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**LAKE VARIATION AND CLIMATE CHANGE STUDY:
ELA LAKES, 1986-1990.**

**VI. PHYTOPLANKTON PHOTOSYNTHESIS, NUTRIENT
STATUS, AND BIOMASS ENUMERATION DATA**

by

L.L. Hendzel, D.L. Findlay, E.U. Schindler and P. Campbell

Central and Arctic Region
Department of Fisheries and Oceans
Winnipeg, Manitoba R3T 2N6

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ABSTRACT

Hendzel, L.L., D.L. Findlay, E.U. Schindler, and P. Campbell. 1994. Lake variation and climate change study: ELA lakes, 1986-1990. VI. Phytoplankton photosynthesis, nutrient status, and biomass enumeration data. Can. Data Rep. Fish. Aquat. Sci. 948: iv + 56 p.

This is the sixth in a series of reports presenting data from 1986-1990 on the Lake Variation and Climate Change Study project at the Experimental Lakes Area (ELA). Phytoplankton photosynthesis, nutrient status and biomass enumeration methodologies are documented and data are reported.

Key words: Biomass; nutrient status; photosynthesis; phytoplankton.

RÉSUMÉ

Hendzel, L.L., D.L. Findlay, E.U. Schindler, and P. Campbell. 1994. Lake variation and climate change study: ELA lakes, 1986-1990. VI. Phytoplankton photosynthesis, nutrient status, and biomass enumeration data. Can. Data Rep. Fish. Aquat. Sci. 948: iv + 56 p.

Sixième d'une série de rapports présentant les données recueillies entre 1986 et 1990 lors de l'étude sur la variation des lacs et le changement climatique, étude qui a été menée dans la Région des Lacs Expérimentaux. On y explique les méthodes utilisées pour mesurer le taux de photosynthèse, l'état nutritif et la biomasse du phytoplancton, et on y présente les données pertinentes.

Mots-clés: Biomasse; état nutritif; photosynthèse; phytoplancton.

INTRODUCTION

Phytoplankton photosynthesis, nutrient status and biomass analysis according to taxa are an integral part of the Lake Variation and Climate Change Study (Campbell 1993). Inherent differences between slow versus fast flushing systems including the relative influences of external and internal processes are being examined. And, spatial and temporal variation in lake limnology are being addressed. The study lakes are small (A_0 's = 16-29 ha), having similar geology/geography and subject to the same weather. They vary in 1) water renewal times, 2) morphometry (lake depth), and 3) drainage types (terrestrial versus lake predominated). For a complete description of the study area and the lakes involved see McCullough and Campbell (1993).

Phytoplankton production, nutrient status and population estimates have traditionally been an important part of the Experimental Lakes Area (ELA) program. This Data Report incorporates three separate data sets all describing related parameters of the same trophic level for the initial phase of the Lake Variation and Climate Change Study (1986-1990). Mean epilimnetic and metalimnetic phytoplankton biomass is enumerated by major taxa. Seasonal epilimnetic and photic zone photosynthesis, and seasonal epilimnetic and metalimnetic nutrient status parameters are presented. Included in tabular form are physical data relevant to the study and annual summaries for mean seasonal biomasses, photosynthesis rates and nutrient status parameters.

METHODS

FIELD SAMPLING

The study lakes are within easy access of the ELA field laboratory. They were sampled every two weeks during the open-water period (nutrient status data includes one sampling period when ice-covered) from 1986-1990. All lakes were normally sampled between 08:00 and 11:30 h at or close to the lake's point of maximum depth (Fig. 1 and Table 1).

Water samples were taken from the epilimnion of all lakes for each of the study years. In 1990, samples were also taken from the metalimnion of lakes which thermally stratify (lakes 164, 373, 377, 442). Phytoplankton photosynthesis

was measured on the epilimnion samples while nutrient status and taxonomy and biomass were measured on both epilimnion and metalimnion samples. Particulate chemistry samples were collected from both strata. The criteria which defined epilimnion and metalimnion were arrived at by analysis of the temperature and light extinction data for a particular lake on the day of sampling. The depth of the epilimnion (surface mixed layer) was set at the top of the "first meter interval" which exhibited a temperature change greater than one degree Celsius. The metalimnion continued from the lower boundary of the epilimnion down to the depth where 0.5% surface illumination occurred, which was usually below the thermocline. All photosynthesis, nutrient status and species data are also expressed areally (per meter²) for the photic zone of each lake, which is defined as the interval from the surface down to the depth where 1% light occurred, as measured at centre buoy; these results were obtained by multiplying the surface volumetric value by the photic zone depth. In some cases the photic zone was equal to the maximum depth of the lake.

Temperature and light were measured at depth intervals of 1 m or less using various meter/sensor combinations as described by Cruikshank et al. (1993).

Epilimnion and metalimnion water samples were collected with an integrating sampler (Shearer 1978). Briefly, the sampler consists of a 2.5 L glass bottle encased in a sleeve of PVC plastic, a rubber stopper with two silicone tubes passing through (one tube extending to the bottom of the bottle, the other tube allowing air to escape as the bottle fills with water), and an epoxy-coated weight heavy enough to sink an empty bottle. An integrated sample was collected by raising and lowering the sampler within the stratum until all air bubbles no longer appeared at the surface. The bottle was removed, capped and kept in the dark. All sampler tubing was handled and stored in such a way as to avoid contamination. Normally, samples arrived at the ELA laboratory in less than 2 h from the time of sampling.

PHYTOPLANKTON BIOMASS ANALYSIS

A 125 mL aliquot was extracted and preserved in acid Lugol's solution for archiving,

identifying and enumerating phytoplankton. Ten mL aliquots of Lugol's preserved samples were gravity settled for 24 h. Counts were performed on an inverted microscope at magnifications of 125X, 400X and 1000X (oil) with phase contrast illumination. All counts were done by the Utermohl technique as modified by Nauwerck (1963).

Cell density for each species was converted to wet weight biomass by measuring individual cells of each species, applying the geometric formula best fitted to the cell shape (Vollenweider 1968), and assuming a specific gravity of 1 for the cellular mass. Cell sizes were measured frequently and averages were calculated from up to 50 individuals of each species. This report will only include phytoplankton counts for 1990; samples for the years 1986-1989 have been preserved and archived but have not otherwise been processed or analyzed.

PHYTOPLANKTON PHOTOSYNTHESIS METHODOLOGY

Samples were processed soon after delivery to the laboratory and under low light conditions to avoid light shock. Subsamples taken from each 2.5 L lake sample include six pairs of 60 mL incubator samples, a 60 mL sample for determining dissolved inorganic carbon (DIC), and a sample for determining chlorophyll *a*. All bottles used for the subsamples were Pyrex with ground glass stoppers. Chlorophyll *a* concentration was determined using a methanol extraction method (Stainton et al. 1977). DIC was determined using an infra-red gas analyzer (Herczeg and Hesslein 1984).

The ^{14}C method was used for determining phytoplankton photosynthesis rates. Laboratory procedures follow Shearer et al. (1985) except that a single aliquot of inorganic ^{14}C (from 1986-1989 the activity was approximately $7.4 \times 10^5 \text{ Bq mL}^{-1} = 20 \mu\text{Ci mL}^{-1}$ and in 1990 the activity was approximately $1.48 \times 10^6 \text{ Bq mL}^{-1} = 40 \mu\text{Ci mL}^{-1}$) was added to a 1 L subsample which was mixed and then siphoned into the incubator bottles. The new method reduces intra-bottle variance by eliminating pipetting errors. The bottles were placed on five separate sample wheels of the light incubator. The sixth pair were the darkened bottles and were placed in the end of the incubator furthest away from the light source. A single 400 Watt metal halide lamp and a

parabolic reflector was the light source of the incubator. The samples were incubated at *in situ* temperature ($\pm 1^\circ\text{C}$) for three hours. During the incubation process, the light levels in the incubator were measured with a Biospherical QSP-200 spherical quantum sensor. Post-incubation processing and calculation of photosynthesis rates have been described in Shearer et al. (1985). A computer program (Fee 1990) was used to calculate annual phytoplankton photosynthesis rates. The program produces estimates both per square meter of lake surface (areal) and per cubic meter (volumetric) of the photic zone. Volumetric rates are morphometrically corrected for each lake.

PHYTOPLANKTON NUTRIENT DEFICIENCY INDICATORS

In 1989, nutrient deficiency assays were done on epilimnetic water samples four times during the course of the summer (April 20, May 31, July 3 and August 9). Water samples were returned to the field lab in acid-washed, opaque, 1 L Nalgene bottles that were kept in the dark at ambient water temperatures. Subsequent analyses were initiated immediately. In 1990, epilimnetic nutrient status assays were performed on 10 occasions from May until October and the metalimnia of the four deeper stratified lakes were also analyzed. The epilimnetic samples used for nutrient status measurements were decanted into acid-washed 1 L opaque Nalgene bottles from the 2.5 L epilimnetic water sample also used for ^{14}C uptake and species enumeration. However, the metalimnion samples also collected with the integrating sampler were transferred into acid-washed 2 L opaque bottles in the field. As in 1989, all measurements were started immediately upon return from the field. Epilimnetic suspended particulate carbon, nitrogen, and phosphorus and chlorophyll *a* data (excluding those samples for July 3, 1989 which were from the metalimnion water sample) were derived from samples collected for the water chemistry component of the study while the metalimnion suspended particulate C, N, P and chlorophyll *a* samples and nutrient status measurements, which were subsamples of the same metalimnion water sample, were collected separately. The particulate samples were filtered onto 47 mm diameter Whatman G/F/C glass fibre filters preignited at 500°C . Volumes filtered were 200-400 mL for each of the suspended C, N and P samples, and 250-800 mL for the chlorophyll *a*

sample. Suspended P samples were stored frozen (-10°C) in acid-washed glass vials while the suspended C, N, and chlorophyll samples were stored frozen (-10°C) in clean plastic petri dishes. Blanks for suspended C, N, and P were prepared using the corresponding filters. These metalimnion samples were analyzed with the methods of Stainton et al. (1977).

Phytoplankton nutrient status was assayed using both the ratios of nutrients in seston and physiological rate assays (alkaline phosphatase and nitrogen debt). Assessments of these data are based on observations of laboratory and natural mixed populations (Table 4).

Epilimnetic and metalimnetic seston composition ratios were calculated on an atom:atom basis (i.e. mol·mol⁻¹) for C:P, C:N, N:P and an atom:weight basis (mol·g⁻¹) for C:Chl *a*.

Alkaline phosphatase activity (APA), a physiological indicator of phosphorus deficiency, was measured using the fluorometric method described by Healey and Hendzel (1979, 1980). Fluorometer tubes were removed from the water bath at intervals of 5-15 min over a period of 30-90 min, wiped dry, and mixed by inverting. Then the fluorescence was measured and compared to that of the control before returning the tube to the waterbath. This was then repeated with the next sample. On occasions when fluorescence exceeded the range of the instrument (Turner model 111), a 10% or 1% neutral density filter was added on top of the secondary filter. Phosphatase activity was calculated based on rates measured during the first 30-60 min and converted to absolute units of o-methylfluorescein phosphate (O-MFP) by linear regression as a function of time. Alkaline phosphatase activity was measured on particulate and soluble fractions for every lake water sample. The whole water activity was the sum of these two fractions. Activity associated with the cellular fraction was derived by subtracting the soluble activity (that fraction dissolved in the lake water which passes through a 47 mm, 0.45 m Millipore filter) from the total activity. Activities are reported in mol O-MFP hydrolysed per hour per unit of chlorophyll *a*.

Nitrogen debt is defined as the amount of ammonium taken up in the dark during a 24 h period (Healey 1977); it was measured on whole lake water samples following the method of Solorzano (1969). The assay was started by

adding 0.5 mL of 1.0 mM NH₄Cl to 100 mL of lake water in a 250 mL acid-washed flask which was then mixed well. An adjustable pipette was used to transfer three 10 mL aliquots into three acid-washed test tubes at the beginning and end of the 24 h dark incubation period. Blanks were 10 mL of deionized-distilled water. Standards, over a range of 1-10 µM, were prepared by diluting a stock solution of 10 µM NH₄Cl to 10 mL with deionized, distilled water. To each 10 mL sample were added, in sequence, the following reagents with complete vortexing between each addition: 1) 0.4 mL phenol-alcohol solution (10 g phenol dissolved in 100 mL of 95% EtOH); 2) 0.4 mL of 0.5% sodium nitroprusside (0.25 g Na-Nitroprusside dissolved in 50 mL of distilled water and stored in a dark bottle for less than 1 month); 3) 1.0 mL of oxidizing solution (prepared fresh by combining 20 mL of alkaline solution [20 g of Sodium Citrate plus 1.0 g of NaOH in 100 mL of distilled water] and 5.0 mL of sodium hypochlorite solution [Javex, which is kept refrigerated]). Samples were left at room temperature in a clean, dark place for 2 h. The OD₆₄₀ was then measured against the blanks using a Spectronic 100 spectrophotometer (Bausch and Lomb). N debt rates were calculated by linear regression against the standards; rates were normalized per unit of chlorophyll *a* for the 24 h period.

RESULTS

PHYTOPLANKTON BIOMASS (APPENDIX 1)

Unstratified lakes

During the open water season of 1990, total phytoplankton biomass was higher in slow-flushing lake 149 (=2000 mg·m⁻³) than in fast flushing lakes 165 or 938 (Fig. A1.a, Table A1.a).

Chrysophytes were generally dominant in the shallow lakes during the 1990 ice-free season. Dinoflagellates were also extremely abundant in lakes 149 and 165; they were dominant in Lake 149 during mid-summer and in Lake 165 late spring and late summer. Diatoms were the most abundant group in Lake 165 in the late fall (Table A1.a).

Stratified lakes

Average epilimnetic phytoplankton biomass in 1990 for lakes 164, 373, 377 and 442 ranged

from 270 to 605 mg·m⁻³. A seasonal pattern which included three peaks was usually apparent. Monthly maximum epilimnetic biomass was observed in May, shortly after ice-out, with secondary peaks evident in mid-summer and early fall. Average metalimnetic biomass for these lakes ranged from 500-830 mg·m⁻³ over the season. Lake 164, the shallowest and fastest flushing of the stratified lakes, had the highest epilimnetic and metalimnetic total biomasses.

The epilimnetic and metalimnetic phytoplankton assemblages in lakes 373, 377 and 442 were dominated by chrysophytes with large mid-summer peaks of cyanophytes (Figs. A1.b, A1.c, A1.d and A1.e). Diatoms, cryptophytes, and dinoflagellates were also significant. The seasonal epilimnetic and metalimnetic phytoplankton compositional pattern depicted for lakes 373, 377 and 442 during 1990 is similar to the long term (1983-1987) pattern from Lake 373. Lake 164 was dominated by chrysophytes but differed from the deeper stratified lakes in that secondary dominants were dinoflagellates, rather than cyanophytes.

PHYTOPLANKTON PHOTOSYNTHESIS (APPENDIX 2)

Phytoplankton photosynthesis volumetric rates (per m³) (Figs. A2.a, A2.b, A2.c, Table A2.a) were lowest in deep Lake 373 and the highest in shallow, unstratified lakes 149 and 938. All other lakes were similar. Areal rates (per m²) (Figs. A2.d, A2.e, A2.f, Table A2.b) were the highest in shallow lakes 938 and 149, followed by deep, stratified Lake 442. Brownwater lakes 164 and 165, also shallow and unstratified, were the least productive (Figs. A2.d, A2.e, Table A2.b). Photosynthesis rates tended to increase in Lake 373 (Fig. A2.f) over the years 1987-1990 whereas all of the other lakes decreased or remained about the same during this period.

Highest rates of photosynthesis were measured in all lakes during the mid-summer portion of the open water season and then decreased into the fall. In lakes 164 and 165, a spring pulse was followed by a decrease, then by an increase to mid-summer, and then decreased through the fall. A similar pattern was measured in Lake 377 in 1989 and 1990. Some high rates were also measured at the time of ice-out in the spring.

PHYTOPLANKTON NUTRIENT DEFICIENCY INDICATOR (APPENDIX 3)

Chlorophyll *a* concentrations (Fig. A3.a, Table A3.a) were generally lower in 1989 than 1990. The shallow lakes (149, 164, 165, 938) all have higher mean seasonal values for 1990 while the deeper lakes (373, 377, 442) are more similar over this same time period. The deep, stratified lakes (373, 377, 442) always had lower chlorophyll *a* values than the shallow, unstratified lakes. In most cases, early spring chlorophyll concentrations were higher in 1990 than 1989 except in two of the shallow, fast flushing lakes (165 and 938). Metalimnion chlorophyll *a* values were higher than those of the epilimnion for the same sampling period.

C:Chla ratios (Fig. A3.d), a non-specific indicator of nutrient deficiency, indicate that, except for some early spring and late fall values in 1990, the phytoplankton of all lakes were nutrient deficient. Ratios for most of the summer were greater than 8.3, indicating severe nutrient deficiency. In contrast, metalimnion values were consistently lower during the same period of time, indicating less nutrient stress. Seasonal means (Table A3.a) were generally higher for the deeper lakes and greater in the epilimnion than the metalimnion in the stratified lakes.

Ratios of C:P and N:P (Fig. A3.e, A3.f, respectively), both used as indicators of phosphorus deficiency, indicated moderate to severe phosphorus deficiency for 1989 and 1990. Metalimnetic ratios of N:P were less variable than epilimnetic values and, in general, C:P and N:P were somewhat lower, indicating less phosphorus deficiency (except in Lake 377 in 1990).

Particulate alkaline phosphatase values (Fig. A3.c) in 1989 were indicative of severe phosphorus deficiency, particularly prior to ice-out for several lakes. Alkaline phosphatase in 1990 rarely reached the extremes of 1989. While all lakes were severely phosphorus deficient, the shallower and humic lakes were less phosphorus deficient than the deeper, stratified lakes (373, 377 and 442). Metalimnion alkaline phosphatase values were approximately 50% less than those of the epilimnion in 1990. Seasonal means (Table 3.a) reflected these differences between the shallow and deep lakes and the epi- and metalimnion samples.

The ratios of C:N (Fig. A3.g), an indicator of nitrogen deficiency, were very similar for all lakes in 1989, indicating moderate to occasional severe nitrogen deficiency. In 1990, C:N ratios increased with time in all lakes and the deeper lakes were severely nitrogen deficient by late summer. Metalimnion phytoplankton was moderately nitrogen deficient through this period. The 1990 seasonal means (Table A3.a) for lakes 373 and 377 were marginally higher than the other lakes.

Nitrogen debt (Fig. A3.b) remained low and variable for all lakes for 1989 and 1990, including the metalimnetic values in the deeper lakes. However, the deeper lakes, particularly 373, 377 and 442, had nitrogen debt values during the summer which were indicative of severe nitrogen deficiency. Seasonal mean values (Table A3.a) were greater for the deeper, stratified lakes for both years where nitrogen debt was found to be higher in the epilimnion than the metalimnion.

SUMMARY

Summarized phytoplankton biomasses by major taxonomic groups, phytoplankton photosynthesis, and phytoplankton nutrient status are presented in Tables 5, 6 and 7, respectively. Phytoplankton photosynthesis is summarized for each lake and for each year. Rates were highest in shallow lakes 149 and 938, and lowest in brownwater lakes (164 and 165); deep, blue, stratified lakes (373, 377 and 442) were intermediate. Yearly trends between lakes were variable.

In the unstratified lakes, phytoplankton biomass was highest in lake 149 ($>2000 \text{ mg} \cdot \text{m}^{-3}$). Chrysophytes were dominant in all of the lakes. Epilimnetic and metalimnetic biomass in the deep lakes ranged from $330\text{-}830 \text{ mg} \cdot \text{m}^{-3}$, with Lake 164 having the highest epilimnetic and metalimnetic biomasses. Some of the deep lakes (373, 377 and 442) had significant mid-summer peaks of cyanophytes while in Lake 164 dinoflagellates were important.

Phytoplankton nutrient status of the study lakes would be described as being severely phosphorus deficient. The deep, stratified lakes were more P deficient than the shallow, faster flushing lakes. The metalimnia were less nutrient deficient than the epilimnia of the stratified lakes. In addition to being severely P deficient, lakes

373 and 377 exhibited signs of significant N deficiency, particularly in mid to late summer. The shallow lakes were less N deficient.

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REFERENCES

- Campbell, P. 1993. Lake variation and climate change study: ELA lakes, 1986-1990. I. Study rationale and lake selection criteria. Can. Tech. Rep. Fish. Aquat. Sci. 1897: iv + 5 p.
- Cruikshank, D.R., P. Campbell, S.E.M. Kasian, E.U. Schindler, and G.K. McCullough. 1993. Lake variation and climate change study: ELA lakes, 1986-1990. II. Field observations, hydrological, light, and temperature measurements. Can. Data Rep. Fish. Aquat. Sci.
- Fee, E.J. 1990. Computer programs for calculating *in situ* phytoplankton photosynthesis. Can. Tech. Rep. Fish. Aquat. Sci. 1740: v + 27 p.
- Fee, E.J., R.E. Hecky, M.P. Stainton, P. Sandberg, L.L. Hendzel, S.J. Guildford, H.J. Kling, G.K. McCullough, C. Anema, and A. Salki. 1989. Lake variability and climate research in northwestern Ontario: Study design and 1985-1986 data from the Red Lake District. Can. Tech. Rep. Fish. Aquat. Sci. 1662: v + 39 p.
- Healey, F.P. 1975. Physiological indicators of nutrient deficiency in algae. Can. Fish. Mar. Serv. Tech. Rep. 585: 30 p.
- Healey, F.P. 1977. Ammonium and urea uptake by some freshwater algae. Can. J. Bot. 55: 61-69.
- Healey, F.P., and L.L. Hendzel. 1979. Fluorometric measurement of alkaline

- phosphatase activity in algae. Freshwat. Biol. 9: 429-439.
- Healey, F.P., and L.L. Hendzel. 1980. Physiological indicators of nutrient deficiency in lake phytoplankton. Can. J. Fish. Aquat. Sci. 37: 442-453.
- Herczeg, A.L., and R.H. Hesslein. 1984. Determination of hydrogen ion concentration in softwater lakes using carbon dioxide equilibria. Geochim. Cosmochim. Acta 48: 837-845.
- McCullough, G.K., and P. Campbell. 1993. Lake variation and climate change study: ELA lakes, 1986-1990. II. Watershed geography and lake morphology. Can. Tech. Rep. Fish. Aquat. Sci. 1898: iv + 29 p.
- Nauwerck, A. 1963. Die beziehungen zwischen zooplankton und phytoplankton in see rken. Symb. Bot. Ups. 17(5): 163 p.
- Shearer, J.A. 1978. Two devices for obtaining water samples integrated over depth. Can. Fish. Mar. Serv. Tech. Rep. 772: iv + 9 p.
- Shearer, J.A., E.R. DeBruyn, D.R. DeClercq, D.W. Schindler, and E.J. Fee. 1985. Manual of phytoplankton primary production methodology. Can. Tech. Rep. Fish. Aquat. Sci. 1341: iv + 58 p.
- Solorzano, L. 1969. Determination of ammonium in natural waters by the phenolhypochlorite method. Limnol. Oceanogr. 14: 799-801.
- Stainton, M.P., M.J. Capel, and F.A.J. Armstrong. 1977. The chemical analysis of freshwater. 2nd ed. Can. Fish. Mar. Serv. Misc. Spec. Publ. 25: 180 p.
- Vollenweider, R.A. 1968. Scientific fundamentals of the eutrophication of lakes and flowing waters, with particular reference to nitrogen and phosphorus as factors in eutrophication. Tech. Rep. O.E.C.D. Paris Das/CSI/68.27: 1-182.

Table 1. Area and volume with depth for each of the seven ELA Lake Variation and Climate Change Study lakes.

Lake 149			Lake 165			Lake 938			Lake 164		
Depth (m)	Area (ha)	Volume 10 · m³									
0.00	26.90		0.00	18.40		0.00	19.20		0.00	20.30	
1.00	20.90	2.39	1.00	16.70	1.75	1.00	17.90	1.85	1.00	18.80	1.96
1.50	16.50	0.93	1.50	15.70	0.81	1.50	16.80	0.87	1.50	17.40	0.90
2.00	12.10	0.71	2.00	14.70	0.76	2.00	14.90	0.79	2.00	16.70	0.85
2.50	9.50	0.54	2.50	13.90	0.72	2.50	9.90	0.62	2.50	16.20	0.82
3.00	6.90	0.41	3.00	13.20	0.68	3.00	6.80	0.42	3.00	15.70	0.80
3.50	4.30	0.28	3.50	12.30	0.64	3.50	4.20	0.27	3.50	15.20	0.77
4.00	0.90	0.12	4.00	9.80	0.55	4.00	3.00	0.18	4.00	14.80	0.75
4.05	0.00	0.00	4.50	2.30	0.28	4.50	1.30	0.10	4.50	14.30	0.73
			4.55	0.00	0.00	5.00	0.50	0.05	5.00	13.60	0.70
						5.50	0.20	0.02	5.50	12.20	0.65
						6.00	0.00	0.00	6.00	9.90	0.55
						6.50			6.50	6.10	0.40
						7.00			7.00	0.60	0.14
						7.05			7.05	0.00	0.00

Lake 442			Lake 377			Lake 373		
Depth (m)	Area (ha)	Volume 10 · m³	Depth (m)	Area (ha)	Volume 10 · m³	Depth (m)	Area (ha)	Volume 10 · m³
0.00	16.00		0.00	26.90		0.00	27.30	
1.00	14.70	1.53	1.00	25.20	2.61	1.00	25.60	2.65
2.00	14.00	1.44	2.00	23.60	2.44	2.00	23.60	2.46
3.00	13.40	1.37	3.00	22.50	2.30	3.00	21.70	2.26
4.00	12.90	1.31	4.00	21.30	2.19	4.00	20.50	2.11
5.00	12.30	1.26	5.00	19.60	2.05	5.00	19.70	2.01
6.00	11.60	1.19	6.00	17.80	1.87	6.00	18.90	1.93
7.00	10.80	1.12	7.00	16.30	1.71	7.00	18.20	1.85
8.00	10.00	1.04	8.00	15.20	1.57	8.00	17.10	1.76
9.00	9.10	0.95	9.00	14.10	1.47	9.00	16.30	1.67
10.00	8.00	0.85	10.00	13.10	1.36	10.00	15.40	1.58
11.00	6.50	0.72	11.00	11.70	1.24	11.00	14.60	1.50
12.00	4.70	0.56	12.00	10.20	1.09	12.00	13.80	1.42
13.00	3.30	0.40	13.00	8.10	0.91	13.00	12.70	1.32
14.00	2.50	0.29	14.00	6.20	0.71	14.00	11.70	1.22
15.00	1.30	0.19	15.00	4.70	0.54	15.00	10.60	1.12
16.00	0.80	0.11	16.00	3.20	0.39	16.00	8.80	0.97
17.00	0.40	0.06	17.00	0.90	0.19	17.00	7.20	0.80
17.80	0.00	0.01	17.90	0.00	0.02	18.00	5.70	0.64
						19.00	3.50	0.45
						20.00	2.30	0.28
						20.75	0.00	0.09

Table 2. Seasonal depths (m) of the epilimnion (E) and metalimnion (M) of the ELA Lake Variation and Climate Study Lakes.

