CALCIUM DYNAMICS IN A SUBTROPICAL IMPOUNDMENT

THESIS

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By

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I would like to thank the Biology faculty and Aquatic Biology graduate students for helping me complete my graduate studies and research Specifically, I would like to thank Dr Alan Groeger for aiding me in my thesis research, as well as Connie Johnson, Joe Martin, and Bruce Kelley for keeping the graduate experience fun I would also like to thank my family for their strong support while I advanced my knowledge of the world

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Abstract

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Canyon Reservoir is a hardwater, oligo-mesotrophic impoundment located on a fourth order stretch of the Guadalupe River in Comal County, TX Canyon Reservoir is distinct from other hardwater systems in that it can have lake-like features during low or no inflow periods, and reservoir properties during average or high inflow, setting up patterns befitting the reservoir zonation model By analyzing the chemical data from the headwaters to the tailrace below the dam the process of decalcification is apparent In the summer months of 2000 the lack of substantial inflow decreased the influence of the watershed and the impact biologically-induced decalcification had on the reservoir was particularly evident. The mechanism controlling calcium sedimentation in Canyon Reservoir appears to be dominated by flow in the riverine zone, predominately biologically controlled in the transitional zone, and biologically and physically controlled in the lacustrine zone by being isolated from the upper reaches of the reservoir

By constantly being supersaturated, with respect to calcite, Canyon Reservoir retards eutrophication via nutrient and trace metal loss and the hastened sedimentation of dissolved organic carbon and phytoplankton An increase in primary production in the

transitional zone of the reservoir appears to catalyze calcite precipitation, thereby inhibiting further production downstream by accelerating the process of algal sedimentation upstream When phytoplankton sink out of the water column, as a result of nucleating calcite, organically-bound as well as inorganically-bound nutrients, such as phosphorous, are lost to the sediments This phenomenon is most likely to occur in the spring and summer months, when primary production is greatest

Introduction

Autochthonous formation and subsequent precipitation of calcium carbonate is an important process in carbon and calcium cycling in many hardwaters (Stabel, 1986). $CaCO_3$ precipitation has been widely implicated as a self-cleansing mechanism in aquatic ecosystems through the removal of biologically available phosphorous via coprecipitation (Otsuki &Wetzel, 1972, Koschel *et al* 1983, Murphy *et al* 1983, Schernewski *et al* , 1994, Hartley *et al* , 1995) Moreover, calcite precipitation and coprecipitation with phytoplankton has been described as a natural control mechanism against eutrophication (Murphy *et al* , 1983, Stabel, 1986, Koschel, 1990, Hartley *et al* , 1995, Hartley *et al* , 1996) Lowenstam (1981) notes that in the algae, mineral formation results from the uptake of CO_2 from the external medium during photosynthesis, while bacterial mineral precipitates form as a result of the interaction between biogenically-formed gases and metal ions present in the external medium

If a solution of calcium bicarbonate in equilibrium with CO_2, H_2CO_3, and CO_3^{2-} loses a portion of the CO_2 required to maintain the equilibrium, $CaCO_3$ will precipitate until the equilibrium is reestablished by the formation of CO_2 (Wetzel, 1983) Biological and physical factors control the saturation and precipitation of $CaCO_3$ (Kelts & Hsu, 1978, Stewart & Wetzel, 1981) In alkaline waters, where the pH ranges from 7 5 to 9, HCO_3^- tends to be the major photosynthetic substrate for photrophic organisms Birmingham & Colman (1979) found evidence to suggest that low CO_2 compensation points were maintained via active bicarbonate uptake by algae, especially at alkaline pH. Experimentally, active uptake and accumulation of bicarbonate at an alkaline pH has been shown to take place in members of the Cyanobacteria, Phaeophyta, and Rhodophyceae (Miller & Colman, 1980; Colman & Gehl, 1983, Raven *et al* , 1996) Photosynthetic uptake of HCO_3^- and release of OH^- can increase the pH in the micro-environment around the cell and thus enhance a supersaturation there (Stabel, 1986) It has been shown that bacteria play a large role in the formation of calcium carbonate deposits in carbonate marine algal tidal flats and travertine-deposited springs (Chafetz & Folk, 1984, Buczynski & Chafetz, 1991; Chafetz & Buczynski, 1992) Moreover, Chafetz & Buczynski (1992) found that dead cyanobacteria were coated with calcium carbonate much more quickly and to a greater extent than live cyanobacteria

The algal cell surface contains many polyfunctional metal-binding sites such as lipid, carbohydrate, and protein components for both cationic and anionic metal complexes (Greene & Darnall, 1990) and an increase in biomass will increase the surface area of cells allowing for increased mineralization and aggragation of $CaCO_3$ on the algal cell surface during photosynthesis

Physically, the solubility of calcite is temperature dependent An increase in temperature decreases the solubility of calcite, conversely a decrease in temperature increases the solubility of calcite In addition, the mixing of two waters, both of which are saturated or undersaturated with respect to calcium carbonate but which have different pH values, may lead to supersaturation and precipitation (Kelts & Hsu, 1978) $CaCO_3$ precipitation may be expressed

$$Ca(HCO_3)_2 \Leftrightarrow CaCO_3(s)\downarrow + H_2O + CO_2$$

In hardwater systems $CaCO_3$ precipitation can function not only as a scavenger of some inorganic nutrients by coprecipitation, but also as a removal agent of dissolved organic matter by adsorption (Otsuki & Wetzel, 1972) However, $CaCO_3$ precipitation can also be inhibited by inorganic phosphorous The inhibition may be caused by the adsorption of dissolved phosphate, or hydrogen phosphate ions, on the calcite growth sites Some of the adsorbed phosphate is then incorporated into the calcite lattice as a coprecipitate (Hartley *et al* , 1995) The degree of inhibition is dependent on both the phosphate concentration and the extent of the supersaturation of the solution with respect to calcite formation (Hartley *et al* , 1995) Stabel (1986) notes that in the central European Lake Constance, saturation conditions only allow calcite precipitation during the stratified period and the concomitant low concentration of inorganic phosphorous was considered not to inhibit the process of calcite formation

Laboratory experiments have shown that calcium losses occur at a faster rate if particles are present in solution during heterogeneous calcite precipitation, which involves nucleation on foreign substances, such as "seeds" (House & Tutton, 1982, Brown *et al* 1993, Hartley *et al* , 1996) Homogeneous calcite nucleation , on the other hand, involves a critical supersaturation and precipitation devoid of foreign particles and is difficult to attain experimentally given the absence of well-defined thermodynamics and lack of control over the surface morpholgy of calcite (Brown *et al* , 1993) House & Tutton (1982), using Pyrex glass seeds, found that the growth rate of calcium carbonate is constant given the known density of growth sites on the seeds Hartley *et al* (1996) used microelectrodes to investigate the microchemical environment measuring pH and pCa above laboratory grown algal biofilms (green alga, *Chlorococcum* sp) The experiments found that the role of biofilms in the precipitation of calcite suggest local conditions near photosynthetic algal cell surfaces influence precipitation rates via an increase in pH and decrease in the concentration of calcium House *et al* (1989), working with recirculating streams, found that the presence of biota, such as phytoplankton, induced nine times more mineral precipitation compared with precipitation in abiotic conditions

Distinctions can be made between hardwater lakes and reservoirs with respect to the dynamics of calcium carbonate Kimmel *et al* (1990) described longitudinal gradients (riverine, transitional, and lacustrine zones) within reservoirs that have distinct chemical, physical, and biological patterns forming along a continuum from the river to the dam, typically referred to as the reservoir zonation model The magnitudes of inflow determine the structure and function of these zones, as well as their location

Canyon Reservoir's watershed is mostly limestone making it an ideal site for the study of calcium dynamics Hannan *et al* (1980) found evidence to suggest biogenically-induced epilimnetic decalcification changed the calcium concentrations in Canyon Reservoir Ground & Groeger (1994) suggested $CaCO_3$ precipitation may be an important factor in determining the low productivity of many central Texas reservoirs It has not been shown, however, which mechanism dominates as a control factor in the oligotrophic conditions found down reservoir or in the lacustrine zone in Canyon Reservoir

According to Kimmel *et al* (1990) the primary producers in reservoirs belong to one of four categories planktonic algae, planktonic-phototrophic bacteria, attached algae, and rooted macrophytes Transitional zones of reservoirs tend to have favorable conditions for photosynthesis and biomass accumulation due to decreased flow, a deeper photic layer, and an increase in nutrient availability Since Canyon Reservoir is deficient in rooted macrophytes, I propose that calcite precipitation and coprecipitation with photosynthetic plankton will be greatest in the transitional zone of Canyon Reservoir In addition, the photosynthetic catalyst of calcite precipitation can lead to an increase in inorganic and organic sedimentation

Sediment traps (fixed or suspended) have been shown to efficiently collect calcite crystals along with algal and bacterial cells (Stabel, 1986, Effler & Johnson, 1987; Vanderploeg *et al*, 1987, Johnson *et al*, 1991, Kozerski, 1994, Womble *et al*, 1996, Dittrich *et al*, 1997) James *et al* (1987) working on DeGray Lake in Arkansas found that sediment traps were sufficient in showing seasonal and longitudinal variations in sediment deposition rates within the reservoir In addition, SEM micrographs of calcite have been used to determine crystal morphology as well as the presence of nucleated algae (*cited by* Kelts & Hsu, 1978, Koschel, 1990, Teranes *et al*, 1999)

The present work describes the dynamics of calcium in Canyon Reservoir from the headwaters to the dam, including precipitation, sedimentation, and resolubilization processes I explore the biological, chemical, and physical processes that control calcium dynamics and help lead to an understanding of the structure and function of this ecosystem

Study Area

Canyon Reservoir is a deep, bottom-draining impoundment located on the Guadalupe River in Comal County, Texas (29°52'07"N, 98°11'55"W) Impoundment began following construction in 1964 The reservoir has a volume of 476 million m^3, a surface area of 33 3 km^2, and a conservation elevation of 277 m asl (Hannan *et al*, 1979) The mean and maximum depths are 14 3 and 48 m (Groeger & Tietjen, 1998) The drainage basin (3,709 km^2), located on the Edwards Plateau, is made up of uplands and rough dissected limestone hills with thin calcareous soils, primarily Glen Rose limestone deposited by shallow seas that completely covered Texas during the Cretaceous period

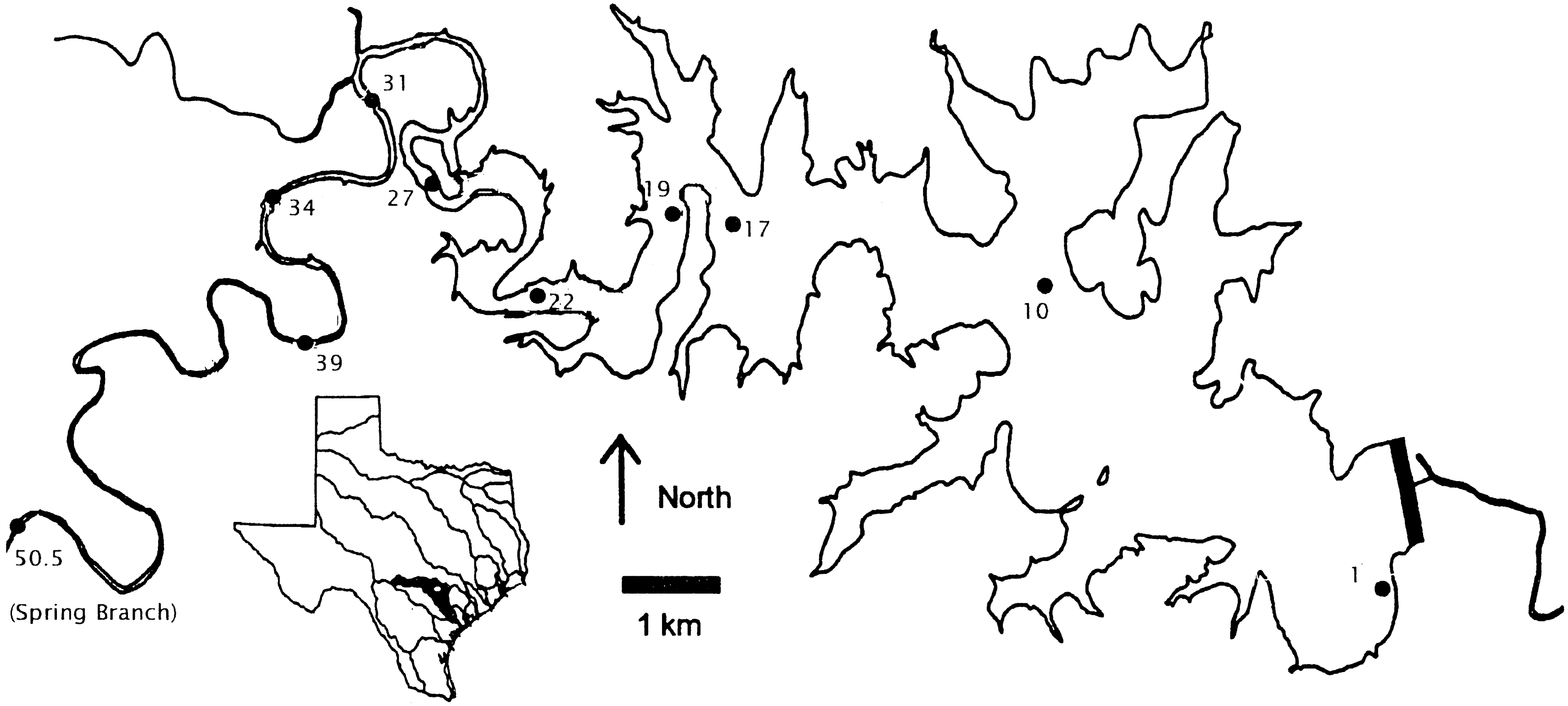

Figure 1. Map of Canyon Reservoir with sampling sites corresponding to river kilometers upstream from the dam

(Ground & Groeger, 1994)

Reservoir study sites for this study corresponded to those used by previous workers (Cook, 1998) and represent the distinct longitudinal zones from the headwaters to the dam Ten reservoir sites were sampled from the headwaters at a USGS flow gage near Spring Branch, TX, 50 5 river km upstream of the dam along the thalweg, to the tailrace below the dam at 236 m asl (Fig 1) The dam site, site 1, is located 1 river km upstream from the dam, site 10 is 10 river km upstream from the dam, site 17 is 17 river km upstream from the dam, site 22 is 22 river km upstream from the dam, site 27 is 27 river km upstream from the dam, site 31 is 31 river km upstream from the dam, site 34 is 34 river kilometers upstream from the dam, site 39 is 39 river kilometers upstream from the dam, and the headwater site is 50.5 river km upstream from the dam

Methods

The study was conducted from April 2000 to April 2001 with samples taken on a monthly basis Field measurements of pH, temperature, and specific conductivity were assessed using a Hydrolab Scout II at 1-meter intervals at each reservoir station Water samples were taken for concentrations of Ca^{2+}, Mg^{2+}, and chlorophyll *a* at three depths in the deep portions of the reservoir during the stratified period and two depths (surface and deep) during the mixed period. Deep (between 1 and 2 meters from the bottom) and metalimnetic samples were taken via a 3 2-liter PVC Kemmerer sampler and stored in 1-liter acid-washed plastic bottles Metalimnetic samples were taken at sites 1, 10, and 17 Duplicate water samples were stored on ice and processed within 24 hours in the lab

Total alkalinity was measured by a titration method according to Wetzel & Likens (1979) Procedures for preservation, filtration, and determinations of Ca^{2+} and Mg^{2+} were carried out using methods following APHA-AWWA-WPCF (1975) Concentrations for dissolved and particulate calcium and magnesium were measured by a Perkin-Elmer 305B atomic absorption spectrophotometer Chlorophyll *a* concentrations were determined fluorometrically according to Burnison (1980) and concentrations were measured using a Turner Fluorometer Model II Saturation indices for calcium carbonate were determined by estimating the IAP (ion activity product) via the uncorrected activity coefficients, obtained from the Debeye-Huckel relation

$$\log \gamma = -\frac{AZI^{1/2}}{1 + a_i BI^{1/2}}$$

where, Z denotes the valence of the ion, I is the ionic strength, A and B are constants for a given solution, and a_i is the diameter of an ion in water Since ionic strength changes with specific conductance (χ_{20} µS cm^{-1}), I can be calculated by the empirical relation (Stabel, 1986) $I = 1\ 83 * \chi_{20} * 10^{-5}$ Using measurements of calcium concentrations, pH, alkalinity, specific conductance, and temperature, calcite saturation indices were calculated according to Hodell *et al* (1998)·

$$\Omega = \frac{a_{Ca} a_{CO_3}}{K_{sp}}$$

where, a represents ion activities of Ca^{2+} and CO_3^{2-} and K_{sp} is the solubility product Positive, negative, and zero saturation index values suggest that a given solution is super-saturated, undersaturated, or in equilibrium, respectively, with respect to the solubility of calcite Calcite saturation indices were calculated using a program spreadsheet (Holm &

Schock, 1998)

Cylindrical sediment traps were deployed at specified sites in the reservoir on a monthly basis in the summer of 2000, from mid-June to mid-September Triplicate traps were suspended at site 1, site 19 (19 km upstream from the dam), site 27, and site 34 The depth of each trap was determined on site based upon conductivity and temperature gradients The dam site trap was placed 20 m from the bottom, the site 19 trap 10-m from the bottom, the site 27 trap 2-m from bottom, and the site 34 trap 1 m from the bottom Each sediment trap was suspended at a depth where resuspension of sediments would be minimal The sediment trap design was a simple PVC tube 38 1 cm high and 7 62 cm in diameter with an aspect of ratio of 5 Theoretical and review studies (Bloesch & Burns, 1980, Blomqvist & Hakansan, 1981; Effler & Driscoll, 1985, Kozerski, 1994) have been in agreement with respect to sediment trap design and aspect ratios of ≥ 5 Moreover, James *et al* (1987) found triplicate cylinders were sufficient in trapping sediments along the longitudinal gradient of DeGray Lake reservoir in Arkansas Trap contents were placed in 1-liter acid-washed bottles and stored in ice and analyzed for total seston dry weight (d w) and particulate organic matter (POM) sedimentation rates using methods described by Stabel (1986)

Results

Calcium and Magnesium

Annual variability in the concentration of calcium (Fig 2) displayed a marked longitudinal gradient in the surface waters from the headwaters to the dam over the year Surface calcium concentrations were at a minimum at sites 31 and 34 in August 2000 (0 41 and 0 39 mM) Concentrations were at a maximum in April 2001 at the headwaters

(2 02 mM), with an annual surface median concentration of 1 13 mM for the whole reservoir Longitudinal distributions of calcium deep in the reservoir (Fig 3) were not as prominent as surface water concentration gradients However, deep calcium concentrations had a higher annual median value of 1 27 mM, with a maximum value (1 85 mM) at site 27 of April 2000 Metalimnetic calcium concentrations (Fig 4) did not have a wide annual longitudinal distribution Minimum concentrations were 0 72 mM and the maximum was 1 32 mM Concentrations of calcium at the trailrace below the dam show a steady decline in the summer of 2000 with the lowest concentrations in August 2000 (0.59 mM), and concentrations increased steadily from mid-October with the highest concentration in April 2001 (1 41 mM)

Particulate calcium follows a similar pattern, longitudinally, as dissolved calcium (Fig 5) in the surface waters of Canyon Reservoir The highest concentration of particulate calcium in the surface waters occurred at the headwaters in April 2001 (0 13 mM) and the annual median concentration was 0 02 mM Deep concentrations of particulate calcium (Fig 6) peaked at site 10 in January 2001 (0 17 mM) Moreover, deep concentrations had a higher annual median concentration (0 03 mM) than surface waters. Particulate calcium in the metalimnion showed a marked longitudinal distribution from site 17 to site 1 (Fig 7) The minimum concentration for particulate calcium was at the dam site in July 2000 (0 002 mM) and the maximum was at site 17 in May 2000 (0 07 mM) Particulate calcium concentrations show a steady decline from April 2000 through the summer of 2000 at the tailrace below the dam, with the lowest concentration in March 2001 (0 009 mM) Highest concentrations were in October 2000 (0 04 mM)

Magnesium concentrations for surface waters (Fig 8) had an annual median value

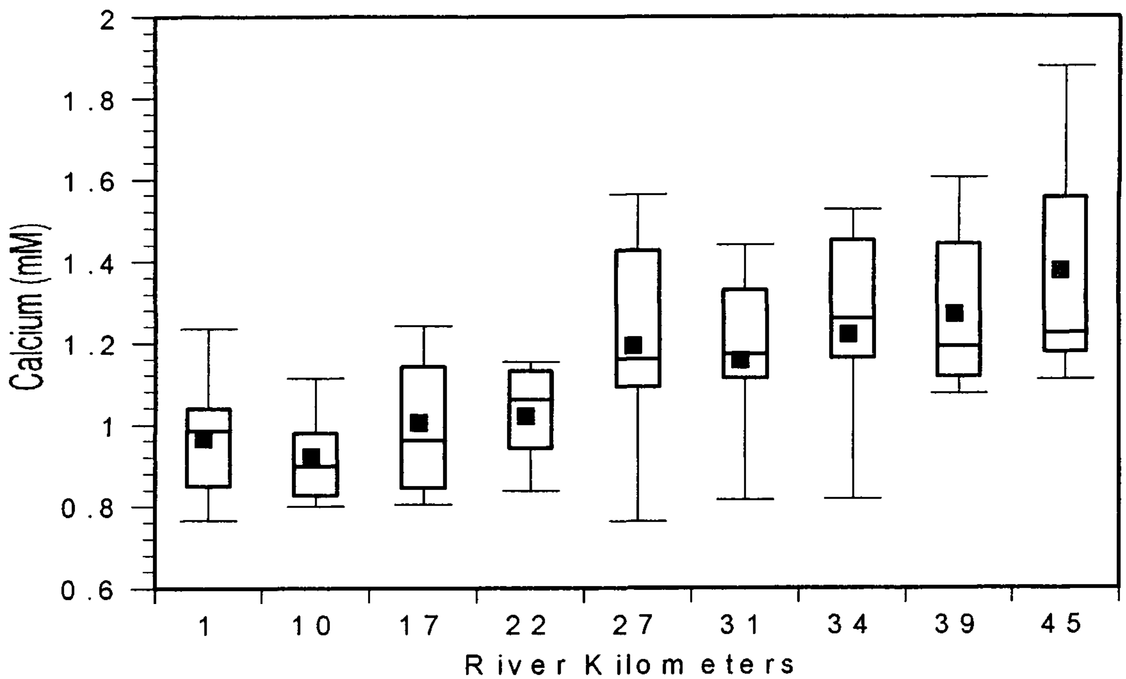

Figure 2. Annual surface [Ca^{+2}] from 50.5 river km upstream to the dam. The lowest, second lowest, middle, second highest, and highest box points represent the 10^{th}, 25^{th}, median, 75^{th}, 90^{th} percentiles, respectively. Means are represented by the black boxes.

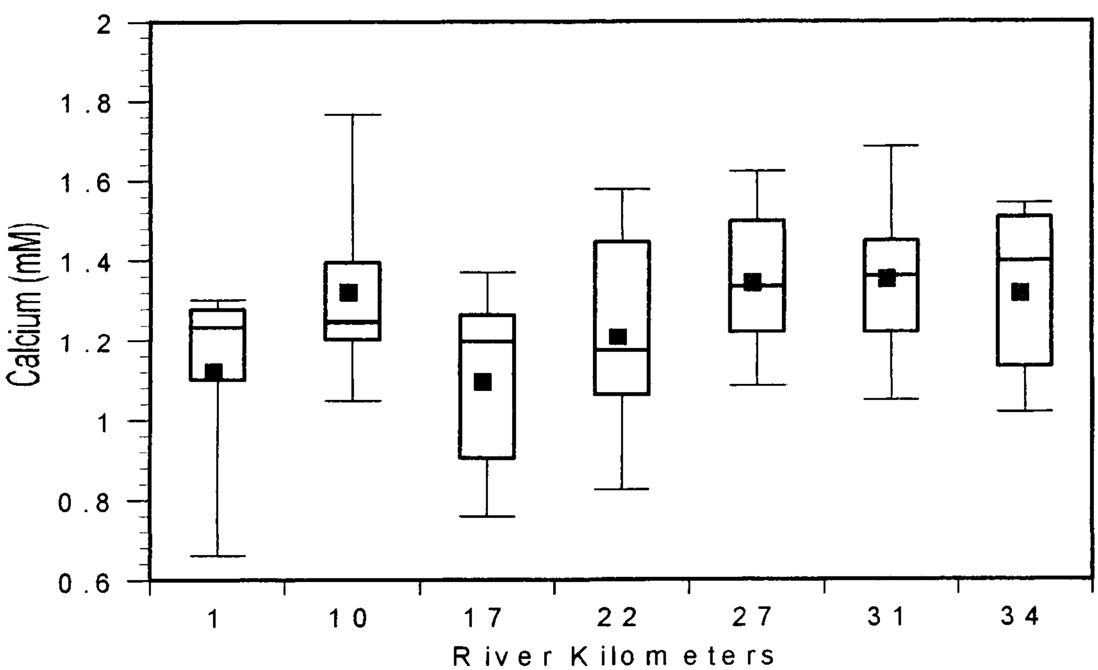

Figure 3. Annual deep [Ca^{+2}] from 34 river km upstream to the dam.

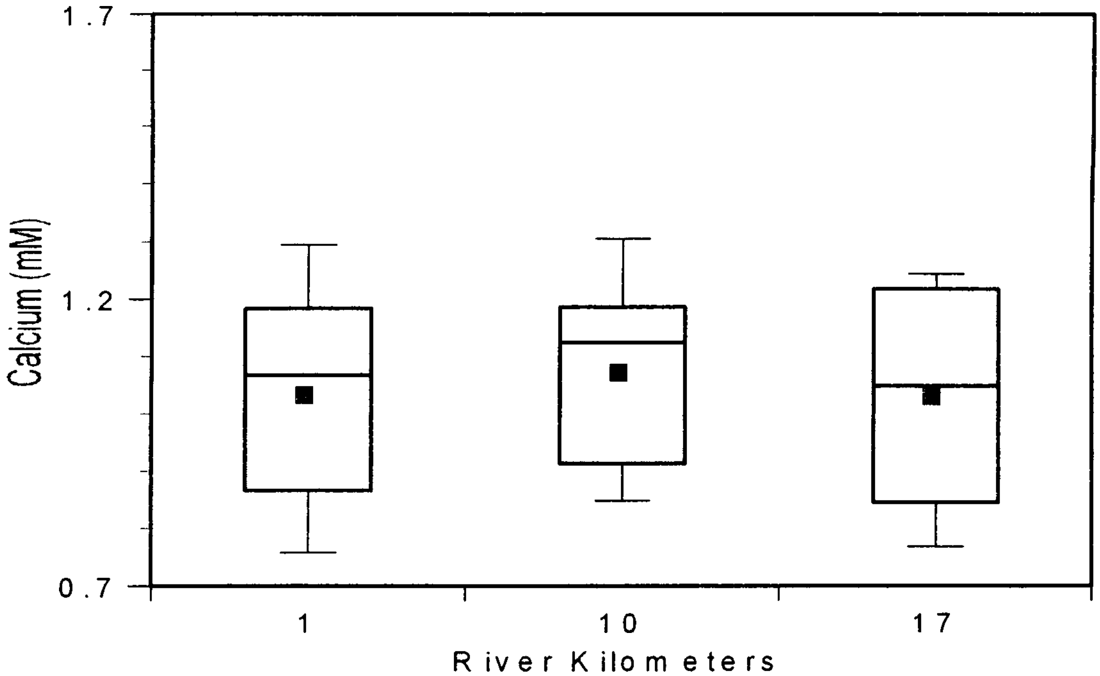

Figure 4. Annual metalimnion [Ca^{+2}] from 17 river km upstream to the dam.

