A COST EFFECTIVE APPROACH TO TAXONOMIC RESOLUTION FOR BIOASSESSMENT AND MONITORING PROGRAMS IN THE STATE OF GEORGIA

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We approve the thesis of Jodi Alene Williams as presented here.

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ABSTRACT

The Georgia Ecoregions Reference Sites Project has developed biological criteria for streams in Georgia according to the *Rapid Bioassessment Protocols For Wadeable Streams and Rivers*. Streams will ultimately be classified into categories of impairment so that management decisions can be made in accordance with the Clean Water Act. A cost-effective approach to accomplish mandates set forth by the Clean Water Act must be employed, as state budgets are limited. One means of examining costs is to assess taxonomic resolution. Taxonomic resolution not only assesses the sensitivity of biocriteria, it also allows one to make recommendations to state agencies regarding the costs and benefits of recommended taxonomic identification requirements. Due to the broad diversity in geology, topography, climate, soils and geography within Georgia, taxonomic resolution requirements may vary. Thirty macroinvertebrate samples from five reference condition streams and five or six impaired streams from three Georgia sub-ecoregions were identified to "lowest possible" or lowest practical level. Lowest practical level includes many taxonomic levels determined by the group identified and the availability of peer-reviewed keys. Specific data from lowest practical level were reduced to generic level then further reduced to familial level so that three identification levels, incorporated into sub-ecoregional specific invertebrate indices, were assessed for discriminatory ability. Time spent on identification was recorded at each taxonomic level so that identification "costs" versus "benefits" or degree of information could be used in conjunction with the indices in determining recommended taxonomic resolution requirements. Final analysis indicated taxonomic resolution requirements vary among subecoregions within Georgia and future benthic work, at least in some subecoregions, will require less time and money. By performing cost/benefit analyses, agencies involved in bioassessment and biomontioring programs can identify regions that may require less taxonomic effort.

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INTRODUCTION.

Water is an essential resource for life and with human populations continually expanding our water resources are becoming depleted. In fact, in some geographical areas, current usage exceeds long-term availability. Furthermore, water that is available is quickly becoming degraded by anthropogenic activities. Water resources must be managed at local, regional, national and global levels to ensure future supplies. Human society is a living system that depends on other living systems for its success; therefore, managing water resources must include the protection of aquatic ecosystems. "The decline in the distribution, abundance, and quality of water and aquatic ecosystems thus represents a threat to the sustainability of all living systems and the quality and long-term viability of human society" (Karr 1995). As Norman Myers (1993) stated, "Our future will be deeply compromised unless we learn to manage water as a critical ingredient of our lives."

To establish goals for the restoration and protection of freshwater ecosystems in the United States, Congress passed the 1972 Clean Water Act (CWA) (33 U.S.C. § *et seq.*) which mandates the improvement of stream conditions in each state. The objective of the act is "to restore and maintain the chemical, physical and biological integrity of the nation's waters." (Clean Water Act, §101(a), 33 U.S.C., 1251(a), 1999). Biological integrity, as defined by Karr and Dudley (1981), is the ability of an aquatic ecosystem, to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitats of a region. Therefore, individual states, as required by the United States Environmental Protection Agency (EPA) and in compliance with Section 319 of the Clean Water Act (Clean Water Act §319, 33 U.S.C., §1329, 1999) must develop biological criteria (biocriteria), based on biological assessment (bioassessment), and implement these biocriteria into State Water Quality Standards so that impacted waters are identified and evaluated for nonpoint sources of pollution (NPS). Bioassessments provide an integrated assessment of water quality when combined with measurements of chemistry and habitat because they directly measure biologic integrity and indirectly measure physical and chemical integrity. The EPA has published guidelines on developing bioassessment systems for use by states, called the Rapid Bioassessment Protocols (RBP's) (Barbour *et al.* 1999) and for biocriteria (Gibson *et al.* 1996).

Traditionally, water quality assessment has been performed almost exclusively by chemical analysis. More recently however, water quality has included the assessment of ecological integrity by using indicator organisms such as fish, periphyton or macroinvertebrates. Benthic macroinvertebrates, those large invertebrates that inhabit the bottom substrates, are often used in bioassessments as indicators of water quality because they offer many advantages. First, they are ubiquitous and therefore are affected by perturbations that occur in different types of habitats within the water (Lenat *et al.*

1980). Second, the large number of benthic species typically collected from a sample can provide a full range of responses to stress (Hellawell 1986, Abel 1989). Third, their sedentary nature allows for spatial analysis of pollutant or disturbance effects (Slack *et al.*, 1973, Hawkes 1979, Penny 1985, Hellawell 1986, Abel 1989). Finally, the life cycles of macroinvertebrates are long in comparison to other groups, allowing for elucidation of temporal changes caused by perturbations (Gaufin 1973, Slack *et al.* 1973, Weber 1973, Lenat *et al.* 1980, Penny 1985, Hellawell 1986, Abel 1989). As a result, benthic macroinvertebrates are continuous monitors of the water they inhabit (Hawkes 1979). Thus, they more accurately reflect chronic conditions than might be indicated by more mobile fish species or short-lived periphyton.

Qualitative approaches using benthic macroinvertebrate assemblages, such as rapid assessment approaches, have recently been accepted as a means to identify water quality problems due to point and non-point source pollution, and to document long-term regional changes in water quality (Barbour *et al.* 1999). Rapid assessments reduce effort and associated costs in evaluating a site in relation to quantitative techniques by (1) reducing the number of habitats sampled and replicate sample units taken per habitat; (2) collecting less silt and particulate matter making sorting faster and easier; (3) considering only a fraction of the animals collected thus reducing time spent on identification; and (4) identifying organisms to family or higher taxonomic levels. Rapid assessment approaches can also provide summary information of study sites in a way that can be understood by non-specialists such as managers, the general public and decision-makers (Resh and Jackson 1993). This form of water quality analysis is accomplished by expressing analytical measures (metrics) as single scores and then placing the scores in categories of varying water quality based on regional background data. The EPA's Rapid Bioassessment Protocols (RPB), although not strictly qualitative, is one method that is frequently employed because elements of both qualitative and quantitative approaches are working in conjunction so that results are achieved in a timely manner.

Although rapid bioassessments are efficient, not all bioassessment protocols allow for identification of organisms to family or higher taxonomic levels. There is considerable debate as to the taxonomic resolution of macroinvertebrates necessary to accurately determine community condition in bioassessments. Resh and Unzicker (1975) have demonstrated that component species for 61 of the 89 genera for which water–quality tolerances have been established fall into different tolerance categories. They stress the importance of species level or "lowest practical level" due to the substantial variation among species within genera and families and their different responses when exposed to various kinds of pollution. Hawkins *et al.* (2000) concluded that, in taxonomically rich areas, it was necessary to identify to the genus or species level in order to explain variation among communities, but in areas of little taxonomic diversity they found that family level was sufficient.

Although a diverse benthic fauna in streams suggests the need for generic or specific levels of identification, it has not been determined whether the aquatic ecosystems in taxonomically rich regions respond to stressors more consistently at the genus or species level than at the family level. Greater variation in species from site to site may reduce the ability to detect a deviation from the unimpaired or minimally impaired stream *(i.e.*, the reference condition), and information gained from the genus level may represent ecological noise depending on the specificity of the benthic community's response to stress (Bailey *et al.* 2001). In addition, species-level identification is not always possible because immature stages are collected and species designations are based on the morphological characteristics of adult insects or larval-adult associations (Lenat and Resh 2001). The lack of complete knowledge of each species' environmental requirements may result in arbitrarily assigning existing knowledge that has been derived at the generic or familial level resulting in similar summary information when the different taxonomic levels are compared (Lenat and Resh 2001).

With varying taxonomic resolution, Bowman and Bailey (1997) found little effect on multivariate descriptions of variation among communities, particularly when comparing reference sites to impaired sites. They argued that sufficient resolution for sensitive and accurate bioassessments is achieved when organisms are identified to family level or higher.

To be effective in evaluation of stream impairment, organisms identified to genus or species level must provide significantly more descriptive information than family level, and they must enable better detection of departure from reference condition or the resources expended on taxonomic identification will not be cost effective (Bailey *et al.*, 2001).

As the RBP continues to increase in application across the United States, it will become necessary to resolve the issue of taxonomic resolution, not only to assess the sensitivity of the assessment, but also to make recommendations to state agencies regarding the costs and benefits of recommended identification levels.

The purpose of this research was to determine if departure of macroinvertebrate metric scores from the reference condition was easier to detect with generic or specific identifications than identification to family level.

The results presented here were part of the third phase of the Georgia Ecoregions Reference Sites Project conducted for the Georgia Department of Natural Resources (GA DNR) by Columbus State University (CSU) as described in the quality assurance program plan (Columbus State University 2000). The project was performed in four phases. Phase I of the project delineated Georgia ecoregions and subecoregions and selected reference sites. Phase II focused on the physical, chemical and biological characterization of reference stream conditions. As part of the biological component of reference stream characterization, the structure of the benthic macroinvertebrate community was broken into a group of metrics and candidate invertebrate indices were developed for each subecoregion (Hughes 2004). Phase III applied the indices to impaired streams as a means to develop a numerical classification system whereas Phase IV categorized stream impairment. The subecoregional invertebrate indices developed for Phase II were the means by which I assessed taxonomic variability.

METHODS.

Bioassessment of aquatic ecosystems using benthic macroinvertebrates involves sampling the community at each of a set of sites and then comparing the community structure and composition at a test site with a reference site or reference condition (Reynoldson *et al.* 1997).

Benthic macroinvertebrates used in this study were collected using the multi-habitat approach or 20-jab method according to the Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers (Barbour *et al.*, 1999) for Phase II and Phase III of the Georgia Ecoregions Reference Sites Project. Systematically, samples were collected from different types of habitat within a representative portion of the stream (100-meter reach). By kicking the substrate and jabbing with a D-frame dip net, a total of twenty jabs were taken from different habitat types proportionate to their representation of total habitat in the reach and combined to obtain a single homogenous sample. Samples were transferred from the net to 1-Liter plastic storage containers, properly labeled internally and externally, preserved with 95% ethanol and transported to CSU where they were stored. Each container was assigned a serial log number that was recorded in a field notebook and on chain-of-custody forms to indicate the person responsible for the samples. When the samples were delivered to the CSU laboratory, the lab manager assumed custody (Columbus State University 2000).

In addition to the biological samples collected, chemical and physical data were measured and recorded in the field for use in characterizing reference conditions. *In situ* chemical data such as pH, dissolved oxygen (DO), turbidity, and conductivity were obtained by using a Hydrolab H_20® Water Quality Multiprobe/Scout® 2 Display Unit (Columbus State University 2000). Water temperature and depth was also measured with the Hydrolab H_20®. Physical data measured included visual habitat assessment, characterization of general land use, description of stream origin and type, and summary of riparian vegetation, substrate, and stream morphology (Barbour *et al.* 1999).

In the lab, samples were processed and subsampled based on a fixed-count (200 organisms) approach and macroinvertebrates were identified to the lowest practical level using compound microscopes and peer-reviewed taxonomic references (Appendix B) as stipulated in the Phase III QAPP (Columbus State University 2001).

Before identification, chironomid larvae were mounted on slides in CMCP-10, a highly viscous mounting and clearing agent and stored in slide cases. All other specimens were stored in vials of denatured 70% ethanol and tightly capped. Each vial had an interior label and an exterior stick-on label indicating sample location, sample identifier and date. For each sample, bench sheets were used to record cumulative count of taxon, life stages, and time spent on taxonomic resolution. Any difficulties encountered during identification (e.g., missing gills or no species key available) were noted on the bench sheets. A Taxonomic Certainty Rating (TCR), ranging from one to five, (used as a measure of confidence) with the lowest value (1) representing greatest confidence in identification, was also recorded on the bench sheets. TCR's of three or greater were accompanied by an explanation.

Biological samples, each containing about 200 individuals, were collected from 31 sites, identified, and evaluated for taxonomic resolution. To represent a spectrum of the diversity in underlying geology and geography of the state, which ultimately affects aquatic biological communities, ten samples from the Blue-ridge Mountain Ecoregion and the Piedmont Ecoregion and eleven samples from the Southeastern Plains Ecoregion were examined. Because recent drought conditions affected the number of streams that could be sampled in some regions of the state, specific subecoregions, having at least ten sampled sites, were chosen for this study to ensure timely analysis, The subecoregions selected were the Southern Metasedimentary Mountains (66g), the Southern Inner Piedmont (45a), and the Sand Hills (65c). Locations of the thirty-one catchments sampled for this study are depicted on the maps in Appendix A. Five of the total catchments sampled from each subecoregion represented reference condition and five or six catchments sampled, depending on the subecoregion, had some degree of impairment as defined by Gore *et al.* (2004).

Georgia's six ecoregions and twenty-eight subecoregions are depicted in Figure 1.

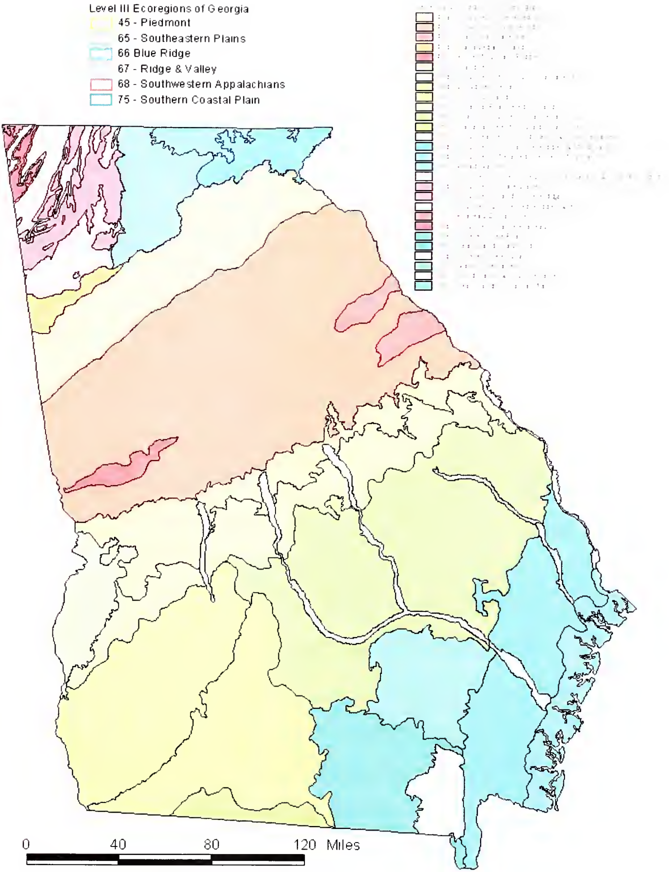


Figure 1. Level III and IV Ecoregions of Georgia (Griffith *et al.* 2001).

Candidate benthic metrics (Table 1) were used for characterizing each reference stream. These metrics were standardized on a 100-point scale and evaluated for discrimination potential. The metrics with the highest discrimination efficiency (DE) were compiled into ecoregional and subecoregional indices (Hughes 2004) and recommended as being the best indices for differentiating impaired and reference conditions (Gore *et al.* 2004).

Metrics incorporated into the subecoregional indices were used to evaluate taxonomic resolution at the lowest practical level (LPL), at the generic level, and at the familial level. When compiling invertebrate indices the metrics that did not apply at the generic and familial identification levels were considered non-valid and were omitted from the index. Index discrimination efficiencies were computed by using the 25th percentile of reference condition scores. A 25th percentile is considered sufficiently conservative to protect aquatic resources and still allow for some uncertainty of reference condition sites (Jessup and Gerritsen 2000). The 25th percentile of reference condition scores is used as a threshold value for management action since impairment measurements, as an index score, fall along a continuum. A threshold reflects the risk and uncertainty of misclassification of stream health: the risk of declaring a good stream as impaired (Type-I error) and the risk of declaring an impaired stream good (Type-II error) (Jessup and Gerritsen 2000). Box and whisker plots were used to exhibit distribution of reference condition and impaired index scores and for evaluating taxonomic resolution requirements.

