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Phosphorous Limitation and Trophic Status in Limestone Quarry Lakes, Dade County, FL

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Phosphorus Limitation and Trophic Status in Limestone Quarry Lakes, Dade County, FL

By

Isaac Peter Chase

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MASTER OF SCIENCE

THESIS

OF

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MARINE BIOLOGY

Approved:

Thesis Committee

Major Professor Curtis Burney

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Phosphorus Limitation and Trophic Status in Limestone Quarry Lakes, Dade County, Florida

by Isaac Chase

Abstract

While limestone quarry lakes have existed in South Florida for many years, only recently have they received serious scrutiny. A thorough understanding of the trophic dynamics of these lakes has yet to be achieved. Questions have arisen as to the value of these lakes for such purposes as water reclamation, conservation, and recreational use. The purpose of this study was twofold, 1) to investigate the trophic processes within these lakes with special regard to phosphorus limitation, and 2) to help provide a better understanding of the limnology of these lakes, specifically through the quantification and identification of the invertebrate life and water quality analysis.

The pH in the four lakes in this study averaged above 8.0 over a two year period from January 1994 to December 1995. The surface dissolved oxygen averaged 7.1 mg/L during the same period. Chlorophyll-a averaged 1.1 mg/m^3 during a six month period from April through September 1995. Surface total phosphorus levels averaged 0.012 mg/L (0.39 ug-at L^{-1})over the same six month period, which is not indicative of highly productive systems. While phytoplankton were abundant during the two year period, the populations were dominated by very small forms of chlorophytes and cyanobacteria. The average alkalinity was high (150.4 mg $CaCO_3$/L, 3.0 meq L^{-1}), which is not surprising considering the geochemistry of these lakes. However, alkalinity was poorly correlated with the trophic measures (chlorophyll a, total phosphorus, alkaline phosphatase activity and orthophosphate).

To investigate phosphorus limitation in these lakes, the specific activity of the enzyme alkaline phosphatase, secreted by the phytoplankton, was studied over the course of 6 months and during a 24 hour period. The assumption was, that if these lakes were phosphorus limited, then alkaline phosphatase activity should vary inversely with orthophosphate. Furthermore, chlorophyll-a should be positively correlated with orthophosphate. In the six-month study the latter relationship was found to be significant (Spearman r= 0.69, p= 0.0002, n= 24). Alkaline phosphatase activity and orthophosphate showed a nearly significant, inverse relationship (Spearman r= -0.402, p= 0.051, n= 24). Regression analysis from the diel study also showed a significant inverse relationship between alkaline phosphatase activity and orthophosphate (r= 0-.548, p= 0.033, n= 12). Alkaline phosphatase activity appears to provide a simple means of assaying the degree of phosphate limitation and the trophic state of these lakes.

Acknowledgments

This thesis is dedicated in memorial to my father Milton Max Chase. The support and encouragement of my wife, Sharon, and my mother, Betty, provided the inspiration needed to achieve this goal.

I would also like to thank Dr. Curtis Burney, for all his help, and Dr. Bart Baca for providing the means to develop this thesis.

I. Introduction and Literature Review

A. Background

The formation of many limestone quarry lakes in South Florida has resulted from mining by the building materials industry. Rock mines in Dade County provide about half of the eighty million tons of construction grade rock used by the state of Florida each year. The resulting lakes are usually rectangular in shape and are similar to bathtubs with nearly vertical sides. Mean depths can be 20 m (Hudy and Gregory 1983), which differentiates them from most other Florida lakes, of which only a few have mean depths greater than 8 meters (Beaver and Crisman 1991, Duarte et al. 1992, Bays and Crisman 1983). While natural Florida lakes have received much attention recently, there is still very limited information available on the aquatic biology and trophic dynamics of these subtropical, man-made lakes.

While limestone quarry lakes have existed in South Florida for nearly 50 years, it was not until the mid-1980s that mitigation in the form of littoral fringes has been required to offset the loss of wetland habitats. Several studies of limestone quarries have been conducted over the years (Baca et al. 1992, Beaven and McPhearson 1978, Burkart et al. 1991, Hudy and Gregory 1983, Jackson and Maurrasse 1976, Weinberg et al. 1980), but very few have included data from lakes with mitigated areas (Baca et al. 1992, Hudy and Gregory 1983). In January of 1994, a comprehensive, two-year study of four such lakes in Dade County was undertaken. The Lake Belt Study included a thorough investigation of species diversity and abundance, and water quality, in and around these lakes. The study included surveys of fish, birds, herpetofauna, and mammals, as well as invertebrates (phytoplankton, zooplankton, and macroinvertebrate surveys) and water quality studies. Sampling sites and transect locations were selected based on coordination with Dade County Environmental Resources Management (DERM) and Everglades Research Group, Inc. (contractor for non-lake segment of study).

The study was undertaken to help evaluate a plan proposed by six rock mining companies. The plan is to create a large lake region made by mining the areas between existing limestone quarries in northwest Dade County. "The Lakebelt Plan", as it is called, is hoped to be a public benefit by creating recreational areas, enhancing municipal water supply, water conservation and/or reclamation areas, and production of construction grade rock for many years to come (Larson 1992). It would also impact many acres of wetlands, most of which have already been impacted by the encroachment of exotic species like Melaleuca (*Melaleuca quinquenervia*) and Australian pine (*Casuarina equisetifolia*), as well as by drainage for agricultural and urban development.

B. Review

One concern about these quarry lakes is that they may contribute to contamination of the groundwater and eventually the aquifer itself. Yet in a study conducted in Broward County, Florida, Weinberg et al. (1980) found that urban stormwater runoff entering a lake was not contaminating the ground-water around the lake. They went on to state that these lakes "...have the potential for reducing some of the effects of urbanization on the groundwater flow system.", and they may be a "...source of increased groundwater recharge, counterbalancing the loss of recharge due to increased surface water runoff resulting from urbanization and the creation of impervious surfaces.".

These lakes have excellent potential for recreation. In a study of eleven Dade County quarry lakes, Baca et al. (1992) found that bass may benefit from deep water because it enhances water quality and provides habitat for forage and open-water species . They concluded that they were "good bass lakes". During this study both largemouth bass and the exotic peacock bass were caught easily on rod and reel in the Rinker North, Tarmac and Florida Rock lakes. Panfish (bluegill) were seen nesting in the littoral zone of the Rinker North lake. Fishing may even lead to improvement in catch size as culling leads to a more vigorous population.

Rock pit lakes also provide good potential as water basins, provided water quality can be maintained. This requires the use of management techniques that are aimed at controlling nutrient enhancement in these lakes. Urban, industrial and agricultural inputs must be controlled if these lakes are to remain clean. Burkart et al. (1991) studied a quarry lake in Davie, Florida, and found the average chlorophyll concentration to be 36.1 mg/m^3 . That lake has been receiving effluent from a wastewater treatment plant for many years, which has obviously affected it. That level of chlorophyll may be considered undesirable by the Florida Department of Environmental Protection (Huber and Brezonik 1982), and it is much higher than the average chlorophyll level of 1.1 mg/m^3 found in this study.

The water quality in existing quarry lakes and borrow pits is quite variable, however. It appears likely that most quarry lakes start out with good water quality and are then influenced by local conditions. An example of how good water quality in these lakes can be maintained comes from a study by Jackson and Maurrasse (1976). One lake in that study (Lake Tahoe, Hialeah, Fla.) was found to have better water quality than that coming from the tap water in the houses (the report did not specify if this was municipal or well- water) around the lake. While it may not be practical or possible to attain this high water quality throughout the entire Lake Belt, it does seem probable that better than acceptable levels can be achieved and maintained with proper management.

C. Phosphorus Limitation

Phosphorus limitation may be studied through the analysis of the enzyme alkaline phosphatase, which is secreted by phytoplankton. Several studies concluded that phosphatases may be induced by low orthophosphate levels and then repressed when orthophosphate levels are no longer limiting (Fitzgerald and Nelson 1966, Berman 1970, Smith and Kalff 1981, Siuda and Chrost 1987). In order to compare several lakes, which have differing chlorophyll and phosphorus levels, it is necessary to use the chlorophyll-specific alkaline phosphatase activity (APA). This is expressed as alkaline phosphatase activity in micro moles p-nitrophenylphosphate hydrolyzed per hour divided by milligrams per cubic meter of chlorophyll-a.

During the mining process the organic top soils are removed from the entire site (demucking), which leaves the excavation pit depleted of organic matter needed to support primary production. Mitigation on these lakes involves the construction of shallow littoral zones along certain portions of the lake shore. The mitigated area is covered with a thin layer of the removed organic material (remucking). This encourages the growth of natural aquatic and wetland plants which help form a healthy and productive littoral area.

Phosphorus (P) deficiency in these quarry lakes may result from the removal of the rich top soils from the mining area prior to excavating the pit. However, the limestone substrate of these lakes may represent the major factor in restricting phosphorus levels.

Phosphorus exists in both organic and inorganic forms in the water. Inorganic phosphorus in natural waters is represented by phosphoric acid (H_3PO_4), which has three dissociation products; $H_2PO_4^-$, HPO_4^{-2}, and PO_4^{-3}, collectively called orthophosphate and often symbolized, P_i . It is the inorganic forms, specifically orthophosphate ions, which are biologically important. Phosphate ions are known to co-precipitate with calcite and aragonite in calcium carbonate solution (Griffin and Jurinak 1974, Kitano et al. 1978). These calcium phosphate complexes can then form the mineral apatite which precipitates out of solution making phosphate unavailable to the phytoplankton (Gulbrandsen and Roberson 1973, Griffin and Jurinak 1974, Kitano et al. 1978).

The lakes have a high alkalinity due to the calcium carbonate in solution. Phosphate interactions are also influenced by other factors such as temperature, pH , other ions, and chemical composition. Griffin and Jurinak (1974) demonstrated that higher temperatures will increase phosphate adsorption on calcium carbonate. Ions may increase phosphate adsorption, as in the case of fluoride or inhibit adsorption, as with sodium and magnesium (Kitano et al. 1978). Thus the conditions exist that could restrict the levels of phosphate accumulating in these lakes.

D. Trophic State

A description of the trophic state helps provide a way of monitoring the eutrophication process and can assist in making any management decisions. The primary production and trophic state of these lakes should be viewed as being very important in understanding the ecology of these lacustrine systems. Natural Florida lakes have received quite a bit of attention recently (Agusti et al. 1990, 1992; Bays and Crisman 1983, Beaver and

Crisman 1991, Canfield 1983, Canfield and Hoyer 1992, Duarte et al. 1992, Huber and Brezonik 1982). However, these quarry lakes may or may not fit in with the general patterns associated with other Florida lakes.

Initial studies indicate the P concentrations in the four study lakes were in the oligotrophic/mesotrophic to mesotrophic range based on the Carlson Trophic State Index (Carlson 1977) and were probably phosphorus limited (Hudy and Gregory 1983). Trophic state indexes (TSI) have been used by others to describe Florida lakes (Huber et al. 1982, Canfield and Hoyer 1992). While the index of Huber, which is based on Chlorophyll-a, works well for most Florida lakes, it is also based on shallow, non-stratifying lakes. Thus, the Huber TSI produces greater variation among the sub-indices (chl-a, Secchi depth, and TP) then does the Carlson TSI. The TSI of Forsberg and Ryding (1980), which Canfield and Hoyer (1992) used, produces even greater variation for these lakes.

E. Eutrophication and Productivity

Wetzel (1983) describes eutrophication as "...increased productivity, structural simplification of biotic components, and a reduction in the ability of the metabolism of the organisms to adapt to imposed changes (reduced stability).". Eutrophication is a natural process which occurs as a lake ages. Natural lakes will develop from oligotrophic to eutrophic and eventually become dry land. This process is usually slow and can be measured on a geologic time scale. However, man has altered this process by increasing the drainage areas and nutrient loading. The effect of man-induced eutrophication is to speed up the process. This eutrophication can lead to noxious algae blooms and the replacement of sport fish species with less desirable ones. In this case pollution acts not as an inhibitor of life, but instead causes a massive proliferation of species, some of which are undesirable .

Water quality may also be negatively impacted by eutrophication. However, it should be noted that highly eutrophic waters do not always have poor water quality. Water quality can be more subjective and is influenced by prevailing attitudes and the intended uses for the lake (Carlson 1977). Highly productive lakes can support dense fish populations because of the increased primary production. If the water is to be used for municipal or industrial uses, then increased algae levels can cause problems in terms of increased costs and bad odors or tastes. Usually it is the proliferation of certain nuisance algae (especially Cyanophyceae) that are responsible for what is perceived as poor water quality.

Algae production can be influenced by many factors, but nutrition, because of its potential for human control, is the focus of most management efforts. While the physical factors of light, temperature, circulation, and stratification are very important, they are usually outside our control. The macronutrients (nitrogen, phosphorus, and potassium) and the micronutrients (iron, magnesium, manganese, copper, zinc, sodium, molybdenum, vanadium, boron, chlorine, cobalt, silicon, calcium, thiamine, vitamin B-12, and so on) are all constituents of algae nutrition (Jackson and Maurrasse 1976). A surplus or deficit of any of these factors can influence algae production. Although oligotrophic fresh waters are usually considered phosphorus limiting, algae nutrition is not simply based on the levels of nitrogen and phosphorus available, but rather by a complex set of interacting factors.

Another factor which can affect production in lakes is turbidity. The mining process produces large amounts of fine particulate material, much of which ends up in the lakes. With the trophic state index it is possible to make some simple deductions about a lake based on differences in the TSI values. For instance, if the TSI based on Secchi depth is greater than the TSI based on chlorophyll-a, then this indicates non-algal turbidity. This is certainly the case in these rock pit lakes. The turbidity produced by the fine calcium carbonate material may increase shading and thus limit production. The particulates also provide a substrate for phosphate adsorption and removal.

F. Purpose

This paper contains an overview of some of the basic limnological features of four study lakes. Macroinvertebrate, zooplankton, and phytoplankton composition are described as well as basic water quality data. However, emphasis is on describing the trophic state of theses lakes by analyzing phosphorus as a limiting nutrient and evaluating its relation to other water and biological parameters. Based on collected data, these lakes appear to be phosphorus limited, which has been reported in other studies (Hudy and Gregory 1983, Beaven and McPherson 1977).

Eutrophication, caused by increased nutrient loading, can be a problem in fresh waters. The value of a lake may be considered in terms of its suitability for municipal, industrial, and recreational purposes, as well as the aesthetic quality and desired habitats. Information about the nutritional status is essential in developing a management plan for the system in question. This paper provides data about the degree of phosphorus limitation in four limestone quarry lakes, which may assist in making decisions about how various levels of nutrient loading may affect these lakes.

II. Materials and Methods

A. Lake Descriptions

Four limestone quarry lakes in Dade County were studied over a two-year period, as part of a larger study, by Nova Southeastern University. The lakes vary in size, age, depth, and amount of littoral area (Figures 1 and 2, Table 1), and are generally rectangular in shape. Florida Rock Lake, which was still being mined, did not have the same rectangular shape (Figure 2). Rinker North Lake, has a rounded indention in the northeast corner which is the result of a large tailing outflow (Figure 2). Although the littoral fringes are an important aspect of these lakes, no attempt was made to correlate amount or quality of littoral area with the water quality data. The littoral areas represent a small percentage of the total lake volume and probably have a small effect on overall water quality. Surface and groundwater inputs probably influence water quality more than the littoral fringes.

B. Water Analysis

1. Overview

Water quality measurements during the two-year Lake Belt study included temperature, pH, dissolved oxygen, turbidity, and total phosphorus. The six-month phosphorus limitation study began in April 1995 and ended in September 1995 which coincided with the summer stratification cycle. Orthophosphate (P_i), alkaline phosphatase activity (APA), alkalinity, and chlorophyll-a measurements were taken monthly starting April 1995 and ending September 1995. Depth profiles of dissolved oxygen were done in the lakes over a year period between September 1994 and September 1995. Also, a diel study with two-hour sampling intervals was performed in June 1995 at the Rinker North Lake. The measurements, methods, and sampling schedule are shown in Table 2.

Water samples for nutrient and mineral analysis were collected from 0.5m below the surface of each lake in acid-washed Nalgene bottles and transported on ice to the laboratory. Laboratory analysis followed APHA Standard Methods (1985), Kuenzler and Perras (1965), Parsons et al. (1984), and Murphy and Riley (1962). The methods used for each measurement are summarized in Table 2.

2. Analytical Equipment

pH was measured in the field using a Cole-Parmer pH meter that was calibrated on site using standard buffers. Dissolved oxygen and temperature were measured with a YSI Model 51A oxygen meter which was air calibrated on site. A Secchi disk was used to determine turbidity. Total P, APA and P_i were measured on a Bausch and Lomb Spectronic 88. Chlorophyll-a was measured by the fluorometric method (Parsons et al. 1984) on a Turner Model 110 fluorometer.

3. APA

The alkaline phosphatase activity follows the method of Kuenzler and Perras (1965). However, because whole unfiltered lake water was used, the ratios of the constituents in the solution were changed. The ratio of 1:1:2:6 (sample:nitrophenyl phosphate:tris:deionized water) was found to produce easily detectable measures. The solution was incubated in the dark at room temperature and measured every hour for six hours.

Figure 1. Map showing location of Dade County and expanded view showing study area.

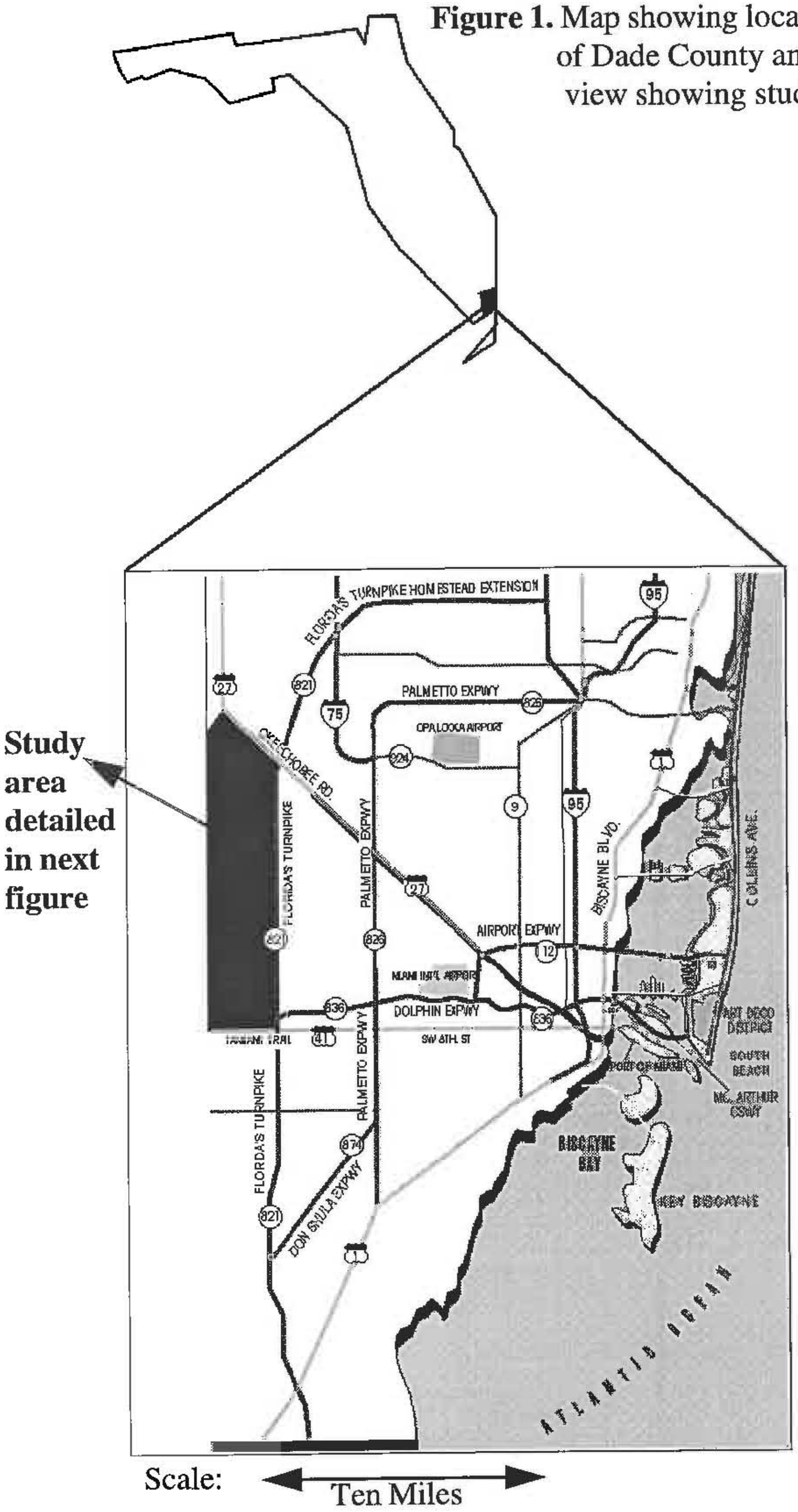


Figure 2. Map showing location of study lakes. Key: RN=Rinker North Lake, TL=Tarmac Lake, FL=Florida Rock Lake, RS=Rinker South Lake. Scale: 1 inch = 1.3 miles.