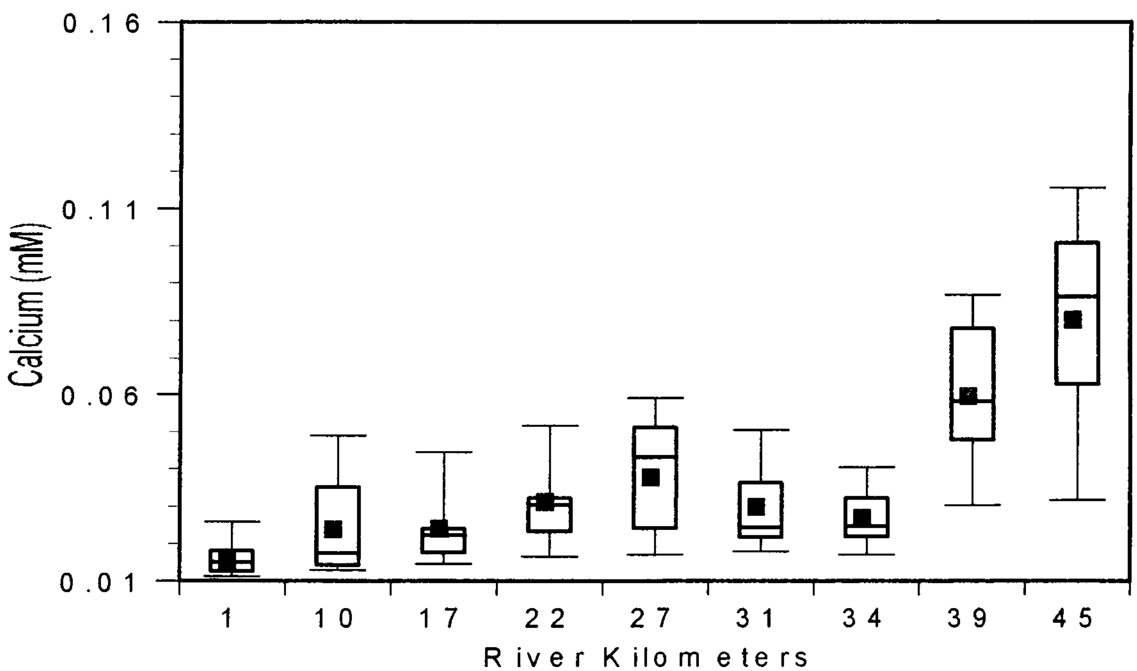

Figure 5. Annual surface particulate [Ca^{+2}] from 50.5 river km upstream to the dam.

-of 0 69mM Maximum concentrations reached 1 05 mM at the headwaters in October 2000 Magnesium surface concentrations had a conservative variability, longitudinally, with a range of 0 62 mM Deep concentrations of magnesium (Fig 9) had a median value of 0 76 mM with a maximum concentration of 1 01 mM at site 27 in October, 2000 Concentrations of magnesium in the metalimnion of Canyon Reservoir (Fig 10) had an annual median value of 0 67 mM and a range of 0 43 mM The tailrace below the dam displayed an increase in magnesium concentrations from April through the summer 2000, with the highest concentrations in August 2000 and March 2001 (0 82 mM)

Particulate magnesium in the surface waters (Fig 11) was at a maximum at the headwaters (0 007 mM) in July 2000 and had an annual median concentration of 0 002 mM Deep and metalimnetic concentrations (Figs 12 and 13) of particulate magnesium were correlated with particulate calcium ($r^2 = 0\ 63$, $p < 0\ 01$) and follow the same longitudinal distribution pattern. Particulate magnesium concentrations at the tailrace below the dam declined through the summer 2000 and peaked in May and September 2000, then again in November 2000 and January 2001 (0 02 mM)

The Mg/Ca ratio for the reservoir reached a maximum in August 2000 in the surface and deep waters (1 54 and 1 60) The median annual Mg/Ca ratio for the entire reservoir was 0 58 At Mg/Ca ratios of < 2, pure phase calcite ($CaCO_3$ only) is said to be the primary chemical precipitate in hardwaters (Kelts and Hsu, 1978)

Saturation Index Ω

The surface waters of Canyon Reservoir were supersaturated with respect to calcite for the entire sampling period, except for November 2000 at site 17 ($\Omega = 0\ 71$) Calculated saturation indices for surface waters (Fig. 14) reached a maximum in April

2000 at site 31 (Ω = 10 2) May 2000 had the highest median saturation index for surface waters (Ω = 4 53) and November 2000 had the lowest median saturation index (Ω = 1 60) The generally close relationship between calcite saturation index, calcium, and chlorophyll *a* in the surface waters was evident in July 2000 (Fig 15)

Calcite saturation indices deep in the reservoir (Fig 16) rarely exceeded saturation from April 2000 to November 2000 Starting in January 2001, deep saturation indices stayed above 1 0 for the entire reservoir with a maximum of 5 98 in March 2001 at site 34 Metalimnetic saturation indices (Fig 17) stayed above 1 0, except for August and September 2000 Based on the spreadsheet model for calcite saturation, pH appears to dominate or control calcite saturation index in Canyon Reservoir

Chlorophyll a

Concentrations of chlorophyll *a* (Chl *a*) in the surface waters of Canyon (Fig 18) peaked at site 27 with an annual median concentration of 6 73 µg L^{-1} and a maximum concentration of 20 99 µg L^{-1} in April 2000 Deep concentrations of chlorophyll *a* (Fig. 19) show a marked longitudinal distribution from the dam to site 31 July 2000 had maximum concentrations of chlorophyll *a* at site 31and site 34 (58 96 and 57 82 µg L^{-1}) The metalimnion had an annual median concentration of 3 03 µg L^{-1} (Fig 20) with the maximum concentration in October 2000 (20 69 µg L^{-1}) at site 10

pH

Annual surface pH measurements (Fig 21) ranged from 7 46 to 8 55, with the maximum pH (8 55) in June 2000 at site 10 The annual median pH was 8 30 Deep measurements of pH (Fig 22) had an annual median value of 7 62 with the highest median pH (7 91) at site 34 Metalimnetic pH (Fig 23) had an annual median measure-

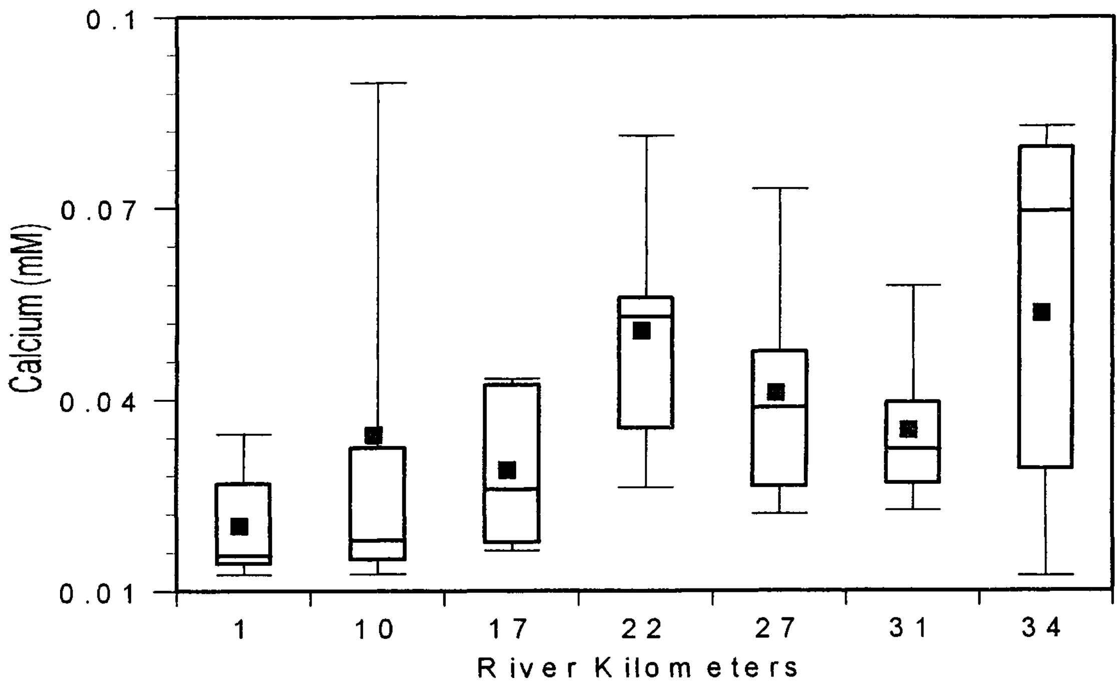

Figure 6. Annual deep particulate [Ca^{+2}] from 34 river km upstream to the dam.

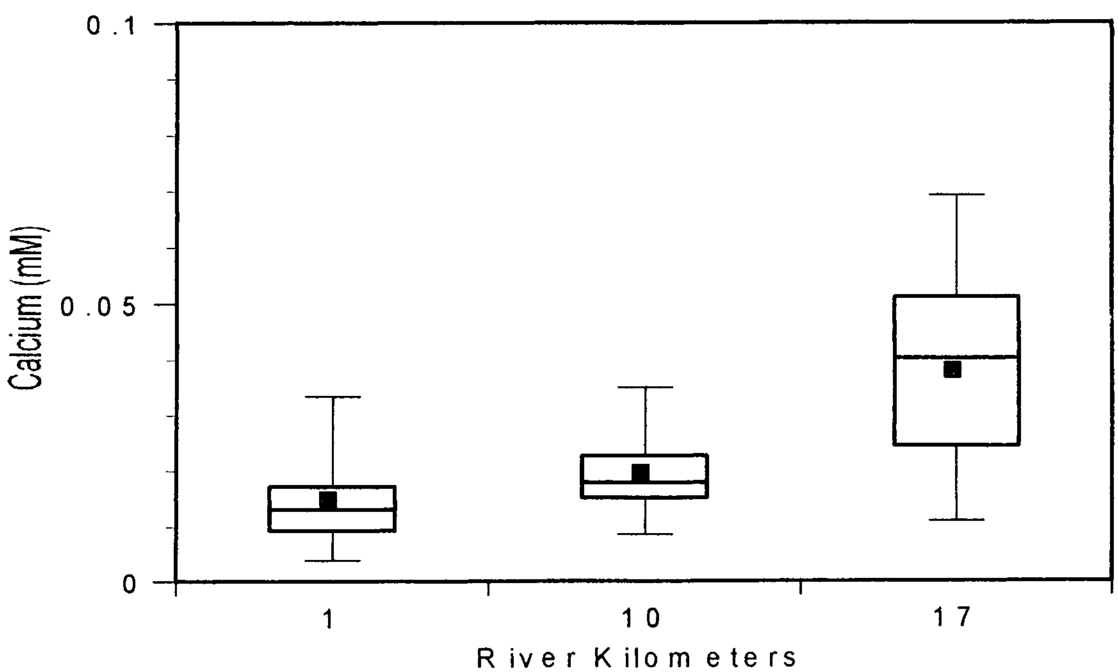

Figure 7. Annual metalimnion particulate [Ca^{+2}] from 17 river km upstream to the dam.

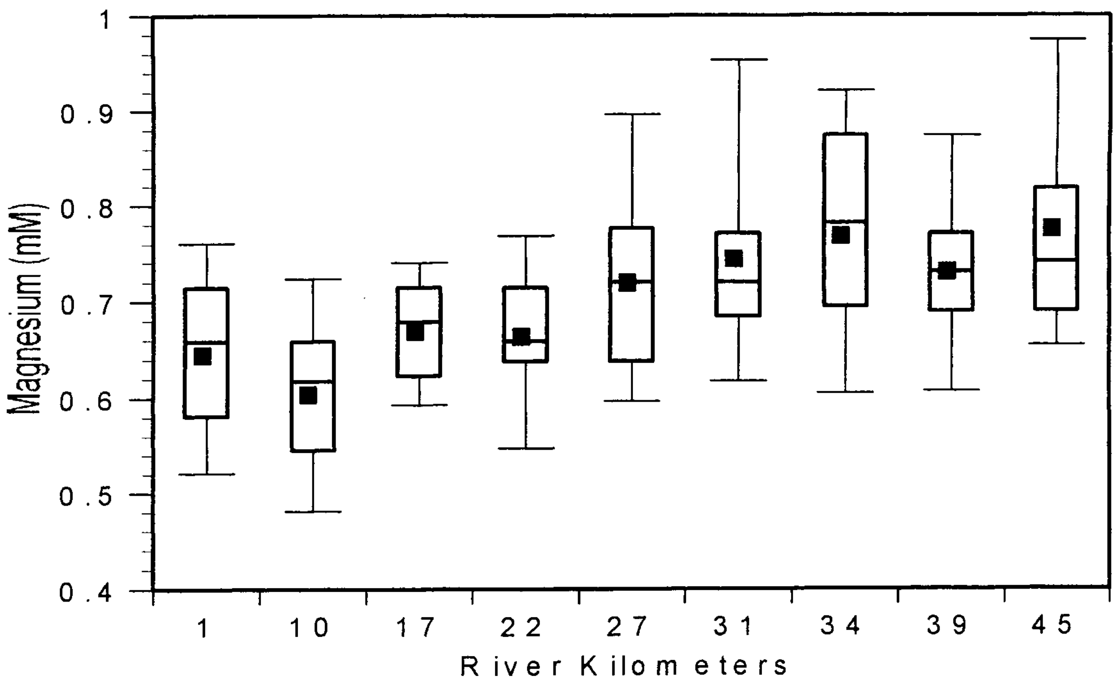

Figure 8. Annual surface [Mg^{+2}] from 50.5 river km upstream to the dam.

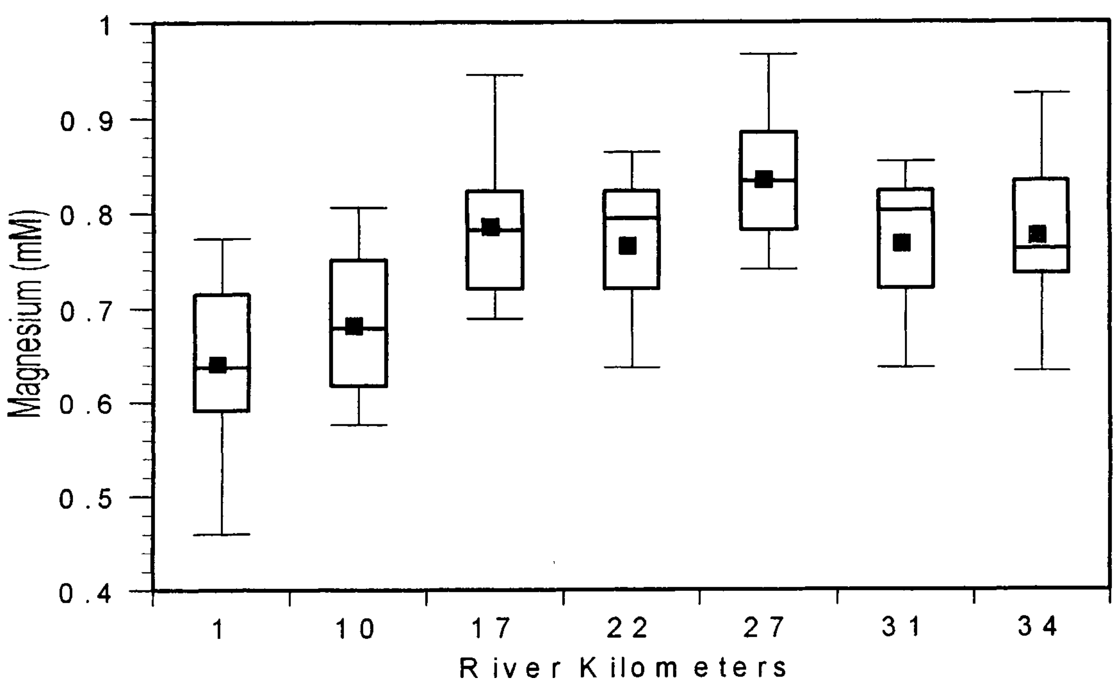

Figure 9. Annual deep [Mg^{+2}] from 34 river km upstream to the dam.

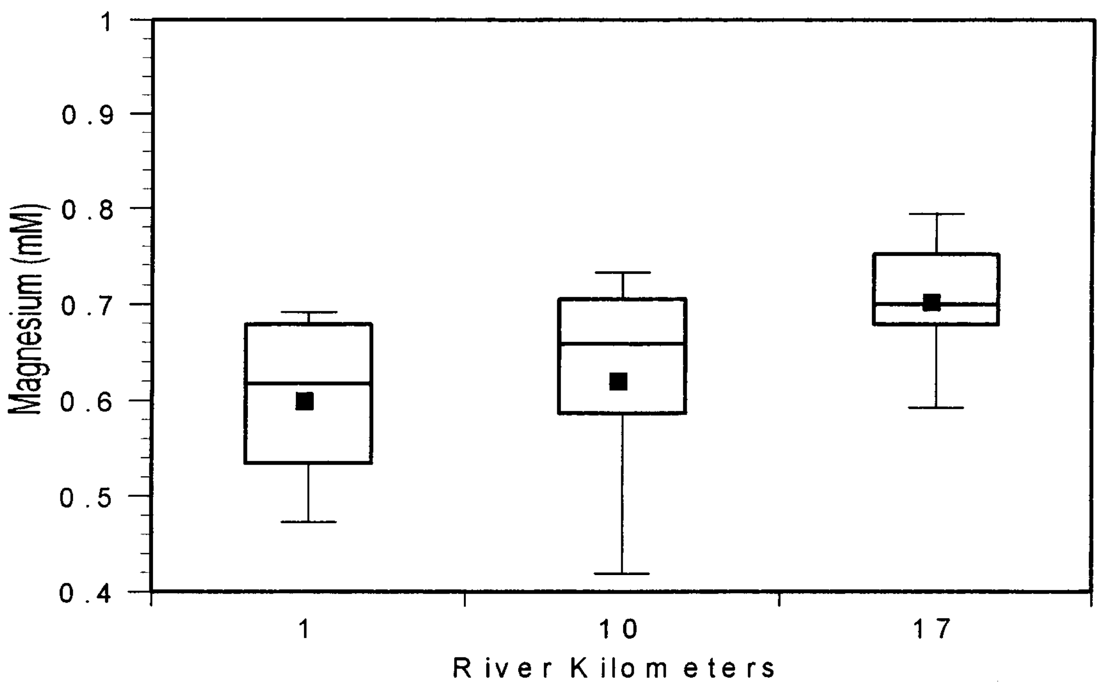

Figure 10. Annual metalimnion [Mg^{+2}] from 17 river km upstream to the dam.

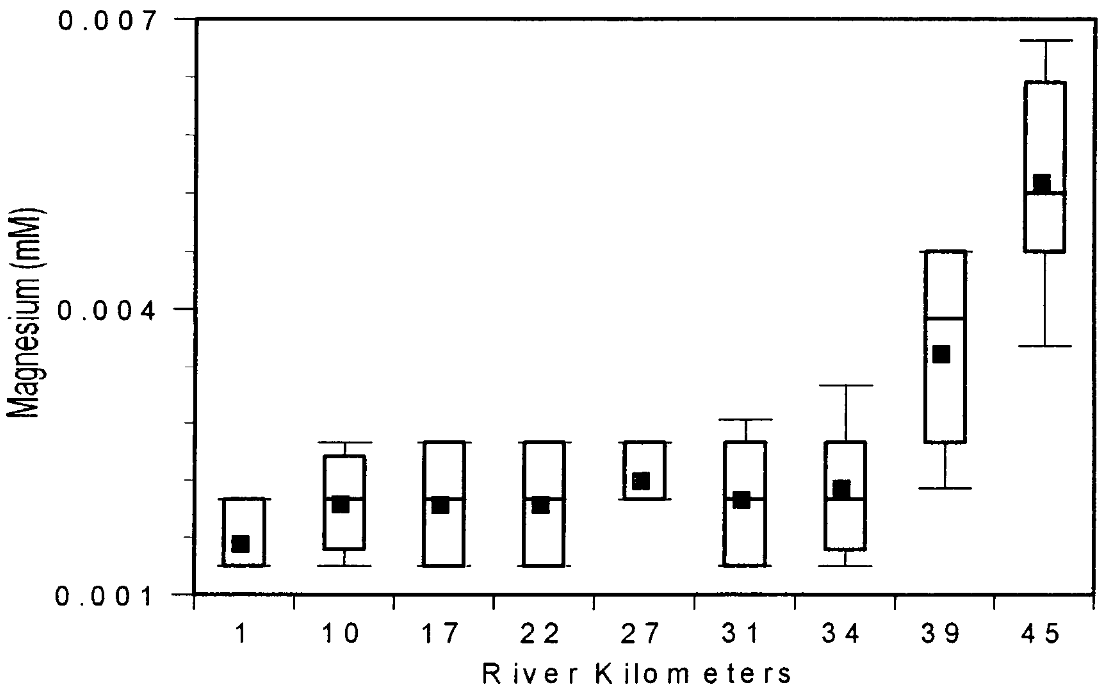

Figure 11. Annual surface particulate [Mg^{+2}] from 50.5 river km upstream to the dam.

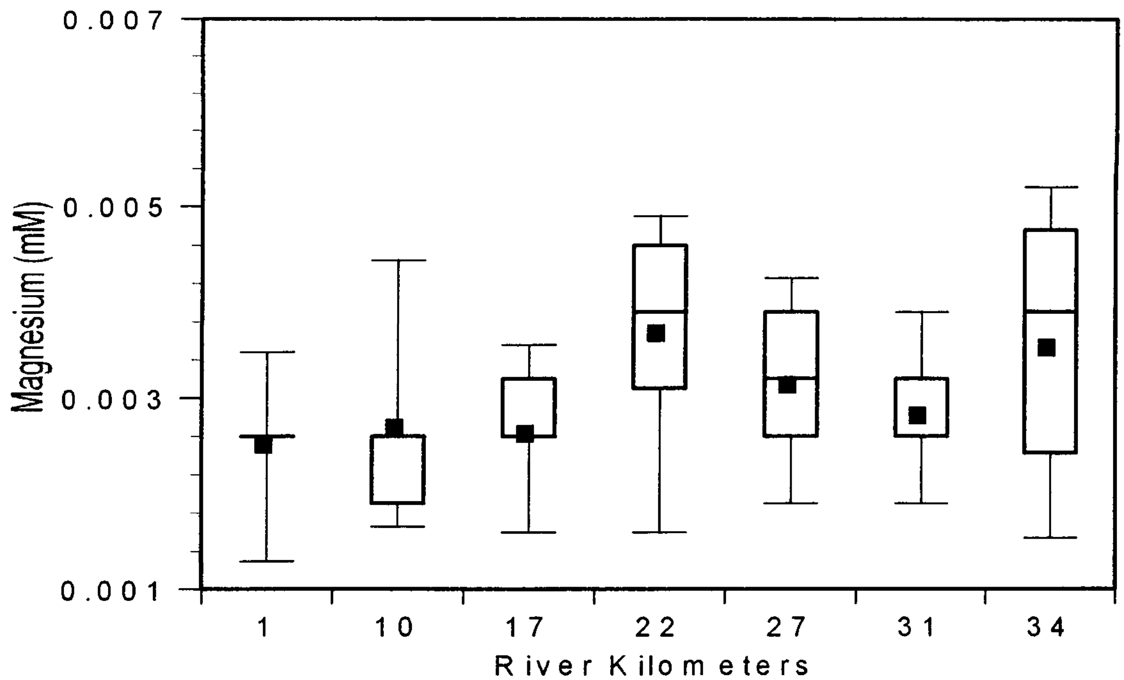

Figure 12. Annual deep particulate [Mg^{+2}] from 34 river km upstream to the dam.

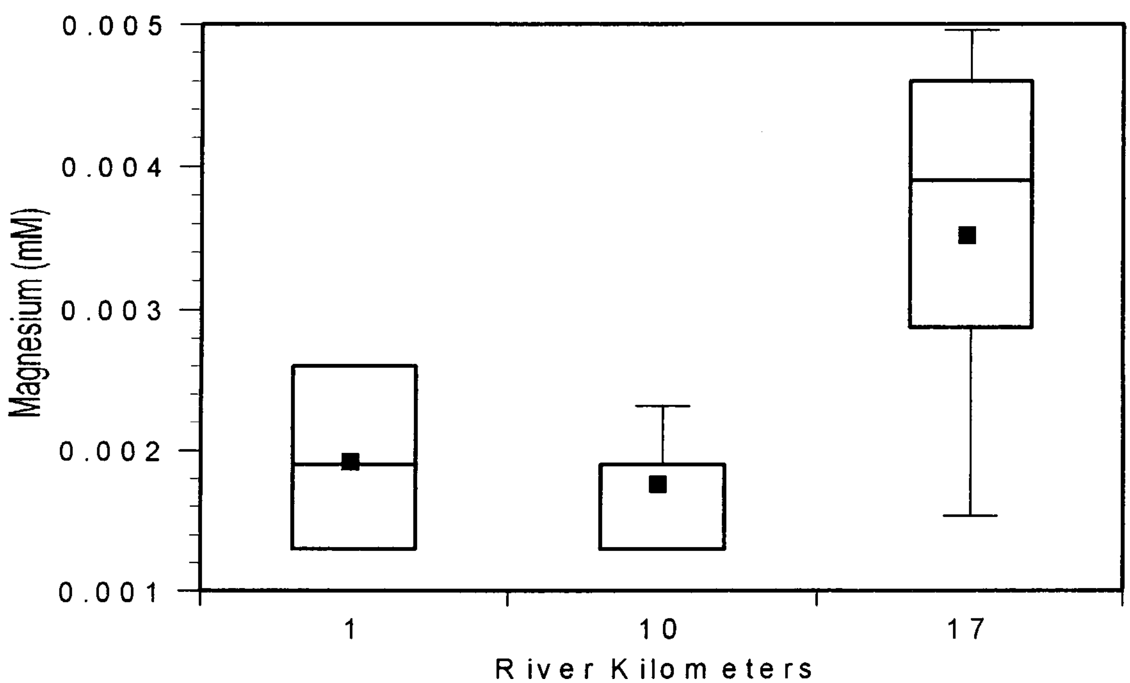

Figure 13. Annual metalimnion particualte [Mg^{+2}] from 17 river km upstream to the dam.