Date \ Lake	149E	164E	164M	165E	938E
May 13/87	0-4.0	0-4.0	-	0-4.5	0-5.5
May 27/87	0-4.0	-	-	0-2.0	0-5.5
Jun 10/87	0-3.0	0-3.0	-	0-2.0	0-5.5
Jun 24/87	0-3.0	0-2.0	-	0-2.0	0-2.0
Jul 08/87	0-2.0	0-1.0	-	0-1.0	0-3.0
Jul 22/87	0-4.0	-	-	0-4.5	0-5.5
Aug 05/87	0-4.0	0-3.0	-	0-2.0	0-5.5
Aug 19/87	0-4.0	0-4.0	-	0-3.0	0-5.5
Sep 02/87	0-4.0	0-5.0	-	0-4.5	0-5.5
Sep 16/87	0-1.0	0-5.0	-	0-4.5	0-5.5
Sep 30/87	0-4.0	0-7.0	-	0-4.5	0-5.5
Oct 14/87	0-4.0	0-7.0	-	0-4.5	0-5.5
Oct 29/87	-	0-7.0	-	0-4.5	0-5.5
May 18/88	0-4.0	0-3.0	-	0-3.0	0-5.5
Jun 01/88	0-2.0	0-1.0	-	0-1.0	0-1.0
Jun 15/88	0-4.0	0-3.0	-	0-2.0	0-3.0
Jun 29/88	0-4.0	0-3.0	-	0-3.0	0-5.5
Jul 13/88	0-4.0	0-3.0	-	0-3.0	0-5.5
Jul 27/88	0-4.0	0-3.0	-	0-2.0	0-4.0
Aug 10/88	0-4.0	0-3.0	-	0-3.0	0-5.5
Aug 24/88	0-4.0	0-3.0	-	0-4.5	0-5.5
Sep 07/88	0-4.0	0-4.0	-	0-4.5	0-5.5
Sep 21/88	0-4.0	0-7.0	-	0-4.5	0-5.5
Oct 05/88	0-4.0	0-7.0	-	0-4.5	0-5.5
Oct 19/88	0-4.0	0-7.0	-	0-4.5	0-5.5
Apr 17-18/89	ice	ice	-	ice	ice
May 17/89	0-3.0	0-2.0	-	0-3.0	0-0.5
May 31/89	0-3.0	0-2.0	-	0-4.5	0-5.5
Jun 14/89	0-4.0	0-4.0	-	0-2.0	0-5.5
Jun 28/89	0-3.0	-	-	0-2.0	0-5.5
Jul 12/89	0-3.0	0-2.0	-	0-2.0	0-5.5
Jul 26/89	0-2.0	0-2.0	-	0-3.0	0-4.0
Aug 09/89	0-3.0	0-3.0	-	0-3.0	0-5.5
Aug 23/89	0-4.0	0-3.0	-	0-2.0	0-5.5
Sep 06/89	0-4.0	0-3.0	-	0-4.5	0-5.5
Sep 20/89	-	-	-	-	-
Oct 04/89	-	-	-	-	-
Oct 18/89	0-3.5	0-6.0	-	0-4.5	0-5.5
Apr 10/90	ice	ice	-	ice	ice
May 08/90	0-3.0	0-6.0	-	0-4.0	0-5
May 22/90	0-3.0	0-2.0	2.0-5.0	0-2.0	0-4
Jun 05/90	0-3.0	0-4.0	4.0-5.0	0-3.0	0-5
Jun 19/90	0-4.0	0-3.0	3.0-6.0	0-3.0	0-4
Jul 03/90	0-2.0	0-2.0	2.0-5.0	0-1.0	0-4
Jul 17/90	0-3.0	0-2.0	2.0-5.0	0-2.0	0-5
Jul 31/90	0-4.0	0-3.0	3.0-5.0	0-3.0	0-5
Aug 14/90	0-4.0	0-3.0	3.0-5.0	0-3.0	0-5
Aug 28/90	0-3.0	0-2.0	2.0-5.0	0-2.0	0-5
Sep 11/90	0-3.5	0-4.0	4.0-5.0	0-3.0	0-5
Sep 25/90	0-3.0	0-6.0	-	0-3.0	0-5
Oct 09/90	0-3.0	0-4.0	-	0-3.0	0-4.5
Oct 23/90	0-3.0	0-5.5	-	0-3.0	0-4.5

Date \ Lake	373E	373M	377E	377M	442E	442M
May 06/87	0-7.0	-	0-5.0	-	0-3.0	-
May 20/87	0-7.0	-	0-5.0	-	0-4.0	-
Jun 01/87	0-4.0	-	0-4.0	-	0-2.0	-
Jun 17/87	0-3.0	-	0-3.0	-	0-2.0	-
Jul 01/87	-	-	0-4.0	-	-	-
Jul 15/87	0-6.0	-	0-4.0	-	0-4.0	-
Jul 29/87	0-6.0	-	0-4.0	-	0-3.0	-
Aug 12/87	0-7.0	-	0-5.0	-	0-4.0	-
Aug 26/87	0-8.0	-	0-6.0	-	0-5.0	-
Sep 16/87	0-9.0	-	0-7.0	-	0-6.0	-
Sep 30/87	0-10.0	-	0-7.0	-	0-7.0	-
Oct 14/87	0-14.0	-	0-10.0	-	0-10.0	-
Oct 29/87	0-20.5	-	0-18.0	-	0-18.0	-
May 11/88	0-5.0	-	0-2.0	-	0-4.0	-
May 25/88	0-5.0	-	0-3.0	-	0-3.0	-
Jun 08/88	0-3.0	-	0-2.0	-	0-2.0	-
Jun 22/88	0-4.0	-	0-3.0	-	0-3.0	-
Jul 06/88	0-5.0	-	0-4.0	-	0-3.0	-
Jul 20/88	0-6.0	-	0-4.0	-	0-4.0	-
Aug 03/88	0-6.0	-	0-4.0	-	0-4.0	-
Aug 17/88	0-6.0	-	0-4.0	-	0-4.0	-
Aug 31/88	0-8.0	-	0-6.0	-	0-6.0	-
Sep 07/88	0-8.0	-	0-6.0	-	0-6.0	-
Sep 21/88	0-10.0	-	0-7.0	-	0-7.0	-
Oct 05/88	0-12.0	-	0-9.0	-	0-9.0	-
Oct 19/88	0-13.0	-	0-9.0	-	0-10.0	-
Apr 18/89	ice	-	ice	-	ice	-
May 18/89	0-2.0	-	0-2.0	-	0-3.0	-
Jun 01/89	0-4.0	-	0-2.0	-	0-3.0	-
Jun 15/89	0-5.0	-	0-5.0	-	0-3.0	-
Jun 29/89	0-4.0	-	0-3.0	-	0-3.0	-
Jul 13/89	0-4.0	-	0-3.0	-	0-3.0	-
Jul 27/89	0-4.0	-	0-3.0	-	0-3.0	-
Aug 10/89	0-5.0	-	0-4.0	-	0-3.0	-
Aug 24/89	0-5.0	-	0-4.0	-	0-4.0	-
Sep 07/89	0-6.0	-	0-3.0	-	0-3.0	-
Oct 18/89	0-12.0	-	0-3.0	-	0-3.0	-
Apr 09/90	ice	-	ice	-	ice	-
May 09/90	0-8.0	8-10	0-6	6-9	0-5	5-7
May 23/90	0-6.0	6-13	0-2	6-9	0-2	2-9
Jun 06/90	0-5.0	5-15	0-4	4-12	0-4	4-9
Jun 20/90	0-4.0	4-16	0-3	3-12.5	0-3	3-11
Jul 04/90	0-4.0	4-15	0-3	3-11	0-3	3-11
Jul 18/90	0-5.0	5-15.5	0-4	4-11	0-3	3-11
Aug 01/90	0-6.0	6-15	0-4	4-11	0-4	4-11
Aug 15/90	0-6.0	6-17	0-4	4-11	0-4	4-11
Aug 29/90	0-7.0	7-16	0-4	4-11	0-4	4-10.5
Sep 12/90	0-7.0	7-16	0-5	5-12	0-5	5-11
Sep 26/90	0-9.0	9-16	0-7	7-10	0-6	6-10
Oct 10/90	0-12.0	12-15	0-9	9-11	0-8	8-10
Oct 23/90	0-20.0	-	0-12	-	0-10	-

Table 3. Depth of the photic zone (1% light transmittance) of the ELA Lake Variation and Climate Change Study lakes.
(nd = no data, emz = exceeds maximum depth of the lake).

Date Lake	149	164	165	938
May 13/87	nd	nd	nd	nd
May 27/87	emz	4.0	emz	emz
Jun 10/87	emz	nd	emz	emz
Jun 24/87	nd	5.5	nd	nd
Jul 08/87	emz	5.0	emz	emz
Jul 22/87	nd	4.0	nd	nd
Aug 05/87	emz	4.0	emz	emz
Aug 19/87	emz	6.0	emz	emz
Sep 02/87	emz	6.0	emz	emz
Sep 16/87	emz	6.0	emz	emz
Sep 30/87	emz	5.0	emz	emz
Oct 14/87	emz	5.0	emz	emz
Oct 29/87	nd	nd	nd	nd
May 18/88	emz	nd	emz	emz
Jun 01/88	emz	5.0	emz	emz
Jun 15/88	emz	6.0	emz	emz
Jun 29/88	emz	5.0	emz	emz
Jul 13/88	emz	5.0	emz	emz
Jul 27/88	emz	4.0	emz	emz
Aug 10/88	emz	4.0	emz	emz
Aug 24/88	emz	4.0	emz	emz
Sep 07/88	emz	4.0	emz	emz
Sep 21/88	nd	nd	nd	nd
Oct 05/88	emz	4.5	emz	emz
Oct 19/88	nd	4.0	nd	nd
Apr 17-18/89	ice	ice	ice	ice
May 17/89	emz	5.0	emz	emz
May 31/89	emz	5.5	emz	emz
Jun 14/89	nd	5.5	3.5	emz
Jun 28/89	emz	4.5	3.5	emz
Jul 12/89	nd	nd	3.5	emz
Jul 26/89	nd	nd	nd	nd
Aug 09/89	nd	3.0	emz	emz
Aug 23/89	emz	3.0	3.0	emz
Sep 06/89	nd	4.0	emz	emz
Sep 20/89	nd	nd	nd	nd
Oct 04/89	nd	nd	nd	nd
Oct 18/89	nd	nd	nd	nd
Apr 10/90	ice	ice	ice	ice
May 08/90	emz	5.0	4.0	emz
May 22/90	emz	5.5	emz	emz
Jun 05/90	emz	5.0	4.0	emz
Jun 19/90	emz	5.5	4.0	emz
Jul 03/90	emz	4.5	3.5	emz
Jul 17/90	emz	4.0	3.0	emz
Jul 31/90	emz	4.5	3.5	emz
Aug 14/90	emz	4.5	3.5	emz
Aug 28/90	emz	5.0	3.5	emz
Sep 11/90	emz	4.5	emz	emz
Sep 25/90	emz	3.5	4.0	emz
Oct 09/90	emz	4.0	3.5	emz
Oct 23/90	emz	4.5	emz	emz

Date Lake	373	377	442
May 06/87	nd	nd	nd
May 20/87	12.0	10.0	7.0
Jun 01/87	14.0	9.0	8.0
Jun 17/87	nd	9.0	nd
Jul 01/87	16.0	nd	10.0
Jul 15/87	13.0	12.0	8.0
Jul 29/87	9.5	9.0	nd
Aug 12/87	16.0	11.0	10.0
Aug 26/87	18.0	9.0	9.0
Sep 16/87	15.5	10.0	10.0
Sep 30/87	15.0	10.0	8.0
Oct 14/87	nd	nd	6.0
Oct 29/87	12.0	7.0	6.0
May 11/88	13.0	9.5	9.0
May 25/88	13.0	nd	8.0
Jun 08/88	15.0	10.0	9.0
Jun 22/88	16.0	9.0	9.0
Jul 06/88	16.0	nd	6.0
Jul 20/88	15.0	9.0	9.0
Aug 03/88	14.0	9.0	10.0
Aug 17/88	15.0	9.0	12.0
Aug 31/88	15.0	9.0	11.0
Sep 07/88	14.0	9.0	10.0
Sep 21/88	14.0	11.0	10.0
Oct 05/88	15.0	9.5	10.0
Oct 19/88	nd	nd	nd
Apr 18/89	ice	ice	ice
May 18/89	14.0	9.0	7.0
Jun 01/89	12.5	9.0	6.0
Jun 15/89	14.0	9.5	9.0
Jun 29/89	14.0	10.0	nd
Jul 13/89	13.5	8.0	9.0
Jul 27/89	14.5	10.0	10.0
Aug 10/89	14.0	8.5	9.0
Aug 24/89	nd	7.0	nd
Sep 07/89	nd	nd	nd
Oct 18/89	nd	nd	nd
Apr 09/90	ice	ice	ice
May 09/90	12.0	8.0	9.0
May 23/90	12.0	8.5	7.0
Jun 06/90	13.0	11.0	9.0
Jun 20/90	14.0	11.5	10.0
Jul 04/90	15.0	10.0	11.0
Jul 18/90	15.0	9.0	10.0
Aug 01/90	15.0	10.0	10.0
Aug 15/90	16.0	10.0	10.0
Aug 29/90	15.0	9.0	10.0
Sep 12/90	16.0	11.0	11.0
Sep 26/90	16.0	9.5	9.0
Oct 10/90	14.0	9.5	8.0
Oct 24/90	13.0	11.0	7.5

Table 4. Algal nutrient deficiency indicators. The range of values for each indicator that are associated with the different degrees of nutrient deficiency are derived from the results of laboratory chemostat experiments; this table summarizes values from the literature (Healey and Hendzel, 1979, 1980).

Ratio	Units	Type of Deficiency	Degree of deficiency		
			none	moderate	severe
Susp C:Susp N	$\mu\text{mol}\cdot\mu\text{mol}^{-1}$	Nitrogen	<8.3	8.3-14.6	>14.6
Susp C:Susp P	$\mu\text{mol}\cdot\mu\text{mol}^{-1}$	Phosphorus	<129	129-258	>258
Susp N:Susp P	$\mu\text{mol}\cdot\mu\text{mol}^{-1}$	Phosphorus	<22		>22
Susp C:Chl a	$\mu\text{mol}\cdot\mu\text{g}^{-1}$	General	<4.2	4.2-8.3	>8.3
APA:Chl a	$\mu\text{mol P}\cdot\text{h}^{-1}\cdot\mu\text{g Chl a}^{-1}$	Phosphorus	<0.003	0.003-0.005	>0.005
NDebt:Chl a	$\mu\text{mol N}\cdot\text{h}^{-1}\cdot\mu\text{g Chl a}^{-1}$	Nitrogen	<0.15		>0.15

Table 5. Summary of epilimnetic and metalimnetic mean ice-free season volumetric phytoplankton biomasses for the seven main taxonomic groupings and total, whole-lake biomass (volumetric and areal) for 1990 including lake 373 for 1983-1987.

Lake	Year	Layer	Cyanophyte mg/m³	Chlorophyte mg/m³	Euglenophyte mg/m³	Chrysophyte mg/m³	Diatom mg/m³	Cryptophyte mg/m³	Dinophyte mg/m³	Total mg/m³	Total mg/m²
149	1990	EPI	37.9	19.8	0.3	1261.5	55.6	58.4	618.2	2051.7	8207.0
164	1990	EPI	9.5	14.7	1.3	325.5	40.9	102.9	109.5	604.4	2842.3
165	1990	EPI	11.2	17.5	2.2	309.8	111.0	88.5	157.5	697.8	2718.4
373	1990	EPI	29.0	12.4	0.0	155.9	17.0	24.2	32.9	271.5	3740.7
377	1990	EPI	39.2	13.5	0.2	162.2	36.9	40.4	43.1	335.6	3209.6
442	1990	EPI	156.3	25.8	0.2	183.7	26.5	67.8	53.2	513.6	4747.9
938	1990	EPI	10.8	30.1	0.6	462.0	43.6	39.6	88.9	676.0	3718.3
164	1990	META	98.1	22.1	3.7	439.3	17.5	55.9	197.1	833.7	-
373	1990	META	43.9	27.7	0.0	318.8	22.4	41.8	40.4	495.0	-
377	1990	META	38.2	11.9	3.0	341.4	73.1	45.5	41.3	554.4	-
442	1990	META	120.4	27.1	0.8	314.5	24.1	97.6	47.1	631.6	-
373	1983	EPI	13.2	25.5	0.0	221.7	23.8	23.0	79.8	386.9	5906.2
373	1984	EPI	40.0	34.5	0.3	208.5	23.2	18.9	71.0	396.4	5728.2
373	1985	EPI	17.2	92.2	0.0	155.5	34.6	28.6	31.9	359.9	4783.9
373	1986	EPI	37.2	23.4	0.1	175.0	25.8	17.6	69.5	384.7	4468.4
373	1987	EPI	32.5	47.8	0.1	138.0	23.4	20.1	42.9	304.8	4013.9
373	1983	META	7.9	53.8	0.1	247.7	28.8	52.6	113.8	504.8	-
373	1984	META	35.3	70.9	0.0	378.8	62.3	62.8	77.9	688.0	-
373	1985	META	23.4	70.2	0.3	149.1	38.5	56.8	68.5	406.7	-
11	373	META	44.5	80.9	0.3	240.1	39.9	60.8	61.9	528.4	-
373	1987	META	31.9	106.6	0.0	234.2	65.2	56.2	82.6	576.9	-

Table 6. Summary of total open water photic zone phytoplankton photosynthesis rates (g C·m⁻³ and g C·m⁻²) for 1987-1990 including Lake 373 for 1983-1986.
Corrected for morphometry.

	phytoplankton photosynthesis (g C·m ⁻³)						
	L149	L164	L165	L373	L377	L442	L938
1983	ns	ns	ns	1.9	ns	ns	ns
1984	ns	ns	ns	3.3	ns	ns	ns
1985	ns	ns	ns	3.1	ns	ns	ns
1986	ns	ns	ns	1.5	ns	ns	ns
1987	13.2	3.0	3.2	2.3	2.2	3.0	9.4
1988	15.6	4.3	4.8	2.4	2.2	3.0	13.3
1989	10.5	3.2	3.9	1.6	2.4	2.8	7.5
1990	12.9	3.5	4.5	2.5	2.8	3.2	10.0

Year	phytoplankton photosynthesis (g C·m ⁻²)						
Year	L149	L164	L165	L373	L377	L442	L938
1983	ns	ns	ns	20.2	ns	ns	ns
1984	ns	ns	ns	35.1	ns	ns	ns
1985	ns	ns	ns	32.7	ns	ns	ns
1986	ns	ns	ns	16.3	ns	ns	ns
1987	26.4	12.3	10.8	25.2	18.8	25.4	25.4
1988	31.3	21.1	16.2	26.3	20.1	26.8	35.9
1989	21.2	16.1	13.2	16.5	19.8	24.6	20.2
1990	25.9	17.5	15.3	27.0	24.0	26.8	27.0

Table 7. Summary of volumetric and areal seasonal means of phytoplankton nutrient status parameters. Volumetric alkaline phosphatase data expressed as total (T), soluble (S), and cellular (C) rates.

Lake	Year	Layer	Susp N µM/L	Susp C µM/L	Susp P µM/L	Chla µg/L	C/Chl µM/µg	C/N µM/µM	N/P µM/µM	C/P µM/µM	N Debt µM/µg Chl/24hr	A-Pase(T) µMPi/hr	A-Pase(S) µMPi/hr	A-Pase(C) µMPi/µg Chla/hr
149	1989	EPI	7.0	77.5	0.2	2.9	51.0	11.0	31.2	353.8	-0.7	1.1	0.2	0.8
164	1989	EPI	4.2	44.5	0.2	1.7	27.4	10.8	26.0	273.0	0.0	0.2	0.0	0.1
165	1989	EPI	4.1	42.9	0.2	1.7	26.5	10.5	27.1	282.0	0.0	0.3	0.1	0.2
373	1989	EPI	2.7	29.1	0.1	0.6	55.9	10.9	31.5	343.6	-0.1	0.1	0.0	0.2
377	1989	EPI	3.2	34.6	0.1	0.9	41.2	10.6	35.1	378.9	-0.0	0.2	0.0	0.2
442	1989	EPI	3.6	34.7	0.1	1.3	34.6	10.1	29.8	333.7	-0.2	0.2	0.1	0.1
938W	1989	EPI	3.5	37.1	0.1	1.1	37.4	10.5	29.0	305.9	-0.1	0.2	0.0	0.2
149	1990	EPI	8.1	92.2	0.2	4.9	19.6	11.7	37.2	428.4	-0.1	0.7	0.2	0.1
164	1990	EPI	4.6	54.3	0.2	3.8	16.0	12.1	27.2	327.3	-0.0	0.3	0.1	0.0
165	1990	EPI	4.8	58.5	0.2	3.3	18.6	12.4	27.0	332.0	0.0	0.3	0.1	0.1
373	1990	EPI	2.6	34.7	0.1	1.3	42.0	14.3	27.1	378.3	0.2	0.1	0.1	0.1
377	1990	EPI	3.2	42.6	0.2	2.0	31.4	14.0	19.0	262.4	0.0	0.2	0.1	0.1
442	1990	EPI	4.0	44.2	0.1	2.0	26.7	12.1	33.1	366.1	0.1	0.2	0.1	0.1
938W	1990	EPI	3.9	48.4	0.1	2.3	23.4	12.7	28.3	354.1	-0.0	0.2	0.1	0.1
164	1990	META	3.8	49.7	0.2	4.4	12.3	13.1	25.2	327.3	0.0	0.2	0.1	0.0
373	1990	META	3.1	39.6	0.1	3.3	16.4	13.2	21.7	285.4	0.0	0.1	0.1	0.0
377	1990	META	3.1	38.0	0.2	3.0	14.1	12.3	21.9	271.9	0.1	0.2	0.1	0.0
442	1990	META	3.6	44.1	0.3	3.3	15.2	12.4	18.1	222.7	-0.1	0.2	0.1	0.0
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Lake	Year	Depth (m)	Photic (mg/m³)	Susp N (mg/m³)	Susp C (mg/m³)	Susp P (mg/m³)	Chla (mg/m³)	NDapt mMN/m²H	A-Pase(C) µMPi/m²Hr					
149	1989	4.0	394.0	3722.0	30.0	11.5	-1.0	3.7						
164	1989	4.3	271.8	2636.0	30.8	8.9	1.2	1.0						
165	1989	4.5	292.5	2682.0	22.5	7.6	2.0	0.9						
373	1989	13.3	489.5	5221.3	32.8	9.1	3.0	1.2						
377	1989	8.8	466.8	4716.3	35.5	8.7	-0.6	1.3						
442	1989	7.5	415.5	2560.5	31.5	11.6	-0.3	1.5						
938W	1989	5.5	269.5	2451.6	20.6	5.8	0.1	0.9						
149	1990	4.0	474.4	4592.7	27.6	18.9	-1.1	1.8						
164	1990	4.6	309.4	3084.5	26.7	16.4	-0.7	0.8						
165	1990	3.7	251.6	2737.3	22.3	12.4	-0.1	0.6						
373	1990	14.2	485.4	5788.2	41.5	14.3	2.7	1.1						
377	1990	9.8	426.0	4866.4	55.8	16.2	-0.8	1.2						
442	1990	9.3	529.0	4889.5	34.5	15.8	0.8	1.3						
938W	1990	5.5	286.5	3200.0	25.0	13.1	-0.5	0.7						

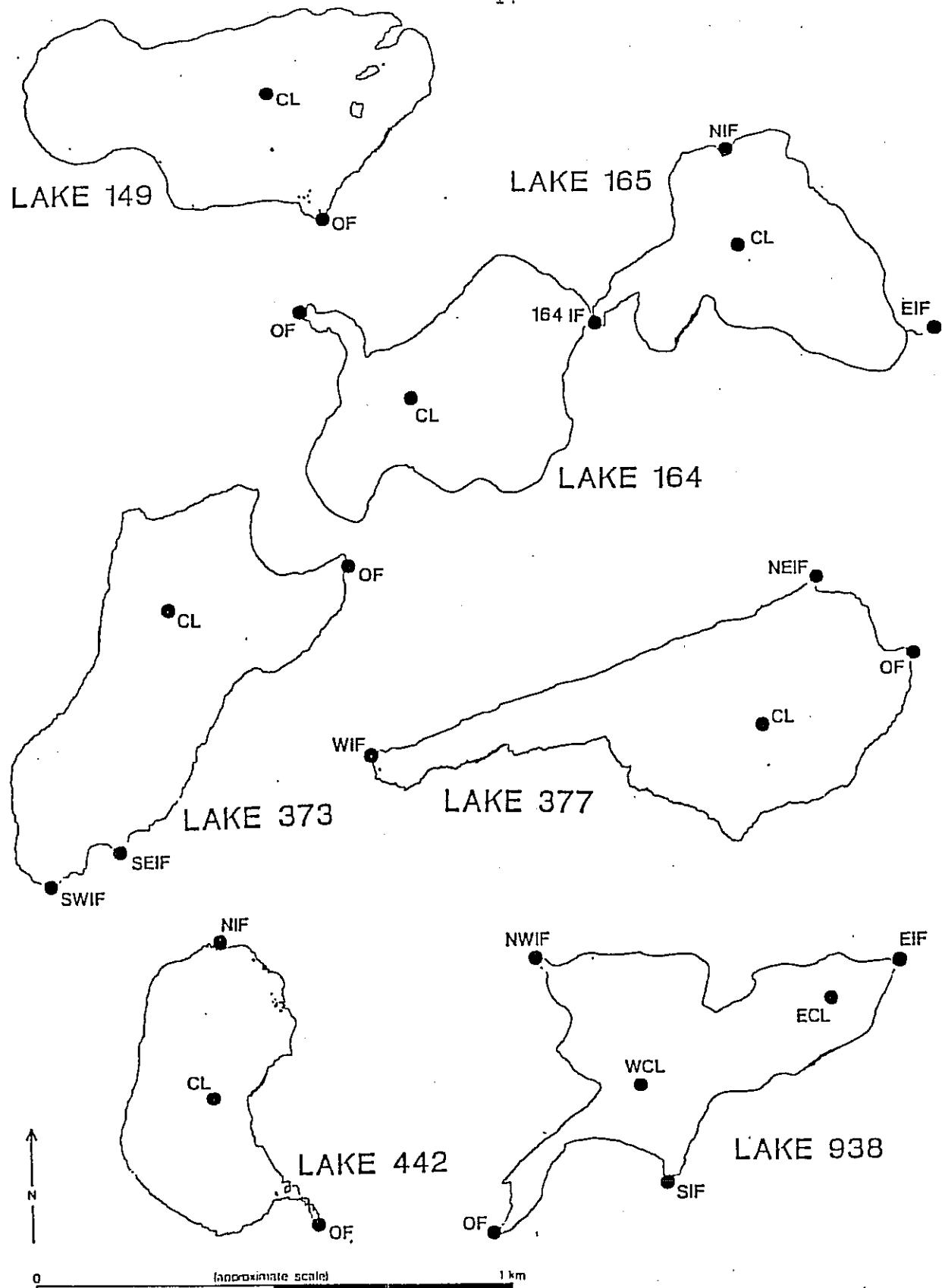


Figure 1. Composite map of the Study Lakes indicating the relative placement of the inflow (IF) and outflow (OF) streams and the centre (CL) lake sampling station. Lake 938 has two sampling stations

APPENDIX 1

PHYTOPLANKTON BIOMASS AND COMPOSITION

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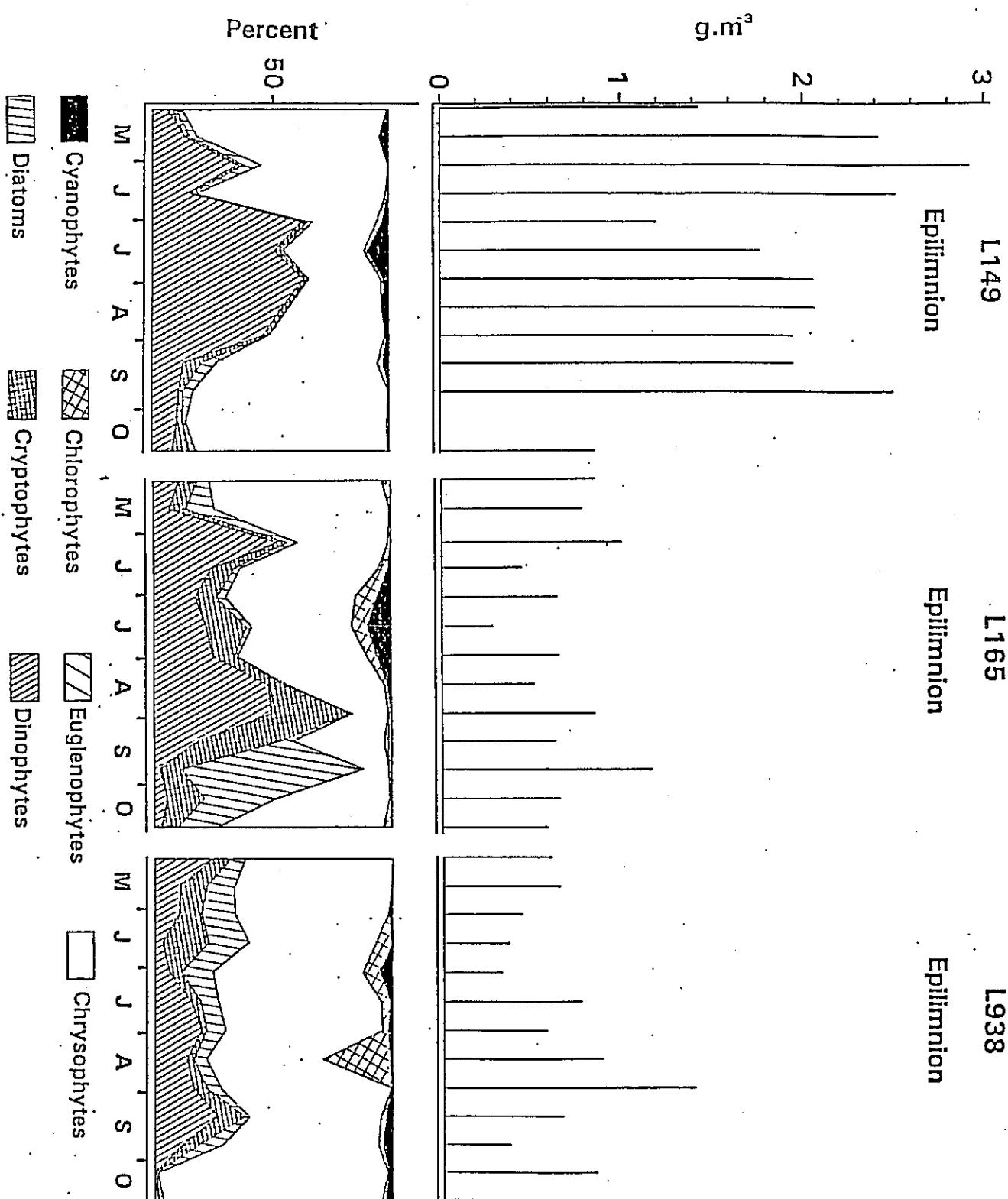


Figure A1.a Average epilimnetic phytoplankton biomass for lakes 149, 165, and 938 for the 1990 ice-free season and accumulative percent composition.

