WATER QUALITY OF CONESUS LAKE, 1985-1986

by

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INTRODUCTION

Conesus Lake is the most western of the Finger Lakes with the Towns of Geneseo, Livonia, Conesus and Groveland bordering on the shoreline of the lake. Historically, the lake community has a rich history of respect and concern for Conesus Lake. As early as 1914, great concern was expressed in the local papers as to the continued purity of the lake water (Conesus Lake Association 1976). Concerns by residents about water quality led to the inspection of disposal systems in 1925 (Forest et al. 1978). In 1973, the first perimeter sewer of a large lake in New York State was completed to control cultural eutrophication of the lake. Although the lake is primarily used for recreational purposes, it serves the Villages of Geneseo and Avon and the Town of Livonia as a municipal water supply.

Turbidity of raw water from Conesus Lake often exceeded the 1 NTU monthly maximum set by the New York State Sanitary Code (Public Health Law 225) (Larsen 1978; T. Klaseus, Personal Communication). In 1981 the NYS Department of Health asked T. Klaseus (Livingston County Health Engineer) and D. Cranston of the Rochester Area Office of the State Department of Health to host a meeting of towns and villages to discuss and possibly share a comprehensive raw water sampling and testing program for Conesus Lake (Faustel 1981). In March of 1982, officials of the Livingston County Health Department initiated discussions with SUNY Brockport on the feasibility of an intensive study of Conesus Lake water quality. In March of 1984, a preliminary scope of work was submitted to the Livingston County Health Department outlining a water quality study of Conesus Lake that incorporated two major areas of concern: 1) turbidity levels that exceeded New York State Health Department guidelines; and 2) an evaluation of nutrient levels in the lake to determine eutrophication trends since the construction of the perimeter sewer. The scope of work was endorsed by the NYS Department of Health in late May of 1984. Subsequently, the Town of Livonia and the Villages of Geneseo and Avon approved the study in March 1985. Larsen Engineers of Rochester, New York, was contracted by SUNY Brockport to review the data and final reports. Sampling began one month later.

An intensive study of Conesus Lake and its tributaries was undertaken between April 1985 and December 1986 with the following general objectives:

(1) To evaluate the water quality of Conesus Lake, the source of drinking water for the Town of Livonia and the Villages of Geneseo and Avon;

(2) To identify, if possible, water of lower turbidity within the lake;

(3) To identify, if possible, causes of higher turbidity in raw water intakes of the Livonia and Geneseo water treatment plants;

(4) To evaluate what effect, if any, the construction of a perimeter sewer has had on nutrient levels within the lake; i.e. eutrophication;

(5) To identify any sources of pollution within the watershed; and

(6) To provide a functional assessment of the ecological components studied and to evaluate their significance in relation to the drinking water supply.

This is the final report. A Summary of Results and Recommendations and Alternatives follow directly. Detailed discussion of results may be found in the Results and Discussion section. Quarterly data reports were presented to the Health Departments (State and County) and to the municipalities (Livonia, Avon, Geneseo) on three previous occasions.

SUMMARY OF RESULTS

Tributaries of Conesus Lake

1. The three creeks at the south end of the lake (North and South McMillan and the Inlet) accounted for 54.6% of the total discharge of flow into Conesus Lake for the 18 sampling dates.

2. High levels of sodium and chloride were observed in Hanna's and Wilkins Creeks. The high level of sodium and chloride in Hanna's Creek was directly attributed to the salt piles at the New York State Department of Transportation garage. The high concentration of sodium and chloride in Wilkins Creek was probably caused by deicing salt located at the DPW garage in Livonia. Further monitoring in the fall of the year would be necessary for confirmation of this finding.

Conesus Lake

3. During July, August and September in the southern basin, a large portion of the lake (10-12m in depth and downward) experienced oxygen concentrations less than 1 mg/L.

4. Copper levels were low ($\bar{x}$ = 2.8 µg/L).

5. Sulfate, calcium, magnesium and potassium concentrations were not significantly different from those levels in the 60's and 70's. Chloride and alkalinity concentrations had increased since the 60's but not significantly since the 70's.

6. Maximum trihalomethane potential (MTP) was high (~300-500 µg/L) indicating that organic precursors exist in the lake. However, total trihalomethanes (TTHM) within the Avon and Livonia systems, which are below the maximum contaminant level (MCL) of 100, suggest that the MTP was simply not realized within the public drinking water system.

7. Nutrient levels (total phosphorus and soluble reactive phoshorus) have remained the same as pre-perimeter sewer days. Nitrate levels were no longer detectable during the summer.

8. Conductivity ($\bar{x}$ = 365 µohms/cm in 1985) appeared to be higher than in the 60's (309) and 70's (335).

9. Mean epilimnetic sodium concentrations (16.95 mg/L) were higher in 1985 than in the early 60's (9.4 mg/L) or the 1972-73 period (12.2 mg/L). The higher sodium chloride and conductivity values were undoubtedly due to deicing salt usage in the watershed and possibly inadvertant losses from deicing salt storage.

10. Total residue ranged from 204.4 to 230 mg/L in the epilimnion. Fixed residue and filtrable residue represented 73.9% and 98.4% of the total mean residue, respectively.

11. 1985 height-of-the-season submersed aquatic macrophyte crops at the northern end of Conesus Lake were similar to pre-sewer years, while crops at

the south end were lower than pre-sewer years.

12. Mean epilimnetic chlorophyll a concentrations were 4.8 and 5.4 µg/L for the south and north basin, respectively. Substantial historical differences in chlorophyll a levels existed between 1972 and 1985. Mean epilimnetic values in 1985 were ~5.2 µg/L versus <1 µg/L during the spring and summer of 1972-73.

13. Mean and maximum transparency values in 1985 were lower than those in 1972.

14. From the north to the southern basin of Conesus Lake in 1985, a gradient of increasing soluble reactive phosphorus, chlorophyll a and transparency was evident.

15. Turbidity decreased from north to south. Lake turbidity has significantly increased since 1977 and may increase further as alewifes continue to crop down the efficient herbivorous Daphnia species in the lake.

16. During the study, raw water from the intake pipes of the Avon, Geneseo and Livonia plant was analyzed. Significant differences in turbidity readings existed between Brockport and the Geneseo and Livonia plants. Brockport and Avon's turbidity readings were statistically the same.

The difference in readings between the plants in Livonia and Brockport was reconciled in the following manner. Turbidity measurements reported on the New York State Health Department Daily Operation Record as raw water turbidity by Livonia were actually turbidity levels after treatment with chlorine in a detention tank.

In addition to the lower turbidity readings at the Geneseo plant compared to the Brockport values, turbidity values for the Geneseo plant also possessed a remarkably low variability in comparison to the other water treatment plants on the lake, as well as to the Brockport measurement for the Geneseo Treatment Plant.

17. Turbidity of water taken from the shoreside raw water intake (i.e. the water treatment plant) should have the same turbidity as water taken directly from the lake. Significantly, higher turbidities were observed at the shoreside intake of the Livonia and Geneseo plants as compared to samples taken directly from the lake at the actual intake site. This was not the situation with the Avon plant. At the Avon plant, turbidity from the raw water intake was statistically the same as that taken directly from the lake. The higher turbidites at the Geneseo and Livonia plants appeared to be related to depth and design of the actual intakes in Conesus Lake.

18. Zooplankton composition has changed dramatically from a Daphnia pulex, Cyclops bicuspidatus, Conochilus unicornis complex of dominants to a Bosmina longirostris, Cyclops bicuspidatus, Conochilus unicornis complex. The large herbivorous D. pulex has been removed by the recently introduced alewife. This seemingly innocuous addition of one species of fish has had significant effects not only on zooplankton but also on phytoplankton and water quality, including turbidity. Lake turbidity has significantly increased since 1977 and is at least partially, if not entirely, attributable to the introduction of alewife in 1978-79. As alewifes continue to crop down other efficient herbivorous Daphnia species in the lake, further increases in

turbidity may occur.

19. In general, the water quality of Conesus Lake meets the standards set by the New York State Sanitary Code (Table 32). Turbidity is an exception. Between April 1985 and December 1985, Avon was out of compliance seven months and Livonia six months out of the eight.

Livonia's non-compliance may have been higher because turbidity readings reported to the Health Department were from partially treated water, which would have a lower turbidity as compared to raw water. Geneseo appears to be in compliance based on the turbidity measurements taken by plant personnel. However, the Brockport measurements do not agree with Geneseo's measurements. Furthermore, the Brockport turbidity measurements suggest non-compliance to the State Sanitary Code for the Geneseo water system.

RECOMMENDATIONS AND ALTERNATIVES

1. Because of the deicing salt entering both Hanna's and Wilkins Creek, further protection of the deicing salt piles at the NYS Department of Transportation garage and the DPW garage in Livonia should be considered.

2. In order to maintain or decrease current nutrient levels in Conesus Lake, the policy requiring that all new homes and businesses in the watershed of Conesus Lake be connected to the perimeter sewer should be continued.

3. The discrepancy in turbidity readings observed at the Geneseo Water Treatment Plant should be resolved. I believe that their turbidity readings are incorrect.

4. The Livonia Water Treatment Plant should be measuring turbidity of raw water, not partially treated water.

5. Consideration should be given to redesigning the intake structures of the Geneseo and Livonia Water Treatment Plants by placing the mouths of the intake pipes at a higher level in the water column. This should provide water more comparable to Avon's system which has the best overall water quality.

6. Turbidity has increased in the lake over the past 10 years. Because the New York State Sanitary Code requires turbidity of raw drinking water not to exceed a 1.0 NTU monthly average, which is not being met routinely, consideration of methods on how to reduce the turbidity problem is required.

7. Because the increase in turbidity appears to be related to the introduction of the alewife, biomanipulation of the lake is a possibility. This is a highly experimental procedure that would require stocking of predaceous fish to crop down the alewife. A discussion of biomanipulation is provided in the text. An attempt at biomanipulation would require the concerted efforts of the NYS Health Department and the NYS Department of Environmental Conservation. Because of the experimental nature, funding may be obtainable from the Environmental Protection Agency. This procedure has the advantage of being economically reasonable and could create a better sportfishery. However, because of its experimental nature, it does not provide any guarantees of turbidity control.

8. Construction of a filtration plant would definitely control the turbidity problem and could provide varying amount of control on potential problems such as Giardia. . However, costs are high.

9. Because turbidity of the south basin is consistently lower than the north basin of the lake, any new construction of a filtration plant and intake should be located in the south basin.

10. If filtration plant construction is decided upon, consideration should be given to a joint project by Avon, Geneseo and Livonia.

METHODS

Sampling Scheme

Sampling stations are shown in Fig. 1. Water samples were taken every two weeks at Stations 13 and 20 and at tributary streams. Other sites were sampled once a month. Details of sampling sites are given in previous data reports.

Turbidity

Turbidity was measured using a Turner nephelometer. The turbidimeter was calibrated with a known standard prior to measurements with routine verifications during analysis.

Secchi disk depth

The secchi disk depth was determined using an all white 20-cm. disk. Measurements were recorded to the nearest 0.1m.

pH

Analyses for pH were made by electronic measurement using a Beckman Expandomatic SS-2 meter. The meter was standardized against two buffers that spanned the sample range.

Chloride

Chloride was determined by titration with 0.0141 N mercuric nitrate (APHA Method 407b, 1980). Titrant was standardized using replicates of standard sodium chloride solution. Diphenylcarbazone indicated the titration endpoint by formation of a purple complex with excess mercuric ions.

Sulfate

100-ml samples were analyzed for sulfate by APHA Turbidimetric Method #426C (1980). Barium chloride was added in the presence of hydrochloric acid to form uniform barium sulfate crystals. Light absorbance by barium sulfate was measured spectrophotometrically using a Beckman Model 24 Spectrophotometer at 420 nm. Four standards were included and a linear regression line fitted and used to calculate final concentrations.

Conductivity

Conductivity in µohms/cm was measured using a Thomas Model 275 Conductivity Meter with a platinum electrode; readings were corrected to 25.0°C. The instrument was calibrated using potassium chloride solutions of known normality.

Alkalinity

Alkalinity, as calcium carbonate, was determined by titrating a 100-ml aliquot to pH 4.8 with 0.02 N sulfuric acid. A Beckman Expandomatic SS-2 Meter, standardized with two pH buffers, was used to monitor pH.

Metals - calcium, magnesium, potassium, sodium, copper

Metals were determined using a Perkin-Elmer 3030 Atomic Absorption Spectrophotometer with air/acetylene flame. Four standards for each metal were used to fit a standard curve. Lanthanum solution was added (10% of sample volume) prior to analyses of calcium and magnesium to eliminate phosphate interference. Ambient copper levels were determined by graphite furnance methodology using a Perkin-Elmer Atomic Absorption Spectrophotometer.

Dissolved oxygen

Field dissolved oxygen measurements were taken using a Delta Scientific Model 1010 Dissolved Oxygen and Temperature Meter. Readings were taken at 1-m intervals for the entire depth of the station. The meter was calibrated, in the field, using the azide modification of the Winkler test.

Soluble reactive phosphorous

Sample water was filtered through a 0.45-µm membrane filter. Filtrate was analyzed for orthophosphate using a Technicon Autoanalyzer II (Technicon Industrial Method No. 15-71W). The formation of a phosphomolybdenum blue complex was read colorimetrically at 880 nm.

Total phosphorous

The various forms of phosphorous were converted to orthophosphate by persulfate digestion (APHA Method 424, 1980). The resultant orthophosphate was analyzed using a Technicon Autoanalyzer II (Technicon Industrial Method No. 15-71W).

Nitrate and nitrite nitrogen

A Technicon Autoanalyzer was used to measure nitrate and nitrite (Technicon Industrial Method No. 100-70W/B). In this procedure, nitrate was reduced to nitrite by means of a copper-cadmium reductor column. Under acidic conditions, the nitrite ion reacted with sulfanilamide and N-1-naphthylethylenediamine to form a reddish-purple azo dye which was measured colorimetricly at 520 nm.

Chlorophyll a

Chlorophyll a was measured fluorometrically using a Turner Model 111

Fluorometer. 350-ml aliquots were filtered through glass fiber filters, and extracted with 90% alkaline acetone. Extracted samples were centrifuged and measured fluorometrically (Wetzel and Likens 1979).

Trihalomethane potential

Maximum trihalomethane potential was measured by EPA Method 510.1 by the New York State Health Department. Water samples were taken at seven locations on one date, 13 August 1985.

Submersed vascular macrophytes

Given the limited opportunity to collect plants, the single most informative time is at the height-of-season. This is generally the last half of August, although there may be little loss and even a small gain during September. The second choice of collecting time is late June or early July. Before this time, growth is generally very slow, afterwards for six weeks or so it is rapid.

Plants were collected by SCUBA divers except in very shallow water. As the pattern of depth and crops were from previous work (Forest et al. 1978), it was possible to limit sampling to a single transect to the plant limit at DaCola Shores and two transects in the north (Fig. 1). The lateral transect was across the broad shelf of ~ 3.3-m maximum depth and the longitudinal transect was due south from Sand Point (alongside the outlet) to the depth limit of plants. With random placement of a 0.25-m quadrant (a barrel hoop), depth and location were recorded (e.g. 2-m depth, longitudinal transect from north of lake). Plants were pulled up or broken off within the sampling quadrant and brought to the surface in bags or bundles. Subsequently, the plants were rinsed, drained, weighed, sorted by species, and volume of each species judged in percentage. From validation studies, dry weight was determined to be ~10% of the fresh weight.

Phytoplankton

100-ml surface water samples (0m) were taken for phytoplankton but not counted. Samples are stored at SUNY Brockport.

Zooplankton

Vertical tows at Stations 13 and 20 were made with a 1/2 m Wisconsin style net (80-μ mesh net). Volume filtered was monitored with a General Oceanics Model 2030 flowmeter mounted in the center of the net mouth.

RESULTS AND DISCUSSION

Tributaries of Conesus Lake

Table 1 lists the means for the following parameters for the study period: alkalinity, conductivity, pH, Cl^-, $SO_4^=$, NO_3^-, SRP, Ca^{++}, Mg^{++}, K^+, Na^+, turbidity, total residue and discharge. North McMillan Creek contributed 28.6% of the total discharge to the lake. The three creeks at the south end of the lake (North and South McMillan and Inlet #1) accounted for 54.6% of the total discharge of water into Conesus Lake for the 18 sampling dates.

Both Hanna's and Wilkins Creeks had relatively high Cl^-, Na^+ and conductivity levels as compared to the other streams. More detailed sampling of these streams took place on 18 October and on 8 and 21 November (Hanna's Creek) and on 7 March (Wilkins Creek). Sampling sites for Hanna's Creek were located above and below the New York State Department of Transportation garage and salt pile (Fig. 2). The results strongly suggested that the high sodium levels observed in Hanna's Creek were directly attributable to the salt pile at the NYS DOT garage (Fig. 3). Sodium levels were highly correlated with chloride levels for all sampling sites.

Sampling sites for Wilkins Creek were located above and below the Department of Public Works Garage in Lakeville and on a control tributary (Fig. 4, sites 3 and 4). The high sodium (584 mg Na/L) and chloride (1142 mg Cl/L) (Table 2) levels observed in the small creek draining the garage (Site #2, Fig. 4) suggest that the DPW garage salt pile was influencing the sodium and chloride levels in Wilkins Creek. This result is not as conclusive as the Hanna's Creek study because relatively high levels of sodium and chloride were also observed at site #5 (66.3 mg Na/L) above the DPW garage. The March sampling date, coupled with the likelihood that deicing salt from roads within the town of Lakeville washed into the stream, complicated the interpretation of the results. This study should be repeated in the autumn prior to appliction of deicing salt to roads. Nevertheless, there is evidence implicating the deicing salt storage pile at the DPW as the source of high sodium and chloride levels in Wilkins Creek.

<u>Conesus Lake</u>

Temperature

Thermal stratification was evident by early June at both Stations 13 and 20 (Figs. 5 and 6). The epilimnion descended to a depth of 11 m by September at the shallower Station 13 (Fig. 5). At the deeper Station 20, the depth of maximum descent of the epilimnion was difficult to determine because of the relatively high temperature of the 12-m to 19-m layer during the summer. The maximum temperature recorded was 24.3ºC on 13 August 1985. Autumnal mixing occurred in the shallower Station 13 by early October, while at Station 20 complete mixing was not evident till late October (Figs. 5 & 6).

Dissolved Oxygen

Isopleths of dissolved oxygen are presented in Figures 7 & 8. During July, August and September at Station 20, a large portion of the lake (10-12m in depth and downward) experienced oxygen concentrations of less than 1 mg/L (Fig 7). A decrease in oxygen was also observed at the shallow Station 13 but the duration of low oxygen concentration was relatively short. Mills (1975) did report low oxygen concentrations from just above the bottom in 1972 and 1973. In previous reports (Mills 1975; Stewart and Markello 1974; Forest et al. 1978), the occurrence of low oxygen concentration in such a large volume of the lake was not reported perhaps because of the lack of suitable data.

Alkalinity

No significant difference in epilimnetic alkalinity ($\bar{x}$ = 117.3 mg $CaCO_3$/L existed between stations 13 and 20 (Table 4). During the study period, alkalinity increased in the epilimnion till late May, decreased through September and reached another plateau during autumn (Fig 9a). Hypolimnetic alkalinity increased sharply during thermal stratification reaching a peak of 150 mg/L in September (Fig. 9a). Except for the higher hypolimnetic concentrations observed in 1985, a historical comparison of alkalinity (Table 3) suggested little change over the past 25 years.

Chloride

The mean epilimnetic chloride concentrations in 1985 was 29.8 mg/L (Table 5) with no significant chloride differences vertically in the water column (Fig. 10a). Although the 1985 values were higher than those observed in the 60's, there has been no increase in lake chloride concentrations since 1972 (Table 3). Chloride varied seasonally with higher spring and fall concentrations than in the summer (Fig. 10a). Winter samples were not taken with this study.

Conductivity

Epilimnetic conductivity averaged 365 µohms/cm in 1985 (Table 6). A comparison to historical data (Table 3) suggests that since the 60's and 70's conductivity has increased. Lake conductivity was high during the spring turnover and after an intense October rain storm (Fig. 11a). The high sediment load during peak flows of the tributaries of Conesus Lake were reflected in the lake's conductivity. Hypolimnetic values at station 20 were higher than those of the shallower Station 13 which probably reflects movement of ions from the sediment into the water column during anoxic conditions.

Nitrate and Nitrite

For the study period, nitrate-nitrogen averaged 0.15 mg/L (Table 7) in the epilimnion for both stations. Nitrate levels decreased from early April to non-detectable levels by July (Fig. 11b). With increasing runoff in November, nitrate increased to a maximum of ~0.5 mg/L. Unlike in Stewart and Markello's (1974) report, a buildup in nitrate and nitrite was not observed in the hypolimnion in 1985. This was probably related to low oxygen concentrations observed in the hypolimnion in 1985. Except for the summer, a comparison of seasonal nitrate concentrations between 1969 and 1985 revealed that no major differences or trends were obvious between years (Fig. 12, Table 8). During the summer of 1985, nitrate levels were non-detectable with the sensitivity of our analysis being ~0.02 mg/L. It thus appears that summer epilimnetic concentrations of nitrate have decreased for ~0.05 mg/L to less than 0.02 mg/L.

pH

Mean epilimnetic pH values (Table 9) were not different from those in 1972 and 1973 (Table 3). pH was low in the spring, increased to 8.3 in June, July and August and decreased to a low of 7.7 by early December. In the hypolimnion pH decreased to a low of 7.5 by August. With autumn turnover, pH in the hypolimnion increased to epilimnetic levels (Fig. 9b).

Sulfate

The mean sulfate value (24.6 mg/L) for the epilimnion in 1985 (Table 10) was not significantly different from the concentration in 1973 (Table 3). There was little seasonal variation (Fig. 10b). Sulfate concentrations did decrease substantially at the deeper Station 20 that became anaerobic during the summer.