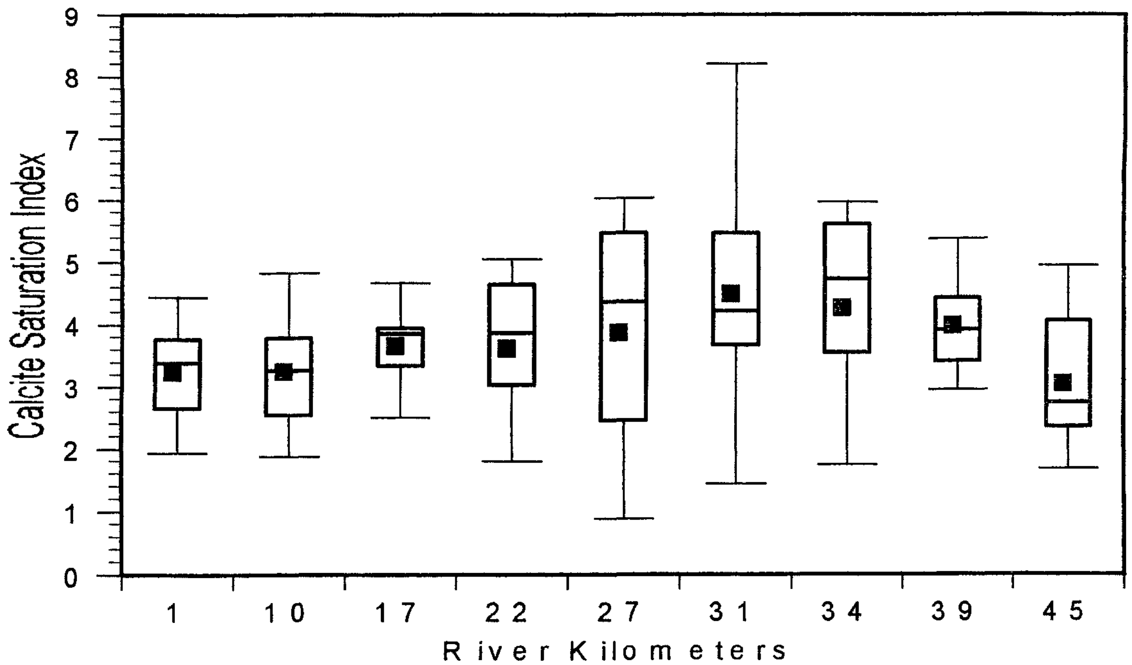

Figure 14 Annual surface calcıte saturatıon ındex from 50 5 rıver km upstream to the dam

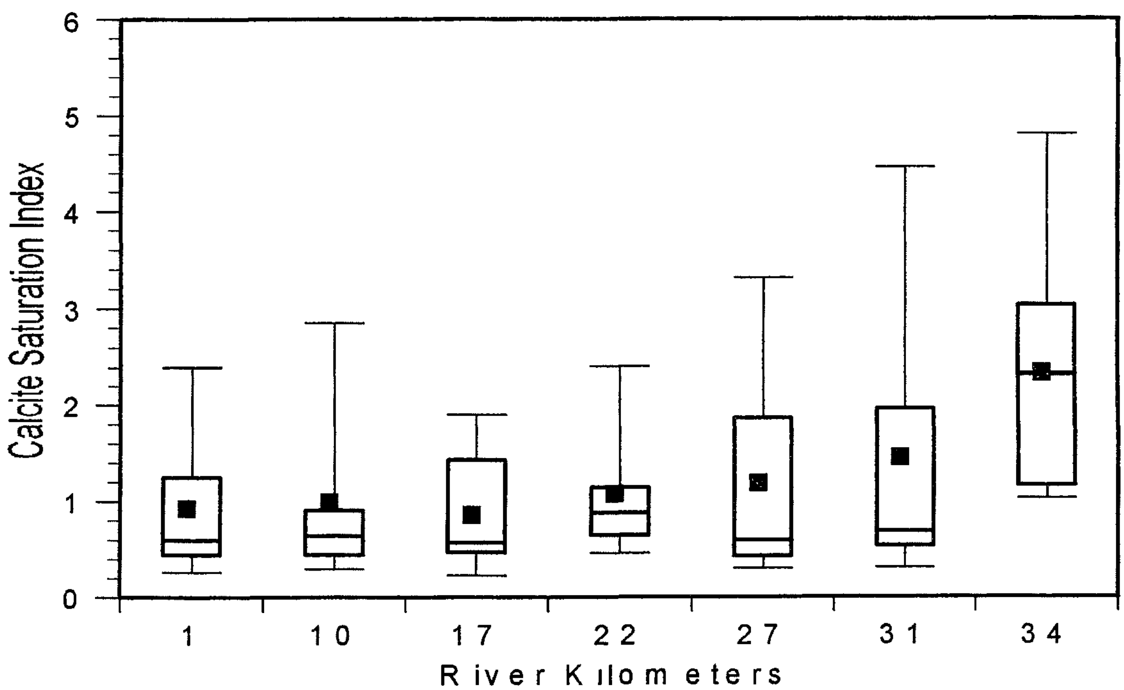

Figure 16 Annual deep calcıte saturatıon ındex from 34 rıver km upstream to the dam

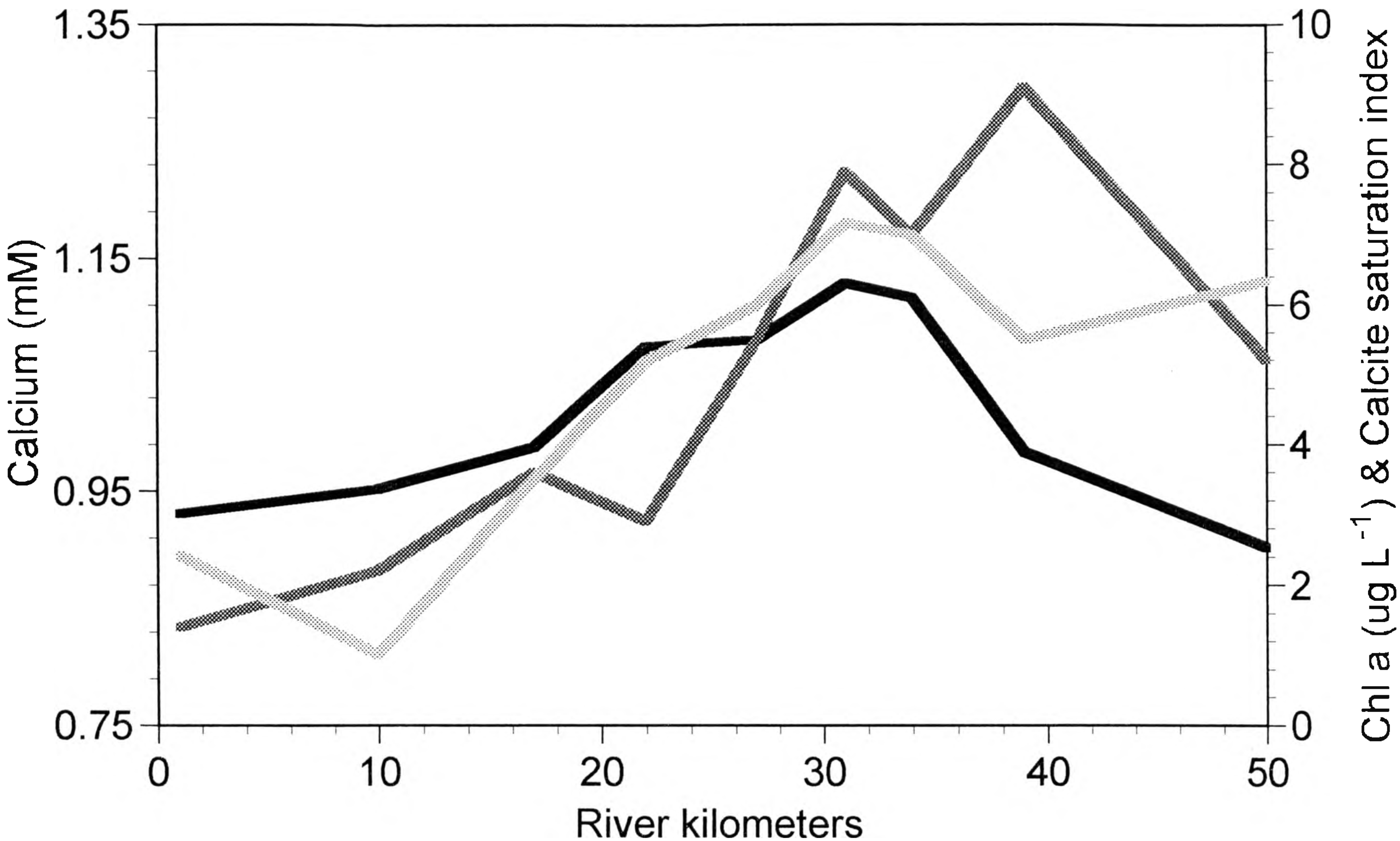

Figure 15. Longitudinal surface water gradients of calcite saturation index (black line), Ca^{+2} (light gray line), and Chl *a* ($\mu g\ L^{-1}$, dark gray line) from the headwaters to the dam in July 2000.

ment of 8 02 with a maximum pH of 8 43 at the dam The pH at the tailrace below the dam was at a minimum in May 2000 (7 41) and a maximum in September 2000 (8 38)

Total Alkalinity and Conductivity

Total alkalinity measurements for the entire reservoir had an annual median value of 3 22 meq L^{-1} Total alkalinity (Fig 24) in the surface waters showed a distinct longitudinal gradient from the dam to the headwaters and were highest at site 34 (4 52 meq L^{-1}) in January 2001 Total alkalinity deep in the reservoir (Fig 25) was at a maximum in March 2001 (4 67 meq L^{-1}) at site 22 Metalimnetic total alkalinity (Fig. 26) reached its maximum in March 2001 at site 17 Total alkalinity slowly declined at the tailrace below the dam from April (3 74 meq L^{-1}) to September 2000 (2 72 meq L^{-1}), then peaked in October 2000 (3 12 meq L^{-1})

Specific conductance was highly variable both spatially and seasonally in Canyon Reservoir The annual median value for specific conductance was 397 µS cm^{-1} for the entire reservoir Surface (Fig 27), deep (Fig 28), and metalimnetic (Fig 29) specific conductance values were highest in March 2001 Surface and metalimnetic specific conductance was at a minimum (316 and 326 µS cm^{-1}) in July 200 at site 10 Maximum specific conductance values for the surface, deep and metalimnion were 518, 529, and 506 µS cm^{-1}, respectively Specific conductance showed a dramatic increase at the tailrace below the dam starting in October 2000 (377 µS cm^{-1}) to March 2001 (514 µS cm^{-1})

Temperature

Surface and metalimnion temperatures were at a maximum in July at site 34 and site 10 (31 90 and 27 32 °C) The minimum annual temperatures for the entire reservoir

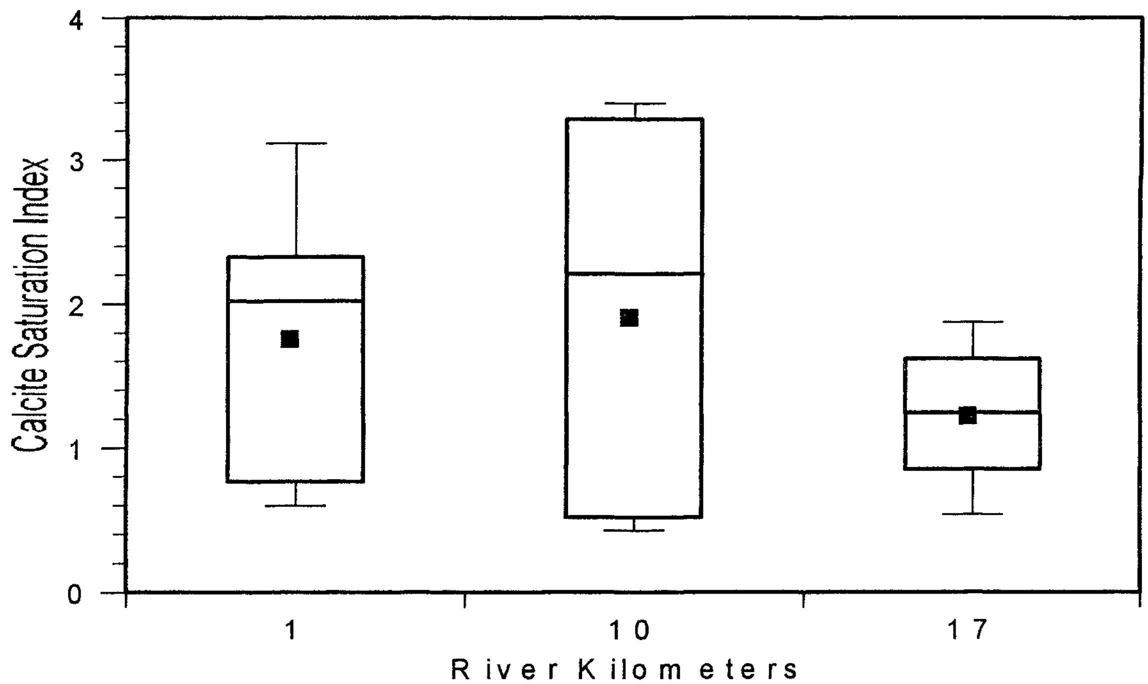

Figure 17 Annual metalimnion calcite saturation index from 17 river km upstream to the dam

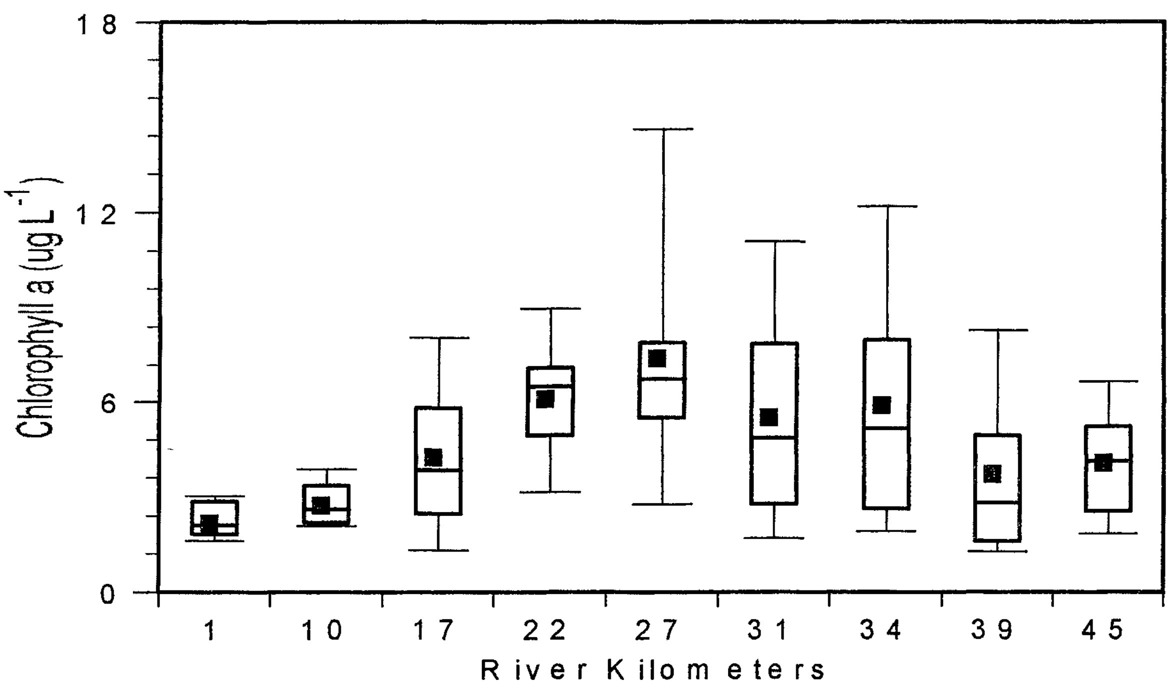

Figure 18 Annual surface chlorophyll *a* concentrations from 50 5 river km upstream to the dam

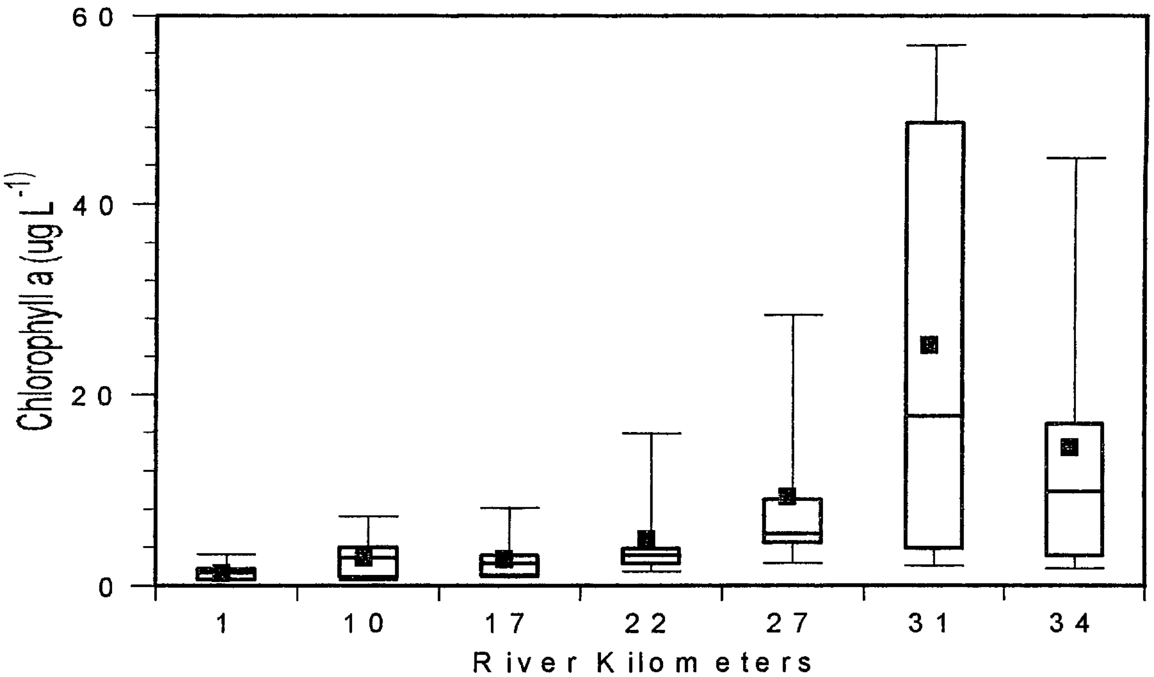

Figure 19 Annual deep chlorophyll *a* concentratıons from 34 rıver km upstream to the dam

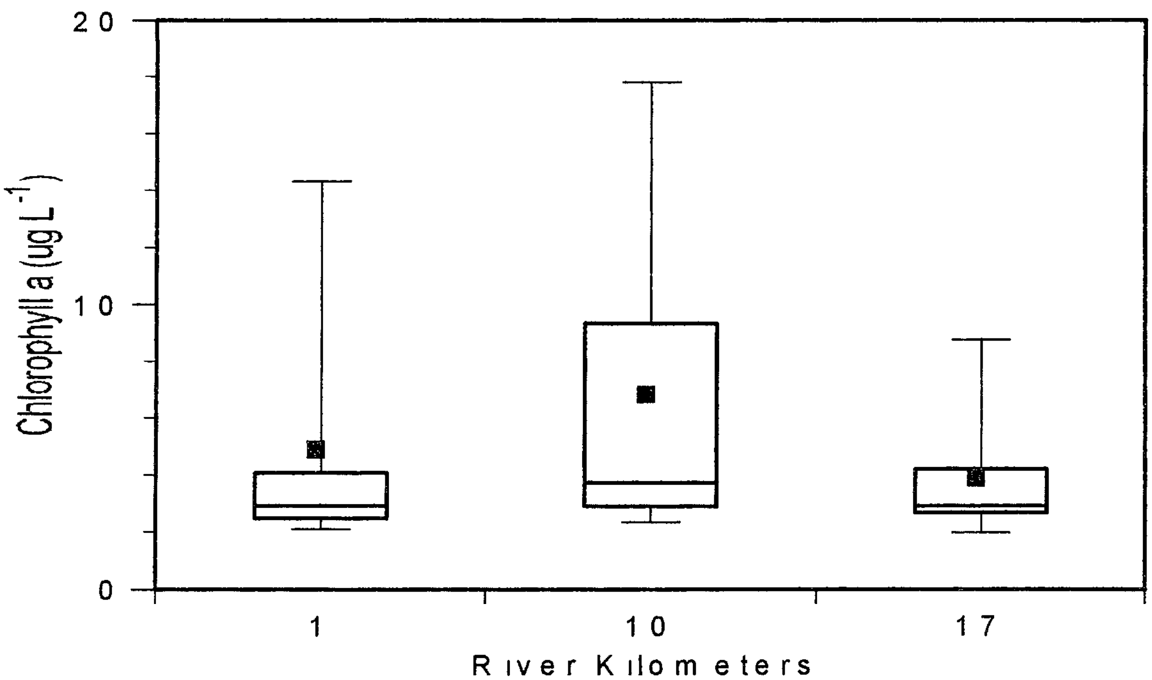

Figure 20 Annual metalımnıon chlorophyll *a* concentratıons from 17 rıver km upstream to the dam

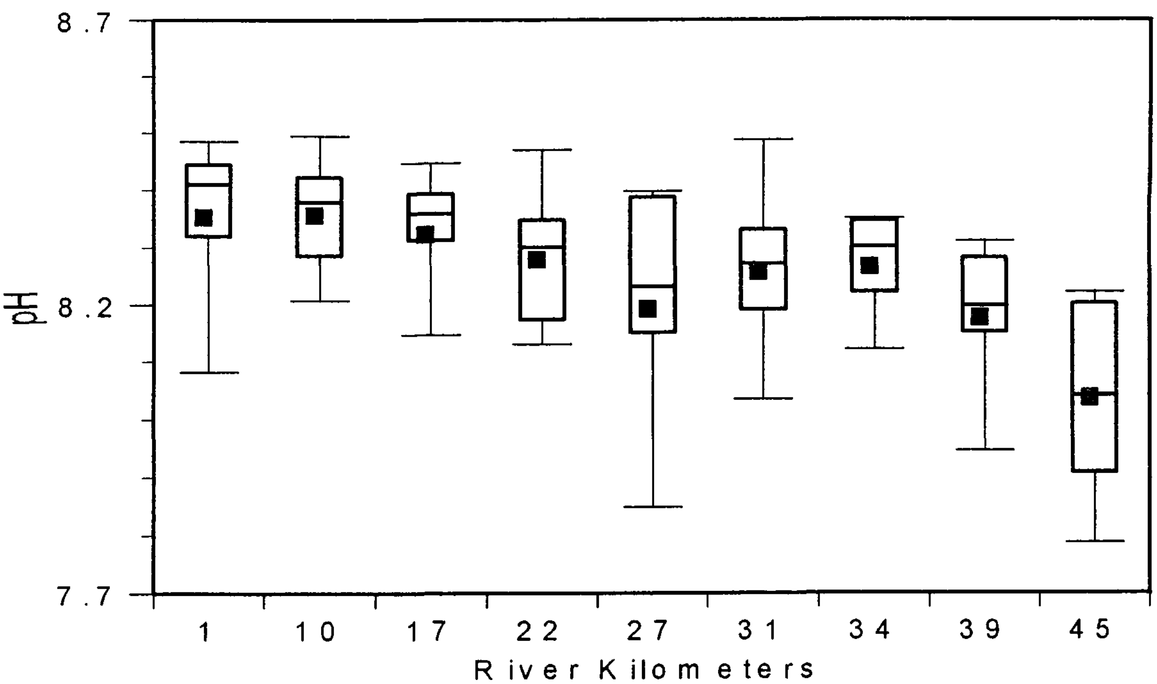

Figure 21. Annual surface pH from 50.5 river km upstream to the dam.

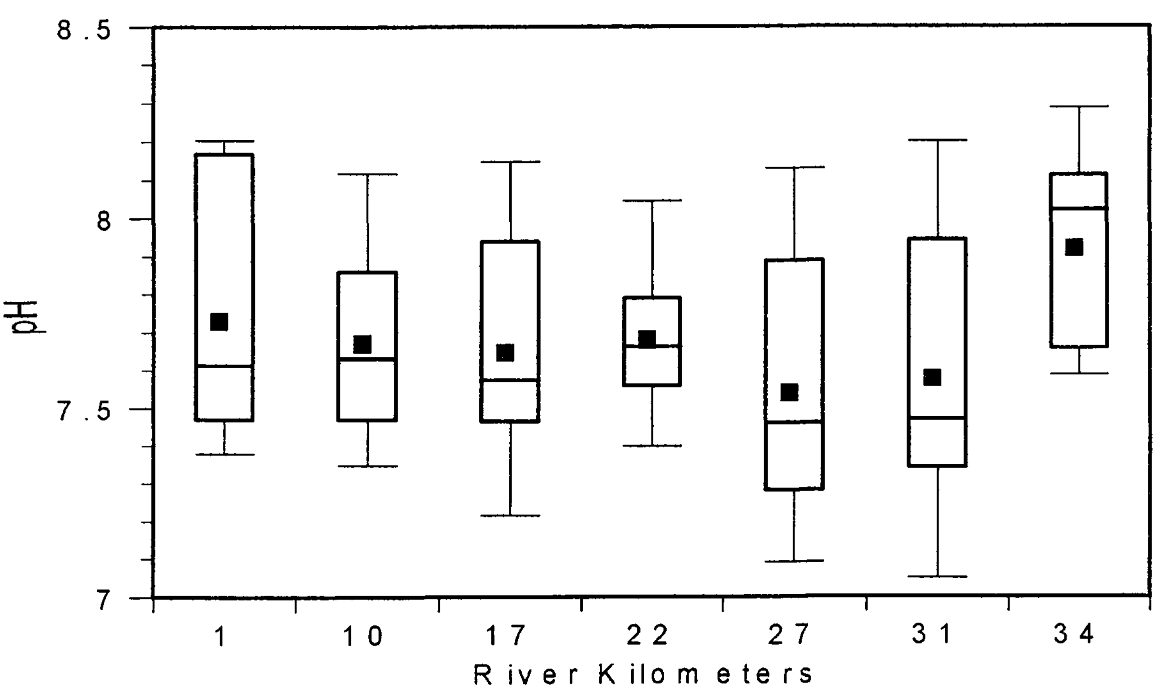

Figure 22. Annual deep pH from 34 river km upstream to the dam.