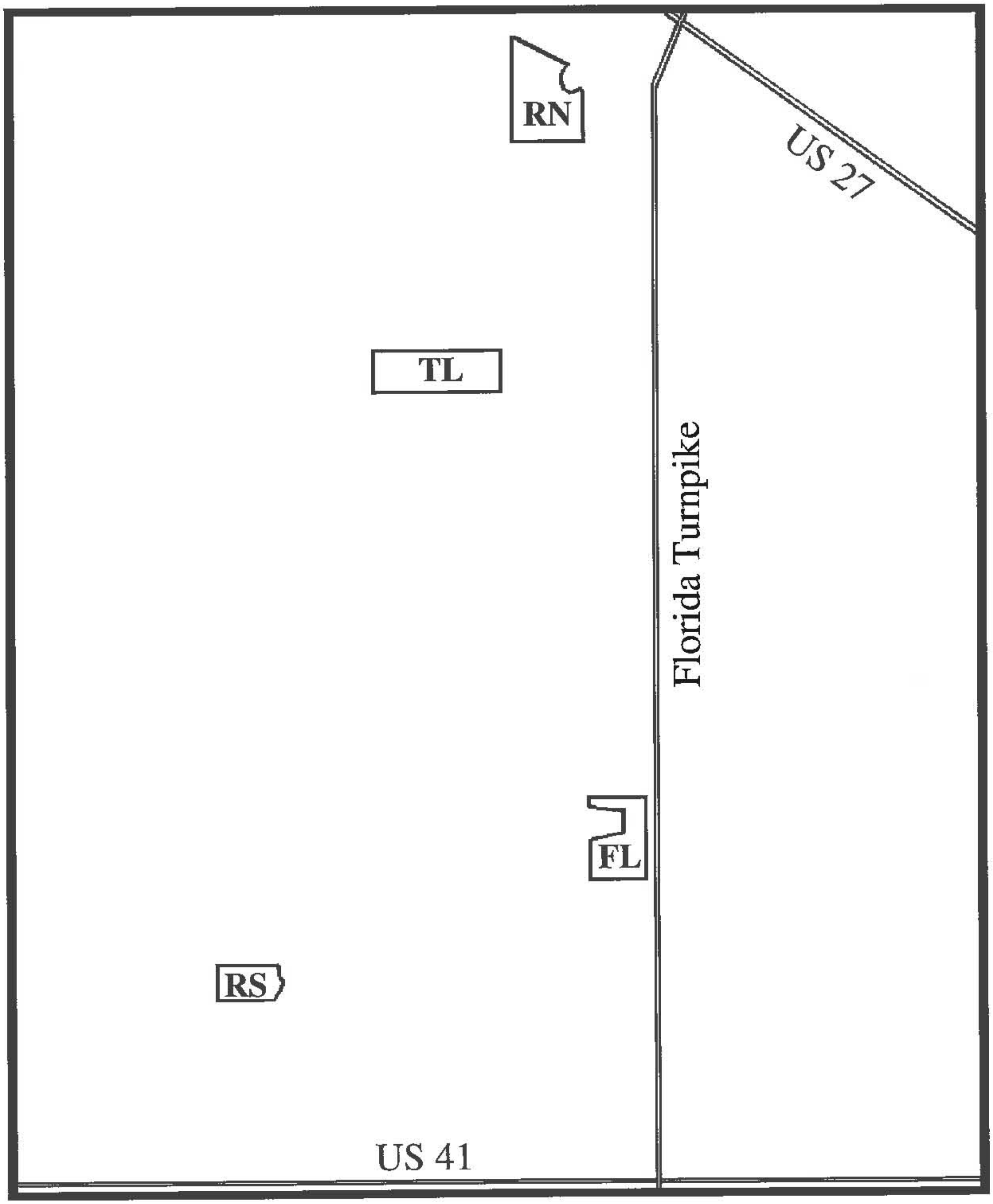


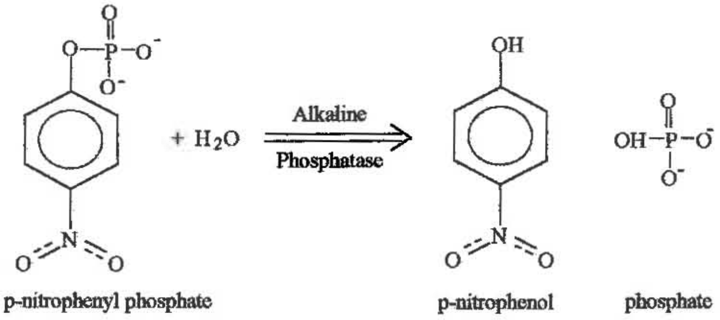
Table 1. Lake Descriptions

Name	Size (Acres)	Age (Years)	Max. Depth (ft.)
Rinker North	222	24	54
Tarmac	178	16	64
Rinker South	72.5	21	48
Florida Rock	122	20	56

Table 2. Summary of sampling activities and methods. Standard methods are used unless otherwise indicated.

	January 1994- December 1995	
Study Component	Methods	Schedule
Invertebrate Survey	Dip Nets (U.S. EPA 1989)	1/Month x 24
Zooplankton Survey	Plankton Net	4/year x 2
Phytoplankton Survey	Bottle Sampler	4/year x 2
Water Quality		
Total Phosphorus	Persulfate digestion/Molybdenum blue	1/month x 24
Dissolved oxygen	YSI meter	1/month x 24
pH	Cole-Parmer pH meter	1/month x 24
Temperature (^{0}C)	YSI meter	1/month x 24
Turbidity (m)	Secchi disc	1/month x 24
	April 1995 - September 1995	
Orthophosphate	Molybdenum blue	1/month x 6
Alkaline phosphatase act.	ρ-nitrophenylphosphate	1/month x 6
Alkalinity	Titration method	1/month x 6
Chlorophyll *a*	Fluorometric	1/month x 6
Diel Study	June 27, 1995	
Total Phosphorus	Persulfate digestion/Molybdenum blue	12 x / 24 hrs
Orthophosphate	Molybdenum blue	12 x / 24 hrs
Alkaline phosphatase act.	ρ-nitrophenylphosphate	12 x / 24 hrs
Alkalinity	Titration method	12 x / 24 hrs
Chlorophyll *a*	Fluorometric	12 x / 24 hrs

Algae in the water sample are provided a phosphorus-rich substrate in the form of p-nitrophenyl phosphate. In order to utilize the phosphate the algae must cleave it from the p-nitrophenyl molecule. This is accomplished by the algae through hydrolysis with the enzyme alkaline phosphatase. A model of the basic reaction is shown below.



The resulting p-nitrophenol produces a greenish-yellow color which can then be measured at 410 nM on the spectrophotometer.

C. Diel Study

The diel study took place after summer stratification had begun and was started on June 27, 1995 at the Rinker North lake. During this 24 hour period water samples were taken from the lake every 2 hours. The samples were kept in a refrigerator at a field office and then transported on ice to the laboratory. Chlorophyll-a samples were filtered at the field office and the filters were put in darkened vials containing acetone. Analyses included chlorophyll-a, alkalinity, total phosphorus, orthophosphate and alkaline phosphatase activity.

D. Phytoplankton

Phytoplankton samples were collected quarterly in one selected lake, based on the contract requirements for the Lake Belt Study. Only three of the lakes were sampled for phytoplankton. Samples were collected by subsurface casts and were preserved with 0.5%

Lugol's solution in darkened glass bottles. Phytoplankton were identified to genus and counted in a hemacytometer at 400x magnification using appropriate keys (Prescott 1962, 1970; Smith 1950).

E. Zooplankton

Zooplankton were collected quarterly from one selected lake according to the contract requirements for the Lake Belt Study. Three of the lakes were sampled for phytoplankton. A Wisconsin style net (WildCo., Saginaw, Mich.) which has a 12.7 cm mouth, 22.9 cm throat and 80 micron mesh, was used. Stationary, vertical tows were made from two locations within the lake. After hauling the net up at a rate of approximately 0.5m/sec, the contents were washed into a bucket with distilled water, and the contents of the bucket were washed into a vial where the sample was preserved with 70% ethanol. Organisms were identified using guides such as Pennak (1989), Needham and Needham (1962), and Pratt (1935) and counted using a Sedgewick-Rafter Counting Cell. Individuals per unit volume were calculated from the total volume sampled (distance traveled times net mouth diameter).

F. Macroinvertebrates

Macroinvertebrates were collected monthly at a selected lake (each lake was sampled), using hand nets and manual methods, based on EPA guidelines (1989). A section of the littoral area of the lake was sampled until approximately 100 macroinvertebrates were collected. These samples were fixed in 10% formalin and then transferred to 70% ethanol. Organisms were be identified to a minimum of genus level with the use of various guides, including Borror and White (1970), Brigham, Brigham and Gnilka (1982), Dunkle (1989), Levi, Levi and Zim (1968), Needham and Needham (1962), Paulson (1966), Pennak (1989) and Pratt (1935). Data was reported as number of species, total organisms and Shannon species diversity.

G. Statistical Analysis

The data were organized and analyzed using the computer programs Quattro Pro, Harvard Graphics, and Statistica. Pearson Product-Moment correlation matrices for the six-month and diel study data were calculated with Quattro Pro. Graphs were created using Quattro Pro and Harvard Graphics. The six-month data from each lake were combined into one data set (n=24) and reanalyzed using Quattro Pro to produce a correlation matrix. This data were checked for normality using the program Statistica to perform the Shapiro-Wilk W test. Both chlorophyll-a and alkaline phosphatase activity failed the test, which means they were not normally distributed. The data set was then subjected to non-parametric testing using Spearman Rank Correlation, in order to check the validity of the relationships between each variable.

III. Results

A. General

Results of the basic water quality measurements including, temperature, dissolved oxygen, pH, total phosphorus and Secchi depth are shown in Table 3. Levels were often consistent between lakes (discussed later). Tables 4 and 5 shows the ranking and mean for each lake for the six main variables. Results of the six-month water quality measurements in the four lakes are shown in Figures 3 - 6, and the correlation matrices for all variables in each lake are shown in Table 6.

B. Six-Month Study

1. Rinker North

From April through September 1995, the Rinker North Lake (Figure 3) had the second highest mean total phosphorus (0.013 mg/l), orthophosphate (0.007 mg/l) and chlorophyll-a (1.30 mg/m^3), yet this lake had the shallowest Secchi depth (Table 4 and 5). Orthophosphate appeared only weakly inversely related (r= -0.668, p= 0.074) to APA in the six month data (Table 6).

2. Tarmac Lake

The Tarmac Lake (Figure 4) was the deepest and had the second lowest mean total phosphorus (0.011 mg/l), orthophosphate (0.004 mg/l) and chlorophyll-a (0.949 mg/m^3), but had the deepest Secchi depth by far (Table 4 and 5). Orthophosphate had a significant (r= -0.829, p= 0.021) inverse relationship with APA. Total phosphorus and orthophosphate were directly related to chlorophyll-a (r= 0.816, p= 0.024 and r= 0.707, p= 0.058 respectively) (Table 6).

Table 3. Two year water quality measurements. Averages are given for Feb. 1994 - Dec. 1995.

	Rinker North	Tarmac	Rinker South	Florida Rock	Lake Means
Temp. (°C)	26.8	27.2	26.9	26.7	26.9
DO (mg/L)	7.1	6.8	7.2	7.3	7.1
pH	8.1	8.13	8.26	8.12	8.15
TP (mg/L)	.015	.010	.013	.010	.012
Secchi depth (m)	1.01	2.42	1.40	1.35	1.55

Table 4. Lake ranking for each variable mean in the six-month study (Apr. 1995-Sep. 1995), from highest (1) to lowest (4) (deepest or clearest to shallowest for Secchi depth).

	Chl. a	Secchi depth	Total Phos.	Orthoph-osphate	APA	Alkalinity
Rinker North	2	4	2	2	3	2
Tarmac	3	1	3	3	1	1
Rinker South	1	3	1	1	4	3
Florida Rock	4	2	4	4	2	4

Table 5. Mean values for each variable in each lake, Apr. 1995-Sep. 1995. Standard deviation is in parenthesis.

	Rinker North	Tarmac	Rinker South	Florida Rock
Secchi Depth (m)	1.03 (0.14)	2.13 (0.37)	1.44 (0.42)	1.53 (0.51)
Alkalinity (mgCaCO3/L)	151.822 (4.989)	176.962 (20.662)	149.219 (15.692)	123.692 (6.130)
Total Phos. (mg/L)	0.013 (0.005)	0.011 (0.004)	0.014 (0.007)	0.010 (.003)
Orthophos. (mg/L)	0.007 (0.002)	0.004 (0.001)	0.008 (0.001)	0.003 (0.001)
Chl.-a (mg/m3)	1.294 (0.825)	0.949 (0.695)	1.875 (1.784)	0.263 (0.121)
APA (uM/hr/mgChl.a)	0.065 (0.087)	0.148 (0.165)	0.051 (0.024)	0.089 (0.087)

Figure 3. Six-month (Apr.-Sep.1995) data from Rinker North Lake. n = 6. Error bars represent standard error of the mean.

Rinker North Lake

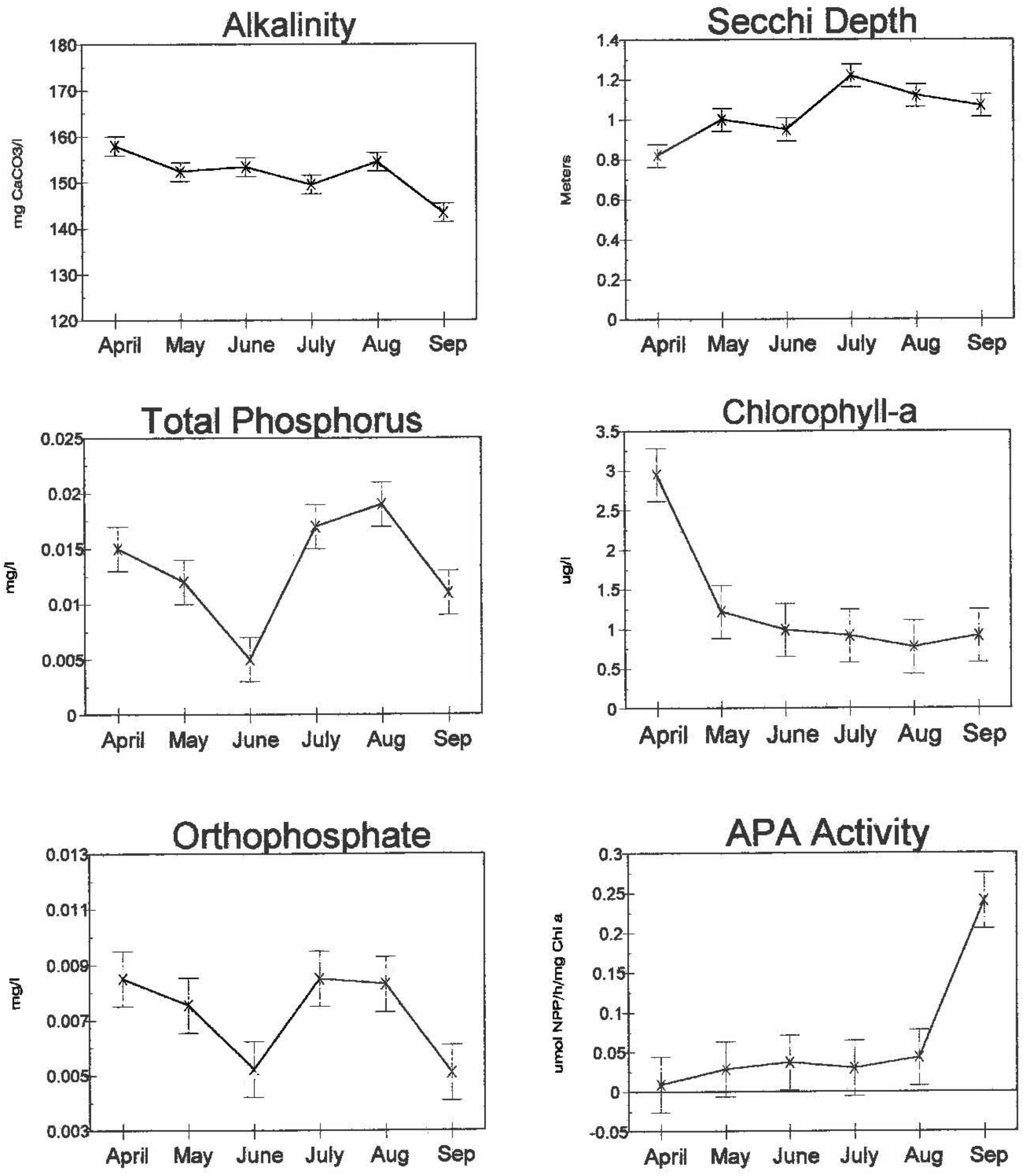


Figure 4. Six-month (Apr.-Sep. 1995) data from Tarmac Lake. n = 6. Error bars represent standard error of the mean.

