8-2019

Evaluating Biotic Functional Lift Provided by Physical Habitat Rehabilitation in Urban Streams of the Ridge and Valley Physiographic Province of Tennessee

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To the Graduate Council:

I am submitting herewith a thesis written by Grant Fisher entitled "Evaluating Biotic Functional Lift Provided by Physical Habitat Rehabilitation in Urban Streams of the Ridge and Valley Physiographic Province of Tennessee." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Wildlife and Fisheries Science.

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Evaluating Biotic Functional Lift Provided by Physical Habitat Rehabilitation in Urban Streams of the Ridge and Valley Physiographic Province of Tennessee

A Thesis Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

Grant Garrett Fisher

August 2019

DEDICATION

Dedicated to my family for all their love and support.

ACKNOWLEDGMENTS

The completion of this project was not the work of a single person. I would like to first thank my advisor Dr. Brian Alford for his assistance throughout this whole process. Having someone with an expertise in the field, as well as a graduate school advisor proved invaluable during my time working on this project.

I would also like to thank the other members of my thesis committee: Dr. John Schwartz for offering advice and assistance, and Dr. Becky Nichols for her continued guidance and insight.

Sampling for this project would have been impossible without assistance. A special thanks to Justin Wolbert for his assistance in identifying fish and benthic macroinvertebrates. I also want to thank all those who volunteered their assistance over the course of this project: Keith Garner, Kyler Hecke, Cory Chapman, Emily Collins, Demaris Locicero, Brakkos King, Austin Archer, Jeremy Melton, Nicholas Pettit, and Carter Groves.

Funding for this project was provided through a TDEC grant. I wish to thank Jonathan Burr, and Karina Bynum at TDEC for their assistance.

ABSTRACT

The business of stream restoration is a billion dollar industry today. Funds are used to correct anthropogenic damage to hydrologic and geomorphic functionality and to allow natural processes to return. Unfortunately, ecological improvement from stream restoration projects, particularly in urban watersheds, have had mixed results. Several reasons exist for limited improvements include: 1) inadequate ecological design criteria based on re-colonization potential and habitat requirements as determined by functional traits expression of 2) insufficient pre- and post-monitoring methods, 3) the biological assemblage chosen for the bioassessment is not sensitive to the restoration actions, and 4) lack of a watershed-scale stressor analysis and adequate project scoping and prioritization. The purpose of this study was to: 1) determine if stream habitat restoration has had an effect on the biotic integrity of fish and benthic macroinvertebrate assemblages in urban streams within the Ridge and Valley Physiographic Province of east Tennessee, and 2) evaluate the effect of stream restoration on the biotic lift in functional traits expressed by fish and benthic macroinvertebrate assemblages. Twelve sites were selected, whereby three were considered physically restored for at least seven years, three were impaired reaches from varied levels of urbanization, and three streams were considered ecoregion reference streams to serve as a baseline for healthy benthic integrity. Invertebrates were collected bimonthly along with water quality and habitat quality data, and fishes were sampled semi-annually. To assess ecosystem health, index of biotic integrity (IBI) metrics and scores were calculated for each sample for fish and benthic macroinvertebrates, respectively, following Tennessee Valley Authority (TVA) and Tennessee Department of Environment and Conservation (TDEC) protocols. Results indicated that restored stream reaches showed improvement over impaired stream reaches, but did not score as high as ecoregion reference streams. Restored streams were observed with higher IBI scores on average than impaired streams for both fish and insect IBI metrics, in addition to improved habitat quality index scores. More research is still needed to properly understand urban stream ecosystems and the effects of stream restoration on the aquatic world.

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CHAPTER I STREAM MONITORING OVERVIEW

Introduction

Many human activities have led to the demise of stream functionality. Large-scale industrialization, urbanization, and other land uses negatively impact the naturally occurring order in aquatic ecosystems (Nuttle et al., 2017). The idea of restoring a stream to an effective ecological state is not new (Burgess and Bides, 1980). In recent years, restoration of degraded streams has become a billion dollar industry (Alexander and Allan, 2006). Major companies and agencies pay large sums of money to physically restore streams to be more geomorphically stable. Unfortunately, the restoration of urban streams to more stable geomorphically and ecologically healthy states has had mixed results due to the altered hydrologic regime. Often the fish assemblage structure and population densities remain low, but aquatic insect density and diversity show major improvement (Tullos et al., 2009; Bernhardt et al., 2005).

One major problem that many rivers face is channelization, which refers to engineering efforts to control water flow and flooding. While these efforts may prove beneficial to the human world, they are quite detrimental to aquatic life. When the natural meander of a stream is straightened, a major increase occurs in the amount of sediment and debris that flows through a channelized reach (Emerson, 1971). Channelization can also increase the stream gradient, and the subsequent flashier flow regime can cause flooding downstream (Emerson, 1971). This altered flow pattern usually causes the stream to lose the typical riffle-run-pool sequence which is detrimental to rheophilic biota, because different species of fish and insects live in different niches provided by a heterogeneous mosaic of habitat and flow types (Schwartz, 2015).Once the physical habitats (e.g., substrate composition) and flow types (e.g., pools, riffles) are homogenized, stream biological communities become less diverse (Brooker, 1985). A study conducted in northeast Missouri by Berckman et al. (1987) found that increased flow due to channelization caused excess sedimentation to occur in streams, which negatively impacted fish species by clogging gills and suffocating eggs. The riffle and run areas were degraded, causing numbers of insectivores and herbivores to drop dramatically. As the amount of fine substrate increased, the abundace of fish in those two habitat types was reduced.

Generally, the process of restoring a stream involves several actions. First, the natural meander (aka, sinuosity) of the stream is restored from the channelized state. Second, the stable flow path is restored by physically reshaping the banks and bed so that flow regime and riffle-run-pool sequences representative of the natural state can be achieved. The stream bank is usually rebuilt using large rocks or wood for stability. Third, rock particles such as cobble, boulder, or gravelare added to supply needed substrates that support attachment sites for benthic vegetation which in turn serves as food and refugia for benthic invertebrates and fishes (Schwartz et al., 2015). The final focus of restoration is the riparian zone, the vegetated areas on either stream bank. Riparian zones have a multitude of benefits for the stream ecosystem. For example, riparian plants buffer the water from excessive surface runoff, bank erosion, and even provide shade for the stream helping to regulate water temperature (WDEQ, 2018). These buffer zones also act as resting areas for adult stages of insects whose larvae and pupae are aquatic (Palmer et al., 2014).Some streams have been negatively impacted by livestock trampling banks in riparian areas, compacting the soil, such that the capacity for water infiltration by riparian vegetation is lost, and surface runoff of excessive nutrients from their wastes increases in the stream.

When restoring a stream, one must consider the functional benefits provided by riparian vegetation. Hupp (1992) investigated the recovery of riparian vegetation along West Tennessee streams by assessing the types of plants that return to the area after being cleared for monoculture row crops. He documented that woody plants initially grow on low- and mid-bank areas, and they helped stabilize the banks and buffered nutrient inputs from the surrounding agricultural landscape. The authors stated that pioneer plants such as herbs, forbes, or shrubs need to be hardy and fast growing to minimize erosion of banks after channel reshaping.

Advantages and Disadvantages of Stream Restoration

The logic behind restoring streams is quite appealing to many conservationists. Through restoration efforts, humans can physically go into a stream and attempt to "fix" the damage that has been done over decades. Restoring a stream acts as a way to return the natural channel and bed form, as well as geomorphic stability. An important factor to consider is that restoration typically involves returning something to its perceived original state. Usually that is not possible if no prior knowledge exists with respect to form or flow regime prior to degradation (Bradshaw, 1996).

One very important factor to consider is the low ecological recovery rate of restored streams. A survey was conducted in Michigan, Wisconsin, and Ohio by Alexander and Allan (2007) who examined the engineering success rate of 1,345 streams. Factors such as stream habitat improvement, channel reconfiguration, riparian zone management, and water quality monitoring were assessed. Unfortunately, 89% of the restoration projects were deemed unsuccessful, and only 11% were considered successful (Alexander and Allan, 2007).

A major problem is that no standardized criteria exist for evaluating the success of a stream restoration project. Many evaluations are performed using protocols that only consider the stability of the channel and stream bed or other physical habitats perceived to be essential for biota, plus monitoring may last only 1-2 years, whereas 10 years may be necessary to allow for colonization and natural recruitment of fishes. A greater need exists for longer-term, biologically-focused monitoring programs (Alexander and Allan, 2007). Roni (2018) conducted a comprehensive meta-analysis of the effects of stream habitat restoration on fish abundance, survival, and recruitment, with a focus on salmonids. He found that results are extremelly varied and differ significantly based on each individual stream and specific geographic region. If fish populations did increase in an area, it was often times due to increased availibility of restored habitat. Fish from unrestored areas likely moved and occupied the improved habitat found in the restored sections of stream (Roni, 2018).

While some stream restorations may be reported as successful in restoring physical habitat, other research indicates that as new evaluation protocols emerge, more and more restorations have been deemed unsuccessful from an ecosystem perspective. Even though the habitat of the stream can be improved, sensitive fish species (particulary non-game species) and insect species that lack dispersal capabilities, very low fecundities or juvenile survival rates often fail to return (Bernhardt et al., 2011).

Another potential problem area for stream restoration is the financial cost incurred. Not every government/company will have the available funds to support a project that requires long-term monitoring or actions to ensure stream biota fully recover. Alexander and Allan (2006) found that the median cost of a site was $12,957 and the total expenditures for projects completed since 1990 came in at $440 million. Unfortunately, only 11% of those sites were monitored for ecological success. More expensive projects were monitored longer than low cost ones. The authors also commented that records of expenses and monitoring data were difficult to locate and better evaluation/and record keepingwas needed.

Correctly evaluating a restored stream is a crucial part of ensuring its future success. As other research shows, more effort needs to be expended on correctly examining restored waters. Kondolf et al. (1995) writes that stream evaluations need to be conducted along the same transects annually. Ideally, the restored stream's geomorphic, hydrologic, and ecological factors need to be evaluated simultaneously prior to and after restoration actions. Post-restoratrion monitoring should continue for at least a decade, and after all major flood events thereafter, so that the restored stream can have a historical record of major disturbance effects. All too often, the success of a stream restoration project is simply judged by the proportional completionof the project goals (e.g., percent of restoration actions met) or by public's perception of the restoration (e.g., via surveys of attitudes). Too great an emphasis is placed on the external appearance of the restoration project itself, and not enough on monitoring the life found within the stream. Bernhardt et al. (2011), found that most stream restoration projects began as a result of habitat degradation, but lack of funding was to blame for no post-project monitoring. Ultimately, a need exists for a national program for strategic monitoring standards. An emphasis also needs to be placed on long-term biological monitoring after projects are completed. Bernhardtet al. (2007) wrote that simply publishing more studies on a case-by-case basis will not significantly improve restoration practices on aglobal or national scale. This only adds to the uncertainty of the expected outcome of new restoration projects.

One factor that also must be evaluated with respect to the rate of ecological recovery is the significance of natural stream disturbance. Differences in the frequency, periodicity, and magnitude of disturbance events can have a major effect on the overall community structure of a stream, even those that are in an unaltered state. When the natural flow regime of a river is altered, however, major repercussions can be felt by stream life (Poff et al., 1997). Resh et al. (1988) defined disturbance as "any relatively discrete event in time that is characterized by a frequency, intensity, and severity outside a predictable range, and that disrupts ecosystem, community, or population structure and changes resources or the physical environment." The degree to which natural or anthropogenic disturbance is apparent can vary drastically between lake and stream ecosystems, and is also quite region-specific. For example, the compostion of boulder, gravel, and sand substrateson the stream bed all respond differently to discharge-related disturbances (e.g., flashy high flows, low flow periods), and this variance must be carefully evaluated and understood before restoration work begins (Resh et al., 1988).

A crucial understanding of flow regime,and its relationship to natural disturbance, is necessary in stream restoration. The natural flow regime of a stream is highly unique and variable due to location, climate, physical geomorphology, land use, and water use. Any anthropogenic changes to natural flow can have negative effects on aquatic organisms. Poff et al. (1997) outline five major aspects of flow regime that need to be understood. First, magnitude is the amount of water moving through a fixed location at a specific time. Second, frequency indicates how often a certain flow level is measured. Flow frequency is inversely related to flow magnitude. The third aspect of flow regime is duration which refers to the amount of time a flow measurement is observed. For example, during a flood event, a specific flow measurement may be observed for multiple days at a time. The fourth aspect is timing or predictability of flow. This is simply the regularity at which a specific magnitude (e.g., discharge) occurs. The fifth and final aspect of flow regime is the rate of change, which is how quickly the flow changes from one magnitude to another. Alterations in the form of impoundments, water withdrawal, land clearing, or channelization can affect the outcomes of stream restoration projects if these five aspects of flow regime are not considered (Poff et al., 1997).

Research suggests that restoration projects are often only addressed from an engineering perspective with little attention dedicated to proper biological monitoring. The need exists for more collaboration with ecologists in restoration projects (Gillilan et al., 2005). Alexander and Allan (2006) conducted a survey of the most common engineering methods used from 1970-2004. The most common type of in-stream restoration was the use of sand traps and rip-rap placement that work to create more habitat for fish species. Aside from adding to the amount of habitat in the stream, the study revealed that, overall, bank stabilization and water quality improved using these techinques.

In Washington, Bash and Ryan (2002) found that the decline in salmon numbers and overall watershed health led to a call for stream restoration. They reported that, of the project managers who received project approvals, a survey was conducted to determine the extent of post-project monitoring. Only half of the managers surveyed reported collecting baseline data and evaluated biological, physical, chemical, or other water quality measurements in the projects. Only 18% of the managers reported that they believed that biological monitoring was required. With so little biological monitoring being conducted, it is difficult, if not impossible to determine if the restoration efforts have been ecologically successful. (Bash and Ryan, 2002).

Ecological Indicators as a Tool for Stream Restoration Monitoring

The use of ecological indicators is one method of monitoring the condition, or relative health, of aquatic ecosystems. They often provide an early warning of potential problems in the environment. Dale and Beyeler (2001) list three areas of concern that prevent ecological indicators from being used as an effective management tool. Ecological monitoring programs use few actual indicators of health and fail to consider the entire ecosystem, instead focusing on counting the numbers of juvenile or adult species that have economic value (e.g., salmon). Also, ecological management plans often have vague long-term goals. Finally, ecological management programs lack accuracy because they fail to use a standardized protocol. They suggest using a hierarchy of indicators. For example, if researchers choose to use organisms as indicators, factors such as lesions, parasite presence, or physical deformations need to be examined. Similarly, if the ecosystem as a whole is used as an indicator, factors such as species richness, eveness, and trophic levels must be examined (Dale and Beyeler, 2001).

The ultimate goal of ecological stream restoration is to support naturally reproductive native biota that are able to colonize and persist in the restored reach. By replenishing the habitat, practitioners of stream restoration aim to provide refugia for organisms to live and reproduce that simply did not exist in the stream's impaired condition. Long-term monitoring is the best method to determine if any new species have returned to the stream and if the overall stream population is reproductively sustainable. Aquatic fauna require a variety of physical structures for cover (e.g., protection from predators or high current velocity). In a study conducted by Miller et al. (2010), researchers found that adding large woody debris yielded the highest population density increase of aquatic biota. Moreover, the addition of boulder areas and reconstructed channels did have positive results, but these were extremely variable among sites (Miller et al., 2010).

Fish species that comprise an entire assemblagemay require a wide range of habitat types. Some species require riffle habitats while others live in pools or runs.Meffe and Sheldon (1988) conducted a study of several southeastern U.S. streams and found that fish of similar taxonomic categories and phenotypic traits, tend to live in similar areas. Changes in habitat structure resulted in different fish species being present whose phenotypes were adapted to the change in habitat (Meffe and Sheldon, 1988). Fish respond positively to increased stream discharge and heterogeneous habitat structure. A study conducted in the United Kingdom (Pretty et al., 2003) found that fish became more abundant in rehabilitated areas of the stream, particularly in fast-flowing riffle sections. The researchers cautioned that while some fish may have returned to the restored areas, the overall restoration was not very successful due to poor water quality from point-source effluents and nonpoint-source runoff of contaminants.

Certain constraints do exist for aquatic life in restored areas. For example, one major problem that will impact restoration success is the presence of physical barriers. In order for aquatic organisms to recolonize restored areas, they must be able to access the area from downstream or upstream reaches (Bond and Lake, 2003). For example, a study of trout populations conducted in Colorado found that dispersal into restored sites was responsible for the increase in number for three different species of salmonid, rather than survival or recruitment of fish that had remained in the restored sites (Riley and Fausch, 1995).

Two important distinctions of barrier types exist. Hard barriers are physical structures like dams that completely block a section of stream and halt passage. In these instances, migration is impossible without human intervention like fish ladders or translocation (Ward and Stanford, 1995). Soft barriers, on the other hand, do not necessarily represent physical barriers, but distances or isolated areas that exist far away from potential source populations of aquatic organisms (Fuchs and Statzner, 1990). These isolated habitats (e.g., by impoundments or dewatered channels) may require translocation of wild fish or stocking of hatchery-reared fish simply due to the fact that recolonization is unlikely (Schlosser, 1995).

Suitable habitat is another potential problem facing non-game aquatic organisms in a restored environment. Stream restoration projects typically target the habitat required by recreationally or economically desirable fish species. Habitat is sometimes created based on the anticipated needs of adult fish without considering the requirements needed at younger life stages. Certain studies found that the lack of habitat for a particular life stage can cause major population bottlenecks in some species (Beck, 1995). On the other hand, lack of habitat for aquatic insects is also a concern. Without proper riparian zones, benthic macroinvertebrates lose the area in which they reproduce during their adult life stages (Peckarsky et al., 2000).

Introduced species are another potential problem for the native creatures trying to repopulate restored areas. Care must be taken to create restored areas that are favorable to native aquatic species even in the presence of invasives. Some research suggests that invasive species respond rapidly to newly restored environments and offer increased competition to the resident native species (Zedler, 2000). Other research indicates that while restored habitat may be lost due to processes such as excessive erosion, it can actually prevent certain invasive aquatic species from taking over. One study by Davis and Finlayson (2000) described how large pooled sections of lowland streams were created during a restoration, but due to stream erosion, ended up being smaller than originally planned. Many would consider that a failure, but the smaller pools actually served a better purpose. Native fish such as the Mountain Galaxias (*Galaxias olidus*) recolonized the area and maintained stable populations. The smaller size of the pools prevented larger invasive species such as the Common Carp (*Cyprinus carpio*) from inhabiting the area.

Many assume that a restored stream completely eliminates problems like erosion and makes a stable stream environment. This is not always true. Channel incision and bank erosion are emergent properties ofnatural flow regimes, and they do have certain benefits. For example, an eroding bank can provide small gravel that fish utilize during spawning. Also, it can cause changes in riparian vegetation, for example, setting back succession. Certain plants are important to disturbance-dependent bird species like Bank Swallows(*Riparia riparia*). Physically restoring a stream does not mean that all problems are repaired. The process simply attempts to restore the anthropocentric perception of natural order of the stream (Rubin et al., 2017). While other studies condemn stream restorations as failures, some are quite successful. Kailet al. (2015) conducted a meta-analysis on the effects of stream restoration on aquatic species in Germany, Austria and the Czech Republic, and found that, on average, stream restorations have had a positive effect on biota, but approximately 30% have no effect or even a negative effect. The authors noted that restoration projects usually result in an increased number of desirable biota already in the stream, but few new species. Also, the effects of a stream restoration depend on the time since the restoration was conducted, and positive effects observed over the short term could eventually disappear.

One study in Finland by Muotka (2002) examined the biotic recovery of streams that had been restored. The recovery period for the sampled sites ranged from four to eight years. The headwater streams evaluated by the project were previously used in timber transport and had been very heavily channelized. Restoration was primarily motivated by the desire to enhance sport fish populations. However, researchers conducted surveys of aquatic macroinvertebrates in restored streams and compared them with unmodified streams. While the invertebrate communities showed little change in the un-restored sites, marked improvement was found in the restored headwater stream habitat. The researchers did reiterate the need for long-term monitoring of the sites to gain a better understanding of the persistence of positive effects of stream habitat restoration (Muotka, 2002).

The River Continuum Concept and Its Relationship to Stream Restoration

When identifying streams for restoration, one important ecological concept needs to be considerd: the River Continuum Concept (RCC), which was developed by Vannote et al. (1980). The RCC attempts to explain the longitudinal gradient in fish, aquatic insect, and organic matter expected to occur from the headwaters to the mouth in unaltered streams that drain forested watersheds in constrained valleys. As stream order (Strahler, 1957) increases down the continuum, the drainage area and channel width increases, thus changing the habitat template for aquatic biota. In headwater areas where the stream order is anywhere from 1-3, there is a greater amount of riparian organic matter input and shade. The extra vegetation provides not only cover for the stream to control aspects such as water temperature, but also provides the base of the food web for the entire continuum (Vannote et al, 1980).

Headwater streams are the primary source for coarse particulate organic matter (CPOM). It is usually composed of rotting bark from trees, fallen leaves, terrestrial animals, or other types of detritus. Because of the heavy canopy cover, the microbial pathway is the primary means for organic matter to be metabolized. Fungi and bacteria colonize CPOM and, through decomposition, these microbes transfer energy throughout the aquatic food web. Some particles of CPOM are partially digested by invertebrates or simply transported downstream for uptake by other invertebrates.

According to Vannote et al. (1980), the proportions of invertebrate functional feeding groups (FFG) change along the continuum. Each FFG (shredder, collector, scraper, grazer, engulfer, etc) describes how aquatic invertebrates acquire food. In the headwater streams, collectors and shredders are found in the largest proportions. Typically, shredders are insects such as stoneflies (Order Plecoptera) that use their mouths to physically masticate CPOM and feed on the microbes that have colonized it. Collectors, on the other hand, will gather smaller, shredded parts of CPOM to feed on (either undigested or partially digested). Vannote et al. (1980) explain that the fish species found in headwater streams are usually types of salmonids like trout, sculpin (Cottidae), and minnows (Cyprinidae) like dace and shiners. These species of fish consume invertebrates as a major food source and are adapted to living and reproducing in small stream environments that typically have colder temperatures and high dissolved oxygen concentration.

The RCC describes mid-order streams as those in stream orders 4-6. In streams of this size, riparian canopy cover decreases as channels widen and more sunlight hits the stream bottom. This causes more benthic algae and aquatic macrophytes to grow on rock surfaces. This benthic vegetation changes the proportions of invertebrate feeding types. At this point, shredders are expected to be found in lower densities due to lower amounts of coarse particulate matter. Instead, more grazer invertebrates will be found. Grazers are herbivorous and feed on vegetative material such as green algae and diatoms on rocks. Collectors are still found in large quantities. Fish found in mid-order streams usually include sunfishes (Centrarchidae) and darters (Percidae). At this point in the continuum, fish and invertebrate density and diversity reach their zenith, because there is greater habitat complexity (e.g., temperatures, substrate sizes, depths, current velocities) and greater amounts of energy available to the food web.

Once the stream reaches its mouth or largest size (stream order 7 and higher) the habitats and biota found in it change yet again. Vannote et al. (1980) predict that the amount of course particulate organic matter from headwater and mid-order reaches has been fully processed by this point and a new, different source of energy is formed in the stream. Fine particulate organic matter (FPOM) is composed of very small sediment-like material, and it is the primary source of energy in larger rivers. This type of organic matter is made from the biological processing of CPOM from upstream. Here, FPOM brings rise to very large numbers of collectors that act as filter feeders in the river, as well as detritivores that burrow and feed on the stream bed deposits. Mostly, these are bivalves such as mussels and clams, and certain types of oligochaete worms. Fish species found in larger rivers are often times large planktivores whose primary food source is zooplankton (Vannote et al. 1980). These include fishes like Shad (*Dorosoma* spp.) and Paddlefish (*Polyodon spathula*). Benthic omnivores that feed on detritus and invertebrate preyinclude fishes like the Buffalo (Family Catastomidae, *Ictiobus* spp.), Sturgeon (Acipenseridae) and Catfishes (Ictaluridae).

Overall, stream stability is very important to maintaining the dynamic equilibrium that the RCC describes. Destruction or removal of streamside vegetation in riparian zones is one method that can cause disruption to the river continuum. Removal of tree cover can cause an increase in water temperature and aquatic vegetation growth, thus shifting the functionality from a headwater reach to a mid-order reach. This not only alters the energy source of CPOM, but also changes the proportions of invertebrate FFGs. The absence of CPOM and increase in algae growth gives rise to less shredders and more grazer invertebrates. With different groups of insects present in headwaters, the continuum can be subsequently altered downstream.

Functional Traits of Aquatic Communities

While natural variations in geology, climate, and physical geomorphic characteristics are normal occurrences, they do have an impact on the presence of certain traits expressed by fish and aquatic invertebrates. Winemiller and Rose (1992) and Winemiller (2005) conceptualized a triangular surface model to illustrate how fish with different life histories and functional traits can live in areas with different levels of human and/or natural disturbance. Fish and freshwater invertebrates have adapted certain behavioral, feeding, survival, and reproductive strategies allowing them to persist in an aquatic environment that varies widely. Winemiller (2005) later outlined three distinct life history strategyendpoints that categorize fish and aquatic invertebrates on the basis of their functional traits. These endpoints are defined as periodic, equilibrium, and opportunistic (Winemiller, 2005).

Periodic strategists tend to be long-lived with high fecundity and are disproportionately represented by commercial fish species (Winemiller, 2005). Often, these speciescarry out long migrations and offer little parental care to their offspring. An example would be sturgeon or salmon. Equilibrium strategists like sunfishes (Centrarchidae), on the other hand, thrive in very stable environments, exhibit densitydependent population regulation from competition and predation, and spend more energy providing parental care to their eggs and offspring. They have much lower fecundity than the periodic strategists, but are different in that they lay much larger eggs. Opportunistic strategists are adapted to unpredictable orfrequently disturbed habitats. These fishes are usually small-bodied and short-lived, like minnows. They dedicate most of their energy to gamete production and spawning as opposed to body growth. However, Winemiller and Rose (1992) and Winemiller (2005) state that some species have adapted traits that may be somewhere along the gradient between two of the three endpoints. For example, many darter species can be considered opportunistic-equilibrium strategists, with low fecundity, high parental care, but also exhibit short life spans and opportunistic batch spawning. According to the triangular surface model, headwater streams should support more opportunistic species, followed by equilibrium species, then periodic species, or some combination thereof. In degraded or channelized streams, functional traits supported by these environments are more likely to be opportunistic, adapted to flashy flows, or equilibrium, being adapted to long periods of stable low flows. For example, the Green Sunfish (*Lepomis cyanellus*) is known to be an invader of channelized small streams, because they spawn frequently (suitable to flashy flows) and are competitive and predacious enough to handle long periods of low flows.

History and Importance of the Index of Biotic Integrity

The index of biotic integrity (IBI)method was originally developed by James Karr, as a way to assess the healthof the fish community in a stream. The IBI methodology allows one to score a stream reach based on the fish species diversity and functional traits present relative to a comparable least-disturbed or undisturbed reference condition. Karr (1991) also writes that regional differences need to be taken into account when scoring impaired streams. In other words, certain areas of the U.S. will have greater biodiversity or endemic species than others (e.g., the Southeastern U.S. has far greater species richness than the Western U.S.). Additionally, certain factors such as stream size, elevation, and gradient need to be evaluated against a similar but undisturbed reference stream. This is because IBI metrics may be different at sites simply because some fishes can only live in small, cold, shaded headwater streams or large, warm, open-canopy streams, regardless of pollution. The IBI assesses the health of streams by calculating metrics within three broad categories that define aquatic ecosystems: 1) species richness and composition, 2) trophic composition, and 3) fish abundance and condition (Karr, 1991).

Species richness is evaluated by countingthe total number of fish species found in the reach, and richness may further be restricted to certain pollution-sensitive families like the Catostomidae, Percidae, or Centrarchidae. Trophic composition categorizes fish based on their functional feeding strategy (e.g., omnivores, insectivores, and piscivores). The final category examines fish abundance and condition. In addition to calculating catch per unit effort (CPUE), any hybrid species, along with any diseased/damaged fish are noted (Karr, 1991). Reaches are scored 1, 3, or 5 based on the value of 12 metrics. The best score a reach can receive is 60 for healthy streams, which reflects the unpolluted or undegraded condition.

Many states and the U.S. EPA use benthic macroinvertebrates instead of fish to assess the health of streams. The Tennessee Department of Environment and Conservation (TDEC) uses seven metrics (TDEC 2017). The goal is to score the healthof a stream based on the diversity, pollution sensitivity, FFGs, and behavioral traits of the genera present. Each of the metrics are scored 0, 2, 4, or 6, based on the value of the metrics, and the score isbased on the ecoregion location and stream size. All seven scores are totaled to calculate the Tennessee Macroinvertebrate Index or TMI (TDEC, 2017). The highest score a reach can receive is 42 for one that reflects the healthiest condition relative to least-disturbed reference sites for a particular ecoregion and watershed size.

