Water Quality Monitoring and Assessment of Agricultural Best Management Practices in the Tri-County Agricultural Area

Phase II
Final Report

submitted to

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in fulfillment of

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CONTENTS

Page

Executive Summary vii

Introduction 1

Background 1

Study Area 2

Preliminary Study 4

Project Scope 10

Study Approach... 11

Project Design 15

Methods 18

Results and Assessments 21

Field Scale Modeling 41

Modeling Results 45

Watershed Scale Modeling 55

Modeling Results 55

BMP Crop Yield Assessment... 63

Receiving Tributaries Assessment 64

Economic Assessment 73

Pesticide Assessment 73

Biological Assessment 76

Summary 80

Conclusion 83

References 85

Appendices

A. Phase II Financial Summary
B. *Water Management Practice for Potato Farms in the Tri-County Agricultural Area*
C. *An Economic Analysis of Best Management Practices for Potatoes in the Hastings Producing Area of North Florida*
D. Pesticide sampling events and data
E. *Assessment to Determine the Biological Response to Best Management Practices in the Tri-County Agriculture Watersheds*

TABLES

Table *Page*

1. Potential TCAA in-field BMPs identified in a literature review 16
2. Summary of study field location, size, BMPs and study design 18
3. Summary of the BMP simulation runs 44
4. Comparison of the predicted annual flow and the annual measured flow for each farm 45
5. Regression summary statistics comparing measured and predicted TN and TP daily loads (kg/ha) for all farms 49
6. BMP effects on annual nitrogen concentrations for all four BMP farms 52
7. BMP effects on annual phosphorus concentrations for all four BMP farms 53
8. Average annual TCAA watershed load and simulated BMP reductions 56
9. Subbasin name, total area and rowcrop hectares for each basin 58
10. Specific fertilizer treatments (lbs/ac) for each study and control field 63
11. Crop yields (cwt/ac) for the Nutrient Management BMP sites 64
12. Seasonal mean TIN and TN concentrations (mg/L) and percent TIN for all agricultural receiving tributaries and DCH 67
13. Seasonal mean TPO4 and TP concentrations (mg/L) and percent TPO4 for all agricultural receiving tributaries and DCH 71
14. Summary of pesticide detections and concentrations 75
15. TCAA project area load with Both-BMPs 80
16. Agricultural only load with BMPs 82

FIGURES

Figure *Page*

1. Project area location map 3
2. Water furrow supply irrigation water 4
3. Phase I pre-BMP diagnostic study - location map of the ten farm study sites 5
4. Mean annual load for each farm studied from 1991 to 1993 (pre-BMP) 7
5. Percentage of nitrogen and phosphorus imported to the farm system by component 8
6. Percentage of accountable nitrogen and phosphorus by output component 9
7. Phase II post-BMP 319 BMP feasibility study – location map of the four farm study sites 20
8. Farm C pre- and post-BMP nitrogen plots 22
9. Farm C pre- and post-BMP phosphorus plots 23
10. Farm G pre- and post-BMP nitrogen plots 24
11. Farm G pre- and post-BMP phosphorus plots 25
12. Farm I pre- and post-BMP nitrogen plots 26
13. Farm I pre- and post-BMP phosphorus plots 27
14. Farm J pre- and post-BMP nitrogen plots 28
15. Farm J pre- and post-BMP phosphorus plots 29
16. Farm C Pre- and post-BMP mean annual flow-weighted concentration for TN, NOx, TP, TDP, TSS and % Reduction 30
17. Farm G Pre- and post-BMP mean annual flow-weighted concentration for TN, NOx, TP, TDP, TSS and % Reduction 31
18. Farm I Pre- and post-BMP mean annual flow-weighted concentration for TN, NOx, TP, TDP, TSS and % Reduction 32

Figures - continued

19. Farm J Pre- and post-BMP mean annual flow-weighted concentration for TN, NOx, TP, TDP, TSS and % Reduction 33

20. Farm C 1996 plots of daily flow volumes, TN and NOx concentration and scheduled fertilizer applications 35

21. Farm G 1996 plots of daily flow volumes, TN and NOx concentration and scheduled fertilizer applications 36

22. Farm I 1996 plots of daily flow volumes, TN and NOx concentration and scheduled fertilizer applications 37

23. Farm J 1996 plots of daily flow volumes, TN and NOx concentration and scheduled fertilizer applications 38

24. TSS in discharges from Farm I before and after BMP implementation 39

25. TSS in discharges from Farm J before and after BMP implementation 40

26. Comparisons of measured vs. predicted loadings for project farms C and G 47

27. Comparisons of measured vs. predicted loadings for project farms I and J 48

28. Annual mean load comparison of BMP effects on TN, TP and TSS at all four farms 50

29. BMP effects on irrigation and runoff for all four farms 51

30. TCAA subbasin boundary, ID and landuse map 57

31. TCAA WAM results: Summary of total suspended solids loads by subbasin for BMPs 60

32. TCAA WAM results: Summary of total nitrogen loads by subbasin for BMPs .. 61

33. TCAA WAM results: Summary of total phosphorous loads by subbasin for BMPs 62

34. TCAA agricultural receiving tributaries and subbasin monitoring sites – location map 65

Figures - continued

35. Seasonal time series plot displaying the seasonal mean, median, maximum and minimum ranges for OHD from 1991-1998 68

35a.Seasonal time series plot displaying the seasonal mean, median, maximum and minimum ranges for all stations from 1991-1998 69

36. Seasonal mean time series plot of TN and the TIN seasonal contribution at all sites 70

37. Pesticide assessment sampling sites - location map 74

38. Biological assessment sampling sites - location map 77

39. Percent of total nutrient load contributed by various land uses in the TCAA 81

40. Pre-colonial basline conditions map 82

EXECUTIVE SUMMARY

Nonpoint source pollution resulting from stormwater runoff is considered to be one of the major sources of pollution within the lower St. Johns River basin (LSJRB). It has been estimated that nonpoint pollutant sources induced by human activities may account for as much as 36% of the basin's total pollutant load. Modeling efforts conducted by District staff have estimated that current levels of point and nonpoint source nutrient loading to the river are elevated 2.4 times for total nitrogen and 6 times for total phosphorus with respect to background. More significant was the contribution of spring and summer inorganic nitrogen loads and resulting algal blooms of such intensity that they result in fish kills and loss of beneficial vegetation.

The Tri-County Agricultural Area (TCAA) project area contains approximately 376,606 acres of which 36,536 acres or 10 percent is irrigated vegetable cropland, predominantly potato and cabbage farms. While the region has been in agricultural development for over 100 years, it was not until the latter half of the 1980s, when basin-wide sampling programs were instituted, that the significance of its water quality impacts were known. Hendrickson (1987) reported that TCAA nutrient export rates were somewhat larger in comparison to other southeast U.S. drainage basins and posing a threat to the St. Johns River.

Water quality and flow monitoring was conducted at edge-of-field on 4 area farm fields in the TCAA located in northeast Florida from 1994-1997. Prescribed best management practices (BMPs) were implemented on the four fields to determine how effective they were in reducing nutrient and sediment loadings from area farms.

The nutrient management BMP, the water table management BMP and the sediment management BMP were initially identified by the representatives of various stakeholders who served on the Technical Task Force Team (TTFT) as having the greatest potential for net load reduction and lowest relative cost. These BMPs were applied to the study fields both independently and combined in order to assess them individually and collectively. Pre-BMP monitoring was conducted from 1991 through 1993. Post-BMP implementation (post-BMP) monitoring was conducted from 1994 through 1997. A field scale model, High Water Table Model (HWTMOD), was used to compare pre- and post-BMP implementation conditions by simulating both periods with and without BMP implementation. A watershed scale model, Watershed Assessment Model (WAM), was also used to examine cumulative effects of BMP implementation on receiving surface water quality. These models were used to provide a quantitative comparison of BMP scenarios that address the annual variability associated with climatic conditions and farming practices.

Modeling results show that irrigation use and drainage loss were reduced 4 – 23 percent and 12 - 18 percent respectively after implementing the water table management BMP. The field scale modeling results show annual load reductions in nitrogen (31 to 42 %) and

phosphorous (8 to 18 %) following the implementation of both nutrient management and water table management BMPs. Long-term modeling simulating the use of both nutrient and water table management BMPs over a 20 year period showed phosphorus reductions at four times the annual load reduction. No conclusions could be drawn as to the effects of the Sediment BMP. Standard sediment management practices seem just as effective to control sediment bedload as the BMP.

Watershed modeling results show the cumulative effect of BMPs implemented throughout the TCAA watershed could reduce the TN and TP load by 21 percent and 13 percent respectively. In summary, the nutrient management BMP and water management BMP combined is the most effective in reducing nitrogen and phosphorus load to the St. Johns River from the TCAA.

INTRODUCTION

The St. Johns River Water Management District (SJRWMD) entered into a contract with the Department of Environmental Protection (DEP) to provide services to determine effective means to reduce agricultural nonpoint sources of pollution to the lower St. Johns River basin. This project was funded in part by a Section 319 Nonpoint Source Management Program grant from the U. S. Environmental Protection Agency (EPA) through a contract with the Nonpoint Source Management Section of the Florida Department of Environmental Protection. Phase I of the EPA Section 319 grant funded project entitled *Water Quality Monitoring and Assessment of Agricultural Best Management Practices in the Tri-County Agricultural Area* was initiated in June 1993 and continued for two growing seasons through June 1995. Phase II of the 319 project commenced upon the completion of Phase I and continued the program for two additional years through June 1997. The Phase I interim report provided background information and a comprehensive accounting of the project actions and status, and summary and conclusions associated with the first two years of the project. This final report will provide a review of the project study area and data collection, and the results, summary, and conclusions of both Phases I and II.

This project was accomplished by means of a cooperative effort involving federal, state and local governments, a commercial group - the North Florida Growers Exchange (NFGE), government services including the United States Department of Agriculture - Natural Resources Conservation Service (NRCS) and local County Extension Service (CES), an academic research institution - the University of Florida - Institute of Food and Agricultural Sciences (IFAS), a state regulatory agency - the Florida Department of Environmental Protection (FDEP), local government Soil and Water Conservation Districts (SWCD), and the private sector - Soil and Water Engineering Technology, Inc. (SWET, Inc.). Without their cooperation and teamwork the Water Management District (WMD) would not have been able to collect the necessary data to complete this project. Much of the modeling data presented in the results and discussion were prepared, analyzed and reported by Soil and Water Engineering Technology, Inc. and USDA – Natural Resources and Conservation Service in their reports entitled *Tri-County Agricultural Best Management Practices Study - Final Report - Phases I, II, III* and *IV* and *Water Quality Monitoring and Assessment of Agricultural Best Management Practices Reports I and II* respectively. Appendix A contains a summary of the Phase II project expenses.

Background

Nonpoint source (NPS) pollution is the unintended delivery of sediment, nutrients, toxic materials and human pathogens to surface waters from agricultural, residential, commercial and industrial lands via surface runoff and shallow groundwater movement. Agricultural production has been identified as a major source of nonpoint source pollution in U.S. lakes and rivers that do not meet water quality goals. Nutrients (nitrogen and phosphorus) and sediments, major pollutants closely associated with agricultural production, affect surface water quality in the United States. Loadings from

these pollutants have been shown to increase in agricultural watersheds (R. A. Smith et al., 1987).

Nonpoint source pollution resulting from stormwater runoff is considered to be one of the major sources of pollution within the lower St. Johns River basin (LSJRB). It has been estimated that nonpoint pollutant sources induced by human activities may account for as much as 36% of the basin's total pollutant load.

The St. Johns River is the largest river system located entirely within the state of Florida. The lower St. Johns River is that portion of the river between the mouth of the Ocklawaha River and the Atlantic Ocean. The lower St. Johns can be differentiated into three riverine salinity and limnologic zones: a fresh tidal zone which extends from the city of Palatka north to the city of Orange Park; a predominantly oligohaline, lacustrine zone extending from Orange Park northward to the Fuller Warren Bridge in Jacksonville; and a mesohaline, riverine zone downstream to the mouth of the river.

The TCAA, comprised of portions of Putnam, St. Johns, and Flagler Counties, in northeast Florida (Figure 1), contains approximately 36,536 acres of irrigated vegetable cropland, predominantly potato and cabbage farms. Typically, one-half of the production resides in St. Johns County and the remainder is split between Putnam and Flagler counties. While the region has been in agricultural development for over 100 years, it was not until the latter half of the 1980s, when basin wide sampling programs were instituted, that the significance of its water quality impacts were known. Hendrickson (1987) reported that TCAA nutrient export rates were somewhat larger in comparison to other southeast U.S. drainage basins and posing a threat to the St. Johns River.

Study Area

The TCAA is positioned in the coastal plain ecoregion of the state and is dominated by nearly level flatwood soils. These poorly drained, sandy and loamy soils typically contain an underlying impermeable layer within approximately 12 to 20 inches of the soil surface. Flatwoods are scattered throughout the area with obscure drainage patterns and depressional areas, which are ponded for long periods of time. Agricultural rowcrop fields are situated primarily on low broad flats and around floodplains. Networks of manmade drainage canals are used to maintain water tables and convey runoff from agricultural production areas. The Flagler Estates, Hastings, and Elkton Water Control Districts have been established to maintain ditches clear of weed and sediment obstructions. The growing season generally starts in late December or early January and continues through late May or early June. The growing seasons will vary slightly depending on the geographical location of the field and its proximity to the river. Sudan Sorghum, a fallow crop, is generally planted after harvest to control wind and water erosion in the field.

Potatoes are grown on high water table soils, which have subirrigation and controlled drainage. A natural high water table or an impermeable layer, fore mentioned, allows for the development of a temporary water table at a desired depth below the root zone.

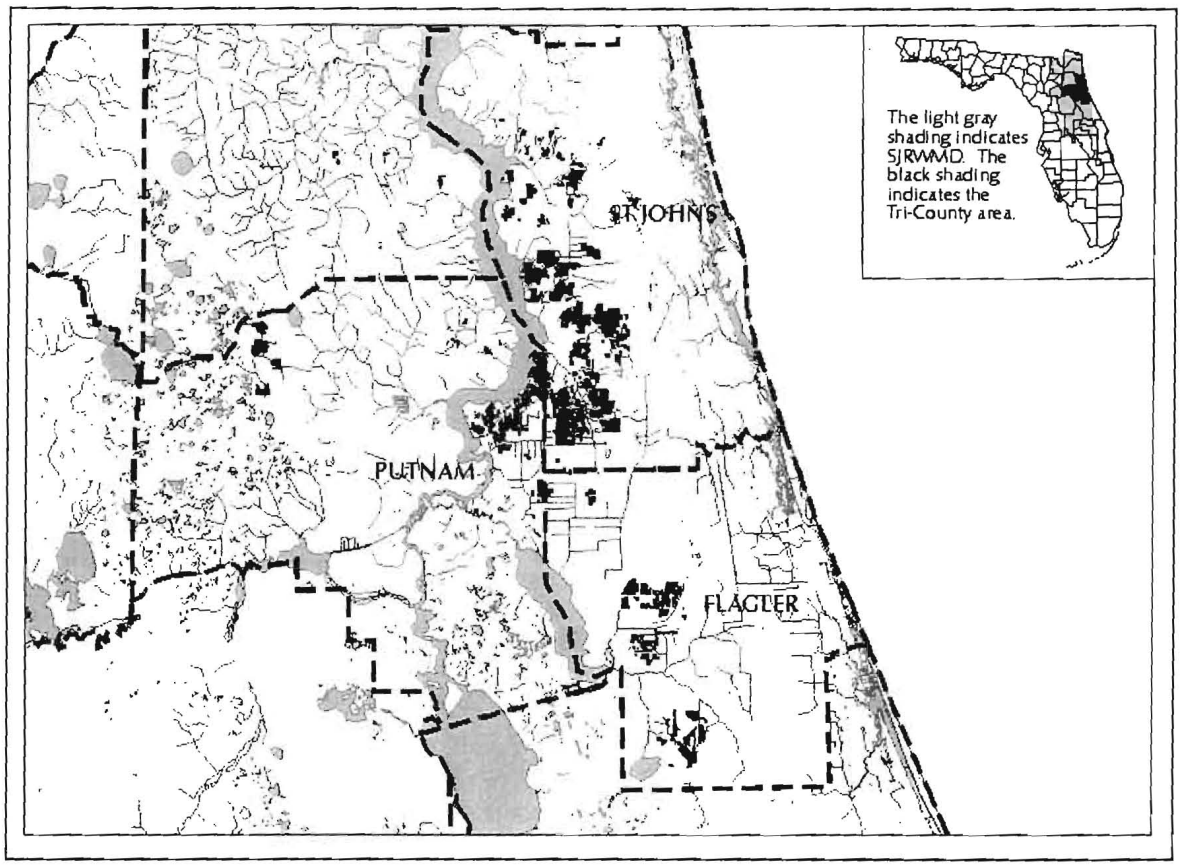


Figure 1. Project area locator map

Wells supply ground water to water furrows via a header pipe. Water furrows spaced 60 feet apart with 16 rows between each water furrow supply irrigation water. Rows are bedded and range in height from 8 to 14 inches. Typically the fields have been laser leveled to facilitate even distribution of gravity drained irrigation water and water table control. The current practice of tailwater recovery, employed by most farmers, uses a weir or a "dam-like" structure to hold the water back in ditches and canals along the edge of the fields. Surface water runoff generated by agricultural activities is then conveyed by gravity flow to receiving waters through drainage canals (Figure 2).

Generally, water tables remain relatively high in the soil profile during the growing season, consequently limiting available storage for rainfall. In order to keep water from damaging the crop, the drainage system must lower the water table to a desired level within a 24-hour period rainfall. It is a standard practice within the TCAA to begin lowering the water table prior to an anticipated storm event to ensure that crop damage is minimized. It is up to the judgment of the grower to determine when to lower the water table prior to a storm and when to raise the water table controls following a storm event. This judgement is very important considering that if the water table is not adjusted in a timely manner, the drainage system may not be capable of lowering the water table

Figure 2. Water furrows supply irrigation water

quickly enough to prevent water damage to the crop. Also, if the water table is lowered too far, the grower must irrigate to bring the water table back to the desired level. Considering the high value of the potato crop and the relatively low cost of pumping irrigation water, there is an economic incentive for the grower to err on the side of lowering the water table too far.

Over the years, increased production has been the primary concern of producer and educational institutions. Crop production on flat and poorly drained soils, combined with standard farm management practices of fertilization, irrigation and drainage, all too effectively convey nutrient laden stormwater to the St. Johns River. Traditionally these standard farm management practices have been documented in conservation plans that address irrigation efficiency and soil erosion, while giving little attention to reducing nutrient loads resulting from agricultural activities.

Preliminary Study

A diagnostic study was conducted from 1991-1993 to quantify and qualify nutrient loading from 10 area farms (Figure 3) and provide baseline measurement for future post-BMP comparisons – if needed. All farms were equipped to measure hydraulic parameters and rainfall. The hydraulic parameters were recorded in the field using a CR10 data logger, which also triggered storm samples in a flow-integrated fashion using ISCO autosamplers. The CR10 data loggers were uniquely preprogrammed for each farm site depending upon the field acreage. Flow was calculated based upon either a weir equation, submerged weir or a head elevation and averaged every 10 minutes. The CR10 recorded calculated flow, depth of water in the tailwater ditch, depth of water over the weir plate, rainfall, and sample collection times. These data were downloaded weekly using a portable personal computer.

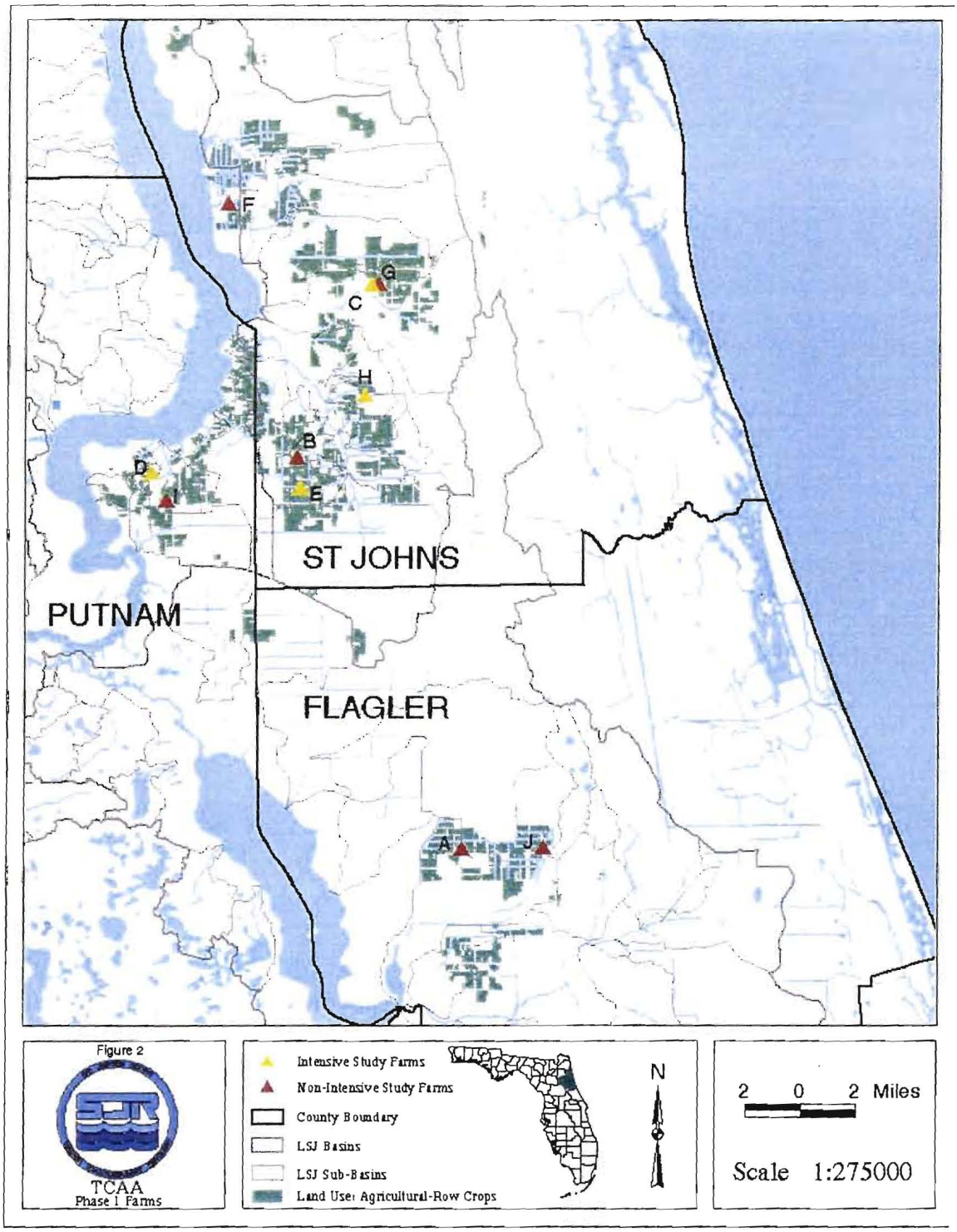


Figure 3. Location of farms that participated in the Phase I study

An outside consulting firm conducted the water quality monitoring while the laboratory analysis was conducted by the WMD. A project specific Quality Assurance Plan was prepared by the WMD and submitted to the Quality Assurance Section of the FDEP outlining the sampling sites, field sampling procedures and laboratory analytical methodologies. Monitoring conducted at edge of field included both storm and discrete water quality sampling at all 10 sites. Discrete sampling at the field sites was conducted weekly during the growing season and bi-monthly during the off-season. Storm samples, collected by automated samplers, were triggered and composited after 0.025 inches of runoff flowed over the weir plate at each of the 10 farms. Cumulative flow was calculated using the averaged flow over 10-minute intervals. Intensive sampling, conducted at four of the sites, included ground water, vadose and irrigation water. Surficial ground water samples were collected bi-monthly from a surficial ground water monitoring well – 6 meters in depth, 5 cm diameter. Vadose water was collected monthly by a lysimeter installed at 30 cm. Three receiving streams, located downstream of the study fields, were sampled monthly during the study. Biomass and soil samples were also collected at the four intensive sites. Nutrient deposition by both dry and wetfall was collected using an Anderson Wet/Dry Collector that was installed at the WMD.

The results of this study revealed that nutrient loading was primarily associated with storm events. The annual area loading rates ranged from 11 – 61 kg/ha and 6 – 35 kg/ha for TN and TP respectively. Figure 4 displays the mean annual area load for each farm studied from 1991 to 1993. This figure clearly shows the inherent variability between the farms and their respective loading rates.

Correlation analysis was conducted to examine the variation between the farms. These analyses showed a slight positive correlation between the amount of applied N and P fertilizer to the annual loads and flow weighted concentrations, but was not significant at the 90 percent confidence level. This is likely due to the small sample size and the inability to precisely quantify known differences between the farms. The correlation between nitrogen fertilizer rate and nitrogen load (r^2= 0.1248) was the strongest, but was only significant at the 67 percent level primarily due to the similarity of the fertilizer rates among the farms.

A mass balance analysis of nutrient inputs and outputs using the four intensive farms showed that the primary nitrogen (N) and phosphorus (P) input to the farm system was from fertilizer application which accounted for more than 97% of the total nitrogen and 99% of the phosphorus input (Figure 5). Only 1% of the nitrogen that entered the farm system was from irrigation water and 2% was from precipitation. Nitrogen and phosphorus input from atmospheric dry deposition was negligible (0.1g and 0.01g/ acre/year for N and P respectively).

Three of the four farms (C, D, and H) had 50 – 75% of their total N input accounted for in output components (i.e. biomass, surface water runoff and deep seepage). This range agrees with other nitrogen balance studies documented in the literature (National Research Council 1993). Farm E had 26% of its total N input accounted for in the output components. The low percentage of N recovered from farm E is probably due to the

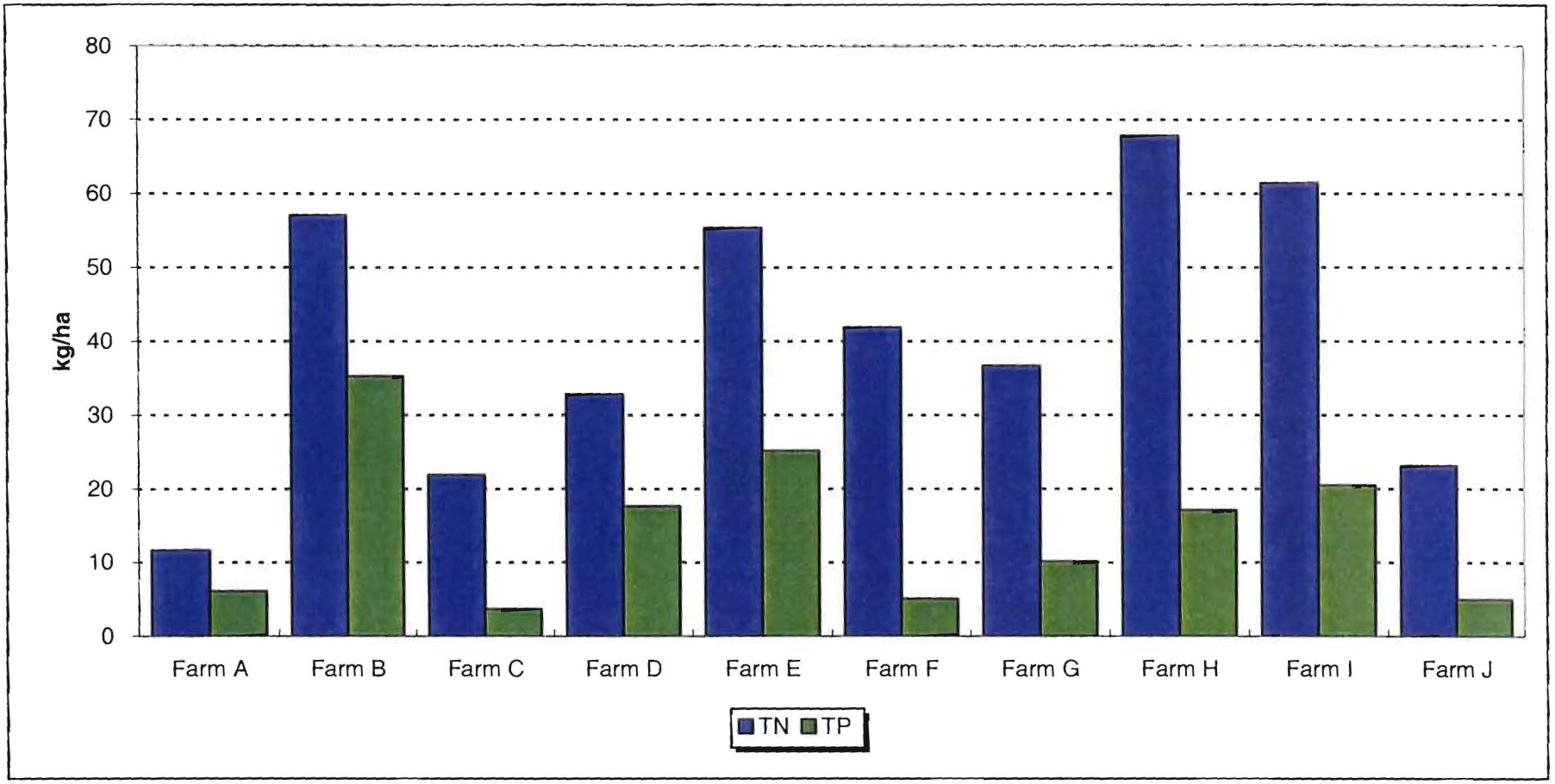


Figure 4. Mean annual area load for each farm studied from 1991 to 1993

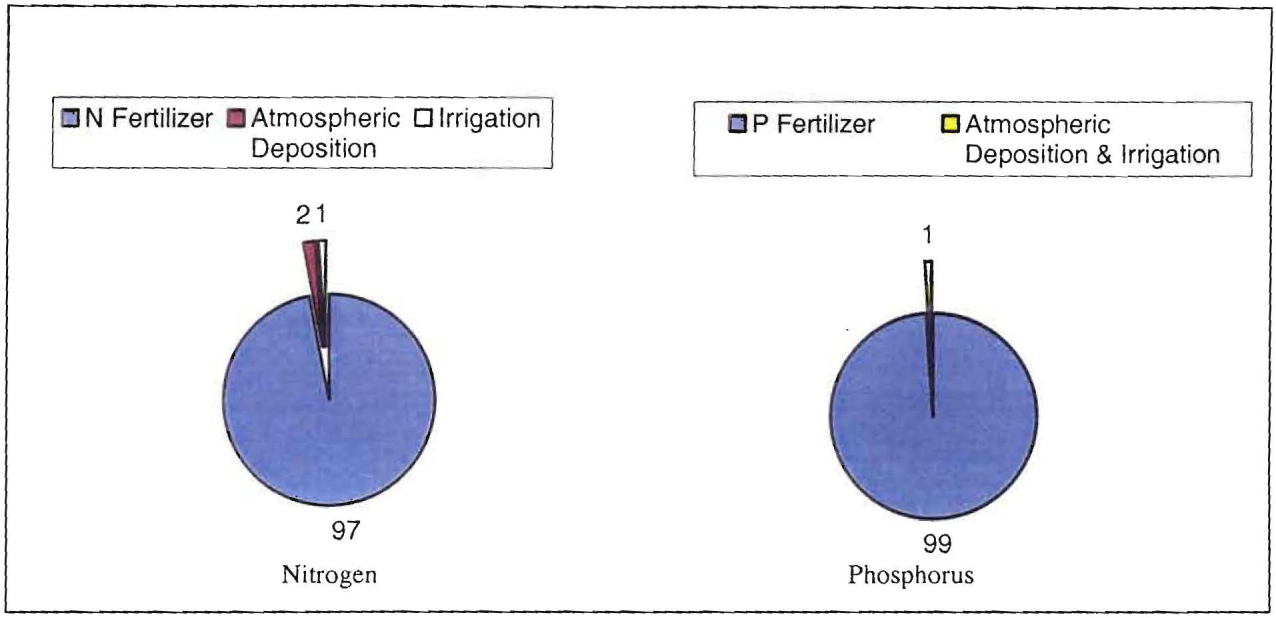


Figure 5. Percentage of nitrogen and phosphorus imported to the farm system by component

excessive fertilizer application rate (343 lbs/ac/yr) resulting in a higher percentage of N loss through volatilization or crop residue recycled back into the soil system.

The phosphorus balance also varied among the farms. Three farms (D, E, and H) had 60 – 69% of the total P input found in the output components (i.e. biomass, surface water runoff and deep seepage). The low percentage (33%) of P recovered from farm C may be due to the net phosphorus build-up in the soil.

Biomass removal and surface water runoff were the two primary processes for farm nutrient export. Seventy percent of the accountable N exported off the farm system was through biomass removal, and 22% was lost through surface water runoff (Figure 6). More than 73% of the accountable P exported off the farms was through biomass removal and 26% through surface water runoff.

These results suggest that fertilizer application rate, biomass removal and surface water runoff are the critical components that most affect the nutrient budget of a farming system in the TCAA. Mass balance analysis can help to identify opportunities for reducing nutrient losses from farming systems. The general conclusion of the preliminary diagnostic study suggests that no one factor controls the losses of the nutrients and sediment in runoff water. Variables, including crop productivity, fertilizer application, weather, crop variety, cover crop, soil properties, irrigation management, and planting and harvest dates, play a role in transport processes that determine how much, and when, nutrients and sediment leave the fields. Consequently, a verified water quality model, which represents soil transport processes, is needed for more quantitative comparison and subsequent comparisons of source control measures to evaluate and verify their effectiveness.

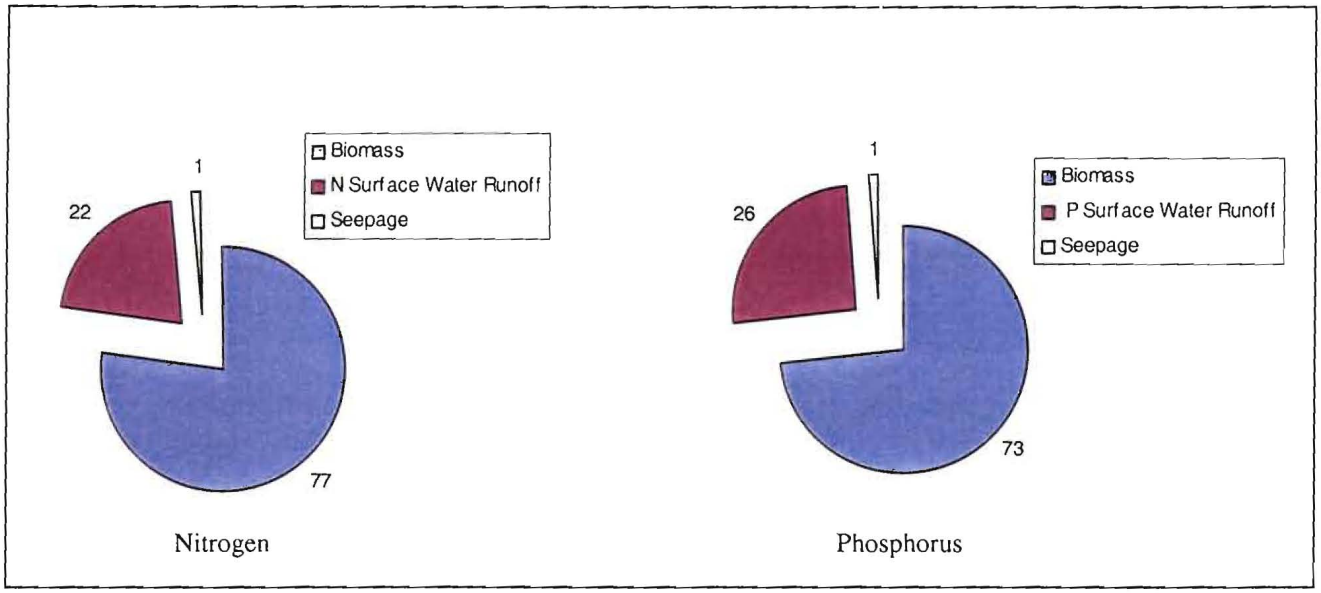


Figure 6. Percentage of accountable nitrogen and phosphorus by output component

PROJECT SCOPE

Current management practices in the TCAA provide few water quality benefits. Consequently, reducing nonpoint source pollution loading from these farms will require modification of current BMPs to enhance their environmental benefits and implementation of new BMPs to further reduce nutrients and other constituents.

The primary goal of the four-year 319 project was to develop and implement economical alternative BMPs and evaluate their abilities to produce measurable reductions in nutrient and sediment loadings from agricultural operations while sustaining profitable crop yields. The objectives of the project are listed below.

1. Coordinate interagency activities and develop working relationships among the program cooperators and the farmers in the TCAA.

2. Implement new/alternative BMPs on selected farms in the TCAA and evaluate their effectiveness by performing necessary monitoring and analyses to quantify the degree of success of BMP applications.

3. Evaluate the effectiveness of selected new/alternative BMPs in the TCAA for water quality treatment and overall water quality improvements to receiving streams of the lower St. Johns River basin.

4. Employ both field and basin scale computer models to assist in the development of Pollution Load Reduction Goals (PLRGs) on a geographical and field scale basis to ensure effective and efficient management of surface water quality.

STUDY APPROACH

Representatives from all TCAA stakeholders (NFGE, NRCS, CES, FDEP, and local SWCD) were invited to participate in the project and provide both their perspective and their expertise. Additionally, a private consulting firm SWET, Inc., with expertise in agricultural engineering and modeling was hired to participate. An initial coordination meeting was scheduled for project organization and to establish project objectives. With total stakeholder representation, a partnership among the Technical Task Force Team (TTFT) was formed to identify potential solutions and conduct the assessment. Each group or agency was responsible for various tasks associated with the project.

USDA- NRCS

1. Provide project engineer dedicated to project coordination and implementation
   - Provide NRCS coordination with other contributing agencies and NFGE
   - Provide documentation of NRCS participation
   - Inspect and make recommendations as to prospective contractor's facilities and equipment
   - Work with contractors in developing schedules for carrying out work covered by contracts
   - Direct construction surveys and layout and inspection of construction work while in progress
   - Make periodic inspections to ensure that work is being performed in accordance with plans and specifications
   - Make minor modification to plans
   - Determine need and make recommendations for major changes
   - Develop and supply information for preparation of work progress
   - Assist in the development of computer models

2. Refine and modify selected BMPs for achievement of interim-Pollution Load Reduction Goals (interim-PLRGs)
   - Evaluate BMP data
   - Modify BMP design based on assessment
   - Revise conservation plans/scope of work for each study site that requires a modification to the prescribed BMP design

3. Provide technical assistance during implementation phase of refined BMPs
   - Coordinate BMP installation
   - Supervise BMP installation
   - Final check of installed BMP

4. Provide technical assistance to project cooperators in managing irrigation water, nutrients and pesticides
   - Make weekly field checks/observe project sites and equipment
   - Make modifications to plans and determine the need for, and make recommendations for, major changes

5. Assist with the project-evaluation process

- Evaluate data to assess BMP effectiveness
- Evaluate project effectiveness

6. Provide public information/education and awareness program
   - Coordinate farm tours and field trips
   - Develop newspaper articles specific to EPA 319 project awareness and success
   - Local community interaction

7. Develop a resource management system at the conclusion of the project for each project cooperator that will address water-quality concerns

North Florida Growers Exchange

1. Provide a forum that fosters participant interaction and promotes the transfer of technology between cooperating agencies and growers
   - Schedule meetings to discuss project actions and success

2. Assist with the project evaluation process
   - Evaluate data to assess BMP effectiveness
   - Evaluate project effectiveness

3. Provide a forum for ideas from growers and present information to the agricultural community concerning the development of interim-PLRGs for affected waterbodies
   - Schedule meetings to discuss the development of interim-PLRGs for affected waterbodies and how this will affect the agricultural community
   - Assist in the preparation of guidelines and timelines for the implementation of PLRGs
   - Provide current management practices and input as to the viability of proposed BMPs

SJRWMD

1. Provide program administration for cooperative agencies
   - Continue to provide administration for contract requirements
   - Coordinate interagency meetings

2. Provide contract administration for nutrient, biological and pesticide sampling and analysis
   - Execute revisions and modifications to project specific QA/QC Plans
   - Continue to manage biological, pesticide and water quality monitoring contracts as needed for data collection and analysis

3. Provide laboratory analysis during project
   - Provide technical assistance for data collection, laboratory login, and tracking process
   - Provide quality assurance during data collection, laboratory analysis, and data management

- Provide data base management

4. Coordinate project progress reports and other reporting requirements of EPA/FDEP during project
   - Retain invoices, receipts, notes, observation and progress reports from participating agencies and growers
   - Submit detailed quarterly reports to FDEP
   - Prepare and submit final report

5. Evaluate effectiveness of new management practices using existing computer models developed by U.S.D.A.- Agricultural Research Station (ARS)
   - Provide additional staff time dedicated to model development
   - Develop input data sets for computer models for NRCS to develop resource management systems for each project cooperator that will address water quality concerns
   - Provide GIS capabilities for data synthesis of computer model data sets

6. Assist with the project evaluation process
   - Evaluate data to assess BMP effectiveness
   - Evaluate project effectiveness

7. Develop PLRGs for individual watershed within the TCAA
   - Work with participating agencies and the NFGE in developing guidelines and timeframes for implementation of interim-PLRGs

8. Develop public awareness program to inform the public/growers of the benefits of the 319 program and BMP implementation
   - Coordinate with the District's Public Information Office to develop a Public Awareness Program
   - Implement programs

Local Soil and Water Conservation Districts

1. Provide liaison between the farm community and cooperating agencies

2. Assist with the project-evaluation process
   - Evaluate data to assess BMP effectiveness
   - Evaluate project effectiveness

IFAS

1. Provide project coordination and implementation
   - Provide IFAS coordination with other contributing agencies and NFGE
   - Provide documentation of IFAS participation

2. Provide technical assistance for the on-farm planning and BMP operation and maintenance, and refinement processes
   - Provide information to grower/commodity groups about fertilization rates, Integrated Pest Management (IPM) programs, soil tests

- Make field checks/observations of project sites and equipment
- Evaluate BMP data
- Modify BMP design based on Phase I data assessment
- Make modifications to plans and determine the need for, and make recommendations for, major changes

3. Provide continued education for grower/commodity groups concerning project goals
   - Provide leadership in the development and implementation of educational and training activities evolving from the project's information
   - Coordinate farm tours and field trips
   - Foster local community interaction

4. Assist with the project evaluation process
   - Provide economic analyses of costs associated with BMP adoption by grower cooperators
   - Evaluate data to assess BMP effectiveness
   - Evaluate project effectiveness

Cooperative Extension Service

1. Provide project coordination and implementation
   - Provide coordination with other contributing agencies and NFGE
   - Provide documentation of participation

2. Provide technical assistance for the on-farm planning and BMP operation and maintenance, and refinement processes
   - Provide information to grower/commodity groups about fertilization rates, Integrated Pest Management (IPM) programs, soil tests
   - Make field checks/observations of project sites and equipment
   - Evaluate BMP data
   - Modify BMP design based on data assessment
   - Make modifications to plans and determine the need for, and make recommendations for, major changes

3. Provide technical assistance for crop yield assessment
   - Collect sap and tissue samples and maintain observation and field notes for each sampling event at each site
   - Collect farm management data including fertilizer dates, rates, amounts and planting dates

SWET, Inc. was employed, under contract with the WMD, to assist in the modeling efforts to evaluate the in-field BMPs and their regional cumulative impact in the basin. SWET, Inc. developed a field scale model - High Water Table model (HWTMOD), a modified version of the EAAMOD - to evaluate the in-field BMPs. The HWTMOD was selected because of its ability to simulate water and phosphorus movement in fields with high water tables representative of the TCAA. A sub-model (NUTMOD) was added to handle the nitrogen transformation and transport processes. The in-field BMPs were

evaluated by modeling both the pre- and post-BMP periods with and without BMPs. This method was used to address the hydrologic variability associated with unfixed annual rainfall and runoff patterns. Detailed information regarding the HWTMOD is discussed in the SWET, Inc. reports for Phases I and IV.

SWET, Inc. developed the TCAA Watershed Assessment Model (WAM) – a Fortan, grid-based, basin model to obtain average annual regional cumulative impact of various BMP implementation scenarios within the TCAA. The basin simulations provide the cumulative contribution of water, sediments, and nutrients losses from various unique soil/crop combinations within each basin. The WAM uses another model, Chemical, Runoff, Erosion from Agricultural Management Systems (CREAMS), to generate the source loads for each unique soil/landuse cell before routing the constituents from source cell to basin outlet. Detailed information regarding the WAM is discussed in the SWET, Inc. reports for Phases I and IV.

Project Design

The primary goal of the four-year 319 project was to develop and implement economical alternative BMPs on four demonstration fields and evaluate their abilities to produce measurable reductions in nutrient and sediment loadings from agricultural operations while sustaining profitable crop yields. The TTFT agreed that each county in the TCAA would have a least one-demonstration field participating in the project. The four fields/farms selected were based on previous grower cooperation during the pre-BMP diagnostic study, field acreage and physical characteristics, farm management practices and existing data.

A preliminary resource inventory was compiled on each of the four project farms by the NRCS. The inventory included historic conservation farm plans that outline soils information and existing farm management practices. It should be noted here that all four study fields had previously incorporated the irrigation header lines, laser leveling, ditch grade stabilization structures, crop covers and vegetated ditch banks into their historic conservation farm plans. Additionally, a detailed field survey and soil survey was conducted by the NRCS. These data proved to be invaluable to the TTFT while evaluating cause and effects of the prescribed BMPs and for developing input modeling data sets for HWTMOD and CREAMS models.

A BMP is defined as an economically feasible on-farm management practice designed to minimize pollutants in drainage waters. A literature search was conducted by SWET, Inc. which identified 76 unique references using the key words best management practice, BMP, potato, cabbage, water quality, phosphorous, and nitrogen. The literature review was useful in identifying the potential BMPs applicable to the TCAA. Table 1 lists those BMPs that were identified in the literature review as having the greatest potential for net load reduction and lowest relative cost and associated yield impact in the TCAA. The effectiveness factors for specific pollutants range from very high to very

Table 1. Potential TCAA in-field BMPs identified in a literature review

	Effectiveness Ranking				
	Nut	Sed	Water	Yield	Cost
Irrigation:					
Manifold irrigation header lines	M	L	H	L	+
Use of flag wells	M	L	H	M	+
Water table response/accountability method	M	L	H	M	+
Use of tensiometers	L	L	M	M	+
Drip/trickle irrigation	H	M	H	M	+++
Laser leveling	L	M	M	H	++
Ditch grade stabilization structures	L	M	M	M	+
Sub-irrigation	L	L	M	M	++
Drainage:					
Use of flag wells for culvert boards mgt.	M	L	M	L	+
Water table response/ET/rainfall accountability method for culvert boards mgt.	M	L	H	M	++
Improved hydraulic capacity	L	L	M	H	++
Laser leveling	L	M	L	H	++
Subsurface tile drainage	L	M	M	M	+++
Fertilizer:					
Reduce amount applied (soil test and following IFAS recommendations)	H	L	L	L	--
Split applications	H	L	L	M	+
No fertilization prior to planting	H	L	L	L	--
Use fertigation with drip/trickle irrigation	H	L	L	M-H	---
Tissue testing for supplemental fertilization	H	L	L	M-H	--
Reduce misplacement of fertilizer	H	L	H	L	-
Pesticide:					
Follow IFAS IPM Guidebook	L	L	L	H	--
Sediments:					
Laser level to even grades	M	M	L	H	++
Reduce ditch and furrow side slopes	L	M	L	L	+
Provide ditch capacity to trap sediments	L	H	L	L	++
Use of sediment traps before outflow culverts	L	M	L	L	+
Routine ditch cleaning of sediments	M	H	L	L	+
Maintain crop covers and vegetated ditch banks	H	H	L	M	+

low. These factors are based on published information, IFAS experts, and analysis of the pre-BMP data and represent the relative potential of the BMP to reduce nutrient, sediment and water loadings from the farm or influence yields.

Listed below are brief technical descriptions of the BMPs that were identified by the TTFT to be implemented on selected field sites and to be evaluated for their effectiveness.

1. **Nutrient BMP** (Fertilization practices) This BMP includes conducting regular soil testing, applying the IFAS fertilizer recommendations, split applications (N and K only), not applying fertilizer prior to the crop's ability to use it, and tissue testing to determine the need for supplemental fertilization. IFAS reduced rates recommend 175 lbs N/acre, 0 P/acre, 140 lbs of K_20 /acre and a supplemental 30 lbs of N /acre and 20 lbs K_20/ acre after each leaching rain of about 3 inches in 3 days or 4 inches in 7 days. Zero phosphorus was recommended when soil test results were high or very high (>30 ppm Mehlich-1 extractable P). All components are designed to minimize fertilizer rates while maintaining or improving yields. Less fertilizer applied is assumed to translate to fewer nutrients in the drainage waters. Additionally, both nitrogen and phosphorus fertilizer was limited for the fallow crop period.

2. **Water Table BMP** (Water table response and accountability method, Tensiometers) Tailwater discharge is managed by gauging weir board removal and replacement before and after storm events to ensure adequate moisture in the field. To determine the appropriate action, staff-gage-type water table float/wells are installed around the field immediately after crop planting. These staff-gage float wells are installed in the center of the potato beds between water furrows and at least 150-ft. in from the sides of the field. The staff-gages are painted with distinctive colors indicating a high (0 – 14 in.), low (24 – 32 in.) or optimum (15 – 24 in.) water table depth from the surface. Various actions are taken in response to fluctuation of the water table (see Appendix B). Additionally, tensiometers are economical instruments used to provide an easy and reliable indication of the root zone moisture. When placed at the low end of the field approximately 6" and 12" below the soil surface, within the root zone, tensiometers warn of excessive or deficient water conditions regardless of water table position.

3. **Sediment Management** (Sediment trapping) This BMP involves reducing flow velocities to allow suspended particulates to settle out and the collection of suspended and bed load solids in the tailwater collection ditch. Adequate ditch capacity, sediment traps, and ditch maintaince decrease velocities and increase sediment trapping. Leaving at least one or two boards in a water control weir creates a sediment trap without excavation, otherwise in-ditch excavation is needed to create a sediment trap.

4. **Integrated Pest Management** (IPM) - Individual study fields are scouted at regular intervals during the growing season to reduce insect and disease infestation that would otherwise confound the BMP effects on yield. Pest densities are estimated using standardized sampling procedures, and data are compared with economic or action thresholds that determine when pesticide applications are economically justified.

Methods

BMP monitoring designs and individual farm BMPs were selected by the TTFT for each farm based on the location, field and soil resource inventories conducted by the NRCS, congruency of the data collected during pre-BMP diagnostic study and the grower's willingness to implement the prescribed BMPs. Conservation plans were developed by the NRCS detailing the prescribed BMPs to be implemented on the four study fields. These plans became the scope of work attached to the contract between the growers and the WMD. Table 2 summarizes the study fields, their respective acreage, county and the prescribed BMPs. Figure 7 shows the location of the four BMP farms.

Table 2. Summary of study field location, size, BMPs and study design

Farms	County	Acres	Nutrient BMP	Water Table BMP	Sediment BMP	Integrated Pest Mgt.
C	St. Johns	27.2	X			X
G	St. Johns	35.4		X		X
I	Putnam	38.6	X	X	X	X
J	Flagler	36.1	X	X	X	X

It was important that the collection of data be consistent from the pre-BMP period to the post-BMP period. A project specific Quality Assurance Plan, prepared by the WMD and approved by the Quality Assurance Section of the FDEP, outlined the sampling sites, field sampling procedures and laboratory analysis methodologies. The four study fields were maintained with the same integrated flow and water quality monitoring devices described earlier. The CR10 was maintained to record calculated flow, depth of water in the tailwater ditch, depth of water over the weir plate, rainfall, and sample collection times. District staff using a portable personal computer downloaded these data weekly.

WMD staff conducted water quality monitoring and laboratory analyses to determine nutrient (TKN, TNH_4, NO_x, TN, PO_4, TP) and sediment (TSS) concentrations in the discharge water. Grab samples were collected at the tailwater ditch on each farm and automated samplers collected stormwater samples. Additional sampling conducted at all four farms included vadose and irrigation water. Ground water was collected exclusively at Farm C. Grab samples were collected weekly during the growing season and bi-

monthly during the off-season. Surficial ground water samples were collected bi-monthly at a monitoring well at Farm C and vadose water was collected monthly by a lysimeter at all four sites. Four receiving streams, three located downstream and one located upstream of agricultural production, were sampled monthly during the study. Nutrient deposition by both dry and wetfall was collected using an Anderson Wet/Dry Collector that was installed at the WMD. A Global Positioning System was used to document monitoring site locations.

From 1995 to 1997, shallow wells were constructed in the fields and Stevens Water Level Recorders were installed to measure water table levels. Also, water meters were installed on the pumps to measure irrigation volumes.

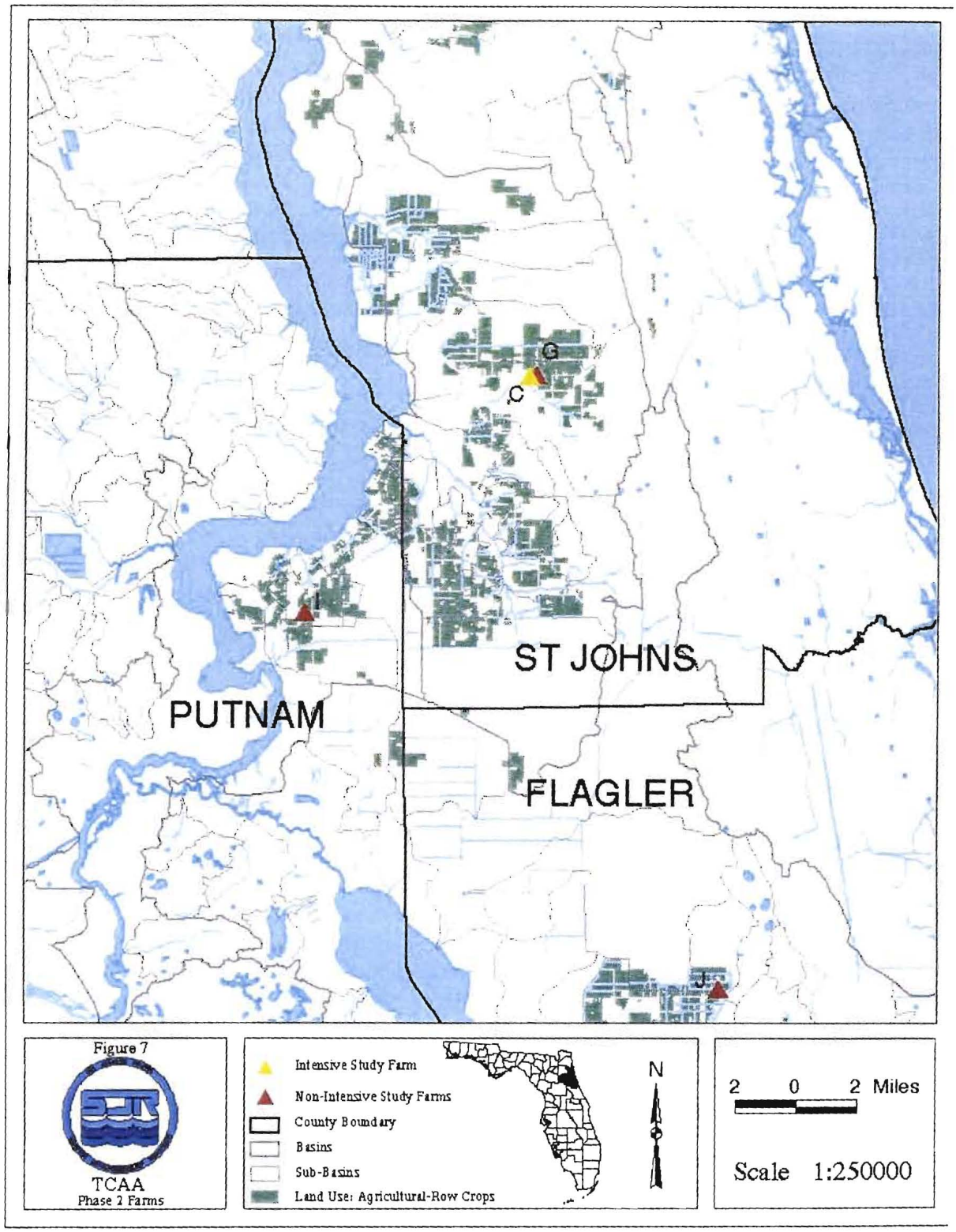


Figure 7. Location of farms participating in the Phase II project

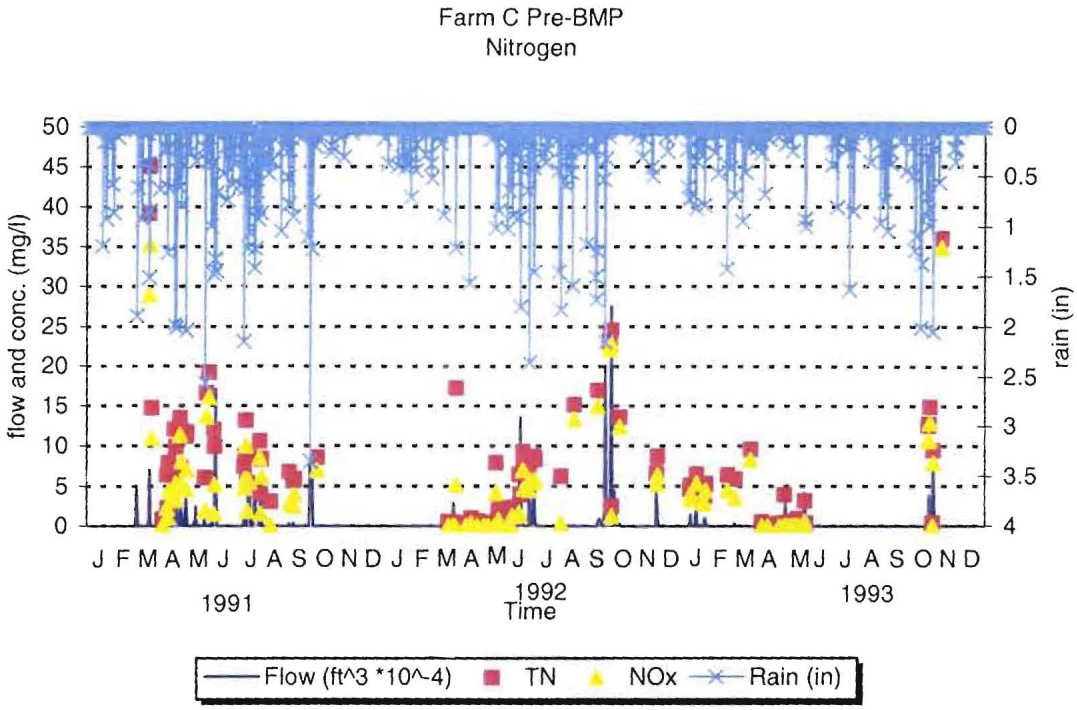
RESULTS AND ASSESSMENTS

Edge-of-field tailwater samples were collected by two methods, grab and automated storm samplers. Since multiple samples could potentially be collected in one day or conversely no samples collected, water quality data were reformatted and converted from a single line time-event into a daily file. Fortran programs were written that output both a daily mean concentration for days with multiple samples and a linearly interpolated concentration for days that had no water quality samples but had observed flow. These files were imported into the flow spreadsheets, and time integration of flows and daily flow-weighted mean concentrations were calculated. For this report, flow-weighted concentrations were calculated using only those data in the spreadsheet that had observed water quality data. In other words, no interpolated concentrations were used for calculating flow-weighted concentrations.

Figures 8 through 15 plot the observed TN, NOX, TP and TPO4 daily mean concentrations, flow and rain for both the pre- (1991-1993) and post-BMP (1994-1997) periods at each field. Figures 16 through 19 show the mean annual pre- and post BMP flow-weighted concentrations for total nitrogen (TN), nitrate plus nitrite nitrogen (NOX), total phosphorus (TP), total dissolved phosphorus (TDP), total suspended solids (TSS) and the pre- and post-BMP percent efficiency for each field.

Although highly variable from year to year, some general statements can be made about the measured data when observing figures 8-15. Figures 8, 10, 12 and 14 show increased nitrogen concentrations during the growing seasons (December – May) for both pre- and post-BMP periods. This trend is more evident during the post-BMP period as nitrogen concentrations are dampened during the fallow months (June – November), thus exaggerating the nitrogen concentration during the growing season. This diminished effect is expected because nitrogen fertilizer was not added during the fallow season for cover crop production during the post-BMP period. As a general rule, growers will apply a small amount of nitrogen to establish their cover crop, but this was not the case during the post-BMP period for those farms applying the nutrient management BMP. This trend is not as apparent with phosphorus concentrations and shows no relationship between increased concentrations and the growing season.

Figures 8-19 show that both nitrogen and phosphorus decreased in 1993 at all farms. Dry conditions during the 1993 growing season made it necessary for growers to irrigate their fields more heavily and for longer periods than normal. Irrigation water will replace much of the shallow ground water as it seeps laterally through the field supplementing water for tuber development. The chemistry composition of irrigation water is naturally lower in nutrients and will subsequently dilute nutrient concentrated discharges in storm water runoff. Therefore, nutrient enriched surface runoff – generated by rain events – will mix with subsurface seepage water that moves out of the system when drainage is expedited to remove water from the field.



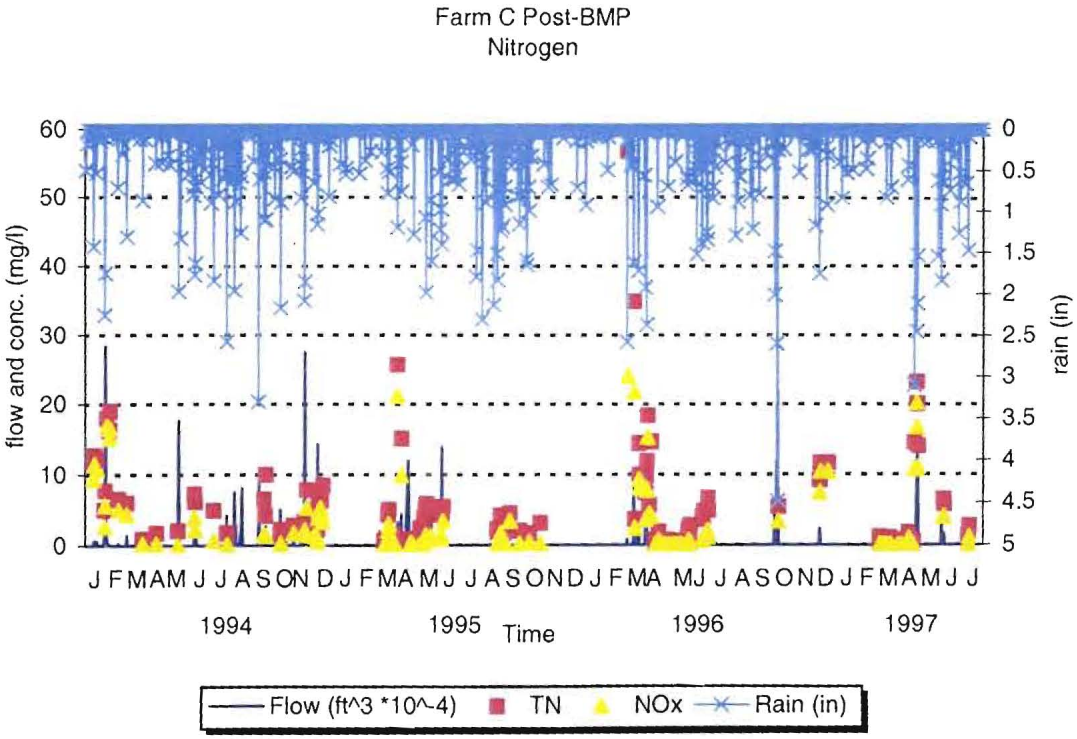
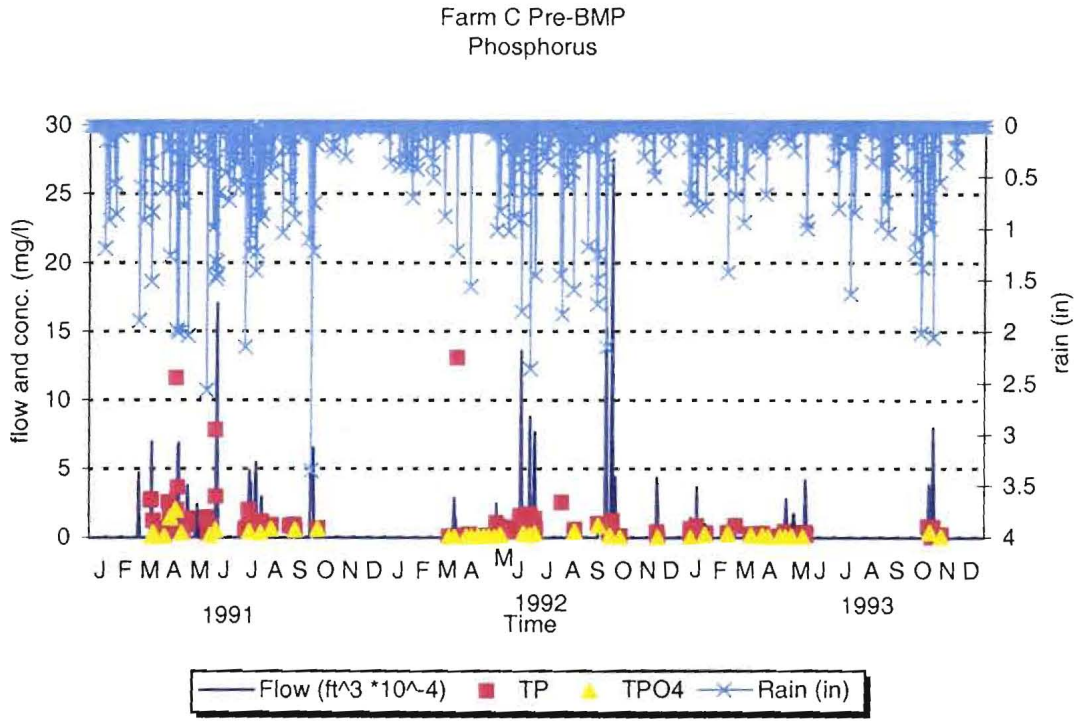


Figure 8. Farm C pre- and post-BMP nitrogen plots



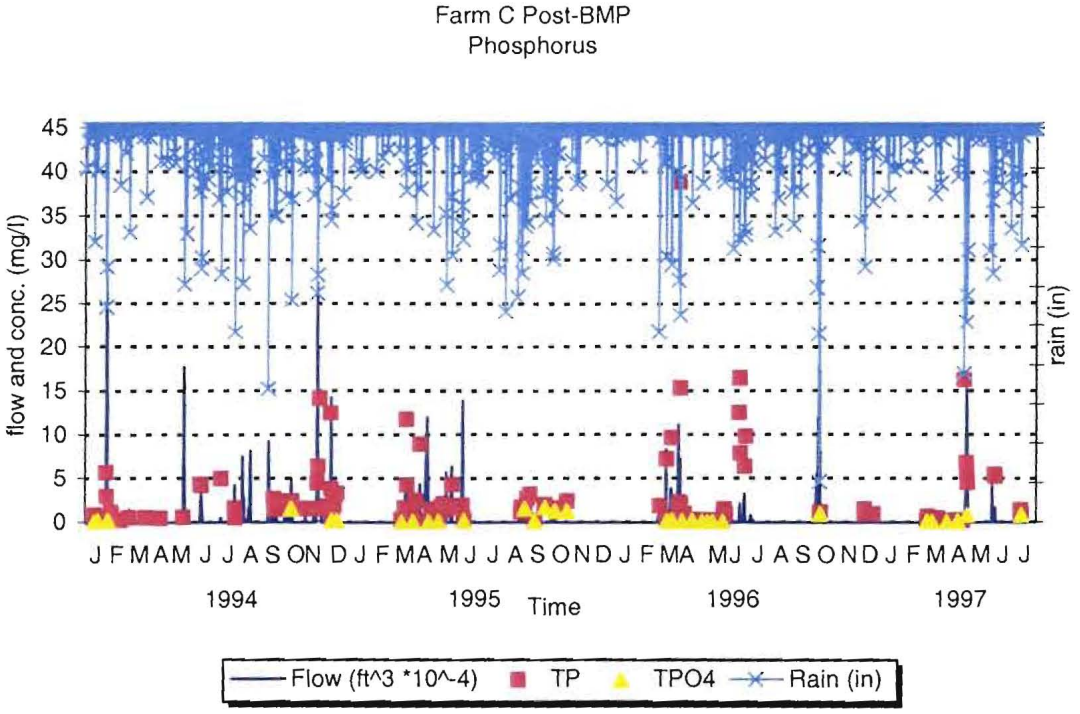


Figure 9: Farm C pre- and post-BMP phosphorus plots

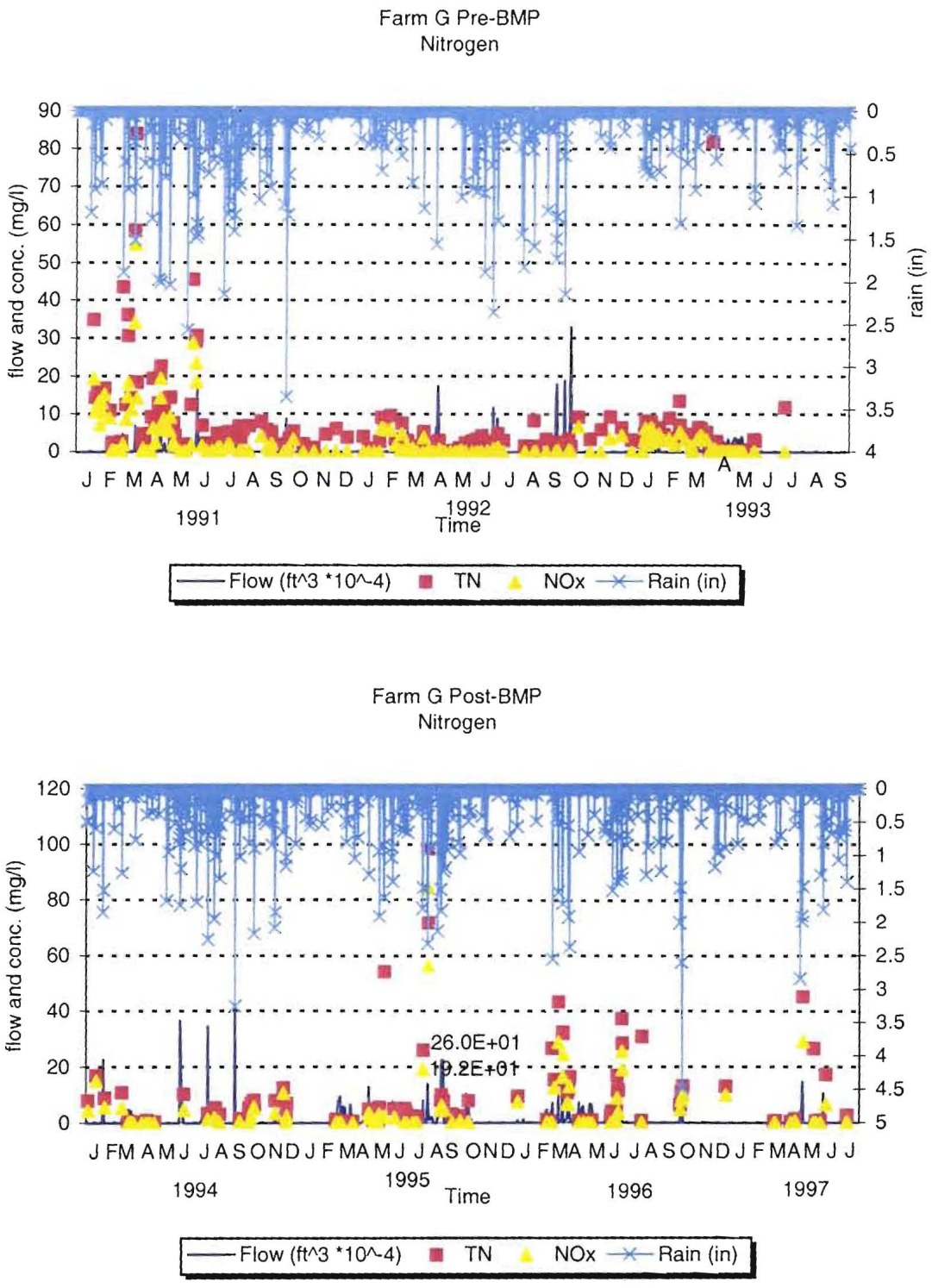
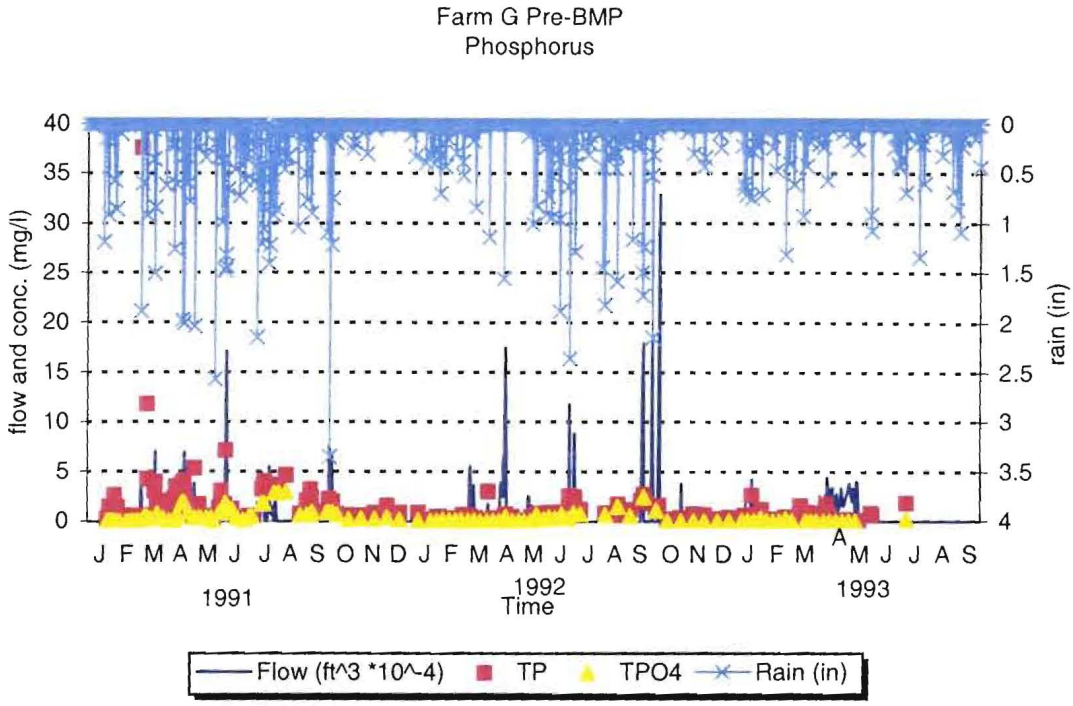


Figure 10. Farm G pre- and post-BMP nitrogen plots



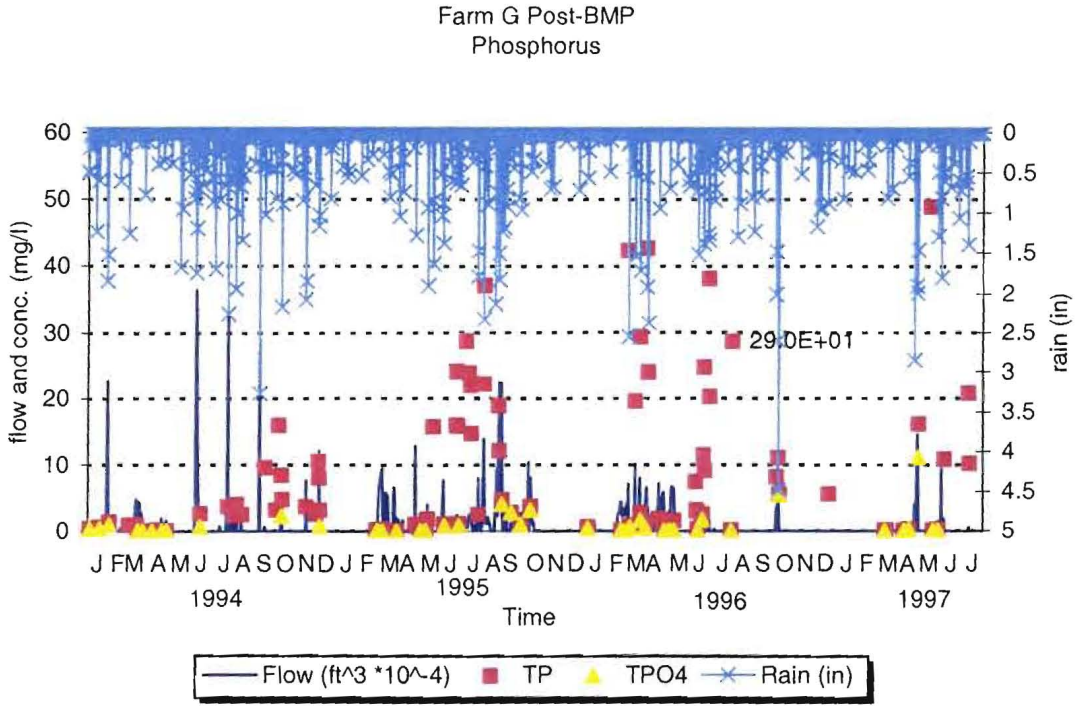


Figure 11. Farm G pre- and post-BMP phosphorus plots

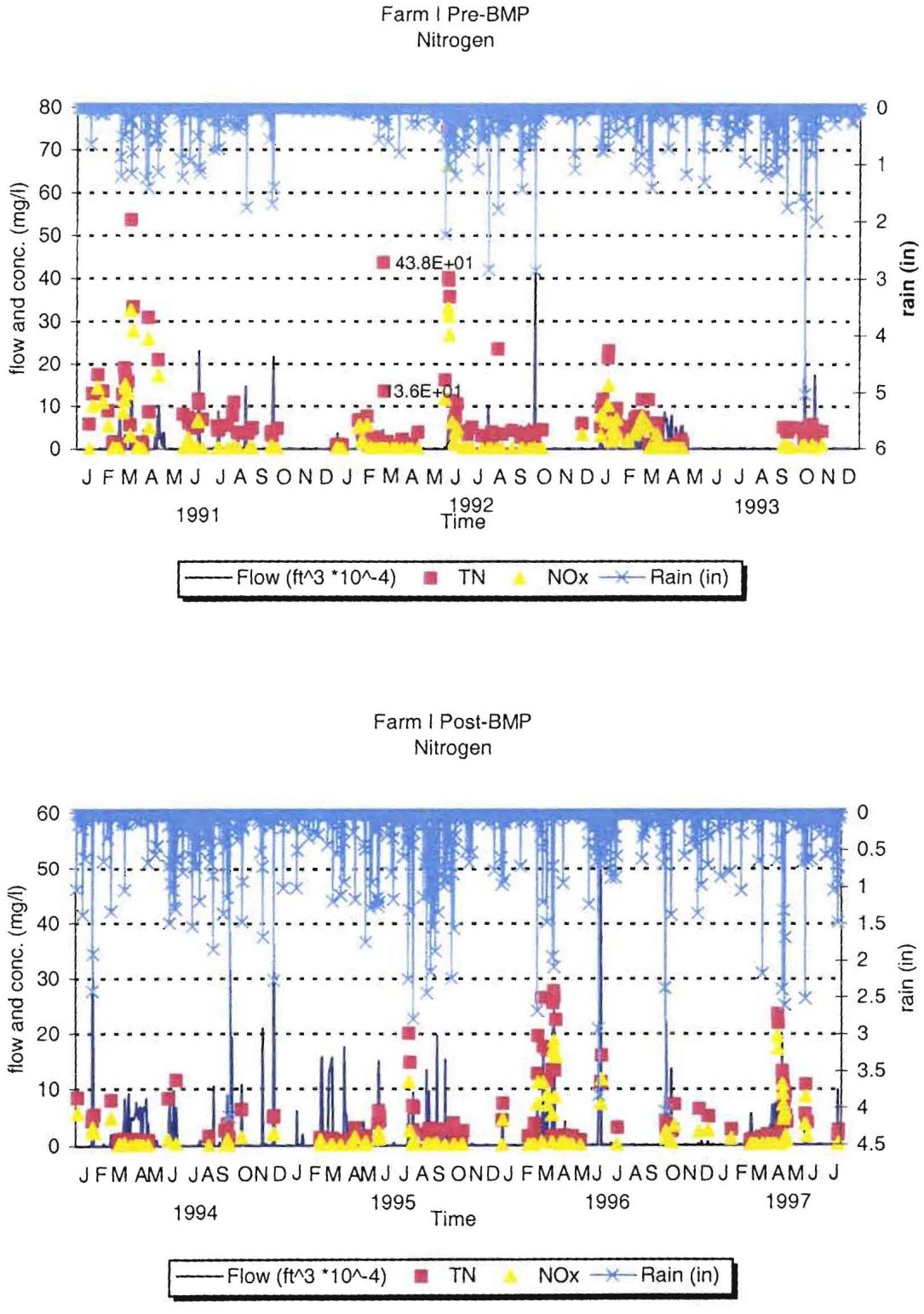


Figure 12 . Farm I pre- and post-BMP nitrogen plots

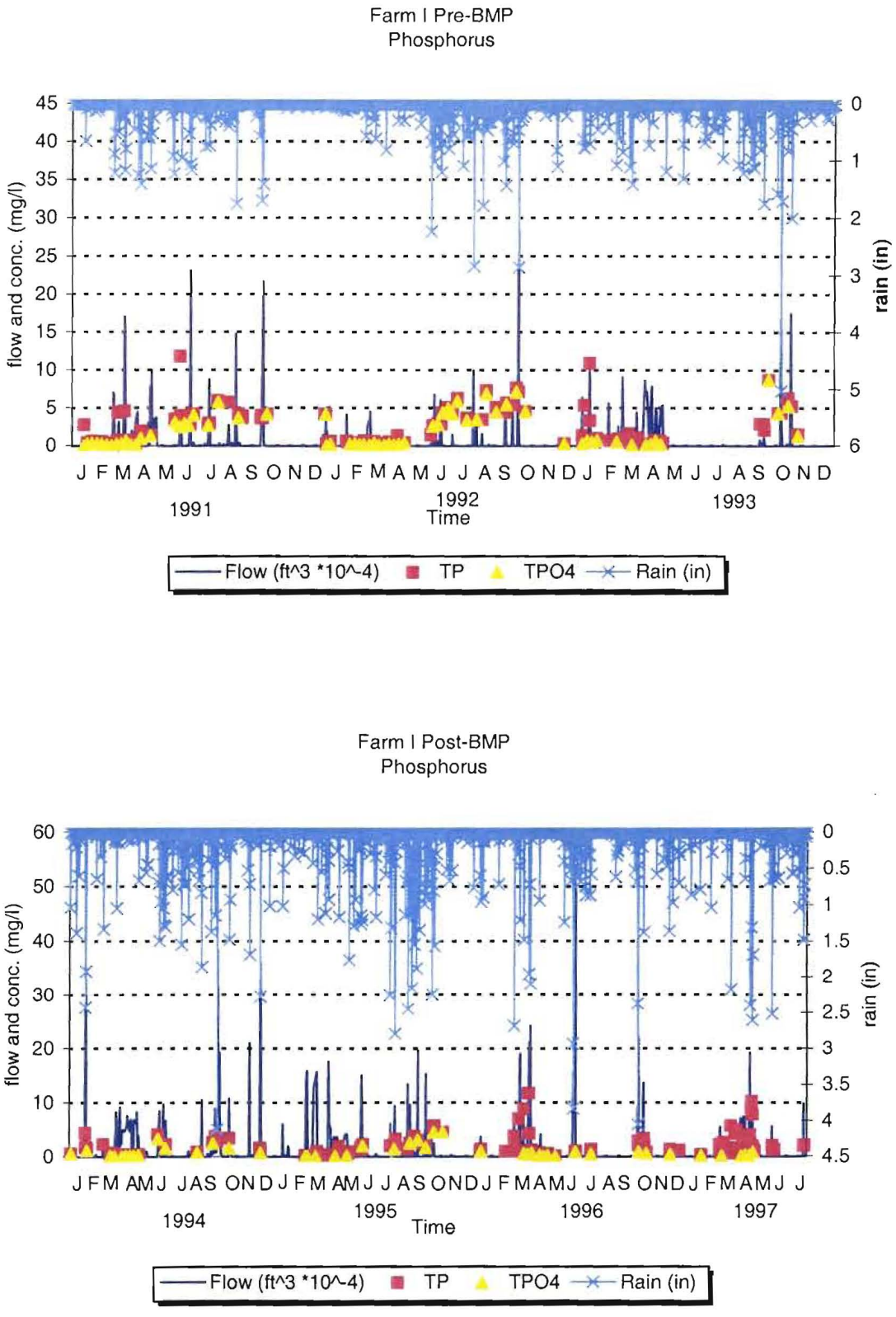


Figure 13. Farm I pre- and post-BMP phosphorus plots

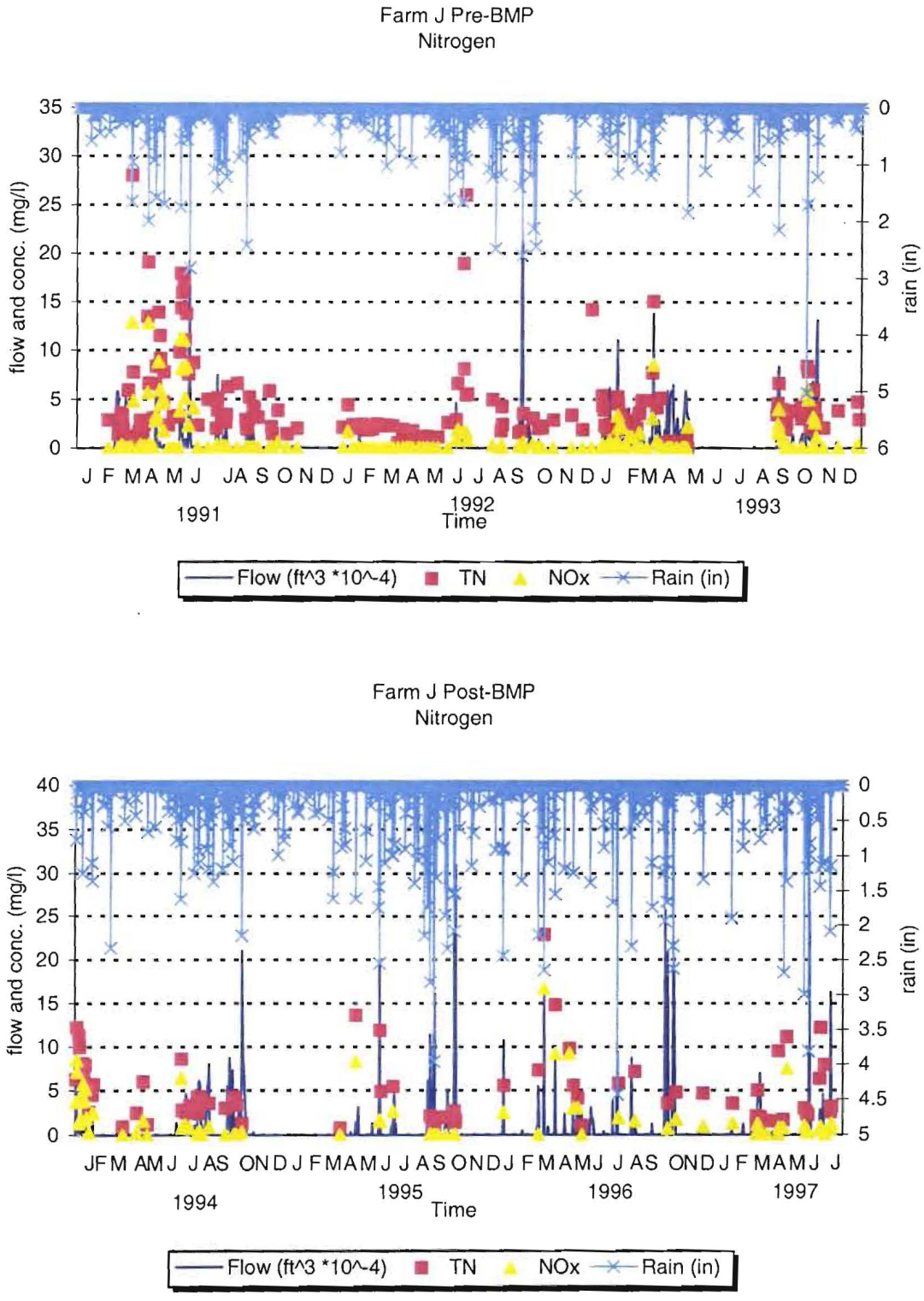
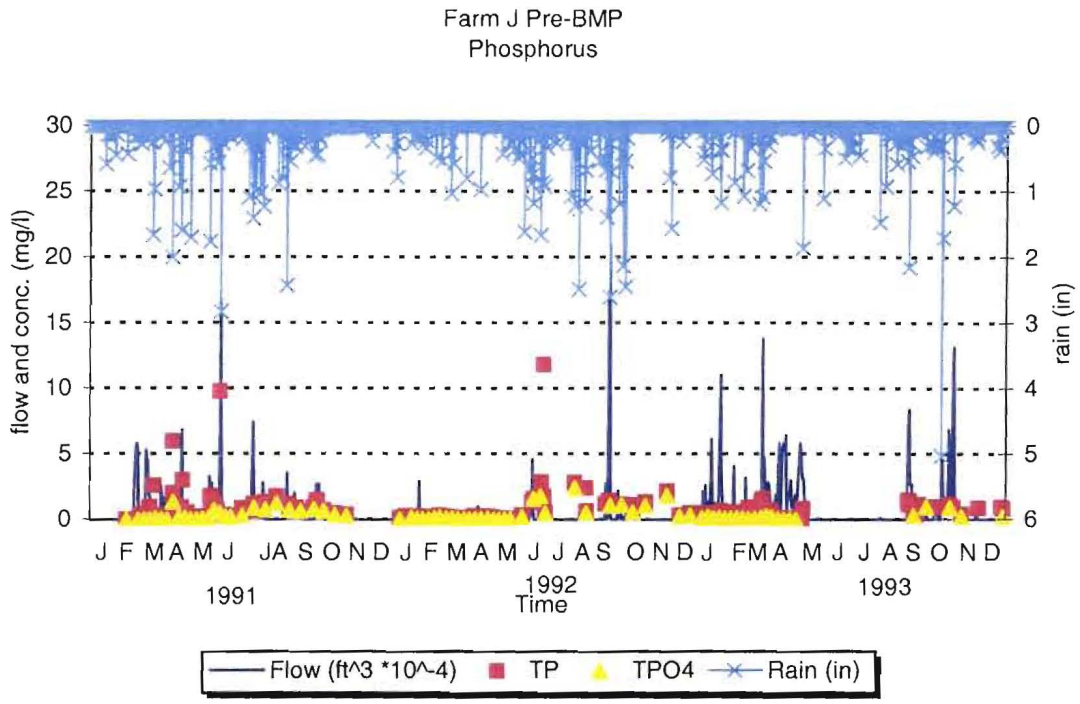


Figure 14. Farm J pre- and post-BMP nitrogen plots



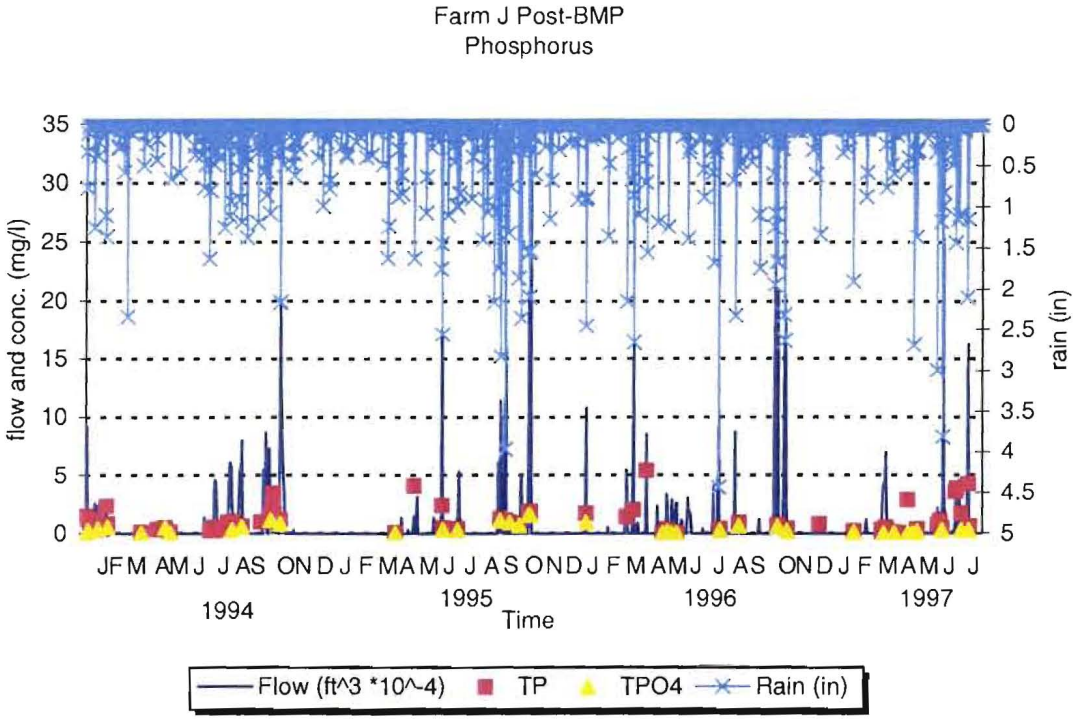


Figure 15. Farm J pre- and post-BMP phosphorus plots

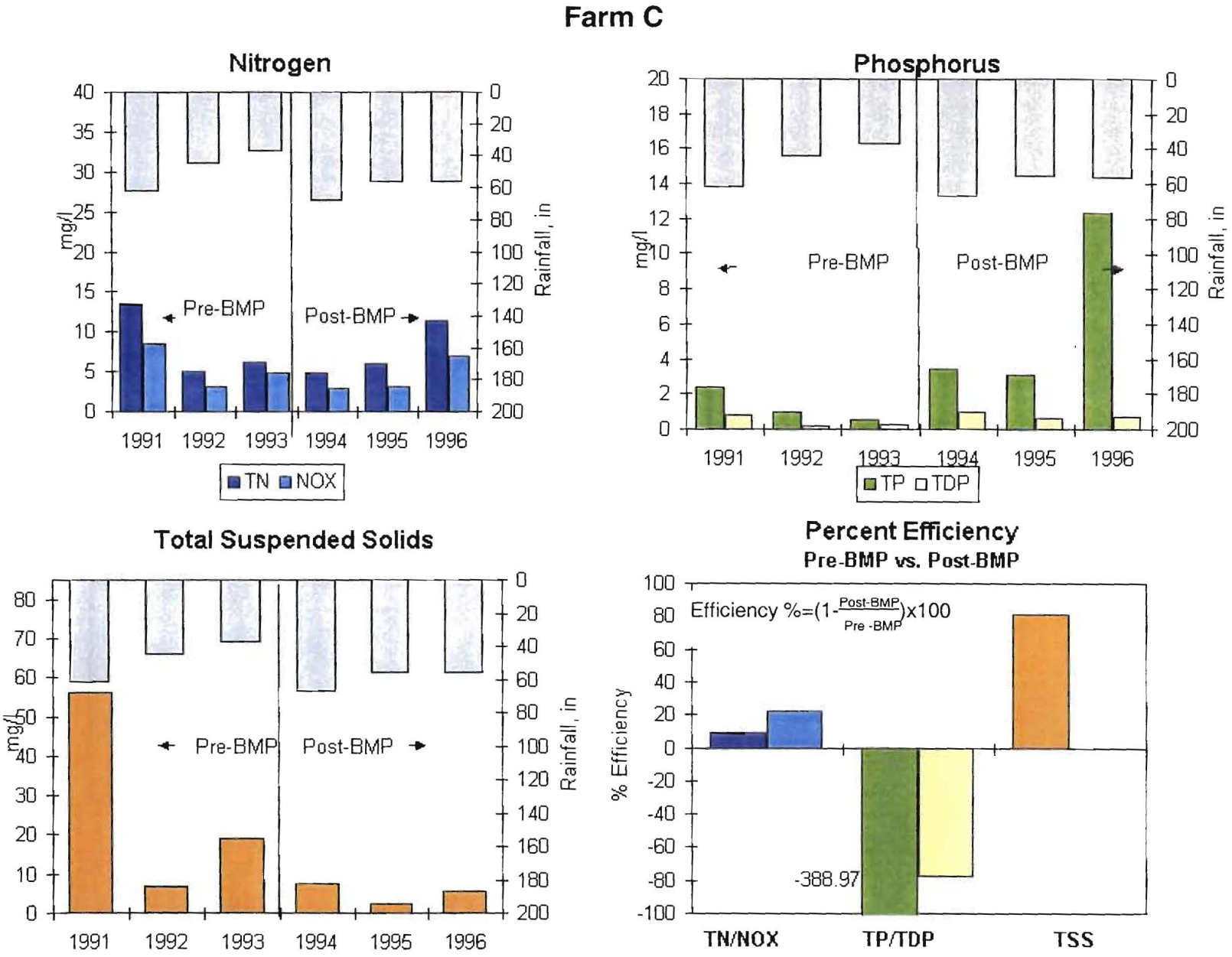


Figure 16. Pre- and post-BMP mean annual flow-weighted concentration for TN, NOX, TP, TDP, TSS and % Reduction

Farm G

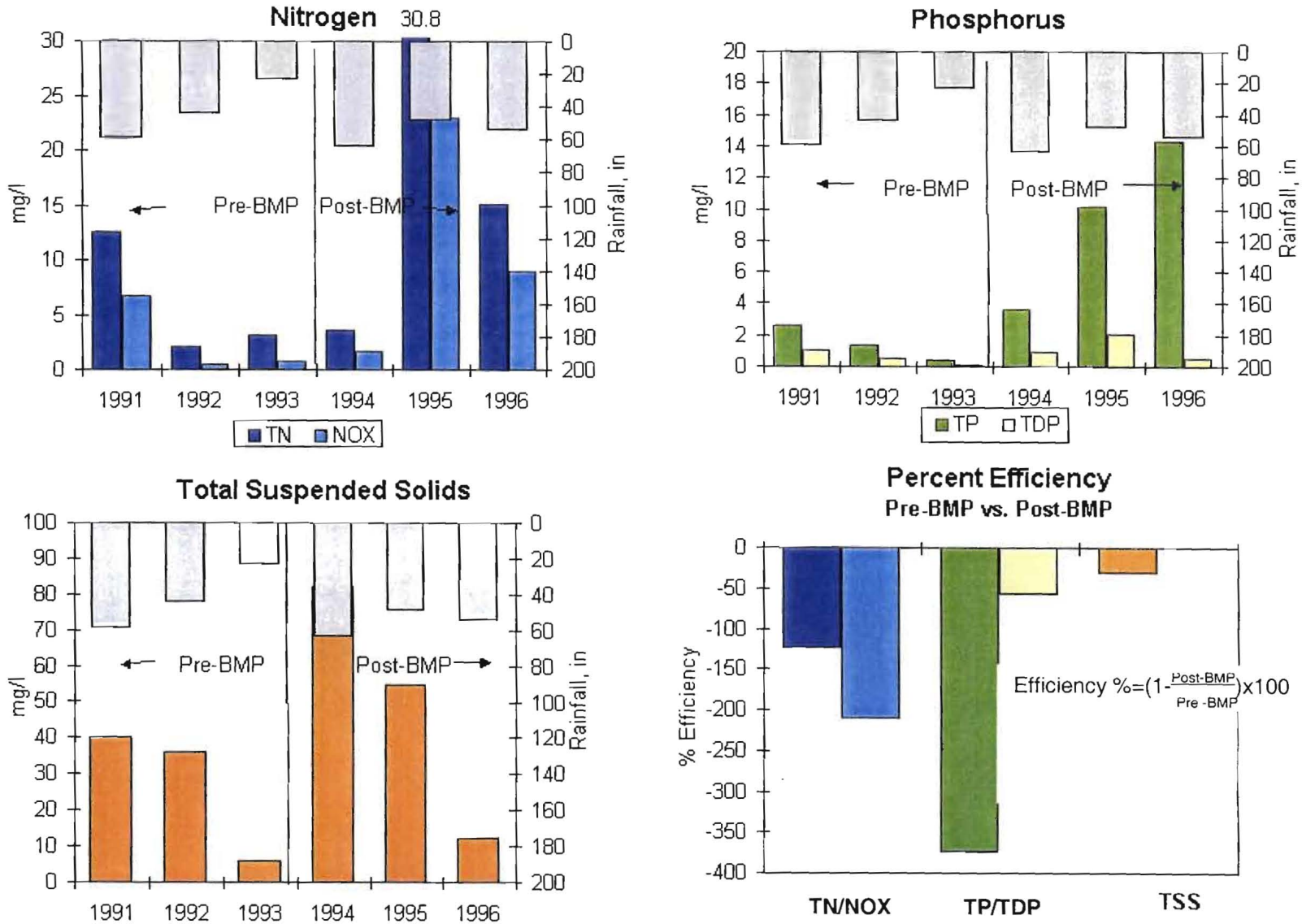


Figure 17. Pre- and post-BMP mean annual flow-weighted concentration for TN, NOX, TP, TDP, TSS and % Reduction

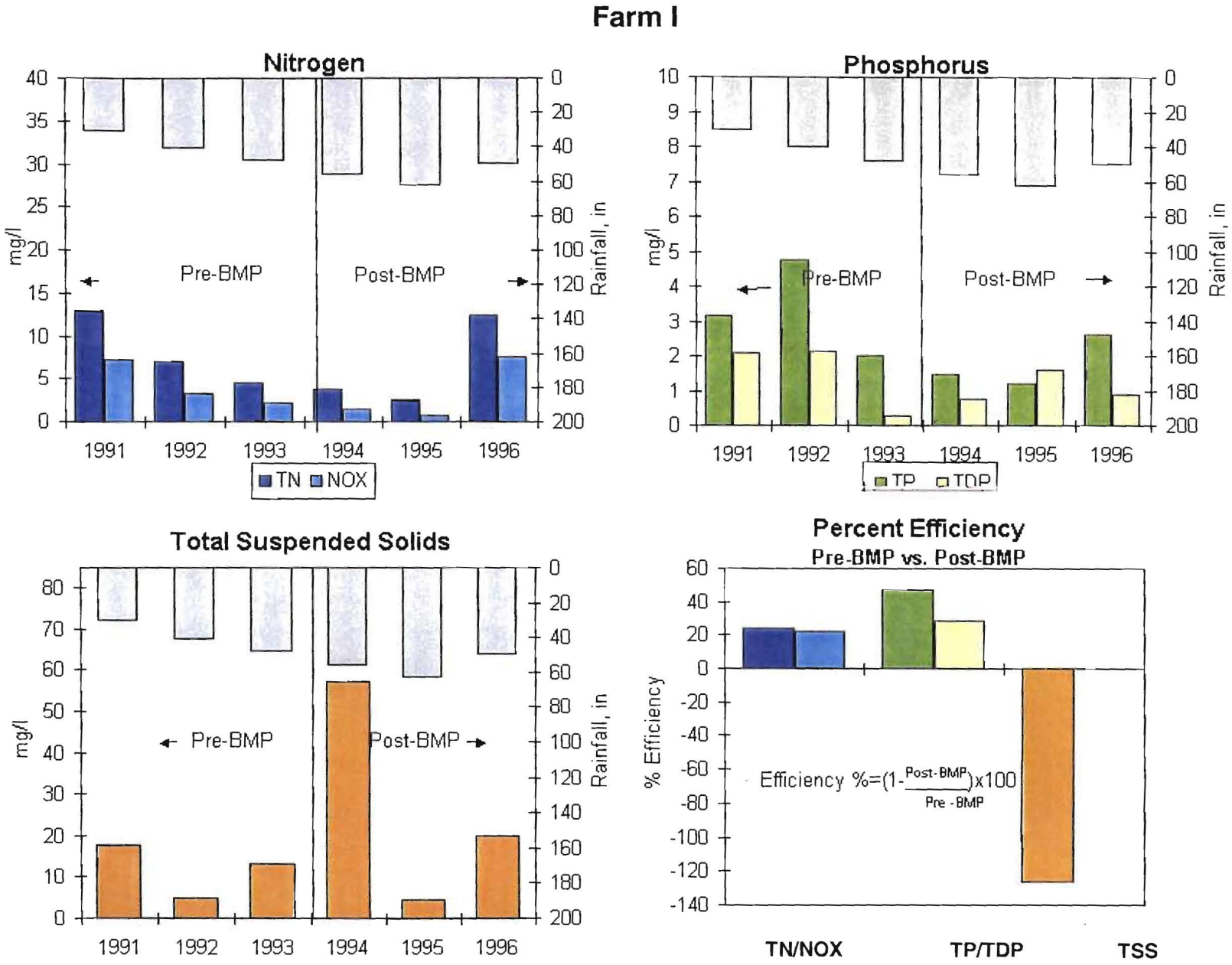


Figure 18. Pre- and post-BMP mean annual flow-weighted concentration for TN, NOX, TP, TDP, TSS and % Reduction

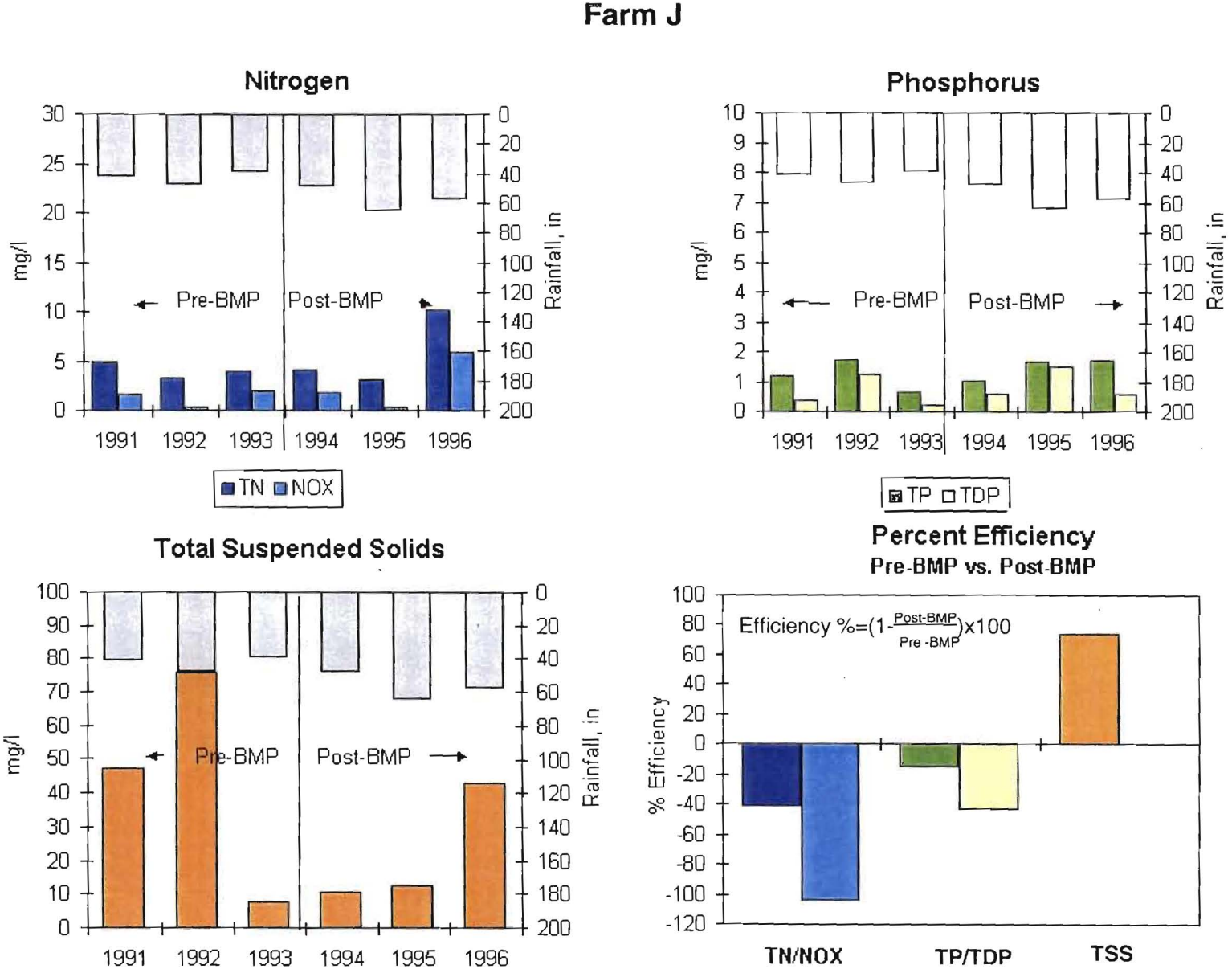


Figure 19. Pre- and post-BMP mean annual flow-weighted concentration for TN, NOX, TP, TDP, TSS and % Reduction

In contrast, 1996 was relatively wet during the growing season and consequently both nitrogen and phosphorus concentrations in discharges increased at all farms. Figures 20 through 23 plot in detail the daily flow volumes, TN and NOx concentration and the date of fertilizer applications for the four farms. Most farms had applied their second application of nitrogen by mid-March. On March 10th and 11th, three inches of rain occurred within 48 hours. This rain event met the criteria for the IFAS "leaching rain" event and prompted all BMP farms to apply a supplemental third application of nitrogen fertilizer. Seven inches of rain fell after March 15. During the month of March, approximately 11 inches of rain fell in the TCAA. The sequence of these events accelerated the increase in nitrogen concentrations during the growing season and influenced the annual mean flow-weighted concentrations.

