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Perspective on the Ecological Causes and Effects of the Variable Algal Composition of Southern Everglades Periphyton

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Everglades National Park, South Florida Research Center, P.O. Box 279, Homestead, Florida 33030

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PERSPECTIVE ON THE ECOLOGICAL CAUSES AND EFFECTS OF THE VARIABLE ALGAL COMPOSITION OF SOUTHERN EVERGLADES PERIPHYTON

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PREFACE

This report is the first of four reports covering research performed by the Rosenstiel School of Marine and Atmospheric Science, University of Miami for the National Park Service under Contract CX-528081904. The primary research objectives are covered in Part I.

Part I is concerned with the taxonomic composition of the periphyton, factors affecting composition, and ramifications of compositional variation on aquatic animals that feed on periphyton. Part II discusses biomass and primary production of periphyton and associated macrophytes. In Part III, details of the methodology used to quantify taxonomic composition are presented. Part IV presents details of the aspect of the study relating periphyton taxonomic composition to aquatic animals. Participants in each part of the study are included as authors for each part. Other parts are:

Part II: Biomass and Primary Production of Microphytes and Macrophytes in Periphyton Habitats of the Southern Everglades

Part III: Methodology Development for Quantitative Analysis of Taxonomic Composition of Everglades Periphyton

Part IV: Comparisons of Laboratory Growth of *Hyla squirella* Tadpoles Fed Three Different Types of Periphyton

PART I

PERSPECTIVE ON THE ECOLOGICAL CAUSES AND EFFECTS OF THE VARIABLE ALGAL COMPOSITION OF SOUTHERN EVERGLADES PERIPHYTON

Joan Browder, Sally Black, Peter Schroeder, Melvin Brown,
Mark Newman, Dan Cottrell, David Black, Robert Pope, and Peck Pope

PART I

Perspective on the Ecological Causes and Effects of the Variable Algal Composition of Southern Everglades Periphyton

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INTRODUCTION

One of the most conspicuous features of shallow-water ecosystems in south Florida is the assemblage of calcium-carbonate-encrusted microscopic algae that surrounds the submerged parts of higher plants and, in some circumstances, covers the bottom like a blanket. Algal assemblages of this nature are found in shallow-water ecosystems throughout the world and are most commonly referred to as periphyton (meaning "around plants") or aufwuchs (German for "attached organisms") (Ruttner, 1972). Locally the material is called the algal mat.

Although more than 200 species of algae have been identified in the periphyton of south Florida (Van Meter-Kasanof, 1973; Gleason and Spackman, 1974; Wood and Maynard, 1974), not all of these occur at each site. A few species dominate the biomass.

Variation in taxonomic composition is found from site to site and is thought to be due to variation in physical and chemical characteristics of the aquatic environment. Different types of algae vary in their food quality, which affects the type and biomass of animals they can support; therefore locational differences in taxonomic composition of periphyton may be reflected in differences in species compositions and standing stocks of aquatic animals that depend upon periphyton as a source of food.

The physical and chemical environment of aquatic habitats in south Florida often are changed by water management. When this occurs aquatic animals may be affected not only directly but also indirectly, through a change in their food supply, due to the influence of the altered environment on periphyton taxonomic composition.

A study was conducted of the periphyton in Everglades National Park and the East Everglades 208 study area of Dade County for the following purposes:

(1) to provide a quantitative description of the gross taxonomic composition of periphyton in various aquatic habitats;

(2) to determine whether statistically significant differences in taxonomic composition between sites can be documented;

(3) to relate variation in periphyton taxonomic composition to variation in environmental variables; and

(4) to evaluate the relative potential value of periphyton of various taxonomic compositions as a food source for algal-feeding aquatic animals.

The objective of the study was to provide information to help guide water management planning and policy in Everglades National Park and southwestern Dade County.

METHODS

A quantitative method was developed to describe the relative representation of algal taxa in the periphyton. To determine seasonal and spatial differences in periphyton composition, samples were collected quarterly at 17 sites over the period of one year. Broader spatial coverage was provided with 40 additional samples collected at one point in time. Results from analyses of the 40 samples were plotted on two maps, one of the Dade County-East Everglades 208 area and the other of Taylor Slough in Everglades National Park. Data on physical and chemical characteristics of the water were collected at each station at the time of each periodic collection of periphyton. Hydroperiod characteristics for each site were estimated from U.S. Geological Survey data. Characteristics of the soil at each site were also determined. Biomasses of periphyton and macrophytic vegetation at the sites were determined. Statistical comparisons of algal representation between stations were made for each period and the mapping collections. Statistical relationships between algal representation and environmental and biological variables were explored. A periphyton feeding and growth study was conducted with one aquatic animal native to south Florida wetlands.

Periodic Sampling

Seventeen stations were selected. Twelve were in Everglades National Park (I-XII) and five were in the Dade County-East Everglades 208 study area (XIII-XVII). Ten of the park stations (I-X) and one of the county stations (XVI) were in Taylor Slough. Two park stations (XI and XII) and three county stations (XIII-XV) were in Shark Slough. One county station (XVII) was in the southeast coastal plain (Canal-111 area). The station locations are indicated in Figures 1 and 2 (the two park stations in Shark Slough cannot be shown in these figures). Table 1 shows the representation of higher plant communities at the stations. Fixed sampling sites were prepared by roping off a 16-square-meter (4 x 4) area in each location.

Stations were visited quarterly for approximately one year to cover the full cycle of seasonally-varying environmental conditions. The sampling period in the park extended from February through November, 1978. In the East Everglades 208 area, sampling was conducted from July, 1978, through March, 1979.

Three periphyton samples were collected on the stems of macrophytes at each station on each sampling date for the volumetric analysis. (Initially, samples were also collected from the substrate so that a comparison of stem periphyton and benthic or "mat" periphyton could be made.) FAA, a fixative (Smith, 1950), was added to the samples immediately upon collection. Physical and chemical parameters of the water that were measured in the field included depth, temperature, dissolved oxygen, pH, conductivity, alkalinity and salinity. Water samples were collected for laboratory analysis of concentrations of inorganic nitrogen ($N\text{-}NO_2$, $N\text{-}NO_3$, $N\text{-}NH_4$), total phosphorus, organic phosphorus, calcium and silica. Some missing values occur in the data records. These were caused by absence of standing water at the site on the sampling day, equipment failure, equipment unavailability, or loss of samples by the laboratory. At some of the stations, water depths were measured several times in addition to the four quarterly collecting times. Soil samples were collected once at each site to determine their relative composition-by-weight of organic material, calcium carbonate ($CaCO_3$) and residuals (silica sand).

Map Sampling

To broaden spatial coverage, one concentrated sampling effort was made and the results were placed on maps. Over a two-week period in May, 1979, periphyton samples were collected at 40 representative sites in the study area and subjected to volumetric analysis. Two maps were drawn -- one of the Taylor Slough area of Everglades National Park and the other of the East Everglades 208 area of Dade County. The base map for the Taylor Slough area was the vegetation map by Rintz and Loope (1978). The base map for the East Everglades 208 area was the vegetation map by Hilsenbeck, Hofstetter and Alexander (1979). Major macrophyte communities, as defined on the original maps, were included on the periphyton maps. Contour lines of height above mean sea level were superimposed on the East Everglades map. The biomass (total and organic) and taxonomic composition (percents volume blue-green and diatoms) of periphyton were indicated on the map at each sampling location. The periphyton maps were drawn at a scale of 1 to 50,000.

Hydrologic Parameters

Water depth was measured at each station each time it was visited. Water depths were measured at the same point (northwest corner stake) at each station each time. At least four water depth values, one for each season, were recorded for each station. More than four values were collected for stations visited more frequently than the quarterly sampling times. A continuous record of water depths at each sampling station during the study period was approximated by relating water depths at each station to water levels at the nearest U.S. Geological Survey continuously-recording station.

Based on the approximated continuous record, a new depth parameter was created in which values were standardized for day of the year and corrected for below-surface conditions by substituting negative values for zero values. In addition to "new depth," four hydroperiod indices were devised on the basis of the approximated record: "quarterly hydroperiod," representing the number of days (counting every fifth day) in the past 150 days when the water was above the estimated zero level at the station; "annual hydroperiod," representing the number of days (counting every fifth day) in the period from October, 1978, through December, 1979, when the water was above the estimated zero level at the station; "time since drought," the number of days (counting every fifth day) since water levels were below the estimated zero level at a station for at least 30 days (counting from December 31, 1978); and length of the last drought of 30 days or more (counting from December 31, 1978). A minimum threshhold of 30 days was selected because this was thought to be the approximate time it would take for surface moisture to entirely evaporate and actual dry conditions to prevail.

Water Quality Analyses

Listed below are the water quality measurements made in the field, and the method and/or the instruments used. All instruments and titration apparatus were calibrated in the laboratory before each field sampling session. The pH meter was also periodically checked in the field using a standard buffer solution. The dissolved oxygen meter was calibrated before each field measurement. In addition, duplicate dissolved oxygen samples were taken and fixed in the field. The samples were returned to the laboratory and titrated using the standard Winkler method (see APHA, 1976). These samples were used as a cross check for the dissolved-oxygen meter. Alkalinity was determined using both the phenolphthalein and methyl-orange end points. See APHA (1976) for a detailed description of this method.

Measurement	Instrument and/or Method
pH	Orion Portable Model 4D7A Specific Ion Meter and Orion combination pH electrode
Salinity	Yellow Springs Instruments Portable Model 33 Salinity/Conductivity/Temperature Meter
Conductivity	Same as above
Temperature	Same as above
Dissolved Oxygen	Yellow Springs Instruments Portable Model 57 Dissolved Oxygen Meter, Standard Winkler titrations
Alkalinity	Titration using both phenolphthalein and Methyl Orange indicators

All methods used for the water analysis are "Standard Methods" approved by Environmental Protection Agency and/or the American Public Health Association, American Water Works Association and Water Pollution Control Federation. Nitrate, nitrite, ammonia, silica and ortho phosphorus were determined using a Technicon Auto-Analyzer. The methods used are described in EPA (1979). Inorganic and organic carbon were determined using a Beckman Model-915 Total-Carbon Analyzer. The operation of this unit and the method of analysis is described in EPA (1979) and APHA (1976). Calcium was determined using a Perkin-Elmer Atomic absorption unit. This method is described in EPA (1979) and APHA (1976).

Since many of the measured parameters change diurnally due to direct or indirect effects of photosynthetic activity, time of day of field measurement (or collection) was part of the data recorded with all water quality measurements.

In addition to periodic sampling, a special "round-robin" of pH and dissolved-oxygen measurements was conducted at Taylor Slough stations on August 8, 1978, and at East Everglades Shark Slough stations on August 10. In the round-robin exercise, stations were visited and measurements taken consecutively throughout the day, from sunrise to sunset. Most stations were visited at least twice. Measurements for all stations of each area were plotted together on graphs.

Soil Analysis

The upper 2 cm of sediment underlying the algae mat was collected for analysis of the weight percent of organic matter and calcium carbonate in the soil. Samples were obtained after harvesting the overlying mat at each site.

Weight percents of both organic matter and calcium carbonate were found by a simple loss-on-ignition procedure suggested by Dean (1974). The procedure is simple and utilizes a minimal amount of sample handling.

Approximately three to five grams of oven-dried and ground sediment were placed into pre-weighed, pre-combusted crucibles. The sample-filled cruicibles were placed in the drying oven for 24 hours, and then weighed to the nearest 0.1 mg. After weighing, the crucibles were placed in a muffle furnace and burned at 550^{o}C for four hours and re-weighed for weight loss. The sample was subjected to a second burning at 1000^{o}C for four hours to obtain the weight percent of calcium carbonate as carbon dioxide. For the calcium carbonate analysis, a sample standard of reagent grade calcium carbonate (99.99%) was used. Weight percent of calcium carbonate was obtained by multiplying the weight percent of carbon dioxide lost by ignition times 2.272.

Biomass Measurements

A one-square-meter sample was harvested at each station on each sampling date. The material was processed in such a way that separate estimates of the following categories of biomass was obtained: total periphyton, organic periphyton, live standing macrophytes, live submergent macrophytes, dead standing macrophytes, and dead prostrate macrophytes.

Volumetric Analysis

A quantitative method was developed to describe the relative contributions of the major algal taxonomic groups to the total algal volume of the periphyton. The method was based on estimation-of-volume-by-eye under the microscope, aided by a micrometer and standard equations for geometric shapes. The method is similar to that described in Standard Methods (APHA, 1955) and those utilized by several previous investigators (Gruendling, 1971; Moore, 1974a, b, c and d). Major taxa, rather than species or genera, were considered to avoid statistical problems (Kutkuhn, 1958) and to simplify the technique, reducing the requirements for processing time and expertise. Major taxonomic groups commonly are referred to as gross ecological units in the literature (Round, 1965; Prescott, 1962; and others). Relative volumes of blue-green algae, green algae and diatoms in periphyton at each station were determined for quarters one through three. In fourth and fifth quarter samples, relative volume of desmids was determined separately from that of other green algae, because they are ecologically distinct from them. Desmids are known to be favored by low pH-environments, whereas the types of other green algae of significance in the samples are noted for their occurrence in high-pH environments (Prescott, 1962). Volumetric analysis also was applied to the mapping samples.

For each station, 60 fields on 6 slides (2 from each sample) were subjected to the volumetric treatment. Total fields were examined. Blue-greens and diatoms were examined in x400 fields. Desmids and other greens were examined in x100 fields. A conversion factor was used to standardize the field size. Measurements were performed under Tasco professional-model and Zeiss research-model binocular microscopes.

Percents volume of dominant genera were determined by pooling the samples for each station and determining the percentage contribution of the obviously-more-important genera to the total volume of their major algal group. Dominant genera were defined for this study as those genera making up the first 50% of algal volume.

Statistical Analyses

Hotelling-T^2 Test

Hotelling-T^2 means and standard deviations of percents volume of algal taxa were determined for each site on each sampling date, based on microscopic field averages for each slide. Hotelling-T^2 analysis, a multivariate statistical technique (Morrison, 1976), was applied to the volumetric data to test the statistical significance of taxonomic differences between sites. The test was based on the two parameters, "percent volume blue-greens" and "percent volume diatoms." Groups were formed of stations that (1) were not significantly different at $p < 0.1$ from each other and (2) were significantly different at at least $p < 0.1$ from all stations in other groups. These criteria could not always be strictly adhered to, and exceptions, where they occurred, are noted with the results.

Correlation-Regression Analysis

Simultaneous correlation-regression analyses were performed to explore potential relationships between taxonomic composition and conditions of the habitat, including environmental factors and several quantifiable biological factors. Potential relationships between the various environmental factors were also explored. Statistical parameters that were obtained were (A) those of simple linear regression analysis: (1) regression coefficient, (2) intercept, (3) standard error of estimate, (4) T-test of regression coefficient (to determine if significantly different from zero), (5) coefficient of determination (an estimate of the fraction of the variation in the dependent variable that cna be explained by variation in the independent variable), and (6) Durbin-Watson statistic (a test for first order autocorrelation in the residuals); and (B) those of correlation analysis: (1) coefficient of correlation and (2) probability level of the correlation coefficient based on an F test. Percentage values (proportions) were arcsin transformed for the analyses (Snedecor and Cochran, 1967). Quarterly values were analyzed separately.

Parameters for the analyses were as follows:

Taxonomic composition parameters: percent blue-green algae (by volume), percent green algae, percent diatoms, and, for Quarter 4 only, percent desmids (separated from other green algae).

Chemical composition parameters: percent organic in periphyton (the converse of percent $CaCO_3$ in periphyton).

Water quality parameters: pH, dissolved oxygen, temperature, alkalinity, salinity, silica, calcium, conductivity, inorganic nitrogen (nitrate, nitrite, and ammonia), and inorganic phosphorus.

Soil composition parameters: percent soil organic, percent soil $CaCO_3$, and percent soil residuals.

Hydrologic parameters: depth, new depth (corrected for zero values and for differences in sampling dates) quarterly hydroperiod (hydroperiod of preceding 150 days), annual hydroperiod (hydroperiod of the 455-day study period), length of last drought (of 30 days or more), and time since last drought (of 30 days or more).

Biological parameters: organic periphyton biomass, total periphyton biomass, combined organic periphyton and submergent macrophyte biomass, total macrophyte biomass, live macrophyte biomass, live standing macrophyte biomass, total dead macrophyte biomass, and dead prostrate macrophyte biomass.

Other parameters: time of day

Multiple Regression Analysis

Multiple regressions were developed using parameters selected on the basis of the results of the correlation analyses. A stepwise multiple linear regression program was used. All statistical analyses were performed on a Commodore-PET Computer using programs in BASIC specifically written or adapted for the PET.

Feeding and Growth Experiment

Three different periphyton rations, "high blue-green," "high green" and "high diatom," were tested for their effect on growth of tadpoles of

Hyla squirella, the squirrel tree frog. A total of 360 tadpoles of approximately equal size, collected from the environment, were separated equally into eight aquaria (allowing two aquaria replicates for each ration) and fed the periphyton rations and a control ration (a tadpole feed from Carolina Biological Supply) for 10 days, after which they were harvested, dried and weighed, and their mean terminal weights compared with mean weights of two additional groups of 45 tadpoles each that had been dried and weighed at the beginning of the experiment. Analysis of variance was used for comparison of treatment pairs.

RESULTS

Physical and Chemical Characteristics of the Environment

Table 2 represents the range of environmental conditions for all measured stations each quarter. Both measured and derived parameters are given. A complete record of measurements is given in Appendix A.

The markedly different water quality characteristics of Taylor Slough and Shark Slough were reflected in our measurements. Alkalinity and conductivity were extremely high at Shark Slough stations that received effluent from Canal-67-extended (XII, XIII, XIV and XV). Salinities at the Shark Slough stations also were high relative to those measured in Taylor Slough and were comparable to those measured at the site near Canal-111 (XVII). Salinities were essentially zero (or at least below the detectable level) at all Taylor Slough sites (I-X) for all but third-quarter sampling. Water quality characteristics of the site near Grossman's Hammock (XVI) indicated that the site was not influenced by artesian water from the flowing well. Organic carbon concentrations were from two to three times higher at Shark Slough sites than at all other sites. Concentrations of inorganic nitrogen were no higher in Shark Slough than in Taylor Slough. Consistently highest concentrations were found near Canal-31 (I) and Canal-111 (XVII). The extremely high value given as the upper end of the range of inorganic nitrogen for Quarter 4 occurred at Station IX and is an aberrant for which we have no explanation. Corresponding phosphorus values were not high enough to support contamination from the death of an animal at the site as a probable cause. Highest concentrations of inorganic phosphorus occurred at Taylor Slough stations IV, VI and X during third-quarter sampling. Organic phosphorus concentrations were similarly high.

The sites could be separated into four fairly distinct groups on the basis of percent organic matter content. Stations having greater than 50% organic matter were VI, VIII, and XII. Those having between 25 and 49.9% organic matter were XIII, XIV, and XV. Station XVI had over 20% (but less than 24.9%) organic matter and was distinguished by having a high residual content (25%) compared to the other stations. The residual was thought to be quartz sand. The rest of the stations had less than 20% organic matter in their soils. Complete results of the soil analysis are given in Appendix A.

Round-robin Diel Measurement of Dissolved Oxygen and pH

Chemical water parameters such as dissolved oxygen and pH change diurnally due to the photosynthetic activity of algae and submerged macrophytes. Figures 3 through 6 display results of a round-robin experiment in which all the stations in one area were visited consecutively with a repeating schedule over the same day for measurement of dissolved oxygen and pH. Each curve gives a generalized picture of diel change in dissolved oxygen and pH at all of the stations of an area. Stations that do not appear to fit on the curve may be intrinsically different, particularly if they are well off the curve at two or more points. For instance, in Figure 3, which is a round-robin dissolved-oxygen diel curve of the Taylor Slough Park sites on August 8, 1978, the canal points (all I's in this case) are obviously not a part of the same curve as the periphyton stations. If only one point at a station falls below the curve it may be due to cloud cover. Figure 4 gives a generalized picture of diel change in dissolved oxygen at the Dade County-East Everglades 208 sites in northeast Shark Slough on August 10, 1978.

Figures 5 and 6 are round-robin diels of pH at the two sites on the above dates. The generalized diel pH curves indicate that the daily range in pH is not as great at the Shark Slough sites as at the Taylor Slough sites, although photosynthetic activity, as indicated by the dissolved-oxygen diels, is just as intense. This is a possible indication of the "buffering" effect of organic material, which was found in abundance in bottom sediments at the Shark Slough site.

Hydroperiod

Measured values for water depth and calculated values for "new depth" and the four hydroperiod indices are given in Tables 3 and 4. If stations were ranked in order from wettest to driest according to each parameter, a slightly different order would result each time. Attempting to rank by depth or even new depth is confusing, because the order changes each quarter, probably because the amplitude of seasonal variation in water depths varies from one area to another, as can be noted in the Appendix B figures. Of the five indices, time-since-last-drought provides the most clear-cut distinction between stations. According to this parameter, the ranking of stations, from wettest to driest, is: XIII, XII, VIII, IX and VI, IV and VII, X, I and II, III and XI, and V. Values for this index could not be estimated for Stations XIV, XV, XVI, and XVII. All hydroperiod indices are in terms of every fifth day and should be multiplied by five to determine actual number of days represented.

In the plots used to calculate the five parameters (Appendix B, Figures B-1-10), the left ordinate is water level (relative to mean sea level) at the U.S.G.S. continuous-recording station nearest to each sampling station. The right ordinate on each plot indicates the calculated corresponding water depth at the sampling station. The horizontal line across the plot indicates the zero depth line (elevation) at the sampling station. Water levels for every fifth day from September 30, 1977, through December 31, 1978, are plotted for Stations I through XII. Plots are continued through March 31, 1979, for stations XIII and XIV.

The U.S.G.S. stations and corresponding sampling stations were as follows:

Taylor Slough at bridge (at S.R. 29)	I, II, III, IV, V
Taylor Slough at Royal Palm	VI, VII, VIII
Taylor Slough at Madeira Ditch	IX, X
Shark Slough at P-33	XI, XII
Shark Slough at south end of C-67	XIII, XIV
C-111	XVII

The regression equations used to relate sampling-station water depth to U.S.G.S.-station water levels are given in Appendix B, Table 1. The R^2 value given for each equation indicates the proportion of variation in our station water depths that can be explained by variation in U.S.G.S.-station water levels. R^2's for six stations exceeded 0.95. For an additional five, R^2's ranged from 0.69 to 0.87. Regression equations for stations I, II, II, and V are not given in Appendix Table B-1, because they were not used. The zero-depth lines calculated from regression equations for Stations I, II, III and V were not realistic, according to actually measured depths of zero (or below). The lack of reliable projections from regression results at these stations was probably due to the fact that water levels were below ground level at the time of two quarterly measurements, which increased the potential for error. Zero depth lines for these stations were estimated on the Taylor Slough bridge plot on the basis of their estimated elevation relative to Station IV. Zero-depth lines for Stations I, II, III, IV and V are shown in Appendix Figure B-1. Water depths on the right ordinate are those calculated for Station IV.

Appendix Figures B-2-10 show the calculated water depths and zero depth lines at Stations VI through XIV. Hydroperiod indices for Station XVII were calculated without a plot.

Biomass of Periphyton and Macrophytes

The average quarterly values for the five biomass compartments each quarter are given in Table 5.

Ranges of the biomass values used in statistical analyses can be found in Table 6. The five biomass compartments distinguished were organic periphyton, live standing macrophytes, live submergent macrophytes, dead standing macrophytes, and dead prostrate macrophytes. In general, the total biomass of macrophytes exceeded the organic biomass of periphyton, although the sampling sites had been placed only where periphyton was conspicuously present. Average organic periphyton biomass exceeded live macrophyte biomass but was less than dead macrophyte biomass. Of the five compartments, dead standing macrophytes had the largest biomass in three out of four quarters. It was exceeded by organic periphyton biomass only in Quarter 4. The live submergent macrophyte compartment consistently had the lowest biomass.

Quarterly Percent Volumes of Major Taxa

Listed in Table 7 are quarterly station means of relative taxal volumes. Standard deviations are given with the means in Appendix C. Blue-green algae were the predominant group. Diatoms were next in importance, based on representation by volume. Desmids consistently made a very minor contribution to algal volume. The other green algae were important only at a few stations.

An increase in the proportions of green algae and diatoms from first quarter, which was the dry season, to fourth quarter, which was the late part of the flooded period, was noted at those stations which had dried in the spring and been flooded continuously through summer, fall and early winter. The increase was not as great at stations which dried in mid-summer as well as in spring. The percentages of diatoms and green algae at locations that had been wet all year were much higher than at the other stations but declined from their spring and early summer levels or remained about the same over the one-year sampling period.

The overall average blue-green volumes for Stations I through XII, which were measured during all of the first four quarters (Stations XIII through XVII were not measured Quarter 1), were 90.26%, 83.89%, 85.33% and 84.54% for Quarters 1 through 4 respectively. The fourth quarter mean was significantly different ($p < 0.1$) from first, second and third quarter means, which were not significantly different from each other. The fourth quarter mean had a much lower standard deviation than that of the other quarters, indicating that taxonomic composition had become more similar. The annual average volume percents of each taxa at each station are given in Table 8.

Dominant Genera

The dominant genera of algae in the quarterly periphyton samples are given for each station in Tables 9 through 13. In Tables 10 through 13, only those genera making up the first 50% of volume are shown. On the basis of volume, Scytonema clearly was the dominant genus, making up 50% or more of volume at most stations. Schizothrix was more important than the tables indicate because it was second in volume at most of those stations where Scytonema made up 50% or more of volume. Spirogyra and Bulbochaete were the only green algae of major consequence in terms of volume. Cymbella was the most important diatom, followed (not in order) by Gomphorema, Mastigloea, Amphora, Navicula and Synedra. No attempt was made to identify algae to the species level due to the complexity of the systematics of everglades-periphyton algae, particularly the blue-green algae.

