Alabama / Mississippi
Pilot Reference Site Project
1990 - 1994

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Alabama Department of Environmental Management

Mississippi Department of Environmental Quality

In Cooperation With:

Environmental Protection Agency - Environmental Research Lab
Corvallis Oregon

Environmental Protection Agency - Region IV
Atlanta, Georgia

Environmental Protection Agency - Region IV
Environmental Services Division
Athens, Georgia

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Preface

Funding for the project was provided by matching grants to the States of Alabama and Mississippi available through Section 106 of the Federal Water Pollution Control Act.

This report includes results from a multi-year project. Comments or questions related to the content of this report should be addressed to:

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Executive Summary

The Clean Water Act directs the U.S. Environmental Protection Agency to develop programs that will evaluate, restore and maintain the chemical, physical, and biological integrity of the Nation's waters. In 1990, the EPA mandated the development of biological water quality criteria to complement the existing chemically based water quality programs. As a direct result of this mandate, an ecoregional reference site project was initiated in order to accomplish the initial biocriteria development steps for wadeable streams in Alabama and Mississippi. The project was a cooperative effort between the Alabama Department of Environmental Management (ADEM), Mississippi Office of Pollution Control (MOPC), the Environmental Protection Agency Region IV (EPA), and the EPA-Environmental Research Laboratory-Corvallis, Oregon (ERL-C). This project provided assistance for ADEM and MOPC to further refine the Southeastern Plains Ecoregion and locate possible reference sites within this ecoregion. It also served to increase the effectiveness of the limited resources available to participating states by allowing them to share data collected in shared ecoregions.

The Southeastern Plains Ecoregion (ecoregion number 65 from Omernik 1987) constitutes approximately fifty percent (50%) of the land area of both Alabama and Mississippi. To better enable state agencies to categorize the biological and physical characteristics of streams and to infer water quality from these characteristics it was first necessary for this large ecoregion to be subregionalized. Interagency cooperation was necessary in order to assemble maps of geographic information and related water quality data and provide this information to ERL-C during the summer of 1990. Utilizing qualitative methods the ERL-C subdivided the Southeastern Plains ecoregion of Mississippi and Alabama into six subregions and delineated the transition zones between the subregions. As a result of further regionalization effort in Florida, a seventh subecoregion was delineated in Alabama.

The development of subecoregions which delineate regions of similar physical and chemical characteristics enabled ADEM and MOPC to share data collected within the four shared subregions in the Southeastern Plains Ecoregion. The biological data available to each state for use in biocriteria development was therefore increased while minimizing the expenditure of resources. The development of a standardized macroinvertebrate Rapid Bioassessment Protocol (RBP) by the EPA in 1989 also aided in the states' efforts, since both

states developed macroinvertebrate sampling protocols modeled after the RBP outlined in Plafkin et al. (1989). Both agencies already had experience with sampling and identification of macroinvertebrates and utilized the original habitat assessment and physical characterization from the EPA Rapid Bioassessment Protocol manual. Each state utilized a multihabitat bioassessment protocol documented in state Standard Operating Procedures manuals. If the states were to share data the comparability of the bioassessment methods utilized by each state, including the habitat assessment, physical characterization, community to be assessed, sampling techniques and organism identification needed to be documented. A core group of physical and chemical parameters to be collected during each reference site bioassessment was selected to further ensure the similarity and usefulness of the collected data to each state agency.

In order to determine the comparability of the data generated by each state, field biologists from ADEM and MOPC have conducted annual side-by-side biological assessments at a common site as a portion of the QA/QC effort from 1991 to 1994. Comparisons of these data show strong similarities in the data collected by ADEM and MOPC field crews as compared to what would be expected to be collected by two ADEM field crews. It was concluded that these slightly differing sampling techniques produced very comparable results, and that the sharing of data between these agencies was a plausible option.

During 1991 and 1992, one-hundred-eight sites within the Southeastern Plains ecoregion were visited by ADEM biologists to determine their suitability as ecoregional reference sites. These sites were located within 78 candidate reference watersheds in five of the seven subecoregions. During this same period, MOPC biologists evaluated 104 sites in 48 different watersheds in four subecoregions of the Southeastern Plains. Generally, there were more physical similarities between sites within the same subecoregion, than between subecoregions. However, there was some overlapping of physical characteristics between the Flatwoods Alluvial Prairie Margins and the Southeastern Plains and Hills subecoregions. Although subregionalization reduces variability, heterogeneity still exists between streams within a subecoregion. Sites were therefore chosen to reflect this variability in order to ensure that reference sites will be comparable to study streams within the subecoregion.

Since initiation of the reference site project, ADEM and MOPC have continued to cooperate and assist each other by 1) exchanging raw data collected at sites within the four

shared subregions of the Southeastern Plains ecoregion and 2) conducting quality assurance sampling events annually to ensure the comparability of sampling techniques. Joint assessment data has been exchanged for all years collected (1990-1994) and comparisons of metrics from these efforts continue to validate the data exchange process. State managers and biologists should continue to make the annual joint assessment effort a priority. Data exchange between the participants must remain an integral part of this effort, as it will add to the existing database at an increased rate while being extremely cost effective.

The ultimate goal of this project was to advance biocriteria development efforts to the point where each state could proceed with subsequent steps independently or in cooperation with another adjoining state. This project provided the necessary groundwork for independent efforts by both agencies in other ecoregions as well as additional cooperative efforts.

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I. Introduction

The Clean Water Act directs the U.S. Environmental Protection Agency to develop programs that will evaluate, restore and maintain the chemical, physical, and biological integrity of the Nation's waters. In 1990, the EPA mandated the development of biological water quality criteria to complement the existing chemically based water quality programs and published a program guidance document for biological surveys and biocriteria development (EPA 1990). In order to develop biological criteria, states would be provided guidance which would allow: 1) identification of least impaired water bodies to establish the reference condition and; 2) characterization of the aquatic communities inhabiting reference surface waters. A regional reference system identifies similarities in the physico-chemical characteristics of watersheds that influence aquatic ecology. An important benefit of this type of approach is the establishment of a baseline condition for the least impacted surface waters within the region's dominant landscape pattern. Establishing the baseline condition provides a foundation from which biological criteria can be derived. At a bioassessment methodology workshop held in March 1989, water quality biologists from the Region IV states agreed that biocriteria should be developed within five years and that these criteria should be based upon ecoregional reference sites. (EPA 1989)

Following the 1989 workshop, EPA Region IV issued a memorandum to the states discussing the region's biocriteria strategy (EPA 1992a). The intent of this strategy was to outline methods necessary to assist states in developing a workable, flexible biocriteria development and adoption process. Biocriteria development guidelines (Table

Table 1
Biocriteria Implementation Guidelines
EPA Region IV Biocriteria Program Support Document (1992)

1. Refine ecoregions/subecoregions
2. Select candidate reference watersheds
3. Select relatively unimpacted candidate reference watersheds
4. Select relatively unimpacted candidate reference sites
5. Choose biological communities, physical habitats and chemical parameters for sampling
6. Document sampling protocols and QA/QC procedures
7. Select an array of biological metrics for evaluation
8. Sample reference sites to establish variability and statistical bounds for biological, habitat, and chemical parameters
9. Develop scoring criteria for metrics (% comparability to reference)
10. Establish condition categories for aquatic ecosystems based on severity of impairment
11. Test applicability at a wide variety of impacted sites
12. Adopt numerical biological criteria in state standards

1) were outlined in greater detail in the Region IV Biocriteria Support Document (EPA 1992b). The initial steps of this process (1 - 8) were the establishment and sampling of least-impacted reference sites and involved: 1) the regionalization process; 2) the documentation and standardization of sampling protocols and QA/QC procedures, and; 3) the selection and sampling of ecoregional reference sites. The final steps of this process (9-12), were dependent upon data collected from the established reference sites, and directed towards the adoption of biological criteria into state standards (Table 1).

Ecological regions are regions of relative homogeneity with respect to ecological systems involving interrelationships among organisms and their environment. Omernik (1987a, b) delineated ecoregions on a national scale. While these cursory regions are appropriate for regional or national assessments, areas of high heterogeneity or complexity may require further subdivision utilizing more detailed and larger scale maps (Omernik 1995). Delineating areas of regionally different water quality allows the use of a more specific definition of attainability and aquatic life uses.

In 1990, an ecoregional reference site project was initiated in order to accomplish the initial biocriteria development steps for wadeable streams in Alabama and Mississippi in the Southeastern Plains Ecoregion (Ecoregion # 65). The project was a cooperative effort between the Alabama Department of Environmental Management (ADEM), Mississippi Office of Pollution Control (MOPC), the Environmental Protection Agency Region IV (EPA), and the EPA-Environmental Research Laboratory-Corvallis, Oregon (ERL-C). The pilot project for the nation, this effort followed guidelines outlined in the EPA's publication of Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish (Plafkin et al. 1989), which provided standardized sampling methodologies, habitat assessments, and data analysis metrics on a national level. This project provided assistance for ADEM and MOPC to further refine the Southeastern Plains Ecoregion and locate possible reference sites within this ecoregion. It also served to increase the effectiveness of the limited resources available to participating states by allowing them to share data collected in shared ecoregions and aided in the advancement of biocriteria development efforts.

Since initiation of the reference site project, ADEM and MOPC have continued to cooperate and assist each other by: 1) exchanging raw data collected at sites within the four shared subregions of the Southeastern Plains Ecoregion, and; 2) conducting quality assurance sampling events annually to ensure the comparability of sampling techniques. Both agencies conduct reference site work independently in the remaining ecoregions and subecoregions.

In Alabama, 14 reference sites are sampled annually in seven subregions of the Southeastern Plains Ecoregion. Independent reconnaissance and selection has yielded an additional 10 sites in the Southwestern Appalachians Ecoregion, four sites from the Interior Plateau Ecoregion and one site from the Central Appalachian Ridges and Valleys Ecoregion, for a total of 29 reference sites throughout the State (Appendix 1). In 1995, additional stations will be added to the 29 current reference sites.

The MOPC currently samples 14 reference sites in four subregions of the Southeastern Plains Ecoregion. Bioassessments are completed at most of these three times per year to account for seasonal variability, and to broaden the existing database. The Mississippi/Louisiana Alluvial Plain Ecoregion project, initiated in 1993, has resulted in the selection of 5 sites to be further studied as candidates for restoration, with the ultimate goal of using them as reference sites. Independent work on the Mississippi Valley Loess Hills and Plains was begun in 1992, and six sites are sampled three times per year from this Ecoregion.

An attempt to locate reference streams in the Mississippi portion of the Southwestern Appalachians in 1992 was unsuccessful due largely to the effects of the Tennessee-Tombigbee Waterway. Reconnaissance in the Southern Coastal Plains Ecoregion and additional site work in the Southwestern Appalachians was planned for 1994, but state budget constraints prevented this occurrence.

The joint AL/MS project has served as the framework for numerous other projects, including the Region III/Region IV reference site project (NC, VA, WVA) and the Mississippi/Louisiana Alluvial Plain Ecoregion project. At present, the Tennessee Department of Environment and Conservation (TN DEC) and the EPA are involved in refinement and subregionalization of the ecoregions of Tennessee. A data exchange project between ADEM and TN DEC for the Interior Plateau and the Southwestern Appalachians ecoregions may be possible pending completion of the ecoregion investigation. A similar project may be initiated between MOPC and TN DEC in the Southeastern Plains and Hills, Southwestern Appalachians, Mississippi Alluvial Plains and Mississippi Valley Loess Hills and Plains Ecoregions.

This report summarizes the efforts of the agencies involved in the AL/MS Pilot Reference Site Project towards biocriteria development in Alabama and Mississippi. Although ADEM and MOPC have begun reference site sampling within other ecoregions, the discussion in this report is limited to data collected within the Southeastern Plains Ecoregion. It will examine: 1) the regionalization process; 2) the standardization of sampling protocols and QA/QC procedures, and; 3) the selection and

sampling of reference sites within this ecoregion in both Alabama and Mississippi. This document will conclude with an evaluation of the premise of interstate cooperation and recommendations for future projects.

II. Methods and Materials

A. Regionalization

The first objective of this project was to refine the aquatic ecoregions/subecoregions in the participating states. The scope of this effort was limited to the Southeastern Plains Ecoregion which constitutes approximately fifty percent (50%) of the land area of both states. Accurate regionalization of an area required a wide variety of information such as geology, topography, soil hydrology, vegetation, precipitation and land use. Therefore, a project attempting to characterize ecoregions benefits from the involvement of several state and federal agencies with experience and expertise in a variety of areas. Interagency cooperation widens the base of maps, information, and resources available to delineate ecoregions. The agencies involved in the AL/MS project are listed in Table 2. These agencies were represented by benthic biologists, geographers, foresters, engineers, and regulatory personnel.

TABLE 2
MEETING ATTENDEES

U.S. EPA Environmental Research Laboratory-Corvallis Oregon
EPA Region IV Water Management Division
EPA Region IV Environmental Services Division
EPA Region III
Alabama Department of Environmental Management
Mississippi Office of Pollution Control
Florida Department of Environment Regulation
Georgia Department of Natural Resources
Kentucky Division of Water
North Carolina Division of Environmental management
South Carolina Department of Health and Environmental Control
Alabama Geological Survey
Mississippi Museum of Natural Resources
Mississippi Automated Resource Information System (MARIS)
Auburn University
E.A. Engineering
U.S. Forest Service

ADEM and MOPC, in cooperation with other interested agencies, assembled maps of geographic information and related water quality data and provided this information to ERL-C during the summer of 1990. These maps included information

relevant to regionalization such as: bedrock and surficial geology, topography, soils, potential and existing vegetation, average annual precipitation and runoff, frost-free period, soil permeability, and other mapped "resource" regions (Griffith and Omernik 1991). The water quality data included the states' latest 305B Water Quality Report to Congress and other available mapped patterns of surface water quality parameters. A list of the most helpful information utilized can be found in Griffith & Omernik (1991).

The procedures utilized by ERL-C to subregionalize the Southeastern Plains Ecoregion included compiling and reviewing relevant materials, maps, and data; outlining the regional characteristics; drafting the regional and subregional boundaries; digitizing the boundary lines; creating digital coverage; producing cartographic products; and revising as needed after review by state managers and scientists. Qualitative methods were primarily employed during the regionalization process. Professional judgement was applied throughout the selection, analysis, and classification of data to form the regions, basing judgments on the quantity and quality of reference data and on interpretation of the relationships between the data and other environmental factors. More detailed descriptions on methods, materials, rationale, and philosophy for regionalization can be found in Omernik (1987a,b, 1995), Gallant et al. (1989) and Omernik and Gallant (1990).

The Southeastern Plains Ecoregion of Mississippi and Alabama was divided into six subregions in 1990 by ERL-C (Figure 1). A seventh subecoregion was added after regionalization efforts in Florida (Griffith et al. 1994). The boundaries between ecoregions are often indistinct transition zones of varying widths and these, too, were delineated by Omernik and Griffith (1992) (Figure 2). In some areas, ecoregional boundaries are distinct and abrupt; for example, where the Fall Line Hills meet the Blackland Prairie or Prairie Margins in Alabama, or where the Loess Bluff Hills meet the Mississippi Alluvial Plain in Mississippi. In other areas, such as the division between the Southern Pine Plains and Hills and the Southeastern Plains and Hills Ecoregions, the boundary is fuzzy and more difficult to determine (Griffith and Omernik 1991).

The resulting subecoregions were reviewed by ADEM and MOPC field biologists. The ecoregional and subecoregional boundaries appeared to delineate areas of similarities. It was decided that no reference sites would be located within the fuzzy boundary areas. Because of the latitudinal differences within the Southeastern Plains and Hills Subecoregion in Mississippi (Figure 1), it was decided that sampling events could be specifically scheduled, but sampling should occur first in the southern and later in the northern part of the subecoregion to negate any sample differences based on degree-days. Significant differences might still remain due to climate differences between the northern

Figure 1

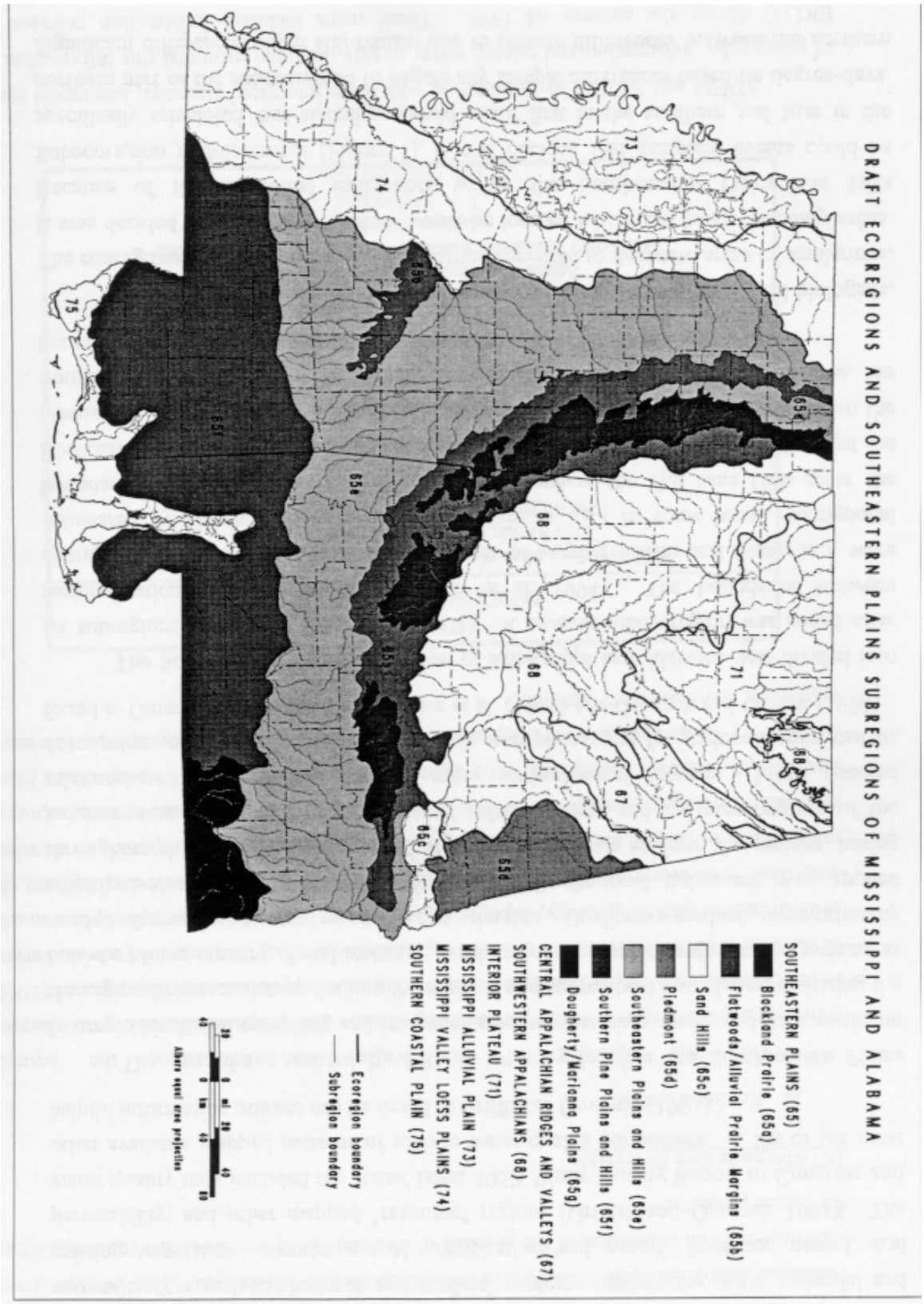
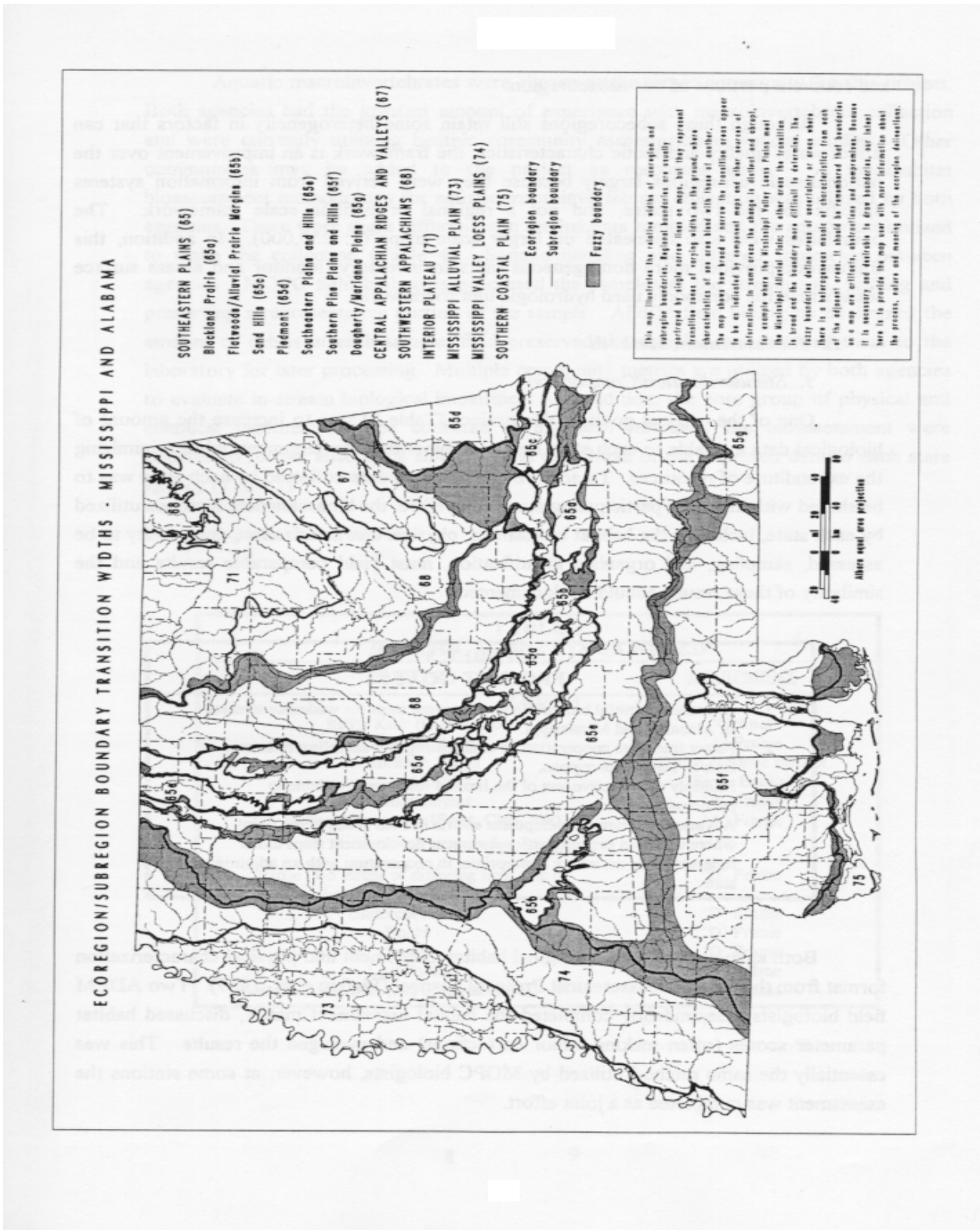

