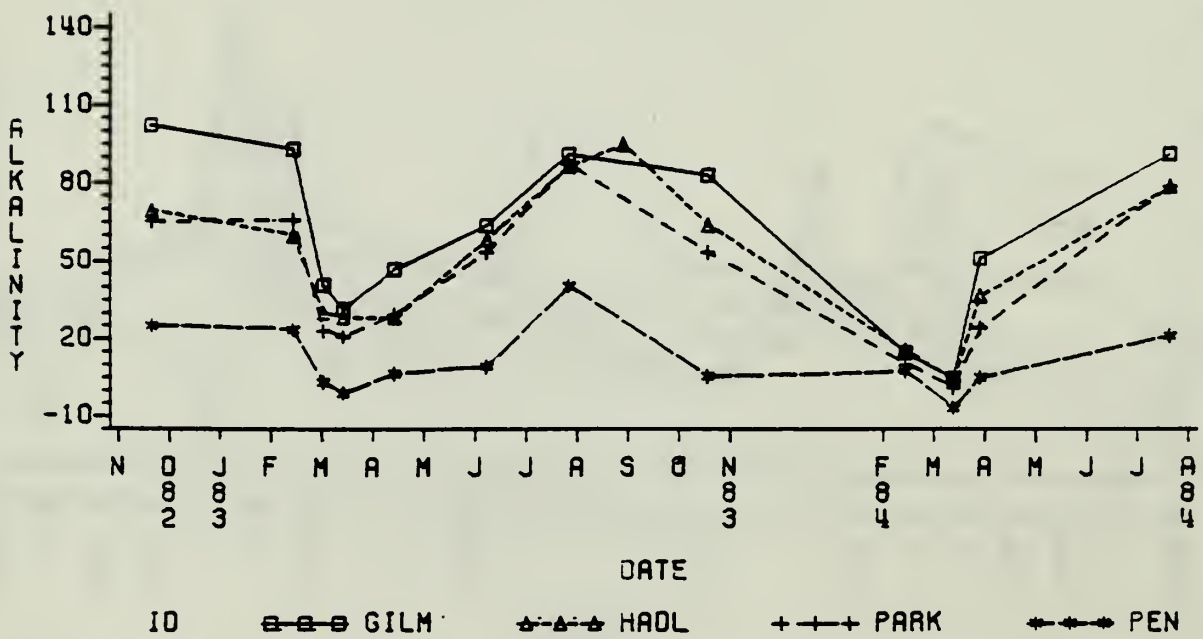
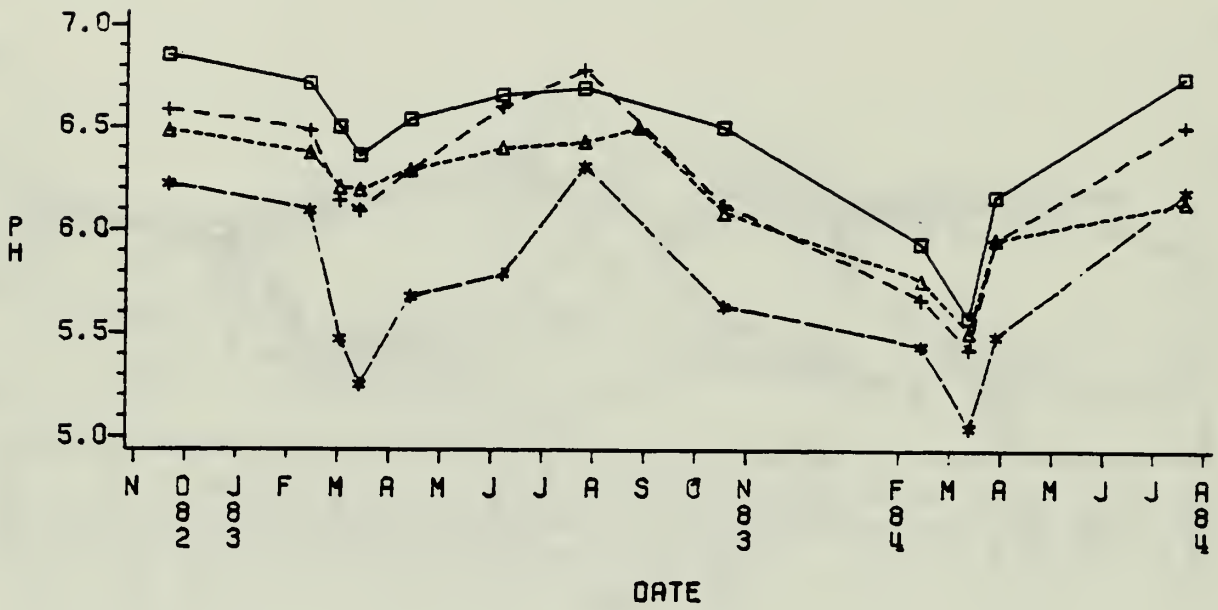
Appendix C (cont)

Canon Brook System

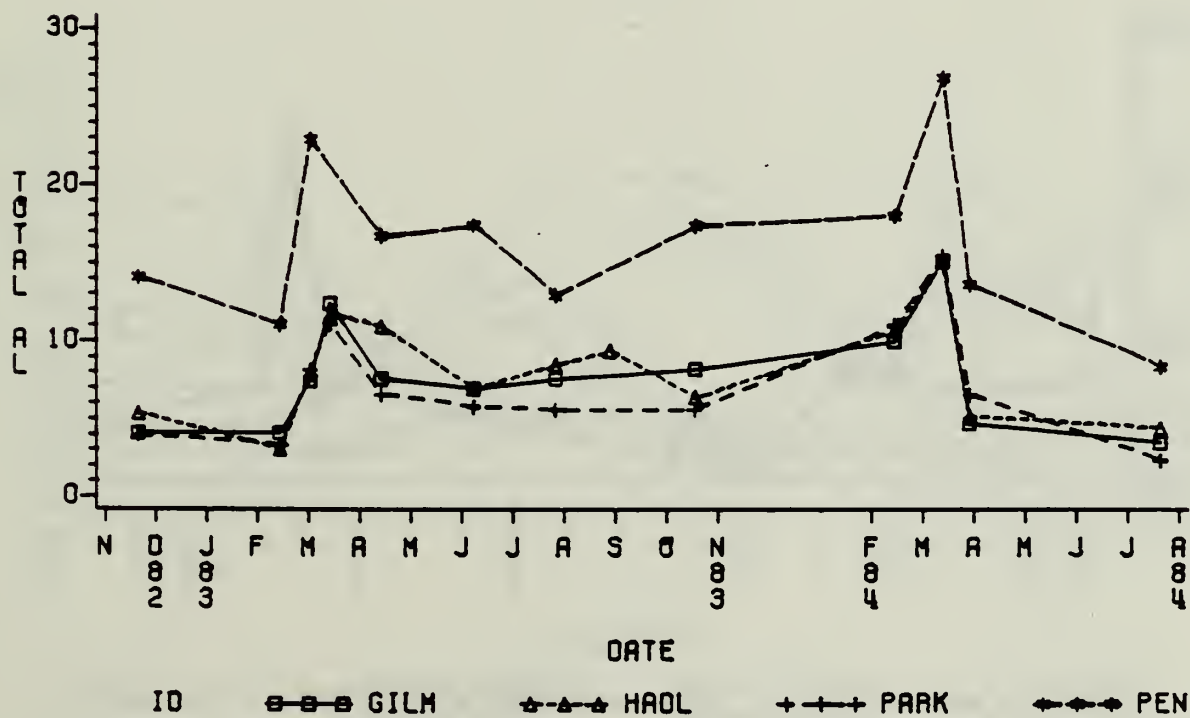
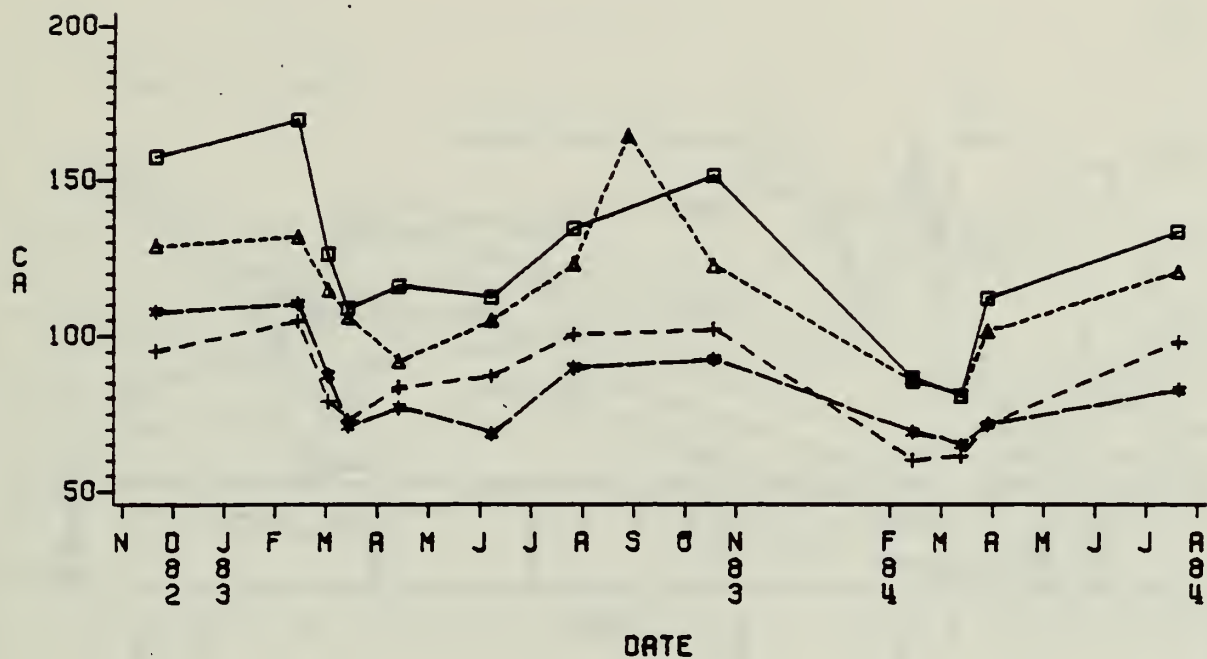


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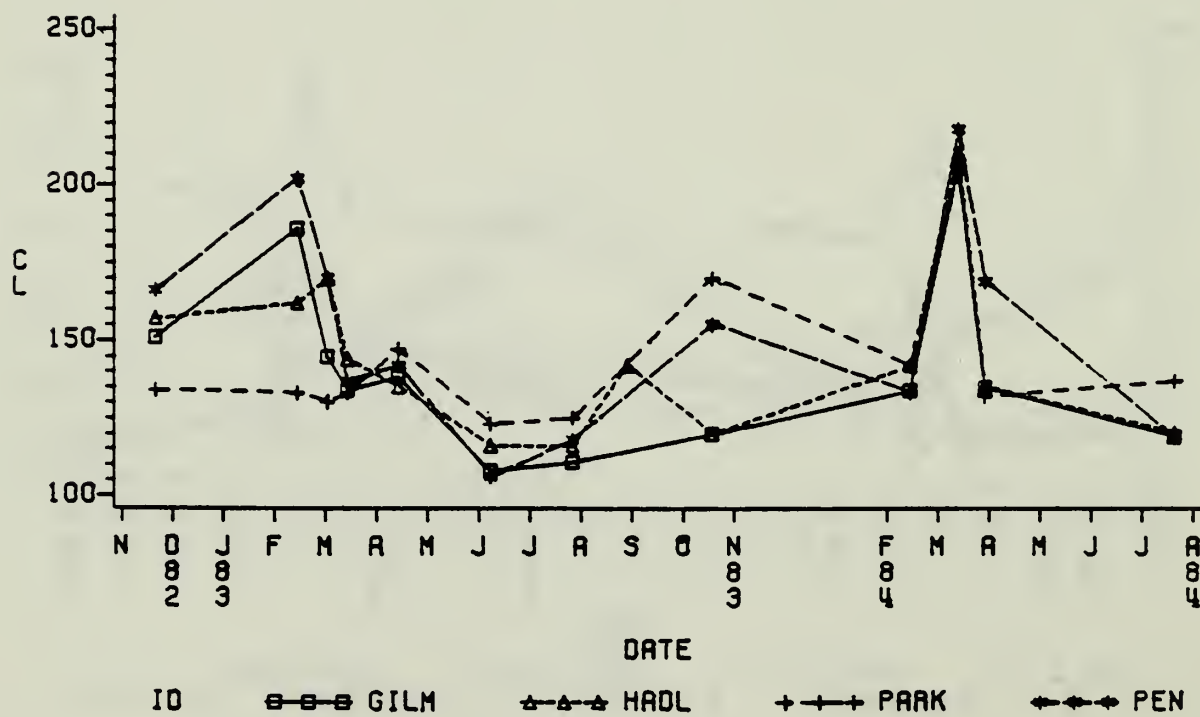
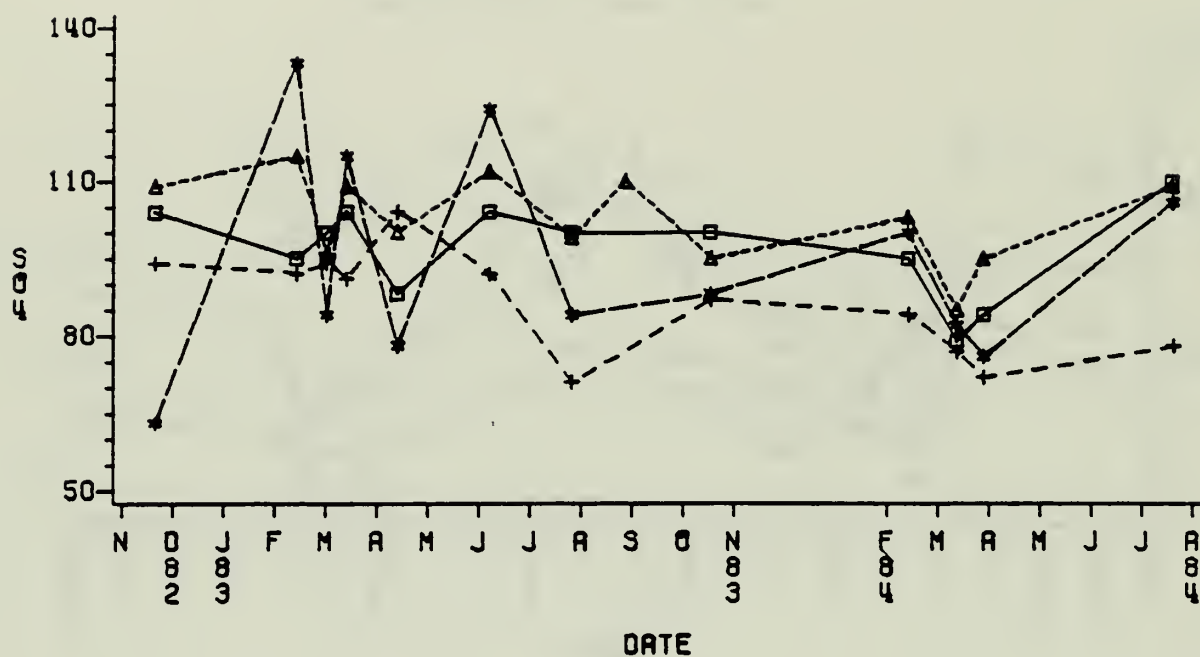
Upper Hadlock Pond System



Upper Hadlock Pond System

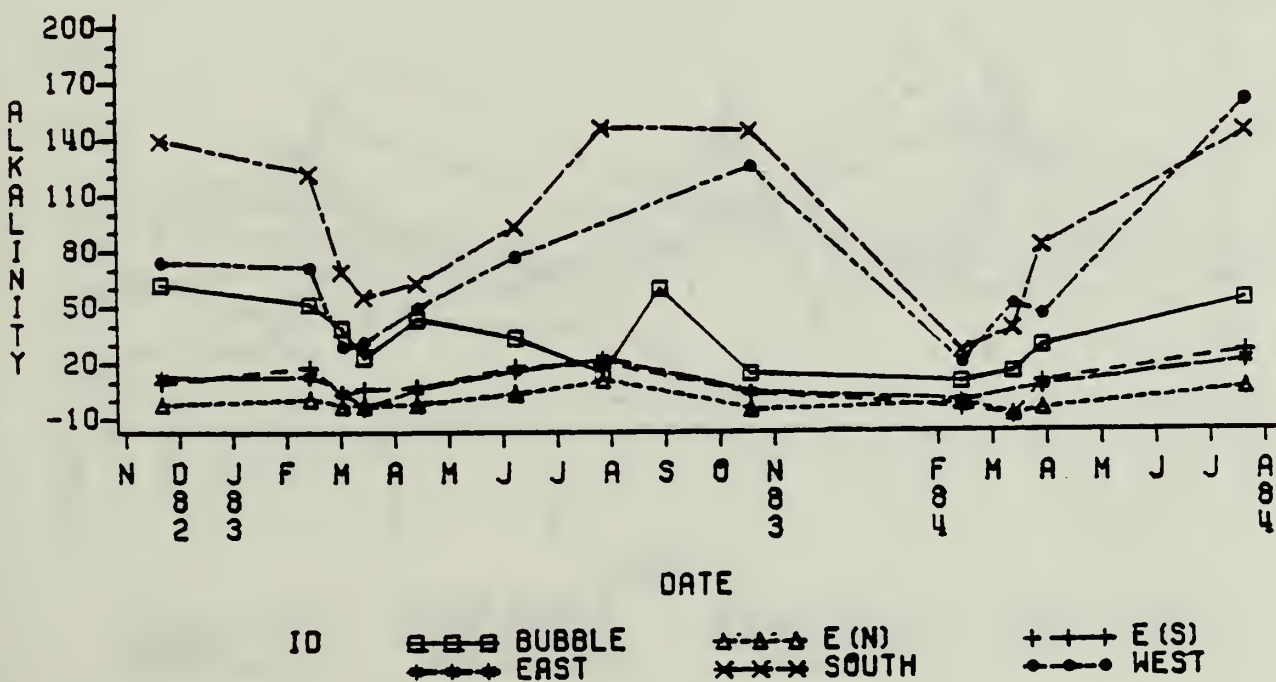
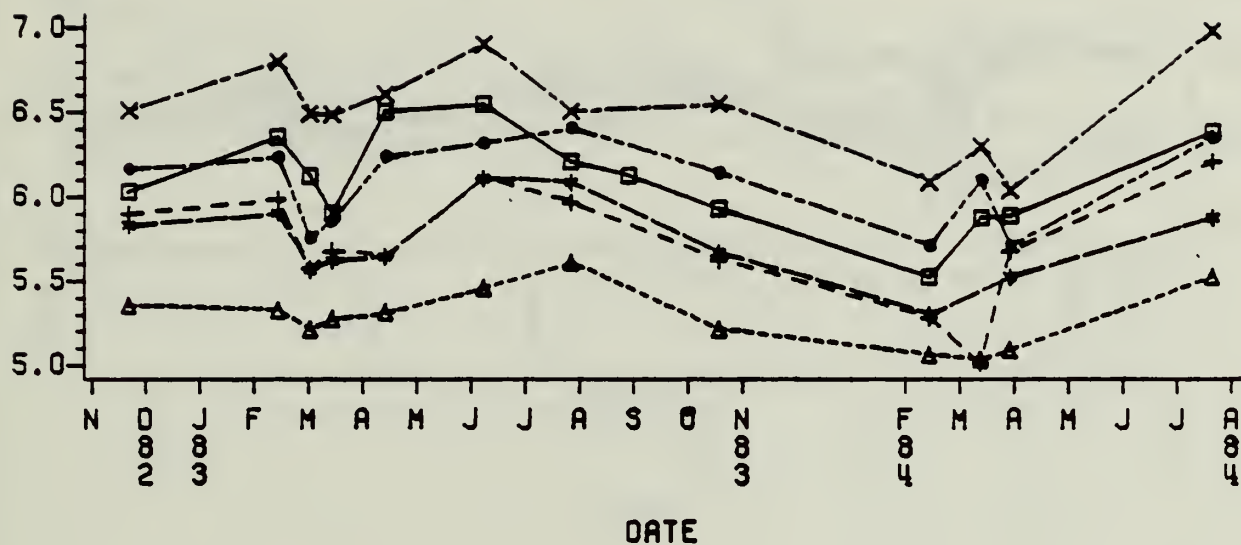


Upper Hadlock Pond System



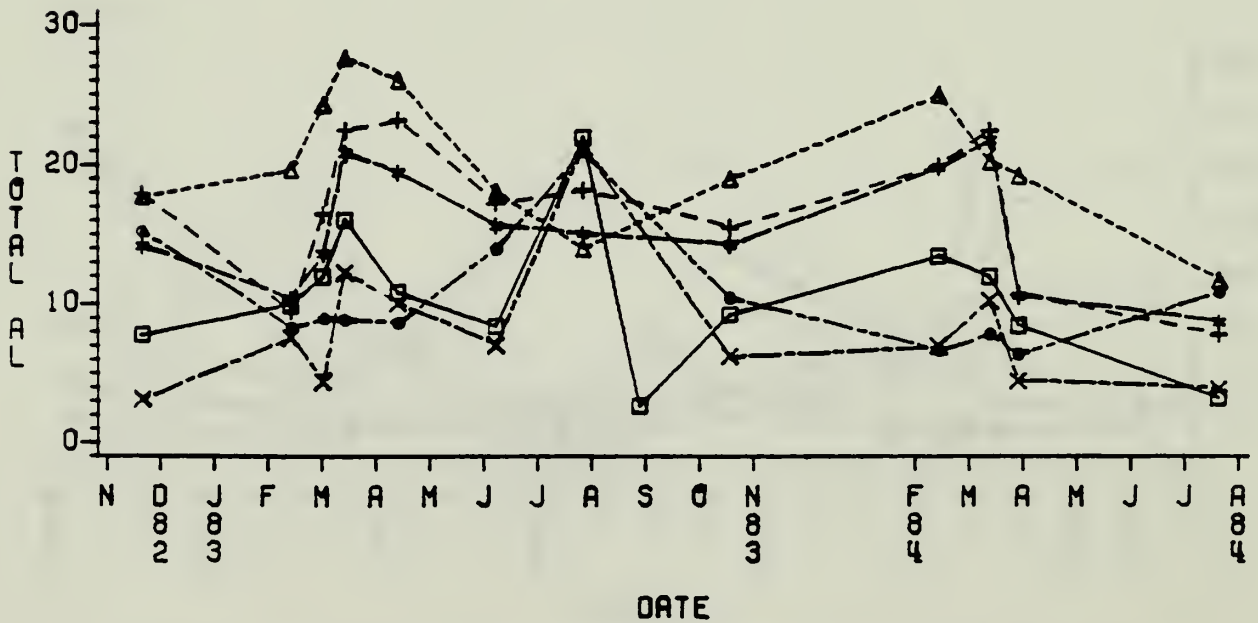
Appendix C (cont)

Eagle Lake System



Appendix C (cont)

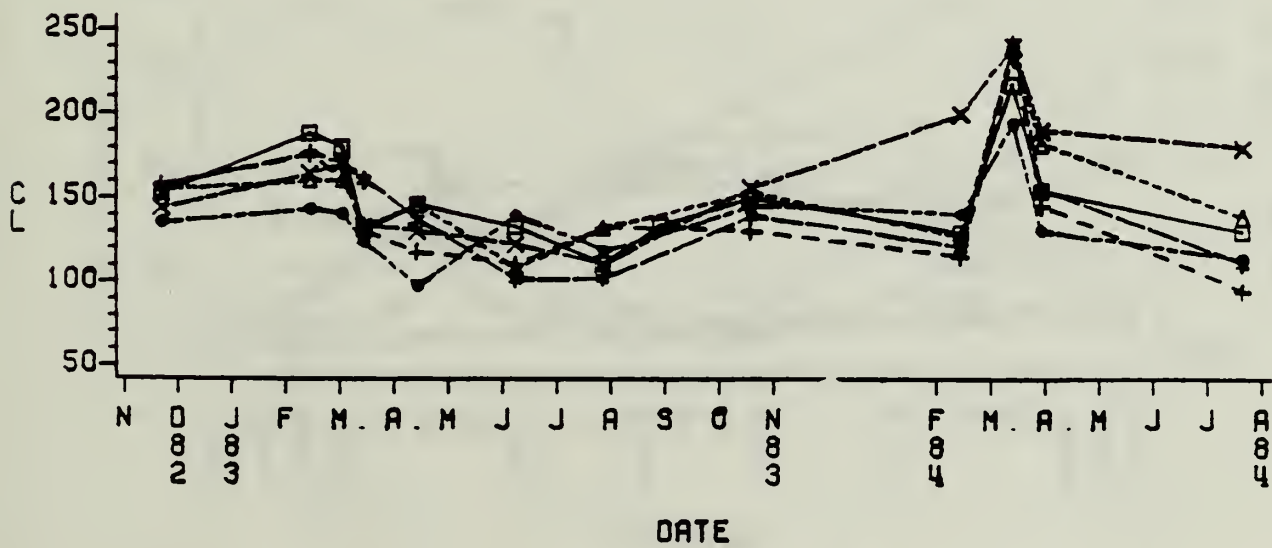
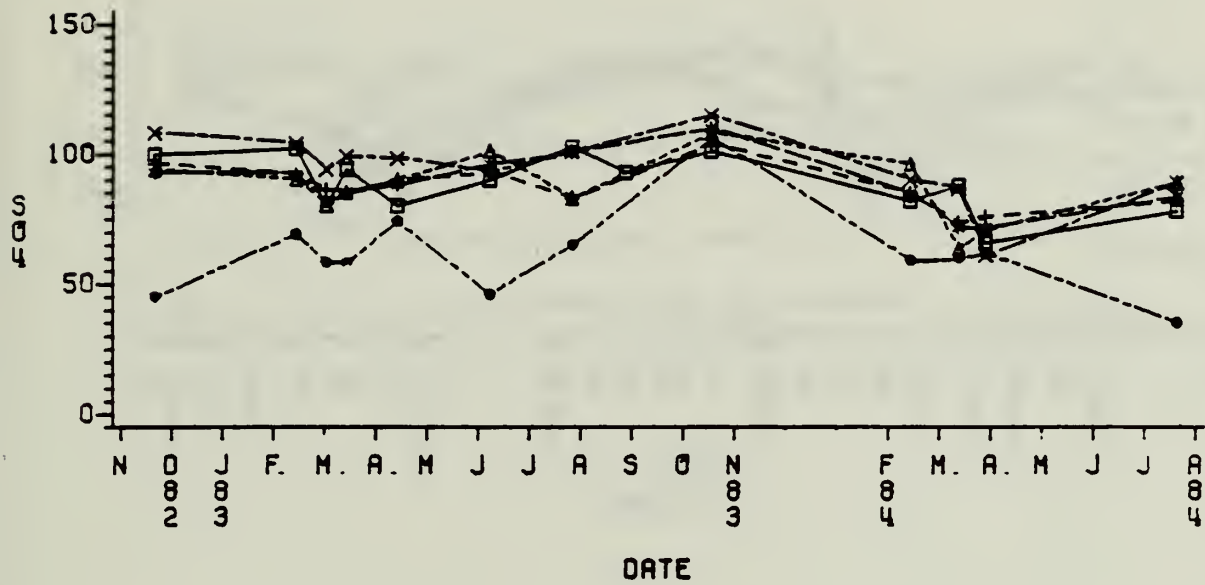
Eagle Lake System



IO BUBBLE EAST E(N) SOUTH E(S) WEST

Appendix C (cont)

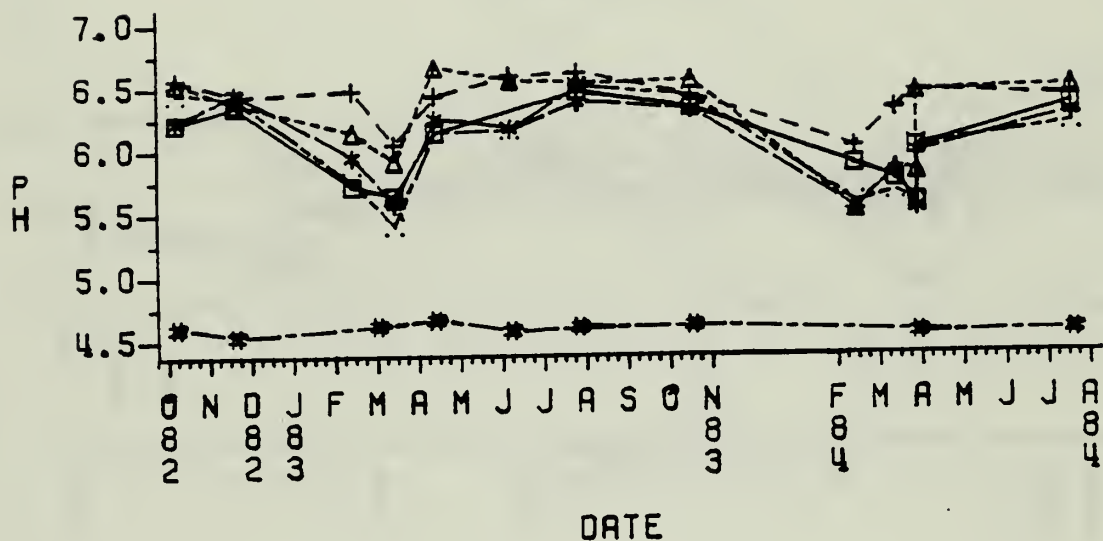
Eagle Lake System



ID BUBBLE E (N) E (S) WEST
 EAST SOUTH

Appendix C (cont)