Tarmac Lake

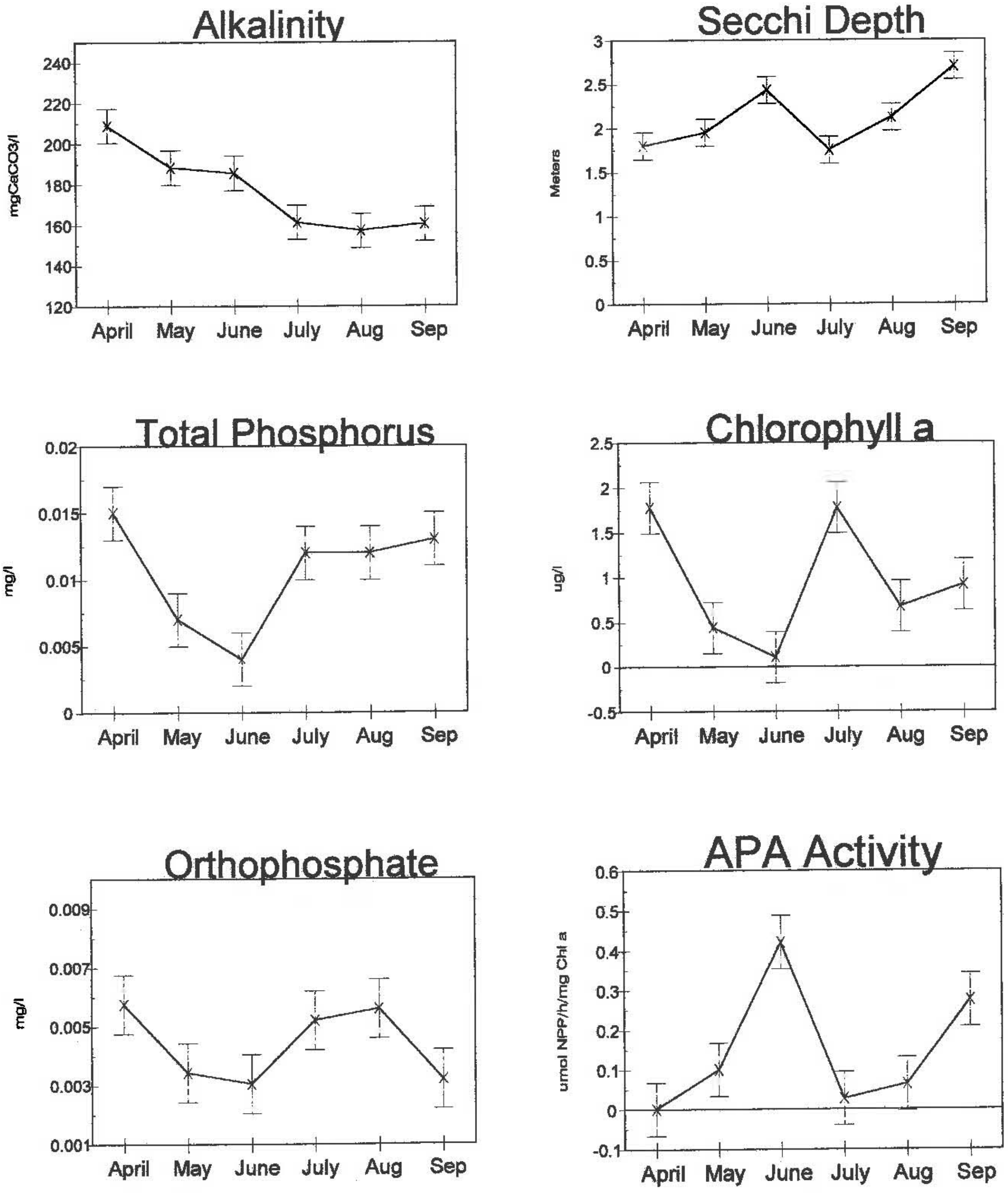


Figure 5. Six-month (Apr.-Sep 1995) data from Rinker South Lake. n = 6. Error bars represent standard error of the mean.

Rinker South Lake

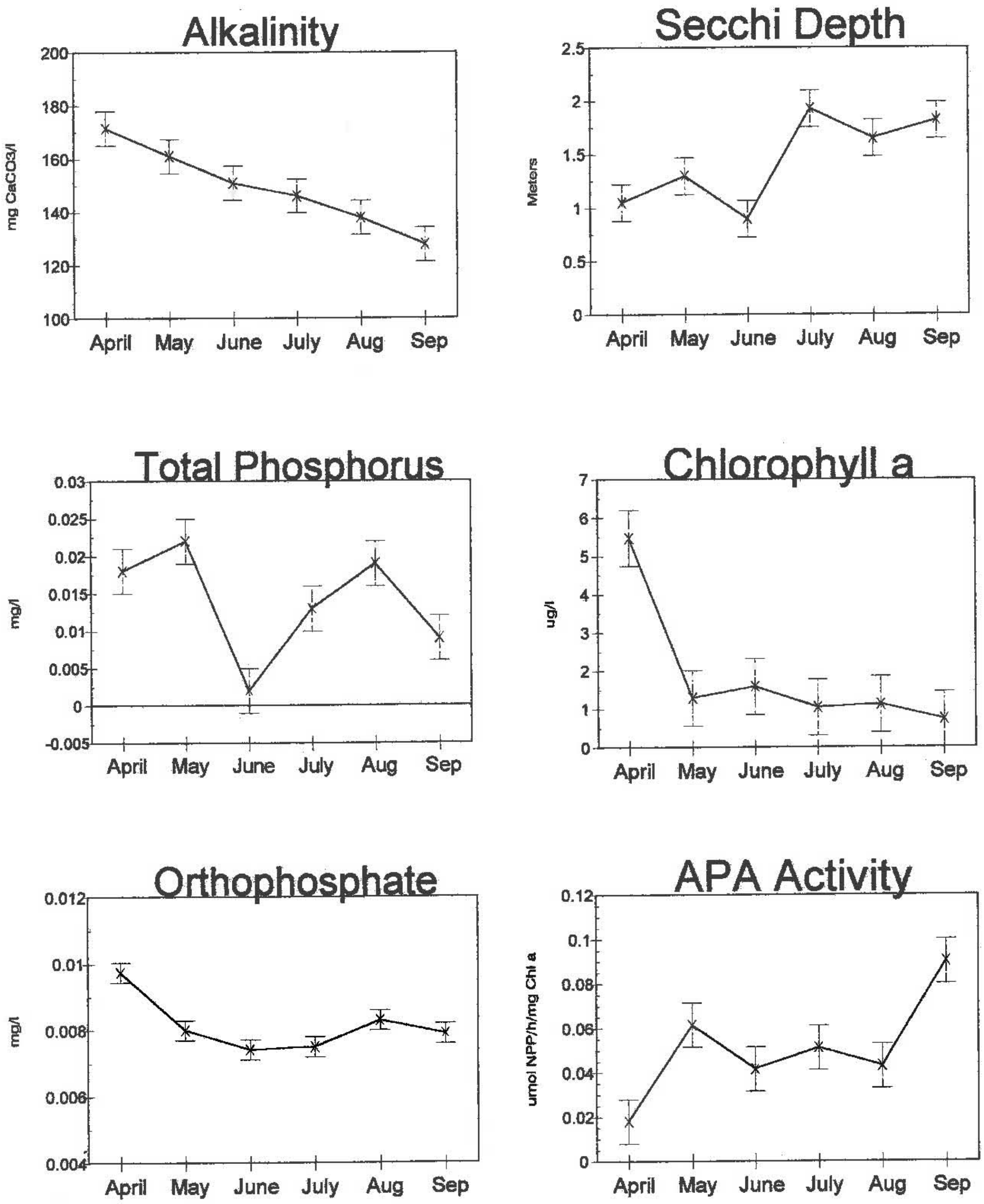


Figure 6. Six-month (Apr.-Sep. 1995) data from Florida Rock Lake. n = 6. Error bars represent standard error of the mean.

Florida Rock Lake

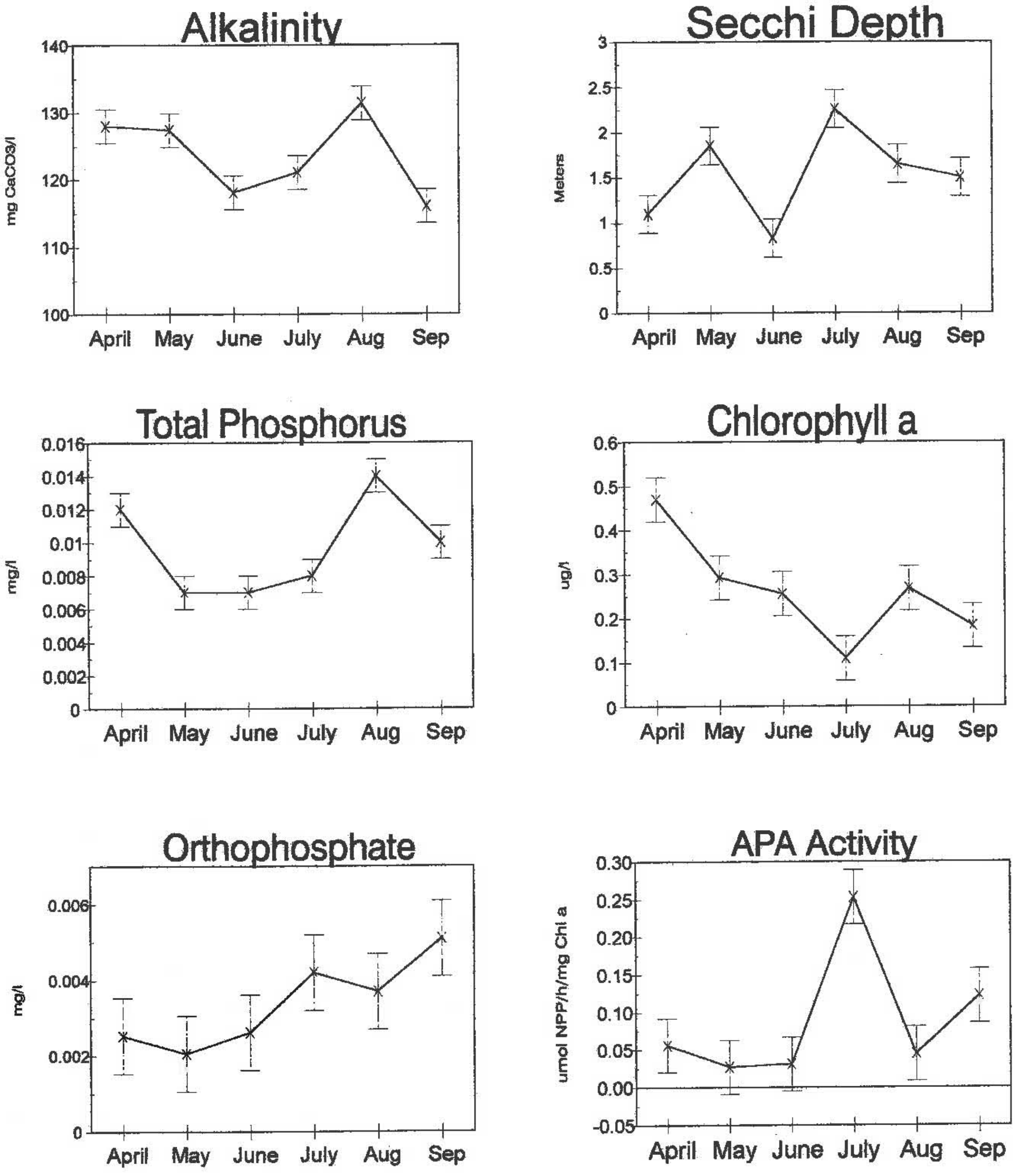


Table 6. Correlation matrices of six-month data for each lake.
(n = 6)
*For p=0.05 minimum r=0.729
**For p=0.01 minimum r=0.882

Rinker North

	SD	Alk	TP	PO4	Chl a	APA
Secchi Depth (SD)	1.000					
Alkalinity (ALK)	-0.565	1.000				
Total Phosphorus (TP)	0.422	0.183	1.000			
Orthophosphate (PO4)	0.121	0.566	0.845*	1.000		
Chlorophyll-a (Chl a)	-0.792*	0.600	0.095	0.370	1.000	
Alkaline phosphatase (APA)	0.222	-0.863*	-0.217	-0.668	-0.344	1.000

Tarmac

	SD	Alk	TP	PO4	Chl a	APA
Secchi Depth	1.000					
Alkalinity	-0.344	1.000				
Total Phosphorus	-0.254	-0.108	1.000			
Orthophosphate	-0.704	0.034	0.694	1.000		
Chlorophyll-a	-0.588	0.093	0.816*	0.707	1.000	
Alkaline phosphatase	0.836*	-0.086	-0.661	-0.829*	-0.711	1.000

Rinker South

	SD	Alk	TP	PO4	Chl a	APA
Secchi Depth	1.000					
Alkalinity	-0.702	1.000				
Total Phosphorus	0.157	0.372	1.000			
Orthophosphate	-0.324	0.571	0.530	1.000		
Chlorophyll-a	-0.576	0.773*	0.241	0.888**	1.000	
Alkaline phosphatase	0.587	-0.729*	-0.193	-0.570	-0.751	1.000

Florida Rock

	SD	Alk	TP	PO4	Chl a	APA
Secchi Depth	1.000					
Alkalinity	0.158	1.000				
Total Phosphorus	-0.094	0.571	1.000			
Orthophosphate	0.354	-0.479	0.248	1.000		
Chlorophyll-a	-0.587	0.560	0.385	-0.668	1.000	
Alkaline Phosphatase	0.659	-0.399	-0.167	0.652	-0.684	1.000

3. Rinker South

The Rinker South Lake (Figure 5) had the highest mean total phosphorus (0.014 mg/l), orthophosphate 0(.008 mg/l) and chlorophyll-a (1.875 mg/m^3). This lake also had the lowest overall APA level. There was a very significant ($r= 0.888$, $p= 0.009$) direct relationship between orthophosphate and chlorophyll-a, but the inverse relation of orthophosphate to APA was nonsignificant ($r= -0.570$, $p= 0.119$).

4. Florida Rock

The Florida Rock Lake (Figure 6) had the lowest mean total phosphorus (0.01 mg/l), orthophosphate (0.003 mg/l) and chlorophyll-a (0.263 mg/m^3). Again, these measurements do not coincide with Secchi depth which was only the second deepest. No other significant relationships in chemical or biological data were apparent in the analysis from this lake.

5. Summary of Six-Month Study Results

The results for the six-month data were mixed, but strong correlations between phosphorus or phosphate, and the alkaline phosphatase activity, or chlorophyll-a, were apparent in at least two lakes. The Carlson Trophic State indexes for each lake are shown in Table 7. It should be noted that the lake with the shallowest Secchi depth does not correspond with the lake having the highest chlorophyll-a and vice versa (Table 4). Table 8 gives the criteria of the Carlson trophic state index based on Secchi depth, total phosphorus and chlorophyll-a. Because of turbidity caused by all the calcium carbonate material, Secchi depth was a poor indicator of chlorophyll-a and trophic status.

C. Analysis of Combined Data

Because of the small data set for the individual lakes, the six-month data were

Table 7. Carlson Trophic State Index values associated with each component in the study lakes. Huber and Brezonik values are in parenthesis.

Lake	Secchi Depth	Total Phosphorus	Chl. a
Rinker North	60 (59)	41 (37)	33 (21)
Tarmac	49 (37)	37 (30)	30 (16)
Rinker South	55 (49)	42 (38)	37 (26)
Florida Rock	54 (47)	37 (30)	17 (-2.4)

Table 8. Carlson Trophic State Index table (1977).

TSI	Secchi Depth (m)	Total Phosphorus (mg/m^3)	Chl. a (mg/m^3)
0	64	0.75	0.04
10	32	1.5	0.12
20 oligotrophic	16	3	0.34
30	8	6	0.94
40 mesotrophic	4	12	2.6
50	2	24	6.4
60 eutrophic	1	48	20
70	0.5	96	56
80	0.25	192	154
90	0.12	384	427
100	0.062	768	1183

combined (n= 24). Figures 7 and 8 show the relationships of orthophosphate to APA and Chl.-a, respectively, for the combined six-month data from all lakes. Table 9 shows the correlation matrix (Pearson Product Moment) for the combined data. This combined data set shows significant relationships between orthophosphate and chlorophyll-a (direct r= 0.622, p= 0.0006), and between orthophosphate and APA (inverse r= -0.418, p= 0.021).

Non-parametric analysis of the combined data using Spearman Rank Order Correlations again showed a significant direct relationship between orthophosphate and chlorophyll-a (Spearman r= 0.69, p= 0.0002, n= 24), and a nearly significant inverse relationship between orthophosphate and APA (Spearman r= -0.402, p= 0.051, n= 24). The other apparent relationships in the combined data were not significant.

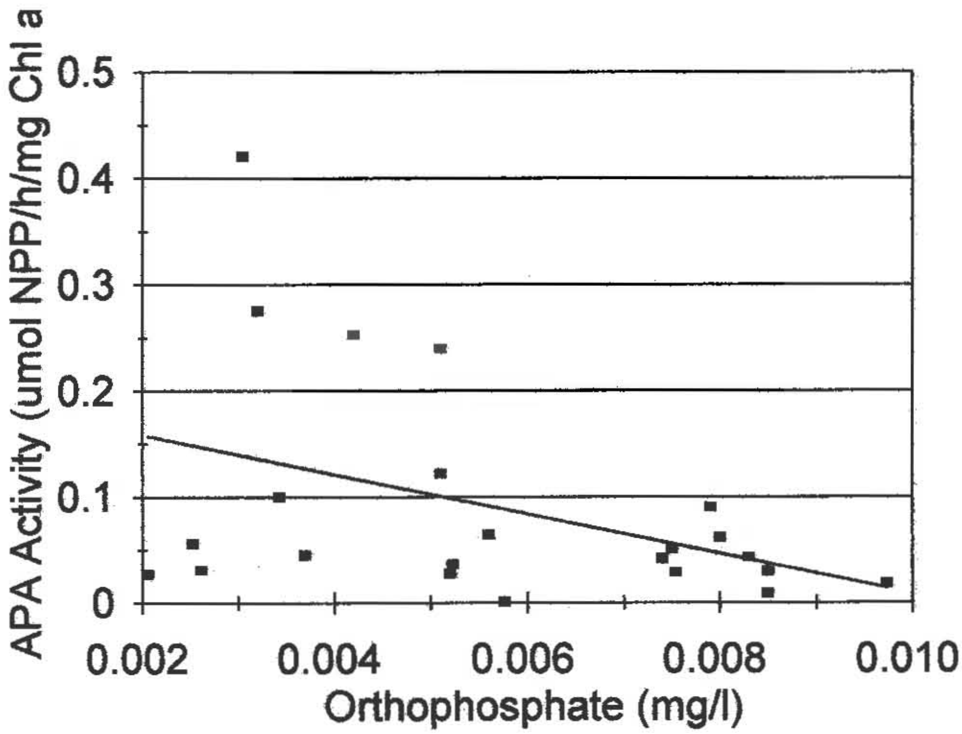
D. Diel Study Results

The diel study was performed on June 27, 1995 at the Rinker North lake (Figure 10). The correlation matrix (Pearson Product Moment) for the data is shown in Table 10. There was a significant inverse relationship (r= -0.548, p= 0.033) between APA and orthophosphate. Alkalinity did not correlate well with the other variables in the diel or the six-month study.

E. Dissolved Oxygen

Dissolved oxygen data are presented in Table 11. The average surface dissolved oxygen measure was 7.1 mg/L for the entire study (Table 3). During winter the lakes circulated freely and dissolved oxygen remained high through the entire water column. In summer the lakes stratified and a nearly anoxic layer formed near the bottom.

Figure 7. Scatter plot of APA vs PO_4, for combined data, with regression line.



Spearman r = -0.402 , p = 0 .051, n = 24

Figure 8. Scatter plot of Chl. a vs PO_4, for combined data, with regression line.

