

FINAL REPORT

Threatened or Endangered Aquatic Insect Survey

Obed Wild and Scenic River

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INTRODUCTION

The Obed Wild and Scenic River (OBRI) is part of the Emory River Watershed, located within the Cumberland Plateau and Cumberland Mountains of east Tennessee. This watershed totals over 2,065 km of streams, of which the OBRI includes over 72 km. Regional geologic formations are composed of Pennsylvanian-age conglomerate, sandstone, siltstone, and shale covered by mostly well-drained, acidic soils of low fertility (TDEC 2000). Land use distribution within the Emory River Watershed is as follows: 73% forest, 25% agriculture, 1% open water, and 1% urban (TDEC 2000). Sixty-eight rare species have been found within this watershed, including federally listed threatened and endangered fish and mussel species (TDEC 2000). Twenty-nine state and/or federally listed species have been identified in the OBRI, therefore, understanding the biodiversity associated with the OBRI is critical.

The OBRI includes portions of three drainages: Daddys Creek, Obed River, and Clear Creek. To properly manage the aquatic resources of the OBRI, a comprehensive survey of aquatic insects is needed. Aquatic macroinvertebrates, especially aquatic insects, are an important component of aquatic ecosystems and have long been used to measure water quality. These organisms are best suited for water quality analysis because they are numerous in most streams, are readily collected and identified, are not very mobile, and generally have life cycles of a year or more (Hilsenhoff 1977). Aquatic macroinvertebrates are excellent for assessing short term pollution events because once a species is eliminated from the ecosystem it will not reappear until the next generation (Hilsenhoff 1977). The southeastern United States has the highest diversity of aquatic species in North America, and approximately 40% of all aquatic

insect species occur in this geographical region. To date, the OBRI has not conducted a survey of aquatic insect species. The goal of this project was to conduct a comprehensive survey, which will enhance data obtained during a previous survey within the Emory River Watershed (Goodfred and Cook, unpublished data).

This study provides baseline data on the aquatic insect fauna within the OBRI. Threats to OBRI aquatic resources exist in the form of altered hydrology, increased sedimentation, increased anthropogenic inputs, and changes in land use. The baseline aquatic insect data from this study provides a measure of current aquatic ecosystem health, and changes detected through future aquatic insect monitoring will provide a means of tracking the status of these ecosystems. Specific objectives of the study were to:

1. Conduct aquatic insect surveys at a representative number of sample sites representing all suitable habitats to determine composition, relative abundance, and location of aquatic insect species, with special attention given to threatened and endangered species;
2. Create a Global Information Systems (GIS) database with which to record locations and species of aquatic insects; and
3. Prepare a final report (MS Word format) detailing survey findings, seasonal variation in aquatic insect communities, and photographs/illustrations of each species.

A Master of Science thesis resulted from these efforts and is attached as Appendix 1 in this document.

METHODS

Macroinvertebrate sampling occurred from spring 2007 through summer 2009. Originally, sampling was to occur over the course of a year; however, severe drought conditions prevented sampling of first and second order streams during 2007 and 2008. Therefore, additional samples of first and second order streams were obtained during 2009. Sample sites were selected through coordination with National Park Service staff. Thirty-six sites were located within the Obed River, Clear Creek, White Creek, Daddys Creek, and Emory River sub-watersheds within the boundaries of the Obed Wild and Scenic River, and included samples from first through sixth order streams (Tables 1-6). Most sample sites were located near accessible road crossings or in areas that were accessible by foot. Global positioning system (GPS) coordinates were obtained at each sample site (Tables 1-6).

Due to drought conditions, seasonal variation was impossible to obtain, therefore, seasonal variation reported is based on results from Goodfred (2006). Seasonal sampling began in summer 2004 and continued through summer 2005. Eight locations were sampled seasonally (summer 2004 and 2005; fall 2004; winter 2005; and spring 2005). Summer months included June, July, and August; fall included September, October, and November; winter included December, January, and February; and spring included March, April, and May. Seasonal sample sites were distributed among Daddys Creek, Obed River, Clear Creek, and Emory River.

Habitat

Width, depth, and substrate were measured at each site. Width was measured at transects located every 10 m along a 100-m reach using a measuring tape or a rangefinder. Substrate and depth were measured at five equidistant points across the width of each transect. Substrate was visually assessed using a modified Wentworth scale (Overton et al. 1997). Depth was measured using a piece of PVC pipe graduated in 1 cm increments. Habitat values for 21 of 36 sites are included in the thesis attached as Appendix 1. The remaining 15 sites were sampled for aquatic insects when research crews happened to find appropriate first and second order sites while working on separate projects, and equipment needed for habitat measurements was not available.

Water Quality

Field water quality parameters were measured at precise locations where aquatic macroinvertebrates were sampled. Water quality parameters measured included temperature (°C), dissolved oxygen (mg/l), conductivity ($\mu\text{S}/\text{cm}$), pH, and turbidity (NTU). Conductivity, dissolved oxygen, and temperature were directly measured using a Yellow Springs Instrument (YSI) Model 85 meter. An Analytical Measurements pH Model 107 meter was used to measure pH and an Orbeco-Hellige model 966 turbidimeter was used to measure turbidity. Water quality values for 21 of 36 sites are included in the thesis attached as Appendix 1. The remaining 15 sites were sampled for aquatic insects when research crews happened to find appropriate first and

second order sites while working on separate projects, and equipment needed for water quality measurements was not available.

Macroinvertebrate Collection

Semi-quantitative macroinvertebrate sampling methods, as defined by TDEC (2006), were used. Riffle habitats were sampled using a 1-m² semi-quantitative riffle kick (SQKICK) net with 500-micron mesh. At each site, samples were collected using two kicks, one from a fast riffle and one from a slow riffle, within each 100-m reach. If coarse woody debris or leaf packs were present, they were sampled using a standard D-frame kick net.

Two individuals were required to obtain benthic macroinvertebrate samples. One individual held the SQKICK net at an angle against the current, ensuring that the net bottom maintained contact with the substrate and the top was above the water's surface. A second individual disturbed the substrate by kicking and shuffling their feet in an area approximating 1 m² upstream of the net, causing organisms and debris to flow into the net. Large rocks within the sample area were lifted, and clinging invertebrates were manually collected. Upon kick completion, the net was moved to a flat surface for processing. Leaf packs were sampled by using the D-frame kick net to collect a portion of the leaf pack. Woody debris was sampled by disturbing the debris and using the D-frame kick net to collect dislodged invertebrates.

Samples were composited and placed into a one-gallon zip-lock freezer bag. All clinging organisms were removed from nets and added to the bag. Large rocks and organic material were returned to the stream after rinsing and removing organisms. Site information, including sample

location and date, was printed with a permanent marker on each sample bag. Samples were preserved with 10% formalin or 70% ethanol and transported to the laboratory for processing.

Upon return to the laboratory, samples were stored in large rubber containers until macroinvertebrates were separated from organic debris. Sorting was performed by hand-picking with tweezers under a magnified picking lamp. Once all invertebrates were sorted, a random sub-sample of 160-240 organisms was selected using a grid pan and a random number table. Sub-sampling continued until at least 200 organisms were collected. However, if 200 were collected but the last selected grid still contained organisms then the remaining organisms were added to the sub-sample. All organisms were collected if there were at least 160 but less than 200 present in a sample. Once sub-sampling was complete, taxa were identified using Pennak (1953), Wiggins (1977), Brigham et al. (1982), and Merritt and Cummins (1996). Chironomid larvae and oligochaetes were mounted on labeled microscope slides using CMCP-10 mounting media. Slides were labeled with sample location and date of collection. Chironomids and oligochaetes were identified with a compound light microscope using Beck (1979), Simpson and Bode (1980), Brigham et al. (1982), and Epler (2001). All macroinvertebrates were identified to the species level unless a viable species key did not exist. If a viable species key did not exist, then an individual was identified to genus level. A reference collection containing representative taxa was compiled and is housed within the Department of Biology at Tennessee Technological University.

RESULTS AND DISCUSSION

Objective 1: To conduct aquatic insect surveys at a representative number of sample sites representing all suitable habitats to determine composition, relative abundance, and location of aquatic insect species, with special attention given to threatened and endangered species.

A total of 5,931 organisms, representing 182 taxa were collected during this study (due to size constraints, a complete list is included as an electronic Excel file to be used with this document). Of these macroinvertebrates, 176 taxa were aquatic insects. The most abundant insect order present was Diptera (true flies), with 52 taxa (Figure 1). The most numerous dipteran collected was *Polypedilum flavum*. *Polypedilum flavum* is commonly encountered in streams and rivers under a wide range of habitat and environmental conditions, ranging from non-impaired to heavily degraded (Epler 2001). Trichoptera (caddisflies) was the next most abundant insect order, with 41 taxa collected (Figure 1). *Cheumatopsyche* sp. was the most abundant caddisfly taxon collected. *Cheumatopsyche* sp. were often present in large numbers. *Cheumatopsyche* sp. larvae occur in waters that are too polluted for other caddisflies (Ross 1944). The capture net of *Cheumatopsyche* sp. is more voluminous and fragile than that of most Hydropsychidae species, and is more suited for lower current velocity (Fremling 1960). Thirty-four Ephemeroptera (mayflies) taxa were sampled during this study (Figure 1). *Baetis intercalaris* was the most abundant mayfly collected. This mayfly species is typically found in streams with swift water, and size of the stream does not affect their presence (Berner and Pescador 1988). The insect order Coleoptera (beetles) was represented by 22 taxa (Figure 1), with *Stenelmis* sp. being the most abundant taxon present. Plecoptera (stoneflies) was represented by 12 taxa (Figure 1) and *Leuctra* sp. were the most abundant representatives within

this order. *Leuctra* sp. were dominant within low order stream insect communities. *Leuctra* sp. commonly occur in small streams, rivers, and spring-fed brooks (Brigham et al. 1982). *Leuctra* sp. are classified as shredders, and analysis of their lacina suggest detritivorous-herbivorous food habits (Stewart and Stark 1988, Merritt and Cummins 1996), which may explain their abundance at low order sites. Odonata (dragonflies and damselflies) was represented by 10 taxa (Figure 1). The most common Odonata taxon was *Lanthus vernalis*. These dragonfly nymphs burrow within sand among rocky substrate streams (Needham and Westfall 1955). Other insect orders sampled included: Hemiptera (2 taxa); Lepidoptera (1 taxon); and Megaloptera (2 taxa) (Figure 1).

Forty-five taxa were collected from six first order sites (Table 7). First order sample sites were dominated by Diptera taxa, with 12 taxa present (Table 7, Figure 2). The dominant Diptera taxon was *Psectrocladius* sp. This Chironomidae larvae is considered as pollution sensitive (Simpson and Bode 1980). Ten Trichoptera taxa were collected from first order sites and *Cheumatopsyche* sp. was most abundant (Table 7, Figure 2). Plecoptera and Ephemeroptera were each represented by six taxa (Table 7, Figure 2). Ephemeroptera was dominated by *Baetis intercalaris* and Plecoptera was dominated by *Leuctra* sp. (Table 7); however, *Amphinemura wui* were also abundant within Plecoptera (Table 7). *Amphinemura wui* are small nymphs that are abundant in pre-emergent sizes during summer months, which could explain their abundance within samples collected during summer 2008 and 2009 (Stewart and Stark 1988). Only two Odonate taxa were collected from first order sites (Table 7, Figure 2); *Boyeria vinosa* and *Neurocordulia yamaskanensis* (Table 7). *Boyeria vinosa* nymphs occur almost exclusively in streams and are often found under stones, sunken wood, or other submerged material (Needham and Westfall 1955, Brigham et al. 1982). *Neurocordulia yamaskanensis* is a stocky nymph that clings to rocks and large woody debris (Needham and Westfall 1955).

A total of 478 individuals, representing 47 taxa were collected from second order streams during the study (Table 8). Diptera and Ephemeroptera were the two most abundant orders represented; each order consisted of 12 taxa (Table 8, Figure 3). *Psectrocladius* sp. was the dominant dipteran, while *Serratella deficiens* was the dominant mayfly taxon (Table 8). *Serratella deficiens* is a clinger and is typically found associated with rocks, large woody debris, and vegetation (Berner and Pescador 1988). The order Trichoptera was represented by eight taxa, with *Cheumatopsyche* as the dominant caddisfly taxon; however only 10 *Cheumatopsyche* were collected from second order streams (Table 8, Figure 3). Six Plecoptera taxa were collected from second order sites, and *Leuctra* sp. were dominant; however, *Isoperla bilineata* were common in second order samples (Table 8, Figure 3). One Odonata taxon, *Lanthus vernalis*, was collected from second order sites (Table 8, Figure 3). Only two individuals of this species were collected (Table 8).

Third order stream samples contained 867 individuals representing 79 taxa. Dipterans were again the most common insects collected, with 24 taxa represented (Table 9, Figure 4). *Polypedilum flavum* was the dominant dipteran taxon (Table 9). Nineteen Ephemeroptera taxa were collected, and *Procladius* sp. was the dominant taxon (Table 8, Figure 4). *Procladius* sp. is assigned to gatherer and scraper functional feeding groups and is a clinger (Merritt and Cummins 1996). The river continuum concept explains the longitudinal shift from taxa that use allochthonous food sources in headwater streams to taxa that rely on autochthonous food sources further downstream (Vannote et al. 1980). Therefore, taxa which feed on CPOM are expected among the dominant taxa in stream orders one through three. As the stream order increases, taxa that rely on FPOM are expected to become more prevalent (Vannote et al. 1980). Gathers process CPOM into FPOM, possibly explaining the abundance of *Procladius* sp. at third order

sites. Eleven Trichoptera taxa were collected from third order sites (Table 9, Figure 4). *Cheumatopsyche* sp. was again the dominant trichopteran taxon (Table 9). Ten Coleoptera taxa were collected from third order sites, with *Optioservus* sp. as the most abundant beetle taxon (Table 9, Figure 4). *Optioservus* sp. is a member of the family Elmidae. Adult and larval Elmidae are truly aquatic and are typically collected in swifter portions of streams and rivers (Brigham et al. 1982). Adult Elmidae are limited to oxygen-rich environments because of their respiratory morphology (Merritt and Cummins 1996). The order Plecoptera was represented by nine taxa (Table 9, Figure 4). *Leuctra* sp. was again the dominant taxon; however, *Acroneuria carolinensis*, *Perlesta placida*, and *Isoperla bilineata* were common within third order samples (Table 9). *Acroneuria carolinensis* and *Perlesta placida* have been described as predators, while *Isoperla bilineata* is typically omnivorous (Stewart and Stark 1988). The large number of taxa present and the habitat of these third order sites would easily support these stonefly populations. Four Odonata taxa were collected within third order sites, with *Lanthus vernalis* being the dominant species collected (Table 9, Figure 4). Two Megaloptera (hellgrammite) species were collected from third order sites (Table 9, Figure 4). *Nigronia serricornis* was the dominant Megaloptera taxon (Table 9). *Nigronia serricornis* is a predaceous species of Megaloptera in the family Corydalidae that feeds upon a variety of aquatic macroinvertebrates (Merritt and Cummins 1996). This species prefers medium to large woodland streams with a substrate of large slab rocks and numerous small stones (Neunzig 1966).

Fourth order stream sites were most commonly sampled during this study. A total of 2073 individuals, representing 119 taxa, was collected from fourth order sites (Table 10). Diptera was again the dominant order collected, with 32 representative taxa (Table 10, Figure 5). *Polypedilum flavum* was again the dominant dipteran species present (Table 10). Trichoptera

was the next most abundant order, with 25 taxa collected (Table 10, Figure 5). *Cheumatopsyche* sp. was again the most common taxon within this insect order. Coleoptera was represented by 20 taxa, and the Elmidae species *Stenelmis* sp. and *Macronychus glabratus* were dominant within this order (Table 10, Figure 5). Ephemeroptera was represented by 19 taxa (Table 10, Figure 5). *Isonychia* sp. and *Maccaffertium vicarium* were the dominant Ephemeroptera taxa (Table 10). *Isonychia* is commonly collected in abundance within eastern North America (Berner and Pescador 1988). *Maccaffertium vicarium* were present throughout the study area, and are considered clingers. The abundance of coarse substrate among sample sites explains their abundance. Odonata was represented by 10 taxa in fourth order streams (Table 10, Figure 5). All Odonate taxa identified during this study were represented in fourth order samples. The most common Odonate taxon was *Lanthus vernalis* (Table 10). Six Plecoptera taxa were identified from fourth order stream samples (Table 10, Figure 5). *Acroneuria carolinensis* and *Perlesta placida* were the most common stonefly species present in fourth order samples (Table 10).

Fifth order stream samples contained 1020 individuals, representing 103 taxa (Table 11). Trichoptera contained 24 taxa, with *Cheumatopsyche* sp. being the most abundant taxon (Table 11, Figure 6). Diptera was represented by 23 taxa, and *Polypedilum flavum* was by far the most numerous species within this order (Table 11, Figure 6). Twenty-two Ephemeroptera taxa were collected from fifth order sites (Table 11, Figure 6). *Baetis intercalaris* was the most abundant mayfly taxon (Table 11). Coleoptera was represented by 15 taxa, with members of the family Elmidae well represented in fifth order samples (Table 11, Figure 6). *Stenelmis bicarinata* was the most common Elmidae present (Table 11). Plecoptera was represented by seven taxa, with *Perlesta placida* the most abundant species (Table 11, Figure 6). Six taxa were found within the

order Odonata, and *Lanthus vernalis* was again the most abundant Odonate species (Table 11, Figure 6).

Four sixth order streams were sampled during this research. A total of 597 individuals representing 56 taxa were collected from these sites (Table 12, Figure 7). Ephemeroptera and Trichoptera each was represented by 13 taxa (Table 12, Figure 7). *Maccaffertium modestum* was the most numerous mayfly species, while *Chimarra* sp. was the most abundant caddisfly taxon (Table 12). *Chimarra* sp. is abundant in moderate currents within running waters, where they feed on small organic material carried in the currents (Wiggins 2004). Twelve taxa were identified from the order Coleoptera, with Elmidae well-represented and *Stenelmis* sp. being most abundant (Table 12, Figure 7). The order Diptera included nine taxa, and *Rheotanytarsus exiguus* was the dominant dipteran species (Table 12, Figure 7). *Rheotanytarsus exiguus* is the most common member of the *R. exiguus* species group (Epler 2001). *Rheotanytarsus exiguus* larvae are common in rivers and streams and construct tubes that are attached to substrate, aquatic plants, and even large insects such as Megaloptera or Odonata (Epler 2001). The coarse substrate found at many sixth order sites provided a suitable surface for attachment of larval tubes, perhaps explaining why *Rheotanytarsus exiguus* was encountered with such frequency. Plecoptera was represented by only six taxa (Table 12, Figure 7). *Neoperla* sp. was the dominant Plecoptera taxon in sixth order sites (Table 12). *Neoperla* sp. nymphs are predators that feed on a variety of benthic organisms and their eggs, but avoid large prey species (Vaught and Stewart 1974). *Neoperla* sp. were collected from fourth, fifth, and sixth order sample sites, but were absent from third order sites. The presence of these predaceous species is consistent with the river continuum concept (Vannote et al. 1980). Only one Odonate taxon, *Argia* sp., was collected from sixth order sites. *Argia* sp. is often found in streams with sediment and detritus

deposits (Merritt et al. 2008). The sixth order sites provided more of this habitat than did the lower order sites.

Taxa richness (TR) fluctuated among seasonal sites (Appendix 2). Obed River at Daddys Junction had the highest TR value with 38 taxa present during summer 2005, while Oakdale had the lowest TR with 15 taxa collected during fall 2004. Emory River sub-watershed values ranged from 33 taxa at Deermont during winter 2005 to 15 taxa during fall 2004 at Oakdale. Clear Creek sub-watershed maximum (TR = 33) and minimum (TR = 20) values were observed at Jett Bridge during spring 2005 and fall 2004, respectively. Daddys Creek sub-watershed values varied from 35 taxa at D.B.T during winter 2005 to 22 taxa during fall 2004 at Daddys Creek at Obed River Junction. Obed River at Daddys Junction values ranged from 28 taxa during fall 2004 and spring 2005 to 38 taxa during summer 2005.

EPT richness (EPT) ranged from 19 taxa at D.B.T. during spring 2005 to 8 taxa encountered during fall 2004 at Jett Bridge (Appendix 2). Emory River sub-watershed values ranged from a high (EPT = 15) at both Oakdale and Nemo during spring 2005 to a low (EPT = 9) at Nemo during winter 2005. Maximum (EPT = 17) and minimum (EPT = 8) values were found at Jett Bridge during spring 2005 and fall 2004. Daddys Creek sub-watershed EPT values ranged from 19 taxa at D.B.T. during spring 2005 to 10 taxa at Obed Junction during fall 2004. Obed River at Daddys Junction values varied from 18 taxa during summer 2005 to 15 taxa during fall 2004.

Percent EPT (% EPT) values among seasonal sites ranged from a high (% EPT = 91.75%) at Lilly Bridge during spring 2005 to a low (% EPT = 14.22%) at Deermont during fall 2004 (Appendix 2). Emory River sub-watershed highest (% EPT = 89.11%) and lowest (% EPT = 14.22%) values were found during fall 2004 at Oakdale and Deermont, respectively. Clear

Creek sub-watershed % EPT values ranged from 91.75% at Lilly Bridge during spring 2005 to 22.42% during fall 2004 at Jett Bridge. Daddys Creek sub-watershed values varied from 75.94% at D.B.T. during winter 2005 to 33.30% at Obed Junction during fall 2004. Obed River at Daddys Creek Junction values ranged from 75.69% during winter 2005 to 59.09% during summer 2005.

Oligochaetes and chironomids were not abundant at seasonal sites; therefore, percent oligochaete/chironomid (% OC) values were low (Appendix 2). Values ranged from 18.26% during spring 2005 at Oakdale to 0% at Jett Bridge (fall 2004 and winter 2005) and Deermont during fall 2004. The highest value (% OC = 8.84%) observed among Clear Creek sub-watershed sites was during winter 2005 at Lilly Bridge. Maximum (% OC = 6.14%) and minimum (% OC = 1.83%) values for Daddys Creek sub-watershed were collected both at D.B.T. during summer 2005 and fall 2004, respectively. Obed River at Daddys Junction values ranged from 8.72% during winter 2005 to 1.83% during fall 2004.

Seasonal NCBI scores were low, indicating that macroinvertebrates reflected good water quality (Appendix 2). Site scores varied from 4.20 at Oakdale during spring 2005 to 2.73 at Jett Bridge during winter 2005. Emory River sub-watershed scores ranged from 4.20 at Oakdale during spring 2005 to 3.40 at Deermont during spring 2005. Clear Creek sub-watershed NCBI scores varied from 3.61 during summer 2005 at Lilly Bridge to 2.73 at Jett Bridge during winter 2005. Daddys Creek sub-watershed scores ranged from 3.89 during summer 2005 at D.B.T. to 2.97 at Obed Junction during winter 2005. Seasonal benthic communities within the Obed River at Daddys Junction site scored the highest value (NCBI = 3.69) during summer 2005, and the lowest (NCBI = 3.23) during fall 2004.

No benthic organisms were found to be excessively dominant in any samples (Appendix 2). Low percentages of dominant organisms were indicative of diverse and healthy benthic macroinvertebrate communities. The percentage of dominant organisms (% Dominant) ranged from 44.55% at Oakdale during fall 2004 to 10.00% at D.B.T during spring 2005. The lowest value (% Dominant = 11.00%) among Emory River sub-watershed sites was collected during spring 2005 at Nemo. Clear Creek sub-watershed values ranged from 33.95% at Lilly Bridge during winter 2005 to 12.88% at Jett Bridge during spring 2005. The maximum value (% Dominant = 32.55%) among Daddys Creek sub-watershed sites was collected at D.B.T during winter 2005. Obed River at Daddys Junction values ranged from 23.39% during winter 2005 to 13.74% during spring 2005. Low % Dominant values positively influenced TR since no one taxon was overly dominant and a diversity of niches could be occupied.

Clinger organisms (% Clingers) were abundant in seasonal samples (Appendix 2). High percentages of clingers were indicative of healthy benthic communities. The highest value (% Clingers = 94.20%) was obtained during fall 2004 at Jett Bridge, while the lowest (% Clingers = 34.16%) was found during fall 2004 at Oakdale. The highest value (% Clingers = 93.12%) among Emory River sub-watershed sites was found during fall 2004 at Deermont. The lowest value (% Clingers = 45.12%) among Clear Creek sub-watershed sites was observed during winter 2005 at Lilly Bridge. Daddys Creek sub-watershed values ranged from 91.04% at Obed Junction during winter 2005 to 62.56% at the same location during spring 2005. Obed River at Daddys Junction maximum (% Clingers = 90.37%) and minimum (% Clingers = 79.82%) values were collected during winter 2005 and summer 2005, respectively.

Biotic scores varied among seasonal sites; however, highest scores were found during spring 2005, and mean scores for all seasons indicated non-impairment (Appendix 2). All winter

2005, spring 2005, and summer 2005 benthic macroinvertebrate communities had biotic index scores indicative of a non-impaired condition (≥ 32), regardless of sub-watershed. Two fall 2004 samples (Jett Bridge and Deermont) had biotic index scores indicative of slight- impairment. However, winter 2005, spring 2005, and summer 2005 biotic index scores for these sites improved due to increased EPT species.

Results and discussion of biological condition and longitudinal variation of macroinvertebrate communities within third through sixth order streams can be found in the thesis attached as Appendix 1. To our knowledge, no rare or endangered aquatic insect taxa were collected during this study. However, within the Ephemeroptera, *Ephemerella needhami* (Site L, Third Order), *Leucrocta juno* (Site AI, Sixth Order), *Leucrocota thetis* (Site AI, Sixth Order), *Maccaffertium mediopunctatum* (Site AF, Fifth Order), and *Serratella serrata* (Site AF, Fifth Order), were only collected once during the study. All of these are typically found in erosion and deposition habitats within streams (Merritt et al. 2008). Since riffles were the primary habitat unit sampled during this study, deposition habitats were rarely encountered unless higher order streams (i.e., third through sixth order) were sampled. Within the Plecoptera, *Agnetina flavescens* (Site AE, Fifth Order) and *Peltoperla arcuata* (Site N, Third Order) were only collected once. Again, these species tend to inhabit erosional or depositional habitats (Merritt et al. 2008). Uncommon Trichoptera included 11 taxa. *Brachycentrus numerosus* (Site AD, Fifth Order), *Brachycentrus spinae* (Site AA, Fourth Order), *Ceraclea* sp. (Site AA, Fourth Order), *Ceratopsyche cheilonis* (Site Y, Fourth Order), *Ceratopsyche macleodi* (Site AE, Fifth Order), *Heteroplectron americanum* (Site L, Third Order), *Ironoquia punctatissima* (Site B, First Order), *Lype diversa* (Site AB, Fourth Order), *Neotrichia* sp. (Site G, Second Order), *Oecetis nocturna* (Site AH, Sixth Order), and *Pycnopsyche* sp. (Site AF, Fifth Order) were only

represented by one individual in the samples. With the exception of *Ironoquia punctatissima* and *Neotrichia* sp., all of these caddisflies were collected from higher order streams. *Ironoquia* typically inhabits temporary pools and streams (Wiggins 1998). Due to the drought conditions of 2007-2008, first order streams would have provided such habitats. *Neotrichia* sp. inhabit rocky streams with swift water (Wiggins 1998). Although they are often found in larger rivers with this habitat, the second order site had a substrate composed of rock. Three Odonate taxa were only represented by one individual; *Gomphus quadricolor* (Site Z, Fourth Order), *Hylogomphus brevis* (Site Z, Fourth Order), and *Somatochlora linearis* (Site W, Fourth Order). All uncommon odonates were collected from fourth order sites, and they tend to inhabit depositional habitats (Merritt et al. 2008) that would be common at such sites. While seasonal variation might account for all of these uncommon taxa, it could also be that they are rare within the Obed Wild and Scenic River.

Objective 2: To create a Global Information Systems (GIS) database with which to record locations and species of aquatic insects.

An electronic Excel file was created containing species lists by sample site. GPS coordinates are provided and a meeting will be held with the GIS coordinator in early 2010 at Obed Wild and Scenic River to make sure that the format is compatible with the current GIS program being used. This file is too large to print and include in this report.

Objective 3: To prepare a final report (MS Word format) detailing survey findings, seasonal variation in aquatic insect communities, and photographs/illustrations of each species.

This document will serve as the final report for the project. Photographs are included as an electronic file. Many of the photos are copyrighted since they were obtained from the

internet, therefore reproduction will require permission. We have limited quality abilities to take pictures of these insects, and once preserved and identified, they often are not in the best shape for photo-documentation.

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TABLES

Table 1. Sampling locations in first order streams, Obed Wild and Scenic River, 2007-2009.

CODE	LOCATION		LATITUDE	LONGITUDE
A	Buck Crk @ Firetower Rd.		N 36° 01' 43.5"	W 84° 45' 16.8"
B	Otter Cr. @ Firetower Rd.		N 36° 3' 16.2"	W 84° 51' 20.9"
C	Obed Canoe Hole Trib		N 36° 6' 28.5"	W 84° 41' 55.8"
D	Obed Trib @ Potters Ford		N 36° 4' 21.9"	W 84° 54' 9.5"
E	Trib @ Deermont		N 36° 01' 36.7"	W 84° 34' 39.0"
F	Trib to Buck Creek		N 36° 2' 21.8"	W 84° 45' 44.6"

Table 2. Sampling locations in second order streams, Obed Wild and Scenic River, 2007-2009.

CODE	LOCATION		LATITUDE	LONGITUDE
G	Trib @ Deermont		N 36° 01' 52.6"	W84° 34' 10.1"
H	Emory Top		N 36° 10' 33.04"	W 84° 28' 54.75"
I	Obed Canoe Hole Trib		N 36° 5' 56.7"	W 84° 41' 27.5"
J	Buck Creek		N 36° 1' 52.8"	W 84° 46' 26.2"
K	Mill Creek @ Camp Austin Rd		N 36° 01' 33.8"	W 84° 35' 20.0"

Table 3. Sampling locations in third order streams, Obed Wild and Scenic River, 2007-2009.

CODE	LOCATION		LATITUDE	LONGITUDE
L	Myatt Crk		N 36° 7' 48.12"	W 84° 58' 52.99"
M	Cook Crk		N 36° 10' 44.21"	W 84° 48' 04.25"
N	Greasy Crk		N 36° 9' 40.58"	W 84° 35' 06.47"
O	Yellow Crk		N 36° 00' 7.10"	W 84° 47' 3.90"
P	Yellow Crk. @ Hebbertsburg Rd.		N 36° 1' 5.50"	W 84° 47' 40.20"
Q	Island Creek @ Catoosa Rd		N 36° 3' 10.26"	W 84° 40' 00.78"

Table 4. Sampling locations in fourth order streams, Obed Wild and Scenic River, 2007-2009.

CODE	LOCATION		LATITUDE	LONGITUDE
R	Obed @Adams Br.		N 36° 3' 49.09"	W 84° 57' 0.06"
S	Emory @ 27		N 36° 7' 28.66"	W 84° 36' 24.70"
T	Obed @ Potters Ford		N 36° 4' 20.9"	W 84° 54' 10.59"
U	Clear Crk @ Norris Ford		N 36° 8' 13.69"	W 84° 52' 20.88"
V	White Crk. @ Lavender Br.		N 36° 9' 27.00"	W 84° 47' 26.10"
W	White Crk @ Twin Br. Rd.		N 36° 10' 43.71"	W 84° 47' 58.45"
X	White Crk Mouth		N 36° 7' 23.13"	W 84° 47' 39.28"
Y	Daddys Crk. @ DBT		N 36° 3' 33.56"	W 84° 47' 31.56"
Z	Daddys Creek @ Antioch Br.		N 35° 59' 54.10"	W 84° 49' 23.80"
AA	Daddys Crk. @ Obed Jct.		N 36° 4' 44.40"	W 84° 45' 55.80"
AB	Rock Creek @ Hwy 62		N 36° 8' 03.50"	W 84° 37' 30.40"

Table 5. Sampling locations in fifth order streams, Obed Wild and Scenic River, 2007-2009.

CODE	LOCATION		LATITUDE	LONGITUDE
AC	Emory R. @ Montgomery Rd.		N 36° 6' 47.10''	W 84° 36' 53.30''
AD	Obed @ Obed Jct.		N 36° 4' 41.94''	W 84° 45' 39.98''
AE	Clear Crk @ Lilly Br.		N 36° 6' 2.35''	W 84° 42' 59.56''
AF	Clear Crk. @ Jett Br.		N 36° 7' 21.95''	W 84° 44' 44.69''
AG	Clear Crk. @ Barnett Br.		N 36° 7' 23.13''	W 84° 47' 39.28''

Table 6. Sampling locations in sixth order streams, Obed Wild and Scenic River, 2007-2009.

CODE	LOCATION		LATITUDE	LONGITUDE
AH	Emory R. @ Nemo		N 36° 4' 12.92''	W 84° 39' 40.47''
AI	Obed @ Canoe Hole		N 36° 5' 41.46''	W 84° 41' 36.52''
AJ	Obed @ Alley Ford		N 36° 4' 49.05''	W 84° 41' 36.52''

Table 7. Species list from first order locations, Obed Wild and Scenic River, 2007-2009.

	Location Code	A	B	C	D	E	F
Order	Species						
Coleoptera	<i>Optioservus ovalis</i>				3		
	<i>Optioservus sp.</i>		5				1
	<i>Psephenus herricki</i>					1	
	<i>Stenelmis crenata</i>					5	
Decapoda	<i>Cambarus sp.</i>			1			3
	<i>Orconectes sp.</i>					6	
	<i>Ablabesmyia mallochi</i>						
Diptera	<i>Ablabesmyia sp.</i>					2	
	<i>Antocha sp.</i>					1	
	<i>Atherix lantha</i>				1	1	
	<i>Corynoneura sp.</i>	1		2	2		
	<i>Eukiefferiella discoloripes</i>	2				11	
	<i>Heterotrisocladius sp.</i>			1			
	<i>Hexatoma sp.</i>	1		1	3		1
	<i>Polypedilum flavum</i>					1	
	<i>Psectrocladius sp.</i>	3	1	3	14	8	
	<i>Rheotanytarsus exiguus</i>		2				
	<i>Simulium sp.</i>	1	1			6	1
	<i>Tipula sp.</i>		9			1	1
Ephemeroptera	<i>Baetis intercalaris</i>	6	11	5	4	2	21
	<i>Heterocloeon curiosum</i>		1		2	2	
	<i>Isonychia sp.</i>		1			1	
	<i>Paraleptophlebia sp.</i>				1	3	
	<i>Serratella deficiens</i>				15		
	<i>Stenonema femoratum</i>					34	
	<i>Lirceus sp.</i>	1		1	12		
	<i>Lumbriculus variegatus</i>					1	3
	<i>Nigronia serricornis</i>	2				8	
Odonata	<i>Boyeria vinosa</i>					1	
	<i>Neurocordulia yamaskanensis</i>						1
Plecoptera	<i>Acroneuria abnormis</i>					1	
	<i>Amphinemura wui</i>	30	6	2	147		
	<i>Isoperla bilineata</i>	21	29		8		4
	<i>Isoperla sp.</i>			7			7
	<i>Leuctra sp.</i>	155	31	13	84	3	8
	<i>Perlesta placida</i>					3	
Trichoptera	<i>Cheumatopsyche sp.</i>					34	
	<i>Chimarra sp.</i>					8	
	<i>Dolophilodes distinctus</i>	1			7		
	<i>Hydropsyche venularis</i>					10	
	<i>Ironoquia punctatissima</i>		1				

	<i>Micrasema sp.</i>						3
	<i>Neureclipsis crepuscularis</i>	3					
	<i>Ptilostomis ocellifera</i>						2
	<i>Rhyacophila carolina</i>	6	8				
	<i>Rhyacophila vuphipes</i>			2	6		

Table 8. Species list from second order locations, Obed Wild and Scenic River, 2007-2009.