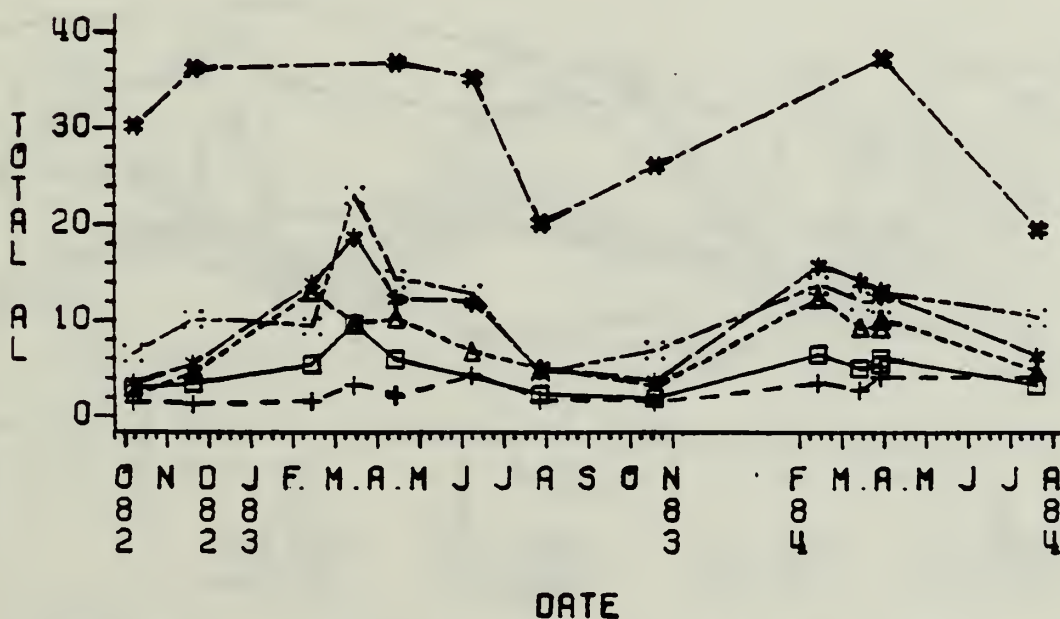
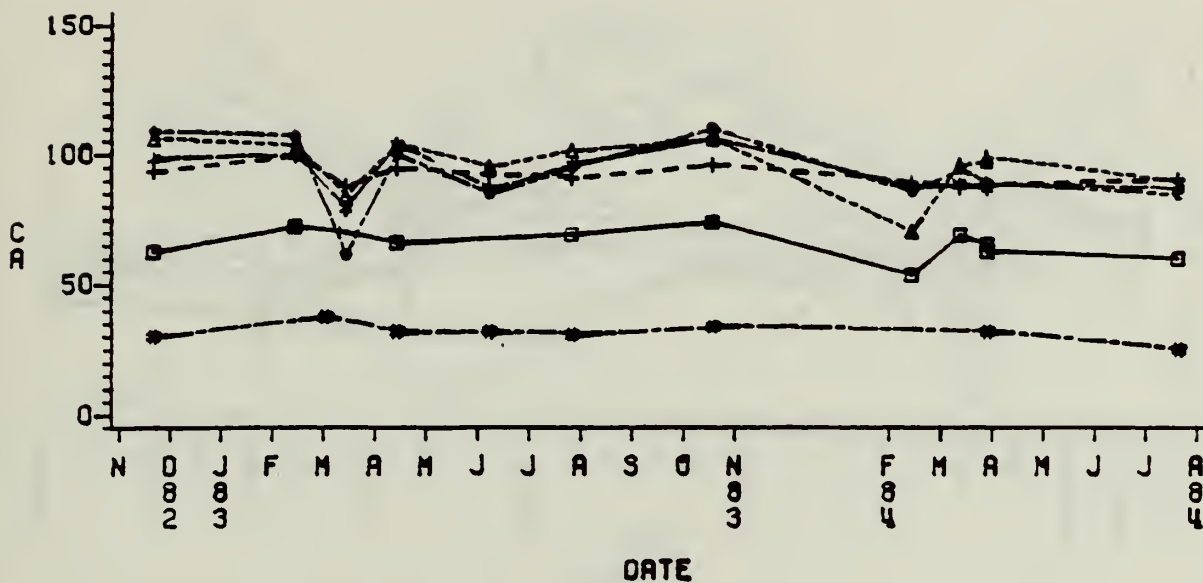
Monitored Lakes



ID BOWL BUBBLE EAGLE
 L. HADL SARG M. U. HADL

Appendix C (cont)

Monitored Lakes



ID

□-□-□ BOWL

◆-◆-◆ L HADL

△-△-△ BUBBLE

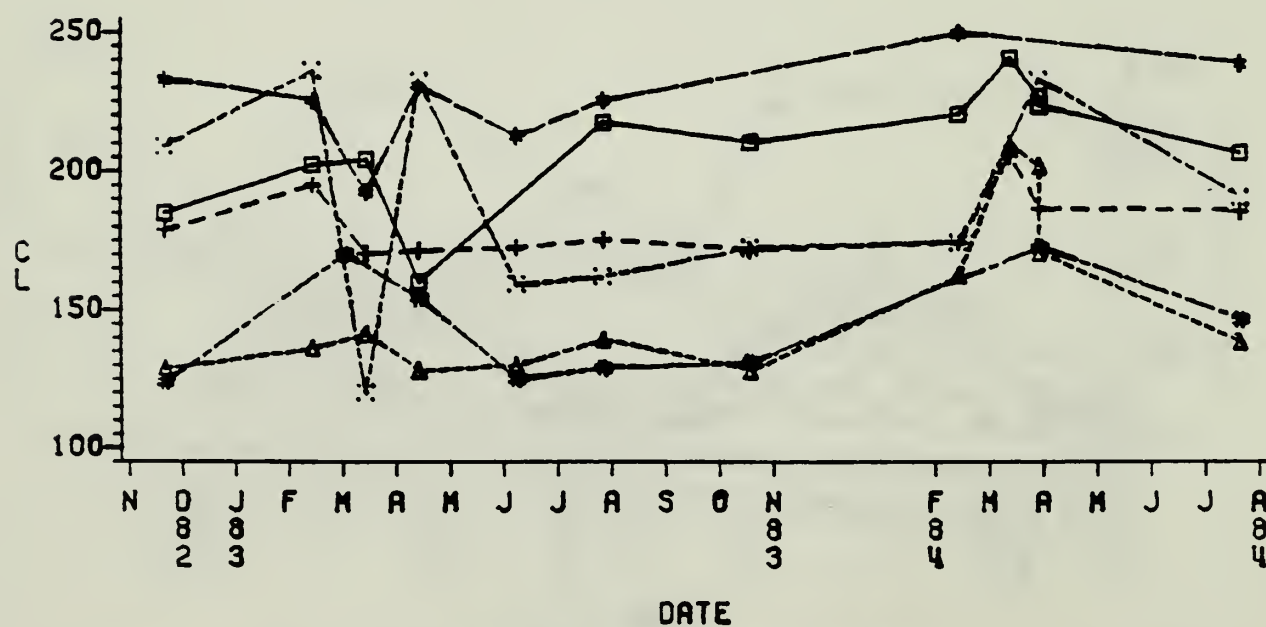
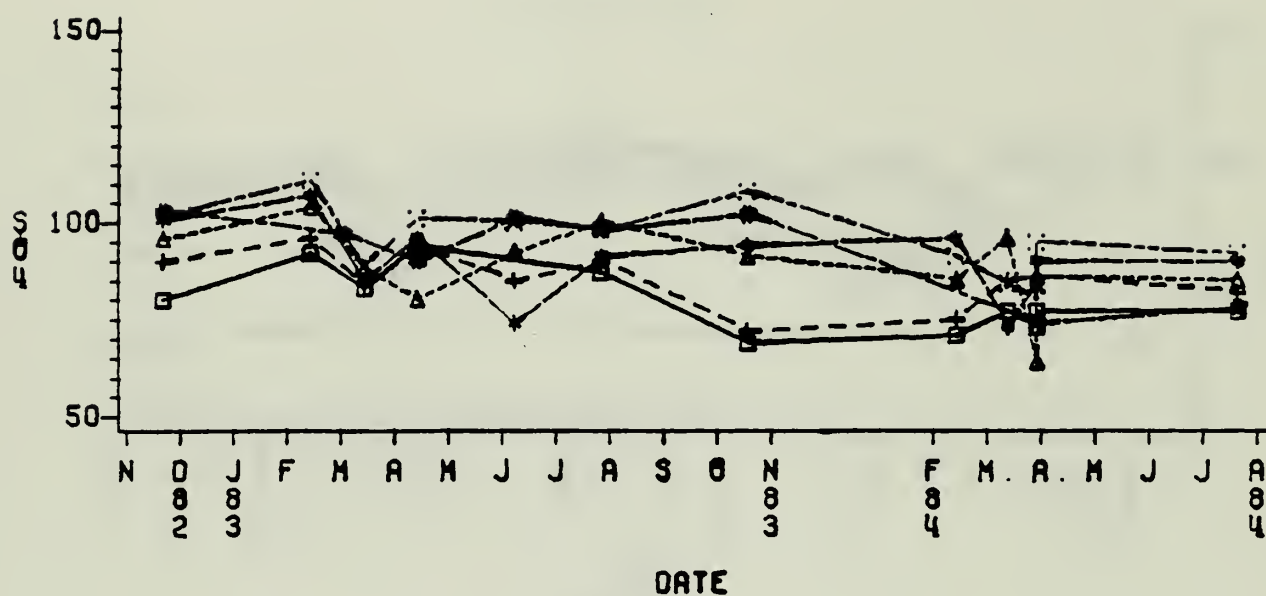
●-●-● SARG M

+ + + EAGLE

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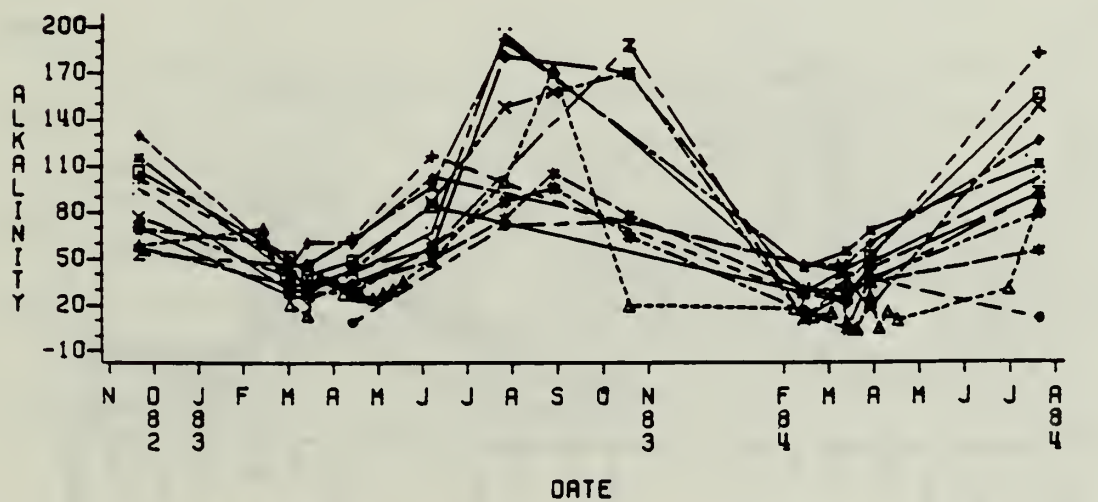
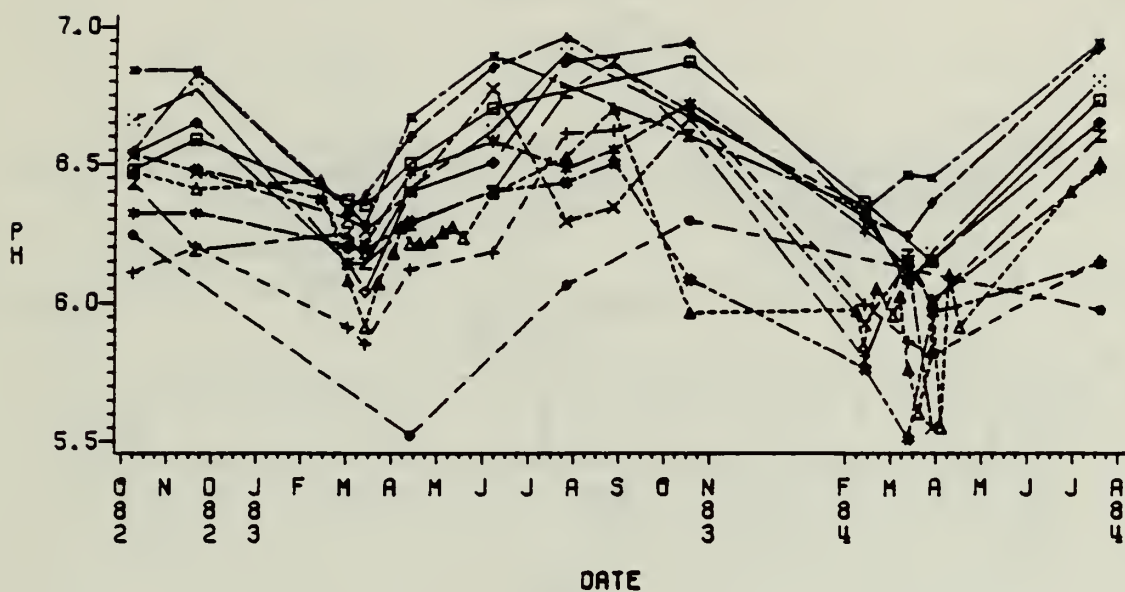
Appendix C (cont)

Monitored Lakes



IO BOWL BUBBLE EAGLE
 L HAOL SARG M U HAOL

Second-order Streams

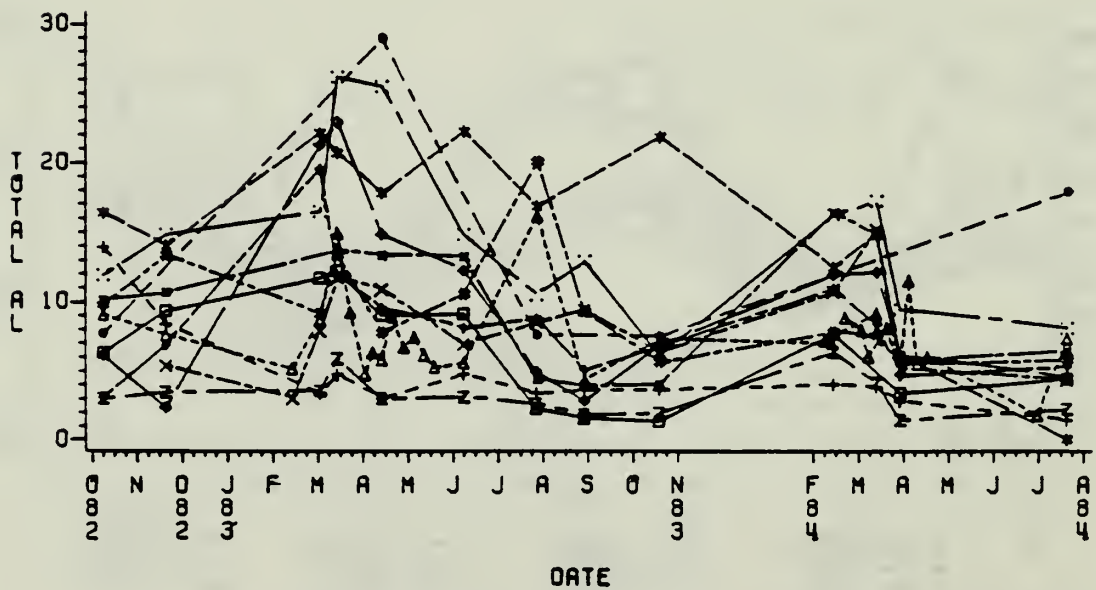
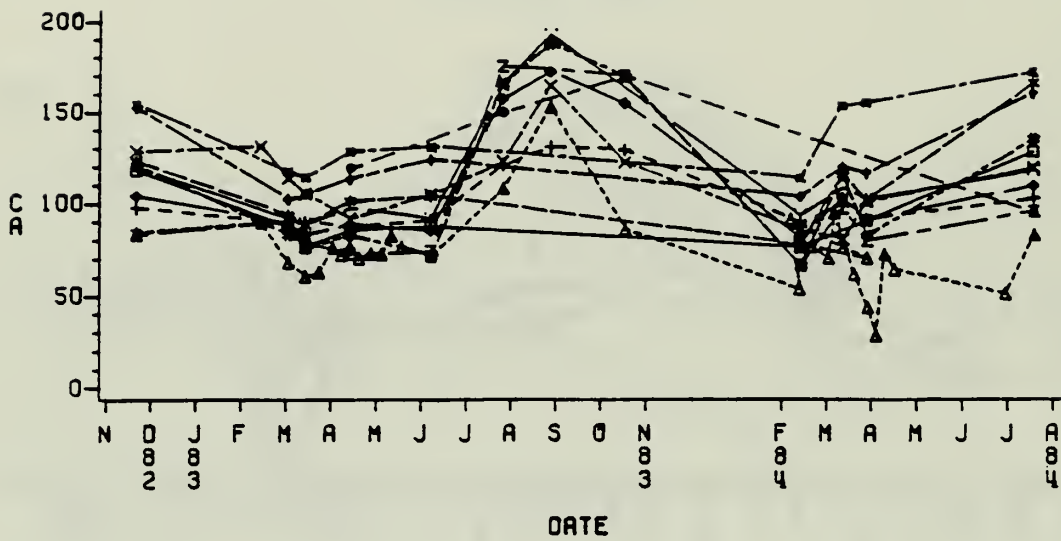


IO

—●—●— BREAK	—△—△— CANON	+—+—+ CROM	—◆—◆— DUCK
—●—●— HAOL	—x—x— HEATH	—◆—◆— HURTN	—:—:— HUNTS
—z—z— KEBO	—+—+— LMBR	—◆—◆— RES	—■—■— STAN

Appendix C (cont)

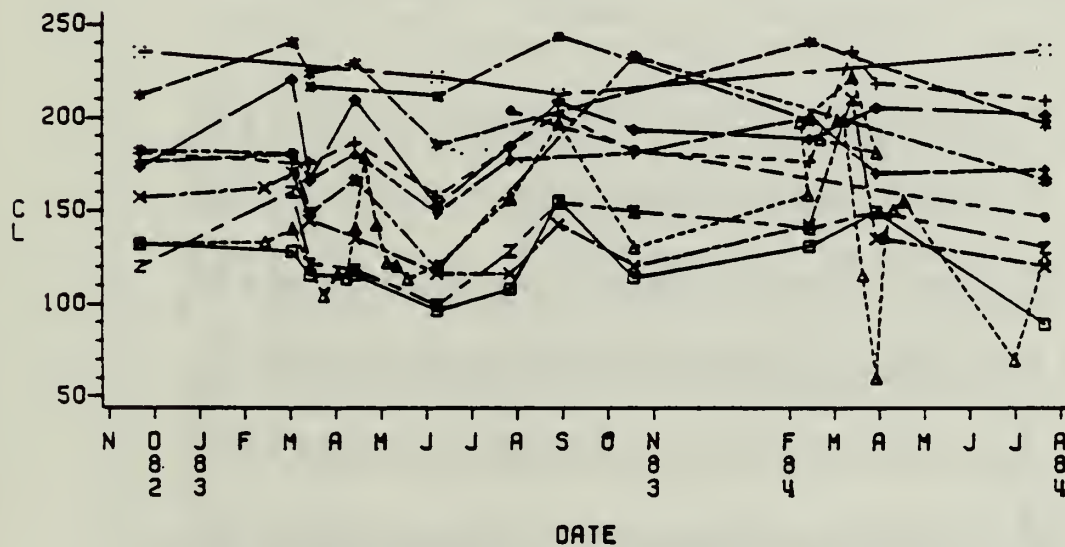
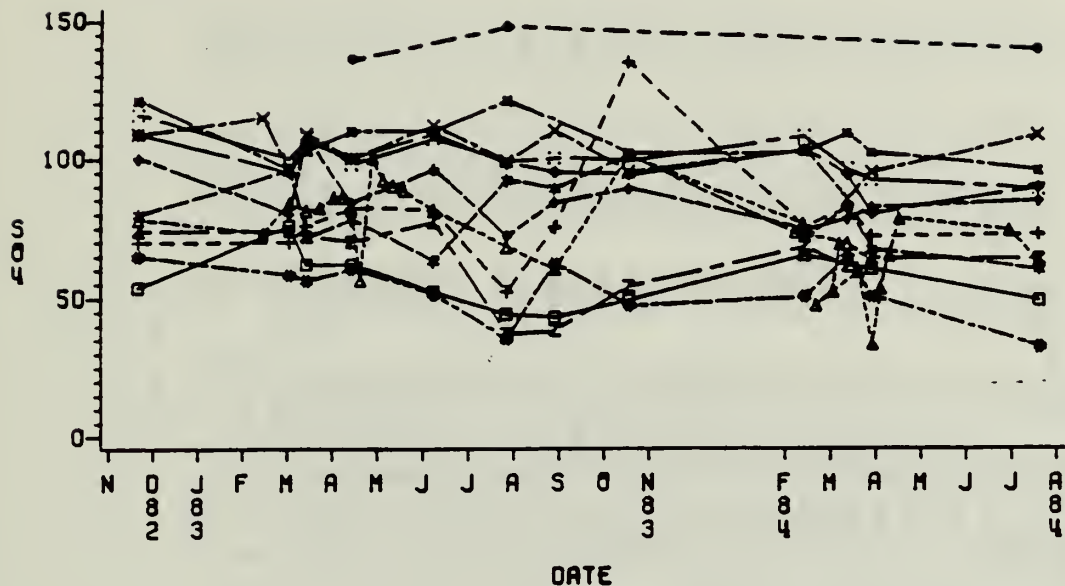
Second-order Streams



IO	BAK	CB-3	DUCK	GMS
	HETH	HHAD	HNTN	HNTS
	KEBO	LHB	RES	STAN

Appendix C (cont)

Second-order Streams



IO	BAK	CB-3	DUCK	GMS
	HETH	HHAO	HNTN	HNTS
	KEBO	LHB	RES	STAN

Appendix D. Mean baseflow chemical parameters for study sites. Units are eq/l except pH, CSI, Sp. conductance (mhos), color (Pt/Co) and ionic strength (mmoles). Labile Al data is only from 1984.

Site	n	Sp. Cond.	color	pH	Alk	Ca	Mg	K	Na	Fe	Zn	Mn	Total Al	Labile Al	SO	NO	Cl	Ionic Strength	CSI
Aunt Betty Pd	2	45	50	6.64	116.0	147.7	45.2	3.3	181.8	10.7	0.18	0.80	7.89	1.56	50.0	0.0	174.0	0.509	3.91
Bear Brook Pd	6	33	40	6.68	155.8	132.2	64.0	7.6	166.0	36.5	0.21	0.97	6.12	1.11	47.6	2.8	135.8	0.543	3.76
Breakneck Pd	2	32	25	6.60	80.2	99.8	32.1	5.4	131.8	5.4	0.00	0.58	4.23	0.44	44.0	0.0	150.0	0.374	4.28
Breakneck Brk	6	32	20	6.70	211.6	170.6	62.4	7.0	169.5	9.2	0.08	0.77	4.74	0.56	49.2	3.4	113.4	0.557	3.56
Bubble Pd	6	31	5	6.48	57.9	100.7	45.1	6.3	146.3	5.4	0.16	0.31	3.87	0.50	91.2	0.8	133.0	0.423	4.54
Bubble Pd 10m	2	31	5	6.45	45.6	95.3	42.0	5.5	141.6	2.2	0.28	0.27	4.11	0.56	96.5	2.0	137.5	0.409	4.69
Bubble Brk	6	32	15	6.10	36.1	89.9	40.9	5.8	143.2	1.2	0.29	0.97	10.54	2.28	95.5	8.0	136.0	0.409	5.24
The Bowl	6	38	15	6.33	32.3	65.3	54.1	8.5	194.7	14.0	0.02	1.16	2.76	0.50	74.8	0.8	197.4	0.437	5.15
The Bowl 6m	2	38	15	6.12	22.5	63.6	53.5	7.8	194.7	11.0	0.31	1.98	4.11	0.89	77.0	3.5	210.0	0.438	5.48
Canon Brk Rt.3	6	32	5	6.31	68.4	88.4	46.6	7.1	157.6	10.9	0.18	1.34	9.45	1.72	75.6	4.2	130.0	0.426	4.69
Canon Cadillac	6	27	5	5.97	38.1	75.5	38.3	3.6	145.8	2.2	0.41	0.14	7.25	3.78	83.3	4.0	128.0	0.371	5.39
Canon Dorr	6	30	5	6.35	92.0	122.6	45.5	4.0	156.9	0.5	0.26	0.19	5.58	1.78	92.3	3.3	120.3	0.457	4.43
Canon West	6	26	5	5.60	10.8	55.8	32.9	3.4	133.0	0.4	0.33	0.35	8.25	4.28	80.8	3.5	120.8	0.319	6.46
Cronwell Brk	6	50	70	6.29	263.0	225.1	115.8	15.8	272.8	28.9	0.10	2.10	13.79	1.67	79.2	4.8	242.6	0.886	3.76
Duck Pd	3	19	30	4.90	-14.0	51.6	38.1	1.9	152.0	7.2	0.03	1.12	20.24	7.67	77.0	1.3	157.0	0.370	--
Duck Brk	6	37	30	6.45	67.9	110.4	55.9	7.9	181.0	5.0	0.10	0.40	6.12	0.61	79.6	2.4	185.4	0.485	4.45
Echo Lake	5	45	15	6.73	74.5	128.1	64.5	9.9	263.9	0.0	0.04	0.28	2.11	0.83	93.2	2.4	254.4	0.591	4.06
Echo Lake 18m	2	41	10	6.84	70.0	128.7	63.8	9.3	259.0	0.8	0.17	0.44	3.34	1.33	101.0	8.0	256.0	0.600	3.97
Eagle Lake North	6	32	10	6.47	40.9	91.3	46.9	6.7	165.7	1.1	0.08	0.41	1.98	1.00	82.6	2.8	173.6	0.420	4.73
Eagle Lake(N) 15m	1	29	10	6.45	32.4	91.3	46.1	6.1	156.6	1.1	0.28	0.15	3.78	--	100.0	3.0	160.0	0.423	4.86
Eagle Lake South	6	30	10	6.45	38.7	92.0	46.9	6.6	165.0	0.4	0.08	0.39	2.25	1.89	81.4	2.0	174.2	0.417	4.78
Eagle Lake(S) 20m	2	29	10	6.27	32.7	90.8	45.7	6.4	163.3	1.3	0.23	0.47	3.23	0.78	88.5	1.5	171.0	0.419	5.04
East Inlet	6	29	10	5.83	14.8	81.0	36.6	4.9	136.7	0.4	0.33	0.28	13.01	3.22	97.0	6.8	127.3	0.380	5.92
East (N) Inlet	6	29	10	5.39	2.3	59.0	37.8	3.3	149.3	0.3	0.21	0.50	15.53	7.89	93.5	6.5	144.5	0.369	6.59
East (S) Inlet	6	29	15	5.87	14.6	87.6	36.2	5.1	133.0	2.1	0.43	0.47	14.79	2.84	91.3	9.5	128.5	0.386	5.87
South Inlet	6	37	30	6.60	142.7	153.4	80.8	9.5	191.3	3.1	0.08	0.52	8.62	0.56	103.3	4.0	147.5	0.602	3.81
West Inlet	6	31	50	6.25	140.2	162.3	60.9	4.7	158.2	11.4	0.13	1.09	14.29	0.61	62.8	3.0	127.8	0.543	4.21
Cronwell Brook	6	50	90	6.29	263.0	225.1	115.8	15.8	272.8	28.9	0.13	2.08	13.79	1.72	79.2	4.8	242.6	0.886	3.76
Hodgdon Pond	4	32	40	6.11	58.2	77.1	68.0	7.2	168.2	10.6	0.06	0.93	11.34	1.17	78.8	2.0	153.4	0.452	5.00
L. Hadlock Pond	6	35	10	6.32	33.8	95.9	48.0	6.5	221.1	3.7	0.11	0.76	4.74	1.56	93.0	2.2	236.4	0.499	4.96
L. Hadlock Pond 8m	2	33	15	5.92	21.6	90.7	46.7	6.3	213.6	1.6	0.26	0.62	8.45	1.22	87.0	1.5	227.5	0.473	5.58

Appendix D. (continued)