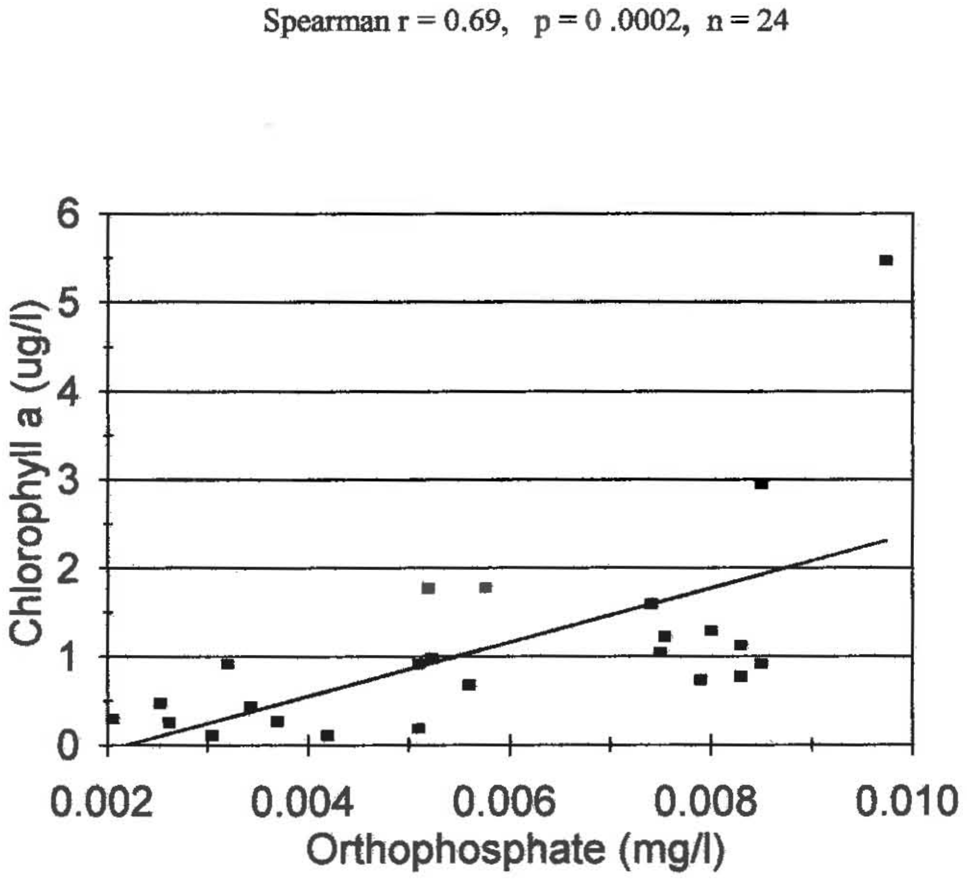


Table 9. Correlation matrix of the combined six month data for all four lakes.
(n = 24)
*for p=0.05 minimum r=0.344
**for p=0.01 minimum r=0.472

Combined Six Month Data

	SD	Alk	TP	PO4	CHL	APA
Secchi Depth (SD)	1.000					
Alkalinity (Alk)	0.192	1.000				
Total Phosphorus (TP)	-0.135	0.139	1.000			
Orthophosphate (PO4)	-0.404*	0.167	0.570**	1.000		
Chlorophyll-a (CHL)	-0.361*	0.389*	0.397*	0.622**	1.000	
Alkaline Phosphatase (APA)	0.586**	0.067	-0.347*	-0.418*	-0.362	1.000

Figure 9. Data for the diel study, June 27, 1995, at Rinker North Lake; n = 12. Error bars represent standard error of the mean.

Diel Study-Rinker North

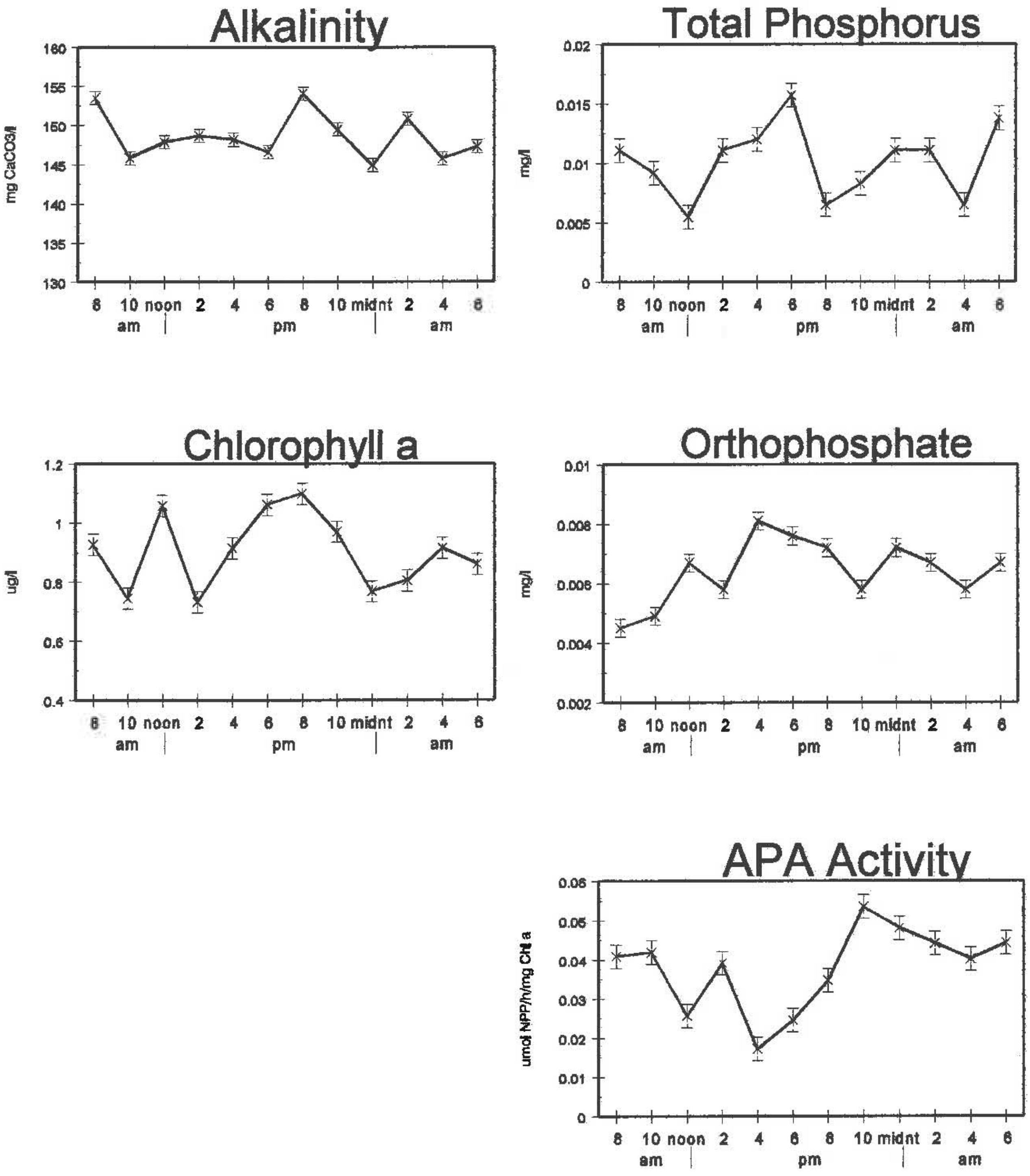


Table 10. Correlation matrix for the diel study at Rinker North lake.
(n = 12)
*for p=0.05 minimum r=0.497
**for p=0.01 minimum r=0.658

Rinker North Diel Study

	Alk	TP	PO4	Chl a	APA
Alkalinity (Alk)	**1.000**				
Total Phosphorus (TP)	**-0.184**	**1.000**			
Orthophosphate (PO4)	**-0.159**	**0.274**	**1.000**		
Chlorophyll a (Chl a)	**0.373**	**-0.248**	**0.341**	**1.000**	
Alkaline Phosphatase (APA)	**0.016**	**-0.117**	**-0.548***	**-0.466**	**1.000**

Table 11. Dissolved oxygen data (single measures) , September 1994 through September 1995.
* S = Stratified M = Mixed.

Dissolved Oxygen

Location	Date	Surface mg/L	Bottom mg/L	S/M *
Rinker North	9/11/94	6.2	1.8	S
Rinker North	12/28/94	8.8	9	M
Rinker North	2/13/95	8.7	10.4	M
Rinker South	2/13/95	8.9	10.7	M
Tarmac	4/12/95	8.1	10.5	M
Florida Rock	4/12/95	8.6	10.2	M
Florida Rock	7/14/95	7.7	0.3	S
Tarmac	9/14/95	8.2	0.5	S

F. Phytoplankton

The relative abundance of major phytoplankton groups is shown in Figure 10. Plankton samples were taken from only three lakes. Phytoplankton in the Tarmac and Rinker South lakes were about 50% Cyanophyta and 50% Chlorophyta. The Rinker North lake was 27% Cyanophyta and 72% Chlorophyta. Most of the phytoplankton were small forms with only a few of the larger filamentous algae. Diatoms were scarce and together with all other rare algae groups compromised only 1% or less of the total. During the entire two year period there were no noxious algae blooms or bad odors noted in the lakes.

G. Macroinvertebrates

Macroinvertebrate samples were taking from the littoral areas of all lakes, although the majority of samples were taken from the Rinker North location. Table 12 shows the Shannon diversity indices for the lakes. Both the Rinker North and Rinker South lakes were within the range of 2.79 to 3.08, which was similar to that reported by Rader (1994) in a study of the Everglades using similar methods. The remaining two lakes had slightly lower diversity index values. Crustacea and gastropods were the dominant groups. Of these, the shrimp *Palaemonetes paludosus* and the snail *Physella* sp. were most abundant. Numerous apple snails (*Pomacea paludosa*) were found at the Rinker North and Florida Rock lakes. Many types of aquatic insects and insect larvae were also found.

A total of 65 species of invertebrates was identified.

H. Zooplankton

Zooplankton at the Rinker North Lake were dominated by copepods from the families Cyclopidae and Diaptomidae. In the Tarmac Lake these copepods were also common, but the small cladoceran *Bosmina* sp. was the most abundant organism. A few other rotifers, cladocerans and ostracods were also found at the three sampled lakes. The one sampling event at the Rinker South Lake revealed a composition similar to the Rinker North Lake; however this was overshadowed by a large bloom of the dinoflagellate *Ceratium hirundinella.*

Figure 10. Graphical display of phytoplankton abundance.

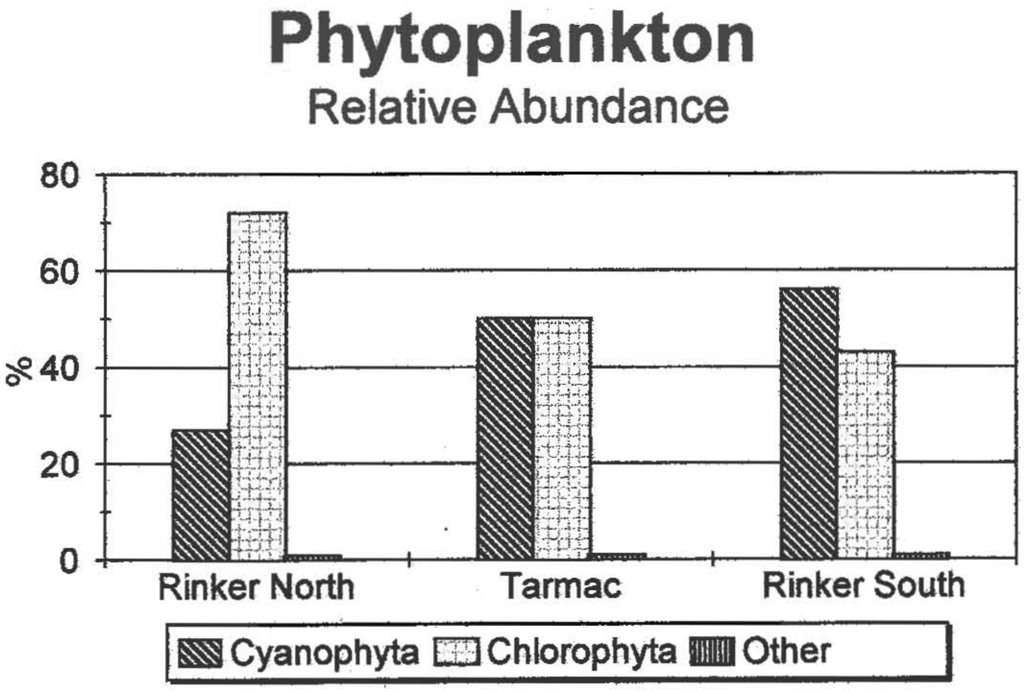


Table 12. Macroinvertebrate Shannon Index per lake.

	Number of Times Sampled	Mean S-W Index	Evenness
Rinker North	14	2.8	0.46
Tarmac	5	2.63	0.53
Rinker South	1	2.97	0.76
Florida rock	2	2.41	0.56

IV. Discussion

A. Rinker North Lake

Phosphorus limitation, indicated by the direct relationships between PO_4^{-3} and chlorophyll-a, and by the inverse relationship of APA and PO_4^{-3}, was not obvious in the Rinker North Lake from the six month study data, but such evidence was apparent in the diel study, when there was an inverse relationship between APA and orthophosphate (Figure 9 and Table 10). The fluctuations seen in the diel study were similar in magnitude to those in the six-month study. The inverse APA vs PO_4^{-3} and direct PO_4^{-3} vs chl.-a patterns in the six-month study may have been an echo of the diel relationships or they may represent actual seasonal changes. Correlations from the diel study imply that fluctuations in phosphate limitation take place over periods of hours. This suggests that the phytoplankton exert tight physiological control over APA and respond rapidly to changes in phosphate availability.

Inputs of particulate material from large tailing mounds located on the east side of the lake probably contributed to the shallow Secchi depth. Based on the TSI for chlorophyll-a this lake was near the mesotrophic range (Table 7).

B. Tarmac Lake

In the Tarmac Lake, indications of phosphorus limitation were seen in terms of the significant direct relationship of Chl.-a with TP and the inverse association of APA and PO_4. There was a large increase in Chl.-a and a drop in APA which corresponded to increases in TP and PO_4^{-3} between June and July. (Figure 4). While this lake was the clearest in the study group, the alkalinity was highest, which suggests that alkalinity was not primarily influenced by the amount of suspended particulate material. The TSI of 30 for chlorophyll-a is in the oligo-mesotrophic range. It is not known if the brown-colored water in this lake had an effect on the productivity.

C. Rinker South Lake

Chlorophyll-a and orthophosphate were closely related in the Rinker South Lake, which is an indication of phosphorus limitation (Table 6). Rinker South, which was the smallest and shallowest, probably has portions which are not stratified in summer. This may help to increase the phosphate levels by keeping more nutrients in circulation.

D. Florida Rock Lake

The Florida Rock Lake studies did not demonstrate any significant relationship in the biological/chemical parameters. This is not surprising since the Florida Rock Lake was still being actively mined and was therefore a highly disturbed system. According to the TSI for chlorophyll-a, this lake would be in the oligotrophic range.

E. Effect of Alkalinity

Alkalinity did not correlate well with either phosphate or total phosphorus. While this was unexpected it does not rule out the possibility that calcium carbonate may restrict the amount of usable phosphorus. Even the clearest lake (Tarmac) was still being disturbed by mining activity and tailing inputs. Orthophosphate levels appeared to fluctuate less than total phosphorus which may be an indication of biological controls exerted by the phytoplankton.

F. Dissolved Oxygen and Stratification

In spite of the high turbidity, these lakes maintained good dissolved oxygen in the upper layer of the lakes (Table 11) throughout the study. Low points in dissolved oxygen corresponded to periods where the thermocline probably broke down and mixing with the lower anoxic layer occurred. These lakes exhibit a warm monomictic (i.e., stratified in summer) pattern which has been reported in other deep Florida lakes (Beaver and Crisman 1991). Destratification occurs as winter approaches and the surface temperatures of the lakes cool and begin to sink. The mixing process is increased by winds until the thermocline breaks down completely and winter turnover occurs. As summer approaches the surface is heated faster than the heat can be removed by mixing and the water becomes less dense and more resistant to mixing which initiates summer stratification.

Depth profiles of dissolved oxygen revealed that mixing occurred for a period of at least 5 months during winter and spring. The profiles showed that a nearly anoxic layer formed along the bottom of the lakes in the summer. During winter and spring dissolved oxygen values remained high all the way to the bottom of the lakes. This is important because it enables nutrients from bottom sediments and water to be recirculated to the top layers. During the period of circulation the dissolved oxygen values were near the air saturation point throughout the entire water column, suggesting rather low rates of microbial oxygen consumption.

G. Plankton and Invertebrates

Phytoplankton structure and composition in these lakes was similar to that reported by Lewis (1974) in Lake Lanao, Phillippines. A low nutrient environment may explain the dominance of small algal forms which can flourish because they have low subsistence quotas and high maximal growth rates (Agusti et al. 1990). It appears that the plankton communities in these lakes may resemble tropical lakes more than temperate ones.

Bacterial counts were not done, but the lack of microzooplankton would tend to suggest that bacterial populations were low (Bays and Crisman 1983). According to Siuda (1984), the bulk of phosphatase activity (80%) in the epilimnion comes from phytoplankton. In a study of hard water marl lakes, Wetzel (1972) noted that, "Loss of labile organics onto carbonates causes substrate limitation for bacterial populations which in turn limits regeneration of inorganic nutrients and organic micro-nutrients". Although most Florida lakes are not nutrient limited (Agusti et al. 1990), these lakes are approaching the mesotrophic level where nutrient constraints are probably most important (Agusti et al. 1992).

While the littoral areas created by the mining companies are an important aspect of these lakes, no attempt was made to compare trophic status or phosphorus limitation with the amount or quality of littoral region. The littoral zone may have a positive impact on water quality by filtering water and returning nutrients to the deeper water (Wetzel 1983), but the returned nutrients are subject to inactivation through carbonate interactions (Wetzel 1972). However, rich macroinvertebrate populations may be sustained in these littoral areas, which are a benefit to both aquatic and terrestrial vertebrates.

H. Phosphorus Limitation

The results seem to indicate that primary production in these lakes is phosphorus limited. The relationship between APA and orthophosphate follow the hypothesized inverse pattern (Figure 7). This relationship was most pronounced in the Rinker North and Tarmac lakes, while it was less evident in the Rinker South lake. There was also a positive relationship between orthophosphate and chlorophyll-a (Figure 8), which also suggests phosphorus limitation, especially in the Rinker South lake. The TSI for chlorophyll-a was a more reliable indicator of nutrient limits and relationships than either Secchi depth or total phosphorus.

This research does not prove that phosphorus is the only limiting nutrient in these lakes, and several other factors may be involved in controlling primary production. The total phosphorus concentrations were well below the 0.1 mg L^{-1} value suggested by Canfield (1983) as the upper limit of phosphate limitation in Florida lakes.

I. Conclusions

1. Trophic Status

Based on the index for chlorophyll-a (Carlson 1977) the lakes were in the oligotrophic to mesotrophic range. Both the Tarmac and Florida Rock lakes scored a TSI of 37 for total phosphorus but had chlorophyll-a scores of 30 and 17 respectively. The Tarmac lake had only slightly higher orthophosphate than the Florida Rock Lake, but with significantly higher chlorophyll-a levels, it had the greatest overall APA. This would be expected from a system that has a higher demand for usable phosphorus.