DRAFT ECOREGIONS AND SOUTHEASTERN PLAINS SUBREGIONS OF MISSISSIPPI AND ALABAMA
SOUTHEASTERN PLAINS (65)
Blackland Prairie (65a)
Flatwoods/Alluvial Prairie Margins (65b)
Sand Hills (65c)
Piedmont (65d)
Southeastern Plains and Hills (65e)
Southern Pine Plains and Hills (65f)
Dougherty/Marianna Plains (65g)
CENTRAL APPALACHIAN RIDGES AND VALLEYS (67)
SOUTHWESTERN APPALACHIANS (68)
INTERIOR PLATEAU (71)
MISSISSIPPI ALLUVIAL PLAIN (73)
MISSISSIPPI VALLEY LOESS PLAINS (74)
SOUTHERN COASTAL PLAIN (75)
Ecoregion boundary
Subregion boundary
65a
65b
65c
65d
65e
65f
65g
67
68
71
73
74
75

Figure 2


ECOREGION/SUBREGION BOUNDARY TRANSITION WIDTHS - MISSISSIPPI AND ALABAMA
SOUTHEASTERN PLAINS (65)
Blackland Prairie (65a)
Flatwoods/Alluvial Prairie Margins (65b)
Sand Hills (65c)
Piedmont (65d)
Southeastern Piedmont and Hills (65e)
Southern Pine Plains and Hills (651)
Dougherty/Marianna Plains (65g)
CENTRAL APPALACHIAN RIDGES AND VALLEYS (67)
SOUTHWESTERN APPALACHIANS (68)
INTERIOR PLATEAU (71)
MISSISSIPPI ALLUVIAL PLAIN (73)
MISSISSIPPI VALLEY LOESS PLAINS (74)
SOUTHERN COASTAL PLAIN (75)
Ecoregion boundary
Subregion boundary
Fuzzy boundary
Albers equal area projection

and southern portions of this subecoregion.

Although these subecoregions still retain some heterogeneity in factors that can affect water quality and biotic characteristics, the framework is an improvement over the national-scale ecoregions largely because they were derived from information systems specific for the two states, and not a regional or national-scale framework. The boundaries were also delineated on larger scale maps (1: 250,000). In addition, this framework provides more homogeneous units to inventory, monitor and assess surface waters than the commonly used hydrologic unit frameworks.

B. Bioassessment Methods

1. Standardization/Comparison

One of the original goals of this project (Table 3) was to increase the amount of biological data available to each state for use in biocriteria development, while minimizing the expenditure of resources. To achieve this goal, the data collected by each state was to be shared with the other participating state. Therefore, the bioassessment methods utilized by each state, including the habitat assessment, physical characterization, community to be assessed, sampling, and organism identification, must yield comparable results and the similarity of these results should be documented.

TABLE 3
PROJECT GOALS

1. Accomplish initial biocriteria development steps for wadeable streams in Alabama and Mississippi.
2. Foster interstate cooperation in establishing and sampling reference sites in shared ecoregions.
3. Multiply the effectiveness of the limited resources available to participating states.
4. Advance biocriteria development efforts in both states to the point where each can proceed with subsequent development steps either independently or, where appropriate, in cooperation with an adjoining state.

Both agencies utilized the original habitat assessment and physical characterization format from the Rapid Bioassessment Protocol Manual (Plafkin et al. 1989). Two ADEM field biologists independently completed the habitat assessment matrix, discussed habitat parameter scores (often making minor corrections) and averaged the results. This was essentially the same method utilized by MOPC biologists, however, at some stations the assessment was completed as a joint effort.

Aquatic macroinvertebrates were chosen as the target community for this project. Both agencies had the greatest amount of experience with macroinvertebrate collection and were currently utilizing benthic community assessments in special studies. Other communities may be added to the project as resources allow. A multihabitat bioassessment methodology for aquatic macroinvertebrate collection was utilized by both agencies. There were slight differences in the habitats sampled and the equipment utilized to make the collection (Table 4). Sample handling also differed somewhat between agencies. MOPC field biologists processed the samples at the stream site, picking and preserving a representative portion of the sample. ADEM field biologists minimized the amount of debris in each sample, field preserved the samples and returned them to the laboratory for later processing. Multiple community metrics are utilized by both agencies to evaluate in-stream biological impairment. In addition, the core group of physical and chemical parameters to be collected during each reference site bioassessment were selected to further ensure the similarity and usefulness of the collected data to each state agency (Table 5).

TABLE 4
BENTHIC HABITATS SAMPLED

HABITAT	EQUIPMENT
ALABAMA	
Riffle Kick (Fast & Slow)	Kicknet
Undercut Banks	'A' Frame
Rocks & Snags	Brush & Sieve Bucket
Leaf Packs	Sieve Bucket
Macrophytes	'A' Frame
Bottom Composite (Sand, Clay, Silt)	'A' Frame
MISSISSIPPI	
Riffle (4-5 Areas of differing flow rate / substrate composition)	'D' Frame
Undercut Banks	'D' Frame
Rocks	'D' Frame
Snags	'D' Frame
Leaf Packs	'D' Frame
Bottom Composite (All substrate types)	'D' Frame

TABLE 5
PHYSICAL / CHEMICAL PARAMETERS

Collection Time	Alkalinity
Air Temperature	Hardness
Water Temperature	Chlorides
Dissolved Oxygen	Total Organic Carbon
Conductivity	Total Phosphate
Turbidity	Total Kjeldahl Nitrogen
Stream Flow	Nitrate + Nitrite Nitrogen
Habitat Assessment *	Ammonia Nitrogen
Physical Characterization Field Data Sheet	Fecal Coliform

* Plafkin et al. 1989

2. Quality Assurance / Quality Control

Standard operating procedure manuals (SOP) were an essential part of the quality assurance / quality control program, as well as an organized biocriteria development effort. Each participating state had a standard operating procedures manual documenting methodologies for macroinvertebrate bioassessments (ADEM 1990; MOPC 1990). These documents were exchanged at the May 1990 meeting and methodologies compared.

Taxonomic references utilized by each state were nearly identical with the exception of some regional and state specific keys. In general, all identifications were taken to the generic level by ADEM biologists. Some identifications were taken to the species level by MOPC, however, for the purpose of making comparisons of taxa lists in this report, species level identifications were combined into the generic level.

In order to determine the comparability of the assessment of habitat quality, biological sample collection methods, and data generated, field biologists from ADEM and MOPC conducted annual biological joint assessments as a portion of the QA/QC effort. If the methodology and the data generated were deemed comparable, then the two state agencies could sample reference sites and share the data. This cooperative effort would thereby increase each state's available database of least impacted sites while reducing the costs incurred by each agency.

This exercise began during the first meeting in May, 1990 where two streams were jointly assessed -- Chubbehatchee Creek, a sand and gravel creek located within the Southeastern Plains Ecoregion and Cheaha Creek, a boulder and cobble creek located on the border of the Central Appalachian Ridges and Valleys and the Southwestern Appalachians Ecoregions. A similar joint sampling effort has been repeated at various

sites annually.

In-stream bioassessments were completed by each agency according to their respective SOP. These data were compared utilizing similarity indices. A comparison of the individual metrics calculated was also completed. The major similarities and differences are discussed in the following paragraphs.

The habitat assessments completed independently by each agency assigned the identical habitat condition category. The habitat quality at Chubbehatchee Creek was judged to be "Good" (Poor, Fair, Good, Excellent), while a designation of "Excellent" was assigned to Cheaha Creek by both MOPC and ADEM.

Both agencies used a multi-habitat method (i.e., sampling all available habitats) and an assessment of habitat quality according to Plafkin et al. (1989) (Table 6). Similar methods were used by both agencies to sample logs, leaf packs, and bottom substrates (Table 4). MOPC field biologists used a "D"--frame net to collect from the riffle areas and undercut banks. ADEM field biologists used a $1m^2$ kick net (Plafkin et al. 1989) to sample the riffle areas, and an "A"-frame net to collect from undercut banks. Organisms were separated from the substrates on-site by MOPC field biologists, while ADEM field biologists preserved the collected material and transported it to the lab for sorting.

TABLE 6
COMPARISON OF BIOASSESSMENT METHODOLOGIES AND EFFORT REQUIRED

ALABAMA

1. Picks samples in Laboratory (subsamples the riffle kick)
2. Identification of organisms to genus level in most cases
3. Habitat Assessment using method of Plafkin et al. (1989)
4. Riffle kick collected using a $1m^2$ net as described in Plafkin et al. (1989)
5. Total time required to complete field portion is approximately 2 person-hours. The lab portion including subsampling the riffle kick and the quality control 100% pick of the remaining riffle kick sample is approximately 30 person-hours (Total 32 hours)

MISSISSIPPI

1. Picks samples in the field
2. Identification to the lowest positive taxa level
3. Habitat Assessment using method of Plafkin et al. (1989)
4. Riffle kick collected using a D-Frame net
5. Total time required to complete the field portion is approximately 5 person-hours. The lab portion is approximately 12 person-hours. (Total 17 hours)

Although the taxa lists produced by these two methods differed somewhat

(Sorenson's Community Similarity Index was 0.39 for Chubbehatchee Creek and 0.44 for Cheaha Creek), other structural and functional metrics calculated for the bioassessments were similar (Table 7a, 7b; Figure 3, 4). EPT taxa richness was comparable, as was the biotic index (Hilsenhoff 1987). Total taxa richness values were more similar for Cheaha Creek than for Chubbehatchee Creek. This was due in part to the lack of sufficient habitat available for sampling by two crews in the same stream reach. Shackleford's Quantitative Similarity Index (Shackleford 1988) for comparison of the trophic community similarity (QSI-FFG) was 89% for both Chubbehatchee and Cheaha Creek.

The time required to complete the entire bioassessment, including collection, processing and identification, was twice as long for ADEM as it was for MOPC (Table 6). Partial field processing of samples by ADEM has decreased this to about one and one-half times. This is largely due to the greater amount of material in the ADEM riffle kick sample (equivalent to RBP III riffle kick sample (Plafkin et al. 1989)), and the greater numbers of organisms (especially Chironomidae) collected by ADEM.

Most importantly, these two methods resulted in identical assessments as to the degree of impact present at both of the sites. Chubbehatchee Creek was determined to be slightly impacted, while Cheaha Creek was judged to be of excellent water quality (utilizing best professional judgement since neither reference sites nor biocriteria were available for comparison). It was further concluded that these two slightly differing techniques produced very comparable results, and that the sharing of data between these two agencies was a plausible option.

Additional joint sampling between these state agencies has further enhanced the confidence in the data comparability of this joint database. Joint assessments have been completed at Yellow Creek in Noxubee County, Mississippi (1991 -- Table 8a, 8b, Figure 5; and 1994 -- Table 9a, 9b, Figure 8), South Sandy Creek in Bibb County, Alabama (1992 -- Table 8a, 8b, Figure 6); and Jones Creek in Sumter County, Alabama (1993 -- Table 9a, 9b, Figure 7).

Efforts during the 1994 Joint Assessment (JA) at Yellow Creek were hampered somewhat by an unusually wet spring. The quantity of habitat available was insufficient for adequate sampling by two field crews. The data appear to reflect these problems in the decrease in the similarity of the samples as compared to previous years.

The comparability of the data collected by ADEM and MOPC during the joint assessments was analyzed by determining the percent similarity between the metrics calculated for each state's collection and averaging the percentages over the six sampling events. The averages for each metric were compared to average percent similarities

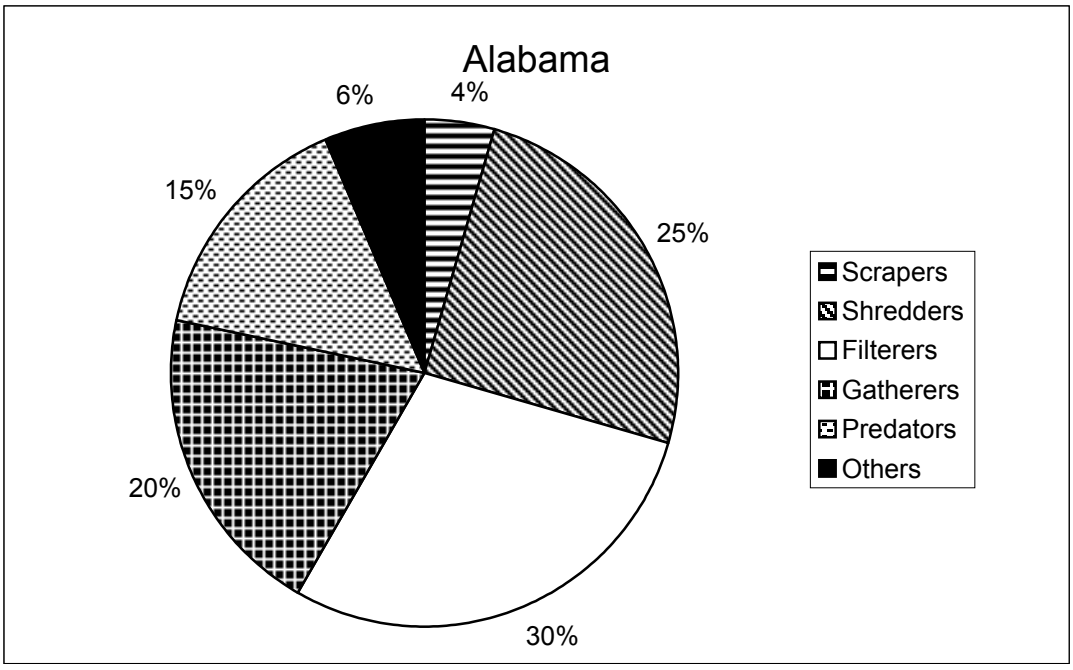
Table 7a. Comparison of single station metrics collected by Alabama (AL) and Mississippi (MS) on Chubbehatchee and Cheaha Creeks during May, 1990.

	SITE			
	Chubbehatchee		Cheaha	
Metric	AL	MS	AL	MS
Taxa Richness	42	25	73	81
EPT Taxa Richness	9	11	34	34
Biotic Index	5.8	5.0	3.6	4.1
% Contribution Dominant Taxon	19	22	11	15
Chironomidae Taxa Richness	16	6	14	12
#EPT / # EPT + # Chironomidae	0.39	0.67	0.65	0.76
# Shredders/Total # Organisms	--	--	0.16	0.08
# Scrapers / # Filterers + Scrapers	0.00	0.05	0.34	0.84

Table 7b. Comparison metrics of samples collected by Alabama (AL) and Mississippi (MS) on Chubbehatchee and Cheaha Creeks during May, 1990.

	SITE	
Metric	Chubbehatchee	Cheaha
Sorenson's Community Similarity Index	0.39	0.44
QSI-Taxa	42	28
QSI-Functional Feeding Group	89	89

Figure 3. Functional Feeding Group Composition: Chubbehatchee Creek



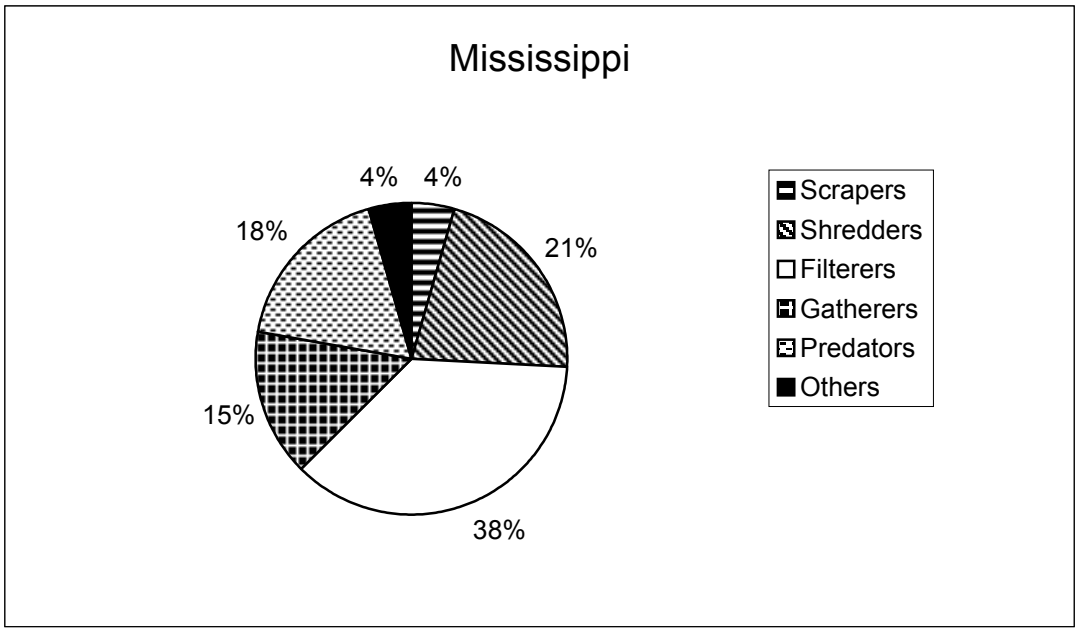
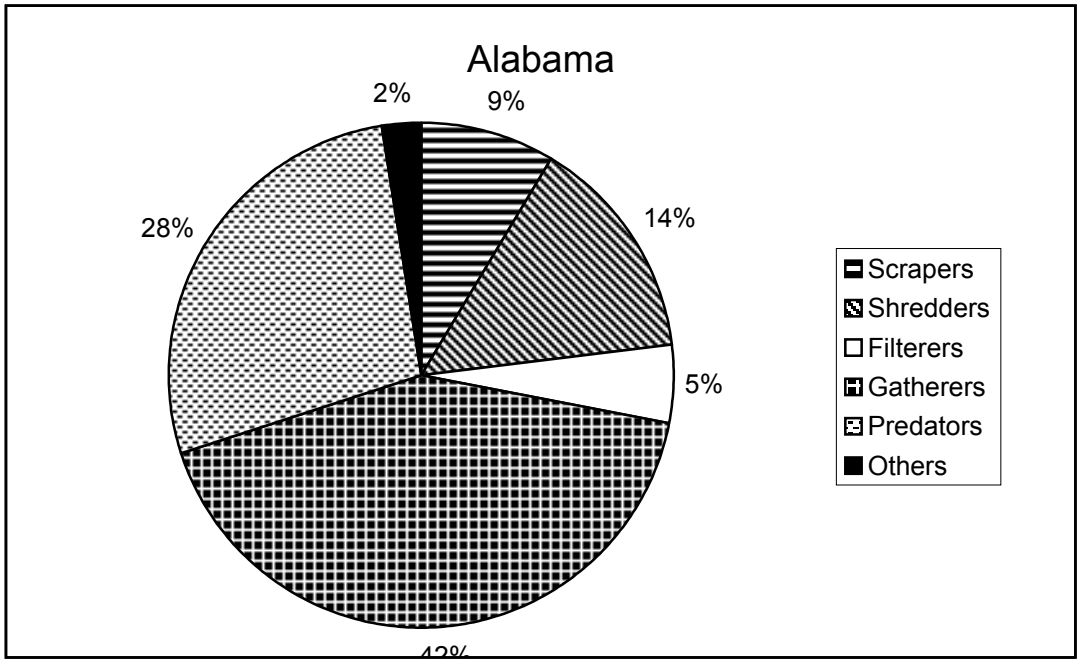


Figure 4. Functional Feeding Group Composition: Cheaha Creek



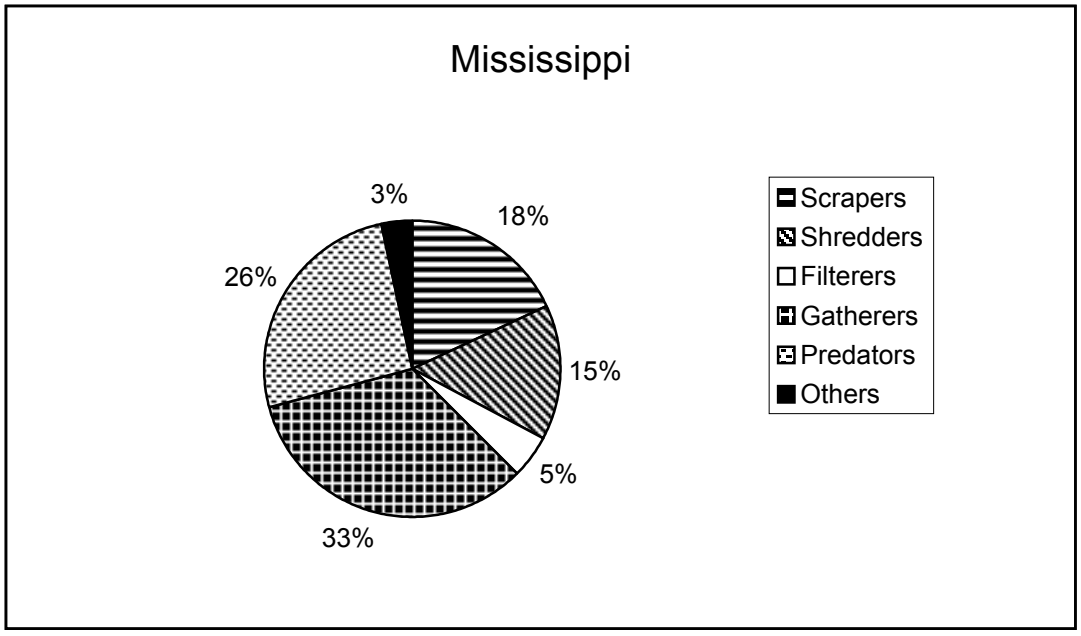


Table 8a. Comparison of single station metrics collected by Alabama (AL) and Mississippi (MS) on Yellow Creek (1991) and South Sandy Creek (1992).