	Location Code	G	H	I	J	K
Order	Species	Number	Number	Number	Number	Number
Coleoptera	<i>Optioservus sp.</i>	3				1
	<i>Psephenus herricki</i>	1	3			1
	<i>Stenelmis crenata</i>					1
	<i>Cambarus sp.</i>					
Decapoda	<i>Orconectes sp.</i>	1				1
Diptera	<i>Ablabesmyia mallochi</i>			1		
	<i>Antocha sp.</i>				2	
	<i>Atherix lantha</i>					1
	<i>Cladotanytarsus sp.</i>	1				
	<i>Conchapelopia sp.</i>	1			1	
	<i>Corynoneura sp.</i>			1		
	<i>Eukiefferiella discoloripes</i>			1		
	<i>Hexatoma sp.</i>			2		
	<i>Orthocladius sp.</i>				1	
	<i>Psectrocladius sp.</i>			12	6	
	<i>Simulium sp.</i>				1	
	<i>Tipula sp.</i>				1	
Ephemeroptera	<i>Baetis intercalaris</i>	6	12	3	16	
	<i>Epeorus dispar</i>				8	
	<i>Ephemerella catawba</i>		13			
	<i>Ephemerella dorothea</i>		2			
	<i>Eurylophella sp.</i>				1	
	<i>Heterocloeon curiosum</i>				15	
	<i>Maccaffertium pudicum</i>		4			
	<i>Paraleptophlebia sp.</i>	5			1	
	<i>Proclaeon sp.</i>		1			
	<i>Serratella deficiens</i>				109	
	<i>Stenacron pallidum</i>	1	2			
	<i>Stenonema femoratum</i>	13	5			2
Hemiptera	<i>Microvelia sp.</i>	4				
Isopoda	<i>Lirceus sp.</i>			2		
Lumbriculida	<i>Lumbriculus variegatus</i>					2
Megaloptera	<i>Nigronia serricornis</i>		3			3
Odonata	<i>Lanthus vernalis</i>					2
Plecoptera	<i>Acroneuria abnormis</i>	5				
	<i>Agnetina annulipes</i>		9			
	<i>Amphinemura wui</i>			4	10	
	<i>Isoperla bilineata</i>			1	38	
	<i>Leuctra sp.</i>	8		59	23	2
	<i>Perlesta placida</i>	15				1

Trichoptera	<i>Ceratopsyche sparna</i>		6			
	<i>Cheumatopsyche sp.</i>	10				
	<i>Hydropsyche venularis</i>	1				
	<i>Micrasema rusticum</i>				2	
	<i>Neotrichia sp.</i>	1				
	<i>Oecetis inconspicua</i>				1	
	<i>Rhyacophila carolina</i>		2			
	<i>Rhyacophila vuphipes</i>				1	

Table 9. Species list from third order locations, Obed Wild and Scenic River, 2007-2009.

	Location Code	L	M	N	O	P	Q
Order	Species	Number	Number	Number	Number	Number	Number
Coleoptera	<i>Dubiraphia vittata</i>						1
	<i>Gonielmis dietrichi</i>					1	
	<i>Helichus fastigiatus</i>	2	1				2
	<i>Limnius latiscularis</i>		1				
	<i>Optioservus ovalis</i>	1					3
	<i>Optioservus sp.</i>		21	3	1		14
	<i>Promoresia elegans</i>	7				1	2
	<i>Psephenus herricki</i>			9	4		4
	<i>Stenelmis bicarinata</i>	3					
	<i>Stenelmis sp.</i>						1
Diptera	<i>Apsectrotanypus sp.</i>						1
	<i>Atherix lantha</i>	1				1	6
	<i>Bezzia sp.</i>						1
	<i>Cladotanytarsus sp.</i>					1	
	<i>Conchapelopia sp.</i>				6	8	1
	<i>Corynoneura sp.</i>					2	
	<i>Cricotopus sylvestris</i>				1		
	<i>Eukiefferiella claripennis</i>					4	
	<i>Eukiefferiella sp.</i>					1	
	<i>Hexatoma sp.</i>						5
	<i>Microtendipes caelum</i>				4	2	
	<i>Orthocladius obumbratus</i>				1		
	<i>Parametriocnemus sp.</i>						6
	<i>Paratanytarsus sp.</i>				1		
	<i>Paratendipes sp.</i>					1	
	<i>Polypedilum flavum</i>					14	10
	<i>Pseudochironomus sp.</i>					1	
	<i>Psilometriocnemus triannulatus</i>						4
	<i>Rheocricotopus robacki</i>					1	4
	<i>Rheotanytarsus exiguus</i>				1	16	1
	<i>Simulium sp.</i>					4	
	<i>Tanytarsus guerlus</i>				9		
	<i>Tanytarsus sp.</i>					2	3
	<i>Zavrelia sp.</i>				1	5	
Ephemeroptera	<i>Baetis intercalaris</i>	1	11	5	10	2	
	<i>Caenis sp.</i>						1
	<i>Drunella cornutella</i>					6	
	<i>Ephemera sp.</i>				1		
	<i>Ephemerella catawba</i>			1			
	<i>Ephemerella dorothea</i>	14	1	2		1	

	<i>Ephemerella needhami</i>	1					
	<i>Eurylophella sp.</i>						3
	<i>Heptagenia sp.</i>					1	
	<i>Heterocloeon curiosum</i>		3				
	<i>Isonychia sp.</i>					3	1
	<i>Maccaffertium ithaca</i>		15	10			
	<i>Maccaffertium modestum</i>		8	7		2	
	<i>Maccaffertium pudicum</i>	4				1	
	<i>Maccaffertium terminatum</i>					3	
	<i>Maccaffertium vicarium</i>			3		2	
	<i>Procloeon sp.</i>				31	20	1
	<i>Stenacron pallidum</i>	2	1	1		4	
	<i>Timpanago sp.</i>					2	
Megaloptera	<i>Corydalus cornutus</i>			2			4
	<i>Nigronia serricornis</i>	2	1	12	1	2	3
Odonata	<i>Argia sp.</i>						3
	<i>Boyeria vinosa</i>	1	1		4	2	2
	<i>Lanthus vernalis</i>				2		26
	<i>Stylogomphus albistylus</i>			1			
Plecoptera	<i>Acroneuria abnormis</i>		1	7	1	2	1
	<i>Acroneuria carolinensis</i>			2	6	4	44
	<i>Amphinemura wui</i>					1	
	<i>Isoperla bilineata</i>	26	7				
	<i>Isoperla sp.</i>			2			
	<i>Leuctra sp.</i>				55	10	3
	<i>Paragnetina immarginata</i>				13	7	
	<i>Peltoperla arcuata</i>			1			
	<i>Perlesta placida</i>	40	5				
Trichoptera	<i>Ceratopsyche sparna</i>	1		6		1	
	<i>Ceratopsyche ventura</i>	1					
	<i>Ceratopsyche sp.</i>				2		
	<i>Cheumatopsyche sp.</i>				21	38	42
	<i>Chimarra sp.</i>				1	5	13
	<i>Dolophilodes distinctus</i>					17	
	<i>Helicopsyche borealis</i>		3				
	<i>Heteroplectron americanum</i>	1					
	<i>Hydropsyche betteni</i>				1	2	2
	<i>Polycentropus sp.</i>				2	3	
	<i>Rhyacophila carolina</i>	1					

Table 10. Species list from fourth order locations, Obed Wild and Scenic River, 2007-2009.

	Location Code	R	S	T	U	V	W	X	Y	Z	AA	AB
Order	Species	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number
Coleoptera	<i>Anchytarsus bicolor</i>						1					
	<i>Ancyronyx variegatus</i>					3	2				2	1
	<i>Dineutus sp.</i>											1
	<i>Dubiraphia vittata</i>										2	
	<i>Ectopria sp.</i>							1		1	2	
	<i>Gonielmis dietrichi</i>					1			1		13	
	<i>Helichus fastigiatus</i>				2	3	2	10				1
	<i>Macronychus glabratus</i>				1	7		1	3	51		3
	<i>Microcyллоepus pusillus</i>			1				4	10		8	5
	<i>Microcyллоepus pusillus aptus</i>										4	
	<i>Microcyллоepus pusillus pusillus</i>				2	1		1	9	2	6	
	<i>Optioservus ovalis</i>			2	4		4		1			
	<i>Optioservus sp.</i>	19		14	3	8	5	8	3	2		12
	<i>Promoresia elegans</i>							2	5		12	
	<i>Psephenus herricki</i>	40		12				1	2	2		1
	<i>Stenelmis bicarinata</i>			6	6	1			2		2	
	<i>Stenelmis crenata</i>					1						
	<i>Stenelmis mera</i>	1			3							
	<i>Stenelmis sandersoni</i>				1					2	10	
	<i>Stenelmis sp.</i>	1		18	16	8	1	1	8	4	10	
Diptera	<i>Ablabesmyia mallochi</i>						1	1				
	<i>Ablabesmyia sp.</i>						1					

	<i>Anopheles sp.</i>						1					
	<i>Antocha sp.</i>			1				1			1	
	<i>Atherix lantha</i>				4	2		3		1	1	4
	<i>Bezzia sp.</i>						1					
	<i>Conchapelopia sp.</i>	4			2	11	17	1		2		2
	<i>Corynoneura sp.</i>										1	
	<i>Cricotopus sp.</i>	3		1	2		1	2		1	7	
	<i>Cryptochironomus fulvus</i>											1
	<i>Dasyhelea sp.</i>				1		2	3				
	<i>Dicrotendipes neomodestus</i>											1
	<i>Eukiefferiella sp.</i>	1				5					1	
	<i>Microtendipes caelum</i>	4										
	<i>Microtendipes sp.</i>									1		
	<i>Orthocladius sp.</i>							1			1	
	<i>Parametriocnemus sp.</i>						3					
	<i>Polypedilum flavum</i>	12		3	4	26	33	31	14	1	1	14
	<i>Polypedilum illinoense</i>	1					1					1
	<i>Polypedilum sp.</i>									1		
	<i>Procladius sublettei</i>											1
	<i>Procladius sp.</i>	1										
	<i>Psectrocladius sp.</i>			2	4			3		7	1	
	<i>Rheocricotopus robacki</i>					1	2	11				6
	<i>Rheotanytarsus exiguus</i>					2	5	2	1	6		11
	<i>Simulium sp.</i>				1	3					1	
	<i>Stictochironomus sp.</i>	4										
	<i>Symbiocladius sp.</i>								1			

	<i>Tanytarsus guerlus</i>											2
	<i>Tanytarsus sp.</i>					1	26					
	<i>Thienemanniella sp.</i>									1	1	
	<i>Tipula sp.</i>	5		2	2		1	1		1		
Ephemeroptera	<i>Acentrella sp.</i>				1				2	2		1
	<i>Baetis intercalaris</i>				1				2	4	16	7
	<i>Caenis sp.</i>									2		
	<i>Ephemera sp.</i>	2					2			1		
	<i>Eurylophella sp.</i>					12		2				1
	<i>Heptagenia sp.</i>			2				1		2	3	2
	<i>Isonychia sp.</i>	6		13	21	3		25		1	6	28
	<i>Labiobaetis propinquus</i>								2			
	<i>Maccaffertium exiguum</i>	3								1		
	<i>Maccaffertium ithaca</i>					1					1	6
	<i>Maccaffertium modestum</i>	1		5	10	6	1	5	3	3	8	5
	<i>Maccaffertium smithae</i>							1				
	<i>Maccaffertium terminatum</i>	9		1	2		1			9		4
	<i>Maccaffertium vicarium</i>	19		2	25		3	25			2	12
	<i>Procloeon sp.</i>											1
	<i>Serratella deficiens</i>			1		3			6	3	4	
	<i>Stenacron carolina</i>							1				
	<i>Stenacron pallidum</i>									3	1	
	<i>Stenonema femoratum</i>	7										
Hemiptera	<i>Microvelia sp.</i>					1		2				
	<i>Rhagovelia obesa</i>									1		
Isopoda	<i>Lirceus sp.</i>								1	1		

Lepidoptera	<i>Petrophila fulicalis</i>									1		
Lumbriculida	<i>Lumbriculus variegatus</i>	1					10		1	1	6	
Megaloptera	<i>Corydalus cornutus</i>				7		12	3	2	7	8	
	<i>Nigronia serricornis</i>				7	18	3	1		1		7
Odonata	<i>Argia sp.</i>	2						7		6		
	<i>Boyeria vinosa</i>					2	1	1		1		
	<i>Gomphus exilis</i>				2							
	<i>Gomphus quadricolor</i>									1		
	<i>Hagenius brevistylus</i>			1		1	2			1		
	<i>Hylogomphus brevis</i>									1		
	<i>Lanthus vernalis</i>	1			5	1	1	4	1	2		6
	<i>Neurocordulia yamaskanensis</i>						4			3		
	<i>Somatochlora linearis</i>						1					
	<i>Stylogomphus albistylus</i>							3		1	1	1
Plecoptera	<i>Acroneuria abnormis</i>	2		17		4			11		3	
	<i>Acroneuria carolinensis</i>	1		2	1	5		5		9	6	8
	<i>Agnetina annulipes</i>	1							2	2		
	<i>Leuctra sp.</i>					1	1					
	<i>Neoperla sp.</i>								4	2	3	
	<i>Perlesta placida</i>		6			2			13	9	6	
Trichoptera	<i>Brachycentrus spinae</i>										1	
	<i>Ceraclea ancylus</i>									1		
	<i>Ceraclea sp.</i>										1	
	<i>Ceratopsyche cheilonis</i>								1			

	<i>Ceratopsyche sparna</i>				1	22	3		25	6	14	1
	<i>Ceratopsyche ventura</i>						2					
	<i>Cheumatopsyche sp.</i>	53		101	12	22	15	20	11	7	18	32
	<i>Chimarra sp.</i>			1	23	6	32	19	13		1	7
	<i>Helicopsyche borealis</i>						4	1				
	<i>Hydatophylax argus</i>	4										
	<i>Hydropsyche betteni</i>						1					
	<i>Hydropsyche demora</i>					3		1	14		3	1
	<i>Hydropsyche hageni</i>								2			1
	<i>Hydropsyche simulans</i>					1			1			
	<i>Hydropsyche venularis</i>				1	3	4		2		5	
	<i>Lype diversa</i>											1
	<i>Micrasema wataga</i>								2			
	<i>Micrasema sp.</i>										7	
	<i>Nectopsyche exquisita</i>						2					
	<i>Neureclipsis crepuscularis</i>				47	1		11				
	<i>Oecetis inconspicua</i>							1				
	<i>Oecetis persimilis</i>										1	
	<i>Oecetis sp.</i>						1				1	
	<i>Polycentropus sp.</i>				2			3				
	<i>Rhyacophila vuphipes</i>									1	1	

Table 11. Species list from fifth order locations, Obed Wild and Scenic River, 2007-2009.

	Location Code	AC	AD	AE	AF	AG
Order	Species	Number	Number	Number	Number	Number
Acarina			2			
Coleoptera	<i>Ancyronyx variegatus</i>				1	
	<i>Dineutus sp.</i>	2				
	<i>Gonielmis dietrichi</i>		1	2	1	
	<i>Helichus fastigiatus</i>	1				
	<i>Macronychus glabratus</i>		1		9	5
	<i>Microcyloepus pusillus</i>		6	1	2	
	<i>Microcyloepus pusillus aptus</i>		2			1
	<i>Microcyloepus pusillus pusillus</i>			1	2	6
	<i>Optioservus ovalis</i>					1
	<i>Optioservus sp.</i>		4		10	3
	<i>Promoresia elegans</i>		4		1	
	<i>Psephenus herricki</i>		1			
	<i>Stenelmis bicarinata</i>		4	12	3	8
	<i>Stenelmis crenata</i>				1	
	<i>Stenelmis sp.</i>		5	6	9	11
Diptera	<i>Ablabesmyia mallochi</i>					3
	<i>Atherix lantha</i>			2		9
	<i>Bezzia sp.</i>	4				
	<i>Cnephia sp.</i>			1		
	<i>Conchapelopia sp.</i>	8			1	8
	<i>Cricotopus sp.</i>					7
	<i>Eukiefferiella discoloripes</i>		5		2	3
	<i>Larsia sp.</i>				1	
	<i>Lopescladius sp.</i>					1
	<i>Nilothauma sp.</i>	1				
	<i>Parametriocnemus sp.</i>	1				
	<i>Paratanytarsus sp.</i>	1				
	<i>Pentaneura sp.</i>				3	
	<i>Polypedilum flavum</i>	155	7		8	2
	<i>Polypedilum illinoense</i>			1		
	<i>Prosimulium sp.</i>		2		1	
	<i>Rheocricotopus robacki</i>	2			1	2
	<i>Rheotanytarsus exiguus</i>	2	4		4	5
	<i>Simulium sp.</i>	1	20	16	2	
	<i>Stictochironomus sp.</i>	1				
	<i>Symbiocladius sp.</i>				2	
	<i>Tanytarsus guerlus</i>				2	

	<i>Xylotopus par</i>	1				
Ephemeroptera	<i>Acentrella sp.</i>		4		5	2
	<i>Baetis intercalaris</i>		35	2	27	3
	<i>Baetis sp.</i>				2	
	<i>Epeorus dispar</i>			4		
	<i>Eurylophella sp.</i>	1				
	<i>Heptagenia sp.</i>				1	1
	<i>Heterocloeon curiosum</i>			17		
	<i>Isonychia sp.</i>	3	3	4	20	12
	<i>Maccaffertium exiguum</i>				2	
	<i>Maccaffertium ithaca</i>					1
	<i>Maccaffertium mediopunctatum</i>				1	
	<i>Maccaffertium modestum</i>	2	2	16		7
	<i>Maccaffertium pudicum</i>	2				
	<i>Maccaffertium smithae</i>					1
	<i>Maccaffertium terminatum</i>				11	
	<i>Maccaffertium vicarium</i>	4		1	16	5
	<i>Procloeon sp.</i>				1	
	<i>Serratella deficiens</i>		10	10	2	6
	<i>Serratella serrata</i>				1	
	<i>Stenacron carolina</i>					1
	<i>Stenacron interpunctatum</i>					1
	<i>Stenacron pallidum</i>				1	1
Lumbriculida	<i>Lumbriculus variegatus</i>		1		2	
Megaloptera	<i>Corydalus cornutus</i>	1		3	3	
	<i>Nigronia serricornis</i>	2			2	
Odonata	<i>Argia sp.</i>				1	
	<i>Boyeria vinosa</i>		1		3	
	<i>Hagenius brevistylus</i>	1				
	<i>Lanthus vernalis</i>	1			1	5
	<i>Neurocordulia yamaskanensis</i>				1	
	<i>Somatochlora linearis</i>					
	<i>Stylogomphus albistylus</i>					1
Plecoptera	<i>Acroneuria abnormis</i>				2	5
	<i>Acroneuria carolinensis</i>			6	1	1
	<i>Agnetina annulipes</i>					1
	<i>Agnetina flavescens</i>			1		
	<i>Neoperla sp.</i>		1	8		
	<i>Paragnetina immarginata</i>			3		

	<i>Perlesta placida</i>		3	5	6	
Rhynchobdellida	<i>Placobdella sp.</i>	1				
Trichoptera	<i>Brachycentrus numerosus</i>		1			
	<i>Ceraclea ancylus</i>			1		
	<i>Ceratopsyche macleodi</i>			1		
	<i>Ceratopsyche sparna</i>		10	11	4	5
	<i>Ceratopsyche ventura</i>			2		
	<i>Cheumatopsyche sp.</i>	34	16	1	5	11
	<i>Chimarra sp.</i>	4	21	12	1	2
	<i>Hydropsyche demora</i>		2	6		
	<i>Hydropsyche hageni</i>			3		
	<i>Hydropsyche simulans</i>		2	5	1	
	<i>Hydropsyche venularis</i>		14	10		
	<i>Lepidostoma sp.</i>		1		1	
	<i>Micrasema rusticum</i>				1	
	<i>Micrasema wataga</i>			30	1	
	<i>Micrasema sp.</i>			11	2	
	<i>Nectopsyche exquisita</i>				1	
	<i>Neureclipsis crepuscularis</i>				1	8
	<i>Oecetis inconspicua</i>				1	
	<i>Oecetis persimilis</i>		1		3	
	<i>Oecetis sp.</i>			2		
	<i>Polycentropus sp.</i>					5
	<i>Pycnopsyche antica</i>				6	
	<i>Pycnopsyche sp.</i>				1	
	<i>Rhyacophila vuphipes</i>		3	1		

Table 12. Species list from sixth order locations, Obed Wild and Scenic River, 2007-2009.

	Location Code	AH	AI	AJ
Order	Species	Number	Number	Number
Coleoptera	<i>Ectopria sp.</i>	1	1	
	<i>Gonielmis dietrichi</i>	1		
	<i>Helichus basalis</i>		1	
	<i>Helichus fastigiatus</i>		2	
	<i>Microcylloepus pusillus</i>	3	3	10
	<i>Microcylloepus pusillus pusillus</i>		13	9
	<i>Optioservus sp.</i>		1	
	<i>Promoresia elegans</i>	3	1	2
	<i>Psephenus herricki</i>		16	
	<i>Stenelmis bicarinata</i>	5	3	
	<i>Stenelmis sandersoni</i>	6	18	
	<i>Stenelmis sp.</i>	40	30	3
Diptera	<i>Atherix lantha</i>	1		
	<i>Conchapelopia sp.</i>	5		
	<i>Corynoneura sp.</i>	1		
	<i>Dasyhelea sp.</i>			1
	<i>Eukiefferiella sp.</i>	2		1
	<i>Polypedilum flavum</i>	1	2	4
	<i>Rheotanytarsus exiguus</i>	9		6
	<i>Simulium sp.</i>	2	2	1
	<i>Symbiocladius sp.</i>	8		
Ephemeroptera	<i>Acentrella sp.</i>	9		1
	<i>Baetis intercalaris</i>	16	16	2
	<i>Eurylophella sp.</i>		2	
	<i>Heptagenia sp.</i>		7	
	<i>Heterocloeon curiosum</i>		8	
	<i>Isonychia sp.</i>	12	4	17
	<i>Leucrocuta junco</i>		1	
	<i>Leucrocuta thetis</i>		1	
	<i>Maccaffertium modestum</i>	10	10	15
	<i>Maccaffertium terminatum</i>			1
	<i>Maccaffertium vicarium</i>	2	2	1
	<i>Serratella deficiens</i>	5		
	<i>Stenacron interpunctatum</i>		1	
Lumbriculida	<i>Lumbriculus variegatus</i>	1	4	1
Megaloptera	<i>Corydalus cornutus</i>	6	2	6
Odonata	<i>Argia sp.</i>		1	
Plecoptera	<i>Acroneuria abnormis</i>	1		
	<i>Acroneuria carolinensis</i>	1	4	1

	<i>Agneta annulipes</i>		7	1
	<i>Neoperla sp.</i>	16	6	1
	<i>Paragnetina immarginata</i>		2	
	<i>Perlesta placida</i>	1		
Trichoptera	<i>Ceraclea flava</i>		1	3
	<i>Ceratopsyche sparna</i>	1		1
	<i>Cheumatopsyche sp.</i>	18	5	26
	<i>Chimarra sp.</i>	3	2	48
	<i>Hydropsyche betteni</i>			1
	<i>Hydropsyche demora</i>	8	1	18
	<i>Hydropsyche hageni</i>	1		
	<i>Hydropsyche venularis</i>	1		19
	<i>Macrostemum zebratum</i>	9		4
	<i>Neureclipsis crepuscularis</i>	1		
	<i>Oecetis inconspicua</i>	1		
	<i>Oecetis nocturna</i>	1		
	<i>Rhyacophila vuphipes</i>	1		

FIGURES

Figure 1. Taxa richness by order (all sites), Obed Wild and Scenic River, 2007-2009.

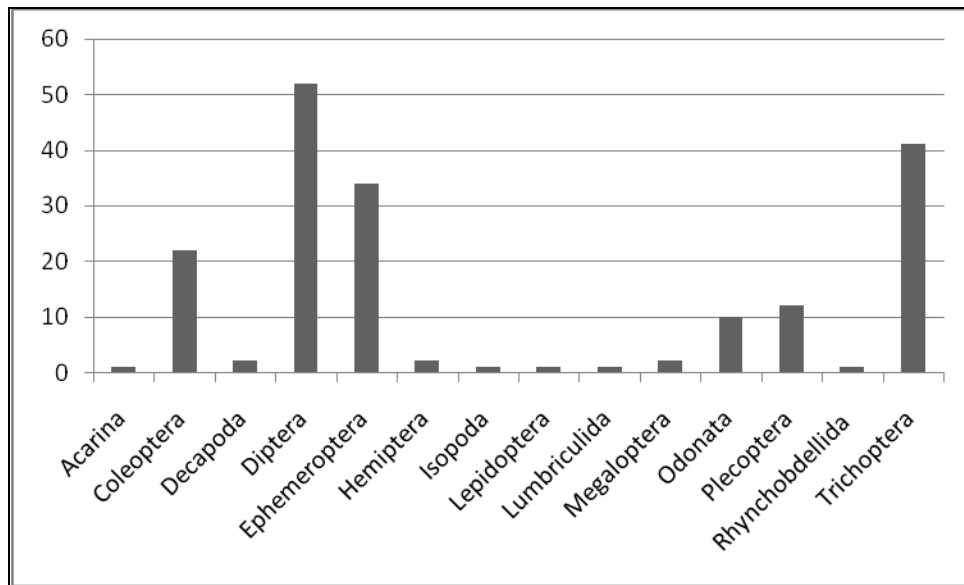


Figure 2. Taxa richness by order, first order sites of Obed Wild and Scenic River, 2007-2009.

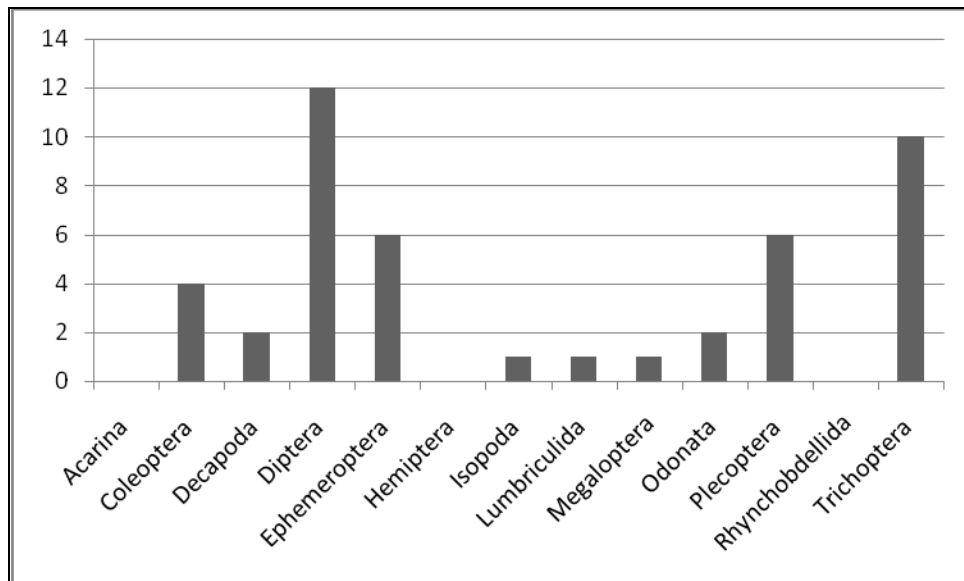


Figure 3. Taxa richness by order, second order sites of Obed Wild and Scenic River, 2007-2009.

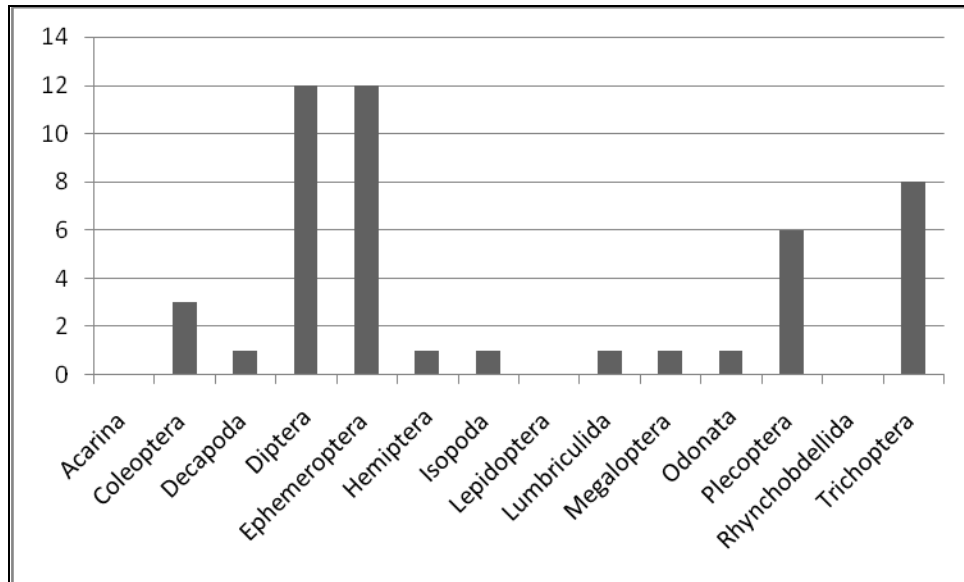


Figure 4. Taxa richness by order, third order sites of Obed Wild and Scenic River, 2007-2009.

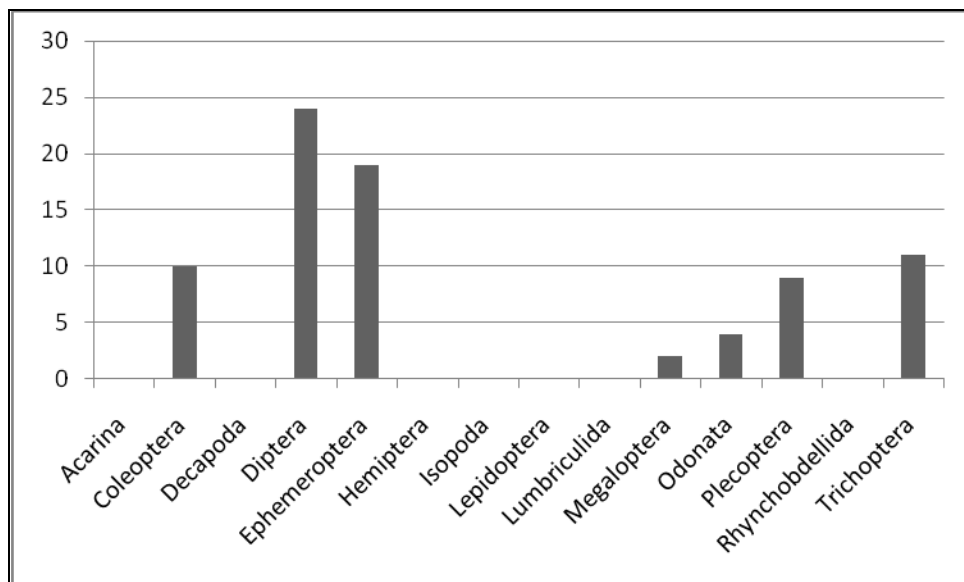


Figure 5. Taxa richness by order, fourth order sites of Obed Wild and Scenic River, 2007-2009.

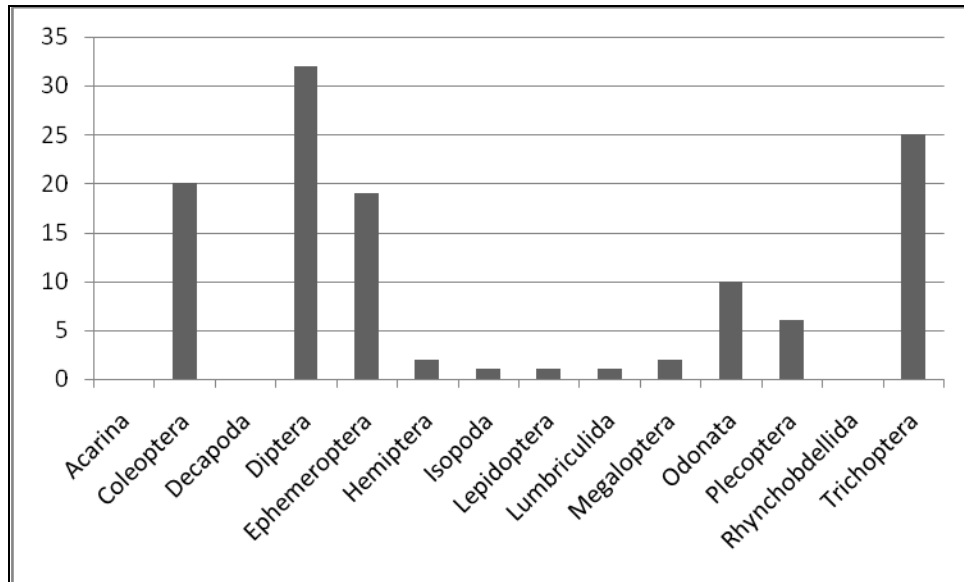


Figure 6. Taxa richness by order, fifth order sites of Obed Wild and Scenic River, 2007-2009.

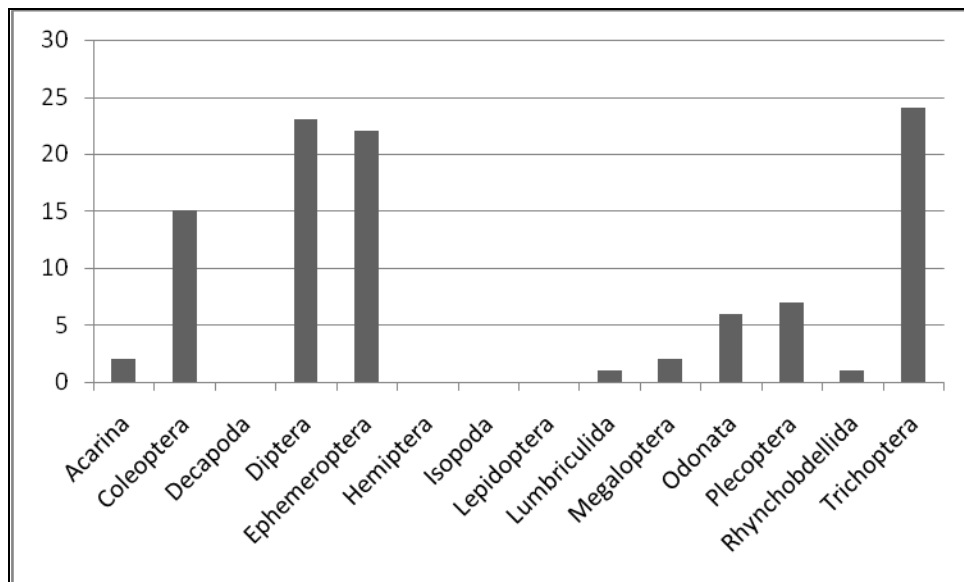
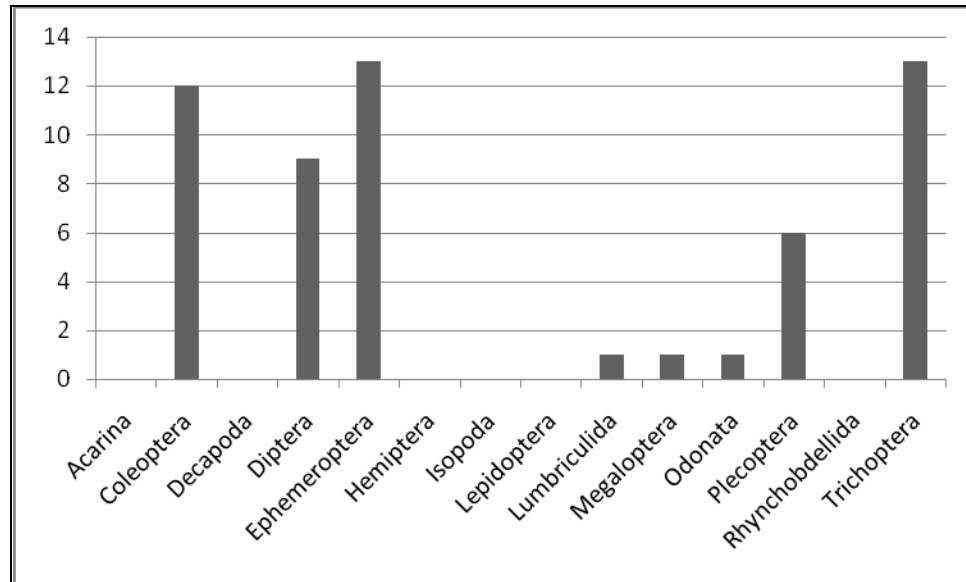


Figure 7. Taxa richness by order, sixth order sites of Obed Wild and Scenic River, 2007-2009.



APPENDIX 1

AN ABSTRACT OF A THESIS

CHARACTERIZATION OF AQUATIC MACROINVERTEBRATE COMMUNITIES WITHIN THE OBED WILD AND SCENIC RIVER SYSTEM

Benjamin C. Hutton

Master of Science in Biology

The Obed Wild and Scenic River is part of the Emory River Watershed, located within the Cumberland Plateau and Cumberland Mountains of east Tennessee. This watershed totals over 2,065 km of streams and includes portions of five drainages: Obed River, Clear Creek, White Creek, Daddys Creek, and Emory River. As part of the National Park Service system, biological integrity must be maintained in the Obed Wild and Scenic River. However, macroinvertebrates have not been monitored, and comprehensive taxa lists do not exist. The objectives of this study are to develop a comprehensive list of aquatic insect species inhabiting the Obed National Wild and Scenic River, determine longitudinal variation in the benthic community, compare biological condition scores between genus and species level identifications, and determine land use influence on benthic community quality.