Site	n	Sp. Cond.	Color	pH	Alk	Ca	Mg	K	Na	Fe	Zn	Mn	Total Al	Labile Al	SO	NO	Cl	Ionic Strength	CSI
U. Hadlock Pd	6	34	15	6.37	40.9	99.5	43.8	6.3	195.9	2.8	0.17	0.45	7.69	2.22	97.8	1.0	182.4	0.470	4.81
U. Hadlock Pd 8m	2	30	20	6.11	23.4	87.6	39.1	5.9	175.1	2.4	0.18	1.20	14.68	2.78	99.0	3.5	165.0	0.796	5.33
Hadlock Brk	6	34	10	6.23	74.6	123.5	46.5	5.9	198.6	41.6	0.13	0.15	6.12	0.56	103.0	3.8	128.3	0.529	4.57
Glinore Brk	6	33	10	6.68	92.1	144.1	42.0	5.4	158.3	1.3	0.05	0.08	5.84	1.89	103.5	5.0	125.3	0.492	3.96
Parkman Brk	6	29	10	6.43	71.2	98.8	43.6	5.3	161.9	1.3	0.11	0.33	4.34	1.45	82.5	6.5	141.5	0.426	4.44
Penobscot Brk	6	30	10	6.01	23.0	93.1	40.5	5.1	157.4	1.3	0.21	0.40	13.14	5.06	85.3	11.8	139.5	0.409	5.46
Heath Brook	6	42	65	6.55	130.5	142.5	65.3	7.1	240.0	11.8	0.12	0.46	10.90	0.72	45.8	3.4	231.4	0.595	3.91
Halfmoon Pd	5	22	35	6.03	70.3	71.6	34.6	5.3	129.7	8.9	0.16	0.60	5.60	0.61	35.8	1.0	111.2	0.323	5.04
Halfmoon Pd 6m	1	22	30	5.84	67.1	73.9	83.7	5.9	113.1	15.6	0.18	2.33	7.12	--	51.0	3.0	111.0	0.345	5.25
Hunters Brk (N)	6	41	10	6.71	124.1	127.6	75.8	8.3	221.1	1.5	0.10	0.31	4.94	2.78	98.2	4.0	183.2	0.581	3.88
Hunters Brk (S)	6	50	15	6.83	156.0	149.5	90.7	11.5	305.2	6.9	0.12	0.35	10.27	0.95	101.2	2.4	258.2	0.734	3.60
Jordan Pd North	4	31	5	6.59	51.4	105.4	50.7	7.6	154.9	0.0	0.12	0.13	2.34	1.39	95.8	2.6	157.8	0.44	4.45
Jordan Pd South	4	30	5	6.57	51.4	105.3	50.5	7.5	154.7	0.0	0.04	0.13	2.05	1.06	96.2	2.8	156.0	0.440	4.47
Jordan Pd 20m	2	30	5	6.62	47.1	105.8	50.2	7.3	153.6	3.0	0.26	0.22	2.95	0.78	100.0	4.0	152.5	0.446	4.47
Kebo Brk	6	30	10	6.47	128.9	122.4	44.3	6.4	145.5	3.1	0.06	0.83	2.62	0.89	58.4	3.4	127.4	0.440	4.15
Lake Wood	5	21	15	6.54	73.9	75.7	36.9	5.7	123.0	3.0	0.04	0.71	2.45	1.22	55.0	1.4	98.8	0.328	4.49
Lake Wood 5m	1	24	15	6.56	84.6	84.3	32.9	5.1	116.2	6.5	0.00	1.38	2.00	--	49.0	7.0	102.0	0.337	4.37
Long Pd North	4	29	10	6.37	38.1	82.0	61.4	8.7	179.3	1.6	0.02	0.14	2.71	0.44	92.6	1.4	181.4	0.446	4.91
Long Pd South	4	35	10	6.38	33.6	82.6	60.5	9.3	178.2	1.5	0.10	0.16	3.76	1.78	93.8	1.6	175.6	0.443	4.94
Long Pd 15m	2	32	10	6.42	32.5	82.6	59.2	8.1	174.0	1.9	0.05	0.18	3.23	0.67	92.5	3.5	186.0	0.443	4.93
Little Harbor Brk	6	41	20	6.62	201.8	189.8	72.1	9.4	219.4	6.0	0.04	0.76	6.16	1.78	88.0	2.8	171.8	0.671	3.38
Little Long Pond	6	301	25	6.68	131.4	229.8	479.9	52.0	990.5	5.0	0.10	0.58	7.09	2.34	335.4	1.2	1199.0	2.250	3.65
Reservoir	2	47	15	6.12	59.2	145.0	57.0	7.3	201.6	3.9	0.13	0.83	10.14	5.00	146.5	2.3	181.5	0.595	4.83
Round Pd	3	30	20	6.10	28.8	56.8	45.9	5.4	153.6	2.8	0.06	0.60	4.43	0.11	70.8	1.4	134.2	0.346	5.51
Round Pd 4m	1	22	25	6.06	21.1	53.9	45.2	4.4	148.3	6.4	0.12	0.91	5.11	--	78.0	9.0	141.0	0.357	5.66
Seal Cove Pd	4	33	15	6.50	52.4	80.9	63.8	7.5	169.9	3.8	0.04	0.39	3.58	0.67	87.6	2.4	154.8	0.437	4.66
Seal Cove Pd 5m	1	29	15	6.57	48.4	78.3	62.5	6.6	163.1	1.6	0.21	0.51	3.45	--	97.0	11.0	154.0	0.437	4.63
Sargent Mtn Pd	6	28	15	4.58	-28.6	28.7	28.3	6.5	127.3	2.2	0.26	0.56	26.40	15.23	95.0	0.8	128.8	0.339	--
Stanley Brk	6	59	20	6.95	169.7	196.8	103.7	18.7	289.4	4.7	0.12	0.22	7.12	1.06	109.2	13.0	277.4	0.811	3.33
The Tarn	5	47	25	6.54	95.4	134.1	58.4	8.3	282.6	14.1	0.06	0.40	9.34	0.50	87.6	1.8	284.8	0.651	4.15
Witchhole Pd	5	22	25	6.33	48.1	61.7	42.3	5.7	136.9	7.4	0.05	0.41	4.60	0.83	49.2	1.0	133.2	0.334	4.99
Witchhole Pd 6m	1	26	30	6.30	44.0	59.9	40.3	5.9	126.2	8.1	0.15	0.69	4.78	--	54.0	7.0	130.0	0.331	5.06

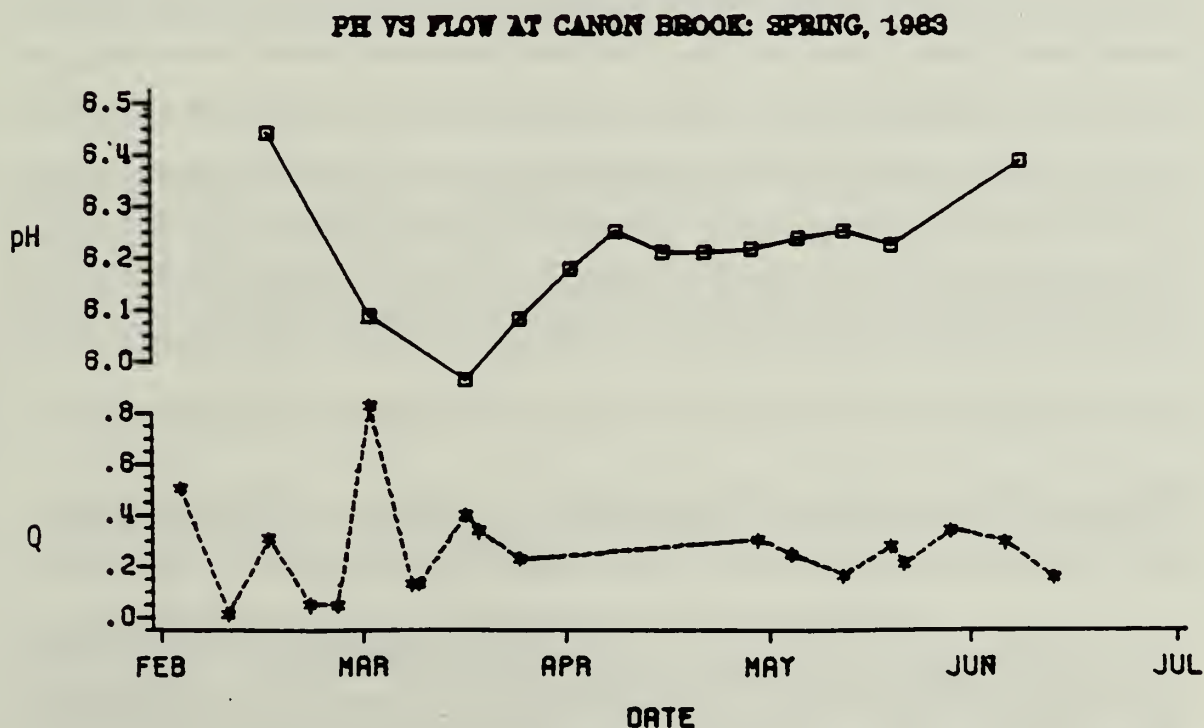
Appendix E. Current mean baseflow pH and alkalinity versus Inferred mean historical pH and alkalinity, based on the Henriksen model. See text.

	n	pH	Past pH	Alkalinity	Past Alkalinity
Aunt Betty Pond	2	6.64	6.64	116.0	126.2
Bear Brook Pond	5	6.68	6.68	155.8	141.0
Breakneck Brook	6	6.60	6.70	211.6	170.0
Breakneck Pond	2	6.70	6.47	80.2	73.8
Bubble Pond	6	6.48	6.52	57.9	86.9
Bubble Brook	5	6.10	6.47	36.1	74.7
The Bowl	5	6.33	6.36	32.3	52.7
Canon Brook - Route 3	6	6.31	6.49	68.4	78.5
Canon - West	5	5.60	6.26	10.8	39.6
Canon - Dorr	5	6.35	6.56	92.0	104.4
Canon - Cadillac	5	5.97	6.39	38.1	58.7
Cromwell Brook	6	6.29	6.79	263.0	228.1
Duck Brook	6	6.45	6.53	67.9	91.8
Echo Lake	5	6.73	6.59	74.5	106.2
Eagle Lake - North	6	6.47	6.47	40.9	72.6
Eagle Lake - South	6	6.45	6.47	38.7	73.6
Eagle East Inlet	5	5.83	6.40	14.8	60.1
Eagle East Inlet (N)	5	5.39	6.28	2.3	41.0
Eagle East Inlet (S)	5	5.87	6.42	14.6	64.6
Eagle West Inlet	5	6.25	6.68	140.2	148.8
Eagle South Inlet	5	6.60	6.71	142.7	156.7
Hodgdon Pond	5	6.11	6.51	58.2	84.8
U. Hadlock Pond	6	6.37	6.47	40.9	73.7
L. Hadlock Pond	6	6.32	6.42	33.8	63.6
Hadlock Brook	5	6.23	6.59	74.6	106.5
Gilmore Brook	5	6.68	6.62	92.1	119.5
Parkman Brook	5	6.43	6.51	71.2	83.0
Penobscot Brook	5	6.01	6.46	23.0	72.5
Heath Brook	6	6.55	6.61	130.5	118.0
Halfmoon Pond	5	6.03	6.41	70.3	70.0
Hunter's Brook - North	6	6.71	6.62	124.1	124.2
Hunter's Brook - South	6	6.83	6.66	156.0	142.0
Jordan Pond - North	5	6.59	6.54	51.4	90.3
Jordan Pond - South	5	6.57	6.54	51.4	90.5
Kebo	6	6.47	6.55	128.9	104.4
Lake Wood	5	6.54	6.45	73.9	68.7
Long Pond - North	5	6.37	6.48	38.1	75.6
Long Pond - South	5	6.38	6.48	33.6	76.8
Little Harbor Brook	6	6.82	6.74	201.8	180.0
Little Long Pond	4	6.68	6.60	131.4	112.5
Reservoir	4	6.12	6.62	59.2	121.7
Round Pond	5	6.10	6.35	28.8	51.5
Seal Cove Pond	5	6.50	6.51	52.4	83.6
Sargent Mtn. Pond	6	4.58	5.70	-28.6	11.8
Stanley Brook	6	6.95	6.75	169.7	186.8
The Tarn	5	6.54	6.56	95.4	99.2
Witchhole	5	6.33	6.36	48.1	53.1

Appendix F. Hydrologic data versus pH at Canon Brook, Spring, 1983.

Flow measurements (depth, velocity) in Canon Brook (Route 3 sample site) were taken periodically from November 1982 to August 1983 by M. Soukup, N. Mitchell, N. Fletcher, K. Jones or J. Anderson. Sufficiently frequent sampling was done between February 1, 1983 to June 1, 1983, to compare pH with flow (figure below). For some dates, only depth data were taken. In these instances, flow is calculated from the regression equation from dates when both velocity and depth were recorded:

$$Q(\text{cms}) = 1.7 (\text{depth}) - 0.16 \quad r^2 = 0.90$$



Appendix G. Tabulation of all data for all sites and all sampling dates. All data are in $\mu\text{eq/l}$ except as noted. Labile Al was determined by the ion-exchange method of Driscoll (1980).

$$I = \frac{1}{2} \sum C_i z_i^2 \quad \text{where } C_i = \text{molar concentration of species} \\ \text{and } z_i = \text{charge of the species}$$

$$\text{CSI} = \log K - \log \text{Ca} - \log \text{HCO}_3 - \text{pH} \\ \text{where } \log K = 2.582 - 0.024 T(^{\circ}\text{C}) \\ \text{and Ca and HCO}_3 \text{ are in moles per liter.}$$

SITE	DATE	PT-CO COLOR	COND UM10S	PH	ALK	CA	MG	K	NA	FE	MN	ZN	TOTAL AL PPB	LABILE AL PPB	SIO2 PPM	SO4 M03	CL	I	CS1	+/- RATIO	
AUNT BETTY POND	83 APR	40	38 6.36	51	108	39	5	172	5	6	6	6	92	-	-	78	1	182	0.445	4.67	1.04
AUNT BETTY POND	84 JUL	50	41 6.64	116	148	45	3	182	11	22	6	71	14	14	2.51	50	0	174	0.492	3.91	1.12
BEAR BROOK POND	82 OCT	45	39 6.61	167	129	67	10	158	16	10	9	93	-	-	3.56	50	0	131	0.495	3.84	1.05
BEAR BROOK POND	82 NOV	25	37 6.78	159	128	66	10	151	11	16	5	54	-	-	-	36	0	120	0.459	3.69	1.12
BEAR BROOK POND	83 APR	25	41 6.57	62	113	58	7	173	16	22	3	98	-	-	-	90	4	185	0.492	4.37	1.03
BEAR BROOK POND	83 JUL	80	42 6.96	182	145	64	6	171	86	41	0	53	-	-	-	35	14	144	0.511	3.60	1.03
BEAR BROOK POND	83 OCT	15	45 6.48	151	145	73	7	193	16	15	0	35	-	-	-	61	0	166	0.544	3.96	1.10
BEAR BROOK POND	84 JUL	35	35 6.72	120	115	49	5	158	54	51	21	42	2	2.06	56	0	118	0.427	3.92	1.12	
BREAKNECK POND	84 JUL	25	32 6.60	80	100	32	5	132	5	16	0	38	4	1.31	44	0	150	0.366	4.28	0.98	
BREAKNECK BROOK	82 OCT	20	35 6.48	126	118	49	8	151	11	19	5	57	-	-	2.87	50	0	124	0.431	4.13	1.09
BREAKNECK BROOK	82 NOV	20	35 6.59	107	118	49	7	151	5	30	5	84	-	-	4.50	54	0	132	0.434	4.09	1.11
BREAKNECK BROOK	83 EMAR	25	31 6.37	51	88	40	5	136	8	23	2	105	-	-	3.37	76	4	128	0.383	4.76	1.04
BREAKNECK BROOK	83 MHAR	10	27 6.35	39	77	35	4	122	4	10	3	110	-	-	3.75	62	4	115	0.333	4.95	1.08
BREAKNECK BROOK	83 APR	25	29 6.50	49	86	37	4	132	5	13	6	81	-	-	2.83	62	4	115	0.350	4.66	1.13
BREAKNECK BROOK	83 JUN	25	27 6.70	84	87	37	4	124	5	16	0	82	-	-	2.44	52	0	96	0.343	4.22	1.09
BREAKNECK BROOK	83 JUL	20	51 7.06	320	220	77	6	178	9	14	3	20	-	-	1.69	44	12	108	0.658	2.87	0.99
BREAKNECK BROOK	83 AUG	15	57 7.11	328	247	84	8	199	5	19	5	14	-	-	1.72	43	10	155	0.727	2.76	1.00
BREAKNECK BROOK	83 OCT	15	57 6.87	349	268	88	9	224	5	18	0	12	-	-	2.12	49	3	114	0.758	2.94	1.14
BREAKNECK BROOK	84 FEB	10	29 6.36	28	76	34	4	137	0	19	0	69	2	2.81	65	3	131	0.338	5.10	1.11	
BREAKNECK BROOK	84 MAR	0	33 6.15	51	91	42	5	163	0	1	8	30	1	2.85	60	1	149	0.382	4.96	1.15	
BREAKNECK BROOK	84 JUL	20	34 6.73	156	129	48	4	144	16	25	0	40	6	2.62	49	2	89	0.425	3.75	1.10	
BREAKNECK BROOK	OCT 26	15	58 6.93	295	225	79	10	235	-	-	-	13	-1	-	-	49	1	183	0.717	3.03	1.04
BREAKNECK BROOK	NOV 9	5	57 6.89	267	222	77	7	231	-	-	-	9	-0	-	-	51	5	182	0.698	3.12	1.07
BREAKNECK BROOK	NOV 13	15	48 6.83	166	161	63	11	220	-	-	-	45	-2	-	-	50	3	190	0.576	3.53	1.11
BUBBLE POND SFC	82 OCT	15	35 6.54	74	101	46	8	150	0	8	10	20	-	-	3.64	84	0	131	0.415	4.37	1.05
BUBBLE POND SFC	82 NOV	10	36 6.37	75	106	48	6	146	0	10	4	41	-	-	-	96	0	129	0.434	4.51	1.02
BUBBLE POND SFC	83 FEB	10	37 6.13	42	103	55	5	145	2	23	15	116	-	-	-	104	3	136	0.456	5.01	1.15
BUBBLE POND SFC	83 MHAR	10	33 5.90	25	84	44	4	141	1	18	13	86	-	-	-	88	6	141	0.388	5.56	1.06
BUBBLE POND SFC	83 APR	10	34 6.65	54	103	49	5	150	0	13	7	91	-	-	-	80	1	128	0.416	4.38	1.17
BUBBLE POND SFC	83 JUN	10	33 6.54	50	95	43	5	143	0	5	5	60	-	-	-	92	0	130	0.402	4.57	1.05
BUBBLE POND SFC	83 JUL	5	35 6.52	51	101	44	5	144	21	7	0	44	-	-	-	100	4	139	0.423	4.55	1.00
BUBBLE POND SFC	83 OCT	-	34 6.53	49	106	48	6	154	5	11	4	27	-	-	-	91	0	128	0.417	4.54	1.17
BUBBLE POND SFC	84 FEB	5	33 5.50	9	70	37	5	144	0	34	11	111	36	2.25	85	6	162	0.375	6.49	1.00	
BUBBLE POND SFC	84 MHAR	10	42 5.82	30	96	52	7	181	0	23	16	83	32	2.62	96	2	209	0.472	5.50	1.01	
BUBBLE POND SFC	84 MAR	10	38 5.80	33	97	48	6	161	0	20	9	82	29	2.87	64	3	201	0.425	5.47	1.05	
BUBBLE POND SFC	84 APR	5	37 6.43	47	99	46	6	157	0	20	11	91	49	3.04	86	0	170	0.435	4.69	1.04	
BUBBLE POND SFC	84 JUL	0	32 6.47	50	101	44	5	144	4	7	9	37	-	-	2.89	85	0	138	0.381	4.75	1.04
BUBBLE POND 10M	83 FEB	15	40 6.30	71	118	54	6	167	2	11	8	80	-	-	-	104	3	151	0.488	4.56	1.05
BUBBLE POND 10M	83 MHAR	10	42 6.20	92	140	56	6	169	4	24	6	36	-	-	-	96	9	151	0.511	4.47	1.07
BUBBLE POND 10M	83 JUN	10	35 6.51	46	93	44	5	145	0	5	7	59	-	-	-	90	0	152	0.409	4.64	0.99
BUBBLE POND 10M	83 JUL	5	36 6.47	50	101	44	5	144	4	7	9	37	-	-	-	101	4	144	0.425	4.61	0.99
BUBBLE POND 10M	84 APR	5	37 6.42	42	100	46	6	157	0	21	17	75	31	-	-	86	0	170	0.432	4.73	1.05
BUBBLE POND 10M	84 JUL	5	32 6.43	42	90	39	6	139	0	8	9	37	5	2.89	92	0	131	0.385	4.78	1.04	
BUBBLE BROOK	82 NOV	10	37 6.03	62	105	48	5	149	0	16	8	70	-	-	-	100	0	153	0.449	4.93	0.98
BUBBLE BROOK	83 FEB	15	42 6.35	52	111	57	5	174	1	17	8	90	-	-	-	102	3	188	0.494	4.67	1.00
BUBBLE BROOK	83 EMAR	15	38 6.12	39	108	50	5	166	2	17	10	107	-	-	-	80	5	180	0.453	5.04	1.08
BUBBLE BROOK	83 MHAR	10	32 5.90	23	83	42	4	141	1	19	11	144	-	-	-	94	6	131	0.394	5.60	1.07
BUBBLE BROOK	83 APR	10	34 6.50	44	102	46	5	144	0	9	5	97	-	-	-	80	5	146	0.415	4.63	1.08
BUBBLE BROOK	83 JUN	5	33 6.54	34	93	43	5	145	0	9	3	75	-	-	-	90	0	133	0.356	4.75	1.11
BUBBLE BROOK	83 JUL	30	29 6.20	15	71	33	5	125	5	6	15	197	-	-	-	103	3	111	0.368	5.56	1.01
BUBBLE BROOK	83 AUG	5	36 6.12	60	106	46	6	159	5	12	2	24	-	-	-	93	3	134	0.425	4.86	1.10
BUBBLE BROOK	83 OCT	10	37 5.92	14	89	43	7	155	0	28	9	83	-	-	-	101	29	150	0.423	5.77	1.00
BUBBLE BROOK	84 FEB	-	29 5.52	9	63	35	5	132	0	48	4	121	37	-	-	82	5	129	0.341	6.49	1.08
BUBBLE BROOK	84 MHAR	10	40 5.87	14	86	49	7	181	0	31	14	107	45	-	-	88	3	217	0.452	5.82	1.02
BUBBLE BROOK	84 MAR	5	34 5.88	29	92	45	6	157	0	15	10	76	24	3.00	66	11	154	0.394	5.48	1.17	

APPENDIX G (CONT)

SITE	DATE	PT-CU COLOR	COND UMHOS	PH	ALK	CA	MG	K	NA	FE	MN	ZN	TOTAL PPB	LABILE AL PPB	SI02 PPM	S04 PPM	NO3	CL	PMOLE	CSI +/- RATIO	
BUBBLE BROOK	84 JUL	10	32	6.38	53	94	40	6	144	0	56	6	29	5	3.04	78	0	130	0.383	4.70	1.09
THE BOWL SFC	82 OCT	25	34	6.22	46	60	51	9	176	16	25	4	26	-	0.75	61	0	169	0.377	5.12	1.08
THE BOWL SFC	82 NOV	15	37	6.34	34	63	51	8	179	5	17	0	31	-	4.87	80	0	185	0.401	5.11	1.01
THE BOWL SFC	83 FEB	20	42	5.71	23	72	63	9	213	6	28	4	49	-	-	92	3	202	0.460	5.85	1.12
THE BOWL SFC	83 MMAR	10	40	5.63	21	70	59	8	200	4	32	9	86	-	2.06	83	6	204	0.446	5.99	1.08
THE BOWL SFC	83 APR	15	36	6.13	18	66	55	7	183	5	24	8	53	-	1.50	94	2	160	0.408	5.57	1.14
THE BOWL SFC	83 JUL	20	41	6.45	30	69	58	8	198	16	24	0	21	-	0.60	87	4	217	0.445	5.02	0.99
THE BOWL SFC	83 OCT	15	41	6.31	33	74	60	10	220	16	36	0	17	-	0.58	69	0	210	0.442	5.08	1.17
THE BOWL SFC	84 FEB	15	38	5.86	10	53	50	7	187	5	58	0	58	16	1.42	71	2	220	0.397	6.21	1.00
THE BOWL SFC	84 MMAR	10	44	5.74	8	69	63	8	235	0	24	4	45	10	-	77	4	240	0.464	6.29	1.15
THE BOWL SFC	84 MMAR	5	42	5.56	10	65	58	8	222	0	42	7	49	14	1.57	73	3	226	0.440	6.42	1.15
THE BOWL SFC	84 APR	5	40	5.99	12	63	58	8	213	5	43	3	54	28	1.41	77	0	223	0.434	5.93	1.11
THE BOWL SFC	84 JUL	5	38	6.33	19	60	51	8	200	16	57	0	29	6	0.75	77	0	206	0.408	5.40	1.06
THE BOWL 6M	83 MMAR	15	43	5.87	32	77	63	9	210	4	35	7	70	-	1.69	85	7	217	0.474	5.51	1.06
THE BOWL 6M	83 JUN	15	38	5.95	20	63	54	7	195	5	40	4	55	-	-	83	0	194	0.417	5.72	1.08
THE BOWL 6M	83 JUL	20	40	5.98	26	68	55	7	188	11	28	0	44	-	1.31	78	7	212	0.428	5.55	0.99
THE BOWL 6M	84 APR	5	40	5.97	11	62	56	8	214	5	43	6	60	31	1.39	78	0	220	0.432	5.96	1.11
THE BOWL 6M	84 JUL	5	38	6.33	19	59	52	8	201	11	81	20	30	8	0.88	76	0	208	0.410	5.40	1.06
CANON BROOK RT 3	82 OCT	15	31	6.47	82	81	44	8	146	11	39	6	81	-	5.25	68	6	108	0.380	4.49	1.06
CANON BROOK RT 3	82 NOV	15	33	6.41	58	84	46	5	152	11	40	6	68	-	5.25	78	0	132	0.393	4.68	1.07
CANON BROOK RT 3	83 FEB	10	35	6.44	69	90	52	5	169	5	28	8	46	-	4.52	73	2	133	0.411	4.55	1.14
CANON BROOK RT 3	83 EMAR	10	31	6.08	20	68	45	4	151	3	37	6	78	-	3.06	84	0	140	0.367	5.56	1.10
CANON BROOK RT 3	83 MMAR	10	28	5.91	13	60	40	4	137	4	24	8	134	-	3.04	81	5	119	0.342	5.98	1.12
CANON BROOK RT 3	MAR 24	-	28	6.07	33	63	40	4	133	0	19	10	83	-	3.21	82	0	104	0.338	5.33	1.08
CANON BROOK RT 3	MAR 31	-	31	6.18	35	76	46	5	152	4	24	7	43	-	3.75	86	0	116	0.368	5.18	1.18
CANON BROOK RT 3	APR 7	-	29	6.27	27	72	42	5	140	3	19	6	57	-	3.37	86	0	113	0.351	5.23	1.15
CANON BROOK RT 3	83 APR	20	32	6.21	26	77	44	5	154	4	20	7	52	-	3.56	82	0	140	0.374	5.26	1.13
CANON BROOK RT 3	APR 21	-	32	6.21	25	70	43	5	145	5	19	5	80	-	3.58	56	3	178	0.360	5.32	1.00
CANON BROOK RT 3	APR 28	-	33	6.22	24	73	43	5	151	2	21	10	60	-	3.37	100	0	142	0.386	5.31	1.02
CANON BROOK RT 3	MAY 5	-	31	6.25	28	72	41	5	149	4	20	8	67	-	3.39	92	0	122	0.368	5.23	1.11
CANON BROOK RT 3	MAY 12	-	32	6.27	30	82	45	6	159	5	28	6	55	-	3.75	90	5	120	0.386	5.12	1.19
CANON BROOK RT 3	MAY 19	-	30	6.23	35	76	42	6	149	5	25	6	47	-	3.62	88	0	113	0.364	5.13	1.16
CANON BROOK RT 3	83 JUN	15	31	6.39	48	71	40	6	150	5	27	9	50	-	3.75	81	0	120	0.362	4.85	1.07
CANON BROOK RT 3	83 JUL	40	39	6.52	100	108	55	8	174	11	28	6	145	-	4.56	68	9	156	0.478	4.23	1.04
CANON BROOK RT 3	83 AUG	10	49	6.70	172	153	63	10	203	16	70	4	39	-	4.31	101	3	130	0.403	5.60	1.19
CANON BROOK RT 3	83 OCT	5	34	5.96	19	86	47	8	158	5	43	7	65	-	4.27	76	0	158	0.334	6.00	0.94
CANON BROOK RT 3	FEB 16	5	30	5.84	16	53	35	4	139	0	47	4	62	11	2.27	76	0	197	0.438	5.62	1.17
CANON BROOK RT 3	FEB 10	10	39	5.97	17	91	54	4	190	5	32	8	44	24	3.67	73	8	221	0.430	4.21	1.13
CANON BROOK RT 3	84 MMAR	15	39	5.76	9	76	53	6	200	0	36	13	82	4	2.62	69	0	181	0.371	5.71	1.04
CANON BROOK RT 3	84 MMAR	10	34	5.82	25	70	44	5	164	5	25	14	79	-	3.75	81	1	198	0.366	5.76	1.18
CANON BROOK RT 3	FEB 24	10	33	6.05	12	77	44	5	160	5	21	7	52	2	3.00	63	0	181	0.371	5.71	1.04
CANON BROOK RT 3	MAR 2	10	34	5.95	15	70	44	5	164	0	21	11	71	3	3.00	52	2	198	0.369	5.82	1.07
CANON BROOK RT 3	MAR 9	10	40	6.32	46	95	52	9	190	5	28	22	54	-	3.75	69	2	222	0.446	4.83	1.10
CANON BROOK RT 3	84 MMAR	10	43	5.74	10	97	64	9	227	5	42	13	85	-	4.26	72	0	222	0.482	6.06	1.31
CANON BROOK RT 3	MAR 23	10	24	5.60	4	61	30	4	106	0	26	10	73	3	1.95	59	1	115	0.278	6.82	1.15
CANON BROOK RT 3	84 MMAR	10	14	6.01	21	43	16	2	57	0	9	2	45	2	2.53	33	0	60	0.171	5.81	1.05
CANON BROOK RT 3	APR 6	10	26	5.55	5	28	37	5	146	5	29	11	103	5	1.93	53	1	136	0.283	7.09	1.13
CANON BROOK RT 3	APR 13	10	31	6.10	15	72	43	5	163	0	17	8	49	2	3.07	65	2	150	0.356	5.64	1.23
CANON BROOK RT 3	APR 20	10	31	5.91	10	64	39	5	152	0	14	6	54	2	2.89	78	2	155	0.351	6.08	1.07
CANON BROOK RT 3	JUN 30	10	21	6.40	30	51	24	4	90	0	14	2	16	11	1.12	74	3	69	0.248	5.20	0.97
CANON BROOK RT 3	84 JUL	10	32	6.50	83	83	41	6	157	16	34	4	66	16	4.12	63	3	124	0.385	4.44	1.06
CANON BROOK RT 3	OCT 26	15	48	6.59	181	160	69	10	204	-	-	-	17	-	-	61	1	168	0.575	3.73	1.08
CANON BROOK RT 3	NOV 9	5	47	6.61	87	129	66	10	202	-	-	-	33	-	-	90	2	210	0.545	4.12	1.04
CANON BROOK RT 3	NOV 13	10	46	5.96	23	99	56	15	204	-	-	-	86	4	-	100	0	240	0.510	5.45	1.03
CANON-CADILLAC	82 NOV	10	35	5.70	20	86	42	2	144	0	2	12	70	-	5.06	89	0	174	0.399	5.84	0.98