Figure 12 shows total nitrogen daily mean concentrations for Farm I. In 1992, on March 4th and 6th,the total nitrogen concentration was in excess of 430 mg/L and 130 mg/L respectively. After reviewing these data and communication with the farmer, it was soon realized that water samples were collected soon after a side-dress application of liquid ammonia in the study field. Typically, the equipment used by farmers to apply liquid fertilizer is not easily shut off and therefore continues to discharge directly into the tailwater ditch while a tractor turns the end rows of the field. Three samples were collected during this period revealing ammonia concentrations ranging from 134 mg/L to 313 mg/L while NOX concentrations (0.005 mg/L) were relatively negligible. As a result of this event, farmers have designed a shut-off valve that will provide easy manipulation of the applicator while continuing to move the tractor through the field.

Sediment traps were constructed at Farms I and J at the base of the control structure. In addition, the bottom flashboard of the flashboard riser structure was also maintained in place to retain sediments on site. As a standard farm management practice, growers annually remove the previous year's sediments. During this study, the sediment traps were also excavated at the time of the annual removal and reshaped for the next growing season. Since it was necessary to clean out these sediment traps, it can be reasoned that the excavated sediment traps did stop some additional sediment from traveling down stream. However, the sediment that has been trapped may actually be bed load. Bed load is sediment that is being rolled or pushed along the bottom by the force of the water and moves in almost continuous contact with the streambed. This bed load may not have gone much beyond the water control structure before settling out in the channel. Given that growers currently practice sediment ditch cleaning, the benefit of these sediment traps is therefore debatable. The TSS data that were collected both pre- and post-installation of the Sediment BMP are shown in Figures 24 and 25. These figures provide a visual observation of the TSS measurements for the two farms and suggest that pre/post BMP wet vs. dry period variability overshadowed probable BMP affects such that no conclusion can be drawn. These data most likely represent the soil organic fraction in the eroded soil that is easily transported downstream.

These measured data not only reflect the importance of weather conditions and the effect extreme wet and dry hydrologic periods have on surface water discharges but also the influence of farm management practices. Caution must be used when using similar data

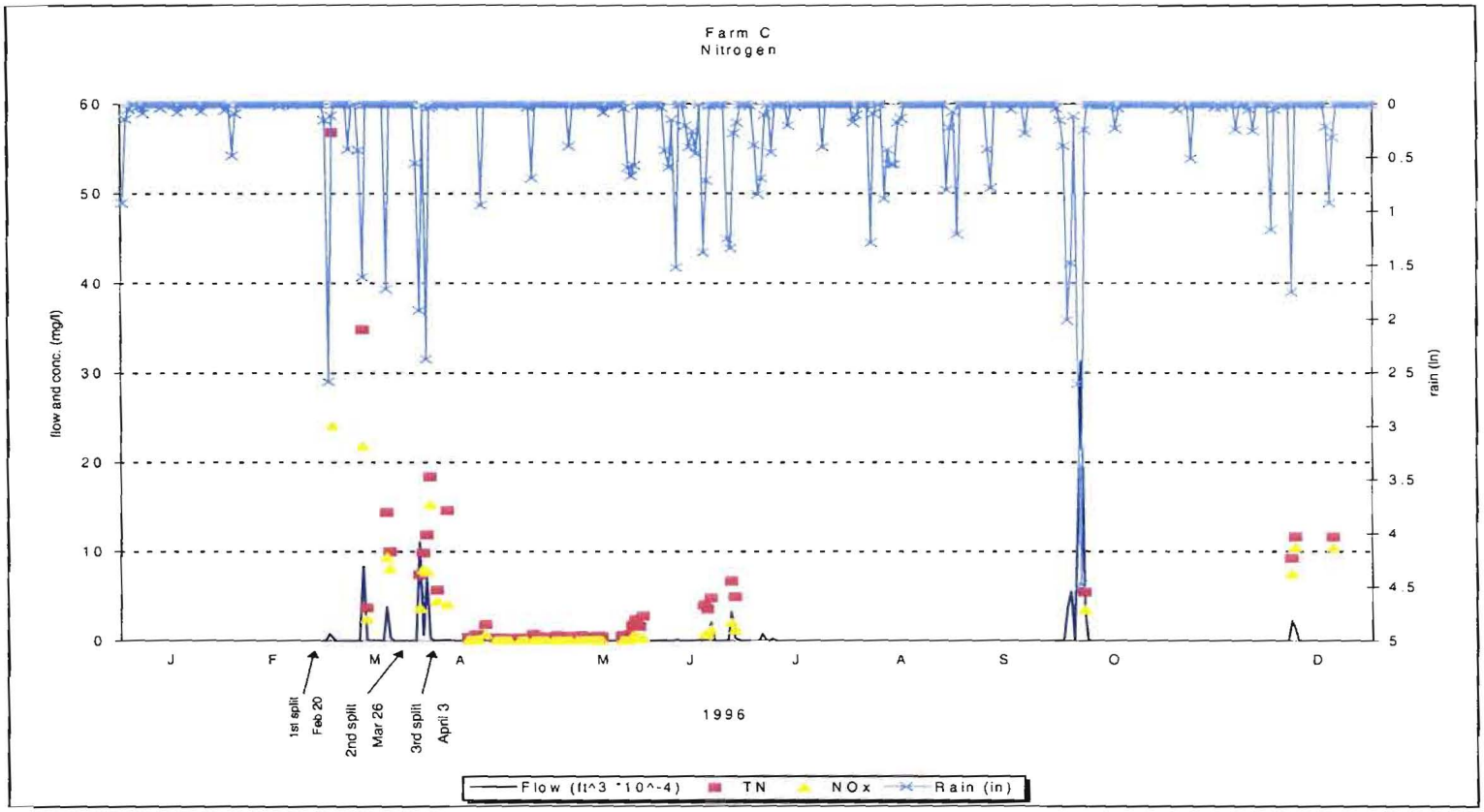


Figure 20. Farm C 1996 plots of daily flow volumes, TN and NOx concentration and scheduled fertilizer applications

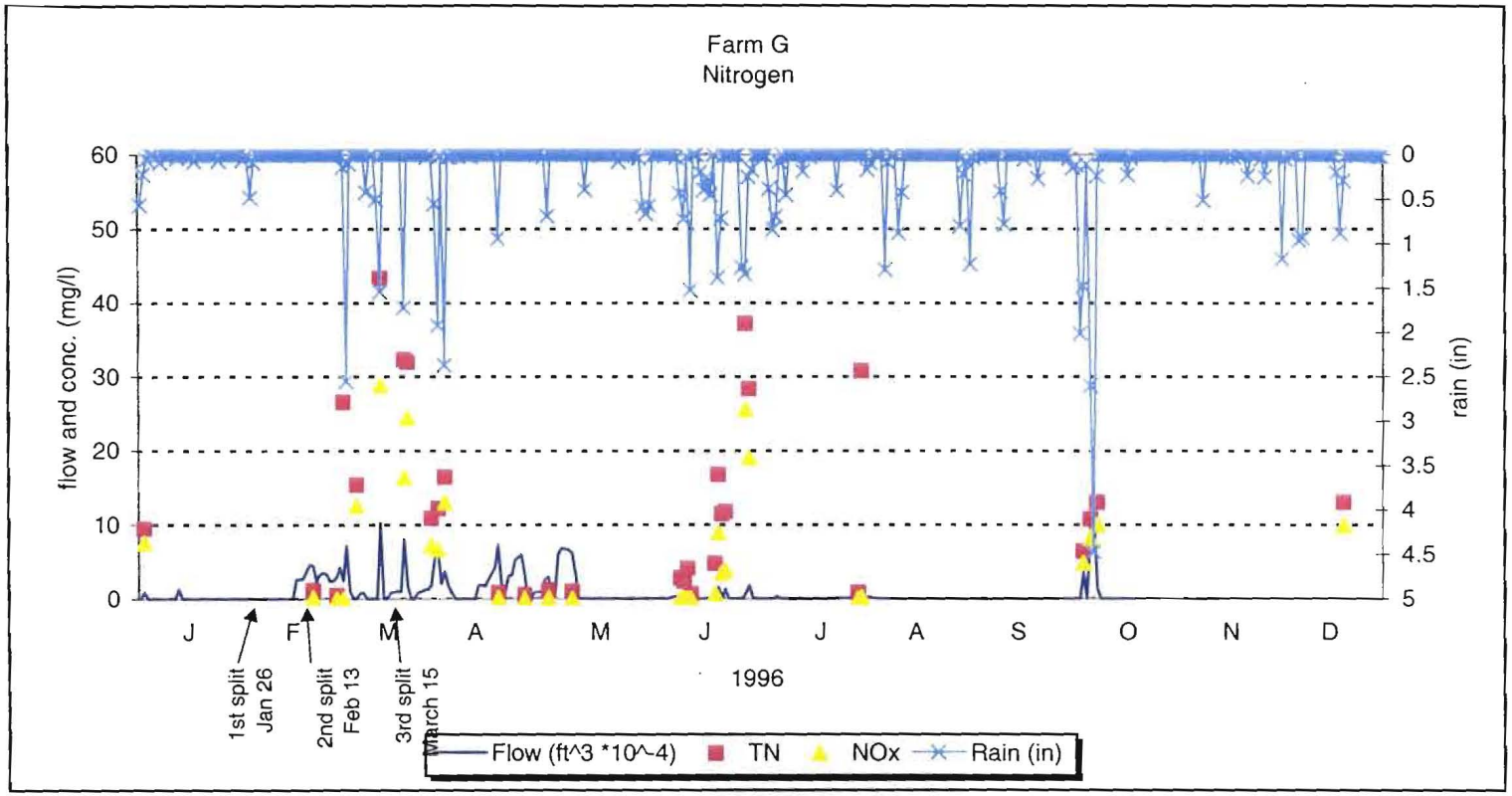


Figure 21. Farm G 1996 plots of daily flow volumes, TN and NOx concentration and scheduled fertilizer applications

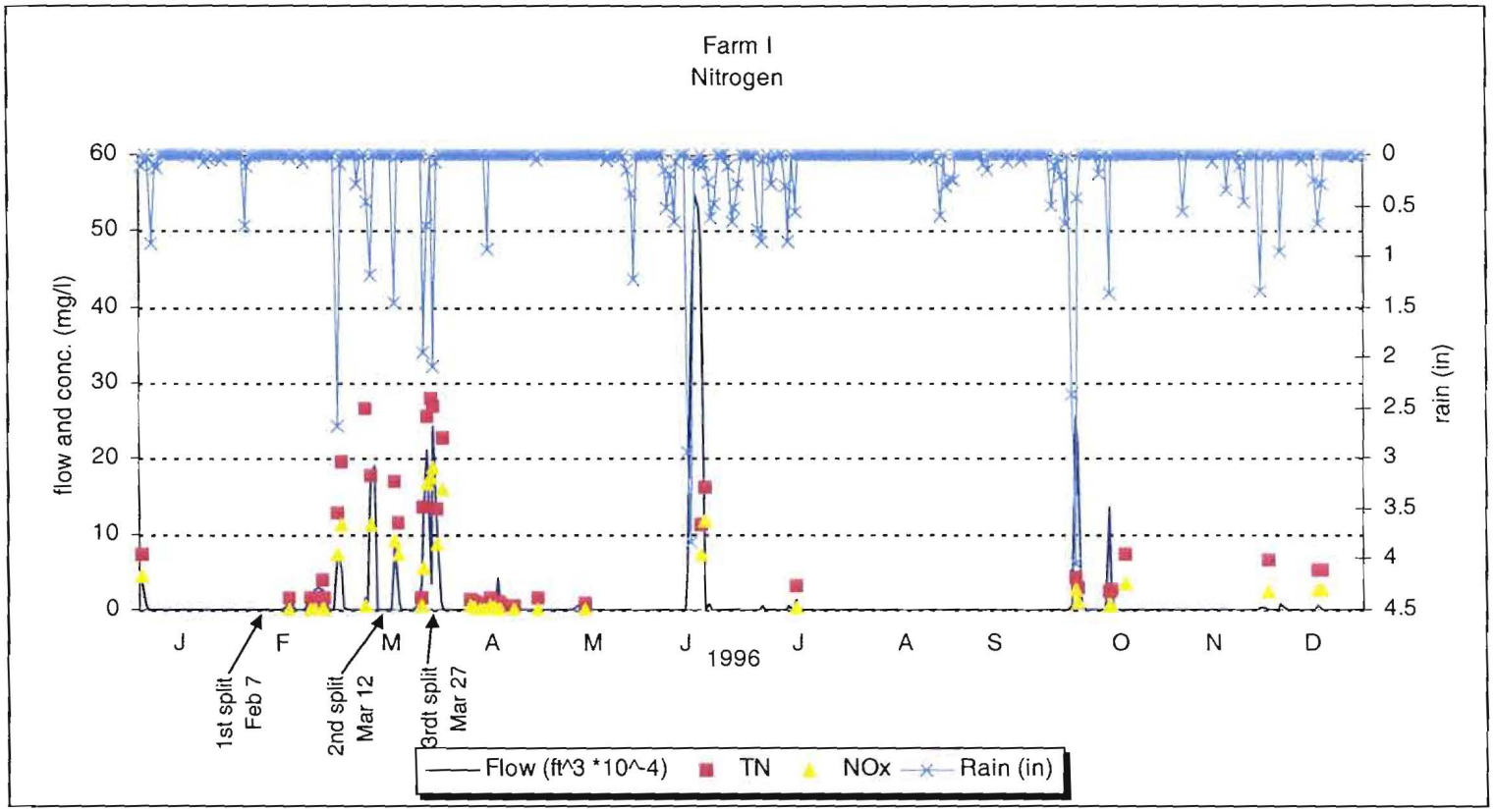


Figure 22. Farm I 1996 plots of daily flow volumes, TN and NOx concentration and scheduled fertilizer applications

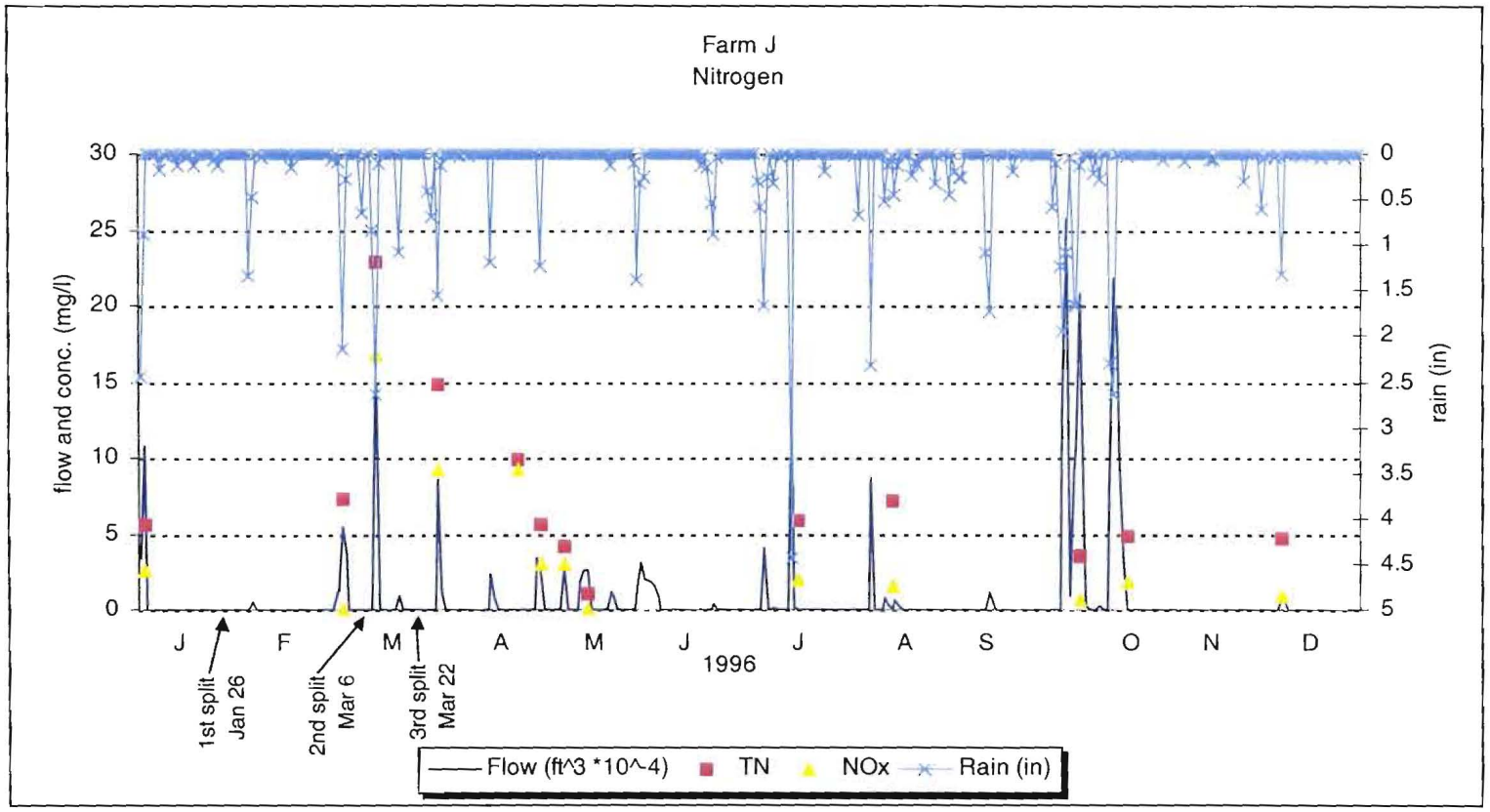


Figure 23. Farm J 1996 plots of daily flow volumes, TN and NOx concentration and scheduled fertilizer applications

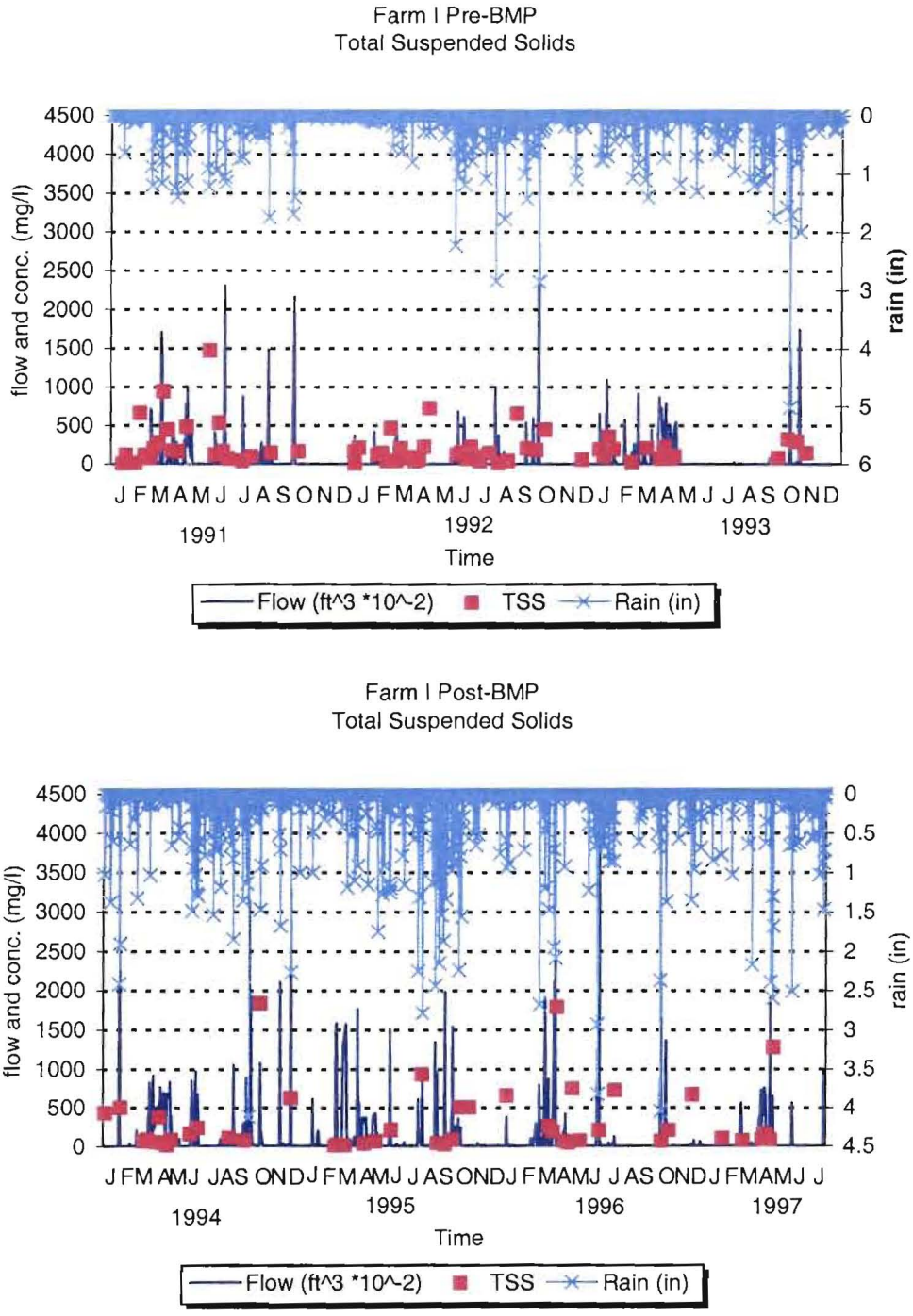


Figure 24. TSS in discharges from Farm I before and after BMP implementation

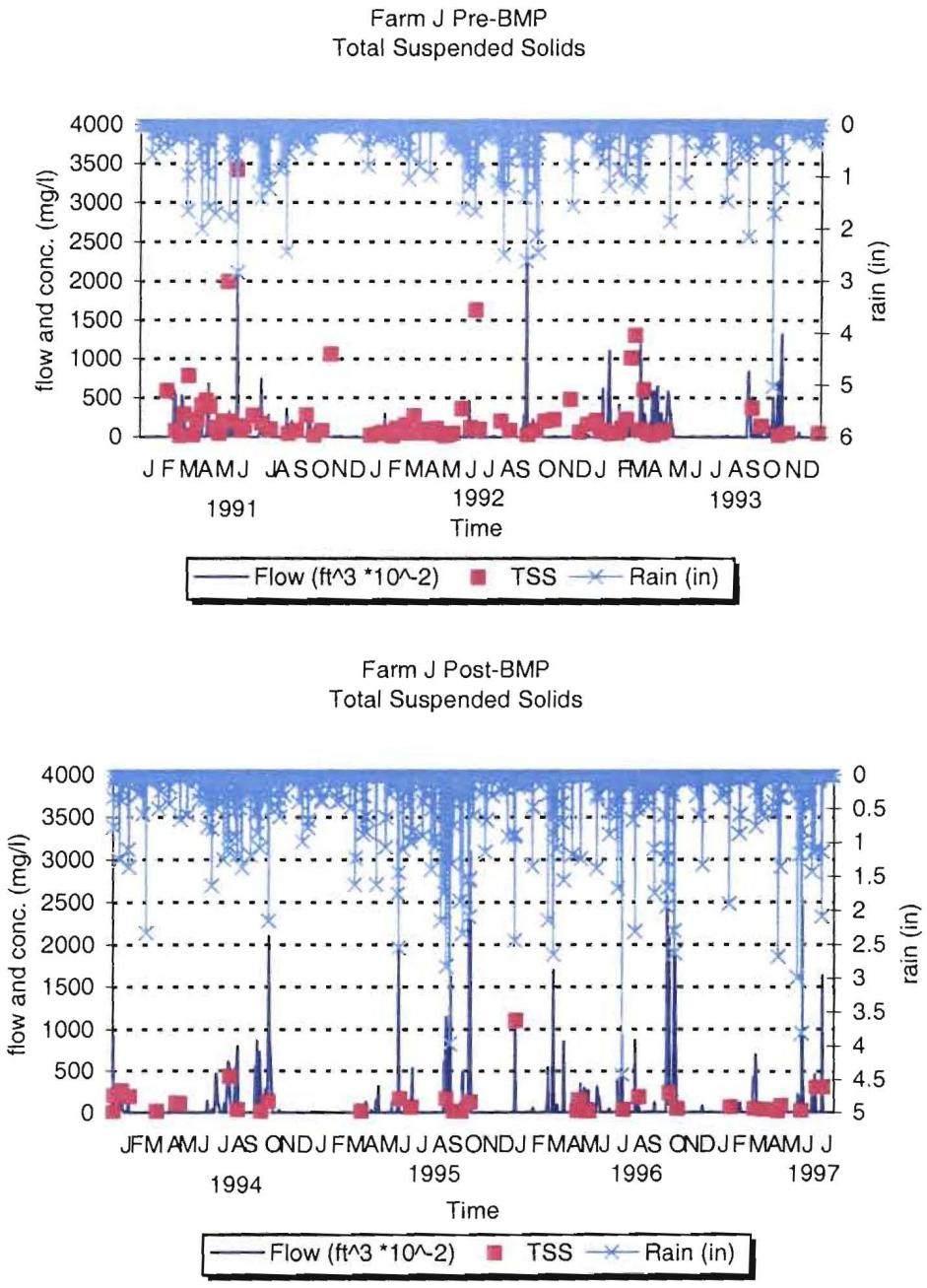


Figure 25. TSS in discharges from Farm J before and after BMP implementation

sets to evaluate the effects of BMPs. Extreme climatic conditions can potentially mask the effects that BMPs have on surface water discharges. As exemplified in 1993 (i.e. dry conditions), decreased nitrogen concentrations could be interpreted as a consequence of the implementation of BMPs. Extreme wet conditions and subsequent increase in concentrations (i.e. 1996) and sediments could potentially mask the BMP effects and be interpreted as no BMP effects or benefits.

Field Scale Modeling

The High Water Table Model (HWTMOD) was used to account for the influence of weather conditions and variable farming practices and provide a quantitative comparative analysis between the pre- and post-BMP periods within each farm. The model has the unique capability of representing the complex irrigation and drainage systems in the TCAA. The model developed by SWET, Inc., continuously predicts the daily water, soil-bound phosphorus and nitrogen, and soluble nitrogen and phosphorus discharge based on weather data (rainfall, solar radiation and temperature), crops grown, and crop management practices.

HWTMOD is an upgraded version of the Everglades Agricultural Area Model (EAAMOD) that is described in the *Tri-County Agricultural Best Management Practices Study Final Report IV* (SWET, 1998) and a published paper (Bottcher et al., 1998). EAAMOD was modified hydraulically to handle the weir-controlled drainage used in the TCAA. A sub-model was added to handle the nitrogen transformation and transport process.

The model simulates the movement of water in the field through evapotranspiration, surface flow, sub-surface flow, deep seepage and the effects of a restrictive soil layer. Nutrient discharge and plant uptake are also simulated. The 1995 – 1997 water table data and board level measurements were used to calibrate the model. Extensive testing of the model using the observed data was conducted to verify its ability to accurately represent farm discharges. Detailed information regarding the SWET, Inc. model and calibration is available in the *Tri-County Agricultural Best Management Practices Study Final Report IV* (pg. 8 – 48).

Modeling was conducted to determine the effects, if any, of the IFAS reduced fertilization rates and water management practices on the quality and quantity of water discharged from the four potato fields in the TCAA. Ostensibly, reduced nitrogen and zero phosphorus fertilization should reduce the nutrient load discharged from edge of field. Improved irrigation and drainage water management should also reduce irrigation demand and water discharge.

The model simulations were run using the 1991 - 1997 data sets to evaluate five different scenarios using the data and information gathered during the study period. The 1991 through 1993 data represent conditions without BMPs and the 1994 through 1997 data represent conditions with BMPs. The five scenarios include:

1) Actual Study Condition Scenario (i.e. `91-`93 Pre and `94-`97 Post)
2) No BMP Scenario (`91-`97 No BMPs)
3) Nutrient Management BMP Scenario
4) Water Table Management BMP Scenario
5) Both BMPs Scenario

Provided below is a discussion describing the BMP modeling runs. Table 3 summarizes this information.

Actual Condition Scenario

This scenario simulates the actual conditions from 1991 through 1997 (denoted as *Actual Scenario).* No farms had previously used the prescribed BMPs prior to 1994 and therefore this scenario includes periods of both pre- and post-BMP conditions. In 1994, Farm C applied a fertility BMP (denoted as *Nutrient BMP*), Farm G implemented a water BMP (denoted as *Water BMP*), while Farms I and J used both BMPs (denoted as *Both BMPs*).

No BMP Scenario

To evaluate the effectiveness of the BMPs, a benchmark or zero BMP scenario was run for comparison of the BMPs. Therefore, the *No BMP Scenario* was developed by examining the water and fertility practices in 1991-1993, prior to the implementation of in-field BMPs. For those farms that implemented an in-field Nutrient BMP in 1994 (Farms C, I, and J), the fertilizer applications for 1991-1993 for that farm were assumed and applied to all years. Both the amount and timing of fertilizer application was used. For the farm that implemented the on-farm Water BMP only (Farm G), actual fertilizer applications were used for all years. The No BMP water management practice was represented by raising the maximum irrigation water level an inch above the top of the boards. Some irrigation water is therefore allowed to overflow the riser boards. This action results in approximately 3-5 in/yr extra irrigation, which is an estimate of the additional irrigation water used during the pre-BMP period.

Nutrient BMP Scenario

The Nutrient BMP was developed using the IFAS recommendations for potato production. Recommended nitrogen rates (i.e. 175 - 200 lbs/ac) were less than the grower's average rate (i.e. 275 lbs/ac). The IFAS recommendation for potato production also states that nitrogen be applied in split applications during the growing season and allows for an additional application of 30 lb/ac following periods of excessive rainfall. This occurrence only happened once during the four years of the study. Phosphorus fertilizer is applied according to the results of the Mehlich-1 soil phosphorus test. Annual soil test results indicated phosphorus levels were sufficient for crop needs and therefore a supplemental phosphorus amendment was not recommended during the four year post-BMP period for all fields. The Nutrient BMP for potatoes therefore used 0 lb/ac P and 175 lb/ac N in two applications during the growing season. The Nutrient BMP used for spring-corn was 200 lb/ac N in two applications and 0 lb/ac P. The Nutrient BMP for

corn following potatoes was 0 lb/ac P and 150 lb/ac N in a single application. The Nutrient BMP had no fertilizer applied to the sorghum cover crop.

Water Management BMP Scenario

The Water BMP maintains an appropriate water table depth in the field. The boards are automatically pulled if the rainfall raised the water table above 1.25 ft deep and are replaced only when the water table drops below the control water table depth. Irrigation was supplied to the furrow ditch and maintained at a given depth level for each field.

Both BMP Scenario

The *Both BMP Scenario* combines the *Nutrient Management* and the *Water Management BMP* scenarios for each farm.

The simulations were run for eight years using the 1991 – 1997 data with the results of the first year discarded. The first year is run as a startup year that minimizes initial error and is identical to the 1991 data set. Long-term modeling was also conducted for Farm I by running four identical 6-year periods (1991-1996) and then appending the last partial year of 1997. Modeling scenarios (1-5) simulated for each farm use the observed rain data for that farm and therefore comparisons of modeling results should be restricted to within-farm.

Table 3. Summary of the BMP simulation runs

Run	Water Management	Fertilizer Management	N (lbs/ac)	P (lb/ac)	P_2O_5 (lb/ac)
Actual	simulated actual	actual applied rates	*273/223	*48/0	*110/0
No BMP	sim. actual + spillage	pre-BMP rates	268	49	113
Water BMP	water table 1.25-1.5'	pre-BMP rates	268	49	113
Fert BMP	sim. actual + spillage	IFAS rates	175	0	0
Both BMPs	water table 1.25-1.5'	IFAS rates	175	0	0
Actual	simulated actual	actual applied rates	*437/451	*55/129	*127/296
No BMP	sim. actual + spillage	actual applied rates	437/451	55/129	127/296
Water BMP	water table 1.25-1.75'	actual applied rates	437/451	55/129	127/296
Fert BMP	sim. actual + spillage	IFAS rates	156-290	0	0
Both BMPs	water table 1.25-1.75'	IFAS rates	156-290	0	0
Actual	simulated actual	actual applied rates	*255/187	*22/0	*50/0
No BMP	sim. actual + spillage	pre-BMP rates	254	22	51
Water BMP	water table 1.25-2.0'	pre-BMP rates	254	22	51
Fert BMP	sim. actual + spillage	IFAS rates	175	0	0
Both BMPs	water table 1.25-2.0'	IFAS rates	175	0	0
Actual	simulated actual	actual applied rates	*220/195	*33/8	*75/19
No BMP	sim. actual + spillage	pre-BMP rates	223	36	82
Water BMP	water table 1.25-2.0'	pre-BMP rates	223	36	82
Fert BMP	sim. actual + spillage	IFAS rates	175	0	0
Both BMPs	water table 1.25-2.0'	IFAS rates	175	0	0

*Pre/Post BMP conditions

Modeling Results

Actual Scenario

The *Actual Scenario* is a simulation of the actual study conditions throughout the seven-year study period. The *Actual Scenario* predicts the nutrient load based on the actual case condition for each farm. Therefore, the years from 1991 to 1993 represent the pre-BMP period with standard farm practices and 1994 to 1997 represent the post-BMP period with the respective BMPs implemented on each farm. The accuracy of the model to represent actual study conditions is critical for establishing greater confidence in its ability to predict BMP effectiveness.

As mentioned previously, the data generated by the Stevens Water Level Recorders were used to calibrate the model. Because the recorders were installed in 1995, a water management plan had to be developed for each farm in order to include the first four years of the data in the model simulation. The water management plan was designed to accurately imitate the way that each farmer managed the board levels and irrigation events as a function of rainfall and crop needs. This way the model simulation could include the 1991- 1994 conditions as part of the *Actual Scenario* since reliable water table data were not available. This water management plan is described in detail in the SWET, Inc. Final Report Phase III.

Table 4 shows the results of predicted annual flow and the measured flow for each farm. In most cases, the predicted and measured annual flow for each farm is similar. However, in some cases there are notable differences where the predicted flows are almost always greater than the measured flows. These differences are attributed to gaps in the measured data where large rainfall events occurred but flow was not measured due to equipment failures or because the flow sensors were not replaced in the correct position over the water control structures after boards were adjusted by the grower. These gaps have been identified and documented in the field study notes and in the quarterly reports submitted to FDEP.

Table 4. Comparison of the predicted annual flow and the annual measured flow for each farm (in/yr)

	Farm C		Farm G		Farm I		Farm J	
	Predicted	Measured	Predicted	Measured	Predicted	Measured	Predicted	Measured
1991	25.23	10.02	33.73	24.23	17.88	13.70	17.22	12.53
1992	15.32	14.63	24.14	15.87	18.19	12.21	23.50	5.96
1993	11.06	3.83	15.32	10.03	24.34	8.99	19.60	18.44
1994	25.32	23.98	32.78	25.58	33.24	38.13	23.30	18.99
1995	20.60	9.26	21.48	33.05	38.17	33.56	37.22	13.91
1996	25.18	11.75	32.28	18.94	34.82	31.32	34.66	21.51

Accuracy of the model can be measured by comparing the modeling results (i.e. predicted) with the observed (i.e. measured) data. As mentioned earlier in this report,

daily loads were not calculated unless an actual water quality sample was collected for that day. Also, where equipment malfunctions occurred, subsequent gaps in the observed data also exist. These two conditions limit the extent to compare the observed data to the predicted data.

The ability of the model to reproduce the observed data can be quantitatively and qualitatively expressed (van der Heijde, 1992). Root mean squared error (RMSE) was calculated and regression analysis performed using only those data where paired predicted and measured daily values occur. The RMSE is the average of the squared differences in measured and predicted data where d_i is the difference between the predicted and measured values.

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n} d_i^2}$$

Figures 26 and 27 plot **all data** for both the measured and predicted TN and TP daily load for all farms. These plots largely show an agreement between the observed and predicted daily loads, except where there are obvious gaps in the observed data. These plots also display the RMSE and the R^2 calculated for the measured versus predicted data.

The plots show that the phosphorus predictions agree with the measured data more so than the nitrogen. The mean R^2 and RMSE for TP is 0.26 and 0.662 kg/ha respectively whereas TN is 0.24 and 2.29 kg/ha respectively. The plots show a general trend of the model to over-predict nitrogen loading, especially where extreme-loading values occur. The over-prediction of nitrogen is indicated by the difference in the mean RMSE of each constituent.

The R^2 calculations range from 0.3177 to 0.2419 and 0.3273 to 0.1442 for TP and TN respectively. Although the R^2 calculations are relatively low, the RMSE values indicate a relatively small mean variance between the measured and predicted data. Further analyses of the regression statistics F-test indicate a highly significant linear relationship between the measured and the predicted data for all farms. Table 5 displays the regression summary statistics for the P-values, F-test and corresponding critical F values. Considering the extreme dynamics of these agronomic systems, these results suggest there is good agreement between the model predictions and the measured data at all farms. The best fit between the measured and the predicted data was observed at Farm J.

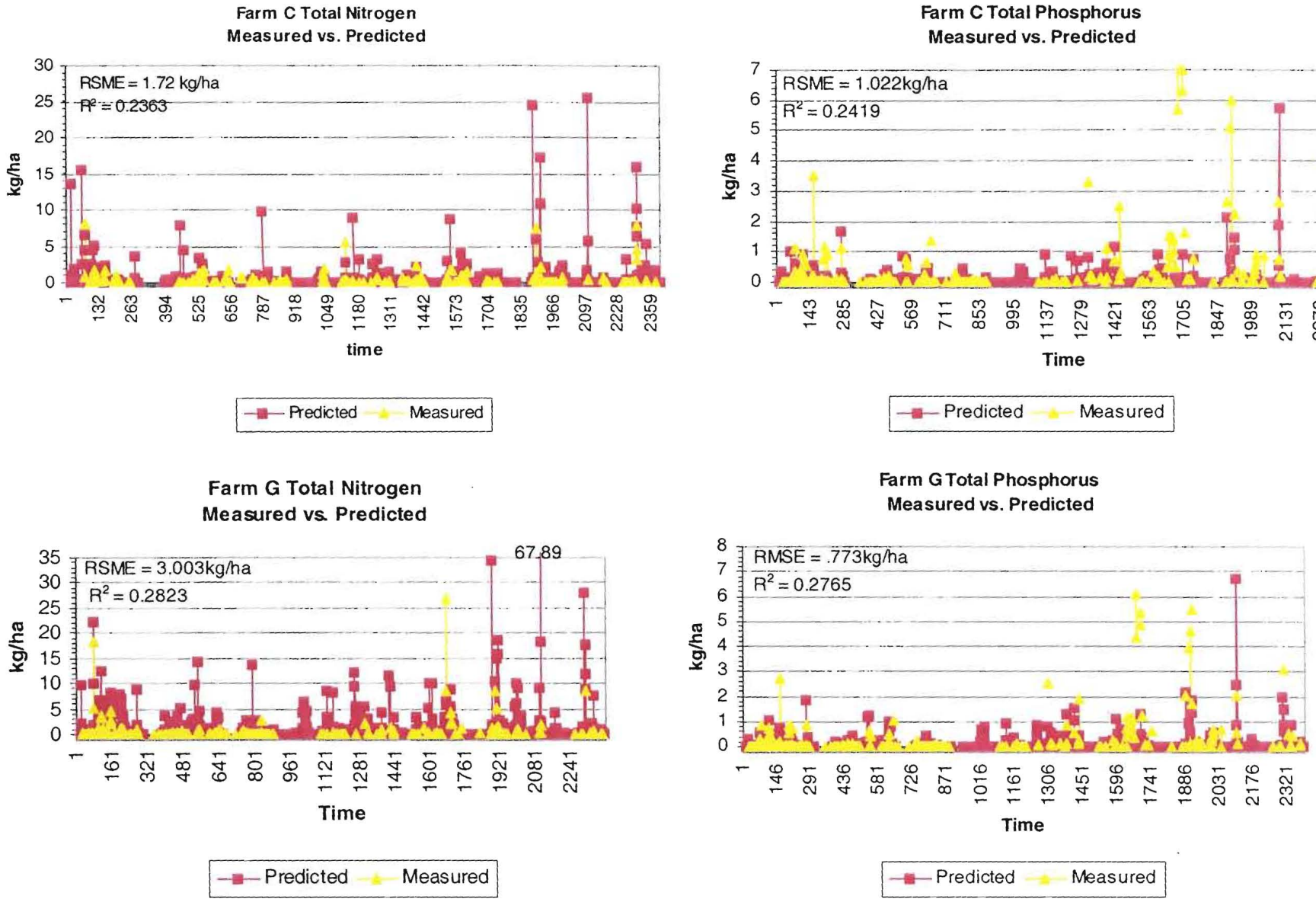


Figure 26. Comparisons of measured vs. predicted loadings for project farms C and G

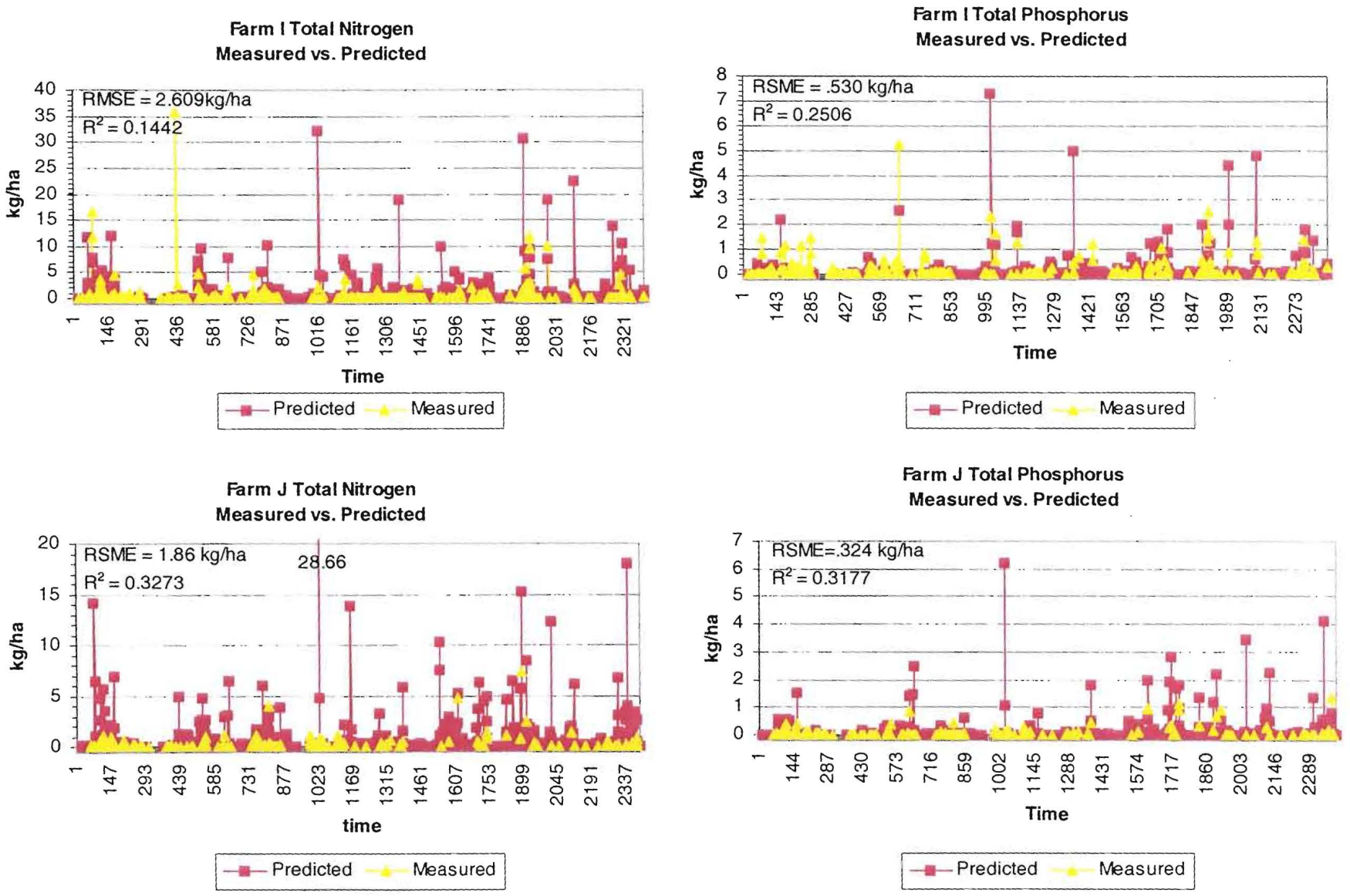


Figure 27. Comparisons of measured vs. predicted loadings for project farms I and J

Table 5. Regression summary statistics comparing measured and predicted TN and TP daily loads (kg/ha) for all farms

Farm	Parameter	P-value	F-test	F value
Farm C	TN	6.06E-05	7.71E-13	59.09
	TP	0.0002	3.83E-16	76.56
Farm G	TN	5.82E-08	3.98E-20	100.31
	TP	3.25E-05	2.19E-20	101.27
Farm I	TN	5.76E-10	8.63E-11	45.64
	TP	0.145	7.22E-25	123.08
Farm J	TN	0.0003	8.03E-18	90.98
	TP	0.047	1.33E-20	105.69

No BMP Scenario

Figure 28 shows the results of all the BMP scenarios and the respective nutrient loads for all four farms. The *No BMP Scenario* assumes pre-BMP conditions for the entire study period. A comparison of the *No BMP Scenario* and the *Actual Scenario* shows an obvious increase in loading with the no-BMP condition. Nitrogen exhibited a greater increase than both phosphorus and suspended solids. This is true for all farms except Farm G that implemented only the Water BMP as the *Actual Scenario* condition and consequently the effects on load reduction were minimal.

The *No BMP Scenario* predicts the nutrient load based on pre-BMP conditions. Farm I realized the greatest increase in nitrogen loading (17%) and farms C (14.8%) and J (13.1%) show only a slight increase in nitrogen load with the No BMP condition. Farm G exhibits a negligible change in loading as the No BMP and Actual BMP conditions were identical except for the water table management. Both phosphorus (1.8%-9.2%) and TSS (1.3%-2.5%) loading show a marginal increase at all farms as a result of the No BMP scenario.

Nutrient BMP Scenario

The *Nutrient BMP Scenario* predicts the nutrient load had the Nutrient Management BMP been implemented independently on each farm. The results from the *Nutrient BMP Scenario* indicate that the Nutrient Management BMP was more effective at reducing total annual nitrogen (24-33%) and phosphorus (6.5-18%) loads, while TSS showed no reduction. Farms C and G realized the greatest reduction in nitrogen load (33%) while farms I and J achieved 28% and 24% reduction respectively. Farm G realized an 18% reduction in phosphorus load, while farms I and J achieved 6.5% and 9% reduction respectively. No reduction in TSS was predicted as a result of implementing the Nutrient Management BMP on each farm.

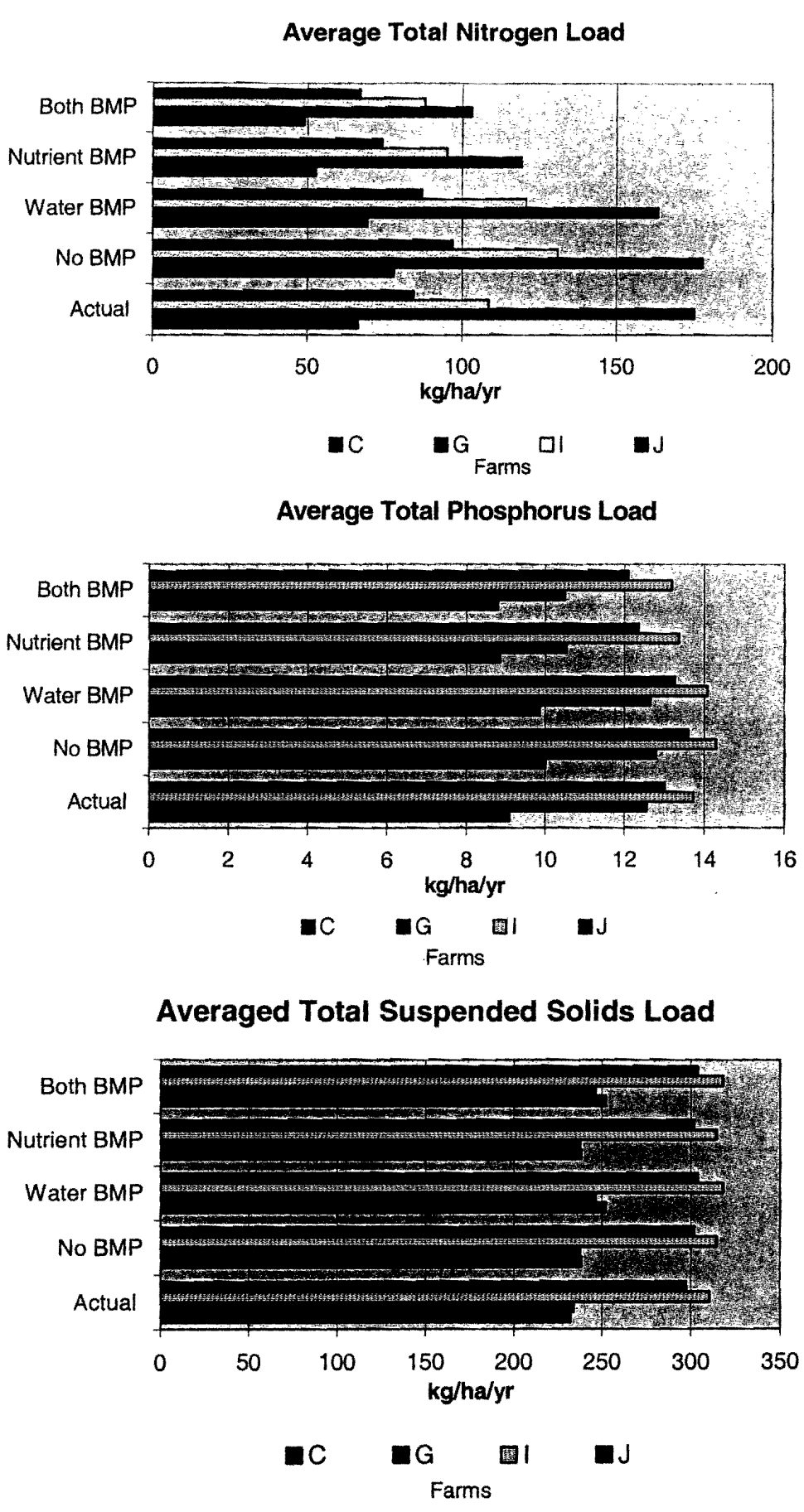


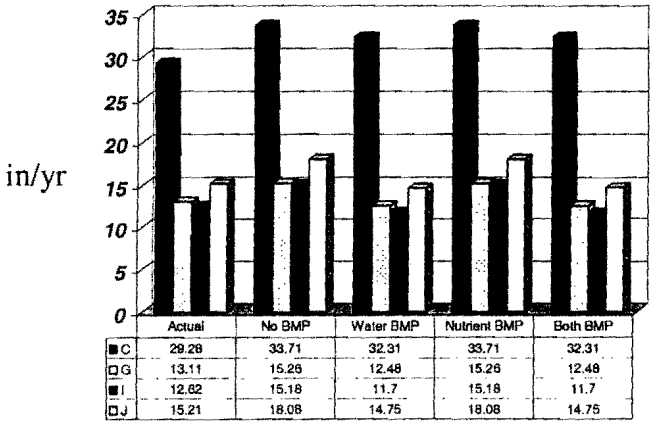
Figure 28. Average BMP effects on nutrient loads at all four farms

As seen in Figure 28, the predicted annual load reduction for phosphorus is relatively small for all farms. However, long-term predictions suggest that phosphorus loads will continue to decrease with the continued use of nutrient management. As most soil test analysis in the TCAA indicate phosphorus levels are sufficient for crop needs, over time the practice of nutrient management (zero phosphorus) could achieve between 26 - 72% reduction in phosphorus loading before soil tests would indicate the need for supplemental phosphorus application. Conversely, nitrogen loading showed no additional reduction over time, as the effect of reduced nitrogen fertilizer is immediate.

Water Management BMP Scenario

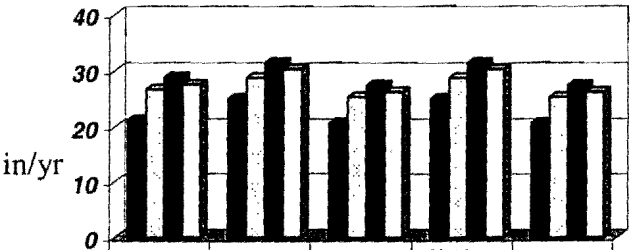
The *Water Table BMP Scenario* predicts the nutrient load had the Water Management BMP been implemented independently on each farm. The model not only shows that the nutrient load is affected under the *Water Table Management Scenario*, but also that irrigation use and runoff – associated with loading - are reduced. Figure 29 shows the predicted Water Management BMP effects on irrigation and runoff for all four farms. The model predicts an average 4 - 23% reduction in irrigation use and 12 - 18% reduction in tailwater runoff. The Water Table Management BMP maintains the water table depth at 1.25 – 2 ft., which is slightly higher than the standard irrigation method. Even after a storm event, when the water table is lowered, the BMP maintains the water table - not allowing it to be over drained - and reduces irrigation use by the volume of water that would otherwise need to be pumped to re-establish the water table. Hence, the reduction in irrigation.

Irrigation



	Actual	No BMP	Water BMP	Nutrient BMP	Both BMP
C	29.28	33.71	32.31	33.71	32.31
G	13.11	15.26	12.48	15.26	12.48
I	12.82	15.18	11.7	15.18	11.7
J	15.21	18.08	14.75	18.08	14.75

Runoff



	Actual	No BMP	Water BMP	Nutrient BMP	Both BMP
C	21.25	25.08	20.7	25.08	20.7
G	26.73	28.79	25.35	28.79	25.35
I	28.88	31.41	27.51	31.41	27.51
J	27.6	30.33	26.28	30.33	26.28

Figure 29. BMP effects on irrigation and runoff for all four farms

The model predicts a 12 - 18% reduction in the total volume of runoff by the BMP, and subsequently an 8 - 11% and 1 - 2.5% decrease in TN and TP load respectively. However, a slight increase in TSS loading (1-6%) does occur (Figure 28). This is attributed to the slightly higher water table that is maintained by the BMP resulting in

increased *potential* for runoff and sedimentation. Tables 6 and 7 show the predicted effects of the five BMP scenarios on the sediment and soluble N and P concentrations. These concentrations represent the annual farm discharge concentration and thus include both surface and subsurface runoff flow. Particulate nitrogen is recognized as the TKN fraction of nitrogen, and the soluble fraction is NOx + NH4. The particulate fraction is shown to increase - especially during high runoff years (1996) - due to the Water Management BMP.

These tables also show the slight increase in the soluble concentrations (1.5%- N, 5%- P) whereas the increase in the particulate fraction (13%-N, 15%-P) is much greater. The slight increase in soluble N and P concentrations is attributed to the *potential* increase in runoff resulting from this BMP. However, when combined (*Both BMP Scenario*) with the nutrient management BMP, the effect is diminished. This potential increase in runoff and the subsequent effects do not outweigh the benefits that the Water Management BMP provides when used in combination with the nutrient management BMP. However, when applied independently, the BMP can potentially have negative effects.

Table 6. BMP effects on annual nitrogen concentrations for all four BMP farms

		Nitrogen (mg/L)									
		Actual		No BMP		Water BMP		Nut BMP		Both BMP	
Farm	Year	Sol N	Sed N	Sol N	Sed N	Sol N	Sed N	Sol N	Sed N	Sol N	Sed N
C	91	11.7	2.25	12.3	2.11	12.1	2.49	6.39	2.11	6.16	2.49
	92	6.57	1.6	8.79	1.32	9.11	1.7	5.31	1.32	5.53	1.7
	93	8.89	0.84	8.8	0.65	8.9	0.97	5.09	0.65	6.26	0.97
	94	5.83	1.27	7.53	1.16	7.05	1.32	5.57	1.16	5.76	1.33
	95	6.5	1.04	7.96	0.94	7.68	1.11	4.35	0.94	4.13	1.11
	96	11.3	7.1	12.2	6.4	12.8	7.7	7.63	6.39	8.34	7.69
G	91	27.8	3.16	26.6	3.06	26.5	3.8	13.6	3.06	11	3.81
	92	15	3.4	14	3.12	13.2	3.71	6.58	3.12	5.29	3.71
	93	22.5	2.1	20.7	1.89	21.1	2.34	6.95	1.88	7.23	2.34
	94	15.8	2.89	15.4	2.73	15.5	2.98	8.11	2.74	8.01	2.98
	95	18.5	2.62	17.4	2.44	19.1	2.79	11.2	2.44	9.15	2.79
	96	23.9	13.37	23.1	12.79	23.3	14.35	13.7	12.77	12.5	14.34
I	91	24.9	2.64	22.5	2.39	23.1	2.8	15.1	2.39	15.2	2.8
	92	14.7	2.27	13.3	2.01	15.2	2.27	8.77	2.01	9.87	2.27
	93	7.71	6.68	7.18	6.18	7.55	6.94	5.39	6.18	5.85	6.94
	94	7.86	4.47	10.9	4.21	11.4	4.69	8.44	4.23	8.99	4.7
	95	6.17	1.97	9.48	1.87	8.8	2.02	5.56	1.87	4.69	2.02
	96	12	6.06	13	5.77	13.4	6.36	8.18	5.77	8.57	6.35
J	91	14.1	2.35	13.9	2.12	14.4	2.55	10.2	2.12	10.4	2.55
	92	9.36	2.19	8.52	1.94	8.01	2.2	5.52	1.95	4.82	2.2
	93	8.24	6.93	7.53	5.99	7.66	7.54	5.44	5.98	6.01	7.53
	94	7.9	1.84	7.24	1.68	8.48	2.34	5.76	1.67	6.03	2.33
	95	5.53	3.18	7.68	2.99	7.24	3.25	5.6	2.99	5.34	3.25
	96	8.04	4	10.4	3.85	10.2	4.16	6.2	3.84	6.2	4.14

Table 7. BMP effects on annual phosphorus concentrations for all four BMP farms

		Phosphorus (mg/L)									
		Actual		No BMP		Water BMP		Nut BMP		Both BMP	
Farm	Year	Sol P	Sed P	Sol P	Sed P	Sol P	Sed P	Sol P	Sed P	Sol P	Sed P
C	91	0.86	0.88	0.81	0.83	0.82	1.05	0.74	0.82	0.75	1.03
	92	0.63	0.73	0.57	0.62	0.62	0.8	0.49	0.61	0.54	0.78
	93	0.46	0.5	0.39	0.39	0.43	0.59	0.32	0.38	0.36	0.57
	94	0.69	0.84	0.69	0.78	0.71	0.91	0.53	0.75	0.55	0.87
	95	0.58	0.71	0.62	0.66	0.6	0.78	0.45	0.63	0.43	0.75
	96	0.65	1.83	0.74	1.71	0.76	2.04	0.52	1.63	0.53	1.95
G	91	1.01	0.64	0.97	0.62	1.06	0.78	0.91	0.62	0.99	0.77
	92	0.87	0.68	0.82	0.63	0.88	0.75	0.71	0.62	0.76	0.73
	93	0.83	0.48	0.76	0.44	0.83	0.53	0.61	0.42	0.67	0.52
	94	1.06	0.7	1.02	0.67	1.06	0.72	0.74	0.64	0.78	0.69
	95	0.99	0.6	0.93	0.57	0.99	0.64	0.61	0.53	0.64	0.6
	96	1.16	1.59	1.12	1.53	1.18	1.71	0.65	1.41	0.68	1.58
I	91	0.82	0.66	0.77	0.61	0.88	0.77	0.74	0.61	0.84	0.76
	92	0.78	0.69	0.72	0.62	0.79	0.72	0.67	0.61	0.74	0.71
	93	0.96	1.36	0.91	1.27	0.97	1.43	0.83	1.25	0.89	1.41
	94	0.95	1.05	0.92	0.99	0.97	1.1	0.82	0.98	0.87	1.08
	95	0.89	0.77	0.9	0.74	0.95	0.8	0.77	0.72	0.82	0.79
	96	0.82	1.51	0.84	1.46	0.9	1.6	0.72	1.42	0.76	1.57
J	91	0.89	0.62	0.83	0.58	0.91	0.73	0.78	0.57	0.86	0.72
	92	0.93	0.79	0.86	0.72	0.97	0.84	0.78	0.71	0.88	0.82
	93	0.72	1.47	0.67	1.29	0.72	1.62	0.59	1.27	0.64	1.58
	94	0.72	0.47	0.67	0.43	0.73	0.57	0.57	0.42	0.62	0.56
	95	0.93	1.15	0.92	1.1	0.95	1.18	0.75	1.06	0.77	1.15
	96	0.76	1.28	0.78	1.25	0.82	1.35	0.62	1.21	0.65	1.31

Both BMP Scenario

The *Both BMP Scenario* predicts the nutrient load had both Nutrient and the Water Management BMPs been implemented on each farm. Figure 28 shows that combining both BMPs is more effective at reducing total annual nitrogen (31-42%) and phosphorus (8-18%) loads than any other BMP scenario. TSS loading showed a slight increase as the Nutrient Management BMP has no effect on TSS and the Water Management BMP increases the loading as mention previously. Farm G realized the greatest reduction in nitrogen load (42%), while farms C, I and J achieved 38%, 33% and 31% reduction respectively. Farm G also realized the greatest reduction (18%) in phosphorus load while farms C, I and J achieved 12%, 8% and 11% reduction respectively.

Summary

The HWTMOD, a field scale model, was used to evaluate five BMP scenarios and provide a quantitative comparison analysis of their potential effects on nutrient and

sediment loads in the tailwater discharged from four area farms. The model was used to account for the annual variability associated with climatic conditions and farming practices. The model demonstrates, with relative confidence, the ability to reproduce the measured data and consequently the comparative effects of the various BMP conditions.

Modeling results conclude that the *Both BMP Scenario* (Nutrient and Water Table Management BMP) is more effective at reducing nitrogen and phosphorus loading from agricultural discharges than all other scenarios. The *Both BMP Scenario* condition combines the effects of the IFAS reduced nutrient rates and improved water management. Ostensibly, reduced nutrient rates and split applications enhance the crop's nutrient efficiency and reduces the luxury amount available for runoff. The effect of the improved water management reduces the potential for runoff associated with loading. The results show that the combined effects are greater than what can be expected from the Nutrient and Water Table BMPs independently.

The *Both BMP Scenario* exhibits a slight increase in TSS loading as the Nutrient Management BMP has no effect on the TSS load, yet the Water Table Management BMP shows a slight potential to increase runoff and subsequently the transport of sediments. The Water Table Management BMP maintains a uniformly higher water table and prevents over drainage and enhances water/irrigation use. Conversely, a slightly higher water table during irrigation events was shown to affect the potential for the transport of sedimentation, especially during wet years. Adjustments should be made to maintain an adequate water table for optimum water storage capacity during wet years to preclude accelerated loss of sediments and, most notably, nutrients. These results suggest that the Water Table Management BMP should only be applied jointly with the Nutrient Management BMP, otherwise negative effects offset the benefits.

The results also reveal that the Nutrient Management BMP has an immediate effect on nitrogen loads, whereas reductions of phosphorus loads occur over time with the continued practice of zero phosphorus applications. Nitrogen loads showed a fairly significant reduction (30%) at all farms each year, where the phosphorus loads showed only a slight reduction (11%) over the 7 year simulated period. The results of the long-term modeling of the Nutrient Management BMP showed a substantial decrease in phosphorus loads (30%) over a twenty-year period.

The goal of the 319 project was to develop economical BMPs and evaluate their ability to produce measurable reductions in nutrient and sediment loading from agricultural operations while sustaining profitable crop yields. The results of the comparison analysis clearly show that the loading associated with current agricultural standard management practices (*No BMP Scenario*) can be significantly reduced with the implementation of both the Nutrient Management and the Water Management BMPs. As previously presented, the percent reduction realized by an individual farm varies considerably. Greater reductions seem more likely where pre-BMP conditions and loadings are extreme. Although this project has been successful at identifying effective BMPs, further research is needed to better control the environmental conditions and improve the characterization of nitrate losses in surface runoff and subsurface seepage resulting from leaching rainfall events.

Watershed-Scale Modeling

The Watershed Assessment Model (WAM) is a GIS-based tool for determining the spatial influence of land uses and soils on water quality and quantity in a watershed (SWET, Inc., 1998). WAM, developed by SWET, Inc., evolved from the Basin New Zealand (BNZ) model (Cooper and Bottcher, 1993). The BNZ model is a Fortan, grid-based, basin model that uses another model, Chemical, Runoff, Erosion from Agricultural Management Systems (CREAMS) (Knisell, 1980), to generate the source loads for each unique soil/land use cell, before routing the constituents from source cell to basin outlet. Detailed information regarding the SWET, Inc. model and results are available in the *Tri-County Agricultural Best Management Practices Study Final Report, Phases II and IV.*

WAM determines the spatial influence of land uses and soils on both the water quality and quantity in a watershed. ARC/INFO grid coverages (100-m x 100-m) of land use and soil are overlain to locate every unique soil/land use combination in the watershed. TCAA WAM predicts average annual loads and flow. The surface and ground water flow and sediment, nitrogen and phosphorus loads from all cells are simulated using a land-use-specific cell model. The HWTMOD model discussed in the field scale modeling effort was used for rowcrops within the basin. The GLEAMS model is used for most other land uses, while wetland and urban areas are handled by other submodels. The individual cell discharges are then routed through the watershed based on the information in the GIS topography and hydrography coverages.

The results of the TCAA WAM provide a quantitative comparison analysis of various BMP scenarios and their potential cumulative effects on nutrient and sediment loads. Therefore, the tendency of the HWTMOD to over predict nitrogen is relative to any scenario that is run by the TCAA WAM.

Modeling Results

The WAM was run for all TCAA subbasins for a total of 14 years. The 1991 – 1997 data set was repeated twice to allow 8 years for initialization. The last 6 years were used to determine the nutrient and sediment average annual loads. Table 8 reports the average annual nutrient and sediment watershed loads and expected Both-BMP scenario load reductions.

Figure 30 shows the landuse coverage (1995), subbasin boundaries and subbasin ID numbers for the TCAA. Table 9 provides the subbasin name, basin ID, total subbasin hectares and rowcrop hectares for all 60 subbasins in the TCAA watershed. It should be noted that the TCAA project area consists of 60 hydrological subbasins as identified in Table 9, but that rowcrop agriculture is only present in 41 of these subbasins and makes up only 10% of the total project area. Figures 31-33 contain the individual subbasin average annual attenuated nutrient and total suspended solids loads for the no-BMP and the both-BMP scenarios predicted by the TCAA WAM. A number of conclusions regarding the ability of agricultural BMPs to reduce basin loading of nutrients and sediments can be drawn from the modeling results. First, the greatest reduction in loads, and therefore the greatest benefit, will be seen in those subbasins where agricultural land use dominates. Those subbasins containing a higher percentage of land use other than

agriculture do not realize the maximum effect of the BMPs, as these other land uses - not implementing BMPs - will mask the beneficial effects. Secondly, the greatest load reductions will be seen in watersheds where the rowcrop land is located within or in close proximity to the basin outlet.

Table 8. Average annual TCAA watershed load and simulated BMP reductions

PARAMETER	NO BMP	COMBINED BMPS
	Total Load (tonne/yr)	
TSS	564	545
TN	367	288
TP	38	32
PARAMETER	**NO BMP**	**COMBINED BMPS**
	Total Reduction (tonne/yr)	
TSS	0	19
TN	0	79
TP	0	6
PARAMETER	**NO BMP**	**COMBINED BMPS**
	Total Reduction (%)	
TSS	0	6.7
TN	0	22
TP	0	13.1

[1] 1 tonne = 1000 kg = 1.1 short ton

Most surface water runoff generated by agricultural activities is conveyed indirectly to the lower St. Johns River through a network of drainage canals and small tributaries. The attenuation of nutrients and sediments in enriched runoff is a naturally occurring phenomenon as discharges are conveyed through natural systems, such as wetlands, to the subbasin outlet. Both physical and biological processes act as natural sinks to reduce nutrient and sediment loads. Subbasins in which the agricultural discharges flow through these types of systems will see less reduction as a result of the BMPs since the load is already attenuated by these natural systems. Therefore, when prioritizing subbasins for BMP implementation, the most significant load reduction, and therefore the greatest benefits, will be realized in those watersheds with the greatest percentage of agricultural land use in close proximity to receiving streams and lacking natural systems that provide attenuation. While subbasins with these characteristics should be considered the highest priority for BMP implementation, lower priority subbasins should not be ignored, as some reduction will be seen and will help to reduce cumulative effects of sediments and nutrients in downstream waters as well as on the natural systems producing the attenuation effects.

The influence of these characteristics can be seen when comparing individual subbasin load reductions presented in Figures 31 - 33. Table 8 shows the predicted average annual TCAA BMP basin-wide reduction, however, reductions achievable in some individual subbasins significantly exceed the basin-wide averages. Both the Deep Creek and Cow Branch subbasins realized greater than 30% nitrogen load reduction by implementing

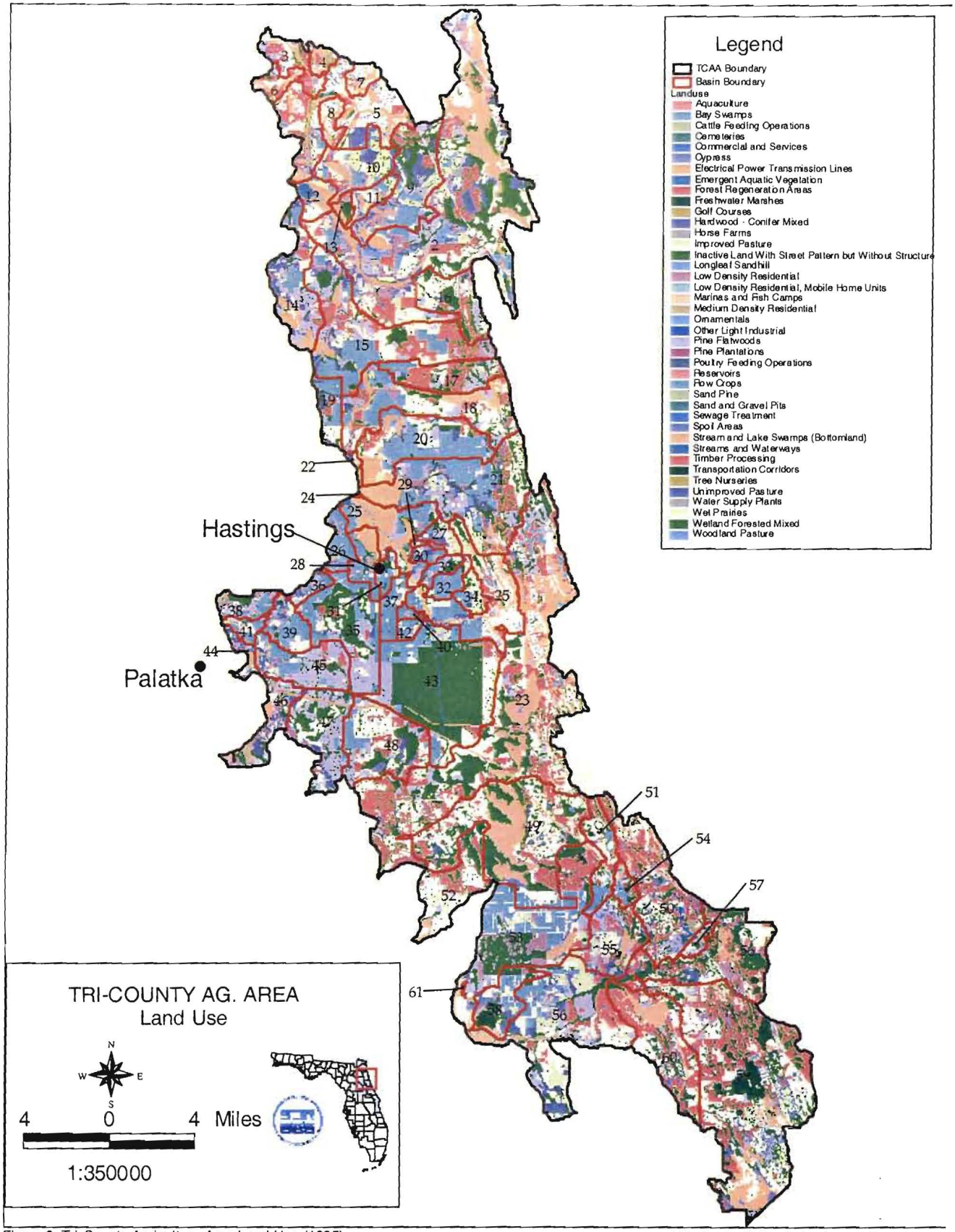


Figure 2. Tri-County Agriculture Area Land Use (1995).

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Figure 30. Landuse coverage (1995), subbasin boundaries and subbasin ID numbers for the TCAA

Table 9. Subbasin name, total area and rowcrop hectares for each basin

Subbasin	Basin ID	Rowcrop	Subbasin
		ha	Ha
SIXMILE CREEK	2	412	14412
WATER HOLE SLOUGH	3	0	1061
GOPHER ISLAND SLOUGH	4	0	386
TROUT CREEK	5	72	4119
UNNAMED SLOUGH	6	0	558
UNNAMED SLOUGH	7	0	477
MOLASSES BRANCH	8	0	533
MILL CREEK	9	327	3004
UNNAMED BRANCH	10	132	1823
UNNAMED DRAIN	11	49	636
SIXMILE CREEK	12	26	724
UNNAMED DRAIN	13	0	254
ST. JOHNS RIVER BANK	14	277	2459
TOCOI CREEK	15	183	5773
TOWN BRANCH	16	0	1769
UNNAMED CANAL	17	185	1746
MCCULLOUGH CREEK	18	659	4065
ST. JOHNS RIVER BANK	19	338	898
UNNAMED	20	1216	3353
MOCCASIN BRANCH	21	1072	5750
ST. JOHNS RIVER BANK	22	0	140
SALT CREEK DITCHES	23	0	14371
ST. JOHNS RIVER BANK	24	0	16
DEEP CREEK	25	1069	5403
ST. JOHNS RIVER BANK	26	424	728
UNNAMED DITCHES	27	27	476
CRACKER BRANCH	28	345	889
UNNAMED DITCHES	29	42	103
UNNAMED DITCHES	30	124	280
UNNAMED DITCHES	31	135	399
UNNAMED DITCHES	32	329	386
UNNAMED DITCHES	33	119	386
UNNAMED DITCH	34	83	537
WEST RUN INTERCEPTER D	35	703	3383
ST. JOHNS RIVER BANK	36	135	388
UNNAMED DITCH	37	446	692
ST. JOHNS RIVER BANK	38	148	779
DOG BRANCH	39	438	1036
UNNAMED DITCHES	40	80	159
COW BRANCH	41	176	424
UNNAMED DITCHES	42	133	266
SIXTEENMILE CREEK	43	676	6684

Subbasin	Basin ID	Rowcrop	Subbasin
		ha	ha
ST. JOHNS RIVER BANK	44	46	388
MILL BRANCH	45	346	2134
ST. JOHNS RIVER BANK	46	0	1421
HELL CAT BAY	47	30	280
UNNAMED DITCHES	48	232	3177
UNNAMED CANAL	49	271	7534
UNNAMED CANAL	50	0	4124
TANK LAKE OUTLET	51	0	1038
WHITE OAK SWAMP	52	0	2334
BULL CREEK DITCHES	53	1351	6039
ESPANOLA DRAIN	54	0	464
BLACK POINT SWAMP	55	25	2089
HAW CREEK	56	517	10174
UNNAMED CANAL	57	0	324
MUD LAKE OUTLET	58	278	3647
PARKER CANAL	59	0	11644
SWEETWATER BRANCH	60	0	3319
BULL CREEK DITCHES	61	0	11

both the nutrient and water table management system. Both Cow Branch and Deep Creek subbasins fit the basin criteria, as described above for priority ranking for source control measures. Almost half (41%) of the Cow Branch subbasin consists of agricultural rowcrop and is spatially located on the eastern shoreline of the river. This subbasin conveys indirect discharges from agricultural fields and canals draining via Cow Branch as well as some direct discharges to the St. Johns River. Though less of the total area (20%) is dedicated to agricultural land use, the Deep Creek subbasin, also located on the eastern shoreline, conveys discharges from 1,069 hectares of rowcrop land. These discharges are both direct shoreline discharges and indirect via Deep Creek to the river. Implementing the Both-BMPs scenario in the Deep Creek subbasin reduced TN loads by 12,352 kg per year, indicating a 10.8 kg/ha load reduction from rowcrop and an average 2.3 kg/ha subbasin load reduction. Contrasting the Cow Branch subbasin, TN loads would be reduced by 1,560 kg per year, indicating a 6.6 kg/ha N reduction from rowcrops and a 3.7 kg/ha subbasin load reduction. The extent and percent of agricultural land use within the subbasin influences the subbasin load reduction for both basins.

This same effect is true for TP load reductions. The maximum BMP related TP load reduction (24%) was achieved at Cow Branch subbasin, whereas Deep Creek achieved an18% load reduction. Implementing combined BMP systems in the Deep Creek and Cow Branch subbasins reduced their TP annual load by 691 kg and 53 kg respectively. This effectively reduces TP subbasin loading rates from 0.68 to 0.55 kg/ha in the Deep Creek and from 0.52 to 0.39 kg/ha in the Cow Branch subbasins.