Soluble Reactive Phosphorus

For the study period, the mean soluble reactive phosporus (SRP) concentration in the epilimnion (Station 20) was 11.7 µg/L (Table 11). Vertically, SRP reached a high of 500 µg/L in the anaerobic hypolimnion at Station 20 (Fig. 13a). A slight increase at the shallower Station 13 was observed, but the quantity of and duration of high SRP was small compared to the deeper Station 20. From Table 12, there is also a suggestion that SRP in the epilimnion decreased from south to north. A comparison to the 1972-73 data of Mills (1975) and Oglesby et al. (1975) (Fig. 14) revealed that SRP levels were not significantly different for the spring, summer and probably winter period. In 1985, early autumn concentrations were higher due to increased runoff from significant rainfall during mid-September.

Total Phosphorus

Mean epilimnetic total phosphorus was 32.5 µg P/L during 1985 (Table 13). Seasonally, epilimnetic concentrations did not reveal any trend except for a peak during autumn (Fig. 13b). In the metalimnion, a sharp peak occured in mid-June and, as in the epilimnion, the general increase in the autumn was evident. The autumn increase in the metalimnion at Station 20 began one month earlier than at Station 13. Hypolimnetic concentrations at Station 20, but not 13, increased dramatically during thermal stratification. A comparison of Stewart and Markello's (1974) seasonal total phosphorus graph to 1985 (Fig. 15) revealed a strikingly similar set of curves for the surface and the bottom. Total phosphorus concentrations increased earlier and dropped earlier in 1985 than in 1969-70, but concentrations were similar.

Calcium

Calcium concentration averaged 39 mg/L in the epilimnion in 1985 (Table 14) which was not dissimilar from Mills' (1975) 1972-1973 mean concentration (Table 3). Seasonally, there was a general trend of decreasing calcium concentration from April to December (Fig. 16a). During thermal stratification, hypolimnion values were higher at Station 20 than at Station 13.

Magnesium

In 1985, magnesium concentrations ranged from 10.04 to 14.63 mg/L with an average of 12.08 for the epilimnion (Table 15). Mills' (1975) average for three sampling dates in 1972-73 was 13.2 mg/L (Table 3). Seasonally, a small but general trend of decreasing magnesium levels was observed from spring to late autumn (Fig. 16b).

Copper

Copper analyses revealed low concentrations of copper (mean = 2.8 µg/L) (Table 16). It is not likely that the lake is the source of high copper occurring in sludge from the sewage treatment plant.

Potassium

Mean epilimnetic potassium levels in 1985 ($\bar{x}$ = 2.72 mg/L) (Table 17) compared with those of 1972-73 ($\bar{x}$ = 2.6 mg/L) (Table 3). Slightly higher concentrations were observed in the hypolimnion at Station 20 as compared to those at Station 13 (Fig. 17a). No obvious seasonal pattern was evident (Fig. 17a).

Sodium

Mean epilimnetic sodium concentrations ($\bar{x}$ = 16.95 mg/L) were higher in 1985 than in the early 60's (9.4 mg/L) or the 1972-1973 period (12.2 mg/L) (Table 3 and 18). No discernable seasonable pattern was observed (Fig. 17b).

Trihalomethanes

Chlorination is generally the most common process for disinfecting and establishing a protective residual in water treatment. At the same time, chlorine reacts with humic substances commonly found in raw surface waters to form undesirable trihalomethanes, principally chloroform and bromodichloromethane. Decaying vegetation produces the humic substances - humic and fulvic acids - referred to as precursors. THMs are of concern because of their carcinogencity in laboratory animals.

Maximum Trihalomethane Potential (MTP), not total trihalomethanes (TTHM), was measured at seven sites on Conesus Lake on 13 August 1985. MTPs were high ranging from ~300 to 500 ug/L; chloroform was the predominant form (Table 19). The State Sanitary Code lists a Maximum Contaminant Level (MCL) of 100 µg/L for TTHM. A MCL for Maximum Trihalomethane Potential does not exist. The high MTP for Conesus Lake suggests that large quantities of organic precursors required for trihalomethane potential exist in raw Conesus Lake water. However, the total trihalomethanes (TTHM) for both Avon, Geneseo and Livonia (Table 19b) indicated that this potential was not realized within the water distribution system. Trihalomethanes were not a problem within the distribution systems sampled.

Residue

Total residue ranged from 204.4 mg/L to 230 mg/L ($\bar{x}$ = 218.7 mg/L) in the epilimnion with a high of 249.6 mg/L ($\bar{x}$ = 227.0 mg/L) in the hypolimnion

(Table 20). Seasonally, total residue was higher in the epilimnion in spring, while in the hypolimnion maximum values occurred in late summer prior to turnover (Fig. 18a). No north/south gradient was observed. Although total residue did not vary much seasonally, volatile and fixed residue varied wildly with no obvious pattern except during the period of late spring turnover. From May to June, the volatile residue decreased significantly while fixed residue increased dramatically. Volatile and fixed residue levels returned to early spring levels by early July (Figs. 18b and 19a). Annually, fixed residue represented 73.9% of total residue. Filtrable ($\bar{x}$ = 215.8 mg/L, Station 13; Table 21) and non-filtrable residue ($\bar{x}$ = 2.6 mg/L, Station 13; Table 22) had no obvious seasonal pattern (Figs. 20 a & b). Filtrable residue represented 98.4% of the total annual residue. This percentage varied little through the course of the year.

Chlorophyll a

Mean epilimnetic chlorophyll a concentrations for Stations 13 and 20 were 4.8 and 5.4 µg/L, respectively. Chlorophyll levels were higher in the hypolimnion than in the epilimnion or metalimnion region (Table 23). Seasonally, chlorophyll a was high during the spring and fall mixing periods as compared to the summer period (Fig. 21a). Substantial historical differences in chlorophyll levels existed between 1972 and 1985 (Fig. 22). Spring, summer and fall concentrations in 1985 were higher than in 1972, except for two sampling dates in late October and early November.

I believe these differences in chlorophyll levels can not be attributed to analytical methodology. The extraction technique used in this study and by Mills (1975) are essentially the same, except that Mills used spectrophotometry while we used fluorometry. We also analyzed Quality Assurance Standards provided by the Environmental Protection Agency Quality

Assurance Program in Cincinnati and found excellent agreement with their values.

Submersed aquatic macrophytes by H.Forest - SUNY Geneseo

The first systematic survey of Conesus Lake for submersed aquatic plants was made by W.C. Muenscher in 1926 (Muenscher 1927). Water quality data before this time had been obtained by Birge and Juday (1914) and by the New York State Health Department (1961). The late 60's to the mid-70's marked a period of extensive limnological interest in Conesus Lake reviewed by Forest, Wade and Maxwell (1978). The limnological studies virtually ceased after this time, but submersed plants were studied regularly until August 1979. Consequently, this report on Conesus Lake draws on unpublished data through 1979 and includes data of a 1984 survey as well as 1985 data gathered for the current project. Although a minimum of data is presented, they have been selected to indicate accurately the base from which conclusions have been derived.

Diversity

The remarkable homeostatic stability of Conesus Lake was noted by 1975. Subsequently, a relationship was proposed between species diversity of the submersed plants and stability of the community when it was disturbed. Disturbance to Conesus Lake was chiefly in the form of human waste, which increased approximately ten-fold in the forty years before 1967. Conesus violated the simplistic eutrophication model in that it remained a comparatively clear lake but a highly fertile one. The species diversity in Conesus was high naturally and remained so in the face of disturbance. The percentage of species lost was one of the lowest in regional waters. Diversity was last assessed in 1979 since the 1984-85 surveys were limited.

Species most likely to be extirpated are infrequent under stable conditions. If species disappear in the future, serious disturbance would be the expected cause.

Quantity of Crop

Contrary to the layman's common understanding, a rich or heavy macrophyte crop with diverse species is an important stabilizing condition. What appears to have happened between 1926 and the late 1960s is that the submersed crop size increased. The plankton crop also increased, but the network of organisms, which received nutrient minerals and made and consumed food, remained intact, and the water usually remained clear. There were spectacular blooms of blue-green algae on occasion, but these had occurred forty years earlier, and in any case, had no harmful effect.

The submersed crop, like terrestrial crops, varied from year to year in amount, and it also varied in species composition. The three or four predominant species changed rank order among themselves from year to year.

Early season (June) crops prior to sewer construction at the south end were ~110.0 g/m^2 and in the north between 284 and 965 g/m^2 at 2 - 3.7 meters and averaging 350 g/m^2. Early season (June) values from 1975 and 1976 (1 and 2 years after sewer construction) were not markedly different at these depths. In 1985, the early season crop in both north and south beds was extraordinarily low, reflecting unusually severe scouring of the bottom at depths to 2 or even 2.5m and very poor early growth. At DaCola Shores, at a depth of 1 and 2m, the crop was only 30 g/m^2. At 3m, however, one collection (three quadrants, principally over-wintered <u>Heteranthera [Zosterella]</u>) was computed at 120 g/m^2. The same condition was suggested in the north but was not pronounced. At 2m the crop was 150-450 g/m^2, and at 4m it was 250-600 g/m^2.

Typical height-of-season crops before the perimeter sewer was completed in 1974 were 567-777 g/m^2 at the south end and ~ 450 g/m^2 at 1 and 2m and 1400-1800 g/m^2 at the 3 and 4-m depths. In 1984, the average height of the season crop was 318 g/m^2 while the highest crop at a site (at 4-m depth) was 601 g/m^2 in the north. 1985 height-of-the-season crops at the north end were similar to pre-sewer years, while crops at the south end were lower than pre-sewer years (Table 24).

In context, 1984 was a somewhat atypical year. There were heavy rains during the last half of the rapid growing season (July-August) after an unusually dry period. The lake was less clear than usual at this time, with secchi disc depth not more than 3m at any time. Consequently, the crop reduction can not be related with certainty to sewer construction.

During late summer of 1984, there was an unusual wash-in of a large quantity of submersed plants (mostly *Vallisneria*) at the northeast corner of the lake. This was not caused by a heavy crop, but by a combination of early season growth, followed by turbulent waters and wind currents carrying dislodged plants from the highest crop area of the lake (South of Pebble Beach area) to the northeast corner.

During the summer of 1985, there was a heavy wash-in of *Cladophora*, a green alga which is common in small amounts around the shores. It was very abundant at the mouth of Wilkins Creek before sewer construction. During the August diving at the maximum crop site, the submersed macrophytes were seen to be festooned with *Cladophora*. This was probably the source for the lake. *Cladophora* had never been observed here previously.

By far, the largest submersed macrophyte community in both area and amount was at the north (outlet) end of the lake; the second largest was at the south (inlet) end. This is the common pattern for all Finger Lakes and Irondequoit Bay, all of which are flow-through lakes with most water entering in the south and discharging in the north.

The end communities are larger not only because of greater area of sufficient shallow water, but because the community actually grows deeper in the ends than on the sides of the lake. Shallows are relatively narrow on the sides and they slope steeply to the depths - plant depth is limited to 2.4m, where as at the south end, off DaCola shores, the extreme depth is 4.5m and in the north, extreme depth is 6.4m before sewer construction in 1974 (Forest, et al. 1978). After sewer construction, plants in the north retreated upward to 5.5m, a marginal retreat seemed to have occurred at DaCola Shores.

Transparency

Mean secchi disk values were 2.94m and 3.28m at Stations 13 and 20, respectively (Table 12). There is a distinct trend of increasing transparency from north to south (Fig. 23). Similarly, the maximum transparency observed in the south basin (in the mid-4m range) was greater than in the north basin (in the mid-3m range). Particularly during summer stratification, transparency was distinctly higher at Station 20 than at Station 13 (Fig. 21b). In general, transparency was higher in the south basin (Station 19, 20, and 21) than in the north basin (Station 2, 8, 13 and 17) (Table 25). Seasonally, secchi disk values reached a minimum during the early spring and became progressively clearer into late August. With mixing in the autumn, transparency decreased (Fig. 21b). A historical comparison of transparency revealed that mean and maximum transparencies observed in 1985 were lower than those from 1972 (Table 26).

Turbidity

Lake

Turbidity of the epilimnion increased from south to north (Table 12) and as expected was the inverse of transparency. Mean turbidity values for the epilimnion ranged from 0.88 NTU at the southern Station 20 to 1.18 NTU at the northern Station 13. Mean turbidity increased with depth with the hypolimnion jumping to 2 NTU at Stations 13 and 20 (Table 27a). Maximum turbidity observed in the lake was ~6 NTU in the hypolimnion.

Seasonally in the epilimnion and metalimnion, turbidity decreased to early May (Fig. 19b). With thermal stratification, turbidity generally increased into early June and then declined till autumn mixing when levels increased to seasonal highs. During statification, there was a turbidity buildup at Station 20 in the hypolimnion. This was not as evident at the shallower Station 13, which was more subject to mixing. High turbidities were also observed in the hypolimnion during April and November. Annually, both chlorophyll a and total residue were statistically significant predictors of turbidity accounting for 65.5% of the variability in turbidity in the hypolimnion at Station 20 (Table 27b). This relationship was not evident in the epilimnion.

Intake-Raw Water

The maximum contaminant levels for turbidity are a monthly average of one turbidity unit and a maximum 2-day average of 5 turbidity units (NTU). The justification for this standard was to reduce interference with disinfection (particles sheltering microorganisms), to maintain a chlorine residual and to permit microbiological testing. Based on measurements by the water treatment personnel, between April 1985 and December 1986, Avon was in compliance two months and Livonia three months out of the eight months of the study period (Table 33). However, there are some questions about the validity of the Geneseo and Livonia measurements.

During the course of the study, raw water from the intake pipe of each water treatment plant was analyzed for turbidity. No statistically significant differences were observed between the turbidity readings at Brockport and Avon (Table 28). Seasonal daily turbidity values as reported by the Avon treatment plant are presented in Figure 24.

A variance ratio analysis revealed a significant difference (P = 0.067) in turbidity between the Livonia and Brockport measurements; the Brockport turbidities being significantly higher. Although not significant at the generally accepted probability level of 0.10, values from the Geneseo plant were very close to being significantly lower (P=0.12) than the Brockport measurements. Turbidity readings from the Geneseo plant also possessed a remarkably low variability (Fig. 25, Table 28) in comparison to the other water treatment plants on the lake, as well as to the Brockport measurements for the Geneseo Treatment Plant. A check of standards and meters by simultaneous measurements of turbidity at the Geneseo and Livonia plants revealed no significant differences between turbidity meters and operators (Table 29).

Discussions with the Livonia plant personnel solved the differences observed between the Brockport measurements and plant measurements. Turbidity measurements reported on the New York State Health Department Daily Operation Record as raw water turbidity were actually turbidity levels after treatment with chlorine in a detention tank. Settling of heavier materials in the tank would be expected resulting in a lower turbidity value than that observed for the raw water in the intake plant. There is no scientific basis for the observed seasonal turbidity differences between the shore intake readings from Geneseo and Brockport

Differences Between the Shore Intake and Lake Water

Using the Brockport measurements of turbidity, significant differences existed between turbidity taken directly from the lake and from the shoreside intake pipe (i.e. the water treatment plant) at the Livonia and Geneseo Treatment Plants (Table 30). This was not the situation at the Avon; that is, turbidity values taken directly from the lake and those from the shoreside intake pipe were statistically the same. Since epilimnetic and metalimnetic turbidity values from the lake at the Livonia and Geneseo intake locations were consistently lower than shoreside intake values (i.e. raw water) from the same lake, it suggested that the location or design of the lakeside opening of the intake pipe may be the problem.

Figure 26 is a diagram of the intake structures of the Avon, Geneseo and Livonia Treatment Plants. The Avon Plant has the best water quality from a turbidity standpoint. Its intake structure is 6 ft long but sits 5 ft off the bottom of the lake; that is, water is being taken from 5 to 11 ft off the bottom. The Geneseo intake is only 3 ft above the bottom on the uphill side; that is, water is being taken from 3 ft off the bottom. The Livonia Water District intake pipe is listed as being several feet above the bottom but in 40 ft of water. Details of the Livonia's intake structure's location, size and construction are just not clear from the engineering diagram available.

Nevertheless, it appeared that there is a relationship between turbidity at the shoreside intake pipe with the height of the entrance of the intake pipe and the depth of the intake pipe. With Avon (intake entrance: 6 to 11 ft off the bottom, 19-25 ft from the surface) turbidity in the shoreside intake was comparable to lake turbidity. With Geneseo (intake entrance: 3 ft off the bottom, 27 ft from the surface) and Livonia (intake entrance: 7 ft? off the bottom, 40 ft from the surface), turbidity at the shoreside intake was high relative to lake turbidity.

It is not possible within this study to prove why higher turbidities were observed in the shoreside intakes closer to the bottom and in deeper water. However, some possibilities are: 1) as surface runoff laden with silt enters the lake, it will sink down the sides of the basin to a depth of water similar in density to the runoff or to the bottom. With sinking silt laden water and a low intake design (e.g. Geneseo), higher intake turbidities would be expected; 2) the greater depth of the Livonia intake pipe (~40 ft) puts it in or near the lower water quality of the hypolimnion (Fig.26) [i.e. lower dissolved oxygen (Fig. 7) and higher turbidity ($\bar{x}$ = 1.44 NTU, Maximum 3.38 NTU at Station 7H)]; 3) internal seiches or internal rockings of the metalimnion that will cause an upwelling of poorer quality hypolimnetic water; and 4) the physical action of taking in large quantities of water into a pipe close to the bottom could result in an erosive current that disturbs the sediments resulting in higher intake turbidities. It is of interest to note that Avon with the best shore intake water quality not only has the entrance pipe highest off the bottom but also in the shallowest water (19 - 25 ft) as compared to the Geneseo (~27 ft) and Livonia (~40 ft) plants.

Building the entrance of the Livonia and Geneseo plants higher off the bottom in shallower water - similar to Avon's depth - should give a better quality water with lower turbidity levels.

Historical Changes in Turbidity Related to Zooplankton Composition

The current species composition represents a significant change since the 1973 study of Chamberlain (1975). Chamberlain (1975) described Conesus Lake as a _D. pulex_, _C. unicornis_, _C. bicuspidatus_ lake. The large _Daphnia pulex_ was the dominant cladoceran occurring on each of the 50 sampling dates in 1973. In 1985 the cladoceran community of Conesus Lake was dominated by the smaller sized _B. longirostris_. _Daphnia retrocurva_ and _D. galaeta mendotae_ occurred but were not dominant (Table 31). _Cyclops bicuspidatus thomasi_ and _Conochilus unicornis_ continued to be the dominant Copepoda and

Rotifera, respectively.

The fish population of Conesus Lake is diverse and includes walleye, perch, pike, largemouth bass, various species of trout and panfish, but historically not the alewife (Forest et al. 1978). In 1978 alewifes were accidentally introduced into Conesus Lake (B. Abraham, personal communication). They were well established by 1984 with a typical late spring and early fall mortality. By 1985 the alewife population was extremely fat and healthy with individuals ranging to 1/3 of pound in size (B. Abraham, personal communication). The change in cladoceran composition can be attributed to the introduction of the alewife.

This seemingly innocuous addition of one species of fish can have significant effects not only on zooplankton (Henrikson et al. 1980; Stenson 1982) but also on phytoplankton and water quality, including turbidity. Recent examination of eutrophication processes from a biological rather than an exclusively physiochemical perspective has shown that organisms at higher trophic levels can have a significant effect (e.g. Taylor 1984; Carpenter et al. 1985). Intense predation by planktivorous fish will reduce mean size and change zooplankton species composition towards dominance of smaller zooplankton species (Lynch and Shapiro 1981). In addition, it has been well documented experimentally that with the addition of planktivorous fish and the resultant loss of large herbivores zooplankton, there is an increase in turbidity, chlorophyll and total phytoplankton generally with larger forms of phytoplankton becoming more prevalent (Elliot et al. 1983; Hrbacek et al. 1961; Anderson et al. 1978).

Between the early 70's and 1985, we have observed the following in Conesus Lake: No significant seasonal difference in total phosphorous, soluble reactive phosphorus and nitrate concentrations , with the exception of the summer decrease in nitrate. There has been a shift in zooplankton composition, a significant increase in chlorophyll levels (i.e. phytoplankton) and decreases in transparency (Table 26). A comparison of the mean annual daily turbidity level for 1977, prior to alewife introduction, to 1985 indicates a highly significant (P>.001) increase over the period (Fig. 27). It is reasonable to conclude that the introduction of the alewife in 1978 has adversely affected turbidity levels in Conesus Lake. In fact, Forest et al.'s statement in 1978 that "Effective grazing by a single crustacean Daphnia" (i.e. D. pulex) "helps keep the open water rather clear most of the time" was true. With the introduction of the alewife, the composition of the zooplankton community has changed, allowing greater phytoplankton abundance and higher turbidity.

Based on experimental work elsewhere (Shapiro and Wright 1984; Stenson et al. 1978), an increase in total phosphorous and total nitrogen of the water column would be expected with alewife introduction. This did not happen in Conesus Lake. Nutrient levels stayed relatively the same between 1985 and the early 70's. This may be related to the reduction of nutrient loading expected from the construction of a perimeter sewer to intercept septic tank losses to the lake in 1973. Prior to sewering, 33% to 50% of the total phosphorous loading was from the human population (Stewart and Markello 1974; Oglesby and Schaffner 1975a). A second possibility for the lack of significant nutrient change expected from alewife introduction was suggested by Wright and Shapiro (1984). They argued that the increase in the epilimnion in Round Lake was due to the removal of migrating Daphnia transorting phosphorous to the hypolimnion. Although D. pulex has been removed from Conesus, D. retrocurva and C. galaeta mendotae are still present. Thus the mechanism suggested by Shapiro and Wright (1984) may still be operating in Conesus Lake.