Comparison of Station Pairs

Results of the Hotelling-T^2 tests are summarized in Figure 7, in which the frequencies of statistical levels for pair comparisons are indicated in histograms. Results are shown in matrix form for each station pair in Appendix D. Determined levels of significance ranged from $p < 0.1$ to $p < 0.001$. Significant differences at $p < 0.001$ were noted in many station pairs. The Hotelling-T^2 test demonstrated that the method of measurement developed by the study was sufficiently precise to allow differences between stations to be detected on a statistically-sound basis. The histograms show a seasonal progression of greater similarity between stations.

Groupings formed on the basis of Hotelling-T^2 results are given in Tables 14 through 17. With a few exceptions, which are noted in the tables, distinct groups of stations could be delineated from the periodic samples on the basis of guidelines described in Methods. These groupings were not fixed but changed to some extent from one period to another. It was not possible to group the mapping samples.

Maps

The maps are Appendix E of this report. Very high percents volume of blue-green algae were found in most of the samples, which had been collected approximately one month following reflooding after a severe, though short, winter-spring drought. With one exception, stations with a substantial representation of green algae and diatoms were those falling within the 5.5 ft-MSL contour line in Shark Slough. The area within this contour line falls in the central, deepest portion of the slough. Although we have no records of water conditions at these locations to allow a conclusive determination, we think it likely that these stations did not dry or were dry only briefly during the winter-spring drought.

Potential Relationships

The correlation coefficients between environmental parameters for which relationships might be expected on a theoretical basis are shown in Tables 18, 19 and 20. Statistically significant correlations (according to computed F-ratios) are indicated with superscripts denoting significance levels.

Correlation coefficients between conductivity and some related water quality parameters - alkalinity, salinity, and silica - are given in Table 18. Although both alkalinity and salinity were correlated with conductivity, they were not correlated with each other. Correlation of conductivity with salinity was stronger than with alkalinity. Conductivity was not correlated with alkalinity Quarter 1. Alkalinity and silica were correlated Quarters 2, 3 and 4 but not Quarter 1.

Correlation coefficients for time of day and diurnally-varying water quality parameters are given in Table 19. Also given in Table 19 is the correlation coefficient between pH and percent soil organic matter. pH was negatively correlated with time-of-day Quarter 1. Both pH and dissolved oxygen were positively correlated with time-of-day Quarters 2 and 3. pH was not correlated with time of day Quarter 1. Dissolved oxygen was not measured Quarter 4. pH was positively correlated with percent soil organic matter Quarter 2 only.

A high degree of correlation between percent soil organic matter and depth and hydroperiod parameters is indicated by Table 20.

Correlation coefficients for each algal taxa with environmental and biological parameters are presented in Table 21. Tables 22, 23 and 24 summarize the significant correlations according to algal taxon, quarter, and environmental or biological parameter, respectively.

Of the algal taxa, diatoms had the greatest number of significant correlations and the highest proportion of correlations in the higher significance-level categories. Blue-green algae had a higher frequency of correlations than green algae. The frequency of desmid correlations was not comparable since data were available for Quarter 4 only.

Fewest significant correlations were found Quarter 1. The number of significant correlations increased over the sampling period, which progressed from dry season through the wet season and from spring through winter.

Soil organic matter and two indices of hydroperiod, annual hydroperiod and time-since-last-drought, were the most-frequently-correlated parameters. The character of the correlations changed somewhat from quarter to quarter. The soil and hydrologic parameters accounted for most of the correlations in Quarter 2 and increased in importance Quarter 3. Water quality parameters correlated to their greatest extent in Quarter 1 and also were important Quarter 4. Correlations with biological parameters, particularly macrophyte biomass, were found primarily in Quarter 4.

The proportion of algal volume as diatoms was positively correlated with soil organic matter, hydrologic conditions, and nitrogen in the spring. Soil and hydrologic conditions correlated with diatoms during the summer and early fall. Biological parameters and water quality parameters such as conductivity were correlated with diatoms in the late fall and early winter, the periods of sustained high water.

Correlations between environmental parameters and percent algal volume as blue-green algae were at a maximum during Quarters 2 and 3.

Correlations of diatoms and green algae tended to be in the same direction, whereas correlations of blue-green algae were opposite to those of diatoms and green algae. An inverse relationship with blue-green algae did not appear to be the case with desmids, but significant correlations were so spotty for this taxon that reliable comparisons were not possible.

The corrected depth parameter, new-depth, which was expected to be a better indication of relative "wetness" of the study sites than the actual measured depth, was not as well correlated with taxonomic composition as uncorrected depth. Three of the hydroperiod indices -- quarterly hydroperiod, annual hydroperiod, and time-since-last-drought -- correlated more frequently with taxonomic composition than either depth parameter.

Although simple linear regressions were performed, results did not add to our understanding of relationships beyond what we had learned from correlation analysis because the independent variables had been measured with error, an unavoidable situation. Measurement error in the independent variable causes the estimated regression coefficient to be lower than its actual value. This lowers its t-statistic and makes the t-statistic less likely to be above the critical level indicating significance.

Several stepwise multiple regressions that were performed yielded statistically significant regression coefficients despite the short-comings of the independent variables. Multiple regression results indicated that the two parameters, percent soil organic and time-of-day-of-measurement, could account for from 32% to 84% of the variability in pH measurements at the study sites during the four quarters. During quarters when the relationship with time-of-day was positive, that with percent soil organic was negative. Conversely, when the relationship of pH to time-of-day was negative that with percent soil organic was positive.

Stepwise multiple regressions were used to explore the relationship between algal composition and a combination of environmental parameters in data for each quarter. Proportion of volume as blue-green algae was selected as the dependent variable in these regressions.

Data sets for Quarters 1 and 2 had so many missing values, largely due to the fact that a number of stations were not flooded at these times (water quality measurements could not be made where there was no standing water) that multiple regression results should be interpreted cautiously. Sample sizes for Quarters 3 and 4 multiple regressions were much larger.

Variation in nitrogen alone explained 96.79% of the variation in proportion of volume as blue-green algae for the five stations included in the regression. Addition of a second paramter, total macrophyte biomass, improved the regression equation slightly ($R^2 = 0.9741$), but the regression coefficient for this parameter was not significant at $p < 0.05$ (not significantly different from zero), according to the t-test. The equation is:

$$Y = 0.1182 - 0.00102X_1 - 0.0000054X_2$$

where y is proportion volume as blue-green algae (transformed), X_1 is inorganic nitrogen, and X_2 is total macrophyte biomass.

In a multiple regression equation with Quarter 2 data, 92.7% of the variation in proportion of volume as blue-green algae could be explained by variation in the four parameters -- proportion soil organic matter, conductivity, depth, and time-since-drought -- loaded in that order. The sample size was so small ($n = 7$), however, that the regression coefficient for conductivity was the only one that was statistically significant at $p < 0.05$. Regression coefficients for proportion soil organic matter and water depth were significant at $p < 0.1$. This equation is:

$$Y = 0.0724 - 1.1139X_1 + 0.0001304X_2 + 0.001846X_3 - 0.00003952X_4$$

where Y is proportion volume as blue-green algae (transformed), X_1 is proportion soil organic (transformed), X_2 is specific conductance, X_3 is water depth, and X_4 is time-since-last-drought.

In the analysis of Quarter 3 data, we started the multiple regression test with the three parameters -- percent soil organic, hydroperiod and conductivity -- variations in which were able to explain 61% of the variation in percent volume of blue-green algae ($p < 0.01$). Replacing conductivity with salinity raised the explained variance to 66.5% ($p < 0.005$). The addition of nitrogen raised explained variance to 76% ($p < 0.01$), but the t-statistics suggested that the regression coefficients for all variables but percent soil organic were not significant in this relationship. (We had lost four data points by the inclusion of the nitrogen parameter.) Adding alkalinity to the regression equation, although it improved the explained variance slightly, did not yield a statistically significant relationship. Missing values in both the nitrogen and alkalinity data sets may have been partially responsible for the poorer statistics for these variables.

The strongest statistical relationship was one that included the following four parameters -- percent soil organic, salinity, quarterly hydroperiod, and depth -- loaded in that order. Combined variation in these parameters explained 70% of variance in the dependent variable ($p < 0.01$), and t-statistics for all parameters except depth were statistically significant ($p < 0.05$). Adding the depth parameter actually improved the t-statistic for quarterly hydroperiod without adversely affecting the t-statistics of the other parameters to any great extent (and without dropping any data points). Considering the multicollinearity in this regression, three out of the four independent variables (percent soil organic, quarterly hydroperiod and depth) being strongly correlated, it is remarkable that three out of the four regression coefficients were statistically significant, according to their t-statistics (Hu, 1973). This suggests the existence of independent effects of these three variables.

The equation for the best relationship was:

$$Y = 0.11932 - 0.51677X_1 - 0.01954X_2 - 0.00055X_3 + 0.00046X_4$$

where Y is proportion volume as blue-green algae (transformed), X_1 is percent soil organic (transformed), X_2 is salinity, X_3 is quarterly hydroperiod and X_4 is water depth. Results of other multiple regressions are given in Appendix F.

A stepwise multiple regression analysis of Quarter 4 data resulted in an equation that explained 78.54% of the variation in blue-green algae by the variation in these parameters -- soil organic matter, total macrophyte biomass, and quarterly hydroperiod -- loaded in that order.

The first two parameters were highly significant ($p < 0.001$). The third was not significant ($p > 0.1$). The equation is:

$$Y = 0.02978 + 0.7498X_1 - 0.0004X_2 - 0.00038X_3$$

where Y is proportion volume as blue-green algae (transformed), X_1 is proportion soil organic matter (transformed), X_2 is total macrophyte biomass, and X_3 is quarterly hydroperiod.

In summary, stepwise multiple regression results indicated the following: (1) Inorganic nitrogen in the water was the major determinant of algal composition at flooded stations in the spring (Quarter 1). Total macrophyte biomass possibly also was a factor, perhaps due to a shading effect. (2) Conductivity played a major role in algal composition at flooded stations in the early summer (Quarter 2). Soil organic matter and water depth probably also were important, and time-since-last-drought may have had some effect. (3) Soil organic matter, water salinity, and quarterly hydroperiod were major factors affecting algal composition in late summer (Quarter 3). Water depth probably also played a role. (4) Soil organic matter and total macrophyte biomass were the major determinants of algal composition in late fall-early winter (Quarter 4).

Effects of Periphyton Rations on Growth

Comparisons of treatment pairs by analysis of variance indicated the following: (1) tadpoles fed a predominantly blue-green periphyton ration did not differ significantly in terminal dry weight from samples harvested at the beginning of the experiment, and therefore did not grow significantly on the ration (one tank even lost weight during the 10 day treatment period); (2) tadpoles fed the diatom-rich periphyton ration and the predominantly green periphyton ration grew significantly and had significantly greater terminal dry weights than those fed predominantly blue-green periphyton; (3) tadpoles fed the diatom-rich ration had significantly higher terminal dry weights than those fed the predominantly green ration; (4) tadpoles fed the Carolina commercial tadpole feed had significantly higher terminal dry weights than those on periphyton diets. Significance levels ranged from $p < 0.005$ to $p < 0.00001$).

DISCUSSION

Soil and hydrologic conditions appear to be the overriding factors influencing the taxonomic composition of everglades periphyton. Other factors were important only among a group of sites that were continuously flooded (the sample in Quarter 1 correlations) or among sites that had been flooded without interruption for several (probably at least six) months.

Not only are percent soil organic matter and hydroperiod suggested as the major factors controlling taxonomic composition of southern everglades periphyton, but the relationship between these two factors, which is reflected in the correlation results, is very strong. Percent soil organic matter is a product of the long-term hydroperiod of an area, because flooding inhibits decomposition, which is primarily a microbial process limited by available oxygen and accelerated by exposure to air (Browder and Volk, 1978).

Where a recent change in hydroperiod has occurred, percent soil organic matter might be expected to temporarily reflect previous hydroperiod conditions. Such a situation was suggested when we compared percent soil organic matter and hydroperiod at some of our stations. Site XVII near Canal-111 had a relatively low soil organic content for prevailing water levels, suggesting that the flow of water across the southern levee of the canal may have increased the depth and period of flooding at that station. Site XV, the northernmost station on Canal-67-extended, represented the opposite situation; soil organic content there was much higher than water levels would have led us to expect, suggesting a reduced hydroperiod. At Station XVI near Grossman's Hammock there was a greater content of organic matter in the soil than would have been expected on the basis of prevailing water conditions. This was an area where the hydroperiod is known to have been reduced. The high percent of silica sand in the soils at this site suggested that the organic layer may once have been much thicker there than it is now. When organic soils oxidize, the mineral fraction of the soil greatly increases.

The winter dry season of 1978 was mild and short. Several of our stations (VI, VIII, XII, XIII, XIV, XV and XVII) did not dry that spring and thus had not been dry for a year or longer. Those stations had a high percentage of diatoms and green algae throughout the year of the study. Their blue-green algal components actually increased from Quarter 1 to Quarter 4, although, at their maxima, were never as great as that at the other stations. In spite of the mildness of the dry season, some of the stations (I, II, III, V, VII, XI) were dry most of Quarter 2. These same stations dried again during a brief rainless period in mid-summer (Quarter 3). The components of diatoms and green algae in the periphyton at these stations were consistently low throughout the study. Stations that had dried during Quarter 1 but were flooded for the rest of the year had a high percentage of blue-green algae initially but had developed substantial percentages of diatoms and green algae by Quarter 4. These generalities were somewhat obscured by the lag between sampling in the park stations and in the East Everglades stations (we started and ended three-months later at the East Everglades stations). The last sampling quarter at the East Everglades stations was not entirely homologous with the first quarter at the park stations, because the 1979 dry season was much more severe than the 1978 dry season, and stations that would not have dried Quarter 1 dried Quarter 5.

Algal composition responded not only to water conditions but also to salinity and various nutrients. The importance of the salinity parameter to the fit of the multiple regression equation for blue-green algae in Quarter 3 suggested an inhibition of some blue-green algae (perhaps the major dominant, Scytonema) by salinity. Stations in the vicinity of Canal-67-extended and Canal-111 experienced much higher salinities than the other stations, where no detectable levels were observed in any but third quarter sampling. Quarter-1 compositions were highly correlated ($p < 0.01$) with nitrogen, the relationship being negative with blue-greens and positive with diatoms and greens, but this effect was not noted at any other time.

The importance of total macrophyte biomass as a factor affecting periphyton algal composition was evident in Quarter 4 data (and possibly also Quarter 1 data) but either this variable was not important, or its effect was masked by stronger effectors during other times of the year. We consider total macrophyte biomass to be an index of shading, although the effect of this variable possibly is manifested in some other way.

Despite complications, the observed progression suggested a seasonal succession keyed to hydroperiod in the periphyton of the study area, with blue-green algae leading the recolonization of reflooded habitat, followed by diatoms and green algae, which become increasingly important components of the periphyton assemblage as the time of flooding lengthens.

Our observations regarding succession support the high correlation of our hydroperiod indices with algal composition in suggesting that hydroperiod is a major factor controlling algal composition in the periphyton of the study area.

The correlation with algal composition of the two parameters, percent soil organic and water depth, is partially due to the fact that these were acting as indicators of water conditions (relative "wetness" or hydroperiod) at the study sites. Additional independent effects of percent soil organic and water depth on algal composition in the southern everglades appear to exist and probably are due to their separate roles in controlling the amplitudes of diurnal fluctuations in pH, dissolved oxygen, and temperature. Blue-green algae are favored by extreme diurnal changes in these environmental characteristics (Padan, 1979).

The change in the relationship of pH to time-of-day from a negative correlation in the winter to a positive correlation in the summer indicates a change from a heterotrophic-dominated system in the winter to an autotrophic-dominated system in the summer. Metabolism results presented in Part II support this interpretation.

A buffering effect of percent soil organic matter on diurnal change in pH was suggested by the round-robin diel curves and by the multiple regression results in which pH was related positively to percent soil organic matter when it was related negatively to time-of-day and was related negatively to percent soil organic matter when related positively to time-of-day. This buffering effect may be the basis of the favorable habitat for diatoms and green algae created by a high percentage of soil organic matter in the bottom sediment.

According to these results, one might expect two effects of a change in the hydroperiod on taxonomic composition: an immediate effect and a delayed effect. The immediate effect would be a direct effect of change in hydroperiod. The second effect would be an indirect effect of hydroperiod due to the change in percent soil organic matter that would eventually result from the change in hydroperiod.

Our limited animal experiments suggest that a change in periphyton taxonomic composition could have an impact on the animals that depend on periphyton for food. Diatoms are a highly nutritious food for many aquatic organisms, and many blue-green algae species are inadequate as a diet for most aquatic organisms. A feeding and growth experiment with one aquatic organism of south Florida, the tadpole of the squirrel tree frog, Hyla squirella, demonstrated that periphyton communities of the study area that are rich in diatoms and, to a lesser degree, green algae, are a higher-quality source of food for this algal-feeding species than those periphyton communities in which blue-green algae predominate. One might expect to find more types of animals that are adapated to feeding on blue-green algae in the aquatic environments of the study area, where the biomasses of this potential food source are so great. Nevertheless periphyton composed almost entirely of blue-green algae (greater than approximately 90% by volume) probably contributes less useful food to the aquatic community than periphytons that contain greater proportion of diatoms and green algae.

Water management projects that decrease the hydroperiods of the seasonally flooded wetlands of the southern everglades appear to make them less supportive of aquatic animals by decreasing the quality of food at the base of the food chain. Managing water to increase the hydroperiod in the Taylor Slough area north and immediately south of S.R. 27 where the periphyton presently is made up almost entirely of blue-green algae, probably would improve their capacity to support aquatic animals.

SUMMARY

1. The relative importance (volume) of the major algal taxa in periphyton differs considerably from site to site in the southern Everglades. Composition can be quantified with a precision that allows statistically significant differences to be determined.

2. Blue-green algae make up 90% or more of algal volume in periphyton at many southern everglades locations. The predominant genus, making up 50% or more of volume at most sites, is Scytonema.

3. Diatoms are next in importance to blue-green algae, in terms of volume.

4. Desmids are a relatively minor component of southern everglades periphyton.

5. Other green algae are important at only a few locations.

6. A succession keyed to hydroperiod appears to occur. Blue-green algae become re-established in an area very quickly upon reflooding following drying. Several months of continuous flooding are required for diatoms and green algae to become fully re-established after an area has dried. Probably for this reason, hydroperiod is a very important factor in determining algal composition of periphyton.

7. Soil organic matter appears to affect algal composition of periphyton, possibly by reducing the diurnal variation in pH. (Large diurnal fluctuations in pH, dissolved oxygen and temperature favor blue-green algae, according to other studies.)

8. Changing the hydroperiod of an area has two effects on taxonomic composition of periphyton: a direct immediate effect and an indirect effect caused by the change in percent soil organic matter in bottom sediment, which is hydroperiod-related.

9. Salinity may inhibit some major blue-green algal species in southern everglades periphyton.

10. Feeding and growth experiments with one everglades organism indicated no growth in 10 days on periphyton with a high component of blue-green algae. Significant growth occurred on diatom-rich periphyton and green-rich periphyton, but growth was best on a commercial feed that was used in the experiments as a control.

11. Changing the water conditions in a wetlands changes the quality of food for aquatic organisms.

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Mr. David Swift of the South Florida Water Management District provided expert advice on the taxonomy of the algae. Mr. Robert Chen of the University of Miami Mathematics Department suggested the use of the Hotelling-T^2 test for the statistical analysis of volumetric data on the major taxa of periphyton. We greatly appreciate their assistance.

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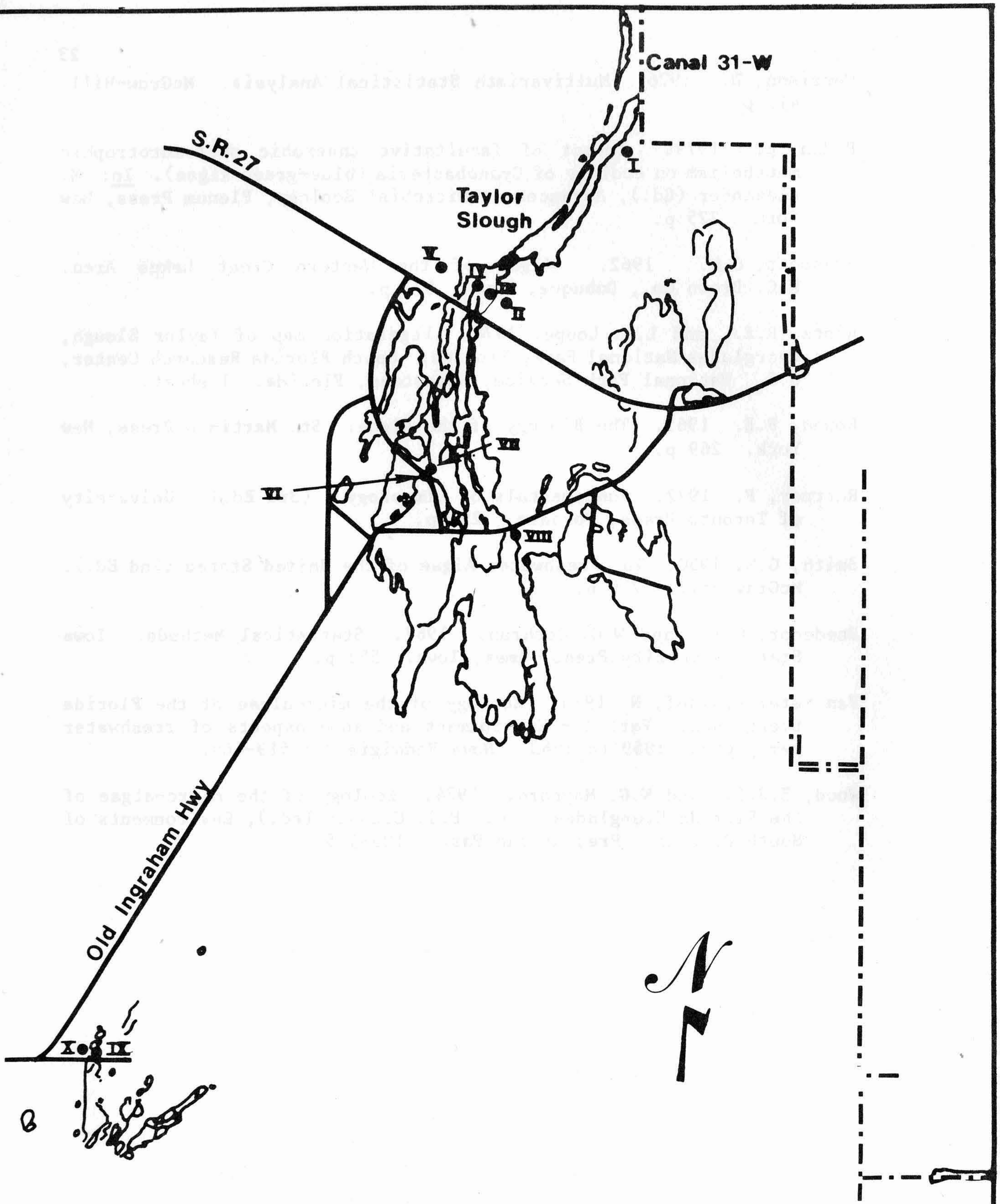


Figure 1 Sampling stations I through X, Taylor Slough area, Everglades National Park

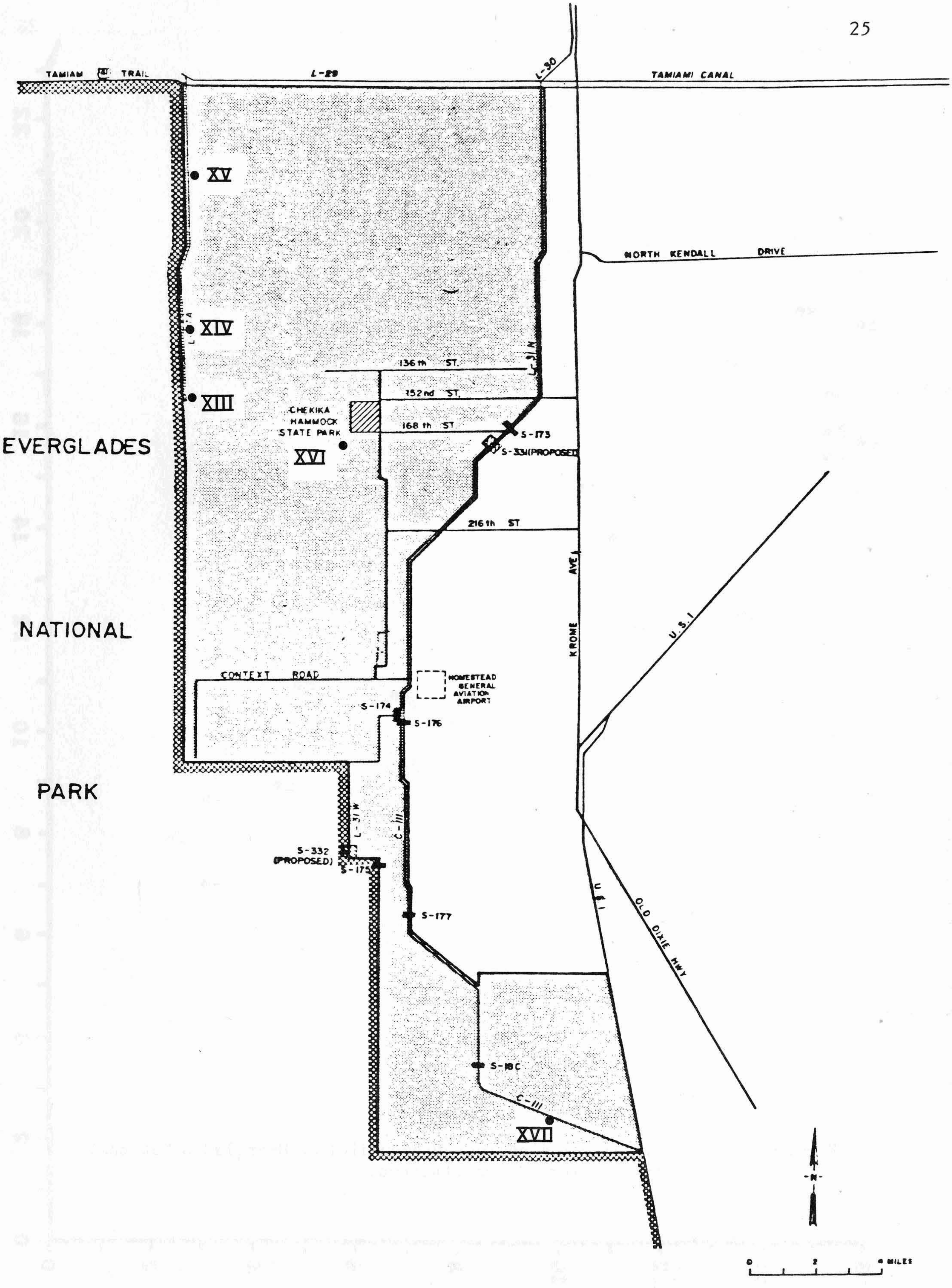


Figure 2 Sampling stations XIII through XVII, Dade County, East Everglades EPA-208 study area.