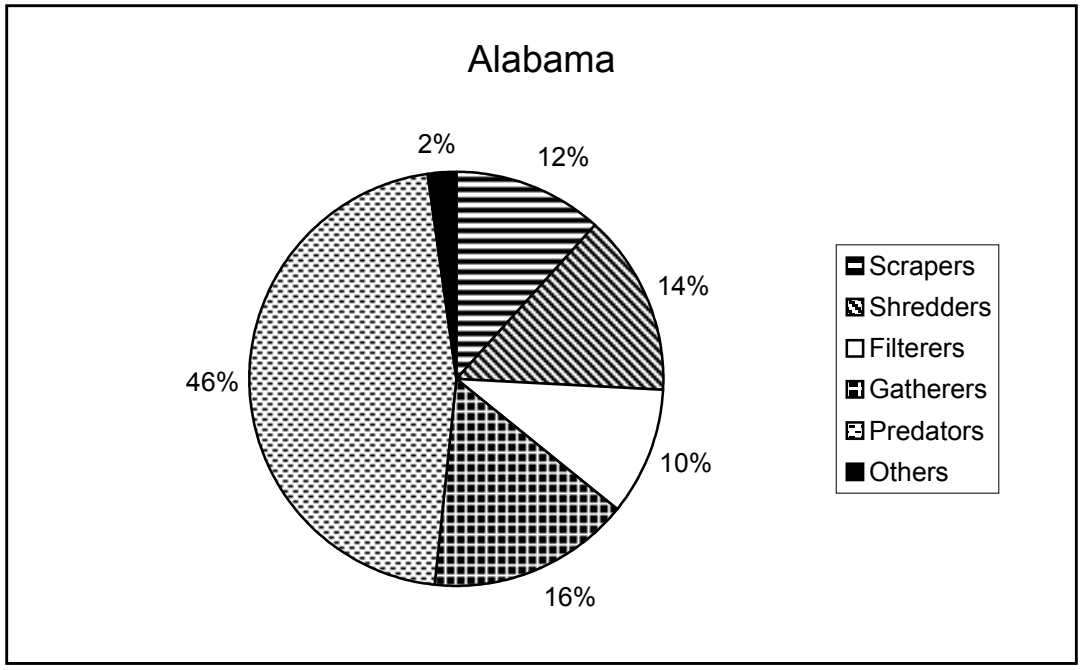
	SITE			
	Yellow Creek, MS		S. Sandy Creek, AL	
Metric	AL	MS	AL	MS
Taxa Richness	33	34	48	45
EPT Taxa Richness	6	10	16	13
Biotic Index	4.3	4.5	4.8	4.8
% Contribution Dominant Taxon	30	17	18	25
Chironomidae Taxa Richness	15	11	13	17
#EPT / # EPT + # Chironomidae	0.80	0.63	0.46	0.37
# Shredders/Total # Organisms	0.32	0.33	0.30	0.28
# Scrapers / # Filterers + Scrapers	0.53	0.63	0.44*	0.33*

*Rock/Log Sample

Table 8b. Comparison metrics of samples collected by Alabama (AL) and Mississippi (MS) on Yellow Creek, MS (1991) and South Sandy Creek, AL (1992).

	SITE	
Metric	Yellow Creek	S. Sandy Creek
Sorenson's Community Similarity Index	0.54	0.52
QSI-Taxa	52	55
QSI-Functional Feeding Group	83	88

Figure 5. Functional Feeding Group Composition: Yellow Creek (1991)



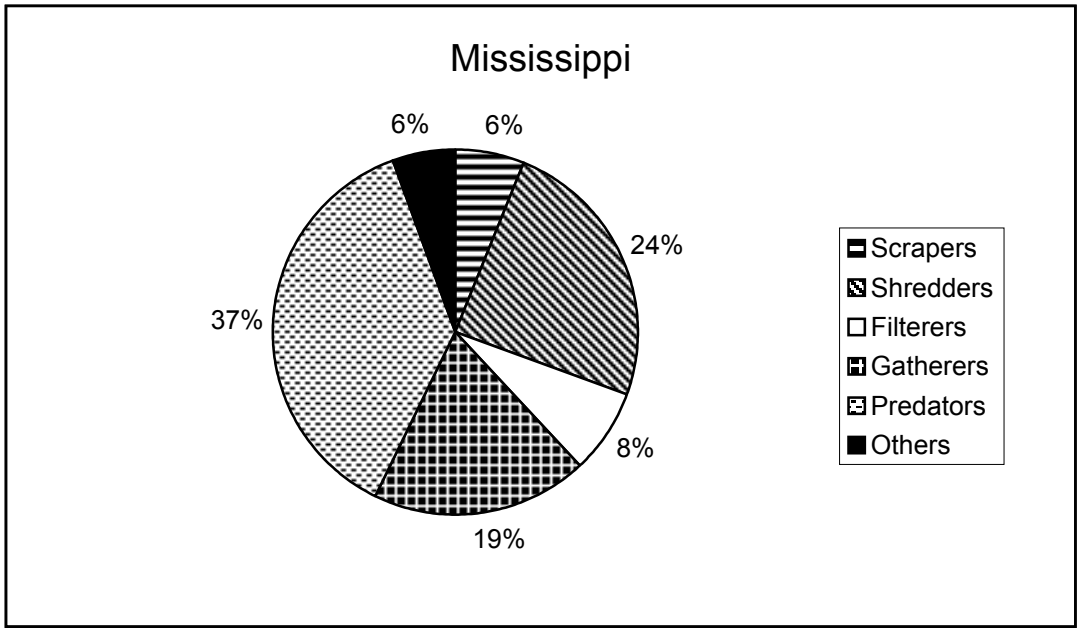
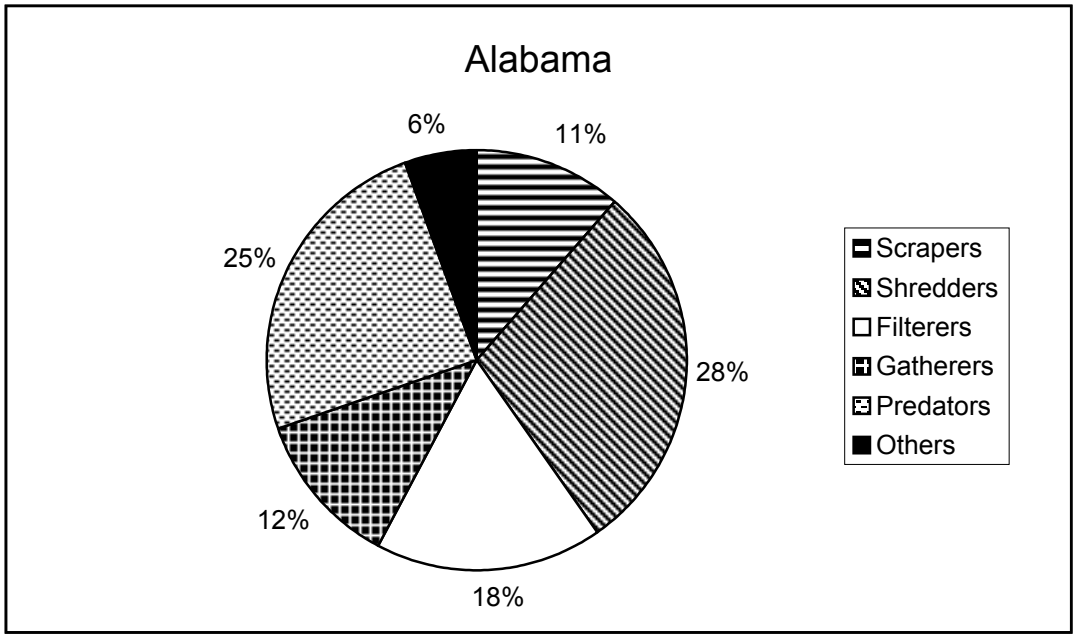


Figure 6. Functional Feeding Group Composition: S. Sandy Creek (1992)



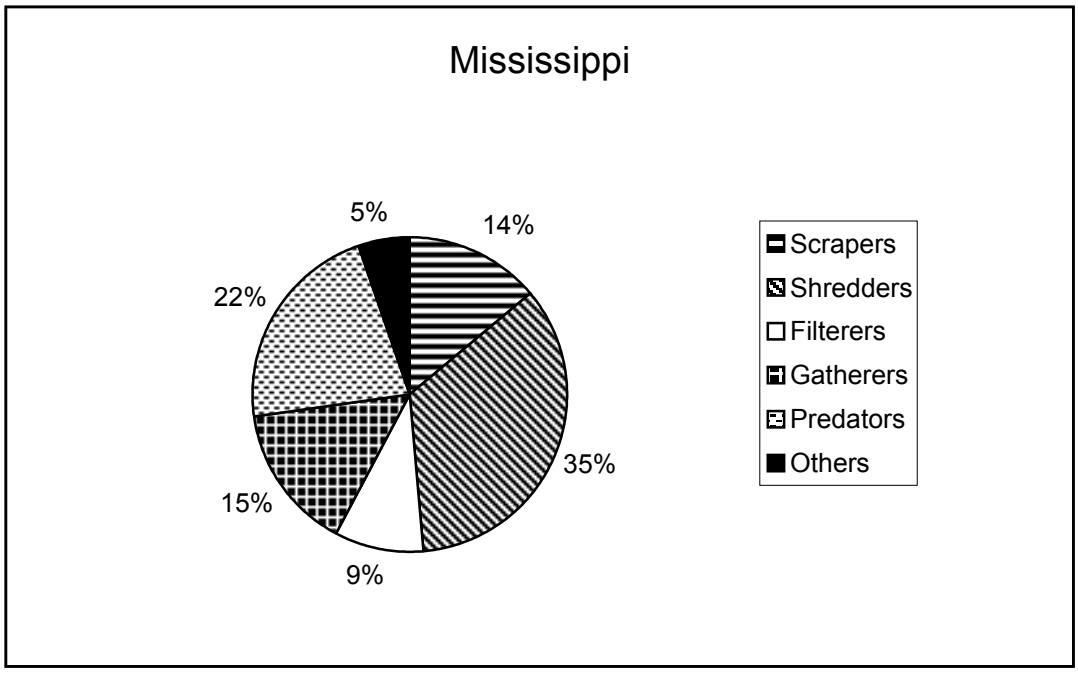


Table 9a. Comparison of single station metrics collected by Alabama (AL) and Mississippi (MS) on Jones Creek, AL (1993) and Yellow Creek, MS (1994).

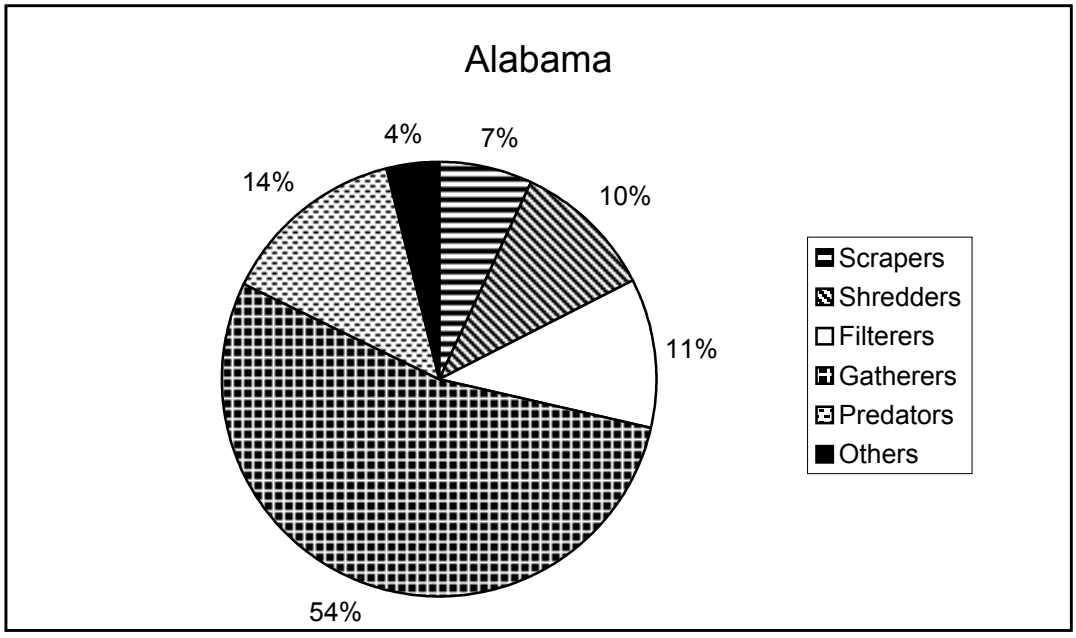
	SITE			
	Jones Creek, AL		Yellow Creek, MS	
Metric	AL	MS	AL	MS
Taxa Richness	52	55	36	36
EPT Taxa Richness	12	15	7	10
Biotic Index	6.3	6.1	5.8	5.1
% Contribution Dominant Taxon	19	14	21	31
Chironomidae Taxa Richness	14	22	14	6
#EPT / # EPT + # Chironomidae	0.66	0.58	0.28	0.76
# Shredders/Total # Organisms	0.34	0.04	0.14	0.05
# Scrapers / # Filterers + Scrapers	1.00	0.78	0.47*	0.00*

*Rock/ Log Sample

Table 9b. Comparison metrics of samples collected by Alabama (AL) and Mississippi (MS) on Jones Creek, AL (1993) and Yellow Creek, MS (1994).

	SITE	
Metric	Jones Creek,AL	Yellow Creek, MS
Sorenson's Community Similarity Index	0.50	0.36
QSI-Taxa	51	18
QSI-Functional Feeding Group	78	57

Figure 7. Functional Feeding Group Composition: Jones Creek (1993)



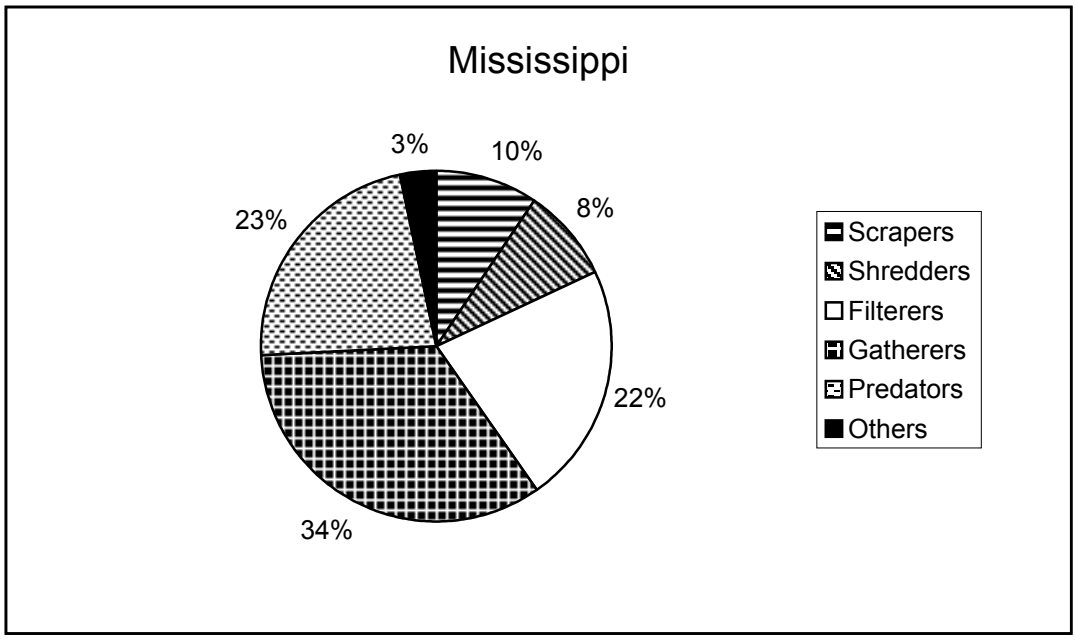
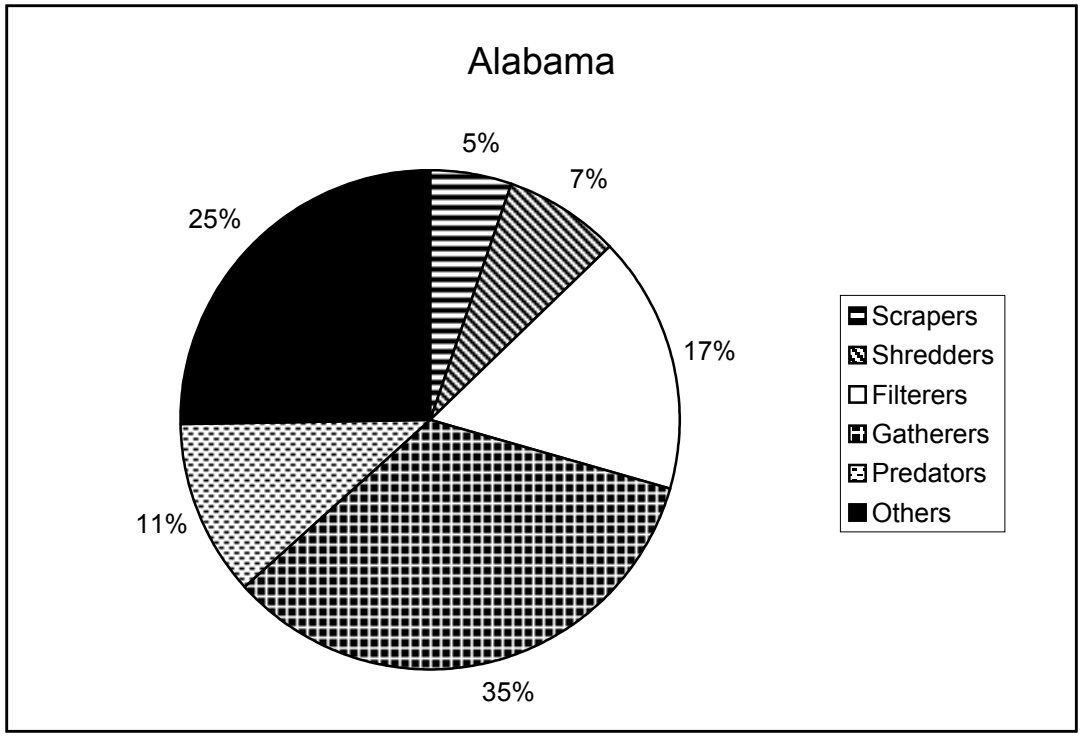
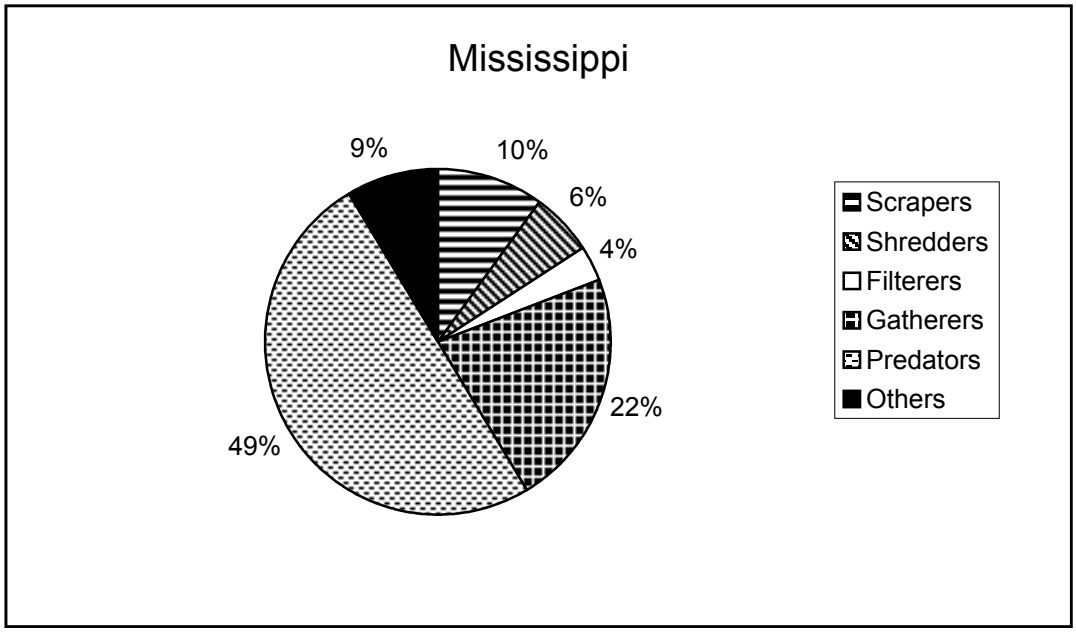


Figure 8. Functional Feeding Group Composition: Yellow Creek (1994)





calculated on data collected during Alabama's annual internal method quality assurance collections (AL-QA) (Table 10). The taxa richness metric averaged 91 percent similarity over the six joint assessment sites as compared to 86 percent for the AL-QA. The EPT taxa richness and biotic index for the JA averaged 79 and 93 percent similarity, respectively (AL-QA 83%, 97%). The community similarity indices averaged 41 percent for the QSI-taxa, 81 percent for the QSI FFG, and 0.46 for the Sorenson's index (CSI). Quality assurance efforts for Alabama sampling methodology indicates that data collected on the same day at the same station by two different field crews utilizing the same method had a community similarity index for taxa composition (QSI-taxa), functional feeding group composition (QSI-FFG) and Sorenson's CSI of approximately 66 percent, 83 percent and 0.71, respectively. These analyses show a strong similarity in the data collected by Alabama and Mississippi field crews as compared to what would be expected to be collected by two Alabama field crews.