The increase in turbidity in Conesus Lake suggested by alewife introduction in Conesus Lake may increase further. Currently Daphnia galeata *mendotae* and *Daphnia retrocurva* are present in fairly high densities. Although working with the effect of a removal of a planktivore, rather than an addition as in Conesus Lake, the work of Shapiro and Wright (1984) did not observe a change in one jump from a small to a large form of *Daphnia*. Instead, a gradual transition from smaller species to larger species occurred. Similarly in Conesus Lake, a gradual decrease in zooplankton size due to changes in species composition would be expected, rather than a quick change from large forms to small forms. With time and continual predation of larger forms of zooplankton by the alewife, it is possible that *D. galeata mendotae* and *D. retrocurva* will be removed to lower abundance than present leaving mainly only the smallest cladocera (e.g. *Bosmina*, *Eubosmina*). A resultant increase in algae would cause a further increase in turbidity. This supposition is supported by the fact that smaller zooplankton [*Conochilus unicornis*, *Diaptomus*, and *Bosmina* in Owasco Lake; *Conochilus unicornis* and *Cyclops bicuspidatus* in Hemlock Lake (Chamberlain 1975)] predominate in other Finger Lakes, such as Owasco and Hemlock, where the alewife has been present for years.

Biomanipulation

Biomanipulation of a lake is an experimental approach aimed at benefiting lakes by manipulating their trophic structure (Shapiro et al. 1975; Shapiro 1980; Shapiro et al. 1982; Shapiro and Wright 1984; Carpenter et al. 1985). One such approach is to reduce the abundance of planktivorous fish in a lake to allow an increase in the size and grazing pressure of herbivorous zooplankton with a consequent reduction in the abundance of algae and turbidity. A recent review has advocated stocking piscivores as a practical approach toward enhanced fishery production and mitigation of water quality problems (Kitchell et al. 1986). The concept of cascading trophic interaction links the principles of limnology with those of fisheries biology and suggests a biological alternative to the engineering techniques that presently dominate lake management.

The approach has been successfully used to control eutrophication in European reservoirs (Benndorf et al. 1984). Closer to Conesus Lake there is tantalizing evidence that the biomanipulation could work in central New York. Introduction of fingerling walleye and tiger muskellunge (Esox lucius and E. masquinongy) were stocked from 1977 to 1982 into Canadarago Lake in east-central New York. As a result, the biomass of all predators in Canadarago Lake between 1979 and 1984 was at least twice as high as the predator biomass prior to 1977. By 1983, changes in the panfish community occurred but more importantly, the previous absent Daphnia pulex appeared in the lake. By 1984 and 1985, it was the dominant species (Mills et al. 1986). Although phytoplankton and turbidity were not monitored in the Canadarago Lake study, it would be expected that phytoplankton levels and turbidity decreased. However, the question remains whether increasing the predator/prey ratio, with alewife as the major prey as in Conesus Lake, would be successful.

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Table 1. Mean values of various parameters for tributary streams of Conesus Lake for the study period. SRP = soluble reactive phosphorus. Values are in mg/l unless otherwise noted.

	Inlet #1	Hannah	Wilkins	Densmore	North McMillan	South McMillan	Long Point Gully
ALKALINITY	166	225	255	260	157	58	210
CONDUCTANCE (µohms/cm)	532	899	1237	804	497	217	602
pH	7.84	8.04	8.16	8.09	7.92	7.71	8.25
Cl^-	35.6	107	177.9	48.5	36	22.9	26.5
$SO_4^=$	41.3	33.8	33.6	45	33.6	19.1	44.5
NO_3^-	.61	1.09	10.38	.45	.43	.31	2.26
SRP (µg/l)	17.5	64.4	44.8	24.2	8.1	14.6	69.2
Ca^{++}	60.2	76	85.7	85.2	52.2	23.3	74
Mg^{++}	15.9	19.2	24.1	24.1	14.5	5.6	20
K^+	3.69	5.95	5.13	5.12	2.92	2.32	5.67
Na^+	20.8	67.2	153.3	41.6	22	12.2	15.7
TURBIDITY (NTU)	10.1	16.1	9.2	17.7	14.7	15	23.1
TOTAL RESIDUE	5	8.6	14.2	6.3	3.9	1.8	5
DISCHARGE (m/s)	.208	.125	.162	.093	.424	.176	.163

TABLE 2 Results of chemical analyses at various sites on Wilkins Creek, March 7, 1986. Locations of sampling sites are listed below and Fig. 4.

PARAMETER	SITES 1	2	3	4	5
SODIUM (mg/L)	57.57	584.50	3.70	20.59	66.25
POTASSIUM (mg/L)	3.07	6.02	0.92	3.10	4.07
CALCIUM (mg/L)	71.91	139.50	61.51	66.42	81.39
MAGNESIUM (mg/L)	21.66	33.08	17.46	20.04	24.07
SULFATE (mg/L)	33.2	51.8	38.4	28.1	35.1
CHLORIDE (mg/L)	113.71	1142.15	7.25	28.74	154.95
CONDUCTANCE (µohms/cm)	868	4107	483	593	1024

#1. Wilkins Creek - Downstream station just above Pennemiten Rd.
#2. Wilkins Tributary - apparently spring fed; downstream of DPW.
#3. Wilkins Creek - south fork; upstream of north fork, just east of park.
#4. Wilkins Creek - south fork; east of Rt. 15, above DPW.
#5. Wilkins Creek - north fork; corner of Big Tree Rd. and Spring St., upstream of DPW.

Table 3. Historical summary of selected chemical parameters for Conesus Lake. Values are in mg/L unless otherwise noted.

Year	pH	Conductivity µohms/cm	Alkalinity	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$SO_4^{=}$	CL^{-}
Before 1961[1]			100						11.25
Before 1963[2]	7.7	309	108.2	40	11	9.4		31	13
1971[3]									
epilimnion	8.4		99.8	44					27.1
hypolimnion	7.7		107.9	53					27.4
1972[4]	8.1	339	118						
1973[5]	8.2	330	118	41	13.2	12.2	2.6	27.8	29.5
1985	8.1	365	117.3	39	12	17	2.7	24.6	29.8

[1] NYSDH(1961)
[2] Berg(1966)
[3] Godfrey in Forest et al.(1978)
[4] USEPA(1974)
[5] Mills(1975)

Table 4. Mean, maximum and minimum alkalinity values for Conesus Lake and its tributaries, 1985. Values are in mg $CaCO_3$/l.

Station	Mean	Maximum	Minimum
13E	117.3	122.8	110.5
13M	117.6	124.4	112.6
13H	120.1	127.4	114.1
20E	117.3	124.9	112.1
20M	117.6	125.4	111.6
20H	126.9	152.5	115.1
HANNAH	224.8	287.1	110.5
WILKINS	254.7	305.5	138.2
DENSMORE	259.6	307.6	151.5
NORTH McMILLAN	156.9	210.3	116.7
SOUTH McMILLAN	58.2	81.4	37.9
LONG POINT GULLY	210.1	252.8	99.3
NORTH GULLY	247.6	277.9	191.9
INLET 1	166.0	220.6	107.0
INLET 2	113.1	188.8	58.3
OUTLET	114.9	129.5	96.2

Table 5. Mean, maximum and minimum chloride concentrations in Conesus Lake and its tributaries, 1985. Values are in mg/l.

Station	Mean	Maximum	Minimum
13E	29.7	34.0	27.1
13M	29.7	34.0	27.1
13H	29.7	34.5	27.1
20E	29.9	35.5	26.9
20M	29.8	34.5	26.9
20H	29.6	35.0	27.1
HANNAH	107.0	272.7	25.0
WILKINS	177.9	565.8	4.6
DENSMORE	48.5	68.7	7.1
NORTH McMILLAN	36.0	59.0	27.5
SOUTH McMILLAN	22.9	39.2	17.2
LONG POINT GULLY	26.5	36.2	7.0
NORTH GULLY	15.5	32.0	2.8
INLET 1	35.6	56.2	15.2
INLET 2	26.6	55.2	12.2
OUTLET	32.7	41.7	28.0

Table 6. Mean, maximum and minimum conductivity values for Conesus Lake and its tributaries, 1985. Values are in µohms/cm.

Station	Mean	Maximum	Minimum
13E	364	444	313
13M	365	449	305
13H	369	444	305
20E	366	444	308
20M	364	446	308
20H	379	444	308
HANNAH	899	1803	451
WILKINS	1237	2306	445
DENSMORE	804	1083	482
NORTH McMILLAN	497	660	377
SOUTH McMILLAN	217	272	164
LONG POINT GULLY	602	828	284
NORTH GULLY	587	763	470
INLET 1	532	828	382
INLET 2	394	677	233
OUTLET	374	464	298

TABLE 7. Mean, maximum and minimum nitrate nitrogen (nitrate+nitrite) concentrations for Conesus Lake and its tributaries, 1985. Values are in mg/l. ND = non-detectable.

Station	Mean	Maximum	Minimum
13E	.15	.49	ND
13M	.12	.49	ND
13H	.13	.48	ND
20E	.16	.51	ND
20M	.17	.50	ND
20H	.17	.51	ND
HANNAH	1.09	3.48	.04
WILKINS	.38	1.33	.09
DENSMORE	.45	1.21	.04
NORTH McMILLAN	.43	1.08	.07
SOUTH McMILLAN	.31	.70	.05
LONG POINT GULLY	2.26	4.25	.38
NORTH GULLY	.52	1.81	.05
INLET 1	.61	2.00	.05
INLET 2	.12	.44	.01
OUTLET	.11	.50	ND

Table 8. Historical comparisons of nitrate-nitrogen for Conesus Lake. Values from the upper 10 meters in mg/l NO_3-N. N.D. = non-detectable.

	1963[1]	1969[2]	1972[2]	1973[2]	1985
Annual Range	.239	0.02 -.074	N.D. - 0.18	0.019 -0.607	N.D. - 0.51
Spring Overturn ($\bar{x}$)	--	0.136	--	0.145	0.11
Summer ($\bar{x}$)	--	0.053	0.048	0.081	N.D. - 0.03
Fall Overturn ($\bar{x}$)	--	0.051	0.046	--	0.03
Winter ($\bar{x}$)	--	0.160	--	0.199	0.23

1 (Berg, 1966).
2 Modified from Forest et.al. (1978).

Table 9. Mean, maximum and minimum pH values for Conesus Lake and its tributaries.

Station	Mean	Maximum	Minimum
13E	8.08	8.30	7.80
13M	7.98	8.25	7.60
13H	7.88	8.10	7.60
20E	8.06	8.30	7.70
20M	7.99	8.20	7.80
20H	7.77	8.05	7.45
HANNAH	8.04	8.35	7.55
WILKINS	8.16	8.40	7.80
DENSMORE	8.09	8.45	7.70
NORTH McMILLAN	7.92	8.10	7.70
SOUTH McMILLAN	7.71	8.05	7.40
LONG POINT GULLY	8.25	8.55	7.70
NORTH GULLY	8.21	8.60	7.95
INLET 1	7.84	8.05	7.20
INLET 2	7.40	7.95	6.70
OUTLET	8.08	8.30	7.90

Table 10. Mean, maximum and minimum sulfate concentrations for Conesus Lake and its tributaries. Values are in mg/l.

Station	Mean	Maximum	Minimum
13E	24.5	26.8	22.0
13M	24.8	26.7	21.0
13H	25.4	27.7	22.4
20E	24.6	27.9	20.1
20M	24.7	27.7	21.3
20H	22.8	27.5	14.2
HANNAH	33.8	63.8	21.3
WILKINS	33.6	58.1	22.7
DENSMORE	45.0	85.4	30.9
NORTH McMILLAN	33.6	49.1	22.8
SOUTH McMILLAN	19.1	30.9	10.8
LONG POINT GULLY	44.5	65.1	28.6
NORTH GULLY	34.1	58.7	22.4
INLET 1	41.3	85.4	21.9
INLET 2	33.3	80.0	7.4
OUTLET	24.5	26.9	19.8

Table 11. Mean, maximum and minimum soluble reactive phosphorus concentrations for Conesus Lake and its tributaries, 1985. Values are in µg P/l.

Station	Mean	Maximum	Minimum
13E	9.7	26.2	2.3
13M	10.4	30.4	1.1
13H	20.9	113.0	2.7
20E	11.7	37.9	.2
20M	12.5	37.0	2.5
20H	114.3	542.5	3.6
HANNAH	64.4	339.7	10.8
WILKINS	44.8	150.8	1.4
DENSMORE	24.2	117.8	1.4
NORTH McMILLAN	8.1	28.3	3.3
SOUTH McMILLAN	14.6	33.2	2.7
LONG POINT GULLY	69.2	309.1	11.8
NORTH GULLY	29.6	206.1	9.8
INLET 1	17.5	98.1	3.0
INLET 2	26.3	109.2	5.2
OUTLET	8.2	23.0	1.5

Table 12. Horizontal gradient of epilimnetic soluble reactive phosphorus, chlorophyll a and transparency in Conesus lake for 1985. Values are the mean for the study period.

Station	SRP µg/l	Chl a µg/l	Secchi Disk(m)	Turbidity (NTU)	
2	9.1	4.7	2.55	1.18	North
8	9.6	4.9	2.94	1.11	|
13	9.7	4.8	2.94	.97	|
20	11.7	5.4	3.28	.88	South

Table 13. Mean, maximum and minimum total phosphorus concentrations for Conesus Lake, 1985. Values are in µg P/l.

Station	Mean	Maximum	Minimum
13E	31.8	66.7	16.2
13M	30.9	50.0	16.3
13H	54.1	252.5	13.3
20E	33.1	50.6	13.6
20M	32.2	52.5	15.2
20H	215.2	1022.5	13.9

Table 14. Mean, maximum and minimum calcium concentrations for Conesus Lake and its tributaries. Values are in mg/l.

Station	Mean	Maximum	Minimum
13E	38.92	47.29	32.92
13M	39.19	45.59	34.05
13H	39.46	44.83	32.21
20E	39.12	45.81	33.36
20M	39.26	44.05	33.67
20H	40.74	44.73	32.79
HANNAH	76.00	101.60	50.54
WILKINS	85.71	120.30	62.54
DENSMORE	85.23	105.56	67.41
NORTH McMILLAN	52.24	61.43	40.04
SOUTH McMILLAN	23.28	28.66	18.17
LONG POINT GULLY	73.95	92.18	56.53
NORTH GULLY	76.65	93.58	64.65
INLET 1	60.18	84.49	38.13
INLET 2	47.14	92.64	27.31
OUTLET	37.97	45.31	29.10

Table 15. Mean, maximum and minimum magnesium concentrations for Conesus Lake and its tributaries, 1985. Values are in mg/l.

Station	Mean	Maximum	Minimum
13E	12.11	14.63	10.04
13M	12.13	13.95	10.45
13H	12.08	13.52	10.16
20E	12.06	14.21	10.51
20M	12.15	13.65	10.51
20H	12.15	13.57	10.25
HANNAH	19.16	26.14	12.05
WILKINS	24.08	33.31	14.67
DENSMORE	24.07	34.42	14.99
NORTH McMILLAN	14.51	18.48	11.82
SOUTH McMILLAN	5.62	7.11	4.34
LONG POINT GULLY	19.98	24.16	9.83
NORTH GULLY	22.36	27.05	18.04
INLET 1	15.92	21.91	10.23
INLET 2	12.07	21.11	7.22
OUTLET	12.26	13.59	10.5

Table 16. Copper concentrations of selected sites on Conesus Lake. Values are in µg/l. N.S.= no sample.

STATION	5/7/85	7/16/85	8/27/85	11/19/85	Mean
13E	4.4	.7	2.3	8.7	4.0
13M	4.5	.7	2.2	3.2	2.6
13H	4.3	1.1	3.4	3.2	3.0
20E	N.S.	1.1	2.9	2.9	2.3
20M	N.S.	1.1	1.9	2.5	1.8
20H	N.S.	2.5	3.4	3.0	3.0
				$\bar{\bar{X}}$	2.8

Table 17. Mean, maximum and minimum potassium concentrations for Conesus Lake and its tributaries. Values are in mg/l.

Station	Mean	Maximum	Minimum
13E	2.76	3.79	2.08
13M	2.76	3.85	2.05
13H	2.75	3.56	2.14
20E	2.68	3.49	2.13
20M	2.75	3.49	2.09
20H	2.85	3.62	2.26
HANNAH	5.95	15.97	1.87
WILKINS	5.13	11.26	2.99
DENSMORE	5.12	13.12	3.55
NORTH McMILLAN	2.92	10.22	1.73
SOUTH MCMILLAN	2.32	7.19	1.32
LONG POINT GULLY	5.67	11.80	3.56
NORTH GULLY	3.48	10.61	2.17
INLET 1	3.69	8.37	2.18
INLET 2	2.32	9.67	.23
OUTLET	2.73	3.95	1.92

TABLE 18. Mean, maximum and minimum sodium concentrations for Conesus Lake and its tributaries. Values are in mg/l.

Station	Mean	Maximum	Minimum
13E	17.00	18.32	14.63
13M	17.20	19.16	15.60
13H	16.71	18.83	12.67
20E	16.91	19.40	15.30
20M	16.92	20.12	14.66
20H	16.77	18.66	15.20
HANNAH	67.19	154.70	24.21
WILKINS	153.31	350.45	26.07
DENSMORE	41.56	59.35	27.59
NORTH McMILLAN	22.01	32.22	15.52
SOUTH McMILLAN	12.24	20.89	8.23
LONG POINT GULLY	15.71	24.70	7.54
NORTH GULLY	13.70	16.95	11.27
INLET 1	20.84	32.59	14.78
INLET 2	13.44	18.71	9.64
OUTLET	17.99	23.62	14.00

Table 19a. Maximum trihalomethane potential (MTP) for selected sites on Conesus lake, August 13, 1985. CHL=Chloroform, BDM=Bromodichloromethane, DBDM=Dibromodichloromethane, BR=Bromoform, ND=not detectable. Values are in ug/l.

	Depth (m)	CHL	BDM	DBDM	BR	MTP
Conesus Lake (Off Conesus Inlet)	2	275	21	1	<1	297+
Conesus Lake (Off Conesus Inlet)	surface	288	21	1	<1	310+
Wilkins Creek (mouth)	surface	360	96	27	3	486+
Conesus Lake (Station 13)	surface	389	21	1	<1	411+
Conesus Lake (Station 20)	surface	351	20	1	<1	372+
Conesus Lake (Station 20)	8	290	15	1	ND	306
Conesus Lake (Station 20)	17	354	21	1	<1	375+

Table 19b. Total trihalomethane (TTHM) potential for the Avon, Lakeville and Geneseo Water Treatments Plants.

Avon	CHL	BDM	DBDM	BR	TTHM
(12/4/84)	44	8	<1	<1	52+
(2/27/84)	39	9	<1	<1	48+
(6/11/84)	87	11	<1	<1	98+
(9/11/84)	74	9	<1	<1	83+
Geneseo					
(4/27/83)	62	10	<1	<1	84+
Lakeville					
(4/26/83)	39	10	<1	<1	49+

Table 20. Mean, maximum and minimum total residue levels for Conesus lake and its tributaries. Values are in mg/l.

Station	Mean	Maximum	Minimum
13E	218.4	230.2	204.4
13M	218.7	231.6	211.8
13H	224.8	240.0	212.0
20E	217.9	230.2	208.4
20M	219.0	228.8	208.0
20H	227.4	249.6	212.6
HANNAH	547.6	803.8	326.0
WILKINS	809.1	1379.4	443.4
DENSMORE	532.8	905.6	416.2
NORTH McMILLAN	335.7	838.0	229.6
SOUTH McMILLAN	182.0	532.0	114.2
LONG POINT GULLY	514.6	1512.8	348.2
NORTH GULLY	414.8	1203.2	328.6
INLET 1	363.6	778.4	217.6
INLET 2	278.8	589.8	159.6
OUTLET	223.0	248.8	195.0

TABLE 21. Mean, maximum and minimum filtrable residue levels for Conesus Lake and its tributaries. Values are in mg/l.

Station	Mean	Maximum	Minimum
13E	215.8	228.8	201.8
13M	216.2	227.2	209.6
13H	219.6	232.6	208.6
20E	215.9	228.0	207.2
20M	214.6	227.2	168.2
20H	223.5	236.4	208.6
HANNAH	518.7	797.0	321.2
WILKINS	780.3	1357.2	284.5
DENSMORE	480.4	622.0	247.0
NORTH McMILLAN	284.7	353.8	38.5
SOUTH McMILLAN	148.5	235.3	126.4
LONG POINT GULLY	372.2	455.2	259.5
NORTH GULLY	352.5	420.8	249.9
INLET 1	346.5	775.2	212.4
INLET 2	274.5	584.4	173.0
OUTLET	218.8	441.4	193.8

Table 22. Mean, maximum and minimum non-filtrable residue levels for Conesus Lake and its tributaries. Values are in mg/l.

Station	Mean	Maximum	Minimum
13E	2.6	5.6	1.4
13M	2.5	5.0	.8
13H	5.2	19.2	1.6
20E	2.0	3.4	.2
20M	4.4	43.2	.4
20H	3.9	15.0	1.4
HANNAH	28.9	332.0	1.6
WILKINS	28.7	426.7	.8
DENSMORE	52.3	546.7	1.0
NORTH McMILLAN	50.8	536.7	.4
SOUTH McMILLAN	33.2	296.7	0.0
LONG POINT GULLY	142.4	1253.3	.4
NORTH GULLY	62.3	953.3	.8
INLET 1	17.1	190.0	.6
INLET 2	5.4	15.0	1.0
OUTLET	4.2	14.8	.8

Table 23. Mean, maximum and minimum chlorophyll a concentrations for Conesus Lake. Values are in µg/l.

Station	Mean	Maximum	Minimum
13E	4.8	18.0	0.8
13M	6.4	21.9	0.7
13H	5.7	20.4	1.1
20E	5.4	27.3	0.0
20M	6.1	19.0	0.8
20H	4.2	19.6	0.0

Table 24. Height of the season macrophyte determinations for Conesus Lake. Crop determinations are in dry weight.

Date	Location	Depth(m)	Crop (g/m^2)
1968[1] (Sept.)	North end	3.7	1470
1969[1] (Sept. 2)	South end	1.9	777
		3.6	567
1969[1] (Sept. 14)	North end (near Wilkins Creek)	2.6-3.6	1816
1970[1] (Aug. 28)	North end (near Wilkins Creek)	1	431
		2	499
		3	1407
1984		Mean	318
		4	601
1985 (Aug.20)	South end	1	422
		2	450
		3	216
	North end	1	120
		2	350
		3	350-700
		4	1400

[1] From Forest et al (1978)

TABLE 25. Mean, maximum and minimum secchi disk values for Conesus Lake.