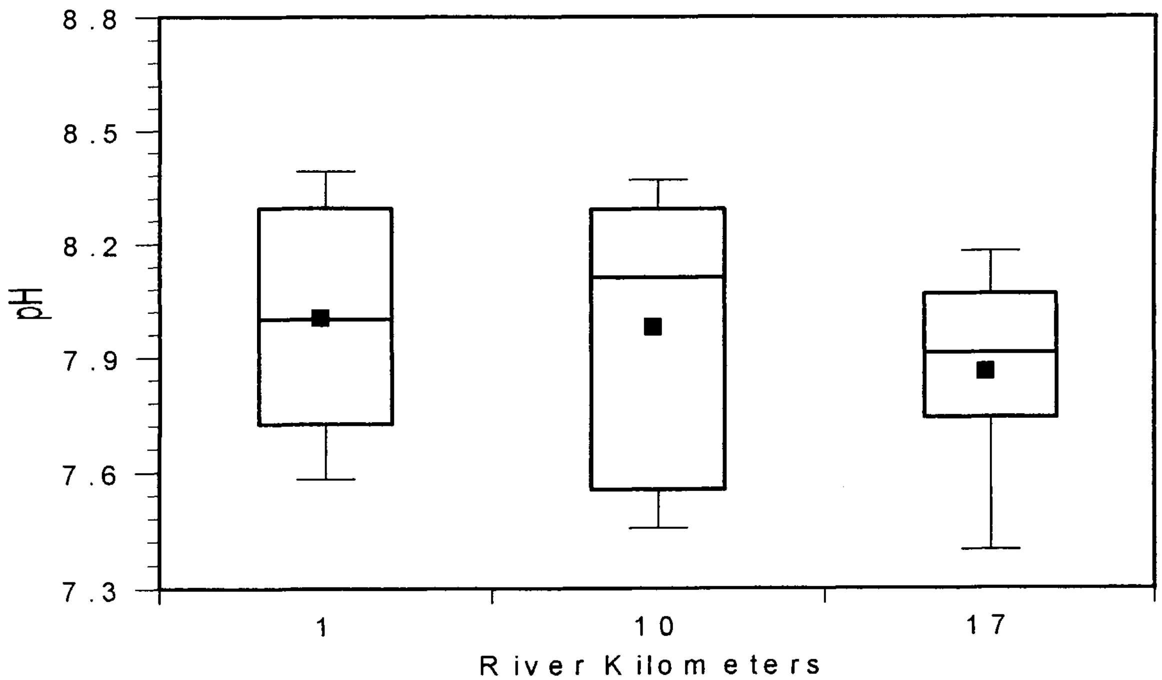

Figure 23. Annual metalimnion pH from 17 river km upstream to the dam.

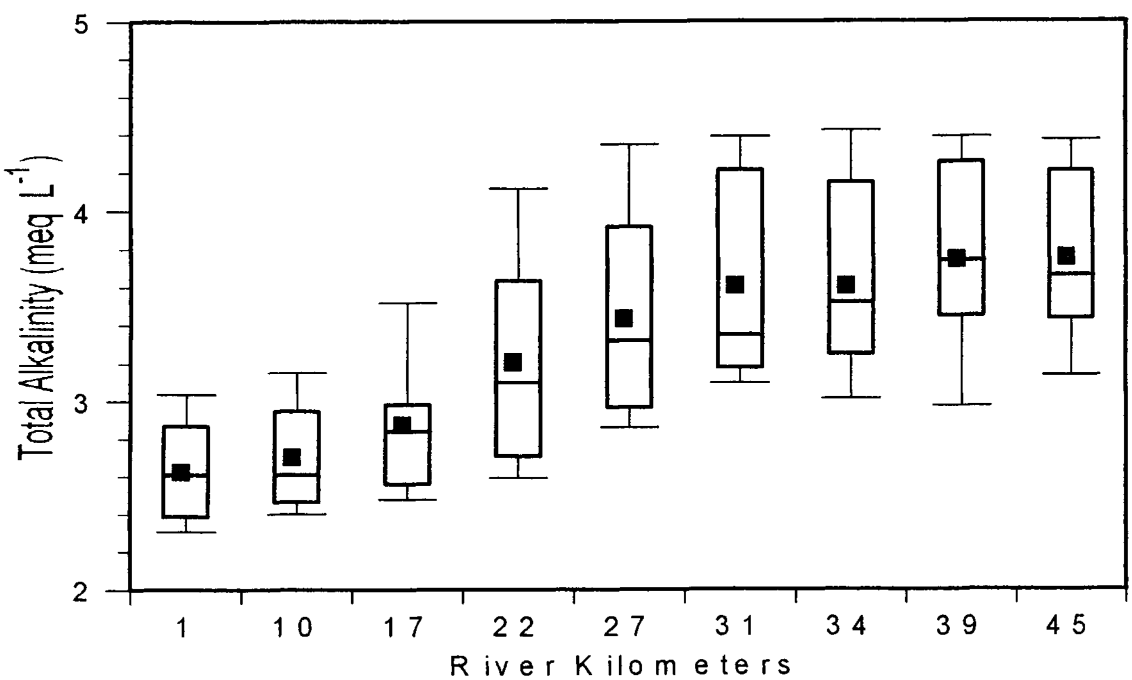

Figure 24. Annual surface total alkalinity from 50.5 river km upstream to the dam.

were in January 2001, with the lowest temperature (9 35 °C) at the deep dam site

Flow

The Guadalupe River coming into Canyon near Spring Branch (Fig 30) was at minimum flow in the summer months of 2000, with the lowest flow in August 2000 (0 16 $m^3 s^{-1}$) Beginning in late October 2000, corresponding to a large rainfall event, river flow increased to a maximum of 345 46 $m^3 s^{-1}$and stayed consistently above 15 $m^3 s^{-1}$ beginning in early January 2001 through the end of sampling in April 2001 Canyon Dam release (Fig 31) at Sattler, TX was at a minimum in mid-September 2000 (1 18 $m^3 s^{-1}$) and a maximum in mid-November 2000 (113 55 $m^3 s^{-1}$)

Turbidity

Surface turbidity reached a maximum at site 39 and the headwaters (43 NTU) in June 2000, with an annual median value of 4 8 NTU Site 1 had the lowest turbidity at all three depths sampled The turbidity maximum (34 NTU) was found at site 10 in January 2001

Seston Sedimentation

Sedimentation of total seston dry weight (Table 1 and Fig 32) showed a marked longitudinal distribution from the dam to site 34 from mid-July to mid-August 2000(One –Way ANOVA, $p < 0 01$) However, daily sedimentation rates of particulate organic matter (POM) between the dam site and site 19 was not significantly different from mid-July to mid-August The greatest apparent mean sedimentation rates of total seston dry weight occurred at site 27 (55 67 g d w $m^{-2} d^{-1}$) from June to September 2000 Average POM sedimentation rates were highest at site 34 (9 24 g d w $m^{-2} d^{-1}$) from June to September 2000 The data set from mid-July to mid-August 2000 (Fig 32) shows that the greatest amount of inorganic sedimentation (48.21g d w $m^{-2} d^{-1}$), as well as organic

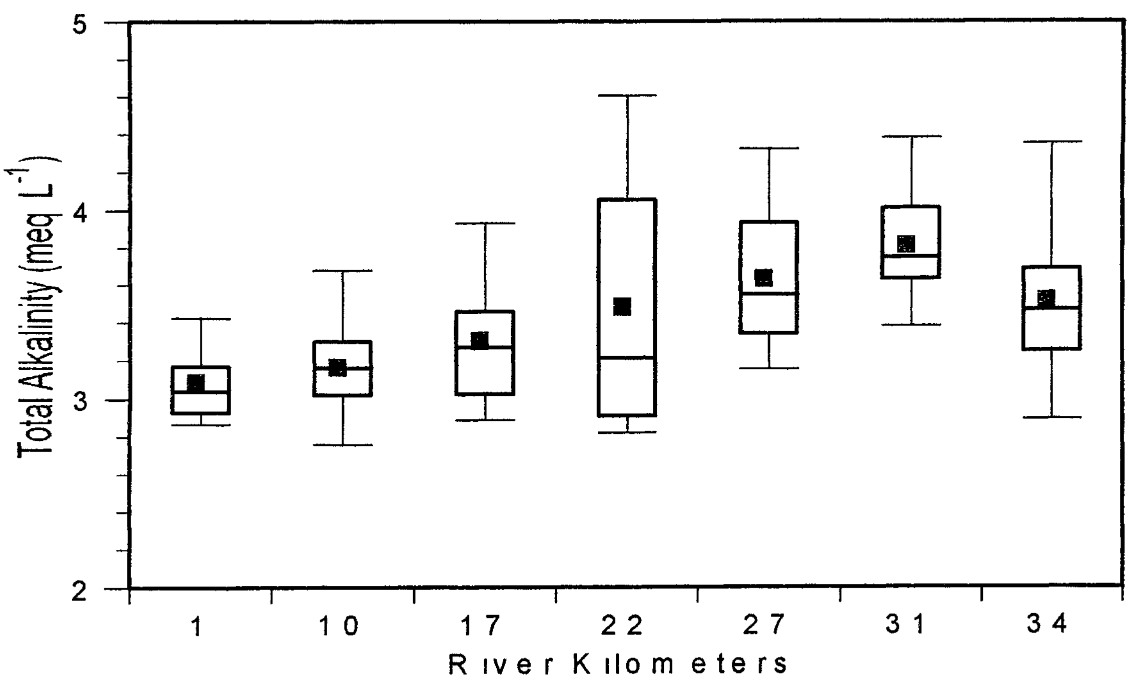

Figure 25 Annual deep total alkalinity from 34 river km upstream to the dam

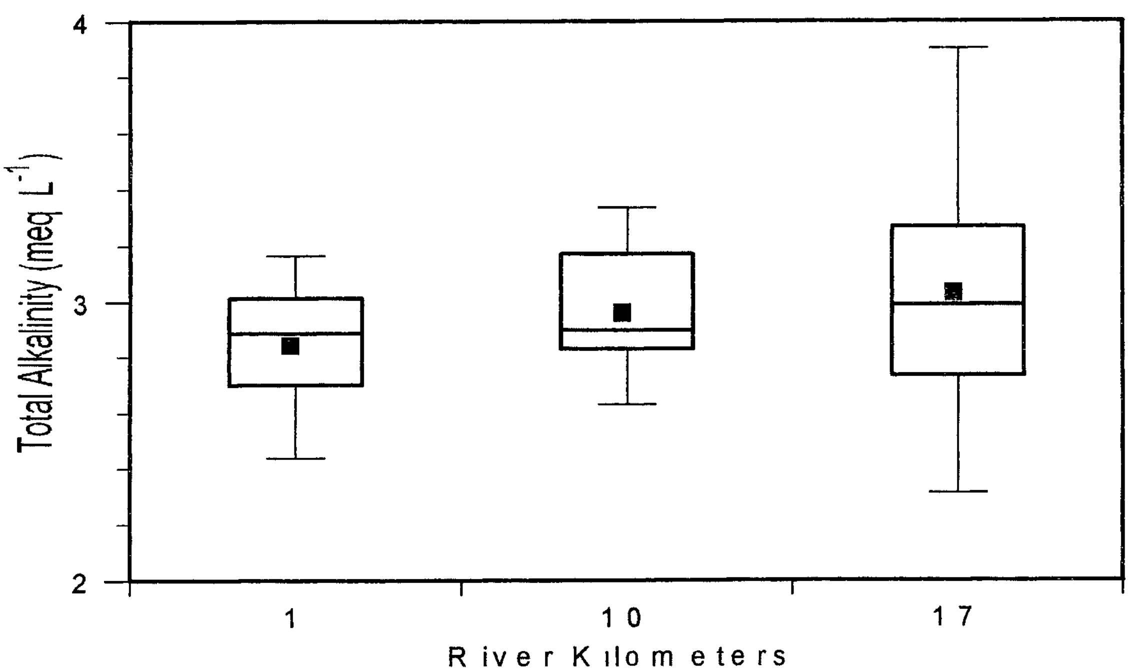

Figure 26 Annual metalimnion total alkalinity from 17 river km upstream to the dam

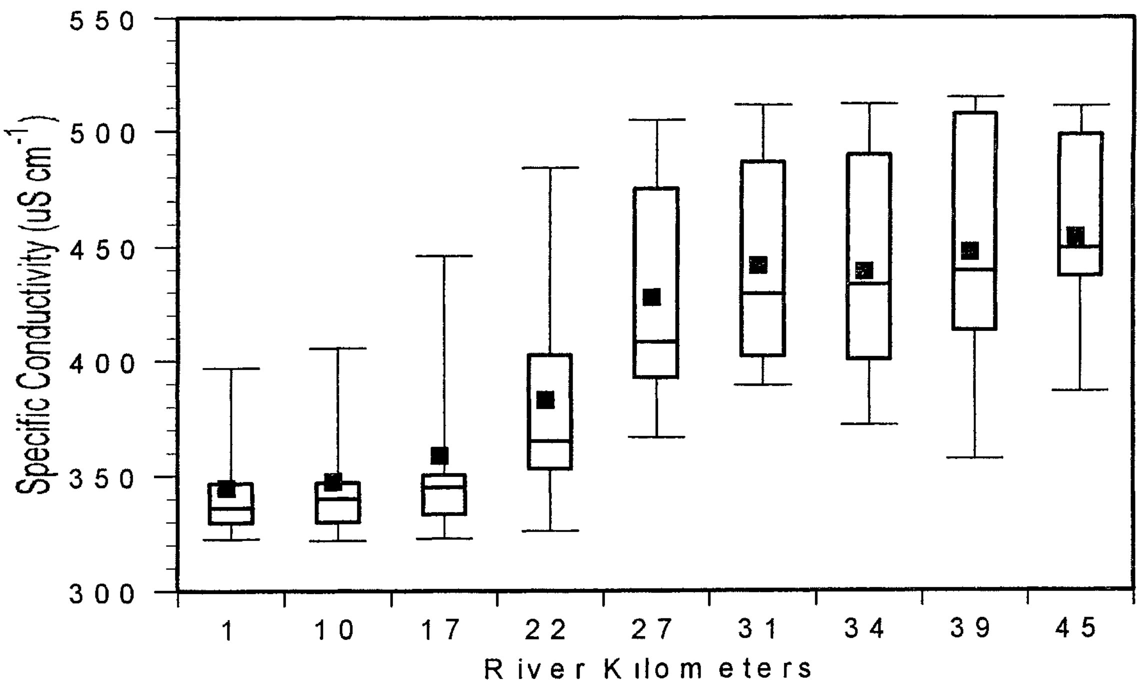

Figure 27. Annual surface specific conductivity from 50 5 river km upstream to the dam

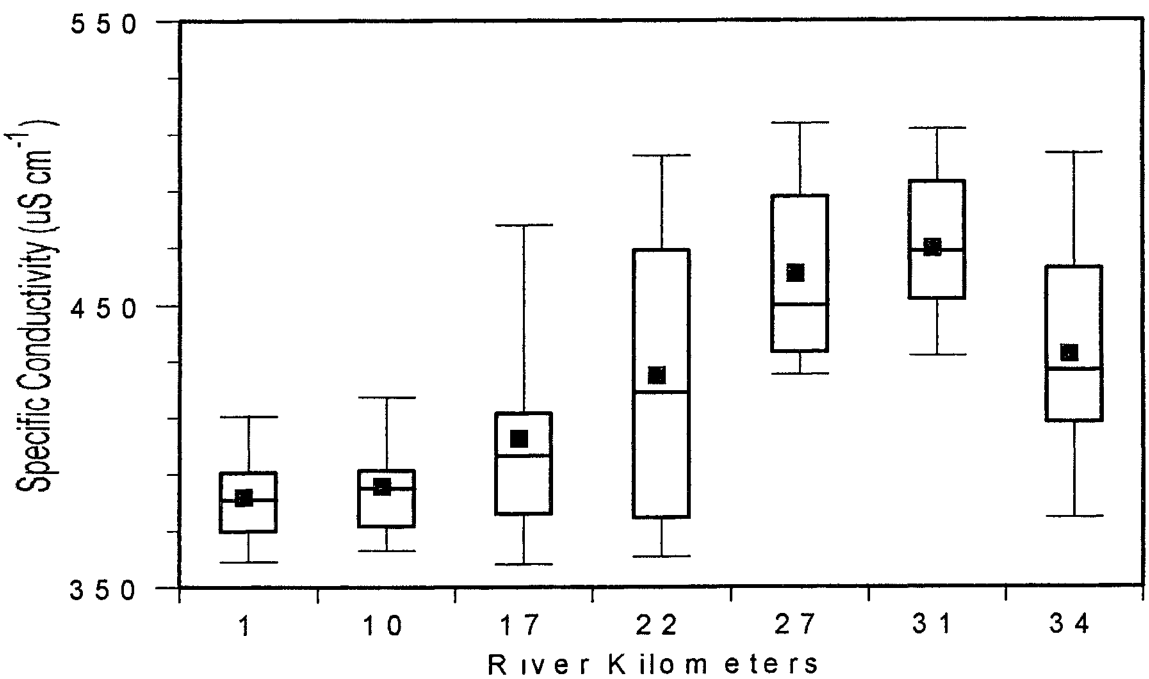

Figure 28 Annual deep specific conductivity from 34 river km upstream to the dam

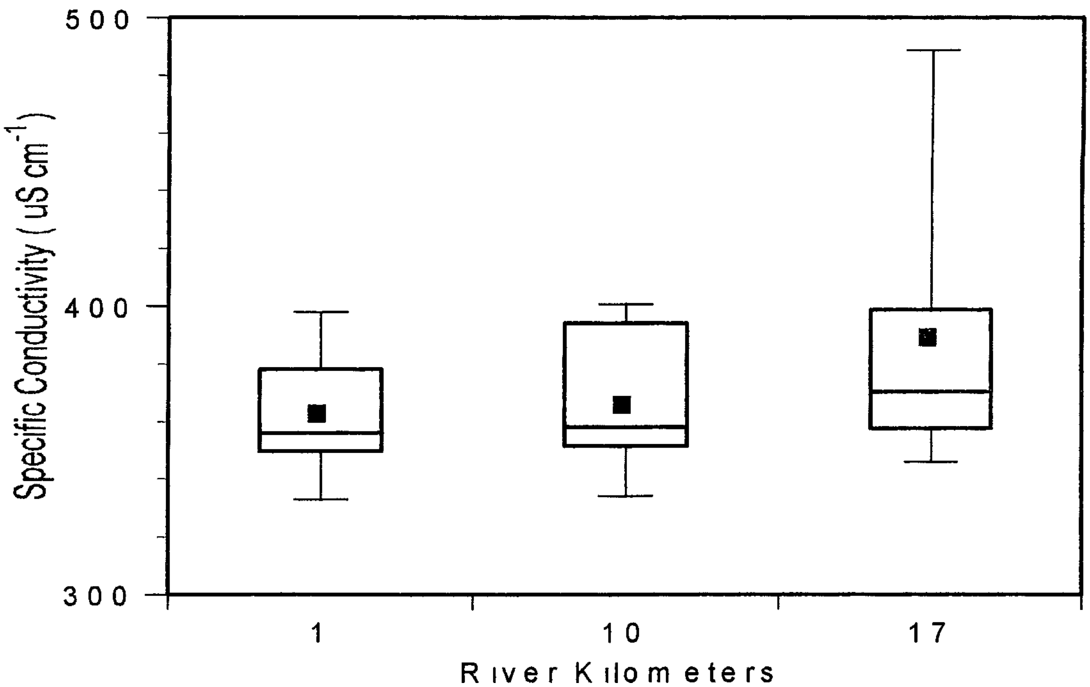

Figure 29 Annual metalimnion specific conductivity from 17 river km upstream to the dam

Date	Site (km)	Dry wt	POM	%POM
June-July/00	1	2 93	1 20	41 9
	27	56.54	9 05	16 0
	34	47 90	5 59	11 6
July-Aug /00	1	4 19	1 26	30 1
	19	27 50	5 47	19 8
	27	58 72	10 51	17 8
	34	50 30	7 65	15 2
Aug-Sept /00	27	51.80	7.25	13.9
	34	59 60	14 61	24 5

Table 1. Summer sedimentation of seston dry weight and particulate organic matter (g d.w m^{-2} d^{-1})

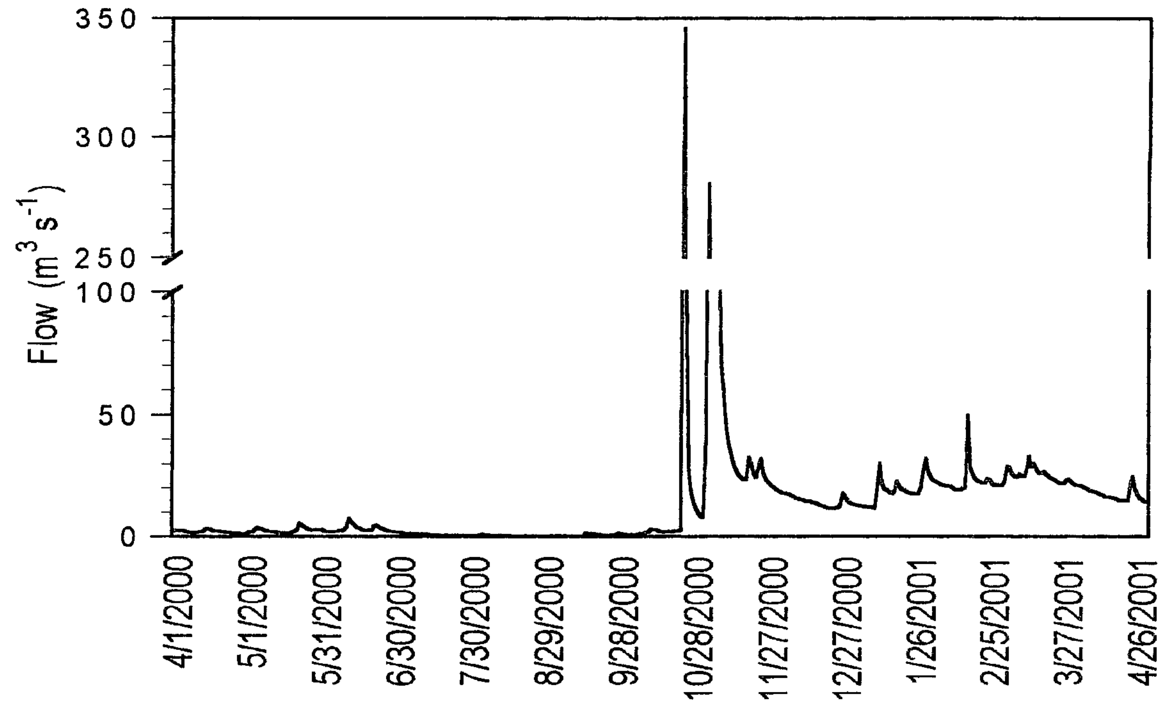

Figure 30 Headwaters of Canyon Reservoir Annual Guadalupe River inflow near Spring Branch, TX

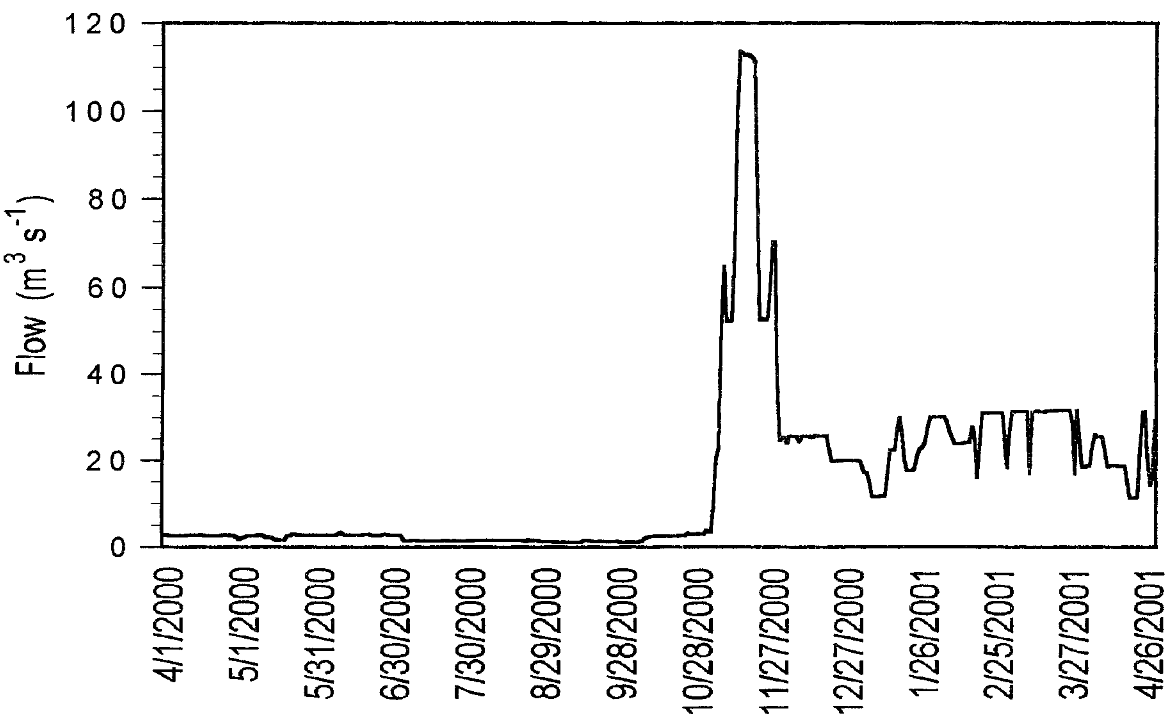

Figure 31 Tailrace at Canyon Dam Annual outflow at Sattler, TX

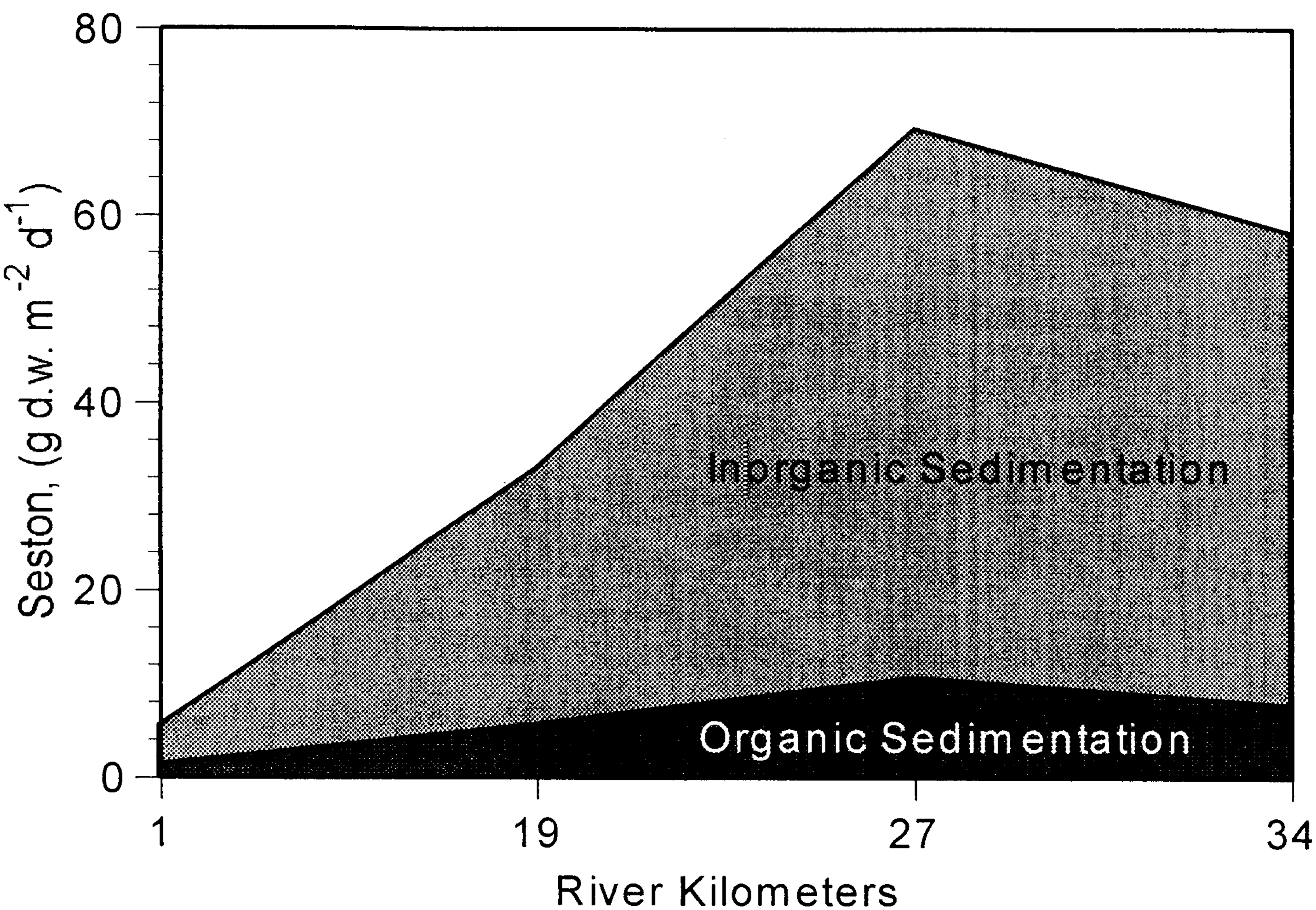

Figure 32. Sedimentation of total seston (dry weight) and particulate organic matter from mid-July to mid-August 2000.