	Basin ID	Total (kg)	Unit (kg/ha)	Total (kg)	Unit (kg/ha)
HAW CREEK	56	39902	3.92	39404	3.87
MILL BRANCH	45	36058	16.90	35619	16.69
SIXTEENMILE CREEK	43	32959	4.93	32310	4.83
SIXMILE CREEK	2	32297	2.24	31692	2.20
BULL CREEK DITCHES	53	32146	5.32	30346	5.03
MOCCASIN BRANCH	21	30113	5.24	28399	4.94
DEEP CREEK	25	29219	5.41	28085	5.20
UNNAMED	20	27260	8.13	25523	7.61
TOCOI CREEK	15	24841	4.30	23519	4.07
ST. JOHNS RIVER BANK	46	23209	16.33	23209	16.33
WEST RUN INTERCEPTER D	35	20853	6.16	19851	5.87
MUD LAKE OUTLET	58	19902	5.46	19307	5.29
DOG BRANCH	39	15576	15.04	14887	14.37
MCCULLOUGH CREEK	18	15057	3.70	14244	3.50
MILL CREEK	9	12686	4.22	12229	4.07
SALT CREEK DITCHES	23	11367	0.79	11367	0.79
UNNAMED CANAL	49	11196	1.49	10819	1.44
ST. JOHNS RIVER BANK	44	10644	27.43	10599	27.32
ST. JOHNS RIVER BANK	26	10057	13.82	9492	13.04
PARKER CANAL	59	9734	0.84	9734	0.84
ST. JOHNS RIVER BANK	14	8872	3.61	8513	3.46
CRACKER BRANCH	28	8862	9.97	8451	9.51
UNNAMED CANAL	50	8825	2.14	8801	2.13
UNNAMED DITCH	37	8737	12.63	8215	11.87
TROUT CREEK	5	7513	1.82	7394	1.80
UNNAMED BRANCH	10	7454	4.09	7186	3.94
ST. JOHNS RIVER BANK	19	7342	8.18	6914	7.70
UNNAMED DITCHES	48	6646	2.09	6294	1.98
ST. JOHNS RIVER BANK	38	5477	7.03	5256	6.75
UNNAMED CANAL	17	4623	2.65	4407	2.52
UNNAMED DITCHES	31	4338	10.87	4156	10.42
UNNAMED DITCHES	32	4233	10.97	3945	10.22
ST. JOHNS RIVER BANK	36	4017	10.35	3840	9.90
UNNAMED DRAIN	11	3786	5.95	3782	5.95
SIXMILE CREEK	12	3610	4.99	3598	4.97
SWEETWATER BRANCH	60	3253	0.98	3253	0.98
UNNAMED DITCHES	42	3024	11.37	2849	10.71
COW BRANCH	41	2965	6.99	2808	6.62
BLACK POINT SWAMP	55	2843	1.36	2797	1.34
UNNAMED DITCH	34	2716	5.06	2542	4.73
UNNAMED DITCHES	30	2647	9.45	2469	8.82
UNNAMED DITCHES	33	2260	5.85	2126	5.51
UNNAMED DITCHES	40	2231	14.03	2095	13.17
ESPANOLA DRAIN	54	1997	4.30	1997	4.30
TANK LAKE OUTLET	51	1984	1.91	1984	1.91
UNNAMED CANAL	57	1952	6.02	1952	6.02
UNNAMED DITCHES	29	1703	16.54	1644	15.96
TOWN BRANCH	16	1422	0.80	1422	0.80
UNNAMED DITCHES	27	1237	2.60	1190	2.50
WHITE OAK SWAMP	52	922	0.40	922	0.40
WATER HOLE SLOUGH	3	701	0.66	701	0.66
UNNAMED DRAIN	13	453	1.79	453	1.79
MOLASSES BRANCH	8	450	0.84	450	0.84
HELL CAT BAY	47	406	1.45	398	1.42
UNNAMED SLOUGH	6	349	0.63	349	0.63
GOPHER ISLAND SLOUGH	4	340	0.88	340	0.88
ST. JOHNS RIVER BANK	22	256	1.83	256	1.83
UNNAMED SLOUGH	7	254	0.53	254	0.53
ST. JOHNS RIVER BANK	24	33	2.03	33	2.03
BULL CREEK DITCHES	61	13	1.19	13	1.19

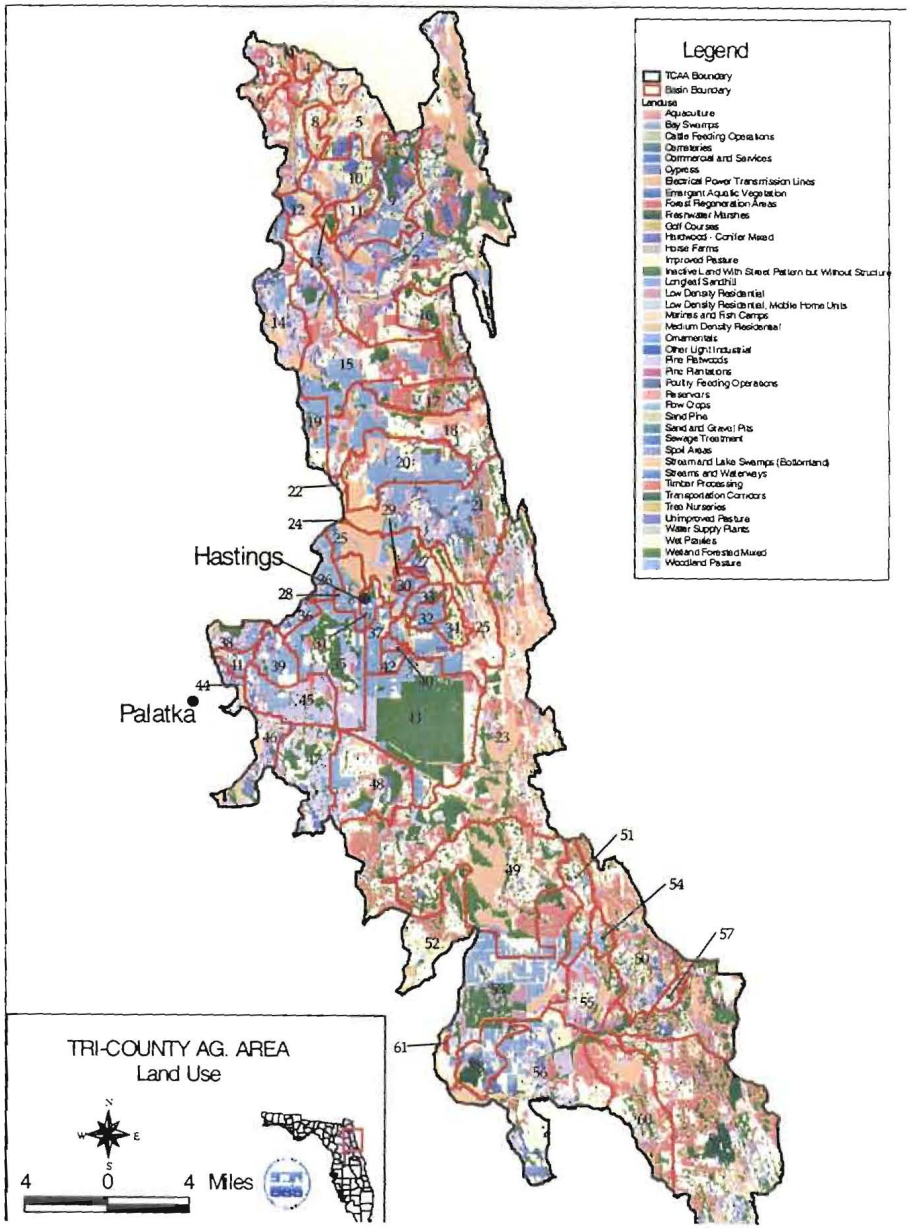

Figure 31. Summary of total suspended solids loads by subbasin for no-BMPs and the both-BMP scenario

Subbasin		No-BMP		Both-BMP	
Name	Basin ID	Total (kg)	Unit (kg/ha)	Total (kg)	Unit (kg/ha)
DEEP CREEK	25	39874	7.38	27404	5.07
TOCOI CREEK	15	32658	5.66	23080	4.00
HAW CREEK	56	25048	2.46	18934	1.86
SIXTEENMILE CREEK	43	23040	3.45	16931	2.53
UNNAMED	20	20309	6.06	16175	4.82
MOCCASIN BRANCH	21	20062	3.49	16353	2.84
BULL CREEK DITCHES	53	17404	2.88	14898	2.47
WEST RUN INTERCEPTER D	35	17203	5.09	13322	3.94
SIXMILE CREEK	2	16977	1.18	13836	0.96
MCCULLOUGH CREEK	18	13793	3.39	10662	2.62
MUD LAKE OUTLET	58	13363	3.66	10591	2.90
ST. JOHNS RIVER BANK	26	11497	15.79	8240	11.32
MILL BRANCH	45	11031	5.17	8214	3.85
DOG BRANCH	39	7628	7.36	6250	6.03
ST. JOHNS RIVER BANK	19	6512	7.25	5042	5.62
UNNAMED DITCH	37	6478	9.36	5314	7.68
MILL CREEK	9	6387	2.13	5578	1.86
ST. JOHNS RIVER BANK	38	5501	7.06	3916	5.03
UNNAMED CANAL	49	5462	0.73	5274	0.70
UNNAMED CANAL	17	5180	2.97	3735	2.14
CRACKER BRANCH	28	4602	5.18	4113	4.63
ST. JOHNS RIVER BANK	14	4598	1.87	4006	1.63
COW BRANCH	41	4561	10.76	3001	7.08
SALT CREEK DITCHES	23	4541	0.32	4541	0.32
UNNAMED BRANCH	10	4065	2.23	3447	1.89
UNNAMED DITCHES	48	3577	1.13	3231	1.02
PARKER CANAL	59	3575	0.31	3575	0.31
ST. JOHNS RIVER BANK	36	3316	8.55	2480	6.39
TROUT CREEK	5	3266	0.79	2751	0.67
ST. JOHNS RIVER BANK	44	3182	8.20	2447	6.31
UNNAMED DITCHES	32	3050	7.90	2512	6.51
SIXMILE CREEK	12	3035	4.19	1974	2.73
UNNAMED CANAL	50	2879	0.70	2858	0.69
ST. JOHNS RIVER BANK	46	2132	1.50	2132	1.50
UNNAMED DITCHES	31	1975	4.95	1806	4.53
UNNAMED DITCHES	42	1898	7.13	1648	6.19
UNNAMED DRAIN	11	1720	2.71	1381	2.17
UNNAMED DITCHES	30	1694	6.05	1439	5.14
UNNAMED DITCH	34	1649	3.07	1395	2.60
UNNAMED DITCHES	33	1545	4.00	1298	3.36
UNNAMED DITCHES	40	1457	9.16	1253	7.88
BLACK POINT SWAMP	55	1124	0.54	1086	0.52
SWEETWATER BRANCH	60	1036	0.31	1036	0.31
UNNAMED DITCHES	27	738	1.55	601	1.26
UNNAMED CANAL	57	733	2.26	733	2.26
TOWN BRANCH	16	607	0.34	607	0.34
UNNAMED DITCHES	29	476	4.63	442	4.30
TANK LAKE OUTLET	51	402	0.39	402	0.39
WHITE OAK SWAMP	52	399	0.17	399	0.17
ESPANOLA DRAIN	54	263	0.57	263	0.57
WATER HOLE SLOUGH	3	246	0.23	246	0.23
HELL CAT BAY	47	192	0.69	179	0.64
UNNAMED SLOUGH	6	174	0.31	174	0.31
MOLASSES BRANCH	8	163	0.31	163	0.31
GOPHER ISLAND SLOUGH	4	159	0.41	159	0.41
UNNAMED DRAIN	13	130	0.51	130	0.51
UNNAMED SLOUGH	7	122	0.26	122	0.26
ST. JOHNS RIVER BANK	22	97	0.69	97	0.69
ST. JOHNS RIVER BANK	24	13	0.79	13	0.79

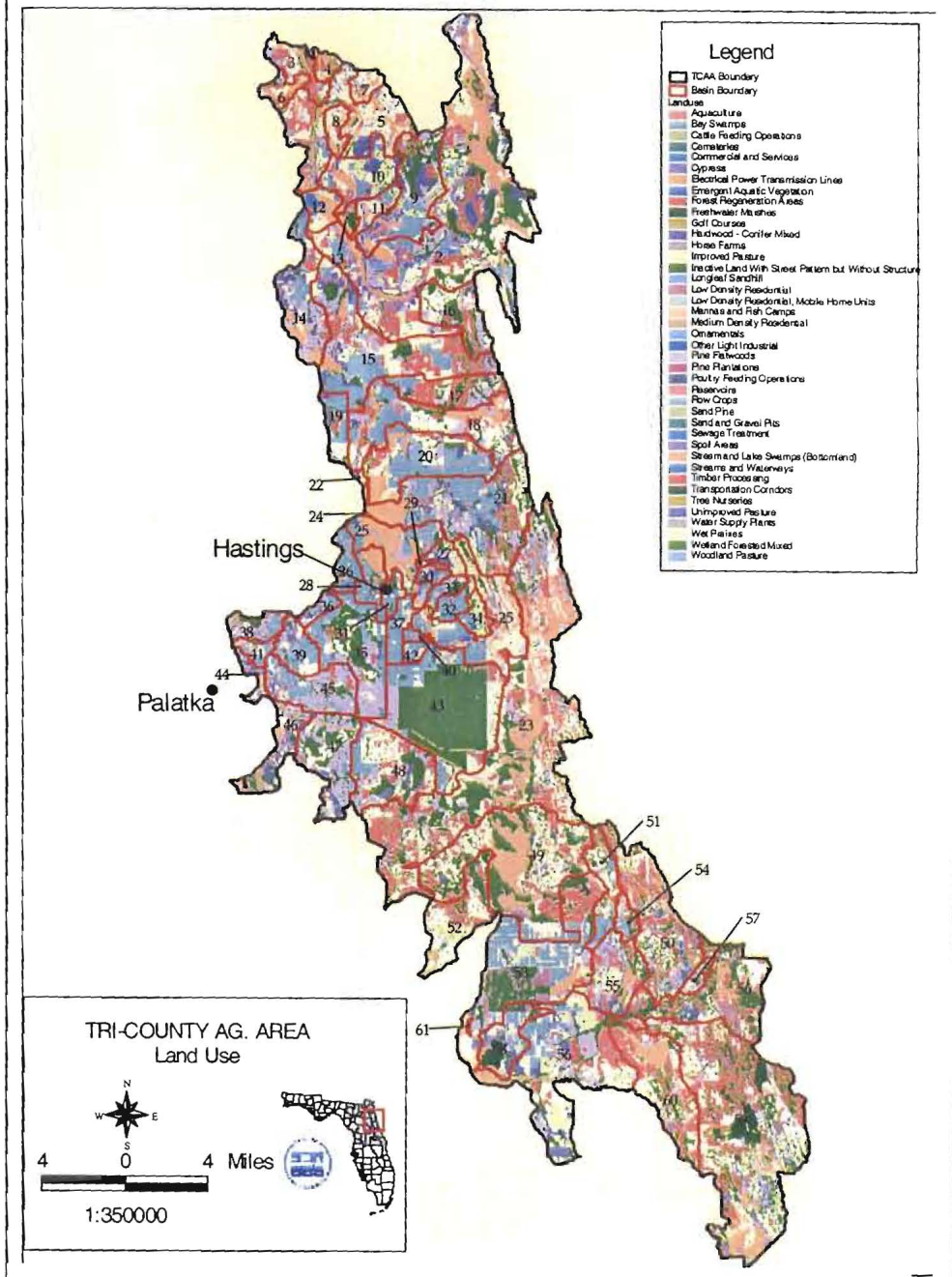

Figure 32. Summary of total nitrogen loads by subbasin for no-BMPs and the both-BMP scenario

Subbasin		No-BMP		Both-BMP	
Name	Basin ID	Total (kg)	Unit (kg/ha)	Total (kg)	Unit (kg/ha)
DEEP CREEK	25	3690	0.68	2999	0.555
TOCOI CREEK	15	2996	0.52	2378	0.412
HAW CREEK	56	2320	0.23	2004	0.197
UNNAMED	20	2059	0.61	1787	0.533
SIXTEENMILE CREEK	43	2059	0.31	1738	0.26
SIXMILE CREEK	2	2047	0.14	1802	0.125
MOCCASIN BRANCH	21	1938	0.34	1708	0.297
BULL CREEK DITCHES	53	1890	0.31	1709	0.283
MUD LAKE OUTLET	58	1776	0.49	1550	0.425
WEST RUN INTERCEPTER D	35	1458	0.43	1242	0.367
MILL BRANCH	45	1366	0.64	1193	0.559
MCCULLOUGH CREEK	18	1346	0.33	1126	0.277
ST. JOHNS RIVER BANK	26	1103	1.52	885	1.216
DOG BRANCH	39	800	0.77	710	0.685
MILL CREEK	9	694	0.23	646	0.215
ST. JOHNS RIVER BANK	19	657	0.73	541	0.602
UNNAMED DITCH	37	600	0.87	525	0.758
UNNAMED CANAL	49	580	0.08	558	0.074
ST. JOHNS RIVER BANK	46	567	0.40	567	0.399
ST. JOHNS RIVER BANK	14	558	0.23	482	0.196
SALT CREEK DITCHES	23	546	0.04	546	0.038
UNNAMED DRAIN	11	544	0.86	488	0.767
ST. JOHNS RIVER BANK	38	514	0.66	416	0.534
CRACKER BRANCH	28	514	0.58	477	0.536
UNNAMED BRANCH	10	487	0.27	447	0.245
ST. JOHNS RIVER BANK	44	462	1.19	403	1.038
UNNAMED CANAL	17	437	0.25	374	0.214
PARKER CANAL	59	396	0.03	396	0.034
UNNAMED DITCHES	48	388	0.12	356	0.112
UNNAMED CANAL	50	375	0.09	371	0.09
TROUT CREEK	5	375	0.09	346	0.084
SIXMILE CREEK	12	332	0.46	277	0.383
ST. JOHNS RIVER BANK	36	314	0.81	255	0.658
UNNAMED DITCHES	32	303	0.78	265	0.687
COW BRANCH	41	219	0.52	166	0.392
UNNAMED DITCHES	31	217	0.55	203	0.51
UNNAMED DITCH	34	187	0.35	168	0.313
UNNAMED DITCHES	30	177	0.63	156	0.556
UNNAMED DITCHES	42	167	0.63	144	0.541
UNNAMED DITCHES	33	161	0.42	142	0.369
BLACK POINT SWAMP	55	146	0.07	138	0.066
UNNAMED DITCHES	40	129	0.81	107	0.675
TANK LAKE OUTLET	51	110	0.11	110	0.106
SWEETWATER BRANCH	60	103	0.03	103	0.031
UNNAMED CANAL	57	93	0.29	93	0.288
UNNAMED DITCHES	27	74	0.16	67	0.141
ESPANOLA DRAIN	54	73	0.16	73	0.158
TOWN BRANCH	16	73	0.04	73	0.041
UNNAMED DITCHES	29	67	0.65	63	0.612
MOLASSES BRANCH	8	45	0.09	45	0.085
UNNAMED SLOUGH	6	38	0.07	38	0.068
WHITE OAK SWAMP	52	35	0.02	35	0.015
ST. JOHNS RIVER BANK	22	35	0.25	35	0.249
WATER HOLE SLOUGH	3	29	0.03	29	0.027
UNNAMED DRAIN	13	23	0.09	23	0.091
HELL CAT BAY	47	22	0.08	20	0.073
GOPHER ISLAND SLOUGH	4	18	0.05	18	0.046
UNNAMED SLOUGH	7	14	0.03	14	0.029
ST. JOHNS RIVER BANK	24	4	0.23	4	0.227
BULL CREEK DITCHES	61	1	0.06	1	0.064

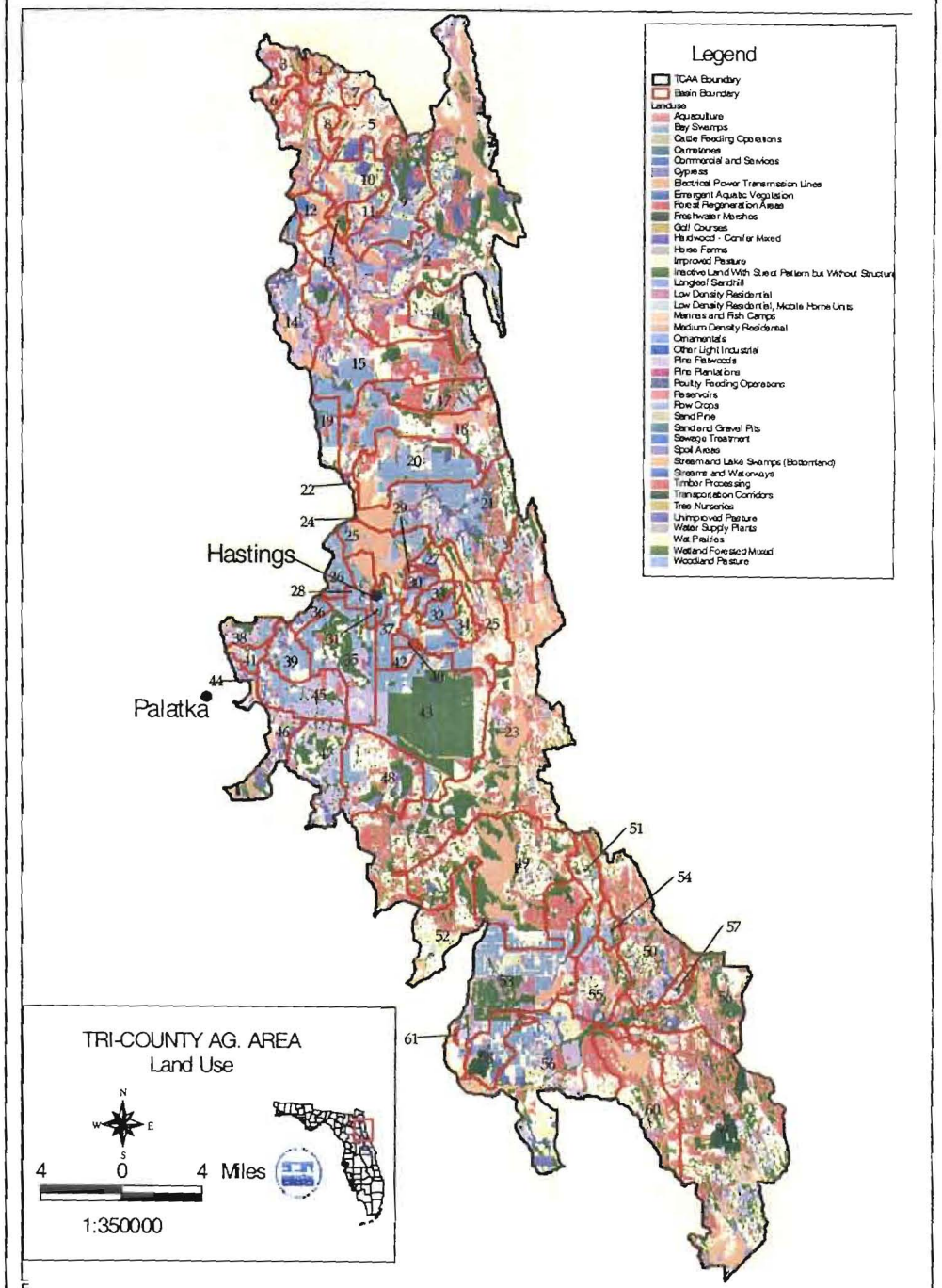

Figure 33. Summary of total phosphorus loads by subbasin for no-BMPs and the both-BMP scenario

BMP Crop Yield Assessment

IFAS scientists and local County Extension Agents were the principle investigators conducting the crop yield assessment. During the project's four-year span, soil samples from farms C, J and I were analyzed prior to fertilization at the University of Florida Analytical Laboratory using the Mehlich-1 (double acid) extractant. The analytical results from all three farms showed very high phosphorus indices and subsequently a zero phosphorus fertilizer recommendation. Potatoes were grown using the IFAS reduced fertilization rates. Comparison fields were established in 1995 to discern possible BMP effects on crop yield and specific gravity. Table 10 lists the farm sites and the specific fertilizer treatments for each study field and the comparison fields. Potatoes grown on both the study fields and the comparison fields were fertilized using commercial machinery and crop management practices were the standard grower practices with exception to the respective BMPs. Potatoes were harvested with commercial farm harvesters and total, ungraded yields were weighed and measured. Fields were subdivided into random one-acre plots so that grading could be conducted on the harvested tubers.

Table 10. Specific fertilizer treatments (lbs/ac) for each study and control field

Farm Site	Program	1994 N-P_2O_5-K_2O	1995 N- P_2O_5 -K_2O	1996 N- P_2O_5 -K_2O	1997 N- P_2O_5 -K_2O
Farm C	IFAS Reduced	200-0-200	168-0-144	240-0-230	210-0-210
	Grower Standard	NA	357-125-350	289-174-294	272-120-280
Farm I	IFAS Reduced	175-0-140	175-0-143	221-0-178	180-0-140
	Grower Standard	NA	246-96-242	243-96-250	243-96-250
Farm J	IFAS Reduced	180-0-140	168-0-144	212-0-156	177-0-140
	Grower Standard	NA	208-70-224	210-45-240	254-70-280

Additionally, potato leaf samples were collected during the growing seasons and were analyzed for N, P, and K, and fresh petiole sap samples were collected weekly and analyzed for nitrate-N and K using hand-held, battery-operated ion specific electrodes. This sap testing provided an immediate measure of the end repository of plant-translocated nutrients. This information was used to quickly diagnose various nutritional problems and reduce response time.

Table 11 presents the crop yield for those sites implementing the Nutrient Management BMP. In general, the crop yield averages for three seasons (1995-97) were similar between potatoes grown with the reduced and commercial/grower fertilization rates. With exception of farms C in 1995 and J in 1996 that experienced slight yield increases, all IFAS sites experienced slight decreases in yield when compared to the grower's comparison site. Farm C experienced the greatest difference in yield (120 cwt/acre) in 1997. Data results from potato leaf and petiole sap samples collected at Farm C during

the 1997 growing season show no cause and effect relationship between plant nutrient content and crop yield.

Table 11. Crop yields (cwt/ac) for the Nutrient Management BMP sites

		Yield Response To Nutrient Management BMP				
Farm Site	**Program**	**1994 cwt/acre**	**1995 cwt/acre**	**1996 cwt/acre**	**1997 cwt/acre**	**3 Year average**
Farm C	**IFAS Reduced**	263	308	404	240	317
	Control-grower	NA	278	465	360	368
Farm I	**IFAS Reduced**	275	311	266	213	263
	Control-grower	NA	332	270	228	277
Farm J	**IFAS Reduced**	305	323	337	325	328
	Control-grower	NA	355	308	342	335

A t-Test was run to determine if there were any statistical differences in the mean yields of potatoes grown with the IFAS reduced rates versus the control/grower rates for each farm site. The data were plotted for normality and tested for equal variances. Results of the t-Test indicated differences in the crop yields at each farm were not statically significant (α =0.05) when using IFAS reduced rates versus grower standard rates. Reported P-values for Farm C, Farm I and Farm J were 0.475, 0.764 and 0.673 respectively.

Receiving Tributaries Assessment

Extensive monitoring has been conducted in the primary tributaries receiving agricultural discharge in the TCAA basin. Long term monitoring has been conducted since 1991 at the receiving stream sites and since 1997 at the subbasin sites. Receiving stream monitoring sites are located at the confluence of the river's mainstem and primary tributaries, whereas the subbasin sites are located further upstream. Figure 34 shows the primary agricultural receiving streams, subbasins, agriculture land use and the monitoring sites. Samples are collected monthly and analyzed for nutrients, major inorganic ions, aggregate properties, trace metals and field measurements. All sites receive agricultural runoff except DCH, which is located upstream of agricultural activities.

Nutrient and sediment-enriched runoff from agricultural activities contributes to the excessive growth of algae and eutrophication of surface waters. Farming activities in the TCAA are typically initiated in early December and continue through the May harvest, after which sudan grass is planted as a cover crop and left standing until disked into the soil and allowed to decompose. Applications of inorganic fertilizers are generally made from January through March. Elevated concentrations of inorganic nitrogen are present

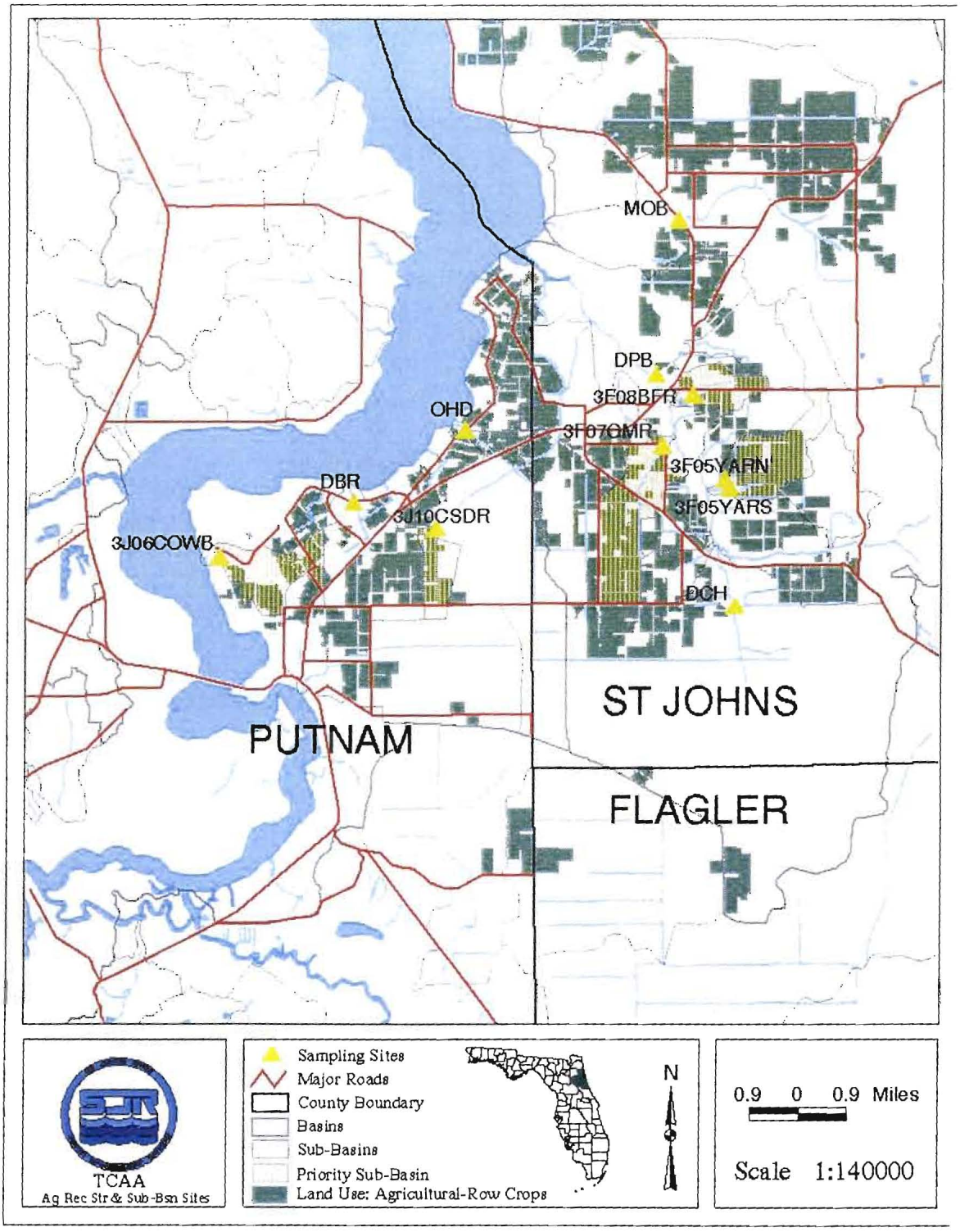

Figure 34. Primary agricultural receiving streams, subbasins, agriculture land use and the monitoring sites

in stormwater runoff discharged from area farms into tailwater ditches and conveyed to the receiving surface water body. Table 12 shows the total inorganic nitrogen (TIN) and TN seasonal mean concentrations and the percent TIN for all receiving stream sites and DCH.

The data presented in Table 12 suggest that TN seasonal mean concentrations exhibit no seasonal trend and generally little variance (s = .53) for DBR, DPB, MOB and OHD. Figures 35 and 35a show seasonal time series plots recognizing the seasonal mean, median, and maximum and minimum ranges for all stations. These figures also compare TN concentrations at the receiving streams and DCH to the median value for 50% and 80% of other Florida streams. A correlation analysis used to determine the extent of the seasonality for DBR, DPB, MOB and OHD showed a weak seasonal relationship ($p_{x,y}$ = 0.25, where $p_{x,y}$=1 positive, -1 negative correlation) and no established trend. However, DCH (upstream site) exhibited a seasonal trend as TN concentrations increased during June to November (fallow season). A negative correlation ($p_{x,y}$ = -0.50) was calculated for DCH, indicating a trend of higher TN concentrations during the fallow season than those observed during the growing season. This trend can be explained by northeast Florida's connective rainfall patterns where rain increases during June to September. Under these conditions, native uplands, dominated primarily by pine flatwoods and saw palmetto, experience rising water tables and leach organic solutes as interstitial water flows into receiving streams, increasing TN and percent Total Organic Nitrogen (TON). This occurrence also influences the water chemistry in agricultural streams, as inorganic nitrogen forms are replaced by organic nitrogen forms.

Figure 36 shows a seasonal mean time series plot of TN and the TIN seasonal contribution. TIN typically represents a small fraction (5 to 17 percent) of TN at DCH. Conversely, TIN can represent at much as 20 to 60 percent of TN at the stream sites receiving agricultural runoff. Higher percentages of TIN are exhibited during the growing season as compared to the fallow season at all sites. Generally, TIN concentrations are higher during the growing season.

As discussed earlier, heavy rainfall occurring soon after fertilization can increase leaching and loss of nitrogen from agricultural fields and amplify nitrogen concentrations in receiving streams. DCH does not exhibit a large shift in nitrogen forms and remains relatively static. DBR subbasin, with 61% of its land area in rowcrop agriculture, consistently demonstrates the highest TN and TIN concentrations compared to DPB, MOB and OHD subbasins containing 20.9%, 23.4% and 16.3% rowcrop agriculture respectively.

Table 13 shows the total orthophosphate concentrations (TP04) and TP seasonal mean concentrations and the percent TP04 for all receiving stream sites and DCH. These data show a seasonal correlation during June - November for both TP and TP04 at all sites. The fallow season concentrations are approximately two times greater than that experienced during the growing season for all receiving stream sites and DCH, with exception of concentrations and percent TP04 at DCH, which is considerably less than the receiving stream sites. This flux of soluble phosphorus can result from

Table 12. Seasonal mean TIN and TN concentrations (mg/L) and percent of TN comprised of TIN

		DBR			DCH			DPB			MOB			OHD		
YR	SEASON[1]	TIN	%	TN	TIN	%	TN	TIN	%	TN	TIN	%	TN	TIN	%	TN
1991	DEC_MAY	1.46	63.4	2.30	na*		na	0.41	38.8	1.05	2.67	71.9	3.72	0.40	23.0	1.75
	JUN_NOV	0.41	19.6	2.12	na		na	0.29	15.9	1.82	0.38	19.0	2.00	0.29	16.7	1.73
1992	DEC_MAY	0.27	23.3	1.17	na		na	0.38	24.7	1.55	0.64	57.4	1.12	0.24	23.5	1.01
	JUN_NOV	0.47	25.8	1.82	na		na	0.47	18.0	2.60	0.46	28.1	1.62	0.29	16.9	1.72
1993	DEC_MAY	0.57	42.4	1.34	na		na	0.18	15.6	1.13	0.28	29.8	0.96	0.29	29.5	0.99
	JUN_NOV	0.46	27.4	1.68	na		na	0.28	15.8	1.75	0.67	34.0	1.97	0.23	15.3	1.53
1994	DEC_MAY	0.82	47.8	1.72	0.09	10.1	0.88	0.33	23.2	1.41	0.72	44.3	1.63	0.25	25.2	1.01
	JUN_NOV	0.36	14.2	2.51	0.14	7.6	1.83	0.25	10.5	2.34	0.29	17.9	1.64	0.18	13.0	1.41
1995	DEC_MAY	1.00	44.1	2.27	0.14	14.4	0.99	0.57	30.8	1.85	0.67	38.2	1.77	0.77	43.2	1.79
	JUN_NOV	0.28	17.3	1.64	0.09	7.6	1.25	0.37	22.6	1.66	0.32	20.9	1.55	0.18	13.1	1.40
1996	DEC_MAY	1.53	52.9	2.89	0.15	14.2	1.04	0.35	26.0	1.35	0.47	30.4	1.56	0.39	23.9	1.61
	JUN_NOV	0.43	21.9	1.96	0.26	11.9	2.18	0.26	11.0	2.35	0.23	16.3	1.44	0.16	10.3	1.56
1997	DEC_MAY	0.55	31.6	1.73	0.10	7.6	1.27	0.30	21.6	1.38	0.29	22.9	1.26	0.24	17.7	1.38
	JUN_NOV	0.45	26.2	1.71	0.06	4.8	1.29	0.13	10.6	1.20	0.20	13.0	1.51	0.21	14.9	1.44
1998	DEC_MAY	0.54	32.8	1.64	0.17	17.9	0.94	0.47	29.8	1.57	0.33	28.4	1.15	0.41	35.0	1.18
	JUN_NOV	1.08	35.2	3.07	0.35	13.0	2.70	0.71	32.1	2.21	0.67	31.8	2.11	0.33	17.0	1.94

*na – not applicable; [1] – Season: Dec-May (growing season); Jun-Nov (fallow season)

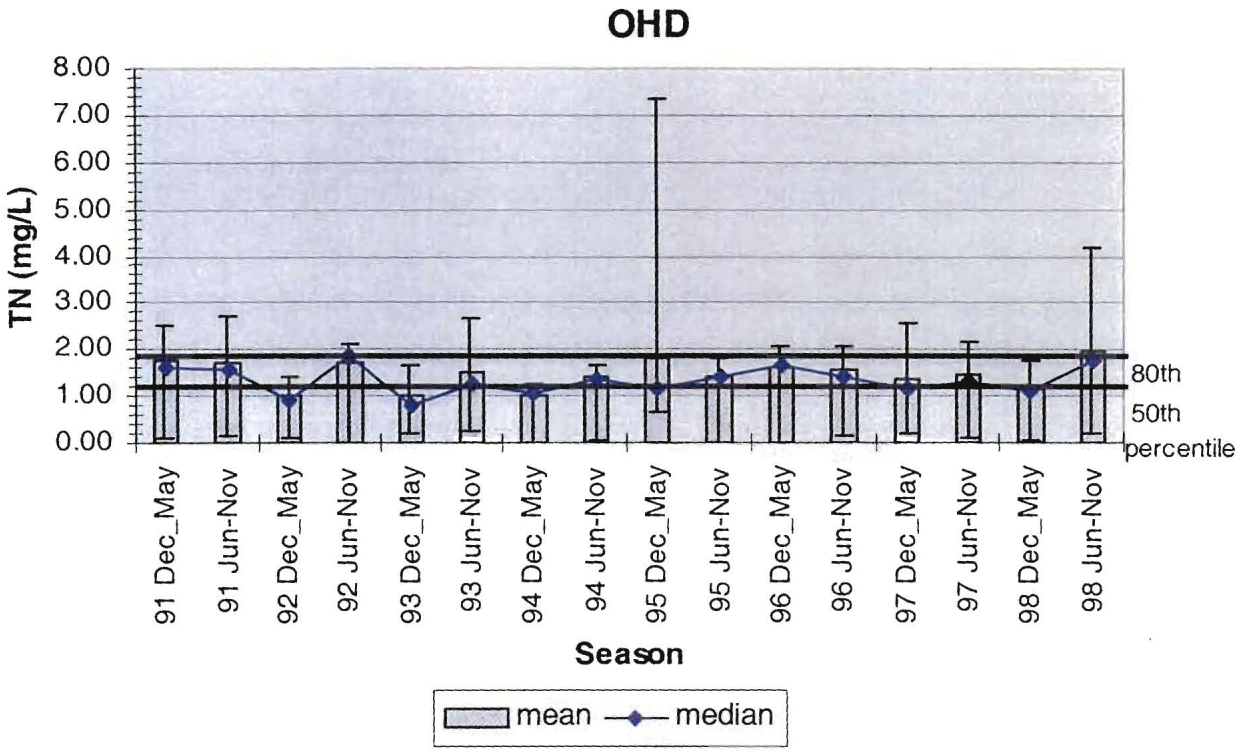

Figure 35. Seasonal time series plot displaying the seasonal mean, median, maximum and minimum ranges for OHD from 1991- 1998

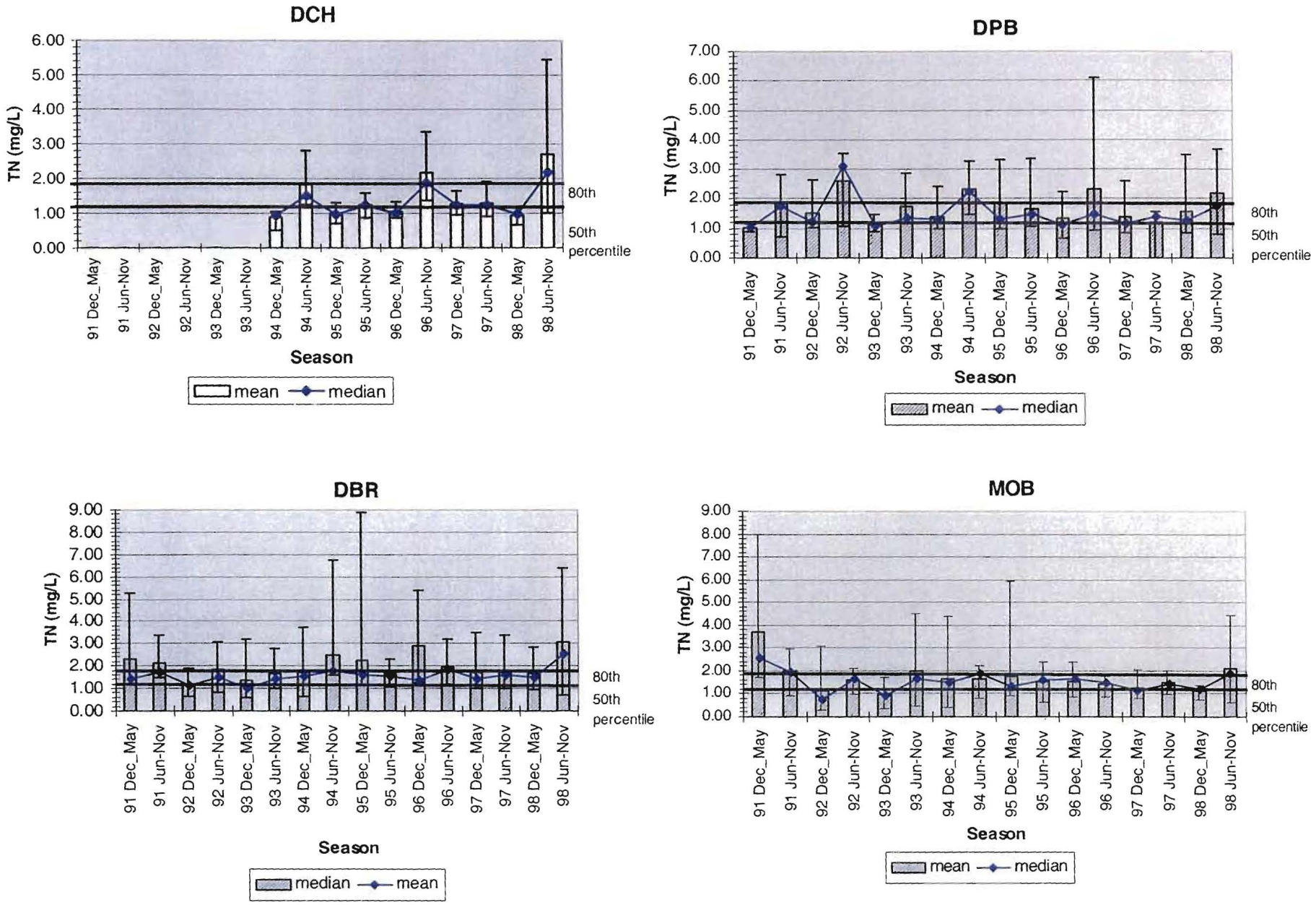

Figure 35a. Seasonal time series plots displaying the seasonal mean, median, maximum and minimum ranges for all stations from 1991- 1998

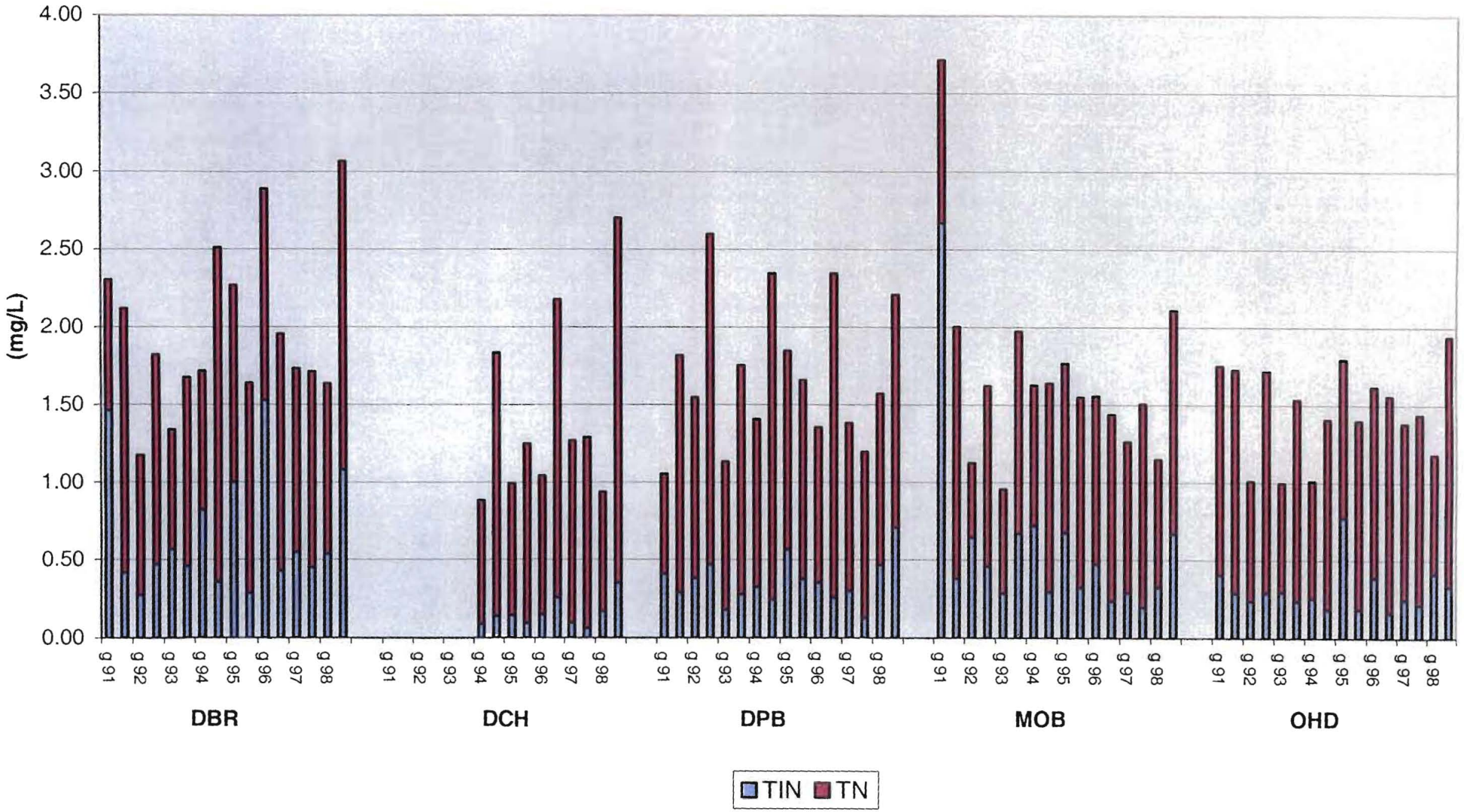

Figure 36. Seasonal mean time series plot of TN and the TIN seasonal contribution for all sites

Table 13. Seasonal mean TP04 and TP concentrations (mg/L) and percent of TP comprised of TP04

		DBR			DCH			DPB			MOB			OHD		
YR	SEASON[1]	TP04	%	TP	TP04	%	TP	TP04	%	TP	TP04	%	TP	TP04	%	TP
1991	DEC_MAY	0.11	91.4	0.13	na		na	0.49	102	0.48	0.34	95.7	0.36	0.15	62.8	0.25
	JUN_NOV	0.32	89.2	0.36	na		na	0.48	102	0.47	0.28	90.2	0.31	0.26	80.4	0.32
1992	DEC_MAY	0.07	74.7	0.1	na		na	0.18	82.3	0.22	0.15	98.3	0.16	0.05	48.7	0.10
	JUN_NOV	0.83	67.6	1.23	na		na	0.52	91.1	0.57	0.29	82.3	0.35	0.42	78.3	0.53
1993	DEC_MAY	0.14	60.7	0.23	na		na	0.22	74.9	0.29	0.16	70.3	0.23	0.17	62.5	0.27
	JUN_NOV	0.2	63.9	0.31	na		na	0.41	77.8	0.53	0.46	83.8	0.55	0.23	66.3	0.35
1994	DEC_MAY	0.1	45.3	0.22	0.05	51.2	0.11	0.16	78.8	0.2	0.13	62.9	0.21	0.13	59.8	0.22
	JUN_NOV	0.58	80.5	0.72	0.11	47.7	0.23	0.54	81.4	0.66	0.39	84	0.47	0.36	75.1	0.48
1995	DEC_MAY	0.18	47.5	0.37	0.07	63.3	0.11	0.27	72.6	0.37	0.19	60.1	0.31	0.21	60.2	0.34
	JUN_NOV	0.46	85.5	0.54	0.14	68.1	0.2	0.63	107	0.59	0.34	71.9	0.48	0.21	67.8	0.31
1996	DEC_MAY	0.18	64	0.29	0.07	67.1	0.1	0.37	162	0.23	0.17	74.6	0.22	0.19	73.3	0.25
	JUN_NOV	0.35	80	0.43	0.2	50.8	0.4	0.41	86.4	0.48	0.21	76	0.28	0.26	79.7	0.32
1997	DEC_MAY	0.27	101	0.27	0.06	36.1	0.16	0.17	74.2	0.22	0.14	68.5	0.21	0.19	65.1	0.29
	JUN_NOV	0.28	65.8	0.42	0.09	42.4	0.22	0.37	78	0.47	0.26	70.2	0.37	0.23	65.3	0.35
1998	DEC_MAY	0.16	62.4	0.26	0.06	58.8	0.1	0.22	51.7	0.43	0.11	67.5	0.16	0.17	65.1	0.26
	JUN_NOV	0.34	65.5	0.53	0.2	47.2	0.43	0.41	68.5	0.6	0.47	72.5	0.65	0.53	77.7	0.68

*na – not applicable

[1] – Season: Dec-May (growing season); Jun-Nov (fallow season)

changes in the soil's chemical properties (i.e. decrease in redox potential, increase in ionic strength, etc.) brought about by flood type conditions experienced during the fallow season that increases the solubility of phosphorus (Ponnamperuma, 1984). This phenomenon also favors the reduction of nitrate and the accumulation of ammonium. The TP04 values at the receiving stream sites ranged from .015 mg/L at OHD to 2.8 mg/L at DBR. TP04 values at DCH ranged from .029 mg/L to 0.413 mg/L. Ostensibly, the use of inorganic phosphate fertilizers as used in these agricultural subbasins contributes significantly to downstream surface water concentrations of this nutrient.

Economic Assessment

The economic assessment was subcontracted to the University of Florida Department of Food and Resource Economics. The assessment was conducted in two phases and separate reports were developed for each phase. The primary goal of this assessment was to determine the cost effectiveness of BMP implementation. More specifically, the model analyzed the impact of implementing BMPs in the TCAA on the production and marketing of potatoes.

A price endogenous mathematical programming model was developed using current production practices and costs (Medina and VanSickle, 1997). The year 1996 was selected as a representative normal production year for the empirical analysis. A price dependent demand equation for spring potatoes in the TCAA was estimated. Production costs were determined based on budgets developed for chip potatoes. The base model and solution were obtained by solving the model without considering the implementation of BMPs. Budgets and yields were then adjusted to reflect the cost of producing spring potatoes with the recommended BMPs. These results were compared to determine the impacts on production and marketing after implementing the recommended BMPs. Environmental impacts due to BMP implementation were resolved as cost of nutrient reduction in runoff.

The model determined that the implementation of the water table management BMP and combined BMPs would reduce crop acreage, but have positive impacts on area potato production. The combined use of water table management and nutrient management BMPs proved: a) to increase crop production (7.89%); b) to be best for consumers; and c) to be more cost effective in regards to agricultural runoff. Both nitrogen (15.1%) and phosphorus (15.3%) loads were reduced. The final report is included in Appendix C.

Pesticide Assessment

Pesticide and biological monitoring programs were conducted during the study. Figure 37 shows the sample site locations. The pesticide monitoring was an event-based monitoring program that occurred periodically after significant rain events and heavy irrigation. The objective of the program was to: 1) examine agricultural discharge for the presence of pesticides used in the potato farming areas; 2) assess the impact of pesticides on the receiving waters; and 3) determine the effectiveness of IPM. Water samples were collected at the four farm sites at edge-of-field, from one surficial ground water well site (20-ft. depth) located at Farm C, and from the four receiving streams. Sediment samples were taken only from the four receiving streams. An outside contractual laboratory conducted sample analyses. Appendix D contains both the Phase I and II pesticide database. Table 14 summarizes the data for each type of sample site (i.e. farms, receiving streams – water, receiving streams – sediment, groundwater). The summary includes the total number of samples (1 sample = 1 sampling event) collected per site and the number of samples testing positive for at least one of the 16 monitored pesticides relative to the total number of samples at each site for comparing occurrences by site location. The

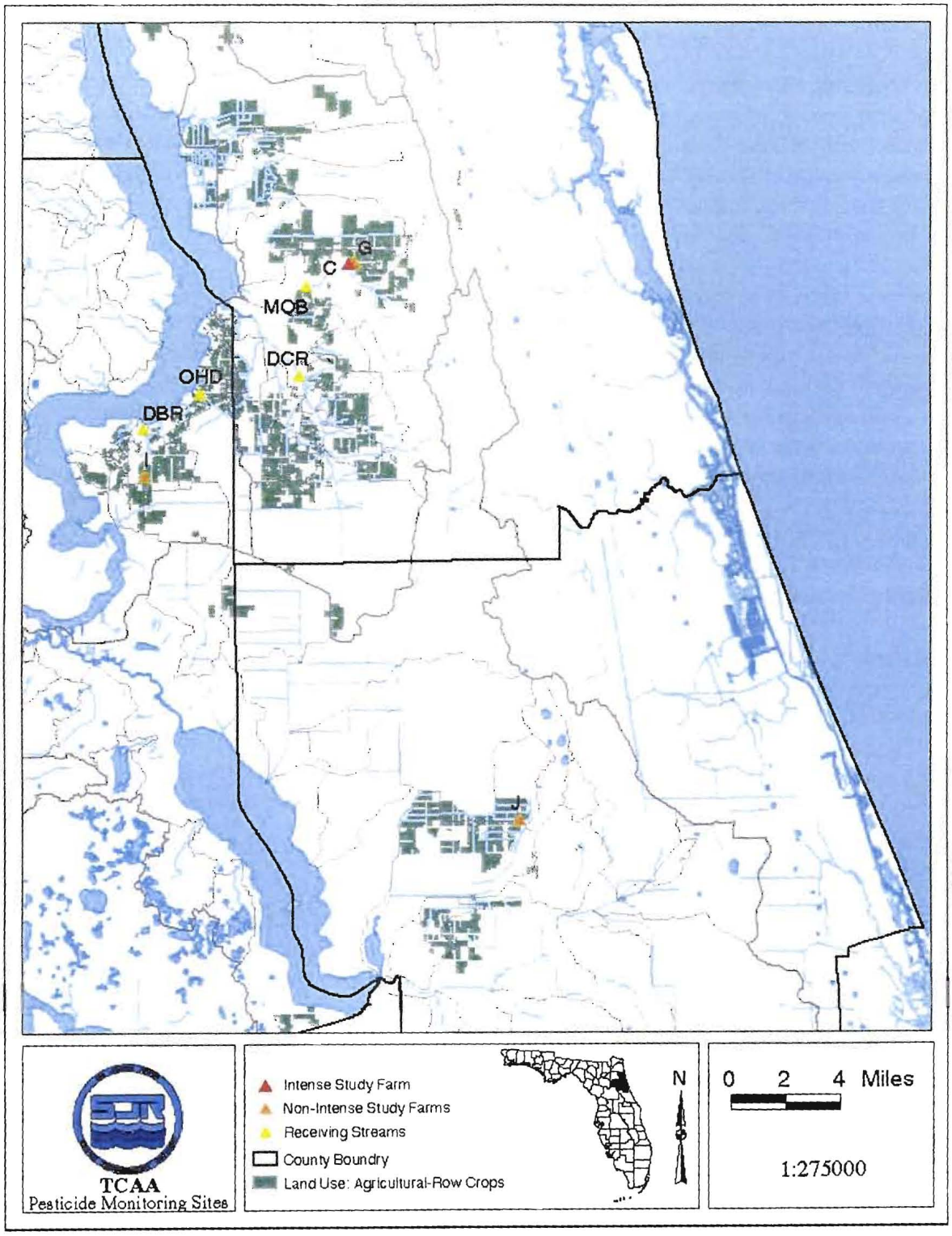

Figure 37. Pesticide monitoring sites

Table 14. Summary of pesticide detections and concentrations

					Reported Concentration Range (ppb) for Detections																	
Sampling Sites[a]	Total samples/ site	Positive samples / total samples	Total detects/ positive sample	Total detects above **HAL Limits**[c]	Chlorothalonil	Metalaxyl	Endosulfan, Beta	Endosulfan, Alpha	TRANS-1,3-Dichloropropene	CIS-1,3-Dichloropropene	Mancozeb	Methamidophos	Methomyl	Diazinon	Phorate	Pendimethalin	Carbofuran	Metribuzin	Ethoprop	Aldicarb	* Aldicarb sulfoxide	* Aldicarb sulfone
Farm TW	39	28	52	8	0.23-**3.70** [d](4)	1.90 (1)	0.11-**0.53** (3)	0.057 **-0.49** (4)	nd[b]	nd	**39.0-300.0** (4)	nd	1.80-53.0 (2)	**5.30** (1)	nd	0.020-0.82 (24)	nd	2.80-9.30 (8)	nd	* (1)	0.70 (1)	1.00 (1)
Rec.St. (water)	37	8	24	6	0.28 (1)	1.90-7.50 (3)	0.23 (1)	0.13-0.33 (2)	nd	nd	**42.0-51.0** (2)	**3.30-5.10** (2)	3.50-4.30 (2)	**1.80** (1)	nd	0.015-0.15 (5)	nd	2.20-10.00 (4)	**0.69** (1)	nd	nd	nd
Ground water	9	8	15	4	0.36 (1)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.022-0.95 (4)	nd	9.20-12.0 (2)	nd	* (4)	0.57-**24.0** (4)	0.52-**23.0** (4)
Rec. St. (Sed)	16	0	0	0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

[a] TW – tailwater discharge, Rec.St. – receiving streams
[b] nd – not detected
[c] HAL – Health Advisory Level
[d] ( ) – number of reported parameter detections

table also lists the total number of times a pesticide was detected relative to the total number of detections at all sites (maximum 16 detections per sample) for comparing relative occurrence across all sites. The table also summarizes the total number of detections above the Health Advisory Level limits, the pesticide parameters, number of samples and the respective concentration ranges.

Biological Assessment

The biological monitoring program was subcontracted in 1994 to the University of Florida, Department of Fisheries and Aquatic Sciences. A two-year (1994-1995) quarterly sampling program of the macroinvertbrate community was conducted at three streams that receive agricultural runoff plus an additional reference stream absent of agricultural runoff. In 1997 (Phase II), four new sites located further upstream, plus additional samples per site were added to the sampling program. The Final Report, provided in Appendix D, provides a detailed description of sampling protocols. Figure 38 shows the sample site locations. The primary goal of the program is to determine the effects of future BMP implementation in the TCAA watersheds on water quality and the biological community.

The analysis of the initial two-year database revealed only a few significant differences among the four TCAA sites. Rankings of the site means were also inconsistent over time. The addition of the 1997 data revealed significant correlations and numerous differences among sites and seasons. Analysis included species richness and composition, abundance of organisms, community diversity, and tolerance to pollution. Below is a summary of the 1997 final report.

Species Richness: A total of 124 benthic macroinvertebrate taxa were collected. Species richness for the three agricultural tributaries and the reference site were 56 taxa for Dog Branch (DBR), 77 for Old Hasting Drainage (OHD), 78 for Moccasin Branch (MOB) and 58 for the Tocoi Creek (TOC) reference site. Sites in Moccasin Branch and Tocoi Creek had high overall species richness. All three sites in OHD and the downstream site in DBR had intermediate species richness, while DBR2 had the lowest number of taxa. Ponar data revealed that TOC had significantly more taxa than two to five of the other seven sites within any season.

Species Composition: Invertebrate communities at DBR, OHD and OHD2 were composed of three major groups; oligochaetes, isopods and dipterans. Dipterans, amphipods and oligochaetes dominated both DBR2 and OHD3. MOB and MOB2 were similar, being dominated by dipterans and oligochaetes. TOC, the reference site, was least similar to the other seven sites. TOC had four abundant invertebrate groups, dipterans, mayflies, oligochaetes and snails. Mayflies were rare at the other sites.

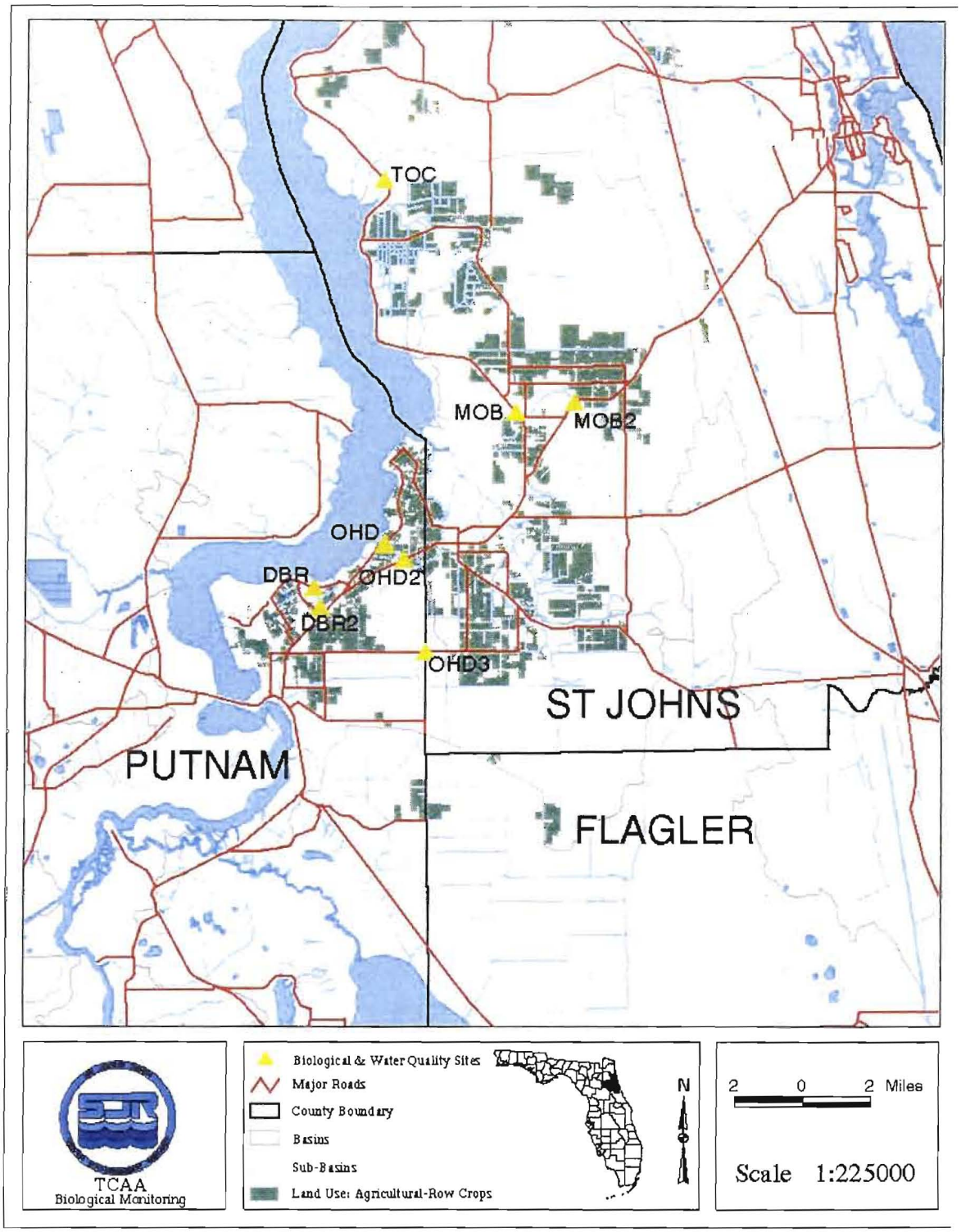

Figure 38. Biological monitoring sites in the TCAA

Abundance: The mean number of benthic invertebrates collected per ponar was found to be significantly highest at DBR, OHD2 and TOC. These three sites were generally not different from each other. OHD and MOB typically had the lowest mean densities. The reference tributary, TOC, supported some of the highest invertebrate abundances observed, but was never the highest when compared to all of the sites in the agricultural tributaries. Mean invertebrate densities were significantly higher in 1997 than in 1994. Densities in 1995 were also significantly higher than in 1994.

Community Diversity: The mean Shannon-Weiner Diversity Index (SWDI) values were significantly higher at OHD3, MOB and TOC in all seasons. DBR2 was significantly lower than OHD3, MOB and TOC in all four seasons, while OHD was significantly lower than these three sites except during the winter. TOC had the greatest diversity in February and May, while MOB had the greatest diversity in August and November. The least diverse sites within individual seasons were generally DBR2 or OHD.

Pollution Tolerance: The Hilsenhoff Biotic Index (HBI) for a given sample of benthic invertebrates is basically the mean weighted value of the individual pollution tolerance values of the organisms in the sample. Tolerance values can range from 1 to 10, with the higher number indicating greater tolerance to pollution/enrichment. Tolerance values of the taxa collected in this study were found to range from 1 to 9.8. HBI values at the DBR and OHD sites were never found to differ from each other. MOB was found to differ from these sites in August. MOB2 and /or TOC differed from DBR in three of the four seasons. Other differences were inconsistent among seasons. TOC, the reference site, had the lowest mean sample HBI in February and May, while MOB had the lowest mean HBI in August and November. OHD had the highest mean sample HBI in May, August and November. A year-to-year analysis found differences at DBR, MOB and TOC, however, there was no apparent year-to-year trend. Samples in 1997 had significantly lower HBI values than did samples taken in 1994 and /or 1995 for three of the six tests, but higher HBI for the other three tests.

Relationship of Biological Analysis to Water Chemistry: Species richness and SWDI were poorly correlated with the water chemistry while the HBI was positively correlated. As nutrients, suspended matter and turbidity increased, the invertebrate communities had fewer taxa and lower diversity. Organisms comprising these communities were those more tolerant to pollution/enrichment. Conductivity and total ammonia showed similar relationships with species richness, SWDI and HBI. Invertebrate density was not correlated to water chemistry.

The initial 1994-1995 two-year database was inconsistent and weak for describing relationships between the three agricultural sampling sites and the reference site. The 1997 Phase II data show a number of significant differences among sites and seasons. The TOC site supported a high total number of taxa. Its species composition also differed from that of the other three sites, having a large component of mayflies. Unlike the Phase I data, Phase II data exhibit some of the significantly highest species richness, density and diversity, and lowest HBI values at TOC. Correlations between several water

chemistry parameters and invertebrate community characteristics were strong, logical and meaningful.

At the time of this report, not enough data were available to determine the relationship between the biological indices and the water quality data. As the intent of the assessment is to monitor the effects of the BMPs on the water chemistry and the biological community, the BMP implementation phase of this overall effort just began in August 2000. More data is needed to determine the relationship between the water quality and biology post-implementation to determine the effects of the BMPs. This assessment is still underway.

SUMMARY

Algal blooms can be particularly severe within the freshwater zone of the lower St. Johns River. Algal organic matter is transported downstream, where the decline, death and decomposition of these blooms dramatically lowers oxygen levels in the Jacksonville reach of the river (SJRWMD, 2001). Severe blooms will peak during the spring and summer with the onset of increased water temperatures and photoperiod. These blooms can lead to the degradation of submerged aquatic vegetation as light is blocked within the photic zone of the river.

Annual growing patterns in the TCAA start in early January and continue through June, coincidental with the advent of algal blooms. The TCAA has been found to supply approximately 40 percent of the inorganic nutrients to the freshwater zone of the river during the spring/summer season (Hendrickson and Konwinski, 1997).

Table 15 shows the existing nitrogen and phosphorus load generated by the TCAA watershed. The existing load shown in Table 15 represents the load from all landuses in the 60-subbasin watershed area. The BMP load represents the TCAA area load and the loading reduction associated with the Both-BMP condition on all rowcrop land (21.5 % N and 13.1% P reduction).

Table 15: TCAA project area load with Both-BMPs

TCAA Watershed Load (kg/year)				
	TN (kg)	**% Red**	**TP (kg)**	**% Red**
Existing	367,090		37,849	
With Both-BMPs	288,097	21.50%	32,880	13.10%
***Baseline (Pre-colonial)**	46,166	87.42%	5,793	84.69%

* Pre-colonial conditions assumed

It is difficult to assess the effects that these (21% nitrogen and 13% phosphorus) reductions will have on the riverine system. It is expected that the reductions will reduce loading in the mainstem of the river by approximately 13% (SWET, 1998). Of greater importance is the seasonal loading reduction of inorganic nutrients during the growing season and the potential to perpetuate conditions for algal production. Albeit, greater phosphorus reductions were predicted over time, nitrogen reductions had an immediate response to the Both-BMP condition.

To date, pollutant-loading limitations have not been established for the TCAA or the LSJRB. To provide a surrogate pollutant reduction target, pre-colonial loads were determined using the TCAAWAM. Table 16 shows the nitrogen and phosphorus load associated with the pre-colonial condition and the Both-BMP condition. Figure 39 displays the landuse conditions for this baseline-modeling scenario.

Table 16 shows the existing total nitrogen and phosphorus loads contributed exclusively by the rowcrop lands and the reductions associated with Both-BMPs.

Table 16: Agricultural (only) load with BMPs

TCAA Agricultural Load (kg/year)				
	TN (kg)	**% Red**	**TP (kg)**	**% Red**
Existing	301,795		27,464	
With Both-BMPs	222,803	26.17%	22,495	18.09%

The load reductions associated with Both-BMPs are greater when applied exclusively to the agricultural load. These reductions are greater as the BMPs are applied exclusively to rowcrop lands contributing the primary agricultural load and therefore not diluted by other landuses. This table also shows the magnitude of the existing agricultural load when compared to the existing TCAA watershed load. Rowcrop agriculture (which comprises approximately 10% of the total TCAA land area) contributes 82% of the existing total nitrogen and 73% of the total phosphorus loads in the TCAA watershed. Figure 40 shows the percent load contribution of the various landuse conditions.

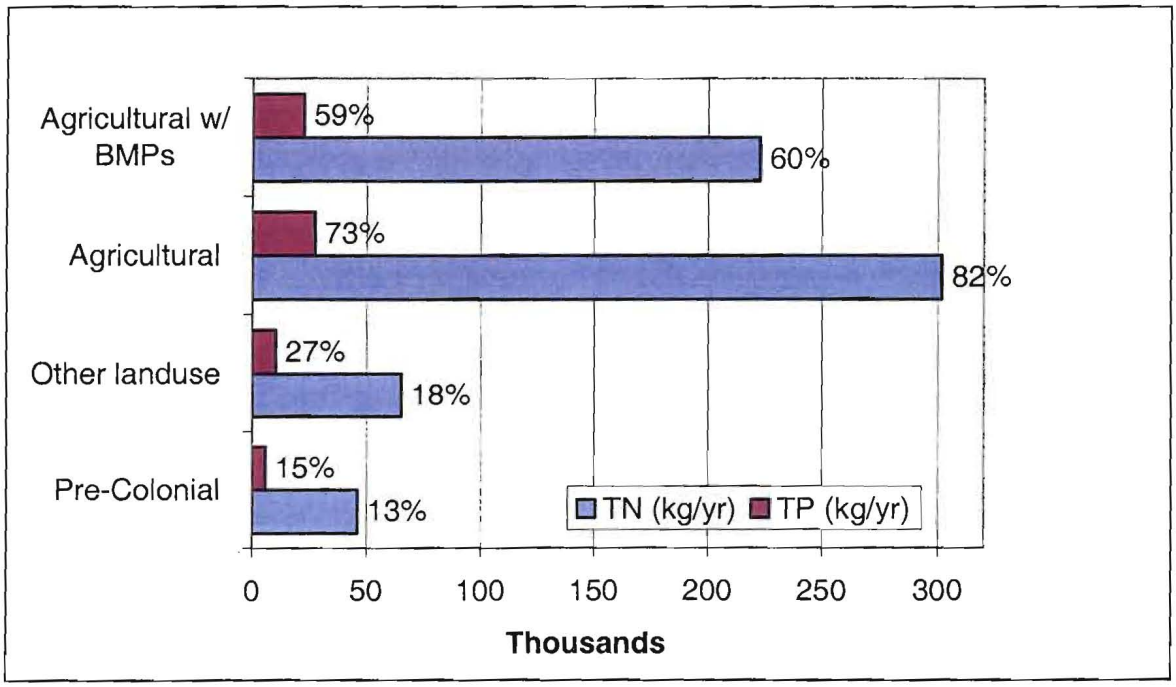

Figure 39. Percent of total nutrient load contributed by various land uses in the TCAA

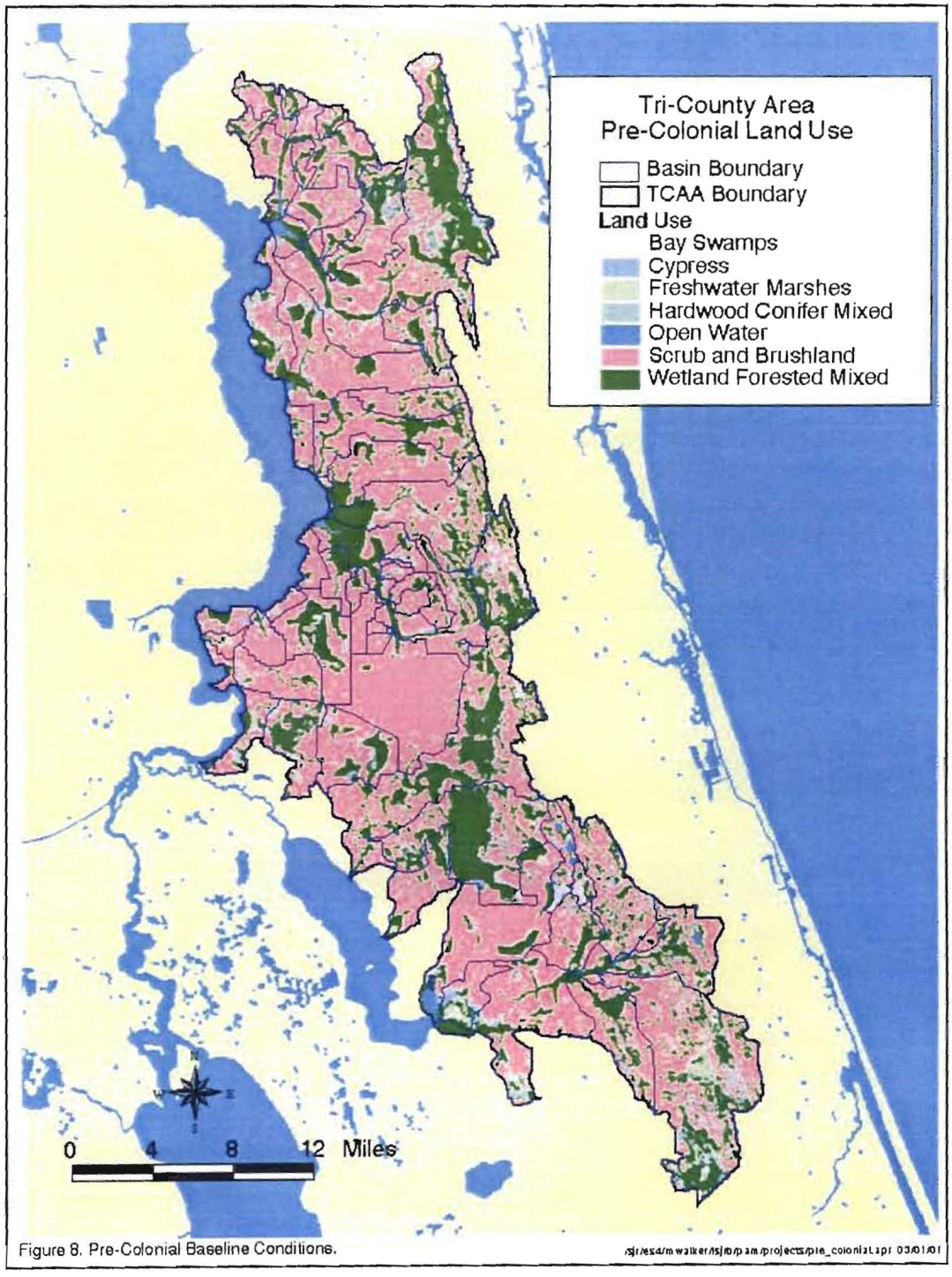

Figure 40: Pre-Colonial baseline conditions

Water Quality Monitoring and Assessment of Agricultural BMPs
Phase II - Quarterly Invoices by Task

Item Description	EPA Budget	SJRWMD Proposed Match	SJRWMD Actual Match	Quarter Invoices 1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	5th Qtr	6th Qtr	7th Qtr	8th Qtr	Extension	Actual Expended Budget
Task 4 - Fixed Cost													
ST. Johns River WMD													
WMD Labor- ES I	$57,700.00			$7,213.00	$7,213.00	$7,213.00	$7,213.00	$7,213.00	$7,213.00	$7,213.00	$7,213.00		$57,704.00
Technical Pgr. Mgr.		$15,000.00	$14,250.00										
Environmental Spec.		$46,000.00	$45,500.00										
Engineer		$20,000.00	$21,000.00										
Extension Service													
Economic Analysis	$6,435.00											$6,081.08	$6,081.08
5% Overhead	$322.00											$321.75	$321.75
Task 5 - Reimbursement													
BMP Implementation	$70,923.00					$28,200.00	$950.00			$28,200.00			$57,350.00
IFAS BMP Budget	$6,000.00											$6,000.00	$6,000.00
Education													
Newsletter	$1,850.00						$111.00		$111.00		$111.00	$111.00	$444.00
Technical Workshop	$4,150.00												$0.00
Task 6 - Sampling & Contractual Services (Reimbursement)													
ST. Johns River WMD													
BMP Study		$130,000.00	$79,420.00										
Seepage Irrigation		$190,000.00	$141,825.00										
Pesticide Sample		$90,000.00	$52,235.00										
Biological Monitoring	$35,000.00											$35,000.00	$35,000.00
Sap and Tissue Sample	$13,500.00						$699.30	$1,464.75	$756.00			$1,735.00	$4,655.05
Water Quality Analysis		$60,000.00	$43,913.00										
Extension Service													
Soil and Tissue Sample	$4,000.00											$4,000.00	$4,000.00
5% Overhead	$720.00						$37.00	$77.50	$40.00			$586.75	$741.25
Retainage												$2,244.22	$2,244.22
Travel Category													
IFAS	$4,400.00												$0.00
TOTAL	$205,000.00	$551,000.00	$398,143.00										$174,541.35

Water Quality Monitoring and Assessment of Agricultural BMPs in the TCAA
Phase I and II - Calculation of Matching Funds

	Matching Funding Ratios			
	Proposed		Actual	
	EPA	SJRWMD	EPA	SJRWMD
Total for Phase I contract period (1993 - 1995)	39%	61%	42%	58%
Total for Phase II contract period (1995 - 1997)	37%	63%	44%	56%

Water Table Float Well Assembly Instructions
For
Potato Farms In Tri-County Agricultural Area

developed by
Soil and Water Engineering Technology, Inc.
Gainesville, FL

Materials Needed:

1 - 10′ aluminum house gutter downspout (white)
1 - 10′ x 4″ plastic sewer pipe (green thinwall drainage pipe)
1 - 4″ coupler for sewer pipe
1 - 4″ white downspout cap for sewer pipe (aluminum downspout slides nicely inside)
1 - 2.5″ dia. foam flotation material (children's swim-noodle at K-Mart, Target, etc.)
4 - 1″ stainless steel sheetmetal screws
1 - can of exterior enamel spray paint (bright blue)
1 - can of exterior enamel spray paint (bright-dayglow orange or red)
1 - filter material (e.g. cloth, window screen (24" x 30"), drain pipe sock or ladies x-large tights

Assembly:

1. Cut aluminum downspout into two pieces, 48 and 72 inches, to make the float staffs. The longer staff is for the well when the 24″ extender section is used. Drill a small hole on each side of the aluminum staffs (downspout sections) about 1" above the bottom of both float staffs.

2. Cut the 4″ diameter sewage pipe into two pieces, 24″ and 48″ long.

3. Cut an 18" length of floatation foam for the 48" float staff and a 24" length of floatation for the 72" float staff. Place the floatation foam into the bottom of the float staff so that half of the foam is in the staff.

4. Measuring from the bottom of the aluminum float staff, mark the 48" staff at 24" and 33" and mark the 72" staff at 48" and 57".

5. Using fine sandpaper, sand the down spouts/staff between the marks and about 12″ below the bottom mark to allow paint to adhere better.

6. Paint both staffs between the two marks using bright blue spray paint. Paint the staffs from the lower mark to about 12″ below the lower mark using bright orange/red spray paint (or other highly contrasting color combinations). When the paint has dried on both float staffs, mark the blue/white interface as 24" and the blue/red interface as 15" with a black enamel paint and brush. For more detail measurements use either 1" or 3" increments to finish filling in the numbers on the staff. .

7. Drill at least 50-1/4 inch holes in the lower 24″ of the 48″ sewer pipe.

Water Management Practice
For
Potato Farms In Tri-County Agricultural Area

developed by
Soil and Water Engineering Technology, Inc.
Gainesville, FL

The following simple water management procedure is designed to optimize the soil moisture regime for a potato crop while minimizing water and phosphorus discharge. The practice was developed based in-field water table observations, as well as model simulations using the HWTMOD developed by Soil and Water Engineering Technology, Inc.

Water Management Procedure Using Observation Float Wells

1. **Preparation.** Immediately after crop planting, install four staff-gage-type water table float/wells in four locations around the field. The wells should be installed in any one of the four center potato beds between water furrows and at least 150′ in from the sides of the field. The staff should have a distinctive color change at the cap reference point when the water table (WT) is at 15″ and 24″ below the top of the potato bed. We suggest that the top of staff be painted white (WT below 24″), the next section painted bright blue (WT between 15″ and 24″), and the lower section painted bright orange/red (WT within 15″of top of bed). The reference cap on the top of the well should be high enough to be seen over the vegetation. We suggest the use of a non-glued coupler/extender for the well-casing which can be taken on and off based on crop height and field operations. An extender section will also be needed on the float staff to keep the proper reference. Specific construction specifications are provided in a separate "Water Table Float Well Assembly Instructions" factsheet.

2. **Set up for Irrigation.** Set boards in discharge culvert about 3″ to 6″ above furrow irrigation water depths or about 12″ to 18″ below the top of beds to prevent any overtopping during irrigation. Ideally, the top of the riser boards should be set just high enough to prevent overtopping, but low enough to allow discharge if a rainfall event occurs before boards can be removed.

3. **Irrigation Control. Irrigation should be on whenever the float staff is showing ONLY WHITE** (see Figure 1). Irrigate at a rate that will just maintain water in the furrow ditches nearest the collector ditch without overtopping riser boards. **Irrigation should be turned off or flow rate reduced whenever board overtopping is about to occur or if BLUE is showing on the well staff gages.** The float well should always be checked following any rainfall to see if irrigation should be turn off.

4. **Drainage/Board Control.** The water table float wells should be checked frequently (at least daily for non-rainfall days and hourly during rainfall) to determine the water table status of the field. **If any RED is showing then two boards should be removed from the discharge culvert.** The boards should be replaced when no RED is showing on the staff. For moderate events, only one board may require removal.

FINAL REPORT – PHASE I

AN ECONOMIC ANALYSIS OF BEST MANAGEMENT PRACTICES (BMPs) FOR POTATOES GROWN IN THE TRI-COUNTY AGRICULTURAL AGREA OF NORTH FLORIDA

submitted to

St. Johns River Water Management District

in fulfillment of

CONTRACT NO. 93G228

prepared by

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January 1997

TABLE OF CONTENTS

PAGE

LIST OF TABLES iv

LIST OF FIGURES vii

ABSTRACT viii

INTRODUCTION 1

Overview of the U.S. Fruit and Vegetable Industry 1

Florida Agriculture 2

Potato: Origins and Global Importance 5

Potato Production in the Hastings Area of Florida 10

Background (Overview of the Agriculture Sector) 14

Best Management Practices (BMPs) 21

Integrated Pest Management (IPM) 27

Problem Statement 29

Objectives of the Work 30

METHODOLOGY 33

Fundamentals of the Model 33

Model Specification and its Components 41

The Empirical Demand Structure 44

Production Costs 46

Environamental Impact Evaluation 49

LIST OF TABLES

PAGE

Table 1. Number of farms operating in Florida and farmland in production, 1930 to 1992 3

Table 2. Florida's top 20 farms products in 1992 4

Table 3. Potatoes: utilization and per capita civilian utilization, United States, 1990-94 6

Table 4. Potatoes: Area, yield, production, season average price, and value, United States, 1990-95 7

Table 5. Potato Production and Prices Received by Farmers in the Hastings Area of Florida, 1985-1995 12

Table 6. Spring potatoes: area, production by farmers in Florida 13

Table 7. BMPs for the TCAA and their relative cost and potential effectiveness factors for net load reduction and associated yield impact 24

Table 8. BMPs chosen to be applied by the four representative farms 40

Table 9. Estimates of demand parameters for processed and table stock potatoes 45

Table 10. Estimated production costs in the Hastings area, 1994-95 47

Table 11. Potato yields under the 1994 BMP implementation 48

PAGE

Table 21. Shadow prices under the different BMP situations..... 63

Table 22. Acres of potatoes planted in the Hastings area with and without BMPs implementation and with a cost of $45.93 per pound imposed on phosphorus loadings..... 64

Table 23. Quantity of potatoes produced in the Hastings area with and without BMPs implementation and with a cost of $45.93 per pound imposed in phosphorus loadings..... 65

Table 24. Consumers' surplus, tax revenue, equilibrium prices with and without BMPs implementation and with a cost of $45.93 per pound imposed in phosphorus loadings..... 67

Table 25. Environmental impact evaluation in terms of phosphorus loadings with a cost of $45.93 per pound imposed..... 67

Table 26. Effect of imposing a shadow price in growers revenues..... 68

LIST OF FIGURES

PAGE

Figure 1. Principal Potato Producing Regions by Seasons..... 9

Figure 2. Location of Hastings potato producing area, Florida..... 11

Figure 3. Objective Function Representation..... 37

ABSTRACT

A management plan to protect the watersheds of the lower St. Johns River Basin (LSJRB) in Florida is being developed in response to recent legislation. Past work has identified the Tri-County Agricultural Area (TCAA), located in St. Johns, Putnam, and Flagler counties, as a possible source of non-point pollution from enriched nutrient runoff. The discharges from ten representative farms in the TCAA were studied from 1991 to 1993, and the evaluation of four of these farms was continued from 1994 to 1996. The economic importance of potates, the large number of pests that attack this crop, and the complicated physiological responses of the potato plant to changes in its environment, make it an interesting study of Best Management Practices (BMPs).

This study focused on determining the impact that adoption of BMPs would have on competitiveness and productivity of growers in the TCAA. This evaluation relied on analyzing the costs and benefits to growers of using alternative BMPs. The environmental impact of the different BMPs used was estimated by determining the cost of runoff associated with pollution. Shadow prices were used as artificial prices to evaluate pollution control BMPs, representing a contribution from a policy perspective.

A price endogenous mathematical programming model was developed using current production practices and costs. The year of 1994 was identified as a representative normal production year and selected for the empirical analysis. The

INTRODUCTION

Overview of the U.S. Fruit and Vegetable Industry

The 1995 U.S. farm bill represented landmark legislation for the U.S. fruit and vegetable industry by recognizing its economic importance and the problems it faces. It also addressed the need for greater public information about industrial practices and policies.

Fruits, vegetables, and specialty crops are an important source of nutrition for the general health and welfare of the United States population. They are recommended as an essential part of a healthy, nutritious diet for improving U.S. dietary and nutritional standards. Domestic fruit and vegetable producers experience many difficulties in the production, harvesting, and marketing of those products, operating in an environment where producers compete among themselves. Growers usually make production and marketing decisions independent of each other with decisions based on market oriented judgements as to individual expected costs of production and anticipated prices over a specific time period. In the fruit and vegetable industry, success is heavily dependent on information acquisition. Effective producer decision making involves acquiring detailed knowledge about buyer demand and an improved understanding about their own production costs and the competitive cost structure of the industry.

There is a need for development of new technologies and techniques that assist domestic producers in meeting the challenges of increased demand for fruit and vegetable products. The 1995 farm bill received widespread support from the industry, due to the "lack" of adequate and complete data to ensure efficient and effective responses to industry problems and issues. It recognized the

Table 1. Number of farms operating in Florida and farmland in production, 1930 to 1992.

Year	Number of farms	Farm acres
1930	58,966	5,026,617
1940	62,248	8,337,708
1950	56,921	16,083,536
1960	45,100	15,236,521
1972	35,586	14,031,998
1982	36,352	12,814,216
1992	39,558	10,568,721

Source: U.S. Department of Commerce, Bureau of Census, 1993.

Potato: Origins and Global Importance

Potato, *Solanum tuberosum*, belongs to Solanaceae family. It is of New World origin and is native to the Andean highlands of Peru. Tomato, pepper, and eggplant are other important vegetables included in the Solanaceae family. Tomatillo and cucumbers, of much less importance, are also in this family.

Potatoes originated in the highlands of South America, most likely around Titicaca. The Spanish took the plant to Europe in the sixteenth century as a botanical curiosity. Today, it is the fourth most important food crop in the world after wheat, rice and maize. Potatoes account for roughly half of the world's annual output of all roots and tubers. Since the early 1960s, the increase in area planted in developing countries has been higher than for any other major food crop.

Annual world production currently totals 274 million metric tons on 18 million hectares. The Russian Federation ranks as the world's largest producer with about 30 percent of total world production. Poland is second with about 17 percent of the total, China third and the United States fourth with about 5 percent of the total world production (International Potato Center, 1996).

The per capita consumption of potatoes in United States has been increasing in recent years, driven in large part by the huge growth in the potato processing industry (Table 3). While the consumer once had only to choose how to fix fresh potatoes, today a much broader array of products is available and includes such items as instant potato flakes, potato chips, and the ubiquitous frozen french fries which are so popular with the fast food industry.

The total potato sales for the different years are broken down into table stock potatoes and those used for processing. In 1994, table stock potatoes accounted for 31.7 percent of total sales and processing potatoes accounted for 61.5 percent. Frozen products, principally french fries,

Atlantic, Kennebec, La Chipper, Sebago, Superior, La Rouge and Red La Soda are the potato varieties must often grown for commercial potato production in Florida. Atlantic is the standard variety for chipping or for potatoes held in very short term storage. It has high yield potential, high specific gravity and uniform tuber size and shape; it is tolerant to scab and vericillium wilt, resistant to pinkeye, and is highly resistant to race A of golden nematode, virus X and tuber net necrosis. Tubers are susceptible to internal heat necrosis, particularly in sandy soils in warm, dry seasons. Hollow heart in the larger diameter tubers (larger than 3 1/4 inches) can be serious in some growing areas. It stores well, but is generally not recommended for chipping out of storage.

Total potato production in the United States is quite variable, although it has increased from 40.2 billion pounds in 1990 to 44.2 billion pounds in 1995 (Table 4).

Table 4 . Potatoes: Area, yield, production, season average price, and value, United States, 1990-95.

Year	Area harvested (1000 acres)	Yield per harvested acre (cwt)	Production (1000 cwt)	Value of production (1000 dollars)
1990	1370.6	293	402,110	2,430,983
1991	1374.4	304	417,622	2,042,899
1992	1315.0	323	425,367	2,336,478
1993	1317.0	326	428,693	2,636,650
1994	1382.7	338	467,924	2,595,999
1995	1371.1	323	442,309	2,799,067

Source: U.S. Dept. Agr., 1996.

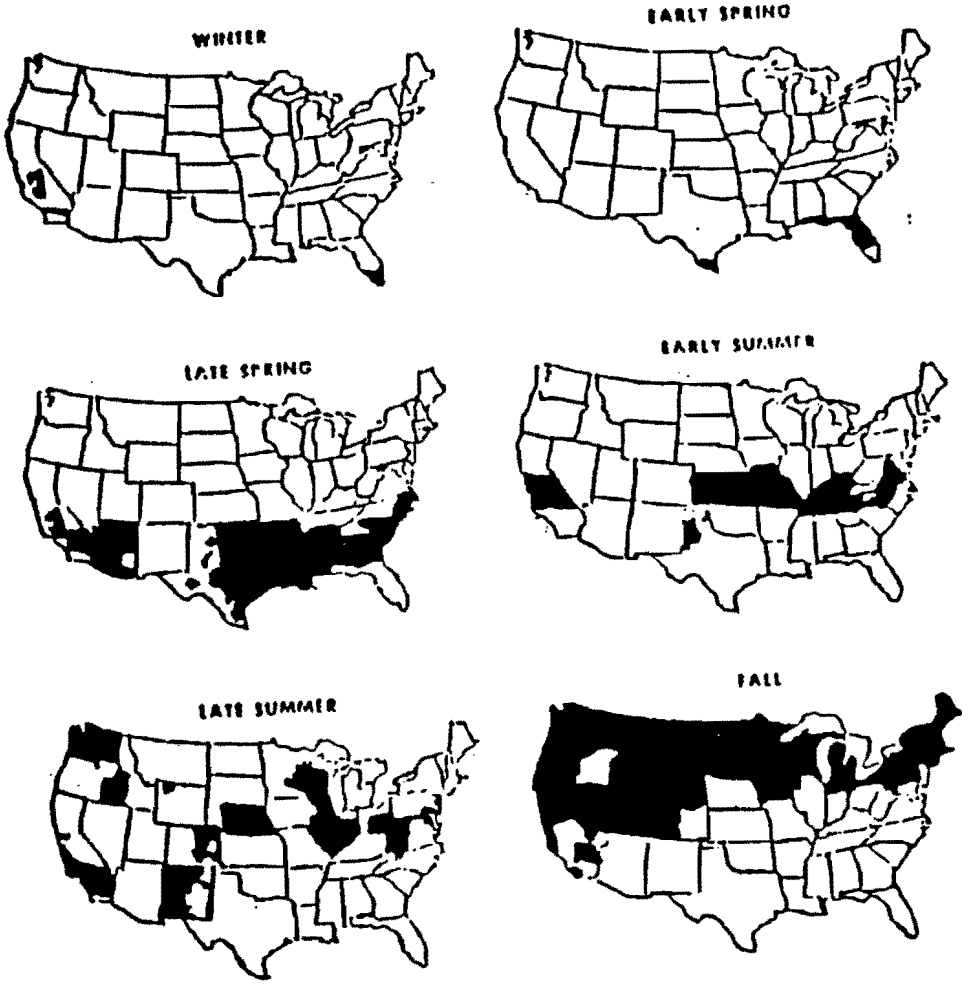

Figure 1 : Principal Potato Producing Regions by Seasons

Source: (Zusman, 1962)

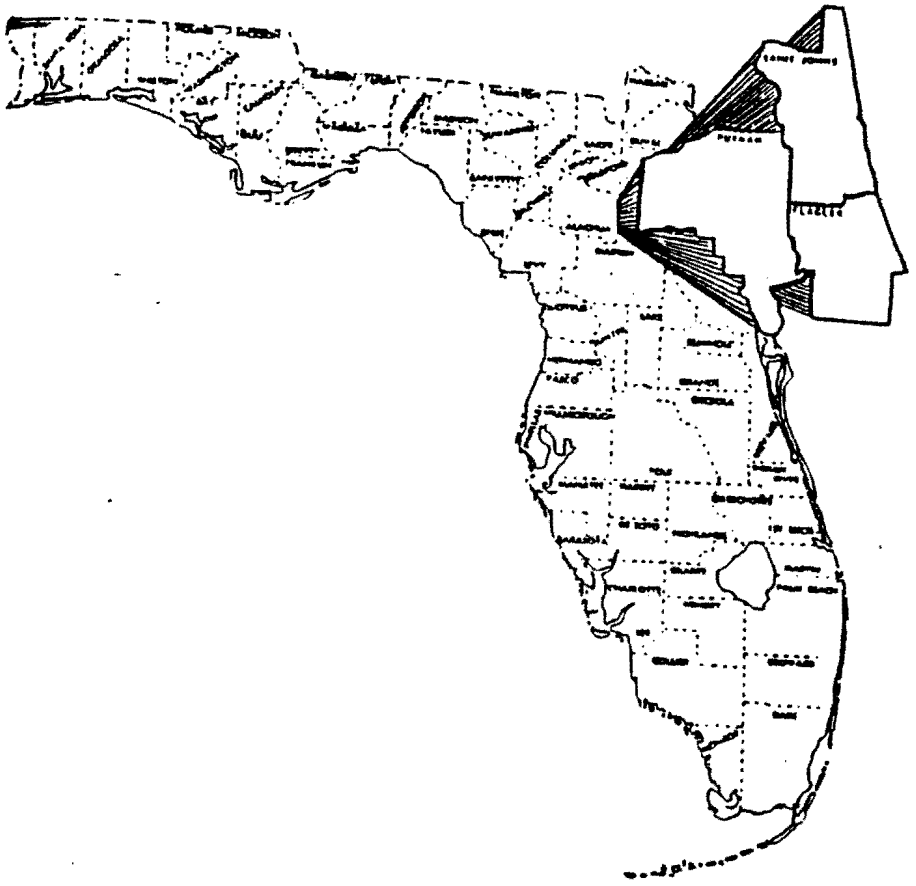

Figure 2. Location of Hastings potato producing area, Florida.

Total production of potatoes in the Hastings area is quite variable, as Table 5 shows. The maximum and minimum production of the Hastings area in the years 1985-1995 differed by over two million hundredweight. Furthermore, prices and total crop value are variable and unpredictable, with variations in the price per bag of over seven dollars in successive years showing up more than once.

The "White-Skinned" varieties dominate in Hastings, with most of the production (85 %) going to the potato processing industry. Since Hastings presently supplies a large portion of its harvest to potato chippers, the welfare of the area is somewhat dependent on that of the chipping industry. Hastings potatoes are used to produce Memorial Day Chips. During the past forty years there has been a large increase in sales of processing potatoes from the area.

"White-Skinned" varieties also dominate in the other Florida spring areas with most of the production going to the fresh market (75%). The "Red-Skinned" varieties are the dominant potatoes grown for winter harvest in South Florida and most of the winter crop is sold for table stock.

Approximately 75 to 80 percent of Florida's spring crop potato acreage is located in the Hastings area (Table 6). The area of potatoes harvested in the Hastings area in 1995 constituted 75 percent of the total area harvested in Florida. In the same year, Hastings production accounted for 76 percent of the total Florida production.

Table 6. Spring potatoes: area, production by farmers in Florida.

Years	Area harvested in Florida (1000 acres)	Area harvested in Hastings area (1000 acres)	Production in Florida (1000 cwt)	Production in Hastings area (1000 cwt)
1990	37	28.7 (77.6)[a]	8,714	6,888 (79.0)[b]
1991	35.4	27.0 (76.3)[a]	6,600	5,130 (77.7)[b]
1992	32	25.0 (78.1)[a]	7,750	6,000 (77.4)[b]
1993	33.5	26.0 (77.6)[a]	6,068	4,680 (77.1)[b]
1994	38.6	29.0 (75.1)[a]	8,588	6,380 (74.3)[b]
1995	36	27.0 (75.0)[a]	7,830	5,940 (75.9)[b]

[a] Area harvested in Hastings as a percent of total
[b] Production in Hastings as a percent of total
Source: U.S. Dept. Agr., 1996.

storm sewer drainage containing a variety of contaminants from heavy metals to petroleum products, agricultural runoff, erosion and sedimentation, atmospheric deposition such as acid rain, chemical and fuel spills, and other pollutants running off large land areas. Other contaminants such as nutrients (nitrogen and phosphorus), toxic substances, pesticides, pathogens, and organics can be water borne and are also considered NPS pollution.

The many types of NPS pollution may be generally defined as either "urban" or "rural". Urban NPS pollution includes runoff from roads, parking lots, lawns, parks, combined sewer overflows, construction sites and industrial storage areas. Rural NPS pollution includes runoff from some of the above sources plus runoff from agriculture, silviculture, feedlots, mining, and extensive areas of soil erosion.

Though nutrients are beneficial in adequate quantities, overloads can upset the natural balance in the receiving water environment. For example, excessive nutrient loadings can lead to algae blooms, which deplete dissolved oxygen in the water and lead to fish kills. NPS runoff contains not only nutrients and particulate matter, but various toxic chemicals including metals, petroleum compounds, pesticides, and other substances, depending on its origin.

NPS pollution is now recognized as a major contributor to water quality problems such as excessive sediment loadings, nutrient enrichment, and bacterial and toxic chemical contamination. It is considered as being the number one cause of water quality violations and failure to achieve designated standards. Recent studies indicated that sediment from nonpoint sources caused 42 percent of the observed impaired river miles. For lakes, 49 percent of the impaired acreage was caused by nutrients, 25 percent by sediment, and 5 percent by pesticides.

However, the pursuit of better erosion control will not necessarily lead to improved water quality. For example, no tillage will greatly reduce losses of soil and particulate nutrients but may have negligible effect on losses of dissolved nutrients (Haith and Loehr, 1979). It may even result in higher amounts of pesticides in runoff because of increased applications (Smith et al., 1979).

Chemical Fertilizers

The use of chemical fertilizers has been increasing over the years. The desire for higher crop yields and the development of highly productive genotypes requiring high rates of fertilizer application for optimum yields further contributed to increased use. During the past decade attention has focused on methods to minimize the utilization of fertilizers because of increased costs and the need to protect water quality.

Of the major nutrients supplied in agricultural fertilizers, nitrogen, phosphorus and potassium have been implicated as important water pollutants, since in surface water as on the tilled field they stimulate plant growth. A healthy aquatic environment requires sufficient nutrients to produce a normal flora and fauna, but in excess these nutrients create water quality problems manifested mostly by growths of algae and aquatic weeds. These growths can restrict navigation, reduce recreational values, produce undesirable tastes and odors in water supplies, and deplete dissolved oxygen, causing fish kills.

Excessive nitrate-N in water supplies can also cause animal and human health problems. Ground water has occasionally been found to contain nitrate-N at concentrations exceeding the 10mg/L standard for public water supplies.

and no phosphorus applied when soil tests are high (greater than 30 ppm Mehlich-I extractable P). The following is a direct quotation from the summary section of the pamphlet.

"IFAS recommendations produced yields equivalent to commercial growers in nearly every test. Higher rates of fertilization than those recommended in this brochure produced the same or lower yields.

N fertilization rates above 275 lb N/acre sometimes produced lower potato yields and quality than fertilization at the IFAS rate of 175 lb N/acre.

Fertilization with P when the soil tested high or very high did not increase yield or quality.

Excessive K fertilization reduced potato specific gravity." (Kidder et al., 1991, p.8)

Animal wastes

Large modern feedlots with thousands of animals have also been recognized as significant point sources of water pollution. Annual total production of animal wastes in the United States is about 100 million tons (dry weight), which includes nearly 4 million tons of nitrogen and nearly 1 million tons of phosphorus (Van Dyne and Gilbertson, 1978). High costs of energy and chemical fertilizers have forced a new look at the feasibility of applying animal wastes to the land for their fertilizer value.

Water pollutants resulting from pastured animal production or application of animal wastes to the land include nitrogen, phosphorus, oxygen demanding biodegradable substances, and pathogenic organisms. Of these, phosphorus is the runoff constituent of most significance for water quality, since the others are markedly attenuated during transport in drainage (Draper et al., 1979).

decreased by an order of magnitude within a few miles downstream. St. Johns River Water Management District (SWET, 1994) conducted a project which studied the occurrence of pesticides in surface and ground waters on or near potato farms in the TCAA. This study provided an indication of the pesticides with the highest chance of reaching receiving streams and the groundwater in the TCAA.

Best Management Practices (BMPs)

Best Management Practices, as a general term, designate any method for controlling the quantity and quality of storm water runoff. Typically, a BMP is considered to be either: (1) a practice that reduces the pollutants available for transport by the normal rainfall-runoff process or; (2) a device that reduces the amount of pollutants in the runoff before it is discharged to a surface water body.

BMPs are expected to reduce the amount of potential pollutant applied to the land and the amount of pollutant entering streams or groundwater. These practices are selected from an array of acceptable practices for managing animals, crops, or land; controlling erosion and drainage; utilizing nutrients; and controlling pests. Selection depends on balancing agronomic and environmental effectiveness, economic feasibility, and social acceptability (Bailey and Waddell, 1979) to find a set of practices that is best for satisfying all of these often conflicting criteria. BMPs are expected to be adapted to specific site conditions, requiring close cooperation between

who applies them than to the downstream water users or the general public who benefit from improved water quality.

Various BMPs that may be applied to the TCAA were previously identified by Soil and Water Engineering Technology (1994) to reduce nutrient, sediment and water loadings from the farm. These included: i) irrigation BMPs; ii) drainage BMPs; iii) fertility BMPs; iv) pesticide BMPs and; v) sediment BMPs.

Table 7 presents the different BMPs and their potential effectiveness factors for net load reduction. Some of the practices were already used on the ten representative farms of the TCAA area from 1991 to 1993 (before 1994 BMPs implementation), while others were implemented together with the 1994 BMP project.