The first metric is taxa richness, the total number of benthic macroinvertebrate (BMI) genera found in the sample. Next, the total number of BMI genera that fall into the orders Ephemeroptera, Plecoptera, and Trichoptera (EPT) is totaled. After that, the percentage of EPT genera is calculated excluding any Trichoptera from the genus *Cheumatopsyche*. That genus of caddisfly is extremely common and less sensitive to pollution. Then the percentage of Oligochaeta (subclass)+Chironomidae (OC) is calculated by dividing the number of OC by the total number of specimens and multiplied by 100. Higher percentages of these taxa signify that a reach has high levels of organic pollution and fine sediments.

Afterwards, the percentage of clingers is calculated. The term clingers refers to insects that grasp onto woody debris or rock surfaces and withstand high currents. Clingers are totaled, divided by the total specimens and multiplied by 100. The final calculation finds the total percentage of nutrient-tolerant organisms. TDEC (2017) lists those taxa as *Cheumatopsyche*, *Stenelmis*, *Polypedilum*, *Cricotopus*, *Cricotopus/Orthocladius*, *Lirceus*, *Caenis*, Gastropoda (snails), and Oligochaeta (subclass) (segmented worms) (TDEC, 2017).

CHAPTER II METHODOLOGY

Study Objectives and Hypotheses

The main objective of this study is to assess the effect that physical habitat rehabilitation of stream bed and channel form has had on fish and benthic macroinvertebrate metrics of biotic integrity in urban streams draining the Ridge and Valley physiographic region of Tennessee. Another objective is to determine the degree to which habitat rehabilitation in urban streams has affected the biotic functional lift of fish and benthic macroinvertebrate assemblages.

The hypothesis is that habitat quality will improve in urban restored streams which, in turn, will improve the overall biotic integrity of the urban restored streams in regards to fish and macroinvertebrates. Also, urban restored streams will not reflect the biotic integrity of reference streams, but the rehabilitated streams will achieve greater biotic integrity than unrehabilitated "impaired" urban streams.

Study Area

The streams for this study were selected and categorized into 3 treatment categories: ecoregion reference, restored, and impaired. Ecoregion reference streams were located in rural forested areas with little anthropogenic impacts and were expected to be in excellent biological condition. Ecoregion reference streams are selected by TDEC for the state's biocriteria and biomonitoring program.Impaired streams are listed by TDEC on their U.S. Clean Water Act Section 303(d) list as impaired due to some outside point-source (i.e., pollution from a known pipe effluent discharge) or nonpoint-source stressor (i.e., nutrients or excessive fine sediment). Restored reaches were impaired reaches that were physically restored by humans at least seven years prior to this study.

Table 1. Different treatment classifications and streams that fall within them.

Ecoregion Reference	**Urban Restored**	**Urban Impaired**
Big War Creek	Third Creek	Third Creek
Indian Creek	Beaver Creek	Beaver Creek
Mill Creek	Williams Creek	Baker Creek
Dry Creek	Friar Branch	Friar Branch

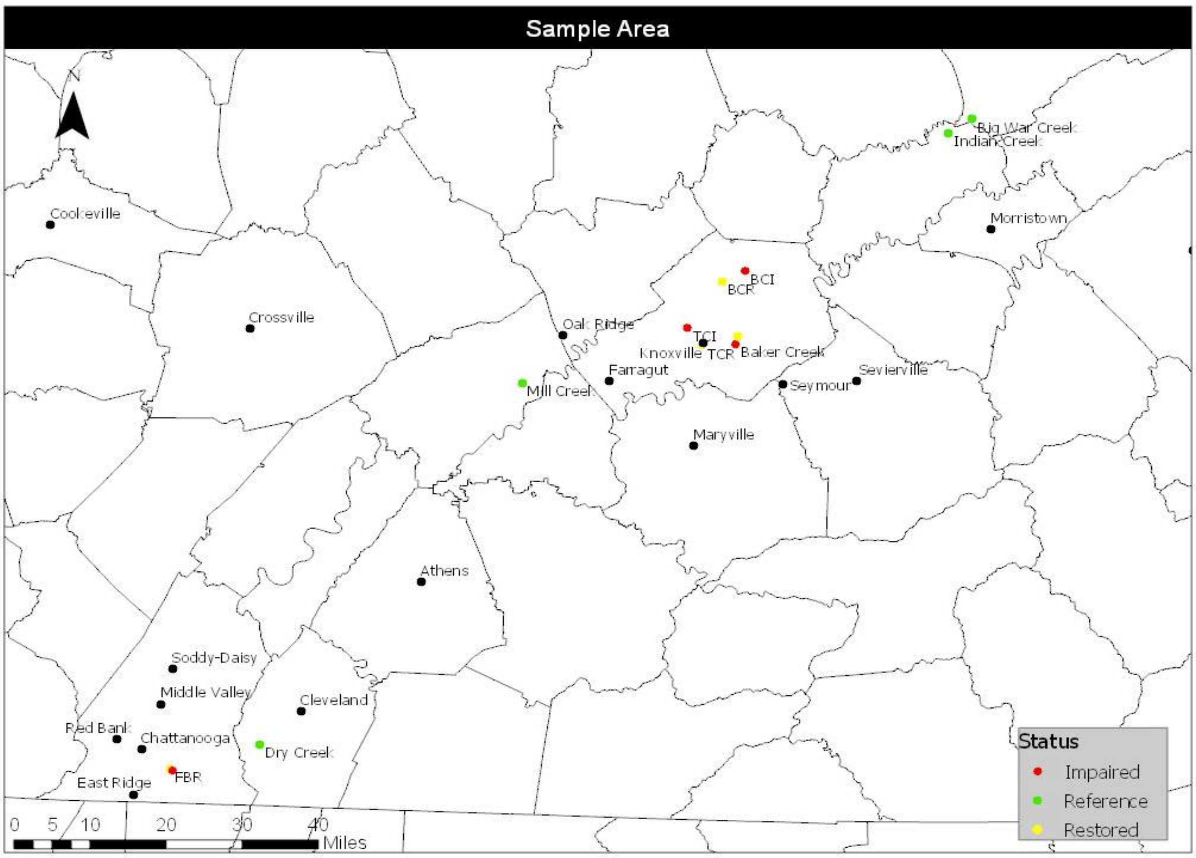

Figure 1. Map showing the 12 sample areas. Note how the restored and impaired streams are close to Knoxville, while the reference streams (Big War, Indian, Mill Creek, Dry Creek) are farther away in more rural areas. The sites are color coded to indicate each one's classification. (Red=Impaired) (Yellow=Restored) (Green=Reference)

Methods

Site Selection

A total of 12 sites (n = 4 for each treatment level) were selected in the Ridge and Valley physiographic province of east Tennessee for sampling. Factors such as watershed size, stream order, geographic location, and water quality were all considered (Table 1, Figure 1). A restored reach was a segment of a stream located in an urban landscape that had been restored to a stable hydrologic and geomorphic state for a minimum of seven years. Typically these restoration projects involved replanting of riparians zones. Many of the banks within the riparian zones were replanted with Black Willow saplings (*Salix nigra*) and other small shrubby plants of various species. On a few projects, the installation of loose stone or "rip rap" to form riffles was also utilized in the restored reaches of streams. Some streams had woody debris (i.e., log sections or rootwads) embedded into the bank for extra stability, and placed to create habitat such as pools for fish. It is important to note that all streams in this study were considered small streams based on their low stream order (1-3) and watershed size (<50 km^2). An impaired reach was a segment of stream, typically upstream of the restored reach, for which it was listed on the 303(d) list by TDEC and was never restored. A reference reach was selected from the TDEC biomonitoring database that was in the physiographic province and occurred in a predominantly forested watershed, but had similar physical characteristics and species pool as that of the restored and impaired reaches.

Water Quality and Benthic Macroinvertebrate Sampling (TDEC, 2017)

Riffle Habitats: Semi-quantitative Kick Net

Prior to benthic macroinvertebrate (BMI) sampling, a YSI 6600 multi-meter sonde was used to measure the water quality *in situ*. Specific conductivity (μS/cm), temperature (°C), pH, dissolved oxygen (% saturation) were measured and recorded. BMI were then sampledwith a 1-m^2 kick net containing 500-μm mesh in a “fast” riffle and “slow” riffle habitat following TDEC (2017) protocols. During sampling, the top of the net was kept 2-4cm above water so no specimens escaped. The bottom of the net was kept as flat as possible. To secure the net bottom, cobble-sized rocks were used to hold it against the stream bottom. While one person held the brails of the net at the downstream end, a second person stood approximately 1m upstream of the net and violently kicked and stomped the substrate within the 1-m^2sample area.Once the kicker reached the bottom of the net, the kicker then reached down and lifted the bottom of the net out of the water while the other person held the brails. Both people then folded the net up and prepared to empty the contents into a sieve bucket.

A 500-μm sieve bucket was used to filter out debris from the organisms. A separate bucket was used to wash the contents of the kick net into the sieve bucket until no more debris remained. After washing the net, it was spread out on a flat area of ground. A pair of forceps was used to carefully remove all invertebrates. Contents in the sieve bucket wereplacedinto white plastic pans, and all BMIwere collected for a period of 1hr per pan. Specimens were euthanized and preserved in a jar of 75% ethyl alcohol. All preserved insects were taken back to the University of Tennessee Fisheries

Research Lab for further identification to genus/species under light microscopy using the most recent dichotomous keys.

Kick Net Metrics

Seven metrics were calculated, scored, and then summed to get a Tennessee Macroinvertebrate Index or TMI value for kick net samples. The metric TR represents taxa richness. This is the total number of insect genera found in the sample.The acronym EPT is the total number of genera that fall within the Ephemeroptera, Plecoptera, and Trichoptera orders. The metric % EPT-C is the percentage of EPT genera found in the sample not including caddisflies of the genus *Cheumatopsyche*. The % OC represents the percentage of oligochaete worms and chironomid fly larva found within the sample. A tolerance score is assigned to each insect genera based on its level of pollution tolerance. The % Clinger represents the percentage of insects defined as "clingers" by TDEC and spend their lives attached to rocky surfaces feeding. The metric % TNUTOL is the percentage of nutrient tolerant organisms found in the sample. Finally, TMI which stands for Tennessee Macroinvertebrate Index, is a total score calculated by totaling all other metric scores which are 0, 2, 4, or 6 (TDEC, 2017). The invertebrate Functional Feeding Group classifications were obtained from Merritt et al., (2008).

Pool Habitats: Dip Net

After kick net samples were taken, one person used a 500-μm mesh D-framed dip net to sample pool habitats, root wads, or leaf litter on the side of the stream.Once at the pool or bank margin, the dip net is used to firmly scoop sediment, leafy, and woody debris from the stream. Ten subsamples were taken at each site, and all subsamples were combined into a clean sieve bucket. Next, sediment was rinsed from the sample by twisting and plunging the sieve bucket in stream water to get mud and sand out. Then, contents of the bucket were dumped into a white plastic pan and insects were collected as described above. The insects were placed in a jar of 75% ethanol for preservation and returned to the lab for further identification. Each sample jar was labeled with the date, sample type (kicknet or dipnet) and site name.

Dip Net Metrics

The IT metric represents intolerant taxa. TDEC defines intolerant taxa as those having an tolerance score of 0-3 (TDEC, 2017). The TMI for dipnet samples was calculated by totaling each metric score (0, 2, 4 or 6). Higher scores indicated improved numbers of specimens found at the site(TDEC, 2017).

Fish Sampling (Tennessee Valley Authority SOP, 2018)

Fish sampling began by selecting representative habitats to sample, which included riffles, runs, and pools.Each habitat type was sampled using a species depletion method, whereby sampling of a habitat ended only after three consecutive runs yielded no new species.

While two people holda seine, backpack electroshocking occurred for each riffle and run habitat sample for an area of 28 m^2 into a seine (6 m wide x 2 m high nylon, 6-mm bar mesh). After each sample, fish were identified, counted, and released alive at the point of capture.Dominant substrate type was recorded (CO=cobble, GR=gravel, SA=sand, SI=silt, CL=clay, BD=bedrock, BO=boulder, RU=rubble)for each riffle and run sample(TVA, 2018). To calculate the total IBI score for each sample, 12 metrics were evaluated. A series of richness metrics are calculated for each sample. These metrics include the number of native fishes, number of darter species, sunfish species minus *Micropterus* spp. (black bass), number of suckers (Family Catostomidae), and number of pollution-intolerant fish taxa. Next, the percentage of pollution-tolerant fish is calculated. Trophic group metrics are calculated and include the percentage of omnivores plus stoneroller (*Campostoma* spp.), percentage of specialized insectivores, and percentage of piscivores in the sample. A relative abundance, or secondary production metric is calculated called catch rate or catch per unit effort (CPUE, fish/m^2). Finally, metrics representing the health or physiological condition of fish are calculated, including the percentage of hybrid fish, percentage of fish exhibiting disease, external parasites, tumors, deformities, or lesions (TVA, 2018).

Fish Functional Trait Information

Fish functional trait information such as spawning and nesting type was obtained from the Virginia Tech functional traits database for each fish species found in this study (http://www.fishtraits.info/). For example, certain fish like darters are listed as guarders and will remain nearby the nest and guard it from other fish. In regards to nesting location, some species are described as specialists or generalists. Fish species such as sunfish would be described as generalist nesters and are typically found in a wide array of habitats. On the other hand, more sensitive species such as the Fantail Darter

(*Etheostoma flabellare*) are categorized as specialists and will utilize areas such as rock cavities to nest. The numbers or presence of fish expressing each functional trait were calculated for each sample.

Long-term Water Quality Data

To account for variation in sites due to point-source water quality issues that may have no relationship with physical habitat degradation, historic water quality data for each site was obtained from TDEC using their public database (http://environment-online.tn.gov:8080/pls/enf_reports/f?p=9034:34510:0:::::). Data were collected for the past 10 years (2009-2019). The measurements for *E. coli* count, dissolved oxygen, conductivity, and pH were all recorded for each site. A table was created with the mean (95% confidence interval) water quality values for each of the three treatment levels. Rapid habitat scores were estimated qualitatively at the end of fish sampling (TDEC, 2017).

Habitat information for the entire reach included substrate embeddedness, riparian zone condition, and bank erosion (TDEC, 2017). Metrics were assigned a score (1-10 or 1-20) and a total score was summed. An example of the rapid habitat score sheet from TDEC (2017) can be viewed in the appendix section. The percentage of urban land use in close proximity to the sample sites was also calculated for each stream site using the stream quantification tool derived from “Operational Draft Regional Guidebook for the Functional Assessment of High-Gradient Headwater Streams and Low-Gradient Perennial Streams in Appalachia." Each watershed was delineated using the StreamStats spatial analysis program (USACE, 2017).

Statistical Analyses

Tests of Restoration Treatment Using IBI and TMI Scores

A repeated measures ANOVA was conducted to test for fixed effects among the three restoration treatments (impaired, restored, and reference) and random effects of time as the repeated measure (n=6 for BMI, n=2 for fish) on total fish IBI scores and TMI scores for the BMI. The program SPSS v. 25 was used to conduct the analysis, and significance was tested at$\alpha = 0.05$.

Multivariate ordination techniques were utilized to assess interdependent relationships between IBI metrics and functional traits and continuous environmental covariates, especially the 10-year water quality data and treatment classification. Multivariate statistics are used when more than two response variables are being analyzed at onceand may potentially be autocorrelated (Wuensch, 2017). All tests conducted in this study were done using the PCORD v. 6.15 program. The first statistical test used in this study was a Redundancy Analysis (RDA). The RDA test was originally developed as an alternative to the Canonical Correspondence Analysis. An RDA test seeks to examine the linear relationship between similarity values calculated among sites based on IBI metrics and environmental variables from a second matrix (McCune and Grace, 2002). In this study, the RDA test was used to compare the different fish and insect IBI metrics across the three different treatment levels.A Monte Carlo randomization test was conducted (1,000 runs) to generate P-values for the first two axes. Convex hulls were generated around samples in a joint plot to interpret the effect of treatment on the functional IBI traits in fish and BMI data.

The second test conducted was the Multiple Response Permutation Procedure (MRPP). The MRPP is a nonparametric technique that tests for pair-wise differences among treatments. The Sorenson index of similarity was tested by the MRPP to discern if sites were different from each other with respect to fish and BMI metrics as a result of being in the restored, impaired, or reference condition.

The final test conducted was a Principle Coordinates Analysis (PCoA)using the Sorenson dissimilarity index on the main matrix of fish and BMI functional traits. The PCoA was used to visualize similarities or dissimilarities of fish functional traits and BMI functional feeding groups as a function of water quality variation or treatment level (McCune and Grace, 2002).

CHAPTER III CONCLUSION

Results

Evaluation of long-term differences (2009-2019) in mean water quality suggested that *E. coli* counts increased from reference, to restored, to impaired treatment status (Table 2). In addition, specific conductivity was lower for reference sites than restored or impaired sites, which tended to be similar to each other. Dissolved oxygen concentration was high and pH tended to be alkaline, and their means were similar across all treatment levels.Habitat scores calculated during this study were highest for reference sites, and tended to decrease for restored, followed by impaired sites. The percent urban watershed land cover was similar for restored and impaired sites, but was an order of magnitude higher than reference sites.

Table 2. Means (95% confidence intervals) for water quality and habitat data collected at each site by TDEC from 2009-2019. A habitat index score describes the physical habitat quality for benthic macroinvertebrates following TDEC (2017). % Urban refers to the percentage of urban land use in close proximity to the sample site.

Treatment	***E. coli* count**	**DO (mg/L)**	**Sp. Cond. (µS)**	**pH**	**Habitat Index Score**	**% Urban**
Reference	260 (315)	9.93 (0.80)	274 (148)	7.68 (0.6)	45.1 (18.4)	0.019 (.038)
Restored	431 (302)	9.40 (1.26)	421 (84)	7.95 (0.3)	38.2 (10.2)	0.2 (0.30)
Impaired	524 (416)	9.27 (1.27)	408 (92)	7.95 (0.3)	32.8 (10.8)	0.25 (0.27)

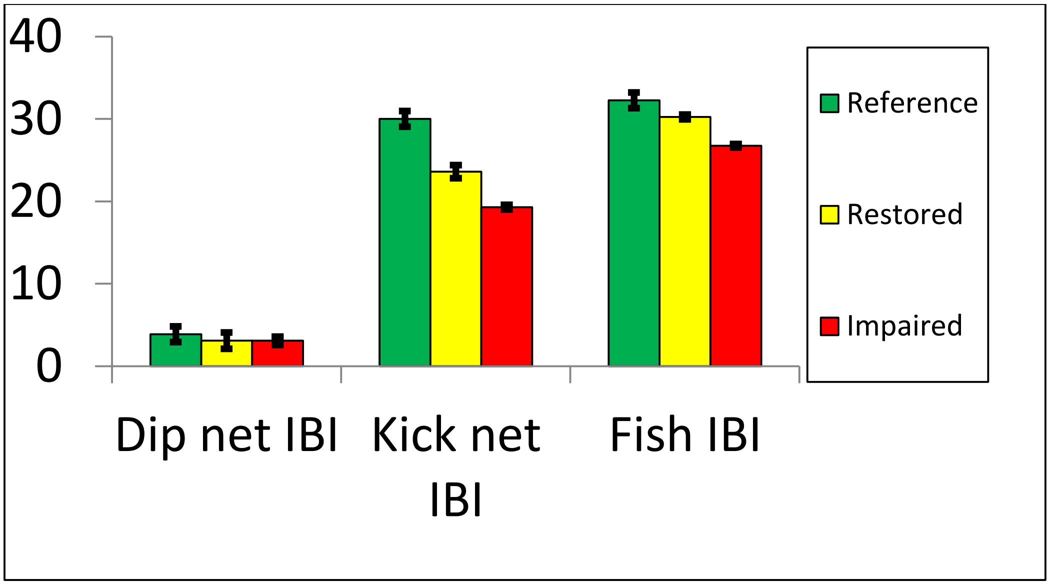

Figure 2. Bar graph representing the averaged IBI scores for the fish, kick net, and dip net IBI samples across the three treatment levels. Error bars were created with a 95% confidence interval.

A significant difference was observed among treatment levels for kick net TMI score ($F_{2,6}$= 8.4, P = 0.02, Power = 0.81). Reference and Impaired site scores were significantly different (Tukey HSD test, P = 0.02), but not Impaired-Restored or Reference-Restored comparisons. No difference was observed with respect to dip net TMI scores (F= 5.7, P = 0.07) or fish IBI scores (F = 1.3, P = 0.34). There were no differences among sample periods for any of the IBI or TMI scores.

Reference reaches scored higher, on average, than either restored or impaired streams (Figure 2, Tables 2, 3a and 3b). However, restored streams did show notably improved scores over the impaired streams. For example, Fish IBI scores averaged 30.25 for restored streams where impaired only averaged 26.75. Impaired streams consistently yielded lower IBI scores with both fish and BMI IBI scores.

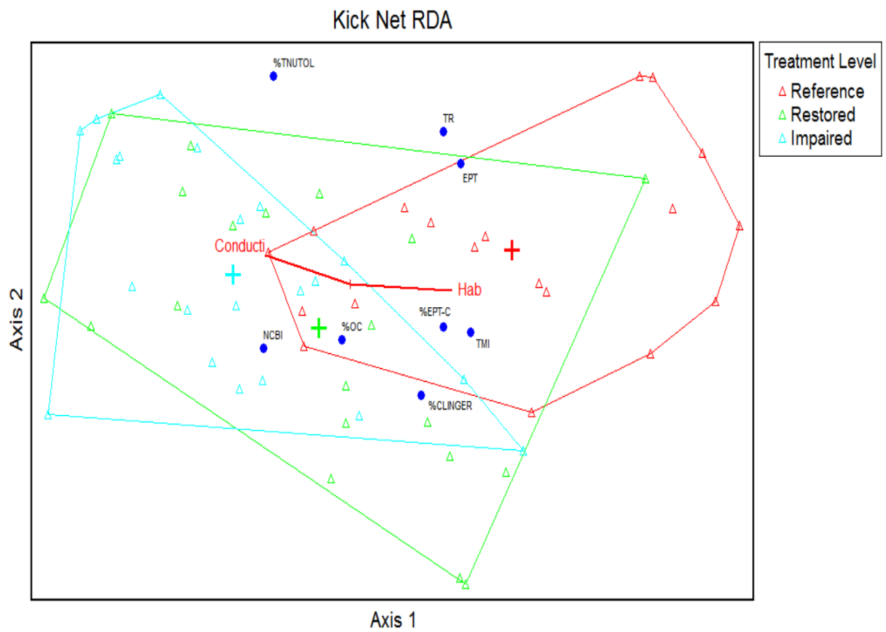

Figure 3. RDA biplot for kick net samples. Each treatment level is represented by a different colored convex hull "circular shape". Centroid "plus signs" mark the center of each hull. Habitat and conductivity trend lines are shown. Direction indicates positive correlation. Individual metrics are displayed as blue points. % Clinger represents the percentage of insect genera that were classified as those who cling to rocks in the stream. TMI is the Tennessee Macroinvertebrate Index, and is a total score calculated by totaling each metric score (0, 2, 4, or 6). %EPT-C is the percentage of EPT insects minus the common caddisly genus *Cheumatopsyche*. %OC represents the percentage of oligochaetes and chironomids found in the sample. NCBI represents the pollution tolerance value assigned to each genera of insect. EPT represents the total number of specimens found in the orders Ephemeroptera, Plecoptera and Trichoptera. Taxa richness is the score assigned based on how many insect genera were present. %TNUTOL is the percentage of insect genera that were considered nutrient tolerant by TDEC.

The results for the kick net BMI RDA test show that higher habitat scores on axis 1 were correlated mostly with reference streams and some of the restored sites (Figure 3). The metrics EPT, % EPT-*Cheumatopsyche*, and % clinger as well as TMI scores were positively correlated with habitat scores. Similarly, a negative correlation was found to exist with specific conductivity and BMI metrics for reference and restored sites. Highest specific conductivity levels were found in sites with the poorest habitat scores such as impaired streams that also contained higher tolerance scores (more pollution-tolerant BMI genera). For the dip net BMI collected from pool habitats, the metrics IT (intolerant richness) and EPT were positively correlated with sites having greater habitat scores, but this was not necessarily due to restoration, because there was a large amount of overlap among the three treatment classifications (Figure 4).

The RDA run on fish IBI metrics also shows that there was no difference in metrics with respect to treatment level (Figure 5). When examining the overlap between reference and restored sites in the joint plot (Figure 5), number of natives, number of darters, and CPUE are positively correlated with habitat scores on axis 1.Secondarily, on axis 2, pH was positively correlated with sites having greater % specialized insectivores and intolerant species richness. Thus, the more acidifed streams tended to have fewer fish species and proportionately fewer individuals classified as selective feeders on aquatic insects (e.g., darters, minnows).

Table 3a. Individual macroinvertebrate IBI metric scores for each site visit. Scores were assigned to each metric specific to sampling type. Kick net samples had 7 metrics and total score.A "R" or "I" listed in each sample name indicates a restored or impaired stream. Reference streams have no clarifying letter.

Sample	TR	EPT	%EPT-C	%OC	Tolerance Score	%CLINGER	%TNUTOL	TMI
Urban Restored Streams								
BCR1	9	4	59.5	0.0	6.0	73.0	10.8	32
BCR2	16	9	66.1	0.6	5.0	91.0	35.0	32
BCR3	7	2	58.8	21.6	3.0	60.8	0.0	30
BCR4	7	4	31.9	0.0	5.2	48.1	15.2	26
BCR5	7	2	41.2	0.0	5.0	64.7	23.5	26
BCR6	9	3	73.8	2.4	4.5	85.7	11.9	30
TCR1	10	5	22.2	0.0	5.7	50.0	13.8	26
TCR2	12	3	28.9	0.0	5.3	45.3	47.4	22
TCR3	8	4	30.4	3.6	5.7	35.6	60.7	20
TCR4	9	2	14.7	0.0	5.6	50.0	70.6	16
TCR5	8	1	0.0	11.4	6.4	22.4	47.7	16
TCR6	9	4	20.3	3.1	5.8	21.9	68.8	18
FBR1	6	3	33.3	0.0	6.5	22.2	44.4	20
FBR2	8	3	60.0	0.0	5.0	66.0	20.0	30
WC1	6	2	58.0	0.0	5.6	47.8	10.1	26
WC2	6	1	80.0	3.3	4.3	88.3	10.0	30
WC3	11	3	26.4	7.5	5.2	26.7	48.1	20
WC4	3	0	0.0	0.0	5.9	64.3	92.9	16
WC5	9	2	5.7	1.9	5.4	15.1	71.7	12
WC6	7	3	43.2	0.0	4.6	48.6	51.4	24

Table 3a continued

Sample	TR	EPT	%EPT-C	%OC	Tolerance Score	%CLINGER	%TNUTOL	TMI
Urban Impaired Streams								
BCI1	9	3	15.0	0.0	6.4	55.0	40.0	20
BCI2	6	0	0.0	0.0	7.1	0.0	5.0	14
BCI3	7	3	18.2	3.0	5.6	18.2	3.0	20
BCI4	8	2	49.3	1.5	5.0	49.3	14.9	26
BCI5	9	2	5.1	0.0	6.4	35.6	13.6	20
BCI6	9	1	30.6	0.0	5.8	30.6	11.1	22
TCI1	8	4	68.5	0.0	4.2	87.7	15.1	32
TCI2	9	3	29.0	1.1	5.1	38.7	57.0	20
TCI3	6	3	15.4	0.0	5.7	15.4	82.1	12
TCI4	11	2	1.7	0.0	5.5	22.0	69.5	16
TCI5	8	2	5.0	0.0	6.5	15.0	30.0	16
TCI6	10	3	13.0	0.0	4.3	43.5	26.1	24
BK1	9	2	22.4	0.0	4.7	51.0	36.7	22
BK2	9	2	19.0	0.0	5.1	51.0	62.0	20
BK3	8	2	17.4	2.9	5.8	24.6	78.3	14
BK4	8	2	9.1	0.0	5.5	15.6	75.3	12
BK5	10	1	0.0	2.8	6.0	36.6	78.9	16
BK6	8	2	13.6	2.3	5.5	15.9	20.5	16
FBI1	11	3	13.6	0.0	6.0	31.8	59.1	16
FBI2	11	5	45.2	0.0	5.3	50.0	38.7	28
Ecoregion Reference Streams								
IC1	12	4	30.4	2.2	3.3	50.0	23.9	30
IC2	17	9	51.1	0.0	3.9	78.7	19.5	36
IC3	12	5	48.8	0.0	4.0	58.1	14.0	34
IC4	15	11	61.0	0.0	4.2	52.5	33.9	34

Table 3a continued

Sample	TR	EPT	%EPT-C	%OC	Tolerance Score	%CLINGER	%TNUTOL	TMI
IC5	9	1	11.8	2.9	4.1	44.1	17.6	22
IC6	11	3	20.5	0.0	4.8	28.2	2.6	24
MC1	13	6	45.8	1.7	4.5	47.5	3.4	32
MC2	12	5	75.3	1.4	2.9	75.3	2.7	34
MC3	12	10	93.5	2.4	3.9	65.0	2.4	36
MC4	9	4	15.8	0.0	4.8	63.2	52.6	22
MC5	11	6	36.0	2.0	5.4	59.0	52.0	28
MC6	9	2	40.5	0.0	5.1	31.0	42.9	20
BWC1	13	6	54.2	0.0	5.6	37.0	15.8	30
BWC2	16	10	57.7	0.0	4.4	54.5	35.2	34
BWC3	12	11	70.2	3.6	4.0	71.4	29.8	36
BWC4	15	9	91.7	0.0	3.8	74.0	12.5	36
BWC5	9	3	25.0	0.0	5.3	50.0	30.0	22
BWC6	13	5	47.3	6.0	5.1	38.2	34.5	28
DC1	9	4	70.0	0.0	4.1	82.5	17.5	32
DC2	9	5	54.2	0.0	5.0	66.7	16.7	30

Table 3b. Dip-net IBI metrics values and TMI scores for each sample.