SITE	DATE	PT-CO COLOR	COND UMHOS	PH	ALK	CA	MG	K	NA	FE	MN	ZN	TOTAL AL PPB	LABILE AL PPB	SIQ2 PPM	SQ4	NO3	CL	I MPOLE	CSI	+/- RATIO
CANON-CADILLAC	83 FEB	10	38	5.93	31	88	49	3	164	0	2	11	34	-	3.64	84	0	201	0.426	5.41	0.96
CANON-CADILLAC	83 EMAR	5	35	5.76	7	78	44	3	149	0	7	10	86	-	3.00	90	C	180	0.395	6.28	0.99
CANON-CADILLAC	83 MHAR	5	29	5.75	5	68	38	2	135	1	4	13	98	-	3.19	87	4	123	0.343	6.48	1.12
CANON-CADILLAC	83 APR	15	28	5.77	8	63	34	4	125	0	30	9	112	-	3.00	84	1	121	0.329	6.33	1.07
CANON-CADILLAC	83 JUN	10	26	6.15	20	57	29	4	126	0	2	8	48	-	3.41	102	0	87	0.313	5.57	1.04
CANON-CADILLAC	83 JUL	5	31	6.22	76	85	44	4	151	3	6	19	61	-	-	71	11	94	0.378	4.75	1.13
CANON-CADILLAC	83 OCT	5	32	5.94	13	70	35	5	151	0	5	14	92	-	4.12	92	4	141	0.370	5.88	1.04
CANON-CADILLAC	84 FEB	0	26	5.64	3	55	30	3	129	0	37	10	84	37	-	84	0	104	0.302	6.90	1.17
CANON-CADILLAC	84 MHAR	10	42	5.17	-4	64	47	5	192	0	27	16	126	66	2.06	80	0	245	0.435	-	0.97
CANON-CADILLAC	84 LMAR	10	30	5.60	7	55	32	3	139	0	3	10	67	35	2.27	75	1	159	0.328	6.59	0.99
CANON-CADILLAC	84 JUL	5	27	6.29	43	60	31	3	137	5	2	8	38	8	3.94	81	1	103	0.321	5.08	1.02
CANON-DORR	82 NOV	10	37	6.29	60	107	45	4	154	0	0	8	54	-	6.00	91	0	152	0.436	4.68	1.02
CANON-DORR	83 FEB	10	42	6.40	71	126	53	4	172	1	1	3	82	-	4.50	91	4	185	0.501	4.43	1.01
CANON-DORR	83 EMAR	10	32	6.16	22	83	43	3	148	1	7	12	85	-	-	88	0	140	0.384	5.36	1.11
CANON-DORR	83 MHAR	10	29	5.97	12	69	36	3	127	1	7	8	135	-	3.19	86	5	123	0.348	5.89	1.05
CANON-DORR	83 APR	10	29	6.32	29	81	37	4	127	0	20	7	66	-	3.58	64	2	135	0.342	5.09	1.09
CANON-DORR	83 JUN	15	30	6.54	53	85	35	4	133	0	4	5	48	-	4.12	99	0	98	0.369	4.59	1.03
CANON-DORR	83 JUL	5	47	6.58	183	188	59	3	171	2	14	9	51	-	5.47	102	11	122	0.602	3.66	1.01
CANON-DORR	83 OCT	5	32	6.20	45	91	39	6	154	0	6	6	65	-	5.31	85	1	112	0.384	4.97	1.20
CANON-DORR	84 FEB	5	25	5.72	10	42	28	4	125	0	22	2	86	28	2.06	78	0	114	0.289	6.45	1.02
CANON-DORR	84 MHAR	10	43	5.84	10	85	51	5	196	0	13	9	65	28	2.44	71	0	262	0.455	6.03	1.00
CANON-DORR	84 LMAR	10	29	5.83	22	68	34	4	137	0	2	4	56	21	2.70	61	1	149	0.328	5.78	1.05
CANON-DORR	84 JUL	0	32	6.45	80	105	39	3	148	0	1	11	31	5	4.87	91	1	95	0.402	4.41	1.11
CANON-WEST	82 NOV	10	31	5.64	7	64	39	3	139	0	5	13	78	-	4.69	77	0	157	0.347	6.51	1.03
CANON-WEST	83 FEB	10	34	5.51	15	49	48	3	160	0	4	11	102	-	3.43	82	0	158	0.384	6.26	1.11
CANON-WEST	83 EMAR	10	30	5.54	15	59	39	3	139	1	10	13	106	-	-	76	2	140	0.342	6.29	1.04
CANON-WEST	83 MHAR	5	26	5.56	2	53	35	3	123	1	11	10	117	-	2.81	76	4	114	0.306	7.20	1.10
CANON-WEST	83 APR	10	24	5.65	3	54	34	3	123	0	5	10	108	-	2.81	80	1	112	0.306	6.95	1.10
CANON-WEST	83 JUN	15	24	5.89	14	45	27	3	123	0	3	7	66	-	2.87	90	0	85	0.285	6.10	1.06
CANON-WEST	83 JUL	5	22	5.64	3	40	24	3	109	2	13	7	78	-	-	78	8	84	0.256	7.03	1.03
CANON-WEST	83 OCT	5	31	5.48	-2	64	35	6	144	0	10	16	93	-	3.96	92	6	134	0.352	-	1.09
CANON-WEST	84 FEB	0	29	5.38	1	54	47	4	128	0	56	7	86	37	1.93	79	1	137	0.331	7.52	1.10
CANON-WEST	84 MHAR	10	42	5.19	-4	63	48	5	190	0	27	14	123	62	2.06	69	0	251	0.425	-	1.00
CANON-WEST	84 LMAR	5	29	5.42	3	46	31	4	137	0	5	9	76	41	2.25	69	2	150	0.308	7.22	1.01
CANON-WEST	84 JUL	0	27	5.66	35	55	33	2	140	0	10	7	48	29	3.75	76	0	108	0.314	5.84	1.08
CANON-WEST	NOV 9	6	40	5.62	29	78	51	7	195	-	-	-	92	4	-	79	0	210	0.445	5.81	1.05
CANON-WEST	NOV 13	10	43	5.47	3	76	48	11	199	-	-	-	123	5	-	92	1	245	0.466	7.03	0.99
CROWELL BROOK	82 OCT	130	51	6.11	165	158	99	8	224	0	37	7	147	-	7.31	63	0	198	0.642	4.25	1.15
CROWELL BROOK	82 NOV	90	48	6.20	102	123	80	9	223	0	22	3	126	-	6.41	80	0	212	0.577	4.48	1.10
CROWELL BROOK	83 EMAR	60	49	5.91	47	94	72	11	235	14	35	6	199	-	4.12	96	3	240	0.563	5.23	1.08
CROWELL BROOK	83 MHAR	40	44	5.85	47	89	61	8	214	9	19	8	186	-	4.50	72	8	223	0.502	5.31	1.07
CROWELL BROOK	83 APR	80	46	6.12	64	101	66	6	223	11	17	6	160	-	3.94	78	5	229	0.535	4.85	1.05
CROWELL BROOK	83 JUN	120	43	6.18	116	104	62	5	213	21	34	8	200	-	3.94	63	0	185	0.521	4.52	1.05
CROWELL BROOK	83 JUL	80	85	6.61	399	314	140	18	322	5	4	5	151	-	5.25	92	9	260	1.076	3.07	1.05
CROWELL BROOK	83 AUG	30	103	6.62	429	308	212	62	412	177	107	11	511	-	-	89	12	352	1.330	3.04	1.13
CROWELL BROOK	83 OCT	30	101	6.70	467	364	153	27	375	27	49	0	196	-	9.02	101	12	347	1.265	2.85	0.99
CROWELL BROOK	84 FEB	40	43	5.99	26	77	54	7	222	5	47	6	112	2	3.00	71	2	240	0.470	5.49	1.07
CROWELL BROOK	84 MHAR	25	56	5.86	34	116	86	11	263	11	45	2	134	14	3.19	82	0	320	0.621	5.33	1.10
CROWELL BROOK	84 LMAR	40	52	5.81	49	102	70	7	275	5	10	3	55	25	2.62	67	1	291	0.560	5.27	1.12
CROWELL BROOK	84 JUL	120	53	6.15	182	166	108	17	220	113	174	6	0	0	8.81	60	3	196	0.643	4.15	1.16
DUCK BROOK	82 OCT	50	39	6.32	75	101	46	11	190	5	9	8	125	-	3.84	68	0	172	0.461	4.58	1.11
DUCK BROOK	82 NOV	30	38	6.32	57	98	46	7	176	0	20	3	75	-	-	70	3	181	0.438	4.71	1.05
DUCK BROOK	83 EMAR	20	35	6.20	33	89	48	6	143	3	18	4	30	-	-	70	5	175	0.392	5.12	1.01
DUCK BROOK	83 MHAR	10	37	6.21	34	90	48	5	183	2	13	4	43	-	-	76	5	175	0.421	5.09	1.13
DUCK BROOK	83 APR	15	38	6.47	33	88	45	5	172	5	8	6	27	-	-	82	5	186	0.419	4.85	1.01

APPENDIX G (CONT)

SITE	DATE	PT-CO COLOR	COND UMHOS	PH	ALK	CA	MG	K	NA	FE	MN	ZN	TOTAL AL	LABILE AL	PPB	SIU2 PPM	SO4	NO3	CL	1 MMOLE	CSI +/- RATIO	
DUCK BROOK	83 JUN	15	35	6.58	49	91	44	5	164	0	17	0	43	-	-	-	81	0	157	0.410	4.55	1.06
DUCK BROOK	83 JUL	25	39	6.48	76	121	53	5	172	9	2	2	30	-	-	0.66	52	6	184	0.452	4.34	1.10
DUCK BROOK	83 AUG	10	45	6.55	104	131	59	7	191	11	23	0	32	-	-	-	75	0	201	0.521	4.09	1.02
DUCK BROOK	83 OCT	30	48	6.72	77	129	86	10	194	5	6	0	32	-	-	3.37	135	0	181	0.585	4.06	1.07
DUCK BROOK	84 FEB	5	37	6.26	29	90	44	6	195	0	23	0	36	10		1.69	75	1	176	0.418	5.10	1.20
DUCK BROOK	84 MAR	15	44	6.13	29	100	51	7	225	0	27	5	34	0		1.86	82	0	235	0.486	5.19	1.11
DUCK BROOK	84 MAR	5	42	6.00	34	92	48	6	209	0	13	4	25	0		2.44	72	3	218	0.451	5.28	1.09
DUCK BROOK	84 JUL	10	40	6.48	55	103	48	6	173	5	18	3	13	6		1.14	79	5	209	0.448	4.55	0.97
EAGLE LK N SFC	82 OCT	10	36	6.57	47	86	46	8	163	0	9	3	13	-	-	-	90	5	158	0.405	4.60	1.03
EAGLE LK N SFC	82 NOV	10	38	6.43	42	93	48	7	162	0	14	5	11	-	-	-	96	0	179	0.427	4.75	1.00
EAGLE LK N SFC	83 FEB	10	41	6.47	40	99	54	7	181	1	9	4	14	-	-	-	96	0	195	0.462	4.71	1.03
EAGLE LK N SFC	83 MAR	5	36	6.04	29	88	47	6	162	1	7	5	29	-	-	-	84	8	170	0.410	5.33	1.04
EAGLE LK N SFC	83 APR	10	38	6.42	36	94	49	6	166	0	10	2	19	-	-	-	94	3	171	0.430	4.83	1.03
EAGLE LK N SFC	83 JUN	10	37	6.58	39	92	45	6	167	0	6	15	38	-	-	-	85	0	172	0.419	4.64	1.05
EAGLE LK N SFC	83 JUL	10	37	6.60	38	91	47	6	161	0	4	5	15	-	-	-	50	4	175	0.421	4.64	0.99
EAGLE LK N SFC	83 OCT	5	36	6.41	38	96	48	7	175	0	19	0	13	-	-	-	72	0	171	0.413	4.80	1.16
EAGLE LK N SFC	84 FEB	5	36	6.00	31	89	48	7	175	0	15	0	31	7		1.50	75	0	174	0.410	5.33	1.14
EAGLE LK N SFC	84 MAR	10	40	6.30	34	87	49	7	177	0	14	2	24	7			85	2	205	0.437	5.00	0.98
EAGLE LK N SFC	84 APR	5	36	6.03	34	91	47	6	175	0	14	0	24	4		1.48	78	3	165	0.411	5.26	1.14
EAGLE LK N SFC	84 APR	0	37	6.44	27	88	46	6	174	0	14	7	37	19		1.56	86	0	186	0.422	4.96	1.06
EAGLE LK N SFC	84 JUL	5	37	6.38	39	90	46	6	167	5	10	0	37	18		1.50	82	1	185	0.423	4.86	1.02
EAGLE LK N SFC	83 FEB	10	40	6.43	45	94	51	6	172	2	24	3	23	-	-	-	92	2	191	0.448	4.72	0.98
EAGLE LK N SFC	83 MAR	10	39	6.45	41	100	51	6	175	0	6	4	22	-	-	-	88	5	176	0.443	4.72	1.07
EAGLE LK N SFC	83 JUN	10	36	6.57	38	87	46	6	164	0	5	8	15	-	-	-	85	0	165	0.407	4.69	1.06
EAGLE LK N SFC	83 JUL	15	36	6.45	32	91	46	6	157	1	4	9	34	-	-	-	100	3	160	0.421	4.86	1.02
EAGLE LK N SFC	84 APR	0	38	6.43	36	89	46	6	174	0	14	6	64	44		1.69	90	0	189	0.437	4.85	1.02
EAGLE LK S SFC	82 OCT	10	35	6.51	44	88	47	7	159	0	12	2	11	-	-	1.12	76	0	166	0.400	4.68	1.05
EAGLE LK S SFC	82 NOV	10	36	6.40	42	94	48	6	161	0	14	4	9	-	-	-	89	5	159	0.418	4.79	1.05
EAGLE LK S SFC	83 FEB	10	38	6.45	41	94	50	6	169	1	7	3	13	-	-	-	91	0	177	0.434	4.74	1.04
EAGLE LK S SFC	83 MAR	5	36	5.91	21	80	43	4	152	1	16	13	122	-	-	-	87	11	175	0.411	5.65	0.96
EAGLE LK S SFC	83 APR	10	37	6.45	37	94	49	6	160	0	9	2	22	-	-	-	92	4	167	0.424	4.79	1.03
EAGLE LK S SFC	83 JUN	10	36	6.59	39	92	46	6	167	0	6	8	23	-	-	-	84	0	164	0.413	4.64	1.08
EAGLE LK S SFC	83 JUL	5	37	6.48	39	91	46	6	159	2	5	4	21	-	-	-	82	5	177	0.415	4.75	1.00
EAGLE LK S SFC	83 OCT	-	37	6.41	37	97	49	7	175	0	18	0	39	-	-	-	79	0	178	0.429	4.81	1.11
EAGLE LK S SFC	84 APR	0	38	6.47	33	90	45	6	172	0	13	3	41	16		-	76	0	203	0.425	4.84	1.01
EAGLE LK S SFC	84 JUL	5	38	6.44	32	90	45	6	172	0	5	3	21	14		1.35	81	0	191	0.420	4.88	1.04
EAGLE LK S SFC	83 FEB	10	39	6.42	41	95	51	6	171	1	6	2	89	-	-	-	90	2	187	0.454	4.77	1.01
EAGLE LK S SFC	83 MAR	5	39	6.30	41	99	51	6	171	1	7	6	36	-	-	-	87	7	176	0.443	4.87	1.05
EAGLE LK S SFC	83 JUN	10	38	6.53	38	89	46	6	165	0	6	13	14	-	-	-	91	0	185	0.425	4.71	0.98
EAGLE LK S SFC	83 JUL	10	36	6.24	36	90	45	6	154	3	20	9	42	-	-	-	94	3	160	0.415	5.03	1.01
EAGLE LK S SFC	84 APR	0	38	6.49	35	91	46	6	172	0	16	5	49	23		1.50	78	0	201	0.429	4.79	1.01
EAGLE LK S SFC	84 JUL	5	37	6.30	30	92	46	7	172	0	6	6	16	7		1.50	83	0	182	0.418	5.04	1.08
EAGLE LK S SFC	82 NOV	10	34	5.83	13	91	43	4	139	0	6	14	127	7		4.57	93	5	157	0.406	5.89	1.04
EAGLE LK S SFC	83 FEB	5	36	5.90	13	88	49	4	157	1	4	12	93	-		3.82	92	4	176	0.420	5.82	1.05
EAGLE LK S SFC	83 MAR	15	34	5.56	4	79	43	4	143	1	13	15	122	-		3.19	82	9	170	0.385	6.71	1.02
EAGLE LK S SFC	83 MAR	15	32	5.62	-3	74	39	4	130	2	11	16	187	-		3.28	85	9	160	0.380	-	0.98
EAGLE LK S SFC	83 APR	15	29	5.64	6	64	32	4	120	0	6	8	174	-		2.89	88	1	137	0.347	4.55	0.96
EAGLE LK S SFC	83 JUN	20	27	6.10	16	61	29	4	122	0	3	9	140	-		3.37	96	0	101	0.330	5.69	1.02
EAGLE LK S SFC	83 JUL	25	30	6.08	22	82	35	5	127	2	14	7	135	-		4.33	101	11	102	0.374	5.45	1.07
EAGLE LK S SFC	83 OCT	10	35	5.66	4	91	41	6	151	0	8	13	128	-		4.87	110	10	139	0.418	6.56	1.11
EAGLE LK S SFC	84 FEB	10	28	5.30	-1	54	31	4	123	0	54	13	178	73		2.06	85	6	120	0.328	-	1.07
EAGLE LK S SFC	84 MAR	10	43	4.91	-11	72	44	5	173	0	34	18	195	96		1.88	72	7	242	0.440	-	0.99
EAGLE LK S SFC	84 MAR	10	31	5.52	7	67	35	4	139	0	8	9	95	35		2.81	72	4	155	0.346	6.56	1.06
EAGLE LK S SFC	84 JUL	5	27	5.87	21	60	27	4	130	0	3	9	78	20		4.31	84	1	111	0.316	5.82	1.04
EAGLE LK S SFC	82 NOV	10	33	5.35	-2	59	44	3	154	0	8	12	159			4.57	94	5	155	0.383	-	1.04

APPENDIX G (CONT)

SITE	DATE	PT-CO COLOR	COND UMIOS	PH	ALK	CA	MG	K	NA	FE	MN	ZN	TOTAL PPB AL	LABILE AL PPB	SI02 PPM	S04 M03	CL	I	CS1	+/- RATIO	
EAGLE EAST IN1	83 FEB	5	34	5.32	1	64	50	3	160	1	7	7	176	-	3.62	90	3	160	0.396	7.81	1.11
EAGLE EAST IN1	83 MAR	15	33	5.21	-3	57	44	3	151	1	17	7	218	-	3.06	80	3	160	0.378	-	1.08
EAGLE EAST IN1	83 MAR	10	30	5.27	-3	51	41	3	141	0	6	10	248	-	3.56	85	5	133	0.361	-	1.09
EAGLE EAST IN1	83 APR	15	30	5.31	-2	51	36	3	129	0	12	3	233	-	-	90	1	146	0.357	-	0.95
EAGLE EAST IN1	83 JUN	5	28	5.45	4	47	31	3	138	0	9	5	162	-	3.21	101	0	108	0.333	7.10	1.05
EAGLE EAST IN1	83 JUL	10	30	5.60	10	55	35	3	139	1	16	5	125	-	3.96	83	16	132	0.343	6.43	0.97
EAGLE EAST IN1	83 OCT	5	36	5.21	-5	65	44	6	167	0	15	5	170	-	4.50	108	4	153	0.412	-	1.09
EAGLE EAST IN1	84 FEB	5	31	5.06	-2	42	35	4	137	0	52	8	224	114	2.27	96	6	126	0.350	-	1.05
EAGLE EAST IN1	84 MAR	15	41	5.03	-8	70	44	5	172	0	34	18	181	99	1.88	64	5	240	0.424	-	1.01
EAGLE EAST IN1	84 MAR	5	34	5.09	-5	51	37	3	147	0	19	6	172	84	2.83	71	1	182	0.358	-	1.01
EAGLE EAST IN1	84 JUL	5	30	5.52	6	57	29	2	137	0	16	6	105	48	3.94	89	1	138	0.334	6.74	1.00
EAGLE EAST IN1	NOV 9	3	38	5.34	8	58	38	5	195	-	-	-	160	7	-	84	0	196	0.410	6.77	1.05
EAGLE EAST IN1	NOV 13	10	51	5.12	5	83	60	15	226	-	-	-	248	11	-	122	3	262	0.564	7.02	1.00
EAGLE EAST IS1	82 NOV	15	35	5.90	10	102	42	3	137	0	12	21	161	-	4.76	96	10	158	0.425	5.89	1.05
EAGLE EAST IS1	83 FEB	5	37	5.98	18	102	48	4	153	2	3	13	84	-	-	92	4	176	0.433	5.53	1.04
EAGLE EAST IS1	83 MAR	15	34	5.57	4	90	42	4	138	1	14	18	148	-	-	86	11	160	0.401	6.70	1.06
EAGLE EAST IS1	83 MAR	10	30	5.67	6	82	38	4	127	1	10	16	202	-	3.37	85	11	130	0.377	6.40	1.09
EAGLE EAST IS1	83 APR	15	27	5.64	7	67	30	4	102	0	8	11	208	-	3.00	90	1	117	0.337	6.45	0.96
EAGLE EAST IS1	83 JUN	20	27	6.10	18	69	27	4	115	0	4	6	155	-	3.37	93	0	110	0.337	5.59	0.98
EAGLE EAST IS1	83 JUL	25	31	5.96	20	89	35	6	125	3	22	9	163	-	4.69	83	9	132	0.380	5.57	1.04
EAGLE EAST IS1	83 OCT	10	34	5.62	4	97	40	7	144	0	12	18	139	-	5.06	104	18	130	0.416	6.63	1.14
EAGLE EAST IS1	84 FEB	10	28	5.28	-5	58	29	5	115	0	57	18	179	62	1.93	85	7	115	0.324	-	1.04
EAGLE EAST IS1	84 MAR	15	42	5.01	-10	74	45	6	171	0	34	24	202	106	1.88	74	7	235	0.440	-	1.00
EAGLE EAST IS1	84 MAR	10	30	5.67	9	77	34	4	131	0	8	11	96	29	2.81	76	4	145	0.350	6.26	1.07
EAGLE EAST IS1	84 JUL	10	25	6.20	26	61	27	4	125	5	6	8	70	14	4.41	82	1	94	0.306	5.39	1.09
EAGLE EAST IS1	OCT 26	15	42	5.95	26	106	49	10	180	-	-	-	80	4	-	106	1	204	0.483	5.39	1.03
EAGLE EAST IS1	NOV 9	0	51	5.75	9	140	60	8	210	-	-	-	97	4	-	110	44	240	0.581	5.92	1.04
EAGLE EAST IS1	NOV 13	20	50	5.21	-4	122	53	13	197	-	-	-	290	13	-	109	33	243	0.577	-	1.02
EAGLE SOUTH INLET	82 NOV	20	45	6.51	139	127	77	7	196	0	2	5	28	-	7.69	108	0	144	0.559	4.02	1.04
EAGLE SOUTH INLET	83 FEB	15	44	6.80	121	100	82	7	191	3	6	2	68	-	3.75	104	0	164	0.538	3.90	0.98
EAGLE SOUTH INLET	83 MAR	20	41	6.49	69	109	64	7	171	3	2	3	39	-	6.94	94	2	170	0.482	4.41	1.05
EAGLE SOUTH INLET	83 MAR	15	36	6.48	55	97	58	5	151	3	9	4	110	-	5.49	99	9	133	0.448	4.57	1.05
EAGLE SOUTH INLET	83 APR	15	36	6.40	63	101	57	6	157	5	5	5	90	-	5.81	58	3	130	0.445	4.38	1.09
EAGLE SOUTH INLET	83 JUN	10	38	6.90	93	110	61	7	170	0	10	0	63	-	5.81	93	0	122	0.470	3.87	1.13
EAGLE SOUTH INLET	83 JUL	75	44	6.50	145	157	80	10	177	7	27	0	191	-	6.77	101	8	110	0.594	3.92	1.16
EAGLE SOUTH INLET	83 OCT	15	52	6.54	144	186	95	12	204	5	20	3	56	-	6.94	115	6	156	0.666	3.81	1.18
EAGLE SOUTH INLET	84 FEB	5	39	6.08	26	92	54	6	151	0	6	0	62	11	3.82	90	3	200	0.439	5.32	0.96
EAGLE SOUTH INLET	84 MAR	10	45	6.29	38	112	68	7	184	5	15	6	92	38	3.47	87	4	240	0.519	4.86	1.02
EAGLE SOUTH INLET	84 MAR	10	40	6.03	82	114	63	6	166	5	7	2	40	4	4.87	61	1	190	0.467	4.78	1.05
EAGLE SOUTH INLET	84 JUL	10	47	6.98	143	144	72	9	188	0	8	2	35	8	6.99	89	2	180	0.570	3.49	1.00
EAGLE SOUTH INLET	OCT 26	30	59	6.77	302	180	114	14	235	-	-	-	30	-1	-	158	2	95	0.779	3.28	0.97
EAGLE SOUTH INLET	NOV 9	7	63	6.78	287	235	115	12	238	-	-	-	21	-1	-	100	1	171	0.807	3.17	1.07
EAGLE SOUTH INLET	NOV 13	15	56	6.58	103	169	94	16	219	-	-	-	47	-3	-	118	0	238	0.679	3.96	1.09
EAGLE WEST INLET	82 NOV	50	32	6.16	74	106	44	3	140	11	19	7	136	-	4.95	45	0	135	0.394	4.72	1.16
EAGLE WEST INLET	83 FEB	5	34	6.23	71	97	48	4	144	6	14	3	74	-	4.50	69	2	143	0.407	4.71	1.03
EAGLE WEST INLET	83 MAR	10	28	5.75	29	69	36	4	124	4	18	2	80	-	3.56	58	0	140	0.325	5.73	1.04
EAGLE WEST INLET	83 MAR	10	26	5.85	31	64	35	3	118	3	12	6	79	-	3.84	58	0	123	0.308	5.63	1.05
EAGLE WEST INLET	83 APR	40	27	6.23	49	77	39	3	121	5	8	4	77	-	4.03	74	3	97	0.335	4.97	1.08
EAGLE WEST INLET	83 JUN	70	32	6.31	77	105	37	5	142	11	17	8	125	-	3.94	46	0	139	0.390	4.56	1.10
EAGLE WEST INLET	83 JUL	75	45	6.40	203	200	72	6	160	8	14	3	188	-	4.69	65	7	118	0.615	3.77	1.11
EAGLE WEST INLET	83 OCT	30	47	6.13	125	192	71	6	179	5	49	3	93	-	5.81	106	4	145	0.613	4.27	1.18
EAGLE WEST INLET	84 FEB	20	28	5.70	19	64	35	3	122	0	25	0	59	0	2.81	59	0	140	0.310	5.99	1.04
EAGLE WEST INLET	84 MAR	20	38	6.09	50	95	55	5	163	0	29	4	70	30	3.26	60	1	194	0.428	5.01	1.05
EAGLE WEST INLET	84 MAR	30	30	5.70	45	80	39	3	130	5	13	3	57	6	3.41	62	3	130	0.346	5.53	1.06
EAGLE WEST INLET	84 JUL	60	37	6.34	159	152	57	4	154	21	38	4	97	4	4.89	35	1	113	0.475	4.06	1.19

APPENDIX G (CONT)

SITE	DATE	PT-CO COLCR	COND UMHOS	PH	ALK	CA	MG	K	NA	FE	MN	ZN	TOTAL AL PPB	LABILE AL PPB	S102 PPM	S04 NO3	CL	I	PMOLE	CSI +/- RATIO	
ECHO LAKE SFC	82 OCT	20	53	6.66	92	126	66	11	265	0	8	2	16	-	2.34	87	0	250	0.550	4.06	1.09
ECHO LAKE SFC	82 NOV	15	54	6.64	79	128	66	10	261	0	9	2	13	-	-	100	0	266	0.603	4.14	1.05
ECHO LAKE SFC	83 APR	15	53	6.85	74	131	67	8	273	0	8	2	25	-	-	32	9	301	0.567	3.95	1.15
ECHO LAKE SFC	83 JUL	10	53	6.80	75	127	63	9	258	0	6	0	25	-	-	101	5	252	0.596	4.00	1.05
ECHO LAKE SFC	83 OCT	-	53	6.66	61	134	66	10	273	0	9	0	17	-	-	80	1	266	0.588	4.20	1.18
ECHO LAKE SFC	84 JUL	10	51	6.95	66	125	62	9	262	0	7	2	24	5	2.34	58	2	238	0.576	3.92	1.14
ECHO LAKE 18M	83 JUL	10	56	6.73	75	130	64	9	257	2	9	2	24	-	-	109	14	272	0.619	4.06	0.98
ECHO LAKE 18M	84 JUL	10	51	6.99	65	128	63	9	261	0	15	9	36	12	2.64	93	2	240	0.578	3.87	1.16
HODGOON PD SFC	82 OCT	50	34	6.20	56	68	63	8	167	0	10	2	101	-	3.00	71	4	143	0.405	4.99	1.12
HODGOON PD SFC	82 NOV	40	39	5.97	60	84	78	8	173	11	16	3	132	-	-	86	0	164	0.472	5.11	1.11
HODGOON PD SFC	83 APR	30	39	6.20	31	77	63	8	177	11	16	2	171	-	-	84	1	194	0.457	5.21	1.05
HODGOON PD SFC	83 JUL	40	35	5.98	68	71	63	5	161	10	23	0	91	-	-	82	5	137	0.420	5.11	1.03
HODGOON PD SFC	83 OCT	-	41	6.25	56	84	72	8	186	11	16	4	88	-	-	91	0	187	0.475	4.86	1.04
HODGOON PD SFC	84 JUL	45	33	6.24	50	78	63	7	154	21	63	0	98	10	2.64	64	1	136	0.396	4.95	1.22
L HAOLLOCK SFC	82 OCT	10	45	6.23	38	93	49	7	234	5	26	10	31	-	1.71	89	0	235	0.492	5.00	1.06
L HAOLLOCK SFC	82 NOV	20	46	6.45	43	98	49	6	228	5	12	3	50	-	-	101	0	233	0.511	4.71	1.01
L HAOLLOCK SFC	83 FEB	15	45	5.94	12	100	53	7	224	5	28	29	125	-	-	107	3	225	0.515	5.75	1.11
L HAOLLOCK SFC	83 MAR	10	38	5.57	10	79	48	4	179	2	23	8	168	-	-	85	10	192	0.438	6.31	1.06
L HAOLLOCK SFC	83 APR	15	45	6.24	30	103	52	5	217	5	15	6	110	-	-	96	5	230	0.512	5.05	1.05
L HAOLLOCK SFC	83 JUN	20	40	6.16	22	86	44	5	204	0	17	3	107	-	-	74	0	212	0.442	5.35	1.10
L HAOLLOCK SFC	83 JUL	10	43	6.37	30	96	48	6	204	2	25	0	43	-	-	91	7	225	0.477	4.95	1.00
L HAOLLOCK SFC	83 OCT	10	47	6.30	37	106	52	7	223	5	23	2	33	-	-	94	3	251	0.516	4.89	1.01
L HAOLLOCK SFC	84 FEB	15	45	5.51	6	87	48	6	211	0	39	6	141	40	3.19	96	6	249	0.494	6.54	1.01
L HAOLLOCK SFC	84 MAR	20	47	5.80	17	88	51	7	222	0	34	10	126	38	-	73	1	291	0.502	5.81	0.98
L HAOLLOCK SFC	84 MAR	10	46	5.51	13	87	48	6	216	0	34	8	118	51	2.70	84	3	268	0.492	6.21	0.59
L HAOLLOCK SFC	84 APR	5	46	5.95	21	88	49	7	226	5	40	12	114	57	2.83	90	0	260	0.502	5.57	1.02
L HAOLLOCK SFC	84 JUL	10	43	6.25	22	87	43	6	216	0	18	3	56	19	2.25	90	1	238	0.465	5.25	1.01
L HAOLLOCK 8M	83 FEB	20	48	6.26	46	112	57	7	239	4	6	6	62	-	-	104	0	230	0.543	4.81	1.09
L HAOLLOCK 8M	83 MAR	15	50	5.96	47	121	58	6	239	3	12	5	97	-	-	106	10	238	0.570	5.07	1.06
L HAOLLOCK 8M	83 JUN	20	40	6.15	25	87	46	5	207	0	14	7	94	-	-	84	0	199	0.450	5.30	1.13
L HAOLLOCK 8M	83 JUL	15	40	5.88	23	91	47	6	203	3	14	8	95	-	-	84	3	197	0.453	5.57	1.13
L HAOLLOCK 8M	84 APR	10	47	5.94	18	88	48	7	226	0	38	17	114	62	-	91	0	270	0.506	5.65	1.00
L HAOLLOCK 8M	84 JUL	15	46	5.95	20	89	44	6	224	0	20	9	57	11	2.44	90	0	258	0.487	5.58	1.00
U HAOLLOCK SFC	82 OCT	20	41	6.45	58	100	45	7	206	5	9	12	59	-	2.70	89	0	179	0.468	4.56	1.10
U HAOLLOCK SFC	82 NOV	25	44	6.41	45	109	46	6	204	0	10	6	91	-	-	102	0	209	0.503	4.68	1.03
U HAOLLOCK SFC	83 FEB	15	46	5.75	14	107	57	7	197	3	18	17	84	-	-	111	11	236	0.520	5.86	0.99
U HAOLLOCK SFC	83 MAR	10	29	5.40	4	61	35	3	123	3	19	10	206	-	-	89	10	120	0.350	6.96	1.02
U HAOLLOCK SFC	83 APR	15	45	6.14	24	100	46	5	209	0	16	7	128	-	-	101	3	232	0.504	5.27	1.00
U HAOLLOCK SFC	83 JUN	20	36	6.15	24	84	38	5	181	0	18	10	114	-	-	100	0	159	0.424	5.33	1.09
U HAOLLOCK SFC	83 JUL	15	38	6.49	35	95	42	5	183	3	14	0	41	-	-	98	3	162	0.435	4.77	1.09
U HAOLLOCK SFC	83 OCT	10	41	6.40	43	110	49	8	200	5	6	4	62	-	-	108	1	172	0.487	4.71	1.13
U HAOLLOCK SFC	84 FEB	15	37	5.56	8	85	44	5	167	0	32	0	123	33	2.81	91	6	174	0.421	6.38	1.10
U HAOLLOCK SFC	84 MAR	15	48	5.64	15	94	53	7	254	0	42	13	108	47	-	84	3	262	0.520	6.00	1.14
U HAOLLOCK SFC	84 MAR	10	44	5.54	17	89	44	6	235	0	38	7	106	44	2.51	80	3	232	0.477	6.07	1.15
U HAOLLOCK SFC	84 APR	5	50	6.01	12	88	48	6	257	5	40	17	115	58	-	95	0	293	0.533	5.76	1.02
U HAOLLOCK SFC	84 JUL	15	38	6.17	23	84	37	5	187	0	23	5	93	30	2.62	92	1	190	0.431	5.32	1.04
U HAOLLOCK 8M	83 FEB	20	50	6.12	53	123	56	6	235	4	12	7	97	-	-	108	0	240	0.569	4.85	1.05
U HAOLLOCK 8M	83 MAR	10	59	5.81	44	127	55	6	293	3	22	12	136	-	-	103	10	317	0.643	5.22	1.02
U HAOLLOCK 8M	83 JUN	20	37	5.98	25	85	40	5	171	0	11	14	125	-	-	91	0	183	0.428	5.48	1.02
U HAOLLOCK 8M	83 JUL	25	38	5.97	26	96	41	6	170	48	26	8	158	46	-	104	4	171	0.455	5.42	1.03
U HAOLLOCK 8M	84 APR	10	52	5.96	15	86	43	6	256	0	42	11	110	48	-	108	0	315	0.550	5.71	0.91
U HAOLLOCK 8M	84 JUL	15	35	6.32	21	79	37	6	181	0	42	4	106	25	2.53	94	3	159	0.411	5.24	1.10
HAOLLOCK BROOK	82 NOV	15	40	6.48	69	129	49	5	163	0	3	5	48	-	-	109	0	157	0.491	4.35	1.03
HAOLLOCK BROOK	83 FEB	5	42	6.37	60	132	58	5	178	1	0	3	27	-	-	115	3	162	0.512	4.51	1.10
HAOLLOCK BROOK	83 MAR	10	39	6.20	30	114	50	4	161	1	4	4	71	-	-	96	7	170	0.458	5.05	1.09