PROJECT BOUNDARY
ENP BOUNDARY

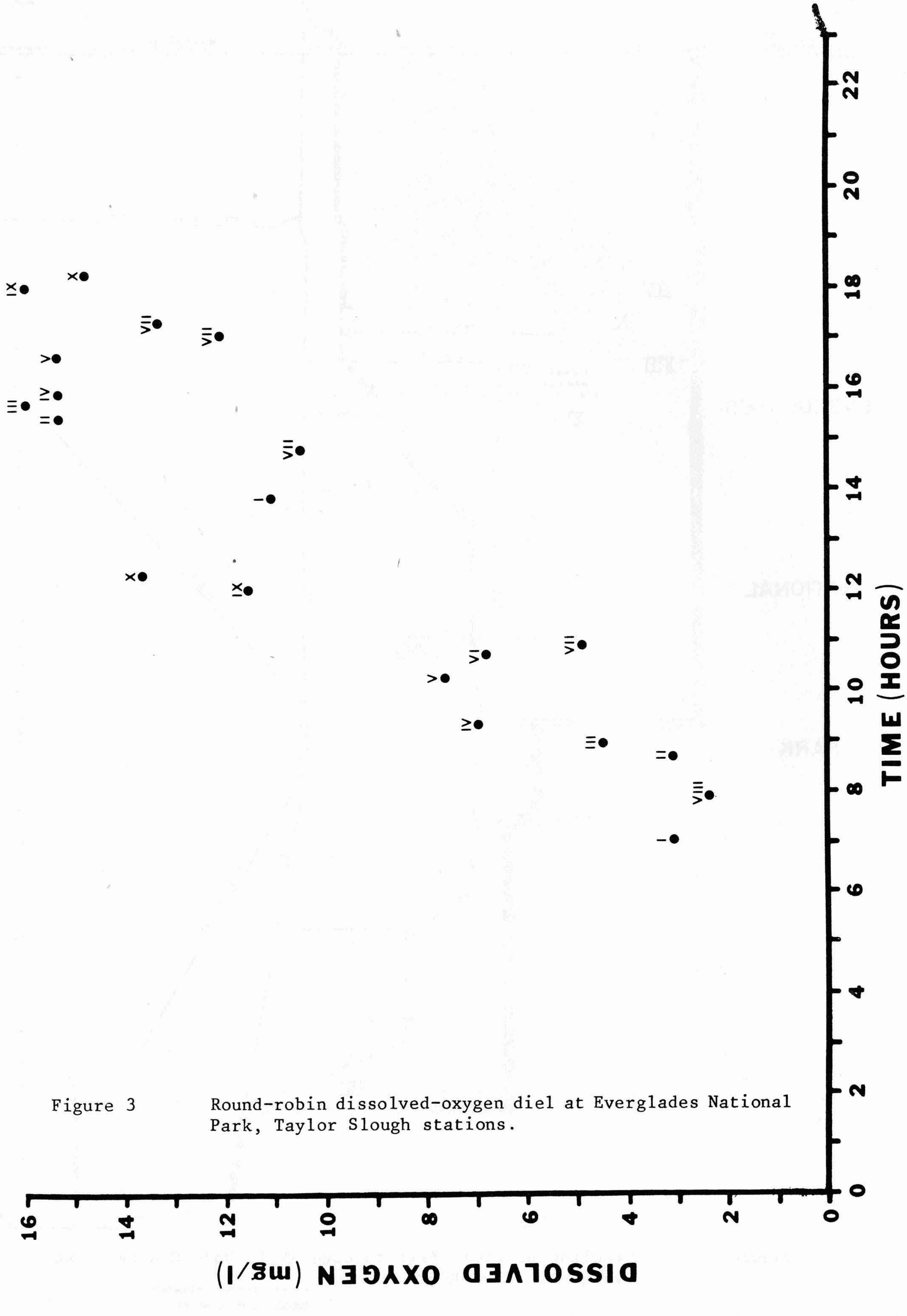


Figure 3 Round-robin dissolved-oxygen diel at Everglades National Park, Taylor Slough stations.

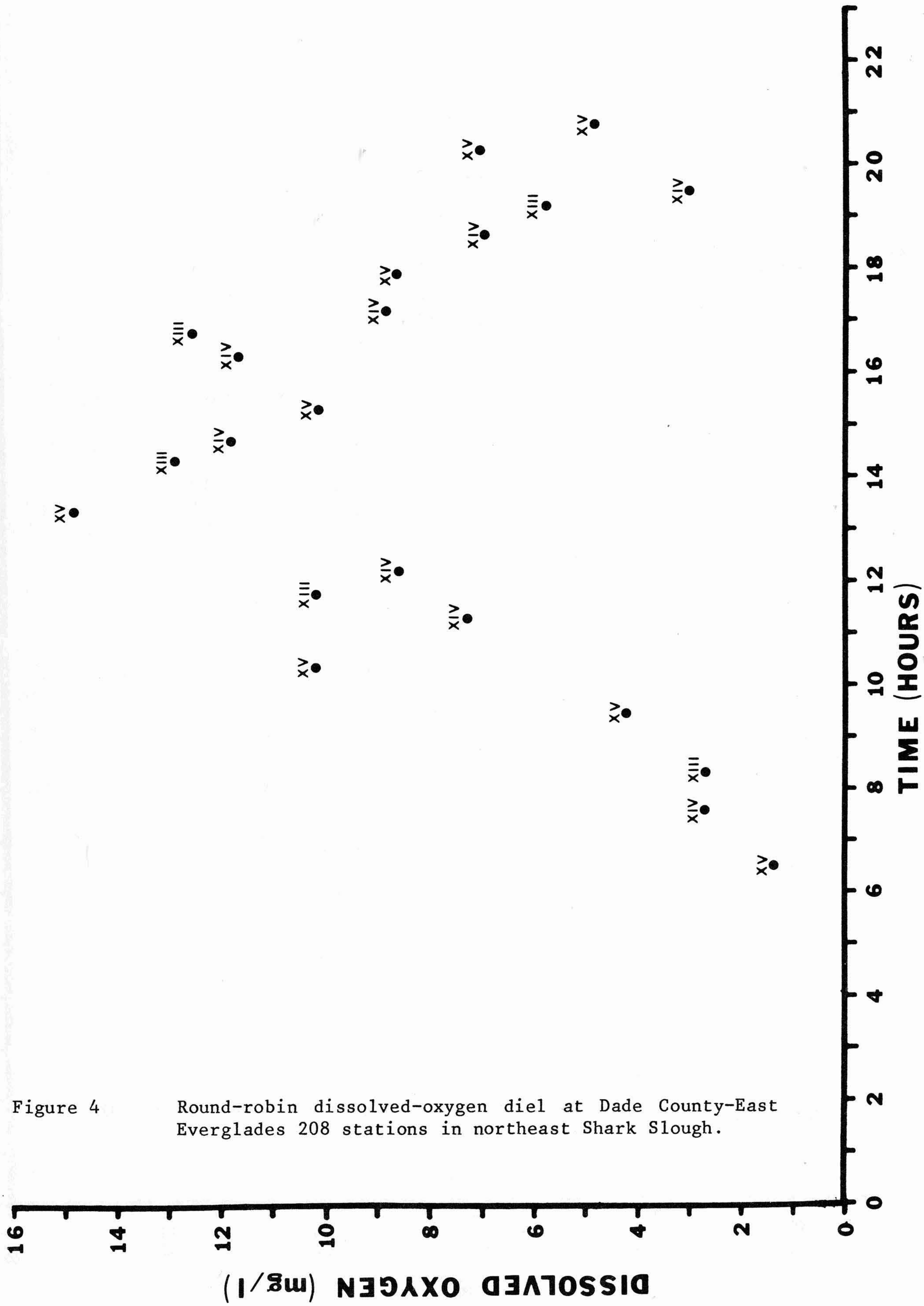


Figure 4 Round-robin dissolved-oxygen diel at Dade County-East Everglades 208 stations in northeast Shark Slough.

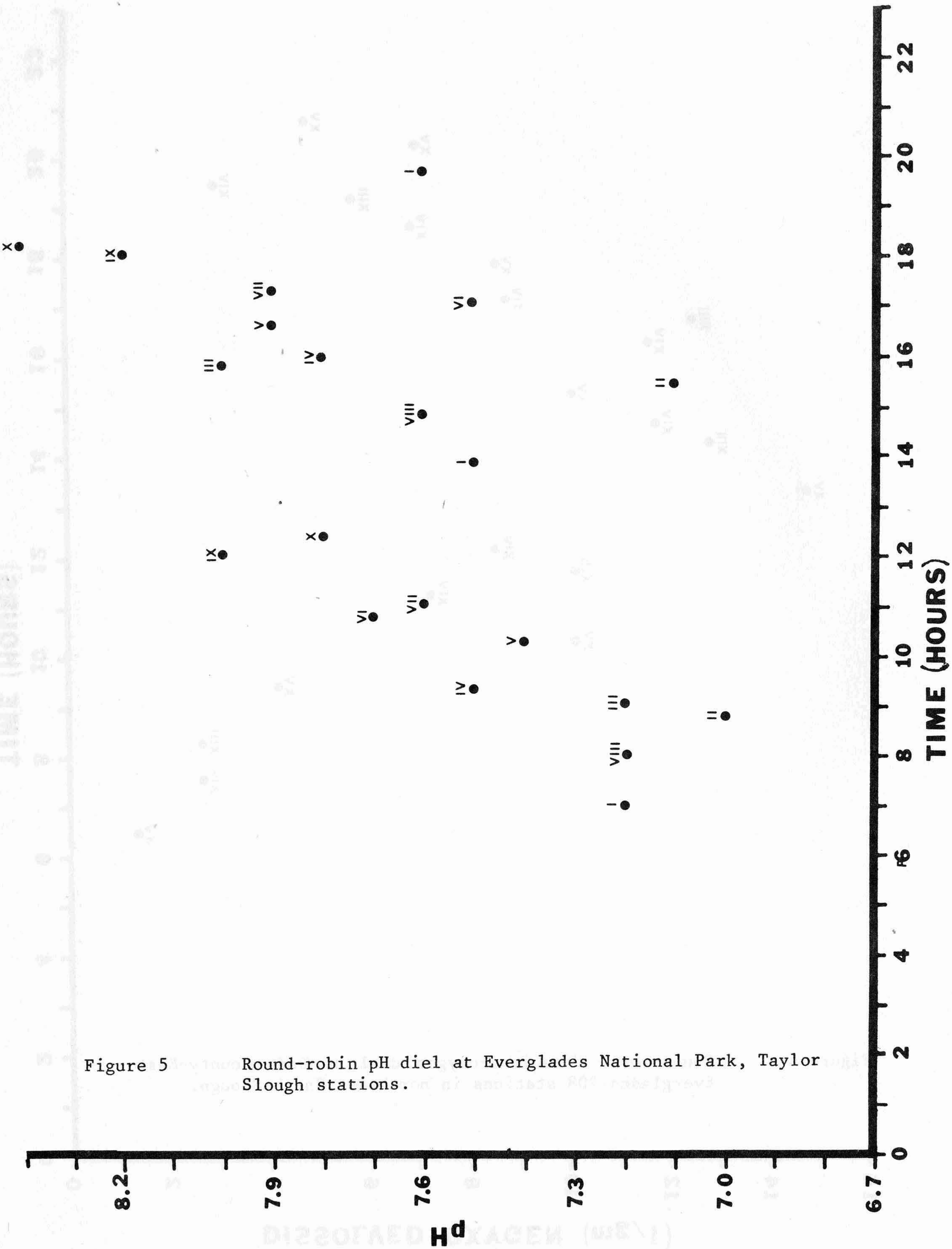


Figure 5 Round-robin pH diel at Everglades National Park, Taylor Slough stations.

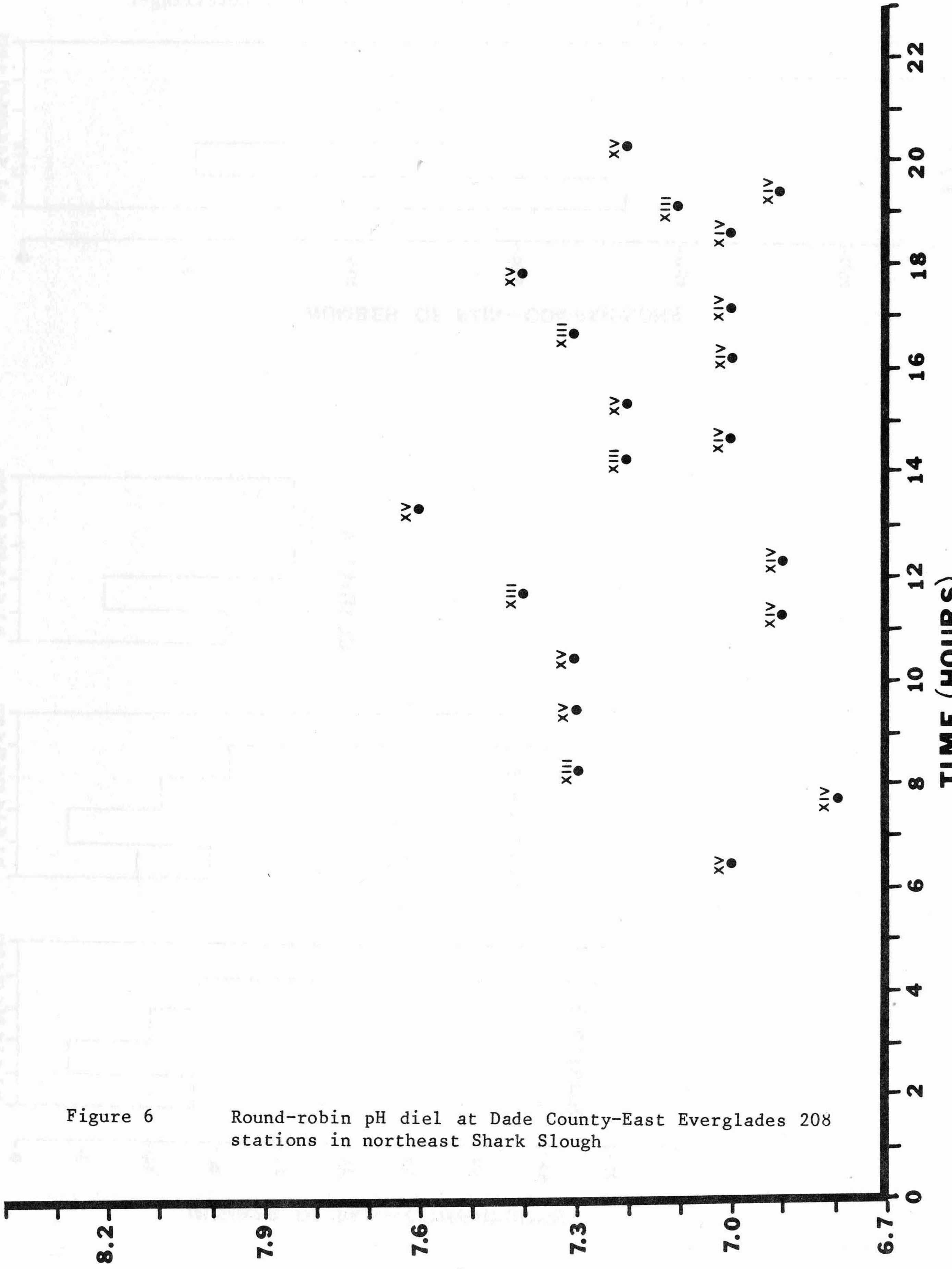


Figure 6 Round-robin pH diel at Dade County-East Everglades 208 stations in northeast Shark Slough

Figure 7 Histo grams of frequency distribution of levels of statistical significance of differences in taxonomic composition of station pairs, according to Hotelling-T^2 analysis.

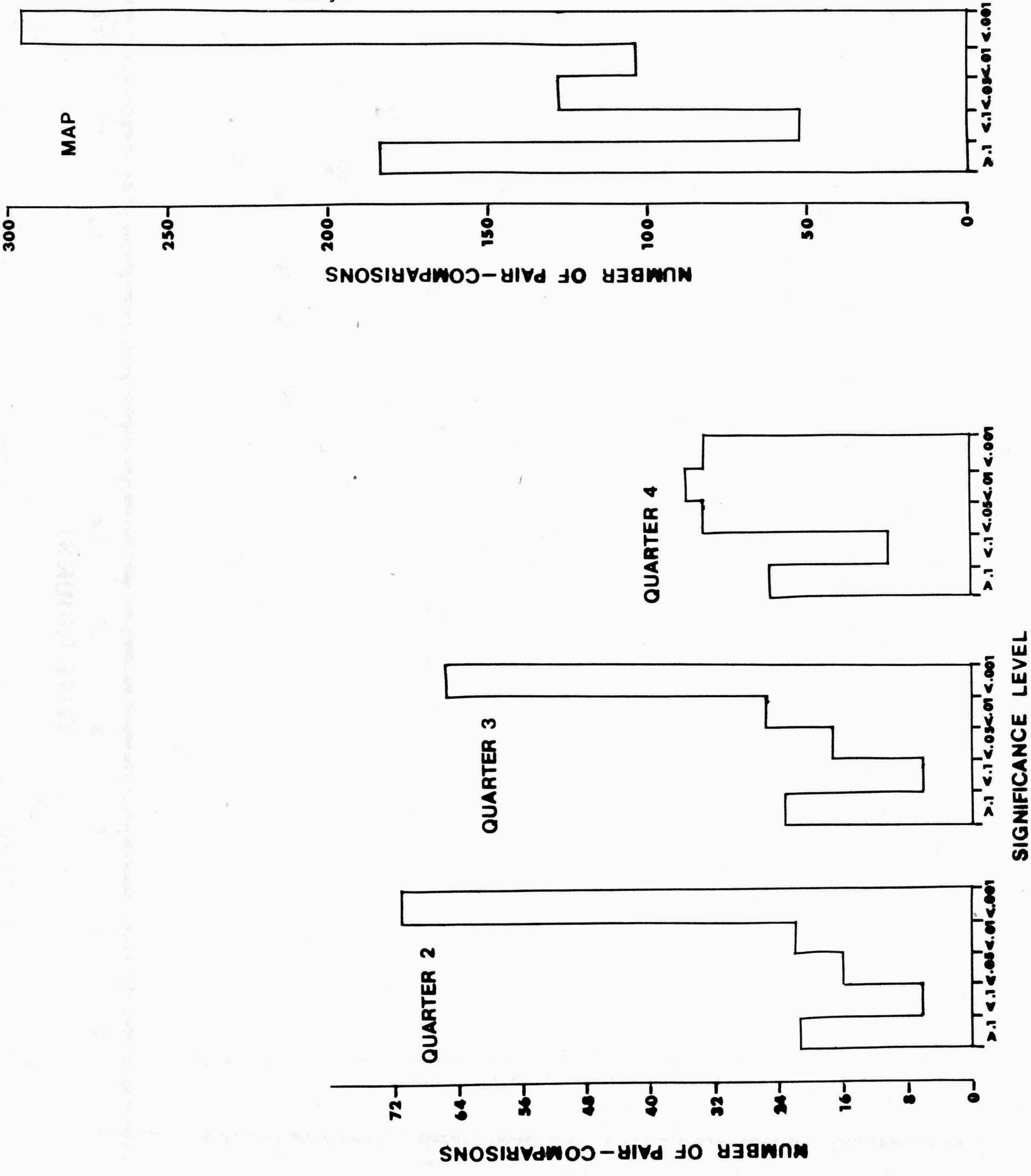


Table 1. Matrix of predominant vegetation at stations.

Common Name	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII
Hairgrass	X				X												
Hairgrass-Sawgrass		X															
Sawgrass			X			X	X			X							
Beakrush-Spikerush									X						X		
Spikerush				X				X			X					X	
Spikerush-Bladderwort													X	X			
Bladderwort-Sawgrass																	X
Spikerush-Sawgrass												X					

Table 2. Quarterly ranges of values for physical and chemical parameters of the study sites.

PARAMETER	QUARTER 1	QUARTER 2	QUARTER 3	QUARTER 4
Measured				
Water depth (cm)	0-39.4 (12)	0-29.0 (17)	8-44.0 (17)	0-58.0 (17)
Water temperature (^{o}C)	14-23 (8)	23.2-36 (12)	26-35.0 (15)	17-28.3 (14)
Dissolved oxygen (mg/1)	6.6-12.4 (8)	2.1-15.2 (12)	--	--
Salinity (ppt)	0-.80 (8)	0-.75 (12)	0-1.20 (17)	0 (14)
pH	6.4-7.8 (8)	6.9-7.9 (12)	6.5-7.4 (15)	6.9-8.5 (14)
Alkalinity (mg/1 $CaCO_3$)	161-198 (8)	130-240 (11)	100-230 (16)	120-240 (14)
Conductivity (μmhos/cm)	295-750 (8)	268-880 (12)	202-910 (17)	240-530 (14)
Calcium (mg/1)	--	31.9-69.3 (5)	8.8-94.6 (17)	45.1-93.5 (7)
Silica (mg/1)	1.83-3.01 (6)	.95-18.24 (11)	4.18-18.24 (16)	2.25-9.20 (14)
Inorganic nitrogen (μg/1)	11.48-53.22 (6)	25.63-67.51 (9)	31.37-123.40 (13)	22.41-1365.65 (13)
Inorganic phosphorus (μg/1)	6.19-9.29 (6)	7.74-38.72 (11)	5.58-12.39 (16)	3.10-15.49 (14)
Organic carbon (mg/1)	12-16 (7)	6-42 (13)	11-32 (17)	6-32 (15)
Soil organic (percent by weight)	--	8.6-73.3 (17)	--	--
Soil $CaCO_3$ (percent by weight)	--	6.2-90.1 (17)	--	--
Soil residuals (percent by weight)	--	0.5-69.3 (17)	--	--
Devised				
Corrected depth (cm)	-11.4-39.4 (17)	-11.6-42.0 (17)	8-60.2 (16)	-11.9-60.4 (17)
Wet days in previous quarter (No. x 5)[a]	0-30 (16)	1-30 (16)	3-30 (16)	10-30 (16)
Wet days Oct. 77-Dec. 78 (No. x 5)[b]	11-91 (16)	--	--	--

Table 2 continued.

PARAMETER	QUARTER 1	QUARTER 2	QUARTER 3	QUARTER 4
Days since last drought of greater than 30 days (counting from Dec. 31, 1978) (No.)[c]	212-957 (12)	--	--	--
Length of last drought of 30 days or more (No. days)[d]	30-165	--	--	--

[a] Quarterly hydroperiod

[b] Annual hydroperiod (annual data only)

[c] Since drought (annual data only)

[d] Drought length (annual data only

Note: Numbers in parenthesis following ranges refer to sample size.

Table 3. Depth and new depth (depth corrected for zero values and standardized for sampling date) (in centimeters) at each station each quarter.

	Quarter 1		Quarter 2		Quarter 3		Quarter 4	
	Depth	New Depth	Depth	New Depth	Depth	New Depth	Depth	New Depth
I	0.0	-3.2	0.0	-0.1	15.1	15.1	0.0	-2.1
II	0.0	-5.9	0.0	-4.3	11.5	11.5	0.0	-7.0
III	0.0	-4.0	0.0	0.0	15.8	15.8	0.0	-3.0
IV	12.9	12.9	17.0	17.0	29.9	29.9	15.0	15.0
V	0.0	-11.4	0.0	-7.4	8.0	8.0	0.0	-11.9
VI	39.4	39.4	42.0	42.0	44.0	44.0	36.5	36.5
VII	15.3	15.3	15.0	15.0	15.0	15.0	7.5	7.5
VIII	32.3	32.3	29.0	29.0	36.4	36.4	33.9	34.5
IX	20.4	20.4	21.5	21.5	25.5	25.5	26.3	26.6
X	11.1	11.1	14.0	14.0	20.5	20.5	22.6	23.1
XI	17.0	18.6	0.0	-11.6	22.0	27.5	24.0	25.1
XII	25.0	27.4	17.0	14.7	52.0	60.2	58.0	60.4
XIII	ND	19.9	15.0	14.4	24.0	24.0	22.0	24.6
XIV	ND	14.1	17.3	12.2	26.1	26.1	22.5	25.0
XV	ND	18.0	16.0	16.0	13.5	13.5	21.0	21.0
XVI	ND	0.0	0.0	0.0	33.0	ND	1.0	1.0
XVII	ND	20.3	24.0	21.7	26.0	24.0	15.0	19.9

Table 4. Hydroperiod indices[a] for each station.