sedimentation (10 51 g d w m $^{-2}$ d $^{-1}$), occurred at site 27

Discussion

Of the three primary natural mechanisms said to control the chemistry of lakes and rivers (Gibbs, 1970), the chemical weathering of rich limestone deposits best characterizes the influence of the watershed on the chemistry of Canyon Reservoir Groeger & Ground (1994) describe the influence of geology on the chemistry of central Texas reservoirs, stating that upper values of salinity in this region are greatly affected by the supersaturation and precipitation of calcium carbonate Runoff and inflow intensify chemical weathering and ultimately decide the chemical, physical, and biological patterns throughout the reservoir The quantity of runoff will be dependent on the shape and size of the watershed, antecedent conditions, and the distribution of precipitation (Thornton *et al.*, 1990)

Using the analytical model described by Thornton *et al* (1981), Canyon Reservoir can be characterized as having three distinct longitudinal zones possessing unique chemical, physical, and biological properties, which occur along a continuum from the river inflow to the dam The uplake, lotic riverine zone is characterized by higher flow, short residence time, higher levels of available nutrients, suspended solids, and light extinction compared to the downstream regions of a reservoir The transitional zone is characterized by increased water residence time, decreasing flow velocity, and an increase in basin width and depth, leading to an increase in phytoplankton productivity and biomass Moreover, the characteristics of the transitional zone induce the physical, chemical, and biological separation of surface and bottom waters Down reservoir, the lacustrine zone, nearest the dam, usually displays a longer water residence time, lower concentrations of dissolved nutrients and suspended abiotic particles, higher water transparency, and a deeper photic layer However, the volumetric phytoplankton productivity of the photic zone is reduced by nutrient limitation during most of the growing season, and is supported primarily by *in situ* nutrient cycling rather than by advective nutrients (Kimmel *et al*, 1990)

Flowing through high limestone cliffs, the riverine zone of Canyon Reservoir, typically site 39, displays all of the hallmarks of the aforementioned model This site is shallow, narrow, and well mixed due to high flow with a high annual median turbidity (7 4 NTU) The influence of the river minimized phytoplankton residence time and light penetration, leading to a low annual median Chl *a* concentration (3 53 $\mu g\ L^{-1}$) The influence of watershed runoff and river inflow were evident at site 39 through a high annual median calcite saturation value ($\Omega = 3\ 82$) and particulate calcium and magnesium concentrations, which taper off as advective force decreases downstream Moreover, high annual median values of total alkalinity in the upper reach of Canyon (site 39 and head-waters) correspond well with high annual median concentrations of particulate calcium Though the riverine zone displayed high calcite saturation values, the physical attributes (high flow) of the riverine zone probably prohibited active coprecipitation of calcite with phytoplankton

The range of the riverine zone in Canyon Reservoir is highly dependent on runoff and inflow During high flow events the riverine zone can extend at least as far down-stream as site 27, a site usually characteristic of a transitional zone High rates of sediment deposition in the upper portion of reservoirs often result in the formation of deltas (Thornton *et al*, 1990) The evidence to suggest how far downstream the riverine zone may extend was evident via the formation of a delta between sites 27 and 31 In addition, between sites 34 and 39, large sedimentation deposits formed another delta, impeding access to site 39 from August to October 2000, when inflow was minimal After a large rainfall event in mid-October, flow increased substantially and access to the site was restored

A deeper, broader basin, reduced flow, an increase in primary production, and pH distinguishes the transitional zone in Canyon Reservoir Numerous emergent trees on either side of the littoral region were used as a marker for tracing the thalweg This region or zone is dynamic and highly dependent on inflow and location of the plunge point, if one occurs (Thornton *et al* , 1990) In the months with higher inflows, the transitional zone stretched from about site 31 to site 22, perhaps even further downstream During months with little to no inflow the transitional zone appeared to extend as far upstream as site 39, perhaps further upstream

The influence a large (3,709 km^2) limestone drainage basin has on the amount of sediment coming into Canyon Reservoir can be compared to a softwater, predominately forested, granitic drainage basin DeGray Lake (32 km long), a multipurpose reservoir located in south central Arkansas, has a watershed area of 2,262 km^2 James & Kennedy (1987) assessed the mean annual apparent sediment deposition rates along the longitudinal gradient of DeGray Lake Deposition rates were 8 55 g m^{-2} d^{-1} at the headwater station (19 3 km upstream from the dam), 2 98 g m^{-2} d^{-1} at the middle station (12 4 km upstream from the dam), and 1 52 g m^{-2} d^{-1}at the dam, 4 9 km upstream from the dam Whereas, in mid-July through mid-August 2000, Canyon Reservoir's apparent deposition rates were 50 30, 58 72, 27 50, and 4 19 g d.w m^{-2} d^{-1} at sites 34, 27, 19, and 1, respectively.

The transitional zone in Canyon Reservoir displayed the highest rates of sedimentation Maximum sedimentation rates in the summer months of 2000 at sites 27 and 34 correspond to maximal Chl *a* concentrations The most productive surface water site in this zone, based on Chl *a*, was site 27 Both light and nutrients are typically available for algal photosynthesis making the transition zone the most fertile region in a reservoir (Thornton *et al*, 1990)

Evidence to suggest calcite nucleates on the cell walls of phytoplankton was obtained via SEM micrographs (Fig 33) of samples taken from sites 27 and 31 in July 2000 The micrographs reveal small polyhedral and rhombic-shaped calcite crystals in association with the cell walls of the photosynthesizing diatom *Fragıllarıa* and filamentous algae Most of the crystals were larger than 10 μm and were predominately polyhedral Both surface and deep concentrations of calcium and values of calcite saturation were greatest in the transitional zone of the reservoir throughout the year of sampling In July 2000, the longitudinal gradients of calcite saturation index, calcium, and Chl *a* show an increase for all three parameters in the transitional zone of Canyon Reservoir, then show a steady decline towards the dam

The distributions of deep calcite saturation in the transitional zone seem to be controlled by photosynthesis due to an increase in CO_2 uptake with a concomitant increase in pH Deep concentrations of Chl *a* at sites 31 and 34 in the summer months of 2000 show a thriving population of phytoplankton A decrease in flow and light attenuation, as well as the presence of depressions isolated from flowing water, facilitate high concentrations of Chl *a* Moreover, in deep waters, Chl *a* at sites 31 and 34 (53.77 and

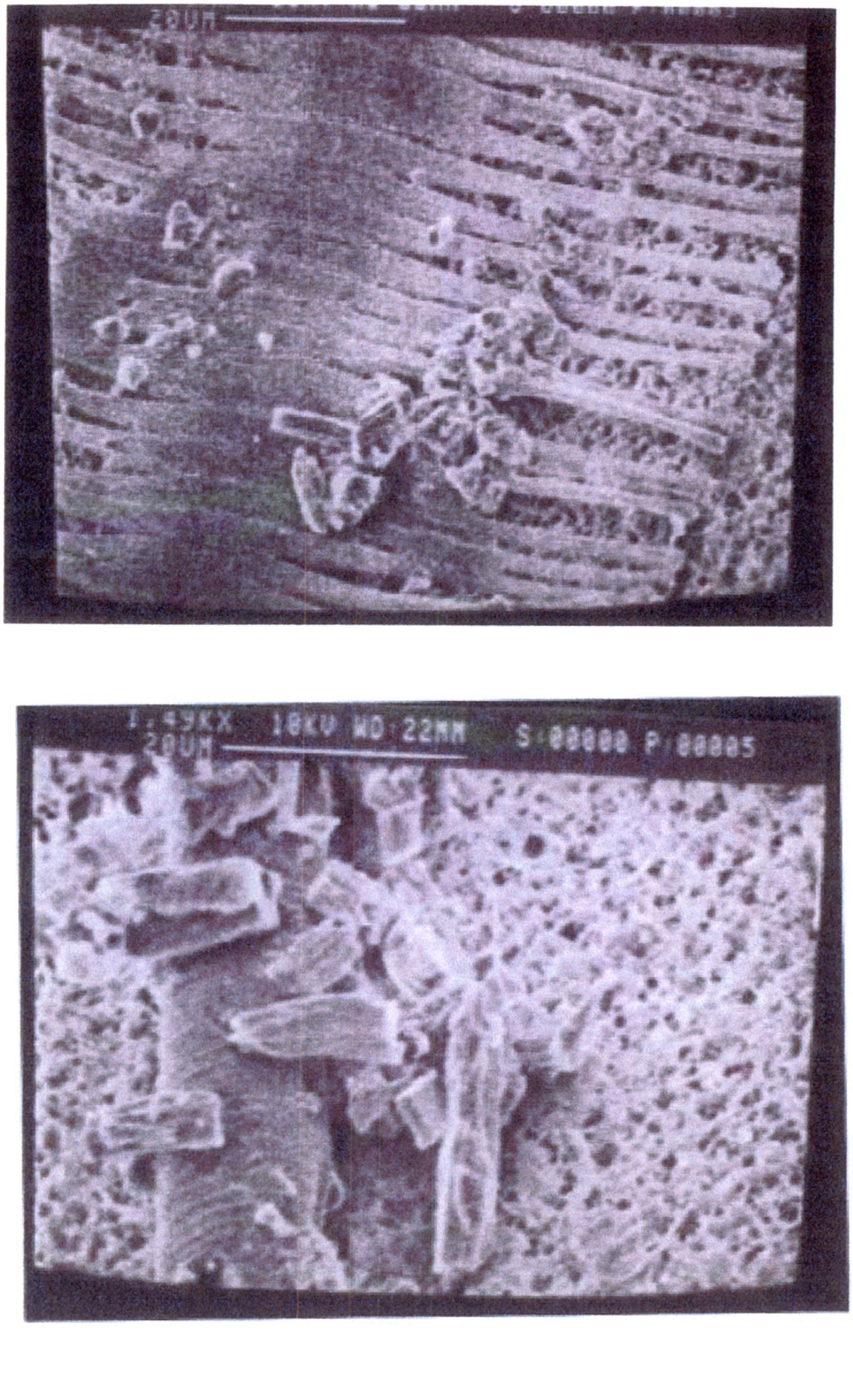

Figure 33. *Fragillaria* in association with polyhedral and rhombic calcite crystals, as well as organic matter (top). Filamentous algae in association with more rhombic calcite crystals and organic matter(bottom).

25.16 μg L^{-1}) had concomitant high concentrations of calcium (1 36 mM) and particulate calcium (0 07 mM) This suggests photosynthetic uptake of CO_2, favoring the shift of equilibria toward the CO_3^{2-} species (Hodell *et al* , 1998), driving calcite saturation and sedimentation In addition, dissolved oxygen was between 0 18 and 0 39 mg L^{-1} for sites 27, 31, and 34, showing that respiration was taking place at the sediment-water interface of the transitional zone in the summer of 2000 In August 2000 there was evidence of a major calcite precipitation event, perhaps a few days before sampling, at sites 27, 31 and 34 Surface calcium concentrations dropped to an annual low of 0.41 and 0 39 mM. Surface calcite saturation indices were at their annual low (Ω = 1 17, 1 20, and 1 13) at sites 27, 31, and 34, respectively Chl *a* concentrations were high (between 6 67 and 10 38 μg L^{-1}), and pH was below 8 15 for all three sites

Heterogeneous, rather than homogeneous nucleation, precipitation, and sedimentation of calcareous particles appears to dominate where concentrations of Chl *a* are highest, suggesting phytoplankton catalyze the calcite nucleation process Stabel (1986) suggested, in the case of *Diatoma elongatum*, very small micritic calcite crystals were precipitated only along well-defined cell structures, indicating a coupling between a surface effect and metabolic activity In the absence of high inflow, this phenomena probably occurs in Canyon Reservoir (i e *Fragillaria*) Because the transitional zone exhibits a decrease in flow, photosynthesizing algae can dominate as the catalyst and medium for calcite nucleation and precipitation, due to increased residence time in the photic layer During large flow events numerous particles (i e clay, calcareous sediment) may be available to act as surface catalysts for calcite to form and precipitate However, the influence of flow was minimal throughout most of the year of sampling

Hartley *et al* (1996) note that freshwater biofilms in illuminated waters form on surfaces such as submerged stones, aquatic plants, and on the surface of sediments, and are usually composed of unicellular green algae and diatoms or simple filamentous green algae or cyanobacteria Heath *et al* (1995) note that biofilms containing large amounts of solid $CaCO_3$ are often observed on structures submerged in hardwaters Calcite form-ations were seen on numerous trees in this zone of Canyon Reservoir, especially during the summer months of 2000 when the reservoir was below conservation level The large number of trees in the transtional zone offer a substantial amount of surface area and may play an important role in ecosystem metabolism The presence of calcite precipitation is less apparent as the transitional zone of Canyon Reservoir widens and emergent trees are less numerous

Towards the dam, the more lake-like lacustrine zone is typified by having a longer residence time, lower concentrations of suspended abiogenic particles, higher water transparency, and a deeper photic layer The chemical, physical, and biological data are in accordance with the description of the lacustrine zone for Canyon Reservoir, typically at sites 1, 10, and 17 During the summer of 2000 and March and April 2001, secchi disk depth exceeded 6 m at sites 1 and 10 and hypolimnetic oxygen concentrations were low Lower annual median surface calcite saturation indices, concentrations of dissolved and particulate calcium, Chl *a*, and summer sedimentation rates of inorganic and organic seston in the lacustrine zone of the reservoir suggest a more autochthonous based system with less influence from allochthonous sources

Biological metabolism in the lacustine zone is more pronounced compared to uplake zones via high annual median surface pH values This phenomema is controlled by the cumulative effect of epilimnetic isolation from uplake zones The separation from the watershed inflow facilitates lower values of total alkalinity, specific conductance, and calcium in the lacustrine zone through continuous calcite supersaturation and precipitation of $CaCO_3$ in the surface waters. In addition, the magnitude of algal cell interaction with the formation of calcite is probably less than in uplake sites

Disparities between surface and deep concentrations of calcium suggest that as calcite sinks from the epilimnion, resolubilization occurs, thereby increasing the deep dissolved concentration of calcium A decrease in pH and dissolved oxygen from the surface to the bottom of the lacustrine zone suggests respiratory processes are largely responsible for the resolubilization of calcite via an increase in CO_2 concentrations Moreover, decreased temperatures deep in this zone can also explain the differences between surface and deep calcium concentrations, especially during the stratified period. Finally, the relatively conservative concentrations and distributions of magnesium fluctuated little and are probably due to its solubility characteristics and minor biotic demand (Wetzel, 1983)

Conclusions

The overall effect Canyon Reservoir has on the measured chemical, physical and biological parameters can best be described by delineating low inflow and high inflow periods Moreover, characterizing Canyon Reservoir as having three distinct zones, possessing unique chemical, physical, and biological properties occurring along a continuum from the river to the dam facilitates the description of the structure and function of the reservoir Canyon Reservoir is distinct from other hardwater systems in that it can have lake-like features during low or no inflow, and reservoir properties during average or high inflow, setting up patterns befitting the reservoir zonation model

Analyzing the chemical data from the headwaters to the tailrace below the dam shows the process of decalcification throughout the year In the summer months of 2000 the lack of substantial inflow decreased the influence of the watershed and the impact biologically-induced decalcification had on the reservoir was particularly evident Dissolved and particulate calcium concentrations, specific conductance, and total alkalinity all increased in deep waters where calcite sedimentation and resolubilization occured The mechanism controlling calcium sedimentation in Canyon Reservoir appears to be dominated by flow in the riverine zone, predominately biologically controlled in the transitional zone, and biologically and physically controlled in the lacustrine zone by being isolated from the upper reaches of the reservoir

The data suggest that an increase in inflow probably control where particulate calcium sedimentation occurs As Thornton *et al* (1981) found, the formation of deltas suggests that most of the larger particles entering the reservoir settle out in the upper reaches of reservoirs Sediment trap data show that the greatest amount of total seston deposition occurs from site 27 and 34 during low flow summer months

By constantly being supersaturated, with respect to calcite, Canyon Reservoir acts as a natural control mechanism against eutrophication via nutrient and trace metal loss and the hastened sedimentation of dissolved organic carbon and phytoplankton An increase in primary production in the transitional zone of the reservoir appears to catalyze calcite precipitation, thereby inhibiting further production downstream by accelerating the process of algal sedimentation upstream. When phytoplankton sink out of the water column, as a result of nucleating calcite, organically-bound, as well as inorganically-bound nutrients, such as phosphorous, are lost to the sediments This phenomenon is most likely to occur during the spring and summer months, when primary production is greatest

Appendix

April 19, 2000

Site	Time	Bottle	Depth(m	Temp. 0C	pH	D O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl a ug/l	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
ailra	8 05		0	13 58	7 94	8 96	356			3 74	5 4		0 9231	0 0259		0 6787	0 0003
C1	8 45	8337, 8312	0	19 74	8 42	9 58	336	1350	3 3	2 89	2 4	1 83	0 7375	0 0183	2 648	0 6787	0 002
			0 5					1100									
			1	19 69	8 43	9 34	340	950									
			2	19 48	8 43	9 41	342	540									
			3	19 29	8 43	9 5	342	320									
			4	19 25	8 43	9 36	343	215									
			5	19 2	8 43	9 28	343	145									
			6	19 14	8 43	9 23	343	95									
			7	19 12	8 43	9 13	343	16									
			8	19 08	8 42	9 23	343										
			9	19 07	8 43	9 28	343										
			10	19 04	8 43	9 29	343										
			11	18 96	8 43	9 41	343										
			12	18 46	8 36	7 74	350										
		76, 2-21	13	17 89	8 28	7 47	353			2 86	2-	5 73	0 885	0 0123	2 121	0 6993	0 0019
			14	17 43	8 25	7 07	353										
			15	17 28	8 24	7 13	354										
			16	17 1	8 23	7 06	354										
			17	16 58	8 18	6 61	356										
			18	16 36	8 17	6 47	355										
			19	16 17	8 16	6 39	356										
			20	15 82	8 12	5 99	355										
			21	15 21	8 06	5 73	356										
			22	14 23	7 99	5 27	357										
			23	14	7 95	5 26	356										
			24	13 72	7 94	5 18	355										
			25	13 62	7 92	4 95	357										
			26	13 41	7 89	4 62	356										
			27														
			28	13 38	7 88	4 4	357										
			29	13 31	7 86	4 32	358										
			30	13 25	7 84	4 14	358										
			31	13 25	7 83	4 04	358										
			32	13 23	7 82	3 91	359										
			33	13 2	7 8	3 63	358										
			34	13 15	7 79	3 49	358										
			35	13 15	7 78	3 45	356										
			36	13 12	7 77	3 31	360										
			37	13 06	7 76	3 22	360										
		23, 22	38	13 05	7 75	3 13	358			3 13	10	1 693	1 2974	0 0411	0 8365	0 6993	0 0039
			39	13 03	7 74	3 09	360										
C2	9 42	Q2, 19	0	20 63	8 4	9 16	340	1700	2 85	2 96	2 6	2 1	0 873	0 0175	3 1688	0 761	0 002
			0 5					1450									
			1	20 66	8 41	8 83	343	1050									

Site	Time	Bottle	Depth(m	Temp. 0C	pH	D O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl a ug/l	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			2	20 66	8 42	8 71	343	690									
			3	20 66	8 42	8 7	343	450									
			4	20 6	8 42	8 64	343	300									
			5	20 48	8 41	8 45	343	195									
			6	20 16	8 41	8 68	344	125									
			7	20 14	8 41	8 59	343	78									
			8	20 05	8 41	8 73	344	55									
			9	20 02	8 41	8 42	344	37									
			10	19 87	8 39	8 46	345	14									
			11	19 28	8 32	7 75	351	8 3									
			12	19 23	8 31	7 57	352										
			13	19 07	8 26	7 02	357										
			14	18 91	8 28	7 16	352										
			15	18 47	8 26	7 22	351										
			16	17 26	8 14	6 28	355										
		JM-1, 17	17	16 87	8 07	5 45	358			3 13	5 2	3 74	0 8483	0 0179	1 327	0 7198	0 0026
			18	16 64	8 05	5 24	359										
			19	16 47	8 02	5 08	359										
			20	16 23	8	4 87	360										
			21	15 8	7 91	4 44	359										
			22	14 87	7 84	3 34	360										
			23	14 5	7 79	2 84	360										
			24	14 19	7 77	2 57	361										
			25	14 01	7 75	2 46	361										
			26	13 82	7 73	2 3	362										
			27	13 68	7 72	2 09	361										
		1I, J-4	28	13 49	7 7	2 06	362			3 26	9 6	1 263	1 21	0 0216	0 7362	0 6993	0 0026
			29	13 43	7 69	2 02	363										
			30	13 4	7 69	1 98	361										
C3	10 52	9, 74	0	21 82	8 42	8 53	345	2400	1 8	2 84	3 8	2 47	0 8735	0 0175	3 331	0 7199	0 0026
			0 5					1950									
			1	21 83	8 42	8 44	346	1550									
			2	21 85	8 42	8 34	346	520									
			3	21 83	8 42	8 2	347	400									
			4	21 82	8 42	8 33	347	160									
			5	21 48	8 41	8 26	346	54									
			6	21 37	8 41	8 55	345										
			7	20 47	8 35	7 89	356										
			8	20 03	8 34	7 85	360										
			9	19 72	8 31	7 38	359										
			10	19 47	8 24	6 81	363										
			11	19 36	8 11	5 96	370										
		1N, 8475	12	19 14	8 05	5 44	370			3 21	8 4	2 9	0 9605	0 0299	1 593	0 6787	0 0032
			13	19 07	7 97	4 8	372										
			14	19 02	7 94	4 6	375										
			15	17 87	7 82	3 32	375										
			16	17 43	7 8	3 09	372										
			17	16 74	7 72	2 08	374										
			18	16 24	7 65	1041	377										
			19	15 75	7 63	0 61	374										

Site	Time	Bottle	Depth(m	Temp 0C	pH	D.O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl a ug/l	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
		J5, 69	20	14 9	7 61	0 26	368			3 03	4	3 037	0 9231	0 024	0 4472	0 8227	0 0039
			21	14 8	7 6	0 21	369										
C4	11 59	4, LL4	0	22 82	8 47	8 84	365	1650	0 95	3 26	7 9	4 95	0 923	0 0263	4 707	0 761	0 0026
			0 5					1100									
			1	22 76	8 46	8 71	366	700									
			2	22 75	8 46	8 7	367	235									
			3	22 63	8 46	8 54	365	81									
			4	22 26	8 39	7 83	377	18 5									
			5	21 73	8 34	7 83	387	3 2									
			6	21 07	8 22	6 66	413										
			7	20 65	8 18	6 33	406										
			8	20 31	8 15	5 95	392										
			9	19 99	8 03	5 11	400										
			10	19 88	7 96	4 3	402										
		1G, 8296	11	19 66	7 78	2 52	411			3 61	11	3 064	1 048	0 0355	1 092	0 8432	0 0046
			12	19 52	7 72	1 95	413										
C5	13 10	41-AZ, 73	0	24 72	8 41	8 72	400	1200	0 9	3 35	8 2	5 59	0 998	0 0199	4 479	0 8636	0 0026
			0 5					790									
			1	24 64	8 4	8 62	399	450									
			2	24 33	8 38	8 46	400	120									
			3	23 45	8 3	8 14	413	35									
			4	21 98	8 24	7 59	425	13 5									
			5	21 32	8 14	6 5	429	6 1									
			6	20 72	8 02	5 01	432										
		2-24, PHQ-2	7	19 26	7 68	0 92	445			3 93	7	2 634	1 85	0 0263	0 5971	0 8844	0 0026
			7 6	18 43	7 46	0 42	448										
C6	13 50	79, 7745	0	24 53	8 43	8 65	429	####	1 45	3 77	4	3 55	1 106	0 0151	10 197	0 905	0 002
			0 5					1000									
			1	24 25	8 42	8 43	430	610									
			2	23 87	8 42	8 48	430	285									
			3	23 46	8 39	8 63	429	145									
			4	20 8	8 12	5 64	429	66									
			5	20 09	7 9	3 01	433	28 5									
			6	19 4	7 7	0 5	440	7 7									
		58, JH-1	7	18 5	7 61	0 24	452			4 01	11	2 58	1 01	0 0395	0 7003	0 8227	0 0026
			7 5	18 39	7 53	0 21	453										
C6 5		J-56, PH-Q	0	24 59	8 35	8 27	433	2500	1 4	3 75	3 9	2 63	1 16	0 0123	5 339	0 905	0 002
			0 5					2000									
			1	24 24	8 34	8 26	433	1200									
			2	23 62	8 35	8 17	432	550									
			3	23 57	8 35	8 01	433	215									
			4	21 35	8 19	6 84	433	77									
		CRJ, D-22	5	20 15	7 9	3 62	434	29		3 86	8 7	2 204	1 148	0 0311	1 249	0 7404	0 0026
			6	19 75	7 75	1 4	440	4 8									
C7		BMF, U2	0	25 44	8 35	7 87	432			3 94	7 4	1 34	1 148	0 0459	3 256	0 905	0 0046
			1	25 38	8 32	7 71	432										