SITE	DATE	PT-CD COLOR	COND UMHDS	PH	ALK	CA	MG	K	NA	FE	MN PPB	ZN PPB	TOTAL AL PPB	LABILE AL PPB	SI02 PPM	SO4 NO3	CL	I PMOLE	CSI +/- RATIO		
HADLOCK BROOK	83 MAR	10	36	6.19	28	106	46	4	150	1	3	6	105	-	4.12	109	7	144	0.444	5.12	1.06
HADLOCK BROOK	83 APR	10	33	6.29	28	92	42	5	136	0	4	5	98	-	4.12	100	3	135	0.402	5.08	1.03
HADLOCK BROOK	83 JUN	10	35	6.40	58	105	41	5	150	0	4	11	62	-	4.50	112	0	116	0.431	4.59	1.05
HADLOCK BROOK	83 JUL	20	37	6.31	87	123	44	6	157	161	7	5	76	-	4.87	99	12	116	0.466	4.44	1.05
HADLOCK BROOK	83 AUG	25	45	6.50	95	164	65	7	184	5	4	5	84	-	5.49	110	5	142	0.569	4.09	1.19
HADLOCK BROOK	83 OCT	5	36	6.08	64	122	47	7	152	5	3	5	57	-	5.06	95	2	120	0.446	4.81	1.17
HADLOCK BROOK	84 FEB	5	34	5.76	15	85	39	5	144	0	17	0	96	29	2.81	103	6	142	0.395	5.91	1.05
HADLOCK BROOK	84 MAR	15	39	5.51	3	81	43	6	164	0	22	6	136	70	2.14	85	6	210	0.426	6.86	1.00
HADLOCK BROOK	84 LMAR	10	34	5.96	37	101	42	5	152	0	1	0	46	9	3.39	95	3	135	0.411	5.25	1.12
HADLOCK BROOK	84 JUL	5	38	6.14	79	120	45	6	162	0	3	2	39	10	4.69	109	1	120	0.464	4.66	1.09
HADLOCK BROOK	OCT 26	3	47	6.06	131	161	60	6	191	-	-	-	40	2	-	110	5	155	0.581	4.39	1.05
HADLOCK BROOK	NOV 9	5	45	6.16	63	135	53	7	185	-	-	-	36	-2	-	108	1	192	0.524	4.69	1.04
HADLOCK BROOK	NOV 13	5	50	6.06	27	137	54	11	211	-	-	-	87	4	-	113	6	256	0.573	5.16	1.03
GILMORE BROOK	82 NOV	15	42	6.85	102	158	47	5	163	0	0	4	37	-	5.49	104	0	151	0.524	3.72	1.04
GILMORE BROOK	83 FEB	10	46	6.71	93	170	53	5	178	1	1	2	37	-	4.76	95	3	186	0.554	3.87	1.08
GILMORE BROOK	83 MAR	10	38	6.50	41	126	45	4	158	1	4	4	67	-	3.94	100	12	145	0.462	4.57	1.12
GILMORE BROOK	83 MHAR	10	35	6.36	31	109	41	4	142	1	4	8	111	-	3.99	104	8	134	0.431	4.89	1.07
GILMORE BROOK	83 APR	10	35	6.54	47	116	40	5	141	0	1	4	68	-	4.31	88	5	138	0.422	4.50	1.08
GILMORE BROOK	83 JUN	5	34	6.66	64	112	37	5	144	0	2	3	62	-	4.20	104	4	108	0.423	4.26	1.08
GILMORE BROOK	83 JUL	15	37	6.69	91	134	39	5	151	0	8	0	68	-	4.74	100	14	111	0.470	4.00	1.04
GILMORE BROOK	83 OCT	10	38	6.50	83	151	41	6	159	5	0	2	74	-	5.46	100	3	120	0.489	4.18	1.17
GILMORE BROOK	84 FEB	5	32	5.94	15	86	35	5	136	0	15	5	90	19	2.51	95	7	134	0.378	5.74	1.06
GILMORE BROOK	84 MHAR	15	37	5.58	5	80	39	6	159	0	23	9	136	54	1.91	79	6	206	0.412	6.44	0.99
GILMORE BROOK	84 LMAR	10	34	6.17	51	112	37	5	143	0	1	1	42	6	3.56	84	3	135	0.407	4.85	1.09
GILMORE BROOK	84 JUL	5	36	6.75	92	133	40	5	161	0	1	0	31	8	5.06	110	3	119	0.477	3.94	1.05
GILMORE BROOK	OCT 26	8	51	6.86	189	210	58	8	190	-	-	-	25	-1	-	112	1	144	0.648	3.32	1.04
GILMORE BROOK	NOV 9	0	50	6.61	105	191	49	7	184	-	-	-	26	-1	-	105	4	200	0.598	3.87	1.04
GILMORE BROOK	NOV 13	10	52	6.22	15	153	50	10	208	-	-	-	100	-4	-	129	7	258	0.596	5.21	1.03
PARKMAN BROOK	82 NOV	10	36	6.58	65	95	45	4	163	0	3	6	35	-	5.29	94	5	134	0.425	4.41	1.03
PARKMAN BROOK	83 FEB	5	36	6.48	66	105	49	4	162	1	0	5	30	-	4.50	92	0	133	0.433	4.46	1.10
PARKMAN BROOK	83 MHAR	10	32	6.14	23	79	48	3	157	1	6	5	73	-	3.82	94	0	130	0.385	5.38	1.16
PARKMAN BROOK	83 JUN	10	31	6.09	21	73	43	3	142	1	4	6	100	-	4.31	91	5	133	0.375	5.51	1.05
PARKMAN BROOK	83 APR	10	34	6.29	30	83	45	4	147	0	3	0	59	-	4.69	104	3	147	0.406	5.10	0.98
PARKMAN BROOK	83 JUL	10	33	6.60	53	87	42	5	150	0	2	3	52	-	4.71	92	0	123	0.394	4.51	1.06
PARKMAN BROOK	83 OCT	10	39	6.78	87	100	42	5	150	0	15	3	50	-	5.25	71	4	125	0.408	4.06	1.03
PARKMAN BROOK	84 FEB	0	31	5.67	10	60	38	4	151	0	14	3	99	44	3.00	84	6	142	0.355	6.33	1.07
PARKMAN BROOK	84 MHAR	10	36	5.43	1	61	43	5	162	0	25	7	139	84	2.44	77	0	205	0.392	7.61	1.01
PARKMAN BROOK	84 LMAR	5	30	5.96	24	71	38	4	144	0	4	3	59	20	3.37	72	0	132	0.343	5.58	1.14
PARKMAN BROOK	84 JUL	10	35	6.51	79	98	42	5	162	0	10	3	21	9	5.25	78	1	137	0.412	4.38	1.04
PENOBSCOT BROOK	82 NOV	10	37	6.22	25	108	45	4	153	0	6	11	126	-	-	63	38	166	0.429	5.13	1.06
PENOBSCOT BROOK	83 FEB	10	45	6.09	24	110	59	5	180	1	2	8	99	-	4.87	133	6	202	0.526	5.27	0.98
PENOBSCOT BROOK	83 MAR	10	36	5.47	3	87	45	4	155	1	16	10	206	-	3.75	84	15	170	0.425	6.86	1.09
PENOBSCOT BROOK	83 MHAR	10	34	5.25	-1	71	44	4	146	1	16	11	270	-	4.12	115	5	137	0.421	-	1.06
PENOBSCOT BROOK	83 APR	10	30	5.68	7	77	41	5	134	0	8	5	150	-	4.12	78	1	142	0.365	6.39	1.14
PENOBSCOT BROOK	83 JUN	10	31	5.79	9	68	35	5	139	0	10	7	156	-	4.12	124	0	106	0.381	6.18	1.04
PENOBSCOT BROOK	83 JUL	15	32	6.43	40	90	38	6	151	0	12	2	116	-	4.69	84	6	118	0.391	4.79	1.14
PENOBSCOT BROOK	83 OCT	10	35	5.63	5	92	42	7	165	5	18	12	156	-	5.63	88	1	155	0.415	6.45	1.24
PENOBSCOT BROOK	84 FEB	5	32	5.44	-7	65	43	7	170	0	31	7	162	70	2.62	100	2	133	0.378	6.64	1.09
PENOBSCOT BROOK	84 MHAR	10	40	5.05	-7	65	43	7	170	0	33	12	241	135	2.25	82	5	218	0.433	-	1.01
PENOBSCOT BROOK	84 LMAR	10	32	5.49	5	71	37	4	139	0	16	6	122	55	3.04	76	0	169	0.364	6.75	1.05
PENOBSCOT BROOK	84 JUL	10	32	6.19	21	82	37	4	161	0	8	2	75	21	4.87	106	2	119	0.39C	5.35	1.16
PENOBSCOT BROOK	OCT 26	20	42	6.23	43	109	53	13	191	-	-	-	81	-4	-	130	0	158	0.506	4.88	1.11
PENOBSCOT BROOK	NOV 9	5	44	6.23	31	111	49	7	197	-	-	-	57	-3	-	115	6	200	0.504	5.01	1.03
PENOBSCOT BROOK	NOV 13	15	55	4.73	-20	99	53	11	221	-	-	-	288	21	-	118	8	258	0.575	-	1.06

APPENDIX G (CONT)

SITE	DATE	PT-CO COLOR	COND UMHOS	PH	ALK	CA	HG	K	NA	FE	MN	ZN	TOTAL AL PPB	LABILE AL PPB	SI02 PPM	SO4 NO3	CL	I MMOLE	CSI +/- RATIO		
HEATH BROOK	82 OCT	70	40	6.53	111	121	58	6	186	5	9	7	88	-	4.35	50	0	165	0.477	4.12	1.14
HEATH BROOK	82 NOV	50	41	6.47	77	121	57	7	184	5	12	3	120	-	5.64	65	3	182	0.489	4.34	1.13
HEATH BROOK	83 EMAR	40	35	6.30	38	83	39	5	171	5	19	2	82	-	3.37	58	5	180	0.354	4.98	1.07
HEATH BROOK	83 MMAR	40	31	6.26	33	76	35	4	161	4	10	3	120	-	3.94	56	3	148	0.360	5.12	1.14
HEATH BROOK	83 APR	40	34	6.40	42	83	38	4	169	5	10	5	70	-	3.07	60	6	166	0.385	4.84	1.07
HEATH BROOK	83 JUN	80	30	6.77	86	71	32	4	154	11	13	5	95	-	2.32	51	0	118	0.350	4.22	1.02
HEATH BROOK	83 JUL	140	74	6.29	147	165	76	6	409	21	6	3	180	-	4.31	35	10	412	0.798	4.10	1.08
HEATH BROOK	83 AUG	25	78	6.34	157	187	86	15	365	11	85	6	83	-	6.00	62	6	440	0.840	3.97	0.98
HEATH BROOK	83 OCT	30	53	6.66	169	169	79	12	228	5	10	1	50	-	3.04	47	1	232	0.625	3.66	1.09
HEATH BROOK	84 FEB	45	50	5.92	10	66	35	5	301	5	50	2	70	8	3.26	50	2	334	0.490	6.03	1.04
HEATH BROOK	84 MMAR	15	56	6.15	36	116	55	6	279	5	23	3	68	11	3.00	64	6	345	0.582	5.01	1.02
HEATH BROOK	84 LMAR	30	67	5.55	17	83	47	6	422	0	6	6	49	0	2.89	50	3	440	0.633	6.07	1.10
HEATH BROOK	84 JUL	40	41	7.18	148	136	58	5	193	21	26	5	52	2	3.94	32	3	166	0.492	3.30	1.12
HEATH BROOK	84 OCT	40	27	5.95	74	73	36	6	131	5	7	15	45	-	1.57	38	0	113	0.318	5.09	1.10
HEATH BROOK	82 NOV	30	28	5.97	59	70	37	8	137	5	12	6	65	-	-	47	0	117	0.326	5.19	1.14
HEATH BROOK	83 APR	20	24	6.05	32	60	30	5	120	0	15	3	47	-	-	52	2	106	0.282	5.44	1.12
HEATH BROOK	83 JUL	35	26	6.29	68	67	31	3	122	7	8	0	35	-	-	34	4	112	0.293	4.83	1.03
HEATH BROOK	83 OCT	-	28	6.10	72	79	39	5	137	5	9	2	40	-	-	37	1	120	0.330	4.93	1.14
HEATH BROOK	84 JUL	40	24	5.91	78	67	29	4	120	21	47	4	67	8	1.56	23	0	94	0.279	5.15	1.14
HEATH BROOK	83 JUL	30	27	5.84	67	74	34	6	113	16	64	6	64	-	-	51	3	111	0.319	5.24	0.98
HUNTERS BRK N	82 OCT	15	44	6.54	111	112	68	10	204	0	6	5	55	-	7.12	100	0	165	0.533	4.15	1.05
HUNTERS BRK N	82 NOV	15	43	6.65	70	104	67	7	193	0	5	6	21	-	6.97	109	0	173	0.504	4.26	1.05
HUNTERS BRK N	83 EMAR	15	43	6.14	26	90	64	6	188	5	23	7	191	-	4.39	95	2	220	0.501	5.27	1.01
HUNTERS BRK N	83 MMAR	15	38	6.04	24	84	58	5	174	5	16	9	206	-	5.68	106	4	166	0.465	5.43	1.08
HUNTERS BRK N	83 APR	15	42	6.40	35	89	60	6	190	5	8	10	133	-	5.63	100	1	209	0.490	4.89	1.00
HUNTERS BRK N	83 JUN	10	39	6.50	56	85	57	7	186	0	6	7	110	-	5.44	109	0	152	0.468	4.60	1.05
HUNTERS BRK N	83 JUL	5	54	6.87	180	157	88	7	235	2	5	0	44	-	7.01	98	15	184	0.660	3.46	1.02
HUNTERS BRK N	83 AUG	5	60	7.15	217	172	95	10	269	5	3	3	25	-	7.31	95	9	208	0.723	3.06	1.03
HUNTERS BRK N	83 OCT	5	55	6.94	169	155	92	10	261	5	20	2	61	-	7.12	94	0	193	0.667	3.42	1.13
HUNTERS BRK N	84 FEB	15	40	6.30	27	81	56	7	191	0	19	10	107	24	3.94	103	1	188	0.463	5.14	1.06
HUNTERS BRK N	84 MMAR	10	51	6.09	21	103	72	8	241	0	25	12	109	40	3.75	94	0	290	0.566	5.36	1.06
HUNTERS BRK N	84 LMAR	0	42	6.15	43	91	63	7	206	0	8	9	55	0	4.54	80	2	205	0.474	5.03	1.11
HUNTERS BRK N	84 JUL	10	46	6.65	91	110	63	8	213	0	6	3	41	11	6.06	90	5	201	0.525	4.13	1.02
HUNTERS BRK N	OCT 26	10	64	7.08	224	187	106	13	289	-	-	-	26	-1	-	97	0	232	0.773	3.08	1.08
HUNTERS BRK N	NOV 9	5	62	6.88	193	180	106	12	265	-	-	-	21	-1	-	98	0	240	0.742	3.36	1.06
HUNTERS BRK N	NOV 13	15	60	6.51	66	143	90	17	265	-	-	-	103	-5	-	119	0	294	0.690	4.30	1.08
HUNTERS BRK S	82 OCT	20	57	6.66	147	135	86	12	278	5	7	5	107	-	7.87	103	0	232	0.676	3.82	1.06
HUNTERS BRK S	82 NOV	15	54	6.77	95	120	81	9	259	5	9	7	133	-	7.69	116	0	235	0.637	3.95	1.05
HUNTERS BRK S	83 EMAR	25	49	6.14	28	92	72	7	245	6	27	9	148	-	4.35	100	3	250	0.554	5.22	1.09
HUNTERS BRK S	83 MMAR	15	49	6.14	31	89	68	8	247	8	18	8	235	-	5.87	108	4	251	0.574	5.20	1.04
HUNTERS BRK S	83 APR	20	51	6.41	41	97	75	9	261	16	12	10	229	-	6.24	98	6	262	0.597	4.77	1.08
HUNTERS BRK S	83 JUN	20	48	6.62	67	92	67	8	248	5	9	7	133	-	5.44	107	0	221	0.555	4.37	1.05
HUNTERS BRK S	83 JUL	15	68	6.90	195	165	97	12	326	8	12	4	94	-	4.99	99	7	280	0.786	3.37	1.03
HUNTERS BRK S	83 AUG	10	68	7.11	244	193	112	15	352	16	26	5	116	-	7.39	100	6	212	0.838	3.00	1.19
HUNTERS BRK S	83 OCT	10	77	7.12	242	209	118	14	370	11	8	0	55	-	7.31	99	2	308	0.902	2.96	1.09
HUNTERS BRK S	84 FEB	20	57	6.34	30	94	68	8	302	5	28	14	146	26	4.20	108	1	314	0.621	4.99	1.05
HUNTERS BRK S	84 MMAR	10	58	6.05	24	109	83	9	278	5	38	15	155	65	3.94	96	0	340	0.639	5.32	1.06
HUNTERS BRK S	84 LMAR	5	58	6.18	46	103	75	9	323	0	10	11	85	0	4.87	92	2	312	0.625	4.92	1.13
HUNTERS BRK S	84 JUL	15	54	6.80	102	119	72	10	292	5	12	3	73	12	6.04	89	3	236	0.613	3.90	1.15
HUNTERS BRK S	OCT 26	25	77	6.88	249	202	122	16	371	-	-	-	52	-2	-	100	0	310	0.905	3.20	1.08
HUNTERS BRK S	NOV 9	10	72	6.89	213	190	119	13	352	-	-	-	48	-2	-	98	0	290	0.849	3.28	1.12
HUNTERS BRK S	NOV 13	25	63	6.61	85	148	102	17	301	-	-	-	138	-6	-	117	0	294	0.738	4.07	1.15
HPRK	NOV 9	5	42	6.41	88	119	55	8	189	-	-	-	93	-4	-	95	0	169	0.511	4.35	1.06
HPRK	NOV 13	10	45	6.12	31	108	53	16	208	-	-	-	43	-2	-	92	1	225	0.500	5.13	1.07
JORDAN PD N SFC	82 OCT	10	36	6.57	55	102	51	9	153	0	4	12	17	-	2.62	82	0	158	0.425	4.46	1.07

SITE	DATE	PT-CO COLOR	COND UMHOS	PH	ALK	CA	MG	K	NA	FE PPB	MN PPB	ZN PPB	TOTAL AL PPB	LABILE AL PPB	SI02 PPM	SC4 MG3	CL	1 PMOLE	CS1 %/-	RATIO	
JORDAN PD N SFC	82 NOV	10	38	6.55	52	105	52	7	151	0	4	2	17	-	-	100	3	160	0.445	4.50	1.00
JORDAN PD N SFC	83 APR	5	38	6.56	47	109	52	7	160	0	5	3	11	-	-	84	7	166	0.440	4.51	1.08
JORDAN PD N SFC	83 JUL	5	38	6.64	53	103	49	7	153	0	2	0	17	-	-	101	5	156	0.441	4.41	0.99
JORDAN PD N SFC	83 OCT	-	39	6.49	51	114	53	8	165	0	2	5	21	-	-	103	3	156	0.464	4.52	1.09
JORDAN PD N SFC	84 JUL	5	37	6.74	47	103	49	7	152	0	6	1	33	17	2.49	93	2	159	0.432	4.36	1.04
JORDAN PD S SFC	82 OCT	10	36	6.59	54	102	50	9	156	0	5	2	18	-	2.44	79	0	154	0.420	4.45	1.11
JORDAN PD S SFC	82 NOV	10	38	6.56	50	105	52	7	154	0	4	3	12	-	-	100	3	158	0.444	4.50	1.02
JORDAN PD S SFC	83 APR	5	39	6.55	51	109	52	6	158	0	5	4	10	-	-	88	7	174	0.447	4.49	1.02
JORDAN PD S SFC	83 JUL	5	38	6.58	52	105	50	7	152	0	2	0	17	-	-	102	6	157	0.446	4.46	0.99
JORDAN PD S SFC	83 OCT	-	39	6.49	51	113	53	8	163	0	2	0	23	-	-	106	3	159	0.466	4.53	1.05
JORDAN PD S SFC	84 JUL	5	36	6.65	49	102	48	7	148	0	5	2	22	9	2.49	94	2	152	0.425	4.43	1.03
JORDAN POND 20M	83 JUL	5	38	6.56	47	106	50	7	154	6	5	11	29	-	-	105	6	150	0.447	4.52	1.03
JORDAN POND 20M	84 JUL	10	37	6.47	47	106	50	7	153	0	7	6	24	7	2.49	95	2	155	0.436	4.42	1.06
KE80 BROOK	82 OCT	15	30	6.43	89	87	39	6	130	0	17	5	27	-	5.06	63	0	110	0.360	4.46	1.00
KE80 BROOK	82 NOV	10	30	6.19	53	83	38	4	126	0	15	2	31	-	4.87	74	0	120	0.351	4.95	1.02
KE80 BROOK	83 EMAR	15	36	6.25	46	91	49	8	165	2	14	3	32	-	3.24	74	6	160	0.410	4.91	1.09
KE80 BROOK	83 MHAR	5	28	6.14	28	78	36	3	122	2	6	3	23	-	3.56	72	3	121	0.333	5.30	1.07
KE80 BROOK	83 APR	10	28	6.28	44	73	35	4	123	0	7	2	27	-	3.56	70	2	118	0.326	5.00	1.00
KE80 BROOK	83 JUN	10	27	6.40	56	74	33	5	120	0	10	8	28	-	3.60	77	0	99	0.327	4.76	1.00
KE80 BROOK	83 JUL	5	43	6.76	224	175	53	8	161	4	7	0	23	-	5.10	37	10	128	0.534	3.43	0.99
KE80 BROOK	83 AUG	5	49	6.87	260	204	61	9	185	5	24	2	16	-	5.32	38	5	154	0.613	3.19	1.01
KE80 BROOK	83 OCT	5	44	6.60	187	170	54	8	169	5	51	0	17	-	4.87	54	3	149	0.539	3.68	1.02
KE80 BROOK	84 FEB	5	28	5.79	11	66	31	4	122	0	9	0	57	0	2.70	61	0	272	0.482	5.20	1.08
KE80 BROOK	84 MHAR	10	46	6.17	26	98	50	6	231	0	15	8	37	12	3.07	64	2	140	0.351	5.34	1.07
KE80 BROOK	84 LMAR	0	31	6.00	34	80	39	4	143	0	1	5	13	0	4.31	64	4	130	0.387	4.23	0.97
KE80 BROOK	84 JUL	5	33	6.60	92	96	38	5	141	5	24	2	20	8	-	55	0	124	0.608	3.43	1.08
KE80 BROOK	OCT 26	5	48	6.64	249	207	62	8	184	-	-	-	8	-	-	68	3	157	0.448	4.22	1.05
KE80 BROOK	NOV 9	0	38	6.52	93	119	47	6	166	-	-	-	13	-	-	82	1	202	0.454	4.97	1.05
KE80 BROOK	NOV 13	7	40	6.25	35	105	46	10	174	-	-	-	63	-	1.37	53	0	89	0.318	4.62	1.07
LAKE WOOD SFC	82 OCT	10	27	6.38	84	72	39	7	125	5	12	3	16	-	-	58	0	94	0.324	4.47	1.07
LAKE WOOD SFC	82 NOV	15	27	6.59	74	71	40	6	126	0	10	2	34	-	-	50	2	110	0.304	4.75	1.13
LAKE WOOD SFC	83 APR	25	25	6.56	40	73	35	4	116	0	8	4	63	-	-	52	7	98	0.328	4.35	0.99
LAKE WOOD SFC	83 JUL	25	28	6.58	85	83	34	5	117	5	37	0	16	-	-	63	0	121	0.344	4.56	1.02
LAKE WOOD SFC	83 OCT	-	30	6.52	65	77	39	6	132	5	14	0	20	-	-	49	0	92	0.297	4.42	1.13
LAKE WOOD SFC	84 JUL	10	25	6.69	62	75	32	4	115	0	25	1	24	14	1.18	49	0	102	0.326	4.37	0.98
LAKE WOOD 5M	83 JUL	15	28	6.56	85	84	33	5	116	6	38	0	18	-	-	86	0	179	0.440	4.75	1.08
LONG PD N SFC	82 OCT	10	39	6.47	45	80	63	9	183	0	3	0	20	-	0.94	86	0	181	0.438	5.08	1.09
LONG PD N SFC	82 NOV	15	39	6.24	35	81	62	9	180	0	4	3	16	-	-	90	4	178	0.439	4.90	1.08
LONG PD N SFC	83 APR	15	39	6.41	35	84	61	8	179	5	5	6	18	-	-	95	5	182	0.442	4.97	1.02
LONG PD N SFC	83 JUL	15	39	6.35	36	82	59	8	174	3	5	0	27	-	-	100	0	187	0.464	4.93	1.07
LONG PD N SFC	83 OCT	-	41	6.35	37	86	64	9	188	5	0	0	26	-	-	92	2	178	0.435	4.81	1.04
LONG PD S SFC	84 JUL	10	38	6.49	37	81	58	9	171	0	7	0	33	8	1.12	92	0	171	0.438	4.80	1.08
LONG PD S SFC	82 OCT	15	38	6.46	41	80	62	10	176	0	4	2	43	-	1.12	91	0	181	0.439	5.05	1.07
LONG PD S SFC	82 NOV	10	39	6.36	29	81	62	9	176	0	4	2	26	-	-	96	0	175	0.443	4.91	1.11
LONG PD S SFC	83 APR	15	39	6.40	34	86	61	8	182	5	4	8	19	-	-	92	4	175	0.441	4.89	1.04
LONG PD S SFC	83 JUL	15	39	6.44	34	84	59	8	174	2	3	0	28	-	-	93	5	182	0.441	4.89	1.04
LONG PD S SFC	83 OCT	-	41	6.19	32	86	62	9	187	5	5	3	27	-	-	102	2	190	0.464	5.15	1.06
LONG PD S SFC	84 JUL	10	36	6.53	32	82	58	11	177	0	6	9	45	21	1.05	87	1	154	0.422	4.83	1.21
LONG POND 15M	83 JUL	15	40	6.37	34	81	59	8	174	4	4	0	28	-	-	92	5	199	0.446	4.97	0.98
LONG POND 15M	84 JUL	10	38	6.48	31	84	59	8	174	0	6	3	30	6	1.31	93	2	173	0.435	4.88	1.09
LIT HARBOR BRK	82 OCT	15	50	6.55	196	176	67	8	194	5	26	4	28	-	6.39	94	0	153	0.616	3.69	1.00
LIT HARBOR BRK	82 NOV	15	47	6.83	130	153	63	7	194	0	14	2	62	-	4.12	80	0	176	0.579	3.65	1.03
LIT HARBOR BRK	83 EMAR	20	39	6.33	46	103	56	5	177	5	18	3	176	-	4.12	80	2	180	0.472	4.78	1.11
LIT HARBOR BRK	83 MHAR	15	40	6.39	61	106	52	5	168	3	12	5	107	-	4.87	108	2	166	0.483	4.58	0.98
LIT HARBOR BRK	83 APR	15	41	6.60	60	114	55	5	180	5	8	8	86	-	5.06	84	5	180	0.482	4.34	1.08