	SECCHI DISK (m)		
STATION	Mean	Maximum	Minimum
1*	2.02	2.80	1.62
2	2.55	3.09	1.70
3	2.93	3.85	1.65
6*	2.43	3.00	1.70
7	2.87	3.84	1.70
8	2.94	3.90	1.70
9	2.65	3.50	1.50
10*	1.75	2.65	1.20
11*	1.80	2.52	.95
12	3.05	3.85	2.20
13	2.94	4.50	1.70
14	2.97	4.09	2.00
15*	1.95	4.41	.50
17	2.73	3.90	2.10
18	2.90	3.83	2.00
19	3.27	4.73	2.00
20	3.28	4.56	2.00
21	3.47	4.37	2.21
22*	1.80	2.30	1.20

*Maximum value is depth at the given site.

TABLE 26. Historical comparison of secchi disk values(m), Conesus Lake[3].

		1910	1969-70	1972[4]	1973[4]	1985
January - March[2]						
	Mean	--	5.3	--	--	--
	Max.	--	10.0	--	--	--
	Min.	--	1.2	--	--	--
August[1]						
	Value	6.3	--	--	--	--
	Mean	--	--	--	--	4.3
	Max.	--	--	--	--	4.5
	Min.	--	--	--	--	3.7
Summer						
	Mean	--	--	4.7	5.1	3.4
	Max.	--	--	7.0	7.0	4.6
	Min.	--	--	1.8	3.6	2.2
Winter and Spring Turnover						
	Mean	--	--	3.3	--	2.6
	Max.	--	--	4.5	--	4.0
	Min.	--	--	2.0	--	1.7
Autumn Turnover						
	Mean	--	--	--	--	2.4
	Max.	--	--	--	--	2.9
	Min.	--	--	--	--	2.2

1 Birge and Juday (1914;1921).
2 Stewart and Markello (1974).
3 Modified form Forest et.al. (1978).
4 Mills (1975)

Table 27a. Mean, maximum and minimum turbidity levels (NTU) for Conesus Lake, 1985.

Station	Mean	Maximum	Minimum
13E	.97	1.44	.59
13M	1.07	1.76	.61
13H	1.93	6.03	.60
20E	.88	1.26	.54
20M	.89	1.41	.52
20H	2.07	6.20	.66
HANNAH	16.07	160.00	.96
WILKINS	9.23	138.00	.48
DENSMORE	17.66	192.00	.48
NORTH McMILLAN	14.69	161.00	.37
SOUTH McMILLAN	14.97	122.00	1.04
LONG POINT GULLY	23.12	216.00	.31
NORTH GULLY	14.24	216.00	.39
INLET 1	10.14	92.00	.50
INLET 2	7.53	36.20	.75
OUTLET	2.32	7.30	1.02

Table 27b. Multiple regression analysis of turbidity on chlorophyll a and total residue levels in the hypolimnion at station 20.

Predictor	Coefficient	t-ratio
Constant	-29.783	-5.46
Chlorophyll	.0975	2.19
Total residue	.1385	5.83

$t_{(.05,13)}$ 2.16

Analysis of Variance

Source	DF	SS	MS	F	Table F $F_{(2,15,.05)}$
Regression	2	29.495	14.748	17.15	6.515
Error	15	12.897	0.860		
Total	17	42.392			

Table 28. Statistical comparison of mean turbidity values of the Avon, Geneseo and Lakeville Water Treatment Plants as compared with the Brockport values. Samples are from the shoreside raw water intake. Plant turbidity values were taken by town personnel. Turbidity is in NTU. S.D. is the standard deviation.

	Lakeville		Geneseo		Avon	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Plant Value	1.17	0.46	0.83	.09	1.15	0.43
Brockport Value	5.36	9.0	2.5	4.24	1.15	0.34
Calculated F	3.90		2.77		0.0	
Table F	2.88		2.88		2.88	
Sample #	18		18		18	

TABLE 29. Calibration check of Geneseo and Lakeville Water Treatment Plant turbidimeters with SUNY Brockport's. The Geneseo plant uses a Hach Model 2100 A Turbidimeter with a 10 NTU standard. The Lakeville plant uses a HF Instruments Model DRT100 Turbidimeter with a 1.0 NTU standard. Brockport uses a Turner Model 40 nephelometer with a 20 NTU standard.

REPLICATE	GENESEO (NTU)	BROCKPORT (NTU)
1	1.2	1.0
2	1.2	1.1
3	1.2	1.2
4	1.2	1.2
5	1.2	1.1
6	1.2	1.2
7	1.3	1.2
8	1.3	1.2
9	1.3	1.2
10	1.2	1.2
	$\bar{X}$=1.23	$\bar{X}$=1.16

REPLICATE	LAKEVILLE (NTU)	BROCKPORT (NTU)
1	.6	1.0
2	.9	1.0
3	1.0	.9
4	.7	.9
5	.8	.9
6	.9	.9
7	1.2	.9
8	.8	.8
9	.9	.8
10	1.1	.8
	$\bar{X}$=0.89	$\bar{X}$=0.80

TABLE 30. Comparison of turbidity from samples taken directly from the epilimnion and from the raw water intake pipe of each water treatment plant. Values are the mean for the study period based on Brockport's measurements.

	LAKEVILLE	GENESEO	AVON
INTAKE PIPE	5.36	2.50	1.15
LAKE WATER	1.11	0.97	1.18

TABLE 31. Summary of Conesus Lake zooplankton, April - December, 1985. Adapted from Teall (1986)

GROUP	TAXON	MAXIMUM ORGANISMS PER CUBIC METER	AVERAGE ORGANISMS PER CUBIC METER	PERCENT
Cladocera	Bosmina longirostris	78,904.00	24,481.42	5.53
	Daphnia retrocurva	19,976.00	5,046.80	1.14
	Eubosmina coregoni	11,631.54	4,584.66	1.04
	Diaphanosoma birgei	10,035.00	1,005.52	0.23
	Daphnia galaeta mendota	2,261.00	770.22	0.17
	Ceriodaphnia reticulata	5,658.00	627.74	0.14

				8.24
Copepoda	Copepoda nauplii	158,710.90	46,658.24	10.53
	Cyclops bicuspidatus thomasi	78,746.81	22,039.21	4.98
	Cyclopoid - copepodite	41,857.82	15,560.71	3.51
	Mesocyclops edax	32,351.68	10,605.77	2.39
	Diaptomus pallidus	3,297.11	1,317.65	0.30

				21.71
Rotifera	Conochilus unicornis	650,847.71	72,532.62	16.37
	Kellicottia longispina	282,418.51	57,900.13	13.07
	Asplanchna priodonta	350,628.44	39,089.09	8.82
	Kellicottia bostonensis	234,753.74	25,094.00	5.67
	Keratella cochlearis	80,935.00	21,602.67	4.88
	Polyarthra major	116,791.00	18,503.67	4.18
	Keratella quadrata	207,833.00	18,320.11	4.14
	Polyarthra dolichoptera	189,881.00	12,982.11	2.93
	Polyarthra vulgaris	67,500.00	12,275.00	2.77
	Polyarthra remata	70,374.00	10,611.67	2.40
	Pompholyx sp.	56,482.00	7,646.94	1.73
	Synchaeta sp.	78,367.35	5,339.66	1.21
	Trichocerca multicrinis	34,015.75	3,808.46	0.86
	Keratella crassa	11,939.00	2,516.06	0.57
	Keratella hiemalis	10,906.00	1,658.45	0.37
	Ascomorpha sp.	4,489.00	249.39	0.06
	Notholca acuminata	1,090.05	124.74	0.03

				70.04
				==========
				100.00

Table 32. Comparison of Conesus Lake water to Maximum Contaminant Levels (MCL) set by the New York State Sanitary Code.

	MCL	Conesus Lake
Nitrate	10mg/L	.15mg/L
Sulfate	250mg/L	24.6mg/L
Sodium	See below[1]	17.0mg/L
Turbidity	1NTU	1.13NTU - Avon[2] .81NTU - Geneseo[2,3] 1.01NTU - Lakeville[2,3]
Trihalomethanes	100µg/L	

[1] No designated limit exists. However, water containing more than 20mg/L of sodium should not be used for drinking by those on severely restricted sodium diets.

[2] Mean of monthly averages (April - December, 1985)

[3] Values are low. See text.

Table 33. Monthly mean turbidity for the Avon, Geneseo and Lakeville Water Treatment Plants, 1985-86. Values are from measurements made by plant personnel.

	Avon	Geneseo	Lakeville
April	1.35	.81	1.06
May	1.16	.82	1.09
June	1.06	.81	1.34
July	.91	.76	.63
August	.84	.80	1.06
September	1.01	.80	1.03
October	1.20	.81	.97
November	1.20	.85	1.00
December	1.48	.82	.95

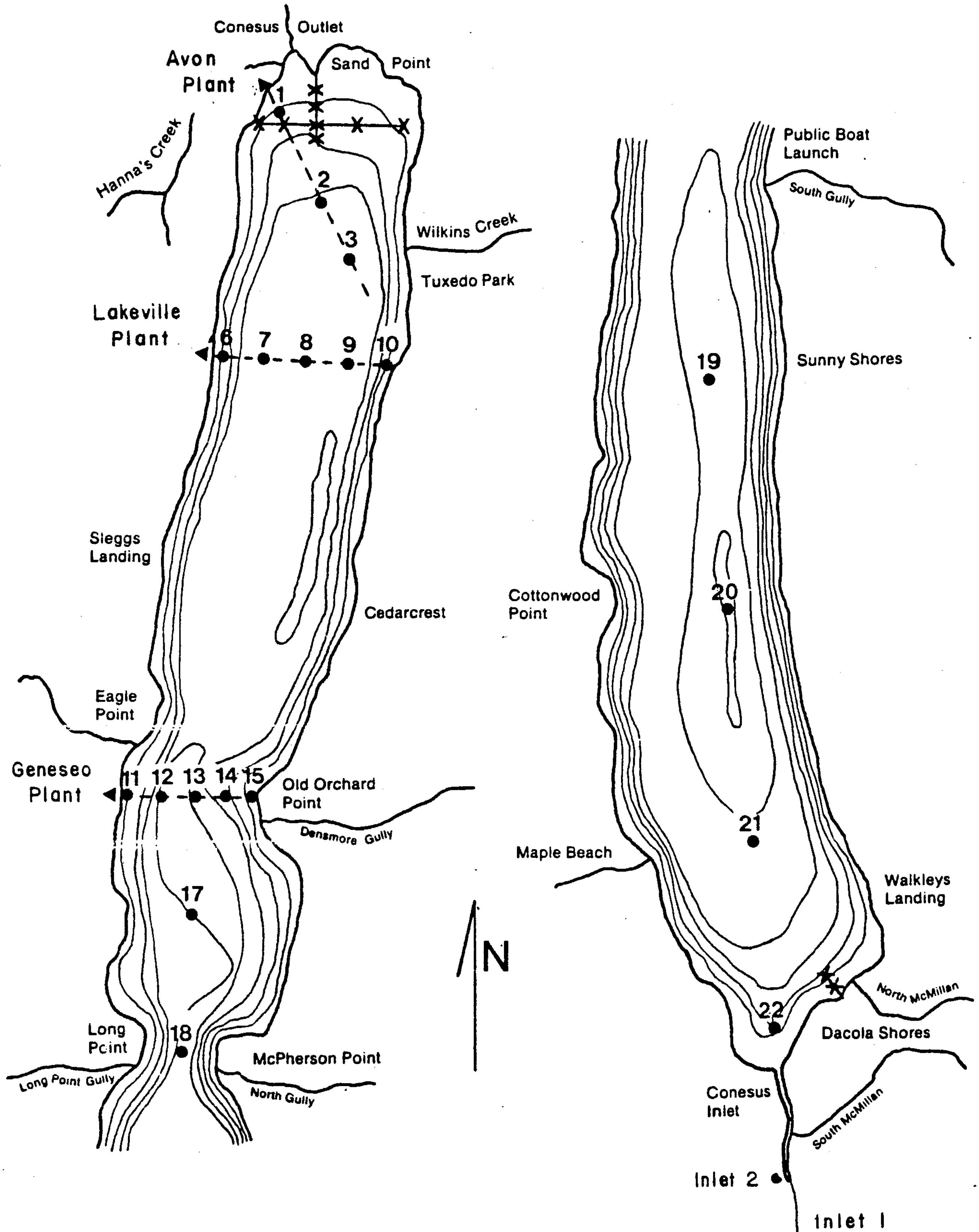

Figure 1. Bathymetric map of Conesus Lake indicating sampling sites. Macrophyte sampling sites are indicated by an "X". Modified from Forest al (1978).

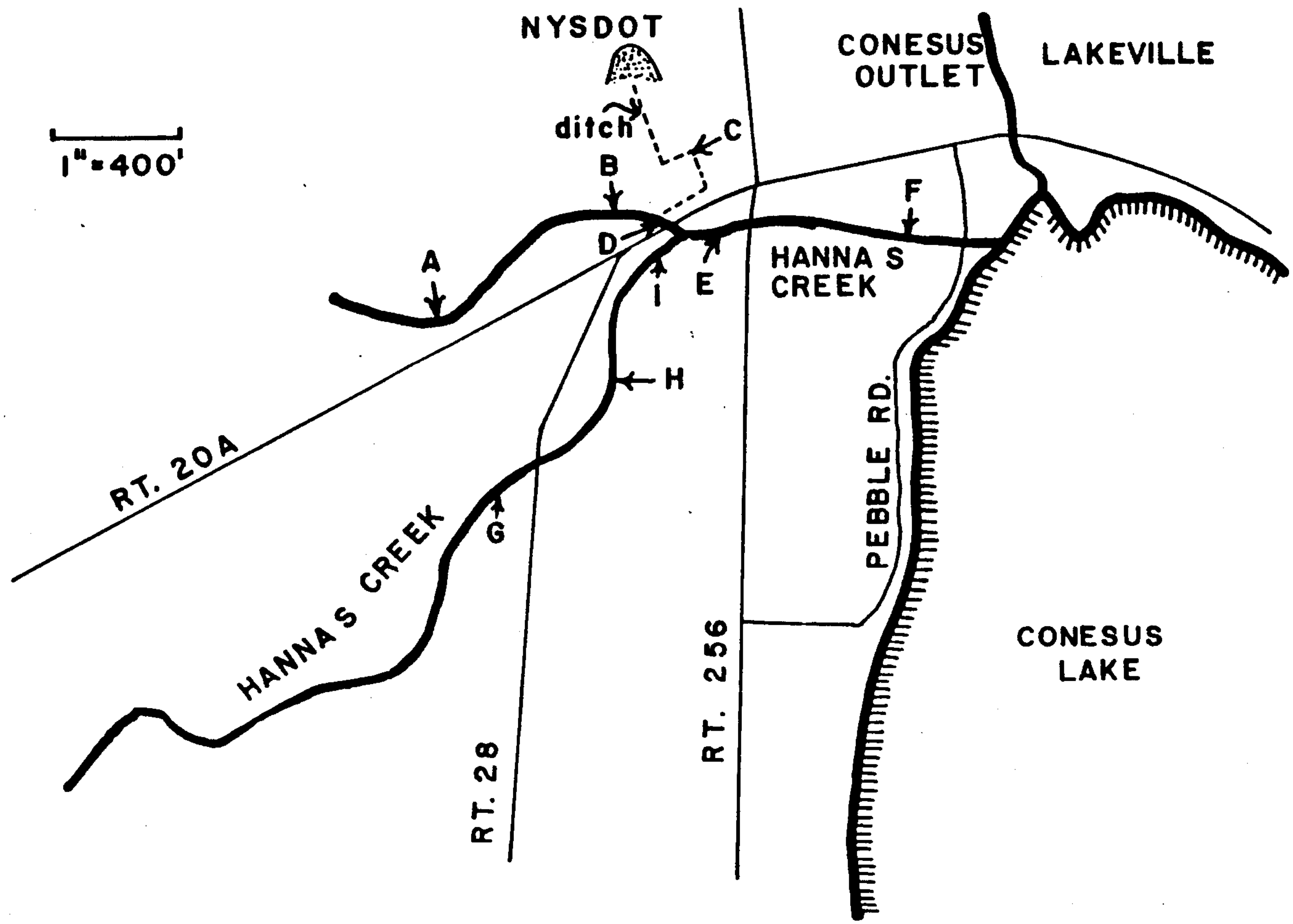

Figure 2   Map of sampling sites, Hanna's Creek. A=Control, B=Near salt pipe above ditch, C=Drain pipe, D=Near salt pipe below ditch, E=Downstream, F=Downstream, G=Control, H= Control, I=Control.

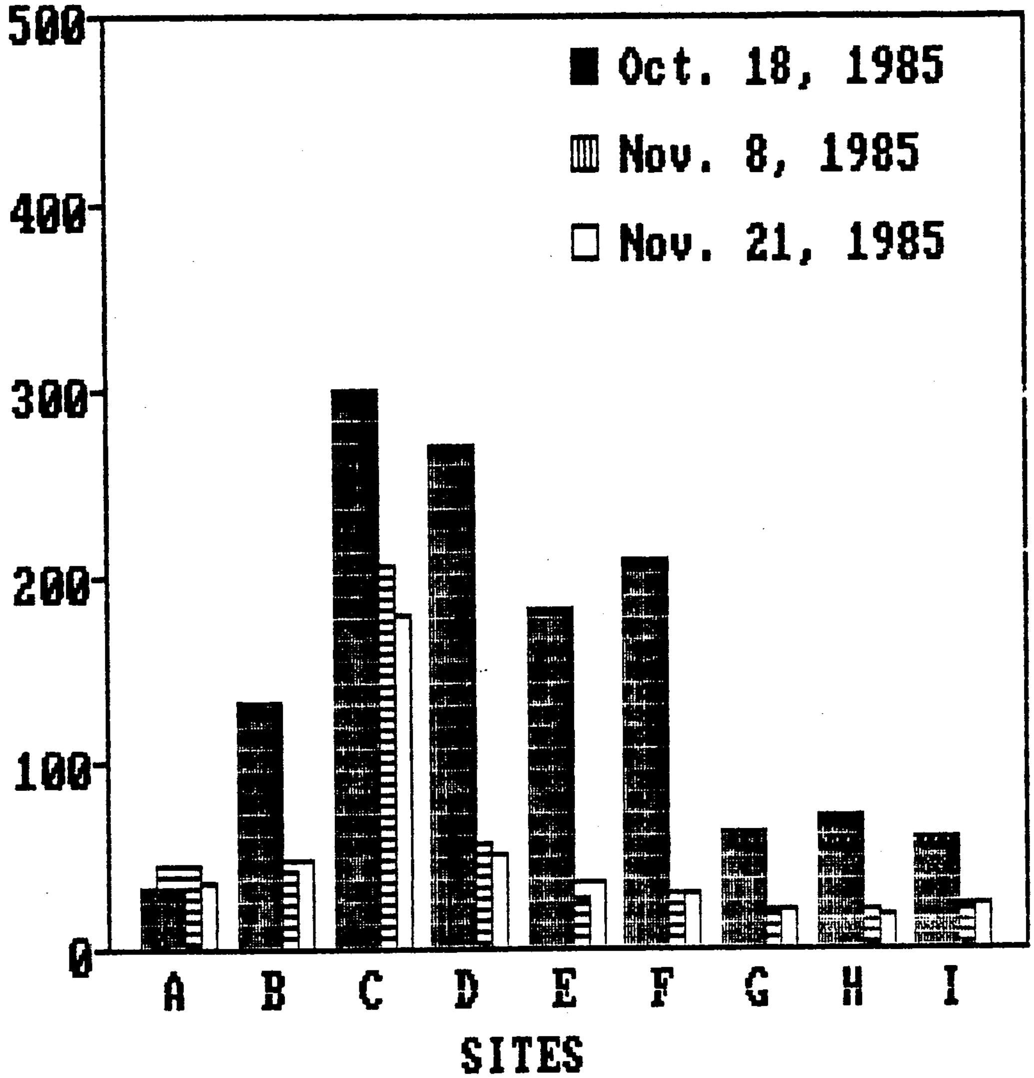

Figure 3 Sodium concentrations in Hanna's Creek. Location of sampling sites are given in Fig.2

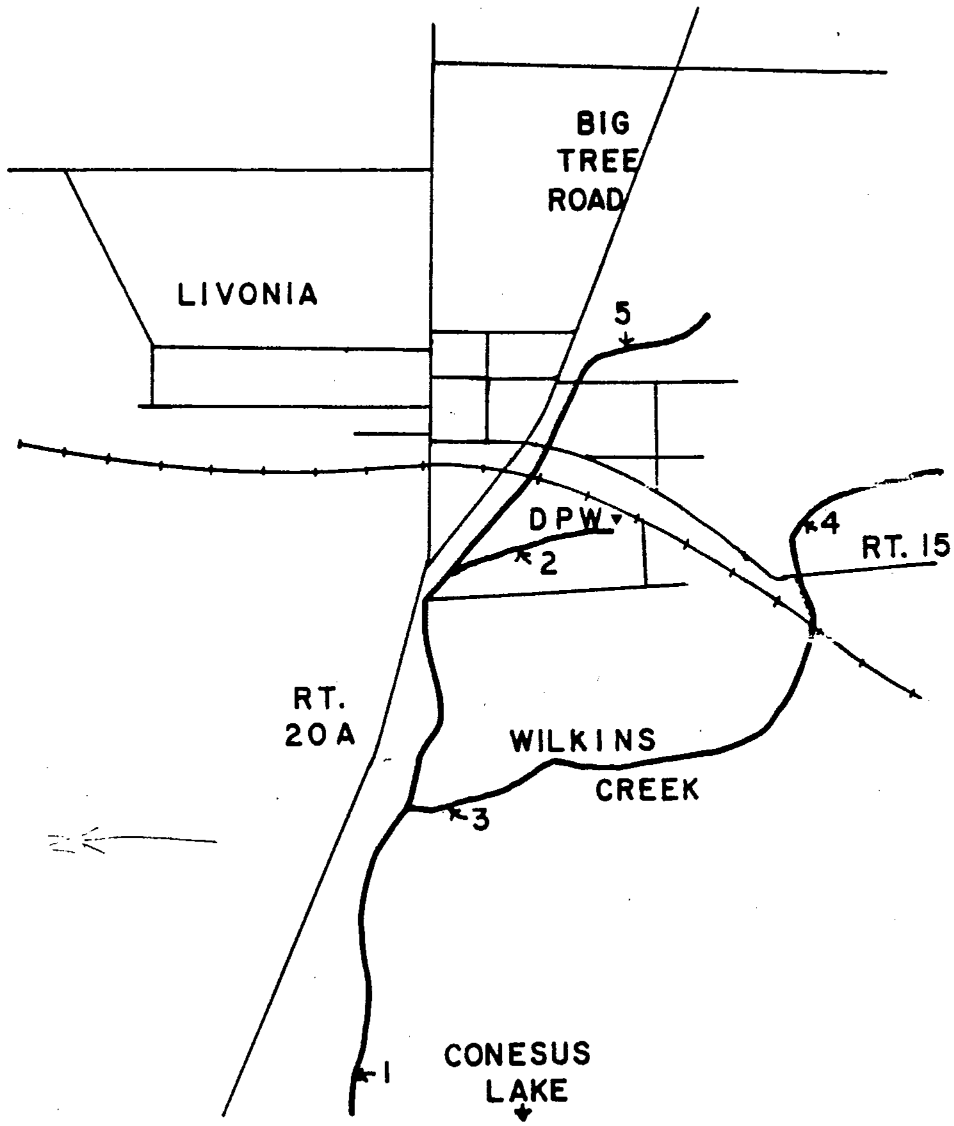

Figure 4 Map of sampling sites (#1 - 5), Wilkins Creek.