Aquatic macroinvertebrates were collected from 21 sites using semi-quantitative (SQKICK) techniques and were identified to the lowest possible taxon. Biological condition scores were calculated using both genus and species level identification. Macroinvertebrate community data were analyzed using the ANOSIM and SIMPER routines within PRIMER software. Linear regression was used to determine the influence of land use and habitat variables on biological condition scores.

A total of 167 species was collected. Mean biological condition scores, calculated with genus and species level identification, indicated non-impaired biological conditions. Benthic community dissimilarity existed between third and fourth order and third and sixth order streams. *Hydropsyche betteni*, *Procloeon* sp., and *Leuctra* sp. were responsible for most of the dissimilarity between third and fourth order streams; and *Procloeon* sp., *Nigronia serricornis*, *Microcyloepus pusillus*, *Neoperla* sp., *Leuctra* sp., *Lumbriculis variegatus*, *Hydropsyche demora*, and *Boyeria vinosa* were responsible for most of the dissimilarity between third and sixth order streams. Linear regression analysis identified one habitat variable (pH) that significantly influenced biotic condition scores.

**CHARACTERIZATION OF AQUATIC MACROINVERTEBRATE
COMMUNITIES WITHIN THE OBED WILD AND SCENIC
RIVER SYSTEM**

A Thesis

Presented to

the Faculty of the Graduate School

Tennessee Technological University

by

Benjamin C. Hutton

In Partial Fulfillment

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COMMUNITIES IN THE OBED WILD AND SCENIC

RIVER SYSTEM

By

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Approved for the Faculty:

Francis Outuonye
Associate Vice President for
Research and Graduate Studies

Date

DEDICATION

This thesis is dedicated to my parents
who have supported me throughout my academic career.

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CHAPTER 1

INTRODUCTION

The Water Quality Act of 1967, an amendment of the Federal Water Pollution Control Act, requires each state to establish water quality criteria for all interstate waters and to develop a plan for implementation and enforcement of these criteria (Wilhm and Dorris 1968). The United States Environmental Protection Agency (EPA) and many state regulatory agencies use both chemical and biological analyses to determine water quality. Aquatic macroinvertebrates are commonly used to assess water quality of rivers and streams by the EPA and many state agencies (Hilsenhoff 1977, TDEC 2006). Aquatic macroinvertebrates, especially arthropods, are an important component of aquatic ecosystems and have long been used to measure water quality. These organisms are best suited for water quality analysis because they are numerous in most streams, are readily collected and identified, are not very mobile, and generally have life cycles of a year or more (Hilsenhoff 1977). Aquatic macroinvertebrates are excellent for assessing short term pollution events because once a species is eliminated from the ecosystem it will not reappear until the next generation (Hilsenhoff 1977).

Arthropods were first used to evaluate water quality by Kolkowitz and Marsson (1909). When using arthropods to evaluate stream water quality, one of three methods has been used to evaluate data. The indicator species concept is the oldest, having been used by Kolkowitz and Marsson (1909) and several others. This method

classifies an arthropod according to pollution tolerance as either tolerant, facultative, or intolerant (Hilsenhoff 1977). A stream is judged to be polluted or unpolluted based on presence or absence of species in each classification. There are several problems with this method. First, intolerant species may occasionally be found in polluted areas, and tolerant species may be found in unpolluted areas. Also, this method does not take into account numbers of each species and community structure. The second method that has been used is the diversity index. This method is based on the premise that pollution reduces the number of species found and frequently creates an environment favorable for only a few species. Thus, a polluted stream has high abundances with low diversity, while unpolluted streams have greater diversities. The problem is that many small, unpolluted streams normally have naturally low diversities. The third method, and the one that is currently used, is development of a biotic index. This method has been standardized by EPA and many state agencies, including the Tennessee Department of Environment and Conservation (TDEC). The biotic index uses a multi-metric approach to evaluate community structure. TDEC's method is based on seven different biometrics that have been developed for use in semi-quantitative macroinvertebrate surveys (TDEC 2006). This index is based on ecoregional reference data and calibrated by bioregion (TDEC 2006).

Aquatic macroinvertebrates play essential roles in lotic ecosystems. They serve as a food source for many species of fish, and they convert allochthonous and autochthonous materials into potential energy for more complex organisms (Giller and Malmqvist 2001). These organisms feed by gathering, shredding, filtering, scraping, and predation. A major role of shredders in stream ecosystems is conversion

of coarse particulate organic matter (CPOM) into fine particulate organic matter (FPOM) in low order streams (Cummins et al. 1989). FPOM generated by shredders is a significant component of the food resource base for gatherers and filterers present in higher order streams (Short and Maslin 1977). A balanced community of aquatic macroinvertebrates occupying these various trophic roles is an indication of a healthy ecosystem. However, many factors influence an aquatic macroinvertebrate community.

Distribution and abundance of aquatic macroinvertebrates are affected by many natural and anthropogenic factors. Habitat variables such as flow, substrate, depth, dissolved oxygen, presence of woody debris, and temperature are natural factors that affect macroinvertebrate distribution and abundance. Flow is a major determinant of physical habitat in streams, which in turn is a major determinant of biotic composition (Bunn and Arthington 2002). Many macroinvertebrates rely on desiccation resistance strategies under drought conditions when flows are low to non-existent. Hydraulic conditions of a stream or river affect macroinvertebrate assemblages directly and indirectly through influences on CPOM retention (Kobayashi and Kagaya 2002). Small-scale differences in hydraulic conditions created by combinations of velocity, depth, and substrate roughness have an important role in spatial distribution of macroinvertebrate assemblages in riffle habitats (Brooks et al. 2005).

Typically, dissolved oxygen levels are higher in lotic than in lentic environments (Wetzel 2001). Water turbulence and lower temperatures are responsible for higher dissolved oxygen levels in flowing waters. However,

photosynthesis by phytoplankton, periphyton, and macrophytes make a fertile pond, lake, or pool in a stream or river have higher dissolved oxygen levels than a cold, turbulent stream (Lamberti and Steinman 1997, Morin et al. 1999). Many macroinvertebrate species require high dissolved oxygen levels, especially those in the orders Ephemeroptera, Plecoptera, and Trichoptera, which respire through a system of tracheal gills (Merritt and Cummins 1996). Plecoptera includes some of the most sensitive taxa of aquatic macroinvertebrates, and these require high dissolved oxygen levels (Stewart and Stark 1988). Aquatic macroinvertebrates have different optimum temperature levels. For example, Plecoptera prefer colder water temperatures than most other species of aquatic macroinvertebrates. Cold water has higher dissolved oxygen levels than warm water (Wetzel 2001).

Presence of woody debris is another factor affecting the distribution and abundance of aquatic macroinvertebrates. Woody debris is an important habitat component, especially in low gradient streams (Kaller and Kelso 2006). Woody debris provides additional habitat for aquatic macroinvertebrates and causes CPOM to accumulate which benefits shredders and some species of Odonata (Wallace and Benke 1984).

Anthropogenic factors that affect the distribution of aquatic macroinvertebrates include habitat loss and degradation of water quality. Habitat loss due to stream alteration is a serious issue and includes channelization, bridge and culvert construction, dam construction, and removal of woody debris. Channelization is a common engineering practice primarily aimed at controlling flooding and draining wetlands (Landwehr and Rhoads 2003). Channelization has many negative

effects on stream habitat, including removal of substrate materials, increasing sediment loads, creating shifting bed loads, simplifying current patterns, lowering stream channels, draining adjacent wetlands, reducing bank stability, and exacerbating downstream flooding (Criss and Shock 2001, Landwehr and Rhoads 2003, Fleming 2004). Bridge and culvert construction affects streams by increasing sediment loads, causing water quality changes, and modifying stream banks (Little and Mayer 1993). Impoundment of a stream or river changes aquatic community composition due to changes in flow, increased sedimentation, and reduced dissolved oxygen levels (Trotzky and Gregory 1974). Large dams intensify the negative effects of impoundments due to fluctuating discharge, altered temperature regimes, and water chemistry changes (Blinn et al. 1995). Removal of woody debris negatively impacts a stream by reducing available habitat and amount of CPOM available to shredders (Wallace and Benke 1984).

Water quality degradation is the most important factor affecting the distribution and abundance of aquatic insects (Merritt and Cummins 1996). Anthropogenic factors that degrade water quality include construction, acid drainage, oil spills, sewage effluent, agricultural runoff, pesticides, industrial chemicals, erosion, and storm water runoff (Spaulding and Ogden 1968, Waters 1995, Giller and Malmqvist 2001). Stream erosion, which is a naturally occurring factor, is affected by rainfall, flow, and channel morphology in combination with types of catchment bedrock, soil profiles, and vegetation (Leopold et al. 1964). Although, erosion is a factor that occurs naturally during and after precipitation events, land use practices directly influence erosion and the amount of sediment that is transported to rivers and

streams. Sedimentation, both natural and anthropogenic, is considered the primary water quality pollutant in the United States (Kohler and Soluk 1997).

Land use practices directly influence water quality, and thus aquatic macroinvertebrate communities. Common land use practices that can degrade water quality include agriculture, industry, oil drilling, silviculture, mining, and urban development. Agriculture is the greatest source of pollution that affects streams and rivers in the United States, contributing over three times more pollutants than the next leading source (EPA 1990). The production of row crops and field cultivation are a major source of agricultural pollution. Combined, both practices are a leading cause of sedimentation in streams and rivers (Costa 1975, Clark 1987). The destruction of riparian vegetation for the purpose of row crop production is a common practice in many agricultural areas. Riparian vegetation provides bank stability, reduction of sedimentation, lower water temperatures, and input of CPOM (Lyons et al. 2000, Bis and Higler 2001). Increased erosion rates associated with destruction of riparian vegetation can result in sedimentation of streams or rivers and can negatively impact aquatic macroinvertebrate communities (Stone et al. 2005, Muenz et al. 2006). Overgrazing of riparian areas by livestock can also lead to destruction of riparian vegetation and can increase erosion on stream banks and in channels (U.S. Department of the Interior, Bureau of Land Management 1998). Other forms of agricultural pollution include herbicides, pesticides, and animal wastes. Herbicides and pesticides have many negative effects on aquatic ecosystems including destruction of aquatic vegetation, death of aquatic invertebrates and fish, and reduction of water quality (Dewey 1986, Gustavson et al. 2003, Anderson et al.

2006). Herbicides and pesticides usually enter streams as the result of improper application, erosion, and/or precipitation events (Dewey 1986). Herbicides most frequently encountered in streams are pre-emergent herbicides, such as atrazine, that have a long soil half-life (Dewey 1986, Giddings et al. 2005). Animal wastes typically enter rivers and streams following precipitation events, as runoff from fields or holding facilities and often alter water chemistry resulting in decreased dissolved oxygen levels (Carpenter et al. 1998).

Oil drilling can be a source of pollution in certain areas of the country. There are five primary stages in oil and gas production that occur in sequential order: geologic analysis (to locate reserves), exploration (seismic, test hole drilling, etc), construction (installment of infrastructure), production, and reclamation (EPA 2000). Installation of infrastructure and accumulation of impacts to the landscape accompany all stages, with the exception of reclamation (EPA 2000). Installation of infrastructure can cause direct disturbance to the landscape, resulting in destruction of soil and vegetation, increased runoff, and industry-associated solid waste (UNEP 1997). Oil drilling requires use of drilling fluids and fuels which potentially impact streams and rivers (Sadiq et al. 2003). Oil spills and leaching of hazardous wastes are potential sources of pollution that damage aquatic ecosystems (EPA 1987, Wernersson 2004).

Timber harvest and other silvicultural techniques can be major contributors of anthropogenic sediment. Construction of logging roads produces the most sediment (Anderson 1971). Disturbance intensity of selected harvest methods influences amount of sediment produced (Smith et al. 2001). Soil type, terrain, and degree of implementation of Best Management Practices (BMPs) influence amount of sediment produced by silviculture (Carrol et al. 2004). Use of streamside management zones

(SMZs), a key element of BMPs, reduces impacts from timber harvest and provides protection of water quality, aquatic habitat, and macroinvertebrate communities (Carroll et al. 2004).

Mining is a major contributor of sediment, metals, and hazardous chemicals to lotic ecosystems, and these impacts can be extremely persistent (Marcus et al. 2001). Metal contamination and stream acidity are common impacts of mining that damage aquatic macroinvertebrate communities (Rosemond et al. 1992, Poulton et al. 1995, Beltman et al. 1999, Valenti et al. 2005). Strip mining is a type of surface mining that involves following seams of minerals and depositing waste materials into spoil piles near excavation sites where sediment later erodes to lotic systems (Spaulding and Ogden 1968). Toxic effluent from hazardous chemicals often leaches from spoil piles. Spoil piles from coal mines allow acid (mainly sulfuric acid) to leach into nearby lotic systems (Spaulding and Ogden 1968). However, sediment is the most important pollutant from coal mines affecting macroinvertebrate communities (Waters 1995).

Urban development is a major source of anthropogenic sediment, especially in metropolitan areas (Simmons 1976). Sedimentation is attributed to residential development, industrial construction, road construction, and installation of utilities (Guy and Ferguson 1970). Sedimentation in urban areas can be up to 50 times greater than in rural areas (Wark and Keller 1963). Storm water runoff can negatively affect rivers and streams that flow through urban areas (Gray 2004, Walsh et al. 2005, Gresens et al. 2007). Impacts include flashy hydrographs, elevated concentrations of nutrients and contaminants, altered channel morphology, and reduced biotic richness with increased dominance of tolerant species (Walsh et al. 2005). Urban areas

contribute increased amounts of storm water runoff during and after precipitation events due to impermeable surfaces, such as roads and parking lots, which allow runoff to reach streams and rivers faster than in rural areas, and can cause flooding in urban areas. Increased stream bank and channel erosion is associated with more frequent flood events. Storm water runoff can carry sediment and other pollutants, such as road salt, fuels, and lawn chemicals, into nearby streams and rivers (Gresens et al. 2007). Additional urban impacts include sewer overflows and wastewater treatment plant effluents (Walsh et al. 2005).

All of these land use practices occur in the Emory River Watershed. Part of this watershed includes the Obed National Wild and Scenic River. As part of the National Park system, the natural quality of this ecosystem must be maintained. Therefore, maintenance of natural aquatic macroinvertebrate communities is mandated. The only database for aquatic macroinvertebrates within the watershed is from Goodfred (2006). The purpose of Goodfred's study was to determine how habitat conditions and land use practices within the Emory River Watershed influenced benthic macroinvertebrate communities and to evaluate seasonal variation in benthic communities. This study expands the work of Goodfred (2006) by sampling sites within the sub-watersheds of Obed River, Clear Creek, White Creek, Daddys Creek, and Emory River. Data from White and Clear Creeks will be analyzed to determine if an oil spill that occurred in July 2002 (Cook 2006) is still impacting aquatic macroinvertebrate communities.

The goal of this study is to conduct a comprehensive survey of aquatic insect species in the Obed National Wild and Scenic River. Specific objectives are to:

- (1) develop a comprehensive list of aquatic insect species inhabiting the Obed National Wild and Scenic River;
- (2) determine longitudinal variation in the benthic community of the Obed National Wild and Scenic River;
- (3) compare biological condition scores using either genus or species level identifications; and
- (4) determine land use influences on benthic community quality in the Obed National Wild and Scenic River.

CHAPTER 2

STUDY AREA

The Obed Wild and Scenic River is part of the Emory River Watershed, located within the Cumberland Plateau and Cumberland Mountains of east Tennessee (Figure 1). This watershed totals over 2,065 km of streams, of which the Obed River includes over 72 km. Regional geologic formations are composed of Pennsylvanian-age conglomerate, sandstone, siltstone, and shale covered by mostly well-drained, acidic soils of low fertility (TDEC 2000). Land use distribution within the Emory River Watershed is: 73% forest, 25% agriculture, 1% open water, and 1% urban (TDEC 2000). The Obed Wild and Scenic River includes portions of five sub-watersheds: Obed River, Clear Creek, White Creek, Daddys Creek, and Emory River.

Obed River

The Obed River is located in Cumberland and Morgan Counties and flows east through the Catoosa WMA (Table 1, Figure 1). The Obed River originates southwest of Crossville, Tennessee, near U.S. Route 70 and drains into the Emory River approximately 8 kilometers southwest of Wartburg, Tennessee. Total length of the Obed River is 75 kilometers, and 40 kilometers are within the Obed Wild and Scenic River boundaries.

Clear Creek

Clear Creek sub-watershed drains portions of Cumberland, Fentress, and Morgan Counties (Table 2, Figure 1). Clear Creek originates near Mayland, Tennessee, and flows into the Obed River south of Potter Chapel Road. Total length of Clear Creek is 76 kilometers, and 28 kilometers are within the Obed Wild and Scenic River boundaries.

Daddys Creek

Daddys Creek drains portions of Bledsoe, Cumberland, and Morgan Counties originating approximately 4 kilometers east of Highway 127 near the intersection of Blaylock Road and Emerson Stone Road (Table 3, Figure 1). The stream flows northeast through Catoosa Wildlife Management Area and into the Obed River. Total length of Daddys Creek is 79 kilometers, and 4 kilometers are within Obed Wild and Scenic River boundaries.

White Creek

White Creek is located in Morgan County, originating approximately 1 kilometer east of the intersection of Gatewood Ford Rd. and Rock Creek Rd. and has a confluence with Clear Creek at Barnett Bridge (Table 4, Figure 1). The majority of White Creek is outside Obed Wild and Scenic River boundaries; however, it is a

major tributary to Clear Creek. The Obed Wild and Scenic River only encompasses White Creek near the Clear Creek confluence.

Emory River

The Emory River is located within Morgan and Roane Counties (Table 5, Figure 1). The Emory River originates north of Frozen Head State Natural Area, west of the Morgan, Scott, and Anderson county lines. The Emory River flows southwest to a confluence with the Obed River. The river eventually flows into the Clinch River section of Watts Bar Reservoir north of Kingston, Tennessee. The majority of the Emory River is outside of the Obed Wild and Scenic River boundaries; the Obed Wild and Scenic River encompasses the Emory River from the Obed River confluence to just below Nemo (approximately 2 kilometers).

CHAPTER 3

METHODS AND MATERIALS

Macroinvertebrate sampling occurred from spring 2007 through fall 2007. Sample sites were selected through coordination with National Park Service staff. This study expanded on the work of Goodfred (2006) by concentrating on low order tributaries. Sites were located within the Obed River, Clear Creek, White Creek, Daddys Creek, and Emory River sub-watersheds within the boundaries of the Obed Wild and Scenic River (Tables 1-5, Figure 1). Each site was sampled once. Sample sites were located near accessible road crossings or in areas that were accessible by foot.

Habitat

Width, depth, and substrate were measured at each site. Width was measured at transects located every 10 m along a 100-m reach using a measuring tape or a rangefinder. Substrate and depth were measured at five equidistant points across the width of each transect. Substrate was visually assessed using a modified Wentworth scale (Overton et al. 1997, Table 6). Depth was measured using a piece of PVC pipe graduated in 1 cm increments.

Water Quality

Field water quality parameters were measured at precise locations where aquatic macroinvertebrates were sampled. Water quality parameters measured included temperature (°C), dissolved oxygen (mg/l), conductivity (µS/cm), pH, and turbidity (NTU). Conductivity, dissolved oxygen, and temperature were directly measured using a Yellow Springs Instrument (YSI) Model 85 meter. An Analytical Measurements pH Model 107 meter was used to measure pH and an Orbeco-Hellige model 966 turbidimeter was used to measure turbidity.

Macroinvertebrate Collection

Semi-quantitative macroinvertebrate sampling methods, as defined by TDEC (2006), were used. Riffle habitats were sampled using a 1-m² semi-quantitative riffle kick (SQKICK) net with 500-micron mesh. At each site, samples were collected using two kicks, one from a fast riffle and one from a slow riffle, within each 100-m reach. If coarse woody debris or leaf packs were present, they were sampled using a standard D-frame kick net.

Two individuals were required to obtain benthic macroinvertebrate samples. One individual held the SQKICK net at an angle against the current, ensuring that the net bottom maintained contact with the substrate and the top was above the water's surface. A second individual disturbed the substrate by kicking and shuffling their feet in an area approximating 1 m² upstream of the net, causing organisms and debris

to flow into the net. Large rocks within the sample area were lifted, and clinging invertebrates were manually collected. Upon kick completion, the net was moved to a flat surface for processing. Leaf packs were sampled by using the D-frame kick net to collect a portion of the leaf pack. Woody debris was sampled by disturbing the debris and using the D-frame kick net to collect dislodged invertebrates.

Samples were composited and placed into a one-gallon zip-lock freezer bag. All clinging organisms were removed from nets and added to the bag. Large rocks and organic material were returned to the stream after rinsing and removing organisms. Site information, including sample location and date, was printed with a permanent marker on each sample bag. Samples were preserved with 10% formalin or 70% ethanol and transported to the laboratory for processing.

Upon return to the laboratory, samples were stored in large rubber containers until macroinvertebrates were separated from organic debris. Sorting was performed by hand-picking with tweezers under a magnified picking lamp. Once all invertebrates were sorted, a random sub-sample of 160-240 organisms was selected using a grid pan and a random number table. Sub-sampling continued until at least 200 organisms were collected. However, if 200 were collected but the last selected grid still contained organisms then the remaining organisms were added to the sub-sample. All organisms were collected if there were at least 160 but less than 200 present in a sample. Once sub-sampling was complete, taxa were identified using Pennak (1953), Wiggins (1977), Brigham et al. (1982), and Merritt and Cummins (1996). Chironomid larvae and oligochaetes were mounted on labeled microscope slides using CMCP-10 mounting media. Slides were labeled with sample location and

date of collection. Chironomids and oligochaetes were identified with a compound light microscope using Beck (1979), Simpson and Bode (1980), Brigham et al. (1982), and Epler (2001). All macroinvertebrates were identified to the species level unless a viable species key did not exist. If a viable species key did not exist, then an individual was identified to genus level.

Data Analysis

Macroinvertebrate samples within each sub-watershed were analyzed using multi-metric analyses as outlined in TDEC (2006). This analytical technique has seven different metrics:

- (1) Ephemeroptera, Plecoptera, Trichoptera Richness (**EPT**);

EPT= Total number of genera in the subsample in the Orders
Ephemeroptera, Plecoptera, and Trichoptera.

- (2) Taxa Richness (**TR**);

TR= Total number of genera found in the subsample.

- (3) Percent oligochaetes and chironomids (**%OC**);

% OC= $\frac{\text{Total number of Oligochaeta} + \text{Chironomidae}}{\text{Total number of individuals in the subsample}} * 100$

- (4) Percent Ephemeroptera, Plecoptera, Trichoptera (**%EPT**);

% EPT= $\frac{\text{Total number of EPT}}{\text{Total number of individuals in the subsample}} * 100$

(5) North Carolina Biotic Index (**NCBI**);

$$\text{NCBI} = \sum \frac{x_i t_i}{n}$$

where: x_i = number of individuals within the i^{th} taxon

t_i = tolerance value of the i^{th} taxon

n = total number of individuals in the subsample

Tolerance values for taxa were obtained using TDEC (2006)

(6) % NUTOL (% Nutrient Tolerant Organisms)

% NUTOL = Total number of *Cheumatopsyche*, *Lirceus*, *Physella*,
Baetis, *Psephenus*, *Stenelmis*, *Simulium*, *Elimia*,
Oligochaeta, *Polypedilum*, *Rheotanytarsus*, *Stenecron*,
Cricotopus and *Chironomus*

* 100

Total number of individuals in the subsample

(7) % **Clingers** (Percent contribution of organisms that build fixed retreats or have adaptations to attach to surfaces in flowing water)

$$\% \text{Clingers} = \frac{\text{Total number of clinger individuals}^1}{\text{Total individuals in the subsample}} * 100$$

¹List of clinger organisms were obtained from TDEC (2006)

After calculating values for each metric, values were converted to a biotic condition score of 0, 2, 4 or 6 based on comparison to an ecoregion reference database (TDEC 2006). Bioregion 68A was used for this study (TDEC 2006). Biotic index scores were calculated with both genus and species level identification of taxa. Analysis of variance, followed by Tukey post-hoc analysis, was used to test for significant differences among sub-watershed means of metrics and biotic condition scores. Significance was determined at $\alpha=0.05$.

PRIMER-E v5 was used to analyze macroinvertebrate community data and determine longitudinal variation. The Primer ANOSIM (Analysis of Similarities) routine was used to identify differences in macroinvertebrate communities among different stream orders. Primer calculated the Bray-Curtis similarity coefficient for the ANOSIM routine. The Primer routine SIMPER (Similarity Percentages) was used to determine which taxa contributed to community variation among stream orders.

Macroinvertebrate data were first standardized so that each taxon in a sample was represented by the percentage it contributed to total abundance. Since qualitative sampling techniques were employed, use of relative numbers through standardization was desirable because samples were not directly comparable due to unknown absolute abundances (Clarke and Warwick 2001). Macroinvertebrate data were then transformed using the presence/absence transformation in PRIMER. This transformation reduced data to presence or absence of each taxon in every sample and gave equal weight to all taxa. Presence/absence data transformation allowed similarities to more accurately reflect overall community composition by downweighting the importance of highly abundant taxa. Transformation severity determined the degree to which highly abundant taxa were downweighted (Clarke and Warwick 2001).

The ANOSIM 1-way routine was performed to determine if significant differences existed in macroinvertebrate communities among stream orders. The ANOSIM 1-way routine calculated a test statistic, R , which ranged from -1 to 1. R values ≥ 0.50 indicated significant differences existed among pairwise stream order comparisons. If a pairwise stream order comparison had an R value ≥ 0.50 , data were

then analyzed using the PRIMER routine SIMPER (Clarke and Warwick 2001). SIMPER was used to determine which taxa were primarily responsible for significant discrimination among stream orders (ie., taxa that contributed to 90% of the overall dissimilarity among stream orders). Taxa were listed in order of decreasing contribution to the overall average dissimilarity among stream orders.

Several methods were used to compare land use and its effect on aquatic insect communities in drainages of the Obed Wild and Scenic River system. Biotic scores, as defined by TDEC (2006), were used to determine condition of the aquatic insect community within each sub-watershed. Land use data were obtained from a GIS-linked database that contained current land use practices within the Emory River Watershed and were analyzed using multiple linear regression in SAS v 9.1. Significance for all tests was determined at $\alpha = 0.10$. Land use and habitat variables were regressed against biotic scores to identify which of them influenced macroinvertebrate community quality. Levels of pH were converted to hydrogen ion concentrations prior to analyses. Percentage data were transformed using the arcsine transformation procedure (Rohlf and Sokal 1994). Proc Corr was used before each test to identify highly correlated variables. Variables with correlation coefficients (CC) ≥ 0.50 were considered to be highly correlated.

CHAPTER 4

RESULTS

Sub-watershed Taxa Richness

Aquatic macroinvertebrate communities within the five sub-watersheds of the Obed Wild and Scenic River contained a total of 167 species within 117 genera (Appendix Tables A-1 – A-21). Daddys Creek, with 101 species and 78 genera, had the highest taxa richness among all four sub-watersheds (Appendix Tables A-13 – A-17). Clear Creek had the second highest taxa richness with 95 species and 65 genera (Appendix Tables A-6 – A-9). The Emory River sub-watershed had 79 species within 66 genera (Appendix Tables A-18 – A-21). Taxa richness within Obed River and White Creek were similar; both had 75 species; however, Obed River had 58 genera, and White Creek had 59 genera (Appendix Tables A-1 – A-5, and Appendix Tables A-10 – A-12, respectively).

Metrics and Biotic Scores

EPT richness (EPT) varied among sub-watersheds, with highest values found within Clear Creek (Tables 7 and 8). Clear Creek EPT values, calculated with genus level identification, ranged from 20 taxa at Jett Bridge to 11 taxa at Norris Ford. EPT richness values, calculated with species level identification, ranged from 30 taxa at Jett Bridge to 13 taxa at Norris Ford. Within the Obed River, genus-level EPT

richness values ranged from 17 taxa at the Obed River at Canoe Hole to 7 taxa at Potters Ford. Species-level EPT richness values ranged from 19 taxa at Obed River at Canoe Hole to 10 taxa at Potters Ford. White Creek genus-level EPT richness values ranged from 13 taxa at White Creek Mouth to 10 taxa at White Creek at Twin Bridge Road, while species-level EPT richness values ranged from 16 taxa at Lavender Bridge to 14 taxa at White Creek at Twin Bridge Road. Within Daddys Creek, genus-level EPT richness values ranged from 19 taxa at Yellow Creek at Hebbertsburg Road to 11 taxa at Yellow Creek. Species-level EPT richness values ranged from 23 taxa at Yellow Creek at Hebbertsburg Road and Daddys Creek at Obed Junction to 12 taxa at Yellow Creek. Emory River genus-level EPT values ranged from 16 taxa at Nemo to 5 taxa at Emory River at Montgomery Road, while species-level values ranged from 21 taxa at Nemo to 7 taxa at Emory River at Montgomery Road.

Taxa Richness (TR) values were highest within White Creek; however, with species identification, Clear Creek had a slightly higher mean taxa richness value (Tables 7 and 8). White Creek genus-level TR values ranged from 40 taxa at White Creek Mouth to 32 taxa at Lavender Bridge. Species-level TR values ranged from 43 taxa at White Creek Mouth to 38 taxa at Lavender Bridge. Clear Creek genus-level TR values ranged from 30 taxa at Jett Bridge to 27 taxa at Lilly Bridge, while species-level values ranged from 59 taxa at Jett Bridge to 34 taxa at Norris Ford. Within Obed River, genus-level TR values ranged from 30 taxa at Obed River at Obed Junction to 16 taxa at Potters Ford, and species-level TR values ranged from 34 taxa at Obed River at Obed Junction and Obed River at Canoe Hole to 22 taxa at Potters Ford. Daddys Creek genus-level TR values ranged from 46 taxa at Daddys

Creek at Antioch Bridge to 25 taxa at Yellow Creek, and species-level TR values ranged from 50 taxa at Daddys Creek at Antioch Bridge to 26 taxa at Yellow Creek. Within Emory River, genus-level TR values ranged from 31 taxa at Nemo and Island Creek at Catoosa Road to 23 taxa at Emory River at Montgomery Road, while species-level TR values ranged from 38 taxa at Nemo to 25 taxa at Emory River at Montgomery Road.

Oligochaetes and chironomids were not abundant at most sub-watershed sites and %OC values were generally low. The lowest %OC values were recorded within Obed River (Tables 7 and 8). Obed River values ranged from 14.90% at Adams Bridge to 2.88% at Potters Ford. Clear Creek values ranged from 19.38% at Barnett Bridge to 0.46% at Lilly Bridge, which was the lowest %OC value recorded among all sub-watershed sites. White Creek values ranged from 47.69% at White Creek at Twin Bridge Road to 22.51% at White Creek Mouth. Daddys Creek values ranged from 28.16% at Yellow Creek at Hebbertsburg Road to 8.88% at Daddys Creek at Obed Junction. Emory River values ranged from 73.19% at Emory River at Montgomery Road, which was the highest recorded value of all sub-watershed sites, to 12.68% at Nemo.

The highest percentage EPT (%EPT) values were observed within Clear Creek (Tables 7 and 8). Clear Creek values ranged from 79.36% at Lilly Bridge to 49.38% at Barnett Bridge, while Obed River %EPT values ranged from 78.43% at Alley Ford to 45.45% at Obed River at Canoe Hole. White Creek values ranged from 52.38% at White Creek Mouth to 33.33% at White Creek at Twin Bridge Road. Daddys Creek values ranged from 79.56% at Yellow Creek to 37.36% at Daddys

Creek at Antioch Bridge. Emory River values ranged from 59.30% at Rock Creek at Highway 62 to 12.28% at Emory River at Montgomery Road.

North Carolina Biotic Index (NCBI) scores were low at most sub-watershed sites, indicating good water quality conditions. The lowest observed NCBI scores were within Clear Creek (Tables 7 and 8). Clear Creek NCBI scores ranged from 4.07 at Jett Bridge to 2.88 at Lilly Bridge. Obed River NCBI scores ranged from 4.72 at Potters Ford to 3.68 at Obed River at Obed Junction. White Creek NCBI scores ranged from 4.82 at White Creek at Twin Bridge Road to 4.33 at White Creek Mouth. Daddys Creek scores ranged from 4.29 at Daddys Creek at Antioch Bridge to 3.6 at Devils Breakfast Table. Emory River scores ranged from the highest score recorded among all sub-watersheds with 5.59 at Emory River at Montgomery Road to 3.61 at Island Creek at Catoosa Road.

Percentage Nutrient Tolerant Organisms (%NUTOL) were lowest within Clear Creek (Tables 7 and 8). Clear Creek values ranged from 30.77% at Jett Bridge to 8.85% at Norris Ford, which was the lowest %NUTOL value recorded among all sub-watershed sites. Obed River %NUTOL values ranged from 67.31% at Potters Ford to 21.08% at Alley Ford, while White Creek values ranged from 31.94% at White Creek at Twin Bridge Road to 25.11% at White Creek Mouth. Daddys Creek %NUTOL values ranged from 37.86% at Yellow Creek at Hebbertsburg Road to 18.13% at Daddys Creek at Antioch Bridge. Emory River values ranged from 81.70% at Emory River at Montgomery Road, which was the highest %NUTOL value recorded among all sub-watershed sites, to 26.61% at Island Creek at Catoosa Road.

Clinger organisms (%Clingers), which are indicators of community health, were abundant in most sub-watershed sites. The highest %Clingers values were recorded within Obed River (Tables 7 and 8) and ranged from 89.42% at Potters Ford to 60.58% at Adams Bridge. Clear Creek %Clingers values ranged from 87.62% at Lilly Bridge to 55.29% at Jett Bridge, and White Creek values ranged from 73.27% at Lavender Bridge to 47.69% at White Creek at Twin Bridge Road. Daddys Creek values ranged from 86.74% at Devils Breakfast Table to 60.77% at Yellow Creek. Emory River values ranged from 72.77% at Nemo to 22.98% at Emory River at Montgomery Road, the lowest percentage recorded among sub-watershed sites.

Mean biotic condition scores of all five sub-watersheds calculated with genus and species level identification indicated non-impaired biological conditions (scores $\geq$ 32) (Tables 7, 8, 9, 10, 11, 12, and 13). The highest and lowest mean biotic condition scores calculated with both genus and species-level identification was recorded within Daddys Creek (40.4 genus-level score and 41.2 species level score) and Emory River (32.5 genus-level score and 33.5 species-level score), respectively. One sub-watershed site within Emory River (Emory River at Montgomery Road) had a score indicative of moderately-impaired biological conditions (biotic score=16) (Tables 7, 8, and 10). Additionally, one sub-watershed site within Obed River (Potters Ford) had a score indicative of slightly-impaired biological conditions (biotic score=30) with genus identification. However, with species identification, this same site had a score indicating non-impaired biological conditions (biotic score=34) (Tables 7, 8, and 11). Significant differences between means of metrics and biotic scores did not exist among sub-watersheds (Tables 7-13).

Longitudinal Variation

ANOSIM one-way analysis identified statistically significant dissimilarities ($p=0.10$) between third and fourth order and between third and sixth order streams using presence/absence transformed data (Table 14). SIMPER identified 21 taxa responsible for 90% of the average dissimilarity (62.87) between third and fourth order streams (Table 15) and 36 taxa responsible for 90% of the average dissimilarity (65.67) between third and sixth order streams (Table 16). Species with the greatest overall contribution to the average dissimilarity between third and fourth order streams were *Hydropsyche betteni* (Diss/SD=2.63), *Procloeon* sp. (Diss/SD= 2.63) and *Leuctra* sp. (Diss/SD=1.84). Eight species (*Procloeon* sp., *Nigronia serricornis*, *Microcylloepus pusillus*, *Neoperla* sp., *Leuctra* sp., *Lumbriculis variegatus*, *Hydropsyche demora*, and *Boyeria vinosa*) contributed the greatest (Diss/SD=8.04) to the average dissimilarity between third and sixth order streams.

Habitat and Land Use

Only one habitat variable significantly affected biotic condition scores ($F=15.63$, $p=0.0010$) (Appendix Tables B1-B5, Figure 2); a positive relationship existed between pH and biotic condition scores. The site with the lowest pH value (Emory River at Montgomery Road) had the lowest biotic condition score (Appendix Table B-5, Table 10). Land use (Appendix Table C-1) did not significantly affect biotic condition scores.