Sample	TR	EPT	IT	TMI
Urban Restored Streams				
BCR1	5	0	0	3
BCR2	7	4	3	3
BCR3	8	2	3	3
BCR4	5	0	0	3
BCR5	5	1	0	3
BCR6	5	2	0	3
TCR1	9	3	2	3
TCR2	7	3	1	3
TCR3	4	0	0	3
TCR4	2	0	0	3
TCR5	5	0	1	3
FBR1	3	0	1	3
FBR2	7	1	0	3
WC1	3	1	0	3
WC2	12	2	1	5
WC3	4	0	1	3
WC4	9	1	0	3
WC5	4	0	0	3
WC6	7	0	1	3
Urban Impaired Streams				
BCI1	9	0	1	5
BCI2	9	1	2	3
BCI3	8	1	2	3
BCI4	7	1	2	3
BCI5	8	0	0	3
BCI6	7	1	1	3
FBI1	2	0	0	3
FBI2	5	0	0	3
BK1	5	0	1	3
BK2	10	1	2	3
BK3	3	0	1	3
BK4	9	1	1	3
BK5	5	0	2	3
BK6	4	0	0	3
TCI1	6	0	1	3
TCI2	10	3	1	3

Table 3b continued

Sample	TR	EPT	IT	TMI
TCI3	7	2	1	3
TCI4	10	2	1	3
TCI5	4	0	0	3
TCI6	7	0	1	3
Ecoregion Reference Streams				
IC1	4	0	1	5
IC2	16	9	3	7
IC3	4	2	4	5
IC4	12	4	4	7
IC5	6	0	1	3
IC6	2	0	0	3
MC1	8	4	1	3
MC2	5	4	1	3
MC3	5	0	0	3
MC4	5	1	1	3
MC5	5	0	0	3
BWC1	3	0	1	3
BWC2	9	4	1	3
BWC3	16	10	4	11
BWC4	7	4	2	3
BWC5	4	0	0	3
BWC6	3	0	0	3
DC1	7	2	1	3
DC2	4	1	0	3

Table 4. Fish IBI data collected from each site visit. Twelve metrics were measured. The Natives= number of native fish collected in the sample. Darters= number of darter species collected in the sample. Sunfishes= the number of sunfish collected in each sample minus *Micropterus* spp. Suckers= the number of sucker fish species collected. Intolerant= number of fish listed by TVA as pollution intolerant. % Tolerant= percentage of fish in the sample that were considered tolerant to pollution. % Omnivores + stonerollers (% Omni) = the percentage of ominvorous fish plus stonrollers in the sample.% Specialized insectivores (% SI) = percentage of fish that feed selectively on aquatic insects. % Piscivores (% Pisc)= the percentage of fish eating fish. CPUE= catch rate per unit of effort. % Hybrids and % Diseased(% Dis) = percentage of fish that are either hybrids or have a disease present.

Sample	Natives	Darters	Sunfishes	Suckers	Intolerant	% Tol.	% Omni	% SI	%Pisc	CPUE	%Hybrid	% Dis.
Urban Restored Streams												
BCR1	14	4	1	2	1	11.4	31.6	59.5	0.6	6.6	0	0
BCR2	14	4	2	0	2	9.8	28.6	55.6	2.3	16.5	0	0
WC2	5	1	0	1	0	4.9	12.3	98.8	0.0	6.2	0	0
WC1	5	1	0	0	0	1.6	30.5	61.9	0.0	4.8	0	0
FBR1	12	2	3	1	0	10.9	65.2	21.0	0.7	9.2	0	0
FBR2	16	2	6	1	0	21.0	58.3	26.3	1.2	17.3	2	0
TCR2	7	2	0	1	0	29.8	3.6	75.0	0.0	4.2	0	0
TCR1	7	1	0	1	0	36.8	47.4	10.5	0.0	4.8	0	0
Urban Impaired Streams												
BCI2	9	3	2	1	1	14.1	16.3	72.6	0.0	5.9	0	0

Table 4 continued

Sample	Natives	Darters	Sunfishes	Suckers	Intolerant	% Tol.	% Omni	% SI	%Pisc	CPUE	%Hybrid	% Dis.
BCI1	10	4	1	1	1	17.4	16.0	49.4	0.2	18.2	0	0
BK2	5	1	1	0	0	34.9	0.0	14.0	0.0	2.3	0	0
BK1	5	1	0	0	0	60.4	0.0	24.5	1.9	3.8	0	0
TCI2	5	1	0	1	0	32.1	13.2	11.3	0.0	5.9	0	0
TCI1	5	1	0	0	0	19.6	17.4	13.0	0.0	3.5	0	0
FBI2	10	1	4	1	0	16.6	38.9	27.4	0.6	8.8	0	0
FBI1	10	1	1	1	0	29.0	18.7	57.9	0.0	3.7	0	0
Ecoregion Reference Streams												
IC1	11	4	0	1	0	25.9	35.2	53.3	0.0	5.3	0	0
IC2	15	3	1	1	0	19.0	41.0	54.0	0.3	17.3	0	0
DC2	17	3	3	2	0	26.2	35.2	33.7	0.0	7.2	0	0
DC1	11	2	2	1	0	37.9	21.1	57.9	0.0	4.8	0	0
MC2	8	1	0	1	0	5.3	6.3	11.6	0.0	10.6	0	0
MC1	5	1	0	0	0	26.7	0.0	32.2	0.0	5.6	0	0
BWC1	14	4	1	0	2	4.3	32.3	93.3	0.0	16.9	0	0
BWC2	19	5	0	1	1	9.1	19.2	95.9	0.3	13.6	0	0

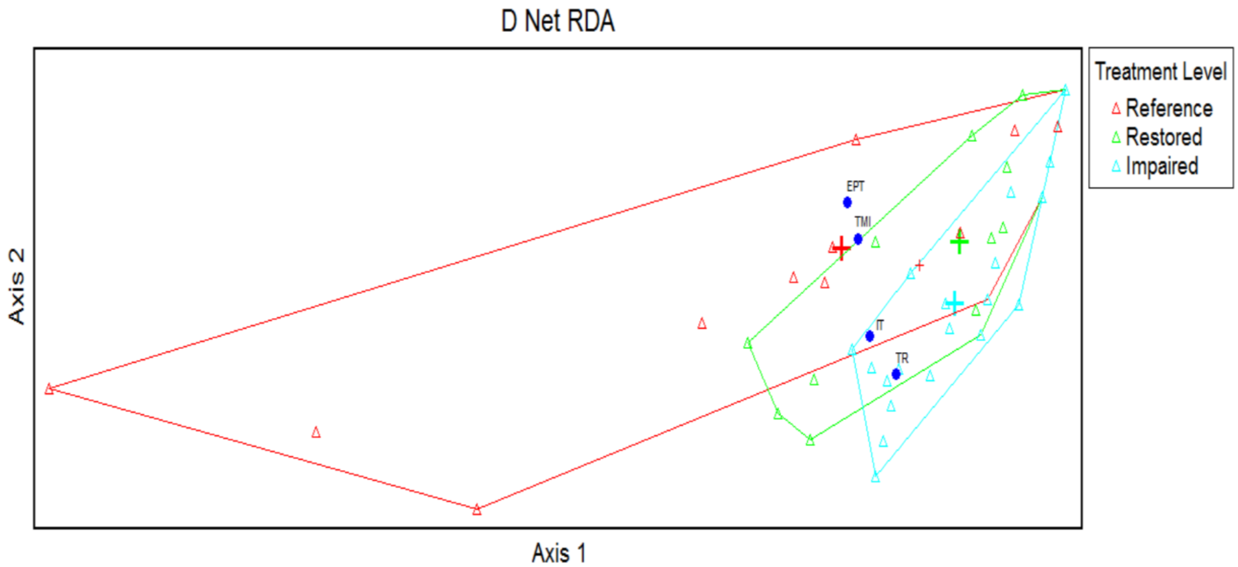

Figure 4. Dip net RDA biplot. Each treatment level is represented by a different colored convex hull "circular shape". Centroid "plus signs" mark the center of each hull. Individual metrics are displayed as blue points. TR stands for taxa richness which is the number of different insect genera found in dip net samples. IT represents intolerant taxa with tolerance scores of 0-3. TMI is the Tennessee Macroinvertebrate Index, and is a total score calculated by totaling each metric score (0, 2, 4, or 6). EPT represents the total number of specimens found in the orders Ephemeroptera, Plecoptera and Trichoptera.

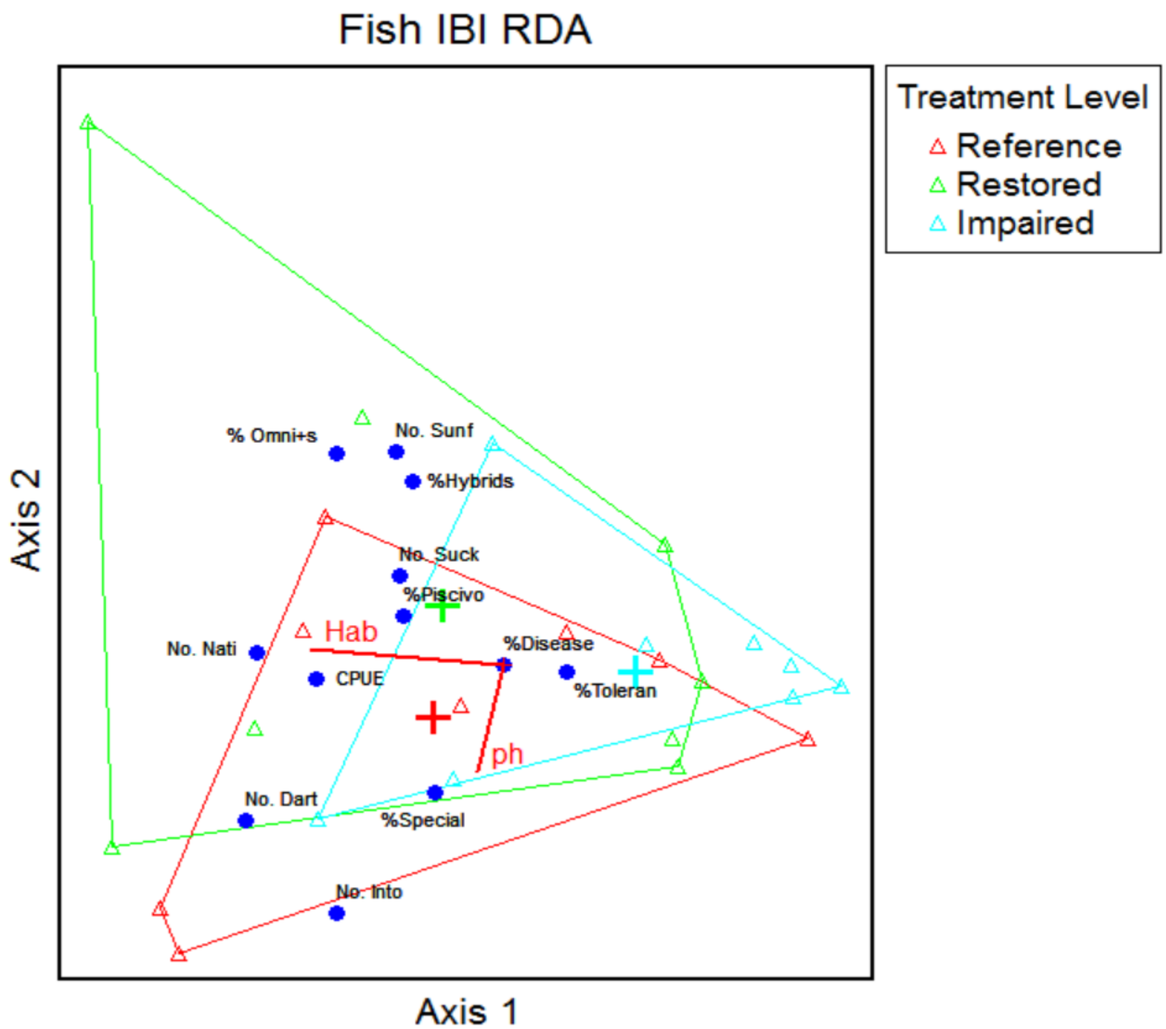

Figure 5. RDA biplot for the fish IBI samples. Each TVA metric is shown as a blue point. Each treatment level is represented by a different colored convex hull "circular shape". Centroid "plus signs" mark the center of each hull. The two trend lines represent habitat score and pH value. Direction of each line indicates positive correlation. The %Omni-s=percentage of omnivorous fish plus stonerollers. No.sunf=number of sunfish in the sample. No. Nati=number of native fish in the sample. %Piscivo=percentage of fish-eating fish collected. %Tolerant=percentage of pollution tolerant fish. CPUE is the catch rate per run. %Special=percentage of specialized insectivores. No. Dart=number of darters collected in sample. No. Intol=number of pollution intolerant fish collected.

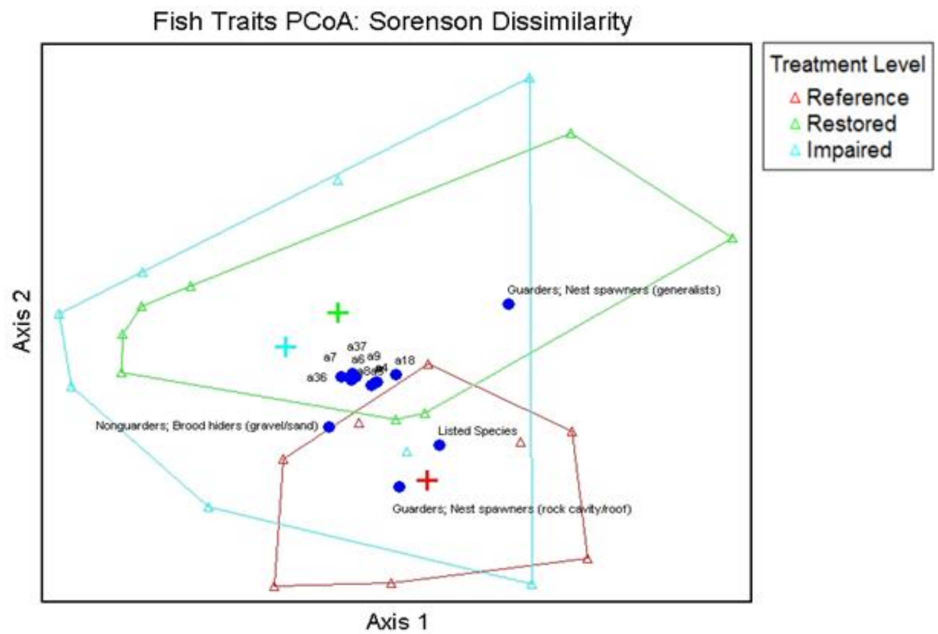

Figure 6. Principle Coordinates Analysis (PCoA) biplot using Sorenson dissimilarity. Fish trait metrics are represented as blue points. Each treatment level is represented by a different colored convex hull "circular shape". Centroid "plus signs" mark the center of each hull.

The PCoA was used to find differences or similarities in functional traits expressed by fish and BMI assemblages among the three treatment classifications. Fish species that lay eggs in rock cavities or on the underside of rocks as well as listed/imperiled species tended to comprise reference and some restored sites (Figure 6, and Table 5). Fish that lay eggs in cavities are sensitive to sedimentation, such as the Stripetail Darter (*E. kennicotti*) which requires small rock crevices to spawn with females, lay eggs,and guardeggs from predators. Fish species categorized as listed/imperlied are not specifically listed on the Endangered Species List, but do have conservation concerns due to their highly specific life strategies.

Table 5. Functional traits examined in the PCoA test. Nonguarders/ Brood Hiders (gravel/sand)= fish that will lay and hide eggs in gravel or sand areas. Guarders/ Nest Spawners (rock cavity/roof)= fish with specialized nesting behaviors such as the Stripetail Darter. Guarders/ Nest Spawners (generalists)= fish with generalized nesting behavior such as sunfish. Listed= fish listed as having some conservation concern by state and federal agencies.

Sample	Nonguarders/ Hiders (gravel/sand)	Guarders/ Nest Spawners (rock cavity/roof)	Guarders/ Nest Spawners (generalists)	Listed
BCR1	35	3	0	7
BCR2	19	3	0	15
BCI2	36	1	0	31
BCI1	214	15	0	6
IC1	10	8	0	6
IC2	14	4	0	8
BWC1	60	26	1	21
BWC2	30	1	0	0
WC2	70	0	0	0
WC1	23	0	0	0
BK2	13	8	0	8
BK1	8	0	0	0
TCI2	40	0	0	0
TCI1	32	1	0	1
DC2	21	23	0	27
DC1	25	6	0	6
FBI2	0	0	1	1
FBI1	2	0	1	1
FBR2	1	0	11	22
FBR1	1	0	0	2
TCR2	13	2	0	0
TCR1	17	1	0	1
MC2	68	19	0	87

Table 5 continued

Sample	Nonguarders/ Hiders (gravel/sand)	Guarders/ Nest Spawners (rock cavity/roof)	Guarders/ Nest Spawners (generalists)	Listed
MC1	36	16	9	16

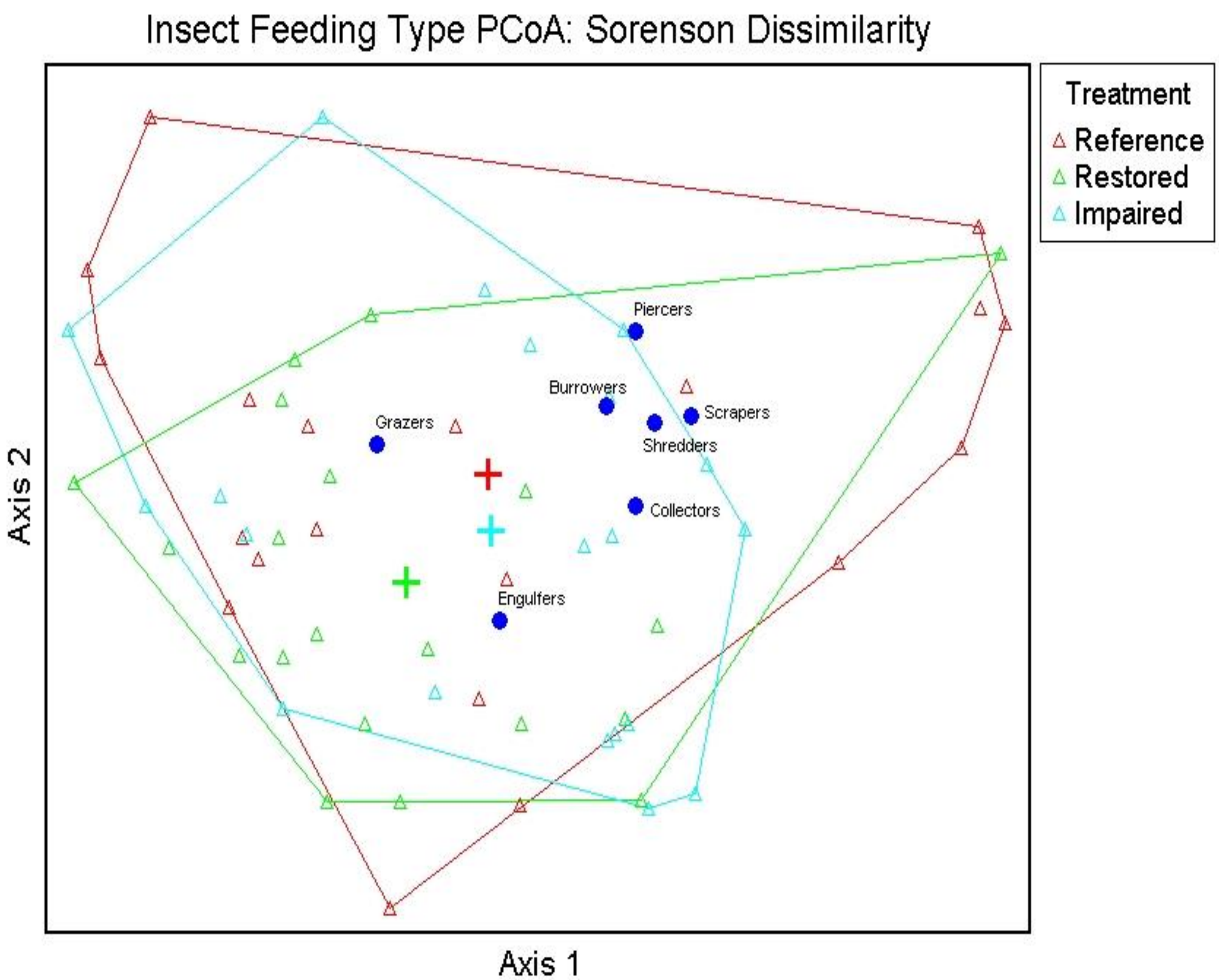

Figure 7. PCoA biplot with Sorenson Dissimilarity for insect feeding types. Each feeding type is represented by a blue point. Each treatment level is represented by a different colored convex hull "circular shape". Centroid "plus signs" mark the center of each hull.

A PCoA was also conducted on the insect Functional Feeding Groups. Again, more overlap is shown in this biplot, but piercers and scrapers were correlated with reference and restored streams (Figure 7). This is a promising sign because the only piercer insects found in the whole study were the fly larva *Atherix* in the family Athericidae*.* That particular insect has a tolerance score of 0.9 (out of 10, which is pollution tolerant) which is very low and indicates that it is quite sensitive. The only insects classified as scrapers in this study were beetle larvae known as water pennies (family Psephenidae) and certain mayflies of the family Ephemerellidae(e.g., *Serratella* sp.*)*. Both of these families are fairly pollution-sensitive groups.

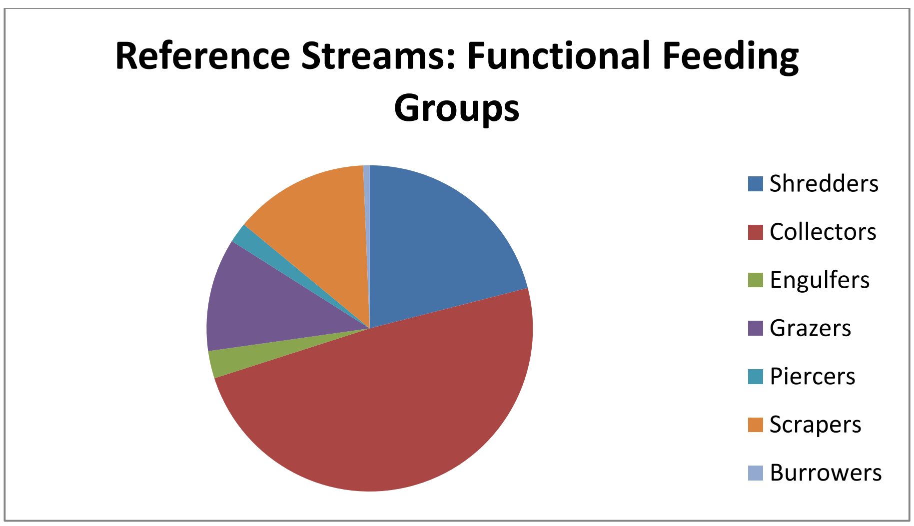

Figure 8. Pie chart showing the distribution of insect functional feeding groups across reference streams.

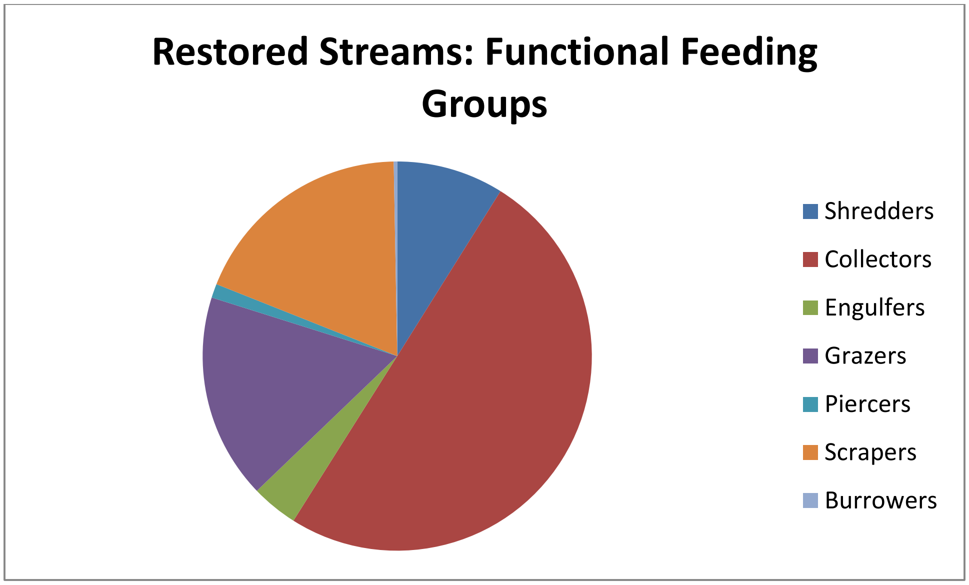

Figure 9. Pie chart showing the distribution of insect functional feeding groups across restored streams.

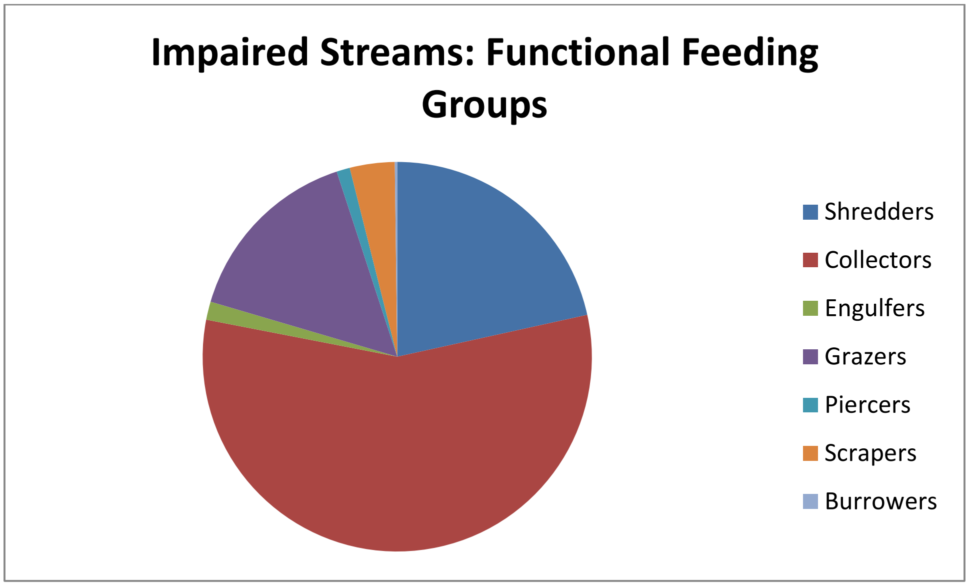

Figure 10. Pie chart showing the distribution of insect functional feeding groups across impaired streams.

The composition of different FFGs varied across different treatment levels (Figures 8, 9 and 10). Collectors comprised the most individuals in allsamples, followed by shredders, grazers and scrapers. Shredders are considered desirable in these small streams because they typically contain specimens such as stoneflies that process CPOM and are pollution-sensitive organisms. An important point to note is that while many shredders are sensitive taxa, not all are. Certain Diptera (true fly order) families such as Tipulidae are considered shredders (Merritt et al, 2008), but have higher tolerance scores. Thus, they are more tolerant to pollution and can be found in lower quality habitat.

Discussion

Overall, the results of this study support the hypotheses. Restoration efforts do seem to have had incremental improvement in improving the biotic functionality of physically degraded urban stream reaches that drain the Ridge and Valley province of East Tennessee.The restored reaches showed improvement in riffle-dwelling invertebrates over impaired streams, even though they did not obtain the full biotic integrity potential of Ridge and Valley reference reaches. The biotic integrity of BMI assemblages from riffle habitats (i.e., kick net samples) was greater for restored reaches compared to impaired reaches, but not as much as reference reaches. However, this was not the case for BMI scores from pool habitats (dip net samples) or for fish IBI scores. Aquatic invertebrates tend to colonize restored habitats quicker than fishes, because the adults can fly across landscapes,and other aquatic forms can colonize downstream reaches via drift (Blakley et al, 2006). Restored habitats may not be suitable for all life stages of fish species (e.g., eggs or larvae), dispersal ability may be limited (e.g., strong site fidelity), or barriers such as impoundments or dams may prevent their dispersal to restored sites (Bond and Lake, 2003).