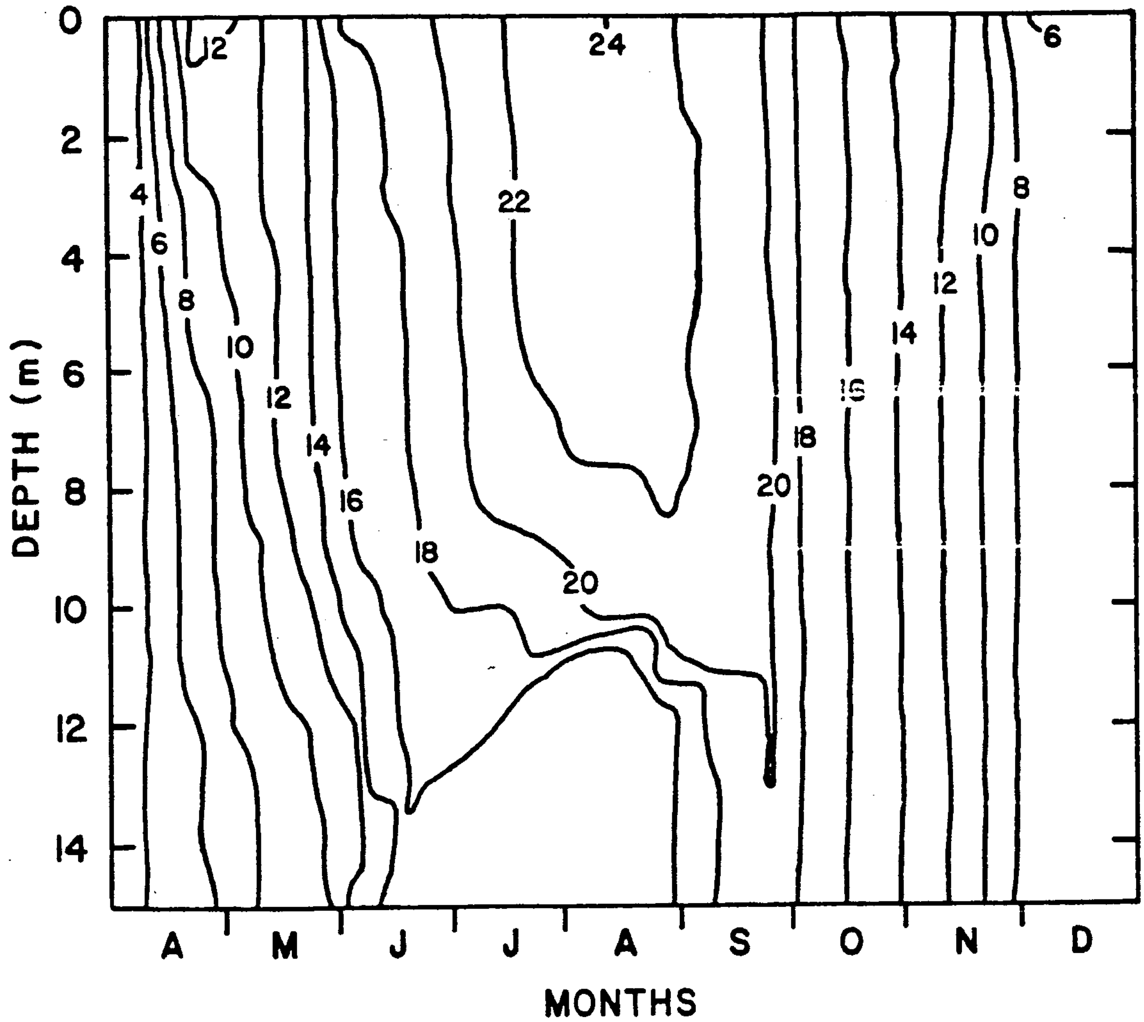

Figure 5. Isopleths of temperature (Station 13), Conesus Lake

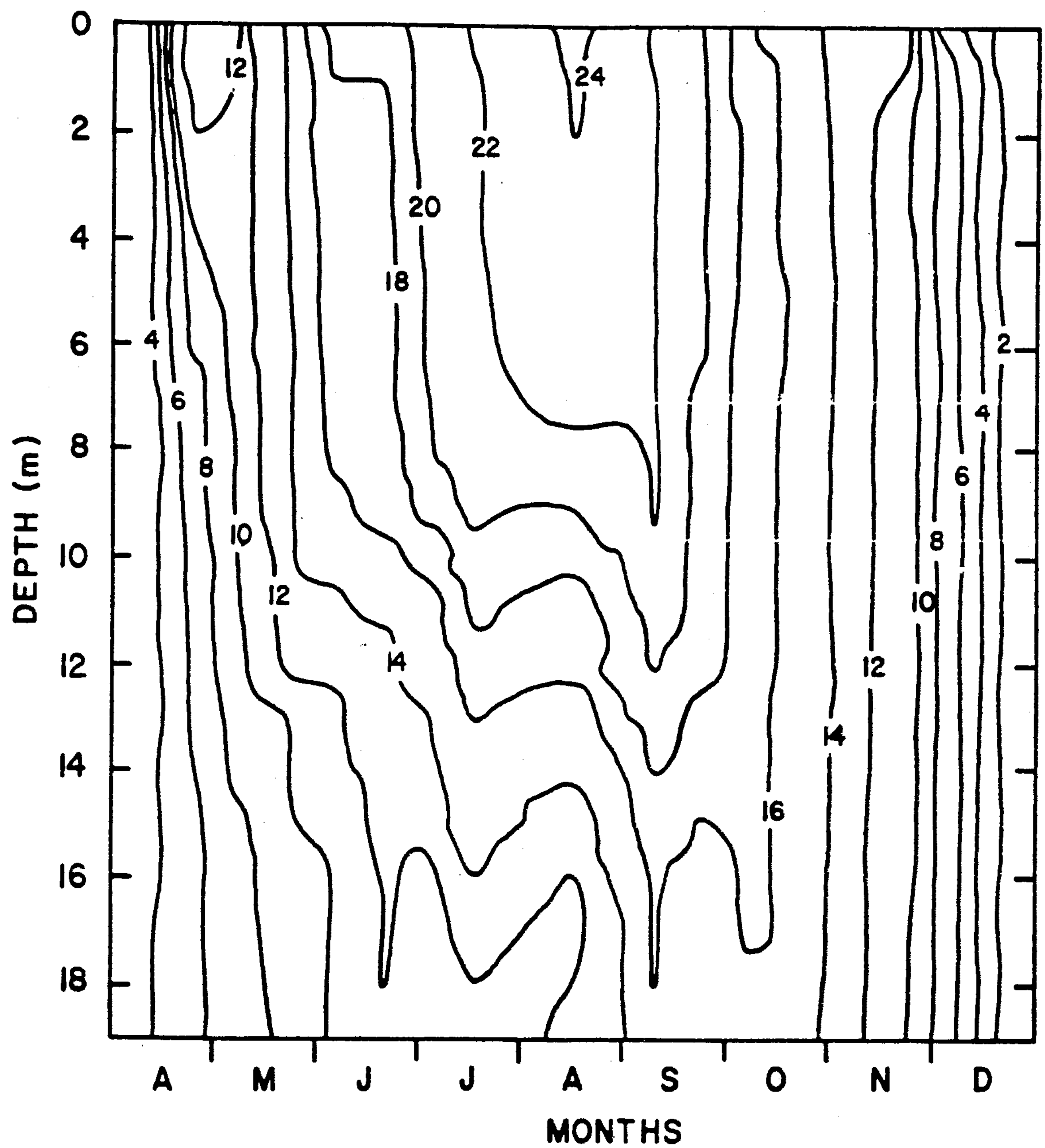

Figure 6. Isopleths of temperature (Station 20), Conesus Lake

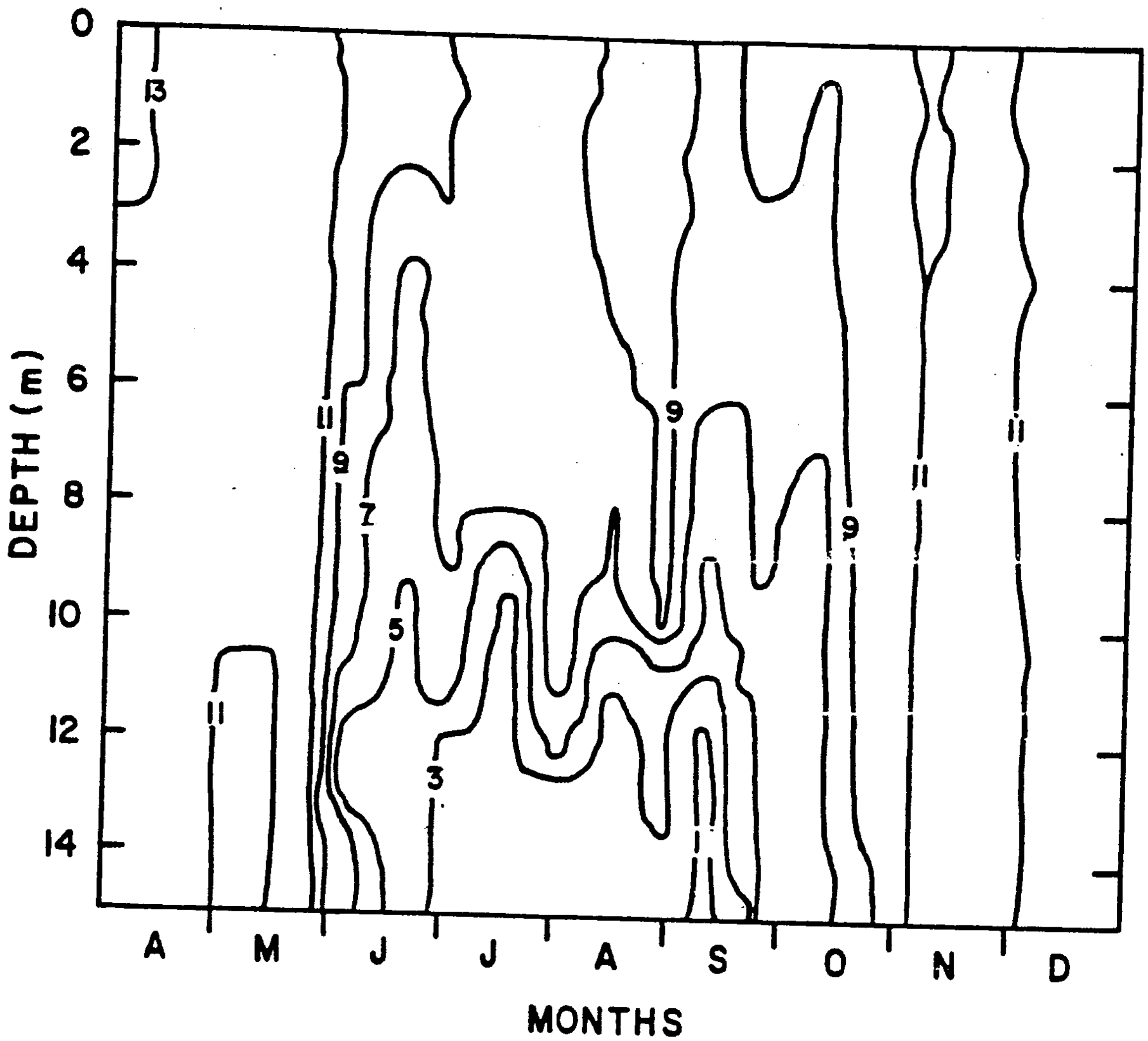

Figure 7. Isopleths of dissolved oxygen concentration (Station 13), Conesus Lake. Values are mg/l

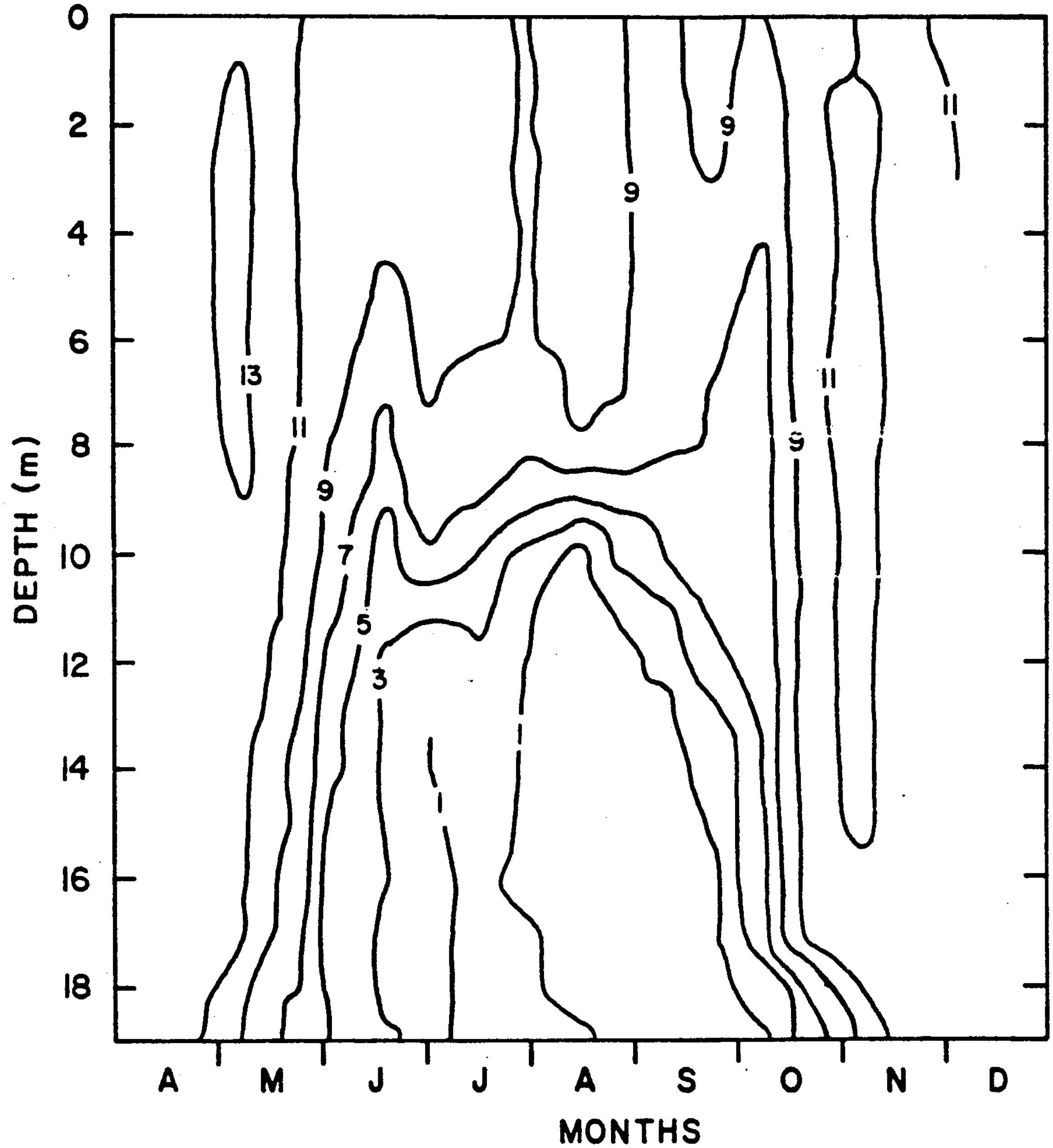

Figure 8. Isopleths of dissolved oxygen concentration (Station 20), Conesus Lake. Values are mg/l

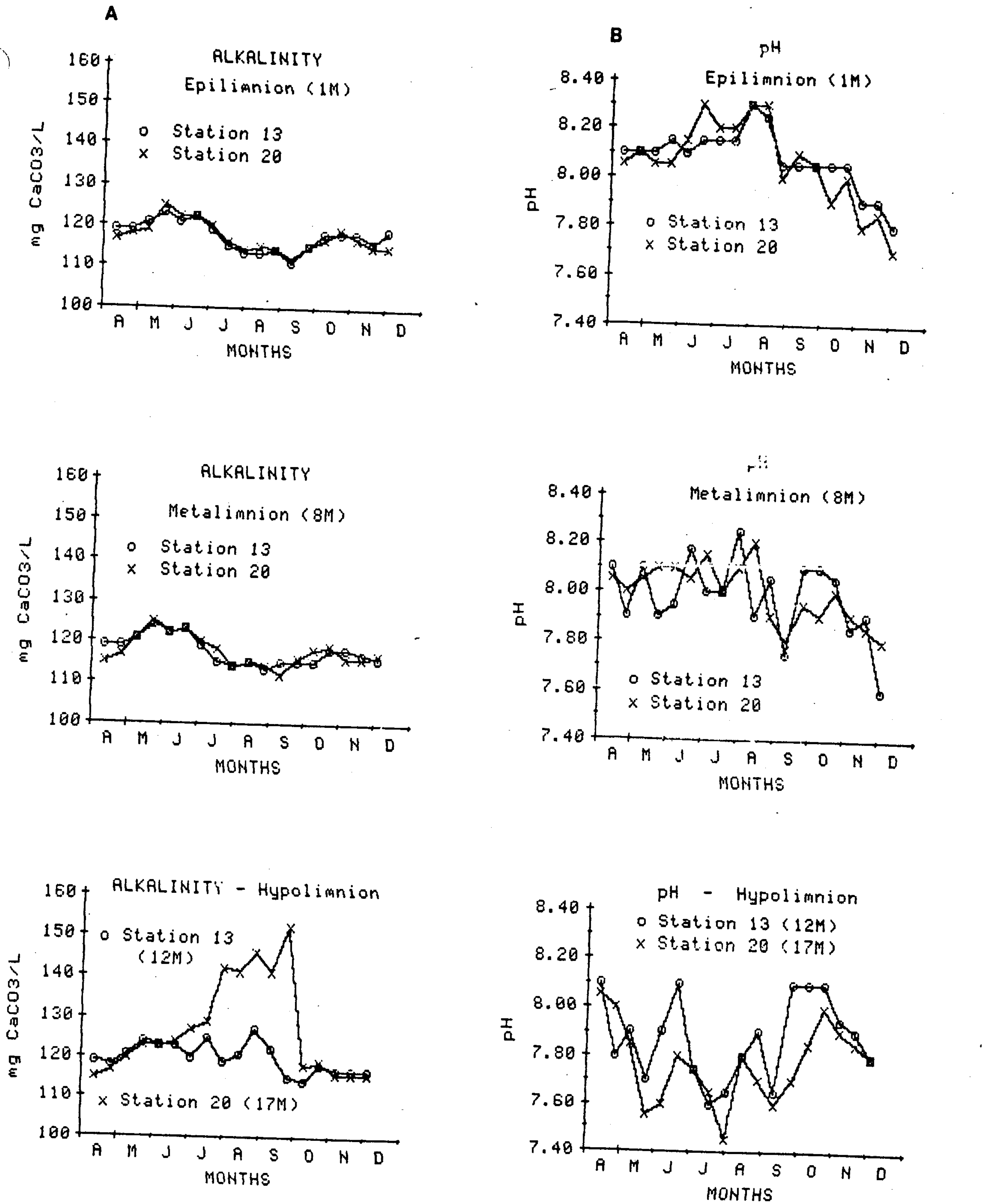

Figure 9. Alkalinity (a) and pH (b) for Conesus Lake, 1985.