CHAPTER 5

DISCUSSION

The Cumberland Plateau region, as well as most of the Southeast, has experienced severe drought conditions during the last two to three years. Originally, 51 sample sites were identified to be sampled in this study, representing first through sixth order streams. However, only 21 sites, representing third through sixth order streams had sufficient water to be sampled. Many were completely dry for the first time in recent memory. Near the end of the sampling period, White Creek, which is a large fourth order stream, was reduced to isolated pools. Higher order streams, especially Clear Creek, experienced a severe reduction in flow. Consequently, results obtained from this study reflect effects of drought conditions on aquatic macroinvertebrate communities within the Obed Wild and Scenic River.

Aquatic macroinvertebrate species assemblages are an important component of lotic ecosystems. Species are assigned to one of several functional feeding groups, which include gatherers, filterers, shredders, scrapers, or predators (Merritt and Cummins 1996). Conversion of autochthonous and allochthonous material is of particular importance. The river continuum concept explains the longitudinal shift from taxa that use allochthonous food sources in headwater streams to taxa that rely on autochthonous food sources further downstream (Vannote et al. 1980). Therefore, shredder taxa which feed on CPOM are expected among the dominant taxa in stream orders one through three. As the stream order increases, taxa that rely on FPOM are expected to become more prevalent (Vannote et al. 1980). Accordingly, stream order

has been found to be a major factor affecting species richness of lotic communities (Malmqvist and Hoffsten 2000, Heino et al. 2005, Heino et al. 2007). Mid-order streams (i.e., orders four through six) generally have the greatest taxa richness due to a mixture of allochthonous and autochthonous energy input and habitat heterogeneity (Vannote et al. 1980, Giller and Malmqvist 2001). Mean taxa richness in the Obed Wild and Scenic River was highest among fifth order streams, followed by sixth, fourth, and third order streams, respectively. The unexpected order of fifth order streams may have been locationally influenced. Three of the five fifth order streams were within Clear Creek sub-watershed which had the highest taxa richness among sub-watersheds.

Three taxa, *Leuctra* sp., *Procloeon* sp., and *Hydropsyche betteni* were identified by SIMPER as primarily responsible for dissimilarity between third and fourth order streams. *Leuctra* sp. are stoneflies in the family Leuctridae and commonly occur in small streams, rivers, and spring-fed brooks (Brigham et al. 1982). The life cycle of *Leuctra* sp. is dependent upon water temperature. *Leuctra* sp. nymphs have been observed to have either a univoltine or semivoltine lifecycle depending upon water temperature and time of emergence (Harper 1973). *Leuctra* sp. are classified as shredders, and analysis of their lacina suggest detritivorous-herbivorous food habits (Stewart and Stark 1988, Merritt and Cummins 1996). *Leuctra* sp. were more abundant in third order sites than in fourth order sites in this study, with only one individual being collected from a fourth order site (Lavender Bridge). The classification of *Leuctra* sp. as shredders may explain their abundance at third order sites.

Procloeon sp., in the family Baetidae, were very abundant at third order sites; however, only one individual was collected at a fourth order site (Rock Creek at Highway 62). *Procloeon* sp. are assigned to gatherer and scraper functional feeding groups and are clingers (Merritt and Cummins 1996). Gathers process CPOM into FPOM, possibly explaining the abundance of *Procloeon* sp. at third order sites. Due to taxonomic revisions of the family Baetidae, little has been published regarding *Procloeon* sp. Other members of Baetidae collected within the Obed Wild and Scenic River included *Acentrella* sp., *Baetis intercalaris*, *Heterocloeon curiosum*, and *Labiobaetis propinquus*. *Baetis intercalaris* was most common and was found throughout the study area.

Hydropsyche betteni was not abundant at any sub-watershed. The majority of *Hydropsyche betteni* was collected at third order sites; only one individual was collected among fourth order sample sites (White Creek at Twin Bridge Road). According to Schuster and Etnier (1978), *Hydropsyche betteni* is a very common species in small, warm water streams and is often found in high numbers in large rivers. *Hydropsyche betteni* is one of the most resistant *Hydropsyche* species to organic pollution and is often collected with *Ceratopsyche sparna* (Schuster and Etnier 1978). In contrast with *Hydropsyche betteni*, *Ceratopsyche sparna* was relatively common within the study area. The non-impaired biological conditions within the Obed Wild and Scenic River may explain why *Hydropsyche betteni* was not abundant. *Ceratopsyche sparna* is less tolerant than *Hydropsyche betteni* (Schuster and Etnier 1978, TDEC 2006).

Eight taxa, *Leuctra* sp., *Neoperla* sp., *Boyeria vinosa*, *Nigronia serricornis*, *Microcylloepus pusillus*, *Lumbriculis variegatus*, *Procloeon* sp., and *Hydropsyche demora* were identified by SIMPER as primarily responsible for dissimilarity between third and sixth order streams. Two of these, *Leuctra* sp., and *Procloeon* sp., also contributed to differences in third and fourth order streams and were previously discussed.

Neoperla sp. are stoneflies in the family Perlidae. *Neoperla clymene* is the most widespread species but nymphs are not readily separated from other species in the genus (Stewart and Stark 1988). *Neoperla* sp. are readily identified by the presence of two ocelli and an occiput with an elevated transverse ridge bearing short, stout setae (Stewart and Stark 1988). *Neoperla clymene* has a univoltine life cycle (Vaught and Stewart 1974). *Neoperla* sp. nymphs are predators that feed on a variety of benthic organisms and their eggs, but avoid large prey species (Vaught and Stewart 1974). *Neoperla* sp. were collected from fourth, fifth, and sixth order sample sites within the Obed Wild and Scenic River, but were absent from third order sites. The presence of these predaceous species is consistent with the river continuum concept.

Boyeria vinosa is a common dragonfly in the family Aeshnidae that is identified by a white spot on the eighth abdominal segment. *Boyeria vinosa* nymphs occur almost exclusively in streams and are often found under stones, sunken wood, or other submerged material (Needham and Westfall 1955, Brigham et al. 1982). *Boyeria vinosa* was collected from third, fourth, and fifth order sample sites but was not collected from sixth order sites within the study area. However, it should be

present at sixth order sites and were observed while snorkeling for a separate project at some sixth order sites.

Nigronia serricornis is a predaceous species of Megaloptera in the family Corydalidae that feeds upon a variety of aquatic macroinvertebrates (Merritt and Cummins 1996). In most species of Corydalidae, eggs are oviposited on objects overhanging the water's surface, and larvae drop into the water upon hatching (Brigham et al. 1982). Pupation typically occurs in an earthen cell under a rock near larval habitat (Neunzig 1966). *Nigronia serricornis* prefers medium to large woodland streams with a substrate of large slab rocks and numerous small stones (Neunzig 1966). In the Obed Wild and Scenic River system, *Nigronia serricornis* was collected from third, fourth, and fifth order streams, but was absent in samples collected from sixth order sites. However, it should be present at sixth order sites and were observed while snorkeling for a separate project at some sixth order sites.

Microcyllloepus pusillus, a member of the Elmidae, was collected throughout the study area with the exception of third order streams. Two adult subspecies, *M. pusillus pusillis* and *M. pusillus aptus*, were collected. Adult and larval Elmidae are truly aquatic and are typically collected in swifter portions of streams and rivers (Brigham et al. 1982). Adult Elmidae are limited to oxygen-rich environments because of their respiratory morphology (Merritt and Cummins 1996). Most adult and larval Elmidae are microphagous and consume decayed plant material and diatoms; however, *Microcyllloepus pusillus* has been reported as cannibalistic on occasions (Susskind 1936, Brown and Shoemaker 1969, and LeSage and Harper 1976). Thus,

this species may be predaceous, which would explain its presence in higher order streams.

Lumbriculis variegatus was collected in low numbers throughout the study area but not from third order sites. *Lumbriculis variegatus* is an aquatic oligochaete in the family Lumbriculidae and is capable of asexual (through fragmentation) and sexual reproduction (Brigham et al. 1982). This burrowing organism requires fine sediment and is commonly collected in shallow water with woody debris, leaves, or rocks (Brigham et al. 1982). Absence of fine sediment at third order sites best explains its absence in lower order streams.

Hydropsyche demora was relatively common within the study area, but it was not collected from third order sample sites. With the exception of *Cheumatopsyche*, *Hydropsyche demora* was the most common member of Hydropsychidae within the Obed Wild and Scenic River system and the greatest numbers were collected from sixth order sites.

Aquatic macroinvertebrates are frequently used for water quality analysis due to their abundance and sensitivity to habitat degradation. The most common method of water quality analysis using aquatic macroinvertebrates is through biotic indices. Although metrics associated with biotic indices are typically designed to use genus-level data, this study compared differences in biotic index scores between genus and species-level identification. Genus-level taxonomic resolution is typically used with benthic macroinvertebrate surveys based on the Rapid Bioassessment Protocols of the EPA due to a balance of cost-effectiveness and sensitivity to biological impairment (Barbour et al. 1999). Two metrics affected by species-level identification were EPT

richness and Taxa richness. An average EPT richness value of 13 was observed among all sites within the Obed Wild and Scenic River system. However, with species identification, the average EPT richness increased to 17. The reason for this increase was that common genera, such as *Maccaffertium* and *Hydropsyche*, would typically have several species present at a site. Taxa richness values experienced similar increases with species level identification. Average taxa richness among all sites with genus level identification was 30 and increased to 37 with species level identification. EPT richness and taxa richness values recorded at most sites were indicative of non-impaired biological conditions. No other metrics were affected with increased taxonomic resolution.

Mean biotic scores for all sub-watersheds indicated non-impaired biological conditions with both genus and species level identification. Species identification increased biotic scores of several sites, generally by only one or two points, but usually at non-impaired sites. All but two sites in this study received scores that were ≥ 32 with genus identification, indicating non-impaired conditions. Species identification elevated the biotic score of Potters Ford from a 30 (slightly-impaired) to a 32 (non-impaired) but reference scores were based on genus-level identification. If species-level identification is used with the current set of metrics, critical scores for non-impairment should be adjusted higher. In most cases, species identification is not necessary for biological monitoring because it has little effect on biotic scores compared to genus-level identifications, and is more time consuming, especially when large numbers of early instars are present in a sample. Also, fewer identification errors are associated with genus-level taxonomic resolution (Hewlett 2000).

Additionally, species keys do not exist for some organisms, or taxa cannot be positively identified unless the specimen is an adult.

Many oligochaete and chironomid taxa are considered indicators of poor environmental quality (Epler 2001). Most samples contained several chironomid or oligochaete taxa, though actual numbers were generally low. The three most commonly encountered chironomid species among all sample sites were *Polypedilum flavum*, *Rheotanytarsus exiguus*, and *Conchapelopia* sp. Of the three, *Polypedilum flavum* was most common and was encountered in all but one of 21 samples. *Polypedilum flavum* is commonly encountered in streams and rivers under a wide range of habitat and environmental conditions, ranging from non-impaired to heavily degraded (Epler 2001). At one particular site (Emory River at Montgomery Rd.), 155 *Polypedilum flavum* were included in a subsample. The %OC value for this site was the highest observed among all sample sites and was indicative of impaired biological conditions.

Rheotanytarsus exiguus is the most common member of the *R. exiguus* species group (Epler 2001). *Rheotanytarsus exiguus* larvae are common in rivers and streams and construct tubes that are attached to substrate, aquatic plants, and even large insects such as Megaloptera or Odonata (Epler 2001). Dominant substrate consisted of either boulder, cobble, or bedrock at all but two sample sites. The coarse substrate provided a suitable surface for attachment of larval tubes, perhaps explaining why *Rheotanytarsus exiguus* was encountered with such frequency.

Conchapelopia sp. larvae were the third most common chironomid species within the study area. These larvae are generally collected in waters with low

conductivity (0-400 μm , generally <300 μm), low alkalinity (0-200 ppm, usually below 40 ppm), and pH values that range from 5.1-8.0 (Epler 2001). The pH values and low alkalinity due to the sandstone geology provided suitable conditions for *Conchapelopia* sp., explaining its frequent occurrence.

Ephemeroptera, Plecoptera, and Trichoptera were abundant within the Obed Wild and Scenic River. Average percent EPT (%EPT) values of all sub-watersheds were indicative of non-impaired biological conditions. Trichoptera and Ephemeroptera provided the greatest contribution to %EPT values. The two most common Ephemeroptera taxa, *Maccaffertium modestum* and *Maccaffertium vicarium*, were present throughout the study area. Both species are clingers and abundance of coarse substrate among sample sites explains their abundance. The two most common Trichoptera larvae were *Cheumatopsyche* sp. and *Chimarra* sp. *Cheumatopsyche* sp. were present at every sample site, often in large numbers. *Cheumatopsyche* sp. larvae occur in waters that are too polluted for other caddisflies (Ross 1944). The capture net of *Cheumatopsyche* sp. is more voluminous and fragile than that of most *Hydropsyche* species, and is more suited for lower current velocity (Fremling 1960). *Chimarra* sp. is a common net-spinning caddisfly in the family Philopotamidae and was present in 20 of 21 samples. *Chimarra* sp. prefer waters with moderate to slow current (Wallace and Malas 1976, Malas and Wallace 1977, Wallace et al. 1977) because of their fine-meshed capture nets with low porosity (Georgian and Wallace 1981, Thorp 1983). Low flows caused by drought conditions during this study probably influenced the abundance of both *Cheumatopsyche* sp. and *Chimarra* sp.

Goodfred (2006) observed a similar abundance of both *Cheumatopsyche* sp. and *Chimarra* sp. under normal flow conditions.

Mean NCBI scores among all sub-watersheds indicated non-impaired biological conditions. NCBI scores were low due to an abundance of intolerant taxa. *Cheumatopsyche* sp. and *Polypedilum flavum* were taxa that influenced NCBI scores the most due to their presence at every sample site. *Cheumatopsyche* sp. and *Polypedilum flavum* have relatively high tolerance values of 6.22 and 5.69, respectively; thus, abundance of these taxa increased NCBI scores.

Biotic condition scores were significantly affected by a single habitat variable (pH). Aquatic insects have relatively high cuticular permeability and regulate ion uptake using specialized chloride cells; thus, osmoregulation and molting may be affected by acidic conditions (Komnick 1977, Witter et al. 1984, Rowe et al. 1988, Gaino and Reborá 2000). A previous study within the Obed Wild and Scenic River (Goodfred 2006) found that dissolved oxygen, conductivity, and turbidity significantly affected biotic condition scores. Goodfred (2006) sampled additional sites outside of the Obed Wild and Scenic River system and found that low order sites in the upper parts of the Emory River Watershed near municipalities such as Crossville and Crab Orchard were degraded by elevated turbidity and conductivity levels, associated with run off and sedimentation. Sample sites in this study were primarily located in higher order streams within the Obed Wild and Scenic River which were more protected. Also, differences between studies can partially be attributed to drought conditions during this study. Sudden changes in pH in the

Emory River Watershed are potentially problematic because of the sandstone geology and reduced buffering capacity (Griffith and Perry 1994).

Dominance of forest cover in the Obed Wild and Scenic River corridor and Catoosa WMA contributed to overall high benthic community quality within sub-watersheds of the Obed Wild and Scenic River. Strip mining appeared to negatively influence the biotic index scores at the Emory River sub-watershed. Stream acidity is a common impact of mining and can damage aquatic macroinvertebrate communities (Rosemond et al. 1992, Poulton et al. 1995, and Beltman et al. 1999). The lowest pH (6.48) was measured at Emory River at Montgomery Road which also had the lowest biotic index score (16). Although 6.48 is not considered extremely low, episodic acid mine drainage events associated with rainfall probably results in periodic flushes that impact the macroinvertebrate community.

Emory River at Montgomery Road had the highest strip mine land use percentage. The species assemblage of the Emory River at Montgomery Road differed from other fifth order sites within the study area, mostly due to abundance of chironomid taxa and low EPT richness. *Polypedilum flavum*, the dominant taxon collected from this site, has a wide environmental tolerance range and can inhabit heavily degraded waters (Epler 2001) and acidic conditions (Curry 1965, Roback 1974, Summers 1981). Abundance of this taxon provided additional evidence that strip mining had affected the aquatic macroinvertebrate community at the site.

Overall, aquatic macroinvertebrate community health within the Obed Wild and Scenic River system is excellent. Aquatic macroinvertebrate communities are resilient (Winesett 2004). In July 2002, an oil spill occurred near the confluence of

White Creek and Clear Creek at Barnett Bridge in the Obed Wild and Scenic River, but the macroinvertebrate community appeared to have recovered from this disturbance by 2006 (Cook 2006). Biotic index scores at previously impacted sites were extremely high (biotic score=40) in this study, supporting the conclusion that benthic communities have completely recovered from the spill.

As a part of the National Park system, habitat quality and community health in the Obed Wild and Scenic River must be maintained. The Obed Wild and Scenic River supports many aquatic species including the threatened spotfin chub (*Erimonax monachus*) and the endangered purple bean mussel (*Villosa perpurpurea*) (Parmalee and Bogan 1998, Russ 2006, and Schmidt 2007). Maintenance of healthy benthic macroinvertebrate communities is essential to ensure that the fish fauna within the Obed Wild and Scenic River can remain for future generations. To maintain quality of the aquatic environment within the Obed Wild Scenic River, monitoring strip mining land use and preservation of forested habitat should be priorities. The National Park Service should establish monitoring stations in all sub-watersheds to monitor water levels, water chemistry, discharge, and macroinvertebrates on a quarterly basis, enabling immediate detection of changes associated with changing land use patterns.

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TABLES

Table 1. Site, collection date, and stream order classification of sample sites within Obed River.

Site	Date	Location	Stream Order
Adams Bridge	5/30/07	N 36° 3' 49.09", W 84° 57' 0.06"	4
Potters Ford	5/30/07	N 36° 4' 20.9", W 84° 54' 10.59"	4
Obed River at Obed Junction	6/19/07	N 36° 4' 41.94", W 84° 45' 39.98"	5
Obed River at Canoe Hole	9/20/07	N 36° 5' 41.46", W 84° 41' 36.52"	6
Alley Ford	10/16/07	N 36° 4' 49.05", W 84° 41' 36.52"	6

Table 2. Site, collection date, and stream order classification of sample sites within Clear Creek.

Site	Date	Location	Stream Order
Norris Ford	9/13/07	N 36° 8' 13.69", W 84° 52' 20.88"	4
Lilly Bridge	6/4/07	N 36° 6' 2.35", W 84° 42' 59.56"	5
Jett Bridge	6/4/07	N 36° 7' 21.95", W 84° 44' 44.69"	5
Barnett Bridge	6/13/07	N 36° 7' 23.13", W 84° 47' 39.28"	5

Table 3. Site, collection date, and stream order classification of sample sites within Daddys Creek.

Site	Date	Location	Stream Order
Yellow Creek	6/6/07	N 36° 00' 7.1", W 84° 47' 03.9"	3
Yellow Creek at Hebbertsburg Rd.	6/6/07	N 36° 1' 5.5", W 84° 47' 40.2"	3
Devils Breakfast Table	5/30/07	N 36° 3' 33.56", W 84° 47' 31.56"	4
Daddys Creek at Antioch Bridge	6/6/07	N 35° 59' 54.1", W 84° 49' 23.8"	4
Daddys Creek at Obed Junction	6/19/07	N 36° 4' 44.4", W 84° 45' 55.8"	4

Table 4. Site, collection date, and stream order classification of sample sites within White Creek.

Site	Date	Location	Stream Order
Lavendar Bridge	6/13/07	N 36° 9' 27", W 84° 47' 26.1"	4
White Creek at Twin Bridge Rd.	9/4/07	N 36° 10' 43.71", W 84° 47' 58.45"	4
White Creek Mouth	10/2/07	N 36° 7' 23.13", W 84° 47' 39.28"	4

Table 5. Site, collection date, and stream order classification of sample sites within Emory River.

Site	Date	Location	Stream Order
Island Creek at Catoosa Rd.	10/2/07	N 36° 3' 10.26", W 84° 40' 0.78"	3
Rock Creek at Highway 62	6/21/07	N 36° 8' 03.5", W 84° 37' 30.4 "	4
Emory River at Montgomery Rd.	6/21/07	N 36° 6' 47.1", W 84° 36" 53.3"	5
Nemo	6/4/07	N 36° 4' 12.92", W 84° 39' 40.47"	6

Table 6. Modified Wentworth Scale *

Substrate Type	Particle Size Range (mm)
Fines	<2
Small Gravel	2-8
Gravel	8-64
Small Cobble	64-128
Cobble	128-256
Small Boulder	256-512
Boulder	>512
Bedrock	Solid Rock

* Scale reproduced from Overton et al. (1997)

Table 7. Biometrics for Obed River, Clear Creek, White Creek, Daddys Creek, and Emory River calculated using genus level identification of taxa. Biotic score, EPT Richness (EPT), Taxa Richness (TR), Percent Oligochaetes and Chironomids (%OC), Percent EPT (%EPT), North Carolina Biotic Index (NCBI), Percent Nutrient Tolerant Organisms (%NUTOL), and Percent Clingers (%Clingers) values are shown for each site. Total means for all sites are shown. Significant differences not detected among sub-watershed means.

Subwatershed\Site	Biotic Score	EPT	TR	% OC	% EPT	NCBI	% NUTOL	% Clingers
<u>Obed River</u>								
Adams Bridge	34	8	23	14.90	51.92	4.24	53.85	60.58
Potters Ford	30	7	16	2.88	69.71	4.72	67.31	89.42
Obed River at Obed Junction	32	15	30	8.54	64.82	3.68	46.73	70.35
Obed River at Canoe Hole	36	17	28	3.41	45.45	3.81	55.11	82.39
Alley Ford	40	13	23	5.88	78.43	3.83	21.08	85.29
Mean	34.4	12	24	6.70*	73.82*	4.056	55.94*	92.63*
<u>Clear Creek</u>								
Norris Ford	38	11	28	5.31	65.04	4.02	8.85	78.32
Barnett Bridge	40	14	29	19.38	49.38	3.9	29.38	66.25
Jett Bridge	38	20	30	12.5	61.54	4.07	30.77	55.29
Lilly Bridge	40	19	27	0.46	79.36	2.88	17.43	87.62
Mean	39	16	28.5	7.80*	76.06*	3.72	22.22*	86.44*
<u>White Creek</u>								
Lavender Bridge	40	12	32	22.77	47.03	4.39	31.19	73.27
White Creek at Twin Bridge Rd.	32	10	35	47.69	33.33	4.82	31.94	47.69
White Creek Mouth	40	13	40	22.51	52.38	4.33	25.11	60.61
Mean	37.33	11.67	35.67	33.52*	50.40*	4.51	32.21*	71.68*

Table 7 (Continued)

Subwatershed\Site	Biotic Score	EPT	TR	% OC	% EPT	NCBI	% NUTOL	% Clingers
<u>Daddys Creek</u>								
Yellow Creek	38	11	25	13.81	79.56	3.65	21	60.77
Yellow Creek at Hebbertsburg Rd.	40	19	38	28.16	65.53	4.27	37.86	65.53
Devils Breakfast Table	40	14	27	9.39	64.09	3.6	23.2	86.74
Daddys Creek at Antioch Bridge	42	17	46	11.54	37.36	4.29	18.13	79.12
Daddys Creek at Obed Junction	42	18	38	8.88	52.34	3.88	27.57	82.24
Mean	40.4	15.8	34.8	14.40*	70.92*	3.94	27.40*	89.56*
<u>Emory River</u>								
Island Creek at Catoosa Rd.	38	9	31	13.76	50.92	3.61	26.61	66.97
Rock Creek at Highway 62	38	13	24	19.6	59.3	4.32	33.17	55.78
Nemo	38	16	31	12.68	55.4	4.25	46.01	72.77
Emory River at Montgomery Rd.	16	5	23	73.19	12.28	5.59	81.7	22.98
Mean	32.5	10.75	27.25	30.56*	49.27*	4.44	54.28*	63.70*

* denotes arcsine transformed mean value

Table 8. Biometrics for Obed River, Clear Creek, White Creek, Daddys Creek, and Emory River calculated using species level identification of taxa. Biotic score, EPT Richness (EPT), Taxa Richness (TR), Percent Oligochaetes and Chironomids (%OC), Percent EPT (%EPT), North Carolina Biotic Index (NCBI), Percent Nutrient Tolerant Organisms (%NUTOL), and Percent Clingers (%Clingers) values are shown for each site. Total means for all sites are shown. Significant differences not detected among sub-watershed means.

Subwatershed\Site	Biotic Score	EPT	TR	% OC	% EPT	NCBI	% NUTOL	% Clingers
<u>Obed River</u>								
Adams Bridge	36	12	28	14.90	51.92	4.24	53.85	60.58
Potters Ford	34	10	22	2.88	69.71	4.72	67.31	89.42
Obed River at Obed Junction	34	17	34	8.54	64.82	3.68	46.73	70.35
Obed River at Canoe Hole	36	19	34	3.41	45.45	3.81	55.11	82.39
Alley Ford	40	17	27	5.88	78.43	3.83	21.08	85.29
Mean	36	15	29	6.70*	73.82*	4.056	55.94*	92.63*
<u>Clear Creek</u>								
Norris Ford	38	13	34	5.31	65.04	4.02	8.85	78.32
Barnett Bridge	42	20	38	19.38	49.38	3.9	29.38	66.25
Jett Bridge	40	30	59	12.5	61.54	4.07	30.77	55.29
Lilly Bridge	42	26	36	0.46	79.36	2.88	17.43	87.62
Mean	40.5	22.25	41.75	7.80*	76.06*	3.7175	22.22*	86.44*
<u>White Creek</u>								
Lavender Bridge	40	16	38	22.77	47.03	4.39	31.19	73.27
White Creek at Twin Bridge Rd.	34	14	42	47.69	33.33	4.82	31.94	47.69
White Creek Mouth	42	15	43	22.51	52.38	4.33	25.11	60.61
Mean	38.67	15	41	33.52*	50.40*	4.51	32.21*	71.68*

Table 8 (Continued)

Subwatershed\Site	Biotic Score	EPT	TR	% OC	% EPT	NCBI	% NUTOL	% Clingers
<u>Daddys Creek</u>								
Yellow Creek	40	12	26	13.81	79.56	3.65	21	60.77
Yellow Creek at Hebbertsburg Rd.	40	23	42	28.16	65.53	4.27	37.86	65.53
Devils Breakfast Table	42	18	35	9.39	64.09	3.6	23.2	86.74
Daddys Creek at Antioch Bridge	42	19	50	11.54	37.36	4.29	18.13	79.12
Daddys Creek at Obed Junction	42	23	47	8.88	52.34	3.88	27.57	82.24
Mean	41.2	19	40	14.40*	70.92*	3.94	27.40*	89.56*
<u>Emory River</u>								
Island Creek at Catoosa Rd.	38	10	33	13.76	50.92	3.61	26.61	66.97
Rock Creek at Highway 62	40	17	37	19.6	59.3	4.32	33.17	55.78
Nemo	40	21	38	12.68	55.4	4.25	46.01	72.77
Emory River at Montgomery Rd.	16	7	25	73.19	12.28	5.59	81.7	22.98
Mean	33.5	13.75	33.25	30.56*	49.27*	4.44	54.28*	63.70*

* denotes arcsine transformed mean value

Table 9. Aquatic macroinvertebrate biotic condition scores for sample sites within Daddys Creek. Biotic condition scores are listed for both genus and species level (sp. ID) identification of taxa. Significant differences not detected among sub-watershed means.

Site	Date	Biotic Score	Biotic Score (sp. ID)	Condition	Condition (sp. ID)
Yellow Creek	6/6/2007	38	40	non-impaired	non-impaired
Yellow Creek at Hebbertsburg Rd.	6/6/2007	40	40	non-impaired	non-impaired
Devils Breakfast Table	5/30/2007	40	42	non-impaired	non-impaired
Daddys Creek at Antioch Bridge	6/6/2007	42	42	non-impaired	non-impaired
Daddys Creek at Obed Junction	6/20/2007	42	42	non-impaired	non-impaired
Mean		40.4	41.2		

Table 10. Aquatic macroinvertebrate biotic condition scores for sample sites within Emory River. Biotic condition scores are listed for both genus and species level (sp. ID) identification of taxa. Significant differences not detected among sub-watershed means.

Site	Date	Biotic Score	Biotic Score (sp. ID)	Condition	Condition (sp. ID)
Island Creek at Catoosa Rd.	10/2/2007	38	38	non-impaired	non-impaired
Rock Creek at Highway 62	6/27/2007	38	40	non-impaired	non-impaired
Nemo	6/4/2007	38	40	non-impaired	non-impaired
Emory River at Montgomery Rd.	6/21/2007	16	16	moderately-impaired	moderately-impaired
Mean		32.5	33.5		

Table 11. Aquatic macroinvertebrate biotic condition scores for sample sites within Obed River. Biotic condition scores are listed for both genus and species level (sp. ID) identification of taxa. Significant differences not detected among sub-watershed means.

Site	Date	Biotic Score	Biotic Score (sp. ID)	Condition	Condition (sp. ID)
Adams Bridge	5/30/2007	34	36	non-impaired	non-impaired
Potters Ford	5/30/2007	30	34	slightly-impaired	non-impaired
Obed River at Obed Junction	6/20/2007	32	34	non-impaired	non-impaired
Obed River at Canoe Hole	9/20/2007	36	36	non-impaired	non-impaired
Alley Ford	10/16/2007	40	40	non-impaired	non-impaired
Mean		34.4	36		

Table 12. Aquatic macroinvertebrate biotic condition scores for sample sites within Clear Creek. Biotic condition scores are listed for both genus and species level (sp. ID) identification of taxa. Significant differences not detected among sub-watershed means.

Site	Date	Biotic Score	Biotic Score (sp. ID)	Condition	Condition (sp. ID)
Norris Ford	9/13/2007	38	38	non-impaired	non-impaired
Barnett Bridge	6/13/2007	40	42	non-impaired	non-impaired
Jett Bridge	6/4/2007	38	40	non-impaired	non-impaired
Lilly Bridge	6/4/2007	40	42	non-impaired	non-impaired
Mean		39	40.5		

Table 13. Aquatic macroinvertebrate biotic condition scores for sample sites within White Creek. Biotic condition scores are listed for both genus and species level (sp. ID) identification of taxa. Significant differences not detected among sub-watershed means.

Site	Date	Biotic Score	Biotic Score (sp. ID)	Condition	Condition (sp. ID)
Lavender Bridge	6/13/2007	40	40	non-impaired	non-impaired
White Creek at Twin Bridge Rd	9/4/2007	32	34	non-impaired	non-impaired
White Creek Mouth	10/2/2007	40	42	non-impaired	non-impaired
Mean		37.3	38.7		

Table 14. ANOSIM one-way stream order comparisons using presence/absence transformed data.

Stream Order Comparisons	Presence/Absence R-statistic
3rd, 4th	0.555*
3rd, 5th	0.349
3rd, 6th	0.963*
4th, 5th	0.124
4th, 6th	0.081
5th, 6th	-0.087

* statistically significant at $p = 0.10$

Table 15. SIMPER output for 3rd and 4th order stream comparisons using presence/absence transformed data. Taxa listed contributed 90% to the dissimilarity between 3rd and 4th order streams. Average Relative Abundance (%) (an average of standardized data values for each taxon over all samples), Avg. Diss. (average contribution of each taxon to the overall dissimilarity (62.87) between 3rd and 4th order streams), Diss/SD (average dissimilarity/standard deviation ratio), and Contribution (%) are listed.

Taxa	Average Relative Abundance		Avg. Diss	Diss/SD	Contribution
	3rd order	4th order			
<i>Hydropsyche betteni</i>	1.67	0.10	1.30	2.63	2.07
<i>Procloeon</i> sp.	17.33	0.10	1.29	2.63	2.06
<i>Leuctra</i> sp.	22.67	0.20	1.16	1.84	1.85
<i>Maccaffertium modestum</i>	0.67	4.70	1.01	1.35	1.61
<i>Cricotopus</i> sp.	0.00	1.70	1.00	1.43	1.60
<i>Zavrelia</i> sp.	2.00	0.00	0.96	1.33	1.52
<i>Paragnetina immarginata</i>	6.67	0.00	0.96	1.33	1.52
<i>Boyeria vinosa</i>	2.67	0.50	0.91	1.17	1.45
<i>Stenelmis</i> sp.	0.33	6.70	0.91	1.24	1.45
<i>Tipula</i> sp.	0.00	1.20	0.88	1.16	1.40
<i>Polycentropus</i> sp.	1.67	0.50	0.86	1.16	1.37
<i>Microtendipes caelum</i>	2.00	0.50	0.86	1.17	1.37
<i>Maccaffertium vicarium</i>	0.67	8.80	0.85	1.09	1.35
<i>Macronychus glabratus</i>	0.00	6.60	0.83	1.18	1.32
<i>Tanytarsus</i> sp.	1.67	2.70	0.83	1.18	1.32
<i>Microcylloepus pusillus pusillus</i>	0.00	2.10	0.81	1.18	1.29
<i>Ceratopsyche sparna</i>	0.33	7.20	0.81	1.11	1.29
<i>Promoresia elegans</i>	1.00	1.90	0.80	1.10	1.27

Table 15 (Continued)

Taxa	<u>Average Relative Abundance</u>		Avg. Diss	Diss/SD	Contribution
	3rd order	4th order			
<i>Maccaffertium terminatum</i>	1.00	2.60	0.79	1.02	1.26
<i>Rheocricotopus robacki</i>	1.67	2.00	0.76	1.03	1.21
<i>Corydalis cornutus</i>	1.33	3.90	0.75	1.03	1.19

Table 16. SIMPER output for 3rd and 6th order stream comparisons using presence/absence transformed data. Taxa listed contributed 90% to the dissimilarity between 3rd and 6th order streams. Average Relative Abundance (%) (an average of standardized data values for each taxon over all samples), Avg. Diss. (average contribution of each taxon to the overall dissimilarity (65.67) between 3rd and 6th order streams), Diss/SD (average dissimilarity/standard deviation ratio), and Contribution (%) are listed.