The fact that some specialized insectivorous fishes were found in restored sites is a good sign. Darters tend to be very sensitive fish species and prefer clean water, riffle-run-pool sequences, and a mix of substrates that can support their larval insect prey. Finding species such as Blueside Darters (*Etheostoma jessiae*), Greenside Darters (*E. blennioides*) and Stripetail Darters in the restored reaches is very promising because they require adequate benthic insect populations as prey. Although these species are common in their range, darters are typically the first group to be lost when streams become physically degraded (Harrison, 2004). Reference and restored streams yielded higher CPUE than the lower habitat scoring impaired streams. This metric tends to act as an indicator of the productive capacity of the streams to support body growth and recruitment of new individuals with a healthy food web structure and suitable spawning habitat (Karr, 1991).

Several IBI metrics from the BMI kick net samples were associated mostly with reference and restored sites. For example, %EPT-*Cheumatopsyche* (%EPT-C), EPT richness (EPT), and taxa richness (TR) helped to explain differences in restored and reference sites versus impaired sites (Figure 4). These are all promising signs because EPT's contain sensitive taxa that require good water quality and suitable woody and rock substratesin order to thrive. The fact that taxa richness was also correlated to some restored sites means that not only were some sensitive species found, but also a relatively high diversity of invertebrate genera.

With respect to FFGs, reference streams aligned most with the RCC in that they contained mostly collectors and shredders. Since all of the streams sampled in this study were considered small streams, collectors and shredders would be expected to make up the largest percentage of the samples (Vannote et al., 1980). Restored streams exhibited a somewhat different result. While collectors were still the largest feeding group, grazer and scrapers made up the second largest groups instead of shredders. This is likely due to the difference in riparian forest structure of restored versus reference streams, but that will be examined further in the discussion. Impaired streams surprisingly exhibited the expected RCC pattern of mostly shredders and collectors, although the percentage of grazers was still high. Thus, adequate amounts of CPOM must be entering these small streamreaches to support the aquatic food web.

The impaired Beaver Creek site acted as somewhat of an anomaly during this study. By all accounts it represented a textbook example of what an impaired stream should look like (Appendix IV). The site was very channelized and had large areas of eroding bank with little to no riparian zone at all. The sample area was also in a less urban area and partially located next to an agricultural field with open water access to several horses. The excess levels of sedimentation were exacerbated whenever there was a rain event. The lack of a riparian zone allowed materials like soil runoff and fecal matter to go directly to the stream. A local resident even commented that a nearby sanitary sewer cover overflowed during heavy rain events.

While the impaired section of Beaver Creek showed all the signs of a degraded stream, it surprisingly contained a large diversity of species. Many of those specimens were even classified as sensitive taxa or listed species.Listed species were species of special conservation concern, but not necessarily listed as endangered or threatened by the USFWS. Nest spawners which are more generalist species such as sunfish (*Lepomis* spp.) tended to occur in impaired and lower scoring restored sites. These sites tended to have excessive pool habitats with very low amounts of riffles, which is advantageous for the more lentic fishes that need low flow areas to build and maintain nests.Several species of darters were collected from the impaired Beaver Creek site, including the Stripetail Darter. This is likely due to the cobble and slab rocks available to them for spawning at this site.The impaired section of Beaver Creek also yielded several specimens of the larval *Atherix* fly. These flies are extremely sensitive to pollution and have an assigned tolerance score of 0.9 (TDEC, 2017). It is possible that groundwater inputs may ameliorate pollutant loads from the surrounding landscape. The water here was often very cool, there was shade provided by the bank opposite the agricultural field, and a diversity of substrate types was available, especially cobble, gravel, sand, and silt. Riffle, run, and pool habitats were evident as well, thus enough suitable habitat seems to support this diversity of BMI and fishes. Also, two species of mussel were found at the impaired Beaver Creek site. A single relic right valve of *Villosa vanuxemensis*, the Mountain Creekshell, was found at a gravel bar. Even more surprisingly, two relic individualsof a candidate species for Edangered Species Act listing were found:*Pleuronaia barnesiana*, or Tennessee Pigtoe.This species is considered to be of special conservation concern in its native distribution in the Tennessee River drainage, and has been listed as either endangered or threatened in other locations (Williams et al., 2008).

Conversely, the restored section of Beaver Creek had a higher habitat score with a robust riparian zone on both banks. That site was also downstream of the impaired portion. The most logical explanation as to why several sensitive species of fish and insects were collected is that the improved habitat downstream has created an area for them to inhabit. Now that the lower section of stream has been recolonized, certain species are moving upstream and expanding their populations. Whether or not the sensitive species such as the Stripetail Darters, *Atherix* flies, or *Pleuronaia barnesiana* will remain in the impaired section of Beaver Creek remains to be seen. A longer term study would need to be conducted to determine if they could remain, or would move on.

A problem that plagued some of the restored sites from reaching their full biotic potential was simply a lack of adequate riparian canopy cover. For example, the restored section of Friar Branch contained predominantly Black Willow (*Salix nigra*) on the banks and other small shrubby plants. While these might accomplish the goal of stabilizing the stream banks relatively quickly after construction and act as buffers for material entering the stream, they do not provide adequate canopy cover for aquatic biota. Open canopies allow excess amounts of sunlight into the water which cause uncontrolled algal and macrophyte growth (see photograph in Appendix IV), particularly Water Willow (*Justicia americana*). This autochthonous production will alter the proportions of fish and especially insect species one should expect to find in a headwater stream. That is likely the case with the restored streams since many of the insects found there were grazers and scrapers which feed by eating or physically scraping algae from rocky surfaces. An important distinction needs to be made between grazers and scrapers. Scrapers are insects such as mayfly larvae whereas grazers are typically all herbivorous non-insects such as snails (Merritt et al., 2008). Additionally, for fishes, the % Omnivores + stoneroller metric was approximately double the value for the the restored Friar Branch site compared to the reference (Dry Creek) and impaired Friar Branch site thathave heavily forested riparian canopies (Table 3). This supports the idea that excessive benthic vegetation is produced in open canopy restored reaches, which increases the grazer biomass of aquatic invertebrates and fishes. If efforts to restore these streams to their natural form are successful, care must be taken to replicate the environment outlined by Vannote et al., (1980) and to ensure that adequate riparian cover exists in headwater sized streams.

The Winemiller and Rose (1992) model is also quite applicable to this study. Many of the impaired and some restored streams showed signs of disturbance, and the fish collected represented that condition. In many of the impaired streams, Western Mosquitofish (*Gambusia affinis*) were observed. As predicted by Winemiller (2005), opportunistic species such as the Mosquitofish were present in the more unstable environments. The opposite was also true, because reaches with improved habitat scores were found to contain more piscivorous fishes such as the Black Bass (*Micropterus* spp.). Those equilibrium species prefer the more stable habitats, particularly in pools and runs, and have adapted life histories to those specific places, but can have lower demographic resilience in the face of frequent or high magnitude disturbance events (Winemiller, 2005).

Pollution is also an ongoing problem at many of the sample sites. Effluent from point- and nonpoint-sources of pollution can have a negative impact on water quality and, in turn, the aquatic life (Cooper, 1993). One of the impaired sites in particular, Friar

Branch, actually contained a sewage pipe running over the top of the stream. During one visit to the site, the pipe was observed disconnected and lying in the water with raw sewage and toilet paper flowing into Friar Branch uninhibited. The TDEC was immediately notified of the problem.

Situations like the one described above seem to be all too common in urban streams and create problems for aquatic life in general and especially restoration efforts (Walsh et al., 2005). Excess waste in the water, along with nonpoint runoff of urban landscapes can lead to higher specific conductivity levels (Mariely, 2002). Based upon the long-term water quality data collected for this project, impaired reaches generally had the highest specific conductivity and *E. coli*levels. Although specific conductivity at these levels may not have direct negative impacts to aquatic organisms, it is indicative of ions and associated chemicals being transported to these reaches from the urbanized watershed (Mariely et al., 2002). For future studies, it would be interesting to examine the longer-term effects that the restorations have had on the streams in this study. This project occurred during a single year. If possible, a 5-10 year study would potentially reveal new information. Moreover, pre-restoration data on all these sites would have made for more rigorous evaluations of the effect of the restoration efforts. A longer study that includes pre-restoration data would give researchers a better idea of the biotic sustainabilityof stream restoration. Also, this study was conducted only in the Ridge and Valley ecoregion of Tennessee. It would be interesting to see if the same trends found in this study would be applicable to other geographic regions.

In conclusion, the fact that some of these urban streams show moderate signs of biological recovery is encouraging. With continued efforts to decrease the amount of pollution that reaches streams, and continuing to increase and enforce water quality regulations, many of these streams may indeed rebound fully. Even so, many problems still exist. As long as the impaired streams get no attention, they will remain impaired, and have very little life within them. Location also plays a major role in the success or failure of a restored stream, such that dispersal ability for fishes to restored sites from source populations need to be considered in future restorations. Some areas will be subject to higher rates of point and nonpoint source pollution than others, thus limiting the success rate of physical habitat restorations.

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APPENDICES

Appendix I. Habitat Score Sheet

WORKSHEET FOR STREAM HABITAT ASSESSMENT

Stream Name_______________________________ Date ___/___/___

Crew ___________________________________ State ____ County_______________

Stream Code_________ Station Number______ Site name_________________________________

Habitat Parameter	4	3	2	1
1. Instream Cover (fish habitat)	Greater than 50% fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential.	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of fish populations.	10-30% mix of stable habitat; habitat availability less than desirable.	Less than 10% stable habitat; lack of habitat is obvious.
SCORE ____	4	3	2	1
2. Epifaunal Substrate (Aquaitc insect habitat)	Well developed riffle and run; riffle is as wide as stream and length extends two times the width of stream; abundance of cobble.	Riffle is as wide as stream but length is less than two times width; abundance of cobble; boulders and gravel common.	Run area may be lacking; riffle not as wide as stream and its length is less than 2 times the stream width; gravel or large boulders and bedrock prevalent; some cobble present.	Riffles or runs virtually nonexistent; large boulders and bedrock prevalent; cobble lacking.
SCORE ____	4	3	2	1
3. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble and boulder particles are >75% surrounded by fine sediment OR substrate is homogenous (i.e. bedrock, sand, detritus, silt/mud/clay).
SCORE ____	4	3	2	1
4. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (> past 20 yrs.) may be present, but recent channelization is not present.	New embankments present on both banks; and 40-80% of stream channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized or disrupted.
SCORE ____	4	3	2	1

5. Sediment Deposition	Little or no enlargement of islands or point bars and < 5% of the bottom affected by sediment deposition.	Some new increase in bar formation mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, coarse sand on old and new bars; 30-50% of the bottom affected; sediment deposits at obstruction, constriction and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE ____	4	3	2	1
6. Frequency of Riffles	Occurrence of riffles frequent; distance between riffles divided by width of stream equals 5 to 7; variety of habitat is key. In highest gradient streams (e.g., headwaters), riffles are continuous and placement of boulders or obstruction is evaluated as providing habitat diversity.	Occurrence of riffles infrequent; distance between riffles divided by width of stream equals 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE ____	4	3	2	1
7. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE ____	4	3	2	1
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
AVERAGE	Left Bank 4	3	2	1
SCORE ____	Right Bank 4	3	2	1
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
AVERAGE	Left Bank 4	3	2	1
SCORE ___	Right Bank 4	3	2	1
10. Riparian Vegetative Zone Width (score each bank riparian zone) (high and low gradient)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 1218 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
AVERAGE	Left Bank 4	3	2	1
SCORE ___	Right Bank 4	3	2	1

Appendix II. Benthic Macroinvertebrate Data

Sample ID	Site	City, State	Date	Order	Family	Genus	Specimens	FFG
K net	Beaver Creek Restored	Knoxville, TN	10/19/2017	Decapoda	Cambaridae	*Cambarus*	2	Shredder
K net	Beaver Creek Restored	Knoxville, TN	10/19/2017	Veneroida	Cyrenidae	*Corbicula*	7	Collector
K net	Beaver Creek Restored	Knoxville, TN	10/19/2017	Trichoptera	Hydropsychidae	*Cheumatopsyche*	2	Collector
K net	Beaver Creek Restored	Knoxville, TN	10/19/2017	Ephemeroptera	Heptageniidae	*Maccaffertium*	9	Scraper
K net	Beaver Creek Restored	Knoxville, TN	10/19/2017	Trichoptera	Hydropsychidae	*Ceratopsyche*	11	Collector
K net	Beaver Creek Restored	Knoxville, TN	10/19/2017	Diptera	Simuliidae	*Simulium*	2	Collector

K net	Beaver Creek Restored	Knoxville, TN	10/19/2017	Coleoptera	Elmidae	*Stenelmis*	1	Shredder
K net	Beaver Creek Restored	Knoxville, TN	10/19/2017	Trichoptera	Philopotamidae	*Chimarra*	2	Collector
K net	Beaver Creek Restored	Knoxville, TN	10/19/2017	Neotaenioglossa	Pleuroceridae	*Pleurocera*	1	Grazer
D net	Beaver Creek Restored	Knoxville, TN	10/19/2017	Decapoda	Cambaridae	*Cambarus*	1	Shredder
D net	Beaver Creek Restored	Knoxville, TN	10/19/2017	Megaloptera	Sialidae	*Sialis*	1	Engulfer
D net	Beaver Creek Restored	Knoxville, TN	10/19/2017	Veneroida	Cyrenidae	*Corbicula*	4	Collector
D net	Beaver Creek Restored	Knoxville, TN	10/19/2017	Odonata	Gomphidae	*Gomphus*	1	Burrower
D net	Beaver Creek Restored	Knoxville, TN	10/19/2017	Neotaenioglossa	Pleuroceridae	*Pleurocera*	5	Grazer

K net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	86	Scraper
K net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Odonata	Aeshnidae	*Basiaeshna*	2	Burrower
K net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Ephemeroptera	Ephemerellidae	*Serratella*	2	Collector
K net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Trichoptera	Philopotamidae	*Chimarra*	1	Collector
K net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Plecoptera	Nemouridae	*Zapada*	2	Shredder
K net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Plecoptera	Taeniopterygidae	*Strophopteryx*	2	Shredder
K net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Ephemeroptera	Baetidae	*Heterocloeon*	20	Collector
K net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	38	Collector

K net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	2	Collector
K net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Diptera	Simuliidae	*Simulium*	13	Collector
K net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Diptera	Tipulidae	*Leptotarsus*	9	Shredder
K net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Trichoptera	Polycentropodidae	*Neureclipsis*	2	Collector
K net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Coleoptera	Elmidae	*Stenelmis*	17	Shredder
K net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Isopoda	Asellidae	*Lirceus*	6	Collector
K net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Decapoda	Cambaridae	*Cambarus*	7	Shredder
K net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Decapoda	Cambaridae	*Orconectes*	1	Shredder

D net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Decapoda	Cambaridae	*Orconectes*	3	Shredder
D net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Ephemeroptera	Ephemerellidae	*Serratella*	7	Collector
D net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Plecoptera	Taeniopterygidae	*Taeniopteryx*	2	Shredder
D net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	1	Collector
D net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Isopoda	Asellidae	*Lirceus*	17	Collector
D net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Odonata	Aeshnidae	*Boyeria*	3	Burrower
D net	Beaver Creek Restored	Knoxville, TN	3/5/2018	Trichoptera	Polycentropodidae	*Neureclipsis*	1	Collector
K net	Beaver Creek Restored	Knoxville, TN	4/17/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	3	grazer

K net	Beaver Creek Restored	Knoxville, TN	4/17/2018	Veneroida	Cyrenidae	*Corbicula*	5	Collector
K net	Beaver Creek Restored	Knoxville, TN	4/17/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	3	Collector
K net	Beaver Creek Restored	Knoxville, TN	4/17/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	27	Scraper
K net	Beaver Creek Restored	Knoxville, TN	4/17/2018	Coleoptera	Elmidae	*Macronychus*	1	Shredder
K net	Beaver Creek Restored	Knoxville, TN	4/17/2018	Coleoptera	Elmidae	*Optioservus*	1	shredder
D net	Beaver Creek Restored	Knoxville, TN	4/17/2018	Odonata	Coenagrionidae	*Argia*	1	burrower
D net	Beaver Creek Restored	Knoxville, TN	4/17/2018	Ephemeroptera	Ephemerellidae	*Ephemerella*	15	Collector
D net	Beaver Creek Restored	Knoxville, TN	4/17/2018	Veneroida	Cyrenidae	*Corbicula*	1	Collector

D net	Beaver Creek Restored	Knoxville, TN	4/17/2018	Odonata	Aeshnidae	*Boyeria*	1	engulfer
D net	Beaver Creek Restored	Knoxville, TN	4/17/2018	Odonata	Calopterygidae	*Calopteryx*	2	engulfer
D net	Beaver Creek Restored	Knoxville, TN	4/17/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	1	grazer
D net	Beaver Creek Restored	Knoxville, TN	4/17/2018	Isopoda	Asellidae	*Lirceus*	2	Collector
D net	Beaver Creek Restored	Knoxville, TN	4/17/2018	Plecoptera	Perlidae	*Agnetina*	1	Shredder
K net	Beaver Creek Restored	Knoxville, TN	5/25/2018	Decapoda	Cambaridae	*Cambarus*	1	shredder
K net	Beaver Creek Restored	Knoxville, TN	5/25/2018	Plecoptera	Perlidae	*Agnetina*	1	shredder
K net	Beaver Creek Restored	Knoxville, TN	5/25/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	7	grazer

K net	Beaver Creek Restored	Knoxville, TN	5/25/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	7	scraper
K net	Beaver Creek Restored	Knoxville, TN	5/25/2018	Veneroida	Cyrenidae	*Corbicula*	5	collector
K net	Beaver Creek Restored	Knoxville, TN	5/25/2018	Odonata	Aeshnidae	*Boyeria*	1	engulfer
K net	Beaver Creek Restored	Knoxville, TN	5/25/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	5	collector
D net	Beaver Creek Restored	Knoxville, TN	5/25/2018	Veneroida	Cyrenidae	*Corbicula*	1	collector
D net	Beaver Creek Restored	Knoxville, TN	5/25/2018	Isopoda	Asellidae	*Lirceus*	6	collector
D net	Beaver Creek Restored	Knoxville, TN	5/25/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	3	grazer
D net	Beaver Creek Restored	Knoxville, TN	5/25/2018	Coleoptera	Elmidae	*Macronychus*	1	shredder

D net	Beaver Creek Restored	Knoxville, TN	5/25/2018	Coleoptera	Elmidae	*Stenelmis*	2	shredder
K net	Beaver Creek Restored	Knoxville, TN	7/9/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	6	grazer
K net	Beaver Creek Restored	Knoxville, TN	7/9/2018	Veneroida	Cyrenidae	*Corbicula*	4	collector
K net	Beaver Creek Restored	Knoxville, TN	7/9/2018	Ephemeroptera	Isonychidae	*Isonychia*	1	collector
K net	Beaver Creek Restored	Knoxville, TN	7/9/2018	Coleoptera	Elmidae	*Stenelmis*	1	shredder
K net	Beaver Creek Restored	Knoxville, TN	7/9/2018	Diptera	Tipulidae	*Tipula*	1	shredder
K net	Beaver Creek Restored	Knoxville, TN	7/9/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	7	collector
K net	Beaver Creek Restored	Knoxville, TN	7/9/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	14	scraper

D net	Beaver Creek Restored	Knoxville, TN	7/9/2018	Coleoptera	Elmidae	*Stenelmis*	1	shredder
D net	Beaver Creek Restored	Knoxville, TN	7/9/2018	Ephemeroptera	Baetidae	*Baetis*	1	collector
D net	Beaver Creek Restored	Knoxville, TN	7/9/2018	Veneroida	Cyrenidae	*Corbicula*	2	collector
D net	Beaver Creek Restored	Knoxville, TN	7/9/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	1	grazer
D net	Beaver Creek Restored	Knoxville, TN	7/9/2018	Coleoptera	Elmidae	*Stenelmis*	2	shredder
K net	Beaver Creek Restored	Knoxville, TN	9/12/2018	Coleoptera	Elmidae	*Ancyronyx*	2	shredder
K net	Beaver Creek Restored	Knoxville, TN	9/12/2018	Ephemeroptera	Isonychiidae	*Isonychia*	1	collector
K net	Beaver Creek Restored	Knoxville, TN	9/12/2018	Coleoptera	Elmidae	*Stenelmis*	4	shredder

K net	Beaver Creek Restored	Knoxville, TN	9/12/2018	Ephemeroptera	Baetidae	*Baetis*	3	collector
K net	Beaver Creek Restored	Knoxville, TN	9/12/2018	Isopoda	Asellidae	*Lirceus*	1	collector
K net	Beaver Creek Restored	Knoxville, TN	9/12/2018	Ephemeroptera	Heptageniidae	*Macaffertium*	6	scraper
K net	Beaver Creek Restored	Knoxville, TN	9/12/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	22	collector
K net	Beaver Creek Restored	Knoxville, TN	9/12/2018	Diptera	Simuliidae	*Simullium*	2	collector
D net	Beaver Creek Restored	Knoxville, TN	9/12/2018	Veneroida	Cyrenidae	*Corbicula*	7	collector
D net	Beaver Creek Restored	Knoxville, TN	9/12/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	7	grazer
D net	Beaver Creek Restored	Knoxville, TN	9/12/2018	Ephemeroptera	Heptageniidae	*Macaffertium*	1	scraper

D net	Beaver Creek Restored	Knoxville, TN	9/12/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	1	collector
D net	Beaver Creek Restored	Knoxville, TN	9/12/2018	Odonata	Coenagrionidae	*Argia*	1	engulfer
K net	Beaver Creek Impaired	Knoxville, TN	11/15/2017	Veneroida	Cyrenidae	*Corbicula*	5	collector
K net	Beaver Creek Impaired	Knoxville, TN	11/15/2017	Decapoda	Cambaridae	*Cambarus*	1	shredder
K net	Beaver Creek Impaired	Knoxville, TN	11/15/2017	Diptera	Tipulidae	*Leptotarsus*	1	shredder
K net	Beaver Creek Impaired	Knoxville, TN	11/15/2017	Trichoptera	Hydropsychidae	*Cheumatopsyche*	16	collector
K net	Beaver Creek Impaired	Knoxville, TN	11/15/2017	Diptera	Ceratopogonidae	*Culicoides*	1	collector
K net	Beaver Creek Impaired	Knoxville, TN	11/15/2017	Diptera	Simuliidae	*Simulium*	4	collector

K net	Beaver Creek Impaired	Knoxville, TN	11/15/2017	Neotaenioglossa	Pleuroceridae	*Pleurocera*	6	grazer
K net	Beaver Creek Impaired	Knoxville, TN	11/15/2017	Ephemeroptera	Heptageniidae	*Stenonema*	2	scraper
K net	Beaver Creek Impaired	Knoxville, TN	11/15/2017	Ephemeroptera	Baetidae	*Baetis*	4	collector
D net	Beaver Creek Impaired	Knoxville, TN	11/15/2017	Decapoda	Cambaridae	*Cambarus*	1	shredder
D net	Beaver Creek Impaired	Knoxville, TN	11/15/2017	Odonata	Calopterygidae	*Calopteryx*	14	engulfer
D net	Beaver Creek Impaired	Knoxville, TN	11/15/2017	Neotaenioglossa	Pleuroceridae	*Pleurocera*	6	grazer
D net	Beaver Creek Impaired	Knoxville, TN	11/15/2017	Diptera	Tipulidae	*Leptotarsus*	1	shredder
D net	Beaver Creek Impaired	Knoxville, TN	11/15/2017	Veneroida	Cyrenidae	*Corbicula*	4	collector

D net	Beaver Creek Impaired	Knoxville, TN	11/15/2017	Odonata	Coenagrionidae	*Argia*	1	engulfer
D net	Beaver Creek Impaired	Knoxville, TN	11/15/2017	Odonata	Gomphidae	*Gomphus*	1	burrower
D net	Beaver Creek Impaired	Knoxville, TN	11/15/2017	Odonata	Aeshnidae	*Boyeria*	5	engulfer
D net	Beaver Creek Impaired	Knoxville, TN	11/15/2017	Coleoptera	Elmidae	*Stenelmis*	1	shredder
K net	Beaver Creek Impaired	Knoxville, TN	3/5/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	4	grazer
K net	Beaver Creek Impaired	Knoxville, TN	3/5/2018	Gastropoda (class)	Physidae	*Physa*	1	grazer
K net	Beaver Creek Impaired	Knoxville, TN	3/5/2018	Diptera	Athericidae	*Atherix*	1	piercer
K net	Beaver Creek Impaired	Knoxville, TN	3/5/2018	Diptera	Tipulidae		3	shredder

K net	Beaver Creek Impaired	Knoxville, TN	3/5/2018	Veneroida	Cyrenidae	*Corbicula*	10	collector
K net	Beaver Creek Impaired	Knoxville, TN	3/5/2018	Coleoptera	Elmidae	*Optioservus*	1	shredder
D net	Beaver Creek Impaired	Knoxville, TN	3/5/2018	Decapoda	Cambaridae	*Cambarus*	1	shredder
D net	Beaver Creek Impaired	Knoxville, TN	3/5/2018	Odonata	Coenagrionidae	*Argia*	1	engulfer
D net	Beaver Creek Impaired	Knoxville, TN	3/5/2018	Odonata	Calopterygidae	*Calopteryx*	3	engulfer
D net	Beaver Creek Impaired	Knoxville, TN	3/5/2018	Veneroida	Cyrenidae	*Corbicula*	3	collector
D net	Beaver Creek Impaired	Knoxville, TN	3/5/2018	Isopoda	Asellidae	*Lirceus*	4	collector
D net	Beaver Creek Impaired	Knoxville, TN	3/5/2018	Ephemeroptera	Ephemerellidae	*Ephemerella*	1	collector

D net	Beaver Creek Impaired	Knoxville, TN	3/5/2018	Coleoptera	Hydrophilidae	*Hydrophilus*	1	shredder
D net	Beaver Creek Impaired	Knoxville, TN	3/5/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	4	grazer
D net	Beaver Creek Impaired	Knoxville, TN	3/5/2018	Gastropoda (class)	Physidae	*Physa*	1	grazer
K Net	Beaver Creek Impaired	Knoxville, TN	4/17/2018	Veneroida	Cyrenidae	*Corbicula*	18	collector
K Net	Beaver Creek Impaired	Knoxville, TN	4/17/2018	Diptera	Tipulidae	*Tipula*	1	shredder
K Net	Beaver Creek Impaired	Knoxville, TN	4/17/2018	Ephemeroptera	Baetidae	*Baetis*	3	collector
K Net	Beaver Creek Impaired	Knoxville, TN	4/17/2018	Coleoptera	Elmidae	*Optioservus*	4	shredder
K Net	Beaver Creek Impaired	Knoxville, TN	4/17/2018	Oligochaeta (subclass)			1	collector

K Net	Beaver Creek Impaired	Knoxville, TN	4/17/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	2	scraper
K Net	Beaver Creek Impaired	Knoxville, TN	4/17/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	4	collector
D Net	Beaver Creek Impaired	Knoxville, TN	4/17/2018	Odonata	Coenagrionidae	*Argia*	2	engulfer
D Net	Beaver Creek Impaired	Knoxville, TN	4/17/2018	Odonata	Aeshnidae	*Boyeria*	1	engulfer
D Net	Beaver Creek Impaired	Knoxville, TN	4/17/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	1	grazer
D Net	Beaver Creek Impaired	Knoxville, TN	4/17/2018	Ephemeroptera	Ephemerellidae	*Serratella*	4	collector
D Net	Beaver Creek Impaired	Knoxville, TN	4/17/2018	Veneroida	Cyrenidae	*Corbicula*	18	collector
D Net	Beaver Creek Impaired	Knoxville, TN	4/17/2018	Odonata	Gomphidae	*Progomphus*	1	burrower

D Net	Beaver Creek Impaired	Knoxville, TN	4/17/2018	Isopoda	Asellidae	*Lirceus*	1	collector
D Net	Beaver Creek Impaired	Knoxville, TN	4/17/2018	Odonata	Calopterygidae	*Calopteryx*	3	engulfer
K net	Beaver Creek Impaired	Knoxville, TN	5/14/2018	Odonata	Aeshnidae	*Boyeria*	2	engulfer
K net	Beaver Creek Impaired	Knoxville, TN	5/14/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	10	grazer
K net	Beaver Creek Impaired	Knoxville, TN	5/14/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	32	collector
K net	Beaver Creek Impaired	Knoxville, TN	5/14/2018	Coleoptera	Elmidae	*Stenelmis*	10	shredder
K net	Beaver Creek Impaired	Knoxville, TN	5/14/2018	Veneroida	Cyrenidae	*Corbicula*	10	collector
K net	Beaver Creek Impaired	Knoxville, TN	5/14/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	1	scraper