Table 1. Candidate benthic metrics and predicted direction of metric response to increasing perturbation (Hughes 2004).

METRIC	STRESS RESPONSE	SOURCE	NOTES
Total Taxa	Decrease	Barbour *et al.* 1999	
EPT Taxa	Decrease	Barbour *et al.* 1999	
Ephemeroptera Taxa	Decrease	Barbour *et al.* 1999	
Plecoptera Taxa	Decrease	Barbour *et al.* 1999	
Trichoptera Taxa	Decrease	Barbour *et al.* 1999	
Coleoptera Taxa	Decrease	Barbour *et al.* 1996	
Diptera Taxa	Decrease	Barbour *et al.* 1999	
Chironomidae Taxa	Decrease	Barbour *et al.* 1999	
Tanytarsini Taxa	Decrease	Barbour *et al.* 1996	
Evenness	Decrease	general literature (Barbour *et al.* 1999)	
Margalef Index	Decrease	general literature (Barbour *et al.* 1999)	
Shannon-Wiener_base_e	Decrease	Stribling *et al.* 2000/ Barbour *et al.* 1996	
Simpson's Diversity	Increase	Stribling *et al.* 2000	
EPT Pct	Decrease	Barbour *et al.* 1999	
Ephemeroptera Pct	Decrease	Barbour *et al.* 1999	
Amphipoda Pct	Decrease	Barbour *et al.* 1996	
Bival Pct	UNKNOWN	UNKNOWN	
Chironomidae Pct	Increase	Barbour *et al.* 1999	
Coleoptera Pct	Decrease	Barbour *et al.* 1996	
Diptera Pct	Increase	Barbour *et al.* 1999	
Gastropoda Pct	Decrease	Barbour *et al.* 1996	
Isopoda Pct	Increase	Barbour *et al.* 1996	
NonInsect Pct	Increase	Barbour *et al.* 1999	
Odonata Pct	Increase	Barbour *et al.* 1996	
Plecoptera Pct	Decrease	Barbour *et al.* 1999	

Table 1. cont.

Tanytarsini Pct	Decrease	Barbour *et al.* 1999	
Oligochaeta Pct	Variable/Increase	Barbour *et al.* 1999/Gerritsen and Leppo 2000	WV & Rockdale also say increase
Trichoptera Pct	Decrease	Barbour *et al.* 1999	
%Chironominae/TC	Variable	Barbour *et al.* 1999	RBP Subfamily Tolerance Value
%Orthocladiinae/TC	Decrease	Barbour *et al.* 1999	RBP Subfamily Tolerance Value
%Tanypodinae/TC	Increase	Barbour *et al.* 1999	RBP Subfamily Tolerance Value
Hydropsychidae/Trichoptera	Increase	Barbour *et al.* 1999	
Hydropsychidae/EPT	Increase	Barbour *et al.* 1999	Inferred/RBP
Tanytarsini/TC	Decrease	Barbour *et al.* 1999	Inferred/RBP
Baetidae/Ephemeroptera	UNKNOWN	UNKNOWN	
Cricotopus&Chironomus/TC	Increase	Barbour *et al.* 1999	RBP Genera Tolerance Values
Tolerant Taxa	Increase	Barbour *et al.* 1999	Inferred/RBP
Tolerant Pct	Increase	Barbour *et al.* 1999	
Intolerant Taxa	Decrease	Barbour *et al.* 1999	
Intolerant Pct	Decrease	Barbour *et al.* 1999	Inferred/RBP
Dominant01 Pct	Increase	Barbour *et al.* 1999	
Dominant01 Individuals	Increase	Barbour *et al.* 1999	
BeckBI	Decrease	Barbour *et al.* 1999	Inferred/RBP (Florida index increases)
HBI	Increase	Barbour *et al.* 1999	
NCBI	Increase	Lenat 1993	
Scraper Pct	Decrease	Barbour *et al.* 1999	

Table 1. cont.

Scraper Taxa	Decrease	Gerritsen and Leppo 2000	WV also says decrease
Collector Pct	Decrease	Gerritsen and Leppo 2000	
Collector Taxa	Decrease	Gerritsen and Leppo 2000	
Predator Pct	Variable/Decrease	Barbour *et al.* 1999/ Gerritsen and Leppo 2000	WV also says decrease
Predator Taxa	Decrease	Gerritsen and Leppo 2000	
Shredder Pct	Decrease	Barbour *et al.* 1999	
Shredder Taxa	Decrease	Stribling *et al.* 2000	
Filter Pct	Variable/Increase	Barbour *et al.* 1999/Gerrritsen and Leppo 2000	WV also says increase
Filter Taxa	Decrease	Barbour *et al.* 1999	Inferred/RBP (all # of taxa metrics decrease)
ClingerTaxa	Decrease	Barbour *et al.* 1999	
Clinger Pct	Decrease	Barbour *et al.* 1999	
Burrower Taxa	Decrease	Barbour *et al.* 1999	Inferred/RBP
Burrower Pct	UNKNOWN	UNKNOWN	
Climber Taxa	Decrease	Barbour *et al.* 1999	Inferred/RBP
Climber Pct	UNKNOWN	UNKNOWN	
Sprawler Taxa	Decrease	Barbour *et al.* 1999	Inferred/RBP
Sprawler Pct	UNKNOWN	UNKNOWN	
Swimmer Taxa	Decrease	Barbour *et al.* 1999	Inferred/RBP
Swimmer Pct	UNKNOWN	UNKNOWN	

To perform cost/benefit analyses, a stopwatch was used to time taxonomic resolution for twelve samples. Times recorded were standardized and averaged so that total time spent on identification at each taxonomic level and total time spent on mounting chironomid larvae within each subecoregion represented “costs”. Costs versus “benefits,” degree of information reflected by high discrimination efficiencies, were compared at each taxonomic level. The level of taxonomy exhibiting the greatest discriminatory efficiency between reference and impaired sites within the subecoregions was determined to be the most economical means for accurately classifying stream water quality.

RESULTS.

Taxonomic Resolution

Thirty-one biological samples from five reference sites and five or six impaired sites from three subecoregions were collected during the index period September through February of 2000, 2001 and 2002. Of the 6,782 macroinvertebrates identified 427 were identified to family level; 3,613 to genus level; 2,557 to species level, and 185 to subfamily, class or tribe (See Appendix B).

Metrics included within the subecoregional-specific invertebrate indices exhibited greater discrimination efficiency at different levels of taxonomic resolution (Table 2).

Metric discrimination efficiencies of the indices for the Southern Inner Piedmont, the Southern Metasedimentary Mountains, and the Sand Hills subecoregions were similar for the most part; however, within the index for the Southern Inner Piedmont (45a), burrower taxa had 0% discrimination efficiency at generic identification and 40% discrimination efficiency at both the family and lowest practical levels of identification. Discrimination efficiency for Ephemeroptera, Plecoptera, Trichoptera (EPT) taxa metric was 20% greater at family identification than it was for both generic and LPL identifications and discrimination efficiency for percent tolerant taxa was 60% less than discrimination efficiencies for the same metric at the lowest practical and generic identification levels. Percent scraper had 20% greater discrimination efficiency at identification to LPL than it did to the genus and family identifications.

Table 2. Metric categories, metrics compiled into invertebrate indices (Hughes 2004) and metric discrimination efficiencies (DE's) for three levels of taxonomy for three subecoregions.

Southern Inner Piedmont		LPL	Genus	Family
Metric Category	Metric	D.E.	D.E.	D.E.
Richness	EPT Taxa	60%	60%	80%
Composition	Chironomidae Percent	100%	100%	100%
Composition	*Cricotopus* & *Chironomus*/TC	100%	100%	*
Tolerance	Tolerance Percent	100%	100%	40%
Trophic	Scraper Percent	80%	60%	60%
Habit	Burrower Taxa	40%	0%	40%
Sand Hills		LPL	Genus	Family
Metric Category	Metric	D.E.	D.E.	D.E.
Richness	Trichoptera Taxa	50%	50%	50%
Composition	Trichoptera Percent	50%	50%	50%
Composition	*Cricotopus* & *Chironomus*/TC	50%	50%	*
Tolerance	Tolerant Taxa	67%	67%	67%
Trophic	Scraper Percent	83%	0%	67%
Habit	Clinger Taxa	33%	33%	33%
Southern Metasedimentary Mountains		LPL	Genus	Family
Metric Category	Metric	D.E.	D.E.	D.E.
Richness	EPT Taxa	80%	80%	100%
Composition	Chironomidae Percent	80%	80%	80%
Composition	Percent Tanypodinae/TC	80%	*	*
Tolerance	Dominant Percent	80%	60%	100%
Tolerance	NCBI	60%	60%	*
Trophic	Scraper Taxa	100%	20%	100%
Habit	Burrower Taxa	60%	100%	60%

* Indicates metric was non-valid at this taxonomic level and was omitted from the index.

The index for the Sand Hills subecoregion (65c) had only one metric that varied in discrimination efficiency with taxonomic resolution: percent scraper. Percent scraper had 0% discrimination efficiency at genus identification but for identifications to LPL and family level, percent scraper had 83% and 67% discrimination efficiencies, respectively. Four metrics in the Southern Metasedimentary Mountains (66g) index had discrimination efficiencies that varied with taxonomic resolution. Family index EPT taxa had 100% discrimination efficiency, 20% greater discrimination efficiency than in the genus and LPL indices. The metric percent dominant taxa varied in discrimination efficiency from 100% at family identification to 60% at generic identification to 80% at LPL. Burrower taxa discriminated best at generic identification with 100% efficiency, a 40% increase in discrimination efficiency than exhibited in the familial and LPL indices. At generic identification, scraper taxa had discrimination efficiency of 20%, 80% less discrimination efficiency than family and LPL indices.

Overall index scores and discrimination efficiencies varied at each taxonomic level within each subecoregion. Discrimination efficiencies were 100% for both the lowest practical level and generic level indices within the Southern Inner Piedmont subecoregion; the family level index had discrimination efficiency of 80% (Table 3). The Sand Hills subecoregion had the greatest variation among the three subecoregions with discrimination efficiencies at the family level, generic level, and LPL of 50%, 83%, and 67%, respectively.

(Table 4); whereas the DE's for the Southern Metasedimentary Mountains subecoregion were 100% for the three indices (Tables 5).

Table 3. Stream index scores and index discrimination efficiencies (DE's) for the Southern Inner Piedmont.

Station ID	LPL Index	Genus Index	Family Index
45a-35	71	66	84
45a-50	23	41	27
45a-59	30	51	33
45a-61	22	36	42
45a-90	59	65	59
45a-03//	77	84	80
45a-3	66	79	63
45a-89	79	63	70
HH16	77	67	75
HH18	72	84	78
D.E.	100%	100%	80%

Note: Reference sites index scores (blue) and Impaired sites index scores (green).

Table 4. Stream index scores and index discrimination efficiencies (DE's) for the Sand Hills.

Station ID	LPL Index	Genus Index	Family Index
65c-12	58	65	47
65c-3	71	70	64
65c-4	17	15	26
65c-40	69	81	67
65c-8	55	71	66
65c-88	34	41	32
65c-80	69	76	59
65c-89	67	67	52
HH24	78	96	79
HH25	91	90	92
HH26	59	72	55
D.E.	67%	83%	50%

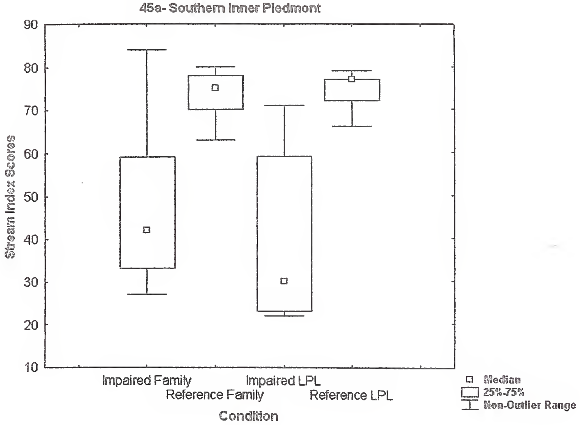
Table 5. Stream index scores and index discrimination efficiencies (DE's) for the Southern Metasedimentary Mountains.

Station ID	LPL Index	Genus Index	Family Index
66g-30	25	29	40
66g-31	35	45	55
66g-42	59	58	46
66g-44	37	27	24
66g-71	45	55	58
66g-2	63	57	56
66g-2-2	70	61	75
66g-23	83	87	87
66g-5	83	74	81
66g-6	74	80	80
D.E.	100%	100%	100%

Taxonomic resolution for assessing bioassessment sensitivity was depicted using box and whisker plots. Box and whisker plots display the statistics of a population of sites, including the median value, minimum and maximum values, and the 25th and 75th percentiles (Figures 2-4).

Identifications to LPL in the Southern Inner Piedmont, to generic level in the Sand Hills, and to familial level in the Southern Metasedimentary Mountains showed the greatest discriminatory efficiency for classifying reference and impaired sites.

Figure 2. Southern Inner Piedmont box and whisker plots exhibiting the distribution of reference condition and impaired index scores for both the family and genus indices as compared to lowest practical level (LPL) score distributions.


45a- Southern Inner Piedmont
Stream Index Scores
90
80
70
60
50
40
30
20
10
Impaired Family
Reference Family
Impaired LPL
Reference LPL
Condition
Median
25%-75%
Non-Outlier Range

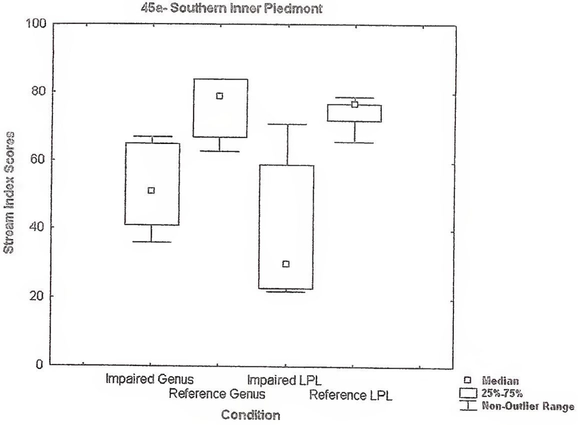
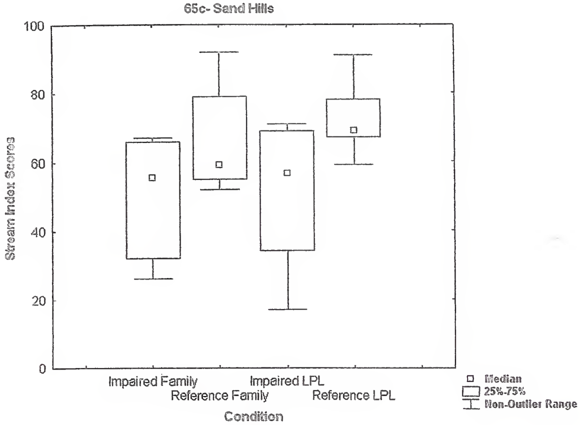

45a- Southern Inner Piedmont
Stream Index Scores
100
80
60
40
20
0
Impaired Genus
Reference Genus
Impaired LPL
Reference LPL
Condition
Median
25%-75%
Non-Outlier Range

Figure 3. Sand Hills box and whisker plots exhibiting the distribution of reference condition and impaired index scores for both the family and genus indices as compared to lowest practical level (LPL) score distributions.