Taxa	Average Relative Abundance		Avg. Diss	Diss/SD	Contribution
	3rd order	6th order			
<i>Procloeon</i> sp.	17.33	0.00	1.51	8.04	2.30
<i>Nigronia serricornis</i>	2.00	0.00	1.51	8.04	2.30
<i>Microcylloepus pusillus</i>	0.00	5.33	1.51	8.04	2.30
<i>Neoperla</i> sp.	0.00	7.67	1.51	8.04	2.30
<i>Leuctra</i> sp.	22.67	0.00	1.51	8.04	2.30
<i>Lumbriculis variegatus</i>	0.00	2.00	1.51	8.04	2.30
<i>Hydropsyche demora</i>	0.00	9.00	1.51	8.04	2.30
<i>Boyeria vinosa</i>	2.67	0.00	1.51	8.04	2.30
<i>Simulium</i> sp.	1.33	1.67	1.07	1.32	1.63
<i>Maccaffertium modestum</i>	0.67	11.67	1.07	1.32	1.63
<i>Maccaffertium vicarium</i>	0.67	1.67	1.07	1.32	1.63
<i>Lanthus vernalis</i>	9.33	0.00	1.07	1.32	1.63
<i>Conchapelopia</i> sp.	5.00	1.67	1.04	1.31	1.59
<i>Ceraclea flava</i>	0.00	1.33	1.04	1.31	1.59
<i>Acroneuria abnormis</i>	1.33	0.33	1.04	1.31	1.59
<i>Agnetina annulipes</i>	0.00	2.67	1.04	1.31	1.59
<i>Macrostemum zebratum</i>	0.00	4.33	1.02	1.30	1.55
<i>Hydropsyche venularis</i>	0.00	6.67	1.02	1.30	1.55

Table 16 (Continued)

Taxa	<u>Average Relative Abundance</u>		Avg. Diss	Diss/SD	Contribution
	3rd order	6th order			
<i>Acentrella</i> sp.	0.00	3.33	1.02	1.30	1.55
<i>Stenelmis</i> sp.	0.33	24.33	1.01	1.30	1.54
<i>Zavrelia</i> sp.	2.00	0.00	1.01	1.30	1.54
<i>Polycentropus</i> sp.	1.67	0.00	1.01	1.30	1.54
<i>Corydalis cornutus</i>	1.33	4.67	1.01	1.30	1.54
<i>Stenelmis bicarinata</i>	0.00	2.67	0.97	1.31	1.47
<i>Stenelmis sandersoni</i>	0.00	8.00	0.97	1.31	1.47
<i>Hydropsyche betteni</i>	1.67	0.33	0.97	1.31	1.47
<i>Ectopria</i> sp.	0.00	0.67	0.97	1.31	1.47
<i>Tanytarsus</i> sp.	1.67	0.00	0.95	1.32	1.44
<i>Rheocricotopus robacki</i>	1.67	0.00	0.95	1.32	1.44
<i>Psephenus herricki</i>	2.67	5.33	0.86	1.04	1.32
<i>Optioservus</i> sp.	5.00	0.33	0.86	1.04	1.32
<i>Eukiefferiella</i> sp.	0.33	1.00	0.86	1.04	1.32
<i>Ceratopsyche sparna</i>	0.33	0.67	0.86	1.04	1.32
<i>Paragnetina immarginata</i>	6.67	0.67	0.84	1.03	1.28
<i>Atherix lantha</i>	2.33	0.33	0.83	1.05	1.26
<i>Microtendipes caelum</i>	2.00	3.00	0.83	1.04	1.26

FIGURES

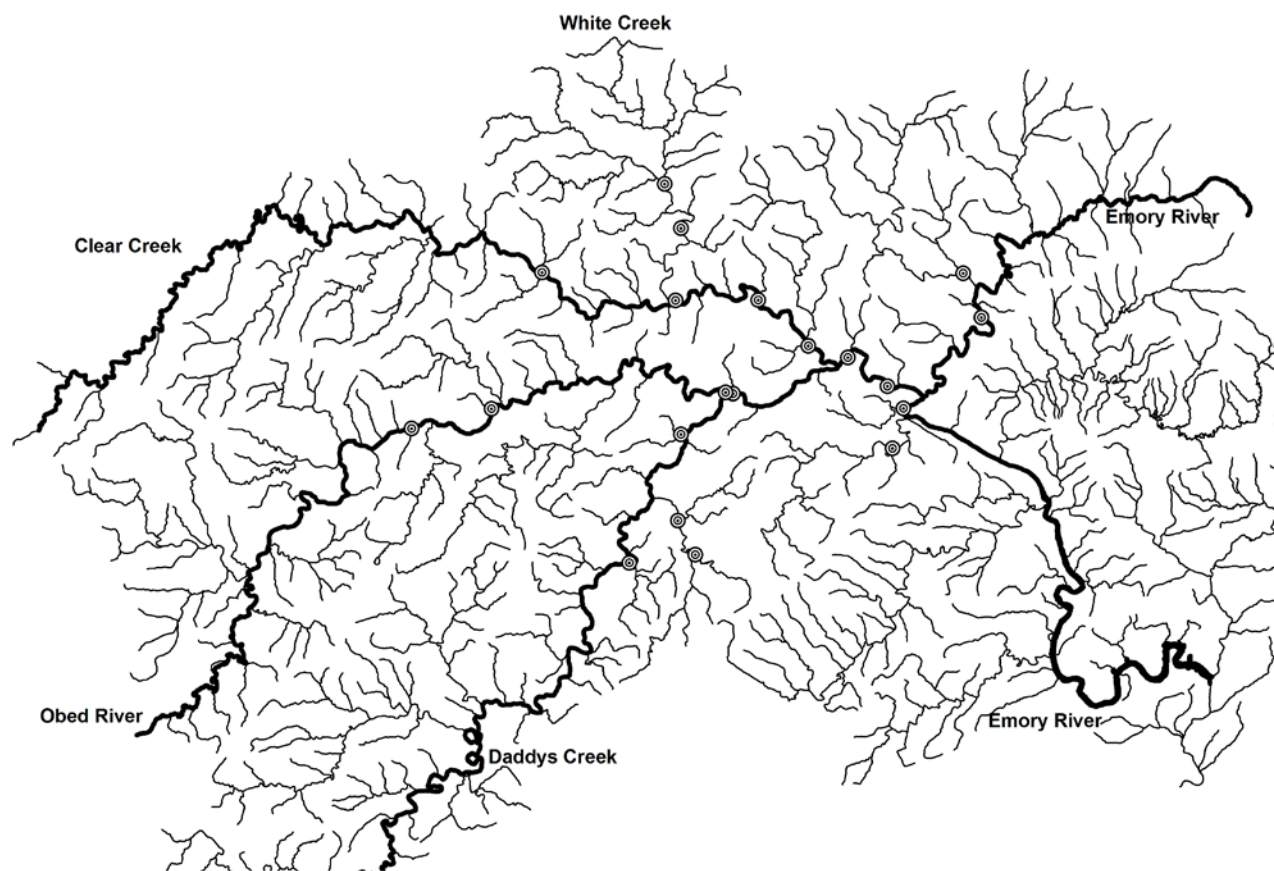


Figure 1. Obed Wild and Scenic River sub-watersheds (Obed River, Clear Creek, Daddys Creek, White Creek, Emory River) and sample site locations.

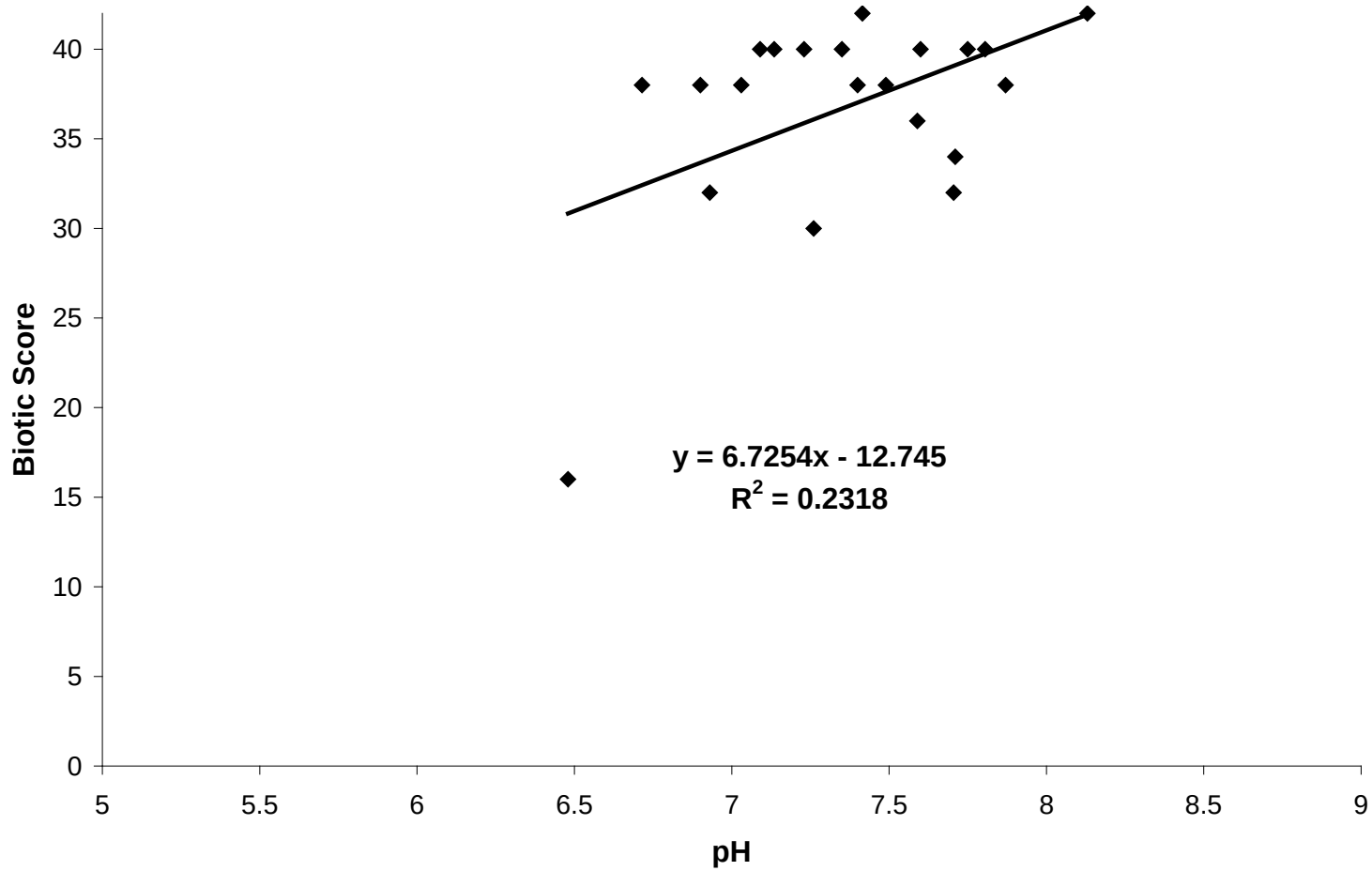


Figure 2. Regression model for the effects of pH on biotic condition scores within the Obed Wild and Scenic River.

APPENDICES

APPENDIX A

TAXA LISTS

Appendix Table A-1: Aquatic macroinvertebrates collected within Obed River at Adams Bridge, Cumberland County, Tennessee (N 36° 3' 49.09", W 84° 57' 0.06"), May 30, 2007.

#Individuals	Order	Family	Genus	Species
40	Coleoptera	Psephenidae	<i>Psephenus</i>	<i>P. herricki</i>
19	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. sp.</i>
1	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sp.</i>
1	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. mera</i> *
5	Diptera	Tipulidae	<i>Tipula</i>	<i>T. sp.</i>
4	Diptera	Chironomidae	<i>Microtendipes</i>	<i>M. caelum</i>
4	Diptera	Chironomidae	<i>Stictochironomus</i>	<i>S. sp.</i>
4	Diptera	Chironomidae	<i>Conchapelopia</i>	<i>C. sp.</i>
1	Diptera	Chironomidae	<i>Procladius</i>	<i>P. sp.</i>
12	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
1	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. illinoense</i>
3	Diptera	Chironomidae	<i>Cricotopus</i>	<i>C. sp.</i>
1	Diptera	Chironomidae	<i>Eukiefferiella</i>	<i>E. sp.</i>
6	Ephemeroptera	Isonychiidae	<i>Isonychia</i>	<i>I. sp.</i>
19	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. vicarium</i>
7	Ephemeroptera	Heptageniidae	<i>Stenonema</i>	<i>S. femoratum</i>
3	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. exiguum</i>
9	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. terminatum</i>
2	Ephemeroptera	Ephemeridae	<i>Ephemera</i>	<i>E. sp.</i>
1	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. modestum</i>
1	Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	<i>L. variegatus</i>
1	Odonata	Gomphidae	<i>Lanthus</i>	<i>L. vernalis</i>
2	Odonata	Coenagrionidae	<i>Argia</i>	<i>A. sp.</i>
1	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. carolinensis</i>
2	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. abnormis</i>
1	Plecoptera	Perlidae	<i>Agnetina</i>	<i>A. annulipes</i>
53	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
4	Trichoptera	Limnephilidae	<i>Hydatophylax</i>	<i>H. argus</i>

n= 208

* adult specimen

Appendix Table A-2: Aquatic macroinvertebrates collected within Obed River at Potters Ford, Cumberland County, Tennessee (N 36° 4' 20.9", W 84° 54' 10.59"), May 30, 2007.

#Individuals	Order	Family	Genus	Species
12	Coleoptera	Psephenidae	<i>Psephenus</i>	<i>P. herricki</i>
18	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sp.</i>
14	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. sp.</i>
1	Coleoptera	Elmidae	<i>Microcyloepus</i>	<i>M. pusillus</i>
6	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. bicarinata</i> *
2	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. ovalis</i> *
2	Diptera	Tipulidae	<i>Tipula</i>	<i>T. sp.</i>
1	Diptera	Tipulidae	<i>Antocha</i>	<i>A. sp.</i>
3	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
2	Diptera	Chironomidae	<i>Psectrocladius</i>	<i>P. sp.</i>
1	Diptera	Chironomidae	<i>Cricotopus</i>	<i>C. sp.</i>
13	Ephemeroptera	Isonychiidae	<i>Isonychia</i>	<i>I. sp.</i>
2	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. vicarium</i>
5	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. modestum</i>
2	Ephemeroptera	Heptageniidae	<i>Heptagenia</i>	<i>H. sp.</i>
1	Ephemeroptera	Ephemerellidae	<i>Serratella</i>	<i>S. deficiens</i>
1	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. terminatum</i>
1	Odonata	Gomphidae	<i>Hagenius</i>	<i>H. brevistylus</i>
17	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. abnormis</i>
2	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. carolinensis</i>
101	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
1	Trichoptera	Philopotamidae	<i>Chimarra</i>	<i>C. sp.</i>

n=208

* adult specimen

Appendix Table A-3: Aquatic macroinvertebrates collected within Obed River at Obed Junction, Morgan County, Tennessee (N 36° 4' 41.94", W 84° 45' 39.98"), June 19, 2007.

#Individuals	Order	Family	Genus	Species
2	Acarina	Acarina	Acarina	Acarina
5	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sp.</i>
4	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. sp.</i>
6	Coleoptera	Elmidae	<i>Microcyloepus</i>	<i>M. pusillus</i>
4	Coleoptera	Elmidae	<i>Promoresia</i>	<i>P. elegans</i>
1	Coleoptera	Elmidae	<i>Gonielmis</i>	<i>G. dietrichi</i> *
2	Coleoptera	Elmidae	<i>Microcyloepus</i>	<i>M. pusillus aptus</i> *
4	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. bicarinata</i> *
1	Coleoptera	Elmidae	<i>Macronychus</i>	<i>M. glabratus</i> *
1	Coleoptera	Psephenidae	<i>Psephenus</i>	<i>P. herricki</i>
20	Diptera	Simuliidae	<i>Simulium</i>	<i>S. sp.</i>
2	Diptera	Simuliidae	<i>Prosimulium</i>	<i>P. sp.</i>
5	Diptera	Chironomidae	<i>Eukiefferiella</i>	<i>E. discoloripes</i>
7	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
4	Diptera	Chironomidae	<i>Rheotanytarsus</i>	<i>R. exiguus</i>
3	Ephemeroptera	Isonychiidae	<i>Isonychia</i>	<i>I. sp.</i>
10	Ephemeroptera	Ephemerellidae	<i>Serratella</i>	<i>S. deficiens</i>
2	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. modestum</i>
4	Ephemeroptera	Baetidae	<i>Acentrella</i>	<i>A. sp.</i>
35	Ephemeroptera	Baetidae	<i>Baetis</i>	<i>B. intercalaris</i>
1	Lumbriculida	Lumbriculidae	<i>Lumbriculis</i>	<i>L. variegatus</i>
1	Odonata	Aeshnidae	<i>Boyeria</i>	<i>B. vinosa</i>
3	Plecoptera	Perlidae	<i>Perlesta</i>	<i>P. placida</i>
1	Plecoptera	Perlidae	<i>Neoperla</i>	<i>N. sp.</i>
3	Trichoptera	Rhyacophilidae	<i>Rhyacophila</i>	<i>R. vuphipes</i>
16	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
10	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	<i>C. sparna</i>
14	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. venularis</i>
21	Trichoptera	Philopotamidae	<i>Chimarra</i>	<i>C. sp.</i>
1	Trichoptera	Brachycentridae	<i>Brachycentrus</i>	<i>B. numerosus</i>
2	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. demora</i>
1	Trichoptera	Lepidostomatidae	<i>Lepidostoma</i>	<i>L. sp.</i>
2	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. simulans</i>
1	Trichoptera	Leptoceridae	<i>Oecetis</i>	<i>O. persimilis</i>

n= 199

* adult specimen

Appendix Table A-4: Aquatic macroinvertebrates collected within Obed River at Canoe Hole, Morgan County, Tennessee (N 36° 5' 41.46", W 84° 41' 36.52"), September 20, 2007.

#Individuals	Order	Family	Genus	Species
16	Coleoptera	Psephenidae	<i>Psephenus</i>	<i>P. herricki</i>
1	Coleoptera	Psephenidae	<i>Ectopria</i>	<i>E. sp.</i>
30	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sp.</i>
1	Coleoptera	Elmidae	<i>Promoresia</i>	<i>P. elegans</i>
3	Coleoptera	Elmidae	<i>Microcyloepus</i>	<i>M. pusillus</i>
1	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. sp.</i>
13	Coleoptera	Elmidae	<i>Microcyloepus</i>	<i>M. pusillus pusillus</i> *
18	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sandersoni</i> *
3	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. bicarinata</i> *
2	Coleoptera	Dryopidae	<i>Helichus</i>	<i>H. fastigiatus</i> *
1	Coleoptera	Dryopidae	<i>Helichus</i>	<i>H. basalis</i> *
2	Diptera	Simuliidae	<i>Simulium</i>	<i>S. sp.</i>
2	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
7	Ephemeroptera	Heptageniidae	<i>Heptagenia</i>	<i>H. sp.</i>
4	Ephemeroptera	Isonychiidae	<i>Isonychia</i>	<i>I. sp.</i>
2	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. vicarium</i>
1	Ephemeroptera	Heptageniidae	<i>Leucrocuta</i>	<i>L. junio</i>
10	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. modestum</i>
1	Ephemeroptera	Heptageniidae	<i>Stenacron</i>	<i>S. interpunctatum</i>
2	Ephemeroptera	Ephemerellidae	<i>Eurylophella</i>	<i>E. sp.</i>
1	Ephemeroptera	Heptageniidae	<i>Leucrocuta</i>	<i>L. thetis</i>
16	Ephemeroptera	Baetidae	<i>Baetis</i>	<i>B. intercalaris</i>
8	Ephemeroptera	Baetidae	<i>Heterocloeon</i>	<i>H. curiosum</i>
4	Lumbriculida	Lumbriculidae	<i>Lumbriculis</i>	<i>L. variegatus</i>
2	Megaloptera	Corydalidae	<i>Corydalis</i>	<i>C. cornutus</i>
1	Odonata	Coenagrionidae	<i>Argia</i>	<i>A. sp.</i>
4	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. carolinensis</i>
6	Plecoptera	Perlidae	<i>Neoperla</i>	<i>N. sp.</i>
2	Plecoptera	Perlidae	<i>Paragnetina</i>	<i>P. immarginata</i>
7	Plecoptera	Perlidae	<i>Agnetina</i>	<i>A. annulipes</i>
2	Trichoptera	Philopotamidae	<i>Chimarra</i>	<i>C. sp.</i>
5	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
1	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. demora</i>
1	Trichoptera	Leptoceridae	<i>Ceraclea</i>	<i>C. flava</i>

n= 180

* adult specimen

Appendix Table A-5: Aquatic macroinvertebrates collected within Obed River at Alley Ford, Morgan County, Tennessee (N 36° 4' 49.05", W 84° 41' 36.52"), October 16, 2007.

#Individuals	Order	Family	Genus	Species
2	Coleoptera	Elmidae	<i>Promoresia</i>	<i>P. elegans</i>
3	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sp.</i>
10	Coleoptera	Elmidae	<i>Microcylloepus</i>	<i>M. pusillus</i>
9	Coleoptera	Elmidae	<i>Microcylloepus</i>	<i>M. pusillus pusillus</i> *
1	Diptera	Simuliidae	<i>Simulium</i>	<i>S. sp.</i>
1	Diptera	Ceratopogonidae	<i>Dasyhelea</i>	<i>D. sp.</i>
4	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
6	Diptera	Chironomidae	<i>Rheotanytarsus</i>	<i>R. exiguus</i>
1	Diptera	Chironomidae	<i>Eukiefferiella</i>	<i>E. sp.</i>
17	Ephemeroptera	Isonychiidae	<i>Isonychia</i>	<i>I. sp.</i>
1	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. vicarium</i>
15	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. modestum</i>
1	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. terminatum</i>
1	Ephemeroptera	Baetidae	<i>Acentrella</i>	<i>A. sp.</i>
2	Ephemeroptera	Baetidae	<i>Baetis</i>	<i>B. intercalaris</i>
1	Lumbriculida	Lumbriculidae	<i>Lumbriculis</i>	<i>L. variegatus</i>
6	Megaloptera	Corydalidae	<i>Corydalus</i>	<i>C. cornutus</i>
1	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. carolinensis</i>
1	Plecoptera	Perlidae	<i>Neoperla</i>	<i>N. sp.</i>
1	Plecoptera	Perlidae	<i>Agnatina</i>	<i>A. annulipes</i>
4	Trichoptera	Hydropsychidae	<i>Macrostemum</i>	<i>M. zebratum</i>
48	Trichoptera	Philopotamidae	<i>Chimarra</i>	<i>C. sp.</i>
26	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
18	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. demora</i>
19	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. venularis</i>
1	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. betteni</i>
1	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	<i>C. sparna</i>
3	Trichoptera	Leptoceridae	<i>Ceraclea</i>	<i>C. flava</i>

n= 204

* adult specimen

Appendix Table A-6: Aquatic macroinvertebrates collected within Clear Creek at Norris Ford, Morgan/Cumberland County, Tennessee (N 36° 8' 13.69", W 84° 52' 20.88"), September 13, 2007.

#Individuals	Order	Family	Genus	Species
16	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sp.</i>
3	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. sp.</i>
2	Coleoptera	Elmidae	<i>Microcylloepus</i>	<i>M. pusillus pusillus</i> *
4	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. ovalis</i> *
3	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. mera</i> *
6	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. bicarinata</i> *
1	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sandersoni</i> *
1	Coleoptera	Elmidae	<i>Macronychus</i>	<i>M. glabratus</i> *
2	Coleoptera	Dryopidae	<i>Helichus</i>	<i>H. fastigiatus</i> *
4	Diptera	Athericidae	<i>Atherix</i>	<i>A. lantha</i>
2	Diptera	Tipulidae	<i>Tipula</i>	<i>T. sp.</i>
1	Diptera	Simuliidae	<i>Simulium</i>	<i>S. sp.</i>
4	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
2	Diptera	Chironomidae	<i>Conchapelopia</i>	<i>C. sp.</i>
2	Diptera	Chironomidae	<i>Cricotopus</i>	<i>C. sp.</i>
1	Diptera	Ceratopogonidae	<i>Dasyhelea</i>	<i>D. sp.</i>
4	Diptera	Chironomidae	<i>Psectrocladius</i>	<i>P. sp.</i>
25	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. vicarium</i>
21	Ephemeroptera	Isonychiidae	<i>Isonychia</i>	<i>I. sp.</i>
1	Ephemeroptera	Baetidae	<i>Acentrella</i>	<i>A. sp.</i>
10	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. modestum</i>
2	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. terminatum</i>
1	Ephemeroptera	Baetidae	<i>Baetis</i>	<i>B. intercalaris</i>
7	Megaloptera	Corydalidae	<i>Corydalus</i>	<i>C. cornutus</i>
7	Megaloptera	Corydalidae	<i>Nigronia</i>	<i>N. serricornis</i>
5	Odonata	Gomphidae	<i>Lanthus</i>	<i>L. vernalis</i>
2	Odonata	Gomphidae	<i>Gomphus</i>	<i>G. exilis</i>
1	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. carolinensis</i>
23	Trichoptera	Philopotamidae	<i>Chimarra</i>	<i>C. sp.</i>
47	Trichoptera	Polycentropodidae	<i>Neureclipsis</i>	<i>N. crepuscularis</i>
12	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
2	Trichoptera	Polycentropodidae	<i>Polycentropus</i>	<i>P. sp.</i>
1	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. venularis</i>
1	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	<i>C. sparna</i>

n= 226

* adult specimen

Appendix Table A-7: Aquatic macroinvertebrates collected within Clear Creek at Lilly Bridge, Morgan County, Tennessee (N 36° 6' 2.35", W 84° 42' 59.56"), June 4, 2007.

#Individuals	Order	Family	Genus	Species
6	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sp.</i>
12	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. bicarinata</i> *
2	Coleoptera	Elmidae	<i>Gonielmis</i>	<i>G. dietrichi</i> *
1	Coleoptera	Elmidae	<i>Microcylloepus</i>	<i>M. pusillus pusillus</i> *
1	Coleoptera	Elmidae	<i>Microcylloepus</i>	<i>M. pusillus</i>
2	Diptera	Athericidae	<i>Atherix</i>	<i>A. lantha</i>
16	Diptera	Simuliidae	<i>Simulium</i>	<i>S. sp.</i>
1	Diptera	Simuliidae	<i>Cnephia</i>	<i>C. sp.</i>
1	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. illinoense</i>
16	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. modestum</i>
4	Ephemeroptera	Heptageniidae	<i>Epeorus</i>	<i>E. dispar</i>
1	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. vicarium</i>
10	Ephemeroptera	Ephemerellidae	<i>Serratella</i>	<i>S. deficiens</i>
17	Ephemeroptera	Baetidae	<i>Heterocloeon</i>	<i>H. curiosum</i>
4	Ephemeroptera	Isonychiidae	<i>Isonychia</i>	<i>I. sp.</i>
2	Ephemeroptera	Baetidae	<i>Baetis</i>	<i>B. intercalaris</i>
3	Megaloptera	Corydalidae	<i>Corydalus</i>	<i>C. cornutus</i>
3	Plecoptera	Perlidae	<i>Paragnetina</i>	<i>P. immarginata</i>
1	Plecoptera	Perlidae	<i>Agnetina</i>	<i>A. flavescens</i>
8	Plecoptera	Perlidae	<i>Neoperla</i>	<i>N. sp.</i>
6	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. carolinensis</i>
5	Plecoptera	Perlidae	<i>Perlesta</i>	<i>P. placida</i>
1	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
6	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. demora</i>
11	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	<i>C. sparna</i>
10	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. venularis</i>
12	Trichoptera	Philopotamidae	<i>Chimarra</i>	<i>C. sp.</i>
2	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	<i>C. ventura</i>
3	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. hageni</i>
1	Trichoptera	Rhyacophilidae	<i>Rhyacophila</i>	<i>R. vuphipes</i>
30	Trichoptera	Brachycentridae	<i>Micrasema</i>	<i>M. wataga</i>
11	Trichoptera	Brachycentridae	<i>Micrasema</i>	<i>M. sp.</i>
5	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. simulans</i>
2	Trichoptera	Leptoceridae	<i>Oecetis</i>	<i>O. sp.</i>
1	Trichoptera	Leptoceridae	<i>Ceraclea</i>	<i>C. ancylus</i>
1	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	<i>C. macleodi</i>

n= 218

* adult specimen

Appendix Table A-8: Aquatic macroinvertebrates collected within Clear Creek at Jett Bridge, Morgan County, Tennessee (N 36° 7' 21.95", W 84° 44' 44.69"), June 4, 2007.

#Individuals	Order	Family	Genus	Species
10	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. sp.</i>
9	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sp.</i>
1	Coleoptera	Elmidae	<i>Ancyronyx</i>	<i>A. variegatus</i>
2	Coleoptera	Elmidae	<i>Microcylloepus</i>	<i>M. pusillus</i>
9	Coleoptera	Elmidae	<i>Macronychus</i>	<i>M. glabratus</i> *
2	Coleoptera	Elmidae	<i>Microcylloepus</i>	<i>M. pusillus pusillus</i> *
1	Coleoptera	Elmidae	<i>Gonielmis</i>	<i>G. dietrichi</i> *
1	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. crenata.</i> *
3	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. bicarinata</i> *
1	Coleoptera	Elmidae	<i>Promoresia</i>	<i>P. elegans</i>
2	Diptera	Simuliidae	<i>Simulium</i>	<i>S. sp.</i>
1	Diptera	Simuliidae	<i>Prosimulium</i>	<i>P. sp.</i>
2	Diptera	Chironomidae	<i>Eukiefferiella</i>	<i>E. discoloripes</i>
8	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
2	Diptera	Chironomidae	<i>Symbiocladius</i>	<i>S. sp.</i>
3	Diptera	Chironomidae	<i>Pentaneura</i>	<i>P. sp.</i>
2	Diptera	Chironomidae	<i>Tanytarsus</i>	<i>T. guerlus</i>
1	Diptera	Chironomidae	<i>Larsia</i>	<i>L. sp.</i>
4	Diptera	Chironomidae	<i>Rheotanytarsus</i>	<i>R. exiguus</i>
1	Diptera	Chironomidae	<i>Rheocricotopus</i>	<i>R. robacki</i>
1	Diptera	Chironomidae	<i>Conchapelopia</i>	<i>C. sp.</i>
1	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. mediopunctatum</i>
16	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. vicarium</i>
2	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. exiguum</i>
1	Ephemeroptera	Heptageniidae	<i>Heptagenia</i>	<i>H. sp.</i>
11	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. terminatum</i>
1	Ephemeroptera	Heptageniidae	<i>Stenecron</i>	<i>S. pallidum</i>
27	Ephemeroptera	Baetidae	<i>Baetis</i>	<i>B. intercalaris</i>
20	Ephemeroptera	Isonychiidae	<i>Isonychia</i>	<i>I. sp.</i>
5	Ephemeroptera	Baetidae	<i>Acentrella</i>	<i>A. sp.</i>
2	Ephemeroptera	Baetidae	<i>Baetis</i>	<i>B. sp.</i>
1	Ephemeroptera	Baetidae	<i>Procloeon</i>	<i>P. sp.</i>
1	Ephemeroptera	Ephemerellidae	<i>Serratella</i>	<i>S. serrata</i>
2	Ephemeroptera	Ephemerellidae	<i>Serratella</i>	<i>S. deficiens</i>
2	Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	<i>L. variegatus</i>
3	Megaloptera	Corydalidae	<i>Corydalus</i>	<i>C. cornutus</i>
2	Megaloptera	Corydalidae	<i>Nigronia</i>	<i>N. serricornis</i>
3	Odonata	Aeshnidae	<i>Boyeria</i>	<i>B. vinosa</i>
1	Odonata	Corduliidae	<i>Neurocordulia</i>	<i>N. yamaskanensis</i>
1	Odonata	Gomphidae	<i>Hylogomphus</i>	<i>H. viridifrons</i>
1	Odonata	Gomphidae	<i>Lanthus</i>	<i>L. vernalis</i>

Appendix Table A-8 (continued)

#Individuals	Order	Family	Genus	Species
1	Odonata	Coenagrionidae	<i>Argia</i>	<i>A. sp.</i>
6	Plecoptera	Perlidae	<i>Perlesta</i>	<i>P. placida</i>
2	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. abnormis</i>
1	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. carolinensis</i>
6	Trichoptera	Limnephilidae	<i>Pycnopsyche</i>	<i>P. antica</i>
1	Trichoptera	Limnephilidae	<i>Pycnopsyche</i>	<i>P. sp.</i>
1	Trichoptera	Leptoceridae	<i>Nectopsyche</i>	<i>N. exquisita</i>
1	Trichoptera	Philopotamidae	<i>Chimarra</i>	<i>C. sp.</i>
1	Trichoptera	Leptoceridae	<i>Oecetis</i>	<i>O. inconspicua</i>
1	Trichoptera	Brachycentridae	<i>Micrasema</i>	<i>M. wataga</i>
2	Trichoptera	Brachycentridae	<i>Micrasema</i>	<i>M. sp.</i>
5	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
4	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	<i>C. sparna</i>
1	Trichoptera	Polycentropodidae	<i>Neureclipsis</i>	<i>N. crepuscularis</i>
1	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. simulans</i>
3	Trichoptera	Leptoceridae	<i>Oecetis</i>	<i>O. persimilis</i>
1	Trichoptera	Brachycentridae	<i>Micrasema</i>	<i>M. rusticum</i>
1	Trichoptera	Lepidostomatidae	<i>Lepidostoma</i>	<i>L. sp.</i>

n= 208

* adult specimen

Appendix Table A-9: Aquatic macroinvertebrates collected within Clear Creek at Barnett Bridge, Morgan County, Tennessee (N 36° 7' 23.13", W 84° 47' 39.28"), June 13, 2007.

#Individuals	Order	Family	Genus	Species
11	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sp.</i>
3	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. sp.</i>
5	Coleoptera	Elmidae	<i>Macronychus</i>	<i>M. glabratus *</i>
1	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. ovalis *</i>
6	Coleoptera	Elmidae	<i>Microcylloepus</i>	<i>M. pusillus pusillus *</i>
8	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. bicarinata *</i>
1	Coleoptera	Elmidae	<i>Microcylloepus</i>	<i>M. pusillus aptus</i>
9	Diptera	Athericidae	<i>Atherix</i>	<i>A. lantha</i>
8	Diptera	Chironomidae	<i>Conchapelopia</i>	<i>C. sp.</i>
3	Diptera	Chironomidae	<i>Ablabesmyia</i>	<i>A. mallochi</i>
1	Diptera	Chironomidae	<i>Lopescladius</i>	<i>L. sp.</i>
5	Diptera	Chironomidae	<i>Rheotanytarsus</i>	<i>R. exiguus</i>
3	Diptera	Chironomidae	<i>Eukiefferiella</i>	<i>E. discoloripes</i>
2	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
7	Diptera	Chironomidae	<i>Cricotopus</i>	<i>C. sp.</i>
2	Diptera	Chironomidae	<i>Rheocricotopus</i>	<i>R. robacki</i>
12	Ephemeroptera	Isonychiidae	<i>Isonychia</i>	<i>I. sp.</i>
7	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. modestum</i>
5	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. vicarium</i>
1	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. smithae</i>
1	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. ithaca</i>
1	Ephemeroptera	Heptageniidae	<i>Stenacron</i>	<i>S. interpunctatum</i>
1	Ephemeroptera	Heptageniidae	<i>Heptagenia</i>	<i>H. sp.</i>
1	Ephemeroptera	Heptageniidae	<i>Stenacron</i>	<i>S. carolina</i>
1	Ephemeroptera	Heptageniidae	<i>Stenacron</i>	<i>S. pallidum</i>
6	Ephemeroptera	Ephemerellidae	<i>Serratella</i>	<i>S. deficiens</i>
2	Ephemeroptera	Baetidae	<i>Acentrella</i>	<i>A. sp.</i>
3	Ephemeroptera	Baetidae	<i>Baetis</i>	<i>B. intercalaris</i>
1	Odonata	Gomphidae	<i>Stylogomphus</i>	<i>S. albistylus</i>
5	Odonata	Gomphidae	<i>Lanthus</i>	<i>L. vernalis</i>
5	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. abnormis</i>
1	Plecoptera	Perlidae	<i>Agnetina</i>	<i>A. annulipes</i>
1	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. carolinenseis</i>
5	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	<i>C. sparna</i>
11	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
2	Trichoptera	Philopotamidae	<i>Chimarra</i>	<i>C. sp.</i>
8	Trichoptera	Polycentropodidae	<i>Neureclipsis</i>	<i>N. crepuscularis</i>
5	Trichoptera	Polycentropodidae	<i>Polycentropus</i>	<i>P. sp.</i>

n= 160

* adult specimen

Appendix Table A-10: Aquatic macroinvertebrates collected within White Creek at Lavender Bridge, Morgan County, Tennessee (N 36° 9' 27", W 84° 47' 26.1"), June 13, 2007.

#Individuals	Order	Family	Genus	Species
8	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sp.</i>
8	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. sp.</i>
7	Coleoptera	Elmidae	<i>Macronychus</i>	<i>M. glabratus</i> *
1	Coleoptera	Elmidae	<i>Gonielmis</i>	<i>G. dietrichi</i> *
3	Coleoptera	Elmidae	<i>Ancyronyx</i>	<i>A. variegatus</i> *
1	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. bicarinata</i> *
1	Coleoptera	Elmidae	<i>Microcyloopus</i>	<i>M. pusillus pusillus</i> *
1	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. crenata</i> *
3	Coleoptera	Dryopidae	<i>Helichus</i>	<i>H. fastigiatus</i> *
2	Diptera	Athericidae	<i>Atherix</i>	<i>A. lantha</i>
3	Diptera	Simuliidae	<i>Simulium</i>	<i>S. sp.</i>
26	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
11	Diptera	Chironomidae	<i>Conchapelopia</i>	<i>C. sp.</i>
1	Diptera	Chironomidae	<i>Rheocricotopus</i>	<i>R. robacki</i>
5	Diptera	Chironomidae	<i>Eukiefferiella</i>	<i>E. sp.</i>
2	Diptera	Chironomidae	<i>Rheotanytarsus</i>	<i>R. exiguus</i>
1	Diptera	Chironomidae	<i>Tanytarsus</i>	<i>T. sp.</i>
6	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. modestum</i>
12	Ephemeroptera	Ephemerellidae	<i>Eurylophella</i>	<i>E. sp.</i>
1	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. ithaca</i>
3	Ephemeroptera	Isonychiidae	<i>Isonychia</i>	<i>I. sp.</i>
3	Ephemeroptera	Ephemerellidae	<i>Serratella</i>	<i>S. deficiens</i>
1	Hemiptera	Veliidae	<i>Microvelia</i>	<i>M. sp. *</i>
18	Megaloptera	Corydalidae	<i>Nigronia</i>	<i>N. serricornis</i>
2	Odonata	Aeshnidae	<i>Boyeria</i>	<i>B. vinosa</i>
1	Odonata	Gomphidae	<i>Hagenius</i>	<i>H. brevistylus</i>
1	Odonata	Gomphidae	<i>Lanthus</i>	<i>L. vernalis</i>
2	Plecoptera	Perlidae	<i>Perlesta</i>	<i>P. placida</i>
5	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. carolinensis</i>
4	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. abnormis</i>
1	Plecoptera	Leuctridae	<i>Leuctra</i>	<i>L. sp.</i>
22	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	<i>C. sparna</i>
22	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
6	Trichoptera	Philopotamidae	<i>Chimarra</i>	<i>C. sp.</i>
3	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. demora</i>
3	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. venularis</i>
1	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. simulans</i>
1	Trichoptera	Polycentropodidae	<i>Neureclipsis</i>	<i>N. crepuscularis</i>

n= 202

* adult specimen

Appendix Table A-11: Aquatic macroinvertebrates collected within White Creek at Twin Bridge Rd, Morgan County, Tennessee (N 36°10'43.71", W 84°47'58.45"), September 4, 2007.