The comparison of the BMPs was made taking into account their relative cost and potential effectiveness factors for net load reduction and associated yield impact. The BMPs with the highest nutrient, water and yield effectiveness factors and the lowest relative cost were identified as having the most potential to be the best overall BMPs for the TCAA (SWET, 1994). Previous studies (SWET, 1994) reported that nutrient management BMPs were likely the most critical to be considered. It was also indicated that fertility, pesticide and irrigation BMPs would be best for the TCAA in relationship to water quality.

The goal of the water table BMP is to provide optimal crop production while minimizing both irrigation input (water use) and drainage outputs (nutrient and sediment losses). Brief descriptions of the identified practices are provided below.

- **Manifold irrigation header lines** are the pipes used to deliver water from the irrigation pump to the top of each water furrow in the field. A valve at each water furrow allows individual

water furrow control. This practice is widely used in the TCAA and eliminates water loss associated with a header ditch.

- **Use of water table wells** provide a visual display of the ground water level in the field. The wells have two flags that rise and fall according to the water table position. Low water tables indicate the need to increase irrigation supplies and high levels indicate the need for additional drainage. The water table wells provide an excellent view of what is happening below the field. Therefore, they can greatly assist in a successful water management program.

- **Water table response/accountability method** allows for tailwater management by better estimating if boards should be removed and for how long following a storm event to assure adequate moisture in the field.

- **Tensiometers** are inexpensive instruments that provide an easy and reliable indication of the root zone moisture status. When placed at 6" and 12" within the root zone, gauges will warn of excessive or deficient water conditions regardless of water table position.

- **Micro (drip/trickle) irrigation** delivers water directly to the planted root zone by using tubing with frequently placed emitters within each crop row. Drip/trickle irrigation offers high water savings while providing higher storm water drainage protection. Fertigation is also possible with this system (see below under fertilization methods).

- **Ditch grade stabilization structures** improve the water table depth uniformity across the field by preventing over drainage and under drainage in the different ends of the field due to elevation changes.

- **Ditch bank side-slopes reduction and maintaining vegetative cover** can reduce the erosion potential of furrow and collector ditches by reducing sloughing and rainfall detachment.

- **Sediment trapping** is accomplished by reducing flow velocities to allow suspended particulates to settle out and collection of suspended and bed load solids. It provides temporary storage of water, silt, and debris, reducing downstream sedimentation. Adequate ditch capacity, sediment traps, and ditch cleaning will decrease velocities and increase sediment trapping. Leaving at least one or two boards in a discharge riser will create a sediment trap without excavation, otherwise in-ditch excavation is needed to create a sediment trap. Sediment traps are excavated to a depth of one foot below the inlet invert elevation of water control. They are graded flat for a length of 50 feet upstream of the structures. Annual maintenance is performed to remove sediment deposits and maintain the designed configuration.

Integrated Pest Management (IPM)

IPM is the coordinated use of pest and environmental information along with available pest control methods, including cultural, biological, genetic and chemical methods, to prevent unacceptable levels of pest damage by the most economical means, and with the least possible hazard to people, property and the environment (National IPM Forum, June 1992).

After several decades of almost exclusive reliance on chemical strategies for controlling agricultural pests, IPM has received wide support in recent years. This support has increased because of the high cost of pesticides and a perception that the negative effects of chemical pesticide dependence have continued to increase. These apparent negative effects include increasing pest resistance which continually reduces pesticide effectiveness; emergence of new

v) incentives for registering pesticides for minor crops.

However, the pesticide reform legislation has had considerable debate, mainly because it eliminates consideration of the benefits of pesticides unless food groups can prove that the loss of a pesticide would seriously disrupt the food supply.

The impetus behind IPM generally has not been a concern for food safety, but rather a concern about the environmental impact of pesticides on wildlife, groundwater and soil quality. Growers and other food producers are interested in protecting our natural resources and want to adopt less chemically intensive methods of farming.

Economics may enter into the design of the IPM strategies such as biological controls, cultural practices and chemical approaches, in three inter-related ways:

- taking into account the pest management goals of farmers, that are largely economic;
- selecting optimal quantities and combinations of pest management inputs and;
- understanding the incentives underlying farmers.

Problem Statement

In response to the 1987 Surface Water Improvement and Management Act (SWIM), the St. Johns River Management District developed a management plan to protect the watershed of the lower St. Johns River basin (LSJRB).

Past work done by the District has identified the Tri-County Agricultural Area (TCAA), located in St. Johns, Putnam, and Flagler counties, as one possible source of nonpoint pollution, and an enriched nutrient source area due to agricultural activity. The TCAA is primarily in row

The goals and objectives of the District's project are to:

i) promote the development of working relationships and the coordination of activities among the program cooperators (IFAS/Extension, NRCS, SWET, District) and the growers/producers in the TCAA;

ii) implement new/alternative BMPs in the TCAA on a number of selected farms (10);

iii) evaluate the effectiveness of the new/alternative BMPs in the improvement of water quality associated with potato production in the TCAA, by performing necessary monitoring and analysis and;

iv) implement educational programs using IFAS extension service for dissemination of project results and alternative BMPs for project community.

This research will focus on point (iii) to determine the impact of BMPs on competitiveness and productivity of growers in the TCAA. This way it will be possible to forecast which BMPs should be selected by growers for implementation, aiding them in that selection process. This evaluation relies on analyzing the costs and benefits to growers of using alternative BMPs. The cost of runoff (associated with pollution) will also be evaluated in order to estimate the environmental impact of the different BMPs used.

A price endogenous mathematical programming model will be used to conduct the analysis. GAMS (General Algebraic Modeling System) will be the programming language used

METHODOLOGY

Fundamentals of the Model

This study employs the use of a price endogenous mathematical programming model (Takayama and Judge, 1971) to evaluate the effects of the implementation of different best management practices (irrigation, drainage, fertilizer, sediments) on the productivity and competitiveness of potato growers in the Hastings area.

The use of models as an input to planning and prediction within an economy long has been an interest by economists and agricultural economists. Mathematical programming has proved to be a useful tool for simulating the impacts of new policies on a sector (Blitzer, Clark, and Taylor, 1975).

Large scale, price-exogenous, linear programming models have been used extensively by agricultural economists to simulate the impact of farm programs on the agricultural sector (Heady and Srivistava, 1975). These large-scale linear programming models have included the restrictive assumption of fixed market prices or quantities.

In economic analysis, a sector is usually assumed to be made up of a large number of participants, each of whom seeks to optimize some objective. Within a competitive framework of producers and consumers, individual producers cannot affect factor or product prices (input and output prices or quantities are assumed fixed and exogenous). Focusing the attention to the

where Γ is a vector of exogenous factors and X is an (m x l) vector of total sectoral use of purchased factors.

The sectoral use of the *i*th purchased factor and the sectoral supply of the *h*th output are:

$$X_i = \sum_{K=1}^{p} \sum_{l=1}^{L} X_{i\,lk} \qquad (i=1,\ldots\ldots\ldots\ldots, m), \qquad (3)$$

$$Z_h = \sum_{K=1}^{p} \sum_{l=1}^{L} Z_{h\,lk} \qquad (h=1,\ldots\ldots\ldots\ldots, S) \qquad (4)$$

where $X_{i\,lk}$ is the use of the *i*th purchased factor in the *k*th production process utilized by the *l*th producer (i = 1,....., m; K = 1,....., p; l = 1,....., L) and $Z_{h\,lk}$ is the yield of the *h*th output from the *k*th production process utilized by the *l*th producer (h = 1,....., S; K = 1,....., p; l = 1,....., L). Individual producers (consumers) are price takers equating aggregate price with the price they receive (pay) when they produce an output (consume a product).

Assuming that both supply and demand functions are linear, the demand and supply curves can be defined as:

$$P_h = G_h - H_h Z \qquad (h = 1, \ldots\ldots\ldots, S) \qquad (7)$$

$$r_i = E_i + F_i X \qquad (i = 1,\ldots\ldots\ldots\ldots, m) \qquad (8)$$

where G_h and E_i are scalars and H_h and F_i are row vectors.

represent a problem. But, if it was a major sector or set of sectors, the income generated within that sector may have a major impact on aggregate consumer demand.

The objective function maximizes the integral of the area underneath the demand curve minus the integral underneath the supply curve (Figure 3), subject to a supply demand balance. The resultant objective function value is commonly called consumers' plus producers' surplus or net social benefit.

Consumers' surplus (CS) corresponds to the difference between the value that a consumer places on the first unit of consumption of a good and what he has to pay for it; while producers' surplus (PS) is the difference between the minimum amount a producer would be willing to sell

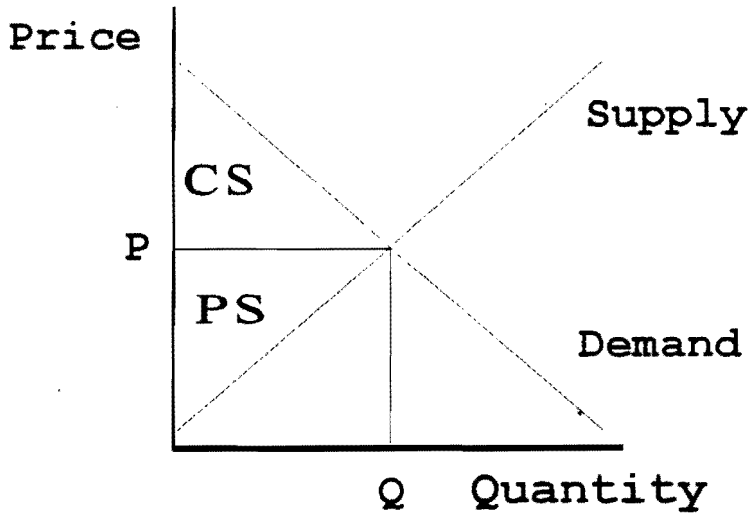

Figure 3: Objective Function Representation

number of acres of potatoes planted, and, therefore, quantity of potatoes produced were estimated for the base model. After solving this base model, the budgets and yields are adjusted to reflect recommendations of production scientists for the costs of growing spring potatoes with implementation of BMPs (quantitative assessment of the impact of BMPs). The results were compared to determine the impact an implementation of BMPs may have in the Hastings Area of Florida on the production and marketing of this crop. The environmental impact due to the implementation of the different BMPs will be estimated by an evaluation of the cost of runoff.

It is assumed in this study that the Hastings area spring potato market is perfectly competitive and free of monopolistic influences at the producer, consumer and intermediate levels. It has many buyers and sellers (small producers), so that no single buyer or seller has a significant impact on price. In equilibrium, the quantity supplied by the Hastings area will equal the quantity demanded. The marginal costs are assumed to be equal across producers and constant. This implies no substitution between preharvest, harvest and marketing costs.

The model assumes that all the farmers have full information about all technologies, so that it is always possible to choose options involving the lowest costs. As such, it ignores behavioral lags in adoption of new technology. The model is also static in the sense that instant returns are available from new technologies.

In order to evaluate the influence of the BMP programs on both drainage water quality and farm profitability, the District chose four farms in the TCAA area where BMPs were applied. The

samples were analyzed for phosphorus content to estimate environmental impacts. Phosphorus is a nutrient that can be found both in water and sediment runoff. Being phosphorus a compound that builds up in the soil, the results in terms of decrease in phosphorus loadings due to an implementation of water table and fertility BMPs will not be immediately seen. Only in the long run will results be realized. Assuming a static model, phosphorus long term impact will be taken into account and farmers behavior will remain constant.

Shadow prices will be estimated from the model results as a method of valuing phosphorus loadings. This will provide a point of reference for policy makers to use in making a value judgement on phosphorus loadings and BMPs. They will represent a contribution from a policy perspective in that it will be possible to judge the cost of phosphorus loadings associated with river pollution.

Model Specification and its Components

The Hastings spring potato market can be characterized as a price endogenous model solved using quadratic programming (Spreen, et al, 1980). This model will be responsible for maximizing social utility minus costs, i.e, the area under the demand curve and above the supply curve (consumers' surplus plus producers' surplus).

capita April stocks for fall potatoes held by growers and local dealers in the 15 major producing states and L is the U.S. per capita disposable income in constant (1982-84) dollars.

The empirical model used is specified in the form to maximize the area below the demand curve less the area below the marginal cost curve.

The model can be stated mathematically as:

$$\text{Max} \sum_{i=1}^{I} (a + b*F - d*T - e*S + f*L - 1/2*c*H) * Q_i - \sum_{i=1}^{I} D_i * A_i - E * \sum_{i=1}^{I} A_i - \sum_{i=1}^{I} U_i * X \quad (8)$$

subject to

$$Q_i = A_i * Y_i \quad (9)$$

$$X = X_1 * A_1 + \sum_{i=2}^{I} X_i * A_i \quad (10)$$

$$X_1 = f(V) \quad (11)$$

$$X_i = X_1 * (1 - Ef_i) \quad \text{and} \quad (12)$$

$$Q_i, A_i, H_i, X_i \geq 0 \text{ for all } i$$

The optimal solution to this model provides the optimal acreage of potatoes planted, and therefore, the quantity of crop produced. Phosphorus loadings are also obtained. The optimal dual solution provides partial equilibrium prices.

goodness of fit was reasonable. A summary of the regression results appears in Table 9. The R^2 for the selected model was 0.43. Only one variable (fall average price) was significant at the 95 percent confidence level.

Table 9. Estimates of demand parameters for processed and table stock potatoes.

Variable	Parameter Estimate	Standard error	T for Ho: Parameter=0
Intercept	-13.0372	13.02951	-1.001
Fall average price	1.066051	.402936	2.646[a]
Per capita Hastings production	-.28492	.152987	-1.862[b]
Other Fl. spring production	-.49477	.359159	-1.378[c]
Fall potatoes stocks	-.00636	.011082	-.574
Disposable income	.002248	.001337	1.682[c]
R^2	.43		

[a] Significant at 95% level of confidence
[b] Significant at 90% level of confidence
[c] Significant at 80% level of confidence

The coefficient for per capita spring Hastings production was negative. This sign is consistent with standard demand theory in that higher prices result in lower quantity demanded. Other spring potato production in Florida and fall potato stocks also yielded negative coefficients.

kilowatt hour of energy ($.08) and the savings in the amount of electricity required for the water pumped (11.26 * 4.0 Kwh).

Table 10. Estimated production costs in the Tri-County Agricultural area, 1994-95

Practices	**Preharvest cost differences ($/acre)[a]**	**Total Preharvest costs ($/acre)**
Base Model Preharvest Cost		1623.81
Water table BMPs		
. Use of water table wells	(1.75)	
. Use of tensiometers	(1.5)	
. Electricity to run the pumps for water[b]	0.09	
. Use of sediment traps	(16)	
		1642.97
Fertility BMPs	28.13	
		1595.68
Water Table BMPs + Fertility BMPs		
		1614.84

[a] Cost differences in parentheses indicate additions to total preharvest costs, others are savings in preharvest costs

[b] cost ($) = 11.26 * (acres.in) * ($/kWh)

Environmental Impact Evaluation

In order to get the shadow values for phosphorus loadings, an equation relating the volume of water runoff from the fields (V) and the total phosphorus measured in runoff (X_1) was estimated. Figures constructed by SWET (1996) were used to derive the equation. The graphic representation of phosphorus loadings as a function of drainage yielded a quadratic correlation ending by a square root correlation. Some odd values appeared, such as data related to farm I (where excess phosphorus had been used) and to farm J (1993). Consequently, these figures were not used in the correlation performed. The phosphorus loadings equation (11) can be specified as:

$$X_1 = a*V^2 + b*V^{0.5} \qquad (13)$$

A summary of the regression results appears in Table 12.

Table 12. Estimates of discharge parameters for phosphorus loadings[a].

Variable	Parameter Estimate	Standard error	T for Ho: Parameter=0	Prob>|T|
intercept	0			
V^2	.019608	.005913	3.316	.0051
$V^{0.5}$	.285578	1.384829	0.206	.8396
R^2	.61			

[a] Estimates based on time series data for 1991-1995.

RESULTS AND DISCUSSION

The model was solved using GAMS on a 486 micro computer. The development of GAMS took place as a result of the previous frustrating experiences of an economic modeling group at the World Bank. Different techniques were already used for solving multi sectoral economy wide models or large simulation and optimization models in sectors such as agriculture, steel and fertilizer, but they had serious faults or weaknesses.

The programmers in the group also wrote FORTRAN programs to prepare each model for solution, but a lot of problems existed in using the programs, as they were only accessible to the specialist who wrote them and not to the person in charge of the project.

The development of GAMS, came out as a possible tool to change this situation by providing a high level language for the compact representation of large and complex models, allowing changes to be made in model specifications simply and safely, allowing unambiguous statements of algebraic relationships and permitting model descriptions that are independent of solution algorithms (Brooke, 1988).

drainage, fertility, sediment and pesticide) were implemented together with the 1994 BMP project. This study analyses the water table and fertility BMPs only. Taking this into consideration, it can be seen (Table 8) that farms C and G only used one kind of BMP (fertility), while farms I and J were able to use the two different BMPs (water table and fertility) at the same time. The impact of each of these three different BMP alternatives over the non BMP practices was evaluated.

The model was solved in three steps. The first step in the solution was to constrain the model to each individual activity, one solution at a time, and to then solve the model with combinations of activities. The second step involved imposing a phosphorus loadings constraint for the different combinations of activities included in the model. The final step involved placing a cost on phosphorous loadings and solving the model for the different combinations of activities.

No phosphorus loadings constraint and no shadow price

The results of this first step are summarized in Tables 14-17. The results show that the water table BMP, fertility BMP and combined BMP will have negative impacts on acreage (Table 14) and positive impacts on Tri-County Agricultural potato production (Table 15).

Table 15. Quantity of potatoes (100,000 pounds) produced in the Tri-County Agricultural area with and without BMPs implementation.[a]

Activities allowed	No BMP	Water table BMP	Fertility BMP	Combined BMP
0[a]	**6,411**			
1[b] Percent change[e]		**6,828** 6.50		
2[c] Percent change[e]			**6,490** 1.23	
3[d] Percent change[e]				**6,900** 7.63
0+**1**		6,828		
0+**2**			6,490	
0+**3**				6,900
1+2		6,828		
1+**3**				6,900
2+**3**				6,900
1+2+**3**				6,900
0+**1**+2		6,665		
0+1+**3**				6,900
0+2+**3**				6,900
0+1+2+**3**				6,900

[a] No BMP
[b] Water Table BMP
[c] Fertility BMP
[d] Combined BMP
[e] Percent change from the base model with no BMP

imply there are no excess profits earned by growers, a solution dictated by the competition market solution.

Table 16. Consumers' surplus and equilibrium prices with and without BMP implementation

Output variable	No BMP	Water Table BMP	Fertility BMP	Combined BMP
Consumers' surplus (million dollars)	22.49	25.50	23.04	26.04
Percent change [a]		13.38	2.45	15.78
Equilibrium price	5.603	5.147	5.517	5.069
Percent change [a]		(8.14)	(1.53)	(9.53)

[a] Percent change from the base model with no BMP

The model shows that significant environmental improvements are possible from BMP implementation (Table 17). Phosphorus loadings were seen to decrease 60.9 percent under the combined BMP. The fertility BMP proved to be more than two times better in comparison with the irrigation BMP in terms of phosphorus loadings reductions.

In order to assess the value of BMP implementation in terms of a reduction in the pollution in the St. Johns River watershed, the different BMPs were ranked based on phosphorous loadings (Table 17). As has already been explained, phosphorous loadings represent a policy variable for environmental protection in the Tri-County Agricultural area. Constraining the different solutions

Table 18. Acres of potatoes planted in the Tri-County Agricultural area with and without BMPs implementation with a phosphorous constraint of 275,000 pounds.

Activities allowed	No BMP	Water table BMP	Fertility BMP	Combined BMP
0[a]	**10,775**			
1[b] Percent change[e]		**12,721** 18.1		
2[c] Percent change[e]			**21,550** 100	
3[d] Percent change[e]				**26,937** 150
0+**1**		12,721		
0+**2**			21,550	
0+**3**				26,937
1+**2**			21,550	
1+**3**				26,937
2+**3**				26,937
1+2+**3**				26,937
0+**1**+2		21,550		
0+1+**3**				26,937
0+2+**3**				26,937
0+1+2+**3**				

[a] No BMP
[b] Water Table BMP
[c] Fertility BMP
[d] Combined BMP
[e] Percent change from the base model with no BMP

When a phosphorous loadings constraint is imposed and farmers are faced with producing potatoes with a water table BMP or a fertility BMP, farmers will "choose" the fertility BMP. Efficiencies corresponding to the removal of phosphorous from the watershed play an important role here, as they are responsible for the BMP chosen. In situations where the farmer is able to have a choice between different BMPs, the combined use of water table and fertility BMPs was always seen as the best option. This can be justified by the value of the efficiency (.60) associated with controlling phosphorous loadings with this BMP.

Imposing the phosphorous loadings constraint resulted in a decrease in consumers' surplus and an increase in producers' surplus (Table 20). However, total surplus is in all situations lower than in the first analysis, due to the presence of a deadweight loss which represents the difference between the surplus achieved with the constraint and the welfare achieved in the original equilibrium (first analysis).

The imposition of the constraint will increase the price paid by the potato buyers. This certainly represents a cost to the buyers but from the economist's viewpoint, the real cost of the constraint is that the output has been reduced and price has increased. The value of lost output represents the social cost of the constraint.

Comparing the different BMPs (Table 20), the combined BMP proved to be the best from the consumer's point of view (an increase of $20.13 million), but the worst from the grower's point of view (a decrease of $7.76 million). Farmers from the Tri-County Agricultural area would be getting economic profits of $2.72 million per year if they decided to implement water table BMP

Table 21. Shadow prices under the different BMP situations

Situation	Shadow price ($/lb)
No BMP	38.11
Water table BMP	45.93
Fertility BMP	33.00
Combined BMP	9.88

It can be seen from Table 21 that the combined effect of the water table and fertility BMP presented the lowest shadow price value. The dependence of the shadow price on yield and efficiency can explain the high shadow price obtained when the phosphorus loadings constraint is imposed and the water table BMP is the only available activity.

Imposing a shadow price for phosphorus loadings

The model was revised by imposing a cost on the phosphorus loadings equal to the highest shadow price ($45.93 per pound). The results of these solutions are contained in Tables 22-25.

Table 23. Quantity of potatoes produced (100,000 pounds) in the TCAA with and without BMPs implementation and with a cost of $45.93 per pound imposed in phosphorus loadings.

Activities	No BMP	Water table BMP	Fertility BMP	Combined BMP
0[a]	**1,541**			
1[b] Percent change[e]		**3,078** 99.7		
2[c] Percent change[e]			**4,055** 99.7	
3[d] Percent change[e]				**5,129** 232.8
0+**1**		3,078		
0+**2**			4,055	
0+**3**				5,129
1+**2**			4,055	
1+**3**				5,129
2+**3**				5,129
1+2+**3**				5,129
0+**1**+2		3,078		
0+1+**3**				5,129
0+2+**3**				5,129
0+1+2+**3**				5,129

[a] No BMP
[b] Water Table BMP
[c] Fertility BMP
[d] Combined BMP
[e] Percent change from the base model with no BMP

Table 24. Consumers' surplus, tax revenue, equilibrium prices with and without BMPs implementation and with a tax of $45.93 per pound imposed on phosphorus loadings.

Output variable	No BMP	Water table BMP	Fertility BMP	Combined BMP
Consumers' surplus (million dollars)	1.30	5.18	9.00	14.39
Tax revenue (million dollars)	8.21	12.63	10.80	9.94
Equilibrium price	10.932	9.250	8.181	7.007
Percent change [e]		(15.4)	(25.2)	(35.9)

[e] Percent change from the base model with no BMP..

Table 25. Environmental impact evaluation in terms of phosphorus loadings with a tax of $45.93 per pound imposed.

Output variable	No BMP	Water table BMP	Fertility BMP	Combined BMP
Phosphorous loadings (1,000 pounds)	178.8	275.0	235.2	216.4

SUMMARY AND CONCLUSIONS

Florida is a very important state in the production of all vegetables. The Tri-County Agricultural Area located in St. Johns, Putnam and Flagler counties is Florida's leading potato producing area. Between five and twenty percent of the lower St. Johns River's nutrient pollution has been attributed to row crop agriculture in the Tri-County area (TCAA). One of the major issues in controlling agricultural nonpoint pollution is the implementation of Best Management Practices (BMPs). The economic importance of potatoes, the enormous number of pests that attack it, and the complicated physiological responses of the potato plant to changes in its environment, make it an ideal choice for studies of BMPs. BMPs designate any method for controlling the quantity and quality of stormwater runoff. They are expected to reduce the amount of potential pollutant applied to the land and entering streams or groundwater. The various BMPs that have been identified for their potential to reduce nutrient, sediment and water loadings from the farms in the TCAA include a water table BMP (irrigation BMP, drainage BMP and sediment BMP) and a fertility BMP.

An economic model was developed and used to evaluate the effects of the implementation of BMPs on the productivity and competitiveness of potato growers in the Tri-County Agricultural area. Two different kinds of BMPs were analyzed, water table and fertility. The use of a water table BMP together with a fertility BMP was also studied. Phosphorus was the nutrient used to evaluate the environmental impact of the BMPs on the St. Johns River water quality. The base solution was obtained by solving the model without considering the implementation of BMPs. The results for this

Total surplus was lower, however, due to the presence of deadweight loss. The imposition of the constraint on phosphorus loadings was responsible for increasing the equilibrium price.

In the third step, once again, the combined use of water table and fertility BMPs was seen to always be the best option. It also provided the lowest mass in terms of phosphorus runoff in the St. Johns River watershed. Consumers' surplus, planted acres of potatoes and quantity of potatoes produced increased due to BMP implementation. The lowest amount in terms of phosphorus loadings provided by the non BMP option, was done at the expense of producing potatoes.

The implementation of Best Management Practices (BMPs) in the Tri-County Agricultural producing area of North Florida is valuable in all the circumstances. There is an increase in the quantity of potatoes produced, a lower equilibrium price and consumers are therefore better off. The combined use of water table BMP and fertility BMP is the best option, when no technological constraints are present. If its implementation is possible, there will be a significative environmental impact, in terms of reduction of phosphorus loadings.

One question can be raised at this point. If BMPs are really so good, with a large number of advantages, why did they begin to be used only a short time ago, and why are they not popular yet? It would appear that the main reason behind this is that people are not aware of the advantages of BMPs. There is a lack of information about these new techniques.

Implementation of BMPs in 1994 on some farms in the Tri-County Agricultural area was associated with policy restrictions. The St. Johns River Water Management District reported that

Suggestions for Further Research

This study provides useful information for discussion about the impact of the implementation of Best Management Practices in the Tri-County Agricultural producing area of North Florida.

One of the weaknesses in the model that was developed is the lack of data for determining impacts on yields, production costs and efficiencies in phosphorus loadings. The author is aware that variation in crop yields exists due to both weather and economic factors. It was also not possible to estimate the environmental impact of BMPs in controlling nitrogen and potassium runoff due to lack of data.

The model could benefit from a more rigorous evaluation of demand. Potato demand was estimated for a combined fresh and processed market. These markets do look for different consumers and could be separated empirically if sufficient data can be collected. The model could also separate the price at the beginning of the season to better account for the contracting that occurs prior to planting. This study can also be used to evaluate a larger number of Best Management Practices, for example a pesticide BMP.

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FINAL REPORT-PHASE IV

AN ECONOMIC ANALYSIS OF BEST MANAGEMENT PRACTICES (BMPs) FOR POTATOES GROWN IN THE TRI-COUNTY AGRICULTURAL AREA OF NORTH FLORIDA

submitted to

St. Johns River Water Management District

in fulfillment of

CONTRACT NO. 93G228

prepared by

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EXECUTIVE SUMMARY

The Tri-County Agricultural Area (TCAA), located in North Florida, is the leading producing area for potatoes in Florida and has been identified as a possible source of non-point pollution from enriched nutrient runoff (SWET, 1994). In response to the 1987 Surface Water Improvement and Management Act (SWIM), the St. Johns River Water Management District developed a large multi-purpose river restoration project aimed at reviving the headwaters of the lower St. Johns River Basin (LSJRB). This project has been touted as a model of sustainable floodplain management by public agencies, environmental groups, and agricultural interests.

Best Management Practices, as a general term, designate any method for controlling the quantity and quality of storm water runoff. The purpose of this study is to present an economic analysis of alternative Best Management Practices (BMPs) for potatoes grown in the TCAA of North Florida. Various BMPs that may be used in the TCAA were previously identified by SWET (1994) and evaluated for their ability to reduce nutrient, sediment and water loadings from the farms. These included a water table BMP and a fertility BMP.

This study provides an analysis of the effects BMPs will have on growers and estimates the environmental impact (in terms of phosphorus and nitrogen loadings into the watershed) due to the implementation of BMPs. The economic importance of potatoes, the large number of pests that attack this crop, and the complicated physiological responses of the potato plant to changes in its environment make it an interesting study of Best Management Practices (BMPs).

A price endogenous mathematical programming model (Takayama and Judge, 1971) was employed to estimate the economic and environmental impact of the BMP practices. Mathematical or gramming has proved to be a useful tool for simulating the impacts of new policies on a sector

TABLE OF CONTENTS

	PAGE
LIST OF TABLES	i
INTRODUCTION	1
METHODOLOGY	1
The Empirical Demand Structure	2
Production Costs	3
Environmental Impact Evaluation	5
RESULTS AND DISCUSSION	6
Base Model	6
Model with implementation of BMPs	6
SUMMARY AND CONCLUSIONS	11
REFERENCES	13

LIST OF TABLES

PAGE

Table 1. Estimates of demand parameters for processed and table stock potatoes..... 2

Table 2. Estimated production costs in the Tri-County Agricultural area, 1996-97..... 4

Table 3. Potato yields under the 1996 BMP implementation..... 5

Table 4. Efficiencies in reduction of phosphorus and nitrogen loadings from BMP implementation..... 6

Table 5. Acres of potatoes planted in the supply region (Tri-County Agricultural area) with and without BMPs implementation..... 8

Table 6. Quantity of potatoes produced in the Tri-County Agricultural area with and without BMPs implementation..... 9

Table 7. Consumers' surplus and equilibrium prices with and without BMP implementation..... 10

Table 8. Environmental impact evaluation in terms of phosphorus loadings..... 11

Table 9. Environmental impact evaluation in terms of nitrogen loadings..... 11

INTRODUCTION

This report is an extension of the work presented in the final report (phase I) to St. Johns River Water Management District in January of 1997.

METHODOLOGY

The model of the Tri-County Agricultural Area (TCAA) chip potato industry was developed using current practices and costs. The year of 1996, being a normal production year, was chosen for the empirical analysis. A price dependent demand equation for spring potatoes in the TCAA was estimated. Production costs in the TCAA were determined based on budgets developed for chip potatoes (Smith and Taylor, 1997). The base solution was obtained by solving the model without considering the implementation of Best Management Practices (BMPs). Consumers' surplus, equilibrium price, number of acres of potatoes planted, and, therefore quantity of potatoes produced were estimated for the base model. After solving the base model, the budgets and yields were adjusted to reflect recommendations of production scientists for the costs of growing spring potatoes with implementation of BMPs (quantitative assessment of the impact of BMPs). The results were compared to determine the impact implementation of BMPs may have in the TCAA of North Florida on the production and marketing of this crop. The environmental impact (in terms of phosphorus and nitrogen lessening) due to the implementation of the different BMPs were estimated by an evaluation of the cost of runoff. Model specification and its components can be found in (VanSickle and Medina. 1997. Final Report-Phase I).

expected.

Production Costs

Base model

The production budgets published annually by the University of Florida (Smith and Taylor, 1997) provided pre-harvest cost of production ($1550.78 per acre) and harvest and marketing costs ($225.00 per acre) for chip potatoes in the Tri-County Agricultural area. Per acre yields (220 hundredweight) were obtained from Florida Agricultural Statistics Service (1996-97).

Modification to include BMPs

Production costs for chip potatoes in the Tri-County Agricultural area were changed to reflect estimates provided by production scientists. Preharvest costs for the different BMPs are shown in Table 2.

The cost of water table wells includes the cost of purchasing the well (capital cost) assuming replacement required each 4 years ($.75 per acre per year) plus the cost of taking the well out and putting it back in year to year ($1 per acre per year). The savings in electricity due to water table BMPs implementation corresponds to the difference between the cost estimated without the BMP and the cost with the BMP. Savings in electricity were therefore determined knowing the cost per kilowatt hour of energy ($.08) and the savings in the amount of electricity required for the water pumped (11.26 * 4.0 Kwh).

fertilizing costs were reduced to $122.76 per acre to reflect a reduction in the amount of fertilizers applied. An annual supplemental application of $8.01 per acre was taken into account, for eventual cases of rainfall. Split applications were priced to $2.50 per acre.

Per acre yields were adjusted to reflect recommendations from production scientists (Table 3). It was assumed that fertility BMPs would not have any impact on yield, while water table BMPs would be responsible for an increase of 10 percent.

Table 3. Potato yields under the 1996 BMP implementation

Situation	**Yield (cwt/acre)**
No BMP	220
Water table BMP	242
Fertility BMP	220
Water table + fertility BMP	242

Environmental Impact Evaluation

The environmental impact due to the implementation of BMPs was measured in terms of phosphorus and nitrogen lessening. Total phosphorus (11.31 pounds per acre) and nitrogen (107.83 pounds per acre) measured in runoff were estimated as an average of the figures provided by SWET (1998).

In order to account for the impact of the different BMPs in the environment, total phosphorus and total nitrogen measured in runoff were determined, taking into account both ontributions not using any BMP and using water table and fertility BMPs. Efficiencies co. esponding to the removal of phosphorus and nitrogen from the watershed were determined by

The model was constrained to each individual activity, one solution at a time, and then solved with combinations of activities.

The results are summarized in Tables #5-9. The results show that the water table BMP and combined BMP will have negative impacts on acreage (Table5), but positive impacts on Tri-County Agricultural area potato production (Table 6).

The water table BMP was the activity with the highest impact on acreage with a decrease in the acres devoted to potato production by 2.99 percent from 35,877 acres to 34,803 acres. The fertility BMP increased acreage by 1.31 percent to 36,347 acres. In terms of potato production, the combination of both BMPs increased Tri-County Agricultural area production by 7.89 percent. The fertility BMP was once again the activity with the lowest impact increasing production only 1.30 percent.

It can be seen in Table 5 that any BMP activity is always preferred to the non-BMP activity. Testing any BMP together with the non-BMP option the model consistently picks up the production system with lower marginal cost, which is always the BMP activity. Comparing the three different BMPs, it can be concluded that the combined BMP is the one involving the lowest marginal costs, followed by the water management BMP and the fertility BMP. The fertility BMP is used only if present by itself or with the non-BMP option.

Increasing the quantity of potatoes produced under BMP practices implies that the equilibrium price, which is the price where quantity demanded by the market equals the quantity supplied by the Tri-County Agricultural production area will decrease. More potatoes can thus be sold at lower prices, making consumers better off (Table7). Producers surplus, which is the economic profit

Table 6. Quantity of potatoes (100,000 pounds) produced in the Tri-County Agricultural area with and without BMPs implementation[a]

Activities allowed	No BMP	Water table BMP	Fertility BMP	Combined BMP
0[b]	**7,893**			
1[c] Percent change[f]		**8,422** 6.70		
2[d] Percent change[f]			**7,996** 1.30	
3[e] Percent change[f]				**8,516** 7.89
0+**1**		8,422		
0+**2**			6,490	
0+**3**				8,516
1+2		8,422		
1+**3**				8,516
2+**3**				8,516
1+2+**3**				8,516
0+**1**+2		8,422		
0+1+**3**				8,516
0+2+**3**				8,516
0+1+2+**3**				8,516

[a] No BMP
[b] Water Table BMP
[c] Fertility BMP
[d] Combined BMP
[e] Percent change from the base model with no BMP

percent) because of the inelastic demand for potatoes, but the return on capital invested will decline only 1.91 percent because costs decline as productivity with the combined BMP increases.

Table 8. Environmental impact evaluation in terms of phosphorus loadings

Output variable	No BMP	Water Table BMP	Fertility BMP	Combined BMP
Phosphorus loadings (1,000 pounds)	405.8	377.5	371.6	344.7
Percent change [a]		(6.97)	(8.43)	(15.1)

[a] Percent change from the base model with no BMP

Table 9. Environmental impact evaluation in terms of nitrogen loadings.

Output variable	No BMP	Water Table BMP	Fertility BMP	Combined BMP
Nitrogen loadings (1,000 pounds)	3868.6	3613.9	3503.8	3274.8
Percent change [a]		(6.58)	(9.43)	(15.3)

[a] Percent change from the base model with no BMP

SUMMARY AND CONCLUSIONS

The Tri-County Agricultural Area is the leading producing area for potatoes in North Florida and has been identified as a possible source of non-point pollution. One of the major issues in controlling agricultural non-point pollution is the implementation of Best Management Practices (BMPs). Various BMPs that may be used in the TCAA were previously identified by SWET (1994) and evaluated for their ability to reduce nutrient, sediment and water loadings from the farms. These

The results of these studies highlight the importance of using BMPs in the production of potatoes in the Tri-County Agricultural Area of North Florida. Any program that encourages producers to adopt BMPs will benefit producers and consumers of potatoes and also result in an improvement in the water quality of the lower St. Johns River Basin.

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Pesticide Sampling Stations

Station	Description	Latitude	Longitude	Water Class	Subbasin
BSGI	Buck Sykes Farm, Shallow Groundwater Well	294701	812717	GR	3F
BSTI	Buck Sykes Farm, Tailwater (Farm C)	294701	812717	TL	3F
DBR	Dog Branch 50 M Dwnstrm of 207a	294143	813450	RS	3J
DCR	Deep Creek at SR 207	294324	812906	EFS	3F
DPB	Deep Creek at Railroad Bridge	294345	812914	EFS	3F
LBTN	Larry Byrd Farm, Tailwater (Farm G)	294705	812705	TL	3F
MOB	Moccasin Branch On SR 13	294617	812850	RS	3F
OHD	Outlet of Hastings Drainage District	294249	813243	RS	3J
RRTN	Robert Revels Farm, Tailwater (Farm I)	294010	813444	TL	3F
STTN	Sam Tilton Farm, Tailwater (Farm J)	292908	812054	TL	3F
TOC	Tocoi Creek at SR 13, 2 Miles N of Tocoi	295218	813250	EFS	3F

Pesticide Sampling
Aqueous Parameters

STORET #	Parameter	Sample Media	Unit	Detection Limit µg/L	Toxicity Level (HAL) µg/L
04254	Metalaxyl	Whole Water	µg/L	1.00	400.00
34356	Endosulfan, Beta	Whole Water	µg/L	0.10	0.40
34361	Endosulfan, Alpha	Whole Water	µg/L	0.05	0.40
34699	TRANS-1,3-Dichloropropene	Whole Water	µg/L	**1.00**	**0.20**
34704	CIS-1,3-Dichloropropene	Whole Water	µg/L	**1.00**	**0.20**
38830	Mancozeb	Whole Water	µg/L	20.00	20.00
38927	Methamidophos (Monitor)	Whole Water	µg/L	**2.00**	**0.40**
39051	Methomyl	Whole Water	µg/L	1.00	200.00
39053	Aldicarb	Whole Water	µg/L	0.50	10.00
39570	Diazinon	Whole Water	µg/L	**1.00**	**0.60**
46313	Phorate	Whole Water	µg/L	1.00	4.00
79190	Pendimethalin	Whole Water	µg/L	0.01	300.00
81405	Carbofuran (Euradan)	Whole Water	µg/L	1.00	40.00
81408	Metribuzin (Sencor)	Whole Water	µg/L	2.00	200.00
81758	Ethoprop	Whole Water	µg/L	**0.50**	**0.10**
?	Chlorothalonil	Whole Water	µg/L	0.20	2.00

Farm Tailwater
Pesticide Sampling

Station	Date	Time	?????	04254	34356	34361	34699	34704	38830	38927	39051	39053	39570	46313	79190	81405	81408	81758
Farm C	4/6/1995	11:55	0.20	1.00	0.10	0.05	1.00	1.00	20	2.00	1.00		**5.30**	1.00	0.55	1.00	6.30	0.50
Farm C	4/19/1995	14:20	0.20	1.00	0.10	0.05	1.00	1.00	20	2.00	1.00		1.00	1.00	0.03	1.00	2.00	0.50
Farm C	6/6/1995	12:26	0.20	1.00	0.10	0.05	1.00	1.00	20	2.00	1.00		1.00	1.00	0.06	1.00	2.00	0.50
Farm C	10/10/1995	11:10	0.20	1.00	0.10	0.05	1.00	1.00	20	2.00	1.00		1.00	1.00	0.01	1.00	2.00	0.50
Farm C	4/1/1996	13:30	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00		1.00	1.00	0.34	1.00	2.00	0.50
Farm C	12/19/1996	13:10	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	*0.05***	1.00	2.00	0.50
Farm C	3/13/1997	12:20	**3.70**	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	0.34	1.00	4.10	0.50
Farm C	4/15/1997	12:45	0.29	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	0.13	1.00	2.00	0.50
Farm C	6/6/1997	12:20	0.23	1.00	0.11	0.057	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	0.10	1.00	2.00	0.50
Farm G	4/6/1995	12:10	0.20	1.00	0.10	0.05	1.00	1.00	**85**	2.00	1.00		.1.00	1.00	0.24	1.00	4.10	0.50
Farm G	6/6/1995	13:20	0.20	1.00	0.10	0.05	1.00	1.00	20	2.00			1.00	1.00	0.12		2.00	0.50
Farm G	10/10/1995	12:15	0.20	1.00	0.10	0.05	1.00	1.00	20	2.00	1.00		1.00	1.00	0.06	1.00	2.00	0.50
Farm G	4/1/1996	13:55	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00		1.00	1.00	0.25	1.00	2.80	0.50
Farm G	4/24/1996	14:00	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00		1.00	1.00	0.02	1.00	2.00	0.50
Farm G	6/18/1996	11:00	0.20	1.90	0.10	0.050	1.00	1.00	20.00	2.00	1.00		1.00	1.00	0.11	1.00	2.00	0.50
Farm G	12/19/1996	12:30	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	*0.05***	1.00	2.00	0.50
Farm G	3/13/1997	13:40	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	0.02	1.00	2.00	0.50
Farm G	4/15/1997	11:30	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	0.02	1.00	2.00	0.50
Farm G	6/6/1997	13:00	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	0.06	1.00	2.00	0.50
Farm G	9/29/1997	11:55	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	*0.05***	1.00	2.00	0.50
Farm I	4/6/1995	11:25	0.20	1.00	0.10	0.05	1.00	1.00	**120**	2.00	1.00		1.00	1.00	0.01	1.00	6.90	0.50
Farm I	4/19/1995	12:40	0.20	1.00	0.10	0.05	1.00	1.00	20	2.00	1.00		1.00	1.00	0.01	1.00	2.00	0.50
Farm I	6/6/1995	10:57	0.20	1.00	0.10	0.05	1.00	1.00	20	2.00	1.00		1.00	1.00	0.01	1.00	2.00	0.50
Farm I	10/10/1995	14:30	0.20	1.00	0.10	0.05	1.00	1.00	20	2.00	1.00		1.00	1.00	0.01	1.00	2.00	0.50
Farm I	4/1/1996	12:10	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00		1.00	1.00	0.06	1.00	4.30	0.50
Farm I	4/24/1996	11:15	0.20	1.00	0.10	0.220	1.00	1.00	20.00	2.00	1.00		1.00	1.00	0.02	1.00	2.00	0.50
Farm I	6/18/1996	9:40	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00		1.00	1.00	0.02	1.00	2.00	0.50
Farm I	12/19/1996	9:30	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	*0.05***	1.00	2.00	0.50
Farm I	4/15/1997	10:20	1.00	1.00	0.10	0.050	1.00	1.00	**39.00**	2.00	1.00	*0.5**	1.00	1.00	0.10	1.00	6.60	0.50
Farm I	6/6/1997	10:20	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	53.00	0.50	1.00	1.00	0.02	1.00	2.00	0.50
Farm I	9/29/1997	9:30	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.80	0.50	1.00	1.00	*0.05***	1.00	2.00	0.50
Farm J	4/6/1995	10:30	0.20	1.00	0.10	0.05	1.00	1.00	**300**	2.00	1.00		1.00	1.00	0.82	1.00	9.30	0.50
Farm J	4/19/1995	10:40	0.20	1.00	0.14	**0.49**	1.00	1.00	20	2.00	1.00		1.00	1.00	0.03	1.00	2.00	0.50
Farm J	6/6/1995	9:49	0.20	1.00	0.10	0.05	1.00	1.00	20	2.00	1.00		1.00	1.00	0.14	1.00	2.00	0.50
Farm J	10/10/1995	10:20	0.20	1.00	0.10	0.05	1.00	1.00	20	2.00	1.00		1.00	1.00	0.01	1.00	2.00	0.50
Farm J	4/1/1996	10:50	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00		1.00	1.00	0.17	1.00	2.00	0.50
Farm J	4/24/1996	10:00	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00		1.00	1.00	0.03	1.00	2.00	0.50
Farm J	3/13/1997	15:45	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	0.16	1.00	2.00	0.50
Farm J	4/15/1997	14:30	0.20	1.00	**0.53**	**0.460**	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	0.02	1.00	2.00	0.50

** DETECTION LIMIT HIGHER THAN BEFORE*

Surface Water
Pesticide Sampling

Station	Date	Time	?????	04254	34356	34361	34699	34704	38830	38927	39051	39053	39570	46313	79190	81405	81408	81758
DBR	4/6/1995	15:10	0.20	7.50	0.23	0.33	1.00	1.00	**51**	**5.10**	1.00		1.00	1.00	0.015	1.00	4.60	0.50
DBR	6/6/1995	14:15	0.20	1.00	0.10	0.05	1.00	1.00	20	2.00	1.00		1.00	1.00	0.01	1.00	2.00	0.50
DBR	10/10/1995	14:10	0.20	1.00	0.10	0.05	1.00	1.00	20	2.00	1.00		1.00	1.00	0.01	1.00	2.00	0.50
DBR	6/19/1996	13:25	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00		1.00	1.00	0.020	1.00	2.00	0.50
DBR	9/26/1996	12:30	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00		1.00	1.00	*0.05***	1.00	1.00	0.50
DBR	12/19/1996	10:15	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	*0.05***	1.00	2.00	0.50
DBR	3/13/1997	10:30	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	0.020	1.00	2.00	0.50
DBR	4/16/1997	12:15	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	0.020	1.00	2.00	0.50
DBR	6/6/1997	10:50	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	3.50	0.50	1.00	1.00	0.026	1.00	2.00	0.50
DBR	9/29/1997	9:55	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	4.30	0.50	1.00	1.00	*0.05***	1.00	2.00	0.50
DCR	4/6/1995	13:40	0.20	1.90	0.10	0.05	1.00	1.00	20	2.00	1.00		1.00	1.00	0.01	1.00	2.00	0.50
DCR	10/10/1995	13:50	0.20	1.00	0.10	0.05	1.00	1.00	20	2.00	1.00		1.00	1.00	0.01	1.00	2.00	0.50
DCR	6/19/1996	10:35	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00		1.00	1.00	0.020	1.00	10.00	0.50
DCR	9/26/1996	9:10	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00		1.00	1.00	*0.05***	1.00	1.00	0.50
DCR	12/19/1996	14:45	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	*0.05***	1.00	2.00	0.50
DCR	3/13/1997	14:30	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	0.025	1.00	2.00	0.50
DCR	4/16/1997	11:40	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	0.020	1.00	2.00	0.50
DCR	6/6/1997	13:25	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	0.020	1.00	2.00	0.50
DCR	9/29/1997	13:10	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	*0.05***	1.00	2.00	0.50
MOB	4/6/1995	12:30	0.20	1.00	0.10	0.13	1.00	1.00	20	2.00	1.00		**1.80**	1.00	0.095	1.00	2.20	**0.69**
MOB	10/10/1995	13:00	0.20	1.00	0.10	0.05	1.00	1.00	20	2.00	1.00		1.00	1.00	0.01	1.00	2.00	0.50
MOB	6/19/1996	12:10	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00		1.00	1.00	0.020	1.00	2.00	0.50
MOB	9/26/1996	10:50	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00		1.00	1.00	*0.05***	1.00	1.00	0.50
MOB	12/19/1996	11:50	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	*0.05***	1.00	2.00	0.50
MOB	3/13/1997	11:45	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	0.020	1.00	2.00	0.50
MOB	4/16/1997	10:25	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	0.020	1.00	2.00	0.50
MOB	6/6/1997	12:00	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	0.020	1.00	2.00	0.50
MOB	9/29/1997	11:05	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	*0.05***	1.00	2.00	0.50
OHD	10/10/1995	13:30	0.20	1.00	0.10	0.05	1.00	1.00	20	2.00	1.00		1.00	1.00	0.01	1.00	2.00	0.50
OHD	6/19/1996	12:55	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00		1.00	1.00	0.020	1.00	2.00	0.50
OHD	9/26/1996	11:40	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00		1.00	1.00	*0.05***	1.00	1.00	0.50
OHD	12/19/1996	11:00	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	*0.05***	1.00	2.00	0.50
OHD	4/16/1997	9:30	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	0.020	1.00	2.00	0.50
OHD	6/6/1997	11:20	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	0.020	1.00	2.00	0.50
OHD	9/29/1997	10:20	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	*0.05***	1.00	2.00	0.50

** DETECTION LIMIT HIGHER THAN BEFORE*

Farm Groundwater
Pesticide Sampling

Station	Date	Time	?????	04254	34356	34361	34699	34704	38830	38927	39051	39053	39570	46313	79190	81405	81408	81758
Farm C	10/10/1995	12:00	0.20	1.00	0.10	0.05	1.00	1.00	20	2.00	1.00		1.00	1.00	0.06	1.00	2.00	0.50
Farm C	4/1/1996	13:10	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00		1.00	1.00	0.950	1.00	9.20	0.50
Farm C	4/25/1996	10:45	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00		1.00	1.00	0.059	1.00	2.00	0.50
Farm C	9/26/1996	10:00	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00		1.00	1.00	*0.05***	1.00	1.00	0.50
Farm C	12/19/1996	13:35	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.5*	1.00	1.00	*0.05***	1.00	2.00	0.50
Farm C	3/13/1997	13:00	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	0.50	1.00	1.00	0.020	1.00	12.00	0.50
Farm C	4/16/1997	11:05	0.36	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	*0.5**	1.00	1.00	0.020	1.00	2.00	0.50
Farm C	6/6/1997	12:50	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	*0.5**	1.00	1.00	0.022	1.00	2.00	0.50
Farm C	9/29/1997	11:35	0.20	1.00	0.10	0.050	1.00	1.00	20.00	2.00	1.00	*0.5**	1.00	1.00	0.05**	1.00	2.00	0.50

** DETECTION LIMIT HIGHER THAN BEFORE*

Pesticide Sampling
Sediment Parameters

STORET #	Parameter	Sample Media	Unit
34359	Endosulfan, Beta	Bottom Depositions	µg/kg dry weight
34364	Endosulfan, Alpha	Bottom Depositions	µg/kg dry weight
34697	TRANS-1,3-Dichloropropene	Bottom Depositions	µg/kg dry weight
34702	CIS-1,3-Dichloropropene	Bottom Depositions	µg/kg dry weight
38833	Mancozeb	Bottom Depositions	µg/kg dry weight
39571	Diazinon	Bottom Depositions	µg/kg dry weight
49190	Methamidophos	Bottom Depositions	µg/kg dry weight
49191	Methomyl	Bottom Depositions	µg/kg dry weight
49197	Chlorothalonil	Bottom Depositions	µg/kg dry weight
81406	Carbofuran	Bottom Depositions	µg/kg dry weight
81409	Metribuzin	Bottom Depositions	µg/kg dry weight
81412	Phorate	Bottom Depositions	µg/kg dry weight
81895	Aldicarb	Bottom Depositions	µg/kg dry weight
82288	Ethoprop	Bottom Depositions	µg/kg dry weight
85793	Pendimethalin	Bottom Depositions	µg/kg dry weight
?	Metalaxyl	Bottom Depositions	µg/kg dry weight

Sediments
Pesticide Sampling

Station	Date	Time	?????	34359	34364	34697	34702	38833	39571	49190	49191	49197	81406	81409	81412	81895	82288	85793
DBR	1/26/1995	10:00	45.0	2.3	2.3	7.4	7.4	**3000.0**	45.0	89.0	41.0	9.1	41.0	45.0	45.0		23.0	91.0
DBR	12/1/1995	9:00	330.0	33.0	17.0	50.0	50.0	10000.0	330.0	660.0	300.0	67.0	300.0	330.0	330.0		170.0	670.0
DBR	11/1/1996	10:40	120.0	2400.0	1200.0	36.0	36.0	7100.0	120.0	240.0	210.0	4800.0	210.0	120.0	120.0	210.0	61.0	48000.0
DBR	9/12/1997	12:00	220.0	22.0	11.0	33.0	33.0	6700.0	220.0	440.0	1000.0	45.0	1000.0	220.0	220.0	1000.0	110.0	450.0
MOB	1/26/1995	11:45	240.0	24.0	24.0	38.0	38.0	7100.0	240.0	470.0	210.0	96.0	210.0	240.0	240.0		120.0	960.0
MOB	12/1/1995	10:55	370.0	37.0	19.0	50.0	50.0	11000.0	370.0	730.0	330.0	74.0	330.0	370.0	370.0		190.0	740.0
MOB	11/1/1996	14:00	97.0	580.0	300.0	29.0	29.0	5900.0	97.0	190.0	180.0	1200.0	180.0	97.0	97.0	180.0	50.0	12000.0
MOB	9/12/1997	10:45	160.0	16.0	8.1	24.0	24.0	4800.0	160.0	310.0	710.0	32.0	710.0	160.0	160.0	710.0	81.0	320.0
OHD	1/26/1995	11:00	75.0	3.9	3.9	12.0	12.0	2300.0	75.0	150.0	68.0	15.0	68.0	75.0	75.0		39.0	150.0
OHD	12/1/1995	9:46	49.0	4.9	2.5	8.0	8.0	1500.0	49.0	99.0	45.0	10.0	45.0	49.0	49.0		25.0	100.0
OHD	11/1/1996	11:20	66.0	1300.0	680.0	20.0	20.0	4000.0	66.0	130.0	120.0	2700.0	120.0	66.0	66.0	120.0	34.0	27000.0
OHD	9/12/1997	13:00	49.0	4.9	2.5	7.3	7.3	1500.0	49.0	97.0	44.0	9.9	44.0	49.0	49.0	44.0	25.0	99.0
TOC	1/26/1995	12:30	49.0	2.5	2.5	8.2	8.2	1500.0	49.0	97.0	44.0	9.9	44.0	49.0	49.0		25.0	99.0
TOC	12/1/1995	12:30	370.0	37.0	19.0	50.0	50.0	11000.0	370.0	730.0	330.0	74.0	330.0	370.0	370.0		190.0	740.0
TOC	11/1/1996	15:10	120.0	710.0	360.0	36.0	36.0	7100.0	120.0	240.0	210.0	1400.0	210.0	120.0	120.0	210.0	61.0	14000.0
TOC	9/12/1997	9:45	300.0	30.0	15.0	45.0	45.0	9000.0	300.0	650.0	1400.0	61.0	1400.0	300.0	300.0	1400.0	150.0	610.0

UNIVERSITY OF FLORIDA

Institute of Food and Agricultural Sciences

FINAL REPORT

Assessment to Determine the Biological Response to Best Management Practices in the Tri-County Agriculture Watersheds Phase I (January - December 1997)

December 1998

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TABLE OF CONTENTS

ACKNOWLEDGEMENTS i

TABLE OF CONTENTS ii

LIST OF TABLES iii

LIST OF FIGURES vii

EXECUTIVE SUMMARY x

INTRODUCTION 1

STUDY SITE 3

General Setting 3
Water Chemistry 7

MATERIALS AND METHODS 27

Field and Laboratory Procedures 27
Statistical Analysis 30

RESULTS AND DISCUSSION 34

Species Richness 34
Species Composition 47
Abundance 52
Community Diversity 59
Pollution Tolerance 66
Relationship to Water Chemistry 80

CONCLUSIONS AND RECOMMENDATIONS 84

REFERENCES 86

APPENDIX A: Raw Benthic Invertebrate Data 89

APPENDIX B: Water Chemistry Values Used in the Benthic Invertebrate Community Characteristics Correlation Analysis 134

APPENDIX C: Benthic Invertebrate Community Characteristics Used in the Water Chemistry Correlation Analysis 138

LIST OF TABLES

Table		Page
1.	Tri-County Agricultural Area (TCAA) tributary characteristics measured at each of the eight sample sites, lower St. Johns River, Florida, 1997	6
2.	Benthic invertebrate sampling dates by month and site, Tri-County Agricultural Area (TCAA), lower St. Johns River, Florida, 1997	28
3.	Total number of each macroinvertebrate taxa collected by both gear types combined (5 ponar dredge and 3 Hester-Dendy plate samples) at each of the eight Tri-County Agricultural Area sample sites, lower St. Johns River, Florida, 1997. Associated species code (Spcode) and tolerance value (TV) are also listed	35
4.	Benthic invertebrate species richness (number of taxa) as sampled by ponar dredge at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sites within season, 1997	41
5.	Benthic invertebrate species richness (number of taxa) as sampled by Hester-Dendy plate sampler at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sites within season, 1997	43
6.	Benthic invertebrate species richness (number of taxa) as sampled by ponar dredge at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sampling seasons at each site, 1997	44
7.	Benthic invertebrate species richness (number of taxa) as sampled by Hester-Dendy plate sampler at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sampling seasons at each site, 1997	45
8.	Benthic invertebrate species richness (number of taxa) sampled by ponar dredge at four sampling sites (DBR, OHD, MOB, TOC) in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among years (1994, 1995, 1997) within sampling site and season	46
9.	Total number of benthic invertebrates sampled by ponar dredge at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sites within sampling season, 1997 .	53

LIST OF TABLES (CONTINUED)

Table		Page
10.	Total number of benthic invertebrates sampled by Hester-Dendy plate sampler at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sites within sampling season, 1997	54
11.	Total number of benthic invertebrates sampled by ponar dredge at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sampling seasons at each site, 1997	55
12.	Total number of benthic invertebrates sampled by Hester-Dendy plate sampler at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sampling seasons at each site, 1997	56
13.	Total number of benthic invertebrates sampled by ponar dredge at four sampling sites (DBR, OHD, MOB, TOC) in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among years (1994, 1995, 1997) within sampling site and season	58
14.	Shannon-Weiner Diversity Index for benthic invertebrates sampled by ponar dredge at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sites within sampling season, 1997	60
15.	Shannon-Weiner Diversity Index for benthic invertebrates sampled by Hester-Dendy plate sampler at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sites within sampling season, 1997	61
16.	Shannon-Weiner Diversity Index for benthic invertebrates sampled by ponar dredge at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sampling seasons at each site, 1997	62
17.	Shannon-Weiner Diversity Index for benthic invertebrates sampled by Hester-Dendy plate sampler at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sampling seasons at each site, 1997	63

LIST OF TABLES (CONTINUED)

Table		Page
18.	Shannon-Weiner Diversity Index for benthic invertebrates sampled by ponar dredge at four sampling sites (DBR, OHD, MOB, TOC) in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among years (1994, 1995, 1997) within sampling site and season	65
19.	Hilsenhoff Biotic Index (HBI) for benthic invertebrates sampled by ponar dredge at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sites within season, 1997	67
20.	Hilsenhoff Biotic Index (HBI) for benthic invertebrates sampled by Hester-Dendy plate sampler at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sites within season, 1997	68
21.	Hilsenhoff Biotic Index (HBI) for benthic invertebrates sampled by ponar dredge at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sampling seasons at each site, 1997	70
22.	Hilsenhoff Biotic Index (HBI) for benthic invertebrates sampled by Hester-Dendy plate sampler at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sampling seasons at each site, 1997	71
23.	Hilsenhoff Biotic Index (HBI) for benthic invertebrates sampled by ponar dredge at four sampling sites (DBR, OHD, MOB, TOC) in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among years (1994, 1995, 1997) within sampling site and season	72
24.	Tolerance values (TV) for benthic invertebrates sampled by both gears combined and by individual gear (ponar dredge and Hester-Dendy plate sampler) at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sites in each gear type, 1997	74
25.	Tolerance values (TV) for benthic invertebrates sampled by ponar dredge at four sampling sites (DBR, OHD, MOB, TOC) in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among years (1994, 1995, 1997) within sampling site and season	79

LIST OF TABLES (CONTINUED)

Table		Page
26.	Spearman correlation coefficients between seasonal site ponar dredge means of four benthic invertebrate community characteristics (species richness [number of taxa], number of individuals, Shannon-Weiner Diversity Index [SWDI], and Hilsenhoff Biotic Index [HBI]) and seasonal site water chemistry, 1997	81
27.	Spearman correlation coefficients between seasonal site Hester-Dendy plate sampler means of four benthic invertebrate community characteristics (species richness [number of taxa], number of individuals, Shannon-Weiner Diversity Index [SWDI], and Hilsenhoff Biotic Index [HBI]) and seasonal site water chemistry, 1997	83

LIST OF FIGURES

Figure — Page

1. Location of five benthic invertebrate sampling sites on Dog Branch (DBR, DBR2) and Old Hastings Drainage (OHD, OHD2, OHD3) in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997 4

2. Location of three benthic invertebrate sampling sites on Moccasin Branch (MOB, MOB2) and Tocoi Creek (TOC) in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997 5

3. Water temperature measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997 8

4. Color measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997 9

5. Conductivity measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997 10

6. Dissolved oxygen concentration measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997 11

7. pH values measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997 12

8. Total suspended solids concentration measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997 13

9. Total ammonia concentration measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997 14

10. Total nitrogen concentration measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997 15

11. Nitrite/nitrate values measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997 16

LIST OF FIGURES (CONTINUED)

Figure — Page

12. Total phosphorus concentration measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997 17

13. Ortho-phosphate concentration measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997 18

14. Total organic carbon concentration measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997 19

15. Chlorophyll-a concentration measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997 20

16. Total dissolved solids concentration measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997 21

17. Turbidity values measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997 22

18. Daily rainfall data measured at Town Branch, lower St. Johns River, Florida, between 1 January and 31 December 1997 25

19. Daily rainfall data measured at Reid Farm, lower St. Johns River, Florida, between 1 January and 31 December 1997 26

20. Relative abundance (percent) of major taxonomic groups of benthic invertebrates at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, ponar dredge and Hester-Dendy plate data combined, 1997 48

21. Relative abundance (percent) of major taxonomic groups of benthic invertebrates at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, ponar dredge samples, 1997 49

22. Relative abundance (percent) of major taxonomic groups of benthic invertebrates at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, Hester-Dendy plate samples, 1997 51

LIST OF FIGURES (CONTINUED)

Figure Page

23. Distribution of pollution tolerance (TV) values for benthic invertebrates from each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, ponar dredge and Hester-Dendy plate data combined, 1997 75

24. Distribution of pollution tolerance (TV) values for benthic invertebrates from each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, ponar dredge data, 1997 76

25. Distribution of pollution tolerance (TV) values for benthic invertebrates from each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, Hester-Dendy plate data, 1997 . . 77

EXECUTIVE SUMMARY

The long-term goal of the St. Johns Water Management District (SJRWMD) is to determine if the use of best management practices (BMPs, i.e, fertilization composition, fertilization rate and managed irrigation) will reduce any effects of agriculture on the water quality and biological community of the lower St. Johns River and its tributaries. Some researchers believe macroinvertebrate communities to be "biological indicators" of the overall status of aquatic ecosystems. The macroinvertebrate communities in four tributaries of the lower St. Johns River in the Tri-County Agricultural Area (TCAA) were sampled during 1997 as a continuation of earlier research of the SJRWMD conducted during 1994 and 1995 (Cichra and Mumma, 1996), to determine the efficacy of new BMPs. The specific objectives of this project were to:

1) continue a data base for benthic macroinvertebrates prior to the implementation of BMPs to which future data bases could be compared,
2) compare the macroinvertebrate communities (species richness [number of taxa], abundance [density], species diversity and tolerance to pollution) of four tributaries of the lower St. Johns River, and
3) examine the relationship between species richness, abundance, diversity and pollution tolerance to water chemistry.

Study Area: Four tributaries within the TCAA of similar size, depth and flow rate were sampled. Three tributaries (Dog Branch [sites DBR and DBR2], Moccasin Branch [sites MOB and MOB2] and Old Hastings Drainage [sites OHD, OHD2 and OHD3]) drained agricultural (row crop) areas, while Tocoi Creek [site TOC] drained a wooded pastoral watershed and was used as the reference site.

Invertebrate Sampling: Quantitative benthic macroinvertebrate sampling was conducted at each of the eight sites during February, April/May, August and November 1997 using Ponar grab (N=5) and

Hester-Dendy multiple-plate (N=3) samplers. After samples were collected, preserved, picked, sorted and identified, the number of taxa (species richness), number of organisms, Shannon-Wiener community diversity index (SWDI), and Hilsenhoff Biotic Index (HBI) were calculated and analyzed to determine differences among sites within seasons, among seasons within sites, and among years within site and season.

Water Chemistry: Temperature, color, conductivity, dissolved oxygen, pH, total suspended solids, total ammonia, total nitrogen, nitrite/nitrate nitrogen, total phosphorus, ortho-phosphate, total organic carbon, chlorophyll-a, total dissolved solids and turbidity data were obtained from the SJRWMD and examined. Dog Branch had the lowest color and total organic carbon, and highest conductivity, total ammonia, nitrite/nitrate nitrogen, total phosphorus, total dissolved solids and turbidity. MOB2 had low pH, total suspended solids and turbidity, and was the most colored. Tocoi Creek, the reference site, had low conductivity, total suspended solids, total phosphorus, total dissolved solids and turbidity, and the highest dissolved oxygen.

Species Richness: A total of 124 benthic macroinvertebrate taxa were collected. Overall species richness for the three agricultural tributaries and the reference tributary were 56 taxa for Dog Branch, 77 Old Hastings Drainage, 78 for Moccasin Branch and 58 for Tocoi Creek. Sites in Moccasin Branch and Tocoi Creek had high overall species richness (64 at MOB, 55 at MOB2 and 58 at TOC). All three sites in Old Hastings Drainage and the downstream site in Dog Branch had intermediate species richness (44 taxa at OHD, 47 at OHD2, 49 at OHD3 and 46 at DBR, respectively), while DBR2 had the lowest number of taxa (35).

Greater overall species richness was observed in 1994 and 1995 (DBR, OHD, MOB and TOC had 86, 81, 77 and 90 taxa, respectively, Cichra and Mumma, 1996) than in 1997. More collections were made over a longer time period during 1994-1995 with more sampling methods and greater detail in taxonomy.

Ponar data revealed that Tocoi Creek had significantly more taxa than two to five of the other seven sites within any season. TOC and MOB were never found to differ, but both almost always differed from DBR2. Seven of the eight highest mean numbers of taxa per sample were recorded at TOC and MOB. DBR2 had significantly lower species richness than two to five of the other sites during any season. Analysis of the plate data found fewer inconsistent among-site within-season differences. Few, but inconsistent, among-season within-site differences in species richness were detected using data from either gear.

Year to year comparisons of the number of taxa per ponar dredge found no differences at DBR and OHD. During five of the eight site x season comparisons, significant differences were detected at MOB and TOC. Species richness was significantly greater in 1997 than in 1994 and 1995.

Species Composition: Invertebrate communities at DBR, OHD and OHD2 were composed of three major groups including oligochaetes (segmented worms), isopods (sow bugs) and dipterans (true flies, primarily midges). Both DBR2 and OHD3 were dominated by dipterans, amphipods (scuds and sideswimmers) and oligochaetes. MOB and MOB2 were similar, being dominated by dipterans and oligochaetes. TOC, the reference site, was least similar to the other seven sites. TOC had four abundant invertebrate groups, dipterans, mayflies, oligochaetes and snails. Mayflies were rare at the other sites.

Abundance: Mean number of invertebrates collected per ponar sample was found to be significantly highest at DBR (February), OHD2 (May) and TOC (November). These three sites were generally not different from each other. OHD and MOB typically had the lowest mean densities. The reference tributary, Tocoi Creek, supported some of the highest invertebrate abundances observed, but never were they higher than all of the sites in the agricultural tributaries. Seasonal density differences within site were detected by the plate data, but no general trends are apparent.

No year to year differences in ponar density were detected within ten of the 16 site-season analyses. Mean densities of invertebrates were significantly higher in 1997 than in 1994. Densities in 1995 were also significantly higher than in 1994.

Community Diversity: SWDI values were significantly highest at OHD3, MOB and TOC in all seasons. DBR2 was significantly lower than OHD3, MOB and TOC in all four seasons, while OHD was significantly lower than these three sites in all but February. TOC had the greatest diversity in February and May, while MOB had the greatest diversity in August and November. The least diverse sites within individual seasons were generally DBR2 or OHD.

Analysis of the plate data reveals that OHD3 had the highest diversity in all seasons, followed by TOC. These two sites were never found to differ significantly from each other nor from DBR. Other stations produced no pattern among seasons.

Mean SWDI was far less variable over time within each site. Seasonal ponar means were statistically different at three of the eight sites, while plate means were different at only one of the eight sites. No seasonal pattern is apparent.

Analysis of the ponar data detected no differences in diversity among years (1994, 1995 and 1997) within seasons at DBR and OHD. During all seasons at MOB, mean SWDI values were significantly larger in 1997 than in 1994 or 1995. SWDI means for 1997 were also significantly greater than the 1994 and 1995 means within the January-February and April-May seasons at TOC.

Pollution Tolerance: The Hilsenhoff Biotic Index (HBI) for a given sample of benthic invertebrates is basically the mean weighted value of the individual pollution tolerance values (TVs) of the organisms in the sample. Tolerance values can range from 0 to 10, with the higher number indicating greater tolerance to pollution/enrichment. Tolerance values of the taxa collected in this study were found to range from 1 to 9.8.

HBI values at the Dog Branch and Old Hastings Drainage sites were never found to differ from each other. MOB was found to

differ from these sites in August. MOB2 and/or TOC differed from DBR in three of the four seasons. Other differences were inconsistent among seasons. TOC, the reference site, had the lowest mean sample HBI in February and May, while MOB had the lowest mean HBI in August and November. OHD had the highest mean sample HBI in May, August and November. Plate HBI values were significantly higher at DBR2 than at DBR in both August and November. Among-season within-site analyses indicate that tolerance values are quite stable within sites throughout the year.

A year to year analysis found differences at DBR, MOB and TOC, however, there was no apparent year to year trend. Samples in 1997 had significantly lower HBI than did samples taken in 1994 and/or 1995 for three of the six tests, but higher HBI for the other three tests.

Mean TVs for all gears combined ranged from 7.22 to 7.73, placing all eight sites (four tributaries) into the classes of "significant to very significant organic pollution". TVs at DBR2 were significantly higher than TVs at the other seven sites. OHD3, MOB and MOB2 had the lowest TVs. Based on ponar data, DBR2 and OHD had the highest TVs, while MOB, MOB2, TOC and OHD3 had the lowest. Fewer differences among sites were detected using the plate data.

A year to year analysis of the ponar tolerance values at DBR, OHD, MOB and TOC found significant differences in TVs among and between years for all site x season comparisons. Tolerance values in 1997 were significantly higher than those in 1994 and/or 1995 for all comparisons. Differences between tolerance values from 1994 and 1995 were inconsistent.

Relationship to Water Chemistry: Total suspended solids, total nitrogen, nitrite/nitrate nitrogen, total phosphorus, total ortho-phosphate and turbidity were negatively correlated to species richness and SWDI, and positively correlated to HBI. As nutrients, suspended matter and turbidity increased, the invertebrate communities had fewer taxa and lower diversity. Organisms comprising these communities were those more tolerant to pollution/enrichment. Conductivity and total ammonia showed

similar relationships with species richness, SWDI and HBI. Invertebrate density was not correlated to water chemistry. Fewer significant correlations were found with the plate data. These correlations, in general, were similar to those of the ponar data.

Recommendations: The initial study design used during 1994 and 1995 was modified during this study conducted in 1997. Modifications included (1) adding four more sites further upstream in representative habitats, (2) collecting more ponar grab and plate sampler replicates, (3) deleting the use of dipnets, and (4) not identifying organisms to the lowest possible taxonomic level. These modifications should continue in subsequent years as numerous differences among sites and seasons were detected, and meaningful significant correlations were found in 1997 that were not found using the 1994/1995 data.

INTRODUCTION

The St. Johns River drops less than 30 feet over its length of 310 miles. This extremely low gradient (less than 1 inch per mile) along with tidal influences, results in extremely low flow rates within the river and its tributaries. Because of these low flow rates and long retention time of water within the river and its tributaries, pollutants from urban and agricultural runoff, wastewater treatment, etc. may take longer to reach the Atlantic Ocean than in most large river systems. The Surface Water Improvement and Management program (SWIM Act of 1987) designates the lower St. Johns River as a Class III priority stream in need of surface water restoration and protection. The lower St. Johns River watershed occupies approximately 2,800 square miles between Georgetown and Mayport, Florida. Surface runoff from the Tri-County Agriculture Area (approximately 38,000 acres in Flagler, Putnam and St. Johns Counties) enters the lower St. Johns River through a network of irrigation canals and small tributaries. Agricultural practices in this area may influence the water chemistry of the lower St. Johns River by increasing the nutrient concentration and sediment load of contributing streams. In an attempt to reduce possible detrimental effects of agriculture on water quality, the St. Johns River Water Management District (SJRWMD) is encouraging farmers to follow University of Florida, Institute of Food and Agricultural Science (IFAS) best management agricultural practices (BMPs).

The long-term overall goal of this project is to determine whether the use of agricultural BMPs (fertilization composition, fertilization rate, and managed irrigation) will reduce any effects of agriculture on the water quality and biological community of the lower St. Johns River and its tributaries. Some researchers believe macroinvertebrate communities to be "biological indicators" of the overall status of the aquatic ecosystem. However, some researchers believe that trends in macroinvertebrate populations may require three or more years to become apparent (ITFM 1992). The macroinvertebrate communities of four tributaries of the lower St. Johns River were sampled during 1994 and 1995 (Cichra and Mumma 1996) and 1997 (present study, Phase I) in order to determine the efficacy of newly developed agricultural BMPs once implemented. The 1997 sampling increased the number of Hester-Dendy plate (N=3) and ponar dredge (N=5) samples taken per site, and dropped qualitative sampling by dip net. The specific objectives of this report are to 1) temporally continue (1997) and geographically expand (four additional sites) a data base for benthic macroinvertebrates prior to the implementation of BMPs to which future data bases may be compared, 2) compare macroinvertebrate communities (species richness [number of taxa], abundance [number of organisms/sample], species diversity, and Hilsenhoff Biotic Index [HBI]) among and within four tributaries of the lower St. Johns River, 3) examine species richness, abundance, diversity, and HBI in relation to available water chemistry data, and 4) provide recommendations to improve study design, sampling methodologies, and data analysis during future phases of this study.

STUDY SITE

General Setting

Four easily accessible tributaries within the TCAA having similar size and flow rates (assumed - no available data) were chosen for comparison of their benthic invertebrate communities (Figures 1 and 2). Three tributaries (Dog Branch, Moccasin Branch, and Old Hastings Drainage) drain agricultural (row crop) areas, while Tocoi Creek drains a wooded pastoral watershed (Pam Livingston, SJRWMD, personal communication).

A total of eight sampling locations (sites) were selected for monitoring. The most downstream site in each of the four tributaries was the same site as that used during the initial 1994 and 1995 benthic invertebrate sampling (Cichra and Mumma 1996). These are designated as DBR (Dog Branch), MOB (Moccasin Branch), OHD (Old Hastings Drainage), and TOC (Tocoi Creek). Four new sites, located further upstream, were added in 1997 (one in Dog Branch [DBR2], one in Moccasin Branch [MOB2], and two in Old Hastings Drainage [OHD2, OHD3]). Seven of the eight sites were located within 100 m upstream from public highway bridges, allowing ease of access. DBR2 was located 25 m upstream of an abandoned railroad bridge. Access to this site was obtained by walking down the old rail bed.

The four tributaries were relatively small (3.2 to 19.4 m mean width), shallow (0.2 to 1.3 m mean depth), with little to no aquatic vegetation, and substrates composed primarily of sand with muck and leaves (Table 1). All sites were relatively devoid of

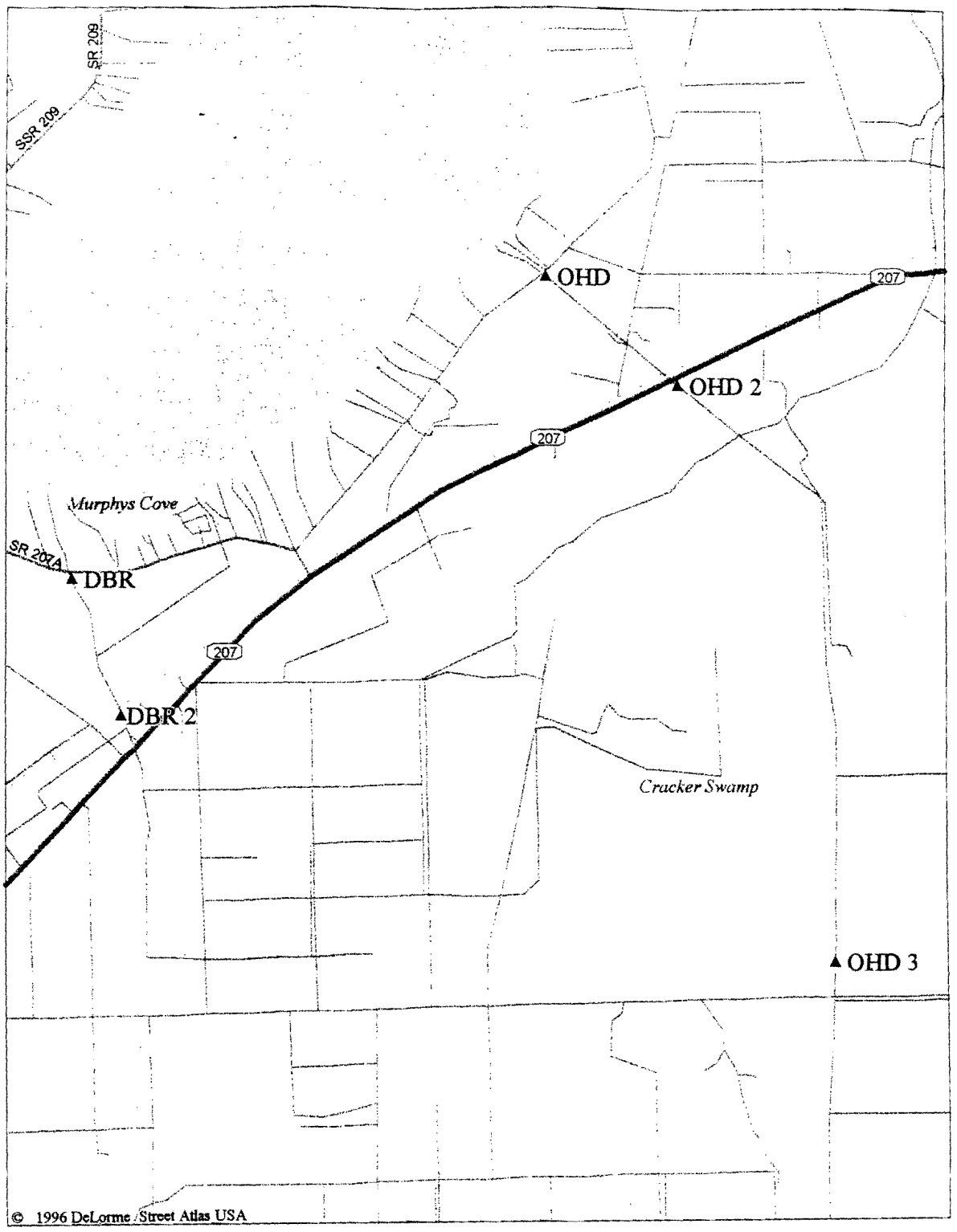


Figure 1. Location of five benthic invertebrate sampling sites on Dog Branch (DBR, DBR2) and Old Hastings Drainage (OHD, OHD2, OHD3) in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997.

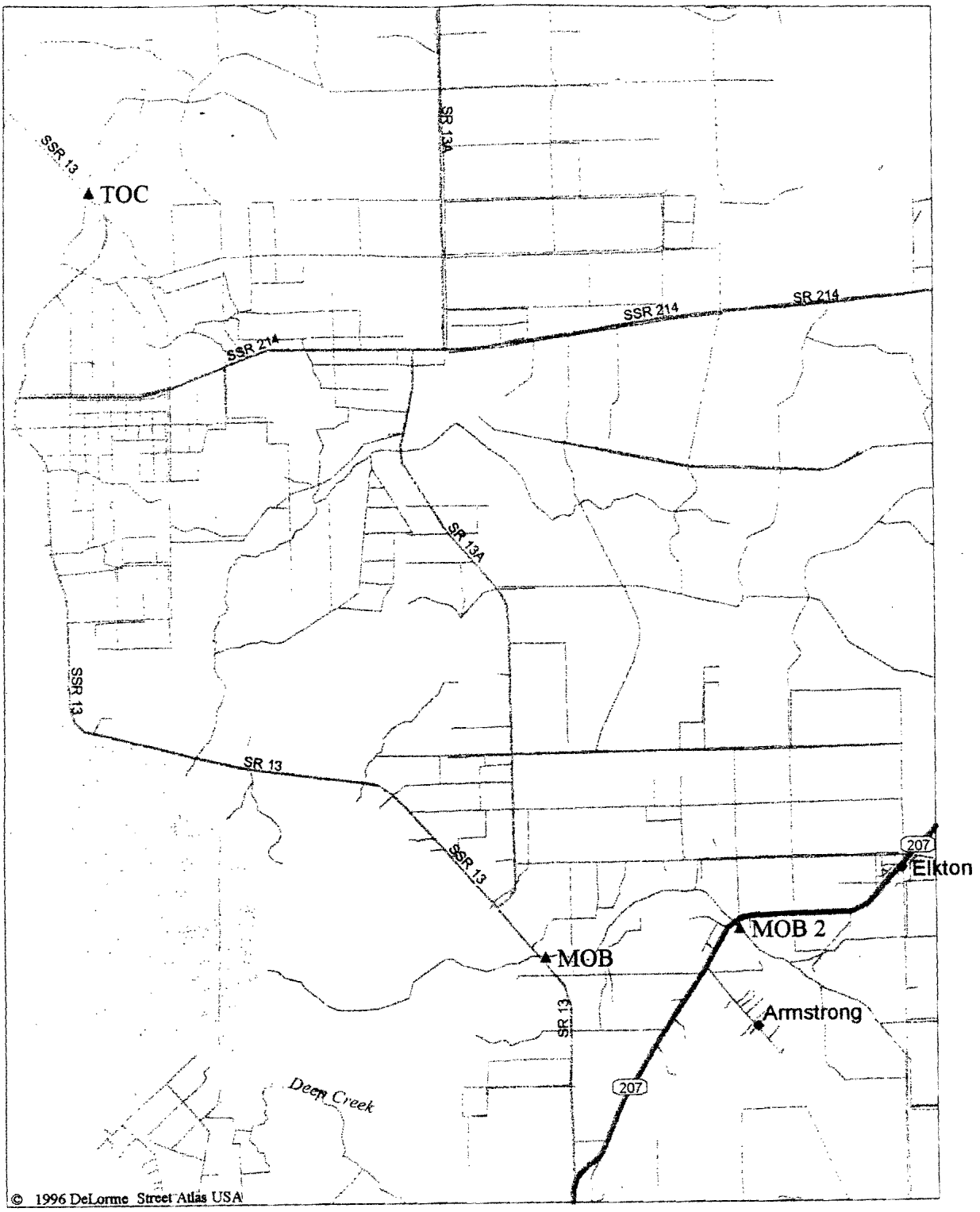


Figure 2. Location of three benthic invertebrate sampling sites on Moccasin Branch (MOB, MOB2) and Tocoi Creek (TOC) in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997.

Table 1. Tri-County Agricultural Area (TCAA) tributary characteristics measured at each of the eight sampling sites, lower St. Johns River, Florida, 1997. Number in () indicates one standard deviation.

Site[1]	Mean Width(m)	Mean Depth(m)	Aquatic Vegetation	Substrate Type
DBR	10.8 (2.0)	1.2 (0.6)	None	sand with muck and leaves
DBR2	4.6 (0.8)	0.5 (0.1)	Colocasia esculenta	packed sand and woody litter
OHD	9.0 (0.8)	0.9 (0.2)	Colocasia esculenta	sand with some leaves
OHD2	6.7 (0.0)	0.6 (0.2)	None	sand with muck and leaves
OHD3	3.2 (0.3)	0.2 (0.1)	Colocasia esculenta Elodea sp.	packed sand and shell
MOB	19.4 (3.5)	1.3 (1.1)	Hydrocotyle umbellata Nuphar luteum	sand with muck and leaves
MOB2	7.1 (0.6)	0.9 (0.3)	None	packed sand with leaf litter
TOC	15.4 (4.9)	1.0 (0.3)	Hydrocotyle umbellata	sand with muck and leaves

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
MOB - Moccasin Branch
TOC - Tocoi Creek

submersed aquatic vegetation. Elodea sp. was present at OHD3. DBR2, OHD and OHD3 each had an emergent fringe of wild taro (Colocasia esculenta). Tocoi Creek and Moccasin Branch (MOB) had substantially higher amounts of emergent aquatic vegetation, primarily water pennywort (Hydrocotyle umbellata) and spatterdock (Nuphar luteum). Of the four most downstream sites, OHD was narrower than the other three sites (DBR, MOB and TOC), with much less variation in stream width. Also, OHD had a much smaller percentage of leaf litter and organic substrate, consisting of primarily a hard, sand bottom. These characteristics of Old Hastings Drainage were likely due to prior channelization. Stream depth was comparable among the four downstream sites. Stream width and depth decreased in an upstream direction in each of the three tributaries with multiple sites (Dog Branch, Old Hastings Drainage and Moccasin Branch). OHD3 was the narrowest and shallowest of the eight sites.

Water Chemistry

Various water chemistry parameters were measured by SJRWMD staff at each of the eight sites concurrently with the quarterly benthic invertebrate sampling during 1997 (SJRWMD, unpublished data). Figures 3 through 17 show water temperature, color, conductivity, dissolved oxygen, pH, total suspended solids, total ammonia, total nitrogen, nitrite/nitrate nitrogen, total phosphorus, ortho-phosphate, total organic carbon, chlorophyll-a, total dissolved solids and turbidity for 1997, respectively.

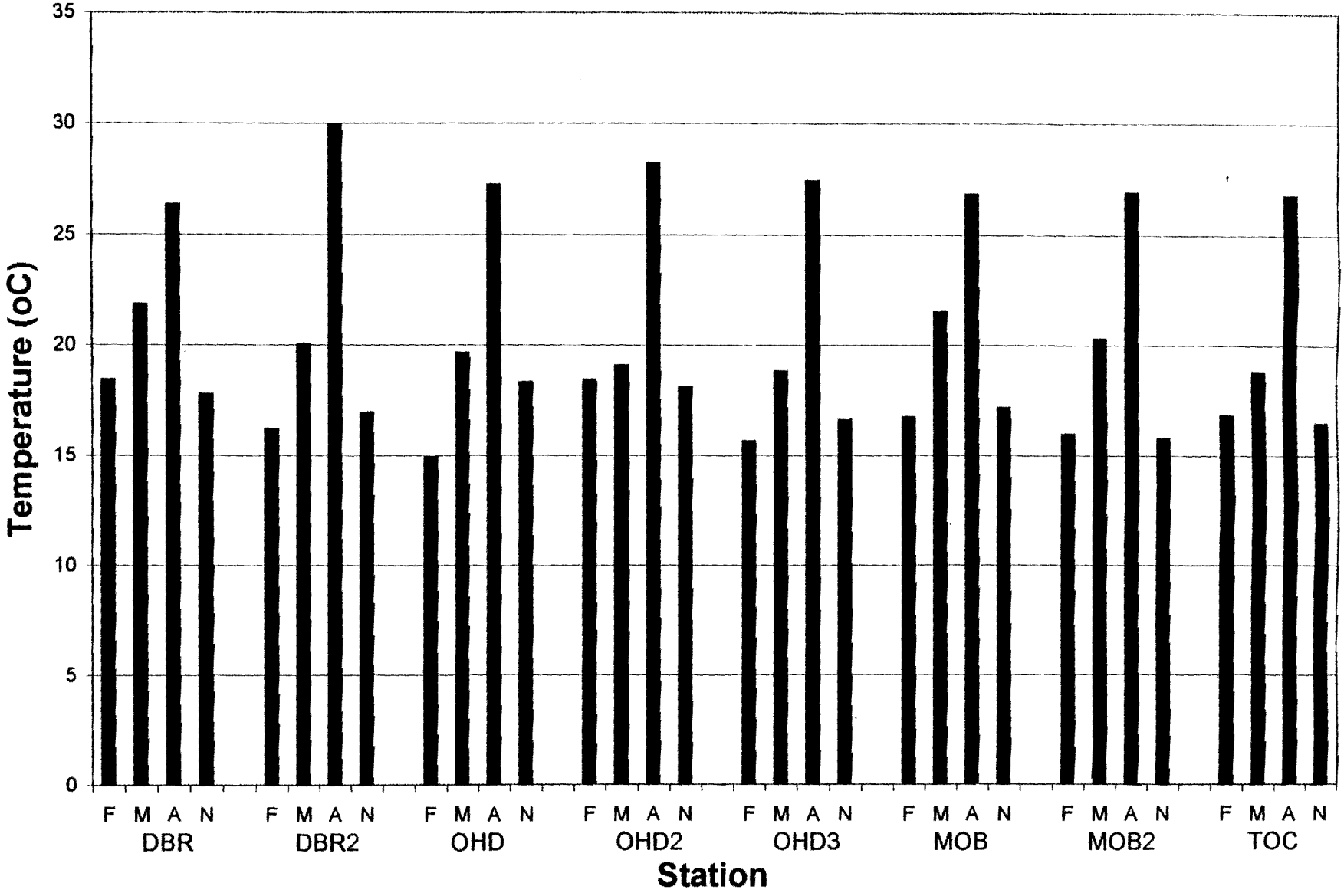


Figure 3. Water temperature measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997.

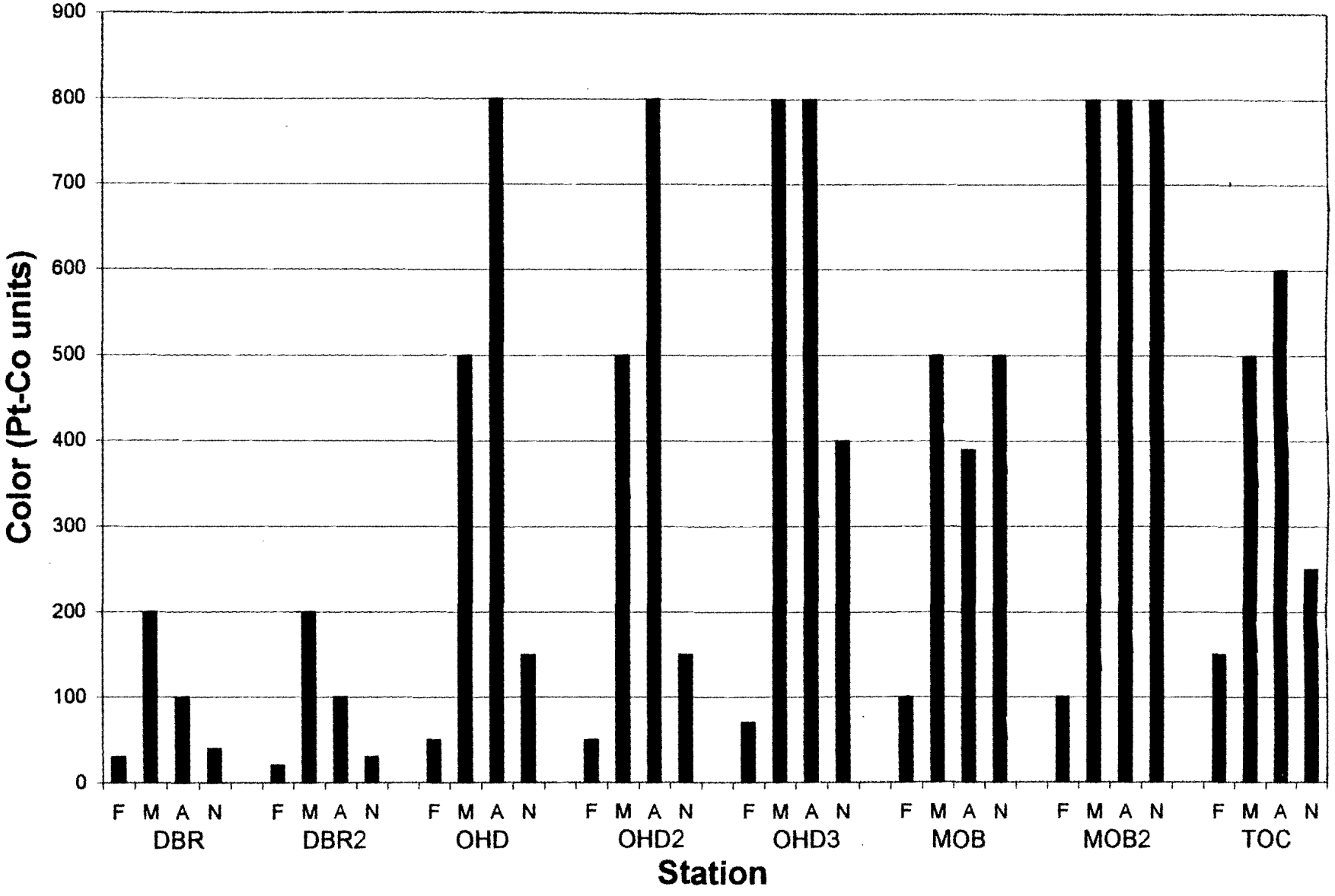


Figure 4. Color measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997.

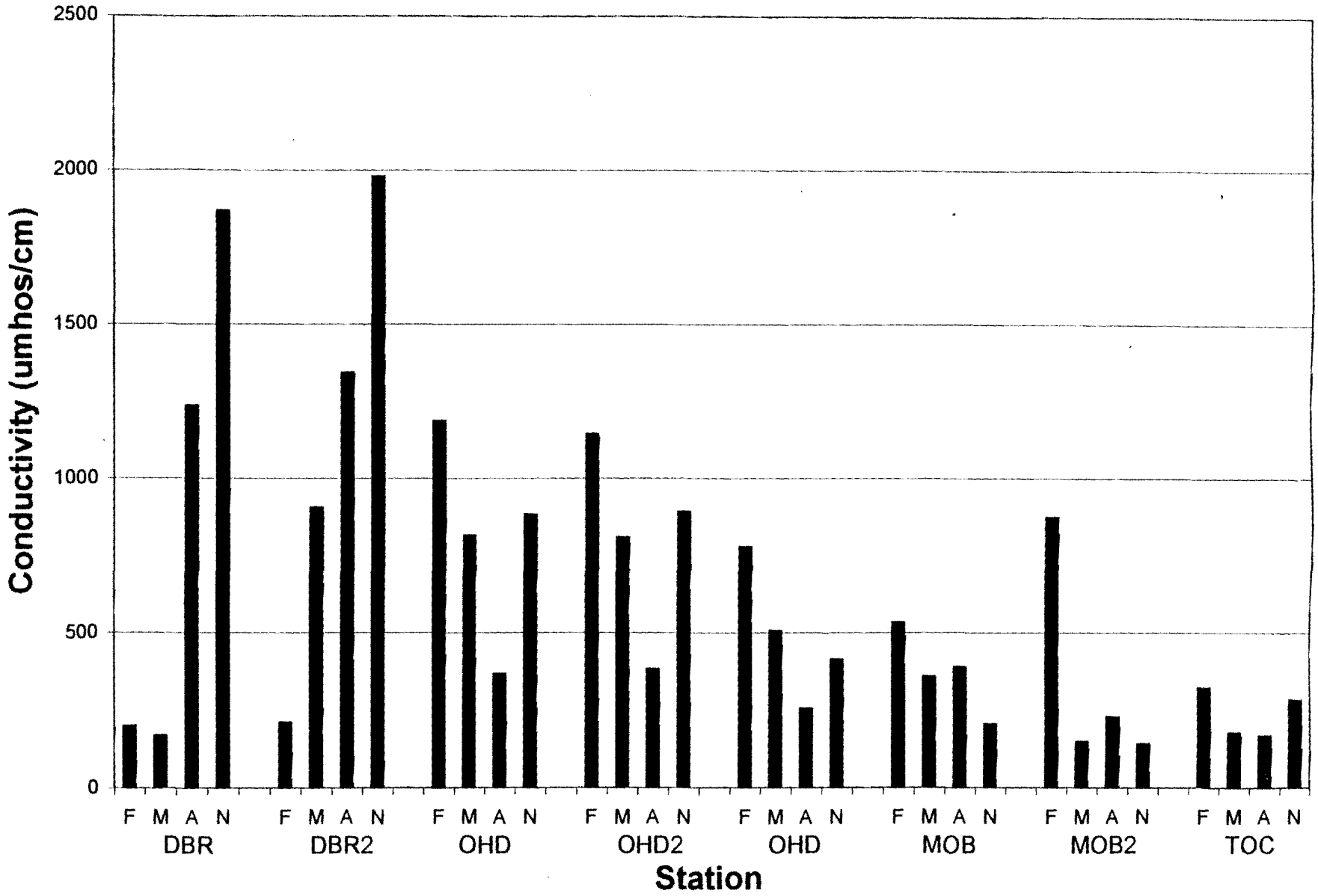


Figure 5. Conductivity measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997.