TABLE 10
ANALYSIS OF JOINT ASSESSMENT DATA

Average Percent Similarity of Metrics

	Taxa Richness	EPT Taxa Richness	Chironomidae Taxa Richness	Biotic Index	EPT / EPT+Chironomidae	Sorenson's Community Similarity Index	QSI-Taxa	QSI-FFG
Alabama Internal Method QA*	86	83	79	97	80	0.71	66	83
Alabama/ Mississippi Joint Assessments**	91	79	63	93	71	0.46	41	81

* Comparison of metrics calculated on collections made utilizing the same method by similarly trained teams of two Alabama field biologists on the same creek on the same day.

** Includes samples collected from 1990 to 1994.

C. Candidate Reference Site Selection and Evaluation

Although it is difficult to strictly follow a detailed, rule-based approach to reference site selection that will be applicable to all regions, general guidelines for selecting reference sites have been given in Hughes et al. (1986) and by Gallant et al. (1989). The following is an outline of the process of selecting candidate reference sites utilized by ERL-C for this project (Griffith and Omernik 1991):

1) The regions and subregions were defined within which there was apparent homogeneity in a combination of geographic characteristics that were likely to be associated with resource quality, quantity, and types of stresses.

2) The disturbances (such as nonpoint source pollution, and local or point sources

of pollution) were generally characterized in each ecoregion and subecoregion along with the corresponding geographic characteristics. Disturbance and degree to which conditions were typical were interpreted from information shown on 1:250,000-scale and 1:100,000-scale USGS topographic maps and thematic maps. The existence of populated areas, industry, agricultural land use, forestry, mining, catfish ponds, fish hatcheries, transportation routes, etc., were all interpreted from mapped information.

3) A set of stream sites with watersheds that appeared relatively undisturbed and completely within the ecoregion or subecoregion was chosen. The actual number of sites/watersheds selected was a function of the apparent homogeneity or heterogeneity of the region, the size of the region, hydrologic characteristics, and simply how many stream sites/watersheds were available for selection. Another consideration was accessibility of the site to the field biologists. The number of preliminary candidate sites per subecoregion varied; for the four subecoregions shared by Alabama and Mississippi, it ranged from about fourteen to more than thirty. A list of the candidate sites for reconnaissance was developed that included the subecoregion, site number, stream name, county, state, 1:100,000 scale map name, watershed area, and additional comments (Appendix 2). This list was given to the state biologists along with photocopies of the exact site locations.

As a part of the March, 1991 progress meeting in Pearl, Mississippi, project participants discussed and developed a consensus on an acceptable procedure for candidate reference site reconnaissance. The following procedure for evaluation of potential reference sites was selected:

1. Ground-truth each site. Visit each site to determine its' suitability as a wadeable reference site.

   a. Complete a habitat assessment (Figure 9). An assessment of the habitat quality at each site is helpful in determining the ranges found in any one subecoregion. Additional notations concerning habitat degradation will assist in determining the ranges of least impacted habitat quality.

   b. Complete a physical characterization data sheet (Figure 10). This data sheet links the watershed with the in-stream characteristics and includes an estimate of the substrate composition.

   c. Survey the surrounding watershed for disturbances. The sites that appear to fit the minimum criteria as least impacted may have potential adverse impacts in the watershed that are not apparent during normal flow. Driving over all

Figure 9

HABITAT ASSESSMENT FIELD DATA SHEET

NAME OF WATER BODY: STATION NUMBER :

DATE: INVESTIGATOR(S):

SCORE:

HABITAT PARAMETER	CATEGORIES			
	EXCELLENT	GOOD	FAIR	POOR
1. BOTTOM SUBSTRATE/ AVAILABLE COVER	>50% rubble,gravel, submerged logs, undercut banks,or other stable habitat 20-16	50-30% rubble,gravel or other stable habitat. Adequate habitat. 15-11	30-10% rubble,gravel or other stable habitat. Habitat availability < desirable. 10-6	<10% rubble,gravel or other stable habitat. Lack of habitat is obvious. 5-0
2. EMBEDDEDNESS *(observe in "run" area)*	Gravel,cobble, boulder, and logs are <25% surrounded by fine sediment or sand. 20-16	Gravel,cobble, boulder, and logs are 25-50% surrounded by fine sediment or sand. 15-11	Gravel,cobble, boulder, and logs are 50-75% surrounded by fine sediment or sand. 10-6	Gravel,cobble, boulder, and logs are >75% surrounded by fine sediment or sand. 5-0
3. STREAM FLOW **<= 5 CFS**	Warm; 5 cfs 20-16	5-2 cfs 15-11	2-1 cfs 10-6	1 cfs 5-0
OR **>5 CFS** *Slow: < 1 ft/s* *Fast: > 1 ft/s* *Deep: >1.6 ft* *Shallow:<1.6 ft*	All habitats present Slow & deep, slow & shallow, fast & deep, fast & shallow. 20-16	3 of 4 habitats present. (Missing riffles or runs get lower score than missing pools). 15-11	2 of 4 habitats present. (Missing riffles/runs get lower score.) 10-6	Dominated by one velocity/depth category (usually pool). 5-0
4. CHANNEL ALTERATION *(resulting in a loss of habitat)*	Little / no enlargement of islands or point bars, and/or no channelization. 15-12	Some new increase in bar formation,mostly from coarse gravel; and/or some channel-ization present. 11-8	Moderate deposition of new gravel,coarse sand on old and new bars;pools partially filled w/silt;and/or embankments on both banks. 7-4	Heavy deposits of fine material, bar development increase Most pools filled w/ silt;and/or extensive channelization. 3-0
5. BOTTOM SCOURING AND DEPOSITION	<5% of bottom affected. 15-12	5-30% affected.Scour at constrictions and steep grades. Some deposition in pools. 11-8	30-50% affected. Deposit and scour at obstructions, bends, and constrictions. Some filling of pools 7-4	>50% bottom changing nearly year long. Pools absent due to deposition. Only large rocks exposed. 3-0
6. RUN/BEND, POOL/RIFFLE RATIO *(distance between riffles or bends/ stream width).*	If ratio is 5-7. 15-12	If ratio is 7-15. 11-8	If ratio is 15-25. 7-4	If ratio is >25. 3-0
7. BANK STABILITY	Stable. No erosion or bank failure. 10-9	Moderately stable. Infrequent erosion mostly healed over. 8-6	Moderately unstable. Moderate erosion. High erosion during high flow. 5-3	Unstable. Many eroded areas. "Raw" areas frequent on straight and bends. 2-0
8. BANK VEGETATIVE STABILITY	>80% of streambank covered by vegetation or boulders and cobbles. 10-9	79-50% covered by vegetation, gravel or larger material. 8-6	49-25% covered by vegetation,gravel or larger material. 5-3	<25% covered by vegetation,gravel or larger material. 2-0
9. STREAMSIDE COVER	Dominant vegetation is shrub 10-9	Dominant vegetation is of tree form. 8-6	Dominant vegetation is grass or forbes. 5-3	>50% no vegetation Dominant material is soil,rock, bridge materials,culverts,or mine tailings. 2-0
CATEGORY RANGE	135-104	103-71	70-35	34-0

COMMENTS:

Figure 10

PHYSICAL CHARACTERIZATION/WATER QUALITY
FIELD DATA SHEET

Water Body Name _____ Station # _____
Collectors Names _____ Date _____

Predominant Surrounding Land Use:
Forest Field Pasture Agriculture Residential
Commercial Industrial Other _____

Local Watershed Erosion: None Slight Moderate Heavy

Local Watershed NPS Pollution: No evidence Potential Sources Obvious Sources

Estimated Stream Width: _____ ft

Estimated Stream depth: Riffle _____ ft Run _____ ft Pool _____ ft

High Water Mark: _____ ft. ft Dam Present: Y N Channelized: Y N

Canopy Cover: Open Mostly Open 50/50 Mostly Shaded Shaded

SEDIMENT/SUBSTRATE

Odors: Normal Sewage Petroleum Chemical Anaerobic
Other _____

Oils: Absent Slight Moderate Profuse

Deposits: Sludge Sawdust Paper-Fiber Relict Shells
Other _____

Are the undersides of stones not deeply embedded, black? yes no

ESTIMATED PERCENT COMPOSITION IN SAMPLING AREA
(Inorganic Substrates + Organic Substrates = 100 %)

Type	Diameter	Percent	Type	Characteristic	Percent
Bedrock		%	Detritus	Stick, Wood	%
Boulder	>10 inches	%		CPOM	%
Cobble	2.5 - 10 inches	%	Mud-muck	FPOM (Black	
Gravel	0.1 - 2.5 inches	%		very fine	
Sand	gritty	%		organic	%
Silt		%	Marl	Gray, Shell	
Clay	slick	%		Fragments	%

WATER QUALITY

Time _____ hrs D.O. _____ mg/l Turbidity _____ s.u.
Temp-air _____ C pH _____ s.u. Conductivity _____ umhos
Temp-H2O _____ C (_____ umhos @ 25C)

Water Odors: Normal Sewage Petroleum Chemical Other _____

Water Surface Oils: None Slick Sheen Globs Flecks

Water Color: Clear Sl. Tannic Mod. Tannic Dark Tannic Green
Gray Other _____

Weather Conditions: Clear P/C Mostly Cloudy Cloudy Raining

Biological Indicators: Periphyton Filamentous Macrophytes Slimes Fish Others

Modified 2/95

road crossings upstream of the potential site may substantiate the least-impacted site assessment.

2. Complete aerial reconnaissance if possible. Aerial reconnaissance is a very useful tool to rapidly gain information about disturbances and riparian zone characteristics in a target watershed.

Each set of sites was reviewed by state biologists, and each site was visited during ground reconnaissance to get a sense of: a) the usefulness of the subecoregions, b) the characteristics that comprise reference sites in each subecoregion, c) the range of characteristics and types of disturbances in each subecoregion, and d) how site characteristics vary between subecoregions. In this process, sites that were found unsuitable were dropped (because of disturbances not apparent on the maps or due to other anomalous situations) and other sites were added.

Aerial reconnaissance was conducted to identify disturbances not observable from the ground and to photograph typical characteristics, site locations, or disturbances for use in briefings and publications. This type of reconnaissance also gave participants a better sense for the spatial patterns of disturbance and geographic characteristics in each subecoregion.

On the basis of the data collected during reconnaissance efforts, a minimum of two sites from each subecoregion was selected for sampling that were considered "least impacted" and representative of the natural range of watershed characteristics. Due to the limited number of sites that could be selected (as a result of personnel and monetary constraints), reference sites within each ecoregion were chosen, in part, to reflect the heterogeneity of stream-types within the subecoregion.

III. Results -- Candidate Reference Site Reconnaissance and Sampling

During 1991 and 1992, one-hundred-eight sites within the Southeastern Plains Ecoregion were visited by ADEM biologists to determine their suitability as ecoregional reference sites (Appendix 3a-f). These sites were located within 78 candidate reference watersheds in five of the seven subecoregions. During this same period MOPC biologists evaluated 104 sites in 48 different watersheds in four subecoregions of the Southeastern Plains (Appendix 3g-j). Generally, there were more physical similarities between sites within the same subecoregion, than between subecoregions. However, there was some overlapping of physical characteristics between the Flatwoods Alluvial Prairie Margins and the Southeastern Plains and Hills subecoregions. Although subregionalization

reduces variability, heterogeneity still exists between streams within a subecoregion. Sites were therefore chosen to reflect this variability in order to ensure that reference sites will be comparable to study streams within the subecoregion.

Blackland Prairie -- 65a

This is one of the most distinct subregions in the Southeastern Plains Ecoregion of Mississippi and Alabama. It is a flat to gently undulating lowland, with soils formed in or underlain by chalks and marls of the Selma Group. The weathered chalk is dark, relatively nutrient rich, with a high content of montmorillonitic clay and calcium carbonate. Soils maps and land-use maps were the most helpful in defining this subecoregion. The Blackland Prairie as delineated is generally that portion of the lowland containing the best cropland soil and most intensive agriculture. Elevations are generally 150-250 feet in Alabama, but are over 300 feet in northern Mississippi. (Griffith & Omernik 1991)

The Blackland Prairie sites generally had "good" habitat quality and were dominated by clay and silt substrates with lesser amounts of sand and gravel (Appendix 3a, 3g). The majority of the sites had riffles or bottlenecks between pools. During spring, when water levels were higher, these constrictions functioned as low quality "riffles". During the summer and fall, however, these streams lacked a sufficient amount of water to maintain flow throughout the year. A slight amount of turbidity was common (most likely due to the clay substrate) and water color ranged from chalky green to colorless. Drainage basin size ranged from approximately 8 to 50 square miles in size. Agriculture was the dominant land use and had an adverse impact on several of the candidate sites. Both the Blackland Prairie and the Flatwoods/Alluvial Prairie Margins were patchy subecoregions that necessitated the use of small drainage basins to wholly include the entire basin within the subecoregion boundary. Two sites were chosen by each agency in this subecoregion: ADEM - Jones Creek and Chaney Creek; MOPC - James Creek and Cedar Creek.

The physical and chemical characteristics of the Blackland Prairie were fairly uniform and distinct, characterized by clay substrates, relatively high pH and conductivity, and lower dissolved oxygen values (Appendix 4a, 4b). The bioassessments yielded total taxa richness values of 27 to 78 with EPT taxa richness ranging from 6 to 13. The biotic index ranged from 4.5 to 6.9 (Appendix 4a, 4b).

Flatwoods/Alluvial Prairie Margins -- 65b

This subecoregion is heterogeneous in terms of land-use/land cover; some areas, as the Flatwoods name implies, being heavily forested, but other prairie areas have significant amounts of cropland and pasture. It is a transition region between the Blackland Prairie and the more forested plains and hills. With flat to gently rolling lowland topography, the elevations tend to be slightly higher than the Blackland Prairie, 200-400 feet. The exceptions are along the alluvial flood-plains of the Tombigbee, Black Warrior, and Alabama Rivers where elevations are closer to 100 feet. Soils are predominantly silt loams or montmorillonitic clays. The heavy clays are sticky when wet, hard and cracked when dry, with generally poor drainage. Including the Blackland Prairie there is a unique "Blackbelt" potential natural vegetation (Liquidamber-Quercus-Juniperus), a tall or medium tall broadleaf deciduous forest with concentrations of low needle leaf evergreen trees and patches of bluestem prairie. The Jackson Prairie of Mississippi is included in the subecoregion. (Griffith & Omernik 1991)

The Flatwoods Alluvial Prairie Margins/Jackson Prairie candidate sites were generally dominated by sand, however, a sandy clay was often present (Appendix 3b, 3h). In one instance the stream bed had been scoured down to the clay hardpan. Habitat quality was generally in the "fair" category, with some sites containing riffles of small gravel. Unlike the Blackland Prairie, these streams maintained at least some discernible flow during the entire year. The water was often slightly tannic in color in Alabama streams while only the Jackson Prairie sites were tannic in Mississippi. Noticeable turbidity was sometimes present. The tree canopy shading the creek ranged from completely open to completely shaded. Drainage basin size ranged from approximately 7 to 30 square miles in size. Two sites were chosen from this subecoregion by each agency: ADEM - Soapstone Creek and Poplar Creek; MOPC - Greenwood Creek and Yellow Creek.

This subecoregion encompassed a wide range of water chemistry characteristics and substrate composition. Differences in substrate composition can influence water chemistry, and the availability of both nutrients and stable habitats between streams. The Flatwoods/ Alluvial Prairie Margins subecoregion is a transition zone between the clay bottomed streams of the Blackland Prairie and the sandy bottomed streams of the Southeastern Plains and Hills (Griffith and Omernik 1991). The subecoregion was characterized by streams with clay stream beds, high conductivity, and pH (similar to streams located within 65a) as well as streams with a primarily sand bottom, low pH and conductivity, more typical of the Southern Pine Plains and Hills (Appendix 4a, 4c). In addition, the Flatwoods Alluvial Prairie Margins and the Southeastern Plains and Hills range farther north in Mississippi than in Alabama. The bioassessments yielded total

taxa richness values of 18 to 81 with EPT taxa richness ranging from 4 to 17. The biotic index ranged from 4.5 to 5.7 (Appendix 4a, 4c).

The Jackson Prairie is a disjunct arm of the Mississippi portion of the Flatwoods/Alluvial Prairie Margins. The current body of knowledge seems to indicate that this portion of the subecoregion is distinct from the more northerly portions, and might need to be considered a separate subecoregion in the future. Tallahalla Creek was chosen by MOPC as a reference site in the Jackson Prairie.

Sand Hills -- 65c

This small area in Alabama (not a shared subecoregion) is an extension of the Sand Hills/Fall Line Hills from the Carolinas through Georgia. It is a mixture of cropland with pasture, woodland and forest, but contains generally more agriculture than the Fall Line Hills subregion of Alabama. Gently sloping to steep soils formed from marine sands and clays of the Tuscaloosa Group and the Eutaw Formation of Upper Cretaceous. The elevations range from 300-500 feet. (Griffith & Omernik 1991)

The Sand Hills subecoregion was visited in 1992 by ADEM biologists (Appendix 3c). Drainage basin size ranged from approximately 7 to 13 square miles in size. The stream channels were generally braided with mostly-open canopies and low creek banks of two to three feet. The water was clear to slightly tannic. Sand was the dominant substrate with small amounts of gravel also present. The streams often lacked a riffle habitat, but habitat quality was generally found to be "good". Again, because of the small size of the subecoregion, the watersheds were also small, ranging from seven to thirteen square miles. Two sites were selected by ADEM as reference sites from this subecoregion: Brush Creek and Long Branch Creek.

The physical and chemical characteristics of the Sand Hills were fairly uniform. The two reference sites located within the small Sand Hills subecoregion had acidic pH's, sandy stream beds, and low conductivity (Appendix 4d). The bioassessments yielded total taxa richness values of 37 to 68 with EPT taxa richness ranging from 5 to 20. The biotic index ranged from 4.0 to 5.2 (Appendix 4d).