	Quarterly Hydroperiod 1	2	3	4	Annual Hydro- period	Time Since Last Drought[c]	Length of Last Drought[c]
I	7	1	10	22	32	217	100
II	6	0	7	20	25	217	165
III	7	1	11	22	33	212	95
IV	22	13	25	30	63	247	40
V	3	0	3	16	20	137	35
VI	30	28	28	30	88	602	65
VII	18	11	21	30	61	247	40
VIII	30	30	30	30	91	607	45
IX	30	30	30	30	91	602	50
X	30	22	28	30	83	237	40
XI	30	29	27	30	85	212	30
XII	30	30	30	30	91	957	30
XIII	30	30	30	30	91	1,312	ND
XIV	30	30	30	30	91	ND	ND
XV	ND	ND	ND	ND	ND	ND	ND
XVI	0	0	5	10	11	ND	ND
XVII	30	30	30	30	91	ND	ND

[a]Index values should be multiplied by five to indicate actual number of days.

[b]Hydroperiod is measured as the time when the water level was at or above ground surface.

[c]Droughts are defined as periods when the water was below ground surface for 30 days or longer.

Table 5. Average quarterly values[a] for the five biomass.

<table>
<tr><th rowspan="2"></th><th colspan="4">QUARTER</th><th rowspan="2">$\bar{X}$</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Organic periphyton</td><td>225</td><td>231</td><td>213</td><td>235</td><td>226</td></tr>
<tr><td>Live standing macrophytes</td><td rowspan="2">98</td><td>114</td><td>133</td><td>136</td><td>120</td></tr>
<tr><td>Live submergent macrophytes</td><td>12</td><td>8</td><td>11</td><td>10</td></tr>
<tr><td>Dead standing macrophytes</td><td>263</td><td>272</td><td>280</td><td>226</td><td>260</td></tr>
<tr><td>Dead prostrate macrophytes</td><td>196</td><td>49</td><td>64</td><td>67</td><td>94</td></tr>
</table>

[a] grams dry weight per square meter.

Table 6. Quarterly ranges of biomass values[a] at the study sites.

PARAMETER	QUARTER 1		2		3		4	
Organic periphyton	1[c]-388	(14)	60-485	(17)	22-441	(15)	61-542	(15)
Total periphyton	1-2,030	(15)	133-2,682	(17)	78-1,770	(15)	93-1,531	(15)
Total macrophytes[b]	6[c]-1,214[c]	(15)	62-1,265	(17)	63-1,405	(15)	46-1,205	(17)
Live macrophytes[b]	3-805[c]	(15)	30-284	(17)	3-360	(15)	32-583	(17)
Dead macrophytes[b]	3[c]-750	(15)	32-1,095	(17)	34-1,052	(16)	88-653	(17)
Live standing macrophytes	ND		11-284	(17)	3-395	(15)	30-583	(17)
Live submerged macrophytes	ND		0-45	(17)	0-37	(17)	0-37	(15)
Dead standing macrophytes	54-344	(10)	20-1,085	(17)	26-1,035	(17)	22-653	(17)
Dead prostrate macrophytes	3-642	(10)	9-103	(17)	6-202	(17)	20-207	(15)
Live submergent macrophytes and organic periphyton	ND		60-567	(17)	28-450	(15)	37-544	(15)

a grams dry weight per square meter

b above-ground biomass only

c March 1979 (Quarter 5)

Note: Numbers in parentheses are sample number

Table 7. Percent volumes of blue-green, green, and diatom taxa in stem periphyton. A. Stations I through XII, Quarters 1 through 4.

	First Quarter			Second Quarter			Third Quarter			Fourth Quarter			
	Blue-greens	Greens	Diatoms	Blue-greens	Greens	Diatoms	Blue-greens	Greens	Diatoms	Blue-greens	Greens	Desmids	Diatoms
I	99.49	0.003	0.50	98.30	0.87	0.84	99.73	0.03	0.23	93.15	0.00	0.06	6.79
II	88.13	1.33	0.0	92.660	0.00	7.40	94.60	2.51	2.87	85.43	3.99	1.49	9.09
III	99.14	0.19	0.24	96.97	2.98	0.05	99.46	0.52	0.01	93.51	.75	1.80	3.93
IV	91.41	2.61	4.85	87.60	2.83	9.56	80.35	4.80	14.83	76.78	5.31	4.12	13.80
V	99.66	0.26	0.06	98.02	0.49	1.49	96.67	0.03	3.28	91.66	.95	0.17	7.23
VI	88.31	3.18	8.49	68.39	2.84	28.78	72.46	14.07	13.45	81.68	9.50	1.47	7.35
VII	96.89	2.31	0.80	100.00	0.00	0.0	98.67	0.20	1.11	96.52	.77	1.14	1.57
VIII	35.93	18.10	45.96	38.66	16.53	44.80	32.41	7.80	59.77	60.70	13.39	1.52	24.39
IX	96.96	3.06	9.96	75.07	1.79	22.81	89.96	1.10	8.92	86.03	.98	2.51	10.48
X	98.53	0.56	0.90	97.86	0.000	2.79	93.35	1.91	4.72	93.27	2.60	0.34	3.80
XI	93.71	0.03	6.25	80.12	0.02	19.86	96.11	0.34	3.53	88.01	.61	0.13	11.25
XII	96.90	0.0	3.10	73.10	7.13	19.76	70.22	8.32	21.45	67.74	2.12	1.16	28.97

Table 7 continued.

B. Stations XIII through XVII, Quarters 2, 3, 4, and 5.

	Second Quarter			Third Quarter			Fourth Quarter				Fifth Quarter			
	Blue-greens	Greens	Diatoms	Blue-greens	Greens	Diatoms	Blue-greens	Greens	Desmids	Diatoms	Blue-greens	Greens	Desmids	Diatoms
XIII	10.69	80.82	8.49	44.89	22.76	32.33	40.53	15.28	.48	43.71	1.34	72.48	.00	26.17
XIV	59.57	24.46	15.56	75.46	3.10	21.43	48.52	4.89	.33	46.25	52.59	10.68	.42	36.31
XV	75.75	1.80	22.46	78.83	7.47	13.68	64.04	1.98	.09	33.89	57.72	3.34	1.25	37.69
XVI	94.68	0.07	5.25	93.55	0.24	6.20	73.90	.00	.83	25.27	81.00	.00	.05	18.96
XVII	39.36	6.95	53.69	49.24	4.20	46.55	33.62	8.56	2.16	55.67	36.53	.12	.80	62.55

Table 8. Annual average percents volume of blue-green, green, and diatom algae in periphyton at stations.

Station	Bluegreen	Green	Diatom
I	97.66	.22	2.09
II	90.19	1.95	5.41
III	97.27	1.71	1.05
IV	84.03	4.16	10.76
V	96.50	.43	3.01
IV	77.71	7.39	14.51
VII	98.02	.82	.87
VIII	41.92	13.95	43.73
IX	87.00	1.73	13.04
X	95.75	1.26	3.05
XI	89.48	.25	10.22
XII	76.99	4.39	18.32
XIII	24.36	47.83	27.67
XIV	59.13	10.78	29.88
XV	69.08	3.64	26.93
XVI	85.78	.07	13.92
XVII	39.68	4.95	54.61

Table 9. Dominant genera, by station and location, winter 1978 (Quarter 1).

Taxa	Algal* Group	I Stem	I Ground	II Stem	II Ground	III Stem	III Ground	IV Stem	IV Ground	V Stem	V Ground
Scytonema	B.G.	55.9	66.6	26.6	21.9	43.5	46.4	49.6	50.4	43.2	35.1
Schizothrix	B.G.	12.9	13.5	43.2	43.0	43.6	50.5	38.3	41.3	37.5	53.2
Stigonema	B.G.	27.3		5.6		7.1		2.2	0.3	12.7	
Microcoleus	B.G.	3.1	2.3		8.7	2.6	1.0		1.9	2.4	3.0
Johannesbaptistia	?		10.3								
Gloeocapsa	B.G.		5.3		10.0		0.7			1.9	3.1
Aphanothece	B.G.		10.6								
Diatoms		0.3		6.1	4.3			2.9	3.1		3.6
Desmids	G.					1.7					
Lyngbya	B.G.						0.9				
Spirogyra	G.F.							2.8			
Oedogonium	G.F.										
Unid sphere	B.G.										
Unid	G.										
Other	--	0.5	2.0	7.9	12.1	1.5	0.5	4.2	3.0	2.3	2.0

* Key to Algal Groups

B.G. Blue-green

G.F. Green filamentous

G. Green

Table 9. Continued.

Taxa	Algal* Group	PERCENT (%) VI Stem	VI Ground	VII Stem	VII Ground	VIII Stem	VIII Ground	IX Stem	IX Ground	X Stem	X Ground
<u>Scytonema</u>	B.G.	71.7	34.7	64.5	44.9	10.4	21.8	51.0	35.2	63.4	51.4
<u>Schizothrix</u>	B.G.	12.5	45.2	10.0	6.9	20.7	16.1	36.0	53.4	23.4	30.4
<u>Stigonema</u>	B.G.	2.8									12.8
<u>Microcoleus</u>	B.G.	1.3		20.4	14.2	0.9				3.1	
<u>Johannesbaptistia</u>	?									1.6	
<u>Gloeocapsa</u>	B.G.								0.9		
<u>Aphanothece</u>	B.G.										
Diatoms		9.6	3.0	1.0		44.0	18.5	7.4	7.0		1.7
Desmids	G.			1.1	0.8	3.1	35.9		1.3		
<u>Lyngbya</u>	B.G.										
<u>Spirogyra</u>	G.F.		2.8				4.7				
<u>Oedogonium</u>	G.F.							1.2			
Unid sphere	B.G.		2.0		1.9			1.3		3.3	
Unid	G.										1.0
Other	--	2.1	12.3	3.0	31.3	20.9	3.0	3.1	2.2	5.2	2.7

* Key to Algal Groups

B.G. Blue-green

G.F. Green filamentous

G. Green

Table 10. Second quarter percent representation of algal genera making up the first 50% of algal composition by volume.

Genus	STATIONS																
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII
Bluegreen																	
Scytonema	≥50	≥50	≥50	≥50	≥50	≥50	≥50	10	≥50	≥50	≥50	41		17	≥50	≥50	33
Schizothrix								28				28	28				
Microcoleus														31			
Green																	
Spirogyra													≥50				
Diatom																	
Cymbella														14			36
Mastigloia								15									

Table 11. Third quarter percent representation of algal genera making up the first 50% of algal composition by volume.

Genus	STATIONS																
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII
Bluegreen																	
Scytonema	≥50	≥50	≥50	≥50	≥50	49	≥50	17	≥50	≥50	≥50	≥50	28	≥50	≥50	≥50	23
Schizothrix						20							15				25
Green																	
Spirogyra													14				
Diatom																	
Cymbella						17											
Gomphonema								27									
Amphora																	21

Table 12. Fourth quarter percent representation of algal genera making up the first 50% of algal composition by volume.

Genus	STATIONS																
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII
Bluegreen																	
Scytonema	≥50	≥50	≥50	≥50	≥50	≥50	≥50	28	≥50	≥50	≥50	≥50	25	38	48	≥50	
Schizothrix								16					14				
Diatom																	
Cymbella													11				28
Mastigloia														29	15		22
Gomphonema								14									
Navicula													10				17

Table 13. Fifth quarter percent representation of algal genera making up the first 50% of algal composition by volume.

Genus	STATIONS				
	XIII	XIV	XV	XVI	XVII
Bluegreen					
<u>Sytonema</u>		40	36	$\geq$50	
<u>Schizothrix</u>			20		11
Green					
<u>Spirogyra</u>		11			
<u>Bulbochaete</u>	$\geq$50				
Diatom					
<u>Cymbella</u>		11			24
<u>Synedra</u>					31

Table 14. Grouping of stations based on Hotelling T^2 analysis of second quarter taxal percentages.

Station	BG	G	D	Macrophytes	Soil
VII	100.	0	0	tall sawgrass	10-19% org
III	96.97	2.98	0.05	short sawgrass	10-19% org
V	98.02	0.493	1.49	hairgrass	< 10% org
I	98.30	0.865	0.84	hairgrass	< 10% org
X	97.86	0	2.79	short sawgrass	< 10% org
XVI	94.68	0.073	5.25	spikerush	20-24% org
II	92.60	0	7.40	hairgrass - short sawgrass	10-19% org
IV	87.60	2.83	9.56	spikerush	10-19% org
XI[a]	80.12	0.02	19.86	spikerush	10-19% org
IX[a]	75.07	1.79	22.81	spikerush - beakrush	10-19% org
XV	75.75	1.80	22.46	spikerush - beakrush	25-49% org
XII[a]	73.10	7.13	19.76	spikerush - sawgrass	> 50% org
XIV	59.97	24.46	15.56	spikerush - bladderwort	25-49% org
VI	68.39	2.84	28.78	tall sawgrass	> 50% org
VIII	38.66	16.53	44.80	spikerush	> 50% org
XVII	39.36	6.95	53.69	short sawgrass - bladderwort	10-19% org
XIII	10.69	80.82	8.49	spikerush - bladderwort	25-49% org

BG = bluegreens, G = greens, D = diatoms

[a] Stations IX, X, XI, and XII were significantly different from each other at the 99% level, but were not significantly different from Station XV at the 90% level.

Table 15. Grouping of stations based on Hotelling T^2 analysis of third quarter taxal percentages.

Station	BG	G	D	Macrophytes	Soil	Water Depth (cm)	Date
I	99.73	0.03	0.23	hairgrass	< 10% org	15.1	8/26
III	99.46	0.52	0.01	short sawgrass	10-19% org	15.8	8/26
VII	98.67	0.20	1.11	tall sawgrass	10-19% org	15.0	8/26
V	96.67	0.03	3.28	hairgrass	< 10% org	8.0	8/27
XI	96.11	0.34	3.53	spikerush	10-19% org	22.0	8/15
II	94.60	2.51	2.87	hairgrass - short sawgrass	10-19% org	11.5	8/26
IX	89.96	1.10	8.92	spikerush - beakrush	10-19% org	25.5	8/27
X	93.35	1.91	4.72	short sawgrass	< 10% org	20.5	8/27
XVI	93.55	0.24	6.20	spikerush	20-24% org	24.0	9/2
IV	80.35	4.80	14.83	spikerush	10-19% org	29.9	8/26
VI	72.46	14.07	13.45	tall sawgrass	> 50% org	44.0	8/26
XII	70.22	8.32	21.45	spikerush - sawgrass	> 50% org	52.0	8/15
XIV	75.46	3.10	21.43	spikerush - bladderwort	25-49% org	26.1	9/2
XV	78.83	7.47	13.68	spikerush - beakrush	25-49% org	13.5	9/2
VIII	32.41	7.80	59.77	spikerush	> 50% org	36.4	8/26
XVII	49.24	4.20	46.55	short sawgrass - bladderwort	10-19% org	26.0	9/3
XIII	44.89	22.76	32.33	spikerush - bladderwort	25-49% org	24.0	9/2

BG = bluegreens, G = greens, D = diatoms.

Table 16. Grouping of stations based on Hotelling T^2 analysis of fourth quarter taxal percentages.

Station	BG	G	D	Macrophytes	Percent Organic Soil	Water Depth (cm)	Date
VII[a]	96.52	1.91	1.57	tall sawgrass	10-19	7.5	11/18
III	93.51	2.56	3.93	short sawgrass	10-19	0	11/18
X[a]	93.27	2.93	3.80	short sawgrass	< 10	22.6	11/19
I	93.15	0.06	6.79	hairgrass	< 10	0	11/19
V	91.66	1.11	7.23	hairgrass	< 10	0	11/19
XI[b]	88.01	0.74	11.25	spikerush	10-19	24.0	11/13
IX	86.03	3.49	10.48	spikerush - beakrush	10-19	26.3	11/19
II	85.43	5.48	9.09	hairgrass - short sawgrass	10-19	0	11/18
VI	81.68	10.97	7.35	tall sawgrass	> 50	36.5	11/18
IV	76.78	9.42	13.80	spikerush	10-19	15.0	11/18
XVI[b,d]	73.90	0.83	25.27	spikerush	20-24	1.0	12/14
XII[d]	67.74	3.29	28.97	spikerush - sawgrass	> 50	58.0	11/13
XV[c,d]	64.04	2.07	33.89	spikerush - beakrush	25-49	21.0	12/13
VIII	60.70	14.91	24.39	spikerush	> 50	33.9	11/19
XIV[c,d]	48.52	5.23	46.25	spikerush - bladderwort	25-49	22.5	12/13
XIII	40.53	15.76	43.71	spikerush - bladderwort	25-49	22.0	12/13
XVII	33.62	10.71	55.67	short sawgrass - bladderwort	10-19	15.0	12/14

Table 17. Grouping of stations based on Hotelling T^2 analysis of fifth quarter taxal percentages.

Station	BG	G	D	Macrophytes	Percent Organic Soil
XVI	81.00	0.04	18.96	spikerush	20-24
XV	57.72	4.59	37.69	spikerush - beakrush	25-49
XIV	52.59	11.10	36.31	spikerush - bladderwort	25-49
XVII	36.53	0.92	62.55	sawgrass - bladderwort	10-19
XIII	1.34	72.49	26.17	spikerush - bladderwort	25-49

Table 18. Correlation coefficients for conductivity and some related water-quality parameters.

	ALK		SAL		SILICA	
QUARTER 1						
Cond	+0.21	(8)	+.965[b]	(8)		
Alk			-.005	(8)	+.555	(6)
QUARTER 2						
Cond	+.815[c]	(11)	+.759[c]	(12)		
Alk			+.408	(11)	+.695[d]	(10)
QUARTER 3						
Cond	+.633[d]	(16)	+.761[b]	(17)		
Alk			+.181	(16)	+.684[c]	(16)
QUARTER 4						
Cond	+.674[d]	(14)	ND			
Alk			ND		+.597[d]	(14)

a <.0001
b <.001
c <.01
d <.05
e <.1
f <.11

Note: Number of samples is given in parentheses

Table 19. Correlation coefficients for time of day, some diurnally-varying water-quality parameters, and percent soil organic matter (transformed).

	DO	Time	Soil Organic
QUARTER 1			
pH	-474 (8)	-.834[d] (8)	+.325 (8)
DO		+.492 (8)	
Temp		+.690[e] (8)	
QUARTER 2			
pH	+.756[c] (12)	+.692[d] (12)	+.726[c] (12)
DO		+.660[d] (12)	
Temp		+.801[c] (12)	
QUARTER 3			
pH	+.624[d] (13)	+.548[d] (15)	+.146 (15)
DO		+.812[b] (15)	
Temp		+.520[d] (15)	
QUARTER 4			
pH		-3.66 (14)	+.361 (14)
DO			
Temp		+.733[b] (14)	

a <.0001
b <.001
c <.01
d <.05
e <.1
f <.11
Note: Number of smaples is given in parentheses

Table 20. Correlation coefficients for percent soil organic matter (transformed) with water depth, new depth[a], quarterly hydroperiod, and annual hydroperiod.

	Depth		New Depth		Hydro (qt)		Hydro (an)	
QUARTER 1								
Soil organic	+.828[c]	(12)	+.733[c]	(17)	+.479[e]	(16)	+.505[d]	(16)
QUARTER 2								
Soil organic	+.639[c]	(17)	+.611[c]	(17)	+.569[d]	(16)		
QUARTER 3								
Soil organic	+.776[b]	(17)	+.772[b]	(16)	+.489[e]	(16)		
QUARTER 4								
Soil organic	+.783[b]	(17)	+.766[b]	(17)	+.310	(16)		

a <.0001
b <.001
c <.01
d <.05
e <.1
f <.11
Note: Number of samples is given in parentheses
a New depth is water depth corrected for below surface conditions and standardized for sampling date.

Table 21. Correlation coefficients for taxonomic composition parameters with environmental and biological parameters. A. Correlation with percent blue-green algae (transformed).

	QUARTER 1		QUARTER 2		QUARTER 3		QUARTER 4	
Percent soil organic (trans)	-.325	(17)	-.450[e]	(17)	-.594[d]	(17)	-.438[e]	(17)
Percent soil $CaCO_3$ (trans)	+.169	(17)	+.196	(17)	+.390	(17)	+.287	(17)
Percent soil residual (trans)	-.061	(17)	+.000	(17)	-.141	(17)	-.201	(17)
Depth	-.488	(12)	-.492[d]	(17)	-.475[e]	(17)	-.302	(17)
Corrected depth	-.259	(17)	-.426[e]	(17)	-.446[e]	(17)	-.386	(17)
Quarterly hydroperiod	-.376	(16)	-.651[c]	(16)	-.588[d]	(16)	-.302	(16)
Annual hydroperiod	-.406	(16)	-.600[d]	(16)	-.595[d]	(16)	-.495[d]	(16)
Length of last drought	+.057	(12)	+.246	(12)	+.243	(12)	+.217	(12)
Time since last drought	-.306	(12)	-.667[d]	(12)	-.611[d]	(12)	-.726[c]	(12)
pH	-.070	(8)	+.362	(12)	+.058	(15)	-.197	(14)
Temperature	-.321	(8)	+.578[d]	(12)	-.084	(15)	+.318	(14)
norganic nitrogen	-.984[c]	(6)	-.055	(9)	-.203	(13)	+.236	(13)
Inorganic phosphorus	-.506	(6)	+.460	(11)	-.078	(16)	-.121	(14)
Silica	-.560	(6)	-.244	(11)	-.327	(16)	-.269	(14)
Calcium	ND		-.661	(5)	+.291	(17)	+.707[e]	(7)
Salinity	+.233	(8)	-.117	(12)	-.436[e]	(17)	ND	
Alkalinity	-.035	(8)	-.529[e]	(11)	-.210	(16)	-.425	(14)
Conductivity	+.190	(8)	-.406	(12)	-.496[d]	(17)	-.624[d]	(14)
Dissolved oxygen	+.140	(8)	+.321	(12)	+.171	(15)		
Percent organic in periphyton (trans)	+.239	(10)	+.417[e]	(17)	+.307	(17)	-.144	(17)
Total periphyton biomass	+.363	(10)	+.351	(17)	+.383	(15)	+.735[c]	(15)
Organic periphyton biomass	+.349	(9)	+.455[e]	(17)	+.420	(15)	+.751[c]	(15)
Total macrophyte biomass	-.029	(10)	+.233	(17)	+.018	(15)	.337	(16)
Live macrophytic biomass	+.022	(10)	-.069	(17)	-.260	(15)	+.176	(16)
Dead macrophytic biomass	-.038	(10)	+.287	(17)	+.129	(16)	+.291	(17)
Live standing macrophyte biomass	+.132	(10)	-.015	(17)	-.219	(15)	+.166	(17)
Live submergent macrophyte biomass	ND		-.278	(17)	-.522[d]	(17)	+.124	(15)
Dead standing macrophyte biomass	+.098	(10)	+.290	(17)	+.113	(15)	+.199	(17)
Dead prostrate macrophyte biomass	-.140	(10)	-.311	(17)	+.125	(17)	+.235	(15)
Organic periphyton and submergent macrophyte biomass	ND		+.413[e]	(17)	+.379	(15)	+.758[c]	(15)

a = $p < .0001$, b = $p < .001$, c = $p < .01$, d = $p < .05$, e = $p < .1$, f = $p < .11$

Table 21. Continued.
B. Correlation with percent green algae (transformed).

	QUARTER 1		QUARTER 2		QUARTER 3		QUARTER 4	
Percent soil organic (trans)	+.303	(17)	+.465[e]	(17)	+.719[c]	(17)	+.485[d]	(17)
Percent soil $CaCO_3$ (trans)	-.049	(17)	-.173	(17)	-.318	(17)	-.125	(17)
Percent soil residual (trans)	-.113	(17)	-.086	(17)	-.194	(17)	-.164	(17)
Depth	+.460	(12)	+.361	(17)	+.522[d]	(17)	+.436[e]	(17)
Corrected depth	+.250	(17)	+.330	(17)	+.539[d]	(16)	+.450[e]	(17)
Quarterly hydroperiod	+.362	(16)	+.519[d]	(16)	+.613[d]	(16)	+.551[d]	(16)
Annual hydroperiod	+.387	(16)	+.490[e]	(16)	+.612[d]	(16)	+.610[d]	(16)
Length of last drought	-.027	(12)	-.223	(12)	-.088	(12)	-.043	(12)
Time since last drought	+.198	(12)	+.682[d]	(12)	+.716[c]	(12)	+.404	(12)
pH	-.409	(8)	-.454	(12)	+.005	(15)	-.215	(14)
Temperature	+.439	(8)	-.462	(12)	-.037	(15)	+.215	(14)
Inorganic nitrogen	+.925[c]	(6)	+.218	(9)	+.095	(13)	-.244	(13)
Inorganic phosphorus	+.668	(6)	-.427	(11)	+.035	(16)	-.209	(14)
Silica	+.674	(6)	+.454	(11)	+.497[d]	(16)	-.003	(14)
Calcium			+.709	(5)	-.026	(17)	-.359	(7)
Salinity	-.649[e]	(8)	+.085	(12)	+.238	(17)		
Alkalinity	+.112	(8)	+.719[d]	(11)	+.349	(16)	+.407	(14)
Conductivity	-.633[e]	(8)	+.522[e]	(12)	+.541[d]	(17)	+.285	(14)
Dissovled oxygen	+.136	(8)	-.235	(12)	-.197	(15)		
Percent organic in periphyton (trans)	-.536[f]	(10)	-.299	(17)	+.031	(17)	+.160	(17)
Total periphyton biomass	-.116	(10)	-.372	(17)	-.335	(15)	-.482[e]	(15)
Organic periphyton biomass	+.124	(9)	-454[e]	(17)	-.359	(15)	-.627[d]	(15)
Total macrophyte biomass	+.044	(10)	-.248	(17)	+.133	(15)	+.153	(16)
Live macrophyte biomass	-.208	(10)	+.154	(17)	+.291	(15)	+.362	(16)
Dead macrophyte biomass	+.111	(10)	-.323	(17)	+.003	(16)	-.016	(17)
Live standing macrophyte biomass	+.086	(10)	+.060	(17)	+.275	(15)	+.327	(17)
Live submergent macrophyte biomass	ND		+.403[f]	(17)	+.187	(17)	+.138	(15)
Dead standing macrophyte biomass	-.198	(10)	-.324	(17)	+.046	(15)	+.024	(17)
Dead prostrate macrophyte biomass	+.322	(10)	+.075	(17)	+.060	(17)	+.054	(15)
Organic periphyton and submergent macrophyte biomass	ND		-.398	(17)	-.337	(15)	-.615[d]	(15)

a = p < .0001, b = p < .001, c = p < .01, d = p < .05, e = p < .1, f = p < .11

Table 21. Continued.
C. Correlation with percent diatoms (transformed).