1.5
L164

Epilimnion

L377

Epilimnion

L442

Epilimnion

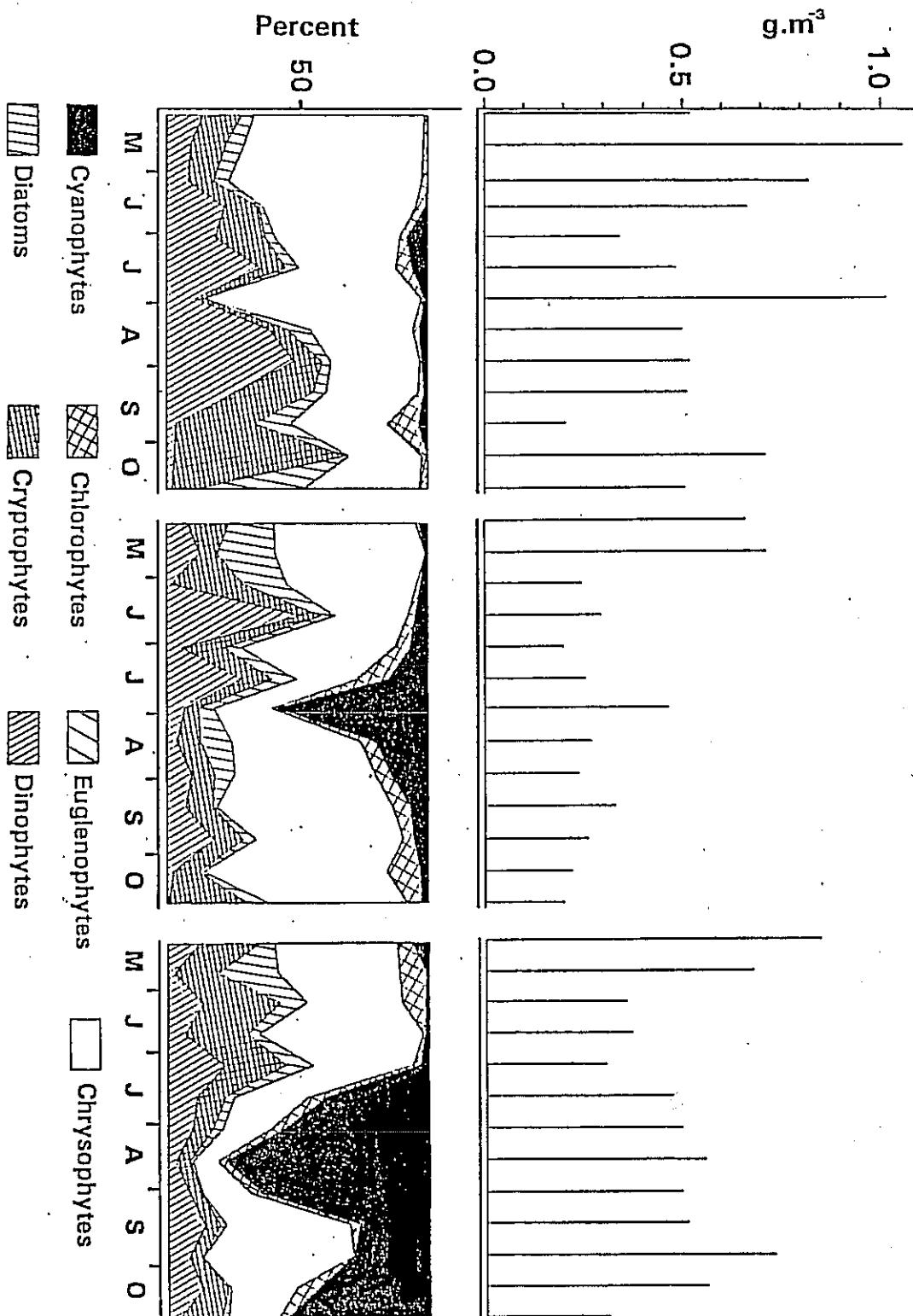


Figure A1.b Average epilimnetic phytoplankton biomass for lakes 164, 377, and 442 for the 1990 ice-free season and accumulative percent composition.

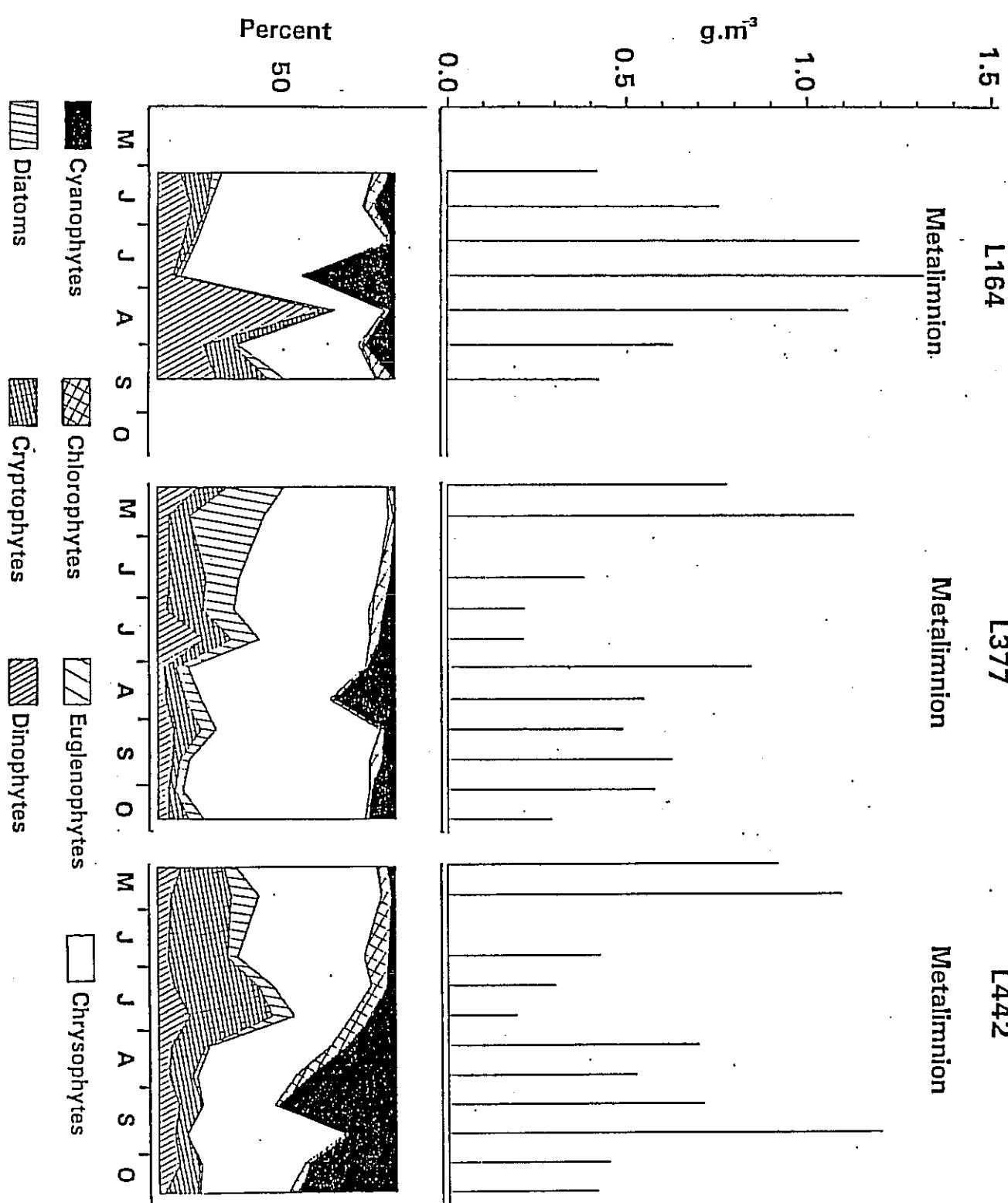


Figure A1.c Average metalimnetic phytoplankton biomass for lakes 164, 377, and 442 for the 1990 ice-free season and accumulative percent composition.

1.5

1.0

0.5

0.0

L373
Epilimnion

1983 1984 1985 1986 1987 1988 1989 1990

1.0

0.5

0.0

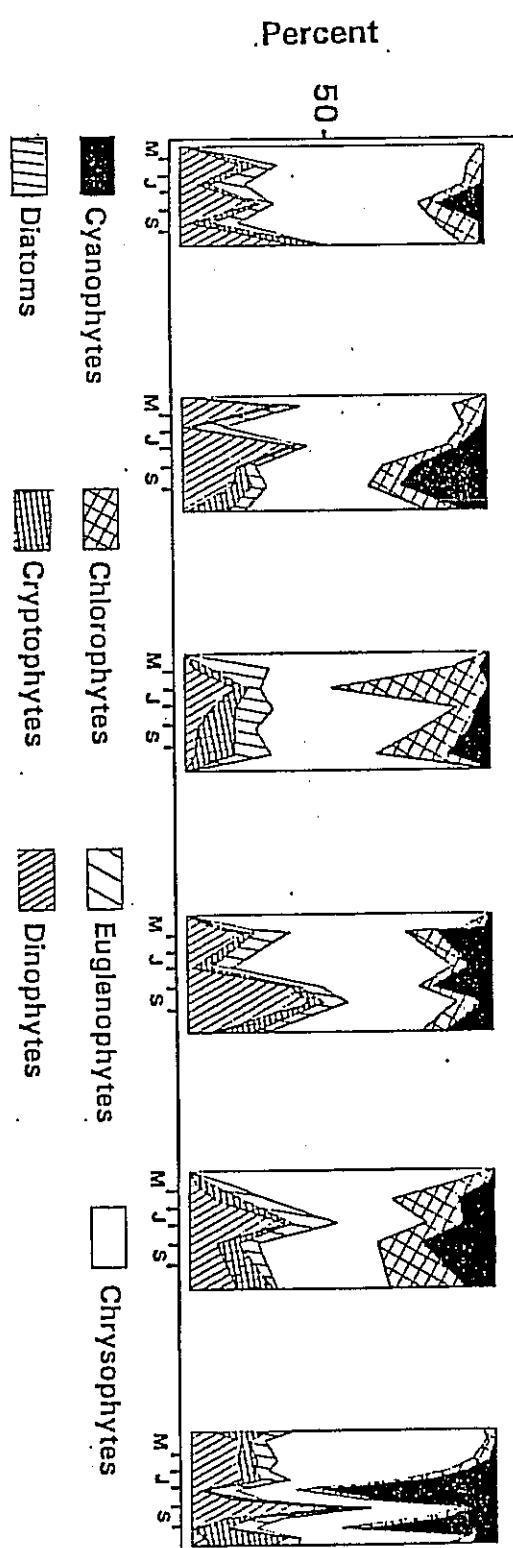
 g.m^{-3} 

Figure A1.d Average epilimnetic phytoplankton biomass for lake 373 for the 1983-1987 and 1990 ice-free season and accumulative percent composition.

L373

Metalimnion

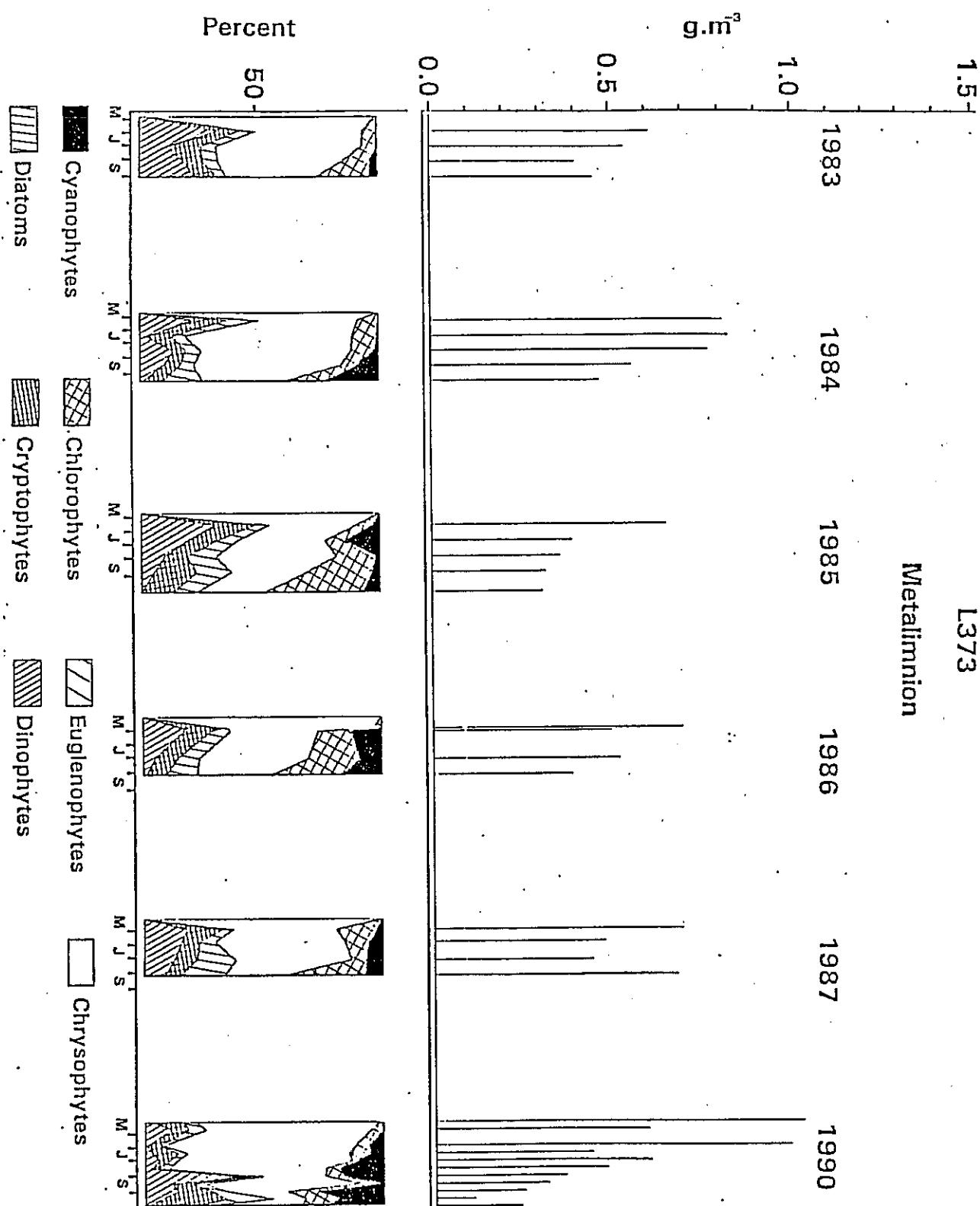


Figure A1.e Average metalimnetic phytoplankton biomass for lake 373 for the 1983-1987 and 1990 ice-free season and accumulative percent composition.

Table Al-a. Daily and annual ice-free season mean phytoplankton biomasses for the seven major taxonomic groupings and total, whole-lake biomass for Lakes 149, 164, 165, 373, 377, 442, 938.

Lake	Date	Layer	Cyanophyte mg/m ³	Chlorophyte mg/m ³	Euglenophyte mg/m ³	Chrysophyte mg/m ³	Diatom mg/m ³	Cryptophyte mg/m ³	Vol. Dinophyte mg/m ³	Areal Total mg/m ³	Total g/m ²
149	08 MAY 90	EPI	0.5	10.0	0.0	1241.3	36.0	58.3	92.8	1439.8	5.8
149	22 MAY 90	EPI	93.3	14.0	0.0	1835.9	73.9	47.2	357.1	2421.6	9.7
149	05 JUN 90	EPI	2.5	4.0	0.0	1555.3	208.4	61.6	1059.1	2921.9	11.7
149	19 JUN 90	EPI	4.1	27.0	0.0	1990.5	38.5	32.6	425.0	2517.8	10.1
149	03 JUL 90	EPI	35.5	29.0	0.0	314.2	24.5	34.1	760.4	1187.3	4.8
149	17 JUL 90	EPI	162.6	28.0	0.0	589.0	30.4	33.9	930.0	1774.7	7.1
149	31 JUL 90	EPI	50.0	23.0	2.1	608.3	15.7	28.9	1329.5	2058.1	8.2
149	14 AUG 90	EPI	55.9	11.0	0.0	790.1	12.0	49.9	1149.9	2069.5	8.3
149	28 AUG 90	EPI	23.3	12.0	0.0	934.8	9.8	42.4	927.3	1949.6	7.8
149	11 SEP 90	EPI	55.7	48.0	0.0	1297.5	18.9	153.3	275.1	1949.5	7.8
149	25 SEP 90	EPI	0.0	11.0	1.1	2033.4	103.3	50.4	301.5	2501.4	10.0
149	09 OCT 90	EPI	8.9	28.0	0.0	2522.0	30.0	81.6	339.0	3009.7	12.0
149	23 OCT 90	EPI	0.0	5.0	1.2	687.2	21.6	64.9	80.2	860.7	3.4
149	mean	EPI	37.9	19.8	0.3	1261.5	55.6	58.4	618.2	2051.7	8.2
164	08 MAY 90	EPI	2.0	4.0	0.0	334.2	22.1	80.5	77.4	520.8	2.6
164	22 MAY 90	EPI	0.0	17.0	0.4	715.6	73.9	141.8	105.8	1054.9	5.8
164	07 JUN 90	EPI	0.0	19.0	0.0	601.1	48.0	79.3	75.6	823.1	4.1
164	19 JUN 90	EPI	6.2	25.0	0.4	381.2	11.0	87.1	152.4	663.5	3.6
164	03 JUL 90	EPI	28.4	8.0	0.4	160.2	11.6	65.8	66.2	341.0	1.5
164	17 JUL 90	EPI	29.9	30.0	0.4	175.6	23.6	45.9	178.9	484.4	1.9
164	31 JUL 90	EPI	10.4	17.0	0.0	828.9	6.5	32.9	118.5	1014.3	4.6
164	14 AUG 90	EPI	17.3	12.0	0.0	192.8	40.2	36.5	201.9	501.1	2.3
164	28 AUG 90	EPI	11.6	0.0	0.4	173.9	16.5	53.0	257.4	517.9	2.6
164	11 SEP 90	EPI	8.0	10.0	2.4	175.8	25.2	149.6	139.8	511.9	2.3
164	25 SEP 90	EPI	8.0	22.0	1.2	74.4	28.2	62.4	9.3	206.3	0.7
164	09 OCT 90	EPI	0.9	4.0	1.0	196.3	12.0	458.7	26.2	709.31	2.8
164	23 OCT 90	EPI	0.9	15.0	0.8	220.8	2.1	44.5	14.2	508.8	2.0
164	mean	EPI	9.5	14.7	1.3	325.5	40.9	102.9	109.5	604.4	2.8
164	19 JUN 90	META	9.3	26.0	1.8	266.4	17.5	55.7	41.4	418.3	
164	03 JUL 90	META	63.4	29.0	7.5	488.3	7.5	49.5	110.3	756.2	
164	17 JUL 90	META	3.9	25.0	1.2	918.7	19.4	43.9	131.2	1143.5	
164	31 JUL 90	META	505.1	16.0	0.0	693.6	26.2	15.8	95.3	1352.4	
164	14 AUG 90	META	25.2	20.0	3.0	228.1	7.9	55.2	770.7	1110.8	
164	28 AUG 90	META	78.3	7.0	8.7	320.3	13.7	77.7	123.6	629.6	
164	11 SEP 90	META	1.4	29.0	3.5	159.8	30.3	93.8	107.0	424.7	
164	mean	META	98.1	22.1	3.7	439.3	17.5	55.9	197.1	833.7	
165	08 MAY 90	EPI	0.0	34.0	0.8	615.5	37.8	69.2	98.4	856.1	3.4
165	22 MAY 90	EPI	0.5	4.0	0.8	568.7	94.1	53.6	57.6	779.9	3.5
165	07 JUN 90	EPI	0.7	12.0	0.8	376.0	40.9	41.0	531.8	1003.9	4.0
165	19 JUN 90	EPI	6.4	12.0	5.3	256.4	10.6	43.4	111.7	446.8	1.8

Table A1.a. Cont'd.

Lake	Date	Layer	Cyanophyte mg/m ³	Chlorophyte mg/m ³	Buglenophyte mg/m ³	Chrysophyte mg/m ³	Diatom mg/m ³	Cryptophyte mg/m ³	Dinophyte mg/m ³	Total mg/m ³	Total mg/m ²
165	03 JUL 90	EPI	40.3	58.0	0.0	344.9	24.1	56.8	117.5	641.7	2.2
165	17 JUL 90	EPI	30.0	18.0	0.7	118.4	6.5	47.3	65.5	286.6	0.9
165	31 JUL 90	EPI	42.2	27.0	0.4	347.1	8.6	58.8	166.0	650.9	2.3
165	14 AUG 90	EPI	9.9	6.0	0.4	203.6	7.8	37.0	231.1	515.8	1.8
165	28 AUG 90	EPI	1.9	9.0	5.4	123.8	10.0	273.9	425.9	850.1	3.0
165	11 SEP 90	EPI	1.1	8.0	1.1	239.9	33.1	217.6	120.8	632.9	2.8
165	25 SEP 90	EPI	5.6	11.0	2.4	121.3	874.6	108.2	38.5	1162.1	4.7
165	09 OCT 90	EPI	3.7	5.0	0.0	306.1	197.9	103.6	40.1	656.6	2.3
165	23 OCT 90	EPI	3.6	18.0	0.4	405.2	97.2	40.2	22.7	587.3	2.6
165	mean	EPI	11.2	17.5	2.2	309.8	111.0	88.5	157.5	697.8	2.7
373	07 JUN 83	EPI	1.7	23.0	0.0	296.0	31.1	28.2	94.6	475.0	6.1
373	02 AUG 83	EPI	44.2	18.0	0.0	140.3	14.5	6.5	71.2	294.8	4.4
373	30 AUG 83	EPI	6.8	43.0	0.0	212.5	26.7	23.1	12.3	325.3	4.6
373	03 OCT 83	EPI	10.1	25.0	0.0	236.9	11.1	45.0	201.4	529.6	8.5
373	mean	EPI	13.2	25.5	0.0	221.7	23.8	23.0	79.8	386.9	5.9
373	21 MAY 84	EPI	0.7	58.0	0.0	275.6	36.9	20.2	155.6	547.5	7.1
373	19 JUN 84	EPI	9.3	25.0	0.0	353.5	42.5	12.3	5.7	448.2	7.2
373	16 JUL 84	EPI	34.1	18.0	0.0	187.5	13.4	8.7	144.8	406.7	6.1
373	13 AUG 84	EPI	77.9	35.0	0.0	139.7	13.1	8.7	60.1	334.9	5.0
373	11 SEP 84	EPI	92.9	33.0	1.4	108.6	17.3	21.9	54.0	330.0	4.3
373	16 OCT 84	EPI	25.1	35.0	0.4	186.2	16.2	41.8	5.7	311.1	4.7
373	mean	EPI	40.0	34.5	0.3	208.5	23.2	18.9	71.0	396.4	5.7
373	29 MAY 85	EPI	9.1	25.0	0.0	171.0	52.3	16.1	11.4	285.0	3.7
373	26 JUN 85	EPI	0.0	295.0	0.0	132.4	22.8	25.0	95.5	571.4	8.0
373	24 JUL 85	EPI	11.0	15.0	0.0	32.8	19.9	32.8	23.3	259.0	3.6
373	21 AUG 85	EPI	24.6	55.0	0.0	211.7	27.1	44.5	17.7	380.7	5.0
373	25 SEP 85	EPI	41.2	69.0	0.0	105.7	37.8	37.4	11.5	303.3	3.6
373	mean	EPI	17.2	92.2	0.0	155.5	34.6	28.6	31.9	359.9	4.8
373	28 MAY 86	EPI	11.5	29.0	0.0	283.6	26.9	15.5	44.1	411.3	4.9
373	02 JUN 86	EPI	56.1	30.0	0.0	121.4	36.1	11.0	60.5	315.8	nd
373	22 JUL 86	EPI	29.7	18.0	0.0	275.2	26.5	20.7	10.0	380.5	5.0
373	19 AUG 86	EPI	81.8	17.0	0.4	136.2	28.6	13.7	147.3	425.0	5.5
373	10 SEP 86	EPI	11.0	27.0	0.4	121.4	26.5	15.0	137.9	339.9	4.1
373	22 OCT 86	EPI	33.0	17.0	0.0	112.4	10.3	29.6	17.3	219.7	2.9
373	mean	EPI	37.2	23.4	0.1	175.0	25.8	17.6	69.5	384.7	4.5
373	26 MAY 87	EPI	7.1	42.0	0.0	279.7	20.5	18.5	12.0	380.7	4.7
373	18 JUN 87	EPI	29.8	53.0	0.0	101.4	22.3	23.8	253.2	nd	3.5
373	21 JUL 87	EPI	35.8	42.0	0.0	108.2	52.5	9.5	114.4	362.8	5.1
373	18 AUG 87	EPI	67.3	41.0	0.4	111.5	20.3	26.1	285.5	285.5	nd

Table A1-a. Cont'd.