Piedmont -- 65d

The Piedmont subecoregion (not a shared subecoregion) consists of rolling hills of moderate relief (300-500 feet), with elevations ranging from 500-1200 feet. It overlays igneous and metamorphic rocks of Precambrian and Paleozoic age, and the southern boundary generally marks the contact of these crystalline rocks with the sedimentary rocks of the Sand Hills subregion. There is a mixture of cropland, pasture,

and forest, although much of the land previously in cropland has reverted to forest and pasture. Vegetation cover is mixed oak-hickory-pine forest. (Griffith & Omernik 1991)

The Piedmont was much more distinct than many of the subregions of the Southeastern Plains Ecoregion (Appendix 3d). The substrate was generally dominated by gravel with lesser amounts of cobble, sand, boulder, and bedrock. Habitat quality was generally "good" to "excellent". The stream channels contained numerous riffles with mostly-open canopies and were twice as wide as the Sand Hills streams even though the watersheds were only slightly larger in size. Evidence of high water was generally found to be twice as deep as that of the Sand Hills. The water was colorless with no noticeable turbidity. Nonpoint source pollution from logging and cow pastures were the dominant adverse impacts to the streams in this subecoregion. Drainage basin size ranged from approximately 8 to 27 square miles in size. Two sites were selected by ADEM as ecoregional reference sites from the Piedmont: Hurricane Creek (a typical Piedmont stream) and Little Chattahospee Creek (may be anomalous).

Hurricane Creek (HCR) is characterized by large and stable substrates, low conductivity, and slightly acidic water. Little Chattahospee Creek (LCC) is a sandy bottomed, slightly tannic colored, neutral pH stream. The bioassessments yielded total taxa richness values for 48 to 74 with EPT taxa richness ranging from 14 to 27. The biotic index ranged from 3.3 to 5.9 (Appendix 4d). Sampling at the Little Chattahospee site may be reevaluated in the future after further reconnaissance is completed to determine the representativeness of the site.

Southeastern Plains and Hills -- 65e

This irregular, belted plain of low hills is comprised of the Red Hills (also called the North Central Hills in Mississippi), as well as the Chunnenuggee Hills and Lime Hills. The Pontotoc Ridge of Mississippi is also included. Several resistant formations create low lines of hills and cuestas that give diversity to this subecoregion. Relief is still generally only 100-300 feet, with elevations 200-700 feet. The soils, mostly Ultisols of Paleudults and Hapludults, range from loams to clays, and tend to be highly leached with low fertility. Forest cover is extensive with oak-hickory-pine mix, especially loblolly-shortleaf pine. Land use is mostly woodland and forest with some cropland and pasture. (Griffith & Omernik 1991)

The greatest amount of physical heterogeneity was found in the Southeastern Plains and Hills subecoregion (Appendix 3e, 3i). Stream bottom substrates were dominated by sand, gravel, bedrock or clay depending upon location. MOPC sites were generally dominated by sand. The canopy cover ranged from mostly open to mostly

shaded. Habitat quality similarly varied from "fair" to "excellent". Water color was generally slightly tannic but some sites were colorless, moderately tannic or milky. A clay red color was noted in some of the Alabama streams. Riffles of some form (often low quality) were generally present at the sites evaluated. Drainage basin size ranged from approximately 9 to 65 square miles in size. Logging activities were the dominant nonpoint source adverse impact to streams in this subecoregion. Due to the size and heterogeneity of the sites visited, further subdivision of this subecoregion may be necessary. Reference sites selected by ADEM were: Pineywoods Creek and Silver Creek. MOPC reference sites were: Lee Creek, Turkey Creek, Lobutcha Creek, and Scoobachitta Creek.

The Southeastern Plains and Hills is a diverse subecoregion characterized by streams of very different substrate compositions, flow regimes, and water chemistry (Appendix 4e - 4g). Differences in substrate composition can influence water chemistry, and the availability of both nutrients and stable habitats between streams. In addition, the Southeastern Plains and Hills ranges farther north in Mississippi than in Alabama. The two reference sites chosen by ADEM were selected to reflect the heterogeneity of the sites visited. Silver Creek (SRC) has much greater stream flow, dissolved oxygen concentrations, and larger substrates than Pineywoods Creek (PYW). The bioassessments yielded total taxa richness values of 25 to 60 with EPT taxa richness ranging from 3 to 22. The biotic index ranged from 3.8 to 6.1 (Appendix 4e, 4f, 4g).

Southern Pine Plains and Hills -- 65f

Called the Pine Hills or Piney Woods in Mississippi and the Southern Pine Hills in Alabama, this subecoregion in places is not easily distinguishable from the Southeastern Plains and Hills (See Figure 2). While the relief and elevations are similar in these two subecoregions, there is a slightly different mix of vegetation and land use in these southern plains, and streams tend to be darker and more acidic as one moves south. The oak-hickory-loblolly/shortleaf pine forest of the north is replaced by the southern mixed forest of beech-sweetgum-magnolia-longleaf/slash pine-oak forest in this subecoregion. Much of this area was at one time known as the Longleaf Pine Belt (Cross et al. 1974). Elevations are generally 200-550 feet, with relief of 100-200 feet between hill and stream bottoms. The hill summits and higher elevations are composed of the Citronelle formation, generally sandy, gravelly, and porous, and more resistant to erosion than the older underlying Miocene sandstones. Although most of this subecoregion is woodland and forest with some cropland and pasture, on the Dougherty Plain of Southeastern Alabama centered around Dothan, there is extensive cultivation. (Griffith

& Omernik 1991)

At the outset of this project, the Southern Pine Plains and Hills was the southern-most subecoregion considered (Figure 1). Concerns expressed by ADEM biologists and subsequent work in Florida by Griffith et al. (1994) have resulted in the division of the Alabama portion of this subecoregion into the Dougherty/Marianna Plains, and the Southern Pine Plains and Hills subecoregions. Streams in the Southern Pine Plains and Hills subecoregion had habitat quality that was rated as "good" by ADEM (Appendix 3f, 3g); however, this subecoregion in Mississippi had the highest quality habitat. The streams generally lack riffles with the substrate dominated by sand with aquatic macrophytes present. Noticeable turbidity was lacking from those sites evaluated and the water color was moderate to dark tannic. Canopy cover ranged from open to fully shaded. Springs were common in the watersheds. Aerial reconnaissance was completed over many of these sites. Three sites in Alabama were selected as candidate reference sites: Halls Creek, Bear Creek (BRE) and Clear Creek; Mississippi sites included Monroe Creek, Black Creek, Lower Little Creek and Little Creek.

The physical and chemical characteristics of the Southern Pine Plains and Hills were fairly uniform and distinct within Alabama, characterized by sand bottom, tannic water streams with low pH and conductivity (Appendix 4h, 4i). However, there appears to be some heterogeneity between the typical sites found in Alabama and those in Mississippi. The bioassessments yielded total taxa richness values of 29 to 63 with EPT taxa richness ranging from 6 to 21. The biotic index ranged from 3.1 to 4.9 (Appendix 4h, 4I). Drainage basin size ranged from approximately 10 to 90 square miles in size.

Dougherty/Marianna Plains -- 65g

Subecoregion 65g is located in the Dougherty Plains of southeast Alabama. These are flat to rolling plains with elevations generally 100 - 300 feet. Soils are sandy to clayey over residuum geology derived from solution and collapse of Eocene and Oligocene-age limestone. The Florida aquifer is generally unconfined in this subregion. Two sites were visited in this small subecoregion (Appendix 3f, 4j). The streams in this area have generally braided channels and slightly to moderately tannic water color. The flood plains are large with low stream banks and shaded channels. Bear Creek (BRH) was selected by ADEM as a reference site from this subecoregion. The bioassessments yielded total taxa richness values of 34 to 50 with EPT taxa richness ranging from 6 to 11. The biotic index ranged from 5.0 to 5.5 (Appendix 4j).

IV. Summary

The primary objective of the joint ecoregion project was to accomplish initial biocriteria development steps for wadeable streams in Alabama and Mississippi. However, neither state had sufficient funds to accomplish this goal independently. Though state resources were limited, cooperation of ADEM, MOPC, EPA and ERL-C, and input from numerous other agencies and disciplines, enhanced the resource effectiveness. This cooperative effort included refinement of the Southeastern Plains Ecoregion, selection and assessment of ecoregional reference sites, and exchange of the collected data between ADEM and MOPC.

The greater refinement provided by the subregionalization of the national scale ecoregions has enabled state biologists in AL and MS to develop a network of reference sites throughout both states and to begin collecting data that will be used to classify biological conditions within each subregion. Since 1991, ADEM and MOPC have collected data at 1-5 reference sites within each subecoregion. Two (1991-1992) and four (1991-1994) years of macroinvertebrate data have been identified by MOPC and ADEM, respectively. Habitat assessments, physical reconnaissance and results of metric analyses have provided information that will enable further refinement of the subregions. The variability of metric values and habitat assessment results reflect heterogeneity of stream types within some of the subregions. Therefore, these results may indicate stream characteristics that influence macroinvertebrate communities and the need for further ecoregion refinement. Additional reconnaissance will be conducted in Ecoregion 65 to select more reference sites and to evaluate the need for further refinement of the subregions in order to reduce variability in metric results and, ultimately, to classify the biological conditions of these streams.

This type of project is dependent upon standardization and documentation of sampling methodology in a well-written SOP accompanied by side-by-side stream assessments to document comparability of data collected. Data exchange programs such as the AL/MS Pilot Ecoregion Project can aid in the development of sound and defensible biocriteria by increasing the rate at which data is collected and biological conditions can be categorized. Results of metric analyses from joint sampling events between AL and MS were very similar and validate the data exchange process. State managers and biologists should continue to make the annual joint assessment efforts a priority.

Appropriate metrics for analyses of bioassessment data need to be selected. Several agencies presently utilize the community metrics to evaluate water quality. The

effectiveness of these metrics almost certainly differs between ecoregions; specifically those with high or low gradient streams. The data collected in each subregion by AL and MS suggest that these community metrics will adequately assess water quality.

This project provided the necessary groundwork for independent efforts by both agencies in other ecoregions. ADEM expanded the selection and sampling of reference sites to include the Southwestern Appalachians Ecoregion in 1993, and the Interior Plateau and the Central Appalachians Ridges and Valleys Ecoregions in 1994. The boundaries of these three ecoregions in Alabama, along with the Southern Coastal Plain, are in need of refinement by the ERL-C. Some of this refinement has begun and increased levels of coordination and collaboration among federal and state agencies to develop ecoregion frameworks is now occurring. In addition, there are opportunities for increased cooperation among the states of the Southeast to share reference site data and methods of biocriteria development.

MOPC initiated a joint project with the state of Louisiana in the Mississippi Alluvial Plains Ecoregion as an effort similar to this project, and is conducting independent efforts in the Southwestern Appalachians and the Mississippi Valley Loess Hills and Plains. The State of Tennessee is currently in the initial phases of refinement and subregionalization of the ecoregions of that state. Once this project is underway, biologists from Tennessee have expressed interest in undertaking a similar data-exchange project with ADEM for the Interior Plateau, Southwestern Appalachians and the Central Appalachians Ridges and Valleys and with MOPC in the Alluvial Plain and the Mississippi Valley Loess Hills and Plains. These efforts not only aid in the development of biocriteria but the increased comparability of the states' bioassessment protocols also improves the usefulness of data which could ultimately be utilized to assess national trends in water quality (Omernik and Griffith 1991, Yoder 1994).

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APPENDIX

Appendix 1

Currently Sampled Ecoregional Reference Sites
Southeastern Plains Ecoregion (65)

Blackland Prairie (65a)

Alabama	Mississippi
Jones Creek (JNS)	James Creek (JMS)
Chaney Creek (CYD)	Cedar Creek (CDRL)

Flatwoods/Alluvial Prairie Margins (65b)

Alabama	Mississippi
Soapstone Creek (SPD)	Greenwood Creek (GRDL)
Poplar Creek (PPM)	Yellow Creek (YLMS)
	Tallahalla Creek (TALJ)*

Sand Hills (65c)

Alabama
Brush Creek (BCR)
Long Branch Creek (LBM)

Piedmont (65d)

Alabama
Hurricane Creek (HCR)
Little Chattahospee Creek (LCC)

Southeastern Plains and Hills (65e)

Alabama	Mississippi
Silver Creek (SRC)	Lee Creek (LEEL)
Pineywoods Creek (PYW)	Turkey Creek (TKYY1, TKYY2)
	Lobutcha Creek (LAW)
	Scoobachitta Creek (SCBT)

Southern Pine Plains and Hills (65f)

Alabama	Mississippi
Halls Creek (HLB)	Monroe Creek (MUNH)
Bear Creek (BRE)	Black Creek (BLK)
Clear Creek (CLC)	Lower Little Creek (LLTL)
	Little Creek (LTLW)

Dougherty/Marianna Plains (65g)

Alabama
Bear Creek BRH)

* Jackson Prairie

APPENDIX 2

Candidate Reference Sites*
Southeastern Plains Ecoregion
Mississippi and Alabama

	Stream Name	Approx. Size	Comments
65A Blackland Prairie			
(Area south of Columbus)			
(Most small tributaries appear to be channelized)			
1.	James Creek (lower site) Lowndes County, MS Starkville 1:100,000	50 mi^2	Good veg. cover.
2.	James Creek (upper site) Lowndes Co./Noxubee Co. Starkville 1:100,000	35 mi^2	May need to go upstream for veg. cover.
3.	Plum Creek Noxubee County, MS Starkville 1:100,000	20 mi^2	May be typical of Blackland streams without riparian veg. cover. Also appears to be channelized.
4.	Cedar Creek Lowndes County, MS Starkville 1:100,000	12 mi^2	Relatively good riparian veg. cover.
5.	Bogue Chitto Creek Noxubee County, MS Starkville 1:100,000	35 mi^2	Heavy impact. Delete.
5a.	Hatchet Creek Sumter County, AL DeKalb 1:100,000	12 mi^2	Little riparian vegetation, some channelization, flow may be small. Headwaters in Mississippi.
5b	Toms Creek Sumter County, AL DeKalb 1:100,00	12 - 15 mi^2	Some channelization, ponds.
6.	Taylor Creek Greene County, AL Demopolis 1:100,000	11 mi^2	
6b.	Jones Creek Sumter County, AL DeKalb 1:100,000	19 mi^2	

* Initial list of sites for reconnaissance provided by EPA-ERL. Many of these sites are no longer considered after reconnaissance efforts.

APPENDIX 2, cont.

Candidate Reference Sites
Southeastern Plains Ecoregion
Mississippi and Alabama

	Stream Name	Approx. Size	Comments
(North of Columbus near Aberdeen, MS)			
6c	Cedar Creek Monroe County, MS West Point 1:100,000	16 mi^2	
6d	Tubbalubba Creek Lee County, MS Tupelo 1:100,000	12 mi^2	Small watershed, some channelization, little riparian veg., impacts likely.
6e	Osborne Creek Prentiss County, MS Corinth 1:100,000	8 - 11 mi^2	Small watershed, some channelization, little riparian veg., impacts likely.
6f	Parmicha Creek Alcorn County, MS Corinth 1:100,000	8 mi^2	Small watershed, some channelization, little riparian veg., impacts likely.
(Area southwest of Selma) (Numerous flowing wells in this area may make it anomalous; stream quality may be different from the rest of subregion.)			
7.	Chaney Creek Dallas County, AL Selma 1:100,000	50 mi^2	One of the few with meandering channel and forest cover in riparian zone.
8.	Bear Creek Dallas County, AL Selma 1:100,000	20 mi^2	Move downstream to pick up gallery forest.
8b.	Mud Creek Dallas/Perry Counties, AL Selma/Demopolis 1:100,000	17 mi^2	More scrutiny needed for streams named Mud.
(Near Montgomery)			
9.	Tallawassee Creek Lowndes County, AL Montgomery 1:100,000	10 & 27 mi^2	Lower site may reflect more of Alluvial Prairie Margins.

APPENDIX 2, cont.

Candidate Reference Sites
Southeastern Plains Ecoregion
Mississippi and Alabama

Stream Name	Approx. Size	Comments
10. Steep Creek Lowndes County, AL Montgomery1:100,000	38 mi^2	More winding than most streams in this subregion. Small reservoirs in watershed seems typical of area.
11. Panther Creek Bullock County, AL Tuskegee 1:100,000	17 mi^2	
12. Johnsons Creek (at Hwy. 110) Bullock/Montgomery Counties , AL Tuskegee/Montgomery 1:100,000	15 mi^2	
65B Flatwoods/Alluvial Prairie Margins		
(Jackson Prairie area)		
1. West Tallahala Creek NW Jasper County, MS Forest 1:100,000	25 mi^2	May be channelized. Good riparian veg. cover.
2. Tallahalla Creek Jasper County, MS Forest 1:100,000	25 mi^2	May be channelized. May need to go downstream to get good riparian cover.
2b. Leaf River S. Scott County, MS Forest 1:100,000	30 mi^2	Good riparian veg. cover, but watershed impacts, incl. gas.
(Near Tupelo)		
2c. Greenwood Creek Itawamba County, MS Tupelo 1:100,000	7 mi^2	May be channelized.
2d. Mud Creek (NW of Houlka) Pontotoc County, MS Oxford 1:100,000	13 mi^2	Channelized and lots of agric. but may be the best in this area in this region.
2e. Yalobusha River at Hwy.8 Chickasaw County, MS Grenada 1:100,000	25 mi^2	Percent of agric. vs. forest sees typical for this arm of the Flatwoods.

APPENDIX 2, cont.

Candidate Reference Sites
Southeastern Plains Ecoregion
Mississippi and Alabama

Stream Name	Approx. Size	Comments
(Margins of Blackland Prairie)		
3. Lynn Creek NW Noxubee County, MS Starkville 1:100,000	25 - 30 mi^2	May lack veg. cover, may need to go downstream.
4. Yellow Creek Noxubee County, MS Starkville 1:100,000	30 mi^2	Upstream site sampled by AL and MS, 3/27/91
5. Sun Creek Noxubee County, MS Starkville 1:100,000	15 mi^2	Upper bridge site should be better re: veg. cover & gradient.
6. Howard Creek Lowndes County, MS West Point 1:100,000	18 mi^2	Stockponds in watershed? Only site on east side of Blackland Prairie.
7. Barton Creek Marengo County, AL Selma 1:100,000	19 mi^2	Appears to not be Channelized. Little agric. land, mostly forest.
8. Poplar Creek Marengo County, AL Selma 1:100,000	15 mi^2	If Chickasaw Bogue from south included 34 mi^2 total. May be channelized and impacted by agric).
9. Soapstone Creek Dallas County, AL Montgomery 1:100,000	16 mi^2	Upper site (3 mi. S. of Hwy. 80) may be better 10 mi^2.
10. Lockhart Creek Bullock County, AL Tuskegee 1:100,000	17 mi^2	Need some representation of this part of the subregion.
11. Halliday Creek Russell County, AL Tuskegee 1:100,000	8 mi^2	Small watershed, mostly forested.
12. Allen Creek Marengo County, AL Selma 1:100,000	10 mi^2	

APPENDIX 2, cont.

Candidate Reference Sites
Southeastern Plains Ecoregion
Mississippi and Alabama

Stream Name	Approx. Size	Comments
13. Foster Creek Wilcox County, AL Selma 1:100,000	14 mi^2	Creek probably backed up at road crossing closer to Boykin.
14. Schoolhouse Branch Russell County, AL Tuskegee 1:100,000	8 mi^2	May be too small.
65E Southeastern Plains and Hills		
(Area northeast of Jackson)		
1. Lobutcha Creek (lower site) Winston County, MS Kosciusko 1:100,000	65 mi^2	Good riparian veg., winding stream channel.
2. Lobutcha Creek (middle site) Winston County, MS Kosciusko 1:100,000	40 mi^2	Good riparian veg., winding stream channel.
3. Lobutcha Creek (upper site) Choctaw County, MS Kosciusko 1:100,000	9 mi^2	
4. Lukfapa Creek Neshoba County, MS Carthage 1:100,000	18 mi^2	
5. Pailey Creek Attala County, MS Carthage 1:100,000	18 mi^2	
(Area southeast of Meridian)		
6. Okatuppa Creek (lower site) Choctaw County, AL Waynesboro 1:100,000	60 mi^2	
7. Okatuppa Creek (upper site) Choctaw County, AL Meridian 1:100,000	19 mi^2	

APPENDIX 2, cont.

Candidate Reference Sites
Southeastern Plains Ecoregion
Mississippi and Alabama

Stream Name	Approx. Size	Comments
8. Big Tallawampa Creek Choctaw County, AL Waynesboro 1:100,000	30 mi^2	
9. Middle Tallawampa Creek Choctaw County, AL Waynesboro 1:100,000	14mi^2	
9b. Bogue Flower Wayne/Clarke County, MS Waynesboro 1:100,000	14 mi^2	Several clay pits in watershed. May be in fuzzy boundary area.
(Area near Magee on Citronelle formation)		
10. Bowie Creek (upper site) Simpson County, MS Laurel 1:100,000	9 mi^2	
11 Bowie Creek (lower site) Jefferson Davis County, MS Laurel 1:100,000	40 mi^2	
12. Dry Creek Covington County, MS Laurel 1:100,000	12 mi^2	Headwater reservoir.
(Near Oxford, MS)		
13. Turkey Creek Yalobush County, MS Oxford 1:100,000	27 / 36 mi^2	Agric. in near-stream area, but may represent the best in this area of subregion.
14. Potlockney Creek Lafayette County, MS Oxford 1:100,000	22 mi^2	Like Turkey Cr. above. These watersheds have fewer res./ ponds. May not be channelized.
15. Lee Creek Lafayette County, MS Oxford 1:100,000	15 mi^2	Forest appears to be in the near-stream area and cleared/ agric. area in interfluves.