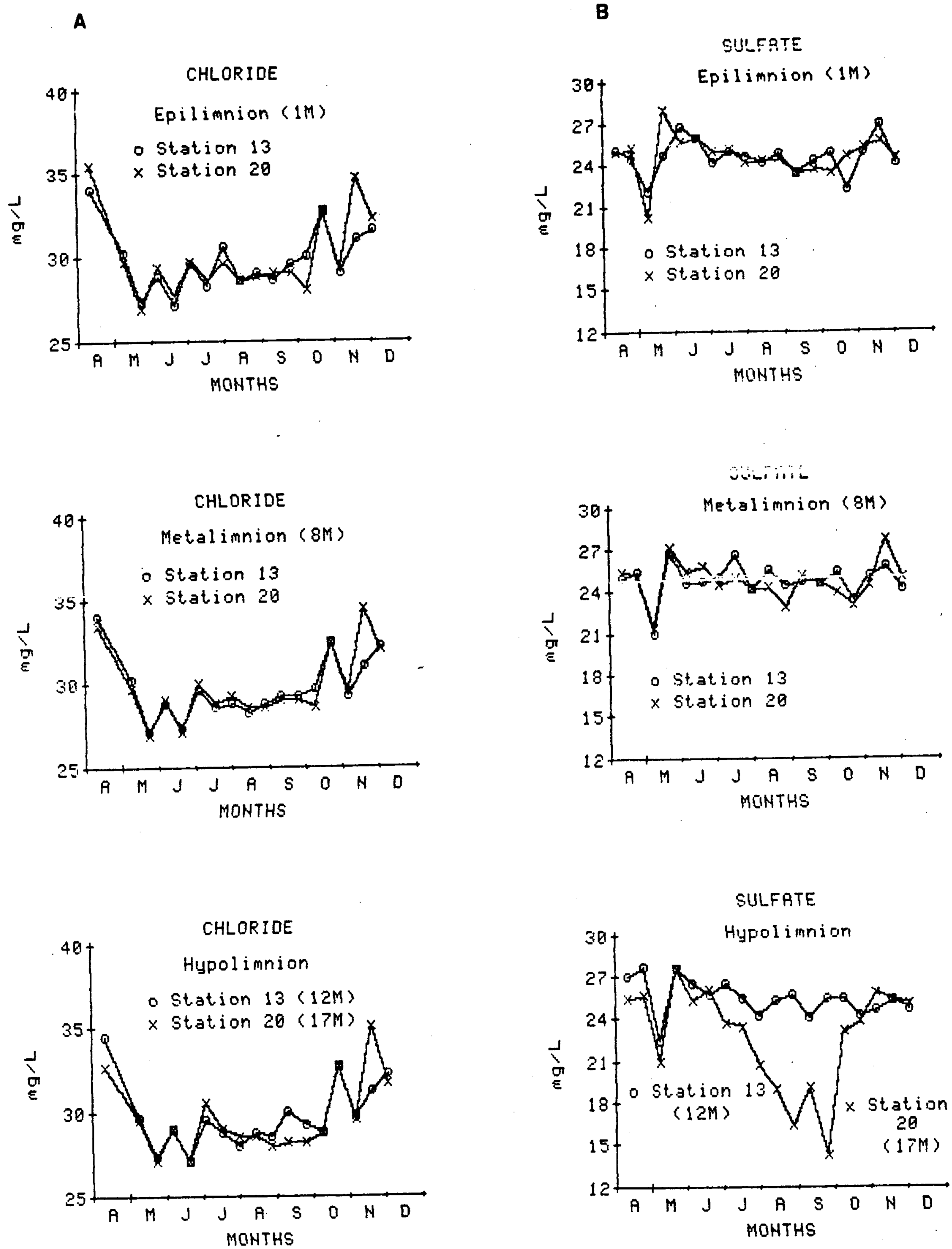

Figure 10. Chloride (a) and sulfate (b) for Conesus Lake, 1985.

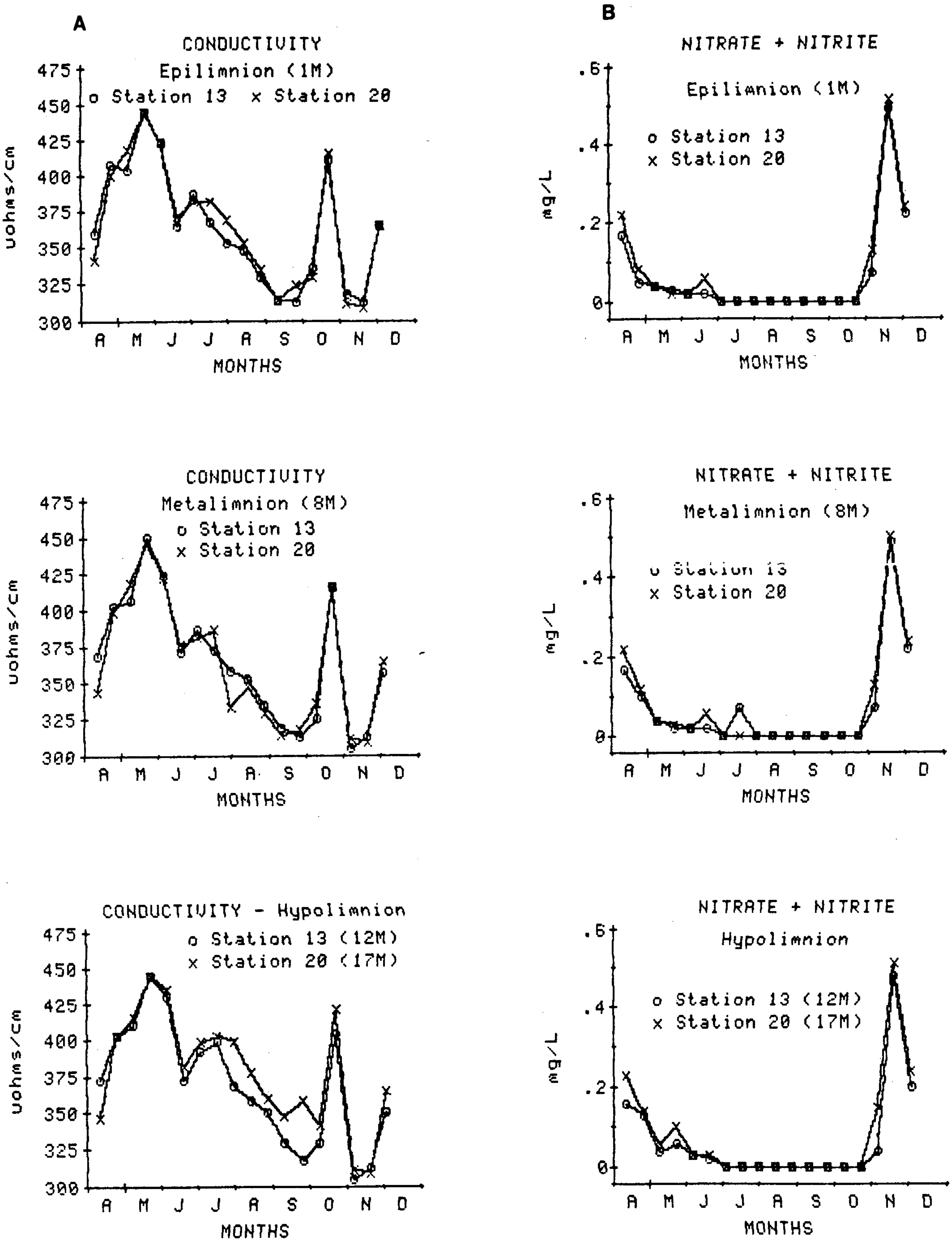

Figure 11. Conductivity (a) and nitrate (b) for Conesus Lake, 1985.

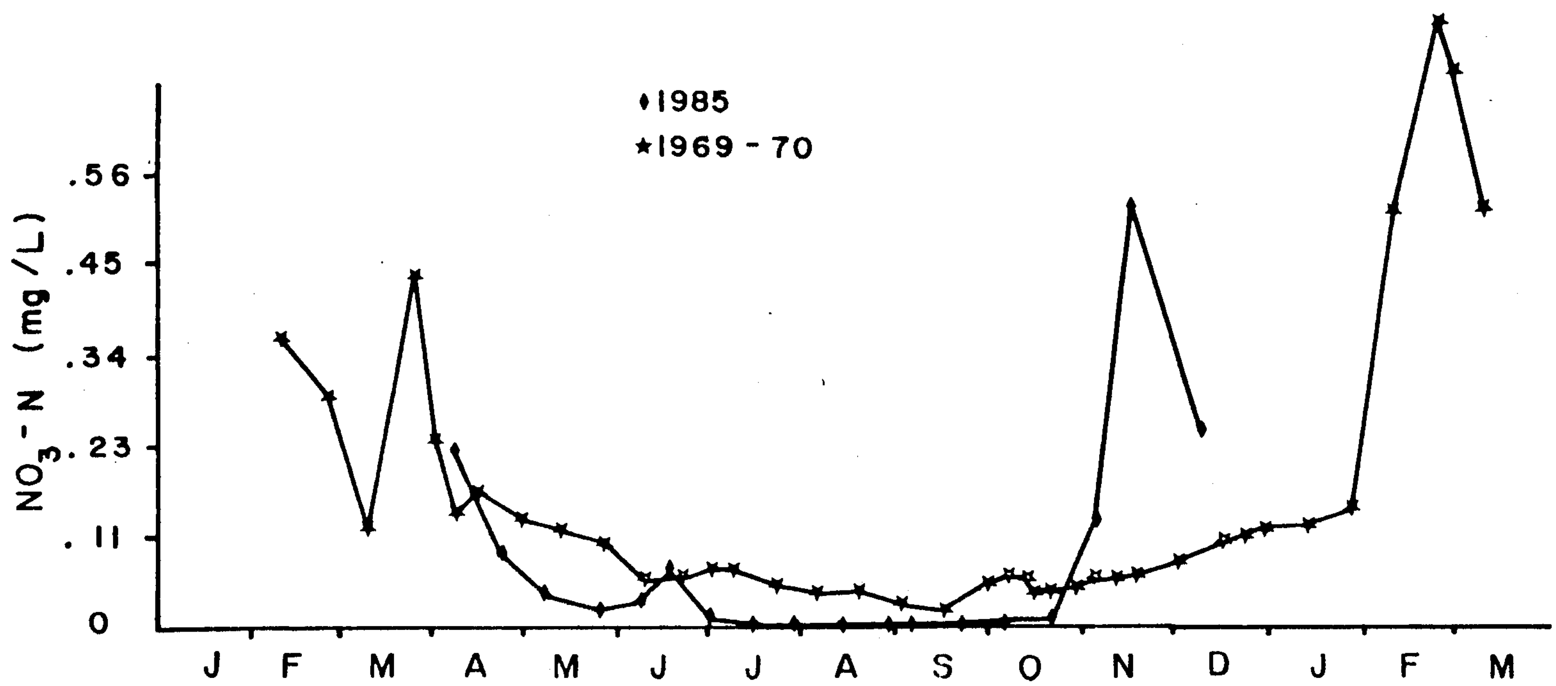

Figure 12. Comparison of nitrate concentrations between 1969-70 and 1985, Conesus Lake. 1969-70 data (0 m) are from Stewart and Markello (1974). 1985 data are from a 1-m depth at Station 20.

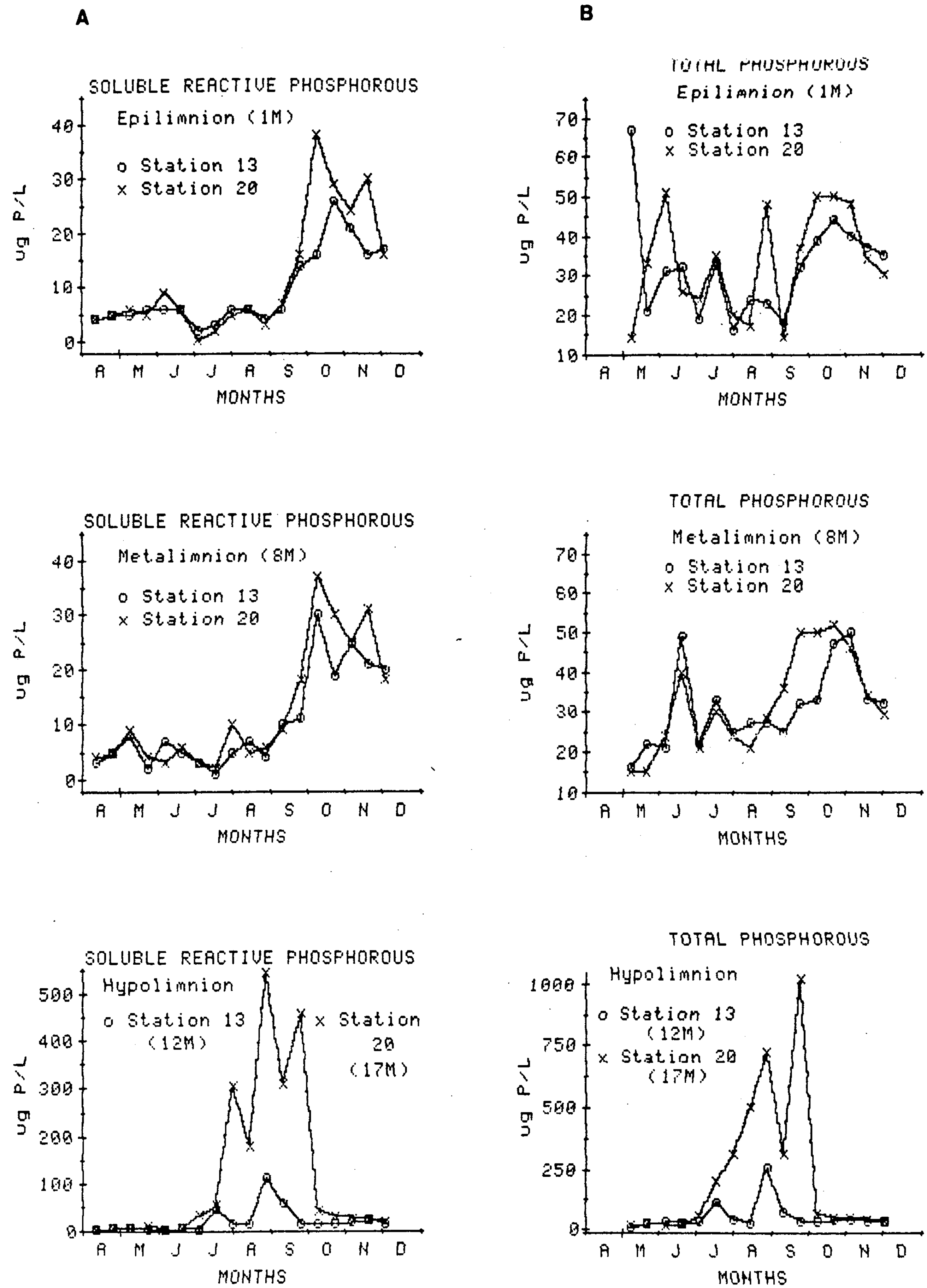

Figure 13. Soluble reactive phosphorus (a) and total phosphorus (b) for Conesus Lake, 1985.

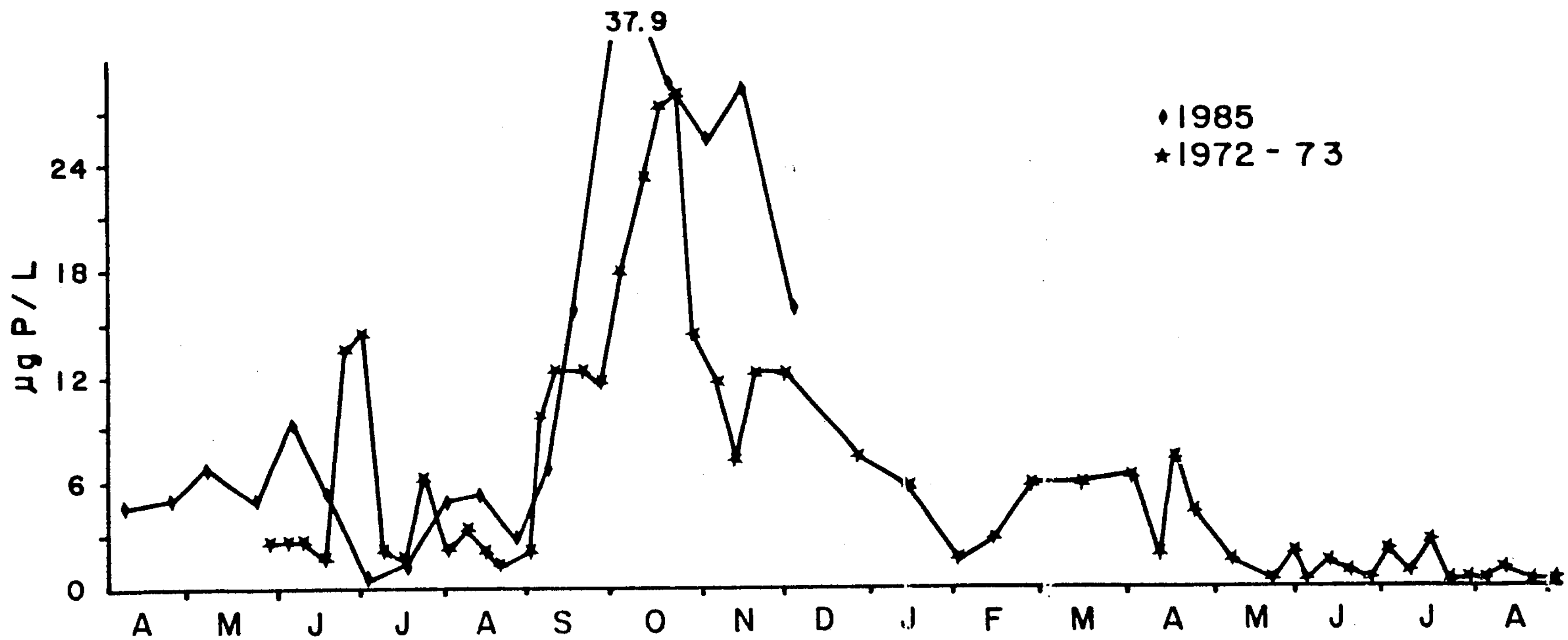

Figure 14. Comparison of soluble phosphorus concentrations between 1972-1973 and 1985, Conesus Lake. 1972-73 data (upper 10m integrated) are from Oglesby et al (1975). 1985 data are from a 1-m depth at Station 20.

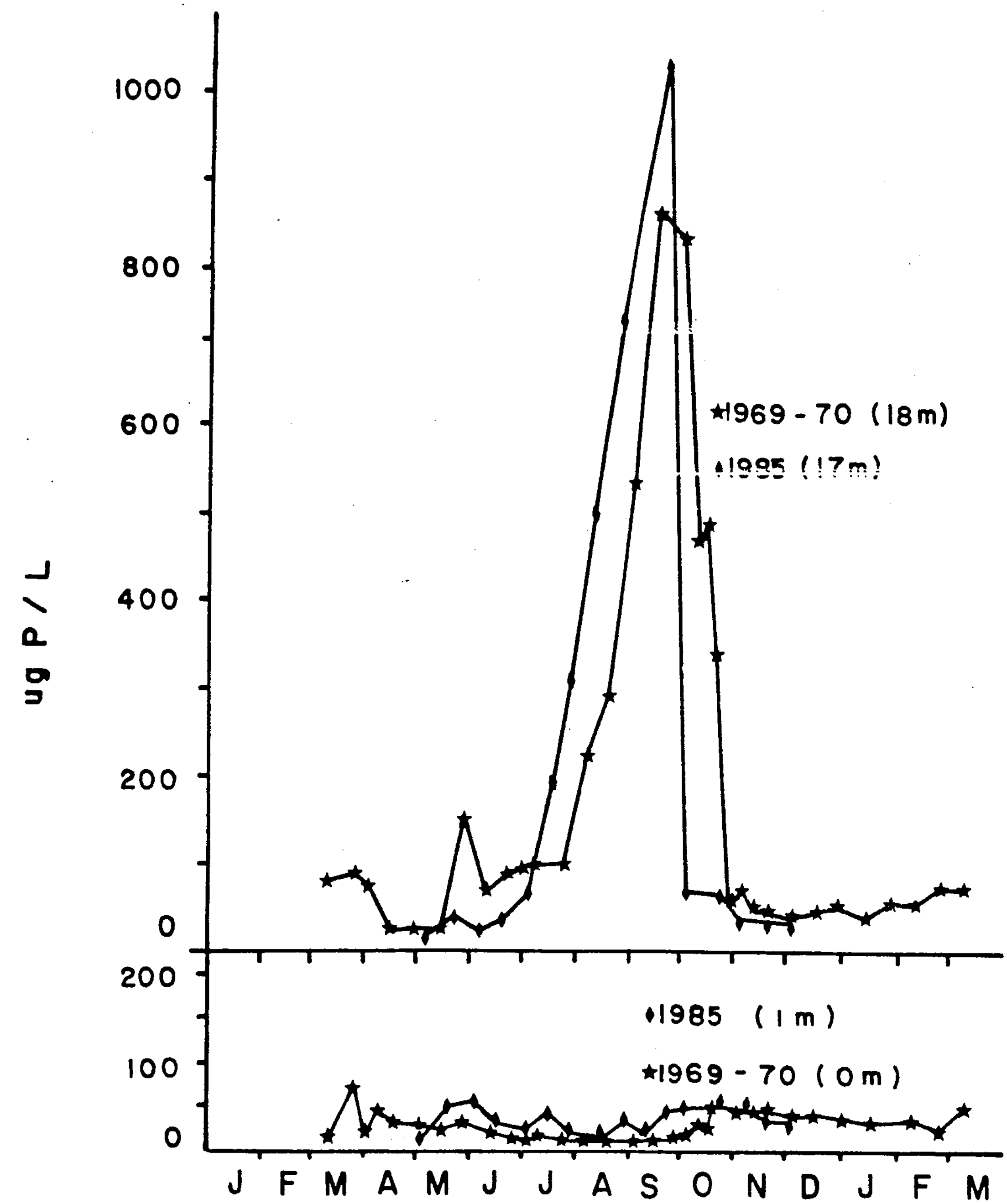

Figure 15. Comparison of total phosphorus concentrations between 1969-70 and 1985, Conesus Lake. 1969-70 data are from Stewart and Markello (1974). 1985 data are from Station 20.