65c- Sand Hills
100
80
60
40
20
0
Stream Index Scores
Impaired Family
Reference Family
Impaired LPL
Reference LPL
Condition
Median
25%-75%
Non-Outlier Range

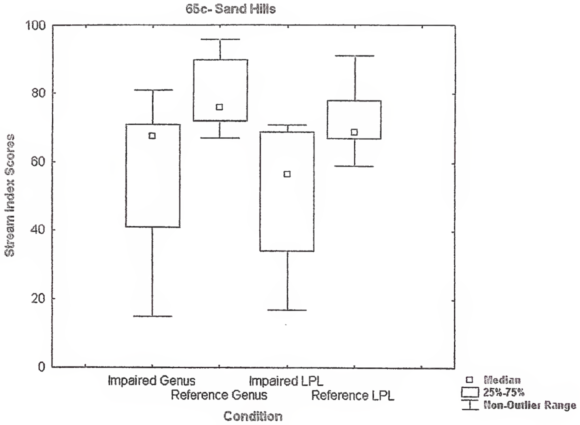
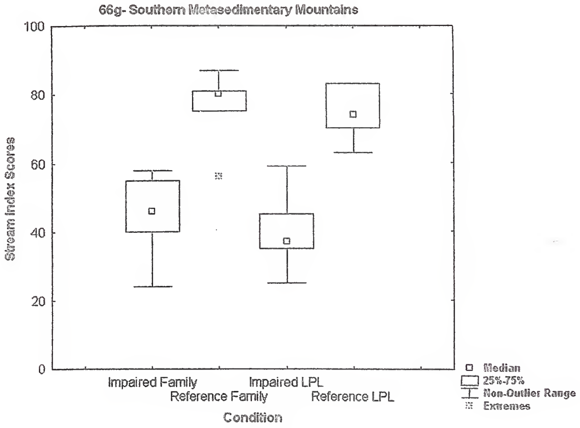
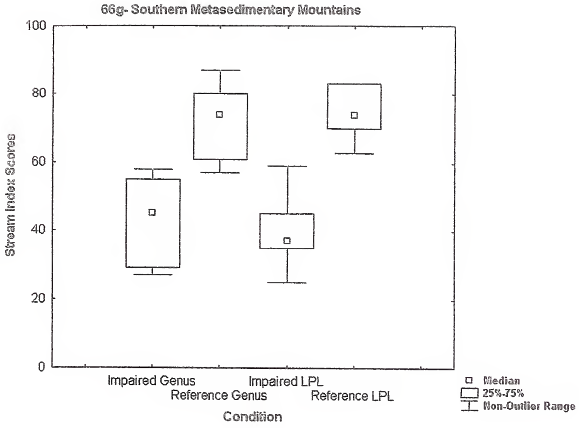

65c- Sand Hills
100
80
60
40
20
0
Stream Index Scores
Impaired Genus
Reference Genus
Impaired LPL
Reference LPL
Condition
Median
25%-75%
Non-Outlier Range

Figure 4. Southern Metasedimentary Mountains box and whisker plots exhibiting the distribution of reference condition and impaired index scores for both the family and genus indices as compared to lowest practical level (LPL) score distributions.


66g- Southern Metasedimentary Mountains
Stream Index Scores
100
80
60
40
20
0
Impaired Family
Reference Family
Impaired LPL
Reference LPL
Condition
Median
25%-75%
Non-Outlier Range
Extremes


66g- Southern Metasedimentary Mountains
Stream Index Scores
100
80
60
40
20
0
Impaired Genus
Reference Genus
Impaired LPL
Reference LPL
Condition
Median
25%-75%
Non-Outlier Range

Time

For 12 impaired sites, approximately forty-one hours were spent mounting chironomid larvae while identification for all macroinvertebrates including the chironomid larvae to LPL took approximately thirty-two hours and forty-five minutes. Time spent on each level of identification for all taxonomic orders, averaged one-half hour for familial level, one hour and forty-five minutes for generic level, and one-half hour for specific level. Average time spent on identification is the cumulative total of time spent on identification for each taxonomic level, in this case two hours and forty-five minutes. However, required mounting time must be included with the identification time to reflect the true costs of identification. By combining cumulative average identification time (two hours and forty-five minutes) with average mounting time (three hours and thirty minutes), cumulative time (costs) spent on identification for all three levels, per sample, averaged six hours and twenty-five minutes (Table 6).

Table 6. Mounting time and identification (ID) time for twelve samples.

Taxonomic Level	ID Time (hrs)	Mount Time (hrs)	Average ID Time (hrs)	Average Mount Time (hrs)	Average Total ID Time (hrs)
Family	~ 4.50	0	~0.50	0	~0.50
Genus	~21.00	~41.0	~1.75*	~3.50	~5.25
Species	~ 7.50	0	~0.50*	0	~0.50
Total (LPL)	~32.75	~41.0	~2.75*	~3.50	~6.25

Note: Time includes only successful attempts of identification to lower taxonomic levels. It does not account for time spent pursuing lower taxonomic levels that proved unsuccessful.

Identification times and mounting times per subecoregion are shown in Tables 7-9. Total time spent for LPL identification was approximately eight and one-half hours, fifteen and one-half hours, and nine hours for the Southern Inner Piedmont, Sand Hills and Southern Metasedimentary Mountains subecoregions, respectively. The Sand Hills subecoregion required more time than the other two subecoregions for mounting due to the large number of Chironomidae in the samples. Approximately eighteen hours and forty-five minutes were spent mounting chironomid larvae for the Sand Hills, whereas, approximately thirteen hours and fifteen minutes were spent on mounting for the Southern Inner Piedmont. The Southern Metasedimentary Mountains subecoregion required about nine hours and twenty-five minutes for mounting purposes. When identification times and mounting times are combined, average total time spent on taxonomy was approximately five hours and fifteen minutes per sample for the Southern Inner Piedmont subecoregion, eight hours and forty-five minutes per sample for the Sand Hills subecoregion and four hours and thirty minutes per sample for the Southern Metasedimentary Mountains subecoregion.

Table 7. Southern Inner Piedmont identification (ID) and mounting times

Taxonomic Level	ID Time (hrs)	Mount Time (hrs)	Average ID Time (hrs)	Average Mount Time (hrs)	Average Total ID Time (hrs)
Family	~ 1.00	0	~0.25	0	~0.25
Genus	~ 5.00	~13.25	~1.25*	~3.25	~4.50
Species	~ 2.75	0	~0.50*	0	~0.50
Total (LPL)	~8.50	~13.25	~2.00*	~3.25	~5.25

Table 8. Sand Hills identification (ID) and mounting times

Taxonomic Level	ID Time (hrs)	Mount Time (hrs)	Average ID Time (hrs)	Average Mount Time (hrs)	Average Total ID Time (hrs)
Family	~ 2.00	0	~0.50	0	~0.50
Genus	~10.75	~18.75	~2.75*	~4.75	~7.50
Species	~ 2.75	0	~0.75*	0	~0.75
Total (LPL)	~15.50	~18.75	~4.00*	~4.75	~8.75

Table 9. Southern Metasedimentary Mountains identification (ID) and mounting times

Taxonomic Level	ID Time (hrs)	Mount Time (hrs)	Average ID Time (hrs)	Average Mount Time (hrs)	Average Total ID Time (hrs)
Family	~1.50	0	~0.50	0	~0.50
Genus	~5.50	~5.50	~1.25*	~2.25	~3.50
Species	~2.25	0	~0.50*	0	~0.50
Total (LPL)	~9.00	~9.25	~2.25*	~2.25	~4.50

* Time includes only successful attempts of identification to lower taxonomic levels.

DISCUSSION.

Taxonomic Resolution Analysis

Subecoregion-specific indices for the Southern Upper Piedmont, the Sand Hills, and the Southern Metasedimentary Mountains were evaluated at the family level, genus level and LPL for taxonomic resolution. Analysis, based on discriminatory ability of the indices and depictions of score distributions indicated that taxonomic resolution requirements varied among subecoregions in Georgia.

Southern Metasedimentary Mountains

The invertebrate index for the Southern Metasedimentary Mountains (66g) had discrimination efficiency of 100% when metric scores for the three levels of identification were computed. When index score distributions for LPL, genus level, and family level identifications were compared LPL index scores exhibited slightly greater discrimination potential than familial index scores due to the slightly greater degree of separation between interquartile ranges of reference condition and impaired index scores. Although the family index exhibited a smaller degree of separation between interquartile ranges, the variance among reference condition scores was less than reference condition scores in the LPL index and 100% of reference condition index scores were above the 25th percentile threshold. One outlier (outliers may indicate natural variability; misclassification of stream conditions *a priori*, or an under-represented site class)(Jessup and Gerritsen 2000) was depicted in the family index but removing it from the index did not affect discrimination efficiency. Although the generic index had 100% discrimination efficiency, the degree of separation between the interquartile ranges was not as great as the other two indices. In fact, the slight overlap of whiskers indicates the chance of making a Type I and/or Type II error when identifications to the generic level are considered. Therefore, identification to either LPL or family level is adequate for stream health classification for this subecoregion.

Southern Inner Piedmont

Identification to LPL is recommended for the Southern Inner Piedmont subecoregion. Discrimination efficiencies for the invertebrate index were 80% at family level, 100% at genus level and 100% at LPL. The greatest degree of overlap between reference condition and impaired index scores occurred when identification to family level was considered. In fact, some impaired index scores (whisker) overlapped the entire suite of reference condition index scores indicating a 20% chance of misclassifying stream health. Although some overlap between reference condition and impaired index scores occurred at both the generic and lowest practical identification levels, the LPL index exhibited the greatest degree of separation between interquartile ranges, indicating LPL identification discriminates between reference condition and impaired sites more efficiently than identification to generic level. There was whisker overlap in the LPL index, but all impaired index scores fell below the 25^{th} percentile threshold.

Sand Hills

Greatest discrimination between reference condition and impaired index scores for the Sand Hills subecoregion occurred when identification was considered at the generic level. Discrimination efficiencies for the Sand Hill's invertebrate index were 50% at family level, 83% at genus level and 67% at LPL. Overall, the genus index exhibited the least degree of overlap and complete separation of interquartile ranges whereas both LPL and family indices exhibited some degree of overlap of both whiskers and interquartile ranges. There is a 33% chance of error when LPL index is used for classifying stream health; whereas, the chance of error is much less (17%) when the genus index is used. Therefore, identification to generic level is recommended for the Sand Hills subecoregion.

Taxonomic Resolution Requirements

Southern Metasedimentary Mountains

Identification to either LPL or familial level is adequate for the Southern Metasedimentary Mountains region, an area of open low hills, with some rugged, isolated mountains such as the Cohutta Mountains and Fort Mountain. Due to the steepness of terrain, anthropogenic activity is somewhat limited within this region. Because anthropogenic activity is limited, stress imposed on aquatic ecosystems may not be as great as it is in the Sand Hills and the Southern Inner

Piedmont regions, easily inhabited regions of rolling hills and plains and may elucidate why family level identification is sufficient.

Ephemeroptera, Plecoptera, Trichoptera (EPT) taxa are known to exist in relatively pristine areas, and historically they have been used as indicators of good stream health. EPT responses to various stressors have been well documented, and pollution tolerance values have long been established.

EPT taxa and Diptera taxa, particularly Chironomidae, were commonly collected in both reference condition and impaired streams within the Southern Metasedimentary Mountains region. Individual metric discrimination efficiency for the three levels of identification was greatest at family level for both the EPT taxa metric and percent dominant metric; whereas, the metric percent Chironomidae remained constant. Therefore, the increase in index performance at family level can be attributed to the presence and abundance of EPT taxa and the lack of community diversity (Table 10).

These findings are similar to research conducted by Hawkins *et al.* (2000). They found that identification to family level was sufficient in areas of limited taxonomic diversity. Among the three subecoregions studied, the Southern Metasedimentary Mountains scored the lowest (0.556) for biotic diversity, further supporting my recommendation that family level identification is sufficient for this subecoregion.

Table 10. Stream diversity values for Southern Inner Piedmont, Sand Hills, and Southern Metasedimentary Mountains

Southern Inner Piedmont		
StationID	Reference	Simpson D
45a-35	No	0.022
45a-50	No	0.064
45a-59	No	0.159
45a-61	No	0.046
45a-90	No	0.104
45a03//	Yes	0.101
45a-3	Yes	0.110
45a-89	Yes	0.143
HH16	Yes	0.063
HH18	Yes	0.123
Sum Of Diversity Values (45a)		0.935
Sand Hills		
StationID	Reference	Simpson D
65c-12	No	0.071
65c-3	No	0.143
65c-4	No	0.049
65c-40	No	0.105
65c-8	No	0.086
65c-88	No	0.039
65c-80	Yes	0.074
65c-89	Yes	0.111
HH24	Yes	0.054
HH25	Yes	0.074
HH26	Yes	0.068
Sum Of Diversity Values (65c)		0.875
Southern Metasedimentary Mountains		
StationID	Reference	Simpson D
66g-30	No	0.093
66g-31	No	0.111
66g-42	No	0.035
66g-44	No	0.070
66g-71	No	0.053
66g-2	Yes	0.074
66g-2-2	Yes	0.038
66g-23	Yes	0.026
66g-5	Yes	0.034
66g-6	Yes	0.022
Sum Of Diversity Values (66g)		0.556

Sand Hills

Identification to generic level is required for the Sand Hills. Metric discrimination efficiencies were similar for all three levels of identification except for the percent scraper metric, which decreased from 83% to 0% when identification data for LPL was reduced to generic level. Yet, even with this loss of information, the genus index discrimination potential was greater than the LPL index. The reduction in information at the generic level for percent scraper may represent ecological noise as suggested by Bailey *et al.* (2001). Also, greater variation in species among the sites may be obfuscating the discriminating potential of the LPL index.

Southern Inner Piedmont

Biotic diversity was highest for this subecoregion (0.935), which might explain identification requirements to LPL. As Resh and Unzicker (1975) reported, established water quality tolerance values for 61 species of the 89 genera fall into different tolerance categories indicating that identification to LPL is necessary to explain the variation among species and their different responses to various stressors. Information gained from the *Cricotopus/Chironomus*/Total Chironomidae metric for both the LPL and genus indices was lost when identification to family was considered, and this metric was not effective at lower taxonomic levels. However, metrics describing organisms' trophic and behavioral habit (percent scraper and burrower taxa) provided adequate information for discrimination at LPL identification.

Cost Benefit Analysis

As stipulated in the protocol, all organisms were identified to LPL. This level of identification entails a fair amount of investment in time and in money, but identification to LPL is needed before taxonomic resolution analysis can be performed, and it is possible taxonomic resolution to LPL may be the only level of identification that adequately discriminates between reference condition streams and impaired streams. Once taxonomic resolution requirements have been predetermined, cost/benefit analyses can be used to examine not only the real costs of taxonomic work but also the potential savings that would be realized when future benthic work is needed for assessment and monitoring programs.

Southern Inner Piedmont

Average costs incurred, per sample, for taxonomic work in the Southern Inner Piedmont (45a) were $5.00 for familial identification plus, $12.50 for generic identification and an additional $2.50 for identification to species. Costs incurred for identification of organisms from family level to genus level increased an average of $7.50. Time needed to mount Chironomidae, however, must be included in total costs at taxonomic levels below familial level as chironomid larvae should be clear-mounted to improve identification accuracy. When mounting time is included with identification time, generic level identification costs averaged $47.50, an increase of $35.00 per sample. Identification of organisms to LPL incurred costs of $55.00 per sample. When total costs for each taxonomic level are compared, family identification, with a minimal average cost of $5.00 is the most economical level of identification. However, based on the discrimination efficiency value and distribution of index scores, family level index for Southern Inner Piedmont does not discriminate between reference condition and impaired sites in fact, taxonomic resolution to LPL has the greatest discriminatory ability so saving time and money on future taxonomic work in this subecoregion is not feasible.

Cost/Benefit Analysis Per Sample
Southern Inner Piedmont Subecoregion (45a)

Family Level Costs:	
Average time spent on identification (.50 hrs X $10/hr)	$ 5.00
Genus Level Costs:	
Average time spent on identification (1.25 hrs X $10/hr	$12.50
Species Level Costs:	
Average time spent on identification (.25 hrs. X $10/hr)	$ 2.50
Combined Level Identification Costs:	
Average time spent on identification (2.00 hrs. X $10/hr)	$20.00
Mounting Costs:	
Average time spent mounting Chironomidae (3.50 hrs. X $10/hr)	$35.00
Total Costs Per Sample	**$55.00**

Sand Hills

Average identification costs incurred at the familial level for the Sand Hills (65c) was $7.50. Average identification costs of $27.50 and average mounting costs of $47.50 were incurred at the generic level; and totaled $82.50 per sample when family level costs are included. Average costs for species identification was $5.00. Identification of organisms to LPL incurred cumulative average costs of $87.50 per sample when species level identification costs were added to generic and familial level costs. Because the best discriminating index for the Sand Hills is the genus index, costs for future benthic work in this subecoregion would decrease. On average, future savings of $5.00 per sample would be realized.