K net	Beaver Creek Impaired	Knoxville, TN	5/14/2018	Diptera	Tipulidae	*Tipula*	1	shredder
D net	Beaver Creek Impaired	Knoxville, TN	5/14/2018	Coleoptera	Elmidae	*Stenelmis*	5	shredder
D net	Beaver Creek Impaired	Knoxville, TN	5/14/2018	Isopoda	Asellidae	*Lirceus*	1	collector
D net	Beaver Creek Impaired	Knoxville, TN	5/14/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	4	grazer
D net	Beaver Creek Impaired	Knoxville, TN	5/14/2018	Veneroida	Cyrenidae	*Corbicula*	4	collector
D net	Beaver Creek Impaired	Knoxville, TN	5/14/2018	Plecoptera	Perlidae	*Agnetina*	1	shredder
D net	Beaver Creek Impaired	Knoxville, TN	5/14/2018	Odonata	Calopterygidae	*Calopteryx*	1	engulfer
D net	Beaver Creek Impaired	Knoxville, TN	5/14/2018	Odonata	Aeshnidae	*Boyeria*	1	engulfer

K net	Beaver Creek Impaired	Knoxville, TN	7/9/2018	Veneroida	Cyrenidae	*Corbicula*	9	collector
K net	Beaver Creek Impaired	Knoxville, TN	7/9/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	3	grazer
K net	Beaver Creek Impaired	Knoxville, TN	7/9/2018	Veneroida	Sphaeriidae		6	collector
K net	Beaver Creek Impaired	Knoxville, TN	7/9/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	3	scraper
K net	Beaver Creek Impaired	Knoxville, TN	7/9/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	17	collector
K net	Beaver Creek Impaired	Knoxville, TN	7/9/2018	Megaloptera	Sialidae	*Sialis*	9	engulfer
K net	Beaver Creek Impaired	Knoxville, TN	7/9/2018	Coleoptera	Elmidae	*Stenelmis*	5	shredder
K net	Beaver Creek Impaired	Knoxville, TN	7/9/2018	Coleoptera	Psephenidae	*Psephenus*	1	shredder

K net	Beaver Creek Impaired	Knoxville, TN	7/9/2018	Diptera	Tipulidae	*Tipula*	6	shredder
D net	Beaver Creek Impaired	Knoxville, TN	7/9/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	2	grazer
D net	Beaver Creek Impaired	Knoxville, TN	7/9/2018	Odonata	Calopterygidae	*Calopteryx*	1	engulfer
D net	Beaver Creek Impaired	Knoxville, TN	7/9/2018	Coleoptera	Elmidae	*Stenelmis*	1	shredder
D net	Beaver Creek Impaired	Knoxville, TN	7/9/2018	Oligochaeta (subclass)			1	collector
D net	Beaver Creek Impaired	Knoxville, TN	7/9/2018	Veneroida	Sphaeriidae		2	collector
D net	Beaver Creek Impaired	Knoxville, TN	7/9/2018	Veneroida	Cyrenidae	*Corbicula*	1	collector
D net	Beaver Creek Impaired	Knoxville, TN	7/9/2018	Diptera	Stratiomyidae	*Stratiomys*	1	collector

D net	Beaver Creek Impaired	Knoxville, TN	7/9/2018	Coleoptera	Elmidae	*Macronychus*	1	shredder
K net	Beaver Creek Impaired	Knoxville, TN	8/31/2018	Unionida	Pleuronaia (genus)	*barnesiena (species)*	3	collector
K net	Beaver Creek Impaired	Knoxville, TN	8/31/2018	Unionida	Villosa (genus)	*vanuxamensis (species)*	1	collector
K net	Beaver Creek Impaired	Knoxville, TN	8/31/2018	Veneroida	Cyrenidae	*Corbicula*	3	collector
K net	Beaver Creek Impaired	Knoxville, TN	8/31/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	11	collector
K net	Beaver Creek Impaired	Knoxville, TN	8/31/2018	Coleoptera	Elmidae	*Optioservus*	1	shredder
K net	Beaver Creek Impaired	Knoxville, TN	8/31/2018	Veneroida	Sphaeriidae		12	collector
K net	Beaver Creek Impaired	Knoxville, TN	8/31/2018	Decapoda	Cambaridae	*Cambarus*	1	shredder

K net	Beaver Creek Impaired	Knoxville, TN	8/31/2018	Diptera	Tipulidae	*Tipula*	3	shredder
K net	Beaver Creek Impaired	Knoxville, TN	8/31/2018	Coleoptera	Elmidae	*Stenelmis*	3	shredder
K net	Beaver Creek Impaired	Knoxville, TN	8/31/2018	Odonata	Aeshnidae	*Boyeria*	1	engulfer
K net	Beaver Creek Impaired	Knoxville, TN	8/31/2018	Gastropoda (class)	Physidae	*Physa*	1	grazer
D net	Beaver Creek Impaired	Knoxville, TN	8/31/2018	Veneroida	Sphaeriidae		2	collector
D net	Beaver Creek Impaired	Knoxville, TN	8/31/2018	Odonata	Aeshnidae	*Boyeria*	4	engulfer
D net	Beaver Creek Impaired	Knoxville, TN	8/31/2018	Ephemeroptera	Ephemeridae	*Hexagenia*	1	collector
D net	Beaver Creek Impaired	Knoxville, TN	8/31/2018	Coleoptera	Elmidae	*Macronychus*	5	shredder

D net	Beaver Creek Impaired	Knoxville, TN	8/31/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	1	grazer
D net	Beaver Creek Impaired	Knoxville, TN	8/31/2018	Odonata	Calopterygidae	*Calopteryx*	4	engulfer
D net	Beaver Creek Impaired	Knoxville, TN	8/31/2018	Odonata	Coenagrionidae	*Argia*	4	engulfer
K net	Indian Creek	Thorn Hill, TN	10/30/2017	Trichoptera	Philopotamidae	*Chimarra*	9	collector
K net	Indian Creek	Thorn Hill, TN	10/30/2017	Megaloptera	Corydalidae	*Nigronia*	2	engulfer
K net	Indian Creek	Thorn Hill, TN	10/30/2017	Coleoptera	Psephenidae	*Psephenus*	5	scraper
K net	Indian Creek	Thorn Hill, TN	10/30/2017	Plecoptera	Perlidae	*Acroneuria*	1	shredder
K net	Indian Creek	Thorn Hill, TN	10/30/2017	Diptera	Athericidae	*Atherix*	5	piercer
K net	Indian Creek	Thorn Hill, TN	10/30/2017	Diptera	Chironomidae	*Chironomus*	1	collector
K net	Indian Creek	Thorn Hill, TN	10/30/2017	Neotaenioglossa	Pleuroceridae	*Pleurocera*	10	grazer
K net	Indian Creek	Thorn Hill, TN	10/30/2017	Diptera	Tipulidae	*Leptotarsus*	6	shredder

K net	Indian Creek	Thorn Hill, TN	10/30/2017	Trichoptera	Hydropsychidae	*Ceratopsyche*	3	collector
K net	Indian Creek	Thorn Hill, TN	10/30/2017	Odonata	Gomphidae	*Gomphus*	1	burrower
K net	Indian Creek	Thorn Hill, TN	10/30/2017	Ephemeroptera	Heptageniidae	*Maccaffertium*	1	scraper
K net	Indian Creek	Thorn Hill, TN	10/30/2017	Megaloptera	Corydalidae	*Corydalus*	2	engulfer
D net	Indian Creek	Thorn Hill, TN	10/30/2017	Coleoptera	Psephenidae	*Ectopria*	1	scraper
D net	Indian Creek	Thorn Hill, TN	10/30/2017	Veneroida	Cyrenidae	*Corbicula*	1	collector
D net	Indian Creek	Thorn Hill, TN	10/30/2017	Neotaenioglossa	Pleuroceridae	*Pleurocera*	2	grazer
D net	Indian Creek	Thorn Hill, TN	10/30/2017	Coleoptera	Psephenidae	*Psephenus*	1	scraper
K net	Indian Creek	Thorn Hill, TN	2/1/2018	Coleoptera	Psephenidae	*Psephenus*	16	scraper
K net	Indian Creek	Thorn Hill, TN	2/1/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	21	collector
K net	Indian Creek	Thorn Hill, TN	2/1/2018	Trichoptera	Brachycentridae	*Brachycentrus*	1	shredder
K net	Indian Creek	Thorn Hill, TN	2/1/2018	Trichoptera	Philopotamidae	*Chimarra*	28	collector
K net	Indian Creek	Thorn Hill, TN	2/1/2018	Trichoptera	Polycentropodidae	*Neureclipsis*	3	collector

K net	Indian Creek	Thorn Hill, TN	2/1/2018	Trichoptera	Limnephilidae	*Pycnopsyche*	1	shredder
K net	Indian Creek	Thorn Hill, TN	2/1/2018	Plecoptera	Taeniopterygidae	*Taeniopteryx*	18	shredder
K net	Indian Creek	Thorn Hill, TN	2/1/2018	Plecoptera	Peltoperlidae	*Tallaperla*	1	shredder
K net	Indian Creek	Thorn Hill, TN	2/1/2018	Plecoptera	Chloroperlidae	*Alloperla*	3	shredder
K net	Indian Creek	Thorn Hill, TN	2/1/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	34	scraper
K net	Indian Creek	Thorn Hill, TN	2/1/2018	Megaloptera	Corydalidae	*Corydalus*	2	engulfer
K net	Indian Creek	Thorn Hill, TN	2/1/2018	Megaloptera	Corydalidae	*Nigronia*	2	engulfer
K net	Indian Creek	Thorn Hill, TN	2/1/2018	Diptera	Tipulidae	*Leptotarsus*	2	shredder
K net	Indian Creek	Thorn Hill, TN	2/1/2018	Diptera	Simuliidae	*Simulium*	13	collector
K net	Indian Creek	Thorn Hill, TN	2/1/2018	Diptera	Athericidae	*Atherix*	14	piercer
K net	Indian Creek	Thorn Hill, TN	2/1/2018	Coleoptera	Elmidae	*Stenelmis*	13	shredder
K net	Indian Creek	Thorn Hill, TN	2/1/2018	Odonata	Gomphidae	*Gomphus*	2	burrower
D net	Indian Creek	Thorn Hill, TN	2/1/2018	Ephemeroptera	Leptophlebiidae	*Leptophlebia*	31	collector

D net	Indian Creek	Thorn Hill, TN	2/1/2018	Ephemeroptera	Ephemerellidae	*Drunella*	1	collector
D net	Indian Creek	Thorn Hill, TN	2/1/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	3	scraper
D net	Indian Creek	Thorn Hill, TN	2/1/2018	Megaloptera	Corydalidae	*Nigronia*	1	engulfer
D net	Indian Creek	Thorn Hill, TN	2/1/2018	Plecoptera	Taeniopterygidae	*Taeniopteryx*	7	shredder
D net	Indian Creek	Thorn Hill, TN	2/1/2018	Plecoptera	Taeniopterygidae	*Strophopteryx*	6	shredder
D net	Indian Creek	Thorn Hill, TN	2/1/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	1	collector
D net	Indian Creek	Thorn Hill, TN	2/1/2018	Trichoptera	Limnephilidae	*Pycnopsyche*	8	shredder
D net	Indian Creek	Thorn Hill, TN	2/1/2018	Diptera	Simuliidae	*Simulium*	4	collector
D net	Indian Creek	Thorn Hill, TN	2/1/2018	Trichoptera	Brachycentridae	*Micrasema*	1	collector
D net	Indian Creek	Thorn Hill, TN	2/1/2018	Coleoptera	Elmidae	*Stenelmis*	3	shredder
D net	Indian Creek	Thorn Hill, TN	2/1/2018	Odonata	Calopterygidae	*Calopteryx*	2	engulfer
D net	Indian Creek	Thorn Hill, TN	2/1/2018	Odonata	Cordulegastridae	*Cordulegaster*	1	burrower
D net	Indian Creek	Thorn Hill, TN	2/1/2018	Odonata	Gomphidae	*Gomphus*	1	burrower

D net	Indian Creek	Thorn Hill, TN	2/1/2018	Trichoptera	Polycentropodidae	*Neureclipsis*	3	collector
D net	Indian Creek	Thorn Hill, TN	2/1/2018	Isopoda	Asellidae	*Lirceus*	5	collector
K net	Indian Creek	Thorn Hill, TN	4/23/2018	Decapoda	Cambaridae	*Cambarus*	1	shredder
K net	Indian Creek	Thorn Hill, TN	4/23/2018	Diptera	Tipulidae	*Tipula*	2	shredder
K net	Indian Creek	Thorn Hill, TN	4/23/2018	Coleoptera	Psephenidae	*Psephenus*	12	scraper
K net	Indian Creek	Thorn Hill, TN	4/23/2018	Plecoptera	Nemouridae	*Amphinemoura*	4	shredder
K net	Indian Creek	Thorn Hill, TN	4/23/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	6	grazer
K net	Indian Creek	Thorn Hill, TN	4/23/2018	Megaloptera	Corydalidae	*Nigronia*	1	engulfer
K net	Indian Creek	Thorn Hill, TN	4/23/2018	Megaloptera	Corydalidae	*Corydalus*	2	engulfer
K net	Indian Creek	Thorn Hill, TN	4/23/2018	Ephemeroptera	Isonychiidae	*Isonychia*	2	collector
K net	Indian Creek	Thorn Hill, TN	4/23/2018	Ephemeroptera	Ephemerellidae	*Ephemerella*	2	collector
K net	Indian Creek	Thorn Hill, TN	4/23/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	8	scraper
K net	Indian Creek	Thorn Hill, TN	4/23/2018	Odonata	Gomphidae	*Progomphus*	1	burrower

K net	Indian Creek	Thorn Hill, TN	4/23/2018	Plecoptera	Taeniopterygidae	*Taeniopteryx*	2	shredder
D net	Indian Creek	Thorn Hill, TN	4/23/2018	Odonata	Aeshnidae	*Boyeria*	2	engulfer
D net	Indian Creek	Thorn Hill, TN	4/23/2018	Plecoptera	Peltoperlidae	*Soliperla*	1	shredder
D net	Indian Creek	Thorn Hill, TN	4/23/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	4	grazer
D net	Indian Creek	Thorn Hill, TN	4/23/2018	Ephemeroptera	Ephemerellidae	*Serratella*	5	collector
K net	Indian Creek	Thorn Hill, TN	5/4/2018	Plecoptera	Taeniopterygidae	*Taenionema*	2	shredder
K net	Indian Creek	Thorn Hill, TN	5/4/2018	Plecoptera	Perlidae	*Agnetina*	4	shredder
K net	Indian Creek	Thorn Hill, TN	5/4/2018	Trichoptera	Rhyacophilidae	*Rhyacophila*	1	engulfer
K net	Indian Creek	Thorn Hill, TN	5/4/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	1	collector
K net	Indian Creek	Thorn Hill, TN	5/4/2018	Ephemeroptera	Baetidae	*Baetis*	6	collector
K net	Indian Creek	Thorn Hill, TN	5/4/2018	Diptera	Simuliidae	*Simulium*	3	collector
K net	Indian Creek	Thorn Hill, TN	5/4/2018	Ephemeroptera	Isonychidae	*Isonychia*	1	collector
K net	Indian Creek	Thorn Hill, TN	5/4/2018	Ephemeroptera	Ephemerellidae	*Ephemerella*	6	collector

K net	Indian Creek	Thorn Hill, TN	5/4/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	11	scraper
K net	Indian Creek	Thorn Hill, TN	5/4/2018	Ephemeroptera	Ephemerellidae	*Ephemerella*	1	collector
K net	Indian Creek	Thorn Hill, TN	5/4/2018	Coleoptera	Elmidae	*Stenelmis*	3	shredder
K net	Indian Creek	Thorn Hill, TN	5/4/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	16	grazer
K net	Indian Creek	Thorn Hill, TN	5/4/2018	Trichoptera	Nemouridae	*Amphinemoura*	2	shredder
K net	Indian Creek	Thorn Hill, TN	5/4/2018	Isopoda	Asellidae	*Lirceus*	1	collector
K net	Indian Creek	Thorn Hill, TN	5/4/2018	Trichoptera	Philopotamidae	*Chimarra*	1	collector
D net	Indian Creek	Thorn Hill, TN	5/4/2018	Plecoptera	Taeniopterygidae	*Taienionema*	1	shredder
D net	Indian Creek	Thorn Hill, TN	5/4/2018	Odonata	Cordulegastridae	*Cordulegaster*	4	burrower
D net	Indian Creek	Thorn Hill, TN	5/4/2018	Coleoptera	Elmidae	*Macronychus*	2	shredder
D net	Indian Creek	Thorn Hill, TN	5/4/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	20	grazer
D net	Indian Creek	Thorn Hill, TN	5/4/2018	Ephemeroptera	Baetidae	*Baetis*	2	collector
D net	Indian Creek	Thorn Hill, TN	5/4/2018	Coleoptera	Elmidae	*Optioservus*	2	shredder

D net	Indian Creek	Thorn Hill, TN	5/4/2018	Gastropoda (class)	Physidae	*Physa*	1	grazer
D net	Indian Creek	Thorn Hill, TN	5/4/2018	Odonata	Gomphidae	*Gomphus*	2	burrower
D net	Indian Creek	Thorn Hill, TN	5/4/2018	Ephemeroptera	Ephemerellidae	*Ephemerella*	5	collector
D net	Indian Creek	Thorn Hill, TN	5/4/2018	Coleoptera	Elmidae	*Stenelmis*	4	shredder
D net	Indian Creek	Thorn Hill, TN	5/4/2018	Plecoptera	Perlidae	*Agnetina*	1	shredder
K net	Indian Creek	Thorn Hill, TN	7/2/2018	Decapoda	Cambaridae	*Cambarus*	1	shredder
K net	Indian Creek	Thorn Hill, TN	7/2/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	12	grazer
K net	Indian Creek	Thorn Hill, TN	7/2/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	4	scraper
K net	Indian Creek	Thorn Hill, TN	7/2/2018	Megaloptera	Corydalidae	*Corydalus*	1	engulfer
K net	Indian Creek	Thorn Hill, TN	7/2/2018	Diptera	Athericidae	*Atherix*	5	piercer
K net	Indian Creek	Thorn Hill, TN	7/2/2018	Coleoptera	Elmidae	*Stenelmis*	3	shredder
K net	Indian Creek	Thorn Hill, TN	7/2/2018	Coleoptera	Psephenidae	*Psephenus*	6	scraper
K net	Indian Creek	Thorn Hill, TN	7/2/2018	Coleoptera	Elmidae	*Optioservus*	1	shredder

D net	Indian Creek	Thorn Hill, TN	7/2/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	13	grazer
D net	Indian Creek	Thorn Hill, TN	7/2/2018	Veneroida	Cyrenidae	*Corbicula*	1	collector
D net	Indian Creek	Thorn Hill, TN	7/2/2018	Coleoptera	Elmidae	*Stenelmis*	3	shredder
D net	Indian Creek	Thorn Hill, TN	7/2/2018	Odonata	Gomphidae	*Progomphus*	1	burrower
D net	Indian Creek	Thorn Hill, TN	7/2/2018	Odonata	Gomphidae	*Gomphus*	1	burrower
D net	Indian Creek	Thorn Hill, TN	7/2/2018	Diptera	Athericidae	*Atherix*	2	piercer
K net	Indian Creek	Thorn Hill, TN	8/28/2018	Decapoda	Cambaridae	*Cambarus*	1	shredder
K net	Indian Creek	Thorn Hill, TN	8/28/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	19	grazer
K net	Indian Creek	Thorn Hill, TN	8/28/2018	Gastropoda (class)	Physidae	*Physa*	1	grazer
K net	Indian Creek	Thorn Hill, TN	8/28/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	2	scraper
K net	Indian Creek	Thorn Hill, TN	8/28/2018	Diptera	Athericidae	*Atherix*	4	piercer
K net	Indian Creek	Thorn Hill, TN	8/28/2018	Veneroida	Sphaeriidae		1	collector
K net	Indian Creek	Thorn Hill, TN	8/28/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	5	collector

K net	Indian Creek	Thorn Hill, TN	8/28/2018	Coleoptera	Elmidae	*Optioservus*	2	shredder
K net	Indian Creek	Thorn Hill, TN	8/28/2018	Hemiptera	Veliidae		1	N/A
K net	Indian Creek	Thorn Hill, TN	8/28/2018	Ephemeroptera	Isonychiidae	*Isonychia*	1	collector
K net	Indian Creek	Thorn Hill, TN	8/28/2018	Coleoptera	Elmidae	*Stenelmis*	1	shredder
K net	Indian Creek	Thorn Hill, TN	8/28/2018	Coleoptera	Psephenidae	*Psephenus*	1	scraper
D net	Indian Creek	Thorn Hill, TN	8/28/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	2	grazer
D net	Indian Creek	Thorn Hill, TN	8/28/2018	Veneroida	Cyrenidae	*Corbicula*	1	collector
K net	Big War Creek	Thorn Hill, TN	10/30/2017	Coleoptera	Elmidae	*Stenelmis*	2	shredder
K net	Big War Creek	Thorn Hill, TN	10/30/2017	Plecoptera	Perlidae	*Agnetina*	1	shredder
K net	Big War Creek	Thorn Hill, TN	10/30/2017	Trichoptera	Hydropsychidae	*Cheumatopsyche*	6	collector
K net	Big War Creek	Thorn Hill, TN	10/30/2017	Ephemeroptera	Isonychiidae	*Isonychia*	24	collector
K net	Big War Creek	Thorn Hill, TN	10/30/2017	Unionida	Unionidae	*Villosa*	1	collector
K net	Big War Creek	Thorn Hill, TN	10/30/2017	Trichoptera	Hydropsychidae	*Hydropsyche*	1	collector

K net	Big War Creek	Thorn Hill, TN	10/30/2017	Ephemeroptera	Heptageniidae	*Maccaffertium*	3	scraper
K net	Big War Creek	Thorn Hill, TN	10/30/2017	Plecoptera	Perlidae	*Neoperla*	1	shredder
K net	Big War Creek	Thorn Hill, TN	10/30/2017	Trichoptera	Philopotamidae	*Chimarra*	8	collector
K net	Big War Creek	Thorn Hill, TN	10/30/2017	Isopoda	Asellidae	*Lirceus*	1	collector
K net	Big War Creek	Thorn Hill, TN	10/30/2017	Megaloptera	Corydalidae	*Corydalus*	3	engulfer
K net	Big War Creek	Thorn Hill, TN	10/30/2017	Neotaenioglossa	Pleuroceridae	*Pleurocera*	6	grazer
K net	Big War Creek	Thorn Hill, TN	10/30/2017	Veneroida	Cyrenidae	*Corbicula*	2	collector
D net	Big War Creek	Thorn Hill, TN	10/30/2017	Neotaenioglossa	Pleuroceridae	*Pleurocera*	10	grazer
D net	Big War Creek	Thorn Hill, TN	10/30/2017	Coleoptera	Elmidae	*Optioservus*	2	shredder
D net	Big War Creek	Thorn Hill, TN	10/30/2017	Veneroida	Cyrenidae	*Corbicula*	2	collector
K net	Big War Creek	Thorn Hill, TN	2/1/2018	Ephemeroptera	Isonychiidae	*Isonychia*	39	collector
K net	Big War Creek	Thorn Hill, TN	2/1/2018	Diptera	Athericidae	*Atherix*	6	piercer
K net	Big War Creek	Thorn Hill, TN	2/1/2018	Megaloptera	Corydalidae	*Nigronia*	2	engulfer

K net	Big War Creek	Thorn Hill, TN	2/1/2018	Diptera	Simuliidae	*Simulium*	8	collector
K net	Big War Creek	Thorn Hill, TN	2/1/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	59	scraper
K net	Big War Creek	Thorn Hill, TN	2/1/2018	Plecoptera	Perlidae	*Acroneuria*	3	shredder
K net	Big War Creek	Thorn Hill, TN	2/1/2018	Megaloptera	Corydalidae	*Corydalus*	1	engulfer
K net	Big War Creek	Thorn Hill, TN	2/1/2018	Plecoptera	Taeniopterygidae	*Taeniopteryx*	17	shredder
K net	Big War Creek	Thorn Hill, TN	2/1/2018	Plecoptera	Taeniopterygidae	*Strophopteryx*	7	shredder
K net	Big War Creek	Thorn Hill, TN	2/1/2018	Ephemeroptera	Ephemerellidae	*Drunella*	2	collector
K net	Big War Creek	Thorn Hill, TN	2/1/2018	Coleoptera	Elmidae	*Stenelmis*	44	shredder
K net	Big War Creek	Thorn Hill, TN	2/1/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	45	collector
K net	Big War Creek	Thorn Hill, TN	2/1/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	1	collector
K net	Big War Creek	Thorn Hill, TN	2/1/2018	Trichoptera	Philopotamidae	*Chimarra*	15	collector
K net	Big War Creek	Thorn Hill, TN	2/1/2018	Trichoptera	Brachycentridae	*Micrasema*	3	collector
K net	Big War Creek	Thorn Hill, TN	2/1/2018	Unionida	Unionidae	*Villosa*	1	collector

D Net	Big War Creek	Thorn Hill, TN	2/1/2018	Plecoptera	Taeniopterygidae	*Taeniopteryx*	7	shredder
D Net	Big War Creek	Thorn Hill, TN	2/1/2018	Odonata	Cordulegastridae	*Cordulegaster*	1	burrower
D Net	Big War Creek	Thorn Hill, TN	2/1/2018	Plecoptera	Taeniopterygidae	*Strophopteryx*	11	shredder
D Net	Big War Creek	Thorn Hill, TN	2/1/2018	Ephemeroptera	Ephemerellidae	*Drunella*	2	collector
D Net	Big War Creek	Thorn Hill, TN	2/1/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	3	scraper
D Net	Big War Creek	Thorn Hill, TN	2/1/2018	Coleoptera	Elmidae	*Hexacylloepus*	1	shredder
D Net	Big War Creek	Thorn Hill, TN	2/1/2018	Coleoptera	Elmidae	*Stenelmis*	1	shredder
D Net	Big War Creek	Thorn Hill, TN	2/1/2018	Isopoda	Asellidae	*Lirceus*	7	collector
D Net	Big War Creek	Thorn Hill, TN	2/1/2018	Gastropoda (class)	Physidae	*Physella*	3	grazer
K Net	Big War Creek	Thorn Hill, TN	4/23/2018	Ephemeroptera	Ephemerellidae	*Ephemerella*	19	collector
K Net	Big War Creek	Thorn Hill, TN	4/23/2018	Ephemeroptera	Ephemerellidae	*Serratella*	3	collector
K Net	Big War Creek	Thorn Hill, TN	4/23/2018	Ephemeroptera	Baetidae	*Plauditus*	7	collector
K Net	Big War Creek	Thorn Hill, TN	4/23/2018	Ephemeroptera	Baetidae	*Baetis*	4	collector

K Net	Big War Creek	Thorn Hill, TN	4/23/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	22	collector
K Net	Big War Creek	Thorn Hill, TN	4/23/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	4	collector
K Net	Big War Creek	Thorn Hill, TN	4/23/2018	Trichoptera	Philopotamidae	*Chimarra*	10	collector
K Net	Big War Creek	Thorn Hill, TN	4/23/2018	Trichoptera	Brachycentridae	*Micrasema*	1	collector
K Net	Big War Creek	Thorn Hill, TN	4/23/2018	Plecoptera	Nemouridae	*Zapada*	6	shredder
K Net	Big War Creek	Thorn Hill, TN	4/23/2018	Plecoptera	Perlidae	*Neoperla*	1	shredder
K Net	Big War Creek	Thorn Hill, TN	4/23/2018	Plecoptera	Taeniopterygidae	*Strophopteryx*	4	shredder
K Net	Big War Creek	Thorn Hill, TN	4/23/2018	Oligochaeta (subclass)			3	collector
D net	Big War Creek	Thorn Hill, TN	4/23/2018	Odonata	Calopterygidae	*Calopteryx*	5	engulfer
D net	Big War Creek	Thorn Hill, TN	4/23/2018	Ephemeroptera	Ephemerellidae	*Ephemerella*	14	collector
D net	Big War Creek	Thorn Hill, TN	4/23/2018	Ephemeroptera	Baetidae	*Baetis*	24	collector
D net	Big War Creek	Thorn Hill, TN	4/23/2018	Ephemeroptera	Baetidae	*Callibaetis*	11	collector
D net	Big War Creek	Thorn Hill, TN	4/23/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	5	scraper