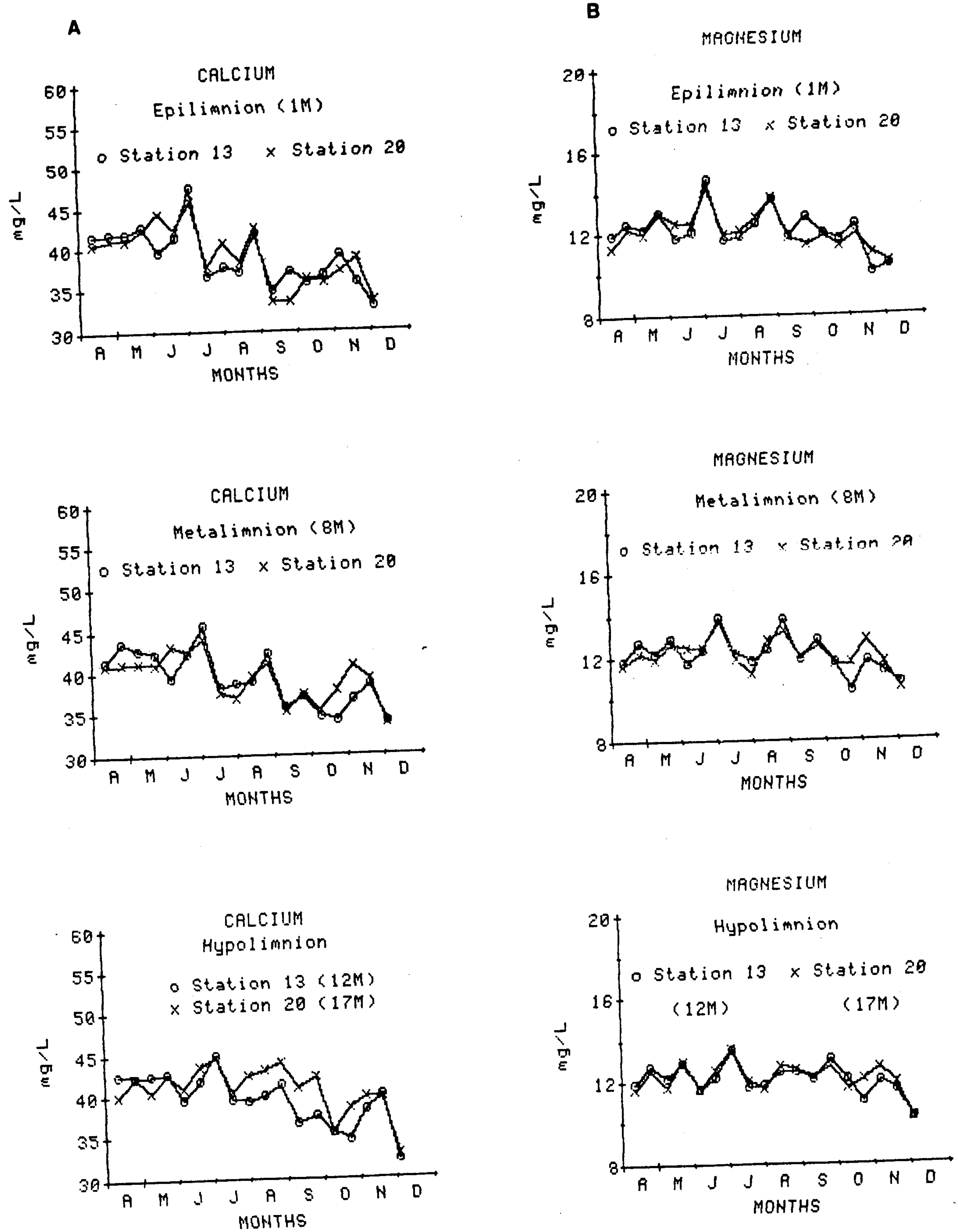

Figure 16. Calcium (a) and magnesium (b) for Conesus Lake, 1985.

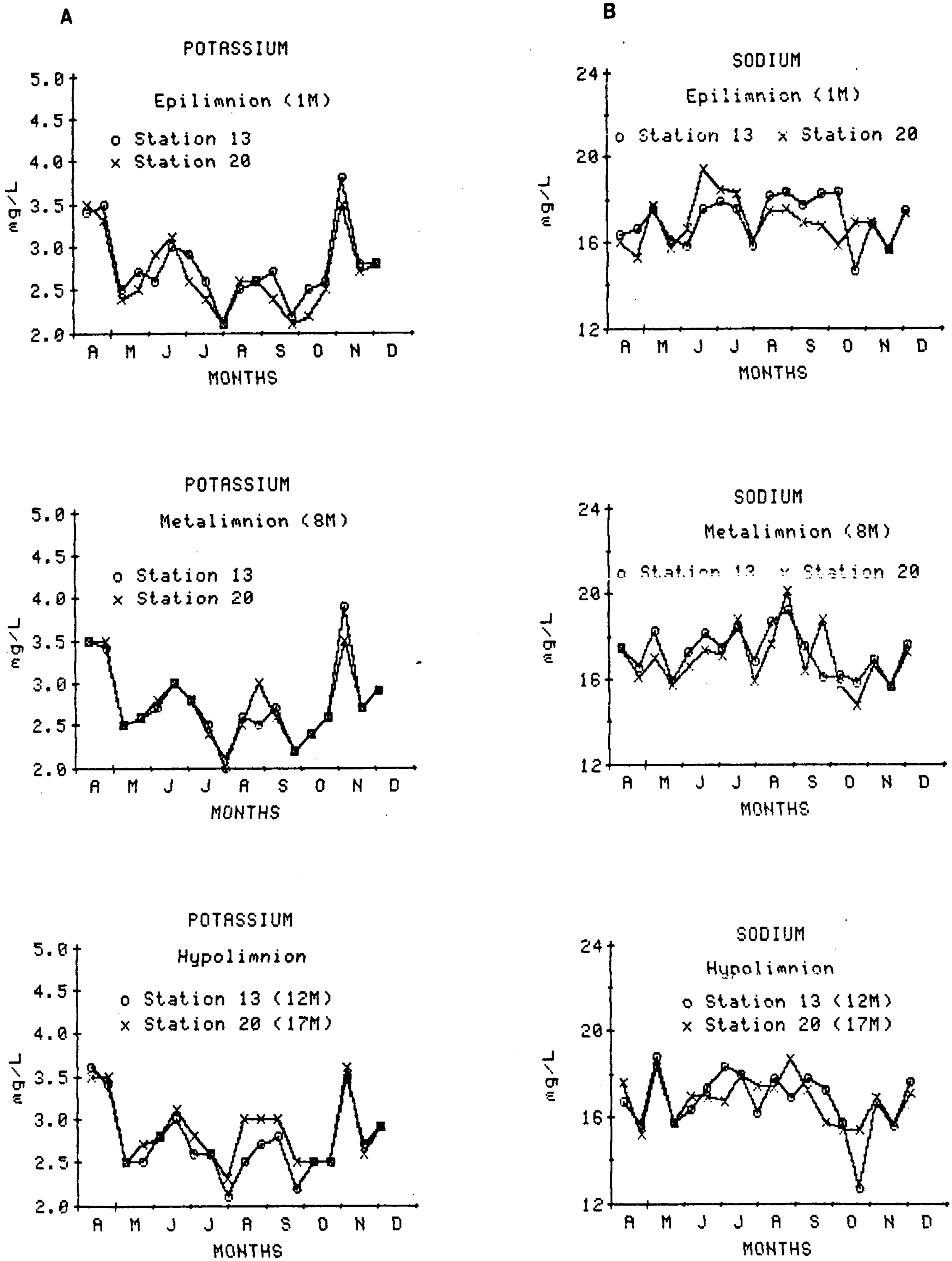

Figure 17. Potassium and sodium for Conesus Lake, 1985.

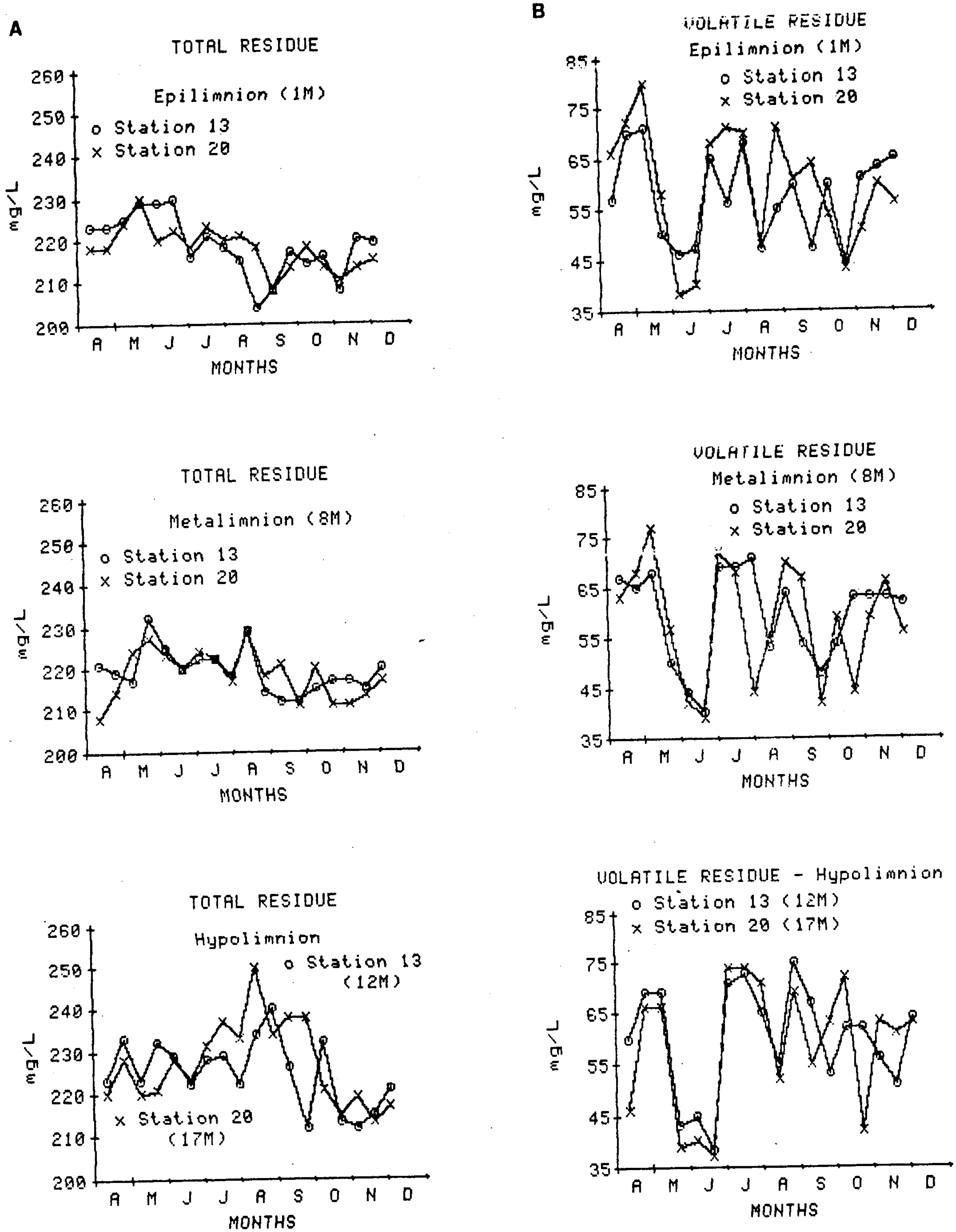

Figure 18 Total residue (a) and volatile residue (b) for Conesus Lake, 1985.

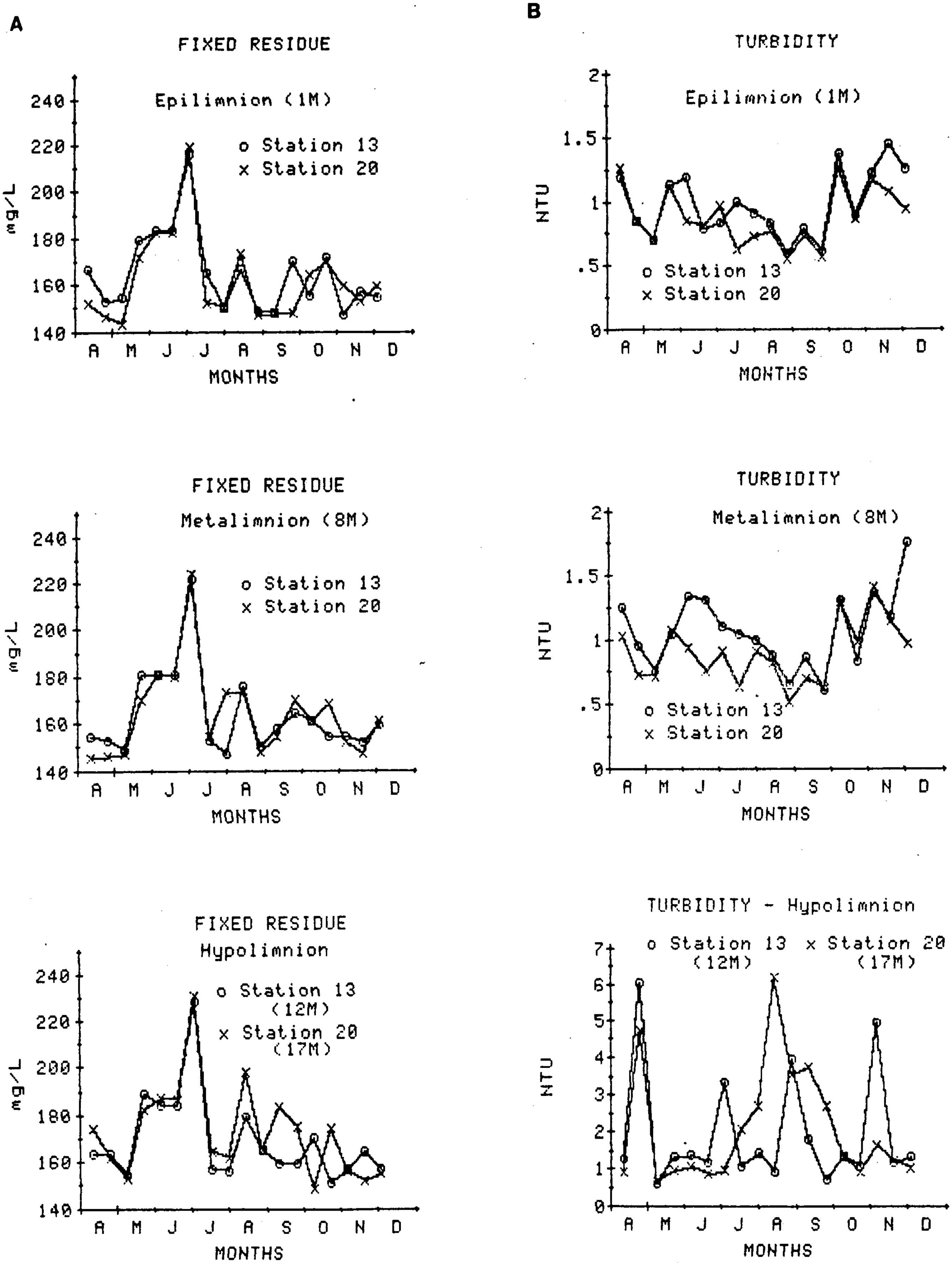

Figure 19 Fixed residue (a) and turbidity (b) for Conesus Lake, 1985.

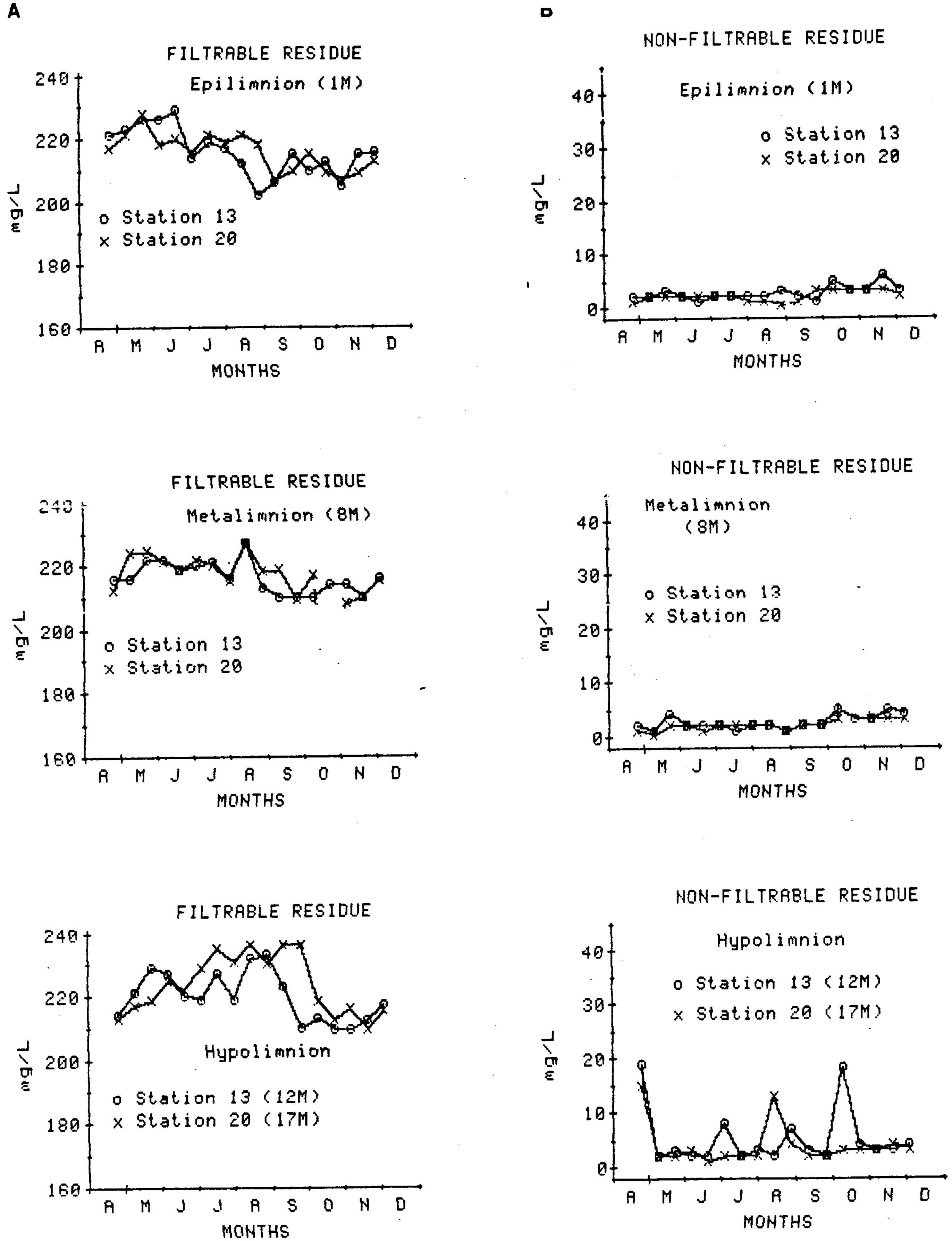

Figure 20. Filtrable (a) and non-filtrable residue (b) for Conesus Lake.