	QUARTER 1		QUARTER 2		QUARTER 3		QUARTER 4	
Percent soil organic (trans)	+.466[e]	(17)	+.569[d]	(17)	+.620[d]	(17)	+.489[d]	(17)
Percent soil $CaCO_3$ (trans)	-.442[e]	(17)	-.386	(17)	-.442[e]	(17)	-.417[e]	(17)
Percent soil residual (trans)	+.482[d]	(17)	+.211	(17)	+.212	(17)	+.339	(17)
Depth	+.724[c]	(12)	+.655[c]	(17)	+.551[d]	(17)	+.331	(17)
Corrected depth	+.511[d]	(17)	+.562[d]	(17)	+.511[d]	(16)	+.403[f]	(17)
Quarterly hydroperiod	+.484[e]	(16)	+.754[c]	(16)	+.659[c]	(16)	+.169	(16)
Annual hydroperiod	+.509[d]	(16)	+.670[c]	(16)	+.658[c]	(16)	+.413[f]	(16)
Length of last drought	-.202	(12)	-.236	(12)	-.375	(12)	-.221	(12)
Time since last drought	+.515[e]	(12)	+.689[d]	(12)	+.681[d]	(12)	+.706[d]	(12)
pH	+.156	(8)	-.343	(12)	+.043	(15)	+.391	(14)
Temperature	+.241	(8)	-.435	(12)	+.021	(15)	-.423	(14)
Inorganic nitrogen	+.938[c]	(6)	+.164	(9)	+.299	(13)	-.215	(13)
Inorganic phosphorus	+.602	(6)	-.146	(11)	+.103	(16)	+.346	(14)
Silica	+.471	(6)	+.025	(11)	+.354	(17)	+.437	(14)
Calcium	ND		+.068	(5)	-.150	(17)	-.727[e]	(7)
Salinity	-.192	(8)	+.428	(12)	+.489[d]	(17)	ND	
Alkalinity	-.029	(8)	+.292	(11)	+.170	(16)	+.457[e]	(14)
Conductivity	-.140	(8)	+.298	(12)	+.527[d]	(17)	+.631[d]	(14)
Dissolved oxygen	-.090	(8)	-.370	(12)	-.170	(15)	ND	
Percent organic in periphyton (trans)	-.415	(10	-.298	(17)	-.361	(17)	+.167	(17)
Total periphyton biomass	-.277	(10)	-.325	(17)	-.424	(15)	-.784[b]	(15)
Organic periphyton biomass	-.115	(9)	-.424[e]	(17)	-.493[e]	(15)	-.780[b]	(15)
Total macrophyte biomass	+.228	(10)	-.142	(17)	-.078	(15)	-.469[e]	(16)
Live macrophyte biomass	-.042	(10)	+.167	(17)	+.243	(15)	-.317	(16)
Dead macrophyte biomass	-.233	(10)	-.215	(17)	-.215	(16)	-.412[e]	(17)
Live standing macrophyte biomass	-.231	(10)	+.189	(17)	+.208	(15)	-.295	(17)
Live submergent macrophyte biomass	ND		-.021	(17)	+.414[e]	(17)	-.143	(15)
Dead standing macrophyte biomass	-.443	(10)	-.214	(17)	-.168	(15)	-.293	(17)
Dead prostrate macrophyte biomass	+.145	(10)	+.451[e]	(17)	-.242	(17)	-.425	(15)
Organic periphyton and submergent macrophyte biomass	ND		-.416[e]	(17)	-.457	(15)	-.789[b]	(15)

a = $p < .0001$, b = $p < .001$, c = $p < .01$, d = $p < .05$, e = $p < .1$, f = $p < .11$

Table 21. Continued.
D. Correlation with percent desmids (transformed).

	QUARTER 1	QUARTER 2	QUARTER 3	QUARTER 4
Percent soil organic (trans)				+.035 (17)
Percent soil $CaCO_3$ (trans)				-.029 (17)
Percent soil residual (trans)				-.068 (17)
Depth				+.115 (17)
Corrected depth				+.137 (17)
Quarterly hydroperiod				+.238 (16)
Annual hydroperiod				+.155 (16)
Length of last drought				+.060 (12)
Time since last drought				+.314 (12)
pH				-.372 (14)
Temperature				+.342 (14)
Inorganic nitrogen				+.370 (13)
Inorganic phosphorus				-.697[c] (14)
Silica				-.611[d] (14)
Calcium				-.399 (7)
Salinity				ND
Alkalinity				-.406 (14)
Conductivity				-.316 (14)
Dissolved oxygen				ND
Percent organic in periphyton (trans)				-.192 (17)
Total periphyton biomass				+.093 (15)
Organic periphyton biomass				-.133 (15)
Total macrophyte biomass				+.118 (16)
Live macrophyte biomass				+.347 (16)
Dead macrophyte biomass				-.058 (17)
Live standing macrophyte biomass				+.267 (17)
Live submergent macrophyte biomass				+.708[c] (15)
Dead standing macrophyte biomass				-.072 (17)
Dead prostrate macrophyte biomass				+.216 (15)
Organic periphyton and submergent macrophyte biomass				-.080 (15)

a = $p < .0001$, b = $p < .001$, c = $p < .01$, d = $p < .05$, e = $p < .1$, f = $p < .11$

Table 21. Continued.
E. correlation coefficients for annual average percents of taxonomic parameters with annual hydroperiod.

Percent blue-green algae (trans)	$-.551^{d}$ (16)
Percent green algae (trans)	$+.552^{d}$ (16)
Percent diatoms (trans)	$+.608^{d}$ (16)

a = $p < .0001$, b = $p < .001$, c = $p < .01$, d = $p < .05$, e = $p < .1$, f = $p < .11$.

Table 22. Tally of statistically significant ($p < .1$) correlations for each algal taxa, covering all quarters and all environmental and biological parameters.

	Number in Significance Categories[a]			
	$p < .001$	$p < .01$	$p < .05$	$p < .1$
Blue-green algae	0	6	12	10
Green algae	0	3	14	9
Diatoms	3	7	15	15
Desmids[b]	0	2	1	0

[a] Categories are exclusive. For instance, category $p < .1$ covers $.049 < p < .1$ only.

[b] Desmid correlations for Quarter 4 only.

Table 23. Tally of statistically significant ($p < .1$) correlations for each quarter, covering all environmental and biological parameters and all algal taxa.[a]

	Number in Significance Categories[b]			
	$p < .001$	$p < .01$	$p < .05$	$p < .1$
Quarter 1[c]	0	4	3	5
Quarter 2	0	4	10	13
Quarter 3	0	4	18	6
Quarter 4[d,e]	3	6[f]	11[g]	10

a Information was developed for desmids for Quarter 4 only.

b Categories are exclusive. For example, Category 1 $p < .1$ covers $.0495 < p \leq .1$ only.

c Three missing data points

d Two missing data points

e Desmid correlations available for this quarter only.

f Includes two desmid correlations

g Includes one desmid correlation

Table 24. Tally of statistically significant ($p < .1$) correlations for each environmental or biological parameter, covering all quarters and algal taxa.[a]

	Number in Significance Categories[b]			
	$p < .001$	$p < .01$	$p < .05$	$p < .1$
Percent soil organic (trans)	0	1	5	4
Percent soil $CaCO_3$ (trans)	0	0	0	3
Percent soil residual (trans)	0	0	1	0
Depth	0	2	3	2
Corrected depth	0	0	4	3
Quarterly hydroperiod	0	3	4	1
Annual hydroperiod	0	2	6	1
Length of last drought	0	0	0	0
Time since last drought	0	2	6	1
pH	0	0	0	0
Temperature	0	0	1	0
Inorganic nitrogen	0	3	0	0
Inorganic phosphorus	0	1	0	0
Silica	0	0	2	0
Calcium[c]	0	0	0	2
Salinity[c]	0	0	0	2
Alkalinity	0	0	1	2
Conductivity	0	0	5	2
Dissolved oxygen[c]	0	0	0	0
Percent organic in periphyton (trans)	0	0	0	1
Total periphyton biomass	1	1	0	1
Organic periphyton biomass	1	1	1	4
Total macrophyte biomass	0	0	0	1
Live macrophyte biomass	0	0	0	0
Dead macrophyte biomass	0	0	0	1
Live standing macrophyte biomass	0	0	0	0
Live submergent macrophyte biomass	0	1	1	1
Dead standing macrophyte biomass	0	0	0	0
Dead prostrate macrophyte biomass	0	0	0	1
Organic periphyton and submergent[c]	1	1	1	2

[a] Information was developed for desmids for Quarter 4 only.

[b] Categories are exclusive. For example, category $p < .1$ covers $0.049 < p \leq .1$ only.

[c] Missing values could affect count of significant correlations.

APPENDIX A

PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE ENVIRONMENT

Appendix Table A-1. Initial and first quarter field measurements of physical and chemical parameters of the water at sampling stations.

Date	Station #	Time (hrs.)	Water Depth (cm)	D.O. (mg/1)	Temp. (^oC)	Salinity ($^o/oo$)	Conductivity (μmhos/cm)	pH	Alkalinity* (Bicarbonate) mg/1 $CaCO_3$
				Taylor Slough, January 26-27, 1978					
1/26/78	I			no water					
1/26/78	I-Canal	1100	-	7.4	22	0	350	7.5	209
1/26/78	II			no water					
1/26/78	III			no water					
1/26/78	IV	1500	-	7.8	24	0	255	6.5	165
1/26/78	V			no water					
1/27/78	VI	1045	22.5	7.7	17	0	325	7.5	207
1/27/78	VII		0	no water					
1/27/78	VIII	1000	16.5	7.3	13	0	312	7.8	192
1/27/78	IX	1415	15.5	13.6	20	0	330	8.3	157
1/27/78	X	1540	14.5	13.0	21	0	360	7.9	140
				Shark Slough, February 15, 1978[a]					
2/15/78	XI	0730	17.0	8.4	14	0.5	750	7.8	179
2/15/78	XII	1015	25.0	6.5	21	0.8	750	7.8	179
				Taylor Slough, February 23-24, 1978[a]					
2/23/78	I		0	no water					
2/23/78	I-Canal	0925	-	5.5	20	0	370	6.6	205
2/24/78	II		0	no water					
2/24/78	III		0	no water					
2/24/78	IV	1020	12.9	8.9	18	0	310	6.9	188

Table A-1 continued.

Date	Station #	Time (hrs.)	Water Depth (cm)	D.O. (mg/l)	Temp. (^{o}C)	Salinity ($^{o}/oo$)	Conductivity (μmhos/cm)	pH	Alkalinity* (Bicarbonate) mg/l $CaCO_3$
2/24/78	V		0	no water					
2/23/78	VI	1545	39.4	8.8	21	0	320	6.8	198
2/23/78	VII	1700	15.3	9.2	20	0	319	6.4	192
2/23/78	VIII	1300	32.3	9.0	23	0	335	7.2	177
2/24/78	IX	1400	20.4	12.2	22	0	295	6.9	161
2/24/78	X	1520	11.1	12.4	23	0	310	7.0	159
				Taylor Slough, March 30 and April 1, 1978					
3/30/78	I			no water					
3/30/78	I-Canal	0920	-	7.5	23	0	385	7.8	210
3/30/78	II			no water					
3/30/78	III			no water					
3/30/78	IV			no water					
3/30/78	V			no water					
3/30/78	VI	1315	17.0	6.8	28	0	370	7.3	210
4/1/78	VII			no water					
4/1/78	VIII	1040	17.0	6.6	22.0	0	370	7.5	230
4/1/78	IX	1300	15.0	11.8	29.0	0	310	8.4	160
4/1/78	X			no water					

[a] First quarter samples were collected on these dates at stations indicated

Appendix Table A-2. Second quarter field measurements of physical and chemical parameters of the water at sampling stations.

Date	Station #	Time (hrs.)	Water Depth (cm)	D.O. (ppm)	Temp. (^{o}C)	Salinity ($^{o}/oo$)	Conductivity (μmhos/cm)	pH	Alkalinity (Bicarbonate) mg/1 $CaCO_3$
				Shark Valley, May 16, 1978					
5/16/78	XI		0	no water					
5/16/78	XII	1045	17.0	4.0	26.5	0.5	880	6.9	240
				Taylor Slough, June 1-2, 1978					
6/1/78	I		0	no water					
6/1/78	I-canal	0825		9.3	22.5	0	358	7.9	160
6/1/78	II		0	no water					
6/1/78	III		0	no water					
6/1/78	UV	1245	17.0	15.2	33.0	0	358	7.9	160
6/2/78	V		0	no water					
6/1/78	VI	1510	42.0	12.4	34.0	0	350	7.6	140
6/1/78	VII	1620	15.0	11.8	36.0	0	320	7.9	130
6/2/78	VIII	0810	29.0	2.1	23.2	0	342	7.1	200
6/2/78	IX	1145	21.5	10.0	32.0	0	315	7.5	130
6/2/78	X	1300	14.0	11.5	34.0	0	348	7.8	140
				Canals 67 and 111 Area, July 8-9, 1978					
7/8/78	XIII	1020	17.3	8.2	26.5	0	600	7.4	210
7/8/78	XIV	1250	15.0	10.6	36.0	0.5	800	7.4	230
7/8/78	XV	1620	16.0	8.0	33.0	0.25	410	7.8	10+
7/9/78	XVI	0853	0	5.0	29.0	0.25	268	7.5	130
7/9/78	XVII	1318	24.0	8.7	30.0	0.75	700	7.8	160

+ Carbonate alkalinity as $CaCO_3$ 100/mg/1

Appendix Table A-3. Third quarter field measurements of physical and chemical parameters of the water at sampling stations.

Date	Station #	Time (hrs.)	Water Depth (cm)	D.O. (ppm)	Temp. (°C)	Salinity (°/oo)	Conductivity (μmhos/cm)	pH	Alkalinity (Bicarbonate) mg/1 $CaCO_3$
				Shark Valley, August 15, 1978					
8/15/76	XI	0700	22.0	no data	no data	0	329	6.7	140
8/15/76	XII	1410	52.0	no data	no data	0.25	400	7.0	no data
				Taylor Slough, August 26-27, 1978					
8/26/78	I	0910	15.1	3.8	27.0	0.25	351	6.8	190
8/26/78	I-canal	0840	--	2.1	26.0	0.25	362	6.7	190
8/26/78	II	1050	11.5	5.9	28.0	0.30	300	6.5	150
8/26/78	III	1135	15.8	8.5	30.0	0.25	311	6.6	160
8/26/78	IV	1230	29.9	9.5	30.0	0.10	338	7.0	170
8/27/78	V	1235	8.0	10.8	35.0	0.25	380	7.2*	160
8/26/78	VI	1430	44.0	11.7	34.0	0.10	400	7.1	150
8/26/78	VII	1542	15.0	13.6	35.0	0.10	300	7.1	140
8/27/78	VIII	1425	36.4	9.1	32.0	0.25	343	no data	170
8/27/78	IX	0900	25.5	4.7	29.0	0.10	238	6.5	110
8/27/78	X	1015	20.5	8.7	30.5	0.10	251	7.4	110
				Canals 67 and 111 Area, September 2-3, 1978					
9/2/78	XIII	0900	24.0	3.4	29.5	0.50	780	6.7	190
9/2/78	XIV	1130	26.1	5.2	27.5	0.50	730	6.7	230
9/2/78	XV	1245	13.5	6.1	26.0	0.75	910	7.1	230
9/2/78	XVI	1500	33.0	8.7	28.5	0.50	202	7.0	100
9/3/78	XVII	1210	26.0	6.9	31.0	1.20	800	no data	120

* questionnable reading due to meter malfunction.

Appendix Table A-4. Fourth quarter field measurements of physical and chemical parameters of the water at sampling stations.

Date	Station #	Time (hrs.)	Water Depth (cm)	D.O. (ppm)	Temp. (°C)	Salinity (°/oo)	Conductivity (μmhos/cm)	pH	Alkalinity* (Bicarbonate) mg/l $CaCO_3$
Shark Valley, November 13, 1978									
11/13/78	XI	07:10	24.0	no data	24.0	0	355	8.1	160
11/13/78	XII	11:00	58.0	no data	27.5	0	450	8.5	150
Taylor Slough, November 18-19, 1978									
11/18/78	I			no water					
11/18/78	I-Canal	08:25	--	no data	26.0	0	400	7.0[a]	210
11/18/78	II			no water					
11/18/78	III	11:00	0	no data	27.0	0	308	7.2[a]	120
11/18/78	IV	12:00	15.0	no data	28.2	0	368	7.2[a]	190
11/19/78	V			no water					
11/18/78	VI	14:00	36.5	no data	28.3	0	320	7.1[a]	160
11/18/78	VII	14:45	7.5	no data	28.0	0	405	7.1[a]	160
11/19/78	VIII	13:00	33.9	no data	27.0	0	305	7.0[a]	170
11/19/78	IX	09:00	26.3	no data	23.2	0	240	7.0[a]	130
11/19/78	X	09:45	22.6	no data	24.5	0	250	6.9[a]	130
Canals 67 and III Area, December 12-14, 1972									
12/13/78	XIII	10:00	22.0	no data	21.5	0	450	7.6[b]	280
12/13/78	XIV	11:15	22.5	no data	21.5	0	500	7.5[b]	240
12/13/78	XV	13:00	21.0	no data	26.5	0	530	7.5[b]	130
12/14/78	XVI	07:30	1.0	no data	17/0	0	257	7.6[b]	130
12/14/78	XVII	10:00	15.0	no data	24.2	0	463	7.3[b]	120

[a] standards used were canal water and pH 14 buffer

[b] standard used was pH 14 buffer only

Appendix Table A-5. Fifth quarter field measurements of physical and chemical paramters of the water at sampling stations.

Canal 67, March 24, 1979

Date	Station No.	Time (hrs)	Water Depth (cm)	D.O. (ppm)	Temp. (^oC)	Salinity $^o/oo$	Con-ductivity	pH	Alkalinity (Bicarbonate) mg/1 $CaCO_3$
3/24/79	XIII	0845	7.0	No data	23.0	No data	No data	7.0	220
3/24/79	XIV	1000	13.0	No data	25.0	No data	No data	7.3	260
3/24/79	XV	1130	18.0	No data	28.5	No data	No data	7.6	250

Note: All-day water quality dates

Taylor Slough (park sites): 8/8/79

208 sites (C-67 sites): 8/10/79

Appendix Table A-6. Calcium in water at various sampling stations on various dates.

		L67, Chekika, and CIII, July 8, 1978
		mg/l
7/8/78	XIII	69.3
7/8/78	XIV	69.3
7/8/78	XV	31.9
7/8/78	XVI	48.4
7/8/78	XVII	64.9
		Shark Slough, August 15, 1978
8/15/78	XI	57.2
8/15/78	XII	45.1
		Taylor Slough, August 26, 1978
8/26/78	I	77.0
	I-Canal	78.1
	II	63.8
	III	8.8
	IV	64.9
	V	59.4
	VI	57.2
	VII	58.3
	VIII	4.4
	IX	44.0
	X	37.4
		L67, Chekika, and CIII, September 2, 1978
9/2/78	XIII	53.9
	XIV	94.6
	XV	68.2
	XVI	33.0
	XVII	46.2
		Shark Slough, November 13, 1978
11/13/78	XI	90.2
	XII	93.5
		L67, Chekika, and CIII, December 13, 1978
12/13/78	XIII	66.0
	XIV	66.0
	XV	66.0
	XVI	60.5
	XVII	45.1

Appendix Table A-7. Carbon analysis (mg/l) of water samples from various stations on various dates.

2/26/79 M3

Date	Sample	Total Carbon	Inorganic Carbon	Organic Carbon
	I Canal			
	IV			
	VI		NO	DATA
	VIII			
	IX			
	X			
2/23/78				
	I-Canal	48	32	16
	IV	44	28	16
	VI	34	22	12
	VII	40	27	13
	VIII	41	26	15
	IX	31	19	12
	X	34	21	13
	I Canal			
	VI			
	VIII		NO	DATA
	IX			
	X			
5/5/78				
	I-Canal	44	38	6
	IV	49	27	22
	VI	45	28	17
	VIII	44	28	16
	IX	43	21	22
	X	47	23	24
5/16/78				
	XII	80	38	42
6/1/78				
	I-Canal	42	33	9
	IV	38	29	9
	VI	32	24	8
	VII	31	23	8
	VIII	45	36	9
	IX	35	20	15
	X	35	22	13
7/8/78				
	XIII	70	40	30
	XVI	75	44	31
	XV	52	21	31

Table A-7 continued.

Date	Sample	Total Carbon	Inorganic Carbon	Organic Carbon
	XVI	44	24	20
	XVII	48	34	14
8/15/78				
	XI	51	24	27
	XII	45	24	21
8/26/78				
	I-Canal	54	41	13
	I	51	38	13
	II	43	30	13
	III			
	IV	47	32	15
	V	41	29	12
	VI	41	27	14
	VII	38	27	11
	VIII			
	IX	37	21	16
	X	34	18	16
9/2/78				
	XIII	73	41	32
	XIV	77	45	32
	XV	76	45	31
	XVI	34	18	16
	XVII	41	23	18
11/13/78				
	XI	56	31	25
	XII	62	32	30
11/18/78				
	I-Canal	52	45	7
	III	44	34	10
	IV	51	43	8
	VI	43	36	7
	VII	41	35	6
	VIII	46	36	10
	IX	40	27	13
	X	39	26	13
12/13/78				
	XIII	78	46	32
	XIV	79	47	32
	XV	78	47	31
12/14/78				
	XI	52	28	24
	XII	42	24	18

Appendix Table A-8. Silica (SiO_3) analysis of water samples from various stations on various dates.

Station	Date	SiO_3 mg/1	Date	SiO_3 mg/1	Date	SiO_3 mg/1	Date	SiO_3 mg/1
I canal	2/23/78	3.42	6/1/78	1.07	8/26/78	5.11	11/18/78	3.89
I	2/23/78	N	6/ 1/78	N	8/26/78	4.60	11/18/78	N
II	2/24/78	N	6/ 1/78	N	8/26/78	6.41	11/18/78	N
III	2/24/78	N	6/ 1/78	N	8/26/78	5.85	11/18/78	3.10
IV	2/24/78	3.01	6/ 1/78	1.14	8/26/78	5.42	11/18/78	3.45
V	2/23/78	N	6/ 2/78	N	8/27/78	5.31	11/19/78	N
VI	2/23/78	2.28	6/ 1/78	1.33	8/26/78	5.31	11/18/78	2.82
VII	2/23/78	2.43	6/ 1/78	0.95	8/26/78	5.42	11/18/78	2.91
VIII	2/23/78	2.89	6/ 2/78	0.95	8/27/78	N	11/19/78	3.54
IX	2/24/78	1.98	6/ 2/78	1.03	8/27/78	6.29	11/19/78	2.13
X	2/24/78	1.83	6/ 2/78	1.07	8/27/78	4.18	11/19/78	2.25
XI			5/16/78	N	8/15/78	9.17	11/13/78	9.20
XII			5/16/78	N	8/15/78	8.40	11/13/78	9.20
XIII			7/ 8/78	8.40	9/ 2/78	18.24	12/13/78	7.23
XIV			7/ 8/78	18.24	9/ 2/78	18.24	12/13/78	7.89
XV			7/ 8/78	10.58	9/ 2/78	13.98	12/13/78	7.63
XVI			7/ 9/78	6.72	9/ 2/78	5.75	12/14/78	3.17
XVII			7/ 9/78	3.97	9/ 3/78	5.61	12/14/78	2.34

N = missing data

Appendix Table A-9. Nitrogen and nitrogen compounds in water samples from various stations on various dates.