2. Management

A phosphorus-limited trophic status has serious management implications for the future use of these lakes and the developing of surrounding areas. Dramatic increases in the TSI of these lakes would be the predictable result of inputs from fertilizers, waste water or other sources. Excessive phosphate inputs could possibly decrease the value of these lakes for human use.

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Appendix A

Data For April Through September 1995

Rinker North Lake

	Secchi	Alk	TP	PO4	Chl.-a	APA
	(meters)	(mg$CaCO_3$/L)	(mg/L)	(mg/L)	(mg/m^3)	(uMNPP/hr/mgChl-a)
April	0.820	157.944	0.015	0.009	2.950	0.009
May	1.000	152.306	0.012	0.008	1.220	0.029
June	0.950	153.381	0.005	0.005	0.988	0.037
July	1.220	149.519	0.017	0.009	0.915	0.030
August	1.120	154.450	0.019	0.008	0.773	0.043
September	1.070	143.330	0.011	0.005	0.915	0.240
Average	1.030	151.822	0.013	0.007	1.294	0.065
Std Error	0.057	2.037	0.002	0.001	0.337	0.035

Tarmac Lake

	Secchi	Alk	TP	PO4	Chl. a	APA
	(meters)	(mg$CaCO_3$/L)	(mg/L)	(mg/L)	(mg/m^3)	(uMNPP/hr/mgChl-a)
April	1.800	208.946	0.015	0.006	1.780	0.001
May	1.950	188.322	0.007	0.003	0.439	0.100
June	2.430	185.555	0.004	0.003	0.110	0.421
July	1.750	161.338	0.012	0.005	1.775	0.028
August	2.120	157.170	0.012	0.006	0.675	0.064
September	2.700	160.440	0.013	0.003	0.915	0.276
Average	2.125	176.962	0.011	0.004	0.949	0.148
Std Error	0.153	8.435	0.002	0.001	0.284	0.067

Appendix A

Data for April through September 1995, continued.

Rinker South Lake

	Secchi	Alk	TP	PO4	Chl. a	APA
	(meters)	($mgCaCO_3/L$)	(mg/L)	(mg/L)	(mg/m^3)	(uMNPP/hr/mg Chl-a)
April	1.050	171.473	0.018	0.010	5.470	0.018
May	1.300	161.028	0.022	0.008	1.293	0.062
June	0.900	150.936	0.002	0.007	1.592	0.042
July	1.930	146.099	0.013	0.008	1.043	0.051
August	1.650	137.920	0.019	0.008	1.122	0.043
September	1.820	127.860	0.009	0.008	0.732	0.090
Average	1.442	149.219	0.014	0.008	1.875	0.051
Std Error	0.172	6.406	0.003	0.0003	0.728	0.010

Florida Rock Lake

	Secchi	Alk	TP	PO4	Chl. a	APA
	(meters)	($mgCaCO_3/L$)	(mg/L)	(mg/L)	(mg/m^3)	(uMNPP/hr/mg Chl-a)
April	1.100	128.007	0.012	0.003	0.470	0.056
May	1.850	127.400	0.007	0.002	0.293	0.027
June	0.830	118.132	0.007	0.003	0.256	0.031
July	2.260	121.112	0.008	0.004	0.110	0.253
August	1.650	131.430	0.014	0.004	0.268	0.045
September	1.500	116.070	0.010	0.005	0.183	0.122
Average	1.532	123.692	0.010	0.003	0.263	0.089
Std Error	0.21	2.503	0.001	0.001	0.05	0.036

Appendix A

Data for diel study at Rinker North Lake, June 1995

Rinker North Lake 24 Hour

	alk	TP	PO4	Chl. a	APA
	(mgCaCO$_3$/L)	(mg/L)	(mg/L)	(mg/m^3)	(uMNPP/hr/mgChl-a)
8am	153.504	0.011	0.005	0.926	0.041
10am	145.844	0.009	0.005	0.745	0.042
noon	147.894	0.006	0.007	1.057	0.026
2pm	148.707	0.011	0.006	0.732	0.039
4pm	148.217	0.012	0.008	0.915	0.017
6pm	146.643	0.016	0.008	1.061	0.025
8pm	154.063	0.007	0.007	1.098	0.035
10pm	149.500	0.008	0.006	0.970	0.054
midnt	144.966	0.011	0.007	0.769	0.048
2am	150.860	0.011	0.007	0.805	0.044
4am	145.781	0.007	0.006	0.915	0.040
6am	147.301	0.014	0.007	0.860	0.044
Average	148.607	0.010	0.006	0.904	0.038
Std Error	0.847	0.001	0.0003	0.036	0.003

Appendix B
Data from Two Year Study- Water Quality

	Rinker North	Florida Rock	Tarmac	Rinker South
Feb. 28, 1994				
Temp. Celsius	22.500	22.900	22.400	23.100
DO mg/L	8.400	8.300	8.400	8.400
PH	8.330	8.460	8.410	8.440
March, 31				
Temp. Celsius	25.200	25.800		26.000
DO mg/L	8.200	7.750		8.100
PH	8.570	8.380		8.460
Phos. mg/L	0.000	0.000	0.000	0.000
Turbidity (SDm)	0.900	0.850		0.950
April 28				
Temp. Celsius	26.000	27.000	27.000	27.000
DO mg/L	7.300	7.700	7.500	8.000
PH	8.120	8.510	8.240	8.400
Phos. mg/L	0.012	0.013	0.011	0.011
Turbidity (SDm)	0.750	0.840	1.250	1.050
May 26,1994				
Temp. Celsius	28.000	28.000	27.000	28.000
DO mg/L	7.000	7.600	7.200	6.400
PH	8.170	8.120	8.340	8.400
Phos. mg/L	0.011	0.006	0.010	0.010
Turbidity (SDm)	1.080	0.660	3.050	1.240
June 16, 1994				
Temp. Celsius	31.000	30.000	32.000	30.000
DO mg/L	7.200	7.200	7.400	7.800
PH	8.270	8.450	8.270	8.500
Phos. mg/L	0.013	0.012	0.012	0.012
Turbidity (SDm)	1.200	0.900	1.000	1.500
July 30, 1994				
Temp. Celsius	31.000	30.000	31.000	29.000
DO mg/L	6.800	6.700	7.400	7.800
PH	8.000	8.570	8.500	8.420
Phos. mg/L	0.023	0.008	0.009	0.017
Turbidity (SDm)	1.200	1.100	3.200	1.500

Appendix B

Data from Two Year Study- Water Quality, Continued.

	Rinker North	Florida Rock	Tarmac	Rinker South
August 31, 1994				
Temp. Celsius	30.000	30.000	31.500	30.000
DO mg/L	6.600	7.800	6.500	6.400
PH	8.190	7.890	8.090	8.310
Phos. mg/L	0.011	0.007	0.008	0.009
Turbidity (SDm)	1.250	2.310	3.100	1.650
September 27, 1994				
Temp. Celsius	28.000	28.000	28.000	28.000
DO mg/L	6.300	6.400	6.400	6.200
PH	8.000	meter fault	8.200	meter fault
Phos. mg/L	0.007	0.003	0.003	0.003
Turbidity (SDm)	0.930	2.100	2.940	1.700
October 26, 1994				
Temp. Celsius	29.000	27.000	29.000	27.000
DO mg/L	4.300	6.800	4.600	7.300
PH	7.610	7.470	7.750	7.520
Phos. mg/L	0.006	0.004	0.003	0.002
Turbidity (SDm)	1.000	1.700	2.220	1.600
November 23, 1994				
Temp. Celsius	29.000	28.500	29.000	29.000
DO mg/L	6.800	7.700	6.200	7.300
PH	8.250	7.360	7.830	7.280
Phos. mg/L	0.012	0.016	0.010	0.013
Turbidity (SDm)	0.800	1.100	2.500	1.500
December 22, 1994				
Temp. Celsius	25.000	25.000	24.000	25.000
DO mg/L	3.200	6.800	4.300	5.500
PH	8.460	8.260	8.050	8.100
Phos. mg/L	0.018	0.007	0.008	0.013
Turbidity (SDm)	0.820	0.850	3.000	1.250

Appendix B

Data from Two Year Study- Water Quality, Continued.

	Rinker North	Florida Rock	Tarmac	Rinker South
January 25, 1995				
Temp. Celsius	21.300	21.500	20.300	21.500
DO mg/L	9.400	8.200	7.800	7.900
PH	8.160	8.060	7.820	8.060
Phos. mg/L	0.016	0.009	0.013	0.006
Turbidity (SDm)	1.000	1.500	3.100	1.200
February 28, 1995				
Temp. Celsius	23.000	23.500	24.000	25.000
DO mg/L	8.700	7.600	7.200	8.300
PH	8.050	8.110	8.000	8.390
Phos. mg/L	0.014	0.011	0.008	0.010
Turbidity (SDm)	1.050	1.000	2.900	1.030
March 28, 1995				
Temp. Celsius	26.500	28.000	25.500	29.000
DO mg/L	8.100	8.200	8.100	7.400
PH	8.310	8.300	8.330	8.590
Phos. mg/L	0.011	0.005	0.005	0.012
Turbidity (SDm)	1.250	1.050	3.050	1.100
April 30, 1995				
Temp. Celsius	29.000	28.000	31.000	28.000
DO mg/L	7.800	6.200	8.200	5.800
PH	8.190	8.320	8.350	8.430
Phos. mg/L	0.015	0.012	0.015	0.018
Turbidity (SDm)	0.820	1.100	1.800	1.050

Appendix B

Data from Two Year Study- Water Quality, Continued.

	Rinker North	Florida Rock	Tarmac	Rinker South
May 23, 1995				
Temp. Celsius	30.500	30.000	32.500	30.000
DO mg/L	meter fault	6.300	meter fault	meter fault
PH	8.460	8.370	8.430	8.600
Phos. mg/L	0.012	0.007	0.007	0.022
Turbidity (SDm)	1.000	1.850	1.950	1.300
June 21, 1995				
Temp. Celsius	29.000	27.000	28.500	28.000
DO mg/L	7.700	6.600	6.400	5.200
PH	8.180	8.240	8.410	8.440
Phos. mg/L	0.005	0.007	0.004	0.002
Turbidity (SDm)	0.950	0.830	2.430	0.900
July 26, 1995				
Temp. Celsius	29.000	30.000	30.000	30.500
DO mg/L	4.300	5.100	6.500	8.000
PH	7.920	8.280	8.250	8.600
Phos. mg/L	0.017	0.008	0.012	0.013
Turbidity (SDm)	1.220	2.260	1.750	1.930
August 30, 1995				
Temp. Celsius	30.500	30.500	30.000	30.500
DO mg/L	7.600	7.300	6.700	7.600
PH	8.170	8.100	8.040	8.390
Phos. mg/L	0.019	0.014	0.012	0.019
Turbidity (SDm)	1.120	1.650	2.120	1.650

Appendix B

Data from Two Year Study- Water Quality, Continued.

	Rinker North	Florida Rock	Tarmac	Rinker South
September 30, 1995				
Temp. Celsius	27.000	26.000	27.000	27.000
DO mg/L	5.300	7.800	3.700	4.400
PH	7.800	7.950	8.110	8.420
Phos. mg/L	0.011	0.010	0.013	0.009
Turbidity (SDm)	1.070	1.500	2.700	1.820
October 26, 1995				
Temp. Celsius	24.000	24.000	25.500	24.000
DO mg/L	7.800	7.700	7.800	7.600
PH	7.960	8.200	8.130	8.400
Phos. mg/L	0.018	0.008	0.006	0.011
Turbidity (SDm)	0.700	1.450	2.000	1.900
November 28, 1995				
Temp. Celsius	20.500	21.000	20.000	20.500
DO mg/L	8.200	7.600	7.500	7.400
PH	7.800	7.800	7.720	7.840
Phos. mg/L	0.025	0.020	0.022	0.026
Turbidity (SDm)	0.900	1.500	2.200	1.650
December 6, 1995				
Temp. Celsius	21.000	21.500	21.000	21.000
DO mg/L	8.800	8.100	7.500	8.800
PH	7.850	8.160	7.900	8.540
Phos. mg/L	0.031	0.028	0.024	0.027
Turbidity (SDm)	1.120	1.750	2.430	1.450

Appendix B
Data from Two Year Study- Phytoplankton.

Order	Family	Species		August 25, 1994
				Rinker North #/L
Chlorococcales	Scenedesmaceae	Scenedesmus	sp.	
		Crucigenia	sp.	
		Closteriopsis	sp.	
	Characiaceae	Schroederia	sp.	
	Oocystaceae	Ankistrodesmus	sp.	2475000
		Palmellococcus	sp.	825000
		Selanastrum	sp.	825000
	Hydrodictyaceae	Pediastrum	sp.	
Zygnematales	Desmidiaceae	Arthrodesmus	sp.	
	Zygnemataceae	Zygnema	sp.	
	Mesotaeniaceae	Mesotaenium	sp.	33000
		Netrium	sp.	33000
Volvocales	Volvocaceae	Eudorina	sp.	
	Chlamydomonadaceae	Polytoma	sp.	
		Chlamydomonas	sp.	
Ulotrichales	Protococcaceae	Protococcus	sp.	8250000
Tetrasporales	Coccomyxaceae	Coccomyxa	sp.	4950000
	Chlorangiaceae	Stylosphaeridum	sp.	
Oscillatoriales	Oscillatoriaceae	Spirulina	sp.	
		Oscillatoria	sp.	33000
	Nostocaceae	Aulosira	sp.	
		Anabaena	sp.	33000
	Rivulariaceae	Calothrix	sp.	1650000
Chroococcales	Chroococcaceae	Eucapsis	sp.	
		Coelosphaerium	sp.	
		Rhabdoderma	sp.	5775000
Centrales	Coscinodiscaceae	Cyclotella	sp.	
Pennales	Fragilariaceae	Fragilaria	sp.	
		Synedra	sp.	825000
	Naviculaceae	Navicula	sp.	33000

Appendix B
Data from Two Year Study- Phytoplankton, continued.

Order	Family	Species		December 8, 1994 Rinker North #/L
Oscillatoriales	Oscillatoriaceae	Spirulina	sp.	
		Oscillatoria	sp.	10000
	Nostocaceae	Aulosira	sp.	
		Anabaena	sp.	
	Rivulariaceae	Calothrix	sp.	
Chroococcales	Chroococcaceae	Eucapsis	sp.	
		Coelosphaerium	sp.	
		Rhabdoderma	sp.	8000000
		Aphanocapsa	sp.	500000
Chlorococcales	Scenedesmaceae	Scenedesmus	sp.	
		Crucigenia	sp.	
		Closteriopsis	sp.	
	Characiaceae	Schroederia	sp.	
	Oocystaceae	Ankistrodesmus	sp.	
		Palmellococcus	sp.	
		Selanastrum	sp.	
	Chlorococcaceae	Chlorococcum	sp.	
	Hydrodictyaceae	Pediastrum	sp.	
Zygnematales	Desmidiaceae	Arthrodesmus	sp.	5680000
		Staurastrum	sp.	
	Zygnemataceae	Zygnema	sp.	
	Mesotaeniaceae	Mesotaenium	sp.	1750000
		Netrium	sp.	
Volvocales	Volvocaceae	Eudorina	sp.	
	Chlamydomonadaceae	Polytoma	sp.	10000
		Chlamydomonas	sp.	
Ulotrichales	Protococcaceae	Protococcus	sp.	12000000
	Ulotrichaceae	Hormidiopsis	sp.	10000
Tetrasporales	Coccomyxaceae	Coccomyxa	sp.	
		Nannochloris	sp.	4000000
Pennales	Fragilariaceae	Fragilaria	sp.	
		Synedra	sp.	
	Naviculaceae	Navicula	sp.	10000

Appendix B
Data from Two Year Study- Phytoplankton, continued.

Order	Family	Species		March 8, 1995 Rinker North #/L
Oscillatoriales	Oscillatoriaceae	Spirulina	sp.	10000
		Oscillatoria	sp.	
		Lyngbya	sp.	
	Nostocaceae	Aulosira	sp.	
		Anabaena	sp.	
	Rivulariaceae	Calothrix	sp.	
Chroococcales	Chroococcaceae	Eucapsis	sp.	
		Coelosphaerium	sp.	
		Rhabdoderma	sp.	4250000
		Aphanocapsa	sp.	1600000
		Synechocystis	sp.	250000
		Polycystis	sp.	
Chlorococcales	Scenedesmaceae	Scenedesmus	sp.	
		Crucigenia	sp.	
		Closteriopsis	sp.	
	Characiaceae	Schroederia	sp.	
	Oocystaceae	Ankistrodesmus	sp.	600000
		Ankistrodesmus	convolutus	1000000
		Chlorella	sp.	8000000
		Palmellococcus	sp.	
		Selanastrum	sp.	250000
		Westella	linearis	250000
	Chlorococcaceae	Chlorococcum	sp.	
	Hydrodictyaceae	Pediastrum	sp.	
Tetrasporales	Coccomyxaceae	Coccomyxa	sp.	8000000
		Nannochloris	sp.	
	Chlorangiaceae	Stylosphaeridum	sp.	
Cryptomonadales	Cryptochrysidaceae	Rhodomonas	sp.	10000
Chrysomonadales	Mallomonadaceae	Mallomonas	sp.	10000
	Ochromonadaceae	Dinobryon	sertularia	10000
Centrales	Coscinodiscaceae	Cyclotella	sp.	10000
Pennales	Fragilariaceae	Fragilaria	sp.	
		Synedra	sp.	
	Naviculaceae	Navicula	sp.	10000

Appendix B
Data from Two Year Study- Phytoplankton, continued.

				May 11, 1995
Order	Family	Species		Rinker South #/L
Oscillatoriales	Oscillatoriaceae	Spirulina	sp.	250000
		Oscillatoria	sp.	500000
		Lyngbya	sp.	
	Nostocaceae	Aulosira	sp.	10000
		Anabaena	sp.	
	Rivulariaceae	Calothrix	sp.	
Chroococcales	Chroococcaceae	Eucapsis	sp.	
		Coelosphaerium	sp.	
		Rhabdoderma	sp.	20000000
		Aphanocapsa	sp.	
		Synechocystis	sp.	1500000
		Aphanothece	sp.	
		Polycystis	sp.	
		Gloeothece	sp.	10000
Chlorococcales	Scenedesmaceae	Scenedesmus	sp.	
		Crucigenia	sp.	30000
		Closteriopsis	sp.	1250000
	Characiaceae	Schroederia	sp.	
	Oocystaceae	Ankistrodesmus	sp.	
		Ankistrodesmus	convolutus	
		Chlorella	sp.	8000000
Tetrasporales	Coccomyxaceae	Coccomyxa	sp.	8000000
		Nannochloris	sp.	
	Chlorangiaceae	Stylosphaeridum	sp.	
Chrysomonadales	Mallomonadaceae	Mallomonas	sp.	
	Ochromonadaceae	Dinobryon	sertularia	
		Ceratium	hirundinella	50000
		Peridinum	sp.	10000
Centrales	Coscinodiscaceae	Cyclotella	sp.	
Pennales	Fragilariaceae	Fragilaria	sp.	
		Synedra	sp.	
	Naviculaceae	Navicula	sp.	250000

Appendix B

Data from Two Year Study- Phytoplankton, continued.