Southern Metasedimentary Mountains

Identification costs for familial level for the Southern Metasedimentary Mountains (66g) averaged $5.00. Generic identification costs totaled $35.00. Sixty four percent of the generic costs resulted from the two and one quarter hours needed for mounting Chironomidae. Average costs for species identifications were $5.00 with average costs for identifications to LPL totaling $45.00 per sample. Although both the LPL index and the family index for this subecoregion provided sufficient information for accurately classifying stream health, in terms of saving time and money, identifications to family, for future benthic work, is sufficient. Because chironomid larvae do not need to be mounted for family identification, $40.00 per sample on average would be saved as future identification costs would be about $5.00 per sample.

Cost/Benefit Analysis Per Sample
Sand Hills Subecoregion (65c)

Family Level Costs:	
Average time spent on identification (.75 hrs. X $10/hr)	$ 7.50
Genus Level Costs:	
Average time spent on identification (2.75 hrs. X $10/hr)	$27.50
Species Level Costs:	
Average time spent on identification (.50 hrs. X $10/hr)	$ 5.00
Combined Level Identification Costs:	
Average time spent on identification (4.00 hrs. X $10/hr)	$40.00
Mounting Costs:	
Average time spent mounting Chironomidae (4.75 hrs. X $10/hr)	$47.50
Total Costs Per Sample	**$87.50**
Less Total Costs Per Sample (Genus Level) ($27.50 + $47.50 + $7.50)	**$82.50**
Future Net Savings Per Sample	**$ 5.00**

Note: An average of 5.7% of total costs is saved when future taxonomic work is needed for the Sand Hills.

Cost/Benefit Analysis Per Sample
Southern Metasedimentary Mountains Subecoregion (66g)

Family Level Costs:	
Average time spent on identification (.50 hrs. X $10/hr)	$ 5.00
Genus Level Costs:	
Average time spent on identification (1.25 hrs. X $10/hr)	$12.50
Species Level Costs:	
Average time spent on identification (.50 hrs. X $10/hr)	$ 5.00
Combined Level Identification Costs:	
Average time spent on identification (2.25 hrs. X $10/hr)	$22.50
Mounting Costs:	
Average time spent mounting Chironomidae (2.25 hrs. X $10/hr)	$22.50
Total Costs Per Sample	**$45.00**
Less Total Costs Per Sample (Family Level)	**$ 5.00**
Future Net Savings Per Sample	**$40.00**

Note: An average of 88.9% of total costs is saved when future taxonomic work is needed for the Southern Metasedimentary Mountains.

CONCLUSIONS.

Taxonomic resolution requirements vary among subecoregions in Georgia. However, additional analysis is necessary to conclude whether or not taxonomic resolution requirements vary within all of Georgia's six ecoregions.

The recommended identification levels: LPL for the Southern Inner Piedmont, generic level for the Sand Hills, and familial level for the Southern Metasedimentary Mountains should be implemented before additional assessment or monitoring takes place if costs are to be minimized as the risks of misclassifying stream health can be costly. If classification results in Type-I errors and healthy streams (reference condition) are classified, as impaired, additional time and money will be spent on unnecessary assessments. If classification results in Type-II errors and impaired streams are classified as healthy, costs become even greater because stream health deterioration is compounded over time, which means more assessments and frequent monitoring is necessary, and there is the also the possibility that Total Maximum Daily Loads (TMDL's) may be imposed on the streams to control non-point sources of pollution as stipulated in §303(d) of the Clean Water Act (J. Gore, Department of Environmental Science, Columbus University, personal communication). Furthermore, the Environmental Protection Agency (EPA) could issue fines up to $25,000/per day for any stream not in compliance (Clean Water Act, §305(b)(1)(B), 33 U.S.C., §1315(b)(1)(B) 1999).

Therefore, by predetermining taxonomic resolution requirements and by performing cost/benefit analyses, agencies involved in assessment and monitoring programs would not only minimize risks of misclassifying stream health, they could also identify regions that may require less taxonomic effort, which can lead to savings in terms of time and money.

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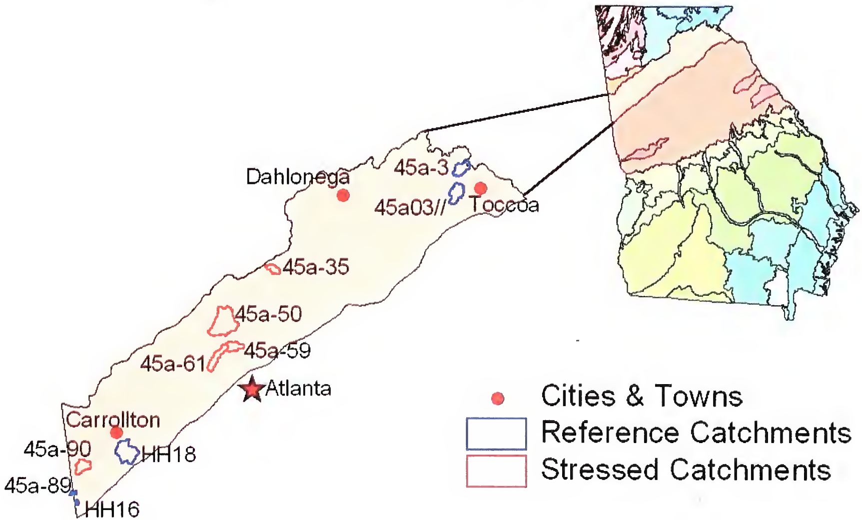
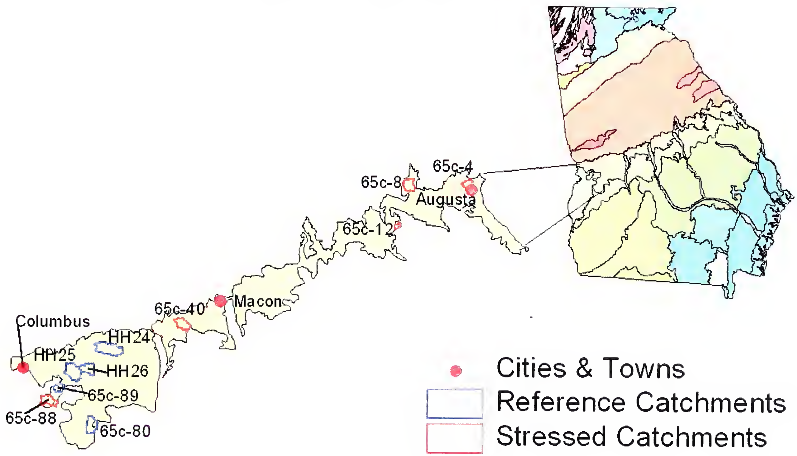
APPENDIX A – MAPS

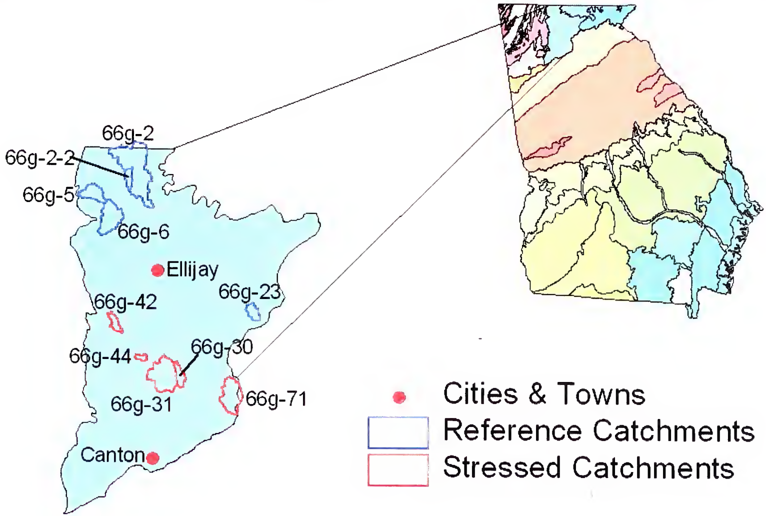
45a - Southern Inner Piedmont



65c - Sand Hills



66g - Southern Metasedimentary Mountains



APPENDIX B – TAXA LISTS AND TAXA REFERENCES

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Middle Fork Broad River					
45a03//	Yes	Coleoptera	Elmidae	*Ancyronyx variegatus*	1
				Microcylloepus pusillus	1
				Promoresia elegans	1
				Stenelmis sp.	2
			Gyrinidae	*Dineutus* sp.	1
		Diptera	Ceratopogonidae	*Bezzia* complex	2
			Chironomidae	*Ablabesmyia annulata*	10
				Ablabesmyia mallochi	2
				Ablabesmyia rhamphe grp.	1
				Apedilum sp.	4
				Brillia flavifrons	1
				Clinotanypus sp.	1
				Cryptochironomus sp.	1
				Endotribelos hesperium	1
				Hydrobaenus sp.	1
				Microtendipes sp.	1
				Orthocladiinae	1
				Parakiefferiella *A*	1
				Paratanytarsus sp.	2
				Phaenopsectra sp.	15
				Phaenopsectra obediens grp.	66
				Polypedilum aviceps	2
				Polypedilum halterale	1
				Psectrocladius elatus	1
				Rheotanytarsus sp.	4
				Robackia demeijerei	1
				Stenochironomus sp.	6
				Stictochironomus sp.	1
				Tanypodinae	1
				Tribelos sp.	1
				Tribelos jucundus	5
				Xestochironomus	1
			Simuliidae	*Simulium* sp.	1
		Ephemeroptera	Baetiscidae	*Baetisca carolina*	1
				Baetisca gibbera	1
			Heptageniidae	*Stenonema* sp.	17
			Isonychiidae	*Isonychia* sp.	1
			Potamanthidae	*Potamanthus distinctus*	5
		Megaloptera	Corydalidae	*Corydalus cornutus*	1
				Nigronia serricornis	2
			Sialidae	*Sialis* sp.	1
		Odonata	Aeshnidae	*Aeshna umbrosa*	1
				Aeshnidae	1

			Coenagrionidae	Coenagrionidae	2
			Gomphidae	Gomphidae	1
				Gomphus borealis	1
				Lanthus vernalis	1
		Plecoptera	Perlidae	*Perlesta placida*	3
				Perlidae	1
			Perlodidae	*Yugus bulbosus*	1
			Taeniopterygidae	*Strophopteryx* sp.	5
		Trichoptera	Brachycentridae	Brachycentridae	2
			Calamoceratidae	*Anisocentropus pyraloides*	1
			Hydropsychidae	*Cheumatopsyche* sp.	13
				Hydropsyche sp.	1
		Trichoptera	Hydropsychidae	Hydropsychidae	8
				Potamyia flava	5
			Leptoceridae	*Nectopsyche* sp.	2
				Setodes sp.	1
			Polycentropodidae	*Polycentropus* sp.	1
		Veneroida	Pisidiidae	*Sphaerium* sp.	1
		Class: Clitellata		Oligochaeta	7

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Davidson Creek					
45a-3	Yes	Diptera	Chironomidae	*Ablabesmyia* sp.	1
				Ablabesmyia mallochi	1
				Apedilum sp.	2
				Chironomidae	3
				Corynoneura B	4
				Larsia sp.	2
				Orthocladiinae	7
				Parakiefferiella sp.	1
				Parametriocnemus sp.	2
				Paratanytarsus sp.	3
				Phaenopsectra sp.	1
				Polypedilum aviceps	3
				Polypedilum flavum	6
				Polypedilum fallax	1
				Rheocricotopus sp.	1
				Rheotanytarsus sp.	1
				Thienemanniella sp.	14
				Thienemanniella xena	6
			Simuliidae	*Simulium* sp.	4
			Tipulidae	*Pseudolimnophila* sp.	1
				Tipula sp.	1
		Ephemeroptera	Ephemeridae	*Hexagenia* sp.	1
			Heptageniidae	Heptageniidae	1
				Stenonema sp.	4
			Isonychiidae	*Isonychia* sp.	5
		Megaloptera	Corydalidae	*Corydalus cornutus*	1
				Nigronia serricornis	1
		Neotaenioglossa	Pleuroceridae	*Pleurocera* sp.	1
		Plecoptera	Perlidae	*Acroneuria abnormis*	17
				Acroneuria internata	3
				Perlidae	2
			Perlodidae	*Helopicus subvarians*	1
			Taeniopterygidae	*Strophopteryx fasciata*	1
				Strophopteryx limata	55
		Trichoptera	Hydropsychidae	*Cheumatopsyche* sp.	23
				Hydropsyche sp.	2
			Philopotamidae	*Chimarra* sp.	12
		Class: Clitellata		Oligochaeta	2

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Smithwick Creek					
45a-35	No	Basommatophora	Lymnaeidae	Lymnaeidae	1
		Coleoptera	Dryopidae	*Helichus lithophilus*	1
			Dytiscidae	*Celina* sp.	1
			Elmidae	*Ancyronyx variegatus*	2
				Dubiraphia sp.	2
				Macronychus glabratus	1
				Microcylloepus pusillus	2
				Optioservus sp.	4
				Optioservus ovalis	1
			Psephenidae	*Psephenus herricki*	1
		Decapoda	Cambaridae	*Procambarus* sp.	1
		Diptera	Ceratopogonidae	*Bezzia* complex	1
			Chironomidae	*Ablabesmyia* sp.	1
				Ablabesmyia mallochi	2
				Brillia sp.	3
				Brillia flavifrons	2
				Chironomus sp.	8
				Corynoneura sp.	1
				Cricotopus bicinctus	7
				Cryptochironomus sp.	4
				Microtendipes pedellus grp.	3
				Odontomesa fulva	1
				Orthocladius sp.	2
				Orthocladius obumbratus	4
				Paracladopelma sp.	1
				Parakiefferiella E	1
				Paralauterborniella nigrohalterale	1
				Parametriocnemus sp.	6
				Paratendipes albimanus	1
				Phaenopsectra obediens grp.	4
				Phaenopsectra punctipes grp.	1
				Phaenopsectra/Tribelos complex	6
				Polypedilum A	2
				Polypedilum aviceps	1
				Polypedilum scalaenum	2
				Polypedilum tritum	1
				Potthastia longimana	2
				Procladius (Holotanypus) sp.	2
				Pseudochironomus sp.	1
				Rheotanytarsus sp.	1
				Rheotanytarsus exiguus group	1
				Rheotanytarsus pellucidus	6

				Stempellinella/Zavrelia complex	1
				Stenochironomus sp.	1
				Tanytarsus sp.	2
				Tanytarsus A	3
				Tanytarsus C	1
				Tanytarsus G	2
				Tanytarsus J	1
				Tanytarsus M	2
				Tanytarsus Q	2
				Thienemanniella sp.	1
				Thienemanniella B	2
				Thienemannimyia group sp.	15
				Tribelos sp.	3
				Tribelos fuscicorne	1
				Tribelos jucundus	7
				Zavrelimyia thryptica	1
			Empididae	*Hemerodromia* sp.	5
			Tipulidae	*Antocha* sp.	4
				Tipula sp.	1
				Tipulidae	1
		Ephemeroptera	Ephemerellidae	*Ephemerella argo*	1
				Ephemerellidae	11
				Serratella deficiens	3
			Ephemeridae	*Hexagenia limbata*	5
			Heptageniidae	Heptageniidae	2
				Stenonema sp.	10
				Stenonema modestum	20
			Leptophlebiidae	Leptophlebiidae	1
			Siphlonuridae	Siphlonuridae	4
		Odonata	Coenagrionidae	*Argia* sp.	2
			Gomphidae	*Progomphus obscurus*	1
		Plecoptera	Capniidae	Capniidae	7
			Nemouridae	Nemouridae	1
			Perlidae	Perlidae	1
			Perlodidae	*Isoperla marlynia*	1
				Perlodidae	3
			Taeniopterygidae	*Oemopteryx* complex	1
		Trichoptera	Hydropsychidae	*Cheumatopsyche* sp.	5
				Hydropsyche betteni/depravata complex	3
				Hydropsychidae	1
			Limnephilidae	*Hydatophylax argus*	1
			Philopotamidae	*Chimarra* sp.	1
			Psychomyiidae	*Lype diversa*	1
		Class: Clitellata		Oligochaeta	2