Lake	Date	Layer	Cyanophyte mg/m ³	Chlorophyte mg/m ³	Buglenophyte mg/m ³	Chrysophyte mg/m ³	Diatom mg/m ³	Cryptophyte mg/m ³	Phytoplankton mg/m ³	Total mg/m ³	Total mg/m ³
373	21 OCT 87	EPI	22.5	59.0	0.0	89.4	2.8	29.5	38.1	241.8	2.9
373	mean	EPI	32.5	47.8	0.1	138.0	23.4	20.1	42.9	304.8	4.0
373	09 MAY 90	EPI	0.8	24.0	0.0	374.6	45.0	115.8	44.0	604.2	7.2
373	23 MAY 90	EPI	1.0	8.0	0.0	237.0	18.0	7.7	54.9	327.1	3.9
373	06 JUN 90	EPI	10.1	2.0	0.0	556.0	17.6	16.6	61.6	616.9	8.0
373	20 JUN 90	EPI	7.8	17.0	0.0	208.2	21.6	22.2	50.1	327.3	4.6
373	04 JUL 90	EPI	18.5	12.0	0.0	128.0	10.2	10.1	35.1	214.7	3.2
373	18 JUL 90	EPI	36.9	15.0	0.4	66.7	15.0	13.4	29.0	176.4	2.6
373	01 AUG 90	EPI	90.7	14.0	0.0	32.3	15.0	2.8	5.8	160.7	2.4
373	15 AUG 90	EPI	85.9	12.0	0.0	68.9	13.6	8.6	31.6	220.9	3.5
373	29 AUG 90	EPI	20.9	8.0	0.0	80.3	15.0	15.3	126.5	266.0	4.0
373	12 SEP 90	EPI	23.3	10.0	0.0	66.0	14.5	12.9	15.7	142.8	2.5
373	26 SEP 90	EPI	58.7	15.0	0.0	41.6	14.5	14.9	2.3	147.3	2.4
373	10 OCT 90	EPI	11.7	4.0	0.0	96.9	7.1	46.3	9.6	175.7	2.5
373	24 OCT 90	EPI	11.2	16.0	0.0	69.9	14.4	28.3	9.8	149.9	2.0
373	mean	EPI	29.0	12.4	0.0	155.9	17.0	24.2	32.9	271.5	3.7
373	07 JUN 83	META	3.3	33.0	0.4	273.0	41.4	55.8	203.6	612.6	5.4
373	05 JUL 83	META	1.4	46.0	0.0	332.9	33.4	78.1	65.0	404.2	4.2
373	02 AUG 83	META	11.4	0.0	0.0	212.0	24.7	30.8	78.7	458.2	5.0
373	30 AUG 83	META	15.6	100.0	0.0	172.9	15.8	45.6	108.0	504.8	5.8
373	mean	META	7.9	53.8	0.1	247.7	28.8	52.6	113.8		
373	21 MAY 84	META	0.0	70.0	0.0	336.0	104.8	115.1	181.3	808.0	8.0
373	19 JUN 84	META	4.3	89.0	0.0	571.5	46.8	82.1	31.9	825.7	7.7
373	16 JUL 84	META	14.6	74.0	0.0	482.3	50.1	40.6	109.5	771.8	6.5
373	13 AUG 84	META	53.1	37.0	0.0	343.0	31.0	39.1	57.2	560.5	5.5
373	11 SEP 84	META	104.4	82.0	0.0	161.3	79.0	37.2	9.5	474.1	4.1
373	25 SEP 85	META	35.3	70.9	0.0	378.8	62.3	62.8	77.9	688.0	6.0
373	mean	META	23.4	70.2	0.3	149.1	38.5	56.8	68.5	406.7	
373	29 MAY 85	META	20.4	43.0	0.8	239.7	39.2	102.6	208.6	655.1	
373	26 JUN 85	META	58.8	32.0	0.0	142.3	34.4	45.8	78.7	392.3	
373	24 JUL 85	META	3.8	61.0	0.4	178.7	42.1	35.6	35.7	357.9	
373	21 AUG 85	META	11.0	85.0	0.4	99.2	46.0	56.9	18.9	318.0	
373	18 AUG 85	META	23.0	127.0	0.0	85.4	30.7	42.8	0.4	310.0	
373	mean	META	20.4	70.2	0.3	149.1	38.5	56.8	68.5	406.7	
373	28 MAY 86	META	0.0	23.0	0.8	422.8	22.2	106.8	122.1	698.6	
373	02 JUL 86	META	64.4	69.0	0.0	180.6	40.5	55.6	88.7	499.4	
373	22 JUL 86	META	50.0	112.0	0.0	236.9	46.7	49.1	28.6	524.1	
373	19 AUG 86	META	63.7	117.0	0.4	120.0	50.2	31.8	8.2	391.6	
373	mean	META	44.5	80.9	0.3	240.1	39.9	60.8	61.9	528.4	

Table Al-a. Cont'd.

Lake	Date	Layer	Cyanophyte mg/m ³	Chlorophyte mg/m ³	Euglenophyte mg/m ³	Chrysophyte mg/m ³	Diatom mg/m ³	Cryptophyte mg/m ³	Dinophyte mg/m ³	Total mg/m ³	Total mg/m ²
373	26 MAY 87	META	14.2	123.0	0.0	296.3	31.2	101.8	131.2	697.8	5.3
373	18 JUN 87	META	29.4	49.0	0.0	257.0	31.1	37.0	77.6	481.9	2.7
373	21 JUL 87	META	32.4	27.0	0.0	212.7	72.6	42.9	58.2	446.4	3.4
373	18 AUG 87	META	51.7	225.0	0.0	170.7	125.7	43.9	63.5	681.2	21.5
373	mean	META	31.9	106.6	0.0	234.2	65.2	56.2	82.6	576.9	30.3
373	09 MAY 90	META	15.2	7.0	0.0	776.7	51.8	128.6	47.9	1027.9	14.6
373	23 MAY 90	META	0.8	29.0	0.0	413.3	42.3	41.5	72.1	599.1	14.6
373	20 JUN 90	META	64.1	56.0	0.0	790.3	13.6	53.3	16.5	993.8	36.7
373	04 JUL 90	META	26.1	41.0	0.0	293.7	16.6	47.5	17.9	443.4	12.2
373	18 JUL 90	META	67.1	14.0	0.0	437.0	20.2	25.6	41.2	605.5	20.0
373	01 AUG 90	META	91.5	27.0	0.0	313.5	12.2	19.6	16.9	484.3	12.2
373	15 AUG 90	META	62.2	28.0	0.0	96.1	15.7	26.4	145.4	367.5	12.2
373	29 AUG 90	META	11.5	22.0	0.0	202.9	16.8	38.6	318.1	359.9	12.2
373	12 SEP 90	META	68.8	31.0	0.5	60.9	15.6	37.4	8.1	251.1	110.7
373	26 SEP 90	META	20.7	15.0	0.0	15.2	20.7	30.4	4.4	243.3	110.7
373	10 OCT 90	META	54.8	30.0	0.0	106.6	5.7	41.7	40.4	495.0	243.3
373	mean	META	43.9	27.7	0.0	318.8	22.4	41.8	40.4	495.0	243.3
377	09 MAY 90	EPI	23.5	10.0	0.0	349.6	112.9	106.6	57.4	660.1	5.3
377	23 MAY 90	EPI	5.6	0.0	0.4	405.4	157.1	48.2	94.6	712.0	2.7
377	06 JUN 90	EPI	7.7	3.0	0.0	40.3	68.6	6.0	246.6	295.6	3.4
377	20 JUN 90	EPI	14.9	8.0	0.4	80.5	15.5	22.3	153.4	200.2	2.0
377	04 JUL 90	EPI	14.4	10.0	1.2	114.6	12.6	33.0	13.6	256.9	2.3
377	18 JUL 90	EPI	39.7	29.0	0.0	58.9	23.6	29.5	76.0	464.8	4.7
377	31 JUL 90	EPI	264.2	10.0	0.0	101.9	28.6	23.9	35.8	270.9	2.7
377	15 AUG 90	EPI	54.5	16.0	0.0	130.2	33.1	24.5	12.5	239.2	2.2
377	29 AUG 90	EPI	34.9	14.0	0.0	125.5	19.2	20.9	24.7	330.8	3.6
377	12 SEP 90	EPI	22.9	22.0	0.0	218.9	5.0	34.5	26.8	263.3	2.5
377	26 SEP 90	EPI	15.0	10.0	0.3	145.0	12.5	30.1	49.7	221.4	2.1
377	10 OCT 90	EPI	6.9	28.0	0.0	152.7	4.4	21.9	7.2	201.1	2.2
377	24 OCT 90	EPI	4.9	11.0	0.8	104.4	15.5	61.7	2.8	335.6	3.3
377	mean	EPI	39.2	13.5	0.2	162.2	36.9	40.4	43.1	576.1	14.6
377	09 MAY 90	META	7.2	19.0	1.5	327.5	181.8	97.2	141.9	776.5	1128.0
377	23 MAY 90	META	0.0	8.0	23.8	589.1	95.6	61.8	382.2	323.6	123.6
377	20 JUN 90	META	8.4	18.0	0.0	223.8	52.9	57.4	21.0	216.7	10.0
377	04 JUL 90	META	10.3	9.0	3.3	123.6	27.9	32.5	9.5	215.1	14.4
377	18 JUL 90	META	14.4	7.0	1.2	100.0	25.1	24.5	42.6	847.0	9.0
377	31 JUL 90	META	96.9	9.0	0.0	629.1	40.8	39.3	31.3	549.9	137.9
377	15 AUG 90	META	137.9	9.0	0.4	300.6	35.7	42.6	23.1	36.2	30.8
377	29 AUG 90	META	23.1	6.0	0.8	338.6	30.7	54.5	41.9	490.7	18.5
377	12 SEP 90	META	34.2	30.0	1.6	473.7	23.9	45.5	624.7	624.7	12.2
377	26 SEP 90	META	56.1	5.0	0.6	451.5	17.8	40.4	30.3	576.1	14.6

Lake	Date	Layer	Cyanophytre mg/m ³	Chlorophytre mg/m ³	Euglenophytre mg/m ³	Chrysophytre mg/m ³	Diatom mg/m ³	Cryptophytre mg/m ³	Dinophytre mg/m ³	Total mg/m ³	Total mg/m ²
377	10 OCT 90	META	31.9	4.0	0.4	197.6	18.7	23.4	15.2	291.9	
377	mean	META	38.2	11.9	3.0	341.4	73.1	45.5	41.3	554.4	
442	09 MAY 90	EPI	59.2	46.0	1.4	388.2	37.6	196.4	114.8	843.9	7.6
442	23 MAY 90	EPI	7.7	71.0	0.4	307.7	151.9	114.1	23.4	676.6	4.7
442	06 JUN 90	EPI	4.8	32.0	0.0	128.0	35.2	104.8	50.6	355.9	3.2
442	20 JUN 90	EPI	5.5	3.0	0.0	227.8	15.2	88.2	28.0	368.4	3.7
442	04 JUL 90	EPI	9.9	9.0	0.4	114.1	31.3	70.3	68.5	304.4	3.3
442	18 JUL 90	EPI	184.3	32.0	0.0	132.3	16.4	50.6	56.0	472.4	4.7
442	01 AUG 90	EPI	272.0	23.0	0.0	92.4	17.9	37.2	50.2	493.6	4.9
442	15 AUG 90	EPI	425.8	16.0	0.0	54.9	6.1	29.8	20.2	552.8	5.5
442	29 AUG 90	EPI	309.2	23.0	0.0	92.5	2.4	21.8	46.3	495.2	5.0
442	12 SEP 90	EPI	137.6	18.0	0.0	236.9	11.7	30.7	75.0	510.3	5.6
442	26 SEP 90	EPI	212.2	1.0	0.4	413.9	3.9	34.4	65.1	731.7	6.6
442	10 OCT 90	EPI	235.8	46.0	0.0	140.6	6.5	54.0	77.7	560.8	4.5
442	24 OCT 90	EPI	168.3	10.0	0.0	58.8	8.7	49.7	15.0	310.8	2.3
442	mean	EPI	156.3	25.8	0.2	183.7	26.5	67.8	53.2	513.6	4.8
442	09 MAY 90	META	30.6	33.0	7.4	544.7	43.2	161.0	98.1	918.6	
442	23 MAY 90	META	17.1	45.0	0.0	565.1	128.0	270.8	69.0	1095.5	
442	20 JUN 90	META	13.0	42.0	0.0	227.6	18.7	104.8	21.0	427.2	
442	04 JUL 90	META	10.8	19.0	0.4	124.3	19.2	105.8	22.4	302.1	
442	18 JUL 90	META	18.7	16.0	0.0	46.7	17.9	67.4	26.2	193.1	
442	01 AUG 90	META	141.1	47.0	0.0	359.0	12.7	97.0	42.0	699.4	
442	15 AUG 90	META	187.6	31.0	0.4	219.4	10.4	50.0	27.5	527.2	
442	29 AUG 90	META	346.3	13.0	0.4	216.1	3.2	66.6	65.7	711.8	
442	12 SEP 90	META	229.6	20.0	0.0	802.3	2.5	57.4	90.9	1202.8	
442	26 SEP 90	META	161.5	8.0	0.0	196.8	4.9	37.3	451.2		
442	10 OCT 90	META	169.6	20.0	0.4	157.3	4.3	55.5	418.3		
442	mean	META	120.4	27.1	0.8	314.5	24.1	97.6	47.1	631.6	
938	08 MAY 90	EPI	0.0	0.0	0.0	366.9	32.9	41.9	156.2	597.8	3.3
938	22 MAY 90	EPI	0.0	2.0	0.0	425.2	74.2	71.1	74.7	647.7	3.6
938	05 JUN 90	EPI	5.6	4.0	0.0	280.0	60.1	41.8	48.0	439.8	2.4
938	19 JUN 90	EPI	1.7	25.0	0.0	194.1	61.0	70.6	15.1	367.6	2.0
938	03 JUL 90	EPI	17.3	24.0	0.0	202.1	41.6	17.0	22.7	325.1	1.8
938	17 JUL 90	EPI	7.9	28.0	3.2	51.6	54.4	29.5	123.7	764.1	4.2
938	31 JUL 90	EPI	12.2	12.0	1.4	374.3	45.9	10.9	117.7	575.1	3.2
938	14 AUG 90	EPI	8.8	0.0	0.0	426.2	46.5	26.4	125.8	884.1	4.9
938	28 AUG 90	EPI	6.6	3.0	0.0	982.9	80.9	77.6	237.7	1391.5	7.7
938	11 SEP 90	EPI	20.3	15.0	0.4	359.7	12.1	74.9	181.0	663.5	3.7
938	25 SEP 90	EPI	15.1	7.0	0.0	241.6	35.7	26.3	46.7	373.6	2.1
938	09 OCT 90	EPI	15.4	5.0	0.0	810.	7.1	11.6	1.7	851.3	4.7
938	23 OCT 90	EPI	0.4	13.0	0.6	825.3	14.7	19.6	5.2	907.5	5.0
938	mean	EPI	10.8	30.1	43.6	39.6	88.9	88.9	676.0	3.7	

Table A1-a. Cont'd.

Lake	Date	Layer	Cyanophyte mg/m ³	Chlorophyte mg/m ³	Euglenophyte mg/m ³	Chrysophyte mg/m ³	Diatom mg/m ³	Cryptophyte mg/m ³	Dinophyte mg/m ³	Total mg/m ³	Total mg/m ²
377	10 OCT 90	META	31.9	4.0	0.4	197.6	18.7	23.4	15.2	291.9	7.5
377	mean	META	38.2	11.9	3.0	341.4	73.1	45.5	41.3	554.4	
442	09 MAY 90	EPI	59.2	46.0	1.4	388.2	37.6	196.4	114.8	843.9	4.7
442	23 MAY 90	EPI	7.7	71.0	0.4	307.7	151.9	114.1	23.4	676.6	
442	06 JUN 90	EPI	4.8	32.0	0.0	128.0	35.2	104.8	50.6	355.9	3.2
442	20 JUN 90	EPI	5.5	3.0	0.0	227.8	15.2	88.2	28.0	368.4	3.7
442	04 JUL 90	EPI	9.9	9.0	0.4	114.1	31.3	70.3	68.5	304.4	3.3
442	18 JUL 90	EPI	184.3	32.0	0.0	132.3	16.4	50.6	56.0	472.4	4.7
442	01 AUG 90	EPI	272.0	23.0	0.0	92.4	17.9	37.2	50.2	493.6	4.9
442	15 AUG 90	EPI	425.8	16.0	0.0	54.9	6.1	29.8	20.2	552.8	5.5
442	29 AUG 90	EPI	309.2	23.0	0.0	92.5	2.4	21.8	46.3	495.2	5.0
442	12 SEP 90	EPI	137.6	18.0	0.0	236.9	11.7	30.7	75.0	510.3	5.6
442	25 SEP 90	EPI	212.2	1.0	0.4	413.9	3.9	34.4	65.1	731.7	6.6
442	10 OCT 90	EPI	235.8	46.0	0.0	140.6	6.5	54.0	77.7	560.8	4.5
442	24 OCT 90	EPI	168.3	10.0	0.0	58.8	8.7	49.7	15.4	310.8	2.3
442	mean	EPI	156.3	25.8	0.2	183.7	26.5	67.8	53.2	513.6	4.8
442	09 MAY 90	META	30.6	33.0	7.4	544.7	43.2	161.0	98.1	918.6	1095.5
442	23 MAY 90	META	17.1	45.0	0.0	565.1	128.0	270.8	69.0		
442	20 JUN 90	META	13.0	42.0	0.0	227.6	18.7	104.8	21.0	427.2	
442	04 JUL 90	META	10.8	19.0	0.4	124.3	19.2	105.8	22.4	302.1	
442	18 JUL 90	META	18.7	16.0	0.0	46.7	17.9	67.4	26.2	193.1	
442	01 AUG 90	META	141.1	47.0	0.0	359.0	12.7	97.0	42.0	699.4	
442	15 AUG 90	META	187.6	31.0	0.4	219.4	10.4	50.0	27.5	537.2	
442	29 AUG 90	META	346.3	13.0	0.4	216.1	3.2	66.6	65.7	711.8	
442	12 SEP 90	META	229.6	20.0	0.0	802.3	2.5	57.4	90.9	1202.8	
442	26 SEP 90	META	161.5	8.0	0.0	196.8	4.9	37.3	41.8	451.2	
442	10 OCT 90	META	167.6	20.0	0.4	157.3	4.3	55.5	13.1	418.3	
442	mean	META	120.4	27.1	0.8	314.5	24.1	97.6	47.1	631.6	
938	08 MAY 90	EPI	0.0	0.0	0.0	366.9	32.9	41.9	156.2	597.8	3.3
938	22 MAY 90	EPI	0.0	2.0	0.0	425.2	74.2	71.1	74.7	647.7	3.6
938	05 JUN 90	EPI	5.6	4.0	0.0	280.0	60.1	41.8	48.0	439.8	2.4
938	19 JUN 90	EPI	1.7	25.0	0.0	194.1	61.0	70.6	15.1	367.6	2.0
938	03 JUL 90	EPI	17.3	24.0	0.0	202.1	41.6	17.0	22.7	325.1	1.8
938	17 JUL 90	EPI	7.9	28.0	0.0	516.9	54.4	29.5	123.7	764.1	4.2
938	31 JUL 90	EPI	12.2	12.0	1.4	374.3	45.9	10.9	117.7	575.1	3.2
938	14 AUG 90	EPI	8.8	250.0	0.0	426.2	46.5	26.4	125.8	884.1	4.9
938	28 AUG 90	EPI	6.6	3.0	2.4	982.9	80.9	77.6	237.7	1391.5	7.7
938	11 SEP 90	EPI	20.3	15.0	0.4	359.7	12.1	74.9	181.0	663.5	3.7
938	25 SEP 90	EPI	16.1	7.0	0.0	241.6	35.7	26.5	46.7	373.6	2.1
938	09 OCT 90	EPI	5.0	1.7	0.0	810.1	7.1	11.6	851.3	4.7	
938	23 OCT 90	EPI	29.1	13.0	0.4	825.3	14.7	19.6	5.2	907.5	5.0

Table A1.b. Species present during the 1990 open-water season in Lakes 149, 164, 165, 373, 377, 442, 938.
 1 = present and . = absent.

TAXON	149	164	165	373	377	442	938
Cyanophyceae							
Anabaena circinalis Raben.	1	1	1	1	1	1	1
A. sp.							
Aphanizomenon flos-aquae Ralfs		1	1	1	1	1	1
Aphanocapsa delicatissima W. & G.S. West		1	1	1	1	1	1
A. elachista W. & G.S. West	1	1	1	1	1	1	1
A. sp.							
Aphanothecae gelatinosa (Henn.) Lemm.							
A. sp.							
Chroococcus dispersus G.M. Smith	1	1	1	1	1	1	1
C. limneticus Lemm.	1	1	1	1	1	1	1
C. minutus (Kutz.) Naeg.	1	1	1	1	1	1	1
Coelsphaerium daegelianum Unger							
Dactylococcopsis linearis Geitler							
Gloeotrichia sp.							
Gomphosphaeria lacustris Chodat							
Lynbya pseudospirulinina Pascher							
L. sp.							
Merismopedia glauca (Ehr.) Naeg.	1	1	1	1	1	1	1
M. minima Beck	1	1	1	1	1	1	1
M. tenuissima Lemm.	1	1	1	1	1	1	1
Microcystis aeruginosa Kutz.	1	1	1	1	1	1	1
M. flos-aquae (Witt.) Kirch.	1	1	1	1	1	1	1
M. sp.							
M. viridis (Braun) Lemm.	1	1	1	1	1	1	1
Oscillatoria Redekel Van Goor	1	1	1	1	1	1	1
O. tenuis Agardh	1	1	1	1	1	1	1
Pelonema sp.							
Radiocystis geminata Skuja							
Rhabdogloea lineare							
S. sp.							
Snowella sp.							
Monorichinia sp.							

Table A1.b. Cont'd.

TAXON	149	164	165	373	377	442	938
Chlorophyceae							
Ankistrodesmus braunii	1	1					
A. sp.							
Ankryva judai G.M. Smith	1	1	1	1	1	1	
Arthrodesmus unicus (Breb.) Hasslow	1	1	1	1	1	1	1
Botryococcus Brauni Kutz.	1	1	1	1	1	1	
Carteria spp.							
Chlamydomonas spp.							
Chlorogonium maximum Skuja							
Closterium Kuttingii Breb.							
C. sp.							
Coelastrum cambricum Archer							
Collodictyon sp.							
Cosmarium sp.							
Crucigeniella quadrata Morren							
C. rectangularis (A. Braun) Gay	1	1	1	1	1	1	
C. spp.							
Dictyosphaerium pulchellum Wood							
D. simplex Skuja	1	1	1	1	1	1	
Elakatothrix gelatinosa Willen							
Euastrum denticulatum (Kirch.) Gay	1	1	1	1	1	1	
E. spp.							
Gloeococcus Schroeteri (Chodat) Lemm.	1	1	1	1	1	1	
Kirchneriella lunaris (Kirch.) Moebius	1	1	1	1	1	1	
Micrasterias sp.							
Monoraphidium contortum (Thuret & Breb.) Komark.	1	1	1	1	1	1	
M. minutum (Naeg.) Komark.	1	1	1	1	1	1	
M. setiforme (Nygaard) Komark.	1	1	1	1	1	1	
M. sp. A	1	1	1	1	1	1	
Mougeotia sp.							
Ocystis Borgei Snow	1	1	1	1	1	1	
O. lacustris Chodat	1	1	1	1	1	1	
O. submarginata var. variabilis Skuja	1	1	1	1	1	1	
Pediastrum duplex Meyen	1	1	1	1	1	1	
P. tetras							

Table A1.b. Cont'd.

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Taxon	149	164	165	373	377	442	938
<u>Planctonema</u> <u>Lauterborni</u> Schmid.	1	1	1	1	1	1	1
<u>Pyramidomonas</u> <u>tetrarhynchus</u> Schmar.	1	1	1	1	1	1	1
<u>Quadrigula</u> <u>closteroides</u> (Bohlin) Printz.	1	1	1	1	1	1	1
<u>Scenedesmus</u> <u>brevispina</u> (Smith) Chodat	1	1	1	1	1	1	1
<u>S.</u> <u>denticulatus</u> Lager.	1	1	1	1	1	1	1
<u>S.</u> sp.	1	1	1	1	1	1	1
<u>S.</u> <u>quadricauda</u> (Turpin) Breb.	1	1	1	1	1	1	1
<u>Schroederia</u> <u>setigera</u> (Schroder) Lemm.	1	1	1	1	1	1	1
<u>Scourfieldia</u> <u>cordiformis</u> Takeda	1	1	1	1	1	1	1
<u>Spondylosium</u> <u>planum</u> (Wolle) W. & G.S. West	1	1	1	1	1	1	1
<u>Staurastrum</u> <u>cuspitatum</u> Breb.	1	1	1	1	1	1	1
<u>S.</u> <u>paradoxum</u> Meyen	1	1	1	1	1	1	1
<u>Tetraedron</u> <u>caudata</u> (Corda) Hansgrig	1	1	1	1	1	1	1
<u>T.</u> <u>minimum</u> (Braun) Hansgrig	1	1	1	1	1	1	1
<u>Ireubarbia</u> sp.	1	1	1	1	1	1	1
<u>Xanthidium</u> sp.	1	1	1	1	1	1	1
 Euglenophyceae							
<u>Euglena</u> <u>acus</u> Ehren.	1	1	1	1	1	1	1
<u>Phacus</u> sp.	1	1	1	1	1	1	1
<u>Irachelomonas</u> <u>hispida</u> (Perty) Stein	1	1	1	1	1	1	1
<u>I.</u> <u>volvocina</u> Ehren.	1	1	1	1	1	1	1
 Chrysophyceae							
<u>Bicoeca</u> <u>ainikiae</u> Jarne.	1	1	1	1	1	1	1
<u>B.</u> <u>lacustris</u> Clark	1	1	1	1	1	1	1
<u>B.</u> <u>bitrichia</u> Chodatii (Reverdin) Chodat	1	1	1	1	1	1	1
<u>B.</u> <u>longispina</u> (Lund) Bourrelly	1	1	1	1	1	1	1
<u>Chromulina</u> spp.	1	1	1	1	1	1	1
<u>Chrysochromulina</u> <u>laurentiana</u> Kling	1	1	1	1	1	1	1
<u>C.</u> <u>parva</u> Lackey	1	1	1	1	1	1	1
<u>Chrysoikos</u> <u>Skuja</u> (Nauwerck) Willen	1	1	1	1	1	1	1
<u>Chrysosphaerella</u> <u>coronae</u>	1	1	1	1	1	1	1
<u>C.</u> <u>longispina</u> Laut.	1	1	1	1	1	1	1
<u>Chrysostephanosphaera</u> <u>globulifera</u> Scherf.	1	1	1	1	1	1	1

Table Al.b. Cont'd.