Order	Family	Species		September 14, 1995 Tarmac #/L
Chroococcales	Chroococcaceae	Eucapsis	sp.	
		Coelosphaerium	sp.	
		Rhabdoderma	sp.	16000000
		Aphanocapsa	sp.	
		Synechocystis	sp.	750000
		Aphanothece	sp.	
		Polycystis	sp.	120000
		Gloeothece	sp.	
		Chroococcus	sp.	20000
Chlorococcales	Scenedesmaceae	Scenedesmus	sp.	
		Crucigenia	sp.	10000
		Closteriopsis	sp.	4000000
	Characiaceae	Schroederia	sp.	
	Oocystaceae	Ankistrodesmus	sp.	
		Ankistrodesmus	convolutus	30000
		Chlorella	sp.	8000000
Tetrasporales	Coccomyxaceae	Coccomyxa	sp.	500000
		Nannochloris	sp.	
	Chlorangiaceae	Stylosphaeridum	sp.	
Centrales	Coscinodiscaceae	Cyclotella	sp.	
Pennales	Fragilariaceae	Fragilaria	sp.	
		Synedra	sp.	
	Naviculaceae	Navicula	sp.	20000

Appendix B
Data from Two Year Study- Phytoplankton, continued.

December 8, 1995

Order	Family	Species		Tarmac #/L
Chroococcales	Chroococcaceae	Eucapsis	sp.	
		Coelosphaerium	sp.	
		Rhabdoderma	sp.	20000000
		Aphanocapsa	sp.	
		Synechocystis	sp.	250000
		Aphanothece	sp.	
		Polycystis	sp.	500000
		Gloeothece	sp.	
		Chroococcus	sp.	
Chlorococcales	Scenedesmaceae	Scenedesmus	sp.	
		Crucigenia	sp.	
		Closteriopsis	sp.	750000
	Characiaceae	Schroederia	sp.	
	Oocystaceae	Ankistrodesmus	sp.	
		Ankistrodesmus	convolutus	250000
		Chlorella	sp.	12000000
Tetrasporales	Coccomyxaceae	Coccomyxa	sp.	16000000
		Nannochloris	sp.	
Pennales	Fragilariaceae	Fragilaria	sp.	
		Synedra	sp.	
	Naviculaceae	Navicula	sp.	30000

Appendix B
Data from Two Year Study- Zooplankton

				May 5,1994
				Rinker North
				#/L
Cyclopoida	Cyclopidae	Cyclops	sp.	12
Calanoida	Diaptomidae	Diaptomus	sp.	12
Harpacticoida	Harpacticidae	Bryocampus	sp.	4

				August 20, 1994
				Rinker North
				#/L
Cyclopoida	Cyclopidae	Cyclops	sp.	7.6
Calanoida	Diaptomidae	Diaptomus	sp.	8.2
Harpacticoida	Harpacticidae	Bryocampus	sp.	3.5
nauplii of uncertain	identity			12.5
	Cypridopsidae	Cypridopsis	sp.	0.1
	Daphniidae	Daphnia	sp.	1.2
Onychopoda	Polyphenidae	Polyphemus	sp.	0.3

				December 8, 1994
				Rinker North
				#/L
Testacea	Arcellidae	Arcella	denata vulgaris	0.13
Ploima	Lacanidae	Monostyla	sp.	0.13
	Brachionidae	Keratella	sp.	0.13
	Daphniidae	Daphnia	sp.	2
Onychopoda	Polyphenidae	Polyphemus	sp.	0.25
Cyclopoida	Cyclopidae	Cyclops	sp.	10.78
Calanoida	Diaptomidae	Diaptomus	sp.	9.26
Harpacticoida	Harpacticidae	Bryocampus	sp.	0.13
nauplii of uncertain	identity			6
	Cypridopsidae	Cypridopsis	sp.	0.13

Appendix B
Data from Two Year Study- Zooplankton, continued.

				March 8, 1995 Rinker North #/L
Dinoflagellida	Ceratidae	Ceratium	hirundinella	2.26
Testacea	Arcellidae	Arcella	denata	
		Arcella	vulgaris	0.16
Ploima	Lacanidae	Monostyla	sp.	
		Keratella	sp.	0.11
Onychopoda	Polyphenidae	Polyphemus	sp.	
	Bosminidae	Bosmina	sp.	0.16
Cyclopoida	Cyclopidae	Cyclops	sp.	3
		Macrocyclops	sp.	0.22
Calanoida	Diaptomidae	Diaptomus	sp.	6.3
nauplii of uncertain	identity			4.7
	Cypridopsidae	Cypridopsis	sp.	0.27

				May 11, 1995 Rinker South #/L
Dinoflagellida	Ceratidae	Ceratium	hirundinella	9.4
Testacea	Arcellidae	Arcella	denata	
		Arcella	vulgaris	0.5
Ploima	Lacanidae	Monostyla	sp.	
	Brachionidae	Platyias	sp.	
		Brachionus	sp.	0.4
	Daphniidae	Daphnia	sp.	
	Sididae	Diaphanosoma	sp.	0.44
	Bosminidae	Bosmina	sp.	0.44
Onychopoda	Polyphenidae	Polyphemus	sp.	
Cyclopoida	Cyclopidae	Cyclops	sp.	3.3
		Macrocyclops	sp.	
Calanoida	Diaptomidae	Diaptomus	sp.	2.25
nauplii of uncertain	identity			2.44

Appendix B
Data from Two Year Study- Zooplankton, continued.

				September 14, 1995 Tarmac #/L
Dinoflagellida	Ceratidae	Ceratium	hirundinella	0.31
Ploima	Lacanidae	Monostyla	sp.	
	Brachionidae	Platyias	sp.	
		Brachionus	sp.	0.31
		Keratella	sp.	0.2
	Daphniidae	Daphnia	sp.	
	Bosminidae	Bosmina	sp.	0.31
Cyclopoida	Cyclopidae	Cyclops	sp.	1.25
		Macrocyclops	sp.	
Calanoida	Diaptomidae	Diaptomus	sp.	0.25
nauplii of uncertain	identity			0.875
	Cypridopsidae	Cypridopsis	sp.	0.2

				December 8, 1995 Tarmac #/L
Dinoflagellida	Ceratidae	Ceratium	hirundinella	1.5
Ploima	Lacanidae	Monostyla	sp.	
	Brachionidae	Platyias	sp.	
		Brachionus	sp.	
		Keratella	sp.	0.8
	Daphniidae	Daphnia	sp.	
	Sididae	Diaphanosoma	sp.	0.06
	Macrothricidae	Macrothrix	sp.	
	Bosminidae	Bosmina	sp.	13.75
Onychopoda	Polyphenidae	Polyphemus	sp.	2
Cyclopoida	Cyclopidae	Cyclops	sp.	5.44
		Macrocyclops	sp.	
Calanoida	Diaptomidae	Diaptomus	sp.	2.94
nauplii of uncertain	identity			5
	Cypridopsidae	Cypridopsis	sp.	0.06

Appendix B
Data from Two Year Study- Macroinvertebrates.

class	family	genus	species	March 18, 1994 Rinker North #s
Turbellaria				
	Planariidae	Euplanaria	sp.	3
Hirudinea				
	Hirudinidae		sp.	3
Crustacea				
	Palaemonidae	Palaemonetes	paludosus	9
	Gammaridae	Gammarus	sp.	2
Arachnoidea				
	Lycosidae	Pirata	sp.	2
	Dictynidae	Dictyna	sp.	1
Insecta				
	Belostomatidae	Belestoma	lutarium	1
	Ochteridae	Ochterus	americanus	1
	Dytiscidae	Uvarus	lucustris	2
	Naucoridae	Pelocorus	sp.	2
	Gyrinidae	Dineutus	sp.	1
	Gerridae	Gerris	sp.	1
		Metrobates	hesparius	1
	Coenagrionidae	Enallagma	sp.	1
	Chironomidae	Chironomus	sp.	1
Gastropoda				
	Planorbidae	Helisoma	sp.	3
		Helisoma	trivolvis	4
	Physidae	Physa	sp.	39
	Pleuroceratidae	Pleurocera	sp.	4
			Total #	81
			# Species	19
		Shannon-Weaver	Diversity Index	3

Appendix B

Data from Two Year Study- Macroinvertebrates, continued.

class	family	genus	species	April 20, 1994 Rinker North #s
Crustacea				
	Palaemonidae	Palaemonetes	paludosus	12
	Gammaridae	Gammarus	sp.	5
Arachnoidea				
	Lycosidae	Pirata	sp.	1
		Lycosa	sp.	2
	Filistatidae	Filistata	sp.	1
Insecta				
	Belostomatidae	Belestoma	lutarium	1
	Dytiscidae	Uvarus	lucustris	1
	Naucoridae	Pelocorus	sp.	3
	Gerridae	Gerris	sp.	
		Metrobates	hesparius	1
	Coenagrionidae	Enallagma	sp.	5
	Chironomidae	Chironomus	sp.	2
	Libellulidae	Celithemis	eponina	1
Gastropoda				
	Planorbidae	Helisoma	sp.	1
		Helisoma	trivolvis	2
	Physidae	Physa	sp.	49
	Pleuroceratidae	Pleurocera	sp.	2
			Total #	89
			# Species	16
		Shannon-Weaver	Diversity Index	2.5

Appendix B

Data from Two Year Study- Macroinvertebrates, continued.

class	family	genus	species	May 24, 1994 Rinker North #s
Crustacea				
	Palaemonidae	Palaemonetes	paludosus	22
	Astacidae	Procambarus	sp.	1
	Gammaridae	Gammarus	sp.	1
Arachnoidea				
		Lycosa	sp.	1
	Filistatidae	Filistata	sp.	1
Insecta				
	Dytiscidae	Uvarus	lucustris	
		Laccophilus	sp.	1
	Gerridae	Gerris	sp.	
		Metrobates	hesparius	
		Trepobates	sp.	2
	Mesoveliidae	Mesovelia	sp.	1
	Corduliidae	Epitheca	stella	1
	Coenagrionidae	Enallagma	sp.	3
	Tabanidae	Chrysops	sp.	1
	Chironomidae	Chironomus	sp.	1
Gastropoda				
		Helisoma	trivolvis	3
	Physidae	Physa	sp.	57
	Pleuroceratidae	Pleurocera	sp.	3
			Total #	99
			# Species	15
		Shannon-Weaver	Diversity Index	2.16

Appendix B
Data from Two Year Study- Macroinvertebrates, continued.

class	family	genus	species	June 15, 1994 Rinker North #s
Crustacea				
	Palaemonidae	Palaemonetes	paludosus	16
	Astacidae	Procambarus	sp.	1
Arachnoidea				
	Filistatidae	Filistata	sp.	
		Pholcus	sp.	2
Insecta				
	Dytiscidae	Uvarus	lucustris	
		Laccophilus	sp.	6
	Gerridae	Gerris	sp.	
		Metrobates	hesparius	
		Trepobates	sp.	11
	Coenagrionidae	Enallagma	sp.	2
	Chironomidae	Chironomus	sp.	4
	Stratiomyidae	Odontomyia	sp.	1
Gastropoda				
	Planorbidae	Helisoma	sp.	2
	Physidae	Physa	sp.	38
	Pleuroceratidae	Pleurocera	sp.	1
			Total #	84
			# Species	11
		Shannon-Weaver	Diversity Index	2.45

Appendix B

Data from Two Year Study- Macroinvertebrates, continued.

July 27, 1994

class	family	genus	species	Rinker North #s
Hirudinea	Rhynchobdellida	Helobdella	sp.	3
Crustacea	Palaemonidae	Palaemonetes	paludosus	11
	Gammaridae	Gammarus	sp.	1
Arachnoidea	Lycosidae	Pirata	sp.	2
Insecta	Belostomatidae	Belostoma	lutarium	
	Gerridae	Gerris	sp.	3
	Corduliidae	Epitheca	stella	2
	Coenagrionidae	Enallagma	sp.	1
Gastropoda	Planorbidae	Helisoma	sp.	1
		Gyraulus	sp.	1
	Physidae	Physella	sp.	33
	Ampullariidae	Pomacea	paludosa	2
			Total #	60
			# Species	11
		Shannon-Weaver	Diversity Index	2.24

Appendix B
Data from Two Year Study- Macroinvertebrates, continued.

August 25, 1994

class	family	genus	species	Rinker North #s
Oligochaeta	Naididae	Paranais	sp.	4
Crustacea	Palaemonidae	Palaemonetes	paludosus	41
	Gammaridae	Gammarus	sp.	3
Arachnoidea	Lycosidae	Pirata	sp.	1
	Filistatidae	Filistata	sp.	2
Insecta	Belostomatidae	Belostoma	sp.	2
	Naucoridae	Pelocorus	sp.	5
	Gerridae	Gerris	sp.	5
	Libellulidae	Celithemis	eponina	
		Sympetrum	sp.	1
	Corduliidae	Epitheca	stella	1
	Coenagrionidae	Enallagma	sp.	3
		Ischnura	sp.	5
	Oligoneuriidae	Isonychia	sp.	1
Gastropoda	Planorbidae	Helisoma	sp.	1
		Gyraulus	sp.	2
	Physidae	Physella	sp.	34
	Pleuroceratidae	Pleurocera	sp.	1
			Total #	112
			# Species	17
		Shannon-Weaver	Diversity Index	2.78

Appendix B

Data from Two Year Study- Macroinvertebrates, continued.

September 22, 1994

class	family	genus	species	Rinker North #s
Crustacea	Palaemonidae	Palaemonetes	paludosus	7
	Gammaridae	Gammarus	sp.	4
Arachnoidea	Lycosidae	Pirata	sp.	
	Attidae	Sitticus	sp.	1
	Filistatidae	Filistata	sp.	
		Pholcus	sp.	1
	Pisauridae	Dolomedes	sp.	4
Insecta	Belostomatidae	Belostoma	sp.	2
	Dytiscidae	Uvarus	sp.	
		Laccophilus	sp.	
		Hydroporus	sp.	2
	Naucoridae	Pelocoris	sp.	14
	Gerridae	Gerris	sp.	
		Metrobates	hesparius	
		Limnoporus	sp.	1
Gastropoda	Planorbidae	Helisoma	sp.	
		Gyraulus	sp.	2
	Physidae	Physella	sp.	35
	Lymnaeidae	Lymnaea	sp.	7
			Total #	80
			# Species	12
		Shannon-Weaver	Diversity Index	2.64

Appendix B

Data from Two Year Study- Macroinvertebrates, continued.

October 19, 1994

class	family	genus	species	Rinker North #s
Crustacea	Palaemonidae	Palaemonetes	paludosus	6
	Gammaridae	Gammarus	sp.	13
Arachnoidea	Lycosidae	Pirata	sp.	
	Tetragnathidae	Tetragnatha	sp.	3
	Filistatidae	Filistata	sp.	
		Pholcus	sp.	1
Insecta	Belostomatidae	Belostoma	sp.	9
	Dytiscidae	Uvarus	sp.	
		Hydroporus	sp.	5
	Naucoridae	Pelocoris	sp.	22
	Gerridae	Gerris	sp.	2
		Metrobates	hesparius	10
	Mesoveliidae	Mesovelia	sp.	3
	Chironomidae	Chironomus	sp.	1
	Coenagrionidae	Enallagma	sp.	1
Gastropoda	Planorbidae	Helisoma	sp.	
		Gyraulus	sp.	1
		Menetus	sp.	3
	Physidae	Physella	sp.	43
		Physella	integra	8
			Total #	131
			# Species	16
		Shannon-Weaver	Diversity Index	3.15

Appendix B
Data from Two Year Study- Macroinvertebrates, continued.

November 22, 1994

class	family	genus	species	Rinker North #s
Crustacea	Palaemonidae	Palaemonetes	paludosus	16
	Gammaridae	Gammarus	sp.	1
Arachnoidea	Lycosidae	Pirata	sp.	
	Tetragnathidae	Tetragnatha	sp.	6
	Filistatidae	Filistata	sp.	
		Pholcus	sp.	4
	Pisauridae	Dolomedes	sp.	1
Insecta	Belostomatidae	Belostoma	sp.	2
	Hydrophilidae	Tropisternus	sp.	
		Helobata	sp.	1
	Naucoridae	Pelocoris	sp.	7
	Gerridae	Gerris	sp.	
		Metrobates	hesparius	
		Limnoporus	sp.	8
	Veliidae	Microvelia	sp.	1
	Chironomidae	Chironomus	sp.	1
	Coenagrionidae	Enallagma	sp.	1
		Ischnura	posita	1
	Caenidae	Caenis	sp.	1
Gastropoda	Planorbidae	Helisoma	sp.	
		Menetus	sp.	1
	Physidae	Physella	sp.	28
		Physella	integra	2
	Ampullariidae	Marisa	rotula	
		Pomacea	paludosa	1
			Total #	83
			# Species	18
		Shannon-Weaver	Diversity Index	3.12

Appendix B
Data from Two Year Study- Macroinvertebrates, continued.

December 28, 1994

class	family	genus	species	Rinker North #s
Crustacea	Palaemonidae	Palaemonetes	paludosus	27
	Gammaridae	Gammarus	sp.	8
Arachnoidea	Lycosidae	Pirata	sp.	
	Tetragnathidae	Tetragnatha	sp.	5
	Filistatidae	Filistata	sp.	
		Pholcus	sp.	3
	Pisauridae	Dolomedes	sp.	1
Insecta	Belostomatidae	Belostoma	sp.	
	Naucoridae	Pelocoris	sp.	2
	Gyrinidae	Gyrinus	sp.	1
	Mesoveliidae	Mesovelia	sp.	1
	Libellulidae	Celithemis	eponina	1
		Perithemis	tenera	1
		Libellula	auripennis	1
	Coenagrionidae	Enallagma	sp.	1
	Baetidae	Callibaetis	sp.	1
Gastropoda	Planorbidae	Helisoma	sp.	
	Physidae	Physella	sp.	46
			Total #	95
			# Species	14
		Shannon-Weaver	Diversity Index	2.34

Appendix B

Data from Two Year Study- Macroinvertebrates, continued.

January 20, 1995

class	family	genus	species	Rinker South #s
Hirudinea	Rhynchobdellida	Helobdella	sp.	
	Erpobdellidae	Erpobdella	sp.	1
Oligochaeta	Naididae	Paranais	sp.	
		Stylaria	sp.	3
Crustacea	Palaemonidae	Palaemonetes	paludosus	39
	Gammaridae	Gammarus	sp.	23
Arachnoidea	Lycosidae	Pirata	sp.	
	Tetragnathidae	Tetragnatha	sp.	13
Insecta	Belostomatidae	Belostoma	sp.	2
	Noteridae	Hydrocanthus	sp.	4
	Hydrometridae	Hydrometra	martini	1
	Gerridae	Gerris	sp.	6
		Trepobates	sp.	1
	Chironomidae	Chironomus	sp.	1
	Coenagrionidae	Enallagma	sp.	
		Ischnura	posita	2
	Caenidae	Caenis	sp.	1
Gastropoda	Planorbidae	Helisoma	sp.	
	Physidae	Physella	sp.	10
		Physella	integra	22
			Total #	129
			# Species	15
		Shannon-Weaver	Diversity Index	2.97

Appendix B

Data from Two Year Study- Macroinvertebrates, continued.