D net	Big War Creek	Thorn Hill, TN	4/23/2018	Plecoptera	Nemouridae	*Zapada*	5	shredder
D net	Big War Creek	Thorn Hill, TN	4/23/2018	Trichoptera	Limnephilidae	*Limnephilus*	2	collector
D net	Big War Creek	Thorn Hill, TN	4/23/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	2	collector
D net	Big War Creek	Thorn Hill, TN	4/23/2018	Plecoptera	Taeniopterygidae	*Strophopteryx*	2	shredder
D net	Big War Creek	Thorn Hill, TN	4/23/2018	Isopoda	Asellidae	*Lirceus*	4	collector
D net	Big War Creek	Thorn Hill, TN	4/23/2018	Diptera	Simuliidae	*Simulium*	1	collector
D net	Big War Creek	Thorn Hill, TN	4/23/2018	Coleoptera	Elmidae	*Stenelmis*	2	shredder
D net	Big War Creek	Thorn Hill, TN	4/23/2018	Odonata	Aeshnidae	*Boyeria*	1	engulfer
D net	Big War Creek	Thorn Hill, TN	4/23/2018	Odonata	Gomphidae	*Gomphus*	1	burrower
D net	Big War Creek	Thorn Hill, TN	4/23/2018	Ephemeroptera	Ephemerellidae	*Serratella*	3	collector
D net	Big War Creek	Thorn Hill, TN	4/23/2018	Plecoptera	Perlodidae	*Isoperla*	2	shredder
K net	Big War Creek	Thorn Hill, TN	5/4/2018	Coleoptera	Psephenidae	*Psephenus*	1	scraper
K net	Big War Creek	Thorn Hill, TN	5/4/2018	Decapoda	Cambaridae	*Orconectes*	1	shredder

K net	Big War Creek	Thorn Hill, TN	5/4/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	10	grazer
K net	Big War Creek	Thorn Hill, TN	5/4/2018	Ephemeroptera	Baetidae	*Baetis*	3	collector
K net	Big War Creek	Thorn Hill, TN	5/4/2018	Ephemeroptera	Ephemerellidae	*Serratella*	4	collector
K net	Big War Creek	Thorn Hill, TN	5/4/2018	Trichoptera	Philopotamidae	*Chimarra*	28	collector
K net	Big War Creek	Thorn Hill, TN	5/4/2018	Megaloptera	Corydalidae	*Nigronia*	2	engulfer
K net	Big War Creek	Thorn Hill, TN	5/4/2018	Megaloptera	Corydalidae	*Corydalus*	1	engulfer
K net	Big War Creek	Thorn Hill, TN	5/4/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	18	collector
K net	Big War Creek	Thorn Hill, TN	5/4/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	4	scraper
K net	Big War Creek	Thorn Hill, TN	5/4/2018	Ephemeroptera	Isonychiidae	*Isonychia*	10	collector
K net	Big War Creek	Thorn Hill, TN	5/4/2018	Plecoptera	Perlidae	*Acroneuria*	10	shredder
K net	Big War Creek	Thorn Hill, TN	5/4/2018	Plecoptera	Taeniopterygidae	*Taeniopteryx*	1	shredder
K net	Big War Creek	Thorn Hill, TN	5/4/2018	Coleoptera	Elmidae	*Stenelmis*	2	shredder
K net	Big War Creek	Thorn Hill, TN	5/4/2018	Plecoptera	Perlidae	*Neoperla*	1	shredder

D net	Big War Creek	Thorn Hill, TN	5/4/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	9	grazer
D net	Big War Creek	Thorn Hill, TN	5/4/2018	Ephemeroptera	Ephemerellidae	*Ephemerella*	2	collector
D net	Big War Creek	Thorn Hill, TN	5/4/2018	Ephemeroptera	Ephemerellidae	*Serratella*	2	collector
D net	Big War Creek	Thorn Hill, TN	5/4/2018	Coleoptera	Psephenidae	*Ectopria*	1	scraper
D net	Big War Creek	Thorn Hill, TN	5/4/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	1	scraper
D net	Big War Creek	Thorn Hill, TN	5/4/2018	Ephemeroptera	Baetidae	*Baetis*	8	collector
D net	Big War Creek	Thorn Hill, TN	5/4/2018	Coleoptera	Elmidae	*Stenelmis*	1	shredder
K net	Big War Creek	Thorn Hill, TN	7/2/2018	Decapoda	Cambaridae	*Cambarus*	1	shredder
K net	Big War Creek	Thorn Hill, TN	7/2/2018	Ephemeroptera	Baetidae	*Baetis*	1	collector
K net	Big War Creek	Thorn Hill, TN	7/2/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	8	collector
K net	Big War Creek	Thorn Hill, TN	7/2/2018	Veneroida	Cyrenidae	*Corbicula*	2	collector
K net	Big War Creek	Thorn Hill, TN	7/2/2018	Diptera	Stratiomyidae	*Stratiomys*	1	collector
K net	Big War Creek	Thorn Hill, TN	7/2/2018	Coleoptera	Elmidae	*Stenelmis*	5	shredder

K net	Big War Creek	Thorn Hill, TN	7/2/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	12	grazer
K net	Big War Creek	Thorn Hill, TN	7/2/2018	Diptera	Athericidae	*Atherix*	2	piercer
K net	Big War Creek	Thorn Hill, TN	7/2/2018	Coleoptera	Elmidae	*Stenelmis*	7	shredder
K net	Big War Creek	Thorn Hill, TN	7/2/2018	Ephemeroptera	Isonychiidae	*Isonychia*	1	collector
D net	Big War Creek	Thorn Hill, TN	7/2/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	9	grazer
D net	Big War Creek	Thorn Hill, TN	7/2/2018	Veneroida	Cyrenidae	*Corbicula*	3	collector
D net	Big War Creek	Thorn Hill, TN	7/2/2018	Coleoptera	Elmidae	*Stenelmis*	1	shredder
D net	Big War Creek	Thorn Hill, TN	7/2/2018	Diptera	Chironomidae	*Stempelinella*	1	collector
K net	Big War Creek	Thorn Hill, TN	8/29/2018	Coleoptera	Elmidae	*Stenelmis*	1	shredder
K net	Big War Creek	Thorn Hill, TN	8/29/2018	Trichoptera	Philopotamidae	*Chimarra*	1	collector
K net	Big War Creek	Thorn Hill, TN	8/29/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	18	grazer
K net	Big War Creek	Thorn Hill, TN	8/29/2018	Coleoptera	Elmidae	*Stenelmis*	3	shredder
K net	Big War Creek	Thorn Hill, TN	8/29/2018	Plecoptera	Perlidae	*Agnetina*	1	shredder

K net	Big War Creek	Thorn Hill, TN	8/29/2018	Ephemeroptera	Isonychiidae	*Isonychia*	10	collector
K net	Big War Creek	Thorn Hill, TN	8/29/2018	Veneroida	Sphaeriidae		3	collector
K net	Big War Creek	Thorn Hill, TN	8/29/2018	Veneroida	Cyrenidae	*Corbicula*	1	collector
K net	Big War Creek	Thorn Hill, TN	8/29/2018	Megaloptera	Corydalidae	*Nigronia*	1	engulfer
K net	Big War Creek	Thorn Hill, TN	8/29/2018	Odonata	Gomphidae	*Stylogomphus*	1	burrower
K net	Big War Creek	Thorn Hill, TN	8/29/2018	Diptera	Athericidae	*Atherix*	1	piercer
K net	Big War Creek	Thorn Hill, TN	8/29/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	11	collector
K net	Big War Creek	Thorn Hill, TN	8/29/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	3	scraper
D net	Big War Creek	Thorn Hill, TN	8/29/2018	Veneroida	Cyrenidae	*Corbicula*	1	collector
D net	Big War Creek	Thorn Hill, TN	8/29/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	15	grazer
D net	Big War Creek	Thorn Hill, TN	8/29/2018	Gastropoda (class)	Physidae	*Physa*	1	grazer
K Net	Williams Creek	Knoxville, TN	11/1/2017	Trichoptera	Hydropsychidae	*Hydropsyche*	33	collector
K Net	Williams Creek	Knoxville, TN	11/1/2017	Decapoda	Cambaridae	*Cambarus*	3	shredder

K Net	Williams Creek	Knoxville, TN	11/1/2017	Neotaenioglossa	Pleuroceridae	*Pleurocera*	7	grazer
K Net	Williams Creek	Knoxville, TN	11/1/2017	Ephemeroptera	Baetidae	*Baetis*	7	collector
K Net	Williams Creek	Knoxville, TN	11/1/2017	Hirudinea (subclass)			1	N/A
K Net	Williams Creek	Knoxville, TN	11/1/2017	Odonata	Calopterygidae	*Calopteryx*	18	engulfer
D Net	Williams Creek	Knoxville, TN	11/1/2017	Diptera	Tipulidae	*Leptotarsus*	1	shredder
D Net	Williams Creek	Knoxville, TN	11/1/2017	Diptera	Simuliidae	*Simulium*	6	collector
D Net	Williams Creek	Knoxville, TN	11/1/2017	Trichoptera	Hydropsychidae	*Cheumatopsyche*	1	collector
K Net	Williams Creek	Knoxville, TN	2/19/2018	Decapoda	Cambaridae	*Cambarus*	3	shredder
K Net	Williams Creek	Knoxville, TN	2/19/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	48	collector
K Net	Williams Creek	Knoxville, TN	2/19/2018	Diptera	Athericidae	*Atherix*	3	piercer
K Net	Williams Creek	Knoxville, TN	2/19/2018	Oligochaeta (subclass)			2	collector
K Net	Williams Creek	Knoxville, TN	2/19/2018	Diptera	Tipulidae	*Leptotarsus*	1	shredder
K Net	Williams Creek	Knoxville, TN	2/19/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	3	grazer

D Net	Williams Creek	Knoxville, TN	2/19/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	3	collector
D Net	Williams Creek	Knoxville, TN	2/19/2018	Coleoptera	Elmidae	*Stenelmis*	1	shredder
D Net	Williams Creek	Knoxville, TN	2/19/2018	Trichoptera	Philopotamidae	*Chimarra*	1	collector
D Net	Williams Creek	Knoxville, TN	2/19/2018	Odonata	Calopterygidae	*Calopteryx*	8	engulfer
D Net	Williams Creek	Knoxville, TN	2/19/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	16	grazer
D Net	Williams Creek	Knoxville, TN	2/19/2018	Veneroida	Cyrenidae	*Corbicula*	1	collector
D Net	Williams Creek	Knoxville, TN	2/19/2018	Isopoda	Asellidae	*Lirceus*	1	collector
D Net	Williams Creek	Knoxville, TN	2/19/2018	Diptera	Chironomidae	*Paratrichocladius*	1	collector
D Net	Williams Creek	Knoxville, TN	2/19/2018	Diptera	Chironomidae	*Orthocladius*	3	collector
D Net	Williams Creek	Knoxville, TN	2/19/2018	Diptera	Chironomidae	*Tribelos*	1	collector
D Net	Williams Creek	Knoxville, TN	2/19/2018	Diptera	Chironomidae	*Alotanypus*	1	collector
D Net	Williams Creek	Knoxville, TN	2/19/2018	Odonata	Aeshnidae	*Boyeria*	1	engulfer
K Net	Williams Creek	Knoxville, TN	4/3/2018	Decapoda	Cambaridae	*Cambarus*	2	shredder

K Net	Williams Creek	Knoxville, TN	4/3/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	4	grazer
K Net	Williams Creek	Knoxville, TN	4/3/2018	Coleoptera	Elmidae	*Stenelmis*	6	shredder
K Net	Williams Creek	Knoxville, TN	4/3/2018	Diptera	Athericidae	*Atherix*	5	piercer
K Net	Williams Creek	Knoxville, TN	4/3/2018	Ephemeroptera	Baetidae	*Baetis*	11	collector
K Net	Williams Creek	Knoxville, TN	4/3/2018	Diptera	Chironomidae	*Alotanypus*	3	collector
K Net	Williams Creek	Knoxville, TN	4/3/2018	Diptera	Chironomidae	*Orthocladius*	2	collector
K Net	Williams Creek	Knoxville, TN	4/3/2018	Diptera	Chironomidae	*Polypedilum*	2	collector
K Net	Williams Creek	Knoxville, TN	4/3/2018	Oligochaeta (subclass)			4	collector
K Net	Williams Creek	Knoxville, TN	4/3/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	11	collector
K Net	Williams Creek	Knoxville, TN	4/3/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	3	scraper
D Net	Williams Creek	Knoxville, TN	4/3/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	7	grazer
D Net	Williams Creek	Knoxville, TN	4/3/2018	Gastropoda (class)	Physidae	*Physa*	3	grazer
D Net	Williams Creek	Knoxville, TN	4/3/2018	Odonata	Calopterygidae	*Calopteryx*	5	engulfer

D Net	Williams Creek	Knoxville, TN	4/3/2018	Odonata	Aeshnidae	*Boyeria*	3	engulfer
K Net	Williams Creek	Knoxville, TN	5/22/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	4	grazer
K Net	Williams Creek	Knoxville, TN	5/22/2018	Coleoptera	Elmidae	*Stenelmis*	9	shredder
K Net	Williams Creek	Knoxville, TN	5/22/2018	Odonata	Calopterygidae	*Calopteryx*	1	engulfer
D Net	Williams Creek	Knoxville, TN	5/22/2018	Odonata	Coenagrionidae	*Argia*	1	engulfer
D Net	Williams Creek	Knoxville, TN	5/22/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	3	grazer
D Net	Williams Creek	Knoxville, TN	5/22/2018	Oligochaeta (subclass)			1	collector
D Net	Williams Creek	Knoxville, TN	5/22/2018	Gastropoda (class)	Physidae	*Physa*	2	grazer
D Net	Williams Creek	Knoxville, TN	5/22/2018	Veneroida	Cyrenidae	*Corbicula*	1	collector
D Net	Williams Creek	Knoxville, TN	5/22/2018	Odonata	Calopterygidae	*Calopteryx*	2	engulfer
D Net	Williams Creek	Knoxville, TN	5/22/2018	Coleoptera	Elmidae	*Stenelmis*	3	shredder
D Net	Williams Creek	Knoxville, TN	5/22/2018	Hirudinea (subclass)			2	N/A
D Net	Williams Creek	Knoxville, TN	5/22/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	4	collector

K Net	Williams Creek	Knoxville, TN	7/10/2018	Decapoda	Cambaridae	*Cambarus*	1	shredder
K Net	Williams Creek	Knoxville, TN	7/10/2018	Oligochaeta (subclass)			1	collector
K Net	Williams Creek	Knoxville, TN	7/10/2018	Coleoptera	Elmidae	*Stenelmis*	5	shredder
K Net	Williams Creek	Knoxville, TN	7/10/2018	Diptera	Tipulidae	*Tipula*	2	shredder
K Net	Williams Creek	Knoxville, TN	7/10/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	22	collector
K Net	Williams Creek	Knoxville, TN	7/10/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	9	grazer
K Net	Williams Creek	Knoxville, TN	7/10/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	3	scraper
K Net	Williams Creek	Knoxville, TN	7/10/2018	Diptera	Athericidae	*Atherix*	9	piercer
K Net	Williams Creek	Knoxville, TN	7/10/2018	Gastropoda (class)	Physidae	*Physa*	1	grazer
D Net	Williams Creek	Knoxville, TN	7/10/2018	Gastropoda (class)	Physidae	*Physa*	3	grazer
D Net	Williams Creek	Knoxville, TN	7/10/2018	Veneroida	Cyrenidae	*Corbicula*	1	collector
D Net	Williams Creek	Knoxville, TN	7/10/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	19	grazer
D Net	Williams Creek	Knoxville, TN	7/10/2018	Coleoptera	Elmidae	*Stenelmis*	2	shredder

K Net	Williams Creek	Knoxville, TN	10/3/2018	Decapoda	Cambaridae	*Cambarus*	1	shredder
K Net	Williams Creek	Knoxville, TN	10/3/2018	Trichoptera	Hydropsychidae	*Ceratopsyche*	10	collector
K Net	Williams Creek	Knoxville, TN	10/3/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	6	collector
K Net	Williams Creek	Knoxville, TN	10/3/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	9	collector
K Net	Williams Creek	Knoxville, TN	10/3/2018	Coleoptera	Elmidae	*Stenelmis*	1	shredder
K Net	Williams Creek	Knoxville, TN	10/3/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	9	grazer
K Net	Williams Creek	Knoxville, TN	10/3/2018	Diptera	Simuliidae	*Cnephia*	1	collector
D Net	Williams Creek	Knoxville, TN	10/3/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	12	grazer
D Net	Williams Creek	Knoxville, TN	10/3/2018	Coleoptera	Elmidae	*Stenelmis*	1	shredder
D Net	Williams Creek	Knoxville, TN	10/3/2018	Isopoda	Asellidae	*Lirceus*	1	collector
D Net	Williams Creek	Knoxville, TN	10/3/2018	Odonata	Coenagrionidae	*Argia*	4	engulfer
D Net	Williams Creek	Knoxville, TN	10/3/2018	Odonata	Calopterygidae	*Calopteryx*	13	engulfer
D Net	Williams Creek	Knoxville, TN	10/3/2018	Odonata	Aeshnidae	*Boyeria*	2	engulfer

D Net	Williams Creek	Knoxville, TN	10/3/2018	Gastropoda (class)	Physidae	*Physa*	1	grazer
K net	Baker Creek	Knoxville, TN	11/21/2017	Decapoda	Cambaridae	*Cambarus*	2	shredder
K net	Baker Creek	Knoxville, TN	11/21/2017	Diptera	Simuliidae	*Simulium*	11	collector
K net	Baker Creek	Knoxville, TN	11/21/2017	Diptera	Tipulidae	*Leptotarsus*	5	shredder
K net	Baker Creek	Knoxville, TN	11/21/2017	Coleoptera	Elmidae	*Stenelmis*	3	shredder
K net	Baker Creek	Knoxville, TN	11/21/2017	Trichoptera	Philopotamidae	*Chimarra*	11	collector
K net	Baker Creek	Knoxville, TN	11/21/2017	Odonata	Aeshnidae	*Boyeria*	1	engulfer
K net	Baker Creek	Knoxville, TN	11/21/2017	Neotaenioglossa	Pleuroceridae	*Pleurocera*	2	grazer
K net	Baker Creek	Knoxville, TN	11/21/2017	Odonata	Calopterygidae	*Calopteryx*	1	engulfer
K net	Baker Creek	Knoxville, TN	11/21/2017	Trichoptera	Hydropsychidae	*Cheumatopsyche*	13	collector
D net	Baker Creek	Knoxville, TN	11/21/2017	Odonata	Aeshnidae	*Boyeria*	5	engulfer
D net	Baker Creek	Knoxville, TN	11/21/2017	Diptera	Tipulidae	*Leptotarsus*	5	shredder
D net	Baker Creek	Knoxville, TN	11/21/2017	Neotaenioglossa	Pleuroceridae	*Pleurocera*	4	grazer
D net	Baker Creek	Knoxville, TN	11/21/2017	Coleoptera	Elmidae	*Stenelmis*	3	shredder
D net	Baker Creek	Knoxville, TN	11/21/2017	Odonata	Calopterygidae	*Calopteryx*	12	engulfer
K net	Baker Creek	Knoxville, TN	2/26/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	23	grazer
K net	Baker Creek	Knoxville, TN	2/26/2018	Diptera	Tipulidae	*Tipula*	4	shredder
K net	Baker Creek	Knoxville, TN	2/26/2018	Diptera	Athericidae	*Atherix*	3	piercer
K net	Baker Creek	Knoxville, TN	2/26/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	17	collector
K net	Baker Creek	Knoxville, TN	2/26/2018	Trichoptera	Philopotamidae	*Chimarra*	19	collector
K net	Baker Creek	Knoxville, TN	2/26/2018	Coleoptera	Elmidae	*Optioservus*	7	shredder
K net	Baker Creek	Knoxville, TN	2/26/2018	Odonata	Calopterygidae	*Calopteryx*	2	engulfer
K net	Baker Creek	Knoxville, TN	2/26/2018	Coleoptera	Elmidae	*Stenelmis*	22	shredder
K net	Baker Creek	Knoxville, TN	2/26/2018	Diptera	Simuliidae	*Simulium*	3	collector
D net	Baker Creek	Knoxville, TN	2/26/2018	Coleoptera	Elmidae	*Optioservus*	2	shredder

D net	Baker Creek	Knoxville, TN	2/26/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	1	grazer
D net	Baker Creek	Knoxville, TN	2/26/2018	Diptera	Chironomidae	*Nanocladius*	1	collector
D net	Baker Creek	Knoxville, TN	2/26/2018	Diptera	Chironomidae	*Xylotopus*	1	collector
D net	Baker Creek	Knoxville, TN	2/26/2018	Diptera	Chironomidae	*Polypedilum*	1	collector
D net	Baker Creek	Knoxville, TN	2/26/2018	Diptera	Chironomidae	*Phaenopsectra*	1	collector
D net	Baker Creek	Knoxville, TN	2/26/2018	Isopoda	Asellidae	*Lirceus*	1	collector
D net	Baker Creek	Knoxville, TN	2/26/2018	Odonata	Calopterygidae	*Calopteryx*	2	engulfer
D net	Baker Creek	Knoxville, TN	2/26/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	2	collector
D net	Baker Creek	Knoxville, TN	2/26/2018	Odonata	Aeshnidae	*Boyeria*	1	engulfer
K net	Baker Creek	Knoxville, TN	4/5/2018	Odonata	Aeshnidae	*Boyeria*	1	engulfer
K net	Baker Creek	Knoxville, TN	4/5/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	39	collector
K net	Baker Creek	Knoxville, TN	4/5/2018	Oligochaeta (subclass)			2	collector
K net	Baker Creek	Knoxville, TN	4/5/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	9	grazer
K net	Baker Creek	Knoxville, TN	4/5/2018	Coleoptera	Elmidae	*Macronychus*	1	shredder
K net	Baker Creek	Knoxville, TN	4/5/2018	Trichoptera	Philopotamidae	*Chimarra*	12	collector
K net	Baker Creek	Knoxville, TN	4/5/2018	Diptera	Athericidae	*Atherix*	1	piercer
K net	Baker Creek	Knoxville, TN	4/5/2018	Coleoptera	Elmidae	*Stenelmis*	4	shredder
D net	Baker Creek	Knoxville, TN	4/5/2018	Odonata	Calopterygidae	*Calopteryx*	6	engulfer
D net	Baker Creek	Knoxville, TN	4/5/2018	Odonata	Cordulegastridae	*Cordulegaster*	3	burrower
D net	Baker Creek	Knoxville, TN	4/5/2018	Odonata	Aeshnidae	*Boyeria*	4	engulfer
K net	Baker Creek	Knoxville, TN	5/15/2018	Coleoptera	Elmidae	*Stenelmis*	18	shredder
K net	Baker Creek	Knoxville, TN	5/15/2018	Diptera	Athericidae	*Atherix*	3	piercer
K net	Baker Creek	Knoxville, TN	5/15/2018	Diptera	Simuliidae	*Simulium*	5	collector
K net	Baker Creek	Knoxville, TN	5/15/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	34	collector
K net	Baker Creek	Knoxville, TN	5/15/2018	Trichoptera	Philopotamidae	*Chimarra*	7	collector

K net	Baker Creek	Knoxville, TN	5/15/2018	Odonata	Calopterygidae	*Calopteryx*	1	engulfer
K net	Baker Creek	Knoxville, TN	5/15/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	6	grazer
K net	Baker Creek	Knoxville, TN	5/15/2018	Coleoptera	Elmidae	*Optioservus*	3	shredder
D net	Baker Creek	Knoxville, TN	5/15/2018	Odonata	Coenagrionidae	*Argia*	1	engulfer
D net	Baker Creek	Knoxville, TN	5/15/2018	Coleoptera	Elmidae	*Stenelmis*	13	shredder
D net	Baker Creek	Knoxville, TN	5/15/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	4	grazer
D net	Baker Creek	Knoxville, TN	5/15/2018	Trichoptera	Phryganeidae	*Phryganea*	3	shredder
D net	Baker Creek	Knoxville, TN	5/15/2018	Coleoptera	Elmidae	*Optioservus*	1	shredder
D net	Baker Creek	Knoxville, TN	5/15/2018	Odonata	Calopterygidae	*Calopteryx*	1	engulfer
D net	Baker Creek	Knoxville, TN	5/15/2018	Odonata	Cordulegastridae	*Cordulegaster*	2	burrower
D net	Baker Creek	Knoxville, TN	5/15/2018	Oligochaeta (subclass)			1	collector
D net	Baker Creek	Knoxville, TN	5/15/2018	Coleoptera	Elmidae	*Macronychus*	3	shredder
K net	Baker Creek	Knoxville, TN	7/10/2018	Decapoda	Cambaridae	*Cambarus*	1	shredder
K net	Baker Creek	Knoxville, TN	7/10/2018	Coleoptera	Elmidae	*Optioservus*	5	shredder
K net	Baker Creek	Knoxville, TN	7/10/2018	Coleoptera	Elmidae	*Stenelmis*	21	shredder
K net	Baker Creek	Knoxville, TN	7/10/2018	Coleoptera	Elmidae	*Macronychus*	2	shredder
K net	Baker Creek	Knoxville, TN	7/10/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	5	grazer
K net	Baker Creek	Knoxville, TN	7/10/2018	Oligochaeta (subclass)			2	collector
K net	Baker Creek	Knoxville, TN	7/10/2018	Diptera	Tipulidae	*Tipula*	5	shredder
K net	Baker Creek	Knoxville, TN	7/10/2018	Odonata	Aeshnidae	*Boyeria*	1	engulfer
K net	Baker Creek	Knoxville, TN	7/10/2018	Megaloptera	Sialidae	*Sialis*	1	engulfer
K net	Baker Creek	Knoxville, TN	7/10/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	28	collector
D net	Baker Creek	Knoxville, TN	7/10/2018	Coleoptera	Elmidae	*Stenelmis*	1	shredder
D net	Baker Creek	Knoxville, TN	7/10/2018	Coleoptera	Elmidae	*Optioservus*	1	shredder

D net	Baker Creek	Knoxville, TN	7/10/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	28	grazer
D net	Baker Creek	Knoxville, TN	7/10/2018	Odonata	Coenagrionidae	*Argia*	1	engulfer
D net	Baker Creek	Knoxville, TN	7/10/2018	Odonata	Aeshnidae	*Boyeria*	1	engulfer
K net	Baker Creek	Knoxville, TN	10/3/2018	Trichoptera	Hydropsychidae	*Ceratopsyche*	5	collector
K net	Baker Creek	Knoxville, TN	10/3/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	1	scraper
K net	Baker Creek	Knoxville, TN	10/3/2018	Odonata	Calopterygidae	*Calopteryx*	2	engulfer
K net	Baker Creek	Knoxville, TN	10/3/2018	Diptera	Tipulidae	*Pseudolimnophila*	1	shredder
K net	Baker Creek	Knoxville, TN	10/3/2018	Diptera	Simuliidae	*Simulium*	1	collector
K net	Baker Creek	Knoxville, TN	10/3/2018	Coleoptera	Elmidae	*Macronychus*	30	shredder
K net	Baker Creek	Knoxville, TN	10/3/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	3	grazer
K net	Baker Creek	Knoxville, TN	10/3/2018	Oligochaeta (subclass)			1	collector
D net	Baker Creek	Knoxville, TN	10/3/2018	Decapoda	Cambaridae	*Cambarus*	1	shredder
D net	Baker Creek	Knoxville, TN	10/3/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	23	grazer
D net	Baker Creek	Knoxville, TN	10/3/2018	Coleoptera	Elmidae	*Macronychus*	1	shredder
D net	Baker Creek	Knoxville, TN	10/3/2018	Odonata	Calopterygidae	*Calopteryx*	3	engulfer
K net	Third Creek Imp	Knoxville, TN	11/14/2017	Trichoptera	Hydropsychidae	*Hydropsyche*	22	collector
K net	Third Creek Imp	Knoxville, TN	11/14/2017	Diptera	Simuliidae	*Simulium*	11	collector
K net	Third Creek Imp	Knoxville, TN	11/14/2017	Trichoptera	Philopotamidae	*Chimarra*	19	collector
K net	Third Creek Imp	Knoxville, TN	11/14/2017	Diptera	Chironomidae	*Polypedilum*	1	collector
K net	Third Creek Imp	Knoxville, TN	11/14/2017	Coleoptera	Elmidae	*Stenelmis*	4	shredder

K net	Third Creek Imp	Knoxville, TN	11/14/2017	Neotaenioglossa	Pleuroceridae	*Pleurocera*	7	grazer
K net	Third Creek Imp	Knoxville, TN	11/14/2017	Ephemeroptera	Heptageniidae	*Maccaffertium*	8	scraper
K net	Third Creek Imp	Knoxville, TN	11/14/2017	Ephemeroptera	Baetidae	*Baetis*	1	collector
D net	Third Creek Imp	Knoxville, TN	11/14/2017	Odonata	Aeshnidae	*Boyeria*	3	engulfer
D net	Third Creek Imp	Knoxville, TN	11/14/2017	Diptera	Tipulidae	*Leptotarus*	1	shredder
D net	Third Creek Imp	Knoxville, TN	11/14/2017	Neotaenioglossa	Pleuroceridae	*Pleurocera*	11	grazer
D net	Third Creek Imp	Knoxville, TN	11/14/2017	Decapoda	Cambaridae	*Cambarus*	2	shredder
D net	Third Creek Imp	Knoxville, TN	11/14/2017	Veneroida	Cyrenidae	*Corbicula*	1	collector
D net	Third Creek Imp	Knoxville, TN	11/14/2017	Odonata	Calopterygidae	*Calopteryx*	8	engulfer
K net	Third Creek Imp	Knoxville, TN	2/6/2018	Diptera	Tipulidae	*Leptotarsus*	4	shredder
K net	Third Creek Imp	Knoxville, TN	2/6/2018	Isopoda	Asellidae	*Lirceus*	10	collector
K net	Third Creek Imp	Knoxville, TN	2/6/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	19	grazer
K net	Third Creek Imp	Knoxville, TN	2/6/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	23	collector