#Individuals	Order	Family	Genus	Species
1	Coleoptera	Elmidae	<i>Ancyronyx</i>	<i>A. variegatus</i>
5	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. sp.</i>
1	Coleoptera	Elmidae	<i>Ancyronyx</i>	<i>A. variegatus</i> *
4	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. ovalis</i> *
2	Coleoptera	Dryopidae	<i>Helichus</i>	<i>H. fastigiatus</i> *
1	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sp.</i>
1	Coleoptera	Ptilodactylidae	<i>Anchytarsus</i>	<i>A. bicolor</i>
1	Diptera	Tipulidae	<i>Tipula</i>	<i>T. sp.</i>
1	Diptera	Culicidae	<i>Anopheles</i>	<i>A. sp.</i>
33	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
17	Diptera	Chironomidae	<i>Conchapelopia</i>	<i>C. sp.</i>
1	Diptera	Chironomidae	<i>Ablabesmyia</i>	<i>A. sp.</i>
3	Diptera	Chironomidae	<i>Parametriocnemus</i>	<i>P. sp.</i>
5	Diptera	Chironomidae	<i>Rheotanytarsus</i>	<i>R. exiguus</i>
26	Diptera	Chironomidae	<i>Tanytarsus</i>	<i>T. sp.</i>
2	Diptera	Chironomidae	<i>Rheocricotopus</i>	<i>R. robacki</i>
2	Diptera	Ceratopogonidae	<i>Dasyhelea</i>	<i>D. sp.</i>
1	Diptera	Ceratopogonidae	<i>Bezzia</i>	<i>B. sp.</i>
1	Diptera	Chironomidae	<i>Cricotopus</i>	<i>C. sp.</i>
1	Diptera	Chironomidae	<i>Ablabesmyia</i>	<i>A. mallochii</i>
1	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. illinoense</i>
3	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. vicarium</i>
1	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. terminatum</i>
2	Ephemeroptera	Ephemeridae	<i>Ephemer</i>	<i>E. sp.</i>
1	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. modestum</i>
10	Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	<i>L. variegatus</i>
12	Megaloptera	Corydalidae	<i>Corydalus</i>	<i>C. cornutus</i>
3	Megaloptera	Corydalidae	<i>Nigronia</i>	<i>N. serricornis</i>
4	Odonata	Corduliidae	<i>Neurocordulia</i>	<i>N. yamaskanensis</i>
1	Odonata	Corduliidae	<i>Somatochlora</i>	<i>S. linearis</i>
1	Odonata	Aeshnidae	<i>Boyeria</i>	<i>B. vinosa</i>
2	Odonata	Gomphidae	<i>Hagenius</i>	<i>H. brevistylus</i>
1	Odonata	Gomphidae	<i>Lanthus</i>	<i>L. vernalis</i>
1	Plecoptera	Leuctridae	<i>Leuctra</i>	<i>L. sp.</i>
4	Trichoptera	Helicopsychidae	<i>Helicopsyche</i>	<i>H. borealis</i>
15	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
32	Trichoptera	Philopotamidae	<i>Chimarra</i>	<i>C. sp.</i>
3	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	<i>C. sparna</i>

Appendix Table A-11 (Continued)

#Individuals	Order	Family	Genus	Species
4	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. venularis</i>
2	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	<i>C. ventura</i>
1	Trichoptera	Leptoceridae	<i>Oecetis</i>	<i>O. sp.</i>
1	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. betteni</i>
2	Trichoptera	Leptoceridae	<i>Nectopsyche</i>	<i>N. exquisita</i>

n= 216

adult specimen

Appendix Table A-12: Aquatic macroinvertebrates collected within White Creek at White Creek Mouth, Morgan County, Tennessee (N 36° 7' 23.13", W 84° 47' 39.28"), October 2, 2007.

#Individuals	Order	Family	Genus	Species
10	Coleoptera	Dryopidae	<i>Helichus</i>	<i>H. fastigiatus</i> *
2	Coleoptera	Elmidae	<i>Promoresia</i>	<i>P. elegans</i>
1	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sp.</i>
8	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. sp.</i>
4	Coleoptera	Elmidae	<i>Microcylloepus</i>	<i>M. pusillus</i>
1	Coleoptera	Elmidae	<i>Microcylloepus</i>	<i>M. pusillus pusillus</i> *
1	Coleoptera	Elmidae	<i>Macronychus</i>	<i>M. glabratus</i> *
1	Coleoptera	Psephenidae	<i>Psephenus</i>	<i>P. herricki</i>
1	Coleoptera	Psephenidae	<i>Ectopria</i>	<i>E. sp.</i>
3	Diptera	Athericidae	<i>Atherix</i>	<i>A. lantha</i>
1	Diptera	Tipulidae	<i>Tipula</i>	<i>T. sp.</i>
1	Diptera	Tipulidae	<i>Antocha</i>	<i>A. sp.</i>
31	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
3	Diptera	Ceratopogonidae	<i>Dasyhelea</i>	<i>D. sp.</i>
11	Diptera	Chironomidae	<i>Rheocricotopus</i>	<i>R. robacki</i>
3	Diptera	Chironomidae	<i>Psectrocladius</i>	<i>P. sp.</i>
2	Diptera	Chironomidae	<i>Rheotanytarsus</i>	<i>R. exiguus</i>
2	Diptera	Chironomidae	<i>Cricotopus</i>	<i>C. sp.</i>
1	Diptera	Chironomidae	<i>Ablabesmyia</i>	<i>A. mallochi</i>
1	Diptera	Chironomidae	<i>Conchapelopia</i>	<i>C. sp.</i>
1	Diptera	Chironomidae	<i>Orthocladius</i>	<i>O. sp.</i>
25	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. vicarium</i>
25	Ephemeroptera	Isonychiidae	<i>Isonychia</i>	<i>I. sp.</i>
5	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. modestum</i>
1	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. smithae</i>
1	Ephemeroptera	Heptageniidae	<i>Heptagenia</i>	<i>H. sp.</i>
1	Ephemeroptera	Heptageniidae	<i>Stenacron</i>	<i>S. carolina</i>
2	Ephemeroptera	Ephemerellidae	<i>Eurylophella</i>	<i>E. sp.</i>
2	Hemiptera	Veliidae	<i>Microvelia</i>	<i>M. sp.</i>
3	Megaloptera	Corydalidae	<i>Corydalus</i>	<i>C. cornutus</i>
1	Megaloptera	Corydalidae	<i>Nigronia</i>	<i>N. serricornis</i>
1	Odonata	Aeshnidae	<i>Boyeria</i>	<i>B. vinosa</i>
3	Odonata	Gomphidae	<i>Stylogomphus</i>	<i>S. albistylus</i>
4	Odonata	Gomphidae	<i>Lanthus</i>	<i>L. vernalis</i>
7	Odonata	Coenagrionidae	<i>Argia</i>	<i>A. sp.</i>
5	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. carolinensis</i>
19	Trichoptera	Philopotamidae	<i>Chimarra</i>	<i>C. sp.</i>
1	Trichoptera	Helicopsychidae	<i>Helicopsyche</i>	<i>H. borealis</i>
11	Trichoptera	Polycentropodidae	<i>Neureclipsis</i>	<i>N. crepuscularis</i>
20	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
1	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. demora</i>

Appendix Table A-12 (Continued)

#Individuals	Order	Family	Genus	Species
3	Trichoptera	Polycentropodidae	<i>Polycentropus</i>	<i>P. sp.</i>
1	Trichoptera	Leptoceridae	<i>Oecetis</i>	<i>O. inconspicua</i>
n= 231				
* adult specimen				

Appendix Table A-13: Aquatic macroinvertebrates collected within Yellow Creek, Cumberland County, Tennessee (N 36° 00' 7.1", W 84° 47' 03.9"), June 6, 2007.

#Individuals	Order	Family	Genus	Species
4	Coleoptera	Psephenidae	<i>Psephenus</i>	<i>P. herricki</i>
1	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. sp.</i>
6	Diptera	Chironomidae	<i>Conchapelopia</i>	<i>C. sp.</i>
9	Diptera	Chironomidae	<i>Tanytarsus</i>	<i>T. guerlus</i>
1	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
1	Diptera	Chironomidae	<i>Paratanytarsus</i>	<i>P. sp.</i>
4	Diptera	Chironomidae	<i>Microtendipes</i>	<i>M. caelum</i>
1	Diptera	Chironomidae	<i>Cricotopus</i>	<i>C. sylvestris</i>
1	Diptera	Chironomidae	<i>Zavrelia</i>	<i>Z. sp.</i>
1	Diptera	Chironomidae	<i>Orthocladius</i>	<i>O. obumbratus</i>
1	Diptera	Chironomidae	<i>Rheotanytarsus</i>	<i>R. exiguus</i>
1	Ephemeroptera	Ephemeridae	<i>Ephemera</i>	<i>E. sp.</i>
31	Ephemeroptera	Baetidae	<i>Proclonia</i>	<i>P. sp.</i>
10	Ephemeroptera	Baetidae	<i>Baetis</i>	<i>B. intercalaris</i>
1	Megaloptera	Corydalidae	<i>Nigronia</i>	<i>N. serricornis</i>
4	Odonata	Aeshnidae	<i>Boyeria</i>	<i>B. vinosa</i>
2	Odonata	Gomphidae	<i>Lanthus</i>	<i>L. vernalis</i>
55	Plecoptera	Leuctridae	<i>Leuctra</i>	<i>L. sp.</i>
6	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. carolinensis</i>
13	Plecoptera	Perlidae	<i>Paragnetina</i>	<i>P. immarginata</i>
1	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. abnormis</i>
21	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
1	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. betteni</i>
2	Trichoptera	Polycentropodidae	<i>Polycentropus</i>	<i>P. sp.</i>
2	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	<i>C. sp.</i>
1	Trichoptera	Philopotamidae	<i>Chimarra</i>	<i>C. sp.</i>

n= 181

* adult specimen

Appendix Table A-14: Aquatic macroinvertebrates collected within Yellow Creek at Hebbertsburg Rd, Cumberland County, Tennessee (N 36° 1' 5.5", W 84° 47' 40.2"), June 6, 2007.

#Individuals	Order	Family	Genus	Species
1	Coleoptera	Elmidae	<i>Promoresia</i>	<i>P. elegans</i>
1	Coleoptera	Elmidae	<i>Gonielmis</i>	<i>G. dietrichi</i> *
1	Diptera	Athericidae	<i>Atherix</i>	<i>A. lantha</i>
4	Diptera	Simuliidae	<i>Simulium</i>	<i>S. sp.</i>
14	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
8	Diptera	Chironomidae	<i>Conchapelopia</i>	<i>C. sp.</i>
16	Diptera	Chironomidae	<i>Rheotanytarsus</i>	<i>R. exiguus</i>
2	Diptera	Chironomidae	<i>Microtendipes</i>	<i>M. caelum</i>
4	Diptera	Chironomidae	<i>Eukiefferiella</i>	<i>E. claripennis</i>
1	Diptera	Chironomidae	<i>Cladotanytarsus</i>	<i>C. sp.</i>
2	Diptera	Chironomidae	<i>Corynoneura</i>	<i>C. sp.</i>
1	Diptera	Chironomidae	<i>Rheocricotopus</i>	<i>R. robacki</i>
5	Diptera	Chironomidae	<i>Zavrelia</i>	<i>Z. sp.</i>
1	Diptera	Chironomidae	<i>Paratendipes</i>	<i>P. sp.</i>
1	Diptera	Chironomidae	<i>Eukiefferiella</i>	<i>E. sp.</i>
2	Diptera	Chironomidae	<i>Tanytarsus</i>	<i>T. sp.</i>
1	Diptera	Chironomidae	<i>Pseudochironomus</i>	<i>P. sp.</i>
3	Ephemeroptera	Isonychiidae	<i>Isonychia</i>	<i>I. sp.</i>
4	Ephemeroptera	Heptageniidae	<i>Stenacron</i>	<i>S. pallidum</i>
2	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. modestum</i>
1	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. pudicum</i>
1	Ephemeroptera	Heptageniidae	<i>Heptagenia</i>	<i>H. sp.</i>
2	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. vicarium</i>
3	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. terminatum</i>
6	Ephemeroptera	Ephemerellidae	<i>Drunella</i>	<i>D. cornutella</i>
2	Ephemeroptera	Ephemerellidae	<i>Timpanago</i>	<i>T. sp.</i>
1	Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	<i>E. dorothea</i>
20	Ephemeroptera	Baetidae	<i>Procloeon</i>	<i>P. sp.</i>
2	Ephemeroptera	Baetidae	<i>Baetis</i>	<i>B. intercalaris</i>
2	Megaloptera	Corydalidae	<i>Nigronia</i>	<i>N. serricornis</i>
2	Odonata	Aeshnidae	<i>Boyeria</i>	<i>B. vinosa</i>
4	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. carolinensis</i>
7	Plecoptera	Perlidae	<i>Paragnetina</i>	<i>P. immarginata</i>
10	Plecoptera	Leuctridae	<i>Leuctra</i>	<i>L. sp.</i>
1	Plecoptera	Nemouridae	<i>Amphinemura</i>	<i>A. wui</i>
2	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. abnormis</i>
17	Trichoptera	Philopotamidae	<i>Dolophilodes</i>	<i>D. distinctus</i>
3	Trichoptera	Polycentropodidae	<i>Polycentropus</i>	<i>P. sp.</i>

Appendix Table A-14 (Continued)

#Individuals	Order	Family	Genus	Species
38	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
5	Trichoptera	Philopotamidae	<i>Chimarra</i>	<i>C. sp.</i>
2	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. betteni</i>
1	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	<i>C. sparna</i>

n= 206

adult specimen

Appendix Table A-15: Aquatic macroinvertebrates collected within Daddys Creek at Devils Breakfast Table, Cumberland/Morgan County, Tennessee (N 36° 3' 33.56", W 84° 47' 31.56"), May 30, 2007.

#Individuals	Order	Family	Genus	Species
2	Coleoptera	Psephenidae	<i>Psephenus</i>	<i>P. herricki</i>
8	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sp.</i>
10	Coleoptera	Elmidae	<i>Microcyloopus</i>	<i>M. pusillus</i>
3	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. sp.</i>
5	Coleoptera	Elmidae	<i>Promoresia</i>	<i>P. elegans</i>
2	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. bicarinata</i> *
3	Coleoptera	Elmidae	<i>Macronychus</i>	<i>M. glabratus</i> *
9	Coleoptera	Elmidae	<i>Microcyloopus</i>	<i>M. pusillus pusillus</i> *
1	Coleoptera	Elmidae	<i>Gonielmis</i>	<i>G. dietrichi</i> *
1	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. ovalis</i> *
14	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
1	Diptera	Chironomidae	<i>Symbiocladius</i>	<i>S. sp.</i>
1	Diptera	Chironomidae	<i>Rheotanytarsus</i>	<i>R. exiguus</i>
3	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. modestum</i>
2	Ephemeroptera	Baetidae	<i>Labiobaetis</i>	<i>L. propinquus</i>
6	Ephemeroptera	Ephemerellidae	<i>Serratella</i>	<i>S. deficiens</i>
2	Ephemeroptera	Baetidae	<i>Baetis</i>	<i>B. intercalaris</i>
2	Ephemeroptera	Baetidae	<i>Acentrella</i>	<i>A. sp.</i>
1	Isopoda	Asellidae	<i>Lirceus</i>	<i>L. sp.</i>
1	Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	<i>L. variegatus</i>
2	Megaloptera	Corydalidae	<i>Corydalus</i>	<i>C. cornutus</i>
1	Odonata	Gomphidae	<i>Lanthus</i>	<i>L. vernalis</i>
11	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. abnormis</i>
2	Plecoptera	Perlidae	<i>Agneta</i>	<i>A. annulipes</i>
4	Plecoptera	Perlidae	<i>Neoperla</i>	<i>N. sp.</i>
13	Plecoptera	Perlidae	<i>Perlesta</i>	<i>P. placida</i>
25	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	<i>C. sparna</i>
2	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. hageni</i>
14	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. demora</i>
2	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. venularis</i>
11	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
13	Trichoptera	Philopotamidae	<i>Chimarra</i>	<i>C. sp.</i>
2	Trichoptera	Brachycentridae	<i>Micrasema</i>	<i>M. wataga</i>
1	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. simulans</i>
1	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	<i>C. cheilonis</i>

n= 181

* adult specimen

Appendix Table A-16: Aquatic macroinvertebrates collected within Daddys Creek at Antioch Bridge, Cumberland County, Tennessee (N 35° 59' 54.1", W 84° 49' 23.8"), June 6, 2007.

#Individuals	Order	Family	Genus	Species
2	Coleoptera	Psephenidae	<i>Psephenus</i>	<i>P. herricki</i>
4	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sp.</i>
2	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. sp.</i>
51	Coleoptera	Elmidae	<i>Macronychus</i>	<i>M. glabratus</i> *
2	Coleoptera	Elmidae	<i>Microcyloepus</i>	<i>M. pusillus pusillus</i> *
2	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sandersoni</i> *
1	Coleoptera	Psephenidae	<i>Ectopria</i>	<i>E. sp.</i>
1	Diptera	Tipulidae	<i>Tipula</i>	<i>T. sp.</i>
1	Diptera	Athericidae	<i>Atherix</i>	<i>A. lantha</i>
2	Diptera	Chironomidae	<i>Conchapelopia</i>	<i>C. sp.</i>
1	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
7	Diptera	Chironomidae	<i>Psectrocladius</i>	<i>P. sp.</i>
6	Diptera	Chironomidae	<i>Rheotanytarus</i>	<i>R. exiguus</i>
1	Diptera	Chironomidae	<i>Microtendipes</i>	<i>M. sp.</i>
1	Diptera	Chironomidae	<i>Cricotopus</i>	<i>C. sp.</i>
1	Diptera	Chironomidae	<i>Thienemanniella</i>	<i>T. sp.</i>
1	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. sp.</i>
1	Ephemeroptera	Ephemeridae	<i>Ephemera</i>	<i>E. sp.</i>
3	Ephemeroptera	Heptageniidae	<i>Stenacron</i>	<i>S. pallidum</i>
2	Ephemeroptera	Heptageniidae	<i>Heptagenia</i>	<i>H. sp.</i>
3	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. modestum</i>
9	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. terminatum</i>
1	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. exiguum</i>
3	Ephemeroptera	Ephemerellidae	<i>Serratella</i>	<i>S. deficiens</i>
1	Ephemeroptera	Isonychiidae	<i>Isonychia</i>	<i>I. sp.</i>
2	Ephemeroptera	Baetidae	<i>Acentrella</i>	<i>A. sp.</i>
2	Ephemeroptera	Caenidae	<i>Caenis</i>	<i>C. sp.</i>
4	Ephemeroptera	Baetidae	<i>Baetis</i>	<i>B. intercalaris</i>
1	Hemiptera	Veliidae	<i>Rhagovelia</i>	<i>R. obesa</i>
1	Isopoda	Asellidae	<i>Lirceus</i>	<i>L. sp.</i>
1	Lepidoptera	Pyalidae	<i>Petrophila</i>	<i>P. fulicalis</i>
1	Lumbriculida	Lumbriculidae	<i>Lumbriculis</i>	<i>L. variegatus</i>
7	Megaloptera	Corydalidae	<i>Corydalus</i>	<i>C. cornutus</i>
1	Megaloptera	Corydalidae	<i>Nigronia</i>	<i>N. serricornis</i>
1	Odonata	Gomphidae	<i>Hagenius</i>	<i>H. brevistylus</i>
3	Odonata	Corduliidae	<i>Neurocordulia</i>	<i>N. yamaskanensis</i>
1	Odonata	Gomphidae	<i>Stylogomphus</i>	<i>S. albistylus</i>
1	Odonata	Gomphidae	<i>Hylogomphus</i>	<i>H. brevis</i>
6	Odonata	Coenagrionidae	<i>Argia</i>	<i>A. sp.</i>
1	Odonata	Gomphidae	<i>Gomphus</i>	<i>G. quadricolor</i>
1	Odonata	Aeshnidae	<i>Boyeria</i>	<i>B. vinosa</i>

Appendix Table A-16 (Continued)

#Individuals	Order	Family	Genus	Species
2	Odonata	Gomphidae	<i>Lanthus</i>	<i>L. vernalis</i>
9	Plecoptera	Perlidae	<i>Perlesta</i>	<i>P. placida</i>
2	Plecoptera	Perlidae	<i>Agnetina</i>	<i>A. annulipes</i>
2	Plecoptera	Perlidae	<i>Neoperla</i>	<i>N. sp.</i>
9	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. carolinensis</i>
1	Trichoptera	Rhyacophilidae	<i>Rhyacophila</i>	<i>R. vuphipes</i>
7	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
6	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	<i>C. sparna</i>
1	Trichoptera	Leptoceridae	<i>Ceraclea</i>	<i>C. ancylus</i>

n= 182

* adult specimen

Appendix Table A-17: Aquatic macroinvertebrates collected within Daddys Creek at Obed Junction, Morgan County, Tennessee (N 36° 4' 44.4", W 84° 45' 55.8"), June 19, 2007.

#Individuals	Order	Family	Genus	Species
12	Coleoptera	Elmidae	<i>Promoresia</i>	<i>P. elegans</i>
10	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sp.</i>
8	Coleoptera	Elmidae	<i>Microcyloopus</i>	<i>M. pusillus</i>
6	Coleoptera	Elmidae	<i>Microcyloopus</i>	<i>M. pusillus pusillus</i> *
13	Coleoptera	Elmidae	<i>Gonielmis</i>	<i>G. dietrichi</i> *
4	Coleoptera	Elmidae	<i>Microcyloopus</i>	<i>M. pusillus aptus</i> *
2	Coleoptera	Elmidae	<i>Dubiraphia</i>	<i>D. vittata</i> *
10	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sandersoni</i> *
2	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. bicarinata</i> *
2	Coleoptera	Elmidae	<i>Ancyronyx</i>	<i>A. variegatus</i> *
2	Coleoptera	Psephenidae	<i>Ectopria</i>	<i>E. sp.</i>
1	Diptera	Tipulidae	<i>Antocha</i>	<i>A. sp.</i>
1	Diptera	Athericidae	<i>Atherix</i>	<i>A. lantha</i>
1	Diptera	Simuliidae	<i>Simulium</i>	<i>S. sp.</i>
1	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
7	Diptera	Chironomidae	<i>Cricotopus</i>	<i>C. sp.</i>
1	Diptera	Chironomidae	<i>Orthocladius</i>	<i>O. sp.</i>
1	Diptera	Chironomidae	<i>Thienemanniella</i>	<i>T. sp.</i>
1	Diptera	Chironomidae	<i>Corynoneura</i>	<i>C. sp.</i>
1	Diptera	Chironomidae	<i>Psectrocladius</i>	<i>P. sp.</i>
1	Diptera	Chironomidae	<i>Eukiefferiella</i>	<i>E. sp.</i>
3	Ephemeroptera	Heptageniidae	<i>Heptagenia</i>	<i>H. sp.</i>
8	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. modestum</i>
1	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. ithaca</i>
2	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. vicarium</i>
6	Ephemeroptera	Isonychiidae	<i>Isonychia</i>	<i>I. sp.</i>
16	Ephemeroptera	Baetidae	<i>Baetis</i>	<i>B. intercalaris</i>
4	Ephemeroptera	Ephemerellidae	<i>Serratella</i>	<i>S. deficiens</i>
1	Ephemeroptera	Heptageniidae	<i>Stenacron</i>	<i>S. pallidum</i>
6	Lumbriculida	Lumbriculidae	<i>Lumbriculis</i>	<i>L. variegatus</i>
8	Megaloptera	Corydalidae	<i>Corydalus</i>	<i>C. cornutus</i>
1	Odonata	Gomphidae	<i>Stylogomphys</i>	<i>S. albistylus</i>
6	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. carolinensis</i>
3	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. abnormis</i>
6	Plecoptera	Perlidae	<i>Perlesta</i>	<i>P. placida</i>
3	Plecoptera	Perlidae	<i>Neoperla</i>	<i>N. sp.</i>
1	Trichoptera	Rhyacophilidae	<i>Rhyacophila</i>	<i>R. vuphipes</i>
14	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	<i>C. sparna</i>
18	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
5	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. venularis</i>
3	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. demora</i>

Appendix Table 17 (Continued)

#Individuals	Order	Family	<i>Genus</i>	<i>Species</i>
1	Trichoptera	Philopotamidae	<i>Chimarra</i>	<i>C. sp.</i>
1	Trichoptera	Brachycentridae	<i>Brachycentrus</i>	<i>B. spinae</i>
7	Trichoptera	Brachycentridae	<i>Micrasema</i>	<i>M. sp.</i>
1	Trichoptera	Leptoceridae	<i>Oecetis</i>	<i>O. persimilis</i>
1	Trichoptera	Leptoceridae	<i>Ceraclea</i>	<i>C. sp.</i>
1	Trichoptera	Leptoceridae	<i>Oecetis</i>	<i>O. sp.</i>

n= 214

* adult specimen

Appendix Table A-18: Aquatic macroinvertebrates collected within Island Creek at Catoosa Rd, Morgan County, Tennessee (N 36° 3' 10.26" W 84° 40' 0.78"), October 2, 2007.

#Individuals	Order	Family	Genus	Species
4	Coleoptera	Psephenidae	<i>Psephenus</i>	<i>P. herricki</i>
1	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sp.</i>
2	Coleoptera	Elmidae	<i>Promoresia</i>	<i>P. elegans</i>
14	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. sp.</i>
3	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. ovalis</i> *
1	Coleoptera	Elmidae	<i>Dubiraphia</i>	<i>D. vittata</i> *
2	Coleoptera	Dryopidae	<i>Helichus</i>	<i>H. fastigiatus</i> *
6	Diptera	Athericidae	<i>Atherix</i>	<i>A. lantha</i>
5	Diptera	Tipulidae	<i>Hexatoma</i>	<i>H. sp.</i>
10	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
6	Diptera	Chironomidae	<i>Parametriocnemus</i>	<i>P. sp.</i>
4	Diptera	Chironomidae	<i>Psilometriocnemus</i>	<i>P. triannulatus</i>
3	Diptera	Chironomidae	<i>Tanytarsus</i>	<i>T. sp.</i>
1	Diptera	Chironomidae	<i>Rheotanytarsus</i>	<i>R. exiguus</i>
4	Diptera	Chironomidae	<i>Rheocricotopus</i>	<i>R. robacki</i>
1	Diptera	Ceratopogonidae	<i>Bezzia</i>	<i>B. sp.</i>
1	Diptera	Chironomidae	<i>Conchapelopia</i>	<i>C. sp.</i>
1	Diptera	Chironomidae	<i>Apsectrotanypus</i>	<i>A. sp.</i>
3	Ephemeroptera	Ephemerellidae	<i>Eurylophella</i>	<i>E. sp.</i>
1	Ephemeroptera	Isonychiidae	<i>Isonychia</i>	<i>I. sp.</i>
1	Ephemeroptera	Baetidae	<i>Procloeon</i>	<i>P. sp.</i>
1	Ephemeroptera	Caenidae	<i>Caenis</i>	<i>C. sp.</i>
4	Megaloptera	Corydalidae	<i>Corydalus</i>	<i>C. cornutus</i>
3	Megaloptera	Corydalidae	<i>Nigronia</i>	<i>N. serricornis</i>
2	Odonata	Aeshnidae	<i>Boyeria</i>	<i>B. vinosa</i>
26	Odonata	Gomphidae	<i>Lanthus</i>	<i>L. vernalis</i>
3	Odonata	Coenagrionidae	<i>Argia</i>	<i>A. sp.</i>
44	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. carolinensis</i>
1	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. abnormis</i>
3	Plecoptera	Leuctridae	<i>Leuctra</i>	<i>L. sp.</i>
13	Trichoptera	Philopotamidae	<i>Chimarra</i>	<i>C. sp.</i>
42	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
2	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. betteni</i>

n= 218

* adult specimen

Appendix Table A-19: Aquatic macroinvertebrates collected within Rock Creek at Highway 62, Morgan County, Tennessee (N 36° 8' 03.5", W 84° 37' 30.4"), June 21, 2007.

#Individuals	Order	Family	Genus	Species
1	Coleoptera	Elmidae	<i>Ancyronyx</i>	<i>A. variegatus</i>
5	Coleoptera	Elmidae	<i>Microcylloepus</i>	<i>M. pusillus</i>
12	Coleoptera	Elmidae	<i>Optioservus</i>	<i>O. sp.</i>
3	Coleoptera	Elmidae	<i>Macronychus</i>	<i>M. glabratus</i> *
1	Coleoptera	Dryopidae	<i>Helichus</i>	<i>H. fastigiatus</i> *
1	Coleoptera	Psephenidae	<i>Psephenus</i>	<i>P. herricki</i>
1	Coleoptera	Gyrinidae	<i>Dineutus</i>	<i>D. sp.</i>
4	Diptera	Athericidae	<i>Atherix</i>	<i>A. lantha</i>
14	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
6	Diptera	Chironomidae	<i>Rheocricotopus</i>	<i>R. robacki</i>
1	Diptera	Chironomidae	<i>Cryptochironomus</i>	<i>C. fulvus</i>
1	Diptera	Chironomidae	<i>Dicrotendipes</i>	<i>D. neomodestus</i>
11	Diptera	Chironomidae	<i>Rheotanytarsus</i>	<i>R. exiguus</i>
2	Diptera	Chironomidae	<i>Conchapelopia</i>	<i>C. sp.</i>
2	Diptera	Chironomidae	<i>Tanytarsus</i>	<i>T. guerlus</i>
1	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. illinoense</i>
1	Diptera	Chironomidae	<i>Procladius</i>	<i>P. sublettei</i>
28	Ephemeroptera	Isonychiidae	<i>Isonychia</i>	<i>I. sp.</i>
12	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. vicarium</i>
6	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. ithaca</i>
4	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. terminatum</i>
2	Ephemeroptera	Heptageniidae	<i>Heptagenia</i>	<i>H. sp.</i>
5	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. modestum</i>
1	Ephemeroptera	Ephemerellidae	<i>Eurylophella</i>	<i>E. sp.</i>
7	Ephemeroptera	Baetidae	<i>Baetis</i>	<i>B. intercalaris</i>
1	Ephemeroptera	Baetidae	<i>Acentrella</i>	<i>A. sp.</i>
1	Ephemeroptera	Baetidae	<i>Procloeon</i>	<i>P. sp.</i>
7	Megaloptera	Corydalidae	<i>Nigronia</i>	<i>N. serricornis</i>
1	Odonata	Gomphidae	<i>Stylogomphus</i>	<i>S. albistylus</i>
6	Odonata	Gomphidae	<i>Lanthus</i>	<i>L. vernalis</i>
8	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. carolinensis</i>
32	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
1	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. hageni</i>
1	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	<i>C. sparna</i>
7	Trichoptera	Philopotamidae	<i>Chimarra</i>	<i>C. sp.</i>
1	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. demora</i>
1	Trichoptera	Psychomyiidae	<i>Lype</i>	<i>L. diversa</i>

n= 199

* adult specimen

Appendix Table A-20: Aquatic macroinvertebrates collected within Emory River at Montgomery Rd, Morgan County, Tennessee (N 36° 6' 47.1", W 84° 36' 53.3"), June 21, 2007.

#Individuals	Order	Family	Genus	Species
1	Coleoptera	Dryopidae	<i>Helichus</i>	<i>H. fastigiatus</i> *
2	Coleoptera	Gyrinidae	<i>Dineutus</i>	<i>D. sp.</i>
1	Diptera	Simuliidae	<i>Simulium</i>	<i>S. sp.</i>
155	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
8	Diptera	Chironomidae	<i>Conchapelopia</i>	<i>C. sp.</i>
1	Diptera	Chironomidae	<i>Stictochironomus</i>	<i>S. sp.</i>
2	Diptera	Chironomidae	<i>Rheocricotopus</i>	<i>R. robacki</i>
2	Diptera	Chironomidae	<i>Rheotanytarsus</i>	<i>R. exiguus</i>
1	Diptera	Chironomidae	<i>Parametriocnemus</i>	<i>P. sp.</i>
4	Diptera	Ceratopogonidae	<i>Bezzia</i>	<i>B. sp.</i>
1	Diptera	Chironomidae	<i>Paratanytarsus</i>	<i>P. sp.</i>
1	Diptera	Chironomidae	<i>Xylotopus</i>	<i>X. par</i>
1	Diptera	Chironomidae	<i>Nilothauma</i>	<i>N. sp.</i>
3	Ephemeroptera	Isonychiidae	<i>Isonychia</i>	<i>I. sp.</i>
1	Ephemeroptera	Ephemerellidae	<i>Eurylophella</i>	<i>E. sp.</i>
4	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. vicarium</i>
2	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. pudicum</i>
2	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. modestum</i>
2	Megaloptera	Corydalidae	<i>Nigronia</i>	<i>N. serricornis</i>
1	Megaloptera	Corydalidae	<i>Corydalus</i>	<i>C. cornutus</i>
1	Odonata	Gomphidae	<i>Hagenius</i>	<i>H. brevistylus</i>
1	Odonata	Gomphidae	<i>Lanthus</i>	<i>L. vernalis</i>
1	Rhynchoabdellida	Glossiphoniidae	<i>Placobdella</i>	<i>P. sp.</i>
34	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
4	Trichoptera	Philopotamidae	<i>Chimarra</i>	<i>C. sp.</i>

n= 236

* adult specimen

Appendix Table A-21: Aquatic macroinvertebrates collected within Emory River at Nemo, Morgan County, Tennessee (N 36° 4' 12.92", W 84° 39' 40.47"), June 4, 2007.

#Individuals	Order	Family	Genus	Species
40	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sp.</i>
3	Coleoptera	Elmidae	<i>Promoresia</i>	<i>P. elegans</i>
6	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. sandersoni</i> *
5	Coleoptera	Elmidae	<i>Stenelmis</i>	<i>S. bicarinata</i> *
1	Coleoptera	Elmidae	<i>Gonielmis</i>	<i>G. dietrichi</i> *
3	Coleoptera	Elmidae	<i>Microcylloepus</i>	<i>M. pusillus</i> *
1	Coleoptera	Psephenidae	<i>Ectopria</i>	<i>E. sp.</i>
1	Diptera	Athericidae	<i>Atherix</i>	<i>A. lantha</i>
2	Diptera	Simuliidae	<i>Simulium</i>	<i>S. sp.</i>
9	Diptera	Chironomidae	<i>Rheotanytarsus</i>	<i>R. exiguus</i>
1	Diptera	Chironomidae	<i>Polypedilum</i>	<i>P. flavum</i>
2	Diptera	Chironomidae	<i>Eukiefferiella</i>	<i>E. sp.</i>
8	Diptera	Chironomidae	<i>Symbiocladius</i>	<i>S. sp.</i>
5	Diptera	Chironomidae	<i>Conchapelopia</i>	<i>C. sp.</i>
1	Diptera	Chironomidae	<i>Corynoneura</i>	<i>C. sp.</i>
10	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. modestum</i>
12	Ephemeroptera	Isonychiidae	<i>Isonychia</i>	<i>I. sp.</i>
16	Ephemeroptera	Baetidae	<i>Baetis</i>	<i>B. intercalaris</i>
5	Ephemeroptera	Ephemerellidae	<i>Serratella</i>	<i>S. deficiens</i>
9	Ephemeroptera	Baetidae	<i>Acentrella</i>	<i>A. sp.</i>
2	Ephemeroptera	Heptageniidae	<i>Maccaffertium</i>	<i>M. vicarium</i>
1	Lumbriculida	Lumbriculidae	<i>Lumbriculis</i>	<i>L. variegatus</i>
6	Megaloptera	Corydalidae	<i>Corydalus</i>	<i>C. cornutus</i>
16	Plecoptera	Perlidae	<i>Neoperla</i>	<i>N. sp.</i>
1	Plecoptera	Perlidae	<i>Perlesta</i>	<i>P. placida</i>
1	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. abnormis</i>
1	Plecoptera	Perlidae	<i>Acroneuria</i>	<i>A. carolinensis</i>
9	Trichoptera	Hydropsychidae	<i>Macrostemum</i>	<i>M. zebratum</i>
1	Trichoptera	Rhyacophilidae	<i>Rhyacophila</i>	<i>R. vuphipes</i>
1	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. hageni</i>
8	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. demora</i>
18	Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	<i>C. sp.</i>
1	Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	<i>H. venularis</i>
3	Trichoptera	Philopotamidae	<i>Chimarra</i>	<i>C. sp.</i>
1	Trichoptera	Polycentropodidae	<i>Neureclipsis</i>	<i>N. crepuscularis</i>
1	Trichoptera	Leptoceridae	<i>Oecetis</i>	<i>O. nocturna</i>
1	Trichoptera	Leptoceridae	<i>Oecetis</i>	<i>O. inconspicua</i>
1	Trichoptera	Hydropsychidae	<i>Ceratopsyche</i>	<i>C. sparna</i>

n= 213

* adult specimen

APPENDIX B
HABITAT VARIABLES

Appendix Table B-1. Habitat variables for sample sites within Obed River recorded spring-fall 2007. Temperature (Temp.), dissolved oxygen (DO), conductivity (Cond.), pH, turbidity, average width (width), average depth (Depth), dominant substrate, and discharge measurements are shown for each site. Total means for all sites are shown.