February 23, 1995

class	family	genus	species	Tarmac #s
Crustacea	Palaemonidae	Palaemonetes	paludosus	57
	Astacidae	Procambarus	sp.	6
	Gammaridae	Gammarus	sp.	3
Arachnoidea	Lycosidae	Pirata	sp.	
	Tetragnathidae	Tetragnatha	sp.	2
	Filistatidae	Filistata	sp.	
		Pholcus	sp.	3
	Pisauridae	Dolomedes	sp.	2
Insecta	Belostomatidae	Belostoma	sp.	
	Naucoridae	Pelocoris	sp.	1
	Gerridae	Gerris	sp.	1
	Mesoveliidae	Mesovelia	sp.	2
	Chironomidae	Chironomus	sp.	1
	Aeshnidae	Anax	junius	1
	Coenagrionidae	Enallagma	sp.	2
	Oligoneuriidae	Isonychia	sp.	1
	Leptoceridae	Nectopsyche	sp.	1
Gastropoda	Planorbidae	Helisoma	sp.	2
	Physidae	Physella	sp.	2
		Physella	integra	1
	Pleuroceratidae	Pleurocera	sp.	1
		Goniobasis	sp.	1
			Total #	90
			# Species	19
		Shannon-Weaver	Diversity Index	2.39

Appendix B

Data from Two Year Study- Macroinvertebrates, continued.

March 16, 1995

class	family	genus	species	Tarmac #s
Oligochaeta	Naididae	Paranais	sp.	
		Stylaria	sp.	1
Crustacea	Palaemonidae	Palaemonetes	paludosus	89
	Astacidae	Procambarus	sp.	4
	Gammaridae	Gammarus	sp.	26
Arachnoidea	Lycosidae	Pirata	sp.	
	Tetragnathidae	Tetragnatha	sp.	2
	Filistatidae	Filistata	sp.	
		Pholcus	sp.	3
	Pisauridae	Dolomedes	sp.	1
Insecta	Belostomatidae	Belostoma	sp.	
	Naucoridae	Pelocoris	sp.	1
	Chironomidae	Chironomus	sp.	2
Gastropoda	Planorbidae	Helisoma	sp.	11
	Physidae	Physella	sp.	15
	Hydrobiidae	Littoridinops	sp.	2
	Pleuroceratidae	Pleurocera	sp.	1
			Total #	158
			# Species	13
		Shannon-Weaver	Diversity Index	2.15

Appendix B
Data from Two Year Study- Macroinvertebrates, continued.

April 25, 1995

class	family	genus	species	Tarmac #s
Hirudinea	Rhynchobdellida	Helobdella	sp.	
		Placobdella	sp.	4
Oligochaeta	Naididae	Paranais	sp.	2
Crustacea	Palaemonidae	Palaemonetes	paludosus	3
	Astacidae	Procambarus	sp.	3
	Gammaridae	Gammarus	sp.	14
Arachnoidea	Lycosidae	Pirata	sp.	
	Tetragnathidae	Tetragnatha	sp.	2
Insecta	Belostomatidae	Belostoma	sp.	
	Naucoridae	Pelocoris	sp.	1
	Gyrinidae	Gyrinus	sp.	3
		Dineutus	sp.	30
	Gerridae	Gerris	sp.	1
Gastropoda	Planorbidae	Helisoma	sp.	
		Gyraulus	sp.	3
	Physidae	Physella	sp.	24
	Pleuroceratidae	Pleurocera	sp.	3
		Goniobasis	sp.	3
			Total #	96
			# Species	14
		Shannon-Weaver	Diversity Index	2.93

Appendix B
Data from Two Year Study- Macroinvertebrates, continued.

May 22, 1995

class	family	genus	species	Florida Rock #s
Crustacea	Palaemonidae	Palaemonetes	paludosus	80
	Astacidae	Procambarus	sp.	1
	Gammaridae	Gammarus	sp.	7
Insecta	Belostomatidae	Belostoma	sp.	
	Hydrophilidae	Tropisternus	sp.	4
	Naucoridae	Pelocoris	sp.	2
	Libellulidae	Celithemis	eponina	1
	Corduliidae	Epitheca	stella	1
			princeps	1
	Coenagrionidae	Enallagma	sp.	
		Amphiagrion	sp.	6
	Caenidae	Caenis	sp.	1
	Leptoceridae	Nectopsyche	sp.	
		Oecetis	sp.	2
Gastropoda	Planorbidae	Helisoma	sp.	
		Menetus	sp.	37
		Vorticifex	sp.	1
	Physidae	Physella	sp.	12
		Physella	integra	2
	Hydrobiidae	Littoridinops	sp.	5
	Ampullariidae	Marisa	rotula	
		Pomacea	paludosa	2
			Total #	164
			# Species	16
		Shannon-Weaver	Diversity Index	2.45

Appendix B
Data from Two Year Study- Macroinvertebrates, continued.

June 14, 1995

class	family	genus	species	Florida Rock #s
Crustacea	Palaemonidae	Palaemonetes	paludosus	54
	Astacidae	Procambarus	sp.	1
	Gammaridae	Gammarus	sp.	6
Insecta	Belostomatidae	Belostoma	sp.	
	Naucoridae	Pelocoris	sp.	1
	Gyrinidae	Gyrinus	sp.	1
	Coenagrionidae	Enallagma	sp.	
		Ischnura	posita	8
Gastropoda	Planorbidae	Helisoma	sp.	
		Gyraulus	sp.	1
		Menetus	sp.	6
	Physidae	Physella	sp.	21
		Physella	integra	1
	Hydrobiidae	Littoridinops	sp.	19
			Total #	119
			# Species	11
		Shannon-Weaver	Diversity Index	2.37

Appendix B

Data from Two Year Study- Macroinvertebrates, continued.

July 20, 1995

class	family	genus	species	Rinker North #s
Crustacea	Palaemonidae	Palaemonetes	paludosus	34
	Astacidae	Procambarus	sp.	2
	Gammaridae	Gammarus	sp.	1
Arachnoidea	Lycosidae	Pirata	sp.	
	Tetragnathidae	Tetragnatha	sp.	2
	Filistatidae	Filistata	sp.	
		Pholcus	sp.	1
	Pisauridae	Dolomedes	sp.	4
Insecta	Belostomatidae	Belostoma	sp.	
	Dytiscidae	Uvarus	sp.	
		Dytiscus	sp.	1
	Pleidae	Neoplea	sp.	4
	Naucoridae	Pelocoris	sp.	2
	Gerridae	Gerris	sp.	2
		Metrobates	hesparius	2
		Trepobates	sp.	16
	Veliidae	Microvelia	sp.	1
	Psychodidae	Psychoda	sp.	1
	Coenagrionidae	Enallagma	sp.	1
		Ischnura	sp.	1
	Hydroptilidae	Oxyethira	sp.	1
Gastropoda	Planorbidae	Helisoma	sp.	
		Gyraulus	sp.	3
		Polygyra	sp.	5
	Physidae	Physella	sp.	11
		Physella	integra	8
	Pleuroceratidae	Pleurocera	sp.	1
		Goniobasis	sp.	1
	Ampullariidae	Marisa	rotula	
		Pomacea	paludosa	1
			Total #	106
			# Species	24
		Shannon-Weaver	Diversity Index	3.5

Appendix B

Data from Two Year Study- Macroinvertebrates, continued.

August 13, 1995

class	family	genus	species	Tarmac #s
Hirudinea	Rhynchobdellida	Helobdella	sp.	
		Placobdella	sp.	1
Crustacea	Palaemonidae	Palaemonetes	paludosus	43
	Astacidae	Procambarus	sp.	2
	Gammaridae	Gammarus	sp.	18
Arachnoidea	Lycosidae	Pirata	sp.	
	Tetragnathidae	Tetragnatha	sp.	3
	Pisauridae	Dolomedes	sp.	2
Insecta	Belostomatidae	Belostoma	sp.	
	Naucoridae	Pelocoris	sp.	5
	Gyrinidae	Gyrinus	sp.	1
	Gerridae	Gerris	sp.	2
		Trepobates	sp.	3
	Coenagrionidae	Enallagma	sp.	2
		Ischnura	sp.	3
Gastropoda	Planorbidae	Helisoma	sp.	
		Gyraulus	sp.	4
	Physidae	Physella	sp.	12
		Physella	integra	2
	Pleuroceratidae	Pleurocera	sp.	5
		Goniobasis	sp.	1
			Total #	109
			# Species	17
		Shannon-Weaver	Diversity Index	3.04

Appendix B
Data from Two Year Study- Macroinvertebrates, continued.

September 15, 1995

class	family	genus	species	Tarmac #s
Crustacea	Palaemonidae	Palaemonetes	paludosus	47
	Gammaridae	Gammarus	sp.	17
Arachnoidea	Lycosidae	Pirata	sp.	
	Filistatidae	Filistata	sp.	
		Pholcus	sp.	2
Insecta	Belostomatidae	Belostoma	sp.	2
	Naucoridae	Pelocoris	sp.	2
	Gyrinidae	Gyrinus	sp.	3
	Gerridae	Gerris	sp.	
		Trepobates	sp.	1
	Chironomidae	Chironomus	sp.	2
	Libellulidae	Celithemis	eponina	
		Perithemis	tenera	1
	Coenagrionidae	Enallagma	sp.	1
		Ischnura	sp.	6
	Baetidae	Callibaetis	sp.	2
	unidentified Trichopt	eran		1
Gastropoda	Planorbidae	Helisoma	sp.	
	Physidae	Physella	sp.	41
		Physella	integra	2
	Pleuroceratidae	Pleurocera	sp.	4
			Total #	134
			# Species	16
	Shannon-Weaver	Diversity Index		2.66

Appendix B

Data from Two Year Study- Macroinvertebrates, continued.

October 12, 1995

class	family	genus	species	Rinker North #s
Crustacea	Palaemonidae	Palaemonetes	paludosus	44
	Astacidae	Procambarus	sp.	1
	Gammaridae	Gammarus	sp.	21
Arachnoidea	Lycosidae	Pirata	sp.	
	Tetragnathidae	Tetragnatha	sp.	6
	Filistatidae	Filistata	sp.	
		Pholcus	sp.	4
	Pisauridae	Dolomedes	sp.	2
Insecta	Belostomatidae	Belostoma	sp.	3
	Pleidae	Neoplea	sp.	3
	Naucoridae	Pelocoris	sp.	15
	Gerridae	Gerris	sp.	9
	Mesoveliidae	Mesovelia	sp.	3
	Chironomidae	Chironomus	sp.	2
	Psychodidae	Psychoda	sp.	1
	Coenagrionidae	Enallagma	sp.	3
		Ischnura	sp.	4
	Baetidae	Callibaetis	sp.	
		Baetis	sp.	1
		Siphlonurus	sp.	1
Gastropoda	Planorbidae	Helisoma	sp.	
		Drepanotrema	sp.	1
	Physidae	Physella	sp.	53
		Physella	integra	2
			Total #	179
			# Species	20
		Shannon-Weaver	Diversity Index	3.13

Appendix B
Data from Two Year Study- Macroinvertebrates, continued.

November 14, 1995

class	family	genus	species	Rinker North #s
Crustacea	Palaemonidae	Palaemonetes	paludosus	56
	Gammaridae	Gammarus	sp.	37
Insecta	Belostomatidae	Belostoma	sp.	
	Naucoridae	Pelocoris	sp.	2
	Gerridae	Gerris	sp.	3
	Mesoveliidae	Mesovelia	sp.	1
	Chironomidae	Chironomus	sp.	2
	Libellulidae	Celithemis	eponina	2
		Perithemis	tenera	1
	Coenagrionidae	Enallagma	sp.	2
		Ischnura	sp.	2
	Caenidae	Caenis	sp.	2
	Baetidae	Callibaetis	sp.	
		Baetis	sp.	2
	Oligoneuriidae	Isonychia	sp.	1
Gastropoda	Planorbidae	Helisoma	sp.	
		Polygyra	sp.	1
	Physidae	Physella	sp.	31
		Physella	integra	1
	Lymnaeidae	Lymnaea	sp.	
		Pseudosuccinea	columella	1
	Ampullariidae	Marisa	rotula	
		Pomacea	paludosa	1
			Total #	148
			# Species	18
		Shannon-Weaver	Diversity Index	2.54

Appendix B

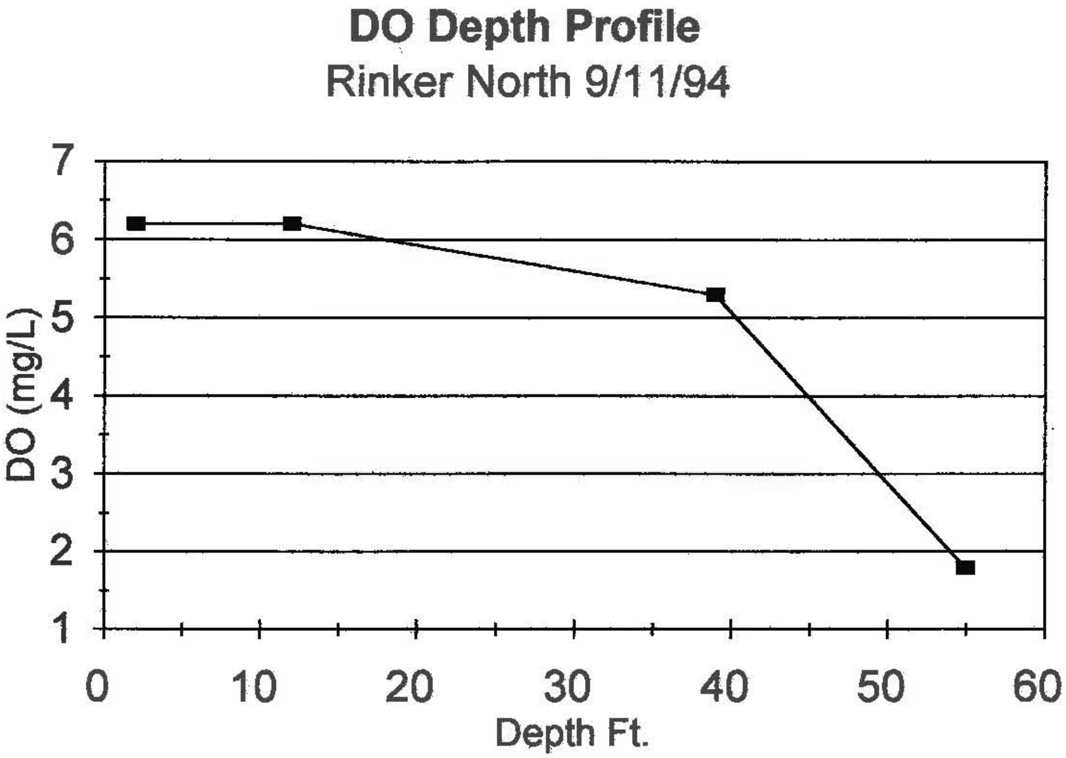
Data from Two Year Study- Macroinvertebrates, continued.

December 4, 1995

class	family	genus	species	Rinker North #s
Crustacea	Palaemonidae	Palaemonetes	paludosus	46
	Gammaridae	Gammarus	sp.	50
Arachnoidea	Lycosidae	Pirata	sp.	
	Tetragnathidae	Tetragnatha	sp.	14
	Filistatidae	Filistata	sp.	
		Pholcus	sp.	5
	Pisauridae	Dolomedes	sp.	1
Insecta	Belostomatidae	Belostoma	sp.	5
	Hydrometridae	Hydrometra	martini	4
	Gerridae	Gerris	sp.	6
		Trepobates	sp.	4
	Mesoveliidae	Mesovelia	sp.	3
	Chironomidae	Chironomus	sp.	2
	Libellulidae	Celithemis	eponina	2
		Pachydiplex	longipennis	1
	Coenagrionidae	Enallagma	sp.	
		Ischnura	sp.	1
	Baetidae	Callibaetis	sp.	
		Baetis	sp.	3
Gastropoda	Planorbidae	Helisoma	sp.	
	Physidae	Physella	sp.	34
		Physella	integra	2
	Lymnaeidae	Lymnaea	sp.	
		Pseudosuccinea	columella	4
			Total #	187
			# Species	18
		Shannon-Weaver	Diversity Index	3.05

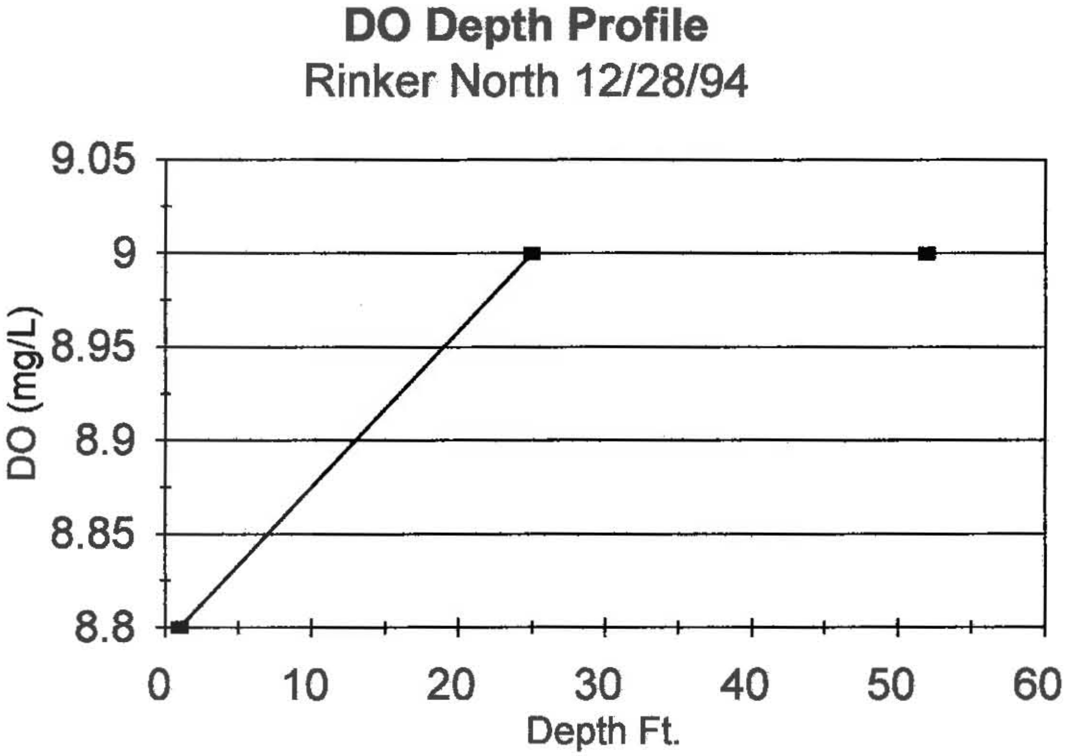
Appendix B

Data from Two Year Study- DO Profiles.