TAXON	149	164	165	373	377	442	938
Dinobryon attenuatum	1	1	1	1	1	1	1
D. Borgei Lemm.	1	1	1	1	1	1	1
D. bavaricum Imhof	1	1	1	1	1	1	1
D. bavaricum var. <i>Vanhoeffenii</i> (Bach.) Krieger	1	1	1	1	1	1	1
D. crenulatum W. & G.S. West	1	1	1	1	1	1	1
D. cylindricum Imhof	1	1	1	1	1	1	1
D. divergens Imhof	1	1	1	1	1	1	1
D. sertularia Ehren.	1	1	1	1	1	1	1
D. sertularia var. <i>protuberans</i> (Lemm.) Krieger	1	1	1	1	1	1	1
D. sociale Ehren.	1	1	1	1	1	1	1
D. suecicum Lemm.	1	1	1	1	1	1	1
D. spp.	1	1	1	1	1	1	1
D. tubaeforme	1	1	1	1	1	1	1
Epiphyxis sp.	1	1	1	1	1	1	1
Gloeobotrys limneticus (G.M. Smith) Pascher	1	1	1	1	1	1	1
Kephyrion boreale Skuja	1	1	1	1	1	1	1
K. spirale (Lackey) Conrad	1	1	1	1	1	1	1
K. sp.	1	1	1	1	1	1	1
Mallomonas acaroides Perty	1	1	1	1	1	1	1
M. akrokomos Ruttner	1	1	1	1	1	1	1
M. dorsichnidii	1	1	1	1	1	1	1
M. caudata Iwanoff	1	1	1	1	1	1	1
M. hamata	1	1	1	1	1	1	1
M. maiorense Skuja	1	1	1	1	1	1	1
M. pseudocoronata	1	1	1	1	1	1	1
M. tonsurata Teiling	1	1	1	1	1	1	1
M. spp.	1	1	1	1	1	1	1
Ochromonas sp.	1	1	1	1	1	1	1
Pteridomonas sp.	1	1	1	1	1	1	1
Salpingoeca sp.	1	1	1	1	1	1	1
Spinifromonas trioralis	1	1	1	1	1	1	1
Stellexomonas dichotoma Lackey	1	1	1	1	1	1	1
Stichogloea spp.	1	1	1	1	1	1	1
Synura sphagnicola Korsch.	1	1	1	1	1	1	1
Uroglena americana Catkins	1	1	1	1	1	1	1

Table Al.b. Cont'd.

Taxon	149	164	165	373	377	442
Diatomeae						
<i>Asterionella formosa</i> Hassall	1	1	1	1	1	1
<i>Cyclotella stelligera</i>	1	1	1	1	1	1
<i>C. glomerata</i> Bach.	1	1	1	1	1	1
<i>Eragilaria construens</i> (Ehren.) Grunow	1	1	1	1	1	1
<i>E. crotoneensis</i> Kitton	1	1	1	1	1	1
<i>Gomphonema</i> sp.	1	1	1	1	1	1
<i>Melosira granulata</i> (Ehren.) Ralfs	1	1	1	1	1	1
<i>M. italica</i> Mueller	1	1	1	1	1	1
<i>M. italica</i> var. <i>subarctica</i> Mueller	1	1	1	1	1	1
<i>Rhizosolenia eriense</i> H.L. Smith	1	1	1	1	1	1
<i>Stauronies</i> sp.	1	1	1	1	1	1
<i>Synedra acus</i> Kutz.	1	1	1	1	1	1
<i>S. acus</i> var. <i>radians</i> (Kutz.) Hustede	1	1	1	1	1	1
<i>Synedra ulna</i> (Nitzsch) Ehren.	1	1	1	1	1	1
<i>Tabellaria fenestrata</i> (Lyngbya) Kutz.	1	1	1	1	1	1
<i>T. flocculosa</i> (Rothe) Kutz.	1	1	1	1	1	1
<i>T. intermedia</i>	1	1	1	1	1	1
Cryptophyceae						
<i>Cryptomonas erosa</i> Ehren.	1	1	1	1	1	1
<i>C. marssonii</i> Skuja	1	1	1	1	1	1
<i>C. ovata</i> Ehren.	1	1	1	1	1	1
<i>C. reflexa</i> (Marsson) Skuja	1	1	1	1	1	1
<i>C. rostriformis</i> Skuja	1	1	1	1	1	1
<i>C. sp.</i>	1	1	1	1	1	1
<i>Gonyostomum semen</i> (Ehren.) Diesing	1	1	1	1	1	1
<i>Katablepharis ovalis</i> Skuja	1	1	1	1	1	1
<i>Rhodomonas minuta</i> Skuja	1	1	1	1	1	1
<i>R. minuta</i> var. <i>dannoplanktonica</i> Skuja	1	1	1	1	1	1
Peridineae						
<i>Ceratium hirundinella</i> (Mueller) Schrank	1	1	1	1	1	1
<i>Gymnodinium helveticum</i> Penard	1	1	1	1	1	1
<i>G. sp.</i>	1	1	1	1	1	1

Table A1.b. Cont'd.

TAXON	149	164	165	373	377	442	938
<i>Peridinium aciculiferrim</i> Lemm.	1	1	1	1	1	1	1
<i>P. goslavense</i> Wołoszynska	1	1	1	1	1	1	1
<i>P. inconspicuum</i> Lemm.	1	1	1	1	1	1	1
<i>P. pusilla</i> (Penard) Lemm.	1	1	1	1	1	1	1
<i>P. Willei</i> Huitfeldt-Kaas	1	1	1	1	1	1	1
<i>P. wisconsiense</i> Eddy	1	1	1	1	1	1	1

APPENDIX 2

PHYTOPLANKTON PHOTOSYNTHESIS

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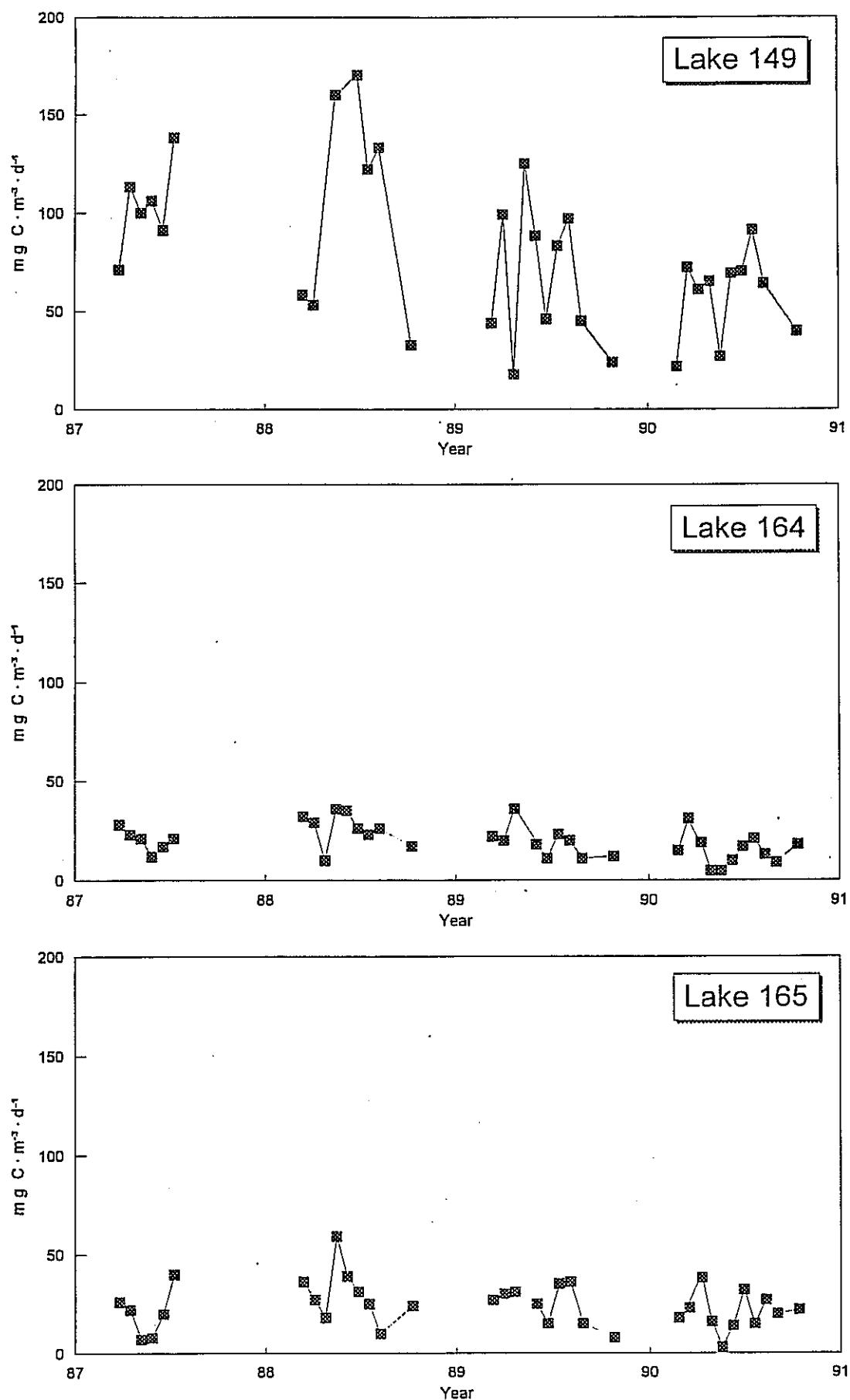


Figure A2.a. Seasonal patterns in photic zone phytoplankton photosynthesis from 1987-1990 for lakes 149, 164, and 165.

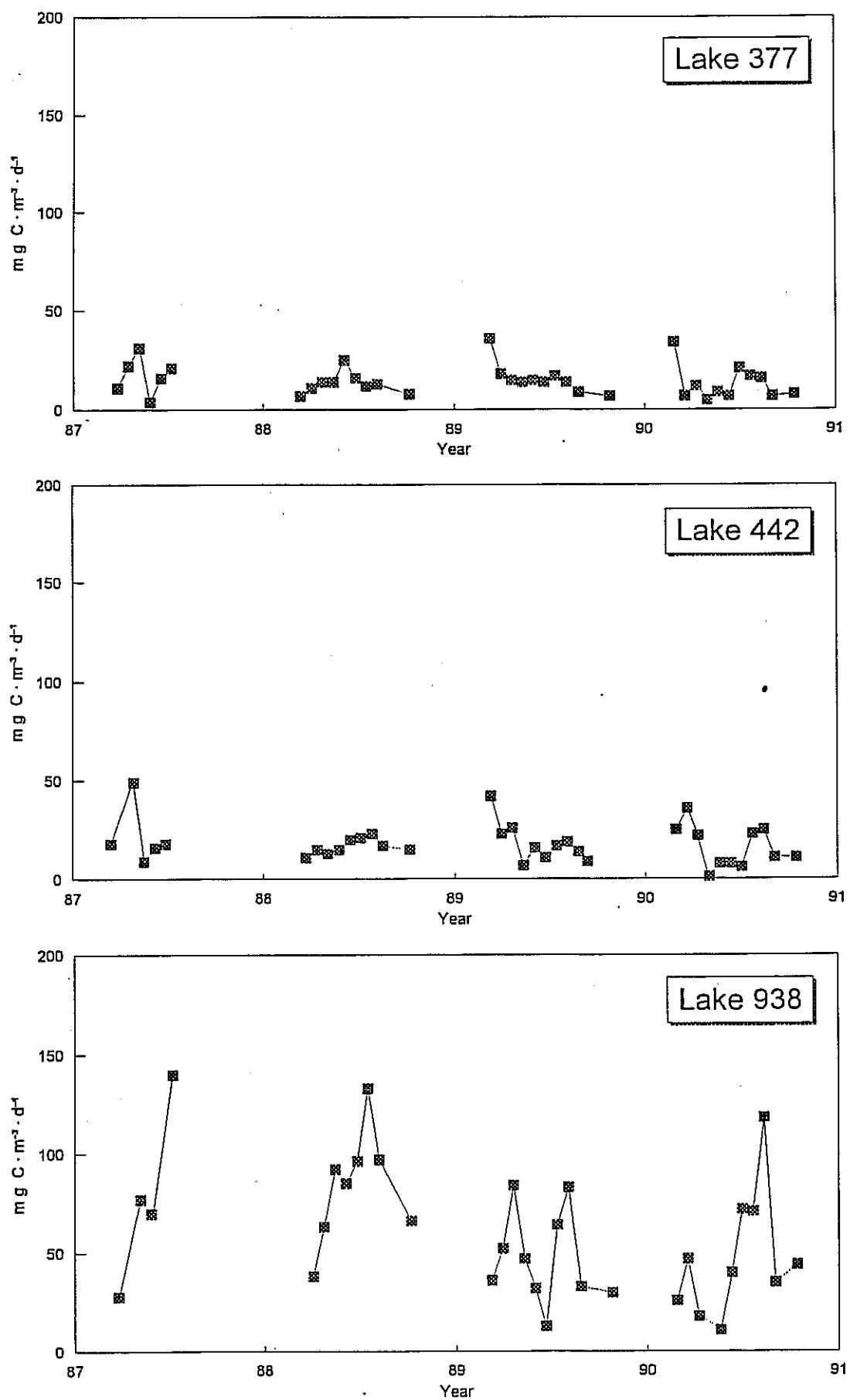


Figure A2.b. Seasonal patterns in photic zone phytoplankton photosynthesis from 1987-1990 for lakes 377, 442, and 938.

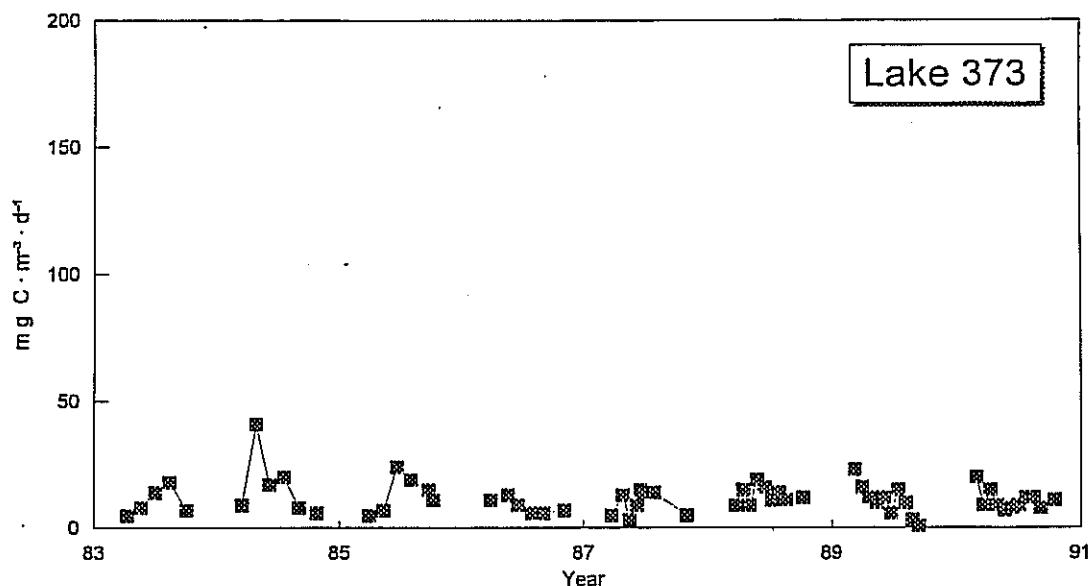


Figure A2.c. Seasonal patterns in photic zone phytoplankton photosynthesis from 1983-1990 for lake 373.

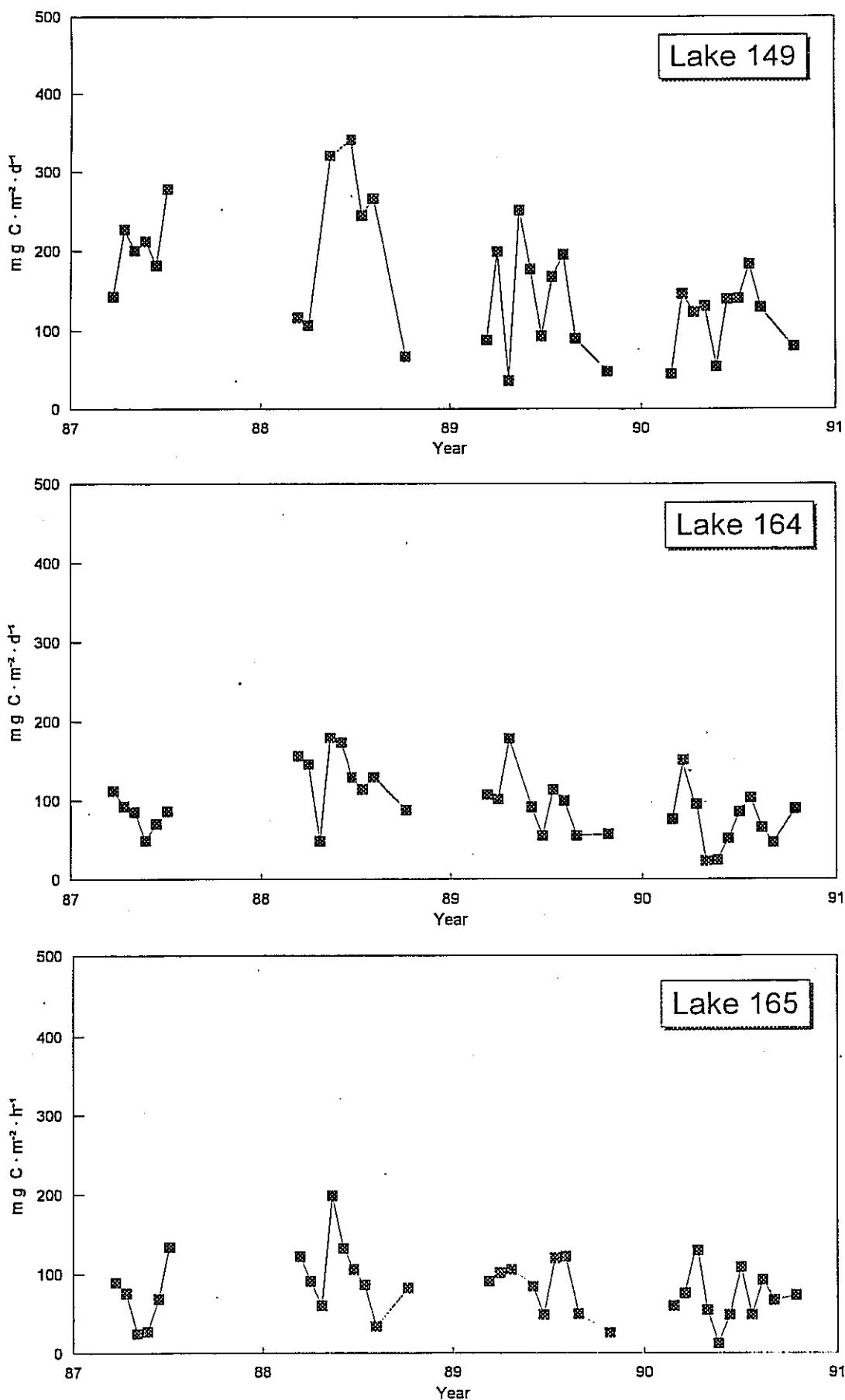


Figure A2.d. Seasonal patterns in areal phytoplankton photosynthesis from 1987-1990 for the epilimnion of lakes 149, 164, and 165.

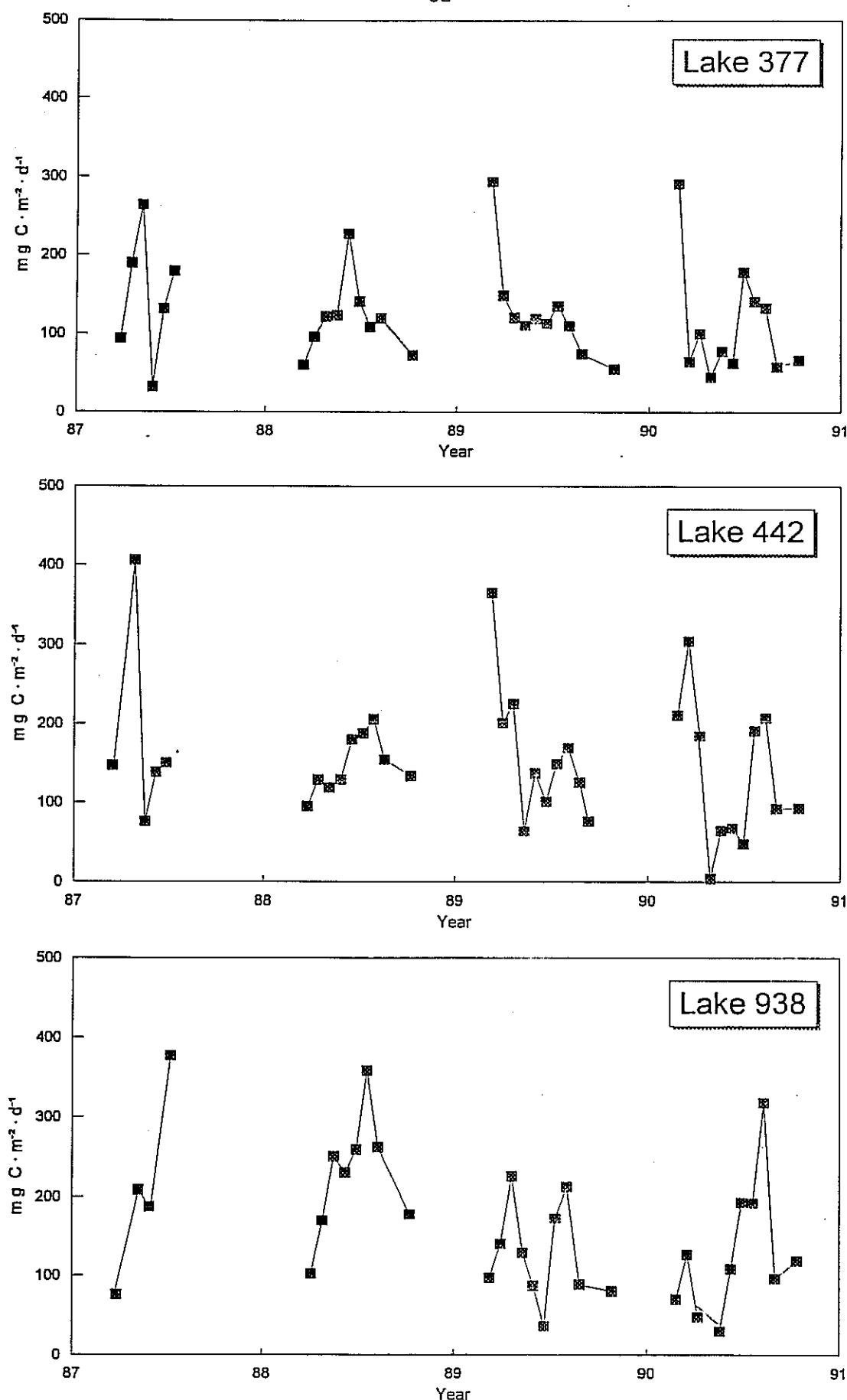


Figure A2.e. Seasonal patterns in areal phytoplankton photosynthesis from 1987-1990 for the epilimnion of lakes 377, 442, and 938.

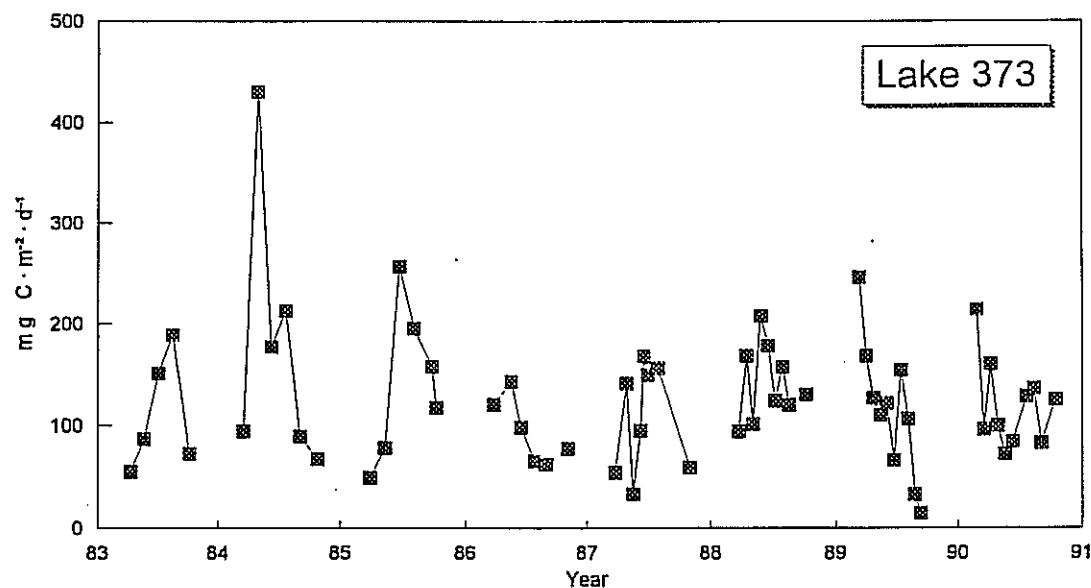


Figure A2.f. Seasonal patterns in areal phytoplankton photosynthesis from 1983-1990 for the epilimnion of lake 373.

Table A2.a. Daily volumetric phytoplankton photosynthesis (mg C·m⁻³·d⁻¹) 1987-1990 (L373, 1983-1990).

Date/Year	L149	L164	L165	L373	L377	L442	L938
1983							
Jun 7				5			
Jul 5				8			
Aug 2				14			
Aug 30				18			
Oct 4				7			
1984							
May 21				9			
Jun 18				41			
Jul 16				17			
Aug 13				20			
Sep 11				8			
Oct 16				6			
1985							
May 29				5			
Jun 26				7			
Jul 24				24			
Aug 21				19			
Sep 25				15			
Oct 5				11			
1986							
May 28				11			
Jul 2				13			
Jul 22				9			
Aug 19				6			
Sep 10				6			
Oct 22				7			
1987							
May 20							
May 26				5			
May 27	71	28	26				
Jun 3				22	nd	28	
Jun 10	113	23	22				
Jun 17				31	49	nd	
Jun 18				13			
Jun 24	100	21	7				
Jul 1				3	4	9	
Jul 8	106	12	8				
Jul 15				9	16	16	
Jul 21				15			
Jul 22	91	17	20				
Jul 29				14	21	18	
Aug 5	138	21	40				
Aug 18				14			
Oct 21				5			
1988							
May 18	58	32	36				
May 25				9	7	11	nd
Jun 1	53	29	27				
Jun 8				15	11	15	38
Jun 15				9	14	13	63
Jun 22	nd	10	18				

Date/Year	L149	L164	L165	L373	L377	L442	L938
1988							
Jun 29	160	36	59				92
Jul 6	nd	35	39	19	14	15	85
Jul 13							
Jul 20	170	26	31	16	25	20	96
Jul 27							
Aug 3							
Aug 10	122	23	25				133
Aug 17							
Aug 24	133	26	10	14	12	23	97
Aug 31							
Oct 4	33	17	24	12	8	15	66
1989							
May 17	44	22	27				36
May 18							
May 31	99	20	30				52
Jun 1							
Jun 14	18	36	31	16	18	23	84
Jun 15							
Jun 28	125	nd	nd	12	15	26	47
Jun 29							
Jul 12	88	18	25				32
Jul 13							
Jul 26	46	11	15	6	14	11	13
Jul 27							
Aug 9	83	23	35				64
Aug 10							
Aug 23	97	20	36	15	17	17	83
Aug 24							
Sep 6	45	11	15	3	9	14	33
Sep 7				1	7	9	30
Oct 18	24	12	8				
1990							
May 8	22	15	18				26
May 9							
May 22	72	31	23	20	34	25	47
May 23							
Jun 5	61	nd	nd	9	7	36	18
Jun 6							
Jun 7	nd	19	38	15	12	22	nd
Jun 19	65	5	16				nd
Jun 20							
Jul 3	27	5	3	9	5	1	11
Jul 4				7	9	8	40
Jul 17	69	10	14				
Jul 18							
Jul 31	70	17	32	8	7	8	72
Aug 1							
Aug 14	91	21	15	9	21	6	71
Aug 15							
Aug 28	64	13	27	12	17	23	118
Aug 29							
Sep 11	nd	9	20				
Sep 12							
Oct 9	40	18	22	8	11	44	
Oct 10				11	8	11	

Table A2.b. Daily photic zone phytoplankton photosynthesis ($\text{mg C}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$) 1987-1990 (L373, 1983-1990).
Uncorrected for morphometry.