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Noonday Creek					
45a-50	No	Coleoptera	Elmidae	*Ancyronyx variegatus*	2
		Diptera	Chironomidae	*Ablabesmyia mallochi*	2
				Brillia flavifrons	1
				Chironomus sp.	6
				Corynoneura sp.	17
				Corynoneura B	1
				Cricotopus bicinctus	33
				Cricotopus sylvestris group	5
				Cricotopus/Orthocladius complex	1
				Eukiefferiella brehmi group	2
				Labrundinia pilosella	1
				Micropsectra D	1
				Orthocladius sp.	2
				Orthocladius dentifer	1
				Parakiefferiella B	2
				Parametriocnemus sp.	1
				Paratrichocladius sp.	1
				Phaenopsectra obediens grp.	1
				Phaenopsectra punctipes grp.	2
				Phaenopsectra/Tribelos complex	3
				Polypedilum flavum	3
				Polypedilum scalaenum	1
				Potthastia longimana	4
				Rheocricotopus robacki	6
				Rheotanytarsus exiguus group	2
				Rheotanytarsus pellucidus	12
				Tanytarsus sp.	1
				Tanytarsus C	1
				Tanytarsus L	1
				Tanytarsus U	11
				Thienemanniella sp.	3
				Thienemanniella xena	10
				Thienemannimyia group sp.	9
				Tribelos sp.	1
				Tribelos jucundus	2
			Empididae	*Hemerodromia* sp.	13
		Ephemeroptera	Baetidae	Baetidae	4
			Heptageniidae	Heptageniidae	1
		Trichoptera	Hydropsychidae	*Cheumatopsyche* sp.	25
				Hydropsyche sp.	2
				Hydropsychidae	6
		Class: Clitellata		Oligochaeta	2

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Rottenwood Creek					
45a-59	No	Coleoptera	Elmidae	*Ancyronyx variegatus*	1
		Decapoda	Cambaridae	*Procambarus spiculifer*	6
		Diptera	Ceratopogonidae	*Bezzia* complex	1
				Dasyhelea sp.	1
			Chironomidae	*Ablabesmyia mallochi*	5
				Chironomus sp.	5
				Cricotopus politus	10
				Dicrotendipes sp.	1
				Endochironomus nymphoides group	1
				Endotribelos hesperium	1
				Larsia sp.	1
				Nanocladius sp.	5
				Parametriocnemus sp.	1
				Paratanytarsus dissimilis	1
				Phaenopsectra obediens grp.	5
				Phaenopsectra/Tribelos complex	1
				Polypedilum A	1
				Polypedilum fallax	1
				Polypedilum flavum	2
				Polypedilum halterale	13
				Polypedilum illinoense	1
				Rheocricotopus robacki	2
				Rheosmittia arcuata	71
				Rheotanytarsus A	1
				Rheotanytarsus pellucidus	1
				Saetheria tylus	3
				Stenochironomus sp.	1
				Tanypodinae	1
				Tanytarsus sp.	1
				Thienemanniella sp.	2
				Thienemanniella xena	2
				Thienemannimyia group sp.	8
				Tribelos jucundus	1
				Trissopelopia ogemawi	1
				Zavrelimyia thryptica	3
			Simuliidae	Simuliidae	1
				Simulium sp.	4
			Tipulidae	*Pedicia* sp.	3
				Pilaria sp.	1
		Heteroptera	Veliidae	*Rhagovelia* sp.	1
		Odonata	Calopterygidae	*Calopteryx* sp.	1
			Coenagrionidae	*Argia* sp.	4
		Trichoptera	Hydropsychidae	Hydropsychidae	1
		Class: Clitellata		Oligochaeta	8

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Olley Creek					
45a-61	No	Amphipoda	Gammaridae	*Gammarus* sp.	1
			Talitridae	*Hyalella azteca*	8
		Basommatophora	Physidae	*Physella* sp.	2
			Planorbidae	Planorbidae	1
		Coleoptera	Elmidae	*Ancyronyx variegatus*	8
				Dubiraphia vittata	1
				Microcylloepus pusillus	1
			Gyrinidae	*Dineutus* sp.	3
				Dineutus robertsi	2
		Decapoda	Cambaridae	*Procambarus spiculifer*	2
		Diptera	Chaoboridae	*Chaoborus* sp.	2
			Chironomidae	*Ablabesmyia* sp.	2
				Ablabesmyia mallochi	6
				Chironomus sp.	37
				Corynoneura sp.	1
				Cricotopus annulator complex	1
				Cricotopus bicinctus	14
				Cryptochironomus sp.	2
				Dicrotendipes sp.	4
				Dicrotendipes nervosus	1
				Labrundinia pilosella	2
				Nanocladius sp.	1
				Orthocladius carlatus	1
				Orthocladius oliveri	2
				Parakiefferiella B	1
				Paratanytarsus sp.	7
				Paratanytarsus dissimilis	1
				Paratendipes albimanus	4
				Phaenopsectra obediens grp.	3
				Phaenopsectra punctipes grp.	3
				Phaenopsectra/Tribelos complex	13
				Polypedilum fallax	2
				Polypedilum scalaenum	1
				Potthastia longimana	2
				Procladius sp.	2
				Psectrocladius simulans	1
				Reomyia sp.	1
				Rheotanytarsus sp.	1
				Rheotanytarsus exiguus group	1
				Rheotanytarsus pellucidus	1
				Stenochironomus sp.	2
				Tanytarsus sp.	9
				Thienemannimyia group sp.	8

				Tribelos jucundus	6
			Dixidae	*Dixella indiana*	3
		Ephemeroptera	Baetiscidae	*Baetisca obesa*	1
			Ephemerellidae	*Eurylophella bicolor*	1
			Heptageniidae	Heptageniidae	4
				Stenonema modestum	15
		Odonata	Aeshnidae	*Boyeria vinosa*	1
			Calopterygidae	*Calopteryx* sp.	1
				Calopteryx dimidiata	1
			Coenagrionidae	*Argia* sp.	1
				Enallagma sp.	2
			Gomphidae	*Progomphus* sp.	4
		Veneroida	Corbiculidae	*Corbicula fluminea*	9
			Pisidiidae	*Pisidium* sp.	14
		Class: Clitellata		Oligochaeta	9

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Hillabahatchee Creek					
45a-89	Yes	Amphipoda	Talitridae	*Hyalella azteca*	10
		Coleoptera	Curculionidae	Curculionidae	1
			Dryopidae	*Helichus* sp.	1
			Elmidae	*Ancyronyx variegatus*	9
				Dubiraphia sp.	5
				Dubiraphia bivittata	9
				Dubiraphia quadrinotata	4
				Elmidae	2
				Macronychus glabratus	3
				Optioservus sp.	5
				Promoresia tardella	1
				Stenelmis sp.	67
			Gyrinidae	*Gyrinus* sp.	2
		Diptera	Ceratopogonidae	*Bezzia* complex	2
			Chironomidae	*Apedilum* sp.	6
				Chironomidae	1
				Nanocladius sp.	1
				Paratanytarsus sp.	1
				Phaenopsectra sp.	1
				Polypedilum A	2
				Polypedilum fallax	1
				Polypedilum halterale	1
				Polypedilum scalaenum	2
				Pseudochironomus sp.	1
				Stelechomyia perpulchra	1
				Thienemannimyia group sp.	1
				Tribelos jucundus	2
			Simuliidae	*Simulium* sp.	1
			Tipulidae	Tipulidae	1
		Ephemeroptera	Heptageniidae	*Stenonema* sp.	17
		Hemiptera	Veliidae	*Microvelia* sp.	1
		Isopoda	Asellidae	Asellidae	1
		Odonata	Coenagrionidae	Coenagrionidae	2
		Plecoptera	Perlidae	*Acroneuria internata*	2
			Taeniopterygidae	*Strophopteryx limata*	41
		Trichoptera	Calamoceratidae	*Anisocentropus pyraloides*	1
			Hydropsychidae	*Cheumatopsyche* sp.	6
			Philopotamidae	*Chimarra* sp.	2

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
			Mountain Creek		
45a-90	No	Basommatophora	Physidae	*Physella* sp.	1
			Planorbidae	*Gyraulus* sp.	2
		Coleoptera	Curculionidae	*Anchytarsus bicolor*	1
			Dytiscidae	*Celina* sp.	3
				Dytiscidae	1
			Elmidae	*Ancyronyx variegatus*	1
				Dubiraphia sp.	5
				Elmidae	4
				Macronychus glabratus	1
				Microcylloepus pusillus	6
				Stenelmis sp.	1
			Psephenidae	*Psephenus herricki*	1
		Decapoda	Cambaridae	*Procambarus spiculifer*	1
		Diptera	Ceratopogonidae	Ceratopogonidae	1
			Chironomidae	Chironominae	1
				Chironomus sp.	2
				Cricotopus bicinctus	1
				Cricotopus/Orthocladius complex	1
				Cryptochironomus sp.	1
				Labrundinia pilosella	1
				Microtendipes sp.	65
				Orthocladius sp.	2
				Parametriocnemus sp.	1
				Phaenopsectra obediens grp.	3
				Phaenopsectra/Tribelos complex	2
				Polypedilum aviceps	1
				Pseudorthocladius sp.	5
				Rheocricotopus sp.	1
				Tanytarsus M	2
				Thienemannimyia group sp.	13
				Tribelos jucundus	1
			Tipulidae	*Leptotarsus* sp.	1
				Tipula sp.	3
		Ephemeroptera	Baetiscidae	*Baetisca carolina*	1
			Heptageniidae	Heptageniidae	7
			Leptophlebiidae	*Leptophlebia* sp.	6
		Heteroptera	Gerridae	Gerridae	1
		Isopoda	Asellidae	Asellidae	1
		Odonata	Calopterygidae	*Calopteryx* sp.	2
			Gomphidae	Gomphidae	1
		Plecoptera	Capniidae	Capniidae	19
			Perlodidae	Perlodidae	4
		Trichoptera	Hydropsychidae	*Ceratopsyche* sp.	4
				Cheumatopsyche sp.	21
				Hydropsyche sp.	3
				Hydropsychidae	26

			Leptoceridae	Leptoceridae	1
		Class: Clitellata		Oligochaeta	3

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Town Creek					
HH16	Yes	Coleoptera	Dryopidae	*Helichus* sp.	1
			Elmidae	*Ancyronyx variegatus*	1
				Dubiraphia sp.	6
				Macronychus glabratus	1
				Optioservus sp.	21
				Promoresia sp.	1
				Promoresia tardella	1
				Stenelmis sp.	2
			Gyrinidae	*Dineutus* sp.	2
			Hydrophilidae	*Helophorus* sp.	1
			Psephenidae	*Psephenus herricki*	8
		Decapoda	Cambaridae	*Cambarus bartonii*	1
		Diptera	Ceratopogonidae	*Bezzia* complex	3
			Chironomidae	*Ablabesmyia janta*	2
				Apedilum sp.	32
				Brillia sp.	1
				Cardiocladius sp.	2
				Chaetocladius sp.	1
				Labrundinia sp.	2
				Nanocladius sp.	1
				Orthocladiinae	1
				Parametriocnemus sp.	1
				Phaenopsectra sp.	28
				Polypedilum sp.	2
				Polypedilum flavum	8
				Polypedilum fallax	1
				Polypedilum illinoense	1
				Psectrocladius sp.	1
				Pseudochironomus sp.	1
				Rheotanytarsus pellucidus	1
				Stelechomyia perpulchra	1
				Telopelopia okoboji	2
				Thienemannimyia group sp.	1
			Tipulidae	*Pseudolimnophila* sp.	3
				Tipula sp.	1
		Ephemeroptera	Ephemeridae	*Hexagenia limbata*	1
			Heptageniidae	*Stenonema* sp.	8
		Megaloptera	Corydalidae	*Nigronia serricornis*	1
		Odonata	Aeshnidae	*Boyeria vinosa*	2
			Cordulegastridae	*Epitheca* sp.	4
			Gomphidae	*Gomphus cavillaris*	1
		Plecoptera	Perlidae	*Acroneuria* sp.	7
				Acroneuria internata	1
			Taeniopterygidae	*Strophopteryx limata*	13
		Trichoptera	Calamoceratidae	*Anisocentropus pyraloides*	2
			Hydropsychidae	*Cheumatopsyche* sp.	18

				Hydropsychidae	1
				Potamyia flava	4
			Leptoceridae	*Nectopsyche* sp.	1
			Philopotamidae	*Chimarra* sp.	4
		Class: Clitellata		Oligochaeta	6

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Whooping Creek					
HH18	Yes	Basommatophora	Physidae	*Physella* sp.	1
		Coleoptera	Elmidae	*Ancyronyx variegatus*	42
				Dubiraphia sp.	2
				Macronychus glabratus	3
				Stenelmis sp.	7
		Decapoda	Cambaridae	*Procambarus* sp.	3
		Diptera	Ceratopogonidae	*Bezzia* complex	1
			Chironomidae	*Ablabesmyia* sp.	2
				Ablabesmyia annulata	1
				Chironomidae	2
				Clinotanypus sp.	2
				Hudsonimyia sp.	1
				Parametriocnemus sp.	1
				Rheocricotopus sp.	1
				Stenochironomus sp.	4
				Xylotopus par	3
		Ephemeroptera	Baetidae	Baetis sp.	2
			Ephemeridae	*Hexagenia limbata*	20
			Heptageniidae	*Stenonema* sp.	20
			Isonychiidae	*Isonychia* sp.	6
		Isopoda	Asellidae	*Lirceus fontinalis*	12
		Megaloptera	Corydalidae	*Corydalus comutus*	4
		Odonata	Calopterygidae	*Hetaerina americana*	1
			Coenagrionidae	*Argia* sp.	1
				Ischnura sp.	1
		Plecoptera	Taeniopterygidae	*Taeniopteryx* sp.	1
		Trichoptera	Hydropsychidae	*Cheumatopsyche* sp.	63
				Hydropsyche sp.	7
			Leptoceridae	*Oecetis inconspicua*	2
			Philopotamidae	*Chimarra* sp.	9
			Polycentropodidae	*Neureclipsis* sp.	2
		Veneroida	Corbiculidae	*Corbicula fluminea*	10

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Rae's Creek					
65c-3	No	Basommatophora	Physidae	*Physella* sp.	3
		Coleoptera	Elmidae	*Ancyronyx variegatus*	2
				Stenelmis sp.	1
			Psephenidae	*Psephenus herricki*	1
		Decapoda	Cambaridae	Cambarinae	1
		Diptera	Chironomidae	*Ablabesmyia* sp.	1
				Ablabesmyia mallochi	3
				Brillia sp.	8
				Chironomidae	2
				Phaenopsectra sp.	2
				Polypedilum sp.	4
				Polypedilum aviceps	30
				Potthastia sp.	1
				Rheocricotopus sp.	3
				Rheocricotopus robacki	4
				Stenochironomus sp.	1
				Tanytarsus L	1
				Thienemannimyia group sp.	4
				Tribelos sp.	2
				Tribelos jucundus	21
			Simuliidae	*Simulium* sp.	5
		Ephemeroptera	Ephemerellidae	*Attenella attenuata*	1
			Heptageniidae	*Stenonema* sp.	55
		Megaloptera	Corydalidae	*Corydalus comutus*	1
		Odonata	Coenagrionidae	*Chromagrion conditum*	1
				Coenagrionidae	2
		Trichoptera	Hydropsychidae	*Ceratopsyche spama*	4
				Cheumatopsyche sp.	7
				Hydropsyche sp.	3
		Class: Clitellata		Oligochaeta	3