APPENDIX G (CONT)

SITE	DATE	PT-CD COLR	COND UMHDS	PH	ALK	CA	HG	K	NA	FE	MN	ZN	TOTAL AL PPB	LABILE AL PPB	SI02 PPM	SO4 M03	CL	I MMOLE	CSI RATIO	+/-	
LIT HARBOR BRK	83 JUN	15	41	6.85	102	124	54	6	182	0	10	7	73	-	4.76	96	0	148	0.504	3.83	1.05
LIT HARBOR BRK	83 JUL	40	57	6.96	240	200	78	12	241	3	16	0	79	-	4.95	72	8	177	0.702	3.14	1.07
LIT HARBOR BRK	83 AUG	15	69	7.03	242	244	88	12	278	16	13	1	45	-	5.31	84	8	265	0.826	2.98	1.04
LIT HARBOR BRK	83 OCT	20	66	7.02	318	259	91	11	261	16	25	0	60	-	5.63	89	3	181	0.836	2.84	1.05
LIT HARBOR BRK	84 FEB	10	40	6.30	46	104	52	5	184	0	20	0	98	20	3.75	74	0	200	0.463	4.80	1.09
LIT HARBOR BRK	84 MMAR	15	47	6.24	46	121	61	6	214	0	23	2	75	19	3.77	78	0	250	0.530	4.80	1.08
LIT HARBOR BRK	84 LMAR	5	39	6.36	60	117	52	5	181	0	9	2	42	0	3.81	82	0	170	0.465	4.58	1.14
LIT HARBOR BRK	84 JUL	15	47	6.92	126	161	61	7	208	5	23	0	48	4	5.44	85	3	172	0.573	3.55	1.14
LIT HARBOR BRK	OCT 26	20	102	6.99	434	279	160	20	531	-	-	-	37	-2	-	118	2	330	1.222	2.71	1.12
LIT HARBOR BRK	NOV 9	10	65	7.05	244	260	95	9	237	-	-	-	17	-1	-	97	2	220	0.811	2.93	1.07
LIT HARBOR BRK	NOV 13	15	56	6.63	101	190	70	14	224	-	-	-	52	-2	-	106	1	245	0.666	3.87	1.10
LIT LONG POND	82 OCT	35	133	6.80	144	151	198	26	726	0	6	0	68	-	-	142	4	810	1.357	3.64	1.00
LIT LONG POND	82 NOV	25	57	6.55	68	115	92	15	278	5	12	4	70	-	-	109	0	280	0.448	4.34	1.10
LIT LONG POND	83 APR	40	223	6.48	66	210	358	33	1348	11	20	6	147	-	-	246	20	1374	2.258	4.16	1.14
LIT LONG POND	83 JUL	20	274	6.97	164	444	1333	133	565	4	27	0	67	-	-	975	0	949	3.667	2.95	1.19
LIT LONG POND	83 OCT	15	520	7.00	193	316	691	74	3088	11	9	12	83	-	-	360	2	3690	4.904	3.00	0.98
LIT LONG POND	84 JUL	20	56	6.40	89	123	86	11	294	5	25	0	31	5	2.62	91	0	266	0.634	4.34	1.15
RESERVOIR	82 OCT	15	52	6.24	82	165	66	8	222	0	7	3	69	-	5.31	142	0	195	0.637	4.41	1.10
RESERVOIR	83 APR	10	50	5.52	8	119	60	8	202	5	13	10	260	-	5.70	136	1	253	0.595	6.26	0.99
RESERVOIR	83 JUL	15	52	6.06	71	150	57	6	212	5	52	2	68	-	-	148	7	203	0.614	4.69	0.99
RESERVOIR	83 OCT	-	53	6.29	74	170	63	7	235	5	9	4	67	-	-	156	1	182	0.648	4.39	1.15
ROUND POND SFC	84 JUL	10	36	5.97	10	95	42	7	137	5	23	8	161	67	5.63	140	1	146	0.453	5.82	0.98
ROUND POND SFC	82 OCT	25	32	6.09	27	55	47	6	159	0	10	0	41	-	0.75	77	0	147	0.355	5.51	1.07
ROUND POND SFC	82 NOV	25	31	6.07	27	60	49	5	154	0	8	2	46	-	-	74	0	145	0.355	5.51	1.10
ROUND POND SFC	83 APR	25	36	6.11	21	59	48	6	197	5	9	8	65	-	-	80	3	181	0.401	5.58	1.09
ROUND POND SFC	83 JUL	20	29	6.05	20	52	45	4	150	3	21	3	37	-	-	73	5	131	0.331	5.71	1.10
ROUND POND SFC	83 OCT	-	31	6.16	53	61	46	6	165	5	8	1	30	-	-	66	1	122	0.351	5.11	1.15
ROUND POND 4M	84 JUL	15	28	6.11	17	55	43	6	140	5	35	3	45	2	1.12	64	1	126	0.314	5.69	1.18
ROUND POND 4M	83 JUL	25	31	6.06	21	54	45	4	148	6	25	4	46	-	-	78	9	141	0.346	5.66	1.02
SEAL COVE PD SFC	82 OCT	20	37	6.45	67	75	66	8	174	5	8	0	26	-	1.01	76	0	158	0.425	4.62	1.08
SEAL COVE PD SFC	82 NOV	15	38	6.58	60	86	67	8	171	0	9	2	44	-	-	89	0	154	0.445	4.49	1.09
SEAL COVE PD SFC	83 APR	25	38	6.40	39	85	67	8	173	11	11	6	211	-	-	86	6	173	0.471	4.86	1.09
SEAL COVE PD SFC	83 JUL	15	38	6.51	48	78	63	7	164	3	14	5	30	-	-	99	10	158	0.437	4.70	0.99
SEAL COVE PD SFC	83 OCT	-	37	6.45	49	87	66	8	181	5	7	0	25	-	-	88	1	152	0.435	4.70	1.18
SEAL COVE PD SFC	84 JUL	10	35	6.50	38	78	58	6	159	5	16	0	36	12	1.69	86	1	152	0.406	4.81	1.10
SEAL COVE PD 5M	83 JUL	15	37	6.57	48	78	63	7	163	2	14	7	31	-	-	97	11	154	0.434	4.63	1.00
SARGENT MT PD	82 OCT	20	33	4.60	-30	25	27	6	114	0	13	12	272	-	0.58	94	0	114	0.320	-	0.96
SARGENT MT PD	82 NOV	25	37	4.53	-25	30	30	8	124	0	17	12	325	-	1.14	103	0	124	0.357	-	0.98
SARGENT MT PD	83 EMAR	15	41	4.61	-26	37	40	6	160	2	21	14	401	-	1.31	97	0	170	0.421	-	1.02
SARGENT MT PD	83 APR	15	36	4.66	-25	31	32	7	127	5	19	16	331	-	0.75	90	0	154	0.362	-	0.91
SARGENT MT PD	83 JUN	15	36	4.57	-27	31	29	5	127	0	17	10	316	-	0.41	101	0	125	0.354	-	0.98
SARGENT MT PD	83 JUL	5	36	4.59	-29	30	29	6	130	0	13	7	181	-	0.19	98	3	129	0.333	-	0.97
SARGENT MT PD	83 OCT	5	37	4.60	-29	33	31	5	142	5	18	3	234	-	0.21	102	0	131	0.355	-	1.02
SARGENT MT PD	84 LMAR	20	41	4.54	-31	31	38	10	167	5	22	13	334	237	1.31	74	5	172	0.385	-	1.20
SARGENT MT PD	84 JUL	15	36	4.55	-30	24	25	8	126	5	16	9	175	97	0.37	78	1	146	0.309	-	0.99
SARG MT PD 3M	83 JUL	5	36	4.55	-34	31	29	4	124	0	13	6	186	-	0.19	96	3	128	0.325	-	0.96
STANLEY BROOK	82 OCT	40	63	6.84	170	174	100	18	280	5	6	6	91	-	7.93	106	7	240	0.752	3.47	1.09
STANLEY BROOK	82 NOV	20	60	6.84	115	155	94	15	259	5	6	4	96	-	7.93	121	9	256	0.712	3.69	1.04
STANLEY BROOK	83 EMAR	40	53	6.34	40	118	80	11	268	11	43	11	283	-	5.06	96	11	260	0.635	4.77	1.17
STANLEY BROOK	83 MMAR	30	48	6.28	46	115	70	10	217	4	25	8	123	-	5.81	103	12	216	0.558	4.78	1.09
STANLEY BROOK	83 APR	35	54	6.67	63	129	76	13	239	5	13	11	120	-	5.85	110	12	262	0.627	4.20	1.02
STANLEY BROOK	83 JUN	35	52	6.89	96	131	75	13	241	5	10	9	119	-	5.29	110	10	211	0.620	3.79	1.07
STANLEY BROOK	83 JUL	15	71	7.03	190	220	107	19	289	2	6	5	33	-	6.94	121	25	267	0.848	3.13	1.05
STANLEY BROOK	83 AUG	10	82	7.20	250	238	122	24	330	5	5	3	35	-	7.35	187	37	243	0.992	2.81	0.99
STANLEY BROOK	83 OCT	10	81	7.15	263	263	130	23	352	5	3	0	36	-	8.06	102	9	301	0.975	2.79	1.14

SITE	DATE	PT-CO COLCR	COND UMHOS	PH	ALK	CA	MG	K	NA	FE PPB	MN PPB	ZN PPB	TOTAL AL PPB	LABILE AL PPB	SIO2 PPM	NO3	CL	I PMOLE	CSI +/- RATIO		
STANLEY BROOK	84 FEB	25	47	6.33	44	114	71	12	246	5	26	3	147	17	4.31	102	7	198	0.564	4.75	1.27
STANLEY BROOK	84 MAR	20	66	6.46	54	154	91	16	357	5	37	13	133	32	4.12	109	0	328	0.754	4.40	1.27
STANLEY BROOK	84 MAR	10	68	6.45	68	156	88	15	351	0	6	4	52	0	5.14	102	10	348	0.750	4.31	1.16
STANLEY BROOK	84 JUL	20	65	6.94	110	173	87	18	266	5	9	5	58	11	6.00	96	15	323	0.731	3.56	1.00
STANLEY BROOK	OCT 26	20	80	6.97	258	240	121	31	331	-	-	-	25	-1	-	114	8	304	0.944	3.02	1.05
STANLEY BROOK	NOV 9	15	78	7.02	226	235	123	20	346	-	-	-	25	-1	-	122	10	297	0.933	3.04	1.11
STANLEY BROOK	NOV 13	40	89	6.66	112	240	150	24	357	-	-	-	171	-8	-	222	0	380	1.074	3.69	1.08
THE TARN	82 OCT	20	49	6.38	97	112	53	10	252	11	6	5	69	-	2.25	86	0	227	0.555	4.36	1.04
THE TARN	82 NOV	20	53	6.63	87	132	59	11	260	11	6	2	80	-	-	97	0	250	0.605	4.09	1.07
THE TARN	83 APR	15	54	6.38	34	107	53	7	269	11	24	5	140	-	-	74	5	329	0.579	4.83	0.99
THE TARN	83 JUL	30	62	6.64	109	148	65	4	296	17	9	0	78	-	-	88	7	320	0.681	3.93	0.98
THE TARN	83 OCT	25	72	6.62	127	175	70	11	354	16	9	1	67	-	-	84	2	386	0.779	3.82	1.02
THE TARN	84 JUL	30	47	6.48	58	103	45	6	251	16	25	2	126	0	1.31	83	0	241	0.530	4.52	1.06
WITCH HOLE SFC	82 OCT	45	29	6.39	57	64	44	7	132	11	8	3	39	-	1.35	50	0	141	0.333	4.83	1.00
WITCH HOLE SFC	82 NOV	35	30	6.25	48	62	45	8	142	5	9	2	69	-	-	50	0	141	0.338	5.06	1.07
WITCH HOLE SFC	83 APR	35	27	6.12	26	53	38	6	132	5	16	7	55	-	-	54	4	129	0.303	5.51	1.08
WITCH HOLE SFC	83 JUL	25	28	6.37	42	59	39	5	134	5	13	0	30	-	-	52	2	137	0.314	5.02	1.02
WITCH HOLE SFC	83 OCT	-	30	6.35	62	67	45	6	148	11	7	0	34	-	-	47	2	130	0.339	4.81	1.11
WITCH HOLE SFC	84 JUL	35	25	6.30	32	56	37	4	129	5	19	3	35	6	0.75	47	1	117	0.287	5.23	1.15
WITCH HOLE 6M	83 JUL	25	28	6.30	44	60	40	6	126	8	19	5	43	-	-	54	7	130	0.318	5.06	0.99

Appendix H. Non-marine parameters for each site and sampling data. Sea salt correction was calculated using a dilution factor relative to seawater ($\text{dilfact} = (\text{Cl} - 19350)$; all units in ppm). Then the following parameters were adjusted as follows: (sea water composition from Stumm and Morgan, 1981).

$$\text{Ca} = \text{Ca} - (\text{dilfact} \times 410)$$

$$\text{Mg} = \text{Mg} - (\text{dilfact} \times 1290)$$

$$\text{K} = \text{K} - (\text{dilfact} \times 400)$$

$$\text{Na} = \text{Na} - (\text{dilfact} \times 10770)$$

$$\text{SO}_4 = \text{SO}_4 - (\text{dilfact} \times 2710)$$

$$\text{Cl} = \text{Cl} - (\text{dilfact} \times 19350)$$

$$\text{HCO}_3 = \text{HCO}_3 - (\text{dilfact} \times 142)$$

SITE	DATE	PT-CO COLOR	COND UMHOS	PH	ALK	CA	MG	K	NA	FE	MN PPB	ZN PPB	TOTAL AL PPB	LABILE AL PPB	SI02 PPM	SD4	MD3	CL
AUNT BETTY PONO	83 APR	40	13	6.36	51	101	3	2	16	5	6	6	92	-	-	59	1	0
AUNT BETTY PONO	84 JUL	50	17	6.64	116	141	11	0	32	11	22	6	71	14	2.51	32	0	0
BEAR BROOK PONO	82 OCT	45	21	6.61	167	124	42	8	45	16	10	9	93	-	3.56	36	0	0
BEAR BROOK PONO	82 NOV	25	20	6.78	159	123	42	8	48	11	16	5	54	-	-	24	0	0
BEAR BROOK PONO	83 APR	25	16	6.57	62	106	22	4	14	16	22	3	98	-	-	71	4	0
BEAR BROOK PONO	83 JUL	80	22	6.96	182	139	36	3	47	86	41	0	53	-	-	20	14	0
BEAR BROOK PONO	83 OCT	15	22	6.48	151	139	41	4	50	16	15	0	35	-	-	44	0	0
BEAR BROOK PONO	84 JUL	35	18	6.72	120	110	26	3	57	56	51	21	42	2	2.06	44	0	0
BREAKNECK PONO	84 JUL	25	11	6.60	80	94	3	3	3	5	16	0	38	4	1.31	28	0	0
BREAKNECK BROOK	82 OCT	20	18	6.48	126	113	25	6	45	11	19	5	57	-	2.87	37	0	0
BREAKNECK BROOK	82 NOV	20	17	6.59	107	113	24	5	37	5	30	5	84	-	4.50	40	0	0
BREAKNECK BROOK	83 MAR	25	14	6.37	51	83	15	2	26	8	23	2	105	-	3.37	63	4	0
BREAKNECK BROOK	83 MAR	10	11	6.35	39	73	12	1	23	4	10	3	110	-	3.75	50	4	0
BREAKNECK BROOK	83 APR	25	13	6.50	49	81	5	2	33	5	13	6	81	-	2.83	50	4	0
BREAKNECK BROOK	83 JUN	25	14	6.70	84	84	18	2	42	5	16	0	82	-	2.44	42	0	0
BREAKNECK BROOK	83 JUL	20	36	7.06	320	216	56	4	85	9	14	3	20	-	1.69	33	12	0
BREAKNECK BROOK	83 AUG	15	36	7.11	328	241	54	5	66	5	19	5	14	-	1.72	27	10	0
BREAKNECK BROOK	83 OCT	15	42	6.87	349	264	66	7	127	5	18	0	12	-	2.12	37	3	0
BREAKNECK BROOK	84 FEB	10	11	6.36	28	71	8	2	25	0	19	0	69	2	2.81	51	3	0
BREAKNECK BROOK	84 MAR	0	12	6.15	51	85	13	2	35	0	1	8	30	0	2.85	45	1	0
BREAKNECK BROOK	84 JUL	20	21	6.73	156	125	30	3	67	16	25	0	43	6	2.62	40	2	0
BREAKNECK BROOK	OCT 26	15	33	6.93	295	218	43	7	78	-	-	-	13	-	-	30	1	0
BREAKNECK BROOK	NOV 9	5	31	6.89	267	215	42	4	75	-	-	-	9	-	-	32	5	0
BREAKNECK BROOK	NOV 13	15	22	6.83	166	154	26	7	57	-	-	-	45	-	-	30	3	0
BUBBLE PONO SFC	82 OCT	15	17	6.54	74	96	21	5	37	0	8	10	20	-	3.64	70	0	0
BUBBLE PONO SFC	82 NOV	10	18	6.37	75	101	23	4	35	0	10	4	41	-	-	83	0	0
BUBBLE PONO SFC	83 FEB	10	18	6.13	42	98	29	3	48	2	23	15	116	-	-	90	3	0
BUBBLE PONO SFC	83 MAR	10	13	5.90	25	79	17	2	19	1	18	13	86	-	-	73	6	0
BUBBLE PONO SFC	83 APR	10	16	6.65	54	98	24	2	40	0	13	7	91	-	-	67	1	0
BUBBLE PONO SFC	83 JUN	10	15	6.54	50	90	18	2	31	0	5	5	60	-	-	75	0	0
BUBBLE PONO SFC	83 JUL	5	16	6.52	51	96	17	3	25	21	7	0	44	-	-	86	4	0
BUBBLE PONO SFC	83 OCT	-	17	6.53	49	101	23	4	44	5	11	4	27	-	-	78	0	0
BUBBLE PONO SFC	84 FEB	5	10	5.50	9	64	6	2	5	0	34	11	111	36	2.25	66	8	0
BUBBLE PONO SFC	84 MAR	10	12	5.82	30	88	11	3	1	0	23	16	83	32	2.62	74	2	0
BUBBLE PONO SFC	84 MAR	10	10	5.80	33	90	9	2	11	0	20	9	82	29	2.87	43	3	0
BUBBLE PONO SFC	84 APR	5	13	6.43	47	52	13	3	12	0	20	11	91	49	3.04	66	0	0
BUBBLE PONO SFC	84 JUL	0	13	6.47	41	84	13	3	20	0	7	8	42	9	2.89	71	0	0
BUBBLE PONO SFC	83 FEB	15	19	6.30	71	113	25	3	37	2	11	8	80	-	-	88	3	0
BUBBLE PONO SFC	83 MAR	10	21	6.20	92	135	27	3	39	4	24	6	36	-	-	80	9	0
BUBBLE PONO SFC	83 JUN	10	14	6.51	46	87	14	2	14	0	5	7	59	-	-	74	0	0
BUBBLE PONO SFC	83 JUL	5	16	6.47	50	95	16	3	21	4	7	9	37	-	-	86	4	0
BUBBLE PONO SFC	84 APR	5	13	6.42	42	93	13	3	12	0	21	17	75	31	-	86	0	0
BUBBLE PONO SFC	84 JUL	5	14	6.43	42	85	14	3	26	0	8	9	37	5	2.89	78	0	0
BUBBLE BROOK	82 NOV	10	16	6.03	62	100	18	3	17	0	16	8	70	-	-	84	0	0
BUBBLE BROOK	83 FEB	15	16	6.35	52	104	20	2	12	1	17	8	90	-	-	83	3	0
BUBBLE BROOK	83 MAR	15	13	6.12	39	101	15	2	11	2	17	10	107	-	-	61	5	0
BUBBLE BROOK	83 MAR	10	14	5.90	23	78	16	2	28	1	19	11	144	-	-	80	6	0
BUBBLE BROOK	83 APR	10	14	6.50	44	97	18	2	18	0	9	5	97	-	-	65	5	0
BUBBLE BROOK	83 JUN	5	14	6.54	34	88	17	2	31	0	9	3	75	-	-	76	0	0
BUBBLE BROOK	83 JUL	30	13	6.20	15	67	11	3	30	5	6	15	197	-	-	92	3	0
BUBBLE BROOK	83 AUG	5	17	6.12	60	101	20	3	44	5	12	2	24	-	-	75	3	0
BUBBLE BROOK	83 OCT	10	16	5.92	14	83	14	4	26	0	28	9	83	-	-	85	29	0
BUBBLE BROOK	84 FEB	-	11	5.52	9	58	10	3	22	0	48	4	121	37	-	69	5	0
BUBBLE BROOK	84 MAR	10	10	5.87	14	78	7	3	-6	0	31	14	107	45	-	46	3	0
BUBBLE BROOK	84 MAR	5	12	5.88	29	86	15	3	25	0	15	10	76	24	3.00	50	11	0

APPENDIX H (CONT)

SITE	DATE	PT-CO COLOR	COND UMIDS	PH	ALK	CA	MG	K	NA	FE	MN PPB	ZN PPB	TOTAL AL PPB	LABILE AL PPB	SIO2 PPM	SO4	NO3	CL
BUBBLE BROOK	04 JUL	10	14	6.38	53	89	15	3	32	0	56	6	29	5	3.04	65	0	0
THE BOWL SFC	02 OCT	25	11	6.22	46	54	18	6	31	16	25	4	26	-	0.75	44	0	0
THE BOWL SFC	02 NOV	15	11	6.34	34	56	15	4	20	5	17	0	31	-	4.87	61	0	0
THE BOWL SFC	03 FEB	20	13	5.71	23	65	23	5	40	6	28	4	49	-	-	71	3	0
THE BOWL SFC	03 MMAR	10	12	5.63	21	62	20	4	25	4	32	9	86	-	2.06	62	6	0
THE BOWL SFC	03 APR	15	13	6.13	18	60	24	4	45	5	24	8	53	-	1.50	77	2	0
THE BOWL SFC	03 JUL	20	11	6.45	30	61	15	4	12	16	24	0	21	-	0.60	65	4	0
THE BOWL SFC	03 OCT	15	12	6.31	33	66	19	6	39	16	36	0	17	-	0.58	47	0	0
THE BOWL SFC	04 FEB	15	7	5.86	10	45	7	3	-1	5	58	0	58	16	1.42	48	2	0
THE BOWL SFC	04 MMAR	10	10	5.74	8	60	16	3	29	0	24	4	45	10	-	52	4	0
THE BOWL SFC	04 LMAR	5	10	5.56	10	57	14	4	28	0	42	7	49	14	1.57	50	3	0
THE BOWL SFC	04 APR	5	9	5.99	12	54	14	4	21	5	43	3	54	28	1.41	54	0	0
THE BOWL SFC	04 JUL	5	13	6.33	19	52	11	4	23	16	57	0	29	6	0.75	56	0	0
THE BOWL 6M	03 MMAR	15	15	5.87	32	69	20	5	23	6	35	7	70	-	1.69	63	7	0
THE BOWL 6M	03 JUN	15	11	5.95	20	56	17	3	28	5	40	4	55	-	-	63	0	0
THE BOWL 6M	03 JUL	20	10	5.58	26	60	14	3	6	11	28	0	44	-	1.31	56	7	0
THE BOWL 6M	04 APR	5	9	5.97	11	54	13	4	25	5	43	6	60	31	1.39	55	0	0
THE BOWL 6M	04 JUL	5	9	6.33	19	52	11	4	22	11	81	20	30	8	0.88	55	0	0
CANON BROOK RT 3	02 OCT	15	16	6.47	82	77	23	6	53	11	39	6	81	-	5.25	57	6	0
CANON BROOK RT 3	02 NOV	15	14	6.41	58	79	20	3	39	11	40	6	68	-	5.25	64	0	0
CANON BROOK RT 3	03 FEB	10	16	6.44	69	85	26	3	55	5	28	8	46	-	4.52	55	2	0
CANON BROOK RT 3	03 EMAR	10	12	6.08	20	63	18	2	30	3	37	6	78	-	3.06	70	0	0
CANON BROOK RT 3	03 MMAR	10	12	5.91	13	56	17	2	34	4	24	8	134	-	3.04	65	5	0
CANON BROOK RT 3	MAR 24	-	13	6.07	38	59	20	2	43	0	19	10	83	-	3.21	71	0	0
CANON BROOK RT 3	MAR 31	-	15	6.18	35	71	24	3	52	4	24	7	43	-	3.75	74	0	0
CANON BROOK RT 3	APR 7	-	13	6.27	27	68	20	2	43	3	19	6	57	-	3.37	74	0	0
CANON BROOK RT 3	03 APR	-	12	6.21	26	72	17	2	34	4	20	7	52	-	3.56	68	0	0
CANON BROOK RT 3	APR 21	20	8	6.21	25	63	8	2	-8	5	19	5	80	-	3.58	38	3	0
CANON BROOK RT 3	APR 28	-	13	6.22	24	68	15	3	29	2	21	10	60	-	3.37	85	0	0
CANON BROOK RT 3	MAY 5	-	14	6.25	28	68	17	3	44	4	20	8	67	-	3.39	74	0	0
CANON BROOK RT 3	MAY 12	-	15	6.23	35	72	20	4	56	5	25	6	55	-	3.75	78	5	0
CANON BROOK RT 3	MAY 19	-	15	6.23	35	72	20	4	52	5	25	6	47	-	3.62	76	0	0
CANON BROOK RT 3	03 JUN	15	14	6.39	48	67	17	3	47	5	27	9	50	-	3.75	65	0	0
CANON BROOK RT 3	03 JUL	40	18	6.52	100	102	25	5	41	11	28	6	145	-	4.56	52	9	0
CANON BROOK RT 3	03 AUG	10	22	6.70	172	145	24	6	35	16	70	4	39	-	4.95	40	4	0
CANON BROOK RT 3	03 OCT	5	15	5.96	19	81	22	5	47	5	43	7	65	-	4.31	88	3	0
CANON BROOK RT 3	FEB 16	5	8	5.84	16	47	5	1	3	0	47	4	62	14	2.27	60	0	0
CANON BROOK RT 3	FEB 10	10	11	5.97	17	84	16	2	21	5	32	8	64	24	3.67	53	8	0
CANON BROOK RT 3	04 MMAR	15	8	5.76	9	68	11	2	10	0	36	13	82	34	2.62	46	0	0
CANON BROOK RT 3	04 LMAR	10	8	5.82	25	64	8	1	5	5	21	7	52	17	3.00	44	0	0
CANON BROOK RT 3	FEB 24	10	7	6.05	12	70	7	2	3	5	25	14	79	-	3.24	28	0	0
CANON BROOK RT 3	MAR 2	10	6	5.95	15	63	5	1	-6	0	21	11	71	-	3.00	32	1	0
CANON BROOK RT 3	MAR 9	10	12	6.32	46	87	13	5	20	5	28	22	54	-	3.75	49	2	0
CANON BROOK RT 3	04 MMAR	10	12	5.74	10	89	21	5	37	5	42	13	85	-	2.68	49	0	0
CANON BROOK RT 3	MAR 23	10	8	5.60	4	57	8	2	7	0	26	10	73	-	1.95	47	1	0
CANON BROOK RT 3	04 LMAR	10	6	6.01	21	41	5	1	6	0	9	2	45	-	2.53	27	0	0
CANON BROOK RT 3	APR 6	10	6	5.55	5	23	11	3	29	5	29	11	103	-	1.93	39	1	0
CANON BROOK RT 3	APR 13	10	10	6.10	15	67	14	3	34	0	17	8	49	-	3.07	45	2	0
CANON BROOK RT 3	APR 20	10	10	5.91	10	58	9	2	19	0	14	6	54	-	2.89	62	2	0
CANON BROOK RT 3	JUN 30	10	11	6.40	30	48	10	2	31	0	14	2	16	11	1.12	67	3	0
CANON BROOK RT 3	04 JUL	10	15	6.50	83	79	17	3	51	16	34	4	66	16	4.12	50	3	0
CANON BROOK RT 3	OCT 26	15	24	6.59	181	154	36	7	59	-	-	-	17	-	-	44	1	0
CANON BROOK RT 3	NOV 9	5	18	6.61	87	121	25	6	22	-	-	-	33	-	-	75	0	0
CANON BROOK RT 3	NOV 13	10	12	5.96	23	90	9	11	-2	-	-	-	86	-	-	75	0	0
CANON-CADILLAC	02 NOV	10	10	5.70	20	79	8	-1	-5	0	2	12	70	-	5.06	71	0	0