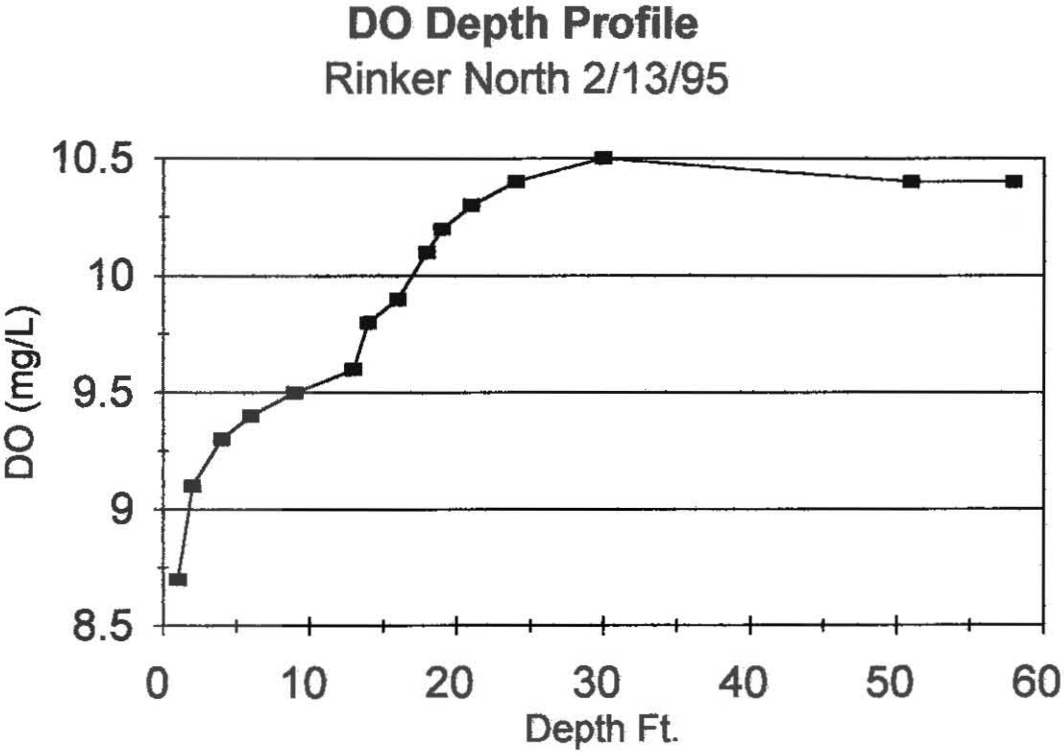
Appendix B

Data from Two Year Study- DO Profiles, continued.

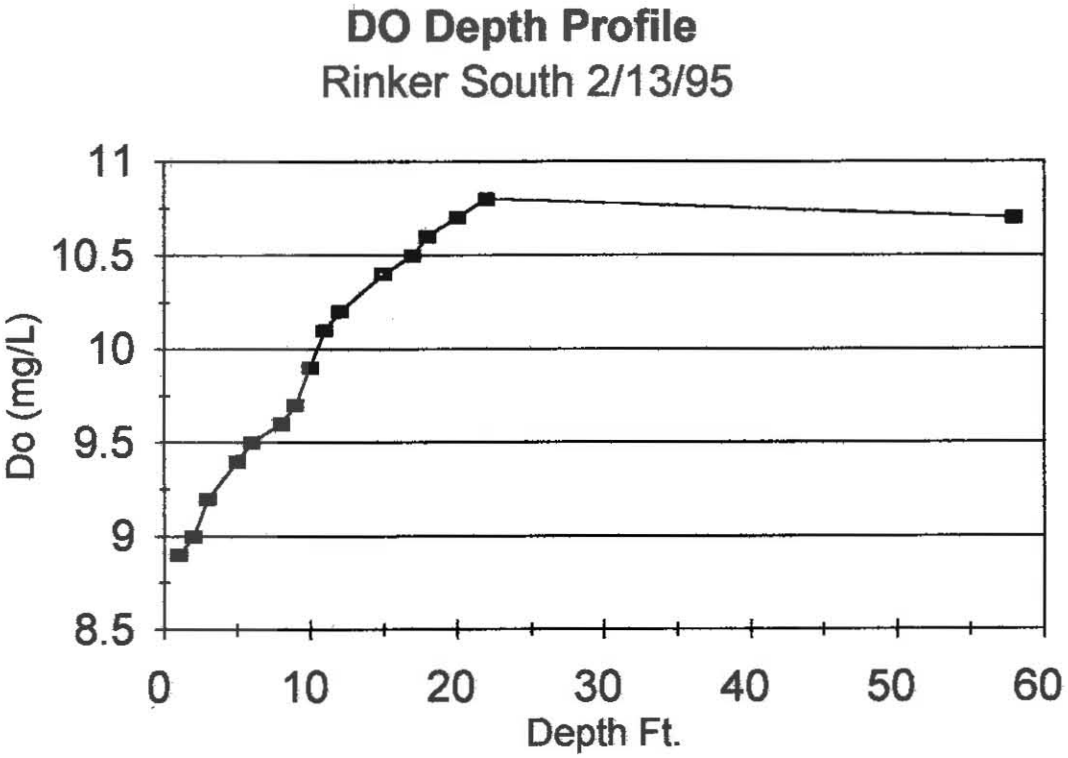


Appendix B

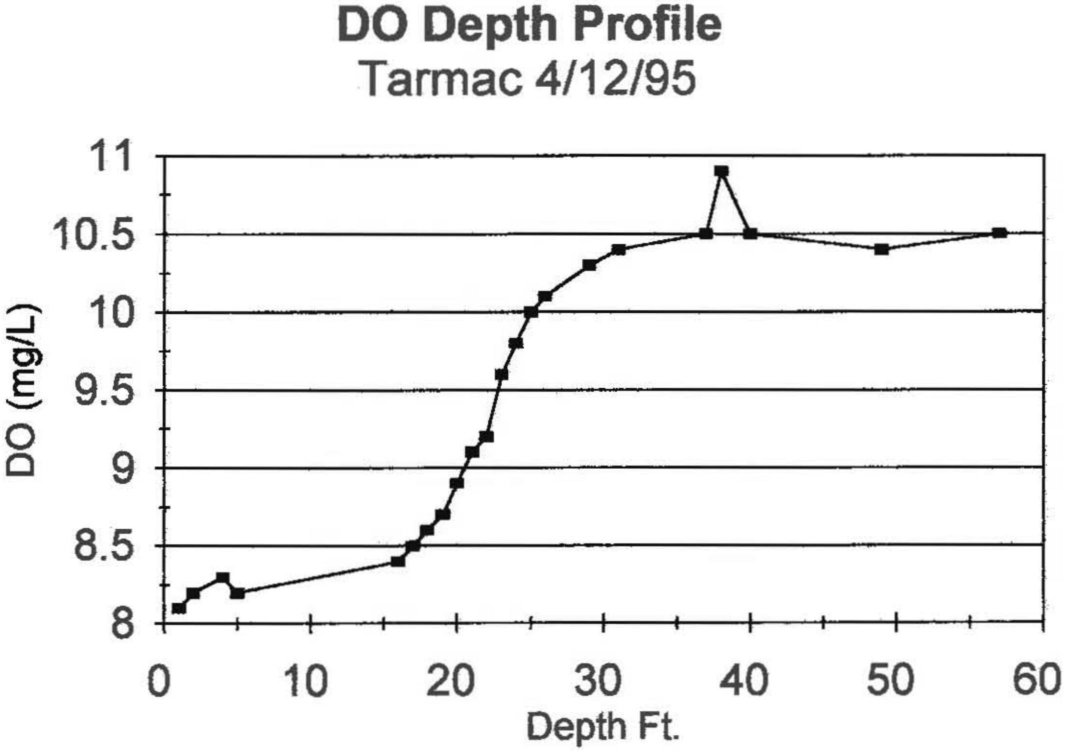
Data from Two Year Study- DO Profiles, continued.



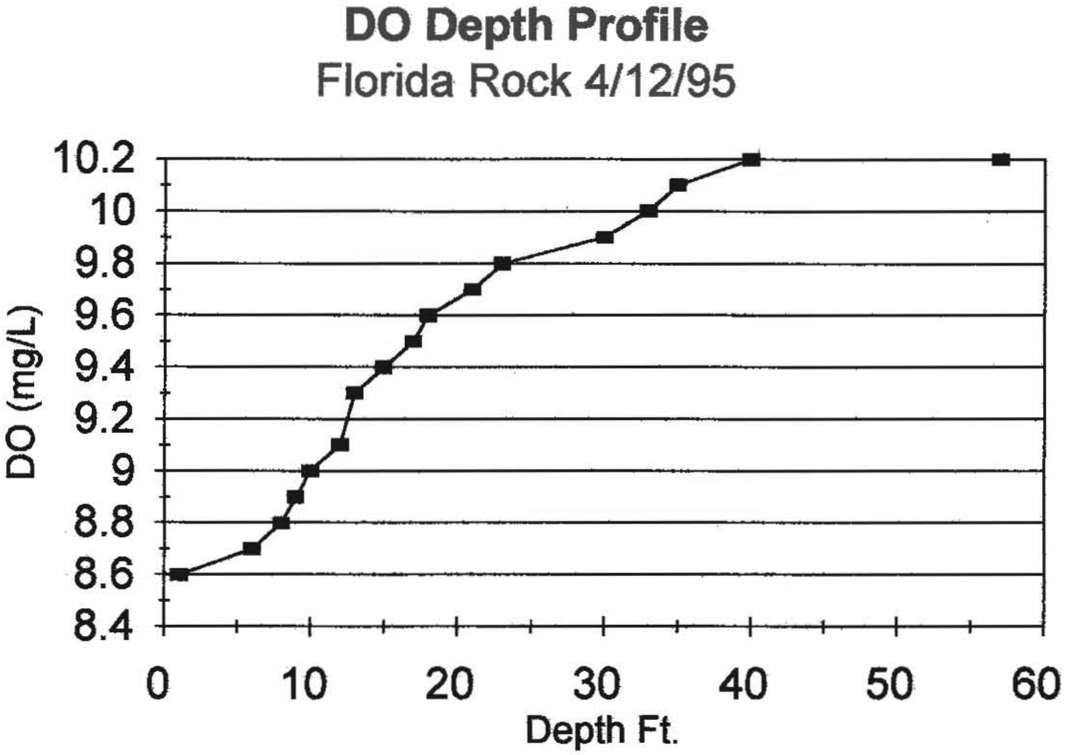
Appendix B
Data from Two Year Study- DO Profiles, continued.



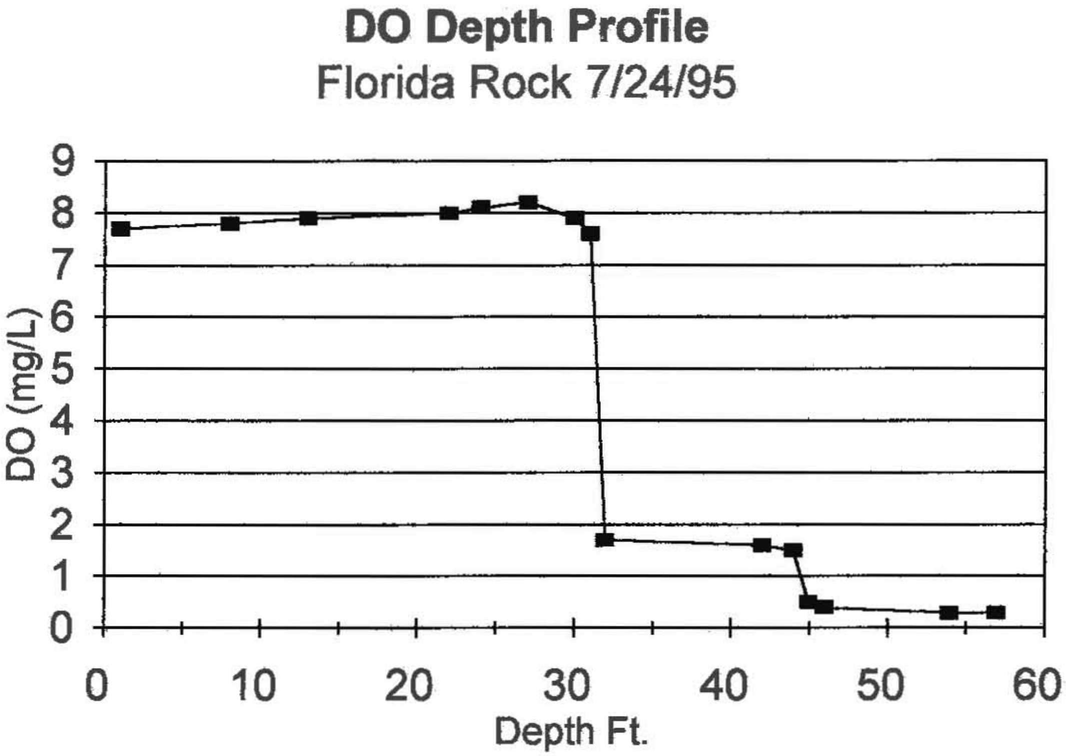
Appendix B
Data from Two Year Study- DO Profiles, continued.



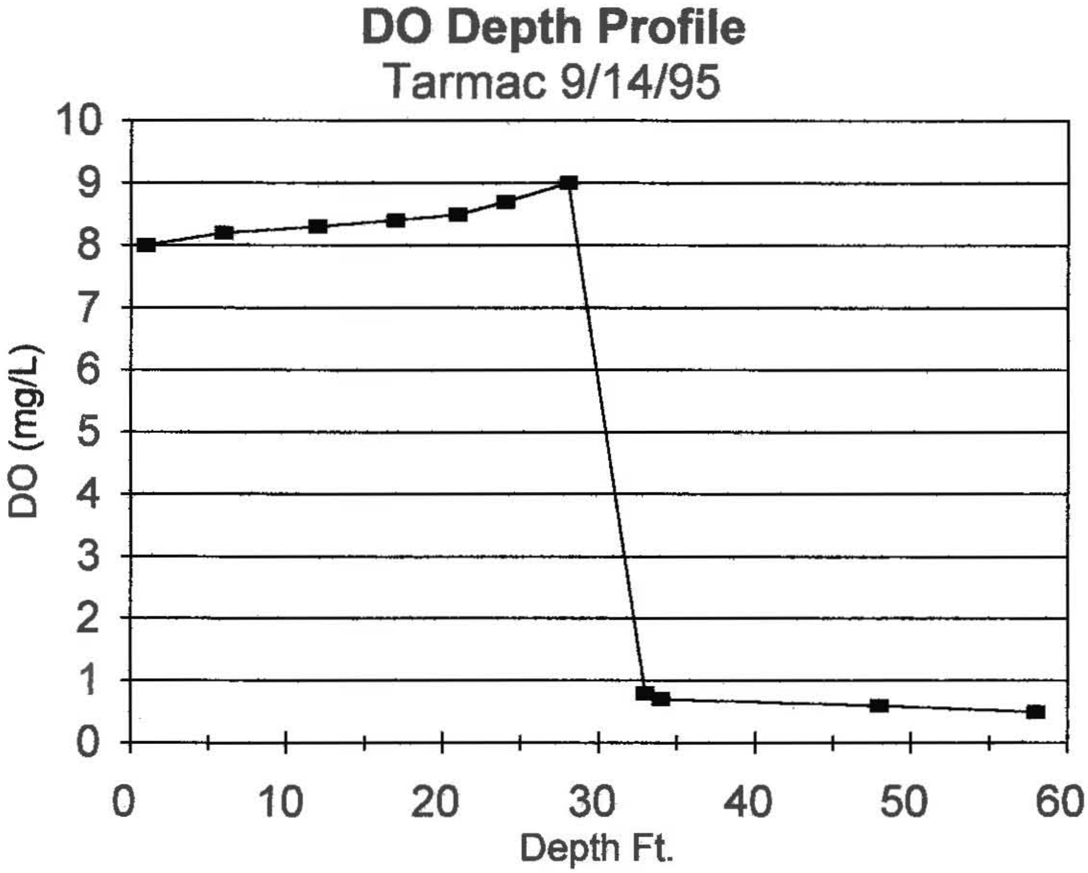
Appendix B
Data from Two Year Study- DO Profiles, continued.



Appendix B
Data from Two Year Study- DO Profiles, continued.



Appendix B
Data from Two Year Study- DO Profiles, continued.



Appendix B

DO Depth Data- Sept. 1994 - Sept. 1995

Rinker North	9/11/94		
Station	Depth Ft.	Temp ^{0}C	DO
North/Center	2	29.7	5.6
	37	29.3	5.1
	55	29	1.3
South/Center	2	29.9	6.2
	12	29.7	6.2
	39	29.4	5.3
	55	30.4	1.8
Rinker North	12/28/94		
North/Center	1	21.7	8.9
	25	20.9	10.7
	52	22.3	10.1
South/Center	1	21.9	8.8
	25	21.2	9
	52	20.9	9
Rinker North	2/13/95		
North/Center	1	18.5	9.1
	5	18.2	9.2
	10	18	9.3
	15	17.5	9.4
	17	17.3	9.5
	20	17.2	9.6
	23	16.8	9.7
	25	16.7	9.8
	28	16.6	9.9
	31	16.5	10
	35	16.4	10.1
	55	16.4	10.1

Appendix B

DO Depth Data- Sept. 1994 - Sept. 1995, Continued.

Rinker North 2/13/95

Station	Depth Ft.	Temp ^{0}C	DO
South/Center	1	21.2	8.7
	2	19.9	9.1
	4	19.5	9.3
	6	19.3	9.4
	9	19.1	9.5
	13	18.6	9.5
	14	18.2	9.8
	16	18.1	9.9
	18	17.7	10.1
	19	17.4	10.2
	21	17.2	10.3
	24	16.9	10.4
	30	16.8	10.5
	51	16.8	10.5
	55	16.8	10.4

Rinker South 2/13/95

Station Center	1	21.9	8.9
	2	21.5	9
	3	21.1	9.2
	5	20.2	9.4
	6	19.8	9.5
	8	19.4	9.6
	9	19.2	9.7
	10	18.6	9.9
	11	18.3	10.1
	12	18	10.2
	15	17.3	10.4
	17	16.9	10.5
	18	16.8	10.6
	20	16.6	10.7
	22	16.5	10.8
	50	16.6	10.7

Appendix B

DO Depth Data- Sept. 1994 - Sept. 1995, Continued.

Tarmac	4/12/95		
Station	Depth Ft.	Temp ^{0}C	DO
Center	1	25	8.1
	2	25	8.2
	4	25	8.3
	5	25	8.2
	16	24.7	8.4
	17	24.1	8.5
	18	23.9	8.6
	19	23.1	8.7
	20	22.5	8.9
	21	21.7	9.1
	22	21	9.2
	23	20.6	9.6
	24	19.8	9.8
	25	19.5	10
	26	19.3	10.1
	29	18.7	10.3
	31	18.3	10.4
	37	17.8	10.5
	38	17.7	10.9
	40	17.7	10.5
	49	17.6	10.4
	57	17.7	10.5

Appendix B

DO Depth Data- Sept. 1994 - Sept. 1995, Continued.

Florida Rock	4/12/95		
Station	Depth Ft.	Temp ^{0}C	DO
South Center	1	25.9	8.6
	6	25.4	8.7
	8	25.2	8.8
	9	24.9	8.9
	10	24.7	9
	12	24	9.1
	13	23.8	9.3
	15	23.5	9.4
	17	23	9.5
	18	22.9	9.6
	21	22.6	9.7
	23	22.4	9.8
	30	22.1	9.9
	33	21.7	10
	35	21.4	10.1
	40	21.2	10.2
	57	21.4	10.2

Florida Rock	7/14/95		
Station			
North/Center	1	32.4	7.7
	8	32	7.8
	13	30.7	7.9
	22	28.4	8
	24	27.4	8.1
	27	26.3	8.2
	30	24.9	7.9
	31	24.6	7.6
	32	23.8	1.7
	42	22.8	1.6
	44	22.7	1.5
	45	22.6	0.5
	46	22.6	0.4
	54	22.5	0.3
	57	22.5	0.3

Appendix B

DO Depth Data- Sept. 1994 - Sept. 1995, Continued.

Tarmac	9/14/95		
Station	Depth Ft.	Temp °C	DO
Center	1	29.5	8
	6	29.3	8.2
	12	28.8	8.3
	17	28.2	8.4
	21	27.2	8.5
	24	26.2	8.7
	28	24.1	9
	33	20.5	0.8
	34	20.1	0.7
	48	19.1	0.6
	58	19.1	0.5