K net	Third Creek Imp	Knoxville, TN	2/6/2018	Diptera	Simuliidae	*Simulium*	7	collector
K net	Third Creek Imp	Knoxville, TN	2/6/2018	Coleoptera	Emidae	*Optioservus*	2	shredder
K net	Third Creek Imp	Knoxville, TN	2/6/2018	Oligochaeta (subclass)			1	collector
K net	Third Creek Imp	Knoxville, TN	2/6/2018	Trichoptera	Philopotamidae	*Chimarra*	13	collector
K net	Third Creek Imp	Knoxville, TN	2/6/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	14	scraper
D net	Third Creek Imp	Knoxville, TN	2/6/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	1	collector
D net	Third Creek Imp	Knoxville, TN	2/6/2018	Diptera	Tipulidae	*Leptotarsus*	1	shredder
D net	Third Creek Imp	Knoxville, TN	2/6/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	1	scraper
D net	Third Creek Imp	Knoxville, TN	2/6/2018	Coleoptera	Elmidae	*Stenelmis*	1	shredder
D net	Third Creek Imp	Knoxville, TN	2/6/2018	Odonata	Calopterygidae	*Calopteryx*	1	engulfer
D net	Third Creek Imp	Knoxville, TN	2/6/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	3	grazer
D net	Third Creek Imp	Knoxville, TN	2/6/2018	Isopoda	Asellidae	*Lirceus*	2	collector
D net	Third Creek Imp	Knoxville, TN	2/6/2018	Diptera	Chironomidae	*Microtendipes*	1	collector

D net	Third Creek Imp	Knoxville, TN	2/6/2018	Ephemeroptera	Ephemerellidae	*Ephemerella*	1	collector
D net	Third Creek Imp	Knoxville, TN	2/6/2018	Oligochaeta (subclass)			3	collector
K net	Third Creek Imp	Knoxville, TN	4/10/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	3	scraper
K net	Third Creek Imp	Knoxville, TN	4/10/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	8	collector
K net	Third Creek Imp	Knoxville, TN	4/10/2018	Diptera	Athericidae	*Atherix*	1	piercer
K net	Third Creek Imp	Knoxville, TN	4/10/2018	Trichoptera	Philopotamidae	*Chimarra*	3	collector
K net	Third Creek Imp	Knoxville, TN	4/10/2018	Isopoda	Asellidae	*Lirceus*	5	collector
K net	Third Creek Imp	Knoxville, TN	4/10/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	19	grazer
D net	Third Creek Imp	Knoxville, TN	4/10/2018	Ephemeroptera	Baetidae	*Baetis*	2	collector
D net	Third Creek Imp	Knoxville, TN	4/10/2018	Odonata	Calopterygidae	*Calopteryx*	3	engulfer
D net	Third Creek Imp	Knoxville, TN	4/10/2018	Odonata	Coenagrionidae	*Argia*	1	engulfer
D net	Third Creek Imp	Knoxville, TN	4/10/2018	Diptera	Tipulidae	*Tipula*	1	shredder
D net	Third Creek Imp	Knoxville, TN	4/10/2018	Ephemeroptera	Ephemerellidae	*Ephemerella*	2	collector

D net	Third Creek Imp	Knoxville, TN	4/10/2018	Coleoptera	Elmidae	*Stenelmis*	2	shredder
D net	Third Creek Imp	Knoxville, TN	4/10/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	4	grazer
K net	Third Creek Imp	Knoxville, TN	5/8/2018	Diptera	Tipulidae	*Tipula*	1	shredder
K net	Third Creek Imp	Knoxville, TN	5/8/2018	Isopoda	Asellidae	*Lirceus*	9	collector
K net	Third Creek Imp	Knoxville, TN	5/8/2018	Diptera	Simuliidae	*Simulium*	6	collector
K net	Third Creek Imp	Knoxville, TN	5/8/2018	Diptera	Athericidae	*Atherix*	3	piercer
K net	Third Creek Imp	Knoxville, TN	5/8/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	13	collector
K net	Third Creek Imp	Knoxville, TN	5/8/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	1	scraper
K net	Third Creek Imp	Knoxville, TN	5/8/2018	Coleoptera	Elmidae	*Stenelmis*	6	shredder
K net	Third Creek Imp	Knoxville, TN	5/8/2018	Odonata	Calopterygidae	*Calopteryx*	1	engulfer
K net	Third Creek Imp	Knoxville, TN	5/8/2018	Veneroida	Cyrenidae	*Corbicula*	2	collector
K net	Third Creek Imp	Knoxville, TN	5/8/2018	Diptera	Chironomidae	*Alotanypus*	4	collector
K net	Third Creek Imp	Knoxville, TN	5/8/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	13	collector

D net	Third Creek Imp	Knoxville, TN	5/8/2018	Diptera	Chironomidae	*Polypedilum*	2	collector
D net	Third Creek Imp	Knoxville, TN	5/8/2018	Diptera	Chironomidae	*Xylotopus*	1	collector
D net	Third Creek Imp	Knoxville, TN	5/8/2018	Diptera	Chironomidae	*Stictochironomus*	5	collector
D net	Third Creek Imp	Knoxville, TN	5/8/2018	Trichoptera	Phryganeidae	*Phryganea*	6	shredder
D net	Third Creek Imp	Knoxville, TN	5/8/2018	Isopoda	Asellidae	*Lirceus*	5	collector
D net	Third Creek Imp	Knoxville, TN	5/8/2018	Veneroida	Cyrenidae	*Corbicula*	1	collector
D net	Third Creek Imp	Knoxville, TN	5/8/2018	Coleoptera	Elmidae	*Stenelmis*	9	shredder
D net	Third Creek Imp	Knoxville, TN	5/8/2018	Ephemeroptera	Ephemerellidae	*Ephemerella*	2	collector
D net	Third Creek Imp	Knoxville, TN	5/8/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	8	grazer
D net	Third Creek Imp	Knoxville, TN	5/8/2018	Odonata	Calopterygidae	*Calopteryx*	2	engulfer
K net	Third Creek Imp	Knoxville, TN	7/8/2018	Diptera	Tipulidae	*Tipula*	5	shredder
K net	Third Creek Imp	Knoxville, TN	7/8/2018	Veneroida	Cyrenidae	*Corbicula*	1	collector
K net	Third Creek Imp	Knoxville, TN	7/8/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	2	collector

K net	Third Creek Imp	Knoxville, TN	7/8/2018	Ephemeroptera	Baetidae	*Baetis*	1	collector
K net	Third Creek Imp	Knoxville, TN	7/8/2018	Coleoptera	Elmidae	*Stenelmis*	3	shredder
K net	Third Creek Imp	Knoxville, TN	7/8/2018	Isopoda	Asellidae	*Lirceus*	1	collector
K net	Third Creek Imp	Knoxville, TN	7/8/2018	Diptera	Chironomidae	*Polypedilum*	1	collector
K net	Third Creek Imp	Knoxville, TN	7/8/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	6	grazer
D net	Third Creek Imp	Knoxville, TN	7/8/2018	Veneroida	Cyrenidae	*Corbicula*	1	collector
D net	Third Creek Imp	Knoxville, TN	7/8/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	8	grazer
D net	Third Creek Imp	Knoxville, TN	7/8/2018	Diptera	Chironomidae	*Microtendipes*	3	collector
D net	Third Creek Imp	Knoxville, TN	7/8/2018	Diptera	Chironomidae	*Tribelos*	1	collector
K net	Third Creek Imp	Knoxville, TN	9/24/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	1	grazer
K net	Third Creek Imp	Knoxville, TN	9/24/2018	Odonata	Calopterygidae	*Calopteryx*	1	engulfer
K net	Third Creek Imp	Knoxville, TN	9/24/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	4	collector
K net	Third Creek Imp	Knoxville, TN	9/24/2018	Hemiptera	Veliidae	*Rhagovelia*	4	N/A

K net	Third Creek Imp	Knoxville, TN	9/24/2018	Coleoptera	Elmidae	*Optioservus*	3	shredder
K net	Third Creek Imp	Knoxville, TN	9/24/2018	Coleoptera	Elmidae	*Macronychus*	4	shredder
K net	Third Creek Imp	Knoxville, TN	9/24/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	1	collector
K net	Third Creek Imp	Knoxville, TN	9/24/2018	Trichoptera	Philopotamidae	*Chimarra*	2	collector
K net	Third Creek Imp	Knoxville, TN	9/24/2018	Isopoda	Asellidae	*Lirceus*	1	collector
K net	Third Creek Imp	Knoxville, TN	9/24/2018	Diptera	Tipulidae	*Tipula*	2	shredder
D net	Third Creek Imp	Knoxville, TN	9/24/2018	Coleoptera	Elmidae	*Stenelmis*	4	shredder
D net	Third Creek Imp	Knoxville, TN	9/24/2018	Odonata	Calopterygidae	*Calopteryx*	4	engulfer
D net	Third Creek Imp	Knoxville, TN	9/24/2018	Odonata	Aeshnidae	*Boyeria*	2	engulfer
D net	Third Creek Imp	Knoxville, TN	9/24/2018	Veneroida	Sphaeriidae		1	collector
D net	Third Creek Imp	Knoxville, TN	9/24/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	13	grazer
D net	Third Creek Imp	Knoxville, TN	9/24/2018	Decapoda	Cambaridae	*Cambarus*	1	shredder
D net	Third Creek Imp	Knoxville, TN	9/24/2018	Isopoda	Asellidae	*Lirceus*	1	collector

K net	Dry Creek	Cleveland, TN	8/10/2018	Veneroida	Sphaeriidae		1	collector
K net	Dry Creek	Cleveland, TN	8/10/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	10	collector
K net	Dry Creek	Cleveland, TN	8/10/2018	Plecoptera	Perlidae	*Acroneuria*	1	shredder
K net	Dry Creek	Cleveland, TN	8/10/2018	Ephemeroptera	Isonychiidae	*Isonychia*	5	collector
K net	Dry Creek	Cleveland, TN	8/10/2018	Diptera	Tipulidae	*Tipula*	1	shredder
K net	Dry Creek	Cleveland, TN	8/10/2018	Coleoptera	Elmidae	*Stenelmis*	2	shredder
K net	Dry Creek	Cleveland, TN	8/10/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	12	scraper
K net	Dry Creek	Cleveland, TN	8/10/2018	Coleoptera	Psephenidae	*Psephenus*	1	scraper
K net	Dry Creek	Cleveland, TN	8/10/2018	Coleoptera	Elmidae	*Stenelmis*	7	shredder
D net	Dry Creek	Cleveland, TN	8/10/2018	Decapoda	Cambaridae	*Orconectes*	2	shredder
D net	Dry Creek	Cleveland, TN	8/10/2018	Odonata	Calopterygidae	*Calopteryx*	2	engulfer
D net	Dry Creek	Cleveland, TN	8/10/2018	Isopoda	Asellidae	*Lirceus*	2	collector
D net	Dry Creek	Cleveland, TN	8/10/2018	Odonata	Macromiidae	*Macromia*	1	engulfer
D net	Dry Creek	Cleveland, TN	8/10/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	1	scraper
D net	Dry Creek	Cleveland, TN	8/10/2018	Trichoptera	Leptoceridae	*Triaenodes*	2	collector
D net	Dry Creek	Cleveland, TN	8/10/2018	Veneroida	Sphaeriidae		1	collector
K net	Dry Creek	Cleveland, TN	10/19/2018	Decapoda	Cambaridae	*Cambarus*	1	shredder
K net	Dry Creek	Cleveland, TN	10/19/2018	Trichoptera	Philopotamidae	*Chimarra*	9	collector
K net	Dry Creek	Cleveland, TN	10/19/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	1	scraper
K net	Dry Creek	Cleveland, TN	10/19/2018	Diptera	Tipulidae	*Tipula*	3	shredder
K net	Dry Creek	Cleveland, TN	10/19/2018	Megaloptera	Corydalidae	*Corydalus*	1	engulfer
K net	Dry Creek	Cleveland, TN	10/19/2018	Plecoptera	Perlidae	*Eccoptura*	1	shredder
K net	Dry Creek	Cleveland, TN	10/19/2018	Isopoda	Asellidae	*Lirceus*	2	collector
K net	Dry Creek	Cleveland, TN	10/19/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	4	collector
K net	Dry Creek	Cleveland, TN	10/19/2018	Ephemeroptera	Isonychiidae	*Isonychia*	2	collector
D net	Dry Creek	Cleveland, TN	10/19/2018	Veneroida	Cyrenidae	*Corbicula*	1	collector

D net	Dry Creek	Cleveland, TN	10/19/2018	Odonata	Calopterygidae	*Calopteryx*	10	engulfer
D net	Dry Creek	Cleveland, TN	10/19/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	1	scraper
D net	Dry Creek	Cleveland, TN	10/19/2018	Odonata	Coenagrionidae	*Argia*	1	engulfer
K net	Friar Branch Imp	Chattanooga, TN	7/27/2018	Odonata	Gomphidae	*Hagenius*	1	burrower
K net	Friar Branch Imp	Chattanooga, TN	7/27/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	7	grazer
K net	Friar Branch Imp	Chattanooga, TN	7/27/2018	Gastropoda (class)	Physidae	*Physa*	3	grazer
K net	Friar Branch Imp	Chattanooga, TN	7/27/2018	Ephemeroptera	Caenidae	*Caenis*	1	collector
K net	Friar Branch Imp	Chattanooga, TN	7/27/2018	Coleoptera	Elmidae	*Stenelmis*	3	shredder
K net	Friar Branch Imp	Chattanooga, TN	7/27/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	1	scraper
K net	Friar Branch Imp	Chattanooga, TN	7/27/2018	Diptera	Chironomidae	*Procladius*	1	collector
K net	Friar Branch Imp	Chattanooga, TN	7/27/2018	Diptera	Chironomidae	*Microtendipes*	2	collector
K net	Friar Branch Imp	Chattanooga, TN	7/27/2018	Diptera	Chironomidae	*Thienemannimyia*	1	collector
K net	Friar Branch Imp	Chattanooga, TN	7/27/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	1	collector
K net	Friar Branch Imp	Chattanooga, TN	7/27/2018	Decapoda	Cambaridae	*Orconectes*	1	shredder

D net	Friar Branch Imp	Chattanooga, TN	7/27/2018	Veneroida	Cyrenidae	*Corbicula*	2	collector
D net	Friar Branch Imp	Chattanooga, TN	7/27/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	10	grazer
K net	Friar Branch Imp	Chattanooga, TN	10/31/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	18	grazer
K net	Friar Branch Imp	Chattanooga, TN	10/31/2018	Veneroida	Cyrenidae	*Corbicula*	1	collector
K net	Friar Branch Imp	Chattanooga, TN	10/31/2018	Veneroida	Sphaeriidae		6	collector
K net	Friar Branch Imp	Chattanooga, TN	10/31/2018	Ephemeroptera	Baetidae	*Baetis*	3	collector
K net	Friar Branch Imp	Chattanooga, TN	10/31/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	6	collector
K net	Friar Branch Imp	Chattanooga, TN	10/31/2018	Megaloptera	Sialidae	*Sialis*	1	engulfer
K net	Friar Branch Imp	Chattanooga, TN	10/31/2018	Trichoptera	Philopotamidae	*Chimarra*	7	collector
K net	Friar Branch Imp	Chattanooga, TN	10/31/2018	Odonata	Calopterygidae	*Calopteryx*	1	engulfer
K net	Friar Branch Imp	Chattanooga, TN	10/31/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	1	scraper
K net	Friar Branch Imp	Chattanooga, TN	10/31/2018	Odonata	Gomphidae	*Stylurus*	1	burrower
K net	Friar Branch Imp	Chattanooga, TN	10/31/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	17	collector

D net	Friar Branch Imp	Chattanooga, TN	10/31/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	46	grazer
D net	Friar Branch Imp	Chattanooga, TN	10/31/2018	Veneroida	Cyrenidae	*Corbicula*	2	collector
D net	Friar Branch Imp	Chattanooga, TN	10/31/2018	Oligochaeta (subclass)			3	collector
D net	Friar Branch Imp	Chattanooga, TN	10/31/2018	Gastropoda (class)	Physidae	*Physa*	4	grazer
D net	Friar Branch Imp	Chattanooga, TN	10/31/2018	Odonata	Calopterygidae	*Calopteryx*	4	engulfer
K net	Friar Branch Rest	Chattanooga, TN	7/27/2018	Coleoptera	Elmidae	*Stenelmis*	1	shredder
K net	Friar Branch Rest	Chattanooga, TN	7/27/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	3	grazer
K net	Friar Branch Rest	Chattanooga, TN	7/27/2018	Ephemeroptera	Caenidae	*Caenis*	1	collector
K net	Friar Branch Rest	Chattanooga, TN	7/27/2018	Ephemeroptera	Baetidae	*Baetis*	1	collector
K net	Friar Branch Rest	Chattanooga, TN	7/27/2018	Diptera	Chironomidae	*Chironomus*	2	collector
K net	Friar Branch Rest	Chattanooga, TN	7/27/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	1	scraper
D net	Friar Branch Rest	Chattanooga, TN	7/27/2018	Veneroida	Cyrenidae	*Corbicula*	3	collector
D net	Friar Branch Rest	Chattanooga, TN	7/27/2018	Decapoda	Cambaridae	*Orconectes*	1	shredder

D net	Friar Branch Rest	Chattanooga, TN	7/27/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	9	grazer
K net	Friar Branch Rest	Chattanooga, TN	10/31/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	2	grazer
K net	Friar Branch Rest	Chattanooga, TN	10/31/2018	Unionoidae	Lasmigona (genus)	*holstonia (species)*	1	collector
K net	Friar Branch Rest	Chattanooga, TN	10/31/2018	Trichoptera	Philopotamidae	*Chimarra*	1	collector
K net	Friar Branch Rest	Chattanooga, TN	10/31/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	14	collector
K net	Friar Branch Rest	Chattanooga, TN	10/31/2018	Diptera	Chironomidae	*Conchapelopia*	1	collector
K net	Friar Branch Rest	Chattanooga, TN	10/31/2018	Diptera	Chironomidae	*Ablabesmyia*	1	collector
K net	Friar Branch Rest	Chattanooga, TN	10/31/2018	Odonata	Coenagrionidae	*Argia*	2	engulfer
K net	Friar Branch Rest	Chattanooga, TN	10/31/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	3	collector
D net	Friar Branch Rest	Chattanooga, TN	10/31/2018	Veneroida	Cyrenidae	*Corbicula*	1	collector
D net	Friar Branch Rest	Chattanooga, TN	10/31/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	6	grazer
D net	Friar Branch Rest	Chattanooga, TN	10/31/2018	Veneroida	Hydropsychidae	*Hydropsyche*	1	collector
D net	Friar Branch Rest	Chattanooga, TN	10/31/2018	Odonata	Calopterygidae	*Calopteryx*	1	engulfer

D net	Friar Branch Rest	Chattanooga, TN	10/31/2018	Coleoptera	Elmidae	*Stenelmis*	1	shredder
D net	Friar Branch Rest	Chattanooga, TN	10/31/2018	Odonata	Coenagrionidae	*Argia*	1	engulfer
D net	Friar Branch Rest	Chattanooga, TN	10/31/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	1	scraper
K net*	Third Creek Rest	Knoxville, TN	11/9/2017	Veneroida	Cyrenidae	*Corbicula*	6	collector
K net*	Third Creek Rest	Knoxville, TN	11/9/2017	Ephemeroptera	Baetidae	*Baetis*	3	collector
K net*	Third Creek Rest	Knoxville, TN	11/9/2017	Neotaenioglossa	Pleuroceridae	*Pleurocera*	24	grazer
K net*	Third Creek Rest	Knoxville, TN	11/9/2017	Odonata	Aeshnidae	*Boyeria*	4	engulfer
K net*	Third Creek Rest	Knoxville, TN	11/9/2017	Trichoptera	Leptoceridae	*Triaenodes*	3	collector
K net*	Third Creek Rest	Knoxville, TN	11/9/2017	Trichoptera	Philopotamidae	*Chimarra*	1	collector
K net*	Third Creek Rest	Knoxville, TN	11/9/2017	Odonata	Calopterygidae	*Calopteryx*	25	engulfer
K net*	Third Creek Rest	Knoxville, TN	11/9/2017	Trichoptera	Hydropsychidae	*Diplectrona*	7	collector
K net*	Third Creek Rest	Knoxville, TN	11/9/2017	Coleoptera	Elmidae	*Stenelmis*	1	shredder
K net*	Third Creek Rest	Knoxville, TN	11/9/2017	Ephemeroptera	Heptageniidae	*Maccaffertium*	6	scraper

K net	Third Creek Rest	Knoxville, TN	3/5/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	17	grazer
K net	Third Creek Rest	Knoxville, TN	3/5/2018	Diptera	Athericidae	*Atherix*	3	piercer
K net	Third Creek Rest	Knoxville, TN	3/5/2018	Veneroida	Cyrenidae	*Corbicula*	6	collector
K net	Third Creek Rest	Knoxville, TN	3/5/2018	Oligochaeta (subclass)			1	collector
K net	Third Creek Rest	Knoxville, TN	3/5/2018	Isopoda	Asellidae	*Lirceus*	7	collector
K net	Third Creek Rest	Knoxville, TN	3/5/2018	Decapoda	Cambaridae	*Cambarus*	2	shredder
K net	Third Creek Rest	Knoxville, TN	3/5/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	21	scraper
K net	Third Creek Rest	Knoxville, TN	3/5/2018	Platyhelminthes (Phylum)			1	collector
K net	Third Creek Rest	Knoxville, TN	3/5/2018	Ephemeroptera	Baetidae	*Baetis*	2	collector
K net	Third Creek Rest	Knoxville, TN	3/5/2018	Odonata	Calopterygidae	*Calopteryx*	3	engulfer
K net	Third Creek Rest	Knoxville, TN	3/5/2018	Trichoptera	Hydropsychidae	*Cheumatopyche*	12	collector
K net	Third Creek Rest	Knoxville, TN	3/5/2018	Trichoptera	Philopotamidae	*Wormaldia*	1	collector
D net	Third Creek Rest	Knoxville, TN	3/5/2018	Oligochaeta (subclass)			1	collector

D net	Third Creek Rest	Knoxville, TN	3/5/2018	Ephemeroptera	Baetidae	*Baetis*	2	collector
D net	Third Creek Rest	Knoxville, TN	3/5/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	3	collector
D net	Third Creek Rest	Knoxville, TN	3/5/2018	Isopoda	Asellidae	*Lirceus*	3	collector
D net	Third Creek Rest	Knoxville, TN	3/5/2018	Ephemeroptera	Ephemerellidae	*Serratella*	3	collector
D net	Third Creek Rest	Knoxville, TN	3/5/2018	Gastropoda (class)	Physidae	*Physa*	2	grazer
D net	Third Creek Rest	Knoxville, TN	3/5/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	4	grazer
D net	Third Creek Rest	Knoxville, TN	3/5/2018	Odonata	Calopterygidae	*Calopteryx*	6	engulfer
D net	Third Creek Rest	Knoxville, TN	3/5/2018	Odonata	Aeshnidae	*Boyeria*	1	engulfer
K net	Third Creek Rest	Knoxville, TN	4/12/2018	Veneroida	Cyrenidae	*Corbicula*	4	collector
K net	Third Creek Rest	Knoxville, TN	4/12/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	11	scraper
K net	Third Creek Rest	Knoxville, TN	4/12/2018	Odonata	Calopterygidae	*Calopteryx*	1	engulfer
K net	Third Creek Rest	Knoxville, TN	4/12/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	18	collector
K net	Third Creek Rest	Knoxville, TN	4/12/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	14	grazer

K net	Third Creek Rest	Knoxville, TN	4/12/2018	Trichoptera	Philopotamidae	*Chimarra*	1	collector
K net	Third Creek Rest	Knoxville, TN	4/12/2018	Ephemeroptera	Baetidae	*Baetis*	5	collector
K net	Third Creek Rest	Knoxville, TN	4/12/2018	Oligochaeta (subclass)			2	collector
D net	Third Creek Rest	Knoxville, TN	4/12/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	62	grazer
D net	Third Creek Rest	Knoxville, TN	4/12/2018	Gastropoda (class)	Physidae	*Physa*	1	grazer
D net	Third Creek Rest	Knoxville, TN	4/12/2018	Ephemeroptera	Ephemerellidae	*Serratella*	1	collector
D net	Third Creek Rest	Knoxville, TN	4/12/2018	Isopoda	Asellidae	*Lirceus*	5	collector
D net	Third Creek Rest	Knoxville, TN	4/12/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	1	collector
D net	Third Creek Rest	Knoxville, TN	4/12/2018	Odonata	Calopterygidae	*Calopteryx*	1	engulfer
D net	Third Creek Rest	Knoxville, TN	4/12/2018	Ephemeroptera	Baetidae	*Baetis*	8	collector
K net	Third Creek Rest	Knoxville, TN	5/29/2018	Veneroida	Cyrenidae	*Corbicula*	2	collector
K net	Third Creek Rest	Knoxville, TN	5/29/2018	Isopoda	Asellidae	*Lirceus*	1	collector
K net	Third Creek Rest	Knoxville, TN	5/29/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	11	collector

K net	Third Creek Rest	Knoxville, TN	5/29/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	11	grazer
K net	Third Creek Rest	Knoxville, TN	5/29/2018	Veneroida	Cambaridae	*Cambarus*	1	shredder
K net	Third Creek Rest	Knoxville, TN	5/29/2018	Diptera	Athericidae	*Atherix*	1	piercer
K net	Third Creek Rest	Knoxville, TN	5/29/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	5	scraper
K net	Third Creek Rest	Knoxville, TN	5/29/2018	Coleoptera	Elmidae	*Stenelmis*	1	shredder
K net	Third Creek Rest	Knoxville, TN	5/29/2018	Odonata	Aeshnidae	*Boyeria*	1	engulfer
D net	Third Creek Rest	Knoxville, TN	5/29/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	2	grazer
D net	Third Creek Rest	Knoxville, TN	5/29/2018	Gastropoda (class)	Physidae	*Physa*	2	grazer
D net	Third Creek Rest	Knoxville, TN	5/29/2018	Oligochaeta (subclass)			1	collector
D net	Third Creek Rest	Knoxville, TN	5/29/2018	Diptera	Chironomidae	*Polypedilum*	1	collector
K net	Third Creek Rest	Knoxville, TN	7/5/2018	Odonata	Aeshnidae	*Boyeria*	1	engulfer
K net	Third Creek Rest	Knoxville, TN	7/5/2018	Diptera	Tipulidae	*Tipula*	1	shredder
K net	Third Creek Rest	Knoxville, TN	7/5/2018	Veneroida	Cyrenidae	*Corbicula*	5	collector

K net	Third Creek Rest	Knoxville, TN	7/5/2018	Decapoda	Cambaridae	*Cambarus*	1	shredder
K net	Third Creek Rest	Knoxville, TN	7/5/2018	Oligochaeta (subclass)			5	collector
K net	Third Creek Rest	Knoxville, TN	7/5/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	15	grazer
K net	Third Creek Rest	Knoxville, TN	7/5/2018	Coleoptera	Elmidae	*Stenelmis*	2	shredder
K net	Third Creek Rest	Knoxville, TN	7/5/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	14	collector
D net	Third Creek Rest	Knoxville, TN	7/5/2018	Isopoda	Asellidae	*Lirceus*	1	collector
D net	Third Creek Rest	Knoxville, TN	7/5/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	39	grazer
K net	Third Creek Rest	Knoxville, TN	9/24/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	36	grazer
K net	Third Creek Rest	Knoxville, TN	9/24/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	3	collector
K net	Third Creek Rest	Knoxville, TN	9/24/2018	Veneroida	Cyrenidae	*Corbicula*	7	collector
K net	Third Creek Rest	Knoxville, TN	9/24/2018	Ephemeroptera	Heptageniidae	*Stenonema*	1	collector
K net	Third Creek Rest	Knoxville, TN	9/24/2018	Oligochaeta (subclass)			2	collector
K net	Third Creek Rest	Knoxville, TN	9/24/2018	Trichoptera	Philopotamidae	*Chimarra*	1	collector