SITE	DATE	PT-CO COLOR	COND UMHOS	PH	ALK	CA	MG	K	NA	FE	MN PPB	ZN PPB	TOTAL AL PPB	LABILE AL PPB	SI02 PPM	SO4	NO3	CL
CANDY-CADILLAC	83 FEB	10	10	5.93	31	81	9	-1	-9	0	2	11	34	-	3.64	63	0	0
CANON-CADILLAC	83 EMAR	5	9	5.76	7	71	9	-1	-5	0	7	10	86	-	3.00	71	0	0
CANON-CADILLAC	83 MHAR	5	11	5.75	5	63	14	-0	29	1	4	13	98	-	3.19	74	4	0
CANON-CADILLAC	83 APR	15	10	5.77	8	59	10	2	21	0	30	9	112	-	3.00	71	1	0
CANON-CADILLAC	83 JUN	10	14	6.15	20	54	12	2	51	0	2	8	48	-	3.41	93	0	0
CANON-CADILLAC	83 JUL	5	18	6.22	76	82	26	2	70	3	6	19	61	-	-	61	11	0
CANON-CADILLAC	83 OCT	5	12	5.94	13	65	8	3	30	0	5	14	92	-	4.12	77	4	0
CANON-CADILLAC	84 FEB	0	11	5.64	3	51	9	1	40	0	37	10	84	37	-	73	0	0
CANON-CADILLAC	84 MHAR	10	6	5.17	-4	55	-1	0	-18	0	27	16	126	66	2.06	55	0	0
CANON-CADILLAC	84 LMAR	10	7	5.60	7	49	1	0	2	0	3	10	67	35	2.27	55	1	0
CANON-CADILLAC	84 JUL	5	13	6.29	43	56	11	1	49	5	2	8	38	8	3.94	70	1	0
CANON-DORR	82 NOV	10	15	6.29	60	101	16	1	24	0	0	8	54	-	6.00	75	0	0
CANON-DORR	83 FEB	10	16	6.40	71	119	18	1	13	1	1	3	82	-	4.50	72	4	0
CANON-DORR	83 EMAR	10	13	6.16	22	78	16	1	28	1	7	12	85	-	-	74	0	0
CANON-DORR	83 MHAR	10	11	5.97	12	64	12	1	21	1	7	8	135	-	3.19	73	5	0
CANON-DORR	83 APR	10	10	6.32	29	76	11	2	12	0	20	7	66	-	3.58	50	2	0
CANON-DORR	83 JUN	15	16	6.54	53	82	15	2	49	0	4	5	48	-	4.12	89	0	0
CANON-DORR	83 JUN	5	30	6.58	183	184	36	1	67	2	14	9	51	-	5.47	89	11	0
CANON-DORR	83 OCT	5	16	6.20	45	87	17	4	58	0	6	6	65	-	5.31	73	1	0
CANON-DORR	84 FEB	5	9	5.72	10	38	6	2	27	0	22	2	86	28	2.06	66	0	0
CANON-DORR	84 MHAR	10	6	5.84	10	75	0	0	-29	0	13	9	65	28	2.44	44	0	0
CANON-DORR	84 LMAR	10	8	5.83	22	62	5	1	9	0	2	4	56	21	2.70	46	1	0
CANON-DORR	84 JUL	0	19	6.45	80	101	20	1	66	0	1	11	31	9	4.87	81	1	0
CANON-WEST	82 NOV	10	8	5.64	7	58	9	-0	4	0	5	13	78	-	4.65	61	0	0
CANON-WEST	83 FEB	10	11	5.51	15	63	17	-0	24	0	4	11	102	-	3.43	66	0	0
CANON-WEST	83 EMAR	10	10	5.54	15	54	11	0	19	1	10	13	106	-	-	62	2	0
CANON-WEST	83 MHAR	5	9	5.56	2	49	12	0	25	1	11	10	117	-	2.81	64	4	0
CANON-WEST	83 APR	10	10	5.65	3	50	12	0	27	0	5	10	108	-	2.81	66	1	0
CANON-WEST	83 JUN	15	12	5.89	14	42	11	2	50	0	3	6	66	-	2.87	81	0	0
CANON-WEST	83 JUL	5	10	5.64	3	37	8	2	37	2	13	7	78	-	-	69	8	0
CANON-WEST	83 OCT	5	11	5.48	-2	59	9	3	29	0	10	16	93	-	3.96	78	6	0
CANON-WEST	84 FEB	0	9	5.38	1	49	20	1	10	0	56	7	86	37	1.93	65	1	0
CANON-WEST	84 MHAR	10	5	5.19	-4	53	-1	-0	-25	0	27	14	123	62	2.06	43	0	0
CANON-WEST	84 LMAR	5	7	5.42	3	40	12	2	8	0	5	9	76	41	2.25	53	2	0
CANON-WEST	84 JUL	0	12	5.66	35	51	12	0	47	0	10	7	48	29	3.75	65	0	0
CANON-WEST	NOV 9	6	11	5.62	29	70	10	3	15	-	-	-	92	-	-	57	0	0
CANON-WEST	NOV 13	10	9	5.47	3	67	0	6	-11	-	-	-	123	-	-	67	1	0
CROMWELL BROOK	82 OCT	130	24	6.11	165	150	60	4	54	0	37	7	147	-	7.31	43	0	0
CROMWELL BROOK	82 NOV	90	19	6.20	102	115	39	5	41	0	22	3	126	-	6.41	58	0	0
CROMWELL BROOK	83 EMAR	60	15	5.91	47	85	26	6	29	16	35	6	199	-	4.12	71	3	0
CROMWELL BROOK	83 MHAR	40	13	5.85	47	80	18	3	23	9	19	8	186	-	4.50	49	8	0
CROMWELL BROOK	83 APR	80	14	6.12	64	93	21	2	26	11	17	6	160	-	3.94	54	5	0
CROMWELL BROOK	83 JUN	120	17	6.18	116	97	26	1	54	21	34	8	200	-	3.94	44	0	0
CROMWELL BROOK	83 JUL	80	49	6.61	399	305	89	14	99	5	4	5	151	-	5.25	65	9	0
CROMWELL BROOK	83 AUG	30	55	6.62	429	295	144	54	110	177	107	11	511	-	-	53	12	0
CROMWELL BROOK	83 OCT	30	54	6.70	467	351	86	20	77	27	49	0	196	-	9.02	65	12	0
CROMWELL BROOK	84 FEB	40	10	5.99	26	68	8	2	16	5	47	6	112	2	3.00	46	2	0
CROMWELL BROOK	84 MHAR	25	11	5.86	34	104	24	5	-12	11	45	2	134	14	3.19	49	0	0
CROMWELL BROOK	84 LMAR	40	12	5.81	49	91	13	2	25	5	10	3	55	25	2.62	37	1	0
CROMWELL BROOK	84 JUL	120	26	6.15	182	159	70	13	52	113	174	6	0	0	8.81	40	3	0
DUCK BROOK	82 OCT	50	15	6.32	75	94	14	8	42	5	9	8	125	-	3.84	50	0	0
DUCK BROOK	82 NOV	30	13	6.32	57	91	11	4	20	0	20	3	75	-	-	51	3	0
DUCK BROOK	83 EMAR	20	10	6.20	33	83	14	2	-8	3	18	4	30	-	-	52	5	0
DUCK BROOK	83 MHAR	10	13	6.21	34	84	14	2	33	2	13	4	43	-	-	58	5	0
DUCK BROOK	83 APR	15	12	6.47	33	81	9	2	12	5	8	6	27	-	-	63	5	0

APPENDIX H (CONT.)

SITE	DATE	PT-CO COLOR	COND UMHOS	PH	ALK	CA	MG	K	NA	FE	MN PPB	ZN PPB	TOTAL AL PPB	LABILE AL PPB	SI02 PPM	SO4 NO3	CL
DUCK BROOK	83 JUN	15	14	6.58	49	85	14	2	29	0	17	0	43	-	-	65	0
DUCK BROOK	83 JUL	25	14	6.48	76	114	17	1	14	9	2	2	30	-	0.66	33	0
DUCK BROOK	83 AUG	10	17	6.55	104	123	20	3	18	11	23	0	32	-	-	54	0
DUCK BROOK	83 OCT	30	23	6.72	77	122	50	7	39	5	6	0	32	-	3.37	116	0
DUCK BROOK	84 FEB	5	13	6.26	29	83	10	3	44	0	23	0	36	10	1.69	57	1
DUCK BROOK	84 MAR	15	12	6.13	29	91	5	2	24	0	27	5	34	0	1.86	58	0
DUCK BROOK	84 MAR	5	11	6.00	34	84	5	2	22	0	13	4	25	0	-	49	3
DUCK BROOK	84 JUL	10	12	6.48	55	55	7	2	-7	5	18	3	13	6	2.44	51	3
EAGLE LK N SFC	82 OCT	10	14	6.57	47	80	15	5	28	0	9	3	13	-	1.14	63	9
EAGLE LK N SFC	82 NOV	10	13	6.43	42	87	13	3	9	0	14	5	11	-	-	71	0
EAGLE LK N SFC	83 FEB	10	14	6.47	40	92	16	3	14	1	9	4	14	-	-	76	0
EAGLE LK N SFC	83 MAR	5	13	6.04	29	81	14	2	16	1	7	5	29	-	-	66	8
EAGLE LK N SFC	83 APR	10	14	6.42	36	88	15	2	19	0	10	2	19	-	-	76	3
EAGLE LK N SFC	83 JUN	10	13	6.58	39	85	12	3	19	0	6	15	38	-	-	67	0
EAGLE LK N SFC	83 JUL	10	13	6.60	38	84	13	3	11	0	4	5	15	-	-	72	4
EAGLE LK N SFC	83 OCT	5	13	6.41	38	89	14	4	28	0	19	0	13	-	-	54	0
EAGLE LK N SFC	84 FEB	5	12	6.00	31	83	14	4	26	0	15	0	31	7	1.50	57	0
EAGLE LK N SFC	84 MAR	10	11	6.30	34	80	9	3	1	0	14	2	24	7	-	64	2
EAGLE LK N SFC	84 MAR	5	13	6.03	34	85	15	3	33	0	14	0	24	4	1.48	61	3
EAGLE LK N SFC	84 APR	0	12	6.44	27	81	10	3	14	0	14	7	37	19	1.56	67	0
EAGLE LK N SFC	84 JUL	5	12	6.38	39	83	10	3	9	5	10	0	37	18	1.50	63	1
EAGLE LK N SFC	83 FEB	10	13	6.43	45	87	14	3	8	2	24	3	23	-	-	72	2
EAGLE LK N SFC	83 MAR	10	14	6.45	41	93	17	3	24	0	6	4	22	-	-	70	5
EAGLE LK N SFC	83 JUN	10	13	6.57	38	81	14	3	23	0	5	8	15	-	-	68	0
EAGLE LK N SFC	83 JUL	15	14	6.45	32	85	15	3	19	1	4	9	34	-	-	83	3
EAGLE LK N SFC	84 APR	0	12	6.43	36	82	9	3	11	0	14	6	64	44	1.69	70	0
EAGLE LK S SFC	82 OCT	10	12	6.51	44	82	15	4	16	0	12	2	11	-	1.12	59	0
EAGLE LK S SFC	82 NOV	10	14	6.40	42	88	17	3	24	0	14	4	9	-	-	73	0
EAGLE LK S SFC	83 FEB	10	14	6.45	41	88	16	3	17	1	7	3	13	-	-	69	11
EAGLE LK S SFC	83 MAR	5	11	5.91	21	74	9	1	2	1	16	13	122	-	-	69	11
EAGLE LK S SFC	83 APR	10	14	6.45	37	88	16	2	17	0	9	2	21	-	-	75	4
EAGLE LK S SFC	83 JUN	10	13	6.59	39	86	14	3	26	0	6	8	23	-	-	67	0
EAGLE LK S SFC	83 JUL	5	12	6.48	39	85	12	3	7	2	5	4	21	-	-	64	5
EAGLE LK S SFC	83 OCT	-	13	6.41	37	90	14	4	22	0	18	0	39	-	-	61	0
EAGLE LK S SFC	84 APR	0	10	6.47	33	83	6	2	-2	0	13	3	41	16	-	55	0
EAGLE LK S SFC	84 JUL	5	11	6.44	32	83	8	3	8	0	5	3	21	14	1.35	61	0
EAGLE LK S 20M	83 FEB	10	13	6.42	41	88	15	3	10	1	6	2	89	-	-	71	2
EAGLE LK S 20M	83 MAR	5	14	6.30	41	93	17	3	19	1	7	6	36	-	-	69	7
EAGLE LK S 20M	83 JUN	10	12	6.53	38	82	10	3	6	0	6	13	14	-	-	72	0
EAGLE LK S 20M	83 JUL	10	14	6.24	36	84	14	3	17	3	20	9	42	-	-	77	3
EAGLE LK S 20M	84 APR	0	11	6.49	35	83	7	2	-1	0	16	5	49	23	1.50	57	0
EAGLE LK S 20M	84 JUL	5	12	6.30	30	85	11	3	16	0	6	6	16	7	1.50	64	0
EAGLE EAST INLET	82 NOV	10	12	5.83	13	85	12	1	4	0	6	14	127	-	4.57	77	5
EAGLE EAST INLET	83 FEB	5	12	5.90	13	82	14	1	6	1	13	15	93	-	3.82	74	4
EAGLE EAST INLET	83 MAR	15	10	5.62	4	73	10	0	-3	1	1	12	122	-	3.19	64	9
EAGLE EAST INLET	83 MAR	15	9	5.62	-3	68	8	1	-8	2	11	16	187	-	3.28	68	9
EAGLE EAST INLET	83 APR	15	9	5.64	6	59	5	1	2	0	6	8	174	-	2.89	74	1
EAGLE EAST INLET	83 JUN	20	12	6.10	16	58	9	2	35	0	3	9	140	-	3.37	86	0
EAGLE EAST INLET	83 JUL	25	15	6.08	22	78	16	3	40	2	14	7	135	-	4.33	90	11
EAGLE EAST INLET	83 OCT	10	15	5.66	4	86	14	4	31	0	8	13	128	-	4.87	96	10
EAGLE EAST INLET	84 FEB	10	10	5.30	-1	50	8	2	20	0	54	13	178	73	2.06	73	6
EAGLE EAST INLET	84 MAR	10	5	4.91	-11	63	-3	1	-35	0	34	18	195	96	1.88	47	7
EAGLE EAST INLET	84 MAR	10	9	5.52	7	62	5	1	6	0	8	9	95	35	2.81	56	4
EAGLE EAST INLET	84 JUL	5	11	5.87	21	56	6	2	34	0	3	9	78	20	4.31	73	1
EAGLE EAST INLET	82 NOV	10	11	5.35	-2	54	13	0	21	0	8	12	159	-	4.57	78	5

SITE	DATE	PT-CO COLOR	COND UMHQS	PH	ALK	CA	HG	K	NA	FE	MN PP8	ZN PP8	TOTAL AL PP8	LABILE AL PP8	SI02 PPH	S04	NO3	CL
EAGLE EAST (N)	83 FEB	5	11	5.32	1	58	19	0	23	1	7	7	176	-	3.62	73	3	0
EAGLE EAST (N)	83 EMAR	15	9	5.21	-3	51	13	-0	13	1	17	7	218	-	3.06	63	3	0
EAGLE EAST (N)	83 MMAR	10	10	5.27	-3	46	15	0	27	0	6	10	248	-	3.56	71	5	0
EAGLE EAST (N)	83 APR	15	9	5.31	-2	46	8	1	3	0	12	3	233	-	-	75	1	0
EAGLE EAST (N)	83 JUN	5	12	5.45	4	43	10	1	46	0	9	5	162	-	3.21	50	0	0
EAGLE EAST (N)	83 JUL	10	11	5.60	10	50	9	0	26	1	16	5	125	-	3.96	69	16	0
EAGLE EAST (N)	83 OCT	5	13	5.21	-5	59	15	3	36	0	15	5	170	-	4.50	92	4	0
EAGLE EAST (N)	84 FEB	5	11	5.06	-2	38	10	1	29	0	52	8	224	114	2.27	83	6	0
EAGLE EAST (N)	84 MMAR	15	5	5.03	-8	61	-2	1	-34	0	34	18	181	99	1.88	35	5	0
EAGLE EAST (N)	84 LMAR	5	6	5.09	-5	45	2	-0	-9	0	19	6	172	84	2.83	52	1	0
EAGLE EAST (N)	84 JUL	5	9	5.52	6	52	2	-1	19	0	16	6	105	48	3.94	75	1	0
EAGLE EAST (N)	NOV 9	3	9	5.34	8	51	-0	1	27	-	-	-	160	-	-	64	0	0
EAGLE EAST (N)	NOV 13	10	12	5.12	5	73	9	10	1	-	-	-	248	-	-	95	3	0
EAGLE EAST (S)	82 NOV	15	13	5.50	10	96	11	0	2	0	12	21	161	-	4.76	80	10	0
EAGLE EAST (S)	83 FEB	5	12	5.98	18	96	13	1	2	2	3	13	84	-	-	74	4	0
EAGLE EAST (S)	83 EMAR	15	11	5.57	4	84	11	1	1	1	14	18	148	-	-	65	11	0
EAGLE EAST (S)	83 MMAR	10	12	5.67	6	77	13	1	15	1	10	16	202	-	3.37	72	11	0
EAGLE EAST (S)	83 APR	15	10	5.64	7	63	7	2	2	0	8	11	208	-	3.00	78	1	0
EAGLE EAST (S)	83 JUN	20	12	6.10	18	65	6	2	21	0	4	6	155	-	3.37	82	0	0
EAGLE EAST (S)	83 JUL	25	12	5.96	20	86	10	3	12	3	22	9	163	-	4.65	65	9	0
EAGLE EAST (S)	83 OCT	10	16	5.62	4	92	15	5	33	0	12	18	139	-	5.06	91	18	0
EAGLE EAST (S)	84 FEB	10	10	5.28	-5	54	6	3	17	0	57	18	179	62	1.93	73	7	0
EAGLE EAST (S)	84 MMAR	15	6	5.01	-10	65	-0	1	-31	0	34	24	202	106	1.88	50	7	0
EAGLE EAST (S)	84 LMAR	10	10	5.67	9	71	6	2	7	0	8	11	96	29	2.81	61	4	0
EAGLE EAST (S)	84 JUL	10	12	6.20	26	58	9	3	44	5	6	8	72	14	4.41	72	1	0
EAGLE EAST (S)	OCT 26	15	14	5.95	26	98	9	6	5	-	-	-	80	-	-	85	1	0
EAGLE EAST (S)	NOV 9	0	18	5.75	9	131	13	3	4	-	-	-	97	-	-	85	44	0
EAGLE EAST (S)	NOV 13	20	15	5.21	-4	113	6	9	-12	-	-	-	290	-	-	84	33	0
EAGLE SOUTH INLET	82 NOV	20	25	6.51	139	122	49	4	72	0	2	5	28	-	7.69	93	0	0
EAGLE SOUTH INLET	83 FEB	15	22	6.80	121	94	50	4	51	3	6	2	68	-	3.75	87	0	0
EAGLE SOUTH INLET	83 EMAR	20	17	6.49	69	103	31	3	25	3	2	3	39	-	6.94	76	2	0
EAGLE SOUTH INLET	83 MMAR	15	18	6.48	55	92	32	3	36	3	9	4	110	-	5.49	85	9	0
EAGLE SOUTH INLET	83 APR	15	18	6.60	63	96	31	3	45	5	5	5	90	-	5.81	85	3	0
EAGLE SOUTH INLET	83 JUN	10	21	6.90	93	106	37	5	65	0	10	0	63	-	5.81	80	0	0
EAGLE SOUTH INLET	83 JUL	75	29	6.50	145	153	58	8	83	7	27	0	191	-	6.77	90	8	0
EAGLE SOUTH INLET	83 OCT	15	31	6.34	144	180	65	9	71	5	20	3	56	-	6.94	99	6	0
EAGLE SOUTH INLET	84 FEB	5	11	6.08	26	85	15	3	-21	0	6	0	62	11	3.82	69	3	0
EAGLE SOUTH INLET	84 MMAR	10	12	6.29	38	103	22	3	-22	5	15	6	92	38	3.47	62	4	0
EAGLE SOUTH INLET	84 LMAR	10	14	6.03	82	107	26	3	3	5	7	2	40	4	4.87	41	1	0
EAGLE SOUTH INLET	84 JUL	10	22	6.98	143	137	37	6	33	0	8	2	35	8	6.99	70	2	0
EAGLE SOUTH INLET	OCT 26	30	46	6.77	302	176	95	13	154	-	-	-	30	-	-	146	2	0
EAGLE SOUTH INLET	NOV 9	7	39	6.78	287	228	82	12	92	-	-	-	21	-	-	82	1	0
EAGLE SOUTH INLET	NOV 13	15	23	6.58	103	160	48	12	15	-	-	-	67	-	-	93	0	0
EAGLE WEST INLET	82 NOV	50	13	6.16	74	101	18	1	24	11	19	7	136	-	4.95	31	0	0
EAGLE WEST INLET	83 FEB	5	14	6.23	71	91	20	1	22	6	14	3	74	-	4.50	54	2	0
EAGLE WEST INLET	83 EMAR	10	8	5.75	29	64	9	1	4	4	18	2	80	-	3.56	44	0	0
EAGLE WEST INLET	83 MMAR	10	9	5.85	31	60	11	1	12	3	12	6	79	-	3.84	45	0	0
EAGLE WEST INLET	83 APR	40	14	6.23	49	73	20	2	38	5	8	4	77	-	4.03	64	3	0
EAGLE WEST INLET	83 JUN	70	13	6.31	77	100	10	2	23	11	17	8	125	-	3.94	32	0	0
EAGLE WEST INLET	83 JUL	75	29	6.40	203	195	49	3	59	8	14	3	188	-	4.69	53	7	0
EAGLE WEST INLET	83 OCT	30	27	6.13	125	186	43	3	55	5	49	3	93	-	5.81	91	4	0
EAGLE WEST INLET	84 FEB	20	8	5.70	19	59	8	0	2	0	25	0	59	0	2.81	45	0	0
EAGLE WEST INLET	84 MMAR	20	10	6.09	50	88	17	1	-3	0	29	4	70	30	3.26	40	1	0
EAGLE WEST INLET	84 LMAR	30	11	5.70	45	75	13	1	19	5	13	3	57	6	3.41	49	3	0
EAGLE WEST INLET	84 JUL	60	21	6.34	159	147	35	2	57	21	38	4	97	4	4.89	23	1	0

APPENDIX H (CONT)

SITE	DATE	PT-CO COLOR	COND UMHOS	PH	ALK	CA	MG	K	NA	FE	MN PPB	ZN PPB	TOTAL AL PPB	LABILE AL PPB	SI02 PPM	SD4	MD3	CL
ECHO LAKE SFC	82 OCT	20	18	6.66	92	117	17	6	51	0	8	2	16	-	2.34	61	0	0
ECHO LAKE SFC	82 NOV	15	18	6.64	79	118	14	5	32	0	9	2	13	-	-	73	0	0
ECHO LAKE SFC	83 APR	15	11	6.85	74	119	9	3	15	0	8	2	25	-	-	1	9	0
ECHO LAKE SFC	83 JUL	10	19	6.80	75	118	14	4	42	0	6	0	25	-	-	75	9	0
ECHO LAKE SFC	83 OCT	-	16	6.66	61	124	14	5	45	0	9	0	17	-	-	53	1	0
ECHO LAKE SFC	84 JUL	10	18	6.95	66	116	15	5	58	0	7	2	24	9	2.34	73	2	0
ECHO LAKE 18M	83 JUL	10	18	6.73	75	119	11	4	23	2	9	2	24	-	-	81	14	0
ECHO LAKE 18M	84 JUL	10	18	6.99	65	119	17	5	55	0	15	9	36	12	2.64	68	2	0
HODGSON PD SFC	82 OCT	50	14	6.20	56	63	36	5	45	0	10	2	101	-	3.00	56	4	0
HODGSON PD SFC	82 NOV	40	16	5.97	60	78	46	5	32	11	16	3	132	-	-	69	0	0
HODGSON PD SFC	83 APR	30	12	6.20	31	70	26	4	10	11	16	2	171	-	-	64	1	0
HODGSON PD SFC	83 JUL	40	16	5.98	68	66	37	2	43	10	23	0	91	-	-	68	5	0
HODGSON PD SFC	83 OCT	-	15	6.25	56	77	35	4	25	11	16	4	88	-	-	72	0	0
HODGSON PD SFC	84 JUL	45	14	6.24	50	73	37	5	37	21	63	0	98	10	2.64	50	1	0
L HADLOCK SFC	82 OCT	10	13	6.23	38	84	3	3	33	5	26	10	31	-	1.71	65	0	0
L HADLOCK SFC	82 NOV	20	14	6.45	43	90	4	2	28	5	12	3	50	-	-	77	0	0
L HADLOCK SFC	83 FEB	15	14	5.54	12	91	9	3	31	5	28	29	125	-	-	84	3	0
L HADLOCK SFC	83 MHAR	10	11	5.57	10	72	10	0	14	2	23	8	168	-	-	45	10	0
L HADLOCK SFC	83 APR	15	13	6.24	30	95	7	1	20	5	15	6	110	-	-	52	0	0
L HADLOCK SFC	83 JUN	20	10	6.16	22	78	2	1	22	0	17	3	107	-	-	72	0	0
L HADLOCK SFC	83 JUL	10	12	6.37	30	87	4	2	11	2	25	0	43	-	-	68	7	0
L HADLOCK SFC	83 OCT	10	13	6.30	37	96	3	2	7	5	23	2	33	-	-	66	3	0
L HADLOCK SFC	84 FEB	15	10	5.51	6	78	-1	1	-3	0	39	6	141	40	3.19	70	6	0
L HADLOCK SFC	84 MHAR	20	7	5.80	17	77	-6	1	-27	0	34	10	126	38	-	43	1	0
L HADLOCK SFC	84 LMAR	10	8	5.51	13	77	-4	1	-14	0	34	8	118	51	2.70	56	3	0
L HADLOCK SFC	84 APR	5	10	5.95	21	79	-2	2	3	5	40	12	114	57	2.83	63	0	0
L HADLOCK SFC	84 JUL	10	10	6.25	22	78	-3	2	11	0	18	3	56	19	2.25	65	1	0
L HADLOCK 8M	83 FEB	20	16	6.26	46	104	12	2	41	4	6	6	62	-	-	80	0	0
L HADLOCK 8M	83 MHAR	15	17	5.56	47	112	11	2	35	3	12	5	97	-	-	81	10	0
L HADLOCK 8M	83 JUN	20	12	6.15	25	80	7	2	36	0	14	7	94	-	-	63	0	0
L HADLOCK 8M	83 JUL	15	13	5.88	23	83	9	2	34	3	14	8	95	-	-	64	3	0
L HADLOCK 8M	84 APR	10	9	5.94	18	78	-5	2	-6	0	38	17	114	62	-	63	0	0
L HADLOCK 8M	84 JUL	15	10	5.95	20	80	-6	2	3	0	20	9	57	11	2.44	63	0	0
U HADLOCK SFC	82 OCT	20	16	6.45	58	93	10	4	52	5	9	12	59	-	2.70	70	0	0
U HADLOCK SFC	82 NOV	25	15	6.41	45	101	5	2	25	0	10	6	91	-	-	60	0	0
U HADLOCK SFC	83 FEB	15	13	5.75	14	98	11	2	-5	3	18	17	84	-	-	87	11	0
U HADLOCK SFC	83 MHAR	10	11	5.40	4	56	12	1	20	3	19	10	206	-	-	77	10	0
U HADLOCK SFC	83 APR	15	12	6.14	24	51	1	1	10	0	16	7	128	-	-	77	3	0
U HADLOCK SFC	83 JUN	20	14	6.15	24	78	7	2	44	0	18	10	114	-	-	84	0	0
U HADLOCK SFC	83 JUL	15	15	6.49	35	89	10	2	44	3	14	0	41	-	-	81	3	0
U HADLOCK SFC	83 OCT	10	18	6.40	43	103	15	4	52	5	6	4	62	-	-	90	1	0
U HADLOCK SFC	84 FEB	15	12	5.56	8	79	10	2	17	0	32	0	123	33	2.81	73	6	0
U HADLOCK SFC	84 MHAR	15	11	5.64	15	84	3	2	29	0	42	13	108	47	-	57	3	0
U HADLOCK SFC	84 LMAR	10	11	5.54	17	80	-2	2	36	0	38	7	106	44	2.51	56	3	0
U HADLOCK SFC	84 APR	5	9	6.01	12	77	-9	1	5	5	40	17	115	58	-	65	0	0
U HADLOCK SFC	84 JUL	15	12	6.17	23	77	0	2	24	4	23	5	93	30	2.62	72	1	0
U HADLOCK SFC	83 FEB	20	16	6.12	53	114	9	2	29	4	12	7	97	-	-	83	0	0
U HADLOCK 8M	83 MHAR	10	15	5.81	44	115	-7	0	21	3	22	12	136	-	-	70	10	0
U HADLOCK 8M	83 JUN	20	11	5.98	25	78	5	2	14	0	11	14	125	-	-	72	0	0
U HADLOCK 8M	83 JUL	25	14	5.97	26	90	8	2	23	48	26	8	158	-	-	86	4	0
U HADLOCK 8M	84 APR	10	9	5.96	15	74	-18	0	-15	0	42	11	110	48	-	75	0	0
U HADLOCK 8M	84 JUL	15	13	6.32	21	73	6	3	44	0	42	4	106	25	2.53	78	3	0
HADLOCK BROOK	82 NOV	15	19	6.48	69	123	19	2	28	0	3	5	27	-	-	93	0	0
HADLOCK BROOK	83 FEB	5	20	6.37	60	126	26	2	39	1	0	3	27	-	4.50	98	3	0
HADLOCK BROOK	83 ENAR	10	15	6.20	30	108	17	1	15	1	4	4	71	-	3.64	78	7	0