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
			Rocky Creek		
65c-4	No	Basommatophora	Physidae	*Physa* sp.	12
			Planorbidae	Planorbidae	1
		Coleoptera	Elmidae	*Ancyronyx variegatus*	2
				Dubiraphia vittata	1
			Sphaeriidae	Sphaeriidae	4
		Decapoda	Cambaridae	*Procambarus* sp.	1
		Diptera	Ceratopogonidae	*Bezzia* complex	2
			Chironomidae	*Ablabesmyia* sp.	8
				Ablabesmyia hauberi	5
				Ablabesmyia mallochi	23
				Ablabesmyia peleensis	1
				Apedilum sp.	1
				Chironomus decorus	1
				Conchapelopia sp. (aberrant 6 teeth)	1
				Dicrotendipes sp.	19
				Dicrotendipes A	13
				Glyptotendipes sp.	1
				Nanocladius sp.	1
				Parachironomus tenuicaudatus complex	1
				Paratanytarsus sp.	1
				Paratanytarsus D	1
				Paratanytarsus dissimilis	2
				Phaenopsectra obediens grp.	9
				Phaenopsectra punctipes grp.	3
				Polypedilum halterale	1
				Polypedilum scalaenum	1
				Polypedilum tritum	1
				Procladius sp.	2
				Procladius (Holotanypus) sp.	1
				Rheotanytarsus exiguus group	7
				Rheotanytarsus pellucidus	1
				Tribe Tanytarsini	2
				Tanytarsus C	2
				Tanytarsus P	2
				Tanytarsus T	2
				Tanytarsus U	2
				Thienemannimyia group sp.	20
				Tribelos atrum	8
				Tribelos fuscicorne	3

				Trissopelopia ogemawi	2
			Tipulidae	*Tipula* sp.	1
		Heteroptera	Nepidae	*Ranatra buenoi*	1
		Odonata	Calopterygidae	Calopterygidae	1
			Coenagrionidae	*Argia* sp.	19
				Coenagrionidae	3
				Enallagma sp.	18
				Enallagma divagans	1
				Ischnura sp.	2
			Gomphidae	Gomphidae	2
		Class: Clitellata		Oligochaeta	8

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Sweetwater Creek					
65c-8	No	Coleoptera	Dytiscidae	*Hydroporus* sp.	7
			Elmidae	*Stenelmis* sp.	2
		Diptera	Chironomidae	*Ablabesmyia* sp.	2
				Ablabesmyia aspera	1
				Ablabesmyia mallochi	11
				Corynoneura sp.	1
				Cricotopus politus	1
				Dicrotendipes sp.	4
				Gillotia alboviridus	1
				Glyptotendipes B	2
				Microtendipes pedellus	1
				Nanocladius sp.	1
				Orthocladius obumbratus	1
				Parametriocnemus sp.	1
				Phaenopsectra sp.	1
				Phaenopsectra obediens grp.	10
				Phaenopsectra/ Tribelos complex	5
				Polypedilum aviceps	4
				Polypedilum flavum	3
				Rheotanytarsus pellucidus	1
				Stenochironomus sp.	9
				Tanypodinae	1
				Tribe Tanytarsini	2
				Tanytarsus sp.	4
				Tanytarsus L	2
				Thienemannimyia group sp.	6
				Tribelos fuscicome	1
				Tribelos jucundus	5
				Unniella multivirga	4
			Empididae	*Hemerodromia* sp.	1
				Rhamphomyia sp.	1
			Simuliidae	*Prosimulium* sp.	41
				Simulium sp.	28
		Ephemeroptera	Caenidae	*Caenis* sp.	1
			Heptageniidae	*Stenonema terminatum*	3
		Trichoptera	Hydropsychidae	*Ceratopsyche spama*	2
				Cheumatopsyche sp.	38
				Hydropsychidae	5
			Leptoceridae	*Oecetis* sp.	1
			Polycentropodidae	*Cernotina* sp.	1
				Polycentropus sp.	7
		Veneroida	Pisidiidae	Pisidiidae	2

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Magtail Branch					
65c-12	No	Amphipoda	Talitridae	*Hyalella azteca*	2
		Coleoptera	Curculionidae	*Anchytarsus bicolor*	1
			Dytiscidae	*Hydaticus* sp.	1
				Hydroporus sp.	2
			Elmidae	*Ancyronyx variegatus*	3
				Stenelmis sp.	1
		Diptera	Ceratopogonidae	*Bezzia* complex	5
			Chironomidae	*Ablabesmyia* sp.	2
				Ablabesmyia mallochi	3
				Chironominae	1
				Corynoneura sp.	2
				Dicrotendipes sp.	1
				Heterotrissocladius Cladwell/boltoni	1
				Labrundinia sp.	1
				Labrundinia pilosella	6
				Larsia sp.	1
				Micropsectra D	1
				Microtendipes rydalensis	1
				Neozavrelia sp.	1
				Paralauterbomiella nigrohalterale	2
				Parametriocnemus sp.	1
				Paratendipes subaequalis	1
				Phaenopsectra obediens grp.	3
				Phaenopsectra punctipes grp.	1
				Polypedilum aviceps	1
				Polypedilum laetum	1
				Psilometriocnemus triannulatus	1
				Rheotanytarsus sp.	1
				Rheotanytarsus exiguus grp.	7
				Rheotanytarsus pellucidus	1
				Stempellinella sp.	1
				Stempellinella A	3
				Stempellinella B	1
				Stempellinella leptocelloides	2
				Stenochironomus sp.	6
				Tanypodinae	1
				Tribe Tanytarsini	3
				Tanytarsus sp.	7
				Tanytarsus A	2
				Tanytarsus L	3

				Tanytarsus M	1
				Tanytarsus S	1
				Tanytarsus T	2
				Tanytarsus W	1
				Thienemannimyia group sp.	12
				Tribelos jucundus	2
				Unniella multivirga	1
			Dixidae	*Dixella indiana*	2
			Empididae	*Hemerodromia* sp.	2
			Tabanidae	*Tabanus* sp.	2
			Tipulidae	*Pseudolimnophila* sp.	2
				Tipula sp.	1
		Ephemeroptera	Ephemerellidae	*Eurylophella bicolor*	4
			Ephemeridae	*Hexagenia limbata*	1
			Heptageniidae	*Stenonema terminatum*	38
			Leptophlebiidae	*Paraleptophlebia* sp.	48
			Potamanthidae	*Potamanthus distinctus*	4
		Odonata	Calopterygidae	*Calopteryx* sp.	1
			Coenagrionidae	*Argia* sp.	2
			Corduliidae	*Macromia* sp.	1
			Gomphidae	Gomphidae	4
				Progomphus sp.	4
			Libellulidae	*Brachymesia gravida*	1
		Plecoptera	Perlidae	*Eccoptura xanthenes*	1
				Perlesta sp.	1
				Perlinella drymo	1
			Perlodidae	*Isoperla marlynia*	2
		Trichoptera	Hydropsychidae	*Cheumatopsyche* sp.	4
			Lepidostomatidae	*Lepidostoma* sp.	1
			Leptoceridae	*Ceraclea diluta*	1
				Leptoceridae	1
				Oecetis sp.	1
			Limnephilidae	Pycnopsyche sp.	2
			Molannidae	*Molanna tryphena*	2
		Veneroida	Pisidiidae	*Sphaerium* sp.	1

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Deep Creek					
65c-40	No	Coleoptera	Curculionidae	*Anchytarsus bicolor*	4
			Dytiscidae	*Liodessus* sp.	1
			Elmidae	*Ancyronyx variegatus*	2
				Stenelmis sp.	8
				Stenelmis antennalis	1
		Decapoda	Cambaridae	Cambarinae	4
				Procambarus gibbus	2
		Diptera	Ceratopogonidae	*Bezzia* complex	3
				Dasyhelea sp.	3
			Chironomidae	*Ablabesmyia mallochi*	1
				Ablabesmyia simpsoni	1
				Chironominae	1
				Clinotanypus sp.	2
				Corynoneura sp.	1
				Djalmabatista pulcher variant (5 toothed)	1
				Georthocladius sp.	1
				Hamischia Complex *D*	3
				Labrundinia sp.	2
				Manoa sp.	6
				Microtendipes sp.	2
				Microtendipes pedellus grp.	4
				Microtendipes rydalensis	1
				Nanocladius sp.	4
				Nilothauma sp.	1
				Orthocladiinae	1
				Parametriocnemus sp.	1
				Paraphaenocladius sp.	1
				Paratanytarsus sp.	1
				Phaenopsectra sp.	2
				Phaenopsectra obediens grp.	2
				Phaenopsectra punctipes grp.	1
				Polypedilum flavum	1
				Procladius sp.	1
				Procladius (Holotanypus) sp.	1
				Pseudorthocladius sp.	1
				Rheocricotopus robacki	5
				Stelechomyia perpulchra	1
				Stempellinella sp.	1
				Stempellinella A	6
				Stempellinella leptocelloides	2
				Stenochironomus sp.	6
				Tanypodinae	1
				Tanytarsus O	1

				Telopelopia okoboji	2
				Thienemannimyia group sp.	75
				Unniella multivirga	7
				Xenochironomus xenolabis	1
			Simuliidae	*Simulium* sp.	7
			Tipulidae	*Hexatoma* sp.	1
				Tipulidae	1
		Ephemeroptera	Ephemeridae	*Hexagenia limbata*	1
			Heptageniidae	Heptageniidae	3
			Isonychiidae	*Isonychia* sp.	1
			Leptophlebiidae	Leptophlebiidae	6
			Polymitarcyidae	*Ephoron leukon*	1
		Megaloptera	Corydalidae	*Nigronia serricornis*	1
		Odonata	Aeshnidae	*Boyeria vinosa*	1
			Calopterygidae	*Calopteryx* sp.	1
				Calopteryx maculata	1
			Coenagrionidae	*Argia* sp.	1
			Corduliidae	*Neurocordulia alabamensis*	1
				Somatochlora linearis	1
			Macromiidae	*Macromia taeniolata*	1
		Plecoptera	Chloroperlidae	Chloroperlidae	1
			Leuctridae	*Leuctra* sp.	1
			Nemouridae	Nemouridae	1
			Perlidae	*Acroneuria lycorias*	1
				Beloneuria sp.	1
				Perlidae	1
			Taeniopterygidae	Taeniopterygidae	2
		Trichoptera	Brachycentridae	*Brachycentrus chelatus*	1
			Calamoceratidae	*Anisocentropus pyraloides*	4
			Hydropsychidae	*Hydropsyche scalaris*	6
				Hydropsychidae	1
			Leptoceridae	Leptoceridae	1
			Philopotamidae	*Chimarra* sp.	4
			Polycentropodidae	*Neureclipsis* sp.	5
				Polycentropodidae	1

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Lanahassee Creek					
65c-80	Yes	Amphipoda	Talitridae	*Hyalella azteca*	5
		Architaenioglossa	Viviparidae	*Campeloma limum*	3
		Coleoptera	Elmidae	*Ancyronyx variegatus*	2
				Macronychus glabratus	1
		Decapoda	Cambaridae	Cambarinae	1
		Diptera	Ceratopogonidae	*Bezzia complex*	2
			Chironomidae	*Ablabesmyia* sp.	3
				Ablabesmyia mallochi	5
				Apedilum sp.	56
				Chironomidae	2
				Clinotanypus sp.	4
				Dicrotendipes sp.	3
				Hudsonimyia sp.	1
				Hydrobaenus sp.	2
				Larsia sp.	1
				Monopelopia sp.	1
				Monopelopia boliekae	1
				Monopelopia tillandsia	3
				Natarsia sp.	1
				Paramerina sp.	1
				Parametriocnemus sp.	7
				Paratanytarsus sp.	5
				Phaenopsectra sp.	17
				Polypedilum sp.	2
				Polypedilum aviceps	4
				Polypedilum flavum	13
				Polypedilum tritum	5
				Procladius sp.	2
				Pseudorthocladius sp.	1
				Rheotanytarsus sp.	5
				Stenochironomus sp.	2
				Tanytarsus sp.	10
				Thienemannimyia group sp.	18
				Xestochironomus sp.	1
			Ephydridae	*Hydrellia* sp.	1
		Ephemeroptera	Ephemeridae	*Hexagenia limbata*	3
			Heptageniidae	*Stenonema* sp.	3
		Megaloptera	Sialidae	*Sialis mohri*	1
		Neotaenioglossa	Pleuroceridae	*Elimia* sp.	1
				Pleurocera sp.	1

		Odonata	Coenagrionidae	Coenagrionidae	4
		Plecoptera	Perlidae	*Acroneuria* sp.	2
			Taeniopterygidae	*Strophopteryx* sp.	2
		Trichoptera	Calamoceratidae	*Anisocentropus pyraloides*	3
			Hydropsychidae	*Cheumatopsyche* sp.	1
				Potamyia flava	1
			Leptoceridae	*Leptocerus americanus*	1
			Limnephilidae	*Hydatophylax argus*	3
			Polycentropodidae	*Neureclipsis* sp.	4
				Nyctiophylax sp.	1
				Polycentropus sp.	7
				Nemata	6
		Class: Clitellata		Oligochaeta	5

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Hichitee Creek					
65c-88	No	Coleoptera	Elmidae	*Stenelmis* sp.	2
		Decapoda	Cambaridae	*Cambarinae*	9
		Diptera	Ceratopogonidae	*Bezzia complex*	13
			Chironomidae	*Ablabesmyia* sp.	6
				Ablabesmyia mallochi	10
				Brillia flavifrons	1
				Chironomus ochreatus	1
				Corynoneura sp.	1
				Gillotia alboviridus	2
				Goeldichironomus sp.	1
				Larsia sp.	1
				Orthocladiinae	1
				Paramerina sp.	2
				Phaenopsectra obediens	18
				Phaenopsectra/Tribelos complex	2
				Polypedilum A	3
				Polypedilum flavum	21
				Polypedilum halterale	4
				Polypedilum illinoense	2
				Polypedilum scalaenum	20
				Reomyia sp.	1
				Rheocricotopus sp.	6
				Rheocricotopus robacki	2
				Rheotanytarsus sp.	1
				Rheotanytarsus exiguus group	1
				Rheotanytarsus pellucidus	2
				Robackia claviger	1
				Stelechomyia perpulchra	3
				Stempellinella sp.	1
				Stempellinella A	1
				Stempellinella leptocelloides	1
				Stenochironomus sp.	3
				Tanypodinae	1
				Tanytarsus sp.	4
				Tanytarsus C	1
				Tanytarsus O	1
				Tanytarsus T	2
				Tanytarsus U	1
				Thienemannimyia group sp.	9
				Tribelos sp.	1
				Tribelos jucundus	3
				Trissopelopia ogemawi	1
			Empididae	*Hemerodromia* sp.	4
			Simuliidae	*Simulium* sp.	1

			Tipulidae	*Hexatoma* sp.	1
				Limnophila sp.	2
				Tipulidae	3
		Ephemeroptera	Caenidae	*Caenis* sp.	1
			Ephemerellidae	*Attenella attenuata*	3
			Ephemeridae	*Hexagenia limbata*	11
			Heptageniidae	*Stenonema terminatum*	4
			Tricorythidae	Tricorythidae	1
		Heteroptera	Gerridae	Gerridae	1
		Megaloptera	Corydalidae	*Corydalus comutus*	1
				Nigronia semicomis	1
		Odonata	Coenagrionidae	*Argia* sp.	2
			Libellulidae	Libellulidae	1
		Plecoptera	Perlidae	*Acroneuria lycorias*	7
		Trichoptera	Hydropsychidae	*Cheumatopsyche* sp.	2
			Leptoceridae	*Oecetis* sp.	3
		Class: Clitellata		Oligochaeta	1