Station	Date	NH_4 µg/1	$N-NH_4$ µg/1	NO_2 µg/1	$N-NO_2$ µg/1	NO_3 µg/1	$N-NO_3$ µg/1	$N-(NH_4+NO_2+NO_3)$ µg/1
I canal	02/23/78	191.39	148.61	11.50	3.50	77.51	17.51	169.62
I	02/23/78	N	N	N	N	N	N	N
II	02/24/78	N	N	N	N	N	N	N
III	02/24/78	N	N	N	N	N	N	N
IV	02/24/78	18.76	14.57	6.90	2.10	12.40	2.80	19.47
V	02/23/78	N	N	N	N	N	N	N
VI	02/23/78	4.51	3.50	11.50	3.50	65.11	14.70	21.70
VII	02/23/78	5.77	4.48	9.20	2.80	18.60	4.20	11.48
VIII	02/23/78	63.14	49.02	6.90	2.10	9.30	2.10	53.22
IX	02/24/78	10.28	7.98	10.12	3.08	29.76	6.72	17.78
X	02/24/78	5.59	4.34	9.20	2.80	49.60	11.21	18.35
I canal	06/01/78	71.80	55.75	9.20	2.80	80.61	18.20	76.75
I	06/01/78	N	N	N	N	N	N	N
II	06/01/78	N	N	N	N	N	N	N
III	06/01/78	N	N	N	N	N	N	N
IV	06/01/78	41.31	32.08	8.28	2.52	91.15	20.59	55.19
V	06/02/78	N	N	N	N	N	N	N
VI	06/01/78	41.84	32.49	6.90	2.10	18.60	4.20	38.79
VII	06/01/78	31.57	24.51	5.98	1.82	16.74	3.78	30.11
VIII	06/02/78	24.89	19.33	5.52	1.68	20.46	4.62	25.63
IX	06/02/78	72.88	56.59	4.60	1.40	7.44	1.68	59.67
X	06/02/78	50.87	39.50	9.20	2.80	12.40	2.80	45.10
XI	05/15/78	N	N	N	N	N	N	N
XII	05/15/78	N	N	N	N	N	N	N
XIII	07/08/78	N	N	9.66	2.94	21.08	4.76	N
XIV	07/08/78	79.01	61.35	10.58	3.22	13.02	2.94	67.51
XV	07/09/78	N	N	9.66	2.94	27.90	6.30	N
XVI	07/09/78	64.03	49.72	6.44	1.96	11.78	2.66	54.34
XVII	07/09/78	79.01	61.35	4.14	1.26	1.24	0.28	62.89

Table A-9 continued.

Station	Date	NH_4 µg/1	$N-NH_4$ µg/1	NO_2 µg/1	$N-NO_2$ µg/1	NO_3 µg/1	$N-NO_3$ µg/1	$N-(NH_4+NO_2+NO_3)$ µg/1
I canal	08/26/78	226.20	175.64	3.22	0.98	114.71	25.91	202.53
I	08/26/78	N	N	2.30	0.70	31.00	7.00	N
II	08/26/78	44.01	34.18	4.14	1.26	14.88	3.36	38.80
III	08/26/78	N	N	4.14	1.26	21.70	4.90	N
IV	08/26/78	151.16	117.38	3.22	0.98	22.32	5.04	123.40
V	08/27/78	44.01	34.18	2.30	0.70	17.36	3.92	38.80
VI	08/26/78	60.97	47.34	2.30	0.70	72.55	16.39	64.43
VII	08/26/78	83.16	64.57	2.30	0.70	31.00	7.00	72.27
VIII	08/27/78	107.15	83.20	N	N	N	N	N
IX	08/27/78	82.08	63.73	4.60	1.40	21.08	4.76	69.89
X	08/27/78	47.62	36.98	6.44	1.96	24.80	5.60	44.54
XI	08/15/78	N	N	6.44	1.96	11.78	2.66	N
XII	08/15/78	54.12	42.02	6.44	1.96	18.60	4.20	48.18
XIII	09/02/78	33.37	25.91	8.74	2.66	1.24	8.50	37.07
XIV	09/02/78	26.70	20.73	9.66	2.94	7.44	11.35	35.02
XV	09/02/78	92.00	71.43	9.66	2.94	63.24	10.08	84.45
XVI	09/02/78	25.25	19.61	4.60	1.40	34.72	10.36	31.37
XVII	09/03/78	120.14	93.28	5.06	1.54	27.28	10.36	105.18
I canal	11/18/78	185.26	143.85	8.74	2.66	112.85	25.49	172.00
I	11/18/78	N	N	N	N	N	N	N
II	11/18/78	40.95	31.80	N	N	N	N	N
III	11/18/78	107.69	83.62	7.82	2.38	29.76	6.72	92.72
IV	11/18/78	120.68	93.70	7.82	2.38	9.30	2.10	98.18
V	11/19/78	N	N	N	N	N	N	N
VI	11/18/78	40.95	31.80	10.12	3.08	26.66	6.02	40.90
VII	11/18/78	N	N	7.82	2.38	22.94	5.18	N
VIII	11/19/78	43.11	33.48	7.82	2.38	2.48	0.56	36.42
IX	11/19/78	96.69	1,354.31	8.74	2.66	38.44	8.68	1,365.65

Table A-9 continued.

Station	Date	NH_4 µg/1	$N-NH_4$ µg/1	NO_2 µg/1	$N-NO_2$ µg/1	NO_3 µg/1	$N-NO_3$ µg/1	$N-(NH_4+NO_2+NO_3)$ µg/1
X	11/19/78	44.01	34.18	6.44	1.96	24.80	5.60	41.74
XI	11/13/78	65.66	50.98	6.44	1.96	25.42	5.74	58.68
XII	11/13/78	33.37	25.91	6.44	1.96	25.42	8.82	36.69
XIII	12/13/78	19.12	14.85	6.44	1.96	39.06	5.60	22.41
XIV	12/13/78	25.25	19.61	7.82	2.38	2.48	0.56	22.55
XV	12/13/78	69.63	54.07	6.44	1.96	24.80	5.60	61.63
XVI	12/14/78	35.36	27.45	4.60	1.40	27.28	6.16	35.01
XVII	12/14/78	140.34	108.97	6.44	1.96	66.35	14.99	125.92

N = missing data

Appendix Table A-10. Phosphorus in water samples from various stations on various dates.

Station	Date	$I-PO_4$ µg/l	I-P µg/l	O-P µg/l	T-P µg/l
I canal	02/23/78	28.49	9.29	21.37	30.66
II	02/23/78	N	N	N	N
II	02/24/78	N	N	N	N
III	02/24/78	N	N	N	N
IV	02/24/78	28.49	9.29	22.61	31.90
V	02/23/78	N	N	N	N
VI	02/23/78	28.49	9.29	21.37	30.66
VII	02/23/78	23.74	7.74	18.59	26.33
VIII	02/23/78	28.49	9.29	21.99	31.28
IX	02/24/78	23.74	7.74	19.21	26.95
X	02/24/78	18.99	6.19	18.90	25.09
I canal	06/01/78	104.47	34.07	26.33	60.40
I	06/01/78	N	N	N	N
II	06/01/78	N	N	N	N
III	06/01/78	N	N	N	N
IV	06/01/78	118.71	38.72	29.42	68.14
V	06/02/78	N	N	N	N
VI	06/01/78	94.97	30.97	28.19	59.16
VII	06/01/78	85.47	27.88	25.09	52.97
VIII	06/02/78	85.47	27.88	25.09	52.97
IX	06/02/78	90.22	29.43	26.94	56.37
X	06/02/78	90.22	29.43	26.32	55.75
XI	05/16/78	N	N	N	N
XII	05/16/78	N	N	N	N
XIII	07/08/78	24.69	8.05	15.49	23.54
XIV	07/08/78	34.19	11.15	22.30	33.45
XV	07/08/78	41.79	13.63	17.03	30.66
XVI	07/09/78	23.74	7.74	15.80	23.54
XVII	07/09/78	23.74	7.74	15.18	22.92
I canal	08/26/78	19.94	6.50	13.01	19.51
I	08/26/78	27.54	8.98	15.17	24.15
II	08/26/78	20.89	6.81	11.77	18.58
III	08/26/78	34.19	11.15	15.17	26.32
IV	08/26/78	30.39	9.91	15.18	25.09
V	08/27/78	19.94	6.50	12.08	18.58
VI	08/26/78	23.74	7.74	14.56	22.30
VII	08/26/78	17.09	5.58	12.08	17.66
VIII	08/27/78	N	N	N	26.33
IX	08/27/78	37.99	12.39	13.94	27.88
X	08/27/78	23.74	7.74	15.18	22.92

Table A-10 continued.

Station	Date	I-PO_4 µg/l	I-P µg/l	O-P µg/l	T-P µg/l
XI	08/15/79	34.19	11.15	16.73	27.88
XII	08/15/79	27.54	8.98	15.18	24.16
XIII	09/02/78	27.54	8.98	15.18	24.16
XIV	09/02/78	27.54	8.98	16.11	25.09
XV	09/02/78	27.54	8.98	13.32	22.30
XVI	09/02/79	23.74	7.74	15.18	22.92
XVII	09/03/79	27.54	8.98	13.94	22.92
I canal	11/18/78	23.74	7.74	15.18	22.92
I	11/18/79	N	N	N	N
II	11/18/78	N	N	N	N
III	11/18/78	19.94	6.50	11.46	17.96
IV	11/18/78	13.30	4.34	8.67	13.01
V	11/19/78	N	N	N	N
VI	11/18/78	13.30	4.34	8.05	12.39
VII	11/18/78	9.50	3.10	8.05	11.15
VIII	11/19/78	19.94	6.50	11.46	17.96
IX	11/19/78	13.30	4.34	8.67	13.01
X	11/19/78	19.94	6.50	12.08	18.58
XI	11/13/78	27.54	8.98	13.32	22.30
XII	11/13/78	23.74	7.74	15.18	22.92
XIII	12/13/78	19.94	6.50	12.08	18.58
XIV	12/13/78	23.74	7.74	14.56	22.30
XV	12/13/78	47.49	15.49	27.56	43.05
XVI	12/14/78	23.74	7.74	15.18	22.92
XVII	12/14/78	13.30	4.34	14.24	18.58

N = missing data

Appendix Table A-11. Results of sediment analysis for sample sites.

Site	% Organic Matter	% $CaCO_3$	% Residual
I	n.s.	n.s.	n.s.
II	n.s.	n.s.	n.s.
III	12.7	84.7	2.6
IV	13.9	84.0	2.1
V	9.7	88.7	1.6
VI	65.5	33.8	0.7
VII	11.7	86.7	1.6
VIII	n.s.	n.s.	n.s.
IX	14.3	84.0	1.7
X	9.7	88.5	1.8
XI	12.9	78.1	9.0
XII	73.3	26.1	0.6
XIII	32.3	67.2	0.5
XIV	n.s.	n.s.	n.s.
XV	41.5	49.6	8.9
XVI	24.5	6.2	69.3
XVII	15.9	77.0	7.1
$CaCO_3$[a]	0.0	99.35	0.65

[a] Standard

APPENDIX B

HYDROPERIOD

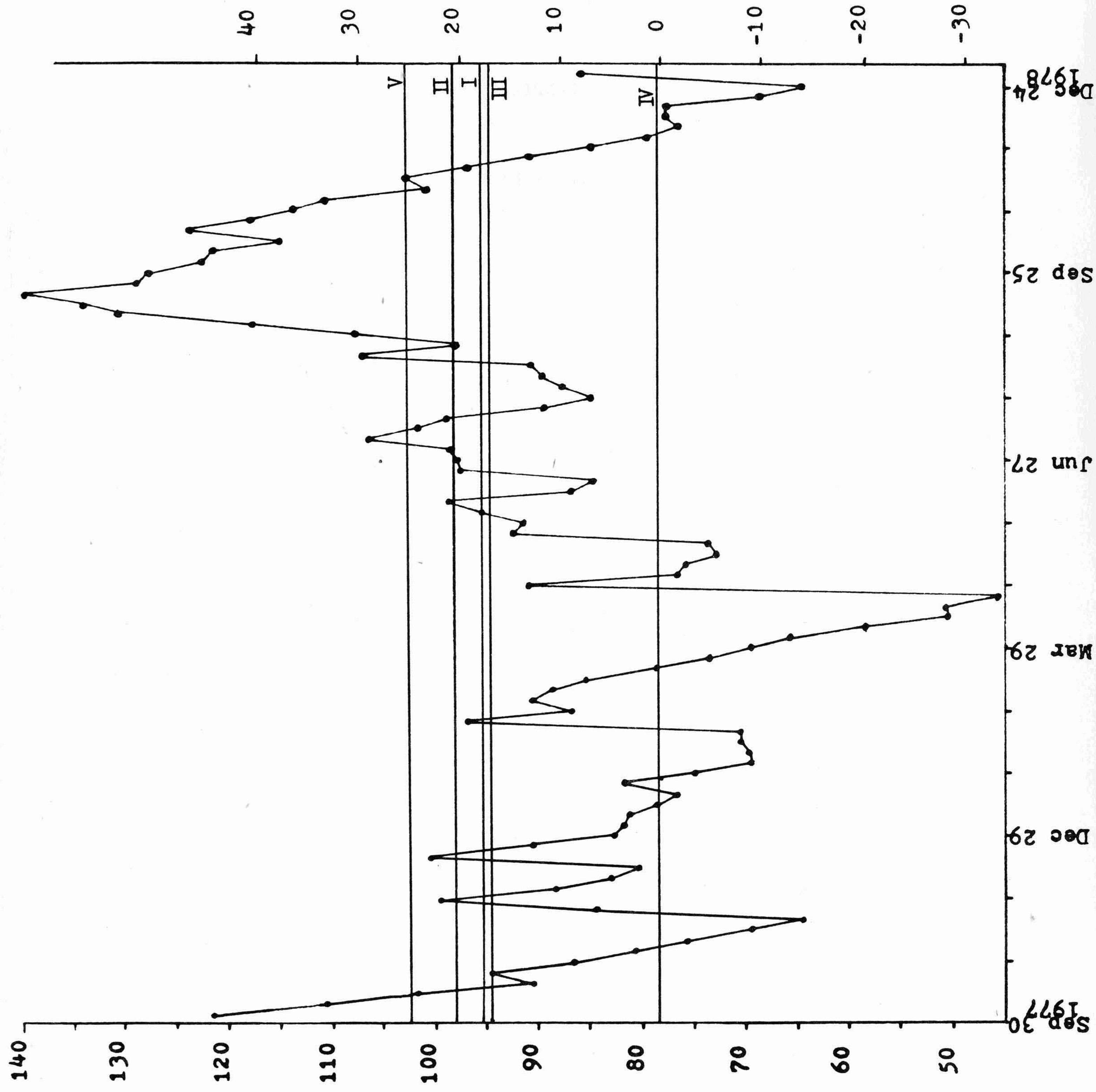


Figure B-1 Water level (cm MSL) every fifth day at the U.S.G.S. recording station at Taylor Slough Bridge (left ordinate) and corresponding estimated water depth (cm) at study site IV, from September 30, 1977, through December 31, 1978. Estimated zero depths for study sites I, II, III, IV and V are indicated with labelled lines.

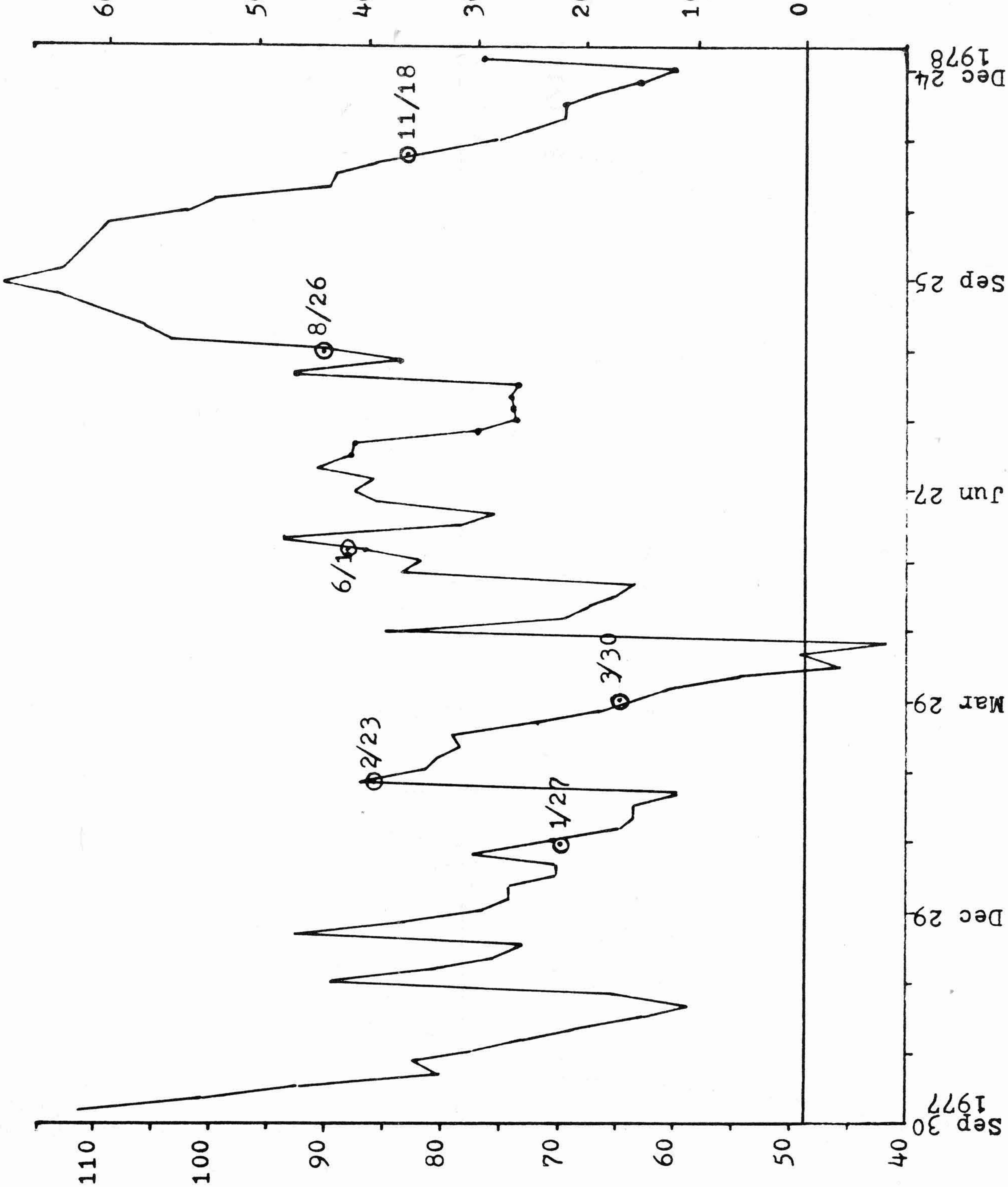


Figure B-2 Water level (cm MSL) every fifth day at the U.S.G.S. recording station at Royal Palm and corresponding estimated water depth (cm) at study site VI from September 30, 1977, through December 31, 1978. Estimated zero depth for study site VI is indicated by the horizontal line.

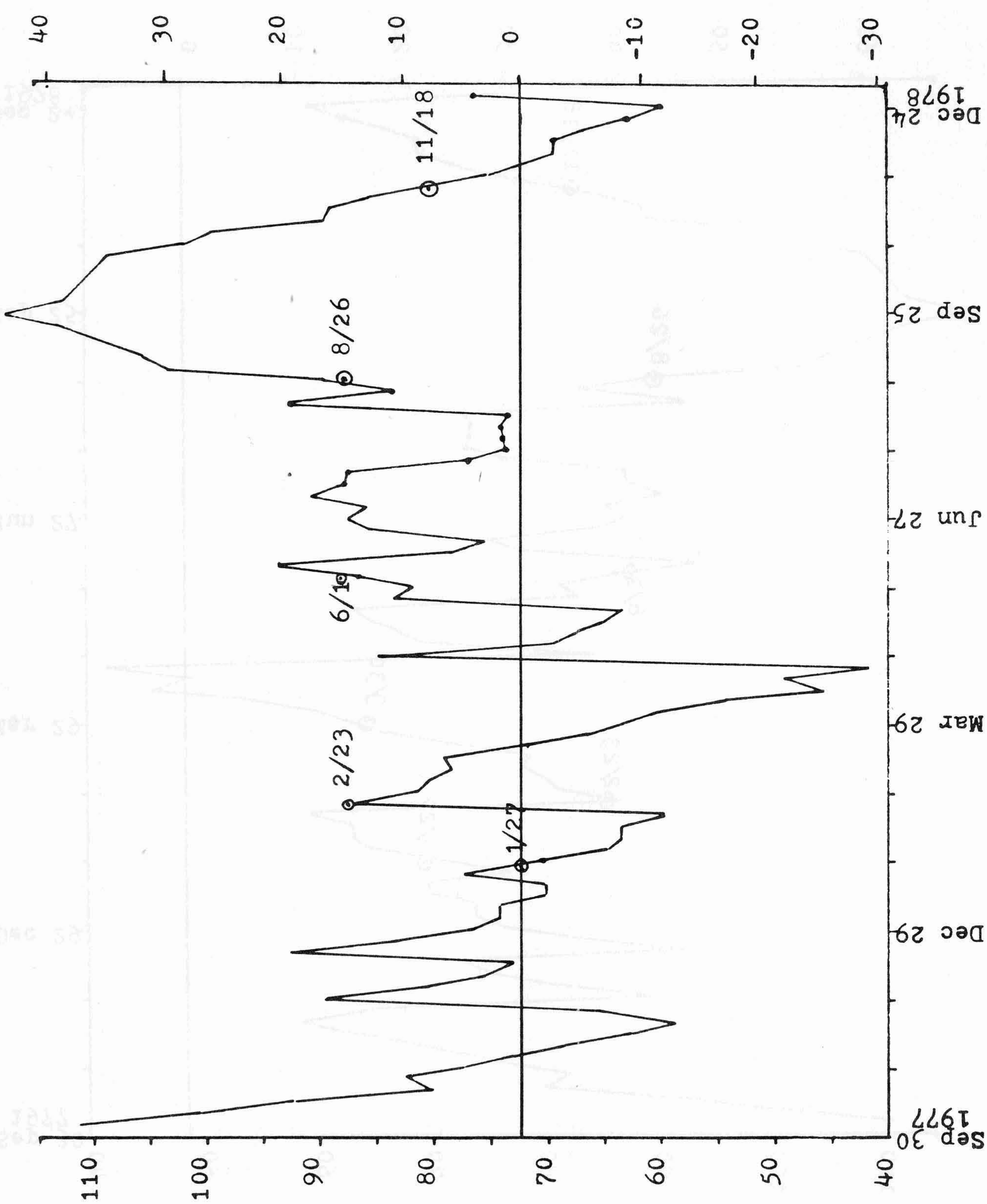


Figure B-3 Water level (cm MSL) every fifth day at the U.S.G.S. recording station at Royal Palm and corresponding estimated water depth (cm) at study site VII from September 30, 1977, through December 31, 1978.

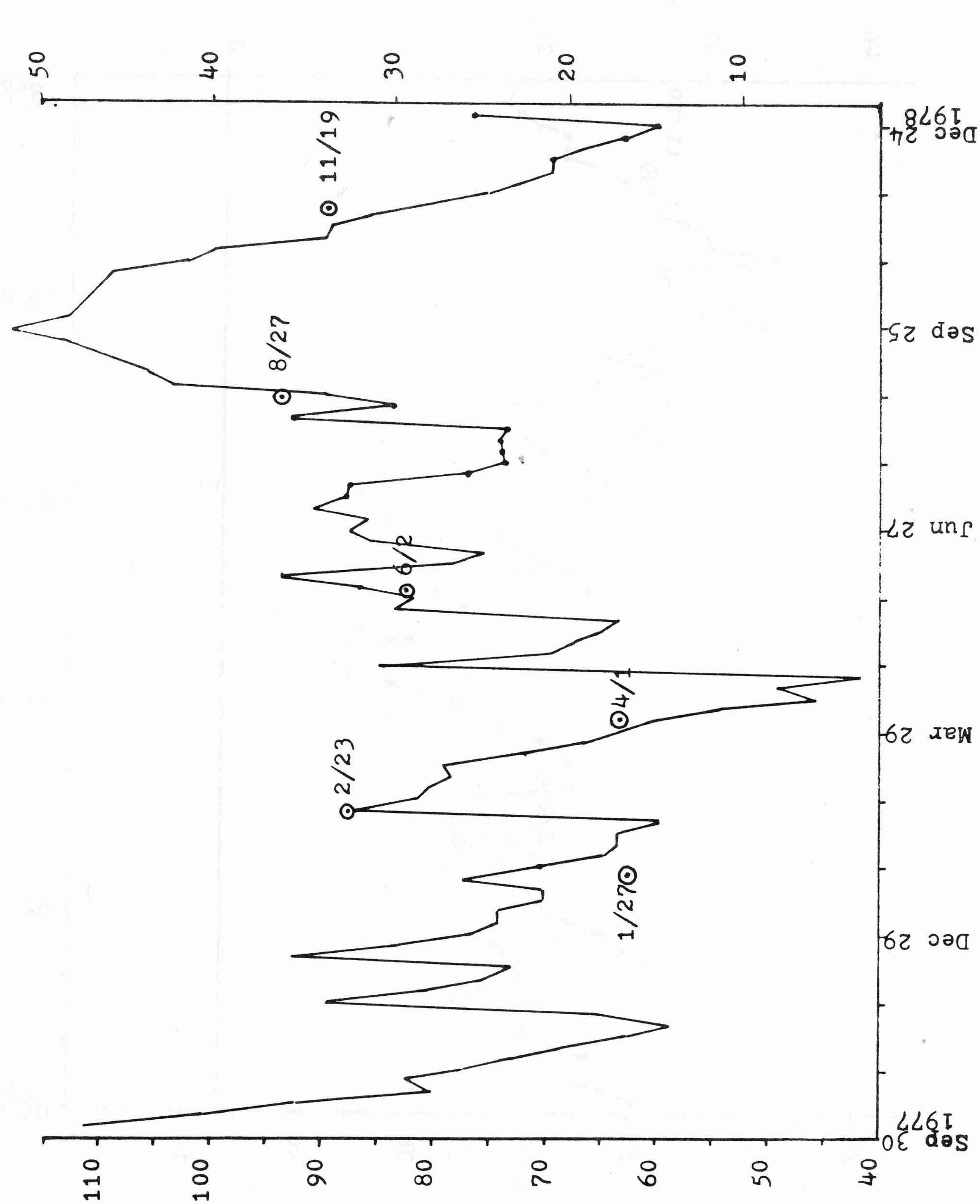


Figure B-4 Water level (cm MSL) every fifth day at the U.S.G.S. recording station at Royal Palm and corresponding estimated water depth (cm) at study site VIII from September 30, 1977, through December 31, 1978.