SITE	DATE	PT-CO COLOR	COND UMHOS	PH	ALK	CA	MG	K	NA	FE	MN PP8	ZN PP8	TOTAL AL PP8	LABILE AL PP8	SI02 PPM	S04	N03	CL
MADLOCK BROOK	83 MAR	10	16	6.19	28	100	18	1	26	1	3	6	105	-	4.12	94	7	0
MADLOCK BROOK	83 APR	10	14	6.29	28	87	16	2	20	0	4	5	98	-	4.12	84	3	0
MADLOCK BROOK	83 JUN	10	19	6.40	58	100	19	3	50	0	4	11	62	-	4.50	100	0	0
MADLOCK BROOK	83 JUL	20	21	6.31	87	118	22	4	57	161	7	5	76	-	4.87	87	12	0
MADLOCK BROOK	83 AUG	25	25	6.50	95	159	37	4	62	5	4	5	84	-	5.45	55	5	0
MADLOCK BROOK	83 OCT	5	19	6.08	64	118	24	5	49	5	3	5	57	-	5.06	83	2	0
MADLOCK BROOK	84 FEB	5	14	5.76	15	80	12	2	22	0	17	0	96	29	2.81	88	6	0
MADLOCK BROOK	84 MAR	15	8	5.51	3	73	2	2	-16	0	22	6	136	70	2.14	63	4	0
MADLOCK BROOK	84 MAR	10	16	5.96	37	56	16	3	36	0	1	0	46	9	3.39	81	3	0
MADLOCK BROOK	84 JUL	5	21	6.14	79	116	22	4	59	0	3	2	39	10	4.69	97	1	0
MADLOCK BROOK	OCT 26	3	26	6.06	131	155	30	3	58	-	-	-	40	-	-	94	5	0
MADLOCK BROOK	NOV 9	5	18	6.16	63	127	15	3	20	-	-	-	36	-	-	88	1	0
MADLOCK BROOK	NOV 13	5	15	6.06	27	127	5	6	-8	-	-	-	87	-	-	87	6	0
GILMORE BROOK	82 NOV	15	22	6.85	102	152	18	2	33	0	0	4	37	-	5.45	88	0	0
GILMORE BROOK	83 FEB	10	20	6.71	93	163	17	1	18	1	1	2	37	-	4.76	76	3	0
GILMORE BROOK	83 MAR	10	18	6.50	41	121	17	1	34	1	4	4	67	-	3.94	85	12	0
GILMORE BROOK	83 MAR	10	16	6.36	31	104	15	1	27	1	4	8	111	-	3.95	90	8	0
GILMORE BROOK	83 APR	10	15	6.54	47	111	13	2	22	0	1	4	68	-	4.31	74	5	0
GILMORE BROOK	83 JUN	5	19	6.66	64	108	16	3	51	0	2	3	62	-	4.20	93	0	0
GILMORE BROOK	83 JUL	15	22	6.65	91	130	18	3	55	0	8	0	68	-	4.74	85	14	0
GILMORE BROOK	83 OCT	10	22	6.50	83	147	18	4	56	5	0	2	74	-	5.46	88	3	0
GILMORE BROOK	84 FEB	5	13	5.94	15	81	8	3	21	0	15	5	90	19	2.51	81	7	0
GILMORE BROOK	84 MAR	15	8	5.58	5	73	-1	2	-18	0	23	9	136	56	1.91	54	6	0
GILMORE BROOK	84 MAR	10	15	6.17	51	107	11	2	27	0	1	1	42	6	3.56	70	3	0
GILMORE BROOK	84 JUL	5	22	6.75	92	129	17	3	59	0	1	0	31	8	5.06	98	3	0
GILMORE BROOK	OCT 26	8	31	6.86	189	204	30	5	66	-	-	-	25	-	-	97	1	0
GILMORE BROOK	NOV 9	0	22	6.61	105	183	10	3	12	-	-	-	26	-	-	84	4	0
GILMORE BROOK	NOV 13	10	16	6.22	15	143	0	5	-14	-	-	-	100	-	-	102	7	0
PARKMAN BROOK	82 NOV	10	17	6.58	65	90	19	1	48	0	3	6	35	-	5.25	60	5	0
PARKMAN BROOK	83 FEB	5	17	6.48	66	100	24	1	48	1	0	5	30	-	4.50	78	0	0
PARKMAN BROOK	83 MAR	10	14	6.14	23	74	22	1	45	1	6	5	73	-	3.82	81	0	0
PARKMAN BROOK	83 MAR	10	13	6.09	21	68	17	1	28	1	4	6	100	-	4.31	77	5	0
PARKMAN BROOK	83 APR	10	14	6.29	30	78	17	1	20	0	3	0	59	-	4.69	89	3	0
PARKMAN BROOK	83 JUN	10	16	6.60	53	82	18	3	45	0	2	3	52	-	4.71	75	0	0
PARKMAN BROOK	83 JUL	20	17	6.78	87	96	18	3	42	0	15	3	50	-	5.25	56	6	0
PARKMAN BROOK	83 OCT	10	16	6.12	53	95	12	4	28	5	8	3	50	-	5.14	69	14	0
PARKMAN BROOK	84 FEB	0	11	5.67	10	55	10	1	29	0	14	3	99	44	3.00	69	6	0
PARKMAN BROOK	84 MAR	10	7	5.43	1	54	3	2	-14	0	25	7	139	84	2.44	54	0	0
PARKMAN BROOK	84 MAR	5	11	5.96	24	66	12	2	31	0	4	3	59	20	3.37	58	0	0
PARKMAN BROOK	84 JUL	10	16	6.51	79	93	15	2	44	0	10	3	21	9	5.25	64	1	0
PARKMAN BROOK	82 NOV	10	14	6.22	25	102	13	0	10	0	6	11	126	-	-	46	38	0
PENOBSCOT BROOK	83 FEB	10	16	6.09	24	103	20	1	7	1	2	8	99	-	4.87	112	6	0
PENOBSCOT BROOK	83 MAR	10	11	5.47	3	81	12	1	9	1	16	10	206	-	3.75	66	15	0
PENOBSCOT BROOK	83 MAR	10	14	5.25	-1	66	17	2	28	1	16	11	270	-	4.12	101	5	0
PENOBSCOT BROOK	83 APR	10	10	5.68	7	71	14	2	12	0	8	5	150	-	4.12	63	1	0
PENOBSCOT BROOK	83 JUN	10	15	5.79	9	64	14	3	48	0	10	7	156	-	4.12	113	0	0
PENOBSCOT BROOK	83 JUL	15	15	6.43	40	85	15	3	50	0	12	2	116	-	4.65	72	6	0
PENOBSCOT BROOK	83 OCT	10	13	5.63	5	86	12	4	32	5	18	12	156	-	5.63	72	1	0
PENOBSCOT BROOK	84 FEB	5	12	5.44	7	64	12	3	26	0	31	7	162	70	2.62	86	2	0
PENOBSCOT BROOK	84 MAR	10	7	5.05	-7	57	0	3	-17	0	33	12	241	135	2.25	55	5	0
PENOBSCOT BROOK	84 MAR	10	8	5.49	5	65	4	1	-6	0	16	6	122	55	3.04	59	0	0
PENOBSCOT BROOK	84 JUL	10	16	6.19	21	78	14	2	58	0	8	2	75	21	4.87	94	2	0
PENOBSCOT BROOK	OCT 26	20	20	6.23	43	103	22	10	56	-	-	-	81	-	-	114	0	0
PENOBSCOT BROOK	NOV 9	5	16	6.23	31	104	10	3	25	-	-	-	57	-	-	94	6	0
PENOBSCOT BROOK	NOV 13	15	13	4.73	-20	89	3	6	-0	-	-	-	288	-	-	91	8	0

APPENDIX H (CONT)

SITE	DATE	PT-CO COLOR	CUMD UMHCS	PH	ALK	CA	MG	K	NA	FE	MN PPB	ZN PPB	TOTAL AL PPB	LABILE AL PPB	SIG2 PPM	S04	N03	CL
HEATH BROOK	82 OCT	70	17	6.53	111	115	26	3	44	5	9	7	88	-	4.35	33	0	0
HEATH BROOK	82 NOV	50	16	6.47	77	114	21	4	28	5	12	3	120	-	5.64	46	3	0
HEATH BROOK	83 EMAR	40	10	6.30	38	77	4	1	17	5	19	2	82	-	3.37	39	5	0
HEATH BROOK	83 MMAR	40	10	6.26	33	70	6	1	33	4	10	3	120	-	3.94	41	3	0
HEATH BROOK	83 APR	40	11	6.40	42	77	6	1	26	5	10	5	70	-	3.07	43	6	0
HEATH BROOK	83 JUN	80	13	6.77	86	67	9	1	52	11	13	5	95	-	2.32	35	0	0
HEATH BROOK	83 JUL	140	17	6.29	147	150	-4	-2	55	21	6	3	180	-	4.31	-8	10	0
HEATH BROOK	83 AUG	25	17	6.34	157	171	0	6	-13	11	85	6	83	-	6.00	17	6	0
HEATH BROOK	83 OCT	30	21	6.66	169	160	34	7	29	5	10	1	50	-	3.04	23	1	0
HEATH BROOK	84 FEB	45	4	5.92	10	54	-30	-1	15	5	50	2	70	8	3.26	15	2	0
HEATH BROOK	84 MMAR	15	8	6.15	36	103	-12	-0	-17	5	23	3	68	11	3.00	28	6	0
HEATH BROOK	84 LMAR	30	5	5.55	17	66	-39	-2	44	0	6	6	5	0	2.89	5	3	0
HEATH BROOK	84 JUL	40	18	7.18	148	129	25	2	51	21	26	5	52	2	3.94	15	3	0
HALFMOON PD SFC	82 OCT	40	11	5.95	74	69	14	4	34	5	7	15	45	-	1.57	26	0	0
HALFMOON PD SFC	82 NOV	30	11	5.97	59	66	14	6	37	5	12	6	65	-	-	35	0	0
HALFMOON PD SFC	83 APR	20	10	6.05	32	56	10	3	29	0	15	3	47	-	-	41	2	0
HALFMOON PD SFC	83 JUL	35	10	6.29	68	63	9	1	26	7	8	0	35	-	-	22	4	0
HALFMOON PD SFC	83 OCT	-	12	6.10	72	75	16	3	34	5	9	2	40	-	-	25	1	0
HALFMOON PD SFC	84 JUL	40	10	5.91	78	64	11	2	40	21	47	4	67	8	1.56	13	0	0
HALFMOON PD 6M	83 JUL	30	11	5.84	67	70	12	4	18	16	64	6	64	-	-	40	3	0
HUNTERS BRK N	82 OCT	15	22	6.54	111	106	36	7	62	0	6	5	55	-	7.12	83	0	0
HUNTERS BRK N	82 NOV	15	19	6.65	70	98	33	4	45	0	5	6	21	-	6.97	91	0	0
HUNTERS BRK N	83 EMAR	15	12	6.14	26	82	21	2	-0	5	23	7	191	-	4.39	72	2	0
HUNTERS BRK N	83 MMAR	15	15	6.04	24	78	26	2	32	5	16	9	206	-	5.68	89	4	0
HUNTERS BRK N	83 APR	15	13	6.40	35	81	19	2	10	5	8	10	133	-	5.63	78	1	0
HUNTERS BRK N	83 JUN	10	18	6.50	56	79	27	4	55	0	6	7	110	-	5.44	53	0	0
HUNTERS BRK N	83 JUL	5	29	6.87	180	150	52	3	77	2	5	0	44	-	7.01	79	15	0
HUNTERS BRK N	83 AUG	5	32	7.15	217	164	55	7	91	5	3	3	25	-	7.31	74	9	0
HUNTERS BRK N	83 OCT	5	28	6.94	169	147	55	6	95	5	20	2	61	-	7.12	74	0	0
HUNTERS BRK N	84 FEB	15	14	6.30	27	74	19	3	29	0	19	10	107	24	3.94	84	1	0
HUNTERS BRK N	84 MMAR	10	11	6.09	21	92	15	2	-8	0	25	12	109	40	3.75	64	0	0
HUNTERS BRK N	84 LMAR	0	13	6.15	43	84	23	3	30	0	8	9	55	0	4.54	55	2	0
HUNTERS BRK N	84 JUL	10	18	6.65	91	103	24	4	41	0	6	3	41	11	6.06	69	5	0
HUNTERS BRK N	OCT 26	10	32	7.08	224	178	61	8	90	-	-	-	26	-	-	73	0	0
HUNTERS BRK N	NOV 9	5	29	6.88	193	171	59	7	59	-	-	-	21	-	-	73	0	0
HUNTERS BRK N	NOV 13	15	19	6.51	66	132	33	11	13	-	-	-	103	-	-	89	0	0
HUNTERS BRK S	82 OCT	20	25	6.66	147	126	40	8	79	5	7	5	107	-	7.87	79	0	0
HUNTERS BRK S	82 NOV	15	21	6.77	95	111	35	5	58	5	9	7	133	-	7.69	92	0	0
HUNTERS BRK S	83 EMAR	25	14	6.14	28	83	23	2	31	6	27	9	148	-	4.35	74	3	0
HUNTERS BRK S	83 MMAR	15	14	6.14	31	80	19	3	31	8	18	8	235	-	5.87	82	4	0
HUNTERS BRK S	83 APR	20	15	6.41	41	87	24	4	36	16	12	10	229	-	6.24	71	6	0
HUNTERS BRK S	83 JUN	20	18	6.62	67	83	24	4	58	5	9	7	133	-	5.44	84	0	0
HUNTERS BRK S	83 JUL	15	29	6.90	195	154	43	7	86	12	4	4	94	-	6.99	70	7	0
HUNTERS BRK S	83 AUG	10	34	7.12	242	197	58	11	170	16	26	5	116	-	7.39	78	6	0
HUNTERS BRK S	83 OCT	10	11	6.05	24	96	17	3	-13	11	8	0	55	-	7.31	67	2	0
HUNTERS BRK S	84 FEB	20	13	6.34	30	82	7	2	33	5	28	14	146	26	4.20	76	1	0
HUNTERS BRK S	84 LMAR	10	11	6.18	46	91	14	3	55	0	10	11	155	65	3.94	61	0	0
HUNTERS BRK S	84 MMAR	5	15	6.05	24	96	17	3	-13	5	38	15	85	0	4.87	60	2	0
HUNTERS BRK S	84 JUL	15	21	6.80	102	110	27	6	90	5	12	3	73	12	6.04	65	3	0
HUNTERS BRK S	OCT 26	25	35	6.88	249	190	61	10	105	-	-	-	52	-	-	68	0	0
HUNTERS BRK S	NOV 9	10	32	6.89	213	179	63	8	103	-	-	-	48	-	-	68	0	0
HUNTERS BRK S	NOV 13	25	23	6.61	85	137	45	12	49	-	-	-	138	-	-	87	0	0
HUNTERS BRK S	NOV 9	5	19	6.41	88	113	22	5	44	-	-	-	93	-	-	78	0	0
HPRK	NOV 13	10	14	6.12	31	100	10	11	15	-	-	-	43	-	-	69	1	0
HPRK	NOV 13	10	14	6.57	55	96	20	6	18	0	4	12	17	-	2.62	66	0	0
JORDAN PD N SFC	82 OCT	10	14	6.57	55	96	20	6	18	0	4	12	17	-	2.62	66	0	0

STTF	DATE	PT-CO COLOR	COND UNHCS	PH	ALK	CA	MG	K	NA	FE	MM PPB	ZN PPB	TOTAL AL PPB	LABILE AL PPB	SI02 PPH	SO4 NO3	CL
JORDAN PD N SFC	82 NOV	10	16	6.55	52	99	21	4	14	0	4	2	17	-	-	83	0
JORDAN PD N SFC	83 APR	5	15	6.56	47	103	20	4	18	0	5	3	11	-	-	67	0
JORDAN PD N SFC	83 JUL	5	16	6.64	53	97	19	4	19	0	2	0	17	-	-	85	0
JORDAN PD N SFC	83 OCT	-	17	6.49	51	108	22	5	31	0	2	5	21	-	-	87	0
JORDAN PD N SFC	84 JUL	5	15	6.74	47	57	18	4	16	0	6	1	33	17	2.49	77	0
JORDAN PD S SFC	82 OCT	10	15	6.59	54	56	20	6	24	0	5	2	18	-	2.44	63	0
JORDAN PD S SFC	82 NOV	10	16	6.56	50	99	21	4	19	0	4	3	12	-	-	84	0
JORDAN PD S SFC	83 APR	5	15	6.55	51	102	18	3	9	0	5	4	10	-	-	70	0
JORDAN PD S SFC	83 JUL	5	16	6.58	52	99	20	4	18	0	2	0	17	-	-	86	0
JORDAN PD S SFC	83 OCT	-	17	6.49	51	107	22	5	26	0	2	0	23	-	-	90	0
JORDAN PD S SFC	84 JUL	5	17	6.65	49	96	18	4	18	0	5	2	22	9	2.49	78	0
JORDAN PD S SFC	84 JUL	5	15	6.56	47	100	21	4	25	6	5	11	29	-	-	89	0
JORDAN PD S SFC	84 JUL	10	15	6.67	47	100	20	5	20	0	7	6	24	7	2.49	79	0
JORDAN PD S SFC	82 OCT	15	15	6.43	89	83	17	4	36	0	17	5	27	-	-	506	0
JORDAN PD S SFC	82 NOV	10	13	6.19	53	79	15	2	23	0	15	2	31	-	-	487	0
JORDAN PD S SFC	83 EMAR	15	14	6.25	46	85	17	5	28	2	14	3	32	-	-	324	0
JORDAN PD S SFC	83 MHAR	5	11	6.14	28	74	13	1	18	2	6	3	53	-	-	356	0
JORDAN PD S SFC	83 APR	10	12	6.28	44	68	12	1	21	0	7	2	27	-	-	354	0
JORDAN PD S SFC	83 JUN	10	14	6.40	56	70	14	3	35	0	10	8	28	-	-	360	0
JORDAN PD S SFC	83 JUL	5	25	6.76	224	170	28	6	52	4	7	0	23	-	-	510	0
JORDAN PD S SFC	83 AUG	5	28	6.87	260	198	31	7	53	5	24	2	16	-	-	532	0
JORDAN PD S SFC	83 OCT	5	23	6.60	187	165	25	5	41	5	51	0	17	-	-	487	0
JORDAN PD S SFC	84 FEB	5	8	5.79	11	61	4	1	2	0	9	0	57	0	-	54	0
JORDAN PD S SFC	84 MHAR	10	10	6.17	26	88	-3	1	-3	0	15	8	37	12	2.70	33	0
JORDAN PD S SFC	84 LMAR	0	10	6.00	34	74	11	1	15	0	1	5	13	0	3.07	49	0
JORDAN PD S SFC	84 JUL	5	15	6.60	92	91	13	3	29	5	24	2	20	8	4.31	51	0
JORDAN PD S SFC	OCT 26	5	30	6.64	249	202	38	6	77	-	-	-	8	-	-	42	0
JORDAN PD S SFC	NOV 9	0	16	6.52	93	113	16	3	31	-	-	-	13	-	-	52	0
JORDAN PD S SFC	NOV 13	7	12	6.25	35	97	7	1	-	-	-	-	63	-	-	41	0
JORDAN PD S SFC	NOV 13	10	14	6.38	84	69	21	5	48	5	12	3	16	-	1.37	44	0
JORDAN PD S SFC	82 NOV	15	14	6.59	74	67	22	4	45	0	10	2	34	-	-	48	0
JORDAN PD S SFC	83 APR	25	14	6.56	40	69	13	2	22	0	8	4	63	-	-	39	0
JORDAN PD S SFC	83 JUL	25	14	6.58	85	80	15	4	33	5	37	0	16	-	-	42	0
JORDAN PD S SFC	83 OCT	-	13	6.52	65	72	16	4	28	5	14	0	20	-	-	50	0
JORDAN PD S SFC	84 JUL	10	12	6.69	62	72	14	2	36	0	25	1	24	14	1.18	39	0
JORDAN PD S SFC	83 JUL	15	13	6.56	85	80	13	3	29	6	38	0	18	-	-	38	0
JORDAN PD S SFC	82 OCT	10	14	6.47	45	73	29	6	29	0	3	0	20	-	0.94	67	0
JORDAN PD S SFC	82 NOV	15	14	6.24	35	75	27	5	25	0	4	3	16	-	-	71	0
JORDAN PD S SFC	83 APR	15	14	6.41	35	77	26	5	26	5	5	6	18	-	-	72	0
JORDAN PD S SFC	83 JUL	15	14	6.35	36	75	24	4	18	3	5	0	27	-	-	76	0
JORDAN PD S SFC	83 OCT	-	15	6.35	37	79	28	6	27	5	0	0	26	-	-	81	0
JORDAN PD S SFC	84 JUL	10	13	6.49	37	75	24	5	19	0	7	0	33	8	1.12	74	0
JORDAN PD S SFC	82 OCT	15	14	6.46	41	74	28	7	29	0	4	2	43	-	1.12	73	0
JORDAN PD S SFC	82 NOV	10	13	6.36	29	74	27	6	20	0	4	2	26	-	-	77	0
JORDAN PD S SFC	83 APR	15	15	6.40	34	80	27	5	32	5	4	8	19	-	-	74	0
JORDAN PD S SFC	83 JUL	15	14	6.44	34	77	24	5	18	2	3	0	28	-	-	74	0
JORDAN PD S SFC	83 OCT	-	15	6.19	32	79	25	6	24	5	5	3	27	-	-	82	0
JORDAN PD S SFC	84 JUL	10	15	6.53	32	76	28	8	45	0	6	9	45	21	1.05	71	0
JORDAN PD S SFC	83 JUL	15	12	6.37	34	73	21	4	3	4	4	0	28	-	-	71	0
JORDAN PD S SFC	84 JUL	10	14	6.48	31	78	26	5	26	0	6	3	30	6	1.31	75	0
JORDAN PD S SFC	82 OCT	15	28	6.55	196	170	37	6	62	5	26	4	28	-	-	639	0
JORDAN PD S SFC	82 NOV	15	23	6.83	130	146	29	4	43	0	14	2	62	-	-	656	0
JORDAN PD S SFC	83 EMAR	20	14	6.33	46	96	21	1	23	5	18	3	176	-	-	412	0
JORDAN PD S SFC	83 MHAR	15	17	6.39	61	100	20	1	25	3	12	5	107	-	-	487	0
JORDAN PD S SFC	83 APR	15	16	6.60	60	107	20	2	26	5	8	8	86	-	-	506	0

APPENDIX H (CONT)

SITE	DATE	PT-CO COLOR	COND UMHGS	PH	ALK	CA	MG	K	NA	FE	MN PPB	ZN PPB	TOTAL AL PPB	LABILE AL PPB	SI02 PPM	SD4	NO3	CL
LIT HARBOR BRK	83 JUN	15	21	6.85	102	118	26	3	55	0	10	7	73	-	4.76	41	0	0
LIT HARBOR BRK	83 JUL	40	32	6.96	240	193	44	9	89	3	16	0	79	-	4.95	54	8	0
LIT HARBOR BRK	83 AUG	15	32	7.03	242	234	37	7	51	16	13	1	45	-	5.31	57	8	0
LIT HARBOR BRK	83 OCT	20	41	7.02	318	253	56	8	105	16	25	0	60	-	5.63	70	3	0
LIT HARBOR DRK	84 FEB	10	12	6.30	46	96	13	1	12	0	20	0	98	20	3.75	53	0	0
LIT HARBOR BRK	84 MAR	15	12	6.24	46	111	12	1	-1	0	23	2	75	19	3.37	52	0	0
LIT HARBOR BRK	84 LMAR	5	16	6.36	60	111	19	2	35	0	9	2	42	0	3.81	64	0	0
LIT HARBOR BRK	84 JUL	15	23	6.92	126	155	27	4	61	5	23	0	48	8	5.44	67	3	0
LIT HARBOR BRK	OCT 26	20	57	6.99	434	267	95	14	247	-	-	-	37	-	-	64	2	0
LIT HARBOR BRK	NOV 9	10	34	7.05	244	252	53	5	48	-	-	-	17	-	-	74	2	0
LIT HARBOR BRK	NOV 13	15	22	6.63	101	180	22	9	14	-	-	-	52	-	-	81	1	0
LIT LONG POND	82 OCT	35	21	6.80	144	121	41	11	31	0	6	0	68	-	-	58	4	0
LIT LONG POND	82 NOV	25	19	6.55	68	105	38	5	38	5	12	4	70	-	-	80	0	0
LIT LONG POND	83 APR	40	33	6.48	66	158	91	7	169	11	20	6	147	-	-	104	20	0
LIT LONG POND	83 JUL	20	143	6.97	164	408	1148	115	-249	4	27	0	67	-	-	877	0	0
LIT LONG POND	83 OCT	15	11	7.00	193	177	-26	5	-78	11	9	12	83	-	-	-21	2	0
LIT LONG POND	84 JUL	20	20	6.40	89	113	34	6	65	5	25	0	31	5	2.62	64	0	0
RESERVOIR	82 OCT	15	25	6.24	82	158	28	4	55	0	7	3	69	-	5.31	122	0	0
RESERVOIR	83 APR	10	14	5.52	8	110	11	3	-15	5	13	10	260	-	5.70	110	1	0
RESERVOIR	83 JUL	15	23	6.06	71	142	17	3	38	5	52	2	68	-	-	127	7	0
RESERVOIR	83 OCT	-	27	6.29	74	163	28	4	79	5	9	4	67	-	6.19	137	1	0
RESERVOIR	84 JUL	10	16	5.97	10	90	14	5	12	5	23	8	161	67	5.63	125	1	0
ROUND POND SFC	82 OCT	25	11	6.07	27	54	20	3	30	0	10	0	41	-	0.75	59	0	0
ROUND POND SFC	82 NOV	25	11	6.07	27	54	20	3	30	0	10	0	41	-	-	-	0	0
ROUND POND SFC	83 APR	25	11	6.11	21	53	13	2	42	5	9	8	65	-	-	59	5	0
ROUND POND SFC	83 JUL	20	11	6.05	20	47	20	1	37	3	21	3	37	-	-	53	1	0
ROUND POND SFC	83 OCT	-	13	6.16	53	56	22	3	61	5	8	1	30	-	1.12	51	1	0
ROUND POND SFC	84 JUL	15	10	6.11	17	51	18	3	32	5	35	3	45	2	-	63	9	0
ROUND POND 4M	83 JUL	25	11	6.06	21	49	18	2	27	6	25	4	46	-	1.01	60	0	0
SEAL COVE PD SFC	82 OCT	20	15	6.45	67	69	35	5	39	5	8	0	26	-	-	73	0	0
SEAL COVE PD SFC	82 NOV	15	16	6.58	60	80	37	5	25	0	9	2	44	-	-	83	10	0
SEAL COVE PD SFC	83 APR	25	14	6.40	39	78	33	4	29	11	11	6	211	-	-	72	1	0
SEAL COVE PD SFC	83 JUL	15	16	6.51	48	72	32	4	29	3	14	5	30	-	-	81	11	0
SEAL COVE PD SFC	83 OCT	-	16	6.45	49	81	36	5	50	5	16	0	25	-	1.69	70	1	0
SEAL COVE PD 5M	84 JUL	10	14	6.50	38	73	29	4	28	5	16	0	36	-	-	82	0	0
SARGENT MT PD	83 JUL	15	16	6.57	48	73	33	4	31	2	14	7	31	-	0.58	82	0	0
SARGENT MT PD	82 OCT	20	9	4.60	-30	21	5	4	17	0	13	12	272	-	1.14	90	0	0
SARGENT MT PD	82 NOV	25	9	4.53	-25	25	6	5	17	0	17	12	325	-	1.31	79	0	0
SARGENT MT PD	83 MAR	15	9	4.61	-26	31	7	3	14	2	21	14	401	-	0.75	74	0	0
SARGENT MT PD	83 APR	15	7	4.56	-25	26	2	4	-6	5	19	16	331	-	0.41	88	0	0
SARGENT MT PD	83 JUN	15	9	4.57	-27	27	4	3	20	0	17	10	316	-	0.19	85	3	0
SARGENT MT PD	83 JUL	5	9	4.59	-29	26	4	4	20	0	13	7	181	-	0.21	83	1	0
SARGENT MT PD	83 OCT	5	10	4.60	-29	28	6	2	29	5	18	3	234	-	1.31	56	5	0
SARGENT MT PD	84 LMAR	20	7	4.54	-31	25	4	6	19	5	22	13	334	237	0.37	63	1	0
SARG MT PD 3M	84 JUL	15	6	4.55	-30	19	-4	5	1	5	16	9	175	97	0.19	83	3	0
STANLEY BROOK	83 JUL	5	9	4.55	-34	26	4	1	15	0	13	6	186	-	7.93	91	7	0
STANLEY BROOK	82 OCT	40	30	6.84	170	165	54	14	74	5	6	4	96	-	7.93	95	9	0
STANLEY BROOK	82 NOV	20	25	6.84	115	145	44	10	40	5	6	4	96	-	5.06	69	11	0
STANLEY BROOK	83 MAR	30	18	6.34	40	108	29	6	45	11	43	11	283	-	5.81	81	12	0
STANLEY BROOK	83 APR	35	18	6.28	46	107	28	6	32	4	25	8	123	-	5.85	83	12	0
STANLEY BROOK	83 JUN	35	23	6.67	63	119	25	8	14	5	13	11	120	-	5.25	88	10	0
STANLEY BROOK	83 JUL	15	34	7.03	190	210	55	14	60	2	6	5	39	-	6.94	93	25	0
STANLEY BROOK	83 AUG	10	48	7.20	250	228	75	19	122	5	5	3	35	-	7.35	162	37	0
STANLEY BROOK	83 OCT	10	40	7.15	263	252	71	17	94	5	3	0	36	-	8.06	71	9	0

SITE	DATE	PT-CO COLOR	COND UMHOS	PH	ALK	CA	MG	K	NA	FE	MN PPB	ZN PPB	TOTAL AL PPB	LABILE AL PPB	SI02 PPM	SO4	NO3	CL
STANLEY BROOK	84 FEB	25	20	6.33	44	107	32	8	76	5	26	3	147	17	4.31	82	7	0
STANLEY BROOK	84 MAR	20	21	6.46	54	142	28	10	75	5	37	13	133	32	4.12	75	0	0
STANLEY BROOK	84 MAR	10	20	6.45	68	143	20	9	52	0	6	4	52	0	5.14	66	10	0
STANLEY BROOK	84 JUL	20	20	6.94	110	160	24	12	-11	5	9	5	58	11	6.00	63	15	0
STANLEY BROOK	OCT 26	20	38	6.97	258	228	62	25	70	-	-	-	25	-	-	83	8	0
STANLEY BROOK	NOV 9	15	37	7.02	226	223	66	15	91	-	-	-	25	-	-	91	10	0
STANLEY BROOK	NOV 13	40	36	6.66	112	225	76	17	31	-	-	-	171	-	-	183	0	0
THE TARN	82 OCT	20	18	6.38	97	104	9	6	57	11	6	5	69	-	2.25	63	0	0
THE TARN	82 NOV	20	19	6.63	87	123	11	6	45	11	6	2	80	-	-	71	0	0
THE TARN	83 APR	15	9	6.38	34	55	-10	1	-14	11	24	5	140	-	-	40	5	0
THE TARN	83 JUL	30	17	6.64	109	136	3	-2	21	17	9	0	78	-	-	55	7	0
THE TARN	83 OCT	25	18	6.62	127	160	-5	4	23	16	9	1	67	-	-	44	2	0
THE TARN	84 JUL	30	14	6.48	58	94	-2	1	45	16	25	2	126	0	1.31	58	0	0
WITCH HOLE SFC	82 OCT	45	10	6.39	57	59	17	4	11	11	8	3	39	-	1.35	35	0	0
WITCH HOLE SFC	82 NOV	35	10	6.25	48	57	18	5	21	5	9	2	69	-	-	35	0	0
WITCH HOLE SFC	83 APR	35	9	6.12	26	49	13	4	21	5	16	7	55	-	-	41	4	0
WITCH HOLE SFC	83 JUL	25	9	6.37	42	54	13	2	16	5	13	0	30	-	-	38	2	0
WITCH HOLE SFC	83 OCT	-	12	6.35	62	62	20	3	36	11	7	0	34	-	-	34	2	0
WITCH HOLE SFC	84 JUL	35	9	6.30	32	52	14	2	28	5	19	3	35	-	0.75	35	1	0
WITCH HOLE 6M	83 JUL	25	10	6.30	44	55	15	3	15	8	19	5	43	-	-	41	7	0