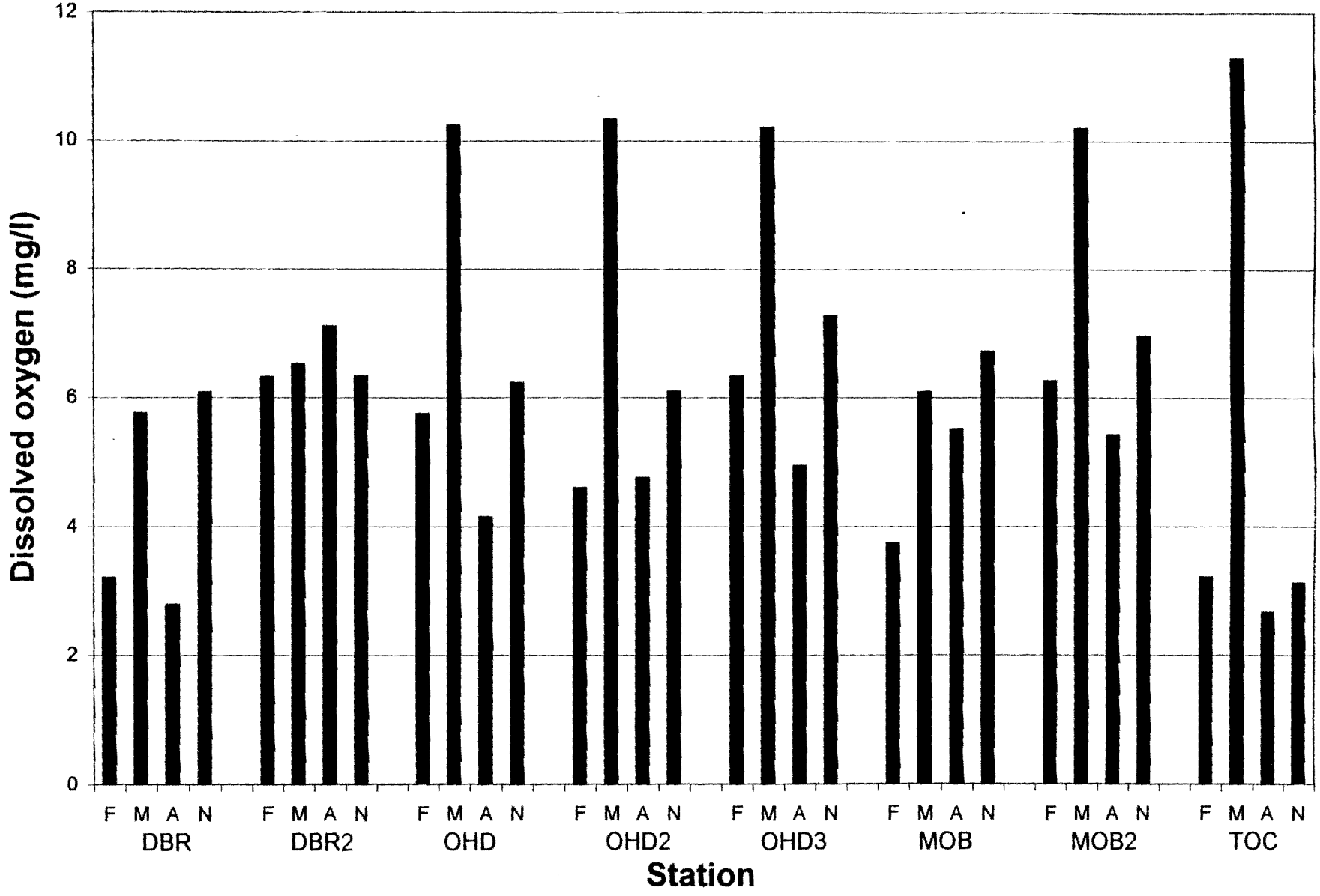


Figure 6. Dissolved oxygen concentration measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997.

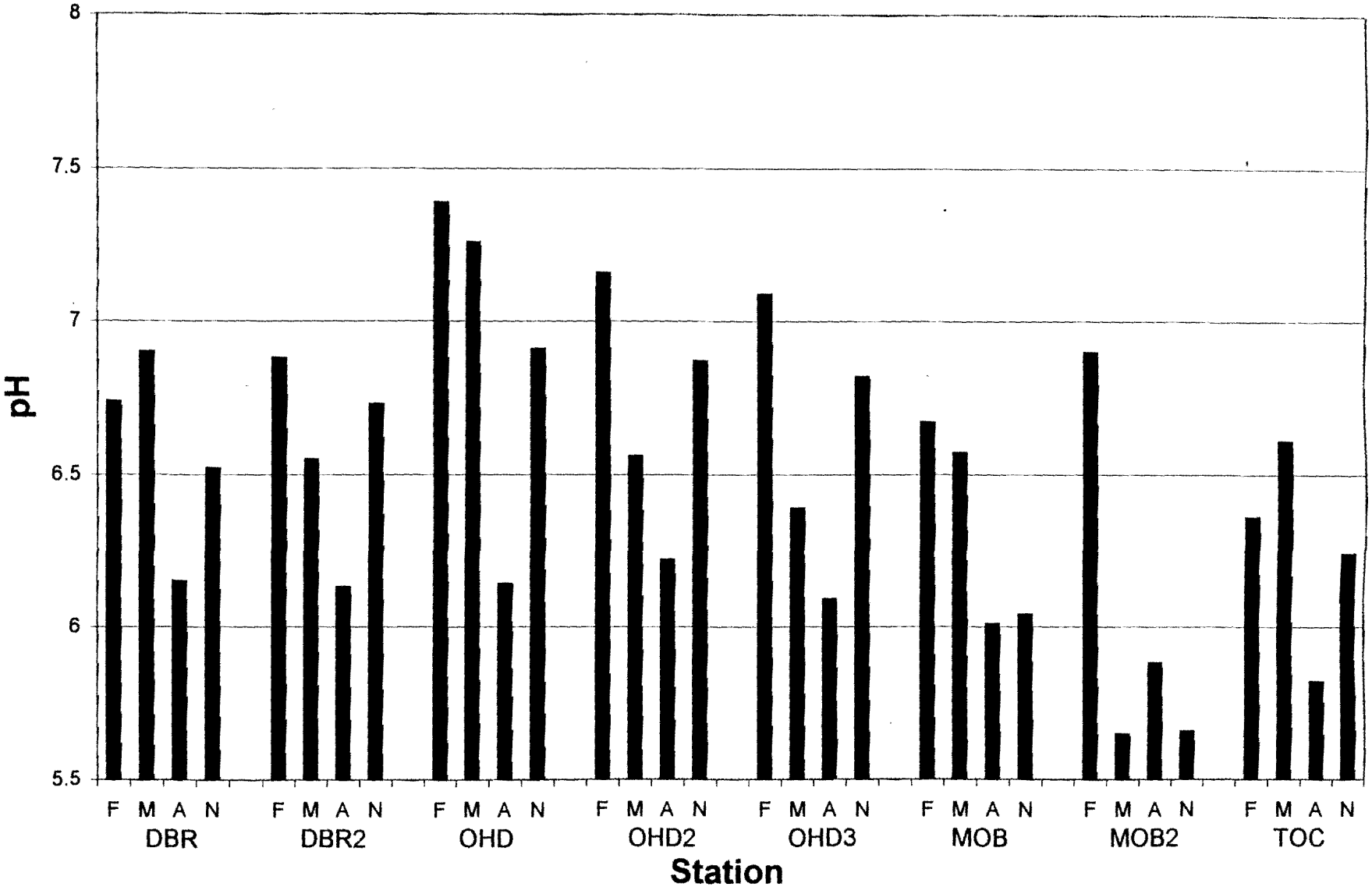


Figure 7. pH values measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997.

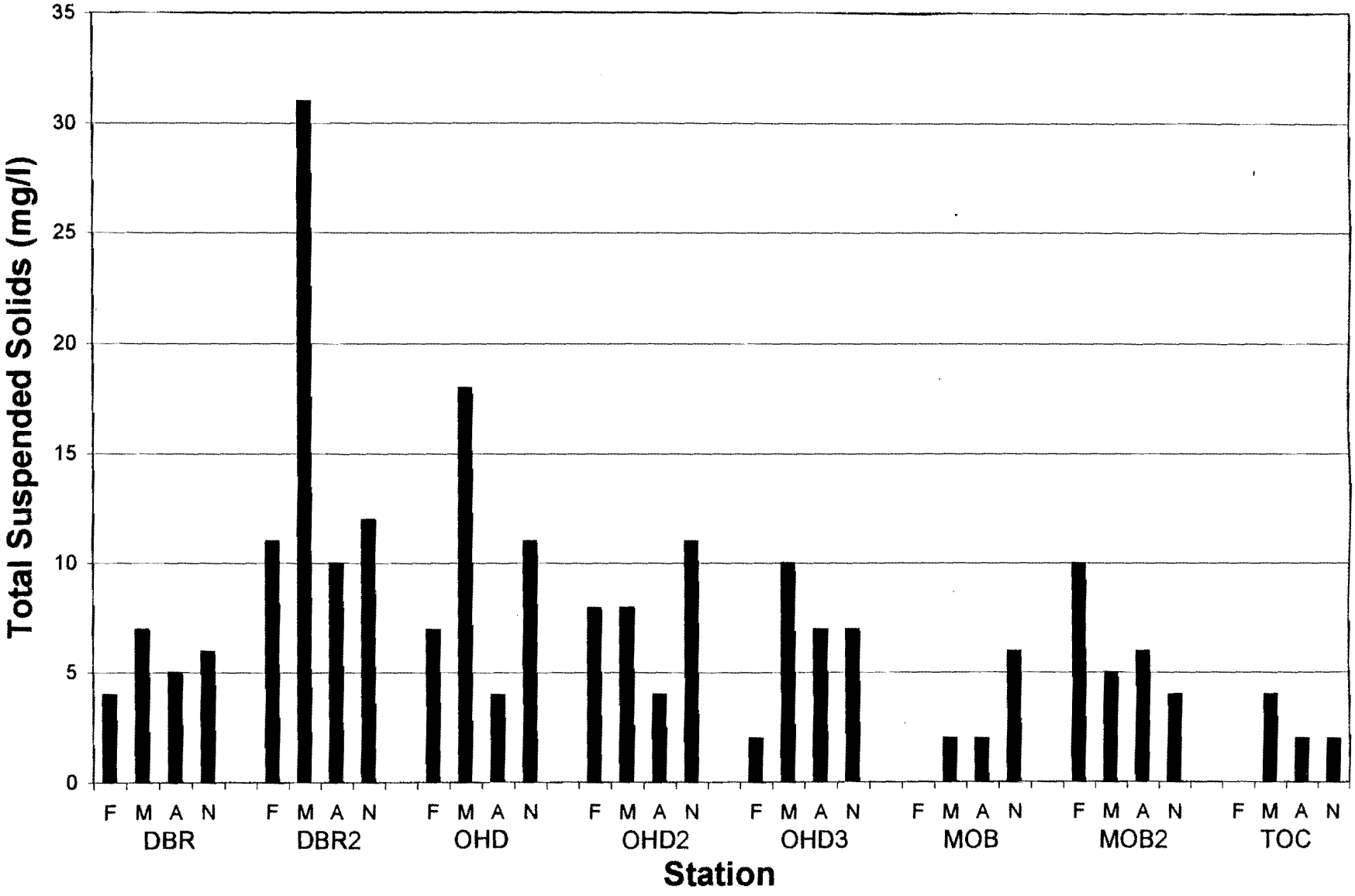


Figure 8. Total suspended solids concentration measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997.

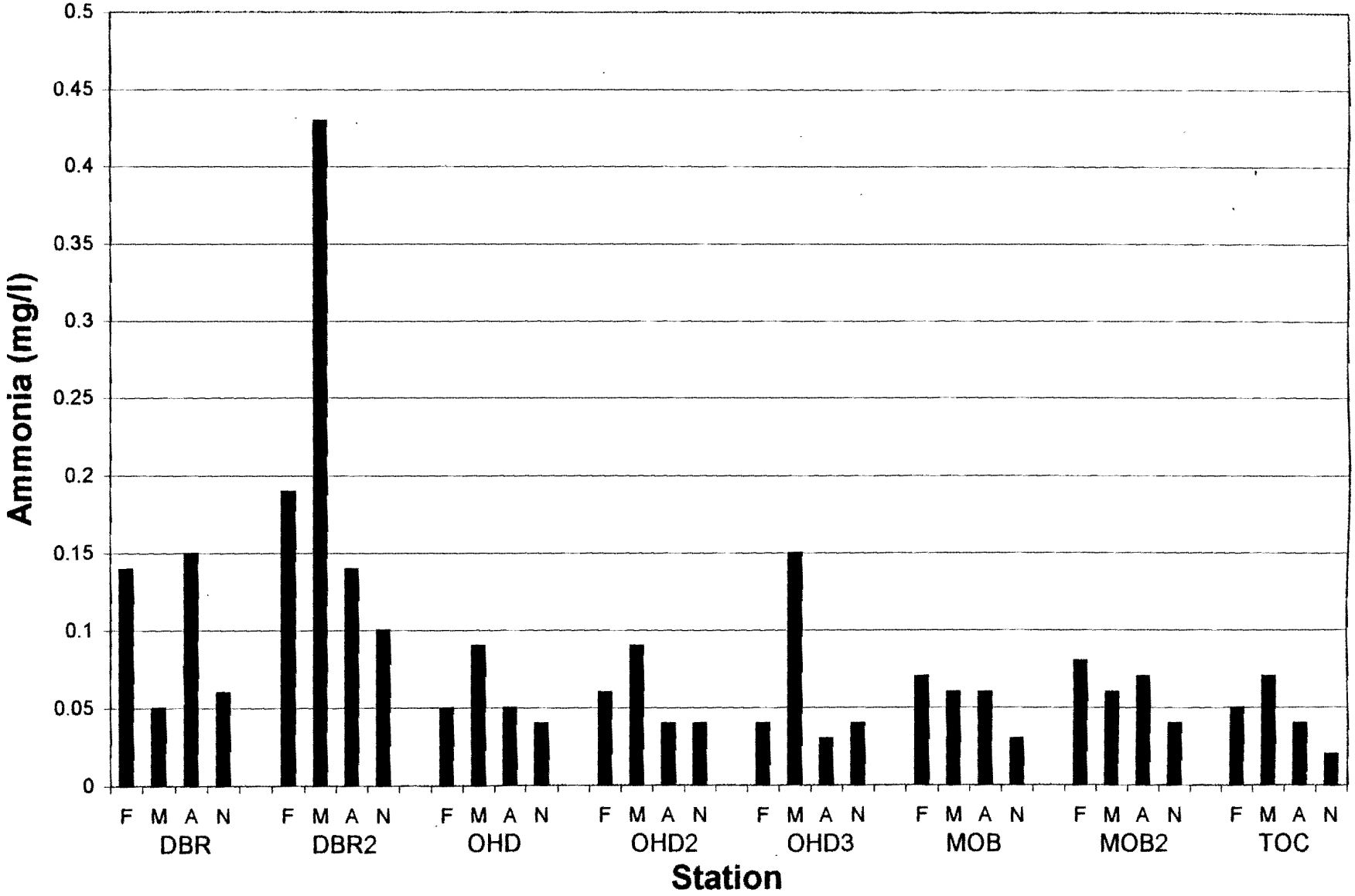


Figure 9. Total ammonia concentration measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997.

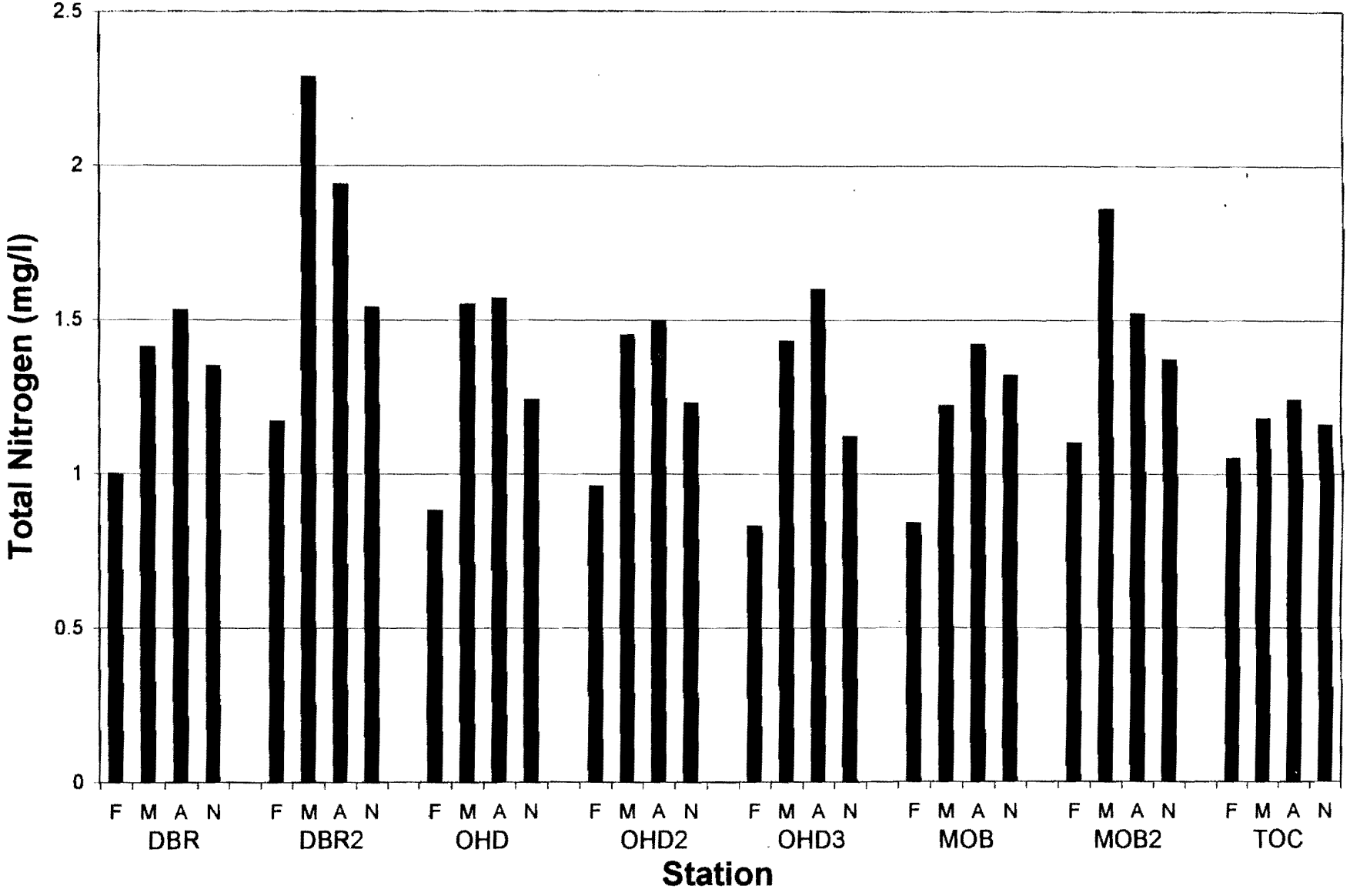


Figure 10. Total nitrogen concentration measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997.

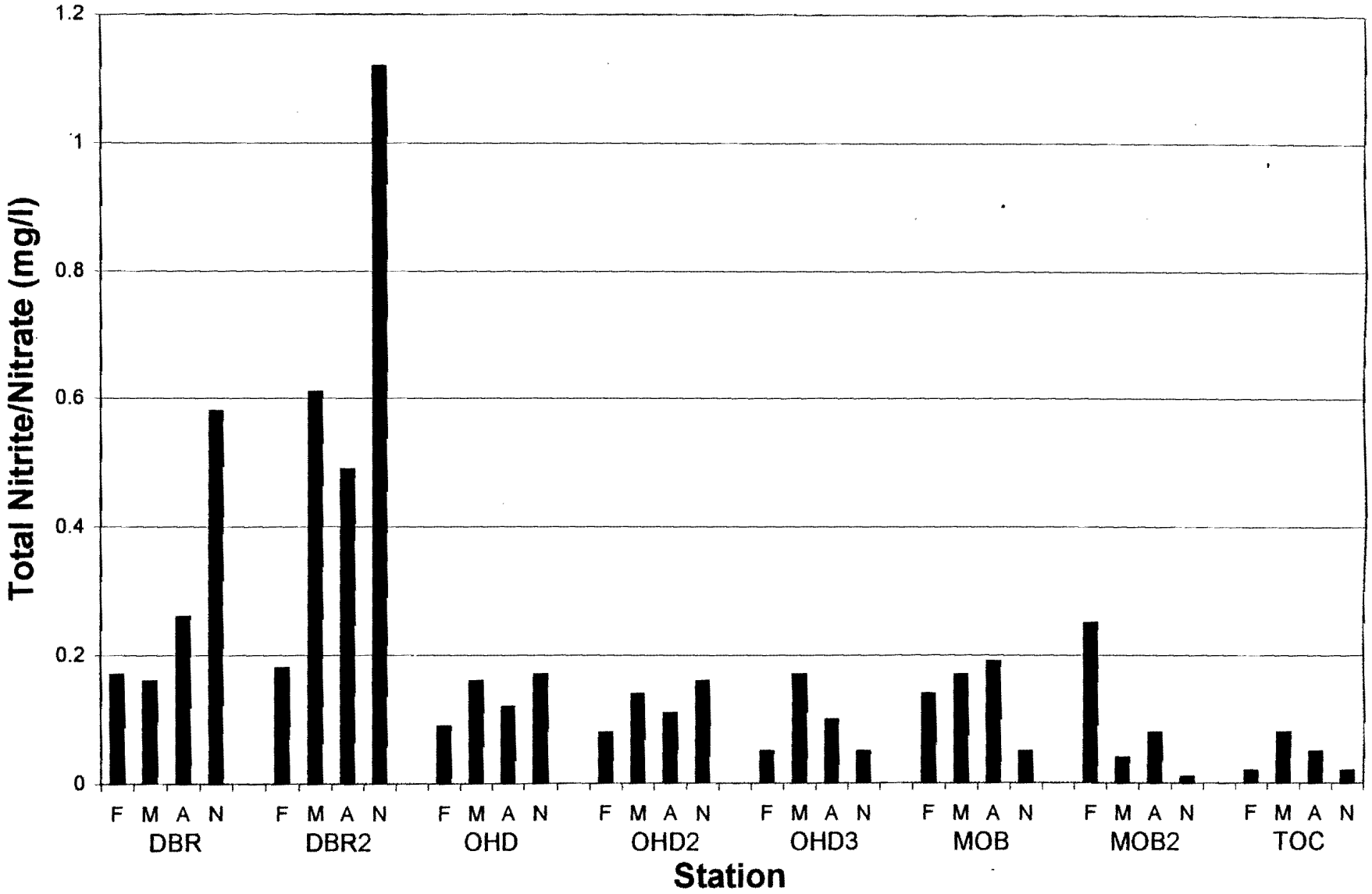


Figure 11. Nitrite/nitrate values measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997.

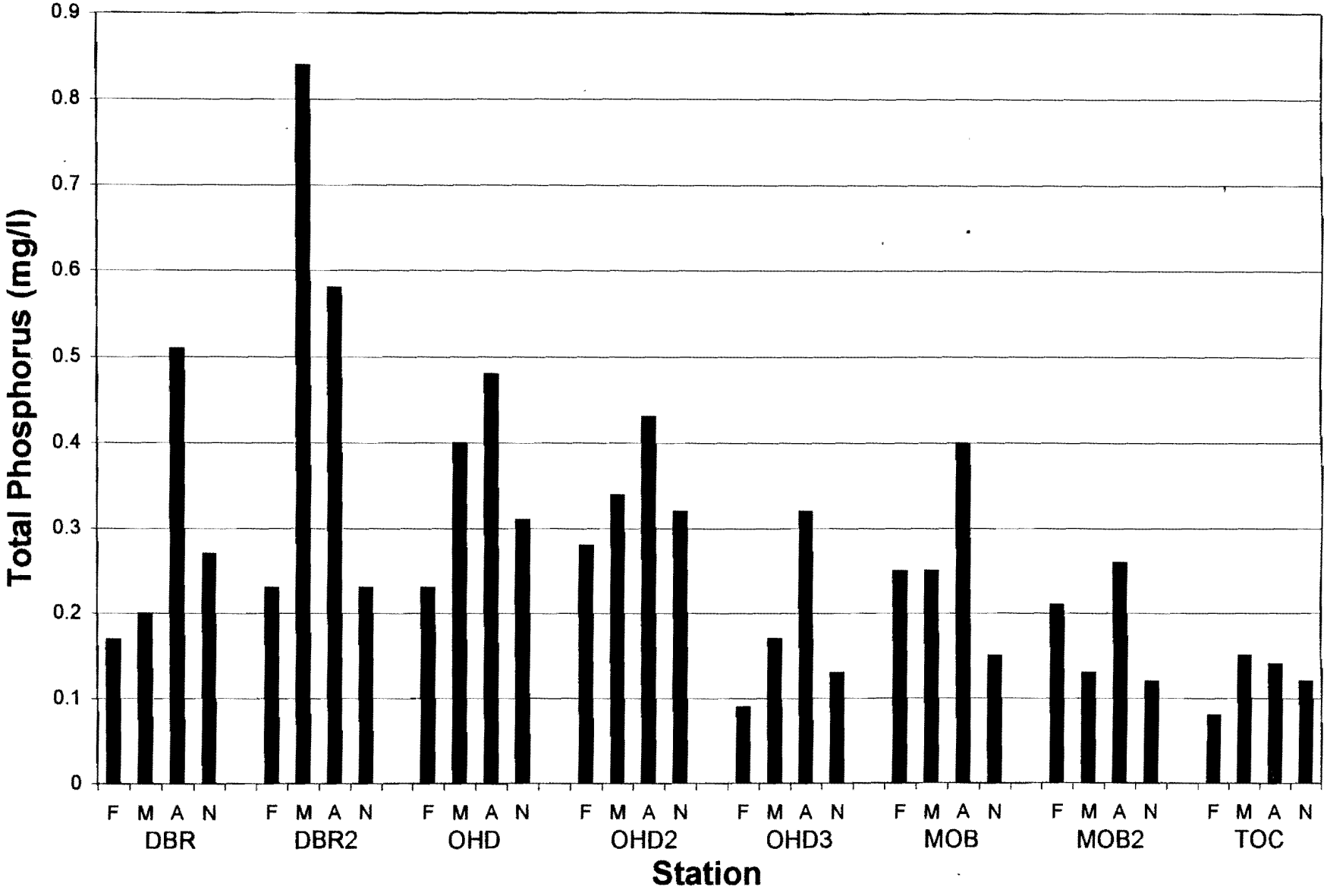


Figure 12. Total phosphorus concentration measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997.

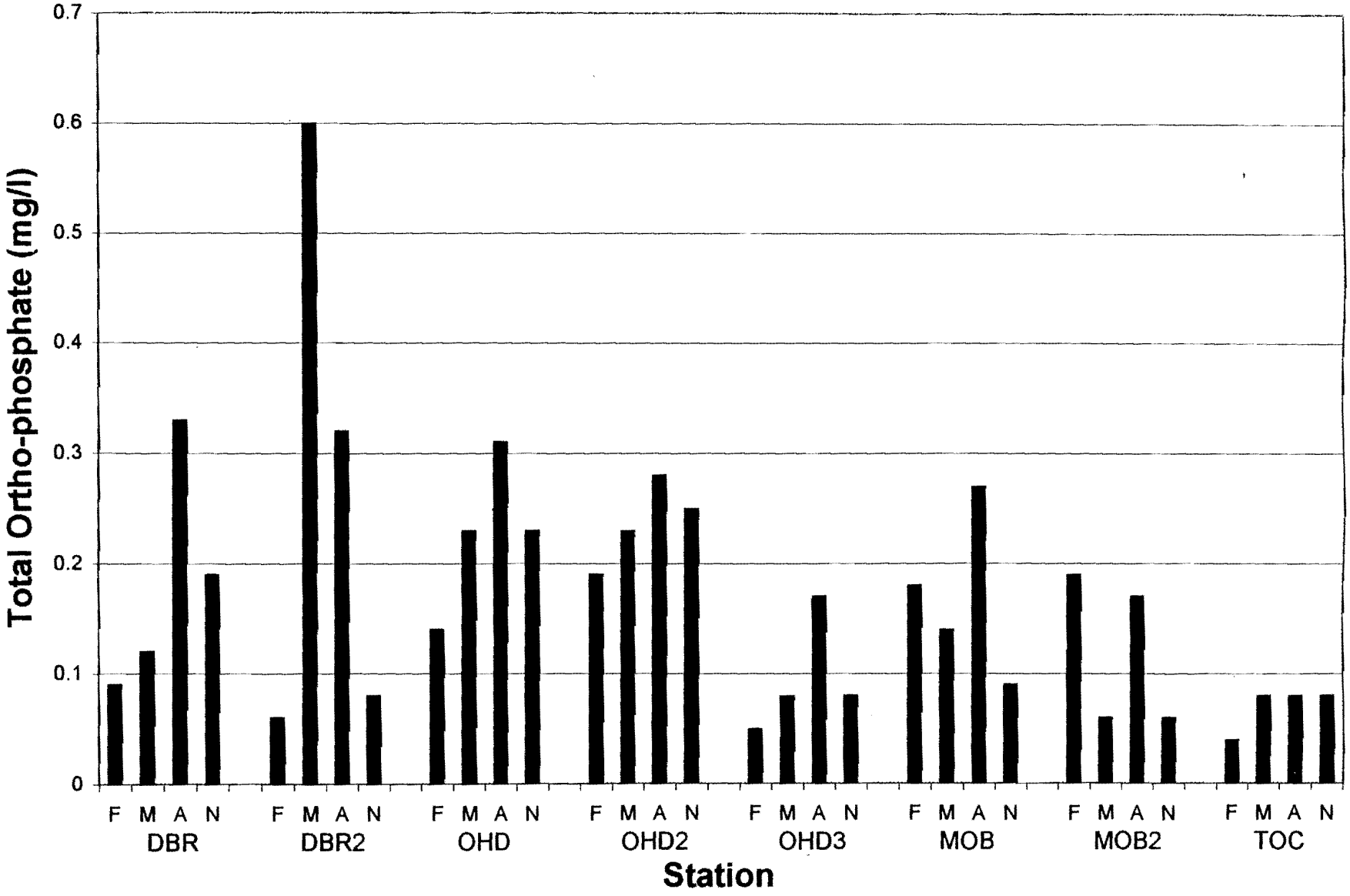


Figure 13. Ortho-phosphate concentration measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997.

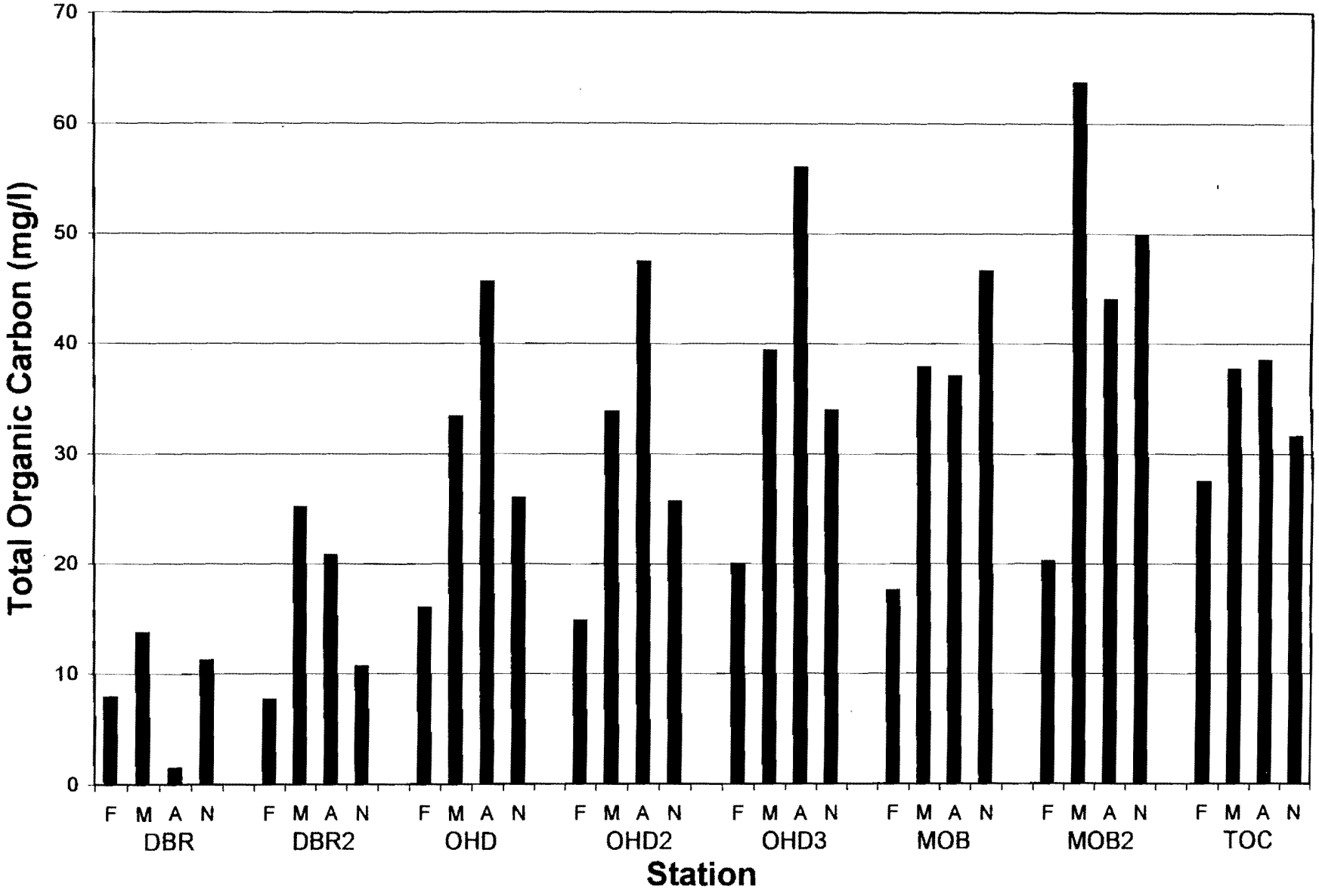


Figure 14. Total organic carbon concentration measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997.

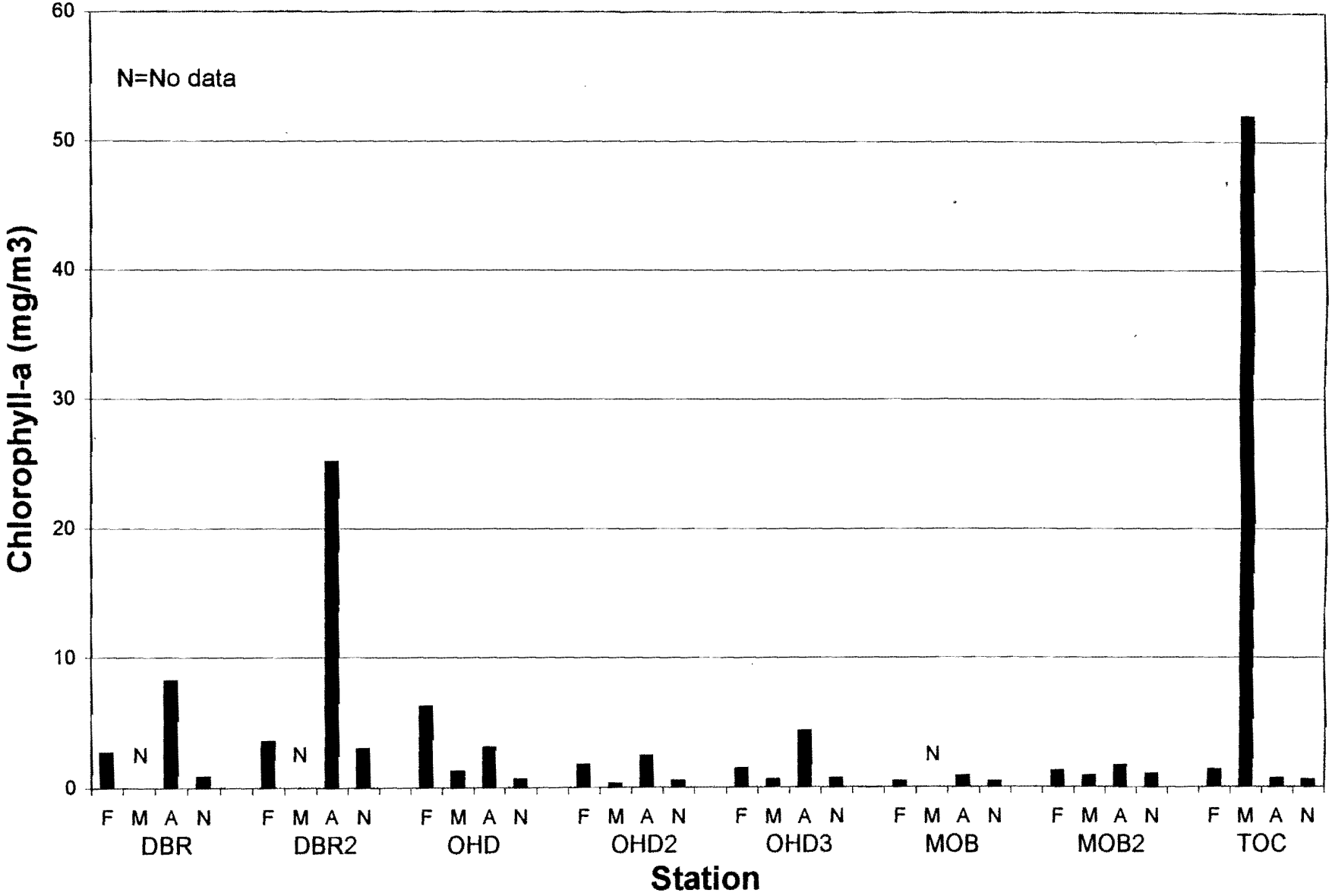


Figure 15. Chlorophyll-a concentration measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997.

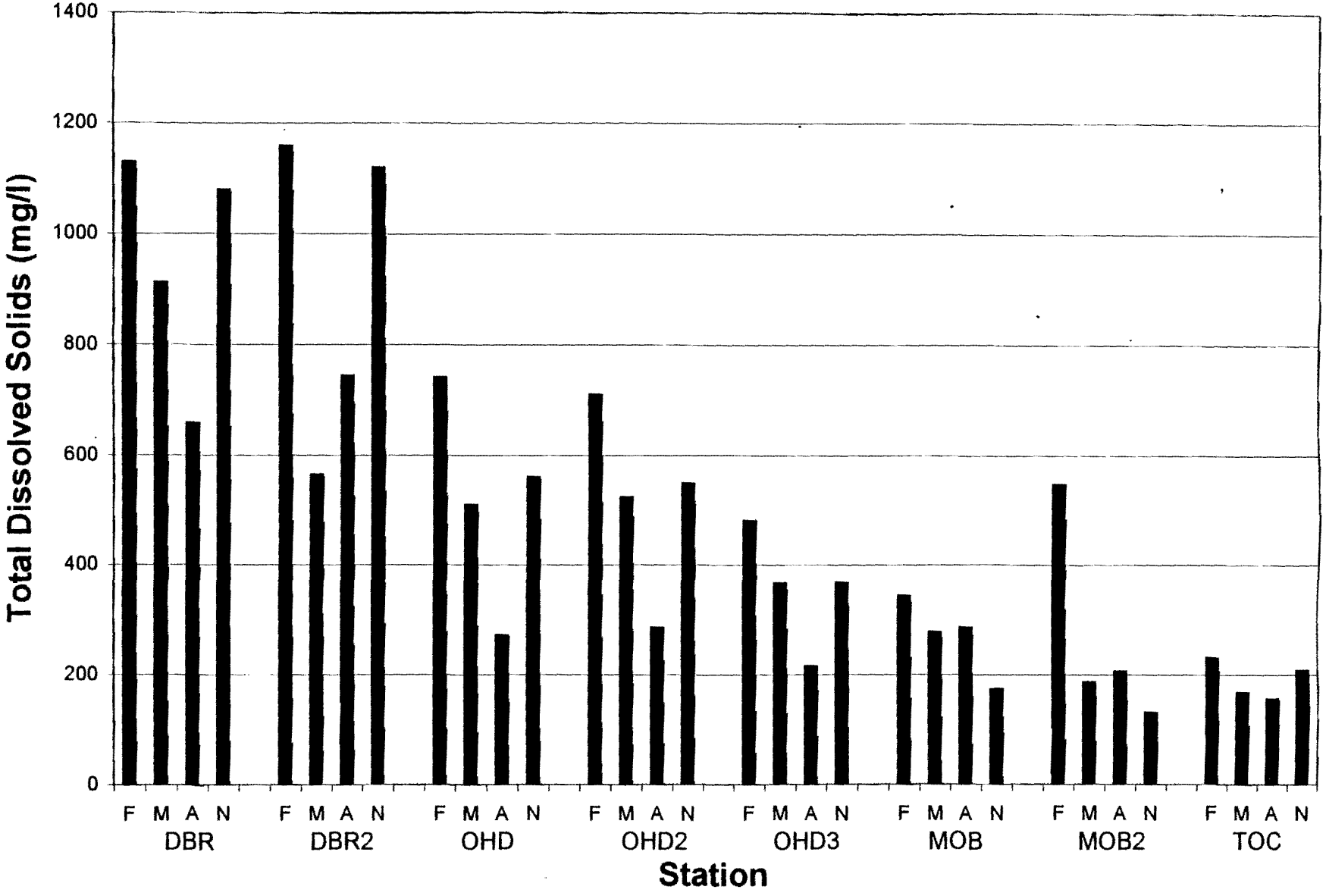


Figure 16. Total dissolved solids concentration measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997.

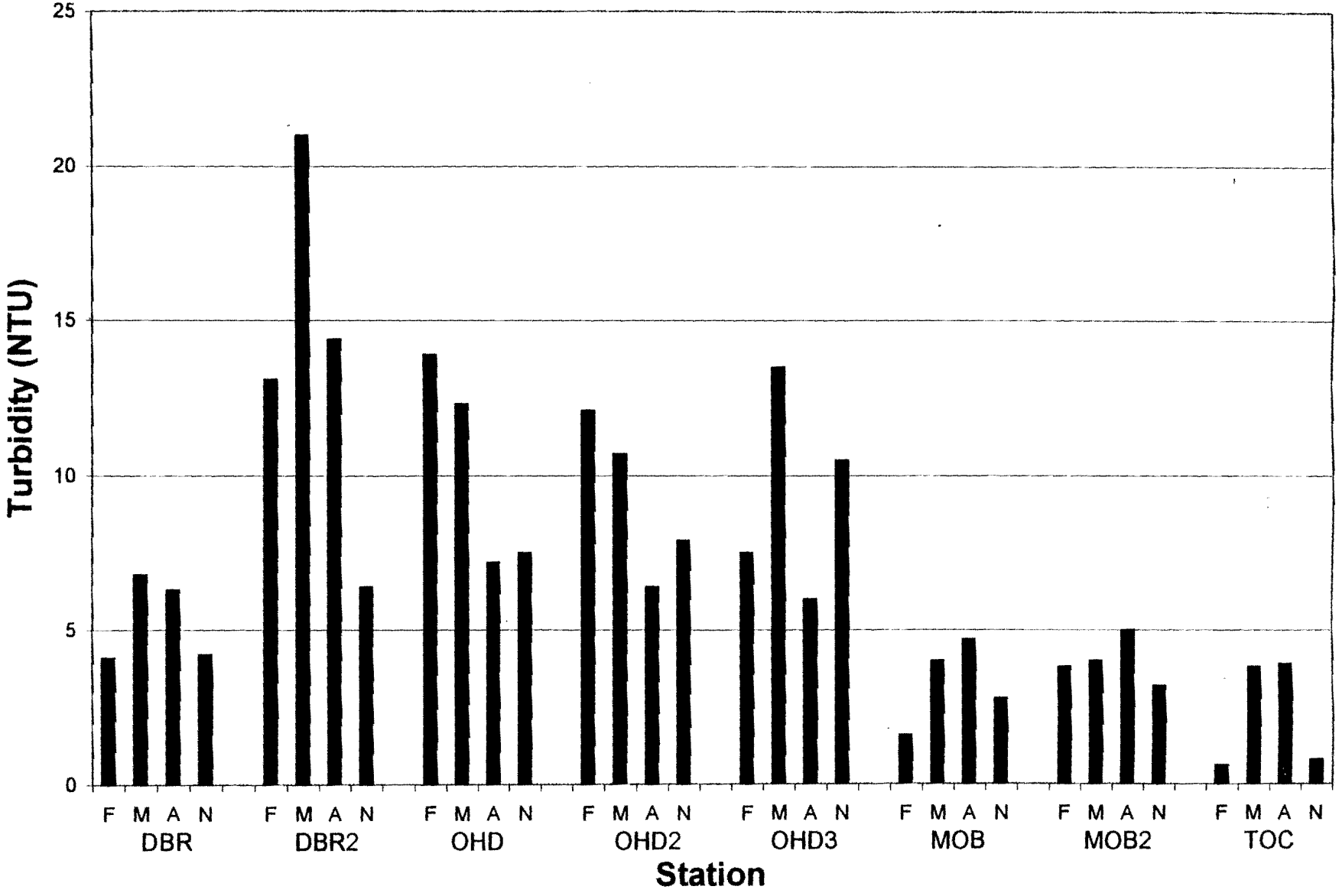


Figure 17. Turbidity values measured quarterly at the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, 1997.

Water temperature ranged between 15 and 30 C at all sites, with highs recorded in August and lows in either February or November (Figure 3). Color was typically lowest at DBR and DBR2 and highest at MOB2 (Figure 4). All three sites in OHD recorded high values equal to MOB2. Water at DBR and DBR2 was the most conductive (Figure 5). Water at the two most downstream sites in Old Hastings Drainage (OHD and OHD2) also was highly conductive. TOC and MOB2 typically had the lowest conductivity. Highest dissolved oxygen values were recorded in March (Figure 6). TOC had both the highest value recorded and 3 of the 5 lowest values recorded during 1997. Most pH values were between 6 to 7 (Figure 7), with lowest values recorded at MOB2, the site that was most colored. Total suspended solids were typically lowest at MOB and TOC (Figure 8). Ammonia values were similar among all sites except at the two sites in Dog Branch where 6 of the 7 highest values were recorded (Figure 9). Total nitrogen appeared to be similar among all sites (Figure 11), while total nitrite/nitrate nitrogen was highest in Dog Branch (Figures 11). Total phosphorus was also highest in Dog Branch, while typically lowest at TOC, OHD3 and MOB2 (Figure 12). DBR2 recorded both the highest and two of the lowest values of total ortho-phosphate (Figure 13). Total organic carbon was lowest at the two Dog Branch sites (Figure 14). Chlorophyll-a values were typically low except in August at DBR2 and in March at TOC (Figure 15). Total Dissolved solids were high at the two Dog Branch sites (DBR and DBR2) and the two most downstream sites in

Old Hastings Drainage (OHD and OHD2), and lowest at TOC (Figure 16). Turbidity was low at TOC, MOB, MOB2 and DBR, while higher at the other four sites (Figure 17).

Some of the observed spatial and temporal variability in the data may be due to changes in stream flow. Runoff during or after rainfall events likely occurs from the surrounding land into the streams in the three agricultural areas. No discharge data were available from these four tributaries to confirm this. Rainfall data were available from two weather stations maintained by the SJRWMD (Figures 18 and 19).

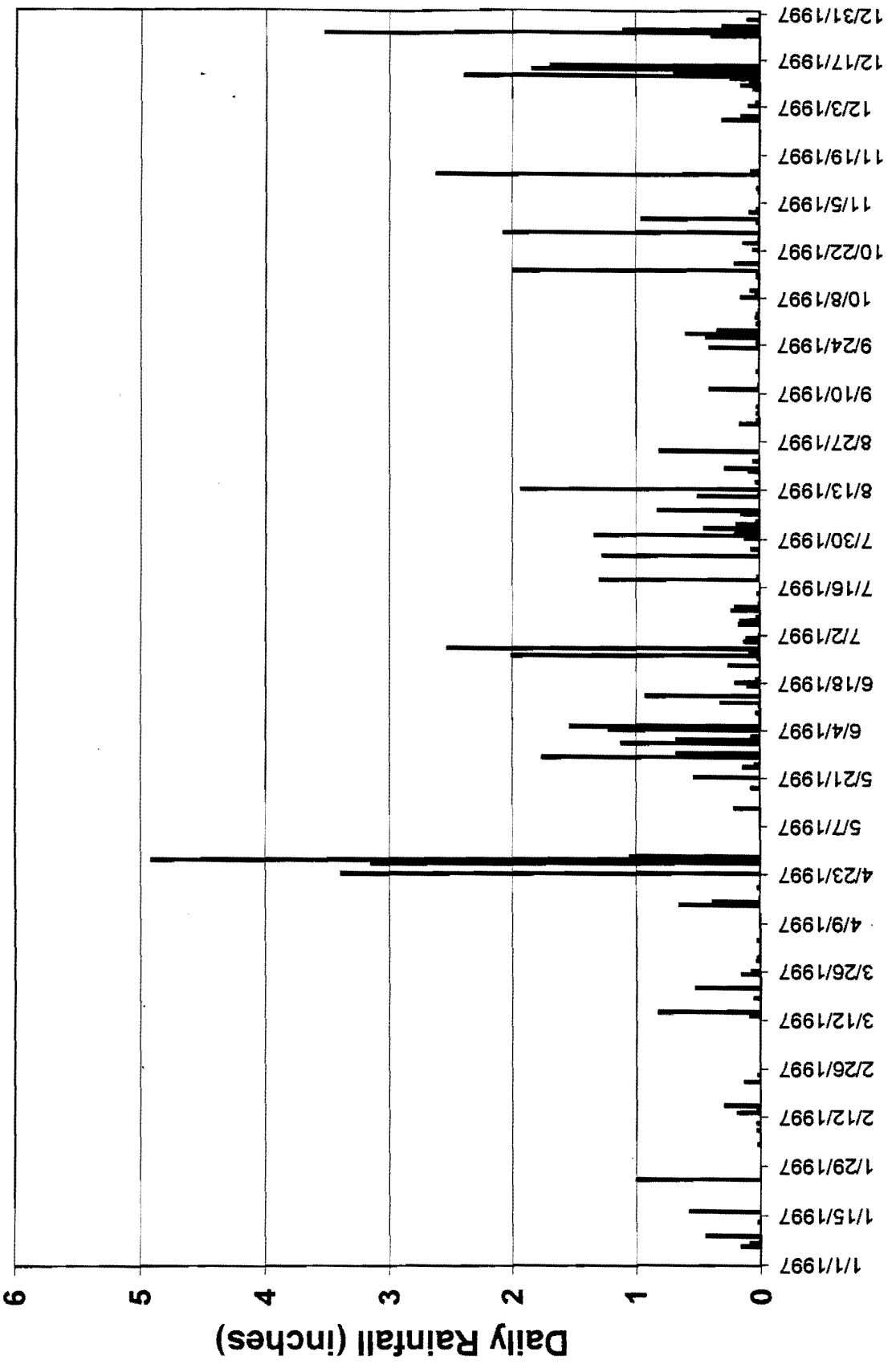


Figure 18. Daily rainfall data measured at Town Branch, lower St. Johns River, Florida, between 1 January 1997 and 31 December 1997.

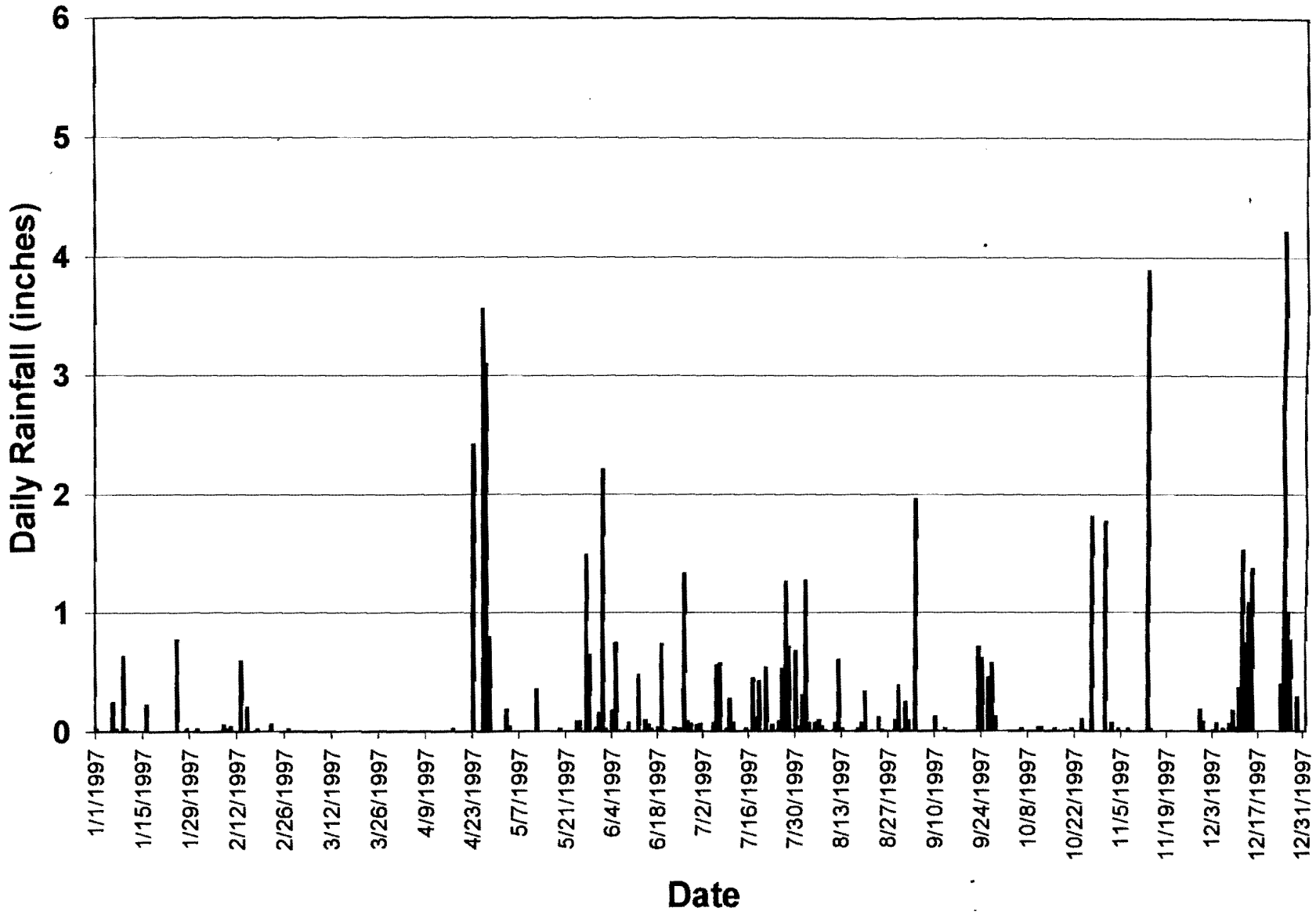


Figure 19. Daily rainfall data measured at Reid Farm, lower St. Johns River, Florida, between 1 January and 31 December 1997. No samples taken from 14 March to 15 April 1997.

MATERIALS AND METHODS

Field and Laboratory Procedures

Quantitative macroinvertebrate sampling was conducted during February, April/May, August and November 1997 using a combination of Ponar dredge and Hester-Dendy multiple-plate samplers (Table 2). Whenever sampling was conducted near a bridge, replicate samples were taken a minimum of approximately 20 m upstream from the bridge in an attempt to minimize any possible impacts of prior bridge construction and channelization.

Ponar dredge sampling was conducted using a Wildco 6-inch (15.24-cm) petite ponar grab sampler. Five replicate samples were taken at each site on all sampling dates. Water depth at ponar sampling locations varied between 0.1 and 2.0 meters. The samples were individually rinsed in a U.S. Standard No. 40, 425 μm sieve, using water from the stream that had been previously filtered through a second U.S. Standard No. 40, 425 μm sieve.

Multiple-plate sampling was conducted using Hester-Dendy style, EPA hardboard multiple-plate samplers composed of seven 7.5-cm diameter plates. Three multiple-plate samplers were placed upstream of the ponar sampling sites, in 0.3 to 1.0 meter of water approximately 30 days before the samples were taken. Plate samplers were retrieved on the same days that the ponar dredge samples were collected. Upon retrieval from the stream, each plate sampler was immediately placed into a U.S. Standard No. 40, 425 μm sieve, disassembled, scrubbed, and rinsed with water from the

Table 2. Benthic invertebrate sampling dates by month and site, Tri-County Agricultural Area (TCAA), lower St. Johns River, Florida, 1997.

	Site[1]							
Month	DBR	DBR2	OHD	OHD2	OHD3	MOB	MOB2	TOC
Jan	.	.	.	.	.	.	.	.
Feb	06	06	06	06	07	07	07	07
Mar	.	.	.	.	.	.	.	.
Apr	30	30	.	.	.	30	.	.
May	.	.	05	05	05	.	05	05
Jun	.	.	.	.	.	.	.	.
Jul	.	.	.	.	.	.	.	.
Aug	04	04	04	04	05	05	05	05
Sep	.	.	.	.	.	.	.	.
Oct	.	.	.	.	.	.	.	.
Nov	20	20	20	20	21	21	21	21
Dec	.	.	.	.	.	.	.	.

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
MOB - Moccasin Branch
TOC - Tocoi Creek

stream that had been previously filtered through a second U.S. Standard No. 40, 425 μm sieve.

Once each sample was collected, both ponar dredge and Hester-Dendy plate samples were removed from the seives, placed into 950-ml glass bottles and preserved with a rose bengal in ethanol solution (0.18 g/L) (Mason and Yevich 1967). Samples exceeding 950 ml were placed into two bottles. Preserved samples were transported to the laboratory and washed in a U.S. Standard No. 40, 425 μm sieve. The contents of the sieve was then emptied into a standard benthic invertebrate sorting tray. If the estimated number of organisms in the sample exceeded 200, the sample was split in the sampling tray. Organisms were removed from the debris in the tray and sorted to taxonomic order with the aid of a lighted magnifying lens and placed into separate vials containing an ethanol and glycerine solution. All organisms were then identified to species or as close to the species level as taxonomically possible, except for chironomids, polychaetes and oligochaetes, using standard taxonomic references (APHA 1989; Berner and Pescador 1988; Daigle 1991; Epler 1996; Klemm et al. 1990; Merritt and Cummins 1996; Pennak 1953 and 1989; Peckarsky et al. 1990; Pescador et al. 1995; Thompson 1984). The results of the identifications and counts were recorded onto data sheets, with one data sheet per sample. Chironomids, polychaetes and oligochaetes were identified to the family or order level only.

Statistical Analysis

Data from each data sheet, including sample identification number, date of collection, location, gear type, taxonomic group, number of individuals of each taxonomic group, and number of laboratory splits, was then coded into an ASCII computer file, printed, verified against original data sheets, corrected, and analyzed by Statistical Analysis Software (SAS 1995).

Species richness (number of taxa), abundance (number of organisms/sample), Shannon-Wiener community diversity index (SWDI) (Krebs 1989), and Hilsenhoff Biotic Index (HBI) (Hilsenhoff 1987) were calculated for each sample. The latter two were calculated as follows:

Diversity Index =

$$\sum (\text{proportion of ith taxa})(\log_2 \text{proportion of ith taxa})$$

where: zero is the lowest possible value and higher numbers indicate greater diversity

$$\text{HBI} = [\sum (\text{number of ith taxa})(\text{Tolerance Value for ith taxa})]/N$$

where:

0	to 2	denotes clean water
2	to 4	denotes slightly polluted water
4	to 7	denotes enriched water
7	to 10	denotes polluted water

Mean values for each of these four statistics were calculated for each of the eight sampling sites for each sampling season and gear type (ponar dredge and Hester-Dendy plate sampler). Median values were also determined for HBI. Data from the ponar dredge and Hester-Dendy plate samplers were used to calculate relative abundances. An overall HBI was also calculated for each site using

the combination of data from both sampling gear types, and for each site for each gear separately. These indices have been used to evaluate the macrofauna of other streams (Hilsenhoff 1987 and 1988; Klemm et al. 1990). HBI tolerance values (TVs) were based on previously reported values (Hilsenhoff 1987 and 1988; Klemm et al. 1990; Lenat 1993; Mason 1998). Taxa were assigned TVs from Lenat (1993). If a taxa was not reported, then TVs from Hilsenhoff 1987 and 1988 were used, followed by those of Mason (1998). TVs were assigned at the species level. If no species specific values were reported, then assignments were made at the genus or family level. Values for higher taxonomic groups were used if reported. If no reported TVs could be found for a taxa, then no TV value was assigned.

Parametric one-way analysis of variance (ANOVA) was used to test for statistical differences in the mean macroinvertebrate species richness, abundance, and Shannon-Wiener Diversity Index among the eight sites for each sampling season, and among sampling seasons at each of the eight sites separately for each gear type. Macroinvertebrate counts (densities) were transformed prior to analysis using a $[\log_{10} (\text{count} + 1)]$ transformation. A nonparametric Kruskal-Wallis test was used for analysis of HBI. When a significant treatment effect (site or season) was detected, pairwise comparisons among the treatment population means (species richness, abundance and SWDI) were made using a Fisher's least significant difference test (LSD)(Ott 1984) or among medians (HBI) using a Dunn's multiple comparison test (Hollander and Wolfe 1973). The Fisher's least significant difference test is one of the least

conservative means separation techniques available, and was selected to maximize the detection of paired differences among treatments.

To determine if there were any year to year (1994 vs. 1995 vs. 1997) differences in the four benthic invertebrate parameters (macroinvertebrate species richness, abundance, SWDI, and HBI), ponar dredge data from the original four sites (DBR, OHD, MOB, TOC - Cichra and Mumma, 1996) were analyzed. Data were analyzed within site and within comparable season (January and February; April and May; June, July and August; October and November). January 1995 vs. February 1997 and October 1994 vs. November 1997 data were analyzed using parametric (species richness, abundance and SWDI) or nonparametric (HBI) t-tests. April 1994 vs. April 1995 vs. May 1997 and July 1994 vs. June 1995 vs. August 1997 data were analyzed using one-way ANOVAs, followed by Fisher's least significant difference tests (LSD) (species richness, abundance and SWDI) or Kruskal-Wallis tests, followed by Dunn's multiple comparison tests (HBI). Macroinvertebrate counts (densities) were transformed prior to analysis using a $[\log_{10} (\text{count} + 1)]$ transformation. Taxa were combined into higher taxonomic levels for the 1994 and 1995 data in order to make it comparable to the 1997 data for these among-year within-site/season comparisons. The following taxa were combined: Hirudinea or leeches (spcodes 1200 - 1202), oligochaetes (spcodes 1300 - 1308), polychaetes (spcodes 1400 - 1402), Chironomidae or midges (spcodes 4201 - 4201.2 + 4206 - 4216.2 + 4217 - 4234), Turbellaria or flatworms (spcodes 8000 - 8001), and Collembola or springtails (spcodes 8500 - 8504, all three years).

In addition to testing for differences in the median HBI values among sites, a Kruskal-Wallis test was used to test for statistical differences in the median macroinvertebrate tolerance values (TVs) among the eight sites using data from both gears combined for all 1997 sampling seasons combined. Additional tests were run for each gear separately using all 1997 data combined. When a significant site effect was detected, pairwise comparisons among site medians were made using a Dunn's multiple comparison test. In addition, year to year comparisons within stations and seasons were performed following the methods outlined previously for HBI. Tolerance values presented in this report were used for all years (1994, 1995 and 1997) in testing for year to year differences in HBI and TV. As a result, descriptive statistics for HBI and TV listed in this report for 1994 and 1995 may differ from those listed in Cichra and Mumma (1996).

In addition to the above analyses, the mean benthic invertebrate characteristics (species richness, abundance, Shannon-Weiner Diversity Index, and HBI) obtained from the ponar dredge samples were correlated (Spearman rank correlation statistic) with the quarterly water chemistry data (conductivity, dissolved oxygen, pH, total suspended solids, total ammonia, total nitrogen, nitrite/nitrate nitrogen, total phosphorus, ortho-phosphate, total organic carbon, chlorophyll-a, total dissolved solids, turbidity, water temperature, and color) provided by the St. Johns River Water Management District.

RESULTS AND DISCUSSION

Species Richness

A total of 124 benthic macroinvertebrate taxa were collected from the four tributaries during the four quarterly samples taken from February through November 1997. Table 3 lists the taxa captured at each site during the study by equal efforts of both methods of collection combined. Appendix A lists the taxa collected in each individual sample taken during the course of this study. Seventy-three taxa were represented by fewer than ten individuals. Many of these taxa were often collected at a single site on a single date.

Various studies have documented the species of invertebrates present in blackwater/sandbottomed streams in the Southeastern United States (Peters and Jones 1970; Soponis 1979; Mason et al. 1994). However, very few studies have provided quantitative data on invertebrate abundance or diversity indices.

Overall species richness for the three agricultural tributaries and the reference tributary for both gear types and all four seasons combined were 56 taxa for Dog Branch (2 sites), 77 taxa for Old Hastings Drainage (3 sites), 78 taxa for Moccasin Branch (2 sites) and 58 taxa for Tocoi Creek (1 site) (Table 3). Moccasin Branch had the most taxa with only 2 sites sampled. The sites in Moccasin Branch and Tocoi Creek had high overall species richness (64 taxa at MOB, 55 at MOB2 and 58 at TOC). All three sites in Old Hastings Drainage and the downstream site in Dog Branch had intermediate species richness (44 taxa at OHD, 47 at

Table 3. Total number of each macroinvertebrate taxa collected by both gear types combined (5 ponar dredge and 3 Hester-Dendy plate samples) at each of the eight Tri-County Agricultural Area sample sites, lower St. Johns River, Florida, 1997. Associated species code (Spcode) and tolerance value (TV) are also listed.

	SPCODE	TV	Site[1]							
			DBR	DBR2	OHD	OHD2	OHD3	MOB	MOB2	TOC
PHYLUM ANNELIDA										
Class Hirudinea (leeches)										
Unidentified Hirudinea	1200	8	3	1	1	7	13	12	11	78
Class Oligochaeta (earthworms)										
Unidentified Oligochaeta	1300	8.2	1900	894	677	1429	336	312	795	1051
Class Polychaeta (bristleworms)										
Unidentified Polychaeta	1404	.	0	0	0	1	3	0	0	0
PHYLUM ARTHROPODA										
Class Crustacea										
Order Amphipoda (scuds, sideswimmers)										
Unidentified Amphipoda	3100	.	1	2	2	1	0	0	0	0
Gammarus cf. fasciatus	3103	6.9	18	47	16	35	80	0	0	0
Gammarus mucronatus	3103.1	.	0	0	3	0	0	0	0	0
Gammarus nr. tigrinus	3103.2	7.5	189	353	113	300	524	0	0	2
Gammarus unidentified sp.	3103.5	.	2	0	0	2	0	0	0	0
Hyalella azteca	3104	7.9	1	2	4	1	0	1	2	30
Orchestia uhlerai	3108	.	15	2	0	1	0	0	0	0
Orchestia grillus	3108.1	.	0	0	1	0	0	2	0	0
Carangonyctidae unidentified	3111	8	0	1	0	0	0	0	0	0
Order Decapoda (fresh-water shrimps, crayfish, crabs)										
Palaemonetes paludosus	3302	6.7	0	0	0	0	0	0	1	1
Procambarus sp.	3303	9.5	0	0	0	1	0	0	0	0
Cambariidae unidentified	3303.1	8.1	0	0	0	1	0	0	0	0
Order Isopoda (aquatic sow bugs)										
Unidentified Isopoda	3400	.	0	0	0	0	1	1	0	0
Asellus/Caecidotea sp.	3401.1	9.4	49	1	7	8	6	31	3	100
Cassidinidea ovalis	3402	6	1212	0	345	591	0	1	7	5
Sphaeroma terebrans	3406.1	5	1	0	0	0	0	0	0	0

Table 3. Continued

	SPCODE	TV	Site[1] DBR	DBR2	OHD	OHD2	OHD3	MOB	MOB2	TOC
Class Insecta										
Order Coleoptera (beetles)										
Unidentified Coleoptera	4100.1	5.7	0	0	1	0	0	0	8	0
Dubiraphia vittata	4101.5	6.4	1	6	5	13	112	205	98	6
Elmidae unidentified	4101.7	4	0	0	0	0	1	0	0	0
Stenelmis sp.	4102.1	5.4	5	6	9	31	209	187	465	8
Neoporus sp.	4103	8.9	0	0	1	0	8	0	1	33
Ancyronyx variegata	4104	6.9	0	0	0	0	0	32	0	0
Dineutus sp.	4105	5.5	0	0	0	0	3	0	0	2
Microcylloepus pusillus	4106	2.1	0	0	0	0	0	3	0	0
Prionocyphon sp.	4107	.	0	0	0	0	0	3	0	0
Coptotomus sp.	4108	9	0	0	0	0	0	0	1	0
Macronychus glabratus	4110	4.7	0	1	0	0	0	2	0	0
Order Diptera (flies)										
Chironomidae unidentified	4200	7.5	1422	1269	855	1898	926	2219	3093	1801
Unidentified Diptera	4200.1	6.4	0	0	1	0	0	0	0	0
Probezzia sp.	4203.1	6	6	0	0	24	9	75	50	93
Dasyhelea sp.	4203.2	6	0	0	1	0	1	1	1	3
Hemerodromia sp.	4216.4	8.1	0	0	0	0	0	6	6	0
Dixella sp.	4236	2.8	0	1	0	0	0	0	0	0
Simulium sp.	4237	4.4	0	0	0	0	1	22	7	0
Culicidae unidentified	4240	6.4	0	0	0	0	0	0	1	0
Allotrichoma sp.	4241	6	0	0	0	0	0	1	0	0
Tipula sp.	4242	7.7	1	0	0	0	0	1	0	0
Muscidae unidentified	4243	6	0	0	0	0	0	4	29	0
Dolichopodidae unidentified	4244	4	0	1	0	0	0	0	0	0
Tipulidae unidentified	4245	3	0	0	0	0	1	0	0	0
Ephydridae unidentified	4246	6	0	1	0	0	0	0	0	1
Empididae unidentified	4247	8.1	0	0	0	0	0	0	5	0
Order Ephemeroptera (mayflies)										
Unidentified Ephemeroptera	4300	2.7	0	0	0	0	1	0	1	2
Caenis diminuta	4302	7.6	7	0	26	37	104	28	30	1280
Caenis sp. unidentified	4302.1	7.6	0	0	0	12	8	1	12	86
Stenacron floridense	4304	.	0	0	0	0	0	0	0	1
Stenacron interpunctatum	4304.1	7.1	0	0	0	0	0	0	0	81
Stenacron sp. unidentified	4304.3	7.1	0	0	0	0	0	0	0	124
Baetis sp. unidentified	4305	6	0	0	0	0	0	15	0	4
Baetidae unidentified	4305.1	4	0	0	0	0	0	1	0	0

Table 3. Continued

	SPCODE	TV	Site[1] DBR	DBR2	OHD	OHD2	OHD3	MOB	MOB2	TOC
Order Hemiptera (true bugs)										
Trepobates sp.	4402.5	.	0	0	0	0	0	0	1	0
Rheumatobates sp.	4408	.	1	0	0	0	0	0	0	0
Metrobates sp.	4409	.	0	0	0	0	0	0	0	1
Order Lepidoptera (moths/butterflies)										
Bellura sp.	4501	.	0	0	0	0	0	0	1	0
Order Neuroptera (spongilla flies)										
Sisyra sp.	4602.1	.	0	0	0	0	0	0	0	1
Order Odonata										
Suborder: Anisoptera (dragonflies)										
Unidentified Anisoptera	4700	6.9	0	1	0	0	1	1	0	0
Libellula sp.	4701	9.8	12	1	0	0	0	2	1	4
Macromia sp.	4701.3	6.7	2	0	0	0	0	0	0	0
Macromia taeniolata	4701.35	6.7	0	0	0	0	0	0	1	0
Macromia georgina	4701.36	6.7	0	0	0	0	0	1	0	0
Sympetrum corruptum	4701.8	7.3	4	0	1	0	0	0	0	1
Cordulegaster sp.	4703	6.1	0	0	0	0	0	1	0	0
Aphylla williamsoni	4704	1	0	0	0	0	0	1	0	1
Suborder: Zygoptera (damselflies)										
Argia sp.	4800.2	8.7	13	17	2	8	26	21	34	2
Argia bipunctulata	4800.05	8.7	15	8	4	3	26	13	19	0
Argia moesta	4800.1	8.7	0	1	0	0	0	0	0	0
Argia tibialis	4800.3	8.7	2	2	0	0	1	0	1	0
Argia apicalis	4800.4	8.7	2	2	1	0	0	0	0	0
Ischnura sp.	4802	9.4	0	1	0	0	2	1	2	0
Ischnura kellicoti	4802.1	9.4	0	0	0	0	0	2	1	0
Coenagrionidae unidentified	4803	6.9	0	0	0	1	0	0	0	0
Order Trichoptera (caddisflies)										
Unidentified Trichoptera	4900	2.3	0	0	0	0	1	0	0	0
Oecetis sp.	4905.2	5.7	0	1	1	0	0	6	27	10
Cheumatopsyche sp.	4908	6.6	0	0	1	0	106	111	150	0

Table 3. Continued

	SPCODE	TV	Site[1] DBR	DBR2	OHD	OHD2	OHD3	MOB	MOB2	TOC
Order Megaloptera (dobsonflies, alderflies)										
Corydalus sp.	4951	5.6	0	0	0	0	1	1	9	0
Sialis sp.	4952	7.5	0	0	0	0	0	0	0	2
Order Collembola (springtails)										
Unidentified Collembola	8500	.	2	0	0	0	0	2	1	0
Sminthurides sp.	8502	.	0	0	1	2	0	3	2	5
Dicyrtoma sp.	8503	.	1	0	2	1	1	0	4	0
Axelsonia sp.	8504	.	1	5	3	4	0	3	28	1
PHYLUM MOLLUSCA										
Class Bivalvia (clams, oysters, mussels)										
Bysanodonta cubensis	5100.5	.	0	0	1	3	0	22	7	1
Corbicula fluminea	5101	6.3	0	0	0	0	18	0	0	6
Musculium/Sphaerium striatum	5103.2	7.7	0	0	0	0	4	0	3	2
Pisidium sp.	5105	6.8	0	0	3	3	13	13	4	29
Pisidium dubium	5105.5	6.8	0	0	0	0	0	0	0	2
Sphaerium sp.	5107	7.7	5	2	1	10	27	15	6	43
Elliptio sp.	5110	.	0	0	0	0	0	2	3	0
Unionidae unidentified	5111	.	0	0	0	0	0	1	0	0
Sphaeriidae unidentified	5109	7.4	120	5	34	581	130	99	240	101
Class Gastropoda (snails)										
Gastropoda unidentified	5200	.	0	0	0	1	0	0	0	0
Hydrobiidae unidentified	5200.1	.	2	0	0	0	1	4	1	0
Amnicola dalli sp.	5201.4	4.8	47	1	13	38	5	61	96	781
Campeloma floridense	5202	4	0	0	0	1	0	0	0	0
Cincinnatia fraterna	5203	6	28	0	1	23	4	0	0	70
Ferrissia hendersoni	5204	6.9	58	0	31	43	265	9	4	18
Ferrissia fragilis	5204.2	6.9	0	0	0	0	12	0	0	0
Ferrissia sp.	5204.1	6.9	0	0	8	0	0	1	0	1
Laevapex fuscus	5207	7.3	0	0	0	0	2	0	0	0
Laevapex peninsulae	5207.5	.	1	0	0	0	0	2	1	8
Littoridinops monroensis	5208	4	19	0	0	8	1	0	0	12
Micromenetus dilatatus	5209	8.4	32	0	31	148	42	30	2	55
Micromenetus floridensis	5209.1	.	0	1	0	1	0	1	0	15
Physella cubensis	5211.5	9.1	142	3	48	9	3	6	14	17
Planorbella duryi	5212.1	.	0	0	0	0	0	1	0	2
Planorbella intertexta	5212.05	.	0	0	0	0	0	2	0	0

Table 3. Continued

	SPCODE	TV	Site[1] DBR	DBR2	OHD	OHD2	OHD3	MOB	MOB2	TOC
Class Gastropoda (snails) (continued)										
Planorbella scalaris	5212	5	0	0	0	0	0	1	0	5
Planorbella sp.	5212.2	.	0	0	0	1	0	0	0	0
Pyrogophorus platyrachis	5212.5	.	23	0	2	15	0	0	0	0
Viviparus georgianus	5213	5	0	0	0	0	0	76	0	0
Ancylidae unidentified	5214	.	0	0	0	0	0	0	0	1
Pseudosuccinia columella	5215.1	7.2	3	0	0	1	0	0	1	0
Hebatancylus excentricus	5216.1	.	2	0	0	0	0	2	0	4
Gyraulus parvus	5217.1	.	0	0	0	0	2	0	0	0
PHYLUM NEMATODA (roundworms)										
Unidentified sp.	6001	.	2	5	0	5	2	3	2	2
PHYLUM PLATYHELMINTHES (flatworms)										
Class Turbellaria										
Planariidae unidentified	8001	.	28	1	1	0	4	6	7	11
MISCELLANEOUS										
Copepoda	9002	.	53	62	44	45	64	5	9	102
Hydracarina	9003	5.7	2	0	1	3	2	0	0	35
Ostracoda	9004	.	2	1	7	289	3	1	2	13
Cladocera	9005	.	0	0	0	2	0	0	0	0
Hydrozoa	9006	.	0	0	1	3	0	0	0	1
Nemertia	9007	.	0	0	2	0	0	1	0	0

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
MOB - Moccasin Branch
TOC - Tocoi Creek

OHD2, 49 at OHD3 and 46 at DBR, respectively), while DBR2 had the lowest number of taxa (35).

Greater overall species richness was observed in 1994 and 1995 (DBR, OHD, MOB and TOC had 86, 81, 77 and 90 taxa, respectively, Cichra and Mumma, 1996) than in 1997. This earlier study covered a 15-month period, during which six collections were made, while only four collections were made in 1997. Dipnet sampling was not used as a collection method in 1997. Also, 39 chironomid taxa were collected in the 1994-1995 study, while in this current study all chironomid taxa were lumped into a single taxa (Chironomidae). Hirudinea, oligochaetes, polychaetes and turbellaria were also not identified to as low a level of taxonomy in 1997 than in 1994 and 1995. Fewer number of sampling seasons over a shorter time, with fewer gear types and less detail in taxonomic identification likely accounted for this reduction in species richness from 1994 and 1995 to 1997, even though more ponar and plate samples were taken during each season in 1997.

An examination of the ponar data reveals that the mean number of taxa collected per ponar dredge sample were significantly different among sites during each of the four seasons (Table 4). Tocoi Creek, the reference stream, had significantly more taxa than two to five of the other seven sites. TOC and MOB were never found to differ from each other, but almost always differed from DBR2. Seven of the eight highest mean numbers of taxa per ponar sample were at TOC and MOB, two of the three sites with highest overall species richness. DBR2 had significantly lower species richness than two to five of the other sites during any season. Analysis of

Table 4. Benthic invertebrate species richness (number of taxa) as sampled by ponar dredge at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sites within season, 1997. Sample size (N), smallest number of taxa (Min), largest number of taxa (Max), mean, standard error (Std Err), and coefficient of variation (CV) are given.

Season	Site[1]	N	Min	Max	Mean	SG[2]	Std Err	CV
February	DBR	5	5	23	12.2	AB	3.1	57.5
	DBR2	5	3	5	4.2	C	0.4	19.9
	OHD	5	4	15	9.2	ABC	2.1	50.0
	OHD2	5	4	15	10.0	AB	2.0	44.2
	OHD3	5	10	16	13.2	A	1.0	16.4
	MOB	5	6	13	9.0	ABC	1.4	34.2
	MOB2	5	5	10	7.6	BC	0.9	25.6
	TOC	5	9	18	12.8	A	1.7	28.9
May	DBR	5	5	16	9.0	ABC	2.0	50.3
	DBR2	5	2	9	5.4	CD	1.1	46.5
	OHD	5	2	8	4.2	D	1.0	54.3
	OHD2	5	7	13	9.0	ABC	1.0	26.1
	OHD3	5	5	13	9.6	ABC	1.5	35.8
	MOB	5	3	15	10.0	AB	2.2	50.0
	MOB2	5	3	13	8.2	BCD	1.9	50.6
	TOC	5	11	17	13.2	A	1.1	18.1
August	DBR	5	4	9	5.6	BC	1.0	41.1
	DBR2	5	3	5	4.0	C	0.4	25.0
	OHD	5	2	6	3.8	C	0.8	47.1
	OHD2	5	3	11	7.4	ABC	1.3	38.9
	OHD3	5	2	16	8.0	AB	2.4	66.7
	MOB	5	9	13	10.6	A	0.7	14.3
	MOB2	5	3	11	7.0	ABC	1.6	50.5
	TOC	5	5	12	8.2	AB	1.2	31.6
November	DBR	5	6	12	8.8	BC	1.1	27.1
	DBR2	5	2	7	3.8	E	0.9	50.6
	OHD	5	2	8	4.4	DE	1.0	52.3
	OHD2	5	5	9	6.2	CDE	0.8	28.9
	OHD3	5	7	10	8.2	CD	0.6	15.9
	MOB	5	5	21	13.0	AB	3.4	58.6
	MOB2	5	2	7	4.8	CDE	0.9	40.1
	TOC	5	12	20	15.6	A	1.4	19.5

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
MOB - Moccasin Branch
TOC - Tocoi Creek

[2]SG: Sites with the same letter are not significantly different within season (1-way ANOVA with Fisher LSD).

the species richness data from the Hester-Dendy plate samples (Table 5) found fewer differences than did the ponar data. The differences within a season were not consistent among seasons.

Few seasonal differences in the number of taxa collected by ponar dredge and plate sampler were detected (Tables 6 and 7). Seasonal differences were found at OHD and TOC using the ponar data, and at DBR based upon the plate data. No trend is apparent.

Year to year comparisons of the number of taxa per ponar dredge found no differences between or among any of the years at DBR and OHD (Table 8). During five of the eight site x season comparisons, significant differences were detected at MOB and TOC. During each of these site x season comparisons, species richness was significantly greater in 1997 than in 1994 and 1995.

Table 5. Benthic invertebrate species richness (number of taxa) as sampled by Hester-Dendy plate sampler at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sites within season, 1997. Sample size (N), smallest number of taxa (Min), largest number of taxa (Max), mean, standard error (Std Err), and coefficient of variation (CV) are given.

Season	Site[1]	N	Min	Max	Mean	SG[2]	Std Err	CV
February	DBR	3	6	9	7.7	A	0.9	19.9
	DBR2	3	4	10	6.3	A	1.9	50.8
	OHD	3	8	10	9.0	A	0.6	11.1
	OHD2	3	6	13	10.0	A	2.1	36.1
	OHD3	3	7	11	9.3	A	1.2	22.3
	MOB	3	4	10	7.3	A	1.8	41.7
	MOB2	3	7	10	8.7	A	0.9	17.6
	TOC	3	11	14	12.0	A	1.0	14.4
May	DBR	3	7	10	9.0	BCD	1.0	19.2
	DBR2	3	6	10	7.3	CD	1.3	31.5
	OHD	3	9	12	10.0	BCD	1.0	17.3
	OHD2	3	12	16	14.0	A	1.2	14.3
	OHD3	3	8	14	11.0	ABC	1.7	27.3
	MOB	3	6	8	7.0	D	0.6	14.3
	MOB2	3	11	16	12.7	AB	1.7	22.8
	TOC	3	8	11	9.7	BCD	0.9	15.8
August	DBR	3	14	17	15.3	A	0.9	10.0
	DBR2	3	6	8	7.3	C	0.7	15.7
	OHD	3	4	10	7.7	C	1.9	41.9
	OHD2	3	8	12	9.7	BC	1.2	21.5
	OHD3	3	10	18	13.7	AB	2.3	29.6
	MOB	3	10	14	12.0	ABC	1.2	16.7
	MOB2	3	10	20	16.3	A	3.2	33.7
	TOC	3	9	10	9.3	BC	0.3	6.2
November	DBR	3	5	11	8.3	AB	1.8	36.7
	DBR2	3	2	6	4.3	B	1.2	48.0
	OHD	3	2	7	5.3	B	1.7	54.1
	OHD2	3	7	12	9.7	AB	1.5	26.0
	OHD3	3	12	13	12.7	A	0.3	4.6
	MOB	3	4	16	9.3	AB	3.5	65.5
	MOB2	3	7	11	9.3	AB	1.2	22.3
	TOC	3	10	15	12.3	A	1.5	20.4

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
MOB - Moccasin Branch
TOC - Tocoi Creek

[2]SG: Sites with the same letter are not significantly different within season (1-way ANOVA with Fisher LSD).

Table 6. Benthic invertebrate species richness (number of taxa) as sampled by ponar dredge at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sampling seasons at each site, 1997. Sample size (N), smallest number of taxa (Min), largest number of taxa (Max), mean, standard error (Std Err), and coefficient of variation (CV) are given.

Site[1]	Season	N	Min	Max	Mean	SG[2]	Std Err	CV
DBR	February	5	5	23	12.2	A	3.1	57.5
	May	5	5	16	9.0	A	2.0	50.3
	August	5	4	9	5.6	A	1.0	41.1
	November	5	6	12	8.8	A	1.1	27.1
DBR2	February	5	3	5	4.2	A	0.4	19.9
	May	5	2	9	5.4	A	1.1	46.5
	August	5	3	5	4.0	A	0.4	25.0
	November	5	2	7	3.8	A	0.9	50.6
OHD	February	5	4	15	9.2	A	2.1	50.0
	May	5	2	8	4.2	B	1.0	54.3
	August	5	2	6	3.8	B	0.8	47.1
	November	5	2	8	4.4	B	1.0	52.3
OHD2	February	5	4	15	10.0	A	2.0	44.2
	May	5	7	13	9.0	A	1.0	26.1
	August	5	3	11	7.4	A	1.3	38.9
	November	5	5	9	6.2	A	0.8	28.9
OHD3	February	5	10	16	13.2	A	1.0	16.4
	May	5	5	13	9.6	A	1.5	35.8
	August	5	2	16	8.0	A	2.4	66.7
	November	5	7	10	8.2	A	0.6	15.9
MOB	February	5	6	13	9.0	A	1.4	34.2
	May	5	3	15	10.0	A	2.2	50.0
	August	5	9	13	10.6	A	0.7	14.3
	November	5	5	21	13.0	A	3.4	58.6
MOB2	February	5	5	10	7.6	A	0.9	25.6
	May	5	3	13	8.2	A	1.9	50.6
	August	5	3	11	7.0	A	1.6	50.5
	November	5	2	7	4.8	A	0.9	40.1
TOC	February	5	9	18	12.8	A	1.7	28.9
	May	5	11	17	13.2	A	1.1	18.1
	August	5	5	12	8.2	B	1.2	31.6
	November	5	12	20	15.6	A	1.4	19.5

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
TOC - Tocoi Creek
MOB - Moccasin Branch

[2]SG: Seasons with the same letter are not significantly different within site (1-way ANOVA with Fisher LSD).

Table 7. Benthic invertebrate species richness (number of taxa) as sampled by Hester-Dendy plate sampler at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sampling seasons at each site, 1997. Sample size (N), smallest number of taxa (Min), largest number of taxa (Max), mean, standard error (Std Err), and coefficient of variation (CV) are given.

Site[1]	Season	N	Min	Max	Mean	SG[2]	Std Err	CV
DBR	February	3	6	9	7.7	B	0.9	19.9
	May	3	7	10	9.0	B	1.0	19.2
	August	3	14	17	15.3	A	0.9	10.0
	November	3	5	11	8.3	B	1.8	36.7
DBR2	February	3	4	10	6.3	A	1.9	50.8
	May	3	6	10	7.3	A	1.3	31.5
	August	3	6	8	7.3	A	0.7	15.7
	November	3	2	6	4.3	A	1.2	48.0
OHD	February	3	8	10	9.0	A	0.6	11.1
	May	3	9	12	10.0	A	1.0	17.3
	August	3	4	10	7.7	A	1.9	41.9
	November	3	2	7	5.3	A	1.7	54.1
OHD2	February	3	6	13	10.0	A	2.1	36.1
	May	3	12	16	14.0	A	1.2	14.3
	August	3	8	12	9.7	A	1.2	21.5
	November	3	7	12	9.7	A	1.5	26.0
OHD3	February	3	7	11	9.3	A	1.2	22.3
	May	3	8	14	11.0	A	1.7	27.3
	August	3	10	18	13.7	A	2.3	29.6
	November	3	12	13	12.7	A	0.3	4.6
MOB	February	3	4	10	7.3	A	1.8	41.7
	May	3	6	8	7.0	A	0.6	14.3
	August	3	10	14	12.0	A	1.2	16.7
	November	3	4	16	9.3	A	3.5	65.5
MOB2	February	3	7	10	8.7	A	0.9	17.6
	May	3	11	16	12.7	A	1.7	22.8
	August	3	10	20	16.3	A	3.2	33.7
	November	3	7	11	9.3	A	1.2	22.3
TOC	February	3	11	14	12.0	A	1.0	14.4
	May	3	8	11	9.7	A	0.9	15.8
	August	3	9	10	9.3	A	0.3	6.2
	November	3	10	15	12.3	A	1.5	20.4

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
TOC - Tocoi Creek
MOB - Moccasin Branch

[2]SG: Seasons with the same letter are not significantly different within site (1-way ANOVA with Fisher LSD).

Table 8. Benthic invertebrate species richness (number of taxa) sampled by ponar dredge at four sampling sites (DBR, OHD, MOB, TOC) in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among years (1994, 1995, 1997) within sampling site and season. Sample size (N), smallest number of taxa (Min), largest number of taxa (Max), mean, standard error (Std Err), and coefficient of variation (CV) are given.

Site[1]	Season	Year	N	Min	Max	Mean	SG[2]	Std Err	CV
DBR	January	1995	3	9	13	11.3	A	1.2	18.4
	February	1997	5	5	23	12.2	A	3.1	57.5
	April	1994	4	4	5	4.2	A	0.2	11.8
	April	1995	3	3	5	4.3	A	0.7	26.6
	May	1997	5	5	16	9.2	A	2.0	49.5
	July	1994	3	4	8	6.3	A	1.2	32.9
	June	1995	3	3	5	4.3	A	0.7	26.6
	August	1997	5	4	9	5.8	A	1.0	37.4
	October	1994	3	5	7	6.0	A	0.6	16.7
	November	1997	5	6	12	8.8	A	1.1	27.1
OHD	January	1995	3	4	9	7.3	A	1.7	39.4
	February	1997	5	4	15	9.4	A	2.0	47.9
	April	1994	4	1	7	3.2	A	1.3	80.9
	April	1995	3	3	9	5.3	A	1.9	60.3
	May	1997	5	2	8	4.6	A	1.0	47.6
	July	1994	3	4	6	5.0	A	0.6	20.0
	June	1995	3	4	6	4.7	A	0.7	24.7
	August	1997	5	2	6	4.0	A	0.7	39.5
	October	1994	3	2	5	3.7	A	0.9	41.7
	November	1997	5	2	8	4.6	A	1.1	52.4
MOB	January	1995	3	4	8	5.3	A	1.3	43.3
	February	1997	5	6	13	9.0	A	1.4	34.2
	April	1994	4	4	5	4.2	B	0.2	11.8
	April	1995	3	4	4	4.0	B	0.0	0.0
	May	1997	5	3	16	10.2	A	2.4	51.6
	July	1994	3	1	5	3.3	B	1.2	62.4
	June	1995	3	2	4	3.0	B	0.6	33.3
	August	1997	5	9	13	10.6	A	0.7	14.3
	October	1994	3	3	3	3.0	A	0.0	0.0
	November	1997	5	5	22	13.4	A	3.6	60.3
TOC	January	1995	3	6	9	7.7	A	0.9	19.9
	February	1997	5	9	18	12.8	A	1.7	28.9
	April	1994	4	3	4	3.2	C	0.2	15.4
	April	1995	3	6	10	8.3	B	1.2	25.0
	May	1997	5	11	17	13.4	A	1.0	17.2
	July	1994	3	2	4	3.3	B	0.7	34.6
	June	1995	3	3	5	3.7	B	0.7	31.5
	August	1997	5	5	13	8.4	A	1.3	35.3
	October	1994	3	8	9	8.7	B	0.3	6.7
	November	1997	5	12	20	15.6	A	1.4	19.5

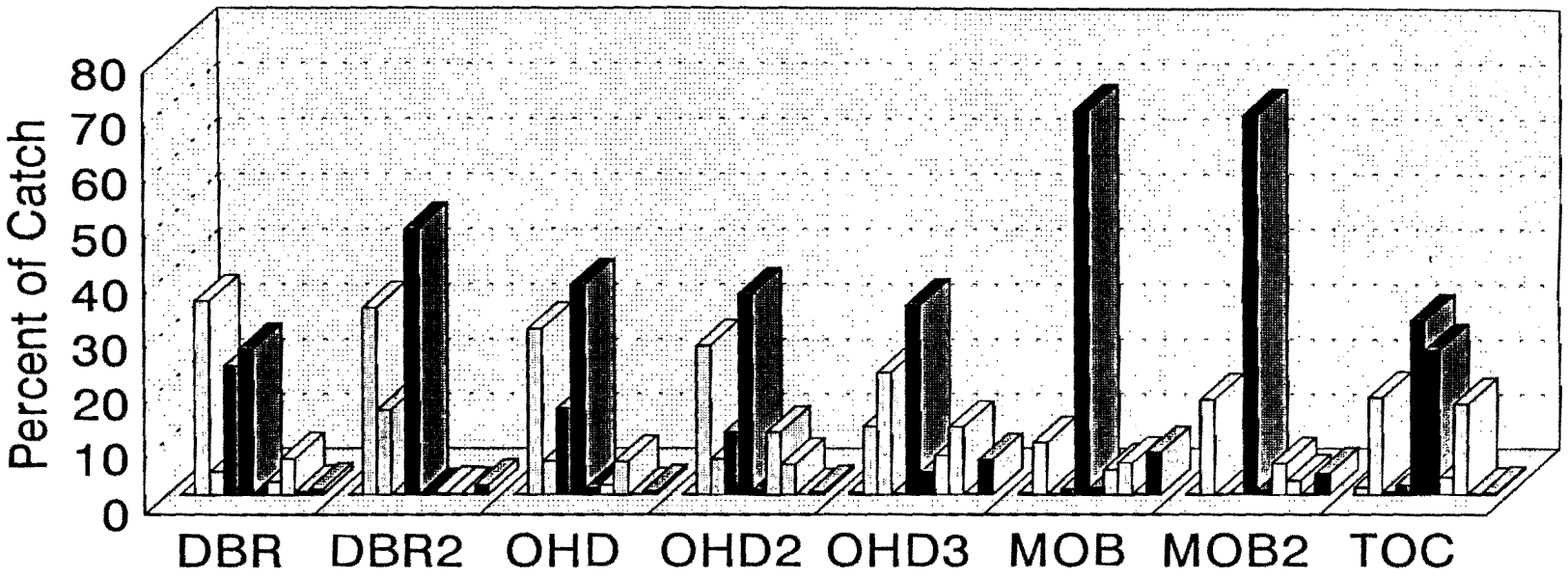
[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
TOC - Tocoi Creek
MOB - Moccasin Branch

[2]SG: Years with the same letter are not significantly different within site and season (t-test or 1-way ANOVA with Fisher LSD).

Species Composition

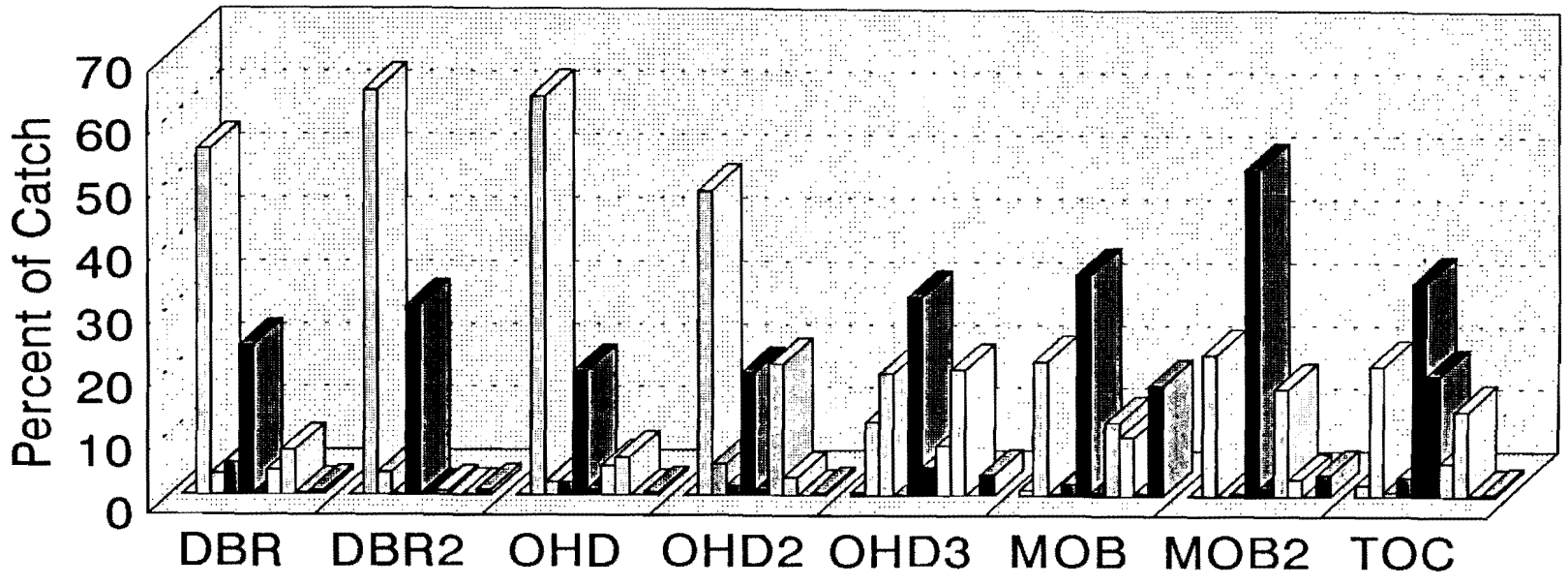
Although the total number of taxa at the four tributaries were generally similar, the composition of the macroinvertebrate communities differed among the eight sites. The organisms can be divided into ten major taxonomic categories including leeches, segmented worms, amphipods, isopods, true flies, bivalves, snails, flatworms and others (Figure 20). After combining data from both sampling methods (ponar dredge and Hester-Dendy plate samplers) and all four sampling seasons, there are similarities in the invertebrate communities at several of the sites. DBR, OHD and OHD2 were similar, being composed of three major groups: oligochaetes (segmented worms), isopods (sow bugs) and dipterans (primarily midges). DBR2 and OHD3 were similar in community composition, being comprised of primarily dipterans (true flies, primarily midges), amphipods (scuds and sideswimmers) and oligochaetes. MOB and MOB2 were likewise similar, being dominated by dipterans (~69%), followed by oligochaetes. TOC, the reference site, was least similar to the other seven sites. The invertebrate community at this site was comprised of four major groups: dipterans, mayflies, oligochaetes and snails. Mayflies were rare at the seven other sites, representing 4.13 percent (OHD3) or less of the collected organisms. Snails were almost as relatively abundant at OHD3 (12.32%) as at TOC (16.57%).