APPENDIX 2, cont.

Candidate Reference Sites
Southeastern Plains Ecoregion
Mississippi and Alabama

Stream Name	Approx. Size	Comments
16. Shutispear Creek Calhoun/Webster County, MS Grenada 1:100,000	14 mi^2	Rel. good for this area. May not be channelized, has less agric./cleared land & no res./ ponds.
(West of Ackerman, MS)		
17. McCurtain Creek Choctaw County, MS Kosciusko 1:100,000	36 mi^2	Site 1 mile upstream may be better.
18. Scoobachita Creek Attala County, MS Kosciusko 1:100,000	20 mi^2	
(Alabama portion)		
19. Baptizing Creek Marengo County, AL Selma 1:100,000	11 mi^2	
20. Morgan Creek/Wells Creek Clarke County, AL Monroeville 1:100,000	20 / 38 mi^2	
21. Bear Creek Wilcox County, AL Monroeville 1:100,000	18 mi^2	
22. Silver Creek Clarke County, AL Monroeville 1:100,000	20 mi^2	Waterfalls above L. Silver Cr.
23. Oak Creek Dallas County, AL Selma 1:100,000	10 mi^2	Some agric. & orchard in upper watershed. Transition area into Prairie Margins?
24. Furlong Creek Butler County, AL Greenville 1:100,000	21 mi^2	
25. Piney Woods Creek Crenshaw County, AL Greenville 1:100,000	15 / 24 mi^2	

APPENDIX 2, cont.

Candidate Reference Sites
Southeastern Plains Ecoregion
Mississippi and Alabama

Stream Name	Approx. Size	Comments
26. Little Patsaliga Creek Crenshaw County, AL Greenville 1:100,000	35 / 40 mi^2	Mix of agric. and forest. May have too many impacts.
27. Bowles Creek Coffee County, AL Dothan 1:100,000	15 - 24 mi^2	Ft. Rucker Military Reservation Access & impacts uncertain. Site above Pumpkins Cr. may be best.
28. Stinking Creek Barbour County, AL Troy 1:100,000	15 mi^2	Why the name? Watershed appears to be relatively undisturbed.
29. Bear Creek Dale County,AL Troy 1:100,000	25 mi^2	Marshy main channel?
30. Leak Creek Barbour County, AL Troy 1:100,000	14 mi^2	
65F Southern Pine Plains and Hills (Al/MS state line area)		
1. Little Creek Wayne County, MS Citronelle 1:100,000	17 mi^2	
2. Griffin Creek Green County, MS Citronelle 1:100,000	20 mi^2	
3. Mason Creek Green County, MS Citronelle 1:100,000	25 mi^2	
4. Henson Creek Washington County, AL Citronelle 1:100,000	20 mi^2	
5. Bear Creek Washington County, AL Citronelle 1:100,000	52 mi^2	

APPENDIX 2, cont.

Candidate Reference Sites
Southeastern Plains Ecoregion
Mississippi and Alabama

Stream Name	Approx. Size	Comments
6. Pond Creek Washington County, AL Citronelle 1:100,000	23 mi^2	USGS gauging station here.
6b. Tiger Creek Jones County, MS Waynesboro/Hattiesburg/ Citronelle 1:100,000's	15 / 42 mi^2	Upstream site may be cleaner. Small reservoirs in headwaters of East Tiger Creek.
(Area northwest of Hattiesburg)		
7. Upper Little Creek Marion County, MS Hattiesburg 1:100,000	22 mi^2	
8. Bay Creek Lamar County, MS Hattiesburg 1:100,000	10 mi^2	High sediment 3/29/91
9. Monroe Creek Lamar County, MS Hattiesburg 1:100,000	12 mi^2	
10. Black Creek Lamar County, MS Hattiesburg 1:100,000	25 mi^2	Bassfield STP appears to drain into Holiday Cr. Chicken impact?
11. Gully Creek or Lower Little Creek Lamar County, MS Hattiesburg 1:100,000	22 mi^2 90 mi^2	Gully Cr. looks good. Gauging station is on Lower Little Creek.
(Alabama Portion)		
12. Halls Creek Baldwin County, AL Atmore 1:100,000	16 mi^2	
13. Turkey Creek Baldwin County, AL Atmore 1:100,000	15 mi^2	Forested watershed but extensive road network.

APPENDIX 2, cont.

Candidate Reference Sites
Southeastern Plains Ecoregion
Mississippi and Alabama

Stream Name	Approx. Size	Comments
14. Escambia Creek Conecuh County, AL Atmore 1:100,000	36 mi^2	A "wetland Creek", many in this area. Impact from Repton? What type of mining in this area?
15 Juniper Creek Escambia County, AL Atmore 1:100,000	18 mi^2	
16. Silas Creek Escambia County, AL Andalusia 1:100,000	22 mi^2	Silas Cr. branches above bridge. Land use map shows all evergreen forest rather than more typical mixed forest.
17. Bear Creek Escambia County, AL Andalusia 1:100,000	27 mi^2	Sample upstream from bridge Stream named Blackwater Cr. on 1:250,000 map.
18. Clear Creek/Dry Creek Covington County, AL Andalusia 1:100,000	33 / 18 mi^2	Upper site is Dry Cr. What are ponds in this area? Beaver?
19. Little Double Bridges Creek Coffee County, AL Dothan 1:100,000	24 mi^2	Agricultural area of Dougherty Plain. Two landing strips in watershed.
20. Bear Creek Houston County, AL Dothan 1:100,000	24 mi^2	Agricultural area of Dougherty Plain. May have channelization.
21. Wrights Creek Geneva County, AL Dothan 1:100,000	15 mi^2	
65D Piedmont		
1. Hurricane Creek Randolph County, AL La Grange 1:100,000	12 mi^2	
2. Emuckfaw Creek Tallapoosa County La Grange 1:100,000	25 mi^2	

APPENDIX 2, cont.

Candidate Reference Sites
Southeastern Plains Ecoregion
Mississippi and Alabama

	Stream Name	Approx. Size	Comments
3.	Shoal Creek Randolph County, AL La Grange 1:100,000	12 mi^2	Georgia headwaters. Agric. impact?
4.	Wedowee Creek Randolph County, AL La Grange 1:100,000	10 / 16 mi^2	Upper site above Haywood, lower site below Boone Cr.
5.	Carlisle Creek Chambers County, AL La Grange 1:100,000	8 mi^2	
6.	Little Chatahospee Creek Chambers County, AL Opelika 1:100,000	20 mi^2	
7.	Wells Creek Chambers County, AL Opelika 1:100,000	27 mi^2	
8.	Little Sandy Creek Chambers County, AL Opelika 1:100,000	20 mi^2	
65C Sand Hills			
1.	Bulger Creek Macon County, AL Opelika 1:100,000	7 mi^2	
2.	Hodnett Creek Macon/Lee County, AL Opelika 1:100,000	9 mi^2	May contain rock types more typical of Piedmont
3.	Long Branch Macon County, AL Tuskegee 1:100,000	10 mi^2	
4.	Snake Creek Russell County, AL Tuskegee 1:100,000	8 mi^2	

APPENDIX 2, cont.

Candidate Reference Sites
Southeastern Plains Ecoregion
Mississippi and Alabama

	Stream Name	Approx. Size	Comments
5.	Brush Creek Russell County, AL Tuskegee 1:100,000	13 mi^2	
6.	Maringo Creek Russell County, AL Tuskegee 1:100,000	9 mi^2	

Appendix 3a. Summary of Alabama Reconnaissance Data From the Blackland Prairie Subregion (65A)

Blackland Prairie

Creek Name	**Taylor**	**Jones**	**Chaney**	**Bear**	**Tallawassee**	**Steep**	**Mud**	**Toms**	**Hatchet**	**Panther**	**Johnsons**
County	Greene	Sumter	Dallas	Dallas	Lowndes	Lowndes	Dallas/Perry	Sumter	Sumter	Bullock	Bullock
Station #	65A-6	65A-6b	65A-7	65A-8	65A-9b	65A-10	65A-8b	65A-5	65A-5a	65A-11	65A-12
Stream Width (Feet)	11	18	15	11	10	11	<1				
Riffle Depth (inches)	3	5	4	4	5	-					
Run Depth (inches)	16	18	16	10	10	15					
Pool Depth (inches)	27	>36	-	21	-	-					
High Water Mark (feet)	9	15	7	12	8	12				10 - 15	10 - 15
Canopy Cover*	S	MO	MO	MS	O	S				S	S
Turbidity*	T	ST	C	C	ST	ST			C		
Color	Green/Brown	Chalky Green	Clear	Clear	Clear	Tannic		Green	Clear		
Drainage Basin Size (Sq. M	11	19	50	20	27	38	17	12 - 15	12	17	15
Habitat Assessment Score	55	72	100	88	87	87					
Habitat Quality	Fair	Good	Good	Good	Good	Good					
EPT Index	1	2	3	2	3	-					
Macrophytes	Absent	Absent	Absent	Absent	Absent	Absent					
Comments	a	b	c	d	e	f	g	h	i	j	k
Substrate Composition											
Bedrock %											
Boulder %											
Cobble %					5						
Gravel %	5	38	12	2	60						
Sand %	85	38	5	3	20	1					
Silt %		2		10	10	3					
Clay %	5	17	75	80		92					
Wood %	5	3		5	3	2					
CPOM%		2	3		2	2					

* Canopy Cover = S=Shaded; MS=Mostly Shaded; MO=Mostly Open; O= Open
* Turbidity= C=Clear; ST=Slightly Turbid; T=Turbid
a - garbage in creek at bridge; banks subject to high erosion during high flow.
b - cows use as a drinking source; very steep clay banks at bridge.
c - good rootbank habitats; very sinuous; predominant land use is forest
d - corn planted upstream with small buffer zone;predominant land use is cow pasture and agriculture.
e - filamentous algae on gravel; cows evident upstream of bridge and fence across creek; aerial reconnaissance showed good forest cover in upper
f - no visible flow; may be in backwater of Pintlala Creek; not wadeable.
g - almost no flow; channel estimated at one foot wide.
h - almost no flow creek bank muddy, some channelization present in watershed
i - almost no water in stream; good blackland prairie type stream, just too small.
j - Clay bottom; very low flow; tributary to this stream runs through a fertilizer plant; cattle in upper watershed
k - not wadeable at this site; upstream crossing goes through cow pasture with a cow path through the creek

Appendix 3b. Summary of Alabama Reconnaissance Data From the Flatwoods/Alluvial Prairie Margins Subregion (65B.

Flatwoods/Alluvial Prairie Margins								
Creek Name	**Barton**	**Poplar**	**Soapstone**	**Lockhart**	**Halliday**	**Allen**	**Foster**	**Schoolhouse**
County	Marengo	Marengo	Dallas	Bullock	Russell	Marengo	Wilcox	Russell
Station #	65B-7	65B-8	65B-9	65B-10	65B-11	65B-12	65B-13	65B-14
Stream Width (feet)	15	10	13	-				
Riffle Depth (inches)	-	-	4	-				
Run Depth (inches)	6	5	15	-				
Pool Depth (inches)	24	24	24	-				
High Water Mark (feet)	11	10	12	6				
Canopy Cover	Mostly Open	Shaded	Shaded	Open				
Turbidity	Sl. Turbid	Clear	Clear			turbid	turbid	
Color	Sl. Tannic	Sl. Tanni	Sl. Tannic	Tannic			tannic	
Drainage Basin Size (Sq. M	19	15	16	17	8	10	14	8
Habitat Assessment Score	61	68	81	68				
Habitat Quality	Fair	Fair	Good	Fair				
EPT Index	-	-	1	-				
Macrophytes	Absent	Absent	Absent	Absent				
Comments	a	b	c	d	e	f	g	h
Substrate Composition								
Bedrock %								
Boulder %								
Cobble %								
Gravel %			35					
Sand %	85	95	42	92				
Silt %								
Clay %	12	1	20					
Wood %	2	2	3	6				
CPOM%	1	2		2				

a - catfish ponds in upper watershed; predominant land use is forest; creek banks on one side composed of a
b - predominant land use is forest and agriculture; aerial reconnaissance shows mostly forested watershed
c - wadeable; good riffles; aerial reconnaissance showed sall amount of fields and houses but no evidence of
d - gases rising from sandy substrate; no wadeable; no noticable flow; upstream crossing is swampy
e - flow estimated at < 0.5 cfs
f - very slow moving; not wadeable
g - cow pasture on both sides of the bridge; upstream runs on edge of a 2 - 3 year old clear cut
h - not visited due to the small size of the drainage basin.

Appendix 3c. Summary of Alabama Reconnaissance Data From the Sand Hills Subregion (65C).

Sand Hills

Creek Name	**Maringo**	**Brush**	**Long Branch**	**Hodnet**	**Snake**	**Bulger**
County	Russell	Russell	Macon	Macon	Russell	Macon
Station #	65C-6	65C-5	65C-3	65C-2	65C-4	65C-1
Stream Width (Feet)	15 - 18	20	16	15 - 20		8
Riffle Depth (inches)	-	-	-	4 - 8		
Run Depth (inches)	12	20	12 - 18	12 - 18		6
Pool Depth (inches)	30	30	30	36 - 42		
High Water Mark (feet)	2 - 2.5	3	2	6		
Canopy Cover*	MO	MO	MO	MO		
Turbidity*	T	ST	C	C		
Color	Clear	Sl. Tannic	Sl. Tannic	Clear		
Drainage Basin Size (Sq. M	9	13	10	9	8	7
Habitat Assessment Score	86	81	77	105		
Habitat Quality	Good	Good	Good	Excellent		
EPT Index	-	-	-	-		
Macrophytes	-	-	-	-		
Comments	a	b	c	d	e	f
Substrate Composition						
Bedrock %	-	-	-	20		
Boulder %	-	-	-	10		
Cobble %	-	-	-	20		
Gravel %	2	4	2	30		
Sand %	85	86	90	17		
Silt %	1	2	3	1		
Clay %	-	-	-	-		
Wood %	6	4	3	1		
CPOM%	6	4	2	1		

* Canopy Cover= S=Shaded; MS=Mostly Shaded; MO=Mostly Open; O=Open
* Turbidity= C=Clear; ST=Slightly Turbid; T=Turbid
a - Braided channel; grass-type macrophytes in channel at upstream site
b - braided channel in several places
c - very braided channel typical of Sand Hills streams
d - huge plant/tree nursery on bothsides of creek; rocks slick with algae; bedrock and
e - Similar in channel and flow regime to Brush Creek. There is a field on the east si
f - Flow estimated to be zero at sampling date. Mostly sand bottom with some gravel.

Appendix 3d. Summary of Alabama Reconnaissance Data From the Piedmont Subregion (65D)

Piedmont								
Creek Name	**Shoal**	**Wedowee**	**Hurricane**	**Emuckfaw**	**L. Chattahospee**	**L. Sandy**	**Carlisle**	**Wells/Waterworks**
County	Randolph	Randolph	Randolph	Tallapoosa	Chambers	Chambers	Chambers	Chambers
Station #	65D-3	65D-4	65D-1	65D-2	65D-6	65D-8	65D-5	65D-7
Stream Width (Feet)	41	34	29	35	27			
Riffle Depth (inches)	5	6 - 8	6 - 8	6	-			
Run Depth (inches)	12	18	12	18	18			
Pool Depth (inches)	18	24 - 36	36	42	36			
High Water Mark (feet)	10	6 - 8	15	10	3.5			
Canopy Cover	MO	MO	MO	O	MO			
Turbidity	C	C	C	C	ST (rained)			
Color	Clear	Clear	Clear	Clear	Sl. Muddy			
Drainage Basin Size (Sq. M	12	10	12	25	20	20	8	27
Habitat Assessment Score	107	108	108	98	76			
Habitat Quality	Excellent	Excellent	Excellent	Good	Good			
EPT Index	-	-	-	-	-			
Macrophytes	-	-	-	-	-			
Comments	a	b	c	d	e	f	g	h
Substrate Composition								
Bedrock %	5	5	-	2	-			
Boulder %	3	5	10	2	-			
Cobble %	20	35	20	2	-			
Gravel %	34	25	40	35	5			
Sand %	34	26	26	50	82			
Silt %	2	1	1	2	3			
Clay %	-	-	-	-	5			
Wood %	1	2	2	3	3			
CPOM%	1	1	1	2	2			

* Canopy Cover= S=Shaded; MS=Mostly Shaded; MO=Mostly Open; O=Open
* Turbidity= C=Clear; ST=Slightly Turbid; T=Turbid
a - some open fields in the watershed for grazing; evidence of cows recently in a small trib to Shoal
b - downstream site has an access area for cows; upstream site fenced parallel to creek bank
c - large amount of silt deposited under bridge; generally forested watershed
d - logging of major concern in this basin
e - different than most Piedmont streams; sand is over 4 feet deep in places; very meandering and braided around islands. q
f - Sampling site with poor access and pooling
g - Creek Bank has been clearcut in past with no buffer zone, Erosion evident. Channel Shape is non-typical of Piedmont s
h - Logging in the watershed, farm animals with access to the creek, other sites either non-wadeable or atypical (bedrock w

Appendix 3e. Summary of Alabama Reconnaissance Data From the Southeastern Plains and Hills Subregion (65E)

Southeastern Plains and Hills																
Creek Name	**Okatuppa**	**Big Tallawampa**	**Baptizing**	**Morgan**	**Wells**	**Bear**	**Silver**	**Oak**	**Pineywoods**	**M. Tallawampa**	**Furlong**	**L. Patsaliga**	**Bowles**	**Stinking**	**Bear**	**Leak**
County	Choctaw	Choctaw	Marengo	Clarke	Clarke	Wilcox	Clarke	Dallas	Crenshaw	Choctaw	Butler	Crenshaw	Coffee	Barbour	Dale	Barbour
Station #	65E-6	65E-8	65E-19	65E-20a	65E-20b	65E-21	65E-22	65E-23	65E-25	65E-9	65E-24	65E-26	65E-27	65E-28	65E-29	65E-30
Stream Width (feet)	38	35	27	19	20	40	36	26	18							
Riffle Depth (inches)	12 (Cobble)	4 (Bedrock)	-	3-6 (Bedrock	-	-	-6 (Gravel	2-10 (Gravel)	-							
Run Depth (inches)	21	15	12 - 36	6 - 18	3 - 6	8 - 18	12 - 24	24 - 30	12 - 36							
Pool Depth (inches)	36	21	18 - 36	48	18 - 24	18 - 36	24 - 36	>24	>48							
High Water Mark (feet)	8	6	7	9	7	6	5	9	10							
Canopy Cover	MO	MO	MO	MO	MS	MO	MS	MS	MS							
Turbidity	C	C	T	C	C	ST	C	ST	ST		T					T
Color	Sl. Tannic	Sl. Tannic	Clear	Sl. Tannic	Sl. Tanni	Clear	Sl. Tannic	Sl. Tannic	Mod. Tannic		Milky					clay red
Drainage Basin Size (Sq. M	60	30	11	20	18	18	20	10	24	14	21	35 - 40	15 - 24	15	25	14
Habitat Assessment Score	82	110	68	107	61	107	105	80	71							
Habitat Quality	Good	Excellent	Fair	Excellent	Fair	Excellent	Excellent	Good	Good							
EPT Index	5	3	2	4	3	4	4	3	2							
Macrophytes	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent							
Comments	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
Substrate Composition																
Bedrock %	15	40		50												
Boulder %				1												
Cobble %	3	10		15			1	1								
Gravel %	3			6	1		70	8								
Sand %	70	40	90	20	90	28	20	80	70							
Silt %	1	1	1	3	1	5	1		5							
Clay %				1		65		3	5							
Wood %	6	5		3	5	1	4	6	12							
CPOM%	2	5	10	2	4	1	4	2	8							

* Canopy Cover= S=Shaded; MS=Mostly Shaded; MO=Mostly Open; O=Open

* Turbidity= C=Clear; ST=Slightly Turbid; T=Turbid

a - appears to have higher gradient than Big Tallawampa; upper site (65E-7) found empty fertilizer bags in creek; 2 gas and 1 oil pi

b - water willow common on the sand; forest is predominant land use.

c - cypress trees on bank; upper part of watershed with several clearcut areas on steep banks, could be source of turbidity.

d - watershed contains wildlife management area;

e - downstream of confluence of Morgan (65E-20a) and Wells Creeks; per resident creek dries up in the early dry fall; revisited durir

f - looks like a Blackland Prairie stream; logging activities provide potential for NPS and two small tribs bearing sand and silt ar

g - much of watershed owned by lumber company; used partially for recreation; no evidence of adverse impact from logging operations;

h - aerial reconnaissance showed no sources of major impact, mostly forested watershed; sandy clay banks; sink up to a foot in loos

i - aerial reconnaissance indicates entire watershed (minus buffer zone) is large replanted pines

j - access unknown; all impassable logging roads

k - a lot of silt present; substrate of sand and clay; abundant woody debris; upstream trib. fille

l - aerial reconnaissance shoed some clearcutting and numerous chicken houses in the watershed

m - sites located on Fort Rucker Military Base

n - visited during high water; swampy stream channel in generally forested area

o - braided channels through a swampy area; aerial reconnaissance showed area to be braided throug

p - during rain; Pine plantation near this location. From Aerial reconnaissance there is a hugh c