K net	Third Creek Rest	Knoxville, TN	9/24/2018	Coleoptera	Elmidae	*Stenelmis*	1	shredder
K net	Third Creek Rest	Knoxville, TN	9/24/2018	Isopoda	Asellidae	*Lirceus*	2	collector
K net	Third Creek Rest	Knoxville, TN	9/24/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	11	collector
D net	Third Creek Rest	Knoxville, TN	9/24/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	4	grazer
D net	Third Creek Rest	Knoxville, TN	9/24/2018	Veneroida	Cambaridae	*Cambarus*	3	shredder
D net	Third Creek Rest	Knoxville, TN	9/24/2018	Odonata	Calopterygidae	*Calopteryx*	7	engulfer
D net	Third Creek Rest	Knoxville, TN	9/24/2018	Gastropoda (class)	Physidae	*Physa*	1	grazer
D net	Third Creek Rest	Knoxville, TN	9/24/2018	Odonata	Aeshnidae	*Boyeria*	1	engulfer
*K net	Mill Creek	Lenoir City, TN	11/10/2017	Plecoptera	Perlidae	*Eccoptura*	1	shredder
*K net	Mill Creek	Lenoir City, TN	11/10/2017	Odonata	Gomphidae	*Stylurus*	1	burrower
*K net	Mill Creek	Lenoir City, TN	11/10/2017	Decapoda	Cambaridae	*Cambarus*	1	shredder
*K net	Mill Creek	Lenoir City, TN	11/10/2017	Neotaenioglossa	Pleuroceridae	*Pleurocera*	21	grazer
*K net	Mill Creek	Lenoir City, TN	11/10/2017	Megaloptera	Corydalidae	*Corydalus*	2	engulfer
*K net	Mill Creek	Lenoir City, TN	11/10/2017	Oligochaeta (subclass)			1	collector
*K net	Mill Creek	Lenoir City, TN	11/10/2017	Trichoptera	Odontoceridae	*Psilotreta*	1	collector
*K net	Mill Creek	Lenoir City, TN	11/10/2017	Ephemeroptera	Baetidae	*Baetis*	1	collector
*K net	Mill Creek	Lenoir City, TN	11/10/2017	Diptera	Tipulidae	*Leptotarsus*	5	shredder

*K net	Mill Creek	Lenoir City, TN	11/10/2017	Trichoptera	Hydropsychidae	*Hydropsyche*	19	collector
*K net	Mill Creek	Lenoir City, TN	11/10/2017	Odonata	Aeshnidae	*Boyeria*	1	engulfer
*K net	Mill Creek	Lenoir City, TN	11/10/2017	Ephemeroptera	Heptageniidae	*Stenacron*	1	collector
*K net	Mill Creek	Lenoir City, TN	11/10/2017	Trichoptera	Philopotamidae	*Chimarra*	4	collector
K net	Mill Creek	Lenoir City, TN	2/20/2018	Collembola			1	collector
K net	Mill Creek	Lenoir City, TN	2/20/2018	Plecoptera	Perlidae	*Paragnetina*	2	shredder
K net	Mill Creek	Lenoir City, TN	2/20/2018	Oligochaeta (subclass)			1	collector
K net	Mill Creek	Lenoir City, TN	2/20/2018	Ephemeroptera	Ephemerellidae	*Ephemerella*	31	collector
K net	Mill Creek	Lenoir City, TN	2/20/2018	Diptera	Tipulidae	*Leptotarsus*	4	shredder
K net	Mill Creek	Lenoir City, TN	2/20/2018	Plecoptera	Chloroperlidae	*Utaperla*	5	shredder
K net	Mill Creek	Lenoir City, TN	2/20/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	1	grazer
K net	Mill Creek	Lenoir City, TN	2/20/2018	Gastropoda (class)	Planorbidae	*Helisoma*	1	grazer
K net	Mill Creek	Lenoir City, TN	2/20/2018	Ephemeroptera	Baetidae	*Baetis*	9	collector
K net	Mill Creek	Lenoir City, TN	2/20/2018	Diptera	Simuliidae	*Simulium*	9	collector
K net	Mill Creek	Lenoir City, TN	2/20/2018	Trichoptera	Hydropsychidae	*Diplectrona*	8	collector
K net	Mill Creek	Lenoir City, TN	2/20/2018	Gastropoda (class)	Physidae	*Physa*	1	grazer
D net	Mill Creek	Lenoir City, TN	2/20/2018	Diptera	Chironomidae	*Orthocladius*	3	collector
D net	Mill Creek	Lenoir City, TN	2/20/2018	Diptera	Chironomidae	*Paracricotopus*	2	collector
D net	Mill Creek	Lenoir City, TN	2/20/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	1	scraper
D net	Mill Creek	Lenoir City, TN	2/20/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	2	grazer
D net	Mill Creek	Lenoir City, TN	2/20/2018	Ephemeroptera	Ephemerellidae	*Ephemerella*	5	collector
D net	Mill Creek	Lenoir City, TN	2/20/2018	Ephemeroptera	Baetidae	*Baetis*	7	collector
D net	Mill Creek	Lenoir City, TN	2/20/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	4	collector

D net	Mill Creek	Lenoir City, TN	2/20/2018	Coleoptera	Elmidae	*Stenelmis*	2	shredder
K net	Mill Creek	Lenoir City, TN	4/30/2018	Plecoptera	Nemouridae	*Zapada*	5	shredder
K net	Mill Creek	Lenoir City, TN	4/30/2018	Plecoptera	Perlodidae	*Isoperla*	38	shredder
K net	Mill Creek	Lenoir City, TN	4/30/2018	Plecoptera	Perlidae	*Perlinella*	2	shredder
K net	Mill Creek	Lenoir City, TN	4/30/2018	Plecoptera	Chloroperlidae	*Alloperla*	2	shredder
K net	Mill Creek	Lenoir City, TN	4/30/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	8	collector
K net	Mill Creek	Lenoir City, TN	4/30/2018	Ephemeroptera	Isonychiidae	*Isonychia*	2	collector
K net	Mill Creek	Lenoir City, TN	4/30/2018	Ephemeroptera	Ephemerellidae	*Ephemerella*	28	collector
K net	Mill Creek	Lenoir City, TN	4/30/2018	Ephemeroptera	Baetidae	*Baetis*	10	collector
K net	Mill Creek	Lenoir City, TN	4/30/2018	Ephemeroptera	Baetidae	*Callibaetis*	18	collector
K net	Mill Creek	Lenoir City, TN	4/30/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	2	scraper
K net	Mill Creek	Lenoir City, TN	4/30/2018	Oligocheata	Oligocheata	*Oligocheata*	3	collector
K net	Mill Creek	Lenoir City, TN	4/30/2018	Diptera	Tipulidae	*Leptotarsus*	5	shredder
D net	Mill Creek	Lenoir City, TN	4/30/2018	Ephemeroptera	Ephemerellidae	*Ephemerella*	22	collector
D net	Mill Creek	Lenoir City, TN	4/30/2018	Ephemeroptera	Baetidae	*Baetis*	15	collector
D net	Mill Creek	Lenoir City, TN	4/30/2018	Diptera	Simuliidae	*Simulium*	1	collector
D net	Mill Creek	Lenoir City, TN	4/30/2018	Ephemeroptera	Baetidae	*Callibaetis*	8	collector
D net	Mill Creek	Lenoir City, TN	4/30/2018	Plecoptera	Perlodidae	*Isoperla*	1	shredder
K net	Mill Creek	Lenoir City, TN	6/15/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	1	scraper
K net	Mill Creek	Lenoir City, TN	6/15/2018	Diptera	Simuliidae	*Simulium*	2	collector
K net	Mill Creek	Lenoir City, TN	6/15/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	7	grazer
K net	Mill Creek	Lenoir City, TN	6/15/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	1	collector
K net	Mill Creek	Lenoir City, TN	6/15/2018	Megaloptera	Corydalidae	*Nigronia*	2	engulfer
K net	Mill Creek	Lenoir City, TN	6/15/2018	Plecoptera	Perlidae	*Paragnetina*	1	shredder
K net	Mill Creek	Lenoir City, TN	6/15/2018	Coleoptera	Elmidae	*Optioservus*	2	shredder
K net	Mill Creek	Lenoir City, TN	6/15/2018	Coleoptera	Elmidae	*Stenelmis*	2	shredder

K net	Mill Creek	Lenoir City, TN	6/15/2018	Ephemeroptera	Ephemerellidae	*Serratella*	1	collector
D net	Mill Creek	Lenoir City, TN	6/15/2018	Veneroida	Cyrenidae	*Corbicula*	4	collector
D net	Mill Creek	Lenoir City, TN	6/15/2018	Oligochaeta (subclass)			1	collector
D net	Mill Creek	Lenoir City, TN	6/15/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	16	grazer
D net	Mill Creek	Lenoir City, TN	6/15/2018	Diptera	Chironomidae	*Natarsia*	1	collector
D net	Mill Creek	Lenoir City, TN	6/15/2018	Gastropoda (class)	Physidae	*Physa*	1	grazer
K net	Mill Creek	Lenoir City, TN	7/6/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	1	grazer
K net	Mill Creek	Lenoir City, TN	7/6/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	7	collector
K net	Mill Creek	Lenoir City, TN	7/6/2018	Diptera	Tipulidae	*Tipula*	1	shredder
K net	Mill Creek	Lenoir City, TN	7/6/2018	Oligochaeta (subclass)			1	collector
K net	Mill Creek	Lenoir City, TN	7/6/2018	Trichoptera	Hydropsychidae	*Cheumatopsyche*	21	collector
K net	Mill Creek	Lenoir City, TN	7/6/2018	Coleoptera	Elmidae	*Stenelmis*	3	shredder
K net	Mill Creek	Lenoir City, TN	7/6/2018	Megaloptera	Corydalidae	*Nigronia*	5	engulfe
K net	Mill Creek	Lenoir City, TN	7/6/2018	Trichoptera	Polycentropodidae	*Cyrnellus*	2	collector
K net	Mill Creek	Lenoir City, TN	7/6/2018	Trichoptera	Philopotamidae	*Chimarra*	1	collector
K net	Mill Creek	Lenoir City, TN	7/6/2018	Ephemeroptera	Isonychiidae	*Isonychia*	7	collector
K net	Mill Creek	Lenoir City, TN	7/6/2018	Ephemeroptera	Ephemerellidae	*Ephemerella*	1	collector
D net	Mill Creek	Lenoir City, TN	7/6/2018	Diptera	Dixidae		2	collector
D net	Mill Creek	Lenoir City, TN	7/6/2018	Odonata	Aeshnidae	*Boyeria*	1	engulfer
D net	Mill Creek	Lenoir City, TN	7/6/2018	Coleoptera	Elmidae	*Stenelmis*	2	shredder
D net	Mill Creek	Lenoir City, TN	7/6/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	4	grazer
D net	Mill Creek	Lenoir City, TN	7/6/2018	Ephemeroptera	Heptageniidae	*Maccaffertium*	1	scraper
K net	Mill Creek	Lenoir City, TN	10/17/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	15	grazer

K net	Mill Creek	Lenoir City, TN	10/17/2018	Ephemeroptera	Isonychiidae	*Isonychia*	10	collector
K net	Mill Creek	Lenoir City, TN	10/17/2018	Diptera	Stratiomyidae	*Allognosta*	1	collector
K net	Mill Creek	Lenoir City, TN	10/17/2018	Megaloptera	Corydalidae	*Nigronia*	2	engulfer
K net	Mill Creek	Lenoir City, TN	10/17/2018	Odonata	Calopterygidae	*Calopteryx*	2	engulfer
K net	Mill Creek	Lenoir City, TN	10/17/2018	Trichoptera	Hydropsychidae	*Hydropsyche*	7	collector
K net	Mill Creek	Lenoir City, TN	10/17/2018	Coleoptera	Elmidae	*Stenelmis*	3	shredder
K net	Mill Creek	Lenoir City, TN	10/17/2018	Coleoptera	Ptilodactylidae	*Anchytarsus*	1	shredder
K net	Mill Creek	Lenoir City, TN	10/17/2018	Diptera	Tipulidae	*Tipula*	1	shredder
D net	Mill Creek	Lenoir City, TN	10/17/2018	Hemiptera	Gerridae	*Aquarius*	1	N/A
D net	Mill Creek	Lenoir City, TN	10/17/2018	Neotaenioglossa	Pleuroceridae	*Pleurocera*	10	grazer
D net	Mill Creek	Lenoir City, TN	10/17/2018	Isopoda	Asellidae	*Lirceus*	2	collector
D net	Mill Creek	Lenoir City, TN	10/17/2018	Odonata	Calopterygidae	*Calopteryx*	4	engulfer
D net	Mill Creek	Lenoir City, TN	10/17/2018	Megaloptera	Corydalidae	*Nigronia*	2	engulfer

Appendix III.Fish Data

Location	Date	Species	Count
Beaver Creek Restored	10/19/2017	TN Shiner	36
Beaver Creek Restored	10/19/2017	Fantail Darter	2
Beaver Creek Restored	10/19/2017	Blacknose Dace	3
Beaver Creek Restored	10/19/2017	Greenside Darter	8
Beaver Creek Restored	10/19/2017	Central Stoneroller	39
Beaver Creek Restored	10/19/2017	Snubnose Darter	13
Beaver Creek Restored	10/19/2017	Northern Hogsucker	10
Beaver Creek Restored	10/19/2017	Sand Shiner	20
Beaver Creek Restored	10/19/2017	Creek Chub	7
Beaver Creek Restored	10/19/2017	Striped Shiner	11
Beaver Creek Restored	10/19/2017	Redbreast Sunfish	1
Beaver Creek Restored	10/19/2017	Blueside Darter	5

Beaver Creek Restored	10/19/2017	Banded Sculpin	1
Beaver Creek Restored	10/19/2017	Golden Redhorse	1
Beaver Creek Restored	10/19/2017	Spotted Bass	1
Big War Creek	10/30/2018	Greenside Darter	11
Big War Creek	10/30/2018	Redline Darter	57
Big War Creek	10/30/2018	Banded Sculpin	21
Big War Creek	10/30/2018	Snubnose Darter	3
Big War Creek	10/30/2018	Central Stoneroller	119
Big War Creek	10/30/2018	TN Shiner	106
Big War Creek	10/30/2018	River Chub	3
Big War Creek	10/30/2018	Striped Shiner	16
Big War Creek	10/30/2018	Bluegill	3
Big War Creek	10/30/2018	Whitetail Shiner	18
Big War Creek	10/30/2018	Telescope Shiner	5
Big War Creek	10/30/2018	Mountain Shiner	3
Big War Creek	10/30/2018	Fantail Darter	5
Big War Creek	10/30/2018	Bluntnose Minnow	1
Big War Creek	5/4/2018	TN Shiner	92
Big War Creek	5/4/2018	Northern Hogsucker	6
Big War Creek	5/4/2018	Telescope Shiner	10
Big War Creek	5/4/2018	Warpaint Shiner	26

Big War Creek	5/4/2018	Mimic Shiner	4
Big War Creek	5/4/2018	Whitetail Shiner	6
Big War Creek	5/4/2018	Central Stoneroller	65
Big War Creek	5/4/2018	Bigeye Chub	9
Big War Creek	5/4/2018	Striped Shiner	31
Big War Creek	5/4/2018	Redline Darter	30
Big War Creek	5/4/2018	Greenside Darter	6
Big War Creek	5/4/2018	Smallmouth Bass	1
Big War Creek	5/4/2018	River Chub	7
Big War Creek	5/4/2018	Snubnose Darter	1
Big War Creek	5/4/2018	Rainbow Darter	1
Big War Creek	5/4/2018	Stripetail Darter	1
Big War Creek	5/4/2018	Sand Shiner	23
Big War Creek	5/4/2018	Spotfin Shiner	1
Big War Creek	5/4/2018	Highland Shiner	19
Indian Creek	10/30/2017	Blacknose Dace	3
Indian Creek	10/30/2017	Saffron Shiner	29
Indian Creek	10/30/2017	Striped Shiner	15
Indian Creek	10/30/2017	Warpaint Shiner	5
Indian Creek	10/30/2017	Central Stoneroller	22
Indian Creek	10/30/2017	Rainbow Darter	12
Indian Creek	10/30/2017	Banded Sculpin	6
Indian Creek	10/30/2017	Redline Darter	7
Indian Creek	10/30/2017	Fantail Darter	2
Indian Creek	10/30/2017	Snubnose Darter	1

Indian Creek	10/30/2017	Northern Hogsucker	3
Third Creek Impaired	5/8/2018	Creek Chub	17
Third Creek Impaired	5/8/2018	Blacknose Dace	23
Third Creek Impaired	5/8/2018	Central Stoneroller	7
Third Creek Impaired	5/8/2018	Snubnose Darter	5
Third Creek Impaired	5/8/2018	Hogsucker	1
Beaver Creek Impaired	5/14/2018	Blueside Darter	31
Beaver Creek Impaired	5/14/2018	Blacknose Dace	5
Beaver Creek Impaired	5/14/2018	Snubnose Darter	18
Beaver Creek Impaired	5/14/2018	Striped Shiner	18
Beaver Creek Impaired	5/14/2018	Highland Shiner	48
Beaver Creek Impaired	5/14/2018	Stripetail Darter	1
Beaver Creek Impaired	5/14/2018	Stoneroller	4

Beaver Creek Impaired	5/14/2018	Mosquitofish	1
Beaver Creek Impaired	5/14/2018	Redbreast Sunfish	6
Beaver Creek Impaired	5/14/2018	Bluegill	2
Beaver Creek Impaired	5/14/2018	Hogsucker	1
Indian Creek	5/10/2018	Striped Shiner	63
Indian Creek	5/10/2018	TN shiner	10
Indian Creek	5/10/2018	Saffron Shiner	64
Indian Creek	5/10/2018	Rainbow Darter	36
Indian Creek	5/10/2018	Snubnose Darter	5
Indian Creek	5/10/2018	Stoneroller	77
Indian Creek	5/10/2018	Blacknose Dace	6
Indian Creek	5/10/2018	Redline Darter	7
Indian Creek	5/10/2018	Warpaint Shiner	65
Indian Creek	5/10/2018	Banded Sculpin	4
Indian Creek	5/10/2018	River Chub	2
Indian Creek	5/10/2018	Largemouth Bass	1
Indian Creek	5/10/2018	Creek Chub	1
Indian Creek	5/10/2018	Bluegill	1
Indian Creek	5/10/2018	Golden Redhorse	3
Mill Creek	6/15/2018	Hogsucker	1
Mill Creek	6/15/2018	Banded Sculpin	19
Mill Creek	6/15/2018	Longnose Dace	68
Mill Creek	6/15/2018	Blacknose Dace	68

Mill Creek	6/15/2018	Snubnose Darter	12
Mill Creek	6/15/2018	River Chub	2
Mill Creek	6/15/2018	Stoneroller	10
Mill Creek	6/15/2018	Striped Shiner	10
Beaver Creek Restored	5/25/2018	Snubnose Darter	12
Beaver Creek Restored	5/25/2018	Bluegill	2
Beaver Creek Restored	5/25/2018	Stripetail Darter	3
Beaver Creek Restored	5/25/2018	Greenside Darter	7
Beaver Creek Restored	5/25/2018	Stoneroller	27
Beaver Creek Restored	5/25/2018	Blueside Darter	12
Beaver Creek Restored	5/25/2018	Mosquitofish	3
Beaver Creek Restored	5/25/2018	TN Shiner	37
Beaver Creek Restored	5/25/2018	Redbreast Sunfish	6
Beaver Creek Restored	5/25/2018	Rock Bass	3
Beaver Creek Restored	5/25/2018	Blacknose Dace	3

Beaver Creek Restored	5/25/2018	Mountain Shiner	3
Beaver Creek Restored	5/25/2018	Creek Chub	1
Beaver Creek Restored	5/25/2018	Striped Shiner	9
Beaver Creek Restored	5/25/2018	Longnose Dace	3
Beaver Creek Restored	5/25/2018	River Chub	2
Third Creek Restored	5/24/2018	Snubnose Darter	36
Third Creek Restored	5/24/2018	Bullhead Minnow	2
Third Creek Restored	5/24/2018	Striped Shiner	25
Third Creek Restored	5/24/2018	Stripetail Darter	2
Third Creek Restored	5/24/2018	Blacknose Dase	13
Third Creek Restored	5/24/2018	Hogsucker	3
Third Creek Restored	5/24/2018	Stoneroller	3
Williams Creek	5/22/2018	Blacknose Dace	67
Williams Creek	5/23/2018	Stoneroller	9
Williams Creek	5/24/2018	Snubnose Darter	1

Williams Creek	5/25/2018	White Sucker	1
Williams Creek	5/26/2018	Creek Chub	3
Baker Creek	5/15/2018	Banded Sculpin	8
Baker Creek	5/16/2018	Snubnose Darter	6
Baker Creek	5/17/2018	Blacknose Dace	13
Baker Creek	5/18/2018	Striped Shiner	15
Baker Creek	5/19/2018	Bluegill	1
Friar Branch Restored	7/27/2018	Bluegill x redbreast	1
Friar Branch Restored	7/27/2018	Snubnose darter	12
Friar Branch Restored	7/27/2018	Hogsucker	7
Friar Branch Restored	7/27/2018	Stoneroller	302
Friar Branch Restored	7/27/2018	Green Sunfish	10
Friar Branch Restored	7/27/2018	Redbreast Sunfish	5
Friar Branch Restored	7/27/2018	Bullhead Minnow	11
Friar Branch Restored	7/27/2018	Striped Shiner	109
Friar Branch Restored	7/27/2018	Flame Chub	15
Friar Branch Restored	7/27/2018	Mosquitofish	24

Friar Branch Restored	7/27/2018	Redear Sunfish	1
Friar Branch Restored	7/27/2018	Bluegill x Green	1
Friar Branch Restored	7/27/2018	Bigeye Chub	2
Friar Branch Restored	7/27/2018	Bluegill	8
Friar Branch Restored	7/27/2018	Rainbow Darter	2
Friar Branch Restored	7/27/2018	Topminnow	1
Friar Branch Restored	7/27/2018	Largemouth bass	6
Friar Branch Restored	7/27/2018	Blacknose Dace	1
Friar Branch Impaired	7/27/2018	Largemouth Bass	1
Friar Branch Impaired	7/27/2018	Striped Shiner	29
Friar Branch Impaired	7/27/2018	Redear Sunfish	3
Friar Branch Impaired	7/27/2018	Green Sunfish	30
Friar Branch Impaired	7/27/2018	Stoneroller	68

Friar Branch Impaired	7/27/2018	Redbrest Sunfish	6
Friar Branch Impaired	7/27/2018	Mosquitofish	1
Friar Branch Impaired	7/27/2018	Hogsucker	11
Friar Branch Impaired	7/27/2018	Snubnose Darter	16
Friar Branch Impaired	7/27/2018	Bullhead Minnow	1
Friar Branch Impaired	7/27/2018	Rainbow Darter	2
Friar Branch Impaired	7/27/2018	Bluegill	7
Dry Creek	8/10/2018	Banded Sculpin	21
Dry Creek	8/10/2018	Snubnose Darter	9
Dry Creek	8/10/2018	Stoneroller	62
Dry Creek	8/10/2018	Blacknose Dace	11
Dry Creek	8/10/2018	Rainbow Darter	1
Dry Creek	8/10/2018	Striped Shiner	45
Dry Creek	8/10/2018	Warpaint shiner	1
Dry Creek	8/10/2018	Blueside Darter	2
Dry Creek	8/10/2018	Bluegill	12
Dry Creek	8/10/2018	Hogsucker	2
Dry Creek	8/10/2018	Creek Chub	4
Dry Creek	8/10/2018	Longear Sunfish	1
Dry Creek	8/10/2018	Redhorse sp	1

Dry Creek	8/10/2018	Topminnow	4
Dry Creek	8/10/2018	Green Sunfish	4
Dry Creek	8/10/2018	Mountain Shiner	5
Dry Creek	8/10/2018	Redbreast Sunfish	2
Beaver Creek Impaired	8/31/2018	Snubnose Darter	64
Beaver Creek Impaired	8/31/2018	Blacknose Dace	82
Beaver Creek Impaired	8/31/2018	Stripetail Darter	15
Beaver Creek Impaired	8/31/2018	Striped Shiner	64
Beaver Creek Impaired	8/31/2018	Mosquitofish	12
Beaver Creek Impaired	8/31/2018	Stoneroller	55
Beaver Creek Impaired	8/31/2018	Greenside Darter	5
Beaver Creek Impaired	8/31/2018	Mountain Shiner	126
Beaver Creek Impaired	8/31/2018	Blueside Darter	6
Beaver Creek Impaired	8/31/2018	Redbreast Sunfish	2
Beaver Creek Impaired	8/31/2018	Spotted Bass	1

Third Creek Restored	9/24/2018	Blacknose Dace	15
Third Creek Restored	9/24/2018	Hogsucker	14
Third Creek Restored	9/24/2018	Snubnose Darter	8
Third Creek Restored	9/24/2018	Stoneroller	10
Third Creek Restored	9/24/2018	Banded Sculpin	1
Third Creek Restored	9/24/2018	Striped Shiner	26
Third Creek Restored	9/24/2018	Creek Chub	2
Third Creek Impaired	9/24/2018	Blacknose Dace	23
Third Creek Impaired	9/24/2018	Stoneroller	8
Third Creek Impaired	9/24/2018	Banded Sculpin	1
Third Creek Impaired	9/24/2018	Snubnose Darter	5
Third Creek Impaired	9/24/2018	Creek Chub	9
Baker Creek	10/3/2018	Snubnose Darter	13
Baker Creek	10/3/2018	Creek Chub	1
Baker Creek	10/3/2018	Striped Shiner	27

Baker Creek	10/3/2018	Mosquitofish	4
Baker Creek	10/3/2018	Blacknose Dace	7
Baker Creek	10/3/2018	Spotted Bass	1
Williams Creek	10/3/2018	Blacknose Dace	21
Williams Creek	10/3/2018	Stoneroller	23
Williams Creek	10/3/2018	Striped Shiner	14
Williams Creek	10/3/2018	Snubnose Darter	4
Williams Creek	10/3/2018	Creek Chub	1
Dry Creek	10/19/2018	Blacknose dace	7
Dry Creek	10/19/2018	Stoneroller	20
Dry Creek	10/19/2018	Bluegill	3
Dry Creek	10/19/2018	Mosquitofish	1
Dry Creek	10/19/2018	Striped shiner	36
Dry Creek	10/19/2018	Banded Sculpin	6
Dry Creek	10/19/2018	Blackstripe Topminnow	1
Dry Creek	10/19/2018	Redbreast Sunfish	1
Dry Creek	10/19/2018	Mountain Shiner	17
Dry Creek	10/19/2018	Snubnose Darter	1
Dry Creek	10/19/2018	Hogsucker	1
Dry Creek	10/19/2018	Redline Darter	1
Mill Creek	10/17/2018	Banded Sculpin	16
Mill Creek	10/17/2018	Blacknose Dace	36
Mill Creek	10/17/2018	Snubnose Darter	5
Mill Creek	10/17/2018	Striped Shiner	24
Mill Creek	10/17/2018	Bullhead Minnow	9

Friar Branch Impaired	10/31/2018	Striped Shiner	31
Friar Branch Impaired	10/31/2018	Snubnose Darter	31
Friar Branch Impaired	10/31/2018	Hogsucker	4
Friar Branch Impaired	10/31/2018	Rainbow Darter	13
Friar Branch Impaired	10/31/2018	Blacknose Dace	2
Friar Branch Impaired	10/31/2018	Stoneroller	19
Friar Branch Impaired	10/31/2018	Bluegill	4
Friar Branch Impaired	10/31/2018	Bluntnose Minnow	1
Friar Branch Impaired	10/31/2018	River Chub	1
Friar Branch Impaired	10/31/2018	Longnose Dace	1
Friar Branch Restored	10/31/2018	Stoneroller	174
Friar Branch Restored	10/31/2018	Redear Sunfish	5
Friar Branch Restored	10/31/2018	Snubnose Darter	15

Friar Branch Restored	10/31/2018	Striped Shiner	29
Friar Branch Restored	10/31/2018	Spotted Bass	1
Friar Branch Restored	10/31/2018	Mosquitofish	7
Friar Branch Restored	10/31/2018	Bluegill	16
Friar Branch Restored	10/31/2018	Rainbow Darter	12
Friar Branch Restored	10/31/2018	Blacknose Dace	1
Friar Branch Restored	10/31/2018	Hogsucker	2
Friar Branch Restored	10/31/2018	Longear Sunfish	1
Friar Branch Restored	10/31/2018	Largemouth Bass	1
Friar Branch Restored	10/31/2018	Blackstripe Topminnow	2
Friar Branch Restored	10/31/2018	Spotted Sunfish	1

Appendix IV. Site Photographs

Baker Creek (Impaired)

Beaver Creek (Impaired)

Beaver Creek (Restored)

Big War Creek (Reference)

Indian Creek (Reference)

Mill Creek (Reference)

Third Creek (Impaired)

Third Creek (Restored)

Williams Creek (Restored)

Dry Creek (Reference)

Friar Branch (Impaired)

Friar Branch (Restored)

VITA

Grant Fisher resides in Sevierville, TN, and enjoys exploring the mountains he calls home. Prior to attending the University of Tennessee, Grant earned a B.S. in Environmental Sciences from Carson-Newman University. He has also worked as a Biological Science Technician for the National Park Service in Great Smoky Mountains National Park since 2014. There, Grant conducted park wide vital signs surveys of fish and aquatic insect species, along with restoring populations of native Brook Trout (*Salvelinus fontinalis*). He is currently a masters student at UTK.