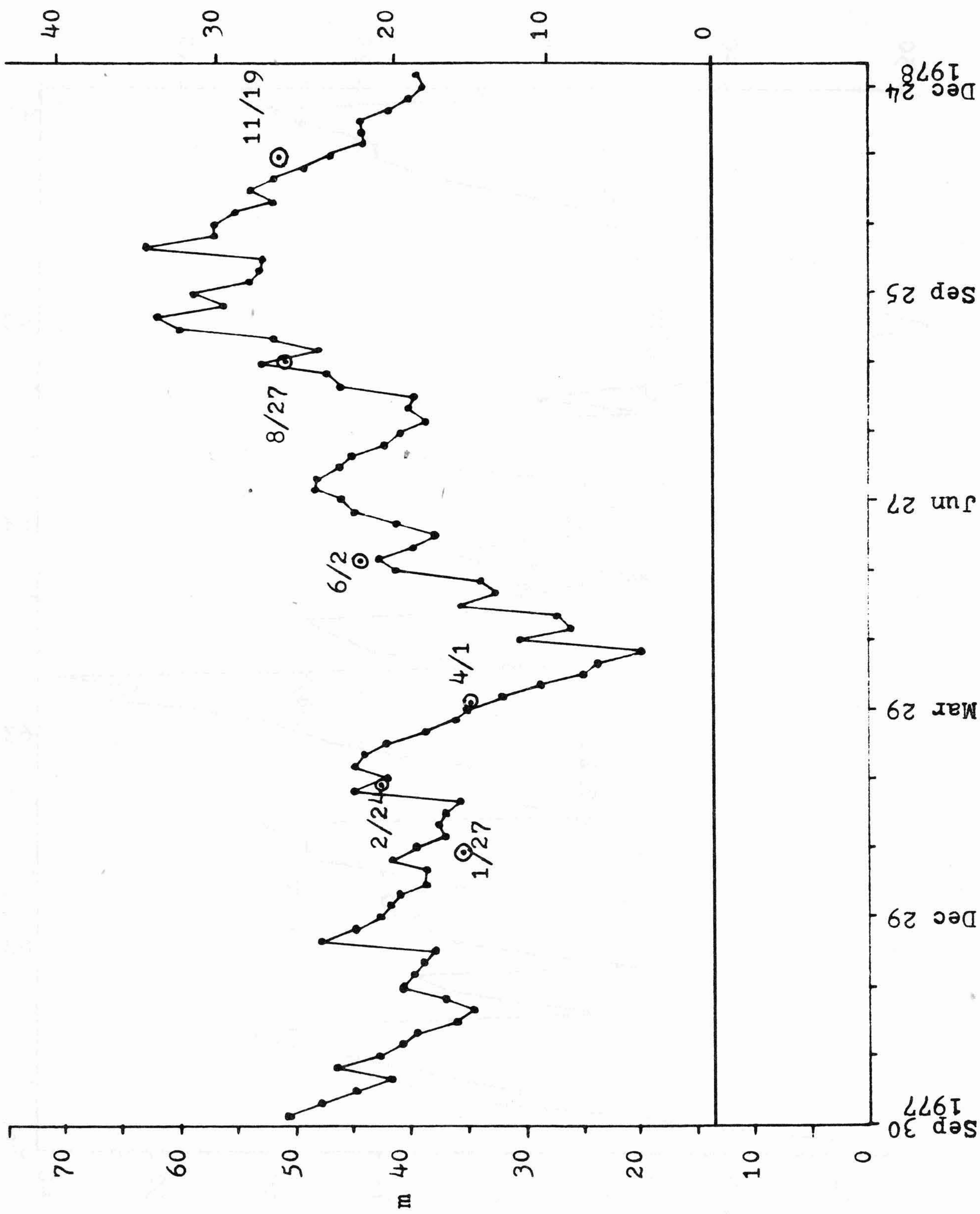


Figure B-5 Water level (cm MSL) every fifth day at the U.S.G.S. recording station at Madeira Ditch and corresponding estimated water depth (cm) at study site IX from September 30, 1977, through December 31, 1978.

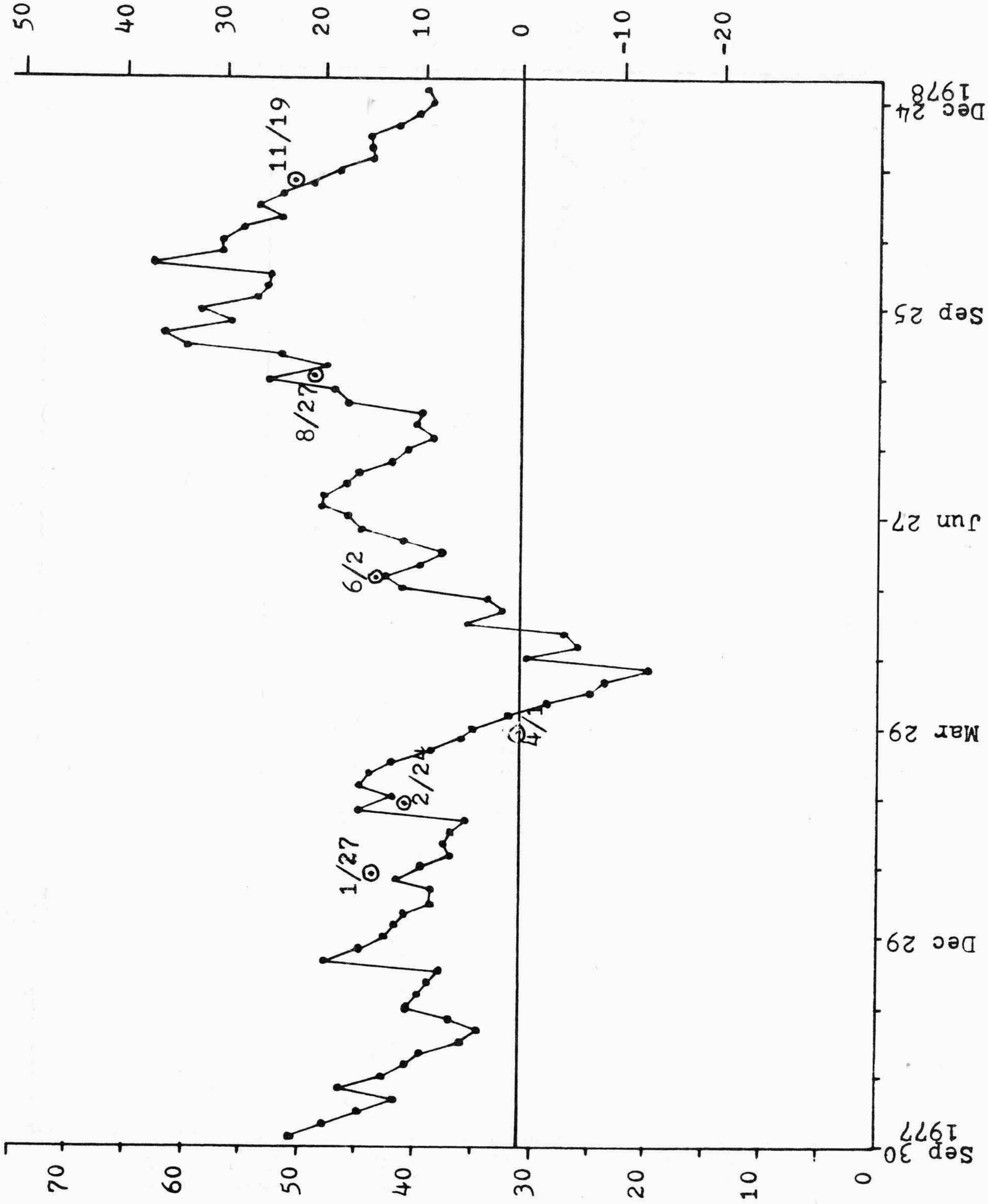


Figure B-6 Water level (cm MSL) every fifth day at the U.S.G.S. recording station at Madeira Ditch and corresponding estimated water depth (cm) at study site X from September 30, 1977, through December 31, 1978.

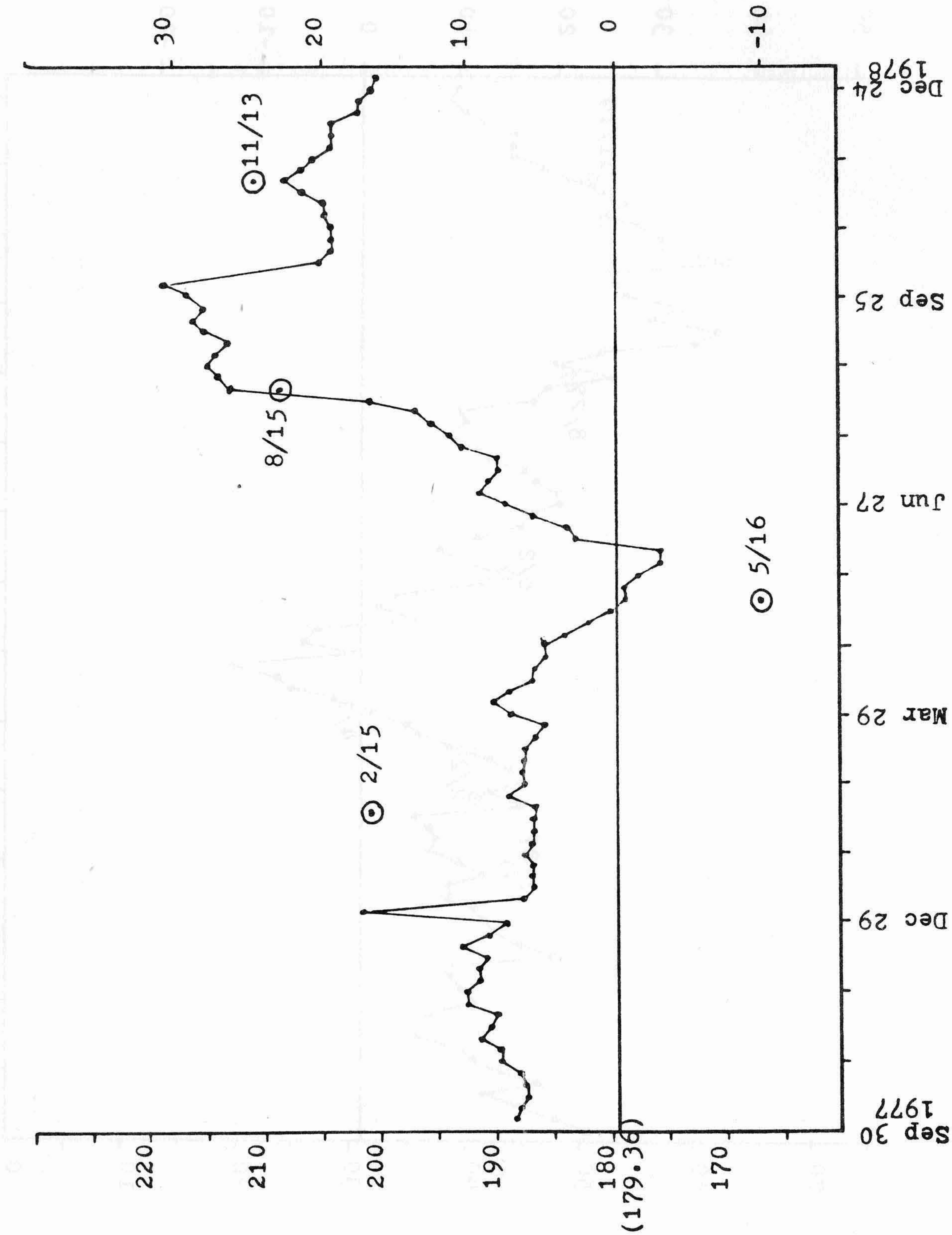


Figure B-7 Water level (cm MSL) every fifth day at the U.S.G.S. recording station in Shark Slough at P-33 and corresponding estimated water depth (cm) at study site XI from September 30, 1977, through December 31, 1978.

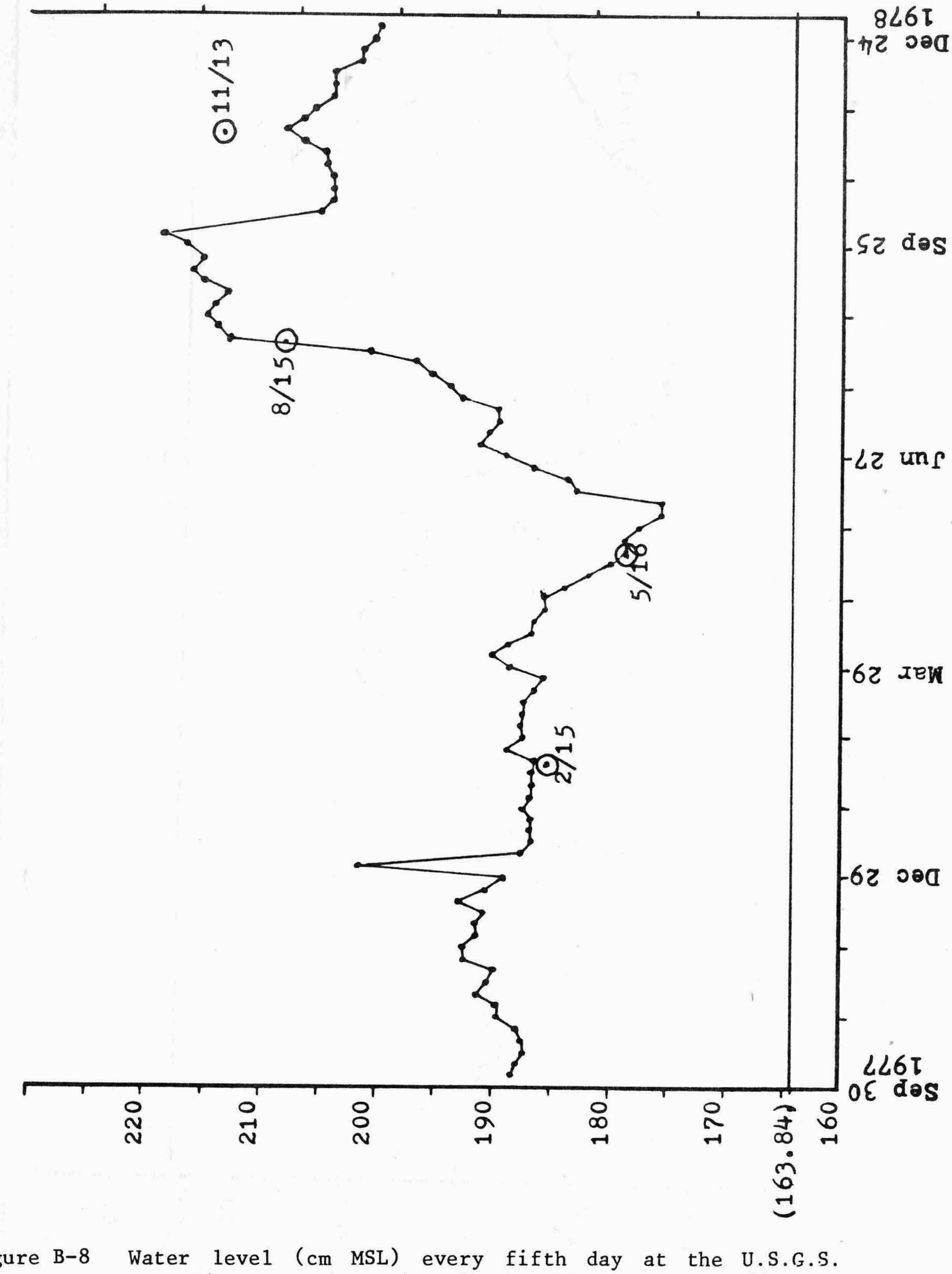


Figure B-8 Water level (cm MSL) every fifth day at the U.S.G.S. recording station in Shark Slough at P-33 and corresponding estimated water depth (cm) at study site XII from September 30, 1977, through December 31, 1978.

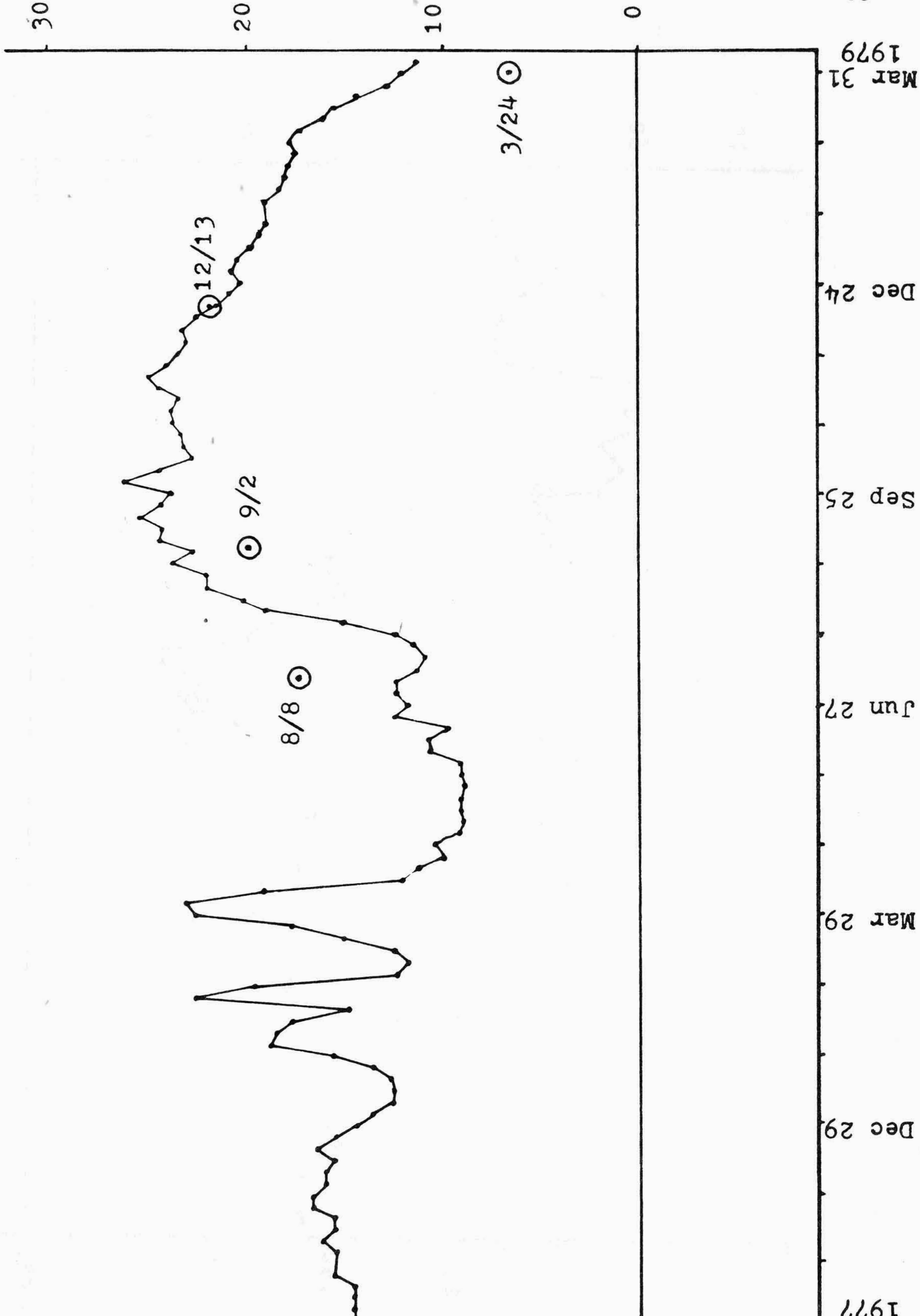


Figure B-9 Water level (cm MSL) every fifth day at the U.S.G.S. recording station in Shark Slough at the south end of Canal 67 and corresponding estimated water depth (cm) at study site XIII from September 30, 1977, through March 31, 1979.

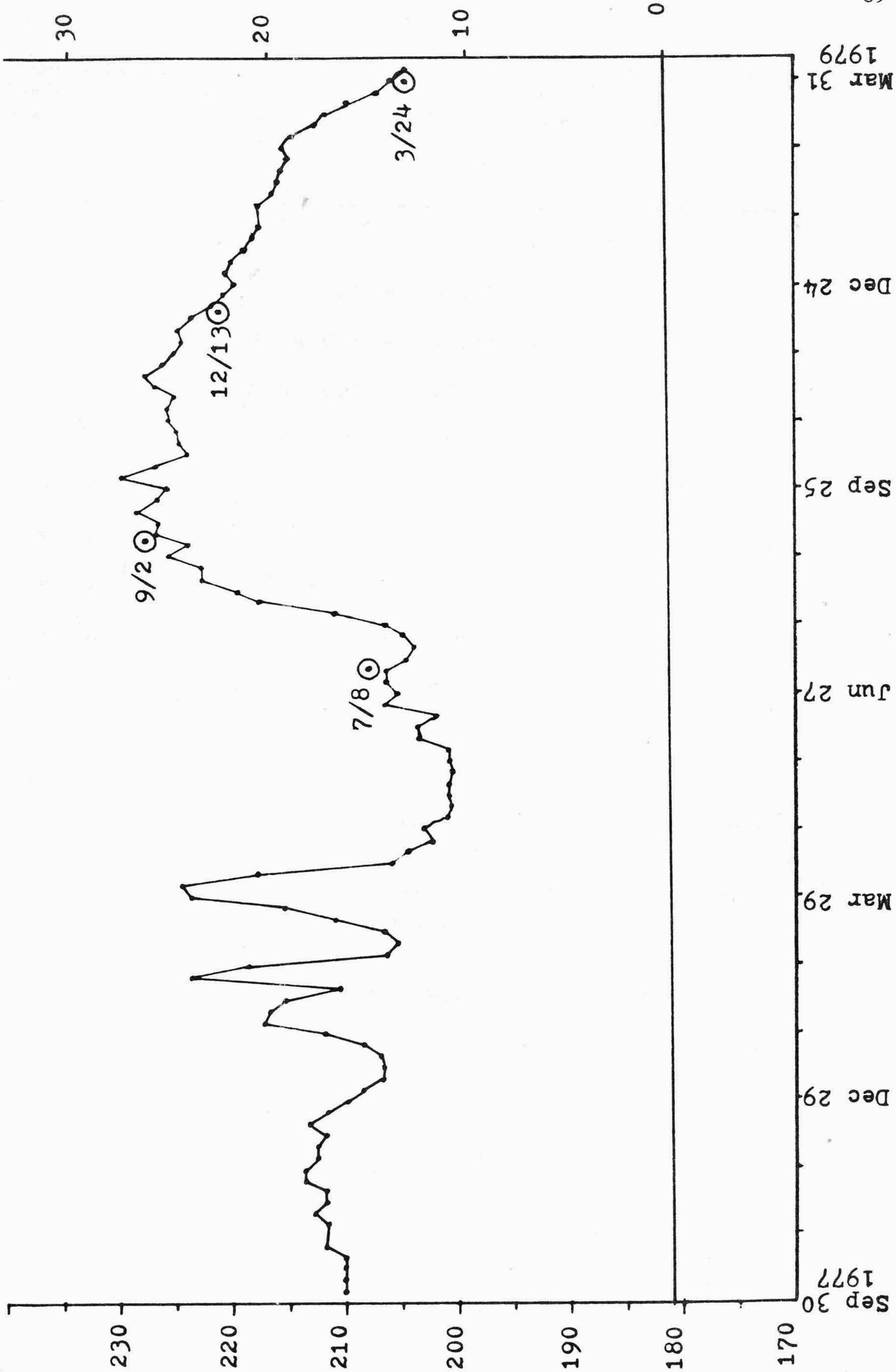


Figure B-10 Water level (cm MSL) every fifth day at the U.S.G.S. recording station in Shark Slough at the south end of Canal 67 and corresponding estimated water depth (cm) at study site XIV from September 30, 1977, through March 31, 1979.

Appendix Table B-1. Regression equations relating water depths at sampling sites (S_4, S_6-S_{14}, S_{17}) to water levels (relative to mean se level) at U.S. Geological Survey continuous recording stations (M_1-M_6).

IV	S_4	=	-79.58	+	1.020	M_1	R^2 =	0.9980
VI	S_6	=	-51.44	+	1.064	M_2	R^2 =	0.968
VII	S_7	=	-69.34	+	0.9596	M_2	R^2 =	0.961
VIII	S_8	=	-23.09	+	0.6346	M_2	R^2 =	0.771
IX	S_9	=	-9.682	+	0.7070	M_3	R^2 =	0.871
X	S_{10}	=	-36.27	+	1.165	M_3	R^2 =	0.845
XI	S_{11}	=	-14.63	+	1.1767	M_4	R^2 =	0.951
XII	S_{12}	=	-141.6	+	0.7897	M_4	R^2 =	0.692
XIII	S_{13}	=	-109.2	+	0.5901	M_5	R^2 =	0.692
XIV	S_{14}	=	-103.5	+	0.5707	M_5	R^2 =	0.977
XV	relationships could not be determined							
XVII	S_{17}	=	-14.82	+	0.4988	M_6	R_2 =	0.9841

[a] M_1 Taylor Slough at bridge
M_2 Taylor Slough at Royal Palm
M_3 Taylor Slough at Madeira Ditch
M_4 Shark Slough at P-33
M_5 Shark Slough at south end of C-67
M_6

APPENDIX C

PERCENTS VOLUME OF ALGAL TAXA

Appendix Table C-1. Volumetric results from first quarter sampling: means and standard deviations.