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Hollis Creek					
65c-89	Yes	Coleoptera	Elmidae	*Ancyronyx variegatus*	1
				Dubiraphia sp.	1
				Macronychus glabratus	1
				Stenelmis sp.	3
		Decapoda	Cambaridae	Cambarinae	5
		Diptera	Ceratopogonidae	*Bezzia* complex	2
			Chironomidae	*Ablabesmyia* sp.	7
				Ablabesmyia rhamphe grp.	2
				Apedilum sp.	16
				Chironomidae	3
				Clinotanypus sp.	1
				Conchapelopia sp.	1
				Doithrix sp.	1
				Georthocladius sp.	3
				Helopelopia sp.	6
				Labrundinia sp.	2
				Larsia sp.	1
				Parametriocnemus sp.	1
				Phaenopsectra sp.	40
				Polypedilum fallax	1
				Rheotanytarsus sp.	1
				Stelechomyia perpulchra	3
				Stenochironomus sp.	5
				Tanypodinae	1
				Tanytarsus sp.	4
				Thienemannimyia group sp.	47
				Xestochironomus sp.	1
				Xylotopus par	1
			Simuliidae	*Simulium* sp.	2
			Tipulidae	*Tipula* sp.	1
		Ephemeroptera	Heptageniidae	*Stenonema* sp.	3
		Megaloptera	Corydalidae	*Nigronia serricomis*	1
		Odonata	Calopterygidae	*Calopteryx* sp.	2
			Coenagrionidae	Coenagrionidae	4
			Corduliidae	*Neurocordulia* sp.	3
			Gomphidae	*Dromogomphus spinosus*	1
		Plecoptera	Perlidae	*Acroneuria lycorias*	2
				Perlinella sp.	2
		Trichoptera	Calamoceratidae	*Anisocentropus pyraloides*	1
			Hydropsychidae	*Cheumatopsyche* sp.	1
				Macrostemum sp.	8
		Class: Clitellata		Oligochaeta	3

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Whitewater Creek					
HH24	Yes	Coleoptera	Elmidae	Elmidae	4
			Psephenidae	*Ectopria* sp.	2
		Diptera	Chironomidae	Ablabesmyia	1
				Ablabesmyia mallochi	1
				Apedilum sp.	29
				Chironomidae	3
				Conchapelopia sp.	14
				Harnischia Complex D	1
				Helopelopia sp.	1
				Heterotrissocladius C	1
				Manoa sp.	4
				Microtendipes rydalensis	4
				Parametriocnemus sp.	2
				Paratanytarsus sp.	7
				Phaenopsectra sp.	6
				Polypedilum sp.	1
				Polypedilum aviceps	6
				Polypedilum flavum	23
				Polypedilum halterale	1
				Polypedilum scalaenum	1
				Procladius sp.	2
				Rheocricotopus sp.	3
				Rheocricotopus tuberculatus	1
				Rheotanytarsus sp.	6
				Tanypodinae	2
				Tanytarsus sp.	6
				Tanytarsus M	2
				Telopelopia okoboji	1
				Thienemannimyia group sp.	11
				Zavrelia sp.	1
			Simuliidae	*Simulium* sp.	4
		Ephemeroptera	Ephemerellidae	*Eurylophella bicolor*	1
			Ephemeridae	*Hexagenia limbata*	2
		Megaloptera	Corydalidae	*Nigronia serricornis*	2
		Odonata	Coenagrionidae	Coenagrionidae	1
			Corduliidae	Corduliidae	1
			Gomphidae	Gomphidae	1
		Plecoptera	Perlidae	*Acroneuria* sp.	1
				Agnetina capitata	2
		Trichoptera	Calamoceratidae	*Anisocentropus pyraloides*	1
			Hydropsychidae	*Cheumatopsyche* sp.	7
				Hydropsyche sp.	19
			Leptoceridae	*Triaenodes* new sps. *A*?	2
			Philopotamidae	*Chimarra* sp.	21
			Polycentropodidae	*Neureclipsis* sp.	6
				Polycentropus sp.	3
		Class: Clitellata		Oligochaeta	3

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
			Pine Knot Creek		
HH25	Yes	Coleoptera	Elmidae	*Gonielmis dietrichi*	2
				Macronychus glabratus	5
				Promoresia tardella	2
				Stenelmis sp.	3
			Gyrinidae	*Dineutus* sp.	1
			Psephenidae	*Ectopria* sp.	2
		Diptera	Ceratopogonidae	*Bezzia* complex	3
			Chironomidae	*Ablabesmyia mallochi*	1
				Ablabesmyia rhamphe grp.	2
				Apedilum sp.	23
				Cladotanytarsus sp.	1
				Georthocladius sp.	5
				Paratanytarsus sp.	15
				Phaenopsectra sp.	34
				Polypedilum aviceps	1
				Stelechomyia perpulchra	2
				Stenochironomus sp.	3
				Thienemannimyia group sp.	1
			Simuliidae	*Simulium* sp.	4
			Tipulidae	*Dicranota* sp.	1
		Ephemeroptera	Heptageniidae	*Stenonema* sp.	10
		Megaloptera	Corydalidae	*Nigronia serricornis*	1
		Odonata	Coenagrionidae	Coenagrionidae	2
			Cordulegastridae	*Epitheca* sp.	7
		Plecoptera	Perlidae	*Acroneuria* sp.	5
				Perlidae	1
			Taeniopterygidae	*Strophopteryx fasciata*	3
				Strophopteryx limata	17
		Trichoptera	Brachycentridae	*Brachycentrus* sp.	3
			Calamoceratidae	*Anisocentropus pyraloides*	1
			Hydropsychidae	*Arctopsyche* sp.	2
				Potamyia flava	5
			Leptoceridae	*Mystacides sepulchralis*	8
			Philopotamidae	*Chimarra* sp.	1
			Polycentropodidae	*Neureclipsis* sp.	5

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Shoal Creek					
HH26	Yes	Coleoptera	Dytiscidae	*Liodessus* sp.	1
			Elmidae	*Macronychus glabratus*	5
				Microcylloepus pusillus	3
				Optioservus sp.	1
				Promoresia elegans	1
				Stenelmis sp.	3
			Psephenidae	*Ectopria* sp.	1
		Decapoda	Cambaridae	Cambarinae	4
		Diptera	Chironomidae	*Ablabesmyia mallochi*	7
				Ablabesmyia rhamphe grp.	1
				Apedilum sp.	39
				Chironomidae	1
				Clinotanypus sp.	3
				Conchapelopia sp.	13
				Cryptochironomus sp.	1
				Harnischia Complex D	4
				Helopelopia sp.	7
				Larsia sp.	1
				Orthocladius luteipes	1
				Phaenopsectra sp.	13
				Polypedilum aviceps	4
				Polypedilum bergi	1
				Polypedilum flavum	1
				Procladius sp.	12
				Stenochironomus sp.	5
				Tanypodinae	2
				Telopelopia okoboji	2
				Thienemannimyia group sp.	11
			Simuliidae	*Simulium* sp.	2
		Ephemeroptera	Heptageniidae	*Stenonema* sp.	3
		Megaloptera	Sialidae	*Sialis mohri*	4
		Odonata	Calopterygidae	*Calopteryx angustipennis*	4
			Coenagrionidae	*Chromagrion* sp.	8
			Corduliidae	*Williamsonia* sp.	1
			Gomphidae	*Dromogomphus armatus*	1
		Plecoptera	Taeniopterygidae	*Strophopteryx fasciata*	2
		Trichoptera	Leptoceridae	*Leptocerus americanus*	1
				Oecetis sp.	1
			Limnephilidae	Limnephilidae	1
			Polycentropodidae	*Nyctiophylax* sp.	4
				Polycentropus sp.	1
		Class: Clitellata		Oligochaeta	5

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Jack's River					
66g-2	Yes	Coleoptera	Elmidae	*Dubiraphia* sp.	14
				Elmidae	14
				Gonielmis dietrichi	37
				Microcylloepus pusillus	2
				Promoresia elegans	6
				Stenelmis sp.	22
			Psephenidae	Psephenidae	1
				Psephenus herricki	2
		Diptera	Chironomidae	Chironomidae	1
				Rheotanytarsus exiguus group	2
				Tvetenia vitracies	5
			Simuliidae	*Simulium* sp.	9
			Tipulidae	*Hexatoma* sp.	4
				Tipula sp.	1
		Ephemeroptera	Baetidae	*Pseudocloeon* sp.	12
			Heptageniidae	*Stenonema* sp.	9
		Hemiptera	Veliidae	*Rhagovelia obesa*	1
		Heteroptera		*Paravelia* sp.	1
		Megaloptera	Corydalidae	Corydalidae	1
				Corydalus comutus	6
		Neotaenioglossa	Pleuroceridae	*Elimia* sp.	1
		Odonata	Gomphidae	Gomphidae	1
		Plecoptera	Perlidae	*Acroneuria abnormis*	10
				Paragnetina media	1
				Perlesta sp.	2
		Trichoptera	Brachycentridae	Brachycentridae	3
			Hydropsychidae	*Cheumatopsyche* sp.	13
				Hydropsyche sp.	29
				Hydropsychidae	8
			Philopotamidae	*Chimarra* sp.	1
			Polycentropodidae	*Polycentropus* sp.	5

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Rough Creek					
66g-2-2	Yes	Coleoptera	Elmidae	Elmidae	1
				Optioservus sp.	3
		Diptera	Ceratopogonidae	*Bezzia* complex	4
			Chironomidae	Chironomidae	2
				Georthocladius sp.	1
				Hudsonimyia sp.	1
				Micropsectra sp.	3
				Microtendipes sp.	1
				Orthocladiinae	6
				Parametriocnemus sp.	2
				Polypedilum A	1
				Pseudorthocladius sp.	2
				Stempellinella sp.	6
				Tribe Tanytarsini	1
				Thienemanniella lobapodema	1
				Thienemannimyia group sp.	1
			Tipulidae	*Hexatoma* sp.	3
				Pseudolimnophila sp.	2
				Tipulidae	3
		Ephemeroptera	Ephemerellidae	*Ephemerella* sp.	4
				Ephemerella crenula	2
				Eurylophella doris complex	1
			Heptageniidae	*Epeorus* sp.	4
				Epeorus dispar	6
				Epeorus pleuralis	5
				Stenonema sp.	15
			Leptophlebiidae	Leptophlebiidae	2
			Siphlonuridae	Siphlonuridae	3
		Isopoda	Asellidae	Asellidae	5
				Lirceus sp.	14
		Plecoptera	Capniidae	Capniidae	11
			Chloroperlidae	Chloroperlidae	4
				Utaperla sp.	18
			Peltoperlidae	*Tallaperla* sp.	4
			Perlidae	*Acroneuria abnormis*	4
			Perlodidae	*Diploperla duplicata*	1
				Isoperla similis	1
			Pteronarcydae	*Pteronarcys dorsata*	1
			Taeniopterygidae	*Oemopteryx* complex	3
				Taeniopteryx sp.	10
		Trichoptera	Brachycentridae	*Micrasema* sp.	4
			Hydropsychidae	*Hydropsyche* sp.	2
			Lepidostomatidae	*Lepidostoma* sp.	9
			Limnephilidae	*Hydatophylax argus*	21
				Limnephilidae	5

			Odontoceridae	*Marilia flexuosa*	2
			Polycentropodidae	*Nyctiophylax* sp.	1
				Polycentropodidae	2
		Class: Clitellata		Oligochaeta	4

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Mill Creek					
66g-5	Yes	Coleoptera	Elmidae	Elmidae	1
				Microcylloepus pusillus	1
				Optioservus sp.	11
			Psephenidae	*Ectopria* sp.	1
				Psephenus herricki	7
		Diptera	Ceratopogonidae	*Bezzia* complex	1
			Chironomidae	*Apedilum* sp.	5
				Chironomidae	2
				Chironominae	3
				Corynoneura sp.	2
				Corynoneura B	1
				Eukiefferiella sp.	1
				Heterotrissocladius Cladwell/boltoni	1
				Heterotrissocladius marcidus	1
				Hydrobaenus sp.	1
				Microtendipes sp.	26
				Nanocladius sp.	2
				Orthocladiinae	3
				Parakiefferiella coronata	1
				Polypedilum aviceps	1
				Polypedilum flavum	2
				Tanypodinae	1
				Thienemanniella lobapodema	1
			Dixidae	*Dixa* sp.	4
			Simuliidae	*Simulium* sp.	1
			Tipulidae	*Dicranota* sp.	2
				Hexatoma sp.	3
				Tipula sp.	2
		Ephemeroptera	Baetidae	*Pseudocloeon* sp.	1
			Baetiscidae	Baetiscidae	1
			Ephemerellidae	*Attenella attenuata*	13
				Dannella sp.	2
				Dannella lita	2
				Ephemerellidae	2
				Eurylophella sp.	3
			Heptageniidae	*Epeorus* sp.	9
				Epeorus pleuralis	1
				Heptageniidae	1
				Stenonema sp.	8
			Isonychiidae	*Isonychia* sp.	4
			Leptophlebiidae	Leptophlebiidae	2
			Siphlonuridae	Siphlonuridae	2
		Megaloptera	Corydalidae	Corydalidae	1
				Corydalus comutus	1

				Nigronia serricomis	1
		Odonata	Cordulegastridae	*Cordulegaster* sp.	1
			Gomphidae	Gomphidae	5
		Plecoptera	Capniidae	*Allocapnia* sp.	2
				Capniidae	13
			Chloroperlidae	*Alloperla* sp.	1
				Chloroperlidae	1
				Haploperla brevis	2
				Utaperla	9
			Perlidae	Paragnetina kansensis	3
				Paragnetina media	5
				Perlidae	2
			Taeniopterygidae	Oemopteryx complex	1
				Taeniopterygidae	2
				Taeniopteryx	2
		Trichoptera	Glossosomatidae	Glossosoma	2
			Hydropsychidae	Cheumatopsyche	19
				Hydropsyche	9
				Hydropsychidae	2
			Lepidostomatidae	Lepidostoma	10
				Lepidostomatidae	1
				Theliopsyche	1
			Philopotamidae	Chimarra	3
				Dolophilodes	2

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Holly Creek					
66g-6	Yes	Coleoptera	Dryopidae	*Helichus basalis*	1
			Elmidae	*Macronychus glabratus*	3
				Optioservus sp.	11
				Promoresia elegans	1
				Stenelmis sp.	7
				Stenelmis bicarinata	1
			Psephenidae	*Psephenus herricki*	14
		Decapoda	Cambaridae	*Procambarus* sp.	4
		Diptera	Ceratopogonidae	*Bezzia* complex	1
			Chironomidae	*Apedilum* sp.	1
				Chironomidae	3
				Conchapelopia sp.	3
				Cricotopus sp.	1
				Helopelopia sp.	1
				Limnophyes sp.	1
				Micropsectra sp.	1
				Microtendipes pedellus grp.	1
				Orthocladiinae	2
				Paracricotopus sp.	3
				Parakiefferiella B	1
				Paratanytarsus sp.	1
				Platysmittia sp.	1
				Polypedilum aviceps	11
				Polypedilum flavum	4
				Polypedilum scalaenum	6
				Pseudochironomus sp.	1
				Rheotanytarsus sp.	5
				Rheotanytarsus A	1
				Rheotanytarsus pellucidus	1
				Stempellinella sp.	1
				Tanytarsus sp.	1
				Thienemanniella sp.	3
				Thienemanniella xena	1
				Tvetenia sp.	1
			Empididae	*Hemerodromia* sp.	4
			Simuliidae	*Simulium* sp.	4
			Tabanidae	*Tabanus* sp.	1
			Tipulidae	*Antocha* sp.	3
				Erioptera sp.	1
				Hexatoma sp.	2
				Tipulidae	1