Site	Time	Bottle	Depth(m	Temp. 0C	pH	D O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl a ug/l	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			2	23 78	8 29	7 31	432										
311	7 20		0	22 63	7 96	6 71	444			4	15	3 74	1 223	0 0323	2 334	0 8021	0 0065

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Site	Time	Bottle	Depth(m	Temp 0C	pH	D O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl a ug/	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
TR	6 45	7745,PHAQ	0	14 38	7 41	7 81	378			3 09	3 25		1 352	0 0207		0 6581	0 0026
C1	8 44	41,52-B	0	26 14	8 47	7 8	348	1600	4 7	2 58	1 6	2 13	1 041	0 0175	4 543	0 5759	0 002
			0 5					1350									
			1	26 2	8 47	7 99	348	1000									
			2	25 94	8 46	8 21	348	670									
			3	25 45	8 46	8 27	347	460									
			4	25 35	8 46	7 96	347	320									
			5	25 27	8 45	8 12	347	250									
			6	25 24	8 45	8 03	347	190									
			7	24 92	8 42	7 84	349	135									
			8	24 57	8 39	7 68	351	95									
			9	24 33	8 35	7 32	352	71									
			10	23 93	8 27	6 54	356	53									
			11	23 56	8 21	6 22	358	32									
			12	23 23	8 18	6 04	359	27									
			13	22 99	8 17	6	360										
			14	20 09	8 06	5 22	370										
			15	19 1	8 02	5 07	370										
		9, 8698	16	18 3	8	4 96	372			3 203	1 7	2 42	1 067	0 0131	1 494	0 6787	0 0013
			17	17 67	7 97	4 63	374										
			18	17 1	7 94	4 33	376										
			19	16 89	7 92	4 12	376										
			20	16 25	7 89	3 93	376										
			21	16 17	7 88	3 68	377										
			22	15 54	7 86	3 65	377										
			23	15 1	7 84	3 39	377										
			24	14 82	7 81	3 27	377										
			25	14 52	7 79	3 09	377										
			26	14 42	7 77	2 8	378										
			27	14 15	7 74	2 47	379										
			28	14 02	7 71	2 03	379										
			29	13 88	7 69	1 9	380										
			30	13 04	7 68	1 88	380										
			31	13 78	7 65	1 54	381										
		K-20, T2	32	13 74	7 64	1 17	381			3 174	2 8	0 857	1 148	0 0171	0 5956	0 6376	0 0026
			33	13 66	7 64	1 17	381										
			34	13 62	7 63	1 18	382										
			35	13 56	7 62	1 04	382										
			36	13 52	7 62	0 95	382										
			37	13 5	7 61	0 9	382										
			38	13 47	7 61	0 81	380										
			39	13 46	7 61	0 71	381										
			40	13 44	7 6	0 66	381										
			41	13 44	7 6	0 62	380										
C2	9 37	69 92	0	26 46	8 39	7 83	348	700	2 6	2 701	2	2 2	0 9855	0 0119	3 78	0 6993	0 0013
			0 5					610									
			1	26 51	8 4	7 74	348	480									
			2	26 52	8 4	7 72	349	320									

Site	Time	Bottle	Depth(m	Temp. 0C	pH	D O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl *a* ug/	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			3	26 52	8 41	7 72	349	210									
			4	26 51	8 41	7 63	348	140									
			5	26 45	8 41	7 62	348	95									
			6	26 48	8 41	7 6	348	67									
			7	26 45	8 41	7 59	349	45									
			8	26 45	8 4	7 55	348	29									
			9	25 42	8 33	7 14	351	20									
		84, 27	10	24 69	8 28	6 58	353	13 5		2 826	2 2	3 26	1 123	0 0171	3 281	0 6375	0 0019
			11	24 03	8 19	5 97	375	8 3									
			12	22 25	8 03	4 81	365										
			13	21 11	7 95	4 21	369										
			14	19 93	7 89	3 71	371										
			15	19 06	7 84	3 33	373										
			16	18 19	7 81	2 93	375										
			17	17 76	7 79	2 63	376										
			18	17 3	7 77	2 23	377										
			19	16 92	7 73	1 62	378										
			20	16 37	7 7	1 21	378										
			21	15 64	7 65	0 5	381										
			22	15 32	7 64	0 3	380										
			23	15 08	7 63	0 17	382										
		R2, 39	24	14 92	7 61	0 08	382			3 174	4 4	0 355	1 198	0 0171	0 6036	0 5758	0 0019
			25	14 66	7 61	0 08	382										
			26	14 39	7 6	0 09	382										
C3	7 58	2-36, 19	0	27 59	8 36	7 62	351	750	2	2 871	2 7	2 2	0 9605	0 0239	0 3798	0 6993	0 002
			0 5					550									
			1	27 61	8 36	7 77	351	350									
			2	27 63	8 37	7 75	351	130									
			3	27 64	8 37	7 73	351	60									
			4	27 65	8 37	7 23	352	35									
			5	27 66	8 38	7 16	351	26									
			6	27 65	8 37	7 12	351	16									
			7	27 49	8 34	6 77	353	8 5									
			8	26 64	8 26	6 22	355										
			9	25 66	8 06	4 61	363										
			10	24 63	8	4 61	364										
		J1-1, 8475	11	24 33	8	4 65	364			2 985	11	1 84	0 8607	0 0734	1 385	0 6787	0 0046
			12	23 87	7 9	3 41	370										
			13	22 66	7 78	2 32	378										
			14	21 63	7 65	0 85	392										
			15	20 01	7 57	0 13	401										
			16	19 06	7 52	0 1	411										
		BMF, 73	17	18 28	7 49	0 07	413			3 268	7 6	0 924	1 223	0 0427	0 5369	0 6993	0 0032
			18	17 75	7 5	0 07	408										
			19	17 28	7 51	0 07	402										
C4	10 35	K-0, 58	0	27 8	8 36	7 26	374	2300	1	2 985	7 4	3 41	0 998	0 0323	4 113	0 7199	0 0026
			0 5					1700									
			1	27 91	8 37	7 01	374	1050									
			2	27 85	8 36	6 88	374	300									

Site	Time	Bottle	Depth(m	Temp 0C	pH	D O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl *a* ug/	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			3	27 54	8 32	6 5	370	95									
			4	27 43	8 31	6 45	370	27									
			5	27 36	8 29	6 25	368	8									
			6	27 18	8 19	4 89	374										
			7	26 8	7 98	3 43	378										
			8	26 25	7 82	2 49	389										
			9	25 65	7 65	0 7	410										
		J-50, 51	10	24 87	7 54	0 1	428			3 087	16	1 78	0 973	0 0578	0 6533	0 8021	0 0039
			11	24 07	7 4	0 08	433										
C5	11 25	2-24, 76	0	29 26	8 39	7 82	408	2500	1 3	3 249	6 4	7 6	1 085	0 0239	5 467	0 6376	0 002
			0 5					1900									
			1	29 28	8 35	7 46	408	1200									
			2	29 12	8 34	7 47	409	550									
			3	29 04	8 33	7 42	410	210									
			4	28 58	8 12	5 25	422	85									
			5	27 5	7 9	3 34	421	28									
			6	26 45	7 7	0 86	433	9									
		J-1, 1I	7	23 77	7 47	0 13	461			3 702	14	5 4	1 397	0 0216	0 58	0 8227	0 0039
			8	20 74	7 29	0 09	490										
C6	12 19	8389, 1E	0	29 51	8 34	7 79	431	2600	1 3	3 532	5	2 77	1 172	0 0315	4 458	0 6787	0 0026
			0 5					2150									
			1	29 38	8 34	7 67	430	1550									
			2	29 28	8 33	7 67	430	850									
			3	29 07	8 32	7 71	427	420									
			4	27 5	8 09	4 5	435	170									
			5	25 2	7 76	0 5	451	79									
		26, J-29	6	23 37	7 59	0 25	466	25		3 748	6 6	17 69	1 285	0 0314	0 6915	0 761	0 0032
			7	21 85	7 47	0 15	477	4									
C6 5	12 35	K-23, WW	0	29 45	8 33	7 43	434	2500	1 4	3 521	4 8	3 48	1 26	0 0275	6 005	0 8433	0 0026
			0 5					1900									
			1	29 48	8 33	7 17	433	1400									
			2	29 26	8 33	7 36	433	550									
			3	29 08	8 32	7 2	432	270									
			4	27 76	8 08	4 22	440	100									
		QP	5	24 74	7 66	0 62	452	37		3 679	10	14 06	1 285	0 0794	0 9948	0 8227	0 0046
			6	23 9	7 54	0 38	460										
C7	13 03	10	0	29 58	8 31	6 83	434		1 8	3 374	9 5	2 42	1 148	0 0582	5 775	0 7404	0 0039
			1	29 05	8 27	6 57	434										
311		D22, K-11	0	27 09	8 17	6 3	442			3 389	12	2 56	1 173	0 0814	4 032	0 7198	0 0052

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Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl *a* ug/	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
TR	6 43	58, J-23	0	14 56	8 1	8 05	371			3 286	4 6		1 3098	0 0255		0 6787	0 0019
1	8 55	33, 19	0	25 37	7 4	8 12	335		4 1,4 53	2 607	2 2	1 96	1 0275	0.0151	3 764	0 617	0 002
			0 5														
			1	25 38	8 41	8 32	336										
			2	25 39	8 41	8 41	335										
			3	25 39	8 41	8 76	335										
			4	25 41	8 41	8 59	335										
			5	25 39	8 41	8 77	335										
			6	25 37	8 41	9 01	335										
			7	25 37	8 41	8 22	335										
			8	25 38	8 41	8 92	336										
			9	25 39	8 06	7 79	335										
			10	25 28	8 31	7 24	335										
			11	24 74	8 25	6 14	337										
		PHAQ,8389	12	23 33	8 13	5 11	347			2 531	1 8	2 93	1 135	0 0099	2 015	0 6787	0 0026
			13	22 05	8 05	4 84	354										
			14	20 49	8	4 72	363										
			15	19 32	7 97	4 51	366										
			16	18 54	7 96	4 41	367										
			17	17 75	7 92	4 09	368										
			18	17 38	7 9	4 05	367										
			19	17 07	7 88	3 75	370										
			20	16 65	7 87	3 58	369										
			21	16 16	7 85	3 28	370										
			22	15 78	7 81	3 1	370										
			23	15 51	7 8	2 98	371										
			24	15 14	7 78	2 91	370										
			25	14 9	7 75	2 65	370										
			26	14 66	7 72	2 42	371										
			27	14 48	7 69	1 96	371										
			28	14 31	7 66	1 39	373										
			29	14 18	7 65	1 13	373										
			30	14 09	7 63	0 72	373										
			31	14 01	7 62	0 5	373										
			32	13 96	7 6	0 27	374										
			33	13 91	7 6	0 22	373										
			34	13 89	7 6	0 22	372										
			35	13 87	7 6	0 23	375										
			36	13 8	7 6	0 13	375										
			37	13 77	7 59	0 09	374										
			38	13 71	7 59	0 04	373										
			39	13 68	7 59	0 04	373										
		69, 2-26	40	13 66	7 59	0 04	373			3 174	2 8	0 591	1 284	0 0123	0 5934	0 7404	0 0013
			41	13 65	7 58	0 04	373										
			42	13 63	7 58	0 04	372										
2	9 55	J-29, J-24	0	25 92	8 55	7 66	336	2150	2 4	2 607	3	2 93	1 047	0 119	5 517	0 6582	0 002
			0 5					1900									
			1	25 92	8 53	7 54	337	1500									

Site	Time	Bottle	Depth(m)	Temp. 0C	pH	D O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl *a* *u* g/	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			2	25 92	8 51	7 48	337	996									
			3	25 94	8 51	7 41	337	620									
			4	25 91	8 51	7 47	337	380									
			5	25 91	8 51	7 42	337	235									
			6	25 9	8 51	7 38	337	160									
			7	25 9	8 5	7 3	337	100									
			8	25 88	8 5	7 09	337	68									
			9	25 88	8 5	7 12	337	47									
			10	25 83	8 49	7 09	337	32									
			11	25 68	8 16	4 81	354	10									
		8384, 7745	12	23 25	8 11	4 68	356			2 871	2 9	2 95	1 148	0 0159	2 201	0 6993	0 0019
			13	22 19	8 01	3 25	361										
			14	20 65	7 89	1 91	368										
			15	19 81	7 88	2 11	370										
			16	18 8	7 81	1 47	371										
			17	18 07	7 8	1 07	372										
			18	17 76	7 78	0 68	373										
			19	17 33	7 75	0 31	373										
			20	16 88	7 73	0 08	372										
			21	16 18	7 71	0 08	376										
			22	15 77	7 7	0 08	376										
			23	15 45	7 69	0 04	378										
			24	15 23	7 68	0 04	378										
			25	14 91	7 68	0 04	378										
			26	14 7	7 67	0 04	378										
			27	14 46	7 67	0 04	377										
		1D, 1H	28	14 32	7 66	0 04	377			3 022	2 4	4 005	1 285	0 0103	0 6783	0 7815	0 0026
			29	14 29	7 66	0 04	378										
			30	14 24	7 65	0 04	378										
3	8 00	9, 73	0	26 32	8 36	7 29	340	400	1 6	2 645	4 6	0 46	1 222	0 0223	4 281	0 6376	0 0026
			0 5					310									
			1	26 36	8 37	7 11	340	215									
			2	26 41	8 37	7 24	340	65									
			3	26 41	8 36	6 95	340	34									
			4	26 42	8 36	7 12	340	19									
			5	26 42	8 36	7 02	340										
			6	26 42	8 36	6 86	340										
			7	26 41	8 36	6 86	341										
			8	26 39	8 35	6 84	341										
			9	26 33	8 29	6 29	345										
			10	25 97	8 17	5 4	350										
			11	25 88	8 11	5 09	351										
		BMF, 76	12	24 7	7 82	2 15	360			2 758	17	2 23	1 247	0 0471	1 238	0 6993	0 0039
			13	21 82	7 65	0 14	380										
			14	20 6	7 59	0 09	388										
			15	19 61	7 51	0 1	407										
			16	19 01	7 55	0 06	391										
			17	18 29	7 52	0 07	395										
			18	17 83	7 52	0 07	393										
			19	17 02	7 54	0 07	389										

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D.O mg/l	Cond.us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl a ug/	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			20	16 58	7 53	0 03	387										
		K-11, 92	21	16 12	7 54	0 04	386			3 174	4 1	0 995	1 347	0 0207	0 6017	0 7815	0 0026
			21 5	16 02	7 54	0 04	384										
4	10 55	8475, 9906	0	26 81	8 26	6 84	376	2750	0 95	2 834	7 3	6 83	1 11	0 0299	4 635	0 6376	0 0026
			0 5					1600									
			1	26 8	8 22	6 19	376										
			2	26 75	8 22	6 17	375										
			3	26 61	8 23	6 14	374										
			4	26 52	8 24	6 1	370										
			5	26 41	8 22	5 43	366										
			6	26 39	8 15	4 96	370										
			7	26 42	8 13	4 88	370										
			8	26 39	8 16	5 01	367										
			9	26 38	8 15	4 92	367										
			10	26 3	8 11	4 63	369										
			11	26 05	7 95	3 94	381										
		8474, JH-1	12	24 7	7 56	1 65	419			3 211	21	2 93	1 222	0 1049	0 7702	0 7199	0 0052
5	11 35	LL-4, 7	0	27 49	8 31	7 25	408		1 25	3 022	5	8 28	1 135	0 0247	4 16	0 6581	0 002
			0 5														
			1	27 53	8 35	7 09	409										
			2	27 48	8 35	6 92	410										
			3	27 05	8 24	5 96	416										
			4	26 77	8 15	5 2	419										
			5	26 61	8 08	4 58	421										
		8298, 18	6	26 54	7 99	3 73	424			3 335	4 7	5 457	1 222	0 0299	1 531	0 7815	0 0032
			7	25 8	7 67	0 32	439										
6	12 20	K-0, JL1	0	26 93	8 27	6 99	398		1 3	3 097	5 2	5 46	1 135	0 0216	3 828	0 7199	0 0013
			0 5														
			1	26 71	8 29	6 83	397										
			2	26 12	8 04	6 68	397										
			3	25 83	8 12	5 64	398										
			4	25 67	8 06	5 15	401										
			5	25 33	7 84	3 15	416										
			6	24 51	7 53	0 13	447										
		88, 28	7	22 53	7 4	0 08	472			3 627	6 9	29 514	1 222	0 0207	0 5551	0 6993	0 0019
			7 5	22 08	7 36	0 08	475										
6 5	12 52	48, 26	0	27 25	8 3	7 19	348		0 55	2 72	20	8 01	1 097	0 0514	3 543	0 7816	
			0 5														
			1	26 51	8 28	6 91	350										
			2	25 94	8 24	6 53	353										
			3	25 7	8 22	6 42	351										
			4	25 64	8 22	6 39	354										
		22, 41	5	25 58	8 21	6 51	355			2 72	31	8 01	0 973	0 085	2 41	0 761	0 0052
			5 5	25 53	8 2	6 35	356										
7	13 15	K-15, QP	0	26 13	8 21	7 34	345		0 3	2 871	43	4 65	1 073	0 0814	2 86	0 7199	0 0046
			1	25 83	8 19	7 22	344										

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl *a* ug/	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
311	7 18	K-23, 1282	0	23 91	8 16	7 27	354			2 985	43	2 56	1 19	0 0866	3 733	0 6787	0 0065

July 24, 2000

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl *a* ug/	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
TR	7 06	10, 60	0	14 79	7 61	9 8	357			3 06	2 9		1 235	0 0183		0 7404	0 0019
C1	8 37	229, 70	0	28 66	8 45	7 14	319	1200	5 9	2 38	1 6	1 45	0 8545	0 0131	1 45	0 6993	0 0013
			0 5					750									
			1	28 72	8 46	7 06	319	630									
			2	28 74	8 47	7 04	318	450									
			3	28 75	8 47	7 06	317	330									
			4	28 77	8 47	7 04	317	235									
			5	28 78	8 47	7 05	318	175									
			6	28 76	8 47	7 08	317	130									
			7	28 67	8 47	7 09	317	100									
			8	28 6	8 47	7 07	318	76									
			9	28 56	8 47	7 01	317	57									
			10	28 43	8 46	7 06	318	44									
		UP2, 39	11	27 11	8 27	5 4	325	32		2 38	2	1 88	0 973	0 0015	2 561	0 5553	0 0013
			12	26 25	8 13	4 6	329	24 5									
			13	24 8	7 98	3 4	335	19									
			14	21 68	7 89	3 08	346	10 5									
			15	20 21	7 89	3 27	349	7									
			16	19 31	7 89	3 45	350										
			17	18 43	7 88	3 38	338										
			18	17 94	7 82	2 63	351										
			19	17 52	7 77	1 98	353										
			20	17 05	7 77	1 84	353										
			21	16 67	7 76	1 91	353										
			22	16 33	7 74	1 63	354										
			23	15 95	7 73	1 5	353										
			24	15 74	7 72	1 36	354										
			25	15 52	7 71	1 17	355										
			26	15 14	7 68	0 76	355										
			27	14 98	7 66	0 55	354										
			28	14 8	7 64	0 26	356										
			29	14 7	7 63	0 17	358										
			30	14 54	7 61	0 17	356										
			31	14 45	7 61	0 17	358										
			32	14 35	7 6	0 13	357										
			33	14 27	7 6	0 13	357										
			34	14 19	7 59	0 13	357										
			35	14 15	7 59	0 13	359										
			36	14 1	7 58	0 13	356										
			37	14 07	7 58	0 13	357										
			38	14 04	7 58	0 13	360										
			39	14 03	7 58	0 13	360										
		221, 8475	40	14 01	7 58	0 13	360			2 8	3 4	0 672	1 235	0 0143	0 4986	0 7198	0 0026
			41	14 01	7 58	0 13	359										
C2	9 29	18, 99	0	29	8 43	7 08	316	700	3 2	2 42	2 8	2 2	0 8105	0 0179	3 348	0 6581	0 0026
			0 5					1400									
			1	29 04	8 44	6 94	317	1000									
			2	29 06	8 44	6 89	317	620									

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl *a* ug/	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			3	29 08	8 45	6 83	317	400									
			4	29 06	8 45	6 85	316	245									
			5	28 99	8 45	6 86	317	165									
			6	28 72	8 46	7 06	318	110									
			7	28 66	8 46	7 07	318	76									
			8	28 27	8 44	7 16	318	54									
			9	28 12	8 43	7 09	319	42									
			10	27 87	8 39	6 56	320	32									
		YMW,221	11	27 32	8 18	4 95	326	23		2 49	2 2	2 07	1 023	0 0127	2 306	0 7404	0 0013
			12	26 17	7 97	3 17	330	14									
			13	24 23	7 82	1 66	340	7									
			14	22 04	7 71	0 29	349										
			15	21 18	7 67	0 21	351										
			16	20 18	7 66	0 19	353										
			17	19 2	7 64	0 17	355										
			18	19	7 63	0 17	355										
			19	18 54	7 62	0 17	357										
			20	18	7 61	0 14	358										
			21	17 48	7 6	0 14	359										
			22	17 1	7 6	0 15	357										
			23	16 85	7 6	0 15	358										
			24	16 42	7 59	0 15	360										
			25	16 06	7 59	0 16	359										
			26	15 69	7 59	0 16	362										
			27	15 43	7 59	0 16	361										
			28	15 29	7 58	0 16	362										
			29	15 03	7 58	0 17	361										
			30	14 8	7 57	0 17	361										
		CRJ, HIV	31	14 68	7 57	0 17	364			3 06	5 4	0 968	1 235	0 0179	0 544	0 6787	0 0013
			32	14 6	7 57	0 17	362										
C3	10 05	33,10	0	29 53	8 4	6 64	321	1900	1 8	2 53	4 2	3 6	0 9605	0 0215	3 935	0 617	0 0026
			0 5					1500									
			1	29 57	8 41	6 67	321	1150									
			2	29 51	8 42	6 66	320	640									
			3	29 49	8 42	6 61	320	340									
			4	29 43	8 4	6 37	321	195									
			5	29 24	8 4	5 09	326	110									
			6	29 06	8 19	4 29	328	61									
			7	28 8	8 1	2 66	334	29									
			8	28 5	8 1	2 4	334	10									
			9	28 25	7 91	2 26	333										
			10	27 6	7 87	2 24	333										
			11	27 2	7 77	0 86	335										
		8698, 48	12	25 77	7 68	0 21	343			2 72	14	2 93	1 235	0 063	0 911	0 8021	0 0032
			13	24 19	7 64	0 15	352										
			14	22 4	7 57	0 17	366										
			15	20 8	7 49	0 15	381										
			16	19 82	7 41	0 16	402										
			17	19 08	7 38	0 17	408										
			18	18 35	7 4	0 17	392										

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl *a* ug/	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
		8475,K23	19	17 66	7 44	0 14	384			3 44	5 6	1 236	1 235	0 0155	0 5003	0 9047	0 0026
			20	17 05	7 47	0 15	378										
C4	10 45	51, 65	0	30 12	8 47	6 86	328	2200	1 1	2 61	8	2 91	1 06	0 0303	5 372	0 6787	0 0013
			0 5					1600									
			1	30 12	8 47	6 7	330	900									
			2	29 89	8 45	6 4	331	225									
			3	29 85	8 44	6 25	332	58									
			4	29 82	8 43	6 17	327	16									
			5	29 73	8 41	5 75	331	4 5									
			6	29 55	8 12	3 24	337										
			7	29 13	7 78	0 51	349										
			8	28 66	7 61	0 19	362										
			9	28 3	7 56	0 17	367										
			10	27 9	7 5	0 15	379										
			11	27	7 41	0 13	405										
		J-56, 25	12	25 89	7 34	0 14	407			3 21	12		1 173	0 0559	0 4642	0 7404	0 0046
C5	11 35	1E, 22	0	31 18	8 39	6 46	360	1400	1 7	2 87	3 4	5 5	1 111	0 0311	6 093	0 761	0 002
			0 5					950									
			1	30 86	8 47	6 53	361	510									
			2	30 72	8 41	6 65	360	210									
			3	30 62	8 37	6 32	360	92									
			4	30 32	8 05	3 07	358	38									
			5	29 76	7 73	1 54	361	12									
			6	28 96	7 55	0 83	375	1 5									
		J-29, 77	7	25 94	7 26	0 38	434			3 4	9	38 43	1 285	0 0379	0 4771	0 8432	0 0032
			7 5	25 45	7 23	0 27	445										
C6	12 36	SOB, 254	0	31 59	8 38	6 95	383	2200	1 5	3 17	3 6	7 89	1 187	0 0235	6 199	0 7198	0 0026
			0 5					1800									
			1	31 3	3 38	6 74	382	1250									
			2	30 95	8 36	6 4	382	620									
			3	30 79	8 35	6 18	383	280									
			4	30 37	8 01	2 93	395	105									
			5	28 61	7 68	0 17	407	47									
		63, 19	6	25 44	7 4	0 15	435	10		3 59	5	58 96	1 335	0 0243	0 6655	0 8227	0 0026
			6 8	24 51	7 29	0 15	459										
C6 5	13 00	PuPu,0-22	0	31 9	8 35	6 41	388	2100	1 95	3 25	2 5	7 03	1 173	0 0211	5 915	0 8844	0 002
			0 5					1800									
			1	31 23	8 36	6 03	388	1350									
			2	30 92	8 35	5 96	388	780									
			3	30 75	8 34	5 9	389	430									
			4	30 61	8 33	5 71	390	195									
			5	29 13	7 74	0 3	404	61									
		75, 2-37	5 7	27 03	7 41	0 11	421			3 55	12	57 83	1 435	0 0694	1 941	0 8021	0 0046
C7	13 30	J1-1, CNN	0	31 6	8 18	5 44	406	2200	0 55	3 4	6 4	9 14	1 085	0 0263	3 823	0 6993	0 0026
			0 5					1700									
			1	30 04	8 09	4 7	408	810									

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl *a* ug/	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			1 5	29 41	8	4	406										
311	7 42	KK, 2-23	0	26 7	8 04	5 23	408			3 51	1 9	5 23	1 135	0 0922	2 53	0 6787	0 0072