Station	Type	Percent Bluegreens		Percent Greens		Percent Diatoms	
		$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
I	Stem	99.49	0.57	0.003	0.005	0.50	0.57
	Ground	100.00	0	0	0	0	0
II	Stem	88.13	14.83	1.33	2.30	2.30	25.00
	Ground	94.13	3.27	0.19	0.27	4.67	3.16
III	Stem	97.14	4.29	2.61	4.28	0.24	0.37
	Ground	100.00	0	0	0	0	0
IV	Stem	91.41	6.33	3.73	2.63	4.85	4.94
	Ground	96.23	1.77	0.36	0.35	3.40	1.53
V	Stem	99.66	0.49	0.26	0.46	0.06	0.05
	Ground	95.46	2.76	0	0	4.53	2.75
VI	Stem	88.31	1.47	3.18	5.46	8.49	4.09
	Ground	93.63	1.35	2.60	1.73	3.76	2.02
VII	Stem	96.89	3.48	2.31	3.97	0.80	1.38
	Ground	96.89	3.48	2.31	3.97	0.80	1.38
VIII	Stem	35.93	19.28	18.10	8.79	45.96	18.20
	Ground	49.10	24.81	26.96	34.15	23.93	11.83
IX	Stem	96.96	6.61	3.06	2.67	9.96	9.18
	Ground	89.88	8.03	1.18	1.25	8.93	8.79
X	Stem	98.53	1.32	0.56	0.85	0.90	1.32
	Ground	97.00	0.26	1.20	0.86	1.80	1.05
XI	Stem	93.71	3.09	0.03	0.04	6.25	3.04
	Ground						
XII	Stem	96.90	2.82	0	0	3.10	2.82
	Ground						

Appendix Table C-2. Volumetric results from second quarter sampling: means and standard deviations.

Station	Percent Bluegreens		Percent Greens		Percent Diatoms	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
I	98.30	1.87	0.865	1.80	0.84	0.98
II	92.60	8.24	0	0	7.40	8.24
III	96.97	4.49	2.98	4.51	0.05	1.12
IV	87.60	8.61	2.83	5.17	9.56	6.19
V	98.02	0.75	0.493	0.886	1.49	0.95
VI[a]	68.39	16.61	2.84	0.106	28.78	16.50
VII	100	0	0	0	0	0
VIII[b]	38.66	12.63	16.53	8.24	44.80	5.52
IX	75.07	6.82	1.79	0.959	22.81	6.53
X	97.86	2.31	0	0	2.79	2.84
XI	80.12	7.05	0.020	0.0490	19.86	7.03
XII	73.10	4.10	7.13	2.98	19.76	4.22
XIII[b]	10.69	3.83	80.82	5.70	8.49	2.08
XIV	59.97	16.53	24.46	9.47	15.56	8.06
XV[b]	75.75	2.18	1.80	3.13	22.46	3.48
XVI	94.68	4.50	0.073	0.116	5.25	4.55
XVII	39.36	11.95	6.95	8.46	53.69	12.31
$\bar{X}$	75.71	25.71	8.80	19.71	15.51	15.69

[a]mean of two values

[b]mean of four values

Appendix Table C-3. Volumetric results from third quarter sampling: means and standard deviations.

Station	Percent Bluegreens		Percent Greens		Percent Diatoms		Algal Volumes	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
I	99.73	.32	.03	.05	.23	.25	98000.64	136420.30
II	94.60	10.90	2.51	5.62	2.87	4.37	52153.13	33891.87
III	99.46	1.27	.52	1.14	.01	.02	20613.23	5600.35
IV	80.35	5.78	4.80	3.16	14.83	3.94	28062.51	4879.61
V	96.67	2.29	.03	.08	3.28	2.14	15332.59	5266.44
VI	72.46	7.35	14.07	7.20	13.45	6.57	35510.93	12340.35
VII	98.67	2.54	.20	.34	1.11	2.39	18520.32	3199.56
VIII	32.41	14.17	7.80	11.00	59.77	14.95	10325.84	5351.94
XI	89.96	4.58	1.10	.70	8.92	4.37	25043.35	6206.77
X	93.35	4.76	1.91	1.69	4.72	4.10	20518.01	6927.19
XI	96.11	1.90	.34	.43	3.53	1.49	22491.79	4971.31
XII	70.22	7.85	8.32	5.75	21.45	6.21	18620.84	4064.32
XIII	44.89	12.29	22.76	7.15	32.33	5.94	21329.75	3029.07
XIV	75.46	11.59	3.10	1.67	21.43	11.07	11378.09	1405.55
XV	78.83	6.77	7.47	5.90	13.68	2.32	21776.36	3390.61
XVI	93.55	4.01	.24	.50	6.20	3.18	25810.99	5745.58
XVII	49.24	12.42	4.20	2.37	46.55	11.18	23614.02	9994.53

Appendix Table C-4. Volumetric results from fourth quarter sampling: means and standard deviations.

Station	Percent Bluegreens		Percent Diatoms		Percent Greens		Percent Desmids	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
I	93.147	4.026	6.791	4.017	.000	.000	.061	.098
II	85.431	9.200	9.089	5.146	3.987	4.381	1.491	.679
III	93.511	2.093	3.930	.999	.754	1.735	1.804	.390
IV	76.776	11.689	13.798	8.227	5.308	4.055	4.115	2.456
V	91.655	5.418	7.229	4.685	.947	1.405	.167	.133
VI	81.675	5.576	7.353	3.175	9.499	6.606	1.471	1.032
VII	96.521	2.218	1.569	.865	.769	1.537	1.139	1.244
VIII	60.701	14.763	24.392	4.669	13.388	10.993	1.517	1.295
IX	86.032	8.070	10.475	6.760	.983	.876	2.509	2.507
X	93.267	4.667	3.800	3.191	2.595	2.348	.336	.337
XI	88.009	6.383	11.249	6.352	.611	1.180	.129	.234
XII	67.741	7.968	28.974	10.143	2.122	3.999	1.161	.842
XIII	40.534	20.767	43.707	14.670	15.275	8.799	.482	.612
XIV	48.524	17.600	46.254	16.255	4.891	3.295	.329	.506
XV	64.038	13.993	33.894	13.851	1.975	3.908	.091	.179
XVI	73.895	21.600	25.269	21.010	.000	.000	.834	.649
XVII	33.617	11.733	55.665	9.913	8.562	7.061	2.155	1.914

Appendix Table C-5. Volumetric results from fifth quarter sampling: means and standard deviations.

	Percent Bluegreens		Percent Diatoms		Percent Desmids		Percent Other Greens	
Station	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
XIII	1.34	2.79	26.17	22.95	.00	.00	72.48	22.11
XIV	52.59	17.15	36.31	17.85	.42	.73	10.68	9.84
XV	57.72	13.09	37.69	16.15	1.25	1.09	3.34	4.52
XVI	81.00	6.22	18.96	6.29	.05	.11	.00	.00
XVII	36.53	28.77	62.55	28.88	.80	.93	.12	.28

Appendix Table C-6. Volumetric results from map sampling (May, 1979): means and standard deviations.

	Percent Bluegreens		Percent Diatoms		Percent Greens	
Station	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
1	98.6002	1.0185	.6328	.8667	.7669	.2104
2	96.3816	1.8867	3.3578	1.9619	.2605	.4135
3	99.9026	.1061	.0497	.0742	.0476	.0996
4	99.9608	.0314	.0391	.0314	.0000	.0000
5	99.6601	.7505	.3395	.7507	.0003	.0007
6	93.0121	9.5692	6.8246	9.6589	.1632	.2069
7	99.7602	.2872	.2397	.2872	.0000	.0000
8	93.9776	2.3798	5.2902	1.9353	.7321	.5699
9	94.3373	2.6473	5.2588	2.5409	.4038	.7133
10	74.2241	14.0087	24.6696	13.1479	1.1061	2.0543
11	99.2283	.7723	.7716	.7723	.0000	.0000
12	98.3174	1.2270	1.3430	1.0176	.3394	.5031
13	99.3970	.2596	.3470	.3408	.2558	.1818
14	98.0043	1.2505	.9591	.4462	1.0365	.9164
15	99.6780	.2877	.0165	.0143	.3054	.2827
16	94.2639	3.1868	5.4911	3.2299	.2449	.0612
17	85.4398	9.9764	.9818	.4880	13.5782	10.0253
18	16.1040	6.3481	.2830	.2208	83.6129	6.4549
19	98.8794	.8314	.7279	.7567	.3925	.3238
20	93.6976	3.7981	5.8152	3.9210	.4871	.4643
21	96.9623	2.2608	2.3833	2.4672	.6542	.6280
22	90.8620	5.2236	9.1123	5.2537	.0256	.0627
23	92.0679	2.7797	6.6187	2.5450	1.3133	1.5912
24	93.2949	1.7386	4.4645	.9687	2.2404	1.5327
25	75.3374	9.9362	10.8459	4.7400	13.8165	7.5831
26	96.9819	1.2390	1.9049	.6486	1.1130	1.0965
27	94.0912	3.0226	3.9899	1.3814	1.9187	2.8741
28	77.1108	17.9069	20.7507	17.0884	2.1383	1.1595
29	92.6324	5.7810	3.4090	3.2831	3.9584	5.6798
30	93.1363	2.8181	6.4840	2.4947	.3759	.3575
31	95.9555	2.2513	3.1660	1.9626	.8783	.4438
32	95.9484	3.0080	3.3328	3.1139	.7186	.9056
33	51.2186	22.1338	43.5117	19.1783	5.2695	4.3961
34	91.4137	3.2211	8.0733	3.3512	.5128	.4486
35	54.6890	23.4399	42.8133	20.6171	2.4976	4.3630
36	45.2736	16.4714	32.8213	11.0361	21.9049	9.0283
37	45.7889	15.8222	48.8553	14.8651	5.3556	2.6106
38	86.9772	8.0239	6.3008	3.6581	6.7218	7.4430
39	93.1285	2.3416	4.4207	1.7881	2.4507	3.6561
40	93.4215	3.7418	5.4236	3.5951	1.1547	.4028

APPENDIX D

COMPARISON OF TAXONOMIC COMPOSITION OF STATION PAIRS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1		o	o	▚	o	▓	#	▓	▓	o	▓	▓	▓	*	▓	o	▓
2			#	o	o	*	o	▓	*	o	#	▓	▓	▓	*	o	▓
3				▚	▚	▓	o	▓	▓	o	▓	▓	▓	*	▓	▚	▓
4					▚	*	▚	▓	▚	#	▚	▚	▓	*	*	o	▓
5						▓	▓	▓	▓	o	▓	▓	▓	▓	▓	o	▓
6							▓	o	▚	▓	▚	▚	▚	▚	o	▓	*
7								▓	▓	o	▓	▓	▓	▓	▓	*	▓
8									▓	▓	▓	▓	▚	*	▚	▓	#
9										▓	*	*	▓	▓	o	*	▓
10											*	▓	▓	▓	▓	#	▓
11												*	▓	▓	o	*	▓
12													▓	▓	o	▓	▓
13														*	*	▓	*
14															*	▓	▓
15																▓	*
16																	▓

Note: ▓ >=.999; * >=.99; ▚ >=.95;
>=.90; o <.90

FIGURE 1 Matrix of significance levels of difference in taxal volume means between station pairs, second quarter, from Hotelling-T^2 analysis.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1		o	o	✸	▚	✸	o	✸	✸	▚	*	✸	✸	✸	✸	✸	✸
2			✸	*	o	▚	o	✸	▚	o	▚	*	✸	▚	*	▚	✸
3				✸	▚	✸	o	✸	*	#	*	✸	✸	✸	✸	*	✸
4					✸	#	✸	✸	▚	*	✸	o	✸	o	o	*	*
5						✸	o	✸	*	#	o	✸	✸	✸	✸	o	✸
6							✸	✸	*	*	✸	o	*	▚	o	✸	*
7								✸	*	#	o	✸	✸	✸	✸	▚	✸
8									✸	✸	✸	*	▚	*	✸	✸	o
9										o	▚	*	✸	*	▚	o	✸
10											o	✸	✸	▚	*	o	✸
11												✸	✸	✸	✸	▚	✸
12													*	o	#	✸	*
13														✸	✸	✸	✸
14															o	*	▚
15																*	✸
16																	✸

Note: ✸ >=.999; * >=.99; ▚ >=.95;
>=.90; o <.90

FIGURE 2 Matrix of significance levels of differences in taxal volume means between station pairs, third quarter, from Hotelling-T^2 analysis.

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	#	▚	*	o	*	*	▒	▚	▚	o	▒	▒	▒	*	#	▒
2		o	o	o	o	▚	*	o	o	#	*	*	*	*	▚	▒
3			▚	#	*	*	▒	o	o	▚	▒	▒	▒	*	▚	▒
4				▚	o	▚	#	#	▚	*	▚	*	*	*	*	▒
5					▚	▚	▒	o	#	o	▒	*	*	*	#	▒
6						▒	▒	#	▚	▚	*	▒	▒	*	*	▒
7							▒	▚	o	▚	▒	▒	▒	*	▚	▒
8								*	▒	*	o	▚	▚	▚	#	▒
9									o	o	▚	*	*	▚	▚	▒
10										▚	▒	▒	▒	*	▚	▒
11											*	*	*	▚	o	▒
12												▚	o	o	o	*
13													▚	▚	▚	o
14														o	▚	o
15															o	*
16																*

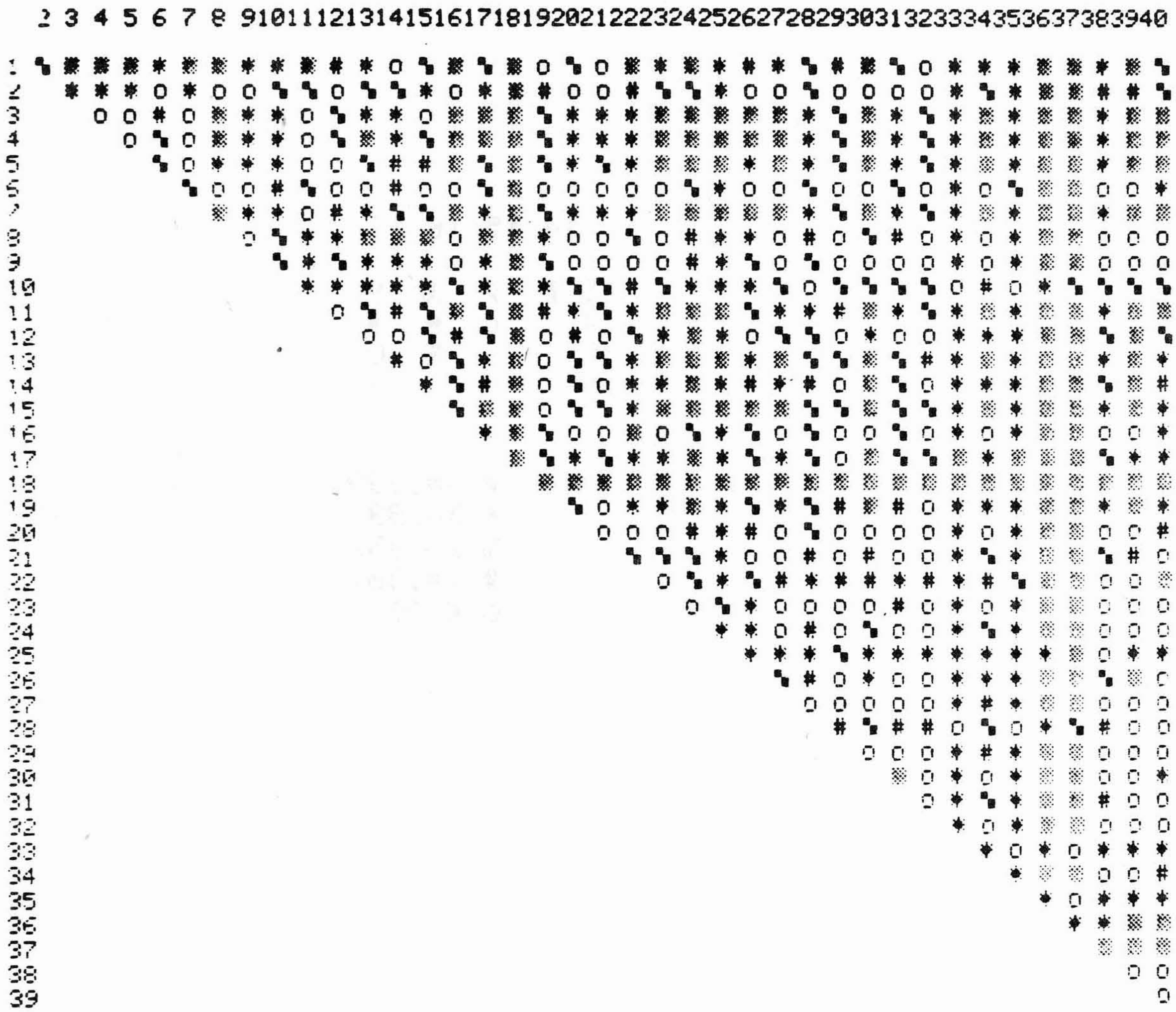
Note: ▒ >=.999; * >=.99; ▚ >=.95;
>=.90; o <.90

FIGURE 3 Matrix of significance levels of differences in taxal volume means between station pairs, fourth quarter, from Hotelling-T^2 analysis.

	14	15	16	17
13	▒	▒	▒	▒
14		o	*	#
15			▒	o
16				*

Note: ▒ >=.999;
* >=.99;
▪ >=.95;
>=.90;
o <.90

FIGURE 4 Matrix of significance levels of differences in taxal volume means between station pairs (Stations XIV-XVII only), fifth quarter, from Hotelling-T^2 analysis.



Note: ▓ >=.999; * >=.99; ▚ >=.95; # >=.90; O <.90

FIGURE 5 Matrix of significance levels of differences in taxal volume means between mapping site pairs (May, 1979 sampling), from Hotelling-T^2 analysis.

APPENDIX E *

MAPS OF PERIPHYTON COMPOSITION AND BIOMASS

MAP 1 Map of vegetation patterns in Taylor Slough, Everglades National Park, showing percent periphyton algal volume as diatoms and as blue-green algae and total periphyton biomass and organic periphyton biomass (g/m^2) at sites sampled in May, 1979. Vegetation patterns are from Rintz and Loope (1978).

MAP 2 Map of vegetation patterns in Dade County-208-East Everglades Area, showing percent periphyton algal volume as diatoms and as blue-green algae and total periphyton biomass and organic periphyton biomass (g/m^2) at sites sampled in May, 1979. Vegetation patterns are from Hilsenbeck, Hofstetter and Alexander (1979).

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* Appendix E not included under this cover.

APPENDIX F

MULTIPLE REGRESSION EQUATIONS

Appendix Table F-1. Equations from stepwise multiple regressions.

Quarter 1	y	$= .1065 - .2577X_1 + .00002X_2 - .00036X_3$	R_2	=	.5343
	df = 4	(.9655) (.7707) (.2689)	R	=	.2855
		y:proportion blue-green algae (trans)	F_{rat}	=	.5327
		X_1:proportion soil organic (trans)	df	=	3,4
		X_2:quarterly hydroperiod	n	=	8
		X_3:specific conductance	DW	=	2.389
Quarter 1	y	$= 0.1182 - 0.00102X_1 - 0.0000054X_2$	R_2	=	.9870
	df = 2	(8.675) (0.6904)	R	=	.9741
		y:proportion blue-green algae (trans)	F_{rat}	=	37.63
		X_1:inorganic nitrogen in water	df	=	2,2
		X_2:total macrophyte biomass	n	=	5
			DW	=	1.939
Quarter 2	y	$= .1108 - .00105X_2 - .00105X_2 - .00000X_3 - .0501X_1$	R_2	=	.6099
	df = 6	(1.436) (.2274) (.1413)	R	=	.3720
			F_{rat}	=	1.382
			df	=	3,7
			n	=	11
			DW	=	2.448

Appendix Table F-1. Continued.

Quarter 2	y	$= .0724 - 1.1139X_1 + .0001304X_2 + .001846X_3 - .00003952X_4$			
		(2.951)* (3.284)** (2.374)* (1.950)			
		y: proportion blue-green algae (trans)	R	=	.9682
		X_1: proportion soil organic (trans)	R_2	=	.9270
		X_2: specific conductance	F_{rat}	=	6.354
		X_3: water depth	df	=	4,2
		X_4: time-since-drought	n	=	7
			DW	=	1.950
Quarter 3	y	$= .1184 - .28810X_1 - .01995X_3 - .00046X_2$	R_2	=	.8157
	df = 12	(2.143)* (2.568)** (1.902)*	R	=	.6654
		(see next given below)	F_{rat}	=	7.99%
			df	=	3,12
			n	=	16
			DW	=	2.557
Quarter 3	y	$= .12569 - .36360X_1 - .01920X_3 - .00045X_2 - .00003X_4$	R_2	=	.8461
	df = 10	(2.273)* (2.452)** (1.826)* (.4382)	R	=	.7159
		(see next given below)	F_{rat}	=	6.298
			df	=	4,10
			n	=	15
			DW	=	2,459

Appendix Table F-1. Continued.

Quarter 3	y	= .12021 - .02033X_3 - .00038X_2 - .1599X_1 - .0004X_4 - .00002X_5			
	df = 5	(2.827)* (1.411) (.8942) (.6957) (.2836)			
		y:proportion blue-green algae (trans)	R_2	=	.8828
		X_1:proportion soil organic (trans)	R	=	.7794
		X_2:hydro (qt)	F_{rat}	=	3.534
		X_3:salinity	df	=	5,5
		X_4:alkalinity	n	=	11
		X_5:nitrogen	DW	=	2.705
Quarter 3	y	= .11348 - .02058X_2 - .00041X_4 - .15705X_1 - .00001X_3	R_2	=	.8699
	df = 7	(3.207)** (1.722) (1.230) (.1886)	R	=	.7567
		y:proportion blue-green algae (trans)	F_{rat}	=	5.44 ***
		X_1:proportion soil organic (trans)	df	=	4,7
		X_2:salinity	n	=	12
		X_3:alkalinity	DW	=	2.305
		X_4:quarterly hydroperiod			
Quarter 3	y	= .1195 - .2793X_1 - .00002X_2 - .00028X_3	R_2	=	.7822
	df = 12	(1.926)* (2.007)* (1.014)	R	=	.6118
		y:proportion blue-green algae	F_{rat}	=	6.305 ***
		X_1:proportion soil organic	df	=	3,12
		X_2:quarterly hydroperiod	n	=	16
		X_3:specific conductance	DW	=	2.348

Appendix Table F-1. Continued.

<u>Quarter 3</u>	y	$= .0870 - .8620X_1 + .00009X_4 + .00002X_2 + .00002X_4$	$R_2 = .8049$
	df = 7	(2.241) (1.204) (1.048) (.3497)	$R = .6479$
		y:proportion blue-green algae (trans)	$F_{rat} = 3.220$
		X_1:proportion soil organic (trans)	df = 4,7
		X_2:time-since-drought	n = 12
		X_3:drought length	DW = 2.071
		X_4:specific conductance	
<u>Quarter 3</u>	y	$= .122\text{-}5 - .52147X_1 - .01902X_3 - .00050X_2 + .0030X_4 - .00000X_5$	
	df = 9	(1.583) (2.337) (1.824) (.5244) (.02432)	
		y:proportion blue-green algae (trans)	$R_2 = .8510$
		X_1:proportion soil organic (trans)	$R = .7243$
		X_2:quarterly hydroperiod	$F_{rat} = 4.278$
		X_3:salinity	df = 5.9
		X_4:depth	n = 15
		X_5:alkalinity	DW = 2.470
<u>Quarter 3</u>	y	$= .11932 - .51677X_1 - .01954X_3 - .00055X_2 - .00055X_2 + .00046X_4$	
	df = 11	(2.132)* (2.541)** (2.178)* (1.128)	
		y:proportion blue-green algae (trans)	$R_2 = .8367$
		X_1:proportion soil organic (trans)	$R = .7001$
		X_2:quarterly hydroperiod	$F_{rat} = 6.420$ ***
		X_3:quarterly hydroperiod	df = 4,11
		X_4:depth	n = 16
			DW = 2.619

Appendix Table F-1. Continued.

<u>Quarter 4</u>	y	= .0940 - .2408X_1 - .00009X_3 + .00001X_4 - .00000X_2	R_2	=	.8093
	df = 4	(1.278) (.8470) (.3674) (.0026)	R	=	.6549
		y:proportion bluegreen algae (trans)	F_{rat}	=	1.900
		X_1:proportion soil organic (trans)	df	=	4,4
		X_2:time-since-drought	n	=	9
		X_3:drought length	DW	=	2.304
		X_4:specific conductance			
<u>Quarter 4</u>	y	= .1081 - .00002603X_1 - .3783X_2 + .00001829X_3	R_2	=	.8185
	df = 9	(.999) (2.697)** (2.215)*	R	=	.670
		y:proportion blue-green algae (trans)	F_{rat}	=	5.816
		X_1:specific conductance	n	=	13
		X_2:proportion soil organic (trans)	df	=	3,9
		X_3:total macrophyte biomass	DW	=	2.182
<u>Quarter 4</u>	y	= .02978 + .7498X_1 - .0004X_2 - .00038X_3	R_2	=	.8862
	df = 12	(5.511)**** (4.664)**** (0.9829)	R	=	.7854
		y:proportion blue-green algae (trans)	F_{rat}	=	13.419
		X_1:proportion soil organic (trans)	n	=	15
		X_2:total macorophyte biomass	df	=	4,10
		X_3:quarterly hydroperiod	DW	=	1.404

Note: Numbers in parentheses are t-statistics. Asterisks indicate level of significance: *:p < 0.1, **:p < 0.05, ***:p < 0.01, ****:p < 0.001.