Appendix 3f. Summary of Alabama Reconnaissance Data From the Southern Pine Plains and Hills (65F) and the Dougherty/Marianna Plains (65G) Subregions

Southern Pine Plains and Hills

Creek Name	Bear/Bates	Pond	Halls	Majors	E.Prong Silas	W.Prong Silas	Bear	Clear	Bear	Henson	Turkey	Excambia	Juniper	L. Dbl Bridges	Wrights
County	Washington	Washington	Baldwin	Baldwin	Escambia	Escambia	Escambia	Covington	Houston	Washington	Baldwin	Conecuh	Escambia	Coffee	Geneva
Station #	65F-5	65F-6	65F-12	65F-?	65F-16	65F-16	65F-17	65F-18	65F-20 (G)	65F-4	65F-13	65F-14	65F-15	65F-19a	65F-21 (G)
Stream Width (Feet)	20	21	21	31	43	-	38	20	10	a	b	c	d	e	f
Riffle Depth (inches)	-	-	-	6 (Clay)	2-6 (Clay)	-	-	-	-						
Run Depth (inches)	24-48	24 - >36	18 - >36	12 - >36	6	-	18 - >24	12 - 18	6 - 12						
Pool Depth (inches)	>48	-	>36	24 - 36	24	-	>60	24 - 60	24 - 48						
High Water Mark (feet)	6	8	6	9	10	-	5	5	3						
Canopy Cover	MS	MO	MS	O	O	O	MS	MS	S		O				
Turbidity	C	C	C	C	C	C	C	C	C		C				ST
Color	Dark Tannic	Tannic	Mod. Tannic	Dark Tannic	no color	Sl. Tannic	Dark Tannic	Dark Tannic	Sl. Tannic		Tannic	Tannic			Mod. Tannic
Drainage Basin Size (Sq. Mi	52	23	16	?	<22	<22	27	33	24	20	15	36	18	8 - 24	15
Habitat Assessment Score	86	72	77	90	80	61	96	86	65						
Habitat Quality	Good	Good	Good	Good	Good	Fair	Good	Good	Fair						
EPT Index	-	0	1	-	1	1	4	4	1						
Macrophytes	Present	Present	Present	Present	Absent	Absent	Present	Present	Present	Present					
Comments	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Substrate Composition															
Bedrock %															
Boulder %															
Cobble %															
Gravel %			1	1	5	3									
Sand %	70	48	83	63	71	90	69	73	50						
Silt %	7		1	1	1	1	1	1							
Clay %	3	48		30	20			1							
Wood %	12	2	7		2	3	25	20	20						
CPOM%	8	2	8	5	1	3	5	5	10						

* Canopy Cover= S=Shaded; MS=Mostly Shaded; MO=Mostly Open; O=Open
* Turbidity= C=Clear; ST=Slightly Turbid; T=Turbid
a - a large amount of decomposition gas coming up from the bottom sediments
b - difficult access; spring upstream of bridge
c - white sand; good access; small spring usptream
d - easy access; clay shelves on both sides; 4 small springs upstream
e - presence of natural iron; tends to give substrate a reddish color; blue clay riffles
f - no clay or iron present; 3 to 6 inch balls of ? (peat) rolling down the creek bottom
g - logs provide the majority of habitat; pools very deep; aerial reconnaissance shows no disturbance in watershed
h - large logs porvide the majority of habitat along with rootbanks
i - aerial reconnaissance showed mostly wetland and agriculture; lots of cropland in watershed; pretty typical; braide
j - braided, swampy stream channel; looks like most of area clear cut est. 8 - 10 years ago and replanted with pines
k - large scale clear cutting in watershed has blown out stream channel.
l - watershed clear cut in varying times over last est. 2 - 15 years and planted in pines. Numerous logging roads in
m - crosses several powerlines upstream of site.
n - downstream site has a chicken rendering plant effluent discharge into it. Aerial reconnaissance indicates lots of
o - very similar to Bear (65F-20) with braided channel. Flow appears better at Bear Creek

Appendix 3g. Summary of Mississippi Reconnaissance Data From the Blackland Prairie Subregion (65A)

Blackland Prarie									
Creek Name	**James**	**James**	**Plum**	**Cedar**	**Bogue Chitto**	**Cedar**	**Tubbalubba**	**Osborne**	**Parmicha**
Station	**lower site**								
County	Lowndes	Lowndes/Noxubee	Noxubee	Lowndes	Noxubee	Monroe	Lee	Prentiss	Alcorn
Site #	1	2	3	4	5	Site 6c	Site 6d	Site 6e	Site 6f
Width (Feet)	20	9	4	10	3	10	3	3	3
Riffle Depth (inches)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Run Depth (inches)	n/a	n/a	n/a	4	n/a	4	n/a	n/a	n/a
Pool Depth (inches)	>48	20	30	4	8	12	12	11	8
High Water Mark (feet)	10	3	4	3	4	8	1	1	1
Canopy Cover+	o	po	o	o	o	s	o	o	o
Turbidity	turbid	turbid	turbid	clear	turbid	slight	turbid	turbid	turbid
Color	green	milky	green	none	green	lt green	green	lt green	green
Drainage Basin Size (Sq. Mi	50	35	20	12		16	15	8	8
Habitat Assessment Score	50	62		45		61			
Habitat Quality	fair	fair		fair		fair			
Macrophytes	none	none		none	none	none	none		
Comments	impacted	best in region	sewage??	deleted	deleted	b	mpacted delete	b/deleted	channelized/deleted
Substrate Composition									
Bedrock %									
Boulder %									
Cobble %									
Gravel %									
Sand %	45	35		10		20			
Silt %	25	40		5		15			
Clay %	20	15		80		45			
Wood %	5	5				5			
CPOM%				5		5			
FPOM%	5	5							

+ Canopy Cover= S=Shaded; ; PO=Partly Open; O=Open
a most flow from lake
b no flow in summer

Appendix 3h. Summary of Mississippi Reconnaissance Data From the Flatwoods Alluvial Prairie Margins Subregion (65B)

Flatwoods/Alluvial Prairie Margins										
Creek Name	**W. Tallahalla #**	**Tallahalla #**	**Leaf R. #**	**Greenwood**	**Mud**	**Yalobusha R.**	**Lynn**	**Yellow**	**Sun**	**Howard**
County	Jasper	Jasper	Scott	Itawamba	Pontotoc	Chickasaw	Noxubee	Noxubee	Noxubee	Lowndes
Site #	1	2	Site 2b	Site 2c	Site 2d	Site 2e	3	4	5	6
Width (Feet)	6	8	5	15	6	12	7	8	5	8
Riffle Depth (inches)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Run Depth (inches)	n/a	7	n/a	3	n/a	n/a	n/a	8	4	10
Pool Depth (inches)	9	14	22	16	24	48	24	19	10	26
High Water Mark (feet)	3	7	5	8	4	4	8	8	7	4
Canopy Cover+	po	s	ps	s	ps	o	po	s	s	ps
Turbidity	slight	none	turbid	clear	turbid	turbid	slight	slight	turbid	slight
Color	tan	none	tan/gray	none	brown	brown	green	lt green	green/brown	dk brown
Drainage Basin Size (Sq. Mi	25	25	30	20	13	25	28	30	15	18
Habitat Assessment Score		67		83				79	57	
Habitat Quality		fair		good				good	fair	
Macrophytes		none		none				none	none	
Comments	disturbed		impacted/deleted		a / deleted	Impacted above	impacted		b	deleted
Substrate Composition										
Bedrock %										
Boulder %										
Cobble %										
Gravel %								30		
Sand %		45		15				30	45	
Silt %		25		5				15	20	
Clay %				70					25	
Wood %		20		4				15	5	
CPOM%		5		1				5		
FPOM%		5		5				5	5	

+ Canopy Cover= S=Shaded; PO=Partly Open; PS= Partly Shaded; O=Open
a construction has altered
b pools in summer
- From Jackson Prairie Area

Appendix 3i. Summary of Mississippi Reconnaissance Data From the Southeastern Plains and Hills Subregion (65E)

Southeastern Plains and Hills

Creek Name	**Lobutcha**	**Lobutcha**	**Lobutcha**	**Lukfapa**	**Pailey**	**Bowie**	**Bowie**	**Dry**	**Turkey**	**Turkey**	**Potlockney**	**Lee**	**Shutispear**	**McCurtin**	**Scoobachitta**
Station	**lower site**	**middle site**	**upper site**			**upper site**	**lower site**		**upper site**	**lower site**					
County	Winston	Winston	Choctaw	Neshoba	Attala	Simpson	Jeff. Davis	Covington	Yalobusha	Yalobusha	Lafayette	Lafayette	Calhoun/Webester	Choctaw	Attalia
Site #	1	2	3	4	5	10	11	12	site 13a	site 13b	14	15	16	17	18
Width (Feet)	10	10	9	6	4	3	10	3	5	15	2	12	4	3	14
Riffle Depth (inches)	n/a	n/a		n/a	n/a	n/a			n/a	n/a	n/a	n/a	n/a	n/a	n/a
Run Depth (inches)	n/a	10		n/a	n/a	n/a			10	8	6	10	8	6	10
Pool Depth (inches)	55	27		35					24	18	12	18	15	24	24
High Water Mark (feet)	7	6		6					6	9	5	9	5	6	2
Canopy Cover+	ps	s		s	ps	s			po	po	po	o	s	ps	s
Turbidity	Clear	Clear		slight	slight	clear			clear	clear	slight	clear	moderate	slight	clear
Color	brown	brown		brown	brown	none			lt brown	none	none	none	brown	lt brown	none
Drainage Basin Size (Sq. Mi	65	40	9	18	18	9	40	12	27	40	22	15	14	36	20
Habitat Assessment Score		70							70	79		89		71	87
Habitat Quality		fair/good							fair/good	good		good		fair/good	good
Macrophytes		none							none	none		none		none	none
Comments			wetland/deleted	impacted/deleted	impacted/deleted	a/deleted	impacted/deleted	impacted/deleted			b/deleted		a	sl. Impact	
Substrate Composition															
Bedrock %															
Boulder %															
Cobble %															
Gravel %												5			
Sand %		50							70	60		40		65	70
Silt %		10							5	5		20		15	15
Clay %		25							5	10		10			5
Wood %		5							5	10		10		5	3
CPOM%		5							10	10		10		5	2
FPOM%		5							5	5		5		10	5

+ Canopy Cover= S=Shaded; PO=Partly Open; PS= Partly Shaded; O=Open
a dry in summer
b agricultural impacts

Appendix 3j. Summary of Mississippi Reconnaissance Data From the Southern Pine Plains and Hills Subregion (65F)

Southern Pine Plains and Hills

Creek Name	**Little**	**Griffin**	**Mason**	**Upper Little**	**Bay**	**Monroe**	**Black**	**Lower Little**
County	Wayne	Greene	Greene	Marion	Lamar	Lamar	Lamar	Lamar
Site #	1	2	3	7	8	9	10	11
Width (Feet)	7.5	5	3	4		2.5	3	20
Riffle Depth (inches)	n/a	n/a	n/a	n/a		n/a	4	n/a
Run Depth (inches)	8	6	12	7		12	6	24
Pool Depth (inches)	20	36	28	40		28	10	48
High Water Mark (feet)	6	9	3	6		3	3	10
Canopy Cover+	s	ps	s	ps		s	s	o
Turbidity	Clear	Clear	clear	clear		clear	clear	clear
Color	Lt Tannic	Lt Tannic	Dk Tannic	Lt Tannic	Lt Tannic	Dk Tannic	Lt Tannic	Lt Tannic
Drainage Basin Size (Sq. Mi	17	20	25	22	10	12	25	90
Habitat Assessment Score	94	72	97	88		113	98	102
Habitat Quality	good	fair	good	good		excellent	good	excellent
Macrophytes	none	none	none	present		present	none	none
Comments					a			
Substrate Composition								
Bedrock %								
Boulder %								
Cobble %								
Gravel %							15	
Sand %	55	60	55	55		55	35	60
Silt %	15	10	10	10		10	10	10
Clay %	5	5	5	5		5	10	5
Wood %	10	5	10	15		15	10	15
CPOM%	5	10	10	10		5	5	10
FPOM%	10	10	10	5		10	15	

+ Canopy Cover= S=Shaded; PO=Partly Open; PS= Partly Shaded; O=Open
a dry in summer

Appendix 4a. Biometrics and physical/chemical data collected from ecoregional reference sites loca within the Blackland Prairie (65a) and the Flatwoods Alluvial Prairie Margins (65b) subregions of A during 1991-1994.

	65A						65B							
	CYD		JNS				PPM			SPD				SPD-1a
Physical/Chemical Parameter	**1992**	**1993**	**1991*** **	**1992**	**1993**	**1993**	**1992**	**1993**	**1994**	**1991*** **	**1992**	**1992**	**1993**	**1994**
Sampling Date	25-Jun	17-Jun	30-Jul	23-Jun	20-Apr	17-Jun	23-Jun	17-Jun	28-Jun	20-Jun	25-Jun	16-Sep	#####	9-Jun
Stream Flow (cfs)	<.1	<.1	<.1	<.1	---	<.1	0.6	0.7	<0.5	3.5	1.1	0.7	1.2	1.6
Temperature (C)	24.0	23.5	26.0	21.5	18.5	25.0	23.0	26.0	25.0	18.3	25.5	21.5	28.0	27.0
pH (s.u.)	7.6	7.5	7.8	7.8	7.9	7.5	7.4	7.5	7.6	8.0	8.6	8.0	8.5	8.1
onductivity (umhos @ 25C	234	242	383	402	455	400	187	59	160	143	129	120	137	135
Dissolved Oxygen (mg/l)	4.8	4.4	5.6	6.7	9	3	7.4	6.4	6.1	8.0	9.9	8.2	9.1	7.8
Total Phosphates (mg/l)	0.046	0.055	0.08	0.036	0.014	0.016	0.059	0.065	0.080	0.033	0.037	0.098	0.011	0.028
Total Nitrates (mg/l)	0.026	0.030	0.10	0.010	0.006	0.014	0.280	0.053	0.075	0.19	0.020	0.034	0.018	0.069
	CYD		JNS				PPM			SPD				SPD-1a
Habitat Assessment	**1992**	**1993**	**1991**	**1992**	**1993**	**1993**	**1992**	**1993**	**1994**	**1991**	**1992**	**1992**	**1993**	**1994**
Total Score	82	88	71	70	80	71	49	50	72	91	77	71	90	97
% Sand	2	1	0	0	40	0	87	80	90	24	10	5	10	2
% Clay	76	80	95	100	40	100	5	10	5	48	49	70	70	86
% Gravel	15	7	0	0	10	0	0	1	1	23	37	5	15	5
Water Color*	Clear	Clear	---	---	Green	Green/ Grey	S. T.	---	Clear	Clear	Clear	Clear	Clear	Clear
	CYD		JNS				PPM			SPD				SPD-1a
Metric	**1992**	**1993**	**1991**	**1992**	**1993**	**1993**	**1992**	**1993**	**1994**	**1991**	**1992**	**1992**	**1993**	**1994**
Taxa Richness	66	78	51	43	51	53	41	47	46	59	75	61	81	61
EPT Taxa Richness	11	13	11	7	12	8	8	9	11	17	17	11	14	15
Biotic Index	5.9	5.9	5.8	5.7	6.3	6.9	5.3	5.6	5.2	5.1	5.3	5.7	5.1	4.6
% Contribution Dominant Taxon	27	21	28	35	19	19	25	18	19	22	23	37	22	22
Chironomidae Taxa Richness	14	22	15	16	14	18	11	15	15	14	22	19	25	21
#EPT / # EPT + # Chironomidae	0.72	0.47	0.66	0.70	0.66	0.31	0.47	0.45	0.55	0.52	0.71	0.24	0.54	0.62
# Shredders/Total # Organisms	0.12	0.06	0.03	0.01	0.34	0.07	0.24	0.14	0.26	0.01	0.60	0.65	0.44	0.21
# Scrapers / # Filterers + Scrapers	0.94**	0.42	0.02	0.15	1.00	0.52**	0.88**	0.90**	0.56**	0.17	0.13	0.83	0.30	0.21

Water Color* = S. T.=slightly tannic; M.T. = moderately tannic; V. T. = very tannic
Scrapers/ # Filterers + Scrapers** = Number based upon rock/log sample.
*** Rainy spring and early summer

Appendix 4b. Biometrics and physical/chemical data collected from ecoregional sites located within the Blackland Prairie (65a) subregion of Mississippi during

	65A						
	CDRL			JMS			
Physical/Chemical Parameter	**1993**	**1993**	**1993**	**1992**	**1992**	**1993**	**1993**
Sampling Date	23-Apr	15-Jun	11-Nov	23-Sep	23-Apr	16-Jun	8-Nov
Stream Flow (cfs)	--	--	---	--	--	---	---
Temperature (C)	12.5	24.9	7.5	23.0	16.0	27.0	9.1
pH (s.u.)	7.4	6.8	7.9	5.7	7.7	7.5	7.8
Conductivity (umhos @ 25C)	335	469	461	372	370	317	427
Dissolved Oxygen (mg/l)	10.6	8.2	5.0	---	9.8	8.2	4.6
Total Phosphates	0.2	0.11	0.42	0.19	<0.01	0.09	0.12
Total Nitrates	0.64	0.12	0.05	0.04	0.04	<0.04	.0.4
	CDRL			JMS			
Habitat Assessment	**1993**	**1993**	**1993**	**1992**	**1993**	**1993**	**1993**
Total Score	63	62	48	62	62	61	61
% Sand	45	40	40	35	25	30	5
% Clay	25	40	45	15	30	45	70
% Gravel	0	0	0	5	5	0	0
Water Color*	Brown/Green	Green	Green	Green	Green	Green	Green
	CDRL			JMS			
Metric	**1993**	**1993**	**1993**	**1992**	**1993**	**1993**	**1993**
Taxa Richness	53	27	---	28	34	---	---
EPT Taxa Richness	11	6	---	7	11	---	---
Biotic Index	4.5	5.2	---	4.8	5.1	---	---
% Contribution Dominant Taxon	20	57	---	25	34	---	---
Chironomidae Taxa Richness	12	6	---	11	9	---	---
#EPT / # EPT + # Chironomidae	0.74	0.79	---	0.71	0.64	---	---
# Shredders/Total # Organisms	0.07	0.15	---	0.14	0.00	---	---
# Scrapers / # Filterers + Scrapers	0.50**	0.21	---	0.04	0.06**	---	---

Water Color* = S. T.=slightly tannic; M.T. = moderately tannic; V. T. = very tannic
** # Scrapers / # Filterers + Scrapers = Number based upon rock/log sample

Appendix 4c. Biometrics and physical/chemical data collected from e reference sites located within theFlatwoods / Alluvial Prairie Margi subregion of Mississippi during 1991-1994.

	65B													
	GRDL			TALJ				YLMS						
Physical/Chemical Parameter	**1991**	**1992**	**1994**	**1991**	**1992**	**1993**	**1994**	**1991**	**1992**	**1993**	**1993**	**1993**	**1994**
Sampling Date	#####	#####	20-Apr	5-Jun	26-Jun	12-Nov	17-May	27-Mar	24-Jun	22-Apr	16-Jun	8-Nov	19-May
Stream Flow (cfs)	---	---	---	---	---	---	---	---	---	---	---	---	---
Temperature (C)	26.0	24.2	16.9	23.3	21.2	10.8	23.0	---	22.0	16.2	27.0	7.4	18.0
pH (s.u.)	---	5.7	6.2	6.4	6.8	7.2	6.5	---	6.8	6.2	6.7	7.1	6.2
Conductivity (umhos @ 25C)	81	55	56	69	92	71	70	---	125	135	120	121	127
Dissolved Oxygen (mg/l)	5.7	8.0	9.3	6.7	5.0	8.6	6.2	---	6.2	8.2	8.2	4.0	9.2
Total Phosphates	0.17	0.15	0.08	<0.01	0.04	<0.01	<0.01	---	0.04	<0.01	0.03	<0.01	0.09
Total Nitrates	<0.04	0.04	0.04	0.06	0.07	<0.04	<0.04	---	<0.04	<0.04	<0.04	<0.04	<0.04
	GRDL			TALJ				YLMS						
Habitat Assessment	**1991**	**1992**	**1994**	**1991**	**1992**	**1993**	**1994**	**1991**	**1992**	**1993**	**1993**	**1993**	**1994**
Total Score	81	83	83	66	100	82	88	---	76	70	73	66	70
% Sand	10	15	---	45	75	50	60	---	30	60	30	55	70
% Clay	70	70	---	0	5	5	5	---	0	10	15	0	5
% Gravel	2	0	---	0	0	0	0	---	30	0	0	15	0
Water Color*	---	---	S.T.	--	S.T.	S.T.	S.T.	---	---	Green	Green	---	Lt. Green
	GRDL			TALJ				YLMS						
Metric	**1991**	**1992**	**1994**	**1991**	**1992**	**1993**	**1994**	**1991**	**1992**	**1993**	**1993**	**1993**	**1994**
Taxa Richness	53	27	---	28	34	---	---	---	18	---	---	---	---
EPT Taxa Richness	11	6	---	7	11	---	---	---	4	---	---	---	---
Biotic Index	4.5	5.2	---	4.8	5.1	---	---	---	4.9	---	---	---	---
% Contribution Dominant Taxon	20	57	---	25	34	---	---	---	14	---	---	---	---
Chironomidae Taxa Richness	12	6	---	11	9	---	---	---	4	---	---	---	---
#EPT / # EPT + # Chironomidae	0.74	0.79	---	0.71	0.64	---	---	---	0.73	---	---	---	---
# Shredders/Total # Organisms	0.07	0.15	---	0.14	0.00	---	---	---	0.07	---	---	---	---
# Scrapers / # Filterers + Scrapers	0.50**	0.21	---	0.04	0.06**	---	---	---	0.53	---	---	---	---

Water Color* = S. T.=slightly tannic; M.T. = moderately tannic; V. T. = very tannic
** # Scrapers / # Filterers + Scrapers = Number based upon rock/log sample

Appendix 4d. Biometrics and physical/ chemical data collected from ecoregional reference s
within the Sand Hills (65c) and the Piedmont (65d) subregions of Alabama during 1991-1994.