The relative abundances of major taxonomic categories as sampled with ponar dredge alone (Figure 21) were quite different from the combined data. The two Dog Branch sites (DBR and DBR2) along with the two furthest downstream sites on Old Hastings



	DBR	DBR2	OHD	OHD2	OHD3	MOB	MOB2	TOC
Leeches	0.06	0.04	0.04	0.13	0.48	0.36	0.24	1.31
Worms	35.32	34.03	30.25	27.17	12.4	9.38	17.37	17.7
Amphipods	4.18	15.38	6.12	6.45	22.29	0.09	0.04	0.54
Isopods	23.44	0.04	15.73	11.39	0.22	0.96	0.22	1.77
Flies	26.54	48.34	38.29	36.55	34.58	69.82	68.99	31.94
Mayflies	0.13	0	1.16	0.93	4.13	1.32	0.92	26.54
Bivalves	2.32	0.27	1.74	11.35	7.08	4.48	5.68	3.1
Snails	6.51	0.19	5.99	5.46	12.32	5.71	2.56	16.57
Flatworms	0.5	0.04	0.04	0	0.15	0.18	0.15	0.19
Others	1	1.67	0.63	0.57	6.35	7.69	3.82	0.35

Figure 20. Relative abundance (percent) of major taxonomic groups of benthic invertebrates at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, ponar dredge and Hester-Dendy plate data combined, 1997.

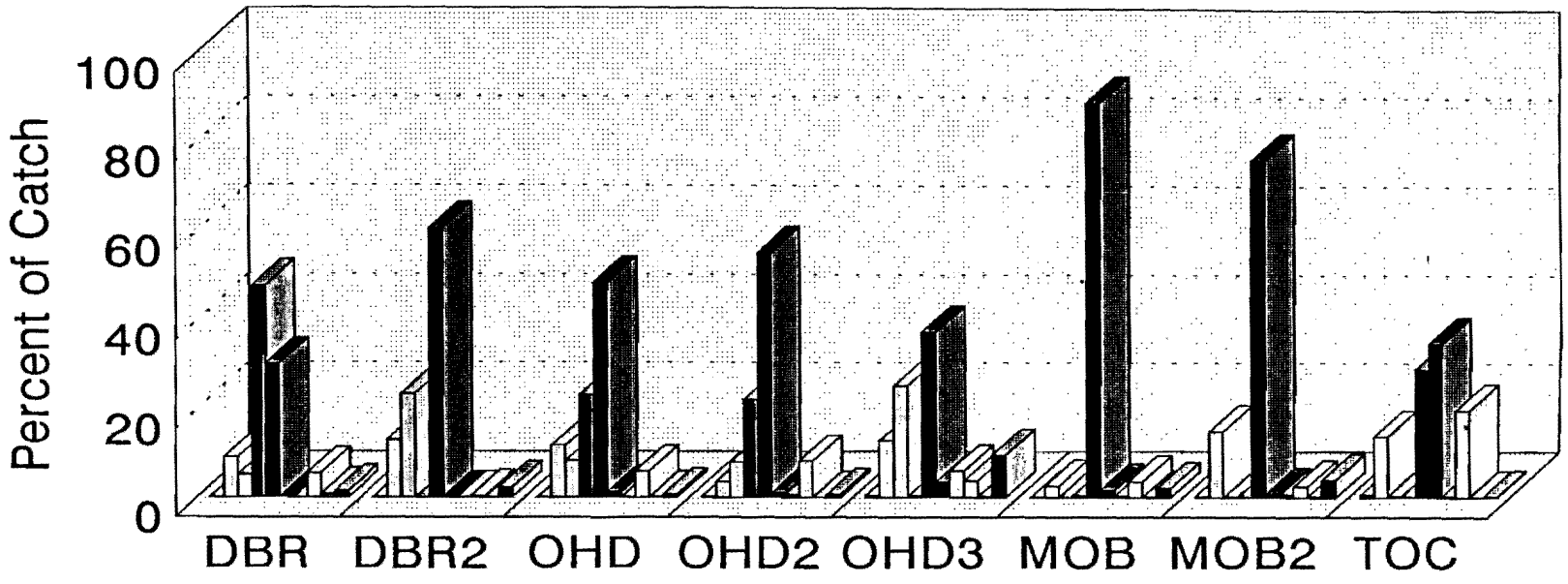


	DBR	DBR2	OHD	OHD2	OHD3	MOB	MOB2	TOC
Leeches	0.1	0	0.13	0.04	0.5	0.92	0.07	1.86
Worms	54.94	64.33	63.38	48.51	11.88	21.5	22.59	20.84
Amphipods	3.44	3.64	2.12	5.07	19.52	0.25	0	0.71
Isopods	5.23	0.09	2.12	1.52	0.07	1.92	0.5	3.03
Flies	23.85	30.25	19.87	19.6	31.82	35.42	52.09	34.23
Mayflies	0.19	0	1	0.83	4.67	0.58	1.29	19.45
Bivalves	4.06	0.65	4.75	21.01	8.06	11.83	17.19	5.41
Snails	7.24	0.09	6.12	2.93	20.16	9.5	2.73	13.76
Flatworms	0.29	0.09	0	0	0	0.42	0.07	0.25
Others	0.65	0.84	0.5	0.47	3.32	17.67	3.45	0.46

Figure 21. Relative abundance (percent) of major taxonomic groups of benthic invertebrates at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, ponar dredge samples, 1997.

Drainage (OHD and OHD2) were dominated by oligochaetes, followed by dipterans. Dipterans were most abundant at the most upstream site on Old Hastings Drainage (OHD3), along with the Moccasin Branch sites (MOB and MOB2) and Tocoi Creek (TOC). The communities at these latter four sites were comprised of three to five almost equally abundant groups of organisms.

The Hester-Dendy plate samplers (Figure 22) collected large proportions of dipterans at all eight sites. Isopods were abundant at DBR, OHD and OHD2, amphipods at DBR2 and OHD3, and mayflies and snails at TOC.



	DBR	DBR2	OHD	OHD2	OHD3	MOB	MOB2	TOC
Leeches	0	0.06	0	0.24	0.46	0.05	0.31	0.67
Worms	9.08	13.17	11.82	3.6	12.96	2.54	15.1	13.94
Amphipods	5.17	23.46	8.34	7.96	25.31	0	0.06	0.33
Isopods	47.78	0	23.3	22.29	0.39	0.42	0.09	0.26
Flies	30.15	60.8	48.54	55.26	37.58	89.23	76.37	29.21
Mayflies	0.04	0	1.25	1.04	3.55	1.74	0.75	35.01
Bivalves	0	0	0.07	0.68	6.02	0.33	0.66	0.33
Snails	5.52	0.26	5.91	8.24	3.78	3.57	2.48	19.93
Flatworms	0.78	0	0.07	0	0.31	0.05	0.19	0.11
Others	1.48	2.25	0.7	0.68	9.65	2.07	3.99	0.22

Figure 22. Relative abundance (percent) of major taxonomic groups of benthic invertebrates at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, Hester-Dendy plate samples, 1997.

Abundance

Invertebrate densities, as estimated by individual ponar dredge samples, ranged from 86 (OHD in August) to 33,200 (TOC in November) organisms per square meter, with seasonal site mean densities ranging from 1,000 (OHD in November) to 16,100 (TOC in November) organisms per square meter (Tables 9 and 11). Invertebrate densities, as estimated by individual plate samples, ranged from 91 (MOB in May) to 9,400 (MOB in August) organisms per square meter, with seasonal site mean densities ranging from 290 (MOB in February) to 4,900 (MOB2 in August) (Tables 10 and 12).

Statistical analysis of the ponar data reveals that the mean number of benthic invertebrates collected per ponar dredge sample at each of the four tributaries were significantly different in three of the four seasons (Table 9). The mean number of invertebrates collected per ponar sample was found to be significantly highest at DBR (February), OHD2 (May) and TOC (November). These three sites were not significantly different from each other except in May, when DBR ponar densities were lower. In February, ponar densities at OHD3 and MOB2 were not different from these three sites. OHD and MOB typically had the lowest mean ponar densities. The reference tributary, Tocoi Creek, supported some of the highest invertebrate abundances observed, but never were they higher than all of the sites in the agricultural tributaries. Invertebrate densities on the plate samplers were not significantly different in November. In May, densities at MOB were significantly smaller (less than half) than means at the seven other sites (Table 10). Numerous site to site differences were detected during February and August, with no apparent pattern other

Table 9. Total number of benthic invertebrates sampled by ponar dredge at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sites within sampling season, 1997. Sample size (N), smallest number of individuals (Min), largest number of individuals (Max), mean, standard error (Std Err), and coefficient of variation (CV) are given. Multiply numbers by 43.06 to obtain number/m^2.

Season	Site[1]	N	Min	Max	Mean	SG[2]	Std Err	CV
February	DBR	5	107	480	247.0	A	63.1	57.2
	DBR2	5	23	198	102.2	BC	32.2	70.4
	OHD	5	6	111	70.0	CD	18.6	59.4
	OHD2	5	33	260	140.2	ABC	44.3	70.7
	OHD3	5	101	248	152.0	AB	26.3	38.7
	MOB	5	13	64	30.4	D	8.7	64.1
	MOB2	5	86	178	134.4	ABC	17.6	29.3
	TOC	5	42	344	161.2	ABC	54.9	76.2
May	DBR	5	43	55	49.2	BC	2.1	9.7
	DBR2	5	16	94	54.2	BC	15.5	63.8
	OHD	5	8	35	24.6	C	4.8	44.0
	OHD2	5	107	280	200.8	A	28.0	31.2
	OHD3	5	34	137	80.2	B	21.9	61.1
	MOB	5	17	101	51.0	BC	16.7	73.3
	MOB2	5	13	144	69.0	BC	24.7	80.1
	TOC	5	41	181	99.2	AB	28.4	64.1
August	DBR	5	20	476	152.2	A	82.3	120.9
	DBR2	5	16	51	35.8	A	6.1	38.2
	OHD	5	2	126	48.8	A	21.6	99.1
	OHD2	5	54	194	121.0	A	24.0	44.4
	OHD3	5	7	83	41.2	A	16.9	91.7
	MOB	5	51	99	73.4	A	9.9	30.0
	MOB2	5	12	175	65.6	A	31.6	107.6
	TOC	5	31	73	49.6	A	8.0	36.3
November	DBR	5	59	299	177.6	AB	48.7	61.3
	DBR2	5	12	78	33.8	C	12.1	80.1
	OHD	5	10	36	23.8	C	4.6	43.5
	OHD2	5	71	228	159.2	AB	26.3	36.9
	OHD3	5	12	55	33.6	C	7.1	47.2
	MOB	5	15	212	114.2	B	37.7	73.9
	MOB2	5	7	70	36.0	C	10.6	65.8
	TOC	5	218	772	373.2	A	101.2	60.6

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
MOB - Moccasin Branch
TOC - Tocoi Creek

[2]SG: Sites with the same letter are not significantly different within season (1-way ANOVA with Fisher LSD).

Table 10. Total number of benthic invertebrates sampled by Hester-Dendy plate sampler at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sites within sampling season, 1997. Sample size (N), smallest number of individuals (Min), largest number of individuals (Max), mean, standard error (Std Err), and coefficient of variation (CV) are given. Multiply numbers by 9.14 to obtain number/m^2.

Season	Site[1]	N	Min	Max	Mean	SG[2]	Std Err	CV
February	DBR	3	48	105	72.3	D	17.0	40.6
	DBR2	3	166	280	235.7	AB	35.3	25.9
	OHD	3	66	155	104.0	BCD	26.5	44.1
	OHD2	3	109	269	187.3	ABC	46.2	42.7
	OHD3	3	29	74	53.0	DE	13.1	42.7
	MOB	3	12	41	31.3	E	9.7	53.4
	MOB2	3	219	500	329.0	A	86.7	45.6
	TOC	3	34	131	97.0	CD	31.5	56.3
May	DBR	3	65	215	164.3	A	49.7	52.4
	DBR2	3	126	224	171.7	A	28.5	28.7
	OHD	3	190	212	197.3	A	7.3	6.4
	OHD2	3	270	512	355.3	A	78.4	38.2
	OHD3	3	184	271	217.7	A	27.0	21.5
	MOB	3	10	128	72.7	B	34.3	81.7
	MOB2	3	113	262	193.7	A	43.5	38.9
	TOC	3	215	576	356.3	A	111.3	54.1
August	DBR	3	247	451	341.7	AB	59.3	30.1
	DBR2	3	59	78	70.7	DE	5.9	14.5
	OHD	3	48	68	57.3	E	5.8	17.6
	OHD2	3	70	134	110.0	CDE	20.1	31.7
	OHD3	3	77	248	164.0	CD	49.4	52.2
	MOB	3	258	1032	537.7	AB	247.9	79.9
	MOB2	3	268	813	540.0	A	157.3	50.5
	TOC	3	152	296	212.0	BC	43.3	35.3
November	DBR	3	131	291	197.0	A	48.3	42.4
	DBR2	3	29	67	48.0	A	11.0	39.6
	OHD	3	54	207	133.7	A	44.3	57.4
	OHD2	3	178	217	193.7	A	11.9	10.6
	OHD3	3	62	113	92.3	A	15.5	29.1
	MOB	3	33	356	143.0	A	106.5	129.0
	MOB2	3	90	346	201.0	A	75.8	65.3
	TOC	3	186	335	249.0	A	44.5	31.0

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
MOB - Moccasin Branch
TOC - Tocoi Creek

[2]SG: Sites with the same letter are not significantly different within season (1-way ANOVA with Fisher LSD).

Table 11. Total number of benthic invertebrates sampled by ponar dredge at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sampling seasons at each site, 1997. Sample size (N), smallest number of individuals (Min), largest number of individuals (Max), mean, standard error (Std Err), and coefficient of variation (CV) are given. Multiply numbers by 43.06 to obtain number/m^2.

Site[1]	Season	N	Min	Max	Mean	SG[2]	Std Err	CV
DBR	February	5	107	480	247.0	A	63.1	57.2
	May	5	43	55	49.2	B	2.1	9.7
	August	5	20	476	152.2	AB	82.3	120.9
	November	5	59	299	177.6	A	48.7	61.3
DBR2	February	5	23	198	102.2	A	32.2	70.4
	May	5	16	94	54.2	A	15.5	63.8
	August	5	16	51	35.8	A	6.1	38.2
	November	5	12	78	33.8	A	12.1	80.1
OHD	February	5	6	111	70.0	A	18.6	59.4
	May	5	8	35	24.6	A	4.8	44.0
	August	5	2	126	48.8	A	21.6	99.1
	November	5	10	36	23.8	A	4.6	43.5
OHD2	February	5	33	260	140.2	A	44.3	70.7
	May	5	107	280	200.8	A	28.0	31.2
	August	5	54	194	121.0	A	24.0	44.4
	November	5	71	228	159.2	A	26.3	36.9
OHD3	February	5	101	248	152.0	A	26.3	38.7
	May	5	34	137	80.2	AB	21.9	61.1
	August	5	7	83	41.2	B	16.9	91.7
	November	5	12	55	33.6	B	7.1	47.2
MOB	February	5	13	64	30.4	A	8.7	64.1
	May	5	17	101	51.0	A	16.7	73.3
	August	5	51	99	73.4	A	9.9	30.0
	November	5	15	212	114.2	A	37.7	73.9
MOB2	February	5	86	178	134.4	A	17.6	29.3
	May	5	13	144	69.0	A	24.7	80.1
	August	5	12	175	65.6	A	31.6	107.6
	November	5	7	70	36.0	A	10.6	65.8
TOC	February	5	42	344	161.2	B	54.9	76.2
	May	5	41	181	99.2	BC	28.4	64.1
	August	5	31	73	49.6	C	8.0	36.3
	November	5	218	772	373.2	A	101.2	60.6

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
TOC - Tocoi Creek
MOB - Moccasin Branch

[2]SG: Seasons with the same letter are not significantly different within site (1-way ANOVA with Fisher LSD).

Table 12. Total number of benthic invertebrates sampled by Hester-Dendy plate sampler at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sampling seasons at each site, 1997. Sample size (N), smallest number of individuals (Min), largest number of individuals (Max), mean, standard error (Std Err), and coefficient of variation (CV) are given. Multiply numbers by 9.14 to obtain number/m^2.

Site[1]	Season	N	Min	Max	Mean	SG[2]	Std Err	CV
DBR	February	3	48	105	72.3	B	17.0	40.6
	May	3	65	215	164.3	AB	49.7	52.4
	August	3	247	451	341.7	A	59.3	30.1
	November	3	131	291	197.0	A	48.3	42.4
DBR2	February	3	166	280	235.7	A	35.3	25.9
	May	3	126	224	171.7	A	28.5	28.7
	August	3	59	78	70.7	B	5.9	14.5
	November	3	29	67	48.0	B	11.0	39.6
OHD	February	3	66	155	104.0	AB	26.5	44.1
	May	3	190	212	197.3	A	7.3	6.4
	August	3	48	68	57.3	B	5.8	17.6
	November	3	54	207	133.7	AB	44.3	57.4
OHD2	February	3	109	269	187.3	B	46.2	42.7
	May	3	270	512	355.3	A	78.4	38.2
	August	3	70	134	110.0	B	20.1	31.7
	November	3	178	217	193.7	AB	11.9	10.6
OHD3	February	3	29	74	53.0	C	13.1	42.7
	May	3	184	271	217.7	A	27.0	21.5
	August	3	77	248	164.0	AB	49.4	52.2
	November	3	62	113	92.3	BC	15.5	29.1
MOB	February	3	12	41	31.3	A	9.7	53.4
	May	3	10	128	72.7	A	34.3	81.7
	August	3	258	1032	537.7	A	247.9	79.9
	November	3	33	356	143.0	A	106.5	129.0
MOB2	February	3	219	500	329.0	A	86.7	45.6
	May	3	113	262	193.7	A	43.5	38.9
	August	3	268	813	540.0	A	157.3	50.5
	November	3	90	346	201.0	A	75.8	65.3
TOC	February	3	34	131	97.0	A	31.5	56.3
	May	3	215	576	356.3	A	111.3	54.1
	August	3	152	296	212.0	A	43.3	35.3
	November	3	186	335	249.0	A	44.5	31.0

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
TOC - Tocoi Creek
MOB - Moccasin Branch

[2]SG: Seasons with the same letter are not significantly different within site (1-way ANOVA with Fisher LSD).

than MOB2 having the highest densities during both months. No consistency in spatial pattern is apparent when comparing the ponar and plate densities.

Further statistical analysis of the ponar data reveals that the mean number of benthic invertebrates collected per ponar dredge sample among seasons within each site were not significantly different at five of the eight sites (Table 11). Seasonal differences were detected at DBR, OHD3 and TOC, but no general trend among seasonal means is apparent. An analysis of the plate data reveals that seasons were found to differ within each of the Dog Branch (DBR and DBR2) and Old Hastings Drainage (OHD, OHD2 and OHD3) sites, while no differences were detected within each of the Moccasin Branch (MOB and MOB2) and Tocoi Creek (TOC) sites (Table 12). No seasonal trend is apparent, high density seasons at one site are low density seasons at others.

A comparison of the 1994, 1995 and 1997 ponar data indicates no difference in the abundance of benthic invertebrates within ten of the 16 site-season analyses (Table 13). Mean densities of invertebrates collected via ponar dredge were significantly higher in 1997 than in 1994 (five of five analyses). Densities in 1995 were also significantly higher than in 1994 (three of three analyses). At MOB during the January-February season, mean ponar densities in 1997 were lower than 1995.

Table 13. Total number of benthic invertebrates sampled by ponar dredge at four sampling sites (DBR, OHD, MOB, TOC) in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among years (1994, 1995, 1997) within sampling site and season. Sample size (N), smallest number of individuals (Min), largest number of individuals (Max), mean, standard error (Std Err), and coefficient of variation (CV) are given. Multiply numbers by 43.06 to obtain number/m^2.

Site[1]	Season	Year	N	Min	Max	Mean	SG[2]	Std Err	CV
DBR	January	1995	3	82	564	294.3	A	142.1	83.6
	February	1997	5	107	480	247.0	A	63.1	57.2
	April	1994	4	50	119	80.2	A	14.4	36.0
	April	1995	3	10	142	63.0	A	40.3	110.7
	May	1997	5	43	55	49.2	A	2.1	9.7
	July	1994	3	34	520	310.0	A	144.1	80.5
	June	1995	3	69	132	93.0	A	19.7	36.6
	August	1997	5	20	476	152.2	A	82.3	120.9
	October	1994	3	24	56	37.7	B	9.5	43.8
	November	1997	5	59	299	177.6	A	48.7	61.3
OHD	January	1995	3	51	66	59.3	A	4.4	12.9
	February	1997	5	6	111	70.0	A	18.6	59.4
	April	1994	4	3	78	45.0	A	15.5	69.1
	April	1995	3	39	620	237.3	A	191.4	139.7
	May	1997	5	8	35	24.6	A	4.8	44.0
	July	1994	3	24	44	34.0	A	5.8	29.4
	June	1995	3	22	146	72.0	A	37.8	90.8
	August	1997	5	2	126	48.8	A	21.6	99.1
	October	1994	3	10	44	25.3	A	10.0	68.1
	November	1997	5	10	36	23.8	A	4.6	43.5
MOB	January	1995	3	60	192	120.0	A	38.6	55.7
	February	1997	5	13	64	30.4	B	8.7	64.1
	April	1994	4	32	59	47.7	A	5.7	23.7
	April	1995	3	21	86	43.7	A	21.2	84.0
	May	1997	5	17	101	51.0	A	16.7	73.3
	July	1994	3	4	22	12.3	B	5.2	73.6
	June	1995	3	27	44	37.3	A	5.2	24.3
	August	1997	5	51	99	73.4	A	9.9	30.0
	October	1994	3	24	68	51.3	A	13.8	46.5
	November	1997	5	15	212	114.2	A	37.7	73.9
TOC	January	1995	3	70	252	145.3	A	54.8	65.3
	February	1997	5	42	344	161.2	A	54.9	76.2
	April	1994	4	22	63	35.2	B	9.6	54.3
	April	1995	3	106	364	203.3	A	80.9	68.9
	May	1997	5	41	181	99.2	A	28.4	64.1
	July	1994	3	5	11	7.7	B	1.8	39.8
	June	1995	3	28	72	53.3	A	13.1	42.6
	August	1997	5	31	73	49.6	A	8.0	36.3
	October	1994	3	60	114	92.7	B	16.6	31.0
	November	1997	5	218	772	373.2	A	101.2	60.6

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
TOC - Tocoi Creek
MOB - Moccasin Branch

[2]SG: Years with the same letter are not significantly different within site and season (t-test or 1-way ANOVA with Fisher LSD).

Community Diversity

Shannon-Weiner Diversity Index (SWDI) values calculated from benthic invertebrate data from individual ponar dredge samples ranged from a low of 0.43 (low diversity, i.e., most individuals were of the same taxa) at OHD to a high of 3.51 (high diversity, individuals distributed fairly equally among many taxa) at DBR (Tables 14 and 16). Seasonal site means ranged from 0.94 (OHD in August) to 2.88 (TOC in February). SWDI values calculated from the plate samples ranged from 0.50 at OHD to 2.96 at OHD3 (August and November) (Tables 15 and 17). Seasonal site means ranged from 0.90 (MOB in August) to 2.64 (OHD3 in August). OHD3, the furthest upstream station in Old Hastings Drainage, had the highest mean SWDI based on both ponar and plate samples.

Statistical analysis of the ponar data reveals that the mean SWDI values of benthic invertebrates collected by ponar dredge at each of the four tributaries were significantly different in all four seasons (Table 14). Mean SWDI values were found to be significantly highest at OHD3, MOB and TOC in all seasons. OHD (February), DBR (May) and OHD2 (February and May) mean SWDI values were not different from OHD3, MOB and TOC. DBR2 was significantly lower than OHD3, MOB and TOC in all four seasons, while OHD was significantly lower than these three stations in all but February. TOC, the reference site, had the highest mean values in February and May, while MOB had the highest mean values in August and November. The two lowest mean SWDI values within individual seasons were generally recorded at DBR2 or OHD.

Table 14. Shannon-Weiner Diversity Index for benthic invertebrates sampled by ponar dredge at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sites within sampling season, 1997. Sample size (N), smallest Index value (Min), largest Index value (Max), mean, standard error (Std Err), and coefficient of variation (CV) are given.

Season	Site[1]	N	Min	Max	Mean	SG[2]	Std Err	CV
February	DBR	5	1.38	3.51	2.12	B	0.38	40.56
	DBR2	5	0.96	1.76	1.38	C	0.14	22.08
	OHD	5	1.72	2.88	2.24	AB	0.22	21.51
	OHD2	5	1.16	3.10	2.31	AB	0.32	31.05
	OHD3	5	1.88	2.88	2.56	AB	0.19	16.49
	MOB	5	1.92	2.91	2.42	AB	0.16	15.01
	MOB2	5	0.56	1.93	1.19	C	0.26	48.14
	TOC	5	2.70	2.98	2.88	A	0.05	4.01
May	DBR	5	1.28	3.30	2.17	AB	0.37	37.84
	DBR2	5	0.63	2.01	1.29	CD	0.28	48.83
	OHD	5	0.47	2.38	1.07	D	0.35	72.64
	OHD2	5	1.80	2.38	2.06	ABC	0.11	11.78
	OHD3	5	1.67	2.51	2.18	AB	0.14	14.58
	MOB	5	1.18	3.17	2.48	AB	0.34	31.09
	MOB2	5	0.77	2.26	1.82	BCD	0.27	33.12
	TOC	5	2.08	3.13	2.69	A	0.17	14.39
August	DBR	5	1.05	2.08	1.59	BCD	0.20	28.35
	DBR2	5	0.53	1.27	1.02	D	0.14	30.16
	OHD	5	0.43	1.56	0.94	D	0.18	43.92
	OHD2	5	0.86	1.65	1.37	CD	0.14	22.91
	OHD3	5	0.86	3.19	2.18	AB	0.39	39.77
	MOB	5	2.13	2.80	2.55	A	0.12	10.81
	MOB2	5	0.87	2.53	1.83	BC	0.29	35.27
	TOC	5	1.48	2.83	2.13	AB	0.25	25.96
November	DBR	5	1.14	2.11	1.69	BC	0.16	21.38
	DBR2	5	0.62	2.07	1.17	C	0.25	47.59
	OHD	5	0.67	2.11	1.25	C	0.26	47.07
	OHD2	5	1.09	2.39	1.69	BC	0.21	27.99
	OHD3	5	2.09	2.90	2.47	A	0.14	13.04
	MOB	5	1.63	3.42	2.57	A	0.33	28.96
	MOB2	5	0.59	2.24	1.46	C	0.33	50.97
	TOC	5	1.82	2.75	2.18	AB	0.15	15.82

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
MOB - Moccasin Branch
TOC - Tocoi Creek

[2]SG: Sites with the same letter are not significantly different within season (1-way ANOVA with Fisher LSD).

Table 15. Shannon-Weiner Diversity Index for benthic invertebrates sampled by Hester-Dendy plate sampler at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sites within sampling season, 1997. Sample size (N), smallest Index value (Min), largest Index value (Max), mean, standard error (Std Err), and coefficient of variation (CV) are given.

Season	Site[1]	N	Min	Max	Mean	SG[2]	Std Err	CV
February	DBR	3	1.55	2.59	2.10	AB	0.30	24.93
	DBR2	3	1.37	1.88	1.55	BC	0.17	18.89
	OHD	3	1.87	2.46	2.21	A	0.18	13.87
	OHD2	3	1.82	2.62	2.19	A	0.23	18.43
	OHD3	3	2.29	2.64	2.46	A	0.10	6.97
	MOB	3	1.55	2.62	2.03	AB	0.31	26.54
	MOB2	3	0.95	1.35	1.11	C	0.12	18.98
	TOC	3	2.09	2.49	2.33	A	0.12	9.17
May	DBR	3	1.36	2.56	1.80	A	0.38	36.63
	DBR2	3	1.08	1.48	1.30	A	0.11	15.28
	OHD	3	1.75	2.13	1.89	A	0.12	10.98
	OHD2	3	1.39	2.02	1.70	A	0.18	18.65
	OHD3	3	2.33	2.89	2.54	A	0.18	12.10
	MOB	3	0.59	2.72	1.49	A	0.64	73.82
	MOB2	3	1.68	2.01	1.82	A	0.10	9.04
	TOC	3	1.76	2.25	2.01	A	0.14	12.09
August	DBR	3	1.32	2.38	1.84	AB	0.31	28.82
	DBR2	3	1.47	2.07	1.79	B	0.17	16.90
	OHD	3	0.97	2.80	2.07	AB	0.56	46.74
	OHD2	3	1.39	2.55	2.04	AB	0.34	29.20
	OHD3	3	2.32	2.96	2.64	A	0.18	12.08
	MOB	3	0.75	0.99	0.90	C	0.08	14.49
	MOB2	3	1.56	1.91	1.74	BC	0.10	9.98
	TOC	3	1.77	2.28	2.05	AB	0.15	12.63
November	DBR	3	1.75	2.00	1.86	ABC	0.07	6.92
	DBR2	3	0.93	1.55	1.28	CD	0.18	24.80
	OHD	3	0.50	1.43	0.99	D	0.27	47.00
	OHD2	3	0.59	2.07	1.26	CD	0.43	59.45
	OHD3	3	2.31	2.96	2.61	A	0.19	12.41
	MOB	3	0.91	2.44	1.64	BCD	0.44	46.57
	MOB2	3	1.77	2.53	2.11	AB	0.22	18.37
	TOC	3	2.07	2.20	2.15	AB	0.04	3.32

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
MOB - Moccasin Branch
TOC - Tocoi Creek

[2]SG: Sites with the same letter are not significantly different within season (1-way ANOVA with Fisher LSD).

Table 16. Shannon-Weiner Diversity Index for benthic invertebrates sampled by ponar dredge at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sampling seasons at each site, 1997. Sample size (N), smallest Index value (Min), largest Index value (Max), mean, standard error (Std Err), and coefficient of variation (CV) are given.

Site[1]	Season	N	Min	Max	Mean	SG[2]	Std Err	CV
DBR	February	5	1.38	3.51	2.12	A	0.38	40.56
	May	5	1.28	3.30	2.17	A	0.37	37.84
	August	5	1.05	2.08	1.59	A	0.20	28.35
	November	5	1.14	2.11	1.69	A	0.16	21.38
DBR2	February	5	0.96	1.76	1.38	A	0.14	22.08
	May	5	0.63	2.01	1.29	A	0.28	48.83
	August	5	0.53	1.27	1.02	A	0.14	30.16
	November	5	0.62	2.07	1.17	A	0.25	47.59
OHD	February	5	1.72	2.88	2.24	A	0.22	21.51
	May	5	0.47	2.38	1.07	B	0.35	72.64
	August	5	0.43	1.56	0.94	B	0.18	43.92
	November	5	0.67	2.11	1.25	B	0.26	47.07
OHD2	February	5	1.16	3.10	2.31	A	0.32	31.05
	May	5	1.80	2.38	2.06	A	0.11	11.78
	August	5	0.86	1.65	1.37	B	0.14	22.91
	November	5	1.09	2.39	1.69	AB	0.21	27.99
OHD3	February	5	1.88	2.88	2.56	A	0.19	16.49
	May	5	1.67	2.51	2.18	A	0.14	14.58
	August	5	0.86	3.19	2.18	A	0.39	39.77
	November	5	2.09	2.90	2.47	A	0.14	13.04
MOB	February	5	1.92	2.91	2.42	A	0.16	15.01
	May	5	1.18	3.17	2.48	A	0.34	31.09
	August	5	2.13	2.80	2.55	A	0.12	10.81
	November	5	1.63	3.42	2.57	A	0.33	28.96
MOB2	February	5	0.56	1.93	1.19	A	0.26	48.14
	May	5	0.77	2.26	1.82	A	0.27	33.12
	August	5	0.87	2.53	1.83	A	0.29	35.27
	November	5	0.59	2.24	1.46	A	0.33	50.97
TOC	February	5	2.70	2.98	2.88	A	0.05	4.01
	May	5	2.08	3.13	2.69	A	0.17	14.39
	August	5	1.48	2.83	2.13	B	0.25	25.96
	November	5	1.82	2.75	2.18	B	0.15	15.82

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
TOC - Tocoi Creek
MOB - Moccasin Branch

[2]SG: Seasons with the same letter are not significantly different within site (1-way ANOVA with Fisher LSD).

Table 17. Shannon-Weiner Diversity Index for benthic invertebrates sampled by Hester-Dendy plate sampler at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sampling seasons at each site, 1997. Sample size (N), smallest Index value (Min), largest Index value (Max), mean, standard error (Std Err), and coefficient of variation (CV) are given.

Site[1]	Season	N	Min	Max	Mean	SG[2]	Std Err	CV
DBR	February	3	1.55	2.59	2.10	A	0.30	24.93
	May	3	1.36	2.56	1.80	A	0.38	36.63
	August	3	1.32	2.38	1.84	A	0.31	28.82
	November	3	1.75	2.00	1.86	A	0.07	6.92
DBR2	February	3	1.37	1.88	1.55	A	0.17	18.89
	May	3	1.08	1.48	1.30	A	0.11	15.28
	August	3	1.47	2.07	1.79	A	0.17	16.90
	November	3	0.93	1.55	1.28	A	0.18	24.80
OHD	February	3	1.87	2.46	2.21	A	0.18	13.87
	May	3	1.75	2.13	1.89	A	0.12	10.98
	August	3	0.97	2.80	2.07	A	0.56	46.74
	November	3	0.50	1.43	0.99	A	0.27	47.00
OHD2	February	3	1.82	2.62	2.19	A	0.23	18.43
	May	3	1.39	2.02	1.70	A	0.18	18.65
	August	3	1.39	2.55	2.04	A	0.34	29.20
	November	3	0.59	2.07	1.26	A	0.43	59.45
OHD3	February	3	2.29	2.64	2.46	A	0.10	6.97
	May	3	2.33	2.89	2.54	A	0.18	12.10
	August	3	2.32	2.96	2.64	A	0.18	12.08
	November	3	2.31	2.96	2.61	A	0.19	12.41
MOB	February	3	1.55	2.62	2.03	A	0.31	26.54
	May	3	0.59	2.72	1.49	A	0.64	73.82
	August	3	0.75	0.99	0.90	A	0.08	14.49
	November	3	0.91	2.44	1.64	A	0.44	46.57
MOB2	February	3	0.95	1.35	1.11	B	0.12	18.98
	May	3	1.68	2.01	1.82	A	0.10	9.04
	August	3	1.56	1.91	1.74	A	0.10	9.98
	November	3	1.77	2.53	2.11	A	0.22	18.37
TOC	February	3	2.09	2.49	2.33	A	0.12	9.17
	May	3	1.76	2.25	2.01	A	0.14	12.09
	August	3	1.77	2.28	2.05	A	0.15	12.63
	November	3	2.07	2.20	2.15	A	0.04	3.32

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
TOC - Tocoi Creek
MOB - Moccasin Branch

[2]SG: Seasons with the same letter are not significantly different within site (1-way ANOVA with Fisher LSD).

Statistical analysis of the plate data reveals that the mean SWDI values at each of the four tributaries were significantly different in three of the four seasons (Table 15). Only in May were no differences detected. OHD3 had the highest mean SWDI in all four seasons, followed by TOC. These two sites were never found to differ significantly from each other nor from DBR. Other similarities and differences were detected, however, they produced no pattern among seasons.

Additional statistical analysis of the ponar data reveals that the mean SWDI values of benthic invertebrates were far less variable over time within each site. Seasonal ponar means were found to be statistically different at three of the eight sites (Table 16), while plate means were different at only one of the eight sites (Table 17). No seasonal pattern is apparent across the four sites for which differences were detected.

Statistical analysis of the ponar data detected no differences in SWDI means among years (1994, 1995 and 1997) within seasons (January-February, April-May, July-August and October-November) at either DBR and OHD (Table 18). Differences were detected between and among years during all seasons at MOB. In all cases, mean SWDI values were significantly larger in 1997 than in 1994 or 1995. SWDI means for 1997 were also significantly greater than the 1994 and 1995 means within the January-February and April-May seasons at TOC. The differences detected were not only significant, but substantial in magnitude.

Table 18. Shannon-Weiner Diversity Index for benthic invertebrates sampled by ponar dredge at four sampling sites (DBR, OHD, MOB, TOC) in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among years (1994, 1995, 1997) within sampling site and season. Sample size (N), smallest Index value (Min), largest Index value (Max), mean, standard error (Std Err), and coefficient of variation (CV) are given.

Site[1]	Season	Year	N	Min	Max	Mean	SG[2]	Std Err	CV
DBR	January	1995	3	2.24	2.68	2.39	A	0.14	10.22
	February	1997	5	1.38	3.51	2.12	A	0.38	40.56
	April	1994	4	1.17	1.54	1.36	A	0.10	14.04
	April	1995	3	1.08	1.77	1.37	A	0.21	26.38
	May	1997	5	1.28	3.30	2.17	A	0.37	37.84
	July	1994	3	0.92	1.50	1.19	A	0.17	24.98
	June	1995	3	1.05	1.50	1.32	A	0.14	17.92
	August	1997	5	1.05	2.08	1.59	A	0.20	28.35
	October	1994	3	1.43	2.40	1.96	A	0.28	24.85
	November	1997	5	1.14	2.11	1.69	A	0.16	21.38
OHD	January	1995	3	0.87	2.59	1.92	A	0.53	48.06
	February	1997	5	1.72	2.88	2.24	A	0.22	21.51
	April	1994	4	0.00	1.68	0.95	A	0.35	74.23
	April	1995	3	0.37	2.17	1.09	A	0.55	87.67
	May	1997	5	0.47	2.38	1.07	A	0.35	72.64
	July	1994	3	1.16	2.14	1.57	A	0.29	32.34
	June	1995	3	0.62	1.33	0.96	A	0.20	37.03
	August	1997	5	0.43	1.56	0.94	A	0.18	43.92
	October	1994	3	0.85	1.87	1.36	A	0.30	37.68
	November	1997	5	0.67	2.11	1.25	A	0.26	47.07
MOB	January	1995	3	1.27	2.15	1.59	B	0.28	30.58
	February	1997	5	1.92	2.91	2.42	A	0.16	15.01
	April	1994	4	1.23	1.38	1.30	B	0.03	4.85
	April	1995	3	0.66	1.28	0.95	B	0.18	32.88
	May	1997	5	1.18	3.17	2.48	A	0.34	31.09
	July	1994	3	0.00	2.04	1.00	B	0.59	102.18
	June	1995	3	0.68	0.83	0.75	B	0.04	9.71
	August	1997	5	2.13	2.80	2.55	A	0.12	10.81
	October	1994	3	0.79	1.04	0.90	B	0.07	14.17
	November	1997	5	1.63	3.42	2.57	A	0.33	28.96
TOC	January	1995	3	1.88	1.98	1.93	B	0.03	2.74
	February	1997	5	2.70	2.98	2.88	A	0.05	4.01
	April	1994	4	0.65	1.82	1.18	B	0.28	48.32
	April	1995	3	1.62	2.43	1.94	AB	0.25	22.22
	May	1997	5	2.08	3.13	2.69	A	0.17	14.39
	July	1994	3	0.72	1.68	1.35	A	0.32	40.44
	June	1995	3	1.13	2.28	1.60	A	0.35	37.78
	August	1997	5	1.48	2.83	2.13	A	0.25	25.96
	October	1994	3	2.11	2.35	2.21	A	0.07	5.83
	November	1997	5	1.82	2.75	2.18	A	0.15	15.82

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
TOC - Tocoi Creek
MOB - Moccasin Branch

[2]SG: Years with the same letter are not significantly different within site and season (t-test or 1-way ANOVA with Fisher LSD).

Pollution Tolerance

The Hilsenhoff Biotic Index (HBI) for a given sample of benthic invertebrates is basically the mean weighted value of the individual pollution tolerance values (TVs) of the organisms in the sample. Tolerance values can range from 0 to 10, with the higher number indicating greater tolerance to pollution/enrichment. Tolerance values of the taxa collected in this study were found to range from 1 to 9.8 (Table 3). HBI values for individual ponar samples ranged from a low of 5.34 (TOC in May) to a high of 8.31 (OHD in August) (Table 19). HBI values for individual plate samples ranged from a low of 5.37 (MOB in May) to a high of 8.12 (OHD in November) (Table 20).

HBI values at the eight sites were significantly different within each of the four sampling seasons based on the ponar data (Table 19). The Dog Branch and Old Hastings Drainage sites were never found to differ from each other. MOB was found to differ from these sites in August. MOB2 and/or TOC differed from DBR in three of the four seasons. Other differences were inconsistent among seasons. TOC, the reference site had the lowest mean sample HBI in February and May, while MOB had the lowest mean HBI in August and November. OHD had the highest mean sample HBI in May, August and November.

Analysis of HBI values based upon the plate samples detected two significant differences among sites within season (Table 20). HBI values were significantly higher at DBR2 than at DBR in both August and November.

Table 19. Hilsenhoff Biotic Index (HBI) for benthic invertebrates sampled by ponar dredge at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sites within season, 1997. Sample size (N), smallest HBI value (Min), largest HBI value (Max), mean, median (Med), standard error (Std Err), and coefficient of variation (CV) are given.

Season	Site[1]	N	Min	Max	Mean	Med	SG[2]	Std Err	CV
February	DBR	5	7.33	7.95	7.73	7.79	A	0.11	3.18
	DBR2	5	7.66	7.99	7.78	7.76	AB	0.06	1.64
	OHD	5	6.48	7.78	7.41	7.64	AB	0.24	7.32
	OHD2	5	7.46	8.08	7.66	7.61	AB	0.11	3.17
	OHD3	5	7.21	7.46	7.33	7.33	AB	0.04	1.32
	MOB	5	6.57	7.52	7.12	7.24	AB	0.17	5.25
	MOB2	5	7.17	7.52	7.34	7.33	B	0.06	1.72
	TOC	5	6.60	7.49	7.01	6.85	B	0.19	5.92
May	DBR	5	6.13	8.10	7.26	7.81	A	0.42	12.89
	DBR2	5	7.62	8.09	7.88	7.96	AB	0.09	2.45
	OHD	5	7.07	8.14	7.83	8.10	AB	0.20	5.84
	OHD2	5	7.59	7.96	7.76	7.78	AB	0.07	2.05
	OHD3	5	7.22	7.64	7.42	7.42	A	0.07	2.05
	MOB	5	6.32	7.64	6.94	7.00	A	0.24	7.85
	MOB2	5	6.58	8.08	7.42	7.53	AB	0.25	7.51
	TOC	5	5.34	6.98	6.15	5.97	B	0.29	10.64
August	DBR	5	7.57	7.96	7.73	7.72	A	0.07	1.90
	DBR2	5	7.30	8.14	7.76	7.90	A	0.17	5.01
	OHD	5	7.31	8.31	8.02	8.11	A	0.18	5.10
	OHD2	5	7.57	8.02	7.86	7.90	A	0.08	2.18
	OHD3	5	6.96	8.00	7.34	7.26	AB	0.20	5.98
	MOB	5	6.33	6.83	6.64	6.68	B	0.08	2.83
	MOB2	5	6.78	7.93	7.32	7.33	AB	0.20	6.20
	TOC	5	7.10	7.72	7.48	7.52	AB	0.11	3.21
November	DBR	5	7.68	7.94	7.80	7.74	A	0.05	1.49
	DBR2	5	7.59	8.14	7.90	8.03	A	0.11	3.25
	OHD	5	7.64	8.10	7.95	8.06	AB	0.08	2.37
	OHD2	5	7.38	7.98	7.70	7.68	A	0.10	2.89
	OHD3	5	7.42	7.78	7.54	7.52	AB	0.06	1.81
	MOB	5	6.51	7.34	6.93	6.91	AB	0.17	5.62
	MOB2	5	6.25	8.09	7.21	7.23	B	0.30	9.28
	TOC	5	7.49	7.86	7.68	7.69	AB	0.06	1.89

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
MOB - Moccasin Branch
TOC - Tocoi Creek

[2]SG: Sites with the same letter are not significantly different within season (Kruskal-Wallis test with Dunn's multiple comparison).

Table 20. Hilsenhoff Biotic Index (HBI) for benthic invertebrates sampled by Hester-Dendy plate sampler at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sites within season, 1997. Sample size (N), smallest HBI value (Min), largest HBI value (Max), mean, median (Med), standard error (Std Err), and coefficient of variation (CV) are given.

Season	Site[1]	N	Min	Max	Mean	Med	SG[2]	Std Err	CV
February	DBR	3	7.01	7.66	7.41	7.56	A*	0.20	4.70
	DBR2	3	7.47	7.51	7.48	7.47	A	0.01	0.25
	OHD	3	7.04	7.39	7.23	7.27	A	0.10	2.49
	OHD2	3	7.07	7.40	7.27	7.33	A	0.10	2.44
	OHD3	3	7.28	7.77	7.52	7.52	A	0.14	3.27
	MOB	3	6.73	7.03	6.91	6.96	A	0.09	2.32
	MOB2	3	7.25	7.54	7.42	7.45	A	0.09	2.04
	TOC	3	5.77	7.14	6.55	6.74	A	0.41	10.80
May	DBR	3	6.53	7.27	6.90	6.91	A	0.21	5.39
	DBR2	3	7.42	7.57	7.51	7.55	A	0.05	1.11
	OHD	3	6.93	7.17	7.08	7.16	A	0.08	1.92
	OHD2	3	6.96	7.06	7.00	6.98	A	0.03	0.77
	OHD3	3	7.16	7.26	7.21	7.21	A	0.03	0.72
	MOB	3	5.37	7.47	6.76	7.43	A	0.69	17.78
	MOB2	3	7.03	7.43	7.18	7.08	A	0.13	3.02
	TOC	3	6.86	7.16	7.06	7.16	A	0.10	2.45
August	DBR	3	6.30	6.73	6.48	6.40	B	0.13	3.52
	DBR2	3	7.63	7.84	7.75	7.79	A	0.06	1.37
	OHD	3	6.37	7.68	7.15	7.39	AB	0.39	9.56
	OHD2	3	6.77	7.21	6.96	6.89	AB	0.13	3.25
	OHD3	3	6.59	7.36	6.99	7.03	AB	0.23	5.59
	MOB	3	7.26	7.40	7.34	7.37	AB	0.04	1.01
	MOB2	3	7.10	7.32	7.18	7.13	AB	0.07	1.61
	TOC	3	6.74	7.18	6.93	6.89	AB	0.13	3.21
November	DBR	3	6.83	7.21	7.05	7.10	B	0.11	2.80
	DBR2	3	7.74	7.88	7.80	7.79	A	0.04	0.89
	OHD	3	7.29	8.12	7.59	7.37	AB	0.26	6.04
	OHD2	3	7.17	7.28	7.24	7.27	AB	0.04	0.86
	OHD3	3	7.56	7.60	7.58	7.58	AB	0.01	0.24
	MOB	3	6.94	7.51	7.21	7.17	AB	0.16	3.93
	MOB2	3	6.84	7.46	7.10	7.00	AB	0.18	4.49
	TOC	3	7.55	7.62	7.59	7.60	AB	0.02	0.51

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
MOB - Moccasin Branch
TOC - Tocoi Creek

[2]SG: Sites with the same letter are not significantly different within season (Kruskal-Wallis test with Dunn's multiple comparison).

* K-S test indicated a significant difference (p=0.0462), however no differences were detected by Dunn's procedure.

Statistically significant differences in ponar sample HBI values were found to occur, among seasons within site, only at TOC, the reference stream, where seasonal HBIs were significantly higher in November than those recorded in February and May (Table 21). Analysis of the plate data, found HBI at DBR2 to be significantly higher in November than in February (Table 22). These data indicate that tolerance values are quite stable within sites throughout the year.

A year to year analysis of the HBI values for individual ponar samples at DBR, OHD, MOB and TOC found significant differences among and between years for six of the sixteen site x season comparisons (Table 23). Differences were found at DBR, MOB and TOC, however, there was no apparent year to year trend. Samples in 1997 had significantly lower HBI than did samples taken in 1994 and/or 1995 for three of the six tests, but higher HBI for the other three tests.

Most applications of using benthic invertebrates as biological indicators of stream pollution have occurred in swift-flowing, riffle streams in the northern U.S. Biotic indices have been successful in detecting changes in invertebrate species composition due to siltation. Hilsenhoff (1987) indicated that slow-flowing, silt-bottomed streams cannot be evaluated with HBI. All four of the tributaries in this study were slow-flowing silt-bottomed streams. In fact, they were tidally influenced, especially Dog Branch and Old Hastings Drainage.

A second method of examining the tolerance values of the benthic invertebrates collected at each of the eight sites is to

Table 21. Hilsenhoff Biotic Index (HBI) for benthic invertebrates sampled by ponar dredge at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sampling seasons at each site, 1997. Sample size (N), smallest HBI value (Min), largest HBI value (Max), mean, median (Med), standard error (Std Err), and coefficient of variation (CV) are given.

Site[1]	Season	N	Min	Max	Mean	Med	SG[2]	Std Err	CV
DBR	February	5	7.33	7.95	7.73	7.79	A	0.11	3.18
	May	5	6.13	8.10	7.26	7.81	A	0.42	12.89
	August	5	7.57	7.96	7.73	7.72	A	0.07	1.90
	November	5	7.68	7.94	7.80	7.74	A	0.05	1.49
DBR2	February	5	7.66	7.99	7.78	7.76	A	0.06	1.64
	May	5	7.62	8.09	7.88	7.96	A	0.09	2.45
	August	5	7.30	8.14	7.76	7.90	A	0.17	5.01
	November	5	7.59	8.14	7.90	8.03	A	0.11	3.25
OHD	February	5	6.48	7.78	7.41	7.64	A	0.24	7.32
	May	5	7.07	8.14	7.83	8.10	A	0.20	5.84
	August	5	7.31	8.31	8.02	8.11	A	0.18	5.10
	November	5	7.64	8.10	7.95	8.06	A	0.08	2.37
OHD2	February	5	7.46	8.08	7.66	7.61	A	0.11	3.17
	May	5	7.59	7.96	7.76	7.78	A	0.07	2.05
	August	5	7.57	8.02	7.86	7.90	A	0.08	2.18
	November	5	7.38	7.98	7.70	7.68	A	0.10	2.89
OHD3	February	5	7.21	7.46	7.33	7.33	A	0.04	1.32
	May	5	7.22	7.64	7.42	7.42	A	0.07	2.05
	August	5	6.96	8.00	7.34	7.26	A	0.20	5.98
	November	5	7.42	7.78	7.54	7.52	A	0.06	1.81
MOB	February	5	6.57	7.52	7.12	7.24	A	0.17	5.25
	May	5	6.32	7.64	6.94	7.00	A	0.24	7.85
	August	5	6.33	6.83	6.64	6.68	A	0.08	2.83
	November	5	6.51	7.34	6.93	6.91	A	0.17	5.62
MOB2	February	5	7.17	7.52	7.34	7.33	A	0.06	1.72
	May	5	6.58	8.08	7.42	7.53	A	0.25	7.51
	August	5	6.78	7.93	7.32	7.33	A	0.20	6.20
	November	5	6.25	8.09	7.21	7.23	A	0.30	9.28
TOC	February	5	6.60	7.49	7.01	6.85	BC	0.19	5.92
	May	5	5.34	6.98	6.15	5.97	C	0.29	10.64
	August	5	7.10	7.72	7.48	7.52	AB	0.11	3.21
	November	5	7.49	7.86	7.68	7.69	A	0.06	1.89

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
TOC - Tocoi Creek
MOB - Moccasin Branch

[2]SG: Seasons with the same letter are not significantly different within site (Kruskal-Wallis test with Dunn's multiple comparison).

Table 22. Hilsenhoff Biotic Index (HBI) for benthic invertebrates sampled by Hester-Dendy plate sampler at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sampling seasons at each site, 1997. Sample size (N), smallest HBI value (Min), largest HBI value (Max), mean, median (Med), standard error (Std Err), and coefficient of variation (CV) are given.

Site[1]	Season	N	Min	Max	Mean	Med	SG[2]	Std Err	CV
DBR	February	3	7.01	7.66	7.41	7.56	A	0.20	4.70
	May	3	6.53	7.27	6.90	6.91	A	0.21	5.39
	August	3	6.30	6.73	6.48	6.40	A	0.13	3.52
	November	3	6.83	7.21	7.05	7.10	A	0.11	2.80
DBR2	February	3	7.47	7.51	7.48	7.47	B	0.01	0.25
	May	3	7.42	7.57	7.51	7.55	AB	0.05	1.11
	August	3	7.63	7.84	7.75	7.79	AB	0.06	1.37
	November	3	7.74	7.88	7.80	7.79	A	0.04	0.89
OHD	February	3	7.04	7.39	7.23	7.27	A	0.10	2.49
	May	3	6.93	7.17	7.08	7.16	A	0.08	1.92
	August	3	6.37	7.68	7.15	7.39	A	0.39	9.56
	November	3	7.29	8.12	7.59	7.37	A	0.26	6.04
OHD2	February	3	7.07	7.40	7.27	7.33	A	0.10	2.44
	May	3	6.96	7.06	7.00	6.98	A	0.03	0.77
	August	3	6.77	7.21	6.96	6.89	A	0.13	3.25
	November	3	7.17	7.28	7.24	7.27	A	0.04	0.86
OHD3	February	3	7.28	7.77	7.52	7.52	A	0.14	3.27
	May	3	7.16	7.26	7.21	7.21	A	0.03	0.72
	August	3	6.59	7.36	6.99	7.03	A	0.23	5.59
	November	3	7.56	7.60	7.58	7.58	A	0.01	0.24
MOB	February	3	6.73	7.03	6.91	6.96	A	0.09	2.32
	May	3	5.37	7.47	6.76	7.43	A	0.69	17.78
	August	3	7.26	7.40	7.34	7.37	A	0.04	1.01
	November	3	6.94	7.51	7.21	7.17	A	0.16	3.93
MOB2	February	3	7.25	7.54	7.42	7.45	A	0.09	2.04
	May	3	7.03	7.43	7.18	7.08	A	0.13	3.02
	August	3	7.10	7.32	7.18	7.13	A	0.07	1.61
	November	3	6.84	7.46	7.10	7.00	A	0.18	4.49
TOC	February	3	5.77	7.14	6.55	6.74	A	0.41	10.80
	May	3	6.86	7.16	7.06	7.16	A	0.10	2.45
	August	3	6.74	7.18	6.93	6.89	A	0.13	3.21
	November	3	7.55	7.62	7.59	7.60	A	0.02	0.51

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
TOC - Tocoi Creek
MOB - Moccasin Branch

[2]SG: Seasons with the same letter are not significantly different within site (Kruskal-Wallis test with Dunn's multiple comparison).

Table 23. Hilsenhoff Biotic Index (HBI) for benthic invertebrates sampled by ponar dredge at four sampling sites (DBR, OHD, MOB, TOC) in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among years (1994, 1995, 1997) within sampling site and season. Sample size (N), smallest HBI value (Min), largest HBI value (Max), mean, median (Med), standard error (Std Err), and coefficient of variation (CV) are given.

Site[1]	Season	Year	N	Min	Max	Mean	Med	SG[2]	Std Err	CV
DBR	January	1995	3	6.35	7.23	6.77	6.71	B	0.26	6.54
	February	1997	5	7.33	7.95	7.73	7.79	A	0.11	3.18
	April	1994	4	6.85	7.68	7.35	7.44	A	0.18	4.83
	April	1995	3	5.25	7.55	6.61	7.02	A	0.70	18.26
	May	1997	5	6.13	8.10	7.26	7.81	A	0.42	12.89
	July	1994	3	6.32	7.18	6.82	6.96	B	0.26	6.50
	June	1995	3	7.36	7.79	7.60	7.66	AB	0.13	2.91
	August	1997	5	7.57	7.96	7.73	7.72	A	0.07	1.90
	October	1994	3	6.93	7.82	7.30	7.15	A	0.27	6.31
	November	1997	5	7.68	7.94	7.80	7.74	A	0.05	1.49
OHD	January	1995	3	7.55	8.09	7.73	7.56	A	0.18	3.96
	February	1997	5	6.48	7.78	7.41	7.64	A	0.24	7.32
	April	1994	4	7.75	8.20	7.96	7.95	A	0.09	2.30
	April	1995	3	7.25	8.09	7.61	7.48	A	0.25	5.72
	May	1997	5	7.07	8.14	7.83	8.10	A	0.20	5.84
	July	1994	3	6.91	7.70	7.28	7.22	A	0.23	5.48
	June	1995	3	7.35	7.97	7.63	7.57	A	0.18	4.13
	August	1997	5	7.31	8.31	8.02	8.11	A	0.18	5.10
	October	1994	3	6.94	8.01	7.32	7.02	A	0.34	8.15
	November	1997	5	7.64	8.10	7.95	8.06	A	0.08	2.37
MOB	January	1995	3	6.96	7.91	7.47	7.55	A	0.28	6.38
	February	1997	5	6.57	7.52	7.12	7.24	A	0.17	5.25
	April	1994	4	6.46	7.26	7.01	7.16	B	0.19	5.39
	April	1995	3	7.65	8.11	7.94	8.06	A	0.14	3.14
	May	1997	5	6.32	7.64	6.94	7.00	B	0.24	7.85
	July	1994	3	6.98	8.20	7.60	7.62	A	0.35	8.02
	June	1995	3	6.71	7.53	7.20	7.37	AB	0.25	6.05
	August	1997	5	6.33	6.83	6.64	6.68	B	0.08	2.83
	October	1994	3	6.97	7.91	7.43	7.40	A	0.27	6.31
	November	1997	5	6.51	7.34	6.93	6.91	A	0.17	5.62
TOC	January	1995	3	6.88	7.45	7.20	7.27	A	0.17	4.09
	February	1997	5	6.60	7.49	7.01	6.85	A	0.19	5.92
	April	1994	4	6.98	8.12	7.70	7.85	A	0.25	6.44
	April	1995	3	5.58	7.34	6.46	6.46	AB	0.51	13.65
	May	1997	5	5.34	6.98	6.15	5.97	B	0.29	10.64
	July	1994	3	6.90	8.06	7.59	7.81	A	0.35	8.04
	June	1995	3	2.71	8.10	6.23	7.89	A	1.76	49.03
	August	1997	5	7.10	7.72	7.48	7.52	A	0.11	3.21
	October	1994	3	6.84	7.28	7.04	6.99	B	0.13	3.16
	November	1997	5	7.49	7.86	7.68	7.69	A	0.06	1.89

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
TOC - Tocoi Creek
MOB - Moccasin Branch

[2]SG: Years with same letter not significantly different within site & season (Wilcoxon test or Kruskal-Wallis test with Dunn's multiple comparison).

calculate an overall site mean TV. In this analysis, individual HBI values were not calculated for each sample, which were then statistically compared, but rather an analysis was performed on the individual TVs themselves. The overall site mean TV is actually the overall site HBI. This method greatly increases sample size from five ponar samples per season per site to many thousands of individual organism TVs for the period from February through November 1997. The data can be analyzed for the two sampling methods combined or by each sampling method separately.

Mean TVs for all gears combined show little variation, ranging from 7.22 at MOB to 7.73 at DBR2 (Table 24). These overall site HBIs place these eight sites (four tributaries) into the classes of "significant to very significant organic pollution" (6.51 < HBI < 8.50, Hilsenhoff 1987). TVs at DBR2 were significantly higher than TVs at the other seven sites. OHD3, MOB and MOB2 had the lowest TVs. Differences among the eight sites based on the ponar data are similar to those for the combined data (Table 24). DBR2 and OHD had the highest TVs, while MOB, MOB2, TOC and OHD3 had the lowest. Fewer differences among sites were detected using the plate data (Table 24). DBR2 had the highest TVs, which were not significantly different from those at TOC.

A closer examination of the distribution of tolerance values for the combined ponar and plate data at each of the eight sites, indicates that one TV dominated at all sites but DBR (Figure 23). Most sites were dominated by taxa with tolerance values that ranged from 7.51 to 8.49. These values were rounded to the nearest whole number for data presentation and show up on Figures 23, 24 and 25

Table 24. Tolerance values (TV) for benthic invertebrates sampled by both gears combined and by individual gear (ponar dredge and Hester-Dendy plate sampler) at each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among sites within each gear type, 1997. Sample size (N), smallest TV (Min), largest TV (Max), mean, median (Med), standard error (Std Err), and coefficient of variation (CV) are given.

Gear	Site[1]	N	Min	Max	Mean	Med	SG[2]	Std Err	CV
Combined	DBR	5319	4.0	9.8	7.43	7.5	B	0.01	13.1
	DBR2	2629	2.8	9.8	7.73	7.5	A	0.01	5.4
	OHD	2242	4.8	9.4	7.49	7.5	B	0.02	10.8
	OHD2	5264	4.0	9.5	7.48	7.5	C	0.01	9.9
	OHD3	3033	2.3	9.4	7.30	7.5	DE	0.01	10.3
	MOB	3632	1.0	9.8	7.22	7.5	E	0.01	12.2
	MOB2	5247	2.7	9.8	7.30	7.5	D	0.01	11.6
	TOC	5953	1.0	9.8	7.27	7.5	B	0.01	15.2
Plate	DBR	2273	4.0	9.4	6.84	6.0	D	0.02	14.1
	DBR2	1556	2.8	9.4	7.59	7.5	A	0.01	4.8
	OHD	1440	4.8	9.4	7.26	7.5	BC	0.02	11.3
	OHD2	2506	4.0	9.5	7.18	7.5	C	0.02	11.3
	OHD3	1559	2.7	9.4	7.25	7.5	BC	0.02	11.5
	MOB	2343	2.1	9.4	7.31	7.5	B	0.01	9.8
	MOB2	3750	2.7	9.8	7.26	7.5	B	0.01	11.8
	TOC	2711	2.7	9.8	7.15	7.5	A	0.02	15.7
Ponar	DBR	3046	4.0	9.8	7.86	8.2	B	0.01	9.1
	DBR2	1073	4.0	9.8	7.94	8.2	A	0.01	5.2
	OHD	802	4.8	9.4	7.91	8.2	A	0.02	7.5
	OHD2	2758	4.0	9.4	7.76	7.6	C	0.01	7.0
	OHD3	1474	2.3	9.4	7.36	7.5	D F	0.02	8.8
	MOB	1289	1.0	9.8	7.08	7.5	F	0.03	15.7
	MOB2	1497	4.8	9.1	7.38	7.5	D	0.02	10.9
	TOC	3242	1.0	9.8	7.37	7.5	E	0.02	14.7

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
MOB - Moccasin Branch
TOC - Tocoi Creek

[2]SG: Sites with the same letter are not significantly different within gear type (Kruskal-Wallis test with Dunn's multiple comparison).

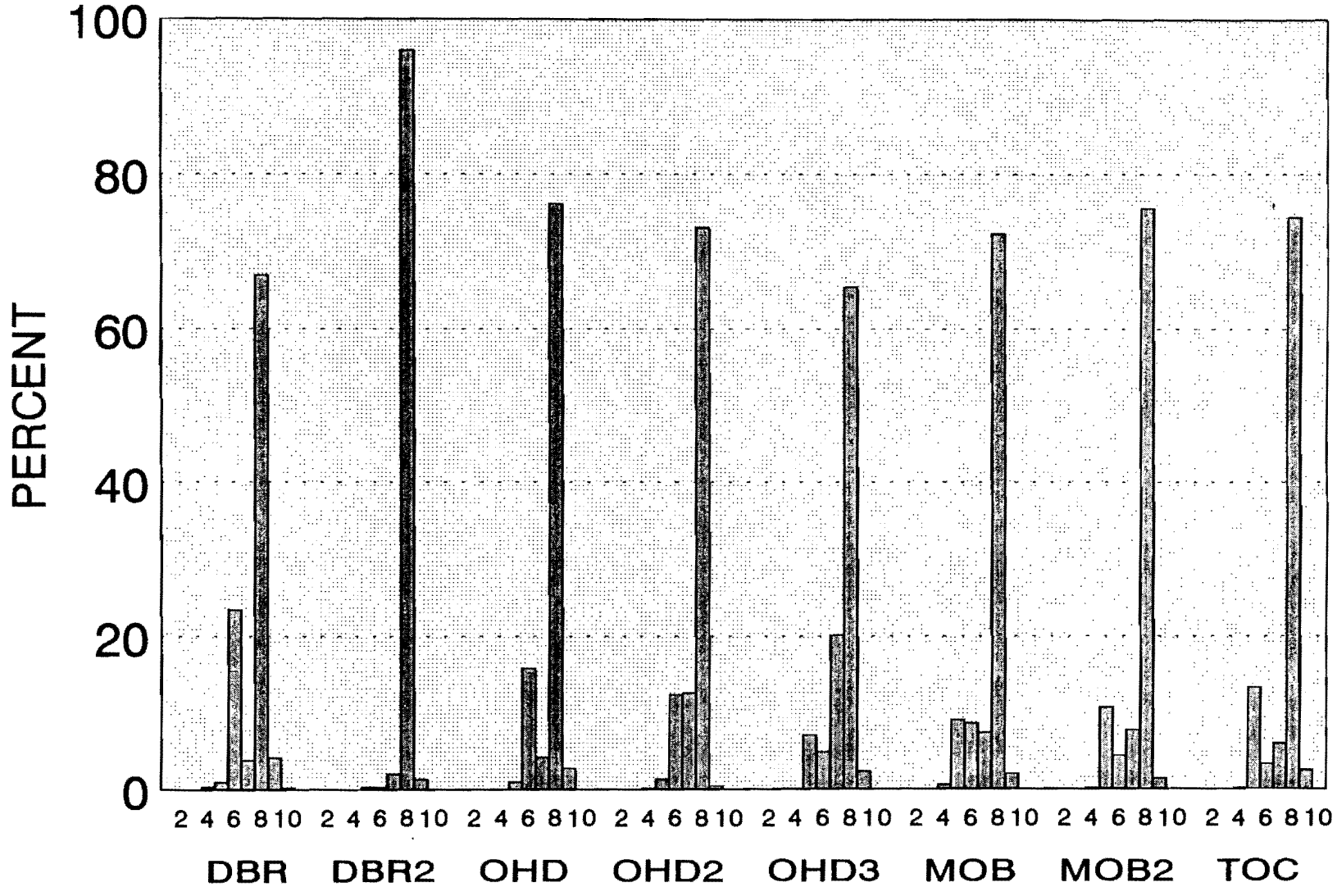


Figure 23. Distribution of pollution tolerance (TV) values for benthic invertebrates from each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, ponar dredge and Hester-Dendy plate data combined, 1997.

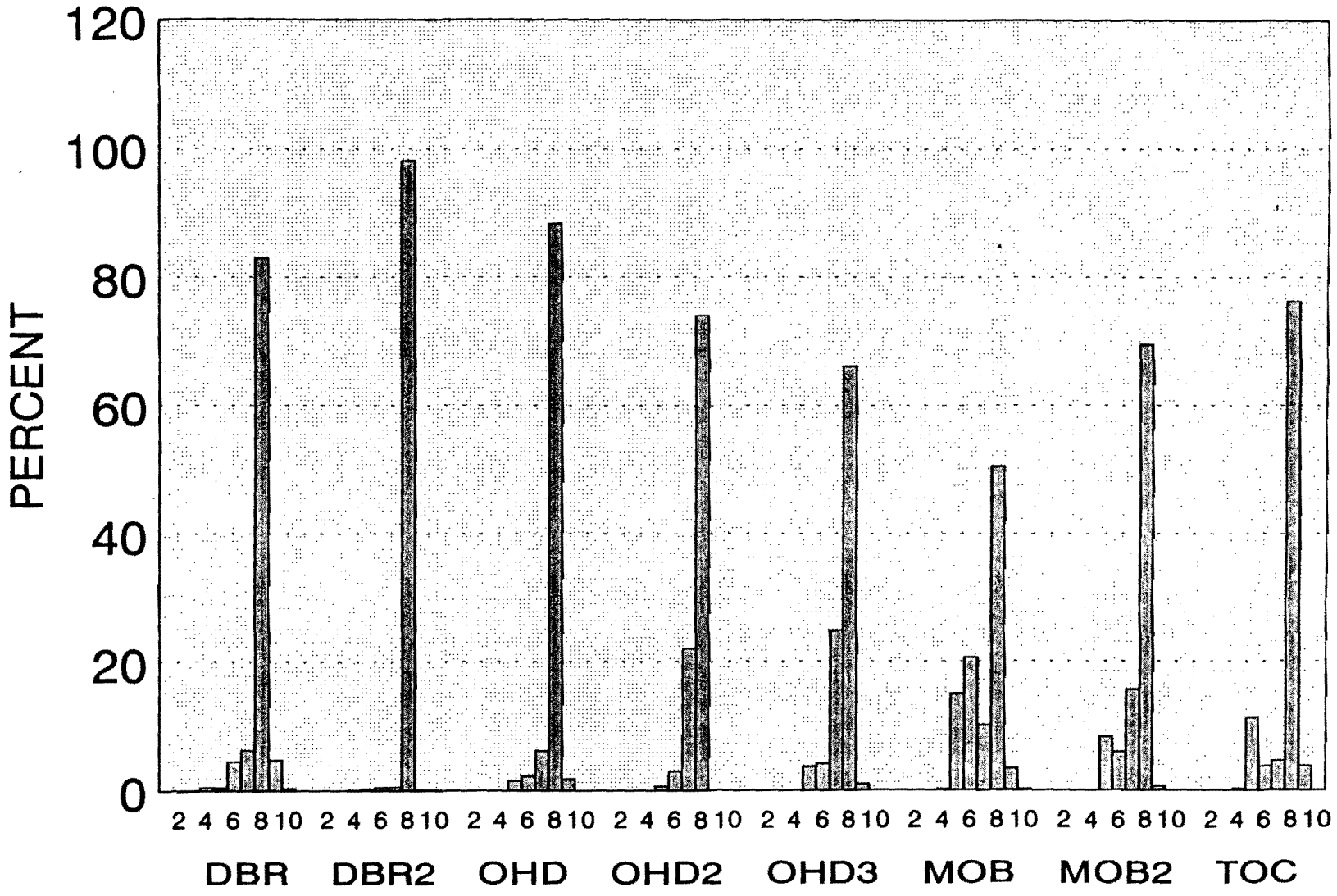


Figure 24. Distribution of pollution tolerance (TV) values for benthic invertebrates from each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, ponar dredge data, 1997.

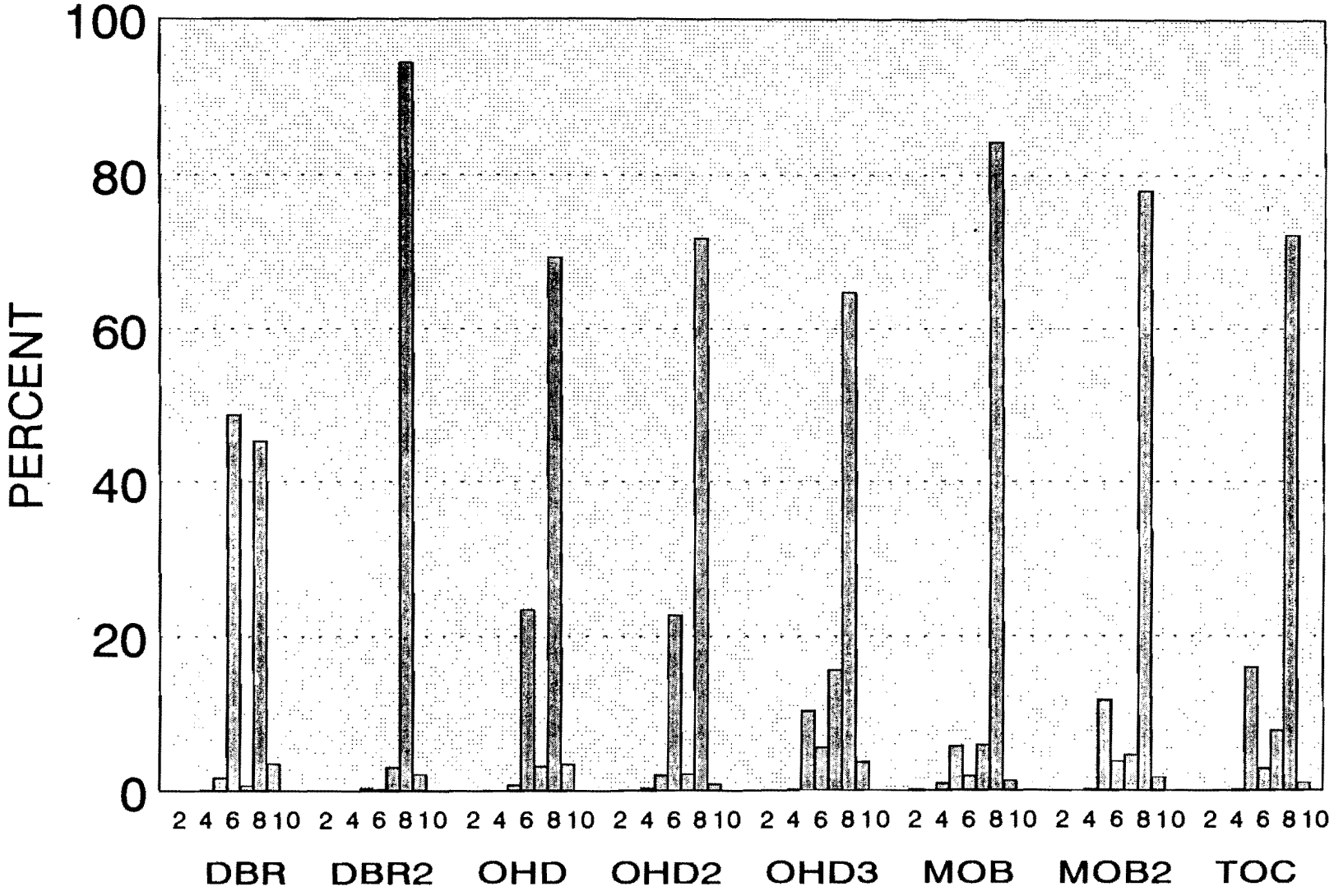


Figure 25. Distribution of pollution tolerance (TV) values for benthic invertebrates from each of the eight sampling sites in the Tri-County Agricultural Area, lower St. Johns River, Florida, Hester-Dendy plate data, 1997.

as a TV of 8. The ponar data is likewise dominated by tolerance values of 8 (Figure 24). The plate data (Figure 25) is somewhat different with tolerance values of 6 and 8 being common at DBR, OHD and OHD2 due to the abundance of isopods at these three sites (see species composition section of this report).

A year to year analysis of the tolerance values of the benthic invertebrates collected by ponar dredge at DBR, OHD, MOB and TOC found significant differences in TVs among and between years for all site x season comparisons (Table 25). Tolerance values in 1997 were significantly higher than those in 1994 and/or 1995 for all comparisons. Differences between tolerance values from 1994 and 1995 were inconsistent.

Table 25. Tolerance values (TV) for benthic invertebrates sampled by ponar dredge at four sampling sites (DBR, OHD, MOB, TOC) in the Tri-County Agricultural Area, lower St. Johns River, Florida - differences among years (1994, 1995, 1997) within sampling site and season. Sample size (N), smallest TV (Min), largest TV (Max), mean, median (Med), standard error (Std Err), and coefficient of variation (CV) are given.

Site[1]	Month	Year	N	Min	Max	Mean	Med	SG[2]	Std Err	CV
DBR	January	1995	813	6.0	8.4	7.40	7.5	B	0.02	8.92
	February	1997	674	8.0	8.2	8.20	8.2	A	0.00	0.09
	April	1994	308	7.5	8.2	7.67	7.5	B	0.02	3.90
	April	1995	179	7.5	8.2	7.74	7.5	B	0.02	4.30
	May	1997	94	8.0	8.2	8.20	7.5	A	0.00	0.35
	July	1994	886	4.0	8.0	7.41	7.5	C	0.01	5.15
	June	1995	277	6.0	9.8	7.70	7.5	B	0.03	5.88
	August	1997	448	8.2	8.2	8.20	8.2	A	0.00	0.00
	October	1994	108	6.0	8.2	7.78	8.2	B	0.05	6.73
	November	1997	478	8.2	8.2	8.20	8.2	A	0.00	0.00
OHD	January	1995	176	6.0	9.1	7.84	8.2	B	0.04	7.53
	February	1997	131	8.0	8.2	8.20	7.5	A	0.00	0.21
	April	1994	178	7.3	8.4	7.96	8.2	B	0.03	4.26
	April	1995	696	6.0	8.2	7.49	7.5	C	0.02	6.28
	May	1997	89	8.2	8.2	8.20	8.2	A	0.00	0.00
	July	1994	96	6.0	8.2	7.78	8.2	C	0.07	9.10
	June	1995	209	6.0	8.2	8.05	8.2	B	0.03	5.15
	August	1997	203	8.2	8.2	8.20	8.2	A	0.00	0.00
	October	1994	73	6.0	8.2	7.88	8.2	B	0.05	5.47
	November	1997	85	8.2	8.2	8.20	8.2	A	0.00	0.00
MOB	January	1995	344	5.0	8.2	7.78	8.2	B	0.04	9.67
	February	1997	28	8.0	8.2	8.18	7.5	A	0.01	0.77
	April	1994	175	7.5	8.2	7.72	7.5	B	0.02	4.22
	April	1995	131	5.0	8.2	8.02	8.2	A	0.05	6.78
	May	1997	28	8.0	8.2	8.19	7.5	A	0.01	0.64
	July	1994	35	5.0	8.2	7.92	8.2	A	0.13	9.65
	June	1995	98	7.3	8.2	8.17	8.2	B	0.02	1.84
	August	1997	53	8.0	8.2	8.20	7.4	A	0.00	0.34
	October	1994	141	7.5	8.2	8.10	8.2	B	0.02	3.03
	November	1997	160	8.0	8.2	8.19	7.5	A	0.00	0.43
TOC	January	1995	415	5.0	8.4	7.43	7.6	B	0.02	6.23
	February	1997	243	8.0	8.2	8.18	7.6	A	0.00	0.81
	April	1994	137	7.5	8.2	8.01	8.2	A	0.03	3.80
	April	1995	549	6.7	9.8	7.59	7.5	B	0.01	3.57
	May	1997	42	8.0	8.2	8.10	6.0	A	0.02	1.25
	July	1994	22	7.5	8.2	7.93	8.2	B	0.07	4.16
	June	1995	112	7.5	9.8	8.05	7.7	B	0.07	8.91
	August	1997	41	8.0	8.2	8.20	7.5	A	0.00	0.38
	October	1994	256	6.4	8.4	7.66	7.6	B	0.02	4.39
	November	1997	391	8.0	8.2	8.20	7.5	A	0.00	0.37

[1]Site: DBR - Dog Branch
OHD - Old Hastings Drainage
TOC - Tocoi Creek
MOB - Moccasin Branch

[2]SG: Years with same letter not significantly different within site & season (Wilcoxon test or Kruskal-Wallis test with Dunn's multiple comparison).

Relationship to Water Chemistry

Analysis of the ponar dredge data from the eight sites found three of the four benthic invertebrate community characteristics (species richness [number of taxa], Shannon-Weiner Diversity Index [SWDI] and Hilsenhoff Biotic Index [HBI]) to be significantly correlated with eight of the fifteen seasonal water chemistry parameters (Table 26). Total suspended solids, total nitrogen, nitrite/nitrate nitrogen, total phosphorus, total ortho-phosphate and turbidity were negatively correlated to species richness and SWDI, and positively correlated to HBI. As nutrients, suspended matter and turbidity increased, the invertebrate communities had fewer taxa and lower diversity. Organisms comprising these communities were those more tolerant to pollution/enrichment. Conductivity and total ammonia showed similar relationships with species richness, SWDI and HBI. While only conductivity and HBI were significantly correlated, p-values for the other correlations were close to being significant. Invertebrate density was not found to be correlated to any of the water chemistry parameters.

This 1997 ponar data showed numerous significant correlations not found with the 1994 and 1995 data (Cichra and Mumma 1996, Tables 14 and 15). Greater sample sizes at each site in 1997 may have produced more accurate estimates for the benthic invertebrate community parameters sampled. Also, by sampling a larger number of sites in 1997, greater ranges of data were encountered for many of the invertebrate and water chemistry parameters sampled. A larger sample size for each testable relationship in 1997 (29 to 32 site

Table 26. Spearman correlation coefficients between seasonal site ponar dredge means of four benthic invertebrate community characteristics (species richness [number of taxa], number of individuals, Shannon-Weiner Diversity Index [SWDI], and Hilsenhoff Biotic Index [HBI]) and seasonal site water chemistry, 1997. Level of significance and number of observations also listed for each correlation. An '*' indicates a significant relationship at the α=0.05 level.

	Benthic Invertebrate Community Characteristic			
Water Chemistry	Species Richness	Number of Individuals	SWDI	HBI
Conductivity	-0.29379 0.1027 32	0.01558 0.9326 32	-0.32844 0.0665 32	* 0.49088 0.0043 32
Dissolved Oxygen	-0.14111 0.4411 32	-0.24342 0.1794 32	-0.10838 0.5549 32	0.00055 0.9976 32
pH	0.05560 0.7625 32	0.01558 0.9326 32	0.00348 0.9849 32	0.19630 0.2816 32
Total Suspended Solids	* -0.57398 0.0006 32	-0.22864 0.2081 32	* -0.56872 0.0007 32	* 0.54525 0.0013 32
Total Ammonia	-0.27726 0.1245 32	0.02163 0.9065 32	-0.34071 0.0564 32	0.25449 0.1598 32
Total Nitrogen	* -0.59547 0.0003 32	-0.33727 0.0591 32	* -0.57216 0.0006 32	* 0.38636 0.0289 32
Nitrite/Nitrate Nitrogen	* -0.42631 0.0150 32	-0.07756 0.6731 32	* -0.50179 0.0034 32	* 0.44448 0.0108 32
Total Phosphorus	* -0.54137 0.0014 32	-0.16806 0.3579 32	* -0.53533 0.0016 32	* 0.51482 0.0026 32
Total Ortho-Phosphate	* -0.41263 0.0189 32	-0.07936 0.6659 32	* -0.47804 0.0057 32	* 0.43811 0.0121 32
Total Organic Carbon	0.03798 0.8365 32	-0.23974 0.1863 32	0.12671 0.4895 32	-0.27906 0.1219 32
Chlorophyll-a	-0.26751 0.1606 29	-0.07980 0.6807 29	-0.21540 0.2618 29	0.11360 0.5574 29
Total Dissolved Solids	-0.26752 0.1388 32	0.10740 0.5585 32	* -0.36307 0.0411 32	* 0.52164 0.0022 32
Turbidity	* -0.42181 0.0162 32	-0.19142 0.2940 32	* -0.37659 0.0336 32	* 0.55246 0.0010 32
Water Temperature	-0.25890 0.1525 32	-0.20125 0.2694 32	-0.23856 0.1885 32	0.15438 0.3989 32
Color	-0.03998 0.8280 32	-0.26233 0.1469 32	0.03625 0.8439 32	-0.21120 0.2459 32

x season combinations) likely reduced the influence of outliers and increased the power of the test.

Fewer significant correlations were found with the Hester-Dendy plate sampler data (Table 27) than were found with the ponar data. These correlations, in general, were similar to those of the ponar data. Of the eleven significant correlations, seven were identical in direction (-/+) and significance as for the ponar data. Four additional correlations were revealed for the plate data: species richness with total organic carbon, total dissolved solids and color, and HBI with color. As with the ponar data analyses, invertebrate density was not found to be correlated to any of the water chemistry parameters. The lower number of significant correlations for the plate data may be due to the selective nature of this sampling gear. The smaller number of organisms collected by this gear, may have also resulted in inaccurate estimates of the benthic invertebrate communities at some of the sites.

Table 27. Spearman correlation coefficients between seasonal site Hester-Dendy plate sampler means of four benthic invertebrate community characteristics (species richness [number of taxa], number of individuals, Shannon-Weiner Diversity Index [SWDI], and Hilsenhoff Biotic Index [HBI]) and seasonal site water chemistry, 1997. Level of significance and number of observations also listed for each correlation. An '*' indicates a significant relationship at the α=0.05 level.

	Benthic Invertebrate Community Characteristic			
Water Chemistry	Species Richness	Number of Individuals	SWDI	HBI
Conductivity	-0.20830 0.2526 32	-0.19157 0.2936 32	-0.20786 0.2536 32	0.31151 0.0826 32
Dissolved Oxygen	-0.02765 0.8806 32	0.12062 0.5108 32	-0.20053 0.2711 32	0.29116 0.1059 32
pH	-0.34690 0.0518 32	-0.24583 0.1750 32	-0.01686 0.9270 32	0.27008 0.1349 32
Total Suspended Solids	-0.19050 0.2963 32	0.10299 0.5749 32	* -0.36306 0.0411 32	* 0.44809 0.0101 32
Total Ammonia	-0.20371 0.2634 32	0.17492 0.3383 32	-0.31652 0.0776 32	0.07231 0.6941 32
Total Nitrogen	0.14080 0.4421 32	0.16315 0.3723 32	-0.27660 0.1254 32	-0.07563 0.6808 32
Nitrite/Nitrate Nitrogen	* -0.48623 0.0048 32	-0.01287 0.9443 32	* -0.58592 0.0004 32	0.19358 0.2884 32
Total Phosphorus	-0.10066 0.5836 32	0.04073 0.8248 32	* -0.41097 0.0195 32	-0.04588 0.8031 32
Total Ortho-Phosphate	-0.06080 0.7410 32	0.06058 0.7419 32	* -0.41521 0.0181 32	-0.03776 0.8374 32
Total Organic Carbon	* 0.40738 0.0207 32	0.15837 0.3866 32	0.16826 0.3573 32	-0.23339 0.1986 32
Chlorophyll-a	-0.13356 0.4897 29	-0.09927 0.6084 29	0.14384 0.4566 29	0.01873 0.9232 29
Total Dissolved Solids	* -0.44761 0.0102 32	-0.22363 0.2186 32	-0.24817 0.1708 32	0.34705 0.0516 32
Turbidity	-0.11925 0.5157 32	-0.08976 0.6252 32	-0.03850 0.8343 32	* 0.37157 0.0363 32
Water Temperature	0.21343 0.2409 32	0.11420 0.5337 32	-0.15103 0.4093 32	-0.34119 0.0560 32
Color	* 0.47982 0.0055 32	0.26716 0.1394 32	0.17100 0.3494 32	* -0.38001 0.0319 32

CONCLUSIONS AND RECOMMENDATIONS

This study resulted in the continued development of a macroinvertebrate data base for four tributaries of the lower St. Johns River Tri-County Agricultural Area (TCAA). These data were collected prior to the implementation of new agricultural best management practices (BMPs). Future data can be compared to these data. One problem with the development of this data base during 1994 and 1995 was the limited number of samples that were collected. After statistically analyzing the benthic invertebrate data for species richness, number or organisms, diversity, and tolerance to pollution, few statistically significant differences among the four TCAA sites were found. Ranking of the site means also generally showed little consistency over time. The lack of statistical differences and change in site rankings was due to two reasons. First, some characteristics showed little variation in site or seasonal means, resulting in the valid lack of significant differences among sites and seasons. Secondly, the lack of statistical differences, along with the change in site and seasonal mean rankings was likely due to the small sample sizes, even though some characteristics appeared to show large differences among means. With only three replicates, it was difficult to detect differences. The number of ponar and dredge samples collected at each site was increased during this study (February through November 1997). A number of significant differences among sites and seasons were detected during analysis of the 1997 data.

A second weakness of the earlier 1994/1995 study was that only one site was sampled on each of the four tributaries. These sites

were located at bridges. It is not certain if the chosen locations were truly indicative of the four tributaries as a whole or if the conditions present were an artifact of past bridge construction and maintenance. Also, future effects of BMP implementation might be masked by habitat alteration at these sites during routine bridge maintenance. The value of this data base could be lost. Four additional sites were added in 1997 to better sample each of the tributaries in the TCAA. Sites within each stream were generally quite similar, although the most upstream sites were often similar to TOC, the reference site.

Tocoi Creek, the reference tributary, supported a high total number of taxa. Its species composition also differed from that of the other three sites, having a large component of mayflies. Tocoi Creek was not found to be different from the other three tributaries based on ponar invertebrate abundance, diversity (SWDI), and tolerance to pollution (HBI) during the 1994/1995 study. During 1997, macroinvertebrate communities of Tocoi Creek had some of the significantly highest species richness, density and diversity, while some of the lowest tolerance to pollution. Correlations between several water chemistry parameters and invertebrate community characteristics were strong, logical and meaningful. This analysis should be conducted using future data.

Future work on the benthic invertebrates of these four tributaries should continue to sample this larger number of sites with this increased effort. Hopefully, better estimates of tolerance values or indicators will someday be available for characterizing benthic invertebrate communities of Florida streams.