August 10, 2000

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl *a* ug/	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
TR	6 50	T-56, 78	0	15 02	7 54	9 04	364			2 72	3 3		0 5988	0 0136		0 8227	0 0013
C1	8 44	K-11, 76	0	28 09	8 07	6 89	328	1150	5 7	2 342	1 4	2 1	1 011	0 0123	1 71	0 7198	0 0013
			0 5					950									
			1	28 12	8 15	6 7	328	670									
			2	28 08	8 17	6 7	328	500									
			3	28 06	8 19	6 85	328	360									
			4	28 05	8 2	6 75	328	270									
			5	28 05	8 2	6 66	328	200									
			6	28 06	8 2	6 7	328	150									
			7	28 04	8 2	6 68	328	120									
			8	28 05	8 19	6 51	328	92									
			9	28 06	8 17	6 48	328	70									
			10	28 06	8 16	6 35	329	55									
			11	27 91	8 07	5 65	331	41									
		QP, 8388	12	26 89	7 75	3 24	339	32		2 38	1 8	3 54	0 8108	0 0131	0 639	0 473	0 0026
			13	25 35	7 64	2 62	345	24									
			14	22 89	7 56	2 29	354	18									
			15	21 5	7 55	2 48	356	13 5									
			16	19 9	7 57	2 84	359	10 5									
			17	19 05	7 57	2 8	361										
			18	18 32	7 54	2 34	360										
			19	17 57	7 49	1 79	361										
			20	17 23	7 47	1 6	362										
			21	16 77	7 45	1 25	362										
			22	16 44	7 44	1 19	364										
			23	16 21	7 42	1	363										
			24	15 9	7 42	0 94	363										
			25	15 62	7 4	0 58	364										
			26	15 29	7 38	0 33	365										
			27	15 07	7 36	0 21	366										
			28	14 91	7 35	0 21	365										
			29	14 8	7 34	0 17	365										
			30	14 73	7 34	0 17	366										
			31	14 63	7 33	0 17	368										
			32	14 53	7 32	0 17	368										
			33	14 51	7 31	0 17	367										
		84, 40	34	14 47	7 31	0 17	369			2 947	3 8	1 68	0 5114	0 0143	0 117	0 823	0 0026
			35	14 4	7 31	0 17	369										
			36	14 3	7 31	0 17	368										
			37	14 22	7 31	0 17	368										
			38	14 2	7 31	0 18	367										
			39	14 16	7 3	0 18	367										
			40	14 16	7 3	0 18	369										
C2	9 45	8295, V-2	0	28 59	8 25	6 93	328	1950	3 2	2 38	2 9	2 07	0 9605	0 0159	2 54	0 6376	0 0026
			0 5					1600									
			1	28 6	8 21	6 93	328	750									
			2	28 6	8 19	6 78	328	450									
			3	28 59	8 18	6 72	328	260									

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O mg/l	Cond.us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl *a* ug/	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			4	28 62	8 18	6 67	328	165									
			5	28 61	8 17	6 51	328	102									
			6	28 58	8 17	6 43	328	72									
			7	28 56	8 17	6 79	327	49									
			8	28 56	8 2	6 75	328	18									
			9	28 56	8 19	6 73	328										
			10	28 54	8 14	6 27	329										
			11	28 47	8 08	5 46	330										
			12	26 25	7 64	2 51	343										
		28, 67	13	25 1	7 51	1 19	346			2 493	2 5	7 95	0 8483	0 0219	0 378	0 3702	0 0019
			14	21 95	7 42	0 38	358										
			15	20 38	7 37	0 22	363										
			16	19 23	7 33	0 2	368										
			17	18 51	7 31	0 21	368										
			18	17 79	7 32	0 18	367										
			19	17 5	7 31	0 18	369										
			20	17 12	7 3	0 19	369										
			21	16 52	7 3	0 19	368										
			22	16 24	7 29	0 2	371										
			23	16 11	7 29	0 2	369										
			24	15 78	7 28	0 2	372										
		8310,2-24	25	15 5	7 28	0 2	370			3 022	4 6	0 887	0 973	0 0176	0 223	0 617	0 0026
			26	15 41	7 28	0 21	371										
			27	15 2	7 27	0 21	371										
C3	8 04	VH1, Z-27	0	28 87	8 49	7 02	331		1 28	2 493	6 4	3 84	0 789	0 0176	3 88	0 7	0 0013
			0 5														
			1	28 92	8 38	6 57	331										
			2	28 95	8 32	6 79	332										
			3	28 96	8 29	6 76	332										
			4	28 97	8 27	6 49	331										
			5	28 98	8 25	6 42	332										
			6	29	8 23	6 44	332										
			7	29	8 22	6 38	332										
			8	28 97	8 22	6 33	331										
			9	28 84	8 17	5 7	334										
			10	28 76	8 13	5 88	334										
			11	28 51	7 86	3 82	334										
			12	28 3	7 71	2 83	350										
			13	25 95	7 36	0 19	370										
		A, K-26	14	23 15	7 28	0 16	377			2 909	8 8	2 84	1 21	0 0419	0 457	0 7404	0 0052
			15	21 55	7 19	0 18	395										
			16	20 49	7 12	0 16	415										
			17	19 64	7 08	0 16	425										
			18	19 07	7 08	0 17	418										
		K-15, 90	19	18 4	7 12	0 17	407			3 514	6 7	1 86	0 6986	0 0176	0 141	0 987	0 0026
			20	17 69	7 15	0 18	397										
			20 5	17 29	7 17	0 15	393										
C4	10 40	ASS, 79	0	29 3	8 31	5 64	353		1	2 758	6 6	6 16	0 998	0 0307	3 59	0 7815	0 002
			0 5														

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D.O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl *a* ug/	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			1	29 17	8 19	5 44	351										
			2	29 01	8 17	5 44	348										
			3	28 92	8 15	5 68	343										
			4	29 9	8 15	5 75	341										
			5	28 9	8 12	5 83	340										
			6	28 89	8 1	5 55	342										
			7	29 87	8 04	5 32	343										
			8	28 85	8 01	4 89	344										
			9	28 8	8	4 89	343										
			10	28 77	7 96	4 55	345										
			11	28 6	7 69	3 57	359										
		hı	12	27 55	7 3	0 76	428			2 796	12	4 01	1 602	0 0531	0 991	0 596	0 0046
C5	11 30	1-08,1975	0	30 18	8 17	6 47	371	1900	1 5	2 947	4 1	6 67	0 4115	0 0622	1 18	0 6375	0 002
			0 5					1500									
			1	30 07	8 15	6 24	372	1000									
			2	30 01	8 14	7 03	374	450									
			3	29 91	8 12	6 62	374	220									
			4	29 83	8 08	6 69	373	100									
			5	29 79	8 04	6 6	373	38									
			6	29 62	7 38	2 8	388	15									
		1, 17	7	26 85	6 98	0 18	446	6		3 476	19	5 19	1 272	0 0743	0 245	0 843	0 0046
			7 4	25 69	6 88	0 17	477										
R C	12 24	2018	0	30 51	7 94	5 61	395		0 5		20						
			0 5														
			1	30 04	7 95	5 13	396										
			2	29 64	7 94	4 78	395										
			2 2	29 69	7 92	4 77	396										
C6	12 34	31, 9	0	30 95	8 15	6 99	393	2450	1 3	3 098	4 4	10 38	0 4115	0 0243	1 21	0 556	0 002
			0 5					2000									
			1	30 88	8 14	6 69	392	1350									
			2	30 32	8 13	641	393	650									
			3	30 17	8 1	6 32	394	290									
			4	29 95	8 06	5 69	395	120									
			5	29 02	7 36	0 25	418	40									
		13,UH-OH	6	26	6 97	0 16	465	5 5		3 665	7 6	53 77	1 36	0 0287	0 21	0 801	0 0026
			7	24 15	6 85	0 18	494										
			7 5	23 71	6 82	0 19	0 504										
C6 5	12 54	B-EZ, 23	0	31 06	8 12	6 75	397		1 7	3 211	4 2	6 85	0 3995	0 0239	1 14	0 497	0 0013
			0 5														
			1	30 98	8 12	6 79	399										
			2	30 32	8 11	6 53	398										
			3	30 15	8 03	5 86	401										
		SFB	4	29 72	7 68	3 1	410			3 249	5	25 16	1 36	0 0227	1 09	0 863	0 0019
			5	29 03	7 37	0 39	417										
311	7 25	17, 2-26	0	27 6	7 02	5 5	435			3 551	19	6 59	1 073	0 0566	1 54	0 617	0 0046

September 16, 2000

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU	Chl a ug/l	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
C1	9 15	PHA-Q	0	28 51	8 38	6 9	335	1051	5 4	2 42	1 9	2 88	99%	0 0127	3 55	0 822	0 002
			0 5					950									
			1	28 57	8 39	7 2	336	730									
			2	28 6	8 39	6 64	335	520									
			3	28 62	8 39	6 84	335	340									
			4	28 61	8 4	6 5	335	250									
			5	28 6	8 4	6 82	335	190									
			6	28 6	8 4	6 54	335	140									
			7	28 6	8 39	6 77	335	74									
			8	28 55	8 39	6 62	335	62									
			9	28 49	8 39	6 56	336	47									
			10	28 46	8 39	6 43	335	36									
			11	28 31	8 35	6 27	337	27 5									
			12	27 14	7 88	2 75	347	19 5									
		227	13	25 75	7 65	0 94	356	13		2 76	1 9	20 1	116%	0 0163	0 807	0 637	0 0019
			14	23 88	7 61	0 96	362	11 5									
			15	21 91	7 6	1 06	367	7 2									
			16	20	7 59	1 05	369										
			17	19 14	7 58	0 91	371										
			18	18 47	7 58	1 07	370										
			19	17 92	7 57	0 9	372										
			20	17 53	7 57	0 95	371										
			21	17 13	7 57	0 97	372										
			22	16 78	7 56	0 91	372										
			23	16 5	7 56	0 89	372										
			24	16 12	7 55	0 95	374										
			25	15 79	7 55	0 97	375										
			26	15 51	7 54	0 98	374										
			27	15 35	7 53	0 99	375										
			28	15 2	7 52	1 04	376										
			29	15 04	7 51	1 05	378										
			30	14 99	7 5	1 05	378										
			31	14 88	7 49	1 06	380										
			32	14 78	7 48	1 06	381										
			33	14 6	7 48	1 07	381										
			34	14 54	7 49	1 07	378										
			35	14 54	7 48	1 08	379										
			36	14 48	7 48	1 12	378										
			37	14 44	7 48	1 13	378										
			38	14 42	7 47	1 13	380										
		K-11	39	14 39	7 47	1 13	381			3 17	4 2	0 672	123%	0 0231	0 443	0 493	0 0026
			40	14 35	7 47	1 13	381										
			41	14 33	7 46	1 13	384										
			41 5	14 32	7 45	1 13	382										
C2	10 06	41	0	28 35	8 37	7 7	337	1450	3-Jan	2 57	2 5	2 29	94%	0 0183	3 47	0 617	0 002
			0 5					1350									
			1	28 4	8 37	7 67	337	1150									
			2	28 44	8 38	7 56	338	750									
			3	28 46	8 39	7 6	337	530									

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O.mg/l	Cond.us/cm	Light	secchi(m	alk(meq/L	Turb(NTU	Chl a ug/l	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			4	28 48	8 39	7 88	337	330									
			5	28 5	8 39	7 7	338	225									
			6	28 51	8 39	7 81	337	160									
			7	28 53	8 4	7 69	337	110									
			8	28 51	8 39	7 51	337	77									
			9	28 44	8 38	7 7	337	57									
			10	28 46	8 35	7 56	337	42									
			11	28 06	8 2	6 67	340	28									
			12	27 78	8 06	5 38	343	17									
			13	27 07	7 76	3 05	349										
		J-23	14	23 75	7 57	1 78	367			2 83	3 2	13 46	94%	0 0247	0 519	0 658	0 0013
			15	21 89	7 54	1 83	373										
			16	20 38	7 51	1 88	377										
			17	19 43	7 49	1 75	380										
			18	18 43	7 48	1 91	383										
			19	17 88	7 48	1 87	383										
			20	17 48	7 47	1 76	383										
			21	16 98	7 47	1 74	384										
			22	16 78	7 47	1 54	383										
			23	16 43	7 47	1 57	385										
			24	16 06	7 47	1 33	385										
			25	15 92	7 47	1 5	384										
			26	15 66	7 47	1 48	384										
		2 24	27	15 48	7 47	1 46	385				4 8	2 42	124%	0 0335	0 37	0 719	0 0019
			28	15 29	7 46	1 51	385										
C3	11 20	2 30	0	29 01		7 7	342	2100	1 5	2 53	4 1	5 81	115%	0 0175	5 04	0 74	0 0026
			0 5					1400									
			1	29 04		7 75	342	1150									
			2	29 04		7 63	341	680									
			3	29 02		7 5	342	360									
			4	29 03		7 4	341	195									
			5	29 01		7 24	341	105									
			6	29		7 35	341	64									
			7	28 92		7 2	341	31									
			8	28 88		7 03	342	17 5									
			9	28 74		5 06	345	9									
			10	28 43		5 3	342										
			11	28 35		5	342										
			12	27 75		3 2	347										
		17	13	25 73		1 15	377			2 87	7	6 66	75%	0 0403	0 658	0 699	0 0046
			14	23 87		1 16	393										
			15	22 35		1 14	408										
			16	70 85		1 15	427										
			16 9	20 16		1 16	440										
C4	12 05	71	0	29 37	8 3	7 03	353	2400	1 1	2 72	7	6 96	107%	0 0327	4 24	0 637	0 0013
			0 5					1900									
			1	29 41	8 3	6 88	352	1100									
			2	29 39	8 29	6 39	354	360									
			3	29 37	8 26	6 38	356	150									

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O.mg/l	Cond.us/cm	Light	secchi(m	alk(meq/L	Turb(NTU	Chl a ug/l	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			4	29 34	8 22	5 89	356	58									
			5	29 26	8 05	4 88	359	18									
			6	29 23	8 25	6 11	356	6 8									
			7	29 2	8 27	6 06	355										
			8	29 16	8 15	5 2	358										
			9	29 11	8 05	4 72	363										
		QE-1	10	28 91	7 64	1 97	373			2 83	14	3 36	121%	0 0558	0 469	0 678	0 0039
			11	28 25	7 41	0 85	402										
			11 8	27 06	7 36	1 36	446										
C5	13 10	2198- 01	0	30 08	8 11	6 31	390	2000	1 75	3 1	2	6 8	136%	0 0447	3 78	0 719	0 0026
			0 5					1500									
			1	29 94	8 05	6 84	391	1050									
			2	29 77	8 07	6 1	392	500									
			3	29 68	8 01	5 52	395	220									
			4	28 57	7 81	3 18	405	95									
			5	29 57	7 74	2 76	4058	40									
		PUPU	6	29 31	7 56	0 84	423	12 5		3 33	4 8	13 1	99%	0 0423	0 39	0 761	0 0039
			7	27 44	7 02	0 89	482	2									
C6	14 02	1Q	0	30 08	8 3	7 5	412	1900	1 83	3 33	2 7	6 32	109%	0 0622	4 68	0 74	0 0013
			0 5					1500									
			1	29 96	8 28	7 45	412	950									
			2	29 59	8 25	6 8	413	390									
			3	29 36	8 07	5 37	416	160									
			4	29 65	7 85	3 73	420	59									
		1K	5	28 65	7 36	0 89	439	15		3 89	6 4	46 74	138%	0 0327	0 472	0 719	0 0032
			6	26 77	7 02	0 76	500	1									
C 6 5	14 28	38	0	30 07	8 35	7 68	410	1950	1 7	3 33	2 8	12 9	119%	0 0243	5 59	0 74	0 002
			0 5					1450									
			1	30 04	8 35	7 63	411	920									
			2	29 88	8 31	6 95	412	400									
			3	29 63	8 24	6 6	414	160									
		90	4	29 48	8 13	5 54	416	70		3 29	4	13 1	140%	0 0395	3 04	0 719	0 0039
			5	29 28	7 71	1 5	422	27									
								9 7									
311	8 15	J-5	0	26 02		4 9	457			3 36	311	4 65	120%	0 0834	1 78	0 781	0 0059
ILRA	7 30	3P0	0	15 07	7 87	10 25	375			2 68	3		126%	0 0103		0 6993	0 0026

October 12, 2000

Site	Time	Bottle	Depth(m)	Temp. 0C	pH	D O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl *a* ug/	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
TR	8 30	1D	0	15 17	7 95	9 78	377			3 118	3		1 3098	0 0419		0 7198	0 0019
C1	12 15	65	0	21 58	8 3	7 9	341		5	2 612	1 7	2 85	0 848	0 0155	2 17	0 555	0 0013
			0 5														
			1	21 75	8 27	7 69	342										
			2	21 76	8 27	7 57	344										
			3	21 78	8 27	7 56	344										
			4	21 79	8 27	7 53	344										
			5	21 8	8 27	7 53	344										
			6	21 8	8 27	7 56	344										
			7	21 81	8 27	7 63	344										
			8	21 82	8 27	7 65	345										
			9	21 81	8 27	7 58	345										
			10	21 81	8 27	7 58	344										
			11	21 81	8 27	7 6	345										
			12	21 73	8 27	7 52	345										
			13	21 52	8 26	7 63	343										
			14	21 25	8 22	7 3	345										
			15	21 16	8 16	6 88	347										
			16	20 72	7 99	5 64	351										
			17	20 18	7 77	4 1	361										
			18	18 84	7 55	1 31	374										
		1E	19	18 03	7 54	1 31	374			2 885	1 7	2 58	1 322	0 0423	0 573	0 596	0 0013
			20	17 67	7 54	1 31	375										
			21	17 31	7 54	1 31	373										
			22	16 78	7 53	1 34	375										
			23	16 64	7 53	1 35	378										
			24	16 3	7 53	1 38	376										
			25	15 98	7 52	1 44	376										
			26	15 88	7 52	1 45	377										
			27	15 57	7 5	1 48	378										
			28	15 32	7 49	1 46	379										
			29	15 24	7 49	1 5	380										
			30	15 14	7 48	1 51	380										
			31	15	7 47	1 56	381										
			32	14 94	7 46	1 57	380										
			33	14 82	7 46	1 6	383										
			34	14 76	7 46	1 62	381										
			35	14 64	7 46	1 63	381										
			36	14 58	7 46	1 64	382										
			37	14 54	7 45	1 64	382										
		J- 29	38	14 48	7 45	1 64	384			2 924	5 5	1 18	1 31	0 0279	0 414	0 699	0 0026
			39	14 48	7 44	1 65	384										
	C2	38	0	21 45	8 27	7 99	344		2 8	2 573	2 9	3 36	0 885	0 0139	2 02	0 575	0 0026
			0 5														
			1	21 47	8 27	7 79	344										
			2	21 48	8 27	7 77	345										
			3	21 48	8 27	7 87	345										
			4	21 48	8 27	7 78	345										

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl *a* ug/	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			5	21 47	8 27	7 71	345										
			6	21 47	8 27	7 74	345										
			7	21 47	8 27	7 88	345										
			8	21 45	8 27	7 8	345										
			9	21 44	8 28	7 89	344										
			10	21 41	8 27	7 82	345										
			11	21 4	8 27	7 74	345										
			12	21 39	8 27	7 77	345										
			13	21 27	8 27	7 76	345										
			14	21 14	8 25	7 68	345										
			15	21 06	8 23	7 65	345										
			16	20 99	8 24	7 68	345										
			17	20 77	8 14	7 02	348										
			18	20 66	7 98	6 32	353										
			19	18 45	7 42	1 42	395										
		7	20	17 73	7 42	1 41	392			3 391	6 9	20 69	1 31	0 0419	0 495	0 617	0 0019
			21	17 16	7 42	1 42	392										
			22	16 75	7 42	1 45	390										
			23	16 41	7 42	1 48	390										
			24	16 21	7 42	1 46	390										
		J5	25	15 86	7 42	1 49	389			3 313	8 6	8 41	1 247	0 0291	0 445	0 617	0 0026
			25 5	15 8	7 41	1 47	392										
C3	11 08	2 34	0	20 95	8 35	7 29	345		1 55	2 729	5 2	4 97	0 81	0 0239	2 38	0 678	0 0013
			0 5														
			1	21 04	8 31	7 25	346										
			2	21 06	8 27	7 17	346										
			3	21 07	8 25	7 11	346										
			4	21 07	8 25	7 09	348										
			5	21 07	8 25	7 11	348										
			6	21 09	8 25	7 2	349										
			7	21 07	8 25	7 06	349										
			8	21 06	8 25	7 06	348										
			9	21 06	8 24	7 06	349										
			10	20 96	8 24	7 1	349										
		QE- 1	11	20 83	8 22	7 21	350			2 681	8 2	3 03	0 798	0 0151	1 68	0 534	0 0039
			12	20 58	8 2	6 98	353										
			13	20 36	8 2	7 14	353										
			14	20 09	8 19	7 14	355										
			15	20 08	8 19	6 98	354										
			16	20 06	8 19	7 11	354										
			17	20 02	8 18	7 13	353										
			18	20 02	8 18	7 07	354										
		8479	19	20	8 18	7 07	354			2 807	17	2 77	0 823	0 0403	1 67	0 72	0 0026
			20	20	8 18	7 07	354										
C4	9 50	2040	0	19 82	8 15	7 01	360		0 95	2 69	7 8	7 12	0 848	0 0315	1 48	0 534	0 0013
			0 5														
			1	19 89	8 15	6 96	360										
			2	19 9	8 15	6 9	359										
			3	19 91	8 15	6 9	359										

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D.O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Chl a ug/	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			4	19 92	8 15	9 89	359										
			5	19 94	8 16	6 65	359										
			6	19 95	8 16	6 73	358										
			7	19 95	8 19	6 7	356										
			8	19 93	8 19	6 94	356										
			9	19 93	8 19	6 68	355										
			10	19 91	8 19	6 67	355										
		PU PU	11	19 89	7 8	6 35	364			2 846	16	3 73	1 21	0 0526	1 15	0 884	0 0039
C5	10 10	2198- 01	0	20 71	7 46	4 18	416		1 1	2 645	6 2	7 93	1 546	0 0419	0 6	0 946	0 002
			0 5														
			1	20 71	7 56	4 3	416										
			2	20 69	7 56	4 21	416										
			3	20 68	7 55	4 01	417										
			4	20 59	7 53	3 7	422										
			5	2 05	7 51	3 21	425										
		80	6	20 44	7 5	3 04	427			2 985	9 8	7 68	0 985	0 0718	0 698	1	0 0032
			7	20 4	7 5	2 96	428										
C6	10 55	7745	0	19 67	7 86	6 61	428		1 1	3 211	6 1	11 83	1 546	0 0351	1 64	1 028	0 0013
			0 5														
			1	19 58	7 92	6 45	428										
			2	18 57	7 8	5 33	430										
			3	18 21	7 83	5 79	430										
			4	17 73	7 89	6 32	431										
			5	17 39	7 89	6 51	430										
		SPF	6	17 09	7 9	6 6	430			3 174	16	12 79	1 384	0 0351	1 51	0 884	0 0026
C6 5	11 22	JH- 1	0	20 29	8 12	8 97	426		1 6	3 136	3 7	11 48	1 484	0 0323	3 02	0 946	0 0013
			0 5														
			1	19 62	8 22	8 76	427										
			2	17 65	8 15	8 85	425										
			3	16 92	8 1	8 44	428										
		2020	4	16 81	8 08	8 23	427			3 06	13	9 87	1 397	0 0723	2 32	0 966	0 0052
311	8 50	LL- IV	0	17 24	8 22	8 83	449			3 249	14	3 76	1 372	0 0862	3 1	1 048	0 0052

November 17, 2000

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
allrac	N/A	17	0	17 17	8 14	11 9	360			3 0444	N/A	1 3522	0 0179		0 6581	0 0026
C1	11 10	2232-02	0	18 72	8 09	7 76	325		1 9	2 2608	4 4	0 913	0 0127	1 135	0 473	0 0013
			1	18 69	8 1	7 54	325									
			2	18 63	8	7 57	3									
			3	18 6	11	7 27	26									
			4	18 58	8 12	7 6	326									
			5	15 57	8 12	7 59	326									
			6	18 56	8 13	7 48	326									
			7	18 54	8 13	7 5	325									
			8	18 54	8 13	7 59	326									
			9	18 52	8 14	7 49	326									
			10	18 52		7 41	325									
			11	18 52		7 77	326									
			12	18 51		7 76	326									
			13	18 51		7 88	326									
			14	18 51		7 53	326									
			15	18 51		7 46	326									
			16	18 51		7 85	326									
			17	18 5		7 81	326									
			18	18 5		7 92	326									
			19	18 5		7 85	326									
			20	18 5		7 89	326									
			21	18 5		7 69	326									
			22	18 5		7 69	326									
			23	18 5		7 89	327									
			24	18 48		7 74	326									
			25	18 23		7 68	330									
			26	18 17		7 62	330									
			27	18 07		7 32	333									
			28	18 03		7 1	334									
			29	17 76		5 51	340									
			30	17 51		5 58	349									
			31	17 31		5 72	355									
			32	17 12		4 29	363									
			33	16 78		2 63	373									
			34	16 44		1 21	381									
		1-k	35	16 03		0 83	382			3 0015	5 2	1 085	0 0155		0 638	0 0032
			36	15 7		0 8	384									
			37	15 51		0 81	386									
			38	15 48		0 77	387									
			39	15 24		0 82	386									
			40	15 14		0 78	386									
			41	15 09		0 65	386									
C2	12 04	J-12	0	18 42	8 14	8 35	326		1 8	2 45574	5	0 898	0 0407	1 35	0 432	0 002
			1	18 43	8 12	8 27	326									
			2	18 39	8 13	8 14	326									
			3	18 36	8 05	8 18	326									
			4	18 37		8 17	327									

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D.O.mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			5	18 32		8 24	327									
			6	18 3		8 28	327									
			7	18 3		8 24	326									
			8	18 3		8 2	326									
			9	18 3		8 32	327									
			10	18 29		8 25	326									
			11	18 29		8 1	326									
			12	18 29		8 05	326									
			13	18 26		8 11	326									
			14	18 18		8 13	326									
			15	318 02		7 98	326									
			16	17 91		8 26	324									
			17	17 85		7 97	326									
			18	17 82		8 02	326									
			19	17 78		8 02	326									
			20	17 76		8 08	326									
			21	17 75		8	327									
			22	17 75		8 01	327									
			23	17 73		8 02	329									
			24	17 65		8 01	333									
			25	17 3		7 86	346									
			26	17 06		6 85	362									
			27	16 91		7 83	370									
			28	16 68		8 02	380									
			29	16 62		7 93	382									
			30	16 59		7 99	384									
			31	16 58		7 84	386									
		2049	32	16 55		7 98	386			3 15738	11 6	1 634	0 0351		0 576	0 0019
			33	16 53		7 99	388									
			34	16 53		7 83	390									
			34 6	16 53		7 4	388									
C3	12 54	2051	0	17 94	7 9	8 81	324		1 3	2 45574	5 2	0 836	0 0383	0 71	0 555	0 002
			1	17 93	8 03	8 66	325									
			2	17 9	8 05	8 5	325									
			3	17 88	8 08	8 4	325									
			4	17 85	8 1	8 05	325									
			5	17 79		8 55	323									
			6	17 7		8 55	324									
			7	17 67		8 61	324									
			8	17 66		8 42	324									
			9	17 62		8 38	324									
			10	17 61		8 48	324									
			11	17 58		8 33	324									
			12	17 56		8 47	325									
			13	17 51		8 36	325									
			14	17 44		8 35	325									
			15	17 4		8 37	326									
			16	17 22		8 19	329									
			17	17 25		8 32	330									
			18	16 65		8	371									