Site	Temp. (°C)	DO (mg/L)	Cond. (µS)	pH	Turbidity (NTU)	Width (m)	Depth (cm)	Dominant Substrate	Discharge (m ³ /s)
Adams Bridge	19.95	7.51	182.05	7.71	0.045	25.21	38.3	Cobble	10.67
Potters Ford	21.95	7.36	136.4	7.26	0.061	26.58	34.24	Cobble	20.81
Obed River at Obed Junction	27	7.61	110.45	7.705	0.25	28.76	37.92	Cobble	12.03
Obed River at Canoe Hole	20.8	8.90	242.2	7.59	1.28	22.95	65.44	Boulder	81.63
Alley Ford	18.65	6.95	177.75	7.23	1.33	44.79	52.4	Boulder	141.26
Mean	21.67	7.66	169.77	7.45*	0.5932	29.658	45.66	n/a	53.28

* denotes transformed mean pH value

Appendix Table B-2. Habitat variables for sample sites within Clear Creek recorded spring-fall 2007. Temperature (Temp.), dissolved oxygen (DO), conductivity (Cond.), pH, turbidity, average width (width), average depth (Depth), dominant substrate, and discharge measurements are shown for each site. Total means for all sites are shown.

Site	Temp. (°C)	DO (mg/L)	Cond. (µS)	pH	Turb. (NTU)	Width (m)	Depth (cm)	Dom. Substrate	Discharge (m ³ /s)
Norris Ford	19.9	6.10	49.4	7.03	0.34	13.07	28.1	Boulder	n/a
Jett Bridge	23	7.37	54.5	7.49	0.13	32.7	56.2	Boulder	13.14
Lilly Bridge	24.8	7.38	57.35	7.35	0.18	9.53	34.2	Boulder	41.32
Barnett Bridge	22.6	7.21	51.3	7.6	0.12	13.91	7.74	Boulder	4.72
Mean	22.58	7.01	53.14	7.31*	0.19	17.30	31.56	n/a	19.73

* denotes transformed mean pH value

Appendix Table B-3. Habitat variables for sample sites within White Creek recorded spring-fall 2007. Temperature (Temp.), dissolved oxygen (DO), conductivity (Cond.), pH, turbidity, average width (width), average depth (Depth), dominant substrate, and discharge measurements are shown for each site. Total means for all sites are shown.

Site	Temp. (°C)	DO (mg/L)	Cond. (µS)	pH	Turb. (NTU)	Width (m)	Depth (cm)	Dominant Substrate	Discharge (m ³ /s)
Lavender Bridge	20.15	6.69	64.2	7.09	0.25	16.13	22.5	Bedrock	0.288
White Creek at Twin Bridge Rd.	21.9	8.35	62.9	6.93	0.53	13.79	15.84	Bedrock	n/a
White Creek Mouth	16	5.725	65.35	7.805	1.42	8.84	8.97	Boulder	-0.0632
Mean	19.35	6.92	64.15	7.15*	0.73	12.92	15.77	n/a	0.11

* denotes transformed mean pH value

Appendix Table B-4. Habitat variables for sample sites within Daddys Creek recorded spring-fall 2007. Temperature (Temp.), dissolved oxygen (DO), conductivity (Cond.), pH, turbidity, average width (width), average depth (Depth), dominant substrate, and discharge measurements are shown for each site. Total means for all sites are shown.

Site	Temp. (°C)	DO (mg/L)	Cond. (µS)	pH	Turb. (NTU)	Width (m)	Depth (cm)	Dominant Substrate	Discharge (m ³ /s)
Yellow Creek	16.95	8.915	887.5	7.4	0.24	5.2	5.04	Bedrock	2.39
Yellow Creek at Hebbertsburg Rd.	19	7.005	46.65	7.135	0.58	10.78	14.44	Bedrock	1.67
Devils Breakfast Table	25.05	7.785	90.55	7.75	0.05	12.53	31	Boulder	26.24
Daddys Creek at Antioch Bridge	24.45	7.515	111.4	7.415	0.26	26.36	39.9	Boulder	7.16
Daddys Creek at Obed Junction	27.1	8.1	103.55	8.13	0.38	12.56	14.52	Cobble	13.7
Mean	22.51	7.86	247.93	7.45*	0.30	13.49	20.98	n/a	10.23

* denotes transformed mean pH value

Appendix Table B-5. Habitat variables for sample sites within Emory River recorded spring-fall 2007. Temperature (Temp.), dissolved oxygen (DO), conductivity (Cond.), pH, turbidity, average width (width), average depth (Depth), dominant substrate, and discharge measurements are shown for each site. Total means for all sites are shown.

Site	Temp. (°C)	DO (mg/L)	Cond. (µS)	pH	Turb. (NTU)	Width (m)	Depth (cm)	Dominant Substrate	Discharge (m ³ /s)
Emory River at Montgomery Rd.	22.05	3.265	104.95	6.48	0.46	23	19.88	Gravel	3.68
Nemo	27.3	7.39	74.9	7.87	0.33	31.36	23.3	Boulder	53.24
Rock Creek at Highway 62	20.55	4.215	72.35	6.715	0.96	9.73	30.06	Sand	-0.17632
Island Creek at Catoosa Rd.	15.7	8.75	1342	6.9	0.97	10.13	8.18	Boulder	-2.304
Mean	21.4	5.91	398.55	6.78*	0.68	18.56	20.36	n/a	13.61

* denotes transformed mean pH value

APPENDIX C
PERCENTAGE LAND USE

Appendix Table C-1. Percentage land use (arcsine transformed) per sub-watershed. Developed, Field, Forest, Pond, Road, Stream-lake, and Strip mine land use percentages are shown.

Site	Developed	Field	Forest	Pond	Road	Stream-lake	Strip mine
<u>Obed River</u>							
Adams Bridge	0.183023	0.316442	0.563208	0.014091	0.035024	0.001362	0.000000
Potters Ford	0.161050	0.276485	0.633958	0.015063	0.032348	0.001656	0.000000
Obed River at Obed Junction	0.135741	0.201524	0.751296	0.013979	0.029356	0.002490	0.000000
Obed River at Canoe Hole	0.105612	0.178569	0.818838	0.010478	0.026532	0.002841	0.000000
Alley Ford	0.105286	0.178185	0.819619	0.010450	0.026451	0.002958	0.000000
Mean	0.136513	0.227271	0.720248	0.012736	0.029850	0.002212	0.000000
<u>Clear Creek</u>							
Norris Ford	0.047499	0.228902	0.847516	0.005554	0.018578	0.002338	0.000000
Jett Bridge	0.036864	0.185624	0.903439	0.005156	0.017527	0.002976	0.000000
Lilly Bridge	0.036880	0.175448	0.913789	0.004962	0.017056	0.002952	0.000000
Barnett Bridge	0.045664	0.210488	0.868691	0.005194	0.018261	0.002808	0.000000
Mean	0.041583	0.199609	0.884433	0.005214	0.017850	0.002762	0.000000
<u>White Creek</u>							
Lavendar Bridge	0.021268	0.154145	0.950288	0.005350	0.015153	0.001425	0.000000
White Creek at Twin Bridge Rd.	0.021063	0.110195	0.983083	0.002533	0.016222	0.000845	0.000000
White Creek Mouth	0.020759	0.150427	0.952872	0.005025	0.015738	0.002132	0.000000
Mean	0.021029	0.137520	0.963669	0.004197	0.015701	0.001419	0.000000
<u>Daddys Creek</u>							
Yellow Creek	0.006708	0.021124	0.944244	0.000971	0.007083	0.000000	0.000000
Yellow Creek at Hebbertsburg Rd.	0.008047	0.043856	0.986423	0.001444	0.010139	0.000000	0.000000

Appendix Table C1 (continued)

Site	Developed	Field	Forest	Pond	Road	Stream-lake	Strip mine
Devils Breakfast Table	0.156400	0.171058	0.756011	0.013541	0.034881	0.002155	0.000000
Daddys Creek at Antioch Bridge	0.195574	0.201989	0.664901	0.016640	0.040751	0.001758	0.000000
Daddys Creek at Obed Junction	0.154855	0.169370	0.759923	0.013422	0.034637	0.002338	0.000000
Mean	0.078977	0.106457	0.920351	0.007409	0.023082	0.000747	0.000000
<u>Emory River</u>							
Emory River at Montgomery Rd.	0.015450	0.037255	0.988721	0.001377	0.008903	0.002244	0.000864
Nemo	0.091923	0.156858	0.861611	0.009095	0.024056	0.003050	0.000117
Rock Creek at Highway 62	0.028593	0.058001	0.999679	0.002925	0.013832	0.001587	0.000032
Island Creek at Catoosa Rd.	0.005896	0.017423	0.940430	0.000450	0.010573	0.000000	0.000000
Mean	0.028355	0.057905	0.999427	0.002699	0.013800	0.001268	0.000131

VITA

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APPENDIX 2

Appendix Table 2-1. Macroinvertebrates collected within Clear Creek at Jett Bridge, Morgan County, Tennessee (N 36°7'21.95", W 84°44'44.69"), September 28, 2004. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Stenelmis</i>	72
Coleoptera	Elmidae	<i>Microcylloepus</i>	6
Coleoptera	Elmidae	<i>Promoresia</i>	68
Coleoptera	Elmidae	<i>Optioservus</i>	4
Coleoptera	Elmidae	<i>Ancyronyx</i>	4
Coleoptera	Psephenidae	<i>Ectopria</i>	1
Diptera	Athericidae	<i>Atherix</i>	3
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	2
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	2
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	2
Megaloptera	Corydalidae	<i>Corydalus</i>	7
Megaloptera	Corydalidae	<i>Nigronia</i>	1
Mesogastropoda	Pleuroceridae	<i>Elimia</i>	4
Odonata	Gomphidae	<i>Gomphus</i>	1
Plecoptera	Perlidae	<i>Agnetina</i>	6
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	14
Trichoptera	Brachycentridae	<i>Micrasema</i>	17
Trichoptera	Molannidae	<i>Molanna</i>	1
Trichoptera	Helicopsychidae	<i>Helicopsyche</i>	6
Veneroida	Corbiculidae	<i>Corbicula</i>	2
		Total	223

Metric	Value	Score	Condition
Taxa Richness (TR)	20	2	
EPT Richness (EPT)	8	2	
% EPT	22.42	2	
% OC	0	6	
NCBI	3.35	6	
% Dominant	32.29	6	
% Clingers	94.2	6	
	Total	30	Slightly Impaired

Appendix Table 2-2. Macroinvertebrates collected within Clear Creek at Jett Bridge, Morgan County, Tennessee (N 36°7'21.95", W 84°44'44.69"), January 26, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Stenelmis</i>	7
Coleoptera	Elmidae	<i>Microcyllloepus</i>	13
Coleoptera	Elmidae	<i>Promoresia</i>	19
Coleoptera	Elmidae	<i>Optioservus</i>	7
Coleoptera	Elmidae	<i>Ancyronyx</i>	1
Coleoptera	Hydrophilidae	<i>Berosus</i>	1
Coleoptera	Psephenidae	<i>Ectopria</i>	2
Diptera	Simuliidae	<i>Simulium</i>	5
Diptera	Tipulidae	<i>Antocha</i>	11
Ephemeroptera	Baetidae	<i>Acentrella</i>	7
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	46
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	24
Megaloptera	Corydalidae	<i>Corydalus</i>	3
Plecoptera	Perlidae	<i>Agnetina</i>	3
Plecoptera	Perlidae	<i>Neoperla</i>	1
Plecoptera	Perlodidae	<i>Isoperla</i>	5
Plecoptera	Taeniopterygidae	<i>Oemopteryx</i>	17
Trichoptera	Brachycentridae	<i>Micrasema</i>	8
Trichoptera	Helicopsychidae	<i>Helicopsyche</i>	1
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	16
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	1
Trichoptera	Hydropsychidae	<i>Parapsyche</i>	1
Unionoida	Unionidae	<i>Villosa iris</i>	1
Veneroida	Corbiculidae	<i>Corbicula</i>	3
		Total	203

Metric	Value	Score	Condition
Taxa Richness (TR)	24	4	
EPT Richness (EPT)	12	4	
% EPT	64.04	6	
% OC	0	6	
NCBI	2.73	6	
% Dominant	22.66	6	
% Clingers	83.25	6	
		38	Non-impaired

Appendix Table 2-3. Macroinvertebrates collected within Clear Creek at Jett Bridge, Morgan County, Tennessee (N 36°7'21.95", W 84°44'44.69"), May 5, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Stenelmis</i>	15
Coleoptera	Elmidae	<i>Microcyllloepus</i>	14
Coleoptera	Elmidae	<i>Promoresia</i>	18
Coleoptera	Elmidae	<i>Optioservus</i>	4
Coleoptera	Elmidae	<i>Ancyronyx</i>	3
Coleoptera	Hydrophilidae	<i>Enochrus</i>	1
Diptera	Empididae	<i>Hemerodromia</i>	2
Diptera	Chironomidae	<i>Eukiefferiella</i>	6
Diptera	Chironomidae	<i>Diplocladius</i>	2
Diptera	Chironomidae	<i>Rheotanytarsus</i>	1
Diptera	Simuliidae	<i>Simulium</i>	19
Diptera	Tipulidae	<i>Antocha</i>	5
Ephemeroptera	Baetidae	<i>Acentrella</i>	20
Ephemeroptera	Caenidae	<i>Caenis</i>	3
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	30
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	25
Ephemeroptera	Heptageniidae	<i>Stenacron</i>	1
Ephemeroptera	Heptageniidae	<i>Epeorus</i>	3
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	5
Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	1
Megaloptera	Corydalidae	<i>Corydalus</i>	5
Megaloptera	Corydalidae	<i>Nigronia</i>	2
Plecoptera	Perlidae	<i>Agnetina</i>	4
Plecoptera	Perlidae	<i>Acroneuria</i>	4
Plecoptera	Perlidae	<i>Perlesta</i>	3
Plecoptera	Leuctridae	<i>Leuctra</i>	1
Trichoptera	Brachycentridae	<i>Micrasema</i>	4
Trichoptera	Helicopsychidae	<i>Helicopsyche</i>	1
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	15
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	6
Trichoptera	Philopotamidae	<i>Chimarra</i>	3
Trichoptera	Philopotamidae	<i>Dolophilodes</i>	4
Veneroida	Corbiculidae	<i>Corbicula</i>	3
		Total	233

Appendix Table 2-3 (Continued)

Metric	Value	Score	Condition
Taxa Richness (TR)	33	4	Non-impaired
EPT Richness (EPT)	17	6	
% EPT	56.65	6	
% OC	4.29	6	
NCBI	3.45	6	
% Dominant	12.88	6	
% Clingers	81.55	6	
		40	Non-impaired

Appendix Table 2-4. Macroinvertebrates collected within Clear Creek at Jett Bridge, Morgan County, Tennessee (N 36°7'21.95", W 84°44'44.69"), June 22, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Stenelmis</i>	34
Coleoptera	Elmidae	<i>Microcyllloepus</i>	27
Coleoptera	Elmidae	<i>Promoresia</i>	20
Coleoptera	Hydrophilidae	<i>Berosus</i>	1
Diptera	Athericidae	<i>Atherix</i>	6
Diptera	Chironomidae	<i>Rheocricotopus</i>	1
Diptera	Simuliidae	<i>Simulium</i>	6
Diptera	Tipulidae	<i>Antocha</i>	3
Ephemeroptera	Baetidae	<i>Acentrella</i>	8
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	15
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	7
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	14
Megaloptera	Corydalidae	<i>Corydalus</i>	2
Mesogastropoda	Lymnaeidae	<i>Fossaria</i>	1
Plecoptera	Perlidae	<i>Agneta</i>	10
Plecoptera	Perlidae	<i>Perlesta</i>	4
Plecoptera	Leuctridae	<i>Leuctra</i>	1
Trichoptera	Brachycentridae	<i>Micrasema</i>	7
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	48
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	8
Trichoptera	Philopotamidae	<i>Chimarra</i>	2
Trichoptera	Rhyacophilidae	<i>Rhyacophila</i>	1
Veneroida	Corbiculidae	<i>Corbicula</i>	2
		Total	228

Metric	Value	Score	Condition
Taxa Richness (TR)	23	4	
EPT Richness (EPT)	12	4	
% EPT	54.82	6	
% OC	0.44	6	
NCBI	3.46	6	
% Dominant	21.05	6	
% Clingers	85.53	6	
		38	Non-impaired

Appendix Table 2-5. Macroinvertebrates collected within Clear Creek at Lilly Bridge, Morgan County, Tennessee (N 36°6'2.35", W 84°42'59.56"), September 15, 2004. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Stenelmis</i>	19
Coleoptera	Elmidae	<i>Promoresia</i>	2
Coleoptera	Elmidae	<i>Optioservus</i>	19
Coleoptera	Elmidae	<i>Microcylloepus</i>	1
Diptera	Athericidae	<i>Atherix</i>	12
Diptera	Simuliidae	<i>Simulium</i>	18
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	19
Ephemeroptera	Heptageniidae	<i>Stenacron</i>	3
Ephemeroptera	Heptageniidae	<i>Epeorus</i>	30
Ephemeroptera	Baetidae	<i>Acentrella</i>	16
Ephemeroptera	Baetidae	<i>Baetis</i>	5
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	15
Lepidoptera	Pyrilidae	<i>Petrophila</i>	1
Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	1
Megaloptera	Corydalidae	<i>Corydalus</i>	6
Plecoptera	Perlidae	<i>Acroneuria</i>	5
Plecoptera	Perlidae	<i>Agnetina</i>	5
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	17
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	6
Trichoptera	Philopotamidae	<i>Chimarra</i>	5
Trichoptera	Polycentropodidae	<i>Polycentropus</i>	2
Veneroida	Corbiculidae	<i>Corbicula</i>	2
		Total	209

Metric	Value	Score	Condition
Taxa Richness (TR)	22	2	
EPT Richness (EPT)	12	4	
% EPT	61.24	6	
% OC	0.5	6	
NCBI	3.26	6	
% Dominant	14.35	6	
% Clingers	75.6	6	
		36	Non-impaired

Appendix Table 2-6. Macroinvertebrates collected within Clear Creek at Lilly Bridge, Morgan County, Tennessee (N 36°6'2.35", W 84°42'59.56"), January 26, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Stenelmis</i>	1
Coleoptera	Elmidae	<i>Promoresia</i>	2
Coleoptera	Elmidae	<i>Microcylloepus</i>	1
Coleoptera	Hydrophilidae	<i>Berosus</i>	1
Diptera	Tipulidae	<i>Antocha</i>	5
Diptera	Chironomidae	<i>Eukiefferiella</i>	9
Diptera	Chironomidae	<i>Psectrocladius</i>	5
Diptera	Chironomidae	<i>Microtendipes</i>	5
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	25
Ephemeroptera	Heptageniidae	<i>Epeorus</i>	11
Ephemeroptera	Baetidae	<i>Acentrella</i>	73
Ephemeroptera	Caenidae	<i>Caenis</i>	1
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	23
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	13
Megaloptera	Corydalidae	<i>Corydalus</i>	1
Megaloptera	Corydalidae	<i>Nigronia</i>	2
Plecoptera	Perlidae	<i>Acroneuria</i>	8
Plecoptera	Perlidae	<i>Agneta</i>	3
Plecoptera	Perlodidae	<i>Isoperla</i>	4
Plecoptera	Taeniopterygidae	<i>Taeniopteryx</i>	3
Plecoptera	Taeniopterygidae	<i>Oemopteryx</i>	9
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	4
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	5
Trichoptera	Philopotamidae	<i>Dolophilodes</i>	1
		Total	215

Metric	Value	Score	Condition
Taxa Richness (TR)	24	4	
EPT Richness (EPT)	14	6	
% EPT	86.05	6	
% OC	8.84	6	
NCBI	3.16	6	
% Dominant	33.95	4	
% Clingers	45.12	4	
		36	Non-impaired

Appendix Table 2-7. Macroinvertebrates collected within Clear Creek at Lilly Bridge, Morgan County, Tennessee (N 36°6'2.35", W 84°42'59.56"), May 9, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Stenelmis</i>	4
Coleoptera	Elmidae	<i>Optioservus</i>	4
Coleoptera	Elmidae	<i>Promoresia</i>	2
Coleoptera	Elmidae	<i>Microcylloepus</i>	1
Coleoptera	Psephenidae	<i>Psephenus</i>	1
Diptera	Chironomidae	<i>Polypedilum</i>	3
Ephemeroptera	Baetidae	<i>Acentrella</i>	55
Ephemeroptera	Baetidae	<i>Baetis</i>	3
Ephemeroptera	Caenidae	<i>Caenis</i>	6
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	33
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	16
Ephemeroptera	Heptageniidae	<i>Epeorus</i>	17
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	3
Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	1
Megaloptera	Corydalidae	<i>Corydalus</i>	1
Plecoptera	Perlidae	<i>Acroneuria</i>	3
Plecoptera	Perlidae	<i>Agnetina</i>	7
Plecoptera	Perlidae	<i>Perlesta</i>	9
Plecoptera	Perlodidae	<i>Isoperla</i>	2
Trichoptera	Brachycentridae	<i>Micrasema</i>	3
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	25
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	3
Trichoptera	Philopotamidae	<i>Dolophilodes</i>	4
Total			206

Metric	Value	Score	Condition
Taxa Richness (TR)	23	4	Non-impaired
EPT Richness (EPT)	15	6	
% EPT	91.75	6	
% OC	1.94	6	
NCBI	3.24	6	
% Dominant	26.7	6	
% Clingers	64.56	6	
		40	

Appendix Table 2-8. Macroinvertebrates collected within Clear Creek at Lilly Bridge, Morgan County, Tennessee (N 36°6'2.35", W 84°42'59.56"), June 22, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Stenelmis</i>	48
Coleoptera	Elmidae	<i>Optioservus</i>	2
Coleoptera	Elmidae	<i>Promoresia</i>	3
Coleoptera	Elmidae	<i>Microcylloepus</i>	5
Diptera	Athericidae	<i>Atherix</i>	8
Diptera	Chironomidae	<i>Microtendipes</i>	1
Diptera	Chironomidae	<i>Rheocricotopus</i>	3
Diptera	Simuliidae	<i>Simulium</i>	15
Diptera	Tipulidae	<i>Antocha</i>	1
Ephemeroptera	Baetidae	<i>Acentrella</i>	22
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	19
Ephemeroptera	Heptageniidae	<i>Stenacron</i>	1
Ephemeroptera	Heptageniidae	<i>Epeorus</i>	8
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	23
Megaloptera	Corydalidae	<i>Corydalus</i>	2
Megaloptera	Corydalidae	<i>Nigronia</i>	1
Plecoptera	Leuctridae	<i>Leuctra</i>	2
Plecoptera	Perlidae	<i>Acroneuria</i>	2
Plecoptera	Perlidae	<i>Agnetina</i>	14
Plecoptera	Perlidae	<i>Perlesta</i>	4
Trichoptera	Brachycentridae	<i>Micrasema</i>	2
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	12
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	4
		<i>Total</i>	202

Metric	Value	Score	Condition
Taxa Richness (TR)	23	4	
EPT Richness (EPT)	12	4	
% EPT	55.94	6	
% OC	2	6	
NCBI	3.61	6	
% Dominant	23.76	6	
% Clingers	72.28	6	
		38	Non-impaired

Appendix Table 2-9. Macroinvertebrates collected within Daddys Creek at Devil's Breakfast Table (D.B.T.), Cumberland County, Tennessee (N 36°3'33.56", W 84° 47'31.56"), October 3, 2004. Metrics, values, scores, and condition associated with . data are listed

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Stenelmis</i>	22
Coleoptera	Elmidae	<i>Optioservus</i>	4
Coleoptera	Elmidae	<i>Promoresia</i>	28
Coleoptera	Elmidae	<i>Dubiraphia</i>	1
Coleoptera	Elmidae	<i>Microcylloepus</i>	10
Coleoptera	Hydrophilidae	<i>Berosus</i>	1
Coleoptera	Psephenidae	<i>Psephenus</i>	2
Decapoda	Cambaridae	<i>Orconectes</i>	1
Diptera	Athericidae	<i>Atherix</i>	5
Diptera	Chironomidae	<i>Microtendipes</i>	3
Diptera	Simuliidae	<i>Simulium</i>	7
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	17
Ephemeroptera	Heptageniidae	<i>Stenacron</i>	3
Ephemeroptera	Heptageniidae	<i>Epeorus</i>	1
Ephemeroptera	Baetidae	<i>Acentrella</i>	3
Ephemeroptera	Baetidae	<i>Baetis</i>	11
Ephemeroptera	Caenidae	<i>Caenis</i>	1
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	31
Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	1
Megaloptera	Corydalidae	<i>Corydalus</i>	7
Mesogastropoda	Pleuroceridae	<i>Elimia</i>	1
Odonata	Gomphidae	<i>Stylogomphus</i>	1
Plecoptera	Leuctridae	<i>Leuctra</i>	1
Plecoptera	Perlidae	<i>Agnetina</i>	3
Plecoptera	Perlodidae	<i>Isoperla</i>	1
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	21
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	17
Trichoptera	Philopotamidae	<i>Chimarra</i>	9
Trichoptera	Philopotamidae	<i>Dolophilodes</i>	4
Trichoptera	Helicopsychidae	<i>Helicopsyche</i>	2
Veneroida	Corbiculidae	<i>Corbicula</i>	2
		Total	221

Appendix Table 2-9 (Continued)

Metric	Value	Score	Condition
Taxa Richness (TR)	31	4	Non-impaired
EPT Richness (EPT)	15	6	
% EPT	56.11	6	
% OC	1.81	6	
NCBI	3.71	6	
% Dominant	14.03	6	
% Clingers	72.85	6	
		40	

Appendix Table 2-10. Macroinvertebrates collected within Daddys Creek at Devil's Breakfast Table (D.B.T.), Cumberland County, Tennessee (N 36°3'33.56", W 84° 47'31.56"), January 27, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Amphipoda	Gammaridae	<i>Gammarus</i>	2
Coleoptera	Elmidae	<i>Optioservus</i>	13
Coleoptera	Elmidae	<i>Microcyloepus</i>	4
Coleoptera	Elmidae	<i>Stenelmis</i>	3
Coleoptera	Elmidae	<i>Promoresia</i>	2
Coleoptera	Elmidae	<i>Dubiraphia</i>	4
Coleoptera	Psephenidae	<i>Psephenus</i>	5
Diptera	Chironomidae	<i>Microtendipes</i>	1
Diptera	Chironomidae	<i>Corynoneura</i>	1
Diptera	Chironomidae	<i>Eukiefferiella</i>	1
Diptera	Simuliidae	<i>Simulium</i>	1
Diptera	Tabanidae	<i>Tabanus</i>	2
Diptera	Tipulidae	<i>Antocha</i>	3
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	32
Ephemeroptera	Heptageniidae	<i>Stenacron</i>	1
Ephemeroptera	Heptageniidae	<i>Epeorus</i>	2
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	69
Ephemeroptera	Baetidae	<i>Acentrella</i>	2
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	4
Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	2
Megaloptera	Corydalidae	<i>Corydalus</i>	4
Odonata	Corduliidae	<i>Epithea</i>	1
Odonata	Gomphidae	<i>Stylogomphus</i>	1
Plecoptera	Perlidae	<i>Acroneuria</i>	5
Plecoptera	Perlidae	<i>Agnetina</i>	10
Plecoptera	Perlidae	<i>Neoperla</i>	1
Plecoptera	Perlodidae	<i>Isoperla</i>	3
Plecoptera	Taeniopterygidae	<i>Oemopteryx</i>	1
Plecoptera	Taeniopterygidae	<i>Taeniopteryx</i>	2
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	16
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	8
Trichoptera	Philopotamidae	<i>Chimarra</i>	2
Trichoptera	Philopotamidae	<i>Dolophilodes</i>	2
Trichoptera	Glossosomatidae	<i>Glossosoma</i>	1
Veneroida	Corbiculidae	<i>Corbicula</i>	1
		Total	212

Appendix Table 2-10 (Continued)

Metric	Values	Score	Condition
Taxa Richness (TR)	35	6	Non-impaired
EPT Richness (EPT)	17	6	
% EPT	75.94	6	
% OC	2.36	6	
NCBI	3.06	6	
% Dominant	32.55	6	
% Clingers	89.15	6	
		42	

Appendix Table 2-11. Macroinvertebrates collected within Daddys Creek at Devil's Breakfast Table (D.B.T.), Cumberland County, Tennessee (N 36°3'33.56", W 84° 47'31.56"), May 18, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Optioservus</i>	7
Coleoptera	Elmidae	<i>Microcylloepus</i>	17
Coleoptera	Elmidae	<i>Stenelmis</i>	12
Coleoptera	Elmidae	<i>Promoresia</i>	12
Coleoptera	Psephenidae	<i>Psephenus</i>	3
Diptera	Tipulidae	<i>Antocha</i>	1
Diptera	Chironomidae	<i>Polypedilum</i>	5
Diptera	Chironomidae	<i>Eukiefferiella</i>	4
Diptera	Simuliidae	<i>Simulium</i>	7
Ephemeroptera	Baetidae	<i>Acentrella</i>	21
Ephemeroptera	Caenidae	<i>Caenis</i>	10
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	4
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	15
Ephemeroptera	Heptageniidae	<i>Epeorus</i>	6
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	16
Isopoda	Asellidae	<i>Lirceus</i>	2
Megaloptera	Corydalidae	<i>Corydalus</i>	1
Odonata	Gomphidae	<i>Stylogomphus</i>	3
Plecoptera	Perlidae	<i>Neoperla</i>	3
Plecoptera	Perlidae	<i>Acroneuria</i>	1
Plecoptera	Perlidae	<i>Agneta</i>	7
Plecoptera	Perlidae	<i>Perlesta</i>	1
Plecoptera	Perlodidae	<i>Isoperla</i>	1
Trichoptera	Brachycentridae	<i>Micrasema</i>	21
Trichoptera	Helicopsychidae	<i>Helicopsyche</i>	1
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	13
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	5
Trichoptera	Molannidae	<i>Molanna</i>	2
Trichoptera	Philopotamidae	<i>Chimarra</i>	5
Trichoptera	Philopotamidae	<i>Dolophilodes</i>	2
Trichoptera	Polycentropodidae	<i>Polycentropus</i>	2
		Total	210

Appendix Table 2-11 (Continued)

Metric	Value	Score	Condition
Taxa Richness (TR)	31	4	Non-impaired
EPT Richness (EPT)	19	6	
% EPT	64.76	6	
% OC	4.29	6	
NCBI	3.2	6	
% Dominant	10	6	
% Clingers	69.52	6	
		40	

Appendix Table 2-12. Macroinvertebrates collected within Daddys Creek at Devil's Breakfast Table (D.B.T.), Cumberland County, Tennessee (N 36°3'33.56", W 84° 47' 31.56"), June 21, 2005. Metric values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Optioservus</i>	7
Coleoptera	Elmidae	<i>Microcylloepus</i>	19
Coleoptera	Elmidae	<i>Stenelmis</i>	44
Coleoptera	Elmidae	<i>Promoresia</i>	5
Coleoptera	Elmidae	<i>Oulimnius</i>	2
Coleoptera	Hydrophilidae	<i>Berosus</i>	2
Coleoptera	Psephenidae	<i>Psephenus</i>	1
Diptera	Athericidae	<i>Atherix</i>	4
Diptera	Tipulidae	<i>Antocha</i>	2
Diptera	Chironomidae	<i>Polypedilum</i>	4
Diptera	Chironomidae	<i>Rheocricotopus</i>	4
Diptera	Chironomidae	<i>Eukiefferiella</i>	6
Diptera	Simuliidae	<i>Simulium</i>	10
Ephemeroptera	Caenidae	<i>Caenis</i>	3
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	7
Ephemeroptera	Heptageniidae	<i>Stenacron</i>	3
Ephemeroptera	Heptageniidae	<i>Epeorus</i>	2
Ephemeroptera	Baetidae	<i>Acentrella</i>	13
Ephemeroptera	Baetidae	<i>Baetis</i>	4
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	14
Megaloptera	Corydalidae	<i>Corydalus</i>	3
Megaloptera	Corydalidae	<i>Nigronia</i>	1
Plecoptera	Perlidae	<i>Neoperla</i>	2
Plecoptera	Perlidae	<i>Agnetina</i>	11
Plecoptera	Perlidae	<i>Perlesta</i>	1
Trichoptera	Brachycentridae	<i>Micrasema</i>	1
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	34
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	11
Trichoptera	Philopotamidae	<i>Chimarra</i>	5
Trichoptera	Philopotamidae	<i>Dolophilodes</i>	1
Veneroida	Corbiculidae	<i>Corbicula</i>	2
		Total	228

Appendix Table 2-12 (Continued)

Metric	Value	Score	Condition
Taxa Richness (TR)	31	4	Non-impaired
EPT Richness (EPT)	15	6	
% EPT	49.12	6	
% OC	6.14	6	
NCBI	3.89	6	
% Dominant	19.3	6	
% Clingers	75.44	6	
		40	

Appendix Table 2-13. Macroinvertebrates collected within Daddys Creek at Obed River Junction, Morgan County, Tennessee (N 34°4'34.23", W 84°46'3.24"), September 15, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Promoresia</i>	56
Coleoptera	Elmidae	<i>Optioservus</i>	31
Coleoptera	Elmidae	<i>Microcylloepus</i>	24
Coleoptera	Elmidae	<i>Stenelmis</i>	16
Coleoptera	Elmidae	<i>Dubiraphia</i>	2
Coleoptera	Psephenidae	<i>Psephenus</i>	1
Diptera	Athericidae	<i>Atherix</i>	5
Diptera	Chironomidae	<i>Procladius</i>	1
Diptera	Chironomidae	<i>Diplocladius</i>	1
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	6
Ephemeroptera	Baetidae	<i>Acentrella</i>	18
Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	3
Megaloptera	Corydalidae	<i>Corydalus</i>	5
Plecoptera	Perlidae	<i>Acroneuria</i>	1
Plecoptera	Perlidae	<i>Agneta</i>	4
Plecoptera	Perlidae	<i>Neoperla</i>	3
Trichoptera	Helicopsychidae	<i>Helicopsyche</i>	1
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	32
Trichoptera	Hydropsychidae	<i>Parapsyche</i>	1
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	2
Trichoptera	Philopotmatidae	<i>Chimarra</i>	5
Veneroida	Corbiculidae	<i>Corbicula</i>	1
		Total	219

Metric	Value	Score	Condition
Taxa Richness (TR)	22	2	
EPT Richness (EPT)	10	4	
% EPT	33.3	4	
% OC	2.28	6	
NCBI	3.13	6	
% Dominant	25.57	6	
% Clingers	86.76	6	
		34	Non-impaired

Appendix Table 2-14. Macroinvertebrates collected within Daddys Creek at Obed River Junction, Morgan County, Tennessee (N 34°4'34.23", W 84°46'3.24"), January 27, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Promoresia</i>	37
Coleoptera	Elmidae	<i>Optioservus</i>	9
Coleoptera	Elmidae	<i>Microcylloepus</i>	7
Coleoptera	Elmidae	<i>Stenelmis</i>	3
Coleoptera	Psephenidae	<i>Ectopria</i>	2
Diptera	Athericidae	<i>Atherix</i>	3
Diptera	Chironomidae	<i>Tanytarsus</i>	1
Diptera	Chironomidae	<i>Eukiefferiella</i>	5
Diptera	Chironomidae	<i>Microtendipes</i>	1
Diptera	Chironomidae	<i>Diplocladius</i>	2
Diptera	Tipulidae	<i>Antocha</i>	7
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	56
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	17
Ephemeroptera	Heptageniidae	<i>Epeorus</i>	2
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	2
Megaloptera	Corydalidae	<i>Corydalus</i>	3
Mesogastropoda	Lymnaeidae	<i>Fossaria</i>	1
Plecoptera	Perlidae	<i>Acroneuria</i>	3
Plecoptera	Perlidae	<i>Agnetina</i>	5
Plecoptera	Perlodidae	<i>Isoperla</i>	1
Plecoptera	Taeniopterygidae	<i>Taeniopteryx</i>	1
Plecoptera	Taeniopterygidae	<i>Oemopteryx</i>	1
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	33
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	4
Trichoptera	Leptoceridae	<i>Mystacides</i>	2
Trichoptera	Philopotmatidae	<i>Chimarra</i>	2
Trichoptera	Polycentropodidae	<i>Polycentropus</i>	1
Veneroida	Corbiculidae	<i>Corbicula</i>	1
		Total	212