	65C					65D				
	BCR			LBM		HCR			LCC	
Physical/Chemical Parameter	**1992**	**1993**	**1994**	**1992**	**1994**	**1992**	**1993**	**1994**	**1992**	**1993**
Sampling Date	24-Jun	23-Jun	9-Jun	24-Jun	9-Jun	9-Jul	15-Jun	14-Jun	15-Jul	15-Jun
Stream Flow (cfs)	0.7	0.4	7.0	0.8	0.9	5.6	11.7	11.3	4.1	7.8
Temperature (C)	20.0	20.0	21.0	20.5	25.0	23.0	21.0	20.0	23.0	22.0
pH (s.u.)	6.2	6.2	6.2	6.5	6.3	6.7	6.8	6.7	7.1	7.1
Conductivity (umhos @ 25C)	22	33	27	33	30	16	22	28	68	64
Dissolved Oxygen (mg/l)	7.6	6.2	7.4	6.3	6.8	8.2	8.4	8.2	6.8	7.2
Total Phosphates (mg/l)	0.015	0.016	0.011	0.021	0.021	0.009	0.010	<0.004	0.006	0.008
Total Nitrates (mg/l)	0.244	0.270	0.140	0.044	0.039	0.160	0.026	0.042	0.190	0.160
	BCR			**LBM**		**HCR**			**LCC**	
Habitat Assessment	**1992**	**1993**	**1994**	**1992**	**1994**	**1992**	**1993**	**1994**	**1992**	**1993**
Total Score	61	69	84	52	59	103	112	103	70	75
% Sand	85	80	60	85	72	7	40	19	65	83
% Clay	0	1	0	0	0	0	2	2	13	2
% Gravel	0	2	20	0	0	15	29	40	0	1
Water Color	S.T.	S.T.	M.T.	M.T.	S.T.	Clear	Clear	Clear	---	Muddy
	BCR			**LBM**		**HCR**			**LCC**	
Metric	**1992**	**1993**	**1994**	**1992**	**1994**	**1992**	**1993**	**1994**	**1992**	**1993**
Taxa Richness	63	68	54	61	37	66	74	68	48	58
EPT Taxa Richness	18	20	16	12	5	23	27	25	15	14
Biotic Index	4.6	4.0	5.0	5.2	5.1	3.4	3.3	3.7	5.9	4.3
% Contribution Dominant Taxon	15	17	27	12	20	11	10	22	46	15
Chironomidae Taxa Richness	18	21	16	19	15	15	19	20	10	20
#EPT / # EPT + # Chironomidae	0.30	0.60	0.41	0.60	0.09	0.73	0.81	0.69	0.27	0.59
# Shredders/Total # Organisms	0.31	0.33	0.51	0.09	0.19	0.19	0.21	0.27	0.00	0.04
# Scrapers / # Filterers + Scrapers	0.78**	0.81**	0.10**	0.69**	0.00**	0.51	0.33	0.74	0.68**	0.47**

Water Color* = S. T.=slightly tannic; M.T. = moderately tannic; V. T. = very tannic
Scrapers/ # Filterers + Scrapers** = Number based upon rock/log sample.

Appendix 4e. Biometrics and physical/chemical data collected from ecoregional refe sites located within the Southeastern Plains and Hills (65e) subregion of Alabama 1991-1994.

	65E						
	PYW			SRC			
Physical/Chemical Parameter	**1991*** **	**1992**	**1993**	**1991*** **	**1992**	**1993**	**1994**
Sampling Date	23-Jul	14-Jul	24-Jun	25-Jun	7-Jul	8-Jun	14-Jun
Stream Flow (cfs)	0.6	0.5	<0.1	33.4	4.5	14.1	17.7
Temperature (C)	23.5	24.0	21.0	22.5	24.0	24.0	24.0
pH (s.u.)	6.8	6.7	6.7	6.8	7.6	7.5	7.5
Conductivity (umhos @ 25C)	72	51	81	74	102	102	76
Dissolved Oxygen (mg/l)	3.5	3.7	3.1	7.6	7.8	7.7	7.9
Total Phosphates (mg/l)	0.05	0.024	0.019	<0.02	0.012	0.015	0.021
Total Nitrates (mg/l)	0.11	0.039	0.031	<0.04	0.011	0.008	0.017
	PYW			SRC			
Habitat Assessment	**1991**	**1992**	**1993**	**1991**	**1992**	**1993**	**1994**
Total Score	59	55	58	110	93	97	63
% Sand	83	88	68	43	46	60	79
% Clay	1	1	10	0	0	0	1
% Gravel	1	2	0	43	47	27	1
Water Color	S.T.	M.T.	M.T.	S.T.	Clear	V.T.	M.T.
	PYW			SRC			
Metric	**1991**	**1992**	**1993**	**1991**	**1992**	**1993**	**1994**
Taxa Richness	43	51	53	50	60	58	54
EPT Taxa Richness	6	8	9	16	22	15	20
Biotic Index	6.0	6.1	5.0	4.4	3.8	5.0	4.3
% Contribution Dominant Taxon	13	11	13	21	10	29	18
Chironomidae Taxa Richness	11	15	12	11	9	17	10
#EPT / # EPT + # Chironomidae	0.47	0.41	0.88	0.72	0.74	0.39	0.67
# Shredders/Total # Organisms	0.04	0.04	0.01	0.13	0.30	0.34	0.16
# Scrapers / # Filterers + Scrapers	0.74**	0.77**	0.95**	0.63	0.53	0.32	0.40

Water Color* = S. T.=slightly tannic; M.T. = moderately tannic; V. T. = very tannic
Scrapers/ # Filterers + Scrapers** = Number based upon rock/log sample.
*** Rainy spring and early summer

Appendix 4f. Biometrics and physical/ chemical data collected from ecoregi sites located within the Southeastern Plains and Hills (65e) subregion of Mi 1991-1994 (Table 1 of 2).

	65E										
	LAW						LEEL				
Physical/Chemical Parameter	**1991**	**1992**	**1993**	**1993**	**1993**	**1994**	**1991**	**1992**	**1993**	**1993**	**1994**
Sampling Date	#####	25-Jun	26-Apr	#####	28-Oct	#####	9-Jul	#####	#####	10-Nov	13-May
Stream Flow (cfs)	---	---	---	---	---	---	---	---	---	---	---
Temperature (C)	26.0	23.0	13.7	23.9	13.4	19.5	29.0	23.2	26.0	6.6	20.2
pH (s.u.)	---	6.4	6.3	6.5	6.0	5.8	6.6	6.8	6.5	6.6	6.5
Conductivity (umhos @ 25C)	81	55	41	54	73	41	45	52	50	53	52
Dissolved Oxygen (mg/l)	5.7	5.4	10.6	8.2	8.6	8.4	6.8	8.8	8.1	10.0	8.4
Total Phosphates (mg/l)	0.17	0.04	<0.01	0.03	0.01	---	0.14	0.08	---	<0.01	---
Total Nitrates (mg/l)	<0.04	0.14	0.04	0.11	0.05	---	0.14	0.09	---	0.05	---
	LAW						LEEL				
Habitat Assessment	**1991**	**1992**	**1993**	**1993**	**1993**	**1994**	**1991**	**1992**	**1993**	**1993**	**1994**
Total Score	78	60	71	76	69	82	93	89	80	84	87
% Sand	45	50	60	45	35	40	70	40	70	40	45
% Clay	35	25	20	30	20	40	5	10	10	40	25
% Gravel	0	0	0	0	0	0	0	5	0	0	15
Water Color*	---	S.T.	V.T.	S.T.	S.T.	V.T.	---	Clear	S.T.	Clear	Clear
	LAW						LEEL				
Metric	**1991**	**1992**	**1993**	**1993**	**1993**	**1994**	**1991**	**1992**	**1993**	**1993**	**1994**
Taxa Richness	31	26	---	---	---	---	37	34	---	---	---
EPT Taxa Richness	7	6	---	---	---	---	7	9	---	---	---
Biotic Index	4.5	5.7	---	---	---	---	4.6	4.8	---	---	---
% Contribution Dominant Taxon	25	16	---	---	---	---	19	42	---	---	---
Chironomidae Taxa Richness	4	7	---	---	---	---	11	9	---	---	---
#EPT / # EPT + # Chironomidae	0.79	0.70	---	---	---	---	0.67	0.66	---	---	---
# Shredders/Total # Organisms	0.00	0.03	---	---	---	---	0.04	0.04	---	---	---
# Scrapers / # Filterers + Scrapers	--	1.00**	---	---	---	---	0.03**	0.01**	---	---	---

Water Color* = S. T.=slightly tannic; M.T. = moderately tannic; V. T. = very tannic
** # Scrapers / # Filterers + Scrapers = Number based upon rock/log sample

Appendix 4g. Biometrics and physical/chemical data collected from ecoregiona sites located within the Southeastern Plains and Hills (65e) subregion of Mis 1991-1994 (Table 2 of 2).

	65E										
	SCBT				TKYY1			TKYY2			
Physical/Chemical Parameter	**1992**	**1993**	**1993**	**1994**	**1991**	**1992**	**1994**	**1992**	**1993**	**1993**	**1994**
Sampling Date	26-Jun	#####	12-Nov	12-May	9-Jul	#####	12-May	#####	#####	9-Nov	12-May
Stream Flow (cfs)	---	---	---	---	---	---	---	---	---	---	---
Temperature (C)	21.2	23.5	9.0	19.0	27.0	24.7	21.4	26.5	24.0	9.0	20.9
pH (s.u.)	6.9	6.4	6.0	5.7	6.5	5.8	6.5	7.0	6.5	6.8	6.7
Conductivity (umhos @ 25C)	52	41	50	45	59	21	60	95	40	50	68
Dissolved Oxygen (mg/l)	8.2	8.8	8.6	8.6	7.5	8.3	6.9	7.8	8.5	8.7	6.8
Total Phosphates (mg/l)	0.02	---	<0.01	---	0.11	0.01	---	1.18	---	0.08	---
Total Nitrates (mg/l)	0.12	---	<0.04	---	0.08	0.08	---	0.38	---	0.09	---
	SCBT				TKYY1			TKYY2			
Habitat Assessment	**1992**	**1993**	**1993**	**1994**	**1991**	**1992**	**1994**	**1992**	**1993**	**1993**	**1994**
Total Score	69	70	75	68	89	68	80	78	74	78	73
% Sand	50	45	50	70	60	50	50	35	40	60	35
% Clay	20	30	10	5	2	5	5	5	5	0	5
% Gravel	0	0	10	0	0	0	10	0	0	10	0
Water Color*	Brown	S.T.	S.T.	S.T.	---	---	Clear	---	Clear	Clear	Clear
	SCBT				TKYY1			TKYY2			
Metric	**1992**	**1993**	**1993**	**1994**	**1991**	**1992**	**1994**	**1992**	**1993**	**1993**	**1994**
Taxa Richness	25	---	---	---	40	27	---	37	---	---	---
EPT Taxa Richness	8	---	---	---	13	3	---	11	---	---	---
Biotic Index	4.2	---	---	---	4.5	5.3	---	4.8	---	---	---
% Contribution Dominant Taxon	21	---	---	---	16	15	---	18	---	---	---
Chironomidae Taxa Richness	4	---	---	---	10	8	---	8	---	---	---
#EPT / # EPT + # Chironomidae	0.71	---	---	---	0.67	0.33	---	0.60	---	---	---
# Shredders/Total # Organisms	0.11	---	---	---	0.04	0.09	---	0.08	---	---	---
# Scrapers / # Filterers + Scrapers	--	---	---	---	0.75	0.57**	---	0.02	---	---	---

Water Color* = S. T.=slightly tannic; M.T. = moderately tannic; V. T. = very tannic
** # Scrapers / # Filterers + Scrapers = Number based upon rock/log sample

Appendix 4h. Biometrics and physical/ chemical data collected from ecoregional referer sites located within the Southern Pine Plains and Hills (65f) subregion of Alabama durir

	65F								
	BRE			CLC		HLB			
Physical/Chemical Parameter	**1991*** **	**1992**	**1993**	**1992**	**1993**	**1991*** **	**1992**	**1993**	**1994**
Sampling Date	23-Jul	8-Jul	9-Jun	8-Jul	9-Jun	23-Jul	7-Jul	8-Jun	14-Jun
Stream Flow (cfs)	36.6	12.9	16.5	17.0	5.8	31.3	11.3	13.8	14.7
Temperature (C)	23.5	22.0	20.0	24.0	22.0	25.0	25.0	26.0	25.0
pH (s.u.)	4.8	5.2	5.2	7.2	7.6	6.0	6.4	6.2	6
Conductivity (umhos @ 25C)	26	16	22	117	180	35	20	29	25
Dissolved Oxygen (mg/l)	6.5	7.1	6.9	6.8	7.0	6.9	7.5	7.4	7.6
Total Phosphates (mg/l)	0.03	<0.004	0.007	<0.004	0.010	0.03	0.006	0.012	0.009
Total Nitrates (mg/l)	0.22	0.500	0.420	0.020	0.060	0.13	0.088	0.050	0.034
	BRE			CLC		HLB			
Habitat Assessment	**1991**	**1992**	**1993**	**1992**	**1993**	**1991**	**1992**	**1993**	**1994**
Total Score	92	78	86	68	83	75	67	77	63
% Sand	85	65	90	80	67	93	80	88	79
% Clay	0	2	1	2	20	1	0	0	1
% Gravel	0	0	1	0	0	0	1	1	1
Water Color	V.T.	M.T.	V.T.	M.T.	M.T.	M.T.	M.T.	V.T.	M.T.
	BRE			CLC		HLB			
Metric	**1991**	**1992**	**1993**	**1992**	**1993**	**1991**	**1992**	**1993**	**1994**
Taxa Richness	29	47	45	63	46	33	62	51	42
EPT Taxa Richness	11	14	14	21	16	7	18	18	12
Biotic Index	4.4	3.1	3.4	4.5	4.9	4.5	3.7	4.3	3.7
% Contribution Dominant Taxon	19	23	14	13	13	16	14	11	19
Chironomidae Taxa Richness	11	12	17	12	14	11	15	13	12
#EPT / # EPT + # Chironomidae	0.54	0.81	0.65	0.54	0.60	0.47	0.60	0.46	0.49
# Shredders/Total # Organisms	0.27	0.27	0.45	0.26	0.16	0.26	0.20	0.27	0.46
# Scrapers / # Filterers + Scrapers	0.77**	0.68**	0.73**	0.86**	0.73**	1.00**	0.38**	0.14**	0.31**

Water Color* = S. T.=slightly tannic; M.T. = moderately tannic; V. T. = very tannic
Scrapers/ # Filterers + Scrapers** = Number based upon rock/log sample.
***Rainy spring and early summer

Appendix 4i. Biometrics and physical/ chemical data collected from ec
reference sites located within the Southern Pine Plains and Hills (65
of Mississippi during 1991-1994.

	65F													
	BLK		LLTL			MUNH					ULRM	LTLW	
Physical/Chemical Parameter	**1992**	**1994**	**1992**	**1993**	**1994**	**1991**	**1992**	**1993**	**1993**	**1994**	**1991**	**1993**	**1994**
Sampling Date	10-Aug	19-May	11-Aug	#####	19-May	#####	10-Aug	#####	25-Oct	19-May	24-Jul	27-Oct	21-May
Stream Flow (cfs)	---	---	---	---	---	---	---	---	---	---	---	---	---
Temperature (C)	22	19	24.0	25.0	18.0	23.4	24.0	25.0	17.5	22.0	23.6	17.1	17.7
pH (s.u.)	6.8	5.9	6.1	6.5	6.0	5.9	6.2	6.8	6.8	5.9	6.0	6.4	6.0
Conductivity (umhos @25C)	29	25	21	45	22	28	28	23	29	19	23	26	18
Dissolved Oxygen (mg/l)	8.6	6.5	8.4	9.9	8.8	6.3	8.4	8.4	9.4	6.6	7.2	9	9
Total Phosphates (mg/l)	---	---	0.02	<0.04	---	0.02	<0.01	0.07	<0.01	---	0.14	0.02	---
Total Nitrates (mg/l)	---	---	0.07	0.1	---	0.32	0.21	0.31	0.14	---	0.14	<0.04	---
	BLK		**LLTL**			**MUNH**					**ULRM**	**LTLW**	
Habitat Assessment	**1992**	**1994**	**1992**	**1993**	**1994**	**1991**	**1992**	**1993**	**1993**	**1994**	**1991**	**1993**	**1994**
Total Score	98	84	118	116	95	101	111	113	100	94	93	94	72
% Sand	35	40	20	35	35	75	50	55	50	60	75	55	70
% Clay	20	15	20	20	30	0	0	5	5	10	5	5	10
% Gravel	15	20	35	15	25	0	0	0	5	0	0	0	0
Water Color*	M.T.	---	---	S.T.	S.T.	---	V.T.	---	V.T.	---	---	---	---
	BLK		**LLTL**			**MUNH**					**ULRM**	**LTLW**	
Metric	**1992**	**1994**	**1992**	**1993**	**1994**	**1991**	**1992**	**1993**	**1993**	**1994**	**1991**	**1993**	**1994**
Taxa Richness	42	---	43	---	---	42	45	---	---	---	36	---	---
EPT Taxa Richness	12	---	17	---	---	19	16	---	---	---	6	---	---
Biotic Index	4.1	---	4.3	---	---	4.1	4.3	---	---	---	4.6	---	---
% Contribution Dominant Taxon	12	---	17	---	---	17	28	---	---	---	33	---	---
Chironomidae Taxa Richness	7	---	3	---	---	11	10	---	---	---	10	---	---
#EPT / # EPT + # Chironomidae	0.77	---	0.94	---	---	0.85	0.75	---	---	---	0.81	---	---
# Shredders/Total # Organisms	0.06	---	0.00	---	---	0.04	0.01	---	---	---	0.09	---	---
# Scrapers / # Filterers + Scrapers	0.73	---	0.29	---	---	0.06**	0.27**	---	---	---	0.14**	---	---

Water Color* = S. T.=slightly tannic; M.T. = moderately tannic; V. T. = very tannic
** # Scrapers / # Filterers + Scrapers = Number based upon rock/log sample

Appendix 4j. Biometrics and physical/ chemical data collected from ecc
reference sites located within the Dougherty/Marianna Plains (65g) subr
Alabama during 1991-1994.

	65G			
	BRH			
Physical/Chemical Parameter	**1991*** **	**1992**	**1993**	**1993**
Sampling Date	24-Jul	14-Jul	10-Jun	4-Aug
Stream Flow (cfs)	--	--	--	--
Temperature (C)	25.0	24.0	22.0	23.0
pH (s.u.)	6.3	6.6	6.5	6.8
Conductivity (umhos @ 25C)	75	56	58	73
Dissolved Oxygen (mg/l)	4.7	4.8	5.2	5.2
Total Phosphates (mg/l)	0.04	0.021	0.019	0.022
Total Nitrates (mg/l)	0.18	0.210	0.310	0.368
	BRH			
Habitat Assessment	**1991**	**1992**	**1993**	**1993**
Total Score	79	86	84	77
% Sand	50	35	76	20
% Clay	0	0	0	0
% Gravel	0	0	0	0
Water Color*	M.T.	V.T.	V.T.	S.T.
	BRH			
Metric	**1991**	**1992**	**1993**	**1993**
Taxa Richness	34	49	36	50
EPT Taxa Richness	6	10	10	11
Biotic Index	5.1	5.5	5.4	5.0
% Contribution Dominant Taxon	32	20	48	12
Chironomidae Taxa Richness	12	12	13	18
#EPT / # EPT + # Chironomidae	0.50	0.22	0.18	0.39
# Shredders/Total # Organisms	0.09	0.13	0.00	0.20
# Scrapers / # Filterers + Scrapers	0.85**	0.48**	0.76**	0.33**

Water Color* = S. T.=slightly tannic; M.T. = moderately tannic; V. T. = very tanni
Scrapers/ # Filterers + Scrapers** = Number based upon rock/log sample.
*** Rainy spring and early summer