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O.mg/l	Cond.us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			19	16 41		7 94	376									
			20	16 49		7 93	373									
			21	16 03		7 98	405									
			22	15 98		7 98	408									
			23	15 96		7 98	409									
			24	15 95		7 9	411					1 384	0 0439		0 782	0 0032
			25	15 95		7 86	410									
			26	15 93		7 82	410									
C4	13 54	K-15	0	17 32	8 1	8 73	323		0 9	2 57268	7 5	1 16	0 0195	1 6	0 658	0 0026
			1	17 25		8 39	324									
			2	17 21		8 16	323									
			3	17 02		7 84	325									
			4	16 88		7 79	325									
			5	16 85		7 69	324									
			6	16 27		7 74	325									
			7	15 79		7 42	366									
			8	15 67		7 92	423									
			9	15 62		8 21	441									
			10	15 61		8 14	450									
			11	15 61		8 19	456									
			12	15 61		8 05	458									
		T-2	13	15 61		7 96	457			2 45574	11 2	1 447	0 0423		0 785	0 0039
			14	15 59		8 24	458									
			15	15 59		7 92	458									
C5	14 21	76	0	15 43	8 15	9 54	496		1 1	4 40474	4 4	1 584	0 0431	3 85	0 534	0 0026
			1	15 46		9 12	494									
			2	15 44		9 09	494									
			3	15 38		8 99	495									
			4	15 28		8 89	495									
			5	15 05		9 04	498									
			6	15 01		9 03	499									
			7	14 98		9	4999									
			8	14 97		8 67	501									
		41	9	14 94		9 07	501			4 17086	9 2	1 659	0 0475		0 926	0 0046
			10	14 9		8 8	501									
			11	14 89		8 33	502									
C6	15 45	PHAQ	0	14 57	8 18	10 21	511		0 95	4 36576	8	1 572	0 0427	3 93	0 699	0 0032
			1	14 58	8 17	9 98	509									
			2	14 48	8 17	9 93	509									
			3	14 3		10 36	510									
			4	14 16		10 63	509									
			5	14 12		10 26	510									
			6	14 03		10 04	510									
			7	12 98		10 34	510									
			8	13 98		10 1	510									
		18	9	13 98		10 13	510			4 32678	4 8	1 722	0 0495		0 576	0 0032
			10	13 98		10 16	510									
			10 5	13 98		10 29	510									

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O.mg/l	Cond.us/cm	Light	secchi(m	alk(meq/L	Turb(NTU)	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
C65	15 02	2--32	0	14 11	8 25	10 42	515		1 5	4 36576	5 4	1 584	0 0315	4 58	0 678	0 0026
			1	14 11	8 24	10 62	515									
			2	14 1		10 62	513									
			3	14 06		10 44	514									
			4	14 05		10 5	513									
			5	14 05		10 62	513									
			6	14 01		10 43	514									
			7	14		10 44	514									
			8	14		10 49	513									
			9	14		10 44	514									
			9 4	14		10 44	515									
C7	15 20	1--5	0	14 5	7 87	11 21	515		1 6	4 366576	4 2	1 534	0 0538	1 87	0 678	0 0046
			1	14 5	7 88	10 88	514									
			2	14 5	8 06	10 78	514									
			3	14 5		10 92	513									
			4	14 5		10 83	515									
			5	14 5		10 73	514									
311	7 34	2052	0	14 24	8 14	11 9	506			4 2878	N/A	1 591	0 1034	1 4	0 7404	0 0059

January 15, 2001

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D.O.mg/l	Cond us/cm	secchi(m	alk(meq/L	Turb(NTU)	Chl *a* *u*g/l	Ca2+ (mM)	pCa2+ (mM)	calcite □	Mg2+ (mM)	pMg2+ (mM)
TR	N/A	J-58	0						2 7289	6 4		1 0603	0 0275		0 6581	0 0026
C1	8 49	237,88	0	10 78	8 43	12 63	343	2 6	2 80656	3	3 2	1 248	0 009	3 21	0 596	0 0013
			1	10 83	8 4	12 41	345									
			2	10 83	8 41	12 28	345									
			3	10 83	8 4	12 19	345									
			4	10 76	8 4	12 16	346									
			5	10 74	8 4	12 36	345									
			6	10 72	8 41	12 3	345									
			7	10 72	8 41	12 37	346									
			8	10 72	8 42	12 38	346									
			9	10 72	8 41	12 18	346									
			10	10 66	8 41	12 04	345									
			11	120 59	8 4	11 97	347									
			12	10 57	8 39	12 03	346									
			13	10 57	8 4	11 89	345									
			14	10 55	8 39	11 92	345									
			15	10 55	8 39	12	346									
			16	10 53	8 4	11 678	345									
			17	10 53	8 4	11 62	345									
			18	10 53	8 39	11 94	346									
			19	10 48	8 37	11 72	347									
			20	10 41	8 37	11 33	351									
			21	10 35	8 36	11 24	351									
			22	10 31	8 35	11 2	352									
			23	10 28	8 35	11 17	354									
			24	10 24	8 34	11 18	360									
			25	10 22	8 33	11 19	364									
			26	10 19	8 32	10 89	365									
			27	10 14	8 32	11 1	368									
			28	10 09	8 31	11 01	371									
			29	10 04	8 31	11	376									
			30	10	8 28	11 09	385									
			31	9 9	8 27	10 99	390									
			32	9 82	8 26	10 67	395									
			33	9 78	8 26	10 77	397									
			34	9 74	8 25	10 6	403									
			35	9 66	8 24	10 86	411									
			36	9 51	8 23	10 94	416									
			37	9 44	8 21	10 58	428									
			38	9 4	8 2	10 29	431									
			39	9 36	8 2	10 28	436									
		2027,R2	40	9 35	8 19	10 3	436		3 81808	8 9	2 07	0 898	0 03	2 42	0 637	
			41	9 35	8 18	10 3	436									
			42	9 36	8 18	10 16	438									
			43	9 35	8 18	10 23	439									
			44	9 35	8 17	10 22	439									
C2	9 45	73	0	10 91	8 33	12 47	343	2 3	3 00146	3 2	4 33	0 786	0 0136	1 72	0 514	0 0013
			1	10 92	8 18	12 51	344									

Site	Time	Bottle	Depth(m)	Temp. 0C	pH	D.O mg/l	Cond us/cm	secchi(m	alk(meq/L	Turb(NTU)	Chl a ug/l	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			2	10 81	8 14	12 48	344									
			3	10 79	8 26	12 39	344									
			4	10 7	8 27	11 89	345									
			5	10 75	8 31	11 94	345									
			6	10 74	8 33	12 02	345									
			7	10 68	8 33	12 02	345									
			8	10 66	8 35	12 07	346									
			9	10 65	8 35	12 11	346									
			10	10 33	8 37	12 1	346									
			11	10 636	8 34	12 1	346									
			12	10 64	8 37	12 21	347									
			13	10 59	8 38	12 3	350									
			14	10 58	8 38	12 27	350									
			15	10 57	8 39	12 15	350									
			16	10 56	8 39	12 21	352									
			17	10 55	8 38	12 24	354									
			18	10 51	8 38	12 19	355									
			19	10 45	8 39	12 1	359									
			20	10 39	8 34	12 01	362									
			21	10 34	8 33	12 21	375									
			22	10 28	8 31	12 34	385									
			23	10 24	8 3	11 73	393									
			24	10 07	8 28	11 51	404									
			25	10 04	8 25	11 55	425									
			26	9 97	8 24	11 09	434									
			27	9 93	8 23	10 97	444									
			28	9 89	8 22	11 07	446									
			29	9 85	8 21	10 7	450									
			30	9 82	8 2	10 69	450									
		58	31	9 83	8 19	10 71	450		4 17086	3 4	6 12	1 7	0 0172	2 61	0 761	
			32	9 82	7 84	9 47	451									
			33	9 84	7 99	9 4	451									
			34	9 85	8 04	9 27	451									
C3	10 54	2--36	0	10 73	8 32	12 91	348	2 2	3 04044	3 1	7 4	1 21	0 024	2 61	0 617	0 0013
			1	10 75	8 34	13 03	348									
			2	10 76	8 37	12 71	347									
			3	10 75	8 38	12 8	348									
			4	10 74	8 39	12 78	348									
			5	10 6	8 38	13 08	349									
			6	10 59	8 38	12 91	349									
			7	10 58	8 39	12 91	349									
			8	10 59	8 39	12 91	353									
			9	10 59	8 38	13 02	355									
			10	10 6	8 37	12 95	355									
			11	10 68	8 21	12 64	374									
			12	10 74	8 19	12 22	383									
C4	11 30	2025	0	11 29	8 16	12 3	411	N/A	3 7031	6	8 1	1 138	0 002	2 08	0 555	0 0013
			1	11 3	8 17	12 25	410									
			2	11 3	8 17	12 19	412									

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O mg/l	Cond.us/cm	secchi(m	alk(meq/L	Turb(NTU)	Chl *a* ug/l	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			3	11 29	8 18	12 07	413									
			4	11 29	8 17	12 02	419									
			5	11 2	8 14	11 75	437									
			6	11 08	8 14	11 62	439									
			7	10 95	8 16	11 53	439									
			8	10 85	8 18	11 47	440									
			9	10 73	8 19	11 48	454									
			10	10 7	8 19	11 25	460									
		2043	11	10 66	8 19	11 16	473		4 20984	11	4 32	1 622	0 042	3 52	0 637	
			12	10 59	8 17	10 83	485									
			13	10 55	8 12	10 5	494									
C5	12 04	1-G	0	11 9	8 15	11 59	470	0 9	4 2878	10	4	1 16	0 051	2 44	0 637	0 002
			1	11 87	8 15	11 55	470									
			2	11 8	8 16	11 67	469									
			3	11 74	8 17	11 66	470									
			4	11 68	8 17	11 63	471									
			5	11 67	8 17	11 56	470									
			6	11 66	8 18	11 53	470									
			7	11 64	8 18	11 47	471									
			8	11 63	8 18	11 36	471									
			9	11 6	8 18	11 21	473									
C6	12 48	T-09	0	12 2	8 24	12 49	487	1 3	4 443272	5 9	2 4	1 355	0 037	3 66	0 658	0 0026
			1	12 21	8 26	12 92	492									
			2	12 23	8 28	12 86	494									
			3	12 2	8 29	12 7	493									
			4	12 17	8 29	12 62	494									
			5	12 15	8 3	12 64	493									
			6	12 13	8 3	12 7	494									
			7	12 11	8 3	12 72	495									
			8	12 11	8 3	12 6	494									
			8 5	12 09	8 3	12 44	494									
C6 5	13 05	B-28	0	12 07	8 21	12 8	489	1 4	4 52168	4 8	2 34	1 385	0 033	3 54	0 678	0 0032
			1	12 08	8 24	12 74	491									
			2	12 07	8 27	12 69	491									
			3	12 07	8 28	12 58	492									
			4	12 04	8 3	12 49	492									
			5	12 04	8 31	12 65	492									
			6	12 04	8 29	12 6	492									
			7	12 04	8 29	12 37	493									
C7	13 29	3	0	NO	YDR	LAB	HERE	N/A	4 52168	2 6						
311	N/A	2032	0	11 68	8 01	13 04	494		4 32678	3 8	2 44	1 784	0 031	3 72	0 74	0 0046

March 25, 2001

Site	Time	Bottle	Depth(m)	Temp. 0C	pH	D O.mg/l	Cond.us/cm	secchi(m	alk(meq/L	Turb(NTU)	Chl *a* ug/l	Ca2+ (mM)	pCa2+ (mM)	calcite □	Mg2+ (mM)	pMg2+ (mM)
TR	7 30	5	0	12 51	8 1	9 34	379		3 001	4		1 4096	0 0091		0 8227	0 0019
C1	12 41	2--36	0	15 04	8 51	9 52	396	8 5+	8 235	1 8	1 8	0 785	0 026	3 21	0 72	0 0013
			1	15	8 52	9 51	396									
			2	14 94	8 52	9 61	396									
			3	14 68	8 51	9 5	396									
			4	14 66	8 52	9 5	396									
			5	14 63	8 52	9 49	395									
			6	14 62	8 53	9 48	396									
			7	14 61	8 53	9 41	396									
			8	14 63	8 53	9 5	395									
			9	14 57	8 53	9 38	395									
			10	14 56	8 53	9 43	395									
			11	14 55	8 53	9 37	395									
			12	14 51	8 53	9 38	394									
			13	14 48	8 53	9 4	393									
			14	14 17	8 52	9 36	390									
			15	13 87	8 49	9 3	390									
			16	13 79	8 49	9 12	390									
			17	13 72	8 48	9 24	390									
			18	13 62	8 47	9 15	390									
			19	13 53	8 45	9 18	390									
		41	20	13 43	8 43	8 88	390		3 118	2	2 49	0 723	0 019	2 45	0 473	0 0026
		K-0	35	13 85	8 17	7 65	394		3 04	5 6	1 42		0 012	1 25	0 576	0 0013
C2	11 55	2058	0	15 14	8 46	9 79	417	3 2	3 391	2 8	3 44	0 811	0 061	3 09	0 534	0 002
			1	15 14	8 48	9 71	417									
			2	15 14	8 48	9 67	417									
			3	15 09	8 48	9 6	418									
			4	14 99	8 49	9 48	418									
			5	14 86	8 49	9 58	414									
			6	14 8	8 49	9 43	413									
			7	14 7	8 49	9 43	411									
			8	14 53	8 49	9 38	405									
			9	14 41	8 49	9 3	404									
			10	14 16	8 49	9 24	401									
			11	14 15	8 49	9 35	397									
			12	14 09	8 49	9 31	396									
			13	13 96	8 48	9 25	396									
			14	13 97	8 47	9 23	396									
			15	14	8 48	9 25	396									
		2028	16	13 64	8 4	8 79	400		3 235	3 8	3 74	1 147	0 006	3 46	0 493	0 0019
			17	13 6	8 4	8 65	400									
			18	13 59	8 4	8 68	400									
			19	13 57	8 41	8 67	398									
			20	13 55	8 41	8 67	398									
		J-27	24	13 43			395		3 352	14	3 92	0 761	0 014	3 1	0 843	0 0026
C3	11 23	66	0	16 35	8 31	9 14	500	1 5	4 248	4 8	3 87	1 073	0 054	3 74	0 74	0 002
			1	16 17	8 31	8 7	500									

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O.mg/l	Cond us/cm	secchi(m	alk(meq/L	Turb(NTU)	Chl *a* ug/l	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			2	16 06	8 31	8 73	499									
			3	16 02	8 31	8 57	499									
			4	16	8 3	8 5	500									
			5	15 98	8 29	8 4	502									
			6	15 9	8 26	8 25	5603									
			7	15 66	8 21	8 06	502									
			8	15 54	8 23	7 8	496									
			9	15 4	8 2	7 72	499									
			10	15 26	8 19	7 62	500									
			11	15 03	8 17	7 54	490									
			12	14 85	8 16	7 42	490									
			13	14 8	8 15	7 19	485									
			14	14 8	8 13	7 13	495									
			15	14 74	8 13	6 88	499									
		K-10	16	14 48	8 08	6 55	506		4 209	9	3 41	1 047	0 017	2	0 782	0 0083
			17	14 42	8 05	6 22	507									
			17 4	14 41	8 04	5 29	507									
C4	10 52	BMF	0	16 77	8 31	9 2	513	N/A	4 404	9 4	5 3	0 823	0 08	3 01	0 658	0 002
			1	16 78	8 31	9 01	513									
			2	16 78	8 3	8 81	514									
			3	16 72	8 31	8 73	513									
			4	16 63	8 31	8 75	513									
			5	16 55	8 31	8 61	513									
			6	16 42	8 31	8 61	512									
			7	16 23	8 26	8 46	520									
		HI	8	16 02	8 13	7 97	524		3 235	16						
			9	15 59	7 96	7 1	526									
			10	15 21	8 12	7 38	523									
			11	14 86	8 08	7 06	522									
			12	14 72	7 06	6 78	522									
		8389	13	14 6	7 99	6 18	527		4 677	25	1 42	1 434	0 017	1 3	0 823	0 0019
			14	14 61	7 71	2 85	532									
C5	9 42	2059	0	17 49	8 23	8 49	518	1	4 443	8 2	1 53	1 45	0 057	4 56	0 761	0 0026
			1	17 5	8 23	8 31	517									
			2	17 48	8 24	8 3	517									
			3	17 48	8 24	8 25	517									
			4	17 45	8 24	8 18	518									
			5	17 42	8 24	8 17	518									
			6	17 27	8 22	8 14	518									
			7	15 12	8 14	7 48	523									
			8	14 71	8 11	7 19	525									
		67	9	14 41	8 09	7 1	527		4 482	9 7	2 32	1 384	0 022	2 87	0 782	0 0019
			10	14 32	8 04	6 5	529									
C6	9 25	2062	0	17 44	8 27	9 58	512	1 5	4 365	6 4	1 02	1 347	0 019	4 57	0 719	0 0013
			1	17 44	8 28	9 06	512									
			2	17 43	8 28	9 05	513									
			3	17 44	8 28	9	514									
			4	17 43	8 28	9 05	514									

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O.mg/l	Cond.us/cm	secchi(m	alk(meq/L	Turb(NTU)	Chl *a* ug/l	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			5	17 4	8 29	8 97	514									
			6	17 4	8 29	9 03	514									
			7	17 41	8 29	8 93	514									
		40	8	17 41	8 28	9	514		4 443	8 8	1 88	1 447	0 026	5 22	0 802	0 0019
C6 5	9 12	6	0	17 52	8 31	9 04	510	1 95	4 287	5 6	1 53	1 472	0 024		0 74	0 0032
			1	17 55	8 31	8 88	510							5 39		
			2	17 55	8 32	8 81	509									
			3	17 55	8 34	8 78	510									
			4	17 55	8 34	8 8	509									
			5	17 55	8 34	8 79	509									
		2B	6	17 53	8 34	8 73	509		4 365	6 6	1 64	1 497	0 005	5 98	0 576	0 0013
			6 7	17 54	8 33	8 66	509									
C7	8 52	NWA	0	16 71	8 31	9 13	514	2 9	4 404	2 8	1 26	1 235	0 088	4 52	0 575	0 0026
			1	16 72	8 32	8 97	514									
			2	16 73	8 33	8 85	513									
		2060	3	16 72	8 33	8 87	513		4 287	4						
			4	16 72	8 33	8 85	513									
311	8 04	68	0	16 68	8 22	9 53	519		4 443	2 5	1 24	1 447	0 109	4 33	0 823	0 0032

April 30, 2001

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O.mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Chl *a* ug/	Turb(NTU)	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
TR	8 00	2--31	0	13 86	8 14	9 2	389			2 878		4 3	1 2225	0 0111		0 6375	0 0013
C1	13 27	K-23	0	20 71	8 41	8 8	398	1500	N/A	2 911	2 4	1 4	1 23	0 025	4 34	0 658	0 0032
			0 5					1200									
			1	20 6	8 41	8 61	398	1100									
			2	20 41	8 41	8 6	398	850									
			3	20 22	8 41	8 54	398	650									
			4	20 2	8 41	8 54	398	500									
			5	20 03	8 42	8 52	398	400									
			6	19 88	8 43	8 46	398	290									
			7	19 76	8 42	8 49	398	230									
			8	19 68	8 42	8 43	398	170									
			9	19 66	8 42	8 46	398	140									
			10	19 49	8 41	8 28	398	120									
			11	18 34	8 36	7 84	402										
		2044	12	18 29	8 33	7 62	403			2 944	3 25	2 2	1 25	0 007	3 49	0 617	0 0019
			13	17 81	8 3	7 5	405										
			14	17 11	8 26	7 39	406										
			15	16 24	8 27	7 33	403										
		QE-2	16	15 84	8 26	7 3	402			2 948	4 22	2 2	1 21	0 015	2 39	0 411	0 0026
			17	15 58	8 26	7 47	401										
			18	15 15	8 27	7 45	397										
			19	14 8	8 26	7 5	397										
			20	14 63	8 25	7 33	396										
			21	14 51	8 24	7 29	395										
			22	14 46	8 24	7 24	395										
			23	14 36	8 23	7 25	394										
			24	14 16	8 22	7 23	392										
			25	14 04	8 22	7 22	391										
C2	12 49	2046	0	21 67	8 38	8 61	398	1900	2 9	2 911	3 17	4	1 21	0 041	4 13	0 576	0 0013
			0 5					1600									
			1	21 63	8 39	8 61	398	1400									
			2	21 57	8 38	8 45	398	1000									
			3	21 47	8 38	8 49	398	740									
			4	21 28	8 39	8 49	398										
			5	21 19	8 39	8 49	399										
			6	21 13	8 39	8 5	400										
			7	21 04	8 39	8 47	399										
			8	19 94	8 37	7 95	400										
		62	9	19 5	8 33	7 74	401			2 911	5 29	4 2	1 3	0 021	3 3	0 658	0 0013
			10	19 29	8 32	7 69	402										
			11	19 05	8 32	7 73	402										
			12	18 72	8 34	7 42	404										
			13	17 85	8 3	7 02	408										
			14	17 32	8 23	6 72	409										
			15	16 94	8 18	6 66	409										
			16	16 07	8 17	6 1	410										
			17	15 6	8 1	5 93	410										
			18	15 3	8 08	5 87	407										

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O mg/l	Cond us/cm	Light	secchi(m	alk(meq/L	Chl *a* ug/	Turb(NTU)	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
			19	15 02	8 08	5 8	406										
			20	14 83	8 09	5 8	404										
			21	14 65	8 07	5 69	402										
			22	14 38	8 05	5 44	400										
			23	14 2	8 03	5 39	400										
			24	14 12	8 02	5 25	398										
			25	13 96	7 99	5 16	399										
		2038	31							2 911	3 47	14	1 1	0 014	0 91	0 658	0 0019
C3	12 23	2053	0	22 32	8 31	8 57	410	2100	2 2	3 01	8 79	5 8	1 272	0 01	3 89	0 679	0 0013
			0 5					1700									
			1	22 31	8 32	8 49	410	1300									
			2	22 2	8 31	8 45	413	750									
			3	22 15	8 31	8 39	416	450									
			4	22 07	8 3	8 32	420										
			5	21 99	8 3	8 38	419										
			6	21 96	8 31	8 28	417										
			7	21 51	8 16	7 03	464										
			8	20 98	8 07	6 05	472										
			9	20 38	7 93	4 85	468										
			10	20 02	7 86	4 2	466										
		2--37	11	19 7	7 8	3 74	463			3 441	10 18	17	1 2	0 027	1 19	0 72	0 0019
			12	19 34	7 79	3 72	455										
C4	11 55	K-21	0	22 92	8 21	8 35	465	1950	1 1	3 441	9 89	7 4	1 147	0 012	3 24	0 699	0 0013
			0 5					1700									
			1	22 86	8 21	8 03	465	1000									
			2	22 78	8 21	8 03	464	900									
			3	22 69	8 21	8 02	463	500									
			4	22 54	8 2	7 8	462	240									
		J-21	5	21 95	8 09	6 42	485	90		3 473		8 1					
			6	21 18	8 09	6 34	490										
			7	20 68	8 06	6 06	493										
			8	20 35	8 01	5 52	496										
			9	20 26	7 98	5 3	498										
			10	20 15	7 92	5 08	499										
			11	20 1	7 86	4 68	500										
			12	19 19	7 54	2 18	497										
		D-22	13	18 07	7 46	0 34	485			3 412	20 96	7 8	1 54	0 035	0 676	0 802	0 0019
			14	17 76	7 42	0 2	488										
C5	10 37	33	0	23 39	8 38	8 7	477		0 9	3 539	20 99	11	1 35	0 013	5 96	0 781	0 002
			1	23 21	8 37	8 52	478										
			2	23 19	8 36	8 5	478										
			3	21 72	8 28	8 17	488										
			4	20 95	8 21	7 6	488										
			5	20 7	8 2	7 4	488										
			6	20 57	8 18	7 1	488										
			7	20 42	8 16	7 01	488										
		94	8	20 37	8 16	6 83	488			3 606	6 32	9 5	1 491	0 039	3 6	0 719	0 0013
			9	20 32	8 14	6 66	488										

Site	Time	Bottle	Depth(m)	Temp 0C	pH	D O.mg/l	Cond.us/cm	Light	secchi(m	alk(meq/L	Chl *a* ug/	Turb(NTU)	Ca2+ (mM)	pCa2+ (mM)	calcite index	Mg2+ (mM)	pMg2+ (mM)
C6	10 07	2041	0	21 37	8 22	7 93	485		1 2	3 638	4 27	7 4	1 272	0 022	3 67	0 781	0 002
			1	21 16	8 23	7 8	485										
			2	21 05	8 22	7 79	485										
			3	21	8 22	7 66	485										
			4	20 88	8 22	7 63	486										
			5	20 74	8 2	7 46	487										
			6	20 66	8 2	7 52	487										
			7	20 5	8 15	7 3	490										
			8	20 4	8 16	7 21	493										
		Q-2	9	20 11	8 07	6 1	495			3 738	4 38	15	1 646	0 065	3 34	0 802	0 0039
C6 5	9 47	PP	0	21 26	8 26	8 44	490		1 2	3 638	3 31	8 2	1 297	0 021	4 08	0 781	0 002
			1	21 24	8 26	8 3	490										
			2	21 22	8 26	8 1	490										
			3	21 19	8 26	8 08	490										
			4	21 18	8 27	8 13	490										
			5	21 16	8 27	8 05	490										
			6	21 13	8 26	8 01	490										
		19	7	21 03	8 25	7 95	489			3 572	4 6	10	1 55	0 079	3 02	0 74	0 0026
			8	20 82	7 9	6 9	500										
C7	9 35	2037	0	20 99	8 25	7 85	487		1 2	3 606	5 02	8 6	1 35	0 068	4 07	0 802	0 002
			1	21	8 25	7 82	487										
			2	20 99	8 25	7 8	487										
			3	20 99	8 26	7 74	487										
			3 2	20 98	8 27	7 69	487										
311	9 35	2--27	0	20 5	8 21	7 88	500			3 638	6 72	6 6	2 02	0 126	5 52	0 923	0 0039

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