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Appendix A

Raw Benthic Invertebrate Data

(Taxa code equivalents given in Table 3 of text)

Appendix A

Raw Benthic Invertebrate Data

(Taxa code equivalents given in Table 3 of text)

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
06FEB97	DBR2	Plate	97001	1300.00	5	1	1	5	8.2
06FEB97	DBR2	Plate	97001	3103.00	17	1	1	17	6.9
06FEB97	DBR2	Plate	97001	3103.20	96	1	1	96	7.5
06FEB97	DBR2	Plate	97001	4200.00	143	1	1	143	7.5
06FEB97	DBR2	Plate	97002	3103.00	13	1	1	13	6.9
06FEB97	DBR2	Plate	97002	3103.20	66	1	1	66	7.5
06FEB97	DBR2	Plate	97002	3104.00	1	1	1	1	7.9
06FEB97	DBR2	Plate	97002	4200.00	72	1	1	72	7.5
06FEB97	DBR2	Plate	97002	4800.05	3	1	1	3	8.7
06FEB97	DBR2	Plate	97002	4800.20	1	1	1	1	8.7
06FEB97	DBR2	Plate	97002	4800.30	2	1	1	2	8.7
06FEB97	DBR2	Plate	97002	5211.50	2	1	1	2	9.1
06FEB97	DBR2	Plate	97002	8504.00	1	1	1	1	.
06FEB97	DBR2	Plate	97002	9002.00	5	1	1	5	.
06FEB97	DBR2	Plate	97003	1300.00	9	1	1	9	8.2
06FEB97	DBR2	Plate	97003	3103.00	8	1	1	8	6.9
06FEB97	DBR2	Plate	97003	3103.20	74	1	1	74	7.5
06FEB97	DBR2	Plate	97003	4200.00	180	1	1	180	7.5
06FEB97	DBR2	Plate	97003	9002.00	9	1	1	9	.
06FEB97	DBR2	Ponar	97004	1300.00	74	1	1	74	8.2
06FEB97	DBR2	Ponar	97004	3103.20	20	1	1	20	7.5
06FEB97	DBR2	Ponar	97004	4101.50	1	1	1	1	6.4
06FEB97	DBR2	Ponar	97004	4200.00	99	1	1	99	7.5
06FEB97	DBR2	Ponar	97004	9002.00	4	1	1	4	.
06FEB97	DBR2	Ponar	97005	1300.00	24	1	1	24	8.2
06FEB97	DBR2	Ponar	97005	4101.50	1	1	1	1	6.4
06FEB97	DBR2	Ponar	97005	4200.00	58	1	1	58	7.5
06FEB97	DBR2	Ponar	97006	1300.00	4	1	1	4	8.2
06FEB97	DBR2	Ponar	97006	3103.20	2	1	1	2	7.5
06FEB97	DBR2	Ponar	97006	4200.00	11	1	1	11	7.5
06FEB97	DBR2	Ponar	97006	9002.00	6	1	1	6	.
06FEB97	DBR2	Ponar	97007	1300.00	100	1	1	100	8.2
06FEB97	DBR2	Ponar	97007	3100.00	1	1	1	1	.
06FEB97	DBR2	Ponar	97007	3103.20	5	1	1	5	7.5
06FEB97	DBR2	Ponar	97007	4200.00	22	1	1	22	7.5
06FEB97	DBR2	Ponar	97007	9002.00	25	1	1	25	.
06FEB97	DBR2	Ponar	97008	1300.00	24	1	1	24	8.2
06FEB97	DBR2	Ponar	97008	3103.20	1	1	1	1	7.5
06FEB97	DBR2	Ponar	97008	4101.50	1	1	1	1	6.4
06FEB97	DBR2	Ponar	97008	4200.00	28	1	1	28	7.5
06FEB97	DBR	Plate	97009	3103.00	5	1	1	5	6.9
06FEB97	DBR	Plate	97009	3103.20	43	1	1	43	7.5
06FEB97	DBR	Plate	97009	3402.00	18	1	1	18	6.0
06FEB97	DBR	Plate	97009	4200.00	5	1	1	5	7.5
06FEB97	DBR	Plate	97009	5201.40	7	1	1	7	4.8
06FEB97	DBR	Plate	97009	5209.00	12	1	1	12	8.4
06FEB97	DBR	Plate	97009	5211.50	4	1	1	4	9.1
06FEB97	DBR	Plate	97009	8001.00	2	1	1	2	.
06FEB97	DBR	Plate	97009	9002.00	9	1	1	9	.
06FEB97	DBR	Plate	97010	3103.00	1	1	1	1	6.9
06FEB97	DBR	Plate	97010	3103.20	17	1	1	17	7.5
06FEB97	DBR	Plate	97010	4200.00	26	1	1	26	7.5
06FEB97	DBR	Plate	97010	4800.05	2	1	1	2	8.7
06FEB97	DBR	Plate	97010	4800.20	1	1	1	1	8.7

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
06FEB97	DBR	Plate	97010	9002.00	1	1	1	1	.
06FEB97	DBR	Plate	97011	3103.00	4	1	1	4	6.9
06FEB97	DBR	Plate	97011	3103.20	34	1	1	34	7.5
06FEB97	DBR	Plate	97011	3401.10	2	1	1	2	9.4
06FEB97	DBR	Plate	97011	3402.00	4	1	1	4	6.0
06FEB97	DBR	Plate	97011	4200.00	5	1	1	5	7.5
06FEB97	DBR	Plate	97011	4302.00	1	1	1	1	7.6
06FEB97	DBR	Plate	97011	5209.00	11	1	1	11	8.4
06FEB97	DBR	Plate	97011	5211.50	3	1	1	3	9.1
06FEB97	DBR	Ponar	97012	1200.00	1	1	1	1	8.0
06FEB97	DBR	Ponar	97012	1300.00	49	1	1	49	8.2
06FEB97	DBR	Ponar	97012	3103.00	1	1	1	1	6.9
06FEB97	DBR	Ponar	97012	3103.20	9	1	1	9	7.5
06FEB97	DBR	Ponar	97012	3401.10	19	1	1	19	9.4
06FEB97	DBR	Ponar	97012	4200.00	9	1	1	9	7.5
06FEB97	DBR	Ponar	97012	4302.00	1	1	1	1	7.6
06FEB97	DBR	Ponar	97012	4701.00	2	1	1	2	9.8
06FEB97	DBR	Ponar	97012	4701.30	1	1	1	1	6.7
06FEB97	DBR	Ponar	97012	5107.00	1	1	1	1	7.7
06FEB97	DBR	Ponar	97012	5109.00	6	1	1	6	7.4
06FEB97	DBR	Ponar	97012	5201.40	1	1	1	1	4.8
06FEB97	DBR	Ponar	97012	5203.00	6	1	1	6	6.0
06FEB97	DBR	Ponar	97012	5204.00	33	1	1	33	6.9
06FEB97	DBR	Ponar	97012	5207.50	1	1	1	1	.
06FEB97	DBR	Ponar	97012	5208.00	5	1	1	5	4.0
06FEB97	DBR	Ponar	97012	5209.00	3	1	1	3	8.4
06FEB97	DBR	Ponar	97012	5211.50	24	1	1	24	9.1
06FEB97	DBR	Ponar	97012	5212.50	8	1	1	8	.
06FEB97	DBR	Ponar	97012	5216.10	2	1	1	2	.
06FEB97	DBR	Ponar	97012	8001.00	2	1	1	2	.
06FEB97	DBR	Ponar	97012	9002.00	13	1	1	13	.
06FEB97	DBR	Ponar	97012	9003.00	1	1	1	1	5.7
06FEB97	DBR	Ponar	97013	1300.00	58	1	2	116	8.2
06FEB97	DBR	Ponar	97013	3103.20	1	1	2	2	7.5
06FEB97	DBR	Ponar	97013	3103.50	1	1	2	2	.
06FEB97	DBR	Ponar	97013	4102.10	1	1	2	2	5.4
06FEB97	DBR	Ponar	97013	4200.00	19	1	2	38	7.5
06FEB97	DBR	Ponar	97013	4302.00	2	1	2	4	7.6
06FEB97	DBR	Ponar	97013	5109.00	8	1	2	16	7.4
06FEB97	DBR	Ponar	97013	5201.40	4	1	2	8	4.8
06FEB97	DBR	Ponar	97013	5215.10	1	1	2	2	7.2
06FEB97	DBR	Ponar	97014	1300.00	68	1	4	272	8.2
06FEB97	DBR	Ponar	97014	3103.00	1	1	4	4	6.9
06FEB97	DBR	Ponar	97014	3103.20	16	1	4	64	7.5
06FEB97	DBR	Ponar	97014	3401.10	2	1	4	8	9.4
06FEB97	DBR	Ponar	97014	3402.00	4	1	4	16	6.0
06FEB97	DBR	Ponar	97014	4200.00	6	1	4	24	7.5
06FEB97	DBR	Ponar	97014	4701.00	1	1	4	4	9.8
06FEB97	DBR	Ponar	97014	4701.80	1	1	4	4	7.3
06FEB97	DBR	Ponar	97014	5109.00	8	1	4	32	7.4
06FEB97	DBR	Ponar	97014	5203.00	1	1	4	4	6.0
06FEB97	DBR	Ponar	97014	5204.00	4	1	4	16	6.9
06FEB97	DBR	Ponar	97014	5208.00	2	1	4	8	4.0
06FEB97	DBR	Ponar	97014	5211.50	4	1	4	16	9.1

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
06FEB97	DBR	Ponar	97014	8001.00	1	1	4	4	.
06FEB97	DBR	Ponar	97014	9002.00	1	1	4	4	.
06FEB97	DBR	Ponar	97015	1300.00	76	1	1	76	8.2
06FEB97	DBR	Ponar	97015	4200.00	5	1	1	5	7.5
06FEB97	DBR	Ponar	97015	4701.00	1	1	1	1	9.8
06FEB97	DBR	Ponar	97015	5109.00	14	1	1	14	7.4
06FEB97	DBR	Ponar	97015	5204.00	4	1	1	4	6.9
06FEB97	DBR	Ponar	97015	5209.00	2	1	1	2	8.4
06FEB97	DBR	Ponar	97015	5211.50	2	1	1	2	9.1
06FEB97	DBR	Ponar	97015	5212.50	2	1	1	2	.
06FEB97	DBR	Ponar	97015	9004.00	1	1	1	1	.
06FEB97	DBR	Ponar	97016	1300.00	40	1	4	160	8.2
06FEB97	DBR	Ponar	97016	4200.00	19	1	4	76	7.5
06FEB97	DBR	Ponar	97016	5107.00	1	1	4	4	7.7
06FEB97	DBR	Ponar	97016	5109.00	4	1	4	16	7.4
06FEB97	DBR	Ponar	97016	5211.50	1	1	4	4	9.1
06FEB97	OHD2	Plate	97017	1300.00	5	1	1	5	8.2
06FEB97	OHD2	Plate	97017	3103.00	11	1	1	11	6.9
06FEB97	OHD2	Plate	97017	3103.20	26	1	1	26	7.5
06FEB97	OHD2	Plate	97017	3402.00	28	1	1	28	6.0
06FEB97	OHD2	Plate	97017	4102.10	1	1	1	1	5.4
06FEB97	OHD2	Plate	97017	4200.00	38	1	1	38	7.5
06FEB97	OHD2	Plate	97018	1300.00	1	1	1	1	8.2
06FEB97	OHD2	Plate	97018	3103.00	13	1	1	13	6.9
06FEB97	OHD2	Plate	97018	3103.20	46	1	1	46	7.5
06FEB97	OHD2	Plate	97018	3103.50	1	1	1	1	.
06FEB97	OHD2	Plate	97018	3402.00	33	1	1	33	6.0
06FEB97	OHD2	Plate	97018	4200.00	51	1	1	51	7.5
06FEB97	OHD2	Plate	97018	4804.00	1	1	1	1	.
06FEB97	OHD2	Plate	97018	5201.40	12	1	1	12	4.8
06FEB97	OHD2	Plate	97018	5203.00	3	1	1	3	6.0
06FEB97	OHD2	Plate	97018	5204.00	8	1	1	8	6.9
06FEB97	OHD2	Plate	97018	5208.00	3	1	1	3	4.0
06FEB97	OHD2	Plate	97018	5209.00	96	1	1	96	8.4
06FEB97	OHD2	Plate	97018	8503.00	1	1	1	1	.
06FEB97	OHD2	Plate	97019	1300.00	3	1	1	3	8.2
06FEB97	OHD2	Plate	97019	3103.00	6	1	1	6	6.9
06FEB97	OHD2	Plate	97019	3103.20	58	1	1	58	7.5
06FEB97	OHD2	Plate	97019	3103.50	1	1	1	1	.
06FEB97	OHD2	Plate	97019	3402.00	4	1	1	4	6.0
06FEB97	OHD2	Plate	97019	4200.00	94	1	1	94	7.5
06FEB97	OHD2	Plate	97019	4200.00	4	1	1	4	7.5
06FEB97	OHD2	Plate	97019	4203.10	1	1	1	1	6.0
06FEB97	OHD2	Plate	97019	5201.40	1	1	1	1	4.8
06FEB97	OHD2	Plate	97019	5209.00	10	1	1	10	8.4
06FEB97	OHD2	Plate	97019	8502.00	1	1	1	1	.
06FEB97	OHD2	Plate	97019	9004.00	1	1	1	1	.
06FEB97	OHD2	Ponar	97020	1300.00	45	1	1	45	8.2
06FEB97	OHD2	Ponar	97020	3100.00	1	1	1	1	.
06FEB97	OHD2	Ponar	97020	3103.20	10	1	1	10	7.5
06FEB97	OHD2	Ponar	97020	3402.00	2	1	1	2	6.0
06FEB97	OHD2	Ponar	97020	4102.10	2	1	1	2	5.4
06FEB97	OHD2	Ponar	97020	4200.00	11	1	1	11	7.5
06FEB97	OHD2	Ponar	97020	4302.00	3	1	1	3	7.6

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
06FEB97	OHD2	Ponar	97020	5109.00	32	1	1	32	7.4
06FEB97	OHD2	Ponar	97020	5204.00	5	1	1	5	6.9
06FEB97	OHD2	Ponar	97020	5209.00	2	1	1	2	8.4
06FEB97	OHD2	Ponar	97020	9002.00	2	1	1	2	.
06FEB97	OHD2	Ponar	97020	9005.00	1	1	1	1	.
06FEB97	OHD2	Ponar	97021	1300.00	6	1	2	12	8.2
06FEB97	OHD2	Ponar	97021	3103.00	1	1	2	2	6.9
06FEB97	OHD2	Ponar	97021	3103.20	12	1	2	24	7.5
06FEB97	OHD2	Ponar	97021	3402.00	2	1	2	4	6.0
06FEB97	OHD2	Ponar	97021	4102.10	1	1	2	2	5.4
06FEB97	OHD2	Ponar	97021	4200.00	10	1	2	20	7.5
06FEB97	OHD2	Ponar	97021	5107.00	1	1	2	2	7.7
06FEB97	OHD2	Ponar	97022	1300.00	23	1	2	46	8.2
06FEB97	OHD2	Ponar	97022	3103.20	21	1	2	42	7.5
06FEB97	OHD2	Ponar	97022	3401.10	1	1	2	2	9.4
06FEB97	OHD2	Ponar	97022	3402.00	2	1	2	4	6.0
06FEB97	OHD2	Ponar	97022	4101.50	2	1	2	4	6.4
06FEB97	OHD2	Ponar	97022	4200.00	22	1	2	44	7.5
06FEB97	OHD2	Ponar	97022	4302.10	6	1	2	12	7.6
06FEB97	OHD2	Ponar	97022	5109.00	17	1	2	34	7.4
06FEB97	OHD2	Ponar	97022	5201.40	1	1	2	2	4.8
06FEB97	OHD2	Ponar	97022	5203.00	1	1	2	2	6.0
06FEB97	OHD2	Ponar	97022	5204.00	9	1	2	18	6.9
06FEB97	OHD2	Ponar	97022	5209.00	2	1	2	4	8.4
06FEB97	OHD2	Ponar	97022	9002.00	2	1	2	4	.
06FEB97	OHD2	Ponar	97022	9004.00	3	1	2	6	.
06FEB97	OHD2	Ponar	97022	9006.00	1	1	2	2	.
06FEB97	OHD2	Ponar	97023	1300.00	36	1	2	72	8.2
06FEB97	OHD2	Ponar	97023	3103.20	19	1	2	38	7.5
06FEB97	OHD2	Ponar	97023	3402.00	4	1	2	8	6.0
06FEB97	OHD2	Ponar	97023	4102.10	1	1	2	2	5.4
06FEB97	OHD2	Ponar	97023	4200.00	43	1	2	86	7.5
06FEB97	OHD2	Ponar	97023	4302.00	4	1	2	8	7.6
06FEB97	OHD2	Ponar	97023	5107.00	1	1	2	2	7.7
06FEB97	OHD2	Ponar	97023	5109.00	13	1	2	26	7.4
06FEB97	OHD2	Ponar	97023	5204.00	6	1	2	12	6.9
06FEB97	OHD2	Ponar	97023	5209.00	1	1	2	2	8.4
06FEB97	OHD2	Ponar	97023	9002.00	1	1	2	2	.
06FEB97	OHD2	Ponar	97023	9004.00	1	1	2	2	.
06FEB97	OHD2	Ponar	97024	1300.00	25	1	1	25	8.2
06FEB97	OHD2	Ponar	97024	4200.00	4	1	1	4	7.5
06FEB97	OHD2	Ponar	97024	5109.00	2	1	1	2	7.4
06FEB97	OHD2	Ponar	97024	5209.00	2	1	1	2	8.4
06FEB97	OHD	Plate	97025	1300.00	1	1	1	1	8.2
06FEB97	OHD	Plate	97025	3103.00	8	1	1	8	6.9
06FEB97	OHD	Plate	97025	3103.20	22	1	1	22	7.5
06FEB97	OHD	Plate	97025	3402.00	12	1	1	12	6.0
06FEB97	OHD	Plate	97025	4200.00	19	1	1	19	7.5
06FEB97	OHD	Plate	97025	5201.40	1	1	1	1	4.8
06FEB97	OHD	Plate	97025	5209.00	2	1	1	2	8.4
06FEB97	OHD	Plate	97025	8001.00	1	1	1	1	.
06FEB97	OHD	Plate	97026	1300.00	5	1	1	5	8.2
06FEB97	OHD	Plate	97026	3103.00	6	1	1	6	6.9
06FEB97	OHD	Plate	97026	3103.20	33	1	1	33	7.5

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
06FEB97	OHD	Plate	97026	3402.00	5	1	1	5	6.0
06FEB97	OHD	Plate	97026	4200.00	93	1	1	93	7.5
06FEB97	OHD	Plate	97026	5201.40	6	1	1	6	4.8
06FEB97	OHD	Plate	97026	5209.00	3	1	1	3	8.4
06FEB97	OHD	Plate	97026	5211.50	3	1	1	3	9.1
06FEB97	OHD	Plate	97026	9002.00	1	1	1	1	.
06FEB97	OHD	Plate	97027	1300.00	1	1	1	1	8.2
06FEB97	OHD	Plate	97027	3103.00	1	1	1	1	6.9
06FEB97	OHD	Plate	97027	3103.20	26	1	1	26	7.5
06FEB97	OHD	Plate	97027	3402.00	18	1	1	18	6.0
06FEB97	OHD	Plate	97027	4200.00	29	1	1	29	7.5
06FEB97	OHD	Plate	97027	5204.00	5	1	1	5	6.9
06FEB97	OHD	Plate	97027	5209.00	5	1	1	5	8.4
06FEB97	OHD	Plate	97027	5211.50	3	1	1	3	9.1
06FEB97	OHD	Plate	97027	9002.00	2	1	1	2	.
06FEB97	OHD	Plate	97027	9006.00	1	1	1	1	.
06FEB97	OHD	Ponar	97028	1300.00	2	1	1	2	8.2
06FEB97	OHD	Ponar	97028	3103.20	2	1	1	2	7.5
06FEB97	OHD	Ponar	97028	4200.00	1	1	1	1	7.5
06FEB97	OHD	Ponar	97028	8503.00	1	1	1	1	.
06FEB97	OHD	Ponar	97029	1300.00	29	1	1	29	8.2
06FEB97	OHD	Ponar	97029	4200.00	25	1	1	25	7.5
06FEB97	OHD	Ponar	97029	4200.00	1	1	1	1	7.5
06FEB97	OHD	Ponar	97029	5109.00	12	1	1	12	7.4
06FEB97	OHD	Ponar	97029	5201.40	1	1	1	1	4.8
06FEB97	OHD	Ponar	97029	5204.00	2	1	1	2	6.9
06FEB97	OHD	Ponar	97029	5209.00	5	1	1	5	8.4
06FEB97	OHD	Ponar	97029	9002.00	2	1	1	2	.
06FEB97	OHD	Ponar	97030	1200.00	1	1	1	1	8.0
06FEB97	OHD	Ponar	97030	1300.00	37	1	1	37	8.2
06FEB97	OHD	Ponar	97030	3103.10	3	1	1	3	.
06FEB97	OHD	Ponar	97030	3103.20	5	1	1	5	7.5
06FEB97	OHD	Ponar	97030	3402.00	4	1	1	4	6.0
06FEB97	OHD	Ponar	97030	4200.00	39	1	1	39	7.5
06FEB97	OHD	Ponar	97030	5109.00	8	1	1	8	7.4
06FEB97	OHD	Ponar	97030	5201.40	1	1	1	1	4.8
06FEB97	OHD	Ponar	97030	5204.00	2	1	1	2	6.9
06FEB97	OHD	Ponar	97030	5209.00	4	1	1	4	8.4
06FEB97	OHD	Ponar	97030	8503.00	1	1	1	1	.
06FEB97	OHD	Ponar	97030	9002.00	2	1	1	2	.
06FEB97	OHD	Ponar	97030	9004.00	4	1	1	4	.
06FEB97	OHD	Ponar	97031	1300.00	30	1	1	30	8.2
06FEB97	OHD	Ponar	97031	3104.00	2	1	1	2	7.9
06FEB97	OHD	Ponar	97031	3402.00	1	1	1	1	6.0
06FEB97	OHD	Ponar	97031	4200.00	18	1	1	18	7.5
06FEB97	OHD	Ponar	97031	4302.00	1	1	1	1	7.6
06FEB97	OHD	Ponar	97031	5201.40	1	1	1	1	4.8
06FEB97	OHD	Ponar	97031	5204.00	3	1	1	3	6.9
06FEB97	OHD	Ponar	97032	1300.00	32	1	1	32	8.2
06FEB97	OHD	Ponar	97032	3103.20	2	1	1	2	7.5
06FEB97	OHD	Ponar	97032	3104.00	2	1	1	2	7.9
06FEB97	OHD	Ponar	97032	3402.00	1	1	1	1	6.0
06FEB97	OHD	Ponar	97032	4200.00	30	1	1	30	7.5
06FEB97	OHD	Ponar	97032	4302.00	4	1	1	4	7.6

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
06FEB97	OHD	Ponar	97032	4905.20	1	1	1	1	5.7
06FEB97	OHD	Ponar	97032	5105.00	1	1	1	1	6.8
06FEB97	OHD	Ponar	97032	5109.00	4	1	1	4	7.4
06FEB97	OHD	Ponar	97032	5201.40	2	1	1	2	4.8
06FEB97	OHD	Ponar	97032	5204.00	5	1	1	5	6.9
06FEB97	OHD	Ponar	97032	5209.00	4	1	1	4	8.4
06FEB97	OHD	Ponar	97032	5211.50	4	1	1	4	9.1
06FEB97	OHD	Ponar	97032	5212.50	1	1	1	1	.
06FEB97	OHD	Ponar	97032	9002.00	7	1	1	7	.
07FEB97	OHD3	Plate	97033	1300.00	4	1	1	4	8.2
07FEB97	OHD3	Plate	97033	3103.20	6	1	1	6	7.5
07FEB97	OHD3	Plate	97033	4200.00	27	1	1	27	7.5
07FEB97	OHD3	Plate	97033	4302.00	5	1	1	5	7.6
07FEB97	OHD3	Plate	97033	4800.05	7	1	1	7	8.7
07FEB97	OHD3	Plate	97033	5204.00	2	1	1	2	6.9
07FEB97	OHD3	Plate	97033	5209.00	5	1	1	5	8.4
07FEB97	OHD3	Plate	97034	1300.00	1	1	1	1	8.2
07FEB97	OHD3	Plate	97034	4101.50	1	1	1	1	6.4
07FEB97	OHD3	Plate	97034	4105.00	1	1	1	1	5.5
07FEB97	OHD3	Plate	97034	4200.00	7	1	1	7	7.5
07FEB97	OHD3	Plate	97034	4302.10	2	1	1	2	7.6
07FEB97	OHD3	Plate	97034	4800.20	1	1	1	1	8.7
07FEB97	OHD3	Plate	97034	5109.00	1	1	1	1	7.4
07FEB97	OHD3	Plate	97034	5203.00	1	1	1	1	6.0
07FEB97	OHD3	Plate	97034	5204.00	11	1	1	11	6.9
07FEB97	OHD3	Plate	97034	5209.00	3	1	1	3	8.4
07FEB97	OHD3	Plate	97035	1300.00	7	1	1	7	8.2
07FEB97	OHD3	Plate	97035	3103.00	7	1	1	7	6.9
07FEB97	OHD3	Plate	97035	3103.20	7	1	1	7	7.5
07FEB97	OHD3	Plate	97035	4103.00	2	1	1	2	8.9
07FEB97	OHD3	Plate	97035	4200.00	38	1	1	38	7.5
07FEB97	OHD3	Plate	97035	4302.00	3	1	1	3	7.6
07FEB97	OHD3	Plate	97035	4800.05	2	1	1	2	8.7
07FEB97	OHD3	Plate	97035	4800.20	1	1	1	1	8.7
07FEB97	OHD3	Plate	97035	5204.00	5	1	1	5	6.9
07FEB97	OHD3	Plate	97035	5208.00	1	1	1	1	4.0
07FEB97	OHD3	Plate	97035	5209.00	1	1	1	1	8.4
07FEB97	OHD3	Ponar	97036	1300.00	7	1	1	7	8.2
07FEB97	OHD3	Ponar	97036	3103.00	1	1	1	1	6.9
07FEB97	OHD3	Ponar	97036	3103.20	54	1	1	54	7.5
07FEB97	OHD3	Ponar	97036	4101.50	1	1	1	1	6.4
07FEB97	OHD3	Ponar	97036	4102.10	3	1	1	3	5.4
07FEB97	OHD3	Ponar	97036	4103.00	1	1	1	1	8.9
07FEB97	OHD3	Ponar	97036	4200.00	21	1	1	21	7.5
07FEB97	OHD3	Ponar	97036	4203.10	1	1	1	1	6.0
07FEB97	OHD3	Ponar	97036	4302.00	9	1	1	9	7.6
07FEB97	OHD3	Ponar	97036	4800.20	1	1	1	1	8.7
07FEB97	OHD3	Ponar	97036	5109.00	4	1	1	4	7.4
07FEB97	OHD3	Ponar	97036	5201.40	1	1	1	1	4.8
07FEB97	OHD3	Ponar	97036	9002.00	5	1	1	5	.
07FEB97	OHD3	Ponar	97037	1200.00	2	1	1	2	8.0
07FEB97	OHD3	Ponar	97037	1300.00	17	1	1	17	8.2
07FEB97	OHD3	Ponar	97037	3103.00	1	1	1	1	6.9
07FEB97	OHD3	Ponar	97037	3103.20	3	1	1	3	7.5

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
07FEB97	OHD3	Ponar	97037	4101.50	6	1	1	6	6.4
07FEB97	OHD3	Ponar	97037	4102.10	2	1	1	2	5.4
07FEB97	OHD3	Ponar	97037	4103.00	1	1	1	1	8.9
07FEB97	OHD3	Ponar	97037	4200.00	58	1	1	58	7.5
07FEB97	OHD3	Ponar	97037	4200.00	3	1	1	3	7.5
07FEB97	OHD3	Ponar	97037	4203.10	1	1	1	1	6.0
07FEB97	OHD3	Ponar	97037	4302.00	8	1	1	8	7.6
07FEB97	OHD3	Ponar	97037	5105.00	7	1	1	7	6.8
07FEB97	OHD3	Ponar	97037	5109.00	14	1	1	14	7.4
07FEB97	OHD3	Ponar	97037	5204.00	31	1	1	31	6.9
07FEB97	OHD3	Ponar	97037	5209.00	2	1	1	2	8.4
07FEB97	OHD3	Ponar	97037	5211.50	1	1	1	1	9.1
07FEB97	OHD3	Ponar	97037	9002.00	4	1	1	4	.
07FEB97	OHD3	Ponar	97038	1300.00	4	1	1	4	8.2
07FEB97	OHD3	Ponar	97038	3103.00	5	1	1	5	6.9
07FEB97	OHD3	Ponar	97038	3103.20	16	1	1	16	7.5
07FEB97	OHD3	Ponar	97038	3401.10	1	1	1	1	9.4
07FEB97	OHD3	Ponar	97038	4101.50	3	1	1	3	6.4
07FEB97	OHD3	Ponar	97038	4103.00	1	1	1	1	8.9
07FEB97	OHD3	Ponar	97038	4200.00	32	1	1	32	7.5
07FEB97	OHD3	Ponar	97038	4302.00	16	1	1	16	7.6
07FEB97	OHD3	Ponar	97038	4800.05	2	1	1	2	8.7
07FEB97	OHD3	Ponar	97038	5204.00	40	1	1	40	6.9
07FEB97	OHD3	Ponar	97038	8503.00	1	1	1	1	.
07FEB97	OHD3	Ponar	97038	9002.00	19	1	1	19	.
07FEB97	OHD3	Ponar	97038	9004.00	1	1	1	1	.
07FEB97	OHD3	Ponar	97039	1300.00	2	1	1	2	8.2
07FEB97	OHD3	Ponar	97039	3103.20	4	1	1	4	7.5
07FEB97	OHD3	Ponar	97039	4101.50	2	1	1	2	6.4
07FEB97	OHD3	Ponar	97039	4102.10	3	1	1	3	5.4
07FEB97	OHD3	Ponar	97039	4103.00	1	1	1	1	8.9
07FEB97	OHD3	Ponar	97039	4200.00	41	1	1	41	7.5
07FEB97	OHD3	Ponar	97039	4302.00	9	1	1	9	7.6
07FEB97	OHD3	Ponar	97039	4800.20	2	1	1	2	8.7
07FEB97	OHD3	Ponar	97039	4900.00	1	1	1	1	2.3
07FEB97	OHD3	Ponar	97039	5109.00	1	1	1	1	7.4
07FEB97	OHD3	Ponar	97039	5204.00	16	1	1	16	6.9
07FEB97	OHD3	Ponar	97039	5207.00	2	1	1	2	7.3
07FEB97	OHD3	Ponar	97039	5209.00	3	1	1	3	8.4
07FEB97	OHD3	Ponar	97039	9002.00	14	1	1	14	.
07FEB97	OHD3	Ponar	97040	1200.00	1	1	4	4	8.0
07FEB97	OHD3	Ponar	97040	1300.00	2	1	4	8	8.2
07FEB97	OHD3	Ponar	97040	3103.00	1	1	4	4	6.9
07FEB97	OHD3	Ponar	97040	3103.20	2	1	4	8	7.5
07FEB97	OHD3	Ponar	97040	4200.00	8	1	4	32	7.5
07FEB97	OHD3	Ponar	97040	4302.00	1	1	4	4	7.6
07FEB97	OHD3	Ponar	97040	4302.10	1	1	4	4	7.6
07FEB97	OHD3	Ponar	97040	5109.00	1	1	4	4	7.4
07FEB97	OHD3	Ponar	97040	5204.00	40	1	4	160	6.9
07FEB97	OHD3	Ponar	97040	5209.00	5	1	4	20	8.4
07FEB97	MOB2	Plate	97041	1200.00	2	1	4	8	8.0
07FEB97	MOB2	Plate	97041	1300.00	26	1	4	104	8.2
07FEB97	MOB2	Plate	97041	4200.00	85	1	4	340	7.5
07FEB97	MOB2	Plate	97041	4200.00	2	1	4	8	7.5

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
07FEB97	MOB2	Plate	97041	4203.10	2	1	4	8	6.0
07FEB97	MOB2	Plate	97041	4302.00	1	1	4	4	7.6
07FEB97	MOB2	Plate	97041	5201.40	1	1	4	4	4.8
07FEB97	MOB2	Plate	97041	8504.00	6	1	4	24	.
07FEB97	MOB2	Plate	97042	1300.00	5	1	1	5	8.2
07FEB97	MOB2	Plate	97042	3104.00	1	1	1	1	7.9
07FEB97	MOB2	Plate	97042	3401.10	1	1	1	1	9.4
07FEB97	MOB2	Plate	97042	4200.00	172	1	1	172	7.5
07FEB97	MOB2	Plate	97042	4200.00	17	1	1	17	7.5
07FEB97	MOB2	Plate	97042	4243.00	10	1	1	10	6.0
07FEB97	MOB2	Plate	97042	4302.10	5	1	1	5	7.6
07FEB97	MOB2	Plate	97042	4800.05	3	1	1	3	8.7
07FEB97	MOB2	Plate	97042	4800.20	1	1	1	1	8.7
07FEB97	MOB2	Plate	97042	5201.40	3	1	1	3	4.8
07FEB97	MOB2	Plate	97042	5211.50	1	1	1	1	9.1
07FEB97	MOB2	Plate	97043	1300.00	36	1	1	36	8.2
07FEB97	MOB2	Plate	97043	4101.50	1	1	1	1	6.4
07FEB97	MOB2	Plate	97043	4103.00	1	1	1	1	8.9
07FEB97	MOB2	Plate	97043	4200.00	214	1	1	214	7.5
07FEB97	MOB2	Plate	97043	4200.00	1	1	1	1	7.5
07FEB97	MOB2	Plate	97043	4243.00	9	1	1	9	6.0
07FEB97	MOB2	Plate	97043	4302.10	2	1	1	2	7.6
07FEB97	MOB2	Plate	97043	4701.35	1	1	1	1	6.7
07FEB97	MOB2	Plate	97043	5201.40	1	1	1	1	4.8
07FEB97	MOB2	Plate	97043	5211.50	2	1	1	2	9.1
07FEB97	MOB2	Ponar	97044	1300.00	24	1	1	24	8.2
07FEB97	MOB2	Ponar	97044	4101.50	6	1	1	6	6.4
07FEB97	MOB2	Ponar	97044	4102.10	2	1	1	2	5.4
07FEB97	MOB2	Ponar	97044	4200.00	115	1	1	115	7.5
07FEB97	MOB2	Ponar	97044	4200.00	2	1	1	2	7.5
07FEB97	MOB2	Ponar	97044	4302.00	4	1	1	4	7.6
07FEB97	MOB2	Ponar	97044	4800.20	1	1	1	1	8.7
07FEB97	MOB2	Ponar	97044	5100.50	1	1	1	1	.
07FEB97	MOB2	Ponar	97044	5201.40	2	1	1	2	4.8
07FEB97	MOB2	Ponar	97044	5209.00	1	1	1	1	8.4
07FEB97	MOB2	Ponar	97044	8503.00	3	1	1	3	.
07FEB97	MOB2	Ponar	97045	1300.00	18	1	1	18	8.2
07FEB97	MOB2	Ponar	97045	4101.50	7	1	1	7	6.4
07FEB97	MOB2	Ponar	97045	4102.10	1	1	1	1	5.4
07FEB97	MOB2	Ponar	97045	4200.00	136	1	1	136	7.5
07FEB97	MOB2	Ponar	97045	4243.00	10	1	1	10	6.0
07FEB97	MOB2	Ponar	97045	5109.00	3	1	1	3	7.4
07FEB97	MOB2	Ponar	97045	5110.00	1	1	1	1	.
07FEB97	MOB2	Ponar	97045	8502.00	1	1	1	1	.
07FEB97	MOB2	Ponar	97045	8503.00	1	1	1	1	.
07FEB97	MOB2	Ponar	97046	1300.00	3	1	1	3	8.2
07FEB97	MOB2	Ponar	97046	4200.00	79	1	1	79	7.5
07FEB97	MOB2	Ponar	97046	5211.50	2	1	1	2	9.1
07FEB97	MOB2	Ponar	97046	8502.00	1	1	1	1	.
07FEB97	MOB2	Ponar	97046	8504.00	1	1	1	1	.
07FEB97	MOB2	Ponar	97047	1300.00	10	1	1	10	8.2
07FEB97	MOB2	Ponar	97047	4101.50	10	1	1	10	6.4
07FEB97	MOB2	Ponar	97047	4102.10	10	1	1	10	5.4
07FEB97	MOB2	Ponar	97047	4200.00	59	1	1	59	7.5

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
07FEB97	MOB2	Ponar	97047	4200.00	1	1	1	1	7.5
07FEB97	MOB2	Ponar	97047	4203.10	5	1	1	5	6.0
07FEB97	MOB2	Ponar	97047	4240.00	1	1	1	1	6.4
07FEB97	MOB2	Ponar	97047	4302.10	5	1	1	5	7.6
07FEB97	MOB2	Ponar	97048	1300.00	4	1	1	4	8.2
07FEB97	MOB2	Ponar	97048	4101.50	1	1	1	1	6.4
07FEB97	MOB2	Ponar	97048	4102.10	1	1	1	1	5.4
07FEB97	MOB2	Ponar	97048	4200.00	131	1	1	131	7.5
07FEB97	MOB2	Ponar	97048	4200.00	1	1	1	1	7.5
07FEB97	MOB2	Ponar	97048	4247.00	5	1	1	5	8.1
07FEB97	MOB2	Ponar	97048	4302.00	1	1	1	1	7.6
07FEB97	MOB2	Ponar	97048	9002.00	2	1	1	2	.
07FEB97	MOB	Plate	97049	4200.00	7	1	1	7	7.5
07FEB97	MOB	Plate	97049	5201.40	1	1	1	1	4.8
07FEB97	MOB	Plate	97049	5209.00	1	1	1	1	8.4
07FEB97	MOB	Plate	97049	5213.00	3	1	1	3	5.0
07FEB97	MOB	Plate	97050	3400.00	1	1	1	1	.
07FEB97	MOB	Plate	97050	3401.10	3	1	1	3	9.4
07FEB97	MOB	Plate	97050	4101.50	2	1	1	2	6.4
07FEB97	MOB	Plate	97050	4200.00	8	1	1	8	7.5
07FEB97	MOB	Plate	97050	5201.40	3	1	1	3	4.8
07FEB97	MOB	Plate	97050	5204.00	3	1	1	3	6.9
07FEB97	MOB	Plate	97050	5209.00	13	1	1	13	8.4
07FEB97	MOB	Plate	97050	5213.00	8	1	1	8	5.0
07FEB97	MOB	Plate	97051	4101.50	1	1	1	1	6.4
07FEB97	MOB	Plate	97051	4200.00	27	1	1	27	7.5
07FEB97	MOB	Plate	97051	4800.05	1	1	1	1	8.7
07FEB97	MOB	Plate	97051	5107.00	1	1	1	1	7.7
07FEB97	MOB	Plate	97051	5109.00	2	1	1	2	7.4
07FEB97	MOB	Plate	97051	5201.40	2	1	1	2	4.8
07FEB97	MOB	Plate	97051	5209.00	4	1	1	4	8.4
07FEB97	MOB	Plate	97051	5213.00	1	1	1	1	5.0
07FEB97	MOB	Plate	97051	5216.10	1	1	1	1	.
07FEB97	MOB	Plate	97051	8502.00	1	1	1	1	.
07FEB97	MOB	Ponar	97052	1200.00	1	1	1	1	8.0
07FEB97	MOB	Ponar	97052	1300.00	9	1	1	9	8.2
07FEB97	MOB	Ponar	97052	3401.10	1	1	1	1	9.4
07FEB97	MOB	Ponar	97052	4101.50	4	1	1	4	6.4
07FEB97	MOB	Ponar	97052	4102.10	7	1	1	7	5.4
07FEB97	MOB	Ponar	97052	4200.00	31	1	1	31	7.5
07FEB97	MOB	Ponar	97052	4203.10	4	1	1	4	6.0
07FEB97	MOB	Ponar	97052	4243.00	2	1	1	2	6.0
07FEB97	MOB	Ponar	97052	4302.00	1	1	1	1	7.6
07FEB97	MOB	Ponar	97052	4700.00	1	1	1	1	6.9
07FEB97	MOB	Ponar	97052	4703.00	1	1	1	1	6.1
07FEB97	MOB	Ponar	97052	8001.00	1	1	1	1	.
07FEB97	MOB	Ponar	97052	8502.00	1	1	1	1	.
07FEB97	MOB	Ponar	97053	4101.50	1	1	1	1	6.4
07FEB97	MOB	Ponar	97053	4102.10	1	1	1	1	5.4
07FEB97	MOB	Ponar	97053	4200.00	4	1	1	4	7.5
07FEB97	MOB	Ponar	97053	4302.00	1	1	1	1	7.6
07FEB97	MOB	Ponar	97053	5109.00	2	1	1	2	7.4
07FEB97	MOB	Ponar	97053	5209.00	4	1	1	4	8.4
07FEB97	MOB	Ponar	97054	1200.00	1	1	1	1	8.0

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
07FEB97	MOB	Ponar	97054	1300.00	1	1	1	1	8.2
07FEB97	MOB	Ponar	97054	3401.10	4	1	1	4	9.4
07FEB97	MOB	Ponar	97054	4101.50	1	1	1	1	6.4
07FEB97	MOB	Ponar	97054	4102.10	1	1	1	1	5.4
07FEB97	MOB	Ponar	97054	4200.00	9	1	1	9	7.5
07FEB97	MOB	Ponar	97054	4203.10	2	1	1	2	6.0
07FEB97	MOB	Ponar	97054	4302.10	1	1	1	1	7.6
07FEB97	MOB	Ponar	97054	4800.20	1	1	1	1	8.7
07FEB97	MOB	Ponar	97054	5105.00	1	1	1	1	6.8
07FEB97	MOB	Ponar	97054	5213.00	3	1	1	3	5.0
07FEB97	MOB	Ponar	97055	1200.00	1	1	1	1	8.0
07FEB97	MOB	Ponar	97055	1300.00	7	1	1	7	8.2
07FEB97	MOB	Ponar	97055	4200.00	11	1	1	11	7.5
07FEB97	MOB	Ponar	97055	4243.00	1	1	1	1	6.0
07FEB97	MOB	Ponar	97055	5204.00	1	1	1	1	6.9
07FEB97	MOB	Ponar	97055	5207.50	2	1	1	2	.
07FEB97	MOB	Ponar	97055	5212.00	1	1	1	1	5.0
07FEB97	MOB	Ponar	97055	5213.00	1	1	1	1	5.0
07FEB97	MOB	Ponar	97055	5216.10	1	1	1	1	.
07FEB97	MOB	Ponar	97056	1300.00	8	1	1	8	8.2
07FEB97	MOB	Ponar	97056	4200.00	11	1	1	11	7.5
07FEB97	MOB	Ponar	97056	4203.10	2	1	1	2	6.0
07FEB97	MOB	Ponar	97056	4203.20	1	1	1	1	6.0
07FEB97	MOB	Ponar	97056	4302.00	1	1	1	1	7.6
07FEB97	MOB	Ponar	97056	8502.00	1	1	1	1	.
07FEB97	TOC	Plate	97057	1300.00	18	1	1	18	8.2
07FEB97	TOC	Plate	97057	3104.00	1	1	1	1	7.9
07FEB97	TOC	Plate	97057	3401.10	1	1	1	1	9.4
07FEB97	TOC	Plate	97057	4200.00	2	1	1	2	7.5
07FEB97	TOC	Plate	97057	4302.00	5	1	1	5	7.6
07FEB97	TOC	Plate	97057	5201.40	2	1	1	2	4.8
07FEB97	TOC	Plate	97057	5204.00	1	1	1	1	6.9
07FEB97	TOC	Plate	97057	5207.50	1	1	1	1	.
07FEB97	TOC	Plate	97057	5209.00	1	1	1	1	8.4
07FEB97	TOC	Plate	97057	8001.00	1	1	1	1	.
07FEB97	TOC	Plate	97057	8504.00	1	1	1	1	.
07FEB97	TOC	Plate	97058	1300.00	35	1	1	35	8.2
07FEB97	TOC	Plate	97058	4200.00	4	1	1	4	7.5
07FEB97	TOC	Plate	97058	4302.00	3	1	1	3	7.6
07FEB97	TOC	Plate	97058	4302.10	1	1	1	1	7.6
07FEB97	TOC	Plate	97058	5107.00	1	1	1	1	7.7
07FEB97	TOC	Plate	97058	5201.40	41	1	1	41	4.8
07FEB97	TOC	Plate	97058	5203.00	5	1	1	5	6.0
07FEB97	TOC	Plate	97058	5204.00	6	1	1	6	6.9
07FEB97	TOC	Plate	97058	5207.50	2	1	1	2	.
07FEB97	TOC	Plate	97058	5208.00	2	1	1	2	4.0
07FEB97	TOC	Plate	97058	5209.00	26	1	1	26	8.4
07FEB97	TOC	Plate	97059	1200.00	13	1	1	13	8.0
07FEB97	TOC	Plate	97059	1300.00	4	1	1	4	8.2
07FEB97	TOC	Plate	97059	3401.10	1	1	1	1	9.4
07FEB97	TOC	Plate	97059	4302.10	1	1	1	1	7.6
07FEB97	TOC	Plate	97059	4701.80	1	1	1	1	7.3
07FEB97	TOC	Plate	97059	5101.00	3	1	1	3	6.3
07FEB97	TOC	Plate	97059	5109.00	5	1	1	5	7.4

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
07FEB97	TOC	Plate	97059	5201.40	83	1	1	83	4.8
07FEB97	TOC	Plate	97059	5203.00	4	1	1	4	6.0
07FEB97	TOC	Plate	97059	5204.00	10	1	1	10	6.9
07FEB97	TOC	Plate	97059	5204.10	1	1	1	1	6.9
07FEB97	TOC	Plate	97059	5209.00	3	1	1	3	8.4
07FEB97	TOC	Plate	97059	5211.50	1	1	1	1	9.1
07FEB97	TOC	Plate	97059	9006.00	1	1	1	1	.
07FEB97	TOC	Ponar	97060	1300.00	75	1	1	75	8.2
07FEB97	TOC	Ponar	97060	3104.00	1	1	1	1	7.9
07FEB97	TOC	Ponar	97060	4103.00	1	1	1	1	8.9
07FEB97	TOC	Ponar	97060	4200.00	15	1	1	15	7.5
07FEB97	TOC	Ponar	97060	4203.10	4	1	1	4	6.0
07FEB97	TOC	Ponar	97060	4203.20	3	1	1	3	6.0
07FEB97	TOC	Ponar	97060	4302.00	14	1	1	14	7.6
07FEB97	TOC	Ponar	97060	5105.00	12	1	1	12	6.8
07FEB97	TOC	Ponar	97060	5107.00	3	1	1	3	7.7
07FEB97	TOC	Ponar	97060	5109.00	12	1	1	12	7.4
07FEB97	TOC	Ponar	97060	5201.40	7	1	1	7	4.8
07FEB97	TOC	Ponar	97060	5204.00	1	1	1	1	6.9
07FEB97	TOC	Ponar	97060	5207.50	1	1	1	1	.
07FEB97	TOC	Ponar	97060	5208.00	2	1	1	2	4.0
07FEB97	TOC	Ponar	97060	5209.00	4	1	1	4	8.4
07FEB97	TOC	Ponar	97060	5214.00	1	1	1	1	.
07FEB97	TOC	Ponar	97060	9002.00	1	1	1	1	.
07FEB97	TOC	Ponar	97060	9004.00	2	1	1	2	.
07FEB97	TOC	Ponar	97061	1300.00	17	1	1	17	8.2
07FEB97	TOC	Ponar	97061	4103.00	2	1	1	2	8.9
07FEB97	TOC	Ponar	97061	4200.00	4	1	1	4	7.5
07FEB97	TOC	Ponar	97061	4302.00	9	1	1	9	7.6
07FEB97	TOC	Ponar	97061	5107.00	1	1	1	1	7.7
07FEB97	TOC	Ponar	97061	5109.00	3	1	1	3	7.4
07FEB97	TOC	Ponar	97061	5201.40	11	1	1	11	4.8
07FEB97	TOC	Ponar	97061	5203.00	1	1	1	1	6.0
07FEB97	TOC	Ponar	97061	5207.50	2	1	1	2	.
07FEB97	TOC	Ponar	97061	5209.00	3	1	1	3	8.4
07FEB97	TOC	Ponar	97061	8001.00	3	1	1	3	.
07FEB97	TOC	Ponar	97061	9002.00	1	1	1	1	.
07FEB97	TOC	Ponar	97062	1200.00	2	1	1	2	8.0
07FEB97	TOC	Ponar	97062	1300.00	13	1	1	13	8.2
07FEB97	TOC	Ponar	97062	4200.00	3	1	1	3	7.5
07FEB97	TOC	Ponar	97062	4203.10	2	1	1	2	6.0
07FEB97	TOC	Ponar	97062	4302.00	7	1	1	7	7.6
07FEB97	TOC	Ponar	97062	5101.50	2	1	1	2	.
07FEB97	TOC	Ponar	97062	5103.20	2	1	1	2	7.7
07FEB97	TOC	Ponar	97062	5105.00	2	1	1	2	6.8
07FEB97	TOC	Ponar	97062	5109.00	2	1	1	2	7.4
07FEB97	TOC	Ponar	97062	5201.40	7	1	1	7	4.8
07FEB97	TOC	Ponar	97063	1300.00	17	1	4	68	8.2
07FEB97	TOC	Ponar	97063	3401.10	2	1	4	8	9.4
07FEB97	TOC	Ponar	97063	4103.00	3	1	4	12	8.9
07FEB97	TOC	Ponar	97063	4200.00	4	1	4	16	7.5
07FEB97	TOC	Ponar	97063	4302.10	16	1	4	64	7.6
07FEB97	TOC	Ponar	97063	4305.00	1	1	4	4	6.0
07FEB97	TOC	Ponar	97063	5105.00	1	1	4	4	6.8

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
07FEB97	TOC	Ponar	97063	5107.00	7	1	4	28	7.7
07FEB97	TOC	Ponar	97063	5109.00	4	1	4	16	7.4
07FEB97	TOC	Ponar	97063	5201.40	26	1	4	104	4.8
07FEB97	TOC	Ponar	97063	5203.00	1	1	4	4	6.0
07FEB97	TOC	Ponar	97063	5208.00	1	1	4	4	4.0
07FEB97	TOC	Ponar	97063	5209.00	1	1	4	4	8.4
07FEB97	TOC	Ponar	97063	5216.10	1	1	4	4	.
07FEB97	TOC	Ponar	97063	8001.00	1	1	4	4	.
07FEB97	TOC	Ponar	97064	1200.00	7	1	4	28	8.0
07FEB97	TOC	Ponar	97064	1300.00	10	1	4	40	8.2
07FEB97	TOC	Ponar	97064	4200.00	3	1	4	12	7.5
07FEB97	TOC	Ponar	97064	4203.10	3	1	4	12	6.0
07FEB97	TOC	Ponar	97064	4302.00	18	1	4	72	7.6
07FEB97	TOC	Ponar	97064	5105.00	2	1	4	8	6.8
07FEB97	TOC	Ponar	97064	5107.00	2	1	4	8	7.7
07FEB97	TOC	Ponar	97064	5109.00	2	1	4	8	7.4
07FEB97	TOC	Ponar	97064	5201.40	4	1	4	16	4.8
30APR97	DBR2	Plate	97065	1300.00	42	1	1	42	8.2
30APR97	DBR2	Plate	97065	3103.00	1	1	1	1	6.9
30APR97	DBR2	Plate	97065	3103.20	28	1	1	28	7.5
30APR97	DBR2	Plate	97065	4102.10	1	1	1	1	5.4
30APR97	DBR2	Plate	97065	4200.00	150	1	1	150	7.5
30APR97	DBR2	Plate	97065	6001.00	2	1	1	2	.
30APR97	DBR2	Plate	97066	1300.00	13	1	1	13	8.2
30APR97	DBR2	Plate	97066	3103.20	11	1	1	11	7.5
30APR97	DBR2	Plate	97066	3104.00	1	1	1	1	7.9
30APR97	DBR2	Plate	97066	4102.10	1	1	1	1	5.4
30APR97	DBR2	Plate	97066	4200.00	98	1	1	98	7.5
30APR97	DBR2	Plate	97066	4200.00	1	1	1	1	7.5
30APR97	DBR2	Plate	97066	5211.50	1	1	1	1	9.1
30APR97	DBR2	Plate	97067	1300.00	26	1	1	26	8.2
30APR97	DBR2	Plate	97067	3103.20	15	1	1	15	7.5
30APR97	DBR2	Plate	97067	3108.00	2	1	1	2	.
30APR97	DBR2	Plate	97067	3111.00	1	1	1	1	8.0
30APR97	DBR2	Plate	97067	4101.50	2	1	1	2	6.4
30APR97	DBR2	Plate	97067	4110.00	1	1	1	1	4.7
30APR97	DBR2	Plate	97067	4200.00	115	1	1	115	7.5
30APR97	DBR2	Plate	97067	4236.00	1	1	1	1	2.8
30APR97	DBR2	Plate	97067	6001.00	1	1	1	1	.
30APR97	DBR2	Plate	97067	9002.00	1	1	1	1	.
30APR97	DBR2	Ponar	97068	1300.00	68	1	1	68	8.2
30APR97	DBR2	Ponar	97068	3103.20	1	1	1	1	7.5
30APR97	DBR2	Ponar	97068	4200.00	13	1	1	13	7.5
30APR97	DBR2	Ponar	97068	6001.00	1	1	1	1	.
30APR97	DBR2	Ponar	97068	9004.00	1	1	1	1	.
30APR97	DBR2	Ponar	97069	1300.00	27	1	1	27	8.2
30APR97	DBR2	Ponar	97069	3103.00	1	1	1	1	6.9
30APR97	DBR2	Ponar	97069	3103.20	4	1	1	4	7.5
30APR97	DBR2	Ponar	97069	4101.50	1	1	1	1	6.4
30APR97	DBR2	Ponar	97069	4102.10	1	1	1	1	5.4
30APR97	DBR2	Ponar	97069	4200.00	14	1	1	14	7.5
30APR97	DBR2	Ponar	97069	4905.20	1	1	1	1	5.7
30APR97	DBR2	Ponar	97069	6001.00	1	1	1	1	.
30APR97	DBR2	Ponar	97069	9002.00	2	1	1	2	.

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
30APR97	DBR2	Ponar	97070	1300.00	76	1	1	76	8.2
30APR97	DBR2	Ponar	97070	3103.20	2	1	1	2	7.5
30APR97	DBR2	Ponar	97070	4200.00	12	1	1	12	7.5
30APR97	DBR2	Ponar	97070	4244.00	1	1	1	1	4.0
30APR97	DBR2	Ponar	97070	5209.10	1	1	1	1	.
30APR97	DBR2	Ponar	97070	9002.00	2	1	1	2	.
30APR97	DBR2	Ponar	97071	1300.00	7	1	1	7	8.2
30APR97	DBR2	Ponar	97071	3103.20	1	1	1	1	7.5
30APR97	DBR2	Ponar	97071	4200.00	5	1	1	5	7.5
30APR97	DBR2	Ponar	97071	4246.00	1	1	1	1	6.0
30APR97	DBR2	Ponar	97071	9002.00	2	1	1	2	.
30APR97	DBR2	Ponar	97072	1300.00	21	1	1	21	8.2
30APR97	DBR2	Ponar	97072	4200.00	4	1	1	4	7.5
30APR97	DBR	Plate	97073	1300.00	2	1	1	2	8.2
30APR97	DBR	Plate	97073	3108.00	2	1	1	2	.
30APR97	DBR	Plate	97073	3401.10	4	1	1	4	9.4
30APR97	DBR	Plate	97073	3402.00	82	1	1	82	6.0
30APR97	DBR	Plate	97073	4101.50	1	1	1	1	6.4
30APR97	DBR	Plate	97073	4200.00	119	1	1	119	7.5
30APR97	DBR	Plate	97073	4800.05	3	1	1	3	8.7
30APR97	DBR	Plate	97074	1300.00	5	1	1	5	8.2
30APR97	DBR	Plate	97074	3401.10	3	1	1	3	9.4
30APR97	DBR	Plate	97074	3402.00	11	1	1	11	6.0
30APR97	DBR	Plate	97074	4200.00	30	1	1	30	7.5
30APR97	DBR	Plate	97074	4800.05	4	1	1	4	8.7
30APR97	DBR	Plate	97074	4800.20	3	1	1	3	8.7
30APR97	DBR	Plate	97074	5201.40	2	1	1	2	4.8
30APR97	DBR	Plate	97074	5211.50	3	1	1	3	9.1
30APR97	DBR	Plate	97074	8001.00	2	1	1	2	.
30APR97	DBR	Plate	97074	9002.00	2	1	1	2	.
30APR97	DBR	Plate	97075	1300.00	7	1	1	7	8.2
30APR97	DBR	Plate	97075	3108.00	1	1	1	1	.
30APR97	DBR	Plate	97075	3401.10	1	1	1	1	9.4
30APR97	DBR	Plate	97075	3402.00	121	1	1	121	6.0
30APR97	DBR	Plate	97075	4102.10	1	1	1	1	5.4
30APR97	DBR	Plate	97075	4200.00	77	1	1	77	7.5
30APR97	DBR	Plate	97075	5201.40	3	1	1	3	4.8
30APR97	DBR	Plate	97075	5208.00	1	1	1	1	4.0
30APR97	DBR	Plate	97075	5211.50	1	1	1	1	9.1
30APR97	DBR	Plate	97075	8001.00	2	1	1	2	.
30APR97	DBR	Ponar	97076	1200.00	1	1	1	1	8.0
30APR97	DBR	Ponar	97076	1300.00	9	1	1	9	8.2
30APR97	DBR	Ponar	97076	3100.00	1	1	1	1	.
30APR97	DBR	Ponar	97076	3103.20	1	1	1	1	7.5
30APR97	DBR	Ponar	97076	3108.00	4	1	1	4	.
30APR97	DBR	Ponar	97076	3401.10	2	1	1	2	9.4
30APR97	DBR	Ponar	97076	3402.00	10	1	1	10	6.0
30APR97	DBR	Ponar	97076	4102.10	1	1	1	1	5.4
30APR97	DBR	Ponar	97076	4200.00	9	1	1	9	7.5
30APR97	DBR	Ponar	97076	4302.00	1	1	1	1	7.6
30APR97	DBR	Ponar	97076	4408.00	1	1	1	1	.
30APR97	DBR	Ponar	97076	4800.20	1	1	1	1	8.7
30APR97	DBR	Ponar	97076	5109.00	2	1	1	2	7.4
30APR97	DBR	Ponar	97076	5201.40	1	1	1	1	4.8

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
30APR97	DBR	Ponar	97076	5211.50	1	1	1	1	9.1
30APR97	DBR	Ponar	97076	9004.00	1	1	1	1	.
30APR97	DBR	Ponar	97077	1200.00	1	1	1	1	8.0
30APR97	DBR	Ponar	97077	1300.00	9	1	1	9	8.2
30APR97	DBR	Ponar	97077	3103.20	3	1	1	3	7.5
30APR97	DBR	Ponar	97077	3108.00	7	1	1	7	.
30APR97	DBR	Ponar	97077	3401.10	1	1	1	1	9.4
30APR97	DBR	Ponar	97077	3402.00	22	1	1	22	6.0
30APR97	DBR	Ponar	97077	4200.00	8	1	1	8	7.5
30APR97	DBR	Ponar	97077	5109.00	1	1	1	1	7.4
30APR97	DBR	Ponar	97077	5203.00	1	1	1	1	6.0
30APR97	DBR	Ponar	97077	5211.50	2	1	1	2	9.1
30APR97	DBR	Ponar	97078	1300.00	17	1	1	17	8.2
30APR97	DBR	Ponar	97078	3103.20	2	1	1	2	7.5
30APR97	DBR	Ponar	97078	4200.00	22	1	1	22	7.5
30APR97	DBR	Ponar	97078	5211.50	1	1	1	1	9.1
30APR97	DBR	Ponar	97078	5215.10	1	1	1	1	7.2
30APR97	DBR	Ponar	97079	1300.00	21	1	1	21	8.2
30APR97	DBR	Ponar	97079	3401.10	3	1	1	3	9.4
30APR97	DBR	Ponar	97079	3402.00	1	1	1	1	6.0
30APR97	DBR	Ponar	97079	4200.00	17	1	1	17	7.5
30APR97	DBR	Ponar	97079	4200.00	1	1	1	1	7.5
30APR97	DBR	Ponar	97079	4203.10	2	1	1	2	6.0
30APR97	DBR	Ponar	97079	4242.00	1	1	1	1	7.7
30APR97	DBR	Ponar	97079	5109.00	2	1	1	2	7.4
30APR97	DBR	Ponar	97079	5211.50	3	1	1	3	9.1
30APR97	DBR	Ponar	97079	9002.00	1	1	1	1	.
30APR97	DBR	Ponar	97080	1300.00	36	1	1	36	8.2
30APR97	DBR	Ponar	97080	3401.10	4	1	1	4	9.4
30APR97	DBR	Ponar	97080	3402.00	1	1	1	1	6.0
30APR97	DBR	Ponar	97080	4200.00	8	1	1	8	7.5
30APR97	DBR	Ponar	97080	5203.00	1	1	1	1	6.0
30APR97	MOB	Plate	97081	1300.00	5	1	1	5	8.2
30APR97	MOB	Plate	97081	4102.10	3	1	1	3	5.4
30APR97	MOB	Plate	97081	4104.00	1	1	1	1	6.9
30APR97	MOB	Plate	97081	4200.00	117	1	1	117	7.5
30APR97	MOB	Plate	97081	5201.40	1	1	1	1	4.8
30APR97	MOB	Plate	97081	5213.00	1	1	1	1	5.0
30APR97	MOB	Plate	97082	1300.00	5	1	1	5	8.2
30APR97	MOB	Plate	97082	3401.10	1	1	1	1	9.4
30APR97	MOB	Plate	97082	4200.00	65	1	1	65	7.5
30APR97	MOB	Plate	97082	4242.00	1	1	1	1	7.7
30APR97	MOB	Plate	97082	4800.05	1	1	1	1	8.7
30APR97	MOB	Plate	97082	4908.00	3	1	1	3	6.6
30APR97	MOB	Plate	97082	5209.00	1	1	1	1	8.4
30APR97	MOB	Plate	97082	5213.00	3	1	1	3	5.0
30APR97	MOB	Plate	97083	1300.00	1	1	1	1	8.2
30APR97	MOB	Plate	97083	3402.00	1	1	1	1	6.0
30APR97	MOB	Plate	97083	4101.50	1	1	1	1	6.4
30APR97	MOB	Plate	97083	4800.05	1	1	1	1	8.7
30APR97	MOB	Plate	97083	5109.00	2	1	1	2	7.4
30APR97	MOB	Plate	97083	5200.10	2	1	1	2	.
30APR97	MOB	Plate	97083	5201.40	2	1	1	2	4.8
30APR97	MOB	Ponar	97084	1300.00	6	1	1	6	8.2

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
30APR97	MOB	Ponar	97084	3401.10	3	1	1	3	9.4
30APR97	MOB	Ponar	97084	4101.50	1	1	1	1	6.4
30APR97	MOB	Ponar	97084	4200.00	14	1	1	14	7.5
30APR97	MOB	Ponar	97084	4203.10	1	1	1	1	6.0
30APR97	MOB	Ponar	97084	5107.00	2	1	1	2	7.7
30APR97	MOB	Ponar	97084	5109.00	3	1	1	3	7.4
30APR97	MOB	Ponar	97084	5200.10	2	1	1	2	.
30APR97	MOB	Ponar	97084	5201.40	1	1	1	1	4.8
30APR97	MOB	Ponar	97084	5211.50	1	1	1	1	9.1
30APR97	MOB	Ponar	97084	9002.00	1	1	1	1	.
30APR97	MOB	Ponar	97085	1300.00	8	1	1	8	8.2
30APR97	MOB	Ponar	97085	4200.00	13	1	1	13	7.5
30APR97	MOB	Ponar	97085	5213.00	1	1	1	1	5.0
30APR97	MOB	Ponar	97086	1300.00	5	1	1	5	8.2
30APR97	MOB	Ponar	97086	4200.00	5	1	1	5	7.5
30APR97	MOB	Ponar	97086	5100.50	1	1	1	1	.
30APR97	MOB	Ponar	97086	5105.00	3	1	1	3	6.8
30APR97	MOB	Ponar	97086	5107.00	1	1	1	1	7.7
30APR97	MOB	Ponar	97086	5109.00	1	1	1	1	7.4
30APR97	MOB	Ponar	97086	5213.00	1	1	1	1	5.0
30APR97	MOB	Ponar	97087	1200.00	1	1	1	1	8.0
30APR97	MOB	Ponar	97087	1300.00	4	1	1	4	8.2
30APR97	MOB	Ponar	97087	3401.10	3	1	1	3	9.4
30APR97	MOB	Ponar	97087	4101.50	5	1	1	5	6.4
30APR97	MOB	Ponar	97087	4102.10	7	1	1	7	5.4
30APR97	MOB	Ponar	97087	4200.00	10	1	1	10	7.5
30APR97	MOB	Ponar	97087	4800.20	2	1	1	2	8.7
30APR97	MOB	Ponar	97087	5109.00	21	1	1	21	7.4
30APR97	MOB	Ponar	97087	5201.40	16	1	1	16	4.8
30APR97	MOB	Ponar	97087	5209.00	1	1	1	1	8.4
30APR97	MOB	Ponar	97087	5209.10	1	1	1	1	.
30APR97	MOB	Ponar	97087	5211.50	1	1	1	1	9.1
30APR97	MOB	Ponar	97087	5213.00	5	1	1	5	5.0
30APR97	MOB	Ponar	97087	8001.00	3	1	1	3	.
30APR97	MOB	Ponar	97088	1200.00	1	1	1	1	8.0
30APR97	MOB	Ponar	97088	1300.00	3	1	1	3	8.2
30APR97	MOB	Ponar	97088	3104.00	1	1	1	1	7.9
30APR97	MOB	Ponar	97088	3401.10	3	1	1	3	9.4
30APR97	MOB	Ponar	97088	4101.50	1	1	1	1	6.4
30APR97	MOB	Ponar	97088	4102.10	13	1	1	13	5.4
30APR97	MOB	Ponar	97088	4104.00	1	1	1	1	6.9
30APR97	MOB	Ponar	97088	4200.00	38	1	1	38	7.5
30APR97	MOB	Ponar	97088	4200.00	1	1	1	1	7.5
30APR97	MOB	Ponar	97088	4908.00	8	1	1	8	6.6
30APR97	MOB	Ponar	97088	4951.00	1	1	1	1	5.6
30APR97	MOB	Ponar	97088	5201.40	4	1	1	4	4.8
30APR97	MOB	Ponar	97088	5211.50	4	1	1	4	9.1
30APR97	MOB	Ponar	97088	5212.05	2	1	1	2	.
30APR97	MOB	Ponar	97088	5212.10	1	1	1	1	.
30APR97	MOB	Ponar	97088	5213.00	19	1	1	19	5.0
05MAY97	OHD3	Plate	97089	1300.00	10	1	1	10	8.2
05MAY97	OHD3	Plate	97089	3103.00	3	1	1	3	6.9
05MAY97	OHD3	Plate	97089	3103.20	24	1	1	24	7.5
05MAY97	OHD3	Plate	97089	3401.10	2	1	1	2	9.4

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
05MAY97	OHD3	Plate	97089	4101.50	14	1	1	14	6.4
05MAY97	OHD3	Plate	97089	4102.10	17	1	1	17	5.4
05MAY97	OHD3	Plate	97089	4200.00	69	1	1	69	7.5
05MAY97	OHD3	Plate	97089	4203.10	1	1	1	1	6.0
05MAY97	OHD3	Plate	97089	4237.00	1	1	1	1	4.4
05MAY97	OHD3	Plate	97089	4302.00	5	1	1	5	7.6
05MAY97	OHD3	Plate	97089	5107.00	16	1	1	16	7.7
05MAY97	OHD3	Plate	97089	5109.00	33	1	1	33	7.4
05MAY97	OHD3	Plate	97089	5201.40	1	1	1	1	4.8
05MAY97	OHD3	Plate	97089	5209.00	2	1	1	2	8.4
05MAY97	OHD3	Plate	97090	1300.00	7	1	1	7	8.2
05MAY97	OHD3	Plate	97090	3103.00	3	1	1	3	6.9
05MAY97	OHD3	Plate	97090	3103.20	29	1	1	29	7.5
05MAY97	OHD3	Plate	97090	3401.10	2	1	1	2	9.4
05MAY97	OHD3	Plate	97090	4101.50	7	1	1	7	6.4
05MAY97	OHD3	Plate	97090	4102.10	14	1	1	14	5.4
05MAY97	OHD3	Plate	97090	4200.00	126	1	1	126	7.5
05MAY97	OHD3	Plate	97090	4200.00	1	1	1	1	7.5
05MAY97	OHD3	Plate	97090	4302.00	23	1	1	23	7.6
05MAY97	OHD3	Plate	97090	4800.05	1	1	1	1	8.7
05MAY97	OHD3	Plate	97090	4908.00	56	1	1	56	6.6
05MAY97	OHD3	Plate	97090	9003.00	2	1	1	2	5.7
05MAY97	OHD3	Plate	97091	1300.00	52	1	1	52	8.2
05MAY97	OHD3	Plate	97091	3103.00	1	1	1	1	6.9
05MAY97	OHD3	Plate	97091	3103.20	10	1	1	10	7.5
05MAY97	OHD3	Plate	97091	4101.50	8	1	1	8	6.4
05MAY97	OHD3	Plate	97091	4102.10	41	1	1	41	5.4
05MAY97	OHD3	Plate	97091	4200.00	50	1	1	50	7.5
05MAY97	OHD3	Plate	97091	4908.00	2	1	1	2	6.6
05MAY97	OHD3	Plate	97091	5109.00	20	1	1	20	7.4
05MAY97	OHD3	Ponar	97092	1300.00	7	1	1	7	8.2
05MAY97	OHD3	Ponar	97092	3103.20	2	1	1	2	7.5
05MAY97	OHD3	Ponar	97092	4200.00	20	1	1	20	7.5
05MAY97	OHD3	Ponar	97092	5107.00	1	1	1	1	7.7
05MAY97	OHD3	Ponar	97092	5109.00	4	1	1	4	7.4
05MAY97	OHD3	Ponar	97093	3103.00	4	1	1	4	6.9
05MAY97	OHD3	Ponar	97093	3103.20	9	1	1	9	7.5
05MAY97	OHD3	Ponar	97093	4102.10	6	1	1	6	5.4
05MAY97	OHD3	Ponar	97093	4200.00	23	1	1	23	7.5
05MAY97	OHD3	Ponar	97093	4302.00	3	1	1	3	7.6
05MAY97	OHD3	Ponar	97093	4908.00	1	1	1	1	6.6
05MAY97	OHD3	Ponar	97093	5103.20	1	1	1	1	7.7
05MAY97	OHD3	Ponar	97093	5107.00	1	1	1	1	7.7
05MAY97	OHD3	Ponar	97093	5109.00	10	1	1	10	7.4
05MAY97	OHD3	Ponar	97094	1300.00	3	1	1	3	8.2
05MAY97	OHD3	Ponar	97094	3103.20	8	1	1	8	7.5
05MAY97	OHD3	Ponar	97094	4102.10	2	1	1	2	5.4
05MAY97	OHD3	Ponar	97094	4200.00	21	1	1	21	7.5
05MAY97	OHD3	Ponar	97094	5105.00	2	1	1	2	6.8
05MAY97	OHD3	Ponar	97094	5107.00	2	1	1	2	7.7
05MAY97	OHD3	Ponar	97094	5109.00	3	1	1	3	7.4
05MAY97	OHD3	Ponar	97094	5203.00	2	1	1	2	6.0
05MAY97	OHD3	Ponar	97095	1300.00	7	1	1	7	8.2
05MAY97	OHD3	Ponar	97095	3103.00	3	1	1	3	6.9

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
05MAY97	OHD3	Ponar	97095	3103.20	33	1	1	33	7.5
05MAY97	OHD3	Ponar	97095	4101.50	1	1	1	1	6.4
05MAY97	OHD3	Ponar	97095	4102.10	6	1	1	6	5.4
05MAY97	OHD3	Ponar	97095	4200.00	63	1	1	63	7.5
05MAY97	OHD3	Ponar	97095	4302.00	6	1	1	6	7.6
05MAY97	OHD3	Ponar	97095	4802.00	1	1	1	1	9.4
05MAY97	OHD3	Ponar	97095	4908.00	1	1	1	1	6.6
05MAY97	OHD3	Ponar	97095	5103.20	3	1	1	3	7.7
05MAY97	OHD3	Ponar	97095	5109.00	3	1	1	3	7.4
05MAY97	OHD3	Ponar	97095	5211.50	1	1	1	1	9.1
05MAY97	OHD3	Ponar	97095	9002.00	1	1	1	1	.
05MAY97	OHD3	Ponar	97096	1300.00	3	1	1	3	8.2
05MAY97	OHD3	Ponar	97096	3103.00	3	1	1	3	6.9
05MAY97	OHD3	Ponar	97096	3103.20	29	1	1	29	7.5
05MAY97	OHD3	Ponar	97096	4101.50	1	1	1	1	6.4
05MAY97	OHD3	Ponar	97096	4102.10	3	1	1	3	5.4
05MAY97	OHD3	Ponar	97096	4200.00	78	1	1	78	7.5
05MAY97	OHD3	Ponar	97096	4203.10	1	1	1	1	6.0
05MAY97	OHD3	Ponar	97096	4302.00	5	1	1	5	7.6
05MAY97	OHD3	Ponar	97096	4908.00	3	1	1	3	6.6
05MAY97	OHD3	Ponar	97096	5105.00	1	1	1	1	6.8
05MAY97	OHD3	Ponar	97096	5107.00	2	1	1	2	7.7
05MAY97	OHD3	Ponar	97096	5109.00	7	1	1	7	7.4
05MAY97	OHD3	Ponar	97096	5209.00	1	1	1	1	8.4
05MAY97	OHD2	Plate	97097	1200.00	1	1	1	1	8.0
05MAY97	OHD2	Plate	97097	1300.00	4	1	1	4	8.2
05MAY97	OHD2	Plate	97097	3103.20	3	1	1	3	7.5
05MAY97	OHD2	Plate	97097	3303.10	1	1	1	1	8.1
05MAY97	OHD2	Plate	97097	3402.00	83	1	1	83	6.0
05MAY97	OHD2	Plate	97097	4101.50	1	1	1	1	6.4
05MAY97	OHD2	Plate	97097	4200.00	178	1	1	178	7.5
05MAY97	OHD2	Plate	97097	4200.00	4	1	1	4	7.5
05MAY97	OHD2	Plate	97097	4302.00	5	1	1	5	7.6
05MAY97	OHD2	Plate	97097	4800.20	1	1	1	1	8.7
05MAY97	OHD2	Plate	97097	5201.40	1	1	1	1	4.8
05MAY97	OHD2	Plate	97097	5203.00	1	1	1	1	6.0
05MAY97	OHD2	Plate	97097	9002.00	1	1	1	1	.
05MAY97	OHD2	Plate	97098	1200.00	4	1	1	4	8.0
05MAY97	OHD2	Plate	97098	1300.00	11	1	1	11	8.2
05MAY97	OHD2	Plate	97098	3103.00	1	1	1	1	6.9
05MAY97	OHD2	Plate	97098	3103.20	15	1	1	15	7.5
05MAY97	OHD2	Plate	97098	3303.00	1	1	1	1	9.5
05MAY97	OHD2	Plate	97098	3401.10	1	1	1	1	9.4
05MAY97	OHD2	Plate	97098	3402.00	87	1	1	87	6.0
05MAY97	OHD2	Plate	97098	4101.50	1	1	1	1	6.4
05MAY97	OHD2	Plate	97098	4102.10	12	1	1	12	5.4
05MAY97	OHD2	Plate	97098	4200.00	128	1	1	128	7.5
05MAY97	OHD2	Plate	97098	4200.00	3	1	1	3	7.5
05MAY97	OHD2	Plate	97098	4302.00	1	1	1	1	7.6
05MAY97	OHD2	Plate	97098	5109.00	1	1	1	1	7.4
05MAY97	OHD2	Plate	97098	9002.00	3	1	1	3	.
05MAY97	OHD2	Plate	97098	9003.00	1	1	1	1	5.7
05MAY97	OHD2	Plate	97099	1200.00	1	1	1	1	8.0
05MAY97	OHD2	Plate	97099	1300.00	21	1	1	21	8.2

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
05MAY97	OHD2	Plate	97099	3103.00	2	1	1	2	6.9
05MAY97	OHD2	Plate	97099	3103.20	11	1	1	11	7.5
05MAY97	OHD2	Plate	97099	3104.00	1	1	1	1	7.9
05MAY97	OHD2	Plate	97099	3401.10	2	1	1	2	9.4
05MAY97	OHD2	Plate	97099	3402.00	176	1	1	176	6.0
05MAY97	OHD2	Plate	97099	4101.50	1	1	1	1	6.4
05MAY97	OHD2	Plate	97099	4102.10	4	1	1	4	5.4
05MAY97	OHD2	Plate	97099	4200.00	276	1	1	276	7.5
05MAY97	OHD2	Plate	97099	4200.00	2	1	1	2	7.5
05MAY97	OHD2	Plate	97099	4203.10	1	1	1	1	6.0
05MAY97	OHD2	Plate	97099	4302.00	9	1	1	9	7.6
05MAY97	OHD2	Plate	97099	4800.20	1	1	1	1	8.7
05MAY97	OHD2	Plate	97099	5100.50	1	1	1	1	.
05MAY97	OHD2	Plate	97099	5201.40	2	1	1	2	4.8
05MAY97	OHD2	Plate	97099	5209.00	1	1	1	1	8.4
05MAY97	OHD2	Ponar	97100	1300.00	40	1	1	40	8.2
05MAY97	OHD2	Ponar	97100	3103.20	3	1	1	3	7.5
05MAY97	OHD2	Ponar	97100	3401.10	3	1	1	3	9.4
05MAY97	OHD2	Ponar	97100	3402.00	1	1	1	1	6.0
05MAY97	OHD2	Ponar	97100	4200.00	15	1	1	15	7.5
05MAY97	OHD2	Ponar	97100	4200.00	2	1	1	2	7.5
05MAY97	OHD2	Ponar	97100	5109.00	95	1	1	95	7.4
05MAY97	OHD2	Ponar	97100	5203.00	4	1	1	4	6.0
05MAY97	OHD2	Ponar	97100	5208.00	1	1	1	1	4.0
05MAY97	OHD2	Ponar	97100	5209.00	1	1	1	1	8.4
05MAY97	OHD2	Ponar	97100	9002.00	16	1	1	16	.
05MAY97	OHD2	Ponar	97100	9004.00	22	1	1	22	.
05MAY97	OHD2	Ponar	97100	9005.00	1	1	1	1	.
05MAY97	OHD2	Ponar	97100	9006.00	1	1	1	1	.
05MAY97	OHD2	Ponar	97101	1300.00	61	1	2	122	8.2
05MAY97	OHD2	Ponar	97101	3103.20	4	1	2	8	7.5
05MAY97	OHD2	Ponar	97101	3402.00	2	1	2	4	6.0
05MAY97	OHD2	Ponar	97101	4200.00	9	1	2	18	7.5
05MAY97	OHD2	Ponar	97101	5109.00	3	1	2	6	7.4
05MAY97	OHD2	Ponar	97101	5201.40	1	1	2	2	4.8
05MAY97	OHD2	Ponar	97101	9002.00	3	1	2	6	.
05MAY97	OHD2	Ponar	97101	9004.00	12	1	2	24	.
05MAY97	OHD2	Ponar	97102	1300.00	77	1	1	77	8.2
05MAY97	OHD2	Ponar	97102	3103.20	1	1	1	1	7.5
05MAY97	OHD2	Ponar	97102	4200.00	7	1	1	7	7.5
05MAY97	OHD2	Ponar	97102	5105.00	2	1	1	2	6.8
05MAY97	OHD2	Ponar	97102	5107.00	3	1	1	3	7.7
05MAY97	OHD2	Ponar	97102	5109.00	25	1	1	25	7.4
05MAY97	OHD2	Ponar	97102	5201.40	2	1	1	2	4.8
05MAY97	OHD2	Ponar	97102	5203.00	1	1	1	1	6.0
05MAY97	OHD2	Ponar	97102	9004.00	104	1	1	104	.
05MAY97	OHD2	Ponar	97103	1300.00	31	1	2	62	8.2
05MAY97	OHD2	Ponar	97103	4200.00	17	1	2	34	7.5
05MAY97	OHD2	Ponar	97103	5109.00	43	1	2	86	7.4
05MAY97	OHD2	Ponar	97103	5201.40	1	1	2	2	4.8
05MAY97	OHD2	Ponar	97103	5203.00	2	1	2	4	6.0
05MAY97	OHD2	Ponar	97103	9002.00	2	1	2	4	.
05MAY97	OHD2	Ponar	97103	9004.00	44	1	2	88	.
05MAY97	OHD2	Ponar	97104	1300.00	43	1	1	43	8.2

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
05MAY97	OHD2	Ponar	97104	3103.20	3	1	1	3	7.5
05MAY97	OHD2	Ponar	97104	3108.00	1	1	1	1	.
05MAY97	OHD2	Ponar	97104	3402.00	1	1	1	1	6.0
05MAY97	OHD2	Ponar	97104	4200.00	12	1	1	12	7.5
05MAY97	OHD2	Ponar	97104	5109.00	11	1	1	11	7.4
05MAY97	OHD2	Ponar	97104	9002.00	3	1	1	3	.
05MAY97	OHD2	Ponar	97104	9004.00	33	1	1	33	.
05MAY97	OHD	Plate	97105	1300.00	66	1	1	66	8.2
05MAY97	OHD	Plate	97105	3401.10	2	1	1	2	9.4
05MAY97	OHD	Plate	97105	3402.00	105	1	1	105	6.0
05MAY97	OHD	Plate	97105	4102.10	1	1	1	1	5.4
05MAY97	OHD	Plate	97105	4200.00	27	1	1	27	7.5
05MAY97	OHD	Plate	97105	4800.05	1	1	1	1	8.7
05MAY97	OHD	Plate	97105	5204.10	8	1	1	8	6.9
05MAY97	OHD	Plate	97105	8504.00	1	1	1	1	.
05MAY97	OHD	Plate	97105	9002.00	1	1	1	1	.
05MAY97	OHD	Plate	97106	1300.00	14	1	1	14	8.2
05MAY97	OHD	Plate	97106	3103.20	3	1	1	3	7.5
05MAY97	OHD	Plate	97106	3108.10	1	1	1	1	.
05MAY97	OHD	Plate	97106	3402.00	41	1	1	41	6.0
05MAY97	OHD	Plate	97106	4101.50	1	1	1	1	6.4
05MAY97	OHD	Plate	97106	4102.10	1	1	1	1	5.4
05MAY97	OHD	Plate	97106	4103.00	1	1	1	1	8.9
05MAY97	OHD	Plate	97106	4200.00	117	1	1	117	7.5
05MAY97	OHD	Plate	97106	4200.10	1	1	1	1	6.4
05MAY97	OHD	Plate	97106	4302.00	8	1	1	8	7.6
05MAY97	OHD	Plate	97106	4908.00	1	1	1	1	6.6
05MAY97	OHD	Plate	97106	9002.00	1	1	1	1	.
05MAY97	OHD	Plate	97107	1300.00	13	1	1	13	8.2
05MAY97	OHD	Plate	97107	3100.00	2	1	1	2	.
05MAY97	OHD	Plate	97107	3103.00	1	1	1	1	6.9
05MAY97	OHD	Plate	97107	3103.20	18	1	1	18	7.5
05MAY97	OHD	Plate	97107	3402.00	36	1	1	36	6.0
05MAY97	OHD	Plate	97107	4200.00	97	1	1	97	7.5
05MAY97	OHD	Plate	97107	4200.00	1	1	1	1	7.5
05MAY97	OHD	Plate	97107	4302.00	6	1	1	6	7.6
05MAY97	OHD	Plate	97107	9002.00	15	1	1	15	.
05MAY97	OHD	Plate	97107	9004.00	1	1	1	1	.
05MAY97	OHD	Ponar	97108	1300.00	25	1	1	25	8.2
05MAY97	OHD	Ponar	97108	4200.00	4	1	1	4	7.5
05MAY97	OHD	Ponar	97108	9002.00	3	1	1	3	.
05MAY97	OHD	Ponar	97108	9003.00	1	1	1	1	5.7
05MAY97	OHD	Ponar	97109	1300.00	18	1	1	18	8.2
05MAY97	OHD	Ponar	97109	5105.00	1	1	1	1	6.8
05MAY97	OHD	Ponar	97109	5107.00	1	1	1	1	7.7
05MAY97	OHD	Ponar	97109	8504.00	1	1	1	1	.
05MAY97	OHD	Ponar	97110	1300.00	7	1	1	7	8.2
05MAY97	OHD	Ponar	97110	4200.00	1	1	1	1	7.5
05MAY97	OHD	Ponar	97111	1300.00	24	1	1	24	8.2
05MAY97	OHD	Ponar	97111	5105.00	1	1	1	1	6.8
05MAY97	OHD	Ponar	97111	9002.00	1	1	1	1	.
05MAY97	OHD	Ponar	97112	1300.00	15	1	1	15	8.2
05MAY97	OHD	Ponar	97112	4100.10	1	1	1	1	5.7
05MAY97	OHD	Ponar	97112	4101.50	3	1	1	3	6.4

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
05MAY97	OHD	Ponar	97112	4102.10	6	1	1	6	5.4
05MAY97	OHD	Ponar	97112	4200.00	6	1	1	6	7.5
05MAY97	OHD	Ponar	97112	4302.00	2	1	1	2	7.6
05MAY97	OHD	Ponar	97112	8504.00	1	1	1	1	.
05MAY97	OHD	Ponar	97112	9004.00	1	1	1	1	.
05MAY97	MOB2	Plate	97113	1200.00	1	1	1	1	8.0
05MAY97	MOB2	Plate	97113	1300.00	7	1	1	7	8.2
05MAY97	MOB2	Plate	97113	4101.50	2	1	1	2	6.4
05MAY97	MOB2	Plate	97113	4200.00	81	1	1	81	7.5
05MAY97	MOB2	Plate	97113	4203.10	9	1	1	9	6.0
05MAY97	MOB2	Plate	97113	4302.00	4	1	1	4	7.6
05MAY97	MOB2	Plate	97113	4800.05	3	1	1	3	8.7
05MAY97	MOB2	Plate	97113	4800.20	1	1	1	1	8.7
05MAY97	MOB2	Plate	97113	5201.40	2	1	1	2	4.8
05MAY97	MOB2	Plate	97113	5204.00	1	1	1	1	6.9
05MAY97	MOB2	Plate	97113	5211.50	2	1	1	2	9.1
05MAY97	MOB2	Plate	97114	1300.00	5	1	1	5	8.2
05MAY97	MOB2	Plate	97114	3104.00	1	1	1	1	7.9
05MAY97	MOB2	Plate	97114	4102.10	19	1	1	19	5.4
05MAY97	MOB2	Plate	97114	4200.00	161	1	1	161	7.5
05MAY97	MOB2	Plate	97114	4200.00	1	1	1	1	7.5
05MAY97	MOB2	Plate	97114	4203.10	1	1	1	1	6.0
05MAY97	MOB2	Plate	97114	4216.40	1	1	1	1	8.1
05MAY97	MOB2	Plate	97114	4302.00	2	1	1	2	7.6
05MAY97	MOB2	Plate	97114	4800.05	1	1	1	1	8.7
05MAY97	MOB2	Plate	97114	4905.20	22	1	1	22	5.7
05MAY97	MOB2	Plate	97114	4908.00	46	1	1	46	6.6
05MAY97	MOB2	Plate	97114	5201.40	2	1	1	2	4.8
05MAY97	MOB2	Plate	97115	1300.00	12	1	1	12	8.2
05MAY97	MOB2	Plate	97115	4101.50	5	1	1	5	6.4
05MAY97	MOB2	Plate	97115	4102.10	23	1	1	23	5.4
05MAY97	MOB2	Plate	97115	4200.00	130	1	1	130	7.5
05MAY97	MOB2	Plate	97115	4200.00	3	1	1	3	7.5
05MAY97	MOB2	Plate	97115	4203.10	2	1	1	2	6.0
05MAY97	MOB2	Plate	97115	4203.20	1	1	1	1	6.0
05MAY97	MOB2	Plate	97115	4302.00	4	1	1	4	7.6
05MAY97	MOB2	Plate	97115	4701.00	1	1	1	1	9.8
05MAY97	MOB2	Plate	97115	4800.05	1	1	1	1	8.7
05MAY97	MOB2	Plate	97115	4908.00	14	1	1	14	6.6
05MAY97	MOB2	Plate	97115	4951.00	1	1	1	1	5.6
05MAY97	MOB2	Plate	97115	5109.00	2	1	1	2	7.4
05MAY97	MOB2	Plate	97115	5200.10	1	1	1	1	.
05MAY97	MOB2	Plate	97115	5201.40	4	1	1	4	4.8
05MAY97	MOB2	Plate	97115	6001.00	1	1	1	1	.
05MAY97	MOB2	Plate	97115	9002.00	1	1	1	1	.
05MAY97	MOB2	Ponar	97116	1300.00	40	1	1	40	8.2
05MAY97	MOB2	Ponar	97116	4101.50	3	1	1	3	6.4
05MAY97	MOB2	Ponar	97116	4102.10	3	1	1	3	5.4
05MAY97	MOB2	Ponar	97116	4200.00	70	1	1	70	7.5
05MAY97	MOB2	Ponar	97116	4203.10	1	1	1	1	6.0
05MAY97	MOB2	Ponar	97116	4216.40	3	1	1	3	8.1
05MAY97	MOB2	Ponar	97116	4302.00	8	1	1	8	7.6
05MAY97	MOB2	Ponar	97116	4803.00	1	1	1	1	6.9
05MAY97	MOB2	Ponar	97116	5109.00	2	1	1	2	7.4

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
05MAY97	MOB2	Ponar	97116	5110.00	1	1	1	1	.
05MAY97	MOB2	Ponar	97116	5201.40	4	1	1	4	4.8
05MAY97	MOB2	Ponar	97116	5211.50	2	1	1	2	9.1
05MAY97	MOB2	Ponar	97116	9002.00	6	1	1	6	.
05MAY97	MOB2	Ponar	97117	1300.00	49	1	1	49	8.2
05MAY97	MOB2	Ponar	97117	3402.00	3	1	1	3	6.0
05MAY97	MOB2	Ponar	97117	4101.50	1	1	1	1	6.4
05MAY97	MOB2	Ponar	97117	4102.10	1	1	1	1	5.4
05MAY97	MOB2	Ponar	97117	4200.00	24	1	1	24	7.5
05MAY97	MOB2	Ponar	97117	4200.00	1	1	1	1	7.5
05MAY97	MOB2	Ponar	97117	5109.00	18	1	1	18	7.4
05MAY97	MOB2	Ponar	97117	5201.40	1	1	1	1	4.8
05MAY97	MOB2	Ponar	97117	5209.00	1	1	1	1	8.4
05MAY97	MOB2	Ponar	97117	6001.00	1	1	1	1	.
05MAY97	MOB2	Ponar	97118	1300.00	3	1	1	3	8.2
05MAY97	MOB2	Ponar	97118	4101.50	1	1	1	1	6.4
05MAY97	MOB2	Ponar	97118	4102.10	7	1	1	7	5.4
05MAY97	MOB2	Ponar	97118	4200.00	45	1	1	45	7.5
05MAY97	MOB2	Ponar	97118	4216.40	1	1	1	1	8.1
05MAY97	MOB2	Ponar	97118	4908.00	1	1	1	1	6.6
05MAY97	MOB2	Ponar	97118	5109.00	4	1	1	4	7.4
05MAY97	MOB2	Ponar	97118	5211.50	4	1	1	4	9.1
05MAY97	MOB2	Ponar	97118	5215.10	1	1	1	1	7.2
05MAY97	MOB2	Ponar	97118	8001.00	1	1	1	1	.
05MAY97	MOB2	Ponar	97118	9004.00	1	1	1	1	.
05MAY97	MOB2	Ponar	97119	1300.00	16	1	1	16	8.2
05MAY97	MOB2	Ponar	97119	4200.00	2	1	1	2	7.5
05MAY97	MOB2	Ponar	97119	5109.00	1	1	1	1	7.4
05MAY97	MOB2	Ponar	97120	1300.00	3	1	1	3	8.2
05MAY97	MOB2	Ponar	97120	3402.00	4	1	1	4	6.0
05MAY97	MOB2	Ponar	97120	5107.00	1	1	1	1	7.7
05MAY97	MOB2	Ponar	97120	5109.00	2	1	1	2	7.4
05MAY97	MOB2	Ponar	97120	5201.40	3	1	1	3	4.8
05MAY97	TOC	Plate	97121	1300.00	3	1	4	12	8.2
05MAY97	TOC	Plate	97121	4200.00	19	1	4	76	7.5
05MAY97	TOC	Plate	97121	4200.00	1	1	4	4	7.5
05MAY97	TOC	Plate	97121	4203.10	3	1	4	12	6.0
05MAY97	TOC	Plate	97121	4302.00	90	1	4	360	7.6
05MAY97	TOC	Plate	97121	4304.30	6	1	4	24	7.1
05MAY97	TOC	Plate	97121	5201.40	19	1	4	76	4.8
05MAY97	TOC	Plate	97121	5203.00	2	1	4	8	6.0
05MAY97	TOC	Plate	97121	5209.00	1	1	4	4	8.4
05MAY97	TOC	Plate	97122	1200.00	1	1	2	2	8.0
05MAY97	TOC	Plate	97122	4105.00	1	1	2	2	5.5
05MAY97	TOC	Plate	97122	4200.00	28	1	2	56	7.5
05MAY97	TOC	Plate	97122	4200.00	1	1	2	2	7.5
05MAY97	TOC	Plate	97122	4300.00	1	1	2	2	2.7
05MAY97	TOC	Plate	97122	4302.00	61	1	2	122	7.6
05MAY97	TOC	Plate	97122	4304.30	17	1	2	34	7.1
05MAY97	TOC	Plate	97122	5201.40	19	1	2	38	4.8
05MAY97	TOC	Plate	97122	5203.00	1	1	2	2	6.0
05MAY97	TOC	Plate	97122	5211.50	8	1	2	16	9.1
05MAY97	TOC	Plate	97122	9002.00	1	1	2	2	.
05MAY97	TOC	Plate	97123	3401.10	3	1	1	3	9.4

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
05MAY97	TOC	Plate	97123	4200.00	28	1	1	28	7.5
05MAY97	TOC	Plate	97123	4200.00	1	1	1	1	7.5
05MAY97	TOC	Plate	97123	4302.00	108	1	1	108	7.6
05MAY97	TOC	Plate	97123	4304.30	18	1	1	18	7.1
05MAY97	TOC	Plate	97123	5201.40	50	1	1	50	4.8
05MAY97	TOC	Plate	97123	5203.00	1	1	1	1	6.0
05MAY97	TOC	Plate	97123	5207.50	1	1	1	1	.
05MAY97	TOC	Plate	97123	5208.00	1	1	1	1	4.0
05MAY97	TOC	Plate	97123	5209.00	2	1	1	2	8.4
05MAY97	TOC	Plate	97123	9002.00	1	1	1	1	.
05MAY97	TOC	Plate	97123	9003.00	1	1	1	1	5.7
05MAY97	TOC	Ponar	97124	1200.00	1	1	1	1	8.0
05MAY97	TOC	Ponar	97124	1300.00	8	1	1	8	8.2
05MAY97	TOC	Ponar	97124	3104.00	1	1	1	1	7.9
05MAY97	TOC	Ponar	97124	4102.10	1	1	1	1	5.4
05MAY97	TOC	Ponar	97124	4200.00	23	1	1	23	7.5
05MAY97	TOC	Ponar	97124	4302.00	7	1	1	7	7.6
05MAY97	TOC	Ponar	97124	4304.30	1	1	1	1	7.1
05MAY97	TOC	Ponar	97124	4409.00	1	1	1	1	.
05MAY97	TOC	Ponar	97124	4905.20	2	1	1	2	5.7
05MAY97	TOC	Ponar	97124	5109.00	2	1	1	2	7.4
05MAY97	TOC	Ponar	97124	5201.40	7	1	1	7	4.8
05MAY97	TOC	Ponar	97124	5203.00	2	1	1	2	6.0
05MAY97	TOC	Ponar	97124	5209.00	1	1	1	1	8.4
05MAY97	TOC	Ponar	97124	5212.00	1	1	1	1	5.0
05MAY97	TOC	Ponar	97125	1200.00	19	1	1	19	8.0
05MAY97	TOC	Ponar	97125	3104.00	6	1	1	6	7.9
05MAY97	TOC	Ponar	97125	3401.10	14	1	1	14	9.4
05MAY97	TOC	Ponar	97125	4200.00	17	1	1	17	7.5
05MAY97	TOC	Ponar	97125	4246.00	1	1	1	1	6.0
05MAY97	TOC	Ponar	97125	4302.00	5	1	1	5	7.6
05MAY97	TOC	Ponar	97125	5109.00	39	1	1	39	7.4
05MAY97	TOC	Ponar	97125	5201.40	24	1	1	24	4.8
05MAY97	TOC	Ponar	97125	5203.00	8	1	1	8	6.0
05MAY97	TOC	Ponar	97125	5209.10	11	1	1	11	.
05MAY97	TOC	Ponar	97125	5212.00	1	1	1	1	5.0
05MAY97	TOC	Ponar	97125	9002.00	9	1	1	9	.
05MAY97	TOC	Ponar	97126	1300.00	6	1	1	6	8.2
05MAY97	TOC	Ponar	97126	3302.00	1	1	1	1	6.7
05MAY97	TOC	Ponar	97126	3401.10	2	1	1	2	9.4
05MAY97	TOC	Ponar	97126	4200.00	10	1	1	10	7.5
05MAY97	TOC	Ponar	97126	4302.00	6	1	1	6	7.6
05MAY97	TOC	Ponar	97126	5105.00	1	1	1	1	6.8
05MAY97	TOC	Ponar	97126	5109.00	1	1	1	1	7.4
05MAY97	TOC	Ponar	97126	5201.40	26	1	1	26	4.8
05MAY97	TOC	Ponar	97126	5203.00	3	1	1	3	6.0
05MAY97	TOC	Ponar	97126	5209.10	3	1	1	3	.
05MAY97	TOC	Ponar	97126	9002.00	3	1	1	3	.
05MAY97	TOC	Ponar	97127	1300.00	7	1	1	7	8.2
05MAY97	TOC	Ponar	97127	3104.00	3	1	1	3	7.9
05MAY97	TOC	Ponar	97127	3401.10	2	1	1	2	9.4
05MAY97	TOC	Ponar	97127	4200.00	7	1	1	7	7.5
05MAY97	TOC	Ponar	97127	4302.00	5	1	1	5	7.6
05MAY97	TOC	Ponar	97127	4304.30	4	1	1	4	7.1

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
05MAY97	TOC	Ponar	97127	4602.10	1	1	1	1	.
05MAY97	TOC	Ponar	97127	4905.20	2	1	1	2	5.7
05MAY97	TOC	Ponar	97127	5101.00	3	1	1	3	6.3
05MAY97	TOC	Ponar	97127	5201.40	122	1	1	122	4.8
05MAY97	TOC	Ponar	97127	5203.00	13	1	1	13	6.0
05MAY97	TOC	Ponar	97127	5208.00	2	1	1	2	4.0
05MAY97	TOC	Ponar	97127	5209.00	1	1	1	1	8.4
05MAY97	TOC	Ponar	97127	5212.00	1	1	1	1	5.0
05MAY97	TOC	Ponar	97127	5212.10	2	1	1	2	.
05MAY97	TOC	Ponar	97127	9002.00	5	1	1	5	.
05MAY97	TOC	Ponar	97127	9003.00	1	1	1	1	5.7
05MAY97	TOC	Ponar	97128	1300.00	1	1	1	1	8.2
05MAY97	TOC	Ponar	97128	3104.00	1	1	1	1	7.9
05MAY97	TOC	Ponar	97128	4200.00	1	1	1	1	7.5
05MAY97	TOC	Ponar	97128	4302.00	6	1	1	6	7.6
05MAY97	TOC	Ponar	97128	4803.00	1	1	1	1	6.9
05MAY97	TOC	Ponar	97128	5100.50	1	1	1	1	.
05MAY97	TOC	Ponar	97128	5109.00	7	1	1	7	7.4
05MAY97	TOC	Ponar	97128	5201.40	17	1	1	17	4.8
05MAY97	TOC	Ponar	97128	5207.50	1	1	1	1	.
05MAY97	TOC	Ponar	97128	9002.00	2	1	1	2	.
05MAY97	TOC	Ponar	97128	9003.00	1	1	1	1	5.7
05MAY97	TOC	Ponar	97128	9004.00	2	1	1	2	.
04AUG97	DBR2	Plate	97129	1300.00	15	1	1	15	8.2
04AUG97	DBR2	Plate	97129	3103.20	5	1	1	5	7.5
04AUG97	DBR2	Plate	97129	4102.10	1	1	1	1	5.4
04AUG97	DBR2	Plate	97129	4200.00	29	1	1	29	7.5
04AUG97	DBR2	Plate	97129	4800.05	2	1	1	2	8.7
04AUG97	DBR2	Plate	97129	4800.20	5	1	1	5	8.7
04AUG97	DBR2	Plate	97129	4800.40	1	1	1	1	8.7
04AUG97	DBR2	Plate	97129	4802.00	1	1	1	1	9.4
04AUG97	DBR2	Plate	97130	1300.00	21	1	1	21	8.2
04AUG97	DBR2	Plate	97130	3103.00	2	1	1	2	6.9
04AUG97	DBR2	Plate	97130	3103.20	4	1	1	4	7.5
04AUG97	DBR2	Plate	97130	4200.00	41	1	1	41	7.5
04AUG97	DBR2	Plate	97130	4800.05	1	1	1	1	8.7
04AUG97	DBR2	Plate	97130	4800.10	1	1	1	1	8.7
04AUG97	DBR2	Plate	97130	4800.20	4	1	1	4	8.7
04AUG97	DBR2	Plate	97130	4800.40	1	1	1	1	8.7
04AUG97	DBR2	Plate	97131	1300.00	3	1	1	3	8.2
04AUG97	DBR2	Plate	97131	3103.00	2	1	1	2	6.9
04AUG97	DBR2	Plate	97131	3103.20	10	1	1	10	7.5
04AUG97	DBR2	Plate	97131	4200.00	53	1	1	53	7.5
04AUG97	DBR2	Plate	97131	4200.00	2	1	1	2	7.5
04AUG97	DBR2	Plate	97131	4800.05	2	1	1	2	8.7
04AUG97	DBR2	Plate	97131	4800.20	6	1	1	6	8.7
04AUG97	DBR2	Ponar	97132	1300.00	8	1	1	8	8.2
04AUG97	DBR2	Ponar	97132	4200.00	7	1	1	7	7.5
04AUG97	DBR2	Ponar	97132	8001.00	1	1	1	1	.
04AUG97	DBR2	Ponar	97133	1300.00	27	1	1	27	8.2
04AUG97	DBR2	Ponar	97133	4200.00	9	1	1	9	7.5
04AUG97	DBR2	Ponar	97133	4701.00	1	1	1	1	9.8
04AUG97	DBR2	Ponar	97133	5107.00	1	1	1	1	7.7
04AUG97	DBR2	Ponar	97133	9002.00	1	1	1	1	.