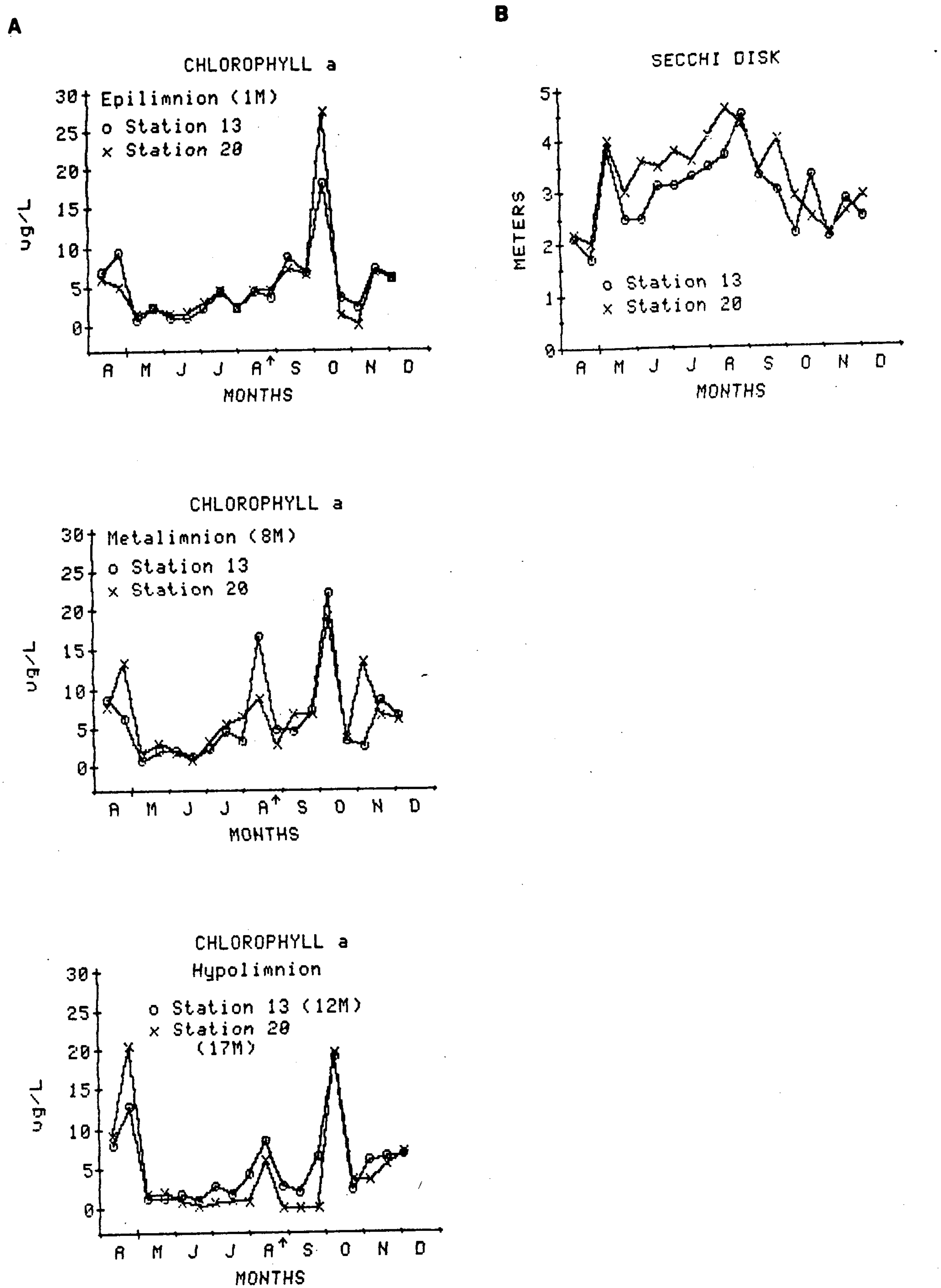

Figure 21 Chlorophyll a (a) and secchi disk (b) for Conesus Lake, 1985

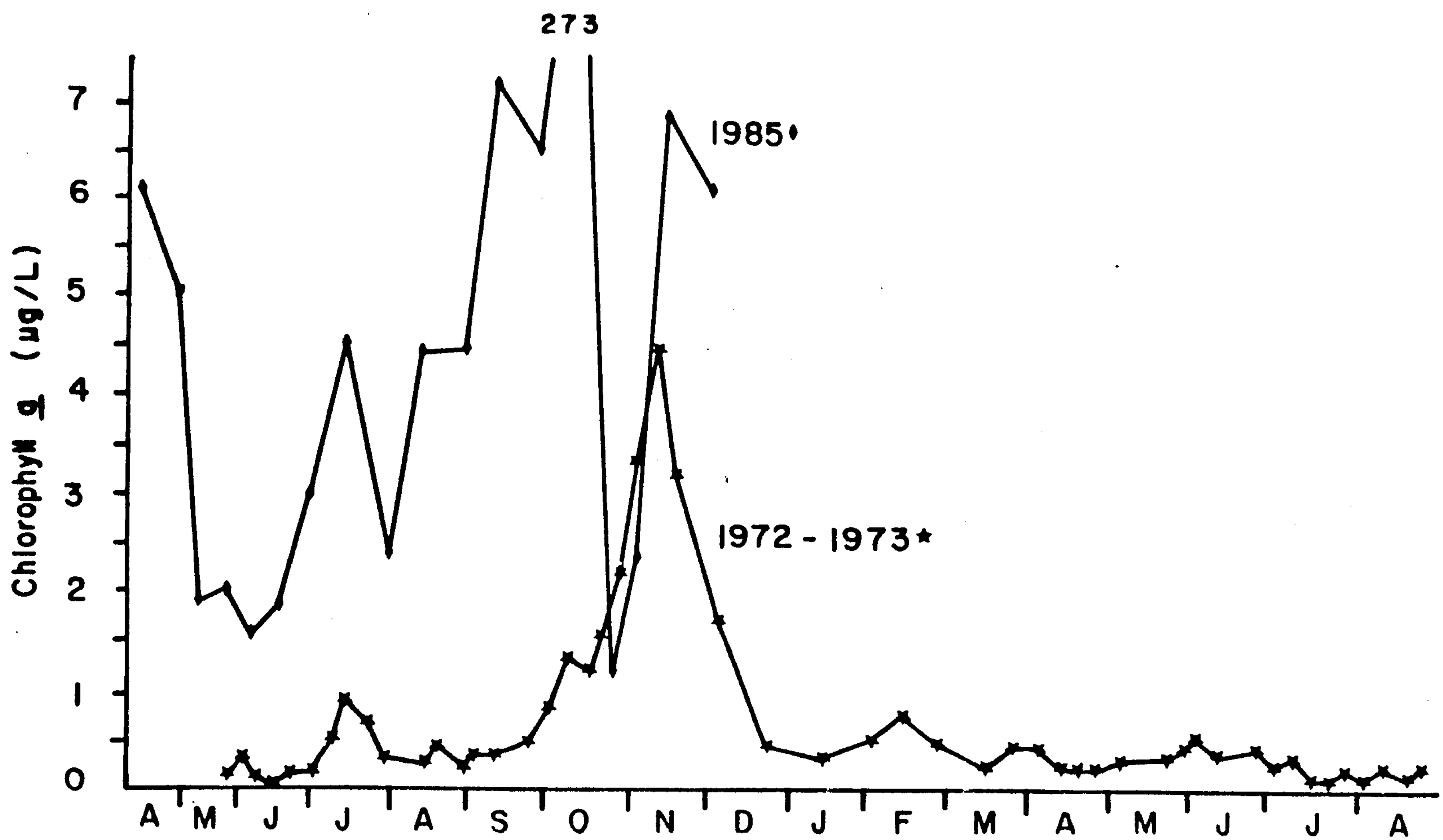

Figure 22. Comparison of chlorophyll a between 1972-73 and 1985. 1972-1973 data (upper 10m integrated) are from Oglesby et al (1975). 1985 data are from a 1-m depth from Station 20.

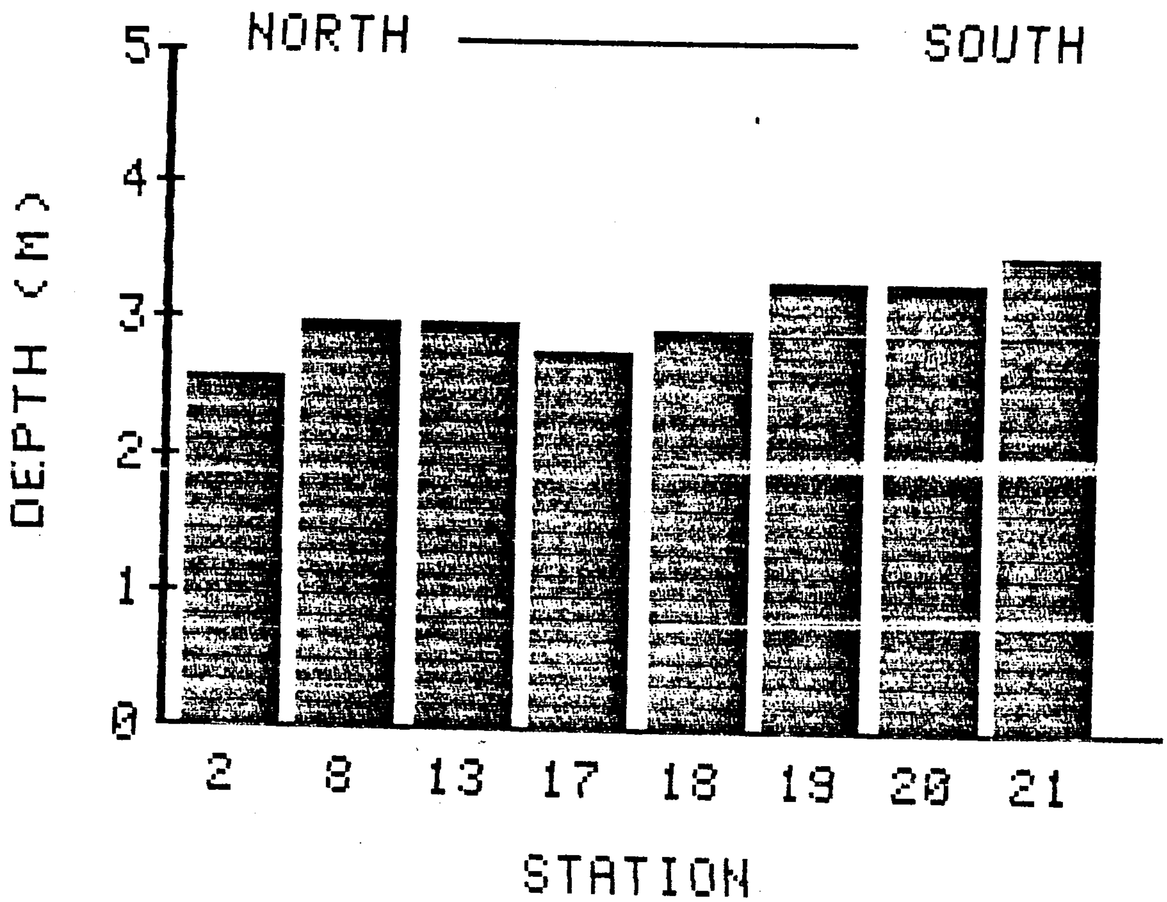

Figure 23. Mean secchi disk readings from north to south, Conesus Lake, 1985.

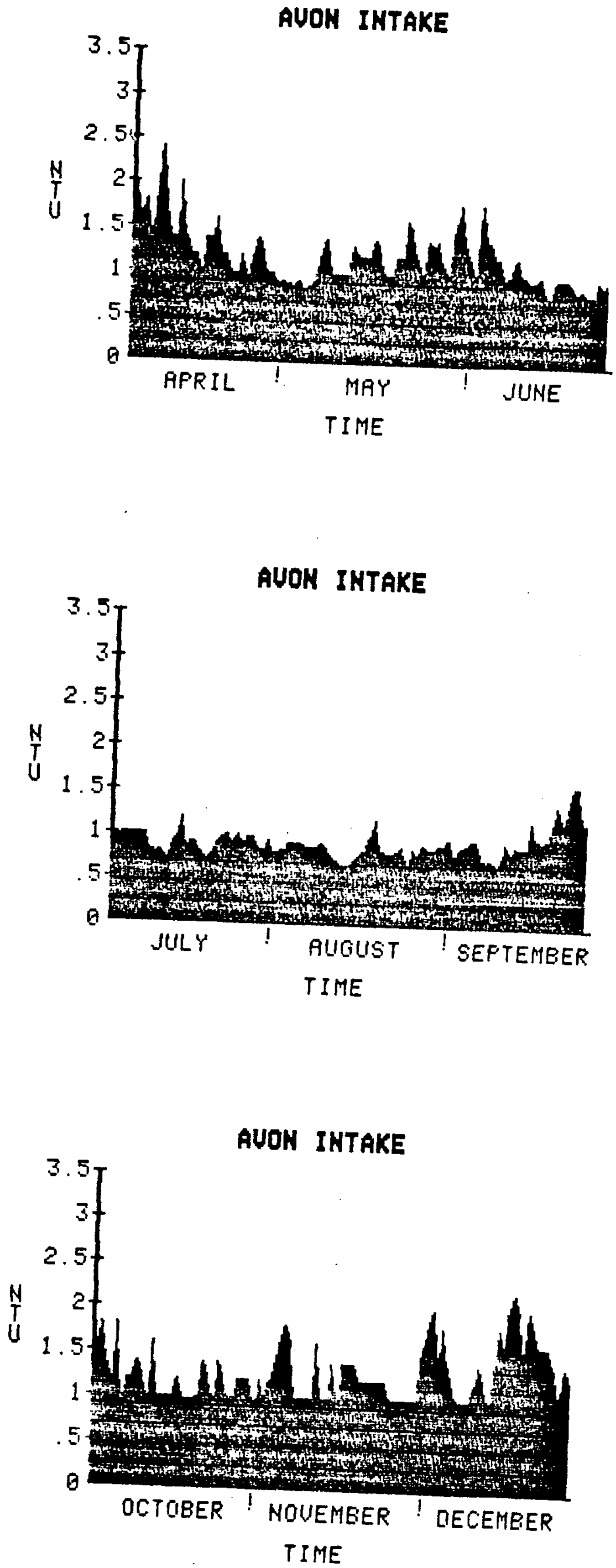

Figure 24. Daily seasonal turbidity values of raw water from the Avon Water Treatment Plant. Turbidity was measured by plant personnel.

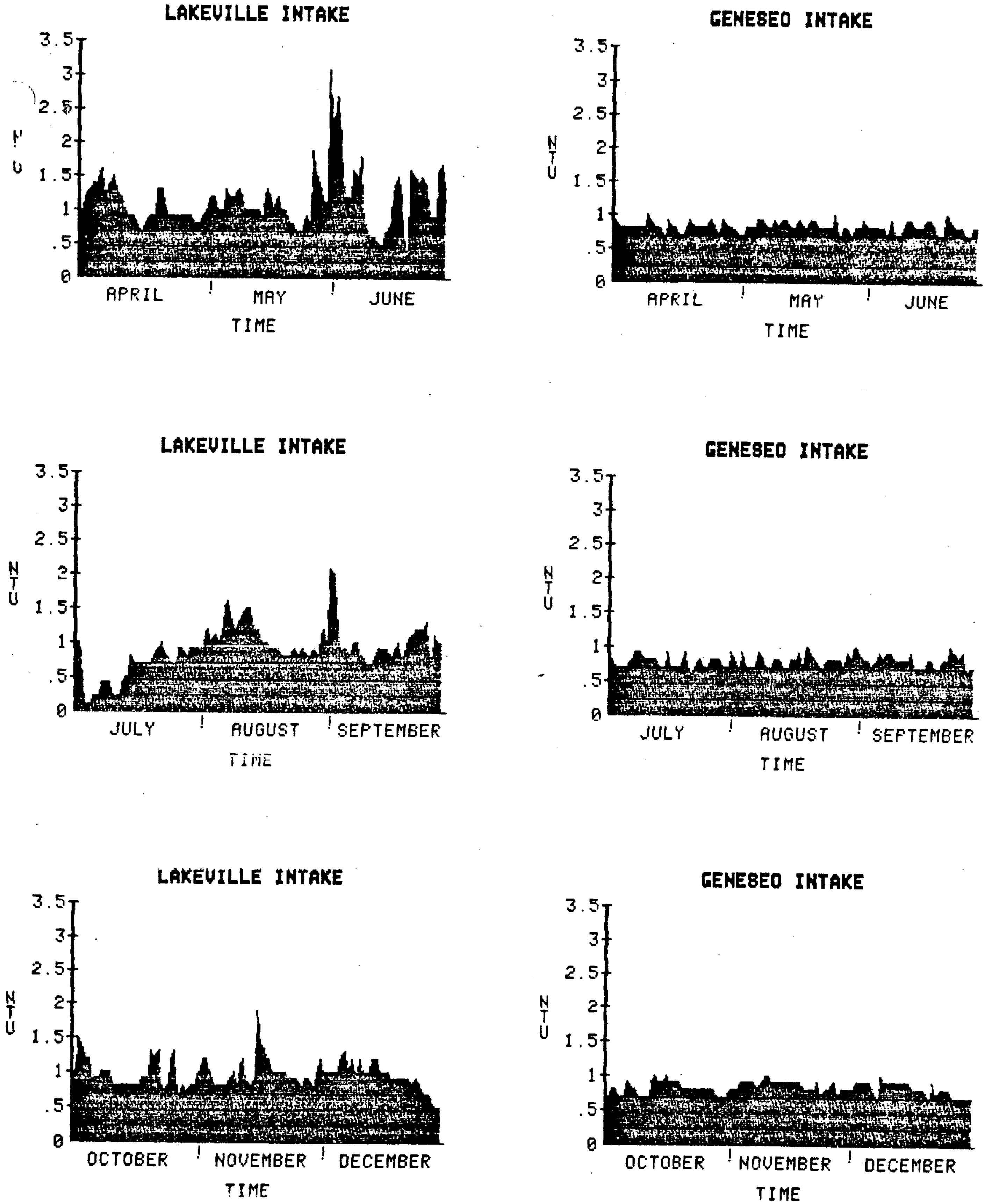

Figure 25. Daily seasonal turbidity values of raw water from the Lakeville (a) and Geneseo (b) Water Treatment Plants. Turbidity was measured by plant personnel.

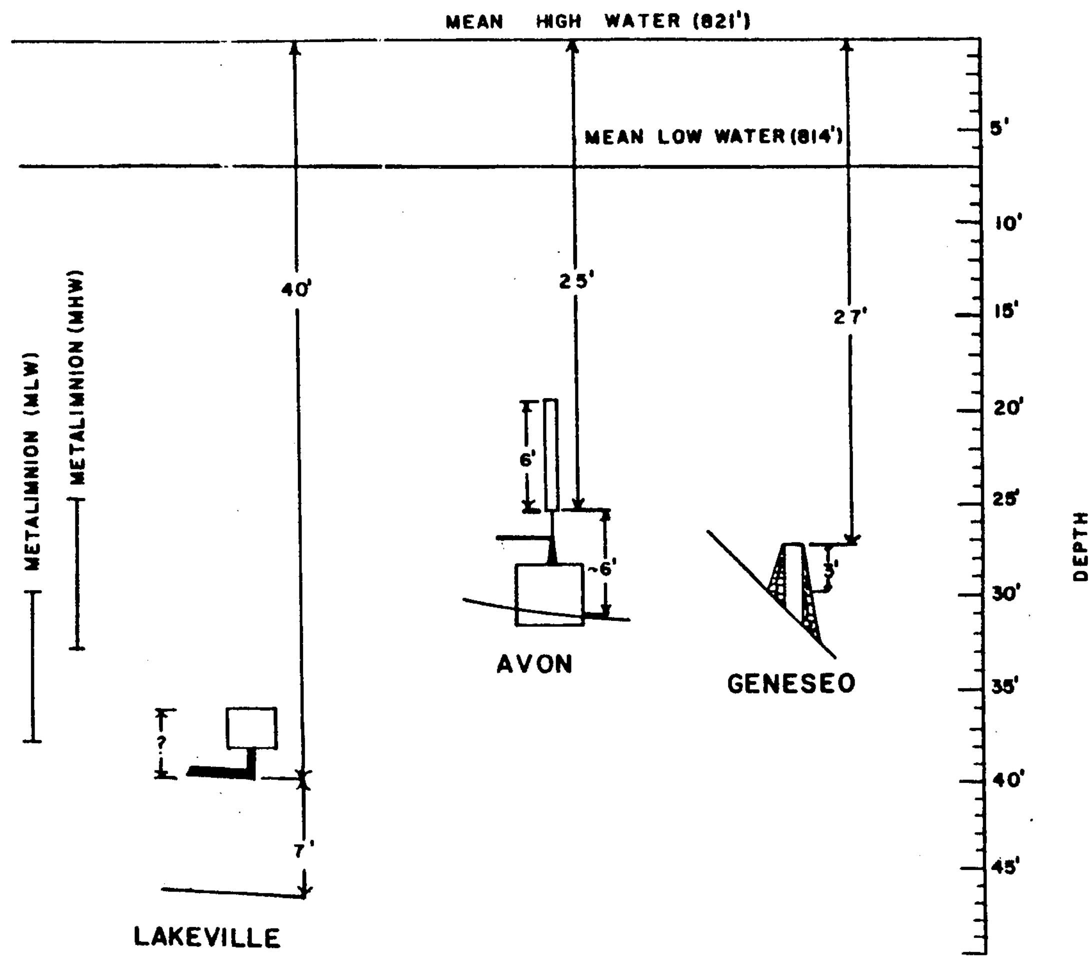

Figure 26. Location and design of lakeside intake structures of the Avon, Geneseo and Lakeville Water Treatment Plants.

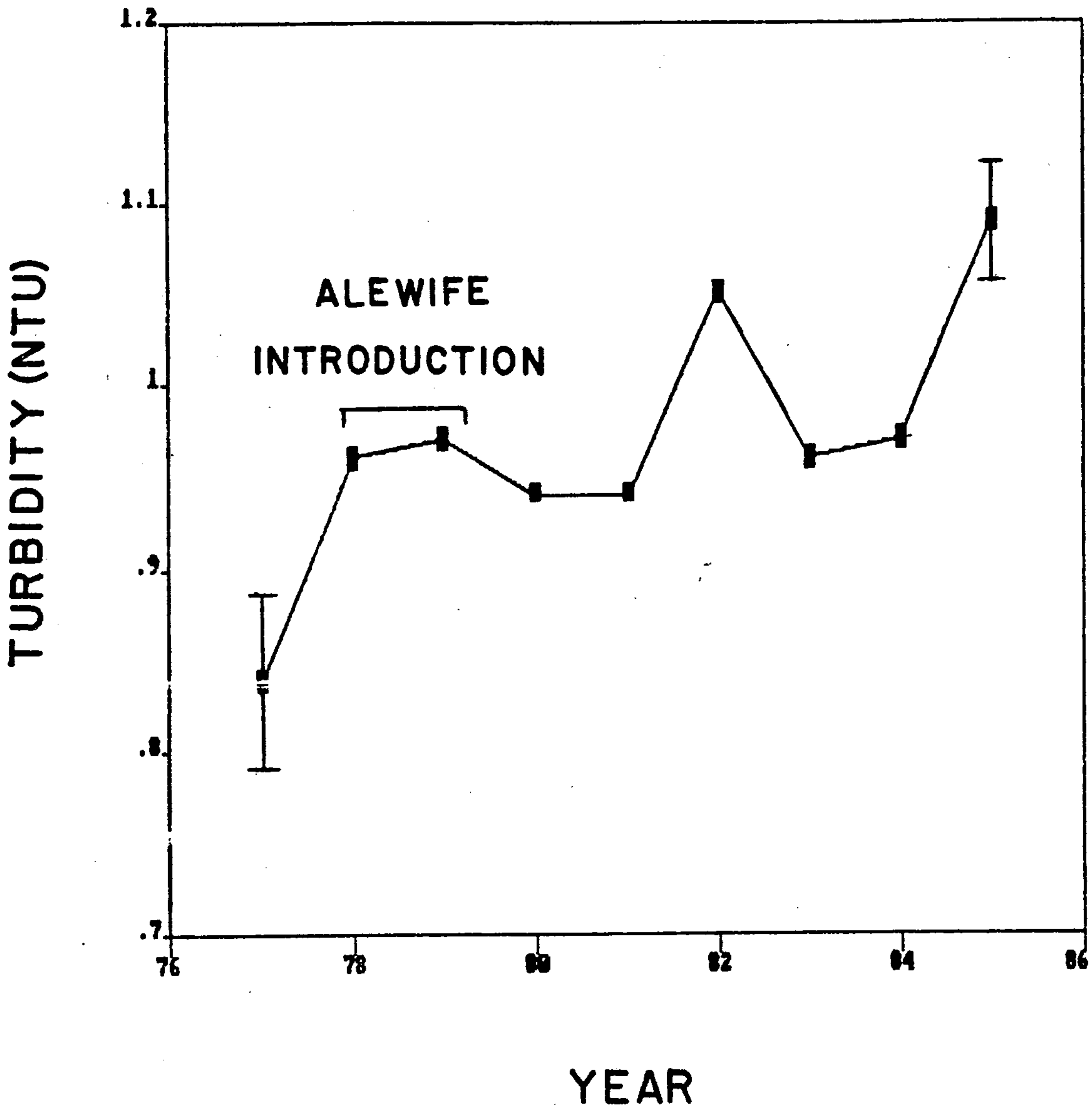

Figure 27. Mean annual daily turbidity for Conesus Lake, 1977-1985. Data are from the Avon Water Treatment Plant. The 1985 value is significantly greater (P>.001) than the 1977 value.