Appendix Table 2-14 (Continued)

Metric	Value	Score	Condition
Taxa Richness (TR)	28	4	Non-impaired
EPT Richness (EPT)	14	6	
% EPT	61.32	6	
% OC	4.25	6	
NCBI	2.97	6	
% Dominant	26.42	6	
% Clingers	91.04	6	
		40	

Appendix Table 2-15. Macroinvertebrates collected within Daddys Creek at Obed River Junction, Morgan County, Tennessee (N 34°4'34.23", W 84°46'3.24"), May 10, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Promoresia</i>	3
Coleoptera	Elmidae	<i>Optioservus</i>	6
Coleoptera	Elmidae	<i>Microcylloepus</i>	13
Coleoptera	Elmidae	<i>Stenelmis</i>	36
Coleoptera	Psephenidae	<i>Psephenus</i>	3
Diptera	Chironomidae	<i>Eukiefferiella</i>	6
Diptera	Chironomidae	<i>Polypedilum</i>	3
Diptera	Empididae	<i>Hemerodromia</i>	2
Diptera	Simuliidae	<i>Simulium</i>	7
Diptera	Tipulidae	<i>Antocha</i>	2
Ephemeroptera	Baetidae	<i>Acentrella</i>	58
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	10
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	15
Ephemeroptera	Heptageniidae	<i>Epeorus</i>	2
Ephemeroptera	Heptageniidae	<i>Stenacron</i>	1
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	2
Mesogastropoda	Pleuroceridae	<i>Elimia</i>	2
Isopoda	Asellidae	<i>Lirceus</i>	1
Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	2
Megaloptera	Corydalidae	<i>Corydalus</i>	3
Plecoptera	Perlidae	<i>Acroneuria</i>	2
Plecoptera	Perlidae	<i>Agnetina</i>	5
Plecoptera	Perlidae	<i>Perlesta</i>	5
Trichoptera	Helicopsychidae	<i>Helicopsyche</i>	1
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	10
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	4
Trichoptera	Molannidae	<i>Molanna</i>	2
Trichoptera	Philopotmatidae	<i>Chimarra</i>	4
Veneroida	Corbiculidae	<i>Corbicula</i>	1
		Total	211

Appendix Table 2-15 (Continued)

Metric	Value	Score	Condition
Taxa Richness (TR)	29	4	Non-impaired
EPT Richness (EPT)	14	6	
% EPT	57.35	6	
% OC	5.21	6	
NCBI	3.72	6	
% Dominant	27.49	6	
% Clingers	62.56	6	
		40	

Appendix Table 2-16. Macroinvertebrates collected within Daddys Creek at Obed River Junction, Morgan County, Tennessee (N 34°4'34.23", W 84°46'3.24"), June 21, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Promoresia</i>	14
Coleoptera	Elmidae	<i>Optioservus</i>	5
Coleoptera	Elmidae	<i>Microcylloepus</i>	26
Coleoptera	Elmidae	<i>Stenelmis</i>	37
Coleoptera	Psephenidae	<i>Psephenus</i>	1
Diptera	Chironomidae	<i>Eukiefferiella</i>	2
Diptera	Chironomidae	<i>Rheotanytarsus</i>	2
Diptera	Chironomidae	<i>Microtendipes</i>	1
Diptera	Chironomidae	<i>Polypedilum</i>	4
Diptera	Empididae	<i>Hemerodromia</i>	1
Diptera	Simuliidae	<i>Simulium</i>	5
Diptera	Tipulidae	<i>Antocha</i>	3
Ephemeroptera	Baetidae	<i>Acentrella</i>	8
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	6
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	9
Ephemeroptera	Heptageniidae	<i>Epeorus</i>	8
Ephemeroptera	Heptageniidae	<i>Stenacron</i>	2
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	5
Megaloptera	Corydalidae	<i>Corydalus</i>	3
Odonata	Gomphidae	<i>Stylogomphus</i>	1
Plecoptera	Perlidae	<i>Acroneuria</i>	3
Plecoptera	Perlidae	<i>Agnetina</i>	13
Trichoptera	Brachycentridae	<i>Micrasema</i>	2
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	36
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	11
Trichoptera	Hydropsychidae	<i>Parapsyche</i>	1
Trichoptera	Philopotmatidae	<i>Chimarra</i>	1
Trichoptera	Rhyacophilidae	<i>Rhyacophila</i>	1
		Total	211

Appendix Table 2-16 (Continued)

Metric	Value	Score	Condition
Taxa Richness (TR)	28	4	Non-impaired
EPT Richness (EPT)	14	6	
% EPT	50.24	6	
% OC	4.27	6	
NCBI	3.49	6	
% Dominant	17.54	6	
% Clingers	90.05	6	
		40	Non-impaired

Appendix Table 2-17. Macroinvertebrates collected within Obed River at Daddys Creek Junction, Morgan County, Tennessee (N 36°4'41.94", W 84°45'39.98"), September 15, 2004. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Optioservus</i>	5
Coleoptera	Elmidae	<i>Promoresia</i>	35
Coleoptera	Elmidae	<i>Microcylloepus</i>	25
Coleoptera	Psephenidae	<i>Ectopria</i>	1
Coleoptera	Psephenidae	<i>Psephenus</i>	2
Diptera	Athericidae	<i>Atherix</i>	1
Diptera	Chironomidae	<i>Rheotanytarsus</i>	3
Diptera	Chironomidae	<i>Paratanytarsus</i>	1
Diptera	Simuliidae	<i>Simulium</i>	9
Ephemeroptera	Baetidae	<i>Acentrella</i>	9
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	1
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	13
Ephemeroptera	Heptageniidae	<i>Stenacron</i>	4
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	24
Lepidoptera	Pyralidae	<i>Petrophila</i>	1
Megaloptera	Corydalidae	<i>Corydalus</i>	4
Mesogastropoda	Pleuroceridae	<i>Elimia</i>	1
Plecoptera	Perlidae	<i>Agnetina</i>	5
Plecoptera	Perlidae	<i>Neoperla</i>	2
Plecoptera	Perlodidae	<i>Isoperla</i>	3
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	45
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	8
Trichoptera	Hydropsychidae	<i>Parapsyche</i>	1
Trichoptera	Molannidae	<i>Molanna</i>	4
Trichoptera	Philopotamidae	<i>Chimarra</i>	2
Trichoptera	Brachycentridae	<i>Micrasema</i>	5
Tricoptera	Helicopsychidae	<i>Helicopsyche</i>	3
Veneroida	Corbiculidae	<i>Corbicula</i>	1
		Total	218

Appendix Table 2-17 (Continued)

Metric	Value	Score	Condition
Taxa Richness (TR)	28	4	Non-impaired
EPT Richness (EPT)	15	6	
% EPT	59.17	6	
% OC	1.83	6	
NCBI	3.23	6	
% Dominant	20.64	6	
% Clingers	79.82	6	
		40	

Appendix Table 2-18. Macroinvertebrates collected within Obed River at Daddys Creek Junction, Morgan County, Tennessee (N 36°4'41.94", W 84°45'39.98"), January 27, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Stenelmis</i>	1
Coleoptera	Elmidae	<i>Promoresia</i>	9
Coleoptera	Elmidae	<i>Microcylloepus</i>	4
Coleoptera	Psephenidae	<i>Ectopria</i>	1
Diptera	Athericidae	<i>Atherix</i>	1
Diptera	Chironomidae	<i>Rheotanytarsus</i>	15
Diptera	Chironomidae	<i>Eukiefferiella</i>	2
Diptera	Chironomidae	<i>Psectrocladius</i>	2
Diptera	Simuliidae	<i>Simulium</i>	11
Diptera	Tipulidae	<i>Antocha</i>	4
Ephemeroptera	Baetidae	<i>Acentrella</i>	1
Ephemeroptera	Caenidae	<i>Caenis</i>	10
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	49
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	16
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	2
Megaloptera	Corydalidae	<i>Corydalus</i>	2
Plecoptera	Taeniopterygidae	<i>Taeniopteryx</i>	1
Plecoptera	Taeniopterygidae	<i>Oemopteryx</i>	1
Plecoptera	Perlidae	<i>Acroneuria</i>	2
Plecoptera	Perlidae	<i>Agnetina</i>	8
Plecoptera	Perlidae	<i>Neoperla</i>	3
Plecoptera	Perlodidae	<i>Isoperla</i>	3
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	51
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	8
Trichoptera	Hydropsychidae	<i>Parapsyche</i>	2
Trichoptera	Glossosomatidae	<i>Glossosoma</i>	5
Trichoptera	Philopotamidae	<i>Chimarra</i>	2
Trichoptera	Rhyacophilidae	<i>Rhyacophila</i>	1
Veneroida	Corbiculidae	<i>Corbicula</i>	1
		Total	218

Appendix Table 2-18 (Continued)

Metric	Value	Score	Condition
Taxa Richness (TR)	29	4	Non-impaired
EPT Richness (EPT)	17	6	
% EPT	75.69	6	
% OC	8.72	6	
NCBI	3.49	6	
% Dominant	23.39	6	
% Clingers	90.37	6	
		40	

Appendix Table 2-19. Macroinvertebrates collected within Obed River at Daddys Creek Junction, Morgan County, Tennessee (N 36°4'41.94", W 84°45'39.98"), May 10, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Stenelmis</i>	16
Coleoptera	Elmidae	<i>Promoresia</i>	5
Coleoptera	Elmidae	<i>Microcylloepus</i>	13
Coleoptera	Elmidae	<i>Optioservus</i>	1
Diptera	Chironomidae	<i>Rheotanytarsus</i>	1
Diptera	Chironomidae	<i>Rheocricotopus</i>	2
Diptera	Chironomidae	<i>Polypedilium</i>	4
Diptera	Simuliidae	<i>Simulium</i>	18
Diptera	Tipulidae	<i>Antocha</i>	5
Ephemeroptera	Baetidae	<i>Acentrella</i>	9
Ephemeroptera	Baetidae	<i>Baetis</i>	1
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	29
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	25
Ephemeroptera	Heptageniidae	<i>Epeorus</i>	3
Ephemeroptera	Heptageniidae	<i>Stenacron</i>	1
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	12
Lepidoptera	Pyrilidae	<i>Petrophila</i>	1
Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	1
Megaloptera	Corydalidae	<i>Corydalus</i>	4
Odonata	Gomphidae	<i>Stylogomphus</i>	2
Plecoptera	Perlidae	<i>Perlesta</i>	10
Plecoptera	Perlidae	<i>Agnetina</i>	5
Trichoptera	Brachycentridae	<i>Micrasema</i>	14
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	11
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	4
Trichoptera	Philopotamidae	<i>Chimarra</i>	6
Trichoptera	Polycentropodidae	<i>Polycentropus</i>	4
Veneroida	Corbiculidae	<i>Corbicula</i>	4
		Total	211

Appendix Table 2-19 (Continued)

Metric	Value	Score	Condition
Taxa Richness (TR)	28	4	Non-impaired
EPT Richness (EPT)	14	6	
% EPT	63.51	6	
% OC	3.79	6	
NCBI	3.38	6	
% Dominant	13.74	6	
% Clingers	83.41	6	
		40	

Appendix Table 2-20. Macroinvertebrates collected within Obed River at Daddys Creek Junction, Morgan County, Tennessee (N 36°4'41.94", W 84°45'39.98"), June 21, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Amphipoda	Gammaridae	<i>Gammarus</i>	1
Coleoptera	Elmidae	<i>Stenelmis</i>	27
Coleoptera	Elmidae	<i>Promoresia</i>	16
Coleoptera	Elmidae	<i>Microcylloepus</i>	7
Coleoptera	Elmidae	<i>Optioservus</i>	3
Coleoptera	Psephenidae	<i>Ectopria</i>	1
Coleoptera	Psephenidae	<i>Psephenus</i>	2
Diptera	Atherididae	<i>Atherix</i>	1
Diptera	Chironomidae	<i>Rheotanytarsus</i>	4
Diptera	Chironomidae	<i>Diplocladius</i>	2
Diptera	Chironomidae	<i>Eukiefferiella</i>	2
Diptera	Chironomidae	<i>Polypedilium</i>	1
Diptera	Simuliidae	<i>Simulium</i>	5
Diptera	Tipulidae	<i>Antocha</i>	6
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	16
Ephemeroptera	Heptageniidae	<i>Stenacron</i>	2
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	15
Ephemeroptera	Baetidae	<i>Acentrella</i>	10
Ephemeroptera	Baetidae	<i>Baetis</i>	3
Ephemeroptera	Caenidae	<i>Caenis</i>	2
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	8
Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	1
Megaloptera	Corydalidae	<i>Corydalus</i>	2
Megaloptera	Corydalidae	<i>Nigronia</i>	5
Mesogastropoda	Pleuroceridae	<i>Elimia</i>	1
Odonata	Calopterygidae	<i>Hetaerina</i>	1
Plecoptera	Perlidae	<i>Perlesta</i>	2
Plecoptera	Perlidae	<i>Acroneuria</i>	4
Plecoptera	Perlidae	<i>Agnetina</i>	14
Trichoptera	Brachycentridae	<i>Micrasema</i>	2
Trichoptera	Glossosomatidae	<i>Glossosoma</i>	1
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	36
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	9
Trichoptera	Leptoceridae	<i>Mystacides</i>	1
Trichoptera	Molannidae	<i>Molanna</i>	1
Trichoptera	Philopotamidae	<i>Chimarra</i>	1
Trichoptera	Rhyacophilidae	<i>Rhyacophila</i>	3

Appendix Table 2-20 (Continued)

Order	Family	Genus	Count
Veneroida	Corbiculidae	<i>Corbicula</i>	2
		Total	220

Metric	Value	Score	Condition
Taxa Richness (TR)	38	6	
EPT Richness (EPT)	18	6	
% EPT	59.09	6	
% OC	4.55	6	
NCBI	3.69	6	
% Dominant	16.36	6	
% Clingers	80	6	
		42	Non-impaired

Appendix Table 2-21. Macroinvertebrates collected within Emory River at Deermont, Morgan County, Tennessee (N 36°1'32.86", W 84°34'39.95"), September 29, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Stenelmis</i>	87
Coleoptera	Elmidae	<i>Microcyllloepus</i>	27
Coleoptera	Elmidae	<i>Promoresia</i>	36
Coleoptera	Elmidae	<i>Optioservus</i>	8
Coleoptera	Psephenidae	<i>Psephenus</i>	1
Diptera	Athericidae	<i>Atherix</i>	2
Diptera	Simuliidae	<i>Simulium</i>	12
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	1
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	1
Ephemeroptera	Baetidae	<i>Acentrella</i>	4
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	1
Megaloptera	Corydalidae	<i>Corydalis</i>	6
Mesogastropoda	Pleuroceridae	<i>Elimia</i>	3
Plecoptera	Perlidae	<i>Agnetina</i>	2
Trichoptera	Brachycentridae	<i>Micrasema</i>	1
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	10
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	2
Trichoptera	Hydropsychidae	<i>Parapsyche</i>	2
Trichoptera	Philopotamidae	<i>Chimarra</i>	7
Veneroida	Corbiculidae	<i>Corbicula</i>	5
		Total	218

Metric	Value	Score	Condition
Taxa Richness (TR)	20	2	
EPT Richness (EPT)	10	4	
% EPT	14.22	2	
% OC	0	6	
NCBI	3.79	6	
% Dominant	39.91	4	
% Clingers	93.12	6	
		30	Slightly Impaired

Appendix Table 2-22. Macroinvertebrates collected within Emory River at Deermont, Morgan County, Tennessee (N 36°1'32.86", W 84°34'39.95"), January 28, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Stenelmis</i>	9
Coleoptera	Elmidae	<i>Microcyllloepus</i>	34
Coleoptera	Elmidae	<i>Promoresia</i>	7
Coleoptera	Elmidae	<i>Optioservus</i>	4
Coleoptera	Elmidae	<i>Dubiraphia</i>	2
Diptera	Athericidae	<i>Atherix</i>	1
Diptera	Chironomidae	<i>Eukiefferiella</i>	11
Diptera	Chironomidae	<i>Parakiefferiella</i>	1
Diptera	Chironomidae	<i>Rheotanytarsus</i>	1
Diptera	Chironomidae	<i>Polypedilum</i>	1
Diptera	Chironomidae	<i>Pseudochironomus</i>	2
Diptera	Chironomidae	<i>Rheocricotopus</i>	1
Diptera	Empididae	<i>Hemerodromia</i>	1
Diptera	Simuliidae	<i>Simulium</i>	5
Ephemeroptera	Caenidae	<i>Caenis</i>	2
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	19
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	17
Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	5
Megaloptera	Corydalidae	<i>Corydalus</i>	7
Megaloptera	Corydalidae	<i>Nigronia</i>	1
Mesogastropoda	Pleuroceridae	<i>Elimia</i>	1
Plecoptera	Leuctridae	<i>Leuctra</i>	3
Plecoptera	Perlidae	<i>Agnetina</i>	7
Plecoptera	Perlodidae	<i>Isoperla</i>	3
Plecoptera	Taeniopterygidae	<i>Oemopteryx</i>	3
Plecoptera	Taeniopterygidae	<i>Taeniopteryx</i>	3
Trichoptera	Brachycentridae	<i>Micrasema</i>	4
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	24
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	14
Trichoptera	Hydropsychidae	<i>Parapsyche</i>	1
Trichoptera	Philopotamidae	<i>Dolophilodes</i>	2
Trichoptera	Philopotamidae	<i>Chimarra</i>	3
Veneroida	Corbiculidae	<i>Corbicula</i>	2
		Total	201

Appendix Table 2-22 (Continued)

Metric	Value	Score	Condition
Taxa Richness (TR)	33	4	Non-impaired
EPT Richness (EPT)	14	6	
% EPT	52.24	6	
% OC	10.95	6	
NCBI	3.43	6	
% Dominant	16.92	6	
% Clingers	81.59	6	
		40	

Appendix Table 2-23. Macroinvertebrates collected within Emory River at Deermont, Morgan County, Tennessee (N 36°1'32.86", W 84°34'39.95"), May 11, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Stenelmis</i>	41
Coleoptera	Elmidae	<i>Microcyllloepus</i>	28
Coleoptera	Elmidae	<i>Promoresia</i>	10
Coleoptera	Elmidae	<i>Optioservus</i>	2
Coleoptera	Psephenidae	<i>Psephenus</i>	1
Diptera	Chironomidae	<i>Eukiefferiella</i>	4
Diptera	Chironomidae	<i>Polypedilum</i>	3
Diptera	Tipulidae	<i>Antocha</i>	2
Ephemeroptera	Baetidae	<i>Acentrella</i>	23
Ephemeroptera	Baetidae	<i>Baetis</i>	5
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	18
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	30
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	2
Ephemeroptera	Caenidae	<i>Caenis</i>	2
Megaloptera	Corydalidae	<i>Corydalus</i>	3
Plecoptera	Perlidae	<i>Agnatina</i>	8
Plecoptera	Perlidae	<i>Perlesta</i>	7
Trichoptera	Brachycentridae	<i>Micrasema</i>	7
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	10
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	1
Trichoptera	Hydropsychidae	<i>Parapsyche</i>	1
Trichoptera	Philopotamidae	<i>Chimarra</i>	4
Trichoptera	Polycentropodidae	<i>Polycentropus</i>	1
Veneroida	Corbiculidae	<i>Corbicula</i>	1
		Total	214

Metric	Value	Score	Condition
Taxa Richness (TR)	24	4	
EPT Richness (EPT)	14	6	
% EPT	54.67	6	
% OC	3.27	6	
NCBI	3.4	6	
% Dominant	19.16	6	
% Clingers	81.31	6	
		40	Non-impaired

Appendix Table 2-24. Macroinvertebrates collected within Emory River at Deermont, Morgan County, Tennessee (N 36°1'32.86", W 84°34'39.95"), June 23, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Stenelmis</i>	46
Coleoptera	Elmidae	<i>Microcylloepus</i>	22
Coleoptera	Elmidae	<i>Promoresia</i>	15
Coleoptera	Elmidae	<i>Optioservus</i>	2
Diptera	Athericidae	<i>Atherix</i>	3
Diptera	Chironomidae	<i>Eukiefferiella</i>	3
Diptera	Chironomidae	<i>Polypedilum</i>	1
Diptera	Chironomidae	<i>Psectrocladius</i>	1
Diptera	Simuliidae	<i>Simulium</i>	5
Ephemeroptera	Baetidae	<i>Acentrella</i>	2
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	4
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	9
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	9
Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	4
Megaloptera	Corydalidae	<i>Corydalus</i>	5
Mesogastropoda	Pleuroceridae	<i>Elimia</i>	2
Odonata	Calopterygidae	<i>Hetaerina</i>	1
Plecoptera	Perlidae	<i>Agnetina</i>	17
Trichoptera	Brachycentridae	<i>Micrasema</i>	8
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	18
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	18
Trichoptera	Hydropsychidae	<i>Parapsyche</i>	4
Trichoptera	Philopotamidae	<i>Chimarra</i>	14
Trichoptera	Philopotamidae	<i>Dolophilodes</i>	2
Trichoptera	Rhyacophilidae	<i>Rhyacophila</i>	2
Veneroida	Corbiculidae	<i>Corbicula</i>	1
Total			218
Metric	Value	Score	Condition
Taxa Richness (TR)	26	4	Non-impaired
EPT Richness (EPT)	12	4	
% EPT	49.08	6	
% OC	4.13	6	
NCBI	3.44	6	
% Dominant	21.1	6	
% Clingers	87.61	6	
		38	

Appendix Table 2-25. Macroinvertebrates collected within Emory River at Nemo, Morgan County, Tennessee (N 36°4'12.92", W 84°39'40.47"), October 3, 2004. Metric values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Stenelmis</i>	45
Coleoptera	Elmidae	<i>Microcyllloepus</i>	10
Coleoptera	Elmidae	<i>Promoresia</i>	22
Coleoptera	Elmidae	<i>Optioservus</i>	1
Coleoptera	Psephenidae	<i>Psephenus</i>	1
Diptera	Simuliidae	<i>Simulium</i>	3
Diptera	Chironomidae	<i>Psectrocladius</i>	2
Diptera	Tipulidae	<i>Antocha</i>	1
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	19
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	7
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	4
Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	5
Megaloptera	Corydalidae	<i>Corydalus</i>	3
Mesogastropoda	Pleuroceridae	<i>Elimia</i>	2
Plecoptera	Perlidae	<i>Acroneuria</i>	5
Plecoptera	Perlidae	<i>Agnatina</i>	4
Plecoptera	Perlidae	<i>Neoperla</i>	12
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	10
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	20
Trichoptera	Hydropsychidae	<i>Parapsyche</i>	5
Trichoptera	Philopotamidae	<i>Chimarra</i>	7
Veneroida	Corbiculidae	<i>Corbicula</i>	13
		Total	201

Metric	Value	Score	Condition
Taxa Richness (TR)	22	4	
EPT Richness (EPT)	11	4	
% EPT	46.27	6	
% OC	3.48	6	
NCBI	3.87	6	
% Dominant	22.39	6	
% Clingers	78.61	6	
		38	Non-impaired

Appendix Table 2-26. Macroinvertebrates collected within Emory River at Nemo, Morgan County, Tennessee (N 36°4'12.92", W 84°39'40.47"), January 26, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Stenelmis</i>	16
Coleoptera	Elmidae	<i>Microcyllloepus</i>	1
Coleoptera	Elmidae	<i>Promoresia</i>	3
Coleoptera	Elmidae	<i>Optioservus</i>	13
Diptera	Athericidae	<i>Atherix</i>	1
Diptera	Chironomidae	<i>Nilothauma</i>	4
Diptera	Chironomidae	<i>Paratanytarsus</i>	1
Diptera	Chironomidae	<i>Diplocladius</i>	3
Diptera	Chironomidae	<i>Polypedilum</i>	2
Diptera	Simuliidae	<i>Simulium</i>	4
Diptera	Tipulidae	<i>Antocha</i>	1
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	8
Ephemeroptera	Heptageniidae	<i>Epeorus</i>	2
Ephemeroptera	Baetidae	<i>Acentrella</i>	16
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	1
Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	18
Mesogastropoda	Pleuroceridae	<i>Elimia</i>	14
Plecoptera	Perlidae	<i>Agnatina</i>	9
Plecoptera	Perlodidae	<i>Isoperla</i>	20
Plecoptera	Taeniopterygidae	<i>Oemopteryx</i>	10
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	3
Trichoptera	Philopotamidae	<i>Chimarra</i>	4
Veneroida	Corbiculidae	<i>Corbicula</i>	12
		Total	166

Metric	Value	Score	Condition
Taxa Richness (TR)	23	4	
EPT Richness (EPT)	9	4	
% EPT	43.98	6	
% OC	16.87	6	
NCBI	3.58	6	
% Dominant	12.05	6	
% Clingers	39.16	4	
		36	Non-impaired

Appendix Table 2-27. Macroinvertebrates collected within Emory River at Nemo, Morgan County, Tennessee (N 36°4'12.92", W 84°39'40.47"), May 10, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Stenelmis</i>	20
Coleoptera	Elmidae	<i>Optioservus</i>	12
Coleoptera	Psephenidae	<i>Psephenus</i>	3
Diptera	Chironomidae	<i>Procladius</i>	2
Diptera	Chironomidae	<i>Rheotanytarsus</i>	2
Diptera	Chironomidae	<i>Rheocricotopus</i>	2
Diptera	Chironomidae	<i>Diplocladius</i>	2
Diptera	Chironomidae	<i>Polypedilum</i>	9
Diptera	Empididae	<i>Hemerodromia</i>	1
Diptera	Simuliidae	<i>Simulium</i>	3
Diptera	Tipulidae	<i>Antocha</i>	1
Ephemeroptera	Baetidae	<i>Acentrella</i>	21
Ephemeroptera	Baetidae	<i>Baetis</i>	16
Ephemeroptera	Caenidae	<i>Caenis</i>	2
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	3
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	23
Ephemeroptera	Heptageniidae	<i>Epeorus</i>	2
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	4
Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	15
Megaloptera	Corydalidae	<i>Corydalus</i>	1
Mesogastropoda	Pleuroceridae	<i>Elimia</i>	4
Plecoptera	Leuctridae	<i>Leuctra</i>	4
Plecoptera	Perlidae	<i>Agnetina</i>	21
Plecoptera	Perlidae	<i>Perlesta</i>	2
Plecoptera	Perlidae	<i>Neoperla</i>	3
Plecoptera	Perlodidae	<i>Isoperla</i>	2
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	9
Trichoptera	Philopotamidae	<i>Dolophilodes</i>	1
Trichoptera	Philopotamidae	<i>Chimarra</i>	15
Veneroida	Corbiculidae	<i>Corbicula</i>	4
			209

Appendix Table 2-27 (Continued)

Metric	Value	Score	Condition
Taxa Richness (TR)	30	4	Non-impaired
EPT Richness (EPT)	15	6	
% EPT	61.24	6	
% OC	15.31	6	
NCBI	3.82	6	
% Dominant	11	6	
% Clingers	59.81	6	
		40	

Appendix Table 2-28. Macroinvertebrates collected within Emory River at Nemo, Morgan County, Tennessee (N 36°4'12.92", W 84°39'40.47"), June 22, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Stenelmis</i>	66
Coleoptera	Elmidae	<i>Optioservus</i>	1
Coleoptera	Elmidae	<i>Microcyllloepus</i>	24
Coleoptera	Elmidae	<i>Promoresia</i>	11
Coleoptera	Psephenidae	<i>Psephenus</i>	1
Diptera	Athericidae	<i>Atherix</i>	1
Diptera	Chironomidae	<i>Diplocladius</i>	2
Diptera	Chironomidae	<i>Polypedilum</i>	3
Diptera	Simuliidae	<i>Simulium</i>	9
Ephemeroptera	Baetidae	<i>Acentrella</i>	19
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	12
Ephemeroptera	Heptageniidae	<i>Stenacron</i>	1
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	9
Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	2
Megaloptera	Corydalidae	<i>Corydalus</i>	1
Mesogastropoda	Pleuroceridae	<i>Elimia</i>	2
Plecoptera	Perlidae	<i>Agnatina</i>	25
Plecoptera	Perlidae	<i>Acroneuria</i>	7
Plecoptera	Perlidae	<i>Neoperla</i>	1
Trichoptera	Brachycentridae	<i>Micrasema</i>	2
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	19
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	5
Trichoptera	Hydropsychidae	<i>Parapsyche</i>	1
Trichoptera	Philopotamidae	<i>Chimarra</i>	5
Trichoptera	Rhyacophilidae	<i>Rhyacophila</i>	2
Veneroida	Corbiculidae	<i>Corbicula</i>	3
Total			234
Metric	Value	Score	Condition
Taxa Richness (TR)	26	4	
EPT Richness (EPT)	13	4	
% EPT	46.15	6	
% OC	2.99	6	
NCBI	3.6	6	
% Dominant	28.21	6	
% Clingers	82.48	6	
		38	Non-impaired

Appendix Table 2-29. Macroinvertebrates collected within Emory River at Oakdale, Morgan County, Tennessee (N 35°58'56.17", W 84°33'35.99"), November 21, 2004. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Microcylloepus</i>	1
Diptera	Athericidae	<i>Atherix</i>	2
Diptera	Chironomidae	<i>Microtendipes</i>	16
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	3
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	30
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	90
Megaloptera	Corydalidae	<i>Corydalus</i>	1
Plecoptera	Leuctridae	<i>Leuctra</i>	4
Plecoptera	Perlidae	<i>Acroneuria</i>	2
Plecoptera	Taeniopterygidae	<i>Taeniopteryx</i>	37
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	8
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	4
Trichoptera	Philopotamidae	<i>Dolophilodes</i>	1
Trichoptera	Rhyacophilidae	<i>Rhyacophila</i>	1
Veneroida	Corbiculidae	<i>Corbicula</i>	2
		Total	202

Metric	Value	Score	Condition
Taxa Richness (TR)	15	2	
EPT Richness (EPT)	10	4	
% EPT	89.11	6	
% OC	7.92	6	
NCBI	3.95	6	
% Dominant	44.55	4	
% Clingers	34.16	4	
		32	Non-impaired

Appendix Table 2-30. Macroinvertebrates collected within Emory River at Oakdale, Morgan County, Tennessee (N 35°58'56.17", W 84°33'35.99"), January 28, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Microcylloepus</i>	6
Coleoptera	Elmidae	<i>Stenelmis</i>	6
Coleoptera	Elmidae	<i>Optioservus</i>	2
Coleoptera	Elmidae	<i>Promoresia</i>	1
Coleoptera	Hydrophilidae	<i>Berosus</i>	2
Diptera	Athericidae	<i>Atherix</i>	3
Diptera	Chironomidae	<i>Rheocricotopus</i>	1
Diptera	Chironomidae	<i>Polypedilum</i>	2
Diptera	Chironomidae	<i>Eukiefferiella</i>	4
Diptera	Chironomidae	<i>Pseudochironomus</i>	1
Diptera	Empididae	<i>Hemerodromia</i>	2
Diptera	Simuliidae	<i>Simulium</i>	11
Diptera	Tipulidae	<i>Antocha</i>	1
Ephemeroptera	Baetidae	<i>Acentrella</i>	1
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	15
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	57
Ephemeroptera	Heptageniidae	<i>Stenacron</i>	2
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	14
Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	2
Megaloptera	Corydalidae	<i>Corydalus</i>	6
Plecoptera	Perlidae	<i>Acroneuria</i>	3
Plecoptera	Perlidae	<i>Neoperla</i>	12
Plecoptera	Perlidae	<i>Agnetina</i>	3
Plecoptera	Perlodidae	<i>Isoperla</i>	5
Plecoptera	Taeniopterygidae	<i>Taeniopteryx</i>	2
Plecoptera	Taeniopterygidae	<i>Oemopteryx</i>	4
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	16
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	12
Trichoptera	Philopotamidae	<i>Chimarra</i>	7
		Total	203

Appendix Table 2-30 (Continued)

Metric	Value	Score	Condition
Taxa Richness (TR)	29	4	Non-impaired
EPT Richness (EPT)	14	6	
% EPT	75.37	6	
% OC	4.93	6	
NCBI	3.51	6	
% Dominant	28.08	6	
% Clingers	78.82	6	
		40	

Appendix Table 2-31. Macroinvertebrates collected within Emory River at Oakdale, Morgan County, Tennessee (N 35°58'56.17", W 84°33'35.99"), May 11, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Microcylloepus</i>	7
Coleoptera	Elmidae	<i>Stenelmis</i>	16
Coleoptera	Elmidae	<i>Optioservus</i>	4
Diptera	Chironomidae	<i>Diplocladius</i>	1
Diptera	Chironomidae	<i>Rheocricotopus</i>	20
Diptera	Chironomidae	<i>Polypedilum</i>	7
Diptera	Chironomidae	<i>Eukiefferiella</i>	5
Diptera	Empididae	<i>Hemerodromia</i>	1
Diptera	Simuliidae	<i>Simulium</i>	17
Ephemeroptera	Baetidae	<i>Acentrella</i>	35
Ephemeroptera	Caenidae	<i>Caenis</i>	3
Ephemeroptera	Ephemerellidae	<i>Ephemerella</i>	3
Ephemeroptera	Isonychidae	<i>Isonychia</i>	4
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	40
Ephemeroptera	Heptageniidae	<i>Epeorus</i>	2
Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	7
Megaloptera	Corydalidae	<i>Corydalus</i>	5
Mesogastropoda	Pleuroceridae	<i>Elimia</i>	1
Plecoptera	Leuctridae	<i>Leuctra</i>	3
Plecoptera	Perlidae	<i>Perlesta</i>	9
Plecoptera	Perlidae	<i>Neoperla</i>	1
Plecoptera	Perlidae	<i>Agnetina</i>	1
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	11
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	3
Trichoptera	Hydropsychidae	<i>Parapsyche</i>	1
Trichoptera	Philopotamidae	<i>Chimarra</i>	10
Trichoptera	Philopotamidae	<i>Dolophilodes</i>	2
		Total	219

Appendix Table 2-31 (Continued)

Metric	Value	Score	Condition
Taxa Richness (TR)	27	4	Non-impaired
EPT Richness (EPT)	15	6	
% EPT	58.45	6	
% OC	18.26	6	
NCBI	4.2	6	
% Dominant	18.26	6	
% Clingers	61.64	6	
		40	

Appendix Table 2-32. Macroinvertebrates collected within Emory River at Oakdale, Morgan County, Tennessee (N 35°58'56.17", W 84°33'35.99"), June 23, 2005. Metrics, values, scores, and condition associated with data are listed.

Order	Family	Genus	Count
Coleoptera	Elmidae	<i>Microcylloepus</i>	11
Coleoptera	Elmidae	<i>Stenelmis</i>	25
Diptera	Athericidae	<i>Atherix</i>	3
Diptera	Chironomidae	<i>Psectrocladius</i>	4
Diptera	Chironomidae	<i>Polypedilum</i>	4
Diptera	Chironomidae	<i>Eukiefferiella</i>	4
Diptera	Simuliidae	<i>Simulium</i>	15
Diptera	Tipulidae	<i>Antocha</i>	1
Ephemeroptera	Baetidae	<i>Acentrella</i>	19
Ephemeroptera	Heptageniidae	<i>Stenonema</i>	31
Ephemeroptera	Heptageniidae	<i>Stenacron</i>	4
Ephemeroptera	Isonychiidae	<i>Isonychia</i>	19
Hemiptera	Gerridae	<i>Metrobates</i>	1
Lumbriculida	Lumbriculidae	<i>Lumbriculus</i>	1
Megaloptera	Corydalidae	<i>Corydalus</i>	2
Plecoptera	Perlidae	<i>Agnatina</i>	15
Trichoptera	Hydropsychidae	<i>Hydropsyche</i>	8
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i>	28
Trichoptera	Hydropsychidae	<i>Parapsyche</i>	6
Trichoptera	Philopotamidae	<i>Chimarra</i>	9
Trichoptera	Philopotamidae	<i>Dolophilodes</i>	3
Veneroida	Corbiculidae	<i>Corbicula</i>	1
		Total	214

Metric	Value	Score	Condition
Taxa Richness (TR)	22	2	
EPT Richness (EPT)	10	4	
% EPT	66.36	6	
% OC	6.07	6	
NCBI	3.67	6	
% Dominant	14.49	6	
% Clingers	73.83	6	
		36	Non-impaired