		Ephemeroptera	Ameletidae	*Ameletus* sp.	6
			Baetidae	Baetidae	8
				Baetis sp.	2
				Baetis brunneicolor	1
				Baetis intercalaris	1
				Fallceon sp.	5
				Pseudocloeon sp.	1
			Baetiscidae	*Baetisca carolina*	2
			Caenidae	*Caenis* sp.	3
			Ephemerellidae	*Attenella attenuata*	1
			Ephemeridae	*Ephemera simulans*	1
			Heptageniidae	*Epeorus* sp.	1
				Stenonema sp.	8
				Stenonema femoratum	3
				Stenonema sinclairi	3
			Isonychiidae	*Isonychia* sp.	3
		Hemiptera	Veliidae	*Rhagovelia obesa*	1
		Megaloptera	Corydalidae	*Corydalus cornutus*	5
				Nigronia serricornis	3
		Odonata	Coenagrionidae	*Argia* sp.	5
				Chromagrion conditum	1
			Gomphidae	*Arigomphus villosipes*	5
		Plecoptera	Chloroperlidae	*Haploperla brevis*	3
			Perlidae	*Acroneuria abnormis*	4
				Paragnetina immarginata	3
		Trichoptera	Hydropsychidae	*Ceratopsyche sparna*	7
				Cheumatopsyche sp.	15
				Hydropsyche decalda	8
			Philopotamidae	*Dolophilodes* sp.	1
			Polycentropodidae	*Neureclipsis* sp.	1
				Polycentropus sp.	1
			Psychomyiidae	*Psychomyia flavida*	1
			Rhyacophilidae	*Rhyacophila fuscula*	1
		Class: Clitellata		Oligochaeta	4

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Nimblewill Creek					
66g-23	Yes	Coleoptera	Elmidae	*Macronychus glabratus*	2
				Optioservus sp.	9
				Optioservus ovalis	2
			Psephenidae	*Ectopria* sp.	2
				Psephenus herricki	5
		Diptera	Ceratopogonidae	*Bezzia* complex	4
			Chironomidae	*Apedilum* sp.	12
				Chironomidae	1
				Corynoneura sp.	2
				Cryptochironomus sp.	1
				Djalmabatista pulcher variant (5 toothed)	1
				Heterotrissocladius marcidus	1
				Micropsectra A	4
				Micropsectra E	1
				Microtendipes sp.	3
				Orthocladiinae	2
				Paracladopelma doris	1
				Paralauterborniella nigrohalterale	2
				Paraphaenocladius sp.	1
				Phaenopsectra sp.	1
				Polypedilum sp.	1
				Polypedilum aviceps	4
				Pseudorthocladius sp.	2
				Reomyia sp.	1
				Stempellinella sp.	11
				Tanypodinae	1
				Thienemanniella lobapodema	1
				Thienemannimyia group sp.	2
				Xylotopus par	1
			Dixidae	*Dixa* sp.	2
			Simuliidae	*Simulium* sp.	1
			Tabanidae	Tabanidae	1
			Tipulidae	*Limnophila* sp.	1
				Tipulidae	2
		Ephemeroptera	Baetiscidae	*Baetisca carolina*	1
			Ephemerellidae	*Attenella attenuata*	1
				Dannella sp.	6
				Dannella lita	1
				Ephemerella sp.	2

				Ephemerella argo	4
				Ephemerellidae	3
				Eurylophella doris complex	2
			Ephemeridae	*Ephemera* sp.	2
			Heptageniidae	*Epeorus* sp.	2
				Epeorus dispar	7
				Epeorus pleuralis	4
				Heptageniidae	1
				Stenonema sp.	21
			Leptophlebiidae	*Habrophlebiodes* sp.	1
				Leptophlebiidae	7
		Hemiptera	Veliidae	*Rhagovelia obesa*	1
		Odonata	Calopterygidae	*Hetaerina* sp.	2
			Cordulegastridae	*Cordulegaster* sp.	2
			Gomphidae	*Dromogomphus spinosus*	2
				Gomphidae	4
		Plecoptera	Capniidae	*Allocapnia* sp.	7
				Capniidae	3
			Peltoperlidae	*Tallaperla* sp.	1
			Perlidae	*Acroneuria abnormis*	4
				Attaneuria ruralis	1
				Paragnetina immarginata	1
			Perlodidae	*Isoperla similis*	1
				Perlodidae	1
				Yugus arinus	1
			Taeniopterygidae	*Oemopteryx* complex	1
				Taeniopteryx sp.	4
		Trichoptera	Hydropsychidae	Cheumatopsyche sp.	7
				Hydropsyche sp.	5
				Hydropsychidae	1
			Hydroptilidae	Hydroptilidae	1
			Limnephilidae	*Hydatophylax argus*	4
				Limnephilidae	2
				Pycnopsyche sp.	5
			Philopotamidae	*Dolophilodes* sp.	4
			Polycentropodidae	*Neureclipsis* sp.	18
			Psychomyiidae	*Lype diversa*	1
		Class: Clitellata		Oligochaeta	3

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
			Polecat Branch		
66g-30	No	Basommatophora	Physidae	Physidae	1
		Coleoptera	Elmidae	*Dubiraphia sp.*	1
				Optioservus sp.	3
		Decapoda	Cambaridae	Cambarinae	1
		Diptera	Ceratopogonidae	Ceratopogonidae	2
			Chironomidae	*Ablabesmyia mallochi*	1
				Brillia sp.	1
				Brillia flavifrons	1
				Chironomus sp.	10
				Corynoneura sp.	5
				Cryptochironomus sp.	2
				Diamesa sp.	4
				Eukiefferiella sp.	5
				Eukiefferiella brehmi group	8
				Microtendipes pedellus grp.	1
				Microtendipes rydalensis	1
				Nanocladius sp.	1
				Odontomesa fulva	3
				Orthocladius obumbratus	5
				Parametriocnemus sp.	12
				Phaenopsectra obediens grp.	7
				Phaenopsectra/Tribelos complex	1
				Polypedilum flavum	1
				Polypedilum laetum	1
				Polypedilum scalaenum	4
				Potthastia longimana	2
				Rheotanytarsus exiguus group	3
				Thienemanniella sp.	1
				Thienemannimyia group sp.	13
				Tribelos jucundus	1
			Dixidae	*Dixa* sp.	1
			Simuliidae	*Prosimulium* sp.	2
				Simulium sp.	1
			Tipulidae	*Antocha* sp.	2
				Leptotarsus sp.	1
		Ephemeroptera	Baetidae	*Centroptilum* sp.	4
			Heptageniidae	Heptageniidae	3

				Stenonema modestum	32
		Megaloptera	Corydalidae	*Corydalus cornutus*	1
		Odonata	Gomphidae	Gomphidae	1
		Plecoptera	Nemouridae	*Shipsa rotunda*	1
		Trichoptera	Hydropsychidae	*Cheumatopsyche* sp.	55
				Hydropsyche betteni/depravata complex	4
			Limnephilidae	Limnephilidae	1
		Veneroida	Pisidiidae	*Pisidium compressum*	1
		Class: Clitellata		Oligochaeta	15

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Sharp Mountain Creek					
66g-31	No	Coleoptera	Elmidae	*Dubiraphia* sp.	1
				Elmidae	1
				Gonielmis dietrichi	1
				Macronychus glabratus	6
				Optioservus sp.	15
		Diptera	Chironomidae	*Ablabesmyia* sp.	1
				Ablabesmyia mallochi	3
				Brillia sp.	2
				Eukiefferiella brehmi group	8
				Orthocladius obumbratus	1
				Paracladopelma undine	1
				Parakiefferiella sp.	1
				Parakiefferiella B	1
				Phaenopsectra punctipes grp.	1
				Polypedilum A	1
				Polypedilum flavum	2
				Potthastia sp.	1
				Potthastia longimana	3
				Rheotanytarsus sp.	1
				Rheotanytarsus exiguus group	5
				Rheotanytarsus pellucidus	1
				Tanytarsus M	1
				Thienemannimyia group sp.	2
				Tribelos jucundus	1
			Empididae	*Hemerodromia* sp.	2
			Simuliidae	*Prosimulium* sp.	1
				Simulium sp.	3
			Tipulidae	*Leptotarsus* sp.	1
		Ephemeroptera	Ephemerellidae	*Ephemerella argo*	57
			Heptageniidae	*Stenonema modestum*	11
			Isonychiidae	*Isonychia* sp.	9
		Neotaenioglossa	Pleuroceridae	*Elimia* sp.	1
		Plecoptera	Perlodidae	*Isoperla clio*	1
				Isoperla lata	17
				Perlodidae	1
			Taeniopterygidae	*Oemopteryx* complex	26
		Trichoptera	Brachycentridae	*Brachycentrus* sp.	1
			Hydropsychidae	*Ceratopsyche spama*	2
				Cheumatopsyche sp.	1
				Hydropsychidae	1
				Potamyia flava	5
			Limnephilidae	*Pycnopsyche divergens*	1

			Philopotamidae	*Dolophilodes* sp.	1
		Class: Clitellata		Oligochaeta	2

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Tributary To Talking Rock					
66g-42	No	Coleoptera	Elmidae	*Microcylloepus pusillus*	7
				Optioservus sp.	1
				Oulimnius latiusculus	4
		Diptera	Ceratopogonidae	*Bezzia* complex	1
				Ceratopogonidae	3
			Chironomidae	*Ablabesmyia mallochi*	2
				Brillia sp.	1
				Corynoneura sp.	1
				Diamesa sp.	1
				Eukiefferiella brehmi group	4
				Microtendipes sp.	1
				Microtendipes pedellus grp.	19
				Parachaetocladius abnobaeus	3
				Parametriocnemus sp.	22
				Polypedilum sp.	1
				Polypedilum aviceps	2
				Rheocricotopus robacki	2
				Rheotanytarsus exiguus group	4
				Stempellinella B	1
				Tribe Tanytarsini	1
				Tanytarsus M	2
				Tanytarsus W	2
				Thienemanniella xena	4
				Thienemannimyia group sp.	4
				Trissopelopia ogemawi	1
				Tvetenia sp.	1
				Zavrelimyia sp.	1
			Empididae	*Hemerodromia* sp.	2
			Simuliidae	*Prosimulium* sp.	5
		Ephemeroptera	Ephemerellidae	*Attenella attenuata*	2
				Ephemerella sp.	17
				Ephemerellidae	10
				Eurylophella doris complex	2
				Serratella sp.	2
			Heptageniidae	*Epeorus* sp.	2
				Epeorus dispar	1
				Epeorus pleuralis	1

				Heptageniidae	4
				Stenonema sp.	5
				Stenonema femoratum	1
				Stenonema modestum	2
		Haplotaxida	Lumbricidae	Lumbricidae	1
		Megaloptera	Corydalidae	*Corydalus cornutus*	4
		Odonata	Calopterygidae	*Calopteryx angustipennis*	1
		Plecoptera	Chloroperlidae	Chloroperlidae	6
				Haploperla brevis	1
			Nemouridae	Nemouridae	1
			Perlidae	*Acroneuria abnormis*	1
				Perlidae	1
			Perlodidae	*Isoperla* sp.	6
				Isoperla clio	2
				Isoperla holochlora	2
				Isoperla marlynia	4
			Taeniopterygidae	*Oemopteryx* complex	1
		Trichoptera	Hydropsychidae	*Ceratopsyche* sp.	1
				Ceratopsyche morosa	1
				Cheumatopsyche sp.	3
				Hydropsychidae	1
			Limnephilidae	Limnephilidae	2
			Philopotamidae	*Chimarra* sp.	5
				Dolophilodes sp.	2
			Polycentropodidae	Polycentropodidae	1
			Rhyacophilidae	*Rhyacophila* sp.	5
				Rhyacophila fuscula	1
		Class: Clitellata		Oligochaeta	2

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Little Scarecorn Creek					
66g-44	No	Coleoptera	Elmidae	*Macronychus glabratus*	3
				Microcylloepus pusillus	1
				Optioservus sp.	1
			Psephenidae	*Psephenus herricki*	3
		Diptera	Chironomidae	*Ablabesmyia mallochi*	1
				Chaetocladius sp.	1
				Eukiefferiella brehmi group	12
				Labrundinia pilosella	1
				Micropsectra D	1
				Orthocladiinae	1
				Orthocladius obumbratus	3
				Parakiefferiella B	2
				Parakiefferiella F	2
				Parametriocnemus sp.	9
				Polypedilum flavum	3
				Potthastia longimana	3
				Rheocricotopus sp.	1
				Rheocricotopus robacki	32
				Rheocricotopus unidentatus	1
				Rheotanytarsus exiguus group	34
				Rheotanytarsus pellucidus	12
				Stenochironomus sp.	1
				Tribe Tanytarsini	1
				Tanytarsus P	3
				Thienemannimyia group sp.	2
				Tribelos jucundus	1
				Tvetenia bravarica grp.	3
				Tvetenia vitracies	2
			Dixidae	*Dixa* sp.	1
			Empididae	*Dolichocephala* sp.	1
				Hemerodromia sp.	2
			Tipulidae	*Leptotarsus* sp.	1
		Ephemeroptera	Heptageniidae	*Stenonema* sp.	15
				Stenonema modestum	21
			Isonychiidae	*Isonychia* sp.	6
		Odonata	Calopterygidae	*Calopteryx* sp.	2
		Plecoptera	Capniidae	Capniidae	2
			Nemouridae	Nemouridae	1
			Perlodidae	*Isoperla* sp.	1
				Isoperla lata	1
		Trichoptera	Hydropsychidae	*Ceratopsyche sparna*	1
				Cheumatopsyche sp.	15
				Hydropsychidae	1
				Potamyia flava	7

			Limnephilidae	*Pycnopsyche* sp.	2
		Class: Clitellata		Oligochaeta	2

Sub-ecoregion /Station ID	Ref.	Order	Family	Final Identification	Individuals
Yellow Creek					
66g-71	No	Coleoptera	Dytiscidae	*Hygrotus farctus*	1
			Elmidae	*Microcylloepus pusillus*	2
				Optioservus sp.	2
				Oulimnius latiusculus	1
		Diptera	Ceratopogonidae	*Bezzia* complex	1
				Dasyhelea sp.	1
			Chironomidae	*Brillia* sp.	2
				Brillia flavifrons	1
				Chironominae	1
				Corynoneura sp.	1
				Eukiefferiella brehmi grp.	2
				Microtendipes rydalensis	1
				Nanocladius alternantherae	1
				Parakiefferiella F	1
				Parametriocnemus sp.	3
				Paratanytarsus sp.	2
				Paratanytarsus dissimilis	1
				Polypedilum aviceps	1
				Polypedilum flavum	2
				Rheotanytarsus sp.	2
				Rheotanytarsus A	4
				Rheotanytarsus exiguus grp.	13
				Stempellinella A	1
				Stenochironomus sp.	2
				Tribe Tanytarsini	1
				Tanytarsus sp.	2
				Tanytarsus M	7
				Tanytarsus W	5
				Thienemanniella sp.	1
				Thienemanniella xena	1
				Thienemannimyia group sp.	9
				Trissopelopia ogemawi	1
				Zavrelimyia thryptica	1
			Empididae	Empididae	1
				Hemerodromia sp.	3
			Simuliidae	Simuliidae	1
				Simulium sp.	4
			Syrphidae	*Neoascia* sp.	1
			Tipulidae	*Antocha* sp.	1
				Tipulidae	1
		Ephemeroptera	Ephemerellidae	*Attenella attenuata*	1
				Ephemerella argo	2
				Ephemerellidae	1
				Eurylophella bicolor	1
				Eurylophella doris complex	1
			Heptageniidae	Stenacron pallidum	1

				Stenonema	10
				Stenonema modestum	27
				Stenonema terminatum	1
			Isonychiidae	Isonychia	12
		Megaloptera	Corydalidae	Corydalus cornutus	1
		Odonata	Coenagrionidae	Argia	1
		Plecoptera	Chloroperlidae	Chloroperlidae	2
			Nemouridae	Nemouridae	1
			Perlodidae	Isoperla	3
				Isoperla holochlora	4
			Taeniopterygidae	Oemopteryx	3
		Trichoptera	Hydropsychidae	Cheumatopsyche	34
				Hydropsyche	1
				Hydropsychidae	3
			Leptoceridae	Oecetis avara	1
				Triaenodes tardus	3
			Limnephilidae	Hydatophylax argus	1
				Pycnopsyche	1
				Pycnopsyche guttifera	1
			Philopotamidae	Chimarra	1
			Psychomyiidae	Lype diversa	2
			Rhyacophilidae	Rhyacophila	1
		Class: Clitellata		Oligochaeta	5

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