Date/Year	L149	L164	L165	L373	L377	L442	L938
1983							
Jun 7				65			
Jul 5				128			
Aug 2				210			
Aug 30				252			
Oct 4				112			
1984							
May 21				117			
Jun 18				656			
Jul 16				255			
Aug 13				300			
Sep 11				104			
Oct 16				90			
1985							
May 29				65			
Jun 26				98			
Jul 24				336			
Aug 21				247			
Sep 25				180			
Oct 5				132			
1986							
May 28				132			
Jul 2				143			
Jul 22				117			
Aug 19				78			
Sep 10				72			
Oct 22				91			
1987							
May 20				nd	110	126	
May 26							
May 27	284	112	104				
Jun 3				198	nd	154	
Jun 10	452	nd	99				
Jun 17				279	nd		
Jun 18				nd			
Jun 24	400	116	28				
Jul 1				48	nd	90	
Jul 8	424	60	28				
Jul 15				117	192	128	
Jul 21							
Jul 22	364	68	80				
Jul 29				133	189	nd	
Aug 5	552	84	160				
Aug 18				nd			
Oct 21				60			
1988							
May 18	232	nd	162				
May 25				117	nd	88	
Jun 1	212	145	122				
Jun 8				225	110	135	
Jun 15		nd	60	72			
Jun 22				144	126	117	

Date/Year	L149	L164	L165	L373	L377	L442	L938
1988							
Jun 29	640	180	266				
Jul 6	nd	175	176	304	nd	90	506
Jul 13							468
Jul 20	680	104	124	240	225	180	528
Jul 27							
Aug 3				154	144	210	732
Aug 10	488	92	88				
Aug 17				210	108	276	
Aug 24	532	104	45				
Aug 31				165	117	187	534
Oct 4	132	77	96	180	76	150	363
1989							
May 17	176	110	122				
May 18				322	324	294	198
May 31	396	110	135				286
Jun 1				200	162	138	
Jun 14	72	198	109				
Jun 15				168	143	234	462
Jun 28	500	nd	nd				259
Jun 29				140	140	nd	
Jul 12	352	nd	88				
Jul 13				162	120	144	176
Jul 26	184	nd	nd				72
Jul 27				87	140	110	352
Aug 9	332	69	158				
Aug 10				210	145	153	
Aug 23	388	60	108				
Aug 24				nd	98	nd	
Sep 6	180	44	68				182
Sep 7				nd	nd	nd	
Oct 18	96	nd	nd				
1990							
May 8	88	75	72				
May 9				240	272	225	143
May 22	288	171	104				
May 23				108	60	252	259
Jun 5	244	nd	nd				
Jun 6				195	132	198	99
Jun 7	nd	95	152				
Jun 19	260	28	64				
Jun 20				126	58	10	
Jul 3	108	23	11				
Jul 4				105	90	88	
Jul 17	276	40	42				
Jul 18				120	63	80	220
Jul 31	280	77	112				
Aug 1				135	210	60	
Aug 14	364	95	53				
Aug 15				192	170	230	391
Aug 28	256	65	95				
Aug 29				nd	144	250	649
Sep 11	nd	41	90				
Sep 12				128	77	121	193
Oct 9	160	72	77				
Oct 10				154	72	88	242

Table A2.c Annual phytoplankton photosynthesis 1987-1990 (L373, L193-L1990).

Photic zone phytoplankton photosynthesis rates (g C·m ⁻² ·month ⁻¹)						
L149	May	Jun	Jul	Aug	Sep	Oct
1987	2.72	3.39	3.35	3.73	ns	ns
1988	1.50	2.72	4.54	3.55	1.92	0.84
1989	1.51	2.26	3.53	2.33	2.04	1.05
1990	2.77	3.50	2.47	2.37	1.28	0.87
Photic zone phytoplankton photosynthesis rates (g C·m ⁻² ·month ⁻¹)						
L149	May	Jun	Jul	Aug	Sep	Oct
1987	5.46	6.78	6.71	7.46	ns	ns
1988	3.07	5.44	9.10	7.11	3.85	1.69
1989	3.02	4.53	7.08	4.67	4.10	2.10
1990	5.55	7.01	4.94	4.75	2.57	1.74
Photic zone phytoplankton photosynthesis rates (g C·m ⁻² ·month ⁻¹)						
L164	May	Jun	Jul	Aug	Sep	Oct
1987	0.86	0.68	0.49	0.47	ns	ns
1988	0.84	0.70	0.95	0.70	0.60	0.45
1989	0.58	1.40	0.63	0.55	0.41	0.32
1990	1.21	1.71	0.59	0.73	0.58	0.87
Photic zone phytoplankton photosynthesis rates (g C·m ⁻² ·month ⁻¹)						
L164	May	Jun	Jul	Aug	Sep	Oct
1987	4.05	3.18	2.29	2.18	ns	ns
1988	3.94	3.29	4.44	3.27	2.80	2.11
1989	2.73	6.57	2.93	2.60	1.94	1.48
1990	4.97	7.04	2.43	3.02	2.18	1.74
Photic zone phytoplankton photosynthesis rates (g C·m ⁻² ·month ⁻¹)						
L165	May	Jun	Jul	Aug	Sep	Oct
1987	1.14	0.52	0.64	1.05	ns	ns
1988	0.86	0.95	1.14	0.51	0.50	0.48
1989	0.71	1.46	0.75	1.03	0.66	0.34
1990	1.19	0.84	0.60	0.66	0.85	0.51
Photic zone phytoplankton photosynthesis rates (g C·m ⁻² ·month ⁻¹)						
L165	May	Jun	Jul	Aug	Sep	Oct
1987	3.64	1.68	2.04	3.36	ns	ns
1988	2.91	3.22	3.86	1.73	1.70	1.61
1989	2.26	4.67	2.41	3.30	2.13	1.10
1990	3.83	2.68	1.93	2.12	2.74	1.62
Photic zone phytoplankton photosynthesis rates (g C·m ⁻² ·month ⁻¹)						
L373	May	Jun	Jul	Aug	Sep	Oct
1983	0.12	0.14	0.29	0.44	0.40	0.28
1984	0.40	0.81	0.74	0.54	0.28	0.21
1985	0.42	0.53	0.75	0.50	0.38	0.29
1986	0.26	0.40	0.30	0.22	0.17	0.16
1987	0.43	0.45	0.32	0.44	0.32	0.20
1988	0.24	0.38	0.57	0.45	0.29	0.29
1989	0.43	0.36	0.72	0.38	0.73	0.19
1990	0.75	0.65	0.32	0.47	0.43	0.33

Photic zone phytoplankton photosynthesis rates (g C·m ⁻² ·month ⁻¹)						
L373	May	Jun	Jul	Aug	Sep	Oct
1983	1.24	1.48	2.99	4.62	4.21	2.95
1984	4.23	8.52	7.73	5.67	2.91	2.17
1985	4.25	5.33	7.51	5.01	3.76	2.86
1986	2.69	4.07	3.04	2.24	1.75	1.62
1987	4.14	4.39	3.13	4.23	3.09	1.96
1988	2.57	4.06	6.04	4.76	3.04	3.03
1989	4.23	3.50	7.03	3.73	7.12	1.83
1990	6.07	5.24	2.59	3.75	3.49	2.68
Photic zone phytoplankton photosynthesis rates (g C·m ⁻² ·month ⁻¹)						
L377	May	Jun	Jul	Aug	Sep	Oct
1987	0.63	0.72	0.42	0.53	ns	ns
1988	0.19	0.36	0.62	0.47	0.29	0.19
1989	0.58	0.43	0.54	0.41	0.25	0.17
1990	0.11	0.33	0.33	0.49	0.32	0.21
Photic zone phytoplankton photosynthesis rates (g C·m ⁻² ·month ⁻¹)						
L377	May	Jun	Jul	Aug	Sep	Oct
1987	5.14	5.84	3.43	4.36	ns	ns
1988	1.68	3.23	5.63	4.31	2.64	1.73
1989	4.71	3.52	4.38	3.33	2.08	1.39
1990	9.57	2.85	2.79	4.20	2.78	1.84
Photic zone phytoplankton photosynthesis rates (g C·m ⁻² ·month ⁻¹)						
L442	May	Jun	Jul	Aug	Sep	Oct
1987	0.94	0.97	0.49	0.43		2.82
1988	0.32	0.43	0.63	0.75	0.44	0.37
1989	0.86	0.76	0.65	0.53	0.42	0.24
1990	1.42	0.29	0.31	0.84	0.63	0.32
Photic zone phytoplankton photosynthesis rates (g C·m ⁻² ·month ⁻¹)						
L442	May	Jun	Jul	Aug	Sep	Oct
1987	7.32	7.87	3.93	3.46		22.58
1988	2.70	3.66	5.31	6.35	3.71	3.18
1989	6.40	5.62	4.82	3.96	3.11	1.76
1990	10.21	2.14	2.22	6.04	4.56	2.27
Photic zone phytoplankton photosynthesis rates (g C·m ⁻² ·month ⁻¹)						
L938	May	Jun	Jul	Aug	Sep	Oct
1987	1.06	2.19	2.46	3.70	ns	ns
1988	1.14	2.26	2.60	3.07	2.18	1.66
1989	0.96	1.66	1.19	1.71	1.00	0.68.
1990	1.76	2.82	1.76	2.68	1.63	0.99
Photic zone phytoplankton photosynthesis rates (g C·m ⁻² ·month ⁻¹)						
L938	May	Jun	Jul	Aug	Sep	Oct
1987	2.90	5.97	6.72	10.11	ns	ns
1988	3.13	6.18	7.11	8.39	5.95	4.53
1989	2.64	4.54	3.25	4.67	2.74	1.87
1990	4.81	7.73	4.81	7.36	4.47	2.71

APPENDIX 3

PHYTOPLANKTON NUTRIENT STATUS INDICATORS

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<u>Table</u>		<u>Page</u>
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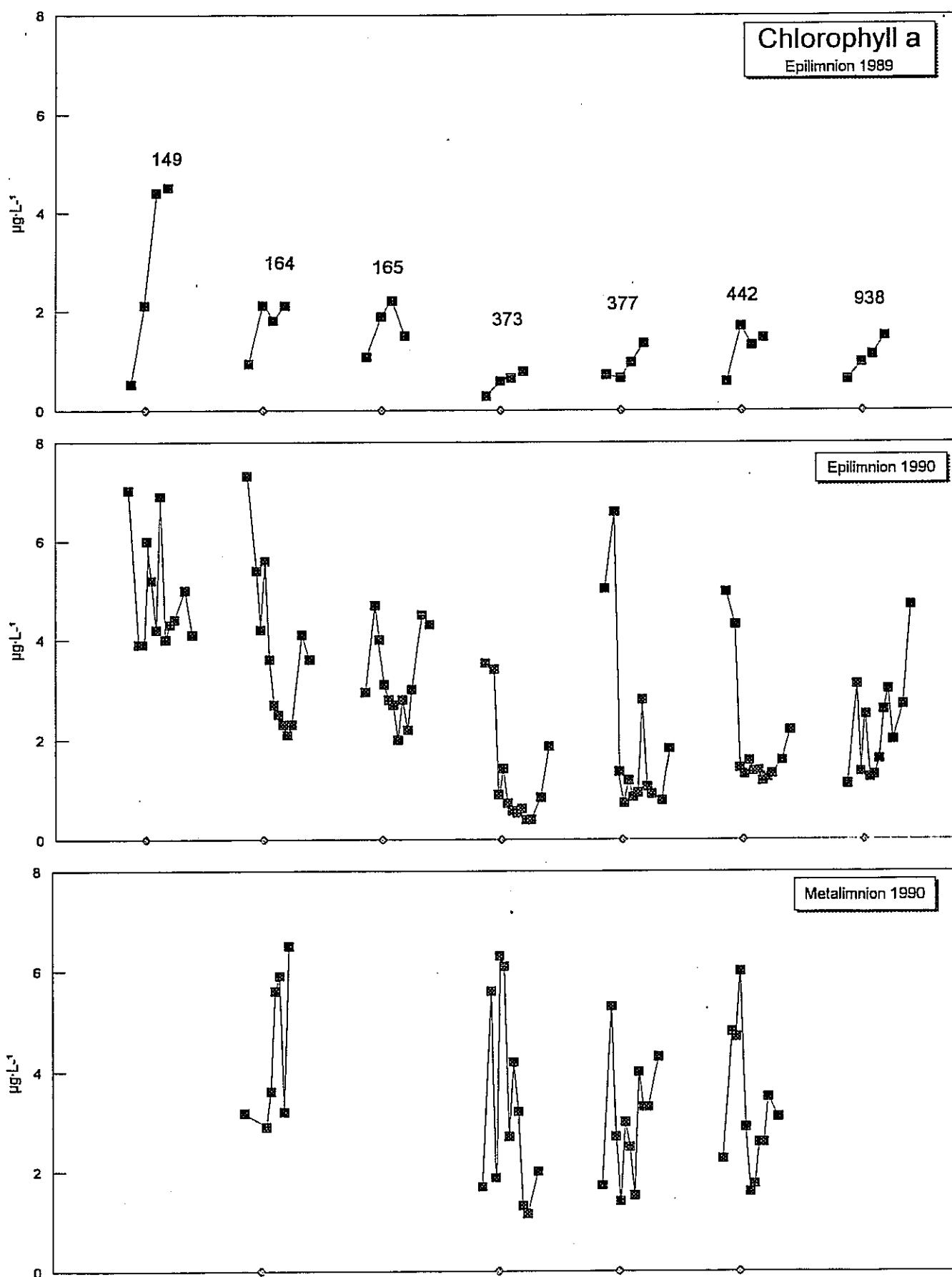


Figure A3.a Chlorophyll a in epilimnion and metalimnion phytoplankton by weight. Index marks along x-axis denote June 1.

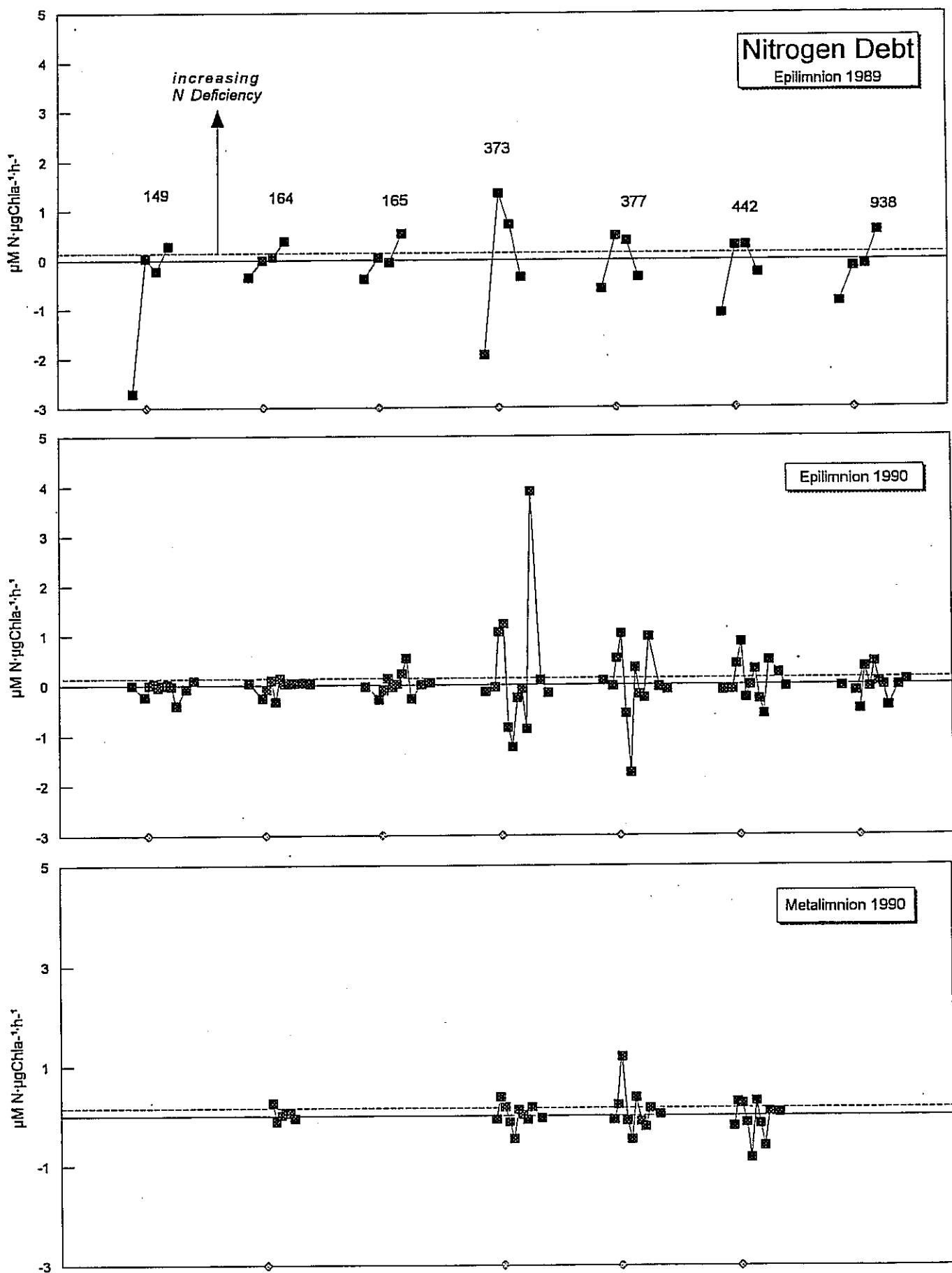


Figure A3.b Nitrogen debt in epilimnion and metalimnion phytoplankton. Index marks along x-axis denote June 1.

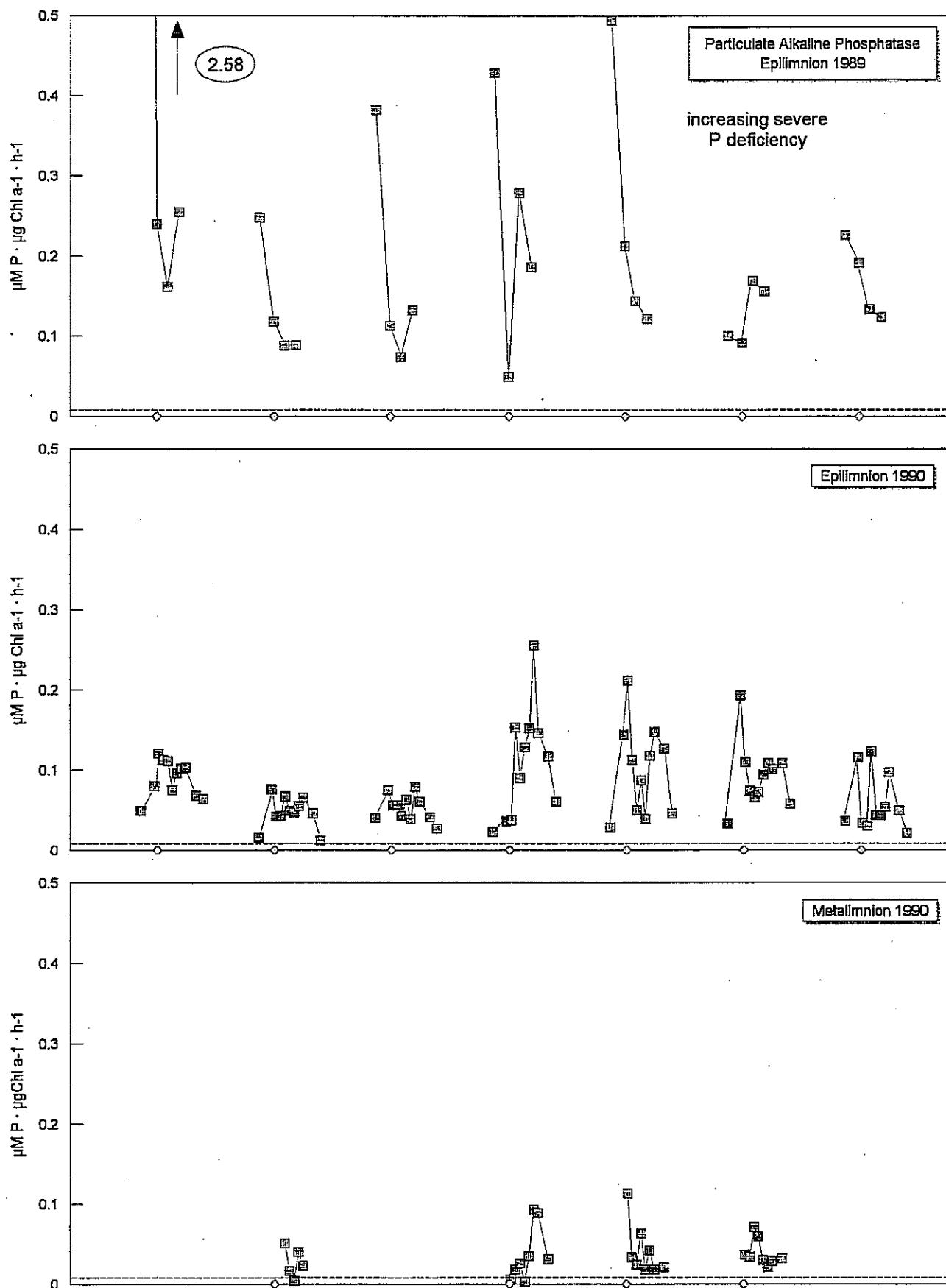


Figure A3.c. Particulate alkaline phosphatase in epilimnion and metalimnion phytoplankton. Index marks along x-axis denotes June 1.

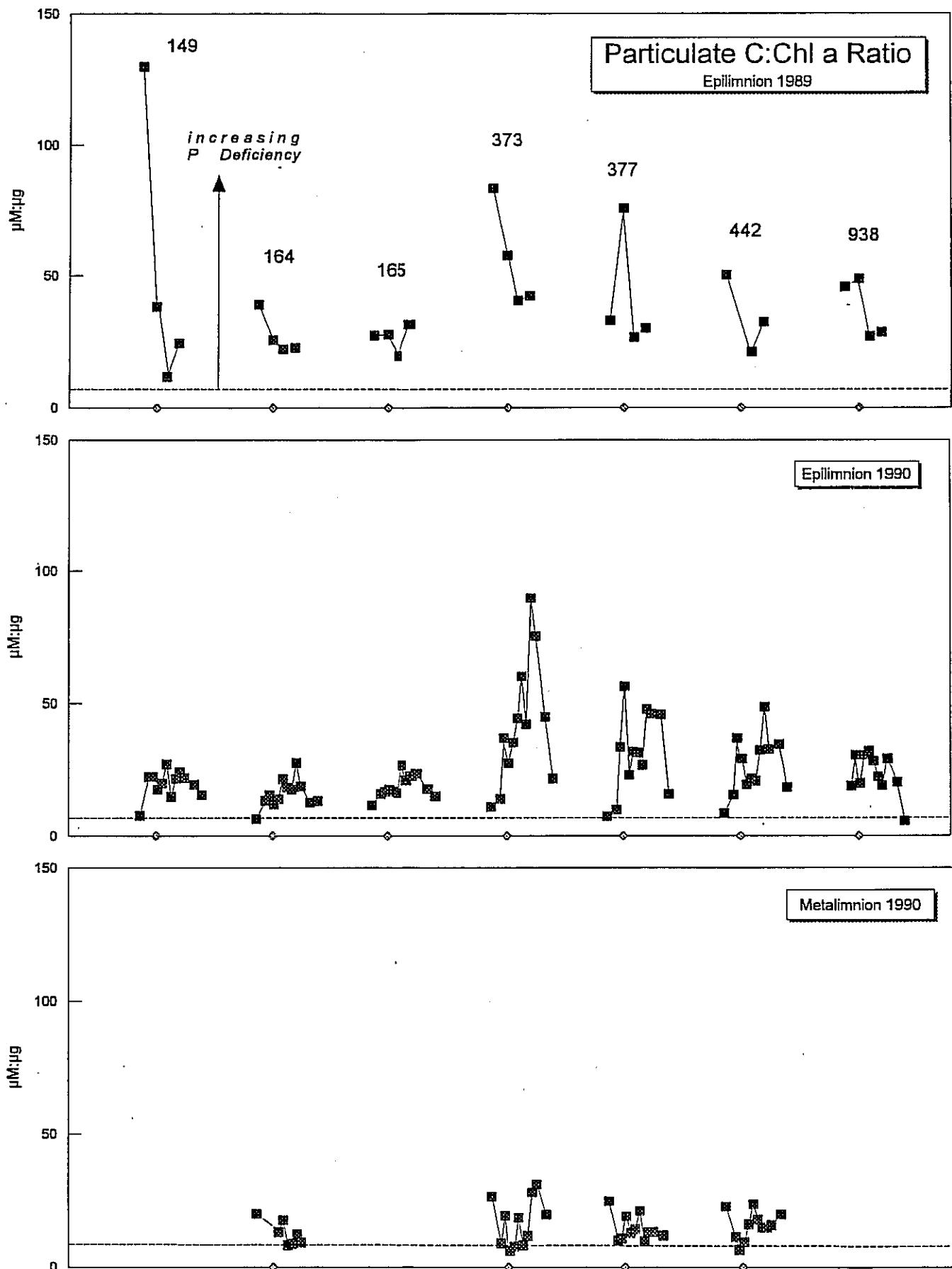


Figure A3.d Particulate C:Chl a ratio in epilimnion and metalimnion phytoplankton. Index marks along x-axis denote June 1.