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
04AUG97	DBR2	Ponar	97134	1300.00	24	1	1	24	8.2
04AUG97	DBR2	Ponar	97134	3100.00	1	1	1	1	.
04AUG97	DBR2	Ponar	97134	4200.00	2	1	1	2	7.5
04AUG97	DBR2	Ponar	97134	8504.00	2	1	1	2	.
04AUG97	DBR2	Ponar	97135	1300.00	40	1	1	40	8.2
04AUG97	DBR2	Ponar	97135	4200.00	6	1	1	6	7.5
04AUG97	DBR2	Ponar	97135	5107.00	1	1	1	1	7.7
04AUG97	DBR2	Ponar	97135	5109.00	3	1	1	3	7.4
04AUG97	DBR2	Ponar	97135	8504.00	1	1	1	1	.
04AUG97	DBR2	Ponar	97136	1300.00	40	1	1	40	8.2
04AUG97	DBR2	Ponar	97136	3103.20	2	1	1	2	7.5
04AUG97	DBR2	Ponar	97136	4200.00	2	1	1	2	7.5
04AUG97	DBR	Plate	97137	1300.00	9	1	1	9	8.2
04AUG97	DBR	Plate	97137	3103.20	2	1	1	2	7.5
04AUG97	DBR	Plate	97137	3402.00	67	1	1	67	6.0
04AUG97	DBR	Plate	97137	4200.00	114	1	1	114	7.5
04AUG97	DBR	Plate	97137	4800.05	2	1	1	2	8.7
04AUG97	DBR	Plate	97137	4800.20	7	1	1	7	8.7
04AUG97	DBR	Plate	97137	4800.40	1	1	1	1	8.7
04AUG97	DBR	Plate	97137	5201.40	13	1	1	13	4.8
04AUG97	DBR	Plate	97137	5203.00	11	1	1	11	6.0
04AUG97	DBR	Plate	97137	5204.00	1	1	1	1	6.9
04AUG97	DBR	Plate	97137	5209.00	1	1	1	1	8.4
04AUG97	DBR	Plate	97137	5211.50	8	1	1	8	9.1
04AUG97	DBR	Plate	97137	5212.50	9	1	1	9	.
04AUG97	DBR	Plate	97137	9002.00	1	1	1	1	.
04AUG97	DBR	Plate	97137	9003.00	1	1	1	1	5.7
04AUG97	DBR	Plate	97138	1300.00	28	1	1	28	8.2
04AUG97	DBR	Plate	97138	3103.00	2	1	1	2	6.9
04AUG97	DBR	Plate	97138	3103.20	4	1	1	4	7.5
04AUG97	DBR	Plate	97138	3402.00	210	1	1	210	6.0
04AUG97	DBR	Plate	97138	4200.00	56	1	1	56	7.5
04AUG97	DBR	Plate	97138	4203.10	1	1	1	1	6.0
04AUG97	DBR	Plate	97138	4800.05	1	1	1	1	8.7
04AUG97	DBR	Plate	97138	4800.40	1	1	1	1	8.7
04AUG97	DBR	Plate	97138	5200.10	2	1	1	2	.
04AUG97	DBR	Plate	97138	5201.40	2	1	1	2	4.8
04AUG97	DBR	Plate	97138	5203.00	1	1	1	1	6.0
04AUG97	DBR	Plate	97138	5204.00	1	1	1	1	6.9
04AUG97	DBR	Plate	97138	5209.00	1	1	1	1	8.4
04AUG97	DBR	Plate	97138	5211.50	5	1	1	5	9.1
04AUG97	DBR	Plate	97138	6001.00	1	1	1	1	.
04AUG97	DBR	Plate	97138	8001.00	10	1	1	10	.
04AUG97	DBR	Plate	97138	9002.00	1	1	1	1	.
04AUG97	DBR	Plate	97139	1300.00	27	1	1	27	8.2
04AUG97	DBR	Plate	97139	3103.20	1	1	1	1	7.5
04AUG97	DBR	Plate	97139	3402.00	320	1	1	320	6.0
04AUG97	DBR	Plate	97139	4102.10	1	1	1	1	5.4
04AUG97	DBR	Plate	97139	4200.00	89	1	1	89	7.5
04AUG97	DBR	Plate	97139	4200.00	1	1	1	1	7.5
04AUG97	DBR	Plate	97139	4203.10	1	1	1	1	6.0
04AUG97	DBR	Plate	97139	4800.05	1	1	1	1	8.7
04AUG97	DBR	Plate	97139	5201.40	2	1	1	2	4.8
04AUG97	DBR	Plate	97139	5203.00	1	1	1	1	6.0

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
04AUG97	DBR	Plate	97139	5211.50	2	1	1	2	9.1
04AUG97	DBR	Plate	97139	6001.00	1	1	1	1	.
04AUG97	DBR	Plate	97139	8001.00	2	1	1	2	.
04AUG97	DBR	Plate	97139	8503.00	1	1	1	1	.
04AUG97	DBR	Plate	97139	9002.00	1	1	1	1	.
04AUG97	DBR	Ponar	97140	1300.00	43	1	1	43	8.2
04AUG97	DBR	Ponar	97140	3402.00	8	1	1	8	6.0
04AUG97	DBR	Ponar	97140	4200.00	42	1	1	42	7.5
04AUG97	DBR	Ponar	97140	5109.00	17	1	1	17	7.4
04AUG97	DBR	Ponar	97141	1300.00	31	1	1	31	8.2
04AUG97	DBR	Ponar	97141	3401.10	1	1	1	1	9.4
04AUG97	DBR	Ponar	97141	4200.00	37	1	1	37	7.5
04AUG97	DBR	Ponar	97141	8504.00	1	1	1	1	.
04AUG97	DBR	Ponar	97142	1300.00	10	1	1	10	8.2
04AUG97	DBR	Ponar	97142	3103.20	1	1	1	1	7.5
04AUG97	DBR	Ponar	97142	4200.00	5	1	1	5	7.5
04AUG97	DBR	Ponar	97142	5109.00	1	1	1	1	7.4
04AUG97	DBR	Ponar	97142	5204.00	1	1	1	1	6.9
04AUG97	DBR	Ponar	97142	5208.00	1	1	1	1	4.0
04AUG97	DBR	Ponar	97142	5211.50	1	1	1	1	9.1
04AUG97	DBR	Ponar	97143	1300.00	48	1	1	48	8.2
04AUG97	DBR	Ponar	97143	3103.20	2	1	1	2	7.5
04AUG97	DBR	Ponar	97143	3402.00	6	1	1	6	6.0
04AUG97	DBR	Ponar	97143	4200.00	21	1	1	21	7.5
04AUG97	DBR	Ponar	97143	4701.00	1	1	1	1	9.8
04AUG97	DBR	Ponar	97143	5109.00	1	1	1	1	7.4
04AUG97	DBR	Ponar	97143	5203.00	1	1	1	1	6.0
04AUG97	DBR	Ponar	97143	5211.50	2	1	1	2	9.1
04AUG97	DBR	Ponar	97143	5212.50	3	1	1	3	.
04AUG97	DBR	Ponar	97144	1300.00	158	1	2	316	8.2
04AUG97	DBR	Ponar	97144	3103.20	1	1	2	2	7.5
04AUG97	DBR	Ponar	97144	4200.00	73	1	2	146	7.5
04AUG97	DBR	Ponar	97144	4200.00	2	1	2	4	7.5
04AUG97	DBR	Ponar	97144	5109.00	4	1	2	8	7.4
04AUG97	OHD	Plate	97145	1300.00	6	1	1	6	8.2
04AUG97	OHD	Plate	97145	3402.00	14	1	1	14	6.0
04AUG97	OHD	Plate	97145	4101.50	1	1	1	1	6.4
04AUG97	OHD	Plate	97145	4200.00	16	1	1	16	7.5
04AUG97	OHD	Plate	97145	4203.20	1	1	1	1	6.0
04AUG97	OHD	Plate	97145	4302.00	2	1	1	2	7.6
04AUG97	OHD	Plate	97145	4800.05	3	1	1	3	8.7
04AUG97	OHD	Plate	97145	5204.00	14	1	1	14	6.9
04AUG97	OHD	Plate	97145	5209.00	2	1	1	2	8.4
04AUG97	OHD	Plate	97145	5211.50	9	1	1	9	9.1
04AUG97	OHD	Plate	97146	1300.00	2	1	1	2	8.2
04AUG97	OHD	Plate	97146	3402.00	43	1	1	43	6.0
04AUG97	OHD	Plate	97146	3402.00	1	1	1	1	6.0
04AUG97	OHD	Plate	97146	4200.00	9	1	1	9	7.5
04AUG97	OHD	Plate	97146	5211.50	1	1	1	1	9.1
04AUG97	OHD	Plate	97147	1300.00	3	1	1	3	8.2
04AUG97	OHD	Plate	97147	3402.00	11	1	1	11	6.0
04AUG97	OHD	Plate	97147	4200.00	16	1	1	16	7.5
04AUG97	OHD	Plate	97147	4302.00	1	1	1	1	7.6
04AUG97	OHD	Plate	97147	4701.80	1	1	1	1	7.3

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
04AUG97	OHD	Plate	97147	4800.20	2	1	1	2	8.7
04AUG97	OHD	Plate	97147	4800.40	1	1	1	1	8.7
04AUG97	OHD	Plate	97147	5211.50	12	1	1	12	9.1
04AUG97	OHD	Plate	97147	9002.00	1	1	1	1	.
04AUG97	OHD	Ponar	97148	4200.00	1	1	1	1	7.5
04AUG97	OHD	Ponar	97148	5211.50	1	1	1	1	9.1
04AUG97	OHD	Ponar	97149	1300.00	7	1	1	7	8.2
04AUG97	OHD	Ponar	97149	4200.00	6	1	1	6	7.5
04AUG97	OHD	Ponar	97149	8502.00	1	1	1	1	.
04AUG97	OHD	Ponar	97149	9002.00	1	1	1	1	.
04AUG97	OHD	Ponar	97150	1300.00	41	1	1	41	8.2
04AUG97	OHD	Ponar	97150	3401.10	4	1	1	4	9.4
04AUG97	OHD	Ponar	97151	1300.00	106	1	1	106	8.2
04AUG97	OHD	Ponar	97151	3402.00	3	1	1	3	6.0
04AUG97	OHD	Ponar	97151	4200.00	11	1	1	11	7.5
04AUG97	OHD	Ponar	97151	4302.00	1	1	1	1	7.6
04AUG97	OHD	Ponar	97151	5203.00	1	1	1	1	6.0
04AUG97	OHD	Ponar	97151	5209.00	4	1	1	4	8.4
04AUG97	OHD	Ponar	97152	1300.00	49	1	1	49	8.2
04AUG97	OHD	Ponar	97152	3401.10	1	1	1	1	9.4
04AUG97	OHD	Ponar	97152	3402.00	1	1	1	1	6.0
04AUG97	OHD	Ponar	97152	4200.00	2	1	1	2	7.5
04AUG97	OHD	Ponar	97152	5109.00	3	1	1	3	7.4
04AUG97	OHD2	Plate	97153	1300.00	2	1	1	2	8.2
04AUG97	OHD2	Plate	97153	3402.00	10	1	1	10	6.0
04AUG97	OHD2	Plate	97153	4101.50	1	1	1	1	6.4
04AUG97	OHD2	Plate	97153	4200.00	57	1	1	57	7.5
04AUG97	OHD2	Plate	97153	4200.00	1	1	1	1	7.5
04AUG97	OHD2	Plate	97153	4302.00	1	1	1	1	7.6
04AUG97	OHD2	Plate	97153	4800.20	2	1	1	2	8.7
04AUG97	OHD2	Plate	97153	5201.40	7	1	1	7	4.8
04AUG97	OHD2	Plate	97153	5203.00	3	1	1	3	6.0
04AUG97	OHD2	Plate	97153	5209.00	21	1	1	21	8.4
04AUG97	OHD2	Plate	97153	5211.50	9	1	1	9	9.1
04AUG97	OHD2	Plate	97153	5212.50	10	1	1	10	.
04AUG97	OHD2	Plate	97153	8504.00	2	1	1	2	.
04AUG97	OHD2	Plate	97154	1300.00	1	1	1	1	8.2
04AUG97	OHD2	Plate	97154	3402.00	17	1	1	17	6.0
04AUG97	OHD2	Plate	97154	4102.10	1	1	1	1	5.4
04AUG97	OHD2	Plate	97154	4200.00	32	1	1	32	7.5
04AUG97	OHD2	Plate	97154	4200.00	1	1	1	1	7.5
04AUG97	OHD2	Plate	97154	4302.00	8	1	1	8	7.6
04AUG97	OHD2	Plate	97154	4800.05	1	1	1	1	8.7
04AUG97	OHD2	Plate	97154	4800.20	2	1	1	2	8.7
04AUG97	OHD2	Plate	97154	5202.00	1	1	1	1	4.0
04AUG97	OHD2	Plate	97154	5209.00	6	1	1	6	8.4
04AUG97	OHD2	Plate	97155	3402.00	50	1	1	50	6.0
04AUG97	OHD2	Plate	97155	4102.10	1	1	1	1	5.4
04AUG97	OHD2	Plate	97155	4200.00	75	1	1	75	7.5
04AUG97	OHD2	Plate	97155	4200.00	1	1	1	1	7.5
04AUG97	OHD2	Plate	97155	4302.00	2	1	1	2	7.6
04AUG97	OHD2	Plate	97155	4800.05	1	1	1	1	8.7
04AUG97	OHD2	Plate	97155	4800.20	1	1	1	1	8.7
04AUG97	OHD2	Plate	97155	5201.40	2	1	1	2	4.8

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
04AUG97	OHD2	Plate	97155	5203.00	1	1	1	1	6.0
04AUG97	OHD2	Ponar	97156	1300.00	102	1	1	102	8.2
04AUG97	OHD2	Ponar	97156	4200.00	6	1	1	6	7.5
04AUG97	OHD2	Ponar	97156	4203.10	2	1	1	2	6.0
04AUG97	OHD2	Ponar	97156	5105.00	1	1	1	1	6.8
04AUG97	OHD2	Ponar	97156	5107.00	1	1	1	1	7.7
04AUG97	OHD2	Ponar	97156	5109.00	31	1	1	31	7.4
04AUG97	OHD2	Ponar	97156	5201.40	1	1	1	1	4.8
04AUG97	OHD2	Ponar	97156	9004.00	9	1	1	9	.
04AUG97	OHD2	Ponar	97157	1300.00	38	1	1	38	8.2
04AUG97	OHD2	Ponar	97157	4200.00	4	1	1	4	7.5
04AUG97	OHD2	Ponar	97157	5107.00	1	1	1	1	7.7
04AUG97	OHD2	Ponar	97157	5109.00	6	1	1	6	7.4
04AUG97	OHD2	Ponar	97157	5203.00	1	1	1	1	6.0
04AUG97	OHD2	Ponar	97157	5209.00	3	1	1	3	8.4
04AUG97	OHD2	Ponar	97157	8504.00	1	1	1	1	.
04AUG97	OHD2	Ponar	97158	1300.00	41	1	2	82	8.2
04AUG97	OHD2	Ponar	97158	4101.50	2	1	2	4	6.4
04AUG97	OHD2	Ponar	97158	4200.00	8	1	2	16	7.5
04AUG97	OHD2	Ponar	97159	1300.00	91	1	1	91	8.2
04AUG97	OHD2	Ponar	97159	3402.00	1	1	1	1	6.0
04AUG97	OHD2	Ponar	97159	4101.50	1	1	1	1	6.4
04AUG97	OHD2	Ponar	97159	4200.00	8	1	1	8	7.5
04AUG97	OHD2	Ponar	97159	5107.00	1	1	1	1	7.7
04AUG97	OHD2	Ponar	97159	5109.00	83	1	1	83	7.4
04AUG97	OHD2	Ponar	97159	5201.40	3	1	1	3	4.8
04AUG97	OHD2	Ponar	97159	5203.00	1	1	1	1	6.0
04AUG97	OHD2	Ponar	97159	5209.10	1	1	1	1	.
04AUG97	OHD2	Ponar	97159	5212.50	3	1	1	3	.
04AUG97	OHD2	Ponar	97159	9003.00	1	1	1	1	5.7
04AUG97	OHD2	Ponar	97160	1300.00	75	1	1	75	8.2
04AUG97	OHD2	Ponar	97160	3402.00	1	1	1	1	6.0
04AUG97	OHD2	Ponar	97160	4200.00	5	1	1	5	7.5
04AUG97	OHD2	Ponar	97160	5109.00	17	1	1	17	7.4
04AUG97	OHD2	Ponar	97160	5203.00	1	1	1	1	6.0
04AUG97	OHD2	Ponar	97160	8504.00	1	1	1	1	.
04AUG97	OHD2	Ponar	97160	9002.00	1	1	1	1	.
04AUG97	OHD2	Ponar	97160	9003.00	1	1	1	1	5.7
05AUG97	TOC	Plate	97161	1300.00	43	1	1	43	8.2
05AUG97	TOC	Plate	97161	3104.00	1	1	1	1	7.9
05AUG97	TOC	Plate	97161	4200.00	178	1	1	178	7.5
05AUG97	TOC	Plate	97161	4203.10	4	1	1	4	6.0
05AUG97	TOC	Plate	97161	4302.00	21	1	1	21	7.6
05AUG97	TOC	Plate	97161	4304.30	1	1	1	1	7.1
05AUG97	TOC	Plate	97161	4701.00	2	1	1	2	9.8
05AUG97	TOC	Plate	97161	5201.40	44	1	1	44	4.8
05AUG97	TOC	Plate	97161	8502.00	1	1	1	1	.
05AUG97	TOC	Plate	97161	9002.00	1	1	1	1	.
05AUG97	TOC	Plate	97162	1300.00	3	1	1	3	8.2
05AUG97	TOC	Plate	97162	3103.20	1	1	1	1	7.5
05AUG97	TOC	Plate	97162	3104.00	1	1	1	1	7.9
05AUG97	TOC	Plate	97162	4200.00	23	1	1	23	7.5
05AUG97	TOC	Plate	97162	4302.00	50	1	1	50	7.6
05AUG97	TOC	Plate	97162	4304.30	30	1	1	30	7.1

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
05AUG97	TOC	Plate	97162	4800.20	1	1	1	1	8.7
05AUG97	TOC	Plate	97162	5201.40	40	1	1	40	4.8
05AUG97	TOC	Plate	97162	5203.00	3	1	1	3	6.0
05AUG97	TOC	Plate	97163	1200.00	1	1	1	1	8.0
05AUG97	TOC	Plate	97163	1300.00	11	1	1	11	8.2
05AUG97	TOC	Plate	97163	4200.00	96	1	1	96	7.5
05AUG97	TOC	Plate	97163	4200.00	1	1	1	1	7.5
05AUG97	TOC	Plate	97163	4203.10	5	1	1	5	6.0
05AUG97	TOC	Plate	97163	4302.10	20	1	1	20	7.6
05AUG97	TOC	Plate	97163	4304.10	7	1	1	7	7.1
05AUG97	TOC	Plate	97163	4800.20	1	1	1	1	8.7
05AUG97	TOC	Plate	97163	5201.40	39	1	1	39	4.8
05AUG97	TOC	Plate	97163	5203.00	7	1	1	7	6.0
05AUG97	TOC	Ponar	97164	1200.00	1	1	1	1	8.0
05AUG97	TOC	Ponar	97164	1300.00	3	1	1	3	8.2
05AUG97	TOC	Ponar	97164	3401.10	3	1	1	3	9.4
05AUG97	TOC	Ponar	97164	3402.00	1	1	1	1	6.0
05AUG97	TOC	Ponar	97164	4200.00	3	1	1	3	7.5
05AUG97	TOC	Ponar	97164	4302.00	10	1	1	10	7.6
05AUG97	TOC	Ponar	97164	4304.30	9	1	1	9	7.1
05AUG97	TOC	Ponar	97164	5109.00	1	1	1	1	7.4
05AUG97	TOC	Ponar	97165	1300.00	18	1	1	18	8.2
05AUG97	TOC	Ponar	97165	4200.00	42	1	1	42	7.5
05AUG97	TOC	Ponar	97165	4203.10	1	1	1	1	6.0
05AUG97	TOC	Ponar	97165	4302.00	8	1	1	8	7.6
05AUG97	TOC	Ponar	97165	4304.00	1	1	1	1	.
05AUG97	TOC	Ponar	97165	5201.40	1	1	1	1	4.8
05AUG97	TOC	Ponar	97165	9002.00	2	1	1	2	.
05AUG97	TOC	Ponar	97166	1300.00	12	1	1	12	8.2
05AUG97	TOC	Ponar	97166	4200.00	17	1	1	17	7.5
05AUG97	TOC	Ponar	97166	4203.10	1	1	1	1	6.0
05AUG97	TOC	Ponar	97166	4302.00	1	1	1	1	7.6
05AUG97	TOC	Ponar	97166	5109.00	1	1	1	1	7.4
05AUG97	TOC	Ponar	97167	1300.00	3	1	1	3	8.2
05AUG97	TOC	Ponar	97167	3104.00	3	1	1	3	7.9
05AUG97	TOC	Ponar	97167	3401.10	5	1	1	5	9.4
05AUG97	TOC	Ponar	97167	3402.00	1	1	1	1	6.0
05AUG97	TOC	Ponar	97167	4200.00	9	1	1	9	7.5
05AUG97	TOC	Ponar	97167	4200.00	1	1	1	1	7.5
05AUG97	TOC	Ponar	97167	4302.00	21	1	1	21	7.6
05AUG97	TOC	Ponar	97167	4701.00	2	1	1	2	9.8
05AUG97	TOC	Ponar	97167	4803.00	1	1	1	1	6.9
05AUG97	TOC	Ponar	97167	4905.20	1	1	1	1	5.7
05AUG97	TOC	Ponar	97167	5201.40	3	1	1	3	4.8
05AUG97	TOC	Ponar	97167	5203.00	3	1	1	3	6.0
05AUG97	TOC	Ponar	97167	5209.10	1	1	1	1	.
05AUG97	TOC	Ponar	97168	1300.00	4	1	1	4	8.2
05AUG97	TOC	Ponar	97168	3103.20	1	1	1	1	7.5
05AUG97	TOC	Ponar	97168	3401.10	1	1	1	1	9.4
05AUG97	TOC	Ponar	97168	3402.00	2	1	1	2	6.0
05AUG97	TOC	Ponar	97168	4200.00	30	1	1	30	7.5
05AUG97	TOC	Ponar	97168	4302.00	12	1	1	12	7.6
05AUG97	TOC	Ponar	97168	5201.40	6	1	1	6	4.8
05AUG97	TOC	Ponar	97168	5212.00	1	1	1	1	5.0

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
05AUG97	TOC	Ponar	97168	8502.00	1	1	1	1	.
05AUG97	MOB	Plate	97169	1300.00	2	1	1	2	8.2
05AUG97	MOB	Plate	97169	4101.50	4	1	1	4	6.4
05AUG97	MOB	Plate	97169	4102.10	11	1	1	11	5.4
05AUG97	MOB	Plate	97169	4200.00	224	1	1	224	7.5
05AUG97	MOB	Plate	97169	4302.00	2	1	1	2	7.6
05AUG97	MOB	Plate	97169	4802.00	1	1	1	1	9.4
05AUG97	MOB	Plate	97169	4802.10	2	1	1	2	9.4
05AUG97	MOB	Plate	97169	5100.50	2	1	1	2	.
05AUG97	MOB	Plate	97169	5201.40	3	1	1	3	4.8
05AUG97	MOB	Plate	97169	5204.00	2	1	1	2	6.9
05AUG97	MOB	Plate	97169	5213.00	4	1	1	4	5.0
05AUG97	MOB	Plate	97169	8001.00	1	1	1	1	.
05AUG97	MOB	Plate	97170	1300.00	8	1	1	8	8.2
05AUG97	MOB	Plate	97170	3401.10	2	1	1	2	9.4
05AUG97	MOB	Plate	97170	4101.50	3	1	1	3	6.4
05AUG97	MOB	Plate	97170	4102.10	11	1	1	11	5.4
05AUG97	MOB	Plate	97170	4110.00	2	1	1	2	4.7
05AUG97	MOB	Plate	97170	4200.00	285	1	1	285	7.5
05AUG97	MOB	Plate	97170	4200.00	5	1	1	5	7.5
05AUG97	MOB	Plate	97170	4203.10	1	1	1	1	6.0
05AUG97	MOB	Plate	97170	4800.20	2	1	1	2	8.7
05AUG97	MOB	Plate	97170	5201.40	2	1	1	2	4.8
05AUG97	MOB	Plate	97170	5213.00	2	1	1	2	5.0
05AUG97	MOB	Plate	97171	1300.00	14	1	1	14	8.2
05AUG97	MOB	Plate	97171	4101.50	4	1	1	4	6.4
05AUG97	MOB	Plate	97171	4102.10	21	1	1	21	5.4
05AUG97	MOB	Plate	97171	4104.00	11	1	1	11	6.9
05AUG97	MOB	Plate	97171	4106.00	3	1	1	3	2.1
05AUG97	MOB	Plate	97171	4200.00	856	1	1	856	7.5
05AUG97	MOB	Plate	97171	4200.00	22	1	1	22	7.5
05AUG97	MOB	Plate	97171	4203.10	1	1	1	1	6.0
05AUG97	MOB	Plate	97171	4216.40	5	1	1	5	8.1
05AUG97	MOB	Plate	97171	4302.00	15	1	1	15	7.6
05AUG97	MOB	Plate	97171	4800.05	1	1	1	1	8.7
05AUG97	MOB	Plate	97171	4905.20	5	1	1	5	5.7
05AUG97	MOB	Plate	97171	4908.00	72	1	1	72	6.6
05AUG97	MOB	Plate	97171	5201.40	1	1	1	1	4.8
05AUG97	MOB	Plate	97171	9004.00	1	1	1	1	.
05AUG97	MOB	Ponar	97172	1300.00	7	1	1	7	8.2
05AUG97	MOB	Ponar	97172	4101.50	3	1	1	3	6.4
05AUG97	MOB	Ponar	97172	4102.10	21	1	1	21	5.4
05AUG97	MOB	Ponar	97172	4200.00	25	1	1	25	7.5
05AUG97	MOB	Ponar	97172	4203.10	1	1	1	1	6.0
05AUG97	MOB	Ponar	97172	4216.40	1	1	1	1	8.1
05AUG97	MOB	Ponar	97172	4800.05	2	1	1	2	8.7
05AUG97	MOB	Ponar	97172	4800.20	3	1	1	3	8.7
05AUG97	MOB	Ponar	97172	5100.50	6	1	1	6	.
05AUG97	MOB	Ponar	97172	5109.00	1	1	1	1	7.4
05AUG97	MOB	Ponar	97172	5201.40	2	1	1	2	4.8
05AUG97	MOB	Ponar	97172	5204.00	3	1	1	3	6.9
05AUG97	MOB	Ponar	97172	5209.00	1	1	1	1	8.4
05AUG97	MOB	Ponar	97173	1300.00	5	1	1	5	8.2
05AUG97	MOB	Ponar	97173	4101.50	38	1	1	38	6.4

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
05AUG97	MOB	Ponar	97173	4102.10	5	1	1	5	5.4
05AUG97	MOB	Ponar	97173	4200.00	22	1	1	22	7.5
05AUG97	MOB	Ponar	97173	4203.10	9	1	1	9	6.0
05AUG97	MOB	Ponar	97173	4800.20	1	1	1	1	8.7
05AUG97	MOB	Ponar	97173	5100.50	1	1	1	1	.
05AUG97	MOB	Ponar	97173	5109.00	6	1	1	6	7.4
05AUG97	MOB	Ponar	97173	5201.40	1	1	1	1	4.8
05AUG97	MOB	Ponar	97173	5213.00	2	1	1	2	5.0
05AUG97	MOB	Ponar	97174	1300.00	11	1	1	11	8.2
05AUG97	MOB	Ponar	97174	4101.50	7	1	1	7	6.4
05AUG97	MOB	Ponar	97174	4102.10	3	1	1	3	5.4
05AUG97	MOB	Ponar	97174	4200.00	15	1	1	15	7.5
05AUG97	MOB	Ponar	97174	4203.10	3	1	1	3	6.0
05AUG97	MOB	Ponar	97174	4241.00	1	1	1	1	6.0
05AUG97	MOB	Ponar	97174	4704.00	1	1	1	1	1.0
05AUG97	MOB	Ponar	97174	5107.00	1	1	1	1	7.7
05AUG97	MOB	Ponar	97174	5109.00	1	1	1	1	7.4
05AUG97	MOB	Ponar	97174	5213.00	8	1	1	8	5.0
05AUG97	MOB	Ponar	97175	1300.00	28	1	1	28	8.2
05AUG97	MOB	Ponar	97175	4101.50	18	1	1	18	6.4
05AUG97	MOB	Ponar	97175	4107.00	2	1	1	2	.
05AUG97	MOB	Ponar	97175	4200.00	7	1	1	7	7.5
05AUG97	MOB	Ponar	97175	4203.10	23	1	1	23	6.0
05AUG97	MOB	Ponar	97175	5105.00	1	1	1	1	6.8
05AUG97	MOB	Ponar	97175	5107.00	2	1	1	2	7.7
05AUG97	MOB	Ponar	97175	5109.00	14	1	1	14	7.4
05AUG97	MOB	Ponar	97175	5111.00	1	1	1	1	.
05AUG97	MOB	Ponar	97175	6001.00	2	1	1	2	.
05AUG97	MOB	Ponar	97175	8504.00	1	1	1	1	.
05AUG97	MOB	Ponar	97176	1200.00	1	1	1	1	8.0
05AUG97	MOB	Ponar	97176	1300.00	1	1	1	1	8.2
05AUG97	MOB	Ponar	97176	4101.50	13	1	1	13	6.4
05AUG97	MOB	Ponar	97176	4102.10	3	1	1	3	5.4
05AUG97	MOB	Ponar	97176	4107.00	1	1	1	1	.
05AUG97	MOB	Ponar	97176	4200.00	25	1	1	25	7.5
05AUG97	MOB	Ponar	97176	4203.10	5	1	1	5	6.0
05AUG97	MOB	Ponar	97176	4302.00	1	1	1	1	7.6
05AUG97	MOB	Ponar	97176	5109.00	1	1	1	1	7.4
05AUG97	MOB2	Plate	97177	1300.00	45	1	1	45	8.2
05AUG97	MOB2	Plate	97177	3401.10	1	1	1	1	9.4
05AUG97	MOB2	Plate	97177	4101.50	11	1	1	11	6.4
05AUG97	MOB2	Plate	97177	4102.10	89	1	1	89	5.4
05AUG97	MOB2	Plate	97177	4200.00	337	1	1	337	7.5
05AUG97	MOB2	Plate	97177	4200.00	6	1	1	6	7.5
05AUG97	MOB2	Plate	97177	4216.40	1	1	1	1	8.1
05AUG97	MOB2	Plate	97177	4302.00	1	1	1	1	7.6
05AUG97	MOB2	Plate	97177	4501.00	1	1	1	1	.
05AUG97	MOB2	Plate	97177	4800.05	4	1	1	4	8.7
05AUG97	MOB2	Plate	97177	4800.20	13	1	1	13	8.7
05AUG97	MOB2	Plate	97177	4800.30	1	1	1	1	8.7
05AUG97	MOB2	Plate	97177	4803.00	2	1	1	2	6.9
05AUG97	MOB2	Plate	97177	4908.00	4	1	1	4	6.6
05AUG97	MOB2	Plate	97177	5103.20	3	1	1	3	7.7
05AUG97	MOB2	Plate	97177	5105.00	2	1	1	2	6.8

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
05AUG97	MOB2	Plate	97177	5109.00	9	1	1	9	7.4
05AUG97	MOB2	Plate	97177	5201.40	2	1	1	2	4.8
05AUG97	MOB2	Plate	97177	5207.50	1	1	1	1	.
05AUG97	MOB2	Plate	97177	8001.00	3	1	1	3	.
05AUG97	MOB2	Plate	97177	8504.00	3	1	1	3	.
05AUG97	MOB2	Plate	97178	1300.00	41	1	1	41	8.2
05AUG97	MOB2	Plate	97178	4101.50	12	1	1	12	6.4
05AUG97	MOB2	Plate	97178	4102.10	14	1	1	14	5.4
05AUG97	MOB2	Plate	97178	4200.00	169	1	1	169	7.5
05AUG97	MOB2	Plate	97178	4200.00	6	1	1	6	7.5
05AUG97	MOB2	Plate	97178	4203.10	1	1	1	1	6.0
05AUG97	MOB2	Plate	97178	4300.00	1	1	1	1	2.7
05AUG97	MOB2	Plate	97178	4800.20	8	1	1	8	8.7
05AUG97	MOB2	Plate	97178	4802.00	2	1	1	2	9.4
05AUG97	MOB2	Plate	97178	5100.50	1	1	1	1	.
05AUG97	MOB2	Plate	97178	5201.40	13	1	1	13	4.8
05AUG97	MOB2	Plate	97179	1200.00	1	1	1	1	8.0
05AUG97	MOB2	Plate	97179	1300.00	35	1	1	35	8.2
05AUG97	MOB2	Plate	97179	4101.50	11	1	1	11	6.4
05AUG97	MOB2	Plate	97179	4102.10	122	1	1	122	5.4
05AUG97	MOB2	Plate	97179	4108.00	1	1	1	1	9.0
05AUG97	MOB2	Plate	97179	4200.00	572	1	1	572	7.5
05AUG97	MOB2	Plate	97179	4200.00	9	1	1	9	7.5
05AUG97	MOB2	Plate	97179	4302.00	1	1	1	1	7.6
05AUG97	MOB2	Plate	97179	4800.05	5	1	1	5	8.7
05AUG97	MOB2	Plate	97179	4800.20	9	1	1	9	8.7
05AUG97	MOB2	Plate	97179	4802.00	1	1	1	1	9.4
05AUG97	MOB2	Plate	97179	4803.00	1	1	1	1	6.9
05AUG97	MOB2	Plate	97179	4905.20	4	1	1	4	5.7
05AUG97	MOB2	Plate	97179	4908.00	25	1	1	25	6.6
05AUG97	MOB2	Plate	97179	5100.50	1	1	1	1	.
05AUG97	MOB2	Plate	97179	5109.00	2	1	1	2	7.4
05AUG97	MOB2	Plate	97179	5201.40	7	1	1	7	4.8
05AUG97	MOB2	Plate	97179	5204.00	3	1	1	3	6.9
05AUG97	MOB2	Plate	97179	8001.00	2	1	1	2	.
05AUG97	MOB2	Plate	97179	9004.00	1	1	1	1	.
05AUG97	MOB2	Ponar	97180	1300.00	7	1	1	7	8.2
05AUG97	MOB2	Ponar	97180	4102.10	1	1	1	1	5.4
05AUG97	MOB2	Ponar	97180	4203.10	1	1	1	1	6.0
05AUG97	MOB2	Ponar	97180	5109.00	3	1	1	3	7.4
05AUG97	MOB2	Ponar	97181	1200.00	1	1	1	1	8.0
05AUG97	MOB2	Ponar	97181	1300.00	11	1	1	11	8.2
05AUG97	MOB2	Ponar	97181	3302.00	1	1	1	1	6.7
05AUG97	MOB2	Ponar	97181	4102.10	1	1	1	1	5.4
05AUG97	MOB2	Ponar	97181	4203.10	4	1	1	4	6.0
05AUG97	MOB2	Ponar	97181	5109.00	1	1	1	1	7.4
05AUG97	MOB2	Ponar	97181	5201.40	1	1	1	1	4.8
05AUG97	MOB2	Ponar	97182	1300.00	43	1	1	43	8.2
05AUG97	MOB2	Ponar	97182	4101.50	3	1	1	3	6.4
05AUG97	MOB2	Ponar	97182	4102.10	20	1	1	20	5.4
05AUG97	MOB2	Ponar	97182	4200.00	6	1	1	6	7.5
05AUG97	MOB2	Ponar	97182	5100.50	2	1	1	2	.
05AUG97	MOB2	Ponar	97182	5105.00	1	1	1	1	6.8
05AUG97	MOB2	Ponar	97182	5107.00	3	1	1	3	7.7

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
05AUG97	MOB2	Ponar	97182	5109.00	81	1	1	81	7.4
05AUG97	MOB2	Ponar	97182	5110.00	1	1	1	1	.
05AUG97	MOB2	Ponar	97182	5201.40	15	1	1	15	4.8
05AUG97	MOB2	Ponar	97183	1300.00	18	1	1	18	8.2
05AUG97	MOB2	Ponar	97183	4203.10	2	1	1	2	6.0
05AUG97	MOB2	Ponar	97183	5109.00	2	1	1	2	7.4
05AUG97	MOB2	Ponar	97184	1300.00	37	1	1	37	8.2
05AUG97	MOB2	Ponar	97184	4100.10	8	1	1	8	5.7
05AUG97	MOB2	Ponar	97184	4101.50	2	1	1	2	6.4
05AUG97	MOB2	Ponar	97184	4102.10	26	1	1	26	5.4
05AUG97	MOB2	Ponar	97184	4200.00	12	1	1	12	7.5
05AUG97	MOB2	Ponar	97184	4203.10	4	1	1	4	6.0
05AUG97	MOB2	Ponar	97184	4402.50	1	1	1	1	.
05AUG97	MOB2	Ponar	97184	4800.20	1	1	1	1	8.7
05AUG97	MOB2	Ponar	97184	5100.50	1	1	1	1	.
05AUG97	MOB2	Ponar	97184	5109.00	5	1	1	5	7.4
05AUG97	MOB2	Ponar	97184	5201.40	2	1	1	2	4.8
05AUG97	OHD3	Plate	97185	1300.00	14	1	1	14	8.2
05AUG97	OHD3	Plate	97185	3103.20	1	1	1	1	7.5
05AUG97	OHD3	Plate	97185	3400.00	1	1	1	1	.
05AUG97	OHD3	Plate	97185	4101.50	8	1	1	8	6.4
05AUG97	OHD3	Plate	97185	4102.10	5	1	1	5	5.4
05AUG97	OHD3	Plate	97185	4200.00	34	1	1	34	7.5
05AUG97	OHD3	Plate	97185	4200.00	2	1	1	2	7.5
05AUG97	OHD3	Plate	97185	4300.00	1	1	1	1	2.7
05AUG97	OHD3	Plate	97185	4700.00	1	1	1	1	6.9
05AUG97	OHD3	Plate	97185	4800.05	1	1	1	1	8.7
05AUG97	OHD3	Plate	97185	4800.20	9	1	1	9	8.7
05AUG97	OHD3	Plate	97186	1300.00	6	1	1	6	8.2
05AUG97	OHD3	Plate	97186	1404.00	1	1	1	1	.
05AUG97	OHD3	Plate	97186	3103.00	1	1	1	1	6.9
05AUG97	OHD3	Plate	97186	3103.20	15	1	1	15	7.5
05AUG97	OHD3	Plate	97186	3401.10	1	1	1	1	9.4
05AUG97	OHD3	Plate	97186	4101.50	18	1	1	18	6.4
05AUG97	OHD3	Plate	97186	4102.10	47	1	1	47	5.4
05AUG97	OHD3	Plate	97186	4105.00	1	1	1	1	5.5
05AUG97	OHD3	Plate	97186	4200.00	46	1	1	46	7.5
05AUG97	OHD3	Plate	97186	4200.00	2	1	1	2	7.5
05AUG97	OHD3	Plate	97186	4203.20	1	1	1	1	6.0
05AUG97	OHD3	Plate	97186	4302.00	3	1	1	3	7.6
05AUG97	OHD3	Plate	97186	4908.00	24	1	1	24	6.6
05AUG97	OHD3	Plate	97186	8001.00	1	1	1	1	.
05AUG97	OHD3	Plate	97187	1200.00	5	1	1	5	8.0
05AUG97	OHD3	Plate	97187	1300.00	6	1	1	6	8.2
05AUG97	OHD3	Plate	97187	1404.00	1	1	1	1	.
05AUG97	OHD3	Plate	97187	3103.00	17	1	1	17	6.9
05AUG97	OHD3	Plate	97187	3103.20	104	1	1	104	7.5
05AUG97	OHD3	Plate	97187	4101.50	20	1	1	20	6.4
05AUG97	OHD3	Plate	97187	4102.10	26	1	1	26	5.4
05AUG97	OHD3	Plate	97187	4105.00	1	1	1	1	5.5
05AUG97	OHD3	Plate	97187	4200.00	21	1	1	21	7.5
05AUG97	OHD3	Plate	97187	4302.10	2	1	1	2	7.6
05AUG97	OHD3	Plate	97187	4800.05	2	1	1	2	8.7
05AUG97	OHD3	Plate	97187	4800.20	5	1	1	5	8.7

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
05AUG97	OHD3	Plate	97187	4800.30	1	1	1	1	8.7
05AUG97	OHD3	Plate	97187	4802.00	1	1	1	1	9.4
05AUG97	OHD3	Plate	97187	4908.00	18	1	1	18	6.6
05AUG97	OHD3	Plate	97187	5109.00	4	1	1	4	7.4
05AUG97	OHD3	Plate	97187	5204.20	12	1	1	12	6.9
05AUG97	OHD3	Plate	97187	8001.00	2	1	1	2	.
05AUG97	OHD3	Ponar	97188	1300.00	21	1	1	21	8.2
05AUG97	OHD3	Ponar	97188	1404.00	1	1	1	1	.
05AUG97	OHD3	Ponar	97188	3103.00	2	1	1	2	6.9
05AUG97	OHD3	Ponar	97188	3103.20	15	1	1	15	7.5
05AUG97	OHD3	Ponar	97188	4101.50	13	1	1	13	6.4
05AUG97	OHD3	Ponar	97188	4102.10	6	1	1	6	5.4
05AUG97	OHD3	Ponar	97188	4200.00	9	1	1	9	7.5
05AUG97	OHD3	Ponar	97188	4203.10	2	1	1	2	6.0
05AUG97	OHD3	Ponar	97188	4245.00	1	1	1	1	3.0
05AUG97	OHD3	Ponar	97188	4302.00	1	1	1	1	7.6
05AUG97	OHD3	Ponar	97188	5101.00	1	1	1	1	6.3
05AUG97	OHD3	Ponar	97188	5105.00	2	1	1	2	6.8
05AUG97	OHD3	Ponar	97188	5107.00	1	1	1	1	7.7
05AUG97	OHD3	Ponar	97188	5109.00	2	1	1	2	7.4
05AUG97	OHD3	Ponar	97188	5209.00	2	1	1	2	8.4
05AUG97	OHD3	Ponar	97188	5217.10	2	1	1	2	.
05AUG97	OHD3	Ponar	97189	1300.00	5	1	1	5	8.2
05AUG97	OHD3	Ponar	97189	4102.10	1	1	1	1	5.4
05AUG97	OHD3	Ponar	97189	4200.00	2	1	1	2	7.5
05AUG97	OHD3	Ponar	97189	4800.05	1	1	1	1	8.7
05AUG97	OHD3	Ponar	97189	5101.00	2	1	1	2	6.3
05AUG97	OHD3	Ponar	97190	1300.00	18	1	1	18	8.2
05AUG97	OHD3	Ponar	97190	3103.00	4	1	1	4	6.9
05AUG97	OHD3	Ponar	97190	3103.20	25	1	1	25	7.5
05AUG97	OHD3	Ponar	97190	4101.50	6	1	1	6	6.4
05AUG97	OHD3	Ponar	97190	4101.70	1	1	1	1	4.0
05AUG97	OHD3	Ponar	97190	4102.10	17	1	1	17	5.4
05AUG97	OHD3	Ponar	97190	4200.00	4	1	1	4	7.5
05AUG97	OHD3	Ponar	97190	4203.10	1	1	1	1	6.0
05AUG97	OHD3	Ponar	97190	5109.00	6	1	1	6	7.4
05AUG97	OHD3	Ponar	97190	6001.00	1	1	1	1	.
05AUG97	OHD3	Ponar	97191	1300.00	5	1	1	5	8.2
05AUG97	OHD3	Ponar	97191	3103.20	2	1	1	2	7.5
05AUG97	OHD3	Ponar	97192	1300.00	6	1	1	6	8.2
05AUG97	OHD3	Ponar	97192	3103.20	11	1	1	11	7.5
05AUG97	OHD3	Ponar	97192	4102.10	1	1	1	1	5.4
05AUG97	OHD3	Ponar	97192	4200.00	3	1	1	3	7.5
05AUG97	OHD3	Ponar	97192	5109.00	1	1	1	1	7.4
05AUG97	OHD3	Ponar	97192	6001.00	1	1	1	1	.
05AUG97	OHD3	Ponar	97192	9004.00	1	1	1	1	.
20NOV97	DBR2	Plate	97200	1300.00	20	1	1	20	8.2
20NOV97	DBR2	Plate	97200	3103.00	1	1	1	1	6.9
20NOV97	DBR2	Plate	97200	3103.20	1	1	1	1	7.5
20NOV97	DBR2	Plate	97200	4200.00	24	1	1	24	7.5
20NOV97	DBR2	Plate	97200	4200.00	1	1	1	1	7.5
20NOV97	DBR2	Plate	97200	9002.00	1	1	1	1	.
20NOV97	DBR2	Plate	97201	1300.00	10	1	1	10	8.2
20NOV97	DBR2	Plate	97201	4200.00	19	1	1	19	7.5

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
20NOV97	DBR2	Plate	97202	1200.00	1	1	1	1	8.0
20NOV97	DBR2	Plate	97202	1300.00	41	1	1	41	8.2
20NOV97	DBR2	Plate	97202	3103.00	2	1	1	2	6.9
20NOV97	DBR2	Plate	97202	3103.20	5	1	1	5	7.5
20NOV97	DBR2	Plate	97202	4200.00	16	1	1	16	7.5
20NOV97	DBR2	Plate	97202	4200.00	1	1	1	1	7.5
20NOV97	DBR2	Plate	97202	5201.40	1	1	1	1	4.8
20NOV97	DBR2	Ponar	97203	1300.00	9	1	1	9	8.2
20NOV97	DBR2	Ponar	97203	4102.10	2	1	1	2	5.4
20NOV97	DBR2	Ponar	97203	4200.00	2	1	1	2	7.5
20NOV97	DBR2	Ponar	97204	1300.00	13	1	1	13	8.2
20NOV97	DBR2	Ponar	97204	4200.00	7	1	1	7	7.5
20NOV97	DBR2	Ponar	97204	4700.00	1	1	1	1	6.9
20NOV97	DBR2	Ponar	97204	4800.20	1	1	1	1	8.7
20NOV97	DBR2	Ponar	97204	5109.00	1	1	1	1	7.4
20NOV97	DBR2	Ponar	97204	8504.00	1	1	1	1	.
20NOV97	DBR2	Ponar	97204	9002.00	3	1	1	3	.
20NOV97	DBR2	Ponar	97205	1300.00	10	1	1	10	8.2
20NOV97	DBR2	Ponar	97205	4200.00	1	1	1	1	7.5
20NOV97	DBR2	Ponar	97205	9002.00	1	1	1	1	.
20NOV97	DBR2	Ponar	97206	1300.00	27	1	1	27	8.2
20NOV97	DBR2	Ponar	97206	3401.10	1	1	1	1	9.4
20NOV97	DBR2	Ponar	97206	4200.00	10	1	1	10	7.5
20NOV97	DBR2	Ponar	97206	5109.00	1	1	1	1	7.4
20NOV97	DBR2	Ponar	97207	1300.00	66	1	1	66	8.2
20NOV97	DBR2	Ponar	97207	4200.00	11	1	1	11	7.5
20NOV97	DBR2	Ponar	97207	4200.00	1	1	1	1	7.5
20NOV97	DBR	Plate	97208	1300.00	25	1	1	25	8.2
20NOV97	DBR	Plate	97208	3103.20	1	1	1	1	7.5
20NOV97	DBR	Plate	97208	3402.00	52	1	1	52	6.0
20NOV97	DBR	Plate	97208	4200.00	48	1	1	48	7.5
20NOV97	DBR	Plate	97208	5211.50	5	1	1	5	9.1
20NOV97	DBR	Plate	97209	1300.00	54	1	1	54	8.2
20NOV97	DBR	Plate	97209	3104.00	1	1	1	1	7.9
20NOV97	DBR	Plate	97209	3402.00	145	1	1	145	6.0
20NOV97	DBR	Plate	97209	3406.10	1	1	1	1	5.0
20NOV97	DBR	Plate	97209	4200.00	77	1	1	77	7.5
20NOV97	DBR	Plate	97209	4800.05	2	1	1	2	8.7
20NOV97	DBR	Plate	97209	4800.30	2	1	1	2	8.7
20NOV97	DBR	Plate	97209	5201.40	4	1	1	4	4.8
20NOV97	DBR	Plate	97209	5203.00	2	1	1	2	6.0
20NOV97	DBR	Plate	97209	5208.00	1	1	1	1	4.0
20NOV97	DBR	Plate	97209	9002.00	2	1	1	2	.
20NOV97	DBR	Plate	97210	1300.00	52	1	1	52	8.2
20NOV97	DBR	Plate	97210	3103.20	1	1	1	1	7.5
20NOV97	DBR	Plate	97210	3402.00	60	1	1	60	6.0
20NOV97	DBR	Plate	97210	4200.00	43	1	1	43	7.5
20NOV97	DBR	Plate	97210	4200.00	1	1	1	1	7.5
20NOV97	DBR	Plate	97210	4203.10	1	1	1	1	6.0
20NOV97	DBR	Plate	97210	4800.20	1	1	1	1	8.7
20NOV97	DBR	Plate	97210	5201.40	2	1	1	2	4.8
20NOV97	DBR	Plate	97210	5204.00	1	1	1	1	6.9
20NOV97	DBR	Plate	97210	5211.50	7	1	1	7	9.1
20NOV97	DBR	Ponar	97211	1300.00	150	1	1	150	8.2

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
20NOV97	DBR	Ponar	97211	3401.10	1	1	1	1	9.4
20NOV97	DBR	Ponar	97211	3402.00	13	1	1	13	6.0
20NOV97	DBR	Ponar	97211	4200.00	79	1	1	79	7.5
20NOV97	DBR	Ponar	97211	4701.00	3	1	1	3	9.8
20NOV97	DBR	Ponar	97211	5109.00	2	1	1	2	7.4
20NOV97	DBR	Ponar	97211	5204.00	1	1	1	1	6.9
20NOV97	DBR	Ponar	97211	5211.50	28	1	1	28	9.1
20NOV97	DBR	Ponar	97211	8001.00	2	1	1	2	.
20NOV97	DBR	Ponar	97211	9002.00	1	1	1	1	.
20NOV97	DBR	Ponar	97212	1300.00	68	1	1	68	8.2
20NOV97	DBR	Ponar	97212	4200.00	14	1	1	14	7.5
20NOV97	DBR	Ponar	97212	5208.00	1	1	1	1	4.0
20NOV97	DBR	Ponar	97212	5211.50	4	1	1	4	9.1
20NOV97	DBR	Ponar	97212	5212.50	1	1	1	1	.
20NOV97	DBR	Ponar	97212	8500.00	1	1	1	1	.
20NOV97	DBR	Ponar	97213	1300.00	85	1	1	85	8.2
20NOV97	DBR	Ponar	97213	3103.00	1	1	1	1	6.9
20NOV97	DBR	Ponar	97213	3402.00	16	1	1	16	6.0
20NOV97	DBR	Ponar	97213	4200.00	31	1	1	31	7.5
20NOV97	DBR	Ponar	97213	4701.00	1	1	1	1	9.8
20NOV97	DBR	Ponar	97213	4701.30	1	1	1	1	6.7
20NOV97	DBR	Ponar	97213	5201.40	1	1	1	1	4.8
20NOV97	DBR	Ponar	97213	5208.00	1	1	1	1	4.0
20NOV97	DBR	Ponar	97213	5211.50	7	1	1	7	9.1
20NOV97	DBR	Ponar	97213	8001.00	1	1	1	1	.
20NOV97	DBR	Ponar	97213	8500.00	1	1	1	1	.
20NOV97	DBR	Ponar	97213	9002.00	15	1	1	15	.
20NOV97	DBR	Ponar	97214	1300.00	148	1	1	148	8.2
20NOV97	DBR	Ponar	97214	3108.00	1	1	1	1	.
20NOV97	DBR	Ponar	97214	3402.00	29	1	1	29	6.0
20NOV97	DBR	Ponar	97214	4200.00	111	1	1	111	7.5
20NOV97	DBR	Ponar	97214	5109.00	1	1	1	1	7.4
20NOV97	DBR	Ponar	97214	5209.00	1	1	1	1	8.4
20NOV97	DBR	Ponar	97214	5211.50	8	1	1	8	9.1
20NOV97	DBR	Ponar	97215	1300.00	27	1	1	27	8.2
20NOV97	DBR	Ponar	97215	4200.00	24	1	1	24	7.5
20NOV97	DBR	Ponar	97215	4203.10	1	1	1	1	6.0
20NOV97	DBR	Ponar	97215	5109.00	1	1	1	1	7.4
20NOV97	DBR	Ponar	97215	5201.40	1	1	1	1	4.8
20NOV97	DBR	Ponar	97215	5208.00	1	1	1	1	4.0
20NOV97	DBR	Ponar	97215	5209.00	1	1	1	1	8.4
20NOV97	DBR	Ponar	97215	5211.50	1	1	1	1	9.1
20NOV97	DBR	Ponar	97215	9002.00	2	1	1	2	.
20NOV97	OHD2	Plate	97216	3402.00	14	1	1	14	6.0
20NOV97	OHD2	Plate	97216	4102.10	2	1	1	2	5.4
20NOV97	OHD2	Plate	97216	4200.00	192	1	1	192	7.5
20NOV97	OHD2	Plate	97216	4200.00	5	1	1	5	7.5
20NOV97	OHD2	Plate	97216	5200.00	1	1	1	1	.
20NOV97	OHD2	Plate	97216	5212.20	1	1	1	1	.
20NOV97	OHD2	Plate	97216	6001.00	1	1	1	1	.
20NOV97	OHD2	Plate	97216	9002.00	1	1	1	1	.
20NOV97	OHD2	Plate	97217	1300.00	38	1	1	38	8.2
20NOV97	OHD2	Plate	97217	3103.20	1	1	1	1	7.5
20NOV97	OHD2	Plate	97217	3402.00	33	1	1	33	6.0

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
20NOV97	OHD2	Plate	97217	4102.10	2	1	1	2	5.4
20NOV97	OHD2	Plate	97217	4200.00	89	1	1	89	7.5
20NOV97	OHD2	Plate	97217	4200.00	3	1	1	3	7.5
20NOV97	OHD2	Plate	97217	4203.10	1	1	1	1	6.0
20NOV97	OHD2	Plate	97217	4800.20	1	1	1	1	8.7
20NOV97	OHD2	Plate	97217	5100.50	2	1	1	2	.
20NOV97	OHD2	Plate	97217	5109.00	13	1	1	13	7.4
20NOV97	OHD2	Plate	97217	5208.00	1	1	1	1	4.0
20NOV97	OHD2	Plate	97217	5212.50	1	1	1	1	.
20NOV97	OHD2	Plate	97217	8502.00	1	1	1	1	.
20NOV97	OHD2	Plate	97218	1300.00	4	1	1	4	8.2
20NOV97	OHD2	Plate	97218	3103.20	3	1	1	3	7.5
20NOV97	OHD2	Plate	97218	3402.00	19	1	1	19	6.0
20NOV97	OHD2	Plate	97218	4102.10	1	1	1	1	5.4
20NOV97	OHD2	Plate	97218	4200.00	144	1	1	144	7.5
20NOV97	OHD2	Plate	97218	4800.05	1	1	1	1	8.7
20NOV97	OHD2	Plate	97218	5201.40	1	1	1	1	4.8
20NOV97	OHD2	Plate	97218	5203.00	1	1	1	1	6.0
20NOV97	OHD2	Plate	97218	5208.00	3	1	1	3	4.0
20NOV97	OHD2	Plate	97218	9002.00	1	1	1	1	.
20NOV97	OHD2	Ponar	97219	1300.00	97	1	1	97	8.2
20NOV97	OHD2	Ponar	97219	3402.00	1	1	1	1	6.0
20NOV97	OHD2	Ponar	97219	4200.00	35	1	1	35	7.5
20NOV97	OHD2	Ponar	97219	4200.00	1	1	1	1	7.5
20NOV97	OHD2	Ponar	97219	5109.00	3	1	1	3	7.4
20NOV97	OHD2	Ponar	97219	5215.10	1	1	1	1	7.2
20NOV97	OHD2	Ponar	97220	1300.00	89	1	1	89	8.2
20NOV97	OHD2	Ponar	97220	4200.00	31	1	1	31	7.5
20NOV97	OHD2	Ponar	97220	4203.10	1	1	1	1	6.0
20NOV97	OHD2	Ponar	97220	5109.00	53	1	1	53	7.4
20NOV97	OHD2	Ponar	97220	6001.00	4	1	1	4	.
20NOV97	OHD2	Ponar	97221	1300.00	20	1	1	20	8.2
20NOV97	OHD2	Ponar	97221	3103.20	5	1	1	5	7.5
20NOV97	OHD2	Ponar	97221	3402.00	7	1	1	7	6.0
20NOV97	OHD2	Ponar	97221	4102.10	1	1	1	1	5.4
20NOV97	OHD2	Ponar	97221	4200.00	24	1	1	24	7.5
20NOV97	OHD2	Ponar	97221	4200.00	1	1	1	1	7.5
20NOV97	OHD2	Ponar	97221	4203.10	1	1	1	1	6.0
20NOV97	OHD2	Ponar	97221	5109.00	10	1	1	10	7.4
20NOV97	OHD2	Ponar	97221	5212.50	1	1	1	1	.
20NOV97	OHD2	Ponar	97221	9002.00	1	1	1	1	.
20NOV97	OHD2	Ponar	97222	1200.00	1	1	1	1	8.0
20NOV97	OHD2	Ponar	97222	1300.00	100	1	1	100	8.2
20NOV97	OHD2	Ponar	97222	1404.00	1	1	1	1	.
20NOV97	OHD2	Ponar	97222	3402.00	3	1	1	3	6.0
20NOV97	OHD2	Ponar	97222	4200.00	76	1	1	76	7.5
20NOV97	OHD2	Ponar	97222	4200.00	2	1	1	2	7.5
20NOV97	OHD2	Ponar	97222	4203.10	9	1	1	9	6.0
20NOV97	OHD2	Ponar	97222	5109.00	36	1	1	36	7.4
20NOV97	OHD2	Ponar	97223	1300.00	101	1	1	101	8.2
20NOV97	OHD2	Ponar	97223	3103.20	3	1	1	3	7.5
20NOV97	OHD2	Ponar	97223	4200.00	53	1	1	53	7.5
20NOV97	OHD2	Ponar	97223	4200.00	5	1	1	5	7.5
20NOV97	OHD2	Ponar	97223	4203.10	8	1	1	8	6.0

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
20NOV97	OHD2	Ponar	97223	5109.00	11	1	1	11	7.4
20NOV97	OHD	Plate	97224	1300.00	8	1	1	8	8.2
20NOV97	OHD	Plate	97224	3103.20	1	1	1	1	7.5
20NOV97	OHD	Plate	97224	3402.00	22	1	1	22	6.0
20NOV97	OHD	Plate	97224	4102.10	1	1	1	1	5.4
20NOV97	OHD	Plate	97224	4200.00	158	1	1	158	7.5
20NOV97	OHD	Plate	97224	4200.00	10	1	1	10	7.5
20NOV97	OHD	Plate	97224	5100.50	1	1	1	1	.
20NOV97	OHD	Plate	97224	5211.50	6	1	1	6	9.1
20NOV97	OHD	Plate	97225	1300.00	48	1	1	48	8.2
20NOV97	OHD	Plate	97225	4200.00	6	1	1	6	7.5
20NOV97	OHD	Plate	97226	1300.00	3	1	1	3	8.2
20NOV97	OHD	Plate	97226	3402.00	25	1	1	25	6.0
20NOV97	OHD	Plate	97226	4200.00	95	1	1	95	7.5
20NOV97	OHD	Plate	97226	4200.00	3	1	1	3	7.5
20NOV97	OHD	Plate	97226	4302.00	1	1	1	1	7.6
20NOV97	OHD	Plate	97226	5211.50	5	1	1	5	9.1
20NOV97	OHD	Plate	97226	9002.00	6	1	1	6	.
20NOV97	OHD	Plate	97226	9007.00	2	1	1	2	.
20NOV97	OHD	Ponar	97227	1300.00	24	1	1	24	8.2
20NOV97	OHD	Ponar	97227	3402.00	1	1	1	1	6.0
20NOV97	OHD	Ponar	97227	4200.00	8	1	1	8	7.5
20NOV97	OHD	Ponar	97227	5211.50	3	1	1	3	9.1
20NOV97	OHD	Ponar	97228	1300.00	26	1	1	26	8.2
20NOV97	OHD	Ponar	97228	4200.00	1	1	1	1	7.5
20NOV97	OHD	Ponar	97228	5109.00	3	1	1	3	7.4
20NOV97	OHD	Ponar	97229	1300.00	8	1	1	8	8.2
20NOV97	OHD	Ponar	97229	4200.00	2	1	1	2	7.5
20NOV97	OHD	Ponar	97230	1300.00	15	1	1	15	8.2
20NOV97	OHD	Ponar	97230	4200.00	3	1	1	3	7.5
20NOV97	OHD	Ponar	97230	5109.00	2	1	1	2	7.4
20NOV97	OHD	Ponar	97230	5201.40	1	1	1	1	4.8
20NOV97	OHD	Ponar	97230	5209.00	2	1	1	2	8.4
20NOV97	OHD	Ponar	97230	5211.50	1	1	1	1	9.1
20NOV97	OHD	Ponar	97230	5212.50	1	1	1	1	.
20NOV97	OHD	Ponar	97230	9004.00	1	1	1	1	.
20NOV97	OHD	Ponar	97231	1300.00	12	1	1	12	8.2
20NOV97	OHD	Ponar	97231	3103.20	1	1	1	1	7.5
20NOV97	OHD	Ponar	97231	3402.00	1	1	1	1	6.0
20NOV97	OHD	Ponar	97231	5109.00	2	1	1	2	7.4
20NOV97	OHD	Ponar	97231	9002.00	1	1	1	1	.
21NOV97	OHD3	Plate	97232	1300.00	45	1	1	45	8.2
21NOV97	OHD3	Plate	97232	3103.00	9	1	1	9	6.9
21NOV97	OHD3	Plate	97232	3103.20	39	1	1	39	7.5
21NOV97	OHD3	Plate	97232	4102.10	2	1	1	2	5.4
21NOV97	OHD3	Plate	97232	4200.00	7	1	1	7	7.5
21NOV97	OHD3	Plate	97232	4800.05	1	1	1	1	8.7
21NOV97	OHD3	Plate	97232	4800.20	2	1	1	2	8.7
21NOV97	OHD3	Plate	97232	4908.00	1	1	1	1	6.6
21NOV97	OHD3	Plate	97232	4951.00	1	1	1	1	5.6
21NOV97	OHD3	Plate	97232	5107.00	2	1	1	2	7.7
21NOV97	OHD3	Plate	97232	5201.40	2	1	1	2	4.8
21NOV97	OHD3	Plate	97232	5209.00	1	1	1	1	8.4
21NOV97	OHD3	Plate	97232	8001.00	1	1	1	1	.

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
21NOV97	OHD3	Plate	97233	1300.00	14	1	1	14	8.2
21NOV97	OHD3	Plate	97233	3103.00	3	1	1	3	6.9
21NOV97	OHD3	Plate	97233	3103.20	8	1	1	8	7.5
21NOV97	OHD3	Plate	97233	4101.50	1	1	1	1	6.4
21NOV97	OHD3	Plate	97233	4102.10	2	1	1	2	5.4
21NOV97	OHD3	Plate	97233	4200.00	15	1	1	15	7.5
21NOV97	OHD3	Plate	97233	4203.10	2	1	1	2	6.0
21NOV97	OHD3	Plate	97233	4302.00	1	1	1	1	7.6
21NOV97	OHD3	Plate	97233	4800.05	4	1	1	4	8.7
21NOV97	OHD3	Plate	97233	5101.00	1	1	1	1	6.3
21NOV97	OHD3	Plate	97233	5209.00	1	1	1	1	8.4
21NOV97	OHD3	Plate	97233	9002.00	10	1	1	10	.
21NOV97	OHD3	Plate	97234	1200.00	1	1	1	1	8.0
21NOV97	OHD3	Plate	97234	1300.00	2	1	1	2	8.2
21NOV97	OHD3	Plate	97234	3103.00	8	1	1	8	6.9
21NOV97	OHD3	Plate	97234	3103.20	33	1	1	33	7.5
21NOV97	OHD3	Plate	97234	4102.10	3	1	1	3	5.4
21NOV97	OHD3	Plate	97234	4103.00	2	1	1	2	8.9
21NOV97	OHD3	Plate	97234	4200.00	36	1	1	36	7.5
21NOV97	OHD3	Plate	97234	4200.00	1	1	1	1	7.5
21NOV97	OHD3	Plate	97234	4302.00	2	1	1	2	7.6
21NOV97	OHD3	Plate	97234	4800.05	5	1	1	5	8.7
21NOV97	OHD3	Plate	97234	4800.20	4	1	1	4	8.7
21NOV97	OHD3	Plate	97234	5109.00	1	1	1	1	7.4
21NOV97	OHD3	Plate	97234	5211.50	1	1	1	1	9.1
21NOV97	OHD3	Plate	97234	9002.00	3	1	1	3	.
21NOV97	OHD3	Ponar	97235	1300.00	15	1	1	15	8.2
21NOV97	OHD3	Ponar	97235	3103.20	3	1	1	3	7.5
21NOV97	OHD3	Ponar	97235	4200.00	13	1	1	13	7.5
21NOV97	OHD3	Ponar	97235	5101.00	4	1	1	4	6.3
21NOV97	OHD3	Ponar	97235	5107.00	1	1	1	1	7.7
21NOV97	OHD3	Ponar	97235	5109.00	3	1	1	3	7.4
21NOV97	OHD3	Ponar	97235	5200.10	1	1	1	1	.
21NOV97	OHD3	Ponar	97235	5203.00	1	1	1	1	6.0
21NOV97	OHD3	Ponar	97236	1300.00	5	1	1	5	8.2
21NOV97	OHD3	Ponar	97236	3103.20	4	1	1	4	7.5
21NOV97	OHD3	Ponar	97236	4101.50	1	1	1	1	6.4
21NOV97	OHD3	Ponar	97236	4200.00	6	1	1	6	7.5
21NOV97	OHD3	Ponar	97236	4200.00	1	1	1	1	7.5
21NOV97	OHD3	Ponar	97236	4800.20	1	1	1	1	8.7
21NOV97	OHD3	Ponar	97236	5101.00	2	1	1	2	6.3
21NOV97	OHD3	Ponar	97236	5105.00	1	1	1	1	6.8
21NOV97	OHD3	Ponar	97236	5109.00	1	1	1	1	7.4
21NOV97	OHD3	Ponar	97236	9002.00	6	1	1	6	.
21NOV97	OHD3	Ponar	97236	9004.00	1	1	1	1	.
21NOV97	OHD3	Ponar	97237	1300.00	13	1	1	13	8.2
21NOV97	OHD3	Ponar	97237	3103.00	1	1	1	1	6.9
21NOV97	OHD3	Ponar	97237	3103.20	18	1	1	18	7.5
21NOV97	OHD3	Ponar	97237	4102.10	1	1	1	1	5.4
21NOV97	OHD3	Ponar	97237	4200.00	12	1	1	12	7.5
21NOV97	OHD3	Ponar	97237	5101.00	6	1	1	6	6.3
21NOV97	OHD3	Ponar	97237	5109.00	4	1	1	4	7.4
21NOV97	OHD3	Ponar	97238	1200.00	1	1	1	1	8.0
21NOV97	OHD3	Ponar	97238	1300.00	3	1	1	3	8.2

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
21NOV97	OHD3	Ponar	97238	3103.20	2	1	1	2	7.5
21NOV97	OHD3	Ponar	97238	4102.10	1	1	1	1	5.4
21NOV97	OHD3	Ponar	97238	4200.00	2	1	1	2	7.5
21NOV97	OHD3	Ponar	97238	4302.00	1	1	1	1	7.6
21NOV97	OHD3	Ponar	97238	5109.00	2	1	1	2	7.4
21NOV97	OHD3	Ponar	97239	1300.00	19	1	1	19	8.2
21NOV97	OHD3	Ponar	97239	3103.20	2	1	1	2	7.5
21NOV97	OHD3	Ponar	97239	4101.50	1	1	1	1	6.4
21NOV97	OHD3	Ponar	97239	5101.00	2	1	1	2	6.3
21NOV97	OHD3	Ponar	97239	5107.00	1	1	1	1	7.7
21NOV97	OHD3	Ponar	97239	5109.00	2	1	1	2	7.4
21NOV97	OHD3	Ponar	97239	5201.40	1	1	1	1	4.8
21NOV97	OHD3	Ponar	97239	5209.00	1	1	1	1	8.4
21NOV97	OHD3	Ponar	97239	9002.00	2	1	1	2	.
21NOV97	MOB2	Plate	97240	1300.00	93	1	1	93	8.2
21NOV97	MOB2	Plate	97240	4101.50	9	1	1	9	6.4
21NOV97	MOB2	Plate	97240	4102.10	60	1	1	60	5.4
21NOV97	MOB2	Plate	97240	4200.00	86	1	1	86	7.5
21NOV97	MOB2	Plate	97240	4200.00	2	1	1	2	7.5
21NOV97	MOB2	Plate	97240	4237.00	7	1	1	7	4.4
21NOV97	MOB2	Plate	97240	4302.00	1	1	1	1	7.6
21NOV97	MOB2	Plate	97240	4905.20	1	1	1	1	5.7
21NOV97	MOB2	Plate	97240	4908.00	55	1	1	55	6.6
21NOV97	MOB2	Plate	97240	4951.00	3	1	1	3	5.6
21NOV97	MOB2	Plate	97240	5201.40	29	1	1	29	4.8
21NOV97	MOB2	Plate	97241	1300.00	9	1	1	9	8.2
21NOV97	MOB2	Plate	97241	4101.50	7	1	1	7	6.4
21NOV97	MOB2	Plate	97241	4102.10	16	1	1	16	5.4
21NOV97	MOB2	Plate	97241	4200.00	52	1	1	52	7.5
21NOV97	MOB2	Plate	97241	4200.00	2	1	1	2	7.5
21NOV97	MOB2	Plate	97241	4951.00	2	1	1	2	5.6
21NOV97	MOB2	Plate	97241	5211.50	1	1	1	1	9.1
21NOV97	MOB2	Plate	97241	8001.00	1	1	1	1	.
21NOV97	MOB2	Plate	97242	1300.00	89	1	1	89	8.2
21NOV97	MOB2	Plate	97242	3401.10	1	1	1	1	9.4
21NOV97	MOB2	Plate	97242	4101.50	6	1	1	6	6.4
21NOV97	MOB2	Plate	97242	4102.10	26	1	1	26	5.4
21NOV97	MOB2	Plate	97242	4200.00	30	1	1	30	7.5
21NOV97	MOB2	Plate	97242	4200.00	3	1	1	3	7.5
21NOV97	MOB2	Plate	97242	4800.05	2	1	1	2	8.7
21NOV97	MOB2	Plate	97242	4803.00	1	1	1	1	6.9
21NOV97	MOB2	Plate	97242	4908.00	4	1	1	4	6.6
21NOV97	MOB2	Plate	97242	4951.00	3	1	1	3	5.6
21NOV97	MOB2	Plate	97242	5109.00	1	1	1	1	7.4
21NOV97	MOB2	Plate	97242	5201.40	1	1	1	1	4.8
21NOV97	MOB2	Ponar	97243	1300.00	6	1	1	6	8.2
21NOV97	MOB2	Ponar	97243	5109.00	1	1	1	1	7.4
21NOV97	MOB2	Ponar	97244	1300.00	4	1	1	4	8.2
21NOV97	MOB2	Ponar	97244	4102.10	10	1	1	10	5.4
21NOV97	MOB2	Ponar	97244	4200.00	2	1	1	2	7.5
21NOV97	MOB2	Ponar	97244	4908.00	1	1	1	1	6.6
21NOV97	MOB2	Ponar	97244	5100.50	1	1	1	1	.
21NOV97	MOB2	Ponar	97244	5109.00	9	1	1	9	7.4
21NOV97	MOB2	Ponar	97244	8500.00	1	1	1	1	.

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
21NOV97	MOB2	Ponar	97245	1300.00	5	1	1	5	8.2
21NOV97	MOB2	Ponar	97245	4102.10	8	1	1	8	5.4
21NOV97	MOB2	Ponar	97245	4200.00	1	1	1	1	7.5
21NOV97	MOB2	Ponar	97245	4203.10	4	1	1	4	6.0
21NOV97	MOB2	Ponar	97245	5105.00	1	1	1	1	6.8
21NOV97	MOB2	Ponar	97245	5109.00	28	1	1	28	7.4
21NOV97	MOB2	Ponar	97246	4102.10	4	1	1	4	5.4
21NOV97	MOB2	Ponar	97246	4203.10	3	1	1	3	6.0
21NOV97	MOB2	Ponar	97246	5107.00	2	1	1	2	7.7
21NOV97	MOB2	Ponar	97246	5109.00	61	1	1	61	7.4
21NOV97	MOB2	Ponar	97247	1300.00	13	1	1	13	8.2
21NOV97	MOB2	Ponar	97247	4102.10	1	1	1	1	5.4
21NOV97	MOB2	Ponar	97247	4200.00	4	1	1	4	7.5
21NOV97	MOB2	Ponar	97247	4203.10	5	1	1	5	6.0
21NOV97	MOB2	Ponar	97247	5109.00	5	1	1	5	7.4
21NOV97	MOB	Plate	97248	4102.10	1	1	1	1	5.4
21NOV97	MOB	Plate	97248	4200.00	27	1	1	27	7.5
21NOV97	MOB	Plate	97248	4800.20	4	1	1	4	8.7
21NOV97	MOB	Plate	97248	5213.00	1	1	1	1	5.0
21NOV97	MOB	Plate	97249	1300.00	2	1	1	2	8.2
21NOV97	MOB	Plate	97249	4200.00	29	1	1	29	7.5
21NOV97	MOB	Plate	97249	4302.00	2	1	1	2	7.6
21NOV97	MOB	Plate	97249	4800.05	1	1	1	1	8.7
21NOV97	MOB	Plate	97249	5204.10	1	1	1	1	6.9
21NOV97	MOB	Plate	97249	5213.00	3	1	1	3	5.0
21NOV97	MOB	Plate	97249	6001.00	1	1	1	1	.
21NOV97	MOB	Plate	97249	9002.00	1	1	1	1	.
21NOV97	MOB	Plate	97250	1200.00	1	1	1	1	8.0
21NOV97	MOB	Plate	97250	1300.00	17	1	1	17	8.2
21NOV97	MOB	Plate	97250	3401.10	2	1	1	2	9.4
21NOV97	MOB	Plate	97250	4101.50	6	1	1	6	6.4
21NOV97	MOB	Plate	97250	4102.10	34	1	1	34	5.4
21NOV97	MOB	Plate	97250	4104.00	13	1	1	13	6.9
21NOV97	MOB	Plate	97250	4200.00	189	1	1	189	7.5
21NOV97	MOB	Plate	97250	4200.00	10	1	1	10	7.5
21NOV97	MOB	Plate	97250	4237.00	20	1	1	20	4.4
21NOV97	MOB	Plate	97250	4302.00	3	1	1	3	7.6
21NOV97	MOB	Plate	97250	4305.00	15	1	1	15	6.0
21NOV97	MOB	Plate	97250	4305.10	1	1	1	1	4.0
21NOV97	MOB	Plate	97250	4800.05	1	1	1	1	8.7
21NOV97	MOB	Plate	97250	4800.20	7	1	1	7	8.7
21NOV97	MOB	Plate	97250	4908.00	27	1	1	27	6.6
21NOV97	MOB	Plate	97250	5201.40	6	1	1	6	4.8
21NOV97	MOB	Plate	97250	5213.00	4	1	1	4	5.0
21NOV97	MOB	Ponar	97251	1200.00	1	1	1	1	8.0
21NOV97	MOB	Ponar	97251	1300.00	14	1	1	14	8.2
21NOV97	MOB	Ponar	97251	3108.10	2	1	1	2	.
21NOV97	MOB	Ponar	97251	4101.50	2	1	1	2	6.4
21NOV97	MOB	Ponar	97251	4200.00	18	1	1	18	7.5
21NOV97	MOB	Ponar	97252	1300.00	6	1	1	6	8.2
21NOV97	MOB	Ponar	97252	4101.50	1	1	1	1	6.4
21NOV97	MOB	Ponar	97252	4102.10	5	1	1	5	5.4
21NOV97	MOB	Ponar	97252	4200.00	2	1	1	2	7.5
21NOV97	MOB	Ponar	97252	5100.50	1	1	1	1	.

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
21NOV97	MOB	Ponar	97253	1300.00	68	1	1	68	8.2
21NOV97	MOB	Ponar	97253	3401.10	3	1	1	3	9.4
21NOV97	MOB	Ponar	97253	4101.50	15	1	1	15	6.4
21NOV97	MOB	Ponar	97253	4102.10	5	1	1	5	5.4
21NOV97	MOB	Ponar	97253	4104.00	1	1	1	1	6.9
21NOV97	MOB	Ponar	97253	4200.00	27	1	1	27	7.5
21NOV97	MOB	Ponar	97253	4200.00	1	1	1	1	7.5
21NOV97	MOB	Ponar	97253	4203.10	4	1	1	4	6.0
21NOV97	MOB	Ponar	97253	4701.00	1	1	1	1	9.8
21NOV97	MOB	Ponar	97253	4701.36	1	1	1	1	6.7
21NOV97	MOB	Ponar	97253	4800.05	1	1	1	1	8.7
21NOV97	MOB	Ponar	97253	5100.50	1	1	1	1	.
21NOV97	MOB	Ponar	97253	5105.00	5	1	1	5	6.8
21NOV97	MOB	Ponar	97253	5107.00	6	1	1	6	7.7
21NOV97	MOB	Ponar	97253	5109.00	6	1	1	6	7.4
21NOV97	MOB	Ponar	97253	5110.00	2	1	1	2	.
21NOV97	MOB	Ponar	97253	5209.00	1	1	1	1	8.4
21NOV97	MOB	Ponar	97253	5213.00	6	1	1	6	5.0
21NOV97	MOB	Ponar	97253	8500.00	1	1	1	1	.
21NOV97	MOB	Ponar	97253	9007.00	1	1	1	1	.
21NOV97	MOB	Ponar	97254	1300.00	51	1	1	51	8.2
21NOV97	MOB	Ponar	97254	3401.10	2	1	1	2	9.4
21NOV97	MOB	Ponar	97254	4101.50	27	1	1	27	6.4
21NOV97	MOB	Ponar	97254	4102.10	15	1	1	15	5.4
21NOV97	MOB	Ponar	97254	4104.00	5	1	1	5	6.9
21NOV97	MOB	Ponar	97254	4200.00	18	1	1	18	7.5
21NOV97	MOB	Ponar	97254	4203.10	9	1	1	9	6.0
21NOV97	MOB	Ponar	97254	4243.00	1	1	1	1	6.0
21NOV97	MOB	Ponar	97254	4302.00	2	1	1	2	7.6
21NOV97	MOB	Ponar	97254	4800.20	1	1	1	1	8.7
21NOV97	MOB	Ponar	97254	4908.00	1	1	1	1	6.6
21NOV97	MOB	Ponar	97254	5100.50	4	1	1	4	.
21NOV97	MOB	Ponar	97254	5105.00	1	1	1	1	6.8
21NOV97	MOB	Ponar	97254	5109.00	7	1	1	7	7.4
21NOV97	MOB	Ponar	97254	5201.40	7	1	1	7	4.8
21NOV97	MOB	Ponar	97255	1200.00	4	1	1	4	8.0
21NOV97	MOB	Ponar	97255	1300.00	16	1	1	16	8.2
21NOV97	MOB	Ponar	97255	3401.10	4	1	1	4	9.4
21NOV97	MOB	Ponar	97255	4101.50	47	1	1	47	6.4
21NOV97	MOB	Ponar	97255	4102.10	20	1	1	20	5.4
21NOV97	MOB	Ponar	97255	4200.00	39	1	1	39	7.5
21NOV97	MOB	Ponar	97255	4200.00	2	1	1	2	7.5
21NOV97	MOB	Ponar	97255	4203.10	10	1	1	10	6.0
21NOV97	MOB	Ponar	97255	4237.00	2	1	1	2	4.4
21NOV97	MOB	Ponar	97255	4701.00	1	1	1	1	9.8
21NOV97	MOB	Ponar	97255	4800.05	4	1	1	4	8.7
21NOV97	MOB	Ponar	97255	4905.20	1	1	1	1	5.7
21NOV97	MOB	Ponar	97255	5100.50	6	1	1	6	.
21NOV97	MOB	Ponar	97255	5105.00	2	1	1	2	6.8
21NOV97	MOB	Ponar	97255	5107.00	2	1	1	2	7.7
21NOV97	MOB	Ponar	97255	5109.00	32	1	1	32	7.4
21NOV97	MOB	Ponar	97255	5201.40	9	1	1	9	4.8
21NOV97	MOB	Ponar	97255	5209.00	4	1	1	4	8.4
21NOV97	MOB	Ponar	97255	8001.00	1	1	1	1	.

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
21NOV97	MOB	Ponar	97255	8500.00	1	1	1	1	.
21NOV97	MOB	Ponar	97255	8504.00	2	1	1	2	.
21NOV97	MOB	Ponar	97255	9002.00	3	1	1	3	.
21NOV97	TOC	Plate	97256	1300.00	55	1	1	55	8.2
21NOV97	TOC	Plate	97256	3104.00	1	1	1	1	7.9
21NOV97	TOC	Plate	97256	3402.00	1	1	1	1	6.0
21NOV97	TOC	Plate	97256	4103.00	2	1	1	2	8.9
21NOV97	TOC	Plate	97256	4200.00	70	1	1	70	7.5
21NOV97	TOC	Plate	97256	4203.10	3	1	1	3	6.0
21NOV97	TOC	Plate	97256	4302.00	27	1	1	27	7.6
21NOV97	TOC	Plate	97256	4304.10	65	1	1	65	7.1
21NOV97	TOC	Plate	97256	5201.40	1	1	1	1	4.8
21NOV97	TOC	Plate	97256	5209.00	1	1	1	1	8.4
21NOV97	TOC	Plate	97257	1200.00	1	1	1	1	8.0
21NOV97	TOC	Plate	97257	1300.00	116	1	1	116	8.2
21NOV97	TOC	Plate	97257	3104.00	4	1	1	4	7.9
21NOV97	TOC	Plate	97257	4103.00	1	1	1	1	8.9
21NOV97	TOC	Plate	97257	4200.00	147	1	1	147	7.5
21NOV97	TOC	Plate	97257	4200.00	3	1	1	3	7.5
21NOV97	TOC	Plate	97257	4203.10	9	1	1	9	6.0
21NOV97	TOC	Plate	97257	4302.00	31	1	1	31	7.6
21NOV97	TOC	Plate	97257	4304.10	6	1	1	6	7.1
21NOV97	TOC	Plate	97257	5201.40	7	1	1	7	4.8
21NOV97	TOC	Plate	97257	5203.00	5	1	1	5	6.0
21NOV97	TOC	Plate	97257	5208.00	1	1	1	1	4.0
21NOV97	TOC	Plate	97257	6001.00	1	1	1	1	.
21NOV97	TOC	Plate	97257	9002.00	1	1	1	1	.
21NOV97	TOC	Plate	97257	9003.00	1	1	1	1	5.7
21NOV97	TOC	Plate	97257	9004.00	1	1	1	1	.
21NOV97	TOC	Plate	97258	1200.00	1	1	1	1	8.0
21NOV97	TOC	Plate	97258	1300.00	80	1	1	80	8.2
21NOV97	TOC	Plate	97258	3401.10	1	1	1	1	9.4
21NOV97	TOC	Plate	97258	4102.10	6	1	1	6	5.4
21NOV97	TOC	Plate	97258	4103.00	1	1	1	1	8.9
21NOV97	TOC	Plate	97258	4200.00	63	1	1	63	7.5
21NOV97	TOC	Plate	97258	4203.10	3	1	1	3	6.0
21NOV97	TOC	Plate	97258	4302.00	13	1	1	13	7.6
21NOV97	TOC	Plate	97258	5201.40	3	1	1	3	4.8
21NOV97	TOC	Plate	97258	8001.00	2	1	1	2	.
21NOV97	TOC	Plate	97258	9002.00	8	1	1	8	.
21NOV97	TOC	Plate	97258	9004.00	5	1	1	5	.
21NOV97	TOC	Ponar	97259	1300.00	93	1	1	93	8.2
21NOV97	TOC	Ponar	97259	3104.00	1	1	1	1	7.9
21NOV97	TOC	Ponar	97259	3401.10	15	1	1	15	9.4
21NOV97	TOC	Ponar	97259	4200.00	67	1	1	67	7.5
21NOV97	TOC	Ponar	97259	4203.10	2	1	1	2	6.0
21NOV97	TOC	Ponar	97259	4302.00	31	1	1	31	7.6
21NOV97	TOC	Ponar	97259	4304.10	1	1	1	1	7.1
21NOV97	TOC	Ponar	97259	4905.20	1	1	1	1	5.7
21NOV97	TOC	Ponar	97259	5209.00	1	1	1	1	8.4
21NOV97	TOC	Ponar	97259	8001.00	1	1	1	1	.
21NOV97	TOC	Ponar	97259	8502.00	1	1	1	1	.
21NOV97	TOC	Ponar	97259	9002.00	4	1	1	4	.
21NOV97	TOC	Ponar	97260	1200.00	2	1	1	2	8.0

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
21NOV97	TOC	Ponar	97260	1300.00	200	1	1	200	8.2
21NOV97	TOC	Ponar	97260	3401.10	8	1	1	8	9.4
21NOV97	TOC	Ponar	97260	4101.50	2	1	1	2	6.4
21NOV97	TOC	Ponar	97260	4102.10	1	1	1	1	5.4
21NOV97	TOC	Ponar	97260	4103.00	9	1	1	9	8.9
21NOV97	TOC	Ponar	97260	4200.00	451	1	1	451	7.5
21NOV97	TOC	Ponar	97260	4203.10	13	1	1	13	6.0
21NOV97	TOC	Ponar	97260	4302.00	36	1	1	36	7.6
21NOV97	TOC	Ponar	97260	4304.10	1	1	1	1	7.1
21NOV97	TOC	Ponar	97260	4704.00	1	1	1	1	1.0
21NOV97	TOC	Ponar	97260	5107.00	1	1	1	1	7.7
21NOV97	TOC	Ponar	97260	5203.00	1	1	1	.	6.0
21NOV97	TOC	Ponar	97260	5209.00	2	1	1	2	8.4
21NOV97	TOC	Ponar	97260	5212.00	1	1	1	1	5.0
21NOV97	TOC	Ponar	97260	9002.00	34	1	1	34	.
21NOV97	TOC	Ponar	97260	9003.00	9	1	1	9	5.7
21NOV97	TOC	Ponar	97261	1200.00	3	1	1	3	8.0
21NOV97	TOC	Ponar	97261	1300.00	28	1	1	28	8.2
21NOV97	TOC	Ponar	97261	3104.00	6	1	1	6	7.9
21NOV97	TOC	Ponar	97261	3401.10	32	1	1	32	9.4
21NOV97	TOC	Ponar	97261	4101.50	1	1	1	1	6.4
21NOV97	TOC	Ponar	97261	4103.00	3	1	1	3	8.9
21NOV97	TOC	Ponar	97261	4200.00	68	1	1	68	7.5
21NOV97	TOC	Ponar	97261	4203.10	2	1	1	2	6.0
21NOV97	TOC	Ponar	97261	4302.00	130	1	1	130	7.6
21NOV97	TOC	Ponar	97261	4304.10	1	1	1	1	7.1
21NOV97	TOC	Ponar	97261	4304.30	3	1	1	3	7.1
21NOV97	TOC	Ponar	97261	4905.20	1	1	1	1	5.7
21NOV97	TOC	Ponar	97261	4952.00	2	1	1	2	7.5
21NOV97	TOC	Ponar	97261	5109.00	1	1	1	1	7.4
21NOV97	TOC	Ponar	97261	5201.40	4	1	1	4	4.8
21NOV97	TOC	Ponar	97261	5209.00	1	1	1	1	8.4
21NOV97	TOC	Ponar	97261	6001.00	1	1	1	1	.
21NOV97	TOC	Ponar	97261	9002.00	22	1	1	22	.
21NOV97	TOC	Ponar	97261	9003.00	16	1	1	16	5.7
21NOV97	TOC	Ponar	97261	9004.00	1	1	1	1	.
21NOV97	TOC	Ponar	97262	1200.00	1	1	1	1	8.0
21NOV97	TOC	Ponar	97262	1300.00	28	1	1	28	8.2
21NOV97	TOC	Ponar	97262	3401.10	2	1	1	2	9.4
21NOV97	TOC	Ponar	97262	4101.50	2	1	1	2	6.4
21NOV97	TOC	Ponar	97262	4103.00	2	1	1	2	8.9
21NOV97	TOC	Ponar	97262	4200.00	139	1	1	139	7.5
21NOV97	TOC	Ponar	97262	4203.10	9	1	1	9	6.0
21NOV97	TOC	Ponar	97262	4302.00	66	1	1	66	7.6
21NOV97	TOC	Ponar	97262	4905.20	3	1	1	3	5.7
21NOV97	TOC	Ponar	97262	5105.00	1	1	1	1	6.8
21NOV97	TOC	Ponar	97262	5201.40	2	1	1	2	4.8
21NOV97	TOC	Ponar	97262	8502.00	1	1	1	1	.
21NOV97	TOC	Ponar	97262	9002.00	5	1	1	5	.
21NOV97	TOC	Ponar	97262	9003.00	5	1	1	5	5.7
21NOV97	TOC	Ponar	97262	9004.00	2	1	1	2	.
21NOV97	TOC	Ponar	97263	1200.00	3	1	1	3	8.0
21NOV97	TOC	Ponar	97263	1300.00	50	1	1	50	8.2
21NOV97	TOC	Ponar	97263	3401.10	2	1	1	2	9.4

Date Collected	Station	Sampling Gear	Sample Number	Taxa Code	Sample Count	Number of Field Splits	Number of Lab Splits	Adjusted Count	Tolerance Value
21NOV97	TOC	Ponar	97263	4101.50	1	1	1	1	6.4
21NOV97	TOC	Ponar	97263	4200.00	112	1	1	112	7.5
21NOV97	TOC	Ponar	97263	4203.10	11	1	1	11	6.0
21NOV97	TOC	Ponar	97263	4302.00	94	1	1	94	7.6
21NOV97	TOC	Ponar	97263	5105.00	1	1	1	1	6.8
21NOV97	TOC	Ponar	97263	5107.00	1	1	1	1	7.7
21NOV97	TOC	Ponar	97263	5109.00	3	1	1	3	7.4
21NOV97	TOC	Ponar	97263	5209.00	1	1	1	1	8.4
21NOV97	TOC	Ponar	97263	8502.00	1	1	1	1	.
21NOV97	TOC	Ponar	97263	9002.00	1	1	1	1	.
21NOV97	TOC	Ponar	97263	9003.00	1	1	1	1	5.7

Appendix B

Water Chemistry Values Used in the Benthic Invertebrate Community Characteristics Correlation Analysis

Site	Season	Conductivity (umhos/cm)	Dissolved Oxygen (mg/L)	pH	Total Suspended Solids (mg/L)	Total Ammonia (mg/L)	Total Nitrogen (mg/L)
DBR	February	200	3.20	6.74	4	0.14	1.00
DBR	May	169	5.76	6.90	7	0.05	1.41
DBR	August	1235	2.78	6.15	5	0.15	1.53
DBR	November	1870	6.08	6.52	6	0.06	1.35
DBR2	February	211	6.32	6.88	11	0.19	1.17
DBR2	May	907	6.53	6.55	31	0.43	2.29
DBR2	August	1343	7.11	6.13	10	0.14	1.94
DBR2	November	1980	6.34	6.73	12	0.10	1.54
OHD	February	1187	5.75	7.39	7	0.05	0.88
OHD	May	815	10.25	7.26	18	0.09	1.55
OHD	August	366	4.15	6.14	4	0.05	1.57
OHD	November	885	6.23	6.91	11	0.04	1.24
OHD2	February	1145	4.60	7.16	8	0.06	0.96
OHD2	May	809	10.34	6.56	8	0.09	1.45
OHD2	August	382	4.76	6.22	4	0.04	1.50
OHD2	November	892	6.10	6.87	11	0.04	1.23
OHD3	February	778	6.34	7.09	2	0.04	0.83
OHD3	May	506	10.21	6.39	10	0.15	1.43
OHD3	August	257	4.95	6.09	7	0.03	1.60
OHD3	November	414	7.28	6.82	7	0.04	1.12
MOB	February	534	3.74	6.67	0	0.07	0.84
MOB	May	359	6.09	6.57	2	0.06	1.22
MOB	August	390	5.52	6.01	2	0.06	1.42
MOB	November	206	6.72	6.04	6	0.03	1.32
MOB2	February	875	6.26	6.90	10	0.08	1.10
MOB2	May	150	10.20	5.65	5	0.06	1.86
MOB2	August	230	5.43	5.88	6	0.07	1.52
MOB2	November	142	6.96	5.66	4	0.04	1.37
TOC	February	322	3.21	6.36	0	0.05	1.05
TOC	May	179	11.29	6.61	4	0.07	1.18
TOC	August	169	2.66	5.82	2	0.04	1.24
TOC	November	285	3.12	6.24	2	0.02	1.16

Site	Season	Nitrite Nitrate (mg/L)	Total Phosphorus (mg/L)	Total Ortho Phosphate (mg/L)	Total Organic Carbon (mg/L)	Chlorophyll-a (mg/m3)
DBR	February	0.17	0.17	0.09	7.90	2.73
DBR	May	0.16	0.20	0.12	13.74	.
DBR	August	0.26	0.51	0.33	1.46	8.23
DBR	November	0.58	0.27	0.19	11.25	0.83
DBR2	February	0.18	0.23	0.06	7.70	3.55
DBR2	May	0.61	0.84	0.60	25.20	.
DBR2	August	0.49	0.58	0.32	20.78	25.16
DBR2	November	1.12	0.23	0.08	10.68	3.02
OHD	February	0.09	0.23	0.14	16.00	6.26
OHD	May	0.16	0.40	0.23	33.37	1.29
OHD	August	0.12	0.48	0.31	45.68	3.10
OHD	November	0.17	0.31	0.23	26.00	0.65
OHD2	February	0.08	0.28	0.19	14.80	1.80
OHD2	May	0.14	0.34	0.23	33.80	0.32
OHD2	August	0.11	0.43	0.28	47.43	2.46
OHD2	November	0.16	0.32	0.25	25.68	0.54
OHD3	February	0.05	0.09	0.05	20.00	1.48
OHD3	May	0.17	0.17	0.08	39.42	0.59
OHD3	August	0.10	0.32	0.17	56.05	4.36
OHD3	November	0.05	0.13	0.08	33.97	0.67
MOB	February	0.14	0.25	0.18	17.60	0.44
MOB	May	0.17	0.25	0.14	37.87	.
MOB	August	0.19	0.40	0.27	37.07	0.89
MOB	November	0.05	0.15	0.09	46.60	0.45
MOB2	February	0.25	0.21	0.19	20.20	1.24
MOB2	May	0.04	0.13	0.06	63.68	0.87
MOB2	August	0.08	0.26	0.17	44.02	1.68
MOB2	November	0.01	0.12	0.06	49.98	1.01
TOC	February	0.02	0.08	0.04	27.50	1.36
TOC	May	0.08	0.15	0.08	37.70	51.98
TOC	August	0.05	0.14	0.08	38.49	0.68
TOC	November	0.02	0.12	0.08	31.55	0.57

Site	Season	Total Dissolved Solids (mg/L)	Turbidity (NTU)	Water Temperature (C)	Color (Pt-Co units)
DBR	February	1130	4.1	18.44	30
DBR	May	912	6.8	21.84	200
DBR	August	658	6.3	26.36	100
DBR	November	1080	4.2	17.78	40
DBR2	February	1160	13.1	16.22	20
DBR2	May	565	21.0	20.05	200
DBR2	August	744	14.4	29.92	100
DBR2	November	1120	6.4	16.95	30
OHD	February	741	13.9	14.93	50
OHD	May	510	12.3	19.64	500
OHD	August	272	7.2	27.25	800
OHD	November	562	7.5	18.31	150
OHD2	February	710	12.1	18.43	50
OHD2	May	524	10.7	19.08	500
OHD2	August	286	6.4	28.21	800
OHD2	November	550	7.9	18.09	150
OHD3	February	482	7.5	15.65	70
OHD3	May	367	13.5	18.83	800
OHD3	August	216	6.0	27.43	800
OHD3	November	368	10.5	16.64	400
MOB	February	344	1.6	16.75	100
MOB	May	278	4.0	21.50	500
MOB	August	287	4.7	26.82	390
MOB	November	174	2.8	17.18	500
MOB2	February	548	3.8	15.97	100
MOB2	May	186	4.0	20.28	800
MOB2	August	206	5.0	26.89	800
MOB2	November	131	3.2	15.79	800
TOC	February	231	0.6	16.83	150
TOC	May	168	3.8	18.80	500
TOC	August	156	3.9	26.78	600
TOC	November	208	0.8	16.46	250

Appendix C

Benthic Invertebrate Community Characteristics Used in the Water Chemistry Correlation Analysis

STATION	SEASON	Ponar Species Richness	Ponar Density	Ponar SWDI	Ponar HBI
DBR	February	12.2	247.0	2.12	7.73
DBR	May	9.0	49.2	2.17	7.26
DBR	August	5.6	152.2	1.59	7.73
DBR	November	8.8	177.6	1.69	7.80
DBR2	February	4.2	102.2	1.38	7.78
DBR2	May	5.4	54.2	1.29	7.88
DBR2	August	4.0	35.8	1.02	7.76
DBR2	November	3.8	33.8	1.17	7.90
MOB	February	9.0	30.4	2.42	7.12
MOB	May	10.0	51.0	2.48	6.94
MOB	August	10.6	73.4	2.55	6.64
MOB	November	13.0	114.2	2.57	6.93
MOB2	February	7.6	134.4	1.19	7.34
MOB2	May	8.2	69.0	1.82	7.42
MOB2	August	7.0	65.6	1.83	7.32
MOB2	November	4.8	36.0	1.46	7.21
OHD	February	9.2	70.0	2.24	7.41
OHD	May	4.2	24.6	1.07	7.83
OHD	August	3.8	48.8	0.94	8.02
OHD	November	4.4	23.8	1.25	7.95
OHD2	February	10.0	140.2	2.31	7.66
OHD2	May	9.0	200.8	2.06	7.76
OHD2	August	7.4	121.0	1.37	7.86
OHD2	November	6.2	159.2	1.69	7.70
OHD3	February	13.2	152.0	2.56	7.33
OHD3	May	9.6	80.2	2.18	7.42
OHD3	August	8.0	41.2	2.18	7.34
OHD3	November	8.2	33.6	2.47	7.54
TOC	February	12.8	161.2	2.88	7.01
TOC	May	13.2	99.2	2.69	6.15
TOC	August	8.2	49.6	2.13	7.48
TOC	November	15.6	373.2	2.18	7.68

STATION	SEASON	HD Plate Species Richness	HD Plate Density	HD Plate SWDI	HD Plate HBI
DBR	February	7.7	72.3	2.10	7.41
DBR	May	9.0	164.3	1.80	6.90
DBR	August	15.3	341.7	1.84	6.48
DBR	November	8.3	197.0	1.86	7.05
DBR2	February	6.3	235.7	1.55	7.48
DBR2	May	7.3	171.7	1.30	7.51
DBR2	August	7.3	70.7	1.79	7.75
DBR2	November	4.3	48.0	1.28	7.80
MOB	February	7.3	31.3	2.03	6.91
MOB	May	7.0	72.7	1.49	6.76
MOB	August	12.0	537.7	0.90	7.34
MOB	November	9.3	143.0	1.64	7.21
MOB2	February	8.7	329.0	1.11	7.42
MOB2	May	12.7	193.7	1.82	7.18
MOB2	August	16.3	540.0	1.74	7.18
MOB2	November	9.3	201.0	2.11	7.10
OHD	February	9.0	104.0	2.21	7.23
OHD	May	10.0	197.3	1.89	7.08
OHD	August	7.7	57.3	2.07	7.15
OHD	November	5.3	133.7	0.99	7.59
OHD2	February	10.0	187.3	2.19	7.27
OHD2	May	14.0	355.3	1.70	7.00
OHD2	August	9.7	110.0	2.04	6.96
OHD2	November	9.7	193.7	1.26	7.24
OHD3	February	9.3	53.0	2.46	7.52
OHD3	May	11.0	217.7	2.54	7.21
OHD3	August	13.7	164.0	2.64	6.99
OHD3	November	12.7	92.3	2.61	7.58
TOC	February	12.0	97.0	2.33	6.55
TOC	May	9.7	356.3	2.01	7.06
TOC	August	9.3	212.0	2.05	6.93
TOC	November	12.3	249.0	2.15	7.59