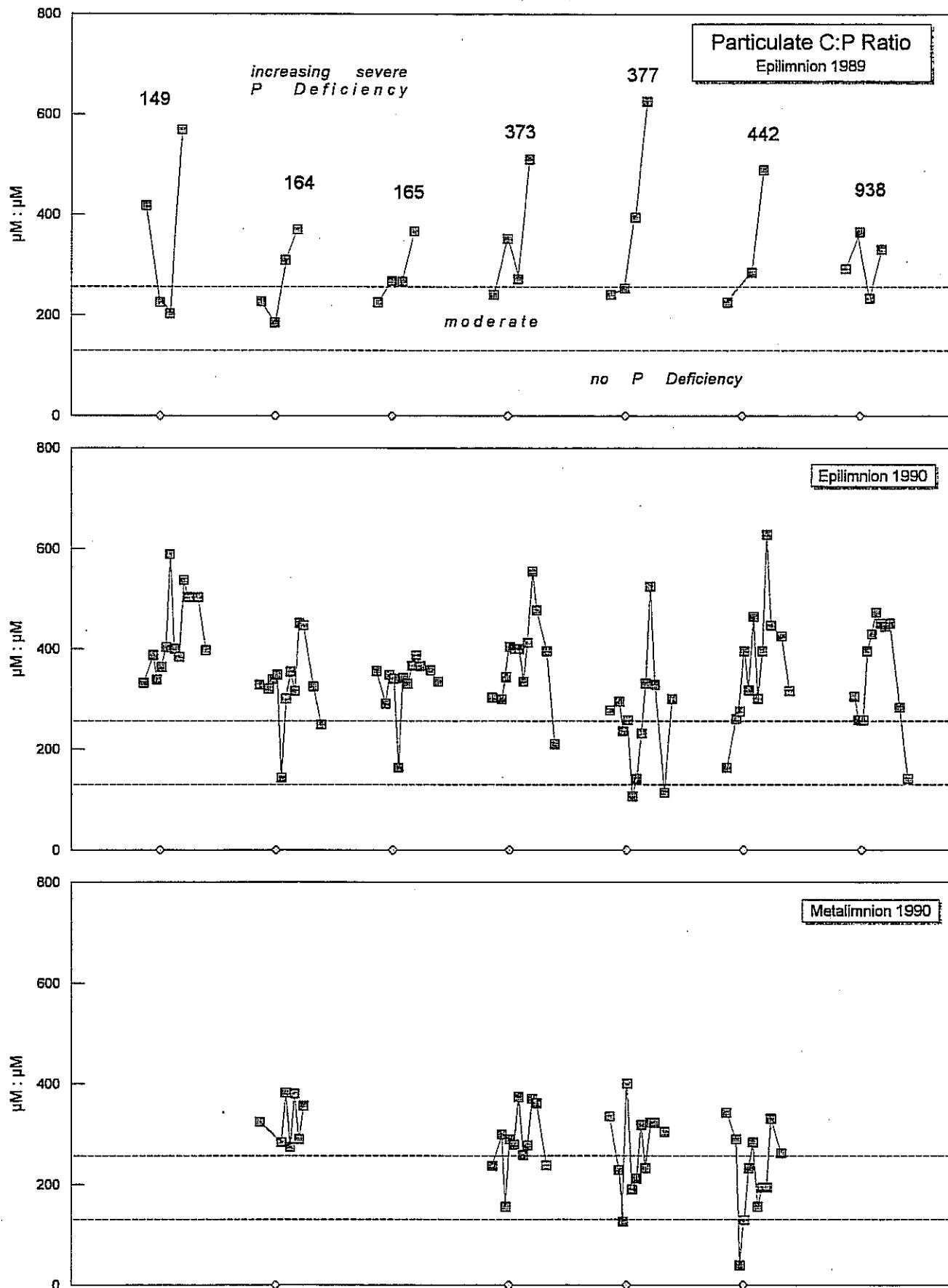


Figure A3.e. Particulate C:P ratio in epilimnion and metalimnion phytoplankton. Index marks along x-axis denote June 1.

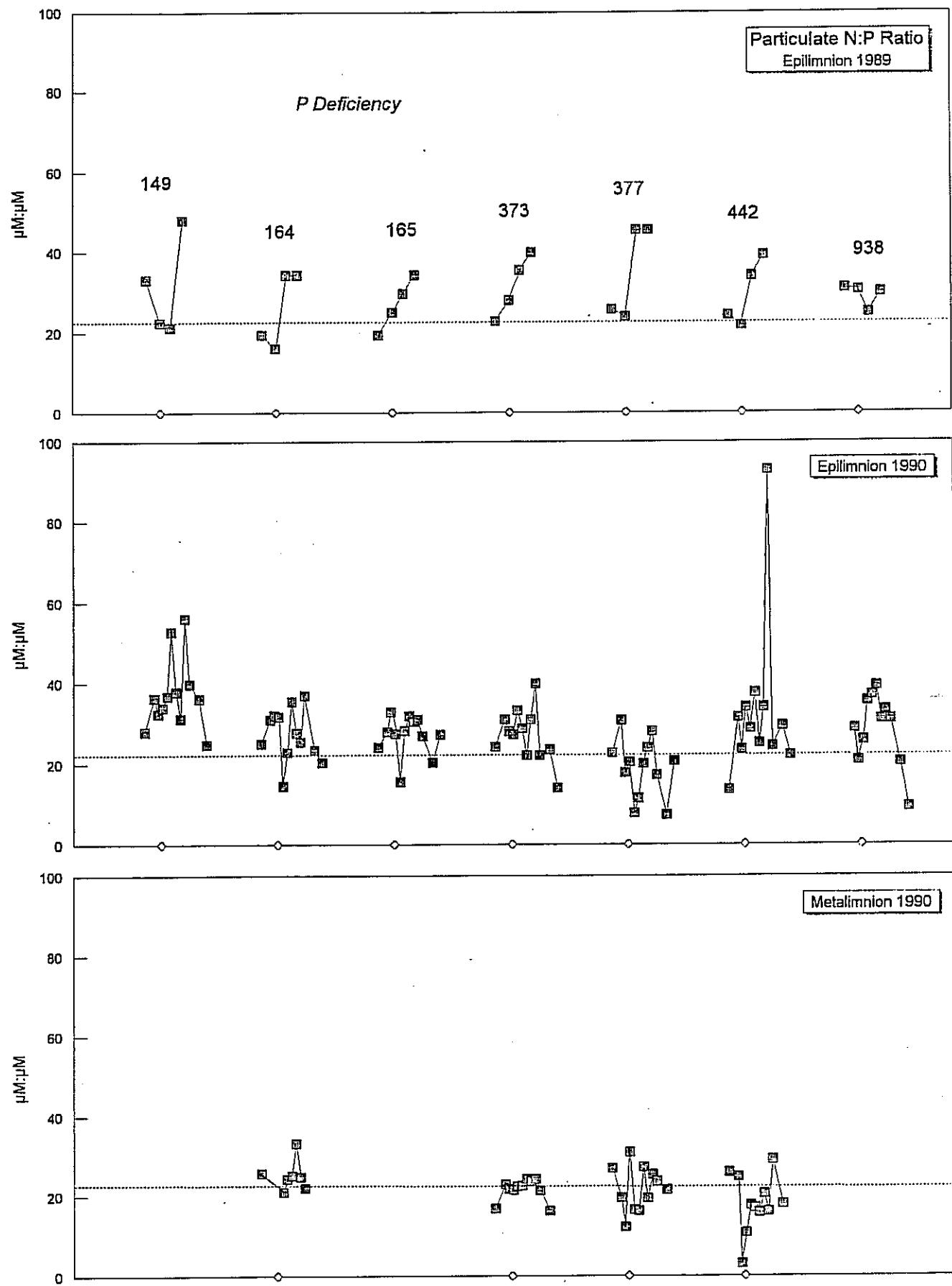


Figure A3.f. Particulate N:P ratio in epilimnion and metalimnion phytoplankton. Index marks along x-axis denotes June 1.

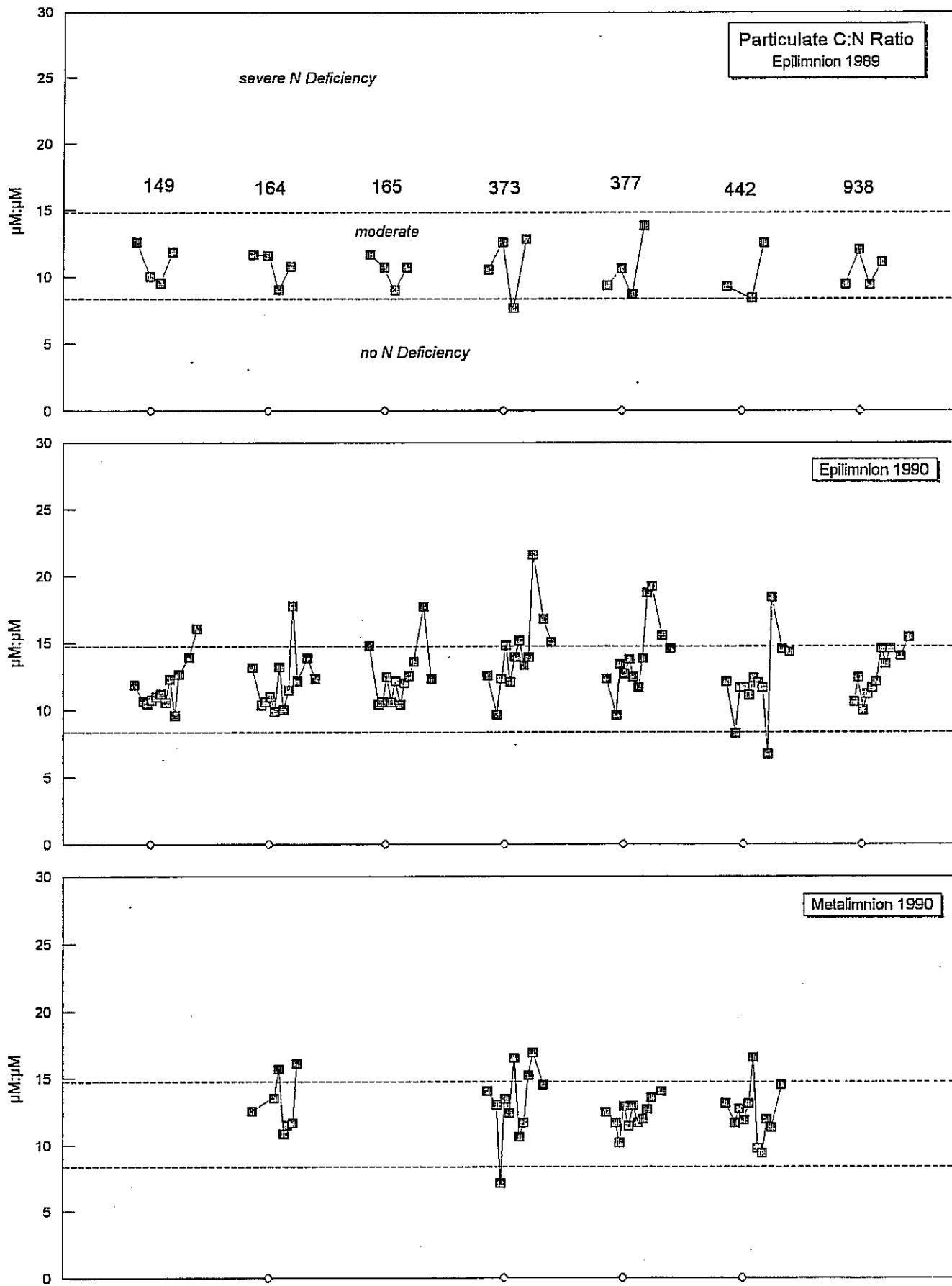


Figure A3.g. Particulate C:N ratio in epilimnion and metalimnion phytoplankton. Index marks along x-axis denote June 1.

Table A3.a. Summary of volumetric and areal phytoplankton nutrient status parameters of the Lake Variation and Climate Change Study lakes for 1989-1990

Lake: 149 epi													
Date	Susp N µM/L	Susp C µM/L	Susp P µM/L	Chla µg/L	C/Chla µM/µg	C/N µM/µM	N/P µM/µM	C/P µM/µM	NDebt µMN/L/h	NDebt µMN/µgChl/24h	A-Pase(T) µMP/h	A-Pase(S) µMP/h	A-Pase(C) µMP/µgChla/h
04/18/89	5.4	67.4	0.2	0.5	129.7	12.6	33.2	418.2	-1.4	-2.7	1.7	0.4	2.6
05/31/89	8.0	80.0	0.4	2.1	38.1	10.0	22.5	225.5	0.1	0.0	0.6	0.1	0.2
07/03/89	5.5	52.4	0.3	4.4	11.9	9.5	21.3	202.9	-1.0	-0.2	0.9	0.2	0.2
08/09/89	9.3	110.1	0.2	4.5	24.5	11.9	47.9	568.7	1.3	0.3	1.3	0.1	0.3
Mean	7.0	77.5	0.2	2.9	51.0	11.0	31.2	353.8	-0.3	-0.7	1.1	0.2	0.8
Date	Photic Depth (m)	Susp N (mg/m³)	Susp C (mg/m³)	Susp P (mg/m³)	Chla (mg/m³)	NDebt mMN/m²/h	A-Pase(C) mMP/m²/h						
04/18/89	4.0	300.0	3240.0	20.0	2.1	-5.6	5.4						
05/31/89	4.0	448.0	3844.0	44.0	8.4	0.2	2.0						
07/03/89	4.0	308.0	2516.0	32.0	17.6	-3.8	2.8						
08/09/89	4.0	520.0	5288.0	24.0	18.0	5.1	4.6						
Mean	4.0	394.0	3722.0	30.0	11.5	-1.0	3.7						
Lake: 164 epi													
Date	Susp N µM/L	Susp C µM/L	Susp P µM/L	Chla µg/L	C/Chla µM/µg	C/N µM/µM	N/P µM/µM	C/P µM/µM	NDebt µMN/L/h	NDebt µMN/µgChl/24h	A-Pase(T) µMP/h	A-Pase(S) µMP/h	A-Pase(C) µMP/µgChla/h
04/18/89	3.1	36.6	0.2	0.9	39.0	11.7	19.5	227.1	-0.3	-0.4	0.2	0.0	0.2
05/31/89	4.6	53.8	0.3	2.1	25.6	11.6	16.0	185.3	-0.0	-0.0	0.3	0.1	0.1
07/03/89	4.4	40.0	0.1	1.8	22.2	9.0	34.3	309.7	0.1	0.1	0.2	0.0	0.1
08/09/89	4.4	47.7	0.1	2.1	22.7	10.8	34.3	369.8	0.8	0.4	0.2	0.0	0.1
Mean	4.2	44.5	0.2	1.7	27.4	10.8	26.0	273.0	0.1	0.0	0.2	0.0	0.1
Date	Photic Depth (m)	Susp N (mg/m³)	Susp C (mg/m³)	Susp P (mg/m³)	Chla (mg/m³)	NDebt mMN/m²/h	A-Pase(C) mMP/m²/h						
04/18/89	nd	nd	nd	nd	nd	nd	nd						
05/31/89	5.5	357.5	3553.0	49.5	11.6	-0.1	1.4						
07/03/89	nd	nd	nd	nd	nd	nd	nd						
08/09/89	3.0	186.0	1719.0	12.0	6.3	2.4	0.6						
Mean	4.3	271.8	2636.0	30.8	8.9	1.2	1.0						
Lake: 165 epi													
Date	Susp N µM/L	Susp C µM/L	Susp P µM/L	Chla µg/L	C/Chla µM/µg	C/N µM/µM	N/P µM/µM	C/P µM/µM	NDebt µMN/L/h	NDebt µMN/µgChl/24h	A-Pase(T) µMP/h	A-Pase(S) µMP/h	A-Pase(C) µMP/µgChla/h
04/18/89	2.5	29.1	0.1	1.1	27.2	11.7	19.4	225.9	-0.4	-0.4	0.5	0.1	0.4
05/31/89	4.9	51.9	0.2	1.9	27.6	10.7	25.1	268.0	0.1	0.0	0.3	0.1	0.1
07/03/89	4.8	43.0	0.2	2.2	19.6	9.0	29.7	266.9	-0.1	-0.1	0.2	0.0	0.1
08/09/89	4.4	47.4	0.1	1.5	31.6	10.7	34.3	367.2	0.8	0.5	0.3	0.1	0.1
Mean	4.1	42.9	0.2	1.7	26.5	10.5	27.1	282.0	0.1	0.0	0.3	0.1	0.2
Date	Photic Depth (m)	Susp N (mg/m³)	Susp C (mg/m³)	Susp P (mg/m³)	Chla (mg/m³)	NDebt mMN/m²/h	A-Pase(C) mMP/m²/h						
04/18/89	nd	nd	nd	nd	nd	nd	nd						
05/31/89	4.5	306.0	2803.5	27.0	8.5	0.4	1.0						
07/03/89	nd	nd	nd	nd	nd	nd	nd						
08/09/89	4.5	279.0	2560.5	18.0	6.8	3.6	0.9						
Mean	4.5	292.5	2682.0	22.5	7.6	2.0	0.9						
Lake: 373 epi													
Date	Susp N µM/L	Susp C µM/L	Susp P µM/L	Chla µg/L	C/Chla µM/µg	C/N µM/µM	N/P µM/µM	C/P µM/µM	NDebt µMN/L/h	NDebt µMN/µgChl/24h	A-Pase(T) µMP/h	A-Pase(S) µMP/h	A-Pase(C) µMP/µgChla/h
04/17/89	2.2	23.3	0.1	0.3	83.3	10.5	22.9	240.9	-0.5	-1.9	0.1	0.0	0.4
06/01/89	2.7	34.1	0.1	0.6	57.7	12.6	26.0	351.9	0.8	1.3	0.1	0.0	0.0
07/03/89	3.4	26.3	0.1	0.7	40.5	7.7	35.4	271.9	0.5	0.7	0.2	0.0	0.3
08/10/89	2.6	32.9	0.1	0.8	42.2	12.8	39.8	509.8	-0.3	-0.3	0.2	0.0	0.2
Mean	2.7	29.1	0.1	0.6	55.9	10.9	31.5	343.6	0.1	-0.1	0.1	0.0	0.2
Date	Photic Depth (m)	Susp N (mg/m³)	Susp C (mg/m³)	Susp P (mg/m³)	Chla (mg/m³)	NDebt mMN/m²/h	A-Pase(C) mMP/m²/h						
04/17/89	nd	nd	nd	nd	nd	nd	nd						
06/01/89	12.5	475.0	5112.5	37.5	7.4	9.9	0.4						
07/03/89	nd	nd	nd	nd	nd	nd	nd						
08/10/89	14.0	504.0	5530.0	28.0	10.9	-3.6	2.0						
Mean	13.3	489.5	5321.3	32.8	9.1	3.0	1.2						

Table A3.a. continued...

Lake: 377 epi													
Date	Susp N µM/L	Susp C µM/L	Susp P µM/L	Chla µg/L	C/Chla µM/µg	C/N µM/µM	N/P µM/µM	C/P µM/µM	NDebt µMN/L/h	NDebt µMN/µgChl/24h	A-Pase(T) µMP/h	A-Pase(S) µMP/h	A-Pase(C) µMP/µgChla/h
04/17/89	2.5	23.3	0.1	0.7	32.8	9.3	25.8	240.9	-0.4	-0.6	0.4	0.0	0.5
06/01/89	4.6	49.1	0.2	0.7	75.6	10.6	24.0	253.8	0.3	0.5	0.2	0.0	0.2
07/03/89	2.9	25.5	0.1	1.0	26.5	8.7	45.4	394.9	0.4	0.4	0.2	0.0	0.1
08/10/89	2.9	40.4	0.1	1.4	29.9	13.8	45.4	625.9	-0.5	-0.3	0.2	0.0	0.1
Mean	3.2	34.6	0.1	0.9	41.2	10.6	35.1	378.9	-0.1	-0.0	0.2	0.0	0.2
Date	Photic Depth (m)	Susp N (mg/m³)	Susp C (mg/m³)	Susp P (mg/m³)	Chla (mg/m³)	NDebt mMN/m²/h	A-Pase(C) mMP/m²/h						
04/17/89	nd	nd	nd	nd	nd	nd	nd						
06/01/89	9.0	585.0	5310.0	54.0	5.9	2.8	1.2						
07/03/89	nd	nd	nd	nd	nd	nd	nd						
08/10/89	8.5	348.5	4122.5	17.0	11.5	-4.0	1.4						
Mean	8.8	466.8	4716.3	35.5	8.7	-0.6	1.3						
Lake: 442 epi													
Date	Susp N µM/L	Susp C µM/L	Susp P µM/L	Chla µg/L	C/Chla µM/µg	C/N µM/µM	N/P µM/µM	C/P µM/µM	NDebt µMN/L/h	NDebt µMN/µgChl/24h	A-Pase(T) µMP/h	A-Pase(S) µMP/h	A-Pase(C) µMP/µgChla/h
04/17/89	3.1	29.1	0.1	0.6	50.2	9.3	24.3	225.9	-0.6	-1.1	0.2	0.1	0.1
06/01/89	4.2	0.2	1.7					21.8	0.5	0.3	0.2	0.0	0.1
07/03/89	3.3	27.6	0.1	1.3	21.1	8.4	33.9	285.7	0.4	0.3	0.3	0.1	0.2
08/10/89	3.8	47.4	0.1	1.5	32.5	12.5	39.1	489.6	-0.4	-0.3	0.3	0.1	0.2
Mean	3.6	34.7	0.1	1.3	34.6	10.1	29.8	333.7	-0.0	-0.2	0.2	0.1	0.1
Date	Photic Depth (m)	Susp N (mg/m³)	Susp C (mg/m³)	Susp P (mg/m³)	Chla (mg/m³)	NDebt mMN/m²/h	A-Pase(C) mMP/m²/h						
04/17/89	nd	nd	nd	nd	nd	nd	nd						
06/01/89	6.0	354.0	0.0	36.0	10.1	2.8	0.9						
07/03/89	nd	nd	nd	nd	nd	nd	nd						
08/10/89	9.0	477.0	5121.0	27.0	13.1	-3.4	2.0						
Mean	7.5	416.5	2860.5	31.5	11.6	-0.3	1.5						
Lake: 938 epiW													
Date	Susp N µM/L	Susp C µM/L	Susp P µM/L	Chla µg/L	C/Chla µM/µg	C/N µM/µM	N/P µM/µM	C/P µM/µM	NDebt µMN/L/h	NDebt µMN/µgChl/24h	A-Pase(T) µMP/h	A-Pase(S) µMP/h	A-Pase(C) µMP/µgChla/h
04/18/89	3.0	28.3	0.1	0.6	45.7	9.4	31.0	292.5	-0.5	-0.8	0.1	0.0	0.2
05/31/89	3.9	47.1	0.1	1.0	48.6	12.0	30.4	365.2	-0.1	-0.1	0.2	0.0	0.2
07/03/89	3.2	30.2	0.1	1.1	27.0	9.4	24.9	234.2	-0.1	-0.1	0.2	0.0	0.1
08/09/89	3.9	42.8	0.1	1.5	28.5	11.1	29.9	331.7	0.9	0.6	0.2	0.1	0.1
Mean	3.5	37.1	0.1	1.1	37.4	10.5	29.0	305.9	0.0	-0.1	0.2	0.0	0.2
Date	Photic Depth (m)	Susp N (mg/m³)	Susp C (mg/m³)	Susp P (mg/m³)	Chla (mg/m³)	NDebt mMN/m²/h	A-Pase(C) mMP/m²/h						
04/18/89	5.5	231.0	1870.0	16.5	3.4	-2.9	0.8						
05/31/89	5.5	302.5	3113.0	22.0	5.3	-0.8	1.0						
07/03/89	5.5	247.5	1996.5	22.0	6.2	-0.6	0.8						
08/09/89	5.5	297.0	2837.0	22.0	8.3	4.7	1.0						
Mean	5.5	269.5	2451.6	20.6	5.8	0.1	0.9						

Table A3.a, continued.....

Lake:
149 epi

Date	Susp N µM/L	Susp C µM/L	Susp P µM/L	Chla µg/L	C/Chla µM/µg	C/N µM/µM	N/P µM/µM	C/P µM/µM	NDebt µMN/L/h	NDebt µMN/µgChl/24h	A-Pase(T) µMP/h	A-Pase(S) µMP/h	A-Pase(C) µMP/µgChla/h
04/10/90	4.6	54.6	0.2	7.0	7.8	11.8	28.0	332.0	0.00	0.00	0.60	0.25	0.05
05/08/90	8.2	87.4	0.2	3.9	22.4	10.6	36.4	387.2					
05/22/90	8.4	87.4	0.3	3.9	22.4	10.5	32.4	338.8	-0.91	-0.23	0.46	0.15	0.08
06/05/90	9.9	105.7	0.3	6.0	17.6	10.7	33.9	364.2	0.00	0.00	0.95	0.22	0.12
06/19/90	9.5	104.1	0.3	5.2	20.0	11.0	36.8	403.3	0.11	0.02	0.81	0.22	0.11
07/03/90	10.2	114.1	0.2	4.2	27.2	11.2	52.7	589.4	-0.21	-0.05	0.78	0.32	0.11
07/17/90	9.8	103.2	0.3	6.9	15.0	10.6	37.9	400.1	0.06	-0.01	0.80	0.28	0.08
07/31/90	7.1	86.6	0.2	4.0	21.6	12.3	31.3	383.5	0.06	0.02	0.51	0.12	0.10
08/14/90	10.9	104.1	0.2	4.3	24.2	9.6	56.1	537.7	-0.10	-0.02	0.66	0.22	0.10
08/28/90	7.7	97.4	0.2	4.4	22.1	12.6	39.8	503.3	-1.77	-0.40	0.66	0.21	0.10
09/25/90	7.0	97.4	0.2	5.0	19.5	13.9	36.1	503.3	-0.36	-0.07	0.77	0.43	0.07
10/23/90	4.0	64.1	0.2	4.1	15.6	16.0	24.8	397.5	0.35	0.09	0.51	0.25	0.06
Mean	8.1	92.2	0.2	4.9	19.6	11.7	37.2	428.4	-0.25	-0.06	0.68	0.24	0.09

Lake:
149 photic

Date	Photic Depth (m)	Susp N (mg/m³)	Susp C (mg/m³)	Susp P (mg/m³)	Chla (mg/m³)	NDebt mMN/m²/h	A-Pase(C) mMP/m²/h
04/10/90	nd	nd	nd	nd	nd	nd	nd
05/08/90	4.0	258.4	4200.0	28.0	15.6	-3.64	1.25
05/22/90	4.0	460.0	4200.0	32.0	15.6	0.00	2.90
06/05/90	4.0	468.0	5080.0	36.0	24.0	0.44	2.35
06/19/90	4.0	552.0	5000.0	32.0	20.8	0.44	1.86
07/03/90	4.0	532.0	5480.0	24.0	16.8	-0.84	1.86
07/17/90	4.0	572.0	4960.0	32.0	27.6	0.24	2.07
07/31/90	4.0	548.0	4160.0	28.0	16.0	0.24	1.54
08/14/90	4.0	396.0	5000.0	24.0	17.2	-0.40	1.75
08/28/90	4.0	608.0	4680.0	24.0	17.6	-7.08	1.81
09/25/90	4.0	432.0	4680.0	24.0	20.0	-1.44	1.36
10/23/90	4.0	392.0	3080.0	20.0	16.4	1.40	1.05
Mean	4.0	474.4	4592.7	27.6	18.9	-1.01	1.63

Lake:
164 epi

Date	Susp N µM/L	Susp C µM/L	Susp P µM/L	Chla µg/L	C/Chla µM/µg	C/N µM/µM	N/P µM/µM	C/P µM/µM	NDebt µMN/L/h	NDebt µMN/µgChl/24h	A-Pase(T) µMP/h	A-Pase(S) µMP/h	A-Pase(C) µMP/µgChla/h
04/10/90	3.6	47.7	0.1	7.3	6.5	13.2	25.0	328.9	0.08	0.03	0.28	0.16	0.02
05/08/90	7.0	72.4	0.2	5.4	13.4	10.4	31.0	320.8					
05/22/90	6.2	65.8	0.2	4.2	15.7	10.6	32.1	339.9	-1.07	-0.26	0.38	0.06	0.08
06/05/90	6.1	67.4	0.2	5.6	12.0	11.0	31.7	348.5	-0.52	-0.09	0.41	0.18	0.04
06/19/90	5.1	50.8	0.4	3.6	14.1	9.9	14.5	143.1	0.36	0.10	0.33	0.18	0.04
07/03/90	4.4	58.3	0.2	2.7	21.6	13.2	22.9	301.1	-0.90	-0.33	0.22	0.04	0.07
07/17/90	4.6	45.8	0.1	2.5	18.3	10.0	35.4	354.9	0.32	0.13	0.17	0.05	0.05
07/31/90	3.6	40.8	0.1	2.3	17.7	11.4	27.7	316.2	0.05	0.02	0.16	0.05	0.05
08/14/90	3.3	58.3	0.1	2.1	27.8	17.7	25.4	451.7	0.08	0.04	0.20	0.08	0.06
08/28/90	3.6	43.3	0.1	2.3	18.8	12.1	36.9	447.4	0.07	0.03	0.28	0.13	0.07
09/25/90	3.8	52.5	0.2	4.1	12.8	13.9	23.5	325.2	0.16	0.04	0.33	0.14	0.05
10/23/90	3.9	48.3	0.2	3.6	13.4	12.3	20.3	249.5	0.10	0.03	0.17	0.13	0.01
Mean	4.6	54.3	0.2	3.8	16.0	12.1	27.2	327.3	-0.12	-0.02	0.27	0.11	0.05

Lake:
164 meta

Date	Susp N µM/L	Susp C µM/L	Susp P µM/L	Chla µg/L	C/Chla µM/µg	C/N µM/µM	N/P µM/µM	C/P µM/µM	NDebt µMN/L/h	NDebt µMN/µgChl/24h	A-Pase(T) µMP/h	A-Pase(S) µMP/h	A-Pase(C) µMP/µgChla/h
04/11/90	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
05/10/90	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
05/22/90	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
06/05/90	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
06/19/90	2.7	36.6	0.1	2.9	12.6	13.51	21.02	283.9	0.77	0.27	0.10	0.14	-0.02
07/03/90	3.9	61.6	0.2	3.6	17.1	15.69	24.34	382.0	-0.43	-0.12	0.21	0.03	0.05
07/17/90	4.1	44.1	0.2	5.6	7.9	10.85	25.23	273.6	0.03	0.01	0.15	0.06	0.02
07/31/90	4.3	49.1	0.1	5.9	8.3	11.47	33.20	380.7	0.42	0.07	0.14	0.12	0.00
08/14/90	3.2	37.5	0.1	3.2	11.7	11.66	24.90	290.4	0.15	0.05	0.21	0.09	0.04
08/28/90	3.6	57.5	0.2	6.5	8.8	16.10	22.13	356.2	-0.34	-0.05	0.23	0.08	0.02
09/28/90	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
10/22/90	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Mean	3.6	47.7	0.1	4.6	11.1	13.2	25.1	327.8	0.10	0.04	0.17	0.08	0.02

Lake:
164 photic

Date	Photic Depth (m)	Susp N (mg/m³)	Susp C (mg/m³)	Susp P (mg/m³)	Chla (mg/m³)	NDebt mMN/m²/h	NDebt mMN/µgChl/24h	A-Pase(C) mMP/m²/h
04/10/90	nd	nd	nd	nd	nd	nd	nd	nd
05/08/90	5.0	254.2	4350.0	35.0	27.0	nd	nd	nd
05/22/90	5.5	539.0	4345.0	33.0	23.1	-5.89	1.60	
06/05/90	5.0	435.0	4050.0	30.0	28.0	-2.60	1.29	
06/19/90	5.5	473.0	3355.0	60.5	19.8	1.98	0.77	
07/03/90	4.5	324.0	3150.0	27.0	12.2	-4.05	0.99	
07/17/90	4.0	248.0	2200.0	16.0	10.0	1.28	0.55	
07/31/90	4.5	288.0	2205.0	18.0	10.4	0.23	0.43	
08/14/90	4.5	225.0	3150.0	18.0	9.5	0.36	0.52	
08/28/90	5.0	230.0	2600.0	15.0	11.5	0.35	0.67	
09/25/90	3.5	175.0	2205.0	17.5	14.4	0.56	0.94	
10/23/90	4.0	212.0	2320.0	24.0	14.4	0.40	0.15	
Mean	4.6	309.4	3084.5	26.7	16.4	-0.74	0.79	

Table A3.a. continued.....

Lake: 165 epl		Susp N μM/L	Susp C μM/L	Susp P μM/L	Chla μg/L	C/Chla μM/μg	C/N μM/μM	N/P μM/μM	C/P μM/μM	NDebt μMN/L/h	NDebt μMN/μgChl/24h	A-Pase(T) μMP/h	A-Pase(S) μMP/h	A-Pase(C) μMP/μgChla/h
Date														
04/10/90		2.3	34.4	0.1	2.9	11.7	14.8	24.1	355.9	-0.17	-0.04	0.25	0.13	0.04
05/08/90		7.2	74.9	0.3	4.7	15.9	10.4	27.9	290.4	nd	nd	nd	nd	nd
05/22/90		6.4	67.4	0.2	4.0	16.9	10.6	32.8	348.5	-1.13	-0.28	0.36	0.06	0.08
06/05/90		4.4	55.0	0.2	3.1	17.7	12.4	27.4	340.7	-0.33	-0.11	0.36	0.19	0.06
06/19/90		4.5	47.5	0.3	2.8	17.0	10.6	15.5	163.5	0.38	0.14	0.29	0.14	0.06
07/03/90		3.6	44.1	0.1	2.7	16.3	12.1	28.2	342.0	-0.42	-0.04	0.22	0.10	0.04
07/17/90		5.1	53.3	0.2	2.0	26.6	10.4	31.9	330.4	0.30	0.02	0.17	0.04	0.06
07/31/90		4.9	59.1	0.2	2.6	21.1	12.0	30.5	366.5	0.61	0.22	0.17	0.06	0.04
08/14/90		4.0	50.0	0.1	2.2	22.7	12.5	31.0	387.2	1.16	0.53	0.26	0.08	0.08
08/28/90		5.2	70.8	0.2	3.0	23.6	13.6	26.9	365.7	-0.82	-0.27	0.31	0.13	0.06
09/25/90		4.6	80.8	0.2	4.5	17.9	17.7	20.2	357.7	0.04	0.01	0.36	0.17	0.04
10/23/90		5.3	64.9	0.2	4.3	15.1	12.3	27.3	335.6	0.17	0.04	0.21	0.09	0.03
Mean		4.8	58.5	0.2	3.3	18.6	12.4	27.0	332.0	-0.02	0.02	0.27	0.11	0.05

Lake: 165 photic		Photic Depth (m)	Susp N (mg/m³)	Susp C (mg/m³)	Susp P (mg/m³)	Chla (mg/m³)	NDebt mMN/m²/h	A-Pase(C) mMP/m²/h
Date								
04/10/90		nd	nd	nd	nd	nd	nd	nd
05/08/90		4.0	130.5	3600.0	32.0	18.8	nd	nd
05/22/90		4.5	454.5	3645.0	27.0	18.0	-5.1	1.2
06/05/90		4.0	356.0	2640.0	20.0	12.4	-1.3	0.8
06/19/90		4.0	248.0	2280.0	36.0	11.2	1.5	0.6
07/03/90		3.5	220.5	1855.0	14.0	9.5	-1.5	0.5
07/17/90		3.0	153.0	1920.0	15.0	6.0	0.9	0.4
07/31/90		3.5	252.0	2485.0	17.5	9.8	2.1	0.3
08/14/90		3.5	241.5	2100.0	14.0	7.7	4.1	0.6
08/28/90		3.5	196.0	2975.0	21.0	10.5	-2.9	0.6
09/25/90		4.0	292.0	3880.0	28.0	18.0	0.2	0.6
10/23/90		3.5	224.0	2730.0	21.0	15.1	0.6	0.5
Mean		3.7	251.6	2737.3	22.3	12.4	-0.14	0.82

Lake: 373 epl		Susp N μM/L	Susp C μM/L	Susp P μM/L	Chla μg/L	C/Chla μM/μg	C/N μM/μM	N/P μM/μM	C/P μM/μM	NDebt μMN/L/h	NDebt μMN/μgChl/24h	A-Pase(T) μMP/h	A-Pase(S) μMP/h	A-Pase(C) μMP/μgChla/h
Date														
04/09/90		3.1	39.2	0.1	3.5	11.1	12.5	24.2	303.6	-0.11	-0.13	0.14	0.06	0.02
05/09/90		5.0	48.3	0.2	3.4	14.2	9.7	31.0	299.4	-0.16	-0.05	nd	nd	nd
05/23/90		2.7	33.3	0.1	0.9	37.0	12.3	28.0	344.2	0.95	1.06	0.08	0.05	0.04
06/06/90		2.6	39.1	0.1	1.4	27.6	14.8	27.3	404.4	1.74	1.23	0.12	0.07	0.04
06/20/90		2.1	25.8	0.1	0.7	35.4	12.1	33.2	400.1	-0.62	-0.85	0.16	0.05	0.15
07/04/90		1.9	25.8	0.1	0.6	44.5	13.9	28.8	400.1	-0.72	-1.24	0.14	0.09	0.09
07/18/90		2.1	32.5	0.1	0.5	60.1	15.2	22.1	335.6	-0.14	-0.26	0.13	0.06	0.13
08/01/90		2.0	26.6	0.1	0.6	42.3	13.3	31.0	413.0	-0.05	-0.08	0.14	0.04	0.15
08/15/90		2.6	35.8	0.1	0.4	89.5	13.9	39.8	555.0	-0.11	-0.88	0.16	0.06	0.26
08/29/90		1.4	30.8	0.1	0.4	75.1	21.6	22.1	477.5	1.60	3.90	0.14	0.08	0.15
09/26/90		2.3	36.3	0.1	0.9	45.1	16.8	23.6	395.8	0.08	0.09	0.15	0.05	0.12
10/24/90		2.7	40.8	0.2	1.9	21.8	15.0	14.0	210.8	-0.30	-0.16	0.16	0.05	0.06
Mean		2.6	34.7	0.1	1.3	42.0	14.3	27.1	378.3	0.18	0.22	0.14	0.06	0.11

Lake: 373 meta		Susp N μM/L	Susp C μM/L	Susp P μM/L	Chla μg/L	C/Chla μM/μg	C/N μM/μM	N/P μM/μM	C/P μM/μM	NDebt μMN/L/24h	NDebt μMN/μgChl/24h	A-Pase(T) μMP/h	A-Pase(S) μMP/h	A-Pase(C) μMP/μgChla/h
Date														
04/11/90		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
05/10/90		3.7	48.3	0.2	5.6	8.6	13.0	23.0	299.4	-0.400	-0.071	nd	nd	nd
05/22/90		4.9	35.0	0.2	1.9	18.6	7.1	21.8	154.9	0.710	0.378	nd	nd	nd
06/05/90		2.8	37.5	0.1	6.3	5.9	13.5	21.6	290.4	1.070	0.170	0.113	0.076	0.006
06/19/90		3.6	45.0	0.2	6.1	7.4	12.3	22.6	278.8	-0.800	-0.131	0.153	0.043	0.018
07/03/90		2.9	48.3	0.1	2.7	17.9	16.5	22.7	374.3	-1.270	-0.470	0.132	0.062	0.026
07/17/90		3.1	33.3	0.1	4.2	7.9	10.6	24.3	258.1	0.490	0.117	0.101	0.088	0.003
07/31/90		3.1	35.8	0.1	3.2	11.2	11.7	23.8	277.5	0.040	0.013	0.154	0.042	0.035
08/14/90		2.4	35.8	0.1	1.3	27.5	15.2	24.3	370.0	-0.110	-0.085	0.176	0.055	0.093
08/28/90		2.1	35.0	0.1	1.1	30.7	16.9	21.4	361.4	0.200	0.175	0.135	0.033	0.089
09/28/90		2.6	38.3	0.2	2.0	19.2	14.5	16.4	237.5	-0.100	-0.050	0.106	0.044	0.031
10/22/90		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Mean		3.1	39.2	0.1	3.4	15.5	13.1	22.2	290.2	-0.02	0.00	0.13	0.06	0.04

Lake: 373 photic		Photic Depth (m)	Susp N (mg/m³)	Susp C (mg/m³)	Susp P (mg/m³)	Chla (mg/m³)	NDebt mMN/m²/h	A-Pase(C) mMP/m²/h
Date								
04/09/90		nd	nd	nd	nd	nd	nd	nd
05/09/90		12.0	840.0	6960.0	60.0	40.8	-1.9	nd
05/23/90		12.0	456.0	4800.0	36.0	10.8	11.4	0.4
06/06/90		13.0	481.0	6110.0	39.0	18.5	22.6	0.7
06/20/90		14.0	420.0	4340.0	28.0	10.2	-8.7	1.6
07/04/90		15.0	390.0	4650.0	30.0	8.7	-10.8	0.8
07/18/90		15.0	450.0	5850.0	45.0	8.1	-2.1	1.0
08/01/90		15.0	420.0	4800.0	30.0	9.5	-0.8	1.4
08/15/90		16.0	576.0	6880.0	32.0	6.4	-1.8	1.6
08/29/90		15.0	300.0	5550.0	30.0	6.2	24.0	0.9
09/26/90		16.0	512.0	7360.0	48.0	13.6	1.3	1.6
10/24/90		13.0	494.0	6370.0	78.0	24.3	-3.9	1.5
Mean		14.2	485.4	5788.2	41.5	14.3	2.67	1.15

Table A3.a. continued.....

Lake: 377 epl	Date	Susp N μM/L	Susp C μM/L	Susp P μM/L	Chla μg/L	C/Chla μM/μg	C/N μM/μM	N/P μM/μM	C/P μM/μM	NDebt μMN/L/h	NDebt μMN/μgChl/24h	A-Pase(T) μMP/h	A-Pase(S) μMP/h	A-Pase(C) μMP/μgChla/h
	04/09/90	3.1	37.7	0.1	5.0	7.5	12.3	22.6	277.7	-0.14	-0.07	0.27	0.12	0.03
	05/09/90	6.9	66.6	0.2	6.6	10.1	9.6	30.7	295.0	-0.17	-0.03	nd	nd	nd
	05/23/90	3.4	45.8	0.2	1.4	33.7	13.4	17.7	236.6	0.71	0.52	0.27	0.07	0.14
	06/06/90	3.3	41.6	0.2	0.7	56.3	12.7	20.4	258.1	0.76	1.03	0.24	0.08	0.21
	06/20/90	2.0	27.5	0.3	1.2	23.1	13.7	7.7	106.5	-0.68	-0.57	0.18	0.05	0.11
	07/04/90	2.2	27.5	0.2	0.9	32.0	12.4	11.4	142.0	-1.51	-1.76	0.12	0.08	0.05
	07/18/90	2.6	30.0	0.1	1.0	31.6	11.7	19.9	232.3	0.32	0.34	0.16	0.08	0.09
	08/01/90	5.4	74.9	0.2	2.8	26.8	13.8	24.0	331.9	-0.52	-0.19	0.15	0.04	0.04
	08/15/90	2.7	50.8	0.1	1.1	47.9	18.7	28.0	524.8	-0.27	-0.26	0.19	0.06	0.12
	08/29/90	2.2	42.5	0.1	0.9	46.2	19.2	17.2	329.1	0.89	0.97	0.19	0.05	0.15
	09/26/90	2.4	36.6	0.3	0.8	45.8	15.6	7.3	113.6	-0.03	-0.04	0.19	0.09	0.13
	10/24/90	2.0	29.1	0.1	1.8	16.0	14.6	20.7	301.1	-0.16	-0.09	0.15	0.07	0.05
	Mean	3.2	42.6	0.2	2.0	31.4	14.0	19.0	262.4	-0.04	0.00	0.19	0.07	0.10
Lake: 377 meta	Date	Susp N μM/L	Susp C μM/L	Susp P μM/L	Chla μg/L	C/Chla μM/μg	C/N μM/μM	N/P μM/μM	C/P μM/μM	NDebt μMN/L/24h	NDebt μMN/μgChl/24h	A-Pase(T) μMP/h	A-Pase(S) μMP/h	A-Pase(C) μMP/μgChla/h
	04/11/90	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	05/10/90	4.4	51.6	0.2	5.3	9.7	11.7	19.6	228.619	-0.420	-0.079	nd	nd	nd
	05/22/90	2.8	28.3	0.2	2.7	10.5	10.2	12.3	125.372	0.600	0.222	nd	nd	nd
	06/05/90	2.0	25.8	0.1	1.4	18.4	12.9	31.0	400.083	1.660	1.186	0.239	0.081	0.113
	06/19/90	3.2	36.6	0.2	3.0	12.2	11.4	16.6	189.287	-0.330	-0.110	0.168	0.069	0.033
	07/03/90	2.6	34.1	0.2	2.5	13.7	12.9	16.4	211.657	-1.190	-0.476	0.145	0.085	0.024
	07/17/90	2.6	30.8	0.1	1.5	20.4	11.7	27.3	318.346	0.560	0.371	0.190	0.095	0.063
	07/31/90	3.1	37.5	0.2	4.0	9.4	11.9	19.5	232.306	-0.480	-0.120	0.120	0.048	0.018
	08/14/90	3.3	41.6	0.1	3.3	12.6	12.7	25.4	322.648	-0.730	-0.221	0.195	0.056	0.042
	08/28/90	3.1	41.6	0.1	3.3	12.6	13.6	23.8	322.648	0.500	0.152	0.102	0.043	0.018
	09/28/90	3.5	49.1	0.2	4.3	11.4	14.0	21.7	304.580	0.130	0.030	0.155	0.065	0.021
	10/22/90	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	Mean	3.1	37.7	0.2	3.1	13.1	12.3	21.4	265.6	0.03	0.10	0.16	0.07	0.04
Lake: 377 photic	Date	Depth (m)	Photic Susp N (mg/m³)	Susp C (mg/m³)	Susp P (mg/m³)	Chla (mg/m³)	NDebt mMN/m²/h	A-Pase(C) mMP/m²/h						
	04/09/90	nd	nd	nd	nd	nd	nd	nd						
	05/09/90	8,000	776,000	6400,000	56,000	52,800	-1.360	nd						
	05/23/90	8,500	408,000	4675,000	51,000	11,560	6,035	1.665						
	06/06/90	11,000	506,000	5500,000	55,000	8,140	6,360	1.718						
	06/20/90	11,500	322,000	3795,000	92,000	13,685	-7,820	1.533						
	07/04/90	10,000	310,000	3300,000	60,000	8,600	-15,100	0.430						
	07/18/90	9,000	324,000	3240,000	36,000	8,550	2,880	0.744						
	08/01/90	10,000	760,000	9000,000	70,000	28,000	-5,200	1.092						
	08/15/90	10,000	380,000	6100,000	30,000	10,600	-2,700	1.251						
	08/29/90	9,000	279,000	4590,000	36,000	8,280	8,010	1.217						
	09/26/90	9,500	313,500	4180,000	95,000	7,600	-0,285	0.960						
	10/24/90	11,000	308,000	3850,000	33,000	20,020	-1,760	0.921						
	Mean	9.8	426,0	4966.4	55.8	16.2	-0.81	1.15						
Lake: 442 epl	Date	Susp N μM/L	Susp C μM/L	Susp P μM/L	Chla μg/L	C/Chla μM/μg	C/N μM/μM	N/P μM/μM	C/P μM/μM	NDebt μMN/L/h	NDebt μMN/μgChl/24h	A-Pase(T) μMP/h	A-Pase(S) μMP/h	A-Pase(C) μMP/μgChla/h
	04/09/90	3.6	43.5	0.3	5.0	8.8	12.1	13.5	163.4	-0.18	-0.11	0.27	0.11	0.03
	05/09/90	8.1	67.4	0.3	4.3	15.7	8.3	31.5	261.3	-0.40	-0.09	nd	nd	nd
	05/23/90	4.6	53.3	0.2	1.4	37.0	11.7	23.6	275.3	0.59	0.41	0.36	0.09	0.19
	06/06/90	3.3	38.3	0.1	1.3	29.2	11.7	33.9	395.8	1.11	0.85	0.23	0.09	0.11
	06/20/90	2.8	30.8	0.1	1.6	19.5	11.1	28.8	318.3	-0.41	-0.26	0.19	0.07	0.07
	07/04/90	2.4	30.0	0.1	1.4	21.7	12.3	37.6	464.6	-0.01	-0.01	0.18	0.09	0.07
	07/18/90	2.4	29.1	0.1	1.4	21.0	12.0	25.1	301.1	0.42	0.30	0.19	0.09	0.07
	08/01/90	3.3	38.3	0.1	1.2	32.5	11.7	33.9	395.8	-0.34	-0.29	0.19	0.07	0.09
	08/15/90	9.0	60.8	0.1	1.3	48.6	6.8	92.9	628.1	-0.73	-0.58	0.21	0.08	0.11
	08/29/90	2.4	43.3	0.1	1.3	32.8	16.4	24.3	447.4	0.63	0.48	0.18	0.05	0.10
	09/26/90	3.8	55.0	0.1	1.6	34.6	14.5	29.3	425.9	0.36	0.23	0.28	0.11	0.11
	10/24/90	2.9	40.8	0.1	2.2	18.5	14.3	22.1	316.2	-0.10	-0.05	0.19	0.06	0.06
	Mean	4.0	44.2	0.1	2.0	26.7	12.1	33.1	366.1	0.08	0.07	0.23	0.08	0.09
Lake: 442 meta	Date	Susp N μM/L	Susp C μM/L	Susp P μM/L	Chla μg/L	C/Chla μM/μg	C/N μM/μM	N/P μM/μM	C/P μM/μM	NDebt μMN/L/24h	NDebt μMN/μgChl/24h	A-Pase(T) μMP/h	A-Pase(S) μMP/h	A-Pase(C) μMP/μgChla/h
	04/11/90	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	05/10/90	4.5	52.5	0.2	4.8	10.9	11.7	24.9	269.9	-1.0	-0.2	nd	nd	nd
	05/22/90	2.4	30.0	0.8	4.7	6.4	12.7	3.0	38.7	1.3	0.3	nd	nd	nd
	06/05/90	4.6	54.1	0.4	6.0	9.0	11.8	10.9	129.1	1.5	0.2	0.3	0.1	0.0
	06/19/90	3.4	45.0	0.2	2.9	15.5	13.1	17.7	232.3	-0.4	-0.1	0.2	0.1	0.0
	07/03/90	2.2	36.6	0.1	1.6	23.0	16.6	17.2	283.9	-1.4	-0.8	0.2	0.1	0.1
	07/17/90	3.1	30.0	0.2	1.8	17.1	9.8	15.9	154.9	0.5	0.3	0.2	0.1	0.1
	07/31/90	4.0	37.5	0.2	2.6	14.4	9.4	20.7	193.6	-0.5	-0.2	0.1	0.0	0.0
	08/14/90	3.1	37.5	0.2	2.6	14.4	11.9	16.2	193.6	-1.6	-0.6	0.2	0.1	0.0
	08/28/90	4.7	53.3	0.2	3.5	15.2	11.3	29.2	330.4	0.3	0.1	0.1	0.0	0.0
	09/28/90	4.1	59.1	0.2	3.1	19.1	14.5	18.0	261.8	0.2	0.1	0.2	0.1	0.0
	10/22/90	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	Mean	3.6	43.5	0.3	3.4	14.5	12.3	17.4	210.8	-0.11	-0.11	0.18	0.07	0.04

Table A3.a. continued.....

Lake:

442 photic							
Date	Photic Depth (m)	Susp N (mg/m³)	Susp C (mg/m³)	Susp P (mg/m³)	Chla (mg/m³)	NDebt mMN/m²/h	A-Pase(C) mMP/m²/h
04/09/90	nd	nd	nd	nd	nd	nd	nd
05/09/90	9.0	1026.0	7290.0	72.0	38.7	-3.6	nd
05/23/90	7.0	448.0	4480.0	42.0	10.1	4.1	1.9
06/06/90	9.0	414.0	4140.0	27.0	11.8	10.0	1.3
06/20/90	10.0	390.0	3700.0	30.0	15.8	-4.1	1.2
07/04/90	11.0	374.0	3960.0	22.0	15.2	-0.1	1.0
07/18/90	10.0	340.0	3500.0	30.0	13.9	4.2	1.0
08/01/90	10.0	480.0	4600.0	30.0	11.8	-3.4	1.1
08/15/90	10.0	1260.0	7300.0	30.0	12.5	-7.3	1.4
08/29/90	10.0	330.0	5200.0	30.0	13.2	6.3	1.3
09/26/90	9.0	477.0	5940.0	36.0	14.3	3.2	1.5
10/24/90	7.5	300.0	3675.0	30.0	16.5	-0.8	1.0
Mean	9.3	529.0	4889.5	34.5	15.8	0.78	1.27

Lake:
938 epiW

Date	Susp N µM/L	Susp C µM/L	Susp P µM/L	Chla µg/L	C/Chla µM/µg	C/N µM/µM	N/P µM/µM	C/P µM/µM	NDebt µMn/µgChl/24h	NDebt	A-Pase(T) µMP/h	A-Pase(S) µMP/h	A-Pase(C) µMP/µgChla/h
04/10/90	nd	nd	nd	nd	nd	nd	nd	nd	-0.04	-0.04	0.11	0.06	0.04
05/08/90	5.6	59.1	0.2	3.1	19.1	10.6	28.8	305.4					
05/22/90	3.4	41.6	0.2	1.4	30.6	12.4	20.8	258.1	-0.18	-0.13	0.20	0.04	0.12
06/05/90	5.0	50.0	0.2	2.5	20.0	10.0	25.8	258.1	-1.30	-0.49	0.22	0.14	0.03
06/19/90	3.4	38.3	0.1	1.3	30.6	11.2	35.4	395.8	0.43	0.34	0.13	0.10	0.03
07/03/90	3.6	41.6	0.1	1.3	32.0	11.7	36.9	430.2	-0.07	-0.05	0.18	0.02	0.12
07/17/90	3.8	45.8	0.1	1.6	28.4	12.1	39.1	473.2	0.68	0.44	0.14	0.07	0.04
07/31/90	4.0	58.3	0.1	2.6	22.4	14.6	31.0	451.7	0.12	0.05	0.14	0.03	0.04
08/14/90	4.3	57.5	0.1	3.0	19.2	13.4	33.2	445.3	-0.05	-0.02	0.20	0.04	0.05
08/28/90	4.0	58.3	0.1	2.0	29.1	14.6	31.0	451.7	-0.66	-0.43	0.25	0.06	0.10
09/25/90	3.9	55.0	0.2	2.7	20.4	14.0	20.3	283.9	-0.09	-0.03	0.24	0.11	0.05
10/23/90	1.8	27.5	0.2	4.7	5.8	15.4	9.2	142.0	0.36	0.08	0.16	0.07	0.02
Mean	3.9	48.4	0.1	2.4	23.4	12.7	26.3	354.1	-0.09	-0.03	0.18	0.07	0.06

Lake: 93B photo

Date	Depth (m)	Photic (mg/m³)	Susp N (mg/m³)	Susp C (mg/m³)	Susp P (mg/m³)	Chla (mg/m³)	NDebt mMN/m³/h	A-Pase(C) mMP/m²/h
04/10/90	nd	nd	nd	nd	nd	nd	nd	nd
05/08/90	5.5	0.0	3505.0	33.0	17.1	nd	nd	nd
05/22/90	5.5	429.0	2750.0	27.5	7.5	-1.0	0.9	
06/05/90	5.5	258.5	3300.0	33.0	13.8	-7.2	0.5	
06/19/90	5.5	385.0	2530.0	16.5	6.9	2.4	0.2	
07/03/90	5.5	264.0	2750.0	16.5	7.2	-0.4	0.9	
07/17/90	5.5	275.0	3025.0	16.5	8.9	3.7	0.4	
07/31/90	5.5	291.5	3850.0	22.0	14.3	0.7	0.6	
08/14/90	5.5	308.0	3795.0	22.0	16.5	-0.3	0.9	
08/28/90	5.5	330.0	3850.0	22.0	11.0	-4.7	1.1	
09/25/90	5.5	308.0	3630.0	33.0	14.9	-0.5	0.7	
10/23/90	5.5	302.5	1815.0	33.0	25.9	2.0	0.5	
Mean	5.5	286.5	3200.0	25.0	13.1	-0.49	0.60	